YUKON RIVER SALMON 2022 SEASON SUMMARY AND 2023 SEASON OUTLOOK

Prepared by

THE UNITED STATES AND CANADA
YUKON RIVER JOINT TECHNICAL COMMITTEE

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Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

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

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1.0 ABSTRACT

The Yukon River Joint Technical Committee (JTC) of the United States and Canada meets twice a year to analyze and discuss harvest and escapement goals, management trends, postseason reviews, preseason outlooks, and results of cooperative research projects for Canadian-origin Yukon River salmon. This report summarizes the status of Chinook *Oncorhynchus tshawytscha*, coho *O. kisutch*, and summer and fall chum salmon *O. keta* stocks in 2022, presents a 2023 season outlook, and provides data about salmon harvests in commercial, subsistence, First Nations, personal use, domestic, and sport or public angling fisheries. Summaries of Yukon River research projects are also included. For 2022, the preliminary estimate of Chinook salmon (mainstem) spawning escapement in Canada was 11,977 fish, which was below the interim management escapement goal (IMEG) range of 42,500–55,000 fish. A preliminary estimate of the total Canadian-origin Chinook salmon run was 13,144 fish. The preliminary estimate of fall chum salmon spawning escapement in the Canadian mainstem Yukon River was approximately 22,059 fish, which was below the IMEG range of 70,000–104,000 fish. The preliminary estimate of fall chum salmon spawning escapement in the Fishing Branch River (Porcupine River), obtained from a weir count was 2,934 fish, which was below the IMEG range of 22,000–49,000 fish. The JTC recommends that the Canadian-origin Chinook salmon stock continue to be managed to achieve escapements within the IMEG range of 42,500–55,000 until such time that the YRP reaches consensus on the management objectives required to inform development of an alternative escapement goal. The JTC recommends that the Canadian-origin Mainstem and Fishing Branch fall chum salmon IMEGs be retained for 3-years (2023–2025).

Key words: Chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta*, coho salmon *O. kisutch*, Yukon River, Yukon River Salmon Agreement, Joint Technical Committee, escapement, escapement goal, interim management escapement goal IMEG, management strategy, season outlook.

2.0 INTRODUCTION

The purpose of this annual Yukon River Season Summary and Season Outlook report is to present data for the Canadian-origin Yukon River salmon stocks subject to the Yukon River Salmon Agreement (YRSA). After 16 years of negotiations, Canada and the United States reached a consensus on the elements of a draft YRSA, which was finalized and signed in December 2002. The YRSA continues to represent an international commitment to the restoration, conservation, and management of Canadian-origin Yukon River salmon. The YRSA also established the Yukon River Panel (YRP) as the main instrument to implement the Treaty and the Joint Technical Committee (JTC) as the body responsible for acquiring the best science and management expertise possible to support the YRP.

The JTC was established as an international advisory committee to evaluate management plans and escapement goals for the transboundary stocks of salmon within the Yukon River drainage. The JTC is comprised of representatives from both State, Territorial, and Federal agencies, and local and regional organizations in the U.S. and Canada. The JTC meets twice a year and is charged with various tasks related primarily to Yukon River salmon stock assessment and management, including reporting on preseason outlooks and postseason reviews, examining management regimes and recommending how they may be improved to achieve management and escapement goals, and evaluating the status of Canadian-origin salmon stocks and making recommendations for adjustments to rebuilding programs. This report fulfills several of the JTC's functions outlined in the YRSA and serves as a repository for important data related to Canadian-origin Yukon River salmon stocks. This repository is used by fisheries managers, Tribal and Yukon First Nation governments, fishers, and other stakeholders as the primary record for Yukon River salmon.

This report focuses on Chinook *Oncorhynchus tshawytscha*, fall chum *O. keta*, and coho salmon *O. kisutch* stocks that originate in Canadian waters and are covered by the Yukon River Salmon Agreement. Summer chum salmon occur entirely within the U.S. portion of the Yukon River drainage and have overlapping run timing with Chinook salmon and fall chum salmon. Where they overlap, the management of summer chum salmon is affected by the management of Chinook salmon and vice versa. As such, this report contains information about summer chum salmon to provide context for fisheries assessment and management decisions that affect Canadian-origin Chinook and fall chum salmon. Few coho salmon are bound for the upper reaches of the Yukon River in Canada, therefore discussion of coho salmon is primarily limited to the Porcupine River population. This annual report covers salmon fishery and management topics addressed by the JTC following the 2022 season and preceding the 2023 season.

YUKON RIVER SALMON AGREEMENT MANAGEMENT PERFORMANCE SUMMARY

The following is a summary of information contained in the main body of the report, tables, figures, and appendices. This information is provided at the request of the YRP to summarize specific outcomes of the 2022 season, forecasted size of the 2023 salmon runs, and 2023 escapement goal recommendations related to the YRSA.

2022 Total Run Size, Harvest, and Escapement of Canadian-origin Chinook Salmon

The preliminary estimate of the 2022 Canadian-origin Chinook salmon run in the mainstem Yukon River was 13,144 fish and was below the 2022 preseason outlook range of 41,000–62,000 fish. There was no total allowable catch for Canadian-origin Chinook in 2022. The harvest of Canadian-origin Chinook salmon in the U.S. was estimated to be 1,121 fish, which was above the U.S. harvest share of 0 fish. The estimated U.S./Canada border passage of Chinook salmon was 12,023 fish. The mainstem harvest of Chinook salmon in Canada was estimated to be 46 fish, which was above the Canada harvest share of 0 fish. The spawning escapement of mainstem Canadian-origin Yukon River Chinook salmon was estimated to be 11,977 fish, which was below the lower end of the interim management escapement goal (IMEG) range of 42,500–55,000 fish.

2022 Total Run Size, Harvest, and Escapement of Canadian-origin Fall Chum Salmon

The preliminary estimate of the 2022 Canadian-origin fall chum salmon run in the mainstem Yukon River was approximately 23,000 fish and was within the preseason outlook range of 20,000–37,000 fish. The preliminary harvest estimate of mainstem Canadian-origin fall chum salmon in the U.S. was approximately 695 fish. The U.S. harvest is not known with certainty and was approximated as 25% of the total U.S. harvest of fall chum salmon (2,778 × 0.25 = 695 fish). The estimated U.S./Canada border passage of mainstem fall chum salmon was 22,059 fish. The harvest of mainstem fall chum salmon in Canada was 0. The spawning escapement of mainstem Canadian-origin fall chum salmon was estimated to be 22,059 fish and was well below the IMEG range of 70,000–104,000 fish.

The total run size estimate for 2022 Fishing Branch fall chum salmon was 3,000 fish and is highly uncertain. Total harvest of Fishing Branch fall chum salmon in the U.S. was approximately 111 fish and assumed that 4% of the total U.S. harvest of fall chum salmon were bound for the Fishing Branch River (2,778 × 0.04 = 111 fish). The total harvest of Porcupine River fall chum salmon in Canada was reported as 15, of which 77% (12 fish) were estimated to be bound for the Fishing Branch River. Escapement past the Fishing Branch River weir was 2,934 fall chum salmon and was well below the IMEG range of 22,000–49,000 fish.

2023 Outlooks

The preseason outlook range presented by the JTC for Canadian-origin salmon stocks:

- Chinook salmon: 26,000–43,000
- Mainstem fall chum salmon: 28,000–150,500
- Fishing Branch fall chum salmon: 4,000–24,000

2023 Escapement Goals

Pertaining to stocks subject to the *Yukon River Salmon Agreement*:

At its March 2022 meeting, the JTC developed a biological escapement goal recommendation of 42,500–62,500 Canadian-origin mainstem Chinook salmon with a target escapement of 52,500. The JTC's 2022 recommendation equally balanced management priorities to achieve maximum sustained yield (i.e., harvest) and maximum sustained recruitment (i.e., run size). The YRP did not implement the JTC's recommendation during their spring 2022 meeting to permit additional time to deliberate the fishery management objectives included in the JTC's recommendation. The 2022 Chinook salmon run was managed to achieve the current IMEG of 42,500–55,000, which has been in place since 2010.

At its March 2023 meeting, the JTC discussed options for providing the YRP with a 2023 escapement goal recommendation for the Canadian-origin mainstem Chinook salmon stock. The JTC agreed that the biological escapement goal presented in 2022 is the most comprehensive and defensible option to accommodate the range of management objectives for this stock. The JTC recommends that the 2023 run of Canadian-origin Chinook salmon be managed to achieve escapements within the range of 42,500–62,500, with a target escapement of 52,500.

The JTC recommends that the Canadian-origin Mainstem and Fishing Branch fall chum salmon IMEGs be retained for 3-years (2023–2025). During that time, the JTC will consider options for conducting a comprehensive stock status and escapement goal review for both stocks, to inform future stock restoration plans and associated escapement goal recommendations.

- Chinook salmon: 42,500–62,500, with a target escapement of 52,500
- Mainstem fall chum salmon: IMEG of 70,000–104,000
- Fishing Branch fall chum salmon: IMEG of 22,000–49,000

3.0 ALASKA MANAGEMENT OVERVIEW

3.1 CHINOOK AND SUMMER CHUM SALMON

The Yukon River drainage in Alaska (Yukon Area) is divided into fishery districts and subdistricts for management purposes (Figure 1). Management of the Yukon Area summer season commercial salmon fisheries is in accordance with *5 AAC 39.222 Policy for the Management of Sustainable Salmon Fisheries, 5 AAC 05.360 Yukon River Drainage King Salmon Management Plan, and 5 AAC 05.362 Yukon River Summer Chum Salmon Management Plan*. The summer chum salmon management plan establishes run size thresholds needed to allow subsistence, commercial, sport, and personal use fishing, prioritizing subsistence among uses, and prioritizing escapement over consumptive uses. Because summer chum and Chinook salmon migrate concurrently, regulations in the management plans allow for using selective gear types that target summer chum salmon during times of Chinook salmon conservation and allow immediate, live release of Chinook salmon back to the water.

During the “summer season” (early May–July 15 in District 1), management and research staff focus on assessing and managing the summer chum and Chinook salmon runs. After July 15, in District 1, Chinook salmon are nearly done entering the river and the summer chum salmon run transitions to the fall chum salmon run. On July 16, management transitions to the “fall season” assessment and management becomes focused on fall chum and coho salmon runs.

Throughout most of the fishing season, the Yukon River Drainage Fisheries Association (YRDFA) facilitated weekly teleconferences to provide managers, fishermen, tribal/traditional council representatives, and other stakeholders the opportunity to share information, provide input, and discuss inseason management options. During these weekly teleconferences, Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (USFWS) staff provided inseason run assessment information from various assessment projects (Figure 2). Managers also relayed information about management strategies and subsistence fishermen reported on river conditions in their respective communities along the river.

Preseason Management Strategy Planning

The 2022 JTC preseason forecast for Canadian-origin Chinook salmon was for a run of approximately 41,000–62,000 fish, and the ADF&G preseason forecast for the Yukon River drainagewide run (U.S. and Canada stocks combined) was 99,000–150,000 fish. For Canadian-origin Chinook salmon, the IMEG range recommended by the YRP was 42,500–55,000 fish. The summer chum salmon outlook was for a run of 162,000–542,000 fish. Directed fishing for both species was considered unlikely.

The Yukon River Panel and Yukon River Drainage Fisheries Association a hosted preseason planning meeting in April. Fishermen from throughout the drainage discussed management options and concerns about low run sizes, environmental factors, bycatch, interception fisheries (Area M), fish diseases, food security, and project operations. An annual informational flyer detailing the outlooks for Chinook, chum, and coho salmon and fishery management strategies was mailed preseason to approximately 2,730 Yukon River households and distributed as an advisory announcement on April 20.

Federal subsistence Regional Advisory Councils discussed temporary Federal Special Action Requests proposing federal management of federal waters on the Yukon River for 2022 salmon season. A special action that would restrict salmon harvest in federal waters to federally qualified users was adopted by the Federal Subsistence Board in early May.

Chinook and Summer Chum Salmon Inseason Management

Due to the poor projected salmon run sizes, the summer season started with all salmon fishing closed, including subsistence, commercial, sport and personal use. Closures began on June 2 in the Coastal District and District 1 and progressed upriver based on run timing (Table 1; Appendix B19).

Operations of the mainstem sonar project near Pilot Station, located three days travel time from the mouth of the Yukon River, began June 1 and the first Chinook salmon was encountered June 6. Therefore, the June 2 closures likely protected nearly all early-arriving fish.

During the salmon fishing closures, fishermen could use nonsalmon gear, including hook and line with a rod or pole (up to and including the Nulato River), hand line, longline, fyke net, dip net, and spear. Gillnets of 4-inch or smaller mesh were restricted to 60 feet in length. Nonsalmon fishing opportunities remained open 24 hours a day, seven days a week throughout the entire summer season. Fishermen were asked to release all Chinook and summer chum salmon alive from selective and nonsalmon gear whenever possible, and to avoid fishing in areas where salmon could be caught. Pink and sockeye salmon retention was allowed, however the abundance of sockeye salmon is low in the Yukon River. Pink salmon abundance is higher in even years, but pink salmon distribution is limited mostly to the Lower Yukon (Appendix B21). More detail on management and conservation measures implemented are summarized in Appendix B19.

As the season progressed, inseason abundance estimates remained low and did not indicate a harvestable surplus of Chinook or summer chum salmon. The Chinook salmon run was 4 days later than average at Pilot Station sonar. At the midpoint of the run on June 28, Pilot Station sonar estimates were under 27,000 Chinook salmon. The end of season cumulative passage estimate at the Pilot Station sonar was 48,439 Chinook salmon (with a 90% confidence interval of 41,060 to 55,818 fish), which was 20% of the average run size (2002–2021).

Genetic mixed stock analysis (MSA) at the Pilot Station sonar site indicated a declining percentage of Canada-origin Chinook salmon through the run. The early group of Chinook salmon (June 1 to June 22) indicated that 67% of the fish sampled were Canadian-origin. The sampling of the second pulse of Chinook salmon at the sonar (June 23 to June 29) indicated that 42% of the fish were Canadian-origin. Genetic MSA on the third pulse and remaining groups of Chinook salmon sampled at the sonar (June 30 to July 27) indicated that 35% of the fish sampled were of Canadian-origin, with a weighted season total of 45% Canadian-origin Chinook salmon, approximately 21,600 fish. These are higher percentages than average, but coupled with an extremely small total run, these percentages do not accurately reflect the strength of the Canadian run of Chinook salmon.

Three pulses of summer chum salmon were detected at the sonar project; the largest group consisted of approximately 202,000 fish and passed by the sonar between June 25 and July 2. The first quarter point, midpoint, and third quarter point at the Pilot Station sonar were June 27, July 2, and July 12, respectively. This indicated that the summer chum salmon run was likely 4 days later than average and one of the latest on record based on the midpoint at the sonar project. An estimated 463,806 summer chum salmon were counted at the Pilot Station sonar (with a 90% confidence interval of 438,989 to 488,623 fish), which was well below the historical median of 1.6 million fish from years with late run timing. This is the fourth lowest summer chum salmon count on record, with previous lowest counts of 153,718 in 2021; 442,546 in 2001, and 448,665 in 2000.

No escapement goals were met, and project counts were below historical medians (Tables 2 and 3). Aerial surveys of the East and West Forks of the Andreafsky River, Anvik River, and Nulato River were conducted but very few fish were observed, and counts were well below average.

Despite very conservative management, inseason passage counts at the Eagle sonar project indicated that like 2019, 2020, and 2021, fewer Canadian-origin Chinook salmon were going to make it to the border than were projected by the Pilot Station sonar genetic estimates. Historically, the midpoint of late Chinook salmon runs at Eagle sonar is around July 28. In 2022, Chinook salmon passage was only 5,492 fish on this date, which was well below average.

It is not certain why the 2019–2022 inseason projections of Canadian-origin Chinook salmon based on Pilot Station sonar passage and application of genetics did not align well with the estimates at the Eagle sonar. The U.S. harvest does not account for the difference between inseason projections and the abundance estimated at the border in 2019–2022. Based on preliminary harvest estimates and genetic analysis, an estimated 1,121 Canadian-origin Chinook salmon were harvested in the U.S. in 2022 (Appendix B18). A large portion of this harvest was salmon from test fishery projects that were distributed to communities. The Eagle Sonar passage of Canadian-origin Chinook salmon was about half of what was estimated at the Pilot Station sonar, which represents a notable "difference between estimates" for the fourth consecutive year.

Beginning in 2023, ADF&G will be implementing a multi-year drainagewide adult Chinook salmon radiotelemetry program to evaluate for mortality of Alaska and Canada stock components as they migrate from the mouth of the Yukon River to the U.S./Canada border. This project will run concurrently with *Ichthyophonus* sampling at Pilot Station, Rapids, Fort Yukon, and Eagle. The combination of telemetry and *Ichthyophonus* data in 2023 and 2024 is expected to provide much insight into the biological implications of disease-associated enroute mortality.

3.2 Fall Chum And Coho Salmon

Management of the Yukon Area fall season salmon fisheries is in accordance with *5 AAC 39.222 Policy for the Management of Sustainable Salmon Fisheries, 5 AAC 01.249 Yukon River Drainage Fall Chum Salmon Management Plan, 5 AAC 05.369 Yukon River Coho Salmon Management Plan, and 5 AAC 05.367 Tanana River Salmon Management Plan.* The intent of these plans is to align management objectives with the established escapement goals, provide flexibility in managing subsistence harvests when stocks are low, and bolster salmon escapement as run abundance increases (Table 4). The sustainable escapement goal (SEG) range for the entire Yukon River drainage is 300,000–600,000 fall chum salmon (Fleischman and Borba 2009). The threshold number of fall chum salmon needed to allow for a fall chum salmon directed commercial fishery is 550,000 fish, and commercial fishing is considered only on the surplus projected above that level.

Management also incorporates conditions found in the *Yukon River Salmon Agreement.* Those conditions include treaty objectives for border passages that are based on the IMEG into Canada, and harvest shares of fall chum salmon. The IMEG for Canadian-origin mainstem Yukon River is 70,000–104,000 fall chum salmon, and the IMEG for Fishing Branch River is 22,000–49,000 fall chum salmon.

The *Yukon River Coho Salmon Management Plan* allows for a coho salmon-directed commercial fishery if the fall chum salmon run is assessed to be more than 500,000 fish, incidental catch of fall chum salmon remains above the 500,000 fish threshold, and a harvestable surplus of coho salmon is identified, or when a commercial fishery will not have a significant impact on fall chum salmon escapement and allocation. The *Tanana River Salmon Management Plan* specifies that commercial fishing in Subdistrict 5-A and District 6 are based on the assessment and timing of salmon stocks bound for the Tanana River drainage as they are considered bound for terminal harvest areas.

Fall Chum Salmon Management Overview

By regulation, the fall season began in District 1 on July 16. Assessment information collected from projects located in the lower river were used to inform management decisions. The projects included two lower river drift gillnet test fisheries that provided run timing and relative abundance information, and a mainstem Yukon River sonar, located near the community of Pilot Station, that provided fish abundance estimates. Stock composition information for chum salmon was provided by genetic samples collected from the test fishery associated with the mainstem Yukon River sonar project.

Upriver projects that monitored escapement consisted of:

- a mainstem Yukon River sonar operated at Eagle near the U.S./Canada border;
- a weir/sonar project operated in the Fishing Branch River located in the headwaters of the Porcupine River;
- sonars in the Teedriinjik and Sheenjek rivers;
- a mainstem sonar in the Canadian portion of the Porcupine River near Old Crow;
- foot surveys conducted in the Delta River which is a tributary of the Tanana River;
- boat surveys in the Delta Clearwater River which is a tributary of the Tanana River; and
- aerial surveys in the Tanana River drainage, Kluane River and mainstem Yukon River between Tatchun Creek and the Pelly River.

Age, sex, and length information was collected at the lower river test fisheries, from the test fishery associated with the Eagle sonar project, and from the Fishing Branch and Delta rivers. Sex and length were also collected at the mainstem sonar test fisheries associated with Pilot Station; however, no age structure was collected.

The preseason forecast was revised to a preseason run size projection in mid-July, using the relationship between historical summer and fall chum salmon run size estimates. Based on the low run size of summer chum salmon, the preseason drainagewide projection for fall chum salmon was a run size of less than 300,000 fish.

Preseason management strategies included the following:

- Concurrent with the fall chum salmon migration upriver, all Yukon Area districts and subdistricts would remain closed to subsistence fishing unless the run projection exceeded 300,000 fish.
- To improve fall chum salmon escapement to the spawning grounds, the department anticipated implementing a complete closure of subsistence salmon fishing in the Alaska portion of the mainstem Porcupine River when the fall chum salmon migration reached that area.
- Commercial salmon fishing would not be allowed unless the inseason drainagewide fall chum salmon run projection exceeded 550,000 fish, and a commercial surplus was identified.

According to the Yukon River Drainage Fall Chum Salmon Management Plan, the preseason projection did not meet the threshold of 300,000 fish needed to allow subsistence, personal use, and commercial salmon fishing. Based on inseason assessment projects at the historical midpoint of the run, the projection indicated a run size of approximately 230,000 fall chum salmon. All Yukon Area districts remained closed to fall chum salmon fishing for the duration of the season. Gillnets of 4-inch or smaller mesh were allowed to target non-salmon. However, due to the conservation concern for Chinook and chum salmon, 4-inch or smaller mesh gillnets were restricted to a maximum length of 60-feet. Subsistence fishing opportunity was provided with selective gears such as dip nets, manned fish wheels, and hook and line (up to and including the Nulato River), for nonsalmon and with retention of pink, sockeye, and coho salmon. While using selective gear, all Chinook and chum salmon were required to be released alive.

Starting October 1, subsistence salmon fishing restrictions were lifted in the Coastal District and District 1. Restrictions were subsequently lifted in upriver districts and subdistricts as the tail end of the fall chum salmon run reached those areas. To protect spawning salmon, important spawning areas for fall chum and coho salmon in Yukon River drainage tributaries remained closed to subsistence salmon fishing through the end of December.

Coho Salmon Management Overview

The coho salmon run overlaps with much of the fall chum salmon run. While subsistence fishing for fall chum salmon was closed for most of the season, fishermen could use selective gear such as dip nets, manned fish wheels, and hook and line for coho salmon. While using selective gear, all Chinook and chum salmon were required to be released alive. The 2022 coho salmon run appeared to be weak and late. The preliminary coho salmon index of run size was estimated to be 101,000 fish, which was below the historical average of 227,000 fish.

4.0 ALASKA HARVEST SUMMARIES

4.1 Subsistence Salmon Fishery

Subsistence salmon fishing activities in the Yukon River drainage typically begin in late May and continue through mid-October (Padilla et al. 2021). Fishing opportunity in the Lower Yukon Area (Districts 1–3) in May and the Upper Yukon Area (Districts 4–6) in October is highly dependent upon river ice conditions. Throughout the drainage, most Chinook salmon harvested for subsistence use are dried, smoked, or frozen for later human consumption. Summer chum, fall chum, and coho salmon harvested in the Lower Yukon Area are primarily utilized for human consumption, often dried, smoked, or frozen for later use. In the Upper Yukon Area, summer chum, fall chum, and coho salmon are an important human food source, but a larger portion of the harvest is fed to dogs used for recreation and transportation (Andersen 2010).

Documentation of the subsistence salmon harvest is necessary to determine if sufficient salmon are returning to the Yukon Area and enough fishing opportunities are being provided to meet subsistence needs. In years with fishery restrictions, estimates of harvest can be used to assess the effect of the management actions taken to meet escapement goals to maintain future salmon production. The primary method of estimating subsistence harvest is voluntary participation in the annual subsistence salmon harvest survey program conducted by ADF&G, Division of Commercial Fisheries. The survey is conducted in 33 communities (including the 2 coastal communities of Hooper Bay and Scammon Bay) during the fall, after most households have completed fishing for salmon. Additional information about harvest timing is obtained from harvest calendars that are sent to households and filled out voluntarily. Fishing permits also provide information about harvest timing for areas of the river where permits are required (District 6 and portions of District 5 and the Koyukuk River).

In 2022, subsistence harvest surveys identified approximately 2,544 households in the Yukon Area in 33 communities. Of these, an estimated 369 households fished for salmon. Permits are not required for subsistence fishing throughout most of the Yukon Area, except for the urban areas around Fairbanks and other areas accessible by road. Therefore, the largest share of subsistence harvest in the Yukon Area is estimated from the postseason survey results. A total of 168 salmon fishing permits were issued in 2022. Approximately 87% of the subsistence permits had been returned at the time of this publication, and 29 permits reported fishing.

All 2022 subsistence harvest data are considered preliminary as of the publication date of this report. Final results will be included in an ADF&G Fishery Data Series publication after the analysis is completed and reviewed. Based on survey, permit, and test fishery donation data, the 2022 preliminary subsistence salmon harvest in the Alaska portion of the Yukon River drainage was estimated to be 1,827 Chinook; 6,724 summer chum; 2,778 fall chum; and 1,090 coho salmon (Appendices B2–B5). For comparison, recent 2017–2021 average subsistence salmon harvest estimates were 28,351 Chinook; 54,117 summer chum; 43,970 fall chum; and 4,252 coho salmon (Appendices B2–B5) from communities in the Alaska portion of the Yukon River drainage. In 2022, Chinook, summer chum, fall chum, and coho salmon harvests all fell below their respective ranges of Amounts Reasonably Necessary for Subsistence (ANS) as defined by the Alaska Board of Fisheries (Brown and Jallen 2012).

For a third year in a row, subsistence salmon harvest surveys were conducted remotely via telephone, mail, and internet. An electronic version of the survey was employed to provide subsistence users an avenue to self-report harvests online. To improve survey response rate, all known households were attempted to be contacted. The survey questions largely remained the same as previous years. The 2022 estimate was 828 ± 148 (95 % CI) Chinook salmon; 5,477 ± 1,253 summer chum; 1,550 ± 689 fall chum; and 790 ± 248 coho salmon. It is important to restate the estimates and 95% CI provided here are preliminary and will change as additional mail surveys are entered and quality control measures are conducted. Survey estimates are a subtotal of the overall subsistence estimates provided above and 95% CI only apply to survey estimates (i.e., does not include subsistence permit harvests).

4.2 Commercial Fishery

Summer Season Harvest

There was no commercial fishing in the Yukon Area during the 2022 summer season. Historical commercial harvest information of Chinook and summer chum salmon can be found in Figure 3 and Appendices B2 and B3.

Fall Season Harvest

There was no commercial fishing in the Yukon Area during the 2022 fall season. Historical commercial harvest information of fall chum and coho salmon can be found in Figures 4 and 5, and Appendices B4 and B5.

4.3 Sport Fishery

Since 2012, sport fishing effort for wild salmon in the Yukon River drainage has been directed primarily at Chinook, chum, and coho salmon, with lesser numbers of sockeye and pink salmon targeted in the lower Yukon River. Over the past decade, Chinook salmon stocks have experienced periods of low productivity with subsequent restrictions to subsistence fishing opportunities. As a result, Chinook salmon sport fishing restrictions and closures have been implemented each year during this period in the ADF&G Division of Sport Fish Yukon Management Area (YMA, excludes the Tanana River drainage) and similarly in the Tanana River Management Area (TRMA), except for 2017.

All chum salmon harvested in the sport fishery are categorized as summer chum salmon because these fish were mostly caught incidental to Chinook salmon during midsummer in clearwater tributaries. Some harvest of fall chum salmon occurs after Chinook salmon spawning concludes, but is considered negligible relative to summer chum salmon harvests. With the recent closures and restrictions to Chinook salmon sport fishing, chum salmon have become a more important target for sport fishers. However, during 2021 and 2022, closures were also implemented in the chum salmon sport fisheries due to poor runs and subsequent closures and restrictions to the subsistence fishery. Coho salmon, which are targeted primarily in the fall, were also closed to sport fishing during 2021 and 2022 due to poor returns.

Alaska sport fishing effort and harvests are monitored annually through the Statewide Harvest Survey (SWHS)[1]. The SWHS is an annual survey of households where at least one person (resident or nonresident) purchased a sport fishing license. Harvest estimates are not available until approximately one calendar year after the fishing season; therefore, 2022 estimates were not available for this report. Total sport harvest of salmon during 2021 in the Alaska portion of the Yukon River drainage (YMA and TRMA) was estimated to be 0 Chinook, 0 chum, and 13 coho salmon (Appendices B2, B3, and B5). The 2017–2021 average sport salmon harvest was estimated to be 54 Chinook, 421 chum, and 451 coho salmon and that for 2012–2021 was estimated to be 85 Chinook, 463 chum, and 577 coho salmon (Appendices B2, B3, and B5). The relatively low harvest numbers for 2021 reflect the closures.

Most sport fishing effort for the Yukon River occurs in the Tanana River along the road system (Stuby 2022) due to the proximity of major population centers such as Fairbanks, North Pole, and Delta Junction. On average, 52% and 94% of Chinook salmon harvested during 2012–2021 and 2017–2021, respectively, occurred in the Tanana River. During 2017–2021, average sport harvests for chum and coho salmon in the Tanana River represented 2% and 39% of the total for these species, respectively, for the Yukon River. In the Tanana River, most Chinook and chum salmon sport fishing effort occurs in the Chena and Salcha rivers, whereas most coho salmon are harvested from the Delta Clearwater and Nenana rivers. The majority of sport fishing effort for Chinook, chum, and coho salmon for the rest of the Yukon River drainage takes place in the Anvik and Andreafsky rivers.

For 2022, all waters of the YMA and TRMA were closed to sport fishing for Chinook salmon effective May 1 and June 20, respectively. Sport fishing for chum salmon closed on May 1 in the YMA and on June 20 in TRMA. Sport fishing for coho salmon closed in both the YMA and TRMA on September 8.

4.4 Personal Use Fishery

The Fairbanks Nonsubsistence Area, located in the middle portion of the Tanana River, contains the only personal use fishery within the Yukon River drainage. Subsistence or personal use permits have been required in this portion of the drainage since 1973. Personal use fishing regulations were in effect from 1988 until July 1990 and from 1992 until April 1994. In 1995, the Joint Board of Fisheries and Game established the Fairbanks Nonsubsistence Area which has subsequently been managed consistently under personal use regulations. Historical harvest data must account for these changes in status. Subdistrict 6-C is completely within the Fairbanks Nonsubsistence Area and therefore falls under personal use fishing regulations. Personal use salmon or whitefish/sucker permits, and a valid resident sport fishing license are required to fish within the Fairbanks

[1] Alaska Sport Fishing Survey database [Internet]. 2011–2021. Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish (cited November 1, 2022). Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/

Nonsubsistence Area. The harvest limit for a personal use salmon household permit is 10 Chinook, 75 summer chum, and 75 fall chum and coho salmon combined. The personal use salmon fishery in Subdistrict 6-C has a subdistrict harvest limit of 750 Chinook; 5,000 summer chum; and 5,200 fall chum and coho salmon combined.

In 2022, a total of 24 personal use salmon permits were issued. The 2022 preliminary harvest, based on 100% of the personal use salmon permits returned in Subdistrict 6-C is 0 salmon. The 2017–2021 average personal use harvest was 123 Chinook, 262 summer chum, 317 fall chum, and 96 coho salmon (Appendices B2–B5) in the Alaska portion of the Yukon River drainage.

5.0 CANADIAN MANAGEMENT OVERVIEW

5.1 CHINOOK SALMON

The 2022 pre-season outlook range for Canadian-origin mainstem Yukon River Chinook salmon was 41,000–62,000 (Figure 6). This range was well below historically-observed run sizes (average 153,411, 1982–1997) and also below the average run size (80,814) observed from 1998–2021. When accounting for uncertainty and past forecast performance, it was recognized that the run size was unlikely to meet the upper end of this range.

New in Canadian Yukon River fisheries management for 2021, and continuing in 2022, was the concept of applying run size probabilities to preseason fisheries management planning and communications. This approach takes into account the inherent uncertainty of the outlook, addresses the reality that some run sizes are more probable than others and provides separate probabilities for different run sizes (e.g. there is a 75% chance that the run size will be at least 45,000 and a 50% chance that the run size will be at least 50,000). This approach is useful in fishery and harvest management planning.

Prior to the season, Fisheries and Oceans Canada (DFO) hosted and/or participated in virtual meetings with the Yukon Salmon Subcommittee (YSSC), Yukon First Nation governments, Renewable Resources Councils, and the public to discuss the 2022 forecast and potential management scenarios.

Each year, in advance of the salmon season, DFO develops an *Integrated Fisheries Management Plan*[2] (IFMP) for Yukon River Chinook, fall chum and coho salmon. The IFMP, is in effect from July 1 of the current year to June 30 of the subsequent year. It serves to identify the primary objectives (i.e. YRSA) and requirements for the management of Canadian salmon fisheries in the Yukon River, as well as the management measures to be used to achieve these objectives in the commercial, domestic (non-aboriginal food fishery) and licensed public angling fisheries.

In accordance with Yukon First Nation self-governing agreements, First Nation fisheries are managed by First Nation governments. In support of this, DFO includes First Nation advisors in Yukon River Panel processes, and provides scientific information and management updates to the First Nations on a weekly basis (more frequently if/when requested) throughout the season.

Canadian management decisions in 2022 were guided by the YRSA, YSSC recommendations, implementation of the precautionary approach, obligations as set out in the Final Land Claim

[2] The IFMP is available online at https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41066832.pdf

Agreements with Yukon First Nations and the application of inseason assessment information to the inseason fishery management decision matrix (a component of the IFMP).

For the 2022 season the Yukon River Panel (YRP) provided the following management recommendation; due to the poor Chinook salmon forecast, the Yukon River Panel anticipates the closure of all Chinook salmon fishing for the duration of the 2022 season.

Based on the preseason forecast, and a 75% probability of the run size being at least 45,000, DFO commenced the 2022 season with limited harvest opportunities for the First Nation fisheries. By the time that Chinook salmon entered the Canadian portion of the Yukon River, First Nations governments were advised that inseason information indicated that the run size would be well below the lower end of the pre-season forecast of 41,000 fish. The public angling fishery was prohibited from catching or retaining Chinook salmon and similarly, the commercial and domestic fisheries remained closed (no allocation). Allocations to the commercial, domestic and public angling fisheries are subject to run abundance, and opportunities (i.e. allocation) may only be provided if there is sufficient confidence that the abundance of Chinook salmon will meet the upper end of the IMEG (55,000), and Canada’s harvest share exceeds the number required for a full allocation to the First Nation fishery.

For 2022, DFO continued to take a more precautionary approach to managing fisheries that interact with stocks of concern and implemented a long-term closure on the Yukon River Chinook salmon commercial fishery. This closure is expected to remain in place for at least 1 salmon generation (4–5 years) or until stock growth and abundance above critical zone levels is witnessed.

As confidence in inseason abundance improved, fishery management actions proceeded according to the inseason fishery management decision matrix. The decision matrix provides guidance for the management of fisheries, is linked to specific inseason run abundance levels, summarizes the management reference points, general allocation plans, and anticipated management responses under different run size scenarios (Table 5).

Inseason Management Yukon River Mainstem Chinook Salmon

DFO commenced the season with a limited allocation available for Yukon First Nations (managed by First Nation governments) while public angling, commercial and domestic fisheries were closed.

Early in the 2022 season, information from the ADF&G’s Lower Yukon Test Fishery (LYTF) near Emmonak (Figure 7) and the Pilot Station sonar (Figure 8) in the Lower Yukon Area suggested a below average run and 3 days later than average. By late-July, the run at Pilot Station sonar was nearly complete with a cumulative passage estimate of around 21,047 Canadian-origin Chinook salmon, resulting in an estimated Canadian harvest share of zero fish. This estimate was below the pre-season forecast, and Canadian managers considered uncertainty, past inseason forecast performance, low run sizes observed at other assessment sites in Alaska, and Yukon River reports of low Chinook salmon abundance among other factors in planning.

Chinook salmon were first counted at Eagle sonar (located near the international border) on July 1. Cumulative passage estimates at Eagle during the early part of the run were low and slow to increase. As the season progressed the difference between the information from Pilot Station and the observed run size at Eagle sonar became increasingly apparent, and inseason estimates at Eagle sonar indicated that the IMEG would not be achieved.

There were no available allocations for the commercial, domestic, and public angling fisheries. First Nation governments were responsive to inseason information and advised their citizens to not harvest. Throughout the season DFO provided weekly email updates to First Nations and harvesters and hosted bi-weekly inseason meetings with the YSSC and First Nation Lands and Resources managers as a means to provide a forum to exchange management and assessment updates. DFO staff also participated in weekly inter-agency meetings with ADF&G summer season staff and provided updates during the weekly YRDFA teleconferences.

DFO maintained closures in the commercial and domestic Chinook salmon fisheries. Daily limits and retention of Chinook salmon in the public angling fishery were set to zero, and from July 1 to November 30 salmon angling on the Yukon River and its tributaries was closed. The YSSC recommended to the First Nation governments to plan to not harvest Chinook salmon, and First Nation governments advised their citizens not to fish for salmon. As the season progressed DFO acknowledged that returns were poor and worse than expected and as a result measures were implemented with a prohibition on retention of Chinook salmon in Canada for all fisheries on August 5. A summary of management and conservation measures implemented in Canada are presented in Appendix B19.

Inseason Management Porcupine River Chinook Salmon

In the absence of stock-specific information about Porcupine River Chinook salmon in Canada, the early season management of this stock is based on information and management of mainstem Yukon River Chinook salmon. Given the below-average outlook for mainstem Chinook salmon in 2022, it was recommended that the First Nation Fishery refrain from harvest.

By late July, the inseason assessment of run strength at the Porcupine River sonar indicated that the 2022 Chinook salmon run was approximately 10% of project average (2014–2021). The Vuntut Gwitchin Government, which directs the First Nation fishery in accordance with Yukon First Nation Self-Governing Agreements and is guided by the *Porcupine River Salmon Plan*, asked their citizens to focus on freshwater species and gear to avoid interception of Chinook salmon. Public angling for Chinook salmon on the Porcupine River was closed from July 1 to November 30.

5.2 FALL CHUM SALMON

Mainstem Yukon River

The 2022 preseason forecast for the Canadian-origin fall chum salmon run on the mainstem Yukon River was 20,000 to 37,000 fish. The preseason forecast was preliminary and was revised in mid–July, following the summer chum salmon run. The IMEG range recommended by the YRP remained at 70,000–104,000 for Canadian-origin fall chum salmon.

Throughout the season DFO provided weekly email updates to First Nations and harvesters and hosted bi-weekly inseason meetings with the YSSC and First Nation Lands and Resources managers as a means to provide a forum to exchange management and assessment updates. DFO staff also participated in regular inter-agency meetings with ADF&G fall season staff and provided updates during the weekly YRDFA teleconferences.

Canadian management decisions were based on the application of in-season assessment information utilizing the management decision matrix – a component of the IFMP. The decision matrix provides detailed guidance for the management of fisheries linked to specific inseason run abundance levels. The 2022 decision matrix summarized the management reference points, general allocation plans, and anticipated management responses under different run size scenarios (Table 6). A summary of management and conservation measures implemented in Canada is presented in Appendix B21.

For 2022, DFO continued to take a more precautionary approach to managing fisheries that interact with stocks of concern and implemented a long-term closure on the Yukon River fall chum salmon commercial fishery. This closure is expected to remain in place for at least 1 salmon generation (4–5 years) or until stock growth and abundance above critical zone levels is witnessed.

Inseason Management Mainstem Yukon Fall Chum Salmon

Inseason decisions about fishery openings and closures in Canada for fall chum salmon were made in a similar way as those for Chinook salmon. 2022 saw the fourth lowest summer chum salmon run on record which resulted in a revised drainagewide fall chum salmon projection that would be similar to the preseason forecast and unlikely to meet spawning escapement goals.

Inseason projections of the Canadian component of the fall chum salmon run were based on cumulative passage estimates and genetic apportionment of Canadian-origin fall chum salmon from the Pilot Station sonar and assessment information from the LYTF. As early as August 10, the revised projection for fall chum salmon was similar to the pre-season forecast and unlikely to meet spawning escapement. As fall chum salmon approached and entered Canada in early September, Canadian managers began considering passage estimates from Eagle sonar.

The intention of management actions in 2022 was to ensure that the IMEG range of 70,000–104,000 fall chum salmon was achieved. However, the revised projection and observed low run size at Pilot Station sonar indicated that the low fall chum salmon run would not be sufficiently abundant to provide for spawning escapement and would result in no available Canadian-origin fall chum salmon allocation.

By early August, information from the lower river in Alaska indicated that the total run would be very low, which was later supported by Eagle sonar passage estimates that indicated that the run into Canada would not meet the IMEG. Given the poor run, First Nation governments were advised that there would not be a Canadian allocation and First Nation governments advised their citizens to forego fall chum salmon harvest.

Fishing Branch (Porcupine) River Fall Chum Salmon

The 2022 preseason forecast estimate for Fishing Branch-origin fall chum salmon was 3,000–6,000 fish. The preseason forecast was preliminary and was revised in mid-July, based on the assessment of the summer chum salmon run. The IMEG for the Fishing Branch River recommended by the YRP was 22,000–49,000 adult fall chum salmon.

Considering that the IMEG has only been achieved in 6 of the last 10 years, the variability in productivity of Fishing Branch chum salmon is not well understood, and the outlook for Fishing Branch fall chum salmon is highly uncertain, a precautionary approach was warranted. In alignment with the IFMP, the First Nation Fishery would be closed at the start of the season. The pre-season management approach would be modified based on early-season and in-season information. Important to note is that in accordance with Yukon First Nation Self-Governing Agreements, the Vuntut Gwitchin Government directs the First Nation fishery. A summary of management and conservation measures implemented on the Porcupine River in Canada is presented in Appendix B23.

Inseason Management Fishing Branch (Porcupine) Fall Chum Salmon

Canadian fisheries managers consider early season information from the LYTF and Pilot Station sonar. Estimates of fall chum salmon passage in combination with genetic mixed stock analysis (MSA) cannot be used to reliably predict run size at Fishing Branch River, as it forms a negligible component of the total run observed at Pilot Station. Management decision, therefore, cannot be made using these data and in-season management is largely based on data from the Porcupine River sonar, located near Old Crow, Yukon. U.S. harvest information is also considered, as some of these fish are removed prior to reaching Canada and the Porcupine River sonar.

As the season progressed, it was apparent that Fishing Branch River fall chum salmon run would not meet the escapement goal. At this time, the Vuntut Gwitchin Government asked their citizens to refrain from harvesting fall chum salmon.

In 2022, escapement to the Fishing Branch River was monitored by a weir and sonar. Only a portion of the fall chum salmon that return to the Canadian Porcupine River are destined for the Fishing Branch River. Based on 2022 Porcupine River sonar counts and Fishing Branch River weir counts, approximately 77% of Canadian-origin Porcupine River fall chum salmon were considered Fishing Branch River origin.

6.0 CANADIAN HARVEST SUMMARIES

6.1 FIRST NATION SUBSISTENCE FISHERIES

Harvest estimates of salmon in the First Nation fisheries on the Yukon and Porcupine rivers are determined from locally-conducted in-season interviews and postseason reports.

Mainstem Yukon River Chinook Salmon

Based on a preseason outlook for a below-average run of 41,000–62,000 Canadian-origin Yukon Chinook salmon, and the probability that the run size would not be at the upper end of the range, it was highly unlikely that spawning escapement goals would be met and early fishing opportunities in the First Nation fisheries would be conservative.

Inseason information from the LYTF and Pilot Station sonar projects strongly suggested that the Chinook salmon run was historically low and below the preseason forecast range, which would not provide for a First Nation fishery. Ultimately, inseason Eagle sonar passage data did not align with Pilot Station sonar projections. As the run progressed, the Eagle sonar passage indicated that the IMEG would not be met in 2022. Yukon First Nation governments were responsive to in-season information and followed conservative management plans at the onset of the 2022 season, prior to DFO implementing a prohibition on retention of Chinook salmon in Canada for all fisheries on August 5. Both of these actions resulted in a significantly reduced harvest compared to long term historical averages. The First Nation harvest in the Canadian Yukon River mainstem drainage in 2022 was estimated to be 46 fish (Appendix B7). For comparison, the First Nations long-term (1961–2021) average harvest is 4,815 fish; the most recent 10-year average (2012–2021) is 1,949; and the most recent 5-year average (2017–2021) is 2,344 fish (Appendix B7).

Mainstem Yukon River Fall Chum Salmon

The preseason outlook for Canadian-origin fall chum salmon in 2022 suggested a well below average run of 20,000–37,000 fish. The preseason forecast was preliminary and was revised in mid–July, following the summer chum salmon run. By early August, the inseason projection was again revised using MSA data from the 2022 LYTF, which showed a lower than normal apportionment of fall chum salmon. The projected run size was not expected to meet the minimum spawning escapement of 70,000 Canadian-origin fall chum salmon. Inseason Eagle sonar counts suggested that border passage would be insufficient to meet border passage obligations under the YRSA. First Nations abstained from harvest on the Yukon River mainstem, and for the third year in a row there was zero fall chum salmon harvest reported in the First Nation fishery on the mainstem Yukon River drainage (Appendix B8). For comparison, the long-term (1961–2021) average First Nation subsistence harvest is 2,137 fish; the most recent 10-year average (2012–2021) is 675 and 5-year average (2017–2021) is 600 fish (Appendix B8).

Porcupine River Chinook, Fall Chum, and Coho Salmon

An estimated harvest of 12 Chinook salmon occurred in the 2022 First Nation subsistence fishery near Old Crow (Appendix B7). For comparison, the long-term (1961–2021) average harvest is 245 fish; the most recent 10-year average (2012–2021) is 180 fish; and, the most recent 5-year average (2017–2021) is 195 fish (Appendix B7).

An estimated harvest of 15 fall chum salmon occurred in the 2022 First Nation subsistence fishery near Old Crow (Appendix B8). For comparison, the long-term (1961–2021) average harvest is 4,036 fish; the most recent 10-year average (2012–2021) is 1,625 fish; and the most recent 5-year average (2017–2021) is 1,061 fish (Appendix B8).

There was no reported harvest of coho salmon on the Porcupine River in 2022.

6.2 COMMERCIAL FISHERY

The commercial Chinook, fall chum, and coho salmon fisheries remained closed throughout the 2022 fishing season (Appendices B7 and B8). The long-term (1961–2021) average commercial harvest of Chinook salmon is 5,717 fish, and there have been 0–4 Chinook salmon harvested annually in the past 12 years (2010–2021; Appendix B7).

The long-term (1961–2021) average commercial harvest of fall chum salmon is 9,351 fish, and the most recent 5-year average (2017–2021) is 2,030 fish (Appendix B8). Since 1997, there has been a marked decrease in commercial catches of Upper Yukon River fall chum salmon as a result of a limited market. Between 1961 and 2019, the commercial fall chum salmon catch ranged from a low of 293 fish in 2009, when the run was late and the fishery had been closed for most of season due to conservation concerns, to a high of 40,591 fish in 1987. Note that commercial harvest of coho salmon in the mainstem Yukon River in Canada rarely occurs. This is thought to be due to a combination of low abundance and their late migration timing which limits availability of this species.

For 2022, DFO took a more precautionary approach to managing fisheries that interact with stocks of concern and implemented a long-term closure on the Yukon River Chinook and fall chum salmon commercial fishery. This closure is expected to remain in place for at least 1 salmon generation (4–5 years) or until stock growth and abundance above critical zone levels is witnessed.

6.3 Domestic Subsistence Fishery

The domestic fishery was closed during the Chinook and fall chum salmon season (Appendices B7 and B8); there were no salmon harvested in the domestic fishery in 2022. Openings in the domestic salmon fisheries are concurrent with commercial fishery openings. For comparison, with respect to harvest of Chinook salmon in the domestic fishery the long-term (1974–2021) average is 393 fish. Domestic harvest of Chinook salmon has been zero since 2010 (Appendix B7). With respect to domestic harvest of fall chum salmon, the long-term (1974–2021) average is 414 fish; the most recent 10-year average (2012–2021) is 13 fish; and the most recent 5-year average (2017–2021) is 10 fish (Appendix B8).

6.4 Licensed Public Angling Fishery

In 1999, the YSSC introduced a mandatory Yukon Salmon Conservation Catch Card to improve harvest estimates and to serve as a statistical base to ascertain the importance of salmon to the Yukon River public angling fishery. Anglers are required to report their catch and harvest by November 30. The information reported includes the number, species, fate (kept or released), sex, size, date, and location of all salmon caught. From preliminary catch card information received at the time of this publication, no Chinook salmon were caught or retained in the Yukon River or its tributaries in the 2022 public angling fishery, which is consistent with the angling restrictions and closures which were in place for the duration of the 2022 Chinook and fall chum salmon seasons.

Over the last 10 years, retention (harvest) of Chinook salmon in the public angling fishery was only permitted in 2009 and 2011 (Appendices B7 and B19). For the 2022 season, the daily catch and possession limits of fall chum salmon in the public angling fishery were varied to zero prior to the start of the season which was followed by a complete angling closure to salmon on the Yukon River and its tributaries (Appendix B21).

7.0 TOTAL RUN, ESCAPEMENT, AND HARVEST SHARE ASSESSMENTS FOR 2022

7.1 Chinook Salmon

In 2022, the total Chinook salmon passage at the Pilot Station sonar was approximately 48,439 fish ±7,379 (90% CI, Table 7, Appendix A1). This is considered an index of the drainagewide Chinook salmon run, rather than a total run size estimate, because some salmon are harvested or enter spawning areas below the sonar site. This passage was below the historical average[3] of 179,853 fish (Appendix A1). Most of the Chinook salmon entered the river in 2 prominent pulses consisting of approximately 12,483 and 16,148 fish. However, similar to recent years, the front end of the run had an unusually long and consistent flow of 'tricklers' that lasted for over 2 weeks before the more distinctive first pulse arrived. The first quarter point, midpoint and third quarter points for Chinook salmon at the Pilot Station sonar project were on June 24, June 28 and July 3, respectively. Post-season it was determined that the 2022 Chinook salmon run was 4 days later than average based on the midpoint at the Pilot Station sonar project.

Chinook salmon passage estimated at Eagle sonar in 2022 was 12,025 fish (Appendix B11). The estimated mainstem border passage into Canada was 12,023 fish, which is calculated by

[3] Average includes years 1995, 1997, 2000, 2002–2008, and 2010–2019. The Pilot Station sonar did not operate in 1996 and project difficulties occurred in 1998–1999, 2001, and 2009.

subtracting the harvest upriver from the Eagle sonar site (Appendices B11 and B18). The estimated spawning escapement of Canadian-origin Yukon River Chinook salmon (mainstem) was 11,977 fish, which is calculated by subtracting Canadian harvest (Figure 9) from border passage (e.g., Appendices B11 and B18). This escapement was below the lower end of the IMEG of 42,500–55,000 Chinook salmon (Figure 10). Combining the spawning escapement estimate with the U.S. and Canadian harvests of Canadian-origin Chinook salmon indicates the total mainstem Canadian-origin run size was approximately 13,144 fish (Appendix B18).

Based on a total run size estimate of 13,144 Chinook salmon, and prescriptions outlined in the YRSA, the TAC for 2022 was 0 fish (Appendix B18). The U.S. harvest of 1,121 exceeded the harvest share of 0. The number of Chinook salmon that passed into Canada (12,023) was 30,477 fewer fish than what was needed to meet the lower end of the IMEG range (42,500 fish). The Canadian mainstem harvest of 46 Chinook salmon also exceeded the Canadian harvest share of 0.

Age, sex, and length (ASL) composition of Chinook salmon were assessed at both mainstem sonar sites and in various escapement projects (Table 8; Appendices A4–A5). The ASL samples collected at the Pilot Station sonar are thought to be representative of all Chinook salmon stocks passing the site and include both U.S. and Canadian stocks. The ASL samples collected at the Eagle sonar are exclusively from Canadian-origin Chinook salmon. Gillnet mesh sizes used to sample the runs differ at each location. The Chinook salmon age composition from 327 samples that were aged from the drift gillnet test fishery at the Pilot Station sonar project (all mesh sizes combined) was 12% age-4, 36% age-5, 46% age-6, and 6% age-7 fish (Appendix A4). Females comprised 53% of all fish sampled (including un-ageable samples; Table 8). The age composition for age-5 fish were below the recent 10-year average. However, all other age classes were above the recent 10-year average with percent female also above average. It is important to note that while the Pilot Station sonar test fishery uses a wide range of gillnet mesh sizes, and likely captures a representative sample across sizes and age classes, the sex is determined visually, and this method has reduced accuracy compared to internal inspection(Table 8; Appendix A4).

The Chinook salmon age composition from 119 samples that were aged from the test fishery at the Eagle sonar project was 6% age-4, 41% age-5, 49% age-6, and 4% age-7 fish (Appendix A4). The age compositions for age-4 and age-5 fish were below the recent 10-year average. However, all other age classes were similar or above the recent 10-year average with percent female also similar to the recent 10-year average. (Table 8). Slight modifications have been made to the drift gillnet mesh sizes used at the Eagle sonar during the first 3 years of operation (2005–2007); however, mesh sizes measuring 5.25, 6.5, 7.5, and 8.5-inch have been used consistently since 2007. Small fish may be underrepresented in the samples, due to not fishing gillnets smaller than 5.25-inch. mesh.

Chinook salmon escapement in U.S. tributaries was assessed at 1 weir, 2 counting towers and 2 aerial surveys (Table 2; Figure 11). In 2022, none of the U.S. tributary Chinook salmon escapement goals were met and escapements for systems without goals were well below average (Liller and Savereide 2018; Table 2; Appendix B10). River conditions were favorable on the Chena River system this year, with below average water levels during the summer season passage dates (late-June to mid-August). However, high water events on the Salcha River for 8 days hindered estimating passage counts for that system and forest fires along with high water events prevented installation of the weir on the East Fork Andreafsky River. The Henshaw River weir did not operate due to needed repairs to the damaged weir panels from flooding the previous year. Aerial surveys of the East and West Forks of the Andreafsky River were conducted but no escapement estimates were possible due to poor survey conditions. The remaining assessment projects were able to provide successful counts for nearly all days of operation.

Passage of Chinook salmon to tributaries in Canada was assessed at the Whitehorse Rapids Fishway and sonars operated on the Porcupine, Klondike and Takhini rivers and at a weir on Tatchun Creek (Appendix B12). The 2022 estimate for Chinook salmon passage on the Porcupine River was 349 fish, much lower than the 2014–2021 average of 3,477. On the Klondike River, 253 Chinook salmon were counted, which was lower than in the previous operating years, 2009–2011 and 2020–2021 (average of 1,691). Takhini River had an estimated passage of 476 Chinook salmon, below the 3 year lifetime project average of 1,224. At Tatchun Creek, 2022 passage was estimated at 206 Chinook salmon, well below the 1970–2000 average of 243 fish. At the Whitehorse Rapids Fishway, 165 Chinook salmon were counted, which was below the 10-year average (2012–2021) count of 948 fish and the lowest on record. Hatchery-produced fish accounted for 40% of the fish that returned to the Whitehorse Fishway in 2022, compared to 2012–2021 average of 46%.

7.2 SUMMER CHUM SALMON ALASKA (U.S. ONLY)

In 2022, an estimated 463,806 summer chum salmon ±24,817 (90% CI) passed the Pilot Station sonar (Table 7, Appendix A1), which was well below the 1995–2021 (excluding 1996, 1998, 1999, 2001, and 2009) median of 1.7 million fish for the project but was above the lowest count of 153,718 from 2021 and slightly above the low counts of 442,546 and 448,665 in 2001 and 2000 respectively. The first quarter point, midpoint, and third quarter point were June 27, July 2, and July 12, respectively, which was 4 days later than average. Four pulses of summer chum salmon were detected at the Pilot Station sonar project with the largest group consisting of approximately 154,360 fish and passed between June 24 and June 29. A summer chum salmon drainagewide biological escapement goal (BEG) with a range of 500,000–1,200,000 was adopted in 2016 (Liller and Savereide 2018; Table 3), and the 2022 estimated escapement of 471,730 fish fell below the lower end of the goal and was the second lowest on record.

In addition to the drainagewide biological escapement goal, escapement goals exist for summer chum salmon on the East Fork Andreafsky and Anvik rivers (Table 3). Unfortunately, the East Fork Andreafsky weir project was unable to operate due to forest fires and high water events delaying deployment of the weir. In addition, aerial survey conditions were poor on both the East and West forks of the Andreafsky River and no escapement estimates were available for that system. The BEG of 350,000–700,000 for the Anvik River was not met with a sonar estimate of only 46,436, which was well below the 2012–2021 average of 351,402 and only larger than the count from 2021 of 18,819 (Appendix B13). Counts at the other projects (Gisasa River Weir, Chena and Salcha River Towers, Nulato River and Anvik River aerial surveys) all were well below the historic medians.

