Special Publication No. 05-22

Stock Status and Escapement Goals for Salmon in Southeast Alaska 2005

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and

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Editors

November 2005

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)

Measures (fisheries)	
fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL
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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by

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November 2005

Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K); Chinook LOA Funding (NOAA grants 1998–2006), the Southeast Sustainable Salmon Fund, and ongoing grants from the National Oceanic and Atmospheric Administration to fund the Southeast Alaska Anadromous Salmon Project.

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This document should be cited as follows:

a) in its entirety:

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

b) for citation of a chapter, e.g., for coho salmon:

Shaul, L, S. E. Jones, and K. Crabtree. 2005. Coho salmon stock status and escapement goals in Southeast Alaska [in] Der Hovanisian, J. A. and H. J. Geiger, editors. Stock status and escapement goals for salmon stocks in Southeast Alaska 2005. Alaska Department of Fish and Game, Special Publication No. 05-22, Anchorage.

FORWARD

Enclosed you will find information on the current status of Pacific salmon stocks in Southeast Alaska and the Yakutat area. All major stocks were reviewed for listing as *stocks of concern* as defined by the Sustainable Salmon Fisheries Policy, and escapement goals were developed, reviewed, or revised for most major stocks or stock groups following the guidelines of this policy.

In 2004, escapement goals for major stocks of all five species of Pacific salmon in Southeast Alaska, together with complete documentation of the methods used to establish the goals and supporting data, were reported under one cover. We followed suit in this report, but abbreviated the discussions for stocks with escapement goals that have not changed. In instances where escapement goals have been revised, we have provided detailed descriptions of the methods used in the analyses. For goals that are in the process of being revised, we included a brief discussion of planned and ongoing analyses. We updated many datasets, including some of the escapement estimates, and several of the changes were extensive.

For citation of the entire report, we suggest the following:

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

For citation of a chapter, we suggest the following format:

Shaul, L., S. E. Jones, and K. Crabtree. 2005. Coho salmon stock status and escapement goals in Southeast Alaska [*in*] Der Hovanisian, J. A. and H. J. Geiger, *editors*. Stock status and escapement goals for salmon stocks in Southeast Alaska 2005. Alaska Department of Fish and Game, Special Publication No. 05-22, Anchorage.

Finally, we thank Robert Clark and Andy McGregor for their help with the extensive review. We also thank Judy Shuler and Joanne MacClellan for preparing the final manuscript for publication.

—John Der Hovanisian and Hal Geiger

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CHAPTER 1: CHINOOK SALMON STATUS AND ESCAPEMENT GOALS FOR STOCKS IN SOUTHEAST ALASKA

by

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PROJECT SPONSORSHIP

Development of this manuscript was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K), Chinook LOA Funding (NOAA grants from 1998 to 2002) and the Southeast Sustainable Salmon Fund.

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ABSTRACT

Chinook salmon *Oncorhynchus tshawytscha* escapements in 11 drainages were evaluated for trends and tracking in relationship to *biological escapement goals* that have been developed for each system, and all are judged to be healthy. Escapement goals for the Unuk, Blossom and Keta river stocks are being updated; results of these analyses will be available prior to the 2006 Board of Fisheries meeting on Southeast Alaska finfish. Methods for determining these three escapement goals are described, and reports containing the detailed analyses for all 11 stocks are cited.

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 incidentally 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 described in other Alaska Board of Fisheries 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 aggregate abundance of all Chinook salmon stocks that are present in Southeast Alaska for the coming year (PSC CTC 2002). The preseason abundance is estimated from the Pacific Salmon Commission Chinook model run by the Chinook Technical Committee, with membership from Alaska, British Columbia, Washington, Oregon, and Idaho. Presently, the all-gear quota is allocated by the Alaska Board of Fisheries between commercial and recreational users as follows: (1) 8,600 Chinook salmon to the gillnet fleet; (2) 4.3% of the total to the purse seine fleet; (3) 80% of the remainder to the troll fleet; and (4) 20% of the remainder to the recreational fleet. Additionally, in February 2005, the U.S. and Canada reached a bilateral terminal harvest sharing agreement for directed Taku and Stikine river Chinook fisheries.

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 from British Columbia or Yukon Territory, Canada, (Kissner 1977). Local Alaska hatchery stocks contribute a sizeable portion of Southeast Alaska Chinook harvests each year (Table 1.1).

STOCK STATUS

Stock status for Chinook salmon stocks in the Southeast region 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 Sustainable Salmon Fisheries Policy (ADF&G and BOF *unpublished*; 5 AAC 39.222). We briefly summarize the assessment program below.

STOCK ASSESSMENT PROGRAM

In the mid-1970s it became apparent that many of the 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 *unpublished*). 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 for all wild stocks of Chinook salmon, under the auspices of the U.S./Canada Pacific Salmon Treaty. In 1999, the Pacific Salmon Treaty was re-signed after extensive negotiations. The Chinook chapter of the new agreement specified coastwide, abundance-based management of Chinook salmon stocks, and called for more comprehensive stock and fishery monitoring.

In the 1970s, a stock assessment program was developed to provide information for tools to manage Chinook 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, and exploitation rates and patterns. Programs are in place in 11 rivers (Figure 1.1) to sample, enumerate and collect biological data from the escapements. These rivers represent all of the region's major producers (production greater than 10,000 fish), seven medium producers (production of 1,500 to 10,000 fish), and one minor producer (production 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 ten 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 (Table 1.2), 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 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. Radio telemetry projects have been conducted once or twice on all major systems to determine spawning distribution and to verify that survey counts were being conducted over the major spawning areas. 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. Selected descriptions and results of the inriver stock assessment programs are contained in Appendix 1.

HARVEST PROGRAMS

Commercial harvests are reported on fish tickets and sport harvests are estimated by creel 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 at present, the five largest stocks in Southeast Alaska are not included in the Chinook Technical Committee Chinook model in part because this information is not available. This is being addressed by two programs: coded wire tagging of wild Chinook stocks in the region and a genetic stock identification program. Fishery sampling of coded wire tags and genetic sampling has been increased in the past few years to improve our estimates of stock composition. Five wild stocks of Chinook salmon are being coded wire tagged at present in the region: the Chilkat, Taku, Stikine, Unuk and Chickamin River stocks. 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.

STOCK STATUS ASSESSMENT

In this section, the status of wild Chinook stocks are evaluated through 2005. The Sustainable Salmon Fisheries Policy (ADF&G and BOF *unpublished*) specifies guidelines to manage salmon stocks for sustainability. Our stock assessment and management program for Chinook salmon in Southeast Alaska should provide a sustained resource, i.e., follow the Sustainable Salmon Fisheries Policy.

Escapement goals for the 11 index stocks of Chinook salmon have been established. These *biological escapement goal* ranges 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 within the *biological escapement goal* ranges wherever possible, and are developed with significant input from the public and users. Escapements have been evaluated in the 11 index stocks against the *biological escapement goal* ranges established for each stock to determine stock status. Escapements were assessed retrospectively back to 1975 as if the current *biological escapement goal* had been in place.

All 11 index stocks are judged to be healthy—estimated escapements have been within or above the escapement goal ranges for all 11 stocks the past two years, and for majority of stocks in all years during the past two decades (Table 1.3 and Figures 1.2, 1.3, and 1.4). Escapement goals for the Unuk, Blossom and Keta rivers are being revised, but revisions are not expected to change this general assessment.

ESCAPEMENT GOALS

At the 2003 Alaska Board of Fisheries meeting for Southeast Region finfish, it was reported that *biological escapement goal* ranges had been established or updated for 11 Chinook index systems in Southeast Alaska. Since that time, we have been revising escapement goals for the Unuk, Blossom and Keta river stocks. In this section, we provide a brief history of the escapement goals for these three stocks, and a brief discussion of the detailed analyses we are using to develop new goals. In Appendix 1, a section is included for each of the 11 stocks, which briefly describes the stock and fisheries that harvest it, key stock assessment data, and the current escapement goal.

Table 1.1–Southeast Alaska Chinook salmon harvest levels and Alaska hatchery contributions in Southeast Alaska harvests, from 1965 to 2004, in thousands of Chinook salmon (2004 data and some recent harvests subject to revision)[a].

Year	Commercial harvest	Sport harvest	Total all gear Southeast Alaska harvest	Alaska hatchery contribution	Southeast Alaska harvest minus AK hatchery contribution
1965	337	13	350	0	350
1966	308	13	321	0	321
1967	301	13	314	0	314
1968	331	14	345	0	345
1969	314	14	328	0	328
1970	323	14	337	0	337
1971	334	15	349	0	349
1972	286	15	301	0	301
1973	344	16	360	0	360
1974	346	17	363	0	363
1975	301	17	318	0	318
1976	242	17	259	0	259
1977	285	17	302	0	302
1978	401	17	416	0	418
1979	366	17	383	0	383
1980	324	20	344	6	338
1981	268	21	289	2	287
1982	289	26	315	1	314
1983	290	22	312	3	309
1984	268	22	290	6	284
1985	250	25	275	13	262
1986	259	23	282	17	265
1987	258	24	282	24	258
1988	253	26	279	29	250
1989	260	31	291	29	262
1990	316	51	367	54	313
1991	299	60	359	70	289
1992	216	43	259	44	215
1993	255	49	304	40	264
1994	222	42	264	36	228
1995	186	50	236	69	167
1996	178	58	236	80	156
1997	271	72	343	53	289
1998	216	55	271	31	239
1999	179	72	251	55	196
2000	200	63	263	82	181
2001	194	72	266	85	180
2002	357	70	427	77	350
2003	331	49	380	66	314
2004	363	66	429	81	348

[a] Harvests statistics for 1975-2002 from Gaudet et al. (2004).

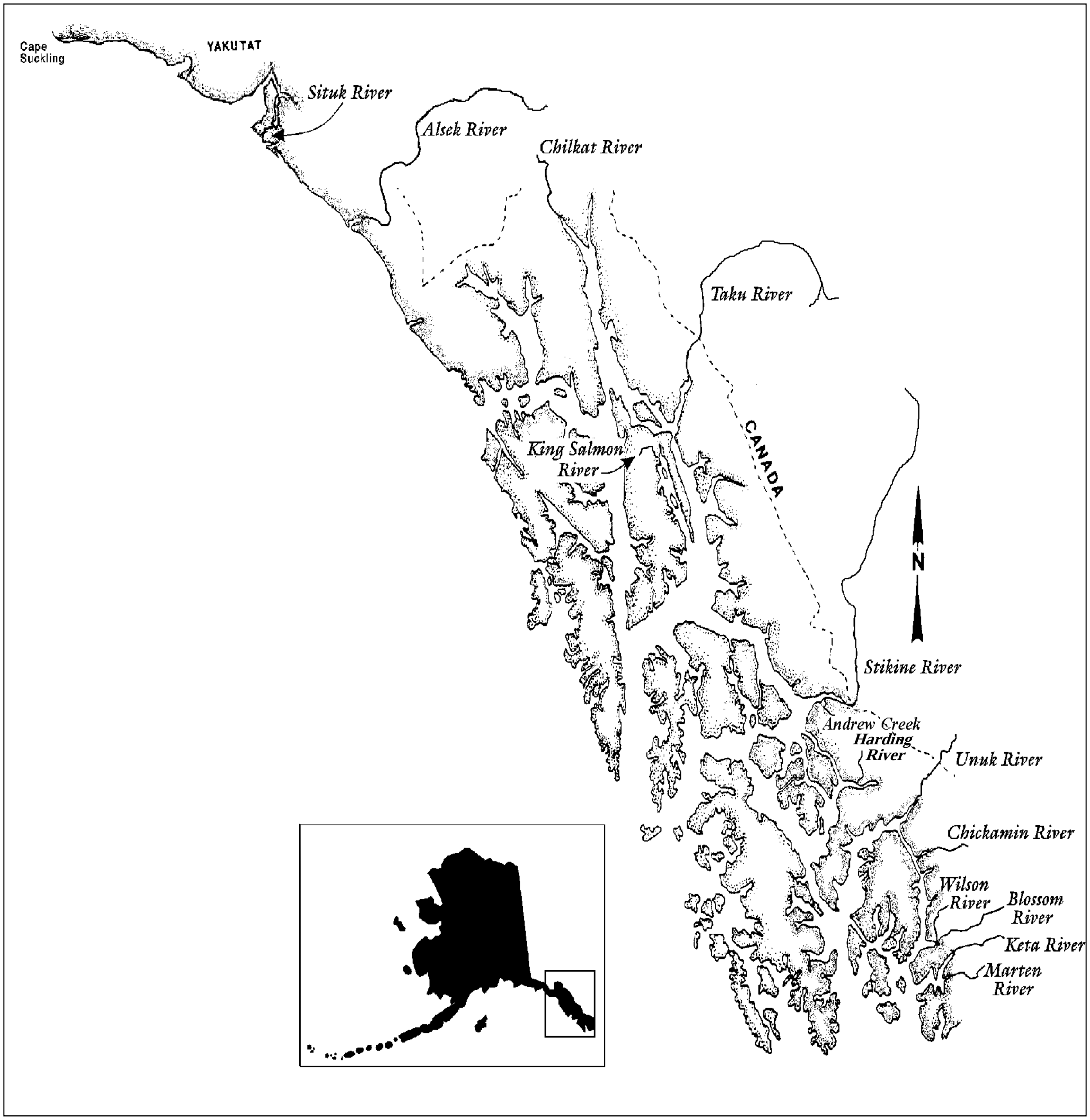

Figure 1.1–Location of selected Chinook salmon systems in Southeast Alaska, Yakutat, and transboundary rivers.

UNUK RIVER

In 1981 the ADF&G escapement goal was 1,800 large index spawners. This goal was mistakenly based on a 1978 count thought to be 1,765 fish, which was revised downward in 1985 to 1,106 fish upon discovery that some tributary counts were entered twice. The corrected count was still the largest pre-1981 index count. In 1994, ADF&G revised the goal to 875 large index spawners,

Table 1.2–Estimated total escapements of Chinook salmon to escapement indicator systems and to Southeast Alaska and transboundary rivers, from 1975 to 2005. (2005 data and some recent estimates are subject to revision). Numbers in bold type are weir counts or mark–recapture total estimates.

	MAJOR SYSTEMS			MEDIUM SYSTEMS							Minor	
Year	Alsek (Klukshu) [a]	Taku	Stikine	Situk	Chilkat	Andrew	Unuk[a]	Chickamin[a]	Blossom[a]	Keta[a]	King Salmon	Total[b]
1975		12,920	7,571			520		1,717	584	609	63	NA
1976	5,267	24,582	5,723	**1,421**		**404**		727	272	252	98	43,350
1977	13,355	29,496	11,445	**1,732**		**456**	4,706	1,682	448	690	201	67,193
1978	12,524	17,124	6,835	**808**		**388**	5,344	1,431	572	1,176	86	48,408
1979	15,365	21,617	12,610	**1,284**		**327**	2,783	1,107	216	1,278	132	59,365
1980	12,311	39,239	30,573	**905**		**282**	4,909	2,063	356	576	105	95,582
1981	9,717	49,559	36,057	**702**		**536**	3,532	1,782	636	987	152	108,510
1982	9,747	23,848	40,488	**434**		**672**	6,528	2,649	1,380	2,262	389	92,468
1983	11,073	9,794	6,424	**592**		**366**	5,436	2,781	2,356	2,466	**245**	43,380
1984	7,781	20,778	13,995	**1,726**		**389**	8,876	5,113	2,032	1,830	**265**	65,602
1985	6,351	35,916	16,037	**1,521**		638	5,721	4,436	2,836	1,872	**175**	78,937
1986	12,905	38,111	14,889	**2,067**		1,414	10,273	8,097	5,112	2,070	**255**	99,457
1987	12,330	28,935	24,632	**1,379**		1,576	9,533	4,524	5,396	2,304	**196**	94,880
1988	9,870	44,524	37,554	**868**		1,128	8,437	3,647	1,536	1,725	**208**	114,547
1989	10,900	**40,329**	24,282	**637**		1,060	5,552	4,334	1,376	3,465	**240**	96,417
1990	8,405	**52,142**	22,619	**628**		1,328	2,856	2,617	1,028	1,818	**179**	97,985
1991	11,004	51,645	23,206	**889**	**5,897**	800	3,165	2,260	956	816	**134**	100,770
1992	6,153	55,889	34,129	**1,595**	**5,284**	1,556	4,223	1,605	600	651	**99**	111,783
1993	15,944	66,125	58,962	**952**	**4,472**	2,120	5,160	1,805	1,212	1,086	263	158,099
1994	17,919	48,368	33,094	**1,271**	**6,795**	1,144	3,435	1,800	644	918	210	116,786
1995	26,715	**33,805**	16,784	**4,330**	**3,790**	686	3,730	**2,309**	868	525	146	93,686
1996	16,741	**79,019**	**28,949**	**1,800**	**4,920**	670	5,639	**1,587**	880	891	288	141,382
1997	14,004	**114,938**	**26,996**	**1,878**	**8,100**	586	**2,970**	1,262	528	738	357	172,357
1998	**4,621**	31,039	**25,968**	**924**	**3,675**	974	**4,132**	1,814	**364**	**446**	132	74,089
1999	**11,597**	**19,734**	**19,947**	**1,461**	**2,271**	1,210	**3,914**	2,283	848	**968**	300	64,533
2000	**8,295**	**30,529**	**27,531**	**1,785**	**2,035**	1,380	**5,872**	3,717	924	**913**	137	83,117
2001	**11,022**	**42,980**	**63,523**	**656**	**4,517**	2,108	**10,541**	**5,177**	816	1,029	147	142,516
2002	**8,504**	**52,409**	**50,875**	**1,000**	**4,051**	1,752	**6,988**	**5,007**	896	1,233	153	132,868
2003	**4,932**	**36,435**	**46,824**	**2,117**	**5,657**	1,190	**5,546**	**4,579**	812	966	117	109,195
2004	**7,343**	**69,199**	**48,900**	**757**	**3,422**	3,068	**3,963**	**3,275**	**734**	1,128	134	141,923
2005	5,297	**36,671**	38,043	**613**	**3,470**	2,030	4,489	4,287	**912**	1,491	141	97,444

[a] Escapements for the four Behm Canal systems are shown here for total escapement, to provide comparisons of magnitude across systems. Escapement goals for these four systems are for survey counts at present and are shown in Table 1.3 and Figure 1.4. Likewise, the escapement goal for the Alsek River is 1,100 to 2,300 Chinook salmon past the Klukshu River weir, which represents approximately 20% of the Chinook salmon production in the Alsek River.

[b] Total includes the estimated totals of large spawning Chinook across all 11 systems. Escapements for the Chilkat River were approximated from 1976 to 1990 to make the totals comparable across years.

Table 1.3–Estimated biological escapement goal ranges for 11 Chinook salmon stocks in Southeast Alaska. These biological escapement goals include large spawners of approximate legal retention size (28 inches total length) and do not include smaller 1- and 2-ocean-age males.

	Chinook salmon stock	***Biological escapement goal* range for large spawners in survey count**	**2001–2005 survey count average**	**Present survey expansion factor**	***Biological escapement goals* range for large spawners estimated in total escapement**	**2001–2005 total escapement average**
1	Chilkat River [a]	NA	NA	NA	1,750-3,500	4,223
2	King Salmon River [b]	80–160	92	1.50	120–240	138
3	Andrew Creek [b]	375–750	1,015	2.00	650–1,500	2,030
4	Blossom River [b]	250–500	282	4.00	NA	834
5	Keta River [b]	250–500	390	3.00		1,169
6	Unuk River [b]	650–1,400	1,195	4.83		6,305
7	Chickamin River [b]	450–900	942	4.64		4,465
8	Situk River [c]	NA	NA	NA	450–1,050	1,029
9	Klukshu (Alsek) River [d]	1,100–2,300	1,827	4.95		7,420
10	Taku River [d]	5,800–10,600	6,346	5.20	30,000–55,000	47,339
11	Stikine River [d]	2,700–5,300	9,674	5.15	14,000–28,000	49,633

[a] The above *biological escapement goal* range has been approved by review teams from ADF&G and the Chinook Technical Committee of the Pacific Salmon Commission.

[b] The above *biological escapement goal* ranges have been approved by review teams from ADF&G and the Chinook Technical Committee of the Pacific Salmon Commission. *Biological escapement goals* for the Blossom, Keta, Unuk and Chickamin rivers are expressed as survey count goals. Escapement goals for the Unuk, Blossom, and Keta rivers are being revised and will be available for review by the Alaska Board of Fisheries by January 2006.

[c] The above *biological escapement goal range* has been approved by review teams from ADF&G.

[d] The above *biological escapement goal* ranges for the three transboundary rivers have been approved by review teams from ADF&G, the Department of Fisheries and Oceans Canada, and the Chinook and Transboundary Technical Committees of the Pacific Salmon Commission.

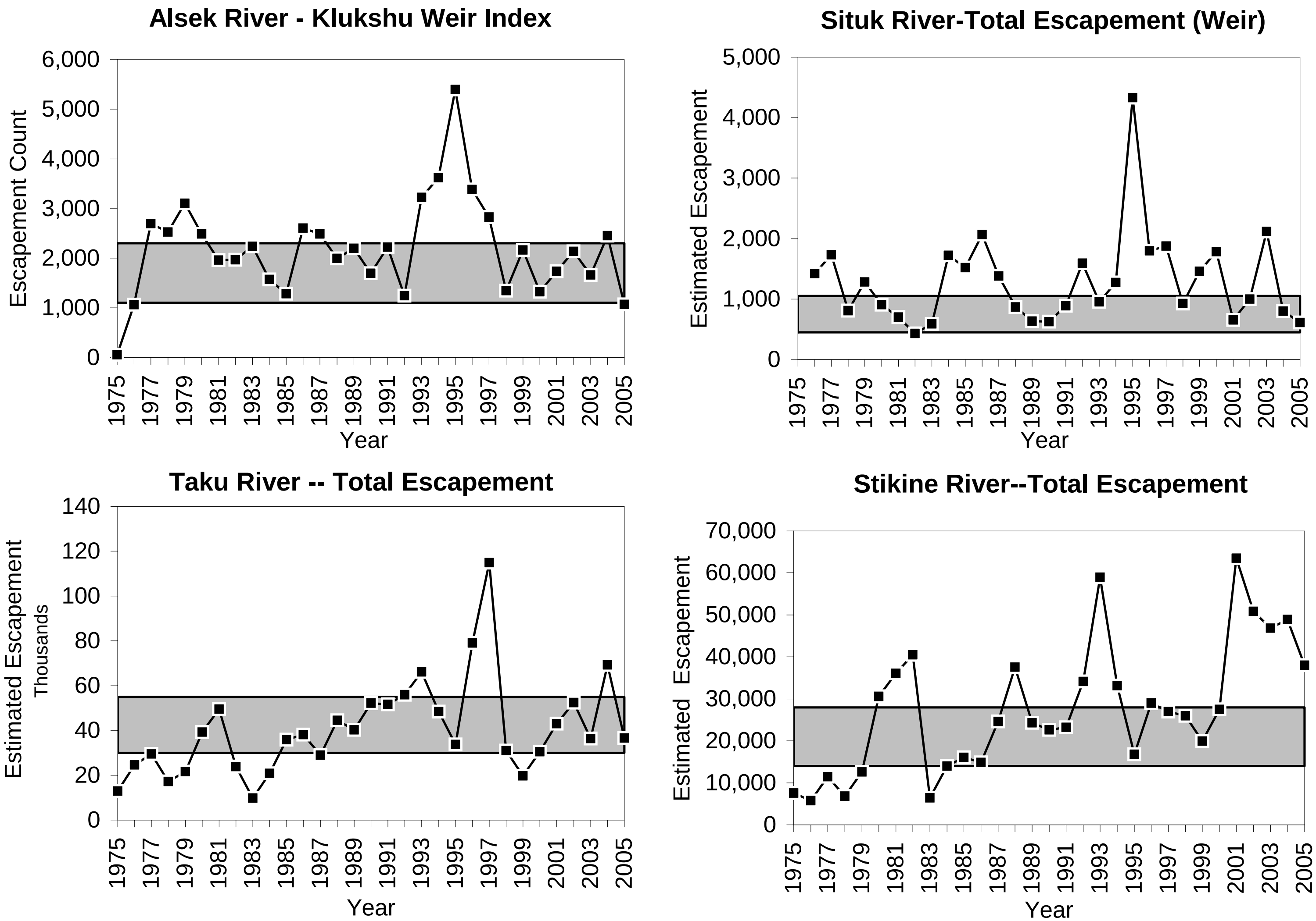

Figure 1.2–Estimated escapements of Chinook salmon in the Alsek, Situk, Taku, and Stikine rivers from 1975 to 2005. All values represent the total escapement of large (3- to 5-ocean-age) Chinook salmon except in the Alsek, which are total escapements past Klukshu weir, an index for the Alsek River.

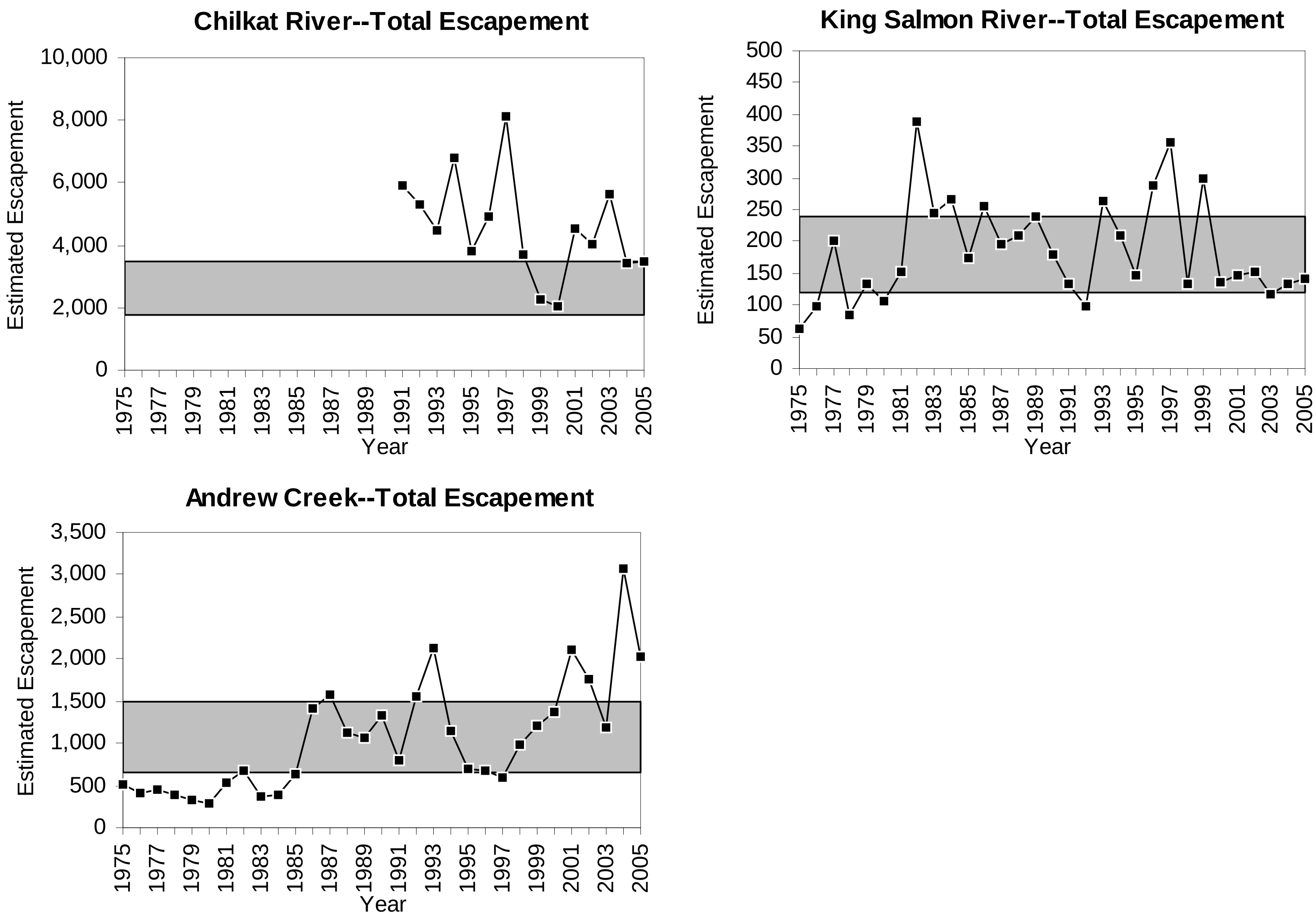

Figure 1.3–Estimated escapements of Chinook salmon in the Chilkat and King Salmon rivers and in Andrew Creek from 1975 to 2005. All values represent the total escapement of large (3- to 5-ocean-age) Chinook salmon.

