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Chinook Salmon Status and Escapement Goals for Stocks in Southeast Alaska

by

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

Symbols and Abbreviations

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

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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ABSTRACT

The status of Chinook salmon *Oncorhynchus tshawytscha* stocks in Southeast Alaska and transboundary rivers is presented, based on results of the inriver stock assessment program in Southeast Alaska and Canada, and catch sampling programs of the Divisions of Sport and Commercial Fisheries. Chinook salmon escapements in 11 drainages were evaluated relative to escapement goals that have been developed for each system. Revised escapement goals were recommended for the Blossom and Keta rivers stocks in 2011 for adoption by the Alaska Department of Fish and Game in 2012. Reports detailing the methods for determining the escapement goals and the analyses for the 11 stocks are cited. The 11 regularly-monitored systems are judged to be healthy.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, escapement, escapement goals, escapement goal ranges, stock status, Taku River, Stikine River, Alsek River, Chilkat River, Unuk River, Chickamin River, Blossom River, Keta River, King Salmon River, Situk River, Andrew Creek, U.S./Canada Pacific Salmon Treaty, transboundary rivers.

INTRODUCTION

Chinook salmon (*Oncorhynchus tshawytscha*) in Southeast Alaska are harvested primarily by the commercial troll fleet and recreational anglers. Chinook salmon are also harvested in U.S. commercial set gillnet, drift gillnet, and purse seine fisheries, and in subsistence fisheries in the region. In addition, Chinook salmon are harvested in Canada in the transboundary Alsek, Taku, and Stikine rivers. Management of Chinook fisheries in Southeast Alaska is covered in other Alaska Board of Fisheries (board) documents, presentations, and regional management plans.

Harvests of Chinook salmon in Southeast Alaska commercial and recreational fisheries are managed on an abundance-based approach with an annual all-gear harvest target provided by the Pacific Salmon Commission, via its Chinook Technical Committee, prior to each fishing season. The annual Pacific Salmon Commission harvest target is based on a preseason forecast of the relative aggregate abundance of most Chinook salmon stocks that are present in Southeast Alaska for the coming year (CTC 2002). The relative preseason abundance is estimated from 30 stock groups in the Pacific Salmon Commission Chinook Model completed each spring by the Chinook Technical Committee, with membership from Alaska, British Columbia, Washington, Oregon, and Idaho. Presently, the all-gear quota is allocated by the board between commercial and recreational users as follows: (1) 4.3% of the total to the purse seine fleet; (2) 2.9% of the total to the drift gillnet fleet; (3) 1,000 Chinook salmon to the set gillnet fishery; (4) 80% of the remainder to the troll fleet; and (5) 20% of the remainder to the recreational fleet (5 AAC 29.060). Additionally, in February 2005, the U.S. and Canada reached a bilateral terminal harvest sharing agreement for directed Taku and Stikine river Chinook salmon fisheries. Annex IV, Chapter 1 of the 2008 Pacific Salmon Treaty agreement includes directives for the conduct of those fisheries. The 2008 Pacific Salmon Treaty agreement (Annex IV, Chapter 3) also recognizes that Chinook salmon stocks in the entire area covered by the treaty vary in status, with many healthy and abundant, while others are considered stocks of concern (some of which are listed under the U.S. Endangered Species Act).

After lengthy negotiations, the allowable Chinook salmon catch levels in fisheries off the west coast of Vancouver Island in British Columbia were reduced by 30%, where Endangered Species Act-listed stocks account for a large portion of the harvest, and by 15% in Southeast Alaska, where Endangered Species Act-listed stocks account for a very small portion of the harvest. Reductions in these two fisheries will be in place from 2009 to 2014, when a 5-year review will be used to evaluate whether these are to continue.

Chinook salmon harvests in Southeast Alaska are known to be composed of stocks originating from as far north as the Yakutat area to the southern coast of Oregon. This includes local Southeast Alaska and transboundary wild stocks. Chinook salmon are known to occur in 34 rivers in, or draining into, the Southeast region of Alaska, including those with headwaters in British Columbia or the Yukon Territory, Canada (Kissner 1977). Local Alaska hatchery stocks contribute a sizeable portion of Southeast Alaska Chinook salmon harvests each year (Table 1).

STOCK STATUS

Stock status for Chinook salmon stocks in Southeast Alaska was judged primarily by performance in meeting escapement requirements; these are local wild stocks that contribute to harvests in Southeast Alaska fisheries. Harvest estimates are also presented for selected stocks. A detailed description of the stock assessment program was presented in the 2003 stock status report (Geiger and McPherson 2004) to provide an understanding of the tools that are available for management of these stocks, and performance in relationship to the principles and criteria in the state's *Policy for the Management of Sustainable Salmon Fisheries* (ADF&G and BOF 2001; 5 AAC 39.222). We briefly summarize the assessment program below.

STOCK ASSESSMENT PROGRAM

In the mid-1970s it became apparent that many local Chinook salmon stocks in this region were depressed relative to historical levels of production (Kissner 1974). A fisheries management program was implemented to rebuild stocks in Southeast Alaska streams and in trans-boundary rivers (rivers that originate in Canada and flow into Southeast Alaska coastal waters; ADF&G 1981). Initially, under this management program, commercial and recreational fisheries in terminal and near-terminal areas in U.S. waters were closed. The troll fishery was also modified extensively by 1982 to reduce exploitation on local wild stocks and later to target Alaska hatchery stocks. In 1985 the Alaskan program was incorporated into a comprehensive, coastwide rebuilding program to represent all wild stocks of Chinook salmon under the auspices of the U.S./Canada Pacific Salmon Treaty. In May 2008, the Pacific Salmon Treaty was re-negotiated and approved by the Pacific Salmon Commission, and subsequently approved by the U.S. and Canadian governments in 2009. The Chinook chapter (Chapter 3) continues the coastwide, abundance-based management regime for Chinook salmon stocks, and as noted above, calls for reduced harvests in Southeast Alaska and off the west coast of Vancouver Island to help address conservation concerns for depressed stocks.

In the 1970s, a stock assessment program was developed to provide information for tools to manage Chinook salmon stocks in the region, to judge stock status and develop sound escapement goals. This program has evolved and expanded over the past few decades, concurrent with increasing information needs. The major components of the stock assessment program in Southeast Alaska include estimation of escapement, survival, harvest, exploitation rates, and distribution. Programs are in place in 11 rivers (Figure 1) to sample, enumerate and collect biological data from the escapements. These rivers represent the entire region's major producers (3 systems having production greater than 10,000 fish), medium producers (7 systems with production of 1,500 to 10,000 fish), and minor producer (1 system with production of less than 1,500 fish). Separate programs are in place to sample, enumerate, and collect biological data from the fisheries that harvest Chinook salmon.

ESCAPEMENT PROGRAMS

Initially, the escapement estimation program consisted of peak survey counts (peak single-day aerial helicopter or foot counts) annually in 10 of the 11 index systems and a weir on the Situk River. This was inadequate for intensive fishery management and population assessment, such as that now in place in the Pacific Salmon Commission forum. Over time the program was modified to estimate total escapement to all 11 systems (Tables 2 and 3), including development of expansion factors relating survey counts to total escapement. Presently, total escapement programs are operated on many of the larger rivers, including the weirs on the Situk and Klukshu (Alsek) rivers, and mark–recapture tagging projects on the Chilkat, Taku, Stikine, and Unuk rivers. Helicopter survey counts are used to monitor escapements to other systems. Radiotelemetry projects have been conducted once or twice on all major systems to determine spawning distribution and verify that survey counts were being conducted over the major spawning areas, and to validate assumptions of the mark-recapture studies. Biological data collected has included age, sex, length, and tag recovery to estimate escapement in total and by sex and age, as well as the fraction of fish that were coded wire tagged in selected systems. Descriptions and results of the inriver stock assessment programs are contained in Appendix A.

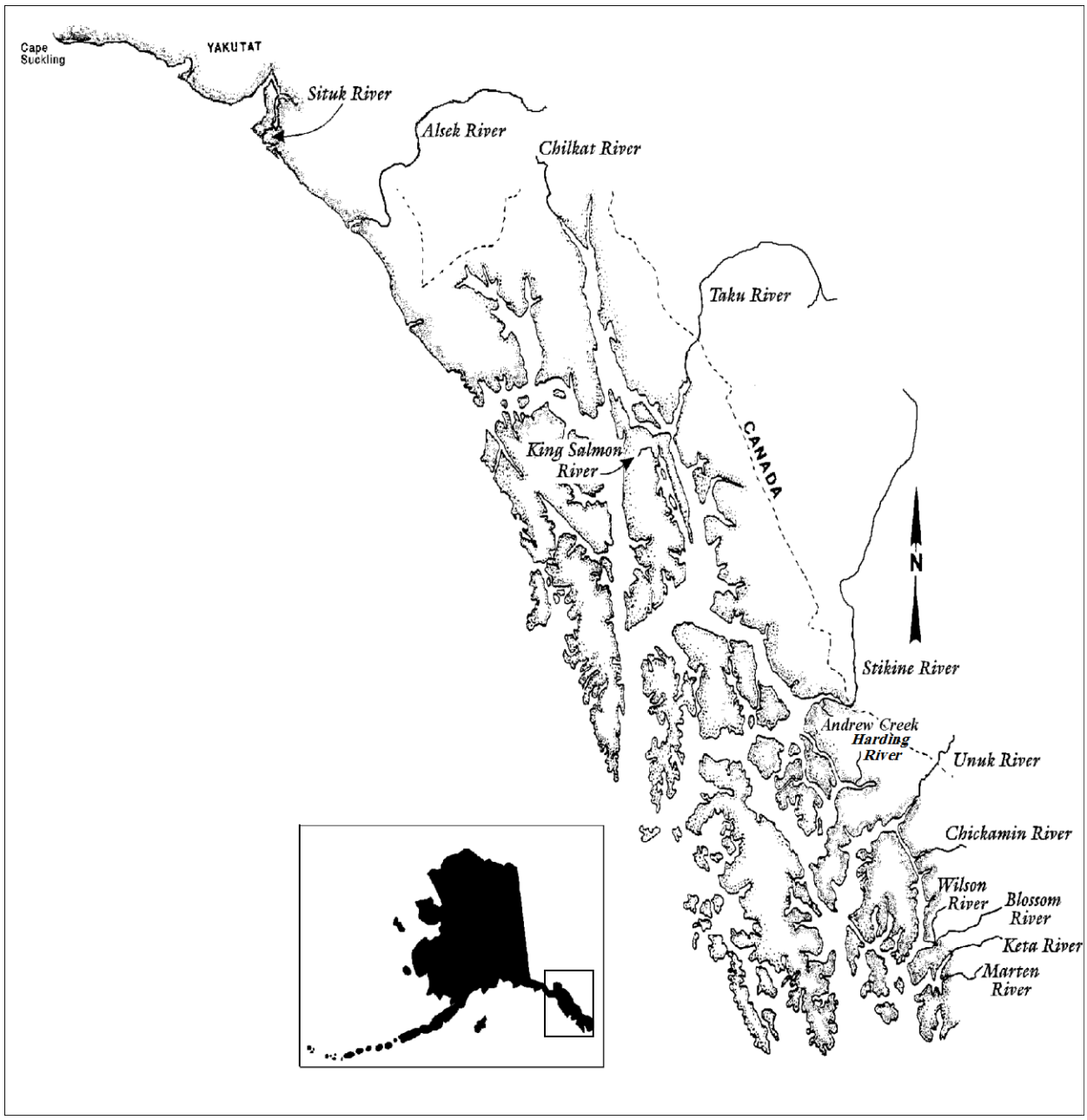

Figure 1.–Location of selected Chinook salmon systems in Southeast Alaska, Yakutat, and transboundary rivers.

Table 1.–Southeast Alaska Chinook salmon harvests, 1975–2009, in thousands of Chinook salmon (2009 data and some recent harvests subject to revision).

