Special Publication No. 22-20

Yukon River Salmon Stock Status and Salmon Fisheries, 2022: A Report to the Alaska Board of Fisheries, January 2023

by

Deena M. Jallen

Christy M. Gleason

Bonnie M. Borba

Fred W. West

Sam K. S. Decker

and

Shane R. Ransbury

December 2022

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

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

SPECIAL PUBLICATION NO. 22-20

YUKON RIVER SALMON STOCK STATUS AND SALMON FISHERIES, 2022: A REPORT TO THE ALASKA BOARD OF FISHERIES, JANUARY 2023

by

Deena M. Jallen, Christy M. Gleason, Bonnie M. Borba, Sam K. S. Decker, and Shane R. Ransbury
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

and

Fred W. West
Alaska Department of Fish and Game, Division of Commercial Fisheries, Fairbanks

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

December 2022

The Special Publication series was established by the Division of Sport Fish in 1991 for the publication of techniques and procedures manuals, informational pamphlets, special subject reports to decision-making bodies, symposia and workshop proceedings, application software documentation, in-house lectures, and became a joint divisional series in 2004 with the Division of Commercial Fisheries. Special Publications are intended for fishery and other technical professionals. Special Publications are available through the Alaska State Library, Alaska Resources Library and Information Services (ARLIS) and on the Internet: http://www.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

Product names used in this publication are included for completeness and do not constitute product endorsement. The Alaska Department of Fish and Game does not endorse or recommend any specific company or their products.

Deena M. Jallen, Christy M. Gleason, Bonnie M. Borba, Sam K. S. Decker, and Shane R. Ransbury
Alaska Department of Fish and Game, Division of Commercial Fisheries,
1300 College Road, Fairbanks, AK 99701, USA

and

Fred W. West
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518, USA

This document should be cited as follows:
Jallen, D. M., C. M. Gleason, B. M. Borba, F. W. West, S. K. S. Decker, and S. R. Ransbury. 2022. Yukon River salmon stock status and salmon fisheries, 2022: A report to the Alaska Board of Fisheries, January 2023. Alaska Department of Fish and Game, Special Publication No. 22-20, Anchorage.

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:
ADF&G ADA Coordinator, P.O. Box 115526, Juneau, AK 99811-5526
U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042, Arlington, VA 22203
Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW MS 5230, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:
(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648,
(Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:
ADF&G, Division of Sport Fish, Research and Technical Services, 333 Raspberry Road, Anchorage AK 99518 (907)267-2375.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

Figure **Page**

LIST OF APPENDICES

Appendix **Page**

ABSTRACT

This report provides the Alaska Board of Fisheries with information on Yukon Area salmon stock status, including escapement and harvest data for the January 2023 regulatory meeting. In response to the guidelines established in the Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222), the Alaska Board of Fisheries (board) classified the Yukon River Chinook salmon *Oncorhynchus tshawytscha* stock as a stock of yield concern at its September 2000 work session. An action plan was developed by the Alaska Department of Fish and Game and acted upon by the board in January 2001. The status as a yield concern was continued for Yukon River Chinook salmon at the January 2004, 2007, 2010, 2013, 2016, and 2019 board meetings. Chinook salmon escapement goal performance has been mixed throughout the past 5 years (2018–2022) throughout the Alaska portion of the Yukon River drainage, but escapement goals were not met from 2020 to 2022. Conservative management actions taken inseason have included full subsistence fishery closures to protect low runs as they migrate upriver. Additionally, Yukon River summer chum, fall chum *O. keta*, and coho salmon *O. kisutch* recently experienced a drastic decline since 2020. Most escapement goals for chum and coho salmon have not been achieved since 2020 despite significant subsistence, personal use, and commercial fishing restrictions and closures. Historically, the Yukon River chum and coho salmon stocks have met or exceeded escapement goals and provided for subsistence, personal use, and commercial fisheries, with a few exceptions of decreased production in a couple tributaries.

Keywords: Yukon River, Chinook salmon, *Oncorhynchus tshawytscha*, summer and fall chum salmon, *Oncorhynchus keta*, coho salmon, *Oncorhynchus kisutch*, stock of concern, commercial, fishing, sustainable salmon fisheries policy, Alaska Board of Fisheries

INTRODUCTION

The *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) directs the Alaska Department of Fish and Game (department) to provide the Alaska Board of Fisheries (board) with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation during regular board meetings. This report provides the department's assessment of Yukon River Chinook salmon (*Oncorhynchus tshawytscha*). A review of Yukon River summer chum salmon (*O. keta*) is also provided because the overlapping run timing with Chinook salmon greatly affects management of both species when conservation of Chinook salmon is necessary. A review of Yukon River fall chum (*O. keta*), and coho salmon (*O. kisutch*), is also provided due to concerns over the recent poor returns of these species.

In response to guidelines established in the SSFP, the board classified Yukon River Chinook salmon as a yield concern at the September 2000 work session and has continued that designation during each subsequent cycle. A *stock of yield concern* is defined as "a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs" (5 AAC 39.222(f)(42)). The SSFP defines chronic inability as "the continuing or anticipated inability to meet expected yields over a 4- to 5-year period." Current escapement goals vary widely by species and area (Table 1). The classification as a yield concern was originally based on low harvest levels for the previous 3-year period (1998–2000) and anticipated low harvest in 2001 compared to the previous 10-year (1989–1998) average harvest (Vania 2000). An action plan was subsequently developed by the department (SSFP; 5 AAC 39.222(d)(4)) and acted upon by the board in January 2001. The board continued the classification of yield concern in 2004, 2007, 2010, 2013, 2016, and 2019. The board has made a positive customary and traditional (C&T) use finding for Chinook, summer chum, fall chum, coho, and pink salmon in the Yukon Area. The board has found that 45,500–66,704 Chinook, 83,500–142,192 summer chum, 89,500–167,900 fall chum, 20,500–51,980 coho, and 2,100–9,700 pink salmon are amounts found reasonably necessary (ANS) for subsistence uses in the Yukon Area. In response to not meeting Chinook salmon escapement goals during the period from 2008 to 2013, the board has made extensive changes to the management plan and regulations to allow for more management flexibility to reduce Chinook salmon harvest during low run abundance years. Chinook salmon escapement goals in Alaska were generally met in systems with assessment projects during 2014–2018 (Table 2). Four out of 7 escapement goals were met in 2019, including 1 that was exceeded. However, no goals were met from 2020 to 2022 in systems where goals were assessed (Table 2).

In response to guidelines established in the SSFP, the board classified Yukon River fall chum salmon as a stock of yield concern and classified Toklat and Fishing Branch Rivers fall chum salmon as a stock of management concern at its September 2000 work session. A stock of management concern is defined as "a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the sustainable escapement goal (SEG), biological escapement goal (BEG), optimum escapement goal (OEG), or other specified management objectives for the fishery" (5 AAC 39.222(f)(21)). The determination for the entire Yukon River fall chum salmon as a stock of yield concern was based on a substantial decrease in yields and harvestable surpluses during the period 1998–2000, and the anticipated very low run expected in 2001. The determination for Toklat and Fishing Branch Rivers as stocks of management concern was based on escapements not meeting the OEG of 33,000 for Toklat River from 1996 to 2000, and not meeting the escapement objective of 50,000–120,000 salmon for Fishing Branch River from 1997 to 2000. An action plan was subsequently developed by the department (ADF&G 2000) and acted upon by the board in January 2001.

Yukon River fall chum salmon classification as a yield concern was continued at the January 2004 board meeting because the combined commercial and subsistence harvests showed a substantial decrease in fall chum salmon yield from the 10-year period (1989–1998) to the more recent 5-year (1999–2003) average (Bue et al. 2004). Toklat River stock was removed from management concern classification because of the BEG review presented at that board meeting. However, as a component of the Yukon River drainage, Toklat River fall chum salmon stock was included in the drainagewide yield concern classification. The Fishing Branch River stock was also removed from the management concern classification because management of that portion of the drainage is covered by an annex to the Pacific Salmon Treaty, the U.S./Canada Yukon River Salmon Agreement, which is governed under the authority of the Yukon River Panel.

In January 2007, the board determined that Yukon River fall chum salmon stock no longer met the criteria for a yield concern. Run strength was poor from 1998 through 2002; however, steady improvement had been observed after 2003 (JTC 2022). The 2005 run was the largest in 30 years, and from 2003–2019, the average run size returned to historical levels of over 1 million fall chum salmon. The smallest run sizes during this 17-year time span were slightly less than 600,000 fall chum salmon and occurred in 2009 and 2010. The drainagewide escapement goal range of 300,000 to 600,000 fall chum salmon has been achieved in all years from 2002–2019 (within 6 years and exceeded in 12 years). Escapements less than 300,000 occurred for 3 years in a row both in 1998–2000, and most recently 2020–2022, and are expected to continue to rebound based on what was observed in 2022.

Summer chum, fall chum, and coho salmon in the Yukon River drainage have been productive in recent years prior to 2020, allowing for subsistence, personal use, and commercial salmon fishing with few restrictions (Tables 3, 4, and 5). However, starting in 2020, chum salmon stocks across western Alaska and the north Pacific Ocean observed unexpected declines. In 2020, Arctic–Yukon–Kuskokwim stocks experienced age-4 chum salmon failures, the dominant age class of Yukon River chum salmon. Fall chum salmon returned at a record low run size in 2020 in the Yukon River drainage, leading to severe subsistence salmon closures and no commercial or personal use fishing. Summer chum and coho salmon, although low in 2020 and 2022, returned record low in 2021. Salmon fishing was closed in the Yukon Area in 2021 and 2022. Of note, the parent years contributing to the poor 2020–2022 chum and coho salmon returns achieved or exceeded escapement goals except for some tributary goals for summer chum salmon in 2016 and 2018, fall chum salmon in 2015 and 2018, and coho salmon in 2018 (Tables 6 and 7).

STOCK OF CONCERN RECOMMENDATION

The Yukon River Chinook salmon runs have been recorded in various ways since 1980, and methods and locations have largely been standard since 1997. During these early years, subsistence fishing was not restricted and there was a large commercial fishery in 1989–1998 and 2003–2007 (Table 8). Since 2007, Chinook salmon productivity has declined. Recent Chinook salmon subsistence harvest (2018–2022) averaged 26,201 fish, which is approximately 7% below the previous 10-year average (2008–2017) of 27,810 fish. The Chinook salmon directed commercial fishery last operated in 2007. From 2008, only summer chum-directed fisheries have operated; however, indirect sales of Chinook salmon have occurred, and in 2019, the sale of incidental Chinook salmon was allowed on one occasion (Table 8).

In the 2019 review of the stock of concern recommendations, the ocean juvenile forecast indicated that Chinook salmon returns were likely to remain at the 2018 level of productivity. Therefore, based on the definitions provided in the SSFP in 5 AAC 39.222(f)(42), the department recommended the continuation of the yield concern classification for the Yukon River Chinook salmon stock at the October 2018 work session. The Chinook salmon run has had mixed success in meeting escapement goals in the recent 5-year period (2018–2022). In 2018 and 2019, several of the assessed goals were met or exceeded; however, from 2020–2022, no assessed goals were met (Tables 2 and 9). The department addressed the Yukon River Chinook salmon stock of concern designation at the October 2022 work session.

For chum and coho salmon there is no recommendation for a stock of concern designation at this time. Summer chum salmon are nearly 50:50 for age-4 and age-5 run classes, and run sizes have only been low for 2021 and 2022. Fall chum salmon are on average 70% age-4 and 26% age-5, and the run has been low from 2020 through 2022. A strong cohort of age-4 fish could allow fall chum salmon numbers to rebound quickly in coming years. The 2022 run size doubled from the previous year, indicating some improved production of the 2018 brood year for age-4 fish in the run. Coho salmon are on average 80% age-4 with below average abundance from 2020 through 2022.

ACTION PLAN REVIEW

Five management plans drive the department's management of Chinook and summer chum salmon on the Yukon River and they have been continually improved and refined (Appendix A1) since the major stock downturns. The plans are: 5 AAC 05.360, *Yukon River King Salmon Management Plan*; 5 AAC 05.362, *Yukon River Summer Chum Salmon Management Plan*; 5 AAC 74.060, *Chena and Salcha River King Salmon Sport Harvest Management Plan*; 5 AAC 05.367, *Tanana River Salmon Management Plan*; and 5 AAC 05.368, *Anvik River Chum Salmon Fishery Management Plan*. Original goals stated in the action plan include reducing fishing mortality to meet spawning escapement goals, providing opportunity for subsistence users to harvest levels within the ANS range, and reestablishing the historical range of harvest levels by other users. It may be that although current Chinook salmon stock productivity does provide some level of yield each year, historical levels of harvest (which include large commercial harvests) may not be achieved in the foreseeable future.

The current challenge for reliably harvesting any surplus is limited by inseason management uncertainty. Despite having the best possible assessment of abundance, inseason projections of run size become more accurate by about the midpoint of the run. This occurs after Chinook salmon have moved through half the districts. Therefore, if the available surplus has been underutilized, it is hard to make up for that later in the run. Additionally, in recent years there has been a significant difference between estimates of Canada-origin Chinook salmon at Pilot Station sonar and Eagle sonar. Although estimates amongst these projects have been variable, from 2019 to 2022, the number of Canada-origin Chinook salmon being counted at the Eagle sonar was much less than expected based on passage and mixed stock analysis (MSA) at Pilot Station sonar. One possible cause for the estimated differences is enroute mortality.

The department continues to refine management actions to meet escapement goals and minimize the amount of fishing restrictions used inseason to maximize the harvest of surpluses and harvest share objectives. The current management plans offer enough management flexibility to achieve this.

STOCK ASSESSMENT BACKGROUND

Management of the Yukon River salmon fishery is complex because of many factors, including difficulties in determining stock-specific abundance and timing, overlapping multi-species salmon runs, increasing efficiency of the fishing fleet, the gauntlet nature of the fisheries, allocation issues between lower and upper river Alaska fisheries, allocation and conservation issues between Alaska and Canada, and the immense size of the drainage (Figure 2). Fisheries within the Yukon River may harvest stocks that are still several weeks, and over a thousand miles, from their spawning grounds. Because the Yukon River fisheries are largely mixed stock fisheries, some tributary populations may be under- or overexploited in relation to their abundance. It is not possible to manage for individual stocks in most areas where commercial and subsistence fisheries occur.

RESEARCH AND ONGOING PROJECTS

The department, federal agencies, Department of Fisheries and Oceans (DFO) Canada, Native organizations, Yukon Delta Fisheries Development Association (YDFDA), and various organized groups of fishers operate salmon stock assessment projects throughout the Yukon River drainage which are used by the department to manage Yukon River salmon fisheries in the Alaska portion of the drainage.

Inseason run assessment includes run timing and relative abundance indices from test fisheries, sonar counts of passing fish, various escapement assessment efforts in tributaries, commercial and subsistence catch data, catch-per-unit-effort (CPUE) data from monitored fisheries, and inseason genetic MSA from lower river test fisheries.

Main river sonars, tributary sonars, weirs, counting towers, and aerial/boat/ground surveys are used to monitor passage and escapement. Other information collected at assessment projects may include, but are not limited to, age, sex, and length (ASL) composition, samples for MSA, count data on resident species, and information from the recovery of tagged fish.

PILOT STATION SONAR

Since 1995, the mainstem sonar project located near the community of Pilot Station (hereafter called Pilot Station sonar) has provided inseason estimates of salmon passage for Yukon River drainage fisheries management. This project produces the first estimation of fish abundance in the Yukon River and is located at river km 197 (Pfisterer et al. 2017). Resident freshwater species and all 5 Pacific salmon species are enumerated through sonar and then apportioned by species through test fishing with gillnets of various mesh sizes. Data quality and environmental events that complicate fish passage estimates are taken into consideration inseason to provide quality estimates.

Updated selectivity parameters for all species were developed after the 2015 season and are used for producing passage estimates inseason at the project (Pfisterer et al. 2017; Table 10). The daily passage estimates, by species, from 1995 to present have been updated with these improved selectivity parameters. Estimates can be obtained from the department, Division of Commercial Fisheries, and the Arctic–Yukon–Kuskokwim database management system (AYKDBMS[1]).

The estimated passage of salmon at Pilot Station sonar is used inseason along with historical run timing comparisons to project the end-of-season run size. Managers then compare the run to the preseason projection and manage fishing accordingly. The drainagewide estimate of Chinook and summer chum salmon is ultimately produced by taking the end-of-season Pilot Station sonar count, along with the harvest and escapement below the sonar (Table 10, Figure 3). Pilot Station sonar is a large component of the run size index for coho salmon; however, fall chum salmon use an alternate means of determining run size, based on escapement assessment (Fleischman and Borba 2009). For fall chum salmon, most of the spawning areas within the drainage have been assessed. By using escapement values, the transition of summer chum salmon in the fall season, as counted at Pilot Station sonar, is negated.

INSEASON MIXED STOCK ANALYSIS

Beginning in 2005, genetic stock identification of Chinook salmon has been used as an additional management tool and is particularly useful in projecting inseason run sizes of Canada-origin stocks. The Canada stock has varied from 32–52%, but on average, makes up 41% of the run (Table 11). In most years, 3 pulses of Chinook salmon sampled in the Pilot Station sonar test fishery are analyzed inseason for stock composition and results are reported within 48 hours of receipt at the department's Gene Conservation Laboratory in Anchorage. The pulse-specific genetic information assists with management decisions. For example, managers use the genetic proportions from each pulse applied to the weighted passage to assess Canada-origin Chinook salmon run strength. Having this information early in the run allows managers to make informed decisions about the ability to meet escapement goals and support subsistence needs.

Genetic samples from chum salmon are collected from the Pilot Station sonar test fishery and have been analyzed by the United States Fish and Wildlife Service (USFWS) on a nearly weekly basis since 2004. Estimates of stock composition provide the relative proportions between summer chum and fall chum salmon stocks that overlap in July and assist with management and assessment of

---

[1] AYKDBMS, https://www.adfg.alaska.gov/CF_R3/external/sites/aykdbms_website/Default.aspx, accessed December 7, 2022.

fall chum salmon. In 2015, coho salmon genetics were also collected from the Pilot Station test fishery and analyzed to look at regional genetic relationships in populations (Flannery and Loges 2016).

EAGLE SONAR

A sonar assessment project was established at Eagle, located below the U.S./Canada border, to assess Chinook salmon in 2005 and fall chum salmon in 2006 to estimate passage into the Canadian mainstem.[2] ASL information from test fishing at Eagle sonar gives reasonable estimates of the age class composition of the escapement to Canada. The sonar site is ideal due to stable river bottom morphology and because Chinook and fall chum salmon runs are clearly separated by time at this location. The community of Eagle is upstream from the sonar site and to estimate border passage estimates by species, the Eagle harvest is subtracted. The border passage estimate is used to assess border objectives agreed to within the Yukon River Salmon Agreement (Table 12).

To achieve the mandated "border objective", managers project the run size and harvest of the Canada-origin Chinook salmon within the Alaska fishery inseason. This includes the interim management escapement goal (IMEG) of 42,500–55,000 Chinook salmon and a harvest share for Canadian fishers of 20–26% of the Total Allowable Catch (surplus above escapement needs) of Canada-origin Chinook salmon as outlined by the Yukon River Salmon Agreement. Spawning escapement in Canada is estimated post season once Canadian harvest estimates are obtained. The lower end of the IMEG and Canadian harvest share objective was achieved in 2011, and from 2014–2018. The upper bound of the IMEG and harvest share was exceeded from 2014–2017 (Table 9, Figures 4 and 5). Despite conservative management actions from 2019 to 2022, low run sizes and inseason management uncertainty resulted in border passage below the objective by an average of 2,657 fish (Table 12).

Many Canadian First Nations tribes and fishers have foregone harvest of Chinook salmon to rebuild the runs, and in some years, the entire Canadian harvest share provided was not taken. In 2020 and 2021, United States and Canadian harvests exceeded the harvest share amounts (Table 12).

Mainstem Yukon River fall chum salmon are managed to achieve the spawning escapement goal (IMEG) of 70,000–104,000 fish. In addition, harvest shares for Canadian fishers of 29–35% of the Total Allowable Catch of Canada-origin fall chum salmon are applied as outlined by the Yukon River Salmon Agreement. Spawning escapement in Canada is estimated post season once Canadian harvest estimates are obtained. Escapements and obligations have been achieved from 2002–2019, with 15 of the 18 years exceeding the upper end of the IMEG range (Table 6). With the extremely poor runs of fall chum salmon, even with all fishing closed, goals were not achieved in 2020–2022.

SUBSISTENCE AND PERSONAL USE HARVEST PROGRAM

Most Yukon Area communities have no regulatory requirements to report their subsistence salmon harvest. For these communities, the department operates a voluntary survey program. Harvest

[2] Evidence suggests that Canada's Department of Fisheries and Oceans (DFO) fish wheel mark–recapture program (1982–2004) tended to underestimate passage of Chinook salmon into Canada. Therefore, adoption of sonar as a more reliable method to estimate this number has dramatically improved estimates of escapement, exploitation rates, and brood year return information. Historical escapement goals were based on DFO fish wheels and are not directly comparable to present sonar-based escapement goals. Conversion factors have been developed to allow comparisons of escapement, exploitation rates, and brood-year return information to historical data, although this should be cautiously considered. In this report, Eagle sonar-based data (2005–2018) are emphasized because they are deemed most accurate.

information is collected through post season household interviews, follow-up telephone interviews, postal questionnaires, and harvest calendars (Padilla et al. *In prep*). For surveyed communities, harvest estimates are created that account for all households in a community, including those not surveyed. In areas along the entire Tanana River drainage (District 6) and where the Yukon River is accessible by the road system (portions of District 5), fishers must document their harvest on a subsistence or personal use permit. Subsistence and personal use harvest is critical for determining total run size and is an index of whether adequate fishing opportunity was provided when harvestable surpluses exist.

FACTORS AFFECTING THE SALMON STOCKS

Yukon River salmon stocks have generally remained healthy because of undisturbed spawning, rearing, and migration habitat throughout much of the United States portion of the drainage; however, some habitat factors are present that may adversely affect salmon production. Although the effect of these factors cannot currently be quantified, the potential individual and cumulative effects of these habitat factors should be considered when assessing the future stock productivity. A detailed discussion of these issues is found in the Yukon River Comprehensive Salmon Plan for Alaska[3] (Holder and Senecal-Albrecht 1998). This plan discusses mining, logging, and potential pollution and habitat changes related to urban development, rural sanitation, increased road traffic along a few tributaries, and agriculture. This plan is currently open for public review.

Although logging and mining may occur in the Yukon Territory of Canada where a large proportion of Yukon River Chinook and fall chum salmon spawn, these processes are monitored by the Canadian government and are not discussed in detail here.

It is estimated that at least 50% of all water bodies in the Yukon watershed have not been evaluated for distribution of anadromous species and a similar or higher percentage of first and second order tributaries similarly have not been surveyed. Without such surveys, and submittal of documentation based on field work, these streams are not afforded legal protection under Alaska Statute 16.05.841 (Fishway Act) or AS 16.05.871 (Anadromous Fish Act). A significant number of streams could be added/corrected in the Anadromous Waters Catalog. Regular review of the catalog is conducted by biologists for their assigned areas and nominations are submitted to document the presence of anadromous fish.

ADVANCES IN MARINE RESEARCH

Over the past decade, the department and its partners have supported research to understand factors leading to poor Yukon River Chinook salmon abundance (e.g., Chinook Salmon Research Initiative, Arctic–Yukon–Kuskokwim Sustainable Salmon Initiative, Alaska Sustainable Salmon Fund). Historically, salmon research has focused on the adult freshwater life stage; however, new research efforts focus on ocean conditions and the marine life history stage. Though these efforts have focused on Chinook salmon, they also provide information on other species of Pacific salmon like chum and coho salmon. These research efforts, combined with those of long-standing marine research lead by the National Oceanic and Atmospheric Administration (NOAA; Murphy et al. 2021) and international entities like the North Pacific Anadromous Fish Commission (NPAFC),

[3] Yukon River Comprehensive Salmon Plan for Alaska, under public review. https://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesPlanning.enhance (accessed October 5, 2022).

have greatly increased our understanding of the marine ecology of Pacific salmon and have helped identify periods in their life stages that are most important to determining run abundance.

To understand potential drivers of marine salmon survival, it is necessary to understand their primary habitats and marine migration patterns. A combination of marine research surveys, high seas tagging data, and genetic stock composition inform our understanding of migration patterns for Yukon River Chinook (Murphy et al. 2009; Myers et al. 2010; Larson et al. 2013) and chum salmon (Myers et al. 2010). After leaving the Yukon River in the early summer months, juvenile Chinook salmon spend their first few months at sea in relatively shallow waters of the continental shelf of the Northern Bering Sea (Murphy et al. 2021). Immature Chinook salmon from the Yukon River are believed to spend the rest of their marine life in the Bering Sea, alternating between southern Bering Sea shelf habitats in the winter, and moving into the central Bering Sea basin in the summer (Myers et al. 2010). Juvenile chum salmon from the Yukon River also spend their first few months in the ocean in the Northern Bering Sea but extend farther offshore and farther south into the southern Bering Sea. Chum salmon from the Yukon River migrate seasonally between the southern Bering Sea shelf in the summer and the North Pacific Ocean/Gulf of Alaska in the winter (Myers et al. 2010; Figure 6).

Annually, since 2002, the northern Bering Sea (NBS) Salmon and Ecosystem Survey (NBS Survey) assesses juvenile salmon during their first summer at sea. Data are collected on the abundance, distribution, health, and genetics of juvenile salmon. These have been used to calculate Yukon-specific juvenile abundance estimates annually (Murphy et al. 2017; Howard et al. 2020; Murphy et al. 2021).

Abundance data from the NBS Survey, combined with total returns, provides a powerful new piece of information that can identify which life stages are most influential to adult run abundance. For Yukon River Chinook salmon, data suggest that later marine survival, after the juvenile life stage, is remarkably stable (Murphy et al. 2017; Howard et al. 2020; Murphy et al. 2021). This means that factors dictating whether run sizes will be good or poor are occurring sometime between the spawner life stage and the juvenile's first winter in the ocean. Stable survival after the juvenile life stage suggests that later marine drivers of mortality, such as competition with hatchery fish, predation, and catch in federal marine fisheries (such as the Bering Sea Aleutian Island [BSAI] pollock fishery), are not substantially changing future run sizes. Although these later marine factors may not be primary drivers of run size decline in Yukon River Chinook salmon, it is still important to consider concerns from stakeholders about whether there is appropriate management balance amongst all fisheries for providing equitable access to salmon. Recent analyses leveraging juvenile Yukon River Chinook salmon data suggest that during the past 20 years, the spawner life stage itself may be particularly influential to abundance patterns of this stock (Kathrine Howard, Fisheries Scientist, ADF&G Division of Commercial Fisheries, Anchorage, 2022, unpublished data). Agencies, nongovernmental organizations (NGOs), and tribal groups are collaboratively investigating factors in the spawning life stage that may be important drivers for the sustained low abundance of Yukon River Chinook salmon. These factors include increased mortality associated with *Ichthyophonus* infection and increased river temperatures, and decreased success of eggs due to poor maternal marine stage food quality.

For most of the past 20 years, later marine survival of Yukon River fall chum salmon also appeared to be stable, indicating factors determining adult abundance occurred before their first winter in the ocean. However, in 2016, later marine drivers of mortality (post-juvenile stage) became more important to determining adult return abundance. Researchers have been examining what factors would be consistent with the timing and magnitude of this shift. Although it is possible marine fisheries harvesting young Yukon River chum salmon (such as South Alaska Peninsula interceptions and BSAI pollock bycatch) may contribute to marine mortality, it does not solely explain the sudden spike in mortality across their Pacific-wide distribution beginning in 2020.

Both the Bering Sea and Gulf of Alaska marine ecosystems have experienced unusually warm conditions over the past decade. The eastern Bering Sea has been in a warm phase since 2014 and has experienced heatwaves between 2016 and 2019 (Siddon 2021). The Gulf of Alaska experienced heatwaves between 2014 and 2016 and again in 2019 (Ferris and Zador 2021). Higher ocean temperatures increase metabolic demands, which require salmon to consume more food to meet their energetic needs. Additionally, changing temperature regimes are associated with changes in the abundance, quality, and distribution of salmon prey (Siddon 2021). For juvenile chum salmon, the amount of food in their stomachs decreases with increasing sea surface temperature (Murphy et al. 2021). Additionally, the amount of lipids (energy) stored by juvenile chum salmon also decrease with increasing sea surface temperature. Juvenile chum salmon from the Yukon River entering the Bering Sea after 2016 have faced marine heatwave conditions in both of their marine habitats and evidence suggests they may not have stored enough energy during their first summer at sea to survive in later marine life. Though temperatures in both the Bering Sea and Gulf of Alaska rebounded to average levels in 2020 and 2021 (Siddon 2021; Ferris and Zador 2021), lag effect of marine heatwave conditions may persist even after temperatures have returned to normal.

NEW AND ONGOING MARINE RESEARCH PROJECTS

The department is currently leading and collaborating with federal, NGOs, academic, and international entities to continue addressing marine research needs. The NBS Survey has been funded through 2023, but funds will need to be secured for future surveys to continue monitoring juvenile salmon abundance, distribution, and ecology. In addition to the information this survey provides for causes of Yukon salmon abundance patterns, data from this survey also provide a forecast for adult Chinook salmon runs up to 3 years into the future. Run forecasting tools are currently being developed for other Yukon River salmon species such as Yukon River fall chum salmon. Although the focus of the NBS Survey has been on Chinook and chum salmon, efforts are underway to begin exploring juvenile abundance estimates for coho salmon and identifying factors that have caused recent run declines.

New projects have been initiated focusing on Chinook salmon bycatch in the BSAI pollock fishery and chum salmon catch in South Alaska Peninsula fisheries. In collaboration with the University of Alaska Fairbanks and NOAA, the department is leading the development of a habitat model to predict where and when Chinook salmon occur in the Bering Sea. If successful, that information can be provided to marine fisheries to reduce bycatch by avoiding fishing in specific areas when Chinook salmon could be present. The department is leading a study to estimate the genetic stock composition of chum salmon caught in South Alaska Peninsula fisheries starting with the 2022 season through 2026 (Foster and Dann 2022). This study seeks to update stock-specific chum salmon harvests in South Alaska Peninsula fisheries that are over a decade old (western Alaska Salmon Stock Identification Program; Eggers et al. 2011).