The Henshaw Creek weir did not operate in 2022 because of needed repairs to the damaged weir panels from the previous season due to flooding. Carcass sampling on the Salcha River was canceled due to low abundance of fish and high water during the peak spawning and carcass sampling periods.

7.3 FALL CHUM SALMON

The initial method of determining total drainagewide (i.e., U.S.-origin and Canadian-origin) fall chum salmon run size inseason was based on the Pilot Station sonar passage estimate and the estimated inriver harvest of fall chum salmon downstream of the sonar site. The inseason run size model primarily uses the commercial fishery, which is usually the largest harvest component below the sonar site, to produce overall projections of abundance used to manage the fishery. In 2022, due to the low run of fall chum salmon, the commercial fishery was not prosecuted, and the subsistence harvest was minimal due to fishery closures; therefore, no harvest was added to the passage estimate inseason. Genetic mixed stock analysis (MSA) was used inseason to account for the fall chum salmon component of the run, which transitions from summer to fall runs in mid-July at the lower Yukon River delta. The inseason total run size using these methods was estimated to be near 240,000 chum salmon (Table 9).

Postseason, a Bayesian state-space model has been used to estimate drainagewide escapement (Fleischman and Borba 2009) through 2021. For 2022, the total drainagewide run size was determined by using the total mixed stock analysis proportion of fall chum salmon plus the harvest below the mainstem sonar site. The drainagewide escapement includes the total run size minus the estimated total harvest (U.S. and Canada). In 2022, these methods resulted in a total drainagewide run size estimate of 242,000 fall chum salmon, which was above the preseason forecast of 78,100–148,000 fish. The total run size ended up closer to the inseason projection of 273,000 fall chum salmon, based on the relationship between summer and fall chum salmon total run sizes.

The drainagewide escapement estimate of 240,000 fall chum salmon, was below the escapement goal range of 300,000–600,000 fall chum salmon (Liller and Savereide 2018; Table 9; Figure 12). Individual fall chum salmon escapement to spawning areas were monitored in the Toklat, Delta, Teedriinjik (Chandalar), Sheenjek, Fishing Branch, and Canadian mainstem Yukon rivers (Appendices B14–B16). None of the individual escapement goals were achieved for fall chum salmon in 2022 (Liller and Savereide 2018; Tables 9 and 10; Figures 13 and 14; Appendices B14–B16).

In 2022, the proportions by age class for fall chum salmon caught in both the LYTF (Emmonak) and MVTF were weighted by project, then combined and used to represent the drainagewide run and included <1% age-3, 77% age-4, 22% age-5, and <1% age-6 fish. The age-3, age-5, and age-6 components were all below average, while the age-4 was above average when compared to LYTF weighted averages for years 1977–2021. The unweighted proportions of fall chum salmon samples from LYTF included 1% age-3, 78% age-4, 21% age-5, and 0% age-6 (Appendix A10). The fall chum salmon unweighted samples collected from the test fishery operated at Mountain Village included 1% age-3, 75% age-4 and 24% age-5. Fall chum salmon ASL composition estimates from collections in the Delta River included 2% age-3, 92% age-4, and 6% age-5. Samples were also collected from fall chum salmon for the escapement into Canada based on test fishing near the Eagle sonar site and included 41% age-4, 58% age-5, and <1% age-6. Fall chum salmon sampled at the weir on the Fishing Branch River included 3% age-3, 49% age-4 and 48% age-5. Most of the projects reported proportions of age-4 above average except for at Eagle. The proportion of females was higher than males in all escapement projects except at Eagle (Appendix A10). Salmon are measured from mid eye to tail fork, here referred to as fork length (MEFL). Fall chum salmon sampled for length at Eagle (upper Yukon River) were 587 mm while the Delta River fish were smallest in length at 553 mm (MEFL). These differences in lengths between Eagle (high proportion age-5) and Delta (high proportion age-4) are consistent with the dominant age class sampled at each of the respective locations.

Mainstem Yukon River Canadian-origin Fall Chum Salmon

The U.S./Canada border passage estimate for fall chum salmon was the lowest on record, at 22,059 fish. There were 16 fish harvested in the U.S. upstream of Eagle sonar in 2022 and none in Canada. Both the border passage and spawning escapement estimates for Canadian-origin Yukon River mainstem fall chum salmon were 22,059 (Figure 15; Appendices B8 and B16). For comparison, the 10-year average (2012–2021) escapement is 145,078 (Appendix B16). The 2022 spawning escapement of Canadian-origin Yukon River mainstem fall chum salmon was well below the IMEG of 70,000–104,000 fish (Figure 14, Table 10).

The preliminary reconstruction of the total 2022 Canadian-origin Yukon River mainstem fall chum salmon run was 23,000 fish (Appendix B20). Total run size was approximated using the expanded estimate of fall chum salmon that passed the Eagle sonar near the U.S./Canada border (22,075 fish) plus 25% of the U.S. harvest of fall chum salmon that occurred downstream of Eagle sonar (2,778 × 0.25 = 695 fish) and then rounded to the nearest 1,000. This run size estimate was within the preseason outlook range of 15,620–29,600 Canadian-origin Yukon River mainstem fall chum salmon and near the midpoint estimate based on Pilot Station sonar and genetic stock identification (24,400; 90% CI 13,000–35,000).

Porcupine River (Including the Fishing Branch River) Canadian-origin Fall Chum Salmon

In 2022 DFO and Vuntut Gwitchin Government operated the Porcupine River sonar immediately downstream of the community of Old Crow. An estimated 3,804 fall chum salmon passed by the sonar (Appendix B15). An estimated 15 fish were harvested in the Old Crow fishery (Appendix B8; details are presented in Section 8.3).

DFO and Vuntut Gwitchin Government also operated the Fishing Branch River weir in 2022. Sonar enumeration of migrating fall chum salmon was conducted from September 7–October 22. The 2022 spawning escapement estimate for fall chum salmon above the Fishing Branch River weir was 2,934 fish, next to the lowest recorded since the program began in 1972 (Figure 14, Table 10 and Appendix B15). The Canadian harvest of Fishing Branch River fall chum salmon in 2022 was estimated at 11 fish (of 15 chum salmon harvested in the Old Crow fishery). This is based on the proportion (77% in 2022) of fall chum salmon estimated at the Porcupine River sonar and upstream at Fishing Branch weir. The total run size estimate for 2022 Fishing Branch fall chum salmon was 3,000 fish (Appendix B22). Total run was calculated as the sum of the weir/sonar passage (2,934 fish), the estimated Canadian harvest (12 fish), and the estimated U.S. harvest of Fishing Branch fall chum salmon (4% of the total U.S. fall chum salmon harvest, 2,778 x 0.04 = 111 fish) (Appendix B22).

8.0 PROJECT SUMMARIES

8.1 ALASKA, U.S.

Salmon assessment programs operated throughout the U.S. portion of the Yukon River drainage are collaborative. This report summarizes salmon run, harvest, and escapement monitoring results from numerous projects. Data were provided by various entities including ADF&G Division of Commercial Fisheries and Division of Sport Fisheries, USFWS, and G. Sandone Consulting, LLC. Partner organizations that assisted with data collection include Yukon Delta Fisheries

Development Association (YDFDA) and DFO. A more in-depth overview of select stock assessment programs are described in subsequent sections of this report.

Lower Yukon Test Fishery

The LYTF program is designed to assess salmon run timing and relative abundance and beginning in 2021 the program consisted of 2 Chinook salmon test fisheries; an 8.5-inch mesh set gillnet test fishery operated in the South Mouth of the Yukon River, and an 8.25-inch mesh drift gillnet test fishery operated in the South (Big Eddy) and Middle mouths. The LYTF also has a summer chum salmon-directed drift gillnet test fishery using 5.5-inch mesh gear operated in the South and Middle mouths. These test fisheries provide catch per unit effort (CPUE), which provides an index of abundance and indicates the presence of large groups of fish, or "pulses", entering the mouths of the river.

The LYTF operated at a reduced effort in 2022 with snag gillnets clearing debris starting on May 27 at the South Mouth (Big Eddy) drift sites, but official start dates were June 2 for drift gillnet and June 5 for set gillnet. The Middle Mouth set gillnet site for Chinook salmon did not operate for the 2022 summer season because of logistical complications of operating a field camp and efforts to reduce test fish harvest. However, an additional 8.25-inch mesh drift gillnet was fished in the Middle Mouth allowing the crew to effectively commute to and from Emmonak while still providing test fishing indices of the run from that mouth of the river. Furthermore, the use of a drift gillnet reduced the incidental mortality of Chinook salmon in a low abundance year and streamlined fish donations for a logistically challenging location.

The LYTF 8.5-inch mesh set gillnet concluded operations on July 12 in the South Mouth (Big Eddy). The cumulative Chinook salmon CPUE for the Big Eddy set gillnet was 6.29. The first quarter point, midpoint, and third quarter point of the set gillnet was on June 10, June 21, and June 26, respectively. The 8.25-inch drift gillnet projects for Chinook salmon operated in both South and Middle mouths until July 15 and provided valuable run timing information for Chinook salmon entering the Yukon River. The combined cumulative Chinook salmon drift gillnet CPUE for the South Mouth and Middle Mouth sites was 47.09. The combined first quarter point, midpoint, and third quarter points of the drift gillnets were on June 22, June 23, and June 27, respectively. The 5.5-inch drift gillnet operations for summer chum salmon at both the South Mouth and Middle Mouth sites concluded on July 15. The combined cumulative chum salmon drift gillnet CPUE for the South Mouth and Middle Mouth sites was 800.43, which was below the historical median CPUE of 6,707.64. The first quarter point, midpoint, and third quarter point were June 23, June 28, and July 6, respectively.

The LYTF project continues in the fall season after switching to 6-inch drift gillnets on July 16 and completed operations on September 10. The cumulative fall chum salmon CPUE of 574.32 was well below the historical median of 1,519.19 and the cumulative coho salmon CPUE of 44.22 was also well below the historical median of 395.49.

Chinook, chum, and coho salmon caught in the LYTF were released alive if healthy enough to do so, otherwise they were kept, sampled, and distributed to local community. Fish kept and distributed are included in the subsistence harvest estimates. The fish donation program was coordinated with village tribal councils and with the assistance of YDFDA.

Pilot Station Sonar

The goal of the Pilot Station sonar project is to estimate daily upstream passage of Chinook (Figure 8), summer and fall chum (Figure 16), and coho salmon (Figure 17). The project has been in operation since 1986 but data is only reported back to 1995. Due to changes in methodology, data from 1995 to present are the most consistent (Appendix A1). Both split-beam and Adaptive Resolution Imaging Sonar (ARIS)[4] are used to estimate total fish passage, and CPUE from the drift gillnet test fishing portion of the project is used to estimate species composition. The project's sonar equipment and apportionment methodologies have evolved over time (Pfisterer et al. 2017; Morrill et al 2021).

Fish passage estimates at the Pilot Station sonar project are based on a sampling design in which sonar equipment is operated daily in three 3-hour periods and drift gillnets 25 fathoms long with mesh sizes ranging from 7.0 cm to 21.6 cm (2.75- to 8.5-inch), approximately 4.3 fathoms in depth, that are fished twice each day between sonar periods to apportion the sonar counts to species. During the 2022 season, both banks were fully operational on June 1 and continued operations through September 7. The ice went out on the mainstem Yukon River near Pilot Station on May 9, based on National Weather Service (NWS) data[5]. Test fishing began on June 1; the first Chinook salmon was caught June 7, the first chum salmon on June 12, and the first coho salmon was caught on July 27.

An estimated 2,022,498 fish passed through the sonar sampling area between June 1 and September 7 (Table 7). Drift gillnetting resulted in a catch of 6,480 fish including 379 Chinook; 1,331 summer chum; 1,576 fall chum, 809 coho; and 34 sockeye salmon. A total of 2,351 fish of other species were also caught. Chinook salmon were sampled for ASL; while only sex (external) and length were collected from chum, pink, sockeye, and coho salmon without aging structures; for all other non-salmon species, only length was collected. Genetic samples were taken from Chinook and chum salmon. Any captured fish that were not successfully released alive were distributed daily to residents in Pilot Station. Overall, in 2022, there were no significant operational problems. Both sonars performed well throughout the season.

River discharge recorded by the United States Geological Service near Pilot Station was above the 2012–2021 mean throughout the duration of the field season, rising above the historical maximum for a brief period from June 27-July 2.

In 2022, all project goals were met, and passage estimates were provided to fisheries managers daily during the season. Information generated at the Pilot Station sonar was also discussed weekly through multi-agency international teleconferences, facilitated by YDFDA, that included stakeholders from the lower Yukon River to the headwater communities in Canada. Preliminary daily salmon passage estimates were available online[6] and disseminated daily to the general public via a listserv.

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

[5] https://www.weather.gov/aprfc/breakupDB?site=488

[6] https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareayukon.main

Ichthyophonus Investigations 2022

In 2020, subsistence fishermen reported concerning levels of *Ichthyophonus* infections in Yukon River Chinook salmon. This prompted ADF&G and USFWS to initiate the feasibility of investigating the disease in 2021 for both prevalence and severity of infections. The laboratory analysis of the limited samples collected in 2021 indicated that the *Ichthyophonus* disease was similar to or higher than peak levels observed in the early 2000's and likely well above the 25% threshold level identified by the Joint Technical Committee to warrant focused studies. The severity of infections were also considered high. Additionally, Eagle sonar counts, and the U.S./Canada border passage estimates in 2020 and 2021 were considerably smaller than what was expected based on the Pilot Station sonar counts. Currently, *Ichthyophonus* disease associated en-route mortality is the leading hypothesis to try and explain these differences. ADF&G, USFWS and multiple partners have initiated a multiple year project that started in 2022 to study the impacts of *Ichthyophonus* on Yukon River Chinook salmon and determine if *Ichthyophonus* is contributing to large scale mortality, develop new tools to monitor the impacts of *Ichthyophonus* and provide actionable advice to fishery managers as needed.

The drainagewide and Canadian-origin Chinook salmon run size in 2022 were the lowest on record and a large discrepancy was again observed between what was expected at the border based on passage at Pilot Station sonar and the actual passage observed at Eagle sonar. Preliminary results of the 2022 samples are summarized below. In 2022, samples were collected from Pilot Station sonar gillnet test fishery, Rampart Rapids fishwheel, and Eagle sonar gillnet test fishery. Results of 202 samples taken from the Pilot Station sonar project (0.42% of passage sampled) indicate that the prevalence of *Ichthyophonus* infections in 2022 was 38% (77 out of 202). This prevalence was similar to peak levels observed in the past when baseline sampling was in place, similar to 2021 levels, and above the threshold level identified by the JTC of 25% to warrant focused studies. Of the 202 samples that were genetically grouped to country of origin, 89 (44%) were of Canadian stocks. Results of 200 samples taken from the Rapids fishwheel indicate that the prevalence of *Ichthyophonus* infections was 40% (79 out of 200), and 169 (85%) were genetically identified as Canadian stock. Results of 50 samples taken from the Eagle sonar test fishery (0.42% of passage sampled) indicate that the prevalence of *Ichthyophonus* infections was 42% (21 out of 50). All fish sampled at the 3 sites were distributed to the local communities, with half (n=25) of the Eagle fish given to First Nations within Canada.

In addition to quantifying the prevalence of infections this study is also estimating the level of intensity or severity of those infections and preliminary results indicate the most heavily infected fish were observed at the Rapids location with less heavily infected fish at Pilot and zero heavily fish infected fish observed at Eagle. These preliminary results suggest that the infection severity increased between Pilot Station and the Rapids and the lack of severely infected fish at Eagle is suggestive that those severely infected fish died downriver due to disease-associated complications. The high proportion (>40%) of infected samples collected at Eagle raises concerns for additional premature mortality in Canada before fish reach their spawning grounds. There is some evidence of temporal trends in the 2022 data, with severity of infections increasing as the season progresses. Therefore, representative late season samples will be important in future years. It is premature to conclude that the 2022 difference between Pilot Station and Eagle sonar estimates of Canadian-origin Chinook salmon is due to *Ichthyophonus* disease-associated mortality, but disease-associated mortality remains the leading hypothesis. Full results will be available post season and ADF&G and USFWS were successful in securing a multi-year grant from the Alaska Sustainable Salmon Fund to continue field sampling in 2023 and 2024.

Fish Health Evaluations, 2022

The Salmon Ocean Ecology Program (SOEP) initiated a pilot study in 2022 to study the condition, diet, and thiamine levels (a vital B-vitamin required for a range of metabolic processes) of returning Yukon River Chinook salmon. Sample collection for this research occurred at the LYTF from June 6 to July 10. The condition and diet of 102 fish was assessed (60 females, 42 males). For female Chinook salmon, additional egg and muscle samples were taken to assess fecundity and thiamine levels for eggs (a measure of thiamine available to offspring) and muscle tissue (a measure of maternally available thiamine). The fecundity and thiamine analyses are ongoing, and results will be disseminated when available. In 2023, the location of sampling will shift to the Pilot Station sonar project. Due to this planned shift, the diet analysis portion of this research will be discontinued because contents would be more digested at that location.

Preliminary results of the fish condition and diet analyses are summarized below. Condition was assessed using a nonlethal Distell FFM-692 fat meter, which uses microwave technology and species-specific calibrations to measure fish whole-body lipid content. Four measurements were taken at standardized areas along the body of each Chinook salmon and then averaged to estimate the percentage whole-body lipid content per fish. When these data were matched with genetic assignment information, 94 fish were available to explore differences in lipid content between Chinook salmon of Canadian versus U.S.-origin, sex, or age. The simplest comparison is that of Canadian versus U.S.-origin Chinook salmon (sex, age, and sampling date pooled). Canadian fish, on average, showed a whole-body lipid content of 22% compared to 12% for U.S.-origin fish. When these data were broken out by country and sex (age and sampling date pooled), there were little differences in average lipid content (Canada: females and males each = 22%; U.S.: females = 14%, males = 12%), but this analysis showed notable differences among sexes of different countries. When considering the dominant age classes of Yukon River Chinook salmon (ages 5 and 6; this analysis with sex and sampling date pooled) the same pattern held true with an average of 22% whole-body lipid for Canadian Chinook salmon versus 13% for U.S.-origin fish.

The diet of the 102 Chinook salmon was examined by pooling across sample date, genetic assignment, sex, and age. Overall, 75% of the stomachs were empty or contained mucous or parasites only. Prey that was found was highly digested and difficult to identify beyond fish and shrimp remains. Fish remains (currently unidentified, some possibly Pacific herring) occurred in 17% of the diets, along with a 2% occurrence of shrimp remains, and 6% unidentifiable animal tissues. Occurrence of stomach parasites was also examined. The trematode (all assumed *Brachyphallus* sp.) was highest in occurrence (97% of fish sampled) and load of this parasite scored as such: <100 trematodes (25% of fish sampled had this load), 100+ (44%), 1,000+ (26%), 10,000+ (4%). Additionally, nematodes were noticed in 17% of the stomachs, and tapeworms in 12%.

Chinook Salmon Genetic Sampling, 2022

In 2022, ADF&G and collaborators collected 817 genetic tissue samples from adult Chinook salmon caught in Alaskan test fisheries on the Yukon River. Samples included 375 fish from the Pilot Station sonar test fishery (PSTF), 133 fish from the Eagle sonar test fishery (ETF), 109 fish from the Lower Yukon Test Fishery (LYTF), and 200 fish from the Rapids fish wheel test fishery.

No Chinook salmon genetic baseline samples were collected from the Yukon River drainage in 2022.

Mixed Stock Analysis of Yukon River Chinook Salmon Sampled at the Pilot Station Sonar, 2005–2022

The ADF&G Gene Conservation Laboratory (GCL) uses mixed stock analysis (MSA) to estimate inseason stock compositions of Chinook salmon passage at the Pilot Station sonar using genotypes of samples collected from the PSTF. These data provide fishery managers an important "first look" at the Canadian-origin Chinook salmon run strength and timing before those fish migrate through most Alaska fisheries. Without genetic MSA of the PSTF samples, fishery managers would have no information about the Canadian-origin run until fish arrive at Eagle sonar, when most of the run has already passed through 1,900 km of fisheries. Knowledge of relative abundance and migration timing from this project has aided in inseason projections of total run size of Canadian-origin Chinook salmon and more refined management strategies to meet border passage goals.

Genetic MSA is conducted to provide insight on stock-specific run dynamics and has proven to be a critical component of inseason management of salmon fisheries in Alaska. Pilot Station sonar project data has been used to estimate the total proportion of Canadian-origin Chinook salmon each year since 2005. The weighted postseason estimates from this project indicate that on average (2005–2021) the Canadian stock makes up 41% of the total run and has ranged from 31%–54% (Table 11). Over this 17-year timeframe, the contribution of the Canadian-origin stock to the total run has been relatively stable; however, this project has highlighted a considerable amount of within-year variability in the relative abundance of Canadian-origin Chinook salmon (Table 11). In nearly all years (2005–2021), the proportion of Canadian-origin stocks has been highest, often exceeding 50%, during the early portion of the run, but typically decreases as the run progresses. This project, combined with the Pilot Station sonar passage estimates, has shown that while the proportion of Canadian-origin stocks are typically highest in the early portion of the run, the abundance (i.e., numbers of fish) of Canadian-origin fish is generally higher during the middle part of the run (Table 11). Analysis of the 2022 PSTF samples conforms to this typical pattern.

Tissue samples taken from Chinook salmon caught in the 2022 PSTF were analyzed in 3 strata for genetic MSA. The 3 strata periods were June 1–June 22 (number analyzed (n) = 106), June 23–June 29 (n = 141), and June 30–July 27 (n = 125). Genetic MSA indicated the proportion of the total Chinook salmon passage at the Pilot Station sonar that were Canadian-origin was 67% in stratum 1 (approximately 7,000 fish), 42%, in stratum 2 (approximately 8,000 fish), and 35%, in stratum 3 (approximately 7,000 fish). The total season Canadian percentage was 45% (weighted by passage) which is slightly higher than average total season Canadian percentage observed within the 2005–2021 time series (Table 11).

Mixed Stock Analysis of Yukon River Chinook Salmon Harvested in Alaska, 2022

Three broad-scale stock (reporting) groups are used to apportion Chinook salmon harvest by Alaska fisheries within the Yukon River drainage. The Lower and Middle Yukon River stock groups spawn in Alaska and the Upper Yukon River stock group spawns in the Canadian. Scale pattern analysis, age composition estimates, and geographic distribution were used by ADF&G from 1981–2003 to estimate Chinook salmon stock composition in Yukon River harvests. From 2004 to present, genetic analysis has been the primary method for stock identification (e.g., DuBois 2018). Harvest percentages by stock group for 2014–2022 include the harvest from the Coastal District, whereas the Coastal District was not included in years prior to 2014.

An estimate of the 2022 total U.S. harvest of Chinook salmon by stock of origin required information about the genetic stock composition of the subsistence harvest and test fish giveaways in each district. The Canadian-origin harvests from each district were then summed for a total estimated U.S. harvest of Canadian-origin stocks (e.g., DuBois 2018). There was no directed subsistence harvest sampling program in place for 2022; therefore, surrogate datasets were used. A total of 106 samples were collected from the LYTF and were used to determine the stock composition of the test fish giveaway in the lower river. A total of 200 samples were collected from the Rapids test fishery as part of the *Ichthyophonus* project and were used to determine the stock composition of the test fish giveaway from the Rapids location. The subsistence fishery was closed and restricted to 4-inch mesh gillnets or less to target non-salmon. In order to represent the stock composition of fish harvested incidentally from 4-inch mesh or less, the 69 samples collected in mesh sizes 5.25-inch or less from the PSTF were applied to harvests from the Coastal District through District 3. Genetic MSA results from prior years' (2006–2018) subsistence harvest sampling programs were used to inform the 2022 subsistence harvest composition for Districts 4 through 5. Chinook salmon harvested in the Black River, Koyukuk River drainage, Teedriinjik (Chandalar River), Birch Creek, and District 6 (Tanana River) are presumed to be U.S.-origin. Stock apportionment information and assumptions were applied to the total U.S. harvest of Chinook salmon (all stocks) of 1,827 (Appendix B2). An estimate of 1,121 Canadian-origin Chinook salmon were harvested in the U.S. in 2022 (Appendix B18). Subsistence harvest and stock composition estimates for 2022 are still considered preliminary as of the publication date of this report.

Genetic MSA results for 2022 indicate that the weighted U.S. harvest of Yukon River Chinook salmon was comprised of 22% Lower, 17% Middle, and 61% Upper (Canadian-origin) stock groups. U.S. harvest composition for 2022 was above the 2017–2021 average for the Lower and Upper stock groups and below the 2017–2021 average for the Middle stock group (Appendix A6).

Yukon River Chum Salmon Mixed Stock Analysis, 2022

Chum salmon were sampled from the Pilot Station sonar from June 12 through September 7 and analyzed by the USFWS genetics lab to provide stock composition estimates for most of the summer and fall chum salmon runs. Populations in the baseline are reported in aggregated stock groups (Table 12). Results from analysis of these samples were reported for each pulse or time stratum and distributed by email to fishery managers within 24–48 hours of receiving the samples. For summer chum salmon, the lower river stock group comprised 72% of the run and the middle river stock group comprised 28%. The Tanana component of the middle river stock group comprised 1% of the total summer chum salmon run and peaked in passage at the Pilot Station sonar during the sampling period of July 19–28. The run transition from summer to fall chum salmon occurred during the second period of the fall management season (July 29–August 14) when 90% of the mixture was comprised of fall chum salmon. For fall chum salmon, 90% of the run was of U.S.-origin and 10% of Canadian-origin (Appendix A7)[7]. The composition of the U.S. contribution was 59% Tanana and 31% Border U.S. (Teedriinjik, Sheenjek, and Black rivers). The composition of the Canadian contribution was 5% mainstem Yukon, 1% Porcupine, and 4% White rivers.

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[7] Fall chum salmon proportions presented in the text of this report can be calculated from Appendix A7 by dividing the stock-specific proportions by the contribution of fall chum salmon to the total chum salmon run (i.e., summer and fall).

Chinook Juvenile Abundance

Surface trawl surveys in the northern Bering Sea (Murphy et al. 2021) are used to estimate the abundance of Yukon River salmon stocks during their first summer at sea (juvenile life-history stage). Since 2003, juvenile Chinook salmon catch from the trawl surveys, coupled with genetic MSA, has been used to provide stock-specific juvenile abundance estimates (Figure 18; Murphy et al. 2017, Howard et al. 2019, Howard et al. 2020, Murphy et al. 2021). No surveys were conducted in 2008 or 2020, and the survey design in 2005 had a significant impact on the abundance estimate for juvenile Chinook salmon and therefore it is not used as part of the abundance index.

Environmental Conditions Report

This U.S. environmental conditions report was added for the first time in 2019. This report differs from the Canadian environmental conditions report, which is much more detailed and was requested by the YRP. Instead, this addition was a first step to document environmental conditions relevant to adult salmon migrating through the U.S. portion of the Yukon River drainage. Currently, environmental monitoring within the U.S. portion of the Yukon River is limited and existing assessment programs are inadequate to quantify environmental impacts to migrating and spawning salmon. Climate change is bringing warming conditions to northern latitudes and in some years water temperatures in the mainstem Yukon River may have exceeded the tolerances of adult salmon. Research has indicated that adult salmon exposed to temperatures of >21–22°C, can experience increased mortality (McCullough et al. 2001).

Water temperature records from LYTF and Pilot Station sonar project sites remain the most reliable and consistent historical inseason data available for the mainstem Yukon River. However, there has been a multi-year effort by ADF&G to expand the spatial distribution of temperate loggers throughout the Yukon River drainage. In 2022, some projects monitoring water temperatures on the mainstem Yukon River included LYTF (Big Eddy and Middle Mouth sites), Mountain Village test fishery, Pilot Station, and Eagle, as well as tributaries Anvik, Sheenjek, Toklat, Delta, and upper Chena rivers (the last 3 loggers remain over winter). ADF&G provides inseason daily updates of water temperature for Yukon River at Pilot Station, Tanana River at Nenana, Chena River near Two Rivers, and Salcha River near Salchaket and several sites in Canada (Big Salmon River, Hess River, and Yukon River at Whitehorse) to keep managers and the public apprised of current conditions. [8] [9]

The LYTF temperature loggers[10] were deployed on June 8 and operated through August 28 in 2022. Water temperatures were variable during the summer season with warmer than average temperatures during the first 2 weeks of June, near average temperatures during late June and early July, and warmer than average temperatures in mid-July. Water temperatures cooled rapidly in the middle of July, and the fall season experienced near record low water temperatures (14°C) on July 31 before rising to average by the end of August. The highest temperatures at LYTF typically occur mid-July. In 2022, the highest water temperatures occurred for 1-week in mid-July, and the maximum water temperature (19.5°C) was observed on July 16 (Figure 19).

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[8] https://waterdata.usgs.gov/ak/nwis/current

[9] https://wateroffice.ec.gc.ca/index_e.html

[10] LYTF monitors daily temperature throughout the season using handheld monitors. These readings are closely aligned with measurements recorded by data loggers since the Yukon River waters are generally well mixed.

Water temperature loggers at Pilot station were deployed for a similar duration during the 2022 season as LYTF, and similar temperatures were recorded at both sites. The maximum water temperature recorded at Pilot Station was 19.6°C and was recorded on July 15.

Eagle sonar temperature loggers were deployed from June 30 through October 6. In 2022, water temperatures at Eagle sonar were above average for a week prior to July 15 and during the last week of August to first week of September. Water temperatures was average to below average the remainder of the season. The maximum water temperature, 18.0°C, occurred at Eagle sonar on July 19.

ADF&G monitors river discharge (cubic feet per second) in the Alaskan portion of the Yukon River, because discharge has implication for salmon travel time, debris load, and effectiveness of fishing gear. Daily river discharge updates are provided to the public from the following sites: Yukon River near Eagle, Stevens Village, and Pilot Station as well as locations on the Tanana River near Nenana, Chena River near Fairbanks, and Salcha River near Salchaket.

Inseason, ADF&G measures water levels (discharge in cubic feet per second) into account when tracking groups of adult salmon as they migrate up the Yukon River as it affects their travel time, debris loads, and effectiveness of fishing gear. ADF&G provides inseason daily updates of water levels to the public for the following sites: Yukon River near Eagle, Stevens Village, and Pilot Station as well as locations on the Tanana River near Nenana, Chena River near Fairbanks, and Salcha River near Salchaket and several sites in Canada[11] (Big Salmon, Pelly River, Yukon River above White River, and Porcupine River). In 2022, water levels were generally above average in the upper portion of the Yukon River drainage most of the season and average to below average in the Tanana River drainage for most of July through October.

8.2 Eagle Sonar

ADF&G and DFO collaborate to jointly assess the passage of Yukon River mainstem Chinook and fall chum salmon just downstream of the international border (project is referred to as Eagle sonar). Since 2006, Chinook and fall chum salmon passage has been estimated using split-beam and imaging sonar operated near the community of Eagle, Alaska (McDougall and Brodersen 2020). There are effectively 2 separate fishing efforts at the project. The first is for collecting ASL and genetic samples from Chinook salmon and utilizes 5.25, 6.5, 7.5, and 8.5-inch mesh gillnets fished in a rotating schedule. These drifts are conducted twice a day (2 fishing periods) until August 1 when one period is discontinued and, in its place, drifts are conducted to determine the crossover date between the Chinook and fall chum salmon runs. The crossover drifts utilize only the 5.25 and 7.5-inch nets and incorporate a beach walk to ensure fall chum salmon are adequately represented in the catches. The drifts for collecting Chinook salmon samples are discontinued August 15 with the crossover drifts continuing through September 30. Although there is some minor overlap, Chinook and fall chum salmon runs are largely discrete in time based on test fishery results, local knowledge of catches, and data collected in Canada. The 2022 Chinook salmon passage estimate at the project was 12,025 fish ± 119 (90% CI) for the dates June 29 through August 21 (Appendix B11). The fall chum salmon passage estimate was 21,063 fish ± 164 (90% CI) for the dates August 22 through October 6. Because of continued passage at the termination of the project, the fall chum salmon estimate was subsequently adjusted to 22,075 fish (Appendix

[11] https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html

B16). This expansion was calculated using a second order polynomial for each day through October 18.

8.3 Yukon, Canada

Yukon River (Mainstem) Adult Chinook Salmon Assessment

Big Salmon Sonar

Sonar operation at the Big Salmon River did not commence for the 2022 season due to logistical and financial constraints, however, the program may resume in 2023. This program ran from 2005–2021, producing a 10-year average (2012–2021) estimate of 4,728 fish (Appendix B12). At 17 years, this is one of the longest running Chinook salmon monitoring programs in the Canadian Yukon River drainage.

Pelly River Sonar

Sonar operation at the Pelly River did not commence for the 2022 season due to logistical and financial constraints, however, the program may resume in 2023. This program ran from 2016–2021, producing an average annual estimate of 7,037 fish (Appendix B12). Since 2017, the sonar at Pelly River has provided the largest annual counts of Chinook salmon in the Canadian Yukon River drainage.

Klondike River Sonar

A single ARIS Explorer 1200 multi-beam sonar system was installed on the right bank of the Klondike River to estimate the 2022 Chinook salmon passage. The 2022 season was the third year of assessment undertaken by the Tr'ondëk Hwëch'in First Nation and EDI Environmental Dynamics Inc. following a trial year in 2019. This project is a continuation of sonar work conducted in 2009–2011 by Mercer and Associates, as supported by the R&E Fund. The 2022 sonar site was located near the Klondike River bridge, and approximately 2.6 km downstream of the 2009–2011 site and 2.1 km from the confluence of Klondike River with the Yukon River. Sonar operation began on July 4 and concluded on August 18, counting 253 Chinook salmon (Appendix B12). The peak daily count of 15 fish on both July 23 and 24 occurred when 41% and 47% of the run had passed, respectively. Project reports will be publicly available through the YRP website after submission to the Pacific Salmon Commission R&E Fund Administrator.

Takhini River Sonar

A single ARIS Explorer 1200 multi-beam sonar system was installed on the right bank of the Takhini River to estimate the 2022 Chinook salmon passage. The 2022 season was the second consecutive season undertaken by Kwanlin Dün First Nation with support from the R&E Fund, while operations in 2017 and 2018 were conducted by DFO Whitehorse. Sonar operation began on August 1 and concluded on September 5, counting 476 Chinook salmon (Appendix B12). The midpoint of the return was on August 20 and the peak daily count of 53 fish occurred on August 22. The average count, consisting of three years (2017, 2018 and 2021) is 1,224 fish, though sonar operation in 2017 was conducted for feasibility.

Tatchun Creek Weir

Tatchun Creek is a 5.5 km long stream, draining into the Yukon River approximately 25 km north of Carmacks, Yukon. The creek is 1 of only 4 documented major Chinook salmon producing streams in the Canadian Yukon River Mainstem region (Brown et al. 2017).). Annual monitoring of the Tatchun Creek Chinook salmon spawning population ceased in 2000. In 2021, Little Salmon Carmacks First Nation re-established an enumeration weir 500 m upstream of the Tatchum Creek confluence with the mainstem Yukon River. In 2022, 206 Chinook salmon were observed passing the Tatchun Creek weir, compared to 17 during the 2021 pilot year (Appendix B12). The weir was set up on August 8 and continued recording fish for 31 days, being demobilized on September 7.

Whitehorse Rapids Fishway Chinook Salmon Enumeration

The Whitehorse Rapids Fishway, owned and operated by Yukon Energy Corporation, is a fish ladder that bypasses the Whitehorse hydroelectric dam. It has an observation window into a chamber with upstream and downstream gates. The viewing window allows visual enumeration of migrating adult Chinook salmon. In 2022, Fishway staff counted 165 adult Chinook salmon at the Whitehorse Rapids Fishway between August 2 and September 2 (Appendix B12). This escapement was well below the 2012–2021 average of 948 Chinook salmon, and 2022 was the lowest count recorded since 1976. Of these salmon, 66 (40% of run) were of hatchery origin and 99 (60% of run) were considered to be wild origin. The hatchery component included 15 females and 51 males. The wild component included 29 females and 70 males. Female Chinook salmon made up 27% of the total run to the Fishway (1974–1975, 1985–1986, 1988–2021 average 33%, range 5–59%, 2012–2021 average 29%, range 18–51%; DFO files).

The Whitehorse Rapids Fishway enumeration program is a joint initiative of the Yukon Fish and Game Association and Yukon Energy Corporation, with support from DFO. Students count all adult salmon migrating through the Fishway, record the sex and size category (small, medium, or large) of each salmon, identify hatchery-origin fish based on the absence of the adipose fin, and describe tags present on migrating salmon. Fishway staff also assist the Whitehorse Rapids Hatchery with broodstock collection at the Fishway.

Whitehorse Hatchery Operations

The Whitehorse Rapids Hatchery, owned and operated by Yukon Energy Corporation, has released Chinook salmon fry upstream of the dam since 1985. The current annual release target of 150,000 (2.0 gram) fry has been in place since 2002.The recent 10-year average (2012–2021) is 136,832 fry clipped and released upstream of the dam.

In 2022, all Chinook salmon fry released from the Whitehorse Rapids Hatchery into the Yukon River were marked. Fish had their adipose fin removed and were released upstream of the dam. This marking facilitates visual determination of the hatchery contribution to the run during observation of adult Chinook salmon migrating upstream through the viewing chamber at the Whitehorse Rapids Fishway years later upon return; it also allows hatchery managers to identify hatchery-origin fish during broodstock collection. Fin clipping also enables researchers to distinguish hatchery fry from wild fry when investigating juvenile Chinook salmon habitat use. Marked fish are also recovered in marine studies, in river stock assessment of juvenile and adult Yukon River Chinook salmon, and in harvests. Genetic samples were collected from parent broodstock to continue a parentage based tagging program, which is expected to enable identification of Whitehorse Rapids Hatchery release groups through genetic sampling of returning Chinook salmon.

In 2022, a total of 101,762 Chinook salmon fry from the 2021 brood year were reared and marked (adipose fin-clipped) at the Whitehorse Rapids Hatchery and then released upstream of the Whitehorse Rapids hydroelectric dam. A total of 99,955 were released by helicopter at two locations (Michie Creek and M'Clintock River) on June 7, 2022. Average weight of all fish at the time of release was 2.47 grams. Additionally, 1,807 fry from Whitehorse Rapids Hatchery eggs grown in the Stream to Sea classroom incubation program, were released to Wolf Creek, tributary to the Yukon River upstream of the dam, on May 29, 2022.

Broodstock collection in 2022 began on August 11, after 10 Chinook salmon had migrated through the Whitehorse Rapids Fishway and ended on August 31. A total of 29 males, including 20 wild and 9 adipose-clipped (hatchery) Chinook salmon, were removed from the Fishway for the broodstock program. The hatchery removed 25% of the male Chinook salmon (29 of 116 total) and 33% of the female Chinook salmon (13 of 39 total, including 8 wild and 5 hatchery reared) for hatchery broodstock. Eggs were taken between August 29 and September 10, 2022 from 13 full (or nearly full) ripe females. Fecundity estimates ranged from 4,330 to 6,532 eggs, with a preliminary average, excluding partial spawns, estimated at 5,100 eggs.

The total estimated egg take in 2022 was 66,308 green eggs. Preliminary fertilization rate was estimated to be 100%. Egg removals prior to the eyed stage included 130 eggs to assess development and 867 mortalities; green egg to eyed egg survival was estimated at 94%. Thereafter, removals included 4,101 mortalities (between October 20 and October 30), and 500 eyed eggs donated to the Stream to Sea classroom incubation program; eyed egg to hatch survival was estimated at 97%. Since hatching, 666 dead alevins have been removed, resulting in an estimated 59,239 Chinook salmon fry on January 4, 2023.

Porcupine River Investigations

Porcupine River Chinook Salmon Sonar

In 2022, the Vuntut Gwitchin First Nation Government and DFO collaborated to enumerate Chinook salmon on the Porcupine River near Old Crow using multi-beam ARIS Explorer 1200 (right bank) and Explorer 1800 (left bank) sonars. Both sonars alternated every 30 minutes between inshore ranges (1–20 m) and offshore ranges (20–40 m) 24 hours a day. Set gillnets are typically deployed throughout the run to assess species composition and collect ASL data from Chinook salmon. Due to high water temperatures and logistical constraints, netting in 2022 commenced on July 29, targeting the end of the Chinook run. This was the eighth year of Chinook salmon sonar enumeration on the Porcupine River.

Chinook salmon sonar operations occurred from June 30 to August 7, producing a passage estimate of 349 Chinook salmon, including interpolated estimates for short periods of sonar downtime (Appendix B12). August 7 was selected as the crossover date, after which all salmon were assumed to be chum salmon. The crossover date was based on daily passage estimates, with a 7-day rolling average showing an upward inflection beginning August 7. This inflection point compares well to past crossover dates and corresponds with an increase in proportion of passage on left bank (typical bank used by migrating chum) and is shortly before a reported increase in 500–600 mm salmon-behaving targets viewed on sonar. Peak daily passage of 40 Chinook salmon occurred on July 14, when 50% of the run had passed the sonar site. The average midpoint of the run from 2014–2021 is July 22. Most Chinook salmon enumerated (57%) migrated along the right bank. Approximately 43% of Chinook salmon enumerated along the right bank migrated within 10 m of the sonar. Approximately 70% of Chinook salmon enumerated along the left bank migrated within 10 m of the sonar.

The estimated passage of Chinook salmon was the lowest on record. In 2022, a small local harvest took place and the escapement estimate for the upper Porcupine River drainage is presumed to align with the sonar estimate of 349 Chinook.

Porcupine River Chum Salmon Sonar

In 2022, the Vuntut Gwitchin First Nation Government and DFO collaborated to enumerate fall chum salmon on the Porcupine River near Old Crow using multi-beam ARIS Explorer 1200 (right bank) and Explorer 1800 (left bank) sonars. Both sonars alternated every 30 minutes between inshore ranges (1–20 m) and offshore ranges (20–40 m) 24 hours a day. This was the tenth year of Porcupine fall chum salmon sonar enumeration (2011–2017, 2019, 2021, 2022).

The first chum salmon was caught in a set gillnet on August 31, and a crossover date of August 7 was determined. Prior to August 7 all salmon were assumed to be Chinook salmon, and after the transition, all salmon were assumed to be chum salmon. The crossover date was based on daily passage estimates, with a 7-day rolling average showing an upward inflection beginning August 7. The final day of sonar operation was October 3. A second order polynomial equation (Crane and Dunbar 2011) for postseason expansion was applied from October 3–15, adding 131 additional chum salmon. The final total season passage estimate was 3,804 fall chum salmon (Appendix B15).

The run had three minor peaks; August 26 (110 fish, 8% of the run passed), September 10 (134 fish, 46% of the run passed) and September 23 (158 fish, 77% of the run passed). Approximately 50% of the run had passed by the sonars on September 11; the average midpoint of the run (2011–2017, 2019 and 2021) is September 15.

The estimated passage of chum salmon was one of the lowest on record. Subtracting the local harvest of 15 resulted in an estimated escapement of 3,789 fall chum salmon to the upper Porcupine River drainage.

Fishing Branch River Chum Salmon Weir

Fall chum salmon runs to the Fishing Branch River have been assessed annually since 1971. Enumeration has been historically estimated using a weir, however, aerial surveys and tagging programs have been applied in certain years. Recently, weir operation has been accompanied by a video counter and/or sonar, with 2022 estimates relying on the weir to focus migration path and an ARIS Explorer 1800 sonar to enumerate chum salmon (Appendix B15). In 2013 and 2014 estimates were based on proportion of radio tag recoveries combined with the sonar-based passage estimate on the Porcupine River mainstem (Appendix B15). Previous spawning escapement estimates for the Fishing Branch River have ranged from 2,413–353,282 fall chum salmon in 2021 and 1975, respectively (Appendix B15).

Weir installation began September 4 and was completed September 7. Sonar enumeration began September 7 and continued until October 22. During the period of sonar and weir operations 2,695 fall chum salmon were enumerated by daily sonar counts. Following weir operations, 239 fall chum salmon were added using pre- and post-season expansions. The final passage estimate was 2,934 fall chum salmon. This was well below the Fishing Branch River interim escapement goal range of 22,000–49,000 fish.

The fall chum salmon run peaked on September 25 with a maximum daily count of 127 fish (54% of the run had passed). Approximately 50% of the run had passed the weir by September 24. The average midpoint of the run from the past 10 years of weir operation (2012 and 2015–2021) is September 25.

ASL data were collected from 221 live fall chum salmon between September 8 and October 20. The mean MEFL was 572 mm for sampled fall chum salmon (564 mm for females and 580 mm for males), and the sex composition of the live sampling (n=223) was 53% female (Appendix A10).

At the time of publication, age data for Fishing Branch fall chum salmon for the 2022 season was not available.

Aerial Surveys

Kluane River Aerial Survey

An aerial survey of fall chum salmon escapement on the Kluane River was conducted on October 20, 2022. The survey area included Silver City, at the SE side of Kluane Lake, then the entirety of Kluane River, from the outflow of Kluane Lake to the confluence with the Donjek River. Annual surveys on Kluane River were conducted 1972–2006 and restarted in 2017 following a river piracy event at the headwaters of Kluane Lake (Shugar et al. 2017). The Kluane River index for 2022 was 290 fall chum salmon. Fish countability was considered fair due to moderate water clarity. This was among the lowest aerial counts on record, with counts reaching a maximum of 39,347 in 2003, and a recent high of 16,265 in 2017 (Appendix B15).

Mainstem Yukon River Aerial Survey

An aerial survey of the Yukon River mainstem index area (from Tatchun River confluence to Pelly River confluence) was conducted on October 22, 2022. Prior aerial surveys of this area occurred in 1973, 1975, 1983–1998, 2000–2006 and 2020–2021. Historical fall chum salmon index counts ranged from 323 (2020) to 16,425 (2005). The 2022 index was 238 fish, the lowest on record (Appendix B15).

Genetic Stock Identification and Stock Composition of Canadian Yukon River Chinook and Fall Chum Salmon

Genetic stock composition of Canadian Chinook salmon is estimated annually using tissue samples collected near Eagle, Alaska, in conjunction with the Eagle sonar project. Genetic stock identification is conducted using single nucleotide polymorphisms (SNPs) and data is compared to a genetic baseline which has been developed to provide population level assignments. In 2022, 133 Chinook samples were collected at Eagle, and all but one returned usable genetic stock identifications. This is the lowest number of samples collected for genetic stock identification since project inception, largely due to the low Chinook abundance.

Chinook sampled in 2022 were identified to mid mainstem Yukon River (50.6%), Carmacks area tributaries (20.1%), Pelly River and tributaries (10.0%), upper Yukon River and tributaries (7.7%), northern Yukon River and tributaries (4.8%), Teslin watershed above Teslin Lake (3.8%), Stewart River and tributaries (2.1%) and the White River and tributaries (0.9%; Appendix B24)

Due to the low sample size in 2022, there is less assignment and statistical power compared to historical averages. Relative stock composition for mid-mainstem Yukon River was considerably higher than average (21.6%; 2008-2021) and higher than the previous maximum (33.5% in 2008). Estimates were much lower than average for Teslin watershed (25.3%), Stewart River and tributaries (6.7%) and the White River and tributaries (4.5%) which all fell below the historical minimums. The remaining stock all had estimated compositions similar to historical averages (Appendix B24).

Genetic stock composition for fall chum salmon passing Eagle sonar was determined in a similar fashion to Chinook salmon. Genetic samples from 232 fall chum salmon captured in the gillnet test fishing program at Eagle sonar in 2022 were analyzed; 220 of the 232 samples returned usable stock identifications using SNPs. Fall chum from the 2022 sample were identified to Yukon River mainstem including Minto area, Tatchun Creek area, Big Creek and Pelly River (70.3%); White River drainage including Kluane and Donjek River (25.5%); Teslin River (4.2%); and the Yukon early stock group including Chandindu River (<0.1%; Appendix B25).

Relative stock composition estimates in 2022 were higher than the 2009–2021 average for Yukon mainstem (53.8%), and also greater than the previous historical maximum from 2016 (70.0%). The White River composition was the lowest of the observed historic values and well below the 2009-2021 average (44.5%). The composition for both the Teslin and early Yukon stocks were similar to their respective 2009-2021 averages (1.1% and 0.6%; Appendix B25).

Environmental Conditions Report

This annual summary describes environmental conditions influencing salmon habitat in the Canadian sub-basin of the Yukon River, including the Yukon and Porcupine rivers. The sub-basin encompasses over 100 documented spawning streams and many more rearing streams.

Due to the spatial scale, specific salmon habitat information is not collected extensively from year to year; the following information is a regional synopsis of what was experienced in the Canadian sub-basin during a given year. Weather records and stream discharge data are examined and compared with historic records to identify anomalies and/or unusual events, and their implications for salmon are considered. This report on environmental conditions is based on scientific evidence, field observations of the public, consultants, and DFO, and professional judgment.

November 2021 to April 2022

The 2021-2022 winter involved a range of conditions throughout the territory. Throughout Yukon, precipitation events between November and March led to higher than average snowpack accumulation[12]. By May, the snowpack accumulation in southern Yukon was above average (up to 287% of the historical median), central Yukon was well above average (up to 417%), and northern Yukon was above average (154%).

Air temperatures were colder than average in November, above average in December to March and colder than average in April[13]. A cold spring helped delay the spring melt, but ultimately the melting of the substantial snowpack would lead to a historic year of flooding in the Southern Lakes region. Yukon University hydrometric summaries[14] documented numerous hydrological records in 2022 due to the snowpack being so large in areas.

Conditions in this period (November to April) align with Chinook and chum salmon incubation and emergence, and the beginning of outmigration of age-1+ Chinook salmon.

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[12] Yukon Snow Survey and Water Forecast Bulletinhttps://yukon.ca/sites/yukon.ca/files/env/snow_bulletin_may_2022_en.pdf

[13] Environment Canada Monthly Climate Data https://dd.weather.gc.ca/climate/observations/monthly/csv/YT/

[14] Benoit Turcotte Hydrometric Blog http://scholar.yukonu.ca/bturcotte/blog/significant-hydrological-events-2022-yukon-%E2%80%93-age-extremes

May 2022 to July 2022

Yukon University hydrometric summaries noted that a combination of record snowpack, a late spring snowmelt, and above average temperatures at the end of June were conducive to flooding in southern Yukon. However, severe flooding as was seen in 2022 in the Southern lakes region was avoided due to the gradual snowmelt. As a result, the summer saw a succession of flood watches, flood advisories, and evacuation notices[15].

Air temperatures between May and July were average across the territory [16,17] and precipitation was below average[18]. Water temperature in the Yukon River near Whitehorse was above average, peaking in early July, then reducing to average temperature the rest of the period[19].

On the Porcupine River, the above average snowpack and delayed snowmelt lead to a rapid snowmelt. Reduced precipitation following the snowmelt led to below average discharge within the drainage. The low volume of water and high air temperatures resulted in above average water temperatures. The average monthly surface temperature measured at DFO and Vuntut Gwitchin Government's Porcupine sonar project near Old Crow in July was 18 °C, and was similar to the 2017, 2019 and 2021 seasons.

For juvenile salmon, May through July corresponds with the downstream migration of age-1+ Chinook salmon, emergence and dispersal to rearing tributaries of age-0+ Chinook salmon, and emergence and downstream migration of chum salmon (age-0+). High water levels and discharge could promote early outmigration of age-1+ Chinook salmon fry, as well as the downstream displacement of newly emerged age-0+ juveniles of both species. Adult Chinook salmon enter the Yukon River in late May/early June and reach the mainstem Canadian border at the beginning of July. Chinook salmon spawning activity peaks in July in the Klondike River and starts in July in many Canadian Yukon River tributaries. Canadian-origin fall chum salmon enter the Yukon River mouth during this time. High water levels may have slowed the adult Chinook salmon migration. Warm water conditions are less favorable for migrating adult salmon.

August 2022 to November 2022

Flood level conditions in the Southern Lakes region persisted into early autumn and the level in Southern Lakes reached its peak on October 20, the latest peak date on record[4]. Water levels in the Pelly and Stewart rivers were normal throughout the season and had minimal flooding throughout the summer. On the White River, relatively high flows were experienced for the season, and a sharp runoff event on June 7 resulted in a large increase in discharge. On the Porcupine River, runoff events in September brought the water level up to average.

Air temperatures in August to October were largely consistent with historical averages. The end of September was colder than average in Old Crow leading to an early freeze up of the Porcupine River. The beginning of October was warmer than average in Dawson and Old Crow. November started off warmer than average, but the month ended with colder than average temperatures. While

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[15] Government of Yukon Active flood warnings and advisories Find out water levels in Yukon lakes and rivers | Government of Yukon
[16] Environment Canada Canadian Climate Normals https://climate.weather.gc.ca/climate_normals/index_e.html
[17] Environment Canada Monthly Climate Data https://dd.weather.gc.ca/climate/observations/monthly/csv/YT/
[18] Environment Canada Seasonal Forecast_ https://weather.gc.ca/saisons/charts_e.html?season=mjj&year=2021&type=p
[19] https://wateroffice.ec.gc.ca/

this pattern was seen across the territory, it was more evident in Old Crow where the mean daily temperature ranged from -7 to -39 °C in November.

Water temperatures from the few stations monitored showed warmer than average temperatures in early August, cooling by the end of the month, and variable temperatures into September.

This period corresponds to Chinook and chum salmon migration, spawning, and early egg incubation. High water may have resulted in slower travel speeds and contributed to late run timing of Chinook salmon to southern spawning areas. Warmer than average water temperatures could negatively affect spawning salmon. For juvenile fish, warmer temperatures can potentially speed up Chinook salmon egg development if temperatures remain favorable throughout the winter. Chum salmon spawning sites in Yukon are dominated by groundwater; fall chum salmon are generally less susceptible than Chinook salmon to thermal effects on development due to moderating groundwater influences.

Summary

Migration, spawning, and rearing conditions in the Canadian sub-basins of the Yukon River were varied throughout the drainage in 2021–2022, but were dominated by above average snowpacks leading to flooding conditions in southern Yukon. These conditions effect the salmon in different ways depending on the age of the salmon and the season. High water could accelerate the downstream migration of ocean bound juvenile salmon and disperse newly emerging Chinook salmon to downstream habitat. High water may also delay the adult Chinook salmon migration in the Yukon River mainstem. While high water levels may allow adults to enter otherwise inaccessible small channels, this can negatively impact eggs by reducing water quality through increased sediment load. Cold conditions in the spring could delay emergence, and slow juvenile growth, while warmer water in the summer and fall are less favorable for adult migrating salmon.

The Porcupine River watershed saw above average winter snowpacks leading to a delayed but rapid melt due to high ambient temperatures. The Porcupine River remained low and warm for much of the summer. Warm temperatures in July and August may have adversely affected migrating Chinook salmon.

With increased climate variability, increased habitat monitoring and assessment in the Yukon River Canadian Sub-basin is encouraged to inform management, research, restoration strategies, and habitat considerations for Yukon River Pacific salmon populations.

9.0 MARINE FISHERIES INFORMATION

Yukon River salmon migrate into the Bering Sea during the spring and summer after spending 0, 1, or 2 winters rearing in fresh water. Information about stock of origin from tagging, scale patterns, parasites, and genetic analysis indicate that Yukon River salmon are present throughout the Bering Sea, in regions of the North Pacific Ocean, south of the Aleutian Chain, and the Gulf of Alaska during their ocean migration (Healey 1991; Salo 1991). Yukon River salmon have the potential to be captured by fisheries that harvest mixed stocks of salmon, other species of fish (bycatch), and by illegal fishing activities throughout their oceanic distribution. Coded-wire tag recoveries in these fisheries and in research surveys provide a key descriptor of the oceanic distribution of Yukon River Chinook salmon. However, genetic stock identification has become the primary tool for identifying Yukon River Chinook salmon in marine habitats (Larson et al. 2013; Guthrie et al. 2016). The U.S. groundfish trawl fisheries in the Gulf of Alaska (GOA) and

Bering Sea-Aleutian Islands (BSAI) management areas are managed to limit the incidental harvest (bycatch) of salmon.

Appendix C was prepared by NOAA in coordination with ADF&G at the request of the YRP. It provides background information on BSAI fisheries, bycatch regulations, and information to understand bycatch impacts on Canadian-origin salmon. Recent year and historical bycatch information is provided and will be updated annually as new information becomes available. Estimated adult equivalent bycatch of Yukon River Canadian-origin Chinook salmon from the BSAI pollock fisheries are available from 1994–2017 (Ianelli and Stram 2018).