Year	Troll	Net	Sport	Total all-gear Southeast Alaska harvest	Hatchery add-on	Terminal exclusion	Treaty catch
1975	287	13	17	318	-	-	-
1976	231	11	17	259	-	-	-
1977	272	13	17	302	-	-	-
1978	376	25	17	418	-	-	-
1979	338	28	17	383	-	-	-
1980	304	20	20	344	-	-	-
1981	249	19	21	289	-	-	-
1982	242	47	26	315	-	-	-
1983	270	20	22	312	-	-	-
1984	236	32	22	290	-	-	-
1985	216	34	25	275	6	-	268
1986	238	22	23	282	11	-	271
1987	243	16	24	282	17	-	265
1988	231	22	26	279	23	-	257
1989	236	24	31	291	22	-	270
1990	288	28	51	367	46	-	321
1991	264	35	60	359	61	-	298
1992	184	32	43	259	37	-	222
1993	227	28	49	304	33	-	271
1994	186	36	42	264	29	-	235
1995	138	48	50	236	59	-	177
1996	141	37	58	236	73	9	155
1997	246	25	72	343	46	10	287
1998	192	24	55	271	25	2	243
1999	146	33	72	251	48	4	199
2000	159	41	63	263	74	2	186
2001	153	40	72	266	77	2	187
2002	325	32	70	427	68	1	357
2003	331	39	69	439	57	2	380
2004	355	64	81	499	76	6	422
2005	338	72	87	497	65	43	388
2006	282	70	86	438	49	31	359
2007	268	56	83	407	70	9	328
2008	152	46	49	247	68	7	172
2009	177	54	70	299	65	5	230

Note: Harvests statistics from PSC (2011).

HARVEST PROGRAMS

Commercial harvests are reported on fish tickets, and sport harvests are estimated by creel and postal surveys. These provide estimates of the total harvest in a fishery, but not the stock composition. Harvests of specific stocks, including Alaskan hatchery fish, can be estimated using coded wire tags. Pacific Salmon Treaty agreements provide Alaska fisheries a special add-on of Alaskan hatchery Chinook salmon to the annual catch ceiling. Estimates of stock composition in Southeast Alaska fisheries that harvest Chinook salmon have been somewhat limited and at present, the five largest stocks in Southeast Alaska are not included in the Pacific Salmon Commission Chinook Model because stock data are limited and the Chinook Technical Committee has not progressed to that point in the model improvement process. This is being addressed by two programs: coded wire-tagging of wild Chinook salmon stocks in the region and a genetic stock identification program. Fishery sampling for coded wire tags and genetic information has increased in the past few years to improve our estimates of stock composition. Four wild stocks of Chinook salmon (Chilkat, Taku, Stikine, and Unuk) are being coded wire-tagged at present. The combination of these two programs has improved, and will continue to further improve, stock identification information available for Southeast Alaska Chinook catches in the near future.

Table 2.–Estimated total escapements of large (≥660 mm MEF, primariliy 3+ ocean age) Chinook salmon, unless otherwise noted, to escapement indicator systems in Southeast Alaska and transboundary rivers, from 1975 to 2011 (2011 data, some recent estimates, and estimates based on expanded survey or weir counts are subject to revision). Numbers in bold type are weir counts or mark-recapture total estimates.

	MAJOR SYSTEMS			MEDIUM SYSTEMS							MINOR
Year	Alsek[a]	Taku	Stikine	Situk[b]	Chilkat[c]	Andrew	Unuk	Chickamin[d]	Blossom[d]	Keta[d]	King Salmon
1975		12,917	7,571			507		1,758	565	611	64
1976	5,282	24,575	5,723	**1,421**		**404**		746	263	253	99
1977	12,706	29,489	11,445	**1,732**		**456**	4,704	1,724	433	692	204
1978	12,034	17,118	6,835	**808**		**388**	5,342	1,463	553	1,180	87
1979	17,354	21,611	12,610	**1,284**		**327**	2,782	1,135	209	1,282	134
1980	10,862	39,229	30,573	**905**		**282**	4,907	2,114	344	578	106
1981	8,502	49,546	36,057	**702**		**536**	3,531	1,824	615	990	154
1982	9,475	23,842	40,488	**434**		**672**	6,525	2,712	1,335	2,270	394
1983	10,344	9,792	6,424	**592**		**366**	5,434	2,845	2,279	2,474	**245**
1984	7,238	20,774	13,995	**1,726**		**389**	8,873	5,235	1,966	1,836	**265**
1985	6,127	35,906	16,037	**1,521**		624	5,719	4,541	2,744	1,878	**175**
1986	11,069	38,100	14,889	**2,067**		1,381	10,269	8,289	4,946	2,077	**255**
1987	11,141	28,928	24,632	**1,379**		1,537	9,530	4,631	5,221	2,312	**196**
1988	8,717	44,512	37,554	**868**		1,100	8,433	3,734	1,486	1,731	**208**
1989	10,119	**40,329**	24,282	**637**		1,034	5,550	4,437	1,331	3,477	**240**
1990	8,609	**52,142**	22,619	**628**		1,295	2,855	2,679	995	1,824	**179**
1991	11,625	51,645	23,206	**889**	**5,897**	780	3,164	2,313	925	819	**134**
1992	5,773	55,889	34,129	**1,595**	**5,284**	1,517	4,221	1,644	581	653	**99**
1993	13,855	66,125	58,962	**952**	**4,472**	2,067	5,158	1,848	1,173	1,090	266
1994	15,863	48,368	33,094	**1,271**	**6,795**	1,115	3,434	1,843	623	921	213
1995	24,772	**33,805**	16,784	**4,330**	**3,790**	669	3,729	**2,309**	840	527	147
1996	15,922	**79,019**	**28,949**	**1,800**	**4,920**	653	5,637	**1,587**	851	894	292
1997	12,494	**114,938**	**26,996**	**1,878**	**8,100**	571	**2,970**	1,292	511	740	362
1998	**6,833**	31,039	**25,968**	**924**	**3,675**	950	**4,132**	1,857	**364**	**446**	134
1999	**14,597**	**16,786**	**19,947**	**1,461**	**2,271**	1,180	**3,914**	2,380	820	**968**	304
2000	**7,905**	**34,997**	**27,531**	**1,785**	**2,035**	1,346	**5,872**	3,805	894	**914**	138
2001	**6,705**	**46,544**	**63,523**	**562**	**4,517**	2,055	**10,541**	**5,177**	789	1,032	149
2002	**5,569**	**55,044**	**50,875**	**1,000**	**4,051**	1,708	**6,988**	**5,007**	867	1,237	155
2003	**5,904**	**36,435**	**46,824**	**2,163**	**5,657**	1,160	**5,546**	**4,579**	786	969	119
2004	**7,083**	**75,032**	**48,900**	**698**	**3,422**	2,991	**3,963**	**4,268**	**734**	1,132	135
2005	4,478	**38,725**	**40,501**	**595**	**3,366**	1,979	**4,742**	**4,257**	**929**	1,496	143
2006	2,323	**42,296**	**24,405**	**695**	**3,039**	2,124	**5,645**	6,318	**1,270**	2,248	150
2007	2,827	**14,854**	**14,560**	**677**	**1,445**	1,736	**5,668**	4,242	**522**	936	181
2008	1,885	**27,383**	**18,352**	**413**	**2,905**	981	**3,104**	5277	995	1,093	120
2009	6,239	**20,762**	**11,086**	**902**	**4,429**	628	**3,157**	2,902	476	518	109
2010	9,518	**29,307**	**15,180**	**167**[e]	**1,815**	1,205	**4,854**	5,491	697	1,430	158
2011	6,668	**27,523**	**14,569**	**240**	**2,803**	936	**3,272**	4,052	569	671	192

[a] The escapement goal for the Alsek River is for age-1.2+ Chinook salmon, which can include fish <660 mm MEF.

[b] Escapement equals weir count minus above-weir harvest.

[c] Inriver run; the inriver run goal is 1,850–3,600 large spawners. Spawning escapement is inriver run minus inriver subsistence harvest, which averages <100 fish.

[d] Escapement goals for the Chickamin, Blossom, and Keta systems are in aerial survey count currency, but expanded aerial counts are shown here to provide comparisons of maganitude across systems.

[e] Weir compromised, partial count.

Table 3.–Estimated escapement goal ranges for 11 Chinook salmon stocks in Southeast Alaska. These escapement goals are germane to large (≥660 mm MEF, primarily 3+ ocean age) spawners unless otherwise noted. BEG = biological escapement goal.

Chinook salmon stock	Goal type	Escapement goal range for large[a] spawners in survey count	Survey expansion factor	Escapement goal range for large spawners estimated in total escapement
1. Chilkat River	BEG	NA	NA	1,750–3,500[b]
2. King Salmon River	BEG	80–160	1.52	120–240
3. Andrew Creek	BEG	325–750	1.95	650–1,500
4. Blossom River[c]	BEG	150–300	3.87	NA
5. Keta River[c]	BEG	175–400	3.01	NA
6. Unuk River	BEG	375–800	4.83	1,800–3,800
7. Chickamin River	BEG	450–900	4.75	NA
8. Situk River	BEG	NA	NA	450–1,050
9. Alsek River	BEG	1,100–2,300	4.00	NA
10. Stikine River	BEG	2,700–5,300	5.15	14,000–28,000
11. Taku River	BEG	NA	5.20	19,000–36,000

[a] The Alsek River survey goal is germane to age-1.2+ Chinook salmon, which can include fish <660 mm MEF.

[b] The inriver run goal is 1,850–3,600 large spawners.

[c] Recommended goal approved by the ADF&G interdivisional escapement goal review team. The goal has also been approved by the Pacific Salmon Commission, Chinook Technical Committee.

STOCK STATUS ASSESSMENT

In this section, the status of wild Chinook salmon stocks is evaluated through 2011. The *Policy for the Management of Sustainable Salmon Fisheries* (ADF&G and BOF 2001; 5 AAC 39.222) specifies guidelines to manage salmon stocks for sustainability.

Escapement goals for the 11 index stocks of Chinook salmon have been established. These escapement goals are designed to maintain wild stocks at high levels of productivity and yields near the theoretical average maximum sustained level. Management plans and regimes are structured for Southeast Alaska fisheries to achieve escapements that met the goals whenever possible, and are developed with significant input from the public and users. Escapements have been evaluated in the 11 index stocks against the escapement goal established for each stock to determine stock status. Escapements were assessed retrospectively back to 1975 as if the current escapement goal had been in place. All of the 11 regularly-monitored systems are judged to be healthy (Figures 2, 3, and 4).

ESCAPEMENT GOALS

Escapement goals for the Blossom and Keta rivers stocks were updated and were approved by an internal review team. These goals were also reviewed by the Pacific Salmon Commission, Chinook Technical Committee, and both have been approved. Both goals were adopted by the Alaska Department of Fish and Game.

Reports detailing the methods for determining the revised escapement goals and the analyses for the current goals of the remaining 9 stocks are cited. In Appendix A, a section is included for each of the 11 stocks that briefly describes the stock and fisheries that harvest it, key stock assessment data, and the current or recommended escapement goal.

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A multitude of individuals from various agencies, organizations, and businesses have helped make the stock assessment program for Chinook salmon in Southeast Alaska the high quality program that it is today. We acknowledge and thank them for their contributions.

