Fishery Manuscript Series No. 14-07

Review of Salmon Escapement Goals in Southeast Alaska, 2014

by

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December 2014

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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REVIEW OF SALMON ESCAPEMENT GOALS IN SOUTHEAST ALASKA, 2014

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December 2014

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

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ABSTRACT

The Alaska Department of Fish and Game interdivisional escapement goal review committee reviewed Pacific salmon *Oncorhynchus* spp. escapement goals for Southeast Alaska in 2014. As specified in the Pacific Salmon Treaty, escapement goal recommendations for transboundary Alsek and Klukshu river Chinook and sockeye salmon runs underwent bilateral U.S./Canada review, and recommended changes were adopted by the Transboundary River Panel of the Pacific Salmon Commission in 2013. Thus, as of 2013, 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 to the directors of the divisions of Commercial Fisheries and Sport Fish that all but 5 of those escapement goals remain unchanged. The committee recommended (1) changing the Speel Lake sockeye salmon goal from a biological escapement goal range of 4,000–13,000 fish to a sustainable escapement goal range of 4,000–9,000 fish; (2) changing the Lost River coho salmon goal from a lower-bound sustainable escapement goal of 2,200 fish to a sustainable escapement goal range of 1,400–4,200 fish, and changing the name of the goal to Tawah Creek (Lost River); (3–4) increasing aggregate lower-bound sustainable escapement goals for summer-run chum salmon in the Southern Southeast and Northern Southeast Outside subregions to account for the addition of new index streams to those stock groups; and, finally, (5) changing the Chilkat River fall-run chum salmon sustainable escapement goal range of 75,000–170,000 fish to a range of 75,000–250,000 fish.

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* (5AAC 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 or modified.

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 5 species of Pacific salmon. That report was updated by Der Hovanisian and Geiger (2005) for the 2005/2006 board cycle. In subsequent board cycles, stock status was reported in individual reports for each species: 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).

In February 2014, ADF&G established a committee to review Southeast Alaska escapement goals in preparation for the 2014/2015 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 through 2013 for all stocks with formal escapement goals.

METHODS

During this review, the Southeast escapement goal review 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., Beverton and Holt 1957; Ricker 1954), 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.

Southeast Alaska escapement goals were last reviewed during the 2011/2012 board cycle, following which formal escapement goals were established for 50 stocks of salmon. In 2013, two new drainagewide escapement goals were established for Chinook and sockeye salmon in the transboundary Alsek River, and goals for Chinook and sockeye salmon in the Klukshu River (a tributary of the Alsek River) were modified. As specified in the Pacific Salmon Treaty, escapement goals for transboundary river and Chinook salmon stocks in Southeast Alaska are established through bilateral review of the Transboundary and Chinook technical committees of the Pacific Salmon Commission. Annex IV [Chapter 1 (c)(i)] of the 2008 Pacific Salmon Treaty directed the U.S. and Canada to identify and establish revised maximum sustained yield escapement goals for Alsek River Chinook and sockeye salmon by 2014. Analyses were completed in 2010 for Chinook salmon (Bernard and Jones 2010) and 2011 for sockeye salmon (Eggers and Bernard 2011). Recommendations from these analyses were to establish drainagewide Alsek River biological escapement goals of 3,500–5,300 Chinook salmon and 24,000–33,500 sockeye salmon, and to modify the existing Klukshu River biological escapement goals to 800–1,200 Chinook salmon and 7,500–11,000 sockeye salmon. The Chinook salmon analysis was reviewed and adopted by the Chinook Technical Committee (CTC 2011), and analyses for both species were reviewed by the Department of Fisheries and Oceans Canada, Centre for Science Advice Pacific (DFO 2011a, 2011b). In February 2013, the bilateral Transboundary Technical Committee and bilateral Transboundary River Panel agreed to the revised biological escapement goals (TTC 2014) and the goals were adopted out of cycle by ADF&G (Appendix D in Munro and Volk 2014). Thus, for the 2014/2015 board cycle, the Southeast escapement goal review committee considered 52 existing escapement goals for 12 Chinook, 14 sockeye, 14 coho, 4 pink, and 8 chum salmon stocks (Tables 1–4).

Table 1.–Southeast Region Chinook salmon escapement goals, 2009–2013 escapements, and 2014 escapement goal recommendations.

System	Assessment method	Goal type[a]	Escapement goal[b]	Year established	Escapement					Escapement goal recommendation
					2009	2010	2011	2012	2013	
Blossom River	AS, IE	BEG	150–300	2012	123	363	147	205	255	No change
Keta River	AS, IE	BEG	175–400	2012	219	475	223	241	493	No change
Unuk River	MR, AS	BEG	1,800–3,800	2009	3,157	3,835[c]	3,195[c]	956[d]	1,135[d]	No change
Chickamin River	AS, IE	BEG	450–900	1997	611	1,156	853	444	468	No change
Andrew Creek	AS	BEG	650–1,500	1998	628	1,205	936	587	920	No change
Stikine River	MR, weir	BEG	14,000–28,000	2000	12,803[c]	15,116[c]	14,480[c]	22,327[c]	16,735[c]	No change
King Salmon River	AS	BEG	120–240	1997	109	158	192	155	94	No change
Taku River	MR, AS	BEG	19,000–36,000	2009	29,797[c]	28,769[c]	27,523[c]	19,429[c]	18,002[cd]	No change
Chilkat River[e]	MR	BEG	1,750–3,500	2003	4,406	1,797	2,674[c]	1,723[c]	1,718[c]	No change
Alsek River[f]	Weir expansion	BEG	3,500–5,300	2013	6,239	9,518	6,846	3,027[c]	4,992[c]	**Adopted 2013**
Klukshu (Alsek) River[f]	Weir	BEG	800–1,200	2013	1,518	2,257	1,609	693[c]	1,227[c]	**Adopted 2013**
Situk River	Weir	BEG	450–1,050	2003	902	166[g]	240	322	912	No change

Note: AS = peak aerial survey, IE = index escapement, MR = mark-recapture; gray cells indicate lower bound of the escapement goal not met.

[a] Escapement goal types are biological escapement goal (BEG).

[b] Goals 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.

[c] Preliminary estimate pending publication of final report.

[d] Estimates based on expanded aerial survey index because mark-recapture studies failed.

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

[f] New Alsek and Klukshu river Chinook salmon escapement goals were bilaterally agreed upon in 2013 (TTC 2014). Escapement is measured using an index weir operated at the Klukshu River and, unlike all other Southeast escapement goals that are germane to large fish, includes smaller age-1.2 fish.

[g] The Situk River weir was compromised for a few days in 2010; however, the consensus is that the escapement was still below goal.

Table 2.–Southeast Region sockeye salmon escapement goals, 2009–2013 escapements, and 2014 escapement goal recommendations.

System	Assessment method	Goal type[a]	Escapement goal	Year established	Escapement					Escapement goal recommendation
					2009	2010	2011	2012	2013	
Hugh Smith Lake	Weir	OEG[b]	8,000–18,000	2003	9,483	15,646	22,029	13,353	5,946	No change
		BEG	8,000–18,000	2003	9,483	15,646	22,029	13,353	5,946	No change
McDonald Lake	FS, MR	SEG	55,000–120,000	2009	51,000	72,500	113,000	57,000	15,400	No change
Mainstem Stikine River	Run reconstruction	SEG	20,000–40,000	1987	24,575[c]	25,185[c]	33,569[c]	32,752[c]	32,689[c]	No change
Tahltan Lake	Weir	BEG	18,000–30,000	1993	30,323	22,702	34,248	13,687	15,828	No change
Speel Lake	Weir	BEG	4,000–13,000	2003	3,689	5,640	4,777	5,681	6,426	**Change to SEG 4,000–9,000**
Taku River	MR	SEG	71,000–80,000	1986	74,339	88,428[c]	112,187[c]	112,564[c]	75,323[c]	No change
Redoubt Lake	Weir	OEG[d]	7,000–25,000	2003	12,851	17,119	21,806	40,903	48,355	No change
		BEG	10,000–25,000	2003	12,851	17,119	21,806	40,903	48,355	No change
Chilkat Lake	Sonar, MR	BEG	70,000–150,000	2009	150,033	61,906	63,628	107,723	110,979	No change
Chilkoot Lake	Weir, MR	SEG	38,000–86,000	2009	33,705	71,657	65,915	118,166	46,140	No change
East Alsek/Doame River	AS, IE	BEG	13,000–26,000	2003	12,000	19,500	27,300	21,500	26,500	No change
Klukshu (Alsek) River[e]	Weir	BEG	7,500–11,000	2013	5,509	18,546	20,769	17,176	3,800	**Adopted 2013**
Lost River	BS, IE	LB SEG	≥1,000	2009	NA	1,525	1,006	453	587	No change
Situk River	Weir	BEG	30,000–70,000	2003	83,959	47,865	89,943	62,500	118,635	No change

Note: AS = peak aerial survey, FS = foot survey, BS = boat survey, IE = index escapement, MR = mark-recapture, NA = not available; gray cells indicate lower bound of the escapement goal not met.

[a] Escapement goal types are biological escapement goal (BEG), sustainable escapement goal (SEG), lower-bound sustainable escapement goal (LB SEG), and optimal escapement goal (OEG).

[b] Hugh Smith Lake sockeye salmon optimal escapement goal (OEG) was set by 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.

[c] Preliminary estimate pending publication of final report.

[d] Redoubt Lake sockeye salmon optimal escapement goal (OEG) set by Alaska Board of Fisheries (5 AAC 01.760).

[e] New Alsek and Klukshu river sockeye salmon escapement goals were bilaterally agreed upon in 2013 (TTC 2014). A drainage-wide Alsek River sockeye salmon BEG (24,000–33,500) was also bilaterally agreed upon; however, recent drainage-wide escapement estimates are pending analysis and not yet available (TTC 2014).

Table 3.–Southeast Region coho salmon escapement goals, 2009–2013 escapements, and 2014 escapement goal recommendations.

System	Assessment method	Goal type[a]	Escapement goal	Year established	Escapement 2009	2010	2011	2012	2013	Escapement goal recommendation
Hugh Smith Lake	Weir	BEG	500–1,600	2009	2,281	2,878	2,137	1,908	3,048	No change
Klawock River	Weir	SEG	4,000–9,000	2007	5,415	9,707	5,572	7,507	8,323	No change
Taku River[b]	MR	Manage. threshold	>70,000	2013	103,950[c]	126,830[c]	70,745[c]	70,742[c]	68,118[c]	No change
Auke Creek	Weir	BEG	200–500	1994	360	417	517	837	736	No change
Juneau Roadside Index Montana Creek	FS, IE	SEG	400–1,200	2006	698	630	709	394	367	No change
Juneau Roadside Index Peterson Creek	FS, IE	SEG	100–250	2006	123	467	138	190	126	No change
Ketchikan Survey Index	AS, IE	BEG	4,250–8,500	2006	8,710	4,563	5,098	11,960	11,295	No change
Sitka Survey Index	FS, IE	BEG	400–800	2006	1,156	1,273	2,222	1,157	1,414	No change
Ford Arm Lake	Weir	BEG	1,300–2,900	1994	2,181	1,610	1,908	2,282	1,573	No change
Berners River	FS, AS	BEG	4,000–9,200	1994	4,230	7,520	6,050	5,480	6,280	No change
Chilkat River	AS/FS, MR, IE	BEG	30,000–70,000	2006	48,867	89,124	66,557	38,677	51,324	No change
Lost River	FS, IE	LB SEG	≥2,200	2009	3,581	2,393	1,221	2,200	2,593	**Change to Tawah Creek (Lost River) goal**
Tawah Creek (Lost River)	FS, IE	None	None	None	3,581	2,393	1,221	NA	2,593	**Establish SEG 1,400–4,200**
Situk River	BS, IE	BEG	3,300–9,800	1994	5,814	11,195	3,652	3,007	14,853	No change
Tsiu/Tsivat Rivers	AS, IE	BEG	10,000–29,000	1994	28,000	11,000	21,000	10,500	47,000	No change

Note: AS = peak aerial survey, FS = foot survey, BS = boat survey, IE = index escapement, MR = mark-recapture, NA = not available; gray cells indicate lower bound of the escapement goal not met.

[a] Escapement goal types are biological escapement goal (BEG), sustainable escapement goal (SEG), and lower-bound sustainable escapement goal (LB SEG).

[b] For Taku River coho salmon, the management intent of the U.S. is to ensure an escapement of 70,000 fish as specified in the Pacific Salmon Treaty management plan (TTC 2014).

[c] Preliminary estimate pending publication of final report.

Table 4.–Southeast Region pink and chum salmon escapement goals, 2009–2013 escapements, and 2014 escapement goal recommendations.

System	Assessment method	Goal type[a]	Escapement goal[b]	Year established	Escapement					Escapement goal recommendation
					2009	2010	2011	2012	2013	
Pink salmon										
Southern Southeast	AS, IE	BEG	3.0–8.0 million	2009	7.2 million	5.9 million	5.5 million	6.5 million	14.5 million	No change
Northern Southeast Inside	AS, IE	BEG	2.5–6.0 million	2009	3.7 million	3.2 million	6.0 million	2.1 million	5.4 million	No change
Northern Southeast Outside	AS, IE	BEG	0.75–2.5 million	2009	1.8 million	2.0 million	2.7 million	2.5 million	5.3 million	No change
Situk River	Weir, IE	LB SEG	≥33,000	2012	62,800	102,200	77,500	30,600	150,500	No change
Chum salmon (summer run)										
Southern Southeast	AS/FS, IE	LB SEG	54,000	2012	41,000	47,000	157,000	144,000	84,000	**Change to LB SEG 62,000**
Northern Southeast Inside	AS/FS, IE	LB SEG	119,000	2012	107,000	77,000	125,000	177,000	278,000	No change
Northern Southeast Outside	AS/FS, IE	LB SEG	19,000	2009	15,000	24,000	23,000	28,000	18,000	**Change to LB SEG 25,000**
Chum salmon (fall run)										
Cholmondeley Sound	AS, IE	SEG	30,000–48,000	2009	39,000	76,000	93,000	54,000	13,000	No change
Port Camden	AS,IE	SEG	2,000–7,000	2009	1,711	5,400	1,800	3,750	2,000	No change
Security Bay	AS,IE	SEG	5,000–15,000	2009	5,100	6,500	5,100	9,800	3,000	No change
Excursion River	AS,IE	SEG	4,000–18,000	2009	1,400	6,100	3,000	2,000	8,000	No change
Chilkat River	MR, FW	SEG	75,000–170,000	2009	329,000	89,000	360,000	287,000	166,000	**Change to SEG 75,000–250,000**

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

[a] Escapement goal types are biological escapement goal (BEG), sustainable escapement goal (SEG), and lower-bound sustainable escapement goal (LB SEG).

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 a range "(SEG Range)" or a lower bound "(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. The Ricker production model (Ricker 1954) is the most widely used method to estimate escapements that produce maximum sustained yield. Stock-recruit models that better fit coho salmon production have also been used, including 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 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—A method for establishing sustainable escapement goals developed by Bue and Hasbrouck[1]; (Clark et al. 2014). 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 sustainable escapement goals in situations where stock assessment data were insufficient to establish a biological escapement goal through a more technical approach. Low contrast (<4) implies that stock productivity is known for only a limited range of escapements. According to this approach, percentiles of escapement values used to estimate a sustainable escapement goal 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 5).

[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 5.–Description of the percentile method algorithm used to set sustainable escapement goals.

Escapement contrast[a]	Sustainable escapement goal range:
Low contrast (<4)	15th percentile to maximum observation
Median contrast (4–8)	15th to 85th percentile
High contrast (>8); low exploitation	15th to 75th percentile
High contrast (>8); exploited population	25th to 75th percentile

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

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 only been used to establish escapement goals for pink salmon.

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 of the Pacific Salmon Commission. 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).

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) which 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 3 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 in conformance with the policies for *Statewide Salmon Escapement Goals* and *Management of Sustainable Salmon Fisheries* (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 and Transboundary River 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 8 stocks have also been reviewed and accepted by the Chinook Technical Committee, some more than once.

Escapements are enumerated annually using weirs operated on the Klukshu River (Alsek River drainage) and the Situk River. Estimates of escapement are made using mark-recapture studies on the Chilkat, Taku, Stikine and Unuk rivers, and survey counts on the King Salmon, Chickamin, Blossom, and Keta rivers and Andrew Creek. Escapement in the Klukshu River includes fish age-1.2 and older, and escapement for the other 10 indicator stocks is germane to large fish (Chinook salmon ≥ 660 mm mid-eye to fork of tail length) which in most systems includes 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".

Southeast Chinook salmon stocks can be classified into two broad categories, inside-rearing (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. These stocks include Chinook salmon returning to the Situk, Alsek, Taku, and Stikine rivers. Inside-rearing stocks are vulnerable to harvest in Southeast Alaska and northern British Columbia fisheries as immature fish as well as during their return spawning migrations and include the other 7 Southeast indicator stocks. Note that there is some overlap in ocean migrations within these 2 broad classifications. All Southeast Alaska and transboundary river indicator stocks produce primarily yearling smolt, fish having spent 2 winters in the freshwater environment. Exceptions to this occur in the Situk River, which produces mostly sub-yearling smolt, which spend only 1 winter in the freshwater, and in the Keta and Blossom rivers which produce around 10% sub-yearling smolt.

Sockeye Salmon

There are more than 200 sockeye salmon-producing systems in Southeast Alaska, most of which are small producers (Van Alen 2000). Important contributions to the region's harvest are also made by transboundary river populations and by natural systems and hatcheries on the northern British Columbia coast. Escapement goals are established for 13 sockeye salmon systems in Southeast Alaska, including 3 Yakutat area stocks (Lost, Situk, and East Alsek/Doame), 4 transboundary river stocks (Klukshu, Taku, Stikine, and Tahltan), and 6 Southeast area stocks (Chilkat, Chilkoot, Speel, Redoubt, McDonald, and Hugh Smith) (Table 2; Appendix B). Comprehensive stock assessment projects are limited primarily to the largest producers, including the Chilkat and Chilkoot systems in Lynn Canal and the transboundary Alsek, Taku, and Stikine rivers. Existing stock identification programs do not provide a high degree of resolution for the many smaller stocks in the region that are harvested in mixed stock fisheries. Lack of information, particularly regarding harvests, greatly limits potential for development of brood tables necessary for stock-

recruit analysis (Geiger et al. 2004). There are many sockeye salmon runs for which intermittent weir counts or escapement survey information exists, but long-term escapement monitoring projects have been maintained at only a small number, including 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, including the East Alsek/Doame and Lost rivers, have been assessed through survey counts.

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 widely distributed nature of the resource, it is practical and feasible to conduct stock assessment projects 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 fisheries that harvest a mixture of stocks in areas distant from most contributing 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 9 with biological escapement goals, 4 with sustainable escapement goals, and 1 (Taku River) with a management threshold (Table 3; Appendix C). Most direct stock assessment occurs at 2 levels: full indicator stock and escapement indicator.

Full indicator stocks are monitored for total adult abundance, 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 extend from the early 1980s for 4 systems (Auke Creek, Berners River, Ford Arm Creek, and Hugh Smith Lake) and were later expanded to include the Taku River in 1992 and the Chilkat River in 2000.

Escapement indicators have been established in the Haines, Sitka, Ketchikan, and Yakutat areas where foot or helicopter surveys are systematically conducted. Escapement goals for surveyed streams near Sitka and Ketchikan apply to the sum of peak survey counts on an aggregate 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 in the index 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 from 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 the Southeast Alaska (Zadina et al. 2004). The vast majority of the pink salmon harvest takes place in mixed stock fisheries in the Southeast area in 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 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 developing escapements (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 to a set 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 2014b). 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 3 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 2014b).

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 2014a). Of the chum salmon populations that have been consistently monitored, most have been monitored through aerial surveys, though several have been monitored annually by foot surveys. Inriver fish wheel counts have been used to monitor salmon escapements to the Taku and Chilkat rivers, 2 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 chum salmon runs, primarily fall-run fish, are harvested directly in terminal or near-terminal fisheries, which allows for some accounting of stock-specific harvest; however, in many cases these fish also migrate through mixed stock fisheries where the stock composition of catches 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 peak during the period mid-July to mid-August and fall-run fish peak in September or later. Southeast Alaska summer-run chum salmon index streams were grouped into 3 stock groups that comprise aggregates of index streams across broad subregions, upon which lower-bound sustainable escapement goals are based (Table 4; Appendix E; Piston and Heinl 2014a): the Southern Southeast Subregion includes 13 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 five 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 4; Appendix E).

ESCAPEMENT GOAL RECOMMENDATIONS

The Southeast escapement goal review committee recommended changes to 1 sockeye (Speel Lake), 1 coho (Lost River), and 3 chum salmon escapement goals (Southern Southeast summer run, Northern Southeast Outside summer run, and Chilkat River fall run) (Tables 1–4). Summaries of these recommendations are provided below. Only stocks having goals that were modified, added, or deleted during this review are discussed in this section—any goals not listed here remained status quo. In the process of developing recommendations, detailed escapement goal analyses were conducted for Speel Lake sockeye salmon and for chum salmon and published in separate reports (Heinl et al. 2014; Piston and Heinl 2014a) as referenced in the sections below.

Speel Lake Sockeye Salmon

Speel Lake, located on mainland Alaska approximately 50 km southeast of Juneau, supports a small run of sockeye salmon, which is harvested primarily in the District 11 commercial drift gillnet fisheries in Taku Inlet, Stephens Passage, and Port Snettisham. The Speel Lake run accounts for a very small portion of mixed stock harvests in the traditional commercial drift gillnet fishery, which is managed primarily to achieve escapement goals for Taku River sockeye and coho salmon as specified in the Pacific Salmon Treaty. Since the late 1990s, wild Speel Lake sockeye salmon have also been harvested in terminal hatchery fisheries conducted in Speel Arm, Port Snettisham, to harvest sockeye salmon returns to Snettisham Hatchery. Hatchery production is managed in accordance with the *District 11: Snettisham Hatchery Salmon Management Plan* (5 AAC 33.378), which requires ADF&G to conduct common property harvests in the special harvest area (in Speel Arm) by limiting time and area of harvest through emergency order authority to protect and sustain production of wild sockeye salmon runs.

