Fishery Manuscript Series No. 17-11

Review of Salmon Escapement Goals in Southeast Alaska, 2017

by

Steven C. Heinl,

Edgar L. Jones III,

Andrew W. Piston,

Philip J. Richards,

Leon D. Shaul,

Brian W. Elliott,

Sara E. Miller,

Richard E. Brenner,

and

Jeff V. Nichols

December 2017

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

FISHERY MANUSCRIPT SERIES NO. 17-11

REVIEW OF SALMON ESCAPEMENT GOALS IN SOUTHEAST ALASKA, 2017

by
Steven C. Heinl and Andrew W. Piston
Alaska Department of Fish and Game, Division of Commercial Fisheries, Ketchikan

Edgar L. Jones III, Philip J. Richards, Brian W. Elliott, and Jeff V. Nichols
Alaska Department of Fish and Game, Division of Sport Fish, Douglas

Leon D. Shaul
Alaska Department of Fish and Game, Division of Commercial Fisheries, Douglas

and

Sara E. Miller and Richard E. Brenner
Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

December 2017

The Fishery Manuscript Series was established in 1987 by the Division of Sport Fish for the publication of technically-oriented results of several years' work undertaken on a project to address common objectives, provide an overview of work undertaken through multiple projects to address specific research or management goal(s), or new and/or highly technical methods, and became a joint divisional series in 2004 with the Division of Commercial Fisheries. Fishery Manuscripts are intended for fishery and other technical professionals. Fishery Manuscripts are available through the Alaska State Library and on the Internet: http://www.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

Steven C. Heinl and Andrew W. Piston,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
2030 Sea Level Drive, Suite 205, Ketchikan, Alaska 99901, USA

Edgar L. Jones III, Philip J. Richards, Brian W. Elliott, and Jeff V. Nichols
Alaska Department of Fish and Game, Division of Sport Fish
802 Third Street, Douglas, Alaska 99824, USA

Leon D. Shaul
Alaska Department of Fish and Game, Division of Commercial Fisheries,
802 Third Street, Douglas, Alaska 99824, USA

and

Sara E. Miller and Richard E. Brenner,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
1255 W. 8th Street, Juneau, Alaska 99801, USA

This document should be cited as follows:
Heinl, S. C., E. L. Jones III, A. W. Piston, P. J. Richards, L. D. Shaul, B. W. Elliott, S. E. Miller, R. E. Brenner, and J. V. Nichols. 2017. Review of salmon escapement goals in Southeast Alaska, 2017. Alaska Department of Fish and Game, Fishery Manuscript Series No. 17-11, Anchorage.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

ABSTRACT

The Alaska Department of Fish and Game interdivisional escapement goal review committee reviewed Pacific salmon *Oncorhynchus* spp. escapement goals for Southeast Alaska in 2017. As of 2016, escapement goals were established for 12 Chinook, 14 sockeye, 14 coho, 4 pink, and 8 chum salmon stocks. The Southeast escapement goal review committee recommended changes to escapement goals to the directors of the divisions of Commercial Fisheries and Sport Fish as follows: (1, 2, 3) replace escapement goal ranges for Chickamin, Blossom, and Keta river Chinook salmon, which are expressed in index survey counts, with ranges expressed as total escapement; (4) eliminate the Klukshu (Alsek) River Chinook salmon goal; (5) eliminate the combined East Alsek-Doame river sockeye salmon biological escapement goal (13,000–26,000 fish) and replace it with a sustainable escapement goal (range 9,000–24,000 fish) germane only to the East Alsek River; (6) eliminate the Lost River sockeye salmon goal; (7) eliminate the Alsek River sockeye salmon goal (8); change the Berners River coho salmon biological escapement goal from 4,000–9,200 fish to 3,600–8,100 fish; (9) change the Tsiu-Tsivat river coho salmon goal from a biological escapement goal to a sustainable escapement goal while maintaining the same goal of 10,000–29,000 fish; (10) eliminate the Ford Arm Creek coho salmon goal; (11) eliminate the Situk River pink salmon goal; and (12) change the aggregate Northern Southeast Inside summer-run chum salmon lower bound sustainable escapement goal from 119,000 to 107,000 fish. As a result of these recommendations, a total of 47 Southeast Alaska escapement goals would be established for 11 Chinook, 12 sockeye, 13 coho, 3 pink, and 8 chum salmon stocks.

Key words: Southeast Alaska, Yakutat, escapement goal, transboundary river, biological escapement goal, sustainable escapement goal, sockeye salmon, *Oncorhynchus nerka*, Chinook salmon, *O. tshawytscha*, coho salmon, *O. kisutch*, chum salmon, *O. keta*, pink salmon, *O. gorbuscha*, Alaska Board of Fisheries

INTRODUCTION

In 2000 and 2001, the Alaska Board of Fisheries (board) adopted 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) into state regulation to ensure that the state's salmon stocks would be conserved, managed, and developed using the sustained yield principle. These policies require the Alaska Department of Fish and Game (ADF&G) to report on salmon stock status and escapement goals to the board on a regular basis, document and review existing salmon escapement goals, establish goals for stocks for which escapement can be reliably measured, and prepare scientific analyses with supporting data when goals are created, modified, or recommended for elimination.

Southeast Alaska salmon stock status and escapement goals have been reviewed and summarized in comprehensive reports on a three-year cycle, beginning with the 2002/2003 board cycle. Geiger and McPherson (2004) produced ADF&G's first report for the Southeast Region, which included chapters on all five species of Pacific salmon. That report was updated by Der Hovanisian and Geiger (2005) for the 2005/2006 board cycle. Stock status was reported in individual reports for each species for the 2008/2009 and 2011/2012 board cycles: Chinook salmon *Oncorhynchus tshawytscha* (McPherson et al. 2008, Der Hovanisian et al. 2011), sockeye salmon *O. nerka* (Eggers et al. 2008, Heinl et al. 2011), coho salmon *O. kisutch* (Shaul et al. 2008, 2011), pink salmon *O. gorbuscha* (Heinl et al. 2008, Piston and Heinl 2011a), and chum salmon *O. keta* (Eggers and Heinl 2008, Piston and Heinl 2011b). Southeast Alaska escapement goal review for the 2014/2015 board cycle was summarized by Heinl et al. (2014a).

In January 2017, ADF&G established a committee to review Southeast Alaska escapement goals in preparation for the 2017/2018 Alaska Board of Fisheries meetings. The Southeast escapement goal review committee consisted of regional biometric, stock assessment, and management staff from the divisions of Sport Fish and Commercial Fisheries, as well as statewide fisheries scientists from both divisions. Here we report the results of our review and provide a summary of

recommended changes. We also provide brief overviews of stock assessment for each species and updates on escapement goal performance from 2012 to 2016 for all stocks with formal escapement goals.

METHODS

During this review, the Southeast escapement goal review committee evaluated 52 existing escapement goals for 12 Chinook, 14 sockeye, 14 coho, 4 pink, and 8 chum salmon stocks (Tables 1–5). The committee considered primarily those goals with recent information that could potentially result in a substantially different escapement goal, those goals with changes in stock assessment that required recalculation of existing goals, or those goals that should be eliminated or established. The committee also considered management needs—how the goal was integrated into fisheries management and how well the goal performed. The committee determined the appropriate goal type (biological or sustainable) for each escapement goal that was reviewed and evaluated the type, quality, and quantity of available data for each stock to determine the appropriate type of escapement goal as defined in regulation.

Generally speaking, an escapement goal for a stock should provide escapement that produces sustainable yields. Escapement goals for salmon are typically based on stock-recruit relationships (e.g., Ricker 1954, Beverton and Holt 1957), representing the productivity of the stock and estimated carrying capacity. In this review, the information sources for stock-recruit models were spawner-return data. However, specific methods to determine escapement goals vary in their technical complexity and are largely determined by the quality and quantity of the available data. Thus, 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.

Table 1.–Southeast Alaska Chinook salmon escapement goals, 2012–2016 escapements, and escapement goal recommendations.

System	Assessment method	Goal type	Escapement Goal[a]	Year established	Escapement 2012	2013	2014	2015	2016	Escapement goal recommendation
Blossom River[b]	HS, IE	BEG	150–300	2012	205	255	217	166	135	Expand to total escapement
	HS expansion	BEG			793	987	840	642	522	500-1,400
Keta River[b]	HS, IE	BEG	175–400	2012	241	493	439	304	446	Expand to total escapement
	HS expansion	BEG			725	1,484	1,321	915	1,342	550-1,300
Unuk River	HS/FS expansion	BEG	1,800–3,800	2009	956	1,135	1,691	2,623	1,463	No change
Chickamin River[b]	HS/FS, IE	BEG	450–900	1997	444	468	652	581	203	Expand to total escapement
	HS/FS expansion	BEG			2,109	2,223	3,097	2,760	964	2,150-4,300
Andrew Creek	FS expansion	BEG	650–1,500	1998	587	920	1,261	796	402	No change
Stikine River	MR	BEG	14,000–28,000	2000	22,327[c]	16,783[c]	24,366[c]	21,597[c]	10,343[c]	No change
King Salmon River	FS expansion	BEG	120–240	1997	155	94	68	50	149	No change
Taku River	MR, HS expansion	BEG	19,000–36,000	2009	19,538[c,d]	18,002[c,e]	23,532[c,d]	28,827[c,d]	12,381[c,d]	No change
Chilkat River[f]	MR	BEG	1,750–3,500	2003	1,723	1,719	1,529[c]	2,456[c]	1,380[c]	No change
Alsek River[g]	Weir expansion	BEG	3,500–5,300	2013	3,027	4,992	3,357	5,697[c]	2,574[c]	No change
Klukshu (Alsek) River[g]	Weir	BEG	800–1,200	2013	693	1,227	832	1,388	646	Eliminate
Situk River	Weir	BEG	450–1,050	2003	322	912	475	174	329	No change

Note: AS = aerial survey, FS = foot survey, HS = helicopter survey, IE = index escapement, MR = mark-recapture, BEG= biological escapement goal; gray cells indicate lower bound of the escapement goal not met.

[a] Goals and escapement numbers for Chinook salmon are for large fish (≥660 mm mid eye to fork length, or fish age 1.3 and older), except Alsek and Klukshu goals which are germane to fish age 1.2 and older and can include fish <660 mm mid eye to fork length.

[b] Escapement goals for Blossom, Keta, and Chickamin river Chinook salmon are index counts expanded to estimates of total escapements based on factors developed from mark–recapture studies.

[c] Preliminary estimate pending publication of final report.

[d] Estimates are based on mark-recapture studies.

[e] Estimates are based on expanded peak aerial survey counts.

[f] The Chilkat River Chinook salmon escapement is the mark–recapture estimate of inriver run minus reported subsistence harvest. The inriver goal of 1,850–3,600 (5 AAC 33.384) is directly measured through mark–recapture and is not discounted for inriver subsistence harvests that average <100 fish.

[g] Alsek and Klukshu river Chinook salmon escapement goals were bilaterally agreed upon in 2013 (TTC 2014). Escapement to the Alsek River is calculated through expansion of the Klukshu River inriver run by a factor of 4.0 and subtraction of any inriver harvests above Dry Bay in the lower Alsek River.

Table 2.–Southeast Alaska sockeye salmon escapement goals, 2012–2016 escapements, and escapement goal recommendations.

System	Assessment method	Goal type	Escapement goal	Year established	Escapement					Escapement goal recommendation
					2012	2013	2014	2015	2016	
Hugh Smith Lake	Weir	OEG[a]	8,000–18,000	2003	13,353	5,946	10,397	21,296	12,865	No change
McDonald Lake	FS expansion	SEG	55,000–120,000	2009	57,000	15,400	43,400	70,200	15,600	No change
Mainstem Stikine River	Run reconstruction	SEG	20,000–40,000	1987	33,812	27,091	21,179	26,432	28,646[b]	No change
Tahltan Lake	Weir	BEG	18,000–30,000	1993	13,463	15,828	39,745	33,159	38,458[b]	No change
Speel Lake	Weir	SEG	4,000–9,000	2015	5,681	6,426	5,059	4,888	5,538	No change
Taku River	MR	SEG	71,000–80,000	1986	126,764	81,177	92,189	132,523	176,417[b]	No change
Redoubt Lake	Weir	OEG[c]	7,000–25,000	2003	40,944	49,124	19,936	13,983	22,774	No change
		BEG	10,000–25,000	2003	40,944	49,124	19,936	13,983	22,774	No change
Chilkat Lake	Sonar	BEG	70,000–150,000	2009	121,810	116,300	70,470	175,874	88,513	No change
Chilkoot Lake	Weir	SEG	38,000–86,000	2009	118,166	46,329	105,713	71,515	86,721	No change
East Alsek-Doame River	AS, IE	BEG	13,000–26,000	2003	21,500	26,500	15,300	15,000	19,200	Eliminate
East Alsek River	AS, IE				16,000	24,000	9,800	12,000	19,200	Establish SEG 9,000–24,000
Alsek River[d]	Run reconstruction	BEG	24,000–33,500	2013	76,598	83,771	87,093	63,709	NA	Eliminate
Klukshu (Alsek) River[d]	Weir	BEG	7,500–11,000	2013	17,176	3,792	12,148	11,363	7,391[b]	No change
Lost River[e]	BS, IE	LB SEG	≥1,000	2009	453	587	NA	373	449	Eliminate
Situk River	Weir	BEG	30,000–70,000	2003	62,500	118,635	102,318	95,093	57,693	No change

Note: AS = aerial survey, FS = foot survey, BS = boat survey, IE = index escapement, MR = mark–recapture, BEG = biological escapement goal, SEG = sustainable escapement goal, LB SEG = lower bound SEG, OEG = optimal escapement goal, NA = not available; gray cells indicate lower bound of the escapement goal not met.

[a] Hugh Smith Lake sockeye salmon OEG was set by the Alaska Board of Fisheries (5 AAC 33.390); the OEG is the same as the BEG (8,000–18,000 fish) but includes wild *and* hatchery-produced fish. No lake stocking has occurred since 2003.

[b] Preliminary estimate pending publication of final report.

[c] Redoubt Lake sockeye salmon OEG was set by the Alaska Board of Fisheries (5 AAC 01.760).

[d] Alsek River escapement estimates are based on an expansion of genetic stock identification information from the U.S. commercial set gillnet fishery in Dry Bay and Klukshu River weir counts (TTC 2017) and are not available on a timely basis. The management approach for the Alsek River continues to be based on meeting the Klukshu River escapement goal, as measured at the Klukshu River weir (TTC 2017).

[e] Survey method for Lost River sockeye salmon escapement changed since LB SEG established; annual counts shown here are not comparable across all years.

Table 3.–Southeast Alaska coho salmon escapement goals, 2012–2016 escapements, and escapement goal recommendations.

System		Assessment method	Goal type	Escapement goal	Year established	Escapement 2012	2013	2014	2015	2016	Escapement goal recommendation
Hugh Smith Lake		Weir	BEG	500–1,600	2009	1,908	3,048	4,110	956	948	No change
Klawock River[a]		Weir	SEG	4,000–9,000	2013	7,507	8,323	7,698	12,780	24,242	No change
Taku River		MR	BEG	50,000–90,000	2015	70,775[b]	68,117[b]	124,171[b]	60,178[b]	87,704[b]	No change
Auke Creek		Weir	BEG	200–500	1994	837	736	1,533	517	204	No change
Juneau Roadside Index	Montana Creek	FS, IE	SEG	400–1,200	2006	394	367	911	1,204	717	No change
	Peterson Creek	FS, IE	SEG	100–250	2006	190	126	284	202	52	No change
Ketchikan Survey Index		HS, IE	BEG	4,250–8,500	2006	11,960	11,295	16,675	10,128	13,420	No change
Sitka Survey Index		FS, IE	BEG	400–800	2006	1,157	1,414	2,161	2,244	2,943	No change
Ford Arm Creek		Weir	BEG	1,300–2,900	1994	2,282	1,573	3,025	3,281	NA	Eliminate
Berners River		FS, HS, IE	BEG	4,000–9,200	1994	5,480	6,280	15,480	9,940	6,733	Change to BEG 3,600–8,100
Chilkat River		AS/FS, MR, IE	BEG	30,000–70,000	2006	36,961	51,324	130,200	47,372	26,280	No change
Tawah Creek (Lost River)		BS, IE	SEG	1,400–4,200	2015	NA	2,593	3,555	2,015	746	No change
Situk River		BS, IE	BEG	3,300–9,800	1994	3,007	14,853	8,226	7,062	6,177	No change
Tsiu-Tsivat rivers		AS, IE	BEG	10,000–29,000	1994	10,500	47,000	27,000	19,500	31,000	Change to SEG 10,000–29,000

Note: AS = aerial survey, FS = foot survey, BS = boat survey, HS = helicopter survey, IE = index escapement, MR = mark–recapture, BEG = biological escapement goal, SEG = sustainable escapement goal, NA = not available; gray cells indicate lower bound of the escapement goal not met.

[a] Klawock coho salmon escapement goal was officially adopted in 2013, but escapement was managed for this goal beginning in 2007.

[b] Preliminary estimate pending publication of final report.

Table 4.–Southeast Alaska pink salmon escapement goals, 2012–2016 escapements, and escapement goal recommendations.

System	Assessment method	Goal type	Escapement goal	Year established	Escapement 2012	2013	2014	2015	2016	Escapement goal recommendation
Southern Southeast	AS, IE	BEG	3.0–8.0 million	2009	6.5 million	14.5 million	9.7 million	4.3 million	6.6 million	No change
Northern Southeast Inside	AS, IE	BEG	2.5–6.0 million	2009	2.1 million	5.4 million	1.4 million	5.3 million	1.8 million	No change
Northern Southeast Outside	AS, IE	BEG	0.75–2.5 million	2009	2.5 million	5.3 million	2.8 million	2.8 million	1.7 million	No change
Situk River	Weir, IE	LB SEG	≥33,000	2012	30,557	150,500	28,238	69,635	24,949	Eliminate

Note: AS = aerial survey, IE = index escapement, BEG = biological escapement goal, LB SEG = lower bound sustainable escapement goal; gray cells indicate lower bound of the escapement goal not met.

Table 5.–Southeast Alaska chum salmon escapement goals, 2012–2016 escapements, and escapement goal recommendations.

System	Assessment method	Goal type	Escapement goal	Year established	Escapement 2012	2013	2014	2015	2016	Escapement goal recommendation
Chum salmon (summer run)										
Southern Southeast	AS/FS/HS, IE	LB SEG	62,000	2015	155,000	86,000	47,000	115,000	90,000	No change
Northern Southeast Inside	AS/FS, IE	LB SEG	119,000	2012	177,000	278,000	93,000	166,000	66,000	Change to LB SEG 107,000
Northern Southeast Outside	AS/FS, IE	LB SEG	25,000	2015	38,000	23,000	28,000	26,000	26,000	No change
Chum salmon (fall run)										
Cholmondeley Sound	AS, IE	SEG	30,000–48,000	2009	54,000	13,000	48,000	73,000	30,000	No change
Port Camden	AS,IE	SEG	2,000–7,000	2009	3,800	2,400	4,300	7,300	4,700	No change
Security Bay	AS,IE	SEG	5,000–15,000	2009	9,800	2,800	6,300	21,500	14,300	No change
Excursion River	AS,IE	SEG	4,000–18,000	2009	2,000	7,600	10,800	12,000	1,400	No change
Chilkat River	FW expansion	SEG	75,000–250,000	2015	287,000	166,000	142,000	207,000	218,000	No change

Note: AS = aerial survey, FS = foot survey, HS = helicopter survey, IE = index escapement, FW = fish wheel index, SEG = sustainable escapement goal, LB SEG = lower bound SEG; gray cells indicate lower bound of the escapement goal not met.

ESCAPEMENT GOAL DEVELOPMENT

Escapement goals were classified as either biological or sustainable escapement goals as defined in the *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) under section (f):

> "(3) "biological escapement goal" or "(BEG)" means the escapement that provides the greatest potential for maximum sustained yield; …" and
>
> "(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; …will …be stated as either a "SEG range" or "lower bound SEG";…"

A wide variety of analytical methods have been used to establish escapement goals for Southeast Alaska salmon stocks. The following methods were used during the current escapement goal review:

Stock-recruit Analysis—Analysis of the relationship between escapement (number of spawners) and subsequent production of recruits (i.e., adults) in the next generation determines levels of spawning abundance that maximize sustained yield over time. The Ricker production model (Ricker 1954) is the most widely used method to estimate these levels of spawning abundance. Stock-recruit models that better fit coho salmon production include Beverton-Holt (Beverton and Holt 1957) and hockey-stick (Barrowman and Myers 2000, Bradford et al. 2000, Shaul et al. 2013) models. Bayesian age-structured state-space models (Fleischman et al. 2013) have also been used recently to better account for observation and measurement error, process variation or natural fluctuations in the actual quantities, and missing data, which are common to salmon data sets. State-space models provide less biased estimates of population parameters and reference points than traditional stock-recruit methods (Su and Peterman 2012).

Percentile Method—The percentile method for establishing SEGs was developed by Bue and Hasbrouck (*unpublished*[1]). Contrast in observed annual escapements or escapement indices (i.e., largest escapement divided by smallest escapement) and estimated exploitation rate of the stock are used to select percentiles of observed escapement values for estimating lower and upper bounds of an escapement goal. This method has been used extensively throughout Alaska (Munro and Volk 2014) to set SEGs in situations where stock assessment data were insufficient to establish a BEG using productivity models. According to this approach, percentiles of escapement values used to estimate a SEG should be relatively wide, in an attempt to improve future knowledge of stock productivity. As contrast increases, percentiles used to estimate the goal are narrowed (Table 6).

[1] Bue, B. G., and J. J. Hasbrouck. 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, unpublished document.

Table 6.–Criteria used to set sustainable escapement goals based on percentiles of observed escapement counts (Bue and Hasbrouck *unpublished*).

Tier	Escapement Contrast[a] and Exploitation	Sustainable Escapement Goal Range
Tier 1	High contrast (>8); exploited population	25th to 75th percentile
Tier 2	High contrast (>8); low exploitation	15th to 75th percentile
Tier 3	Medium contrast (4–8)	15th to 85th percentile
Tier 4	Low contrast (<4)	15th percentile to maximum observation

[a] Relative range of the entire time series of escapement data calculated by dividing the maximum observed escapement by the minimum observed escapement.

Clark et al. (2014) recently provided a comprehensive evaluation of the percentile approach as a scientifically defensible method to estimate proxies for escapements that produce maximum sustainable yield (S_{MSY}). Clark et al. (2014) concluded:

> "All of [our] analyses indicate that the four tiers of the Percentile Approach are likely sub-optimal as proxies for determining a range of escapements around S_{MSY}. The upper bounds of SEGs developed with this approach may actually be unsustainable in that they may specify spawning escapement that is close to or exceeds the carrying capacity of the stock. The lower bound percentile of SEG Tier 1 (25%) also appears somewhat higher than necessary. Escapements in the lower 60 to 65 percentiles are optimal across a wide range of productivities, serial correlation in escapements, and measurement error in escapements."

As a result of their evaluation, Clark et al. (2014) recommended replacing the four tiers with three new tiers that appear to represent reasonable proxies for S_{MSY} for stocks with low to moderate (≤40%) average harvest rates (Table 7). In addition, Clark et al. (2014) recommended that the percentile approach *not* be used for stocks which experience harvest rates greater than 40%; instead, they recommended making improvements in stock assessment so that goals could be based on productivity models. If, however, the percentile approach is used for stocks with average harvest rates greater than 40% they suggested that the lower bound should be set no lower than the 25th percentile to avoid potential overfishing and the upper bound should be set at the 75th percentile or greater, regardless of the level of measurement error.

Table 7.–Criteria used to estimate sustainable escapement goals for stocks with low to moderate (<40%) average harvest rates (Clark et al. 2014).

Tier	Escapement Contrast and Measurement Error	Sustainable Escapement Goal Range
Tier 1	High contrast (>8); high measurement error (aerial and foot surveys)	20th to 60th percentiles
Tier 2	High contrast (>8); low measurement error (weirs, towers)	15th to 65th percentiles
Tier 3	Low contrast (≤8)	5th to 65th percentiles

Yield Analysis—Graphical or tabular examination of yields produced from observed escapements or escapement indices from which the escapement range with the greatest yields is identified (Hilborn and Walters 1992). In Southeast Alaska, this method has been used to establish escapement goals for pink salmon in the Northern Southeast Outside, Northern Southeast Inside, and Southern Southeast subregions.

STOCK ASSESSMENT OVERVIEW

The Southeast Alaska region encompasses all coastal waters and inland drainages entering the Gulf of Alaska from Dixon Entrance north and west to Cape Suckling. Salmon runs within the region can be divided into three groups: the Yakutat area (Cape Fairweather to Cape Suckling), the Southeast area (Dixon Entrance to Cape Fairweather), and transboundary rivers that flow from Canada and into Alaska. Stock assessment and escapement goal development for transboundary Alsek, Taku, and Stikine river salmon runs is conducted jointly by ADF&G, Department of Fisheries and Oceans Canada, and several Canadian First Nations groups, through the Transboundary Technical Committee (TTC) of the Pacific Salmon Commission (PSC). These projects include estimation of stock-specific harvests and drainagewide escapement estimates based on mark–recapture studies, weir counts of some tributary stocks, and postseason run-reconstruction analyses of fishery data. Detailed overviews of transboundary river escapement estimation projects are outlined in annual management plans (e.g., TTC 2014). Stock assessment and escapement goal development for other non-transboundary stocks of salmon is conducted by ADF&G, reviewed by the BOF, and in some cases, additionally reviewed by the PSC.

Chinook Salmon

In Southeast Alaska, Chinook salmon are known to occur in 34 rivers (Kissner 1978). Assessment programs are currently in place to estimate spawning escapements in 11 of these rivers (Situk, Alsek, Chilkat, Taku, King Salmon, Stikine, Unuk, Chickamin, Blossom, and Keta rivers and Andrew Creek) that serve as indicator stocks for Southeast Alaska Chinook salmon production. Stock specific information for these indicator stocks, including current and historical escapements, escapement goals, and stock status can be found in Appendix A.

In the mid-1970s it became apparent that many Chinook salmon stocks in Southeast Alaska were depressed relative to historical levels of production (Kissner 1978), and a management plan was implemented that closed commercial and recreational fisheries in terminal and near-terminal areas in U.S. waters. A 15-year (roughly three life-cycles) Chinook salmon rebuilding program was formally established by ADF&G in 1981 (ADF&G 1981). The program used regionwide, all-gear catch ceilings for Chinook salmon, designed to rebuild spawning escapements by 1995. This rebuilding program was incorporated into a comprehensive coastwide rebuilding program for all wild stocks of Chinook salmon, under the auspices of the U.S./Canada Pacific Salmon Treaty.

During the rebuilding program, ADF&G established interim point escapement goals for the 11 indicator stocks in Southeast Alaska, based on the highest observed escapement count prior to 1981. Biological escapement goal ranges based on more rigorous analyses have subsequently been established for all indicator stocks (Table 1). Escapement goals for the three transboundary river stocks (Taku, Stikine, and Alsek rivers) have additionally been reviewed and accepted by the Chinook Technical Committee (CTC) and Transboundary Panel of the Pacific Salmon Commission, and the Department of Fisheries and Oceans Canada, Centre for Science Advice

Pacific. Revised escapement goals for the other eight stocks have also been reviewed and accepted by the CTC; some goals have been revised after initial acceptance.

Escapements to the 11 indicator systems are monitored and estimated using river-specific approaches, which are described here. Escapements are enumerated annually using weirs operated on the Klukshu River (in the Alsek River drainage) and the Situk River. Escapements are estimated using mark–recapture experiments on the Chilkat, Taku, and Stikine rivers, and using survey counts on the King Salmon, Chickamin, Unuk, Blossom, and Keta rivers and Andrew Creek. Escapement estimates in the Alsek River include fish age-1.2 and older, and escapement estimates for the other 10 indicator stocks are germane to large fish (Chinook salmon ≥660 mm mid-eye to fork of tail length), which in most systems include fish age-1.3 and older. In Southeast Alaska, nearly all female Chinook salmon are age-1.3 and older, whereas younger Chinook salmon (age-1.1 and age-1.2 fish) are predominantly precocious males or "jacks".

Among the 11 Southeast Alaska Chinook stocks that are monitored for escapement, there are 4 stocks (Chilkat, Taku, Stikine, and Unuk rivers) for which a full stock assessment is performed. This includes coded-wire-tagging juveniles and smolt, which provide estimates of smolt abundance, and estimates of harvest by gear, area, and time in mixed stock commercial and sport fisheries. These data, when paired with spawning abundance estimates, create estimates of marine (smolt-to-adult) survival, total return, and exploitation rates for these 4 Chinook stocks.

Southeast Chinook salmon stocks can be classified into two broad categories, inside-rearing (mostly within Southeast Alaska waters) and outside-rearing (Gulf of Alaska and Bering Sea), based on ocean migrations. Outside-rearing stocks spend limited time rearing in marine waters in Southeast Alaska and are harvested primarily during their return spawning migrations in the spring and early summer (mid-March through June). These stocks include Chinook salmon returning to the Situk, Alsek, Taku, and Stikine rivers. Inside-rearing stocks are more vulnerable to harvest in Southeast Alaska and northern British Columbia fisheries as immature fish as well as during their ocean migrations as mature fish, and include the other seven Southeast indicator stocks. These stocks include Chinook salmon returning to the Chilkat, King Salmon, Unuk, Chickamin, Blossom and Keta rivers and Andrew Creek. Note that there is some overlap in ocean migrations within these two broad classifications. Most Southeast Alaska and transboundary river indicator stocks produce primarily yearling smolt, which are fish having spent two winters in the freshwater environment. Exceptions occur in the Situk River, which produces mostly sub-yearling smolt, which spend only one winter in the freshwater, and in the Keta and Blossom rivers, which produce around 10% sub-yearling smolt.

Sockeye Salmon

Sockeye salmon harvested in Southeast Alaska originate from three sources: coastal lakes and rivers, transboundary rivers that flow through Canada and into Alaska (e.g., the Alsek, Taku, and Stikine rivers), and Canadian river systems whose returning adult salmon migrate through U.S. waters (e.g., the Nass and Skeena rivers). Although there are more than 200 systems within Southeast Alaska that produce sockeye salmon, most are small and comprehensive stock assessment projects that provide detailed information on escapement and harvest are limited to the largest producers, including the Chilkat and Chilkoot systems in Lynn Canal and the transboundary Alsek, Taku, and Stikine rivers. Lack of long-term monitoring information, particularly regarding harvests, which often occur in mixed stock commercial net fisheries, greatly limits potential for development of escapement goals for the many smaller systems

(Geiger et al. 2004). Long-term escapement monitoring projects have been maintained at Chilkat, Chilkoot, Redoubt, Speel, McDonald, and Hugh Smith lakes. In the Yakutat area, sockeye salmon escapements have been measured with a weir at the Situk River since 1976, but most other Yakutat area sockeye salmon systems have been assessed through survey counts. Escapement goals are currently established for three Yakutat area stocks (Lost, Situk, and East Alsek-Doame), five transboundary river stocks (Alsek, Klukshu, Taku, Stikine, and Tahltan), and six other Southeast stocks (Chilkat, Chilkoot, Speel, Redoubt, McDonald, and Hugh Smith) (Table 2; Appendix B).

Coho Salmon

Excellent coho salmon habitat occurs in thousands of streams distributed throughout Southeast Alaska, many of which are small producers about which little is known. Due to the abundant and widely distributed nature of the resource, stock assessment projects occur on only a small fraction of producing streams. Assessment is further challenged by the wet coastal climate of the region, including frequent freshets during the fall months when spawners return to freshwater. The majority of the harvest is taken in mixed stock fisheries in areas distant from natal streams. In addition to wild stocks within Southeast Alaska, important contributions to the region's total harvest are made by local hatchery stocks (13 total), several transboundary rivers, and by natural systems and hatcheries on the northern British Columbia coast. Overall, 14 systems or groups of systems have escapement goals, including 10 with biological escapement goals and 4 with sustainable escapement goals (Table 3; Appendix C). Most direct stock assessment occurs at two levels: full indicator stock and escapement indicator.

Full indicator stocks are monitored for spawning escapement and are coded-wire-tagged as smolts, which provides estimates of total adult abundance and spawning escapement (including age, size, and sex), smolt production (abundance, age, and size), marine survival, fishery contributions (by area, gear type, and time), and exploitation rates. Over time, these parameters are used to evaluate the relationship between spawning escapement and production and to establish biological escapement goals that produce maximum sustained yield. Annual estimates for these parameters extend from the early 1980s for 4 systems (Auke Creek, Berners River, Hugh Smith Lake, and Ford Arm Creek, the latter of which is no longer monitored) and were later expanded to include the Taku River in 1992 and the Chilkat River in 2000.

In addition to the full indicator stocks, a systematic escapement survey program was developed to assess coho salmon spawning abundance in individual streams and aggregates of index streams. Escapement indicators have been established in the Haines, Juneau, Sitka, Ketchikan, and Yakutat areas where foot, helicopter, or boat surveys are systematically conducted. Escapement goals for surveyed streams near Sitka and Ketchikan apply to the sum of peak survey counts on aggregates of streams in each area (5 near Sitka and 14 near Ketchikan). Only peak survey counts that meet standards for timing, survey conditions, and completeness are included in the indices, and statistical interpolations are made for missing counts on individual streams to maintain comparability of the index across years. In the Juneau and Yakutat areas, survey-based escapement goals apply to individual streams (2 near Juneau and 3 near Yakutat). In the Haines area, peak survey counts at 4 tributaries are expanded to estimate total escapement to the Chilkat River.

Pink Salmon

Wild pink salmon spawn in more than 2,500 short, coastal streams in Southeast Alaska (Zadina et al. 2004). The vast majority of the pink salmon harvest takes place in mixed stock commercial fisheries in Southeast Alaska waters from Dixon Entrance, north to Cross Sound. Yakutat area pink salmon stocks are spatially segregated from the rest of Southeast Alaska and are harvested primarily in terminal, inriver commercial set gillnet fisheries (Clark 1995a). The majority (96%) of the pink salmon harvest in Southeast Alaska occurs in commercial purse seine fisheries, which are managed through extensive inseason monitoring of harvests, fishing effort, and movement of pink salmon into spawning streams (Van Alen 2000; Zadina et al. 2004).

Because pink salmon production in Southeast Alaska is broadly dispersed, assessment of escapements has been based on aerial surveys. Peak aerial survey counts of 714 streams in the region are used to generate an annual escapement measure, or index of abundance, upon which pink salmon escapement goals are based (Piston and Heinl *in prep* b). Southeast Alaska pink salmon are largely harvested in mixed stock fisheries, so it is not possible to allocate harvests of pink salmon to stock group of origin at any finer scale than subregion. Therefore, escapement goals for Southeast Alaska pink salmon have been established for aggregates of pink salmon runs in three broad subregions (Table 4; Appendix D; Zadina et al. 2004). The Southern Southeast Subregion includes 366 index streams from Sumner Strait south to Dixon Entrance (Districts 1–8), the Northern Southeast Inside Subregion includes 307 index streams located on inside waters north of Sumner Strait (Districts 9–12, 14–15, and District 13 subdistricts 51–59), and the Northern Southeast Outside Subregion includes 41 index streams located on the outside waters of Chichagof and Baranof islands in northern Southeast Alaska (District 13, excluding Peril Straits and Hoonah Sound subdistricts 51–59). Management and assessment of Yakutat area pink salmon stocks has occurred consistently only for the Situk River, one of the larger pink salmon producers in the Yakutat area (Clark 1995a) and the only Yakutat pink salmon stock with an escapement goal (Table 4; Piston and Heinl *in prep* b).

Chum Salmon

There are more than 1,200 streams and rivers in Southeast Alaska for which ADF&G has a record of at least one annual adult chum salmon spawning count since 1960, and counts of 1,000 or more chum salmon were obtained at approximately 450 of those streams prior to 1985 (Piston and Heinl *in prep* a). Of the chum salmon populations that have been consistently monitored, most have been monitored through aerial surveys, though small numbers have been monitored annually by foot surveys. Inriver fish wheel counts have been used to monitor salmon escapements to the Taku and Chilkat rivers, which are large glacial, mainland river systems. Stock-specific harvest information is not available for the vast majority of wild chum salmon stocks in Southeast Alaska, which are predominantly harvested in mixed stock fisheries. Some fall chum salmon runs are harvested directly in terminal or near-terminal fisheries, which allows for some accounting of stock-specific harvest; however, in many cases these fall-run fish also migrate through mixed stock fisheries where stock composition of the harvest may not be known.

