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Escapement Goal Review of Copper and Bering Rivers, and Prince William Sound Pacific Salmon Stocks, 2024

by

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

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	\$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	′
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	″
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

This report is a summary of escapement goal review findings for major salmon stocks of the Prince William Sound and Upper Copper River Management Areas in preparation for the 2024 Board of Fisheries meeting. Escapement goals were reviewed based on the *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223) adopted by the Alaska Board of Fisheries into regulation in 2001. The escapement goal committee reviewed 29 existing escapement goals, including 1 Chinook *Oncorhynchus tshawytscha*, 5 chum *O. keta*, 2 coho *O. kisutch*, 16 pink *O. gorbuscha* (8 goals for each even- and odd-year brood line), and 5 sockeye *O. nerka* salmon stocks. The escapement goal committee findings are that no modifications be made to existing salmon escapement goals, and that no goals be eliminated or created at this time.

Keywords: Copper River, Bering River, Prince William Sound, escapement goal, biological escapement goal, sustainable escapement goal, Chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta*, sockeye salmon *O. nerka*, coho salmon *O. kisutch*, pink salmon *O. gorbuscha*.

INTRODUCTION

The Prince William Sound Management Area (PWSMA) and the Upper Copper/Upper Susitna Management Area (UCUSMA) encompass all coastal waters and inland drainages entering the north central Gulf of Alaska between Cape Suckling and Cape Fairfield (Figure 1). In addition to Prince William Sound (PWS), these management areas include the Bering and Copper River watersheds with a total adjacent land area of approximately 38,000 square miles. The PWSMA is divided into 11 commercial fishing districts that correspond to local geography and distribution of the 5 species of Pacific salmon. Saltwater subsistence fishery openings parallel commercial fishery openings. During the commercial fishing season, these subsistence fisheries are also open on Saturdays from 6:00 a.m. to 10:00 p.m. and by emergency order. Before and after the commercial fishing season, excluding a 2-day buffer on either side, these subsistence fisheries are open 7 days a week between May 15 and October 31. Copper River freshwater subsistence fisheries occur on the western Copper River Delta and in the lower Copper River (federal subsistence), in the Chitina Subdistrict (federal subsistence), Glennallen Subdistrict (state and federal), and Batzulnetas permit area (state and federal) of the Upper Copper River. Personal use fishing only occurs in the Chitina Subdistrict. Sport fisheries are broken out into PWSMA and UCUSMA.

The primary management objective for all districts is to achieve spawning escapement goals for the major stocks while allowing for an orderly harvest of all fish surplus to spawning requirements and inriver goals. Escapement refers to the annual estimated size of a spawning salmon stock and is affected by a variety of factors including harvest, predation, disease, and numerous physical and biological characteristics of the environment.

The Alaska Department of Fish and Game (department) reviews escapement goals for PWSMA and UCUSMA salmon stocks on a schedule corresponding to the Alaska Board of Fisheries (board) 3-year cycle for considering area regulatory proposals. Reviews are based on the *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (EGP; 5 AAC 39.223). The board adopted these policies into regulation during the 2000/2001 cycle to ensure Alaska's salmon stocks are conserved, managed, and developed using the sustained yield principle. The EGP states that it is the department's responsibility to document existing salmon escapement goals for all salmon stocks that are currently managed for an escapement goal and to review existing, or propose new, escapement goals on a schedule that conforms to the board's regular cycle of consideration of area regulatory proposals. For this review, there are 2 important terms defined in the SSFP:

5 AAC 39.222 (f)(3) "*biological escapement goal*" or "BEG" means the escapement that provides the greatest potential for maximum sustained yield; the BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted; the BEG will be developed from the best available biological information, and should be scientifically defensible on the basis of available biological information; the BEG will be determined by the department and will be expressed as a range based on factors such as salmon stock productivity and data uncertainty; the department will seek to maintain evenly distributed salmon escapements within the bounds of a BEG; and

5 AAC 39.222 (f)(36) "*sustainable escapement goal*" or "SEG" means a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10 year period, used in situations where a BEG cannot be estimated or managed for; the SEG is the primary management objective for the escapement, unless an optimal escapement or inriver run goal has been adopted by the board; the SEG will be developed from the best available biological information and should be scientifically defensible on the basis of that information; the SEG will be determined by the department and will take into account data uncertainty and be stated as either an "SEG range" or "lower-bound SEG"; the department will seek to maintain escapements within the bounds of the SEG range or above the level of a lower-bound SEG.

Many salmon escapement goals in this area have been set and evaluated at regular intervals since statehood. This was the 11th time an interdivisional committee reviewed escapement goals for stocks in these areas. In 1994 and 1999, committees reviewed and recommended goals with guidance from ADF&G's *Salmon Escapement Goal Policy* adopted in 1992 (Fried 1994). Since the 2002 review, escapement goals have been compliant with the SSFP and EGP and comprehensive analyses were conducted in Bue et al. (2002), Evenson et al. (2008), Fair et al. (2008), Fair et al. (2011), Moffitt et al. (2014), Haught et al. (2017), and Joy et al. (2021). An interdivisional escapement goal committee (hereafter referred to as the committee), including staff from the Divisions of Commercial Fisheries and Sport Fish, held an initial meeting to discuss and develop findings in November 2023. The committee recommended the appropriate type of escapement goal (BEG or SEG), based on the quality and quantity of available data and provided an analysis for recommending escapement goals. The committee met in January 2024 to review stock assessments and prepare escapement goal findings for the PWSMA and UCUSMA regulatory meeting in December 2024.

This report describes PWSMA and UCUSMA salmon escapement goals reviewed in 2024 and presents information from the previous 3 years in the context of these goals. All committee findings are reviewed by ADF&G regional and headquarters staff prior to adoption as escapement goals per the SSFP and EGP. The purpose of this report is to inform the Alaska Board of Fisheries (board) and the public about the review of PWSMA and UCUSMA salmon escapement goals and the committee's recommendations to the Divisions of Commercial Fisheries and Sport Fish directors.

During the 2024 review process, the committee reviewed all existing goals and updated analyses for stocks with recent (2021–2023) data that might have resulted in a substantially different escapement goal from the last review, or those that should be eliminated or established. The committee updated escapement goal analyses for Copper River Chinook salmon *Oncorhynchus tshawytscha*, and Upper Copper River and Copper River Delta sockeye salmon *O. nerka* stocks.

OBJECTIVES

Objectives of the 2024 escapement goal review were to:

1) review existing escapement goals to determine whether they are still appropriate given (a) new data collected since the last review, (b) current assessment techniques, and (c) current management practices;
2) review the methods used to establish the existing escapement goals to determine whether alternative methods should be investigated;
3) consider additional stocks that may have sufficient data to develop an escapement goal; and
4) recommend new escapement goals if appropriate.

OVERVIEW OF STOCK ASSESSMENT METHODS

The committee reviewed each of the existing escapement goals using updated escapement and harvest data (if available) collected since the 2020 review. Available escapement, harvest, and age data for each stock originated from research reports, management reports, and unpublished historical databases. Escapement goals for salmon are ideally based on spawner-recruit relationships (e.g., Beverton and Holt 1957; Ricker 1954) that describe the productivity and carrying capacity of a stock. However, for the PWSMA and UCUSMA, stock assessment data are often not suitable for describing a spawner-recruit relationship (e.g., no stock-specific harvest data, short escapement time series, or inconsistent escapement monitoring). Therefore, utilizing the percentile method, which requires less stock assessment data, is often necessary. This process ensures escapement goals are evaluated and revised over time, as improved methods of assessment and goal setting are developed, and when new and better information becomes available.

ESCAPEMENT AND HARVEST DATA

Estimates or indices of salmon escapement are assessed with a variety of methods such as aerial surveys, mark–recapture experiments, weir counts, and hydroacoustics (sonar). The department estimates total annual harvests in various ways: commercial fishery from fish ticket receipts, personal use and subsistence fisheries from the return of fishery-specific harvest permits and household surveys, and sport fishery from the annual Statewide Harvest Survey (http://www.adfg.alaska.gov/sf/sportfishingsurvey).

Inriver abundance of Copper River Chinook salmon has been assessed by mark–recapture projects since 1999. Total drainage escapement is derived by subtracting inriver harvests from the inriver abundance estimate. Escapements from 1980 to 1998 were indexed in select spawning tributaries using aerial surveys, and these indices were integrated into a state-space age-structured model (Joy et al. 2021) to estimate total drainage escapement for the same years. Chinook salmon are primarily harvested commercially but are also important for subsistence, personal use, and sport fisheries.

Chum salmon escapement estimates were based on expanded counts from aerial surveys that have been conducted since 1963. Streams within each district were flown multiple times each year with escapement estimated using area-under-the-curve (AUC) calculations adjusted with an estimate of stream life (12.6 days; Fried et al. 1998). Due to the lack of complete marking of hatchery fish, reliable estimates of hatchery contributions to commercial harvests of chum salmon are unavailable for 1986–2003. Instead, harvest estimates of wild chum salmon from that period rely on average harvests of wild chum salmon from 1970–1985. Since 2004, hatchery released chum have been thermal-marked for identification. Due to the interception of wild chum bound for other districts, there are no reliable estimates of district of origin for wild stock chum salmon in the commercial harvest data.

Coho salmon escapements to the Copper River Delta (CRD) and Bering River District have been measured as peak index counts from fixed-wing aerial surveys. Although many streams have been surveyed for each coho salmon stock over the years, only surveys conducted annually for the same streams were used to evaluate and set escapement goals: 17 streams in the CRD surveyed back to 1981 and 7 streams in the Bering River District surveyed back to 1984. Coho salmon are primarily harvested commercially but also by subsistence, personal use, and sport fisheries.

Since 1960, the department has conducted aerial surveys of select pink salmon streams to index the spawning escapement in PWS. There are approximately 1,000 pink salmon spawning systems in PWSMA; historically, more than 200 streams have been surveyed annually. Between 1960 and 1989, an average of 266 streams were surveyed (range = 203 to 489). The 208 streams surveyed during 1989 represented approximately 20–25% of the anadromous streams in each district and 75–85% of the total spawning escapement (Fried 1994; Fried et al. 1998). Beginning in 1990, a standardized set of 214 were surveyed with streams chosen to survey a similar proportion of the spawning escapement in each commercial fishing district. However, due to budget reductions, in 2015 the number of streams surveyed was reduced to 134 streams (Figure 2). Indices of spawning escapement are estimated using AUC methodology and appropriate stream life values (Bue et al. 1998; Fried et al. 1998). Hatchery-produced pink salmon have been returning to PWS since 1977 (Pirtle 1979). Hatchery pink salmon returns have been estimated using wild stock exploitation rates (1977–1986) or mark–recapture methods that employed either coded wire tags or otolith thermal marks (1987–present; Brady et al. 1987; Joyce and Riffe 1998). Although studies have shown hatchery salmon strays throughout PWS, including some streams with high proportions of hatchery pink salmon (Joyce and Evans 1999; Brenner et al. 2012; Knudsen et al. 2021), estimates of wild pink salmon escapement have not been adjusted for these hatchery fish. Finally, because there are no methods to allocate commercial harvests to stream or district of origin, productivity and harvest rate have only been estimated for all PWS and not for individual districts.

The inriver abundance of sockeye salmon in the Upper Copper River (UCR) has been monitored at Miles Lake since 1978 with sonar. Beginning on the south bank in 2005, after a period of comparison, the Bendix side-scan sonar was replaced with dual-frequency identification sonar (DIDSON); this same replacement occurred in 2008 on the north bank (Maxwell et al. 2011). Beginning in 2017, after a period of comparison, DIDSON was replaced with adaptive resolution imaging sonar (ARIS). However, even with a reliable measure of inriver abundance, the contribution of the upriver stock to the commercial fishery is not known. Studies in the 1980s based on inherent differences in scale patterns attempted to estimate harvests by stock (UCR vs. CRD vs. Bering River stocks; Figure 3); however, these studies were discontinued because of imprecision in estimates (Marshall et al. 1987). The CRD aerial index of sockeye salmon is estimated as the sum of the peak aerial counts for 17 index streams (Fried 1994). No adjustments were made for AUC or stream life. Estimates of contribution by the CRD stock to the Copper River harvests are unavailable. The Bering River District sockeye salmon aerial index is estimated as the sum of the peak aerial counts from 6 survey reaches.

Two sockeye salmon weirs are currently operated in PWS. Sockeye salmon escapements into Coghill Lake have been visually counted since 1960. From 1960 to 1973, escapements were counted using a partial weir and tower with a full river weir coming into use in 1974. Escapement of sockeye salmon into Eshamy Lake has been visually counted through a weir, intermittently since 1931 (Pirtle 1981), but reliable age composition data were unavailable until 1970; therefore, the spawner-recruit analysis used only complete brood years beginning with 1970 (Bue et al. 2002). Due to reduced funding, the weir was replaced with a video system for 2013–2017 that collected partial minimum counts; it was not operated in any capacity from 2018–2020, and it operated for a partial season in 2021 and operated for complete seasons in 2022–2024.

ESCAPEMENT GOAL DETERMINATION

Escapement goals were evaluated for PWSMA and UCUSMA stocks using either a Spawner–Recruitment Analysis or a Percentile Approach. Spawner and return data were used to estimate escapement goals when the committee determined there were reliable estimates of total return (escapement; age and stock-specific harvest) for a stock.

Spawner–Recruit Analysis

The most commonly used spawner-recruit model, and the model used for these analyses, is described by Ricker (1954).

$$R = \alpha S e^{-\beta S} \tag{1}$$

where α and β are model parameters, S is the total number of spawners, and R is the number of recruits.[1]

For this review a Bayesian approach was used to describe the spawner-recruit relationship and estimate the model parameters for Copper River Chinook salmon (Joy et al. 2021) and Copper River sockeye salmon. State-space age-structured models have been previously used for Ricker spawner-recruit data analysis (Rivot et al. 2001; Fleischman et al. 2013), and the department has applied the Bayesian approach to Ricker models in previous escapement goal analyses (e.g., Fleischman and Reimer 2017).

Biological reference points MSY (maximum sustainable yield) and S_{MSY} (the estimate of spawning escapement that produces MSY) represent quantities that maximize yield for the long-term.

We used approximate formulae given by Hilborn (1985) to estimate S_{MSY} for Copper River Chinook salmon:

$$S_{MSY} \approx \frac{\ln(\alpha')}{\beta}\left[0.5 - 0.07\ln(\alpha')\right]. \tag{2}$$

where $\ln(\alpha')$ allows the Ricker spawner-recruit curve to travel through the mean of recruitment data. The same formula (2) was used with standard $\ln(\alpha)$ to estimate S_{MSY} for the UCR and CRD stocks combined.