The current biological escapement goal of 4,000–13,000 fish was established in 2003, based on run-reconstruction and stock-recruit analysis of the 1983–1996 brood years, and the range of escapements expected to produce at least 80% of maximum sustained yield (Riffe and Clark 2003). Estimated harvests, provided through U.S./Canada stock identification studies, were fairly complete; however, run-reconstruction required expansion of incomplete Speel Lake weir counts in nearly all years in the time series. The Speel Lake weir has been operated annually through the entire season since 2002, providing a much better base to recalibrate historical weir counts.

Heinl et al. (2014) reviewed and updated Speel Lake sockeye salmon stock assessment information, and updated the stock-recruit analysis. In order to address shortcomings of the dataset, Bayesian statistical methods were used to assess uncertainty in the presence of measurement error in escapement counts, serial correlation, and missing data (2 missing years of escapement data and four years of missing harvest data). An age-structured state-space spawner–recruit model was fit to harvest data and age composition of the total run from 1983 to 2011, along with estimates of expanded escapement counts (based on the longer time series of complete weir counts). Based on this analysis, the Southeast escapement goal committee recommended changing the goal to a sustainable escapement goal of 4,000–9,000 fish; a range of escapements estimated to provide a 74–95% probability of achieving 70% of maximum sustained yield, and a 60–91% probability of achieving greater than 80% of maximum sustained yield. These probabilities were based on yield profiles developed from outputs of the state-space model, where the point estimate of the escapement that produces a fixed percentage (e.g., 70% or 80%) of maximum sustained yield has

a probability of 50%. The highest probability of the yield profiles can be less than 100% because there may be a less than 100% chance that a fixed level of escapement will provide a fixed percentage of maximum sustained yield with 100% certainty.

The recommended escapement goal is consistent with management considerations and sustained yield as defined in the sustainable salmon fisheries policy. An escapement goal based on maximizing yield would require raising the lower bound of the Speel Lake goal to 5,000 fish. As noted above, however, the Speel Lake run is small and not directly targeted in fisheries. Escapements within the recommended range should sustain the run as required by 5 AAC 33.378, while also providing for harvests of Speel Lake sockeye salmon that occur in traditional mixed stock fisheries in District 11 and hatchery fisheries in Speel Arm (Heinl et al. 2014).

Lost River Coho Salmon

The Lost River is located on the Yakutat forelands, approximately 12 km southeast of Yakutat, Alaska. Coho salmon spawn in the Lost River and its main tributary system, Tawah Creek/Summit Lake/Ophir Creek. Lost River coho salmon are harvested primarily in terminal commercial set gillnet and sport fisheries, and also to some degree in the offshore commercial troll fishery (Clark and Clark 1994). Coho salmon escapements have been assessed through aerial, boat, and foot surveys since the early 1970s. In 1994, ADF&G established a biological escapement goal of 2,200–6,500 coho salmon counted on a peak survey, based on a stock-recruit analysis by Clark and Clark (1994). Changes in the shoreline morphology at the Lost River mouth during the winter of 1998–1999 caused the river to flow into the Situk-Ahrnklin Inlet, rather than directly into the Gulf of Alaska (Burkholder 2000). This shift made it difficult to actively manage the commercial set gillnet fishery for a goal specific for 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 now harvested incidentally in the Situk-Ahrnklin set gillnet fishery (Woods and Zeiser 2010). In 2009 the escapement goal was changed to a lower-bound sustainable escapement goal of 2,200 coho salmon counted on a peak survey.

In reviewing the Lost River escapement goal, it was determined that a return to an escapement goal range would be useful for management of large runs in the freshwater sport fishery. Also, a review of historical escapement counts indicated that survey information had not been compiled consistently over time. Annual peak survey counts sometimes, but not always, included the sum of maximum counts at 2 or more locations in the system, often conducted at different times during the run. Furthermore, with the exception of the Tawah Creek tributary, turbid water in the Lost River prevents accurate counting of fish, and most historical counts for the "Lost River" were obtained from Tawah Creek. Therefore, the historical index was reconstructed based only on the annual peak count obtained in Tawah Creek between Summit Lake and the confluence with the Lost River (Appendix C). This area is most conducive to providing survey counts that are comparable over time and should help to standardize survey effort in the future.

The escapement goal was evaluated using the simple percentile approach recommended by Bue and Hasbrouck. The Tawah Creek escapement index series exhibits high contrast (contrast = 12), and harvest rates are assumed to be low to moderate. Lost River coho salmon are likely exposed to less fishing pressure than nearby Situk River coho salmon, which experienced estimated harvest rates of 41–44% in 2005 and 2006, because they exhibit relatively later run timing and likely transit less distance across the Situk-Ahrnklin fishing area (Shaul et al. 2010). Harvest rates have also presumably been lower since the area around the mouth of the Lost River was closed to fishing in

the late 1990s. Given the high contrast and low exploitation rate, the Southeast escapement goal review committee recommended the Lost River coho salmon escapement goal be changed to a sustainable escapement goal range of 1,400–4,200 fish, based on the 15th–75th percentiles of peak annual survey counts in Tawah Creek, and recommended renaming the goal Tawah Creek (Lost River).

Southern Southeast Summer-Run Chum Salmon

The current escapement goal for Southern Southeast Subregion summer-run chum salmon is an aggregate lower-bound sustainable escapement goal of 54,000 index spawners, based on the 25th percentile of the sum of annual peak escapement survey counts to 13 index streams over the years 1960–2007 (Piston and Heinl 2011b). Piston and Heinl (2014a) identified 2 new index streams with consistent survey data to be added to this stock group, bringing the total number of index streams to 15, and recalculated the escapement index over the years 1960–2013. The addition of new index streams will improve geographic coverage of chum salmon escapements for this stock group. As a result of this change, the Southeast escapement goal review committee recommended a new lower-bound sustainable escapement goal of 62,000 chum salmon, based on the 25th percentile of the sum of annual peak escapement survey counts to the 15 index streams in this stock group.

Northern Southeast Outside Summer-Run Chum Salmon

The current escapement goal for Northern Southeast Outside Subregion summer-run chum salmon is an aggregate lower-bound sustainable escapement goal of 19,000 index spawners, based on the 25th percentile of the sum of annual peak escapement survey counts to five index streams over the years 1982–2007 (Piston and Heinl 2011b). Piston and Heinl (2014a) identified four new index streams with consistent survey data to be added to this stock group, bringing the total number of index streams to 9, and recalculated the escapement index over the years 1982–2013. The addition of new index streams will improve geographic coverage of chum salmon escapements for this stock group. As a result of this change, the Southeast escapement goal review committee recommended a new lower-bound sustainable escapement goal of 25,000 chum salmon, based on the 25th percentile of the sum of annual peak escapement survey counts to the 9 index streams in this stock group.

Chilkat River Fall-Run Chum Salmon

The Chilkat River drainage near Haines, Alaska, supports the largest fall chum salmon run in the region (Halupka et al. 2000). Chilkat River fall-run chum salmon are primarily harvested in the Lynn Canal (District 15) commercial drift gillnet fishery. Escapements 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, designed to estimate the spawning population of chum salmon and relate those estimates to inriver fish wheel catches and aerial surveys of the primary spawning areas.

The current sustainable escapement goal for Chilkat River fall-run chum salmon is 75,000–170,000 fish, based on a stock recruit analysis and escapement range estimated to provide 90% of maximum sustained yield (Eggers and Heinl 2008). The goal was considered a sustainable goal, because only 10 complete brood years were available for analysis (1994–2003). It was also noted that contrast in the stock-recruit data would increase once returns from recent, large escapements were manifested. Piston and Heinl (2014a) reviewed and updated stock assessment information,

and updated the stock-recruit analysis for the 1994–2008 brood years. Based on this analysis, the Southeast escapement goal review committee recommended increasing the *sustainable* escapement goal range to 75,000–250,000 fish; a range of escapements estimated to provide a 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 translates to an equivalent fish wheel index catch of 1,160–3,875 chum salmon.

SUMMARY

The Southeast escapement goal review committee recommended that all but 5 of 52 escapement goals for Southeast Alaska salmon stocks remain at status quo. Committee recommendations were reviewed by ADF&G regional and headquarters staff prior to adoption as escapement goals per sustainable salmon fisheries and escapement goal policies. Brief overviews of stock assessment, escapement goal history, and escapement goal performance through 2013 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: Randy Bachman, Julie Bednarski, Rich Chapell, Bob Clark, John Der Hovanisian, Brian Elliot, Lowell Fair, Steve Fleischman, Scott Forbes, Dave Harris, Jim Hasbrouck, Troy Jaecks, Judy Lum, Brian Marsten, Sara Miller, Andrew Munro, Garold Pryor, Mark Sogge, Eric Volk, Gordie Woods, and Nicole Zeiser.

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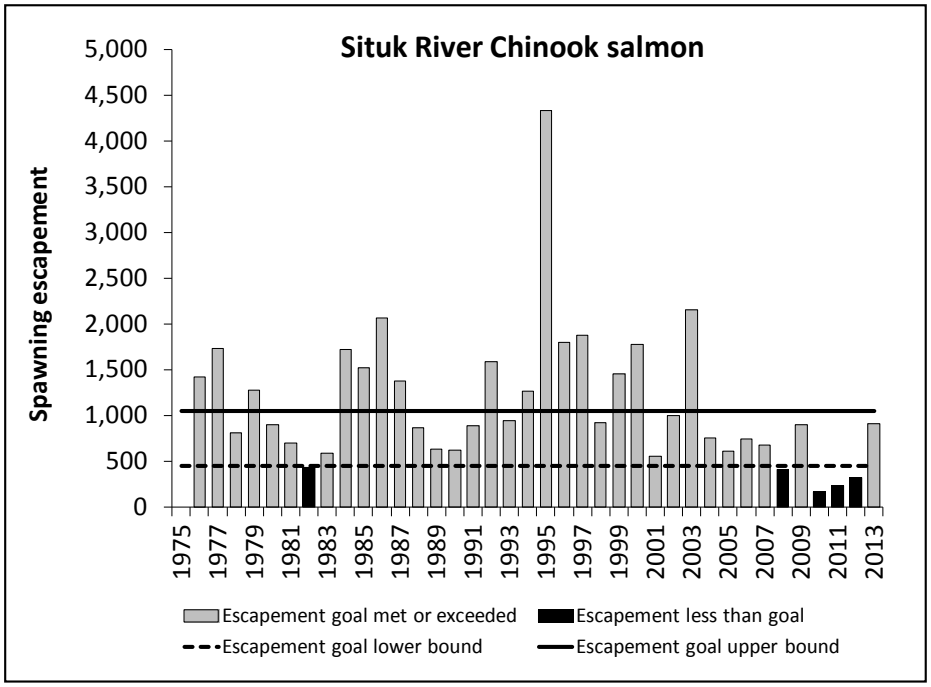
APPENDIX A.
CHINOOK SALMON ESCAPEMENT GOAL PERFORMANCE

Appendix A1.–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. Escapement estimates 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 and escapement goal of 600 large spawners, based on stock-recruit analysis. The escapement goal was revised to a range of 500–1,000 in 1997 (McPherson et al. 2003). The current biological escapement goal range of 450–1,050 large spawners was established in 2003, based on an updated stock-recruit analysis by 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 (Woods and Zeiser 2014). The 2013 escapement of 912 fish was a significant improvement over escapements from 2010 to 2012. 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. Escapements were below the escapement goal range in 3 of the past 5 years (Appendix Figure A1).

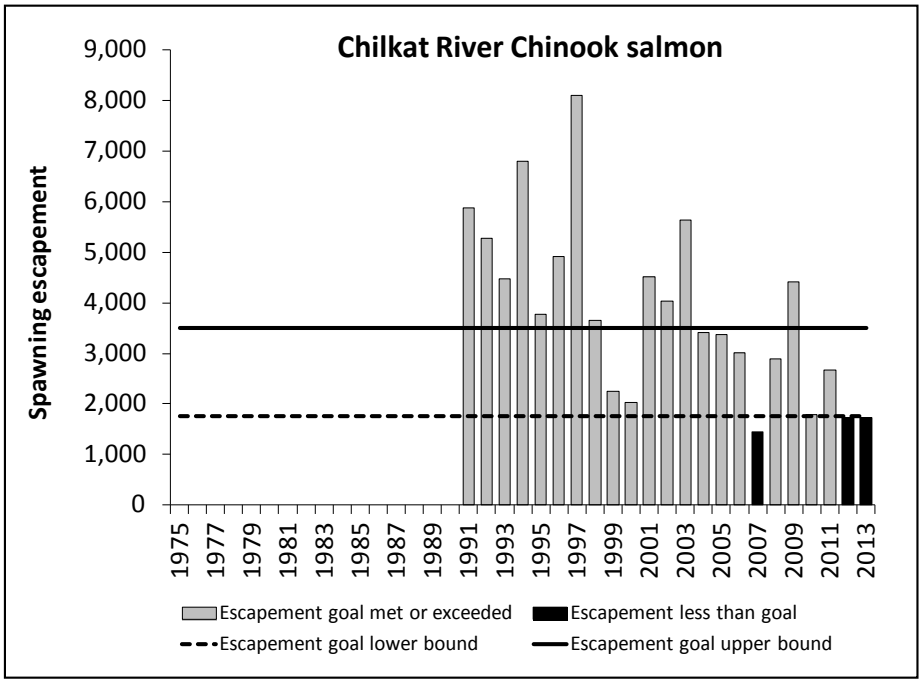


Appendix Figure A1.–Situk River Chinook salmon escapements, 1976–2013, and biological escapement goal range of 450–1,050 large spawners.

Appendix A2.–Chilkat River Chinook salmon.

The Chilkat River is a glacial system located near Haines, Alaska, that supports a mostly inside-rearing stock of Chinook salmon. A relatively small terminal marine sport fishery in Chilkat Inlet targets this stock, which 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 spawning abundance from a mark-recapture program conducted annually since 1991. Escapement data are relatively precise, with CVs for annual escapements averaging 15% since 1991. From 1975 to 1992, aerial survey counts were conducted on 2 small clear-water tributaries. Radio telemetry studies conducted 1991–1992, 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%) beginning in 1999; additional wild-stock tagging occurred in 3 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 (now) discontinued survey counts. The current biological escapement goal range of 1,750–3,500 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 1,850–3,600 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 20% for recent brood years. Escapements were within or above the escapement goal range in 3 of the past 5 years (Appendix Figure A2).

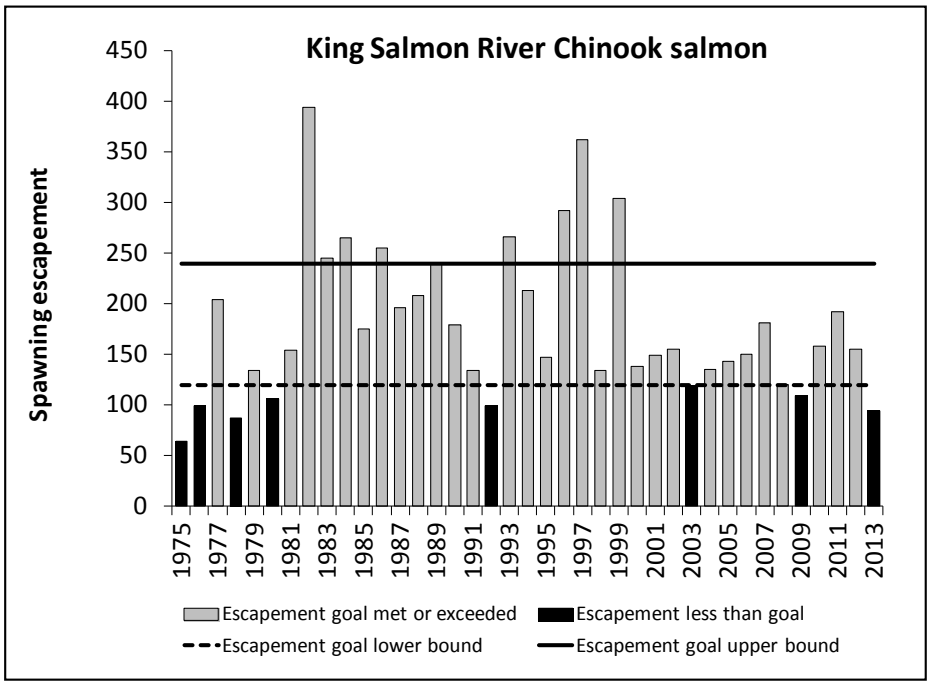


Appendix Figure A2.–Chilkat River Chinook salmon escapements, 1991–2013, and biological escapement goal range of 1,750–3,500 large spawners.

Appendix A3.–King Salmon River Chinook salmon.

The King Salmon River is a clearwater system located on Admiralty Island, 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 from 1971 to 1982 and 1993 to 2013. 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 120–240 large spawners was established in 1997, based on a stock-recruit analysis of the 1971–1991 brood years (McPherson and Clark 2001). Escapements were within the escapement goal range in 3 of the past 5 years. (Appendix Figure A3).

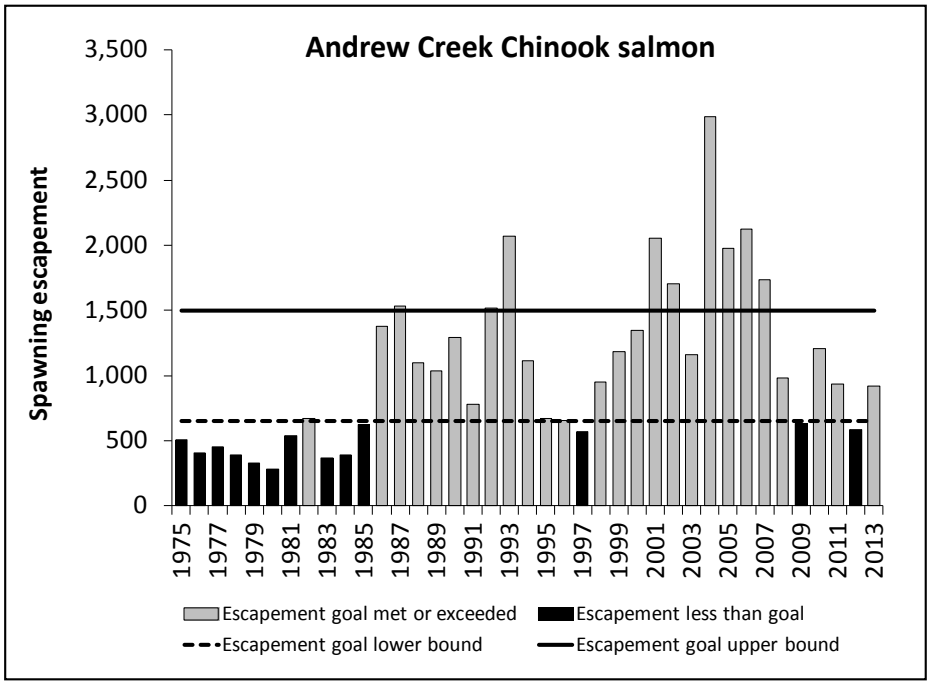


Appendix Figure A3.–King Salmon River Chinook salmon escapements, 1975–2013, and biological escapement goal of 120–240 large spawners.

Appendix A4.–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 in 1975 and from 1985 to 2013. 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 650–1,500 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. Prior to 1976, a large terminal marine gillnet fishery occurred in the spring, near the mouth of the Stikine River, to target Stikine River and other nearby Chinook salmon stocks. Starting in 2005, during years of surplus 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 sport fisheries were implemented between 2005 and 2009. Limited directed fisheries occurred in 2011 and 2012. These directed fisheries have likely resulted in increased harvest rates on Andrew Creek Chinook salmon. Escapements were within the escapement goal range in 3 of the past 5 years (Appendix Figure A4).

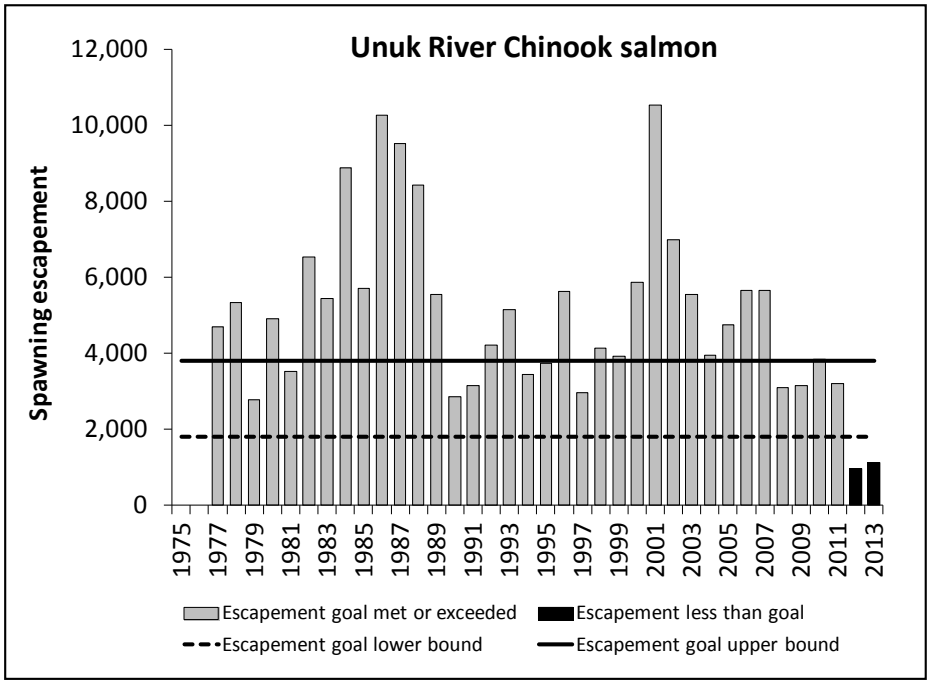


Appendix Figure A4.–Andrew Creek Chinook salmon escapements, 1975–2013, and biological escapement goal of 650–1,500 large spawners.

Appendix A5.–Unuk River Chinook salmon.