Southeast Alaska chum salmon index streams were grouped into appropriate stock groups by area and run-timing based on marine-tagging and genetic studies (Eggers and Heinl 2008). Chum salmon populations in Southeast Alaska are generally divided into two runs based on migration timing: summer-run fish spawn during the period mid-July to mid-August and fall-run fish

spawn in September or later. Southeast Alaska summer-run chum salmon index streams were grouped into three stock groups that comprise aggregates of index streams across broad subregions, upon which lower bound sustainable escapement goals are based (Table 5; Appendix E; Piston and Heinl *in prep* a): the Southern Southeast Subregion includes 15 index streams (Districts 1–7); the Northern Southeast Inside Subregion includes 63 index streams (Districts 8–12, 14–15, and District 13 subdistricts 51–59); and the Northern Southeast Outside Subregion includes nine index streams (District 13, excluding Peril Straits and Hoonah Sound subdistricts 51–59). Southeast Alaska fall-run chum salmon index streams were grouped into stocks that support terminal commercial fisheries or have supported fisheries in the past. Fall-run stocks with sustainable escapement goals include Cholmondeley Sound, Security Bay, Port Camden, Excursion Inlet, and the Chilkat River (Table 5; Appendix E).

ESCAPEMENT GOAL RECOMMENDATIONS

The Southeast escapement goal review committee recommended that 12 of 52 escapement goals be changed, replaced, or eliminated (Tables 1−5). Summaries of these specific reviews and recommendations are provided in the accounts below. Escapement goal reviews conducted for several additional stocks are also summarized below, though no changes were subsequently recommended. Reviews of Chilkat and Chilkoot lake sockeye salmon, in particular, were substantially different from previous analyses and provided new information regarding potential for current escapement goals to provide for maximum sustained yield. Escapement goals not listed below remained status quo.

Chinook Salmon:

Chickamin, Blossom, and Keta Chinook Salmon

Escapements of large Chinook salmon in the Chickamin, Blossom, and Keta rivers have been monitored through standardized helicopter surveys conducted annually since the 1970s. Biological escapement goals and escapement performance for all three have been expressed in survey count units, rather than estimated escapements (Der Hovanisian et al. 2011), though expansion factors based on mark–recapture population studies were developed for each system to convert survey counts into estimates of total escapement. Those expansion factors met standards established by the U.S. and Canada in the PSC CTC and escapement performance for these stocks, as with all other Southeast Alaska Chinook salmon indicator stocks, have been reported in terms of total escapement. The escapement goal review committee recommended that biological escapement goal ranges for the Chickamin, Blossom, and Keta be formally converted to total escapement to be consistent with reporting of other Southeast Alaska Chinook salmon stocks and to conform to reporting in the PSC CTC.

The current biological escapement goal for the Chickamin River is a range of 450 to 900 large fish counted on a peak index survey (McPherson and Carlile 1997). An expansion factor of 4.75 was developed from a comparison of mark–recapture studies and concurrent peak index survey counts conducted in six years (1996 and 2001–2005; Weller et al. 2007). The escapement goal range converts to a total escapement range of 2,138 to 4,275 fish when multiplied by the expansion factor. As a result, the escapement goal review committee recommended the biological escapement goal range be changed to estimated total escapements of 2,150 to 4,300 large fish.

The current biological escapement goal for the Blossom River is a range of 150 to 300 large fish counted on a peak index survey (Fleischman et al. 2011). An expansion factor of 3.87 was developed from a comparison of mark–recapture studies and concurrent peak index survey counts conducted in four years (1998 and 2004–2006; Fleischman et al. 2011). The escapement goal range for this stock was originally based on index counts of 122 to 358 fish, which were later rounded (Fleischman et al. 2011). The unrounded index range converts to a total escapement range of 472 to 1,385 fish when multiplied by the expansion factor. As a result, the escapement goal review committee recommended the biological escapement goal range be changed to estimated total escapements of 500 to 1,400 large fish.

The current biological escapement goal for the Keta River is a range of 175 to 400 large fish counted on a peak survey. An expansion factor of 3.01 was developed from a comparison of mark–recapture studies and concurrent peak index survey counts conducted in three years (1998–2000; Fleischman et al. 2011). The escapement goal range for this stock was originally based on index counts of 179 to 436 fish, which were later rounded (Fleischman et al. 2011). The unrounded index range converts to a total escapement range of 539 to 1,312 fish when multiplied by the expansion factor. As a result, the escapement goal review committee recommended the biological escapement goal range be changed to estimated total escapements of 550 to 1,300 large fish.

Klukshu (Alsek) River Chinook Salmon

The Klukshu River is a tributary of the Alsek River, a large transboundary river located on the mainland, approximately 80 km southeast of Yakutat, Alaska. In 1998, a biological escapement goal of 1,100 to 2,300 Chinook salmon was established for the Klukshu River (McPherson et al. 1998). In 2013, the goal was revised to a biological escapement goal of 800 to 1,200 fish and a corresponding drainagewide biological escapement goal of 3,500 to 5,300 fish was adopted for the Alsek River, based on run-reconstruction and stock-recruit analysis (Bernard and Jones 2010; TTC 2014). The drainagewide Alsek River escapement is estimated through simple linear expansion of the Klukshu River weir count. An expansion factor of 4.0 was developed from concurrent mark–recapture estimates and index weir counts from 1998 to 2004. The expansion factor met standards established by the U.S. and Canada in the PSC CTC, and escapement performance for the Alsek River, as with all other Southeast Alaska Chinook salmon stocks, has been reported to the CTC in terms of total drainagewide escapement. The escapement goal committee recommended eliminating the Klukshu River goal, which is redundant with the drainagewide Alsek River goal.

Sockeye Salmon:

Chilkoot Lake Sockeye Salmon

Chilkoot Lake, located on mainland Alaska approximately 13 km northeast of Haines, supports one of the largest runs of sockeye salmon in Southeast Alaska (Eggers et al. 2009b). Chilkoot Lake sockeye salmon are primarily harvested in the District 15 commercial drift gillnet fishery in northern Lynn Canal. Smaller, but unknown, portions of this run are also harvested in purse seine fisheries in Icy and northern Chatham straits (Ingledue 1989; Gilk-Baumer et al. 2015). In addition, several thousand Chilkoot Lake sockeye salmon are harvested in subsistence and sport fisheries each year. Escapement of sockeye salmon to Chilkoot Lake has been assessed annually with a weir located on the Chilkoot River since 1976, and estimates have ranged from 7,177 (1995) to 118,166 (2012), with a median of 72,678 (Bednarski et al. 2016). However, mark–

recapture studies conducted in 12 years averaged 1.73 times greater than weir counts (Bachman et al. 2014). Therefore, there is some uncertainty about the extent to which the weir has counted all sockeye salmon spawning in the Chilkoot system or whether mark-recapture methods might result in a significant overestimate. Scale pattern analysis has been used to apportion District 15 commercial harvests of sockeye salmon bound for Chilkoot Lake and other systems in the area (McPherson 1990), and the estimated annual harvest of the Chilkoot Lake component has ranged from 2,838 (1998) to 327,323 (1987), with a median harvest of 61,833 and estimated harvest rates of 18–84% (median of 46%).

The current sustainable escapement goal range of 38,000–86,000 sockeye salmon was established in 2009, based on stock-recruit analysis of the 1976–2003 brood years (Eggers et al. 2009b). Eggers et al. (2009b) used an autoregressive Ricker model optimized using maximum likelihood, and the recommended escapement goal range was expected to produce at least 90% of maximum sustained yield over the long term. Eggers et al. (2009b) opted for a sustainable goal rather than a biological goal due to the uncertainty in harvest and escapement estimates and large fluctuations in the productivity of this system over time, possibly as a result of density dependence of juvenile sockeye salmon in Chilkoot Lake in association with environmental drivers.

Brenner et al. (*in prep.*) reviewed and updated Chilkoot Lake sockeye salmon stock assessment information with escapement and return data from brood years 1976–2010. Similar to the Eggers et al. (2009b) analysis, significant correlation of recruitment parameters at a lag of 1 year dictated the use of an autoregressive Ricker model (AR1); however, the updated analysis was constructed in a Bayesian framework. Based on analysis results, the Southeast escapement goal review committee recommended maintaining the existing sustainable escapement goal of 38,000–86,000 fish; a range of escapements estimated to provide a 57–93% probability of achieving at least 80% of maximum sustained yield, and a 39–85% probability of achieving at least 90% of maximum sustained yield, with the highest probabilities of achieving maximum yield at escapements of around 53,000 fish (Appendix Figure B7).

The current escapement goal is consistent with management considerations and sustained yield as defined in the sustainable salmon fisheries policy. A somewhat narrower range of escapements would increase the probability of achieving maximum sustainable yield. For example, escapements of 36,000–72,000 fish would result in an 80% probability of achieving at least 80% of maximum sustained yield. However, three large escapements (86,700–118,166) since 2012 will provide additional information about the productivity of this stock once recruits from these brood years return. The escapement goal will be reviewed again prior to the 2021 Board of Fisheries meeting to reassess available spawner-recruitment relationships.

Chilkat Lake Sockeye Salmon

Chilkat Lake, located approximately 44 river km upstream from the city of Haines, supports one of the largest runs of sockeye salmon in Southeast Alaska. Chilkat Lake sockeye salmon are primarily harvested in the District 15 commercial drift gillnet fishery in northern Lynn Canal. Smaller but unknown portions of the Chilkat run are harvested in the commercial purse seine fisheries that target pink salmon in Icy and northern Chatham straits (Ingledue 1989; Gilk-Baumer et al. 2015) and in subsistence fisheries in Chilkat Inlet and in the Chilkat River. As noted above, scale pattern analysis has been used to apportion District 15 commercial harvests of sockeye salmon bound for Chilkat Lake and other systems in the area (McPherson 1990). Chilkat

Lake sockeye salmon escapements have been estimated through weir counts (1967–1993), weir counts with concurrent mark–recapture estimates (1994 and 1995, 1999–2007), mark–recapture estimates only (1996–1998), and Dual-frequency Identification Sonar (DIDSON) counts with concurrent mark–recapture estimates (2008–2016) (Eggers et al. 2010; Sogge and Bachman 2014). Visual weir counts provided minimum estimates of escapement due to flow reversals, turbid water, and frequent lowering of a boat gate in the middle of the weir, all of which potentially allowed fish to pass undetected. Conversely, mark–recapture estimates may be greatly inflated, but may provide an index of escapement (Bednarksi et al. *in prep*). DIDSON counts are also considered minimum estimates of escapement due to undetected passage of small numbers of fish at night during flow reversals; however, confidence in DIDSON counts is much greater than in the visual weir counts.

The current biological escapement goal range of 70,000–150,000 sockeye salmon (Eggers et al. 2008, 2010) was established in 2009. Eggers et al. (2010) scaled weir counts to mark–recapture estimates, then fit a hierarchal set of stock-recruit models to the Chilkat River recruits from parental escapements of the 1979–2002 brood years using traditional stock-recruit analysis. The biological escapement goal is the escapement range estimated to produce ≥90% of maximum sustained yield as determined by an autoregressive Ricker (density dependence with first order autoregressive term) model that incorporated stocking of hatchery fry. This model was selected because it accounted for the bias in assessing wild stock production due to the added production from enhancement stocking of fry that occurred from 1989 to 2003 and was, therefore, considered the most meaningful biological model (Eggers et al. 2010).

In addition to the accumulation of more brood year returns since the escapement goal was last reviewed, all historical information associated with Chilkat Lake sockeye salmon stock assessment was recently reviewed, edited, and updated, including weir counts, DIDSON counts, fish wheel counts, age composition data, and mark–recapture and commercial harvest estimates (Bednarski et al. *in prep*). Bednarski et al. (*in prep*) recommended the escapement goal be reviewed to ensure that the goal, which was developed using mark–recapture estimates (Eggers et al. 2010), is in the same units as escapement counts, which will continue to be measured with the DIDSON. Miller and Heinl (*in prep*) fit age-structured state-space spawner-recruit models to 1976–2016 data on abundance, harvest, age composition, and coefficients of variation to examine the effect of autocorrelation and fry stocking on recruits, to account for multiple overlapping methods of escapement enumeration and missing data (age composition was considered unknown in the model for years 1996–1998 when the weir was not operated). DIDSON escapement counts were treated as the 'true' counts and the weir counts and mark–recapture estimates of escapement were treated as indices of escapement in the state-space models.

Despite the additional years of data (brood years 1976−2012), a more sophisticated age-structured model framework, a slightly different Ricker model form, and the exclusion of the fry stocking term, parameter estimates of spawning abundance that produce maximum sustained yield (S_{MSY}) were similar to those of Eggers et al. (2010). The estimated spawning abundance that produced maximum sustained yield from Eggers et al. (2010) was 105,000 spawners. The posterior median of escapement leading to maximum sustained yield from the output of the state-space model was 98,370 spawners (95% credibility interval 66,765–223,966 spawners). The probability of achieving 90% of maximum sustained yield (MSY) at the upper and lower bounds of the current escapement goal is estimated to be 62% and 34%, respectively (Appendix Figure

B10), and an average 65% over the entire escapement goal range. Yield would be maximized at escapements near S_{MSY} (near 84% probability of achieving 90% of MSY). These probabilities improve substantially with respect to achieving 80% of MSY. The escapement goal review committee recommended maintaining the current biological escapement goal of 70,000–150,000 fish counted with the DIDSON system at the Chilkat Lake weir site.

East Alsek-Doame River Sockeye Salmon

The East Alsek River is located on the Alsek River flood plain approximately 90 km southeast of Yakutat. Prior to the early 1900s, the East Alsek was a distributary channel of the Alsek River but is now fed by groundwater and has no direct connection to the Alsek River itself (Faber 2008). The Doame River, a clear water system with two lakes located just east of the East Alsek River, once entered the Gulf of Alaska directly, but a 1966 earthquake caused the river to flow west and empty into the East Alsek River (Clark et al. 2003).

Sockeye salmon are harvested in the commercial set gillnet fishery in the East Alsek River lagoon (statistical area 182-20), just below the confluence of the two rivers. Sockeye salmon escapements have been assessed through aerial surveys since the early 1970s (Appendix Table B1), although the Doame River was not surveyed as often as the East Alsek River, and in some years it was surveyed only once or not at all. In 1995, ADF&G established a biological escapement goal of 26,000–57,000 sockeye salmon counted on peak aerial surveys in the East Alsek and Doame rivers combined, based on a stock-recruit analysis (Clark et al. 1995b).

The East Alsek River sockeye salmon run has undergone dramatic response to environmental changes over the past 100 years due to rapid post-glacial uplift of the Alsek River flood plain. Smith et al. (2006) summarized this history: (1) colonization by sockeye salmon in the early 1900s, (2) adaptation to the environment (e.g., large "zero-check" population), (3) population explosion in the 1970s–1980s (average commercial harvest of more than 100,000 fish, 1980–1994), and (4) decline in the 1990s due to deteriorating habitat. Sockeye salmon escapements dropped below the escapement goal and the commercial fishery was closed from 1999 to 2002. Reduced production in the East Alsek River is thought to be the result of increased sedimentation and growth of aquatic vegetation through the 1990s. Flow from the much larger Alsek River was historically diverted into the East Alsek River during periodic flood events that flushed the river channel and maintained excellent spawning habitat. As the land is uplifted, the Alsek River becomes more deeply channelized and flooding of the East Alsek River has become increasingly infrequent (e.g., major floods since 1981 did not affect the East Alsek; Smith et al. 2006; Faber et al. 2006, Faber 2008). In 2003, the East Alsek-Doame river escapement goal was revised downward to a biological escapement goal of 13,000–26,000 sockeye salmon in response to greatly reduced production in the East Alsek River (Clark et al. 2003). The commercial harvest has averaged 11,000 fish since 2003 (Appendix Table B1) and fishing effort has declined substantially.

ADF&G fishery managers have pointed out the complication of managing for a combined East Alsek-Doame river escapement goal, because management of the commercial fishery has been based primarily on assessment of sockeye salmon run strength in the East Alsek River. The Doame River run is thought to be substantially smaller and earlier in run timing (Clark et al. 2003). Since 2003, when the commercial fishery resumed, maximum survey counts averaged 23,000 fish in the East Alsek River and 4,000 fish in the Doame River (Appendix Table B1).

The escapement goal review committee recommended the escapement goal be based on percentiles of East Alsek River sockeye salmon survey counts from 1999 to 2016, the period that best encompasses decreased production in the East Alsek River. Lack of total escapement estimates and stock-specific harvest estimates, and limited age composition data precluded escapement goal analysis based on production models. The East Alsek River sockeye salmon run fits the criteria for Tier 3 stocks (Table 7), as there is high measurement error and low contrast in escapement survey counts (the maximum count divided by the minimum count = 7.2). Approximate harvest rate averaged less than 30% since 2003, based simply on using raw survey counts as total escapement and assigning all harvest to the East Alsek River run; therefore, the true harvest rate has certainly been much lower. (The harvest rate on the Doame River stock is probably lower still, as a result of its earlier run timing.) The 5th and 65th percentiles of East Alsek River escapement counts since 1999 produced a range of 9,000–24,000 fish (rounded to the nearest thousand). The range is slightly lower than the current escapement goal due partly to removal of the Doame River counts from the analysis. The escapement goal review committee recommended eliminating the combined East Alsek-Doame river goal and replacing it with a sustainable escapement goal range of 9,000–24,000 sockeye salmon counted on a peak survey of the East Alsek River. An escapement goal based on the dominant East Alsek River sockeye salmon run would be more consistent with and simplify management of the set gillnet fishery.

Lost River Sockeye Salmon

The Lost River, located on the Yakutat forelands, approximately 12 km southeast of Yakutat, supports a relatively small sockeye salmon run that migrates into Tawah Creek, through Summit Lake, and into Ophir Creek where the fish spawn. Sockeye salmon escapements have been assessed primarily through boat and foot surveys since the early 1970s. In 1995, ADF&G established a biological escapement goal range of 1,000–2,300 sockeye salmon counted on a peak survey, based on a stock-recruit analysis (Clark et al. 1995b). The reported Lost River subsistence harvest from 1989 to 2016 totaled only 148 sockeye salmon, all years combined.

Prior to 1999, Lost River sockeye salmon were harvested in a commercial set gillnet fishery (average = 2,800 fish) at the mouth of the Lost River, which was located west of the mouth of the Situk-Ahrnklin Inlet. Because the fishery took place in the ocean surf and lagoon areas, a "considerable" portion of the commercial harvest likely consisted of fish bound for the Situk River (Thomason and Woods 1988). The Situk-Ahrnklin Inlet, which parallels the ocean shoreline, has slowly extended westward over time; it overlapped the Lost River mouth during the winter of 1998–1999 (Burkholder 2000) and the mouth of the inlet is now about 2 km west of the Lost River mouth. The Lost River discharges into the Situk-Ahrnklin Inlet, rather than directly into the Gulf of Alaska, and Lost River salmon are now harvested incidentally in the Situk-Ahrnklin commercial set gillnet fishery, the oldest and most productive commercial fishery in the Yakutat Area (Woods and Zeiser 2010). This change made it impossible to manage the commercial fishery for a goal specific to the Lost River because peak survey counts are usually obtained well after the peak of sockeye salmon harvest in the commercial fishery. Since 1999, an area 100–500 yards on either side of the mouth of the Lost River has been closed to commercial fishing to conserve Lost River sockeye and coho salmon (5 AAC 30.350(a)(7)) (Woods and Zeiser 2010). In 2009 the escapement goal was revised to the current lower bound sustainable escapement goal of 1,000 sockeye salmon counted on a peak survey (Eggers et al. 2008).

The Lost River sockeye salmon escapement goal was to be reviewed using the percentile approach, as little information exists regarding stock composition of the harvest and age

composition of the run. Escapement information is limited to survey counts which have been conducted nearly annually since the early 1970s. Survey methods, however, were not standardized; the survey type (aerial, foot, boat), area (Tawah Creek, Ophir Creek, or Summit Lake, or combinations of multiple areas), and timing have varied considerably. As a result, the annual peak survey counts used to establish the escapement goal (Appendix Figure B2) are not comparable. In addition, it was not possible to reconstruct a set of reasonably comparable escapement counts from historical survey data with which to revise the escapement goal. Survey effort was standardized beginning in 2015 as a result of this review and previous review of the Tawah Creek coho salmon escapement goal (Heinl et al. 2014). For these reasons, the escapement goal review committee recommended eliminating the Lost River sockeye salmon escapement goal. The goal could be reviewed again in the future if a long series of standardized, comparable survey counts can be compiled.

Alsek River Sockeye Salmon

The Alsek River is a large transboundary river located on the mainland, approximately 80 km southeast of Yakutat, Alaska. In 2013, biological escapement goals were adopted for sockeye salmon from the transboundary Alsek River and the Klukshu River, a tributary of the Alsek River (Eggers and Bernard 2011, TTC 2014). Alsek River sockeye salmon escapement estimates have been based on an expansion of genetic stock identification information from the U.S. commercial set gillnet fishery in Dry Bay and Klukshu River weir counts (TTC 2017). Alsek River escapement estimates are only available for recent years, and the genetic stock identification information has not been provided on a timely basis (e.g., the 2016 estimate was not available for this review). As a result, the Alsek River sockeye salmon escapement goal and escapement estimates were not reported in previous ADF&G escapement goal reviews (Heinl et al. 2014a). In addition, the management approach for Alsek River sockeye salmon continues to be focused on meeting the Klukshu River escapement goal as measured at the Klukshu River weir (TTC 2017). The escapement goal review committee recommended eliminating the Alsek River sockeye salmon escapement goal based on management considerations and lack of timely information with which to measure the goal.

Coho Salmon:

Berners River Coho Salmon

The Berners River is located on the mainland in Lynn Canal, approximately 70 km northwest of Juneau, Alaska. A biological escapement goal range of 4,000–9,200 spawners using survey count data was established for the Berners River in 1994 based on a Ricker stock-recruit analysis (Clark et al. 1994). This goal has since been met or exceeded in all years except for 2007. Several factors indicate that a review of the goal is appropriate including: (a) accumulation of over two decades of additional observations; (b) development of spawner-recruit models that are more consistent with the biology of coho salmon compared with the classic Ricker model; and (c) development of a method for calibrating the survey count to total escapement.

Unique features of the Berners River system and its spawning population enable enumerating a high proportion of total escapement during a foot and helicopter survey in late October, and the survey count has been used to represent total escapement (Clark et al. 1994). However, in the current spawner-recruit analysis, the count was expanded to estimate total escapement. The annual survey count was multiplied by a constant expansion factor of 1.241 based on an assumed equal troll harvest rate, on average, between the Berners River and nearby Auke Creek, where

returning adults are enumerated at a weir. The Auke Creek population closely matches the Berners River stock in the temporal and geographic distribution of harvest by the troll commercial fishery.

The current analysis (Shaul et al. *in prep*) is based on estimated escapements and returns for the 1989–2010 brood years. The analysis was limited to this later period because escapement survey efficiency appeared to have stabilized after 1988 and because a transition from coded-wire tagging of presmolts (with over 10 months of freshwater residence remaining) to tagging of migrating smolts after 1988 resulted in dramatic improvement in the precision of harvest estimates and a clear delineation between freshwater and marine effects. Adult runs to the Berners River have been highly variable, decreasing sharply from a 15-year period of high smolt production coincident with high marine survival during 1990–2004 to a post-2004 period when both smolt abundance and marine survival averaged substantially lower. Brood year production during both periods appeared largely unaffected by variation in escapement.

Marine survival was standardized to a constant rate for all brood years under the assumption that marine survival is independent of spawner abundance, a common assumption for coho salmon but not all species. A hockey stick production model (Bradford et al. 2000) was fit to both freshwater "regimes" including an earlier warm period (1989–1999) and a later cool period (2000–2010), as well as the full series, at constant marine survival rates that simulate varying ocean regimes including low marine survival (bottom quintile: 9.5%), high survival (top quintile: 25.4%), and average survival (16.3%).

Annual estimates of the number of spawners (i.e., nominal escapement) were standardized to a constant average per capita reproductive capacity in order to estimate "effective escapement" for each brood year. Per capita egg biomass was used to represent per capita reproductive potential, and was computed as a function of (a) the proportion of females in the spawning escapement and (b) their average egg biomass (a function of female size). Per capita reproductive potential of spawners has been highly variable and positively correlated with marine survival, leading to greater variation in effective spawning escapement compared with nominal escapement (Shaul and Geiger 2016; Shaul et al. *in prep*).

Although the intent is to compare only unadjusted nominal estimates of escapement against the biological escapement goal, the recommended lower goal bound was increased by 26% to account for a pattern of lower per capita egg biomass in years when returns (and potential escapements) were low. The recommended upper goal bound is based on analysis for a period of favorable freshwater conditions (1989–1999 brood years) combined with assumed high marine survival (average for the upper quintile) to insure that the biological escapement goal will encompass optimal escapement during a period of favorable conditions. The recommended biological escapement goal for the expanded survey count is 4,500–10,000 spawners. After adjusting for the survey expansion factor, the biological escapement goal for the unexpanded survey count is 3,600–8,100 spawners.

Tsiu-Tsivat River Coho Salmon

Coho salmon runs in the Tsiu and Tsivat rivers, located approximately 190 km northwest of Yakutat, are harvested primarily in the commercial set gillnet fishery that takes place in the estuary immediately below where the two rivers meet (statistical area 192-42). The commercial set gillnet harvest averaged 39,574 coho salmon from 1973 to 2016. Tsiu-Tsivat river coho salmon are also harvested in inriver sport fisheries and offshore commercial troll fisheries (Clark

and Clark 1994). Escapement information consists of aerial survey counts, which have been conducted weekly since the early 1970s in conjunction with management of the commercial fishery. Both rivers are surveyed to obtain a total index count (Zeiser 2015). In 1994, ADF&G established a biological escapement goal range of 10,000–29,000 coho salmon counted on a peak survey, based on a stock-recruit analysis (Clark and Clark 1994).

The Tsiu-Tsivat river escapement goal was reviewed using the percentile approach as stock assessment information is limited primarily to maximum survey counts (Appendix Table C2). Lack of total escapement estimates, limited age composition data, and incomplete commercial troll harvest estimates precluded escapement goal analysis based on production models. The Tsiu-Tsivat river coho salmon run fits the criteria for Tier 3 stocks (Table 7), as there is high measurement error and low contrast in escapement survey counts (the maximum count divided by the minimum count = 6.7). Harvest information is incomplete but the harvest rate has likely averaged less than 40%. Potential harvest rate was assessed in two steps. Escapement survey counts were multiplied by 3, the lowest ratio of peak survey counts to total escapement estimated at two other Yakutat-area coho salmon streams (Appendix Table C1), to provide a conservative approximation of total escapement. Known terminal harvest (set gillnet and sport) was then divided by harvest + total escapement to approximate harvest rate, which averaged 32%. The commercial troll harvest rate in 1986, the only year that information is available, was thought to be 8% (Clark and Clark 1994); however, the commercial troll harvest rate on Situk River coho salmon (another Yakutat-area run) was estimated to be 3% in 2005 and 5% in 2006 (Shaul et al. 2010), and was likely to have been even lower on Tsiu-Tsivat river coho salmon. It is highly probable, therefore, that the annual harvest rate on Tsiu-Tsivat river coho salmon has averaged less than 40%.

The 5th and 65th percentiles of Tsiu-Tsivat river coho salmon escapement survey counts produced a range of 10,940–30,000 fish, which is very close to the current escapement goal of 10,000–29,000 fish. The current escapement goal was met or exceeded in every year since 1973, with the exception of years when survey effort was curtailed by inclement weather. The escapement goal review committee recommended maintaining the current escapement goal of 10,000–29,000 coho salmon counted on a peak aerial survey, but recommended reclassifying the goal from a biological to a sustainable escapement goal based on percentiles of historical survey counts.

Ford Arm Creek Coho Salmon

Funding for salmon stock assessment at Ford Arm Lake was eliminated in 2016 due to state budget cuts. The review committee recommended eliminating the biological escapement goal for Ford Arm Creek coho salmon because the run is no longer monitored. The department would recommend reestablishing the goal if the stock assessment program is resurrected in the future.

Pink Salmon:

Situk River Pink Salmon

The Situk River is located approximately 15 km southeast of Yakutat. Situk River pink salmon are harvested in the Situk-Ahrnklin commercial set gillnet fishery, which has been managed primarily to harvest sockeye and coho salmon (Clark 1995a). In 1995, ADF&G established biological escapement goal ranges for even- and odd-year runs of Situk River pink salmon of 42,000–105,000 fish and 54,000–200,000 fish, respectively (Clark 1995a). Pink salmon have

been counted annually at the Situk River weir since 1976, and more sporadically during boat surveys, which have been conducted annually to count coho salmon. Weir counts greatly underestimated escapements in all years (Piston and Heinl 2011a). Prior to 1988, the weir was located 13.5 river miles upstream and counts did not include pink salmon spawning between the weir and the river mouth. The weir was moved to the lower river in 1988, but since 1991 it has been operated primarily to count Chinook and sockeye salmon. The weir has been removed once the sockeye salmon run has ended in early to mid-August, well before the pink salmon run peaks in late August–early September. Survey counts of pink salmon, available for only eight years since 1995, averaged three times greater than weir counts despite covering only part of the available spawning area.

In 2012, ADF&G adopted the current lower bound sustainable escapement goal of 33,000 pink salmon counted at the weir through 5 August in an effort to provide a consistent early season index of abundance and to maintain a goal for fisheries management (Piston and Heinl 2011a). In practice, however, the escapement goal has not been useful for management, because pink salmon escapement changes too dramatically in early August (e.g., more than 200% on average in just the first 5 days of August) for weir counts to provide a meaningful indication of overall abundance. Management options for maximizing the harvest of Situk River pink salmon are limited due to overlap in run timing with more valuable sockeye and coho salmon (Clark 1995a; Woods and Zeiser 2010). In recent years, there has been little economic incentive to harvest pink salmon, and harvest rates are probably very low (the harvest rate has averaged less than 10%, assuming 100% of the harvest is of Situk River origin and boat survey counts average one third of the total pink salmon escapement). The escapement goal review committee recommended eliminating the Situk River pink salmon escapement goal, given the limited utility of available escapement information and the low harvest rates on this stock.

Northern Southeast Inside Subregion Pink Salmon

As part of regular review of pink salmon escapement indices, 12 index streams were identified for removal from the Northern Southeast Inside Subregion pink salmon escapement index, because the streams are not surveyed regularly due to poor visibility from the air or due to their proximity to busy flight corridors in the Juneau area (Appendix Table D1; Piston and Heinl *in prep* b). Removal of these streams reduced the number of streams in the Northern Southeast Inside Subregion pink salmon escapement index from 307 to 295 streams and reduced the average 1960–2016 index value by about 1%. The change was too small to require modification of the Northern Southeast Inside Subregion escapement goal, but did require minor adjustments to management targets for districts and stock groups within the subregion (Piston and Heinl *in prep* b). As stated by Zadina et al. (2004), recommended escapement goals by subregion are considered to be biological escapement goals, whereas recommended escapement targets, by district and by stock group, are considered to provide an aid to management in achieving subregion escapement goals.

Chum Salmon:

Southeast Alaska chum salmon escapement goals, nearly all of which are based on the 25th to 75th percentiles of historical escapement indices, were reviewed (Piston and Heinl *in prep a*) to determine if changes are required with respect to the new percentile approach outlined by Clark et al. (2014). Southeast Alaska chum salmon stocks fit the criteria of Tier 1 stocks (Table 7), as there is high measurement error and high contrast (>8) in available escapement data. Harvest

rates on chum salmon, however, are poorly known but are assumed to be moderate (Eggers and Heinl 2008) and possibly exceed 40% in many cases for both summer-run and fall-run fish (Piston and Heinl *in prep* a). Therefore, sustainable escapement goals for chum salmon should continue to be based on the 25th percentile (for lower bound goals) or 25–75th percentiles of historical escapement index counts—a precautionary approach recommended by Clark et al. (2014) for stocks that experience average harvest rates ≥40%.

Summer-run Chum Salmon

The 25th percentiles of escapement indices for summer-run chum salmon were calculated using all available data (1960–2016 for Northern Southeast Inside and Southern Southeast subregions; 1982–2016 for Northern Southeast Outside Subregion; Piston and Heinl *in prep* a). The escapement goals for the Southern Southeast and Northern Southeast Outside subregions were modified in 2015 (using data through 2013; Piston and Heinl 2014a) and, as a result, the newly calculated 25th percentiles were the same as the current lower bound sustainable escapement goals (Table 5). The 25th percentile of Northern Southeast Inside Subregion index counts was 107,000 index fish, 10% lower than the current lower bound escapement goal of 119,000 index fish. Although it will result in only a small change to the Northern Southeast Inside Subregion escapement goal, the escapement goal committee recommended updating lower bound sustainable escapement goals for summer-run chum salmon using escapement survey data over all years available through 2016, which will be considered the set of baseline years for each subregion. Escapement goals will remain unchanged into the future unless streams are added or removed from the indices or stock assessment improves to a point that more rigorous escapement goal development methods can be used to review escapement goals. Note that the small reduction to the Northern Southeast Inside Subregion escapement goal does not change the escapement goal performance over the past 5 years (Appendix E2).

Fall-run Chum Salmon

The 25–75th percentile ranges of escapement indices for fall-run chum salmon stocks at Cholmondeley Sound, Port Camden, Security Bay, and Excursion River were calculated using all available data through 2016 (Piston and Heinl *in prep* a). For the Cholmondeley Sound, Security Bay, and Port Camden stocks, the newly calculated 25th percentiles were identical to the lower bounds of current escapement goals (Table 5), and differences between the newly calculated 75th percentiles and the upper bounds of current escapement goals were too small to warrant changes to the goals. Conversely, newly calculated percentiles of Excursion River escapement indices were lower (3,000–12,000) than the current sustainable escapement goal (4,000–18,000). A combination of poor stock assessment information, potentially high harvest rates in the terminal area, and general declines in fall-run chum salmon in northern Southeast Alaska since the mid- to late 1980s suggests revising (lowering) the goal would be potentially risky. Maintaining the current goal will likely have little impact on management of the directed fishery and offers an extra degree of stock protection. Despite the lower runs since the late 1980s, the current Excursion River goal has not been missed in more than two consecutive years since 1990 (Appendix E8).

SUMMARY

The Southeast escapement goal review committee recommended that 12 of 52 escapement goals be changed, replaced, or eliminated. A total of 47 Southeast Alaska escapement goals would be established for 11 Chinook, 12 sockeye, 13 coho, 3 pink, and 8 chum salmon stocks as a result of

these recommendations. Committee recommendations were reviewed by ADF&G regional and headquarters staff prior to adoption as escapement goals. Brief overviews of stock assessment, escapement goal history, and escapement goal performance through 2016 are provided in Appendices A–E for all stocks with formal escapement goals. Specific details regarding the escapement goals currently in place for each stock can be found in the reports cited within these appendices.

ACKNOWLEDGMENTS

We would like to thank the members of the Southeast escapement goal review committee and all the people who provided advice and information used in this report: Jim Andel, Julie Bednarski, Bob Clark, Lowell Fair, Steve Fleischman, Scott Forbes, Dave Harris, Jim Hasbrouck, Troy Jaecks, Judy Lum, Brian Marston, Andrew Munro, Mark Sogge, Bill Templin, Gordie Woods, Jeff Williams, and Nicole Zeiser. We also thank Andrew Munro and Jim Hasbrouck for their helpful reviews of the final manuscript.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 1981. Proposed management plan for Southeast Alaska Chinook salmon runs in 1981. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J81-03, Douglas.

Bachman, R. L., J. A. Bednarski, and S. C. Heinl. 2014. Escapement and harvest of Chilkoot River sockeye salmon, 2007–2012. Alaska Department of Fish and Game, Fishery Data Series No. 14-07, Anchorage.

Barrowman, N. J., and R. A. Myers. 2000. Still more spawner-recruitment curves: the hockey stick and its generalizations. Canadian Journal of Fisheries and Aquatic Sciences. 57:665–676.

Beauchamp, D. A., and N. C. Overman. 2004. Evaluating the effects of fertilization on sockeye salmon production in Redoubt Lake, Alaska. Final Report to U.S. Forest Service, Washington Cooperative Fish and Wildlife Research Unit Report #WACFWRU-03-03, Seattle.

Bednarski, J. A., M. Sogge, and S. C. Heinl. 2016. Stock assessment study of Chilkoot Lake sockeye salmon, 2013–2015. Alaska Department of Fish and Game, Fishery Data Series No. 16-29, Anchorage.

Bednarski, J. A., M. Sogge, S. E. Miller, and S. C. Heinl. *In prep*. A comprehensive review of Chilkat River drainage sockeye salmon stock assessment studies. Alaska Department of Fish and Game, Fishery Manuscript Series, Anchorage.

Bergander, F. E., S. A. McPherson, and J. P. Koenings. 1988. Southeast Alaska sockeye salmon studies, 1987–1988. Technical Report for the period July 1, 1987, to June 30, 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J88-44, Juneau.

Bernard, D. R., and E. L. Jones III. 2010. Optimum escapement goals for Chinook salmon in the transboundary Alsek River. Alaska Department of Fish and Game, Fishery Manuscript Series No. 10-02, Anchorage.

Bernard, D. R., S. A. McPherson, K. A. Pahlke, and P. Etherton. 2000. Optimal production of Chinook salmon from the Stikine River. Alaska Department of Fish and Game, Fishery Manuscript Series No. 00-01, Anchorage.

Beverton, R. J., and S. J. Holt. 1957. On the dynamics of exploited fish populations. MAFF Fisheries Investigations Series II 19:533.