Analysis was performed using JAGS (Just Another Gibbs Sampler; Plummer 2003), which used Markov Chain Monte Carlo (MCMC) methods to sample from the joint posterior of the parameters and posteriors of MSY and S_{MSY}.

[1] A repository of code used in analysis of escapement goals for Copper River sockeye salmon can be found at https://github.com/hhamazaki/Shiny-Apps

Percentile Approach

Many salmon stocks in PWSMA have an SEG developed using a percentile approach. In 2001 Bue and Hasbrouck[2] (*unpublished*) developed an algorithm using percentiles of observed escapements, whether estimates or indices, that incorporated contrast in the escapement data and assumed exploitation of the stock. Percentile ranking is the percent of escapement values that fall below a particular value. To calculate percentiles, escapement data are ranked from the smallest to the largest value, with the smallest value the 0th percentile (i.e., none of the escapement values are less than the smallest). The percentile of all remaining escapement values is cumulative, or a summation, of 1/(*n*-1), where *n* is the number of escapement values. Contrast in the escapement data is the maximum observed escapement divided by the minimum observed escapement. As contrast in the escapements increases, the percentiles used to estimate the SEG are narrowed, primarily from the upper end, to better utilize the yields from the larger runs.

Clark et al. (2014) evaluated the percentile ranges recommended by Bue and Hasbrouck (*unpublished*) and recommended changes to the approach because the tiers are likely suboptimal as proxies for determining a range of escapements around S_{MSY}. Escapements in the lower 60 to 65 percentiles were found to be optimal across a wide range of productivities and serial correlation and measurement error in escapements (Clark et al. 2014). Based on this information Clark et al. (2014) recommend percentiles with the following 3 tiers for stocks with low to moderate (less than 0.40) average harvest rates:

> Tier 1: high contrast (>8) and high measurement error (aerial and foot surveys) with low to moderate average harvest rates (<0.40), the 20th to 60th percentiles
>
> Tier 2: high contrast (>8) and low measurement error (weirs, towers) with low to moderate average harvest rates (<0.40), the 15th to 65th percentiles
>
> Tier 3: low contrast (8 or less) and high or low measurement error with low to moderate average harvest rates (<0.40), the 5th to 65th percentiles

Use of the percentile approach is not recommended when the average harvest rate is 0.40 or greater, or when escapements have very low contrast (4 or less) and escapement is measured with high measurement error (e.g., aerial or foot surveys).

Yield Approach

A yield approach was used for coho stocks with estimated harvest rates above those recommended for a percentile approach by Clark et al. (2014). Markov yield tables were constructed to evaluate yields at different ranges of escapement. Yield tables are generated by partitioning historical escapement data for each stock into overlapping escapement ranges and calculated the mean, median, and range of yields observed for each escapement interval. This tabular approach describes historical observations of escapement but is not useful for predicting future recruitment patterns and is only recommended for stocks with many years of data (Hilborn and Walters 1992).

[2] Bue, B. G. and J. J. Hasbrouck. Unpublished. Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage. Subsequently referred to as Bue and Hasbrouck (*Unpublished*).

STOCK-SPECIFIC METHODS, RESULTS, AND FINDINGS

For this review, the escapement goal committee recommended no changes to the existing salmon escapement goals in PWSMA and UCUSMA (Table 1). The committee specifically reviewed all of the recent escapements (Table 2) and current methodology to determine whether there was sufficient new information or methodology to warrant an update of the existing goal. Details for these updated analyses and recommendations are provided below. All data sets were updated through 2023 (Tables 1–2 and Appendices A1–A25) and a comprehensive review of goal performance for all salmon stocks from 2014 to 2023 is found in Table 2.

CHINOOK SALMON

Copper River Chinook Salmon

The current SEG range (21,000–31,000) was adopted in 2021 (Joy et al. 2021). The Chinook salmon SEG has been achieved in 6 of the 10 recent years (Table 2, Appendix A2). Since 1999, mark–recapture techniques have been used to estimate inriver abundance, and total drainage escapement was then estimated by subtracting inriver harvest. The 24 escapement estimates exhibit low contrast (4.7), which provides limited information for estimating a spawner-recruit relationship. This escapement goal has been reviewed every BOF cycle since 2002 (Evenson et al. 2008; Fair et al. 2008, 2011; Moffitt et al. 2014). During these reviews, the committee evaluated spawner-recruit data, the percentile approach (Clark et al. 2014), and habitat-based models (Liermann et al. 2010) as a means of setting an escapement goal. The current goal is based on analysis from a state-space model that simultaneously reconstructs runs and fits a spawner-recruit model to estimate total return, escapement, and recruitment of Copper River Chinook salmon from 1980 to 2018 and from 1999 to 2018 (Joy et al. 2021). Both models were considered in selecting the current SEG, which captured S_{MSY} from both analyses and allows for conservative management in times of decreased productivity.

The state-space model was updated using data from 2019 through 2023, and a median estimate of S_{MSY} was produced for each model. The estimate of S_{MSY} using data from 1980–2023 decreased and is now below the current SEG of 21,000–31,000; however, the estimate of S_{MSY} using data from 1999–2023 is within the current escapement goal range (Figure 4). Even though the model is updated every year to obtain a run forecast for the upcoming fishing season, inferences related to the true spawner-recruit relationship and subsequent reference points were uncertain and there is still no basis for estimating the carrying capacity of the population (i.e., the β parameter). Lack of spawner contrast can help explain the uncertainty because the stock has never experienced density-dependence at the level where they completely fail to replace themselves. Even though there is uncertainty about the true spawner-recruit relationship and subsequent reference points, it is still possible to evaluate what levels of escapement will lead to sustained yields. The committee opted not to change the goal because a thorough review was completed last cycle, a thorough review using apportionment data from the Miles Lake sonar program will be completed for the next board cycle, and more data should accumulate before proposing a change to a recently adopted goal that provides for sustainable yields.

The committee findings are for no changes to the SEG range of 21,000 to 31,000 fish for Copper River Chinook salmon.

SOCKEYE SALMON

Upper Copper River and Copper River Delta Sockeye Salmon

The current SEG's for Upper Copper River sockeye (360,000–750,000) and Copper River Delta sockeye salmon (55,000–130,000) were adopted in 2011 using the percentile approach (Bue and Hasbrouck *unpublished*). To evaluate possible changes to the existing goals, the data set for both stocks were updated through return year 2023 and examined using the percentile approach (Clark et al. 2014).

In addition, a Bayesian Ricker spawner-recruit model was updated for the 2 stocks combined. The updated time series used in this analysis include 4 of the highest escapements ever observed for this combined stock, including the first 2 brood years that failed to replace themselves (2012 and 2015). The upriver and delta stocks were combined for this spawner-recruitment analysis because we currently cannot allocate the commercial harvest to specific stock or stock group.

The UCR spawning escapement is estimated from ARIS sonar counts, and the CRD escapements are estimated as the peak counts of aerial surveys for 17 index systems. Spawning escapements were calculated as the combined upriver wild spawners and the delta aerial indices. Prior to the start of the Miles Lake sonar operation in 1978, estimates of upriver escapement were made using mark–recapture methods and expansion of upriver aerial indices. Beginning in 1978, upriver wild spawners were estimated as adjusted Miles Lake sonar total count minus upriver subsistence, personal use, and sport harvests; and the Gulkana Hatchery broodstock and hatchery excess. Therefore, counts were adjusted to approximate sockeye salmon by assuming the same proportion counted by the sonar as occurred in the subsistence and personal use fisheries (1961–1998), or by subtracting the Chinook salmon mark-recapture estimate of inriver abundance (1999–present). Species apportionment at Miles Lake is being reviewed for implementation but is not currently used to adjust counts.

Delta aerial indices were estimated as the peak counts for 17 index systems. Peak counts were adjusted for an observer efficiency of 0.5 (expansion of 2.0) unless otherwise noted. This adjustment was made based on weir and aerial survey count comparisons conducted on a limited number of systems in the late 1970s and early 1980s; however, no documentation of the observer efficiency calculations is available. No adjustments were made for sockeye salmon stream or lake life because no estimates of spawner life are available.

Percentiles

Because separate spawning escapement estimates for each stock grouping are available, the percentile approach can be considered. However, the criteria for when the percentile approach is not recommended include when the harvest rate is ≥0.40 or for stocks with low contrast (4 or less) and high measurement error. Data were updated through 2023 for this review (Table 4). These stocks remain outside the recommendation for the percentile approach: harvest on these stocks remained above 40% on average, contrast in the upper Copper River escapements is 3.8 and contrast in the CRD escapement index is 6.0 with high measurement error.

Spawner-Recruit

A Bayesian Ricker spawner-recruit model was used to analyze Copper River sockeye salmon data for brood years with complete returns (1965–2017), which is an update from the 2014 escapement goal analysis that went through the 2008 brood year (Moffitt et al. 2014). The upriver and delta stocks were combined for this stock recruitment analysis because we currently cannot allocate the commercial harvest to specific stocks or stock groups. Studies of scale growth pattern differences in the 1980s attempted to allocate to area of origin but had low accuracy in some years and were discontinued. Currently there is an ongoing genetic stock identification pilot project for Copper River District commercial sockeye salmon harvest but without historical estimates it cannot be used in escapement goal analysis. Total brood returns were the sum of the combined UCR and expanded CRD escapements, and all harvests summed across all ages of the return.

The updated model produced a median estimate of S_{MSY} (~449,000; Table 3) that is below the combined lower bounds of the current UCR and CRD SEGs (470,000). The updated estimate of S_{MSY} is considerably lower than the estimate of S_{MSY} in the last spawner-recruit model run for this stock (~713,000; Figure 6) and is likely more reliable due to the information provided by the 2012–2015 brood years. The updated optimum yield profile suggests the current combined goal range has a 100% probability of achieving at least 80% of MSY at the lower bound but only a 4% probability of achieving at least 80% of MSY at the upper bound of the range (Figure 5). Despite the updated combined spawner-recruit model suggesting that the combined EG range is too high, the escapement goal review committee was uncomfortable with combining the stocks for analysis and how to split the combined goal into 2 distinct goals for management purposes. The department will continue to explore a spawner-recruit model for the combined stock but note that our current goals have produced sustained yields. No changes are recommended.

The committee findings are for no changes to the current SEG range of 360,000–750,000 fish for the UCR stock and 55,000–130,000 fish for the CRD stock.

Bering River Sockeye Salmon

The current SEG (15,000–24,000) for Bering River sockeye salmon was adopted in 2021 (Joy et al. 2021) and was developed using the percentile approach. There is high contrast (12.8) in the escapement data, with a moderate average harvest rate and high measurement error (aerial surveys), resulting in a Tier 1 percentile recommendation (20th and 60th percentiles). Escapements observed in the past 3 years were within the range of past observations and provided no new information to warrant re-evaluation of the current escapement goal; however, the committee discussed how the increasingly frequent glacial outburst floods from the drainage of Berg Lake may affect sedimentation of spawning areas and spawning success in the future.

The committee findings are for no changes to the SEG range of 15,000–24,000 fish for Bering River sockeye salmon.

Coghill Lake Sockeye Salmon

The current SEG (20,000–75,000) for Coghill Lake sockeye salmon was adopted in 2021 (Joy et al. 2021) using a Bayesian Ricker spawner-recruit model. There is evidence that multiple years of high spawning escapements into Coghill Lake may result in density-dependent effects including depleted zooplankton abundances for rearing juvenile sockeye salmon (Edmundson et al. 1997; Koenings and Kyle 1997), and therefore it was suggested that consecutive escapements at the upper end of the goal be avoided. Escapements observed in the past 3 years were within the range of past observations and provided no new information to warrant updating of the current escapement goal.

The committee findings are for no changes to the SEG range of 20,000–75,000 fish for Coghill Lake sockeye salmon.

Eshamy Lake Sockeye Salmon

The current BEG (13,000–28,000) for Eshamy Lake sockeye salmon was adopted in 2008 (Fair et al. 2008) and was derived from the Ricker spawner-recruit model. Escapements within the range of the current goal were determined to have a probability greater than 50% of producing returns of at least 90% of MSY. The Eshamy River weir, operated since the 1930s, was discontinued in 2012 due to budget reductions. A video weir was operated between 2013–2017 but has only enumerated a portion of the escapement believed to enter Eshamy Lake. The picket weir was operated in 2022–2024. The additional escapement data is not continuous enough to provide complete brood year returns to warrant updating the current escapement goal.

The committee findings are for no changes to the BEG range of 13,000–28,000 fish for Eshamy Lake sockeye salmon.

CHUM SALMON

Escapement goals for PWS wild chum salmon stocks are based on counts from aerial surveys dating back to the 1960s. Prior to 2015, approximately 214 index streams were flown multiple times each year to index escapement using AUC calculations adjusted for an estimate of stream life (Fried et al. 1998; Bue et al. 1998). In 2015, due to budget cuts, a reduced subset of 134 streams were selected from across PWS (Figure 2) based on these streams having a high proportion of the overall escapement for pink and chum salmon (Morella and Scannell 2024).

In 2017, based on recommendations from the percentile approach, for escapements with high measurement error, such as those assessed using aerial surveys, and low to moderate harvest rates, we classified all 5 PWS chum salmon escapement goals as Tier 1 and used the 20th and 60th percentiles to inform the goals for all districts. The decision to use Tier 1 percentiles was also supported by contrast in escapements being classified as “high” (>8) for all but the Northern District, for which contrast was approximately 7.6. Due to high measurement error, lack of evidence that maximum yield can be easily attained given the complicated nature of management in this mixed-stock fishery, an unknown proportion of stray hatchery fish counted in aerial surveys, and lack of evidence that larger escapements have reduced productivity, all PWS chum salmon goals are lower-bound SEGs at the 20th percentiles, implemented in 2018.

There has been substantial variation in chum salmon counts for several decades for a variety of reasons, including high abundances of pink salmon in the streams obscuring chum salmon observations during aerial surveys, too few surveys being conducted, and multiple area management biologists throughout the years employing different methods of enumerating chum salmon. For this review, a thorough examination of aerial survey data was conducted. Difficulties enumerating chum salmon in streams that are overwhelmingly dominated by pink salmon have been recorded since the inception of this survey program, but the approach to address this has not been consistent through time. Some observers have applied a fixed percentage of overall escapement in streams to estimate chum salmon counts, which inflated historical chum salmon counts used in past goal development. This method is no longer used but these counts remain part of the historical escapement estimates. Additionally, since budget cuts in 2015, fewer surveys have been flown per district per year, which have likely biased escapement estimates low. These challenges are not unique to PWS and the department will continue to explore improved methods for chum salmon assessment and escapement estimation.