The Unuk 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 1982–1986 and from 1992 to present. The average harvest distribution for the 1992–2006 broods by area was 95.3% Southeast Alaska, 3.0% British Columbia, and 1.7% in outside waters (Kodiak, Cook Inlet, Gulf of Alaska and Bering Sea). The average harvest for the 1992–2006 broods by gear group was 56.8% troll, 27.7% sport, 9.7% drift gillnet,1.6% purse Seine, 1.0% trawl (National Marine Fisheries Service surveys), and 3.0% in other fisheries (test, terminal, private non-profit and Canadian mixed net fisheries). Estimated annual harvest rates averaged about 29% from 1989 to 2011. Preliminary estimates of annual harvest rates for 2012 and 2013 were 64% and 45%, respectively. Escapements of large spawners are based on mark-recapture estimates of total escapement from 1997–2009 and 2011, and expanded peak survey counts from 1977 to 1996 and from 2010 and 2012 to 2013. Radio telemetry studies conducted in 1994 and 2009 showed that index surveys are conducted in stream reaches where 80% of the spawning occurs; the expansion factor for survey counts is 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 650–1,400 large spawners (McPherson and Carlile 1997). The current biological escapement goal range of 1,800–3,800 large spawners was established in 2009, based on a stock-recruit analysis of the 1982–2001 brood years (Hendrich et al. 2008). The Unuk River stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. This abrupt decline in productivity was unexpected given the history of strong runs through 2011. The preliminary average harvest rate for 2012 and 2013 is 54%. Escapements were within or above the escapement goal range in 3 of the past 5 years (Appendix Figure A5).

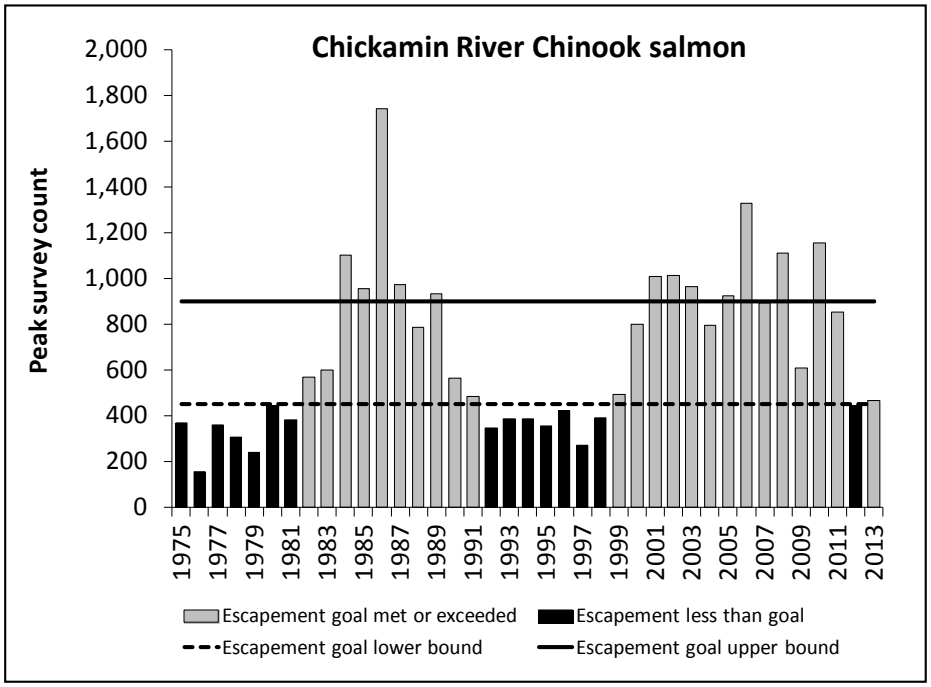


Appendix Figure A5.–Unuk River Chinook salmon escapements, 1977–2013, and biological escapement goal of 1,800–3,800 large spawners.

Appendix A6.–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 1982–1986 and from 2000–2006. The average harvest distribution of the 2000–2005 broods by area was 99% Southeast Alaska and 1% British Columbia. The average harvest for the 2000–2005 broods by gear group was 50% Troll, 15% Sport, 2% gillnet, 2% seine, and 5% Terminal/Private Non-Profit fisheries. The average annual harvest rate was 33.1% (range: 24–42%) for the 2000–2005 brood years. Escapement is measured using index counts of large fish. Mark-recapture studies conducted in 1995, 1996, and 2001–2005 showed that an average 21% of the total escapement is counted during peak surveys (Weller et al. 2007). A radio telemetry study in 1996 also showed that index surveys are conducted in stream reaches where more than 80% of all spawning occurs.

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 450–900 large index spawners as recommended by McPherson and Carlile (1997). The Chickamin River stock shows a cyclic pattern of escapement: peak survey counts during 1975–1981 and 1992–1998 were below the goal range, and those during 1982–1991 and 1999–2011 were within or above the range (Appendix Figure A6). The Chickamin River stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. Escapements were within or above the escapement goal range in 4 of the past 5 years (Appendix Figure A6).

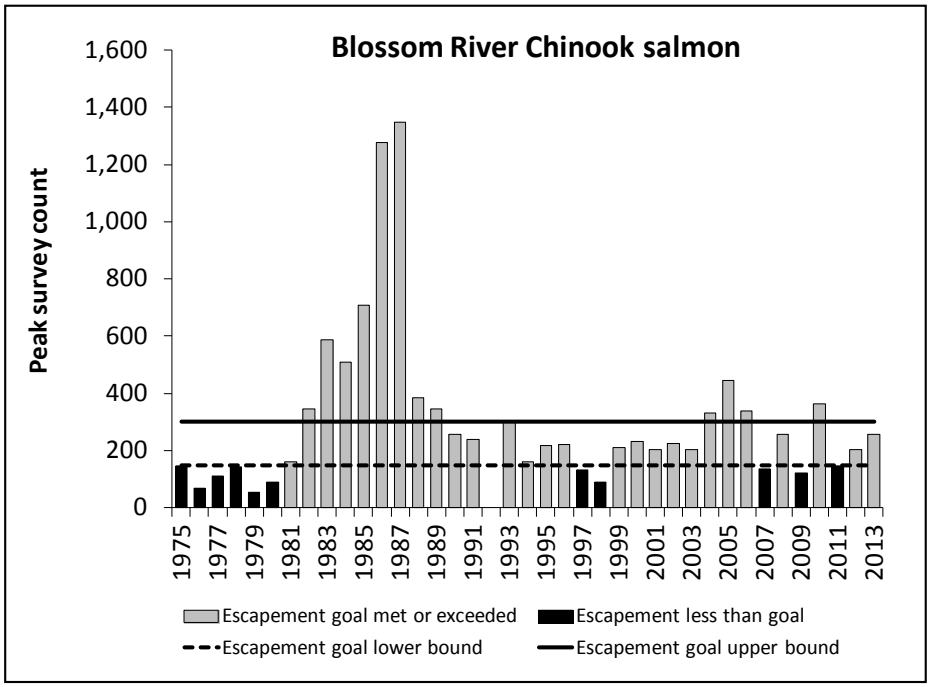


Appendix Figure A6.–Chickamin River Chinook salmon peak survey counts, 1975–2013, and biological escapement goal of 450–900 large fish counted on a peak survey.

Appendix A7.–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 using mark-recapture studies in 1998 and 2004–2006; index survey counts were obtained in all other years since 1975. Four years of concurrent mark-recapture and index count data 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 250–500 large spawners. The current biological escapement goal range of 150–300 large spawners counted on a peak survey was established in 2012, based on a stock-recruit analysis by Fleischman et al. (2010). Between 1976 and 1980, index counts were below the current escapement goal (Appendix Figure A7). These smaller escapements subsequently produced large runs with resultant large escapements during the 6-year period 1982–1987. This 6-year period of larger escapements has been followed by a 24-year period (1988–2011) of reduced but relatively stable escapements averaging about 225 large fish. Escapements were within or above the escapement goal range in 3 of the past 5 years (Appendix Figure A7).

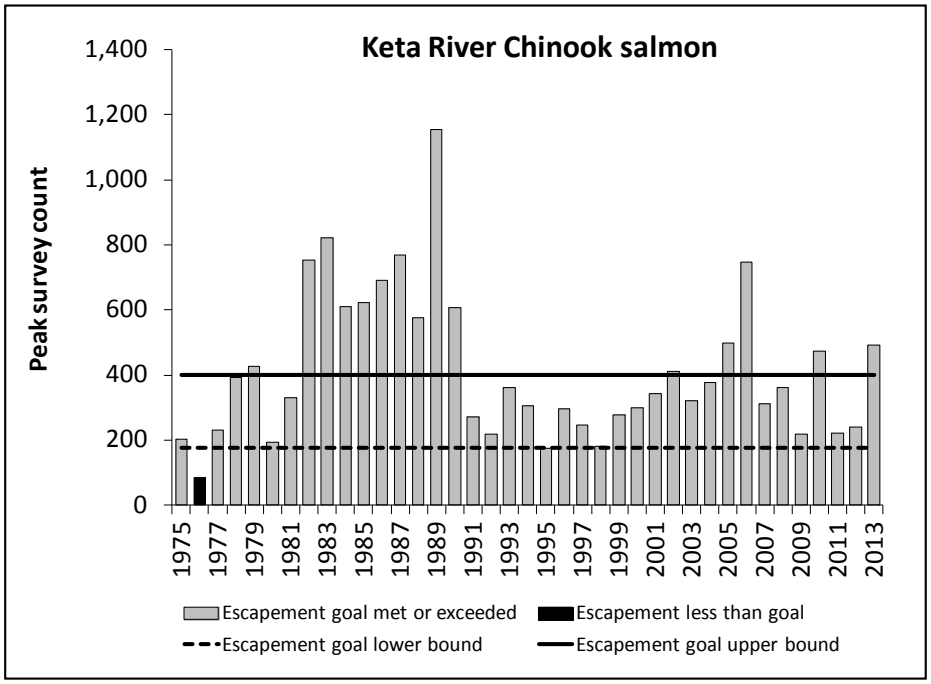


Appendix Figure A7.–Blossom River Chinook salmon peak survey counts, 1975–2013, and biological escapement goal of 150–300 large fish counted on a peak survey.

Appendix A8.–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 using mark-recapture studies from 1998 to 2000. Survey counts were performed in all other years since 1975. Three years of concurrent mark-recapture and index count information 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 250–500 large index spawners. The current biological escapement goal range of 175–400 large spawners was established in 2012, based on a stock-recruit analysis by Fleischman et al. (2010). 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 (Appendix Figure A8). Escapements were within or above the escapement goal range in 5 of the past 5 years (Appendix Figure A8).

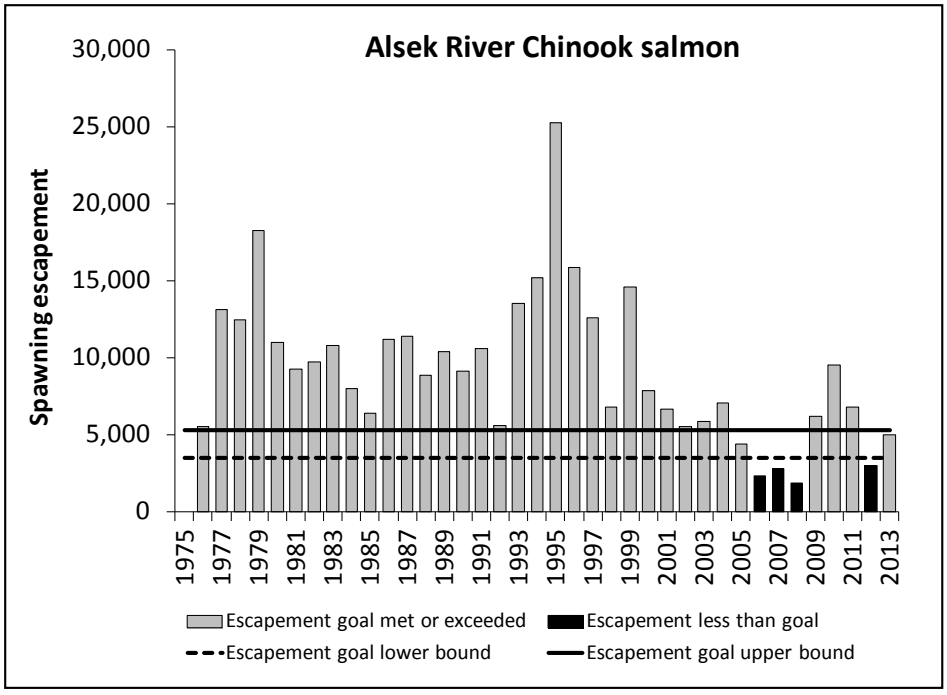


Appendix Figure A8.–Keta River Chinook salmon peak survey counts, 1975–2013, and biological escapement goal of 175–400 large fish counted on a peak survey.

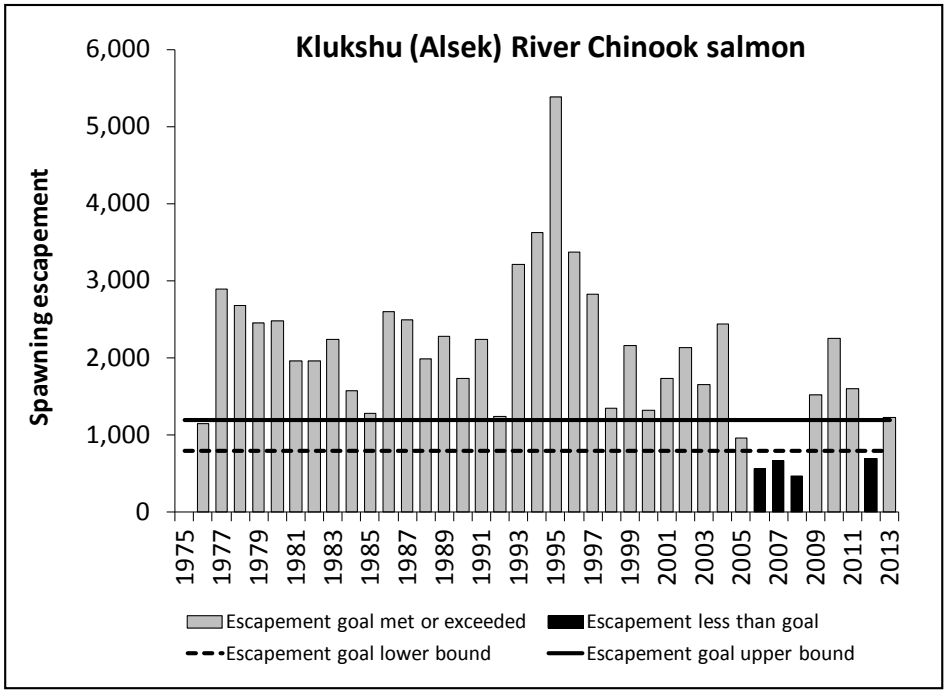
Appendix A9.–Alsek and Klukshu river Chinook salmon.

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. Directed Canadian sport and aboriginal fisheries occur in various upriver sections of the Alsek River. Some Chinook salmon are caught as bycatch in the U.S. directed sockeye fishery that takes place in the lower river and estuary at Dry Bay. A few Chinook salmon are also caught in a U.S. subsistence fishery that takes place in the same area. The harvest rate has averaged about 12% since 1976. Unlike other systems in Southeast Alaska that monitor escapement in terms of large fish, escapement in the Alsek River drainage includes 2-ocean (4-year old) fish. 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 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 1,100–2,300 Chinook salmon was established for the Klukshu River (McPherson et al. 1998). In 2013, the escapement goal was revised to biological escapement goal of 800–1,200 fish for the Klukshu River, and a drainage-wide biological escapement goal of 3,500–5,300 fish was established for the Alsek River, based on run-reconstruction and stock-recruit analysis (Bernard and Jones 2010; TTC 2014). The Alsek River stock, like other Chinook salmon stocks in Alaska, has recently experienced a decline in productivity. Recent poor escapements appear to be the result of reduced productivity that has occurred in most of the last 8 years, because known harvest rates exerted on this stock are very small—some of the lowest observed on a wild Chinook salmon stock in the world. Moreover, if no harvest had occurred from 2006 to 2008 and in 2012, the stock would still have failed to achieve the lower bound of the index escapement goal range. Escapements Alsek and Klukshu river Chinook salmon were within or above the escapement goal range in 4 of the past 5 years (Appendix Figures A9 and A10).



Appendix Figure A9.–Alsek River Chinook salmon escapements, 1976–2013, and biological escapement goal of 3,500–5,300 fish.

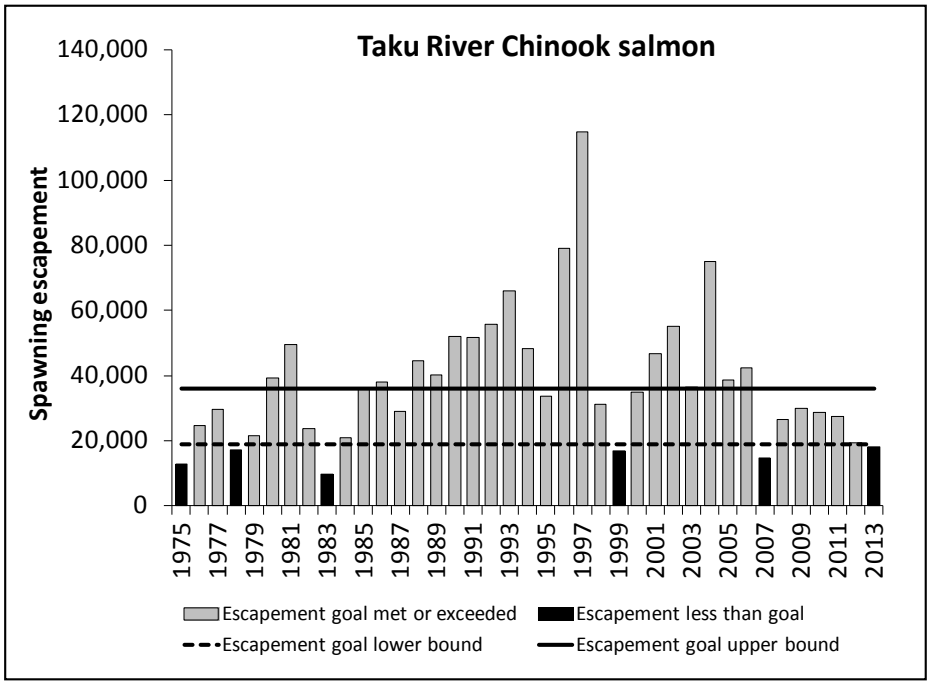


Appendix Figure A10.–Klukshu (Alsek) River Chinook salmon escapements, 1976–2013, and biological escapement goal of 800–1,200 fish.

Appendix A10.–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 it's terminus at Taku Inlet approximately 40 km east of Juneau. Starting in 2005, during years of surplus production to the Taku River, directed Chinook salmon fisheries were allowed in the marine waters in District 11 near Juneau and in Canada. Wild smolt were coded-wire tagged from 1976 to 1981 and from 1993 to present. Harvest rates average about 20% in years with no directed Chinook salmon fisheries and about 40% in years with directed fisheries. Most harvests occur in the U.S. commercial drift gillnet and sport fisheries in District 11 near Juneau and in Canadian gillnet and Aboriginal fisheries. Total escapement was estimated from mark-recapture studies conducted from 1989 to 1990, 1995 to 1998, and 2000 to 2012. In all other years, survey counts were used to estimate escapement. Concurrent mark-recapture 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 30,000–55,000 large spawners was established based on a stock-recruit analysis that maximized smolt production. The current biological escapement goal range of 19,000–36,000 large spawners was established in 2009, based on a stock-recruit analysis by McPherson et al. (2010). The stock exhibited a decline in productivity in recent years due to reduced marine survivals. It is unlikely that directed fisheries will be prosecuted until conditions improve. Escapements were within the escapement goal range in 4 of the past 5 years (Appendix Figure A11).

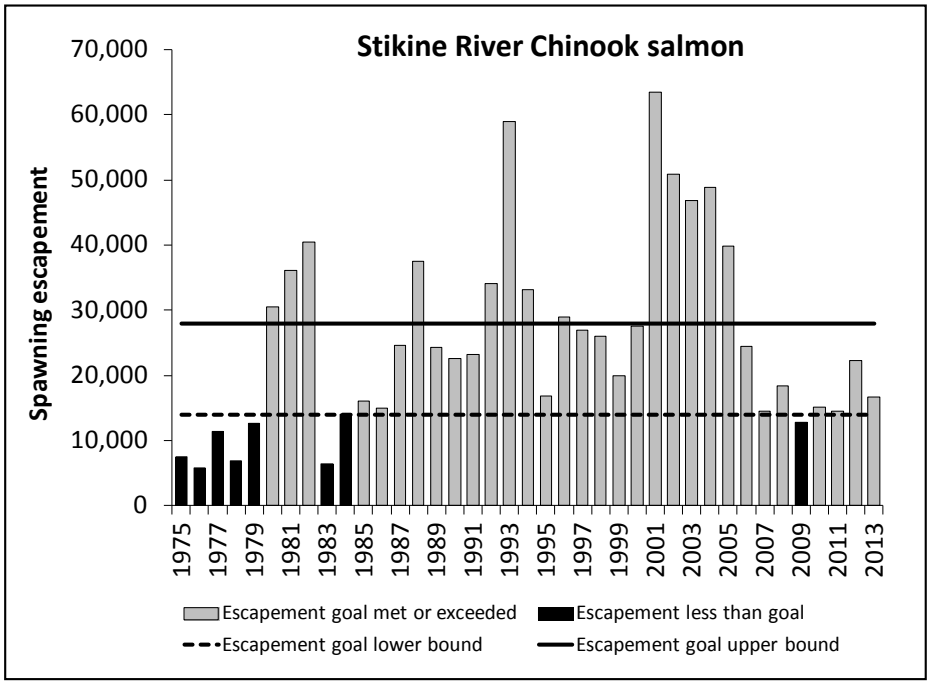


Appendix Figure A11.–Taku River Chinook salmon escapements, 1975–2013, and biological escapement goal of 19,000–36,000 large spawners.

Appendix A11.–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, and it is the largest river emptying into Southeast Alaska. Starting in 2005, during years of surplus production to the Stikine River, directed Chinook salmon fisheries were allowed in the marine waters in District 8 near Petersburg and Wrangell and in Canada. Wild smolt have been coded-wire tagged since 2000 to estimate smolt and adult production and harvest rates. In years of directed Chinook salmon fishing, harvest rates ranged between 50% and 70%. Most harvests occur in the U.S. commercial gillnet and sport fisheries in District 108 near Petersburg and Wrangell and in Canadian gillnet and Aboriginal fisheries. 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 represent 3–33% of the total escapement.

Escapement Goals and Stock Status: The current biological escapement goal range of 14,000–28,000 large spawners was established in 2000, based on a stock-recruit analysis by Bernard et al. (2000). The stock exhibited a decline in productivity in recent years due to reduced marine survivals. It is unlikely that directed fisheries will be prosecuted until conditions improve. Escapements were within the escapement goal range in 4 of the past 5 years (Appendix Figure A12).