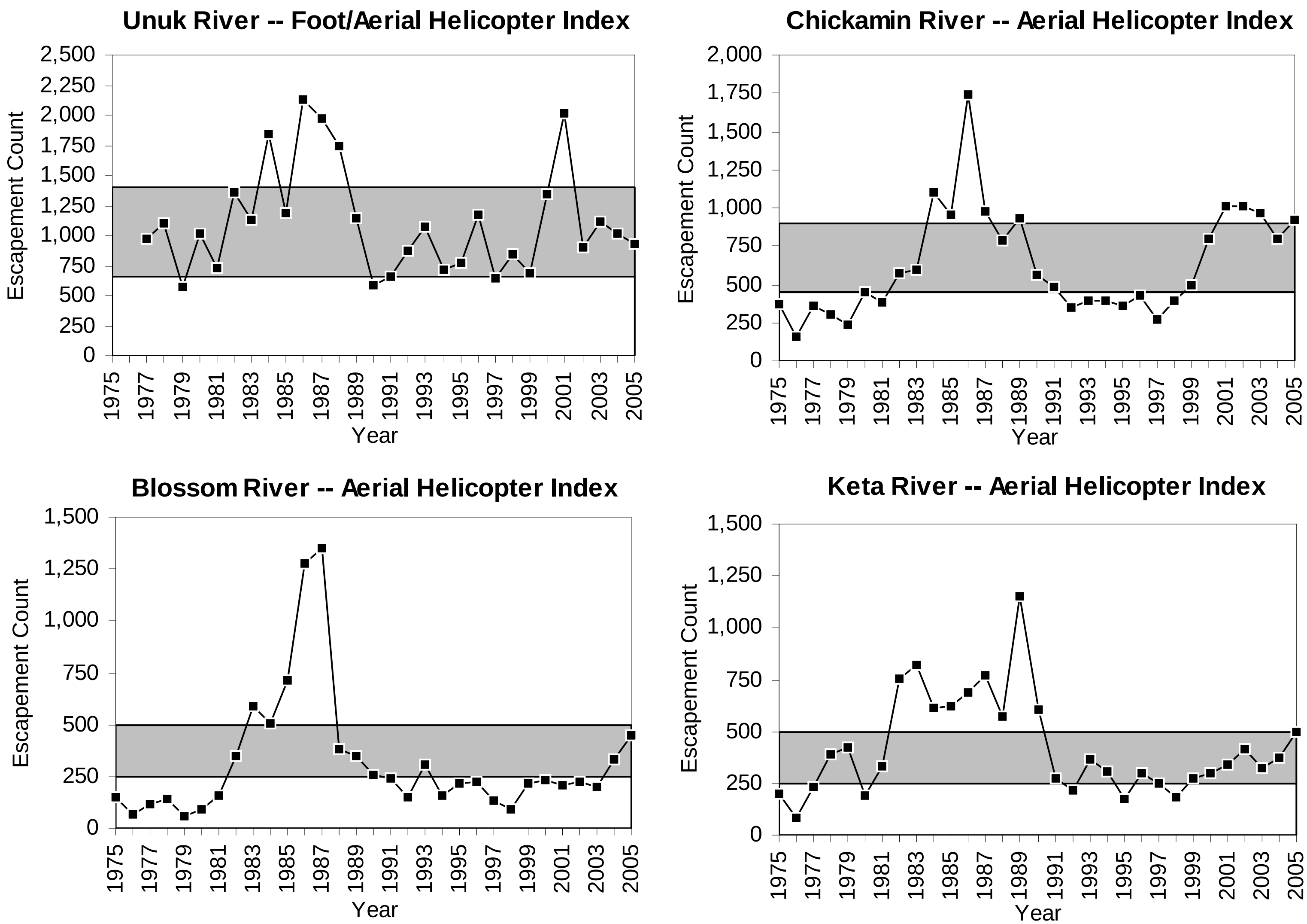

Figure 1.4–Peak survey counts of escapements of Chinook salmon in the Unuk, Chickamin, Blossom, and Keta rivers from 1975 to 2005. All values represent the peak survey count of large (3- to 5-ocean-age; ≥ 660 mm MEF) Chinook salmon.

based on a spawner-recruit analysis (McPherson and Carlile 1997), which the Chinook Technical Committee reviewed and accepted. In 1997, ADF&G revised the goal to a range of 650 to 1,400 large index spawners as recommended in the McPherson and Carlile (1997) report and in compliance with the ADF&G Escapement Goal Policy. The Chinook Technical Committee reviewed and accepted this change in 1998 (Appendix 1.8). Harvest data for the 1981 to 1998 brood years are currently being analyzed to determine exploitation and incidental mortality rates for the Unuk River stock. An updated stock-recruit analysis is being developed to revise the existing escapement goal and results will be available by January 2006 (Hendrich *unpublished*).

KETA RIVER

In 1981, ADF&G set the index goal at 500 large fish, based on counts of 500 spawners in 1948 and 462 spawners in 1952 (ADF&G *unpublished*). In 1994, ADF&G revised the escapement goal to 300 large index spawners, based on a spawner-recruit analysis (McPherson and Carlile 1997), which the Chinook Technical Committee reviewed and accepted in 1994. In 1997, ADF&G revised the escapement goal to a range of 250 to 500 large index spawners, in conformance with the McPherson and Carlile (1997) report and in compliance with the ADF&G Escapement Goal Policy. The Chinook Technical Committee reviewed and accepted this change in 1998 (Appendix 1.10). Because coded wire tag data are not available for the Keta River Chinook stock and the Unuk River has the longest time series for such information, harvest and incidental mortality rates from the Unuk River will be used as surrogates in an updated stock-recruit analysis being developed to revise the existing escapement goal. Revised escapement goals for the Keta River Chinook stock will be available by January 2006 (Der Hovanisian et al. *in prep*).

BLOSSOM RIVER

In 1981, ADF&G set an index escapement goal, as a combined count of 800 large fish from the Blossom and Wilson rivers, based on a 1963 count of 825 fish, 450 in the Blossom and 375 in the Wilson. In 1985, the Wilson surveys were dropped for budgetary reasons, but the goal of 800 continued to be applied to the Blossom. In 1994, ADF&G revised the Blossom goal to 300 large index spawners, based on a spawner-recruit analysis (McPherson and Carlile 1997), which the Chinook Technical Committee reviewed and accepted in 1994. In 1997, ADF&G revised the goal to a range of 250 to 500 large index spawners in conformance with the McPherson and Carlile (1997) report and in compliance with the ADF&G Escapement Goal Policy. Because coded wire tag data are not available for the Blossom River Chinook stock and the Unuk River has the longest time series for such information, harvest and incidental mortality rates from the Unuk River will be used as surrogates in an updated stock-recruit analysis being developed to revise the existing escapement goal. Revised escapement goals for the Blossom River Chinook stock will be available by January 2006 (Der Hovanisian et al. *in prep*).

ACKNOWLEDGMENTS

A multitude of individuals have helped make the stock assessment program for Chinook salmon in Southeast Alaska the high quality program that it is today. The authors thank the following individuals for key contributions to the program and to this manuscript. We acknowledge the contributions of the following current or former members of ADF&G: Paul Kissner, Mel Seibel, Rocky Holmes, Dennis Hubartt, Paul Suchanek, Mike Jaenicke, Glen Oliver, Dave Gaudet, Dave Benton, Don Collinsworth, Steve Pennoyer, Brian Lynch, Mark Stopha, Andy McGregor, Scott Kelley, Dave Magnus, Dave Dreyer, John E. Clark, Glenn Freeman, Bob Johnson, Amy Holm, Rich Yanusz, Scott Raborn, Kelly Hepler, Rob Bentz, Irv Brock, Doug Mecum, Doug Eggers, John Carlile, Kevin Duffy, Gordie Woods, Alan Burkholder, Keith Weiland, Scott Marshall, Dave Cantillon, Lisa Seeb, Bill Templin, Judy Berger, Steve Elliott, Ron Josephson, Karen Crandall, Sam Bertoni, Anna Sharp, Bob Zorich, William Bergmann, Bob Marshall, Allen Bingham, Amy Skilbred, Tim Schantz, Dale Brandenburger, Jarbo Crete, Heather Stilwell, Jerry Owens, Britt Lobdell, Shane Rear, Mark Olsen, Sue Millard, Larry Derby, Becky Wilson, Nevette Bowen, Tom Rockne, Greg Vaughn, Christie Hendrich, Kent Crabtree, Brian Glynn, Tim Sands, Peter Branson, Stephen Todd, Micah Sanguinetti, Roger Wagner, Jason Levitt, Roger Hayward and Nicole Zeiser. We thank Alex Wertheimer, John Eiler, Frank Thrower, Bill Heard and John Joyce of the NMFS Auke Bay Laboratory, and Tony Gharrett and Milo Atkinson of the University of Alaska. We acknowledge the following members of the Canadian Department of Fisheries and Oceans and members of Canadian First Nations: Sandy Johnston, Peter Etherton, Ian Boyce, Pat Milligan, Phil Timpany, Richard Erhardt, Francis Naylen, Alex Joseph, Gerald Quash, Shawn Hewes, Dan McPherson, Ivan Quock, Josee DesLandes, Peter Beck, and Colin Barnard. We thank members of the Chinook Technical Committee who have helped improve the Chinook stock assessment program in this region. We acknowledge the following user group representatives: Jev Shelton, Bill Foster, Dale Kelley, Howard Pendell, Dennis Longstreth, Arnold Enge, Jim Bacon, Kathy Hansen, Bill Hines, Bob Thorstenson, Andy Ebona and Jim Becker. We thank Misty Fjords Air, Coastal Helicopters, ERA Helicopters, Carlin Air and ProMech Air. We thank Eric Prestegard, Steve Reifenstuhl, Pete Esquiro, Ladd Macauley, John Burke, Gary Freitag, Rick Focht and other Southeast Alaska hatchery personnel. We thank Alma Seward and Cori Cashen for publication support over the years. We thank the Federal Aid program, U.S. Congress, the National Marine Fisheries Service, the Southeast Sustainable Salmon and Fisheries Fund, and anglers fishing in Alaska, for providing funding for the program. We acknowledge many other individuals or organizations who have made contributions to the program who are not listed here.

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APPENDICES

Appendix 1.1–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 on mature adults; 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 divisions:	Divisions of Sport Fish and Commercial Fisheries
Management jurisdictions:	ADF&G; joint management ADF&G and CDFO 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:	30,000 to 55,000 range; 35,938 point estimate
Population for goal:	Large spawners (3- to 5-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 six 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 (multiplier for cumulative helicopter peak survey count in five tributaries—Nahlin, Nakina, Dudidontu, Tatsamenie and Kowatua rivers)
Brood years in analysis:	8
Data in analysis:	Estimated total escapement of large female spawners and subsequent smolt production
Data quality:	Good
Contrast in escapements:	NA
Model used for escapement goal:	Empirical observation of optimal smolt production range and associated number of female spawners
Criteria for range:	Highest smolt production
Value of alpha parameter:	4.406
Value of beta parameter:	0.00001643
Document supporting goal:	McPherson, S. A., D. R. Bernard, and J. H. Clark. 2000. Optimal production of Chinook salmon from the Taku River. Alaska Department of Fish and Game, Fishery Manuscript No. 00-2, Anchorage.

Table 1.1.1–Estimated harvests, escapements, and total runs by year of large Chinook salmon (3- to 5-ocean-age; 5- to 6-year total age) bound for the Taku River, from 1979 to 2005. (2005 data and some recent estimates are subject to revision). Numbers in **bold** are mark-recapture estimates.

		U.S.					Canada					Total		
YEAR	Escapement[a]	Gillnet	Sport	Troll[b]	P.U.	Total	Test Fishery	Gillnet	Sport[c]	Abor.	Total	Harvest	Run	Exp.
1979	21,617	217	1,853	4,850		6,920		73	300		373	7,293	28,910	25.2%
1980	39,239	696	2,512	5,352		8,560		169	300	64	533	9,093	48,332	18.8%
1981	49,559	611	1,703	5,276		7,590		119	300		419	8,009	57,568	13.9%
1982	23,848	847	1,359	2,709		4,915		41	300		341	5,256	29,104	18.1%
1983	9,794	106	1,089	419		1,614		418	300	7	724	2,339	12,133	19.3%
1984	20,778	399	1,210	2,754		4,363		387	300		687	5,049	25,827	19.6%
1985	35,916	802	1,863	749		3,414		263	300	3	566	3,979	39,895	10.0%
1986	38,111	849	755	749		2,353		264	300	8	572	2,925	41,036	7.1%
1987	28,935	557	1,019	399		1,975		175	300		475	2,450	31,385	7.8%
1988	44,524	240	765			1,005	54	557	300	20	877	1,936	46,460	4.2%
1989	**40,329**	933	1,857		62	2,852	23	777	300	5	1,081	3,956	44,285	8.9%
1990	**52,142**	960	2,085		57	3,102	36	1,041	300		1,341	4,479	56,621	7.9%
1991	51,645	1,150	4,199		47	5,396		1,208	300		1,508	6,905	58,550	11.8%
1992	55,889	869	3,334		34	4,237		1,196	300	91	1,587	5,823	61,712	9.4%
1993	66,125	1,823	6,273		17	8,113		1,344	300	19	1,663	9,776	75,901	12.9%
1994	48,368	1,426	3,213		36	4,675		1,727	300	89	2,117	6,791	55,159	12.3%
1995	**33,805**	608	2,225		37	2,870		1,408	300	53	1,761	4,631	38,436	12.0%
1996	**79,019**	1,814	4,602	1,605	87	8,108		2,610	300	47	2,957	11,066	90,085	12.3%
1997	**114,938**	2,197	5,017	1,479	33	8,726		2,114	300	77	2,492	11,218	126,156	8.9%
1998	31,039	278	2,088	650	31	3,047		1,002	300	45	1,347	4,394	35,433	12.4%
1999	**19,734**	785	2,408	804	22	4,019	311	781	300	38	1,119	5,449	25,183	21.6%
2000	**30,529**	426	1,553	1,471	21	3,471	1,312	1,314	300	38	1,651	6,434	36,963	17.4%
2001	**42,980**	538	1,437	1,900		3,875	1,175	1,381	300	94	1,775	6,825	49,805	13.7%
2002	**52,409**	869	2,399	1,519		4,787	1,311	1,463	300	28	1,791	7,889	60,297	13.1%
2003	**36,435**	738	2,017			2,755	1,401	1,350	300	277	1,927	6,083	42,518	14.3%
2004	**68,199**	971	2,700			3,671	1,410	1,777	300	277	2,354	7,435	75,634	9.8%
2005	**36,671**	19,001	3,158			22,159		7,441	300		7,741	29,900	66,571	44.9%
Averages:														
1979-05	43,429	1,508	2,396	2,043	40	5,132	781	1,200	300	49	1,547	6,940	50,369	14.4%
1979-89	32,059	569	1,453	2,584	62	4,142	39	295	300	10	604	4,753	36,812	13.9%
1990-05	51,245	2,153	3,044	1,347	38	5,813	994	1,822	300	78	2,196	8,444	59,689	14.7%

[a] Escapement: escapement estimates shown here are from mark–recapture estimates in 1989 to 1990 and 1995 to 1997 (McPherson et al. 2000), and preliminary mark–recapture estimates for 1999 to 2005. Estimates for 1975 to 1988, 1991 to 1994, and 1998 are expanded survey counts of large spawners. No estimates are available prior to 1973.

[b] Troll harvest estimates are incomplete for 1975 to 1978, 1988 to 1995, and 2003 to 2005 and likely averaged about 1,500 fish per year for incomplete years after 1987.

[c] The sport harvest in Canada is assumed to average 300 fish per year.

Table 1.1.2–Estimated abundance of females, smolts, subsequent production of adult salmon, and estimated mean fork length for smolts for several year classes of Chinook salmon in the Taku River. Standard errors for ratios (in parentheses) were approximated with the delta method (Seber 1982).

Year class	Females	Smolts	Mean smolt FL (mm)	Smolts / female	Recruits	Adult / smolt
1975	4,593	1,189,118	79	258.9	87,450	0.074
	(2,139)	(174,197)		(126)	(23,384)	(0.0224)
1976	15,165	1,549,052	71	102.1	65,457	0.042
	(6,478)	(374,227)		(50)	(16,615)	(0.0148)
1979	10,997	661,150	74	60.1	39,833	0.060
	(4,991)	(97,648)		(29)	(9,288)	(0.0166)
1991	27,435	2,098,862	80	76.5	196,114	0.093
	(11,842)	(295,390)		(35)	(14,153)	(0.0148)
1992	22,935	1,968,167	73	85.8	79,307 [a]	0.0403
	(10,391)	(438,569)		(43)		
1993	29,976	1,267,907	78	42.3	19,114 [b]	0.0151
	(13,573)	(564,432)		(27)		
1994	31,553	1,328,553	76	42.1		
	(13,565)	(352,068)		(21)		
1995	19,705	1,898,233	77	96.3		
	(2,644)	(626,335)		(34)		

[a] Estimate is based on final estimate of spawning abundance and preliminary statistics on harvest.

[b] Estimate is based on inputting production of age-1.4 and -1.5 salmon as the average (34% of production) over all age groups for the 1973 to 1991 year classes.

Appendix 1.2–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 incidentally 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 gillnet, 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:	Sport and Commercial Fisheries Divisions
Management jurisdictions:	ADF&G, joint management ADF&G and CDFO 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 (3- to 5-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 (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
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, Division of Sport Fish, Fishery Manuscript No. 00-1, Anchorage.

Table 1.2.1–Escapement index counts, spawning escapement estimates, harvests, run sizes, and exploitation rates for Stikine River Chinook salmon, from 1975 to 2005. Escapement estimates in bold are from mark-recapture estimates (1996 to 2004), estimates in italics (1975 to 1984) are from expansions of aerial counts, and estimates from 1985 to 1995 and 2005 are from expansions of Little Tahltan River weir counts (2005 data and some recent estimates are subject to revision).

Year	Aerial counts	Little Tahltan weir count	Spawning escapement	U.S. sport harvest	U.S. gillnet harvest	Canadian harvest	Total harvest	Total run size	Exploitation 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	48	1,262	3,069	15,679	19.6%
1980	2,137		*30,573*	2,498	407	2,655	5,560	36,133	15.4%
1981	3,334		*36,057*	2,022	258	1,650	3,930	39,987	9.8%
1982	2,830		*40,488*	2,929	1,032	2,597	6,558	47,046	13.9%
1983	594		*6,424*	2,634	46	2,106	4,786	11,210	42.7%
.1984	1,294		*13,995*	2,171	14	796	2,981	16,976	17.6%
1985	1,598	3,114	16,037	2,953	20	1,491	4,464	20,501	21.8%
1986	1,201	2,891	14,889	2,475	76	3,473	6,024	20,913	28.8%
1987	2,706	4,783	24,632	2,834	94	3,020	5,948	30,580	19.5%
1988	3,796	7,292	37,554	2,440	137	3,333	5,910	43,464	13.6%
1989	2,527	4,715	24,282	2,776	227	3,349	6,352	30,634	20.7%
1990	1,755	4,392	22,619	4,283	308	3,604	8,195	30,814	26.6%
1991	1,768	4,506	23,206	3,657	876	3,258	7,791	30,997	25.1%
1992	3,607	6,627	34,129	3,322	528	3,080	6,930	41,059	16.9%
1993	4,010	11,449	58,962	4,227	866	3,204	8,297	67,259	12.3%
1994	2,422	6,387	33,094	2,140	1,402	2,760	6,302	39,396	16.0%
1995	1,117	3,072	16,784	1,218	945	3,059	5,222	22,006	23.7%
1996	1,920	4,8	**28,949**	2,464	878	3,450	6,792	35,741	19.0%
1997	1,907	5,613,	**26,996**	3,475	1,934	5,019	10,428	37,424	27.9%
1998	1,385	4,879	**25,968**	1,438	157	2,812	4,407	30,375	14.5%
1999	1,379	4,738	**19,947**	3,668	688	5,318	9,674	29,621	32.7%
2000	2,720	6,640	**27,531**	2,581	737	4,684	8,002	35,533	22.5%
2001	4,158	9,738	**63,523**	2,263	7	3,297	5,567	69,090	8.1%
2002	1,131	7,490	**50,875**	3,077	26	4,007	7,110	57,985	12.3%
2003	1,903	6,492	**46,824**	3,252	103	4,739	8,094	54,918	14.7%
2004	6,014	16,381	**48,900**	2,939	5,515	6,743	15,197	64,097	23.7%
2005	1,997	7,387	38,043						

Table 1.2.2–Estimated total returns of Stikine River Chinook salmon for brood years 1977 to 2000. (2000 data and some recent estimates are subject to revision). Escapement estimates in bold are from mark-recapture estimates (1996-2000), estimates in italics (1997-1984) are from expansions of aerial counts, and estimates from 1985 to 1995 are from expansions of Little Tahltan River weir counts.

Brood year	Parent escapement	Age-1.2 return	Age-1.3 return	Age-1.4 return	Age-1.5 return	Total return
1977	*11,445*	869	8,217	5,814	154	15,055
1978	*6,835*	1,364	3,909	2,196	151	7,621
1979	*12,610*	4,296	14,394	15,908	313	34,911
1980	*30,573*	1,728	4,063	13,078	1,053	19,923
1981	*36,057*	1,148	6,408	22,261	772	30,588
1982	*40,488*	1,798	6,594	38,133	5,900	52,426
1983	*6,424*	1,830	3,949	13,538	1,595	20,913
1984	*13,995*	1,174	10,838	25,748	979	38,738
1985	16,037	845	2,286	17,213	79	20,423
1986	14,889	3,175	11,437	31,968	1,674	48,254
1987	24,632	2,854	8,712	58,592	3,181	73,339
1988	37,554	812	6,323	31,269	2,350	40,753
1989	24,282	848	4,386	13,185	135	18,554
1990	22,619	1,223	5,045	9,783	167	16,218
1991	23,206	5,101	26,685	28,208	692	60,686
1992	34,129	1,927	9,116	22,283	985	34,311
1993	58,962	1,329	7,197	15,075	544	24,145
1994	33,094	2,437	11,116	13,801	207	27,560
1995	16,784	6,670	18,980	16,061	468	42,179
1996	**28,949**	14,470	52,738	42,750	176	110,134
1997	**26,996**	772	14,686	15,663	133	31,254
1998	**25,968**	5,528	36,062	20,559		
1999	**19,947**	11,325	36,469			
2000	**27,531**	17,499				

Appendix 1.3–Alsek River Chinook Salmon Stock

The Alsek River produces the third or fourth largest Chinook 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:	Sport and Commercial Fisheries Divisions
Management jurisdictions:	Joint management ADF&G and CDFO through Pacific Salmon Commission
Fisheries:	U.S. subsistence/personal use, gillnet, troll; First Nations, Canadian recreational
Escapement goal type:	*Biological Escapement Goal*
Escapement goal:	1,100 to 2,300 range; no point estimate
Population for goal:	Large spawners (3- to 5-ocean-age) counted past the Klukshu River Weir, a clearwater tributary of the Alsek
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1981 to present
	Index weir counts Klukshu River: 1976 to present
	Mark–recapture estimates for Alsek: 1998 to 2004
Index count expansion factor:	4.95 (multiplier for weir count on Klukshu River)
Brood years in analysis:	16 (1976 to 1991)
Data in analysis:	Estimated total escapement of large spawners, 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 the spawner-recruit relationship
Criteria for range:	Range producing largest total returns
Value of alpha parameter:	7.44
Value of beta parameter:	0.00081
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, Division of Sport Fish, Fisheries Manuscript 98-2, Anchorage.

Table 1.3.1–Spawning escapement, estimated harvests, run size, and exploitation rates for Chinook salmon in Klukshu River, a tributary of Alsek River, from 1976 to 2005. (2005 data and some recent estimates are subject to revision).

Klukshu River							Alsek River total escapement[d]
Year	Spawning escapement [a]	Total Canada harvest [b]	Total U.S. harvest [c]	Total harvest	Total run size	Exploitation rate	
1976	1,064	354	154	508	1,572	32%	
1977	2,698	656	421	1,077	3,775	29%	
1978	2,530	656	732	1,388	3,918	35%	
1979	3,104	1,755	758	2,513	5,617	45%	
1980	2,487	290	415	705	3,192	22%	
1981	1,963	430	234	664	2,627	25%	
1982	1,969	633	160	793	2,762	29%	
1983	2,237	518	28	546	2,783	20%	
1984	1,572	415	14	429	2,001	21%	
1985	1,283	322	64	386	1,669	23%	
1986	2,607	218	151	368	2,975	12%	
1987	2,491	476	112	589	3,080	19%	
1988	1,994	312	71	383	2,377	16%	
1989	2,202	486	74	560	2,762	20%	
1990	1,698	722	49	771	2,469	31%	
1991	2,223	822	42	864	3,087	28%	
1992	1,243	253	95	348	1,591	22%	
1993	3,221	332	101	433	3,654	12%	
1994	3,620	500	260	760	4,380	17%	
1995	5,397	1,316	216	1,532	6,929	22%	
1996	3,382	893	249	1,143	4,525	25%	
1997	2,829	437	182	619	3,448	18%	
1998	1,347	286	184	470	1,817	26%	4,621
1999	2,166	349	158	507	2,673	19%	11,597
2000	1,321	114	225	339	1,660	20%	8,295
2001	1,738	189	168	357	2,095	17%	11,022
2002	2,140	235	228	463	2,603	18%	8,504
2003	1,661	175	288	463	2,124	22%	4,932
2004	2,457	165	208	373	2,830	13%	7,343
2005	1,070						
Average	2,219	397	212	609	2,866	20%	8,045

[a] Klukshu River spawning escapement = weir count minus above weir harvest.

[b] Total Canada harvest Klukshu stock = above weir harvest plus 70% Dalton Post sport and 95% Aboriginal Food Fishery.

[c] Total U.S. Harvest of Klukshu stock = 30% Dry Bay commercial, subsistence and personal use gillnet harvest.

[d] Alsek River total escapement from mark–recapture estimates.

Table 1.3.2–Estimated brood year returns of Klukshu River Chinook salmon by age, calculated by using the 30% assumption to apportion U.S. Alsek fishery harvests for brood year 1971 to 1991 (per McPherson et al. 1998a).

Brood year	Estimated escapement	Estimated returns by age					Estimated total return
		Age 3	Age 4	Age 5	Age 6	Age 7	
1971	unknown			498	1,153	0	1,651
1972	unknown		122	1,357	1,235	0	2,714
1973	unknown	0	1,068	2,121	2,414	0	5,603
1974	unknown	43	421	2,655	2,008	73	5,199
1975	unknown	0	412	1,085	1,299	2	2,799
1976	1,064	0	67	813	1,125	0	2,005
1977	2,698	0	276	1,156	696	28	2,156
1978	2,530	0	371	1,941	991	0	3,302
1979	3,104	29	77	739	661	0	1,506
1980	2,487	1	91	812	513	16	1,433
1981	1,963	30	156	1,955	1,086	10	3,238
1982	1,969	16	479	1,656	1,293	6	3,450
1983	2,237	1	196	674	1,329	9	2,209
1984	1,572	2	295	853	768	87	2,006
1985	1,283	10	493	1,265	1,645	2	3,415
1986	2,607	0	246	1,242	871	17	2,376
1987	2,491	4	73	456	1,412	49	1,994
1988	1,994	7	197	1,635	1,461	1	3,301
1989	2,202	47	387	1,514	992	5	2,945
1990	1,698	155	1,279	5,095	1,791		8,320
1991	2,223	11	511	1,773			3,958[a]
Statistics for 1976 to 1990:							
Averages	2,127	20	312	1,454	1,109	16	2,911
Minimum	1,064	0	67	456	513	0	1,433
Maximum	3,104	155	1,279	5,095	1,791	87	8,320

[a] Brood year 1991 total return estimated as the average of 58% of total return at age 3 to 5 for brood years 1976 to 1990.

Table 1.4.1–Weir counts, harvests, run size and exploitation rates for Situk River Chinook salmon, 1976 to 2005. (2005 data and some recent estimates are subject to revision.) The Situk weir count and spawning escapement includes large Chinook (3- to 5-ocean-age), 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 size	Exploitation rate
1976	1,421	1,421	200	1,002	41	1,243	3,184	39.0%
1977	1,732	1,732	244	833	24	1,101	2,981	36.9%
1978	808	808	210	382	50	642	1,745	36.8%
1979	1,284	1,284	282	1,028	25	1,335	3,089	43.2%
1980	905	905	353	969	57	1,379	2,504	55.1%
1981	702	702	130	858	62	1,050	1,857	56.5%
1982	434	434	63	248	27	338	949	35.6%
1983	592	592	42	349	50	441	1,290	34.2%
1984	1,726	1,726	146	512	89	747	2,948	25.3%
1985	1,521	1,521	294	484	156	934	2,916	32.0%
1986	2,067	2,067	0	202	99	301	2,873	10.5%
1987	1,379	1,379	75	891	24	990	2,874	34.4%
1988	885	868	185	299	90	574	1,596	36.0%
1989	637	637	0	1	496	497	1,377	36.1%
1990	628	628	0	0	516	516	1,643	31.4%
1991	897	889	88	784	220	1,092	2,095	52.1%
1992	1,618	1,595	172	1,504	341	2,017	3,819	52.8%
1993	980	952	137	790	202	1,129	2,558	44.1%
1994	1,311	1,271	400	2,656	367	3,423	6,085	56.3%
1995	4,700	4,330	1,407	8,107	578	10,092	14,987	67.3%
1996	2,175	1,800	1,529	3,717	559	5,805	8,100	71.7%
1997	2,690	1,878	1,598	2,339	352	4,289	6,601	65.0%
1998	1,353	924	1,156	2,101	594	3,851	5,420	71.1%
1999	1,947	1,461	1,160	3,810	588	5,558	7,208	77.1%
2000	2,518	1,785	1,143	1,318	594	3,055	4,941	61.8%
2001	696	656	75	1,087	402	1,564	2,290	67.1%
2002	1,024	1,000	99	1,078	416	1,593	2,317	67.5%
2003	2,615	2,117	909	2,342	600	3,851	6,267	61.4%
2004	798	757	294 [b]	1,222	396	1,912	2,669	71.6%
2005		613						

[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] Preliminary data from Situk River creel survey.

Table 1.4.2–Estimated total returns of Situk River Chinook salmon for brood years 1977 to 2001. (2001 and some recent estimates are subject to revision).

Brood year	Parent escapement[a]	Age-3 return	Age-4 return	Age-5 return	Age-6 return	Age-7 return	Total return	Return/ spawner
1977	1,732	399	802	199	6	0	1,406	0.81
1978	808	150	438	313	180	29	1,110	1.37
1979	1,284	156	704	1,289	606	0	2,755	2.15
1980	905	268	1,118	895	556	0	2,837	3.13
1981	702	137	1,068	1,019	315	0	2,539	3.62
1982	434	318	973	1,299	439	0	3,029	6.98
1983	592	324	1,181	835	93	0	2,433	4.11
1984	1,726	79	290	441	222	3	1,035	0.60
1985	1,521	35	618	488	68	0	1,209	0.79
1986	2,067	225	396	259	305	4	1,189	0.58
1987	1,379	540	1,267	1,964	314	0	4,085	2.96
1988	868	491	988	904	289	0	2,672	3.08
1989	637	544	821	1,314	79	0	2,758	4.33
1990	628	497	2,366	2,849	461	9	6,182	9.84
1991	889	2,103	11,104	3,089	124	0	16,420	18.47
1992	1,595	934	3,468	2,076	29	0	6,507	4.08
1993	952	1,071	3,014	893	60	0	5,038	5.29
1994	1,271	1,346	2,744	1,034	50	0	5,174	4.07
1995	4,330	1,674	4,570	902	69	0	7,215	1.67
1996	1,800	1,496	3,704	1,301	26	0	6,527	3.63
1997	1,878	284	570	207	42	0	1,103	0.59
1998	924	406	1,204	678	190		*2,478*	
1999	1,461	1,557	4,912	1,322			*7,791*	
2000	1,785	451	1,104				*1,555*	1,785
2001	656	624						

[a] Age-2. and older Chinook salmon.

Appendix 1.4–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 fishers. 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:	Sport and Commercial Fisheries Divisions
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 River 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 *MSY*
Value of alpha parameter:	14.806, corrected for autocorrelation
Value of beta parameter:	0.0011135
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, Division of Sport Fisheries, Fishery Manuscript No. 05-04, Anchorage.

Appendix 1.5–Chilkat River Chinook Salmon Stock

The Chilkat River produces the third or fourth largest population of Chinook salmon in Southeast Alaska (Pahlke 2001). 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:	Sport and Commercial Fisheries Divisions
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, subsistence, gillnet, troll
Escapement goal type:	*Biological Escapement Goal*
Escapement goal:	1,750 to 3,500 range; point estimate 2,200
Population for goal:	Large spawners (3- to 5-ocean-age)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial helicopter surveys: 1981 to 1992 (not used and discontinued in 1992 because deemed not representative of population trends in escapement). 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 in the next three to five years.
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
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, Division of Sport Fish, Fishery Manuscript No. 04-01, Anchorage.