10.0 RUN OUTLOOKS 2023

10.1 YUKON RIVER CHINOOK SALMON

Over the years, the JTC has used a range of methods to produce an annual preseason outlook of Canadian-origin Chinook salmon run abundance. Run outlooks are used by fishery managers and stakeholders as a tool for guiding the development of preseason harvest strategies (Table 13).

Canadian-origin Brood Table

The brood table for Canadian-origin Yukon River Chinook salmon (Appendix A3) is the basis of the current dynamic spawner-recruitment model and the dynamic sibling model, which are 2 of the models used to forecast returns in future years. Age-specific returns have been estimated from border passage, harvest and escapement data. Because assessment methods have changed over time, the brood table is constructed from a variety of data sources. For the years 1982–2001, initial border passage estimates were derived from the DFO Chinook salmon mark–recapture program, but information from several sources, reviewed in 2008, indicated that these data were biased low. Subsequently, the 1982–2001 Canadian spawning escapement estimates were reconstructed using a linear regression of the estimated total spawning escapements for 2002–2007 against a 3-area aerial survey index of combined counts from Big Salmon, Little Salmon, and Nisutlin rivers. Spawning escapement estimates for years 2002–2004 were based on radiotelemetry studies. Since 2005, spawning escapement estimates of the Canadian Chinook aggregate have been derived by first estimating passage at the Eagle sonar site, then subtracting Canadian and U.S. harvests that occurred upriver from the sonar project site. A standardized age dataset for Chinook salmon passage at the U.S./Canada border (Hamazaki 2018) was adopted by the JTC in 2019 and used to update the brood table (JTC 2020).

Canadian-origin Yukon River Chinook Salmon

The JTC forecast subcommittee has been in the process of updating the Canadian-origin Chinook salmon run-size forecast model to improve the forecast accuracy and to improve methods used to account for uncertainty. The 2023 preseason forecast for Canadian-origin Chinook salmon is based on 3 independent models weighted by forecast performance within a Bayesian framework. The 3 models include a dynamic sibling model, dynamic spawner-recruitment model, and juvenile abundance model based on Northern Bering Sea surface trawl surveys. The common time period over which performance of these 3 models is evaluated for weighting purposes is 2007–2022.

Dynamic Sibling Model

This model predicts age class returns based on prior years sibling (younger) returns and accounts for change in age at maturity over time. Age-5, age-6, and age-7 predictions were based on the dynamic sibling model using model fits from 1982–2022; whereas age-3, age-4, and age-8 predictions were based on the recent 10-year average return. Age class predictions were summed to produce the total estimated run size.

Dynamic Spawner-recruit Model

This model uses a Ricker relationship based on the number of spawners and recruits from 1982–2016 to calculate the total expected returns from each brood year escapement and accounts for a change in productivity over time by allowing α (expected productivity) to evolve over time as a random walk. Run size predictions for 2023 were based on the predicted recruitment from the appropriate brood years, multiplied by the 5-year average (2018–2022) proportions for age-5, age-6, and age-7 fish. Predictions for the subdominant age classes, age-3, age-4, and age-8 are the recent 10-year average of abundance.

Juvenile Forecast Model

The survival of juvenile Chinook salmon has been relatively stable after their first summer in the northern Bering Sea; therefore, juvenile abundance provides an informative outlook for adult returns to the Yukon River. Juvenile abundance and forecasts for Canadian-origin Chinook salmon have been provided to the JTC and YRP since 2013 and juvenile abundance has been integrated into the bilateral outlook by the JTC since 2018.

Juvenile-based run-size forecasts in 2023 are largely dependent on juvenile abundance during 2019 and 2020 as Canadian-origin Chinook salmon typically spend 3 to 4 years at sea before returning to the Yukon River. The northern Bering Sea survey was not completed in 2020 due to the inability of the Alaska Fisheries Science Center to meet health and safety requirements for the survey during the COVID-19 pandemic. A Kalman smoother with a structural time-series framework (Moritz and Bartz-Beielstein 2017) was used to estimate juvenile abundance in 2020.

2023 Canadian-origin Chinook Salmon Forecast

The final forecast for 2023 Canadian-origin Chinook salmon run was developed using an integrated Bayesian approach to better account for uncertainty and to weight each individual component model (i.e., dynamic sibling, dynamic spawner recruit and juvenile models) by its performance in the recent past. To weight each component model the empirical standard deviation was calculated based on predictions for the comparable time period of 2007 to 2022. Standard deviation was calculated as the standard deviation of the log of predicted divided by observed. A random variable for the combined run size prediction was estimated with an uninformative prior, and log-normal likelihoods aligned this estimate with the prediction from each forecast model, in proportion to past performance. This integrated Bayesian estimation procedure results in forecast component models with low relative standard deviation being given a higher weight in the integrated model (and vice versa). All three models are showing equivalent forecasts as compared to actual run sizes indicating all models are performing very similar and providing complementary information (Figures 20 and 21). The result is a posterior distribution for the integrated forecast that resulted in a combined point estimate of 34,000 with an 80% credible interval of 26,000–43,000 (Table 13).

The JTC recommends using an 80% credible interval as the basis for informing preseason management discussions. The 2023 forecast of Canadian-origin Chinook salmon is 26,000–43,000 (Table 13). The 80% credible interval implies a 20% chance (1 in 5) that the 2023 run size will fall outside the forecast range based on past model performance. The lower end of the 2023 outlook range suggests a possible run size similar to but above the record low run size observed in 2022 (Table 13). The upper end of the outlook is for a run size just above the lower end of the escapement goal of 42,500–55,000 Chinook salmon, smaller than the recent 10-year average (2013–2022) of 61,000 Chinook salmon (Appendix B18), and well below the 1982–1997 average of 153,000 Chinook salmon (Appendix B11).

The Chinook salmon runs on the Yukon River are typically dominated by age-5 and age-6 fish. The brood years producing these age classes in 2023 are 2017 (age-6) and 2018 (age-5). The Canadian-origin Yukon River Chinook salmon spawning escapement in 2017 of 68,315 fish and 2018 escapement of 54,474 fish were above the 1982–2015 average escapement of 48,000 fish (Appendix A3; Figure 10). Returns of all age classes in 2022 were record low and well below average with the exception of age-4 fish (910), which was only slightly above last year's return of 725 fish (Appendix A3).

10.2 YUKON RIVER SUMMER CHUM SALMON

The strength of the summer chum salmon run in 2023 will be dependent on production from the 2019 (age-4) and 2018 (age-5) escapements, because these age classes generally dominate the run. The drainagewide spawning escapement in 2018 and 2019 was approximately 1.4 million summer chum salmon for both years. The return of age-4 and age-5 fish in 2022 were the fourth and second smallest, respectively, observed since 1978. The overall return of 478,130 summer chum salmon in 2022 was the second smallest on record and 80% smaller than the 1978–2021 average of 2.5 million. Below average returns of age-4 and age-5 chum salmon were also observed in Yukon fall chum salmon, other wild chum salmon stocks throughout Alaska, as well as hatchery stocks of chum salmon in Alaska. Common ocean conditions likely contributed to the recent poor run of age-4 and age-5 chum salmon. Recent poor age-class returns indicate that age-5 and age-6 summer chum salmon in 2022 may also be poor. In addition, a high level of uncertainty exists in the return of age-4 due to the extreme above average water temperatures in the mainstem and tributaries of the Yukon River and the observed die off of summer chum salmon on the Koyukuk River in 2019, the parent year for the age-4 return in 2023.

A drainagewide run reconstruction model was developed in 2016 (Hamazaki and Conitz 2015), and the resulting model estimates of escapement and total return (1978–2020) were used to develop a drainagewide brood table and forecast the 2023 summer chum salmon run based on sibling relationships. Sibling relationships are used to project the return of age-5 chum salmon using the prior year return of age-4 fish. The ten year average maturity schedule is then used to expand to the remaining age classes. The expected 2023 summer chum salmon run is forecast to be 557,000 (80% CI range of 280,000–900,000) fish, which is slightly larger than the 2022 run of approximately 478,000 fish. The relatively wide forecast range is representative of the uncertainty associated with recent-year sibling relationships the possible impacts to spawners due to the high water temperatures and the die-off of summer chum salmon observed in 2019. Even though the point estimate and upper end of the forecast are within the drainagewide escapement goal of 500,000–1,200,000 summer chum salmon, nearly half of the expected run sizes are below the lower end of the drainagewide goal.

The current forecast range assumes a (2013–2022) average maturity schedule of an expected 50% age-4 return in 2023. The impacts of the above average water temperature and chum die off in 2019 are unknown. If greater than 10% of the expected age-4 chum do not return, the point estimate of the forecast would fall below the drainage wide escapement goal. If we see a 40% reduction of expected age-4 chum, the total forecast range falls below the escapement goal. Unless the 2023 summer chum salmon run is stronger than predicted, or limited summer chum salmon would be available for harvest.

10.3 YUKON RIVER FALL CHUM SALMON

Drainagewide Fall Chum Salmon

The preseason forecast is determined using estimates of escapement and resulting production (spawner-recruit). The brood table for the drainagewide fall chum salmon is the basis of the current spawner-recruitment model. The age-specific returns have been estimated based on the samples collected in the lower Yukon River which is primarily gillnet fisheries applied to the escapement and harvests throughout the drainage. Yukon River drainagewide estimated escapement of fall chum salmon for the period 1974 through 2016 has ranged from approximately 221,000 (2000) to 2,300,000 (1975) fish, based on Bayesian analysis of escapement assessments to approximate overall abundance (Fleischman and Borba 2009). Escapements between 1974 and 2016 resulted in subsequent brood year returns that ranged in size from approximately 311,000 (1996 production) to 2,900,000 (2001 production) fish. Corresponding return per spawner rates ranged from 0.3–9.0, averaging 1.7 for all years combined (1974–2016; Appendix A8).

A considerable amount of uncertainty has been associated with these run forecasts, particularly in the last two decades, because of unexpected run failures from 1998–2002, strong runs from 2003–2008, and unexpected run failures from 2020–2022. Poor salmon runs prior to 2003 was generally attributed to reduced productivity in the marine environment and not to low levels of parental escapement. The 2020–2022 run failures also appear to be attributed to the marine environment as it was initially observed to be widespread in chum salmon throughout western Alaska with prolonged recovery in the Yukon River stock.

Beginning in 1999, Yukon River fall chum salmon preseason forecasts have been presented as a range to better represent uncertainty in the expected run size. In most years, the expected run size (point estimate) was forecast using estimates of brood year escapement, estimates of returns per spawner (production), and maturity schedules developed for even and odd years based on historical averages. In 1998, the forecast method overestimated run size due to an unexpected poor return. To account for this, the point estimate was used as the upper bound of the forecast range in subsequent years (1999–2005; Brenner et al. 2022). The lower end of the forecast range was generated by adjusting the point estimate based on the average forecast performance (i.e., ratio of observed to predicted). Forecast performance from 1998–2003 were used to inform the 1999–2004 outlooks. As run sizes increased over the early to mid-2000s, the forecast performance improved, and in 2005 the lower bound of the forecast range was based on the 2001–2004 average forecast performance. Beginning in 2006, adjustments to the point estimate were no longer applied. Instead, the forecast range was based on a statistical confidence interval around the point estimate. Since 2006, the annual forecasts have been informed by different odd- and even-year maturity schedules based on the historical averages available at the time and assumptions of stock productivity. For example, in 2006 and 2007 average age composition from years 1974–1983 were used to represent high productivity years, whereas in 2008–2012 data from 1984–2012 was used to represent low productivity years. Since 2013, the average odd- and even-year maturity schedules have been calculated from the complete historical dataset. Poor forecast performance in 2020 and 2021, prompted the use of a bias correction applied to the 2022 forecast, based on recent-year forecast performance.

Most fall chum salmon return at age-4 and age-5, and a smaller proportion return at age-3 and age-6 (Appendix A8). As such, the 2023 run will be composed of brood years 2017–2020, with most fish returning from the 2018 and 219 broods (Table 14). The escapement estimates in 2018 were above the upper end of the drainagewide escapement goal range of 300,000–600,000 fall chum salmon and 2019 was near the upper end of the goal. It is anticipated that the 2023 return will be dominated by age-4 fish (Table 14), with a below average age-5 component. Estimates of returns per spawner (R/S) were used to estimate production for 2017 and 2018, and a Ricker spawner-recruit model was used to predict returns from 2019 and 2020. In 2017 and 2018 recruits for incomplete brood years are estimated (Appendix A8). The average odd and even year maturity schedule was calculated from the complete historical dataset since 1974–2016. That maturity schedule was applied to the estimated production (i.e., returns) for each contributing brood year and summed to estimate the total number of fall chum salmon that are expected to return in the coming year. The result from the Ricker model was a 2023 run forecast point estimate of 675,000 fall chum salmon returning drainagewide.

The sibling model predicts the 2023 drainagewide run size will be approximately 324,000 fall chum salmon. The model predicts age class returns based on prior years sibling returns. Age-3 fish were based on average return, while age-4, age-5, and age-6 predictions were based on the sibling model using model fits from 1974–2016. Age class predictions were summed to produce the total estimated run size. Brood year returns of age-3 fish range from 0–196,000 fall chum salmon. Returns of age-4 fish from odd-numbered brood years averages 865,000 fall chum salmon with a range from a low of 242,000 for brood year 1997 to a high of 2,000,000 for brood year 2001. Returns of age-5 fish from the same time for even-numbered brood years average 206,000 fall chum salmon with a range from a low of 6,000 fish for brood year 2016 to a high of 456,000 fish for brood year 1990.

Forecast models rarely predict extreme changes in production and ad hoc adjustments can be applied to improve forecast accuracy when the direction and relative magnitude of the forecast bias is known with some certainty. The difference between the preseason expected and postseason estimated run sizes of fall chum salmon for years 1998–2022 provide a measure of forecast performance (Table 15). Considering the recent unexpected run failures beginning in 2020, a bias correction for the 2023 forecast was considered necessary to improve the accuracy of the standard Ricker forecast model. The 2023 Ricker forecast point estimate of 675,000 fall chum was multiplied by 0.372, which corresponded to the 2019–2022 average forecast error (observed / expected). The adjusted 2023 forecast point estimate was 251,000 (rounded). To represent the forecast as a range, the 80% CI of the standard Ricker model (568,000–783,000) was adjusted based on the range of forecast performance over the past 4 years. Specifically, the lower 80% CI (568,000) multiplied 0.197 (2020), and the upper 80% CI (783,000) was multiplied by 0.769 (2019). The adjusted 2023 forecast range was 112,000–602,000.

The drainagewide escapement goal is 300,000–600,000 fall chum salmon. If the run materializes near the midpoint or lower bound of the forecast range (i.e., 251,000: 80% CI range of 112,000–602,000), minimum drainagewide escapement would not be met and all fisheries will be closed. However, there is potential for limited subsistence fisheries if the run materializes within the upper portion of the forecasted range. The forecast suggests no surplus of fall chum salmon will be available for commercial harvest. Actual harvestable surpluses for Yukon River fall chum salmon fisheries will be determined inseason, based on inseason run projections and guidelines outlined in the fall chum salmon management plan. The first inseason projection will be conducted in mid-

July, at the beginning of the fall season, and the preseason forecast will be updated based on an established relationship between summer and fall chum salmon run abundances.

Canadian-origin Upper Yukon River Fall Chum Salmon

To develop an outlook for the 2023 Canadian-origin Yukon River fall chum salmon, the drainagewide outlook range of 112,000–602,000 fall chum salmon (point estimate 251,000) was multiplied by 25% (the estimated contribution of mainstem Yukon River Canadian-origin fall chum salmon), producing an outlook range of 28,000–150,500 fish with a midpoint of 62,750 fish (rounded to the nearest 1,000; Table 16). Genetic stock identification analyses have indicated that 25% is reasonable, however, recent years have shown a decreased Canadian component and this will be monitored in subsequent years.

Canadian-origin Porcupine River Fall Chum Salmon

In the Canadian section of the Porcupine River, a majority of the production of fall chum salmon originates from the Fishing Branch River. Canadian-origin Porcupine River stocks have been estimated to comprise approximately 5% of the drainagewide run. Fishing Branch River fall chum salmon are estimated to comprise between 40% and 80% of the Canadian-origin Porcupine River stocks, and approximately 4% of the drainagewide run, though estimates have ranged from 1%–7%. Applying the 4% average estimate to the drainagewide outlook range of 112,000– 602,000 fish (point estimate 251,000) results in a Fishing Branch River outlook of 4,000–24,000 fish, with a midpoint of 10,000 fish (rounded to the nearest 1,000 fish; Table 17). This outlook is considered uncertain due to the high variation in contributions of Fishing Branch River fall chum salmon to drainagewide stocks.

Though the models used to develop forecasts have varied from year-to-year, the postseason run size estimates of Fishing Branch River fall chum salmon have been consistently below preseason outlooks since 1998, except for 2003–2005, 2016, and 2017.

10.4 YUKON RIVER COHO SALMON

Although there is little comprehensive escapement information for coho salmon within the Yukon River drainage, it is known that they primarily return as age-2.1 fish and overlap in run timing with fall chum salmon. The major contributor to the 2023 coho salmon run will be age-4 fish returning from the 2019 parent year. Based on the index of run size (1995–2022, excluding 1996 and 2009), the 2019 escapement was estimated to be 105,000 coho salmon, which was below the average (158,000). In 2019, a large amount of coho salmon was harvested incidentally in the directed fall chum salmon commercial fisheries (exploitation estimate at 38%). Subsistence harvest in 2019 was well below the 2013–2018 average of 12,000 coho salmon (Appendix B5). The runs from 2014 through 2018 have been high abundance years (averaging over 323,000 fish) which may indicate good productivity. Within the dataset runs above/below average typically cycle for several years in succession. However, the run sizes have been declining since 2016 with run sizes of less than 200,000 coho salmon from 2019 and 2020 with a record low return in 2021 and a slight improvement in 2022.

Escapements are primarily monitored within the Tanana River drainage. The Delta Clearwater River (DCR) is a major producer of coho salmon in the upper Tanana River drainage and has comparative escapement monitoring data since 1972 (Appendix B17). The DCR parent year escapement of 2,043 fish in 2019 was well below the SEG range of 5,200–17,000 coho salmon. Surveys usually occur in 5 other locations in the Tanana River drainage for coho salmon specifically; and 4 of them were below average when compared to the 2017–2021 average escapements. Very informal coho salmon outlooks are made preseason based on average survival of the primary parent year escapement estimate, which in 2023 would indicate that the run would be below average.

11.0 STATUS OF ESCAPEMENT GOALS

11.1 SPAWNING ESCAPEMENT TARGET OPTIONS IN 2023

Canadian-origin mainstem Yukon River Chinook salmon, and mainstem and Fishing Branch fall chum salmon, are managed under the umbrella of the YRSA. The YRP meets annually and recommends escapement goals for Canadian-origin stocks to the Canadian and U.S. management agencies.

Canadian-origin Mainstem Yukon River Chinook Salmon

In 2010, the YRP adopted an IMEG range of 42,500–55,000 Chinook salmon. In the absence of a bilaterally approved production or population model to inform a biologically based escapement goal, the IMEG has been retained each year since 2010. Beginning in 2019, the JTC undertook a comprehensive bilateral effort to model the spawner-recruit dynamics for this stock aggregate and estimate biological reference points and probability profiles that could be used to recommend a biological escapement goal to the YRP. Model results were peer-reviewed in January of 2022 through the Canadian Science Advisory Secretariat and found to be appropriate for informing management decisions. At its March 2022 meeting, the JTC developed a biological escapement goal recommendation of 42,500–62,500 with a target escapement of 52,500. The JTC's 2022 recommendation equally balanced management priorities to achieve maximum sustained yield (i.e., harvest) and maximum sustained recruitment (i.e., run size). The biological escapement goal recommendation provided by the JTC has not yet been implemented, in part, because the YRP considerations of specific fishery management objectives are still being deliberated. As such, the long-standing IMEG range of 42,500–55,000 was used to manage the 2022 Canadian-origin Chinook salmon run.

The biological escapement goal recommendation provided to the YRP in 2022 was the result of an extensive multi-year bilateral process. The JTC's 2022 recommendation was informed by a comprehensive assessment of historical stock production patterns and explicit consideration of future uncertainties. The statistical approaches used by the JTC were consistent with best practices in both the U.S. and Canada for modeling salmon population dynamics and were extensively peer reviewed through the Canadian Science Advisory Secretariat. The JTC formulated its 2022 recommendation with a view to address guidance provided via the Pacific Salmon Treaty (specifically Chapter 8, Yukon River Salmon Agreement) and the YRP. The guidance provided to the JTC by the YRP made it clear that a range of perspectives, values, and fishery performance objectives exist for this stock aggregate. As such, the JTC's 2022 recommendation was an explicit attempt to balance the tradeoffs associated with competing fishery objectives.

No new information or guidance has been provided to the JTC that would justify changing the escapement goal recommendation provided to the YRP in 2022. As such, the JTC recommends that the 2023 Canadian-origin mainstem Chinook salmon stock aggregate be managed to achieve the biological escapement goal of 42,500–62,500, with a target escapement of 52,500. The JTC recommendation is based on the best available information and an explicit acknowledgment that compromise is needed to balance the range of fishery objectives held for this stock. The JTC plans to provide the same recommendation annually until such time that the YRP implements the new escapement goal or reaches consensus on specific fishery management objectives that would be needed to inform an alternate option.

Canadian-origin Mainstem Yukon River Fall Chum Salmon and Fishing Branch Fall Chum Salmon

An IMEG has been established for each of the Canadian-origin mainstem Yukon River fall chum salmon and Fishing Branch fall chum salmon stocks. In 2010, the YRP adopted an IMEG range of 70,000–104,000 Canadian-origin mainstem Yukon River fall chum salmon. This range was developed as 0.8–1.2 times the estimated spawners at maximum sustained yield (86,600 fish), which was derived prior to the returns from the exceptional 2005 spawning escapement of over 437,000 fall chum salmon. In 2008, the YRP adopted an IMEG range of 22,000–49,000 fall chum salmon for the Fishing Branch River. Since the establishment of the IMEGs, there has been no new analyses to inform a change to either goal range. As such, the YRP has approved multiple JTC recommendations to extend the IMEGs for 3-year periods (Appendix B15). The first 3-year recommendation for Fishing Branch River began in 2008 and the mainstem stock in 2010. The most recent 3-year extension for both stocks ended in 2022. The JTC recommends that the YRP extend the Canadian-origin Mainstem Yukon River and Fishing Branch River fall chum salmon IMEGs for a 3-year period of 2023–2025.

The Yukon River Salmon Agreement authorizes the JTC to evaluate annually the status of Canadian-origin chum salmon stocks and make recommendations for adjustments to rebuilding programs set out in the Agreement. Such fishery rebuilding plans are required to consider the relative health of the brood years with the objective of rebuilding stronger brood years in one cycle and weaker brood years in no more than three cycles, which is defined as 4 years for chum salmon. Historically, this process has resulted in establishing IMEG ranges lower than what is outlined in the Agreement to allow for continued harvest opportunities in both countries during times of low productivity.

The 2023 forecast for both Canadian chum salmon stocks is for a poor run that may not be large enough to achieve the lower bound of the existing IMEGs. The exact cause of the recent decline in Canadian-origin mainstem fall chum salmon run sizes and the prolonged poor runs of Fishing Branch fall chum salmon is currently unknown. The JTC does not support lowering existing IMEGs for either stock to allow for additional harvest opportunity in both countries during this time of poorly understood low productivity. Instead, the JTC recommends a focus on developing stock restoration plans to promote increased future run sizes. The JTC anticipates that a comprehensive understanding of the population dynamics of both stocks will be needed to inform future restoration planning and associated IMEG recommendations. Time is needed to complete JTC analyses and have products peer reviewed in a transparent manner. Over the next 3 years, (2023–2025) the JTC will discuss options and possibly initiate a comprehensive stock status and escapement goal review of Canadian-origin mainstem and fall chum salmon stocks.

12.0 REFERENCES CITED

Andersen D.B. and C.L. Scott. 2010. An update on the use of subsistence-caught fish to feed sled dogs in the Yukon River drainage, Alaska. Final Report 08-250. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program.

Arnason, A. N., C. W. Kirby, C. J. Schwarz, and J. R. Irvine. 1995. Computer analysis of data from stratified mark-recovery experiments for estimation of salmon escapements and other populations. Canadian Technical Report of Fisheries and Aquatic Sciences 2106: 37p.

Bergstrom, D. J., C. Blaney, K. Schultz, R. Holder, G. Sandone, D. Schneiderhan, L. H. Barton, and D. Mesiar. 1992. Annual management report Yukon Area, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A92-17, Anchorage.

Brenner, R. E., S. J. Donnellan, and A. R. Munro editors. 2022. Run forecasts and harvest projections for 2022 Alaska salmon fisheries and review of the 2021 season. Alaska Department of Fish and Game, Special Publication No. 20-11, Anchorage.

Brown, C., and D. Jallen. 2012. Options for amounts reasonably necessary for subsistence uses of salmon: Yukon Management Area; prepared for the January 2013 Anchorage Alaska Board of Fisheries meeting. Alaska Department of Fish and Game, Division of Subsistence, Special Publications No. BOF 2012-08, Fairbanks.

Brown RJ, von Finster A, Henszey RJ, Eiler JH. 2017. Catalog of Chinook Salmon Spawning Areas in Yukon River Basin in Canada and United States. Journal of Fish and Wildlife Management 8(2):558-586; e1944-687X. doi:10.3996/ 052017-JFWM-045

Crane, A. B., and R. D. Dunbar. 2011. Sonar estimation of Chinook and fall chum salmon passage in the Yukon River near Eagle, Alaska, 2009. Alaska Department of Fish and Game, Fishery Data Series No. 11-08, Anchorage.

DuBois, L. 2018. Origins of Chinook salmon in the Yukon Area fisheries, 2014. Alaska Department of Fish and Game, Fishery Data Series No. 18-25, Anchorage.

Fleischman, S. J., and B. M. Borba. 2009. Escapement estimation, spawner-recruit analysis, and escapement goal recommendation for fall chum salmon in the Yukon River drainage. Alaska Department of Fish and Game, Fishery Manuscript No. 09-08, Anchorage.

Guthrie, C. M., H. T. Nguyen, and J. R. Guyon. 2016. Genetic stock composition analysis of the Chinook salmon bycatch from the 2014 Bering Sea walleye pollock (*Gadus chalcogrammus*) trawl fishery. U.S. Dep. Commerce NOAA Tech. Memo. NMFS-AFSC-310. 25 p.

Hamazaki, T. 2018. Estimation of U.S.-Canada border age-composition of Yukon River Chinook salmon, 1982–2006. Alaska Department of Fish and Game, Fishery Data Series No. 18-21, Anchorage.

Hamazaki, T., and J. M. Conitz. 2015. Yukon River summer chum salmon run reconstruction, spawner-recruitment analysis, and escapement goal recommendation. Alaska Department of Fish and Game, Fishery Manuscript Series No. 15-07, Anchorage.

Healey, M. C. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). [In]: Groot, C. and L. Margolis, editors, Pacific Salmon Life Histories. UBC Press, Vancouver, B.C., Canada, pp. 311-394.

Howard, K. G., S. Garcia, J. Murphy, and T. H. Dann. 2019. Juvenile Chinook salmon abundance index and survey feasibility assessment in the Northern Bering Sea, 2014–2016. Alaska Department of Fish and Game, Fishery Data Series No. 19-04, Anchorage.

Howard, K. G., S. Garcia, J. Murphy, and T. H. Dann. 2020. Northeastern Bering Sea juvenile Chinook salmon survey, 2017 and Yukon River adult run forecasts, 2018–2020. Alaska Department of Fish and Game, Fishery Data Series No. 20-08, Anchorage.

Ianelli, J. N., and D. L. Stram. 2018. Chinook Bycatch Mortality Update. Discussion paper presented to the North Pacific Fishery Management Council, April 2018. Available online at: http://npfmc.legistar.com/gateway.aspx?M=F&ID=e172520e-fc22-46e8-b5aa-72ba233f129e.pdf

JTC (Joint Technical Committee of the Yukon River U.S./Canada Panel). 2020. Yukon River salmon 2019 season summary and 2020 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A20-01, Anchorage.

Larson, W. A., F. M. Utter, K. W. Myers, W. D. Templin, J. E. Seeb, C. M. Guthrie, A. V. Bugaev, and L. W. Seeb. 2013. Single-nucleotide polymorphisms reveal distribution and migration of Chinook salmon (*Oncorhynchus tshawytscha*) in the Bering Sea and North Pacific Ocean. Canadian Journal of Fisheries and Aquatic Sciences 70:128-141.

Liller, Z. W., and J. W. Savereide. 2018. Escapement goal recommendations for select Arctic-Yukon-Kuskokwim Region salmon stocks, 2019. Alaska Department of Fish and Game, Fishery Manuscript No. 18-08, Anchorage.

McCullough, D. S. Spalding, D. Sturdevant, and M. Hicks. 2001. Summary of technical literature examining the physiological effects of temperature on salmonids. Issue Paper 5. U.S. Environmental Protection Agency. EPA-910-D-01-005.

McDougall, M. J., and N. B. Brodersen. 2020. Sonar estimation of Chinook and fall chum salmon passage in the Yukon River near Eagle, Alaska, 2019. Alaska Department of Fish and Game, Fishery Data Series No. 20-26, Anchorage.

Moritz S, Bartz-Beielstein T (2017). "imputeTS: Time Series Missing Value Imputation in R." The R Journal, 9(1), 207–218. doi:10.32614/RJ-2017-009.

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

Murphy, J. M., K. G. Howard, J. C. Gann, K. C. Cieciel, W. D. Templin, and C. M. Guthrie. 2017. Juvenile Chinook salmon abundance in the northern Bering Sea: Implications for future returns and fisheries in the Yukon River. Deep Sea Research Part II: Topical Studies in Oceanography 135:156-167.

Murphy, J., S. Garcia, J. Dimond, J. Moss, F. Sewall, W. Strasburger, E. Lee, T. Dann, E. Labunski, T.Zeller, A. Gray, C. Waters, D. Jallen, D. Nicolls, R. Conlon, K. Cieciel, K. Howard, B. Harris, N.Wolf, and E. Farley Jr. 2021. Northern Bering Sea surface trawl and ecosystem survey cruise report, 2019. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-423, 124 p.

Padilla, A. J., S. K. S. Decker, B. M. Borba and T. Hamazaki. 2021. Subsistence and personal use salmon harvests in the Alaska portion of the Yukon River drainage, 2016. Alaska Department of Fish and Game, Fishery Data Series No. 21-06, Anchorage.

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

Salo, E. O. 1991. Life history of chum salmon, Oncorhynchus keta. [In]: Groot, C., and L. Margolis, editors. Pacific Salmon Life Histories. UBC Press, Vancouver, B.C., Canada, pp. 231-309.

Shugar, D.H., J. J. Clage, J. L. Best, C. Schoof, M. J. Willie, L. Copeland and G. H. Roe. 2017. River piracy and drainage basin reorganization led by climate driven glacier retreat. Nature Geoscience 10:3701-376.

Stuby, L. 2022. Fishery management report for sport fisheries in the Yukon Management Area, 2021. Alaska Department of Fish and Game, Fishery Management Report No. 22-21, Anchorage.

TABLES AND FIGURES

Table 1.–Yukon Area regulatory subsistence salmon fishing schedule, in U.S. waters.

Area	Regulatory subsistence fishing periods	Open fishing times
Coastal District	7 days per week	M/T/W/TH/F/SA/SU - 24 hours/day
District 1	Two 36-hour periods per week	Mon 8 pm to Wed 8 am / Thu 8 pm to Sat 8 am
District 2	Two 36-hour periods per week	Wed 8 pm to Fri 8 am / Sun 8 pm to Tue 8 am
District 3	Two 36-hour periods per week	Wed 8 pm to Fri 8 am / Sun 8 pm to Tue 8 am
District 4	Two 48-hour periods per week	Sun 6 pm to Tue 6 pm / Wed 6 pm to Fri 6 pm
Koyukuk and Innoko rivers	7 days per week	M/T/W/TH/F/SA/SU - 24 hours/day
Subdistricts 5-A, -B, -C	Two 48-hour periods per week	Tue 6 pm to Thu 6 pm / Fri 6 pm to Sun 6 pm
Subdistrict 5-D	7 days per week	M/T/W/TH/F/SA/SU - 24 hours/day
Subdistrict 6	Two 42-hour periods per week	Mon 6 pm to Wed Noon / Fri 6 pm to Sun Noon
Old Minto Area	5 days per week	Friday 6 pm to Wednesday 6 pm

Note: In the Upper Yukon River, fishing times are longer by regulation to help account for longer travel times and lower numbers of fish available as fish leave the mainstem Yukon River to spawn in U.S. tributaries. This schedule was not used in 2022; salmon fishing closed as Chinook salmon moved upriver and remained closed all season.

Table 2.–Summary of 2022 Chinook salmon escapement estimates in U.S. (Alaska) tributaries compared to existing escapement goals.

Location	Assessment method	Escapement goal (type)	2022 Chinook salmon
East Fork Andreafsky	Weir	2,100–4,900 (SEG)	Not operated
West Fork Andreafsky	Aerial survey	640–1,600 (SEG)	Poor Survey
Anvik (drainagewide)	Aerial survey	1,100–1,700 (SEG)	179
Nulato (forks combined)	Aerial survey	940–1,900 (SEG)	60
Gisasa	Weir	none	503
Henshaw	Weir	none	Not operated
Chena	Tower/Sonar	2,800–5,700 (BEG)	355
Salcha	Tower/Sonar	3,300–6,500 (BEG)	1,041

Note: Biological escapement goal (BEG) and sustainable escapement goal (SEG).

Table 3.–Summary of 2022 summer chum salmon escapement estimates in U.S. (Alaska) compared to existing escapement goals.

Location	Assessment method	Escapement goal (type)	2022 Summer chum salmon escapement
Yukon (drainagewide)	Sonar	500,000–1,200,000 (BEG)	471,730 [a]
East Fork Andreafsky	Weir	>40,000 (SEG)	Not operated
Anvik	Sonar	350,000–700,000 (BEG)	46,436
Gisasa	Weir	none	3,300 [b]
Henshaw	Weir	none	Not operated
Chena	Tower/sonar	none	897 [b]
Salcha	Tower/sonar	none	1,237 [c]

Note: Biological escapement goal (BEG) and sustainable escapement goal (SEG).

[a] A drainagewide summer chum run reconstruction model was developed in 2016 (Hamazaki and Conitz 2015), and the resulting model estimate of escapement for 2021 is presented here.

[b] Considered a minimum count since project ended before all summer chum salmon were assessed.

[c] Incomplete count due to high water events and considered a minimum estimate.

Table 4.–Yukon River drainage fall chum salmon management plan overview, in U.S. waters.

Run size estimate [b]	Recommended management action [a] Fall chum salmon directed fisheries				Targeted drainagewide
(point estimate)	Commercial	Personal use	Sport	Subsistence	escapement
300,000 or Less	Closure	Closure	Closure	Closure [c]	300,000
300,001 to 550,000	Closure	Closure [c]	Closure [c]	Possible Restrictions [c, d]	to
Greater than 550,001	Open [e]	Open	Open	No restrictions	600,000

[a] Considerations for the Canadian mainstem interim management escapement goal may require more restrictive management actions.

[b] Alaska Department of Fish and Game will use the best available data, including preseason projections, mainstem river sonar passage estimates, test fisheries indices, subsistence and commercial fishing reports, and passage estimates from escapement monitoring projects.

[c] The fisheries may be opened or less restrictive in areas where indicator(s) suggest the escapement goal(s) in that area will be achieved.

[d] Subsistence fishing will be managed to achieve a minimum drainagewide escapement goal of 300,000 fall chum salmon.

[e] Drainagewide commercial fisheries may be open and the harvestable surplus above 550,000 fall chum salmon will be distributed by district or subdistrict (in proportion to the guidelines harvest levels established in 5 AAC 05.365 and 5 AAC 05.367).

Table 5.–Inseason fishery management decision matrix for Yukon River mainstem Chinook salmon in Canada, 2022.

Canada total run size	Border passage projection [a]	Canada allowable harvest (CAH) [b]	Projected escapement [b]	Fishery allocations [c]		
				First Nation	Public angling	Commercial & domestic
0–42,500	0–42,500	0	0–42,500	0	0	0
42,501–96,848	42,501–55,000	1–6,250	42,500–48,750	1–6,250	0	0
96,849–141,196	55,001–65,200	6,251–10,200	48,751–55,000	6,251–10,000	0–200 [d]	0
141,197–143,804	65,201–65,800	10,201–10,800	55,000	10,000	201–800	0
143,805–150,761	65,801–67,400	10,801–12,400	55,000	10,000	801–1,260	0–1,140 [d]
150,762–259,891	67,401–92,500	12,401–37,500	55,000	10,000	1,261–2,515	1,141–24,985
259,892–292,500	92,501–100,000	37,501–45,000	55,000	10,000	2,516–2,890	24,986–32,110

[a] Border passage projection is Eagle Sonar estimate minus estimated U.S. harvest between sonar site and U.S./Canada border.

[b] Canadian allowable harvest and projected escapement levels may vary within the First Nation fishery depending on the trade-offs between the two; this is influenced by the priority that First Nations may place on escapement or harvest in any given year.

[c] Allocations to fisheries are depicted categories of opportunity, with dark grey representing no fishery opportunities, light grey as limited fishery opportunities, and unshaded as extensive fishery opportunities.

[d] This fishery allocation represents the level of management precision for that fishery and is the threshold required before considering harvest opportunities.

Table 6.–Inseason fishery management decision matrix for mainstem Yukon River fall chum salmon in Canada, 2022.

International border passage *(based on Eagle sonar estimate)*	Fishery			
	First Nation	Public angling	Commercial	Domestic
< 40,000 (Red Zone)	**Closed** Removal of allocation for conservation purposes	**Closed** No retention permitted	**Closed**	**Closed**
40,000 to 73,000 (Yellow Zone)	**Varies [a]** Catch target to vary with abundance within zone	**Closed** No retention permitted	**Closed**	**Closed**
> 73,000 (Green Zone)	**Open** Unrestricted	**Open [a]** Retention permitted. No catch anticipated	**Open [a]** Allocation varies with run size	**Open [a]** Allocation varies with run size

[a] Allocations (harvest opportunities) are subject to run abundance and international harvest sharing provisions (Yukon River Salmon Agreement).

Table 7.–Cumulative fish passage estimates by species with 90% confidence intervals (CI), at the Pilot Station sonar in 2022.

Species		Total passage	90% CI Lower	90% CI Upper
Large Chinook [a]		33,159	26,665	39,653
Small Chinook [b]		15,280	11,774	18,786
	All Chinook Subtotal	48,439	41,060	55,818
Summer chum		463,806	438,989	488,623
Fall chum		325,717	306,520	344,914
Coho		92,102	84,602	99,602
Sockeye		4,184	1,772	6,596
Pink		158,767	137,032	180,502
Cisco		238,030	205,257	270,803
Humpback whitefish *C. pidschian*		170,551	152,986	188,116
Broad whitefish *C. nasus*		22,019	16,484	27,554
Sheefish *Stenodus leucicthys*		28,902	22,899	34,905
Other [c]		469,981	431,848	508,114
Total [d]		2,022,498		

[a] Large Chinook salmon >655 mm.

[b] Small Chinook salmon ≤655 mm.

[c] Includes burbot *Lota lo*ta, longnose sucker *Catostomus catostomus*, Dolly Varden *Salvelinus malma*, and northern pike *Esox lucius*.

[d] "All Chinook subtotal" not included in total passage sum.

Table 8.–Yukon River Chinook salmon age and female percentage estimated from samples collected at the Pilot Station and Eagle sonar projects, 2022.

	Chinook salmon age and sex composition (percentage of test fishery samples)			
	Pilot Station sonar		Eagle sonar	
Age/sex	Historical average (2012–2021)	2022	Historical average (2012–2021)	2022
Age-4	10.4%	12.2%	6.7%	5.9%
Age-5	49.6%	36.4%	42.9%	41.2%
Age-6	37.4%	45.6%	47.6%	48.7%
Female	44.8%	53.4%	44.8%	44.4%

Note: Sampling at the Pilot Station sonar uses 6 gillnets that range in mesh sizes from 2.75–8.5 inch whereas sampling at Eagle sonar uses 4 gillnets that range in mesh size from 5.25–8.5 inch. This difference in gillnet mesh sizes can possibly affect the difference in observed age classes. In addition, sex is determined only through visual inspection of external body characteristics at both projects. Sexual dimorphism is more pronounced by the time fish reach Eagle making sex identification more accurate at that site. These factors need to be considered when comparing between projects. Percent female was calculated using all sampled Chinook salmon including fish that were unable to be aged successfully.

Table 9.–Summary of 2022 fall chum salmon escapement estimates in U.S. (Alaska) compared to existing escapement goals.

Location	Assessment method	Escapement goal (type)	2022 Fall chum salmon escapement [a]
Drainagewide	Sonar and harvest	300,000–600,000 (SEG)	240,000
Chandalar River [b]	Sonar	85,000–234,000 (SEG)	69,333
Sheenjek River	Sonar	none	13,957
Delta River	Ground surveys	7,000–20,000 (SEG)	5,670

Note: Sustainable escapement goal (SEG).

[a] Drainagewide estimate is rounded.

[b] The Chandalar River and North Fork collectively were renamed the Teedriinjik and the Middle Fork was renamed Ch'idriinjik in September of 2015.

Table 10.–Summary of 2022 preliminary fall chum salmon escapement counts to Canada in comparison with existing international interim management escapement goals (IMEG).

Location	Assessment method	Escapement goal (type)	2022 Fall chum salmon escapement
Yukon River Mainstem	Sonar minus harvest	70,000–104,000 (IMEG)	22,059
Fishing Branch River	Weir and sonar count	22,000–49,000 (IMEG)	2,934
Porcupine River (Canadian portion)	Sonar minus harvest	none	3,789

Table 11.–Pilot Station sonar Chinook salmon passage and Canadian-origin proportion by strata, 2005–2022.

Year	Strata	Dates	Pilot Station passage	Proportion of run	Canadian proportion [a]	Estimated number of Canadian fish
2005	Stratum 1	06/04–06/17	91,136	0.35	0.57	51,998
	Stratum 2	06/18–07/03	119,607	0.46	0.43	51,925
	Stratum 3	07/04–08/20	48,271	0.19	0.27	13,231
	Total		259,014	1.00	0.45	117,155
2006	Stratum 1	06/08–06/20	37,986	0.17	0.48	18,317
	Stratum 2	06/21–06/28	96,569	0.42	0.43	41,766
	Stratum 3	06/29–07/03	57,940	0.25	0.36	20,870
	Stratum 4	07/04–07/26	36,268	0.16	0.35	12,789
	Total		228,763	1.00	0.40	93,742
2007	Stratum 1	06/06–06/19	50,083	0.29	0.52	26,207
	Stratum 2	06/20–06/30	62,907	0.37	0.35	21,787
	Stratum 3	07/01–08/16	57,256	0.34	0.20	11,203
	Total		170,246	1.00	0.35	59,197
2008	Stratum 1	06/01–06/23	41,294	0.24	0.48	19,679
	Stratum 2	06/24–06/29	42,554	0.24	0.33	14,157
	Stratum 3	06/30–09/06	91,198	0.52	0.34	30,731
	Total		175,046	1.00	0.37	64,568
2009	Stratum 1	06/09–06/22	34,229	0.19	0.48	16,490
	Stratum 2	06/23–06/29	83,866	0.47	0.35	29,490
	Stratum 3	06/30–07/31	59,701	0.34	0.16	9,335
	Total		177,796	1.00	0.31	55,315
2010	Stratum 1	06/12–06/21	28,885	0.21	0.53	15,281
	Stratum 2	06/22–06/27	45,306	0.33	0.52	23,442
	Stratum 3	06/28–09/05	63,708	0.46	0.27	17,435
	Total		137,899	1.00	0.41	56,159
2011	Stratum 1	06/01–06/18	31,273	0.21	0.55	17,245
	Stratum 2	06/19–06/27	67,686	0.45	0.35	23,663
	Stratum 3	06/28–08/07	49,838	0.33	0.16	7,803
	Total		148,797	1.00	0.33	48,711
2012	Stratum 1	06/10–06/24	31,998	0.25	0.40	12,951
	Stratum 2	06/25–07/02	63,648	0.50	0.44	28,192
	Stratum 3	07/03–07/30	31,909	0.25	0.32	10,318
	Total		127,555	1.00	0.40	51,461
2013	Stratum 1	06/14–06/24	64,830	0.47	0.74	48,244
	Stratum 2	06/25–07/01	26,362	0.19	0.44	11,673
	Stratum 3	07/02–08/02	45,613	0.33	0.18	8,421
	Total		136,805	1.00	0.50	68,337
2014	Stratum 1	06/03–06/14	45,236	0.28	0.50	22,450
	Stratum 2	06/15–06/24	82,146	0.50	0.42	34,198
	Stratum 3	06/25–08/04	36,513	0.22	0.18	6,725
	Total		163,895	1.00	0.39	63,373
2015	Stratum 1	05/30–06/17	30,600	0.21	0.49	15,061
	Stratum 2	06/18–06/26	51,172	0.35	0.37	18,736
	Stratum 3	06/27–08/17	65,087	0.44	0.33	21,352
	Total		146,859	1.00	0.38	55,149

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Table 11.–Page 2 of 2.

Year	Strata	Dates	Pilot Station passage	Proportion of run	Canadian proportion [a]	Estimated number of Canadian fish
2016	Stratum 1	05/30–06/14	37,511	0.21	0.52	19,354
	Stratum 2	06/15–06/25	86,622	0.49	0.34	29,678
	Stratum 3	06/26–08/24	52,765	0.30	0.44	22,949
	Total		176,898	1.00	0.41	71,981
2017	Stratum 1	05/31–06/20	110,001	0.42	0.43	47,817
	Stratum 2	06/21–06/25	69,392	0.26	0.40	28,072
	Stratum 3	06/26–08/11	83,621	0.32	0.40	33,346
	Total		263,014	1.00	0.42	109,236
2018	Stratum 1	06/02–06/24	72,545	0.45	0.47	33,967
	Stratum 2	06/25–07/03	57,070	0.35	0.40	22,889
	Stratum 3	07/04–08/05	32,216	0.20	0.28	8,864
	Total		161,831	1.00	0.41	65,720
2019	Stratum 1	06/02–06/23	82,035	0.37	0.56	45,637
	Stratum 2	06/24–06/30	73,551	0.33	0.42	30,563
	Stratum 3	07/01–08/24	64,038	0.29	0.36	22,910
	Total		219,624	1.00	0.45	99,110
2020	Stratum 1	06/07–06/22	34,551	0.21	0.63	21,891
	Stratum 2	06/23–06/29	64,298	0.40	0.48	30,873
	Stratum 3	06/30–07/06	35,047	0.22	0.44	15,453
	Stratum 4	07/07–08/17	28,356	0.17	0.37	10,468
	Total		162,252	1.00	0.48	78,685
2021	Stratum 1	05/31–06/22	44,751	0.36	0.62	27,527
	Stratum 2	06/23–07/06	59,173	0.47	0.54	32,065
	Stratum 3	07/07–08/06	20,921	0.17	0.35	7,409
	Total		124,845	1.00	0.54	67,001
2022	Stratum 1	06/01–06/22	10,491	0.22	0.67	7,022
	Stratum 2	06/23–06/29	18,559	0.38	0.42	7,766
	Stratum 3	06/30–07/27	19,389	0.40	0.35	6,860
	Total		48,439	1.00	0.45	21,648
Average annual proportion of Canadian stock					0.41	
Minimum annual proportion of Canadian stock					0.31	
Maximum annual proportion of Canadian stock					0.54	

Note: Average, minimum, and maximum values exclude the most recent year data.

[a] Total Canadian proportion is weighted with "Proportion of run".

Table 12.–Genetic baseline (microsatellite, 37 populations) used for stock separation of chum salmon sampled in the Pilot Station sonar drift gillnet test fishery, 2022.

Stock aggregate name	Populations in baseline
Lower	Andreafsky, Anvik, California, Chulinak, Clear, Dakli, Kaltag, Nulato, Gisasa, Melozitna, Rodo, Tolstoi
Upper Koyukuk+Main	Henshaw, Jim, Middle Fork Koyukuk, South Fork Koyukuk (early and late run), Tozitna
Tanana Summer	Chena, Salcha
Tanana Fall	Bluff Cabin, Delta, Nenana, Kantishna, Tanana Mainstem, Toklat
Border U.S.	Big Salt, Black, Chandalar[a], Sheenjek
Porcupine	Fishing Branch
Mainstem	Big Creek, Minto, Pelly, Tatchun
White	Donjek, Kluane
Teslin	Teslin
Aggregate name	**Aggregate within aggregate**
Summer	Lower, Middle
Middle	Upper Koyukuk+Main, Tanana Summer
Fall	Tanana Fall, Border U.S., Border Canada, Upper Canada
Fall U.S.	Tanana Fall, Border U.S.
U.S.	Lower, Middle, Tanana Fall, Border U.S.
Border Canada	Porcupine, Mainstem
Upper Canada	White, Teslin
Canada	Border Canada, Upper Canada

[a] The Chandalar River and North Fork collectively were renamed the Teedriinjik and the Middle Fork was renamed the Ch'idriinjik in September of 2015.

Table 13.–Preseason Canadian-origin Yukon River Chinook salmon outlooks for 2000–2023 and the observed run sizes for 2000–2022.

	Outlook range [a]		Postseason estimate
Year	Low end	High end	Estimated run size [b]
2000	91,000	128,000	53,000
2001	37,000	37,000	86,000
2002	49,000	49,000	81,000
2003	62,000	62,000	150,000
2004	69,700	107,200	117,000
2005	117,000	117,000	124,000
2006	93,000	93,000	119,000
2007	74,500	112,900	88,000
2008	80,000	111,000	63,000
2009	60,700	99,800	88,000
2010	77,800	113,000	60,000
2011	65,000	89,000	72,000
2012	54,000	73,000	48,000
2013	49,000	72,000	37,000
2014	32,000	61,000	65,000
2015	59,000	70,000	87,000
2016	65,000	88,000	83,000
2017	73,000	97,000	93,000
2018	71,000	103,000	76,000
2019	69,000	99,000	73,000
2020	59,000	90,000	46,000
2021	42,000	77,000	33,000
2022	41,000	62,000	13,000
2023	26,000	43,000	

Note: Run sizes are rounded to the nearest 1,000 fish.

[a] The outlook range has been calculated using a variety of different methods. Refer to previous published JTC reports for a full description for a particular year.

[b] Estimated run size is the border passage estimate plus the U.S. and Canada harvest of Canadian-origin Chinook salmon. U.S. harvest estimates are determined using Canadian stock genetic proportion estimates applied to U.S. harvest.

Table 14.–Forecasted 2023 total run size of fall chum salmon based on parent year escapement for each brood year and predicted return per spawner (R/S) rates, Yukon River, 2017–2020.

Brood year	Escapement	Estimated production (R/S)	Estimated production	Age	Contribution based on age	Ricker return	Forecasted return
2017	1,733,500	0.09	156,015	6	0.2%	1,201	447
2018	656,150	0.40	262,460	5	10.8%	72,635	27,027
2019	529,300	1.53	809,829	4	87.1%	588,136	218,843
2020	178,400	2.36	421,024	3	1.9%	13,138	4,889
Total forecasted run size point estimate (unadjusted and adjusted)						675,110	**251,206**
Total unadjusted forecasted run size, 80% CI:					568,000	to	783,000
Total adjusted forecasted run size:					112,000	to	602,000

Note: The 2023 unadjusted forecast was based on previously-established JTC methods. The 2023 forecast point estimate and 80% CI were adjusted down to account for unprecedented poor run sizes in 2020–2022. Adjustment to the point estimate was based on the average (37.2%) of observed return to forecast for 2019 and 2022. Adjustment to the 80% CI range is based on the (19.7%) and (76.9%) differences observed in 2019 and 2020. Escapements and forecast range are rounded.

Table 15.–Preseason Yukon River drainagewide fall chum salmon outlooks 1998–2023 and estimated run sizes for 1998–2022.

Year	Expected run size (preseason)	Estimated run size (postseason) [a]	Performance of preseason outlook (preseason/postseason)
1998	880,000	352,000	2.50
1999	1,197,000	420,000	2.85
2000	1,137,000	253,000	4.49
2001	962,000	375,000	2.57
2002	646,000	428,000	1.51
2003	647,000	792,000	0.82
2004	672,000	653,000	1.03
2005	776,000	2,181,000	0.36
2006	1,211,000	1,212,000	1.00
2007	1,106,000	1,161,000	0.95
2008	1,057,000	857,000	1.23
2009	791,000	598,000	1.32
2010	690,000	587,000	1.18
2011	740,000	1,239,000	0.60
2012	1,114,000	1,086,000	1.03
2013	1,029,000	1,212,000	0.85
2014	932,000	955,000	0.98
2015	1,060,000	824,000	1.29
2016	666,000	1,389,000	0.48
2017	1,560,000	2,288,000	0.68
2018	1,700,000	1,113,000	1.53
2019	1,045,000	802,000	1.30
2020	936,000	194,000	4.82
2021	652,000	95,000	6.86
2022	110,000	242,000	0.45
2023	251,000		

Note: Run sizes are rounded to the nearest 1,000 fish. The expected run sizes are point estimates (rounded). Preseason run size ranges in 1999–2005 and 2022–2023 are not distributed around the point estimate, (due to compensation for drastic downturns in production). From 2006–2021, expected run sizes are the midpoint of the outlook range. Refer to previous published JTC reports for a full method description for a particular year.

[a] Postseason estimates are updated annually based on the Bayesian space-state modeling of the drainagewide estimates and may include refined harvest estimates.

Table 16.–Preseason Canadian-origin mainstem Yukon River fall chum salmon outlooks for 1998–2023 and observed run sizes for 1998–2022.

Year	Expected run size (preseason)	Estimated run size (postseason) [a]	Performance of preseason outlook (preseason/postseason)
1998	198,000	70,000	2.83
1999	336,000	116,000	2.90
2000	334,000	66,000	5.06
2001	245,000	49,000	5.00
2002	144,000	113,000	1.27
2003	145,000	182,000	0.80
2004	147,000	193,000	0.76
2005	126,000	558,000	0.23
2006	126,000	330,000	0.38
2007	147,000	347,000	0.42
2008	229,000	269,000	0.85
2009	195,000	128,000	1.52
2010	172,000	143,000	1.20
2011	184,000	326,000	0.56
2012	273,000	238,000	1.15
2013	257,000	303,000	0.85
2014	230,000	223,000	1.03
2015	265,000	205,000	1.29
2016	166,000	298,000	0.56
2017	388,000	563,000	0.69
2018	425,000	279,000	1.52
2019	262,000	178,000	1.47
2020	234,000	25,000	9.36
2021	163,000	23,000	7.09
2022	28,000	22,000	1.27
2023	63,000		

Note: Run sizes are rounded to the nearest 1,000 fish. The 2009 through 2023 preseason expected run sizes are the midpoint of the outlook range. Estimated run sizes are calculated by adding estimated U.S. harvest of Canadian-origin fall chum salmon to the mainstem Yukon River Eagle sonar passage estimate. The proportion of Canadian mainstem fall chum salmon in the total U.S. harvest is assumed to be equal to the proportion of Canadian-origin fall chum salmon in the drainagewide escapement (i.e. 25%).

Table 17.–Preseason Fishing Branch River fall chum salmon outlooks for 1998–2023 and observed run sizes for 1998–2022.