The department has also initiated new projects to understand root causes of declines of Yukon River salmon stocks. This includes a collaboration with NOAA to use chum salmon samples collected during a high seas winter survey in the North Pacific Ocean to assess winter distribution, overlap in habitat utilization with wild and hatchery salmon, diet, and health condition of Arctic–Yukon–Kuskokwim chum salmon. In collaboration with Baylor University, the department is using salmon bony structures, such as vertebrae and opercula, to recreate the life histories of Yukon River fall chum salmon using new technologies. Trends in hormone and chemical concentrations over the fish's life can be assessed for changes in growth, stress, and reproduction to see how those might be affected by the environmental conditions experienced by the fish. This new technology enables learning about the marine life of salmon without the need to catch them in the open ocean. Finally, a new project in collaboration with NOAA, the U.S. Geological Survey, and the Yukon River Drainage Fisheries Association, aims to tie the marine environment with the freshwater migration of Chinook salmon. The objective of this research is to determine if female Chinook salmon achieve adequate ocean nutrition to successfully reach their spawning grounds and produce eggs that are equipped to survive, given changes in marine diet, heat stress, long spawning migrations, and increased disease.

CHINOOK SALMON STOCK STATUS

ESCAPEMENT

Tributary escapements have been monitored with counting towers and sonar projects on the Chena and Salcha Rivers, a weir project on the East Fork Andreafsky River, and aerial surveys on the Anvik, West Fork Andreafsky, and Nulato Rivers (Figure 1). For the Chena and Salcha River salmon enumeration projects, visual counts from a counting tower are the primary means of enumeration that are supplemented by sonar counts during periods of high, occluded water. The BEG for the Chena River was met or exceeded from 2014 to 2018. The BEG for the Salcha River was met from 2017 to 2019. The Salcha River enumeration project was not operated in 2020 due to lack of funding. During 2022, the Chena River abundance estimate was based solely on visual counts, and the Salcha River estimate was a combination of visual counts and modelled data due to mechanical issues with the sonars. Chinook salmon aerial surveys were not assessed in 2021, and several tributaries in 2022 were unable to be indexed due to poor conditions. In the past 5 years (2018–2022), several escapement goals were met (Tables 2 and 11). The lower end of the U.S./Canada border objective was met from 2014 to 2018. The objective was not met from 2019 to 2022 (Table 11).

YIELD

Poor Chinook salmon runs have caused a dramatic decline in commercial and sport Chinook salmon harvests since 1998, and decreased subsistence harvests since 2007 (Table 8, Figure 5). A Chinook salmon directed commercial fishery has not occurred since 2007 and the summer chum salmon directed fishery has been conservatively managed to reduce incidental harvest of Chinook salmon. Two management areas encompass the Yukon River sport fisheries: the Yukon River Area (YRA) that excludes the Tanana River, and the Tanana River Area (TRA). Due to poor projected Chinook salmon run sizes during 2018–2022, the sport fishery closed preseason in the YRA. However, in 2019, sport fishing was reopened on July 11 with an annual limit of 1 Chinook salmon greater than 20 inches. For the TRA, the majority of sport fishing occurs in the Chena and Salcha Rivers and the earliest portion of the run arrives in late June, so management decisions are usually made later than the YRA that includes the lowermost portion of the Yukon River. During 2018, the Chinook salmon bag limit was reduced to 1 fish and bait was prohibited in the TRA. During 2019, the Chinook salmon fishery in TRA was restricted to catch-and-release, and in late July sport fishing closed for Chinook salmon. During 2020–2022, sport fishing for Chinook salmon was closed in the TRA for the entire season.

From 2018 through 2022, harvests fell below the lower end of the ANS range of 45,500–66,704 Chinook salmon in each year, except for 2019 (Table 8). Subsistence fishing for salmon was closed the entire season in 2021 and 2022; the subsistence harvests of 1,945 Chinook salmon in 2021 and 1,827 Chinook salmon in 2022 were the lowest on record (Table 8).

EXPLOITATION RATES

The exploitation rate is defined as that proportion of the run that is harvested; hence, stock-specific total run, escapement, and harvest estimates are needed to calculate exploitation rates. Exploitation rates cannot be estimated for Chinook salmon stocks that spawn in the lower or middle regions of the Yukon River in Alaska because total escapement to these regions cannot be estimated accurately. However, total run estimates and stock-specific harvest for the Canada-origin stock can be determined based on border passage estimates and genetic mixed stock analysis.

From 1998 through 2007, when Chinook salmon run sizes were higher than recent years, an average of 43% of the Canada-origin Chinook salmon total run was taken in the Alaska harvest (Figure 5). With poor returns of Canada-origin fish in recent years, and a conservative management strategy, the average exploitation rate for the recent period of 2018–2022 has decreased to approximately 23% and was as low as 4% in 2021 (Figure 5). Estimated exploitation rate is preliminary for 2022.

BROOD YEAR RETURN INFORMATION

The brood year data for Canada-origin Chinook salmon is used to assess the productivity of the Canada-origin stock and serves as a representative of the drainagewide run. Total brood year return divided by the parent-year escapement is a measure of stock productivity and is expressed as recruits or returns per spawner (R/S). Higher R/S values suggest better productivity. The minimum level of replacement for a stock is set at an R/S of 1; i.e., for each fish that spawns, 1 fish returns to spawn (Figure 7). The most recent brood year with most of the age classes returned (ages 3 through 6) is 2015. The ratio of R/S for Canada-origin Chinook salmon stock has ranged from a low of 0.50 to high of 5.19, with an overall average of 2.26 R/S from 1982–2015 (Figure 7).

Brood year tables also provide information regarding age class composition of the return. Yukon River Chinook salmon return as age-2 through age-8 fish, but age-5 and age-6 salmon dominate the run. Age class composition of the run varies from year to year because of the variability in individual year class strengths.

CHINOOK SALMON OUTLOOK

The preseason outlook for total Yukon River Chinook salmon is generated by applying the historical average proportions of Canada-origin fish in the total run (41%) to the Joint Technical Committee (JTC) approved Canada-origin run outlook, which is based on a combination of sibling, spawner–recruit, and marine juvenile abundance forecast methods (JTC 2022). The 2023 preseason outlook will not be available until early spring, 2023.

Marine surveys in the northeastern Bering Sea (NBS) have provided important ecological and management insights for Yukon River Chinook salmon (Murphy et al. 2013). These surveys occur primarily in September and use surface trawls to capture juvenile salmon after they experience the critical transition from freshwater to marine environments. The most recent surveys have included sampling in both August and September in order to increase our understanding of factors affecting early marine survival. Important products of these surveys include indices of juvenile Yukon River Chinook salmon abundance which can predict adult run size up to 3 years in advance. Current run sizes and recent projections indicate decreasing abundance should be expected over the next few years (Figure 8). Unfortunately, no juvenile forecast is currently available for 2023 and beyond due to the missed survey in 2020 because of COVID-19 travel restrictions. However, staff are currently developing a method to interpolate the missed survey in order to allow juvenile forecasts to be used in the future.

FACTORS AFFECTING CHINOOK SALMON STOCKS

Bering Sea Bycatch of Yukon River Stocks

Yukon River bound Chinook salmon are taken as bycatch in the Bering Sea groundfish fishery and Yukon subsistence fishers have consistently expressed concern about effects on western Alaska salmon stocks, particularly after an estimated 130,000 Chinook salmon were taken as bycatch in 2007. The North Pacific Fishery Management Council (council) acted in 2009 to manage Chinook salmon bycatch under Amendment 91 by creating a hard cap on Chinook salmon bycatch and creating a bycatch avoidance program with incentive plans. Amendment 91 went into effect during the 2011 fishing season. In April 2015, the council approved regulations that lowered the bycatch cap for Chinook salmon during historically low runs as indexed by the Unalakleet, Upper Yukon, and Kuskokwim River stocks. When this 3-system index of inriver adult Chinook salmon run sizes is below the threshold of 250,000 fish, the performance standard and hard cap applicable to the Bering Sea pollock fishery are lowered in the following year. This cap was triggered in 2018 and from 2020 to 2022.

A marked reduction in bycatch has occurred since 2008, and the recent 5-year (2018–2022) average bycatch in the pollock directed fishery is less than 19,000 Chinook salmon. Approximately 6,300 Chinook salmon have been caught through October 2022, although these numbers are preliminary.

Change in Size and Age at Return

Yukon River Chinook salmon appear to have declined in size over the past 34 years, largely due to a higher proportion of younger age classes returning, i.e., the loss of age-8 and age-7 returns. This could be a result of size-selective harvest but is more likely a result of changing ocean conditions which have dynamic effects on food sources, growth rates, competition amongst species, predator/prey interactions, and other factors affecting survival and age at maturity (Lewis et al. 2015).

Age class composition of the Canada-origin Chinook salmon returns from brood years 1979–2015 indicates that there was a dramatic decrease in age-7 salmon from an average of 28% during years 1979–1982, to an average of 8% during the following 10-year period (1983–1992). From 1993 to 2015, the age-7 age class has composed, on average, about 4% of the return. The brood year age class composition for age-4 salmon has remained relatively stable from 1993 to 2001, with an increase from 2001–2015 (Figure 9). Starting in 2001, there has been a trend of age-5 and age-6 Chinook salmon alternately dominating the brood year age class composition, with age-5 dominating consistently since 2010 (Figure 9).

Declining body size (at age), coupled with a reduction in older age classes, influences the quality of spawning escapement. Due to these concerns, the board reduced the maximum mesh size allowed on the Yukon River for Chinook salmon subsistence fishing to 7.5-inch or smaller mesh in 2010. The reduction in mesh size was based on a study that established net selectivity models for Chinook salmon (Bromaghin 2005). Applying these net selectivity models to Pilot Station sonar test fishery data showed that 7.5-inch mesh net selectivity more closely resembled the length distribution of the population and consequently would result in a broader distribution for escapement. The department also addresses this concern for achieving quality escapements by monitoring the age composition at assessment projects and the harvest when possible. The department is not able to manage the fishery to protect a particular stock or age class; instead, the focus is on achieving escapement goals for long-term sustainability. The board effectively capped commercial gillnets for chum salmon to 6-inch or smaller mesh, which is an ideal mesh size to target chum salmon. Any incidental catch of Chinook salmon in this gear size is statistically less probable to be the larger, more fecund, female Chinook salmon.

Flood Control and Other Dams

A large contributor to the Yukon River Chinook and chum salmon runs is the Tanana River, with fish spawning mainly in the Chena and Salcha River tributaries. The Chena River Lake Flood Control Project was built by the U.S. Army Corps of Engineers during 1973–1979 to control flood waters in downtown Fairbanks in response to the devastating 1967 flood. Some fish resource users have raised concerns about the dam's effects on the emigration of salmon fry or migration of adults. During high water events, the dam's gates are lowered to divert some of the Chena River's flow to a vegetated floodway immediately upstream of the dam until the flow recedes to manageable levels. This diverted water may later flow into the Tanana River or drain back into the Chena River. The potential impacts on outgoing juveniles from stranding, avian predation, and disruption of imprinting are unknown.

The Whitehorse Dam on the mainstem Yukon River in Whitehorse, Canada, is the only other dam on the Yukon River that may impede passage of spawning salmon and the outmigration of juvenile salmon. This dam provides a fish ladder to allow passage of fish and has a hatchery that has an annual release target of 150,000 Chinook salmon fry each year upstream of the dam. These projects have been in place since the mid-1980s and data are summarized in the annual JTC report (JTC 2022).

Fish Health

Many factors affect the fish health and disease burden of Yukon River salmon. Water temperature, environmental stresses for salmon and their prey, and natural rhythms of disease may result in increased viral load impacting the overall health of salmon. *Ichthyophonus* has affected Chinook salmon populations, with an increased virulence between 1999 and 2004, along with documented declines in the population (Kocan et al. 2004). In 2020, subsistence users reported seeing signs of *Ichthyophonus* in Chinook salmon hearts and flesh. These reports resulted in a department sampling program in 2021, followed by partnership with USFWS to conduct a 3-year sampling program that began in 2022 at Pilot Station sonar, Rampart Rapids, and Eagle sonar. Preliminary results from samples taken in 2022 show that *Ichthyophonus* was prevalent in Chinook salmon at all points on the river with signs that the infection is increasing during upstream migration. The department is hoping to quantify Chinook salmon affected by *Ichthyophonus* as well as other diseases such as microsporidiosis, an emerging disease recognized in Oregon Chinook salmon in

2021. In addition to possible disease induced mortality, high water temperatures have been shown to cause decreased spawning success and early mortality. Evidence of heat stress in Yukon River Chinook salmon has been documented in 2016 and 2017 (von Biela et al. 2020). Samples to detect heat stress in Chinook salmon is an ongoing project with plans to continue for the next several years. Understanding disease burden and other factors that may cause inriver prespawning mortality will allow for more accurate run reconstruction and better management strategies to detect disease and account for excess mortality to continue to reach escapement goals.

SUMMER CHUM SALMON STOCK STATUS

Most summer chum salmon spawn in the Yukon River drainage downstream of and within the Tanana River drainage (Figure 2). Stock composition of Yukon River summer chum salmon runs has varied over the last decade. The contribution of the Anvik River, the largest producer of summer chum salmon, to the overall Yukon River stock production above Pilot Station sonar has decreased from approximately 46% during the years 1995–2002 to an average of 22% after 2002. This reduction corresponds with increased production in other chum salmon spawning streams. In 2014 and 2015, the department implemented a comprehensive radiotagging project for summer chum salmon to gain a better understanding of spawning distribution and abundance. Roughly 22% of the radiotagged summer chum salmon entered the Koyukuk River in 2014; however, that number increased to 27% in 2015. During both years, roughly 21% of tagged summer chum salmon entered the Anvik River and roughly 10% entered the Bonasila River (Larson et al. 2017).

The Yukon River summer chum salmon run is typically managed as a single stock. The regulatory management plan, 5 AAC 05.362 *Yukon River Summer Chum Salmon Management Plan,* was modified in 2016 to provide recommended management actions based on various run sizes and to account for the new drainagewide escapement goal (Table 1).

SUMMER CHUM SALMON HARVEST

Commercial and subsistence harvests of summer chum salmon have fluctuated from decade to decade. The average harvest was highest in the 1980s with approximately 1,200,000 summer chum salmon harvested, and lowest in the 2000s with an average harvest of 158,000 summer chum salmon. The recent (2018–2022) average of summer chum salmon harvested in commercial, subsistence, personal use, and sport fisheries combined is 202,333 fish (Table 3). Subsistence harvests for summer chum salmon have been relatively stable in the Yukon Area; however, the recent 5-year average (2018–2022) of 37,975 fish is lower than the previous 5-year average (2013–2017) of 92,184 fish, reflecting recent low run sizes and restricted fishing to protect Chinook and summer chum salmon runs.

Subsistence fishers mainly target summer chum salmon in the Lower Yukon River. Although summer chum salmon are found as far upstream as the lower portions of Districts 5 and 6, fishers typically do not target them for human consumption due to their declining quality at those upstream areas. Starting in 2012, managers have had the option of opening fishing periods during the summer season with selective gear types (beach seines, dip nets, and fish wheels) and require the live release of Chinook salmon. These gear types are less effective than gillnets but allow fisheries to target chum salmon in times of Chinook salmon conservation.

Commercial harvest of summer chum salmon averaged about 394,000 during the 1990s and 71,000 during the 2000s. The recent 5-year average (2018–2022) of 163,549 summer chum salmon is a decrease from the previous 10-year average (2008–2017) of 360,649 fish (Table 3). These averages include commercial harvests from Subdistrict 4-A which operated from 2008 to 2010, 2012 to 2014, and 2017 and 2018.

Average summer chum and Chinook salmon run timing overlap considerably with the middle 50% of the Chinook salmon run overlapping with the middle 50% of the summer chum salmon run for 9 days (Figure 10). Due to this overlap, and Chinook salmon harvest restrictions, the department has developed management strategies that address the need to conserve Chinook salmon during poor runs while also providing harvest opportunities on the available surplus of summer chum salmon.

With the use of selective gear types to commercially harvest summer chum salmon, commercial fishing during 2014–2018 was initiated earlier than other years; however, commercial fishing did not start until July 3 in 2019 and June 27 in 2020 (Table 13). Although dip nets are not as efficient as gillnets for harvesting summer chum salmon, the success of the 2014–2018 commercial fisheries is largely due to the use of selective gear which accounted for 34–64% of the total summer chum salmon commercial harvest. Summer chum salmon commercial harvests during this same period were the largest since 1996 (Table 3). Due to the late start of the season in 2019, there were no selective gear openings due to the Chinook salmon run being nearly complete. The commercial harvest was 227,089 summer chum salmon before the transition date to fall season. In 2020, the commercial fishery was closed after 5 periods due to low abundance and harvest levels. The commercial season was not opened in 2021 and 2022.

ESCAPEMENT

A Bayesian state-space integrated run reconstruction and spawner–recruitment analysis, using data from 1978 to 2014, was used to establish a summer chum salmon drainagewide escapement goal range of 500,000–1,200,000 in 2016 (Hamazaki and Conitz 2015; Figure 11), and the model output is used to represent the total run of summer chum salmon. The run reconstruction model is updated annually and is used to evaluate if the escapement goal was met each year. The drainagewide goal was met or exceeded from 2016 to 2020. If the same BEG had been in place historically, it would have been exceeded from 2002 to 2020 (Figure 11).

Tributary escapements have been monitored with a weir project on the East Fork Andreafsky River and a sonar on the Anvik River (Figure 12). The East Fork Andreafsky River SEG of at least 40,000 fish was established in 2010 and was not met in 2014, 2018, and from 2020 to 2022. The Anvik River BEG was established in 2005 and has been met most years except for 2009, 2016, and from 2018 to 2022. Both projects were not operated in 2020, and the East Fork Andreafsky River weir did not operate in 2022 (Figure 12).

YIELD

The average yield is 370,000 summer chum salmon based on brood return from Yukon River drainagewide escapements from 1978 to 2017 (Figure 13). In the early years, between 1978 and 1992, the average yield was 1.2 million summer chum salmon with a range of -1.2 million to 2.8 million fish. Most years up through 1992, the yield was positive, except the returns from 1985 and 1988. In the last 2 decades, yields have become highly variable, like the run abundances, with the yield from 1993 to 2017 averaging a negative 98,000 summer chum salmon, with a range of -2.9 million to 5.1 million fish. Since 1993, 11 of the 25 (44%) brood year returns through 2017 resulted in not meeting replacement and producing yield. With larger and more variable run sizes, the frequency and depth of negative yields has resulted in substantially less production.

EXPLOITATION RATES

Similar to Chinook salmon, the exploitation rate for summer chum salmon is defined as that proportion of the run that is harvested; hence, stock-specific total run, escapement, and harvest estimates are needed to calculate exploitation rates.

Total exploitation rates exerted by Yukon River fisheries on summer chum salmon over 45 years averages about 20%, ranging from a high of 47% in 1983 to a low of 0.81% in 2021 (Figure 14). Exploitation rates from years 2000–2001, the last extreme low production cycle, were reduced to 13% in 2000, and 11% in 2001. Now, 2 decades later, even worse returns in 2021 and 2022 have further reduced the exploitation to new lows of less than 1%. The previous 10-year average (2008–2017) exploitation rate was 18%, which is higher than the recent 5-year average (2018–2022) exploitation rate of 11%.

BROOD YEAR RETURN INFORMATION

Total brood year return divided by the parent-year escapement is a measure of stock productivity and is expressed as recruits or returns per spawner (R/S). Higher R/S values suggest better productivity. The minimum level of replacement for a stock is set at an R/S of 1; i.e., for each fish that spawns, 1 fish returns to spawn (Figure 15). The most recent brood year with most of the age classes returned (ages 3 through 5) is 2016. The ratio of R/S for summer chum salmon stocks has ranged from a low of 0.10 to high of 11.64, with an overall average of 1.60 R/S from 1978–2016 (Figure 15).

Brood year tables also provide information regarding age class composition of the return. Yukon summer chum salmon return as age-2 through age-7 fish, but age-4 and age-5 salmon dominate the run. Age class composition of the run varies from year to year because of the variability in individual year class strengths.

OUTLOOK

The preseason outlook for total Yukon River summer chum salmon is generated using a drainagewide run reconstruction model (Hamazaki and Conitz 2015). Resulting model estimates of escapement and total return are used to develop a drainagewide brood table and forecast the summer chum salmon run. The 2023 preseason outlook will not be available until early spring of 2023.

The returns of age-4 and age-5 fish in 2021 were each the second smallest observed since 1978. The overall return of 154,000 summer chum salmon in 2021 was the smallest on record, 93% smaller than the 1978–2021 average of 2.5 million. The 2022 preliminary return is the second smallest on record at 83% smaller than the 1978–2021 average. The parent years of 2016 and 2017 both failed to return as age-4 fish in any significant numbers in 2020 and 2021. The lack of age-4 fish from 2016 also contributed to the lack of age-5 fish in 2021, followed by a second poor age-4 return that resulted in a new record low run that year. Return per spawner for 2016 and 2017 was near 0.10 and was the lowest on record. Returns from 2018 appear to be slightly improved for age-4 fish and improved the run size that returned in 2022. If both primary age classes for 2023 return slightly better than 2022, there is potential to have a surplus for subsistence harvests.

FACTORS AFFECTING SUMMER CHUM SALMON STOCKS

Summer chum salmon run timing starts in early June, peaks in late June, and in recent years, has extended through the end of July. They spawn in tributaries on the lower 500 miles of the Yukon River, using sloughs with silty and small gravel substrates. Upwelling, water temperatures, and dewatering are critical factors for successful hatching and rearing. Offspring migrate to the ocean with spring floods the following year. Several months are spent in estuarine environments acclimating and growing, feeding primarily on insects and invertebrates. Finally, Yukon River summer chum spend 3 or 4 years in the ocean before returning to their natal streams to spawn. In the ocean, chum salmon eat a variety of foods: copepods, small fish, squid, and gelatinous zooplankton. Salmon are an integral part of the food web and are prey to larger fishes, mammals, and birds during their entire life cycle.

Warm waters at any part of their life cycle can affect their metabolic rate and disease response resulting in decreased survival. In the past 5 years the Gulf of Alaska, Bering Sea, and Yukon River have had periodic warm water events. Warm waters have also affected the prey abundance and quality, and the predators present in these waters. They encounter a variety of fishing pressures along their return migration from the Gulf of Alaska, including commercial, subsistence, personal use, and sport fisheries.

FALL CHUM SALMON STOCK STATUS

Currently, the Yukon River fall chum salmon run is in a low abundance cycle that began in 2020 when there was a lack of age-4 fish returning from the 2016 parent year. The occurrence was widespread, affecting chum salmon stocks in all of western Alaska, including both hatchery and wild stocks as far south as British Columbia. The Yukon Area stocks since then have been slower to recover than other areas; however, 2022 was twice the abundance of the new record low observed in 2021. The run had recovered from the previous low abundance years that occurred between 1998 and 2001. From 2002 through 2019, the fall chum salmon stocks were averaging over 1 million fish, similar to the run sizes of the past, with escapements within or exceeding the drainagewide goal range of 300,000 to 600,000 fall chum salmon during those years.

The fall chum salmon dataset includes runs back to 1974, and although there is little difference in the average run abundance (1 million fish) between the 1974–1992 period and the 2002–2019 period, the annual run sizes in the latter period have been more variable. From 1974 through 1992, there was a prominent even/odd-year abundance cycle, where odd-numbered years were substantially larger; however, after 1993, the pattern changed. Since then, years 1993, 2000, and 2021 were extreme lows, with the largest runs occurring in 1995, 2005, and 2017. After 1993, and again after the recovery from the poor observed returns from 1998 to 2002, it became more common to have 3 consecutive years of high abundance.

ESCAPEMENT

Fall chum salmon are discrete spawners choosing areas of upwelling and relatively warmer water to incubate their eggs in a shorter time than summer chum salmon. Major fall chum salmon spawning areas are located in the Tanana, Teedriinjik, and Porcupine River drainages, and within the Canadian portion of the mainstem Yukon River drainage (Figure 1).

Since the last stock status report to the board (Borba et al. 2009), some escapement goals have been revised. Drainagewide fall chum salmon escapement was managed in reference to a BEG from 2001 until 2009 (Eggers 2011), when the goal was converted to an SEG of 300,000–600,000 fish (Fleischman and Borba 2009). Since 2014, a Bayesian state-space model has been used to determine the drainagewide escapement. The goals for the Sheenjek River, an upper Yukon River tributary, were discontinued in 2015, and the Tanana River goal was discontinued in 2019, with no means to monitor the systems that contributed to these components (Figure 1). The Teedriinjik and Delta River goals were updated in 2019 using the percentile method (Clark et al. 2014) and developed as SEGs from their former BEG status.

If the current drainagewide SEG for fall chum salmon been in place historically, it would have been met or exceeded every year except the following 7 years: 1982, 1998–2000, and 2020–2022 (Table 6, Figure 16). Several individual tributary escapement goals are used for fall chum salmon. Over the last 20 years, the Delta River SEG of 7,000–20,000 fall chum salmon was met 19 times (2002–2020), the Teedriinjik River SEG of 85,000–234,000 fish was met at least 18 times (2002–2019; the project was not operated in 2020), the mainstem Canada IMEG of 70,000–104,000 fish was met 18 times (2002–2019), and the Fishing Branch River IMEG of 22,000–49,000 fish was met 9 times (2003, 2005–2007, 2009, 2012–2013, and 2016–2017; Table 6).

YIELD

The average yield is 215,000 fall chum salmon based on brood return from Yukon River drainagewide escapements from 1974 to 2018 (Figure 17). In the early years, between 1974 and 1993, during the consistent even/odd-year abundance cycles, the average yield was 356,000 fall chum salmon, with a range of -274,000 to 952,000 fish. Most years up through 1993, the yield was positive except for the returns from 1975, 1978, and 1979. In the last 2 decades, yields have become highly variable, like the run abundances, with the yield from 1994 to 2017 averaging only 103,000 fall chum salmon, with a range of -1.6 million to 2.6 million fish. Since 1994, 11 of the 25 (44%) brood year returns through 2018 resulted in not meeting replacement and producing yield. With larger and more variable run sizes the frequency and depth of negative yields has resulted in substantially less production.

Production levels for years 1974 through 1992 allowed for average harvests of 439,000 fall chum salmon, whereas more recent production levels, markets, buyer capacity, along with conservative management actions taken through periods of high and low production extremes have reduced harvests to 205,000 fish. During the low productivity years from 1998 to 2002, harvests were at all-time lows that averaged only 61,000 fall chum salmon drainagewide. The following years (2004–2013) average harvests were 232,000 fall chum salmon, which was comparable to average harvest taken from 1993–1997 (Figure 16). Harvests continued to increase from 2014 to 2019 to an average of 395,000 fall chum salmon. As a result of previous poor fall chum salmon runs in the early 2000s and subsequent fishing restrictions and closures, it appears subsistence fishing effort and harvest has remained relatively low (Table 4) even in those years with much larger runs, as in 2003, 2005–2008, and 2016–2019 (Figure 16). With the exception of 1995, fall chum salmon commercial harvests (Table 4) have been low since 1992, partly due to weak market conditions, but also because of uncertainty in predicting run strength. Most recently, this has resulted in underutilization of the stock in commercial fisheries in 2003, and 2005 through 2007. Fall chum salmon runs in 2008 and 2009 were fully utilized, with most escapement objectives attained and below average harvests due to below average available surpluses. With the low number of processors remaining operational in the Yukon Area, and the uncertainty in forecasting large returns, commercial fisheries were unable to harvest the surplus in years such as 2017.

EXPLOITATION RATES

Annual total run estimates and total inriver harvests are used to estimate exploitation rates exerted on fall chum salmon for the years 1974–2022 (Figure 18). Total exploitation rates exerted by Yukon River fisheries on fall chum salmon over the past 49 years averages about 30%, ranging from as high as 62% in 1982 to as low as 0.76% in 2021. Exploitation rates from 2000–2002, the last extreme low production cycle, were reduced to 11%, 12%, and 6%, respectively. Two decades later, fishing opportunity had to be severely restricted on returns during 2020–2022, thereby reducing the exploitation to new lows, with an average of 2%.

From 1974 to 1991, exploitation rates for fall chum salmon averaged 44%. With increased research on Yukon River stocks of fall chum salmon, managers have more tools now than in the past to more effectively manage stocks. Some of the improvements include the development of species-specific management plans, recruit per spawner analyses, forecasting, mixed stock analysis, and the development of the relationship between the summer and fall chum salmon runs. After the first collapse of chum salmon in the early 2000s, and the conservative management that followed, exploitation began to slowly increase from 2002 to 2019. Commercial markets took several years to be reestablished. Current exploitation rates are much lower than historical rates (averaging 44% pre-1992 to an average of 23% for 1991–2019), partly due to highly variable runs occurring in the last 2 decades. The tools to predict and manage reduced runs have improved considerably; however, predicting extremes of high production is still lacking. Trends in subsistence exploitation were stabilizing at 10% from 2005 to 2019, which was down from the pre-1992 exploitation of 20% (restrictions on subsistence fisheries were enacted for several years between 1993 and 2004). Commercial exploitation was 25% pre-1992 but only 18% from 2005 to 2019, partially due to slow regaining of markets, processing power being significantly reduced as the run sizes became highly variable in abundance, and the soaring high costs of transportation in the region.

BROOD YEAR RETURN INFORMATION

The brood year data are used to assess the productivity of the aggregate fall season chum salmon stocks to represent the drainagewide run. Total brood year return divided by the parent-year escapement is a measure of stock productivity and is expressed as recruits or returns per spawner (R/S). Higher R/S values suggest better productivity. The minimum level of replacement for a stock is set at an R/S of 1; i.e., for each fish that spawns, 1 fish returns to spawn (Table 14, Figure 19). The most recent brood year with most of the age classes returned (ages 3 through 6) is 2016. The ratio of R/S for fall season chum salmon stock for complete brood years has ranged from a low of 0.13 from 2016 to high of 9.00 from 2001, with an overall average of 1.73 R/S from 1974 to 2016 (Table 14, Figure 19). Estimated returns from the 2017 brood year appears to be the new record low return per spawner.

Brood year tables also provide information regarding age class composition of the return. Yukon River chum salmon return as age-3 through age-6 fish, but age-4 and age-5 salmon dominate the run. During the fall season, age-4 chum salmon contribute on average 69%, whereas age-5 fish represent 27% of the return.

The development of the Canada-origin fall chum salmon IMEG used a brood table based on ages of fish passing into the mainstem Yukon River near the U.S./Canada border. This brood table contained complete brood years through 2004. This data interpretation is in the purview of the

U.S./Canada JTC and there remains additional issues, including determining Canadian-origin harvests within the U.S. fisheries.

The Yukon River Salmon Agreement also provides for an agreed level of escapement for fall chum salmon within Fishing Branch River in the headwaters of the Porcupine River drainage. An IMEG of 22,000–49,000 fall chum salmon was established in 2008 and is not based on a brood table due to lack of stock-specific age structure and harvest data. This stock has been exhibiting lower productivity than the other stocks in the drainage. Evaluating the current goal back to 2002 through 2018, similar to the mainstem, would have resulted in meeting the goal 8 years, exceeding it in 1 year, and not meeting it in 9 years.