Bradford, M. J., R. A. Myers, and J. R. Irvine. 2000. Reference points for coho salmon (Oncorhynchus kisutch) harvest rates and escapement goals based on freshwater production. Canadian Journal of Fisheries and Aquatic Sciences. 57:677–686.

Brenner, R. E., S. E. Miller, S. C. Heinl, X. Zhang, J. A. Bednarski, M. M. Sogge, and S. J. Fleischman. *In prep*. Sockeye salmon stock status and escapement goals for Chilkoot Lake in Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Burkholder, A. 2000. Yakutat set gillnet fishery 2000 management plan. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J00-20, Juneau.

Clark, J. H. 1995a. Biological escapement goals for even and odd-year pink salmon returning to the Situk River and to Humpy Creek near Yakutat, Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J95-08, Juneau.

Clark, J. H. 1995b. Escapement goals for coho salmon stocks returning to streams located along the Juneau road system of Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J95-02, Douglas.

Clark, R. A. 2005. Stock status and recommended escapement goals for coho salmon in selected waters along the Juneau road system, 1981–2004. Alaska Department of Fish and Game, Special Publication No. 05-21, Anchorage.

Clark, J. H., and J. E. Clark. 1994. Escapement goals for Yakutat area coho salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J95-14, Douglas.

REFERENCES CITED (Continued)

Clark, J. H., and P. Etherton. 2000. Biological escapement goal for Klukshu River system sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Informational Report No. 1J00-24, Juneau.

Clark, J. E., J. H. Clark, and L. D. Shaul. 1994. Escapement goals for coho salmon stocks returning to Berners River, Auke Creek, Ford Arm Lake, and Hugh Smith Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report No. 1J94-26, Juneau.

Clark, J. H., S. A. McPherson, and A. Burkholder. 1995a. Biological escapement goal for Situk River sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Informational Report No. 1J95-22, Douglas.

Clark, J. H., A. Burkholder, and J. E. Clark. 1995b. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Informational Report No. 1J95-16, Juneau.

Clark, J. H., S. A. McPherson, and D. M. Gaudet. 1998. Biological escapement goal for Andrew Creek Chinook salmon, Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 5J98-08, Juneau.

Clark, J. H., S. A. McPherson, and G. F. Woods. 2002. Biological escapement goal for sockeye salmon in the Situk River, Yakutat, Alaska. Alaska Department of Fish and Game, Special Publication No. 02-03, Anchorage.

Clark, J. H., G. F. Woods, and S. Fleischman. 2003. Revised biological escapement goal for the sockeye salmon stock returning to the East Alsek-Doame river system of Yakutat, Alaska. Alaska Department of Fish and Game, Special Publication No. 03-04, Anchorage.

Clark, J. H., D. Reed, and M. Tracy. 2005. Abundance of coho salmon in the Lost River System, Yakutat, Alaska, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-66, Anchorage.

Clark, J. H., D. Reed, and M. Tracy. 2006. Abundance of coho salmon in the Lost River System, Yakutat, Alaska, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 06-11, 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.

Der Hovanisian, J. 2013. Escapement goal for Klawock River coho salmon. Alaska Department of Fish and Game, Fishery Manuscript Series No. 13-09, Anchorage.

Der Hovanisian, J. A., and H. J. Geiger, editors. 2005. Stock status and escapement goals for salmon stocks in Southeast Alaska 2005. Alaska Department of Fish and Game, Special Publication No. 05-22, Anchorage.

Der Hovanisian, J., S. McPherson, E. Jones, P. Richards, R. Chapell, B. Elliott, T. Johnson, and S. Fleischman. 2011. Chinook salmon status and escapement goals for stocks in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 11-19, Anchorage.

Eggers, D. M., and D. R. Bernard. 2011. Run reconstruction and escapement goals for Alsek River sockeye salmon. Alaska Department of Fish and Game, Fishery Manuscript Series No. 11-01, Anchorage.

Eggers, D. M., and S. C. Heinl. 2008. Chum salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 08-19, Anchorage.

Eggers, D. M., and M. Tracy. 2007. A mark–recapture experiment to estimate the escapement of coho salmon in the Situk River, 2005, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-70, Anchorage.

Eggers, D. M., J. H. Clark, R. L. Bachman, and S. C. Heinl. 2008. Sockeye salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries, Special Publication No. 08-17, Anchorage.

REFERENCES CITED (Continued)

Eggers, D. M., S. C. Heinl, and A. W. Piston. 2009a. McDonald Lake sockeye salmon stock status and escapement goal recommendations, 2008. Alaska Department of Fish and Game, Fishery Data Series No. 09-31, Anchorage.

Eggers, D. M., X. Zhang, R. L. Bachman, and M. M. Sogge. 2009b. Sockeye salmon stock status and escapement goals for Chilkoot Lake in Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 09-63, Anchorage.

Eggers, D. M., R. L. Bachman, and J. Stahl. 2010. Stock status and escapement goals for Chilkat Lake sockeye salmon in southeast Alaska. Alaska Department of Fish and Game, Fishery Manuscript No. 10-05, Anchorage.

Elliot, B. W. 2013. Production, harvest, and escapement of Chilkat River coho salmon, 2009–2010. Alaska Department of Fish and Game, Fishery Data Series No. 13-14, Anchorage.

Ericksen, R. P., and S. J. Fleischman. 2006. Optimal production of coho salmon from the Chilkat River. Alaska Department of Fish and Game, Fishery Manuscript No. 06-06, Anchorage.

Ericksen, R. P., and S. A. McPherson. 2004. Optimal production of Chinook salmon from the Chilkat River. Alaska Department of Fish and Game, Fishery Manuscript No. 04-01, Anchorage.

Faber, D. M. 2008. Loss of spawning habitat due to isostatic rebound and the subsequent effect on the commercial East Alsek sockeye fishery, Alaska. M. S. Thesis, University of Alaska, Fairbanks.

Faber, D., C. Soiseth, C. Murdoch, and J. Wardell. 2006. Evaluation of habitat and growth trends for East Alsek River sockeye salmon (*Oncorhynchus nerka*) in Glacier Bay National Preserve, Alaska. Annual Data Summary Report–2005. Available from Glacier Bay National Park and Preserve, P.O. Box 294, Gustavus, Alaska.

Fleischman, S. J., J. A. Der Hovanisian, and S. A. McPherson. 2011. Escapement goals for Chinook salmon in the Blossom and Keta rivers. Alaska Department of Fish and Game, Fishery Manuscript No. 11-05, Anchorage.

Fleischman, S. J., M. J. Catalano, R. A. Clark, and D. R. Bernard. 2013. An age-structured state-space stock-recruit model for Pacific salmon (*Oncorhynchus* spp.). Canadian Journal of Fisheries and Aquatic Sciences. 70:401–414.

Geiger, H. J. 2003. Sockeye salmon stock status and escapement goal for Redoubt Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J03-01, Juneau.

Geiger, H. J., and S. McPherson, *editors*. 2004. Stock status and escapement goals for salmon stocks in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries, Special Publication No. 04-02, Anchorage.

Geiger, H. J., T. P. Zadina, and S. C. Heinl. 2003. Sockeye salmon stock status and escapement goal for Hugh Smith Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J03-05, Juneau.

Geiger, H. J., M. A. Cartwright, J. H. Clark, J. Conitz, S. C. Heinl, K. Jensen, B. Lewis, A. J. McGregor, R. Riffe, G. Woods and T. P. Zadina. 2004. Sockeye salmon stock status and escapement goals in Southeast Alaska [*in*] H. J. Geiger, and S. McPherson, editors. Stock status and escapement goals for salmon stocks in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 04-02, Anchorage.

Geiger, H. J., R.L. Bachman, S. C. Heinl, K. Jensen, B. Lewis, T. A. Johnson, A. Piston, and R. Riffe. 2005. Sockeye salmon stock status and escapement goals in Southeast Alaska [*in*] J. A. Der Hovanisian and H. J. Geiger, editors. Stock status and escapement goals for salmon in Southeast Alaska 2005. Alaska Department of Fish and Game, Special Publication No. 05-22, Anchorage.

Gilk-Baumer, S. E., S. D. Rogers Olive, D. K. Harris, S. C. Heinl, E. K. C. Fox, and W. D. Templin. 2015. Genetic mixed stock analysis of sockeye salmon harvests in selected northern Chatham Strait commercial fisheries, Southeast Alaska, 2012–2014. Alaska Department of Fish and Game, Fishery Data Series No. 15-03, Anchorage.

REFERENCES CITED (Continued)

Halupka, K. C., M. D. Bryant, M. F. Willson, and F. H. Everest. 2000. Biological characteristics and population status of anadromous salmon in Southeast Alaska. United States Forest Service. General Technical Report. PNW-GTR-468.

Heinl, S. C., D. M. Eggers, and A. W. Piston. 2008. Pink salmon stock status and escapement goals in Southeast Alaska and Yakutat. Alaska Department of Fish and Game, Special Publication No. 08-16, Anchorage.

Heinl, S. C., R. L. Bachman, and K. Jensen. 2011. Sockeye salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries, Special Publication No. 11-20, Anchorage.

Heinl, S. C., E. L. Jones III, A. W. Piston, P. J. Richards, and L. D. Shaul. 2014a. Review of salmon escapement goals in Southeast Alaska, 2014. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-07, Anchorage.

Heinl, S. C., S. E. Miller, and J. A. Bednarski. 2014b. Speel Lake sockeye salmon stock status and escapement goal review. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-04, Anchorage.

Hendrich, C. F., J. L. Weller, S. A. McPherson, and D. R. Bernard. 2008. Optimal production of Chinook salmon from the Unuk River. Alaska Department of Fish and Game, Fishery Manuscript No. 08-03, Anchorage.

Hilborn, R., and C. J. Walters. 1992. Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty. Chapman and Hall, New York.

Humphreys, R. D., S. M. McKinnel, D. Welch, M. Stocker, B. Turris, F. Dickson, and D. Ware, editors. 1994. Pacific Stock Assessment Review Committee (PSARC) Annual Report for 1993. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2227.

Ingledue, D. 1989. Hawk Inlet shore purse seine fishery, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J89-31, Juneau.

Johnson, T. A., S. C. Heinl, and H. J. Geiger. 2005. McDonald Lake: Stock status and escapement goal recommendations. Alaska Department of Fish and Game, Fishery Manuscript No. 05-07, Anchorage.

Kissner, P. D. 1978. Status of important native Chinook salmon stocks in Southeastern Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1976–1977, Project F-9-9(18) AFS 41-5, Juneau.

McPherson, S. A. 1990. An inseason management system for sockeye salmon returns to Lynn Canal, Southeast Alaska. M. S. Thesis, University of Alaska, Fairbanks.

McPherson, S. A., and J. K. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report No. 1J97-06, Juneau.

McPherson, S. A., and J. H. Clark. 2001. Biological escapement goal for King Salmon River Chinook salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J01-40, Juneau.

McPherson, S., S. Marshall, and M. Rowse. 1987. Situk River sockeye salmon spawner-recruit analysis. Alaska Department of Fish and Game, Division of Commercial Fisheries, Southeast Region Report 87(2), Douglas.

McPherson, S. A., P. Etherton, and J. H. Clark. 1998. Biological escapement goal for Klukshu River Chinook salmon. Alaska Department of Fish and Game, Fishery Manuscript No. 98-02, Anchorage.

McPherson, S. A., D. Bernard, J. H. Clark, K. Pahlke, E. Jones, J. Der Hovanisian, J. Weller, and R. Ericksen. 2003. Stock status and escapement goals for Chinook salmon stocks in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 03-01, Anchorage.

McPherson, S. A., R. E. Johnson, and G. F. Woods. 2005. Optimal production of Chinook salmon from the Situk River. Alaska Department of Fish and Game, Fishery Manuscript No. 05-04, Anchorage.

REFERENCES CITED (Continued)

McPherson, S., J. H. Clark, D. R. Bernard, J. Der Hovanisian, E. Jones, K. Pahlke, P. Richards, J. Weller, and T. Johnson. 2008. Chinook salmon status and escapement goals for stocks in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No.08-18, Anchorage.

McPherson, S. A., E. L. Jones III, S. J. Fleischman, and I. M. Boyce. 2010. Optimal production of Chinook salmon from the Taku River through the 2001 year class. Alaska Department of Fish and Game, Fishery Manuscript Series No. 10-03, Anchorage.

Miller, S. E., and S. C. Heinl. *In prep*. Chilkat Lake sockeye salmon escapement goal review. Alaska Department of Fish and Game, Fishery Manuscript Series, Anchorage.

Munro, A. R., and E. C. Volk. 2014. Summary of Pacific salmon escapement goals in Alaska with a review of escapements from 2005 to 2013. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-01, Anchorage.

Pestal, G., and S. Johnston. 2015. Estimates of a biologically-based spawning goal and biological benchmarks for the Canadian-origin Taku River coho stock aggregate. DFO Canadian Science Advisory Secretariat Research Document 2015/048, Ottawa.

Piston, A. W., and S. C. Heinl. 2011a. Pink salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No.11-18, Anchorage.

Piston, A. W., and S. C. Heinl. 2011b. Chum salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No.11-21, Anchorage.

Piston, A. W., and S. C. Heinl. 2014a. Chum salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-13, Anchorage.

Piston, A. W., and S. C. Heinl. 2014b. Pink salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-14, Anchorage.

Piston, A. W., and S. C. Heinl. *In prep* a. Chum salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Fishery Manuscript Series, Anchorage.

Piston, A. W., and S. C. Heinl. *In prep* b. Pink salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Fishery Manuscript Series, Anchorage.

Ricker, W. E. 1954. Stock and recruitment. Journal of Fisheries Research Board of Canada 11:559–623.

Riffe, R., and J. H. Clark. 2003. Biological escapement goal for Speel Lake sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J03-04, Juneau.

Shaul, L. D., and H. J. Geiger. 2016. Effects of climate and competition for offshore prey on growth, survival, and reproductive potential of coho salmon in Southeast Alaska. North Pacific Anadromous Fish Commission Bulletin 6:329–347.

Shaul, L. D., and T. A. Tydingco. 2006. Escapement goals for coho salmon counted in aggregate surveys in the Ketchikan and Sitka areas. Alaska Department of Fish and Game, Special Publication No. 06-11, Anchorage.

Shaul, L., E. Jones, K. Crabtree, T. Tydingco, S. McCurdy, and B. Elliott. 2008. Coho Salmon Stock Status and Escapement Goals in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 08-20, Anchorage.

Shaul, L. D., K. F. Crabtree, M. Kemp, and N. Olmsted. 2009. Coho salmon studies at Hugh Smith Lake, 1982–2007. Alaska Department of Fish and Game, Fishery Manuscript Series No. 09-04, Anchorage.

Shaul, L. D., K. F. Crabtree, D. M. Eggers, M. Tracy, and J. H. Clark. 2010. Estimates of harvest, escapement, exploitation rate, smolt production, and marine survival for coho salmon stocks in the Situk-Ahrnklin Lagoon, 2004–2006. Alaska Department of Fish and Game, Fishery Data Series No. 10-11, Anchorage.

Shaul, L., K. Crabtree, E. Jones, S. McCurdy, and B. Elliott. 2011. Coho salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 11-23, Anchorage.

REFERENCES CITED (Continued)

Shaul, L. D., R. Ericksen, K. Crabtree, and J. Lum. 2013. Beyond the estuary: an extension of the nomad life history strategy in coho salmon. North Pacific Anadromous Fish Commission Technical Report No. 9:171–175.

Shaul, L. D., K. F. Crabtree, K. C. Koolmo, K. M. Koolmo, J. V. Nichols, and H. J. Geiger. 2014. Studies of coho salmon and other *Oncorhynchus* species at Ford Arm Creek, 1982–2009. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-02, Anchorage.

Shaul, L. D., K. F. Crabtree, and M. Kemp. *In prep*. Berners River Coho Salmon Studies, 1972–2014. Alaska Department of Fish and Game, Fishery Manuscript Series, Anchorage.

Smith, J. J., D. Reed, M. Tracy, and J. H. Clark. 2006. A mark-recapture experiment to estimate the escapement of sockeye salmon in the East Alsek River, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 06-71, Anchorage.

Sogge, M. M., and R. L. Bachman. 2014. Operational Plan: Stock assessment studies of Chilkat River adult salmon. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF1J.14-03, Douglas.

Su, Z., and R. M. Peterman. 2012. Performance of a Bayesian state-space model of semelparous species for stock-recruitment data subject to measurement error. Ecological Modelling 224:76–89.

Thomason, G. J., and G. F. Woods. 1988. Annual summary of Yakutat finfish and shellfish operations 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J88-40, Yakutat.

TTC (Transboundary Technical Committee). 1990. Long-term research plans for the transboundary rivers. Pacific Salmon Commission Report TCTR (90)-3, Vancouver.

TTC (Transboundary Technical Committee). 1993. Salmon management and enhancement plans for the Stikine, Taku, and Alsek rivers, 1993. Pacific Salmon Commission Report TCTR (93)-2, Vancouver.

TTC (Transboundary Technical Committee). 2014. Salmon management and enhancement plans for the Stikine, Taku, and Alsek rivers, 2013. Pacific Salmon Commission Report TCTR (14)-1, Vancouver.

TTC (Transboundary Technical Committee). 2017. Salmon management and enhancement plans for the Stikine, Taku, and Alsek rivers, 2017. Pacific Salmon Commission Report TCTR (17)-3, Vancouver.

Van Alen, B. W. 2000. Status and stewardship of salmon stocks in Southeast Alaska. Pages 161–194 [*in*] E. E Knudsen, C. R. Steward, D. D. McDonald, J. E. Williams, D. W. Reiser, editors. Sustainable Fisheries Management: Pacific salmon. CRC Press. Boca Raton.

Waltemyer, D. L., D. Reed, M. Tracy, and J. H. Clark. 2005. A Mark–Recapture Experiment to Estimate the Spawning Escapement of Coho Salmon in the Situk River, 2004. Alaska Department of Fish and Game, Fishery Data Series No.05-31, Anchorage.

Weller, J. L., D. J. Reed, and G. M. Freeman. 2007. Spawning abundance of Chinook salmon in the Chickamin River in 2005. Alaska Department of Fish and Game, Fishery Data Series No. 07-63, Anchorage.

Woods, G. F. 2007. Summary of the 2006 Yakutat Area commercial salmon fisheries. Alaska Department of Fish and Game, Fishery Management Report No. 07-11, Anchorage.

Woods, G. F., and N. L. Zeiser. 2010. 2010 Yakutat set gillnet fishery management plan. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J10-10, Douglas.

Zadina, T. P., S. C. Heinl, A. J. McGregor, and H. J. Geiger. 2004. Pink salmon stock status and escapement goals in Southeast Alaska and Yakutat [in] Stock status and escapement goals for salmon stocks in Southeast Alaska. H. J. Geiger and S. McPherson [eds]. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries, Special Publication No. 04-02, Anchorage.

REFERENCES CITED (Continued)

Zeiser, N. L. 2015. Operational plan: Yakutat salmon escapement surveys. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF1J.15-05, Douglas.

Zeiser, N. L., and G. F. Woods. 2016. Annual Management Report of the 2015 Yakutat Area commercial salmon fisheries. Alaska Department of Fish and Game, Fishery Management Report No. 16-22, Anchorage.

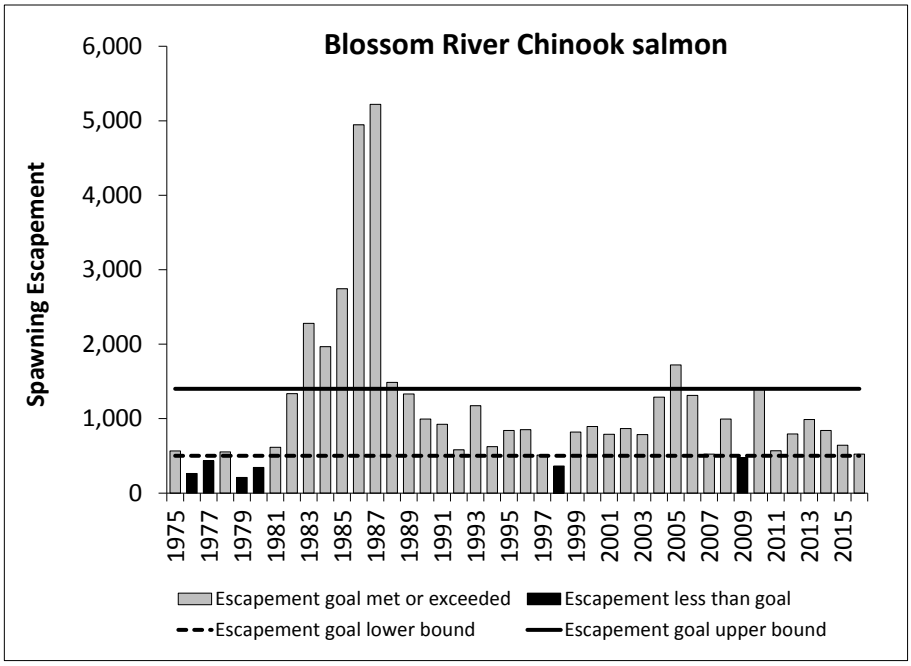
APPENDIX A.
CHINOOK SALMON ESCAPEMENT GOAL PERFORMANCE

Appendix A1.–Blossom River Chinook salmon.

The Blossom River is a clearwater system that empties into Behm Canal, near Ketchikan, Alaska, and supports a mostly inside-rearing stock of Chinook salmon. The waters of east Behm Canal are closed to Chinook salmon fishing year round and there are no directed fisheries that target this stock. Immature and mature fish are harvested in marine mixed stock fisheries in Southeast Alaska and northern British Columbia (based on coded-wire tagging information from the nearby Unuk and Chickamin wild stocks and Whitman, Neets, and Deer Mountain hatchery stocks). Age data collected since 1998 indicate that about 10% of these fish are sub-yearling smolt. Total escapement was estimated from mark–recapture studies conducted in 1998 and from 2004 to 2006, and index counts using helicopter surveys were obtained in all years since 1975. Four years of concurrent mark–recapture estimates and index counts were used to estimate the expansion factor of 3.87.

Escapement Goals and Stock Status: In 1994, ADF&G established a peak index escapement goal of 300 large spawners, based on a stock-recruit analysis. In 1997, the goal was revised to a range of 250 to 500 large spawners. The current biological escapement goal range of 150 to 300 large index spawners was established in 2012, based on a stock-recruit analysis by Fleischman et al. (2011). After applying the expansion factor, the escapement goal based on the index of large spawners was then converted to a total drainagewide escapement goal range of 500 to 1,400 large spawners, which is the current recommendation (in this report).

Between 1976 and 1980, estimated escapements were below the current escapement goal and these smaller escapements subsequently produced large runs with resultant large escapements from 1982 to 1987. This was then followed by a 24-year period (1988–2011) of reduced but relatively stable escapements averaging about 225 large fish. From 2012 to 2016, escapements were below the escapement goal range in 1 year (Appendix Figure A1).



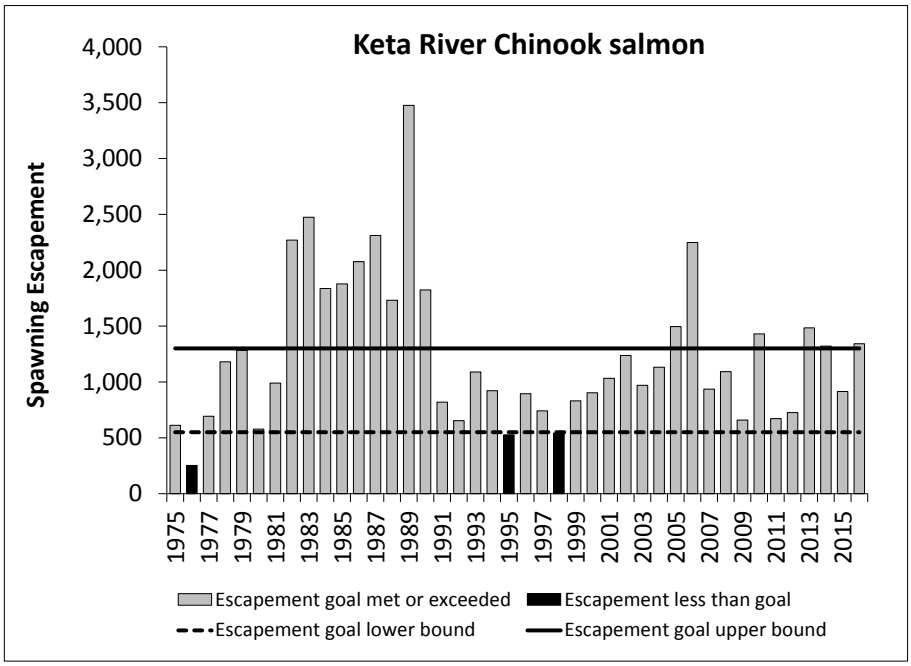
Appendix Figure A1.–Estimated Blossom River Chinook salmon escapements, 1975–2016, and recommended biological escapement goal range of 500–1,400 large spawners.

Appendix A2.–Keta River Chinook salmon.

The Keta River is a clearwater system that empties into Behm Canal, near Ketchikan, that supports a mostly inside-rearing stock of Chinook salmon. The waters of east Behm Canal are closed to Chinook salmon fishing year round and there are no directed fisheries that target this stock. Immature and mature fish are harvested in marine mixed stock fisheries in Southeast Alaska and northern British Columbia (based on coded-wire tagging information from the nearby Unuk and Chickamin wild stocks and Whitman, Neets, and Deer Mountain hatchery stocks). Age data collected since 1998 indicate that about 10% of these fish are sub-yearling smolt. Total escapement was estimated from mark–recapture studies conducted from 1998 to 2000. Index counts, using helicopter surveys, were performed in all other years since 1975. Three years of concurrent mark–recapture estimates and index counts were used to estimate the expansion factor of 3.01.

Escapement Goals and Stock Status: In 1994, ADF&G established a peak index escapement goal of 300 large spawners based on a stock-recruit analysis. In 1997, the goal was revised to a range of 250 to 500 large index spawners. The current biological escapement goal range of 175 to 400 large index spawners was established in 2012, based on a stock-recruit analysis by Fleischman et al. (2011). After applying the expansion factor, the escapement goal based on the index of large spawners was then converted to a total drainagewide escapement goal range of 550 to 1,300 large spawners, which is the current recommendation (in this report).

Like the nearby Blossom River, survey counts were low in the 1970s, rose in the mid- to late 1980s, and have been relatively stable since that time. From 2012 to 2016, escapements were within or above the escapement goal range in each year (Appendix Figure A2).



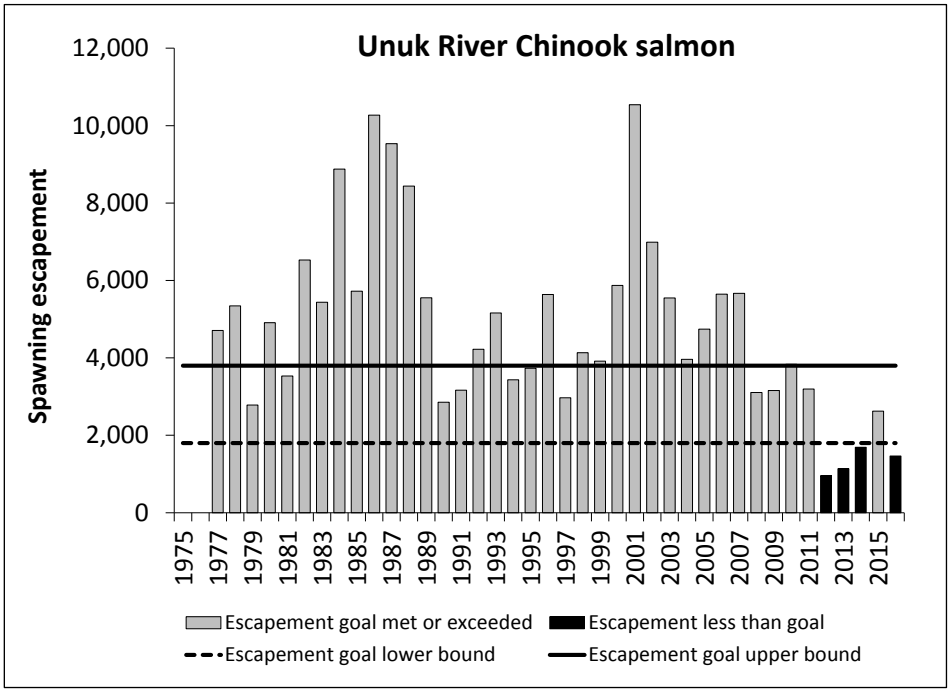
Appendix Figure A2.–Estimated Keta River Chinook salmon escapements, 1975–2016, and recommended biological escapement goal range of 550–1,300 large spawners.

Appendix A3.–Unuk River Chinook salmon.

The Unuk River is a glacial system which flows into Behm Canal near Ketchikan, Alaska, that supports a mostly inside-rearing stock of Chinook salmon. The waters of east Behm Canal are closed to Chinook salmon fishing and there are no directed fisheries that target this stock. Immature and mature fish are harvested in marine mixed stock fisheries in Southeast Alaska and northern British Columbia. Coded-wire tagging of this stock was conducted from 1982 to 1986 and from 1992 to present. Escapements of large spawners were based on mark–recapture estimates of total escapement from 1997 to 2009 and in 2011, and expanded index counts using helicopter and foot surveys from 1977 to 1996 and from 2010 to 2016. Radio telemetry studies conducted in 1994 and 2009 indicated that aerial and foot surveys covered 80% of the spawning area. Seven years of concurrent mark-recapture estimates and survey counts were used to estimate the expansion factor of 4.83.

Escapement Goals and Stock Status: In 1994, ADF&G established a peak index escapement goal of 875 large spawners. In 1997, the goal was revised to an index goal range of 650 to 1,400 large spawners (McPherson and Carlile 1997). The current biological escapement goal range of 1,800 to 3,800 large spawners was established in 2009, based on a stock-recruit analysis of the 1982 to 2001 brood years (Hendrich et al. 2008). The troll fishery accounts for 70% of the total harvest, followed by the sport fishery (15%), the drift gillnet and terminal hatchery fisheries (6% each), and marginal amounts in the purse seine, high seas trawl, and Canadian mixed net fisheries. On average, 95% of the harvest occurs in Southeast Alaska.

The recent abrupt decline in productivity was unexpected given escapements had exceed the lower bound of the current escapement goal established in 2009 for 34 straight years and harvest rates averaged around 30% through 2011. However, in 2012 the escapement goal was missed for the first time on record, and the harvest rate was a record high of 72%. From 2012 to 2016, escapements were below the escapement goal range in 4 years (Appendix Figure A3) and harvest rates averaged 45% (range 36–72%).



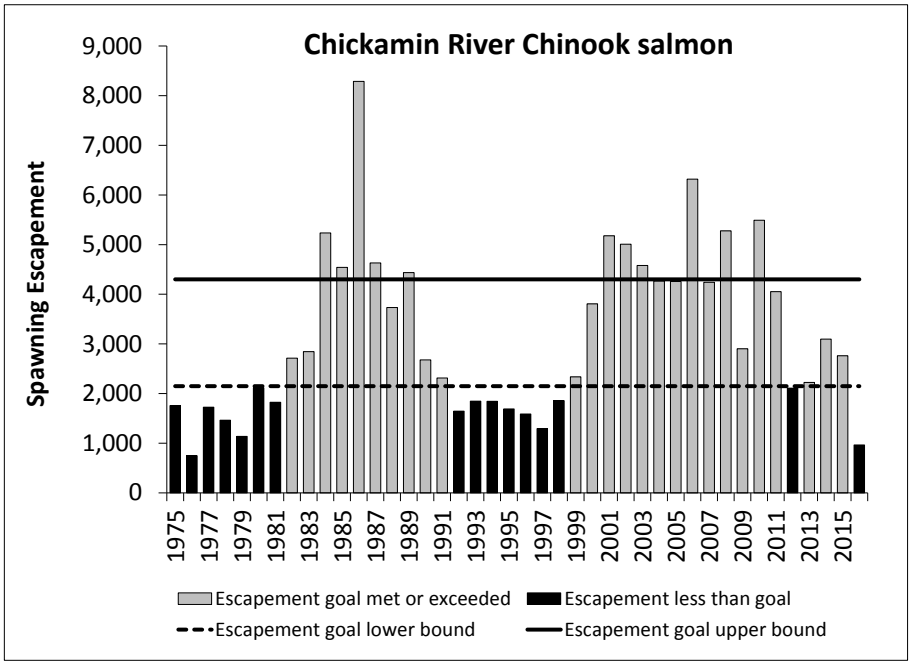
Appendix Figure A3.–Estimated Unuk River Chinook salmon escapements, 1977–2016, and biological escapement goal range of 1,800–3,800 large spawners.

Appendix A4.–Chickamin River Chinook salmon.

The Chickamin River is a glacial system that empties into Behm Canal, near Ketchikan, Alaska that supports a mostly inside-rearing stock of Chinook salmon. The waters of east Behm Canal are closed to Chinook salmon fishing year round and there are no directed fisheries that target this stock. Immature and mature fish are harvested in marine mixed stock fisheries in Southeast Alaska and northern British Columbia. Coded-wire tagging of this stock was conducted from 1982 to 1986 and from 1992 to 2007. Escapement is measured using index counts of large fish. Mark–recapture studies conducted in 1995, 1996, and from 2001 to 2005 showed that an average 21% of the total escapement is counted during index counts using helicopter and foot surveys (Weller et al. 2007). A radio telemetry study in 1996 also showed that index counts are conducted in stream reaches where more than 80% of all spawning occurs. Seven years of concurrent mark–recapture estimates and index counts were used to estimate the expansion factor of 4.75.

Escapement Goals and Stock Status: In 1994, ADF&G established a peak index escapement goal of 525 large spawners, based on a stock-recruit analysis by McPherson and Carlile (1997). The goal was revised in 1997 to the current biological escapement goal range of 450 to 900 large index spawners as recommended by McPherson and Carlile (1997). After applying the expansion factor, the escapement goal based on the index of large spawners was then converted to a total drainagewide escapement goal range of 2,150 to 4,300 large spawners, which is the current recommendation (in this report).

Nearly all (99%) Chickamin River Chinook salmon are harvested in Southeast Alaska. The troll fishery takes about half of the total harvest, followed by sport at 15%, and marginal harvests in drift gillnet, purse seine, and terminal/private non-profit fisheries. The Chickamin River stock shows a cyclic pattern of escapement; peak survey counts from 1975 to 1981 and 1992 to 1998 were below the current goal range, and those from 1982 to 1991 and 1999 to 2011 were within or above the range. This stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. From 2012 to 2016, escapements were below the escapement goal range in 2 years (Appendix Figure A4).

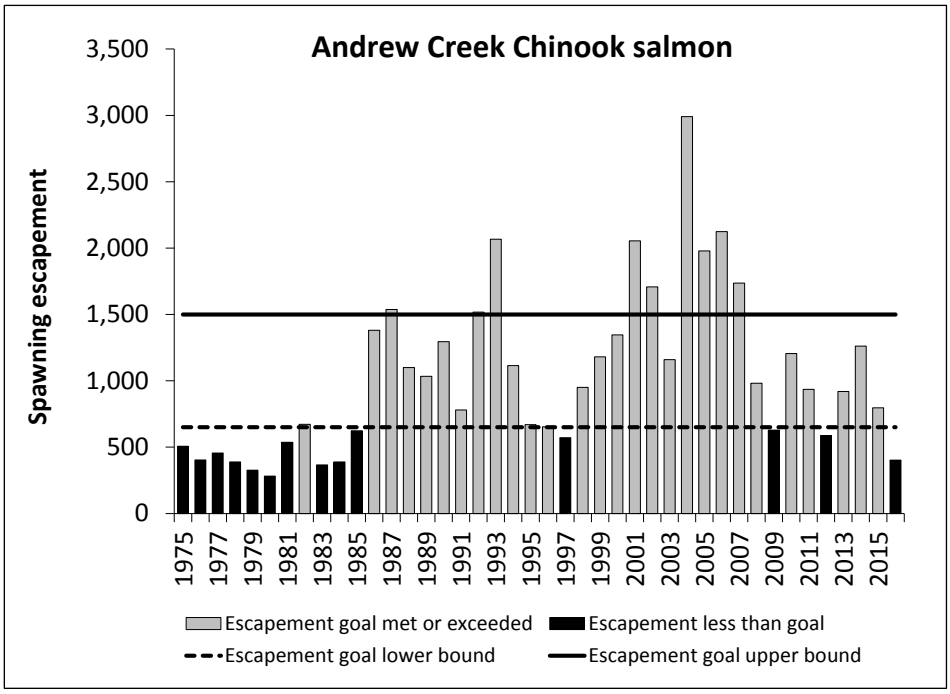


Appendix Figure A4.–Estimated Chickamin River Chinook salmon escapements, 1975–2016, and recommended biological escapement goal range of 2,150–4,300 large spawners.

Appendix A5.–Andrew Creek Chinook salmon.