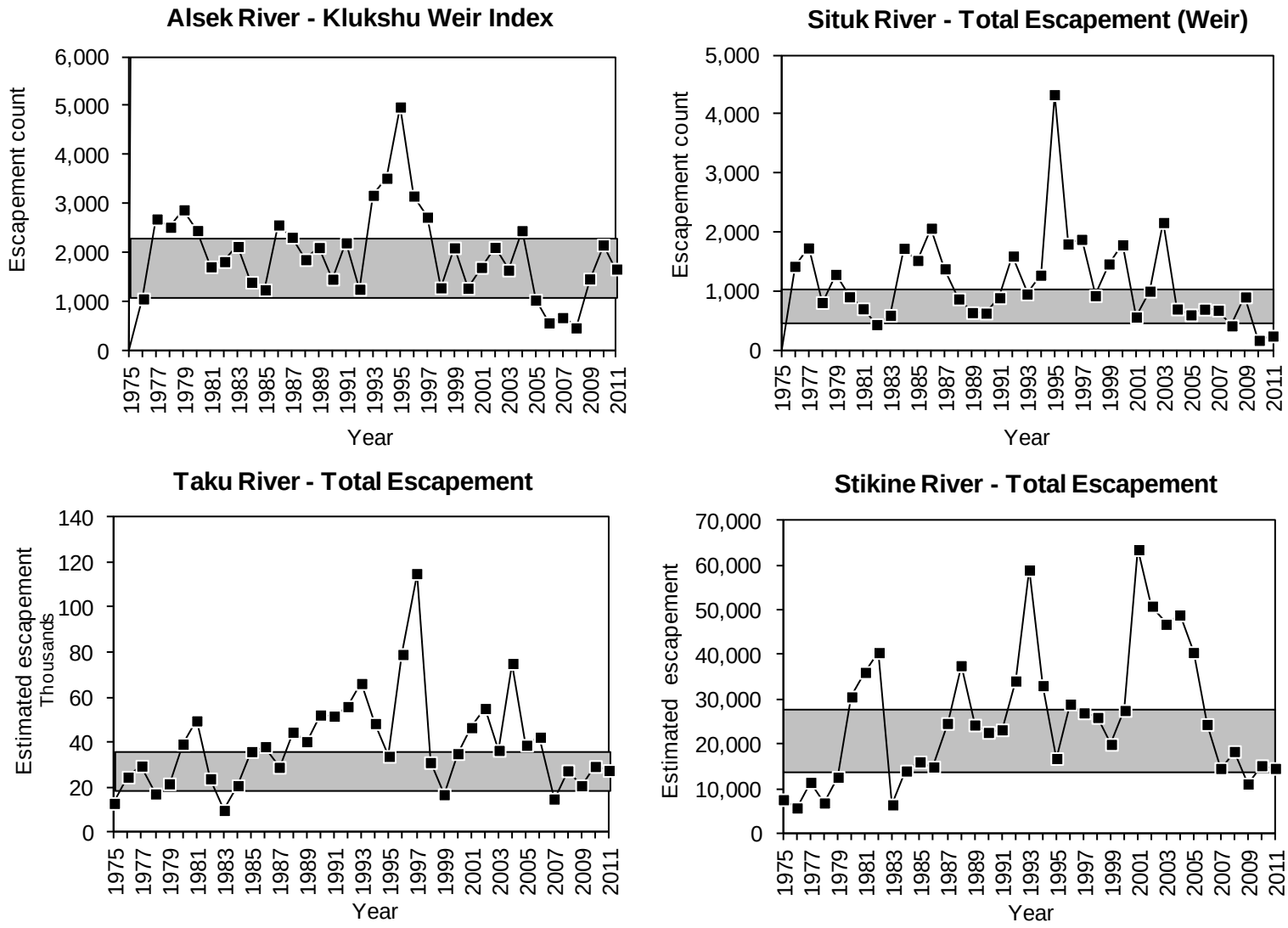

Figure 2.–Escapements of Chinook salmon in the Alsek, Situk, Taku, and Stikine rivers from 1975 to 2011. All values represent the total escapement of large (≥ 660 mm MEF, primarily 3+ ocean age) Chinook salmon except in the Alsek River, where the escapement is germane to 2+ ocean-age fish, some of which can be <660 mm MEF.

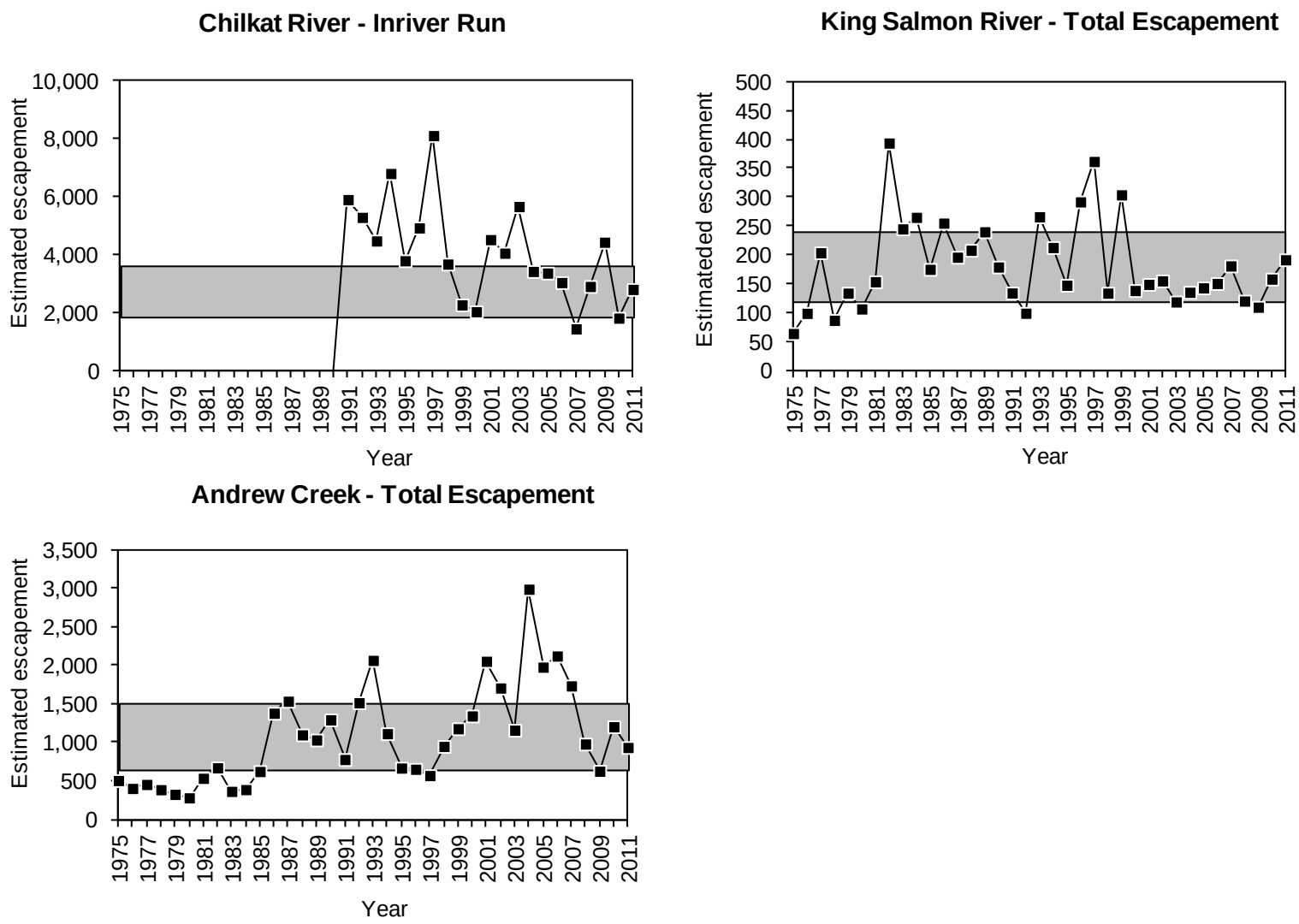

Figure 3.–Escapements of Chinook salmon in the Chilkat and King Salmon rivers and in Andrew Creek from 1975 to 2011. Values represent the total escapement of large (≥ 660 mm MEF, primarily 3+ ocean age) Chinook salmon, with the exception of the Chilkat River (the numbers presented here are inriver run estimates and the inriver run goal).

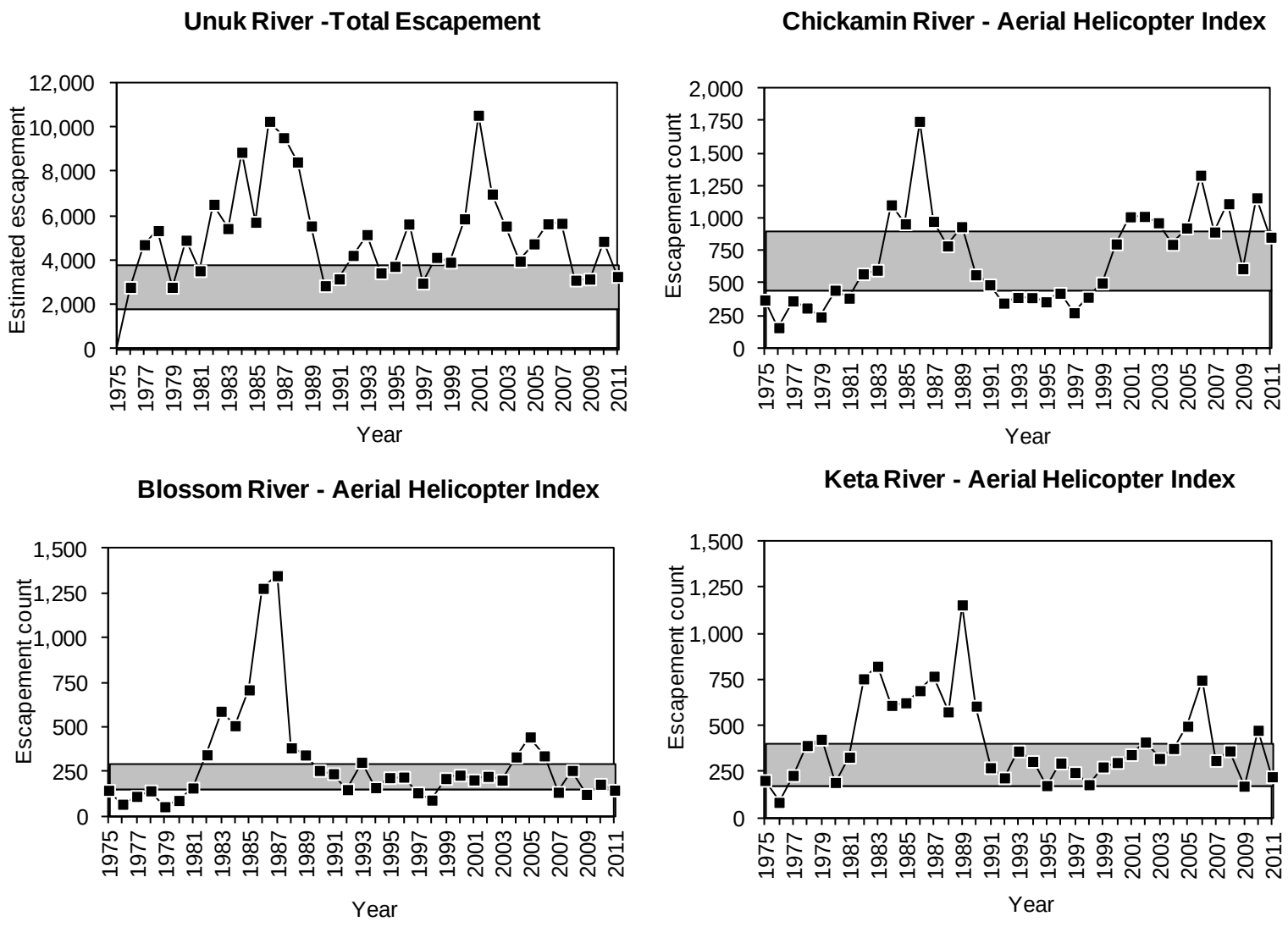

Figure 4.–Escapements of Chinook salmon in the Unuk, Chickamin, Blossom, and Keta rivers from 1975 to 2011. Values for the Chickamin, Blossom, and Keta rivers represent the peak survey counts of large (≥ 660 mm MEF, primarily 3+ ocean age) Chinook salmon.

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APPENDIX A

Appendix A1.–Taku River Chinook salmon stock.

The Taku River, which originates in northwestern British Columbia, produces the largest local population of Chinook salmon on average in Southeast Alaska (McPherson et al. 2000). This spring run is harvested primarily as mature adults from late April to early July; immature fish rear primarily outside of the region. Stock assessment includes: coded wire-tagging of smolt, estimation of adult escapement (inseason and postseason), harvest, exploitation, smolt abundance, and survival.