Year	Expected run size (preseason)	Estimated run size (postseason) [a]	Performance of preseason outlook (preseason/postseason)
1998	112,000	25,000	4.48
1999	124,000	24,000	5.17
2000	150,000	13,000	11.54
2001	101,000	33,000	3.06
2002	41,000	19,000	2.16
2003	29,000	46,000	0.63
2004	22,000	32,000	0.69
2005	48,000	186,000	0.26
2006	54,000	48,000	1.13
2007	80,000	50,000	1.60
2008	78,000	30,000	2.60
2009	49,000	40,000	1.23
2010	43,000	20,000	2.15
2011	37,000	28,000	1.32
2012	55,000	50,000	1.10
2013	52,000	39,000 (52,000) [b]	–
2014	46,000	13,000 (24,000) [b]	–
2015	17,000	13,000	1.31
2016	27,000	54,000	0.50
2017	62,000	73,000	0.85
2018	68,000	29,000	2.34
2019	42,000	29,000	1.45
2020	37,000	5,000	7.40
2021	26,000	2,500	10.40
2022	4,000	3,000	1.33
2023	10,000		

[a] Estimated total run size from 1998–2014 is for the Canadian Porcupine River. The total run size is estimated by adding the estimated Canadian harvest of Fishing Branch River fall chum salmon and estimated U.S. harvest of Fishing Branch River fall chum salmon to the Fishing Branch River weir escapement estimate, unless otherwise noted. In 2003, total run size was calculated using the equation; ((Fishing Branch River escapement/0.88) + Canadian Porcupine River harvest) x 1.15. From 2004–2009, total run size was calculated using the equation; Fishing Branch River escapement/0.8/0.8. In 2010, total run size was calculated using the equation; Fishing Branch River escapement/0.8. In 2011, total run size was calculated using the equation; (Fishing Branch River escapement + 75% of Canadian Porcupine harvest)/0.68/0.75. In 2012, total run size was calculated using the equation; Fishing Branch River escapement x 1.25 + Canadian Porcupine River harvest + 5% U.S. harvest of fall chum. From 2013–2015, the proportion of Fishing Branch River fall chum salmon in the total U.S. harvest is assumed to be equal to the proportion of Fishing Branch River fall chum salmon in the drainagewide escapement. From 2016–2021, the proportion of Fishing Branch River fall chum salmon in the total U.S. harvest is assumed to be 4%. In 2020, proportion of Fishing Branch-origin fall chum salmon in the total Canadian-origin Porcupine River fall chum salmon harvest was calculated as 63%, estimated by regression of Porcupine sonar to Fishing Branch River weir passage estimates from 2015–2019 (excluding an incomplete Porcupine sonar estimate in 2018). For 2016–2018, Fishing Branch River proportion within Porcupine River fall chum was considered 80%, based on historical telemetry work. From 2012–2015, 100% of Canadian fall chum salmon harvest in the Porcupine River was included in the Fishing Branch River estimated run size. From 2003–2010, 80% of Canadian fall chum salmon harvest in the Porcupine River was included in the total run estimate.

[b] Run size was based on Old Crow sonar counts and proportion of tag recoveries. Numbers in parentheses are the corresponding Canadian-origin Porcupine River sonar-based estimates. Outlook performances are not included due to uncertainty in the assessment methods compared with previous years.

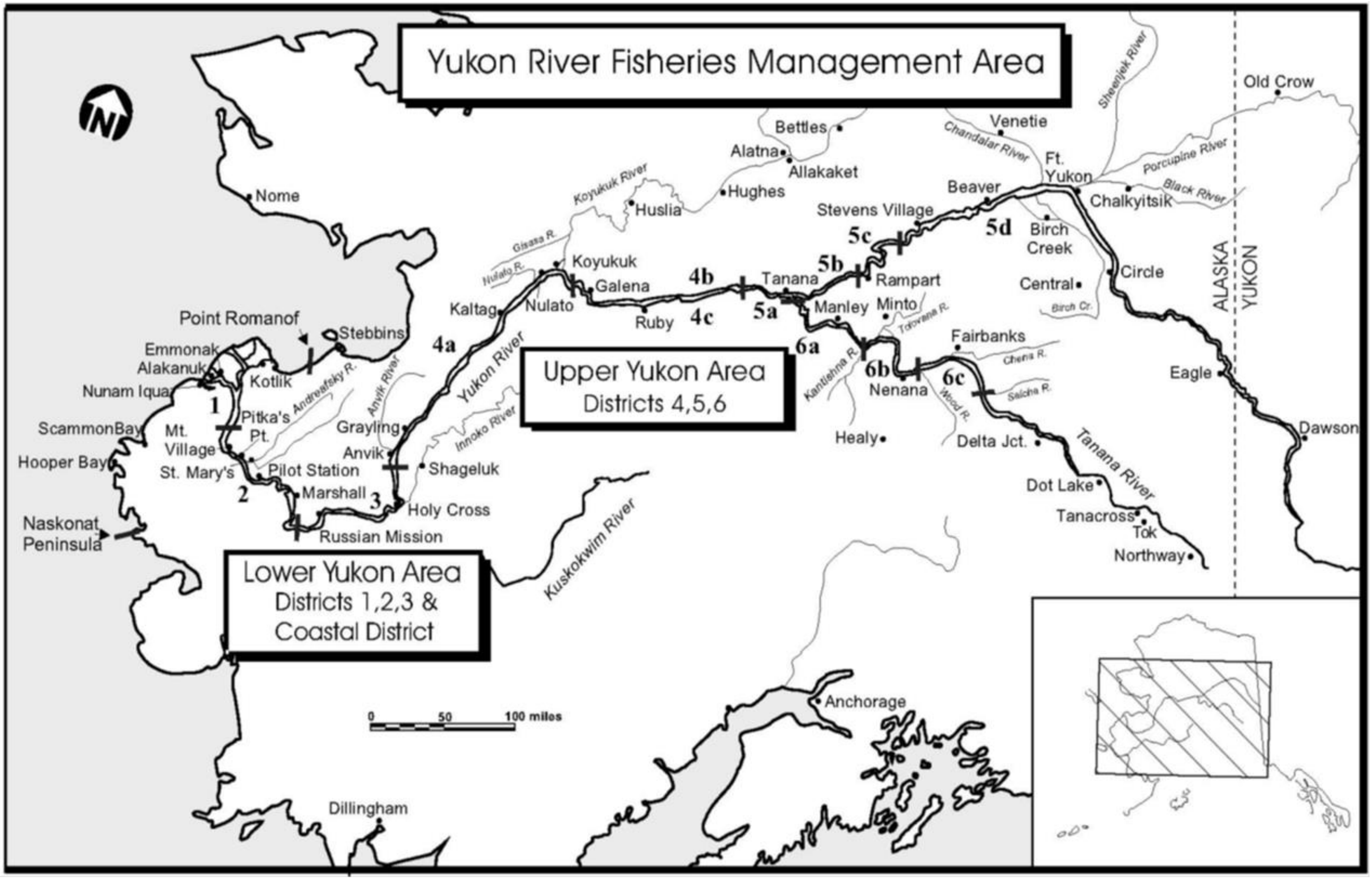

Figure 1.–Map of the Alaska (U.S.) portion of the Yukon River drainage showing communities and fishing districts.

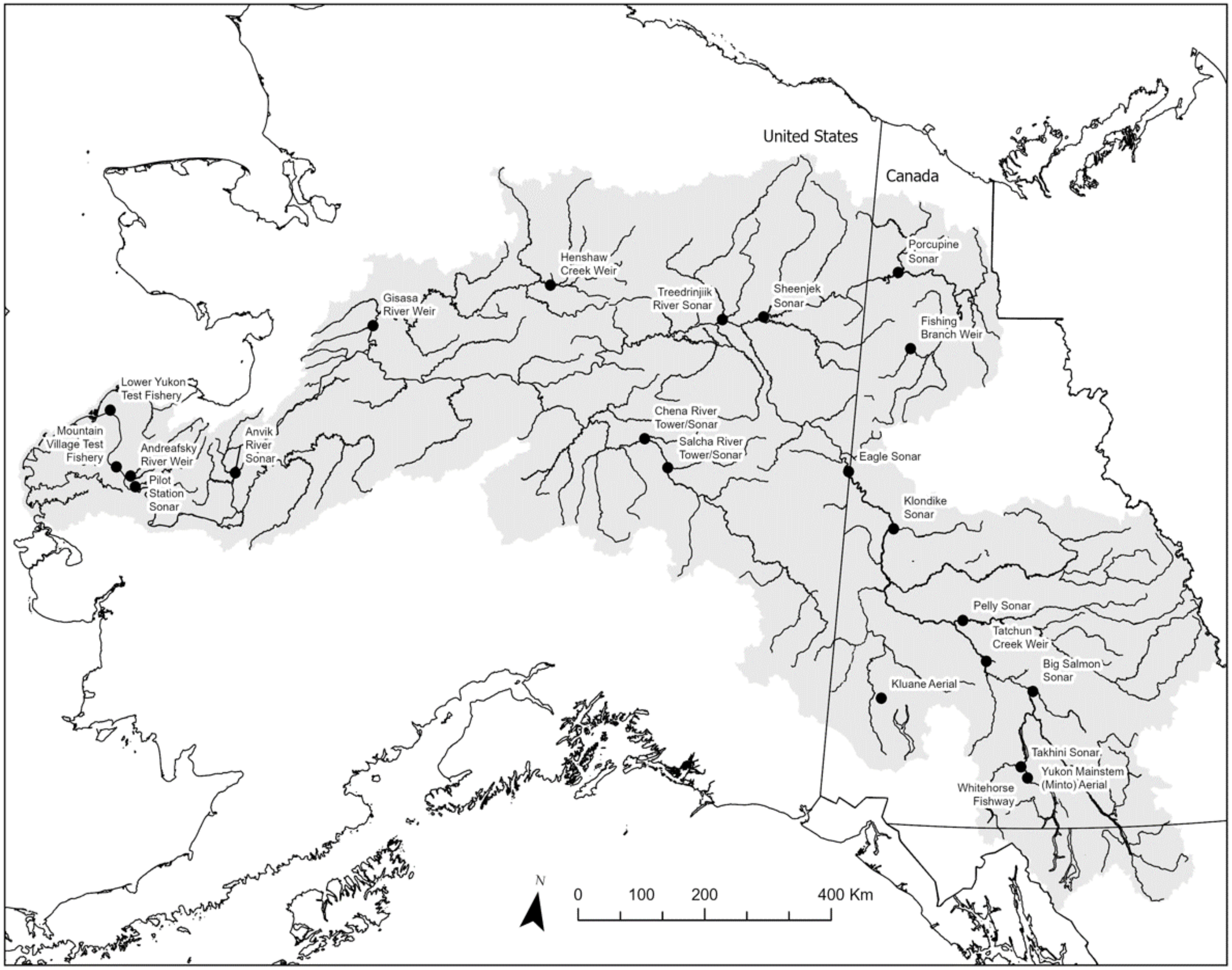

Figure 2.– Primary assessment projects operated in the U.S. and Canada used to assess Chinook and fall chum salmon run strength or escapement.

Note: The following projects did not operate in 2022 but are core assessment programs that are anticipated to continue in the future: Henshaw Creek weir (U.S.), Pelly River sonar and Big Salmon River sonar (Canada).

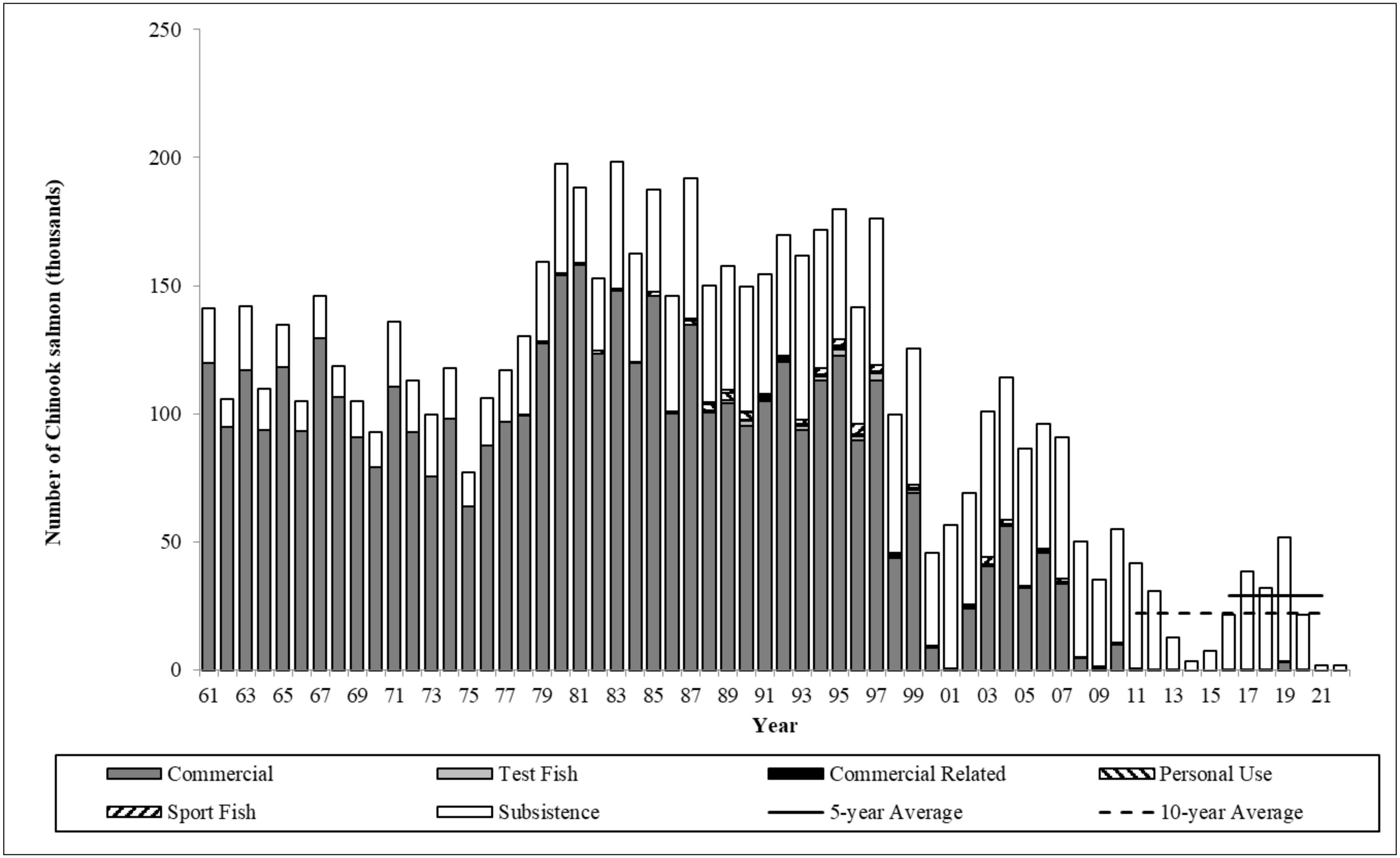

Figure 3.–U.S. (Alaska) harvest of Chinook salmon, Yukon River, 1961–2022.

Note: The 2017–2022 harvest estimates are preliminary. Commercial harvests through 2007 were Chinook salmon-directed commercial fishing. Commercial harvests 2008 to present include Chinook salmon incidentally harvested and sold from the chum salmon-directed fisheries. 'Commercial related' refers to the estimated harvest of female Chinook salmon to produce roe sold between 1990 and 2002.

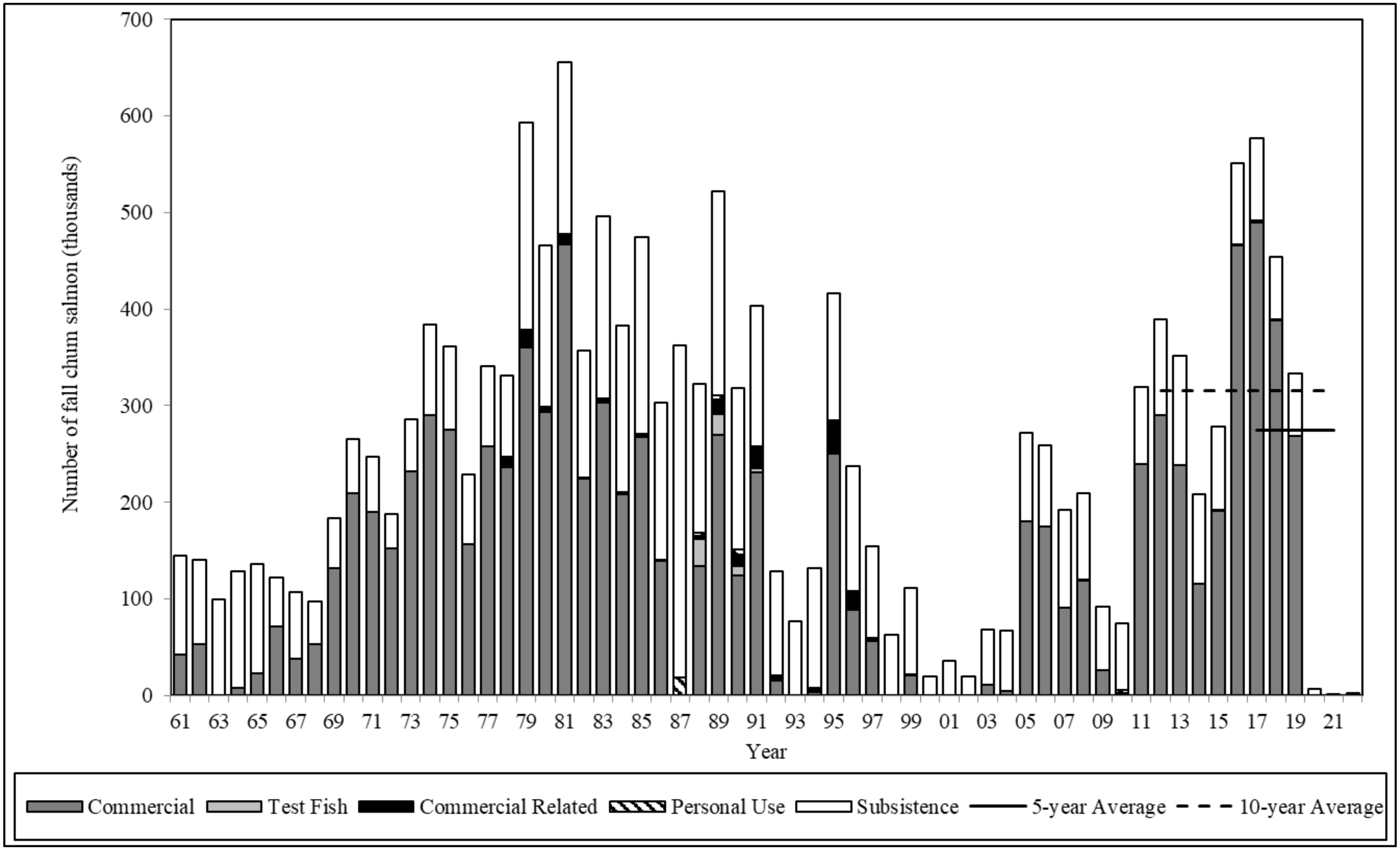

Figure 4.–U.S. (Alaska) harvest of fall chum salmon, Yukon River, 1961–2022.

Note: Subsistence harvest estimates of fall chum salmon are minimal prior to 1979 because of timing of harvest surveys. The commercial fishery was closed in 1963, 1987, 1993, 1998, 2000–2002, and 2020–2022. 'Commercial related' refers to the estimated harvest of female salmon to produce roe sold. The 2017–2022 harvest estimates are preliminary.

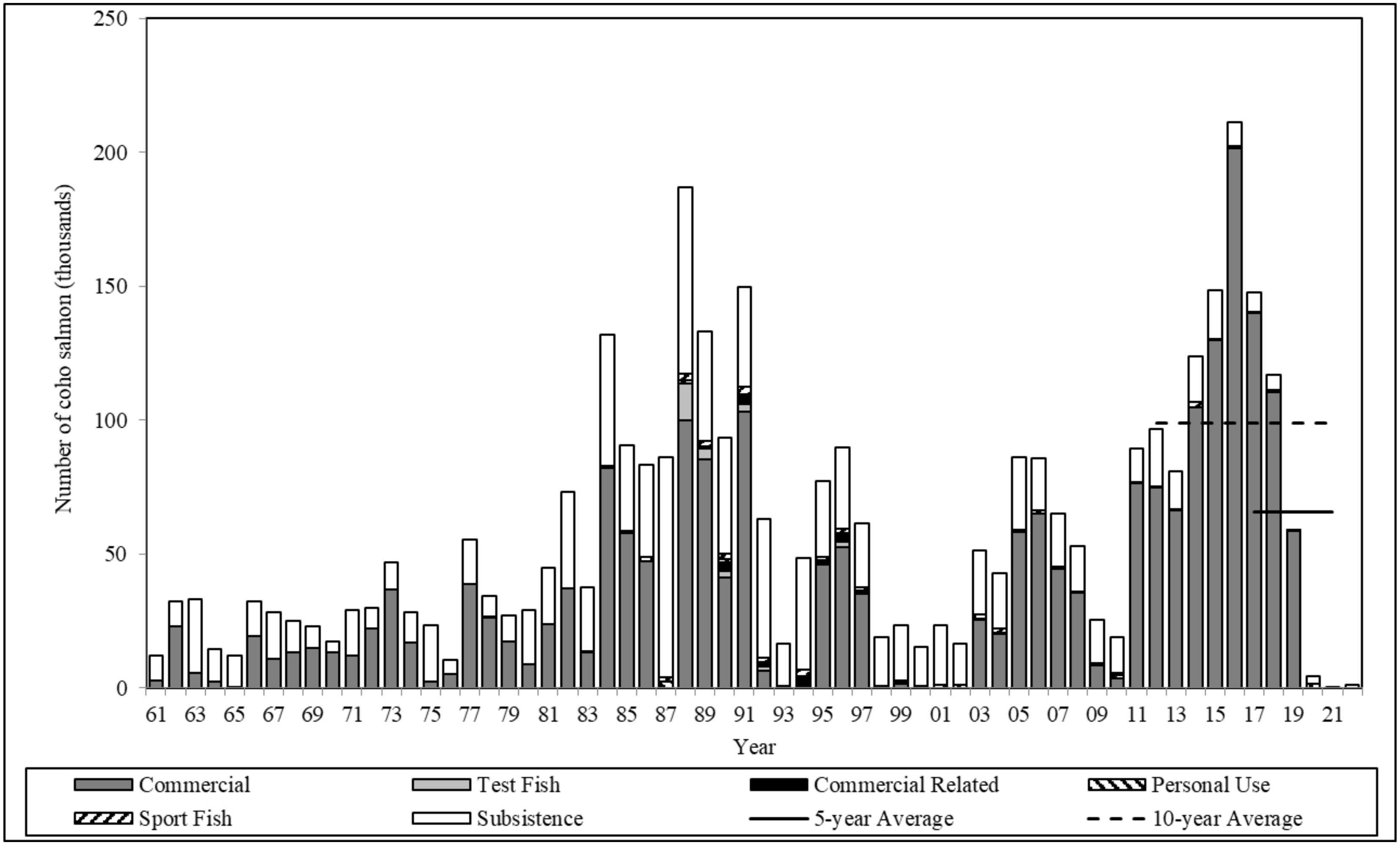

Figure 5.–U.S. (Alaska) harvest of coho salmon, Yukon River, 1961–2022.

Note: Subsistence harvest estimates of coho salmon are minimal prior to 1979 because of timing of harvest surveys. The commercial fishery was closed 1987, 1993, 1998, 2000–2002, and 2020–2022. 'Commercial related' refers to the estimated harvest of female salmon to produce roe sold. The 2017–2022 harvest estimates are preliminary.

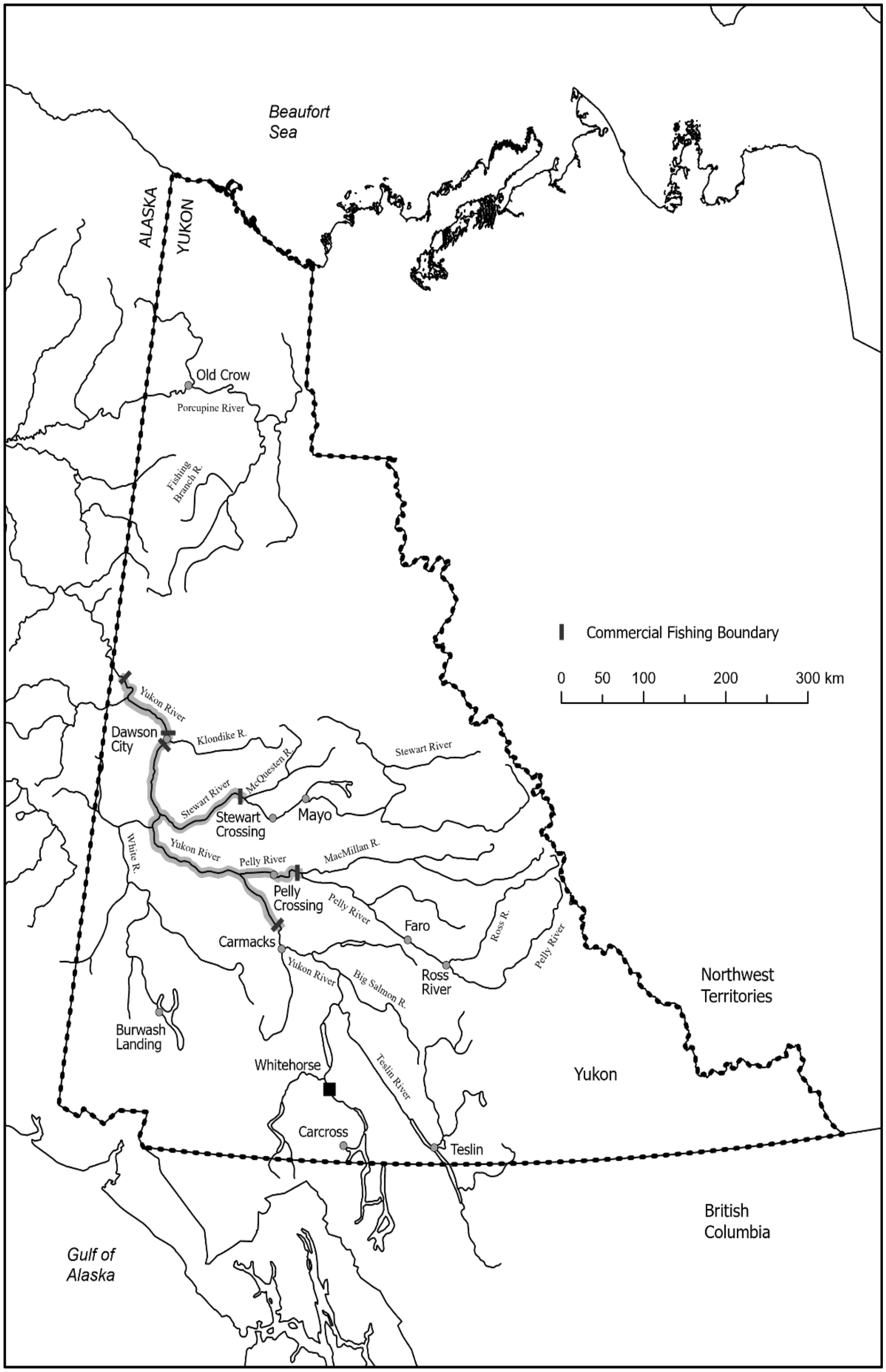

Figure 6.–Commercial fishing boundaries, tributaries, and major towns within the Yukon, Canada.

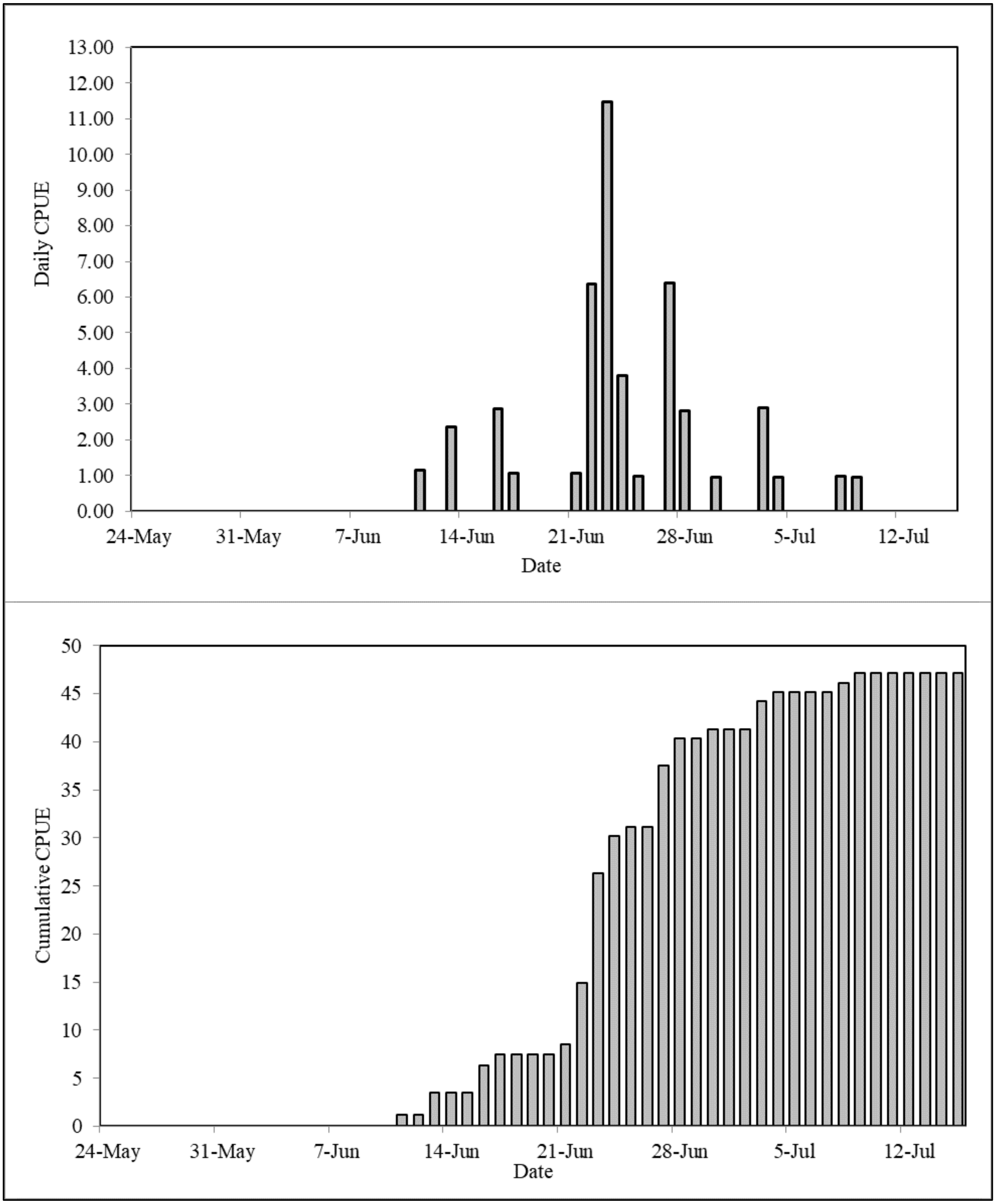

Figure 7.–Daily (top) and cumulative (bottom) catch per unit effort (CPUE) for Chinook salmon in the Lower Yukon drift gillnet test fishery at Big Eddy and Middle Mouth combined in 2022.

Note: Started Middle Mouth drifts with a gillnet in 2021 in addition to the Big Eddy site. Unable to compare 2022 CPUE to historical averages at this time until more years of combined Big Eddy and Middle Mouth CPUE data can be collected.

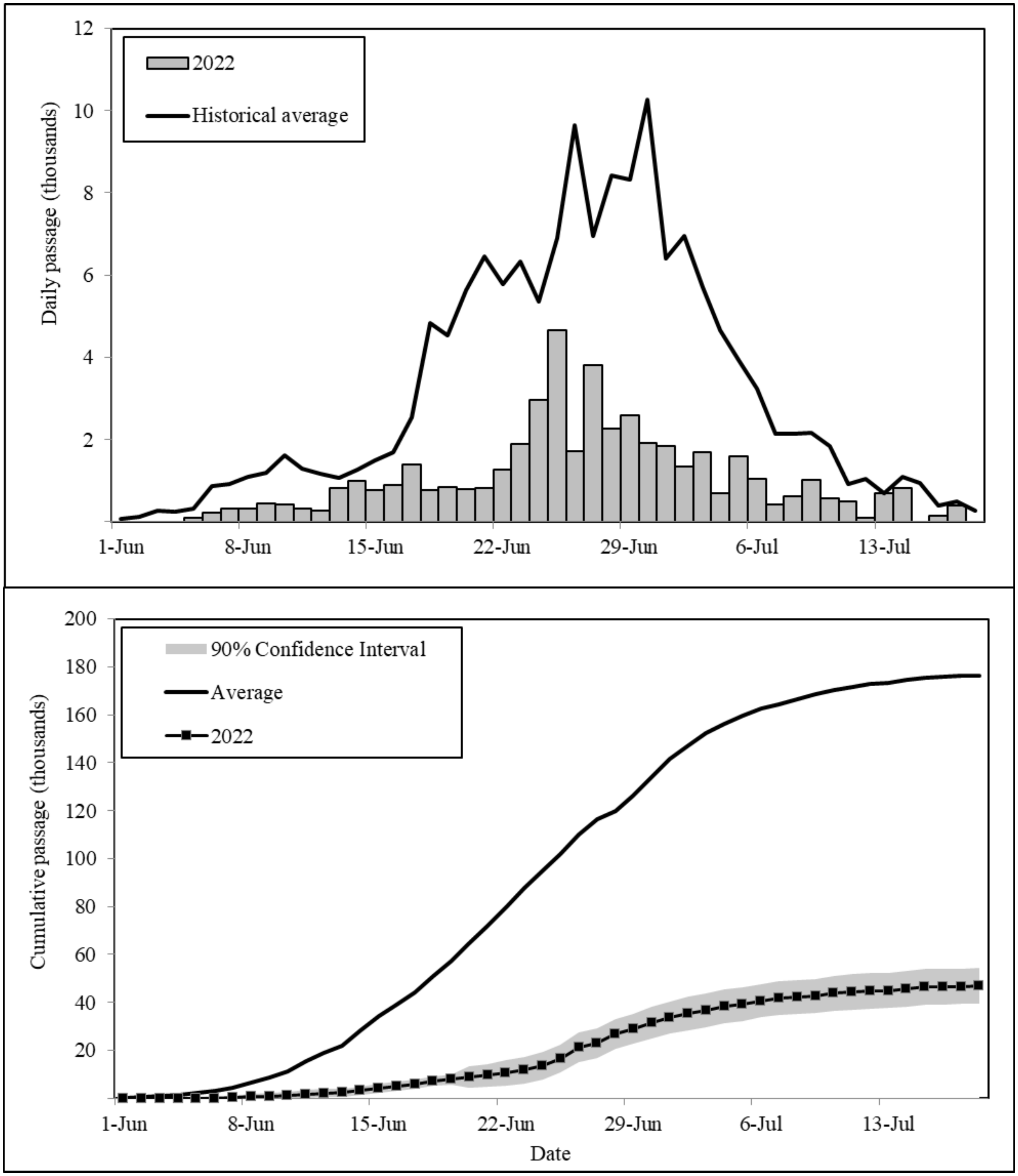

Figure 8.–Daily passage estimates of Chinook salmon at the Pilot Station sonar in 2022 (top) and cumulative passage estimate, including 90% confidence intervals (bottom), 2022 compared to historical average.

Note: Historical average includes 1995, 1997, 2000, 2002–2008, and 2010–2021.

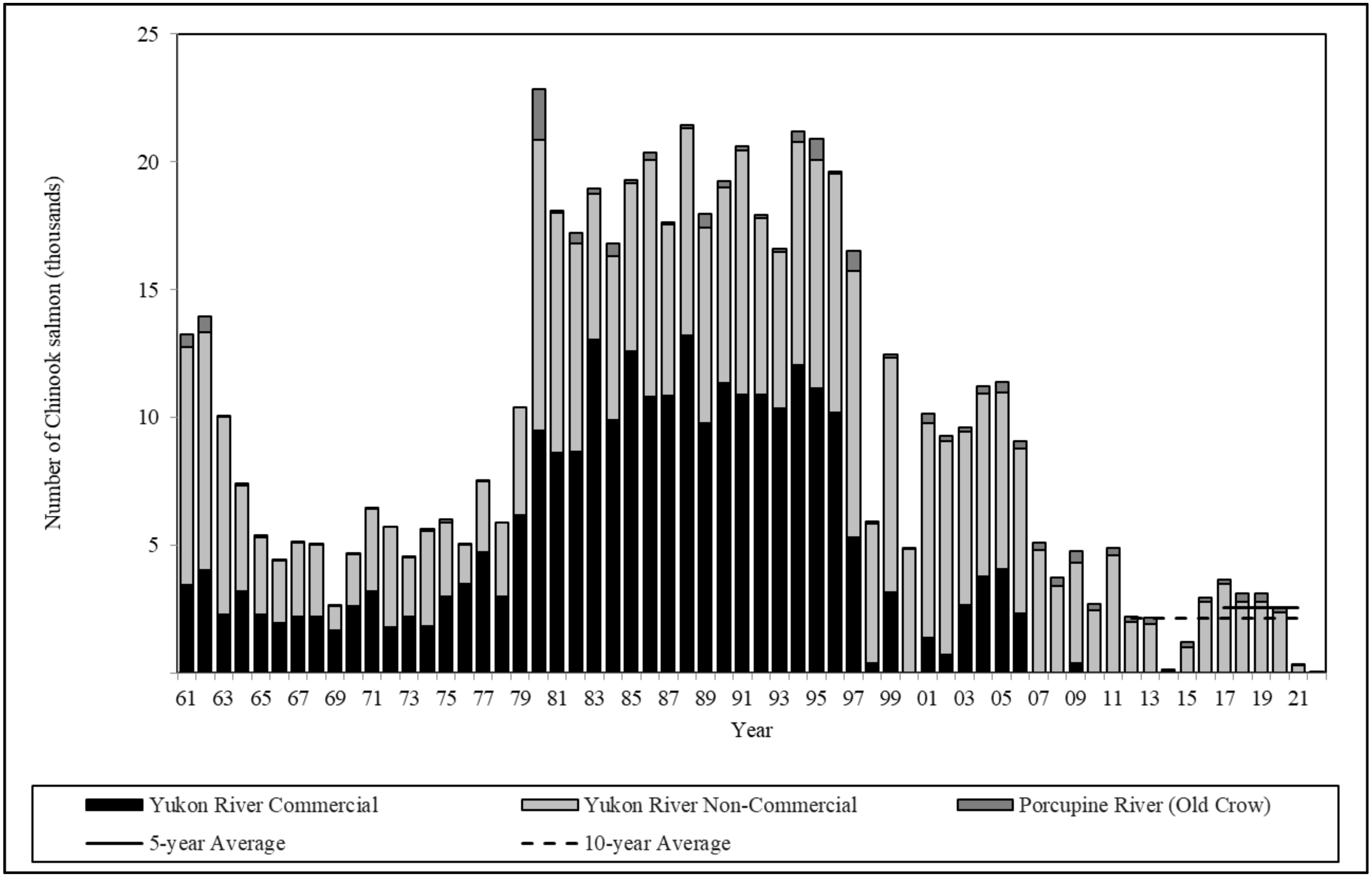

Figure 9.–Canadian harvest of Chinook salmon, Yukon River, 1961–2022.

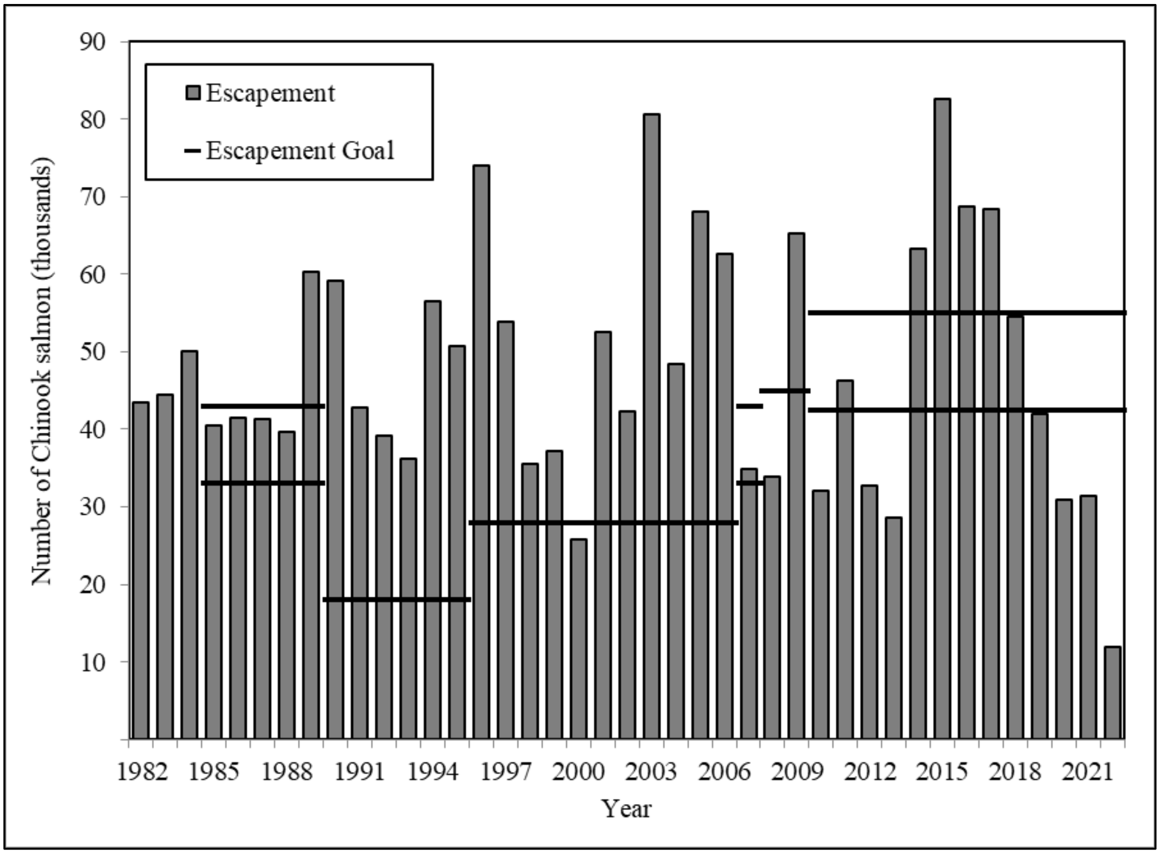

Figure 10.– Estimated spawning escapement estimates and escapement goals (minimum or range) for Canadian-origin Yukon River mainstem Chinook salmon, 1982–2022.

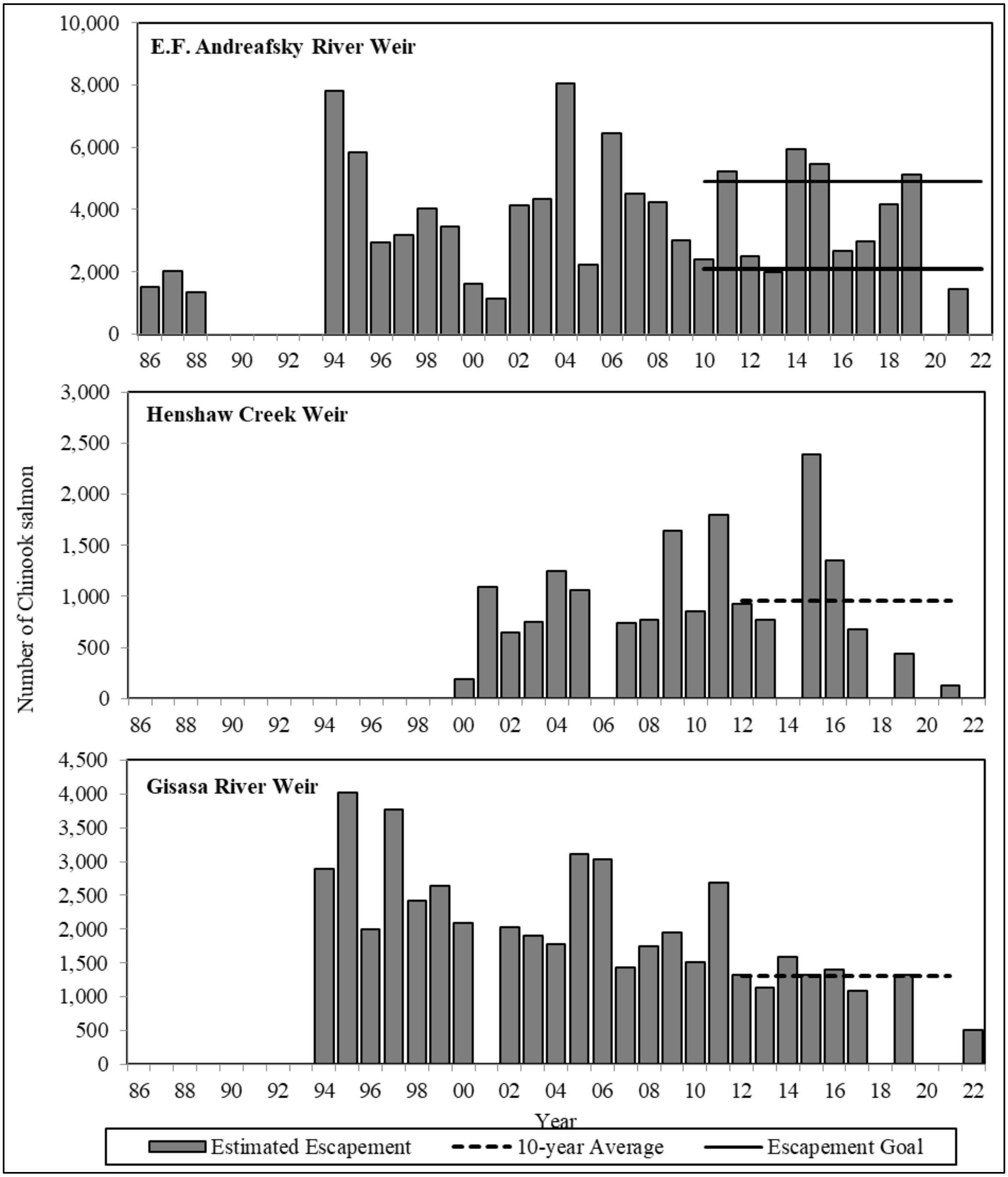

Figure 11.–Chinook salmon ground-based escapement estimates for selected tributaries in the U.S. (Alaska) portion of the Yukon River drainage, 1986–2022.

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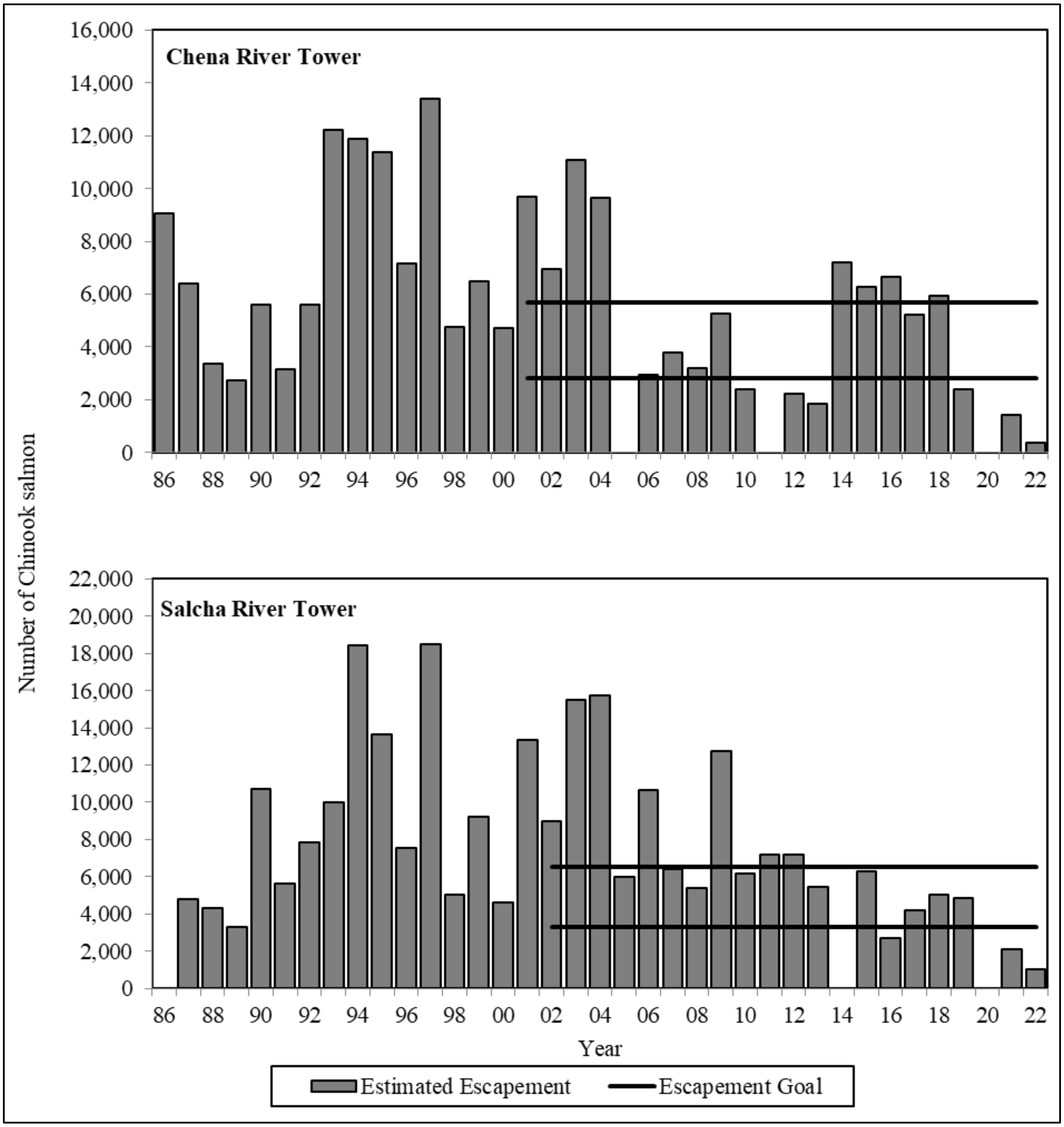

Figure 11. -Page 2 of 2

Note: Escapement goal range relative to years when the goal was in effect. There are no escapement goals at the Henshaw Creek and Gisasa River weirs. Vertical scale is variable.

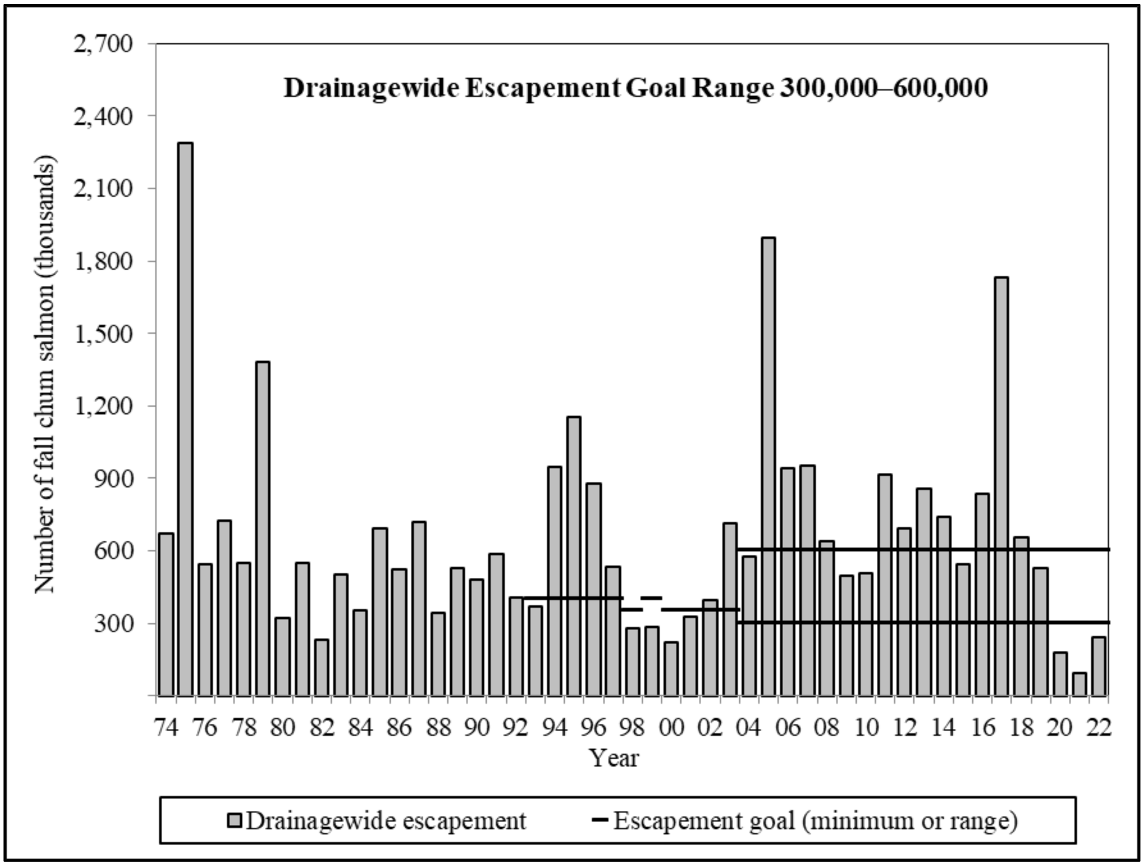

Figure 12.–Estimated drainagewide escapement of fall chum salmon, Yukon River, 1974–2022.

Note: Horizontal lines represent escapement goals and are relative to years applied as either minimums or ranges.

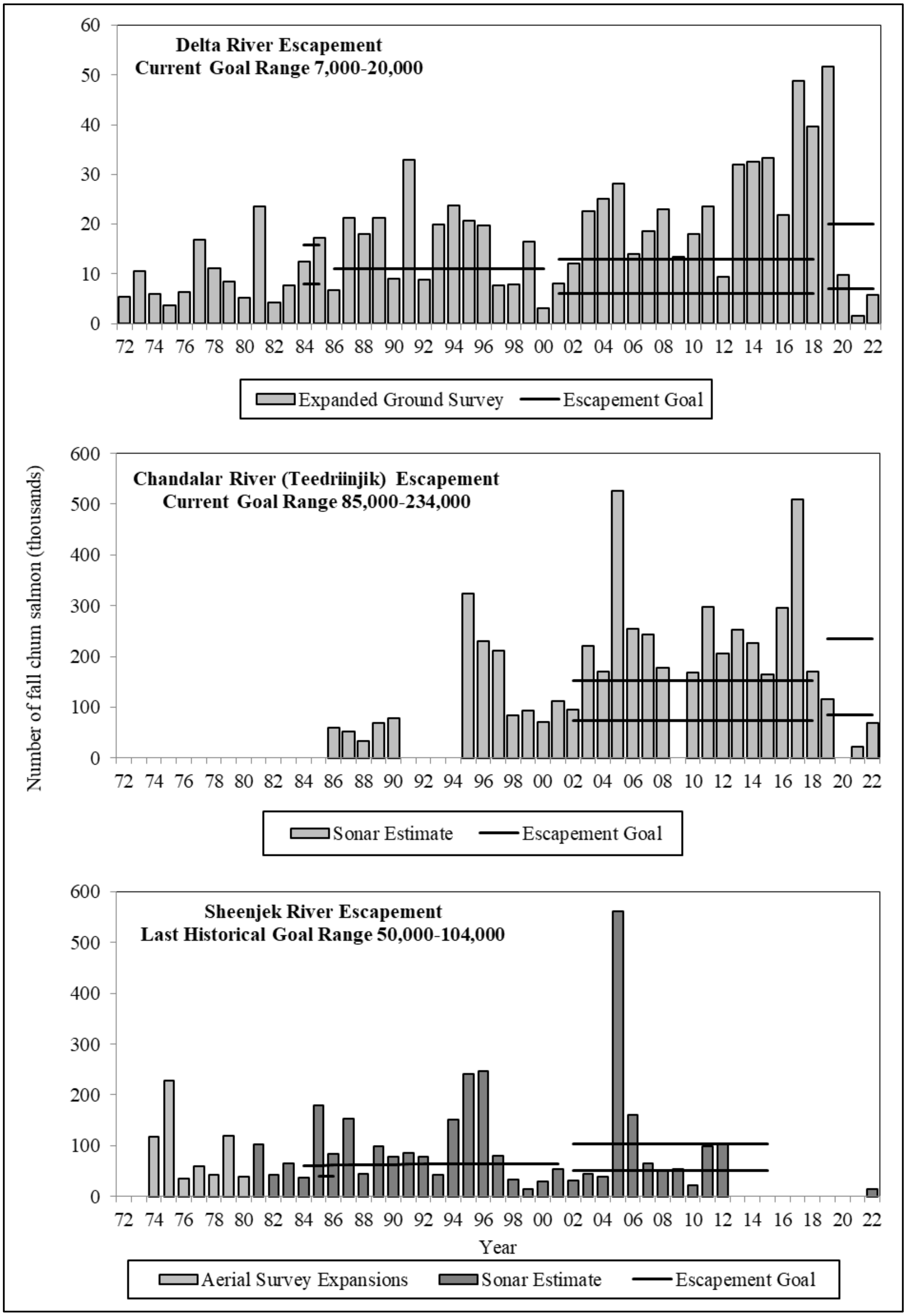

Figure 13.–Fall chum salmon escapement estimates for selected spawning areas in the U.S. (Alaska) portion of the Yukon River drainage, 1972–2022.