The committee findings are for no changes to the current lower-bound SEGs for the 5 PWS chum goals.

COHO SALMON

Bering River District and Copper River Delta Coho Salmon

Both the Bering River District and Copper River Delta escapement goals for coho salmon were adopted in 2021 (Joy et al. 2021) and were developed using Markov yield tables. These stocks have high contrast in escapements and average harvest rates likely greater than 0.40 coupled with high measurement error (aerial surveys), and therefore the percentile approach (previous approach) was not recommended. Escapements observed in the past 3 years for both stocks were within the range of past observations and provided no new information to warrant re-evaluation of current escapement goals.

The committee findings are for no changes to the Bering River District coho salmon SEG range of 13,000–22,000 fish and the Copper River District coho salmon SEG range of 32,000–50,000 fish.

PINK SALMON

Even and Odd Years

Escapement goals for PWS wild pink salmon stocks are based on counts from aerial surveys dating back to the 1960s. Prior to 2012, PWS had area-wide escapement goals for the even- and odd-year runs based on 214 aerial index streams that were flown multiple times each year to index escapement using AUC calculations adjusted for an estimate of stream life (Morella and Scannell 2024; Fried et al. 1998; Bue et al. 1998). In 2012, the escapement goals were converted to district-specific goals using the percentile approach (Bue and Hasbrouck *unpublished*) because inseason escapements assessment and management was by district and not by returns to the entire sound.

In 2015, due to budget cuts, a reduced subset of 134 streams were selected from across PWS (Figure 2) based on these streams having a high proportion of the overall escapement for pink and chum salmon. In 2017, based on recommendations from Clark et al. (2014) SEGs with a lower bound at the 20th percentile and an upper bound at the 60th percentile were adopted for even brood year pink salmon, and SEGs with a lower bound at the 25th percentile and an upper bound at the 75th percentile were adopted for odd brood year pink salmon. For this review the data set was updated through 2023. Escapements observed in the past 3 years were within the range of past observations and therefore have not changed the contrast for this stock or warranted re-evaluation of the current escapement goals.

The committee findings are for no changes to the current even and odd broodline PWS pink salmon escapement goal ranges.

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TABLES

Table 1.–Summary of escapement goals for Prince William Sound Management Area salmon stocks, 2024.

System	Current escapement goal			Data	Action
	Goal	Type	Year adopted		
Chinook salmon					
Copper River	21,000–31,000	SEG	2022	Mark-recapture	No change
Sockeye salmon					
Upper Copper River	360,000–750,000	SEG	2012	Sonar	No change
Copper River Delta	55,000–130,000	SEG	2003	Aerial surveys	No change
Bering River	15,000–24,000	SEG	2022	Aerial surveys	No change
Coghill Lake	20,000–75,000	SEG	2022	Weir	No change
Eshamy Lake	13,000–28,000	BEG	2009	Weir	No change
Coho salmon					
Copper River Delta	32,000–50,000	SEG	2022	Aerial surveys	No change
Bering River	13,000–25,000	SEG	2022	Aerial surveys	No change
Chum salmon					
Eastern District	79,000	LB SEG	2018	Aerial surveys	No change
Northern District	28,000	LB SEG	2018	Aerial surveys	No change
Coghill District	10,000	LB SEG	2018	Aerial surveys	No change
Northwestern District	7,000	LB SEG	2018	Aerial surveys	No change
Southeastern District	11,000	LB SEG	2018	Aerial surveys	No change
Pink salmon					
Eastern District (even year)	203,000–328,000	SEG	2018	Aerial surveys	No change
Eastern District (odd year)	346,000–863,000	SEG	2018	Aerial surveys	No change
Northern District (even year)	96,000–127,000	SEG	2018	Aerial surveys	No change
Northern District (odd year)	111,000–208,000	SEG	2018	Aerial surveys	No change
Coghill District (even year)	37,000–110,000	SEG	2018	Aerial surveys	No change
Coghill District (odd year)	54,000–233,000	SEG	2018	Aerial surveys	No change
Northwestern District (even year)	52,000–93,000	SEG	2018	Aerial surveys	No change
Northwestern District (odd year)	64,000–144,000	SEG	2018	Aerial surveys	No change
Eshamy District (even year)	1,000–4,000	SEG	2018	Aerial surveys	No change
Eshamy District (odd year)	5,000–31,000	SEG	2018	Aerial surveys	No change
Southwestern District (even year)	62,000–105,000	SEG	2018	Aerial surveys	No change
Southwestern District (odd year)	112,000–231,000	SEG	2018	Aerial surveys	No change
Montague District (even year)	36,000–72,000	SEG	2018	Aerial surveys	No change
Montague District (odd year)	143,000–330,000	SEG	2018	Aerial surveys	No change
Southeastern District (even year)	88,000–153,000	SEG	2018	Aerial surveys	No change
Southeastern District (odd year)	286,000–515,000	SEG	2018	Aerial surveys	No change

Table 2.–Current escapement goals compared to escapements observed from 2014 through 2023 for salmon stocks of the Prince William Sound Management Area. Shaded cells indicate spawning escapement was below the lower-bound of the escapement goal in place at the time.

	2024 goal range			Initial	Escapement									
System	Lower	Upper	Type	year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
CHINOOK SALMON														
Copper River	21,000	31,000	SEG	2022	20,709	26,764	12,485	33,655	42,202	35,145	21,587	18,431	32,006	40,102[a]
CHUM SALMON														
Eastern District	79,000		LB SEG	2018	90,445	104,437	116,685	76,836	109,598	56,846	103,849	58,965	64,365	157,274
Northern District	28,000		LB SEG	2018	27,385	41,253	10,410	33,437	18,407	11,690	23,542	20,404	26,014	55,482
Coghill District	10,000		LB SEG	2018	9,491	14,929	976	13,210	13,617	3,437	8,998	2,395	8,629	6,250
Northwestern District	7,000		LB SEG	2018	5,041	7,060	3,954	7,118	15,563	3,258	7,405	6,979	13,372	738[b]
Southeastern District	11,000		LB SEG	2018	29,362	44,095	13,919	26,330	10,164	19,451	26,909	46,391	12,944	7,791
COHO SALMON														
Copper River Delta	32,000	50,000	SEG	2022	44,040	42,065	76,200	43,760	53,800	36,420	36,445	45,485	30,340	44,440
Bering River	13,000	25,000	SEG	2022	26,475	15,550	26,150	30,650	26,525	10,015	25,825	19,450	4,685	20,950
PINK SALMON														
Eastern District (even year)	203,000	328,000	SEG	2018	250,381		594,778		309,325		206,152		353,187	
Eastern District (odd year)	346,000	863,000	SEG	2018		1,440,254		557,545		445,075		729,369		650,740
Northern District (even year)	96,000	127,000	SEG	2018	95,134		133,460		111,174		105,226		161,748	
Northern District (odd year)	111,000	208,000	SEG	2018		708,920		395,437		195,169		464,350		299,845
Coghill District (even year)	37,000	110,000	SEG	2018	60,921		63,986		70,881		88,401		73,971	
Coghill District (odd year)	54,000	233,000	SEG	2018		775,488		181,153		153,129		300,227		169,737
Northwestern District (even)	52,000	93,000	SEG	2018	66,350		168,272		111,194		77,828		292,892	
Northwestern District (odd)	64,000	144,000	SEG	2018		438,944		250,989		91,267		368,406		312,060
Eshamy District (even year)	1,000	4,000	SEG	2018	12,167		NA		16,594		7,250		14,937	
Eshamy District (odd year)	5,000	31,000	SEG	2018		68,988		2,836		1,402		17,925		12,756
Southwestern District (even)	62,000	105,000	SEG	2018	73,104		NA		81,100		64,470		200,057	
Southwestern District (odd)	112,000	231,000	SEG	2018		644,158		172,930		33,340		339,920		134,089
Montague District (even)	36,000	72,000	SEG	2018	23,136		NA		135,208		84,238		143,917	
Montague District (odd year)	143,000	330,000	SEG	2018		559,994		205,252		25,385		242,151		177,472

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Table 2.–Page 2 of 2.

System	2024 goal range		Type	Initial	Escapement									
	Lower	Upper		year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Southeastern District (even year)	88,000	153,000	SEG	2018	141,845		107,769		293,275		138,330		137,692	
Southeastern District (odd year)	286,000	515,000	SEG	2018		1,529,543		372,960		290,452		544,906		183,087
SOCKEYE SALMON														
Upper Copper River	360,000	750,000	SEG	2012	864,958	930,061	513,546	465,539	478,701	721,033	362,445	511,274	521,313	694,007
Copper River Delta	55,000	130,000	SEG	2003	64,205	66,665	51,550	56,950	58,470	61,825	55,620	87,075	55,075	65,775
Bering River	15,000	24,000	SEG	2022	15,385	22,705	16,390	19,115	13,300	17,630	15,795	13,774	7,095	19,125
Coghill Lake	20,000	75,000	SEG	2022	21,836	13,684	8,708	50,462	62,295	32,247	53,901	101,083	34,092[b]	64,212
Eshamy Lake	13,000	28,000	BEG	2009	NS	NS	NS	NS	NS	NS	NS	7,001[b]	19,325	11,194

Note: BEG = biological escapement goal; SEG = sustainable escapement goal; LB SEG = lower-bound SEG; NA = data not available; NS = no survey.

[a] Preliminary data.

[b] Incomplete survey or weir count.

Table 3.–Ricker spawner-recruit model estimates from Copper River sockeye salmon from brood years 1965–2017.

	Current analysis		
Parameter	5%	Median	95%
α	4.735	6.762	10.006
ln α	1.555	1.911	2.303
β	0.103	0.155	0.214
σ	0.258	0.504	0.742
S_{EQ}	1,017,477	1,232,275	1,575,580
S_{MSY}	355,323	449,235	604,279
U_{MSY}	0.608	0.700	0.876

Table 4.–Copper River Sockeye salmon escapement percentiles by stock.

	Upper Copper River	Copper River Delta
Minimum	251,903	27,993
15th Percentile	381,000	55,000
25th Percentile	406,000	58,000
75th Percentile	546,000	87,000
85th Percentile	655,000	99,000
Maximum	954,010	168,840
Contrast	3.8	6.0
Assessment method	Sonar	Aerial Surveys
Measurement error	Moderate	High

FIGURES

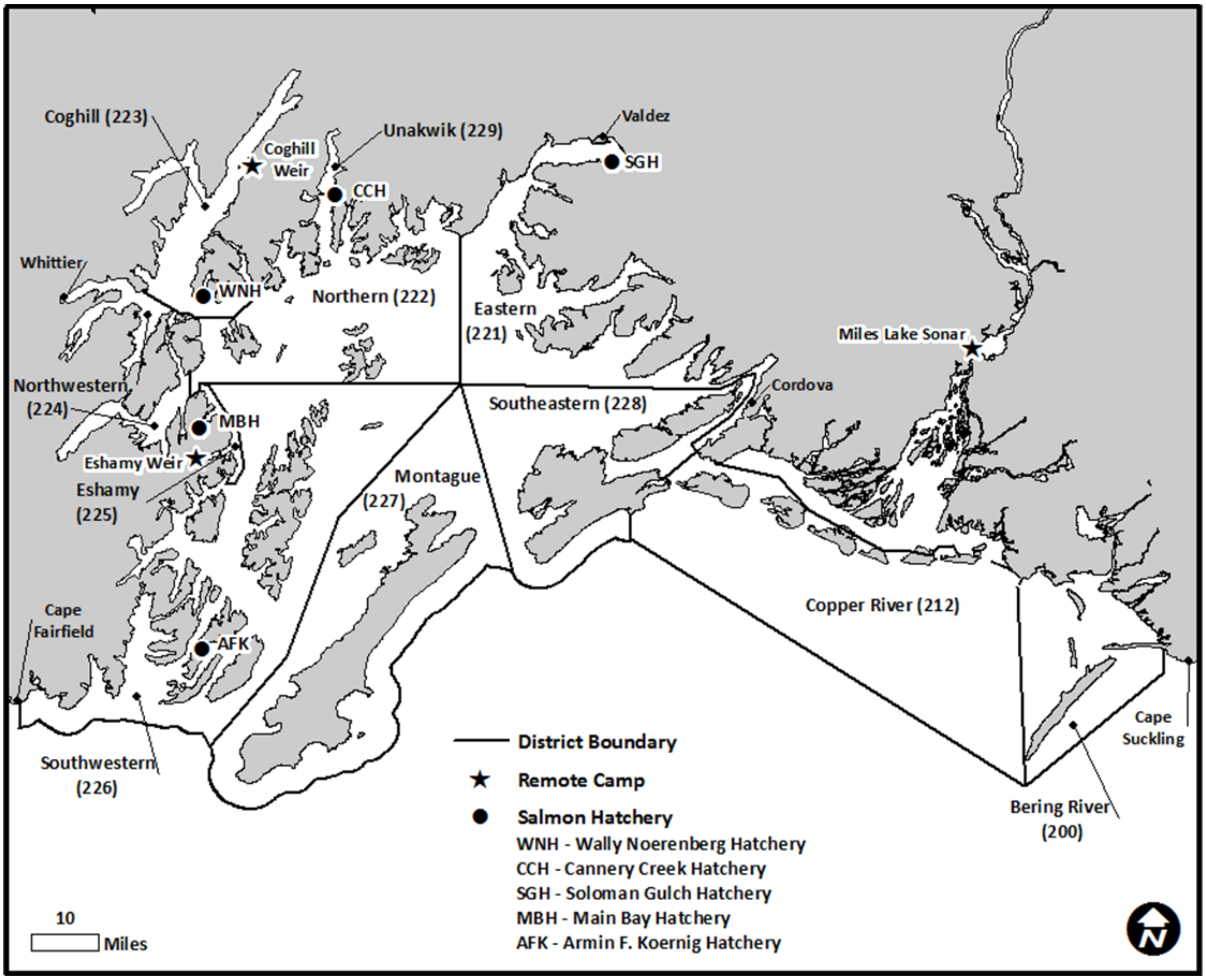


Figure 1.–Prince William Sound Management Area showing commercial fishing districts, salmon hatcheries, weir locations, and Miles Lake sonar camp.