Outline of stock management, assessment, and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	Joint management by ADF&G and Canadian Department of Fisheries and Oceans through Pacific Salmon Commission of terminal run
Fisheries:	U.S. recreational, gillnet, troll; Canadian gillnet, First Nations, recreational
Escapement goal type:	Biological Escapement Goal
Escapement goal:	19,000 to 36,000 range; 25,500 point estimate
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age) in entire drainage
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1973 to present, conducted in 6 major tributaries—the Nahlin, Nakina, Dudidontu, Tatsamenie, and Kowatua rivers, and Tseta Creek and standardized since 1973 Mark-recapture estimates: 1989, 1990, 1995 to present
Index count expansion factor:	5.20 (SE = 1.99); multiplier for cumulative helicopter peak survey count in 5 tributaries—Nahlin, Nakina, Dudidontu, Tatsamenie, and Kowatua rivers
Brood years in analysis:	29 (1973 to 2001)
Data in analysis:	Estimated total escapement of large spawners, all terminal and near terminal harvests, age structure all years
Data quality:	Good
Contrast in escapements:	11.7
Model used for escapement goal:	Bayesian age-structured analysis using Ricker model
Criteria for range:	Range predicted to produce 90% of maximum sustained yield
Value of alpha parameter:	3.38
Value of beta parameter:	0.00001978
Value of $sigma^2$ parameter:	0.36
Document supporting goal:	McPherson, S. A., E. L. Jones III, S. J. Fleischman, and I. M. Boyce. 2010. Optimal production of Chinook salmon from the Taku River through the 2001 year class. Alaska Department of Fish and Game, Fishery Manuscript Series No. 10-03, Anchorage.

Appendix Table A1.1.–Estimated harvests, escapements, and total runs by year of large (≥660 mm MEF, primarily 3+ ocean age) Chinook salmon bound for the Taku River from 1979 to 2011. Escapement estimates in bold are from mark–recapture estimates and estimates in italics are from expanded survey counts (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

		U.S.						Canada						
Year	Escapement[a]	Gillnet	Sport	Troll[b]	P.U.	Total	Test fishery	Gillnet	Sport[c]	Abor.	Total	Harvest	Total run	Harvest rate
1979	*21,611*	217	1,853	4,544		6,614		97	300		397	7,011	28,622	24.5%
1980	*39,229*	696	2,900	3,813		7,409		225	300	85	610	8,019	47,248	17.0%
1981	*49,546*	611	1,931	5,276		7,818		159	300		459	8,277	57,823	14.3%
1982	*23,842*	847	1,571	2,709		5,127		54	300		354	5,481	29,323	18.7%
1983	*9,792*	106	1,089	419		1,614		156	300	9	465	2,079	211,871	17.5%
1984	*20,774*	399	1,210	2,754		4,363		294	300		594	4,957	25,731	19.3%
1985	*35,906*	802	1,863	750		3,415		326	300	4	630	4,045	39,951	10.1%
1986	*38,100*	849	755	808		2,412		275	300	10	585	2,997	41,097	7.3%
1987	*28,928*	557	1,019	399		1,975		127	300		427	2,402	31,330	7.7%
1988	*44,512*	240	765	2,034		3,039	72	555	300	27	954	3,993	48,505	8.2%
1989	**40,329**	933	1,857	2,034	25	4,848	31	895	300	6	1,232	6,080	46,409	13.1%
1990	**52,142**	960	2,039	2,034	26	5,058	48	1,258	300		1,606	6,664	58,806	11.3%
1991	*51,645*	1,150	4,199	2,034	25	7,407		1,177	300		1,477	8,884	60,529	14.7%
1992	*55,889*	869	3,099	2,034	21	6,022		1,445	300	121	1,866	7,888	63,777	12.4%
1993	*66,125*	1,823	5,860	2,034	9	9,725		1,619	300	25	1,944	11,669	77,794	15.0%
1994	*48,368*	1,426	2,672	2,034	21	6,152		2,065	300	119	2,484	8,636	57,004	15.2%
1995	**33,805**	608	3,486	2,034	18	6,145		1,577	300	70	1,947	8,092	41,897	19.3%
1996	**79,019**	1,814	4,121	1,605	33	7,573		3,331	300	63	3,694	11,267	90,286	12.5%
1997	**114,938**	2,197	5,991	1,478	16	9,682		2,731	300	103	3,134	12,816	127,754	10.0%
1998	*31,039*	278	2,088	656	15	3,037		1,107	300	60	1,467	4,504	35,543	12.7%
1999	**16,786**	785	2,408	811	22	4,026	577	908	300	50	1,835	5,861	22,647	25.9%
2000	**34,997**	426	1,553	1,390	22	3,391	1,312	1,576	300	50	3,238	6,629	41,626	15.9%
2001	**46,644**	538	1,437	2,324	8	4,307	1,175	1,458	300	125	3,058	7,365	53,909	13.7%
2002	**55,044**	869	2,399	2,658	14	5,940	1,311	1,561	300	37	3,209	9,149	64,193	14.3%
2003	**36,435**	738	2,017	1,930	13	4,698	1,403	1,894	300	277	3,874	8,572	45,007	19.0%
2004	**75,032**	971	2,700	3,916	25	7,612	1,489	2,082	300	530	4,401	12,013	87,045	13.8%
2005	**38,725**	18,962	2,967	1,625	32	23,586		7,399	300	212	7,911	31,497	70,222	44.9%
2006	**42,296**	10,525	2,396	2,021	18	14,960	630	7,377	186	222	8,415	23,375	65,671	35.6%
2007	**14,854**	910	1,411	1,763	22	4,106	1,396	874	105	167	2,542	6,648	21,502	30.9%
2008	**27,383**	850	1,255	1,216	46	3,372	1,399	913	270		2,582	5,954	33,337	17.9%

-continued-

Appendix Table A1.1.–Page 2 of 2.

		U.S.						Canada						
Year	Escapement[a]	Gillnet	Sport	Troll[b]	P.U.	Total	Test fishery	Gillnet	Sport[c]	Abor.	Total	Harvest	Total run	Harvest rate
2009	**20,762**	4,667	1,287	1,245	25	7,223		6,759	100	172	7,031	14,254	35,016	40.7%
2010	**29,307**	679	1,406	545	36	2,666		5,213	100	126	5,439	8,105	37,412	21.7%
2011	**27,523**	763	1,065	998	30	2,855		3,032	100	103	3,235	6,090	33,613	18.1%
Averages:														
79–10	41,366	1,822	2,300	1,966	22	6,104	904	1,796	277	107	2,496	8,599	49,965	18.0%
06–10	23,077	1,776	1,340	1,194	32	4,342	1,398	3,440	144	116	4,399	8,740	31,817	27.8%

[a] Escapement: escapement estimates shown here are from mark–recapture estimates in 1989 to 1990 and 1995 to 1997 (McPherson et al. 2000), and mark–recapture estimates from 1999 to 2007 (Jones III et al. 2010), and preliminary mark-recapture estimates from 2008 to 2010. Estimates for 1979 to 1988, 1991 to 1994, 1998, and 2011 are expanded survey counts of large spawners. No estimates are available prior to 1973.

[b] Troll harvest estimates for 1988 to 1995 were estimated using averages for 1996–2011 and all other years are estimates from coded wire tag recoveries.

[c] The sport harvest in Canada is unknown, yet assumed to average 300 fish per year unless otherwise noted.

Appendix A2.–Stikine River Chinook salmon stock.

The Stikine River is a glacial transboundary river that produces the second largest population of Chinook salmon, on average, in Southeast Alaska (Bernard et al. 2000). These fish are caught in the troll fishery, a commercial gillnet fishery in U.S. waters near the river, recreational fisheries near Wrangell and Petersburg, and in inriver commercial, aboriginal, and recreational fisheries in Canada. Stock assessment includes: coded wire-tagging of smolt, estimation of adult escapement (inseason and postseason), harvest, exploitation, smolt abundance, and survival.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	Joint management by ADF&G and Canadian Department of Fisheries and Oceans through Pacific Salmon Commission of terminal run
Fisheries:	U.S. recreational, gillnet, troll; Canadian gillnet, First Nations, recreational
Escapement goal type:	Biological Escapement Goal
Escapement goal:	14,000 to 28,000 range; 17,368 point estimate
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age) in entire drainage
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1975 to present Index weir counts, Little Tahltan River: 1985 to present Mark-recapture estimates: 1996 to present
Index count expansion factor:	5.15 (SE = 0.77); multiplier for weir count on Little Tahltan River
Brood years in analysis:	15 (1977 to 1991)
Data in analysis:	Estimated total escapement of large spawners, all terminal and near terminal harvests, age structure all years
Data quality:	Excellent
Contrast in escapements:	6.3
Model used for escapement goal:	Ricker model incorporating measurement error in escapements and returns
Criteria for range:	S_{MSY} times 0.8 (lower) and 1.6 (upper), per Eggers (1993)
Value of alpha parameter:	2.61
Value of beta parameter:	0.000026592
Value of sigma^2 parameter:	0.2613
Document supporting goal:	Bernard, D. R., S. A. McPherson, K. A. Pahlke, and P. Etherton. 2000. Optimal production of Chinook salmon from the Stikine River. Alaska Department of Fish and Game, Fishery Manuscript Series No. 00-1, Anchorage.

Appendix Table A2.1.–Escapement index counts, spawning escapement estimates, harvests, run sizes, and harvest rates for large (≥660 mm MEF, primarily 3+ ocean age) Stikine River Chinook salmon, from 1975 to 2011. Escapement estimates in bold are from mark–recapture estimates, estimates in italics are from expanded survey counts, and the remainder are from expansions of Little Tahltan River weir counts (2011 data, some recent estimates, and estimates based on expanded weir counts are subject to revision).

Year	Aerial counts	Little Tahltan weir count	Spawning escapement	U.S. sport harvest	U.S. gillnet/troll harvest	U.S. subsistence harvest	Canadian harvest	Total harvest	Total run	Harvest rate
1975	700		*7,571*		1,529		1,202	2,731	10,302	26.5%
1976	400		*5,723*		1,101		1,160	2,261	7,984	28.3%
1977	800		*11,445*		1,378		162	1,540	12,985	11.9%
1978	632		*6,835*	2,282			500	2,782	9,617	28.9%
1979	1,166		*12,610*	1,759	432		1,262	3,453	16,063	21.5%
1980	2,137		*30,573*	2,498	926		2,655	6,079	36,652	16.6%
1981	3,334		*36,057*	2,022	823		1,650	4,495	40,552	11.1%
1982	2,830		*40,488*	2,929	1,753		2,597	7,279	47,767	15.2%
1983	594		*6,424*	2,634	1,024		2,106	5,764	12,188	47.3%
1984	1,294		*13,995*	2,171	1,039		796	4,006	18,001	22.3%
1985	1,598	3,114	16,037	2,953	2,823		1,491	7,267	23,304	31.2%
1986	1,201	2,891	14,889	2,475	2,510		3,473	8,458	23,347	36.2%
1987	2,706	4,783	24,632	2,834	2,404		3,020	8,258	32,890	25.1%
1988	3,796	7,292	37,554	2,440	1,299		3,333	7,072	44,626	15.8%
1989	2,527	4,715	24,282	2,776	1,887		3,349	8,012	32,294	24.8%
1990	1,755	4,392	22,619	4,283	1,912		3,604	9,799	32,418	30.2%
1991	1,768	4,506	23,206	3,657	2,080		3,258	8,995	32,201	27.9%
1992	3,607	6,627	34,129	3,322	752		3,080	7,154	41,283	17.3%
1993	4,010	11,449	58,962	4,227	1,201		3,204	8,632	67,594	12.8%
1994	2,422	6,426	33,094	2,140	1,777		2,760	6,677	39,771	16.8%
1995	1,117	3,259	16,784	1,218	1,291		3,059	5,568	22,352	24.9%
1996	1,920	4,821	**28,949**	2,464	1,161		3,450	7,075	36,024	19.6%
1997	1,907	5,557	**26,996**	3,475	2,146		5,019	10,640	37,636	28.3%
1998	1,385	4,879	**25,968**	1,438	276		2,812	4,526	30,494	14.8%
1999	1,379	4,738	**19,947**	3,668	1,125		5,318	10,111	30,058	33.6%
2000	2,720	6,640	**27,531**	2,581	1,262		4,684	8,527	36,058	23.6%
2001	4,158	9,738	**63,523**	2,263	687		3,297	6,247	69,770	9.0%
2002	1,191	7,490	**50,875**	3,077	1,009		4,007	8,093	58,968	13.7%
2003	1,903	6,492	**46,824**	3,252	1,529		4,739	9,520	56,344	16.9%
2004	6,014	16,381	**48,900**	2,939	8,282	31	6,712	17,964	66,864	26.9%
2005	1,997	7,387	**40,501**	3,002	26,710	15	20,049	49,776	90,277	55.1%
2006	1,374	3,860	**24,405**	2,944	23,756	37	15,776	42,513	66,918	63.5%
2007	562	562	**14,560**	3,273	10,355	37	10,509	24,174	38,734	62.4%
2008	837	2,657	**18,352**	1,352	8,337	26	7,932	17,647	35,999	49.0%
2009	[a]	2,350	**11,086**	753	801	31	2,163	3,748	14,834	25.3%
2010	[a]	1,057	**15,180**	994	946	53	3,183	5,176	20,356	25.4%
2011	[a]	1,754	**14,569**	[b]	[b]	[b]	[b]	[b]	[b]	[b]
Averages:										
75–10	1,992[c]	5,541	26,153	2,609	3,381	33	4,094	9,778	35,931	26.7%
06–10	924[c]	2,097	16,717	1,863	8,839	37	7,913	18,652	35,368	45.1%

[a] Aerial surveys were discontinued in 2009.