Andrew Creek is a clearwater tributary of the lower Stikine River, located on the mainland near Petersburg and Wrangell, Alaska, that supports a mostly inside-rearing stock of Chinook salmon. Harvests of immature and mature Andrew Creek fish occur primarily in Southeast Alaska and to a small extent in northern British Columbia fisheries, based on coded-wire tag recoveries of Chinook salmon from Southeast Alaska hatcheries that use Andrew Creek brood stock. Escapements are based on weir counts from 1976 to 1984 and expanded index counts using a combination of helicopter, fixed-wing and foot surveys, in 1975 and from 1985 to 2011, and foot surveys from 2012 to 2016. Four years of concurrent weir and index count data were used to estimate the expansion factor of 1.95.

Escapement Goals and Stock Status: In 1985, ADF&G established an escapement goal of 750 large fish. The current biological escapement goal range of 650 to 1,500 large spawners was established in 1998, based on a stock-recruit analysis by Clark et al. (1998). The Andrew Creek stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. A large terminal marine drift gillnet fishery occurred in the spring, near the mouth of the Stikine River, that targeted Stikine River and other nearby Chinook salmon stocks but that fishery closed in 1976. Then, beginning in 2005, in years of surplus Chinook salmon production to the Stikine River, directed Chinook salmon fisheries were allowed in the marine waters in District 8 near Petersburg and Wrangell. Directed commercial and liberalized sport fisheries were implemented between 2005 and 2009. Limited directed fisheries occurred in 2011, 2012 and 2015 and these directed fisheries likely increased harvest rates on Andrew Creek Chinook salmon. From 2012 to 2016, escapements were below the escapement goal range in 2 years (Appendix Figure A5).



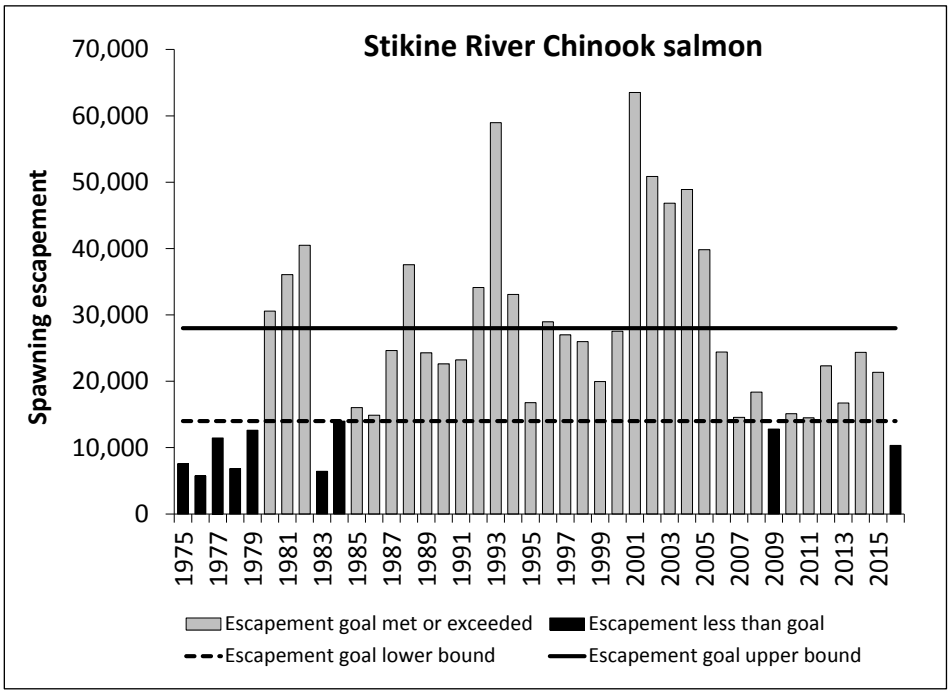
Appendix Figure A5.–Estimated Andrew Creek Chinook salmon escapements, 1975–2016, and biological escapement goal range of 650–1,500 large spawners.

Appendix A6.–Stikine River Chinook salmon.

The Stikine River is a transboundary glacial system that supports an outside-rearing stock of Chinook salmon. The Stikine River originates in British Columbia and flows into central Southeast Alaska near the towns of Petersburg and Wrangell. It is the largest river by volume flowing into Southeast Alaska. Wild smolt have been coded-wire-tagged since 2000 to estimate smolt and adult production and harvest rates. Escapements were evaluated through survey counts conducted on the Little Tahltan River, a tributary in the upper Stikine River drainage, from 1975 to 1984, and weir counts from 1985 to present. Since 1996, mark–recapture studies have been conducted to estimate total Stikine River escapement; these studies indicate the Little Tahltan River weir counts are quite variable in comparison to the total Stikine River escapement, and represent 3% to 33% of the total annual escapement.

Escapement Goals and Stock Status: The current biological escapement goal range of 14,000 to 28,000 large spawners was established in 2000, based on a stock-recruit analysis by Bernard et al. (2000). Beginning in 2005, during years of surplus Chinook salmon production to the Stikine River, directed commercial and liberalized sport fisheries for Chinook salmon were implemented in the marine waters in District 8 near Petersburg and Wrangell and inriver in Canada. In years of directed Chinook salmon fishing, total harvest rates ranged between 50% and 70%. In other years, harvest rates average only 20%, and most harvest occurs in the late winter and spring commercial troll fisheries, commercial drift gillnet and sport fisheries in District 8 near Petersburg and Wrangell, and in Canadian inriver gillnet and Aboriginal fisheries.

This stock has shown a decline in productivity in recent years due to reduced marine survivals and it is unlikely that directed fisheries will be prosecuted until productivity improves. From 2012 to 2016, escapements were below the escapement goal range in 1 year (Appendix Figure A6), and the harvest rate averaged 19%.

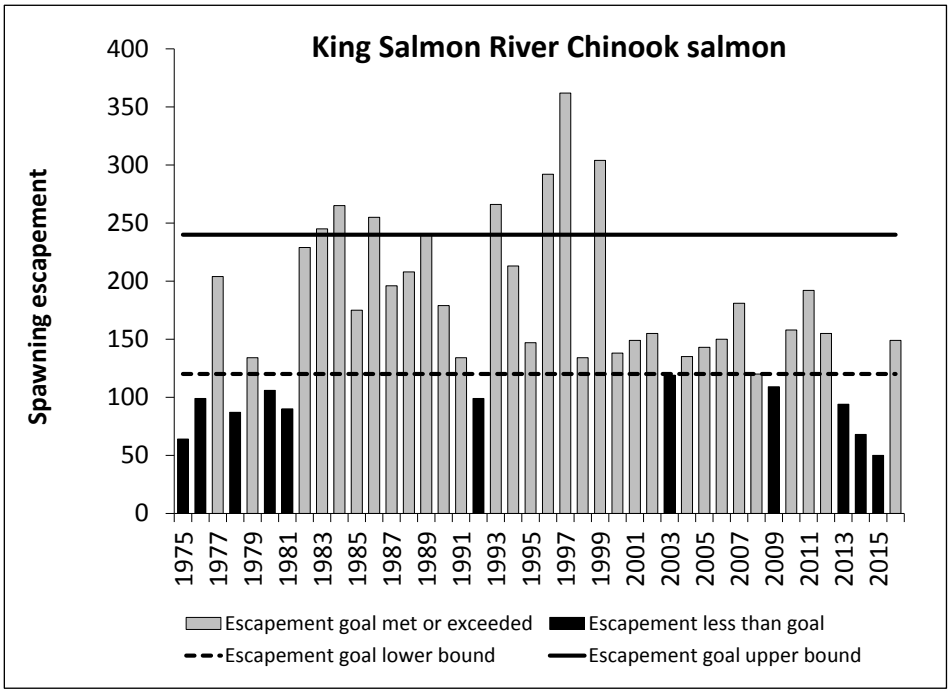


Appendix Figure A6.–Estimated Stikine River Chinook salmon escapements, 1975–2016, and biological escapement goal range of 14,000–28,000 large spawners.

Appendix A7.–King Salmon River Chinook salmon.

The King Salmon River is a clearwater system located on Admiralty Island (and thus the only monitored Chinook salmon island stock), about 30 km south of Juneau, Alaska, that supports a mostly inside-rearing stock of Chinook salmon. This stock does not support directed fisheries but is harvested incidentally in marine waters in sport and commercial fisheries. Escapements of large Chinook salmon are based on weir counts from 1983 to 1992 and expanded index counts using helicopter or foot surveys from 1971 to 1982 and 1993 to 2011 and foot surveys from 2012 to 2016. Ten years of concurrent weir and index count data were used to estimate the expansion factor of 1.52.

Escapement Goals and Stock Status: In 1981, ADF&G established a peak index escapement goal of 200 large fish, based on maximum counts of 200 spawners in 1957 and 211 spawners in 1973. In the mid-1980s, the goal was revised to 250 large spawners counted through the weir that was operated at the time. The current biological escapement goal range of 120 to 240 large spawners was established in 1997, based on a stock-recruit analysis of the 1971 to 1991 brood years (McPherson and Clark 2001). From 2012 to 2016, escapements were below the escapement goal range in 3 years (Appendix Figure A7).



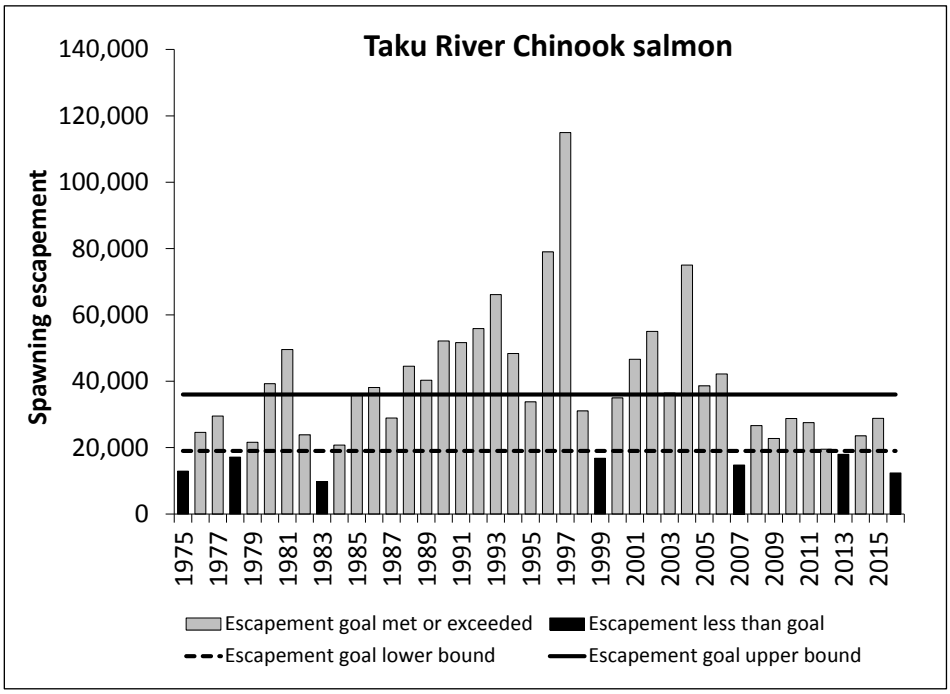
Appendix Figure A7.–Estimated King Salmon River Chinook salmon escapements, 1975–2016, and biological escapement goal range of 120–240 large spawners.

Appendix A8.–Taku River Chinook salmon.

The Taku River is a transboundary glacial system that supports an outside-rearing stock of Chinook salmon. The Taku River originates in British Columbia and drains over 17,000 square kilometers before its terminus at Taku Inlet, approximately 40 km east of Juneau. Wild smolt were coded-wire-tagged from 1976 to 1981 and from 1993 to present. Total escapement was estimated from mark–recapture studies conducted from 1989 to 1990, 1995 to 1998, 2000 to 2012, and 2014 to 2016. In all other years expanded index counts using helicopter surveys were used to estimate escapement. Concurrent mark–recapture estimates and index survey counts were used to estimate the expansion factor of 5.2.

Escapement Goals and Stock Status: Prior to 1999, several system-wide or index goals were developed based on limited data. In 1999, an escapement goal range of 30,000 to 55,000 large spawners was established based on a stock-recruit analysis that maximized smolt production. The current biological escapement goal range of 19,000 to 36,000 large spawners was established in 2009, based on a stock-recruit analysis by McPherson et al. (2010).

Starting in 2005, during years of surplus Chinook salmon production to the Taku River, directed commercial and liberalized sport fisheries for Chinook salmon were prosecuted in the marine waters in District 11 near Juneau and inriver in Canada. In years of directed fishing, total harvest rates averaged about 40%. In other years, harvest rates average only about 20%, and most harvest occurs in the late winter and spring commercial troll fisheries (mid-March through June), commercial drift gillnet and sport fisheries in District 11 near Juneau, and in Canadian inriver gillnet and Aboriginal fisheries. This stock has shown a decline in productivity in recent years due to reduced marine survivals and it is unlikely that directed fisheries will be prosecuted until conditions improve. From 2012 to 2016, escapements were below the escapement goal range in 2 years (Appendix Figure A8), and harvest rates averaged 18%.

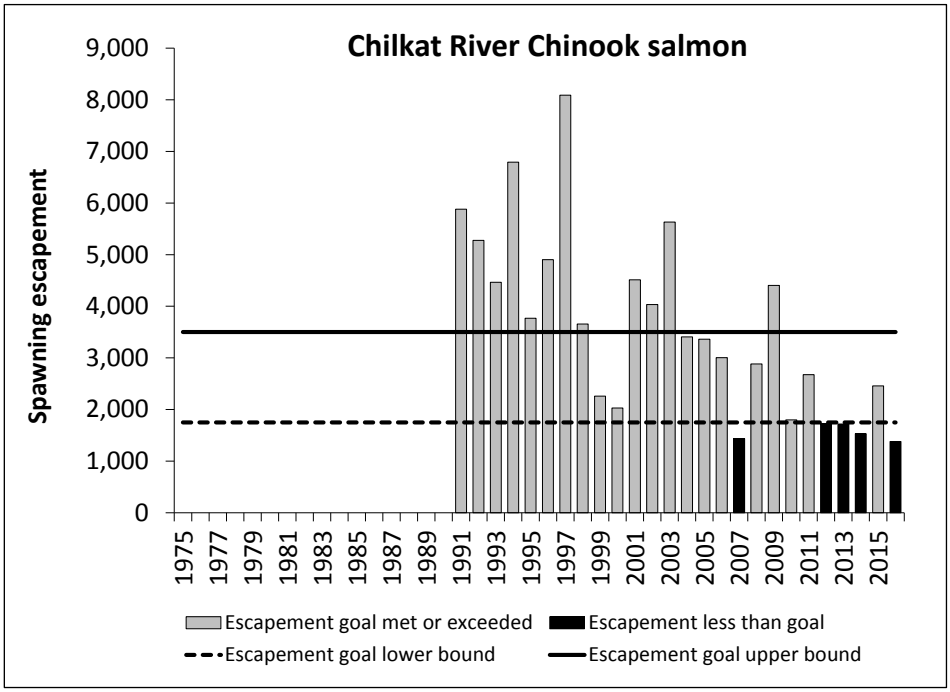


Appendix Figure A8.–Estimated Taku River Chinook salmon escapements, 1975–2016, and biological escapement goal range of 19,000–36,000 large spawners.

Appendix A9.–Chilkat River Chinook salmon.

The Chilkat River is a glacial system located near Haines, Alaska, which supports a mostly inside-rearing stock of Chinook salmon. This stock is targeted in a relatively small terminal marine sport fishery in Chilkat Inlet and is also harvested incidentally in mixed stock sport, and commercial drift gillnet and troll fisheries, primarily in northern Southeast Alaska. The Chilkat stock is also harvested incidentally in Chilkat Inlet and Chilkat River subsistence fisheries. Lynn Canal fisheries that harvest this stock are managed according to the *Lynn Canal and Chilkat River King Salmon Fishery Management Plan* (5 AAC 33.384) to achieve escapements within the escapement goal range. Escapements are based on estimates of large spawner abundance from a mark–recapture program conducted annually since 1991. Escapement data are relatively precise, with CVs for annual escapements averaging 14% since 1991. From 1975 to 1992, aerial survey counts were conducted on two small clear-water tributaries. Radio telemetry studies conducted in 1991 and 1992, however, showed that survey counts were not representative of escapement in the entire drainage and the surveys were discontinued. Smolts have been coded-wire-tagged at relatively high rates (8–10%) since 1999; additional wild-stock tagging occurred in three prior years.

Escapement Goals and Stock Status: In 1981, ADF&G established an escapement goal of 2,000 large fish, based on the assumed fraction of the escapement represented by survey counts (now discontinued). The current biological escapement goal range of 1,750 to 3,500 large spawners was established in 2003, based on a stock-recruit analysis by Ericksen and McPherson (2004). In 2003, the Board of Fisheries also adopted an inriver goal of 1,850 to 3,600 large fish (5 AAC 33.384) to account for incidental harvest in the Chilkat River subsistence sockeye salmon fishery. The Chilkat River stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. Coded-wire tagging information suggests harvest rates have been low, at about 24% for recent brood years. From 2012 to 2016, escapements were below the escapement goal range in 4 years (Appendix Figure A9), and harvest rates averaged 14%.



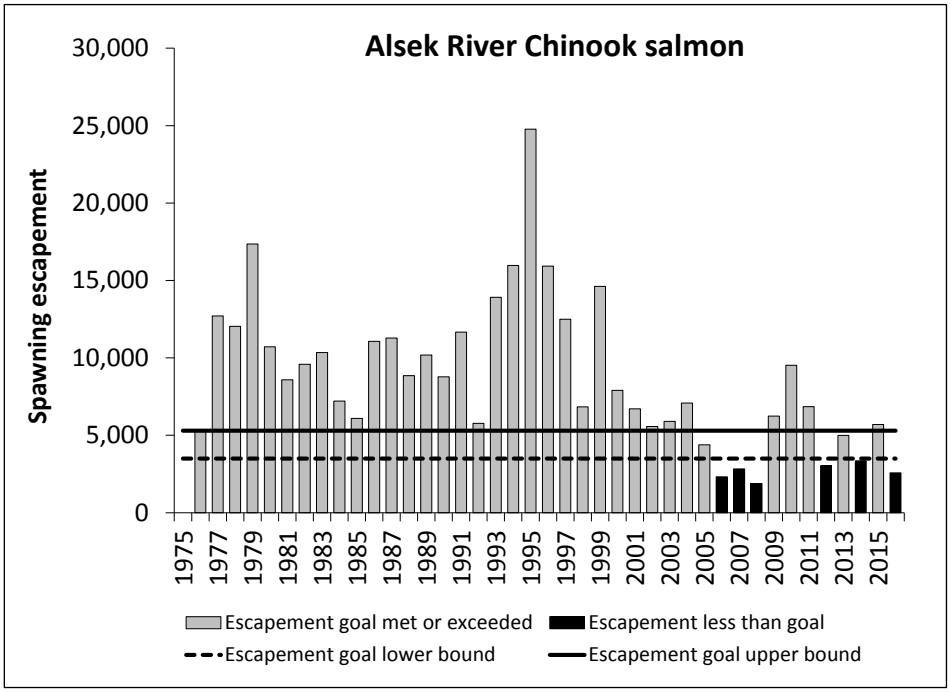
Appendix Figure A9.–Chilkat River Chinook salmon escapements (mark–recapture estimates), 1991–2016, and biological escapement goal range of 1,750–3,500 large spawners.

Appendix A10.–Alsek and Klukshu river Chinook salmon.

The Alsek River is a transboundary glacial system that originates in southwestern Yukon and northwestern British Columbia and flows into the Gulf of Alaska about 80 km southeast of Yakutat. This river supports an outside-rearing stock of Chinook salmon. Since 1976, the principle means of indexing escapement has been through a weir operated at the Klukshu River, one of 51 tributaries of the Tatshenshini River, the principal salmon-producing branch of the Alsek River. Mark–recapture studies of total escapement in the Alsek River were conducted from 1998 to 2004. Concurrent mark–recapture estimates and index weir counts were used to estimate the expansion factor of 4.0.

Escapement Goals and Stock Status: In 1998, a biological escapement goal of 1,100 to 2,300 Chinook salmon was established for the Klukshu River (McPherson et al. 1998). Unlike other Chinook salmon escapement goals in Southeast Alaska which are germane only to large fish, both the Alsek and Klukshu goals includes 2-ocean (4-year old) aged fish. In 2013, the goal was revised to a biological escapement goal of 800 to 1,200 fish for the Klukshu River, with a corresponding Alsek drainagewide biological escapement goal of 3,500 to 5,300 fish based on run-reconstruction and stock-recruit analysis (Bernard and Jones 2010; TTC 2014). Because the drainagewide escapement is a simple linear expansion of the Klukshu River escapement and for consistency with other index systems in Southeast that report total drainagewide escapements, the Alsek drainagewide escapement goal is the preferred escapement goal performance metric and the Klukshu goal is redundant and unnecessary.

Directed Canadian sport and Aboriginal fisheries occur in various upriver sections of the Alsek River. In the U.S., some fish are caught as bycatch in the commercial set gillnet sockeye salmon and subsistence fisheries that take place in the lower river and at Dry Bay. The Alsek River stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. Harvest rates for this stock are some of the lowest observed for a wild Chinook salmon stock and have averaged only about 12% since 1976. From 2012 to 2016, escapements in the Alsek River were below the escapement goal range in 3 years (Appendix Figures A10), and harvest rates averaged 12%.

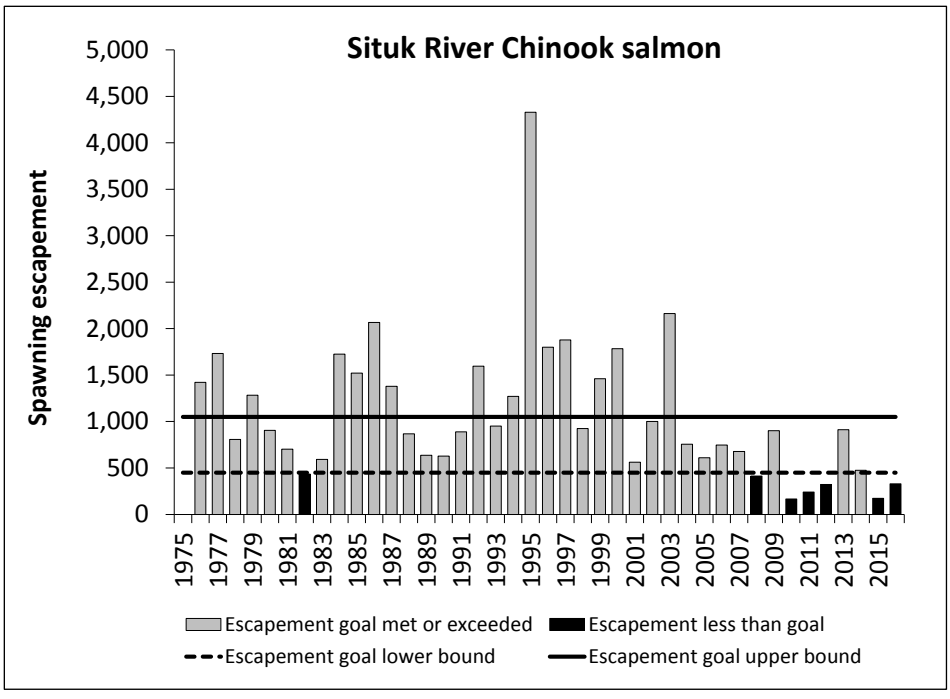


Appendix Figure A10.–Estimated Alsek River Chinook salmon escapements, 1976–2016, and biological escapement goal range of 3,500–5,300 fish.

Appendix A11.–Situk River Chinook salmon.

The Situk River is a clearwater system located near Yakutat, Alaska, that supports an outside-rearing stock of Chinook salmon. Situk-origin Chinook salmon are harvested primarily in directed sport, commercial, and subsistence fisheries located inriver, in the Situk-Ahrnklin inlet, and in nearby surf waters. Fisheries that target this stock are managed according to the *Situk-Ahrnklin Inlet and Lost River King Salmon Fisheries Management Plan* (5 AAC 30.365) to achieve escapements within the escapement goal range. Escapements are based on weir counts minus upstream sport fishery harvests, which are estimated from an on-site creel survey and a post-season mail-out survey. The weir has been operated annually since 1976, and was also operated from 1928 to 1955.

Escapement Goals and Stock Status: In 1991, ADF&G established an escapement goal of 600 large spawners, based on stock-recruit analysis, and in 1997 the escapement goal was revised to a range of 500 to 1,000 large spawners (McPherson et al. 2003). A new biological escapement goal range of 450 to 1,050 large spawners was established in 2003 using a more robust dataset and an updated stock-recruit analysis (McPherson et al. 2005). The Situk River stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. Sport fishery regulations and harvests have been significantly restricted, with partial (above weir) or total closures since 2008. Terminal net fishery harvests for commercial and or subsistence fisheries were also curtailed beginning in 2008, but retention of Chinook salmon incidentally harvested in net fisheries continued until 2011. Significant management actions have been taken since 2011, and all inlet net fisheries have been closed to the retention of Chinook salmon unless it was apparent the lower bound of the escapement goal would be met (Zeiser and Woods 2016). The 2013 escapement of 912 fish was a significant improvement over escapements from 2010 to 2012. Since 2013, however, escapement estimates have declined including 329 large Situk Chinook in 2016. Total annual terminal harvest rates for all gear groups combined averaged about 60% from 1990 to 2003; however, harvest rates have been substantially lower since 2004. From 2012 to 2016, escapements were below the escapement goal range in 3 years (Appendix Figure A11), and harvest rates averaged 14%.



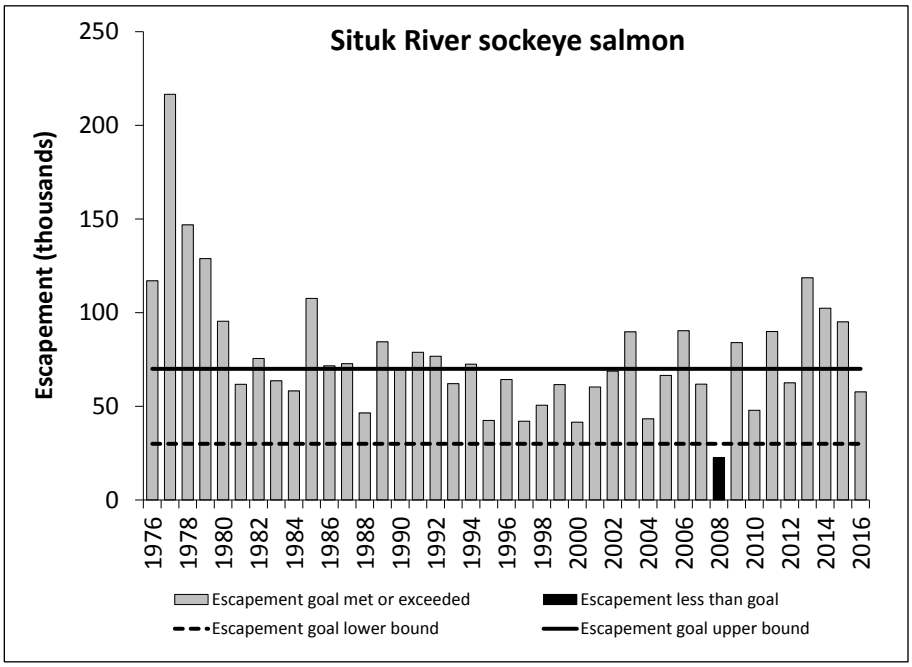
Appendix Figure A11.–Situk River Chinook salmon escapements (weir counts), 1976–2016, and biological escapement goal range of 450–1,050 large spawners.

APPENDIX B.
SOCKEYE SALMON ESCAPEMENT GOAL PERFORMANCE

Appendix B1.–Situk River sockeye salmon.

The Situk River is located on the Yakutat forelands, approximately 15 km southeast of Yakutat, Alaska. The river flows into the Situk-Ahrnklin Inlet, the site of the oldest and, historically, most productive set gillnet fishery in the Yakutat area (Woods and Zeiser 2010). Sockeye salmon escapements have been enumerated annually at an adult counting weir on the Situk River since 1976.

Escapement Goals and Stock Status: Prior to 1987, ADF&G managed the Situk-Ahrnklin Inlet fisheries to achieve a Situk River escapement of 80,000–100,000 sockeye salmon An escapement goal range of 40,000–55,000 sockeye salmon was established in 1987 based on preliminary stock-recruit analysis (McPherson et al. 1987). The escapement goal was revised in 1995 to a biological escapement goal range of 30,000–70,000 sockeye salmon based on a stock-recruit analysis by Clark et al. (1995a) and an updated analysis by Clark et al. (2002). From 2012 to 2016, escapements were within or above the escapement goal range in each year (Appendix Figure B1).



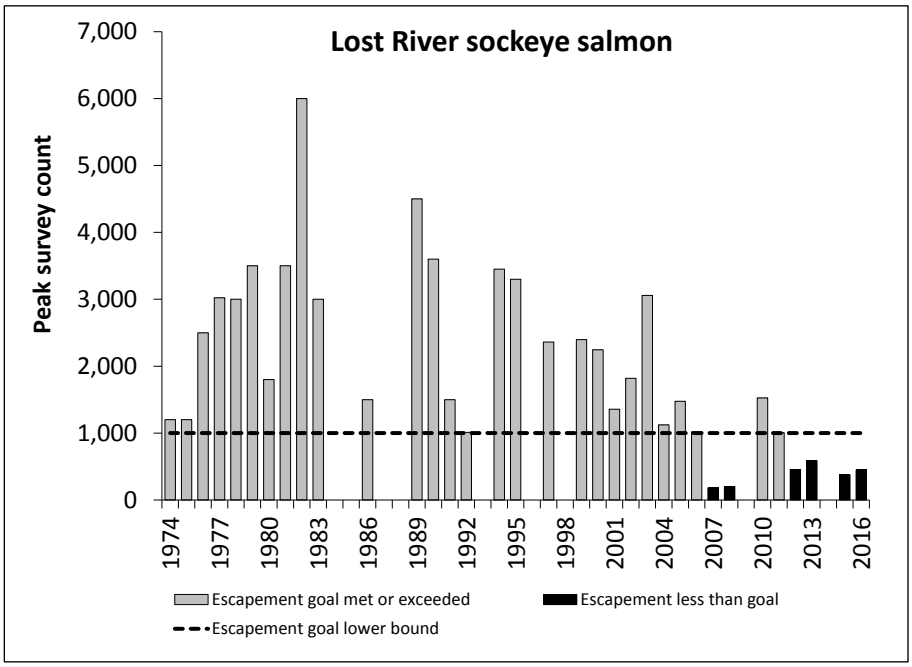
Appendix Figure B1.–Situk River sockeye salmon escapement (weir counts), 1976–2016, and biological escapement goal range of 30,000–70,000 fish.

Appendix B2.–Lost River sockeye salmon.

The Lost River, located on the Yakutat forelands, approximately 12 km southeast of Yakutat, supports a small sockeye salmon run that migrates into Tawah Creek and into Ophir Creek where the fish spawn. Sockeye salmon escapements have been assessed through boat and foot surveys since the early 1970s.

Escapement Goals and Stock Status: In 1995, ADF&G established a biological escapement goal range of 1,000–2,300 sockeye salmon counted on a peak survey in the Lost River tributaries (Clark et al. 1995b). Lost River sockeye salmon were harvested to some degree in a commercial set gillnet fishery at the Lost River mouth through the 1990s. Changes in the shoreline morphology during the winter of 1998–1999 caused the river to flow directly into the Situk-Ahrnklin Inlet, rather than directly into the Gulf of Alaska (Burkholder 2000), which made it impossible to manage commercial fisheries for a goal specific to the Lost River. Since 1999, an area 100–500 yards on either side of the mouth of the Lost River has been closed to commercial fishing to conserve Lost River salmon, which are harvested incidentally in the Situk-Ahrnklin set gillnet fishery (Woods and Zeiser 2010). In 2009, the escapement goal was changed to the current lower bound sustainable escapement goal of 1,000 sockeye salmon counted on a peak survey (Eggers et al. 2008). From 2012 to 2016, peak survey counts were below goal in 4 years (a peak survey count was not obtained in 2014; Appendix Figure B2).

The department recently (in this report) reviewed information related to the Lost River escapement goal. Little information exists on harvest and age composition of the run. Escapement information is limited to aerial, boat, and foot survey counts conducted in different parts of the drainage at different times, none of which was standardized by area or time, which made it impossible to produce a set of reasonably comparable escapement counts with which to assess escapements. As a result of the poor quality of available information the escapement goal review committee recommended eliminating the Lost River sockeye salmon escapement goal.

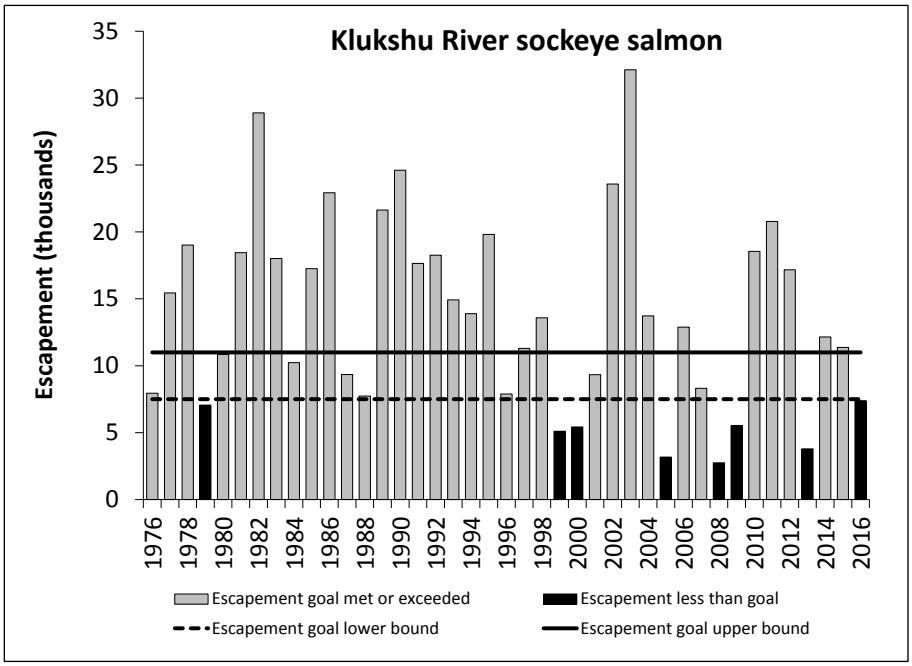


Appendix Figure B2.–Lost River sockeye salmon escapement index (peak survey counts), 1974–2016, and lower bound sustainable escapement goal of 1,000 fish. *Note*: Peak survey counts were not obtained in 1984, 1985, 1987, 1988, 1993, 1996, 1998, 2009, and 2014; survey method was not standardized, and annual maximum counts shown here are not comparable across all years.

Appendix B3.–Klukshu (Alsek) River sockeye salmon.

The Alsek River is a large transboundary river located on the mainland, approximately 80 km southeast of Yakutat, Alaska. Alsek river sockeye salmon are harvested primarily in U.S. commercial set gillnet fisheries in Dry Bay, at the mouth of the Alsek River, and in Canadian recreational and traditional aboriginal fisheries that take place primarily in the upper Tatshenshini drainage. Escapements to the Klukshu River, a major sockeye salmon-producing tributary, have been enumerated annually since 1976 at an adult counting weir just upstream of the confluence of the Klukshu and Tatshenshini rivers. The Klukshu weir is the principle tool for monitoring sockeye salmon stocks in the Alsek River (TTC 2014).

Escapement Goals and Stock Status: In 1984, the Transboundary Technical Committee of the Pacific Salmon Commission established an interim Alsek River drainage escapement goal range of 33,000–58,000 sockeye salmon, of which 12,000–35,000 were expected to enter the Klukshu River (TTC 1990). In 2000, a biological escapement goal of 7,500–15,000 sockeye salmon was established for the Klukshu River, based on a stock-recruit analysis (Clark and Etherton 2000). In 2013, the Klukshu River goal was revised to biological escapement goal of 7,500–11,000 fish, and a drainagewide biological escapement goal of 24,000–33,500 fish was established for the Alsek River, based on a run-reconstruction and stock-recruit analysis (Eggers and Bernard 2011; TTC 2014). The department recently recommended (in this report) eliminating the Alsek River sockeye salmon goal, however, due to lack of timely escapement information with which to measure performance and based on management considerations, which continue to be focused on meeting the escapement goal for the Klukshu River (TTC 2017). From 2012 to 2016, Klukshu River spawning escapements were below the escapement goal range in 2 years (Appendix Figure B3).