Note: Horizontal lines represent escapement goals or ranges. The vertical scale is variable. Escapement goal is relative to years applied as either minimums or ranges. Sheenjek escapement project goal was discontinued in 2016, no funding 2013–2021.

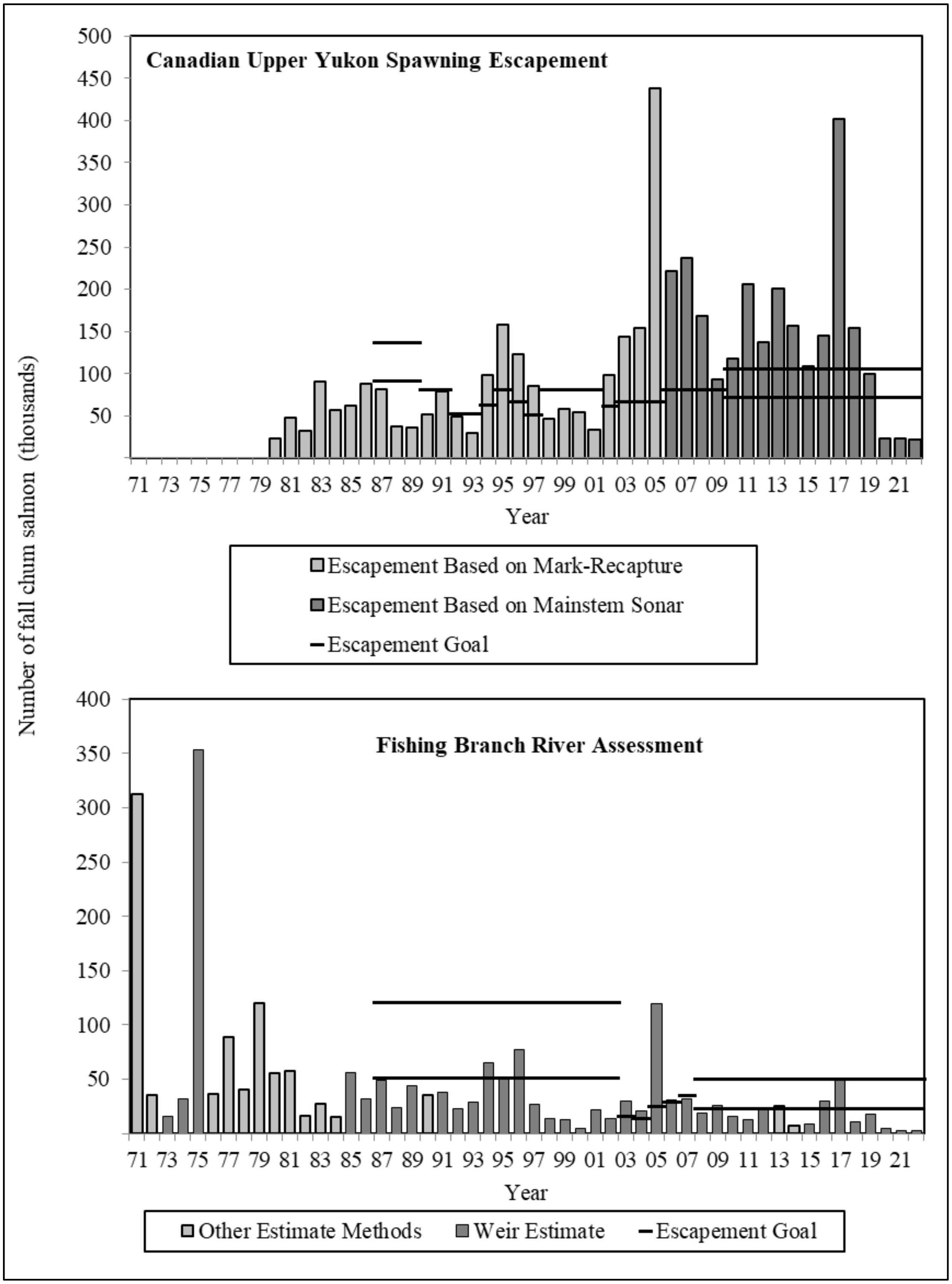

Figure 14.– Estimated spawning escapement and escapement goals (minimum or range) for Canadian-origin fall chum salmon for the mainstem Yukon River and Fishing Branch River, 1972–2022.

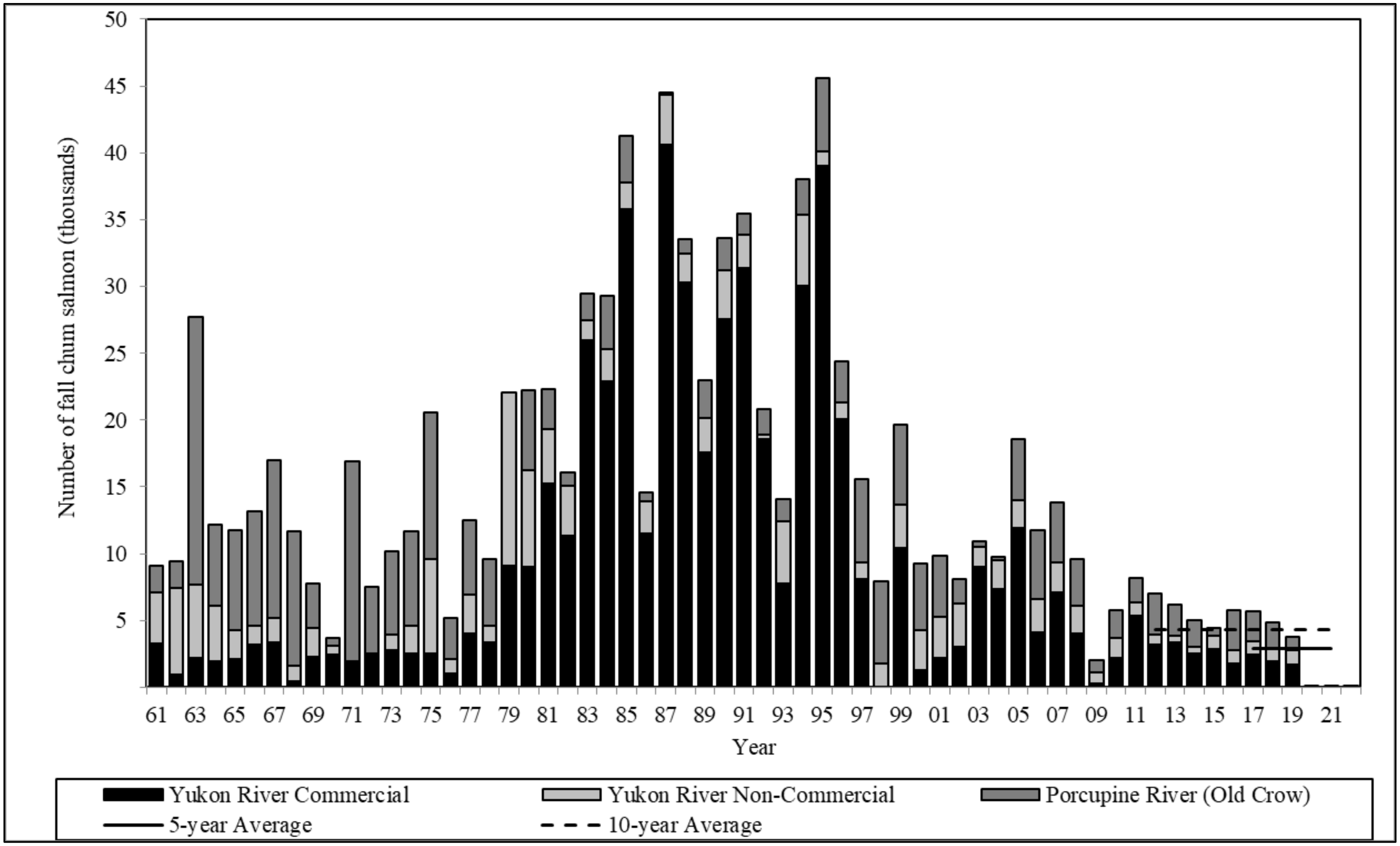

Figure 15.–Canadian harvest of fall chum salmon, Yukon River, 1961–2022.

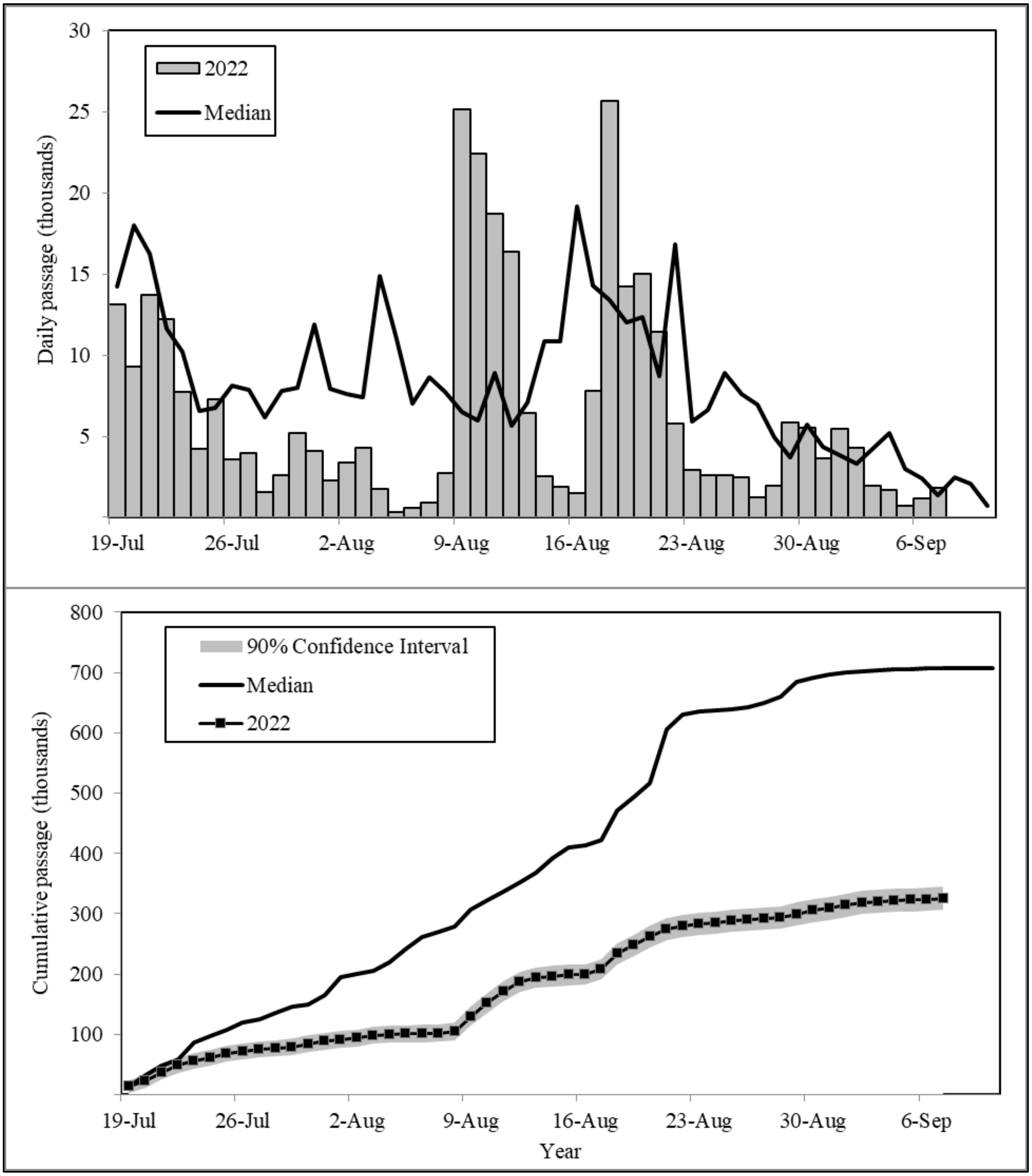

Figure 16.–Daily passage estimates of chum salmon at the Pilot Station sonar in the fall season in 2022 (top), cumulative passage estimates, including 90% confidence intervals (bottom), compared to median passages.

Note: Historical median includes 1995–2021, excluding 1996 and 2009.

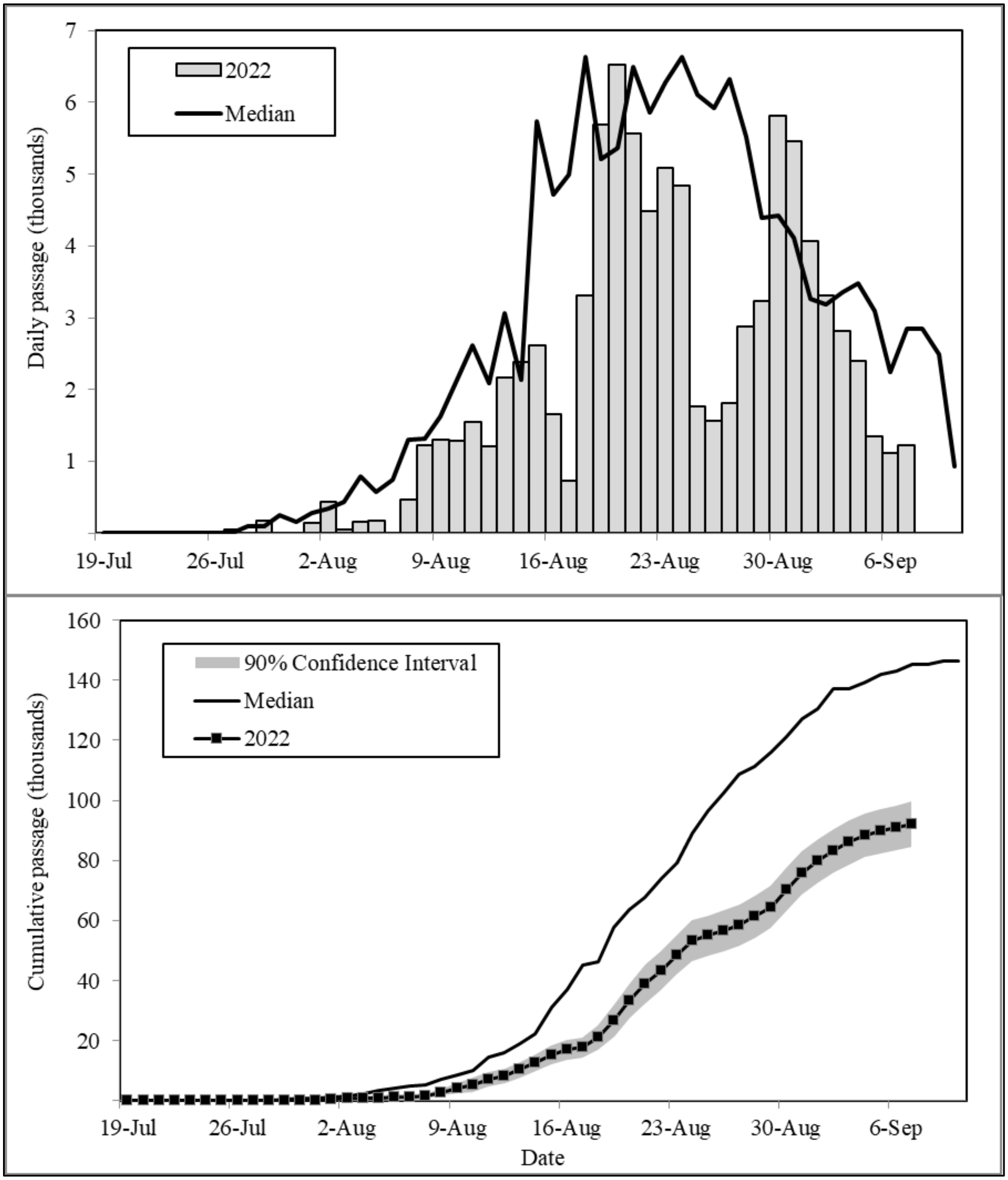

Figure 17.–Daily passage estimates of coho salmon at the Pilot Station sonar in 2022 (top), cumulative passage estimates, including 90% confidence intervals (bottom), compared to median passages.

Note: Historical median includes 1995–2021, excluding 1996 and 2009.

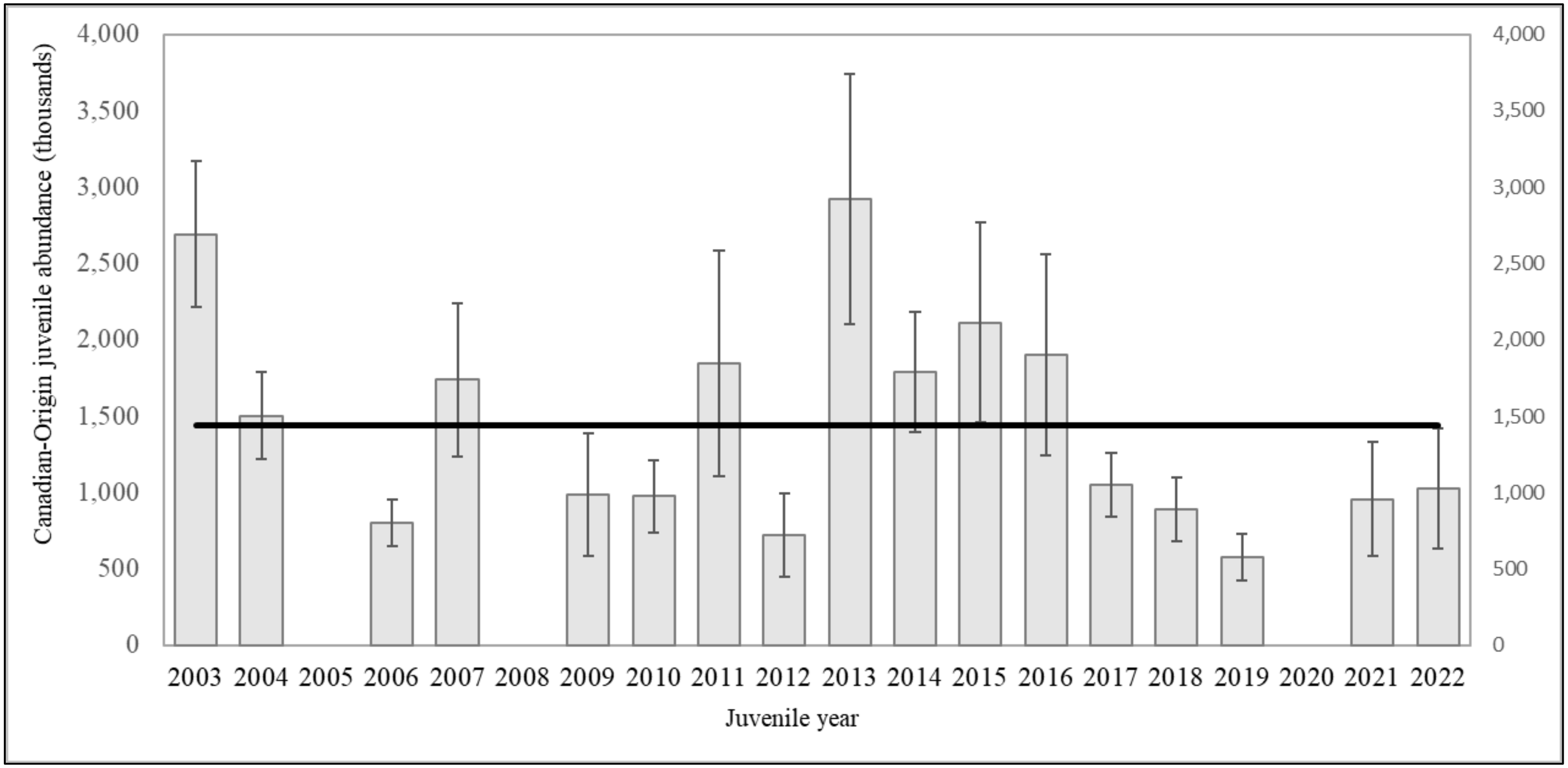

Figure 18.– Juvenile abundance estimates of Canadian-origin Chinook salmon from the Yukon River based on pelagic trawl research surveys in the northern Bering Sea (2003–2022).

Notes: Error bars ranges are one deviation above and below the abundance estimates and the horizontal black line shows the average Canadian-origin juvenile abundance across all years. No surveys occurred in 2008 or 2020 and the survey design in 2005 was inconsistent with other years.

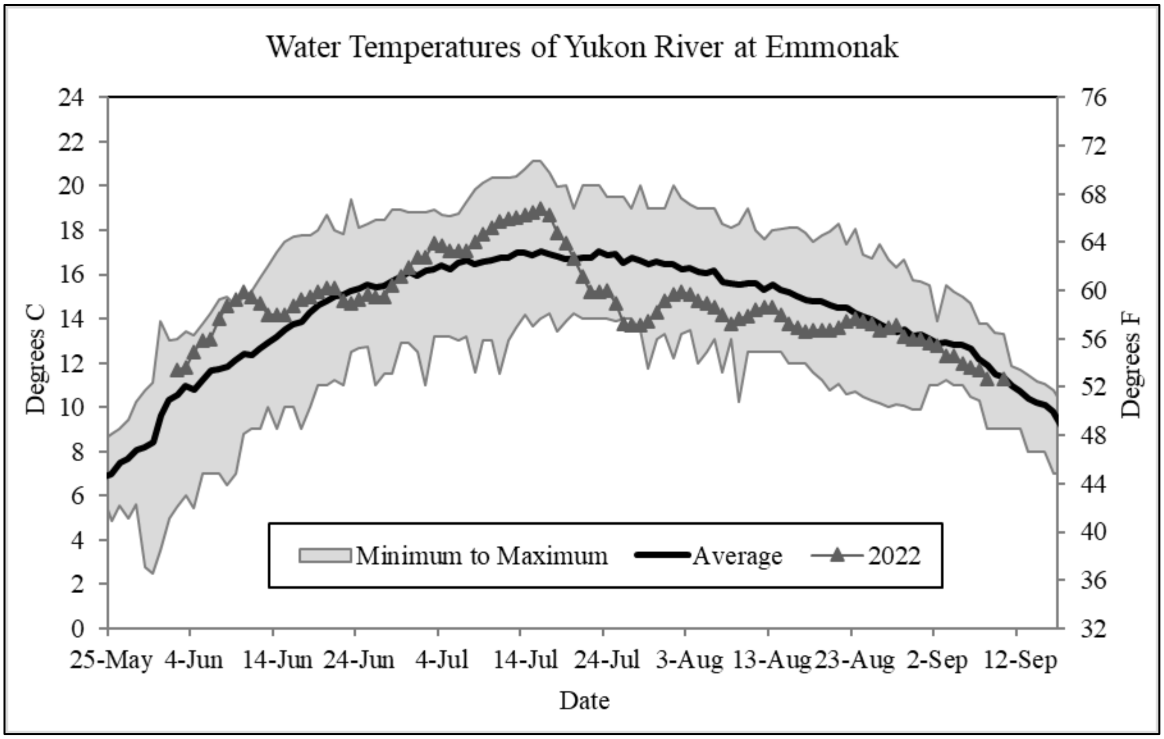

Figure 19.– Lower Yukon daily water temperatures, comparing 2022 to historical minimum, maximum, and average temperatures.

Note: Temperatures were collected in the Yukon River near Emmonak using handheld thermometers (1984–present) and data loggers (2004–present). The years the data types overlap are averaged together.

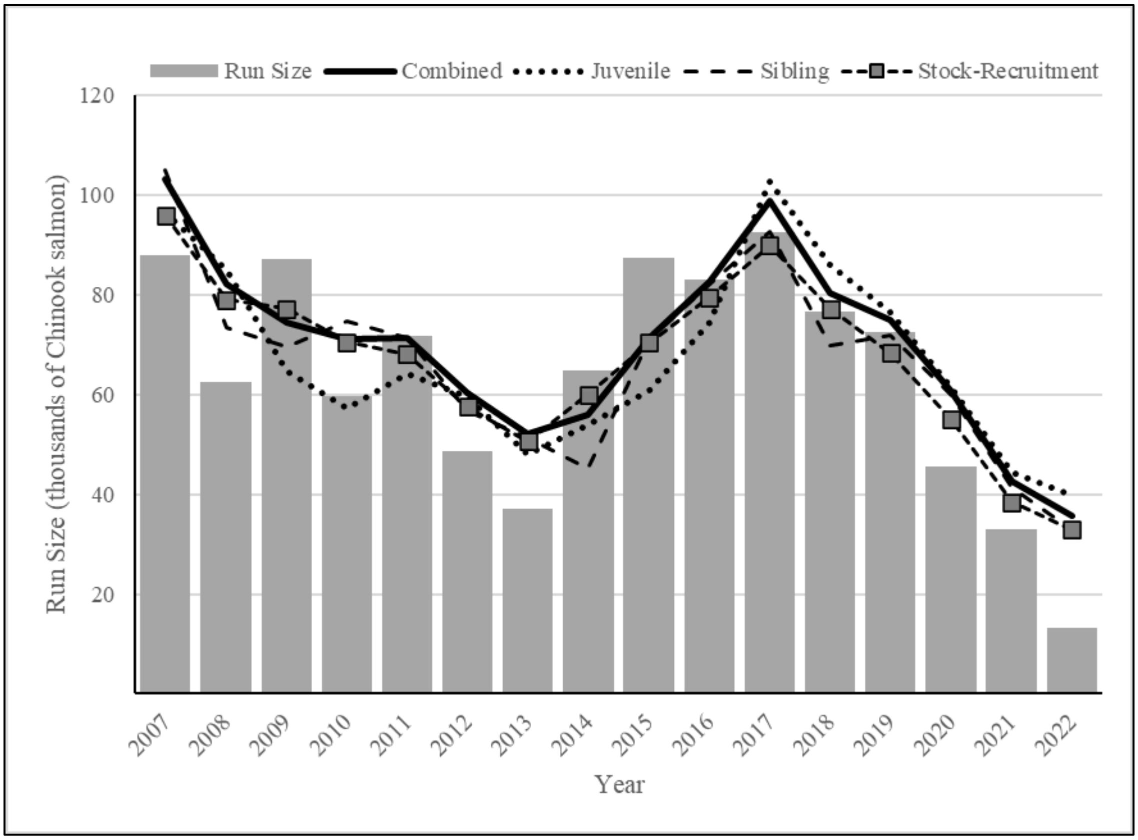

Figure 20.–Comparison of the Juvenile, Dynamic sibling, Dynamic stock-recruitment and combined Canadian-origin Chinook forecast models (lines) to actual run sizes (gray bars), 2007–2022.

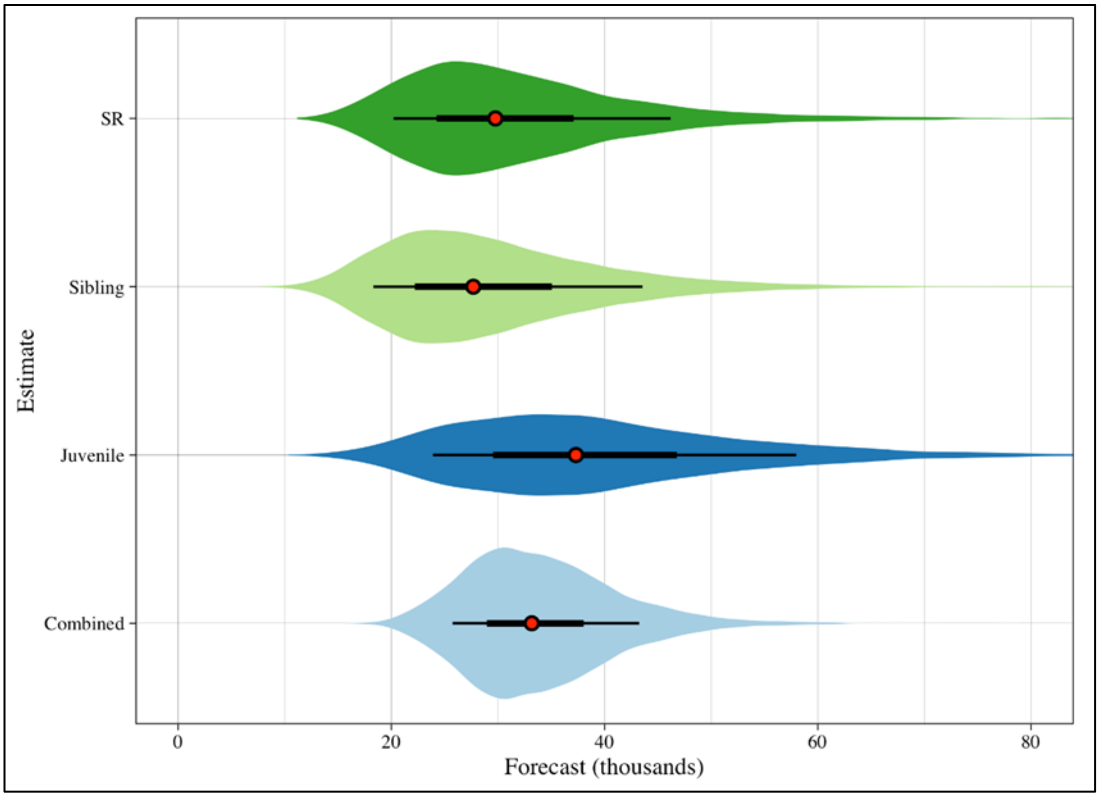

Figure 21.–Comparison of the Dynamic spawner-recruit, Dynamic sibling, Juvenile and Combined forecast models with associated uncertainty. The center dot is the forecast median along with the 50% and 80% credible intervals shown in the black lines. The shape of the bubble indicates the probability of that run size occurring.

APPENDIX A: TABLES

Appendix A1.–Passage estimates from the Pilot Station sonar, 1995 and 1997–2022.

	Chinook			Chum						
Year [a]	Large [b]	Small	Total	Summer	Fall [c]	Total	Coho [c]	Pink	Other [d]	Total
1995	173,437	47,920	221,357	3,620,102	1,148,916	4,769,018	115,569	53,165	721,739	5,880,848
1997 [e]	114,519	85,244	199,763	1,359,117	579,767	1,938,884	118,065	3,872	376,841	2,637,425
1998	88,129	19,909	108,038	824,901	375,222	1,200,123	146,365	103,416	210,677	1,768,619
1999	159,805	24,413	184,218	969,459	451,505	1,420,964	76,174	3,947	337,701	2,023,004
2000	48,321	6,239	54,560	448,665	273,206	721,871	206,365	61,389	262,627	1,306,812
2001 [f]	104,060	17,029	121,089	442,546	408,961	851,507	160,272	2,846	265,749	1,401,463
2002	111,290	40,423	151,713	1,097,769	367,886	1,465,655	137,077	123,698	405,534	2,283,677
2003	287,729	30,359	318,088	1,183,009	923,540	2,106,549	280,552	11,370	379,651	3,096,210
2004	138,317	62,444	200,761	1,344,213	633,368	1,977,581	207,844	399,339	391,939	3,177,464
2005 [g]	227,154	31,861	259,015	2,570,696	1,893,688	4,464,384	194,372	61,091	364,250	5,343,112
2006	192,296	36,467	228,763	3,780,760	964,238	4,744,998	163,889	183,006	531,047	5,851,703
2007	119,622	50,624	170,246	1,875,491	740,195	2,615,686	192,406	126,282	761,657	3,866,277
2008	138,220	36,826	175,046	1,849,553	636,525	2,486,078	145,378	580,127	306,225	3,692,854
2009 [h]	128,154	49,642	177,796	1,477,186	274,227	1,751,413	240,779	34,529	589,916	2,794,433
2010	118,335	26,753	145,088	1,415,027	458,103	1,873,130	177,724	917,731	567,454	3,681,127
2011	117,213	31,584	148,797	2,051,501	873,877	2,925,378	149,533	9,754	453,537	3,686,999
2012	106,529	21,026	127,555	2,136,476	778,158	2,914,634	130,734	420,344	464,058	4,057,325
2013	120,536	16,269	136,805	2,849,683	865,295	3,714,978	110,515	6,126	732,009	4,700,433
2014	120,060	43,835	163,895	2,020,309	706,630	2,726,939	283,421	679,126	584,831	4,438,212
2015	105,063	41,796	146,859	1,591,505	669,483	2,260,988	121,193	39,690	853,989	3,422,719
2016	135,013	41,885	176,898	1,921,748	994,760	2,916,508	168,297	1,364,849	355,365	4,981,917
2017	217,821	45,193	263,014	3,093,735	1,829,931	4,923,666	166,320	166,529	796,199	6,315,728
2018	122,394	39,437	161,831	1,612,688	928,664	2,541,352	136,347	689,607	547,959	4,077,096
2019	172,242	47,382	219,624	1,402,925	842,041	2,244,966	86,401	42,353	568,576	3,161,920
2020	124,905	37,347	162,252	692,602	262,439	955,041	107,680	207,942	388,287	1,821,202
2021	104,267	20,578	124,845	153,718	146,197	299,915	37,255	22,181	556,464	1,040,660
2022	33,159	15,280	48,439	463,806	325,717	789,523	92,102	158,767	933,667	2,022,498

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Note: Historical passage estimates at the Pilot Station sonar were adjusted in 2016 after the adoption of a new species apportionment model.

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

[b] Chinook salmon >655 mm measured mid eye to tail fork length.

[c] This estimate may not include the entire run. Most years operated through August 31, except 1995 (September 3), 1998 (September 9), 2000 (September 14), 2008–2014, 2017–2018, and 2021–2022 (September 7).

[d] Includes sockeye salmon, cisco, whitefish, sheefish, burbot, suckers, Dolly Varden, and northern pike.

[e] The Yukon River 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 on site at Pilot Station in 2001 throughout the season, and passage estimates are considered conservative.

[g] Estimates include extrapolations for the dates June 10–June 18, 2005 to account for the time before the DIDSON was deployed.

[h] High water levels were experienced at Pilot Station in 2009 during the summer season and extreme low water occurred during the fall season, and therefore passage estimates are considered conservative.

Appendix A2.–Alaska commercial salmon sales (number of fish) by district and subdistrict, 2022.

District/Subdistrict	Number of fishermen [a]	Chinook [b]	Summer chum [b]	Fall chum [b]	Coho [b]	Pink [b]
1	–	–	–	–	–	–
2	–	–	–	–	–	–
3	–	–	–	–	–	–
Total Lower Yukon	0	0	0	0	0	0
Anvik River	–	–	–	–	–	–
4-A	–	–	–	–	–	–
4-BC	–	–	–	–	–	–
Subtotal District 4	0	0	0	0	0	0
5-ABC	–	–	–	–	–	–
5-D	–	–	–	–	–	–
Subtotal District 5	0	0	0	0	0	0
6-ABC	–	–	–	–	–	–
Total Upper Yukon	0	0	0	0	0	0
Total Alaska	0	0	0	0	0	0

Note: En dash indicates no commercial fishing activity occurred. Does not include ADF&G test fishery sales.

[a] Number of unique permits fished by district, subdistrict, or area. Totals by area may not add up due to transfers between districts or subdistricts.

[b] Fishery did not operate in 2022.

Appendix A3.–Yukon River Canadian-origin Chinook salmon total run by brood year and escapement by year.

Brood	Age								
year	3	4	5	6	7	8	Return	Spawners	R/S
1974						4,388			
1975					34,696	278			
1976				82,801	20,859	47			
1977			18,964	107,561	20,000	547	147,071		
1978		5,204	28,339	63,387	32,684	793	130,406		
1979	1,534	3,168	21,293	99,647	44,935	1,202	171,780		
1980	15	6,308	10,976	78,443	30,605	4,332	130,679		
1981	0	1,505	29,105	124,142	65,576	1,076	221,404		
1982	0	5,246	13,141	32,404	27,166	171	78,128	43,538	1.79
1983	560	4,970	32,100	86,220	13,707	108	137,665	44,475	3.10
1984	69	11,041	37,824	81,832	20,060	192	151,018	50,005	3.02
1985	223	11,873	36,643	59,757	4,771	64	113,331	40,435	2.80
1986	356	18,829	42,293	114,716	16,137	138	192,470	41,425	4.65
1987	7	2,142	27,309	69,477	15,988	18	114,941	41,307	2.78
1988	21	6,760	35,595	83,506	12,893	68	138,844	39,699	3.50
1989	471	10,480	68,225	126,578	31,814	0	237,568	60,299	3.94
1990	125	4,665	22,520	56,724	4,836	9	88,880	59,212	1.50
1991	363	7,470	89,841	126,660	11,207	0	235,540	42,728	5.51
1992	309	4,035	24,212	39,924	2,295	0	70,775	39,155	1.81
1993	21	5,860	34,834	84,973	7,450	477	133,615	36,244	3.69
1994	132	2,189	20,831	27,856	8,334	0	59,341	56,449	1.05
1995	119	2,330	15,468	48,952	10,113	10	76,991	50,673	1.52
1996	19	2,069	23,375	43,760	11,789	2	81,013	74,060	1.09
1997	0	4,526	22,321	94,778	6,426	14	128,065	53,821	2.38
1998	0	5,237	41,060	80,818	6,271	0	133,386	35,497	3.76
1999	56	2,330	25,048	73,931	1,411	0	102,775	37,184	2.76
2000	12	4,954	40,562	49,713	1,202	0	96,443	25,870	3.73
2001	0	2,813	63,400	51,278	2,223	0	119,713	52,564	2.28
2002	21	4,962	29,302	20,646	227	9	55,166	42,359	1.30
2003	0	6,118	37,202	52,067	2,261	1	97,649	80,594	1.21
2004	0	2,531	26,680	21,938	4,763	1	55,913	48,469	1.15
2005	9	8,232	29,477	38,855	1,755	0	78,327	67,985	1.15
2006	15	6,009	25,248	25,697	1,567	0	58,536	62,630	0.93

-continued-

Brood	Age								
year	3	4	5	6	7	8	Return	Spawners	R/S
2007	47	2,858	17,737	22,193	1,694	0	44,529	34,904	1.28
2008	1	3,131	11,091	25,750	1,853	1	41,828	33,883	1.23
2009	173	2,325	32,868	44,942	454	0	80,762	65,278	1.24
2010	1	4,379	29,627	19,751	876	0	54,634	32,014	1.71
2011	194	10,645	52,818	42,322	1,209	1	107,188	46,307	2.31
2012	255	9,650	44,760	31,923	858	1	87,448	32,656	2.68
2013	92	5,116	33,631	29,713	1,453	1	70,005	28,669	2.44
2014	115	9,566	35,089	22,475	1,316	2	68,562	63,331	1.08
2015	28	6,954	18,310	15,990	549		41,831	82,674	0.50
2016	5	3,160	14,940	6,211			24,317	68,798	0.35
2017	102	725	5,469					68,315	
2018	0	910						54,474	
2019	3							42,052	
2020								30,967	
2021								31,452	
2022								11,977	
			Average 1982–2015				101,649	48,423	2.28
							Contrast	3.12	

Note: Spawner data are derived from a 3-area aerial survey index of combined counts from Big Salmon, Little Salmon, and Nisutlin rivers (1982–2001), radiotelemetry (2002–2004), and the mainstem Yukon River sonar at Eagle (2005–present). Shaded values are preliminary estimates by brood year. Average includes the years with complete brood information through age-7. Ages used were from samples collected at the mainstem sonar test fishery (2007–present) and converted fish wheel data based on a length selectivity method for years 1982–2006 (Hamazaki 2018).

Appendix A4.–Chinook salmon age and sex percentages from selected Yukon River monitoring projects operated in U.S. (Alaska), 2022.

Location	Sample size		Percent by age class							Mean
			Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Total	length
Pilot Station	327	Male	0.0	10.1	23.5	10.1	1.5	0.0	45.3	664
test fishery [a]		Female	0.0	2.1	12.8	35.5	4.3	0.0	54.7	767
		Total	0.0	12.2	36.4	45.6	5.8	0.0	100.0	719
Gisasa River weir [b]	37	Male	2.7	32.4	51.4	0.0	0.0	0.0	86.5	566
		Female	0.0	0.0	5.4	8.1	0.0	0.0	13.5	804
		Total	2.7	32.4	56.8	8.1	0.0	0.0	100.0	600
Eagle test fishery [a]	119	Male	0.0	5.0	35.3	13.4	1.7	0.0	55.5	715
		Female	0.0	0.8	5.9	35.3	2.5	0.0	44.5	820
		Total	0.0	5.9	41.2	48.7	4.2	0.0	100.0	762
Salcha River tower [b,c]	48	Male	0.0	16.7	39.6	4.2	0.0	0.0	60.4	633
		Female	0.0	0.0	16.7	22.9	0.0	0.0	39.6	780
		Total	0.0	16.7	56.2	27.1	0.0	0.0	100.0	689

Note: Length is measured mid eye to the fork of tail to the nearest millimeter. Male and female percentages are based on the subset of aged samples and may differ from estimates based on all samples.

[a] Samples were from test fishing with drift gillnets.

[b] Sample size was below established sample size goal.

[c] Carcass samples collected throughout the spawning grounds upriver from the tower project.

Appendix A5.–Yukon River Chinook salmon age, female percentage, and mean length from Eagle sonar project, 2005–2022.

		Percent by age class						
Year	Sample size	Age-3	Age-4	Age-5	Age-6	Age-7	Percent female	Mean length
2005	171	0.0	8.2	50.3	38.0	3.5	33.9	779
2006	256	0.0	16.8	60.2	22.7	0.4	37.9	737
2007	389	0.0	5.7	40.1	53.7	0.5	43.4	787
2008	375	0.0	2.7	56.3	36.5	4.5	36.8	780
2009	647	0.0	7.7	33.2	59.0	0.0	39.6	791
2010	336	0.0	7.4	46.4	42.0	4.2	40.5	770
2011	419	0.0	2.1	29.6	60.4	7.9	51.3	809
2012	246	0.4	6.1	29.7	59.3	4.5	49.6	780
2013	265	0.0	4.2	27.5	63.4	4.9	51.7	807
2014	606	0.2	6.6	50.5	40.1	2.6	35.1	763
2015	926	0.3	10.8	34.3	52.4	2.2	42.1	776
2016	666	0.0	9.2	65.0	25.2	0.6	32.4	759
2017	719	0.1	4.2	46.5	48.1	1.1	50.9	797
2018	700	0.0	10.3	43.0	45.0	1.7	43.4	769
2019	554	0.0	8.5	48.4	41.9	1.3	47.8	772
2020	513	0.2	5.2	38.4	52.9	3.3	56.0	777
2021	327	0.0	2.1	45.3	48.6	4.0	45.0	763
2022	119	0.0	5.9	41.2	48.7	4.2	44.5	762
Average (2005-2021)	477	0	7	44	46	3	43	777
5-yr Average (2017-2021)	563	0	6	44	47	2	49	776

Note: Length is measured mid eye to the fork of tail to the nearest millimeter. Age nomenclature (years in freshwater "." years at sea). Slight modifications have been made to the drift gillnet mesh sizes used at the Eagle sonar during the first three years of operation (2005–2007); however, mesh sizes measuring 5.25, 6.5, 7.5, and 8.5-inch have been used consistently since 2007. Small fish may be underrepresented in the samples due to not fishing gillnets smaller than 5.25-inch mesh.

Appendix A6.–Yukon River Chinook salmon harvest percentage by stock group for U.S. harvest, U.S. and Canada harvest combined, and the percentage of the upper stock group harvest by each country, 1981–2022.

	Stock groups (U.S. harvest)			Stock groups (U.S. and Canada harvest)			Upper stock group	
Year	Lower	Middle	Upper	Lower	Middle	Upper	U.S.	Canada
1981	5.9	59.8	34.3	5.4	54.5	40.1	78.1	21.9
1982	15.4	27.5	57.1	13.9	24.7	61.4	83.5	16.5
1983	14.2	37.0	48.9	12.9	33.7	53.3	83.7	16.3
1984	28.0	44.3	27.7	25.3	40.2	34.5	72.7	27.3
1985	30.4	24.6	45.1	27.6	22.3	50.1	81.6	18.4
1986	22.3	10.9	66.8	19.5	9.6	70.9	82.7	17.3
1987	17.4	21.4	61.2	15.9	19.6	64.5	86.7	13.3
1988	24.9	18.1	57.0	21.8	15.8	62.5	79.8	20.2
1989	27.2	17.7	55.1	24.4	15.9	59.7	82.9	17.1
1990	22.8	28.4	48.8	20.2	25.2	54.7	79.2	20.8
1991	31.8	28.7	39.6	28.0	25.3	46.7	74.8	25.2
1992	18.0	24.1	57.8	16.3	21.8	61.9	84.5	15.5
1993	23.7	28.0	48.3	21.5	25.4	53.1	82.6	17.4
1994	20.4	24.1	55.5	18.2	21.4	60.4	81.8	18.2
1995	20.0	25.0	55.0	17.9	22.4	59.7	82.4	17.6
1996	24.0	11.8	64.2	21.0	10.4	68.6	81.9	18.1
1997	28.9	18.3	52.8	26.4	16.8	56.9	84.8	15.2
1998	34.7	18.5	46.8	32.7	17.4	49.8	88.8	11.2
1999	44.1	6.9	49.0	40.1	6.3	53.6	83.0	17.0
2000	37.5	13.6	48.9	33.9	12.3	53.8	81.9	18.1
2001	37.5	19.0	43.5	31.6	16.0	52.4	69.8	30.3
2002	22.1	33.3	44.6	19.4	29.2	51.4	76.3	23.5
2003	7.5	31.7	60.8	6.8	28.9	64.3	86.2	13.8
2004	16.9	31.6	51.5	15.3	28.8	55.9	83.7	16.3
2005	23.4	24.2	52.4	20.7	21.4	57.9	80.1	19.9
2006	19.2	30.2	50.5	17.6	27.6	54.9	84.1	15.9
2007	13.7	32.3	54.0	13.0	30.6	56.4	90.5	9.5
2008	18.2	30.0	51.8	17.0	28.0	55.0	88.1	11.9
2009	12.7	35.8	51.6	11.1	31.4	57.5	78.8	21.2
2010	18.7	34.3	47.0	17.8	32.7	49.5	90.5	9.5
2011	15.6	33.3	51.1	13.9	29.8	56.3	81.0	19.0
2012	14.4	37.5	48.2	13.3	34.8	51.9	86.3	13.7
2013	16.0	25.0	59.0	13.4	21.0	65.6	75.5	24.5
2014	29.8	26.0	44.3	25.4	27.8	46.8	93.4	6.6
2015	15.6	36.3	48.1	13.5	31.3	55.2	75.2	24.8
2016	15.1	33.5	51.5	13.3	29.5	57.2	80.4	19.6
2017 [a]	9.3	35.0	55.6	8.5	32.1	59.3	85.9	14.1
2018 [a]	8.6	31.8	59.6	7.9	29.2	62.9	87.2	12.8
2019 [a]	14.0	32.3	53.7	13.3	30.6	56.1	91.0	9.0
2020 [a]	11.1	35.5	53.4	10.0	32.1	57.8	83.7	16.3
2021 [a]	14.6	23.0	62.4	12.6	19.9	67.5	79.9	20.1
2022 [a]	21.8	16.9	61.4	21.3	16.4	62.3	96.1	3.9

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Average								
2012–2021	14.8	31.6	53.6	13.1	28.8	58.0	83.9	16.1
2017–2021	11.5	31.5	57.0	10.5	28.8	60.7	85.5	14.5
Minimum	5.9	6.9	27.7	5.4	6.3	34.5	69.8	6.6
Maximum	44.1	59.8	66.8	40.1	54.5	70.9	93.4	30.3

Note: The Lower and Middle stock groups are composed of tributary populations in the Alaska portion of the Yukon River drainage. The Upper stock group is composed of tributary populations in Canada. U.S. fisheries harvest all stock groups, while Canadian fisheries only harvest the Upper (Canadian) stock. Stock composition of U.S. harvest has been estimated annually from dedicated harvest sampling programs. Minimum and maximum values exclude the most recent year data.

[a] Data is not published and considered preliminary.

Appendix A7.–Stock group percentage by major stock and by country, from chum salmon beginning July 19 at the Pilot Station sonar, Yukon River, 1999–2022.

	Season stock groups		U.S. stock groups		Fall stock country groups	
Year [a]	Summer	Fall	Tanana fall	Border U.S. [b]	Fall U.S.	Canada
1999	16.2	83.8	–	–	–	–
2000	12.0	88.0	–	–	–	–
2001	13.3	86.7	–	–	–	–
2002	19.2	80.8	–	–	–	–
2003	–	–	–	–	–	–
2004	13.6	86.4	31.5	27.4	58.8	27.6
2005	11.2	88.8	20.6	42.7	63.3	25.5
2006	18.2	81.8	16.8	36.1	52.9	28.9
2007	21.2	78.8	22.9	25.7	48.6	30.2
2008	16.2	83.8	21.8	31.2	53.1	30.8
2009	24.4	75.6	19.4	30.0	49.4	26.2
2010	24.9	75.1	24.2	19.6	43.8	31.3
2011	13.7	86.3	13.3	38.4	51.7	34.5
2012	20.0	80.0	25.9	31.8	57.8	22.2
2013	11.2	88.8	33.1	23.7	56.7	32.1
2014	9.7	90.3	28.7	32.2	60.9	29.4
2015	22.7	77.3	22.0	28.8	50.8	26.4
2016	20.1	79.9	23.5	28.9	52.5	27.4
2017	11.9	88.1	32.5	33.2	65.6	22.4
2018	17.3	82.7	35.1	22.9	58.0	24.7
2019	34.8	65.2	24.3	19.8	44.2	21.0
2020	30.0	70.0	30.8	22.9	53.7	16.4
2021	31.0	69.0	29.1	27.8	56.9	12.1
2022	27.5	72.5	42.6	22.5	65.0	7.5
Average						
2004–2021	19.6	80.4	25.3	29.1	54.4	26.1
2012–2021	20.9	79.1	28.5	27.2	55.7	23.4
2017–2021	25.0	77.2	29.3	25.5	54.8	22.4
Minimum	9.7	65.2	13.3	19.6	43.8	16.4
Maximum	34.8	90.3	35.1	42.7	65.6	34.5

Note: July 19 is the date when U.S. management switches from a focus on summer chum to fall chum salmon in this section of the river. Minimum and maximum values exclude the most recent year data and 1999-2002. En dash indicates no analysis is available.

[a] Stock identification methods from 1999 through 2002 were based on allozyme analysis. No samples were collected in 2003. Beginning in 2004, analysis was based on microsatellite baseline.

[b] Border U.S. stocks include Big Salt, Teedriinjik (Chandalar), Sheenjek and Draanjik (Black) rivers.

Appendix A8.–Drainagewide Yukon River fall chum salmon estimated brood year production and return per spawner estimates 1974–2022.

Brood	Number of salmon by age [a]						Return/
year	Age-3	Age-4	Age-5	Age-6	Return	Spawners [b]	spawner
1974	111,941	649,758	98,222	0	859,921	671,600	1.28
1975	196,395	1,752,220	66,194	0	2,014,809	2,289,000	0.88
1976	145,935	633,337	137,437	4,780	921,489	545,700	1.69
1977	110,674	1,072,744	191,801	6,301	1,381,521	726,700	1.90
1978	22,112	366,655	106,028	0	494,795	550,900	0.90
1979	44,039	899,410	306,719	4,214	1,254,382	1,381,000	0.91
1980	13,527	405,881	199,289	2,812	621,509	321,900	1.93
1981	51,122	992,599	334,849	8,938	1,387,507	548,800	2.53
1982	12,378	488,757	173,213	769	675,117	234,100	2.88
1983	15,011	935,830	229,435	3,995	1,184,271	500,250	2.37
1984	6,584	420,144	160,931	8,978	596,637	351,400	1.70
1985	46,799	907,658	300,006	2,593	1,257,055	693,000	1.81
1986	1,438	514,782	338,977	5,584	860,781	523,400	1.64
1987	11,947	674,142	340,136	7,557	1,033,782	718,200	1.44
1988	12,085	207,914	158,085	33,443 [c]	411,528	341,200	1.21
1989	3,218	296,426	412,466 [c]	20,937	733,045	528,700	1.39
1990	667	668,863 [c]	456,441	33,267	1,159,238	483,450	2.40
1991	0 [c]	1,129,308	398,114	12,981	1,540,403	588,700	2.62
1992	7,848	699,151	206,950	4,106	918,056	407,800	2.25
1993	9,883	480,712	107,485	3,235	601,315	371,600	1.62
1994	4,536	236,381	148,145	2,502 [c]	391,564	945,200	0.41
1995	2,485	264,683	72,570 [c]	417	340,156	1,153,000	0.30
1996	417	172,667 [c]	129,263	8,339	310,686	879,100	0.35
1997	2,502 [c]	242,268	119,056	3,634	367,459	535,100	0.69
1998	437	269,931	59,828	6,302	336,499	279,600	1.20
1999	29,143	719,861	195,476	17,239	961,719	285,100	3.37
2000	9,052	319,947	114,613	0	443,612	221,600	2.00
2001	130,891	2,056,636	720,124	34,781	2,942,432	326,800	9.00
2002	0	465,507	250,500	15,228	731,235	398,700	1.83
2003	27,642	875,820	477,686	17,778	1,398,926	713,150	1.96
2004	0	362,469	153,436	2,519	518,424	576,000	0.90
2005	2,437	393,354	92,116	3,912	491,818	1,898,000	0.26
2006	26,509	396,210	361,308	30,629 [d]	814,655	942,600	0.86

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Brood year	Number of salmon by age [a] 3		4		5		6		Return	Spawners [b]	Return/ spawner
2007	94,946		866,455		189,211	d	9,094		1,159,707	955,200	1.21
2008	12,466		857,376	d	415,894		9,495		1,295,232	639,450	2.03
2009	11,984	d	788,517		426,860		22,748		1,250,109	497,600	2.51
2010	2,303		497,316		247,109		9,175		755,903	505,600	1.50
2011	22,998		489,135		182,134		1,797		696,064	916,450	0.76
2012	69,462		1,169,894		332,334		5,653		1,577,342	692,600	2.28
2013	29,126		1,923,980		319,216		3,237		2,275,559	857,700	2.65
2014	57,773		760,050		126,832		2,483		947,138	743,200	1.27
2015	29,765		664,836		86,658		430	d	781,689	545,800	1.43
2016	8,059		89,521		6,437	d	596	d	104,613	833,500	0.13
2017	5,571		87,444	d	53,302	d	1,135		147,452	1,733,500	0.09
2018	940	d	185,721	d	76,274				262,934	656,150	0.40
2019	2,846	d								529,300	
2020										178,400	
2021										94,500	
2022										239,700	
Average 1974–2016									948,830	677,200	1.73
Minimum									104,613	221,600	0.13
Maximum									2,942,432	2,289,000	9.00

Note: Spawner data are derived from Bayesian spawner-recruit model 1974–2021. Return in 2022 was developed using mixed stock analysis and harvest. Average includes the years with complete brood information through age-6. Minimums and maximum indicate the lowest and highest values for each year presented through 2016.

[a] Age composition is based on samples from the Lower Yukon test fishery gillnets, weighted by test fish catch per unit effort. Prior to 1983 commercial sampling was used to supplement test fishery age samples.

[b] Contrast in escapement data is 10.33. Values are rounded to the nearest 100.

[c] Based upon expanded test fish age composition estimates for years in which the test fishery terminated early both in 1994 and 2000.

[d] Combination of Mt. Village test fishery weighted ages with Lower Yukon test fishery to bolster sample sizes.

[e] Return per spawner includes preliminary estimates from incomplete brood year (shaded value).

Appendix A9.–Escapement, rebuilding and interim goals for Canadian-origin Chinook and fall chum salmon stocks, 1985–2023.