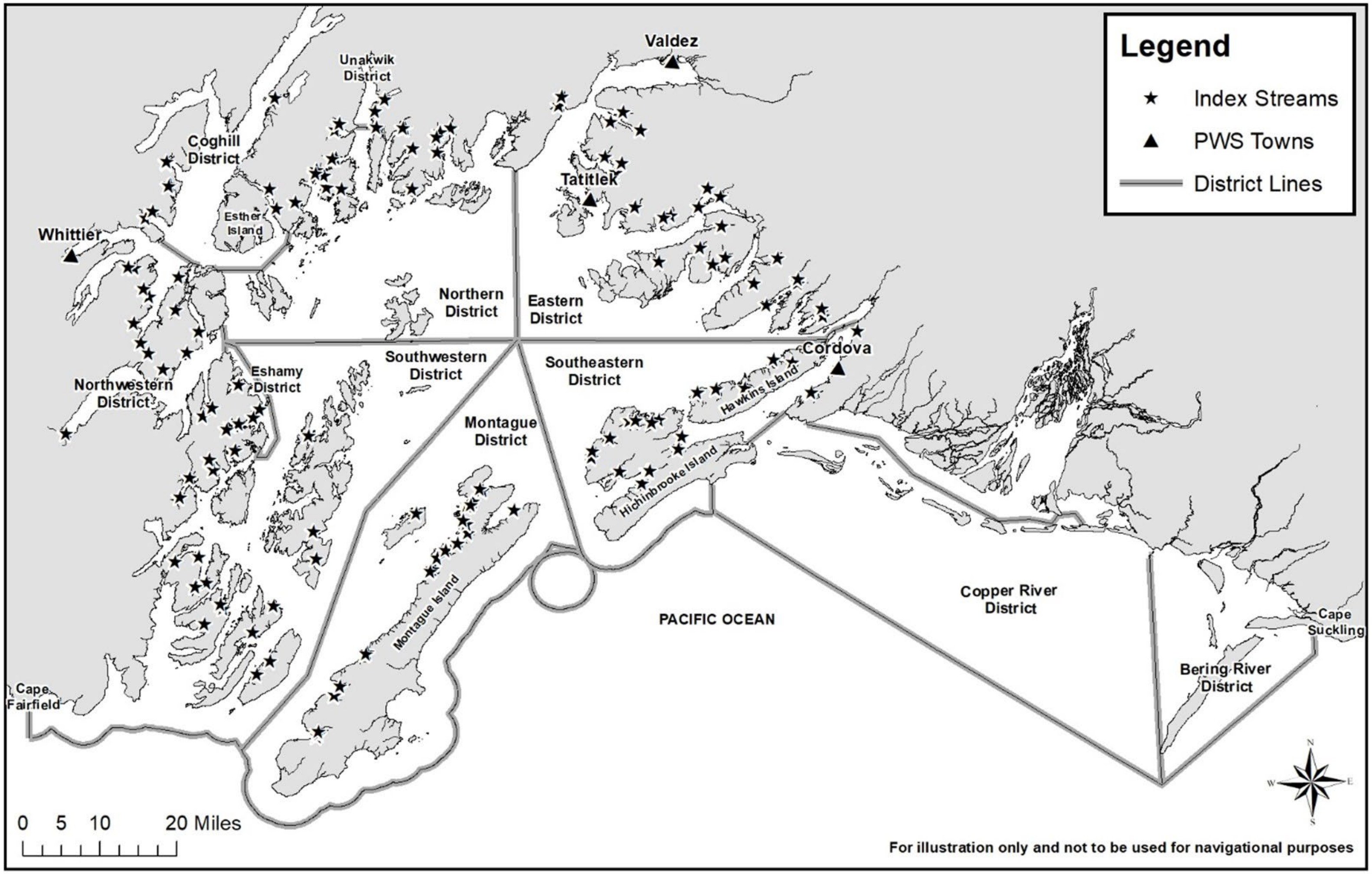


Figure 2.–Locations of pink and chum salmon index streams in Prince William Sound.

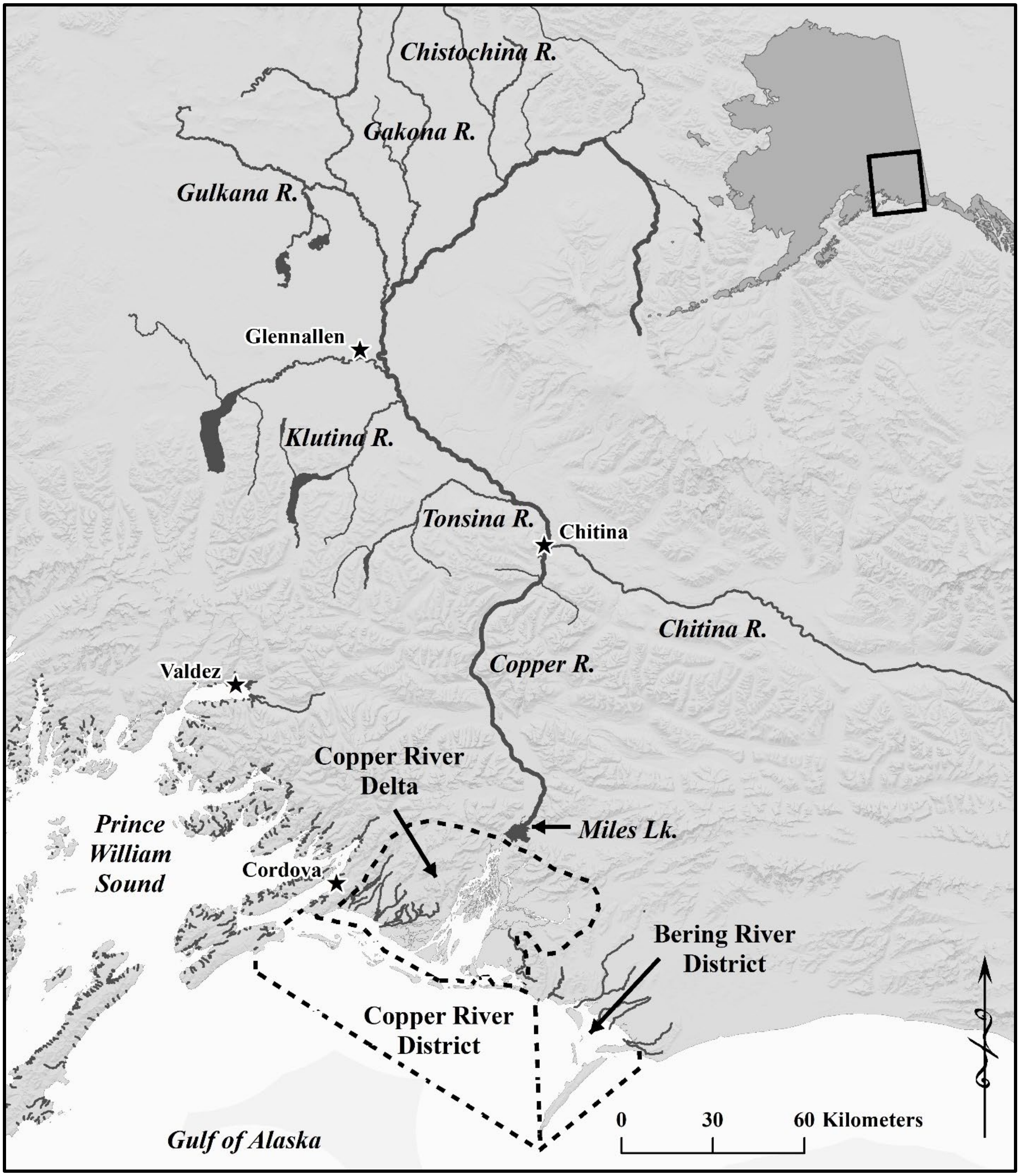


Figure 3.–Copper and Bering River drainages showing commercial fishing districts, Copper River delta, and Upper Copper River (above Miles Lake sonar site).

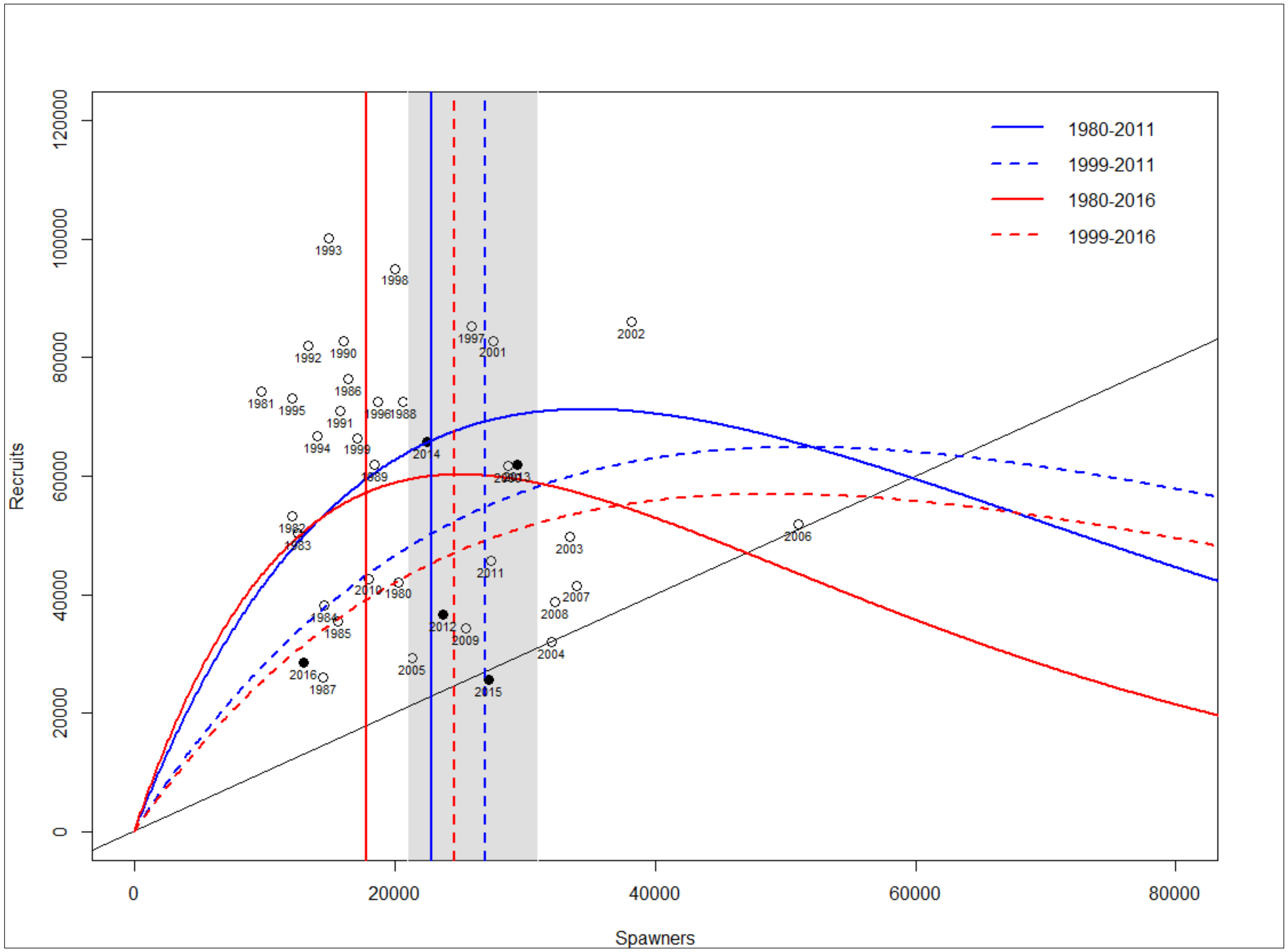


Figure 4.–Changes to S_{MSY} and Ricker spawner-recruit curves for Copper River Chinook salmon. Blue solid and dashed lines show the Ricker curves and S_{MSY} estimates from complete brood year returns from 1980–2011 and 1999–2011, which is how the current SEG was established. Red solid and dashed lines show the Ricker curves and S_{MSY} estimates from complete brood year returns from 1980–2016 and 1999–2016. Spawner-recruit pairs added since the last review are filled black circles. The grey shaded area represents the current escapement goal range.

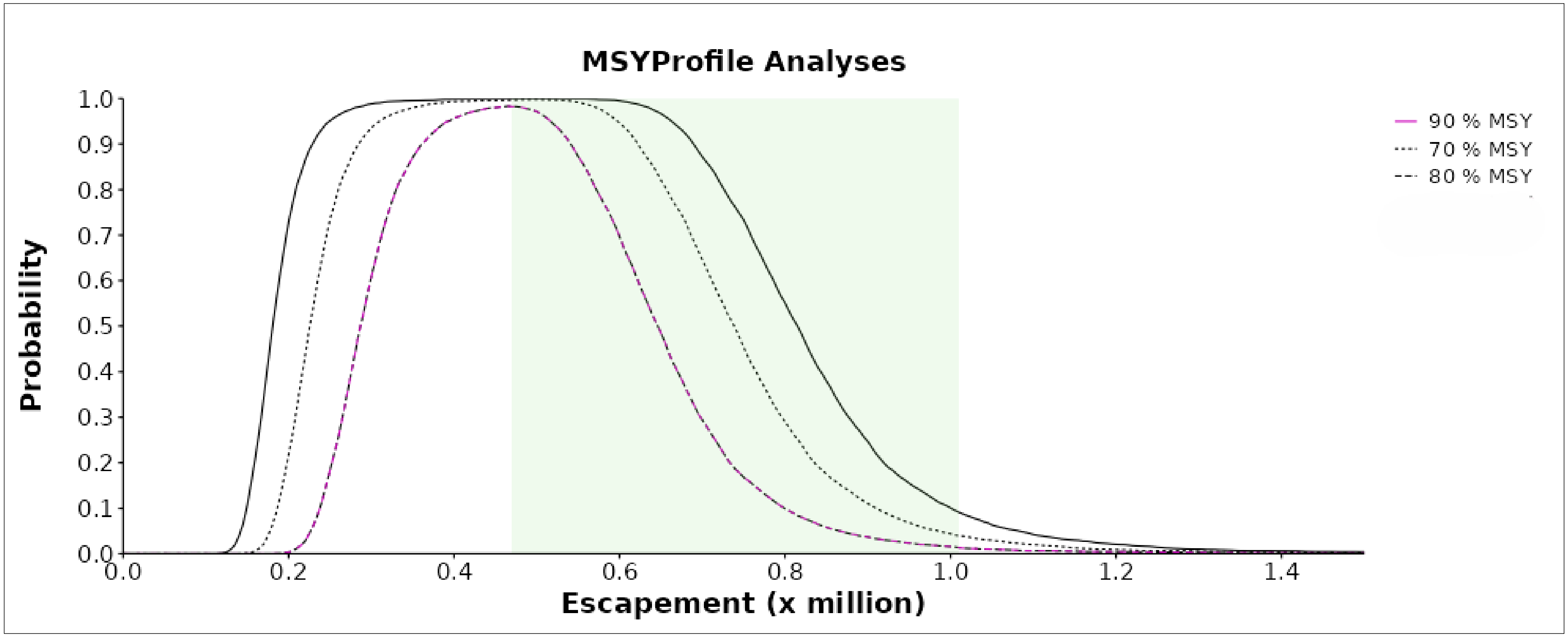


Figure 5.–Optimal yield profiles for Upper Copper River and Copper River Delta combined sockeye salmon.