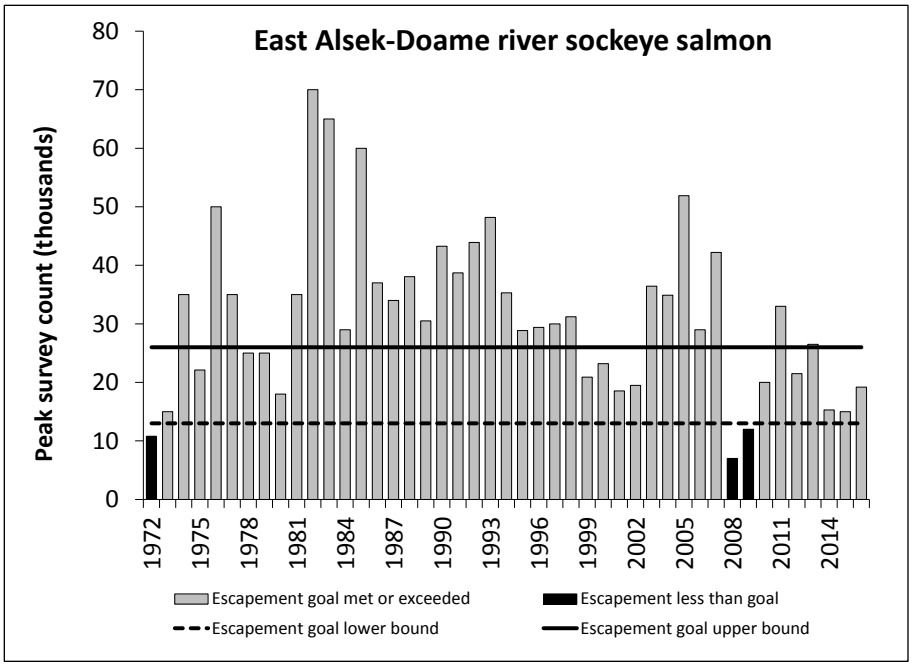
Appendix Figure B3.–Klukshu River sockeye salmon escapement (weir counts adjusted for upstream removals), 1976–2016, and biological escapement goal range of 7,500–11,000 spawners.

Appendix B4.–East Alsek-Doame River sockeye salmon.

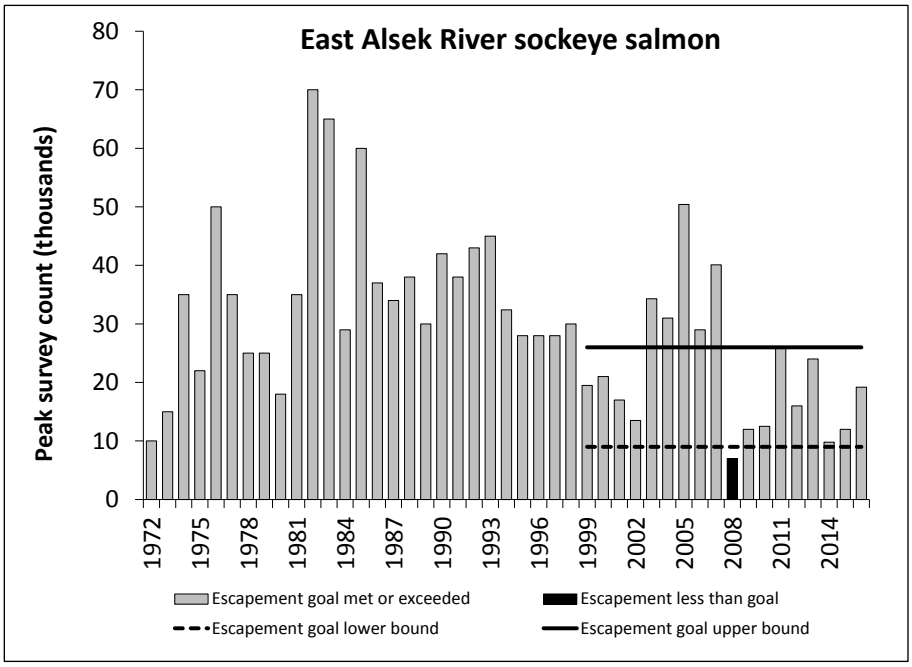
The East Alsek River is located on the Alsek River flood plain approximately 90 km southeast of Yakutat, Alaska. Prior to the early 1900s, the East Alsek River was a distributary channel of the Alsek River but is now fed by groundwater and has no direct connection to the Alsek River itself (Smith et al. 2006). The Doame River is a clear water system with two lakes, located just east of the East Alsek River. The Doame once entered the Gulf of Alaska directly, but a 1966 earthquake caused the river to flow west and empty into the East Alsek River (Clark et al. 2003). The Doame River sockeye salmon run is thought to be substantially smaller and earlier in run timing than the East Alsek River run (Clark et al. 2003). Sockeye salmon are harvested in the District 182-20 commercial set gillnet fishery in the East Alsek River lagoon, just below the confluence of the two rivers. Sockeye salmon escapements have been assessed through aerial surveys since the early 1970s.

Escapement Goals and Stock Status: In 1995, ADF&G established a biological escapement goal range of 26,000–57,000 sockeye salmon counted on peak aerial surveys in the East Alsek-Doame rivers combined, based on a stock-recruit analysis (Clark et al. 1995b). The East Alsek River run has undergone dramatic response to environmental changes over the past 100 years due to rapid post-glacial uplift of the Alsek River flood plain, including a population explosion in the 1970s–1980s followed by a decline in the 1990s due to deteriorating spawning habitat (Smith et al. 2006; Faber 2008). Sockeye salmon escapements dropped below the escapement goal and the commercial fishery was closed from 1999 to 2002. The decline in production was thought to be the result of increased sedimentation and growth of aquatic vegetation through the 1990s (Smith et al. 2006; Faber 2008). Flow from the much larger Alsek River was historically diverted into the East Alsek River during periodic flood events that flushed the East Alsek River channel and maintained excellent spawning habitat; as the land is uplifted, and the Alsek River becomes more deeply channelized, flooding of the East Alsek will become increasingly infrequent (e.g., several major floods since 1981 did not affect the East Alsek). In 2003, the escapement goal was revised downward to a biological escapement goal range of 13,000–26,000 sockeye salmon (Clark et al. 2003). From 2012 to 2016, peak survey counts met or exceeded the current escapement goal range in all years (Appendix Figure B4).

The department recently (in this report) recommended removing the Doame River counts from the escapement goal and changing the goal to a sustainable escapement goal range of 9,000–24,000 fish counted on a peak survey in the East Alsek River. The goal is based on the 5th–65th percentiles of 1999–2016 survey counts, the period that best encompasses decreased production in the East Alsek River. The change would simplify management considerations, which has historically been based on assessment of sockeye salmon run strength in the dominant East Alsek River. From 2012 to 2016, peak survey counts met or exceeded the recommended escapement goal range in all years (Appendix Figure B5).



Appendix Figure B4.–East Alsek-Doame River sockeye salmon escapement index (peak aerial survey counts), 1972–2016, and biological escapement goal range of 13,000–26,000 fish.



Appendix Figure B5.–East Alsek River sockeye salmon escapement index (peak aerial survey counts), 1972–2016, and recommended sustainable escapement goal range of 9,000–24,000 fish, based on the 5th and 65th percentiles of 1999–2016 peak aerial survey counts.

Appendix Table B1.–Available escapement survey and harvest data for East Alsek and Doame river sockeye salmon.

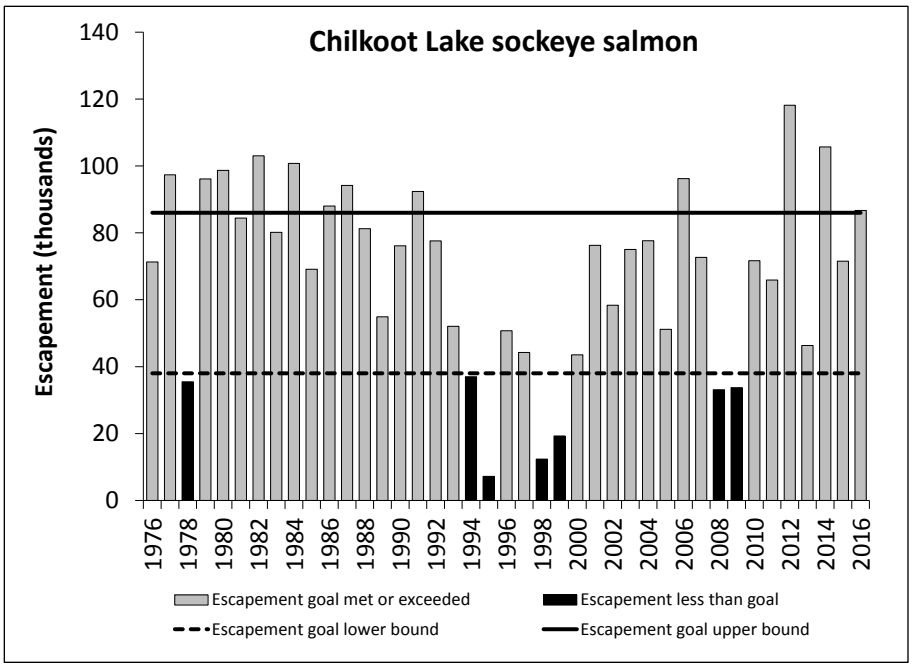
Year	East Alsek Peak Count	Set Gillnet Harvest	Subsistence Harvest	Sport Harvest	Total Harvest	Harvest Rate[a]	Doame River Peak Count
1972	10,000	9,575	NA	NA	9,575	49%	800
1973	15,000	12,342	NA	NA	12,342	45%	NA
1974	35,000	14,520	NA	NA	14,520	29%	NA
1975	22,000	18,235	NA	NA	18,235	45%	120
1976	50,000	30,057	NA	NA	30,057	38%	NA
1977	35,000	21,500	NA	NA	21,500	38%	NA
1978	25,000	30,922	NA	NA	30,922	55%	NA
1979	25,000	47,442	NA	NA	47,442	65%	NA
1980	18,000	48,616	NA	NA	48,616	73%	NA
1981	35,000	49,126	NA	NA	49,126	58%	NA
1982	70,000	98,501	NA	NA	98,501	58%	NA
1983	65,000	81,362	NA	NA	81,362	56%	NA
1984	29,000	39,373	NA	NA	39,373	58%	NA
1985	60,000	184,962	NA	NA	184,962	76%	NA
1986	37,000	74,972	NA	68	75,040	67%	NA
1987	34,000	133,740	NA	NA	133,740	80%	NA
1988	38,000	61,483	NA	NA	61,483	62%	50
1989	30,000	145,426	252	95	145,773	83%	500
1990	42,000	161,383	450	NA	161,833	79%	1,270
1991	38,000	45,334	385	45	45,764	55%	700
1992	43,000	144,378	189	82	144,649	77%	900
1993	45,000	189,207	235	39	189,481	81%	3,200
1994	32,400	99,998	335	NA	100,333	76%	2,900
1995	28,000	11,772	70	134	11,976	30%	850
1996	28,000	55,025	64	NA	55,089	66%	1,400
1997	28,000	12,665	180	11	12,856	31%	2,000
1998	30,000	5,802	0	138	5,940	17%	1,200
1999	19,500	*closed*	0	792	792	4%	1,400
2000	21,000	*closed*	44	598	642	3%	2,200
2001	17,000	*closed*	39	*closed*	39	0%	1,545
2002	13,500	10	11	NA	21	0%	6,000
2003	34,300	2,617	24	385	3,026	8%	2,140
2004	31,000	4,590	104	1,923	6,617	18%	3,900
2005	50,400	5,099	21	570	5,690	10%	1,500
2006	29,000	14,848	0	183	15,031	34%	NA
2007	40,100	63,080	0	740	63,820	61%	2,100
2008	7,000	1	0	237	238	3%	NA
2009	12,000	7,388	72	151	7,611	39%	NA
2010	12,500	103	40	402	545	4%	7,500
2011	26,000	14,867	113	1,028	16,008	31%	7,000
2012	16,000	12,124	0	NA	12,124	43%	5,500
2013	24,000	18,474	0	NA	18,474	42%	2,500
2014	9,800	3,069	0	NA	3,069	24%	5,500
2015	12,000	2,542	0	NA	2,542	17%	3,000
2016	19,200	8,771		NA	8,771	31%	NA

[a] The Harvest rate was estimated as the total harvest divided by the total harvest + peak survey count.

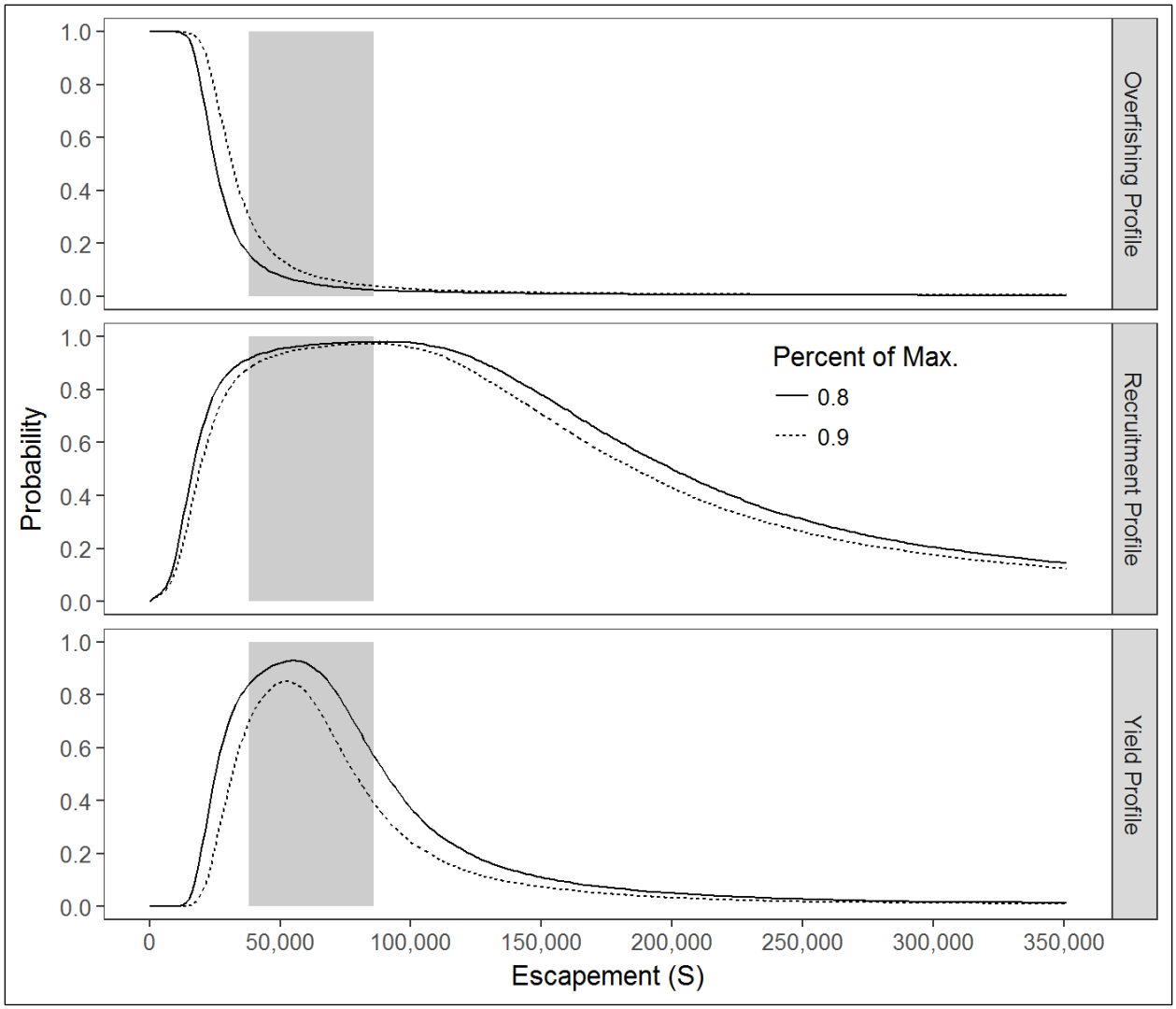
Appendix B5.–Chilkoot Lake sockeye salmon.

Chilkoot Lake is a glacial system located on the mainland, approximately 13 km northwest of Haines, Alaska. The Chilkoot drainage supports one of the larger runs of sockeye salmon in the region, which is harvested primarily in the District 15 Lynn Canal commercial drift gillnet fishery and in a subsistence fishery in Lutak Inlet. Escapements have been enumerated annually at an adult counting weir in the Chilkoot River, below the outlet of the lake, since 1976.

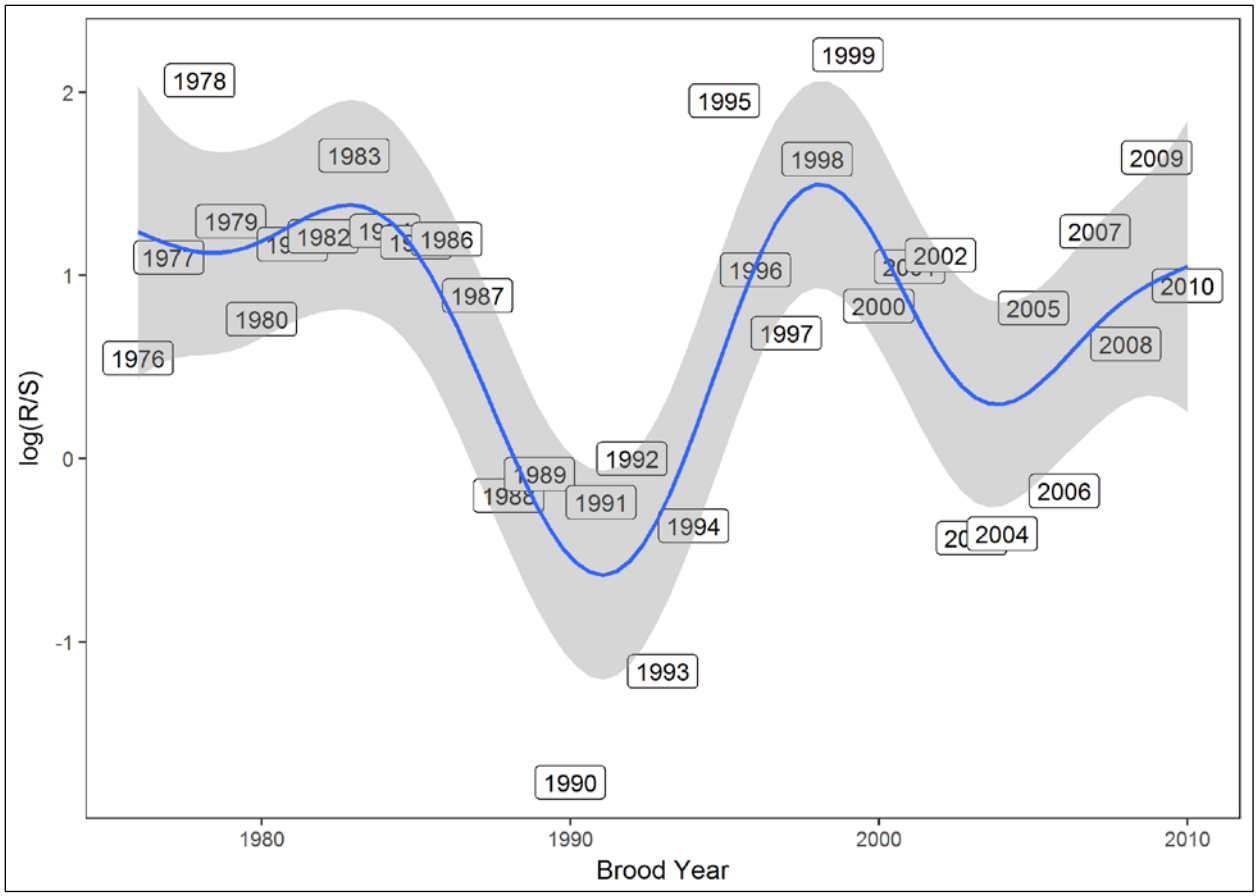
Escapement Goals and Stock Status: This stock was managed for informal escapement goals of 80,000–100,000 sockeye salmon starting in 1976, and 60,000–80,000 sockeye salmon starting in 1981 (McPherson 1990). In 1990, ADF&G established a biological escapement goal range of 50,500–91,500 sockeye salmon divided into separate goals for early- and late-runs, based on a stock-recruit analysis (McPherson 1990). The run underwent an extended downturn in production in the 1990s related to changes in the lake rearing environment, which is glacially turbid; very warm summers increased the silt load in the lake, which greatly reduced zooplankton abundance (Eggers et al. 2009b). An extremely low weir count in 1995 prompted ADF&G to verify weir counts with mark–recapture studies, which were conducted in 12 years between 1996 and 2011 (Bachman et al. 2014). Mark–recapture estimates were greater than weir counts, consistent with the idea that weir counts likely under-represented total escapement, but differences between the two estimates were not consistent enough to calibrate weir counts. Geiger et al. (2005) recommended maintaining essentially the same escapement goal range, 50,000–90,000 sockeye salmon, but reclassified the goal as a sustainable escapement goal. In 2009, the escapement goal was changed to a sustainable escapement goal range of 38,000–86,000 sockeye salmon based on an updated stock-recruit analysis (Eggers et al. 2008, 2009b). The goal was considered a sustainable goal, rather than a biological goal, due to uncertainty in weir counts. A recent review (Brenner et al. *in prep*; and in this report) suggests the escapement goal should remain unchanged until returns from recent very large brood years (2012 and 2014) can be incorporated into the analysis. From 2012 to 2016, escapements were within or above the escapement goal range in each year (Appendix Figure B6).



Appendix Figure B6.–Chilkoot Lake sockeye salmon escapement (weir counts), 1976–2016, and sustainable escapement goal range of 38,000–86,000 fish.



Appendix Figure B7.–Chilkoot Lake sockeye salmon 80% and 90% probability profiles for overfishing, optimal recruitment, and optimal yield based on updated brood year escapement and return data, 1976–2010 (Brenner et al. *In prep*). Results are from an autoregressive Ricker model and the shaded areas shows the current sustainable escapement goal range of 38,000–86,000 fish.

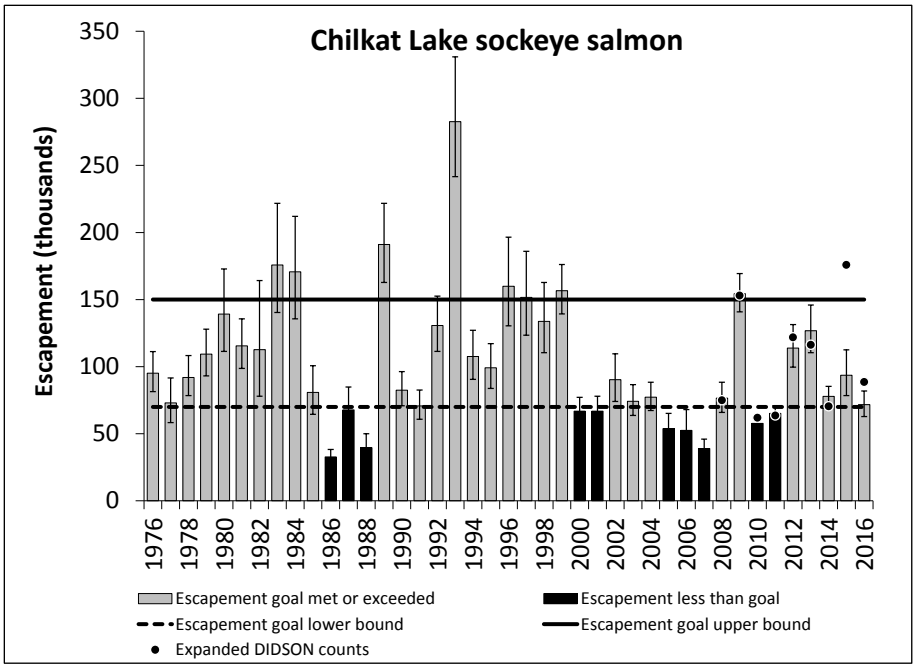


Appendix Figure B8.–Productivity (log (R/S)) of Chilkoot Lake sockeye salmon from brood years 1976–2010. The solid line is a general additive model (GAM) fit and the shaded area the 95% confidence intervals.

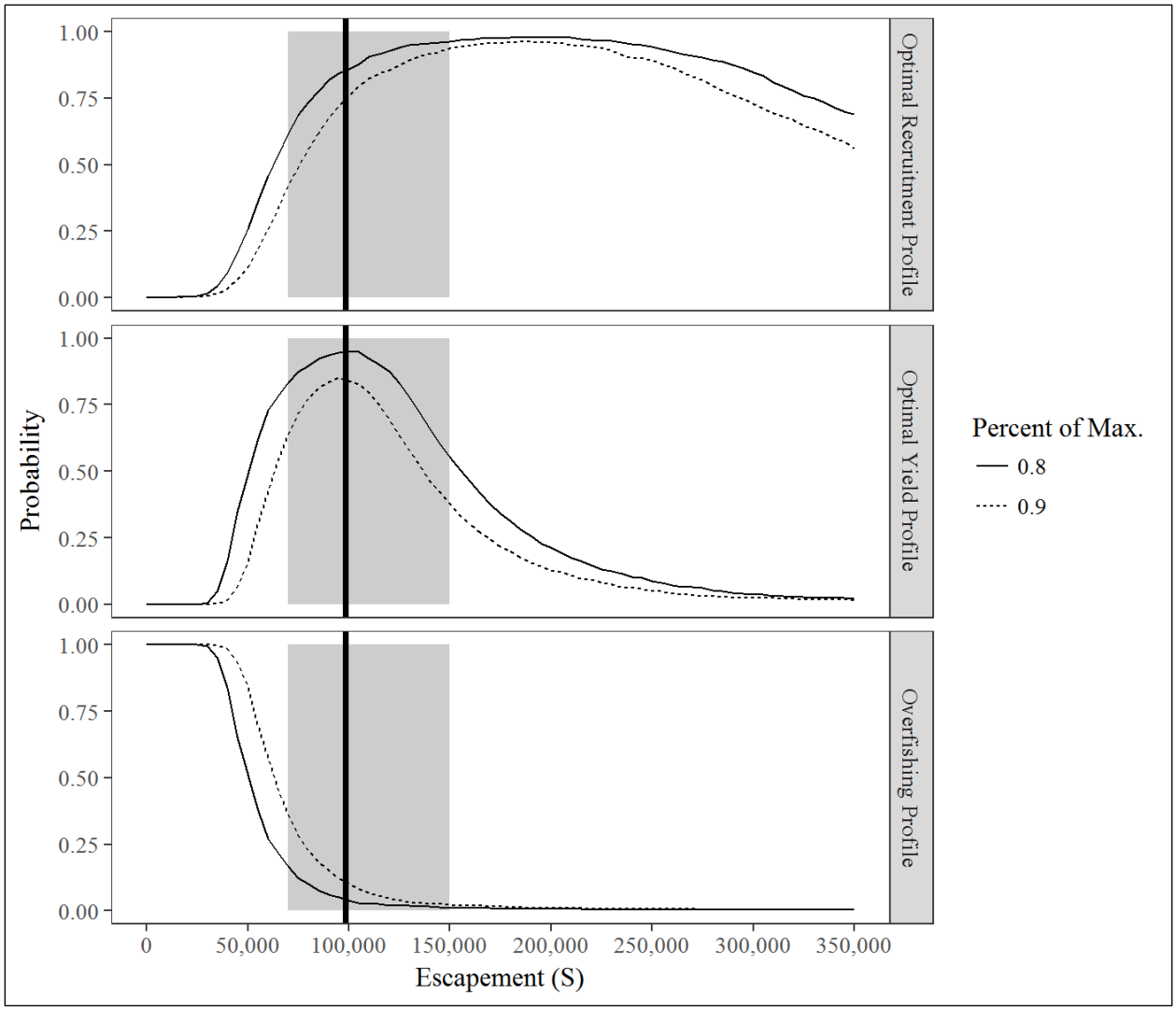
Appendix B6.–Chilkat Lake sockeye salmon.

Chilkat Lake is a relatively clear lake located approximately 43 river km upstream from the city of Haines. The Chilkat drainage supports one of the larger runs of sockeye salmon in the region, which is harvested primarily in the District 15 Lynn Canal commercial drift gillnet fishery. Chilkat Lake sockeye salmon escapements have been estimated through weir counts (1967–1993), weir counts with concurrent mark–recapture estimates (1994, 1995, and 1999–2007), mark–recapture estimates only (1996–1998), and DIDSON counts with concurrent mark–recapture estimates (2008–2016) (Eggers et al. 2010; Sogge and Bachman 2014; Bednarski et al. *in prep*).

Escapement Goals and Stock Status: The Chilkat Lake sockeye salmon run has been managed for at least five different escapement goals since 1976. Informal goals of 60,000–70,000 fish (1976–1980) and 70,000–90,000 fish (1981–1989) (Bergander et al. 1988) were replaced in 1990 with a biological escapement goal range of 52,000–106,000 sockeye salmon based on a stock-recruit analysis (McPherson 1990). Efforts to update the escapement goal were hindered by lake stocking in the 1990s and concerns regarding accuracy of weir counts (Geiger et al. 2005). Geiger et al. (2005) converted the weir based goal to mark–recapture units and the goal was revised to a sustainable escapement goal range of 80,000–200,000 sockeye salmon from 2006 to 2008. In 2009, the Chilkat Lake escapement goal was revised to the current biological escapement goal range of 70,000–150,000 sockeye salmon (Eggers et al. 2008, 2010). Eggers et al. (2010) scaled weir counts to mark–recapture estimates, then fit a hierarchal set of stock-recruit models to the Chilkat River recruits from parental escapements of the 1979 to 2002 brood years. The biological escapement goal is the escapement range that produces ≥ 90% of maximum sustained yield as determined by an autoregressive Ricker (density dependence with first order autoregressive term) model with fry plants. A recent review (Miller and Heinl *in prep*; and in this report) suggests the escapement goal should remain unchanged. Escapements were within or above the escapement goal range in 5 of the past 5 years (Appendix Figure B9).



Appendix Figure B9.–Estimated Chilkat Lake sockeye salmon escapements (and 95% credibility intervals), 1976–2016, and biological escapement goal range of 70,000–150,000 fish. Expanded DIDSON counts are shown as data points, 2008–2016.

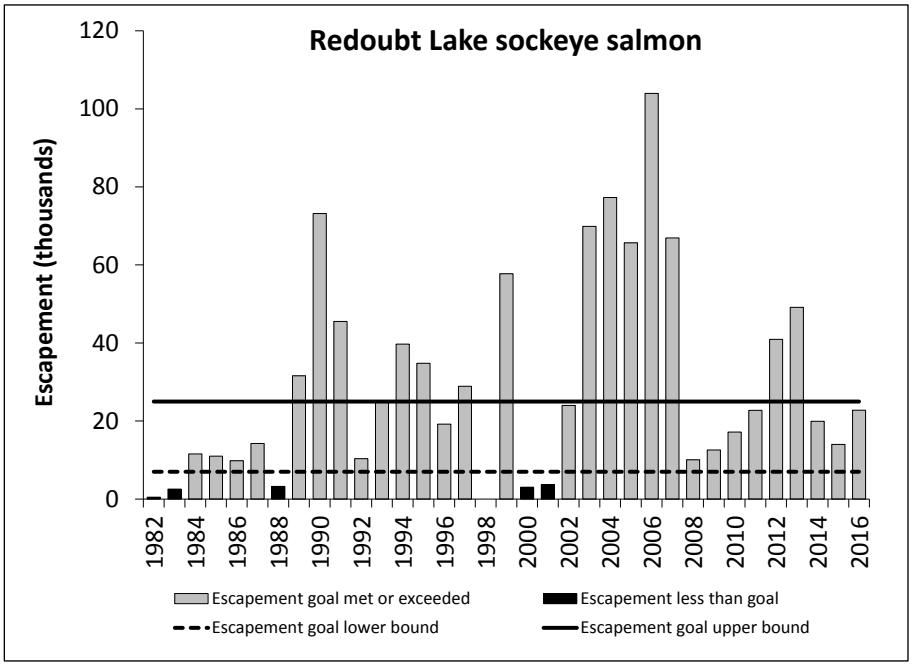


Appendix Figure B10.–Chilkat Lake sockeye salmon 80% and 90% probability profiles for optimal recruitment, optimal yield, and overfishing based on updated brood year escapement and return data, 1976–2016 (Miller and Heinl *in prep*). The shaded region shows the current biological escapement goal range of 70,000 to 150,000 and the solid vertical line is the posterior median of spawning abundance at maximum sustained yield (approximately 98,000 fish) from the state-space model.

Appendix B7.–Redoubt Lake sockeye salmon.

Redoubt Lake is located on Baranof Island, approximately 19 km south of Sitka, Alaska. Redoubt Lake sockeye salmon are harvested primarily in terminal subsistence and sport fisheries and, to a lesser extent, mixed stock commercial fisheries in Sitka Sound. Sockeye salmon escapements have been enumerated annually at an adult counting weir at the outlet of the lake in all but one year since 1982 (the USDA Forest Service has operated the weir since the mid-1990s).

Escapement Goals and Stock Status: In 2003, ADF&G recommended a biological escapement goal range of 10,000–25,000 sockeye salmon based on a stock-recruit analysis (Geiger 2003). In 2003, the Board of Fisheries adopted a management plan for Redoubt Lake and set an optimal escapement goal range of 7,000–25,000 sockeye salmon (5 AAC 01.760 *Redoubt Bay and Lake Sockeye Salmon Fisheries Management Plan*). The management plan provides guidelines for allocating Redoubt Lake sockeye salmon between subsistence, sport, and commercial fisheries based on projected inseason run strength. Redoubt Lake was intensively fertilized during most years when stock-recruit observations were made (1984–1987 and 1990–1995). Lake fertilization was discontinued from 1996 to 1998, but a less intensive fertilization program has been conducted annually by the USDA Forest Service since 1999. An attempt to assess the effect of the lake fertilization project on freshwater production and adult recruitment of sockeye salmon was limited by lack of data from non-fertilized years (Beauchamp and Overman 2004). From 2012 to 2016, escapements were within or above the escapement goal range in all years (Appendix Figure B11).

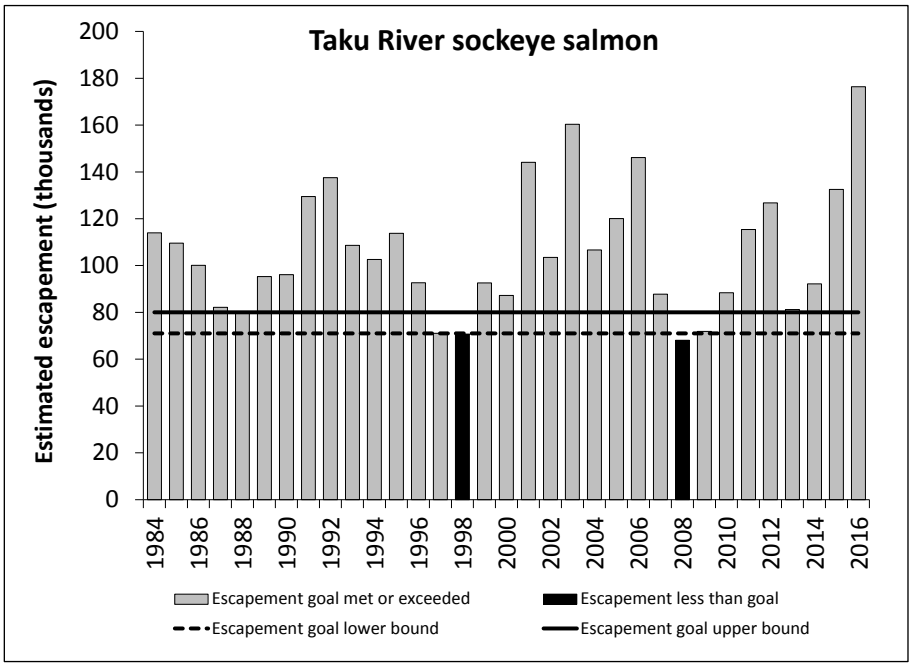


Appendix Figure B11.–Redoubt Lake sockeye salmon escapement (weir counts), 1982–2016, and optimal escapement goal range of 7,000–25,000 fish. (The weir was not operated in 1998.)

Appendix B8.–Taku River sockeye salmon.

The Taku River is a large transboundary river located on the mainland, approximately 30 km northeast of Juneau, Alaska. Taku River sockeye salmon are harvested primarily in Alaska commercial drift gillnet fisheries in District 11 and Canadian inriver fisheries. Harvests have been estimated through postseason run-reconstruction analysis by the Transboundary Technical Committee of the Pacific Salmon Commission. Sockeye salmon escapements have been estimated through joint U.S./Canada mark–recapture studies conducted since 1984.

Escapement Goals and Stock Status: In 1985, the Transboundary Technical Committee established an escapement goal range of 71,000–80,000 sockeye salmon in Canadian spawning areas of the Taku River drainage. The escapement goal was based on professional judgment and the technical committee considers it an interim goal until a scientifically-based goal is developed (TTC 2014). ADF&G considers the goal to be a sustainable escapement goal (Geiger et al. 2004). From 2012 to 2016, escapements were within or above the escapement goal in all years (Appendix Figure B12).