	Canadian origin stock targets		
	Chinook salmon	Fall chum salmon	
Year	Mainstem	Mainstem	Fishing Branch River
1985	33,000-43,000		
1986	33,000-43,000		
1987	33,000-43,000	90,000-135,000	50,000-120,000
1988	33,000-43,000	90,000-135,000	50,000-120,000
1989	33,000-43,000	90,000-135,000	50,000-120,000
1990	18,000	80,000	50,000-120,000
1991	18,000	80,000	50,000-120,000
1992	18,000	51,000	50,000-120,000
1993	18,000	51,000	50,000-120,000
1994	18,000	61,000	50,000-120,000
1995	18,000	80,000	50,000-120,000
1996	28,000	65,000	50,000-120,000
1997	28,000	49,000	50,000-120,000
1998	28,000	80,000	50,000-120,000
1999	28,000	80,000	50,000-120,000
2000	28,000	80,000	50,000-120,000
2001	28,000	80,000	50,000-120,000
2002	28,000	60,000	50,000-120,000
2003 [a]	28,000 [b]	65,000	15,000
2004	28,000	65,000	13,000
2005	28,000	65,000	24,000
2006	28,000	80,000	28,000
2007	33,000-43,000	80,000	34,000
2008	45000 [c]	80,000	22,000-49,000 [d]
2009	45000	80,000	22,000-49,000
2010	42,500-55,000 [e]	70,000-104,000 [f]	22,000-49,000
2011	42,500-55,000	70,000-104,000	22,000-49,000
2012	42,500-55,000	70,000-104,000	22,000-49,000
2013	42,500-55,000	70,000-104,000	22,000-49,000
2014	42,500-55,000	70,000-104,000	22,000-49,000
2015	42,500-55,000	70,000-104,000	22,000-49,000
2016	42,500-55,000	70,000-104,000	22,000-49,000
2017	42,500-55,000	70,000-104,000	22,000-49,000
2018	42,500-55,000	70,000-104,000	22,000-49,000
2019	42,500-55,000	70,000-104,000	22,000-49,000
2020	42,500-55,000	70,000-104,000	22,000-49,000
2021	42,500-55,000	70,000-104,000	22,000-49,000
2022	42,500-55,000	70,000-104,000	22,000-49,000
2023	42,500-55,000	70,000-104,000	22,000-49,000

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Note: As per the Yukon River Salmon Agreement (YRSA), the Yukon River Panel (YRP) may recommend that both parties manage the current year salmon run to achieve annual stabilization/rebuilding/interim spawning escapement goals that differ from the escapement goals outlined in Appendix 1 and 2 of the YRSA. The goals shown in this table document what both parties managed to achieve in each year, based on recommendations by the YRP. All single numbers are considered minimums.

[a] Treaty was signed by governments in December 2002.

[b] In 2003, the Chinook salmon goal was set at 25,000 fish. However, if the U.S. conducted a commercial fishery the goal would be increased to 28,000 fish.

[c] Interim management escapement goal (IMEG) assessed using sonar near Eagle (previous years were measured by mark–recapture abundance estimates).

[d] Interim Management Escapement Goal (IMEG) established for 2008–2010, based on percentile method.

[e] IMEG of 42,500 to 55,000 fish recommended in 2010, based on levels selected from several unpublished analyses.

[f] IMEG established in 2010 based on brood table of Canadian-origin mainstem stocks (1982–2003).

Appendix A10.–Fall chum salmon age and sex percentages with average lengths from selected Yukon River monitoring projects, 2022.

			Age						Mean
Location	Sample size		3	4	5	6	7	Total	length
Emmonak, Alaska [a]	392	Males	1.3	37.0	8.4	0.0	0.0	46.7	566
		Females	0.0	40.6	12.8	0.0	0.0	53.3	566
		Total	1.3	77.6	21.2	0.0	0.0	100.0	566
Mt. Village, Alaska [a]	137	Males	1.5	33.6	7.3	0.0	0.0	42.3	564
		Females	0.0	40.9	16.8	0.0	0.0	57.7	562
		Total	1.5	74.5	24.1	0.0	0.0	100.0	563
Delta River, Alaska [b]	160	Males	1.3	43.8	2.5	0.0	0.0	47.5	567
		Females	1.3	48.1	3.1	0.0	0.0	52.5	540
		Total	2.5	91.9	5.6	0.0	0.0	100.0	553
Yukon mainstem at Eagle, Alaska [a]	209	Males	0.0	19.6	36.4	0.5	0.0	56.5	595
		Females	0.0	21.5	22.0	0.0	0.0	43.5	577
		Total	0.0	41.1	58.4	0.5	0.0	100.0	587
Fishing Branch River, Canada [c]	205	Males	2.0	23.4	22.4	0.0	0.0	49.5	579
		Females	0.5	25.9	25.9	0.0	0.0	50.5	564
		Total	2.4	49.3	48.3	0.0	0.0	100.0	571

Note: Length is measured mid eye to the fork of tail to the nearest millimeter. Data is unweighted.

[a] Samples were from test fishing with drift gillnets, structure is scales.

[b] Samples were handpicked carcasses from east and middle channels, structure is vertebrae.

[c] Samples were collected from live fish passing the Fishing Branch River weir, supplemented by opportunistic carcass sampling, structure is scales.

APPENDIX B: TABLES

Appendix B1.–Alaska (U.S.) and Canada total utilization of Yukon River Chinook, chum, and coho salmon, 1961–2022.

	Alaska/U.S. [a, b]			Yukon/Canada [c]			Total		
Year	Chinook	Other salmon	Total	Chinook	Other salmon [d]	Total	Chinook	Other salmon	Total
1961	141,152	461,597	602,749	13,246	9,076	22,322	154,398	470,673	625,071
1962	105,844	434,663	540,507	13,937	9,436	23,373	119,781	444,099	563,880
1963	141,910	429,396	571,306	10,077	27,696	37,773	151,987	457,092	609,079
1964	109,818	504,420	614,238	7,408	12,221	19,629	117,226	516,641	633,867
1965	134,706	484,587	619,293	5,380	11,789	17,169	140,086	496,376	636,462
1966	104,822	309,502	414,324	4,452	13,324	17,776	109,274	322,826	432,100
1967	146,104	352,397	498,501	5,150	16,961	22,111	151,254	369,358	520,612
1968	118,530	270,818	389,348	5,042	11,633	16,675	123,572	282,451	406,023
1969	104,999	424,399	529,398	2,624	7,776	10,400	107,623	432,175	539,798
1970	93,019	585,760	678,779	4,663	3,711	8,374	97,682	589,471	687,153
1971	136,091	547,448	683,539	6,447	17,471	23,918	142,538	564,919	707,457
1972	113,098	461,617	574,715	5,729	7,532	13,261	118,827	469,149	587,976
1973	99,696	779,158	878,854	4,522	10,182	14,704	104,218	789,340	893,558
1974	117,847	1,229,678	1,347,525	5,631	11,646	17,277	123,478	1,241,324	1,364,802
1975	76,959	1,307,037	1,383,996	6,000	20,600	26,600	82,959	1,327,637	1,410,596
1976	105,950	1,026,908	1,132,858	5,025	5,200	10,225	110,975	1,032,108	1,143,083
1977	117,014	1,090,758	1,207,772	7,527	12,479	20,006	124,541	1,103,237	1,227,778
1978	130,476	1,615,312	1,745,788	5,881	9,566	15,447	136,357	1,624,878	1,761,235
1979	159,232	1,596,133	1,755,365	10,375	22,084	32,459	169,607	1,618,217	1,787,824
1980	197,665	1,730,960	1,928,625	22,846	23,718	46,564	220,511	1,754,678	1,975,189
1981	188,477	2,097,871	2,286,348	18,109	22,781	40,890	206,586	2,120,652	2,327,238
1982	152,808	1,265,457	1,418,265	17,208	16,091	33,299	170,016	1,281,548	1,451,564
1983	198,436	1,678,597	1,877,033	18,952	29,490	48,442	217,388	1,708,087	1,925,475
1984	162,683	1,548,101	1,710,784	16,795	29,767	46,562	179,478	1,577,868	1,757,346
1985	187,327	1,657,984	1,845,311	19,301	41,515	60,816	206,628	1,699,499	1,906,127
1986	146,004	1,758,825	1,904,829	20,364	14,843	35,207	166,368	1,773,668	1,940,036
1987	192,007	1,276,066	1,468,073	17,614	44,786	62,400	209,621	1,320,852	1,530,473
1988	150,009	2,360,718	2,510,727	21,427	33,915	55,342	171,436	2,394,633	2,566,069
1989	157,632	2,292,211	2,449,843	17,944	23,490	41,434	175,576	2,315,701	2,491,277
1990	149,433	1,055,515	1,204,948	19,227	34,304	53,531	168,660	1,089,819	1,258,479
1991	154,651	1,335,111	1,489,762	20,607	35,653	56,260	175,258	1,370,764	1,546,022
1992	169,642	880,535	1,050,177	17,903	21,312	39,215	187,545	901,847	1,089,392

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	Alaska/U.S. [a, b]			Yukon/Canada [c]			Total		
Year	Chinook	Other salmon	Total	Chinook	Other salmon [d]	Total	Chinook	Other salmon	Total
1993	161,718	362,551	524,269	16,611	14,150	30,761	178,329	376,701	555,030
1994	171,654	567,074	738,728	21,198	38,342	59,540	192,852	605,416	798,268
1995	179,748	1,455,736	1,635,484	20,884	46,109	66,993	200,632	1,501,845	1,702,477
1996	141,649	1,143,992	1,285,641	19,612	24,395	44,007	161,261	1,168,387	1,329,648
1997	176,025	560,777	736,802	16,528	15,900	32,428	192,553	576,677	769,230
1998	99,760	201,480	301,240	5,937	8,168	14,105	105,697	209,648	315,345
1999	125,427	250,198	375,625	12,468	19,736	32,204	137,895	269,934	407,829
2000	45,867	120,424	166,291	4,879	9,283	14,162	50,746	129,707	180,453
2001	56,620	131,500	188,120	10,144	9,872	20,016	66,764	141,372	208,136
2002	69,240	137,688	206,928	9,258	8,567	17,825	78,498	146,255	224,753
2003	101,000	214,323	315,323	9,619	11,435	21,054	110,619	225,758	336,377
2004	114,370	214,744	329,114	11,238	9,930	21,168	125,608	224,674	350,282
2005	86,369	493,542	579,911	11,371	18,583	29,954	97,740	512,125	609,865
2006	96,067	553,299	649,366	9,072	11,908	20,980	105,139	565,207	670,346
2007	90,753	548,568	639,321	5,094	14,332	19,426	95,847	562,900	658,747
2008	50,362	500,029	550,391	3,713	9,566	13,279	54,075	509,595	563,670
2009	35,111	368,717	403,828	4,758	2,011	6,769	39,869	370,728	410,597
2010	55,092	415,968	471,060	2,706	5,891	8,597	57,798	421,859	479,657
2011	41,625	780,784	822,409	4,884	8,226	13,110	46,509	789,010	835,519
2012	30,831	935,740	966,571	2,200	7,033	9,233	33,031	942,773	975,804
2013	12,741	1,037,537	1,050,278	2,146	6,170	8,316	14,887	1,043,707	1,058,594
2014	3,287	950,408	953,695	103	5,166	5,269	3,390	955,574	958,964
2015	7,595	872,084	879,679	1,204	4,453	5,657	8,799	876,537	885,336
2016	21,689	1,376,854	1,398,543	2,946	5,750	8,696	24,635	1,382,604	1,407,239
2017 [e]	38,347	1,370,813	1,409,160	3,631	5,787	9,418	41,978	1,376,600	1,418,578
2018 [e]	32,213	1,225,903	1,258,116	3,098	4,856	7,954	35,311	1,230,759	1,266,070
2019 [e]	51,771	688,447	740,218	3,104	3,759	6,863	54,875	692,206	747,081

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Year	Alaska/U.S. [a, b] Chinook	Other salmon	Total	Yukon/Canada [c] Chinook	Other salmon [d]	Total	Total Chinook	Other salmon	Total
2020 [e]	21,692	66,849	88,541	2,543	100	2,643	24,235	66,949	91,184
2021 [e]	1,995	7,738	9,733	322	21	343	2,317	7,759	10,076
2022 [e]	1,827	10,592	12,419	58	15	73	1,885	10,607	12,492
Average									
1961–2021	107,945	859,071	967,016	9,814	15,435	25,250	119,684	888,952	1,008,635
2012–2021	22,216	853,237	875,453	2,130	4,310	6,439	24,346	857,547	881,893
2017–2021	29,204	671,950	701,154	2,540	2,905	5,444	31,743	674,855	706,598
Minimum	1,995	7,738	9,733	103	21	343	2,317	7,759	10,076
Maximum	198,436	2,360,718	2,510,727	22,846	46,109	66,993	220,511	2,394,633	2,566,069

Note: Minimum and maximum values exclude the most recent year data.

[a] Catch in number of salmon. Includes estimated number of salmon harvested for the commercial production of salmon roe.

[b] Commercial, subsistence, personal use, test fish retained for subsistence, and sport catches combined. Beginning in 2017 report includes harvest from the Coastal District communities of Scammon Bay and Hooper Bay even though not all stocks are bound for the Yukon River. Coastal District harvest information is included in the following years: 1978, 1987–1989 and 1992 to present.

[c] Catch in number of salmon. Commercial, Aboriginal, domestic, and sport catches combined.

[d] Includes coho salmon harvests in First Nations public angling and commercial fisheries, most of which was harvested in the Old Crow Aboriginal fishery (99.8%).

[e] Data are preliminary; particularly not yet published Alaska subsistence harvest data.

Appendix B2.–Alaska harvest of Yukon River Chinook salmon, 1961–2022.

Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales	Sport fish	Yukon Area total
1961	21,488	119,664	–	–	–	–	141,152
1962	11,110	94,734	–	–	–	–	105,844
1963	24,862	117,048	–	–	–	–	141,910
1964	16,231	93,587	–	–	–	–	109,818
1965	16,608	118,098	–	–	–	–	134,706
1966	11,507	93,315	–	–	–	–	104,822
1967	16,448	129,656	–	–	–	–	146,104
1968	12,004	106,526	–	–	–	–	118,530
1969	13,972	91,027	–	–	–	–	104,999
1970	13,874	79,145	–	–	–	–	93,019
1971	25,584	110,507	–	–	–	–	136,091
1972	20,258	92,840	–	–	–	–	113,098
1973	24,343	75,353	–	–	–	–	99,696
1974	19,758	98,089	–	–	–	–	117,847
1975	13,121	63,838	–	–	–	–	76,959
1976	18,174	87,776	–	–	–	–	105,950
1977	20,101	96,757	–	–	–	156	117,014
1978	30,785	99,168	–	–	–	523	130,476
1979	31,005	127,673	–	–	–	554	159,232
1980	42,724	153,985	–	–	–	956	197,665
1981	29,690	158,018	–	–	–	769	188,477
1982	28,158	123,644	–	–	–	1,006	152,808
1983	49,478	147,910	–	–	–	1,048	198,436
1984	42,428	119,904	–	–	–	351	162,683
1985	39,771	146,188	–	–	–	1,368	187,327
1986	45,238	99,970	–	–	–	796	146,004
1987	55,039	134,760 [e]	–	1,706	–	502	192,007

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales	Sport fish	Yukon Area total
1988	45,495	100,364	–	2,125	1,081	944	150,009
1989	48,462	104,198	–	2,616	1,293	1,063	157,632
1990	48,587	95,247 [e]	413	2,594	2,048	544	149,433
1991	46,773	104,878 [e]	1,538	–	689	773	154,651
1992	47,077	120,245 [e]	927	–	962	431	169,642
1993	63,915	93,550	560	426	1,572	1,695	161,718
1994	53,902	113,137	703	–	1,631	2,281	171,654
1995	50,620	122,728	1,324	399	2,152	2,525	179,748
1996	45,671	89,671	521	215	1,698	3,873	141,649
1997	57,117	112,841	769	313	2,811	2,174	176,025
1998	54,124	43,618	81	357	926	654	99,760
1999	53,305	69,275	288	331	1,205	1,023	125,427
2000	36,404	8,515	–	75	597	276	45,867
2001	55,819	–	–	122	–	679	56,620
2002	43,742	24,128	230	126	528	486	69,240
2003	56,959	40,438	–	204	680	2,719	101,000
2004	55,713	56,151	–	201	792	1,513	114,370
2005	53,409	32,029	–	138	310	483	86,369
2006	48,593	45,829	–	89	817	739	96,067
2007	55,174	33,634	–	136	849	960	90,753
2008	45,186	4,641	–	126	–	409	50,362
2009	33,805	316	–	127	–	863	35,111
2010	44,559	9,897	–	162	–	474	55,092
2011	40,980	82 [f]	–	89	–	474	41,625
2012	30,415	–	–	71	–	345	30,831
2013	12,533	–	–	42	–	166	12,741
2014	3,286	–	–	1	–	0	3,287

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales	Sport fish	Yukon Area total
2015	7,577	–	–	5	–	13	7,595
2016	21,612	–	–	57	–	20	21,689
2017	38,036 [g]	168 [f]	–	125 [g]	–	18	38,347
2018	31,812 [g]	–	–	201 [g]	–	200	32,213
2019	48,379 [g]	3,110 [h]	–	244 [g]	–	38	51,771
2020	21,531 [g]	–	–	112 [g]	–	49	21,692
2021	1,995 [g]	–	–	0 [g]	–	0	1,995
2022	1,827 [g]	–	–	0 [g]	–	0 [i]	1,827
Averages							
1961–2021	34,366	84,767	669	423	1,192	821	107,945
2012–2021	21,718	1,639	–	86	–	85	22,216
2017–2021	28,351	1,639	–	123	–	54	29,204
Minimum	1,995	82	81	1	310	0	3,287
Maximum	63,915	158,018	1,538	2,616	2,811	3,873	198,436

Note: Minimum and maximum values exclude the most recent year data. Dashes indicate no data.

[a] Includes test fish harvest and commercial retained fish (not sold) that were utilized for subsistence. Coastal District harvest information is included in the following years: 1975–1978, 1987–1989 and 1992–present even though not all stocks harvested in the Coastal District are bound for the Yukon River.

[b] Includes ADF&G test fish sales prior to 1988. The 2007 season was the last year with directed Chinook salmon commercial harvest.

[c] Includes an estimate of the number of salmon harvested for the commercial production of salmon roe; including carcasses from subsistence caught fish. These data are only available since 1990.

[d] Regulations did not provide for personal use fisheries in the Yukon River drainage prior to 1987 and in 1990, 1991, and 1994 therefore fishing occured under subsistence regulations.

[e] Includes Chinook salmon sold illegally.

[f] No Chinook salmon were sold in the summer season. A total of 82 and 168 Chinook salmon were sold in District 1 and 2 in the fall season in 2011 and 2017 respectively.

[g] Data are not yet published and are considered preliminary.

[h] Incidental harvest to chum salmon directed fishery in the summer season and allowed sales in the fall season.

[I] Data are unavailable at this time.

Appendix B3.–Alaska harvest of Yukon River summer chum salmon, 1970–2022.

Year	Subsistence[a]	Commercial[b]	Commercial related[c]	Personal use[d]	Test fish sales	Sport fish	Yukon Area total
1970	166,504	137,006	–	–	–	–	303,510
1971	171,487	100,090	–	–	–	–	271,577
1972	108,006	135,668	–	–	–	–	243,674
1973	161,012	285,509	–	–	–	–	446,521
1974	227,811	589,892	–	–	–	–	817,703
1975	211,888	710,295	–	–	–	–	922,183
1976	186,872	600,894	–	–	–	–	787,766
1977	159,502	534,875	–	–	–	316	694,693
1978	171,383	1,052,226	25,761	–	–	451	1,249,821
1979	155,970	779,316	40,217	–	–	328	975,831
1980	167,705	928,609	139,106	–	–	483	1,235,903
1981	117,629	1,006,938	272,763	–	–	612	1,397,942
1982	117,413	461,403	255,610	–	–	780	835,206
1983	149,180	744,879	250,590	–	–	998	1,145,647
1984	166,630	588,597	277,443	–	–	585	1,033,255
1985	157,744	516,997	417,016	–	–	1,267	1,093,024
1986	182,337	721,469	467,381	–	–	895	1,372,082
1987	200,346	442,238	180,303	4,262		846	827,995
1988	227,829	1,148,650	468,032	2,225	3,587	1,037	1,851,360
1989	169,496	955,806[e]	496,934	1,891	10,605	2,132	1,636,864
1990	115,609	302,625	214,552	1,827	8,263	472	643,348
1991	118,540	349,113[e]	308,989	–	3,934	1,037	781,613
1992	142,192	332,313[e]	211,264	–	1,967	1,308	689,044
1993	125,574	96,522	43,594	674	1,869	564	268,797
1994	124,807	80,284	178,457	–	3,212	350	387,110
1995	136,083	259,774	558,640	780	6,073	1,174	962,524
1996	124,738	147,127	535,106	905	7,309	1,946	817,131

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales	Sport fish	Yukon Area total
1997	112,820	95,242	133,010	391	2,590	662	344,715
1998	87,366	28,611	187	84	3,019	421	119,688
1999	83,784	29,389	24	382	836	555	114,970
2000	78,072	6,624	0	30	648	161	85,535
2001	72,155	– [f]	0	146	0	82	72,383
2002	87,056	13,558	19	175	218	384	101,410
2003	82,272	10,685	0	148	119	1,638	94,862
2004	77,934	26,410	0	231	217	203	104,995
2005	93,259	41,264	0	152	134	435	135,244
2006	115,078	92,116	0	262	456	583	208,495
2007	92,926	198,201	0	184	10	245	291,566
2008	86,514	151,186	0	138	80	371	238,289
2009	80,539	170,272	0	308	0	174	251,293
2010	88,373	232,888	0	319	0	1,183	322,763
2011	96,020	275,161	0	439	0	294	371,914
2012	126,992	319,575	0	321	2,412	271	449,571
2013	115,114	485,587	0	138	2,304	1,423	604,566
2014	86,900	530,644	0	235	0	374	618,153
2015	83,567	358,856	0	220	2,494 [g]	194	445,331
2016	87,902	525,809	0	176	380	264	614,531
2017	87,437 [h]	556,516	0	438 [h]	1,819	186	646,396
2018	76,926 [h]	576,700	0	509 [h]	1,028	200	655,363
2019	63,303 [h]	227,089	0	294 [h]	230	36	290,952
2020	41,655 [h]	13,955	0	67 [h]	0	1,684	57,361
2021	1,266 [h]	– [f]	0	0 [h]	0	0	1,266
2022	6,724 [h]	– [f]	0	0 [h]	0	0 [i]	6,724

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Year	Subsistence[a]	Commercial[b]	Commercial related[c]	Personal use[d]	Test fish sales	Sport fish	Yukon Area total
Averages							
1970–2021	122,491	379,509	124,432	573	1,936	658	594,880
2012–2021	77,106	399,415	0	240	1,067	463	438,349
2017–2021	54,117	343,565	0	262	615	421	452,921
Minimum	1,266	6,624	0	0	0	0	1,266
Maximum	227,829	1,148,650	558,640	4,262	10,605	2,132	1,851,360

Note: Minimum and maximum values exclude the most recent year data. Dash indicates no data.

[a] Includes test fish giveaways and commercial retained fish (not sold) that were utilized for subsistence. Coastal District harvest information is included in the following years: 1987–1989 and 1992–present even though not all stocks harvested in the Coastal District are bound for the Yukon River.

[b] Includes ADF&G test fish sales prior to 1988.

[c] Includes an estimate of the number of salmon harvested for the commercial production of salmon roe; including carcasses from subsistence caught fish.

[d] Regulations did not provide for personal use fisheries in the Yukon River drainage prior to 1987 and in 1990, 1991, and 1994 therefore fishing occurred under subsistence regulations.

[e] Includes illegal sales of summer chum salmon.

[f] Summer season commercial fishery was not conducted.

[g] Test fish sales includes both the Lower Yukon Test Fishery sales and Purse Seine Test Fishery sales.

[h] Data are not yet published and are considered preliminary.

[I] Data are unavailable at this time.

Appendix B4.–Alaska harvest of Yukon River fall chum salmon, 1961–2022.

Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales [e]	Yukon Area total
1961	101,772 [f, g]	42,461	0			144,233
1962	87,285 [f, g]	53,116	0			140,401
1963	99,031 [f, g]					99,031
1964	120,360 [f, g]	8,347	0			128,707
1965	112,283 [f, g]	23,317	0			135,600
1966	51,503 [f, g]	71,045	0			122,548
1967	68,744 [f, g]	38,274	0			107,018
1968	44,627 [f, g]	52,925	0			97,552
1969	52,063 [f, g]	131,310	0			183,373
1970	55,501 [f, g]	209,595	0			265,096
1971	57,162 [f, g]	189,594	0			246,756
1972	36,002 [f, g]	152,176	0			188,178
1973	53,670 [f, g]	232,090	0			285,760
1974	93,776 [f, g]	289,776	0			383,552
1975	86,591 [f, g]	275,009	0			361,600
1976	72,327 [f, g]	156,390	0			228,717
1977	82,771 [g]	257,986	0			340,757
1978	84,239 [g]	236,383	10,628			331,250
1979	214,881	359,946	18,466			593,293
1980	167,637	293,430	5,020			466,087
1981	177,240	466,451	11,285			654,976
1982	132,092	224,187	805			357,084
1983	187,864	302,598	5,064			495,526
1984	172,495	208,232	2,328			383,055
1985	203,947	267,744	2,525			474,216
1986	163,466	139,442	577			303,485
1987	342,819 [h]	[i]		19,066		361,885
1988	153,848	133,763	3,227	3,881	27,663	322,382
1989	211,303	270,195	14,749	5,082	20,973	522,302

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales [e]	Yukon Area total
1990	167,900	124,174	12,168	5,176	9,224	318,642
1991	145,524	230,852	23,366	0	3,936	403,678
1992	107,808	15,721 [j]	3,301	0	1,407	128,237
1993	76,882	[i]		163	0	77,045
1994	123,565	3,631	4,368	0	0	131,564
1995	130,860	250,766	32,324	863	1,121	415,934
1996	129,258	88,342	17,288	356	1,717	236,961
1997	95,141	56,713	1,474	284	867	154,479
1998	62,901	[i]		2	0	62,903
1999	89,940	20,371	0	262	1,171	111,744
2000	19,395	[i]		1	0	19,396
2001	35,703	[i]		10	0	35,713
2002	19,674	[i]		3	0	19,677
2003	56,930	10,996	0	394	0	68,320
2004	62,526	4,110	0	230	0	66,866
2005	91,534	180,249	0	133	87	272,003
2006	84,002	174,542	0	333	0	258,877
2007	101,221	90,677	0	173	0	192,071
2008	89,357	119,265	0	181	0	208,803
2009	66,119	25,876	0	78	0	92,073
2010	68,645	2,550	0	3,209	0	74,404
2011	80,202	238,979	0	347	0	319,528
2012	99,309	289,692	0	410	166	389,577
2013	113,384	238,051	0	383	121	351,939
2014	92,529	115,599	0	278	30	208,436
2015	86,600	191,470	0	80	50	278,200
2016	84,617	465,511	0	283	668	551,079
2017	85,093 [k]	489,702	0	626 [k]	1,246	576,667
2018	64,494 [k]	387,788	0	514 [k]	907	453,703

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales [e]	Yukon Area total
2019	63,862 [k]	268,360 [l]	0	408 [k]	275	332,905
2020	5,696 [k]	[i]	0	37 [k]	0	5,733
2021	705 [k]	[i]	0	0 [k]	0	705
2022	2,778 [k]	[i]	0	0 [k]	0	2,778
Averages						
1961–2021	99,814	176,342	3,129	1,236	2,107	254,792
2012–2021	69,629	305,772	0	302	346	314,894
2017–2021	43,970	381,950	0	317	486	273,943
Minimum	705	2,550	0	0	0	705
Maximum	342,819	489,702	32,324	19,066	27,663	654,976

Note: Minimum and maximum values exclude the most recent year data. Blanks indicate no data.

[a] Includes test fish harvest and commercial retained fish (not sold) that were utilized for subsistence. Coastal District harvest information is included in the following years: 1978, 1987–1989 and 1992–present even though not all stocks harvested in the Coastal District are bound for the Yukon River.

[b] Includes fish sold in the round and estimated numbers of female salmon commercially harvested for production of salmon roe (see Bergstrom et al. 1992). Includes ADF&G test fish prior to 1988. Beginning in 1999, commercial harvest may include some commercial related harvest.

[c] Includes an estimate of number of salmon harvested for the commercial production of salmon roe and the carcasses used for subsistence. In prior JTC reports, subsistence plus commercial related harvests are noted as subsistence "use".

[d] Regulations did not provide for personal use fisheries in the Yukon River drainage prior to 1987 and in 1990, 1991, and 1994 therefore fishing occurred under subsistence regulations.

[e] Test fish sales is the number of salmon sold by ADF&G test fisheries.

[f] Catches estimated because harvests of species other than Chinook salmon were not differentiated.

[g] Minimum estimates from 1961–1978 because subsistence surveys were conducted prior to the end of the fishing season.

[h] Includes an estimated 95,768 and 119,168 fall chum salmon illegally sold in Districts 5 (Yukon River) and 6 (Tanana River), respectively.

[I] Commercial fishery was not conducted.

[j] Commercial fishery operated only in District 6, the Tanana River.

[k] Data are not yet published and are considered preliminary.

[l] Commercial harvest includes an estimated 63,000 summer chum salmon that is removed for the total run size estimate.

Appendix B5.–Alaska harvest of Yukon River coho salmon, 1961–2022.

Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales [e]	Sport fish [f]	Yukon Area total
1961	9,192 [g, h]	2,855	0				12,047
1962	9,480 [g, h]	22,926	0				32,406
1963	27,699 [g, h]	5,572	0				33,271
1964	12,187 [g, h]	2,446	0				14,633
1965	11,789 [g, h]	350	0				12,139
1966	13,192 [g, h]	19,254	0				32,446
1967	17,164 [g, h]	11,047	0				28,211
1968	11,613 [g, h]	13,303	0				24,916
1969	7,776 [g, h]	15,093	0				22,869
1970	3,966 [g, h]	13,188	0				17,154
1971	16,912 [g, h]	12,203	0				29,115
1972	7,532 [g, h]	22,233	0				29,765
1973	10,236 [g, h]	36,641	0				46,877
1974	11,646 [g, h]	16,777	0				28,423
1975	20,708 [g, h]	2,546	0				23,254
1976	5,241 [g, h]	5,184	0				10,425
1977	16,333 [h]	38,863	0			112	55,308
1978	7,787 [h]	26,152	0			302	34,241
1979	9,794	17,165	0			50	27,009
1980	20,158	8,745	0			67	28,970
1981	21,228	23,680	0			45	44,953
1982	35,894	37,176	0			97	73,167
1983	23,905	13,320	0			199	37,424
1984	49,020	81,940	0			831	131,791
1985	32,264	57,672	0			808	90,744
1986	34,468	47,255	0			1,535	83,258
1987	82,371 [i]	[j]		2,523		1,292	86,186
1988	69,679	99,907	0	1,250	13,720	2,420	186,976
1989	40,924	85,493	0	872	3,945	1,811	133,045

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales [e]	Sport fish [f]	Yukon Area total
1990	43,460	41,032	3,255	1,181	2,650	1,947	93,525
1991	37,388	103,180	3,506	0	2,971	2,775	149,820
1992	51,980	6,556 [k]	1,423	0	1,629	1,666	63,254
1993	15,812	[j]		0	0	897	16,709
1994	41,775	120	4,331	0	0	2,174	48,400
1995	28,377	45,939	1,074	417	193	1,278	77,278
1996	30,404	52,643	3,339	198	1,728	1,588	89,900
1997	23,945	35,320	0	350	498	1,470	61,583
1998	18,121	1	0	9	0	758	18,889
1999	20,891	1,601	0	147	236	609	23,484
2000	14,939	[j]		0	0	554	15,493
2001	22,122	[j]		34	0	1,248	23,404
2002	15,489	[j]		20	0	1,092	16,601
2003	23,872	25,243	0	549	0	1,477	51,141
2004	20,795	20,232	0	233	0	1,623	42,883
2005	27,250	58,311	0	107	0	627	86,295
2006	19,706	64,942	0	279	0	1,000	85,927
2007	19,624	44,575	0	135	0	597	64,931
2008	16,855	35,691	0	50	0	341	52,937
2009	16,006	8,311	0	70	0	964	25,351
2010	13,045	3,750	0	1,062	0	944	18,801
2011	12,344	76,303	0	232	0	463	89,342
2012	21,533	74,789	0	100	39	131	96,592
2013	14,457	66,199	0	109	1	266	81,032
2014	17,098	104,692	0	174	0	1,855	123,819
2015	18,107	129,700	0	145	8	593	148,553
2016	8,815	201,482	0	266	11	670	211,244
2017	7,281 [l]	139,915	0	200 [l]	63	291	147,750
2018	5,527 [l]	110,587	0	131 [l]	48	544	116,837

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Year	Subsistence [a]	Commercial [b]	Commercial related [c]	Personal use [d]	Test fish sales [e]	Sport fish [f]	Yukon Area total
2019	5,819 [l]	58,591	0	68 [l]	40	72	64,590
2020	2,339 [l]	[j]	0	79 [l]	0	1,337	3,755
2021	296 [l]	[j]	0	0 [l]	0	13	309
2022	1,090 [l]	[j]	0	0 [l]	0	[m]	1,090
Averages							
1961–2021	20,912	41,642	302	314	817	921	59,368
2012–2021	10,127	110,744	0	127	21	577	99,448
2017–2021	4,252	103,031	0	96	30	451	66,648
Minimum	296	1	0	0	0	13	309
Maximum	82,371	201,482	4,331	2,523	13,720	2,775	211,244

Note: Minimum and maximum values exclude the most recent year data. Blanks indicate no data.

[a] Includes test fish harvest and commercial retained fish (not sold) that were utilized for subsistence. Coastal District harvest information is included in the following years: 1978, 1988, 1989, and 1992–present even though not all stocks harvested in the Coastal District are bound for the Yukon River.

[b] Includes fish sold in the round and estimated numbers of female salmon commercially harvested for production of salmon roe (see Bergstrom et al. 1992: 1990 Yukon Area Annual Management Report). Includes ADF&G test fish prior to 1988. Beginning in 1999, commercial harvest may include some commercial related harvest.

[c] Includes an estimate of number of salmon harvested for the commercial production of salmon roe and the carcasses used for subsistence.

[d] Regulations did not provide for personal use fisheries in the Yukon River drainage prior to 1987 and in 1990, 1991, and 1994 therefore fishing occured under subsistence regulations.

[e] Test fish sales is the number of salmon sold by ADF&G test fisheries.

[f] The majority of the sport-fish harvest is taken in the Tanana River drainage.

[g] Catches estimated because harvests of species other than Chinook salmon were not differentiated.

[h] Minimum estimates from 1961–1978 because subsistence surveys were conducted prior to the end of the fishing season.

[I] Includes an estimated 5,015 and 31,276 coho salmon illegally sold in Districts 5 (Yukon River) and 6 (Tanana River), respectively.

[j] Commercial fishery was not conducted.

[k] Commercial fishery operated only in District 6, the Tanana River.

[l] Data are not yet published and are considered preliminary.

[m] Data are unavailable at this time.

Appendix B6.–Alaska (U.S.) and Canada total utilization of Yukon River Chinook and fall chum salmon, 1961–2022.

	Chinook salmon			Fall chum salmon		
Year	Canada [a]	Alaska [b, c]	Total	Canada [a]	Alaska [b, c]	Total
1961	13,246	141,152	154,398	9,076	144,233	153,309
1962	13,937	105,844	119,781	9,436	140,401	149,837
1963	10,077	141,910	151,987	27,696	99,031 [d]	126,727
1964	7,408	109,818	117,226	12,187	128,707	140,894
1965	5,380	134,706	140,086	11,789	135,600	147,389
1966	4,452	104,822	109,274	13,192	122,548	135,740
1967	5,150	146,104	151,254	16,961	107,018	123,979
1968	5,042	118,530	123,572	11,633	97,552	109,185
1969	2,624	104,999	107,623	7,776	183,373	191,149
1970	4,663	93,019	97,682	3,711	265,096	268,807
1971	6,447	136,091	142,538	16,911	246,756	263,667
1972	5,729	113,098	118,827	7,532	188,178	195,710
1973	4,522	99,696	104,218	10,135	285,760	295,895
1974	5,631	117,847	123,478	11,646	383,552	395,198
1975	6,000	76,959	82,959	20,600	361,600	382,200
1976	5,025	105,950	110,975	5,200	228,717	233,917
1977	7,527	117,014	124,541	12,479	340,757	353,236
1978	5,881	130,476	136,357	9,566	331,250	340,816
1979	10,375	159,232	169,607	22,084	593,293	615,377
1980	22,846	197,665	220,511	22,218	466,087	488,305
1981	18,109	188,477	206,586	22,281	654,976	677,257
1982	17,208	152,808	170,016	16,091	357,084	373,175
1983	18,952	198,436	217,388	29,490	495,526	525,016
1984	16,795	162,683	179,478	29,267	383,055	412,322
1985	19,301	187,327	206,628	41,265	474,216	515,481

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	Chinook salmon			Fall chum salmon		
Year	Canada [a]	Alaska [b, c]	Total	Canada [a]	Alaska [b, c]	Total
1986	20,364	146,004	166,368	14,543	303,485	318,028
1987	17,614	192,007	209,621	44,480	361,885 [d]	406,365
1988	21,427	150,009	171,436	33,565	322,382	355,947
1989	17,944	157,632	175,576	23,020	522,302	545,322
1990	19,227	149,433	168,660	33,622	318,642	352,264
1991	20,607	154,651	175,258	35,418	403,678	439,096
1992	17,903	169,642	187,545	20,815	128,237 [e]	149,052
1993	16,611	161,718	178,329	14,090	77,045 [d]	91,135
1994	21,198	171,654	192,852	38,008	131,564	169,572
1995	20,884	179,748	200,632	45,600	415,934	461,534
1996	19,612	141,649	161,261	24,354	236,961	261,315
1997	16,528	176,025	192,553	15,600	154,479	170,079
1998	5,937	99,760	105,697	7,954	62,903	70,857
1999	12,468	125,427	137,895	19,636	111,744	131,380
2000	4,879	45,867	50,746	9,246	19,396 [d]	28,642
2001	10,144	56,620 [f]	66,764	9,872	35,713 [d]	45,585
2002	9,258	69,240	78,498	8,092	19,677 [d]	27,769
2003	9,619	101,000	110,619	10,905	68,320	79,225
2004	11,238	114,370	125,608	9,750	66,866	76,616
2005	11,371	86,369	97,740	18,572	272,003	290,575
2006	9,072	96,067	105,139	11,796	258,877	270,673
2007	5,094	90,753	95,847	13,830	192,071	205,901
2008	3,713	50,362	54,075	9,566	208,803	218,369
2009	4,758	35,111	39,869	2,011	92,073	94,084
2010	2,706	55,092	57,798	5,787	74,404	80,191

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Year	Chinook salmon Canada [a]	Alaska [b, c]	Total	Fall chum salmon Canada [a]	Alaska [b, c]	Total
2011	4,884	41,625 [f]	46,509	8,163	319,528	327,691
2012	2,200	30,831 [f]	33,031	7,023	389,577	396,600
2013	2,146	12,741 [f]	14,887	6,170	351,939	358,109
2014	103	3,287 [f]	3,390	5,033	208,436	213,469
2015	1,204	7,595 [f]	8,799	4,453	278,200	282,653
2016	2,946	21,689 [f]	24,635	5,750	551,079	556,829
2017 [g]	3,631	38,347 [f]	41,978	5,716	576,667	582,383
2018 [g]	3,098	32,213 [f]	35,311	4,831	453,703	458,534
2019 [g]	3,104	51,771 [f]	54,875	3,759	332,905	336,664
2020 [g]	2,543	21,692 [f]	24,235	100	5,733	5,833
2021 [g]	322	1,995 [f]	2,317	21	705	726
2022 [g]	58	1,827 [f]	1,885	15	2,778	2,793
Averages						
1961–2021	9,814	107,945	117,760	15,268	254,792	270,060
2012–2021	2,130	22,216	24,346	4,286	314,894	319,180
2017–2021	2,540	29,204	31,743	2,885	273,943	276,828
Minimum	103	1,995	2,317	21	705	726
Maximum	22,846	198,436	220,511	45,600	654,976	677,257

Note: Minimum and maximum values exclude the most recent year data.

[a] Catches in number of salmon. Includes commercial, Aboriginal, domestic, and sport catches combined.

[b] Catch in number of salmon. Includes estimated number of salmon harvested for the commercial production of salmon roe (see Bergstrom et al. 1992: 1990 Yukon Area Annual Management Report).

[c] Commercial, subsistence, personal-use, test fish, and sport catches combined. Coastal District harvest information is included in the following years: 1975–1978, 1987–1989 and 1992–present even though not all stocks harvested in the Coastal District are bound for the Yukon River.

[d] Commercial fishery did not operate within the Alaskan portion of the drainage.

[e] Commercial fishery operated only in District 6, the Tanana River.

[f] No Chinook salmon directed commercial fishery was conducted during the summer season.

[g] Data are preliminary, particularly not yet published Alaska subsistence and personal use harvest data from 2017–2022.

Appendix B7.–Canadian harvest of Yukon River Chinook salmon, 1961–2022.

	Mainstem Yukon River harvest							Porcupine River	Total
Year	Commercial	Domestic	First Nation fishery	Public Angling [a]	Test fishery	Combined non-commercial	Total	First Nation fishery	Canadian harvest
1961	3,446		9,300			9,300	12,746	500	13,246
1962	4,037		9,300			9,300	13,337	600	13,937
1963	2,283		7,750			7,750	10,033	44	10,077
1964	3,208		4,124			4,124	7,332	76	7,408
1965	2,265		3,021			3,021	5,286	94	5,380
1966	1,942		2,445			2,445	4,387	65	4,452
1967	2,187		2,920			2,920	5,107	43	5,150
1968	2,212		2,800			2,800	5,012	30	5,042
1969	1,640		957			957	2,597	27	2,624
1970	2,611		2,044			2,044	4,655	8	4,663
1971	3,178		3,260			3,260	6,438	9	6,447
1972	1,769		3,960			3,960	5,729		5,729
1973	2,199		2,319			2,319	4,518	4	4,522
1974	1,808	406	3,342			3,748	5,556	75	5,631
1975	3,000	400	2,500			2,900	5,900	100	6,000
1976	3,500	500	1,000			1,500	5,000	25	5,025
1977	4,720	531	2,247			2,778	7,498	29	7,527
1978	2,975	421	2,485			2,906	5,881		5,881
1979	6,175	1,200	3,000			4,200	10,375		10,375
1980	9,500	3,500	7,546	300		11,346	20,846	2,000	22,846
1981	8,593	237	8,879	300		9,416	18,009	100	18,109
1982	8,640	435	7,433	300		8,168	16,808	400	17,208
1983	13,027	400	5,025	300		5,725	18,752	200	18,952
1984	9,885	260	5,850	300		6,410	16,295	500	16,795
1985	12,573	478	5,800	300		6,578	19,151	150	19,301
1986	10,797	342	8,625	300		9,267	20,064	300	20,364
1987	10,864	330	6,069	300		6,699	17,563	51	17,614
1988	13,217	282	7,178	650		8,110	21,327	100	21,427
1989	9,789	400	6,930	300		7,630	17,419	525	17,944
1990	11,324	247	7,109	300		7,656	18,980	247	19,227
1991	10,906	227	9,011	300		9,538	20,444	163	20,607
1992	10,877	277	6,349	300		6,926	17,803	100	17,903

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Year	Mainstem Yukon River harvest							Porcupine River	Total
	Commercial	Domestic	First Nation fishery	Public Angling [a]	Test fishery	Combined non-commercial	Total	First Nation fishery	Canadian harvest
1993	10,350	243	5,576	300		6,119	16,469	142	16,611
1994	12,028	373	8,069	300		8,742	20,770	428	21,198
1995	11,146	300	7,942	700		8,942	20,088	796	20,884
1996	10,164	141	8,451	790		9,382	19,546	66	19,612
1997	5,311	288	8,888	1,230		10,406	15,717	811	16,528
1998	390	24	4,687	-	737	5,448	5,838	99	5,937
1999	3,160	213	8,804	177		9,194	12,354	114	12,468
2000	-	-	4,068	-	761	4,829	4,829	50	4,879
2001	1,351	89	7,421	146	767	8,423	9,774	370	10,144
2002	708	59	7,139	128	1,036	8,362	9,070	188	9,258
2003	2,672	115	6,121	275	263	6,774	9,446	173	9,619
2004	3,785	88	6,483	423	167	7,161	10,946	292	11,238
2005	4,066	99	6,376	436		6,911	10,977	394	11,371
2006	2,332	63	5,757	606		6,426	8,758	314	9,072
2007	-	-	4,175	2 [b]	617	4,794	4,794	300	5,094
2008	1 [c]	-	2,885	-	513	3,398	3,399	314	3,713
2009	364	17	3,791	125	-	3,933	4,297	461	4,758
2010	-	-	2,455 [d]	1 [e]	-	2,456	2,456	250	2,706
2011	4 [c]	-	4,550 [d]	40	-	4,590	4,594	290	4,884
2012	-	-	2,000 [d]	-	-	2,000	2,000	200	2,200
2013	2 [c]	-	1,902 [d]	-	-	1,902	1,904	242	2,146
2014	-	-	100	-	-	100	100	3	103
2015	-	-	1,000	-	-	1,000	1,000	204	1,204
2016	1 [c]	-	2,768	-	-	2,768	2,769	177	2,946
2017	-	-	3,500	-	-	3,500	3,500	131	3,631
2018	1 [c]	-	2,789	-	-	2,789	2,790	308	3,098
2019	-	-	2,764	-	-	2,764	2,764	340	3,104
2020	-	-	2,363	-	-	2,363	2,363	180	2,543
2021	-	-	306	-	-	306	306	16	322
2022	-	-	46	-	-	46	46	12	58

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	Mainstem Yukon River harvest							Porcupine River	Total
Year	Commercial	Domestic	First Nation fishery	Public Angling [a]	Test fishery	Combined non-commercial	Total	First Nation fishery	Canadian harvest
Averages									
1961–2021	5,157 [f]	393	4,815	342 [f]	608	5,270	9,581	245	9,814
2012–2021	1 [f]	-	1,949	-	-	1,949	1,950	180	2,130
2017–2021	1	-	2,344	-	-	2,344	2,345	195	2,540
Minimum	1	17	100	1	167	100	100	3	103
Maximum	13,217	3,500	9,300	1,230	1,036	11,346	21,327	2,000	22,846

Note: Minimum and maximum values exclude the most recent year data. Dash indicates fishery did not occur. Blank cells indicate no harvest data was available.

[a] Public angling harvest unknown before 1980.

[b] Public angling fishery involved non-retention of Chinook salmon for most of the season thus effectively closed.

[c] Closed during Chinook salmon season, harvested in chum salmon fishery.

[d] Adjusted to account for underreporting.

[e] Fishery was closed, 1 fish mistakenly caught and retained.

[f] Excluding years when no directed fishery occurred.

Appendix B8.–Canadian harvest of Yukon River fall chum salmon, 1961–2022.

	Mainstem Yukon River Harvest						Porcupine River	Total
Year	Commercial	Domestic	First Nation fishery	Test fishery	Combined non-commercial [a]	Total [a]	First Nation fishery	Canadian harvest
1961	3,276		3,800		3,800	7,076	2,000	9,076
1962	936		6,500		6,500	7,436	2,000	9,436
1963	2,196		5,500		5,500	7,696	20,000	27,696
1964	1,929		4,200		4,200	6,129	6,058	12,187
1965	2,071		2,183		2,183	4,254	7,535	11,789
1966	3,157		1,430		1,430	4,587	8,605	13,192
1967	3,343		1,850		1,850	5,193	11,768	16,961
1968	453		1,180		1,180	1,633	10,000	11,633
1969	2,279		2,120		2,120	4,399	3,377	7,776
1970	2,479		612		612	3,091	620	3,711
1971	1,761		150		150	1,911	15,000	16,911
1972	2,532				0	2,532	5,000	7,532
1973	2,806		1,129		1,129	3,935	6,200	10,135
1974	2,544	466	1,636		2,102	4,646	7,000	11,646
1975	2,500	4,600	2,500		7,100	9,600	11,000	20,600
1976	1,000	1,000	100		1,100	2,100	3,100	5,200
1977	3,990	1,499	1,430		2,929	6,919	5,560	12,479
1978	3,356	728	482		1,210	4,566	5,000	9,566
1979	9,084	2,000	11,000		13,000	22,084		22,084
1980	9,000	4,000	3,218		7,218	16,218	6,000	22,218
1981	15,260	1,611	2,410		4,021	19,281	3,000	22,281
1982	11,312	683	3,096		3,779	15,091	1,000	16,091
1983	25,990	300	1,200		1,500	27,490	2,000	29,490
1984	22,932	535	1,800		2,335	25,267	4,000	29,267
1985	35,746	279	1,740		2,019	37,765	3,500	41,265
1986	11,464	222	2,200		2,422	13,886	657	14,543
1987	40,591	132	3,622		3,754	44,345	135	44,480

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	Mainstem Yukon River Harvest						Porcupine River	Total
Year	Commercial	Domestic	First Nation fishery	Test fishery	Combined non-commercial [a]	Total [a]	First Nation fishery	Canadian harvest
1988	30,263	349	1,882		2,231	32,494	1,071	33,565
1989	17,549	100	2,462	300	2,562	20,111	2,909	23,020
1990	27,537	0	3,675		3,675	31,212	2,410	33,622
1991	31,404	0	2,438		2,438	33,842	1,576	35,418
1992	18,576	0	304		304	18,880	1,935	20,815
1993	7,762	0	4,660		4,660	12,422	1,668	14,090
1994	30,035	0	5,319		5,319	35,354	2,654	38,008
1995	39,012	0	1,099		1,099	40,111	5,489	45,600
1996	20,069	0	1,260		1,260	21,329	3,025	24,354
1997	8,068	0	1,238		1,238	9,306	6,294	15,600
1998 [b]	–		1,795		1,795	1,795	6,159	7,954
1999	10,402	0	3,234		3,234	13,636	6,000	19,636
2000	1,319	0	2,927		2,927	4,246	5,000	9,246
2001	2,198	3	3,077	1 [b]	3,080	5,278	4,594	9,872
2002	3,065	0	3,167	2,756 [b]	3,167	6,232	1,860	8,092
2003	9,030	0	1,493	990 [b]	1,493	10,523	382	10,905
2004	7,365	0	2,180	995 [b]	2,180	9,545	205	9,750
2005	11,931	13	2,035		2,048	13,979	4,593	18,572
2006	4,096	0	2,521		2,521	6,617	5,179	11,796
2007	7,109	0	2,221	3,765 [b]	2,221	9,330	4,500	13,830
2008	4,062	0	2,068	–	2,068	6,130	3,436	9,566
2009	293	0	820	–	820	1,113	898	2,011
2010	2,186	0	1,523 [c]	–	1,523	3,709	2,078	5,787
2011	5,312	0	1,000 [c]	–	1,000	6,312	1,851	8,163
2012	3,205	0	700 [c]	–	700	3,905	3,118	7,023
2013	3,369	18	500 [c]	–	518	3,887	2,283	6,170

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	Mainstem Yukon River Harvest						Porcupine River	Total
Year	Commercial	Domestic	First Nation fishery	Test fishery	Combined non-commercial [a]	Total [a]	First Nation fishery	Canadian harvest
2014	2,485	19	546	–	565	3,050	1,983	5,033
2015	2,862	35	1,000 [c]	–	1,035	3,897	556	4,453
2016	1,745	0	1,000 [c]	–	1,000	2,745	3,005	5,750
2017	2,404	0	1,000 [c]	–	1,000	3,404	2,312	5,716
2018	1,957	0	1,000 [c]	–	1,000	2,957	1,874	4,831
2019	1,728	31	1,000 [c]	–	1,031	2,759	1,000	3,759
2020	–	–	0		0	0	100	100
2021	–	–	0		0	0	21	21
2022	–	–	0		0	0	15	15
Averages								
1961–2021	9,351	414	2,137	1,468	2,407	11,299	4,036	15,268
2012–2021	2,469	13	675	–	685	2,660	1,625	4,286
2017–2021	2,030	10	600	–	606	1,824	1,061	2,885
Minimum	293	0	0	1	0	0	21	21
Maximum	40,591	4,600	11,000	3,765	13,000	44,345	20,000	45,600

Note: Minimum and maximum values exclude the most recent year data. Dash indicates fishery did not occur.

[a] The chum salmon test fishery practiced live release and therefor is not included in the harvest totals

[b] Test fishery catch not included in harvest total.

[c] Adjusted to account for underreporting.

Appendix B9.–Chinook salmon aerial survey indices for selected spawning areas in the U.S. (Alaska) portion of the Yukon River drainage, 1961–2021.

	Andreafsky River		Anvik River		Nulato River			Gisasa River
Year	East Fork	West Fork	Drainagewide total	Index area [a]	North Fork [b]	South Fork	Both forks	
1961	1,003	-	1,226		376 [c]	167	543	266 [c]
1962	675 [c]	762 [c]	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-
1964	867	705	-	-	-	-	-	-
1965	-	344 [c]	650 [c]	-	-	-	-	-
1966	361	303	638	-	-	-	-	-
1967	-	276 [c]	336 [c]	-	-	-	-	-
1968	383	383	310 [c]	-	-	-	-	-
1969	274 [c]	231 [c]	296 [c]	-	-	-	-	-
1970	665	574 [c]	368	-	-	-	-	-
1971	1,904	1,682	-	-	-	-	-	-
1972	798	582 [c]	418	-	-	-	-	-
1973	825	788	222	-	-	-	-	-
1974	-	285 [c]	-	-	55 [c]	23 [c]	78 [c]	161
1975	993	301 [c]	730	-	123	81	204	385
1976	818	643	1,053	-	471	177	648	332
1977	2,008	1,499	1,371	-	286	201	487	255
1978	2,487	1,062	1,324	-	498	422	920	45 [c]
1979	1,180	1,134	1,484	-	1,093	414	1,507	484
1980	958	1,500	1,330	1,192	954 [c]	369 [c]	1,323 [c]	951
1981	2,146 [c]	231 [c]	807 [c]	577 [c]	-	791 [c]	791 [c]	
1982	1,274	851	-		-	-	-	421
1983	-	-	653 [c]	376 [c]	526	480	1,006	572
1984	1,573	1,993	641 [c]	574 [c]	-	-	-	-
1985	1,617	2,248	1,051	720	1,600	1,180	2,780	735
1986	1,954	3,158	1,118	918	1,452	1,522	2,974	1,346
1987	1,608	3,281	1,174	879	1,145	493	1,638	731
1988	1,020	1,448	1,805	1,449	1,061	714	1,775	797
1989	1,399	1,089	442 [c]	212 [c]	-	-	-	-

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	Andreafsky River		Anvik River		Nulato River			Gisasa River
Year	East Fork	West Fork	Drainagewide total	Index area [a]	North Fork [b]	South Fork	Both forks	
1990	2,503	1,545	2,347	1,595	568 [c]	430 [c]	998 [c]	884 [c]
1991	1,938	2,544	875 [c]	625 [c]	767	1,253	2,020	1,690
1992	1,030 [c]	2,052 [c]	1,536	931	348	231	579	910
1993	5,855	2,765	1,720	1,526	1,844	1,181	3,025	1,385
1994	300 [c]	213 [c]	913 [c]	913 [c]	-	-	-	2,775
1995	1,635	1,108	1,996	1,147	968	681	1,649	410
1996		624	839	709	-	100	100 [c]	-
1997	1,140	1,510	3,979	2,690	-	-	-	144 [c]
1998	1,027	1,249 [c]	709 [c]	648 [c]	507	546	1,053	889 [c]
1999	-	870 [c]	950 [c]	950 [c]	-	-	-	-
2000	1,018	427	1,721	1,394	-	-	-	-
2001	1,059	565	1,420	1,177	1,116	768	1,884 [d]	1,298 [c]
2002	1,447	917	1,713	1,329	687	897	1,584	506
2003	1,116 [c]	1,578	973 [c]	973 [c]	-	-	-	-
2004	2,879	1,317	3,679	3,304	856	465	1,321	731
2005	1,715	1,492	2,421	1,922	323	230	553	958
2006	591 [c]	824	1,886	1,776 [e]	620	672	1,292	843
2007	1,758	976	1,650	1,497	1,684	899	2,583	593
2008	278 [c]	262 [c]	992 [c]	827 [c]	415	507	922	487
2009	84 [c]	1,678	832	590	1,418	842	2,260	515
2010	537 [c]	858	974	721	356	355	711	264
2011	620	1,173	642	501	788	613	1,401	906
2012	-	227 [c]	722	451	682	692	1,374	[c]
2013	1,441	1,090	940	656	586	532	1,118	201 [c]
2014	-	1,695	1,584	800	[c]	[c]	[c]	[c]
2015	2,167	1,356	2,616	1,726	999	565	1,564	558
2016	-	-	-	-	-	-	-	-
2017	-	942	1,101	894	500	443	943	
2018	746	455	1,109 [c]	800	438	432	870	452

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	Andreafsky River		Anvik River		Nulato River			Gisasa River
Year	East Fork	West Fork	Drainagewide total	Index area [a]	North Fork [b]	South Fork	Both forks	
2019	1,547	904	1,432	1,043	656	485	1,141	-
2020	335	508	675	506	459	403	862	419
2021	-	-	-	-	-	-	-	-
2022	- [c]	- [c]	179	179	31	29	60	-
SEG [f]	[g]	640-1,600	1,100-1,700				940-1,900 [d]	[h]
Averages								
1961–2020	1,297	1,091	1,215	1,065	756	559	1,276	703
2011–2020	1,247	897	1,272	860	617	507	1,125	408
2016–2020	876	702	1,079	811	513	441	954	436
Minimum	84	213	222	212	55	23	78	45
Maximum	5,855	3,281	3,979	3,304	1,844	1,522	3,025	2,775

Note: Aerial survey counts are peak counts only. Survey rating was fair or good unless otherwise noted. Minimum and maximum values exclude the most recent year data. Dash indicates no survey.