OUTLOOK

The preseason forecast for Yukon River drainagewide fall chum salmon is generated using a spawner–recruit model (JTC 2022). The Canada-origin forecasts of fall chum salmon are then derived by applying 25% for the mainstem Yukon River stocks and 4% to represent the Fishing Branch River contribution. The 2023 preseason forecast will not be available until February 2023.

The parent years 2016 and 2017 both failed to return as age-4 fish in any appreciable numbers in 2020 and 2021. The lack of age-4 fish from 2016 also contributed to the lack of age-5 fish in 2021, followed by a second poor age-4 return from 2017 resulted in a new record low run that year. Return per spawner for 2016 is near 0.13, and for 2017 is near 0.09, the new lowest on record. Returns from 2018 appear to be slightly improved for age-4 fish and somewhat improved the run size that returned in 2022. If both returning primary age classes for 2023 return slightly better than 2022, there is potential to have a surplus for subsistence harvests.

FACTORS AFFECTING FALL CHUM SALMON STOCKS

Fall chum salmon generally have a shorter incubation period since they spawn in late October but still hatch in April, similar to emergence of other salmon species. Because the fall chum salmon spawning areas are concentrated in upwelling waters that are relatively warmer and have a more consistent temperature regime throughout the wintertime period, sufficient degree days are accrued. Habitat issues such as geological changes in aquifers of upwelling waters would have a drastic effect on the suitability for spawning beds. Severe cold winters with low levels of insulating snow could reduce the available habitat if freezing occurred deep enough or caused areas to become dewatered. Juvenile chum salmon travel to the ocean with the spring runoff that first year of emergence and face predation for the rest of their lives. The department monitors select spawning ground overwintering temperatures in the Delta and Toklat Rivers. Research is ongoing in the Canadian portion of the drainage concerning the shift of the Kaskawulsh Glacier in 2016. Previously, the glacier supplied Kluane Lake with significant annual summer influx, but now primarily drains into the Kaskawulsh River. Kluane Lake is now primarily supported by upwelling water and summer rain runoff. It is unknown whether or not this will be enough to support the fall chum salmon populations in the drainage.

Some factors related to the consistent incubation temperatures may contribute to fall chum salmon being larger than summer chum salmon which allows them to return younger (predominantly as age-4 fish), whereas summer chum salmon typically contain a higher proportion of age-5 fish.

COHO SALMON STOCK STATUS

Coho salmon are the latest species of salmon to enter the Yukon River and they overlap considerably with the more abundant fall chum salmon. Coho salmon range upriver to the Tanana River but not many ascend to the mainstem Yukon River to Canada except for a few known to make a migration to the upper Porcupine River. In the United States fisheries, coho salmon are typically harvested incidentally while targeting fall chum salmon.

ESCAPEMENT

There is only one established escapement goal for coho salmon in the Yukon River drainage, which is an SEG of 5,200–17,000 fish for the Delta Clearwater River (Table 7). Since 1993, the lower end of the SEG has been exceeded 24 times and the upper end of the SEG has been exceeded 8 times (last in 2015). The goal has not been achieved since 2018. Several areas in the Nenana and upper Tanana River drainages are also monitored, but no escapement goals exist for these systems (Table 7).

In recent years, a coho salmon run size index has been developed that expands the Pilot Station sonar passage estimates by comparing the timing of the next closest monitoring project in the Lower Yukon River (test fisheries near Emmonak or Mountain Village) using the appropriate lag for travel time. Further, commercial and subsistence harvests below the sonar site are included to provide an index of coho salmon abundance for the Yukon River. Subsistence harvest in this area is fairly stable, averaging 3,000 coho salmon annually. However, the commercial harvest can vary drastically (<1,000 to 177,000) depending on the management of the fall chum salmon fishery. This index does not include coho salmon spawning in tributaries below the sonar site. Currently, the data used for estimating the coho salmon run size index is based on the years 1995 and 1997 through 2022 (excluding 2009). This model results in an average (1995–2022) run size of 222,000 coho salmon in the Yukon River (Table 14).

An index of Yukon River drainagewide escapement is derived from the coho salmon run size index minus the total harvest of coho salmon (Table 14, Figure 20). The average escapement using this dataset was 156,000 coho salmon from 1995 to 2022. In 2021, the run size index was estimated to be approximately 45,500 coho salmon with an estimated escapement of 45,000 fish (lowest on record) after removal of 296 coho salmon harvested incidental to nonsalmon fishing opportunities. The coho salmon index of run size in 2022 was more than double 2021 and ranks as the second lowest on record. None of the monitored escapements correlate with the index of abundance estimates for coho salmon.

EXPLOITATION RATES

With the development of the index of coho salmon run size, estimates of exploitation can be calculated. The average exploitation based on all harvests on coho salmon from 1995 to 2019 is 29% and range from 7% in 2000 to 58% in 2015 (Figure 20). Harvests of coho salmon from 2020 to 2022 were extremely low, with an average exploitation of 2%. Subsistence harvest exploitation averaged 8% from 1995 to 2019 and ranged from 2% to 15%, whereas the commercial fishery averaged 21%, with the highest, 51%, occurring in 2015 and 2016.

Subsistence harvests of coho salmon have been decreasing on average by decade from 31,000 in the 1990s, 20,000 in the 2000s, and 12,000 fish through 2019 (Table 5; JTC 2022). The most recent decline in subsistence is not for lack of need but partly due to a different way of obtaining the fish, through the use of local catcher–sellers filling the needs, thereby, a portion of the historical subsistence harvest is now documented under commercial, and the harvest is primarily used for dog food. Commercial harvests of coho salmon have been increasing on average by decade from 32,000 in the 1990s, 37,000 in the 2000s, and 97,000 fish (Table 5; JTC 2022) through 2019. The recent increase in coho salmon commercial harvests includes some changes in the markets, changes in the fishery as described, and also above average run sizes this past decade prior to 2020.

OUTLOOK

Outlooks for the coming season are based on the level of escapement achieved across various projects based on the parent year of age-4 fish. The 2022 run was expected and materialized to be below average based on the escapements observed in 2018 (Table 7). Coho salmon are currently in a cycle of low abundance years and 2023 returns, from the primary parent-year 2019, are expected to be below average.

FACTORS AFFECTING COHO SALMON STOCKS

Coho salmon hatch and remain in freshwater for 1 to 2 years before smolting and migrating to the sea. Once at sea, they spend 1 year growing rapidly before primarily returning as 4-year-old adults to spawn. While in fresh water, coho salmon feed on insects, copepods, and small fish (including other salmon species). Although coho salmon are known to eat other salmon species, they do not appear to compose a significant portion of their diet. As juveniles, they switch to a diet of small fishes (such as herring, sand lance, and pollock), squid, larval crab, and shrimp. Adult coho salmon tend to eat more fish and squid than juvenile coho salmon. However, invertebrate prey like amphipods, euphausiids, and shrimp are still present in their diet. Coho salmon abundance could potentially be affected by a number of factors affecting the food chain.

Freshwater habitats are critical, since so much of their life cycle occurs there, and refuge from predators, overwintering environment, and availability of prey are important for survival. A lot is unknown about Yukon River coho salmon.

SUMMER SEASON MANAGEMENT REVIEW

MANAGEMENT 2018–2022

2018

In 2018, the Chinook salmon run outlook was 173,000 to 251,000 fish and the summer chum salmon outlook was approximately 2.5 million fish. Fishing was restricted to half of the regulatory schedule during most of the Chinook salmon run. Subsistence periods were cancelled during the first and second pulses of the run in most districts. Subsistence fishing was allowed with salmon gear all season and was not restricted to the use of selective gear. Subsistence fisheries were not relaxed to the full regulatory schedule with 7.5-inch gillnets until the majority of the Chinook salmon run had migrated through each district. Sport fishing for Chinook salmon was closed in the Yukon River Area (YRA) and reduced to a bag limit of 1 fish in the Tanana River Area (TRA).

No Chinook salmon directed commercial fisheries occurred. Commercial fishing for summer chum salmon in Districts 1 and 2 was restricted to dip nets and beach seines and all Chinook salmon were required to be released alive until most of the Chinook salmon run had passed. The majority of the harvest (55%) was from selective gear (Table 13). Commercial fishing occurred in

Subdistrict 4-A with live release fishwheels; all Chinook salmon had to be released alive. The total commercial harvest of 576,700 summer chum salmon was the largest since 1988 (Table 8).

2019

The 2019 drainagewide Chinook salmon outlook was for a run size of 168,000 to 241,000 fish. The summer chum salmon outlook was for an average run of 1.9 million fish, with an up to 1.2 million commercially harvestable surplus.

Inseason projections from Pilot Station sonar indicated the drainagewide Chinook salmon run might be upwards of 200,000 fish; however, management actions remained conservative. Water temperatures were high enough to cause salmon stress and mortality and there were concerns that due to the late timing of summer chum salmon (6 days late at the midpoint), that Chinook salmon would be more efficiently harvested during subsistence openings due to fewer summer chum salmon migrating at the same time.

To protect Chinook salmon while allowing for summer chum harvest, subsistence fishing periods were limited, cancelled, or restricted to 6-inch or smaller mesh. Summer chum salmon directed commercial fishing was delayed until after 94% of the Chinook salmon run was complete in the Lower Yukon River. Chinook salmon could be retained for personal use from commercial openings, and the sale of Chinook salmon was allowed after July 9 in the summer and fall chum commercial seasons.

By July 24, the Eagle sonar counts indicated fewer Chinook salmon than were expected based on the Pilot Station sonar. A reduced schedule was implemented in Subdistrict 5-D with a 6-inch gillnet restriction. This was followed by a cancelled period which resulted in a 10-day closure in Subdistrict 5-D. The cumulative count of 45,560 Chinook salmon at Eagle sonar near the U.S./Canada border was much lower than the expected 95,000 based on inseason abundance estimates of Canada-origin Chinook salmon at Pilot Station sonar.

The summer chum salmon drainagewide escapement goal and the East Fork Andreafsky River goals were exceeded; however, the Anvik River goal was not met (Figure 12) and passage estimates at the Gisasa River and Henshaw Creek weirs in the Koyukuk River drainage were well below average. En route mortality related to the record high water temperatures may have contributed to the exceptionally low passage in the Koyukuk River. During a boat survey between Hughes and Huslia, researchers counted around 800 chum salmon carcasses, which was considered an underestimate. All carcasses that were examined had not spawned. Most of the Koyukuk River summer chum salmon probably migrated through the mainstem Yukon during a period of extremely warm days with critically warm water temperatures.

An estimated 48,379 Chinook salmon were harvested for subsistence, which was the largest harvest since 2006 (Table 8). An estimated total of 63,303 summer chum salmon were harvested for subsistence, which was the lowest estimated harvest from 1989 to 2019 (Table 3). Commercial fishing for summer chum opened in Districts 1, 2, and 6, with a total harvest of 227,089 fish, which was the lowest commercial harvest since 2009 (Table 3). Chinook salmon were allowed to be sold in the Lower Yukon chum-directed commercial fisheries after July 9, when the run was estimated to be over 90% complete. A total of 3,110 Chinook salmon were sold, of which 528 Chinook salmon were sold during the fall season (Table 8).

Sport fishing in the YRA was closed at the start of the season on May 11 and opened with a 1 Chinook salmon limit on July 11. In TRA, sport fishing was restricted to catch-and-release fishing for Chinook salmon on July 17 and closed on July 26 due to low passage numbers at the Chena and Salcha River assessment projects. Sport fishing for coho salmon closed in the Delta Clearwater River in the TRA on October 11.

2020

The Emmonak department field office remained closed for the duration of the 2020 season due to the COVID-19 pandemic. Operations of the Lower Yukon Test Fishery (LYTF) were conducted by YDFDA under the remote guidance of department staff. The East Fork Andreafsky weir, Anvik River Sonar, Gisasa River weir, Henshaw Creek weir, and Salcha River tower/sonar did not operate due to COVID-19 travel restrictions or funding concerns. However, aerial surveys were conducted on the East and West Forks of Andreafsky River, Anvik River, Nulato River, Gisasa River, and Henshaw Creek.

The 2020 drainagewide Chinook salmon outlook was for a run size of 144,000 to 220,000 fish, which was slightly smaller than the 2019 run outlook, but enough to provide limited subsistence opportunity. Due to the uncertainty associated with the outlook, a cautious management approach was taken. It was expected that the 2020 summer chum run would be about average at approximately 1.9 million summer chum salmon, with a commercially harvestable surplus of up to 1.1 million.

Fishing remained open during the early trickle of the Chinook salmon run, which also provides early opportunity to target sheefish. Based on run timing, after the first Chinook salmon were expected to reach most districts, fishing schedules with reduced time and 6-inch or smaller mesh gillnets were announced. By mid-June, it appeared that the first pulse of Chinook and summer chum salmon runs were late, and fishing in most districts was closed or restricted to selective gear types. The summer chum run was a week late, giving managers concerns about the strength of the run.

June 23 marked the first day of Pilot Station sonar counts of over 20,000 summer chum and the first pulse of Chinook salmon. Over the next 2 weeks, nearly 100,000 Chinook salmon were counted, passage of summer chum salmon increased, and fishing was reopened in most districts on reduced schedule with 6-inch mesh. Summer chum salmon continued to enter the river during the first part of the fall season; however, on July 18 (the cross over date between summer and fall seasons), less than 700,000 summer chum salmon had been counted at Pilot Station sonar, which was well below the historical cumulative median of 1.86 million fish.

With a drainagewide Chinook salmon run estimated at about 160,000 fish and the Canada-origin run estimated to be about 77,000 fish, it was determined that there should be a harvestable surplus of Chinook salmon available to provide about half the harvest taken in 2019. However, despite very conservative management and widespread reports of poor harvests, the early run passage counts at the Eagle sonar project started to indicate that, similar to 2019, fewer Canada-origin Chinook salmon were arriving at the border than predicted by the Pilot Station sonar genetic estimates. At the midpoint of the Chinook salmon run past Eagle sonar (July 28), passage was only 16,300 fish, which was well below average. Projections indicated it was unlikely the IMEG at the border would be met and fishing for salmon in District 5 closed on July 28 and remained closed for the rest of the summer season. Additional closures of 4-inch mesh nets were implemented throughout the drainage to avoid any harvest of Chinook salmon in this gear. This action caused considerable hardship for dog mushers and other subsistence users that rely on 4-inch or smaller mesh to target nonsalmon species. Harvest opportunities for summer chum salmon were limited due to the late and weak run, persistent high-water levels, and closures to protect Chinook salmon. Sport fishing for Chinook salmon closed in the YRA on May 6 and on June 25 in the TRA. Chum salmon sport fishing in the YRA closed on August 1 and August 14 for the TRA. In sport fish regulations, Yukon River chum salmon represent both summer and fall species.

2021

The 2021 drainagewide outlook for Chinook salmon was for a run size of 102,000 to 189,000 Chinook salmon. Because of the poor projected run size, preseason closures were required. The 2021 outlook for summer chum salmon was for a below average run of 1.2 million fish. A run of this size was anticipated to provide for escapements, an average subsistence harvest, and a surplus for commercial harvest. Based on the preseason outlook, it was expected that a commercially harvestable surplus of up to 0.5 million summer chum salmon would be available.

Due to the low projection for Chinook salmon, subsistence fishing closures began on June 2 in the Coastal District and District 1 and progressed upriver based on Chinook salmon run timing. The farthest upriver subdistrict (upper portion of 5-D) closed on June 28. At the typical midpoint of the Chinook salmon run (June 23) inseason run projections at Pilot Station sonar indicated that the drainagewide Chinook salmon run was too small to provide for a harvestable surplus. Cumulative summer chum salmon counts at Pilot Station sonar were the lowest observed in the history of the project, and at the midpoint of the summer chum salmon run (July 6), only 79,000 summer chum salmon had been estimated. The summer chum salmon run midpoint at Pilot Station sonar was 4 days later than the average midpoint (June 2) for late years. The total run sizes for Chinook and summer chum salmon in 2021 were well below the recent 5- and 10-year averages. Commercial, personal use, and subsistence salmon fishing remained closed all summer season. The opportunity to harvest nonsalmon species for subsistence with 4-inch or smaller mesh gillnets remained open.

The summer chum salmon sex composition from the 5.5-inch mesh LYTF drift nets was 44% female, which was below the average of 59%. The summer chum salmon age composition was 84% age-4, 11% age-5, and 4% age-6 fish. The age-4 and age-5 percentages were the highest and lowest observed since 2005. This suggests very poor survival of the age-5 summer chum salmon from the 2016 parent year and follows a very low percentage of age-4 fish seen in 2020.

During the full season subsistence salmon fishery closures, a small number of Chinook and summer chum salmon were taken incidentally in nonsalmon gear or harvested before or after closures went into place. The total estimated subsistence harvest was 1,950 Chinook salmon and 1,250 summer chum salmon (Tables 3 and 8). These totals include fish that were harvested in test fisheries and distributed within nearby communities. Sport fishing for Chinook salmon closed in the YRA on May 11 and on June 24 in the TRA. Sport fishing closed for chum salmon in both the YRA and TRA on July 1, and similarly, closed for coho salmon on August 26.

2022

The 2022 drainagewide Chinook salmon outlook was for a run size of 99,000 to 150,000 fish. The summer chum salmon outlook was for a run of 162,000 to 542,000 fish. Based on the preseason outlook for summer chum salmon, it was expected that a commercially harvestable surplus would be unlikely. Because of the poor projected run sizes, a cautious management approach was developed.

Similar to 2021, subsistence fishing closures began on June 2 in the Coastal District and District 1 and progressed upriver based on Chinook salmon run timing. The farthest upriver subdistrict (upper portion of 5-D) closed on June 30. At the typical midpoint of the Chinook salmon run (June 23) at Pilot Station sonar, inseason cumulative counts were below the lowest observed for that date and run projections indicated that the drainagewide Chinook salmon run was well below historical averages and below the preseason forecast.

The summer chum salmon run in 2022 was late, similar to 2020 and 2021. Median counts at Pilot Station sonar was July 2, which is average for late years. On July 2, 220,000 fish had been estimated at the sonar, which was the second lowest counts of summer chum salmon for that date (only 2021 counts were lower). Recent years have been notable for a long trickle of fish and counts that have not picked up until after the third week of June. When compared to other late years (2003, 2005, and 2008) in which the average date of the first quartile was on June 24, counts at Pilot Station sonar for summer chum salmon in recent years have an average first quartile of June 28 (2019–2022). At the summer and fall chum salmon transition date (July 18) at Pilot Station sonar, the cumulative count for summer chum salmon was 463,806 fish (+/- 24,817 fish; 90% confidence interval), which was the second lowest count for that date.

The summer chum salmon sex composition from the 5.5-inch mesh LYTF drift nets through July 15 was 57% age-4, 43% age-5, and less than 1% age-6 fish. This compares to a recent 10-year average of 51% age-4 and 46% age-5 summer chum salmon. The age-4 fish average length of 537 mm and the age-5 average length of 549 mm are both record small when compared to average (1981–2021). The percentage of female summer chum salmon are also low at 47% compared to a historical average (1983–2021) of 57%.

Commercial, personal use, and subsistence salmon fishing remained closed all summer season. The opportunity to harvest nonsalmon species for subsistence with 4-inch or smaller mesh gillnets remained open. During the closures in the 2022 summer season, some Chinook and summer chum salmon were probably taken incidentally in nonsalmon gear or harvested before or after closures went into place. An estimated 1,827 Chinook and 6,734 summer chum salmon were harvested. Sport fishing for Chinook salmon closed in the YRA on May 1 and on June 20 in the TRA. Sport fishing closed for chum salmon in the YRA on May 1 and on June 20 for TRA on July 1, and for coho salmon in both management areas on September 8.

FALL SEASON MANAGEMENT REVIEW

The regulatory management plans provide for escapement and subsistence fishing priority above personal use, sport, and commercial fisheries. Management of the Yukon Area fall chum salmon subsistence, personal use, and commercial salmon fisheries follows the *Yukon River Drainage Fall Chum Salmon Management Plan (*5 ACC 01.249). The plan sets the current threshold number of fall chum salmon needed to prosecute a subsistence fishery at 300,000 fish, personal use and sport fishery at 500,000 fish, and a commercial fishery at 550,000 fish, unless an individual escapement goal or priority use needs are met for a specific district or subdistrict. The management plan incorporates the amount of fall chum salmon needed to meet U.S./Canada treaty objectives for border passage and provides guidelines necessary for escapement and prioritized uses. The plan aligns management objectives with the established escapement goals, provides flexibility in managing subsistence harvests when stocks are low, and bolsters salmon escapement as run abundance increases. Additional guidance for fall chum and coho salmon fisheries management include the *Yukon River fall chum salmon guideline harvest ranges* (5 AAC 05.365) and the *Tanana River Salmon Management Plan* (5 AAC 05.367).

Fall season fishery management decisions are based on the forecast, preseason projection, inseason projection, and available fisheries information of fall chum salmon. Initial management of the fall season is determined by the preseason projection for fall chum salmon in mid-July. The preseason projection is based on the historical relationship between the summer chum and fall chum salmon run sizes. Fall chum salmon on average represent approximately 30% of the complete chum salmon run in the Yukon River. Fall chum salmon management transitions to using inseason projections from assessment projects and genetic data (referred to as mixed stock analysis) in early August.

Because the coho salmon run is smaller than the fall chum salmon run, and timing is later, coho salmon are secondarily harvested during the fall season fisheries. Subsistence and personal use fisheries harvest coho salmon while targeting fall chum salmon. Coho salmon are primarily harvested incidentally during the fall chum salmon directed commercial fishery. The *Yukon River Coho Salmon Management Plan (*5 ACC 05.369) allows a coho salmon directed commercial fishery in the absence of achieving the threshold number of fall chum salmon if a harvestable surplus of coho salmon exists and if a commercial fishery will not have a significant effect on fall chum salmon escapement and allocation. In order to implement a coho-directed commercial fishery, there must be a run size of at least 500,000 fall chum salmon.

2018–2022

Following average fall chum and coho salmon runs in 2018 and 2019, sharp declines in salmon returns were experienced during 2020–2022. In 2018 and 2019, subsistence and personal use fishing was open on the regulatory fishing schedules and commercial fishing occurred for fall chum and coho salmon. Due to the poor salmon runs during 2020–2022, salmon closures occurred for all fisheries. The parent years for the 2020–2022 returns met or exceeded escapement goals, except for the Fishing Branch River IMEG for fall chum salmon in 2015 and 2018, and coho salmon in 2018 (Tables 6 and 7). Fall chum and coho salmon subsistence harvest have been below ANS (89,500–167,900 fall chum and 20,500–51,980 coho salmon) due to a lower harvest level by users and transfer of harvest patterns from subsistence users purchasing salmon from catcher–sellers in 2018 and 2019, and extreme salmon fishing closures during 2020–2022.

The forecast in 2018 was 1,700,000 (range: 1,600,000–1,800,000) fall chum salmon, and in 2019, was 1,045,000 (range: 930,000–1,160,000) fall chum salmon (JTC 2018 and 2019). A preseason projection was then generated just prior to the fall season that is based on the relationship between the historical summer and fall chum salmon run sizes. The preseason projections for fall chum salmon were 700,000 to 900,000 fish in 2018 and 700,000 to 800,000 fish in 2019. Subsistence and personal use fishing was open on the regulatory fishing schedules, and subsistence fishing was further liberalized in the Yukon River mainstem. Subsistence salmon fishing restrictions occurred in the mainstem Porcupine River in attempt to meet the IMEG for the Fishing Branch River in Canada. Subsistence and personal use harvests were 65,008 fall chum salmon in 2018 and 64,270 fall chum salmon 2019. Both years were below the 10-year average (2008–2017) of 87,174 fish (Table 4). Subsistence and personal use harvests were 5,658 coho salmon in 2018, and 5,887 coho salmon in 2019. Both years were below the 10-year average (2008–2017) of 14,824 fish (Table 5). Fall chum salmon commercial harvests were above the 10-year average (2008–2017; 217,670) at 387,788 fish in 2018 and 268,360 fish in 2019 (Table 4). Coho salmon commercial harvest was above the 10-year average (2008–2017; 83,984) at 110,590 fish in 2018, whereas 2019 was below average at 58,591 fish (Table 5).

In 2020, the forecast was 936,000 fall chum salmon with a range of 827,000 to 1,045,000 fish (JTC 2020). The preseason projection (summer to fall chum salmon run size relationship) was less than 450,000 fish. No commercial salmon fisheries occurred. Subsistence salmon fisheries in the Lower Yukon Area began the season on the regulatory fishing schedules, then inseason projections fell below 300,000 and the Yukon Area closed to subsistence salmon fishing. Subsistence and personal use harvests were 6,006 fall chum and 2,418 coho salmon, and well below the 10-year averages (2008–2017: 87,174 fall chum salmon and 14,795 coho salmon; Tables 4 and 5).

In 2021, the forecast was 652,000 (range: 542,000–762,000) fall chum salmon, and in 2021 the forecast was 110,000 (range: 78,100–148,000) fall chum salmon (JTC 2021 and 2022). The preseason and inseason projections in both years were less than the 300,000 fish. No commercial salmon fisheries occurred. Subsistence and personal use salmon fisheries experienced unprecedented closures for the duration of fall season. In 2021, subsistence and personal use harvests were record low (705 fall chum and 296 coho salmon; Tables 4 and 5). Sport fishing for coho salmon for the Delta Clearwater River in the TRA closed on October 17, 2022.

2023 ALASKA BOARD OF FISHERIES REGULATORY PROPOSALS

At the 2023 Arctic–Yukon–Kuskokwim Board of Fisheries meeting, the board will consider a total of 35 proposals. In the Yukon Area, 10 proposals relate to subsistence, personal use, and commercial fisheries predominantly focused on salmon, some of which will be addressed at the statewide meeting. Two proposals relate to the subsistence fishery for northern pike in the Chatanika River. Ten proposals address sport fisheries in the Tanana River drainage. One proposal addresses retention of sport caught salmon in the Yukon Area.

Seven proposals address the Yukon River drainage subsistence and personal use fisheries:

- Proposal 79 – Allow hook and line attached to a rod or pole when subsistence fishing upstream of the Nulato River mouth, to and including the Koyukuk River drainage up to the closed waters of the Koyukuk and the subsistence permit area.
- Proposal 80 – Restrict subsistence Chinook salmon harvest in the middle and upper Yukon River.
- Proposal 81 – Implement a Yukon River drainage subsistence salmon permit to allow retention of Chinook salmon less than 24 inches with an annual limit 10 fish during times of Chinook salmon conservation.
- Proposal 82 – Modify the dates sinking of gillnets is allowed in the Yukon Area from October 1 to April 30.
- Proposal 83 – After August 15, a person may not take salmon with a gillnet that has a mesh size greater than 6 inches in the Yukon Area Personal Use Salmon Fishery.
- Proposal 84 – Repeal and readopt Yukon Area subsistence fishery lawful gear and gear specifications.
- Proposal 85 – Modify Yukon Area Personal Use Salmon Fishery specifications for selective gear types and gillnet mesh size during times of salmon conservation.

Three proposals address the Yukon River drainage commercial fisheries:

- Proposal 87 – Establish a definition of an eel stick.

- Proposal 88 – Repeal and replace Yukon Area commercial salmon fishing gear specifications.
- Proposal 89 – Modify Yukon Area commercial dip net gear operations in the commercial fishery to include a single rigid handle with a single line attached.

ACKNOWLEDGEMENTS

Employees of the Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, Yukon Delta Fisheries Development Association, Bering Sea Fishermen's Association, Tanana Chiefs Conference, Association of Village Council Presidents, Yukon River Drainage Fisheries Association, and other agencies and organizations worked long and irregular hours at various locations throughout the Yukon Area collecting data presented in this report; we gratefully acknowledge their hard work. We also thank the AYK Regional Management Supervisor, Chuck Brazil, for his guidance, support, and review of this report.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 2000. Yukon River fall chum salmon stock status and development of management/action plan options. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A00-37, Anchorage.

Behr, A., B. Scanlon, and K. Wuttig. 2015. Fishery management report for sport fisheries in the Yukon Management Area, 2014. Alaska Department of Fish and Game, Fishery Management Report No. 15-51, Anchorage.

Borba, B. M., D. J. Bergstrom, and F. J. Bue. 2009. Yukon River fall chum salmon stock status and fall season salmon fisheries, 2009; a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Special Publication No. 09-24, Anchorage.

Bromaghin, J. F. 2005. A versatile net selectivity model, with applications to Pacific salmon and freshwater species of the Yukon River, Alaska. Fisheries Research 74(1–3):157–168.

Bue, F. J., B. M. Borba, and D. J. Bergstrom. 2004. Yukon River fall chum salmon stock status and action plan. A Report to the Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A04-05. Anchorage.

Clark, R. A., D. M. Eggers, A. R. Munro, S. J. Fleischman, B. G. Bue, and J. J. Hasbrouck. 2014. An evaluation of the percentile approach for establishing Sustainable Escapement Goals in lieu of stock productivity information. Alaska Department of Fish and Game, Fishery Manuscript No. 14-06, Anchorage.

Eggers, D. M., M. J. Witteveen, T. T. Baker, D. F. Evenson, J. M. Berger, H. A. Hoyt, H. L. Hildebrand, W. D. Templin, C. Habicht, and E. C. Volk. 2011. Results from sampling the 2006–2009 commercial and subsistence fisheries in the Western Alaska Salmon Stock Identification Project. Alaska Department of Fish and Game, Special Publication No. 11-10, Anchorage.

Ferris, B. E., and S. Zador. 2021. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, Anchorage, Alaska.

Flannery, B., and R. Loges. 2016. Yukon River coho salmon microsatellite baseline. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report for Study 14-206, Anchorage, Alaska.

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 Series No. 09-08, Anchorage.

Foster, M. B., and T. H. Dann. 2022. Genetic stock composition of chum salmon harvested in commercial salmon fisheries of the South Alaska Peninsula, 2022–2026. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Operational Plan No. ROP.CF.4K.2022.02, 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 Management Series No. 15-07, Anchorage.

Holder, R. R., and D. Senecal-Albrecht. 1998. Yukon River comprehensive salmon plan for Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, CFSP.26, Juneau.

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.

JTC (Joint Technical Committee of the Yukon River U.S./Canada Panel). 2018. Yukon River salmon 2017 season summary and 2018 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A18-01, Anchorage.

JTC (Joint Technical Committee of the Yukon River U.S./Canada Panel). 2019. Yukon River salmon 2018 season summary and 2019 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A19-01, Anchorage.

REFERENCES CITED (Continued)

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 No. 3A20-01, Anchorage.

JTC (Joint Technical Committee of the Yukon River U.S./Canada Panel). 2021. Yukon River salmon 2020 season summary and 2021 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A21-01, Anchorage.

JTC (Joint Technical Committee of the Yukon River U.S./Canada Panel). 2022. Yukon River salmon 2021 season summary and 2022 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A22-01, Anchorage.

Larson, S. D., H. C. Carroll, J. M. Conitz, and B. M. Borba. 2017. Abundance, distribution, and migration patterns of summer chum salmon in the Yukon River drainage, 2014–2015. Alaska Department of Fish and Game, Fishery Data Series No. 17-35, Anchorage.