[b] Harvest information was unavailable at time of press.

[c] Through 2008.

The Alsek River produces the third or fourth largest Chinook salmon run in Southeast Alaska. Harvest of this stock primarily occurs in U.S. commercial and subsistence set gillnet fisheries in the lower Alsek River in Dry Bay, and in recreational and aboriginal fisheries on the upper Tatshenshini River in Canada. Stock assessment includes weir counts, direct fishery enumeration, and age, sex, and size sampling.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	Joint management by ADF&G and Canadian Department of Fisheries and Oceans through Pacific Salmon Commission
Fisheries:	U.S. subsistence/personal use, gillnet, troll; First Nations, Canadian recreational
Escapement goal type:	Biological Escapement Goal
Escapement goal:	Klukshu River: 1,100 to 2,300 range; no point estimate
Population for goal:	All spawners (ages 1.2+)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Index weir counts Klukshu River: 1976 to present Mark-recapture estimates for Alsek: 1998 to 2004
Index count expansion factor:	4.00 (SE = 1.48); multiplier for weir count plus below-weir sport harvest on the Klukshu River, minus Canadian sport and Aboriginal harvest
Brood years in analysis:	16 (1976 to 1991)
Data in analysis:	Estimated total escapement, all terminal, near terminal harvests, and age structure all years.
Data quality:	Very good to excellent
Contrast in escapements:	2.9
Model used for escapement goal:	Ricker model and empirical inspection of spawner-recruit relationship
Criteria for range:	Range producing largest total returns
Value of alpha parameter:	7.44
Value of beta parameter:	0.00081
Value of $sigma^2$ parameter:	Not available.
Document supporting goal:	McPherson, S. A., P. Etherton, and J. H. Clark. 1998. Biological escapement goal for Klukshu River Chinook salmon. Alaska Department of Fish and Game, Fishery Manuscript No. 98-2, Anchorage.

Appendix Table A3.1.–Spawning escapement, estimated harvests, run size, and harvest rates for Chinook salmon in the Alsek River, from 1976 to 2011. Escapement estimates in bold are from mark–recapture estimates; all others are based on expanded weir counts plus below-weir sport harvest on the Klukshu River (2011 data and some recent estimates are subject to revision).

Year	Total escapement[a]	Klushu River escapement[b]	Klukshu weir count + below-weir sport harvest	Total Canadian harvest[c]	Total U.S. harvest	Total harvest	Total run	Harvest rate
1976	5,282	1,058	1,408	350	512	862	6,144	14.0%
1977	12,706	2,689	3,339	650	1,402	2,052	14,758	13.9%
1978	12,034	2,521	3,171	650	2,441	3,091	15,125	20.4%
1979	17,354	2,876	4,826	1,950	2,525	4,475	21,829	20.5%
1980	10,862	2,453	2,803	350	1,382	1,732	12,594	13.8%
1981	8,502	1,713	2,263	550	779	1,329	9,831	13.5%
1982	9,475	1,819	2,552	733	532	1,265	10,740	11.8%
1983	10,344	2,127	2,739	612	93	705	11,049	6.4%
1984	7,238	1,397	1,947	550	46	596	7,834	7.6%
1985	6,127	1,243	1,628	385	213	598	6,725	8.9%
1986	11,069	2,567	2,834	267	503	770	11,839	6.5%
1987	11,141	2,315	2,942	627	369	996	12,137	8.2%
1988	8,717	1,859	2,286	427	236	663	9,380	7.1%
1989	10,119	2,106	2,671	565	248	813	10,932	7.4%
1990	8,609	1,460	2,383	923	163	1,086	9,695	11.2%
1991	11,625	2,202	3,141	939	141	1,080	12,705	8.5%
1992	5,773	1,255	1,506	251	316	567	6,340	8.9%
1993	13,855	3,172	3,561	389	338	727	14,582	5.0%
1994	15,863	3,521	4,114	593	865	1,458	17,321	8.4%
1995	24,772	4,975	6,599	1,624	721	2,345	27,117	8.6%
1996	15,922	3,157	4,255	1,098	831	1,929	17,851	10.8%
1997	12,494	2,726	3,256	530	606	1,136	13,630	8.3%
1998	**6,833**	1,284	1,630	346	613	959	7,792	12.3%
1999	**14,597**	2,100	2,530	430	526	956	15,553	6.1%
2000	**7,905**	1,276	1,418	142	650	792	8,697	9.1%
2001	**6,705**	1,700	1,977	277	560	837	7,542	11.1%
2002	**5,569**	2,109	2,426	317	760	1,077	6,646	16.2%
2003	**5,904**	1,645	1,873	228	961	1,189	7,093	16.8%
2004	**7,083**	2,451	2,636	185	694	879	7,962	11.0%
2005	4,478	1,034	1,148	114	693	807	5,285	15.3%
2006	2,323	568	585	17	712	729	3,052	23.9%
2007	2,827	676	717	41	826	867	3,694	23.5%
2008	1,885	466	473	7	597	604	2,489	24.3%
2009	6,239	1,466	1,591	125	659	784	7,023	11.2%
2010	9,518	2,159	2,453	294	343	637	10,055	6.3%
2011	6,668[d]	1,667[e]	1,667[e]	[f]	546	[f]	[f]	[f]
Averages:								
76–10	9,479	2,004	2,505	501	682	1,199	10,658	11.9%
06–10	4,558	1,067	1,164	97	627	746	5,263	17.8%

[a] In years without mark-recapture estimates, total escapement = [(weir count plus sport harvest below the weir on Klukshu River) x 4.00] – total Canadian harvest.

[b] Klushu River escapement = (weir count plus sport harvest below the weir on Klukshu River) – total Canadian harvest.

[c] Total Canadian harvest = sport (Dalton Post + Blanchard River + Takhanne River) + Aboriginal (above and below the weir on the Klukshu River).

[d] Klukshu weir count x 4.00.

[e] Klukshu weir count only.

[f] Canadian harvest information was unavailable at press time.

Appendix A4.–Situk River Chinook salmon stock.

The Situk River is a relatively small but productive drainage located near Yakutat. It usually produces runs of Chinook salmon in the 2,000 to 5,000 fish range, but runs have been as large as 15,000. This stock is primarily exploited in or near the river by commercial set gillnet, subsistence, and recreational harvesters. Stock assessment includes: weir counts, direct fishery enumeration for the commercial, subsistence and recreational fisheries, and age, sex, and size sampling in the commercial gillnet and recreational fisheries and in the escapement.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, subsistence, troll
Escapement goal type:	Biological Escapement Goal
Escapement goal:	450 to 1,050 range; 730 point estimate
Population for goal:	Large spawners (3- to 5-ocean-age) in entire drainage
Optimal escapement goal:	None
Inriver goal:	None
Action points:	See *Situk-Ahrnklin Inlet and Lost River King Salmon Fisheries Management Plan* (5 AAC 30.365)
Escapement enumeration:	Weir counts: 1976 to present
Brood years in analysis:	18 (1977 to 1994)
Data in analysis:	Escapement of large spawners, all terminal and near terminal harvests, age structure all years.
Data quality:	Excellent
Contrast in escapements:	4.8
Model used for escapement goal:	Ricker model incorporating correction for autocorrelation seen in the spawner-recruit relationship
Criteria for range:	Range predicted to produce 90% of maximum sustained yield
Value of alpha parameter:	14.806, corrected for autocorrelation
Value of beta parameter:	0.0011135
Value of $sigma^2$ parameter:	Not available
Document supporting goal:	McPherson, S. A., R. E. Johnson and G. F. Woods. 2005. Optimal production of Chinook salmon from the Situk River. Alaska Department of Fish and Game, Fishery Manuscript Series No. 05-04, Anchorage.

Appendix Table A4.1.–Weir counts, harvests, run size, and harvest rates for Situk River Chinook salmon, 1976 to 2011 (2011 data and some recent estimates are subject to revision). The Situk weir count and spawning escapement includes large (≥660 mm MEF, primarily 3+ ocean age) Chinook salmon, whereas the remainder of the statistics include 2-ocean-age fish as well as large Chinook salmon. One-ocean-age jack males are not included in this table, but annual returns of these fish often number over 1,000.

Year	Situk weir count	Spawning escapement	Sport harvest	Gillnet harvest	Subsistence harvest[a]	Total harvest	Total run	Harvest rate
1976	1,421	1,421	200	1,002	41	1,243	2,664	46.7%
1977	1,732	1,732	244	833	24	1,101	2,833	38.9%
1978	808	808	210	382	50	642	1,450	44.3%
1979	1,284	1,284	282	1,028	25	1,335	2,619	51.0%
1980	905	905	353	969	57	1,379	2,284	60.4%
1981	702	702	130	858	62	1,050	1,752	59.9%
1982	434	434	63	248	27	338	772	43.8%
1983	592	592	42	349	50	441	1,033	42.7%
1984	1,726	1,726	146	512	89	747	2,473	30.2%
1985	1,521	1,521	294	484	156	934	2,455	38.0%
1986	2,067	2,067	0	202	99	301	2,368	12.7%
1987	1,379	1,379	75	891	24	990	2,369	41.8%
1988	885	868	185	299	90	574	1,442	39.8%
1989	637	637	0	1	496	497	1,134	43.8%
1990	628	628	0	0	516	516	1,144	45.1%
1991	897	889	88	784	220	1,092	1,981	55.1%
1992	1,618	1,595	172	1,504	341	2,017	3,612	55.8%
1993	980	952	137	790	202	1,129	2,081	54.3%
1994	1,311	1,271	400	2,656	367	3,423	4,694	72.9%
1995	4,700	4,330	1,407	8,107	578	10,092	14,422	70.0%
1996	2,175	1,800	1,529	3,717	559	5,805	7,605	76.3%
1997	2,690	1,878	1,598	2,339	352	4,289	6,167	69.5%
1998	1,353	924	1,156	2,101	594	3,851	4,775	80.6%
1999	1,947	1,461	1,160	3,810	588	5,558	7,019	79.2%
2000	2,518	1,785	1,143	1,318	594	3,055	4,840	63.1%
2001	696	562	235	1,087	402	1,724	2,286	75.4%
2002	1,024	1,000	72	1,078	416	1,566	2,566	61.0%
2003	2,615	2,163	826	2,342	613	3,781	5,944	63.6%
2004	798	698	454	1,222	396	2,072	2,770	74.8%
2005	613	599	255	1	152	408	1,007	40.5%
2006	749	695	64	6	218	288	983	29.3%
2007	677	677	65	83	229	377	1,054	35.7%
2008	413	413	0	91	325	416	829	50.2%
2009	902	902	0	307	297	604	1,506	40.1%
2010	167[b]	167	0	50	140	190	357	53.2%
2011	240	240	0[c]	22	0	22	262	8.4%
Averages:								
76–10	1,302	1,158	361	1,152	261	1,774	2,932	51.3%
06–10	540	479	13	111	198	322	801	37.5%

[a] Subsistence harvests include 400 fish in 1989, 415 in 1990, and 109 in 1991 taken home during commercial openings in those years with non-retention for Chinook salmon.