Table 1.5.1–Spawning escapement estimates, terminal harvests, terminal run size and exploitation rates for Chilkat River Chinook salmon, from 1991 to 2005. (2005 data and some recent estimates are subject to revision). Escapement estimates are from mark–recapture estimates (1991 to 2005).

Year	Spawning escapement	Subsistence harvest	Sport harvest	D115 Gillnet harvest	Terminal harvest[a]	Terminal run size	Exploitation rate
1991	5,897	0	0	262	262	6,159	0.04
1992	5,284	0	0	129	129	5,413	0.02
1993	4,472	2	314	232	548	5,020	0.11
1994	6,795	10	220	96	326	7,121	0.05
1995	3,790	38	228	41	307	4,097	0.07
1996	4,920	44	354	58	456	5,376	0.08
1997	8,100	18	381	167	566	8,666	0.07
1998	3,675	17	215	177	409	4,084	0.10
1999	2,271	31	184	301	516	2,787	0.19
2000	2,035	34	49	58	141	2,176	0.06
2001	4,517	60	185	71	316	4,833	0.07
2002	4,051	60	337	40	437	4,448	0.10
2003	5,657	46	404	40	490	6,147	0.08
2004	3,422	146	403	295	844	4,266	0.20
2005	3,490						

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

Table 1.5.2–Estimated total returns of Chilkat River Chinook salmon for brood years 1991 to 1997. (1997 data and some recent estimates are subject to revision)

Brood year	Parent escapement	Age-1.2 return	Age-1.3 return	Age-1.4 return	Age-1.5 return	Total return
1991	5,897	1,676	4,613	6,424	219	12,932
1992	5,284	552	2,281	2,628	81	5,542
1993	4,472	222	1,193	1,784	32	3,321
1994	6,795	314	627	704	0	1,645
1995	3,790	592	1,584	2,141	30	4,348
1996	4,920	872	2,969	1,795	41	5,678
1997	8,100	1,047	2,763	4,075	44	7,927

Appendix 1.6–King Salmon River Chinook Salmon Stock

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.

Management division:	Sport and Commercial Fisheries Divisions
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 (3- to 5-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:	1.50 (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
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, Regional Information Report No. 1J-0140, Juneau.

Table 1.6.1–Escapement index counts, spawning escapement estimates of large spawners, expansion factors, and available age/sex composition for King Salmon River Chinook salmon, from 1971 to 2005. Escapement estimates are from expansions of survey counts in 1971 to 1982 and 1993 to 2005, using an expansion factor of 1.50. Estimates in bold are weir counts.

Year	Survey counts	Spawning escapement	Expansion factor	Age 1.2	Age 1.3	Age 1.4	Age 1.5	Age-.2-.5 total	Large females
1971	94	141							
1972	90	135							
1973	211	317							
1974	104	156							
1975	42	63							
1976	65	98							
1977	134	201							
1978	57	86							
1979	71	132							
1980	70	105							
1981	90	152							
1982	229	389		16	49	344	0	410	279
1983	183	**245**	1.17	**39**	**64**	**142**	**39**	**284**	**172**
1984	184	**265**	1.37	**94**	**47**	**200**	**18**	**359**	**194**
1985	105	**175**	1.57	**32**	**97**	**78**	**0**	**207**	**91**
1986	190	**255**	1.25	**95**	**51**	**204**	**0**	**350**	**175**
1987	128	**196**	1.38	**16**	**78**	**110**	**8**	**212**	**118**
1988	94	**208**	2.02	**14**	**21**	**174**	**7**	**216**	**153**
1989	133	**240**	1.59	**14**	**67**	**156**	**15**	**251**	**156**
1990	98	**179**	1.74	**12**	**87**	**87**	**6**	**191**	**104**
1991	91	**134**	1.38	**0**	**10**	**124**	**0**	**134**	**96**
1992	58	**99**	1.71	**25**	**72**	**27**	**0**	**124**	**44**
1993	175	263							
1994	140	210							
1995	97	146							
1996	192	288							
1997	238	357							
1998	88	132							
1999	200	300		*47*	*125*	*172*	*0*	*344*	*165*
2000	92	137		*36*	*65*	*57*	*4*	*162*	*81*
2001	98	147		*51*	*56*	*65*	*0*	*172*	*65*
2002	102	153		*14*	*96*	*56*	*0*	*166*	*58*
2003	78	117		*62*	*34*	*74*	*0*	*170*	*74*
2004	89	134		*10*	*111*	*12*	*6*	*139*	*49*
2005	94	141							

Appendix 1.7–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:	Sport and Commercial Fisheries Divisions
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 (3- to 5-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:	2.00 (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 eight years.
Data quality:	Good
Contrast in escapements:	5.10
Model used for escapement goal:	Ricker
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
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 No. 5J98-08, Juneau.

Table 1.7.1–Escapement peak survey counts, spawning escapement estimates, and expansion factors for Andrew Creek River Chinook salmon, from 1975 to 2005. Escapement estimates are from expansions of survey counts in 1975 and 1985 to 2005, using an expansion factor of 2.0. Estimates in bold are weir counts.

Year	Survey counts	Spawning escapement	Expansion factor	Age 1.2	Age 1.3	Age 1.4	Age 1.5	Age-.2-.5 total	Large females
1975	260	520							
1976		**404**							
1977		**456**							
1978		**388**							
1979	221	**327**	1.48	**74**	**186**	**133**	**11**	**404**	**170**
1980		**282**		**183**	**146**	**136**	**0**	**465**	**146**
1981	300	**536**	1.79	**69**	**314**	**220**	**4**	**607**	**274**
1982	332	**672**	2.02	**49**	**102**	**550**	**18**	**718**	**422**
1983		**366**		**110**	**279**	**81**	**3**	**473**	**168**
1984	154	**389**	2.53	**985**	**242**	**104**	**17**	**1,349**	**182**
1985	319	638							
1986	707	1,414							
1987	788	1,576							
1988	564	1,128							
1989	530	1,060							
1990	664	1,328							
1991	400	800							
1992	778	1,556							
1993	1,060	2,120							
1994	572	1,144							
1995	343	686							
1996	335	670							
1997	293	586		**59**	**248**	**363**	**4**	**674**	**339**
1998	487	974		**330**	**272**	**714**	**22**	**1,338**	**565**
1999	605	1,210		578	504	545	80	1,706	558
2000	690	1,380		193	891	457	12	1,554	831
2001	1,054	2,108		56	917	1,194	12	2,179	1,135
2002	876	1,752		161	475	1,203	35	1,874	1,029
2003	595	1,190		203	648	450	43	1,344	536
2004	1,534	3,068		689	1,540	1,330	53	3,613	1,490
2005	1,015	2,030							

Appendix 1.8–Unuk River Chinook Salmon Stock

Stock Description

The Unuk River originates in northern British Columbia and flows for 129 km where it traverses Misty Fjords National Monument and empties into Burroughs Bay, 85 km northeast of Ketchikan, Alaska. The drainage encompasses approximately 3,885 km^2 (Jones and McPherson 2002), with the lower 39 km flowing through Alaska. In most years, the Unuk River is the fourth or fifth largest producer of Chinook salmon in Southeast Alaska.

Unuk River Chinook salmon are a spring run that produces yearling (age-1) fish almost exclusively. Juvenile coded wire tagging studies indicate that the majority of Chinook salmon rear in the U.S. portion of the river. Survey counts of large Chinook salmon have been made on the Unuk River since 1977. Indices of escapement on the Unuk River are determined annually by summing the peak observer aerial and foot survey counts of large spawners seen in six tributaries: Cripple, Gene's Lake, Kerr, Clear, and Lake creeks plus the Eulachon River (Pahlke 2001).

Several consecutive years of low survey counts in the early 1990s generated concern for the health of the Unuk River Chinook salmon stock. In response, the Division of Sport Fish began a full stock assessment program on the Unuk River to estimate smolt production, escapement, total run size, exploitation rates, harvest distribution, overwinter survival, and marine survival. In 1994, mark–recapture and radio telemetry studies were conducted, and mark–recapture studies have occurred since 1997.

Coded wire tagging studies on the 1982 to 1986 (Pahlke 1995) and on the 1992 to present brood years indicate that harvest rates for Unuk River Chinook salmon (age-1.1 to 1.5) average about 17% in landed catch. This information, coupled with similar data on Chinook salmon from the nearby Chickamin River, provide strong evidence that Unuk River fish are mostly *inside rearing* in nature, but a few recoveries have been recorded as far north as Kodiak and several coded wire tags each year are recovered in northern British Columbia fisheries in Canada.

The current stock assessment program for adult Chinook salmon returning to the Unuk River has three primary goals: (1) to estimate escapement; (2) to estimate age, sex, and length distribution in the escapement; and (3) to sample escapement for the fraction of fish possessing coded wire tags by brood year. The results are essential to estimate the marked fraction of each brood for coded wire tagged fish and to estimate harvest of this stock in current and future sport and commercial fisheries. These harvest and escapement data will enable us to estimate total run size, exploitation rates, harvest distribution, and marine survival for this important Chinook salmon indicator stock in southern Southeast Alaska.

Escapements over the past 5 years of estimates (2001 to 2005) have averaged 6,305 total large spawners, and 1,195 large spawners in peak survey counts (Table 1.3). All five of these escapements were within or above the current (1997) goal range (Figure 1.4). Our most current spawner-recruit data are summarized in Tables 1.8.1 and 1.8.2. The ADF&G is in the process of analyzing these data and will provide an escapement goal for total large spawners, as measured in the annual mark-recapture program, by January 2006 (Hendrich *unpublished*).

Appendix 1.8. Unuk River Chinook Salmon Stock

System:	Unuk River
Species:	Chinook salmon

Outline of stock management, assessment and escapement goal analysis

Management division:	Sport and Commercial Fisheries Divisions
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll
Escapement goal type:	*Biological Escapement Goal*
Current escapement goal:	650 to 1,400; 800 point estimate
Population for goal:	Large spawners (3- to 5-ocean-age) as counted in **peak survey counts** in the standardized survey areas on six clear water tributaries: Eulachon River and Clear, Lake, Kerr, Genes Lake and Cripple Creeks.
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	<u>Helicopter and foot peak survey counts</u>: 1977 to present in standard time and areas on: Eulachon River and Clear, Lake, Kerr, Genes Lake and Cripple Creeks. <u>Mark–recapture estimates</u>: 1994, 1997 to present
Index count expansion factor in revision analysis:	4.83 (multiplier for the sum of peak survey counts)
Brood years in revision analysis:	22 (1977 to 1998)
Data in revision analysis:	Survey counts, expanded by 4.8:1 , and mark-recapture estimates of the total escapement of large spawners, marine harvest by age for 12 wild broods with average harvest data for the remainder, age structure sampled directly in most years, estimated for all broods.
Data quality:	Good to excellent
Contrast in escapements:	Hendrich *unpublished*
Model used for escapement goal:	Hendrich *unpublished*
Criteria for range:	Hendrich *unpublished*
Value of alpha parameter:	Hendrich *unpublished*
Value of beta parameter:	Hendrich *unpublished*
Document supporting current goal:	McPherson, S. A. and J. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 1J97-06, Juneau. Additional comments: The ADF&G is in the process of analyzing the additional spawner-recruit data for this stock and plans to provide a revised escapement goal by January 2006 (Hendrich *unpublished)*.

Table 1.8.1–Escapement survey counts, spawning escapement estimates of large spawners, and available age/sex composition for Unuk River Chinook salmon, from 1977 to 2005. Escapement estimates in bold are from mark–recapture studies, the remainder are from expanded survey counts. (2005 data and some recent estimates are subject to revision).

Year	Survey count	Spawning Escapement[a]	Age 1.2	Age 1.3	Age 1.4	Age 1.5	Age-.2-.5 total	Large females
1977	974	4,706						
1978	1,106	5,344						
1979	576	2,783						
1980	1,016	4,909						
1981	731	3,532						
1982	1,351	6,528	225	1,031	5,497	0	6,753	3,779
1983	1,125	5,436						
1984	1,837	8,876	1,041	6,026	2,918	0	9,986	4,985
1985	1,184	5,721	3,103	4,819	660	0	8,582	4,181
1986	2,126	10,273	7,132	5,123	4,800	92	17,147	6,757
1987	1,973	9,533	2,011	4,578	4,261	50	10,900	5,741
1988	1,746	8,437	1,293	3,358	4,433	64	9,148	3,856
1989	1,149	5,552	337	2,544	2,721	80	5,682	3,393
1990	591	2,856	1,509	707	1,526	145	3,887	1,624
1991	655	3,165	786	2,414	551	38	3,789	1,369
1992	874	4,233	1,319	1,914	2,232	30	5,496	2,836
1993	1,068	5,160	568	2,241	2,797	99	5,704	2,818
1994[b]	711	3,435	1,044	1,382	2,124	122	4,673	2,039
1995	772	3,730	1,616	995	2,362	0	4,974	1,989
1996	1,167	5,639	736	3,061	2,319	187	6,303	2,661
1997	636	**2,970**	**916**	**1,240**	**1,408**	**59**	**3,623**	**1,658**
1998	840	**4,132**	**1,269**	**2,595**	**1,207**	**35**	**5,106**	**2,087**
1999	680	**3,914**	**2,427**	**1,918**	**1,581**	**16**	**5,942**	**1,998**
2000	1,341	**5,872**	**3,140**	**3,499**	**1,447**	**50**	**8,136**	**2,506**
2001	2,019	**10,541**	**946**	**6,923**	**3,337**	**21**	**11,227**	**5,697**
2002	897	**6,988**	**2,485**	**2,887**	**3,188**	**66**	**8,626**	**3,330**
2003	1,121	**5,546**	**592**	**3,942**	**1,474**	**46**	**6,054**	**2,874**
2004	1,008	**3,963**	**2,936**	**1,289**	**1,756**	**19**	**6,000**	**1,645**
2005	929	4,487						

[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] 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.

Table 1.8.2–Estimated parent escapements, harvests, total returns, and exploitation rates of Unuk River Chinook salmon for brood years 1981 to 1998. Estimates for escapement data in bold are from mark–recapture studies, the remainder are from expanded survey counts.

Brood year	Parent escapement	Inriver total return[a]	Marine harvest (landed catch)	Incidental mortality	Total return[b]	Return/ spawner[b,c]	Exploitation rate[b]
1981[d]	3,532	12,552	2,207	628	15,387	4.4	18.4%
1982	6,528	16,223	1,895	1,007	19,124	2.9	15.2%
1983	5,436	8,235	870	350	9,455	1.7	12.9%
1984	8,876	5,401	315	187	5,904	0.7	8.5%
1985	5,721	1,626	367	182	2,174	0.4	25.2%
1986	10,273	6,254	1,192	646	8,092	0.8	22.7%
1987[d]	9,533	5,619	988	281	6,889	0.7	18.4%
1988[d]	8,437	5,684	999	284	6,968	0.8	18.4%
1989[d]	5,552	4,500	791	225	5,517	1.0	18.4%
1990[d]	2,856	4,417	777	221	5,415	1.9	18.4%
1991[d]	3,165	6,121	1,076	306	7,503	2.4	18.4%
1992	4,223	3,199	252	89	3,540	0.8	9.6%
1993	5,160	**5,142**	1,084	315	6,541	1.3	21.4%
1994[e]	3,435	4,655	840	241	5,737	1.7	18.9%
1995	3,730	**9,329**	1,730	549	11,608	3.1	19.6%
1996	5,639	**13,297**	1,992	629	15,918	2.8	16.5%
1997	**2,970**	**5,326**	982	205	6,513	2.2	18.2%
1998	**4,132**	**8,183**	1,200	353	9,736	2.4	16.0%

[a] Inriver total returns include 2- to 5-ocean-age fish (total age 4 to 7 years).

[b] Total returns, return per spawner, and exploitation rate all include incidental mortalities.

[c] Expressed in terms of the number of large fish per 2- to 5-ocean-age spawner.

[d] No wild stock CWT data for years 1981 and 1987-1991. Marine harvest and incidental mortality were calculated using the average brood year exploitation and incidental mortality rates from years 1993-1998.

[e] 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.

Appendix 1.9–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:	Sport and Commercial Fisheries Divisions
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 (3- to 5-ocean-age) as counted in **peak survey counts** in the standardized survey areas on eight clearwater tributaries: South Fork, Barrier, Butler, Leduc, Indian, Humpy, King, and Clear Falls.
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:	4.64 (multiplier for the sum of peak survey counts)
Brood years in analysis:	15 (1975 to 1989), as in McPherson and Carlile (1997).
Data in analysis:	Survey counts, expanded by 4:1 and 6.7:1 to estimate total escapement of large spawners, marine harvest by age for five 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, McPherson and Carlile (1997)
Contrast in escapements:	11.1, McPherson and Carlile (1997)
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
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, Commercial Fisheries Division, Regional Information Report 1J97-06, Juneau.

Table 1.9.1–Escapement survey counts, spawning escapement estimates of large spawners, expansion factors and available age/sex composition for Chickamin River Chinook salmon, from 1975 to 2005. (2005 data and some recent estimates are subject to revision). Escapement estimates in bold are from mark–recapture studies, the remainder are from expanded survey counts.

Year	Survey count	Spawning escapement	Expansion factor [a]	Age 1.2	Age 1.3	Age 1.4	Age 1.5	Age-.2-.5 total	Large females
1975	370	1,717							
1976	157	727							
1977	363	1,682							
1978	308	1,431							
1979	239	1,107							
1980	445	2,063							
1981	384	1,782							
1982	571	2,649							
1983	599	2,781							
1984	1,102	5,113							
1985	956	4,436		1,143	2,906	1,224	0	5,273	2,345
1986	1,745	8,097		1,204	5,736	2,397	0	9,336	4,470
1987	975	4,524		1,893	2,778	1,490	55	6,216	2,841
1988	786	3,647		539	2,183	1,547	44	4,314	1,768
1989	934	4,334		300	1,663	2,441	249	4,653	3,014
1990	564	2,617		688	593	1,738	102	3,120	1,840
1991	487	2,260		784	2,279	253	17	3,333	NE
1992	346	1,605		555	905	551	8	2,019	NE
1993	389	1,805		302	1,242	665	19	2,228	NE
1994	388	1,800		277	902	873	36	2,089	NE
1995	356	**2,309**	6.5	**274**	**416**	**1,219**	**57**	**1,966**	**980**
1996	422	**1,587**	3.8	**214**	**992**	**527**	**46**	**1,779**	**890**
1997	272	1,262		269	652	454	28	1,404	666
1998	391	1,814		534	1,601	213	0	2,348	960
1999	492	2,283		600	1,094	779	14	2,487	1,107
2000	801	3,717		972	2,146	1,034	0	4,152	1,749
2001	1,010	**5,177**	5.1	**1,080**	**3,778**	**1,190**	**32**	**6,080**	**2,841**
2002	1,013	**5,007**	4.9	**1,648**	**2,214**	**1,722**	**25**	**5,610**	**2,285**
2003	964	**4,579**	4.8	**555**	**3,371**	**1,145**	**21**	**5,092**	**2,550**
2004	798	**3,275**	4.1	**2,077**	**969**	**1,396**	**16**	**4,458**	**1,357**
2005	924	4,287							

[a] The expansion factor is 4.64 (SE=0.61) to convert peak survey counts to total escapement of large spawners, based on the 1995 to 1996 and 2001 to 2003 mark–recapture estimates.

Appendix 1.10–Keta River Chinook Salmon Stock.

Stock Description

The Keta River enters Boca de Quadra Inlet in the Misty Fjords National Monument about 75 km east of Ketchikan, Alaska. The Keta River produces a small run of Chinook salmon representing about 1% of the wild stock production in Southeast Alaska. Like other Chinook salmon found in the region, these fish are a spring run. This stock produces yearling (age-1.) smolt primarily with about 10% subyearling fish (age-0.). Information inferred from coded wire tagging studies in the nearby Chickamin and Unuk rivers suggests that Keta River Chinook salmon are *inside rearing* in behavior, spending most of their lives in Southeast Alaska and perhaps northern British Columbia. Keta River Chinook salmon are very robust, attaining lengths and weights rarely seen elsewhere in the region. The Keta River itself has many exposed gravel bars with intermittent large pools and logjams. This river is typified by large sediments, probably the result of extremely high flows common to the system. Habitats of this nature are suited for the larger, more robust fish common to the Keta River.

This river is one of four Behm Canal index systems in which Chinook are counted annually (Pahlke 2001). Peak counts of Chinook salmon in the Keta River have increased from the average seen during the base period (1975 to 1980), and in recent years have steadily increased towards the upper end of the current *biological escapement goal* range (Figure 1.4). Temporal trends in Chinook salmon abundance are reasonably consistent among the four Behm Canal index systems. In general, counts were at or above escapement goal ranges for most of the 1980s, but a significant downward trend began for all four systems near the end of the decade. Although this decline is apparent for the Keta River, counts have been near or above the lower end of the range since 1990. In recent years, escapements have been about double the values seen during the base years.

The ADF&G Division of Sport Fish performed three mark–recapture studies from 1998 to 2000 to estimate Chinook salmon escapement in the Keta River (Brownlee et al. 1999; Freeman et al. 2001). The estimated escapement of large Chinook salmon in 2000 was 913, about the same as the 968 estimated in 1999, and up from the 446 estimated in 1998. Expansion factors for the peak aerial survey counts were 3.0 in 2000, 2.5 in 1998 and 3.5 in 1999. The expansion factor used to expand index counts to estimates of total escapement is 3.0, the mean value seen during the three years of mark–recapture study (Table 1.10.1).

Escapements over the past 5 years of estimates (2001 to 2005) have averaged 1,169 total large spawners, and 390 large spawners in peak survey counts (Table 1.3). All five of these escapements were within or above the current (1997) goal range (Figure 1.4). Our most current spawner-recruit data are summarized in Table 1.10.1. The ADF&G is in the process of analyzing these data and will provide an escapement goal for large spawners, as measured in the annual survey program, by January 2006 (Der Hovanisian et al. *in prep*).

Appendix 1.10. Keta River Chinook Salmon Stock

System:	Keta River
Species:	Chinook salmon

Outline of stock management, assessment and escapement goal analysis

Management division:	Sport and Commercial Fisheries Divisions
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll; non directed
Escapement goal type:	*Biological Escapement Goal*
Current escapement goal:	250 to 500 range; 300 point estimate
Population for goal:	Large spawners (≥ 660 mm MEF, or 2- to 5-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 in revision analysis:	3.0: multiplier for helicopter peak survey count in the standardized survey area on the Keta River.
Brood years in revision analysis:	24 (1975 to 1998)
Data in revision analysis:	Survey counts, expanded by 3.0:1 to estimate total escapement of large spawners, harvest rates assumed from Unuk, age structure limited, but estimated for all broods.
Data quality:	Fair
Contrast in escapements:	Der Hovanisian et al. *in prep*
Model used for escapement goal:	Der Hovanisian et al. *in prep*
Criteria for range:	Der Hovanisian et al. *in prep*
Value of alpha parameter:	Der Hovanisian et al. *in prep*
Value of beta parameter:	Der Hovanisian et al. *in prep*
Document supporting current goal:	McPherson, S. A. and J. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 1J97-06, Juneau. Additional comments: The ADF&G is in the process of analyzing the additional spawner-recruit data for this stock and plans to provide a revised escapement goal by January 2006 (Der Hovanisian et al. *in prep*).

Table 1.10.1–Escapement survey counts, spawning escapement estimates of large spawners, expansion factors, and available age/sex composition for Keta River Chinook salmon, from 1975 to 2005. (2005 data and some recent estimates are subject to revision). Escapement estimates in bold are from mark–recapture studies, the remainder are from expanded survey counts.

Year	Survey count	Spawning escapement	Expansion factor [a]	Total age 3	Total age 4	Total age 5	Total age 6	Large females
1975	203	609						
1976	84	252						
1977	230	690						
1978	392	1,176						
1979	426	1,278						
1980	192	576						
1981	329	987						
1982	754	2,262						
1983	822	2,466						
1984	610	1,830						
1985	624	1,872						
1986	690	2,070						
1987	768	2,304						
1988	575	1,725						
1989	1,155	3,465						
1990	606	1,818						
1991	272	816						
1992	217	651						
1993	362	1,086						
1994	306	918						
1995	175	525						
1996	297	891						
1997	246	738						
1998	180	**446**	2.5	**0**	**55**	**151**	**234**	**240**
1999	276	**968**	3.5	**13**	**320**	**509**	**126**	**390**
2000	300	**914**	3.0	**12**	**318**	**378**	**206**	**377**
2001	343	1,029		31	217	704	78	464
2002	411	1,233		0	317	523	393	464
2003	322	966		0	186	610	169	390
2004	376	1,128		27	385	358	358	464
2005	497	1,491						

a The expansion factor is 3.00 (SE = 0.52) to convert peak survey counts to total escapement of large spawners, based on the 1998 to 2000 mark–recapture estimates.

Appendix 1.11–Blossom River Chinook Salmon Stock

Stock Description

The Blossom River is a clearwater river on the mainland in southern Southeast Alaska, approximately 40 miles east of Ketchikan. Chinook salmon from the Blossom River, along with fish from the Keta, Unuk, and Chickamin rivers are collectively known as the Behm Canal stocks, named for the long narrow body of water that they all flow into.

Chinook spawn in the main channel of the river. They start to enter the river in late June and complete spawning by early September. The stock produces primarily yearling smolt (age-1.), but returns have comprised as much as 15% subyearling fish (age-0.), which is unusual in Southeast Alaska (Pahlke 2001). The only other stocks which produce subyearling smolt, to any degree, are the Keta River stock and those in the Yakutat Forelands area, such as the Situk River. Based on coded wire tagging of Unuk and Chickamin Chinook wild and hatchery stocks, we believe the ocean distribution of this stock is primarily in Southeast Alaska waters and to a lesser extent in northern British Columbia.

The stock assessment program for the Blossom River stock consisted solely of standardized helicopter surveys from 1975 to 1998 (Pahlke 2001). In 1998, ADF&G received special funding from the U.S. Congress to improve abundance-based management for Chinook salmon in the Pacific Salmon Treaty area. ADF&G directed a portion of the money received to improving stock assessment by addressing the lack of information of Southeast Alaska Chinook stocks. Those funds and monies secured through the Pacific Coastal Salmon Recovery Fund program have been used to collect age, sex, and size information and estimate total on the Blossom, Keta, and Chickamin rivers in specific years since 1998. Annual surveys of escapement have continued in the Blossom River. A mark–recapture tagging experiment was conducted in 1998, which provided the current expansion factor of 4.0, i.e., 25% of the total escapement of large spawners is counted in the helicopter surveys (Brownlee et al. 1999). Mark-recapture experiments were also conducted in 2004 and 2005, but variability of the mean expansion factor exceeded data standards developed by the Chinook Technical Committee (coefficient of variation greater than 20%). Funding is being sought to conduct a fourth mark-recapture experiment in 2006.

We have sampled the escapement for age, sex, and size data since 1998. The age data indicate that returns of large Chinook salmon in this stock are composed 2-, 3- and 4-ocean-age fish (Pahlke 2001). The 2-ocean fish (primarily 4-year-old total age) are larger than Chinook salmon in most other systems (but similar to the Chickamin and Keta), and about 75% of the 2-ocean-age spawners in the Blossom River are of legal size. We have also found that the Chickamin, Keta, and Blossom River stocks produce the largest Chinook salmon at age in the region.

Survey counts have been relatively stable since 1975, with the exception of three years (Figure 1.4). Survey counts were the lowest in the period from 1975 to 1980, rose for a few years to unprecedented levels, and then have been relatively stable since 1989. The high counts from 1985 to 1987 are the result of an exceptionally high survival from one particular brood, a phenomenon that has occurred at least once in the last 28 years for most Southeast Alaska Chinook stocks. The 2001 to 2005 average survey count was 282 large Chinook, which is about three times the average escapement counts (102 large Chinook) from 1975 to 1980, the base period used by the Pacific Salmon Commission.

As mentioned in the body of the report above, a *biological escapement goal* range was established in 1997 for the Blossom River stock, based on limited data through the 1989 brood year (calendar year data through 1995). That escapement goal range was a survey count of 250 to 500 large spawners. Escapements in the Blossom River meet the 1997 *biological escapement goal* in 2004 and 2005.

The 1997 escapement goals were established prior to gathering new stock assessment data for Behm Canal Chinook salmon stocks. Preliminary analyses indicate that the existing goal overestimates the escapement level that will provide maximum sustained yield for this stock. Our most current spawner-recruit data are summarized in Table 1.11.1. The ADF&G will continue to analyze these data and will provide an escapement goal for large spawners, as measured in the annual survey program, by January 2006 (Der Hovanisian et al. *in prep*).

Appendix 1.11. Blossom River Chinook Salmon Stock

System:	Blossom River
Species:	Chinook salmon

Outline of stock management, assessment and escapement goal analysis

Management division:	Sport and Commercial Fisheries Divisions
Management jurisdictions:	ADF&G
Fisheries:	U.S. recreational, gillnet, and troll; non directed
Escapement goal type:	*Biological Escapement Goal*
Current escapement goal:	250 to 500 range; 300 point estimate
Population for goal:	Large spawners (≥ 660 mm MEF, or 2- to 5-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 2003-2005
Index count expansion factor: revision analysis	4.0: multiplier for helicopter peak survey count, based on one year (1998).
Brood years in revision analysis:	24 (1975 to 1998)
Data in revision analysis:	Survey counts, expanded by 4.0:1 to estimate total escapement of large spawners, harvest rates assumed from Unuk, age structure limited, but estimated for all broods.
Data quality:	Fair
Contrast in escapements:	Der Hovanisian et al. *in prep*
Model used for escapement goal:	Der Hovanisian et al. *in prep*
Criteria for range:	Der Hovanisian et al. *in prep*
Value of alpha parameter:	Der Hovanisian et al. *in prep*
Value of beta parameter:	Der Hovanisian et al. *in prep*
Document supporting current goal:	McPherson, S. A. and J. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 1J97-06, Juneau. Additional comments: The ADF&G is in the process of analyzing the additional spawner-recruit data for this stock and plans to provide a revised escapement goal by January 2006 (Der Hovanisian et al. *in prep*).

Table 1.11.1–Escapement index counts and spawning escapement estimates for large spawners, expansion factors, and available age/sex composition for the Blossom River Chinook salmon population, from 1975 to 2005. (2005 data and some recent estimates are subject to revision). Escapement estimates are from expansions of aerial survey counts from 1975 to 1997 and 1999 to 2003, using the 1998 expansion factor of 4.0. Numbers in bold are mark-recapture estimates.