Note: OYPs show probability that a specified spawning abundance will result in specified fractions (70%, 80%, and 90% line) of maximum sustained yield. The shaded range represents the current combined escapement goal range.

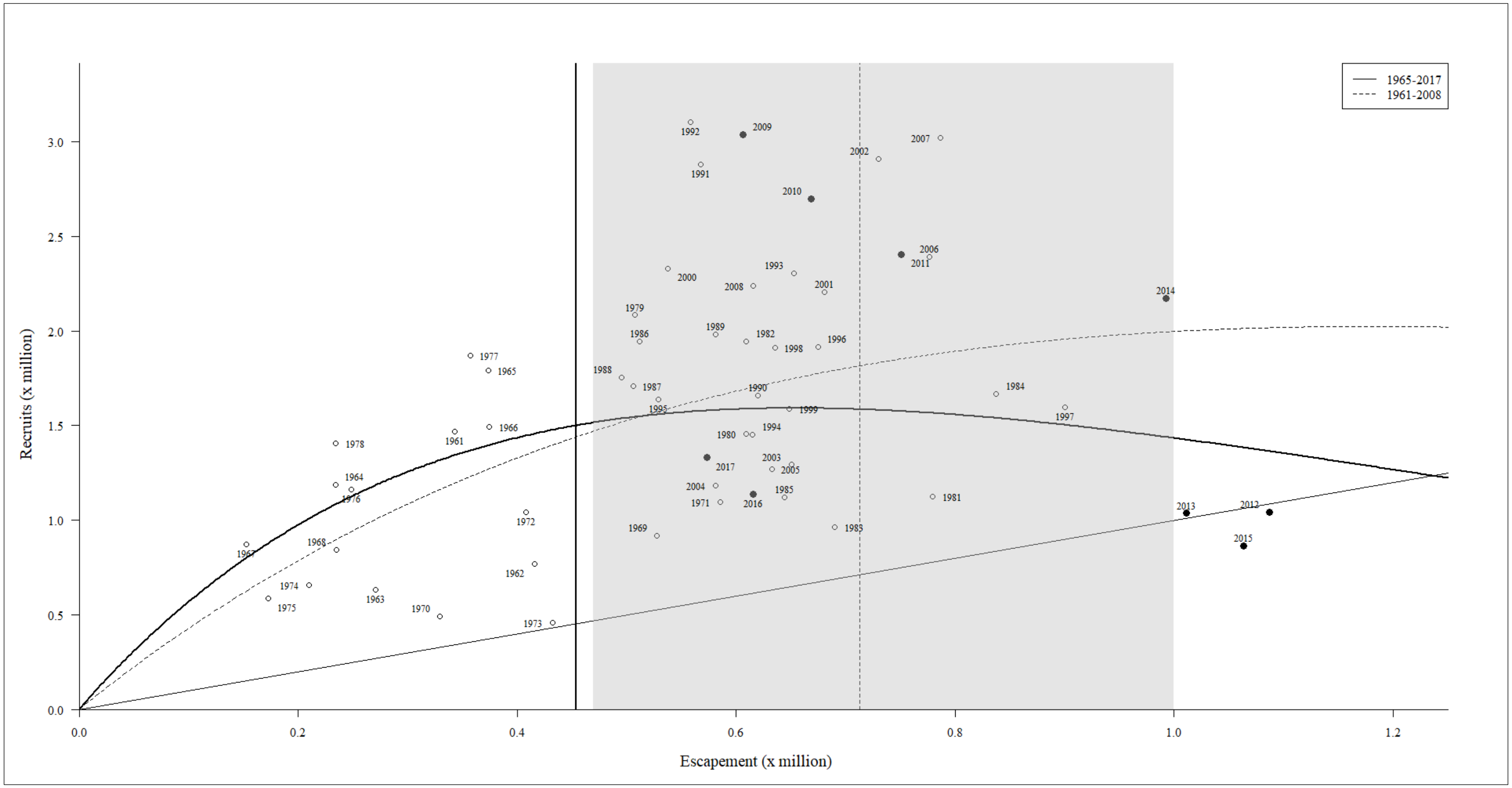


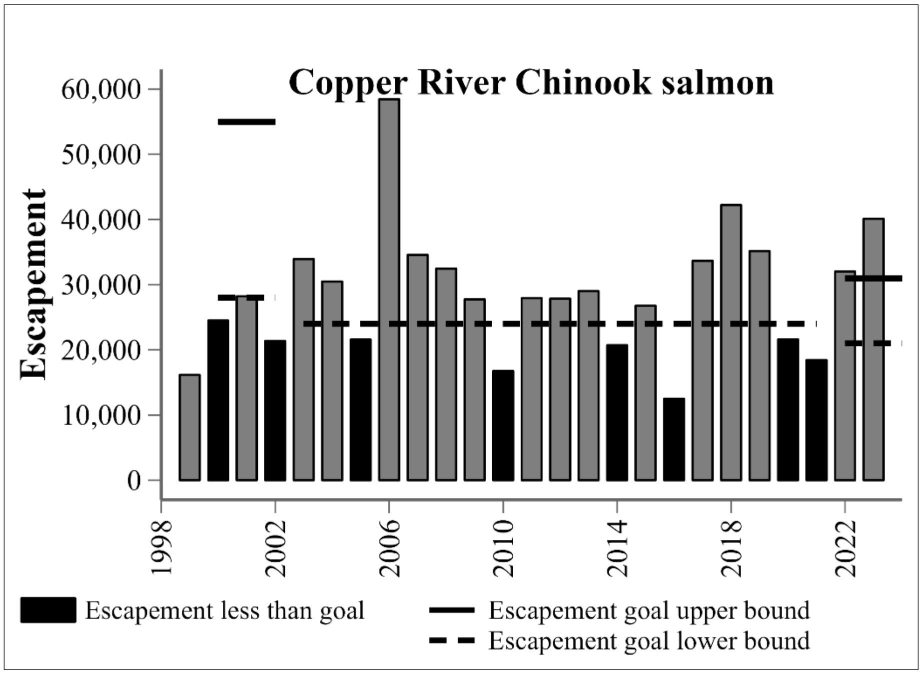
Figure 6.–Changes to S_{MSY} and Ricker spawner-recruit curve for Copper River sockeye salmon. Solid lines show the current estimates for the Ricker Curve and S_{MSY} using data from 1965–2023 (complete brood years 1965–2017). Dashed lines show estimates for the Ricker Curve and S_{MSY} using data from 1961–2014 (complete brood years 1961–2008) from the 2014 escapement goal review. Spawner-recruit pairs added since the last review are filled black circles. The gray shaded area represents the current combined escapement goal range.

APPENDIX A: SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR SALMON STOCKS IN THE COPPER RIVER, BERING RIVER, AND PRINCE WILLIAM SOUND AREAS

Appendix A1.–Description of stock and escapement goal for Copper River Chinook salmon.

Stream Location:	Prince William Sound Management Area; stream 212-20-10080
Fishery:	Commercial, Subsistence, Personal Use and Sport
Current escapement goal:	Drainagewide SEG: 21,000–31,000 (2022)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type	Sonar, mark–recapture, aerial survey index, tower counts
Data available:	
Counts:	Miles Lake sonar counts (1984–present). Estimates of inriver abundance and associated uncertainty (CVs) from mark–recapture (1999–present). Gulkana River aerial counts (1984–present). Gulkana River counting tower escapement estimates and associated uncertainty (CVs) (2002–2018). Estimated total annual harvest and associated uncertainty (CVs) from above Miles Lake sonar (1980–present). Estimated total annual harvest and associated uncertainty (CVs) from below Miles Lake sonar (1980–present). Genetic stock identification estimates (2005–2008, 2013–2017).
Age composition:	Age-composition estimates from the commercial harvest (1965–present). Age-composition estimates from the personal use and subsistence harvest (1992–present).
Stock-specific harvest:	None
Data contrast:	Copper River Chinook escapement data sets <4
Methodology:	Age-structured state-space spawner-recruit model
Criteria for updated goal	None
Goal history:	The age-structured state-space model approach was used in 2021 and a new SEG of 21,00–31,000 was implemented in 2022. In 2017, a state-space model was implemented and a change to the SEG (18,500–33,000) was recommended but ultimately not adopted after stakeholder concerns and the SEG remained at 24,000. In 2002, a catch–age model (1980–2000) was used and a new goal of 24,000 (LB) was adopted to keep escapements near the historical average (25,800). In subsequent reviews, the percentile approach and habitat-based models were explored with no change to the established SEG. The Copper River Chinook salmon SEG of 28,0000–55,000 was established in 1999. A BEG of 15,000 (lb) Chinook salmon was adopted in 1972.
Comments:	

Appendix A2.–Copper River Chinook salmon escapement and escapement goals, 1998–2023.



Appendix A3.–Supporting information for analysis of escapement goal for Copper River Chinook salmon.

System: Copper River
Species: Chinook salmon
Data available for analysis of escapement goals.

Brood year	Measured escapement[a]	Total run
1999	16,157	95,951
2000	24,492	70,754
2001	28,208	81,139
2002	21,354	72,974
2003	33,919	94,555
2004	30,473	80,405
2005	21,556	66,080
2006	58,425	99,639
2007	34,562	87,678
2008	32,453	53,838
2009	27,749	42,996
2010	16,746	33,181
2011	27,936	53,889
2012	27,846	44,312
2013	29,013	42,880
2014	20,709	35,322
2015	26,764	56,174
2016	12,485	29,243
2017	33,655	56,131
2018	42,202	61,623
2019	35,145	64,443
2020	21,587	33,069
2021	18,431	30,087
2022	32,006	52,176
2023	40,102	61,534

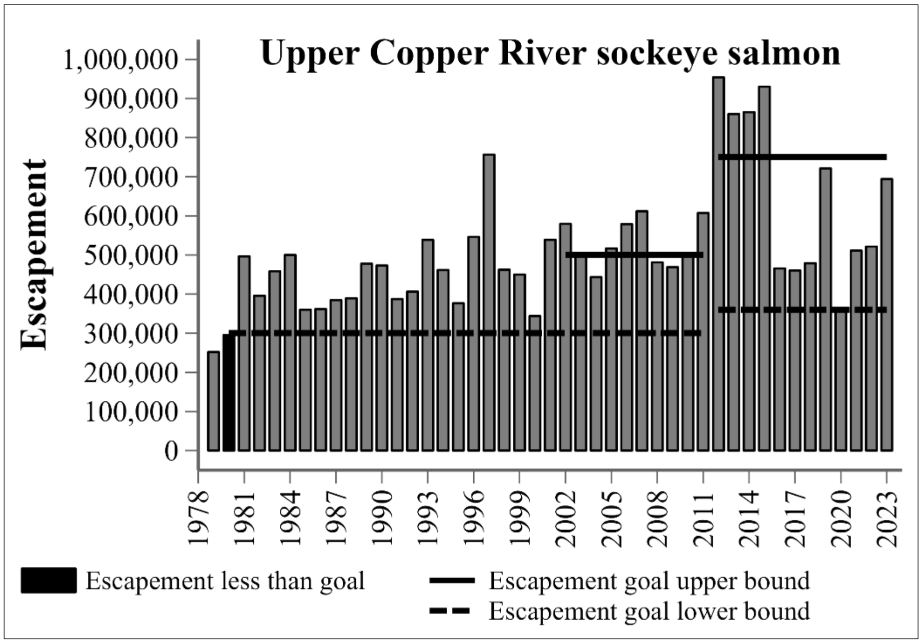
Note: Current SEG is 21,000–31,000.

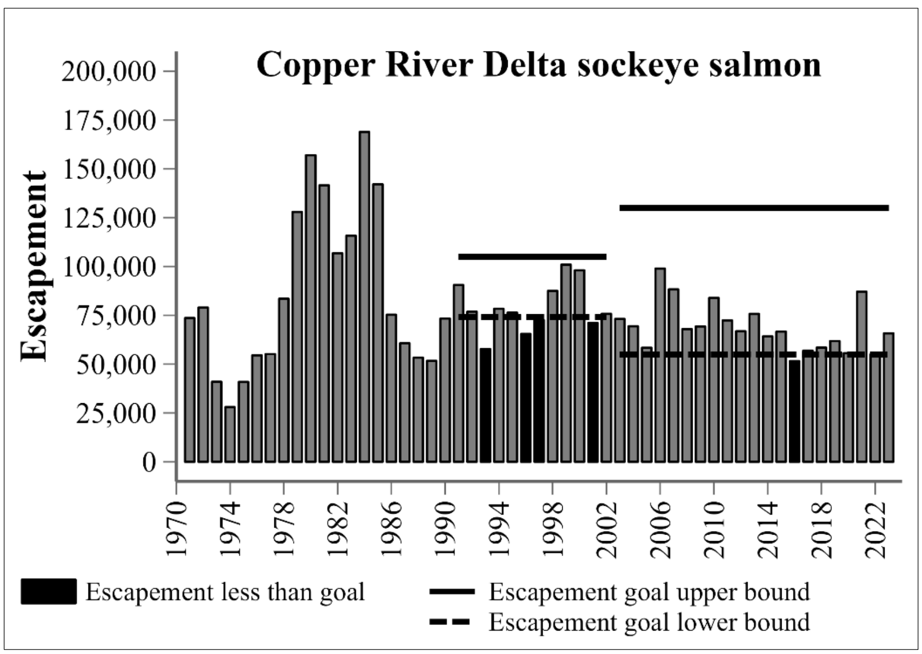
[a] Estimated by mark–recapture minus upriver harvests.