[b] Weir compromised; partial count.

[c] Preliminary data from Situk River creel survey.

Appendix A5.–Chilkat River Chinook salmon stock.

The Chilkat River produces the fifth or sixth largest population of Chinook salmon in Southeast Alaska (Pahlke 2008). Returning adults are present in terminal marine areas from late April through early July. A spring sport fishery occurs annually in Chilkat Inlet and targets mature Chilkat River Chinook salmon. Stock assessment includes: juvenile coded wire-tagging, estimation of adult escapement, harvest, exploitation, smolt abundance, and survival.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisons of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, subsistence, gillnet, troll
Escapement goal type:	Biological Escapement Goal
Escapement goal:	Spawning escapement: 1,750 to 3,500 range, 2,200 point estimate; inriver run: 1,850 to 3,600
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1981 to 1992 (not used; discontinued in 1992: deemed not representative). Mark-recapture estimates: 1991 to present
Brood years in analysis:	7 (1991 to 1997)
Data in analysis:	Estimated total escapement of large spawners, all terminal and near terminal harvests, age structure all years.
Data quality:	Very good escapement data, but limited to a short time series and low contrast; harvest and exploitation rate data limited, but current coded wire tag program will address this shortfall.
Contrast in escapements:	2.1 (1991 to 1997)
Model used for escapement goal:	Empirical inspection to determine replacement level and appropriate escapement goal range, supported with Ricker model to estimate replacement level. The optimal escapement level (S_{MSY}) was estimated from the relationship between spawners at replacement and S_{MSY} in 10 other Southeast Alaska Chinook stocks.
Criteria for range:	S_{MSY} times 0.8 (lower) and 1.6 (upper), per Eggers (1993)
Value of alpha parameter:	NA
Value of beta parameter:	NA
Value of sigma^2 parameter:	NA
Document supporting goal:	Ericksen, R. P., and S. A. McPherson. 2004. Optimal production of Chinook salmon from the Chilkat River. Alaska Department of Fish and Game, Fishery Manuscript Series No. 04-01, Anchorage.

Appendix Table A5.1.–Inriver run estimates, terminal harvests, terminal run size, and harvest rates for large (≥660 mm MEF, primarily 3+ ocean age) Chilkat River Chinook salmon, from 1991 to 2011. Inriver run estimates are from mark-recapture estimates (2011 data and some recent estimates are subject to revision).

Year	Inriver run[a]	Subsistence harvest	Sport harvest	D115 gillnet harvest[b]	Terminal harvest[c]	Terminal run	Harvest rate
1991	5,897	0	0	233	233	6,130	3.8%
1992	5,284	0	0	124	124	5,408	2.3%
1993	4,472	2	314	220	536	5,008	10.7%
1994	6,795	10	220	68	298	7,093	4.2%
1995	3,790	38	228	38	304	4,094	7.4%
1996	4,920	44	354	45	443	5,363	8.3%
1997	8,100	18	381	165	564	8,664	6.5%
1998	3,675	17	215	113	345	4,020	8.6%
1999	2,271	31	184	279	494	2,765	17.9%
2000	2,035	34	49	45	128	2,163	5.9%
2001	4,517	60	185	38	283	4,800	5.9%
2002	4,051	60	337	32	429	4,480	9.6%
2003	5,657	46	404	27	477	6,134	7.8%
2004	3,422	146	403	108	657	4,079	16.1%
2005	3,366	78	252	165	495	3,861	12.8%
2006	3,039	86	165	16	267	3,306	8.1%
2007	1,445	90	285	16	391	1,836	21.3%
2008	2,905	28	27	4	59	2,964	2.0%
2009	4,429	46	143	68	257	4,686	5.5%
2010	1,815	59	216	93	368	2,183	16.9%
2011[d]	2,803	[e]	236	54	[e]	[e]	[e]
Averages:							
91–10	4,094	45	218	93	358	4,452	8.0%
06–10	2,727	62	167	39	268	2,995	9.0%

[a] Spawning escapement is inriver run minus inriver subsistence harvest, which averages <100 fish. The inriver run goal is 1,850 to 3,600 large spawners.

[b] 1991–2004 harvests in subdistricts 31 and 34 through statistical week 28, 2005–2011 harvests in subdistricts 31 and 32 through statweek 29.

[c] Chilkat Inlet was closed to all fishing during the springs of 1991, 1992, and 2008 because of conservation concerns.

[d] Preliminary estimates before age composition data are available.

[e] Harvest reporting is incomplete.

Appendix A6.–King Salmon River Chinook salmon stock.

The King Salmon River, located on Admiralty Island in northern Southeast Alaska, produces a small run of Chinook salmon (McPherson and Clark 2001). This stock supports no directed fisheries, but is taken incidentally in recreational, drift gillnet, and troll fisheries in marine waters in the region. Stock assessment includes peak survey counts and age/sex/length escapement sampling.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, drift gillnet, and troll
Escapement goal type:	Biological Escapement Goal
Escapement Goal:	Weir count: 120 to 240 range; 150 point estimate Survey count: 80 to 160 range; 100 point estimate
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter or foot surveys: 1971 to present, standardized over the duration. Weir counts: 1983 to 1992
Index count expansion factor:	1.52 (SE = 0.27); multiplier for peak survey count)
Brood years in analysis:	21 (1971 to 1991)
Data in analysis:	Estimated total escapement of large spawners, exploitation assumed similar to nearby hatchery stock, age structure 1982 to 1992 extrapolated to all years.
Data quality:	Excellent
Contrast in escapements:	5.7
Model used for escapement goal:	Ricker model
Criteria for range:	S_{MSY} times 0.8 (lower) and 1.6 (upper), per Eggers (1993)
Value of alpha parameter:	7.8
Value of beta parameter:	0.0054
Value of sigma^2 parameter:	Not available
Document supporting goal:	McPherson, S. and J. H. Clark. 2001. Biological escapement goal for King Salmon River Chinook salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J-0140, Juneau.

Appendix Table A6.1.–Escapement index counts, spawning escapement estimates of large (≥660 mm MEF, primarily 3+ ocean age) spawners, and expansion factors for King Salmon River Chinook salmon from 1971 to 2011. Escapements in bold are weir counts and estimates in italics are from expanded survey counts (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

Year	Survey counts	Spawning escapement	Expansion factor
1971	94	*141*	
1972	90	*135*	
1973	211	*317*	
1974	104	*156*	
1975	42	64	
1976	65	99	
1977	134	204	
1978	57	87	
1979	88	134	
1980	70	106	
1981	101	154	
1982	259	394	
1983	183	**245**	1.17
1984	184	**265**	1.37
1985	105	**175**	1.57
1986	190	**255**	1.25
1987	128	**196**	1.38
1988	94	**208**	2.02
1989	133	**240**	1.59
1990	98	**179**	1.74
1991	91	**134**	1.38
1992	58	**99**	1.71
1993	175	266	
1994	140	213	
1995	97	147	
1996	192	292	
1997	238	362	
1998	88	134	
1999	200	304	
2000	91	138	
2001	98	149	
2002	102	155	
2003	78	119	
2004	89	135	
2005	94	143	
2006	99	150	
2007	119	181	
2008	79	120	
2009	72	109	
2010	104	158	
2011	126	192	
Averages:			
71–10	118	182	
06–10	95	144	

Appendix A7.–Andrew Creek Chinook salmon stock.

Andrew Creek is a lower drainage and U. S. tributary to the transboundary Stikine River that supports a moderate-sized run of Chinook salmon (Clark et al. 1998). Chinook salmon from Andrew Creek are harvested in the U.S. marine recreational fishery out of Petersburg and Wrangell, and in drift gillnet (primarily Districts 106 and 108) and troll fisheries (regionwide). Stock assessment includes: peak survey counts and age/sex/length escapement sampling.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll
Escapement goal type:	Biological Escapement Goal
Escapement goal:	650 to 1,500 range; 800 point estimate
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age); total escapement or expanded survey count
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial, foot, and/or fixed-wing helicopter surveys: 1975 to present, in standardized area and time
Index count expansion factor:	1.95 (SE = 0.45); multiplier for peak survey count
Brood years in analysis:	17 (1975 to 1991)
Data in analysis:	Estimated total escapement of large spawners, assumed annual harvest rates from nearby hatchery stock, age structure measured or inferred from sampled age structure data in 8 years
Data quality:	Good
Contrast in escapements:	5.10
Model used for escapement goal:	Ricker model
Criteria for range:	S_{MSY} times 0.8 (lower) and 1.6 (upper), per Eggers (1993)
Value of alpha parameter:	6.07
Value of beta parameter:	0.0008426
Value of sigma^2 parameter:	Not available
Document supporting goal:	Clark, J. H., S. A. McPherson, and D. M. Gaudet. 1998. Biological escapement goal for Andrew Creek Chinook salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J98-08, Juneau.

Appendix Table A7.1.–Escapement peak survey counts, spawning escapement estimates of large spawners (≥660 mm MEF, primarily 3+ ocean age), and expansion factors for Andrew Creek Chinook salmon, from 1975 to 2011. Escapements in bold are weir counts and estimates in italics are from expanded survey counts (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

Year	Survey counts	Spawning escapement	Expansion factor
1975	260	*507*	
1976		**404**	
1977		**456**	
1978		**388**	
1979	221	**327**	1.48
1980		**282**	
1981	300	**536**	1.79
1982	332	**672**	2.02
1983		**366**	
1984	154	**389**	2.53
1985	320	624	
1986	708	1,381	
1987	788	1,537	
1988	564	1,100	
1989	530	1,034	
1990	664	1,295	
1991	400	780	
1992	778	1,517	
1993	1,060	2,067	
1994	572	1,115	
1995	343	669	
1996	335	653	
1997	293	571	
1998	487	950	
1999	605	1,180	
2000	690	1,346	
2001	1,054	2,055	
2002	876	1,708	
2003	595	1,160	
2004	1,534	2,991	
2005	1,015	1,979	
2006	1,089	2,124	
2007	890	1,736	
2008	503	981	
2009	322	628	
2010	618	1,205	
2011	480	936	
75–10	*610*	1,075	
06–10	*684*	1,335	

Appendix A8.–Unuk River Chinook salmon stock.

The Unuk River is a transboundary river that is the third or fourth largest producer of Chinook salmon in Southeast Alaska (Pahlke 2008). Coded wire tagging studies indicate that the majority of Unuk River Chinook salmon rear in the U.S. portion of the river and spend their marine residence in *inside* waters, but a few recoveries have been recorded as far as Kodiak and northern British Columbia. Stock assessment includes: coded wire-tagging of smolt, estimation of adult escapement, harvest, exploitation, smolt abundance, and survival.

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll
Escapement goal type:	Biological Escapement Goal
Revised escapement goal:	1,800 to 3,800 range ; 2,764 point estimate
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age) to the entire drainage
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Helicopter and foot peak survey counts: 1977 to present in Eulachon River and Clear, Lake, Kerr, Genes Lake, and Cripple creeks
	Mark-recapture estimates: 1994, 1997 to present
Index count expansion factor:	4.83 (SE = 0.59); multiplier for the sum of peak survey counts in revision analysis
Brood years in revision analysis:	12 (1982 to 1986, and 1992 to 1998)
Data in revision analysis:	Expanded survey counts and mark-recapture estimates, marine harvest by age, age structure sampled directly in most years
Data quality:	Good to excellent
Contrast in escapements:	3.7
Model used for escapement goal:	Ricker model using a marine survival covariate
Criteria for range:	Range predicted to produce 90% of *MSY*
Value of alpha parameter:	4.61
Value of beta parameter:	0.0001849
Value of $sigma^2$ parameter:	0.1136
Document supporting goal:	Hendrich, C. F., J. L. Weller, S. A. McPherson, and D. R. Bernard. 2008. Optimal production of Chinook salmon from the Unuk River. Alaska Department of Fish and Game, Fishery Manuscript Series No. 08-03, Anchorage.