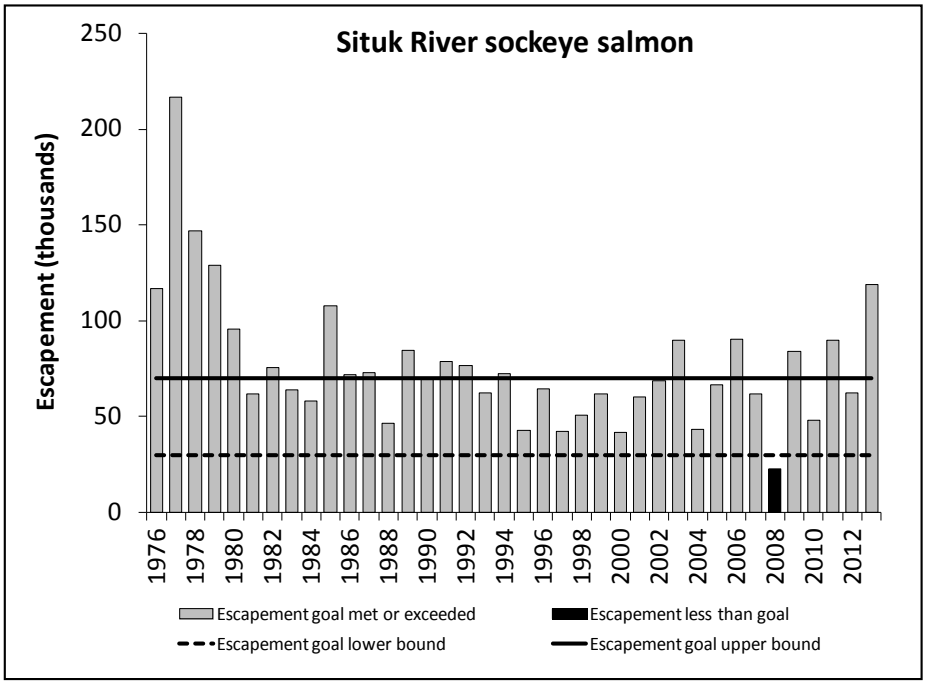
Appendix Figure A12.–Stikine River Chinook salmon escapements, 1975–2013, and biological escapement goal of 14,000–28,000 large spawners.

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. 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 of 40,000–55,000 sockeye salmon was established in 1987 based on preliminary stock-recruit analysis by McPherson et al. (1987). The escapement goal was revised in 1995 to a biological escapement goal of 30,000–70,000 sockeye salmon based on a stock-recruit analysis by Clark et al. (1995b) and an updated analysis by Clark et al. (2002). Escapements were within or above the escapement goal range in all but one year since 1976 (Appendix Figure B1).

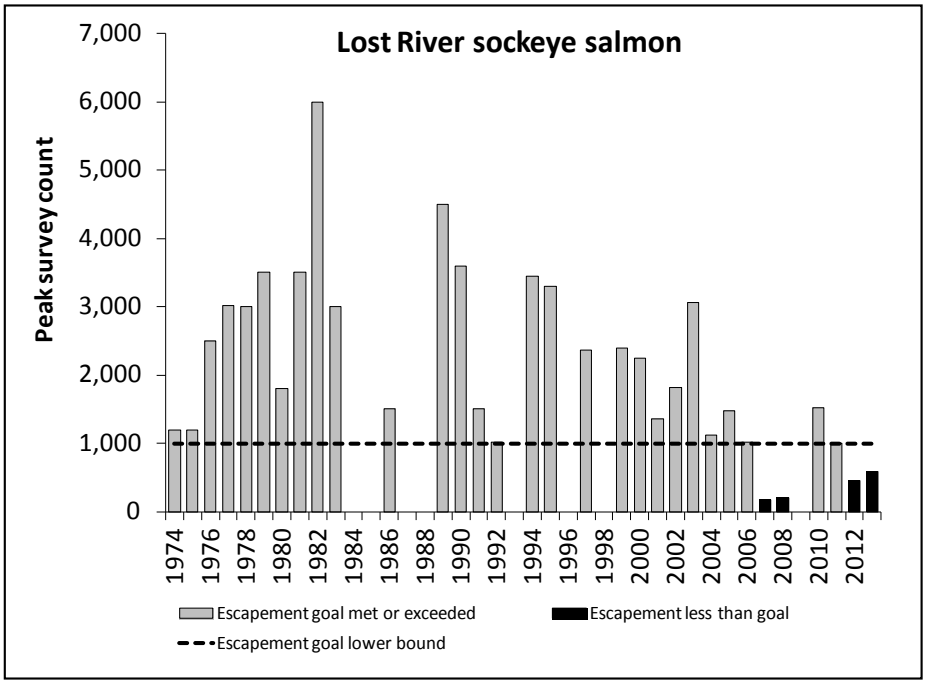


Appendix Figure B1.–Situk River sockeye salmon escapement (weir counts), 1976–2013, and biological escapement goal range of 30,000–70,000 fish.

Appendix B2.–Lost River sockeye salmon.

The Lost River is located on the Yakutat forelands, approximately 12 km southeast of Yakutat, Alaska. What is commonly referred to as the "Lost River" sockeye run, is actually a small run of sockeye salmon that migrates less than 1.5 km up the Lost River, then migrates northwest into Tawah Creek/Summit Lake/Ophir Creek tributary. 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 of 1,000–2,300 sockeye salmon counted on a peak survey in the Lost River tributaries, based on a stock-recruit analysis by Clark et al. (1995a). Lost River sockeye salmon were harvested to some degree in a directed, set gillnet fishery at the Lost River mouth through the 1990s; however, 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). This shift made it difficult to manage the commercial fishery for a goal specific for 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 now 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). Peak survey counts were above the escapement goal in 6 of the last 10 years; however, counts were below goal in 4 of the most recent 7 years (a peak survey count was not obtained in 2009; Appendix Figure B2). The department is currently reviewing historical survey data to standardize survey time and area, as was recently done for Lost River coho salmon, which may result in a future change to the escapement goal.

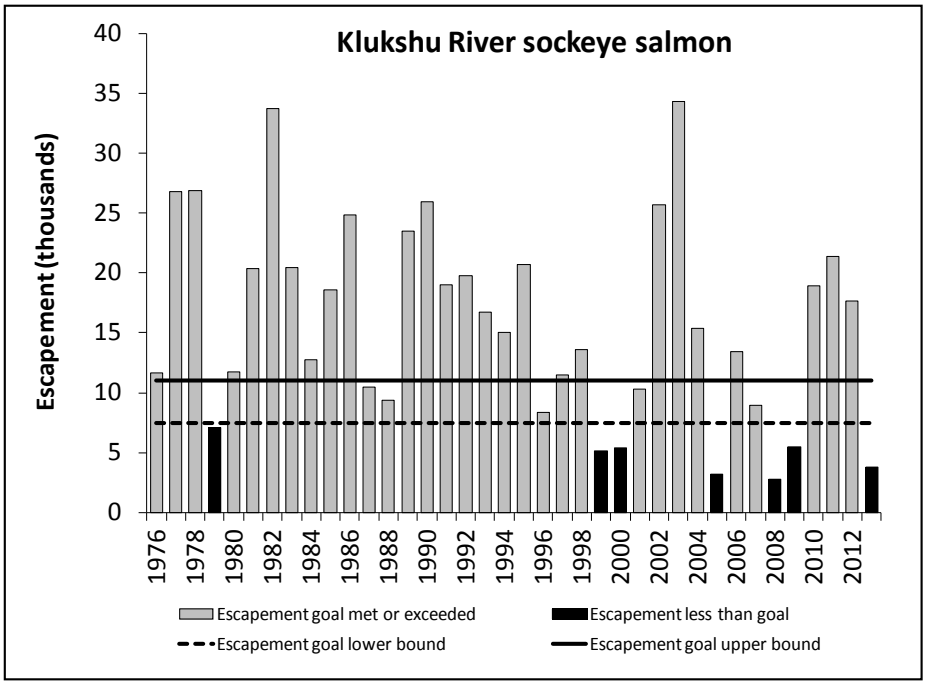


Appendix Figure B2.–Lost River sockeye salmon escapement index (peak survey counts), 1974–2013, and lower-bound sustainable escapement goal of 1,000 fish. (Peak survey counts were not obtained in 1984, 1985, 1987, 1988, 1993, 1996, 1998, and 2009.)

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 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 drainage-wide biological escapement goal of 24,000–33,500 fish was established for the Alsek River, based on run-reconstruction and stock-recruit analysis (Eggers and Bernard 2011; TTC 2014). Drainage-wide sockeye salmon escapements were estimated through 2008; however, recent escapement estimates are pending further analysis (TTC 2014). Klukshu River spawning escapements met or exceeded the escapement goal range in 3 of the past 5 years (Appendix Figure B3).

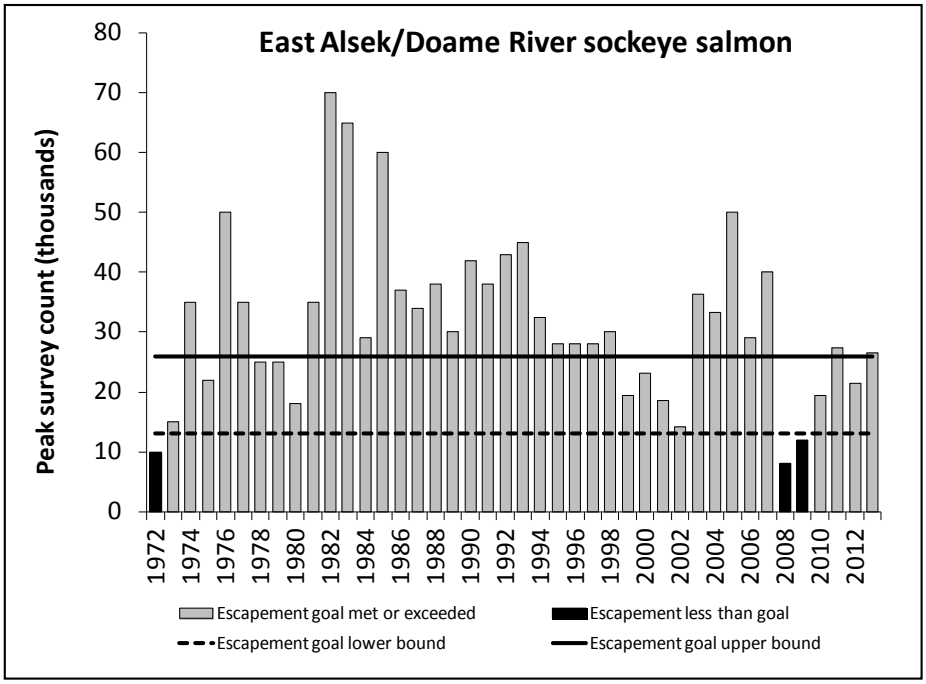


Appendix Figure B3.–Klukshu River sockeye salmon escapement (weir counts adjusted for upstream removals), 1976–2013, and biological escapement goal range of 7,500–11,000 spawners.

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 was a distributary channel of the Alsek River but is now fed by groundwater and has no direct connection to the Alsek. The Doame River, is a clear water system with 2 lakes, located just east of the East Alsek. 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 (Clark et al. 2003). Sockeye salmon in the East Alsek-Doame system are harvested in terminal set gillnet fisheries in the East Alsek River lagoon and adjacent near-shore ocean waters. 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 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 by Clark et al. (1995a). 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. Smith et al. (2006) summarized this history as: (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, 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. This decline 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) and spawning habitat may continue to diminish through time (Faber 2008). In 2003, the escapement goal was revised downward to a biological escapement goal of 13,000–26,000 sockeye salmon (Clark et al. 2003). Escapement indices were within or above the escapement goal range in 4 of the past 5 years (Appendix Figure B4).

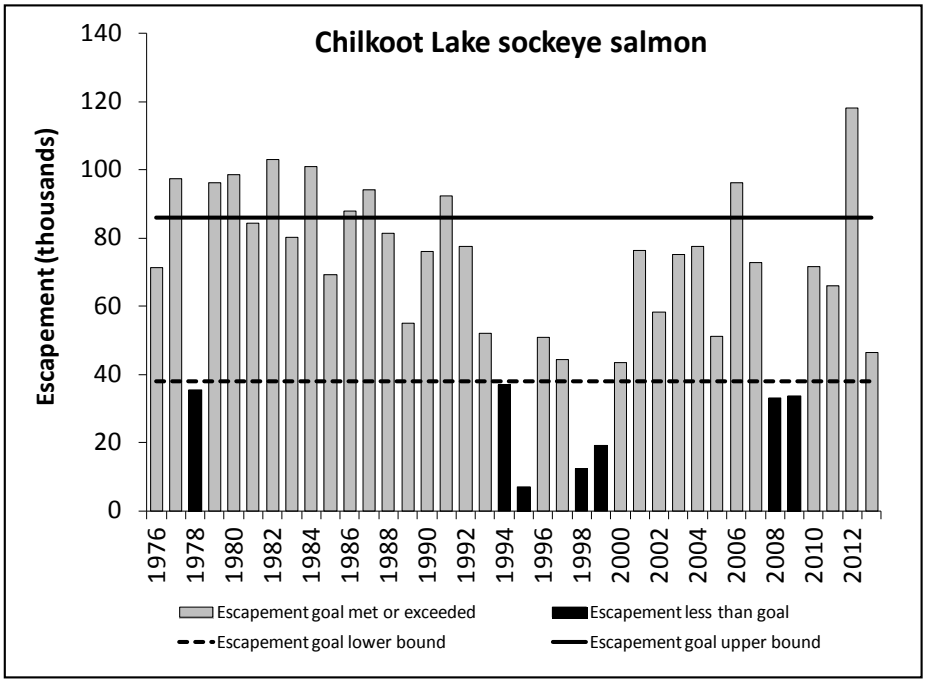


Appendix Figure B4.–East Alsek-Doame River sockeye salmon escapement index (peak aerial survey counts), 1972–2013, and biological escapement goal of 13,000–26,000 fish.

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 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 of 50,500–91,500 sockeye salmon divided into separate goals for early- and late-runs, based on an extensive stock-recruit analysis by 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 2 estimates were not consistent enough to calibrate weir counts. Geiger et al. (2005) recommended maintaining essentially the same escapement goal, 50,000–90,000 sockeye salmon, but classified the goal as a sustainable escapement goal. In 2009, the escapement goal was changed to a sustainable escapement goal of 38,000–86,000 sockeye salmon based on an updated stock-recruit analysis by Eggers et al. (2008, 2009b). The goal was considered a sustainable goal, rather than a biological goal, due to uncertainty in escapement levels based on weir counts. Eggers et al. (2009b) developed weekly escapement targets, based on historical run timing at the weir, rather than separate escapement goals for early- and late-run fish. Escapements were within or above the escapement goal range in 4 of the past 5 years (Appendix Figure B5).

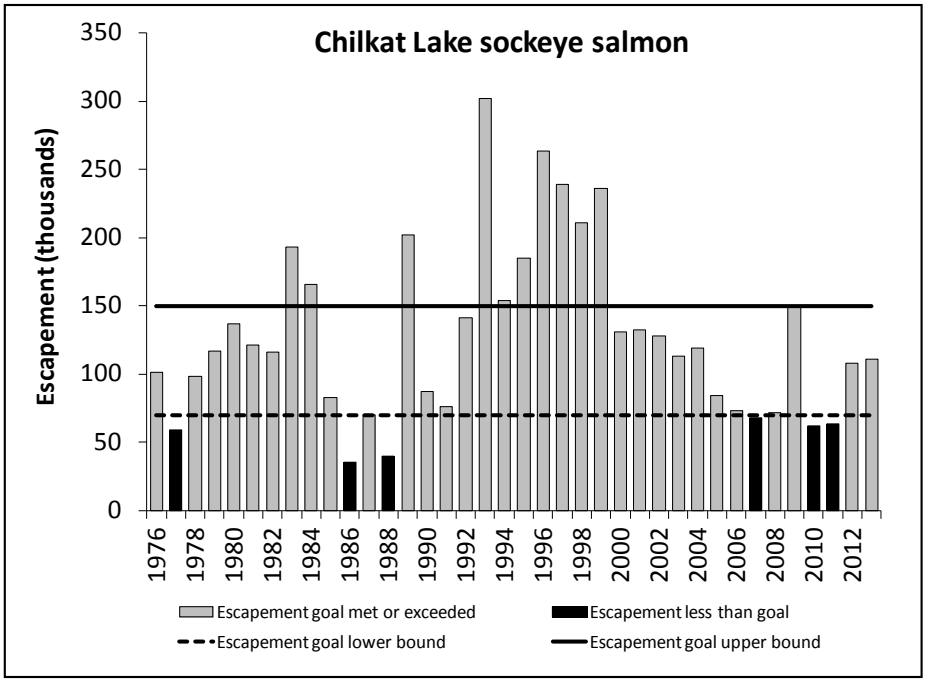


Appendix Figure B5.–Chilkoot Lake sockeye salmon escapement (weir counts), 1976–2013, and sustainable escapement goal range of 38,000–86,000 fish.

Appendix B6.–Chilkat Lake sockeye salmon.

Chilkat Lake is located on the mainland, approximately 30 km west of Haines, Alaska. The lake supports one of the largest sockeye salmon runs in the region and, along with Chilkoot Lake sockeye salmon, provides most of the sockeye salmon harvested in the District 15 Lynn Canal drift gillnet fishery. Escapements have been estimated through an adult counting weir at the lake outlet (1967–1995 and 1999–2007), mark-recapture studies (1994–2007 in conjunction with fish wheels operated in the Chilkat River), and through a DIDSON sonar operated at the lake outlet since 2008.

Escapement Goals and Stock Status: This stock was managed for informal escapement goals of 60,000–70,000 sockeye salmon starting in 1976, then 70,000–90,000 sockeye salmon starting in 1981 (McPherson 1990). In 1990, ADF&G established a biological escapement goal of 52,000–106,000 sockeye salmon, divided into separate goals for early- and late-runs, based on an extensive stock-recruit analysis by McPherson (1990). Efforts to update the goal using standard stock-recruit methods have been hindered by lake stocking and inaccurate weir counts (Geiger et al. 2005). Lake productivity studies conducted in the 1980s suggested the lake was spawning-area limited and capable of rearing an additional 10–12 million fry (Eggers et al. 2010). The lake was stocked with 2–4 million fry annually 1994–1997 and 2001, and an additional 300,000 fry produced annually from incubation boxes 1989–1998 and 2003. Mark-recapture studies conducted in 1994 and 1995 suggested that weir counts were considerably biased, and escapements were subsequently estimated from mark-recapture studies 1996–2007. In 2006, the escapement goal was revised to a sustainable escapement goal of 80,000–200,000 sockeye salmon, which was intended to provide an escapement level in mark-recapture units that was approximately the same as the weir-based goal (Geiger et al. 2005). In 2009, the goal was revised to a biological escapement goal of 70,000–150,000 sockeye salmon (Eggers et al. 2008, 2010). Eggers et al. (2010) converted historical weir counts to total escapement and developed a stock-recruit model with spawner density and fry-plant terms to account for bias due to added production from enhancement. That analysis suggested sockeye salmon production is rearing limited and fry plants depressed wild smolt production. Escapements were within or above the escapement goal range in 3 of the past 5 years (Appendix Figure B6).

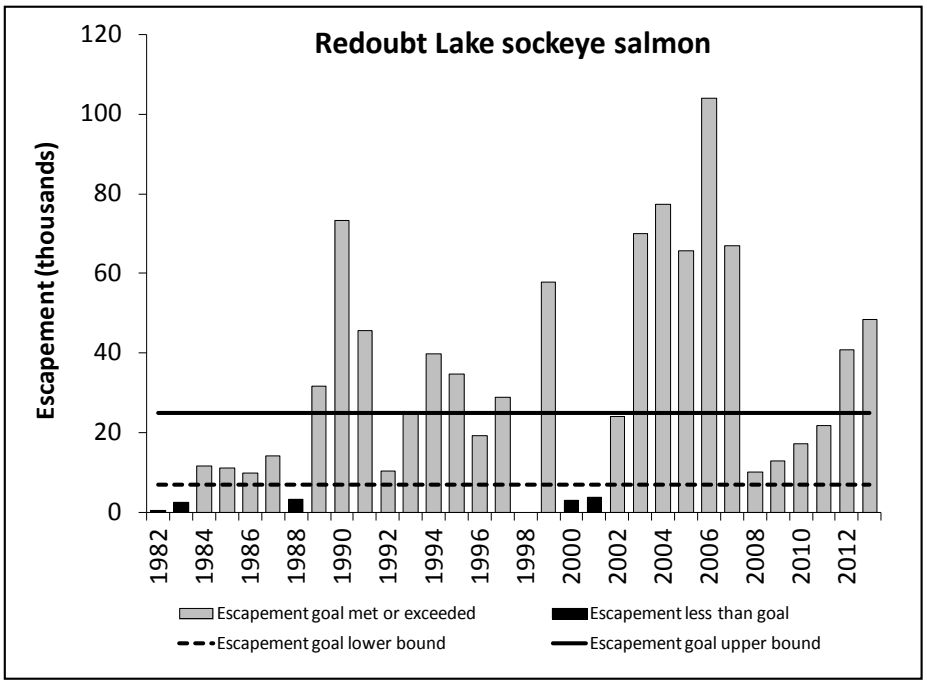


Appendix Figure B6.–Chilkat Lake sockeye salmon escapement estimates, 1976–2013, and biological escapement goal range of 70,000–150,000 fish.

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 of 10,000–25,000 sockeye salmon based on a stock-recruit analysis by Geiger (2003). In 2003, the Board of Fisheries adopted a management plan for Redoubt Lake and set an optimal escapement goal 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). Escapements have been highly variable but were within or above the escapement goal range annually since 2002 (Appendix Figure B7).