Year	Survey counts	Spawning escapement	Expansion factor[a]	Total age 3	Total age 4	Total age 5	Total age 6	Large females
1975	146	584						
1976	68	272						
1977	112	448						
1978	143	572						
1979	54	216						
1980	89	356						
1981	159	636						
1982	345	1,380						
1983	589	2,356						
1984	508	2,032						
1985	709	2,836						
1986	1,278	5,112						
1987	1,349	5,396						
1988	384	1,536						
1989	344	1,376						
1990	257	1,028						
1991	239	956						
1992	150	600						
1993	303	1,212						
1994	161	644						
1995	217	868						
1996	220	880						
1997	132	528						
1998	**91**	**364**	4.0	**0**	**70**	**143**	**144**	**180**
1999	212	848		848	353	354	71	283
2000	231	924		12	318	378	206	377
2001	204	816		0	272	317	227	544
2002	224	896		0	151	477	268	500
2003	203	812		0	90	451	271	511
2004	333	**734**	2.2	**18**	**257**	**295**	**164**	**247**
2005	445	**912**	2.0	**9**	**199**	**560**	**140**	**369**

[a] Based on an expansion factor of 4.0 observed in 1998.

CHAPTER 2: SOCKEYE SALMON STOCK STATUS AND ESCAPEMENT GOALS IN SOUTHEAST ALASKA

by

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PROJECT SPONSORSHIP

This work was partially financed by grants from the Anadromous Fish Conservation Act Program, administered by the National Oceanic and Atmospheric Administration, and from the Southeast Sustainable Salmon Fund.

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ABSTRACT

Following a 2005 review of existing escapement goals for Southeast Alaska and the Yakutat area, three sockeye salmon (*Oncorhynchus nerka*) goals (Chilkat Lake, Chilkoot Lake and McDonald Lake) were revised and one goal (the Akwe River) was eliminated. There are currently 13 escapement goals for sockeye producing systems in the Southeast Alaska and Yakutat area. Over the last five years, escapement measures have been generally within or above the escapement goal ranges for at least four years; exceptions include Tahltan, McDonald and Hugh Smith lakes. Hugh Smith Lake was classified as a *stock of management concern* in 2003. In 2003 ADF&G lowered the escapement goal ranges and cooperated in stocking Hugh Smith Lake with hatchery-produced pre-smolts. The Board of Fisheries approved an action plan for the stock's recovery, and approved an *optimal escapement goal*, which explicitly included the hatchery-produced returns. Hugh Smith escapements were above the upper end of the new goal range from 2003 to 2005, but large numbers of the stocked fish counted as escapement failed to successfully spawn in the lake. Because the stocked returns were identifiable with an otolith mark, we were able to show that the Board-approved action plan was effective at reducing the harvest of this stock in the mixed-stock fisheries, and we showed that the number of naturally produced sockeye has increased in the escapement. ADF&G recommends removing the *stock of concern* designation from the Hugh Smith stock. We found no other stock in our review that we can recommend as *stocks of concern*. Although sockeye yields have generally been maintained in Southeast Alaska over two decades, yields are below peak historic levels. Yields in the Yakutat area have declined since the early 1990s, although escapement goals have been met in most cases.

Key words: Sockeye salmon, *Oncorhynchus nerka*, escapement, escapement goals, escapement goal ranges, stock status, lakes, Situk River, Chilkat Lake, Chilkoot Lake, Tahltan Lake, McDonald Lake, Hugh Smith Lake, stocks of concern

INTRODUCTION

Sockeye salmon (*Oncorhynchus nerka*) that are harvested in Southeast Alaska and the Yakutat area originate from three sources: transboundary rivers that flow through Canada and into Alaska (such as the Alsek, Taku, and Stikine rivers), coastal lakes (such as Chilkat and Chilkoot lakes in northern Lynn Canal, McDonald Lake near Ketchikan, as well as the Situk River near Yakutat; Figure 2.1), and Canadian rivers systems (such as the Nass and Skeena rivers). There are over 200 sockeye producing systems in the region (Van Alen 2000). Many but not all of these are small producers, however, their combined production is substantial. Most sockeye salmon originate in lake systems, but in Southeast Alaska and the Yakutat area, sockeye salmon also originate in riverine areas within the region's large mainland glacial systems. In addition to the larger systems in the Southeast Region, we have long-term stock assessment information for several smaller producers in the Yakutat area, including the Lost, Italio, Akwe and East Alsek-Doame rivers, and information on Redoubt Lake near Sitka, Speel Lake near Juneau, and Hugh Smith Lake near Ketchikan. Harvest information is recorded on a district-specific basis (Figure 2.2), and because stock-specific harvest information does not exist, it is usually not possible to study the productivity of a particular stock.

The timing of the return varies among runs throughout the region, and within individual stocks in several of the larger drainages. Sockeye salmon are available to fisheries in the region between early June and mid-September. Peak abundance occurs during the month of July. Spawn timing is also highly variable, with most spawning occurring between early August and late October.

Many of the region's sockeye salmon systems are monitored, most by the Alaska Department of Fish and Game (ADF&G). But in recent years monitoring efforts have been augmented by other agencies, including the U.S. Forest Service (USFS), National Marine Fisheries Service-Auke Bay Laboratory, and the Canadian Department of Fisheries and Oceans (CDFO) on Canadian portions of the transboundary rivers, as well as by non-governmental groups including several tribal associations and aquaculture associations. A subset of the region's sockeye salmon systems have been examined intensively and over a long enough time period to gain sufficient understanding of stock productivity to develop escapement goals (Figure 2.1).

Alaska's Sustainable Salmon Fisheries Policy (5AAC 39.222) was adopted into state regulation in 2000. This policy requires ADF&G to report on salmon stock status to the Alaska Board of Fisheries on a regular basis. The Policy for Statewide Escapement Goals (5 AAC 39.223) directs ADF&G to document existing salmon escapement goals, establish goals for stocks for which escapement can be reliably measured, and perform an analysis when these goals are created or modified. In order to meet requirements of the policies, Geiger et al. (2004) produced ADF&G's first report on stock status and escapement goals of sockeye salmon for the Southeast Alaska and Yakutat region. This chapter represents an updated, and somewhat abridged, version of that report, including changes in escapement goals recommended by ADF&G.

The first records of substantial commercial sockeye salmon catches date to 1883, when just over 100,000 fish were reported in the commercial harvest, although there was some level of commercial activity before that year (Byerly et al. 1999; Figure 2.3). Subsistence, personal use, and sport fishers harvest and use sockeye salmon in Southeast Alaska and the Yakutat area. After Alaskan statehood the commercial harvest can be used as a proxy for the total harvest, or even total abundance, in this area of the state because the commercial harvest has been such a large fraction of the runs. Catch records show commercial harvests in the Yakutat area in the early 20th century, with a peak of 453,000 in 1914. Annual commercial catches in Southeast Alaska and the Yakutat area were consistently in excess of 2 million fish from 1902 to 1920, peaking at 3.5 million in 1914. From 1925 to 1945 major fishing districts were defined, and a number of management measures and weekend fishing closures were introduced. Catches began a slow decline during this period, and ranged from 1.1 million to 2.5 million per year through the mid-1940s. By 1940 many runs were severely overfished and catch trends were on their way down. Until the 1940s, harvests of sockeye salmon in southern Southeast Alaska were more stable and consistent than in northern portions of the region. However, catches dropped in both areas in the 1940s (Figure 2.3). The region's commercial catch of sockeye salmon reached a trough of 490,000 in 1949 and generally remained below 1 million fish annually through the 1960s. After statehood, harvests in the Yakutat area generally increased up to a peak of nearly 350,000 in 1993 (Figure 2.4), and then declined to about the levels of the 1970s (slightly above 100,000).

Throughout Alaska, many salmon stocks declined in the early 1970s and then increased in the mid- to late-1970s— partially due to ocean-climate effects called the "regime shift" (Mantua et al. 1997; Beamish et al. 1998). Sockeye harvest levels began increasing in the late 1970s, especially in southern Southeast Alaska, although not as dramatically as with most other Alaskan salmon stocks (e.g., see Heinl and Geiger *in this volume*) and consistently exceeded 2 million fish between the late 1980s and late 1990s. Van Alen (2000) and others cite increased sockeye production spawning channels on the Skeena River in Canada as the main reason for the increased catch of sockeye salmon in southern Southeast Alaska, beginning in the 1980s.

The sockeye salmon is the primary species harvested in the region's drift gillnet fisheries during the summer months of June through late August, although substantial harvests of summer chum, pink, and coho salmon occur as well in the drift gillnet fisheries. During September and early October the fisheries target coho and fall-run chum salmon. There are five traditional drift gillnet fishing areas in Southeast Alaska: District 101 (Tree Point and Portland Canal), District 106 (Sumner and Clarence straits), District 108 (Stikine), District 111 (Taku-Snettisham), and District 115 (Lynn Canal). In addition, there is a terminal harvest area near the Snettisham

Hatchery where drift gillnet gear is allowed to harvest returns of Snettisham Hatchery sockeye salmon. Each of the traditional fisheries harvests mixed stocks of sockeye salmon.

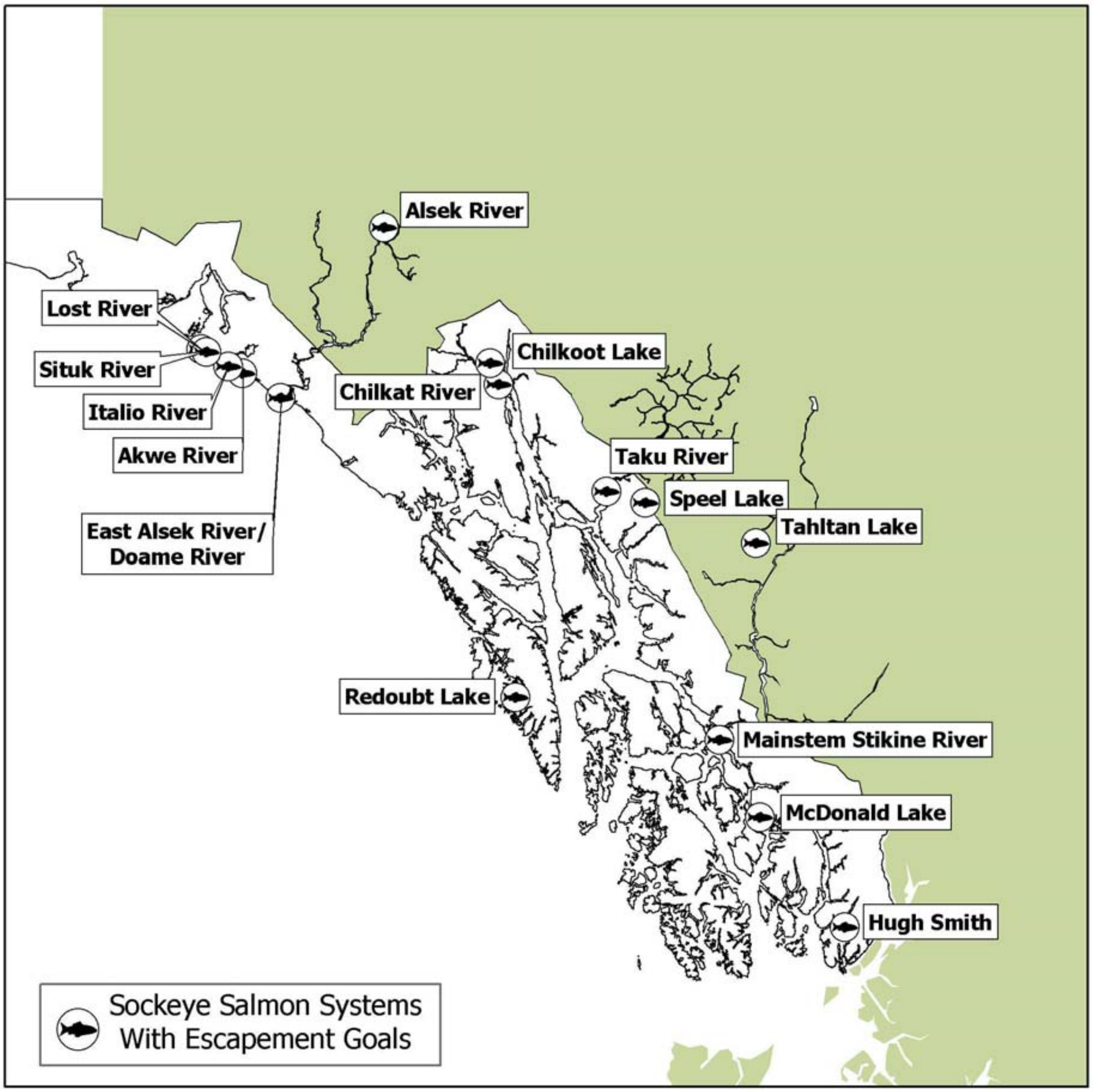

Figure 2.1–Sockeye salmon systems in Southeast Alaska and the Yakutat area that had escapement goals between 2002 and 2005. Escapement goals have been eliminated for the Akwe and Italio systems in the Yakutat area.

Management of the District 101, 106, 108, and 111 fisheries is governed by specific agreements with Canada in the Pacific Salmon Treaty as well as consideration of domestic stocks. The Tree Point fishery (in District 101) is constrained by the current Pacific Salmon Treaty agreement to harvest 13.8% of the annual allowable harvest of Nass River sockeye salmon. The District 106

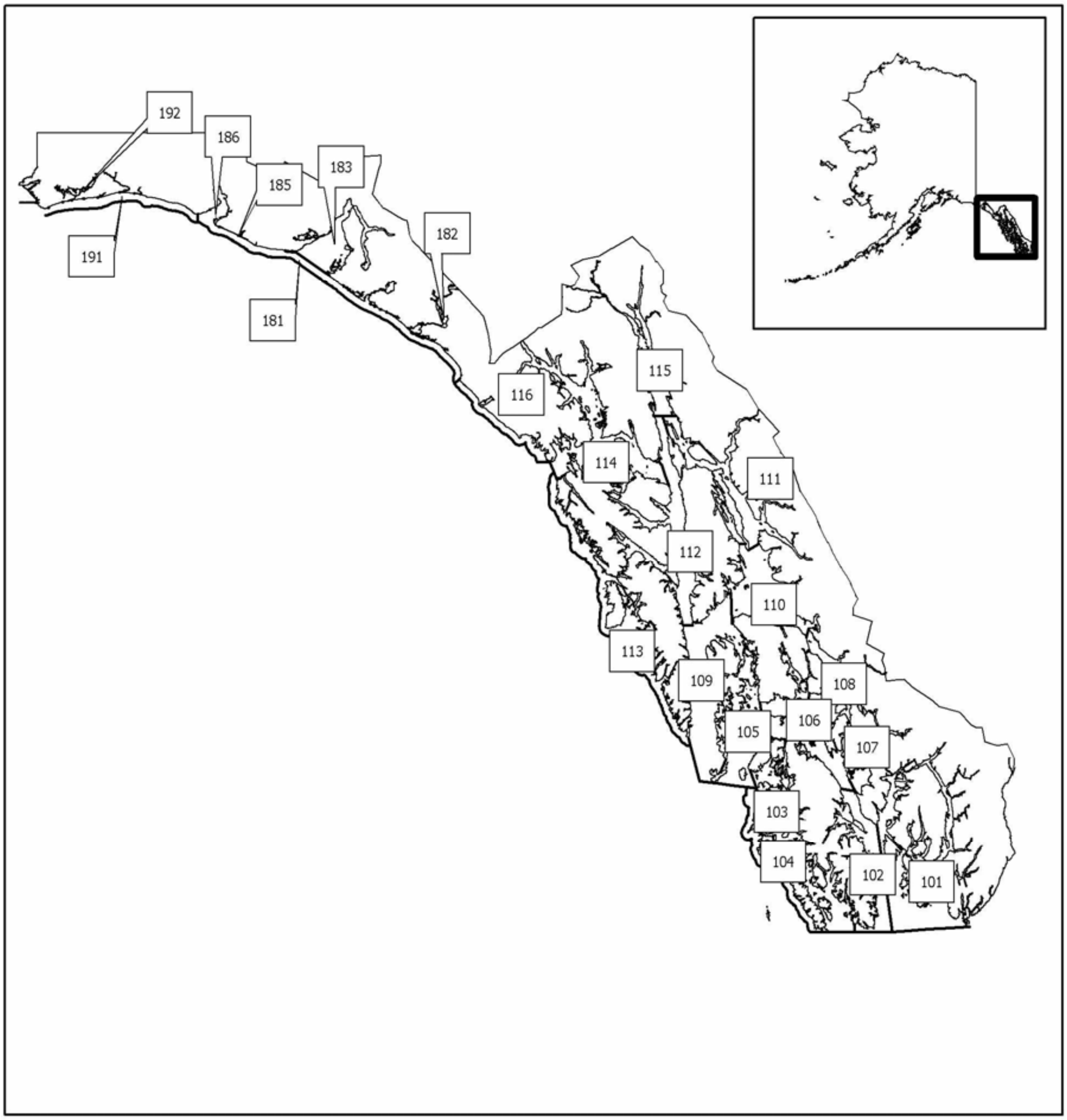

Figure 2.2–Fishing districts in Southeast Alaska and the Yakutat area.

and 108 fisheries are managed to abide by harvest-sharing agreements for transboundary Stikine River sockeye salmon; the current agreement specifies equal sharing of the total allowable catch[1] of Stikine River sockeye salmon in the two countries' fisheries. Harvest sharing of transboundary Taku River sockeye salmon is a major consideration in the District 111 fishery, with the U.S. entitled to 82% of the total allowable catch of wild Taku River sockeye salmon and 50% of the total allowable catch of sockeye salmon resulting from joint U.S./Canada enhancement programs on the river. The District 115 fishery, which targets sockeye salmon returns to the Chilkat and Chilkoot rivers, is the only drift gillnet fishery not directly affected by the Pacific Salmon Treaty.

[1] AAH (annual allowable harvest) and TAC (total allowable catch) are terms defined in the Pacific Salmon Treaty that represent the harvestable surplus in excess of the agreed upon escapement goal.

ADF&G operates intensive stock identification programs in order to effectively manage the stocks harvested in the fisheries and to abide by Pacific Salmon Treaty agreements. These programs have been operated since the early 1980s and are integral to the assessment of the region's sockeye salmon runs.

Although purse seine fisheries are frequently the largest harvester of sockeye salmon in the region, the primary targets of the seine fisheries are pink salmon and hatchery returns of chum salmon. The District 104 fishery, on the outer coast of southern Southeast Alaska, is where most sockeye salmon are taken by the purse seine fleet. Pacific Salmon Treaty provisions currently limit the District 104 harvest of sockeye salmon prior to Statistical Week 31 (near 31 July) to 2.45% of the annual allowable harvest of the combined Nass and Skeena River sockeye salmon runs. Directed purse seine fisheries on sockeye salmon occasionally occur in terminal areas when surpluses to spawning needs are identified; examples include Yes Bay (McDonald Lake run) in southern Southeast Alaska, and Redfish Bay and Necker Bay along the outside coast of northern Southeast Alaska near Sitka. Sockeye harvests in most other purse seine fisheries in the region are incidental to directed fishing on other species. To abide by Pacific Salmon Treaty agreements, contributions of Nass and Skeena sockeye salmon runs and a conglomerate of Alaska sockeye runs are estimated annually in southern Southeast Alaska purse seine fisheries. At present, these programs do not provide stock-specific information on harvests of individual Alaska sockeye runs in the region.

Set gillnet gear is allowed in the Yakutat area; there are no other commercial set gillnet fisheries in the rest of the region. Moreover, set gillnets are the only net gear allowed for commercial harvest of salmon in the Yakutat area. Sockeye salmon are the primary species targeted by Yakutat area fisheries during June through late August. The fisheries occur at or near the mouths of streams draining into the Gulf of Alaska, and thus are managed according to developing returns to each specific river. The exception to this is the Yakutat Bay fishery. This fishery harvests mixed stocks returning to all the systems in the area.

STOCK STATUS

This section provides a short summary of harvest and escapement assessment programs used to develop data series for monitoring stocks and establishing escapement goals. Status of the stocks is then reviewed by comparing measured escapements relative to established goals.

HARVEST ESTIMATION

Commercial harvest is recorded on a legal document called a *fish ticket*. The total weight of the harvest is the primary measure, and serves as the basis of payment on the part of the processors to the fishers. Fish tickets contain temporal and spatial information about the harvest, as well as information about the vessel making the catch and sale. Catch, in units of weight, is converted into units of fish numbers by the processors based on their own individual methods of determining the average weight of individual fish. By far, the largest removals are in the commercial fisheries, and the most accurate harvest estimates are for these fisheries.

Subsistence and personal use harvests have traditionally been estimated by means of returned permits. Since there are no important disincentives for non-reporting, harvests in these categories

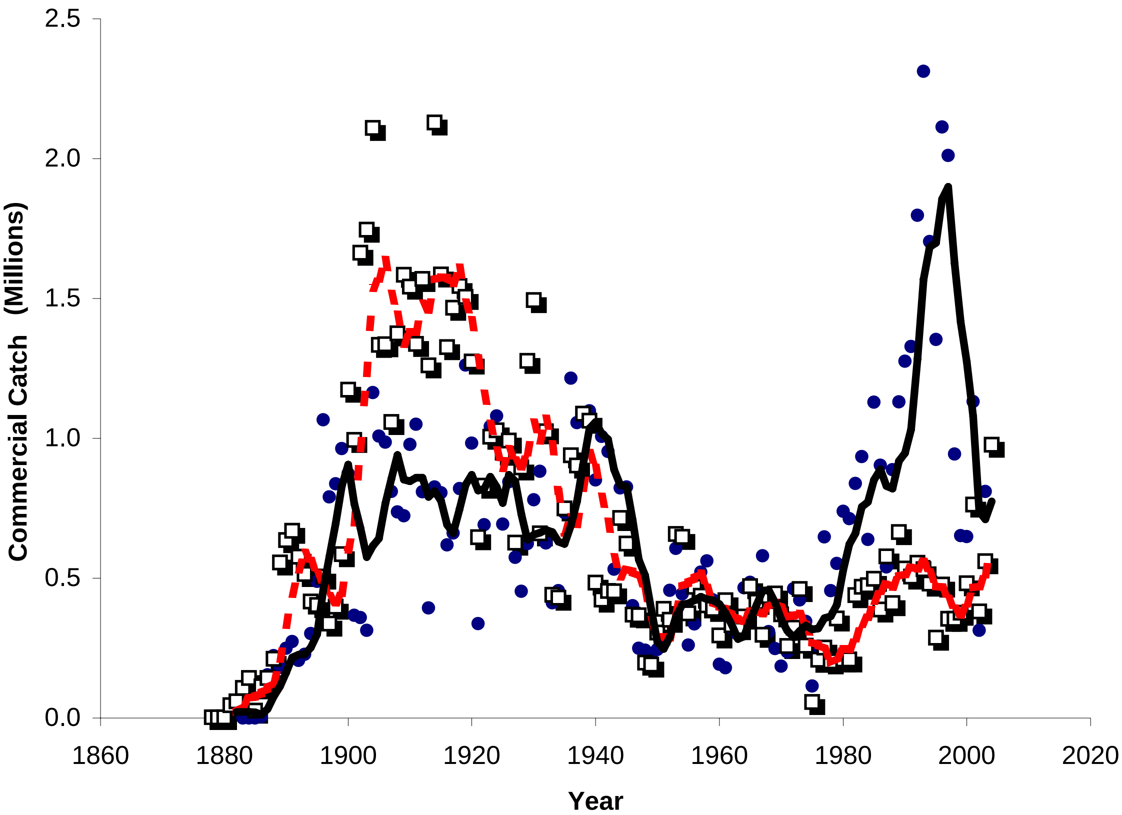

Figure 2.3–Commercial catch of sockeye salmon in Southeast Alaska (not including the Yakutat area) from 1878 to 2004. Open squares show catch of sockeye salmon in northern Southeast Alaska, and dots show catch of in southern Southeast Alaska. The curves show 5-year running averages. The solid curve is the estimated trend for southern Southeast Alaska, and the dashed curve is the estimated trend for northern Southeast Alaska.

are usually underreported and underestimated. Probability based surveys of subsistence harvest have been conducted for two years at Falls, Klag, Hetta, and Klawock lakes. These studies showed that the reported harvest was lower than the actual harvest (Conitz and Cartwright 2002a, 2002b, 2002c; Conitz et al. 2002; Lewis and Cartwright 2002a, 2002b, 2002c). Sport harvest is assessed by means of a household-based postal survey (e.g., Jennings et al. 2004).

Biological sampling is conducted in most commercial net fisheries that harvest sockeye salmon in Southeast Alaska and the Yakutat area. Age, sex and size data are collected, analyzed and summarized annually. ADF&G estimates stock compositions of sockeye harvests in most of the region's major mixed stock fisheries. A variety of techniques are used, including analyses of scale pattern, brain parasites, genetic stock identification, and thermal otolith marking of hatchery releases (Van Alen 2000; Jensen 2000). However, some fisheries directed at other species are not intensively sampled for sockeye stock composition (e.g. some purse seine fisheries in northern Southeast Alaska). Some of the stock-separation programs provide estimates for groups of stocks

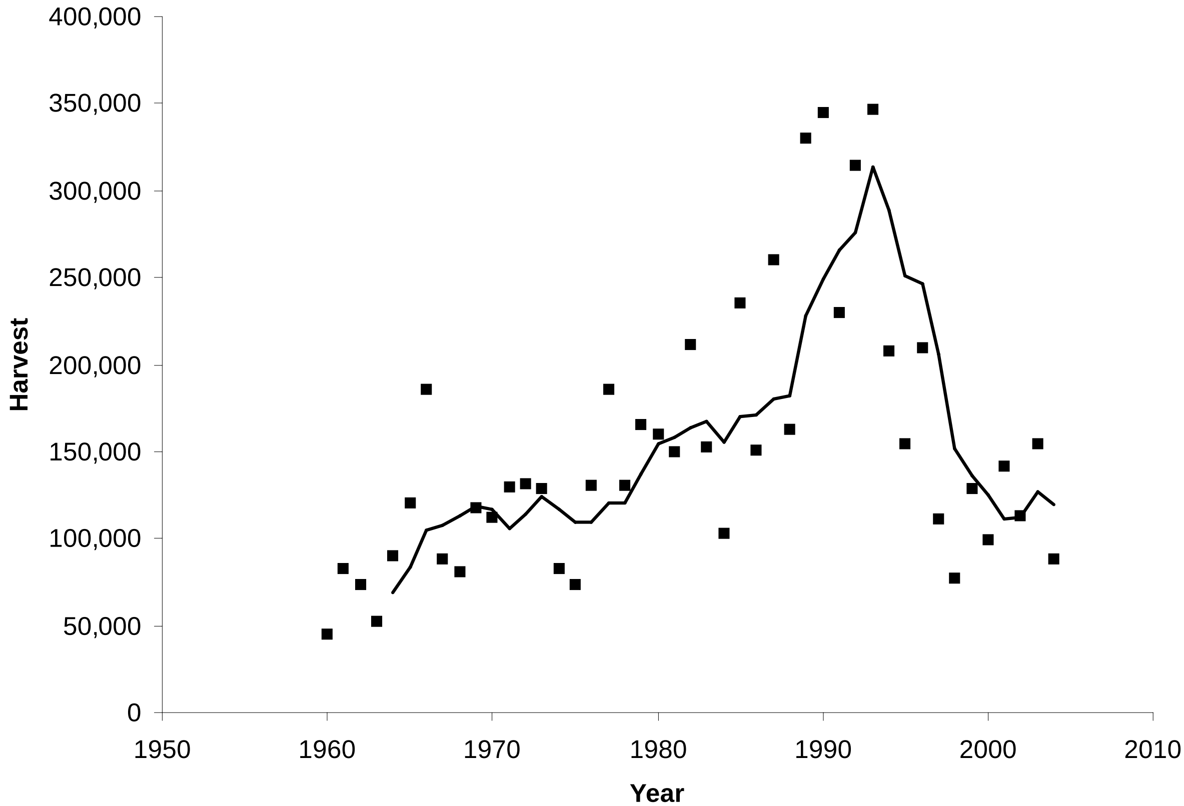

Figure 2.4–Commercial harvests of sockeye salmon in the Yakutat area from statehood to 2004. The curve represents the 5-year running average.

useful for management purposes, but do not provide a high degree of resolution for individual Southeast Alaska wild stocks (e.g. stock composition of fisheries in southern Southeast Alaska). This has limited the development of brood year tables necessary for stock-recruit analysis for some stocks, particularly for smaller stocks in the region that are harvested in mixed stock fisheries. Virtually all releases of sockeye salmon from hatchery programs have been otolith marked in recent years; very precise estimates of the contributions of hatchery sockeye are available for fisheries targeting these stocks (e.g. District 106, 108 and 111 drift gillnet fisheries, northern Chatham Strait purse seine fishery, etc).

ESCAPEMENT MEASUREMENT

A variety of methods are used to estimate escapements throughout the region, including mark-recapture studies, counting weirs, and aerial and foot surveys. Weirs are operated on several clear-water streams, and mark-recapture studies are generally used to verify the weir counts in Southeast Alaska. Mark-recapture programs are operated on several large glacial systems where fish cannot be visually counted. A relationship between repeated foot surveys and weir counts was developed for McDonald Lake, and expansions of foot surveys have been used to estimate escapements to this system since the mid-1980s. When an incomplete or inaccurate counting of the salmon is used to monitor escapement trends, we call that measure an *escapement index* to distinguish that kind of measure from an estimate of total escapement. Aerial surveys are used to index escapement trends throughout the region, and particularly in the small Yakutat area streams.

In the Yakutat area, sockeye escapement is assessed with a weir on the Situk River. Escapement is measured by means of a peak-count aerial index in the Italio, Akwe, East Alsek, and Doame rivers and peak foot or boat surveys in the Lost River; peak-count series for these systems go back to the 1970s. The CDFO has operated a counting weir since 1976 on the Klukshu River, a major tributary of the Alsek River, to index escapement to the Alsek drainage. The proportion of the Klukshu stock within the larger Alsek was evaluated with mark-recapture in 1983, and 2000 through 2004, in combination with several years of radio telemetry studies. Mark-recapture programs were operated in four Yakutat area systems from 2003 through 2005 to estimate total escapement and provide information on the relationship between ongoing index survey counts and total escapement; these included the East Alsek River (Waltemyer et al. 2005a, 2005b), Lost River and Akwe and Italio rivers.

In Upper Lynn Canal, a fish-wheel based mark-recovery study has provided information on run strength, run timing, and many other biological features of sockeye salmon returning to the Chilkat River (Bachman 2005). Mark-recapture estimates of escapement are available for Chilkat Lake and the mainstem Chilkat River (all other spawning areas combined) since 1994. Historically, ADF&G operated a weir at Chilkat Lake as the primary escapement assessment tool for the drainage, but (unpublished) mark-recapture studies and a radio tagging study showed that the weir was an unreliable escapement measure in this system because large and variable fractions of the escapement passed into Chilkat Lake undetected at the weir (Brian Elliot, University of Alaska Fairbanks, personal communication). The other major Upper Lynn Canal stock, Chilkoot Lake sockeye salmon, is monitored by means of a counting weir, which has been verified in recent years by a backup mark-recapture study (Sogge and Bachman *in prep*).