Appendix Table A8.1.–Escapement survey counts, spawning escapement estimates of large (≥660 mm MEF, primarily 3+ ocean age) spawners, annual harvest estimates, and harvest rates for Unuk River Chinook salmon from 1977 to 2011. Harvest and harvest rate estimates are germane to 1+ ocean-age fish. Escapement estimates in bold are from mark–recapture studies and estimates in italics are from expanded survey counts (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

Year	Survey count	Spawning escapement[a]	Expansion factor	Landed catch[b]	Incidental mortality[b]	Total run	Harvest rate
1977	974	*4,704*					
1978	1,106	*5,342*					
1979	576	*2,782*					
1980	1,016	*4,907*					
1981	731	*3,531*					
1982	1,351	*6,525*					
1983	1,125	*5,434*					
1984	1,837	*8,873*					
1985	1,184	*5,719*					
1986	2,126	*10,269*					
1987	1,973	*9,530*					
1988	1,746	*8,433*					
1989	1,149	*5,550*					
1990	591	*2,855*					
1991	655	*3,164*					
1992	874	*4,231*					
1993	1,068	*5,158*					
1994[c]	711	*3,434*					
1995	772	*3,729*					
1996	1,167	*5,637*					
1997	636	**2,970**	4.67	379	295	3,067	28.1%
1998	840	**4,132**	4.92	729	279	6,548	19.1%
1999	680	**3,914**	5.76	1,440	743	8,820	29.9%
2000	1,341	**5,872**	4.38	2,055	6338	11,247	27.5%
2001	2,019	**10,541**	5.22	1,724	365	13,639	17.1%
2002	897	**6,988**	7.79	1,557	278	10,639	18.9%
2003	1,121	**5,546**	4.95	1,434	403	8,373	25.4%
2004	1,008	**3,963**	3.93	1,279	844	8,582	29.2%
2005	929	**4,742**	5.10	2,582	748	9,261	41.5%
2006	940	**5,645**	6.01	2,112	636	10,801	28.5%
2007	720	**5,668**	7.87	2,036	507	9,413	29.6%
2008	103[d]	**3,104**	30.1	805	298	5,420	24.5%
2009	687	**3,157**	4.60	1,045	385	6,420	26.1%
2010	732	**4,854**	5.86	1,732	[e]	[e]	[e]
2011	431	**3,272**	7.59	[e]	[e]	[e]	[e]
Averages:							
77–10	1,041	5,262		1,494	932	8,633	26.6%
06–10	636	4,486		1,546	457	8,014	27.2%

[a] The expansion factor 4.83 (SE = 0.59), based on the 1997–2001 and 2003–2004 mark-recapture estimates, was used to convert survey counts to total escapement of large spawners for years prior to 1997.

[b] Harvest estimates are in adult equivalents.

[c] A mark-recapture experiment was conducted in 1994 to estimate escapement, but the data were biased. The expanded survey count was used for the revised goal analysis.

[d] Partial count. Three tributaries that on average account for 80% of the count were not surveyed.

[e] Harvest information was unavailable at press time.

[f] Through 2009.

Appendix A9.–Chickamin River Chinook salmon stock.

The Chickamin River produces between 5,000 to 10,000 Chinook salmon annually. Harvest is spread throughout the fisheries of southern and central Southeast Alaska, with occasional recoveries in outside waters as far north as Prince William Sound and as far south as northern British Columbia. Stock assessment includes peak survey counts and age/sex/length data escapement sampling

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll
Escapement goal type:	Biological Escapement Goal
Escapement goal:	450 to 900 range; 525 point estimate
Population for goal:	Large spawners (≥660 mm MEF, primarily 3+ ocean age) as counted in peak survey counts in South Fork and Leduc rivers, and Barrier, Butler, Indian, Humpy, King, and Clear creeks.
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Helicopter and foot peak survey counts: 1975 to present in standard time and areas on: South Fork, Barrier, Butler, Leduc, Indian, Humpy, King, and Clear Falls tributaries. Mark-recapture estimates: 1995 to 1996, and 2001 to 2003
Index count expansion factor:	4.75 (SE = 0.70); multiplier for the sum of peak survey counts
Brood years in analysis:	15 (1975 to 1989)
Data in analysis:	Expanded survey counts, marine harvest by age for 5 wild broods with adjusted hatchery harvest data for the remainder, age structure estimated directly in about half of the years, estimated for all broods.
Data quality:	Fair
Contrast in escapements:	11.1
Model used for escapement goal:	Ricker model
Criteria for range:	S_{MSY} times 0.8 (lower) and 1.6 (upper), per Eggers (1993)
Value of alpha parameter:	7.46
Value of beta parameter:	0.0003446
Value of sigma^2 parameter:	Not available
Document supporting goal:	McPherson, S. A. and J. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J97-06, Juneau.

Appendix Table A9.1.–Escapement survey counts, spawning escapement estimates of large (≥660 mm MEF, primarily 3+ ocean age) spawners, and expansion factors for Chickamin River Chinook salmon from 1975 to 2011. Escapement estimates in bold are from mark-recapture studies and estimates in italics are from expanded survey counts (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

Year	Survey count	Spawning escapement	Expansion factor
1975	370	*1,758*	
1976	157	*746*	
1977	363	*1,724*	
1978	308	*1,463*	
1979	239	*1,135*	
1980	445	*2,114*	
1981	384	*1,824*	
1982	571	*2,712*	
1983	599	*2,845*	
1984	1,102	*5,235*	
1985	956	*4,541*	
1986	1,745	*8,289*	
1987	975	*4,631*	
1988	786	*3,734*	
1989	934	*4,437*	
1990	564	*2,679*	
1991	487	*2,313*	
1992	346	*1,644*	
1993	389	*1,848*	
1994	388	*1,843*	
1995	356	**2,309**	6.5
1996	422	**1,587**	3.8
1997	272	*1,292*	
1998	391	*1,857*	
1999	501	*2,380*	
2000	801	*3,805*	
2001	1,010	**5,177**	5.1
2002	1,013	**5,007**	4.9
2003	964	**4,579**	4.8
2004	798	**4,268**	5.3
2005	924	**4,257**	4.6
2006	1,330	*6,318*	
2007	893	*4,242*	
2008	1,111	*5,277*	
2009	611	*2,902*	
2010	1,156	*5,491*	
2011	853	*4,052*	
Averages:			
75–10	685	3,285	
06–10	1,020	4,846	

The Keta River produces a small run of Chinook salmon representing about 3% of the wild stock production in Southeast Alaska (Pahlke 2008). This stock primarily produces yearling (age-1.) smolt, but about 10% are sub-yearling fish (age-0.). The only other stocks that produce sub-yearling smolt, to any degree, are the Blossom River stock and those in the Yakutat Forelands area, such as the Situk River. Information inferred from coded wire tagging studies in the nearby Chickamin and Unuk rivers suggests that Keta River Chinook salmon are *inside rearing*, spending most of their lives in Southeast Alaska, and perhaps northern British Columbia, waters. Stock assessment includes peak survey counts and age/sex/length data escapement sampling.

An escapement goal of 250–500 large (≥660 mm MEF) fish, as counted in aerial surveys, was established for Keta River Chinook salmon in 1997. At that time, information was limited to aerial survey counts (1975–1995) expanded by hypothetical expansion factors, 2 years of escapement age composition data, and harvest estimates from fish produced by hatcheries near Ketchikan and on south Baranof Island (scaled by limited wild stock harvest information). Since that time, an empirically-derived expansion factor was developed, 12 years of additional escapement and 10 additional years of escapement age composition data were collected, and 15 years of exploitation rate information from a nearby wild Chinook salmon stock were available.

Production of adult Chinook salmon from the Keta River, a Behm Canal stock, was re-investigated using estimates of inriver returns, relative age composition, and escapements (mark-recapture estimates, and expanded aerial survey counts) collected in 1975–2007. Exploitation rates from the nearby Unuk River stock were fit to a hierarchical model and used as proxies to estimate total returns. An age-structured Ricker spawner-recruit model was fitted to the data, which allowed estimation of key population reference points and an informed choice of escapement goals. Bayesian statistical methods were employed to provide realistic assessment of uncertainty in the presence of measurement error, serial correlation (i.e., similarity between observations as a function of time), and missing data.

The results of the analysis were used to construct sustained yield and overfishing probability profiles, which were then used to select an escapement goal. The Keta River Chinook stock is passively managed, and for non-targeted stocks like this one, the lower bound of the escapement goal is most critical. The lower bound should be high enough to minimize the possibility of recruitment overfishing, yet low enough to not exclude the best opportunities for high yield. Specifically, fishing down to the lower bound should pose a small risk of reducing yields below some high percentage of maximum yield (overfishing profiles in Figure A10.1). Also, escapements above the lower bound should have greater sustained yield potential than escapements below the lower bound, i.e., the lower bound should be to the left of the sustained yield probability maxima in Figure A10.1.

A lower bound of 175 large fish observed in aerial surveys is recommended. At this level of average spawning abundance, there is an 87% chance of achieving optimum yield (i.e., a sustained yield of ≥80% of maximum sustained yield). At average survey counts less than 175 fish, the risk of overfishing sharply increases and the potential for optimal yield sharply decreases. An upper bound of 400 large fish is recommended and occurs at the inflection point on the descending arm of the sustained yield profile where there is a 48% chance of achieving 80% of maximum sustained yield. Using this goal, Keta River survey counts have been at or above the lower bound in 35 of 37 years since 1975 (Table A10.1).

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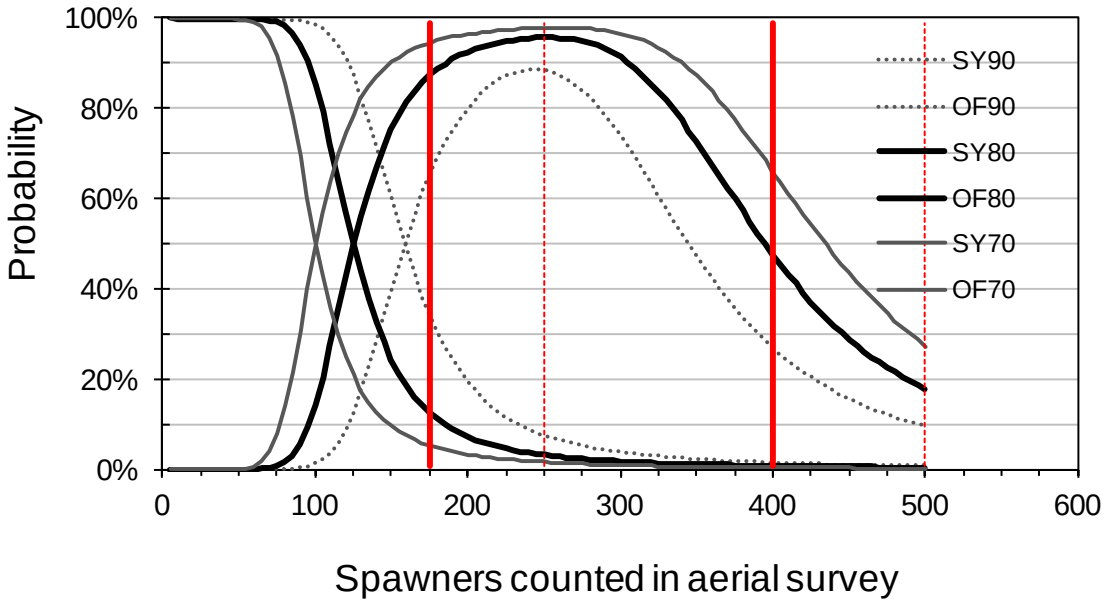
Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll; non directed
Escapement goal type:	Biological Escapement Goal
Escapement goal:	175 to 400 range
Population for goal:	Large spawners (≥660 mm MEF, 2+ ocean age) as counted in peak survey counts under standardized survey conditions (time and area).
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1975 to present, standardized by time and area. Mark-recapture estimates: 1998 to 2000
Index count expansion factor:	3.01 (SE = 0.56); multiplier for helicopter peak survey standardized survey area on the Keta River.
Brood years in analysis:	29 (1975 to 2003)
Data in analysis:	Expanded survey counts, harvest rates assumed from the Unuk River, age structure limited, but estimated for all broods.
Data quality:	Fair
Contrast in escapements:	13.8
Model used for escapement goal:	Bayesian age-structured analysis using Ricker model
Value of alpha parameter:	4.05
Value of beta parameter:	0.0009
Value of $sigma^2$ parameter:	0.26
Document supporting current goal:	Fleischman, S. J., J. A. Der Hovanisian, and S. A. McPherson. 2011. Escapement goals for Chinook salmon in the Blossom and Keta rivers. Alaska Department of Fish and Game, Fishery Manuscript Series No. 11-05, Anchorage.