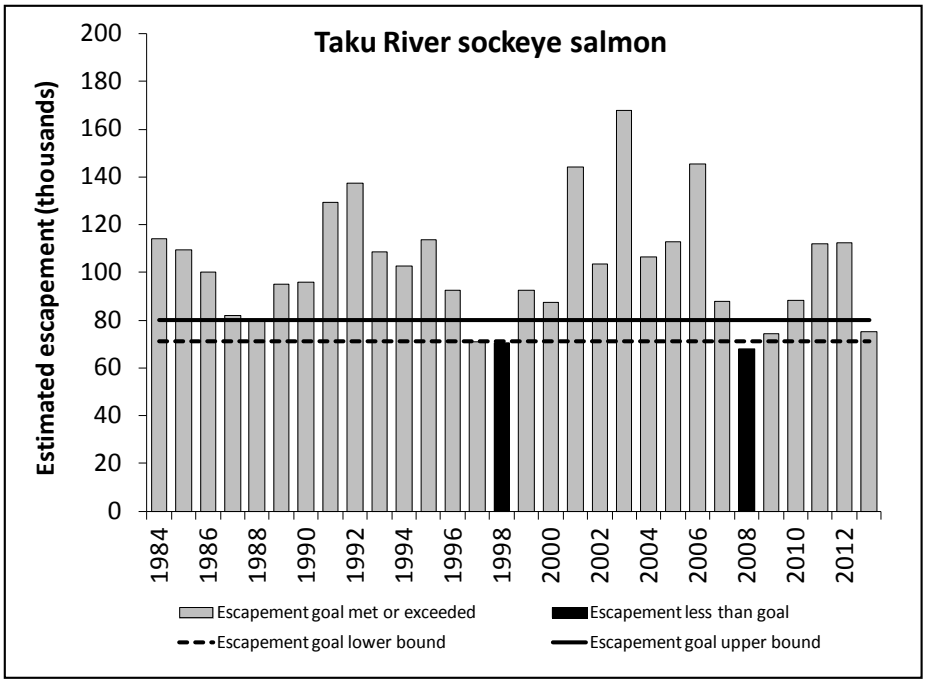


Appendix Figure B7.–Redoubt Lake sockeye salmon escapement (weir counts), 1982–2013, and optimal escapement goal range of 7,000–25,000 fish. (The weir was not operated in 1998.)

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 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). Escapements met or exceeded the escapement goal in 27 of 29 years since 1985, and escapements were within or above the escapement goal in 5 of the past 5 years (Appendix Figure B8).

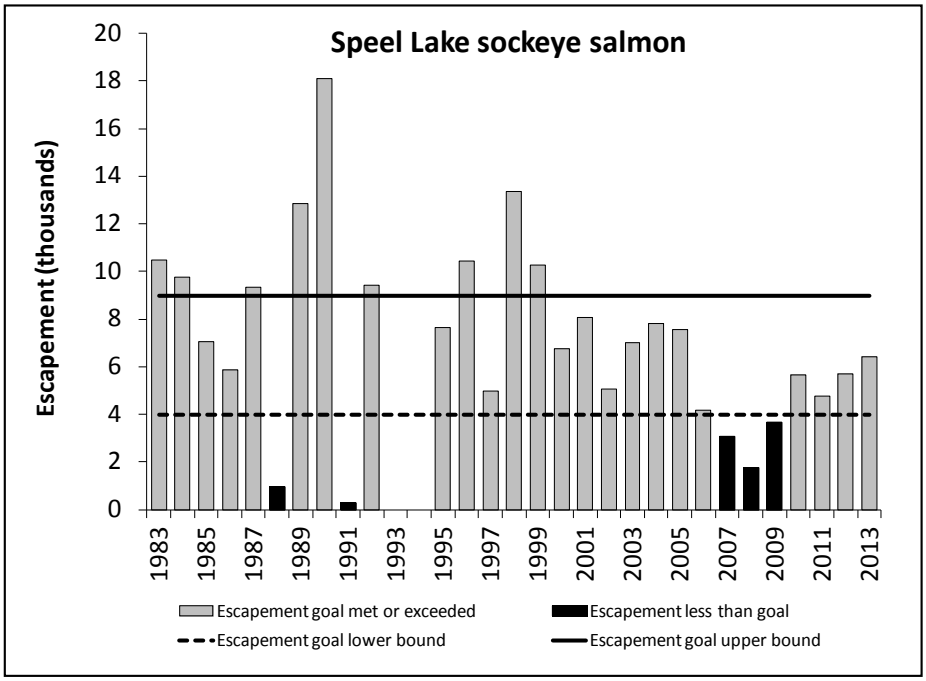


Appendix Figure B8.–Taku River sockeye salmon escapements (mark-recapture estimates), 1984–2013, and sustainable escapement goal range of 71,000–80,000 fish.

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 2 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 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. (2014) reviewed and updated Speel Lake sockeye salmon stock assessment information and updated the stock-recruit analysis. As a result, the department recommends (in this report) the goal be changed to a sustainable escapement goal of 4,000–9,000 fish, based on the range of escapements estimated to provide for 70–80% of maximum sustained yield. Estimated escapements were within the recommended escapement goal range in 4 of the past 5 years (Appendix Figure B9).

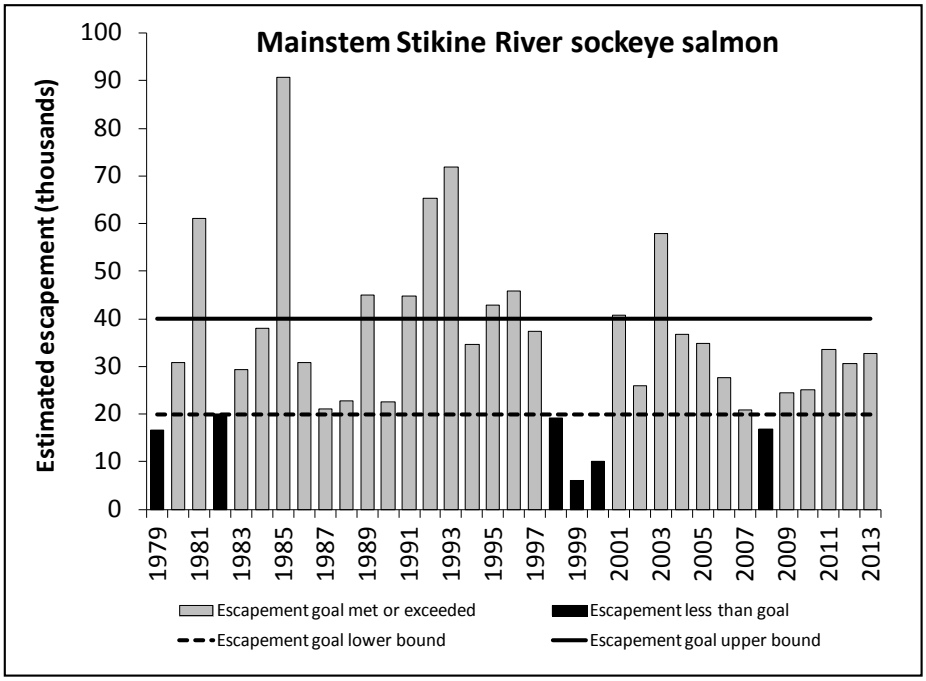


Appendix Figure B9.–Estimated Speel Lake sockeye salmon escapements (expanded weir counts), 1983–2013, and recommended sustainable escapement goal range of 4,000–9,000 fish. (Escapement estimates are from Heinl et al. 2014. The weir was not operated in 1993 or 1994.)

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 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). Escapements met or exceeded the escapement goal in 24 of 27 years since 1987, and escapements were within the escapement goal range in 5 of the past 5 years (Appendix Figure B10).

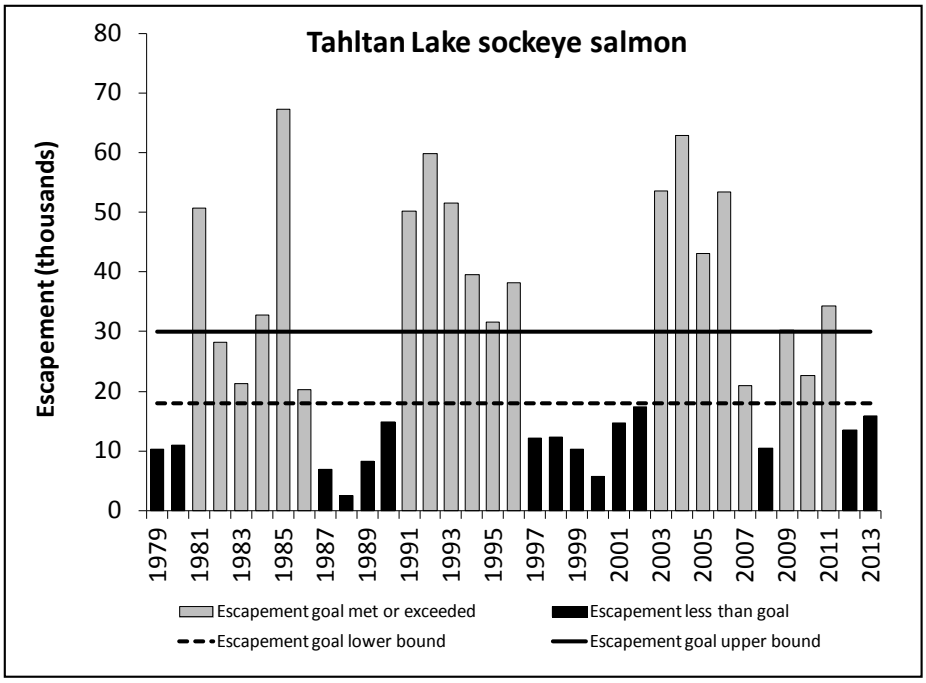


Appendix Figure B10.–Mainstem Stikine River sockeye salmon escapement (run-reconstruction estimates), 1979–2013, and sustainable escapement goal range of 20,000–40,000 fish.

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 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, and escapements were within or above the escapement goal range in 3 of the past 5 years (Appendix Figure B11).

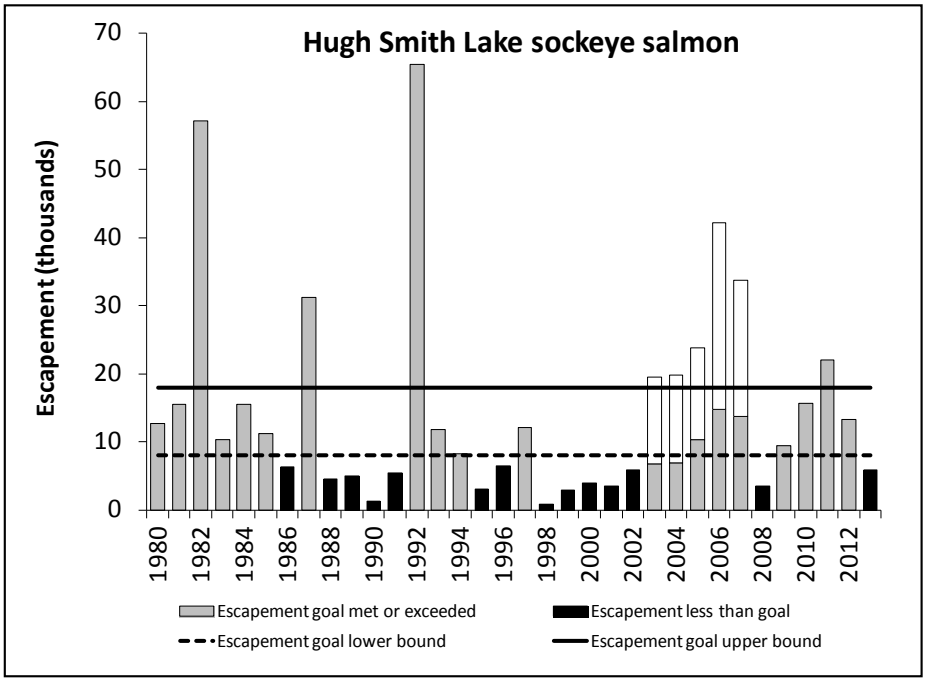


Appendix Figure B11.–Tahltan Lake sockeye salmon escapement (weir counts), 1979–2013, and biological escapement goal range of 18,000–30,000 fish.

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 of 15,000–35,000 sockeye salmon was established in the early 1990s, based on professional judgment. The current optimal escapement goal 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 B12), 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 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, and escapements were within or above the escapement goal range in 4 of the past 5 years (Appendix Figure B12).

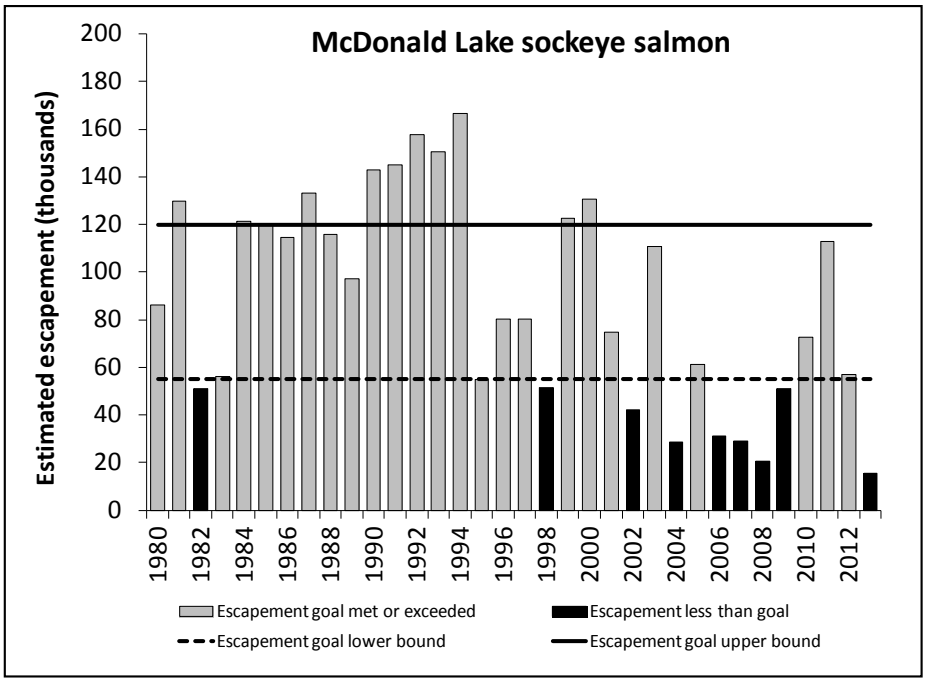


Appendix Figure B12.–Hugh Smith Lake sockeye salmon escapements (weir counts), 1980–2013, and optimal escapement goal range of 8,000–18,000 fish. The optimal escapement goal includes both wild and hatchery-stocked fish. Escapements from 2003 to 2007 are divided to show estimated wild and hatchery-stocked (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 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 of 55,000–120,000 fish in 2009, based on a stock-recruit analysis of recalibrated escapement estimates by Eggers et al. (2009a). The goal was considered a sustainable escapement goal due to uncertainty regarding the affects 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 B13). 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 3 consecutive years, 2010–2012, and the stock of concern designation was removed in 2012. Estimated escapements were within the escapement goal range in 3 of the past 5 years.



Appendix Figure B13.–McDonald Lake sockeye salmon escapements (expanded foot surveys), 1980–2013, and sustainable escapement goal range of 55,000–120,000 fish.

APPENDIX C.
COHO SALMON ESCAPEMENT GOAL PERFORMANCE

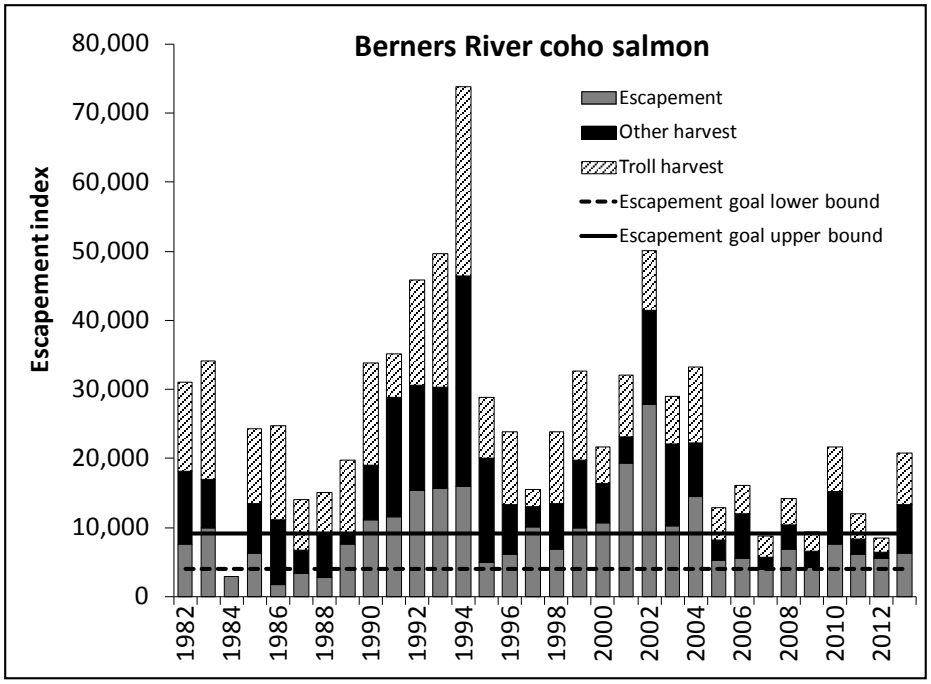
Appendix C1.–Berners and Chilkat rivers coho salmon.

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.

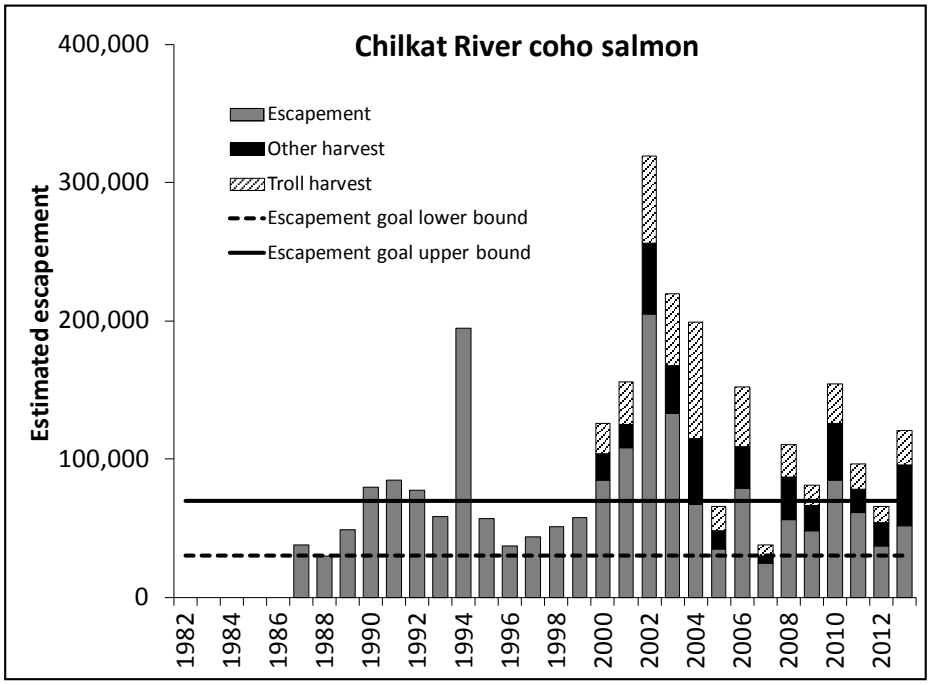
Escapement Goals and Stock Status: Preliminary results of an ongoing analysis of the existing biological escapement goal of 4,000–9,200 spawners for the Berners River (Clark et al. 1994) suggest that little if any adjustment is warranted. The biological escapement goal for the Chilkat River is 30,000–70,000 (Ericksen and Fleischman 2006). Escapements in both rivers were below their respective goals in 2007, but both stocks have been within or above the current goals in all other years since 1989 (Appendix Figures C1 and C2).

Total adult returns to the Berners and Chilkat rivers have been closely correlated ($R^2 = 0.88$) over the 14-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 cooling trend in the Northeast Pacific was likely an important agent in both declines. Berners River smolt production closely tracked total precipitation during July–November, as measured at the Juneau Airport for a decade and a half, before smolt abundance began consistently falling below predictions based on precipitation (Shaul et al. 2011). The cause of the change is unknown, but thought likely to have been caused by reduced over-winter survival of juveniles in off-channel rearing habitats, perhaps due to oxygen levels reaching critical levels during longer periods of ice cover with an increase in the ratio of snow to rain in precipitation falling in winter and early spring months.

The decrease in marine survival may also have been affected by climatic conditions in local marine waters during early ocean residence. However, there are also indications that increased mortality during later ocean residence, particularly in years of poor growth, has reduced over-all marine survival. During the most-recent 10-year period, marine survival was strongly positively correlated with the average size of both male and female 1-ocean spawners and with the ratio of females to males in the escapement. The best predictive models developed thus far to explain average spawner size explain 54% if inter-annual variation in average length of males, and 64% for females, with the Pacific Decadal Oscillation (an index of North Pacific climate) and pink salmon abundance (as measured by the commercial catch of fish rearing primarily in the Gulf of Alaska) both explaining about equal proportions of variation in average size. Females have averaged both smaller and fewer (relative to males) in poor growth years, resulting in substantially fewer (>30%) eggs-per-spawner, on average, in years of poor growth (usually odd years).



Appendix Figure C1.–Total estimated run size, catch, and escapement of coho salmon bound for the Berners River, 1982–2013, and biological escapement goal of 4,000–9,200 fish counted on a peak survey. (Harvest estimates are not available for 1984).