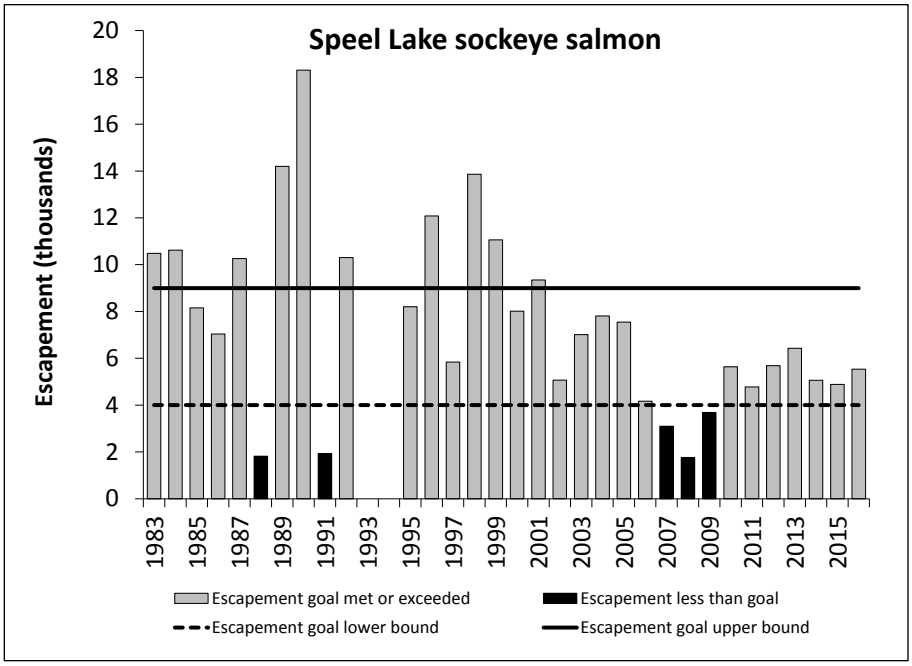


Appendix Figure B12.–Taku River sockeye salmon escapements (mark–recapture estimates), 1984–2016, and sustainable escapement goal range of 71,000–80,000 fish.

Appendix B9.–Speel Lake sockeye salmon.

Speel Lake is located on mainland Alaska, in Speel Arm of Port Snettisham, approximately 50 km southeast of Juneau, Alaska. Speel Lake sockeye salmon are harvested in traditional mixed stock commercial drift gillnet fisheries in District 11 and in terminal hatchery fisheries in Speel Arm. Escapements have been enumerated annually at an adult counting weir at the outlet of the lake in all but two years since 1983 (the weir has been operated by Douglas Island Pink and Chum, Inc. since 1996). Weir counts during most of the 1980s and 1990s underestimated the escapement, however, due to early removal of the weir. Speel Lake harvests have been estimated annually in conjunction with U.S./Canada stock identification programs to allocate harvests in the District 11 drift gillnet fisheries.

Escapement Goals and Stock Status: This stock was managed for informal escapement goals of 10,000 sockeye salmon in the 1980s, then 5,000 sockeye salmon starting in 1992. In 2003, ADF&G established a biological escapement goal range of 4,000–13,000 sockeye salmon, the range of escapements estimated to provide for greater than 80% of maximum sustained yield (Riffe and Clark 2003). Riffe and Clark (2003) recommended the Speel Lake weir continue to be operated through late September to ensure complete enumeration of the escapement, and recommended the escapement goal be reviewed once sufficient new information had been collected. Heinl et al. (2014b) reviewed and updated Speel Lake sockeye salmon stock assessment information and updated the stock-recruit analysis. As a result, the goal was changed to a sustainable escapement goal range of 4,000–9,000 fish, based on the range of escapements estimated to provide for 70–80% of maximum sustained yield. From 2012 to 2016, escapements were within the escapement goal range in all years (Appendix Figure B13).

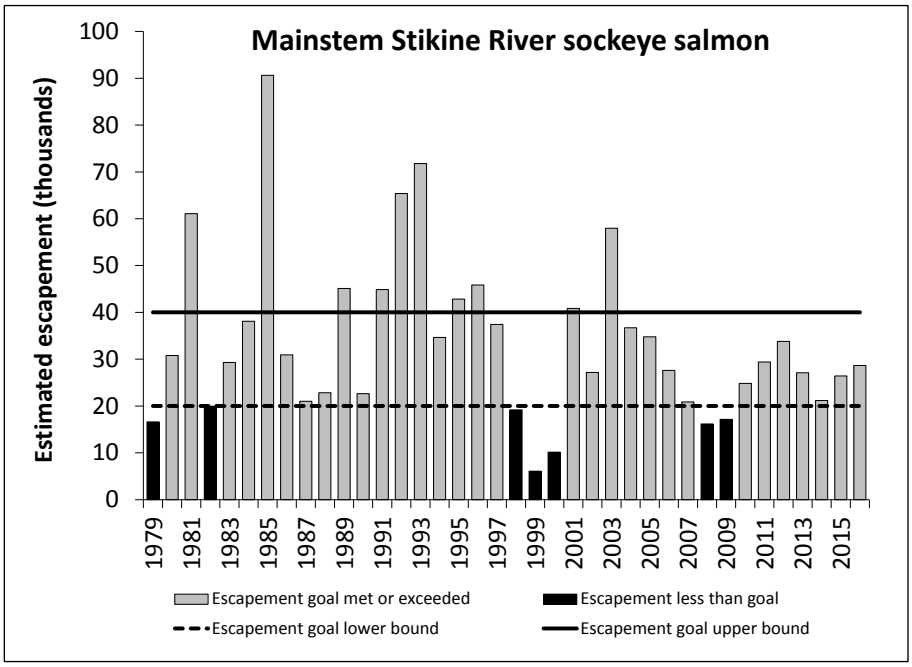


Appendix Figure B13.–Estimated Speel Lake sockeye salmon escapements (expanded weir counts), 1983–2016, and sustainable escapement goal range of 4,000–9,000 fish. (The weir was not operated in 1993 or 1994.)

Appendix B10.–Mainstem Stikine River sockeye salmon.

The Stikine River is a large transboundary river located on the mainland, approximately 15 km north of Wrangell, Alaska. The mainstem Stikine stock includes all Stikine River sockeye salmon populations aside from wild and hatchery runs at Tahltan and Tuya lakes (TTC 2014). Mainstem Stikine sockeye salmon are harvested primarily in Alaska commercial drift gillnet fisheries in districts 6 and 8 and Canadian inriver fisheries. Harvests and escapements have been estimated through postseason run-reconstruction analysis of fishery data by the Transboundary Technical Committee of the Pacific Salmon Commission.

Escapement Goals and Stock Status: In 1987, the Transboundary Technical Committee established an interim escapement goal range of 20,000–40,000 sockeye salmon for mainstem Stikine stocks based on professional judgment (TTC 1990, 1993). This goal has not been updated and ADF&G considers it to be a sustainable escapement goal (Geiger et al. 2004). From 2012 to 2016, escapements were within the escapement goal range in all years (Appendix Figure B14).

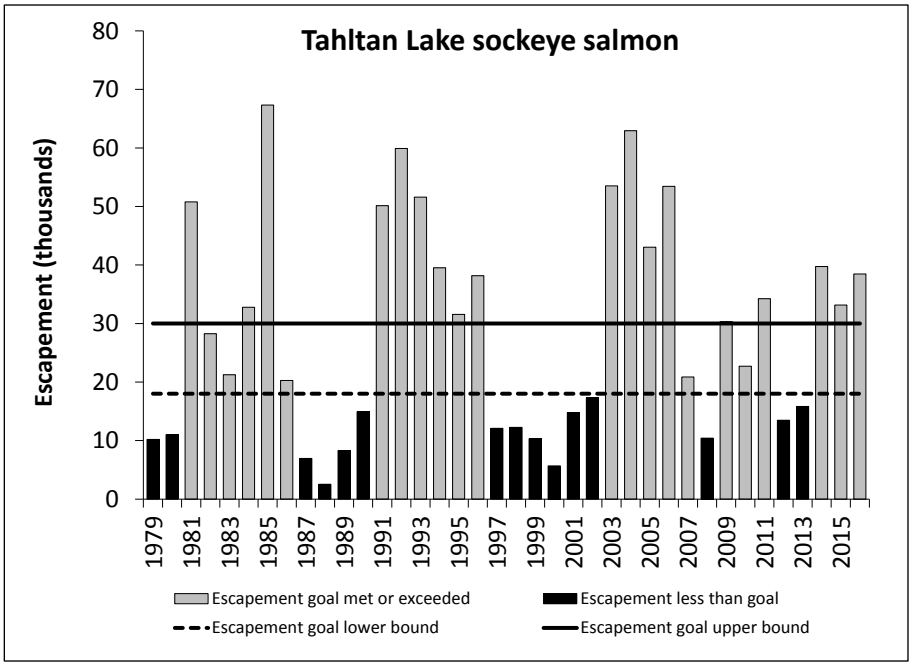


Appendix Figure B14.–Mainstem Stikine River sockeye salmon escapement (run-reconstruction estimates), 1979–2016, and sustainable escapement goal range of 20,000–40,000 fish.

Appendix B11.–Tahltan Lake sockeye salmon.

Tahltan Lake is the largest producer of sockeye salmon in the transboundary Stikine River drainage. The lake is located in Canada, approximately 170 km north of Wrangell, Alaska. Tahltan sockeye salmon are harvested primarily in Alaska commercial drift gillnet fisheries in Districts 6 and 8 and Canadian inriver fisheries. Sockeye salmon escapements have been enumerated annually at an adult counting weir at the outlet of the lake since 1959.

Escapement Goals and Stock Status: In 1987, the Transboundary Technical Committee of the Pacific Salmon Commission established an interim escapement goal of 30,000 sockeye salmon (TTC 1990). In 1993, the committee revised the escapement goal to a range of 18,000–30,000 sockeye salmon (TTC 1993; Humphreys et al. 1994). ADF&G considered the goal to be a biological escapement goal in 2003 (Geiger et al. 2004). The escapement goal represents a mix of naturally spawning fish and a maximum of approximately 4,000 fish used for hatchery broodstock for stocking into Tahltan and Tuya lakes under the bilateral enhancement program specified in the Pacific Salmon Treaty. Sockeye salmon production has fluctuated dramatically over time. From 2012 to 2016, escapements were below the escapement goal range in 2 years (Appendix Figure B15).

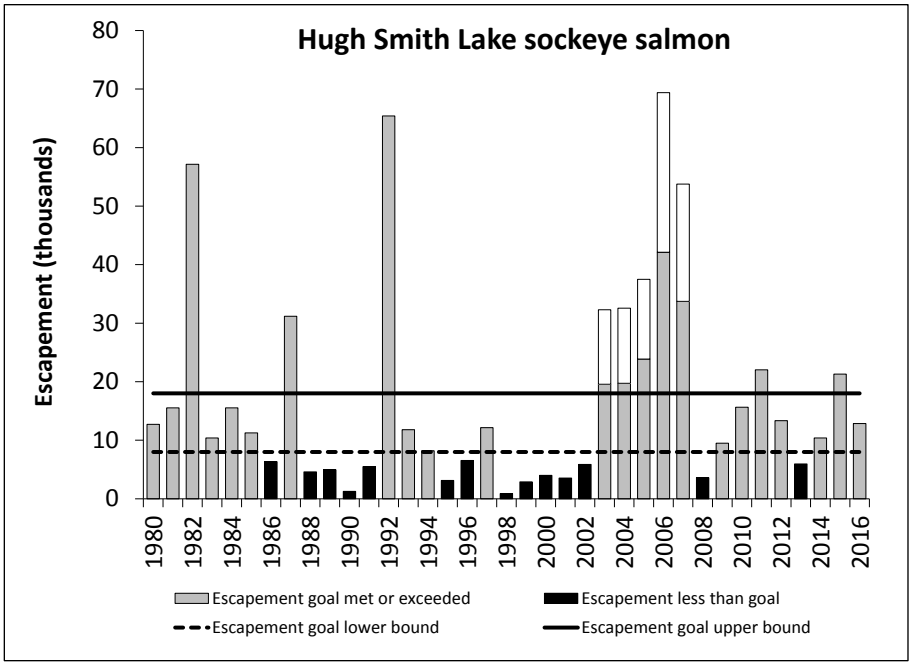


Appendix Figure B15.–Tahltan Lake sockeye salmon escapement (weir counts), 1979–2016, and biological escapement goal range of 18,000–30,000 fish.

Appendix B12.–Hugh Smith Lake sockeye salmon.

Hugh Smith Lake is located on mainland Alaska, approximately 65 km southeast of Ketchikan, Alaska. Hugh Smith sockeye salmon are harvested in mixed stock commercial net fisheries in the Northern Boundary area of Alaska and Canada. Sockeye salmon escapements have been enumerated annually at an adult counting weir at the outlet of the lake since 1980.

Escapement Goals and Stock Status: An escapement goal range of 15,000–35,000 sockeye salmon was established in the early 1990s, based on professional judgment. The current optimal escapement goal range of 8,000–18,000 fish was established by the Board of Fisheries in 2003, based on escapement goal analyses outlined in Geiger et al. (2003). The optimal escapement goal includes spawning salmon of both wild and hatchery origin (5 AAC 33.390). Escapements were below goal for five consecutive years 1998–2002 (Appendix Figure B16), and the stock was formally designated as a stock of management concern by the Board of Fisheries in 2003 (Geiger et al. 2005). The board adopted an action plan that included fishery restrictions to reduce harvests in nearby District 1 commercial drift gillnet and purse seine fisheries. Various stocking projects were conducted at the lake in most years 1986–2003, most of which were thought to be unsuccessful (Geiger et al. 2003); however, large numbers of adults from the last pre-smolt stocking project returned from 2003 to 2007, and escapements exceeded the upper bound of the escapement goal range in each of those years. As a result of improved escapements, the Hugh Smith Lake sockeye salmon run was removed from stock of concern status in 2006 (Geiger et al. 2005). Escapements have improved from low levels in the 1990s. From 2012 to 2016, escapements were below the escapement goal range in 1 year (Appendix Figure B16).

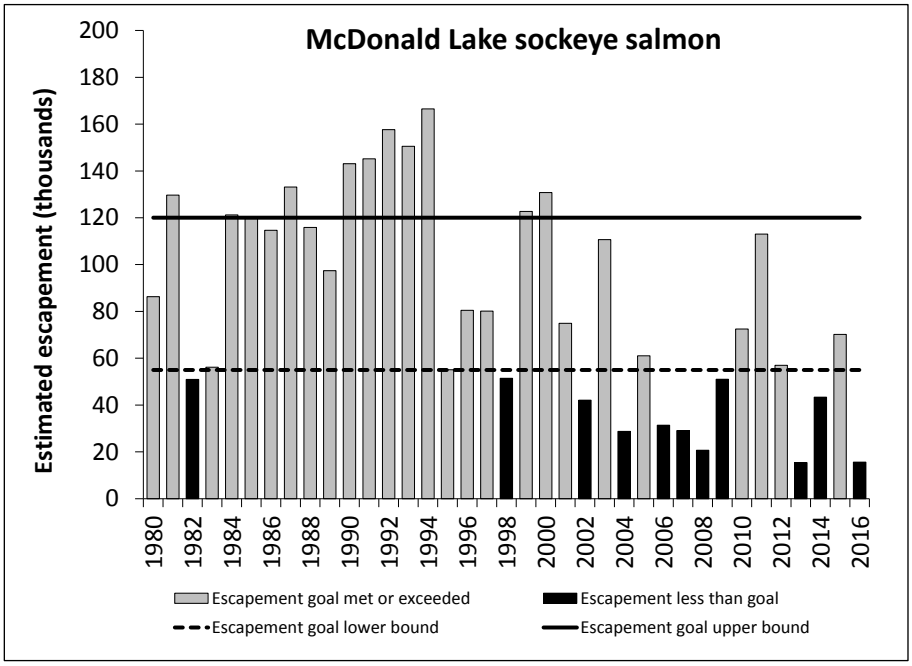


Appendix Figure B16.–Hugh Smith Lake sockeye salmon escapements (weir counts), 1980–2016, and optimal escapement goal range of 8,000–18,000 fish. The optimal escapement goal includes both wild and hatchery-stocked fish. Escapements from 2003 to 2007 are divided to show estimated wild and hatchery-stocked (white columns) fish. Estimates of the contributions of wild and hatchery-stocked fish are not available for years prior to 2003.

Appendix B13.–McDonald Lake sockeye salmon.

McDonald Lake, located on the mainland, approximately 65 km north of Ketchikan, supports one of the largest runs of sockeye salmon in southern Southeast Alaska. McDonald Lake sockeye salmon are harvested in mixed stock commercial net fisheries in the Northern Boundary area of Alaska and Canada. McDonald Lake was the target of a lake fertilization enhancement project conducted from 1982 to 2004 (Johnson et al. 2005). Escapements have been estimated from calibrated foot survey counts conducted since 1980.

Escapement Goals and Stock Status: In 1989, ADF&G established an escapement goal of 85,000 sockeye salmon based on a euphotic volume habitat model. The goal was revised in 1993, to a range of 65,000–85,000 sockeye salmon based on an undocumented stock-recruit analysis. In 2006, the escapement goal was changed to a sustainable escapement goal range of 70,000–100,000 sockeye salmon based on a simple yield analysis (Johnson et al. 2005). The goal was revised again to the current sustainable escapement goal range of 55,000–120,000 fish in 2009, based on a stock-recruit analysis of recalibrated escapement estimates (Eggers et al. 2009a). The goal was considered a sustainable escapement goal due to uncertainty regarding the effects of lake fertilization on stock productivity, as essentially all adult returns in the stock-recruit series experienced nutrient enhancement during the lake residence portion of their life history. The run was strong over most of the enhancement period: estimated escapements averaged more than 100,000 fish in the 1980s and 1990s. The run underwent a decline beginning in the mid-1990s, however, despite nutrient enhancement, and estimated escapements fell below escapement goals in 5 of 7 years 2002–2008 (Appendix Figure B17). The stock was formally designated as a stock of management concern by the Board of Fisheries in 2009. Escapements were within the escapement goal range for three consecutive years, 2010–2012, and the stock of concern designation was removed in 2012. From 2012 to 2016, estimated escapements were below the escapement goal range in 3 years.



Appendix Figure B17.–McDonald Lake sockeye salmon escapements (expanded foot surveys), 1980–2016, and sustainable escapement goal range of 55,000–120,000 fish.

APPENDIX C.
COHO SALMON ESCAPEMENT GOAL PERFORMANCE

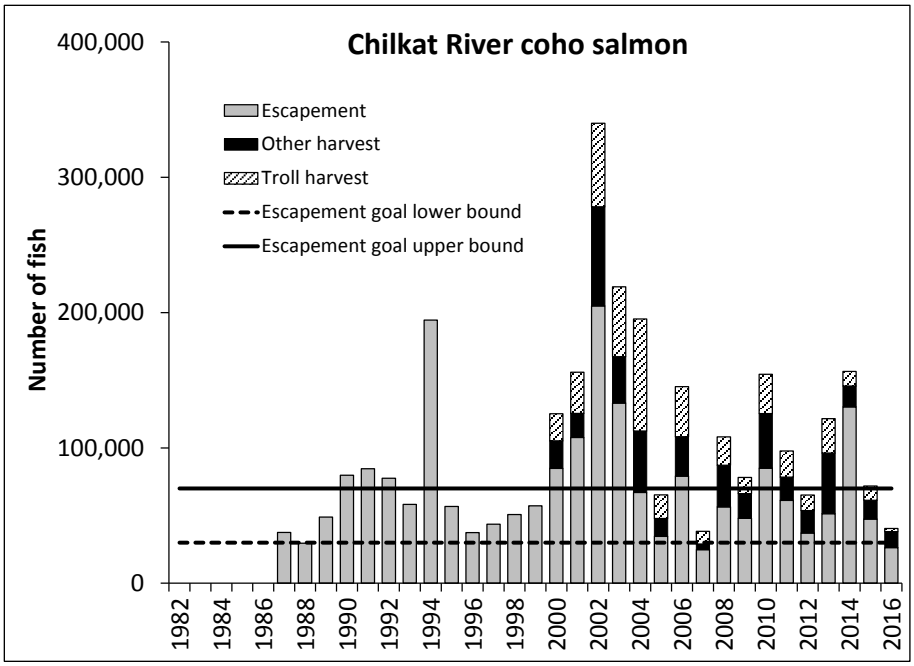
Appendix C1.–Berners and Chilkat rivers coho salmon.

Coho salmon from the Berners River in lower Lynn Canal and the Chilkat River in upper Lynn Canal are harvested primarily in the northern Southeast troll fishery and the Lynn Canal drift gillnet fishery, with lesser exploitation rates by purse seine fisheries and marine and freshwater sport fisheries (Shaul et al. 2011; Elliott 2013). The Chilkat River stock is also exploited by a subsistence fishery conducted in the Chilkat River and Chilkat Inlet. Both systems have similar mainland valley rearing habitat, including wetlands, ponds, and sloughs. The Berners River is a compact system with concentrated, high-quality coho spawning and rearing habitat. It has a late, highly migratory run that typically increases in the outside troll catch throughout August, primarily in the vicinity of Cross Sound and northward, peaks around 1 September, and continues to contribute to the troll catch until late-September. Compressed timing, combined with the specific physical features of the Berners River drainage, make it possible to consistently observe and count a high proportion of the total escapement during foot and helicopter surveys in mid- to late October. The Chilkat River is a much larger, more complex system, with several important spawning areas. Although coded-wire tag recoveries indicate that the majority of returning Chilkat River fish exhibit late, compressed migratory behavior similar to the Berners River stock, the Chilkat run also includes earlier segments that enter the river beginning in late August and early September, with peak spawning in upper tributaries (Assignation Creek and the Tahini River) typically occurring in early October.

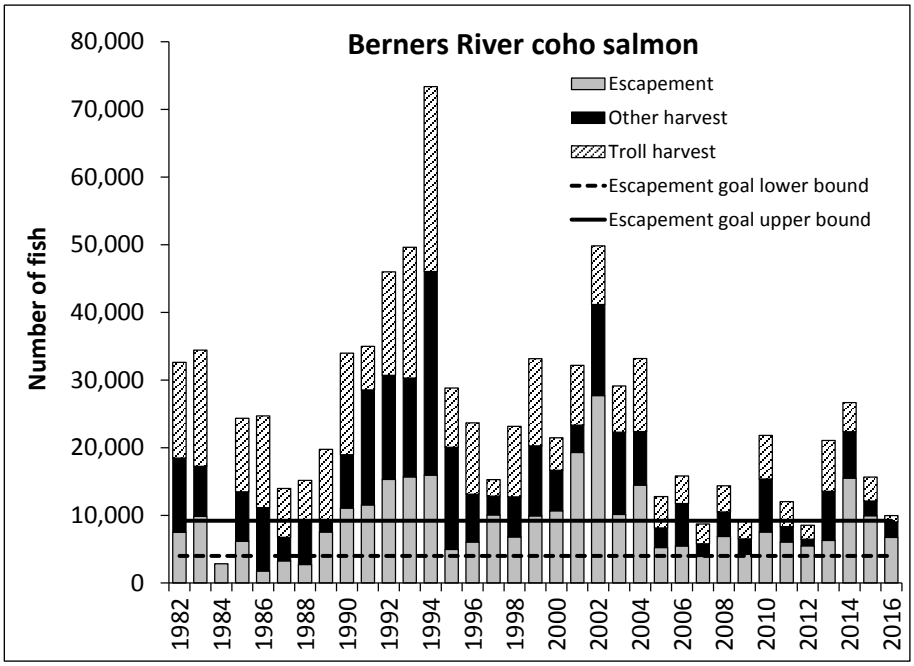
Escapement Goals and Stock Status: Current biological escapement goal ranges are 4,000–9,200 spawners for the Berners River (Clark et al. 1994), based on an unexpanded survey count, and 30,000–70,000 spawners for the Chilkat River (Ericksen and Fleischman 2006) based on a combination of mark-recapture estimates for some years and expanded survey counts for others. Escapements in both rivers were below their respective goals in 2007 while the Chilkat River escapement was below-goal in 2016, but both stocks have been within or above the current goals in all other years since 1989 (Appendix Figures C1 and C2). A revised biological escapement goal range of 3,600–8,100 spawners is recommended for the Berners River (in this report; Appendix Figure C3).

Total adult returns to the Berners and Chilkat rivers have been closely correlated ($R^2 = 0.87$) over the 17-year period since full assessment of the Chilkat River stock was initiated in 2000 (Appendix Figures C1 and C2). Both runs exhibited a marked decline beginning in 2005. The estimated total adult return to the Berners River remained at a high level (average 38,000 fish) for a 15-year period, 1990–2004, before declining abruptly to an average of 15,000 fish during 2005–2013 (Appendix Figure C1). The compounded effect of 38% declines in both smolt production and marine survival resulted in a 61% reduction in the average number of returning adults between the periods. The recent post-1998 cooling trend in the Northeast Pacific was likely an important agent in the smolt decline through increased winter–spring mortality of rearing juveniles. Smolt production has rebounded during the subsequent warm period beginning in 2014, and appears to be tracking with summer–fall precipitation in the year prior to smolthood, similar to the strong correlation that existed during a 17-year earlier period that corresponded with 1990–2006 adult returns.

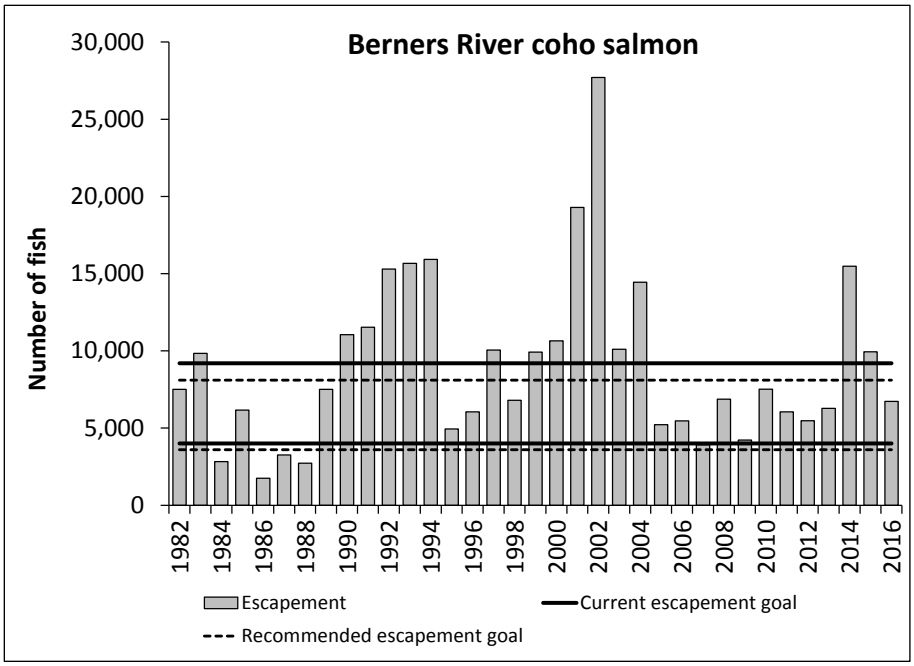
However, recent marine survival rates have remained well below the 1990–2004 average of 19.0%, declining to an average of 12.0% during 2005–2015 before dropping further to a record low of 6.4% in 2016. The decrease in marine survival is likely driven by conditions in both local marine waters during early ocean residence and later in offshore waters of the Gulf of Alaska. In coho salmon in northern Southeast, much of the variation in marine mortality, particularly in females, appears to be growth-related and linked to availability of offshore squid prey (Shaul and Geiger 2016; Shaul et al. *in prep*). However, there are also indications of an increase in early marine mortality for the 2016 and 2017 adult returns to northern inside systems, based on a low proportion of Auke Creek smolts that have returned as 0-ocean jacks in 2015 and 2016 (despite large average jack size, a predictor of a probable advance in maturity schedule).



Appendix Figure C1.–Total estimated run size, harvest, and escapement of Chilkat River coho salmon, 1982–2016, and biological escapement goal range of 30,000–70,000 spawners. (Harvest estimates are not available for 1987–1999.)



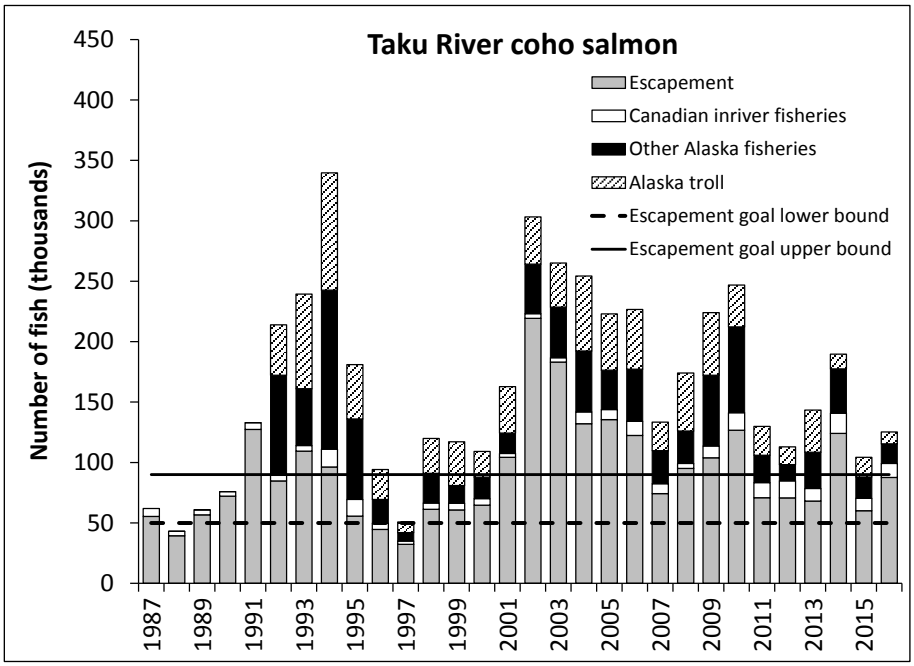
Appendix Figure C2.–Total estimated run size, harvest, and escapement of Berners River coho salmon, 1982–2016, and current biological escapement goal range of 4,000–9,200 fish counted on a peak survey. (Harvest estimates are not available for 1984).



Appendix Figure C3.–Berners River coho salmon escapement, 1982–2016, current biological escapement goal of 4,000–9,200 fish (solid horizontal lines), and recommended biological escapement goal of 3,600–8,100 fish (dashed horizontal lines).

The transboundary Taku River may be the single largest coho salmon-producing system in the region, and it supports a diversity of runs, ranging from early-run stocks bound for high interior tributaries that are harvested primarily in sockeye-directed fisheries, to fall-run stocks located primarily in mainstem tributaries that are harvested primarily in coho-directed troll and drift gillnet fisheries. Escapement estimates were first made in 1987 and run reconstruction estimates are available since 1992 (Shaul et al. 2011; Pestal and Johnston 2015). The inriver run past Canyon Island, near the U.S./Canada boundary, is estimated through a mark–recapture project. Marking is conducted at research fish wheel sites in the canyon, and recovery sampling is conducted in test and Canadian commercial fisheries. Results of a 1991 radio-telemetry study indicated that the fish wheel estimate represented about 78% of the total system escapement, with about 22% spawning in Alaska below Canyon Island (Eiler et al. *unpublished*[2]).

Escapement Goals and Stock Status: The current biological escapement goal range of 50,000 to 90,000 spawners in the Taku River above Canyon Island was established in 2015 based on an analysis by Pestal and Johnston (2015). The new biological escapement goal replaces a 1999 statement of management intent under the Pacific Salmon Treaty for the U.S. to ensure a minimum above border inriver run of 38,000 coho salmon. From 2012 to 2016, escapements met or exceeded the current escapement goal each year (Appendix Figure C4).



Appendix Figure C4.–Total estimated run size, harvest, and escapement of coho salmon bound for the Taku River above Canyon Island, 1987–2016, and biological escapement goal range of 50,000–90,000 spawners. (Marine harvest estimates are not available for 1987–1991.)

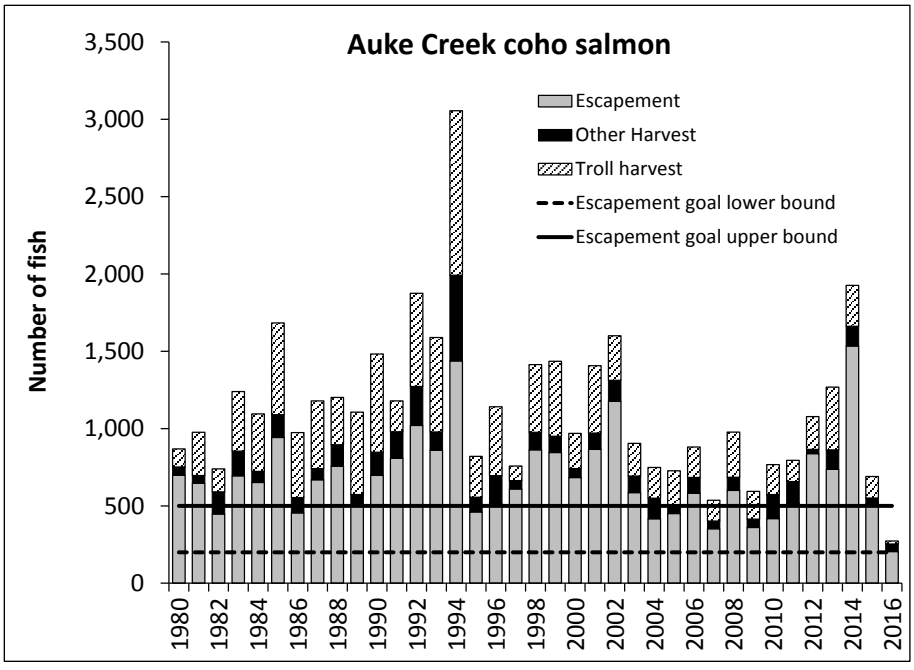
[2] Eiler, J. H., M. M. Masuda, and H. R. Carlson. *Unpublished*. Stock composition, timing, and movement patterns of adult coho salmon in the Taku River drainage, 1992. National Marine Fisheries Service report, Juneau.

Appendix C3.–Auke Creek coho salmon.

Auke Creek, located in Juneau, is a long-term indicator stock with migratory characteristics similar to the nearby Berners and Chilkat rivers. However, because of its location outside the boundaries of major commercial drift gillnet fishing areas, it is subjected to lower average all-fishery exploitation rates (long-term average 38%) compared with nearby major river stocks in Lynn Canal and Taku Inlet that are targeted by drift gillnet fisheries. Rearing habitat in Auke Creek is dominated by the environment of Auke Lake. As a result of the high (100%) coded-wire tagging rate on smolts and precise total accounting of returning adults, the Auke Creek stock is an important indicator of the commercial troll exploitation rate on northern inside stocks that is used in inseason estimation of regional wild coho salmon abundance.

Escapement Goals and Stock Status: A biological escapement goal range of 200–500 fish was established in 1994 (Clark et al. 1994). Smolt production underwent a protracted multi-decadal decline, decreasing by nearly half between 1979–1983 (average 8,000 smolts) and 2002–2008 (4,100 smolts) before increasing sharply and making an approximately full recovery during 2011–2016 (7,900 smolts). The recent rebound may have been related to structure added to the lake rearing habitat from construction of a trail around the lake in summer 2008, which included sections of floating walkway.

Auke Creek produces smolts that are large, on average, and tend to survive well at sea, and a high proportion of males return as age-.0 jacks. Average marine survival decreased from 23% during 1990–2004 to 16% during 2005–2015, similar to the pattern exhibited by other northern inside stocks, before dropping sharply to a record low 4% in 2016 (less than half of the previous low of 9% in 1981). Escapements have consistently remained within or above the upper half of the escapement goal range until 2016 when 204 spawners returned, slightly above the lower goal bound (Appendix Figure C5). Exploitation rates have been moderate over the past decade (2007–2016) at an average of 33% (range: 20–46%), of which the majority (22%) was harvested by the commercial troll fishery, and exploitation rates by other fisheries averaged 1% commercial purse seine, 8% commercial drift gillnet, and 2% marine sport. Escapements met or exceeded the escapement goal range in 5 of the past 5 years.



Appendix Figure C5.–Total estimated run size, harvest, and escapement (weir counts) of Auke Creek coho salmon, 1980–2016, and biological escapement goal range of 200–500 spawners.