[a] Anvik River Index Area includes mainstem counts between Beaver Creek and McDonald Creek.

[b] Nulato River mainstem aerial survey counts below the forks are included with the North Fork.

[c] Incomplete, poor timing and/or poor survey conditions resulting in minimal, inaccurate, or no counts.

[d] In 2001, the Nulato River escapement goal was established for both forks combined.

[e] The count represents the index area and an additional 8 river miles downstream of Yellow River confluence.

[f] Sustainable Escapement Goal.

[g] Aerial escapement goal for Andreafsky River was discontinued in 2010. Note: weir-based goal replaced East Fork Andreafsky River aerial survey goal.

[h] Gisasa River aerial escapement goal was discontinued in 2010.

Appendix B10.–Chinook salmon escapement counts and percentage females counted for selected spawning areas in the U.S. (Alaska) portion of the Yukon River drainage, 1986–2022.

	East Fork Andreafsky River weir		Nulato River tower	Henshaw Creek weir		Gisasa River weir		Chena River tower/sonar		Salcha River tower/sonar	
Year	No. fish	% Fem.	No. fish	No. fish	% Fem.	No. fish	% Fem.	No. fish	% Fem. [a]	No. fish	% Fem. [a]
1986	1,530 [b]	29	-	-	-	-	-	9,065 [c]	25	-	35
1987	2,011 [b]	53	-	-	-	-	-	6,404 [c]	58	4,771 [c]	63
1988	1,341 [b]	42	-	-	-	-	-	3,346 [c]	61	4,322 [c]	40
1989	-	5	-	-	-	-	-	2,730 [c]	65	3,294 [c]	62
1990	-	38	-	-	-	-	-	5,603 [c]	47	10,728 [c]	47
1991	-	28	-	-	-	-	-	3,172 [c]	32	5,608 [c]	47
1992	-	26	-	-	-	-	-	5,580 [c]	38	7,862 [c]	34
1993	-	29	-	-	-	-	-	12,241	17	10,008	28
1994	7,801	35	1,795	-	-	2,888	-	11,877	45	18,404	45
1995	5,841	42	1,412	-	-	4,023	46	11,394 [c]	66	13,643	56
1996	2,955	42	756	-	-	1,991	20	7,153 [c]	44	7,570 [c]	51
1997	3,186	37	4,766	-	-	3,764	26	13,390	40	18,514	50
1998	4,034	29	1,536	-	-	2,414	16	4,745	41	5,027	30
1999	3,444	29	1,932	-	-	2,644	26	6,485	66	9,198	55
2000	1,609	32	908	193	30	2,089	34	4,694 [c]	26	4,595	44
2001	1,148	64	-	1,091	36	3,052	49	9,696	43	13,328	38
2002	4,123 [d]	21	2,696	649	31	2,025	21	6,967 [c]	32	9,000 [e]	35
2003	4,336	48	1,716 [f]	748	39	1,901	38	11,100	45	15,500 [e]	42
2004	8,045	35	-	1,248	23	1,774	34	9,645	63	15,761	63
2005	2,239	50	-	1,059	42	3,111	36	- [d]	42	5,988	54
2006	6,463	44	-	- [d]	-	3,031	29	2,936	46	10,679	43
2007	4,504	45	-	740	43	1,427	41	3,806	40	6,425	36
2008	4,242	39	-	766	27	1,738	15	3,208	44	5,415 [e]	39
2009	3,004	47	-	1,637	54	1,955	28	5,253	55	12,774	39
2010	2,413	49	-	857	49	1,516	30	2,382	31	6,135	33
2011	5,213	20	-	1,796	34	2,692	19	- [d]	32	7,200 [e]	42
2012	2,517	27	-	922	43	1,323	39	2,220 [g]	56	7,165	60
2013	1,998	39	-	772	47	1,126	34	1,859 [d]	40	5,465	50
2014	5,949	48	-	- [d]	-	1,589	19	7,192 [h]	33	- [d]	32
2015	5,474	40	-	2,391	41	1,319	30	6,294	55	6,288 [i]	43
2016	2,676	49	-	1,354	48	1,395	27	6,665 [i]	23	2,675 [i]	39
2017	2,970	26	-	677	42	1,083	28	5,235 [i]	45	4,195 [i]	41

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Year	East Fork Andreafsky River weir No. fish	% Fem.	Nulato River tower No. fish	Henshaw Creek weir No. fish	% Fem.	Gisasa River weir No. fish	% Fem.	Chena River tower No. fish	% Fem. [a]	Salcha River tower No. fish	% Fem. [a]
2018	4,114	25	-	-	- [d]	-	-	5,947 [i]	55	5,021	56
2019	5,111	34	-	438	61	1,328	24	2,404 [i]	- [k]	4,863	44
2020 [l]	-	-	-	-	-	-	-	- [m]	-	-	-
2021 [j]	1,418	37	-	130	35	-	- [l]	1,416	41	2,081	46
2022 [j]	- [n]	-	-	- [o]	-	503	14	355	- [k]	1,041	37
SEG [p]	2,100–4,900										
BEG [q]								2,800–5,700		3,300–6,500	
Averages											
1986–2021	3,724	37	1,946	970	40	2,128	30	6,124	44	8,167	45
2012–2021	3,581	36		955	45	1,309	29	4,359	44	4,719	46
2017–2021	3,403	30		415	46	1,206	26	3,751	47	4,040	47
Minimum	1,148	5	756	130	23	1,083	15	1,416	17	2,081	28
Maximum	8,045	64	4,766	2,391	61	4,023	49	13,390	66	18,514	63

Note: Minimum and maximum values exclude the most recent year data. No. = number; Fem. = female. Dashes indicate no survey or a value cannot be calculated.

[a] Adjustment factor was applied.
[b] Tower counts.
[c] Mark–recapture population estimate.
[d] Project operations were hindered by high water most of the season.
[e] Estimate includes an expansion for missed counting days based on average run timing.
[f] Weir count.
[g] Estimate includes an expansion for missed counting days based on using 2 DIDSON sonars to assess Chinook salmon passage.
[h] Due to high water, DIDSON sonar was used and preliminary species apportionment was estimated using average run timing.
[I] Final estimate uses a binomial mixed-effects model to create passage estimates for periods of missed counts.
[j] Preliminary.
[k] Only 8 fish were sampled for sex; value not presented due to low sample size.
[l] Projects did not operate due to COVID-19 or funding.
[m] Total escapement could not be determined. Sonar only operated 17 days due to flooding and debris.
[n] Project did not operate due to forest fires early in the season and high water preventing weir deployment
[o] Project did not operate due to weir repair from damage sustained the prior year due to high water.
[p] Sustainable Escapement Goal (SEG).
[q] Biological Escapement Goal (BEG).

Appendix B11.–Estimated run size and spawning escapement of Canadian-origin Yukon River mainstem Chinook salmon, 1982–2022.

Year	Historic mark-recapture border passage estimate [a]	Eagle sonar estimate	U.S. harvest above Eagle sonar [b]	Canadian mainstem border passage estimate	Canadian mainstem harvest	Spawning escapement estimate [c]	Canadian origin total run size estimate [d]
1982	36,598			60,346 [e]	16,808	43,538	147,587
1983	47,741			63,227 [e]	18,752	44,475	160,221
1984	43,911 [f]			66,300 [e]	16,295	50,005	111,035
1985	29,881			59,586 [e]	19,151	40,435	145,359
1986	36,479			61,489 [e]	20,064	41,425	159,082
1987	30,823			58,870 [e]	17,563	41,307	174,128
1988	44,445			61,026 [e]	21,327	39,699	145,675
1989	42,620			77,718 [e]	17,419	60,299	164,516
1990	56,679			78,192 [e]	18,980	59,212	151,188
1991	41,187			63,172 [e]	20,444	42,728	124,382
1992	43,185			56,958 [e]	17,803	39,155	154,219
1993	45,027			52,713 [e]	16,469	36,244	131,528
1994	46,680			77,219 [e]	20,770	56,449	172,885
1995	52,353			70,761 [e]	20,088	50,673	168,502
1996	47,955			93,606 [e]	19,546	74,060	182,564
1997	53,400			69,538 [e]	15,717	53,821	161,700
1998	22,588			41,335 [e]	5,838	35,497	88,282
1999	23,716			49,538 [e]	12,354	37,184	110,446
2000	16,173			30,699 [e]	4,829	25,870	52,842
2001	52,207			62,338 [e]	9,774	52,564	85,663
2002	49,214			51,428 [g]	9,070	42,358	81,486
2003	56,929			90,040 [g]	9,446	80,594	149,980
2004	48,111			59,415 [g]	10,946	48,469	117,246
2005	42,245	81,528	2,566	78,962 [h]	10,977	67,985	123,612
2006	36,748	73,691	2,303	71,388 [h]	8,758	62,630	119,485
2007	22,120	41,697	1,999	39,698 [h]	4,794	34,904	88,018
2008	14,666	38,097	815	37,282 [h]	3,399	33,883	62,611
2009	-	69,957	382	69,575 [h]	4,297	65,278	87,221
2010	-	35,074	604	34,470 [h]	2,456	32,014	59,741
2011	-	51,271	370	50,901 [h]	4,594	46,307	71,725
2012	-	34,747	91	34,656 [h]	2,000	32,656	48,498

-continued-

Year	Historic mark-recapture border passage estimate [a]	Eagle sonar estimate	U.S. harvest above Eagle sonar [b]	Canadian mainstem border passage estimate	Canadian mainstem harvest	Spawning escapement estimate [c]	Canadian origin total run size estimate [d]
2013	-	30,725	152	30,573 [h]	1,904	28,669	37,177
2014	-	63,482	51	63,431 [h]	100	63,331	64,886
2015	-	84,015	341	83,674 [h]	1,000	82,674	87,323
2016	-	72,329	762	71,567 [h]	2,769	68,798	83,043
2017	-	73,313	1,498	71,815 [h]	3,500	68,315	92,622
2018	-	57,893	629	57,264 [h]	2,790	54,474	76,530
2019	-	45,560	744	44,816 [h]	2,764	42,052	72,620
2020	-	33,550	220	33,330 [h]	2,363	30,967	45,501
2021	-	31,796	38	31,758 [h]	306	31,452	32,970
2022	-	12,025	2	12,023 [h]	46	11,978	13,144
Averages							
1982–2021	40,136	54,043	798	59,017	10,456	48,561	109,852
2012–2021	-	52,741	453	52,288	1,950	50,339	64,117
2017–2021	-	48,422	626	47,797	2,345	45,452	64,049
Minimum	14,666	30,725	38	30,573	100	25,870	32,970
Maximum	56,929	84,015	2,566	93,606	21,327	82,674	182,564

Note: Minimum and maximum values exclude the most recent year data. Dashes indicate no survey or a value cannot be calculated.

[a] From 1982–2008, a mark–recapture program was used to determine border passage; fish were sampled and tagged near the border using fish wheels and sampled for marks/tags in upstream fisheries. The Eagle sonar project replaced the mark–recapture program in 2005.

[b] U.S. harvests between the sonar site and border prior to 2008 is unknown because subsistence harvest in the Eagle area extended above and below the sonar site but were most likely in the hundreds for Chinook salmon. Starting in 2008, subsistence harvests between the sonar site and the U.S./Canada border were recorded specifically for the purpose of estimating border passage.

[c] Canadian spawning escapement estimated as border passage minus Canadian harvest.

[d] Canadian total origin run size is estimated as the border passage plus the U.S. harvest of Canadian origin fish. In 1984, border passage was estimated using harvest and escapement estimate based on proportion of aerial surveys.

[e] Chinook salmon passage for Yukon mainstem at U.S./Canada border from 1982–2001 was reconstructed using a linear relationship with 3-area index (aerial surveys of Little Salmon, Big Salmon, and Nisutlin rivers in 2002–2007) plus Canadian harvests.

[f] In 1984, border passage was estimated using harvest and escapement estimates based on proportion of aerial surveys.

[g] Border passage estimated in 2002–2004 using escapement estimate from a radio tagging proportion study, plus Canadian harvest.

[h] Since 2005, border passage was estimated as fish counted by the Eagle sonar minus the U.S. harvest upriver from the sonar project.

Appendix B12.–Chinook salmon escapement counts for selected spawning areas in the Canadian (Yukon) portion of the Yukon River drainage, 1961–2022.

		Weirs		Sonars						Whitehorse Fishway	
Year	Tatchun Creek [a]	Blind Creek	Chandindu River	Big Salmon	Klondike River	Teslin River	Pelly River	Porcupine River	Takhini River	Count	% hatchery contribution
1961										1,068	0
1962										1,500	0
1963										483	0
1964										595	0
1965										903	0
1966	[b]									563	0
1967										533	0
1968										414	0
1969										334	0
1970	100									625	0
1971	130									856	0
1972	80									391	0
1973	99									224	0
1974	192									273	0
1975	175									313	0
1976	52									121	0
1977	150									277	0
1978	200									725	0
1979	150									1,184	0
1980	222									1,383	0
1981	133									1,555	0
1982	73									473	0
1983	264									905	0
1984	153									1,042	0
1985	190									508	0
1986	155									557	0
1987	159									327	0
1988	152									405	16
1989	100									549	19
1990	643									1,407	24
1991										1,266 [c]	51 [c]
1992	106									758 [c]	84 [c]

-continued-

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Year	Tatchun Creek [a]	Blind Creek (Weirs)	Chandindu River (Weirs)	Big Salmon (Sonars)	Klondike River (Sonars)	Teslin River (Sonars)	Pelly River (Sonars)	Porcupine River (Sonars)	Takhini River (Sonars)	Whitehorse Fishway Count	Whitehorse Fishway % hatchery contribution
1993	183									668 [c]	73 [c]
1994	477									1,577 [c]	54 [c]
1995	397	826 [d]								2,103	57
1996	423									2,958	35
1997	1,198	957								2,084	24
1998	405	373	132							777	95
1999	252	892	239							1,118	74
2000	276 [e]		4 [f]							677	69
2001			129 [g]							988	36
2002			[h]							605	39
2003		1,155	185 [i]							1,443	70
2004		792								1,989	76
2005		525		5,618						2,632	57
2006		677		7,308						1,720	47
2007		304		4,506						427	56
2008		276		1,431						399	54
2009		716		9,261	5,147					828	47
2010		270		3,817	803					672	49
2011		360		5,156	1,181					1,534	48
2012		157		2,584		3,454 [j]				1,030	59
2013		312		3,242		9,916				1,139	67
2014		602		6,321		17,507		3,066		1,601	78
2015		964		10,078		20,463		4,851		1,465	60
2016		664		6,761			5,807 [k]	6,665		1,556	42
2017		[l]		5,672			9,081	1,191	1,872 [k]	1,226	39
2018		612		5,159			9,751	3,414	1,554	691	37
2019				3,874			6,927	4,740		282	13
2020				1,635	470		5,678	[m]		216	24
2021	17			1,958	855		4,980	409	247	274	36
2022 [n]	206				253			349	476	165	40

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		Weirs		Sonars						Whitehorse Fishway	
Year	Tatchun Creek [a]	Blind Creek	Chandindu River	Big Salmon	Klondike River	Teslin River	Pelly River	Porcupine River	Takhini River	Count	% hatchery contribution
Averages											
1961–2021	236	589	138	4,964	1,691	15,962	7,037	3,477	1,224	938	28
2012–2021	17	552	-	4,728	663	15,962	7,037	3,477	1,224	948	46
2017–2021	17	612	-	3,660	663	-	7,283	2,439	1,224	538	30
Minimum	17	157	4	1,431	470	9,916	4,980	409	247	121	0
Maximum	1,198	1,155	239	10,078	5,147	20,463	9,751	6,665	1,872	2,958	95

Note: Minimum and maximum values exclude the most recent year data. Dashes indicate a value cannot be calculated.

[a] All aerial surveys prior to 1980, subsequently foot surveys except 1982 and 1986 (aerial), and weir counts from 1997–2000 and 2021.

[b] Incomplete and/or poor survey conditions resulting in minimal or inaccurate counts (Tatchun 1966 only 7 fish observed).

[c] Counts and estimated percentages may be slightly exaggerated. In some or all of these years, a number of adipose-clipped fish ascended the Fishway and were counted more than once. These fish would have been released into the Fishway as fry between 1989 and 1994, inclusive.

[d] Details lacking; no reported data beyond annual passage estimate

[e] Flood conditions caused early termination of this program.

[f] High water delayed project installation; therefore, counts are incomplete.

[g] Weir was breached from July 31–August 7 due to high water.

[h] Resistance board weir (RBW) tested for 3 weeks.

[i] Combination RBW and conduit weir tested and operational from July 10–30.

[j] Chinook salmon counted on the left bank due to high water; estimate should be considered a minimum.

[k] Sonar feasibility year.

[l] High water conditions prevented weir operation.

[m] Project cancelled due to COVID-19.

[n] Data are preliminary.

Appendix B13.–Summer chum salmon escapement counts for selected spawning areas in the U.S. (Alaska) portion of the Yukon River drainage, 1973–2022.

	Andreafsky River			Anvik River		Rodo River	Kaltag River	Nulato River		
	East Fork		West Fork					South Fork	North Fork [a]	Mainstem
Year	Aerial [b]	Sonar, tower, or weir counts [c]	Aerial [b]	Tower and aerial [d]	Sonar	Aerial [b]	Tower	Aerial [b]	Aerial [b]	Tower
1973	10,149 [e]		51,835	249,015	-					
1974	3,215 [e]		33,578	411,133	-	16,137		29,016	29,334	
1975	223,485		235,954	900,967	-	25,335		51,215	87,280	
1976	105,347		118,420	511,475	-	38,258		9,230 [e]	30,771	
1977	112,722		63,120	358,771	-	16,118		11,385	58,275	
1978	127,050		57,321	307,270	-	17,845		12,821	41,659	
1979	66,471		43,391	-	277,712	-		1,506	35,598	
1980	36,823 [e]		114,759	-	482,181	-		3,702 [e]	11,244 [e]	
1981	81,555	152,665	-	-	1,479,582	-		14,348	-	
1982	7,501 [e]	181,352	7,267 [e]	-	444,581	-		-	-	
1983	-	113,328	-	-	362,912	-		1,263 [e]	19,749	
1984	95,200 [e]	72,598	238,565	-	891,028	-		-	-	
1985	66,146	-	52,750	-	1,080,243	24,576		10,494	19,344	
1986	83,931	152,730	99,373	-	1,085,750	-		16,848	47,417	
1987	6,687 [e]	45,221	35,535	-	455,876	-		4,094	7,163	
1988	43,056	68,937	45,432	-	1,125,449	13,872		15,132	26,951	
1989	21,460 [e]	-	-	-	636,906	-		-	-	
1990	11,519 [e]	-	20,426 [e]	-	403,627	1,941 [e]		3,196 [e, f]	1,419 [e]	
1991	31,886	-	46,657	-	847,772	3,977		13,150	12,491	
1992	11,308 [e]	-	37,808 [e]	-	775,626	4,465		5,322	12,358	
1993	10,935 [e]	-	9,111 [e]	-	517,409	7,867		5,486	7,698	
1994	-	200,981 [g]	-	-	1,124,689	-	47,295	-	-	148,762 [g]
1995	-	172,148	-	-	1,339,418	12,849	77,193	10,875	29,949	236,890
1996	-	108,450	-	-	933,240	4,380	51,269	8,490 [e]	-	129,694
1997	-	51,139	-	-	605,751	2,775 [e]	48,018	-	-	157,975
1998	-	67,720	-	-	487,300	-	8,113	-	-	49,140
1999	-	32,587	-	-	437,355	-	5,339	-	-	30,076
2000	2,094 [e]	24,785	18,989 [e]	-	196,350	-	6,727	-	-	24,308

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	Andreafsky River			Anvik River		Rodo River	Kaltag River	Nulato River		
	East Fork		West Fork					South Fork	North Fork [a]	Mainstem
Year	Aerial [b]	Sonar, tower, or weir counts [c]	Aerial [b]	Tower and aerial [d]	Sonar	Aerial [b]	Tower	Aerial [b]	Aerial [b]	Tower
2001	-	2,134 [g]	-	-	224,059	-	-	-	-	-
2002	-	44,194	-	-	459,058	-	13,583	-	-	72,232
2003	-	22,461	-	-	256,920	-	3,056	-	-	19,590 [g]
2004	-	64,883	-	-	365,354	-	5,247	-	-	-
2005	-	20,127	-	-	525,392	-	22,093	-	-	-
2006	3,100 [e]	102,260	617	-	605,487	-	-	7,772	11,658	-
2007	-	69,642	-	-	459,038	-	-	21,825	15,277	-
2008	9,300	57,259	25,850	-	374,933	-	-	12,070	10,715	-
2009	736	8,770	3,877	-	193,098	621	-	2,120	567	-
2010	1,982	72,893	24,380	-	396,174	-	-	1,891	1,038	-
2011	12,889	100,473	10,020	-	642,529	6,011	-	9,454	8,493	-
2012	-	56,680	-	-	484,091	15,606	-	20,600	14,948	-
2013	10,965	61,234	9,685	38,915	577,876	-	-	13,695	13,230	-
2014	-	37,793	9,650	54,061	399,796	-	-	-	-	-
2015	6,004 [e]	48,809	2,837 [e]	36,871	374,968	3,685	-	4,102	9,525	-
2016	-	50,362	-	-	337,821	-	-	-	-	-
2017	-	55,532	11,655	38,191	415,139	-	-	4,890	7,882	-
2018	16,206	36,330	13,837	30,309	305,098	-	-	3,930	1,164	-
2019	26,048	49,881	17,198	15,499	249,014	-	-	2,612	4,898	-
2020	10,628	-	9,932	8,461	-	-	-	861	722	-
2021	-	2,531	-	-	18,819	-	-	-	-	-
2022 [h]	- [e]	- [c]	- [e]	397	46,436	-	-	14	53	-
Goal [i]		>40,000			350,000–700,000					
Average										
1973–2021	40,529	70,850	47,414	227,764	563,224	12,018	26,176	10,419	19,294	96,519
2012–2021	13,970	44,350	10,685	31,758	351,402	9,646	-	7,241	7,481	-
2017–2021	17,627	36,069	13,156	23,115	247,018	-	-	3,073	3,667	-
Minimum	736	2,134	617	8,461	18,819	621	3,056	861	567	19,590
Maximum	223,485	200,981	238,565	900,967	1,479,582	38,258	77,193	51,215	87,280	236,890

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	Henshaw Creek	Gisasa River		Hogatza River		Tozitna River	Chena River		Salcha River	
				Clear & Caribou Cr.	Clear Creek					
Year	Weir	Aerial [b]	Weir	Aerial [b]	Tower	Weir and Aerial [b]	Aerial [b]	Tower	Aerial [b]	Tower
1973							79 [e]		290	
1974		22,022				1,823	4,349		3,510	
1975		56,904		22,355		3,512	1,670		7,573	
1976		21,342		20,744		725 [e]	685		6,484	
1977		2,204 [e]		10,734		761 [e]	610		677 [e]	
1978		9,280 [e]		5,102		2,262	1,609		5,405	
1979		10,962		14,221		-	1,025 [e]		3,060	
1980		10,388		19,786		580	338		4,140	
1981		-		-		-	3,500		8,500	
1982		334 [e]		4,984 [e]		874	1,509		3,756	
1983		2,356 [e]		28,141		1,604	1,097		716 [e]	
1984		-		184 [e]		-	1,861		9,810	
1985		13,232		22,566		1,030	1,005		3,178	
1986		12,114		-		1,778	1,509		8,028	
1987		2,123		5,669 [e]		-	333		3,657	
1988		9,284		6,890		2,983	432		2,889 [e]	
1989		-		-		-	714 [e]		1,574 [e]	
1990		450 [e]		2,177 [e]		36	245 [e]		450 [e]	
1991		7,003		9,947		93	115 [e]		154 [e]	
1992		9,300		2,986		794	848 [e]		3,222	
1993		1,581		-		970	168	5,483	212	5,809
1994		6,827	51,116 [g]	8,247 [j]		-	1,137	9,984	4,916	39,450
1995		6,458	136,886	-	116,735	4,985	185 [e]	3,519 [g]	934 [e]	30,784
1996		-	158,752	27,090 [j]	100,912	2,310	2,061	12,810 [g]	9,722	74,827
1997		686 [e]	31,800	1,821 [e]	76,454	428 [e]	594 [e]	9,439 [g]	3,968 [e]	35,741
1998		-	21,142	120 [e]	212 [g]	7 [e]	24 [e]	5,901	370 [e]	17,289
1999		-	10,155	-	11,283	-	520	9,165	150	23,221
2000	24,457	-	11,410	-	19,376	480	105	3,515	228	20,516
2001	34,777	-	17,946	-	3,674	12,527	2	4,773	-	14,900

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Year	Henshaw Creek	Gisasa River		Hogatza River		Tozitna River	Chena River		Salcha River	
				Clear & Caribou Cr.	Clear Creek					
	Weir	Aerial [b]	Weir	Aerial [b]	Tower	Weir and Aerial [b]	Aerial [b]	Tower	Aerial [b]	Tower
2002	25,249	-	33,481	-	13,150	18,789	-	1,021 [g]	78	27,012
2003	21,400	-	25,999	-	6,159	8,487	-	573 [g]	-	-
2004	86,474	-	37,851	-	15,661	25,003	-	15,163 [g]	-	47,861
2005	237,481	-	172,259	-	26,420	39,700	219	16,873 [g]	4,320	194,933
2006	-	1,000	261,306	-	29,166 [k]	22,629	469	35,109 [g]	152	113,960
2007	44,425	-	46,257	-	6,029 [k]	8,470	-	4,999	4 [e]	13,069
2008	96,731	20,470	36,938	-	-	9,133	37	1,300 [g]	0 [e]	2,213
2009	156,933	1,060	25,904	3,981	-	8,434	-	16,516	-	31,035
2010	105,398	1,096	47,669	840	-	-	-	7,561	-	22,185
2011	248,247	13,228	95,796	3,665	-	11,351	4,600	-	1,154	66,564
2012	292,082	-	83,423	23,022	-	11,045	1,180	6,882	-	46,252
2013	285,008	9,300 [e]	80,055	-	-	-	135 [e]	21,372	-	60,981
2014	-	-	32,523	-	-	-	1,317	13,303 [g]	1993 [e]	-
2015	238,529	5,601	42,747	6,080	-	-	-	8,620	0 [e]	12,812
2016	286,780	-	66,670	-	-	-	-	6,493 [g]	-	2,897
2017	360,687	-	73,584	-	-	-	-	21,176 [g]	-	29,093
2018	-	8,058	-	3,307	-	-	-	13,084 [g]	-	39,996
2019	34,342	-	19,099	-	-	-	-	3,553	-	3,646
2020	-	754	-	-	-	-	-	- [m]	-	-
2021	3,729	-	-	-	-	-	-	578	-	2,193
2022 [h]	-	-	3,300	-	-	-	-	897	-	1,237
Goal [i]										
Average										
1973–2021	143,485	9,152	64,831	10,186	32,710	6,568	1,008	9,584	2,924	37,663
2012–2021	214,451	5,928	56,872	10,803	-	-	-	10,562	-	24,734
2017–2021	132,919	4,406	46,342	-	-	-	-	9,598	-	18,732
Minimum	3,729	334	10,155	120	212	7	2	573	0	2,193
Maximum	360,687	56,904	261,306	28,141	116,735	39,700	4,600	35,109	9,810	194,933

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Note: Unless otherwise noted blank cells indicate years prior to the project being operational. Dashes indicate years in which no information was collected. Minimum and maximum values exclude the most recent year data.

[a] Includes mainstem counts below the confluence of the North and South Forks, unless otherwise noted.

[b] Aerial survey counts are peak counts only, survey rating is fair or good unless otherwise noted.

[c] East Fork Andreafsky passage estimated with sonar 1981–1984, tower counts 1986–1988; weir counts from 1994–present. The project did not operate in 1985, 1989–1993, 2020 (COVID), and 2021 (forest fires followed by high water).

[d] From 1972–1979, counting tower operated; escapement estimate listed is the tower counts plus expanded aerial survey counts below the tower.

[e] Incomplete survey and/or poor survey timing or conditions resulted in minimal or inaccurate count.

[f] Mainstem counts below the confluence of the North and South Forks of the Nulato River included in the South Fork counts.

[g] Incomplete count due to late installation and/or early removal of project or high water events.

[h] Data are preliminary.

[I] Biological escapement goal (Andreafsky) or sustainable escapement goal (Anvik).

[j] Bureau of Land management helicopter survey.

[k] Project operated as a video monitoring system.

[l] Estimate includes an expansion for missed counting days based on average run timing. Minimum documented abundance from successful counting days was 30,411 (standard error not reported).

[m] Total escapement could not be determined. Sonar only operated 17 days due to flooding and debris.

Appendix B14.–Fall chum salmon abundance estimates or escapement estimates for selected spawning areas in the U.S. (Alaska) portions of the Yukon River drainage, 1971–2022.

		Tanana River drainage					Upper Yukon River drainage	
Year	Yukon River mainstem sonar estimate [a]	Toklat River [b]	Kantishna River abundance estimate [c]	Delta River [d]	Bluff Cabin Slough [e]	Upper Tanana River abundance estimate [f]	Teedriinjik-Chandalar River [g]	Sheenjek River [h]
1971								
1972				5,384 [i]				
1973				10,469 [i]				
1974		41,798		5,915 [i]				117,921 [j]
1975		92,265		3,734				227,935 [j]
1976		52,891		6,312				34,649 [j]
1977		34,887		16,876				59,878 [j]
1978		37,001		11,136 [i]				42,661 [j]
1979		158,336		8,355 [i]				120,129 [j]
1980		26,346 [k]		5,137 [i]	3,190 [l]			38,093 [j]
1981		15,623		23,508 [i]	6,120 [l]			102,137 [m]
1982		3,624		4,235 [i]	1,156			43,042 [m]
1983		21,869		7,705 [i]	12,715			64,989 [m]
1984		16,758		12,411 [i]	4,017			36,173 [m]
1985		22,750		17,276	2,655 [l]			179,727 [m, n]
1986		17,976		6,703	3,458		59,313	84,207 [n, o]
1987		22,117		21,180 [i]	9,395		52,416	153,267 [n, o]
1988		13,436		18,024 [i]	4,481 [l]		33,619	45,206 [o]
1989		30,421		21,342	5,386 [l]		69,161	99,116 [o]
1990		34,739		8,992	1,632		78,631	77,750 [o]
1991		13,347		32,905	7,198			86,496 [p]
1992		14,070		8,893	3,615 [l]			78,808
1993		27,838		19,857 [i]	5,550 [l]			42,922
1994		76,057		23,777	2,277 [l]			150,565
1995	1,148,196	54,513 [k]		20,587 [i]	19,460	268,173	323,586	241,855
1996	[q]	18,264		19,758	7,074 [d]	134,563	230,450	246,889
1997	579,767	14,511		7,705	5,707 [d]	71,661	211,914	80,423 [r]
1998	375,222	15,605		7,804	3,549 [d]	62,014	83,899	33,058
1999	451,505	4,551	27,199	16,534	7,559 [d]	97,843	92,685	14,229

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	Yukon River mainstem sonar estimate [a]	Tanana River drainage					Upper Yukon River drainage	
Year		Toklat River [b]	Kantishna River abundance estimate [c]	Delta River [d]	Bluff Cabin Slough [e]	Upper Tanana River abundance estimate [f]	Teedriinjik-Chandalar River [g]	Sheenjek River [h]
2000	273,206	8,911	21,450	3,001	1,595	34,844	71,048	30,084 [s]
2001	408,961	6,007 [t]	22,992	8,103	1,808 [l]	96,556 [u]	112,664	53,932
2002	367,886	28,519	56,665	11,992	3,116	109,961	94,472	31,642
2003	923,540	21,492	87,359	22,582	10,600 [l]	193,418	221,343	44,047 [v]
2004	633,368	35,480	76,163	25,073	10,270 [l]	123,879	169,848	37,878
2005	1,893,688	17,779 [j]	107,719	28,132	11,964 [l]	337,755	526,838	561,863 [n]
2006	964,238		71,135	14,055		202,669	254,778	160,178 [n]
2007	740,195		81,843	18,610		320,811	243,805	65,435 [n]
2008	636,525			23,055	1,198 [l]		178,278	50,353 [n]
2009	[q]			13,492	2,900 [l]		[q]	54,126 [n]
2010	458,103			17,993	1,610 [l]		167,532	22,053
2011	873,877			23,639	2,655 [l]		298,223	97,976 [n]
2012	778,158			9,377 [e]			205,791	104,701 [n]
2013	865,295	9,161 [l]		31,955	5,554 [l]		252,710	
2014	706,630			32,480 [e]	4,095 [l]		226,489	
2015	669,483	8,422 [l]		33,401 [e]	6,020 [l]		164,486	
2016	994,760	16,885 [l]		21,913 [e]	4,936 [l]		295,023	
2017	1,829,931			48,783 [e]			509,115	
2018	928,664	19,141 [l]		39,641 [e]	5,554 [l]		170,356	
2019	842,041			51,748 [e]	4,664 [l]		116,323	
2020	262,439	1,330 [l]		9,854 [e]	1,124 [l]			
2021	146,172			1,613	1,085 [l]		21,162	
2022 [w]	325,717	7,360 [l]		5,670 [e]	1,844 [l]		69,333	13,957 [n,r]
Escapement [x]	300,000 [y]			7,000 [z]			85,000 [z]	
Goal Ranges	600,000			20,000			234,000	

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		Tanana River drainage					Upper Yukon River drainage	
Year	Yukon River mainstem sonar estimate [a]	Toklat River [b]	Kantishna River abundance estimate [c]	Delta River [d]	Bluff Cabin Slough [e]	Upper Tanana River abundance estimate [f]	Teedriinjik-Chandalar River [g]	Sheenjek River [h]
Averages								
1971–2021	750,074	28,506	61,392	17,260	5,183	158,011	184,532	97,856
2012–2021	802,357	10,988	-	28,077	4,129	-	217,939	-
2017–2021	801,849	10,236	-	30,328	3,107	-	204,239	-
Minimum	146,172	1,330	21,450	1,613	1,085	34,844	21,162	14,229
Maximum	1,893,688	158,336	107,719	51,748	19,460	337,755	526,838	561,863

Note: Minimum and maximum values exclude the most recent year data. Dashes indicate a value cannot be calculated.

[a] New model estimates generated in 2015 and applied to dataset back to 1995 and used since.

[b] Expanded total abundance estimates for upper Toklat River index area using stream life curve (SLC) developed with 1987–1993 data, unless otherwise indicated. Index area includes Geiger Creek, Sushana River, and mainstem floodplain sloughs from approximately 0.25 mile upstream of roadhouse.

[c] Fall chum salmon abundance estimate for the Kantishna and Toklat River drainages is based on a mark–recapture program. Number of tagging and recovery wheels changed over the years.

[d] Population estimate generated from replicate foot surveys and stream life data (area under the curve method), unless otherwise indicated.

[e] Peak foot survey, unless otherwise indicated.

[f] Fall chum salmon abundance estimate for the upper Tanana River drainage is based on a mark–recapture program. Upper Tanana River consists of that portion upstream of the confluence with the Kantishna River. Number of tagging and recovery wheels changed over the years.

[g] Single-beam sonar estimate for 1986–1990 (not used in run reconstruction), split-beam sonar estimate 1995–2006, DIDSON in use since 2007, project was aborted in 2009 and not operated in 2020. Sonar counts on the Teedriinjik are extrapolated after conclusion of the project through October 9 from 1995–present, with 2018 expanded to October 14 due to late run timing.

[h] Single-beam sonar estimate beginning in 1981, split-beam sonar estimate 2003–2004, and DIDSON 2005–2012. Sonar counts on the Sheenjek River are extrapolated after conclusion of the project through October 9 from 2005–2012 and 2022.

[I] Estimates are a total spawner abundance, using migratory time density curves and stream life data.

[j] Total escapement estimate using sonar to aerial survey expansion factor of 2.22.

[k] Minimal estimate because of late timing of ground surveys with respect to peak of spawning.

[l] Aerial survey count, unless otherwise indicated.

[m] Project started late, estimated escapements expanded for portion missed using average run timing curves based on Teedriinjik (1986–1990) and Sheenjek (1991–1993) rivers.

[n] Sonar counts include both banks in 1985–1987, 2005–2009, 2011–2012, and 2022.

[o] Expanded estimates for period approximating second week of August through fourth week of September, using annual Chandalar River run timing data (1986–1990).

[p] Total abundance estimates are for the period approximating second week of August through fourth week of September (1991–2012). Comparative escapement estimates before 1986 are considered more conservative, approximating the period end of August through September.

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[q] Project operated all or partial season, estimate was not useable.

[r] Data interpolated due to high water (from August 29–September 3, 1997 and September 12–19, 2022) during buildup to peak passage on the Sheenjek River.

[s] Sheenjek sonar project ended early (September 12) because of low water therefore estimate was expanded based on average run timing (62%).

[t] Minimal estimate because Sushana River was breached by the main channel and uncountable.

[u] Low numbers of tags deployed and recovered resulted in an estimate with an extremely large confidence interval (95% CI +/- 41,072).

[v] Sheenjek sonar project ended on peak daily passages due to late run timing, estimate was expanded based on run timing (87%) at Rampart.

[w] Data are preliminary.

[x] Escapement Goals (EG) expressed as ranges.

[y] Drainagewide escapement goal is related to mainstem passage estimate based on the sonar near Pilot Station minus upriver harvests.

[z] Escapement goal revised to a sustainable escapement goal range in 2019 based on percentile method.

Appendix B15.–Fall chum salmon escapement estimates for selected spawning areas in Canadian (Yukon) portions of the Yukon River drainage, 1971–2022.

Year	Mainstem Yukon River Index [a,b]	Koidern River [b]	Kluane River [b, c]	Teslin River [b, d]	Porcupine Drainage: Fishing Branch River [e]	Porcupine Drainage: Porcupine River Sonar
1971					312,800 [f]	
1972			198 [g,h]		35,230 [i]	
1973	383		2,500		15,991	
1974			400		31,841	
1975	7,671		362 [g]		353,282	
1976			20		36,584 [f]	
1977			3,555		88,400 [f]	
1978			0 [g]		40,800 [f]	
1979			4,640 [g]		119,898 [f]	
1980			3,150		55,268 [f]	
1981			25,806		57,386 [h]	
1982	1,020 [j]		5,378		15,901 [f]	
1983	7,560		8,578 [g]		27,200 [f]	
1984	2,800 [k]	1,300	7,200	200	15,150 [f]	
1985	10,760	1,195	7,538	356	56,223	
1986	825	14	16,686	213	31,811	
1987	6,115	50	12,000		49,038	
1988	1,550	0	6,950	140	23,645	
1989	5,320	40	3,050	210 [l]	44,042	
1990	3,651	1	4,683	739	35,000 [m]	
1991	2,426	53	11,675	468	37,870	
1992	4,438	4	3,339	450	22,539	
1993	2,620	0	4,610	555	28,707	
1994	1,429 [j]	20 [j]	10,734	209 [l]	65,247	
1995	4,701	0	16,456	633	51,971 [n]	
1996	4,977		14,431	315	77,302	
1997	2,189		3,350	207	27,031	
1998	7,292		7,337	235	13,687	
1999			5,136	19 [i]	12,958	
2000	933 [l]		1,442	204	5,057	
2001	2,453		4,884	5	21,737	
2002	973		7,147	64	13,636	
2003	7,982		39,347	390	29,713	
2004	3,440		18,982	167	20,417	

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Year	Mainstem Yukon River Index [a,b]	Koidern River [b]	Kluane River [b, c]	Teslin River [b, d]	Porcupine Drainage: Fishing Branch River [e]	Porcupine Drainage: Porcupine River Sonar
2005	16,425		34,600	585	119,058	
2006	6,553		18,208	620	30,954	
2007					32,150	
2008					19,086 [n]	
2009					25,828 [o]	
2010					15,413 [o]	
2011					13,085 [n,o]	14,640 [p]
2012					22,399 [o]	33,496 [p]
2013					25,376 [q]	35,615
2014					7,304 [q]	17,244 [r]
2015					8,351	21,397
2016					29,397 [x]	54,395
2017			16,265 [s]		48,524 [x]	67,818
2018			1,734		10,151 [x]	[t]
2019			928		18,171 [x,y]	27,447
2020	323		120		4,795 [x,y]	[u]
2021	1,131		64		2,413 [x,y]	3,486
2022	238		290		2,934 z	3,804
Goal [v]	50,000-120,000					
IMEG [w]	22,000-49,000					
Averages						
1971–2021	4,212	223	8,337	317	45,212	30,615
2012–2021	727	-	3,822	-	17,688	32,612
2017–2021	727	-	3,822	-	16,811	32,917
Minimum	323	0	0	5	2,413	3,486
Maximum	16,425	1,300	39,347	739	353,282	67,818

Note: Minimum and maximum values exclude the most recent year data. Dashes indicate a value cannot be calculated.

[a] Aerial survey, unless otherwise indicated.

[b] Index area includes Tatchun Creek to Fort Selkirk.

[c] Index area includes Duke River to end of spawning sloughs below Swede Johnson Creek.

[d] Index area includes Boswell Creek area (5 km below to 5 km above confluence).

[e] Weir count, unless otherwise indicated. Weir counts from 1972–1975, 1985–1989, 1991–1992, 1996–2012, and 2022 were expanded to represent the remainder of the run after the project was terminated for the season through October 25.

[f] Total escapement estimated using weir to aerial survey expansion factor of 2.72, unless otherwise indicated.

[g] Foot survey.

[h] Initial aerial survey count doubled before applying the weir/aerial expansion factor of 2.72 because only half of the spawning area was surveyed.

[I] Weir installed September 22. Estimate consists of weir count of 17,190 after September 22, and tagging passage estimate of 17,935 before weir installation.

[j] Boat survey.

[k] Total index area not surveyed. Survey included the mainstem Yukon River between Yukon Crossing to 30 km below Fort Selkirk.

[l] Incomplete and/or poor survey conditions resulting in minimal or inaccurate counts

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[m] Weir not operated. Although only 7,541 chum salmon were counted on a single survey flown October 26, a population estimate of approximately 27,000 fish was made through date of survey, based upon historic average aerial-to-weir expansion of 28%. Actual population of spawners was reported by DFO as between 30,000–40,000 fish considering aerial survey timing.

[n] Incomplete count caused by late installation and/or early removal of project or high water events.

[o] Run timing was late and counts were expanded to represent the remainder of the run after the project was terminated for the season.

[p] Counts taken from corresponding R&E reports. Polynomial expansion calculated from last day of counts to October 14.

[q] Fishing Branch River weir did not operate, and escapement was estimated from a sonar operated on the upper Porcupine River minus Old Crow harvest and the proportion of radio tags to Fishing Branch River.

[r] Left bank estimate (15,363) was re-calculated post 2014 season after extensive review of 2014 sonar file data. The 2014 in season right bank estimate was deemed substandard and discarded. The 2014 post season estimate (1881) was calculated using the average proportion of right bank passage from 2015 and 2016.

[s] Aerial surveys resumed following permanent diversion of Kluane Lake headwaters in 2016 by glacial retreat.

[t] High water in August and early ice up prevented a complete passage estimate for Porcupine River fall chum salmon.

[u] Project cancelled due to COVID-19.

[v] Escapement goal in Pacific Salmon Treaty for Fishing Branch River fall chum salmon.

[w] Interim Management Escapement Goal (IMEG) established for 2008–2010, based on percentile method.

[x] Sonar augmented brief periods when the weir was inoperable.

[y] Video box was incorporated to visually identify and measure fish.

[z] Sonar was the primarily tool to estimate escapement, with the weir focusing fish passage in front of lens.

Appendix B16.–Estimated spawning escapement of Canadian-origin mainstem Yukon River fall chum salmon, 1980–2022.

Date	Eagle sonar estimate	Eagle sonar expanded estimate [a]	U.S. harvest above Eagle sonar [b]	U.S./Canada mainstem border passage estimate	[b]	Canadian mainstem harvest	Spawning escapement estimate	[c]
1980				39,130		16,218	22,912	
1981				66,347		19,281	47,066	d
1982				47,049		15,091	31,958	
1983				118,365		27,490	90,875	
1984				81,900		25,267	56,633	d
1985				99,775		37,765	62,010	
1986				101,826		13,886	87,940	
1987				125,121		44,345	80,776	
1988				69,280		32,494	36,786	
1989				55,861		20,111	35,750	
1990				82,947		31,212	51,735	
1991				112,303		33,842	78,461	
1992				67,962		18,880	49,082	
1993				42,165		12,422	29,743	
1994				133,712		35,354	98,358	
1995				198,203		40,111	158,092	
1996				143,758		21,329	122,429	
1997				94,725		9,306	85,419	
1998				48,047		1,795	46,252	
1999				72,188	e	13,636	58,552	
2000				57,978	e	4,246	53,732	
2001				38,769	e	5,278	33,491	
2002				104,853	e	6,232	98,621	
2003				153,656	e	10,523	143,133	
2004				163,625	e	9,545	154,080	
2005				451,477		13,979	437,498	
2006	236,386	245,290	17,775	227,515	f,g	6,617	220,898	
2007	235,871	265,008	18,691	246,317	f,g	9,330	236,987	
2008	171,347	185,409	11,381	174,028	f,g	6,130	167,898	
2009	95,462	101,734	6,995	94,739	f	1,113	93,626	
2010	125,547	132,930	11,432	121,498	f	3,709	117,789	
2011	212,162	224,355	12,477	211,878	f	6,312	205,566	
2012	147,710	153,248	11,681	141,567	f	3,905	137,662	
2013	200,754	216,791	12,642	204,149	f	3,887	200,262	
2014	167,715	172,887	13,041	159,846	f	3,050	156,796	
2015	112,136	125,095	12,540	112,555	f	3,897	108,658	

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Date	Eagle sonar estimate	Eagle sonar expanded estimate [a]	U.S. harvest above Eagle sonar	U.S./Canada mainstem border passage estimate [b]	Canadian mainstem harvest	Spawning escapement estimate [c]
2016	144,035	161,027	13,015	148,012 [f]	2,745	145,267
2017 [h]	407,166	419,099	14,110	404,989 [f]	3,404	401,585
2018 [h]	136,732	168,798	11,715	157,083 [f]	2,957	154,126
2019 [h]	101,678	113,256	10,759	102,497 [f]	2,759	99,738
2020 [h]	20,766	23,512	0	23,512 [f]	0	23,512
2021 [h]	19,668	23,170	0	23,170 [f]	0	23,170
2022 [h]	21,063	22,075	16	22,059 [f]	0	22,059
Goal [i]						>80,000
IMEG [c]						70,000–104,000
Averages						
1980–2021	158,446	170,726	11,141	126,771	13,797	112,974
2012–2021	145,836	157,688	9,950	147,738	2,660	145,078
2017–2021	137,202	149,567	7,317	142,250	1,824	140,426
Minimum	19,668	23,170	0	23,170	0	22,912
Maximum	407,166	419,099	18,691	451,477	44,345	437,498

Note: Table includes information on U.S/Canada border passage estimates, Eagle area subsistence harvest between the sonar and the border (where applicable), and Canadian mainstem harvest. Estimates for subsistence caught salmon between the sonar site and border (Eagle area) prior to 2008 include an unknown portion caught below the sonar site. This number is most likely in the thousands for chum salmon. Starting in 2008, the estimates for subsistence-caught salmon only include salmon harvested between the sonar site and the U.S./Canada border. Minimum and maximum values exclude the most recent year data.

[a] Sonar estimates include an expansion for fish that may have passed after operations ceased through October 18. In 2018, expanded to October 23 due to late run timing.

[b] Border passage estimate is based on a mark–recapture estimate unless otherwise indicated.

[c] Estimated mainstem border passage minus Canadian mainstem harvest (excludes Fishing Branch River). Current interim management escapement goal (IMEG) is 70,000 to 104,000 fall chum salmon. IMEG was established in 2010 based on brood table of Canadian-origin mainstem stocks (1982–2003).

[d] Escapement estimate based on mark–recapture program unavailable. Estimate based on assumed average exploitation rate.

[e] From 1999–2004, border passage estimates were revised using a Stratified Population Analysis System (Arnason et. al 1995).

[f] From 2006–present, border passage estimate is based on sonar minus harvest from U.S. residents upstream. However, it was not until 2008 that Eagle community harvests were reported seperately by permits.

[g] Mark–recapture border passage estimates include 217,810; 235,956; and 132,048 fish from 2006–2008 respectively, during transition to sonar.

[h] Data are preliminary as harvest information is not published yet.

[I] Escapement goal in Pacific Salmon Treaty for mainstem Yukon River Canadian-origin fall chum salmon.

Appendix B17.–Coho salmon passage estimates or escapement estimates for selected spawning areas in the U.S. (Alaska) portion of the Yukon River drainage, 1972–2022.

		Nenana River drainage				Upper Tanana River drainage		
Year	Yukon River mainstem sonar estimate [a]	Lost Slough	Nenana mainstem [b]	Wood Creek	Seventeen Mile Slough	Delta Clearwater River [c]	Clearwater Lake and outlet	Richardson Clearwater River
1972						632 (b)	417 (f)	454 (f) [d]
1973						3,322 (u)	551 (u)	375 (u)
1974		1,388 (f)			27 (f)	3,954 (h) [d]	560 (f)	652 (h)
1975		827 (f)			956 (f)	5,100 (b)	1,575 (b)	
1976		118 (f)			281 (f)	1,920 (b)	1,500 (b)	80 (f) [d]
1977		524 (f) [d]		310 (g)	1,167 (f)	4,793 (b)	730 (b)	327 (f)
1978		350 (f)		300 (g)	466 (f)	4,798 (b)	570 (b)	
1979		227 (f)			1,987 (f)	8,970 (b)	1,015 (b)	372 (f)
1980		499 (f) [d]		1,603 (g)	592 (f)	3,946 (b)	1,545 (b)	611 (f)
1981		274 (f)		849 (w) [e]	1,005 (f)	8,563 (u) [f]	459 (f)	550 (f)
1982				1,436 (w) [e]	(f)	8,365 (g) [f]		
1983		766 (f)		1,042 (w)	103 (f)	8,019 (b) [f]	253 (f)	88 (f)
1984		2,677 (f)		8,826 (w)	(f)	11,061 (b)	1,368 (f)	428 (f)
1985		1,584 (f)		4,470 (w)	2,081 (f)	5,358 (b)	750 (f)	
1986		794 (f)		1,664 (w)	218 (b)	10,857 (b)	3,577 (f)	146 (f) [d]
1987		2,511 (f)		2,387 (w)	3,802 (f)	22,300 (b)	4,225 (b)	
1988		348 (f)		2,046 (w)		21,600 (b)	825 (b)	
1989				412 (w)	824 (f) [d]	11,000 (b)	1,600 (b)	483 (f)
1990		688 (f)	1,308 (f)		(h) [d]	8,325 (b)	2,375 (b)	
1991		564 (f)	447 (f)		52 (f)	23,900 (b)	3,150 (b)	
1992		372 (f)			490 (f)	3,963 (b)	229 (b)	500 (f)
1993		350 (f)	419 (f)	666 (w) [g]	581 (h)	10,875 (b)	3,525 (b)	
1994		944 (h)	1,648 (h)	1,317 (w) [h]	2,909 (h)	62,675 (b)	3,425 (b)	5,800 (f)
1995	115,569	4,169 (f)	2,218 (h)	500 (w)	1,512 (h)	20,100 (b)	3,625 (b)	
1996	[i]	2,040 (h)	2,171 (h)	201 (u) [d]	3,668 (g/b)	14,075 (b)	1,125 (h) [d]	
1997	118,065	1,524 (h)	1,446 (h)	[j]	1,996 (h)	11,525 (b)	2,775 (b)	
1998	146,365	1,360 (h) [d]	2,771 (h) [d]	[j]	1,413 (g/b)	11,100 (b)	2,775 (b)	
1999	76,174	1,002 (h) [d]	745 (h) [d]	370 (h)	662 (h) [d]	10,975 (b)		

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Year	Yukon River mainstem sonar estimate [a]	Nenana River drainage: Lost Slough	Nenana River drainage: Nenana mainstem [b]	Nenana River drainage: Wood Creek	Nenana River drainage: Seventeen Mile Slough	Upper Tanana River drainage: Delta Clearwater River [c]	Upper Tanana River drainage: Clearwater Lake and outlet	Upper Tanana River drainage: Richardson Clearwater River
2000	206,365	55 (h) [d]	68 (h) [d]	[j]	879 (h) [d]	9,225 (b)	1,025 (b)	2,175 (h)
2001	160,272	242 (h)	859 (h)	699 (h)	3,753 (h)	46,985 (b)	4,425 (b)	1,531 (f)
2002	137,077	0 (h)	328 (h)	935 (h)	1,910 (h)	38,625 (b)	5,900 (b)	874 (f)
2003	280,552	85 (h)	658 (h)	3,055 (h)	4,535 (h)	102,800 (b)	8,800 (b)	6,232 (h)
2004	207,844	220 (h)	450 (h)	840 (h)	3,370 (h)	37,550 (b)	2,925 (b)	8,626 (h)
2005	194,372	430 (h)	325 (h)	1,030 (h)	3,890 (h)	34,293 (b)	2,100 (b)	2,024 (h)
2006	163,889	194 (h)	160 (h)	634 (h)	1,916 (h)	16,748 (b)	4,375 (b)	271 (h)
2007	192,406	63 (h)	520 (h)	605 (h)	1,733 (h)	14,650 (b)	2,075 (b)	553 (h)
2008	145,378	1,342 (h)	1,539 (h)	578 (h)	1,652 (h)	7,500 (b)	1,275 (b)	265 (h)
2009	[i]	410 (h)		470 (h)	680 (h)	16,850 (b)	5,450 (b)	155 (h)
2010	177,724	1,110 (h)	280 (h)	340 (h)	720 (h)	5,867 (b)	813 (b)	1,002 (h)
2011	149,533	369 (h)		0 (h) [j]	912 (h)	6,180 (b)	2,092 (b)	575 (h)
2012	130,734		106 (h)	0 (h) [j]	405 (h)	5,230 (b)	396 (h)	515 (h)
2013	110,515	721 (h)		55 (h)	425 (h)	6,222 (b)	2,221 (h)	647 (h)
2014	283,421	333 (h)	378 (h)	649 (h)	886 (h)	4,285 (b)	434 (h)	1,941 (h)
2015	121,193	242 (h)	1,789 (h)	1,419 (h)	3,890 (h)	19,533 (b)	1,621 (h)	3,742 (h)
2016	168,297	334 (h)	1,680 (h)	1,327 (h)	2,746 (h)	6,767 (b)	1,421 (h)	1,350 (h)
2017	166,320	1,278 (h)	862 (h)	2,025 (h)	1,942 (h)	9,617 (b)		
2018	136,347	1,822 (h)	241 (h)	361 (h)	347 (h)	2,884 (b)	2,465 (h)	976 (h)
2019	86,401		749 (h)	184 (h)	424 (h)	2,043 (b)	258 (h)	300 (h)
2020	107,680	28 (h)	206 (h)	231 (h)	507 (h)	2,557 (b)	210 (h)	475 (h)
2021	37,257	126 (h)	104 (h)	226 (h)	213 (h)	913 (b)	130 (h)	17 (h)
2022 [k]	92,102					1,750 (b)	101 (h)	57 (h)

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Year	Yukon River mainstem sonar estimate [a]	Nenana River drainage: Lost Slough	Nenana River drainage: Nenana mainstem [b]	Nenana River drainage: Wood Creek	Nenana River drainage: Seventeen Mile Slough	Upper Tanana River drainage: Delta Clearwater River [c]	Upper Tanana River drainage: Clearwater Lake and outlet	Upper Tanana River drainage: Richardson Clearwater River
SEG [l]						5,200-17,000		
Averages								
1972–2021	152,790	802	874	1,160	1,467	14,388	2,020	1,289
2012–2021	134,817	611	679	648	1,179	6,005	1,017	1,107
2017–2021	106,801	814	432	605	687	3,603	766	442
Minimum	37,257	0	68	0	27	632	130	17
Maximum	283,421	4,169	2,771	8,826	4,535	102,800	8,800	8,626

Note: Only peak counts presented. Survey rating is fair to good, unless otherwise noted. Denotations of survey methods include: (b)=boat, (f)=fixed wing, (g)=ground/foot, (h)=helicopter, (u)=undocumented, and (w)=weir. Minimum and maximum values exclude the most recent year data.