Larson, W. A., F. M. Utter, K. W. Myers, W. D. Templin, J. E. Seeb, C. M. Guthrie III, 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(1):128–141.

Lewis, B., W. S. Grant, R. E. Brenner, and T. Hamazaki. 2015. Changes in size and age of Chinook salmon *Oncorhynchus tshawytscha* returning to Alaska. PLoS ONE 10(6):e0130184. doi:10.1371/journal.pone.0130184.

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., K. Howard, L. Eisner, A. Andrews, W. Templin, C. Guthrie, K. Cox, and E. Farley. 2013. Linking abundance, distribution, and size of juvenile Yukon River Chinook salmon to survival in the Northern Bering Sea. North Pacific Anadromous Fish Commission Technical Report No. 9:25–30.

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. Dept. Commer. NOAA Tech Memo, NOAA-TM-AFSC-423.

Murphy J. M., W. D. Templin, E. V. Farley, and J. E. Seeb. 2009. Stock-structured distribution of western Alaska and Yukon juvenile Chinook salmon (*Oncorhynchus tshawytscha*) from United States BASIS surveys, 2002–2007. North Pacific Anadromous Fish Commission Bulletin No. 5:51–59.

Myers, K. W., R. V. Walker, N. D. Davis, J. A. Armstrong, W. J. Fournier, N. J. Mantua, and J. Raymond-Yakoubian. 2010. Climate-ocean effects on Chinook salmon. Arctic Yukon Kuskokwim Sustainable Salmon Initiative, Project Final Product. SAFS-UW-1003, School of Aquatic and Fishery Sciences, University of Washington, Seattle.

Padilla, A. J., S. K. S. Decker, and T. Hamazaki. *In prep*. Subsistence and personal use salmon harvests in the Alaska portion of the Yukon River drainage, 2019. Alaska Department of Fish and Game, Fishery Data Series, 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.

Siddon, E. 2021. Ecosystem Status Report 2021: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, Anchorage, Alaska.

Vania, T. 2000. Yukon River Chinook salmon stock status and development of management/action plan options; a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, No. 3A00-38, Anchorage.

von Biela, V. R., L. Bowen, S. D. McCormick, M. P. Carey, D. S. Donnelly, S. Waters, A. M. Regish, S. M. Laske, R. J. Brown, S. Larson, S. Zuray, and C. E. Zimmerman. 2020. Evidence of prevalent heat stress in Yukon River Chinook salmon. Canadian Journal of Fisheries and Aquatic Sciences 77(12):1878–1892.

REFERENCES CITED (Continued)

Wuttig K. G., and B. Baker. 2017. Fishery management report for recreational fisheries in the Tanana River management area, 2015. Alaska Department of Fish and Game, Fishery Management Report No. 17-30, Anchorage.

TABLES AND FIGURES

Table 1.–Summary of 2022 salmon escapement counts compared to existing goals.

Stock/location	Assessment method	2022 Escapement	Goal type	Goals	Year established	Primary source
Chinook salmon stock						
East Fork Andreafsky River	Weir	Not operated	SEG	2,100–4,900	2010	Volk et al. (2009)
West Fork Andreafsky River [a]	Aerial survey	[b]	SEG	640–1,600	2005	ADF&G (2004)
Anvik River drainage	Aerial survey	179	SEG	1,100–1,700	2005	ADF&G (2004)
Nulato River (forks combined)	Aerial survey	60	SEG	940–1900	2005	ADF&G (2004)
Gisasa River	Weir	503	none	–	–	–
Henshaw River	Weir	Not operated	none	–	–	–
Chena River	Tower/Sonar	1,417	BEG	2,800–5,700	2001	Evenson (2002)
Salcha River	Tower/Sonar	2,082	BEG	3,300–6,500	2001	Evenson (2002)
Canada (upper Yukon River)	Sonar-harvest		IMEG	42,500–55,000	2010	JTC (2010)
Summer chum salmon stock						
Yukon drainagewide	Sonar	483,000	BEG	500,000–1,200,000	2016	Hamazaki and Conitz (2015)
East Fork Andreafsky	Weir	Not operated	BEG	>40,000	2010	Fleischman and Evenson (2010)
Anvik River	Sonar	45,580	BEG	350,000–700,000	2005	ADF&G (2004)
Gisasa River	Weir	3,300	none	–	–	–
Henshaw River	Weir	Not operated	none	–	–	–
Chena River	Tower/sonar	897 [c]	none	–	–	–
Salcha River	Tower/sonar	1,982 [c]	none	–	–	–
Fall chum salmon stock						
Yukon River drainage	Sonar and harvest	242,500	SEG	300,000–600,000	2010	Fleischman and Borba (2009)
Teedriinjik River	Sonar	69,333	SEG	85,000–234,000	2019	Liller and Savereide (2018)
Sheenjek River	Sonar	13,957	none	–	–	–
Delta River	Ground surveys	5,670	SEG	7,000–20,000	2019	Liller and Savereide (2018)
Fishing Branch River	Weir/sonar	2,695	IMEG	22,000–49,000	2010	JTC (2010)
Canada (upper Yukon River)	Sonar-harvest	22,059	IMEG	70,000–104,000	2008	JTC (2008)
Porcupine River (Canada Portion)	Sonar-harvest	3,673	none	–	–	–
Coho salmon stock						
Delta Clearwater River	Boat survey		SEG	5,200–17,000	2004	ADF&G (2004)

Note: BEG = biological escapement goal; IMEG = interim management escapement goal; SEG = sustainable escapement goal. En dash = no data.

[a] Drainagewide escapement based on the Pilot Station sonar and estimate of escapement to the Andreafsky River drainage minus harvest estimates above the sonar site.

[b] Poor survey conditions prevented an accurate count.

[c] Incomplete count due to late installation, early removal of project, or high-water events.

Table 2.–Yukon River Chinook salmon escapement estimates from sonar projects and selected tributaries, 2002–2022.

	Sonar		Tower or weir			Aerial survey [a]		
Year	Pilot	Eagle [b]	Chena	Salcha	East Fork Andreafsky	West Fork Andreafsky	Anvik [c]	Nulato
2002	151,713	–	6,967	9,000 [d, e]	4,123	917	1,713	1,584
2003	318,088	–	11,100 [d, e]	15,500 [d, e]	4,336	–	–	–
2004	200,761	–	9,645	15,761	8,045	1,317	3,625	1,321
2005	259,015	81,529	– [d]	6,000	2,239	1,492	2,410	553
2006	228,763	73,691	2,936	10,679	6,463	824	–	1,292
2007	170,246	41,697	3,806	6,425	4,504	976	–	2,583
2008	175,046	38,097	3,210	2,731 [d]	4,242	–	–	922
2009	177,796	69,957	5,253	12,774	3,004	1,678	832	2,260
2010	145,088	35,074	2,382	6,135	2,413	858	965	711
2011	148,797	51,271	– [d]	– [d, f]	5,213	1,173	642	1,401
2012	127,555	34,747	2,219	7,165	2,517	–	722	1,374
2013	136,805	30,725	1,860	5,465	1,998	1,090	941	1,118
2014	163,895	63,462	7,191	– [d]	5,949	1,695	1,051	–
2015	146,859	84,015	6,294	6,288 [g]	5,474	1,356	2,487	1,564
2016	176,898	72,329	6,665	2,675	2,676	–	–	–
2017	263,014	73,313	4,949 [d]	4,195 [d]	2,970	942	1,080	943
2018	161,900	57,959	4,227 [d]	4,053 [d]	3,972	455	1,109	870
2019	219,624	45,560	2,018	4,678	5,111	904	1,432	656
2020	162,252	33,550	502	–	–	508	675	459
2021	124,845	31,796	1,417	2,082	1,425	–	–	–
2022 [h]	48,439	12,025	355	1,130	–	–	179	60
5-year Average (2018–2022)	142,640	36,178	1,704	2,986	3,503	622	849	511
Goal range and type		42,500–55,000 (IMEG)	2,800–5,700 (BEG)	3,300–6,500 (BEG)	2,100–4,900 (SEG)	640–1,600 (SEG)	1,100–1,700 (SEG)	940–1,900 (SEG)

Note: En dash indicates no data. Chena biological escapement goal (BEG) was established in 2001. IMEG = interim management escapement goal; SEG = sustainable escapement goal.

[a] Only surveys that were complete and had a higher rating than fair are included.

[b] Estimated number of Chinook salmon at Eagle sonar. Does not account for harvest above the sonar project.

[c] Standardized for escapement goal review to include mainstem between sonar and McDonald Creek. Also includes Beaver, Swift and Otter Creeks.

[d] Incomplete count, project was not operated or was inoperable for a large portion of the season due to water conditions.

[e] Estimate includes an expansion for missed counting days based on average run timing.

[f] Aerial survey indicated escapement of at least 3,500 Chinook salmon.

[g] Final estimate uses a binomial mixed-effects model to create passage estimates for the period of missed counts prior to start of tower operations on July 12.

[h] Preliminary estimate and subject to change.

Table 3.–Yukon River summer chum salmon commercial and subsistence utilization in numbers of fish, 2002–2022.

Year	Subsistence [a]	Commercial	Commercial related [b]	Personal use [c]	Test fish sales	Sport fish [d]	Yukon Area total
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	194	445,331
2016	87,902	525,809	0	176	380	264	614,531
2017	87,437	556,516	0	438	1,819	186	646,396
2018	76,926	576,700	0	509	1,028	200	655,363
2019	63,303	227,089	0	294	230	36	290,952
2020 [e]	41,655	13,955	0	67	0	1,684	57,361
2021 [e]	1,266	0	0	0	0	–	1,266
2022 [e]	6,724	0	0	0	0	–	6,724
Recent average 2018–2022 [f]	37,975	163,549	0	174	252	640	202,333

Note: En dash indicates data not available.

[a] Subsistence harvest includes the Coastal District communities of Hooper Bay and Scammon Bay.

[b] In District 4 (excluding the Anvik River), 5, and 6, commercial related refers to the estimated number of females and incidental males harvested to produce roe sold. Beginning in 2006, the numbers of females harvested are included in the total commercial harvest.

[c] The Fairbanks nonsubsistence area is the only personal use area in the Yukon River drainage.

[d] Estimated sport fish harvest for all chum salmon (assumes majority of chum caught during summer season) in Alaska portion of the drainage. A majority of the sport fish harvest occurs in the Tanana River drainage (District 6).

[e] Subsistence data are preliminary.

[f] Averages do not include data that is unavailable from recent year or years with no information.

Table 4.–Harvest of Yukon River fall chum salmon, 2002–2022.

	Alaska					Canada				Total harvest
Year	Subsistence[a]	Commercial[b]	Personal use	Test fish sales[c]	Total	Aboriginal	Commercial	Domestic	Total	United States and Canada
2002	19,674	–[d]	3	0	19,677	5,027	3,065	0	8,092	27,769
2003	56,930	10,996	394	0	68,320	1,875	9,030	0	10,905	79,225
2004	62,526	4,110	230	0	66,866	2,385	7,365	0	9,750	76,616
2005	91,534	180,249	133	87	272,003	6,628	11,931	13	18,572	290,575
2006	84,002	174,542	333	0	258,877	7,700	4,096	0	11,796	270,673
2007	101,221	90,677	173	0	192,071	6,721	7,109	0	13,830	205,901
2008	89,357	119,265	181	0	208,803	5,504	4,062	0	9,566	218,369
2009	66,119	25,876	78	0	92,073	1,718	293	0	2,011	94,084
2010	68,645	2,550	3,209	0	74,404	3,601	2,186	0	5,787	80,191
2011	80,202	238,979	347	0	319,528	2,851	5,312	0	8,163	327,691
2012	99,309	289,692	410	166	389,577	3,818	3,205	0	7,023	396,600
2013	113,384	238,051	383	121	351,939	2,783	3,369	18	6,170	358,109
2014	92,529	115,599	278	30	208,436	2,529	2,485	19	5,033	213,469
2015	86,600	191,470	80	50	278,200	1,556	2,862	35	4,453	282,653
2016	84,617	465,511	283	668	551,079	4,005	1,745	0	5,750	556,829
2017	85,093[e]	489,702	626[e]	1,246	576,667	3,312	2,404	0	5,716	582,383
2018	64,494[e]	387,788	514[e]	907	453,703	2,874	1,957	0	4,831	458,534
2019	63,862[e]	268,360	408[e]	275	332,905	2,000	1,728	31	3,759	336,664
2020	5,969[e]	–[d]	37[e]	0	6,006	100	–[d]	–[d]	100	6,106
2021	705[e]	–[d]	0[e]	0	705	21	–[d]	–[d]	21	726
2022	2,778[e]	–[d]	0[e]	0	2,778	0	–[d]	–[d]	0	2,778
Averages										
2008–2017	86,586	217,670	588	228	305,071	3,168	2,792	7	5,967	311,038
2018–2022	27,562	328,074	192	236	159,219	999	1,843	16	1,742	160,962

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

[a] Includes test fish harvest and commercial retained fish (not sold) that were utilized for subsistence. Coastal District harvest information is included 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).

[c] Test fish sales is the number of salmon sold by department test fisheries.

[d] Commercial or domestic fishery was not conducted.

[e] Data are preliminary.

Table 5.–Harvest of Yukon River coho salmon, 2002–2022.

	Alaska						Canada			Total harvest
Year	Subsistence [a]	Commercial [b]	Personal use	Test fish sales [c]	Sport fish	Total	Mainstem	Porcupine	Total	United States and Canada
2002	15,489	– [d]	20	–	1,092	16,601	26	449	475	17,076
2003	23,872	25,243	549	0	1,477	51,141	7	523	530	51,671
2004	20,795	20,232	233	0	1,623	42,883	5	175	180	43,063
2005	27,250	58,311	107	0	627	86,295	0	11	11	86,306
2006	19,706	64,942	279	0	1,000	85,927	1	111	112	86,039
2007	19,624	44,575	135	0	597	64,931	2	500	502	65,433
2008	16,855	35,691	50	0	341	52,937	0	200	200	53,137
2009	16,006	8,318	70	0	964	25,358	0	0	0	25,358
2010	13,045	3,750	1,062	0	944	18,801	0	12	12	18,813
2011	12,344	76,303	232	0	463	89,342	0	63	63	89,405
2012	21,533	74,789	100	39	131	96,592	0	10	10	96,602
2013	14,457	66,203	109	1	266	81,036	0	10	10	81,046
2014	17,098	104,692	174	0	1,855	123,819	0	133	133	123,952
2015	18,107	129,700	145	8	593	148,553	0	0	0	148,553
2016	8,815	201,482	266	11	670	211,244	0	0	0	211,244
2017	7,281 [e]	138,915	200 [e]	63	291	146,750	0	71	71	146,821
2018	5,527 [e]	110,587	131 [e]	48	544	116,837	0	25	25	116,862
2019	5,819 [e]	58,591	68 [e]	40	72	64,590	0	0	0	64,590
2020	2,339 [e]	– [d]	79 [e]	–	1,337	3,755	0	0	0	3,755
2021	296 [e]	– [d]	0 [e]	–	13	309	0	0	0	309
2022	1,090 [e]	– [d]	0 [e]	–	– [f]	0	0	0	0	1,090
Averages										
2008–2017	14,554	83,984	241	12	652	99,443	0	50	50	99,492
2018–2022	3,014	84,589	56	44	492	37,317	0	6	5	37,322

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

[a] Includes test fish harvest and commercial retained fish (not sold) that were utilized for subsistence. Coastal District harvest information is included 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).

[c] Test fish sales is the number of salmon sold by department test fisheries.

[d] Commercial or domestic fishery was not conducted.

[e] Data are preliminary.

[f] Data unavailable.

Table 6.–Fall chum salmon passage or escapement estimates for selected spawning areas in the Yukon River Drainage, 2002–2022.

		Alaska					Canada		
		Tanana River drainage			Upper Yukon River drainage		Porcupine drainage	Canada mainstem	
Year	Yukon River mainstem sonar chum salmon estimate after July 18 (Pilot Station)	Toklat River [a]	Delta River [b]	Upper Tanana River abundance estimate [c]	Teedriinjik River [d]	Sheenjek River [e]	Fishing Branch River [f]	Border passage estimate [g]	Spawning escapement estimate [h]
2002	367,886	28,519	11,992	109,961	94,472	31,642 [i]	13,636	104,853 [j]	98,621
2003	923,540	21,492	22,582	193,418	221,343	44,047 [i, k]	29,713	153,656 [j]	143,133
2004	633,368	35,480	25,073	123,879	169,848	37,878 [i]	20,417	163,625 [j]	154,080
2005	1,894,078	17,779 [l]	28,132	337,755	526,838	485,886	119,058	451,477	437,498
2006	964,238	–	14,055	202,669	254,778	175,620	30,954	227,515	220,898
2007	740,195	–	18,610	320,811	243,805	69,184	32,150	246,317	236,987
2008	636,525	–	23,055	–	178,278	50,348	19,086 [l]	174,028	167,898
2009	– [l]	–	13,492	–	–	54,126	25,828	94,739	93,626
2010	458,103	–	17,993	–	167,532	24,669 [i]	15,413	121,498	117,789
2011	873,877	–	23,639	–	298,223	97,976	13,085 [l]	211,878	205,566
2012	778,158	–	9,377 [j]	–	205,791	104,701	22,399	141,567	137,662
2013	865,295	9,161 [m]	31,955	–	252,710	–	– [n]	204,149	200,262
2014	706,630	–	32,480	–	221,421	–	– [n]	159,846	156,796
2015	669,483	8,422 [m]	33,401	–	164,486	–	8,351	112,555	108,658
2016	994,760	16,885 [m]	21,913	–	295,023	–	29,397	148,012	145,267
2017	1,829,931	–	48,783	–	509,115	–	48,524	404,989	401,585
2018	928,664	25,587 [m]	39,641	–	170,356	–	10,151	157,083	154,257
2019	842,041	–	51,748	–	116,323	–	18,171	102,497	99,738
2020	262,439	1,328 [m]	9,854	–	–	–	4,795	23,512	23,512
2021	146,197	–	1,613	–	21,162	–	2,413	23,170	23,170
2022 [o]	325,717	7,360 [m]	5,670	–	69,333	13,957	2,695	22,059	22,059
Escapement objective [p]		15,000 [q]	7,000	46,000 [q]	85,000	50,000 [q]	50,000–120,000		>80,000
		33,000	20,000	103,000	234,000	104,000	22,000–49,000 [r]		70,000–104,000 [s]
Averages									
2008–2017	868,085	11,489	25,609	NA	254,731	66,364	22,760	177,326	173,511
2018–2022	501,012	11,425	21,705	NA	94,294	NA	7,645	65,664	64,547

-continued-

Note: Yukon River mainstem sonar historical estimates were revised in 2016 using selectivity parameters. En dashes indicate no data. NA indicates insufficient data to generate an average.

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

[b] Population estimate typically generated from replicate foot surveys and stream life data (area under the curve method).

[c] 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 confluences with the Kantishna River.

[d] Split-beam sonar estimates from 2002 to 2006, DIDSON sonar since 2007. Project was aborted or did not operate in 2009 and 2020. Sonar counts were expanded to represent the remainder of the run after the project was terminated for the season.

[e] Split-beam sonar estimates from 2002 to 2004 and DIDSON from 2005 to 2012 and 2022. Sonar counts were expanded to represent the remainder of the run after the project was terminated for the season.

[f] Weir counts with expansions through October 25, unless otherwise indicated.

[g] Border passage estimate is based on mark–recapture from 1980 to 2005, 2006 to present is based on sonar minus harvest from Eagle residents upstream of deployment.

[h] Excludes Fishing Branch River escapement (estimated border passage minus Canada mainstem harvest).

[i] Sonar counts only used one bank (right).

[j] Border passage estimates for 1999 to 2004 were revised using a stratified population analysis system (Arnason et al. 1995).

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

[l] Count considered minimum due to issues with apportionment, the length of weir operations, time of survey, or water level.

[m] Aerial surveys.

[n] Fishing Branch River weir did not operate, estimates based on radio telemetry resulted in Canada estimates of 25,376 for 2013 and 7,304 for 2014.

[o] Data are preliminary.

[p] Escapement objectives include historical tributary project biological escapement goals (BEGs) and current project and drainagewide sustainable escapement goals (SEGs). Also included are U.S./Canada Yukon River treaty goals along with the current interim management escapement goals (IMEGs).

[q] Biological escapement goals discontinued in 2010 for Toklat River, 2016 for Sheenjek River, and 2019 for Tanana River (upper Tanana plus Toklat).

[r] IMEG established for 2008–2010 based on percentile method and carried forward.

[s] IMEG established for 2010 based on brood table of Canada-origin mainstem stocks (1982 to 2003).

Table 7.–Coho salmon passage or escapement estimates for selected spawning areas in the Alaska portion of the Yukon River drainage, 2002–2022.

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
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	194,622	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	NA [d]	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)	–	–	912 (h)	6,180 (b)	2,092 (b)	575 (h)
2012	130,734	–	106 (h)	–	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	37,255	126 (h)	104 (h)	226 (h)	213 (h)	913 (b)	130 (h)	17 (h)
2022 [e]	92,102	–	–	–	–	1,750 (b)	101 (h)	57 (h)
SEG [f]						5,200–17,000		
Averages								
2008–2017	161,457	682	948	858	1,426	8,805	1,747	1,132
2018–2022	91,957	659	325	251	373	2,029	614	365

Note: Only peak counts presented. Denotations of survey methods include: (b) = boat, (f) = fixed wing, and (h) = helicopter. En dashes indicate no data. NA indicates not available.

[a] Passage estimates for coho salmon are incomplete. The sonar project is terminated prior to the end of the coho salmon run. Yukon River mainstem sonar historical estimates were revised in 2016, using new selectivity parameters.

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

[c] Index area is lower 17.5 miles of system surveys conducted generally during October 21–27 (through November 7 in 2018).

[d] Pilot Station sonar project encountered record low water levels during the fall season causing difficulties with species apportionment and catchability.

[e] Data are preliminary.

[f] Sustainable escapement goal (SEG) established January 2004, (replaces BEG of greater than 9,000 fish established March 1993).

Table 8.–Alaska harvest of Yukon River Chinook salmon, 1989–2022.

Year	Commercial	Commercial related [a]	Total commercial	Subsistence [b]	Personal use [c]	Test fish sales [d]	Sport fish [e]	Total
1989	104,198	–	104,198	48,462	2,616	1,293	1,063	157,632
1990	95,247	413	95,660	48,587	2,594	2,048	544	149,433
1991	104,878	1,538	106,416	46,773	–	689	773	154,651
1992	120,245	927	121,172	47,077	–	962	431	169,642
1993	93,550	560	94,110	63,915	426	1,572	1,695	161,718
1994	113,137	703	113,840	53,902	–	1,631	2,281	171,654
1995	122,728	1,324	124,052	50,620	399	2,152	2,525	179,748
1996	89,671	521	90,192	45,671	215	1,698	3,873	141,649
1997	112,841	769	113,610	57,117	313	2,811	2,174	176,025
1998	43,618	81	43,699	54,124	357	926	654	99,760
1999	69,275	288	69,563	53,305	331	1,205	1,023	125,427
2000	8,515	0	8,515	36,404	75	597	276	45,867
2001	0 [f]	0	0 [f]	55,819	122	0	679	56,620
2002	24,128	230	24,358	43,742	126	528	486	69,240
2003	40,438	0	40,438	56,959	204	680	2,719	101,000
2004	56,151	0	56,151	55,713	201	792	1,513	114,370
2005	32,029	0	32,029	53,409	138	310	483	86,369
2006	45,829	0	45,829	48,593	89	817	739	96,067
2007	33,634	0	33,634	55,174	136	849	960	90,753
2008	4,641 [f, g]	0	4,641 [f, g]	45,186	126	0	409	50,362
2009	316 [f, g]	0	316 [f, g]	33,805	127	0	863	35,111
2010	9,897 [f, g]	0	9,897 [f, g]	44,559	162	0	474	55,092
2011	82 [f, g]	0	82 [f, g]	40,980	89	0	474	41,625
2012	0 [f]	0	0 [f]	30,415	71	0	345	30,831
2013	0 [f]	0	0 [f]	12,533	42	0	166	12,741
2014	0 [f]	0	0 [f]	3,286	1	0	0	3,287
2015	0 [f]	0	0 [f]	7,577	5	0	13	7,595
2016	0 [f]	0	0 [f]	21,658	57	0	20	21,735

-continued-

Table 8.–Page 2 of 2.

Year	Commercial	Commercial related [a]	Total commercial	Subsistence [b]	Personal use [c]	Test fish sales [d]	Sport fish [e]	Total
2017	168 [f, g]	0	168 [f, g]	38,100	125	0	18	38,411
2018	0 [f]	0	0 [f]	31,812	201	0	200	32,213
2019	3,110 [f, g]	0	3,110 [f, g]	48,379	244	0	38	51,771
2020	0 [f]	0	0 [f]	21,531	112	0	49	21,692
2021	0 [f]	0	0 [f]	1,995	0	0	0	1,995
2022	0 [f]	0	0 [f]	1,827	0	0	0	1,827
Recent average (2018–2022)	622	0	622	21,109	111	0	57	21,900
Historical average (1989–1998)	1,510	0	1,510	27,810	81	0	278	29,679

Note: En dashes indicate no data.

[a] Refers to production of salmon roe, including carcasses from subsistence-caught fish. These data are only available since 1990.

[b] Includes harvest from the Coastal District and test fishery harvest that were utilized for subsistence. Subsistence includes fish commercially caught but not sold and test fishery catch given to subsistence users.

[c] Prior to 1987, and in 1990, 1991, and 1994, personal use was considered part of subsistence.

[d] Includes only test fishery fish that were sold commercially.

[e] Sport fish harvest for the Alaska portion of the Yukon River drainage. Most of this harvest is taken within the Tanana River drainage (see Wuttig and Baker 2017; Behr 2015).

[f] No directed Chinook salmon commercial fishery was conducted.

[g] Chinook salmon sold commercially were incidentally caught in chum-directed commercial fishery.

[h] Data are not yet available.

Table 9.–Pilot Station sonar project estimates with 90% confidence interval (CI), 2002–2022.

Year [a]	Chinook	CI (+/-)	Summer chum [b]	CI (+/-)	Fall chum [b]	CI (+/-)	Coho [c]	CI (+/-)	Pink	CI (+/-)
2002	151,713	24,298	1,097,769	31,062	367,886	17,508	137,077	7,689	123,698	11,745
2003	318,088	17,359	1,183,009	36,869	923,540	36,052	280,552	20,301	11,370	2,251
2004	200,761	12,145	1,344,213	30,363	633,368	22,206	207,844	11,933	399,339	20,531
2005 [d]	259,014	42,452	2,570,697	78,867	1,893,688	110,806	194,372	29,319	61,091	11,294
2006	228,763	27,696	3,780,760	155,452	964,238	45,647	163,889	18,167	183,006	23,648
2007	170,246	25,535	1,875,491	74,394	740,195	46,349	192,406	19,259	126,282	22,462
2008	175,046	21,367	1,849,553	68,542	636,525	30,023	145,378	13,885	580,127	86,243
2009 [e]	177,796	26,130	1,477,186	69,895	274,227	38,552	240,779	29,211	34,529	12,597
2010	137,899	61,122	1,423,372	89,356	458,103	40,796	177,724	12,489	919,036	639,693
2011	148,797	20,174	2,051,501	77,486	873,877	42,660	149,533	20,770	9,754	2,983
2012	127,555	18,652	2,136,476	79,036	778,158	62,184	130,734	15,795	420,344	59,823
2013	136,805	32,901	2,849,683	114,602	865,295	72,277	110,515	23,297	6,126	6,495
2014	163,895	18,735	2,020,309	98,909	706,630	61,902	283,421	28,112	679,126	59,992
2015	146,859	30,958	1,591,505	98,413	669,483	40,757	121,193	14,614	39,690	12,436
2016	176,898	18,467	1,921,748	80,516	994,760	64,435	168,297	18,403	1,364,849	87,144
2017	263,014	29,110	3,093,735	138,259	1,829,931	89,124	166,320	33,528	166,529	31,240
2018	161,831	24,538	1,612,688	107,348	928,664	55,042	136,347	11,895	689,607	47,967
2019	219,624	20,477	1,402,925	85,902	842,041	37,151	86,401	9,529	42,353	8,893
2020	162,252	18,967	692,602	36,325	262,439	17,810	107,680	6,843	207,942	18,745
2021	124,845	10,831	153,718	16,149	146,197	11,686	37,255	3,879	22,181	5,832
2022	48,439	7,379	463,806	24,817	325,717	19,197	92,102	7,500	158,767	21,735
Averages										
2008–2017	165,456		2,041,507		808,699		169,389		422,011	
2018–2022	143,398		865,148		501,012		91,957		224,170	

Note: These values are not escapement or run size estimates.

[a] Estimates for all years were generated with the most current apportionment model.

[b] Reported chum salmon numbers are before July 19 (summer) and after July 18 (fall). These values do not remove genetically fall fish in summer or summer fish in fall season.

[c] Estimate may not include entire run. From 2008 to present, operations were extended to September 7, instead of the usual end date of August 31.

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

[e] In 2009 high water levels occurred during the summer season followed by extreme low water during the fall season, therefore passage estimates are considered speculative.

Table 10.–Reconstructed drainagewide Yukon River Chinook salmon run size, 1997–2022.

Year	Canada-origin Chinook salmon total run	Harvest below Pilot Station sonar [a]	Total Andreafsky River [b]	Pilot Station sonar estimate	Drainagewide total run [c]
1997	161,700	115,336	6,372	199,763	321,471
1998	88,282	52,323	8,068	108,038	168,429
1999	110,446	69,838	6,888	184,218	260,944
2000	52,842	21,257	3,218	54,560	79,035
2001	85,663	18,915	2,296	121,089	142,300
2002	81,487	31,660	8,246	151,713	191,619
2003	149,979	47,911	8,672	318,088	374,671
2004	117,247	61,717	16,090	200,761	278,568
2005	123,612	40,469	4,478	259,015	303,962
2006	119,485	50,802	12,926	228,763	292,491
2007	88,018	44,656	9,008	170,246	223,910
2008	62,611	17,837	8,484	175,046	201,367
2009	87,221	10,252	6,008	177,796	194,056
2010	59,741	22,435	4,826	145,088	172,349
2011	71,725	12,407	10,426	148,797	171,630
2012	48,498	11,889	5,034	127,555	144,478
2013	37,177	3,952	3,996	136,805	144,753
2014	64,886	2,407	11,898	163,895	178,200
2015	87,323	3,942	10,948	146,859	161,749
2016	83,043	6,301	5,352	176,898	188,551
2017	92,622	9,212	5,940	263,014	278,166
2018	76,530	7,620	8,228	161,831	177,679
2019	72,620	19,009	10,222	219,624	248,855
2020 [d]	45,501	8,741	6,500	162,252	178,000
2021	32,970	1,485	2,850	124,845	129,180
2022 [e, f]	33,201	1,028	1,790	48,439	51,000
Average 2018–2022	56,905	9,214	6,950	167,138	183,429

[a] Harvest below Pilot Station sonar includes commercial and subsistence harvest in statistical area codes 334-11 through 334-19 and 334-21 through 334-23. Also includes test fish sales for 1988–2007. Test fish harvest after 2007 is combined with subsistence harvest.