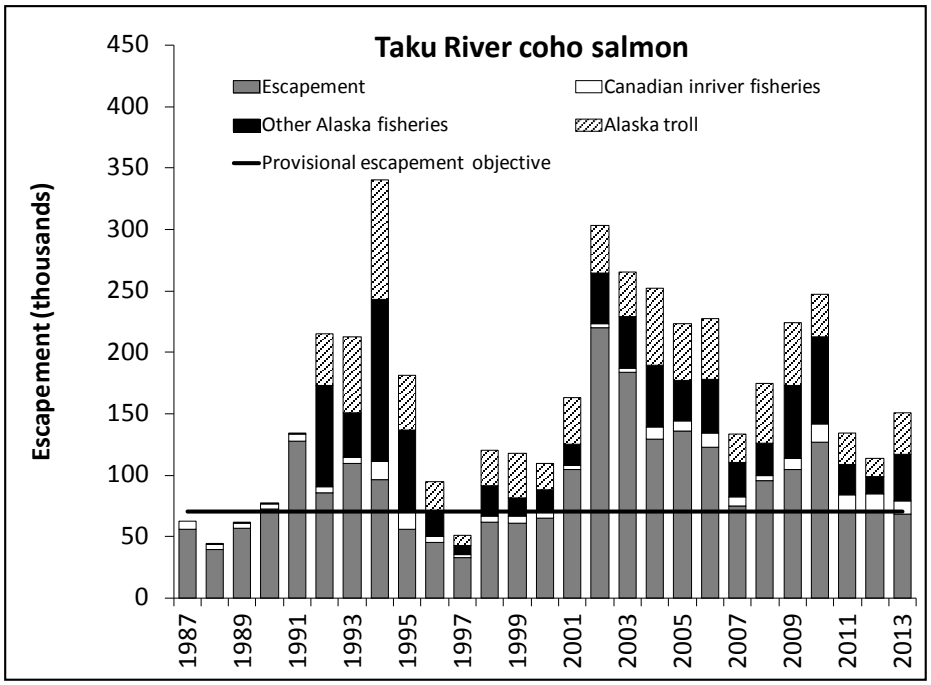


Appendix Figure C2.–Total estimated run size, catch, and escapement of coho salmon bound for the Berners and Chilkat rivers, 1982–2013, and biological escapement goal of 30,000–70,000 spawners. (Catch estimates are not available for 1987–1999.)

Appendix C2.–Taku River coho salmon.

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). 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. 1993).

Escapement Goals and Stock Status: A biological escapement goal has not yet been established for the Taku River. The 1999 Pacific Salmon Treaty specified that the U.S. would pass a minimum of 38,000 fish above the border, which effectively translates to an escapement of about 35,000 spawners after an expected Canadian inriver catch of about 3,000 fish. In 2013, the Transboundary River Panel of the Pacific Salmon Commission agreed to a provisional escapement target of 70,000 spawners, pending completion of a biological analysis (TTC 2014). Estimated escapements in the past 3 years, ranging from 68,100–70,700 in 2011–2013, have been close to the interim objective (Appendix Figure C3).

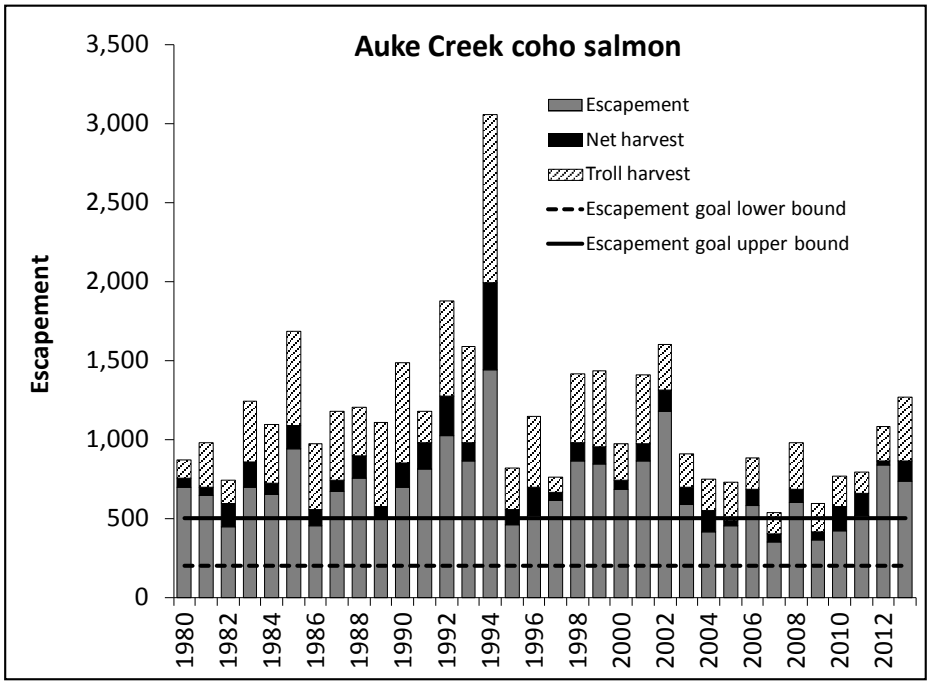


Appendix Figure C3.–Total estimated run size, catch, and escapement of coho salmon bound from the Taku River above Canyon Island, 1987–2013, and the current provisional escapement objective of 70,000 fish under the Pacific Salmon Treaty. (Marine catch estimates are not available 1987–1991.)

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 drift gillnet fishing areas, it is subjected to lower average all-fishery exploitation rates (long-term average 39%) 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%) tagging rate on smolts and precise total accounting of returning adults, the Auke Creek stock is an important indicator of the troll exploitation rate on northern inside stocks that is used in estimation of regional wild coho salmon abundance.

Escapement Goals and Stock Status: A biological escapement goal of 200–500 fish was established in 1994 (Clark et al. 1994). Smolt production underwent a protracted decline over the course of 2 decades from an average of 8,000 smolts during 1979–1984 to a lowest 5-year average of 4,100 smolts during 2002–2006, prior to a sharp rebound to an average of 7,500 smolts since 2010. Although the trend in smolt production is thought to be related to changes in rearing habitat, specific reasons for the decline and recent rebound are poorly understood. Auke Creek produces smolts that are large, on average, and tend to survive well at sea with a high proportion of males returning as age-.0 jacks. Average marine survival decreased from 23% during 1990–2004 to 17% during 2005–2013, similar to the pattern exhibited by other northern inside stocks. Escapements have consistently remained within or above the upper half of the escapement goal range (Appendix Figure C4), even throughout a recent period of both lower smolt production and survival and lower total returns that averaged only 753 adults 2004–2011. Exploitation rates have been moderate over the past decade (2004–2013) at an average of 37% (range: 17–33%), of which the majority (26%) was harvested by the troll fishery, with exploitation rates by other fisheries averaging 1% purse seine, 8% drift gillnet, and 2% marine sport.

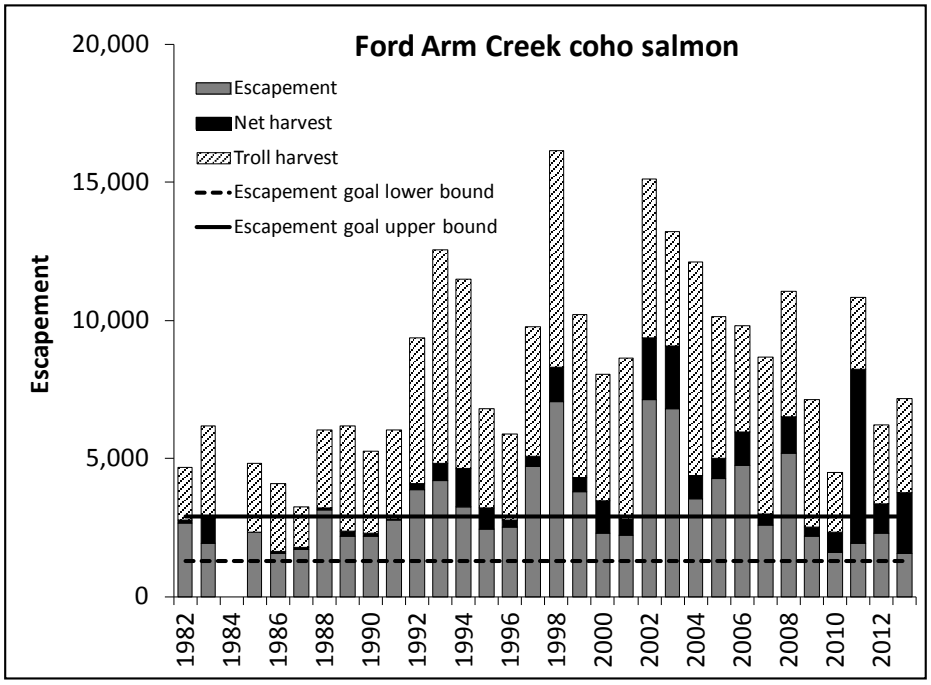


Appendix Figure C4.–Total estimated run size, catch, and escapement (weir counts) of coho salmon returning to Auke Creek, 1980–2013, and biological escapement goal of 200–500 spawners.

Appendix C4.–Ford Arm Creek coho salmon.

Ford Arm Creek, located on western Chichagof Island, is currently the only outer coastal coho salmon indicator stock in the region. 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 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 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). Although marine survival has shown a level long-term trend, 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 1982–1991 to 1992–2009 (Shaul et al. 2014). While total nutrient inputs from spawning salmon have remained high in recent years, average coho salmon returns have declined since the mid-2000s to an intermediate level, possibly reflecting effects of a recent cooling trend in the North Pacific climate cycle. Age 1-ocean Ford Arm Creek spawners have exhibited a dramatic long-term decrease in average size between 1982–1986 and 2011–2013 (43% decrease in weight for males, 29% for females) that was likely caused by a decline in their principal high seas prey, gonatid squids. The decline in size of females has likely had a substantial effect on the per capital reproductive potential of the spawning escapement. Coincidentally, during 2011–2013, the stock exhibited uncharacteristic migratory behavior in which a large number of fish left the ocean earlier than in previous years and migrated into local inlets where a substantial fraction were harvested incidentally by a purse seine fishery targeting pink salmon. The estimated purse seine exploitation rate averaged 34% during 2011–2013, compared with only 4% during 1982–2010. Although the troll fishery harvested an average of 39% of the total run in 2011–2013 (down from 53%) and the marine sport fishery accounted for 2% (down from 4%), overall exploitation rates during 2011–2013 were still relatively high (average 75%; range: 63–82%). However, the biological escapement goal continued to be met (Appendix Figure C5).

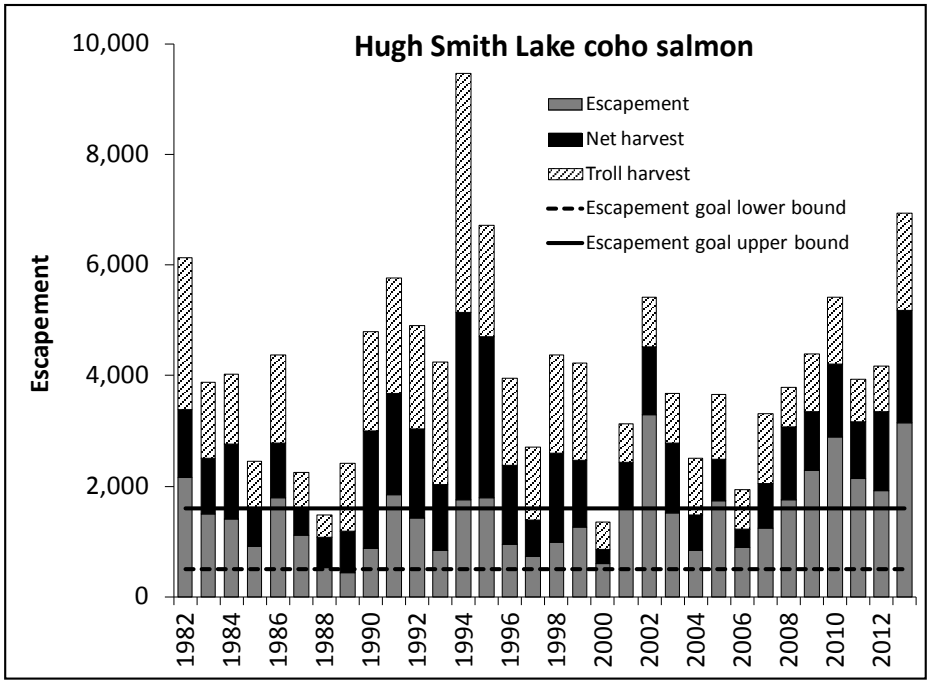


Appendix Figure C5.–Total estimated run size, catch, and escapement (weir counts) of coho salmon returning to Ford Arm Creek, 1982–2013, and biological escapement goal of 1,300–2,900 spawners.

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 counted at a weir across the short lake outlet and spawn in 2 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 31,800 smolts. Marine survival has been more variable, ranging from 4–21% around a long-term average of 13%. Marine survival and adult abundance were strongly correlated with the Berners River (located 490 km to the north) from the early-1980s until the mid-2000s. However, in contrast with the Berners River, where both smolt production and marine survival have both declined since the mid-2000s, the 2008–2013 average survival rate of 15.4% for the Hugh Smith Lake stock was higher than the 1983–2007 average (12.3%). A geographic shift in marine survival in favor of southern areas of the region is also evident in hatchery stocks (Shaul et al. 2011).

Escapement Goals and Stock Status: A biological escapement goal was first established at 500–1,100 spawners in 1994 (Clark et al. 1994) and expanded to 500–1,600 spawners in 2009 (Shaul et al. 2009). 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 the most recent 6-year period (2008–2013), with the estimated 2013 return (6,936 adults) being the second largest on record. Despite liberal fishing opportunity in most of those years, including reduced or eliminated mid-season troll fishery closures, extended Tree Point drift gillnet fishery openings, and 10-day troll season extensions, the all-fishery exploitation rate during 2008–2013 averaged only 50% (range: 45–54%) compared with an average of 75% (range: 68–82%) in the 1990s. The stock recently appears to have been making landfall farther south during the recent cooling trend in the North Pacific climate cycle compared with the warmer period in late-1980s and 1990s, resulting in reduced exposure to intensive fisheries to the north. The combined result of strong returns and moderate exploitation rates has been escapements that consistently exceeded even the recently expanded escapement goal range during the past 6 years (Appendix Figure C6).

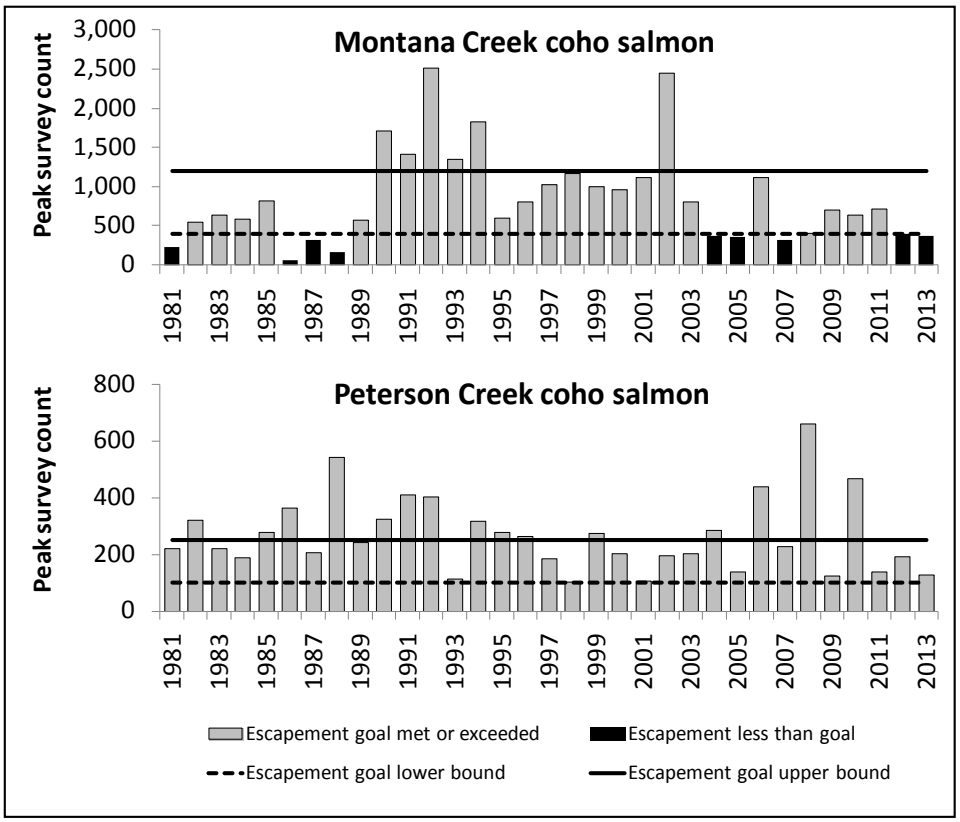


Appendix Figure C6.–Total estimated run size, catch, and escapement (weir counts) of coho salmon returning to Hugh Smith Lake, 1982–2013, and biological escapement goal of 500–1,600 spawners.

Appendix C6.–Montana and Peterson creeks coho salmon.

Escapement goals have been established based on peak survey counts for 2 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 1980–2013 averaged 39% (range: 20–55%).

Escapement Goals and Stock Status: Escapement goals were initially established as biological escapement goals 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 goals of 400–1,200 spawners for Montana Creek and 100–250 spawners for Petersen Creek (Clark 2005). The Peterson Creek escapement goal has been met or exceeded annually since surveys were initiated in 1981. The Montana Creek escapement goal was not met in 9 years out of 33, including the 2 most recent years—394 spawners in 2012 and 357 spawners in 2013 (Appendix Figure C7). Escapements to Montana Creek during 1982–2013 closely tracked escapements in the Berners River ($R^2 = 0.60$) where returns and escapements have declined substantially since the mid-2000s, due in about equal part to lower smolt production and marine survival during a recent cooling trend in the North Pacific climate cycle. Recent peak counts for Peterson Creek have been more variable, with historically high counts above the goal in 2008 and 2010 mixed with lower counts of 123–138 spawners near the lower bound of the escapement goal in 2009, 2011, and 2013 (Appendix Figure C7).

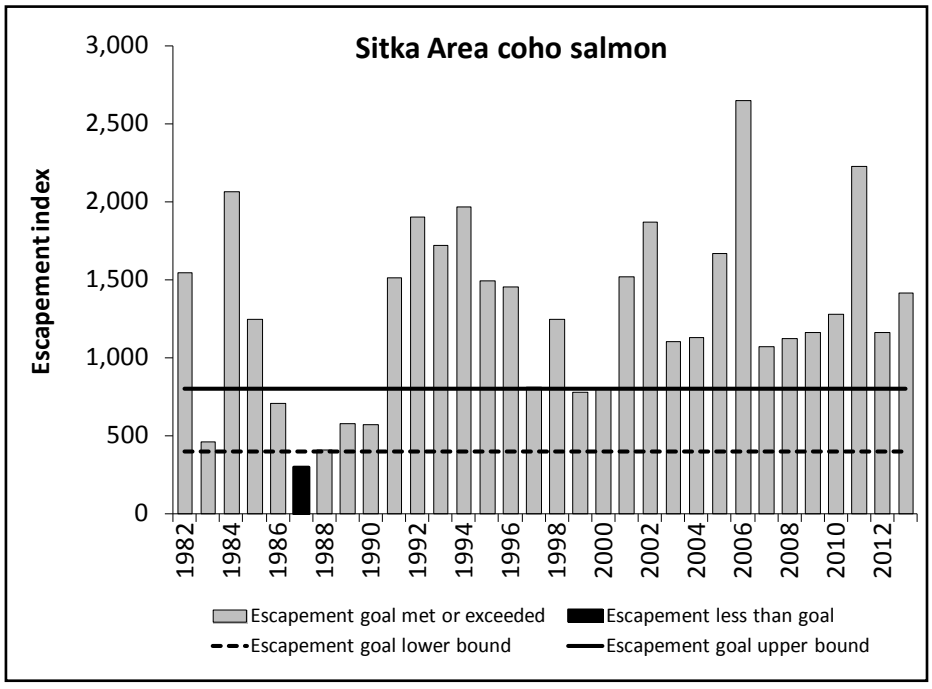


Appendix Figure C7.–Peak coho salmon escapement survey counts and sustainable escapement goals for 2 Juneau roadside streams, Montana Creek and Peterson Creek, 1981–2013.

Appendix C7.–Sitka Area coho salmon survey index.

Five small streams within and north of Sitka Sound, that comprise 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 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 (Appendix Figure C8).

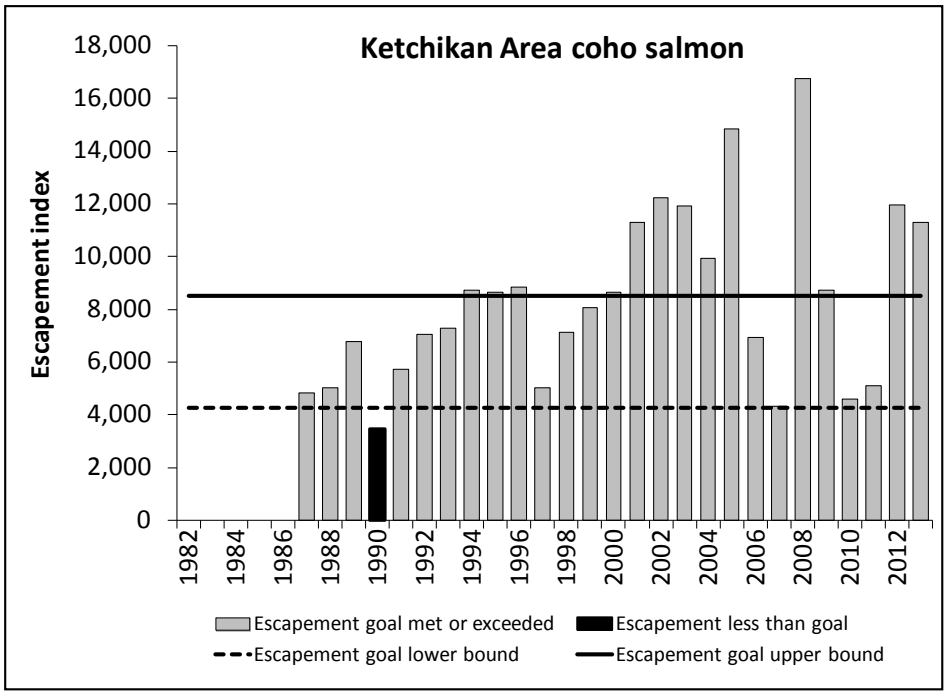


Appendix Figure C8.–Aggregate peak coho salmon escapement survey counts and biological escapement goal for five index streams in the Sitka area, 1982–2013.

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 2 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 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, escapements counts exceeded the lower bound of the escapement goal in every year but one (in 1990), were within the escapement goal range 13 times, and exceeded the escapement goal range 13 times (Appendix Figure C9).