[a] Passage estimates for coho salmon are incomplete. The sonar project is terminated prior to the end of the coho salmon run. New model estimates generated in 2015 and applied to dataset back to 1995 and used since.

[b] Index area includes mainstem Nenana River between confluences of Lost Slough and Teklanika River.

[c] Index area is lower 28km (17.5 mi) of system.

[d] Poor survey resulted in minimal count.

[e] Weir was operated at the mouth of Clear Creek (Shores Landing).

[f] Expanded estimate based on partial survey counts and historic distribution of spawners from 1977–1980.

[g] Weir project terminated on October 4, 1993. Weir normally operated until mid- to late October.

[h] Weir project terminated September 27, 1994. Weir normally operated until mid- to late October.

[i] Project operated all or partial season, estimate was not useable.

[j] No survey of Wood Creek due to obstructions in creek or surveyed with zero fish observed.

[k] Data are preliminary. All Nenana River drainage surveys were affected by a military airspace closure in 2022.

[l] Sustainable escapement goal (SEG) established January 2004 (replaces BEG of greater than 9,000 fish established March 1993), based on boat survey counts of coho salmon in the lower 17.5 river miles during the period October 21–27.

Appendix B18.–Yukon River Salmon Agreement specified obligations for harvest shares, border passage and spawning escapement for mainstem Canadian-origin Yukon River Chinook salmon, 2001–2022

Year	Total estimated Canadian-origin run size[a]	Total allowable catch (TAC)[b] From	Total allowable catch (TAC)[b] To	U.S. share (%) of TAC 0.74	U.S. share (%) of TAC 0.8	U.S. harvest[c]	Border passage objective[d]	Border passage[e]	Canada share (%) of TAC 0.20	Canada share (%) of TAC 0.26	Canada mainstem harvest	Yukon River Panel goal or IMEG[f] From	Yukon River Panel goal or IMEG[f] To	Spawning escapement[g]
2001	77,354	49,354		36,522	39,483	23,325	39,351	54,029	9,871	12,832	9,774	28,000	[h]	44,255
2002	73,417	45,417		33,609	36,334	30,058	38,446	43,359	9,083	11,808	9,070	28,000	[i]	34,289
2003	118,022	90,022		66,616	72,018	59,940	48,705	58,082	18,004	23,406	9,446	28,000	[i]	48,636
2004	105,942	77,942		57,677	62,354	57,831	45,927	48,111	15,588	20,265	10,946	28,000	[j]	37,165
2005	86,895	58,895		43,582	47,116	44,650	41,546	42,245	11,779	15,313	10,977	28,000		31,268
2006	84,845	56,845		42,065	45,476	48,097	41,074	36,748	11,369	14,780	8,758	28,000		27,990
2007	70,440	27,440	37,440	20,306	29,952	48,320	40,611	22,120	5,488	9,734	4,794	33,000	43,000	17,326
2008 [e]	62,358	17,358		12,845	13,886	25,329	48,992	37,029	3,472	4,513	3,399	45,000		33,630
2009	87,221	42,221		31,244	33,777	17,646	54,711	69,575	8,444	10,977	4,297	45,000		65,278
2010	59,736	4,736	17,236	3,505	13,789	25,271	45,214	34,465	947	4,481	2,456	42,500	55,000	32,009
2011	71,725	16,725	29,225	12,377	23,380	20,824	47,972	50,901	3,345	7,599	4,594	42,500	55,000	46,307
2012	48,498	0	5,998	0	4,798	13,842	43,280	34,656	0	1,559	2,000	42,500	55,000	32,656
2013	37,177	0	0	0	0	6,604	42,500	30,573	0	0	1,904	42,500	55,000	28,669
2014	64,886	9,886	22,386	7,316	17,909	1,455	46,399	63,431	1,977	5,820	100	42,500	55,000	63,331
2015	87,323	32,323	44,823	23,919	35,858	3,649	51,559	83,674	6,465	11,654	1,000	42,500	55,000	82,674
2016	82,765	27,765	40,265	20,546	32,212	11,198	50,511	71,567	5,553	10,469	2,769	42,500	55,000	68,798
2017	93,188	38,188	50,688	28,259	40,551	21,373	52,908	71,815	7,638	13,179	3,500	42,500	55,000	68,315
2018	76,356	21,356	33,856	15,804	27,085	19,092	49,037	57,264	4,271	8,803	2,790	42,500	55,000	54,474
2019	72,620	17,620	30,120	13,039	24,096	27,804	48,178	44,816	3,524	7,831	2,764	42,500	55,000	42,052
2020	45,501	0	3,001	0	2,401	12,171	42,890	33,330	0	780	2,363	42,500	55,000	30,967
2021	32,972	0	0	0	0	1,214	42,500	31,758	0	0	306	42,500	55,000	31,452
2022	13,144	0	0	0	0	1,121	42,500	12,023	0	0	46	42,500	55,000	11,978

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Note: The table does not represent a dataset, its intent is to represent the information at the time. Data presented for each year is from the assessment methods of that year, and represents final values (may not be the same as preliminary values published in that years annual JTC report, or as retroactively finalized values using revised calculation techniques). Gray shaded boxes indicate Yukon River Salmon Agreement performance obligations that were not met.

[a] Total estimated Canadian-origin run size is calculated as border passage plus Alaskan harvest of Canadian-origin Chinook salmon. From 2001 to 2012, these values were not specifically presented in annual JTC reports, and have been retroactively calculated based on best available historical information, from the assessment methods used in that year.

[b] Total run size, total allowable catch (TAC) and harvest share calculations are finalized post-season. TAC is calculated by subtracting the IMEG from the total run size. Delivering the IMEG plus the midpoint of Canada's harvest share to the Alaska-Yukon border is part of the U.S. obligation as per the Pacific Salmon Treaty's Yukon River Salmon Agreement.

[c] Scale pattern analysis was used to determine the U.S. Harvest stock proportions prior to 2004. Since 2004 U.S. Harvest estimates of the Canadian-origin stock were estimated by applying the stock proportions collected from harvest sampling to number of fish harvested in Alaska. Beginning in 2014, the U.S. harvest includes harvest from the Coastal District. Values from 2001-2012 were obtained from the annual ADF&G report "Origins of Chinook Salmon in Yukon Area Fisheries", and values from 2013 onwards have been reported in the annual JTC Report.

[d] Border passage objective is calculated post season as the agreed spawning escapement goal plus the mid-point of the Canadian harvest share. For years where the escapement goal is a range, this is represented as the average of the Canadian Harvest Share, plus the lower end of the escapement goal.

[e] From 2001 to 2007 the border passage was estimated from a mark recapture project. Beginning in 2008 border passage was estimated from the Eagle sonar, minus any Alaskan harvest upstream of the sonar. The bold horizontal line between 2007 and 2008 indicates the JTC's recommendation to use the Eagle sonar as the primary assessment tool for the border passage estimate. Values from this year forward are sonar based.

[f] Yukon River Panel goals have changed over time, and have been both points and ranges. IMEGs are not biologically based escapement goals.

[g] Spawning escapement is calculated as the border passage estimate minus the harvest in Canada using the assessment methods of that year.

[h] In the 2001 JTC report, there are some references to a lower goal of 18,000 although further reports state the goal of 28,000 was the only goal for this year.

[i] In 2002 and 2003, the Chinook salmon goal was set at 25,000 fish. However, if the U.S. conducted a commercial fishery the goal would be increased to 28,000 fish.

[j] In 2004, the escapement target for Canadian-origin Upper Yukon Chinook salmon was >28,000 Chinook salmon. If the run was gauged to be sufficiently strong, the escapement target could range up to 38,000 Chinook salmon, although the Panel did not describe what constituted a “strong” run.

Appendix B19.–Summary of management and conservation measures implemented in the U.S. (Alaska) and Canada for Chinook salmon, 2001–2022.

Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2001	Subsistence fishing schedule implemented (and continued in following years).	No commercial fishing for Chinook or summer chum salmon.	Unrestricted	Test fishery implemented in early season; commercial/domestic openings determined by weekly estimates of abundance, public angling open.
2002		Chinook commercial fishing shifted to midpoint of run and later.	Unrestricted	Test fishery implemented in early season; commercial/domestic openings determined by weekly estimates of abundance, public angling open.
2003		Chinook commercial fishing shifted to midpoint of run and later.	Unrestricted	Test fishery implemented in early season; commercial/domestic openings determined by weekly estimates of abundance, public angling open.
2004		Chinook commercial fishing shifted to midpoint of run and later.	Unrestricted	Test fishery implemented in early season; commercial/domestic openings determined by weekly estimates of abundance, public angling open.
2005		Chinook commercial fishing shifted to midpoint of run and later.	Unrestricted	Commercial/domestic openings determined by weekly estimates of abundance, public angling open.
2006		Chinook commercial fishing delayed until start of second pulse.	Unrestricted	Commercial/domestic openings determined by weekly estimates of abundance, public angling open.
2007		Short fishing period on historic first quarter point date. Majority of harvest spread over middle 50% of the run.	Unrestricted	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.
2008	Protection on 2nd and 3rd pulses.	Chinook commercial fishing closed.	Voluntary reduction in harvest.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.
2009	1st and 2nd pulse closure.	Chinook commercial fishing closed and no sale of incidental catch; summer chum fishing delayed.	Voluntary reduction in harvest in early season.	Commercial/domestic openings determined by weekly estimates of abundance, public angling open.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2010		Chinook commercial fishing closed; summer chum fishing delayed.	Voluntary reduction in harvest.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery.
2011	1st and 2nd pulse closure; additional fishing time reductions in upper districts; 7.5 inch mesh size restriction all season.	Chinook commercial fishing closed and no sale of incidental catch; summer chum fishing delayed; summer chum fishing restricted to certain areas of low Chinook abundance.	Voluntary reduction in harvest in early season.	Chinook commercial/domestic fishing closed; recreational fishing varied to non-retention in the public angling fishery, angling closure at Tatchun River, public angling restrictions lifted late in the season.
2012	1st and 2nd pulse closure; additional fishing time reductions in upper districts; 6 inch mesh size restriction after closures.	Chinook commercial fishing closed and no sale of incidental catch; summer chum fishing delayed and restricted to areas of low Chinook abundance; chum fish wheels attended at all times and Chinook released alive.	Voluntary reduction in harvest.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.
2013	1st, 2nd and 3rd pulse closures - limited opportunity in between pulses; additional fishing time reductions in upper districts; 6 inch mesh size restriction all season.	Chinook commercial fishing closed and no sale of incidental catch. Summer chum fishing with beach seines and dip nets, all Chinook released alive. Gillnet summer chum fishing restricted to 5.5 inch and 30 meshes; delayed and restricted to areas of low Chinook abundance; chum fish wheels attended at all times and Chinook released alive.	Voluntary reduction in harvest.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River and Teslin River.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2014	Entire Yukon River mainstem closed to Chinook-directed fishing; no gillnets allowed greater than 4 inch mesh size to harvest non-salmon species; opportunity to harvest summer chum salmon in Districts 1-4 using elective gear that allows immediate and live release of Chinook allowed (dip nets, beach seines, and fish wheels); short openings with 6 inch or smaller gillnets allowed in each districts after greater than 90% of Chinook salmon run had passed through; greater than 99% in District 5.	Chinook commercial fishing closed; liberal opportunity for summer chum fishing with beach seines and dip nets - all Chinook released immediately and alive; 6 inch or smaller gillnet summer chum fishing delayed until majority of Chinook run complete; no sale of incidental Chinook; chum fish wheels had to be attended at all times and all Chinook released immediately to the water; concurrent subsistence and commercial openings.	Regulatory removal of Total Allowable Catch (TAC) until 3rd quartile, voluntary reduction or closure maintained by majority of First Nations.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River and Teslin River

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2015	Entire river closed to Chinook-directed fishing; no gillnets allowed greater than 4 inch mesh size to harvest non-salmon species; opportunity to harvest summer chum salmon in Districts 1–4 using selective gear that allows immediate and live release of Chinook (dipnets, beach seines, and fish wheels); short openings with 6 inch or smaller gillnets allowed in each district between pulses of Chinook salmon when summer chum abundance was high. Subsistence fishing was allowed in Subdistrict 5-D on the early trickle of Chinook salmon. Subsistence schedules liberalized in Districts 4 and 5 once Chinook salmon border escapement was surpassed.	Chinook commercial fishing closed; liberal opportunity for summer chum fishing with beach seines and dipnets - all Chinook released immediately and alive; 6 inch or smaller gillnet summer chum fishing delayed until majority of Chinook run complete; no sale of incidental Chinook; fish wheels had to be attended at all times and all Chinook released immediately to the water; concurrent subsistence and commercial openings.	Regulatory removal of TAC until 2nd quartile, voluntary reduction or closure maintained by majority of First Nations.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2016	Early season only: Districts 1–5 using selective gear requiring live release of Chinook (dipnets, beach seines, and fish wheels); Subdistrict 5-D had open fishing on the early trickle with 6 inch gillnets. Reduced regulatory schedule fishing with gillnets restricted to 6” in most districts. Followed by surgical openings with 7.5 inch gillnets late in the run. Subsistence schedules liberalized in Districts 4 and 5 once Chinook salmon border escapement was surpassed.	Chinook commercial fishing closed; liberal opportunity for summer chum fishing with selective gear - all Chinook released immediately and alive; 6 inch or smaller gillnet summer chum fishing delayed until majority of Chinook run complete; no sale of incidental Chinook. No concurrent subsistence and commercial openings.	Open with recommendation for reduced harvest (30%), voluntary reduction or closure maintained by majority of First Nations.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2017	Early season only: Districts 1–5 placed on regulatory schedule fishing with gillnets restricted to 6 inch prior to the first pulse. Fishing restricted to selective gear requiring live release of Chinook (dipnets, beach seines, and fish wheels), then reopened to regulatory schedule with 7.5 inch of smaller mesh. Coastal District, Koyukuk and Innoko rivers, and Subdistrict 5-D remained open with 7.5 inch or smaller mesh size all season.	Chinook commercial fishing closed; liberal opportunity for summer chum fishing with selective gear - all Chinook released immediately and alive; 6 inch or smaller gillnet summer chum fishing delayed until majority of Chinook salmon run had entered the river. No sale of incidental Chinook salmon in summer season; one commercial period occurred in District 1 where Chinook salmon caught during fall chum directed commercial fishing were allowed to be sold. No concurrent commercial and subsistence openings in Districts 1 and 2.	Open with recommendation for reduced harvest, voluntary reduction or closure maintained by majority of First Nations.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2018	Early season: Districts 1–5 placed on half regulatory schedule fishing with gillnets restricted to 6 inch. Two subsistence periods (one per week) were cancelled in Districts 1–4A. Later in the season, limited opportunity (one reduced time opening per week) was provided with 7.5 inch mesh in Districts 1-4. District 5 remained restricted to 6 inch mesh through the third pulse of the Chinook salmon run. Coastal District, Koyukuk and Innoko rivers remained open with 7.5 inch or smaller mesh all season.	Chinook commercial fishing closed; liberal opportunity for summer chum fishing with selective gear - all Chinook released immediately and alive; 6 inch or smaller gillnet summer chum fishing delayed until majority of Chinook salmon run had entered the river. No sale of incidental Chinook salmon. No concurrent commercial and subsistence openings in Districts 1 and 2.	Open with recommendation for reduced harvest; voluntary reduction or closure maintained by majority of First Nations.	Chinook commercial/domestic fishing closed; varied to non-retention in the public angling fishery, angling closure at Tatchun River.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2019	Most of season: Districts 1-5 placed on half regulatory schedule fishing. 6 inch or smaller mesh restrictions added for at least 2 periods in Districts 1-6. One subsistence period was cancelled in Districts 1-4. Fishing was closed for 10 days in Subdistrict 5-D. Coastal District, Koyukuk and Innoko rivers remained open with 7.5 inch or smaller mesh all season.	Summer chum commercial fishing delayed due to late run timing; 6 inch or smaller gillnet summer chum commercial fishing occurred after the majority of Chinook run complete. Sale of incidental Chinook salmon allowed in the summer season after over 200,000 Chinook salmon had been counted at Pilot Station sonar. Sale of incidental Chinook salmon allowed during fall chum-directed commercial fishing. No concurrent commercial and subsistence openings.	Season commenced on July 1 with an opening and full allocation available for First Nation Chinook Fishery. Voluntary reduction or closure maintained by majority of First Nations. First Nation Governments were notified in early August advised to implement additional precautionary measures due to lower than expected passage at Eagle sonar and unlikeliness of achieving the midpoint of the IMEG.	Commercial and domestic fishery conditions of licence limited harvesters to gillnets with a 6 inch or smaller mesh size; Chinook commercial/domestic fisheries were closed. In advance of the Chinook return, retention varied to zero in the public angling fishery. A complete angling closure was enacted on the Yukon River and its tributaries as a Chinook conservation measure. Similarly, chum commercial/domestic fishery opening delayed to mid-September due to Chinook late run timing and low returns. Salmon angling fishery reopened in late September.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2020	Start of season; Districts 1-4 on half time and 6 inch or smaller mesh gillnets. Fishing in most districts closed or restricted to selective gear types in late June in response to late run timing. Fishing re-opened in most districts on reduced schedule with 6 inch mesh. Eagle sonar midpoint projections were poor; District 5 closed in late July for the rest of the summer season. Additional closures of 4 inch mesh were implemented throughout the drainage to avoid any harvest of Chinook salmon.	Summer chum commercial fishing delayed due to late run timing; 6 inch or smaller gillnet summer chum commercial fishing occurred after the majority of Chinook run was complete. Only 5 commercial periods were fished in the Lower Yukon due to low summer chum salmon run. No Chinook commercial fishing; less than 350 fish retained for subsistence from gillnet openings. No commercial fishing occurred in Upper Yukon Area.	Season commenced July 1 with an opening available for limited First Nation (FN) Chinook Fishery. FN Governments manage FN Fisheries as per Yukon First Nation Self-Governing Agreements. FNs initiate harvest in conservative manner. Late July, FN Governments advised to implement additional precautionary measures due to lower than expected passage at Eagle sonar and unlikeliness of achieving the IMEG. Early August FN Governments implement voluntary Chinook harvest restriction followed by harvest restriction for chum.	Conditions of licence in the commercial and domestic fisheries obligated harvesters to gillnets with 6 inch or smaller mesh size; Chinook and chum commercial and domestic fisheries closed for duration of the season. Chinook and chum retention prohibited in the public angling fishery from June 26 to November 30 and September 11 to November 30, respectively. Public angling fishery closed from July 29 to November 30. Public angling fishery effectively closed for duration of salmon season.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2021	Subsistence salmon fishing closed starting on June 2 in District 1 and the Coastal District when the first Chinook salmon began entering the river. All districts, subdistricts, and tributaries closed based on run timing of early Chinook salmon. Salmon fishing remained closed all season. Gillnets with 4 inch or smaller mesh size was allowed for harvest of nonsalmon but were restricted to 60 feet or less in length.	No commercial fishing occurred.	Season commenced July 1 with no harvest allocation for First Nation (FN) Chinook Fishery. FN Governments manage FN Fisheries as per Yukon First Nation Self-Governing Agreements. Early July, FN Governments advised to not harvest Chinook due to lower than expected passage at Eagle sonar and unlikeliness of achieving the IMEG.	Conditions of licence in the commercial and domestic fisheries restricted harvesters to gillnets with 6" or smaller mesh size; Chinook commercial and domestic fisheries closed for duration of the season. Public angling fishery closed for duration of salmon season.

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Year	U.S. management actions (subsistence)	U.S. management actions (commercial)	Canadian management actions (First Nation fishery)	Canadian management actions (commercial, domestic, public angling)
2022	Subsistence salmon fishing closed starting on June 2 in District 1 and the Coastal District when the first Chinook salmon began entering the river. All districts, subdistricts, and tributaries closed based on run timing of early Chinook salmon. Salmon fishing remained closed all season. Gillnets with 4 inch or smaller mesh size was allowed for harvest of nonsalmon but were restricted to 60 feet or less in length.	No commercial fishing occurred.	Season commenced July 1 with limited to no harvest allocation for First Nation (FN) Chinook Fishery. FN Governments manage FN Fisheries as per Yukon First Nation Self-Governing Agreements. Early to mid-July, FN Governments advised to not harvest Chinook due to lower than expected passage at Eagle sonar and unlikeliness of achieving the IMEG. Measures implemented with a prohibition on retention of Chinook in Canada for all fisheries in early August	Chinook commercial and domestic fisheries closed for duration of the season. Public angling fishery closed for duration of salmon season.

Note: Personal Use (PU) and Sport Fisheries are not listed. PU fisheries which occur only in the Tanana River drainage and Sport Fisheries which occur primarily in US tributaries are therefore of no concern to Canadian Chinook Salmon stocks.

Appendix B20.–Yukon River Salmon Agreement specified obligations for harvest shares, border passage and spawning escapement for mainstem Canadian-origin fall chum salmon, 2001–2022.

Year	Total estimated Canadian-origin run size [a]	Total allowable catch (TAC) [b]		U.S. share (%) of TAC [c]		U.S. harvest of Canadian-origin [d]	Border passage objective [e]	Border passage [f]	Canada share (%) of TAC		Canada mainstem harvest	Yukon River Treaty goal or Panel Interim Management Escapement Goal [g]		Spawning escapement [h]
		From	To	65%	71%				29%	35%		From	To	
2001	90,100	10,100		6,565	7,154	8,789	83,240	38,908	2,946	3,535	4,919	80,000		33,989
2002	89,900	29,900		19,435	21,179	4,848	69,593	91,808	8,721	10,465	6,158	60,000		85,650
2003	170,800	105,800		68,770	74,941	17,044	98,944	142,591	30,859	37,030	10,973	65,000		131,618
2004	181,300	116,300		75,595	82,379	16,637	102,313	125,000	33,921	40,705	9,545	65,000		115,455
2005	504,500	439,500		237,750	244,750	67,332	263,250	451,477	194,750	201,750	13,744	65,000		437,733
2006	284,200	204,200		120,100	127,100	64,669	160,600	217,810	77,100	84,100	6,617	80,000		211,193
2007	278,500	198,500		117,250	124,250	47,449	157,750	235,956	74,250	81,250	9,330	80,000		226,626
2008	237,000	157,000		96,500	103,500	49,954	137,000	180,379	53,500	60,500	6,130	80,000		174,249
2009	128,000	48,000		31,200	34,000	22,886	95,400	94,739	14,000	16,800	1,115	80,000		93,624
2010	143,000	39,000	73,000	25,350	51,708	18,601	88,463	121,580	11,375	25,550	3,709	70,000	104,000	117,871
2011	326,000	222,000	256,000	129,000	153,000	79,882	168,000	211,929	86,000	110,000	6,312	70,000	104,000	205,617
2012	238,000	134,000	168,000	85,000	109,000	97,394	124,000	141,648	42,000	66,000	3,905	70,000	104,000	137,743
2013	303,000	199,000	233,000	117,500	141,500	87,985	156,500	204,149	74,500	98,500	3,887	70,000	104,000	200,262
2014	223,000	119,000	153,000	77,350	101,500	50,098	116,604	159,846	34,709	58,500	3,050	70,000	104,000	156,796
2015	205,000	101,000	135,000	65,650	92,500	69,583	109,479	112,555	29,459	49,500	3,897	70,000	104,000	108,658
2016	298,000	194,000	228,000	115,000	139,000	137,770	154,000	148,012	72,000	96,000	2,745	70,000	104,000	145,267
2017	563,000	459,000	493,000	247,500	271,500	144,167	286,500	404,989	204,500	228,500	3,404	70,000	104,000	401,585
2018	279,000	175,000	209,000	105,500	129,500	113,426	144,500	157,083	62,500	86,500	2,957	70,000	104,000	154,126
2019	178,000	74,000	108,000	48,100	76,500	83,226	99,692	102,497	21,584	37,800	2,759	70,000	104,000	99,738
2020	25,000	0	0	0	0	1,561	70,000	23,512	0	0	0	70,000	104,000	23,512
2021	23,000	0	0	0	0	176	70,000	23,170	0	0	0	70,000	104,000	23,170
2022	23,000	0	0	0	0	695	70,000	22,059	0	0	0	70,000	104,000	22,059

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Note: The table does not represent a dataset, its intent is to represent the information at the time. Data presented for each year is from the assessment methods of that year. Harvest numbers were taken from the following year JTC summary report. Gray shaded boxes indicate Yukon River Salmon Agreement performance obligations that were not met.

[a] For 2001 to 2002 values were not specifically presented in JTC reports, and have been retroactively calculated. 2003 and 2004 values were preliminary and taken from the 2005 JTC summary report.

[b] Total run size, total allowable catch (TAC) and harvest share calculations are finalized post-season. TAC is calculated by subtracting the IMEG from the total run size. Delivering the IMEG plus the midpoint of Canada's harvest share to the Alaska-Yukon border is part of the U.S. obligation as per the Pacific Salmon Treaty's Yukon River Salmon Agreement.

[c] Includes 50% of the portion of total allowable catch if greater than 120,000 chum salmon.

[d] Assumed Canadian portion is 25% for all years.

[e] Border passage objective is calculated post season as the agreed spawning escapement goal plus the mid-point of the Canadian harvest share. For years where the escapement goal is a range, this is represented as the average of the Canadian harvest shares, plus the lower end of the escapement goal.

[f] From 2001 to 2007 the border passage was estimated from a mark recapture project. From 2008 on border passage was estimated from the Eagle sonar, minus any Alaskan harvest upstream of the sonar. The bold horizontal line between 2007 and 2008 indicates the JTC's recommendation to use the Eagle sonar as the primary assessment tool for the border passage estimate. Values from this year forward are sonar based.

[g] Yukon River Panel goals have changed over time and have been both points and ranges. IMEGs are not biologically based escapement goals.

[h] Spawning escapement is calculated as the border passage estimate minus the harvest in Canada.

Appendix B21.–Summary of management and conservation measures implemented in the U.S. (Alaska) fall season fisheries and Canada Yukon mainstem for fall chum salmon fisheries, 2001–2022.

	U.S. management actions		Canada management actions	
Year	Subsistence	Commercial	First Nation fishery	Commercial, Domestic, and Public Angling
2001	Full and partial closures to begin season, followed by full regulatory schedules.	Closed	Unrestricted	Commercial closed, limited to one 48 hr opening Sep. 12 to 14
2002	Full schedule to begin season, time and gear restrictions later in season.	Closed	Early season restrictions due to low escapement projections, restrictions lifted Sep. 25.	Commercial and domestic closed except two, 96 hr openings between Oct. 2-13. Public angling implemented non salmon retention Aug. 20.
2003	Started season restricted then on regulatory schedules by mid season.	Only directed at coho salmon at end of season.	Unrestricted	Commercial fishery opened Sep. 7-9. Commercial fishery opened 5 days/week from Sep. 9-Oct. 24.
2004	Started on windows schedule relaxed mid season.	Only directed at coho salmon at end of season.	Unrestricted	Commercial and domestic opened Sep. 12-14, then open 4-5 days for the following 4 weeks. Public angling open
2005	Relaxed subsistence schedule.	Delayed opening to first quarter point.	Unrestricted	Commercial and Domestic opened Aug. 27 for 5 days, open continuously Sep. 3-Oct. 15. Public angling open
2006	Relaxed subsistence schedule.	Delayed opening to first quarter point.	Unrestricted	Commercial and domestic opened Sep. 3 for 4 days. Open Sep. 10 for 4 days. Open Sep. 17 and 30 for 5 days. Open Oct. 1-14.
2007	Open on schedule.	Delayed opening to mid-point.	Unrestricted	Commercial and domestic open Sep. 18 for 7 days and Sep. 28 for 14 days (21 days total).
2008	Open on schedule.	Fished July during summer to fall transition and after three quarter point.	Unrestricted	Commercial and domestic open Aug. 31 for 4 days, open Sep. 5-9, Sep. 12-16, and Sep. 19-Oct. 7.
2009	Open on schedule-some restrictions were taken.	Fished during summer to fall transition and after three quarter point.	Unrestricted	Commercial and domestic closed in the early season. Limited 4 day opening Oct. 8-12.
2010	Open on schedule-some restrictions were taken.	Only directed at coho salmon in September.	Unrestricted	Commercial and domestic limited 24 hour opening, Sep. 22-23. Public angling open

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	U.S. management actions		Canada management actions	
Year	Subsistence	Commercial	First Nation fishery	Commercial, Domestic, and Public Angling
2011	Open on schedule.	Open throughout season	Unrestricted	Commercial and domestic opened Aug. 26; two 4 day openings on Sep. 2 and Sep. 9; open Sep. 16-Oct. 16. Public angling open.
2012	Open on schedule then relaxed to 7 days a week.	Open throughout season.	Unrestricted	Commercial and domestic open on Aug. 31 for 4 days, open continuously Sep. 7-Oct. 31. Public angling open.
2013	Open on schedule then relaxed to 7 days a week.	Fished during summer to fall transition and after three quarter point.	Unrestricted	Commercial and domestic fishery open Aug. 27 for 3 days; open continuously Sep. 2-Oct. 14. Public angling open.
2014	Open on schedule then relaxed to 7 days a week.	Open throughout season.	Unrestricted	Commercial and domestic opened Aug. 26 for 6 days below confluence of Yukon River and Coffee Ck.; open continuously Sep. 3-Oct.31. Public angling open.
2015	Open on schedule then relaxed to 7 days a week. Porcupine River mainstem, some restrictions were implemented.	Open throughout season.	Unrestricted	Commercial and domestic open Aug. 28 for 5 days below confluence of Yukon River and Coffee Ck.; open continuously Sep. 4-Oct. 21. Public angling open.
2016	Open on schedule then relaxed to 7 days a week. Porcupine River mainstem, some restrictions were implemented.	Open throughout season.	Unrestricted	Commercial and domestic open Aug. 30 for 8 days below the confluence of Yukon River and Coffee Ck.; open continuously Sep. 8-Oct. 21. Public angling open.
2017	Open on schedule then relaxed to 7 days a week. Porcupine River mainstem, some restrictions were implemented.	Open throughout season.	Unrestricted	Commercial, domestic and public angling fisheries open Aug. 31-Oct. 19.
2018	Open on schedule then relaxed to 7 days a week on mainstem. Porcupine River mainstem, some restrictions were implemented.	Open throughout season.	Unrestricted	Commercial, domestic and public angling fisheries open Aug. 31-Oct. 19.

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	U.S. management actions		Canada management actions	
Year	Subsistence	Commercial	First Nation fishery	Commercial, Domestic, and Public Angling
2019	Open on schedule then relaxed to 7 days a week on mainstem. Porcupine River mainstem closed all season.	Open throughout season.	Unrestricted	Fishery opening delayed to protect late running Chinook salmon. Commercial and domestic opened Sep. 12-Oct. 31. Public angling open.
2020	Open on schedule then restricted followed by full closure. Porcupine River drainage closed all season.	Commercial closed.	Closed	Commercial, domestic, public angling closed for the season.
2021	Closed all season. Porcupine River drainage closed all season.	Commercial closed.	Closed	Commercial, domestic, public angling closed for the season; catch and retention limits varied to zero at beginning of season.
2022	Closed all season. Porcupine River drainage closed all season.	Commercial closed.	Closed	Commercial, domestic, public angling closed for the season; Chum catch and retention limits varied to zero prior to beginning of season.

Note: Personal Use (PU) and Sport Fisheries are not listed. PU fisheries occur only in the Tanana River drainage and are not bound for Canada and sport fisheries do not occur on fall chum salmon.

Appendix B 22.–Yukon River Salmon Agreement specified obligations for spawning escapement for Fishing Branch River fall chum salmon, 2001–2022.

Year	Total estimated Fishing Branch River run size [a]	Estimated % of Fishing Branch River stock within Canadian Porcupine River stock [b]	Canada Fishing Branch River harvest [c]	U.S. Fishing Branch River harvest [d]	Yukon River Treaty goal or Panel interim management escapement goal [e]		Spawning Escapement [f]
					From	To	
2001					50,000	120,000	21,669
2002					50,000	120,000	13,563
2003	35,112	88			15,000		29,519
2004	25,600	80			13,000		20,274
2005	151,760	80			24,000		121,413
2006	38,560	80			28,000		30,849
2007	42,160	80			34,000		33,750
2008	24,800	80			22,000	49,000	20,055
2009	32,000	80			22,000	49,000	25,828
2010	16,000	80			22,000	49,000	15,773
2011	21,000	75	1,388		22,000	49,000	13,085
2012	37,500	75	2,339	19,479	22,000	49,000	22,399
2013 [g]	36,705	74	1,689	10,306	22,000	49,000	25,376
2014 [g]	9,998	46	912	1,830	22,000	49,000	7,304
2015	13,000	73	406	4,136	22,000	49,000	8,351
2016	54,000	80	2,404	22,043	22,000	49,000	29,397
2017	73,000	80	1,850	23,067	22,000	49,000	48,524
2018	29,000	80	1,499	17,680	22,000	49,000	10,151
2019	29,000	66	660	10,366	22,000	49,000	18,171
2020	5,000	63	63	250	22,000	49,000	4,795
2021	2,500	69	14	28	22,000	49,000	2,413
2022	3,000	77	12	111	22,000	49,000	2,934

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Note: The table does not represent a dataset, its intent is to represent the information at the time. Data presented for each year is from the assessment methods of that year. Harvest numbers were taken from the following year JTC summary report. Gray shaded boxes indicate Yukon River Salmon Agreement performance obligations that were not met.

[a] Total run size is finalized post-season. 2003-2012 values are calculated using reported proportion of Fishing Branch River chum salmon within reported Porcupine River Total Run Size from summary year's JTC report. 2013 and 2014 values are calculated using Porcupine River sonar counts and the proportion of tagged chum salmon that reached Fishing Branch, plus proportion of Fishing Branch chum salmon within U.S. harvest.

[b] Fishing Branch proportions of Porcupine River stock are presented as published in that year's JTC Report (2003, 2004, 2011–2021), except for 2005–2010, when they were assumed to follow the 80% proportion detailed in the 2004/2005 JTC Report.

[c] Prior to 2011, annual Canadian harvest of Fishing Branch River chum salmon was not considered in total run size calculation (with the exception of 2003).

[d] Prior to 2012, annual U.S. harvest was not considered in total run size calculation. For 2012, U.S. harvest of Porcupine River chum salmon is considered 5% of total U.S. harvest. From 2013–2015, the proportion of Fishing Branch River chum salmon within total U.S. harvest was assumed to be equal to the proportion of Fishing Branch River escapement in the drainagewide escapement. From 2016-present, U.S. harvest of Fishing Branch River chum salmon is assumed to be 4% of total U.S. harvest.

[e] Yukon River Panel goals have changed over time and have been both points and ranges. Interim management escapement goals (IMEG) are not biologically based escapement goals.

[f] Fishing Branch River weir site escapement, unless otherwise indicated.

[g] Fishing Branch River weir did not operate. Escapement was estimated from a sonar operated on the upper Porcupine River minus upstream Old Crow harvest then multiplied by the proportion of tags to Fishing Branch River. Escapement taken from 2015 summary JTC report.

Appendix B23.–Summary of management and conservation measures implemented for fall chum salmon in the U.S. (Alaska) and Canada on the Porcupine River, 2001–2022.

Year	Subsistence U.S. management actions	First Nation fishery Canada management actions
2001	Open	Open
2002	Closed to begin fall season, followed by some restrictions, open at end of season.	Porcupine River restrictions to 25% of normal allocation. Vuntut Gwitchin restricted to 2 days/week from Sep. 4-Oct. 11.
2003	Open with some restrictions.	Closed Aug. 10-Oct. 15.
2004	Open	Voluntary closure Aug. 10-Oct. 15.
2005	Open	Open
2006	Open	Open
2007	Open	Open
2008	Open	Open
2009	Open, followed by some restrictions taken, open at end of season.	Closed from noon Sep. 21-noon Oct. 1.
2010	Open	Open
2011	Open	Open
2012	Open	Open
2013	Open	Open
2014	Open	Conservative harvest suggested.
2015	Porcupine River mainstem closed all fall season.	Recommend no fishery.
2016	Porcupine River mainstem closed at start of fall season, followed by some restrictions, open at end of season.	Conservative harvest suggested.
2017	Open, then some restrictions on Porcupine River mainstem, open at end of season.	Conservative harvest suggested.
2018	Open, then some restrictions on Porcupine River mainstem, followed by closure.	Conservative harvest suggested.
2019	Porcupine River mainstem closed all fall season.	Conservative harvest suggested.
2020	Porcupine River drainage closed all fall season.	Closed
2021	Porcupine River drainage closed all fall season.	Closed
2022	Porcupine River drainage closed all fall season.	Closed

Note: Personal Use (PU) and Sport Fisheries are not listed. PU fisheries occur only in the Tanana River drainage and are not bound for Canada and sport fisheries do not occur on fall chum salmon.

Appendix B24.–Relative proportion of eight Canadian Chinook salmon stock aggregates 2005–2022 as estimated by genetic stock identification of samples collected in the test netting associated with Eagle sonar project (and the Bio Island fish wheel 2005–2008). Percentages are unweighted by sonar passage periods.

	Stock Aggregate							
Year	Upper Yukon Tributaries	Teslin River	Carmacks Tributaries	Mid-Mainstem	Pelly River	Stewart River	North Yukon Tributaries	White River
2005 [a, b]	5.6%	19.2%	24.6%	11.1%	17.5%	9.1%	12.5%	0.5%
2006 [a, b]	6.1%	13.0%	33.0%	10.2%	12.4%	13.4%	10.3%	1.7%
2007 [a, c]	2.4%	19.0%	21.7%	9.2%	20.9%	14.2%	11.5%	1.1%
2008 [a, d]	0.0%	14.7%	20.4%	11.6%	23.9%	13.1%	14.6%	1.7%
2008 [c, d]	1.6%	16.4%	10.8%	33.5%	12.1%	7.2%	8.3%	10.1%
2009 [c, d]	3.3%	25.6%	16.0%	10.5%	16.2%	9.3%	12.7%	6.4%
2010 [c, d]	7.5%	33.0%	13.1%	19.6%	9.3%	7.5%	4.6%	5.4%
2011[c, d]	4.8%	25.3%	9.6%	22.9%	17.2%	6.0%	8.1%	6.3%
2012 [c, b]	6.4%	37.8%	13.0%	18.8%	9.7%	6.4%	3.6%	4.3%
2013 [c, b]	6.7%	25.6%	18.5%	28.6%	11.5%	5.3%	0.7%	3.2%
2014 [c, d]	4.1%	28.2%	14.3%	23.6%	14.4%	7.4%	3.1%	4.9%
2015 [c,e]	4.6%	25.4%	17.5%	16.0%	18.2%	8.2%	4.4%	5.6%
2016 [c,e]	6.6%	35.0%	16.4%	11.8%	15.3%	8.0%	4.2%	2.7%
2017 [c,f]	5.1%	30.9%	20.7%	16.0%	13.8%	5.7%	4.9%	2.9%
2018 [c,f]	8.7%	22.6%	24.9%	22.3%	8.6%	5.8%	4.1%	3.0%
2019 [c,f]	6.1%	18.9%	26.3%	26.8%	12.0%	3.6%	3.3%	2.9%
2020 [c,f]	2.7%	16.4%	25.6%	24.3%	17.7%	5.0%	6.0%	2.3%
2021 [c,f]	5.1%	13.4%	22.5%	27.8%	13.1%	8.8%	6.4%	3.0%
2022								
Average (2008–2021)[c]	5.2%	25.3%	17.8%	21.6%	13.5%	6.7%	5.3%	4.5%
Minimum (2008–2021)[c]	1.6%	13.4%	9.6%	10.5%	8.6%	3.6%	0.7%	2.3%
Maximum (2008–2021)[c]	8.7%	37.8%	26.3%	33.5%	18.2%	9.3%	12.7%	10.1%

[a] Samples from BioIsland site collected from fish wheels.

[b] Samples were run against the corresponding year's baseline.

[c] Samples from the mainstem Yukon River sonar operated near Eagle collected from the drift gillnet test fishery and may not be comparable to those collected at the fish wheels because of the proportion of Chinook salmon migrating offshore. Average, minimum and maximum are calculated using Eagle sonar samples only.

[d] Samples were run against the 2011 baseline.

[e] Samples were run against the 2015 baseline.

[f] Samples were run against the 2017 single-nucleotide polymorphism (SNP) baseline.

Appendix B25.–Stock percentage estimates of fall chum salmon migrating across the mainstem U.S./Canada border, Yukon River, 2005–2022,unweighted by sonar passage periods.

	Stock Aggregate			
Year	Mainstem	White	Teslin	Yukon Early
2005 [a]	67.70%	29.80%	0.40%	2.10%
2006 [a]	41.00%	54.90%	3.10%	1.00%
2007 [a]	46.90%	52.10%	0.50%	0.50%
2008 [a]	48.00%	49.90%	2.10%	0.10%
2009 [b,c,]	68.30%	30.60%	1.00%	0.10%
2010 [b,c,]	52.80%	46.30%	0.20%	0.70%
2011 [b,c,]	51.20%	48.00%	0.70%	0.10%
2012 [b,c,]	47.30%	52.60%	0.10%	0.10%
2013 [b,c,]	50.50%	48.90%	0.40%	0.20%
2014 [b,c,]	49.50%	50.10%	0.00%	0.20%
2015 [b,c,]	61.90%	37.20%	0.10%	0.80%
2016 [b,c,]	70.00%	29.30%	0.60%	0.00%
2017 [b,c,]	47.80%	52.00%	0.10%	0.10%
2018 [b,c,]	38.68%	56.38%	2.90%	2.05%
2019 [b,c,]	41.44%	51.56%	4.63%	2.37%
2020 [b,c,]	55.28%	41.82%	2.28%	0.62%
2021 [b,c]	65.00%	34.20%	0.70%	0.00%
2022 [b,c]	70.32%	25.51%	4.17%	0.00%
Average (2009–2021)	53.8%	44.5%	1.1%	0.6%
Minimum (2009–2021)	38.7%	29.3%	0.0%	0.0%
Maximum (2009–2021)	70.0%	56.4%	4.6%	2.4%

Note: Samples were run against the current year's baseline (ex. 2005 samples were run against the 2005 baseline).

[a] Samples from Bio Island site collected from fish wheels.

[b] Samples from the mainstem Yukon River sonar operated near Eagle collected from the drift test fishery.

[c] Samples collected from the drift gillnet test fishery at the mainstem Yukon River sonar near Eagle may not be comparable to those collected at the fish wheels. Average, minimum, and maximum were calculated using mainstem Yukon River sonar project test fishery samples only.

APPENDIX C: BERING SEA-ALEUTIAN ISLANDS BYCATCH SUMMARY AND IMPACT ON YUKON RIVER CANADIAN-ORIGIN SALMON

Appendix C1.–Bering Sea-Aleutian Islands Bycatch Summary and impact on Yukon river Canadian-origin salmon. Prepared by NOAA, in coordination with ADF&G, at the request of the Yukon River Panel.

Yukon River Salmon Bycatch Summary

January 2022, DRAFT

The Yukon River Salmon Agreement identifies the need to identify, quantify, and undertake efforts to reduce marine catches and bycatch of Yukon River salmon. This section provides an overview of information on U.S. groundfish fisheries in the Bering Sea-Aleutian Islands (BSAI) management region, bycatch regulations, and bycatch impacts on Yukon River Canadian-origin salmon.

Bycatch impacts on Canadian-origin salmon

Yukon River Canadian-origin salmon are caught as bycatch in BSAI groundfish fisheries along with other salmon stocks from Alaska, the west coast of Canada and the United States, eastern Asia, and Russia. The total number of salmon captured as bycatch is always much greater than the number of returning adult Canadian-origin salmon that are removed from the Yukon River due to bycatch. For example, the total annual bycatch of Chinook salmon in BSAI pollock fishery has varied from approximately 5,000 to 122,000 (Table 1), but the adult equivalent (AEQ) bycatch of Canadian-origin Chinook salmon varied from approximately 400 to 2,400 fish over the same time period (Table 2). The average bycatch impact rate by the pollock fishery on the Canadian-origin Chinook salmon run is estimated to be 1.0% with an annual impact rate less than 3.1% (Ianelli and Stram, 2018). Average bycatch impact rates to western Alaska chum salmon (not Canadian-origin chum salmon) is estimated to be 0.4% with an annual rate less than 1.3% (Murphy et al. 2017). Ongoing regulatory and management measures implemented by the North Pacific Fisheries Management Council (NPFMC) are a key factor limiting bycatch impact rates on Canadian-origin salmon in BSAI groundfish fisheries.

Current BSAI bycatch information

- Total bycatch of Chinook salmon in BSAI groundfish fisheries (pelagic trawl, bottom trawl, and hook-and-line fisheries) during 2021 (*n*=15,827) was 52% lower than the recent 5-year average (Table 1). Chinook salmon bycatch in the BSAI pollock fishery accounted for 87% (*n*=13,783) of the bycatch during 2021.
- Total bycatch of non-Chinook salmon (primarily chum salmon) in BSAI groundfish fisheries (pelagic trawl, bottom trawl, and hook-and-line fisheries) during 2021 (*n*=535,282) was a 49% increase in the recent 5-year average (Table 1). Bycatch of non-Chinook salmon in the BSAI pollock fishery accounted for 99% (*n*=530,626) of the bycatch during 2021.
- Bycatch impacts to Canadian-origin Chinook salmon by BSAI Pollock fishery is estimated by run year. The 2017 run is the most recent year for which bycatch impact estimates are available for Canadian-origin Chinook salmon.
    - The total Canadian-origin Chinook salmon run in 2017 was 93,188. Adult equivalent models estimate that an additional 772 Canadian-origin Chinook salmon would have contributed to the 2017 run if they had not been captured as bycatch in the BSAI pollock fishery (Table 2). This represents an impact rate of 0.83% on the Canadian-origin Chinook salmon run during 2017.

Background Information

Bycatch management

- U.S. groundfish trawl fisheries in the BSAI management area are managed to limit the bycatch of salmon under the Magnuson-Stevens Fisheries Conservation and Management Act by the NPFMC and are regulated by National Marine Fisheries Service (NMFS).
- The pollock fishery is the primary focus of bycatch management as it accounts for an average of 88% of the total Chinook salmon bycatch and 99% of the non-Chinook salmon bycatch in the BSAI management area.
- The pollock fishery is managed according to the Fishery Management Plan (FMP) for Groundfish of the BSAI Management Area.
  https://www.npfmc.org/wp-content/PDFdocuments/fmp/BSAI/BSAIfmp.pdf

Bycatch regulations

- The BSAI groundfish FMP contains regulatory measures to reduce salmon bycatch.
- The BSAI pollock fishery is one of the most heavily regulated and monitored fisheries in the world and includes 100% observer coverage.
- Notable bycatch reduction measures include amendment 91 and amendment 110.
- Amendment 91 (https://alaskafisheries.noaa.gov/rules-notices/search) was implemented in 2011 and, among other things, established bycatch caps.
- Amendment 110 (https://alaskafisheries.noaa.gov/rules-notices/search) was implemented in 2016 and, among other things, established abundance-based bycatch caps to further protect western Alaska and Canadian-origin Chinook salmon stocks harvested for subsistence purposes. Bycatch caps are set relative to the combined in-river run size for the Unalakleet, Upper Yukon (Canadian-origin), and Kuskokwim River Chinook salmon stock groups (termed the three-system index).

Bycatch impact methods

- The number of salmon captured as bycatch in a given year is not equivalent to the number of adult salmon that would have returned to the Canadian portion of the Yukon River drainage in that year for two reasons.
  - Salmon stocks throughout the North Pacific are captured as bycatch in the BSAI groundfish fisheries. Information on stock origin is required to evaluate the impact of bycatch to a given stock or stock group.
  - Salmon are predominately captured as bycatch during their immature life-history stage and will spend one or more years in the ocean before returning to freshwater. Bycatch numbers of immature salmon require an adjustment for natural mortality before they can be compared to the number of mature adults returning to freshwater. Bycatch estimates that are adjusted for natural mortality are referred to as Adult Equivalent (AEQ) bycatch.
- Bycatch impacts on Yukon River Canadian-origin salmon require stock-specific Adult Equivalent (AEQ) estimates of bycatch. These estimates rely on the following data inputs: total salmon bycatch, bycatch stock mixtures, bycatch age composition, salmon maturity schedules, and assumptions on the natural mortality of salmon in marine habitats (Ianelli and Stram 2014).

- The bycatch AEQ analysis has not been updated since the last Yukon River Panel bycatch summary. AEQ analysis may not be updated annually depending on the regulatory application and need through the NPFMC. Updated AEQ analysis will be reported in the annual Yukon River Panel bycatch summary as it occurs.

Additional resources

- Bycatch numbers are reported by the National Marine Fisheries Service, available at: https://alaskafisheries.noaa.gov/fisheries-catch-landings?tid=286
- Bycatch updates are reported by the North Pacific Fisheries Management Council, available at: https://www.npfmc.org/bsai-salmon-bycatch/
- Genetic Stock Identification of Bycatch available at: https://repository.library.noaa.gov/view/noaa/45362

References

Ianelli, J. N. and D. L. Stram. 2014. Estimating impacts of the pollock fishery bycatch on western Alaska Chinook salmon. ICES J. Mar. Sci. **72**: 1159-1172. doi:10.1093/icesjms/fsu173

Ianelli, J. N., and D. L. Stram. 2018. Chinook Bycatch Mortality Update. Discussion paper presented to the North Pacific Fishery Management Council, April 2018. Available online at: http://npfmc.legistar.com/gateway.aspx?M=F&ID=e172520e-fc22-46e8-b5aa-72ba233f129e.pdf

Murphy, J.M. E.V. Farley, J.N. Ianelli, and D.L. Stram. 2017. Distribution, diet, and bycatch of chum salmon in the Eastern Bering Sea. N. Pac. Anadr. Fish. Comm. Bull. 6:219-234. doi: 10.23849/npafcb6/219.234

Appendix C-Table 1. – Numbers of Chinook and non-Chinook (chum) salmon captured as bycatch in the Bering Sea-Aleutian Islands (BSAI) groundfish fisheries by season (A-season: winter, B-season: summer/fall), 1991-2022.

	BSAI Chinook Salmon Bycatch						BSAI Non-Chinook Salmon Bycatch					
	A-season		B-season		Annual		A-season		B-season		Annual	
Year	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries
1991 [a]	38,791	46,392	2,114	2,488	40,906	48,880	2,850	3,016	26,100	27,246	28,950	30,262
1992 [a]	25,691	31,419	10,259	10,536	35,950	41,955	1,950	2,120	38,323	39,329	40,273	41,450
1993 [a]	17,264	24,688	21,252	21,326	38,516	46,014	1,593	1,848	240,597	241,422	242,190	243,270
1994	28,451	38,921	4,686	4,900	33,136	43,821	3,990	5,599	88,680	88,949	92,670	94,548
1995	10,579	18,939	4,405	4,497	14,984	23,436	1,707	3,033	17,555	18,842	19,262	21,875
1996	36,068	43,316	19,554	19,888	55,623	63,205	221	665	77,013	77,395	77,234	78,060
1997	10,935	16,401	33,973	34,129	44,909	50,530	2,083	2,710	63,903	64,285	65,986	66,994
1998	16,132	19,870	40,308	40,679	56,440	60,549	4,090	4,608	60,865	62,004	64,955	66,612
1999	6,352	8,794	5,627	5,805	11,978	14,599	362	393	44,909	46,841	45,271	47,234
2000	3,422	6,568	1,539	1,655	4,961	8,223	212	350	58,357	58,977	58,569	59,327
2001	18,484	24,871	14,961	15,676	33,444	40,547	2,386	2,903	54,620	57,828	57,006	60,731
2002	21,794	26,277	12,701	13,407	34,495	39,684	1,377	1,698	79,274	80,785	80,651	82,483
2003	32,606	40,058	13,055	13,603	45,661	53,661	3,831	3,831	184,513	184,559	188,344	188,390
2004	23,099	30,767	28,663	29,274	51,762	60,040	426	429	451,907	452,131	452,333	452,560
2005	27,323	33,622	40,861	41,462	68,184	75,084	594	594	710,196	710,926	710,790	711,520
2006	58,390	62,547	24,362	24,568	82,752	87,114	1,323	1,323	305,674	305,852	306,997	307,175
2007	70,414	78,157	51,781	51,854	122,195	130,011	8,481	8,489	84,387	85,152	92,868	93,641
2008	16,495	18,829	4,811	5,009	21,307	23,838	247	247	14,732	14,732	14,980	14,980
2009	9,882	11,377	2,697	2,894	12,579	14,272	48	48	45,397	45,397	45,445	45,445
2010	7,668	9,502	2,069	3,012	9,737	12,515	40	40	13,243	13,243	13,283	13,283
2011	7,137	7,602	18,362	19,007	25,499	26,609	297	414	191,138	194,405	191,435	194,819
2012	7,765	8,989	3,578	3,948	11,343	12,937	11	307	22,172	23,766	22,183	24,073
2013	8,219	9,188	4,797	6,896	13,016	16,084	215	447	125,101	126,554	125,316	127,001
2014	11,539	13,839	3,498	4,365	15,037	18,204	577	1,629	218,865	222,634	219,442	224,263
2015	12,304	17,534	6,025	7,755	18,329	25,289	4,756	6,158	232,996	237,196	237,752	243,354
2016	16,828	26,086	5,098	6,839	21,926	32,925	3,903	4,838	339,098	342,503	343,001	347,341
2017	21,828	27,007	8,248	9,272	30,076	36,280	1,906	2,313	465,772	469,134	467,678	471,447

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	BSAI Chinook Salmon Bycatch						BSAI Non-Chinook Salmon Bycatch					
	A-season		B-season		Annual		A-season		B-season		Annual	
Year	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries	Pollock Fisheries	All Fisheries
2018	8,645	11,264	5,095	6,135	13,740	17,399	1,201	2,120	293,863	306,925	295,064	309,045
2019	15,781	20,088	9,203	11,378	24,984	31,467	2,239	4,509	345,643	354,294	347,882	358,804
2020	18,369	20,442	13,925	14,534	32,294	34,976	807	1,161	343,014	345,214	343,821	346,375
2021	9,503	10,719	4,281	5,177	13,784	15,896	159	371	545,883	550,327	546,042	550,698
2022	5,185	6,308	1,152	2,034	6,337	8,342	66	633	242,309	244,637	242,375	245,269

https://www.fisheries.noaa.gov/sites/default/files/akro/chinook_salmon_mortality2022.html
https://www.fisheries.noaa.gov/sites/default/files/akro/chum_salmon_mortality2022.html

[a] Community Development Quota (CDQ) bycatch not included.

Appendix C-Table 2. –Estimated adult equivalent (AEQ) bycatch of Canadian-origin Chinook salmon from the Yukon River in the Bering Sea-Aleutian Islands (BSAI) pollock fisheries by run year, run size of the Canadian-origin Chinook salmon, and bycatch exploitation rates, 1994–2017 (Ianelli and Stram, 2018).

Run Year	Canadian-Origin AEQ Bycatch	Canadian-Origin Run	Canadian-Origin Impact Rate
1994	1,035	172,885	0.60%
1995	817	169,789	0.48%
1996	998	182,504	0.55%
1997	995	161,700	0.62%
1998	760	88,282	0.86%
1999	588	110,446	0.53%
2000	347	52,842	0.66%
2001	508	85,663	0.59%
2002	835	81,487	1.02%
2003	1,044	149,979	0.70%
2004	1,214	117,247	1.04%
2005	1,267	123,612	1.02%
2006	1,843	119,485	1.54%
2007	2,361	87,899	2.69%
2008	1,918	62,610	3.06%
2009	1,127	87,899	1.28%
2010	518	59,741	0.87%
2011	359	71,726	0.50%
2012	351	48,494	0.72%
2013	364	37,177	0.98%
2014	401	64,886	0.62%
2015	455	87,323	0.52%
2016	532	82,765	0.64%
2017	772	93,188	0.83%