[b] East Fork Andreafsky River weir escapement count multiplied by 2.

[c] Drainagewide total run for 1997–2017 is the sum of harvest below Pilot Station sonar, the total Andreafsky River passage, and the Pilot Station sonar count.

[d] An aerial survey was conducted on both the East and West forks for a total count of approximately 843 Chinook salmon. The total run was estimated by extrapolating the Andreafsky River contribution from the 5-year average and adding the aerial survey count and the harvest below Pilot Station sonar.

[e] East Fork Andreafsky weir did not operate in 2022 due to forest fires and high water and aerial surveys conducted on both the East and West forks were rated poor. The 1995–2021 average contribution of East Fork Andreafsky weir count doubled to total run is 4%. Assuming 4% (1,790) to account for Andreafsky, the total run is estimated to be approximately 51,000.

[f] Data are preliminary.

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

Year	Strata	Dates	Pilot Station passage	Proportion of run	Canada proportion [a]	Number of Canada 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

-continued-

Table 11.–Page 2 of 2.

Year	Strata	Dates	Pilot Station passage	Proportion of run	Canada proportion [a]	Number of Canada 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	0.34	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.–Estimated run size, escapement, and harvest shares for Canada-origin Yukon River Chinook salmon, 2005–2022.

Year	Yukon River Panel goal or IMEG[a] from	Yukon River Panel goal or IMEG[a] to	Border passage[b]	Total Chinook salmon run size[c]	United States share (%) of TAC 74%	United States share (%) of TAC 80%	United Sates Harvest[d]	Canada share (%) of TAC 20%	Canada share (%) of TAC 26%	Canada harvest	Spawning escapement[e]	Border objective[f] Lower end border objective	Border objective[f] Upper end border objective	Objectives exceeded? Lower end border objective[g]	Objectives exceeded? Upper end border objective[h]
2005	28,000	28,000	78,962	86,895	43,582	47,116	44,650	11,779	15,313	10,977	31,268	39,779	43,313	39,183	35,649
2006	28,000	28000	71388	84,845	42,065	45,476	48,097	11,369	14,780	8,758	27,990	39,369	42,780	32,019	28,608
2007	33,000	43,000	39,698	70,440	20,306	29,952	48,320	5,488	9,734	4,794	17,326	38,488	52,734	1,210	-13,036
2008	45,000	45000	37282	62,358	12,845	13,886	25,329	3,472	4,513	3,399	33,630	48,472	49,513	-11,190	-12,231
2009	45,000	45000	69575	87,221	31,244	33,777	17,646	8,444	10,977	4,297	65,278	53,444	55,977	16,131	13,598
2010	42,500	55,000	34,470	59,736	3,505	13,789	25,271	947	4,481	2,456	32,009	43,447	59,481	-8,977	-25,011
2011	42,500	55,000	50,901	71,725	12,377	23,380	20,824	3,345	7,599	4,594	46,307	45,845	62,599	5,056	-11,698
2012	42,500	55,000	34,656	48,498	0	4,798	13,842	0	1,559	2,000	32,656	42,500	56,559	-7,844	-21,903
2013	42,500	55,000	30,573	37,177	0	0	6,604	0	0	1,904	28,669	42,500	55,000	-11,927	-24,427
2014	42,500	55,000	63,431	64,886	7,316	17,909	1,455	1,977	5,820	100	63,331	44,477	60,820	18,954	2,611
2015	42,500	55,000	83,674	87,323	23,919	35,858	3,649	6,465	11,654	1,000	82,674	48,965	66,654	34,709	17,020
2016	42,500	55,000	71,567	82,765	20,546	32,212	11,198	5,553	10,469	2,769	68,798	48,053	65,469	23,514	6,098
2017	42,500	55,000	71,815	93,188	28,259	40,551	21,373	7,638	13,179	3,500	68,315	50,138	68,179	21,677	3,636
2018	42,500	55,000	57,264	76,356	15,804	27,085	19,092	4,271	8,803	2,790	54,474	46,771	63,803	10,493	-6,539
2019	42,500	55,000	44,816	72,620	13,039	24,096	27,804	3,524	7,831	2,764	42,056	46,024	62,831	-1,208	-18,015
2020	42,500	55,000	33,330	45,501	0	2,401	12,171	0	780	2,363	30,967	42,500	55,780	-9,170	-22,450
2021	42,500	55,000	31,758	32,972	0	0	1,214	0	0	306	31,452	42,500	55,000	-10,742	-23,242
2022[i]	42,500	55,000	11,987	13,201	0	0	1,214	0	0	100	11,887	42,500	55,000	-30,513	-43,013
2018–2022 Average			35,831	48,130	5,769	10,716	12,299	1,559	3,483	1,665	34,167	44,059	58,483	-8,228	-22,652

Note: The total allowable catch (TAC) can be calculated by adding the 80% U.S. share and 20% Canada share, TAC range is calculated by subtracting each end of the goal range from the total run; a more detailed explanation is available in JTC (2022). Meeting the interim management escapement goal (IMEG) and providing Canada's share of the TAC is part of the U.S. obligation to meet the harvest share objectives. Border objective is the number of fish that would achieve the goal and the harvest share.

[a] The IMEG is not a biologically-based escapement goal.

[b] Border passage estimates are the Eagle sonar estimate minus Alaska harvest from the community of Eagle upstream of the sonar.

[c] Total Canada-origin run size is equal to Eagle sonar passage. Beginning in 2014, this includes harvests from the Coastal District.

[d] United States Harvest estimates are estimated by applying the Canadian-origin genetic stock proportions collected from harvest sampling to number of fish harvested in Alaska.

[e] Spawning escapement is the border passage estimate minus the Canadian harvest.

[f] Border passage required to meet IMEG and provide 20% and 26% Canadian Harvest share (Lower and Upper objective).

[g] Number of fish additional to Lower end of Agreement (a negative number is the number of fish below required value).

[h] Number of fish additional to Upper end of Agreement (a negative number is the number of fish below required value).

[i] Preliminary data.

Table 13.–Salmon commercial harvests in summer chum-directed commercial fishing periods in Districts 1 and 2, Yukon River, 2008–2022.

Year	Date of first commercial	Gear	Proportion of Chinook salmon passage [b]	Number of periods	Incidental Chinook salmon [a]			Summer chum salmon sales	Proportion of commercial harvest
					Sales	Caught but not sold	Caught and released		
2008	2-Jul	6.0″ gillnet	0.87	11	4,348	0	0	125,598	1.00
2009 [c]	29-Jun	6.0″ gillnet	0.81	13	131	3,540	0	157,906	1.00
2010	28-Jun	6.0″ gillnet	0.72	15	9,897	1,810	0	183,215	1.00
2011 [c]	24-Jun	6.0″ gillnet	0.62	20	82	4,090	0	266,510	1.00
2012 [c]	29-Jun	6.0″ gillnet	0.42	16	0	2,421	0	207,849	1.00
2013 [c]	18-Jun	selective gear	0.06	32	0	– [d]	927	189,208	0.50
	7/2/2015 [e, f]	5.5″, 30 mesh gillnet	0.84	6	0	88	0	74,452	0.20
	8-Jul	6.0″ gillnet	0.93	10	0	351	0	115,483	0.30
			SEASON TOTAL		0	439	927	379,143	
2014 [c]	9-Jun	selective gear	0.14	44	0	– [d]	5,440	272,849	0.64
	3-Jul	6.0″ gillnet	0.99	12	0	440	0	154,498	0.36
			SEASON TOTAL		0	440	5,440	427,347	
2015 [c]	11-Jun	selective gear	0.18	39	0	– [d]	9,507	227,214	0.64
	7/2/2015 [e]	5.5″, 30 mesh gillnet	0.89	3	0	874	0	34,153	0.10
	6-Jul	6.0" gillnet	0.97	12	0	2,415	6	92,719	0.26
			SEASON TOTAL		0	3,289	9,513	354,086	
2016	7-Jun	selective gear		22	0	0	8,213	181,146	0.35
	6/25/2018 [e]	5.5″, 30 mesh gillnet		9	0	2,417	44	126,033	0.24
	27-Jun	6.0″ gillnet		18	0	2,912	4	214,610	0.41
			SEASON TOTAL		0	5,329	8,261	521,789	
2017	10-Jun	selective gear		17	0	0	4,618	135,043	0.34
	6/23/2018 [e]	5.5″, 30 mesh gillnet		4	0	2,875	0	107,519	0.27
	2-Jul	6.0″ gillnet		10	0	2,939	7	150,603	0.38
			SEASON TOTAL		0	5,814	4,625	393,165	

-continued-

Table 13.–Page 2 of 3.

Year	Date of first commercial	Gear	Proportion of Chinook salmon passage [b]	Number of periods	Incidental Chinook salmon [a]			Summer chum salmon sales	Proportion of commercial harvest
					Sales	Caught but not sold	Caught and released		
2016	7-Jun	selective gear		22	0	0	8,213	181,146	0.35
	6/25/2018 [e]	5.5″, 30 mesh gillnet		9	0	2,417	44	126,033	0.24
	27-Jun	6.0″ gillnet		18	0	2,912	4	214,610	0.41
			SEASON TOTAL		0	5,329	8,261	521,789	
2017	10-Jun	selective gear		17	0	0	4,618	135,043	0.34
	6/23/2018 [e]	5.5″, 30 mesh gillnet		4	0	2,875	0	107,519	0.27
	2-Jul	6.0″ gillnet		10	0	2,939	7	150,603	0.38
			SEASON TOTAL		0	5,814	4,625	393,165	
2018	9-Jun	selective gear		39	0	0	11,928	243,811	0.55
	4-Jul	6.0″ gillnet		19	0	2,982	60	202,570	0.45
			SEASON TOTAL		0	2,982	11,988	446,381	
2019		selective gear		–	–	–	–	–	–
	3-Jul	6.0″ gillnet		9	3,105	1,148	–	225,493	1.00
			SEASON TOTAL		3,105	1,148	0	225,493	
2020	27-Jun	selective gear		3	0	0	795	8,736	0.63
	4-Jul	6.0″ gillnet		2	0	349	0	5,232	0.37
			SEASON TOTAL		0	349	795	13,968	
2021	–	–		–	–	–	–	–	–
			SEASON TOTAL		–	–	–	–	
2022	–	–		–	–	–	–	–	–
			SEASON TOTAL		–	–	–	–	
Averages		selective gear			0	0	6,362	126,274	0.59
2018–2022		5.5″, 30 mesh gillnet [g]			0	1,209	30	144,432	–
		6.0″ gillnet			1,035	1,855	4,261	228,614	0.61
			Average total		0	2,573	4,352	269,752	

-continued-

Table 13.–Page 3 of 3.

Note: Selective gear includes dip nets and beach seines. Few fishers use beach seines, and harvest from beach seines represented less than 5% of the selective gear harvest.

[a] Does not include Chinook salmon caught during the fall season fishery.

[b] The proportion of Chinook salmon run passed at time of first commercial is based on the Lower Yukon Fishery CPUE information.

[c] The sale of incidentally caught Chinook salmon was prohibited during portions or all of the summer season.

[d] Regulations do not allow for retention of Chinook salmon from this gear type.

[e] Implemented in District 1 only.

[f] First 5 commercial periods restricted to South Mouth only.

[g] Average does not include 2018 and 2014 when there were no openings restricted to this mesh size.

Table 14.–Yukon River fall chum salmon estimated brood year production and return per spawner estimates, 1974–2022.

	(P)	Estimated annual totals		Estimated brood year return								(R)	(R/P)
				Number of salmon [a]				Proportion				Total brood	Return/
Year	Escapement [b]	Catch	Run	Age 3	Age 4	Age 5	Age 6	Age 3	Age 4	Age 5	Age 6	year return [a]	spawner
1974	685,200	478,875	1,164,075	112,017	654,046	96,746	0	0.13	0.76	0.11	0.00	862,809	1.26
1975	2,220,000	473,062	2,693,062	197,691	1,725,889	67,333	0	0.10	0.87	0.03	0.00	1,990,914	0.90
1976	557,600	339,043	896,643	143,742	644,242	138,736	4,889	0.15	0.69	0.15	0.01	931,609	1.67
1977	727,500	447,918	1,175,418	112,580	1,082,886	196,160	6,351	0.08	0.77	0.14	0.00	1,397,976	1.92
1978	557,400	434,030	991,430	22,321	374,987	106,866	0	0.04	0.74	0.21	0.00	504,173	0.90
1979	1,351,000	615,377	1,966,377	45,040	906,515	310,715	4,233	0.04	0.72	0.25	0.00	1,266,504	0.94
1980	335,850	488,305	824,155	13,634	411,169	200,180	2,852	0.02	0.65	0.32	0.00	627,834	1.87
1981	560,450	683,493	1,243,943	51,788	997,034	339,584	8,934	0.04	0.71	0.24	0.01	1,397,340	2.49
1982	247,900	373,175	621,075	12,434	495,669	173,136	782	0.02	0.73	0.25	0.00	682,021	2.75
1983	508,350	525,016	1,033,366	15,223	935,414	233,352	4,040	0.01	0.79	0.20	0.00	1,188,029	2.34
1984	361,350	412,322	773,672	6,581	427,316	162,759	9,142	0.01	0.71	0.27	0.02	605,797	1.68
1985	698,400	515,481	1,213,881	47,598	917,968	305,462	2,604	0.04	0.72	0.24	0.00	1,273,632	1.82
1986	535,300	318,028	853,328	1,454	524,145	340,461	5,702	0.00	0.60	0.39	0.01	871,763	1.63
1987	717,700	406,365	1,124,065	12,165	677,093	347,344	7,733	0.01	0.65	0.33	0.01	1,044,335	1.46
1988	353,100	355,947	709,047	12,138	212,320	161,775	33,287 [c]	0.03	0.51	0.39	0.08	419,520	1.19
1989	540,900	545,322	1,086,222	3,286	303,344	410,542 [c]	20,898	0.00	0.41	0.56	0.03	738,069	1.36
1990	498,650	352,264	850,914	683	665,743 [c]	455,593	33,287	0.00	0.58	0.39	0.03	1,155,306	2.32
1991	593,200	439,096	1,032,296	0 [c]	1,127,210	398,358	13,019	0.00	0.73	0.26	0.01	1,538,588	2.59
1992	419,600	149,052	568,652	7,834	699,580	207,567	4,124	0.01	0.76	0.23	0.00	919,104	2.19
1993	382,400	91,135	473,535	9,889	482,144	107,945	3,258	0.02	0.80	0.18	0.01	603,236	1.58
1994	940,000	169,572	1,109,572	4,550	237,392	149,212	2,529 [c]	0.01	0.60	0.38	0.01	393,684	0.42
1995	1,150,000	461,534	1,611,534	2,496	266,589	73,353 [c]	420	0.01	0.78	0.21	0.00	342,859	0.30
1996	879,800	261,315	1,141,115	420	174,530 [c]	130,130	8,369	0.00	0.56	0.42	0.03	313,449	0.36
1997	537,200	170,079	707,279	2,529 [c]	243,894	119,474	3,632	0.01	0.66	0.32	0.01	369,530	0.69
1998	281,100	70,857	351,957	440	270,880	59,802	6,308	0.00	0.80	0.18	0.02	337,430	1.20
1999	288,100	131,380	419,480	29,245	719,543	195,655	17,176	0.03	0.75	0.20	0.02	961,620	3.34
2000	224,300	28,642	252,942	9,048	320,241	114,194	0	0.02	0.72	0.26	0.00	443483	1.98
2001	329,300	45,585	374,885	131,012	2,049,118	718,937	34,751	0.04	0.70	0.25	0.01	2,933,817	8.91

-continued-

Table 14.–Page 2 of 3.

	(P)	Estimated annual totals		Estimated brood year return								(R)	(R/P)
				Number of salmon [a]				Proportion				Total brood year	
Year	Escapement [b]	Catch	Run	Age 3	Age 4	Age 5	Age 6	Age 3	Age 4	Age 5	Age 6	return [a]	Return/ spawner
2002	398,700	27,769	426,469	0	465,507	250,500	15,228	0.00	0.64	0.34	0.02	731,235	1.83
2003	713,150	79,225	792,375	27,642	875,820	477,686	17,778	0.02	0.63	0.34	0.01	1398926	1.96
2004	576,000	76,616	652,616	0	362,469	153,436	2,519	0.00	0.70	0.30	0.00	518,424	0.90
2005	1,898,000	290,488	2,188,488	2,437	393,354	92,116	3,912	0.00	0.80	0.19	0.01	491,818	0.26
2006	942,600	270,673	1,213,273	26,509	396,210	361,308	30,629 [d]	0.03	0.49	0.44	0.04	814,655	0.86
2007	955,200	205,901	1,161,101	94,946	866,455	189,211 [d]	9,094	0.08	0.75	0.16	0.01	1,159,707	1.21
2008	639,450	218,369	857,819	12,466	857,376 [d]	415,894	9,495	0.01	0.66	0.32	0.01	1,295,232	2.03
2009	497,600	93,477	591,077	11,984 [d]	788,517	426,860	22,748	0.01	0.63	0.34	0.02	1,250,109	2.51
2010	505,600	80,191	585,791	2,303	497,316	247,109	9,175	0.00	0.66	0.33	0.01	755,903	1.50
2011	916,450	327,691	1,244,141	22,998	489,135	182,134	1,797	0.03	0.70	0.26	0.00	696,064	0.76
2012	692,600	396,600	1,089,200	69,462	1,169,894	332,334	5,653	0.04	0.74	0.21	0.00	1,577,342	2.28
2013	857,700	358,109	1,215,809	29,126	1,923,980	319,216	3,237	0.01	0.85	0.14	0.00	2,275,559	2.65
2014	743,200	213,469	956,669	57,773	760,050	126,832	2,483	0.06	0.80	0.13	0.00	947,138	1.27
2015	545,800	282,653	828,453	29,765	664,836	86,658	430 [d]	0.04	0.85	0.11	0.00	781,689	1.43
2016	833,500	556,829	1,390,329	8,059	89,521	6,437 [d]	596 [d]	0.08	0.86	0.06	0.01	104,613	0.13
2017	1,733,500	582,383	2,315,883	5,571	87,443 [d]	53,302 [d]	1,135	0.04	0.59	0.36	NA	147,452	~0.09 [e]
2018	656,150	458,534	1,114,684	940 [d]	185,721 [d]	76,274	NA	NA	NA	NA	NA	262,934	~0.40 [f]
2019	529,300	273,664	802,964	2,846 [d]	NA	NA	NA	NA	NA	NA	NA	NA	NA
2020	178,400	5,833	184,233	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2021	94,525	724	95,249	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2022	239,987	2,778	242,465	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average-22	664,292	297,638	961,924										
Min-16	221,600	27,769	250,242	0	89,521	6,437	0	0.00	0.40	0.03	0.00	104,613	0.13
Max-16	2,289,000	683,493	2,762,062	196,395	2,056,636	720,124	34,781	0.16	0.87	0.56	0.08	2,942,432	9.00
	677,173	All brood years (1974–2016)		32,524	676,258	231,386	8,662	0.03	0.70	0.26	0.01	948,830	1.73
	549,482	Even brood years (1974–2016)		23,888	484,205	199,149	8,485	0.03	0.68	0.28	0.01	715,726	1.48
	810,945	Odd brood years (1974–2016)		41,572	877,457	265,158	8,848	0.03	0.73	0.24	0.01	1,193,035	1.98

-continued-

Note: Minimum ("Min-16") and maximum ("Max-16") indicate the lowest and highest values for each year presented through 2016. "Average-22" is the average value through the year 2022. Current brood year data are preliminary as are 2017 to 2022 harvest estimates. Drainagewide escapement for 1974–2021 is based on Bayesian analysis, which began in 2014.

[a] The estimated number of salmon which returned are based upon annual age composition observed in Lower Yukon Test Fishery gillnets each year, weighted by test fish catch per unit effort.

[b] Contrast in escapement data is 10.33.

[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.

[e] Brood year return for 3-, 4-, and 5-year fish indicate that production (R/P) from brood year 2017 was approximately 0.09. Recruits estimated for incomplete brood year denoted by shaded values.

[f] Brood year return for 3- and 4-year fish indicate that production (R/P) from brood year 2018 was approximately 0.40. Recruits estimated for incomplete brood year denoted by shaded values.

Table 15.–Index of coho salmon run size minus estimated total Yukon River harvest provides an estimate of escapement upstream of the mainstem Yukon River sonar operated near Pilot Station, 1995–2022.

Year	Coho salmon reconstruction index [a]	Total Yukon harvest	Estimated escapement
1995	199,551	77,787	121,764
1996 [b]	–	–	–
1997	197,883	61,883	136,000
1998	154,560	19,103	135,457
1999	143,457	23,584	119,873
2000	208,918	15,530	193,388
2001	186,751	23,404	163,347
2002	182,391	17,076	165,315
2003	307,672	51,671	256,001
2004	296,423	43,063	253,360
2005	261,861	86,306	175,555
2006	309,275	86,039	223,236
2007	284,304	65,433	218,871
2008	181,154	52,937	128,217
2009 [c]	–	–	–
2010	188,372	18,905	169,467
2011	243,795	89,405	154,390
2012	216,839	96,602	120,237
2013	163,768	81,032	82,736
2014	388,971	123,952	265,019
2015	255,541	148,553	106,988
2016	397,643	211,244	186,399
2017 [d]	315,247	147,821	167,426
2018 [d]	259,847	116,862	142,985
2019 [d]	169,586	64,590	104,996
2020 [d]	120,456	3,755	116,701
2021 [d]	45,545	330	45,215
2022 [d]	101,631	1,090	100,541
Averages			
2008–2017	261,259	107,828	153,431
2018–2022	139,413	37,325	102,088

Note: En dashes indicate no data.

[a] Does not include escapements to systems downstream of Yukon River mile 123 including the Andreafsky River. A weir counted coho salmon in the East Fork Andreafsky from 1995 to 2005, with escapement ranging from 3,000 to 16,000 with an average of 8,000 fish. Escapement into this system is typically doubled to represent the West Fork Andreafsky contributions.

[b] Sonar operated in research mode only.

[c] Pilot Station sonar operations in 2009 were compounded by extreme low water and poor catchability of fall chum salmon resulting in concerns for over estimation of coho salmon in the drift gillnet apportionment.

[d] Data are preliminary, particularly estimates of subsistence and personal use harvests.

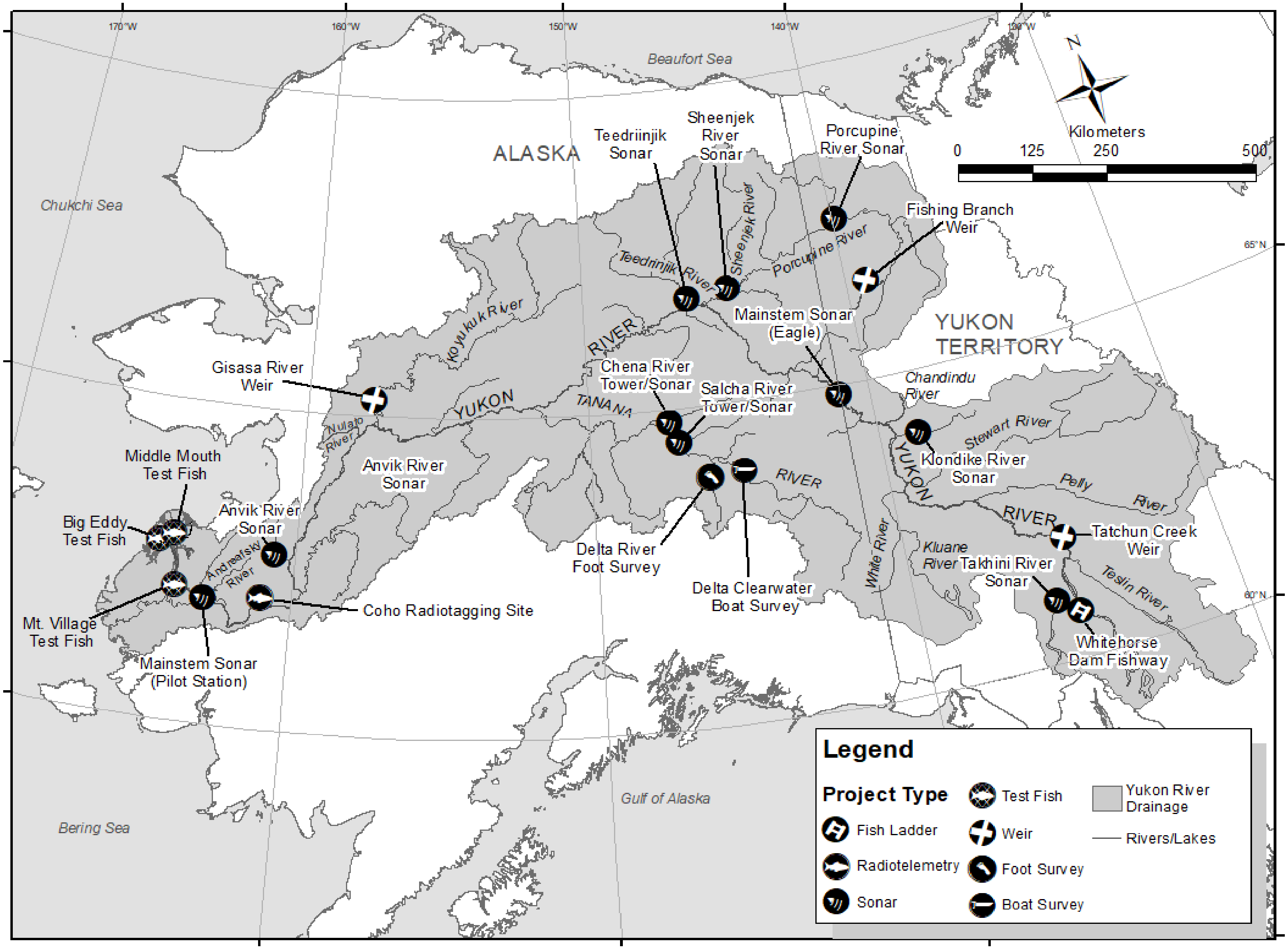

Figure 1.–Map of Yukon Area salmon monitoring projects.

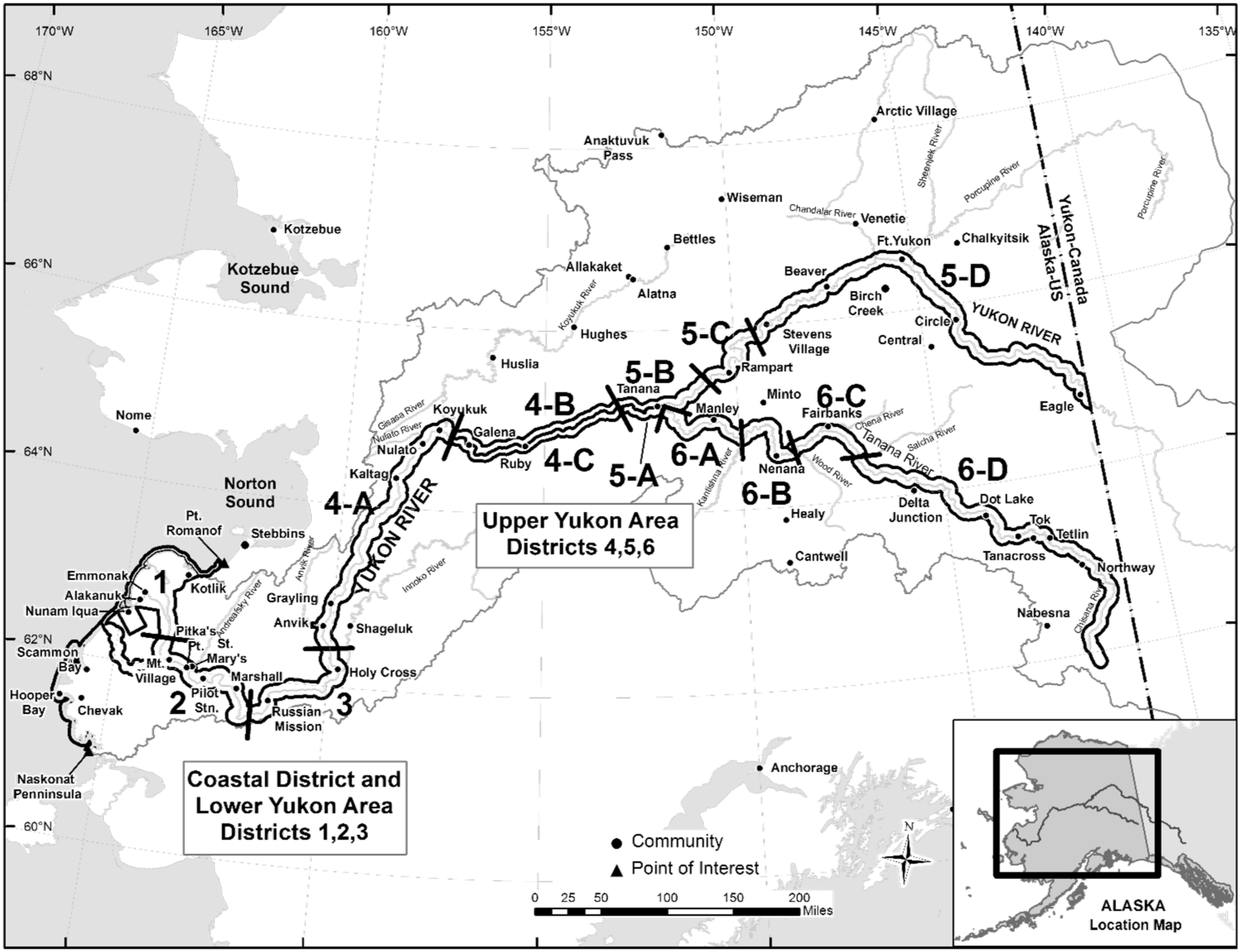

Figure 2.–Alaska portion of the Yukon River drainage showing communities and fishing districts.