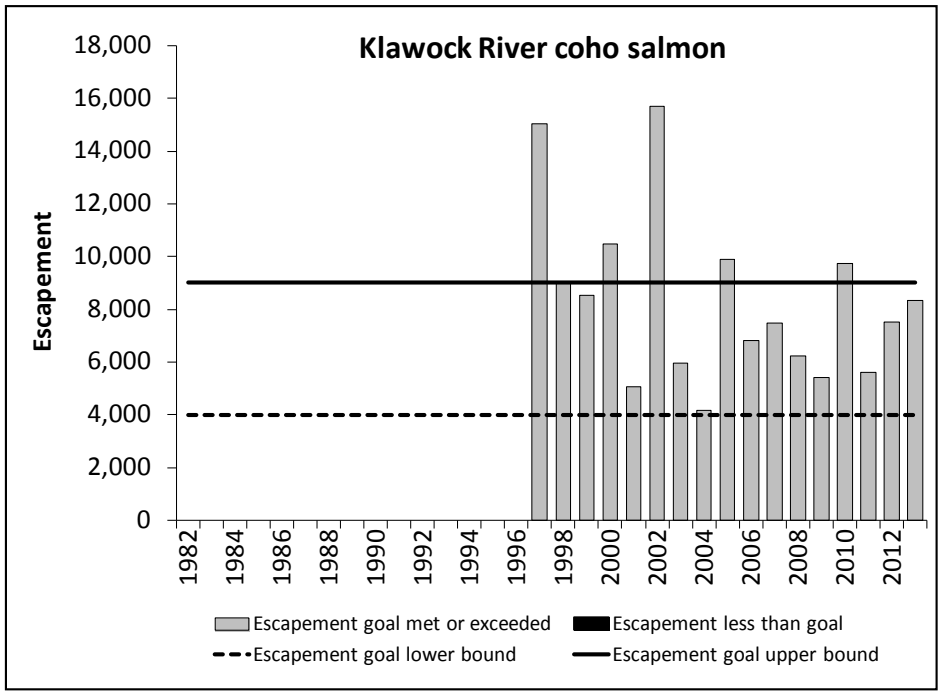


Appendix Figure C9.–Aggregate peak coho salmon escapement survey counts and biological escapement goal for 14 index streams in the Ketchikan area, 1987–2013.

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 Prince of Wales Hatchery Association operates a hatchery (Klawock River Hatchery) and weir on the Klawock River, approximately 300 m below Klawock Lake. 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 Prince of Wales Hatchery management plan[2] currently 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 C10).



Appendix Figure C10.–Klawock River coho salmon escapement (weir counts), 1997–2013, and sustainable escapement goal range of 4,000–9,000 fish.

[2] 2014 Klawock River Hatchery Annual Management Plan, unpublished document http://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesPlanning.annual (Accessed 10/27/2014).

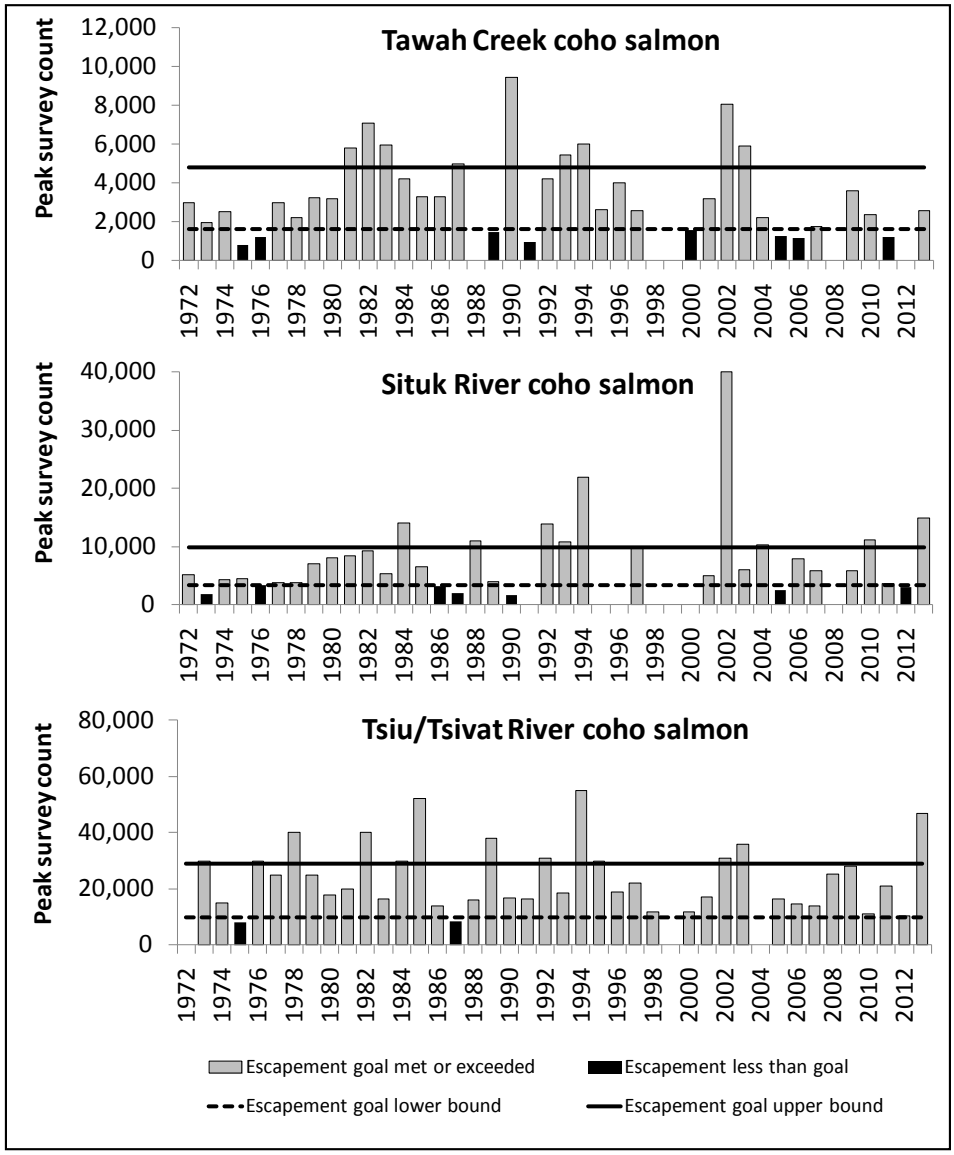
Appendix C10.–Yakutat Area coho salmon.

Yakutat stocks are harvested primarily in set gillnet and sport fisheries that target runs to discrete systems, but trollers fishing on mixed stocks off the coast account for some of the catch. 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 3 systems: the Lost, Situk, and Tsiu/Tsivat rivers.

Escapement Goals and Stock Status: Biological escapement goals 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 River. 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 (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. Based on estimates of average smolt production from the Lost River, Shaul et al. (2010) suggested that the current escapement goal for the Lost River is conservatively high if intrinsic productivity of the stock is similar to other coho indicator stocks. However, they did not recommend that the goal be changed based on that observation, because of inconsistency in the estimated survey expansions.

In the most recent review of the Lost River goal (in this report) it was determined that a return to a target range would be useful for management of the freshwater sport fishery. Also, a review of historical counts indicated that locations included in the index had not been consistent over time. Therefore, the historical index was reconstructed based only on peak counts obtained from Tawah Creek, a primary tributary where the majority of historical survey counts were conducted and the area most conducive to providing comparable survey counts (Appendix Table C1). The department recommends changing the goal to a sustainable escapement goal range of 1,400–4,200 fish counted on a peak survey of Tawah Creek, based on the 15^{th}–75^{th} percentiles of historical counts, and changing the name of the goal to Tawah Creek (Lost River).

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 C11). The North Pacific climate cycle has likely been influential in returns and escapements to Yakutat. Peak counts have averaged lower (by a range of 18–53%) for the 3 systems during 2005–2013, compared with the period encompassing the warm phase of the Pacific Decadal Oscillation (1977–1998), but still averaged 0–81% higher than average counts during the prior cold regime (1972–1976).



Appendix Figure C11.–Peak coho salmon escapement survey counts in the Yakutat area, compared to escapement goals, 1972–2013. (Horizontal lines indicate escapement goal ranges. Blank columns in time series indicate that peak survey counts were not available.)

Appendix Table C1.–Peak coho salmon escapement survey counts for Tawah Creek (Lost River), 1972–2013.

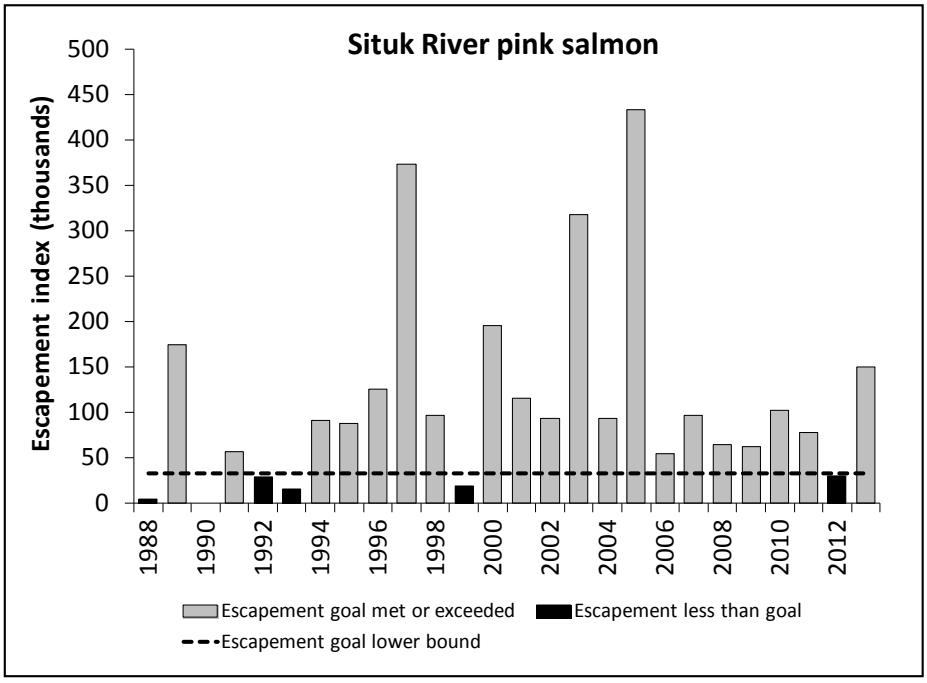
Year	Peak count	Year	Peak count	Year	Peak count
1972	3,000	1986	3,300	2000	1,572
1973	1,978	1987	5,000	2001	3,190
1974	2,500	1988	1,600	2002	8,093
1975	800	1989	1,490	2003	5,907
1976	1,200	1990	9,460	2004	2,214
1977	3,000	1991	975	2005	1,241
1978	2,200	1992	4,235	2006	1,156
1979	3,250	1993	5,436	2007	1,751
1980	3,200	1994	6,000	2008	ND
1981	5,793	1995	2,642	2009	3,581
1982	7,100	1996	4,030	2010	2,393
1983	5,950	1997	2,550	2011	1,221
1984	4,200	1998	ND	2012	ND
1985	3,300	1999	ND	2013	2,593
				Minimum:	800
				Maximum:	9,460
				Contrast:	12
				15^{th} percentile:	1,378
				75^{th} percentile:	4,226

APPENDIX D.
PINK SALMON ESCAPEMENT GOAL PERFORMANCE

Appendix D1.–Situk River pink salmon.

Yakutat area pink salmon stocks are spatially segregated from the rest of Southeast Alaska and are harvested primarily in terminal, inriver set gillnet fisheries. 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). From 2004 to 2013, the Situk River harvest accounted for an average 79% of the Yakutat area pink salmon harvest. The Situk River supports a fishery that primarily targets Chinook, sockeye, and coho salmon (Clark 1995a). In recent years, there has been little economic incentive to harvest pink salmon and they have been harvested incidentally to sockeye and coho salmon (Woods 2007). Escapements in the Situk River have been assessed through aerial and boat surveys, and with a weir. Weir counts were available for the Situk River for 14 years between 1971 and 1990, and annually since 1991. Since 1991, however, the weir has been removed in early August—well before the peak of the pink salmon run (Piston and Heinl 2011a).

Escapement Goals and Stock Status: In 1995, ADF&G established biological escapement goals 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). Escapement estimates of Situk River pink salmon based on weir or survey counts since 1991, however, greatly underestimate total escapement. In 2012, the escapement goal was changed to a lower-bound sustainable escapement goal of 33,000 pink salmon, a weir-based index of the pink salmon run based on the 15th percentile of cumulative weir counts through 5 August (Piston and Heinl 2011a). Harvests of Situk River pink salmon increased over past 2 decades, from an average of 12,000 through 1990, to 34,000 in the 1990s and 59,000 since 2001 (Piston and Heinl 2014b). Survey counts of more than 500,000 pink salmon in the Situk River in 2005, 2007, and 2010 also suggest pink salmon returns have been at their highest levels since statehood and that harvest rates have been very low (Piston and Heinl 2014b). Situk River pink salmon escapements exceeded the lower-bound sustainable escapement goal of 33,000 fish in 4 of the past 5 years (Appendix Figure D1).



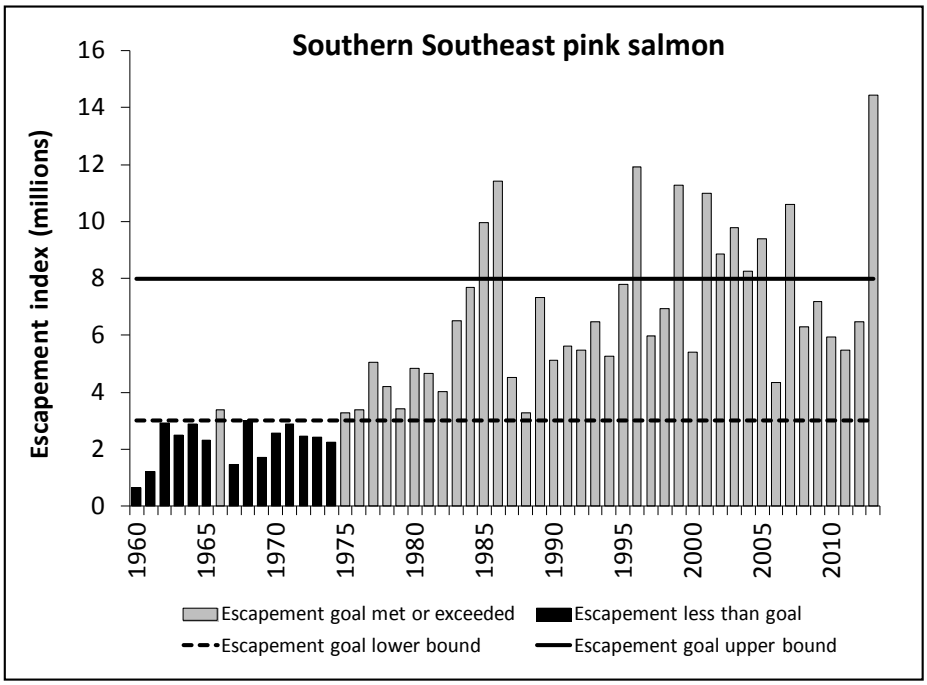
Appendix Figure D1.–Situk River pink salmon weir-based escapement index, 1988–2013, and lower-bound sustainable escapement goal of 33,000 fish counted through the weir by 5 August.

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 for pink salmon in the Southern Southeast Subregion is 3.0–8.0 million index spawners.

The harvest of pink salmon in the Southern Southeast Subregion averaged 22 million fish per year over the past decade, 2004–2013, which was down from an average harvest of 31 million in the 1990s (Piston and Heinl 2014b). The harvest of 53 million fish in 2013 was just under the all-time record of 54 million set in 1996. The biological escapement goal of 3.0–8.0 million index spawners was met annually since 1974 in the Southern Southeast Subregion and the escapement index of 14.4 million in 2013 was the highest since statehood (1960–2013; Appendix Figure D2).



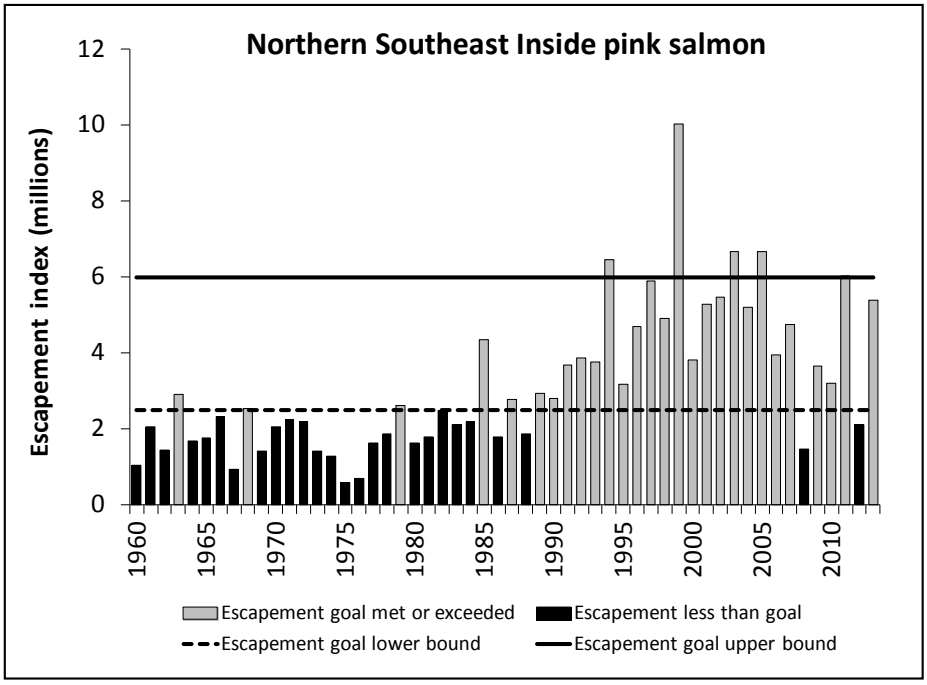
Appendix Figure D2.–Southern Southeast Subregion pink salmon escapement index, 1960–2013, and biological escapement goal range of 3.0–8.0 million index fish.

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 for pink salmon in the Northern Southeast Inside Subregion is 2.5–6.0 million index spawners.

The harvest of pink salmon in the Northern Southeast Inside Subregion averaged 15 million fish per year over the past decade, 2004–2013, which was below the average harvest of 17 million in the 1990s (Piston and Heinl 2014b). The biological escapement goal of 2.5–6.0 million index spawners was met annually since 1988, with the notable exception of 2008 and 2012 (Appendix Figure D3). Pink salmon returns to the Northern Southeast Inside Subregion have developed an extreme odd-even cycle since 2008, with some very high odd-year harvests, including the all time record harvest of 41 million in 2011, and very low even-year harvests (Piston and Heinl 2014b).



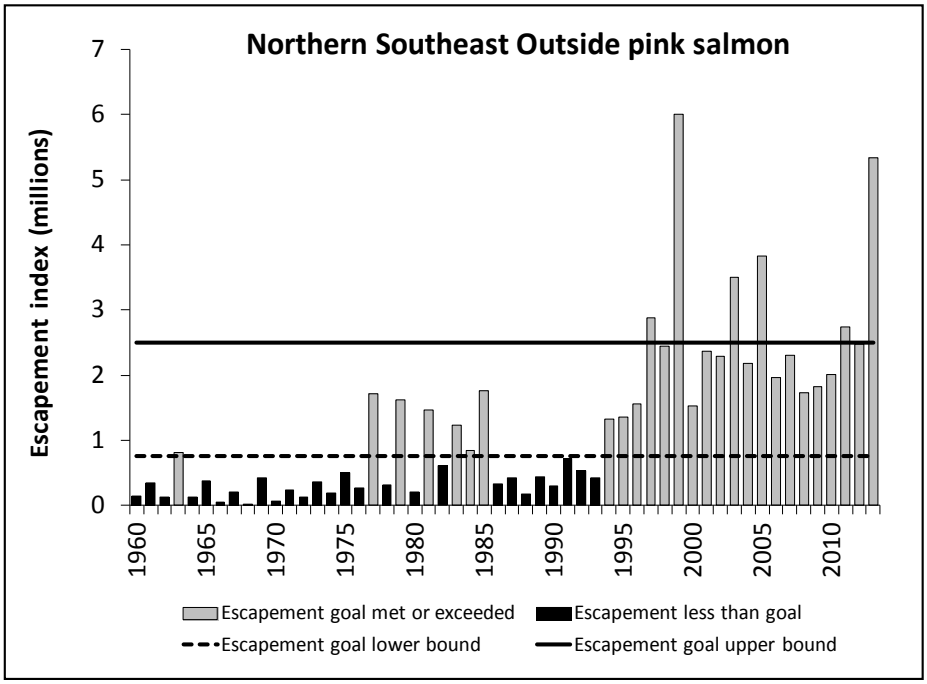
Appendix Figure D3.–Northern Southeast Inside Subregion pink salmon escapement index, 1960–2013, and biological escapement goal range of 2.5–6.0 million index fish.

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 for pink salmon in the Northern Southeast Outside Subregion is 0.75–2.5 million index spawners.

The harvest of pink salmon in the Northern Southeast Outside Subregion averaged 4.1 million fish per year over the past decade, 2004–2013, which more than doubled the average harvest of 2.0 million in the 1990s (Piston and Heinl 2014b). Record harvests of 7.1 and 11.2 million fish occurred in 2011 and 2013, respectively. The biological escapement goal of 0.75–2.5 million index spawners has been met or exceeded annually since 1994 (Appendix Figure D4). The escapement index averaged 2.6 million over the past 10 years (2004–2013)—an increase of 37% over the 1990s.



Appendix Figure D4.–Northern Southeast Outside Subregion pink salmon escapement index, 1960–2013, and biological escapement goal range of 0.75–2.5 million index fish.