Appendix A4.–Description of stock and escapement goal for Copper River sockeye salmon.

Stream Location:	Prince William Sound Management Area; stream 212-20-10080
Fishery:	Commercial, Subsistence, Personal Use and Sport
Current escapement goal:	Upper Copper River (UCR) SEG: 360,000–750,000 (2011)
	Copper River Delta (CRD) SEG: 55,000–130,000 (2002)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	Varies annually
SOC status (type and year):	None
Escapement enumeration type	UCR: Adaptive resolution imaging sonar, CRD: Peak aerial survey index
Data available:	
Counts:	
Upper Copper River	Mark–recapture methods with expansion of upriver aerial survey indices (1965–1977). Sonar without species apportionment for Chinook and sockeye salmon passage (1978–present). Counts of sockeye salmon apportioned from proportion of sockeye harvested in the subsistence and personal use fisheries (1978–1998), and subtraction of Chinook salmon mark–recapture estimate of in river abundance (1999–present).
Copper River Delta	Aerial indices as peak counts for 17 index systems. Peak counts adjusted for an observer efficiency of 0.5 (expansion of 2.0). Expansion rate is based on weir and aerial survey count comparisons of a limited number of systems 1974–1986. No documentation of observer efficiency calculation is available.
Age composition:	Copper River delta escapement 1965–present; Copper River commercial harvest 1965–present; Upper Copper River personal use and subsistence harvest 2016–present.
Stock-specific harvest:	None
Data contrast:	Upper Copper River 3.8 (1979–2023) Copper River Delta 6.0 (1971–2023)
Methodology:	Percentile approach (Bue and Hasbrouck, *unpub.*)
Criteria for updated goal	None
Goal History:	UCR and CRD SEG established in 2002 using percentile approach (UCR:300,000–500,0000, CRD: 55,000–130,000). UCR SEG updated to 360,000–750,000 in 2011, with 1979–2010 escapement data. CRD: 1991–2002: 74,000–105,000 UCR: 1979–2002: LB 300,000
Comments:	Percentile approach is not recommended for harvests ≥40% with low contrast (<4), UCR escapement stocks meet these criteria. Bayesian Ricker spawner-recruit model used to analyze combined catch and escapement data (commercial harvest data cannot be apportioned to stock) is being explored. Goal excludes 1978 sonar counts from first year of sonar use on the Copper River.

Appendix A5.–Upper Copper River 1978–2012 (above) and Copper River Delta 1970–2023 (below) sockeye salmon escapement and escapement goals.





Appendix A6.–Supporting information for analysis of escapement goal for Copper River sockeye salmon.

			Harvest			
Year	UCR Escapement [a]	Adjusted CRD Escapement	Wild Commercial	UCR Sport	UCR Sub/PU	CRD Sub
1979	251,903	255,800	79,628	1,599	33,096	26
1980	295,346	313,900	18,558	2,109	31,041	27
1981	496,244	283,100	474,062	1,523	67,897	145
1982	395,719	213,540	1,174,032	3,343	108,611	634
1983	458,405	231,500	620,135	2,619	116,988	107
1984	499,792	337,680	894,725	3,267	76,177	324
1985	359,971	284,100	895,598	4,752	61,551	261
1986	361,591	150,590	749,795	4,137	68,495	348
1987	384,603	121,396	1,133,273	4,876	76,620	359
1988	389,150	106,630	484,654	3,038	71,525	226
1989	477,667	103,400	850,358	4,509	84,138	339
1990	472,978	146,690	779,861	3,569	98,197	469
1991	387,196	181,000	1,104,802	5,511	117,189	830
1992	406,255	153,654	883,818	4,560	131,956	785
1993	538,602	115,440	1,248,390	5,288	146,884	428
1994	461,315	156,740	1,057,564	6,533	163,299	474
1995	376,565	152,740	1,123,978	6,068	131,538	692
1996	546,131	130,940	2,029,032	11,851	147,059	969
1997	756,179	145,125	2,675,630	12,293	231,961	1,001
1998	462,396	175,000	812,561	11,184	202,206	850
1999	449,892	201,850	734,627	11,101	219,082	1,330
2000	343,691	196,090	512,817	12,361	167,353	4,360
2001	538,681	142,130	1,127,251	8,169	215,957	3,072
2002	579,598	151,470	910,966	7,761	147,670	3,067
2003	505,008	146,300	1,028,868	7,108	145,187	1,607
2004	443,340	138,770	980,091	6,464	181,741	1,822
2005	516,555	116,812	1,234,770	8,135	208,603	830
2006	578,720	197,792	1,268,973	14,297	200,866	4,355
2007	611,648	176,570	1,800,234	23,028	209,492	6,148
2008	481,167	135,900	299,207	11,431	139,950	3,969
2009	468,819	138,584	833,154	13,415	151,434	1,764
2010	502,445	167,810	412,828	14,743	225,667	1,980
2011	607,140	144,734	1,558,858	7,727	205,360	1,783
2012	954,010	133,700	1,516,771	23,404	220,850	4,270
2013	860,253	151,410	1,254,143	26,711	273,703	5,639
2014	864,958	128,410	1,679,370	18,005	257,414	1,675
2015	930,061	133,330	1,583,601	9,489	334,121	1,403
2016	465,539	103,100	1,000,670	7,555	232,142	1,075

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			Harvest			
Year	UCR Escapement [a]	Adjusted CRD Escapement	Wild Commercial	UCR Sport	UCR Sub/PU	CRD Sub
2017	460,295	113,900	547,167	9,589	190,404	2,448
2018	478,701	116,940	40,349	2,943	136,635	5,189
2019	721,033	123,650	1,210,566	9,379	251,800	6,163
2020	362,445	111,240	87,325	3,896	127,239	7,091
2021	511,274	174,150	349,411	6,907	206,201	5,338
2022	521,313	110,150	581,092	5,871	218,461	5,828
2023	694,007	131,550	803,812	3,658	237,334	6,326

Appendix A7.–Supporting information for analysis of escapement goal for Copper River sockeye salmon, combined Upper Copper River and Copper River Delta brood table.

Year	Spawners	Recruits	age-2	age-3	age-4	age-5	age-6	age-7
1958	–	–	–	–	–	–	–	0
1959	–	–	–	–	–	–	226,785	0
1960	–	–	–	–	–	728,101	49,096	0
1961	–	–	–	–	251,849	1,199,355	14,972	0
1962	–	–	–	0	151,498	570,532	30,654	0
1963	–	620,328	0	4,208	101,829	503,556	10,585	151
1964	–	1,187,843	0	429	297,079	859,314	30,777	243
1965	373,563	1,790,511	0	2,207	386,756	1,152,419	245,735	3,394
1966	374,673	1,492,946	0	1,000	306,495	901,096	284,355	0
1967	152,518	870,450	0	1,840	99,888	717,245	51,477	0
1968	234,702	844,271	0	3,685	163,455	607,383	69,597	150
1969	527,822	917,048	0	0	126,993	682,106	107,949	0
1970	329,729	492,016	0	9,126	91,047	361,840	30,003	0
1971	585,402	1,095,889	0	930	51,622	950,614	92,723	0
1972	408,349	1,040,831	0	1,798	153,396	850,198	35,438	0
1973	432,245	458,673	0	3,412	57,495	314,429	83,337	0
1974	209,834	655,955	0	1,467	160,993	459,524	32,640	1,331
1975	172,586	584,121	0	19	78,790	438,716	66,561	36
1976	248,496	1,161,709	0	8	178,349	904,643	78,709	0
1977	357,096	1,869,012	0	10,687	340,639	1,371,837	144,837	1,012
1978	234,394	1,405,965	0	9,319	408,800	846,477	140,252	1,117
1979	507,703	2,083,041	0	36,176	427,264	1,438,283	180,922	396
1980	609,246	1,455,751	0	10,008	220,415	1,067,959	156,865	504
1981	779,344	1,123,043	0	11,553	275,356	735,635	99,417	1,082
1982	609,259	1,942,986	0	78,457	421,546	1,369,205	72,750	1,029
1983	689,905	962,659	301	17,840	236,242	551,376	153,605	3,295
1984	837,472	1,666,014	7	12,476	401,821	1,026,626	225,086	0
1985	644,071	1,121,397	213	15,843	301,035	714,072	88,868	1,367
1986	512,181	1,943,558	0	25,928	514,739	1,289,115	112,355	1,421
1987	505,999	1,709,549	717	37,686	393,711	1,099,433	177,527	475
1988	495,780	1,755,019	440	14,108	325,654	1,348,344	66,146	327
1989	581,067	1,982,784	1,208	29,047	489,649	1,345,686	116,749	445
1990	619,668	1,657,988	161	21,931	386,071	1,095,145	154,680	0
1991	567,390	2,878,971	115	35,697	536,225	2,025,237	281,150	547

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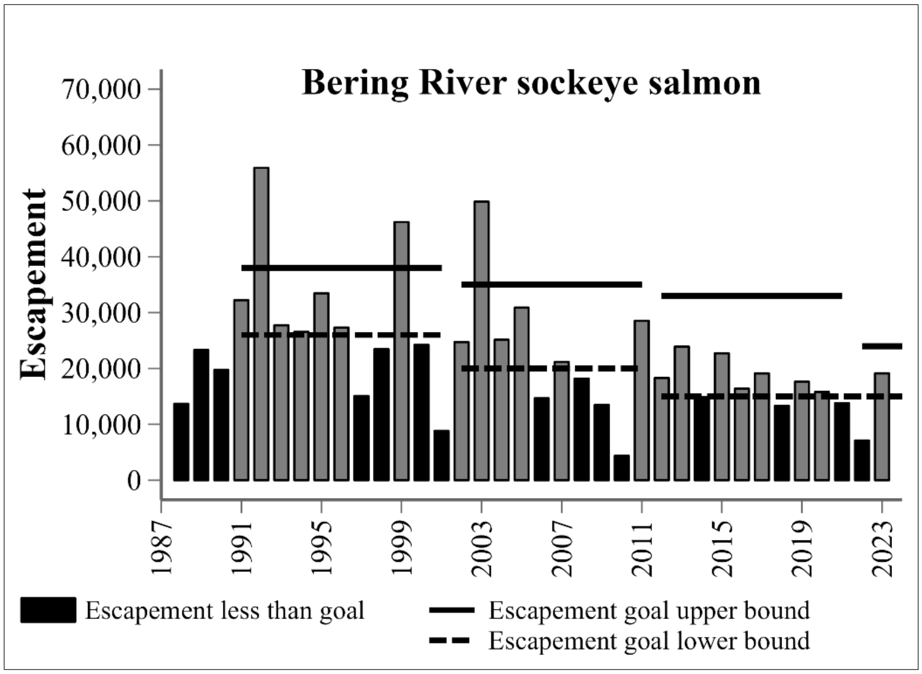
Year	Spawners	Recruits	age-2	age-3	age-4	age-5	age-6	age-7
1992	558,331	3,102,764	567	27,095	613,351	2,373,269	88,483	0
1993	652,721	2,303,634	150	53,235	1,097,514	1,067,686	84,828	220
1994	614,989	1,452,973	200	62,108	432,515	860,516	97,633	0
1995	528,715	1,638,429	117	44,171	598,054	931,893	63,473	721
1996	674,836	1,916,390	589	28,321	137,201	1,667,127	82,463	689
1997	900,333	1,596,776	82	28,983	263,456	1,256,200	48,055	0
1998	635,381	1,911,930	247	7,470	409,895	1,411,903	81,682	732
1999	648,887	1,586,667	50	20,382	334,617	1,052,005	177,091	2,523
2000	537,592	2,331,004	653	25,104	610,276	1,472,395	217,104	5,472
2001	680,513	2,204,290	88	10,576	391,929	1,500,631	300,155	912
2002	730,270	2,909,187	36	24,095	483,669	2,276,521	124,866	0
2003	650,677	1,292,461	538	35,944	230,355	801,309	222,965	1,350
2004	581,158	1,183,901	496	8,298	117,747	967,175	90,185	0
2005	632,602	1,268,098	0	7,832	388,490	739,228	131,692	856
2006	776,249	2,390,334	255	4,805	423,258	1,846,482	114,354	1,180
2007	786,478	3,022,162	290	9,862	521,147	2,170,808	320,056	0
2008	615,810	2,239,368	109	1,846	516,191	1,537,342	183,880	0
2009	606,398	3,036,103	20	7,318	677,883	1,981,496	368,602	784
2010	668,835	2,699,897	0	3,130	738,286	1,791,742	166,047	691
2011	751,003	2,405,593	0	13,470	792,189	1,421,204	178,730	0
2012	1,086,874	1,041,307	23	8,136	247,292	735,407	49,778	672
2013	1,011,175	1,035,460	190	10,766	398,603	467,178	158,044	679
2014	992,408	2,172,740	2,570	9,136	257,012	1,811,081	92,942	0
2015	1,063,193	862,785	90	32	349,015	407,430	104,235	1,984
2016	615,763	1,135,370	0	7,377	187,294	836,222	104,477	0
2017	573,163	–	0	2,765	282,807	912,521	133,936	–

Note: En dashes indicate a lack of data due to incomplete brood year returns.

Appendix A8.–Description of stock and escapement goal for Berring River sockeye salmon.

Stream Location:	Bering River District – includes 6 survey reaches
Fishery:	Commercial Drift, Subsistence and Sport
Current escapement goal:	SEG 15,000–24,000 (2022)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Peak aerial survey index
Data available:	
Counts:	1970–1982: aerial escapement estimates, inconsistent streams flown (excluded in goal development) 1983–present: aerial escapement estimates
Age composition:	Escapement age data: intermittent from 1980–present Commercial age data: intermittent from 1990–present, often mixed with Copper River district
Stock-specific harvest:	None
Data contrast:	12.8
Methodology:	Percentile method – Tier 1 (20th and 60th percentiles)
Criteria for updated goal	None
Goal history:	2022–present: 15,000–24,000 2012–2021: 15,000–33,000 2002–2011: 20,000–35,000 1991–2001: 26,000–38,000
Comments:	Increasingly frequent glacial outburst floods from the drainage of Berg Lake may affect sedimentation of spawning areas and spawning success in the future.

Appendix A9.–Bering River sockeye salmon escapement and escapement goals, 1987–2023.



Appendix A10.–Supporting information for analysis of escapement goal for Bering River District sockeye salmon.