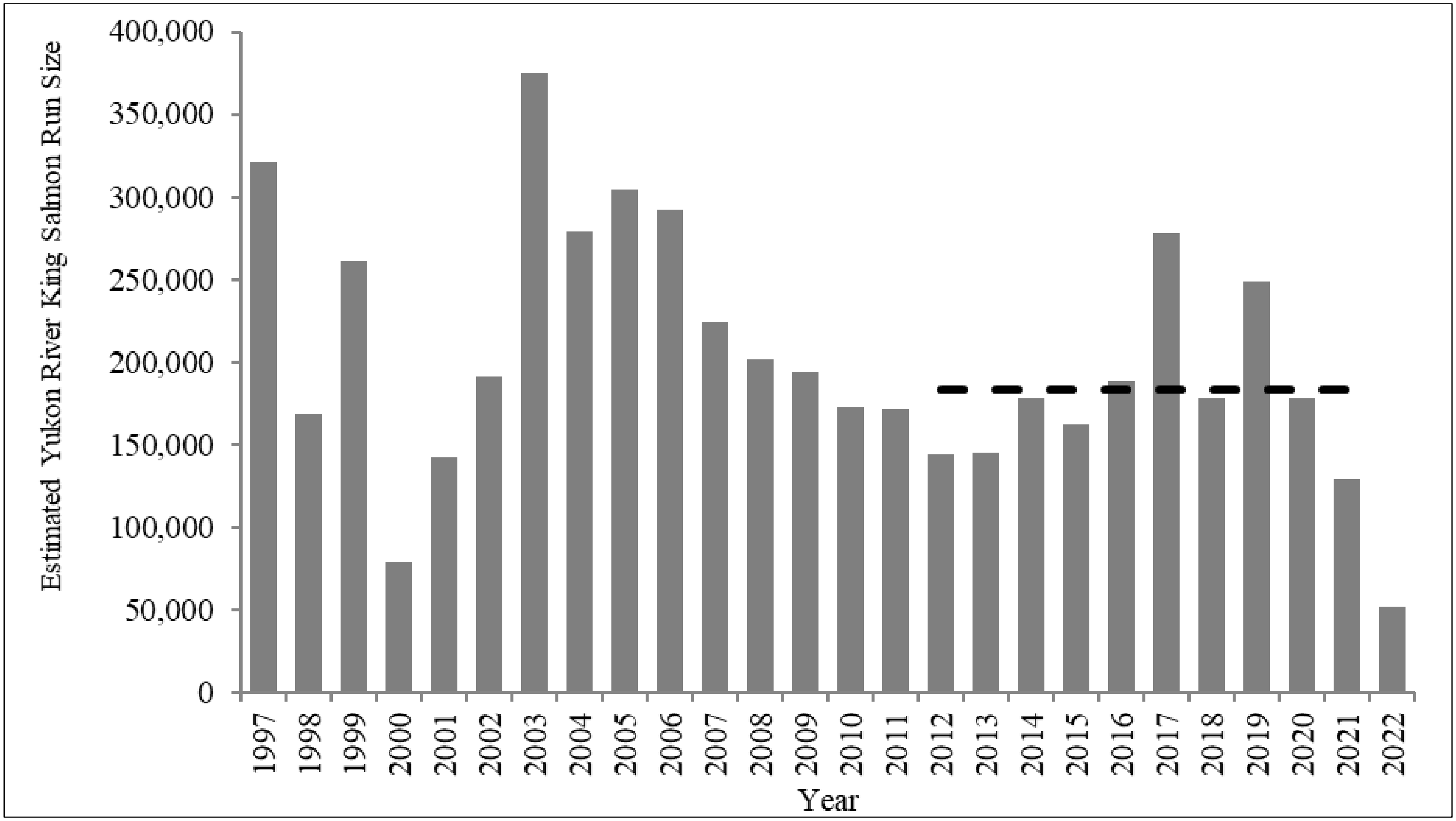

Figure 3.–Drainagewide Chinook salmon run size 1997–2022.

Note: Drainagewide total run is the sum of harvest below Pilot Station sonar, the total Andreafsky River passage, and the Pilot Station sonar count. The dashed line is the 2012–2021 average run size.

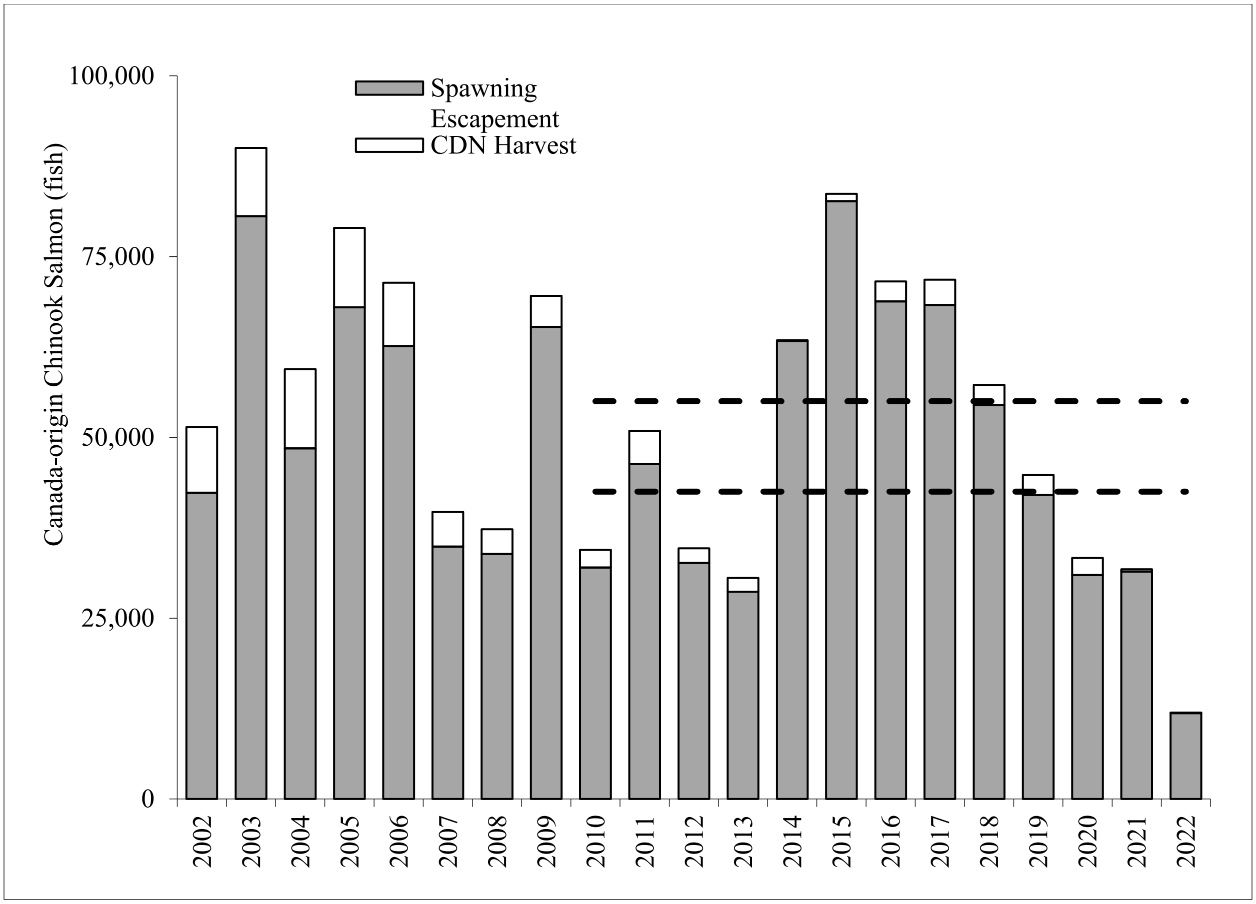

Figure 4.–Spawning escapement and harvest estimates for Canada-origin Yukon River Chinook salmon, 2002–2022.

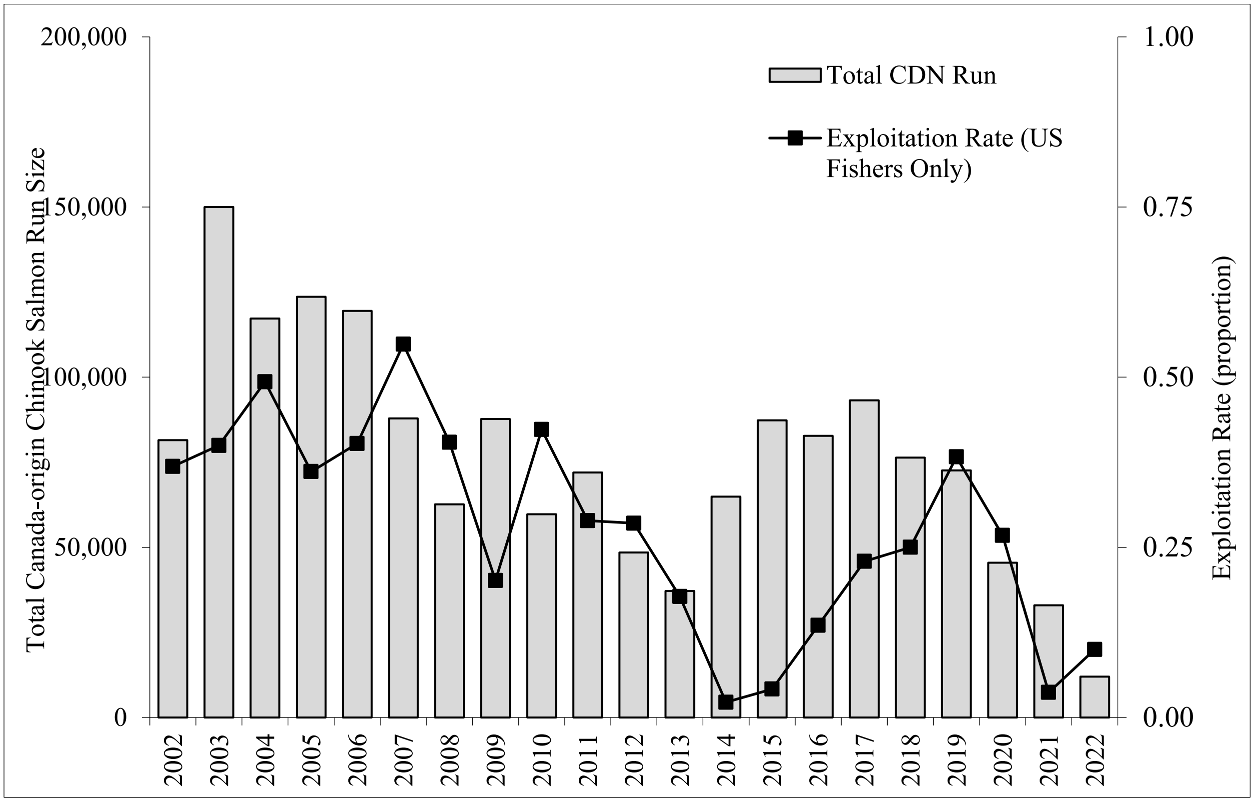

Figure 5.–Total Canada-origin Yukon River Chinook salmon run size and exploitation rate in United States fisheries, 2002–2022.

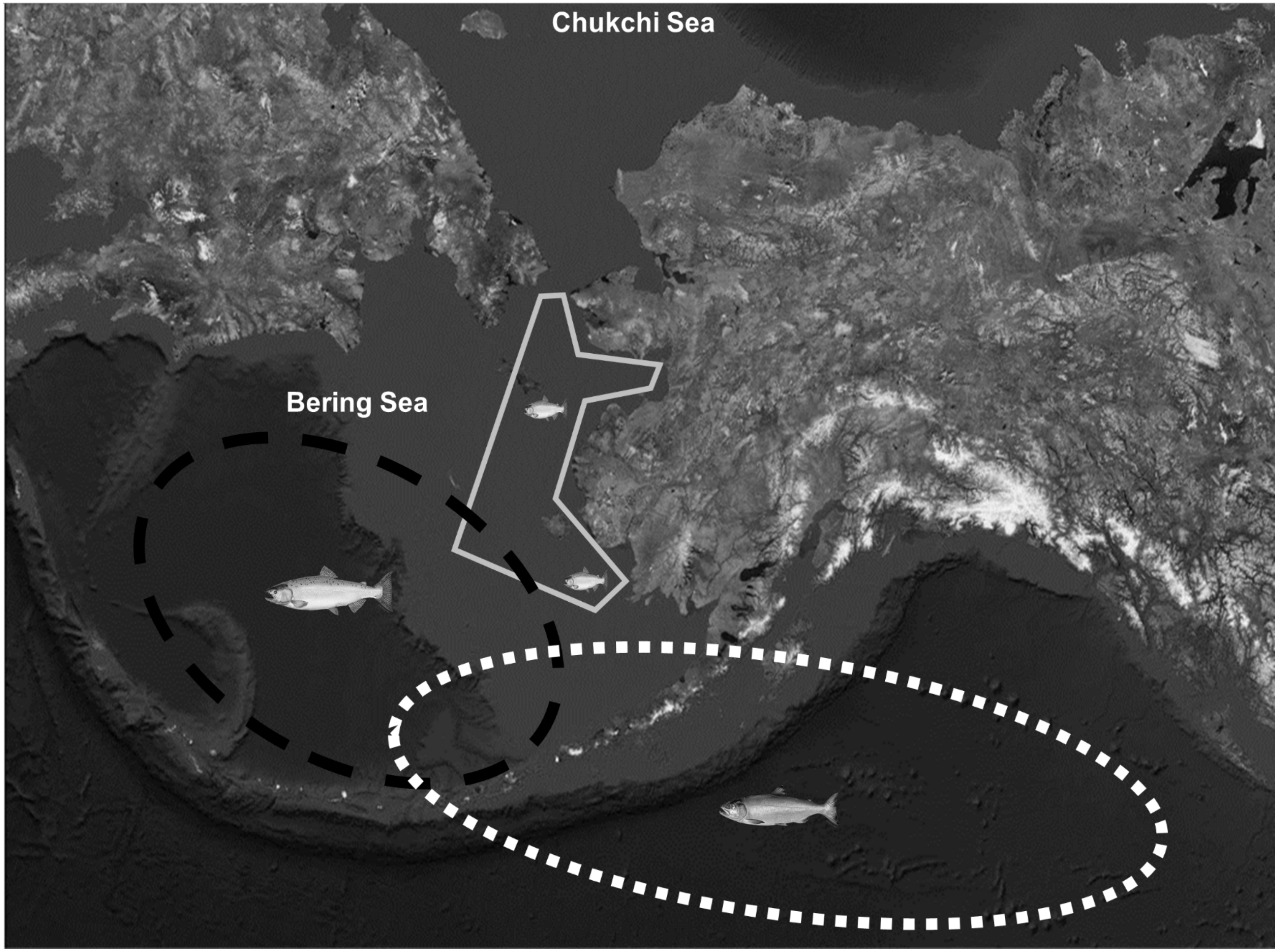

Figure 6.–Marine habitats during juvenile (grey polygon) and immature life stages of Yukon River Chinook (black dashed oval) and chum (white dashed oval) salmon.

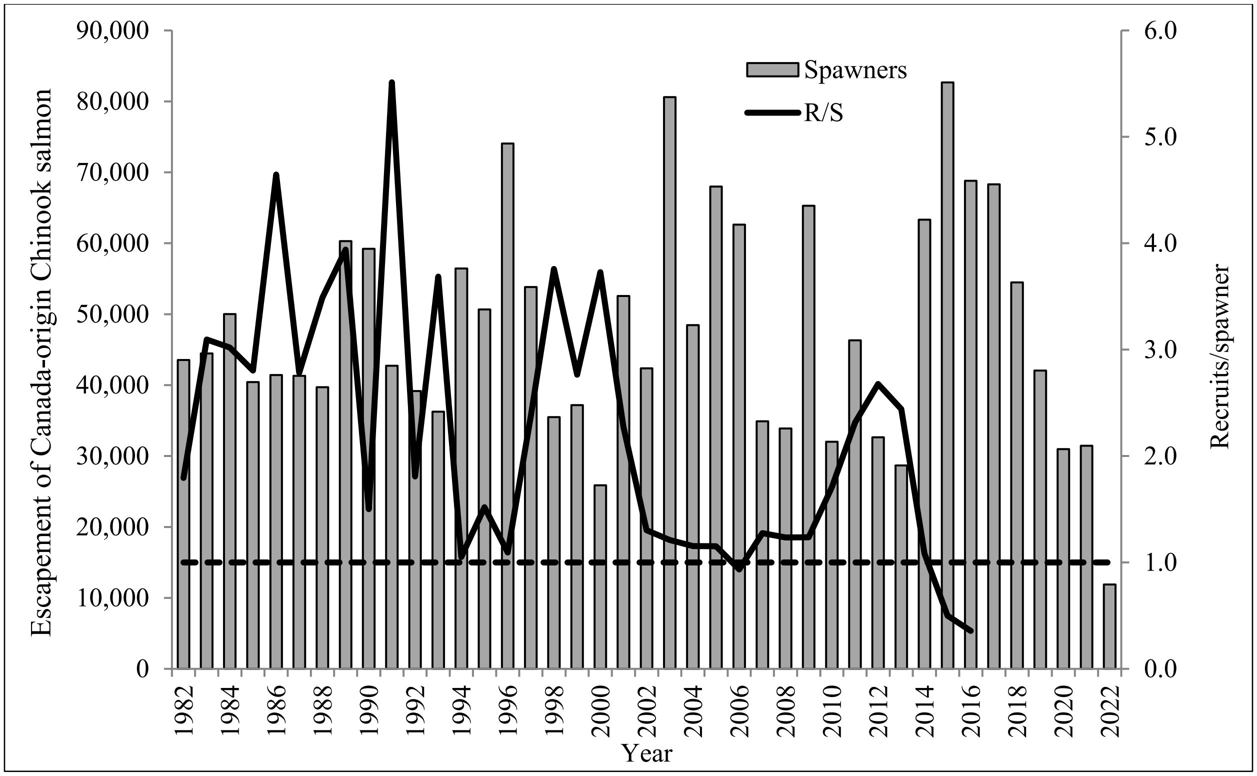

Figure 7.–Total escapement for Canada-origin Chinook salmon and returns per spawner (R/S) from each brood year with the age-3 through age-6 returns. (Age-7 returns do not change the R/S value considerably because of the relatively small proportion of the run they represent.)

Note: the dashed line indicates a necessary replacement level of recruits per spawner of 1.

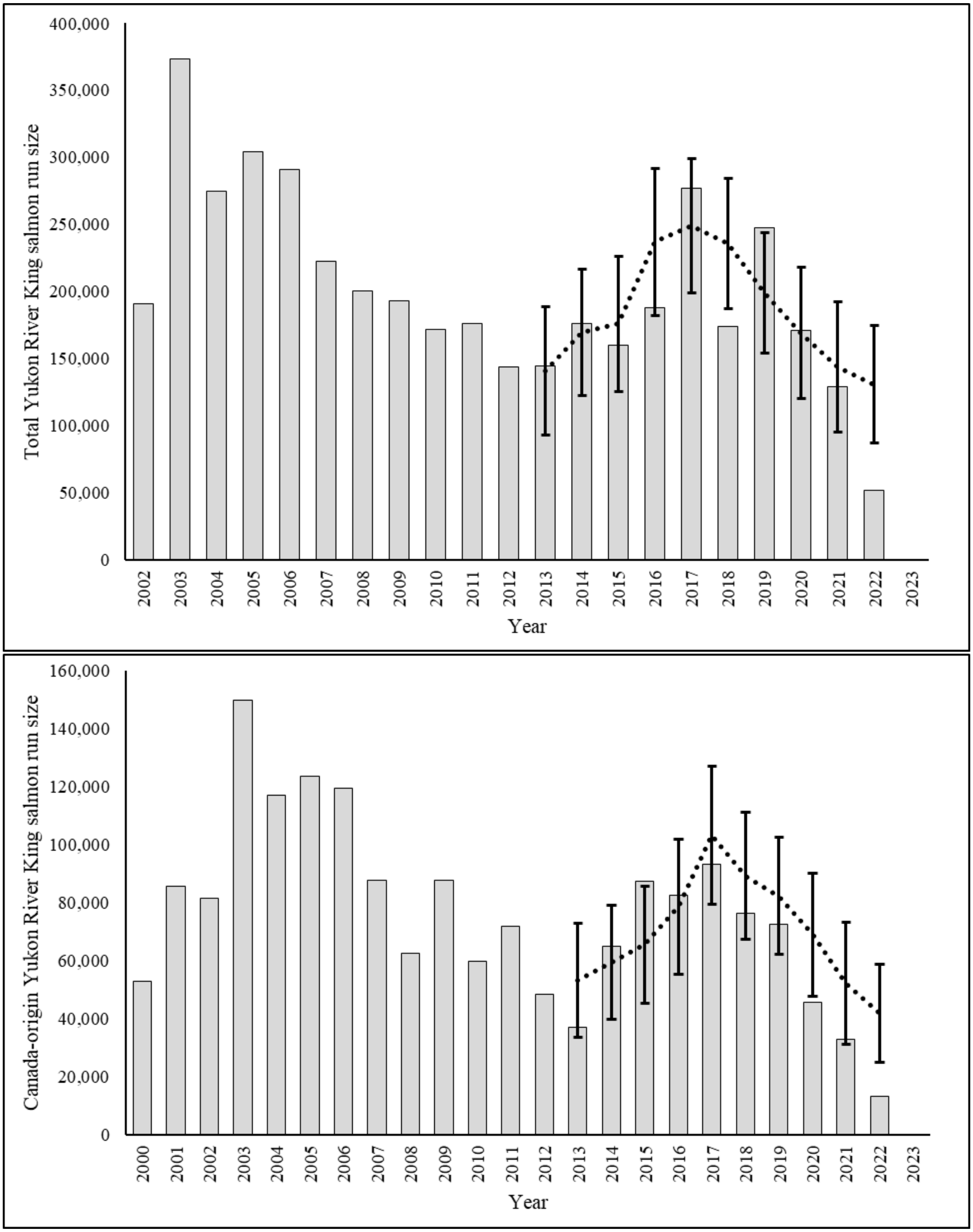

Figure 8.–Adult run size of total Yukon (top) and Canada-origin (bottom) Yukon River Chinook salmon (grey bars) and projected run size based on juvenile abundance forecast (black dashed line and error bars indicating forecast range).

Note: There are different scales on the y-axes of each panel. No forecast available for 2023.

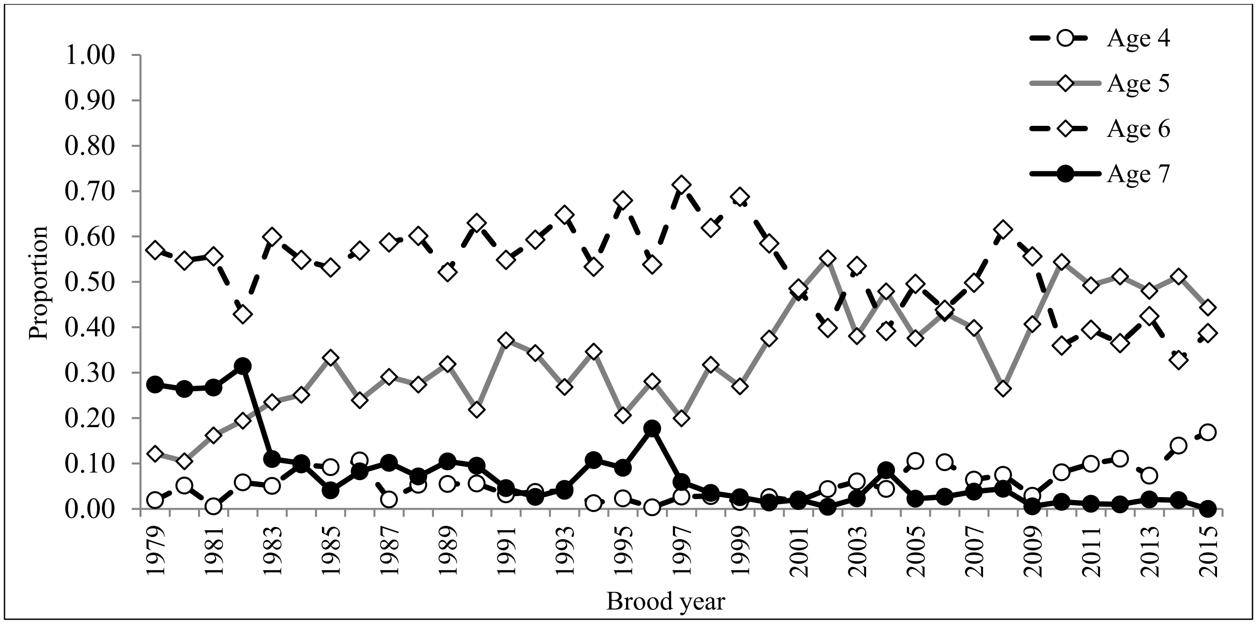

Figure 9.–Chinook salmon proportion-at-age from brood years 1979–2015.

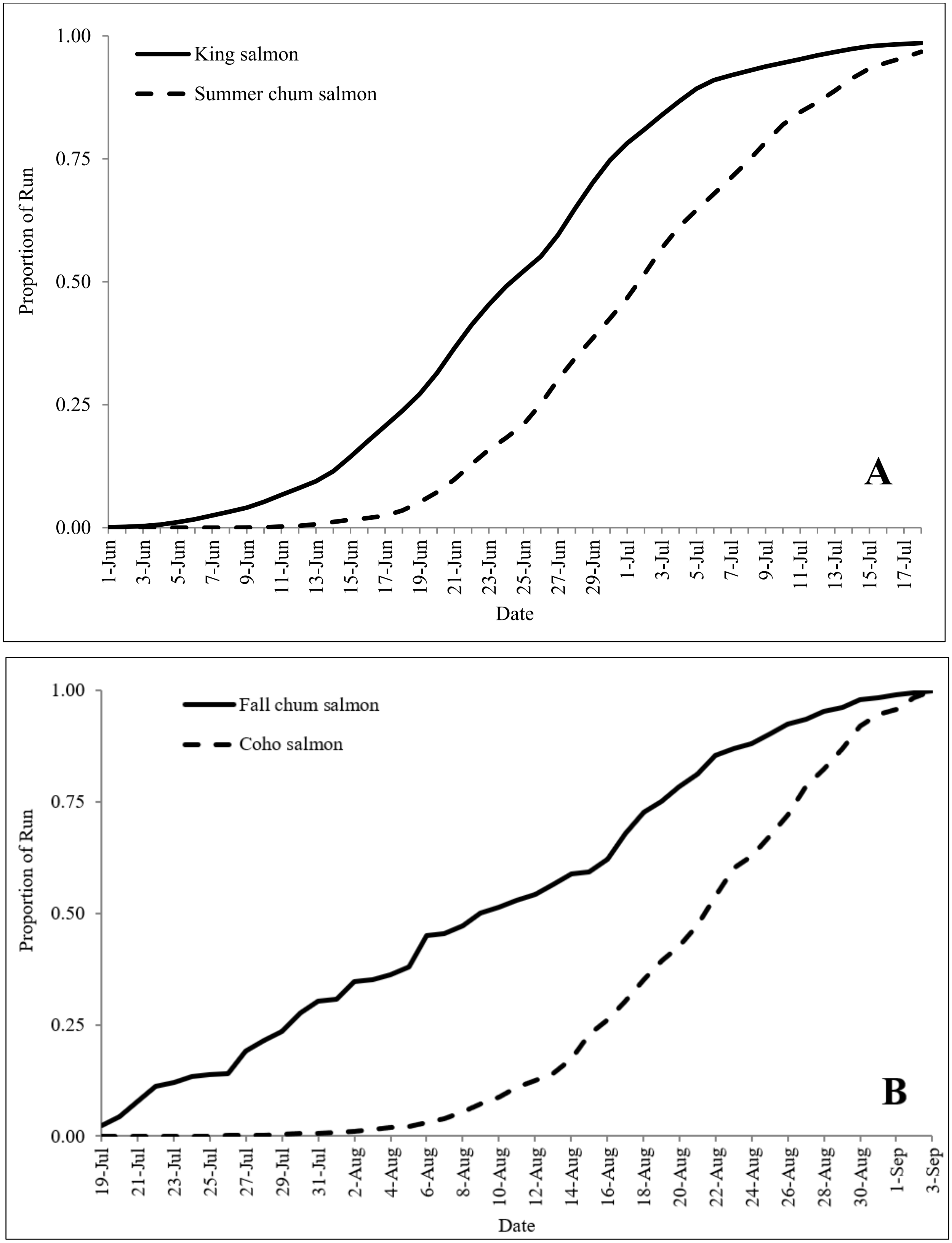

Figure 10.–Cumulative proportion of (A) Chinook ("king") and summer chum salmon and (B) fall chum and coho salmon runs past the sonar project near Pilot Station.

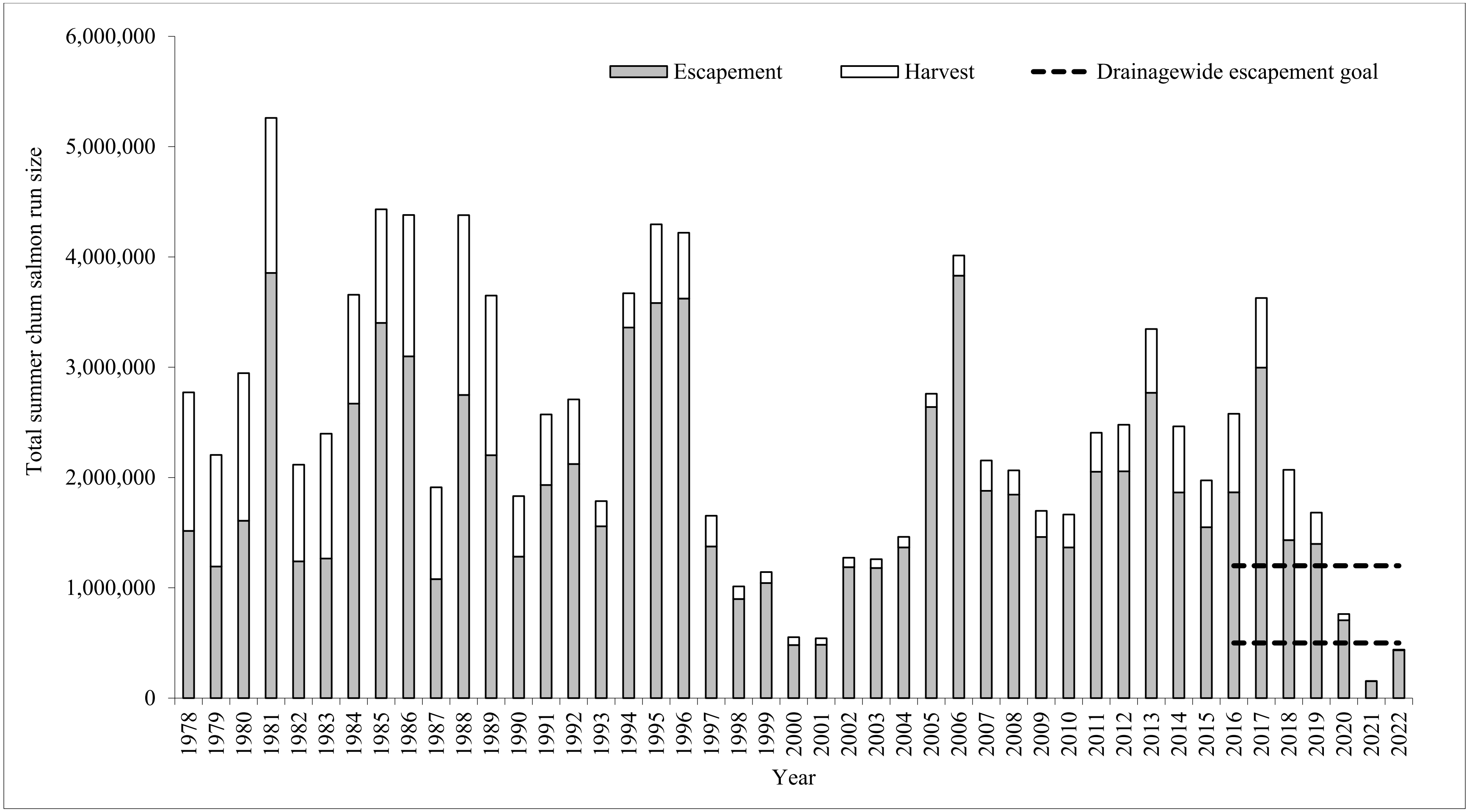

Figure 11.–Total run reconstruction based on estimated harvest and escapement of summer chum salmon, Yukon River drainage, 1978–2022.