In the District 111 area, weekly inseason estimates of the sockeye salmon escapement to Canadian portions of the Taku River have been generated since 1984 through a joint U.S.-Canada fish wheel mark recapture project. Several weirs are operated by CDFO on systems within the Taku drainage, including Tatsamenie Lake (from 1985 to the present), Little Trapper Lake (1983 to the present) and Kuthai Lake (1992 to the present). ADF&G and CDFO have cooperated in operating a weir on the Nahlin River (most years between 1988 and 1998). ADF&G has also operated weirs on systems that produce fish that co-mingle with Taku stocks in District 111, including Crescent Lake (1982 to 1993), and Speel Lake (1982 to 1993, and 1995 to the present). Douglas Island Pink and Chum, Inc (DIPAC) has taken over operation of the Speel Lake weir in recent years. The National Marine Fisheries Service-Auke Bay Laboratory conducted extensive radio telemetry studies on Taku River sockeye in the 1980s that provided valuable information on spawning distribution in the drainage (Eiler et al. 1992). The Auke Bay Laboratory has also operated a weir to count the adult sockeye salmon escapement into Auke Creek, located just north of Juneau, since 1963 (Taylor and Lum *unpublished*); the weir has also been operated for much of this period to document outmigrating smolt abundance.

Escapement to the Stikine River is estimated by several methods, with assistance from CDFO. A weir has been operated annually since 1959 at Tahltan Lake, the largest spawning stock into the drainage, but counts are not available on a timely basis for inseason management. Total escapement to the drainage has been estimated by the Transboundary Technical Committee of the Pacific Salmon Commission, through an indirect method that relies on stock-composition data, catch-per-unit-effort data from Canadian inriver fisheries and the Tahltan Lake escapement. Methods were further refined in recent years, using the presence of otolith marked returns of enhanced fish to Tahltan and Tuya lakes. An inseason management model has been used by ADF&G and CDFO to provide in-season estimates of escapement, but the model produced inaccurate estimates in some recent years. As a result, the two agencies began mark-recapture studies on the river in 2001 to provide an alternate method for estimating escapement.

Two long-term sockeye escapement monitoring programs are in place along the outside coast of northern Southeast Alaska. ADF&G has estimated escapement of sockeye salmon to Ford Arm using mark-recapture methods in combination with operation of a weir to count coho salmon since 1983 (Leon Shaul, ADF&G, Douglas, personal communication). The U.S. Forest Service has operated a weir since 1982 (with the exception of 1998) on Redoubt Lake, a large meromectic system about 11 km south of Sitka.

Because of the dispersed production of sockeye salmon in coastal lakes in southern Southeast Alaska, there are very few long-term monitoring projects, except at large systems associated with enhancement projects. Escapement into McDonald Lake has been assessed by a series of standardized foot surveys (Johnson et al. *in press*). Escapement into Hugh Smith Lake is assessed by means of a weir, which has been operated since 1980, and with mark-recapture studies since 1992 to verify the weir estimates.

Since 2001 ADF&G and federal and tribal cooperators launched short-term assessment projects on 19 sockeye producing lakes in Southeast Alaska. Most of these projects are still ongoing. These cooperators intended to measure or index adult sockeye salmon escapement and collect biological and lake-productivity measurements on sockeye salmon-producing lakes important to local subsistence users in the region. In some cases they directly estimate subsistence harvests. Initial results from 12 of these programs operated by ADF&G were briefly summarized in Geiger et al (2004). On Prince of Wales Island, projects were located at Klawock, Hetta, Eek, Luck, Salmon Bay lakes. On Baranof Island monitoring projects were located at Falls, Gut Bay, Salmon, and Redfish lakes. On Chichagof Island projects were located at Kook, Sitkoh, Pavlov, and Klag Bay lakes. On Admiralty Island a project was placed at Kanalku Lake. A Hoktaheen Lake project was launched on Yakobi Island and a Kutlaku Lake project was launched on Kuiu Island. On Wrangell Island a project was located at Thoms Lake. On the mainland projects were launched at Virginia Lake. A project was placed on the Chilkat Peninsula at Neva Lake.

STOCK ASSESSMENT OVERVIEW

Geiger et al. (2004) reported 14 systems in Southeast Alaska and the Yakutat area with escapement goals, and these goals form the basis of our review since the last stock assessment. The primary assessment tool for these stocks is the escapement goal performance. The goals are described in the Escapement Goal section that follows, and an overview of the analysis that supported each escapement goal is provided in an appendix (Appendix 2).

Yakutat Stocks

Escapements to the non-transboundary Yakutat sockeye systems have usually met or exceeded the current escapement goals every year since 2000, with the exception of the Akwe River, where conditions in recent years have not allowed escapement to be adequately assessed. As previously mentioned, sockeye harvests in the Yakutat area in the last decade have declined below levels seen in the mid-1980s through the mid-1990s (Figure 2.4). Recent reduction in the productivity of the East Alsek River, presumably due to hydrological changes in that watershed (Clark et al. 2003), is a contributing factor to lower catches in the Yakutat area, but yields to the Situk River have also declined. In all cases, recent yields in the Yakutat area were substantially lower than predicted by the Ricker models (described in Geiger and McPherson 2004) that were used to set escapement goals. The combined Ricker-model prediction is for an average sustained yield for the five stocks with escapement goals in excess of 200,000 fish. However, the yield for all of the Yakutat area has averaged about 125,000 fish from 1996 to 2004. The combined yield for this area has not been above 155,000 since 1996. This discrepancy could be an indication that the environment in the Yakutat area has substantially changed, or it could indicate problem with the models that were used to set the escapement goals. In any event, the sockeye yields in the Yakutat area have fallen since the early 1990s (when they were typically near 300,000) to levels near what was observed in the 1970s (typically near 100,000, Figure 2.4).

Transboundary River Stocks

Transboundary river stocks are managed jointly with Canada. We have escapement goals for the Klukshu index tributary of the Alsek River, for the Taku River drainage as a whole, and for the Tahltan and Mainstem stocks in the Stikine River drainage. Sockeye escapements to the Taku and Klukshu rivers have been within or above goal ranges in most years since 2000. Harvests of sockeye salmon in the U.S. Alsek River fishery have averaged 20,000 fish over the last decade (1995–2004 average), very close to the historical average harvest for the fishery (1961–1994 average harvest was 21,000 fish). Harvests of Taku sockeye salmon in the terminal U.S. and Canadian inriver fisheries have been at high levels during the last decade, including record harvests in several years. Returns to Tahltan Lake, however, have been highly variable in the last decade. Tahltan Lake escapements were below the escapement goal range between 1997 and 2002. This was a major concern to Alaskan and Canadian managers. They developed coordinated management and assessment responses to improve escapements. As a result, exploitation rates were reduced and the escapement goal was missed by only several hundred fish in 2002. Escapements were above the upper end of the escapement goal range in 2003 through 2005.

Southeast Alaska Stocks

Escapement goals have been established for six additional systems in Southeast Alaska, including four systems in northern Southeast Alaska (Chilkat and Chilkoot lakes, Redoubt Lake, and Speel Lake), and two in southern Southeast Alaska (McDonald and Hugh Smith lakes).

ESCAPEMENT GOALS AND ESCAPEMENT PERFORMANCE

There are currently 13 escapement goals for sockeye stocks in Southeast Alaska and the Yakutat area (Table 2.1). During ADF&G's review of existing escapement goals in 2005, we updated goals for three large sockeye salmon stocks in the region (McDonald, Chilkat and Chilkoot lakes) and recommend eliminating the goal for the Akwe River. Geiger et al. (2004) provided an extensive record of statistics on escapement performance, stock-specific harvest, where available, and age-class distribution in the catch and escapement for the monitored systems, current up to the 2002 return year, which we have not repeated here. Table 2.2 includes escapement information since 2000 for systems with escapement goals, including information for 2005, where available. Figures 2.5 through 2.18 in this section show longer escapement histories for these stocks, and additional information on each system is presented in the Appendices 2.1 through 2.14.

Table 2.1–Escapement goals for sockeye salmon stocks or stock groups in Southeast Alaska and the Yakutat area.

System	Additional Material in Appendix	Escapement Goal	Year Established	If Recently Revised, Previous Goal
Situk River	2.1	30,000–70,000	1995[a]	
Lost River	2.2	1,000–2,300	1995	
Akwe River	2.3	Eliminated	1995	600–1500
Klukshu River	2.4	7,500–15,000	2000	
East Alsek-Doame River	2.5	13,000–26,000	2003	26,000–57,000
Chilkoot Lake	2.6	50,000–90,000	2005	50,500–91,500
Chilkat Lake	2.7	80,000–200,000[b]	2005	52,000–106,000
Redoubt Lake	2.8	10,000–25,000	2003	No previous goal
Taku River	2.9	71,000–80,000	1986	
Speel Lake	2.10	4,000 –13,000	2003	5,000
Tahltan Lake	2.11	18,000–30,000	1993	20,000–40,000
Mainstem Stikine River	2.12	20,000–40,000	1987	
Hugh Smith	2.13	8,000–18,000	2003	15,000–35,000
McDonald Lake	2.14	70,000–100,000	2005	65,000–85,000

[a] An analysis in 2002 produced the same goal.

[b] The previous escapement goal was based on weir counts. The new goal is based on mark-recapture estimates of escapement, and the intent is to keep the number of fish entering the lake essentially unchanged.

SITUK RIVER

ADF&G has managed the Situk-Ahrnklin Inlet and inriver fisheries to achieve an escapement goal of over 100,000 spawners in the early 1980s, then 45,000 to 55,000 sockeye salmon past the Situk River weir for several years prior to 1995. In 1995, ADF&G adopted an escapement goal of 30,000 to 70,000 sockeye salmon (weir count minus upstream sport harvest; Clark et al. 1995a). At that time the authors of the escapement goal report recommended the goal be reviewed in five years. A Situk River stock-recruit analysis using data from the 1976 through 1997 brood years is the basis for the current goal range (Clark et al. 2002; Appendix 2.1). Escapements have been within or above the goal range (Figure 2.5).

LOST RIVER

In 1995, ADF&G established a *biological escapement goal* for the Lost River of 1,000 to 2,300 peak survey counts, based on a stock-recruit analysis using data from the 1972 to 1983, 1986, and 1988 brood years (Clark et al. 1995b; Appendix 2.2). This goal has not been updated since 1995. Escapements have been within the goal range four of the last five years, with escapement above the range in 2003 (Figure 2.6).

Table 2.2–Escapement measures for 13 sockeye systems with escapement goals in Southeast Alaska and the Yakutat area for the years 2000 to 2005.

System	Units	Previous Goals	2000	2001	2002	2003	2004	2005
Hugh Smith Lake[a]	Total Fish	8,000–18,000	4,300	3,800	6,200	19,600	19,700	23,800
McDonald Lake	Total Fish	65,000–85,000	90,600	42,800	25,800	89,200	21,300	n.a.
Mainstem Stikine River	Total Fish	20,000–40,000	10,100	40,900	31,400	62,300	38,000	30,000
Tahltan Lake	Total Fish	18,000–30,000	5,700	14,700	17,300	49,600	63,300	42,000
Speel Lake	Total Fish	4,000–13,000	9,400	12,700	5,000	7,000	7,900	7,500
Taku River	Total Fish	71,000–80,000	75,500	144,300	103,300	160,400	108,000	130,000
Redoubt Lake	Total Fish	7,000–25,000	3,000	3,700	23,900	69,900	77,300	64,500
Chilkat Lake[b]	Weir counts	52,000–106,000	131,000	132,000	134,000	117,000	119,000	n.a.
Chilkoot Lake	Total Fish	50,500–91,500	43,600	76,300	58,400	74,500	75,600	51,200
East Alsek-Doame River	Index units	13,000–26,000	23,200	18,500	14,200	36,400	33,300	50,000
Klukshu River	Total Fish	7,500–15,000	5,400	9,200	23,600	32,100	13,700	3,400
Lost River	Index units	1,000–2,300	2,200	1,400	1,800	3,000	1,100	1,500
Situk River	Total Fish	30,000–70,000	36,300	57,700	65,400	89,700	42,500	66,500

[a] Includes hatchery fish.

[b] The previous Chilkat Lake escapement goal was based on weir-count observations, although these escapement measures are in mark-recapture units.

AKWE RIVER

Although ADF&G adopted a *biological escapement goal* of 600 to 1,500 peak aerial survey (Appendix 2.3) counts for this system in 1995, we have no peak counts on this system after 2001. The escapement goal has not been updated and ADF&G recommends deleting this escapement goal.

KLUKSHU RIVER (IN THE ALSEK RIVER SYSTEM)

The Klukshu River is a major sockeye salmon producing tributary of the transboundary Alsek River system. A *biological escapement goal* of 7,500 to 15,000 sockeye salmon spawning upstream of the Klukshu River weir was established in 2000, based on a stock-recruit analysis of data from the 1976 through 1992 brood years (Clark and Etherton 2000; Appendix 2.4). This goal was adopted later by the ADF&G, CDFO, and Transboundary Technical Committee. Expanded stock assessment work is being conducted to improve estimates of total escapement to the entire Alsek River drainage. Escapements were above the upper end of the goal range two out of the last five years, within the goal range in two years and below the lower end of the goal one out of the last five years (Figure 2.7).

EAST ALSEK-DOAME RIVERS

A *biological escapement goal* of 26,000 to 57,000 peak aerial survey counts was established for the East Alsek-Doame River in 1995 (Clark et al. 1995b). The escapement goal was derived from stock–recruit data collected in the 1970s and 1980s, when spawning habitat was in excellent condition. The *biological escapement goal* was recently revised downward to 13,000 to 26,000 peak aerial survey counts as a result of deteriorated spawning habitat since about 1990 (Clark et al. 2003; Appendix 2.5). Escapements have been above the upper end of the goal range three of the last five years and above the lower end of the goal range five of the last five years (Figure 2.8).

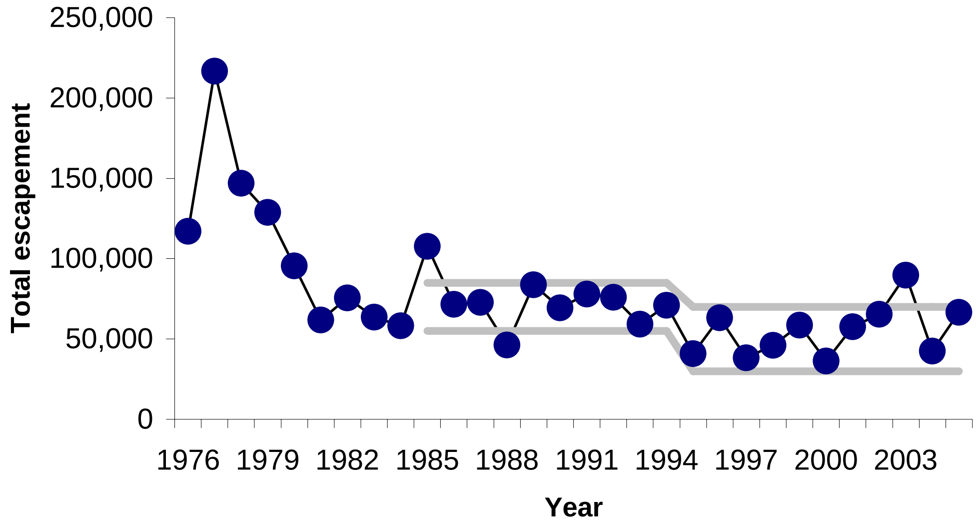

Figure 2.5–Escapement measures (weir count) for Situk River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

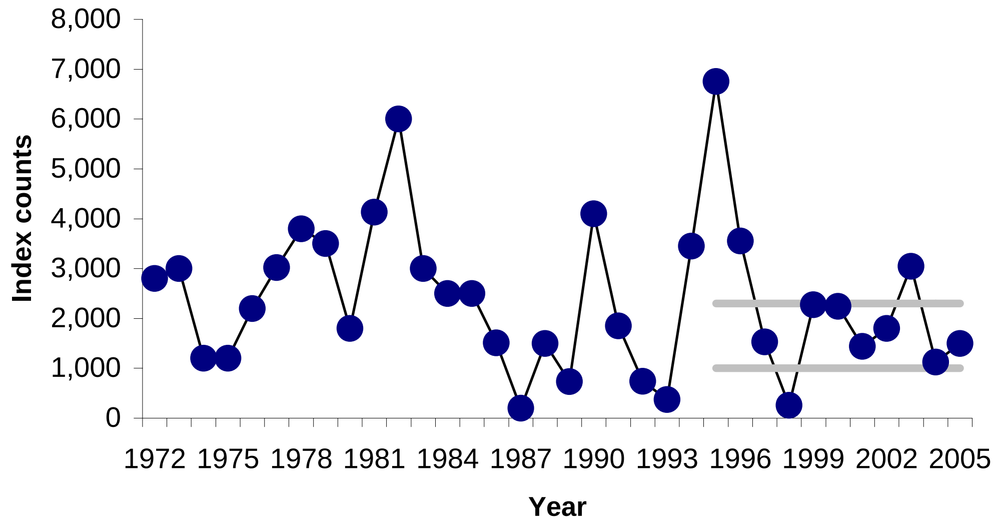

Figure 2.6–Escapement index (peak survey counts) for Lost River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

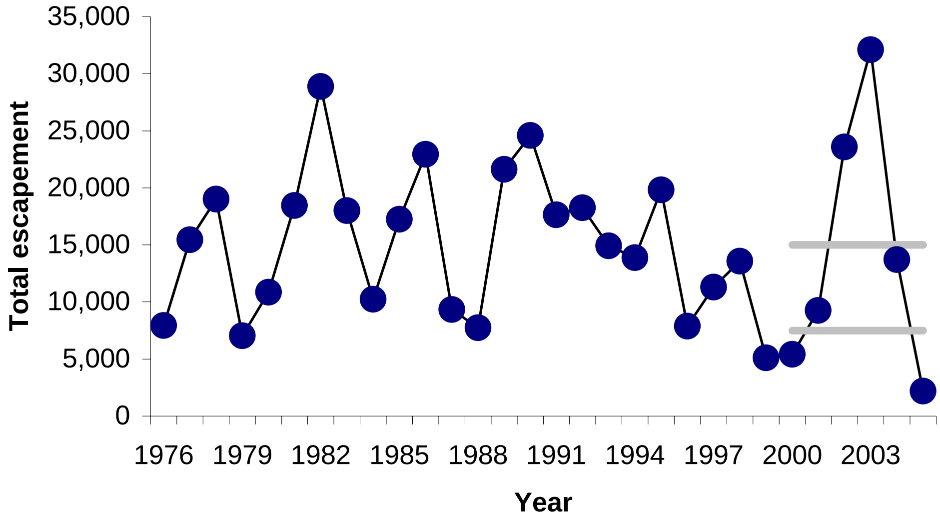

Figure 2.7–Escapement measures (weir counts) for Klukshu River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

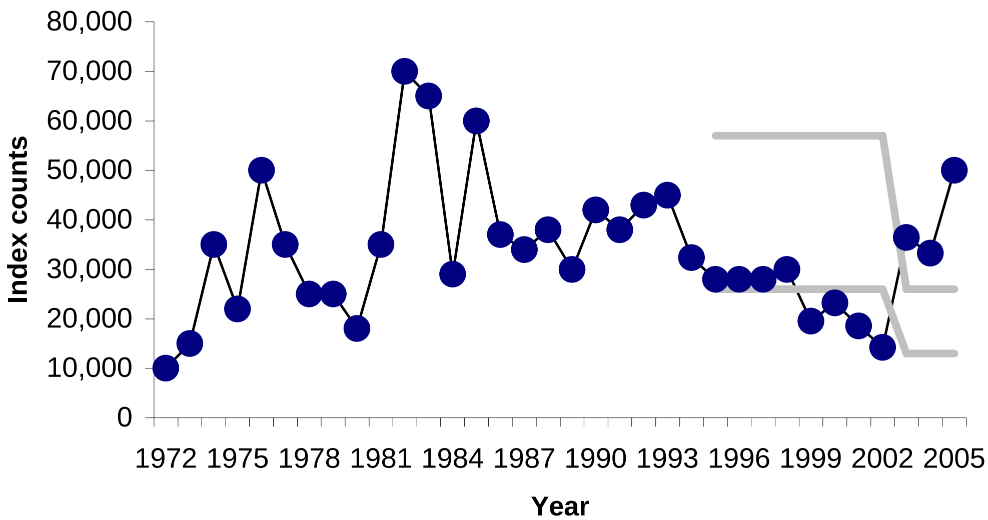

Figure 2.8–Escapement index (peak aerial counts) for East Alsek-Doame River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

CHILKOOT LAKE

ADF&G has operated an adult weir at the Chilkoot Lake outlet since 1976. An escapement goal range was established in 1990 on the basis of a stock-recruit analysis of catches and weir counts from the 1976 to 1984 brood years (McPherson 1990). An extremely low weir count in 1995 prompted ADF&G to check the weir counts with mark-recapture estimates. Mark-recapture estimates have been considerably higher than the weir counts at times. Chilkoot Lake underwent an extended downturn in production in the 1990s. The commercial catch of Chilkoot Lake sockeye salmon averaged 149 thousand fish from 1976 to 1989, but the recent ten-year average harvest is only 26 thousand fish. An extensive stock-recruit analysis in 2005 failed to produce a statistically reliable stock-recruit relationship because of rapid changes in this stock's productivity. ADF&G recommends essentially the same escapement goal range, of 50,000 to 90,000, although we are now classifying this as a *sustainable escapement goal* (Appendix 2.6). We further recommend weekly escapement targets, based on historical run timing (Appendix Table 2.6.1). Our rationale is that even though production is now too unstable to develop a statistically reliable stock-recruit model, the previous escapement goal was based on a substantial analysis, and escapements in the current goal range resulted in high yields in the past. We are operating on the assumption that the lake will return to a more stable production regime in the near future. The escapement has been within the previous escapement goal range five out of the last five years, with the escapement below the lower end of the range in 2000 (Figure 2.9).

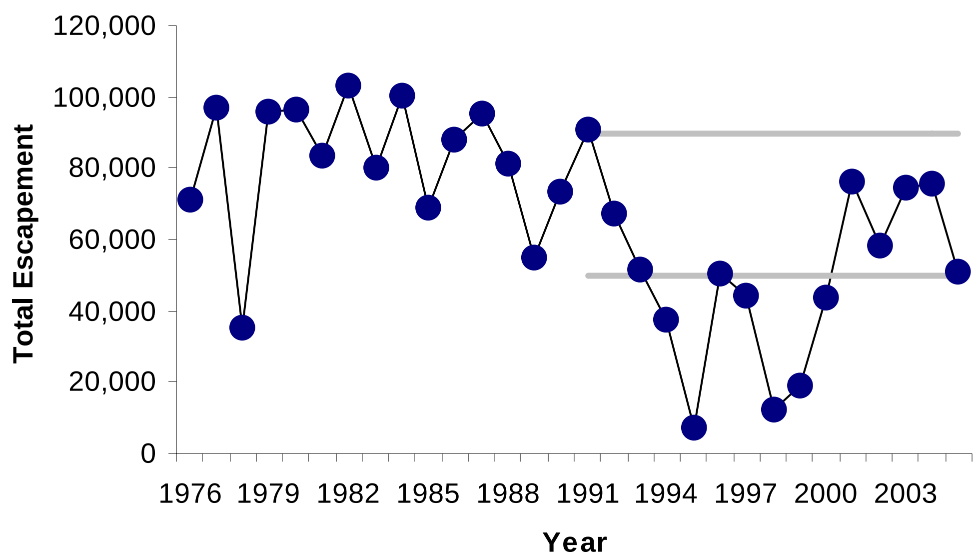

Figure 2.9–Escapement measures (weir counts) for Chilkoot Lake sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

CHILKAT LAKE

Like the Chilkoot system, the escapement goal in this system was established in 1990 based on a stock-recruit analysis of data from the 1976 to 1984 brood years (McPherson 1990). Mark-recapture methods are now used to measure escapement into Chilkat Lake, although the previous goal was based on weir-count observations of escapement. There are two main challenges in updating the escapement goal for this system. First, like the Chilkoot system, recent mark-recapture studies have shown that the historic weir counts are biased low, but not consistently biased. The problem seems to be far worse with the Chilkat Lake escapement measures. Although it was possible to develop an apparent statistical relationship between the weir counts and the far more reliable mark-recapture estimates, this relationship is largely based on a single outlier (Figure 2.10). Even so, the weir counts seem to typically be about half of the mark-recapture estimates. The second problem with updating the goal is that the stock's productivity has been influenced by lake stocking. Based on the euphotic volume of the lake, ADF&G recommended that Chilkat Lake be used as a site for lake stocking in the 1980s. Eggs and milt were harvested from the lake, and fry were stocked in the lake from the 1993 to 1995 brood years. The first fry plants occurred in June of 1994 with 4.4 million juvenile salmon. The mean smolt size dropped in 1995 and again in 1996. By 1997 the zooplankton showed alarming declines, and the project initiators were rethinking their initial assumptions about this lake's capacity to support additional sockeye fry. Clearly, this stocking decreased the productivity of Chilkat Lake. In 2000, Alaska Department of Fish and Game tied future lake stocking in the system to zooplankton abundance and sockeye salmon smolt size. Because of the stocking, the stock-recruit observations for the 1993–1997 brood years are not suitable for use in setting future escapement goals. Escapements have been measured on two different scales at Chilkat Lake. The escapement goals are in weir-count units, and the generally higher recent mark-recapture estimates are not directly comparable. Even so, we believe that the most recent five escapements are consistent with the intent of the previous escapement goals (Figure 2.11).

We recommend revising this goal so the goal is in the units of the mark-recapture estimates. Because we do not have a reliable means of converting between the weir-count estimates and the mark-recapture estimates, we relied on professional judgment to determine that an escapement level of 80,000 to 200,000 in mark-recapture units is approximately the same as the previous weir-count escapement goal (Appendix 2.7). Although this goal is intended as a *sustainable escapement goal*, this goal range is consistent with two independent, unpublished attempts at a Ricker analysis of the pre-1993 brood year stock-recruit observations.

REDOUBT LAKE

A *biological escapement goal* of 10,000 to 25,000 spawners was recently established for Redoubt Lake based on stock-recruit analysis of data from the 1982 to 1996 brood years (Geiger 2003; Appendix 2.8). In 2003 the BOF established an *optimal escapement goal* of 7,000 to 25,000 spawners. Escapements have been below the lower end of this goal range one of the last five years, within the range in one year and above the upper end of the goal range three of the last five years (Figure 2.12).

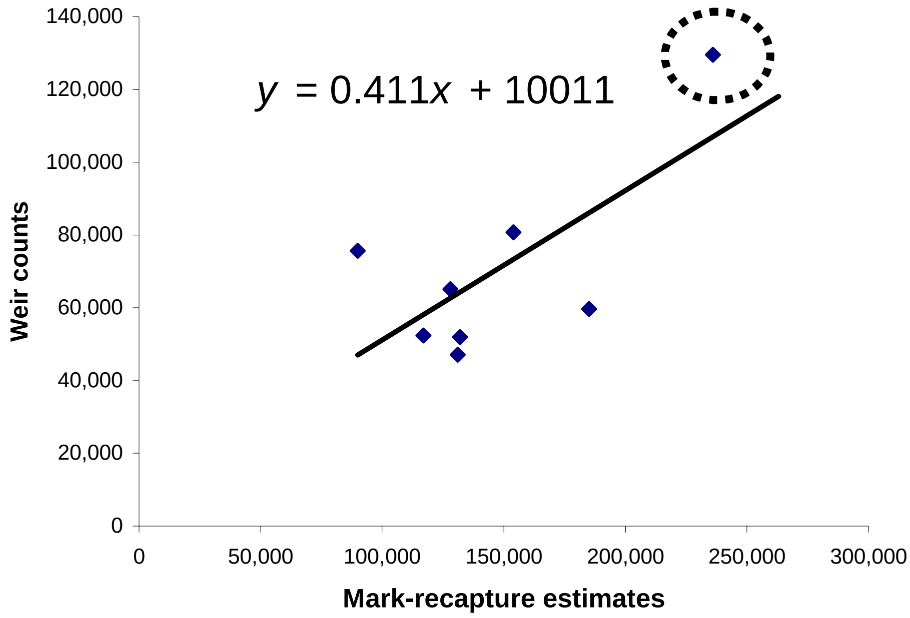

Figure 2.10–A regression relationship between Chilkat Lake weir counts and mark-recapture estimates using paired 1994 to 2004 observations. The false appearance of a statistical relationship is controlled by a single outlier, denoted by the dotted circle. The deletion of this point results in an entirely different relation with a drop in the R^2 statistic from 50% to less than 1%.

TAKU RIVER

An escapement goal of 71,000 to 80,000 sockeye salmon into Canadian spawning areas of the transboundary Taku River was established by the Transboundary Technical Committee (TTC 1986) in 1985 (Appendix 2.9). The escapement goal was established based on professional judgment and the technical committee considers it an interim goal until a formal scientifically based goal is developed. ADF&G considers this goal to be a *sustainable escapement goal*. Escapements have been above the upper end of the escapement goal range five of the last five years, and within the escapement goal range in 2000 (Figure 2.13).

SPEEL LAKE

The Speel Lake sockeye escapement has been monitored with a weir in all but two years since 1983. The stock has been managed for an escapement goal of 5,000 fish until 2003. Riffe and Clark (2003) recommended a goal of 4,000 to 13,000 spawners (Appendix 2.10). Estimated escapements have been within this range for five of the last five years (Figure 2.14).

TAHLTAN LAKE SOCKEYE SALMON

Tahltan Lake is a major sockeye producing tributary of the transboundary Stikine River. The Transboundary Technical Committee of the Pacific Salmon Commission adopted the current escapement goal of 18,000 to 30,000 spawners for Tahltan Lake in 1993, based on a stock-recruit analysis conducted by CDFO staff (Humphreys et al. 1994). We consider this goal to

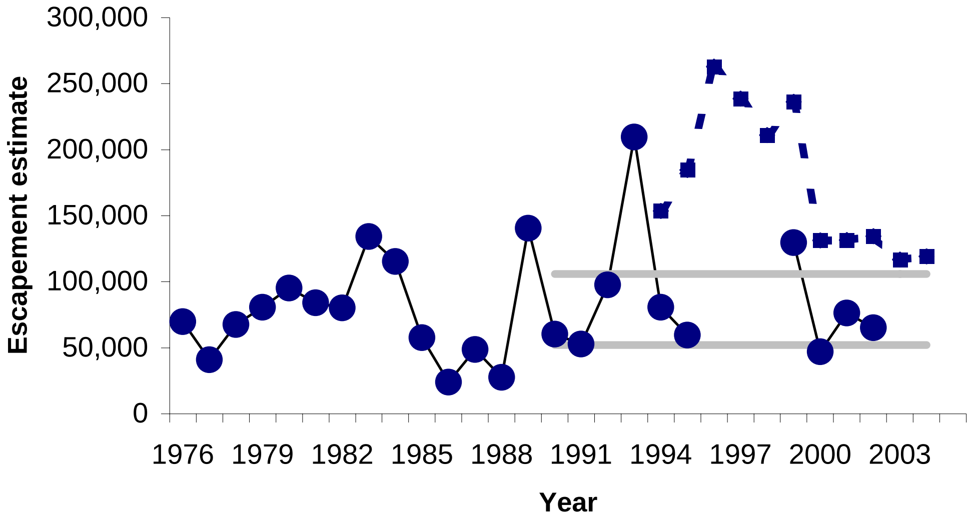

Figure 2.11–Two escapement measures for Chilkat Lake sockeye salmon (1976–2004, the 2005 statistic is not yet available). The dots connected by a solid line are the weir counts, which have been shown to be inaccurate. The squares connected by the dashed lines are the mark-recapture estimates. The two horizontal lines show the previous escapement goals, in weir-count units, beginning the year that the goals were established.