Year	Escapement [a]	Commercial harvest [b]
1988	13,680	7,152
1989	23,300	9,225
1990	19,741	8,332
1991	32,220	19,181
1992	55,895	19,721
1993	27,725	33,951
1994	26,550	27,926
1995	33,450	21,585
1996	27,310	37,712
1997	15,065	9,651
1998	23,450	8,439
1999	46,195	13,697
2000	24,220	1,279
2001	8,823	5,450
2002	24,715	235
2003	49,840	18,266
2004	25,135	13,165
2005	30,890	77,465
2006	14,671	36,867
2007	21,170	16,470
2008	18,196	1,175
2009	13,471	4,157
2010	4,367	51
2011	28,530	6
2012	18,290	0
2013	23,900	3,321
2014	14,885	50
2015	22,705	2,137
2016	16,390	9,840
2017	19,115	2,578
2018	13,300	34
2019	17,630	21,099
2020	15,795	9
2021	13,774	243
2022	7,095	5,299
2023	19,125	11,463

Note: Current goal is an SEG of 15,000 to 33,000, and the recommendation is no change to the goal.

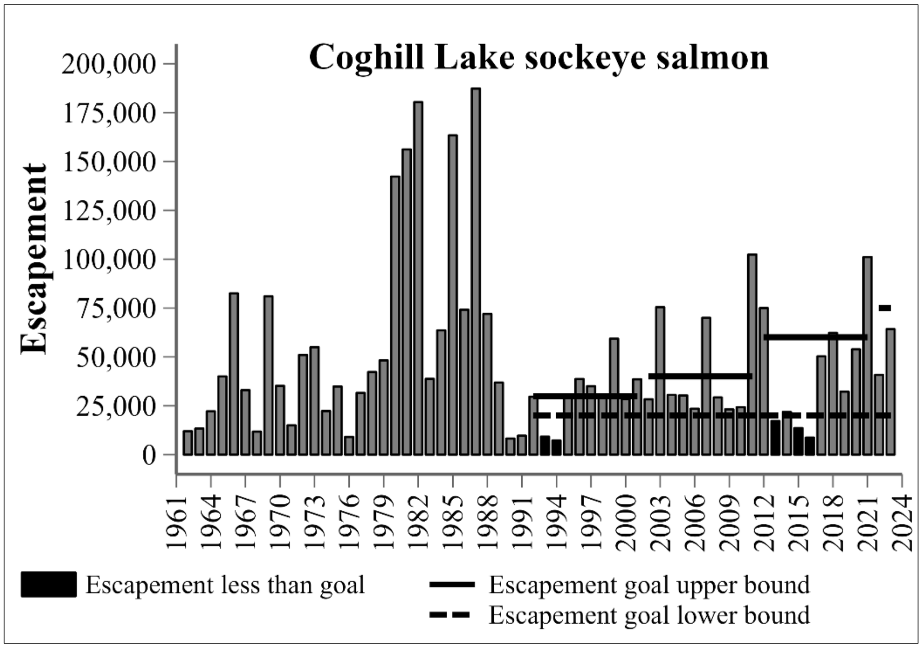
[a] Escapement indices calculated as peak aerial survey from the 6 primary index systems.

[b] Bering River District harvest, not stock specific

Appendix A11.–Description of stock and escapement goal for Coghill Lake sockeye salmon.

Stream Location:	Prince William Sound Management Area; stream 223-30-13220
Fishery:	Commercial Drift Gillnet and Purse Seine, Subsistence and Sport
Current escapement goal:	SEG 20,000–75,000 (2022)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Resistance board weir
Data available:	
Counts:	1960–1973: partial weir and tower (incomplete estimates) 1960, 1964, 1968, 1971: visual counts during fixed-wing aerial and foot surveys 1974–2018: picket weir 2019–present: resistance board weir
Age composition:	Escapement age data: 1963, 1965, 1974, 1976–present Commercial age data (mixed stock): intermittent from 1965– present
Stock-specific harvest:	None
Data contrast:	25.8 (1974 to present data)
Methodology:	Bayesian Ricker spawner-recruit model
Criteria for updated goal	None
Goal history:	2022–present: SEG 20,000–75,000 2012–2021: SEG 20,000–60,000 2006–2011: SEG 20,000– 40,000 2002–2005: BEG 20,000–40,000 1992–2001: BEG 20,000–30,000 Prior to 1992: limited documentation available in Fried (1994)
Comments:	It has been suggested that the productivity of Coghill Lake sockeye salmon may be influenced by abiotic factors that include a short ice-free period, cold temperatures, high inorganic turbidity, and meromictic characteristics that can also be disrupted by unpredictable stochastic processes (Edmundson et al. 1992, 1997). There is some evidence that multiple years of high spawning escapements into Coghill Lake may result in density-dependent effects including depleted zooplankton abundances for rearing juvenile sockeye salmon (Edmundson et al. 1997; Koenings and Kyle 1997) and therefore it was suggested that consecutive escapements at the upper end of the goal be avoided.

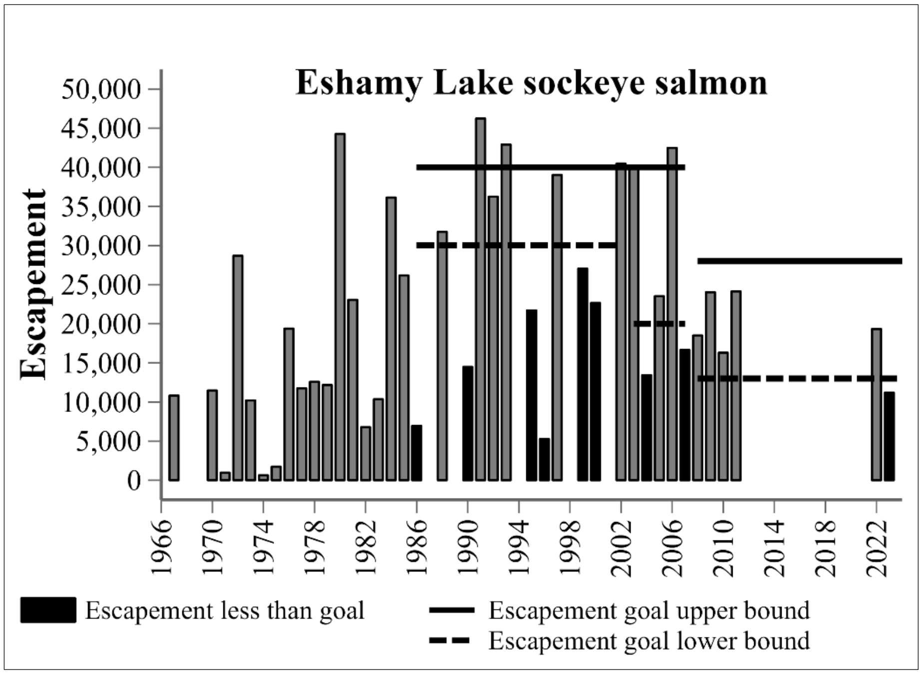
Appendix A12.–Coghill Lake sockeye salmon escapement and escapement goals, 1982–2023.



Appendix A13.–Description of stock and escapement goal for Eshamy Lake sockeye salmon.

Stream Location:	Prince William Sound Management Area; stream 225-30-15110
Fishery:	Commercial Drift and Set Gillnet, Subsistence and Sport
Current escapement goal:	BEG 13,000–28,000 (2008)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Picket weir
Data available:	
Counts:	1960–2011: weir 2013–2017: video monitoring (incomplete estimate) 2021: partial season weir operation 2022–present: weir
Age composition:	Escapement age data: 1960–2011, 2021–present Commercial age data (mixed stock): intermittent from 1965– present
Stock-specific harvest:	None
Data contrast:	107.5
Methodology:	Ricker spawner-recruit model
Criteria for updated goal	None
Goal History:	2008–present: BEG 13,000–28,000 2003–2007: SEG 20,000–40,000 1986–2002: BEG 30,000–40,000 Prior to 1986: 20,000–30,000 limited documentation available in Fried (1994)
Comments:	

Appendix A14.–Eshamy Lake sockeye salmon escapement and escapement goals, 1966–2023.



Appendix A15.–Description of stock and escapement goal for Prince William Sound Chum Salmon.

Stream Location:	Includes 134 index systems, full list available in Morella and Scannell (2024)
Fishery:	Commercial: Purse Seine, drift gillnet, set gillnet, Subsistence, and Sport
Current escapement goal:	Lower-bound SEGs (2017): Eastern District 79,000 Northern District 28,000 Coghill District 10,000 Northwestern District 7,000 Southeastern District 11,000
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Area under the curve aerial survey index of 134 index streams
Data available:	
Counts:	1961–2014: 214 stream aerial survey index 2015–present: 134 stream aerial survey index
Age composition:	Escapement age data: none Commercial age data: 1973–present intermittent and mixed stock
Stock-specific harvest:	Hatchery chum salmon are thermally marked and stock contributions from thermal marks are generated by district and period for hatchery or wild origin
Data contrast:	
Methodology:	Percentile approach, Tier 1 (20th and 60th percentiles)
Criteria for updated goal	None
Goal history:	2009–2016: Eastern District 50,000 Northern District 20,000 Coghill District 8,000 Northwestern District 5,000 Southeastern District 8,000

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	2003–2008:	
	Eastern District	50,000–13,000
	Northern District	20,000–60,000
	Coghill District	8,000–25,000
	Northwestern District	5,000–19,000
	Southeastern District	15,000–20,000
	1977–2002:	
	Eastern District	87,200–109,000
	Northern District	29,400–36,750
	Coghill District	29,600–37,050
	Northwestern District	19,000–23,700
	Southeastern District	20,000–25,000
Comments:	Prior escapement goals are not comparable to the current escapement index due to the reduction in the number of index streams flown beginning in 2015. The historical escapement estimates have been recalculated to reflect the reduced subset of index streams. Montague and Southwestern district goals were removed due to loss of spawning habitat from uplift from the 1964 earthquake.	

Appendix A16.–Supporting information for analysis of escapement goals for Prince William Sound chum salmon.

	Chum salmon escapements				
Year	Eastern	Northern	Coghill	Northwestern	Southeastern
1980	20,198	18,544	21,165	1,419	7,829
1981	65,913	37,442	1,000	10,302	14,933
1982	124,757	70,698	14,368	8,345	17,262
1983	120,689	91,188	55,119	32,022	17,240
1984	106,352	62,128	12,094	4,645	3,577
1985	32,743	30,068	15,656	11,052	2,220
1986	143,518	63,518	17,604	20,878	13,909
1987	189,502	34,388	19,654	32,807	44,617
1988	313,522	98,884	57,921	54,072	89,549
1989	126,836	55,440	21,240	30,827	23,093
1990	127,676	116,265	19,588	31,340	7,181
1991	60,686	19,954	5,572	8,211	7,692
1992	43,953	15,189	7,677	12,107	3,559
1993	55,691	24,863	9,642	19,810	23,555
1994	45,947	27,949	18,178	14,633	4,108
1995	96,443	38,405	15,258	6,575	25,417
1996	182,383	73,362	26,703	33,143	36,971
1997	108,477	25,133	3,822	10,867	49,101
1998	87,383	28,855	13,278	5,552	32,365
1999	163,516	36,727	6,426	4,748	26,164
2000	198,132	31,074	26,540	10,145	40,448
2001	250,878	93,667	18,033	7,613	38,322
2002	116,992	38,763	9,560	21,427	91,469
2003	258,516	55,648	23,839	14,747	102,106
2004	146,246	47,487	11,614	13,040	50,507
2005	160,064	36,641	13,571	13,994	11,471
2006	136,562	56,259	23,465	22,710	34,085
2007	140,595	51,168	13,757	11,499	59,199
2008	79,450	49,595	48,008	33,635	18,142
2009	146,577	29,464	7,763	15,730	123,607
2010	140,940	58,029	84,752	34,131	80,927
2011	237,372	63,876	19,614	11,951	107,857
2012	94,986	23,273	13,896	9,360	28,374
2013	146,349	40,475	14,086	4,995	33,678
2014	90,445	27,385	9,491	5,041	29,362

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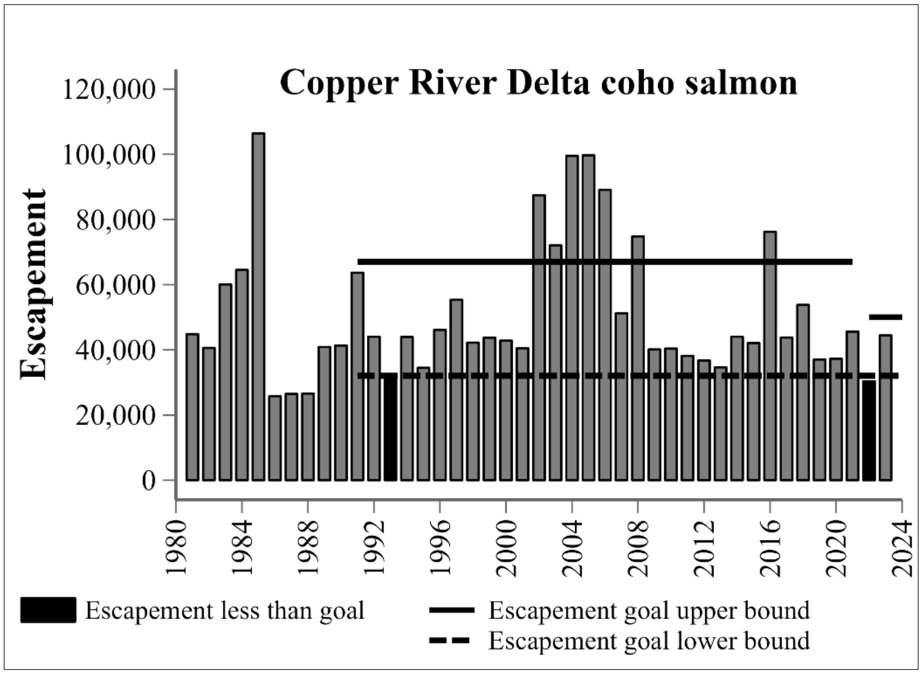
Year	Eastern	Northern	Coghill	Northwestern	Southeastern
2015	104,437	41,253	14,929	7,060	44,095
2016	116,685	10,410	976	3,954	13,919
2017	76,836	33,437	13,210	7,118	26,330
2018	109,598	18,407	13,617	15,563	10,164
2019	56,846	11,690	3,437	3,258	19,451
2020	103,849	23,542	8,998	7,405	26,909
2021	58,965	20,404	2,395	6,979	46,391
2022	64,365	26,014	8,629	13,372	12,944
2023	157,274	55,482	6,250	738	7,791

Note: The chum salmon escapement index is the area under the curve (AUC) of weekly aerial survey counts of 134 index streams adjusted for stream life (adjusted AUC). Escapement estimates are for streams with 3 or more surveys per year only.