Appendix Table A10.1.–Escapement survey counts, spawning escapement estimates of large (≥660 mm MEF, 2+ ocean age) spawners, and expansion factors, for Keta River Chinook salmon from 1975 to 2011. Escapement estimates in bold are from mark–recapture studies and estimates in italics are from expanded survey counts (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

Year	Survey count	Spawning escapement	Expansion factor
1975	203	*611*	
1976	84	*253*	
1977	230	*692*	
1978	392	*1,180*	
1979	426	*1,282*	
1980	192	*578*	
1981	329	*990*	
1982	754	*2,270*	
1983	822	*2,474*	
1984	610	*1,836*	
1985	624	*1,878*	
1986	690	*2,077*	
1987	768	*2,312*	
1988	575	*1,731*	
1989	1,155	*3,477*	
1990	606	*1,824*	
1991	272	*819*	
1992	217	*653*	
1993	362	*1,090*	
1994	306	*921*	
1995	175	*527*	
1996	297	*894*	
1997	246	*740*	
1998	180	**446**	2.5
1999	276	**968**	3.5
2000	300	**914**	3.0
2001	343	*1,032*	
2002	411	*1,237*	
2003	322	*969*	
2004	376	*1,132*	
2005	497	*1,496*	
2006	747	*2,248*	
2007	311	*936*	
2008	363	*1,093*	
2009	172	*518*	
2010	475	*1,430*	
2011	223	*671*	
Averages:			
75–10	420	1,265	
06–10	414	1,245	



Appendix Figure A10.1.–Probability that a specified average survey count of Keta River Chinook salmon will result in sustained yield exceeding 70%, 80%, and 90% of maximum sustained yield (*MSY*) hump-shaped functions), and probability of overfishing such that sustained yield is reduced to less than 70%, 80%, and 90% of *MSY* (monotonically decreasing functions). From Bayesian age-structured spawner-recruit analysis of Keta River Chinook salmon, 1975-2007. Vertical lines are current (dashed) and recommended (solid) escapement goals. SY = sustained yield, OF = overfishing.

The Blossom River produces less than 1% of the wild stock production in Southeast Alaska (Pahlke 2008). The stock produces primarily yearling smolt (age-1.), but returns have comprised as much as 15% sub yearling fish (age-0.). Coded wire-tagging of Unuk and Chickamin Chinook wild and hatchery stocks suggest that Blossom River Chinook salmon are *inside rearing*, spending most of their lives in Southeast Alaska waters and to a lesser extent, in northern British Columbia. About 75% of the 2-ocean-age spawners in the Blossom River are of legal size. Stock assessment includes peak survey counts and age/sex/length data escapement sampling.

An escapement goal of 250-500 large (≥660 mm MEF) fish, as counted in aerial surveys, was established for Blossom River Chinook salmon in 1997. At that time, information was limited to aerial survey counts (197–1995) expanded by hypothetical expansion factors, 1 year of escapement age composition data, and harvest estimates from fish produced by hatcheries near Ketchikan and on south Baranof Island (scaled by limited wild stock harvest information). Since that time, an empirically-derived expansion factor was developed, 12 years of additional escapement and 10 additional years of escapement age composition data were collected, and 15 years of exploitation rate information from a nearby wild Chinook salmon stock were available.

Production of adult Chinook salmon from the Blossom River, a Behm Canal stock, was re-investigated using estimates of inriver returns, relative age composition, and escapements (mark-recapture estimates, and expanded aerial survey counts based) collected in 1975–2007. Exploitation rates from the nearby Unuk River stock were fit to a hierarchical model and used as proxies to estimate total returns. An age-structured Ricker spawner-recruit model was fitted to the data, which allowed estimation of key population reference points and an informed choice of escapement goals. Bayesian statistical methods were employed to provide realistic assessment of uncertainty in the presence of measurement error, serial correlation (i.e., similarity between observations as a function of time), and missing data.

The results of the analysis were used to construct sustained yield and overfishing probability profiles, which were then used to select an escapement goal. The Blossom River Chinook stock is passively managed, and for non-targeted stocks like this one, the lower bound of the escapement goal is most critical. The lower bound should be high enough to minimize the possibility of recruitment overfishing, yet low enough to not exclude the best opportunities for high yield. Specifically, fishing down to the lower bound should pose a small risk of reducing yields below some high percentage of maximum yield (overfishing profiles in Figure A11.1). Also, escapements above the lower bound should have greater sustained yield potential than escapements below the lower bound, i.e., the lower bound should be to the left of the sustained yield probability maxima in Figure A11.1.

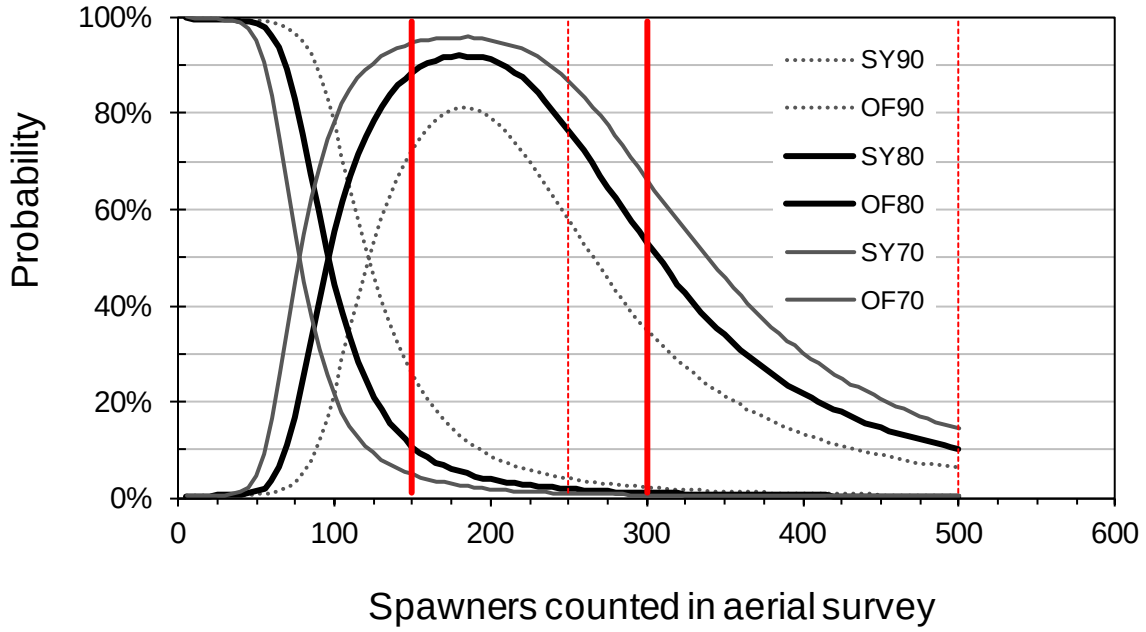
A lower bound of 150 large fish observed in aerial surveys is recommended. At this level of average spawning abundance, there is an 88% chance of achieving optimum yield (i.e., a sustained yield of ≥80% of maximum sustained yield). At average survey counts less than 150 fish, the risk of overfishing sharply increases and the potential for optimal yield sharply decreases. An upper bound of 300 large fish is recommended and occurs at the inflection point on the descending arm of the sustained yield profile where there is a 53% chance of achieving 80% of maximum sustained yield. Using this goal, Blossom River survey counts have been at or above the lower bound in 26 of 37 years since 1975 (Table A11.1).

Outline of stock management, assessment and escapement goal analysis

Management division:	Divisions of Sport and Commercial Fisheries
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll; non directed
Escapement goal type:	Biological Escapement Goal
Escapement goal:	150 to 300 range
Population for goal:	Large spawners (≥660 mm MEF, 2+ ocean age) as counted in peak survey counts under standardized survey conditions (time and area).
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1975 to present, standardized by time and area.
	Mark-recapture estimate: 1998 and 2004–2006
Index count expansion factor:	3.87 (SE = 0.62): multiplier for helicopter peak survey count, based on 2 years (1998 and 2006).
Brood years in analysis:	29 (1975 to 2003)
Data in analysis:	Expanded survey counts, harvest rates assumed from the Unuk river, age structure limited, but estimated for all broods
Data quality:	Fair
Contrast in escapements:	25.0
Model used for escapement goal:	Bayesian age-structured analysis using Ricker model
Value of alpha parameter:	4.05
Value of beta parameter:	0.0011
Value of $sigma^2$ parameter:	0.16
Document supporting current goal:	Fleischman, S. J., J. A. Der Hovanisian, and S. A. McPherson. 2011. Escapement goals for Chinook salmon in the Blossom and Keta rivers. Alaska Department of Fish and Game, Fishery Manuscript Series No. 11-05, Anchorage.

Appendix Table A11.1.–Escapement index counts, spawning escapement estimates of large (≥660 mm MEF, 2+ ocean age) spawners, and expansion factors for Blossom River Chinook salmon population from 1975 to 2011. Escapement estimates in bold are from mark–recapture studies and estimates in italics are from expanded survey counts. (2011 data, some recent estimates, and estimates based on expanded survey counts are subject to revision).

Year	Survey counts	Spawning escapement	Expansion factor
1975	146	*565*	
1976	68	*263*	
1977	112	*433*	
1978	143	*553*	
1979	54	*209*	
1980	89	*344*	
1981	159	*615*	
1982	345	*1,335*	
1983	589	*2,279*	
1984	508	*1,966*	
1985	709	*2,744*	
1986	1,278	*4,946*	
1987	1,349	*5,221*	
1988	384	*1,486*	
1989	344	*1,331*	
1990	257	*995*	
1991	239	*925*	
1992	150	*581*	
1993	303	*1,173*	
1994	161	*623*	
1995	217	*840*	
1996	220	*851*	
1997	132	*511*	
1998	91	**364**	4.0
1999	212	*820*	
2000	231	*894*	
2001	204	*789*	
2002	224	*867*	
2003	203	*786*	
2004	333	**734**	2.2
2005	445	**926**	2.0
2006	339	**1,270**	3.8
2007	135	*522*	
2008	257	*995*	
2009	123	*476*	
2010	180	*697*	
2011	147	*569*	
Averages:			
75–10	304	1,137	
06–10	207	900	



Appendix Figure A11.1.–Probability that a specified average survey count of Blossom River Chinook salmon will result in sustained yield exceeding 70%, 80%, and 90% of maximum sustained yield (*MSY*) (hump-shaped functions), and probability of overfishing such that sustained yield is reduced to less than 70%, 80%, and 90% of *MSY* (monotonically decreasing functions). From Bayesian age-structured spawner-recruit analysis of Blossom River Chinook salmon, 1975-2007. Vertical lines are current (dashed) and recommended (solid) escapement goals. SY = sustained yield, OF = overfishing.