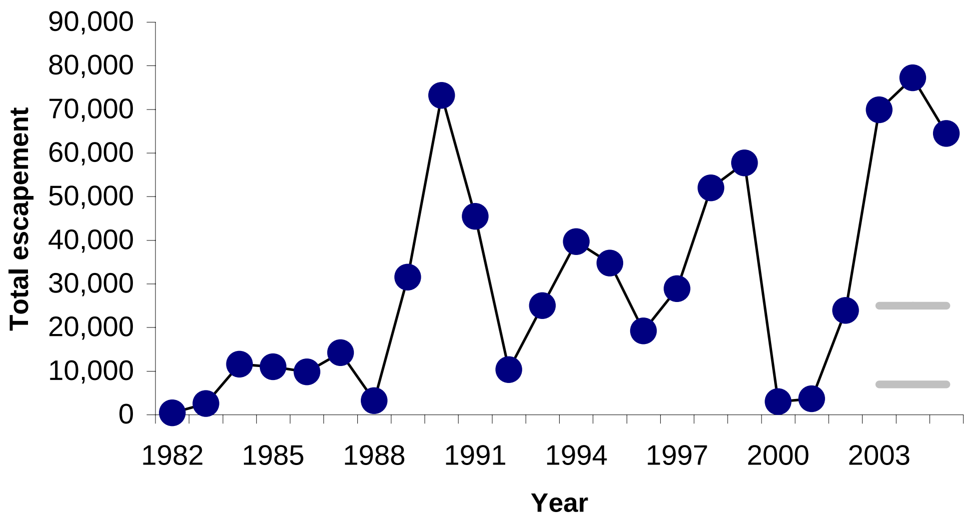

Figure 2.12–Escapement measures (weir counts) for Redoubt Lake sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

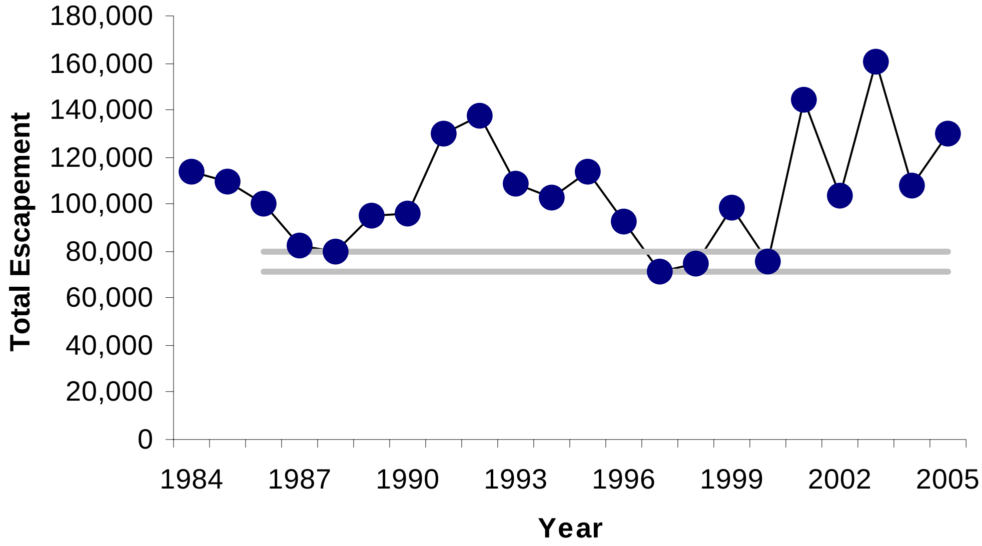

Figure 2.13–Escapement measures (mark-recapture estimates) for Taku River sockeye salmon. The horizontal lines show the current escapement goals, beginning the year that the goals were established**.**

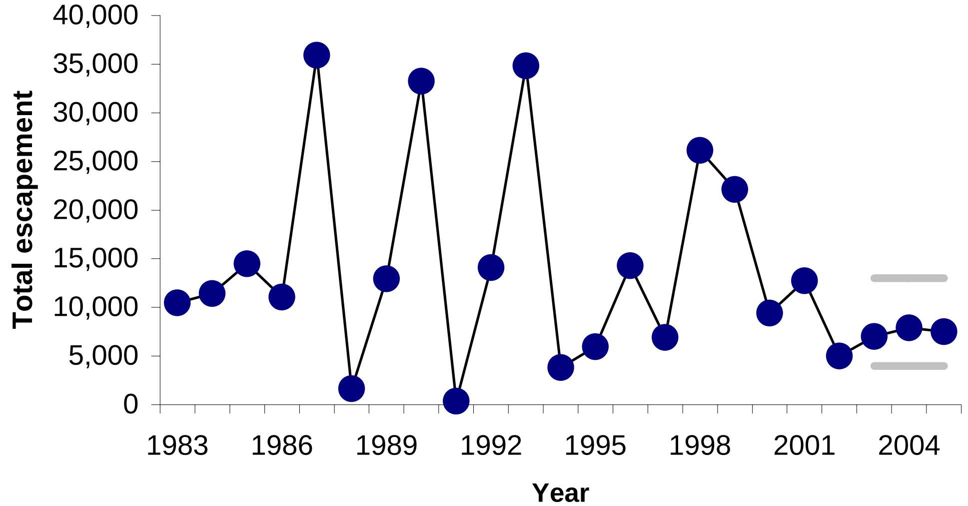

Figure 2.14–Escapement measures (expanded weir counts) for Speel Lake sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

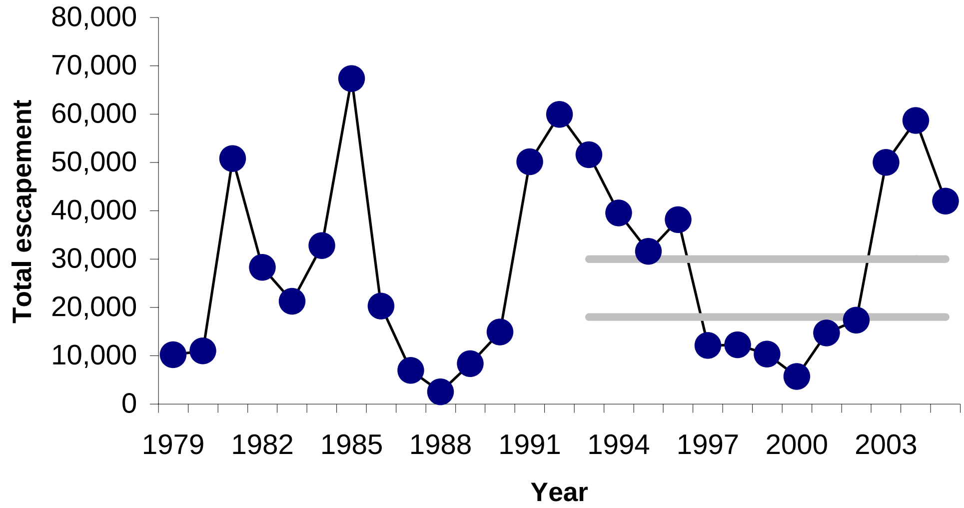

Figure 2.15–Escapement measures (weir counts) for Tahltan Lake sockeye salmon. The two horizontal lines show the current escapement goals, beginning the year that the goals were established.

be a *biological escapement goal*. It 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. Further review of this goal is scheduled to occur in the near future within the Transboundary Technical Committee (Appendix 2.11). The escapement was above the upper end of the goal range in 2003 through 2005, and below the lower end of the goal range in two of the last five years (Figure 2.15).

Mainstem Stikine River

The Transboundary Technical Committee established an escapement goal of 20,000 to 40,000 in 1987, based on professional judgment "of the quantity and quality of available spawning and rearing habitat, observed patterns in the distribution and abundance of spawners, and historical patterns of the near terminal area gill net harvest" (TTC 1990). We consider the goal to be a *sustainable escapement goal* (Appendix 2.12). Escapements have been within the goal range three of the last five years, and above the goal range in two of those years (Figure 2.16).

Hugh Smith Sockeye Salmon

An escapement goal of 15,000 to 35,000 spawners was established for Hugh Smith Lake in the 1990s, largely based on professional judgment. In 2003 the Board of Fisheries set an *optimum escapement goal* of 8,000 to 18,000 based on the analysis outlined in Geiger et al. (2003; Appendix 2.13). This goal includes both naturally produced and hatchery stocked fish. The escapement has been above the upper end of the new escapement goal range three of the last five years, and below the lower end of the previous goal range two of the last five years (Figure 2.17). This stock was adopted as a *stock of management concern* in 2003 (see below).

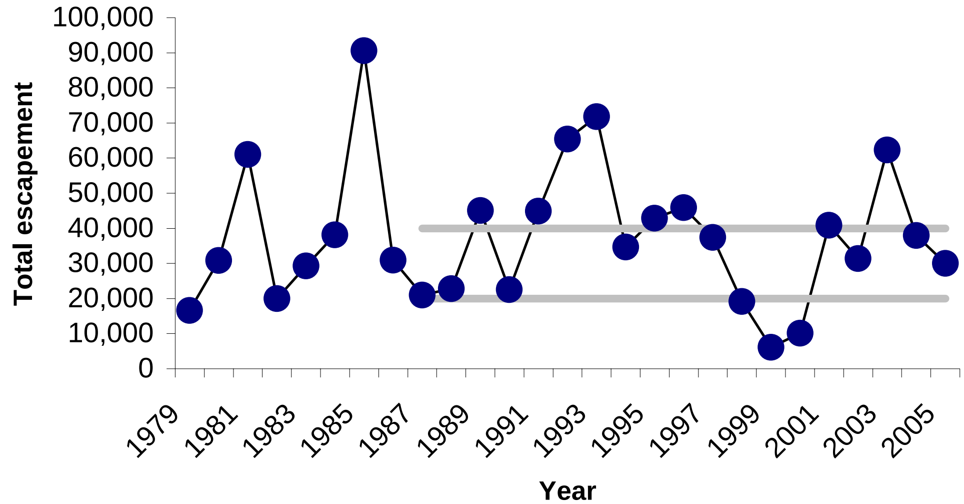

Figure 2.16–Escapement measures (estimated total escapement) for Mainstem Stikine River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

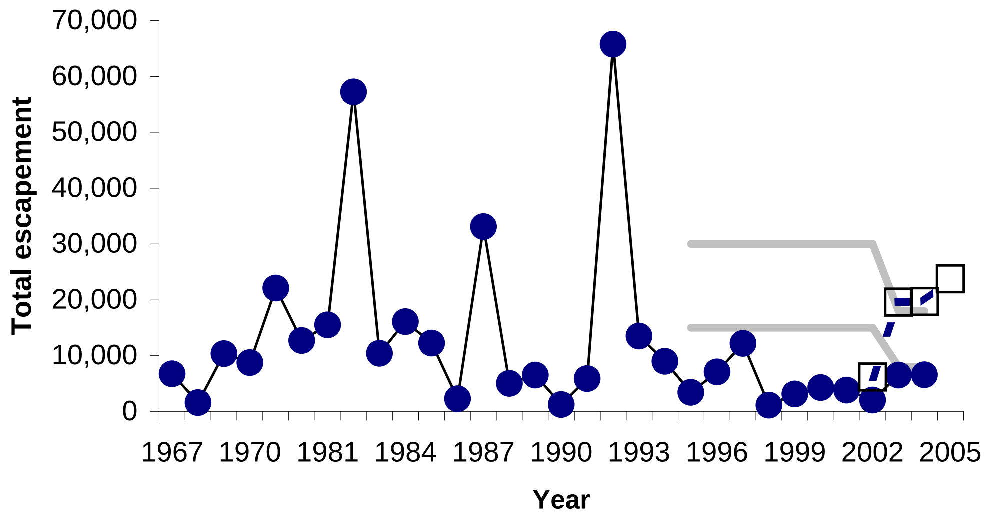

Figure 2.17–Escapement measures (weir counts) for Hugh Smith Lake sockeye salmon. The two gray horizontal lines show the escapement goals, by year. The dots connected by the solid line shows the estimated escapement of naturally spawned sockeye salmon. The open squares connected by the dashed line shows the escapement of both naturally spawned and hatchery stocked fish; the current escapement goal includes both naturally produced and stocked fish. Note that no data is available from 1972 through 1979.

McDonald Lake Sockeye Salmon

The ADF&G monitors escapements in McDonald Lake by means of a calibrated series of foot surveys. The escapement goal for McDonald Lake was lowered in 1993 to the previous range of 65,000 to 85,000 sockeye salmon. ADF&G now is recommending a new goal range of 70,000 to 100,000 as a *sustainable escapement goal* (Appendix 2.14) based on the analysis of Johnson et al. (*in press*). Johnson et al. provided a detailed description of stock assessment measures for the system, a description and listing of enhancement activities, including fish stocking, lake fertilization, and fish transport. The escapement was below the lower end of both the previous and the new escapement goal range four of the last five years (Figure 2.18). The escapement goal was not met in 2001 because of management error combined with below-average recruitment; the run came in under a pre-season forecast, and a directed fishery in west Behm Canal harvested the stock below the escapement goal. No directed fisheries have taken place since 2001, and low escapements in 2002 and 2004 resulted from very low adult recruitment in those years. The preliminary escapement estimate for 2005 also appears below the escapement goal range.

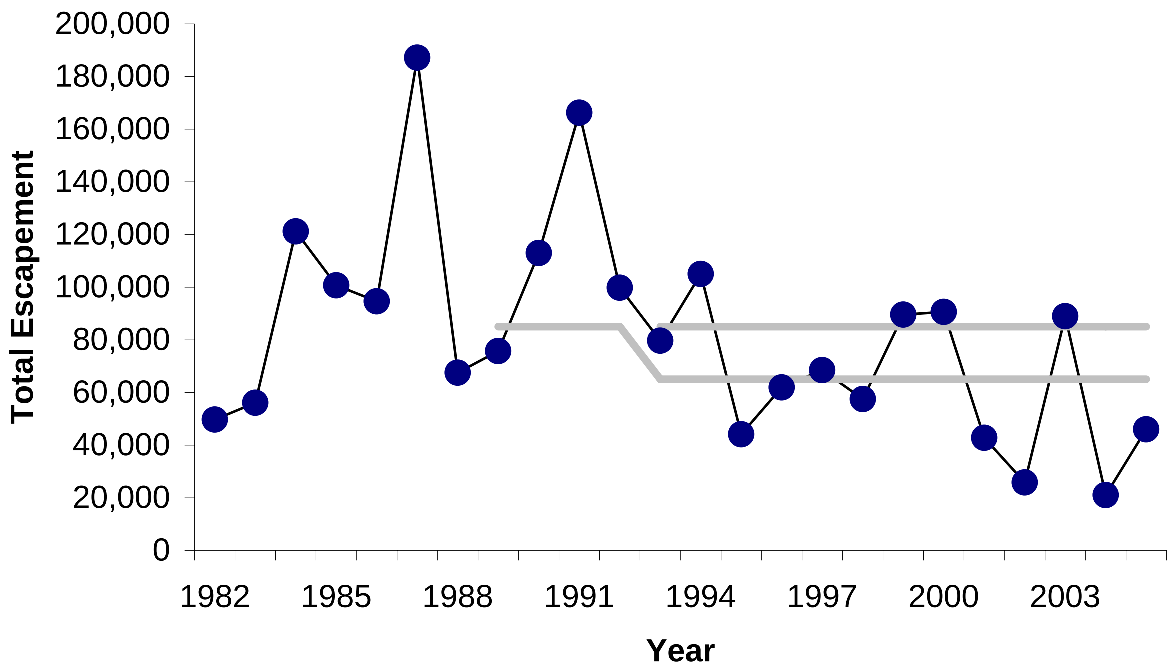

Figure 2.18–Escapement measures (expanded foot counts) for McDonald Lake, 1982–2005. The two horizontal lines show the current escapement goals, beginning the year that the goals were established. The 1989 goal was not expressed as a range.

STOCKS OF CONCERN

In 2003, the Alaska Board of Fisheries formally classified Hugh Smith Lake sockeye salmon as *a stock of management concern*, and adopted an action plan (ADF&G 2003) to rebuild this sockeye run. The plan outlined specific management actions to be implemented in District 101 purse seine and drift gillnet fisheries should the escapement be projected to fall below the lower bound of the *optimal escapement goal* range. Management actions were taken per the action plan in 2003 and 2005.

The action plan also included provisions for lake stocking. Early attempts by ADF&G and Southern Southeast Regional Aquaculture Association (SSRAA) to enhance and rehabilitate the sockeye salmon run at Hugh Smith Lake were unsuccessful, but the most recent method of pen-rearing fry in the lake prior to release has boosted survival rates of stocked fish, resulting in adult escapements counted past the weir over the upper end of the escapement goal range, from 2003 to 2005.

However, unusual behavior of adult sockeye salmon during each of the past three years, a dearth of stocked fish in the actual breeding population in Buschmann Creek, and the observation that large numbers of stocked fish died outside of suitable spawning habitat, all point to the conclusion that these stocked fish did not breed successfully and boost long-term production at Hugh Smith Lake. The first evidence of a problem was the observations of large numbers of sexually mature sockeye salmon milling near the weir in September, at a time when they would normally be spawning in the inlet streams at the head of the lake—something that had not be seen before the return of the stocked fish. Many of these fish appeared to be attempting to spawn at the outlet of the lake. An analysis of a sample of otoliths from these fish from 2002 to 2004 showed that almost all of these sockeye salmon that exhibited abnormal spawning behavior were stocked fish from pre-smolt releases (Table 2.3). To determine the percentage of otolith-marked adult sockeye salmon in the 2004 escapement, a systematic sample of fish was collected from approximately every 100th adult sockeye salmon that was passed through the weir. Out of 192 adult otoliths collected at the weir, 118 (65%) were thermally marked, 67 (35%) were unmarked, and 7 non-readable, yielding estimates of 65% (or 13,000, SE=500) fish in the escapement originating from the lake stocking. As only 16% of the fish in Buschmann Creek (the site of the egg collections for the stocking) had marks, the dearth of fish in Buschmann appears to correspond to the large numbers of fish with abnormal spawning behavior at the weir in 2004.

A relatively low smolt count of 77,000 in 2005 reinforces the idea that the large numbers of stocked fish returning to Hugh Smith Lake in 2003 had poor spawning success. This smolt count ranks 13th out of 25 smolt-count observations, even though there were only three measured escapements higher than what was observed in 2003, going back to 1992. Based on hydroacoustic surveys conducted in summer and fall 2005, it appears that the large 2004 adult escapement also failed to produce many juvenile sockeye salmon. Fish spawning in poor substrate near the weir, or along the lake shore near the release site, probably added little or nothing to the overall production, and it seems this was the fate of many of the stocked sockeye salmon.

Table 2.3–Proportion of marked and unmarked otoliths from adult sockeye salmon carcass samples, by recovery location, Hugh Smith Lake, 2002–2004.

		Year		
Sample Location	Otolith Status	2002	2003	2004
Buschmann Creek	Unmarked	187	36	96
	%	83%	67%	84%
	Marked	37	18	18
	%	17%	33%	16%
				96
Cobb Creek	Unmarked	19	41	30
	%	17%	32%	36%
	Marked	90	87	53
	%	83%	68%	64%
Weir (opportunistic)	Unmarked	4	19	7
	%	6%	9%	5%
	Marked	64	190	144
	%	94%	91%	95%

If stocking is ever resumed we will attempt to better distinguish between what we call the *accounted escapement*, which is the number fish that are simply counted through the weir, and the *effective escapement*, which is the number of adult breeders that effectively contribute to future production of the stock. Currently the *optimum escapement goal* is for the accounted fish, and it includes both the effective spawners and the fish not successfully contributing to production from the lake.

The system of fisheries closures, outlined in the action plan, appears to have been effective. Coded wire tagging studies in the 1980s and 1990s showed that Hugh Smith Lake sockeye salmon were harvested primarily in the District 101 fisheries (Geiger et al. 2003). The District 101 sampling indicated that the system of fisheries closures around the mouth of Boca de Quadra, closures that the action plan calls for when the escapement through the weir is projected to be less than 8,000 adult sockeye salmon, should be effective at reducing harvest of this stock. In 2004, stocked Hugh Smith Lake sockeye salmon accounted for an average 22% (weekly range: 8–31%) of the sockeye salmon harvested in the District 101 "inside" area purse seine fishery (subdistricts 101-23 and 101-41), and 7.1% of the total sockeye salmon harvest in the District 101-11 drift gillnet fishery, from Statistical Week 26 (20 June–26 June) to week 36 (29 August–4 September; weighted by week). The estimated minimum harvest rate in District 101 fisheries that we sampled was 63%. The peak catches of Hugh Smith Lake sockeye salmon in District 101 took place in Statistical Weeks 29 to 35 (11 July–28 August), which corresponds well with the timing of potential fisheries closures as outlined in the Hugh Smith Lake Action

Plan. Looking at past sockeye salmon escapements into Hugh Smith Lake, it appears that there is minimal risk of implementing a closure unnecessarily, and conversely, little risk of not putting closures into effect when escapements are going to be below 8,000 adult sockeye salmon. In the past 11 occurrences of final escapements less than 8,000 adults, fisheries closures would have occurred in 53 of 55 weeks covered by the action plan, had it been in effect. In the past 11 occurrences where the final escapement was more than 8,000 adults, fisheries closures would have occurred unnecessarily in just 13 of 55 weeks covered by the action plan.

Because the accounted escapements to the system were over the *optimal escapement goal* range for three consecutive years (Figure 2.17), which was a stated objective of the Board of Fisheries-approved action plan, ADF&G has concluded that this system no longer meets the definition of a *management concern*, as described in 5 AAC 39.222. In making this recommendation, we also noted an increase in our estimated effective escapement (Figure 2.17) and the presumed recent reduction in harvest rates on this stock.

This fall, ADF&G conducted a review of the Hugh Smith Lake sockeye stock and the effectiveness of the action plan. The review team reached several conclusions, including a consensus that the management actions outlined in the action plan are well timed and effectively located, the principal reasons for the stock decline in the past was high harvest rates, the stocking efforts were ineffective at boosting long-term production, and the past stocking efforts were not benign and likely resulted in some genetic consequences for the stock. The review team recommended suspending the lake stocking. As a result, ADF&G has decided to halt stocking of fry into the lake for one life cycle in order to more fully assess the benefits, risks, and potential consequences of continuing or not continuing stocking thereafter.

We have not identified any new sockeye stocks that would meet the criteria of stocks of concern, as defined by the Sustainable Salmon Fishery Policy. The McDonald Lake sockeye salmon stock has recently undergone a reduction in recruitment, although we are not recommending this stock for *stock of concern status*. The escapement goal was not met in four of five years between 2001 and 2005 at McDonald Lake (Johnson et al. *in press*). These four low escapements do not yet meet the definition of "chronic" in the Sustainable Fishery Policy. The escapement goal was not met in 2001 because of management error combined with below-average recruitment. Low escapements and low catches in 2002 and 2004 resulted from very low adult recruitment in those years. Those low recruitments followed low zooplankton measurements in the lake in the late 1990s. Zooplankton levels have increased in recent years. If zooplankton reductions were responsible for the recruitment downturn, then we expect recruitment to increase. If zooplankton levels were not involved in this reduction, but some unusual ocean event was, there is no reason, at this time, to think that these unusual conditions will persist.

DISCUSSION

The overall situation in the sockeye salmon fisheries in Southeast Alaska looks to be similar to the one described by Geiger et al. (2004) before the 2003 Board of Fisheries meeting. Over the last five years the escapements in the monitored systems have been generally within, or even slightly above the escapement goal ranges, although we noted several exceptions. Along with escapements, sockeye yields have generally been maintained in Southeast Alaska over two decades. Although yields have fallen somewhat in McDonald Lake southern Southeast Alaska, yields have improved in Lynn Canal since the 1990s, and these ups and downs appear to us to be normal stock fluctuations. Overall, yields are probably fairly high for these sockeye stocks, under the current management regime. However, yields are not high in either Southeast Alaska or the

Yakutat area, when compared to historical benchmarks. As was previously mentioned, the last two or three decades have been a period of high marine survival for Pacific salmon stocks migrating into the Gulf of Alaska.

The average yields of pink, and coho salmon, in both the southern and northern Southeast Alaska ends of the region, increased by a factor between 3 to 9 from the 1970s to the 1990s. In the southern end of the Southeast Region, the sockeye yield increased by about a factor of 4—largely because of increased stock sizes of Canadian sockeye stocks. In the northern end, the sockeye yield increased by a factor of about 2, to some extent due to the increased catches of hatchery produced fish from the Snettisham Hatchery in the past few years. Yields in the Yakutat area have declined since the early 1990s. Yields from this area are now similar to what they were in the 1970s. In summary, the sockeye stocks are stable, fisheries are being sustained; yet, for reasons that we don't fully understand, the sockeye stocks in Southeast Alaska and Yakutat have not responded to the favorable marine conditions the way pink and coho salmon have in Southeast Alaska, and the way sockeye stocks have in the Kodiak area and Cook Inlet.

As an appropriate part of this stock status review the salmon research staff in the Southeast Region considered our stock assessment program and developed the following four recommendations.

First, considering the size and the importance of McDonald Lake in southern Southeast Alaska, this system should have a better escapement-monitoring program. ADF&G received funding from the Southeast Sustainable Salmon Fund to assess the effectiveness of the current program by conducting concurrent mark-recapture studies in 2005 and 2006. We suggest that this study be used to develop recommendations for a cost effective and accurate long-term monitoring project.

Second, although extensive sockeye salmon stock identification programs are operated though most of the region, the programs do not provide fine-scale harvest estimates for most of the region's stocks. At this time, genetic stock identification appears to be the most cost-effective and technically manageable means of providing such information. The technique also offers the potential advantage of in-season applicability that could aid fisheries management. Substantial funding has been secured from the Southeast Sustainable Salmon Fund to begin development of a genetic stock identification program for Southeast Alaska sockeye salmon. We recommend that ADF&G continue to move towards a genetic stock identification program for sockeye salmon in Southeast Alaska, and put this in place as soon as possible.

Third, we recommend a complete review of the Yakutat area escapement goals, including a careful look at the statistical strategies and the use of peak aerial counts in setting these goals. A complete review before 2007 would be well timed, as we will have the results of escapement estimation studies being conducted from 2003 through 2005 for Yakutat forelands systems (East Alsek, Lost, Akwe and Italio rivers).

Fourth, we recommend continuing assessment of juvenile and adult production of sockeye salmon at Hugh Smith Lake, at least for several years, to gain a better understanding of the stock dynamics at this system.

ACKNOWLEDGMENTS

ADF&G was assisted by a large number of other organizations in monitoring escapements in the region. The Canadian Department of Fisheries and Oceans, the Taku River Tlingit First Nation, and the Tahltan First Nation helped with monitoring escapements into the transboundary rivers. The Douglas Island Pink and Chum Corporation, Northern and Southern Southeast Regional Aquaculture Associations, U.S. Forest Service, U.S. Fish and Wildlife Service, Sitka Tribe of Alaska, and others each provided support for projects operated in the region. We thank Andy McGregor and Bob Clark for careful reviews of an earlier draft, and for their many suggestions that substantially improved our presentation.

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APPENDICES

Appendix 2.1–Situk River Sockeye Salmon

System:	Situk River
Species:	Sockeye Salmon
Stock Unit:	Situk River sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fishery:	Set gillnet commercial fishery
Secondary Fisheries:	Sport, and set gillnet subsistence fishery
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis using brood years 1976 to 1997
Documentation:	Clark, J. H., S. A. McPherson, and G. Woods. 2002. Biological escapement goal for sockeye salmon in the Situk River, Yakutat, Alaska. Alaska Department of Fish and Game, Division of Sport Fish, Special Publication 02-03. Anchorage. Clark, J. H., S. A. McPherson, and A. Burkholder. 1995. Biological escapement goal for Situk River sockeye salmon. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 1J95-22. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	30,000 to 70,000 fish
Escapement Measures:	Weir counts minus upstream sport catch, 1976 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 22

Ratio of highest escapement to lowest escapement: 5.7

Parameter estimates: α-parameter = 4.04 (adjusted), $1/\beta \approx 92{,}000$,

(β-parameter =$1.09\ 10^{-5}$)

Basis of range of escapement goal: Escapement level is 0.8 to 1.6 times the escapement that forecasts the *maximum sustainable catch*

Appendix 2.2.–Lost River Sockeye Salmon**.**

System:	Lost River
Species:	Sockeye Salmon
Stock Unit:	Lost River sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fishery:	Set gillnet commercial fishery
Secondary Fisheries:	Sport, and subsistence fisheries
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis using brood years 1972 to 1983, 1986, and 1988
Documentation:	Clark, J. H., A. Burkholder, and J. E. Clark. 1995. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J95-16. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	1,000 to 2,300 peak counts
Escapement Measures:	Foot and boat surveys from 1972 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 14

Ratio of highest escapement to lowest escapement: 5.0

Parameter estimates: α-parameter = 6.34 (adjusted), 1/ β ≈ 3,600 (β-parameter = 0.000279)

Basis of range of escapement goal: Expected yield is at least 90% of maximum sustainable catch

Appendix 2.3–Akwe River Sockeye Salmon

System:	Akwe River
Species:	Sockeye salmon
Stock Unit:	Akwe River sockeye salmon
Management Jurisdictions:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fishery:	Set gillnet commercial
Secondary Fishery:	Subsistence fishery
Escapement Goal Type:	*Biological Escapement Goal*
Basis for the Goal:	Stock-recruit analysis using brood years 1973 to 1987, not including 1975 and 1981
Documentation:	Clark, J. H., A. Burkholder, and J. E. Clark. 1995. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J95-16. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	Deleted (previously 600 to 1,500 peak counts)
Escapement Measures:	Peak aerial count of sockeye in Akwe River system, 1973 to 2001

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 13

Ratio of highest escapement to lowest escapement: 20

Parameter estimates: α-parameter = 4.31 (adjusted), $1/\beta \approx 20{,}200$ (β-parameter = $4.96\ 10^{-5}$)

Basis of range of escapement goal: Expected yield is at least 90% of *maximum sustainable catch*

Appendix 2.4–Klukshu River Sockeye Salmon

System:	Alsek River
Species:	Sockeye salmon
Stock Unit:	Klukshu River sockeye salmon
Management Jurisdictions:	Alaska Department of Fish and Game, Department of Fisheries and Oceans, Canada (CDFO): joint management through the Pacific Salmon Commission
Area Office:	Yakutat (ADF&G), Whitehorse, Y.T. (CDFO)
Primary Fisheries:	U.S. set gillnet commercial and Canadian aboriginal fishery
Secondary Fisheries:	U.S. subsistence and Canadian sport
Escapement Goal Type:	*Biological Escapement Goal*
Basis for the Goal:	Stock-recruit analysis, using brood years 1976 to 1992
Documentation:	Clark, J. H. and P. Etherton. 2000. Biological escapement goal for Klukshu River system sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J00-24. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	7,500 to 15,000 fish
Escapement Measures:	Klukshu weir counts minus upstream removals, 1976 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 17

Ratio of highest escapement to lowest escapement: 4.1

Parameter estimates: α-parameter = 4.586, $1/\beta \approx 15{,}800$ (β-parameter = $6.332 \cdot 10^{-5}$)

Basis of range of escapement goal: Escapement goal range is 0.8 to 1.6 times the escapement that forecasts the *maximum sustainable catch*

Appendix 2.5–East Alsek-Doame River system sockeye salmon stock.