Appendix A17.–Description of stock and escapement goal for Copper River coho salmon.

Stream Location:	Copper River District – includes 17 index streams
Fishery:	Commercial Drift Gillnet, Subsistence, and Sport
Current escapement goal:	SEG 32,000–50,000 (2022)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Peak aerial survey index
Data available:	
Counts:	1970–1980: aerial escapement estimates, inconsistent streams flown (excluded in goal development) 1981–present: aerial escapement estimates
Age composition:	Escapement age data: none Commercial age data: 1965–present
Stock-specific harvest:	None
Data contrast:	4.1
Methodology:	Markov Yield Table
Criteria for updated goal	None
Goal history:	2022–present: SEG 32,000–50,000 2003–2021: SEG 32,000–67,000 1991–2002: BEG 32,000–67,000
Comments:	Although many streams have been surveyed for each stock over the years, only surveys conducted annually over the same streams were used to evaluate escapement goals.

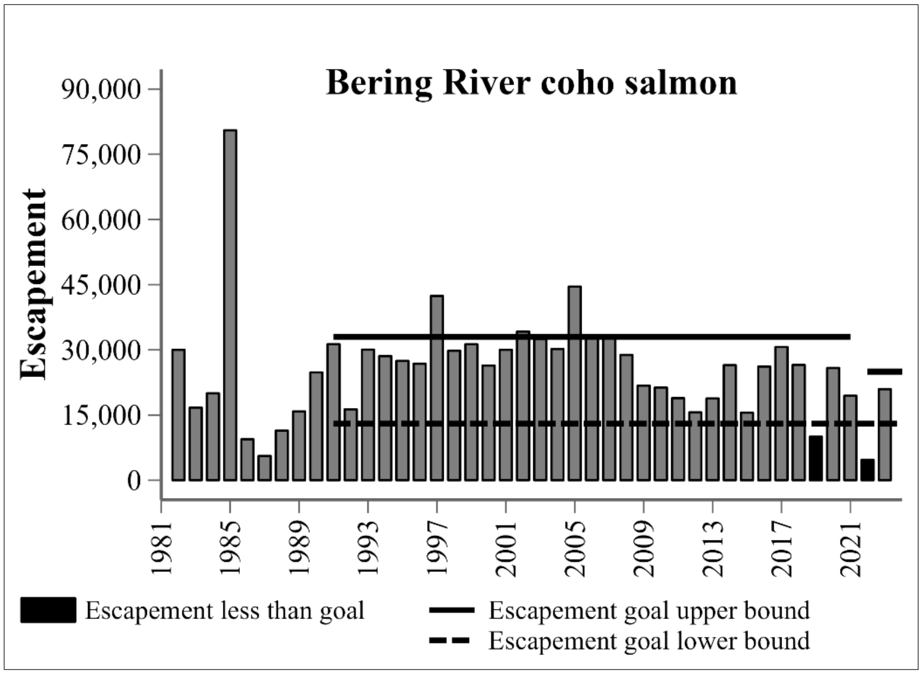
Appendix A18.–Copper River Delta coho salmon escapement and escapement goals, 1980–2023.



Appendix A19.–Description of stock and escapement goal for Bering River coho salmon.

Stream Location:	Bering River District – includes 7 index systems
Fishery:	Commercial Drift Gillnet, Subsistence, and Sport
Current escapement goal:	SEG 13,000–22,000 (2022)
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Peak aerial survey index
Data available:	
Counts:	1970–1981: aerial escapement estimates, inconsistent streams flown (excluded in goal development) 1982–present: aerial escapement estimates
Age composition:	Escapement age data: none Commercial age data: intermittent from 1965–present, often mixed with Copper River district
Stock-specific harvest:	None
Data contrast:	17.2
Methodology:	Markov Yield Table
Criteria for updated goal	None
Goal history:	2022–present: SEG 13,000–25,000 2003–2021: SEG 13,000–33,000 1991–2002: BEG 13,000–33,000
Comments:	Although many streams have been surveyed for each stock over the years, only surveys conducted annually over the same streams were used to evaluate escapement goals.

Appendix A20.–Bering River coho salmon escapement and escapement goals, 1980–2023.



Appendix A21.–Description of stock and escapement goal for Prince William Sound even-year pink salmon.

Stream Location:	Includes 134 index systems, full list available in Morella and Scannell (2024)	
Fishery:	Commercial: Purse Seine, drift gillnet, set gillnet, Subsistence, and Sport	
Current escapement goal:	SEGs (2017):	
	Eastern District	203,000–328,000
	Northern District	96,000–127,000
	Coghill District	37,000– 110,000
	Northwestern District	52,000–93,000
	Eshamy District	1,000–4,000
	Southwestern District	62,000–105,000
	Montague District	36,000–72,000
	Southeastern District	88,000–153,000
Updated escapement goal:	No change	
Optimal escapement goal:	None	
Inriver goal:	None	
SOC status (type and year):	None	
Escapement enumeration type:	Area under the curve aerial survey index of 134 index streams	
Data available:		
Counts:	1961–2014: 214 stream aerial survey index 2015–present: 134 stream aerial survey index	
Age composition:	None, fixed 2-year life history assumed	
Stock-specific harvest:	Hatchery pink salmon are thermally marked and stock contributions from thermal marks are generated by district and period for hatchery or wild origin; district-specific origin of wild stocks in commercial harvest is unknown.	
Methodology:	Percentile approach, Tier 1 (20th and 60th percentiles)	
Criteria for updated goal	None	

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Goal history:	SEGs 2012–2017	
	Eastern District	250,000–580,000
	Northern District	140,000–210,000
	Coghill District	60,000–150,000
	Northwestern District	70,000–140,000
	Eshamy District	3,000–11,000
	Southwestern District	70,000–160,000
	Montague District	50,000–140,000
	Southeastern District	150,000–310,000
	SEG 2002–2011	
	Even-year brood line all districts combined:	1,250,000–2,750,000
	SEGs 1990–2000	
	Eastern District	427,000–521,000
	Northern District	140,000–210,000
	Coghill District	129,000–158,000
	Northwestern District	122,000–149,000
	Eshamy District	7,000–9,000
	Southwestern District	139,000–159,000
	Montague District	63,000–77,000
	Southeastern District	215,000–263,000
	SEGs 1960–1988	
	Eastern District	403,700–484,500
	Northern District	140,000–168,000
	Coghill District/ Northwestern	262,500–315,000
	Eshamy District/ Southwestern	112,500–135,000
	Montague District	106,200–127,500
	Southeastern District	225,000–270,000
Comments:	Prior escapement goals are not comparable to the current escapement index due to the reduction in the number of index streams flown beginning in 2015. The historical escapement estimates have been recalculated to reflect the reduced subset of index streams.	

Appendix A22.–Supporting information for analysis of escapement goals for Prince William Sound even-year pink salmon.

Year	Eastern	Northern/ Unakwik	Coghill	Northwestern	Eshamy	Southwestern	Montague	Southeastern	Total
1982	333,392	139,533	188,841	93,998	288	55,611	42,506	186,455	1,040,624
1984	839,339	353,175	232,592	367,782	NA	246,298	89,130	396,810	2,525,125
1986	266,051	125,507	89,825	65,328	3,690	59,630	24,939	87,771	722,741
1988	283,057	98,261	34,004	82,126	NA	126,318	50,927	86,037	760,729
1990	320,285	103,386	36,181	110,549	27,731	155,093	73,511	162,204	988,938
1992	150,193	61,195	18,324	46,766	4,310	69,782	38,170	64,113	452,851
1994	485,152	143,478	55,116	168,058	12,604	135,104	35,114	116,949	1,151,575
1996	450,974	148,585	63,240	76,696	2,207	63,175	58,570	116,870	980,319
1998	246,423	127,375	42,434	51,978	2,852	333,787	109,016	88,655	1,002,519
2000	360,133	107,466	137,665	54,523	2,772	97,918	114,597	158,708	1,033,782
2002	119,689	77,126	26,572	32,839	1,157	33,847	33,121	143,375	467,726
2004	534,679	107,478	49,050	39,153	1,364	111,427	128,553	314,418	1,286,122
2006	192,217	134,672	123,881	90,347	8,056	70,426	94,143	129,858	843,600
2008	161,710	121,502	142,733	138,968	579	61,820	51,571	85,869	764,753
2010	437,191	244,810	328,447	207,490	9,261	109,012	129,968	223,178	1,689,357
2012	268,432	91,211	170,752	114,518	1,052	79,774	70,695	213,071	1,009,505
2014	250,381	95,643	60,921	66,350	12,167	73,104	23,136	141,845	723,548
2016	594,778	135,037	63,986	168,272	NA	NA	NA	107,769	1,069,842
2018	309,325	113,384	70,881	111,194	16,594	81,100	135,208	293,275	1,130,961
2020	206,152	106,493	88,401	77,828	7,250	64,470	84,238	138,330	773,162
2022	353,187	163,498	73,971	292,892	14,937	200,057	143,917	137,692	1,380,152

Notes: The pink salmon escapement index is the area under the curve (AUC) of weekly aerial survey counts of 134 index streams adjusted for stream life (adjusted AUC). Escapement estimates are for streams with 3 or more surveys per year only.

Appendix A23.–Description of stock and escapement goal for Prince William Sound odd-year pink salmon.

Stream Location:	Includes 134 index systems, full list available in Morella and Scannell (2024)
Fishery:	Commercial: Purse Seine, drift gillnet, set gillnet, Subsistence, and Sport
Current escapement goal:	SEGs (2017):
	Eastern District 346,000–863,000
	Northern District 110,000–208,000
	Coghill District 54,000–233,000
	Northwestern District 64,000–144,000
	Eshamy District 5,000–31,000
	Southwestern District 112,000–231,000
	Montague District 140,000–280,000
	Southeastern District 270,000–620,000
Updated escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
SOC status (type and year):	None
Escapement enumeration type:	Area under the curve aerial survey index of 134 index streams
Data available:	
Counts:	1961–2014: 214 stream aerial survey index 2015–present: 134 stream aerial survey index
Age composition:	None, fixed 2-year life history assumed
Stock-specific harvest:	Hatchery pink salmon are thermally marked and stock contributions from thermal marks are generated by district and period for hatchery or wild origin, unable to allocate commercial harvest to district of origin.
Methodology:	Percentile approach (25th and 75th percentiles)
Criteria for updated goal	None

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Goal history:	SEGs 2012–2017	
	Eastern District	250,000–580,000
	Northern District	140,000–210,000
	Coghill District	60,000–150,000
	Northwestern District	50,000–110,000
	Eshamy District	4,000–11,000
	Southwestern District	70,000–190,000
	Montague District	140,000–280,000
	Southeastern District	270,000–620,000
	SEG 2002–2011	
	Odd-year brood line all districts combined: 1,250,000–2,750,000	
	SEGs 1990–2000	
	Eastern District	380,000–465,000
	Northern District	115,000–141,000
	Coghill District	160,000–196,000
	Northwestern District	75,000–92,000
	Eshamy District	5,100–6,200
	Southwestern District	105,000–128,000
	Montague District	146,000–179,000
	Southeastern District	300,000–366,000
	SEGs 1960–1988	
	Eastern District	403,700–484,500
	Northern District	140,000–168,000
	Coghill District/ Northwestern	262,500–315,000
	Eshamy District/ Southwestern	112,500–135,000
	Montague District	106,200–127,500
	Southeastern District	225,000–270,000
Comments:	Prior escapement goals are not comparable to the current escapement index due to the reduction in the number of index streams flown beginning in 2015. The historical escapement estimates have been recalculated to reflect the reduced subset of index streams.	

Appendix A24.–Supporting information for analysis of escapement goals for Prince William Sound odd-year pink salmon.

Year	Eastern	Northern/ Unakwik	Coghill	Northwestern	Eshamy	Southwestern	Montague	Southeastern	Total
1981	543,023	221,272	87,281	58,123	NA	106,757	176,488	199,729	1,392,673
1983	347,486	127,242	191,220	147,170	NA	91,123	105,172	284,749	1,294,162
1985	598,507	166,714	179,321	145,410	NA	104,184	202,946	378,249	1,775,331
1987	421,972	109,380	36,410	77,296	NA	137,040	120,511	239,862	1,142,471
1989	250,082	101,436	37,487	81,846	34,600	212,757	126,294	205,178	1,049,680
1991	345,169	114,718	68,899	83,940	33,941	169,162	132,545	373,277	1,321,651
1993	315,598	96,955	38,498	61,353	20,700	130,824	140,902	289,492	1,094,323
1995	402,264	84,312	49,310	54,656	8,990	111,495	165,572	261,894	1,138,494
1997	322,445	50,427	48,374	49,982	853	92,913	158,475	437,989	1,161,458
1999	310,051	126,575	147,845	45,282	4,795	153,763	237,219	372,836	1,398,366
2001	424,655	144,113	157,927	126,442	4,413	237,739	299,577	367,359	1,762,225
2003	964,355	253,962	370,688	108,073	6,954	136,902	304,685	485,550	2,631,169
2005	1,109,422	613,712	553,954	430,024	69,175	340,708	540,669	1,265,986	4,923,650
2007	424,938	169,596	238,770	72,040	11,727	115,112	149,881	448,990	1,631,054
2009	700,027	152,979	147,498	137,036	12,966	258,404	338,998	524,415	2,272,323
2011	916,690	156,362	217,560	139,334	3,643	188,475	489,313	1,138,410	3,249,789
2013	1,266,630	299,592	625,991	201,836	12,145	337,952	365,807	1,137,736	4,247,690
2015	1,440,254	708,920	775,488	438,944	68,988	644,158	559,994	1,529,543	6,166,289
2017	557,545	395,437	181,153	250,989	2,836	172,930	205,252	372,960	2,139,101
2019	445,075	195,169	153,129	91,267	1,402	33,340	25,385	290,452	1,235,219
2021	729,369	471,417	300,227	368,406	17,925	339,920	242,151	544,906	3,014,321
2023	650,740	302,345	169,737	312,060	12,756	134,089	177,472	183,087	1,942,285

Notes: The pink salmon escapement index is the area under the curve (AUC) of weekly aerial survey counts of 134 index streams adjusted for stream life (adjusted AUC). Escapement estimates are for streams with 3 or more surveys per year only.