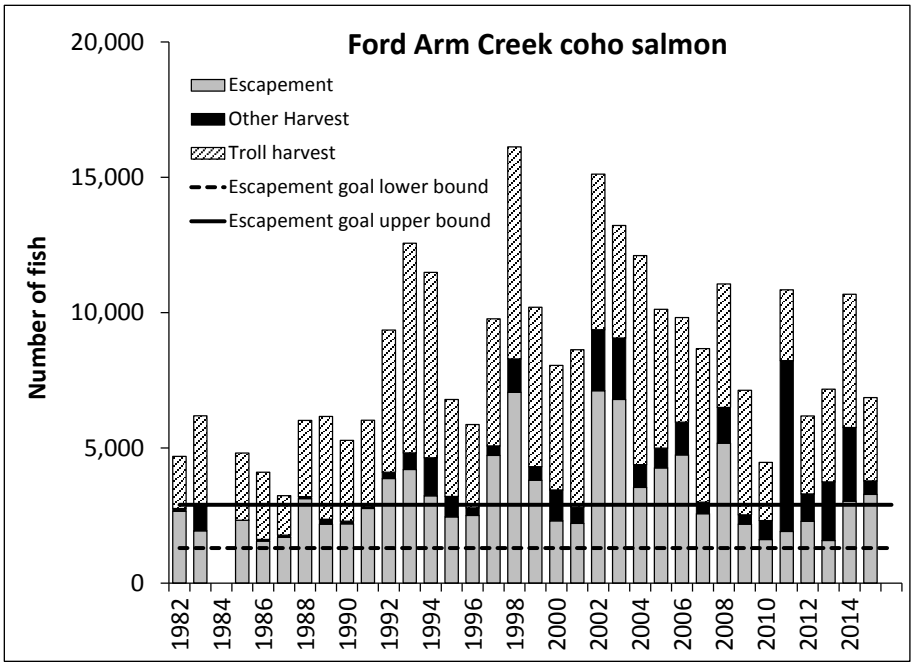
Appendix C4.–Ford Arm Creek coho salmon.

Ford Arm Creek, located on western Chichagof Island, was the only outer coastal coho salmon indicator stock in the region but the project was discontinued after 2015. The system is small but pristine, with a variety of rearing habitats (lake, pond, and stream). Unlike other wild coho indicator stocks, the Ford Arm Creek population is a less migratory "milling" stock that is already concentrated along the coast by the beginning of the summer commercial troll season (1 July) and is heavily exploited by hook and line fisheries through early September.

Escapement Goals and Stock Status: A biological escapement goal range of 1,300–2,900 spawners was established in 1994 (Clark et al. 1994). The goal was recently reviewed but left unchanged (Shaul et al. 2014). While average marine survival increased after 1991, nutrients from increasing pink salmon escapements in the 1990s and 2000s are thought to be the primary factor responsible for a doubling of average adult returns from an average of 5,260 adults in 1982–1991 to 10,340 adults in 1992–2009 (Shaul et al. 2014). More recent returns during 2010–2015 averaged 7,700 (range 4,460–10,840) adults as a result of a decrease in average survival to 8% from 12% in 1992–2009, while average freshwater production has remained high.

During 33 years of escapement counts and estimates from 1982–2015, the biological escapement goal was attained in 18 years and exceeded in 15 years (Appendix Figure C6). The lowest observed escapement of 1,552 spawners in 1986 was 19% above the lower goal bound. The goal was consistently attained or exceeded despite a substantial exploitation rate that averaged 61% and increased from 55% (range 43–69%) during the first decade (1982–1991) to 66% (range 52–82%) during 2006–2015. Age 1-ocean Ford Arm Creek spawners have exhibited a marked long-term decrease in average size that was likely caused by a decline in their principal high seas prey, gonatid squids. Average weight of males and females declined by 35% and 23%, respectively, between 1982–1986 and 2011–2015. The decline in size of females has likely had a substantial negative effect on the per capital reproductive potential of the spawning escapement.

Although the stock receives substantially higher commercial troll exploitation (averaging 51%) than any other coho salmon stock that has been studied in the region, the increasing total exploitation trend was not attributed to the troll fishery which harvested an average of only 47% of the return in 2006–2015 compared with 52% in 1982–1991. Beginning in 2010, the commercial purse seine fishery, which targets primarily pink salmon in nearby waters, became a proportionately larger factor, exploiting the stock at an average rate of 17% (range 13–58%) in 2010–2014, up sharply from the 1982–2009 average of 3% (range 0–11%). Although an increase in purse seine effort to harvest large pink salmon returns to Khaz Bay appears to explain some of this increase, there were also indications of a change in fish behavior beginning in 2011 when much of the run left the ocean earlier than in previous years and migrated into local inlets where a substantial fraction were harvested incidentally by purse seiners. The marine sport charter fishery became a small but consistent factor in overall exploitation of the stock beginning in the early 1990s, removing an average of 4% (range 1–13%) of the total population during 1996–2015.



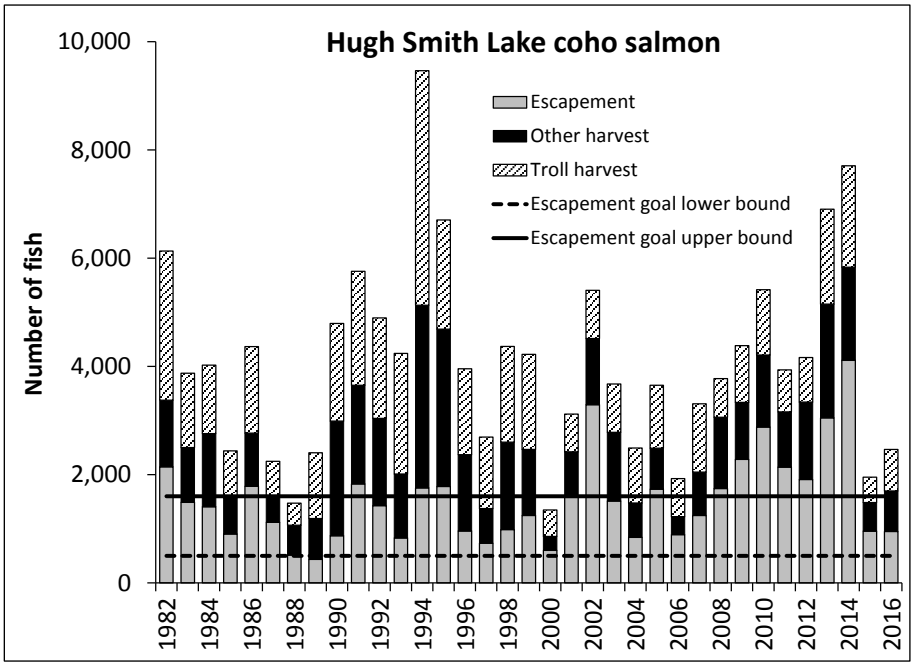
Appendix Figure C6.–Total estimated run size, harvest, and escapement (weir counts) of Ford Arm Creek coho salmon, 1982–2015, and biological escapement goal range of 1,300–2,900 spawners. The Ford Arm stock assessment project was discontinued after the 2015 season due to budget cuts.

Appendix C5.–Hugh Smith Lake coho salmon.

Hugh Smith Lake, located on the mainland southeast of Ketchikan, is currently the only wild coho salmon indicator stock in southern Southeast. Returning adults are exposed to a broad array of troll, net and sport fisheries from northern Southeast Alaska to northern British Columbia. Spawners are counted at a weir across the short lake outlet and spawn in two inlet streams, Cobb and Buschmann creeks. A limited amount of rearing habitat is available in the inlet streams, but most juveniles rear around wood and rock structure along the steep lakeshore and in the extensive log jam at the outlet. Smolt production has varied around a stable trend, averaging 32,500 smolts. Marine survival has been more variable, ranging from 4–21% around a long-term average of 13%.

Escapement Goals and Stock Status: A biological escapement goal range was first established at 500–1,100 spawners in 1994 (Clark et al. 1994) and expanded to a range of 500–1,600 spawners in 2009 (Shaul et al. 2009). During the 35-year period from 1982 to 2016, escapement fell under the current goal in only one year (1989) while the biological escapement goal has been met in 20 years and exceeded in 14 years. In contrast with northern Southeast indicator stocks, a coincidence of favorable freshwater and marine conditions resulted in a series of average or larger returns to Hugh Smith Lake during 2008–2014 when the goal was consistently exceeded, and total runs in 2013 and 2014 were the second and third largest on record. During 2015 and 2016, smolt production remained high but marine survival decreased markedly from an average of 16% in 2018–2014 to 6% in 2015–2016, resulting in a substantial decrease in total returns. Escapements in 2015 and 2016 fell just under the middle of the biological escapement goal range in both years (Appendix Figure C7).

Despite liberal fishing opportunity during much of the past decade, including reduced or eliminated mid-season troll fishery closures, extended Tree Point drift gillnet fishery openings, and 10-day troll season extensions in some years, the all-fishery exploitation rate during 2006–2015 averaged only 53% (range: 46–62%) compared with an average of 75% (range: 68–82%) in the 1990s. The decrease in exploitation may be related to a general decrease in troll effort, but also appeared to be influenced by the stock making landfall farther to the south for several years, resulting in reduced exposure to the area of most intensive commercial troll effort in northern Southeast.

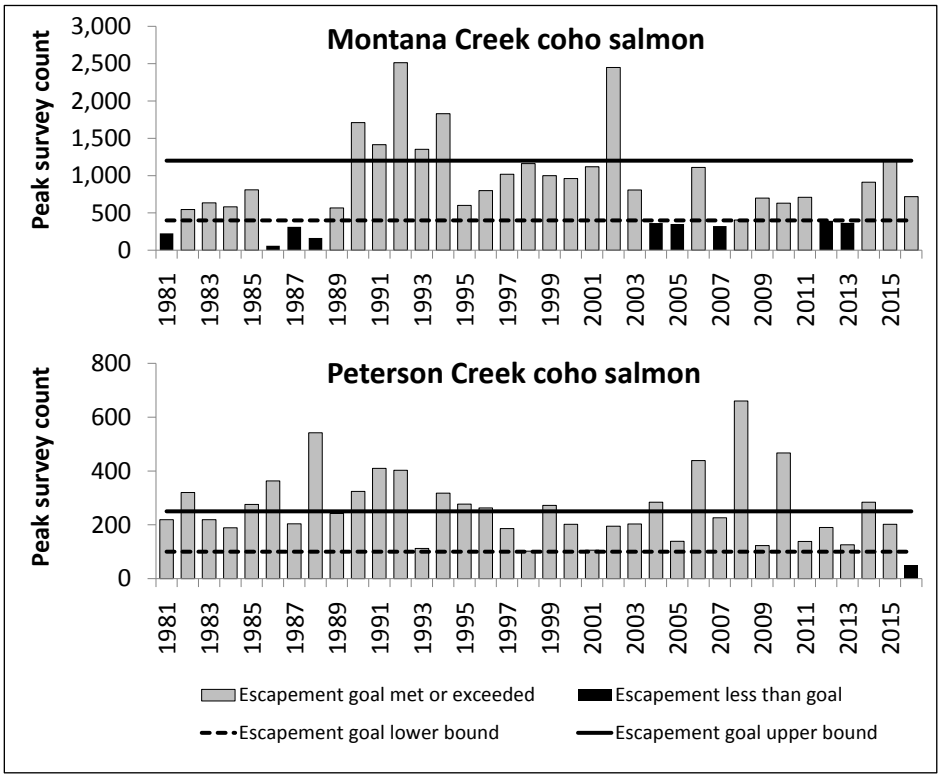


Appendix Figure C7.–Total estimated run size, harvest, and escapement (weir counts) of Hugh Smith Lake coho salmon, 1982–2016, and biological escapement goal range of 500–1,600 spawners.

Appendix C6.–Montana and Peterson creeks coho salmon.

Escapement goals have been established based on peak survey counts for two stocks accessible from the Juneau road system, Montana and Peterson creeks. Both stocks are likely harvested at moderate rates, similar to nearby Auke Creek, where the all-fishery exploitation rate during 1980–2016 averaged 38% (range: 20–55%).

Escapement Goals and Stock Status: Escapement goals were initially established as biological escapement goal ranges of 200–500 for Montana Creek and 100–350 for Peterson Creek, based on an analysis by Clark (1995b) but were more recently changed to sustainable escapement goal ranges of 400–1,200 for Montana Creek and 100–250 for Petersen Creek based on peak survey counts (Clark 2005). The Peterson Creek escapement goal has been met or exceeded annually since surveys were initiated in 1981, except in 2016. The Montana Creek escapement goal was not met in 9 years out of 36, but has been achieved in each of the past 3 years (Appendix Figure C8). Escapements to Montana Creek during 1982–2013 closely tracked escapements in the Berners River (R^2 = 0.57) where returns and escapements have declined substantially since the mid-2000s, due in about equal part to lower smolt production and marine survival. Escapements in Peterson Creek have been more variable in the past decade, ranging from a record high count of 660 spawners in 2008 to a record low count of 52 spawners in 2016 (Appendix Figure C7).

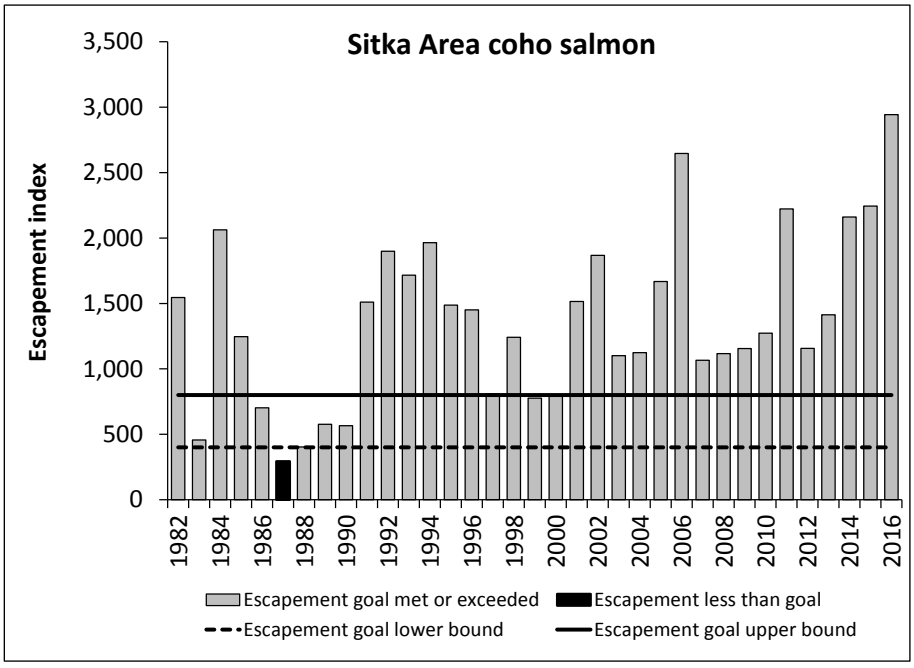


Appendix Figure C8.–Peak coho salmon escapement survey counts and sustainable escapement goal ranges for two Juneau roadside streams, Montana Creek and Peterson Creek, 1981–2016.

Appendix C7.–Sitka Area coho salmon survey index.

Five small streams within and north of Sitka Sound, that make up the Sitka survey index, have been surveyed one or more times annually by foot since 1982. The streams include Starrigavan Creek, Sinitsin Creek, St. John's Creek, Nakwasina River, and Eagle River.

Escapement Goals and Stock Status: Shaul and Tydingco (2006) recommended the current biological escapement goal range of 400–800 spawners for the aggregate count in the 5 index streams, based on an analysis that assumes productivity (smolts per spawner at maximum sustained yield) for Sitka Sound stocks to be average for coho stocks that have been studied. Escapement counts have exceeded the lower bound of the escapement goal in every year except one (1987) and have exceeded the goal range annually since 2000, with an increasing trend in escapement over the past 5 years leading to a record count of 2,943 spawners in 2016 (Appendix Figure C9).

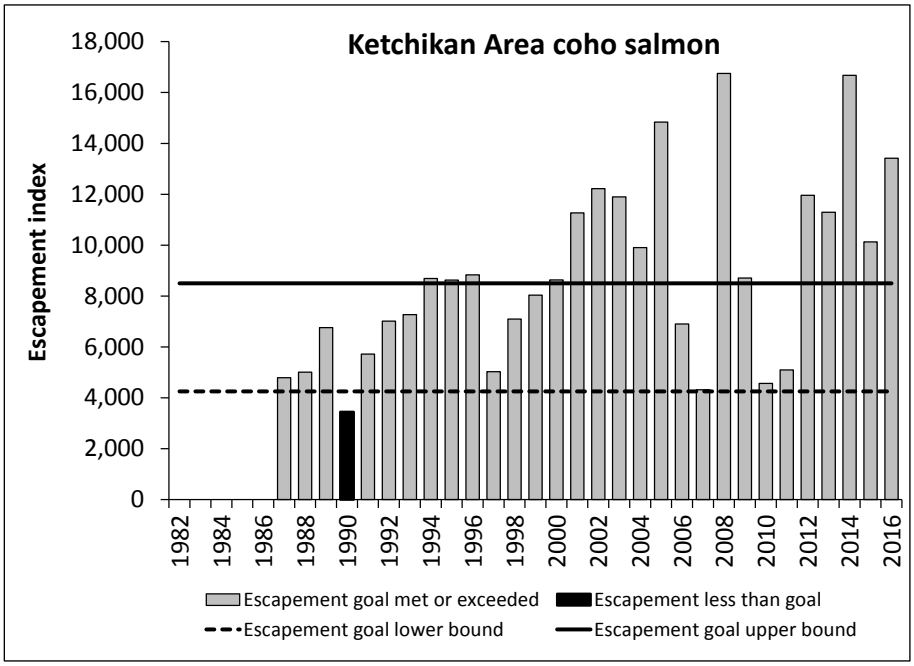


Appendix Figure C9.–Aggregate peak coho salmon escapement survey counts and biological escapement goal range for five index streams in the Sitka area, 1982–2016.

Appendix C8.–Ketchikan Area coho salmon survey index.

Coho salmon escapements in 14 streams in District 1, comprising the Ketchikan survey index, have been surveyed annually since 1987. The surveys are conducted by helicopter and are usually done separately in two circuits, with the northern circuit comprising tributaries of the Chickamin River (Indian River, Barrier Creek, King Creek, Choca Creek) and streams in Burroughs Bay near the mouth of the Unuk River (Herman Creek, Grant Creek, Eulachon River, Klahini River). The southern circuit includes Carroll River, Blossom River, Keta River, Marten River, Humpback Creek, and the Tombstone River. Two surveys of each stream are tentatively scheduled (contingent on favorable weather and water conditions), with the early survey scheduled for 28 September–1 October and the later survey scheduled for 15–20 October. The largest (peak) survey for each stream is summed with the others in the total index. Only peak survey counts that meet standards for timing, survey conditions, and completeness are included in the annual index, and missing counts are interpolated in order to maintain a comparable aggregate escapement index (Shaul et al. 2011).

Escapement Goals and Stock Status: Shaul and Tydingco (2006) recommended the current biological escapement goal range of 4,250–8,500 spawners for the aggregate count in the 14 index streams, based on an analysis that assumes productivity (smolts per spawner at maximum sustained yield) for Ketchikan area stocks to be average for coho stocks that have been studied. Since 1987, escapement counts exceeded the lower bound of the escapement goal in every year but one (1990), were within the escapement goal range 13 times, and exceeded the escapement goal range 16 times (Appendix Figure C10).

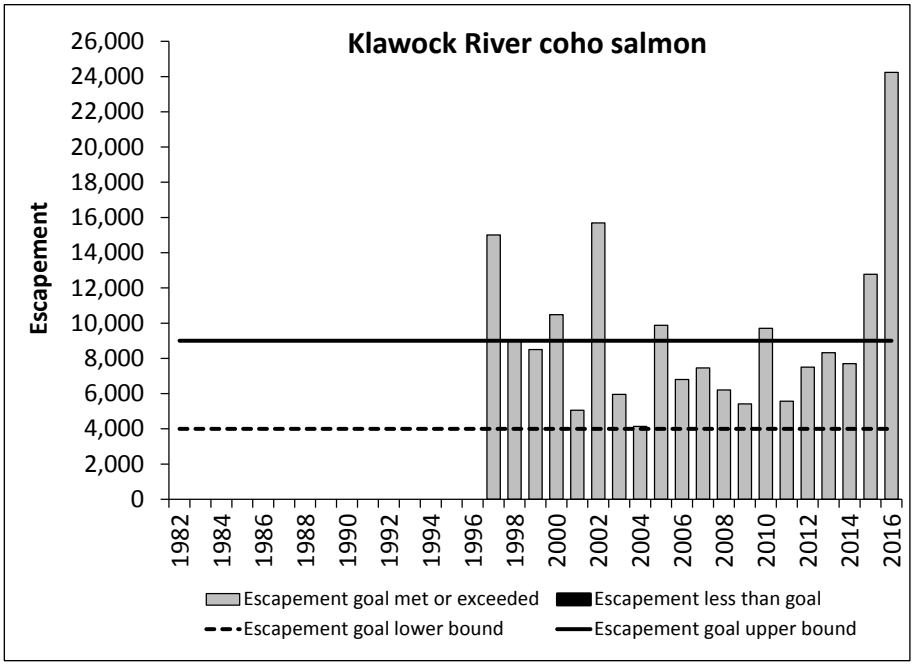


Appendix Figure C10.–Aggregate peak coho salmon escapement survey counts and biological escapement goal range for 14 index streams in the Ketchikan area, 1987–2016.

Appendix C9.–Klawock River coho salmon.

The Klawock River is located on the west side of Prince of Wales Island, near the town of Klawock. The Southern Southeast Regional Aquaculture Association operates a hatchery (Klawock River Hatchery) and weir on the Klawock River, approximately 300 m below Klawock Lake. (Southern Southeast Regional Aquaculture Association took over management of the hatchery from the Prince of Wales Hatchery Association in 2016). Over the past decade, the hatchery released an average of 3.6 million coho smolt per year in Klawock Lake. A portion of the annual coho salmon run is used for broodstock and cost recovery. The remainder of the run is allowed to pass through the weir to spawn naturally. Progeny from these fish are regarded as "wild" (Der Hovanisian 2013).

Escapement Goals and Stock Status: Prior to 2007, an informal, maximum escapement goal of 6,000 coho salmon was established for the Klawock River (Der Hovanisian 2013). A sustainable escapement goal range of 4,000–9,000 fish was established in 2007 (though the goal was not formally adopted until 2013; Der Hovanisian 2013; and see Appendix E in Munro and Volk 2014). The goal was based on smolt-per-spawner and theoretical stock-recruit analyses, because, although some coho salmon run abundance and escapement data were available for 1999–2005, exploitation rate, marine survival rate, and smolt age composition information was not available, and estimates from nearby Chuck Creek were used as surrogates (Der Hovanisian 2013). The annual hatchery management plan[3] includes stipulations for the hatchery to operate the weir from early July through 30 November, and includes a weekly escapement schedule that provides for a target escapement of 6,500 coho salmon. Escapements were within or above the escapement goal range in all years since 1997 (Appendix Figure C11).



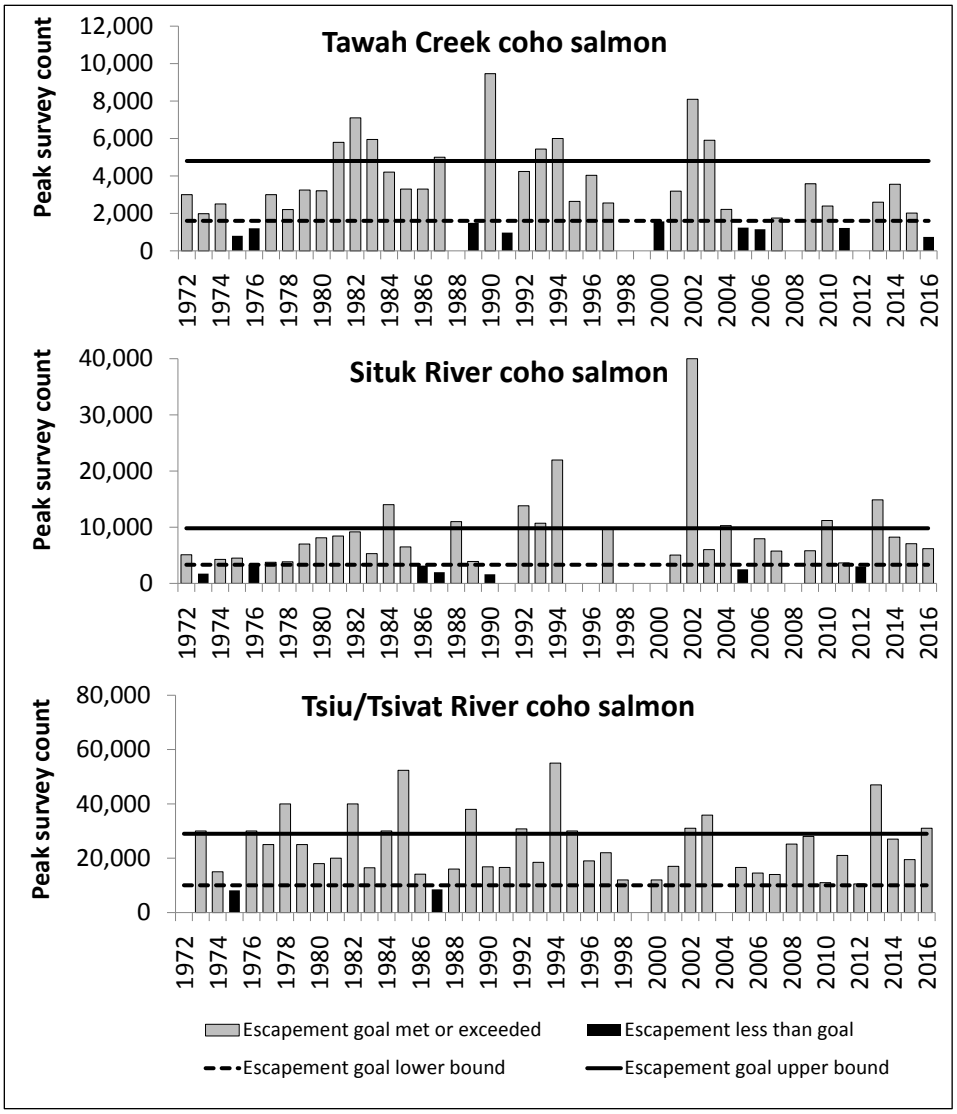
Appendix Figure C11.–Klawock River coho salmon escapement (weir counts), 1997–2016, and sustainable escapement goal range of 4,000–9,000 fish.

[3] 2017 Annual Management Plan, Southern Southeast Regional Aquaculture Association, unpublished document. http://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesPlanning.annual (Accessed 8/9/2017).

Yakutat stocks are harvested primarily in commercial set gillnet and sport fisheries that target runs to discrete systems, but commercial trollers fishing on mixed stocks off the coast account for some of the harvest. Yakutat area escapements have been assessed through foot, boat, and aerial surveys. Although the data series starts in 1972, the quality and comparability of peak survey counts in the Yakutat area are somewhat lower than is the case in other areas of the Southeast Region. Most surveys have been conducted early in the run to support inseason management of the set gillnet fisheries. Comparable peak escapement surveys have been conducted relatively consistently in recent years on only three systems: the Lost, Situk, and Tsiu-Tsivat rivers.

Escapement Goals and Stock Status: Escapement goal ranges based on peak survey counts were developed for Yakutat coho salmon stocks in 1994 (Clark and Clark 1994), including 2,200–6,500 for the Lost River, 3,300–9,800 for the Situk River, and 10,000–29,000 for the Tsiu-Tsivat rivers. The upper bound of the Lost River goal of 2,200–6,500 spawners was dropped in 2009, and it was re-designated a lower bound sustainable escapement goal, following a geological shift that resulted in the Lost River draining into the Situk-Ahrnklin Lagoon instead of directly into the Gulf of Alaska. This shift made it difficult to actively manage the commercial set gillnet fishery for a goal specific for the Lost River. Mark-recapture studies were conducted to estimate escapements of coho salmon in both the Situk (2004–2006) and Lost (2003–2004) rivers in hopes of providing a calibration for index counts; however, mark-recapture estimates were not consistent with index counts and meaningful expansion factors could not be estimated (Appendix Table C1; Shaul et al. 2010). Index counts were substantially lower than total escapement in all years and accounted for minor and variable portions of total escapements. In 2015, the Lost River goal was revised to a sustainable escapement goal range of 1,400–4,200 fish counted on a peak survey, based on the 15th–75th percentiles of historical counts obtained in Tawah Creek, a primary tributary where the majority of historical survey counts were conducted, and the name of the goal was changed to Tawah Creek (Lost River) (Heinl et al. 2014a).

The utility of peak survey counts in assessing historical escapement in the Yakutat area is limited by decreasing survey effort near the peak of spawner abundance at the end of the fishery and by frequently deteriorating weather conditions after mid-September. Survey effort on these systems declined from 1995 to 2000, but has improved somewhat since 2001. The combined escapement index for Yakutat shows peaks in the early to mid-1990s and in 2002, with relatively strong escapements in the Situk and Tsiu rivers in 2013 (Appendix Figure C12). Goals have been met or achieved in the past 3 years with the exception of Tawah Creek in 2016. A recent analysis (in this report) supports a recommendation to change the goal for the Tsiu-Tsivat system from a biological to a sustainable escapement goal, based on percentiles of annual survey counts conducted since 1973, while leaving the target range unchanged at 10,000–29,000 fish.



Appendix Figure C12.–Peak coho salmon escapement survey counts in the Yakutat area, compared to escapement goal ranges, 1972–2016. (Horizontal lines indicate escapement goal ranges. Blank columns in time series indicate that peak survey counts were not available.)

Appendix Table C1.–Estimated escapements and survey expansion factors for coho salmon at the Situk and Lost rivers in the Yakutat area.

System	Year	Escapement Estimate	SE	Maximum Survey Count	Expansion Factor	Data Source:
Situk River	2004	54,014	17,000	10,284	5.3	Waltemyer et al. 2005
Situk River	2005	35,079	12,310	2,514	14.0	Eggers and Tracy 2007
Situk River	2006	24,804	8,582	7,951	3.1	Eggers and Tracy 2007
Lost River	2003	23,685	7,835	6,396	3.7	Clark et al. 2006
Lost River	2004	47,566	18,560	5,047	9.4	Clark et al. 2005
Median					5.3	

Appendix Table C2.–Available escapement and harvest data for Tsiu-Tsivat river coho salmon.

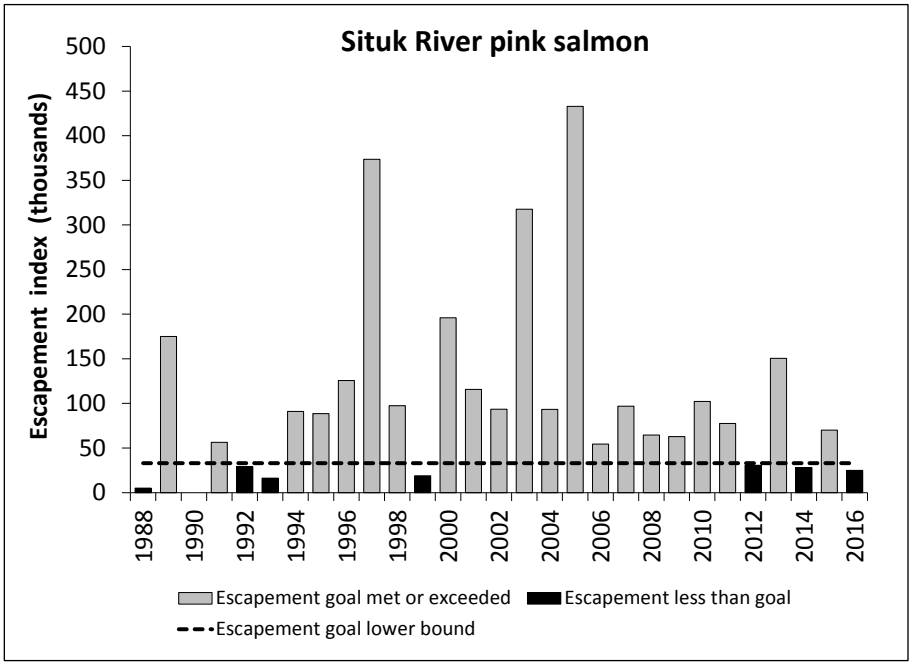
Year	Escapement Index	Commercial Set Gillnet Harvest	Commercial Troll Harvest	Sport Harvest	Total Harvest	Approximate Harvest Rate[a]
1973	30,000	8,803	NA	NA	8,803	NA
1974	15,000	8,258	NA	NA	8,258	NA
1975	8,150	0	NA	NA	0	NA
1976	30,000	3,129	NA	NA	3,129	NA
1977	25,000	5,691	NA	NA	5,691	NA
1978	40,000	34,392	NA	NA	34,392	NA
1979	25,000	32,621	NA	NA	32,621	NA
1980	18,000	28,711	NA	NA	28,711	NA
1981	20,000	30,109	NA	NA	30,109	NA
1982	40,000	46,436	NA	NA	46,436	NA
1983	16,500	20,119	NA	NA	20,119	NA
1984	30,000	51,322	NA	NA	51,322	NA
1985	52,350	63,922	NA	NA	63,922	NA
1986	14,100	21,193	8,120	NA	29,313	28%
1987	NA	35,300	NA	NA	35,300	NA
1988	16,000	56,146	NA	NA	56,146	NA
1989	38,000	62,989	NA	NA	62,989	NA
1990	16,800	33,867	NA	NA	33,867	NA
1991	16,600	38,333	NA	835	39,168	31%
1992	30,000	92,406	NA	866	93,272	37%
1993	NA	56,765	NA	NA	56,765	NA
1994	55,000	64,205	NA	451	64,656	18%
1995	30,000	50,399	NA	456	50,855	24%
1996	NA	35,702	NA	1,244	36,946	NA
1997	22,000	58,647	NA	2,283	60,930	35%
1998	14,000	71,066	NA	764	71,830	49%
1999	NA	61,617	NA	1,728	63,345	NA
2000	12,000	59,080	NA	2,057	61,137	49%
2001	17,000	31,748	NA	1,783	33,531	27%
2002	31,000	0	NA	2,713	2,713	2%
2003	35,850	0	NA	4,286	4,286	2%
2004	NA	3,512	NA	2,372	5,884	NA
2005	10,600	25,429	NA	2,325	27,754	33%
2006	14,200	26,438	NA	2,158	28,596	28%
2007	14,000	22,323	NA	2,752	25,075	25%
2008	25,200	49,295	NA	3,317	52,612	28%
2009	28,000	43,920	NA	3,399	47,319	24%
2010	11,000	77,792	NA	3,862	81,654	59%
2011	21,000	34,934	NA	2,490	37,424	25%
2012	NA	45,827	NA	***2,500***	48,327	NA
2013	47,000	44,887	NA	***2,500***	47,387	16%
2014	27,000	37,613	NA	***2,500***	40,113	22%
2015	19,500	16,993	NA	***2,500***	19,493	16%
2016	31,000	11,210	NA	***2,500***	13,710	8%
Average:	24,917	39,574	NA	2,186	42,045	27%

[a] The Harvest rate was estimated as the harvest divided by the estimated total run (harvest + peak survey count × 5.3).

APPENDIX D.
PINK SALMON ESCAPEMENT GOAL PERFORMANCE

Yakutat area pink salmon stocks are spatially segregated from the rest of Southeast Alaska and are harvested primarily in terminal, inriver set gillnet fisheries. From 2007 to 2016, the Situk River harvest accounted for an average 77% of the Yakutat area pink salmon harvest; however, there has been little economic incentive to harvest pink salmon, which are harvested incidentally to more valuable sockeye and coho salmon (Woods 2007).

Escapement Goals and Stock Status: In 1995, ADF&G established biological escapement goal ranges for even- and odd-year runs of Situk River pink salmon of 42,000–105,000 fish and 54,000–200,000 fish, respectively (Clark 1995a). Information regarding Situk River pink salmon escapements is of poor quality. Weir counts are not complete, due either to location of the weir above pink salmon spawning habitat (prior to 1988) or to early removal of the weir (since 1991). Survey counts of pink salmon, obtained only sporadically, averaged three times greater than weir counts despite covering only part of the available spawning area. In 2012, ADF&G adopted the current lower bound sustainable escapement goal of 33,000 pink salmon counted at the weir through 5 August in an effort to provide a consistent early season index of abundance and to maintain a goal for fisheries management (Piston and Heinl 2011a). Harvests of Situk River pink salmon increased over the past two decades, from an average of 12,000 through 1990, to 34,000 in the 1990s and 53,000 since 2001 (Piston and Heinl *in prep* b). Survey counts of more than 500,000 pink salmon in the Situk River in 2005, 2007, and 2010, however, suggest pink salmon returns have been at their highest levels since statehood and that harvest rates have been very low (Piston and Heinl 2014b). From 2012 to 2016, escapement indices were below the lower bound sustainable escapement goal in 3 years (Appendix Figure D1). In practice, the escapement goal has not been useful for management, because the Situk River weir is removed too early to provide a meaningful indication of overall abundance, and the department recently (in this report) recommended eliminating the goal.