System:	East Alsek-Doame River
Species:	Sockeye salmon
Stock Unit:	East Alsek-Doame River system sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fisheries:	Set gillnet commercial
Secondary Fisheries:	Subsistence and sport
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis for brood years 1972 to 1990; separate stock-recruit analysis for brood years 1991 to 1997.
Documentation:	Flushed Habitat: Clark, J. H., A. Burkholder, J. E. Clark. 1995. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J95-16. Douglas. Clark, J. H., S. Fleischman, and G. Woods. 2003. Revised biological escapement goal for the sockeye salmon stock returning to the East Alsek-Doame River system of Yakutat, Alaska. Special Publication 03-04. Sport Fish Division, Anchorage.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	Flushed Habitat, 26,000 to 57,000 index units Unflushed Habitat, 13,000 to 26,000 index units
Escapement Measures:	Sum of peak aerial counts in East Alsek & Doame (1972-present)

Stock-Recruit Analysis Summary

Model: Ricker for brood years 1972 to 1990 (0.43 times estimate of replacement for brood years 1991 to 1997)

Number of years in model: 19 for brood years 1972 to 1990, 7 for 1991 to 1997

Ratio of highest escapement to lowest escapement: 6.6 for brood years 1972 to 1990, 1.7 for 1991 to 1997

Parameter estimates: α-parameter = 5.72 (adjusted), $1/\beta \approx 85{,}500$, (β-parameter = $4.96 \cdot 10^{-5}$)

Basis of range of escapement goal:

For brood years 1972 to 1990, expected yield is at least 90% of maximum sustainable catch

For 1991–1997, escapement levels that range from 0.8 to 1.6 times escapement producing the maximum sustainable catch

Appendix 2.6–Chilkoot Lake Sockeye Salmon stocks.

System:	Chilkoot Lake
Species:	Sockeye salmon
Stock Unit:	Early and late runs
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Haines
Primary Fisheries:	Drift gillnet commercial, subsistence, and sport
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for the Goal:	Stock-recruit analysis using brood years 1976 to 1984
Documentation:	Zhang, X., R.L. Bachman, M.M. Sogge, and H.J. Geiger. *in prep.* Sockeye salmon stock status and escapement goals for Chilkoot Lake in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries Special Publication, Anchorage. Previous goal documented in McPherson, S. A. 1990. An inseason management system for sockeye salmon returns to Lynn Canal, Southeast Alaska. M. S. Thesis, University of Alaska Fairbanks.
Inriver Goal:	None
Action Points:	If the Chilkoot River weir count is less than 4,500 sockeye salmon through June 13, the eastern side of Section 15-C will be closed north of the latitude of Bridget Point and 6-inch mesh size gear restrictions will be in effect for Section 15-C. The eastern shoreline of Section 15-A will be closed if there are less than 4,500 sockeye salmon through the weir by June 13. This date was picked, so as to occur prior to the first news release announcing the general opening of the SE drift gillnet fishery.
Escapement Goal:	Overall escapement goal is 50,000 to 90,000 sockeye salmon, with weekly cumulative catch goals in Appendix Table 2.6.1.
Escapement Measures:	Weir counts and mark-recapture estimates, 1976 to present

Table 2.6.1–Weekly cumulative escapement goals for Chilkoot Lake.

Statistical Week	Weekly Goal	Cumulative Goal	Cumulative Lower Bound	Cumulative Upper Bound
23	697	697	498	896
24	2,847	3,544	2,532	4,557
25	4,918	8,462	6,045	10,880
26	4,161	12,624	9,017	16,230
27	2,727	15,350	10,964	19,736
28	3,260	18,610	13,293	23,928
29	5,865	24,475	17,482	31,468
30	8,110	32,585	23,275	41,894
31	10,219	42,804	30,574	55,033
32	9,268	52,071	37,194	66,949
33	6,075	58,147	41,533	74,760
34	5,168	63,315	45,225	81,405
35	3,508	66,823	47,730	85,915
36	2,301	69,123	49,374	88,873
37	877	70,000	50,000	90,000

Appendix 2.7–Chilkat Lake sockeye salmon stocks.

System:	Chilkat Lake
Species:	Sockeye salmon
Stock Unit:	Early and late runs
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Haines
Primary Fisheries:	Drift gillnet commercial, subsistence, and sport
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for the Goal:	Based on assumptions about past escapement levels, converted to the units of the mark-recapture estimates of escapement
Documentation:	The proposed goal will be documented in a report that is still in process. The previous goal was documented in, McPherson, S. A. 1990. An inseason management system for sockeye salmon returns to Lynn Canal, Southeast Alaska. M. S. Thesis, University of Alaska Fairbanks.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	An overall escapement goal is 80,000 to 200,000 adult sockeye salmon, measured with mark-recapture methods.
Escapement Measures:	Fish wheel-based mark-recapture estimates

Stock-Recruit Analysis Summary

Not applicable

Appendix 2.8–Redoubt Lake sockeye salmon.

System:	Redoubt Lake
Species:	Sockeye salmon
Stock Unit:	Redoubt Lake
Management Jurisdiction:	Alaska Department of Fish and Game, U.S. Forest Service
Area Office:	Sitka
Primary Fishery:	Subsistence and sport
Escapement Goal Type:	*Biological Escapement Goal, Optimal Escapement Goal*
Basis for Goal:	Stock-recruit model using brood years 1982 to 1996 Modified by Board of Fisheries action.
Documentation:	Geiger, H. J. 2003. Sockeye salmon stock status and escapement goals for Redoubt Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J03-01. Juneau, Alaska.
Inriver Goal:	None
Action Points:	Numerous (described in new Redoubt Lake Management Plan passed by the Board of Fisheries in January 2003)
Escapement Goal:	*7,000 to 25,000 fish (Optimal Escapement Goal)*
Escapement Measures:	Weir counts, 1982 to 1997, 1999 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 15

Ratio of highest escapement to lowest escapement: 160

Parameter estimates: α-parameter = 4.30 ("bias adjusted" value is 8.55), $1/\beta \approx 23{,}000$ (β-parameter = $4.30\ 10^{-5}$), σ^2-parameter = 1.294

Basis of range of escapement goal: Range of sustained escapements expected to produce at least 90% of *maximum sustained catch*, rounded to the nearest whole 2,500 spawners.

Appendix 2.9–Taku River sockeye salmon stock

System:	Taku River
Species:	Sockeye Salmon
Stock Units:	Kuthai Lake, Little Trapper Lake, Tatsamenie Lake, Mainstem Taku River
Management Jurisdiction:	ADF&G, CDFO: Joint management through the Pacific Salmon Commission
Area Office:	Douglas (ADF&G), Whitehorse Y. T. (CDFO)
Primary Fisheries:	Drift Gillnet, U.S. Commercial, Canadian Commercial
Secondary Fisheries:	Personal Use, Canadian Aboriginal, Recreational
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for Goal:	Best professional judgment. Goal set by Transboundary Technical Committee in 1985.
Documentation:	Transboundary Technical Committee. 1986. Report of the Canada/United States Transboundary Technical Committee. Transboundary Technical Committee Report (86). Final Report. February 5, 1986.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	System-wide escapement goal of 71,000 to 80,000 fish
Escapement Measures:	Darroch Mark-Recapture Estimate, 1984–2002, Canyon Island Fish Wheel project, ADF&G; Canadian Dept. Fisheries and Oceans weir sites on Kuthai, Little Trapper, and Tatsamenie lakes.

Stock-Recruit Analysis Summary

Not applicable

Appendix 2.10–Speel Lake sockeye salmon stocks

System:	Speel River
Species:	Sockeye salmon
Stock Unit:	Speel Lake
Management Jurisdiction:	Alaska Department of Fish and Game (ADF&G)
Area Office:	Douglas
Primary Fisheries:	Commercial drift gillnet
Escapement Goal Type:	*Biological Escapement Goal*
Basis for the Goal:	Stock-recruit analysis using brood years 1983 to 1996
Documentation:	Riffe, R. R. and J. H. Clark. 2003. Biological escapement goal for Speel Lake sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, 03-34. Juneau, Alaska.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	4,000 to 13,000 fish
Escapement Measures:	Weir counts, 1983 to 1992 and 1995 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 13

Ratio of highest escapement to lowest escapement:

Parameter values: α-parameter = 17.22 (adjusted), $1/\beta \approx$ 9,100, (β-parameter = .00011)

Basis of range of escapement goal: Escapement range predicted to provide for 80% or more of estimated *maximum sustainable yield*

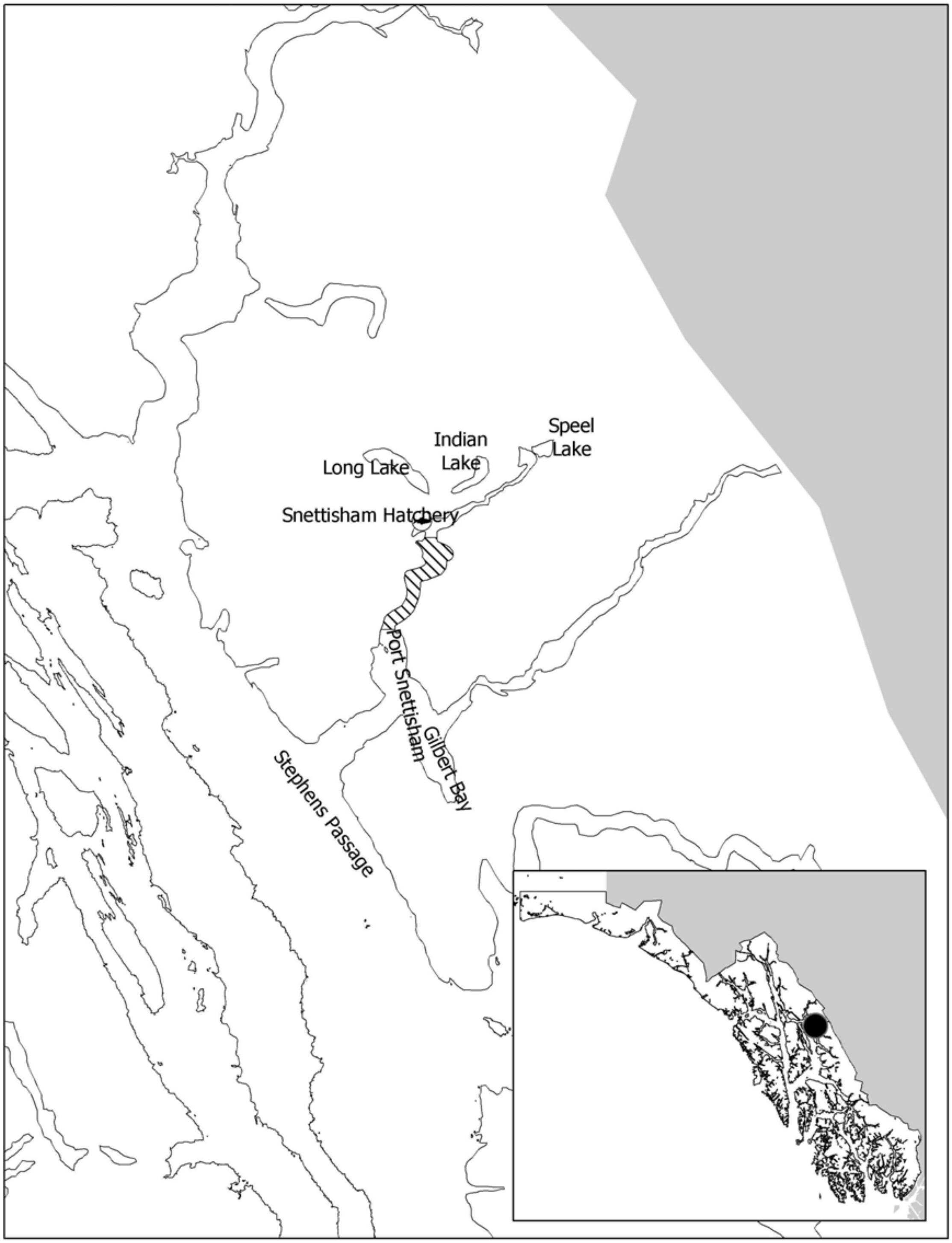

Figure 2.10.1–Speel Lake and surrounding area. Striped area denotes the hatchery Special Harvest Area (SHA).

Appendix 2.11–Tahltan Lake sockeye salmon stocks

System:	Stikine River
Species:	Sockeye salmon
Stock Unit:	Tahltan Lake sockeye salmon
Management Jurisdictions:	Alaska Department of Fish and Game, Department of Fisheries and Oceans, Canada (CDFO): joint management through the Pacific Salmon Commission
Area Office:	Petersburg/Wrangell (ADF&G), Whitehorse, Y. T. (CDFO)
Primary Fisheries:	District 106 and 108 commercial gillnet, Canadian inriver commercial and aboriginal gillnet
Secondary Fisheries:	U.S. and Canadian sport and subsistence fisheries
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis, using data from brood years 1975 to 1987
Documentation:	Humphreys, R. D., S. M. McKinnel, D. Welch, M. Stocker, B. Turris, F. Dickson, and D. Ware (*editors*). 1994. Pacific Stock Assessment Review Committee (PSARC) Annual Report for 1993. Canadian. Manuscript. Report of Fisheries and Aquatic Sciences, Number 2227.
Inriver Goal:	None
Action Points:	Based on inseason assessment and agreement between managers if the run size projection has a very small allowable catch District 108 may be closed and the Canadian commercial fishery in the lower river may be limited. This is not a formal set action but rather a negotiation.
Escapement Goal:	18,000 to 30,000 fish (of which 4,000 are for hatchery supplementation broodstock)
Escapement Measures:	Weir counts since 1959; brood stock removal documented since inception in 1989 and apportionment between natural wild fish and hatchery plants available since 1993 (return in 1992 likely had a small number of planted fish).

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 12

Ratio of highest escapement to lowest escapement: 8.2

Parameter estimates: α-parameter = 1.44, $1/\beta \approx 33{,}300$ (β-parameter = $3.0 \cdot 10^{-5}$)

Basis of range of escapement goal: Best professional judgment

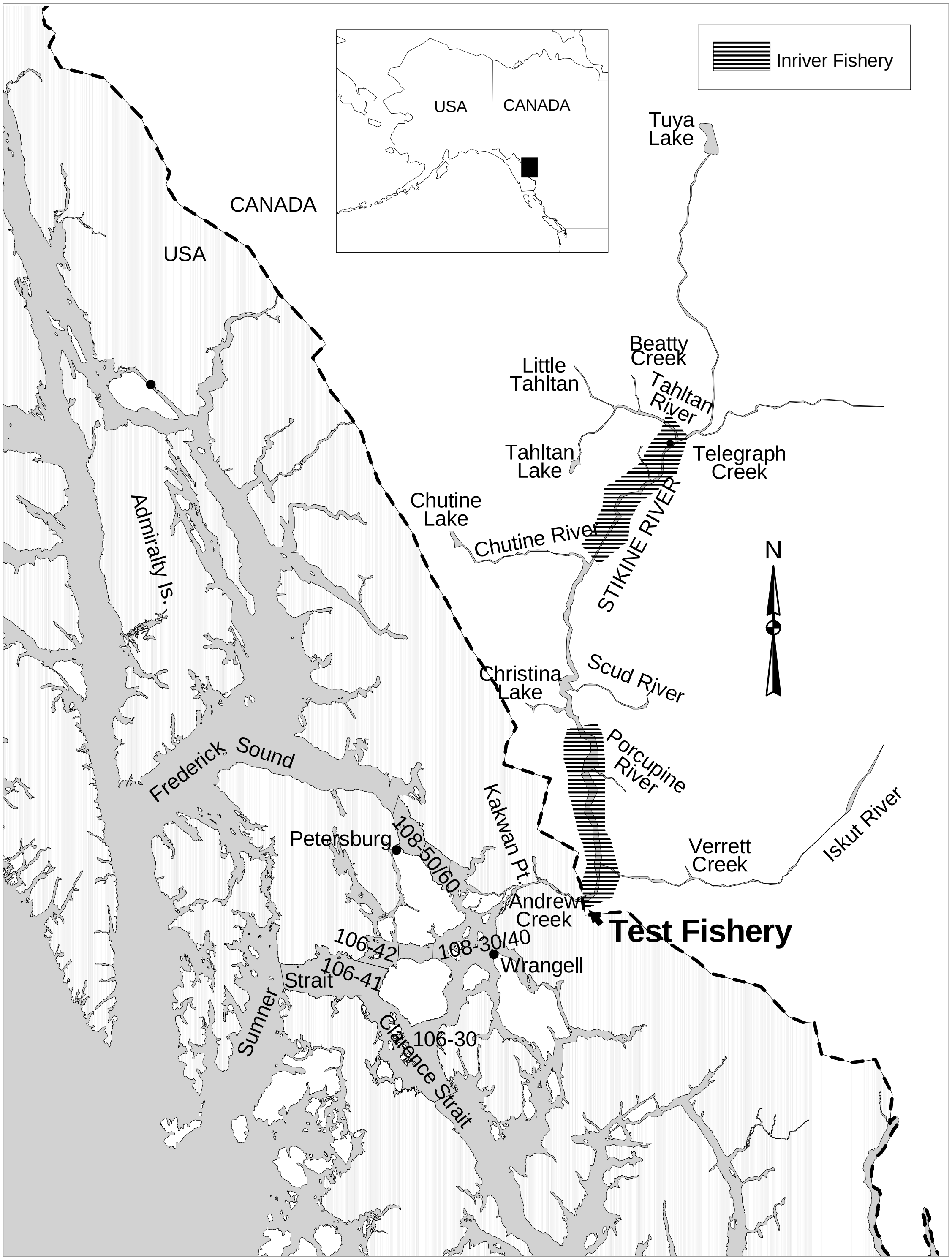

Figure 2.11.1–Stikine River drainage and surroundings, showing location of commercial, subsistence, and recreational fisheries.

Appendix 2.12–Mainstem Stikine sockeye salmon stock

System:	Stikine River
Species:	Sockeye Salmon
Stock Unit:	Mainstem Stikine River
Management Jurisdiction:	Alaska Department of Fish and Game, (ADF&G), Department. of Fisheries and Oceans Canada (CDFO)): joint management through the Pacific Salmon Commission
Area Office:	Petersburg/Wrangell (ADF&G), Whitehorse, Yukon Territory (CDFO)
Primary Fisheries:	District 106 and 108 commercial gillnet fisheries, Canadian commercial gillnet fisheries in the lower and upper Stikine River
Secondary Fisheries:	Canadian aboriginal, recreational, mixed stock seine fisheries in Southeast Alaska
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for Goal:	Best professional judgment. Set in 1987 by the Transboundary Technical Committee.
Documentation:	Transboundary Technical Committee. 1987. Report of the U.S./Canada Transboundary Technical Committee to the Pacific Salmon Commission, February 8, 1987, Vancouver, British Columbia.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	20,000 to 40,000 estimated mainstem spawners
Escapement Measures:	Estimated harvest rates, based on returns of Tahltan Lake stocks. Tahltan adult weir operated from 1959 to present. Scale pattern analysis in use since 1984.

Stock-Recruit Analysis Summary

Not applicable

Appendix 2.13–Hugh Smith sockeye salmon stock

System:	Hugh Smith
Species:	Sockeye Salmon
Stock Unit:	Hugh Smith Lake
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Ketchikan
Primary Fisheries:	Gillnet and seine commercial fisheries
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Three unconventional methods
Documentation:	Geiger, H. J., T. P. Zadina, and S C. Heinl. 2003. Sockeye salmon stock status and escapement goal for Hugh Smith Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J03-05. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	8,000 to 18,000 fish
Escapement Measures:	Weir counts minus hatchery removals

Stock-Recruit Analysis Summary

Not applicable

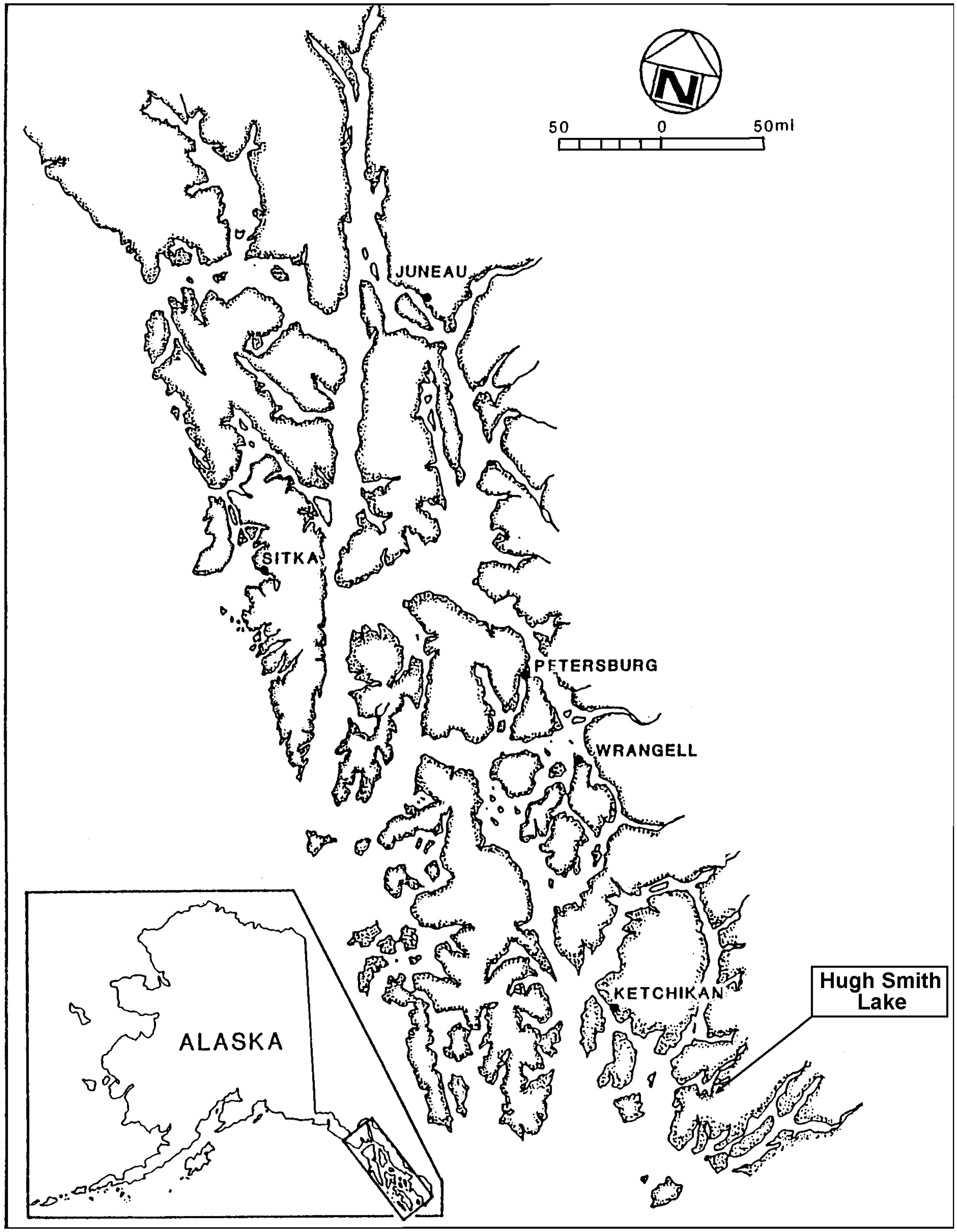

Figure 2.13.1–The location of Hugh Smith Lake in Southeast Alaska.

Appendix 2.14–McDonald Lake sockeye salmon stock

System:	McDonald Lake
Species:	Sockeye salmon
Stock Unit:	McDonald Lake sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game, (ADF&G)
Area Office:	Ketchikan (ADF&G)
Primary Fisheries:	Mixed stock commercial fisheries in Southeast Alaska
Secondary Fisheries:	Directed commercial purse seine fishery in upper west Behm Canal in Southeast Alaska
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for Goal:	The third of ranked escapement estimates with highest median harvests
Documentation:	Johnson, T.A., S.C. Heinl, and H.J. Geiger. *in press.* Stock status and escapement goals for McDonald Lake, in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries Special Publication.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	70,000 to 100,000 fish
Escapement Measures:	A series of standard foot surveys, expanded to an estimate of total escapement by historic ratio of weir to foot-survey estimate

Stock-Recruit Analysis Summary

Not applicable

CHAPTER 3: COHO SALMON STOCK STATUS AND ESCAPEMENT GOALS IN SOUTHEAST ALASKA

by

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PROJECT SPONSORSHIP

Development of this manuscript was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K). This work was partially financed by grants from the Anadromous Fish Conservation Act Program, administered by the National Oceanic and Atmospheric Administration, and from the Southeast Sustainable Salmon Fund.

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ABSTRACT

The status of coho salmon stocks in Southeast Alaska was assessed from information on escapement, smolt abundance, marine survival and total abundance from coded wire tagged indicator stocks and streams that were surveyed for escapement. The escapement trend since the early to mid-1980s has been relatively level for most stocks, with a peak in the early to mid-1990s. Escapements to most systems have remained high during 2001–2004 as a result of continued strong returns and moderate exploitation rates.

As part of a triennial review of the region's salmon escapement goals, several changes to coho escapement goals were made in 2005. *Biological escapement goals* were established for index counts and total escapements to the Chilkat River and for aggregate survey counts in streams in the Ketchikan and Sitka areas. Goals were changed for two Juneau roadside streams (Montana and Peterson creeks) and eliminated for three others (Steep, Jordan and Switzer creeks). Goals were also eliminated for three Yakutat area stocks that are no longer routinely or consistently surveyed.

Escapements were assessed relative to current objectives for stocks that have goals. With very few exceptions, observed escapements were within or above goal since 1990. Smolt production from Auke Creek continued a long-term declining trend of 1.5%/year from 1980 to 2004 despite stable, high levels of spawning escapement that exceeded the goal range in 21 of 25 years. Smolt production from the Taku River and Ford Arm Lake has trended higher in the past decade while trends have been stable for the Berners River and Hugh Smith Lake. We identified no coho salmon *stocks of concern* in Southeast Alaska.

Recent marine survival rates have been moderate-to-high, on average. In most cases, marine survival of 2003 and 2004 returning adults was near average for the prior eight years but below peak levels in the early 1990s. Average marine survival rates for four long-term indicator stocks during 1995–2004 ranged from 10–22% with a mean-average of 15%.

Exploitation rates increased substantially in 2004 following a period of low exploitation rates that were likely influenced by low salmon prices during 2000–2003. In particular, 2004 troll fishery exploitation rates increased to a level that was in most cases equal to or higher than average rates prior to 2000. Drift gillnet exploitation rates remained reduced from pre-2000 averages in most cases. However, marine sport exploitation rates have trended upward with increased charter activity. During 2000–2004, marine sport exploitation rate estimates reached as high as 5–13% for some stocks, including the Taku River, Ford Arm Lake and Chuck Creek. In addition to assessing stock abundance, fishery managers will need to continue to account for fluctuating fishing effort and efficiency in order to achieve escapement goals.

Key words: coho salmon, *Oncorhynchus kisutch*, escapement, escapement goals, smolts, marine survival, exploitation rates, Auke Creek, Berners River, Taku River, Ford Arm Lake, Hugh Smith Lake, Chilkat River, Chuck Creek.

INTRODUCTION

Coho salmon (*Oncorhynchus kisutch*) are important to a variety of commercial, sport, and subsistence users in Southeast Alaska. Trollers have accounted for over 60% of the commercial catch, on average, but coho salmon are also important to seine, drift gillnet and set gillnet fisheries. Recreational fisheries occur in both fresh and saltwater areas and have constituted an increasing component of the catch in recent years. Directed subsistence fisheries have been very limited, but regulations allowing directed subsistence fishing for coho salmon have been recently expanded under federal rules in many freshwater areas. This report updates an earlier assessment (Shaul et al. 2004) of the stocks that support these fisheries through the 2004 return.