Note: Approximate total run size of Yukon River summer chum salmon, by harvest and escapement, compared to the drainagewide escapement goal of 500,000 to 1,200,000 fish, 1997–2017. Estimates from 2022 are preliminary.

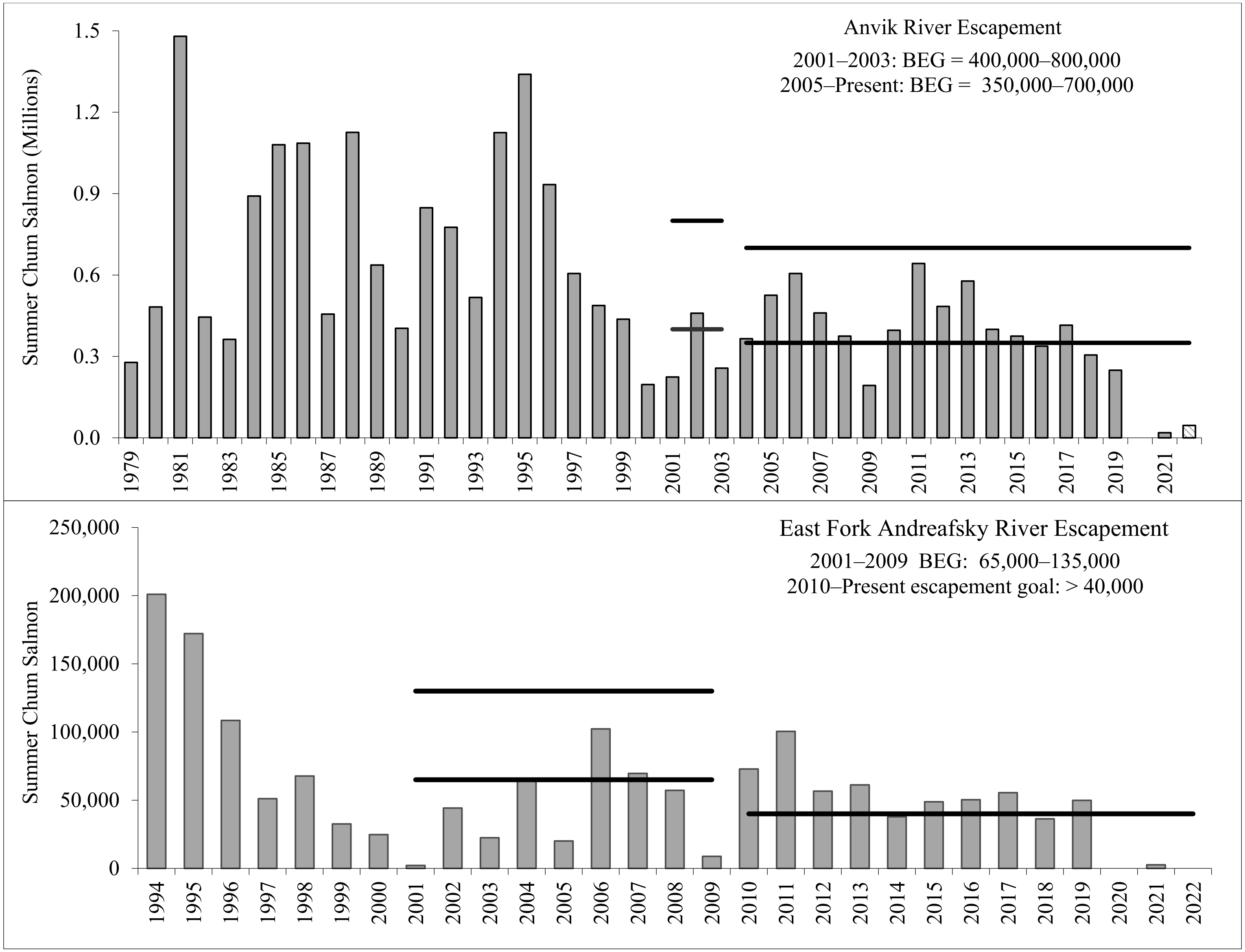

Figure 12.–Anvik River and East Fork Andreafsky River summer chum salmon passage estimates and escapement goals.

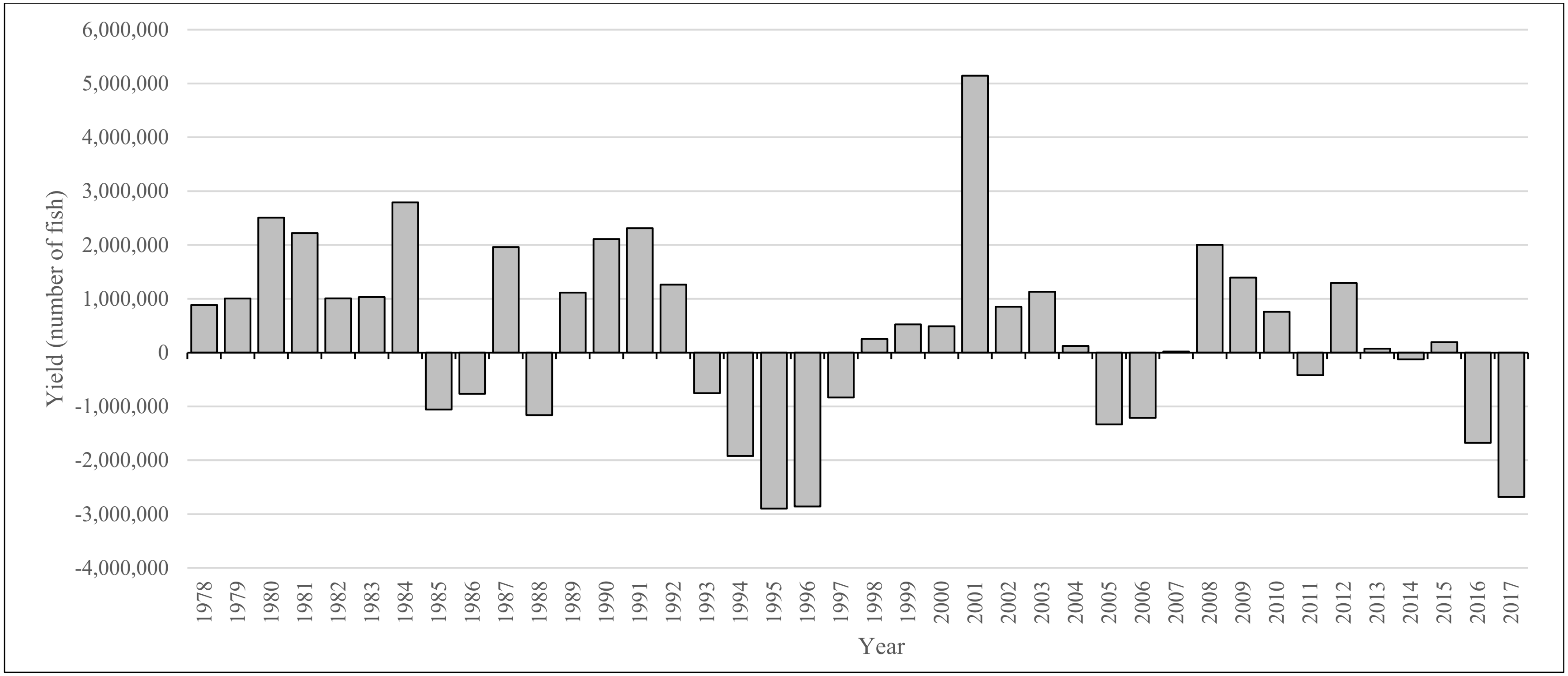

Figure 13.–Yields of summer chum salmon based on parent-year escapements and resulting brood year returns, 1974–2017.

Note: Yield equals the number of offspring produced (brood year returns for ages 3–6), minus the parent-year escapement number. As an example of yield, in 2008, an escapement of 1.8 million summer chum salmon produced 3.8 million fish. Data from, 2016 and 2017 are preliminary as recruits were estimated for incomplete brood year returns.

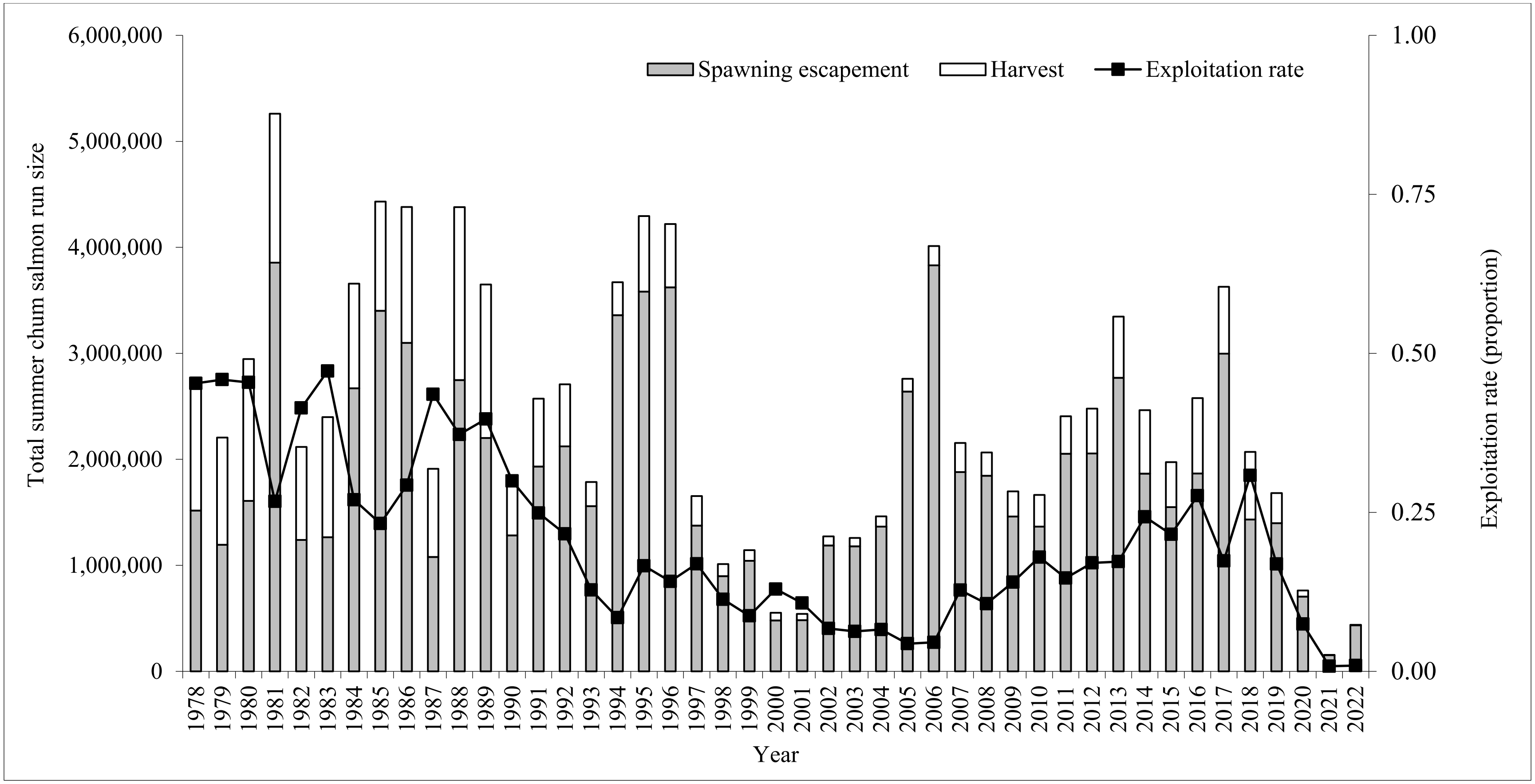

Figure 14.–Estimated summer chum salmon harvest and escapement with exploitation rate, Yukon Area, 1978–2022.

Note: Data for 2022 is preliminary.

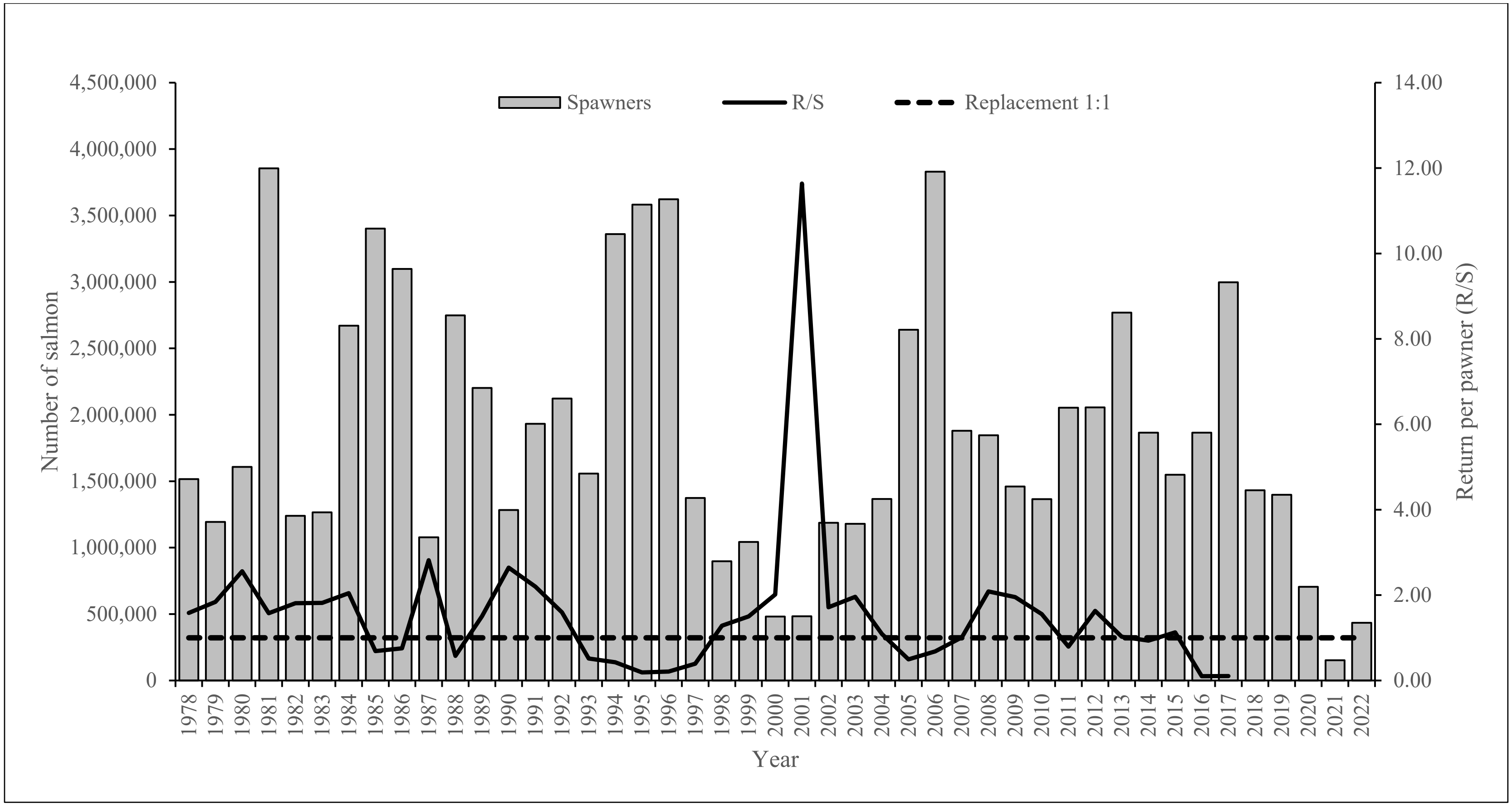

Figure 15.–Summer chum salmon total escapement and returns per spawner (R/S) from each brood year with the age-3 through age-5 returns. (Age-6 returns do not change the R/S value considerably because of the relatively small proportion of the run they represent).

Note: the dashed line indicates a necessary replacement level of recruits per spawner of 1.

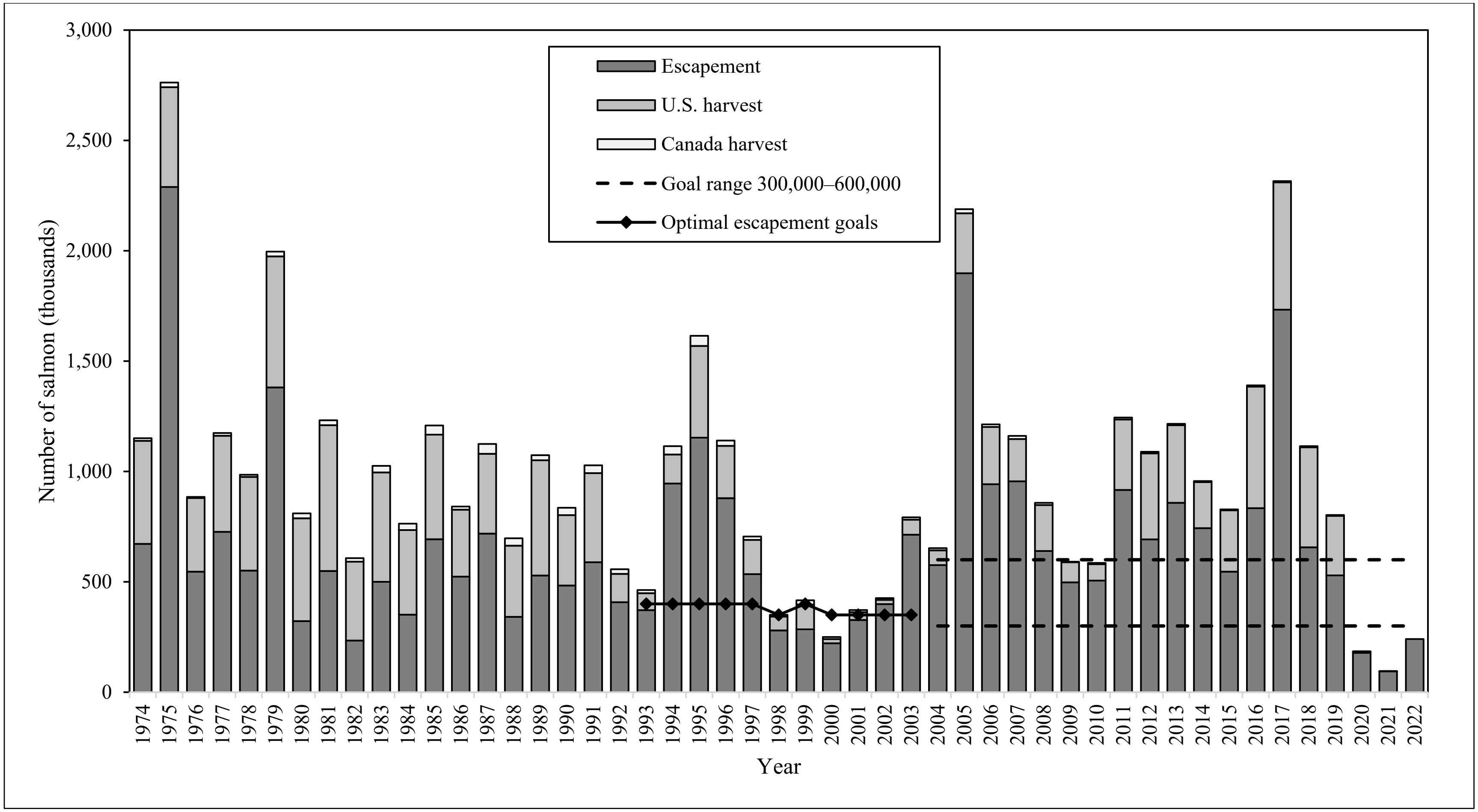

Figure 16.–Total run reconstruction based on estimated harvest and escapement of fall chum salmon, Yukon River drainage, 1974–2022.

Note: The drainagewide escapement goal of 400,000 fall chum salmon was established in 1993. In 1996, an optimal escapement goal of 350,000 fall chum salmon was established in the Yukon River Fall Chum Salmon Management Plan and was utilized in 1998, 2000, and 2001. In 2004, a drainagewide escapement goal range of 300,000 to 600,000 fall chum salmon was established.

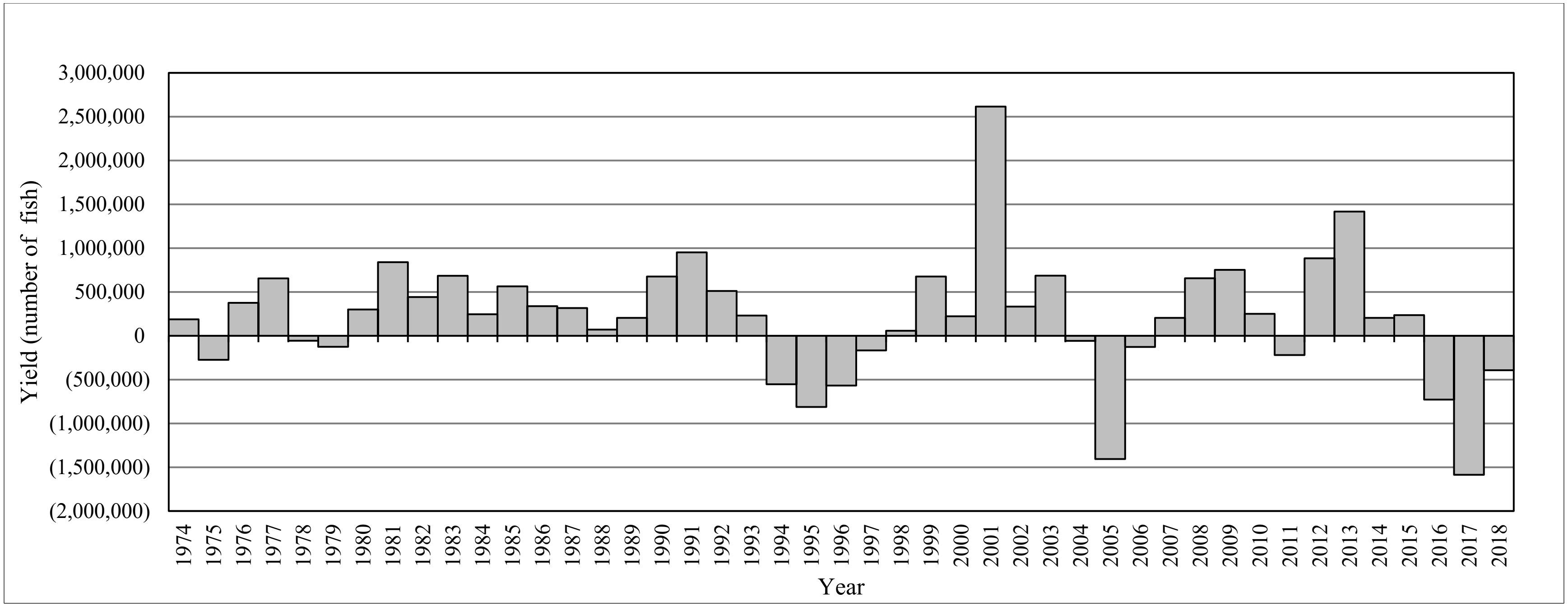

Figure 17.–Yields of fall chum salmon based on parent-year escapements and resulting brood year returns, 1974–2018.

Note: Yield equals the number of offspring produced (brood year returns for ages 3–6), minus the parent-year escapement number. As an example of yield, in 2008, an escapement of 1.8 million fall chum salmon produced 3.8 million fish. Data from 2017 and 2018 are preliminary because recruits were estimated for incomplete brood year returns.

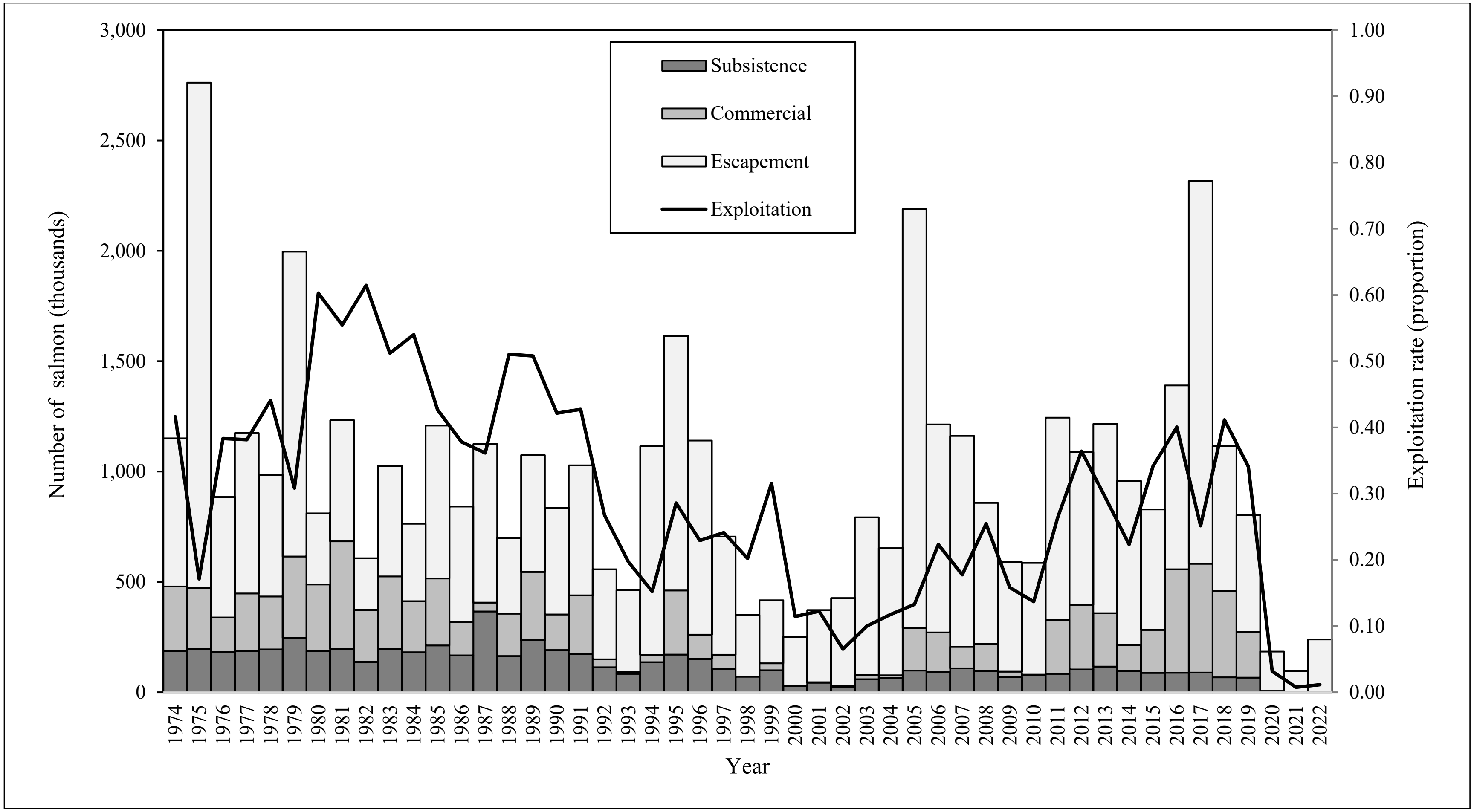

Figure 18.–Estimated fall chum salmon drainagewide harvest and escapement with exploitation rate, Yukon River drainage, 1974–2022.

Note: Data for 2022 is preliminary.

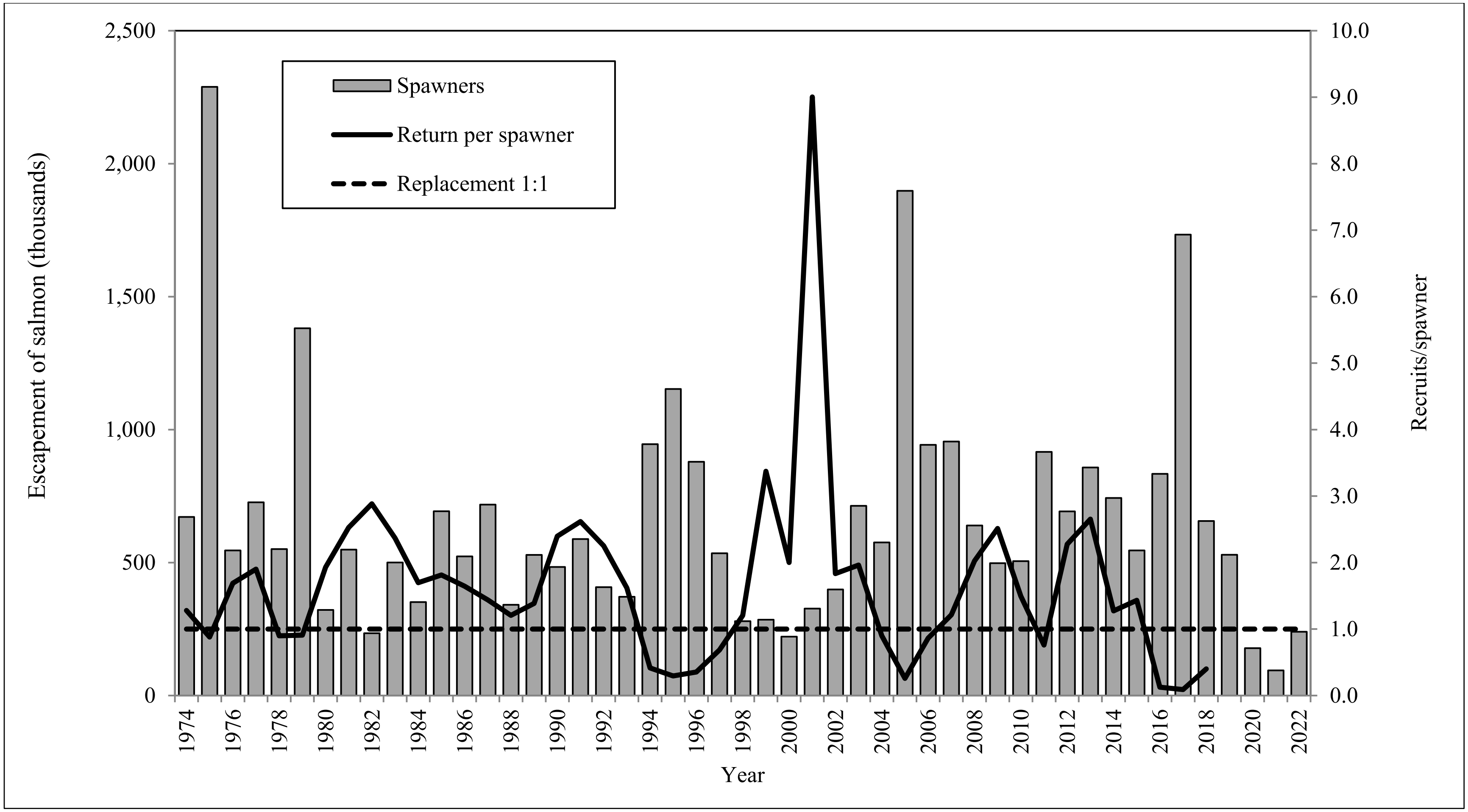

Figure 19.–Estimated historical productivity of Yukon River fall chum salmon, 1974–2022.