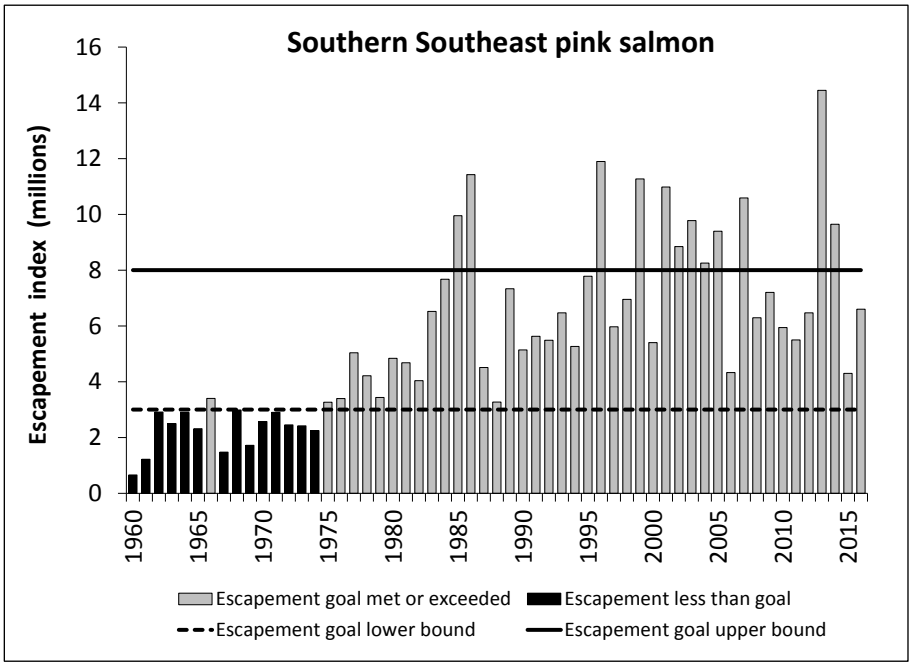
Appendix Figure D1.–Situk River pink salmon weir-based escapement index, 1988–2016, and lower bound sustainable escapement goal of 33,000 fish counted through the weir by 5 August.

Appendix D2.–Southern Southeast Subregion pink salmon.

The Southern Southeast Subregion comprises pink salmon stocks from Sumner Strait south to Dixon Entrance (districts 1–8), and includes a total of 366 pink salmon index streams.

Escapement Goals and Stock Status: The department has maintained an annual index of the pink salmon escapement in Southeast Alaska, generated from aerial survey observations, conducted at intervals during most of the migration period. Zadina et al. (2004) developed biological escapement goals for Southeast Alaska pink salmon based on the "tabular approach" described by Hilborn and Walters (1992); a yield analysis that is useful for setting escapement goals when the form of the stock recruit relationship is not known. Heinl et al. (2008) updated the goals in 2009 using the same yield analysis. The current biological escapement goal range for pink salmon in the Southern Southeast Subregion is 3.0–8.0 million index spawners, as measured by the sum of annual peak survey counts to the aggregate 366 index streams.

The harvest of pink salmon in the Southern Southeast Subregion averaged 23 million fish per year over the past decade, 2007–2016, which was down from an average harvest of 31 million in the 1990s (Piston and Heinl *in prep* b). The harvest of 53 million fish in 2013 was just below the all-time record harvest of 54 million fish set in 1996. From 2012 to 2016, escapement indices were within or above the escapement goal range in all years (Appendix Figure D2), and the escapement index of 14.4 million in 2013 was the highest since statehood.



Appendix Figure D2.–Southern Southeast Subregion pink salmon escapement index, 1960–2016, and biological escapement goal range of 3.0–8.0 million index fish.

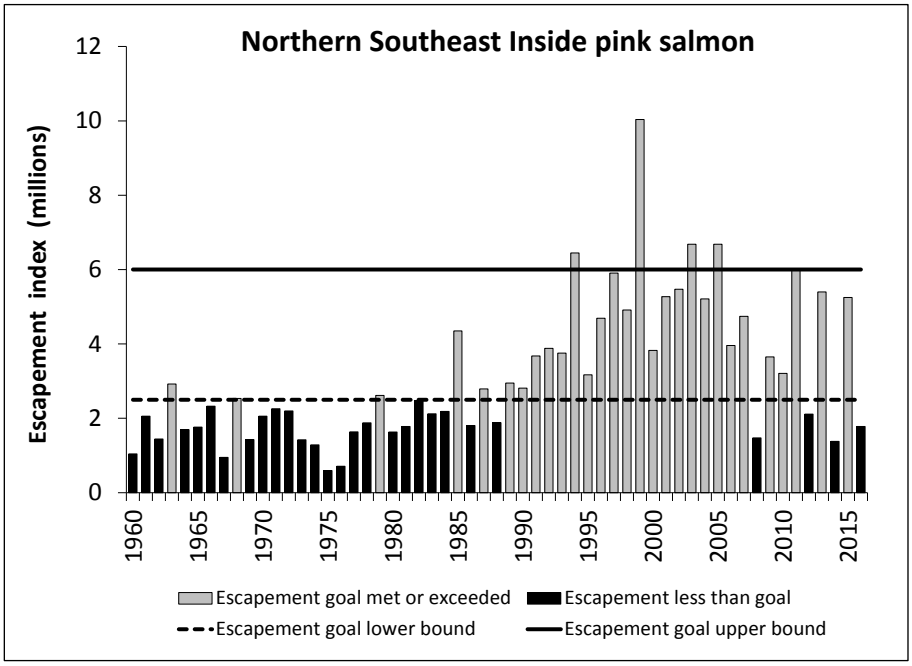
Appendix D3.–Northern Southeast Inside Subregion pink salmon.

The Northern Southeast Inside Subregion comprises pink salmon stocks on inside waters of Southeast Alaska north of Sumner Strait (districts 9–15), and includes 307 pink salmon index streams.

Escapement Goals and Stock Status: The department has maintained an annual index of the pink salmon escapement in Southeast Alaska, generated from aerial survey observations, conducted at intervals during most of the migration period. Zadina et al. (2004) developed biological escapement goals for Southeast Alaska pink salmon based on the "tabular approach" described by Hilborn and Walters (1992); a yield analysis that is useful for setting escapement goals when the form of the stock recruit relationship is not known. Heinl et al. (2008) updated the goals in 2009 using the same yield analysis. The current biological escapement goal range for pink salmon in the Northern Southeast Inside Subregion is 2.5–6.0 million index spawners, as measured by the sum of annual peak survey counts to the aggregate 307 index streams.

Pink salmon returns to the Northern Southeast Inside Subregion have developed an extreme odd- and even-year cycle since 2006 (Appendix Figure D3), with some very high odd-year harvests, including the all-time record harvest of 41 million fish in 2011, and very low even-year harvests. The harvest of pink salmon in the Northern Southeast Inside Subregion averaged 11.5 million fish per year over the past decade, 2007–2016, which was below the average harvest of 17 million fish from 1997 to 2006 (Piston and Heinl *in prep* b). Even-year harvests have averaged only 2.5 million fish since 2007, and harvests have been less than 1.2 million fish in 4 of the past 5 even years. From 2012 to 2016, escapement indices were below goal in 3 years (all even years; Appendix Figure D3).

The department recently recommended removal of 12 index streams that are not surveyed regularly (Piston and Heinl *in prep* b; and in this report). The change reduced the number of pink salmon index streams in the Northern Southeast Inside Subregion from 307 to 295 streams, but reduced the 1960–2016 average index value by only 1%, which did not require modifying the escapement goal.



Appendix Figure D3.–Northern Southeast Inside Subregion pink salmon escapement index, 1960–2016, and biological escapement goal range of 2.5–6.0 million index fish.

Appendix Table D1.–Streams removed from the Northern Southeast Inside Subregion pink salmon escapement Index in 2017.

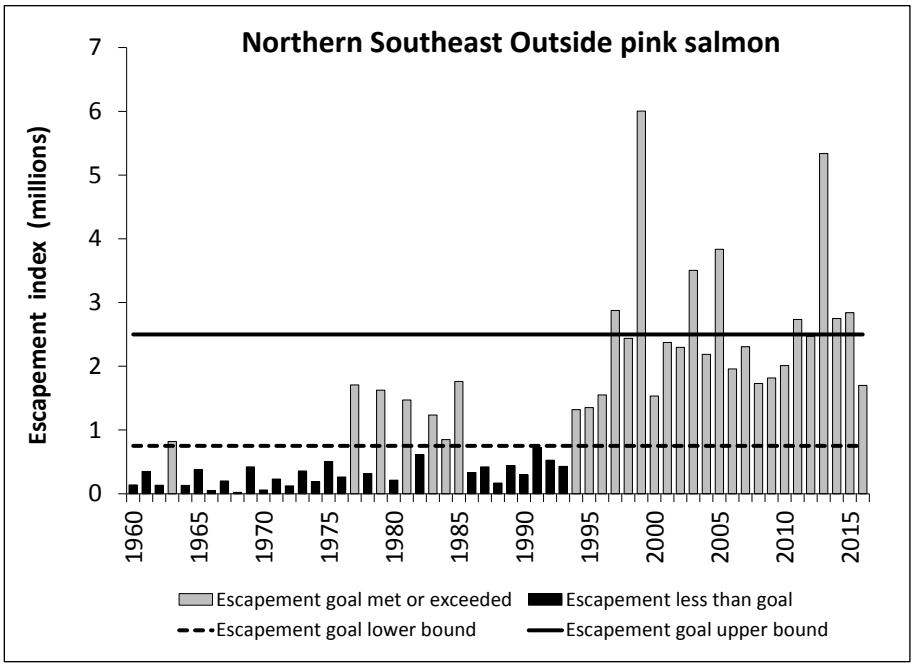
Subregion	District	ADF&G Stream Number	Stream Name
NSEI	111	111-40-015	Salmon Creek Gastineau Channel
NSEI	111	111-40-028	Sheep Creek
NSEI	111	111-50-010	Peterson Creek Favor Cove
NSEI	111	111-50-037	Wadleigh Creek
NSEI	111	111-50-042	Auke Creek
NSEI	111	111-50-075	Peterson Creek Douglas Island
NSEI	112	112-12-016	Little Basket Bay
NSEI	112	112-12-025	Kook Lake Outlet
NSEI	112	112-50-010	Pavlof River
NSEI	112	112-43-009	Crab Bay South Head
NSEI	114	114-23-073	West Mud Bay Head
NSEI	114	114-40-019	Idaho Sandspit

Appendix D4.–Northern Southeast Outside Subregion pink salmon.

The Northern Southeast Outside Subregion comprises pink salmon stocks along the outer coasts of Chichagof and Baranof islands (District 13, excluding Peril Straits and Hoonah Sound subdistricts 51–59, which are considered part of the Northern Southeast Inside Subregion), and includes 41 pink salmon index streams.

Escapement Goals and Stock Status: The department has maintained an annual index of the pink salmon escapement in Southeast Alaska, generated from aerial survey observations, conducted at intervals during most of the migration period. Zadina et al. (2004) developed biological escapement goals for Southeast Alaska pink salmon based on the "tabular approach" described by Hilborn and Walters (1992); a yield analysis that is useful for setting escapement goals when the form of the stock recruit relationship is not known. Heinl et al. (2008) updated the goals in 2009 using the same yield analysis. The current biological escapement goal range for pink salmon in the Northern Southeast Outside Subregion is 0.75–2.5 million index spawners, as measured by the sum of annual peak survey counts to the aggregate 41 index streams.

The harvest of pink salmon in the Northern Southeast Outside Subregion averaged 4.2 million fish per year over the past decade, 2007–2016, which more than doubled the average harvest of 2.0 million fish in the 1990s (Piston and Heinl *in prep* b). Record harvests of 7.1 and 11.2 million fish occurred in 2011 and 2013, respectively. The escapement index averaged 2.6 million over the past 10 years (2007–2016), an increase of 37% over the 1990s. From 2012 to 2016, escapement indices were within or above the escapement goal range in all years (Appendix Figure D4), and in all years since 1994.



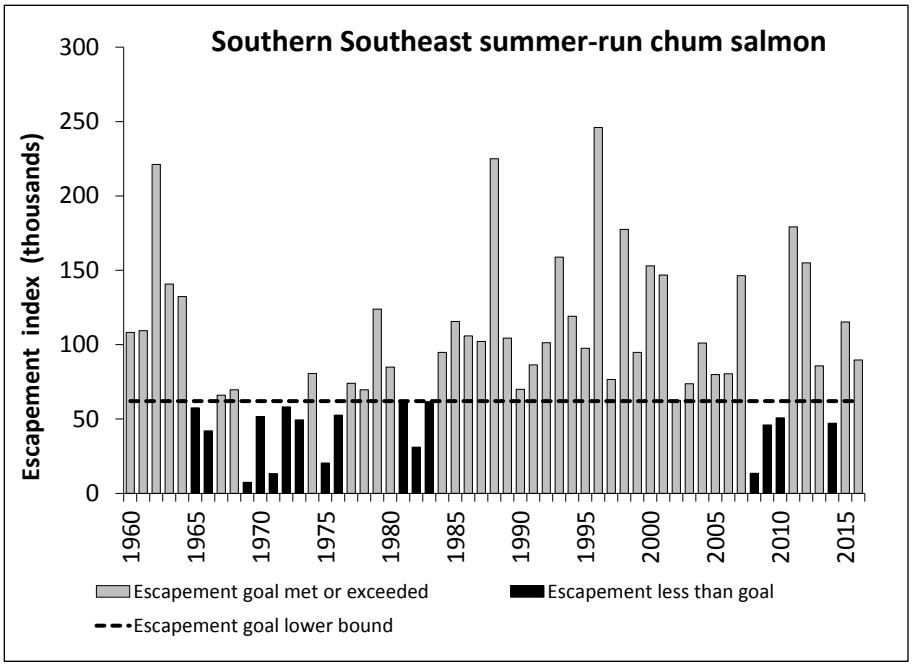
Appendix Figure D4.–Northern Southeast Outside Subregion pink salmon escapement index, 1960–2016, and biological escapement goal range of 0.75–2.5 million index fish.

APPENDIX E.
CHUM SALMON ESCAPEMENT GOAL PERFORMANCE

Appendix E1.–Southern Southeast Subregion summer-run chum salmon.

The Southern Southeast Subregion includes 15 summer-run chum salmon index streams located on the inner islands and mainland of Southeast Alaska, from Sumner Strait south to Dixon entrance.

Escapement Goals and Stock Status: The Southern Southeast Subregion summer-run chum salmon escapement goal was derived using the percentile approach. The goal of 62,000 chum salmon counted on peak surveys to the aggregate set of index streams was based on the 25th percentile of historical escapement data (Piston and Heinl 2014b). The goal is a lower bound sustainable escapement goal, rather than an escapement goal range, because summer-run chum salmon are harvested in mixed stock commercial fisheries and their escapements cannot be effectively managed to fall within a range. Escapement indices were at low levels during the mid-1960s to late 1970s, exhibited an increasing trend into the 1990s, and have generally remained above goal over the past two decades, with the exception of poor escapement years from 2008 to 2010. From 2012 to 2016, escapement indices were below the lower bound sustainable escapement goal in 1 year (Appendix Figure E1), and the 2011 index of 157,000 was the fourth highest in the time series.

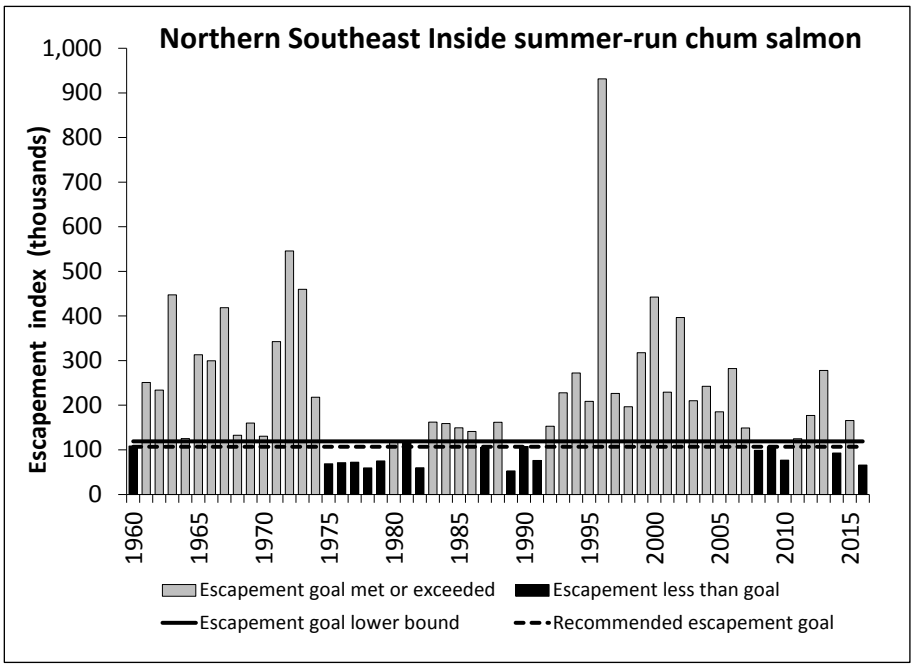


Appendix Figure E1.–Southern Southeast Subregion summer-run chum salmon escapement index (peak aerial and foot surveys), 1960–2016, and lower bound sustainable escapement goal of 62,000 fish.

The Northern Southeast Inside Subregion includes 63 summer-run chum salmon index streams located on the inside waters of Southeast Alaska north of Sumner Strait.

Escapement Goals and Stock Status: The Northern Southeast Inside Subregion summer-run chum salmon escapement goal was derived using the percentile approach. The goal of 119,000 chum salmon counted on peak surveys to the aggregate set of index streams was based on the 25th percentile of historical escapement data (Piston and Heinl 2011b). The goal is a lower bound sustainable escapement goal, rather than an escapement goal range, because summer-run chum salmon are harvested in mixed stock commercial fisheries and their escapements cannot be effectively managed to fall within a range. Escapement indices were at high levels in the 1960s, and then declined to low levels in the 1970s–1980s. The escapement index trended upward into the late 1990s, trended downward through 2010, and has fluctuated considerably since that time. From 2012 to 2016, escapement indices were below the current lower bound sustainable escapement goal in 2 years (Appendix Figure E2).

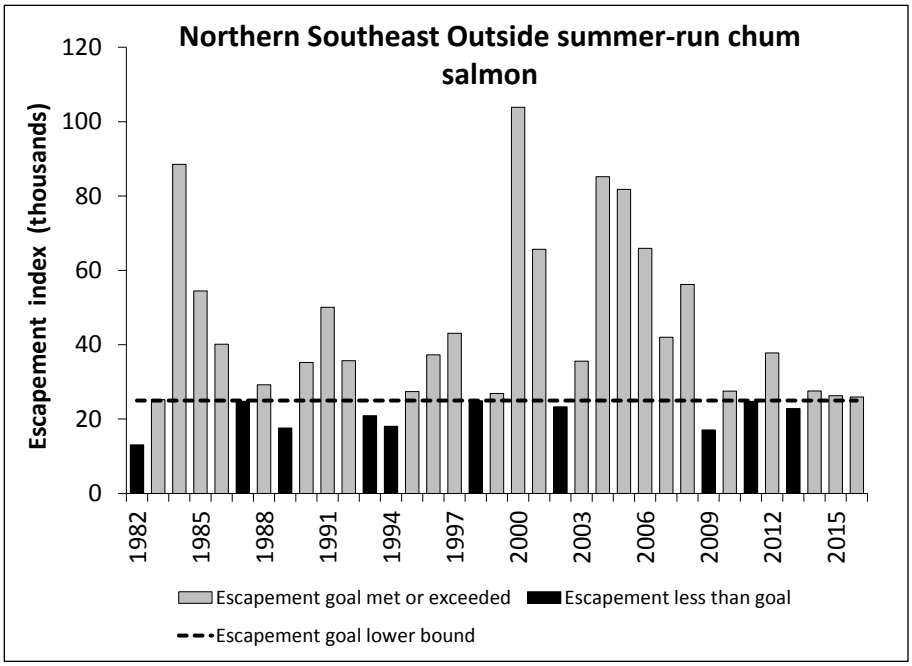
Following a review of chum salmon escapement goals (Piston and Heinl *in prep* a; and in this report), the department recommended updating all summer-run chum salmon goals to include escapement data through 2016, and recommended revising the Northern Southeast Inside Subregion lower bound sustainable escapement goal to 107,000 fish counted on peak surveys to the aggregate set of index streams based on the 25th percentile of 1960–2016 historical escapement data (Appendix Figure E2). Summer-run chum salmon goals will remain unchanged into the future unless streams are added or removed from the indices, or stock assessment improves to a point that more rigorous escapement goal development methods can be used.



Appendix Figure E2.–Northern Southeast Inside Subregion summer-run chum salmon escapement index (peak aerial and foot surveys), 1960–2016, lower bound sustainable escapement goal of 119,000 fish, and recommended lower bound sustainable escapement goal of 107,000 fish.

The Northern Southeast Outside Subregion includes nine summer-run chum salmon index streams on the outside waters of Chichagof and Baranof islands in northern Southeast Alaska.

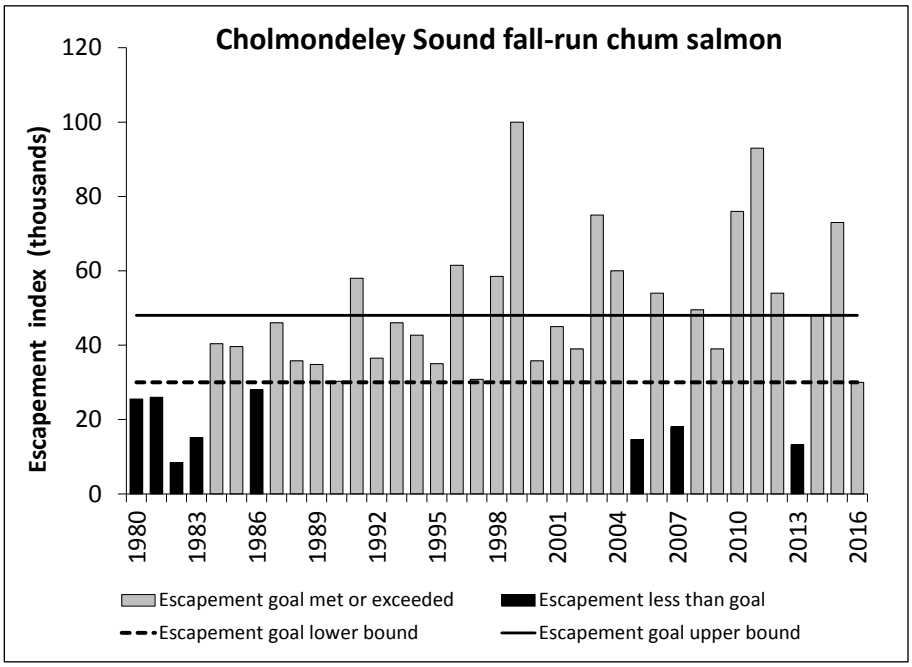
Escapement Goals and Stock Status: The Northern Southeast Outside Subregion summer chum salmon escapement goal was derived using the percentile approach. The goal of 25,000 chum salmon counted on peak surveys to the aggregate set of index streams was based on the 25th percentile of historical escapement data (Piston and Heinl 2014b). The goal is a lower bound sustainable escapement goal, rather than a range, because summer-run chum salmon are harvested in mixed stock commercial fisheries and their escapements cannot be effectively managed to fall within a range. From 2012 to 2016, escapement indices were below the lower bound sustainable escapement goal in 1 year (Appendix Figure E3).



Appendix Figure E3.–Northern Southeast Outside Subregion summer-run chum salmon escapement index (peak aerial and foot surveys), 1982–2016, and lower bound sustainable escapement goal of 25,000 fish.

Disappearance and Lagoon creeks, located west of Ketchikan, on Prince of Wales Island, are the two most productive fall-run chum salmon systems in Cholmondeley Sound. Cholmondeley Sound fall-run chum salmon support a terminal commercial purse seine fishery (statistical area 102-40) that has historically provided commercial fishermen with a valuable opportunity to extend the fishing season beyond the directed pink salmon purse seine season that ends in late August (Piston and Heinl 2014a). Escapements have been regularly assessed through aerial surveys since 1980.

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal range of 30,000–48,000 chum salmon counted on combined peak aerial surveys at Disappearance and Lagoon creeks (Eggers and Heinl 2008). The goal range was based on the 25th and 75th percentiles of historical escapement data. From 2012 to 2016, escapement indices were below the sustainable escapement goal range in 1 year (Appendix Figure E4).

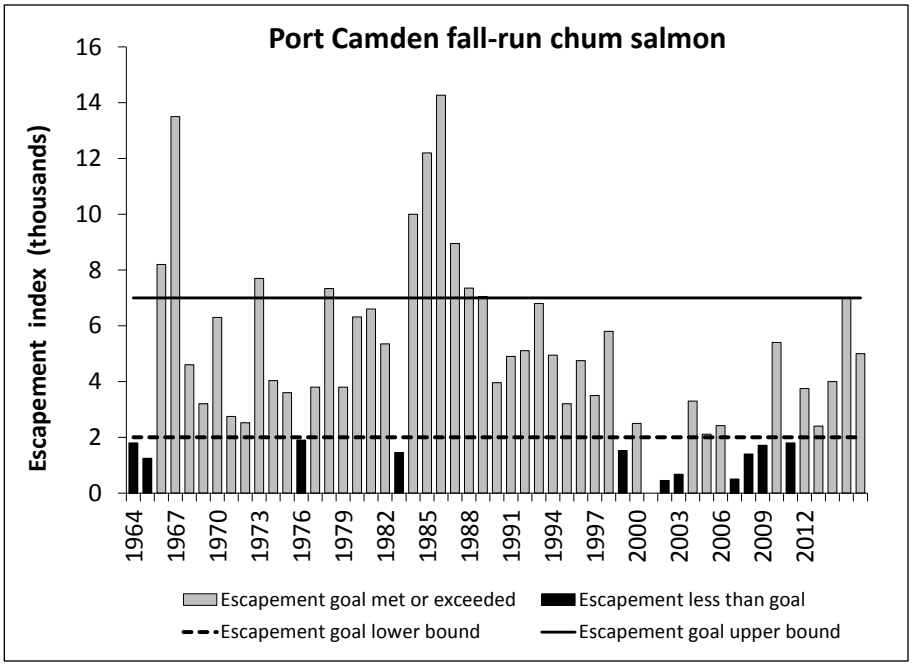


Appendix Figure E4.–Cholmondeley Sound fall-run chum salmon escapement index (peak aerial surveys), 1980–2016, and sustainable escapement goal range of 30,000–48,000 fish.

Appendix E5.–Port Camden fall-run chum salmon.

Port Camden (Kuiu Island) fall-run chum salmon have been harvested in a terminal commercial purse seine fishery (statistical area 109-43) in years when run strength appeared adequate to provide a harvest of fish surplus to escapement needs. Management of the Port Camden stock is based on aerial surveys conducted since the early 1960s at each of the two primary fall-run chum salmon streams, Port Camden South Head Creek and Port Camden West Head Creek. Both are relatively short streams in terms of spawning habitat; chum salmon runs average slightly smaller in the west head creek and run timing is about 10–14 days later than in the south head creek (Eggers and Heinl 2008).

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal range of 2,000–7,000 chum salmon counted on combined peak aerial surveys at Port Camden South Head and Port Camden West Head creeks (Eggers and Heinl 2008). The goal range was derived using a simple percentile approach and a risk analysis approach. The goal range was calculated based on the 25th and 75th percentiles of historical escapement data and the lower bound of the goal was set based on the risk analysis approach (Eggers and Heinl 2008). From 2012 to 2016, escapement indices were within the sustainable escapement goal range in all years (Appendix Figure E5).

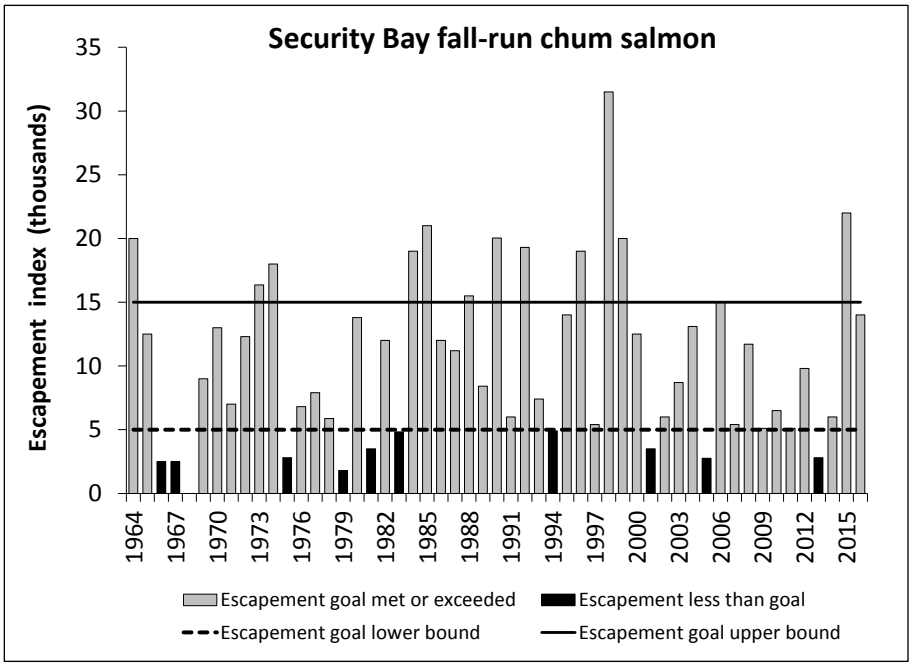


Appendix Figure E5.–Port Camden fall-run chum salmon escapement index (peak aerial surveys), 1964–2016, and sustainable escapement goal range of 2,000–7,000 fish.

Appendix E6.–Security Bay fall-run chum salmon.

Security Bay (Kuiu Island) fall-run chum salmon have been harvested in a terminal commercial purse seine fishery (statistical area 109-45) in years when run strength appeared adequate to provide a harvest of fish surplus to escapement needs. Management of the Security Bay stock is based on aerial surveys at Salt Chuck Creek, which have been conducted since the early 1960s (Eggers and Heinl 2008).

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal range of 5,000–15,000 chum salmon counted on a peak aerial survey at Salt Chuck Creek (Eggers and Heinl 2008). The goal range was based on the 25th and 75th percentiles of historical escapement data. From 2012 to 2016, escapement indices were below the sustainable escapement goal range in 1 year (Appendix Figure E6).

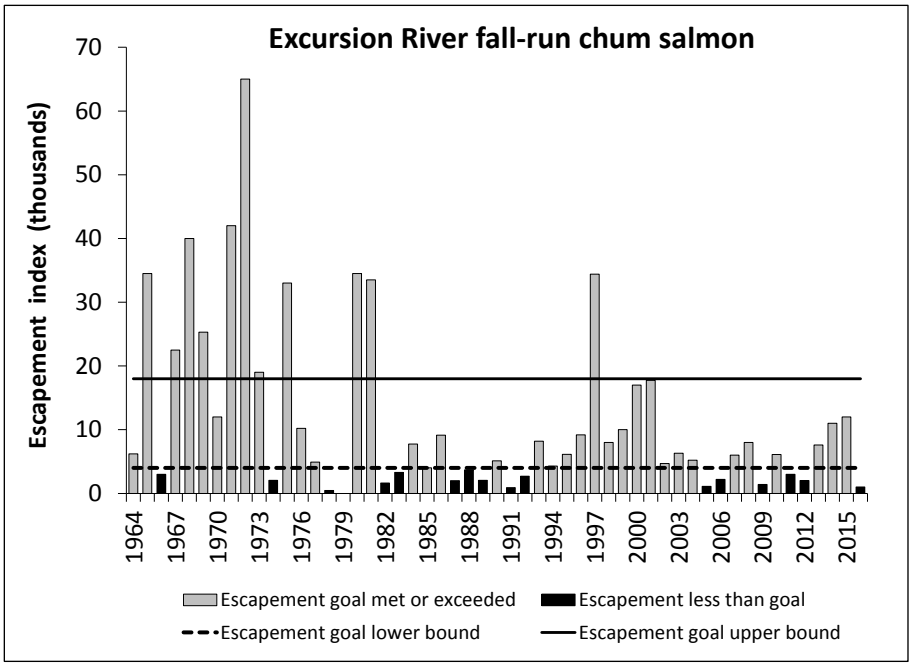


Appendix Figure E6.–Security Bay fall-run chum salmon escapement index (peak aerial surveys), 1964–2016, and sustainable escapement goal range of 5,000–15,000 fish.

Appendix E7.–Excursion River fall-run chum salmon.

Excursion Inlet fall-run chum salmon have been harvested in a terminal commercial purse seine fishery (statistical area 114-80) during years when run strength appeared adequate to provide a harvest of fish surplus to escapement needs. Escapements have been assessed through aerial surveys since 1960 at the Excursion River, the primary chum salmon producing stream in Excursion Inlet

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal range of 4,000–18,000 chum salmon counted on a peak aerial survey at the Excursion River (Eggers and Heinl 2008). The goal range was based on the 25th and 75th percentiles of historical escapement data. From 2012 to 2016, escapement indices were below the sustainable escapement goal range in 2 years (Appendix Figure E7).

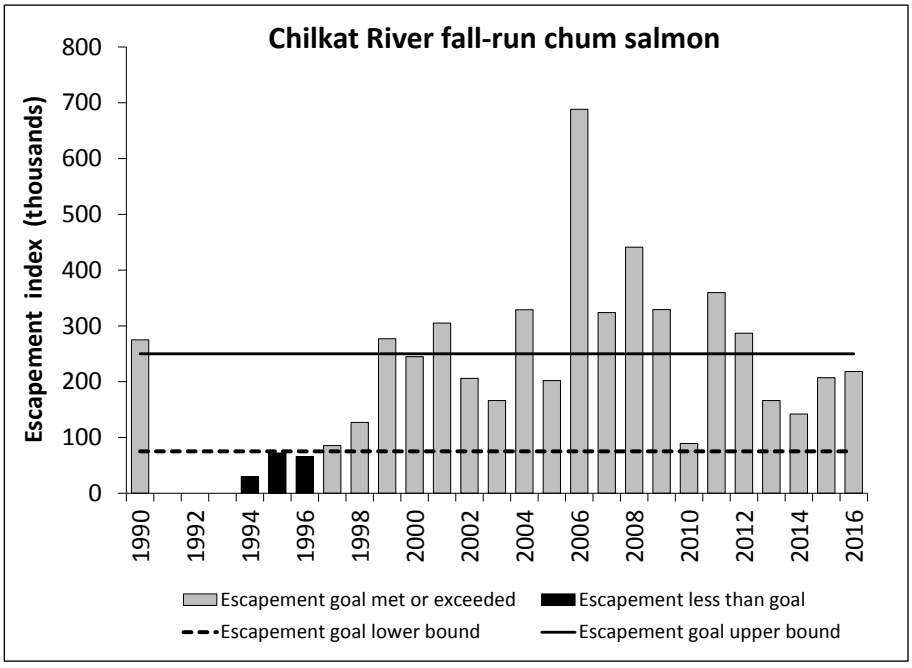


Appendix Figure E7.–Excursion River fall-run chum salmon escapement index (peak aerial surveys), 1964–2016, and sustainable escapement goal range of 4,000–18,000 fish.

Appendix E8.–Chilkat River fall-run chum salmon.

The Chilkat River drainage near Haines supports the largest fall chum salmon run in the region (Halupka et al. 2000). Most spawning takes place in the mainstem and side channels of the Chilkat River and a major tributary, the Klehini River. Chilkat River fall-run chum salmon are primarily harvested in the District 15 Lynn Canal commercial drift gillnet fishery, although they are likely also harvested to some degree in other mixed stock fisheries prior to reaching Lynn Canal. Escapements by age have been estimated through a fish wheel project operated by ADF&G on the river since 1994. The department conducted in-river mark–recapture studies in 1990 and from 2002 to 2005 that were designed to estimate the spawning population of chum salmon and relate those estimates to the fish wheel catches and aerial surveys of the primary spawning areas. The cumulative fish wheel catch, which averaged 1.55% of total escapement, was used to estimate the total chum salmon escapement for years when a mark–recapture estimate was not available.

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal range of 75,000–170,000 or, equivalently, a fish wheel index catch of 1,125–2,550 chum salmon, based on a stock-recruit analysis of the 1994–2002 brood years (Eggers and Heinl 2008). In 2015, the sustainable escapement goal was revised to a range of 75,000–250,000 fish, based on an updated stock-recruit analysis (Piston and Heinl 2014a). The escapement goal is the range of escapements estimated to provide 70–100% probability of achieving greater than 70% of maximum sustained yield. The goal is considered a sustainable escapement goal due to uncertainty in escapement estimates (Piston and Heinl 2014a). The escapement goal range converts to an equivalent fish wheel index catch of 1,160–3,875 chum salmon (Piston and Heinl 2014a). From 2012 to 2016, estimated escapements were within or above the escapement goal range every year (Appendix Figure E8), and in all years since 1997.



Appendix Figure E8.–Chilkat River fall-run chum salmon escapements (expanded fish wheel counts), 1990–2016, and sustainable escapement goal range of 75,000–250,000 fish. (Escapement estimates are not available for 1991–1993.)