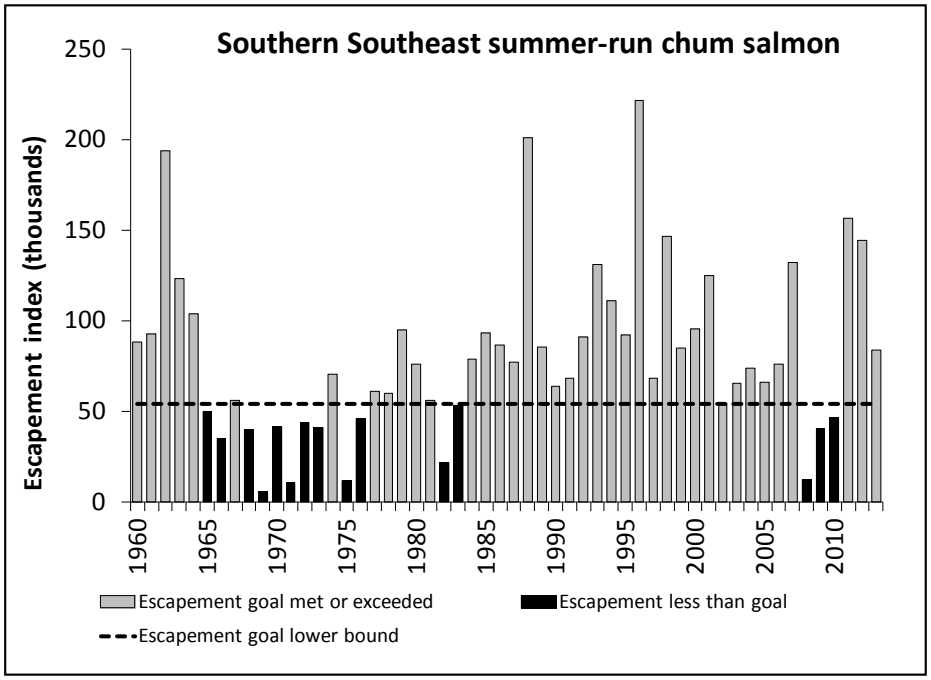
APPENDIX E.
CHUM SALMON ESCAPEMENT GOAL PERFORMANCE

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

The Southern Southeast Subregion includes 13 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 a simple percentile approach. The goal of 54,000 chum salmon counted on peak surveys to the aggregate set of index streams was based on the 25th percentile of historic escapement data (Piston and Heinl 2011b). The goal is a lower-bound sustainable escapement goal, rather than a range, because summer 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 2 decades, with the exception of poor escapement years from 2008 to 2010 (Appendix Figure E1). Escapement indices were well above the current escapement goal from 2011 to 2013, and the 2011 index of 157,000 was the fourth highest in the time series.

Two additional index streams were recently added to the Southern Southeast Subregion, which will improve geographic coverage of chum salmon escapements for this stock group (Piston and Heinl 2014a). As a result of this change, the aggregate index series and escapement goal were recalculated, and the department recommends (in this report) increasing the lower-bound sustainable escapement goal to 62,000 index spawners. Future escapement indices will be based on the aggregate peak aerial and foot survey counts to the 15 index streams in this stock group.

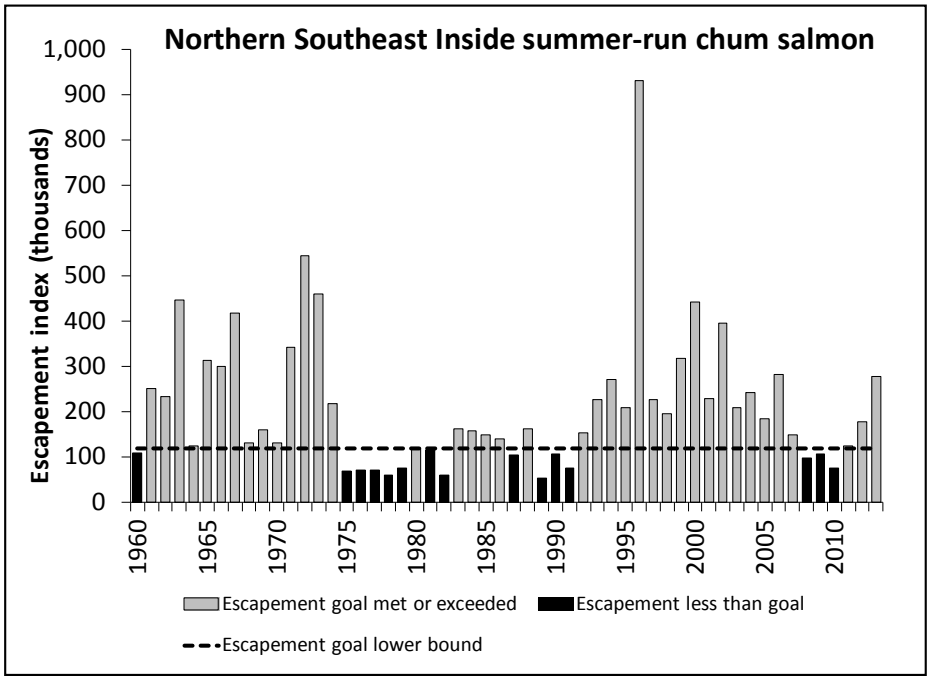


Appendix Figure E1.–Southern Southeast Subregion summer-run chum salmon escapement index (peak aerial and foot surveys), 1960–2013, and lower-bound sustainable escapement goal of 54,000 fish.

Appendix E2.–Northern Southeast Inside Subregion summer-run chum salmon.

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 a simple 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 historic escapement data (Piston and Heinl 2011b). The goal is a lower-bound sustainable escapement goal, rather than a range, because summer 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 increased over the past 3 years (Appendix Figure E2). Escapement indices were above the current escapement goal in 3 of the past 5 years, 2011–2013.



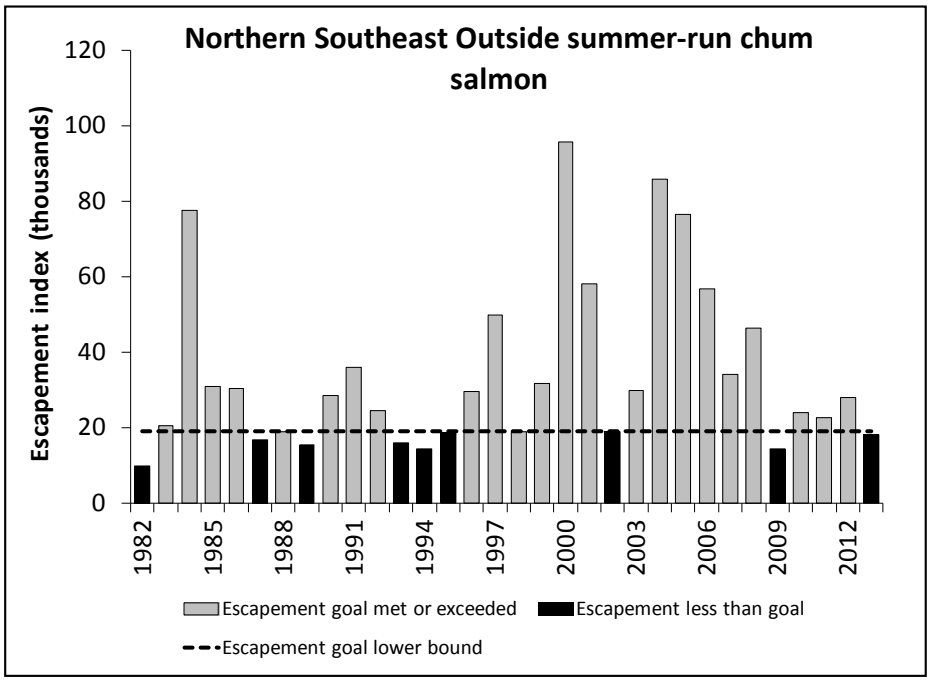
Appendix Figure E2.–Northern Southeast Inside Subregion summer-run chum salmon escapement index (peak aerial and foot surveys), 1960–2013, and lower-bound sustainable escapement goal of 119,000 fish.

Appendix E3.–Northern Southeast Outside Subregion summer-run chum salmon.

The Northern Southeast Outside Subregion includes five 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 a simple percentile approach. The goal of 19,000 chum salmon counted on peak surveys to the aggregate set of index streams was based on the 25th percentile of historic escapement data (Eggers and Heinl 2008). The goal is a lower-bound sustainable escapement goal, rather than a range, because summer chum salmon are harvested in mixed stock commercial fisheries and their escapements cannot be effectively managed to fall within a range. Escapement indices were slightly below the current goal in 2009 and 2013, but have been above goal in 8 of the past 10 years (Appendix Figure E3).

Four additional index streams were recently added to the Northern Southeast Outside Subregion, which will improve geographic coverage of chum salmon escapements for this stock group (Piston and Heinl 2014a). As a result of this change, the aggregate index series and escapement goal were recalculated, and the department recommends (in this report) increasing the lower-bound sustainable escapement goal to 25,000 index spawners. Future escapement indices will be based on the aggregate peak aerial and foot survey counts to the 9 index streams in this stock group.

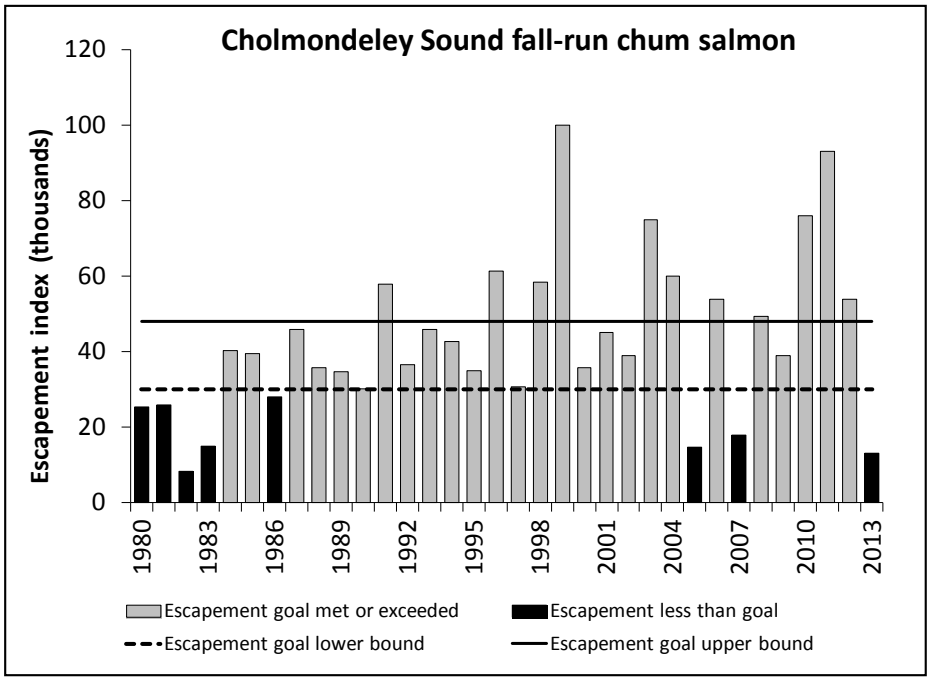


Appendix Figure E3.–Northern Southeast Outside Subregion summer-run chum salmon escapement index (peak aerial and foot surveys), 1982–2013, and lower-bound sustainable escapement goal of 19,000 fish.

Appendix E4.–Cholmondeley Sound fall-run chum salmon.

Disappearance and Lagoon creeks are the 2 most productive fall chum salmon systems in Cholmondeley Sound, west of Ketchikan, on Prince of Wales Island. Cholmondeley Sound fall-run chum salmon support a terminal commercial purse seine fishery that has 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).

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal of 30,000–48,000 chum salmon counted on peak aerial surveys to Disappearance and Lagoon creeks combined (Eggers and Heinl 2008). The goal range was derived using a simple percentile approach, based on the 25th and 75th percentiles of historic escapement data. Escapement indices were within or above the escapement goal range in 4 of the past 5 years (Appendix Figure E4).

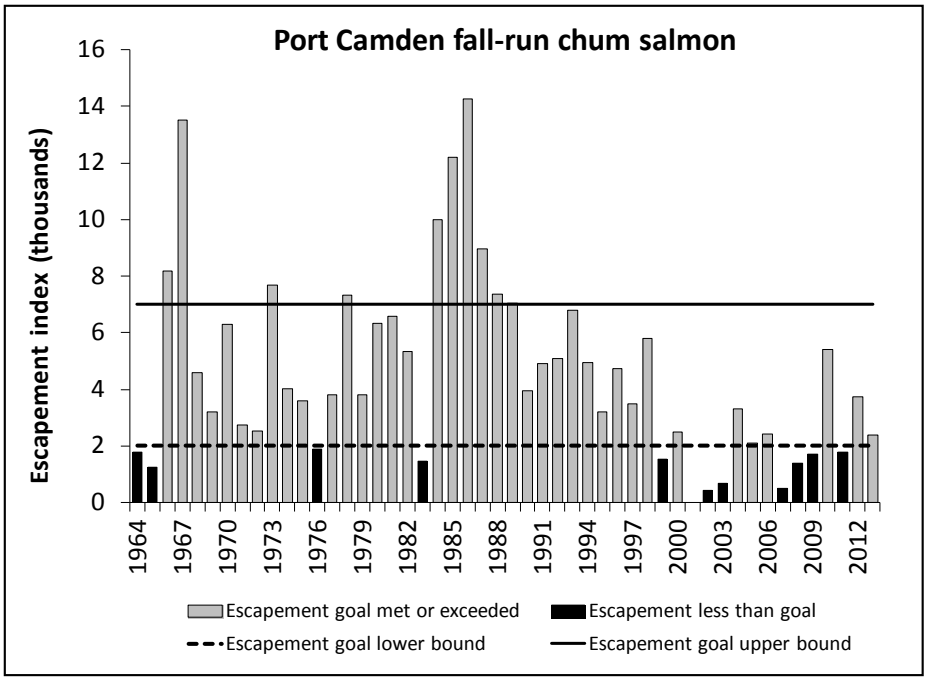


Appendix Figure E4.–Cholmondeley Sound fall-run chum salmon escapement index (peak aerial surveys), 1980–2013, and sustainable escapement goal range of 30,000–48,000 fish.

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 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 at each of the 2 primary fall-run chum salmon streams in Port Camden: Port Camden South Head Creek and Port Camden West Head Creek. Both are relatively short streams in terms of spawning habitat; 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 of 2,000–7,000 chum salmon counted on peak aerial surveys to Port Camden South Head Creek and Port Camden West Head Creek (Eggers and Heinl 2008). The goal range was derived using a simple percentile approach and a risk analysis approach. The goal was calculated based on the 25th and 75th percentiles of historic escapement data and then the lower bound of the goal was reduced based on the risk analysis approach (Eggers and Heinl 2008). Escapement indices were within the escapement goal range in 3 of the past 5 years (Appendix Figure E5).

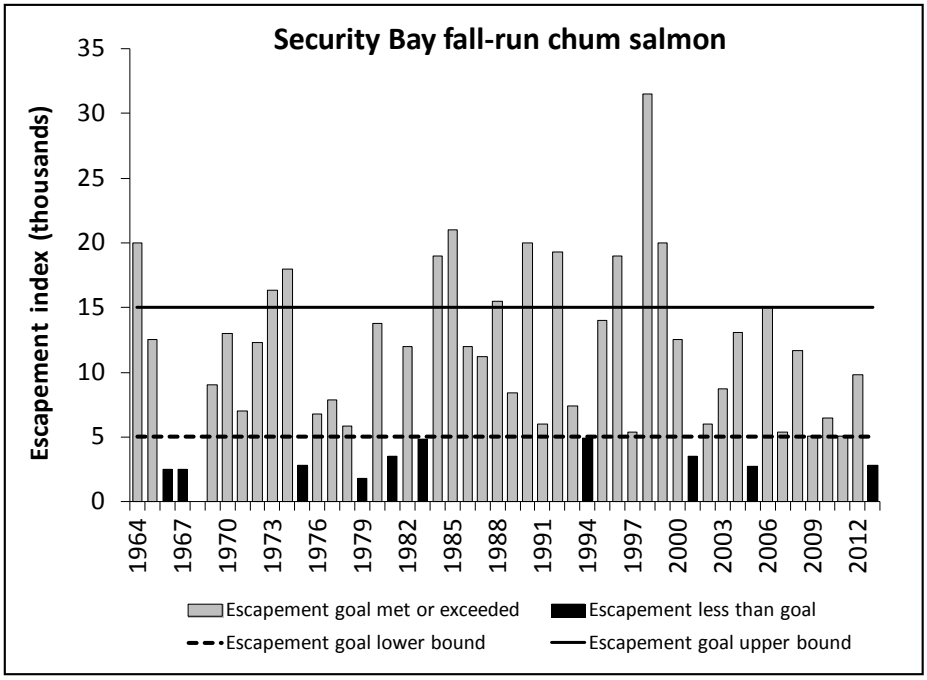


Appendix Figure E5.–Port Camden fall-run chum salmon escapement index (peak aerial surveys), 1964–2013, and sustainable escapement goal range of 2,000–7,000 fish.

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 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 (Eggers and Heinl 2008).

Escapement Goals and Stock Status: In 2009, ADF&G established a sustainable escapement goal 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 derived using a simple percentile approach, based on the 25th and 75th percentiles of historic escapement data. Escapement indices were within the escapement goal range in 4 of the past 5 years (Appendix Figure E6).

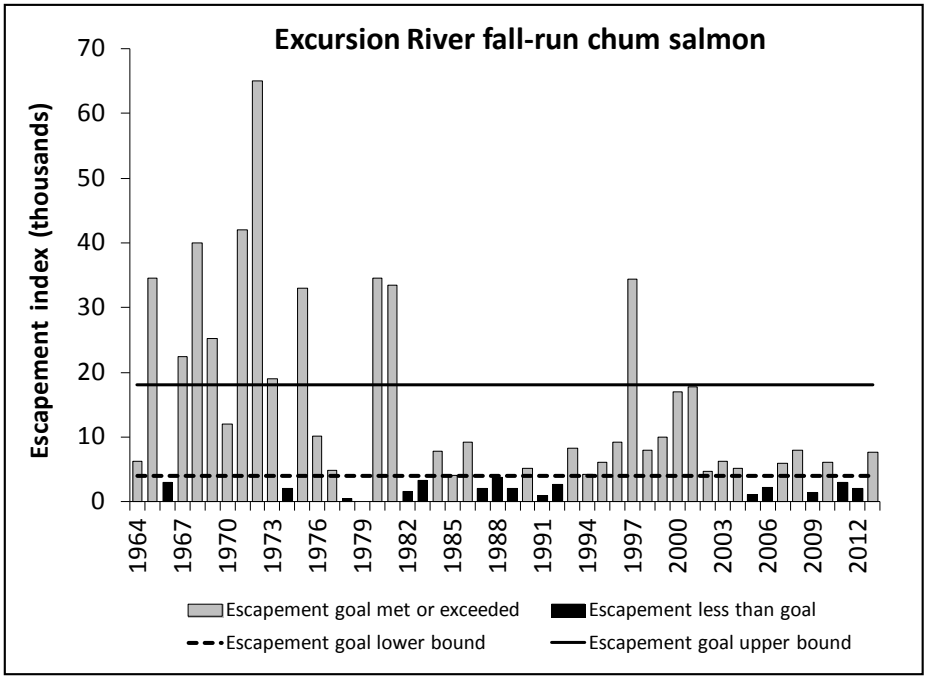


Appendix Figure E6.–Security Bay fall-run chum salmon escapement index (peak aerial surveys), 1964–2013, and sustainable escapement goal range of 5,000–15,000 fish.

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

Excursion Inlet fall-run chum salmon have been harvested in a terminal commercial purse seine fishery 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 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 derived using a simple percentile approach, based on the 25th and 75th percentiles of historic escapement data. Escapement indices were within the escapement goal range in 2 of the past 5 years (Appendix Figure E7).

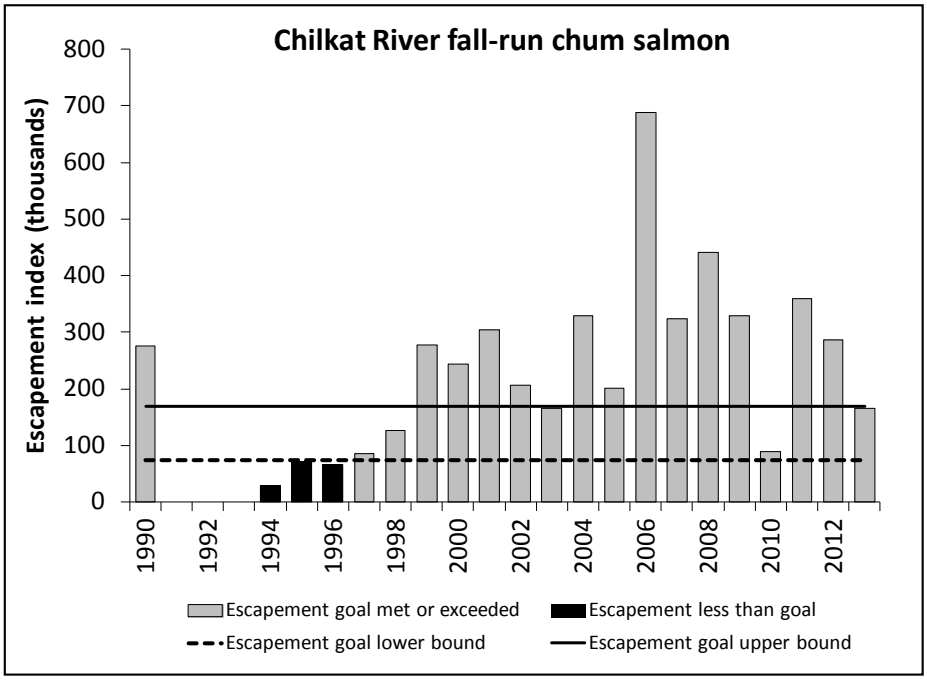


Appendix Figure E7.–Excursion River fall-run chum salmon escapement index (peak aerial surveys), 1964–2013, and sustainable escapement goal range of 4,000–18,000 fish.

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 its major tributary, the Klehini River. Chilkat River fall-run chum salmon are primarily harvested in the 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 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). The goal was considered a *sustainable* escapement goal rather than a biological escapement goal because only 9 brood years were available for analysis. It was also noted that contrast in the stock-recruit data would increase once returns from recent, large escapements were manifested. Estimated escapements were within or above the current escapement goal range annually since 1997 (Appendix Figure E8). Piston and Heinl (2014a) reviewed and updated Chilkat River fall chum salmon stock assessment information and updated the stock-recruit analysis. As a result, the department recommends (in this report) changing the sustainable escapement goal to a range of 75,000–250,000; a range of escapements estimated to provide 70–100% probability of achieving 70% of maximum sustained yield. The goal is considered a sustainable escapement goal due to uncertainty in escapement estimates (Piston and Heinl 2014a). The recommended escapement goal range converts to an equivalent fish wheel index catch of 1,160–3,875 chum salmon (Piston and Heinl 2014a).



Appendix Figure E8.–Chilkat River fall-run chum salmon escapements (expanded fish wheel counts), 1990–2013, and sustainable escapement goal range of 75,000–170,000 fish. (Escapement estimates are not available for 1991–1993.)