Note: Incomplete brood years 2017 and 2018 are estimated.

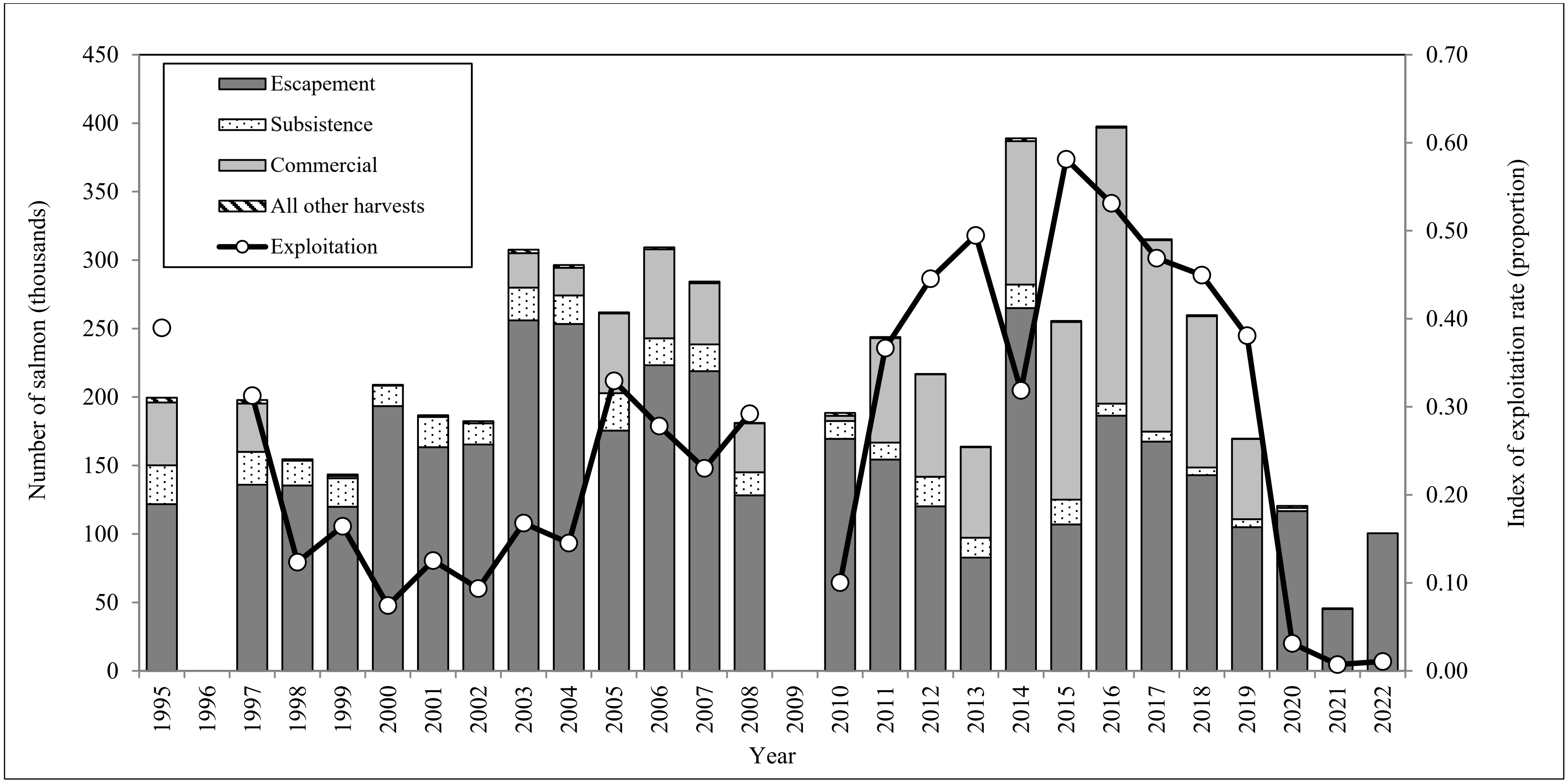

Figure 20.–Index of coho salmon run size, Yukon River drainage, 1995–2022.

APPENDIX A: HISTORY OF CHINOOK SALMON ACTION PLAN REGULATORY CHANGES

Regulation Changes Adopted in 2001

In January 2001, after reviewing management action plan options addressing this stock of concern, the board modified the *Yukon River King Salmon Management Plan*.

The board added wording to the plan under section (a) regarding management objectives and data used to manage Chinook salmon fisheries. Additionally, when the projected commercial harvest is 0–67,350 Chinook salmon, the board provided the percentage of harvest allocated by district or subdistrict determined from the low end of the established guideline harvest ranges:

Districts 1 and 2:	89.1%
District 3:	2.7%
District 4:	3.3%
Subdistricts 5-B and 5-C:	3.6%
Subdistricts 5-D:	0.4%
District 6:	0.9%

The board also adopted a fishing schedule for subsistence salmon fisheries. The schedule is implemented chronologically, consistent with migratory timing as the run progresses upstream. Managers may alter the subsistence schedule by emergency order if preseason or inseason indicators suggest this change is necessary. The subsistence schedule is as follows:

- Coastal District; Koyukuk River drainage; Subdistrict 5-D: 7 days/week;
- Districts 1–3: two 36-hour periods/week;
- District 4; Subdistricts 5-B and C: two 48-hour periods/week;
- Subdistrict 5-A; District 6: two 42-hour periods/week; and
- Old Minto Area: 5 days/week.

The board provided the department with emergency order authority to restrict subsistence gillnets to no greater than 6-inch mesh size for conservation of Chinook salmon.

Management plan changes:

Yukon River Summer Chum Salmon Management Plan: the board added wording regarding management objectives and data used to manage summer chum salmon fisheries including a subsistence salmon fishing schedule. Additionally, the board set the percentage of harvest allocated by district or subdistrict when the harvestable surplus is in excess of subsistence needs, but below the low end of established commercial guideline harvest ranges. Amendments included 4 trigger ranges to be used to guide salmon management actions.

Fall Chum Management Plan was reauthorized with the removal of the expiration date.

Yukon River fall chum salmon guideline harvest ranges. The range of 5,000 to 40,000 had previously included only Subdistricts 4-B and 4-C, with Subdistrict 4-A not allowed in the fishery. The board added Subdistrict 4-A as sharing in the District 4 combined commercial harvest.

The Toklat River Fall Chum Salmon Rebuilding Management Plan was reauthorized with the removal of the expiration date.

-continued-

Tanana River Salmon Management Plan: The one 42-hour commercial salmon fishing period per week provision was changed to not more than 42 hours fishing per week to provide more management flexibility by allowing periods to be broken up into shorter lengths. Language was also added to clarify that the Tanana River would be managed to achieve spawning escapement goals. The expiration date was also removed.

Yukon River Coho Salmon Management Plan was reauthorized with the removal of the expiration date.

Several proposals were submitted to the board for the 2001 meeting. The following is a summary of the adopted proposals:

1. Subsistence fishing gear changes included restricting gillnet mesh size in Birch and Beaver Creeks to target nonsalmon species, dip nets were added as a gear type to be available during times of salmon conservation, and the "livebox" regulation utilized in times of conservation was modified to reduce the holding time from 12 hours to 6 hours maximum for checking the livebox. The board provided the department emergency order authority to restrict subsistence gillnets to no greater than 6-inch mesh size for the conservation of Chinook salmon. In addition, use of hook and line fishing gear was authorized for subsistence use in the Yukon River drainage downstream from the lower mouth of Paimiut Slough.
2. Beaver and Birch Creeks were removed from waters closed to subsistence fishing. However, gillnets used for subsistence fishing were restricted to those 3 inches or less stretch mesh to protect salmon.
3. The board found that individual salmon species were customarily used in the Yukon-Northern Area and established the following corresponding amounts of salmon reasonably necessary for subsistence uses:
   (1) Chinook salmon: 45,500–66,704
   (2) summer chum salmon: 83,500–142,192
   (3) fall chum salmon: 89,500–167,100
   (4) coho salmon: 20,500–51,980
4. New language was adopted defining the use of Chinook salmon as primarily human food with specific provisions for feeding them to dogs based on unfitness for human consumption. Chinook salmon may be retained for dog food after July 10 in the Koyukuk River drainage, after July 20 in District 6 of the Tanana River drainage, and after August 10 in Subdistrict 5-D, upstream of Circle City. Dried Chinook salmon may not be used for dog food throughout the Yukon River drainage, except that whole fish that are unfit for human consumption, scraps, and fish under 16 inches in length may be fed to dogs.
5. A previous restrictive regulation was repealed which now allows Lower Yukon fishers to subsistence fish in different districts other than the district they are registered to commercial fish.

-continued-

6. The board added several islands to the descriptions of Subdistricts 5-A (Second, Corbusier, Sixmile, Deet'laa, Swanson, and Blind Islands) and 5-B (Willow I, II, III, Steamboat, and Grant Islands). Additionally, the lower boundary of the Old Minto Area was extended to the downstream end of Upper Tolovana Island.
7. The Black River (lower Yukon) closed area was redefined to be a rectangular box one mile south of Black River extending seaward one mile and enclosing the area to one mile north of Black River. The closed waters area at the mouth of the Andreafsky River was enlarged and will be denoted by location of department regulatory markers.
8. Dip nets were added to the list of lawful personal use salmon gear and an exception was made that allowed dip net fishers to operate their gear within less than 200 feet of one another.
9. The board authorized the personal use harvest of whitefish and suckers by dip nets and fyke nets (hoop traps) that are strictly monitored through individual permit requirements.

Regulation Changes Adopted in 2002

The board provided the department with emergency order authority to suspend the requirement for Districts 1–3 to mark Chinook salmon taken for subsistence uses when there is no commercial fishing season. If there is no commercial fishing season, Chinook salmon taken for subsistence may have the dorsal fin left intact.

Personal use salmon fishing gear changes included adding dip nets as a gear type available during times of salmon conservation. Dip nets were removed as a lawful gear for personal use salmon under general regulations. During times when it is necessary for the conservation of a salmon species, gear limitations, such as gillnet mesh size limits, livebox/live chute requirements on fish wheels, and the use of dip nets will allow for personal use fishing for a more abundant species.

Regulation Changes Adopted in 2003

Managers experienced difficulty maintaining the subsistence fishing schedule in Districts 1, 2, and 3, and Subdistrict 4-A. The difficulties were due in part to subsistence and commercial fishing times being addressed in separate regulations. In March 2003, the board addressed 2 Agenda Change Requests (ACRs) regarding the subsistence fishing schedule, specifically whether the schedule can be terminated inseason on the basis of run abundance and, if so, how that would be done based on current regulations. The board adopted a change to terminate the subsistence fishing schedule and revert to pre-2001 subsistence fishing regulations when sufficient abundance exists:

> 5 AAC 05.360(e) If inseason run strength indicates a sufficient abundance of Chinook salmon to allow a commercial fishery, subsistence fishing shall revert to the fishing periods specified in 5 AAC 01.210(c)-(h).

-continued-

Regulation Changes Adopted in 2004

Several proposals were submitted to the board for the 2004 meeting. The following is a summary of the adopted proposals:

1. The board increased the permit harvest area for subsistence salmon fishing to include all of Subdistrict 5-C as a means to track resource use changes due to the anticipated completion of the Rampart road construction project and increased mobility of fishers.
2. The board adopted a regulation requiring gillnets greater than 4-inch mesh size to be removed from the water and requiring fish wheels to stop rotating during subsistence closures.
3. The board increased the subsistence fishing schedule from two 42-hour periods per week to two 48-hour periods per week in Subdistrict 5-A.
4. In Subdistrict 4-A, during times when the commissioner determines that it is necessary for chum salmon conservation, the commissioner may, by emergency order, close the commercial fish wheel fishing season and immediately reopen the season during which set gillnet gear may be used instead of fish wheels.
5. The board voted to allow the department to set a weekend schedule day by emergency order and not to set the start date in regulation. This was in response to a proposal to revise the subsistence fishing schedule in Districts 3 and 4 to provide weekend subsistence fishing opportunity for fishers that work.
6. In the Tanana River (District 6) subsistence fishing may be open 24-hours per day after September 30 if the abundance of salmon is adequate.
7. The board adopted a proposal to allow subsistence fishing with 3.5-inch or smaller mesh gillnets from November 1 to June 30 in the South and Middle Forks of the Koyukuk River along the Dalton Highway. This proposal was adopted with the amendment to require a subsistence fishing permit in the area.
8. A board generated proposal allowing commercial fishing for herring throughout the entire Cape Romanzof herring district was adopted.
9. The board modified the Yukon River Drainage Fall Chum Salmon Management Plan by aligning the escapement goal threshold with the lower end of the established biological escapement goal (BEG) range of 300,000 to 600,000 fish. Commercial fishing drainage wide will not be allowed until the fall chum salmon run is projected to be 600,000 fish. Elements of the Toklat River Fall Chum Salmon Rebuilding Management Plan were incorporated into the Fall Chum Salmon Plan which included changing management of the Toklat Stock from the optimum escapement goal (OEG) target to the established BEG range of 15,000–33,000 fish.
10. The board amended the Tanana River Salmon Management Plan to remove the restriction requiring no more than 42 hours of commercial fishing per week after August 15.

-continued-

Regulation Changes Adopted in 2007

There were several proposals submitted to the board, including requests to change commercial gillnet mesh sizes and depth, commercial harvest allocations, and district boundaries. None of these proposals were adopted. The subsistence marking requirement for Districts 1–3 was changed such that from June 1 to July 15, a person may not possess Chinook salmon taken for subsistence uses unless both tips and lobes of the tail fin have been removed. Marking must be done before the person conceals the salmon from plain view or transfers the salmon from the fishing site. Additionally, a person may not sell or purchase salmon from which both lobes of the tail fin have been removed. Previously, the marking requirement was to remove the dorsal fin.

The board passed a proposal that allowed catch-and-release of Chinook salmon in the sport fishery on a portion of the Goodpaster River, downstream from the department regulatory markers located approximately 25 miles upstream from the confluence with the Tanana River. Chinook salmon may not be removed from the water and must be released immediately without further harm. Additionally, in the Goodpaster River drainage, from June 1 through August 31, only one unbaited single-hook artificial lure may be used.

Additionally, the board modified the Yukon River Coho Salmon Management Plan by reducing the threshold required to allow a directed coho salmon commercial fishery from a run size of 625,000 fall chum salmon down to 550,000 fall chum salmon. The closure of the directed coho salmon commercial season was extended to September 10 in Districts 1, 2, and 3, and Subdistrict 4-A was included with the remainder of District 4 to close no later than October 5. The board considered but made no changes to harvest allocation.

Regulation Action in 2009

Effective July 1, 2009, due to the conservation concern for Chinook salmon and to provide opportunity for a directed summer chum commercial fishery in Districts 1 and 2, the board adopted an emergency regulation specifying that during the commercial summer chum salmon season in Districts 1 through 5; Chinook salmon taken may be retained but not sold. Therefore, fishers could release live Chinook salmon or use them for subsistence purposes. Chinook salmon caught but not sold were to be reported on fish tickets. This emergency regulation was discontinued, effective July 16, because the majority of the Chinook salmon run had passed the lower river districts.

On September 8, 2009, the board met and passed an emergency regulation to allow for a directed coho salmon commercial fishery if the department determined that there was a harvestable surplus of coho salmon above escapement needs and those necessary for subsistence uses and that a directed coho salmon commercial fishery would not have a significant impact on escapement or allocation of fall chum salmon.

-continued-

Regulation Changes Adopted in 2010

Chinook salmon on the Yukon River were continued as a "Stock of Yield Concern" due to variable run sizes, reduced and eliminated commercial harvest since 2001, and subsistence harvests that were steady until 2007 but were restricted in 2008 and 2009. The board adopted several changes to the regulations pertaining to Yukon Area fisheries management in January 2010. The following is a summary of the board's actions at that meeting:

1. The *Yukon River Summer Chum Salmon Management Plan* was modified to allow, by emergency order, a commercial harvest up to 50,000 fish if the total run size is between 900,000 and 1,000,000 fish, distributed by district or subdistrict in proportion to the guideline harvest levels.
2. The *Yukon River Fall Chum Salmon Management Plan* was modified by lowering the threshold required to allow a directed fall chum salmon commercial fishery from a run size of 600,000 fall chum salmon to 500,000 fall chum salmon. This modification also changed the threshold in the Yukon River Coho Salmon Management Plan from a run size of 550,000 fall chum salmon to 500,000 fall chum salmon in order to conduct a coho salmon directed commercial fishery.
3. The *Yukon River Coho Salmon Management Plan* was modified to allow for late season harvest of coho salmon if the department determines there is a harvestable surplus of coho salmon above escapement needs and those necessary for subsistence uses and that a directed coho salmon commercial fishery will not have a significant impact on escapement or allocation of fall chum salmon.
4. Effective in 2011, the maximum mesh size for subsistence, commercial, and personal use gillnets in the Yukon River Area will be 7.5 inches. Previously mesh size was unrestricted.
5. During times of Chinook salmon conservation, the department now has emergency order authority to prohibit the sale of Chinook salmon during chum salmon directed commercial fishing periods.
6. The *Yukon River King Salmon Management Plan* was amended by adding a new subsection that the department may use emergency order authority to close all salmon fishing in a district or portion of a district if run assessment information indicates an insufficient abundance of Chinook salmon.
7. The subsistence fishing schedule in Subdistrict 4-A was changed to two 48-hour periods per week, regardless of commercial fishing periods.
8. The subsistence fishing schedule in Subdistricts 4-B and 4-C was modified to open from 6:00 PM Sundays until 6:00 PM Fridays when commercial fishing closures last longer than 5 days.
9. The Innoko River subsistence fishing schedule was changed to open 7 days per week.

-continued-

Regulation Changes Adopted in 2012

Regulations adopted by the board out of cycle in March 2012 allowed the department to open summer chum salmon directed commercial fishing periods in Subdistrict 4-A during time of Chinook salmon conservation with fish wheels only. In addition, fish wheels must be attended at all times during operation, and all Chinook salmon caught in the fish wheels must be released to the water alive immediately.

An emergency regulation was adopted by the board on July 17, 2012, to allow the department to open summer chum salmon directed commercial fishing periods in District 6 during times of Chinook salmon conservation with fish wheels only. Fish wheels must be attended at all times during operation, and all Chinook salmon caught in the fish wheels must be released to the water alive immediately. This regulatory change implemented by the board was effective only for the 2012 fishing season.

Regulation Changes Adopted in 2013

During the 2013 board cycle, numerous regulation changes were adopted pertaining to Chinook salmon in the Yukon River. The following list is a summary of the board's actions at that meeting:

1. Require first pulse protection in the Chinook salmon management plan regardless of preseason run forecasts. After initiating the pulse closure, the department may discontinue subsistence fishing closures if inseason run assessment indicates that escapement objectives on specific components of the run and subsistence harvest needs are likely to be met.
2. Prohibit the sale of Chinook salmon from the Yukon River drainage if Chinook salmon escapement goals are not going to be met or subsistence salmon fishing is restricted in more than one district or portion of a district.
3. Allow for a directed chum salmon commercial fishery in Districts 1–3 in the Lower Yukon Area during times of Chinook salmon conservation with 5.5-inch or smaller mesh size gillnets not exceeding 30 meshes in depth.
4. Align Yukon Area subsistence regulations in Districts 1–3 with current management practices by adjusting closures around commercial fishing periods and allowing concurrent subsistence and commercial fishing by emergency order.
5. District 1 boundaries redefined to include coastal waters adjacent to the south mouth of the Yukon River from Chris Point to Black River, which opens Acharon Channel to salmon fishing.
6. Establish times when a commercial gillnet permit holder in the Lower Yukon Area may use dip net and beach seine gear to commercially harvest summer chum salmon during times of Chinook salmon conservation. All Chinook salmon caught in dip net and beach seine gear must immediately be returned to the water alive, except that a dead Chinook salmon may be taken but may not be retained; the dead Chinook salmon must be recorded on a fish ticket and forfeited to the state. Beach seine mesh size is not to exceed 4-inches. Dip net gear specifications are in 5 AAC 39.105(24).

-continued-

7. Provide the department with emergency order authority to restrict gear to fish wheels only, require fish wheels to be closely attended, and require the live release of Chinook salmon in District 6 during times necessary to conserve Chinook salmon. Additionally, fish-friendly fish wheel construction specifications were adopted (5 AAC 05.362(j)) to reduce the potential for injury that Chinook salmon may incur while being captured and released.
8. The amounts reasonably necessary (ANS) for subsistence salmon in Yukon Area was reviewed. An ANS range was established for pink salmon (2,100–9,700), no other changes were adopted to the other species-specific ranges.

Regulation Changes Adopted in 2014

Three regulatory changes were adopted by the board out of cycle at the March 2014 meeting. One of the regulations adopted was a modification to provide a larger dip net frame for noncircular dip nets in which the width-height dimensions may not exceed 6 feet by 3 feet in the Lower Yukon Area commercial summer chum salmon fishery. All other existing dip net specifications remained unaltered. Also, the board adopted a proposal that allows the use of a lead during commercial fish wheel operations. The final proposal adopted by the board was the removal of the exception that allows dead Chinook salmon to be taken but not retained in the Yukon Area Districts 1–3 dip net and beach seine commercial summer chum salmon fisheries. Adoption of this proposal closed the loophole that may allow fishers to illegally harvest Chinook salmon whereas commercial fishing and clearly ensured that all Chinook salmon are returned immediately to the water alive.

Regulation Changes Adopted in 2015

Two ACRs were accepted and the proposals were carried unanimously by the board during the March 2015 board meeting. The first proposal modified language to allow drift gillnet subsistence fishing after June 10 in the upper portion of Subdistrict 4-A for the harvest of summer chum salmon by emergency order. This modification gives the department the flexibility to allow for the efficient harvest of chum salmon when the incidental harvest of Chinook salmon is expected to be low.

The second proposal allows fish wheel fishers in the Yukon Area to retain Chinook salmon while fishing for and targeting summer chum salmon. Adoption of this proposal provides the department the flexibility to allow for a small incidental Chinook salmon harvest when justified based on inseason run assessment. Both of these changes in regulations went into effect for the 2015 summer season.

-continued-

Regulation Changes Adopted in 2016

The board continued the stock of yield concern designation for Yukon River Chinook salmon. Several proposals were submitted to the board for the 2016 meeting. The following is a summary of the board's actions:

1. Establish a new drainagewide escapement goal for summer chum salmon (500,000–1,200,000) and lower management triggers in the *Yukon River Summer Chum Salmon Management Plan*. Subsistence fishing may occur at projected run sizes above 500,000 fish; up to 50,000 fish may be harvested commercially when the projected run size is more than 650,000 fish but less than 750,000 fish; and a drainagewide commercial fishery may be opened above a projected run size of 750,000 fish. Sport fishing and personal use may be allowed for run sizes above 650,000.
2. Fall chum salmon directed commercial fishing may now occur when the run is projected to be greater than 550,000 fish. The previously used trigger point value was 500,000 fish.
3. Eliminate holding of a salmon caught in fish wheels in liveboxes prior to live release. Fish wheel operators must closely attend their fish wheel while it is in operation and must release specified salmon to the water alive in times of conservation.
4. Established beach seine specifications for subsistence and commercial salmon fishing in the Yukon Area. beach seines used for subsistence and commercial salmon fishing may not exceed 150 fathoms in length, 100 meshes in depth, and 4-inches stretched measure. Beach seines may not be constructed of single-strand or multiple-strand monofilament web.
5. Require the live release of Chinook salmon from subsistence beach seines during times of Chinook salmon conservation for both subsistence and commercial beach seines.
6. Expand the area of allowable subsistence drift gillnet fishing for chum salmon in Subdistrict 4-A by emergency order only from June 10 to August 2.
7. Modify the Yukon Area commercial set gillnet to an aggregate combined total length of 150 fathoms.
8. Allow the department to restrict gillnets in the District 6 commercial fishery to 6-inches or less stretched measure during periods established by emergency order.
9. Establish gillnet specifications for a pink salmon directed commercial fishery in District 1 of the Yukon River from June 15 to July 31 using gillnets that do not exceed 4.75-inches stretched measure. A pink salmon commercial fishery may only occur if a harvestable surplus of pink salmon is sufficient for subsistence use and if chum salmon escapement goals are expected to be achieved.
10. Expand the commercial fishing area in Yukon Area District 1 from its terminus at the Black River to its terminus at Point Romanof and includes marine waters that extend 3 miles outward from any grassland bank.

-continued-

11. Modify the dates gillnet gear may be used for subsistence fishing in the South and Middle Forks of the Koyukuk River from August 30 through June 1.
12. Under new regulations, that portion of the Chatanika River from its confluence with Goldstream Creek to a point 3 miles upriver is closed to the subsistence taking of northern pike through the ice. No changes to the bag and possession limits were adopted, nor were any size restrictions adopted.
13. In Racetrack Slough off of the Koyukuk River and in the sloughs of the Huslia River drainage, from when each river is free of ice through June 15, the offshore end of a set gillnet may not be closer than 20 feet from the opposite bank, unless closed by emergency order.
14. Allow the retention of incidentally caught northern pike in the Yukon Area Subdistrict 6-C personal use area.

Regulation Changes Adopted in 2018

Several proposals were submitted as out of cycle ACR to the board for the 2018 statewide meeting. The following is a summary of the board's actions:

1. Allowed salmon to be taken by drift gillnets in Subdistricts 4-B and 4-C during subsistence fishing periods. Drift gillnets may not be longer than 150 feet (25 fathoms).
2. Removed the mandatory closure on the first pulse of Chinook salmon in Districts 1 and 2 and direct the department to manage the Chinook salmon run conservatively, and only require first pulse closure in Districts 1 and 2 if the preseason forecast indicates a poor run of Chinook salmon.
3. Specified that if Chinook salmon escapement goals are projected to be met, subsistence fishing is not restricted, and subsistence fishing opportunity for Chinook salmon has been provided within the season, the department may open a commercial salmon fishery (e.g., for summer chum, fall chum, coho, or pink salmon) during which incidentally caught Chinook salmon may be sold.
4. Clarified District 1 boundaries and specified that during the fall commercial fishing season set nets only may be used in the coastal waters of District 1.
5. Removed the October 1 closure date for commercial fishing in District 6 and allows the season to be closed by emergency order.
6. Adopted as an emergency regulation: in Subdistrict 4-A of the Yukon River allow the harvest of chum salmon by drift gillnets after August 2 downstream from Stink Creek. (This took effect during a July emergency petition meeting of the board and went into effect prior to the fall 2018 fishing season.)
7. Under new regulations adopted at the 2017 Prince William Sound Finfish Alaska Board of Fisheries Meeting, the previously closed 3-mile portion of the Chatanika

-continued-

8. River upstream of the confluence with Goldstream Creek was reduced to 1 river mile of closed waters to subsistence fishing of northern pike through the ice. Effective January 2, 2018, subsistence fishing for northern pike through the ice closed on the Chatanika River from the confluence of Goldstream Creek to 1 river mile upstream.

Regulation Changes Adopted in 2019

Several proposals were submitted to the board for the 2019 meeting. The following is a summary of the board's actions:

1. The use of hook and line as a legal subsistence gear is extended from Paimiut Slough (near Holy Cross) to the Nulato River (near the community of Nulato); in waters of the Yukon River drainage from the coast to the north bank of the mouth of the Nulato River (including the Nulato River drainage), hook and line may be used year-round as subsistence gear for salmon and nonsalmon species.
2. During times of Chinook salmon conservation, fish wheels must be closely attended, and all Chinook salmon must be immediately released to the water alive by means of a chute, net, or tote, and may not enter any livebox.
3. Added dip nets to the list of legal gear types subsistence fishers may use for salmon. Additionally, during times of Chinook salmon conservation, the department may allow the retention of Chinook salmon from dip nets, beach seines, or fish wheels by emergency order.
4. The department may reduce the 24-hour subsistence fishing closure prior to the start of the commercial fishing season.
5. Removed the requirement to clip both tips (lobes) of the tail of subsistence-taken Chinook salmon in Districts 1-3 when there is no commercial fishery for Chinook salmon. However, if the department anticipates the sale of Chinook salmon, fishers will be required to remove the lobes in order to mark fish and prevent the illegal sale of subsistence-caught Chinook salmon.
6. Modified the maximum amount of gear used in a portion of Subdistrict 5-C. In Subdistrict 5-C, between the department marker near Waldron Creek and Hess Creek, a set gillnet used by an individual for subsistence fishing may not exceed 150 feet in length.
7. Modified the subsistence fishing schedule in Subdistricts 5-A, 5-B, and 5-C. When the fall chum salmon inseason projection, based on the summer chum to fall chum salmon relationship, is for 700,000 or more fish, in Subdistricts 5-A, 5-B and 5-C, subsistence salmon fishing will be open 7 days a week consistent with the migratory timing of the fall chum salmon fishery. Fishing periods may be altered for the conservation of Chinook salmon.
8. Allowed drift gillnets (with a maximum length of 150 feet) for subsistence salmon fishing (Chinook, summer and fall chum and coho) in all portions of District 4.

-continued-

9. Allowed the department flexibility in continuing late season fall commercial fishing; the department may close the fall chum and coho salmon commercial seasons by emergency order, instead of by a date set in regulation.

10. Added a size restriction to northern pike which can be kept within the Chatanika River Harvest Area (from a department marker approximately 1 river mile upstream of the confluence of the Chatanika River and Goldstream Creek to a department marker at the boundary of the Fairbanks Nonsubsistence Area).