Full development of a troll fishery targeting coho salmon occurred around 1940, and the commercial catch (Figure 3.1) provides an indication of the trend in coho salmon abundance after that time. Stocks recovered in the early 1980s from a prolonged period of low abundance

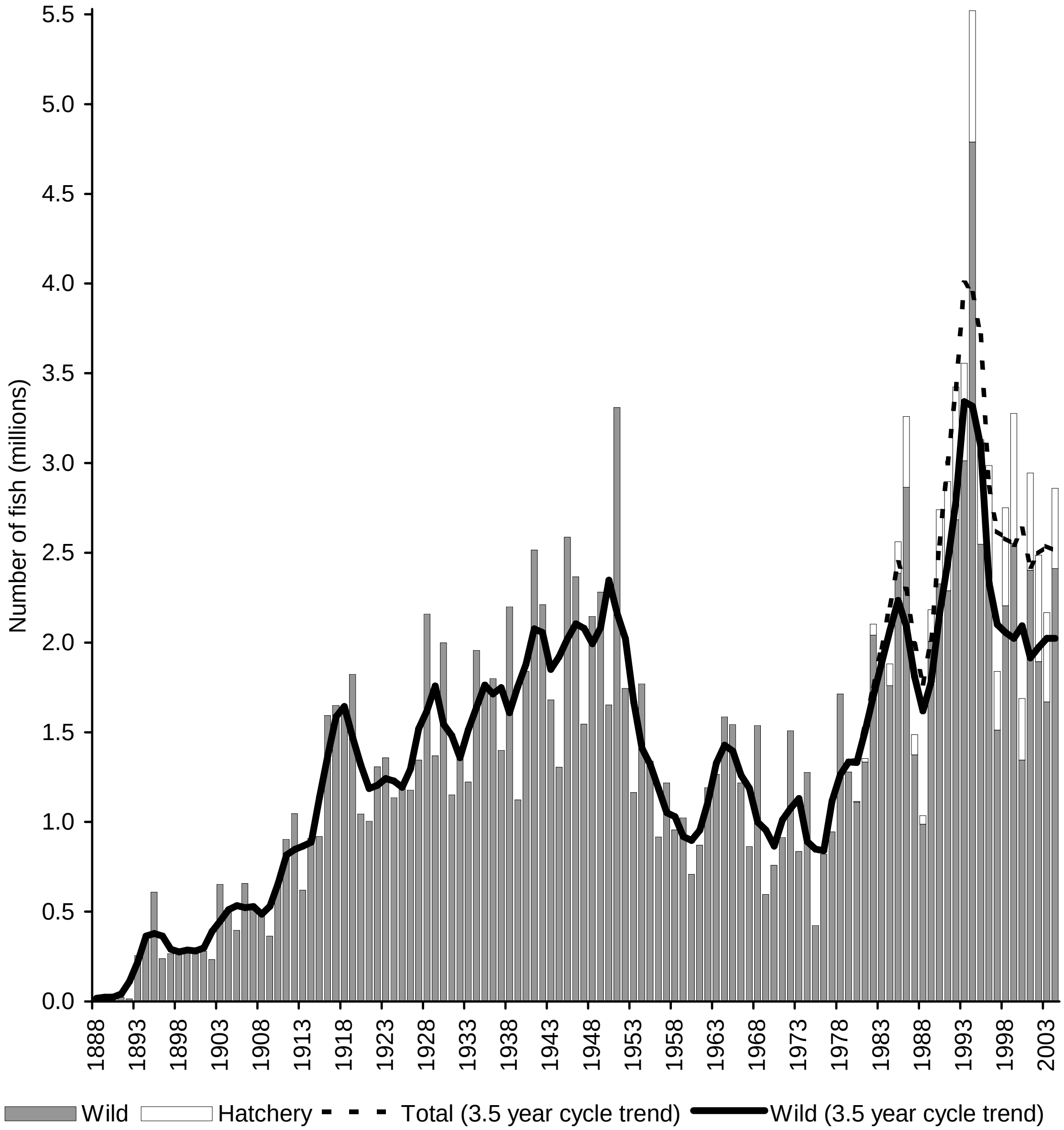


Figure 3.1–Commercial harvest of wild and hatchery coho salmon in Southeast Alaska, 1888–2004.

extending for over 2 ½ decades. Whereas poor marine survival was likely a major factor driving poor catches from 1956 to 1981, improved marine survival has been an important factor influencing larger wild stock catches since 1982. Abundant commercial wild coho salmon catches of 1.67 million fish in 2003 and 2.42 million fish in 2004 suggest a continuation of the recent trend of high wild stock abundance.

Excellent coho salmon habitat occurs throughout Southeast Alaska (Figure 3.2). In addition to wild stocks within Southeast, important contributions to the region's total harvest are made by local hatchery stocks, several transboundary rivers, and by natural systems and hatcheries on the

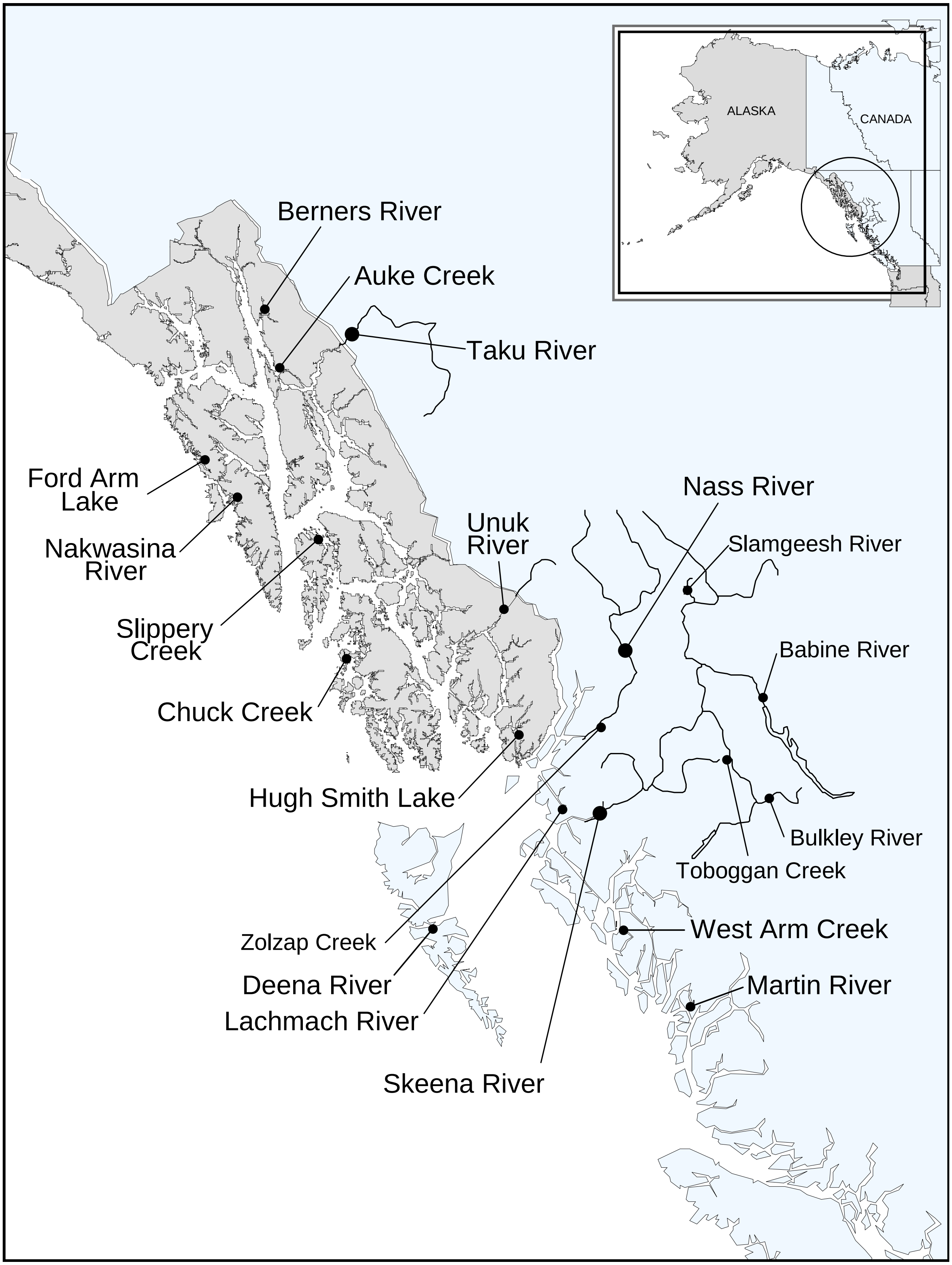


Figure 3.2–Map of Southeast Alaska and northern British Columbia, showing the locations of coho salmon full indicator stock assessment projects.

northern British Columbia coast. Coho salmon are produced by thousands of streams and by 13 hatcheries in Southeast Alaska. Many of the streams are small producers about which little is known. During 1995 to 2004, hatcheries contributed an average of 20% (range 15% to 24%) of the Southeast Alaska commercial catch, of which over 97% was produced by Alaskan facilities (Integrated Fisheries Database, ADF&G, Douglas, AK).

The Alaska Department of Fish and Game implemented an improved stock assessment program in the early 1980s to better understand and manage coho salmon stocks. New assessment projects were implemented to monitor population and fishery parameters for indicator stocks (Shaul 1994; Shaul and Crabtree 1998). In addition, a systematic escapement survey program was developed. These programs have bettered the understanding among fishery researchers and managers of the status of Southeast Alaska coho salmon stocks and have formed the basis for improved management.

The principal management objective for Southeast Alaska fisheries for coho salmon is to achieve *maximum sustained yield* from wild stocks. Hatchery contributions and natural production are identified inseason in key fisheries using coded wire tags. Fisheries directed primarily at coho salmon are managed based on wild stock fishery performance to achieve adequate escapement while harvesting the surplus. *Biological escapement goal* ranges have been established for a number of wild indicator stocks and surveyed systems.

A secondary management objective is to achieve long-term commercial gear-type allocations that were established by the Alaska Board of Fisheries in 1989. These allocations preserve a 1969 to 1988 historical base distribution of 61% for troll gear, 19% for purse seine gear, 13% for drift gillnet gear, and 7% for set gillnet gear.

The wide distribution of coho salmon production across thousands of small stream systems necessitates that much of the harvest occur in highly mixed-stock fisheries where the stocks intermingle. Except for years of strong deviations from average abundance, commercial trollers fish a relatively stable season and harvest a relatively stable proportion of the total run. This pattern of fishing results in a more even distribution of the troll harvest across all stocks in the region, thereby realizing some harvest from all stocks, while insuring that more heavily exploited inside stocks are able to support some harvest in inside fisheries while still maintaining escapement. Most active management to harvest surpluses and achieve escapements is conducted in gillnet fisheries, based on returns to single major systems or local concentrations of productive systems. Nearly all of the harvest of many small to medium stocks on the outer coast and along inside passages occurs in the commercial troll and marine sport fisheries, with a small incidental harvest by purse seine fisheries for pink salmon.

The commercial fisheries are managed under specific management plans for each fishery. The troll management plan for coho salmon contains several decision points that potentially trigger early or midseason closures for conservation and allocation, and an extension of the troll coho season for up to 10 days after the regulatory closing date of September 20. Most provisions of the plan were written in the late 1970s and 1980s when direct information on coho stocks was very limited, aside from fishery catch and effort. In recent years, fishery managers have tried to balance the specific provisions of the management plan with increasing capability to assess stocks and their escapement needs. Inseason management has increasingly focused on escapement goals that produce *maximum sustained yield* as a specific priority objective.

In addition to provisions specified in the management plans, the Pacific Salmon Treaty contains provisions for the conservation of northern British Columbia coho stocks. The Pacific Salmon Treaty provisions are essentially the same as Board of Fisheries management plan provisions for potential early and midseason troll fishery closures. However, the Pacific Salmon Treaty also contains provisions that trigger a closure of the troll fishery in boundary areas of Southern Southeast and in northern British Columbia when abundance of northern British Columbia stocks is indicated to be low based on fishery performance.

Marine sport fisheries are managed primarily under a 6-fish bag limit. The same bag limit applies in most freshwater systems, except for some more accessible streams where the bag limit is two fish. The sport fishery has accounted for a small but increasing component of the catch, reaching 13% of the all-user region harvest in 2003 (Figure 3.3). Although emergency inseason management actions have been less frequent in the recreational fisheries, seasons have been closed or bag limits reduced in both marine and freshwater fisheries in response to inseason indicators of low abundance. Bag limits were increased in some locations to harvest the very large 1994 return.

Small subsistence coho salmon fisheries occur in Southeast Alaska, primarily in terminal areas near Yakutat and Angoon. These fisheries have not been actively managed, but harvest levels are monitored through permit returns. The reported harvest during 1995 to 2004 averaged only 2,396 fish (Integrated Fisheries Database, ADF&G, Douglas, AK).

STOCK STATUS

Status of coho salmon stocks in the Southeast region was judged by trends in abundance and escapement of indicator stocks relative to established goals. Coho salmon stocks are very widely distributed and are believed to be present in over 2,500 primary anadromous streams; however it is practical and feasible to conduct stock assessment projects on only a small fraction of those streams. Most direct assessment of the stocks occurs at two levels: full indicator stock and escapement indicator.

FULL INDICATOR STOCKS

Full indicator stocks are marked as smolts or pre-smolts with coded wire tags, which makes it possible to estimate their smolt production (from the marked rate at return) and contribution to the fisheries by systematically sampling fishery harvests and escapements.

These programs have been expanded in recent years and are now well established in seven systems in the region (Figure 3.2). The data series extends from the early 1980s for four systems (Auke Creek, Berners River, Ford Arm Lake, and Hugh Smith Lake). Programs were expanded in the 1990s to include the Taku River, Unuk River, Nakwasina River, Chilkat River and Slippery Creek. In addition, Chuck Creek, which was added as an indicator stock in 2001, has total run estimates for three earlier years (1982, 1983, and 1985). However, the Unuk River project was discontinued in 2003 and the project at Slippery Creek, where escapement estimation has been difficult, is scheduled for discontinuation after 2005.

Full indicator stock programs provide detailed population information needed to establish and manage for *biological escapement goals*. Specific parameters that are estimated for these stocks include: total adult abundance, spawning escapement (including age, size, and sex), smolt production (abundance, age, size), marine survival, fishery contributions by area, gear type and time, and exploitation rates. Over time, these parameters are used to evaluate the relationship

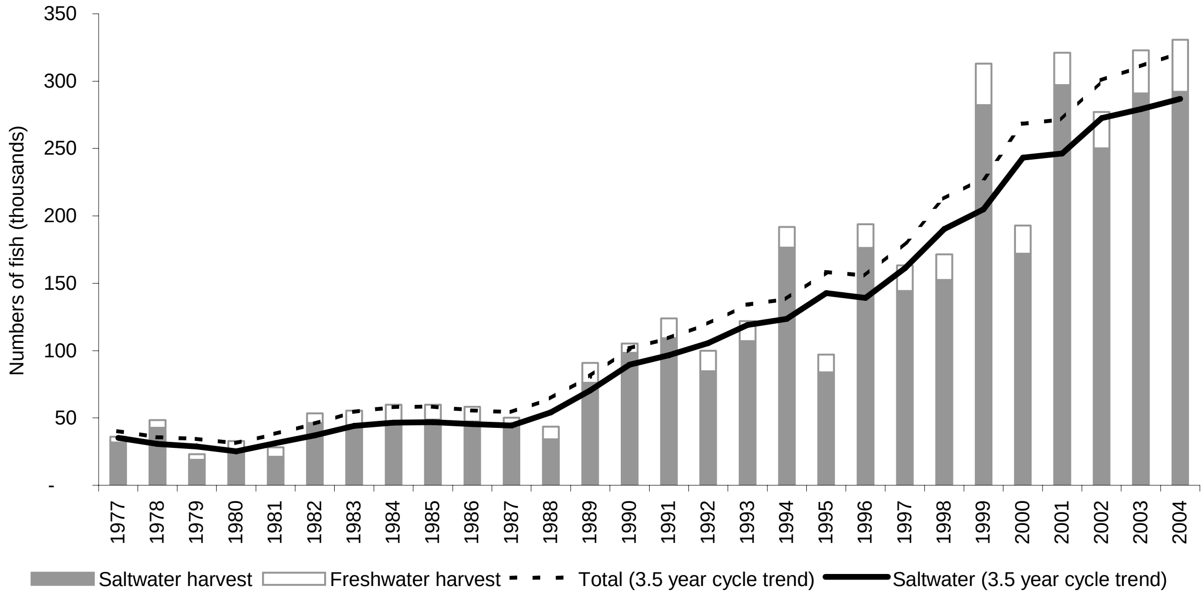


Figure 3.3–Sport harvest in saltwater and freshwater of coho salmon in Southeast Alaska, 1977-2004

between spawning escapement and production and to establish *biological escapement goals* that produce *maximum sustained yield*. One major advantage of the smolt estimation programs associated with coho indicator stocks is that they make it possible to filter out variation in return abundance caused by variation in marine survival and to improve resolution of the relationship between escapement and brood-year production.

In 1994, *biological escapement goals* were established for the four long-term indicator stocks based on Ricker spawner-recruit relationships (Clark et al. 1994). A *biological escapement goal* of 30,000-70,000 spawners was recently developed for the Chilkat River (Ericksen and Fleischman *in prep*). Also, for the Taku River a minimum inriver abundance goal of 38,000 spawners is specified in the 1999 Pacific Salmon Treaty. In practical terms, the abundance goal upriver of the US/Canada border translates into an escapement goal of about 35,000 fish after inriver harvests by commercial, food and test fisheries.

ESCAPEMENT INDICATORS

Foot or helicopter surveys have been systematically carried out on sets of streams in the Juneau, Haines, Sitka, and Ketchikan areas. These projects provide greater coverage but a much lower level of resolution about stock status compared with full indicator stocks. High and variable rainfall in the fall months makes it difficult to obtain consistent surveys. In the Juneau area, repetitive foot surveys are conducted on five streams of which two have individual goals (Clark *in prep*). In the Haines area, surveys are conducted on four tributaries of the Chilkat River (Ericksen and Fleischman *in prep*). In the Sitka area, five local streams have been surveyed on foot most years since 1985, and the Black River north of Sitka has been surveyed by helicopter since 1984. In the Ketchikan area, surveys have been conducted by helicopter on 14 streams since 1987. *Biological escapement goals* for the aggregate survey counts in the Ketchikan and Sitka areas were developed recently by Shaul and Tydingco (*in prep*).

Only peak survey counts that met standards for timing, survey conditions, and completeness were included in the indexes. Interpolations were made for missing counts under the assumption that the expected value is determined for a given stream and year in a multiplicative way (i.e., counts across streams for a given year are multiples of counts for other years, and counts across years for a stream are multiples of counts for other streams). The estimated expected count for a given stream, in a given year, is then equal to the sum of all counts for the year, times the sum of all counts for the stream, divided by the sum of counts over all streams and years. If there is more than one missing value, an iterative procedure, as described by Brown (1974), must be used since the sums change as missing counts are filled in at each step. Most of the consistent indicators of coho salmon escapement were established in the early to mid-1980s (Table 3.1).

NORTHERN INSIDE AREA STOCKS

Escapement to Auke Creek, a stream on the Juneau road system having a weir, has been consistently within or above escapement goal since the early 1980s (Figure 3.4; Table 3.2). Goals have recently been revised for surveyed Juneau roadside streams (Clark *in prep*). The goal for the largest producer, Montana Creek, was increased from 200–500 to 400–1,200 while the goal for Peterson Creek was changed from 100–350 spawners to 100–250 spawners. Goals were eliminated for the other three Juneau roadside streams (Steep, Jordan and Switzer Creeks).

The current goal for Peterson Creek has been met annually since surveys were initiated in 1981 while the current goal for Montana Creek was not met in 5 years out of 24 (1981, 1986-1988, and 2004). Peak counts have been extremely variable in Jordan Creek, ranging from only 18 spawners in 1997 to 1,396 spawners in 2002. Shaul et al. (2004) attributed the spike in escapement in 2002 to an unusually strong 2001 smolt migration. Brood year escapement counts for the 2002 return were low (47–63 spawners), suggesting that improved seeding was not a factor. They suggested that wide variation in smolt production from Jordan Creek may reflect intermittent movement of juveniles into Jordan Creek from other systems prior to final sea-migration. Such movement was evidenced by recovery of a coded-wire tagged smolt from Jordan Creek in 2002 that had been tagged in the Chilkat River in 2001 (Brian Glynn, Alaska Department of Fish and Game, Douglas, personal communication). However, the reason for the increased frequency of low counts since 1994 is unclear, but may reflect human-caused habitat changes in this largely urban stream.

Strong escapements relative to goals for most Juneau area streams in most years reflect high marine survival rates and moderate exploitation rates for roadside stocks since the early 1980s. Auke Creek and surveyed stocks on the Juneau roadside are harvested primarily in highly mixed-stock troll, seine, and sport fisheries, with only light exploitation in inside gillnet fisheries.

The Berners River in lower Lynn Canal, Chilkat River in upper Lynn Canal and the Taku River south of Juneau all had relatively strong escapements at or above goal during 1999–2004, with a peak in 2002 (Figure 3.4; Table 3.2). All three of these systems support similar mainland valley rearing habitat, including wetlands, ponds and sloughs, and their coho salmon runs are targeted by drift gillnet fisheries in addition to the troll fishery.

The Berners River is a compact system with concentrated high quality coho spawning and rearing habitat. Although a substantially smaller producer than the Taku and Chilkat Rivers, the Berners River is an important contributor to the fisheries in northern Southeast. Escapement counts in the Berners River peaked at 27,700 spawners in 2002.

Table 3.1–Southeast Alaska coho salmon escapement estimates and index counts from 1980 to 2004.

Year	Auke Creek	Juneau roadside index[a]	Berners River	Chilkat River	Taku River	Ford Arm Lake	Black River	Sitka survey index[b]	Hugh Smith Lake	Ketchikan survey index[c]	Chuck Creek
1980	698										
1981	646	1,552									
1982	447	1,545	7,505			2,662		1,545	2,144		1,017
1983	694	1,287	9,840			1,938		457	1,490		1,238
1984	651	1,312	2,825				425	2,063	1,408		
1985	942	1,466	6,169			2,324	1,628	1,246	903		956
1986	454	887	1,752			1,546	312	702	1,783		
1987	668	945	3,260	1,113	55,457	1,694	262	293	1,118	4,933	
1988	756	1,127	2,724	877	39,450	3,028	280	403	513	5,007	
1989	502	1,241	7,509	1,452	56,808	2,177	181	576	433	6,761	
1990	697	2,518	11,050	3,383	72,196	2,190	842	566	870	3,533	
1991	808	2,641	11,530	2,513	127,484	2,761	690	1,510	1,826	5,721	
1992	1,02	4,405	15,300	2,307	84,853	3,847	866	1,899	1,426	7,017	
1993	859	2,351	15,670	1,731	109,457	4,202	764	1,716	830	7,270	
1994	1,43	2,916	15,920	5,781	96,343	3,228	758	1,965	1,753	8,690	
1995	460	1,405	4,945	1,687	55,710	2,445	1,265	1,487	1,781	8,627	
1996	515	1,291	6,050	1,110	44,635	2,500	385	1,451	950	8,831	
1997	609	1,471	10,050	1,294	32,345	4,965	686	809	732	5,063	
1998	862	1,516	6,802	1,460	61,382	7,049	1,520	1,242	983	7,070	
1999	845	1,762	9,920	1,699	60,844	3,598	1,590	776	1,246	8,038	
2000	683	1,355	10,650	2,635	64,700	2,287	880	803	600	8,634	
2001	865	1,760	19,290	3,232	104,460	2,178	1,080	1,515	1,580	11,475	1,350
2002	1,17	4,543	27,700	5,660	219,789	7,109	1,194	1,868	3,291	12,223	2,189
2003	585	1,589	10,110	3,950	167,919	6,789	1,055	1,101	1,510	11,859	614
2004	416	837	14,450	2,006	132,706	3,539	380	1,124	840	9,904	606
Goal range											
Lower	200		4,000	950[f]	35,000[d]	1,300		400[e]	500	4,250[e]	
Upper	500		9,200	2,200[f]		2,900		800[e]	1,100	8,500[e]	

[a] The Juneau roadside index is the sum of peak survey counts on five streams.

[b] The Sitka survey index is the sum of peak survey counts on five streams.

[c] The Ketchikan survey index is the sum of peak survey counts on 14 streams.

[d] For the Taku River stock of coho salmon, the management objective of the U.S. is to insure a minimum above-border run of 38,000 fish as specified in the Pacific Salmon Treaty. The listed figure of 35,000 fish, shown for comparison with spawning escapement estimates, reflects a probable Canadian catch above the border of up to 3,000 fish in non-coho directed fisheries when the total above-border run is 38,000 fish.

[e] Goal range recommended by Shaul and Tydingco (*in prep*).

[f] Goal range recommended by Ericksen (*in prep*).

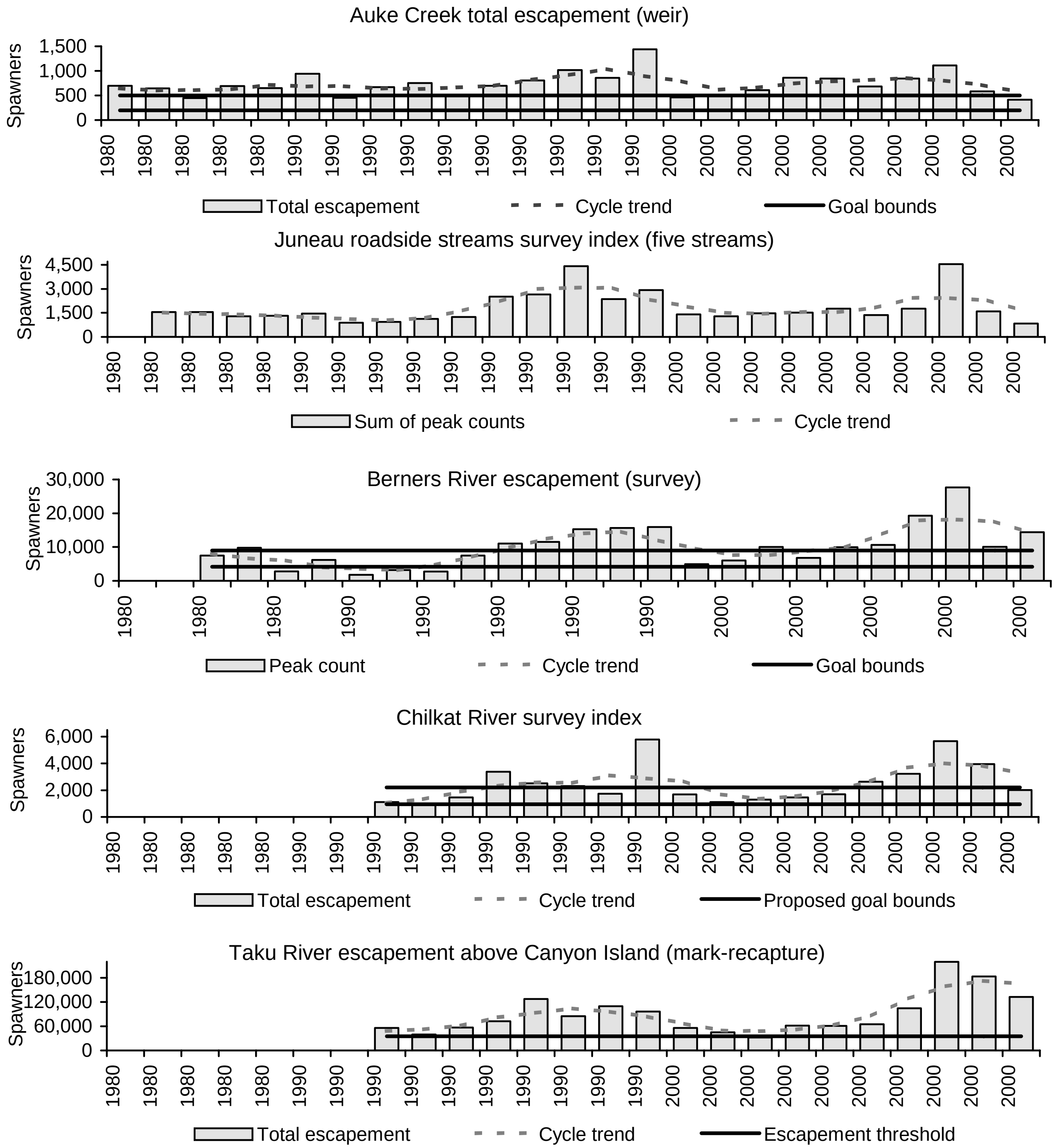


Figure 3.4–Coho salmon escapement estimates and indexes for streams in the Northern Inside area (Districts 111 and 115). Also shown are 3½-year moving average "cycle" trends and escapement goal ranges. The threshold of 35,000 shown for the Taku includes the inriver run threshold of 38,000 under the Pacific Salmon Treaty minus an allowance for a catch of 3,000 fish in inriver commercial, food, personal use and test fisheries.

Table 3.2–Peak coho salmon escapement survey counts for Juneau roadside streams and total count of wild adult coho salmon at the Auke Creek weir from 1981 to 2004.

	Juneau roadside peak surveys								Chilkat River		
Year	Auke Cr (weir)	Montana Creek	Steep Creek	Jordan Creek	Switzer Creek	Peterson Creek	Roadside survey index[a]	Berners River	Index count	Expanded estimate	Taku River
1981	646	227	515	482	109	219	1,552				
1982	447	545	232	368	80	320	1,545	7,505			
1983	694	636	171	184	77	219	1,287	9,840			
1984	651	581	168	251	123	189	1,312	2,825			
1985	942	810	186	72	122	276	1,466	6,169			
1986	454	60	247	163	54	363	887	1,752			
1987	668	314	128	251	48	204	945	3,260	1,113	35,800	55,457
1988	756	164	155	215	51	542	1,127	2,724	877	28,209	39,450
1989	502	566	222	133	78	242	1,241	7,509	1,452	46,704	56,808
1990	697	1,711	185	216	82	324	2,518	11,050	3,383	79,807[b]	72,196
1991	808	1,415	267	322	227	410	2,641	11,530	2,513	80,831	127,484
1992	1,020	2,512	612	785	93	403	4,405	15,300	2,307	74,205	84,853
1993	859	1,352	471	322	94	112	2,351	15,670	1,731	55,678	109,457
1994	1,437	1,829	200	371	198	318	2,916	15,920	5,781	185,948	96,343
1995	460	600	409	77	42	277	1,405	4,945	1,687	54,263	55,710
1996	511	798	134	54	42	263	1,291	6,050	1,110	35,704	44,635
1997	609	1,018	182	18	67	186	1,471	10,050	1,294	41,622	32,345
1998	862	1,160	149	63	42	102	1,516	6,802	1,460	50,758[b]	61,382
1999	845	1,000	392	47	51	272	1,762	9,920	1,699	54,649	60,768
2000	683	961	88	30	74	202	1,355	10,650	2,635	84,756	64,700
2001	842	1,119	366	119	50	106	1,760	19,290	3,232	103,958	104,394
2002	1,112	2,448	380	1,396	124	195	4,543	27,700	5,660	205,429[b]	219,360
2003	585	808	400	78	100	203	1,589	10,110	3,950	134,340[b]	183,038
2004	416	364	82	38	69	284	837	14,450	2,006	64,524	132,405
Avg.	729	958	264	252	87	260	1,822	10,044	2,438	78,733	88,932
Goals:											
Point	340							6,300	1,550	50,000	
Lower	200	400				100		4,000	950	30,000	35,000[c]
Upper	500	1,200				250		9,200	2,200	70,000	

[a] The roadside index is the sum of peak survey counts on five streams in the Juneau area.

[b] Mark-recapture estimates of Chilkat River escapement. Other estimates are expanded index counts.

[c] For the Taku River stock of coho salmon, the management objective of the U.S. is to insure a minimum above-border run of 38,000 fish as specified in the Pacific Salmon Treaty. The listed figure of 35,000 fish, shown for comparison with spawning escapement estimates, reflects a probable Canadian catch above the border of up to 3,000 fish in non-coho directed fisheries when the total above-border run is 38,000 fish.

The Taku River may be the single largest coho salmon producing system in the region. Escapement estimates were first made in 1987 and run reconstruction estimates are available since 1992 (Elliott and Bernard 1994; McPherson et al. 1994, 1997, 1998b; McPherson and Bernard 1995, 1996; Yanusz et al. 1999, 2000; Jones et al. *in prep*). The inriver run past Canyon Island near the US/Canada boundary is estimated using a mark–recapture technique. Marking is done at research fishwheel sites in the Canyon while recovery sampling is done in test and Canadian commercial fisheries. Results of a 1991 radio-telemetry study indicated that the fishwheel estimate represented about 78% of the total system escapement with about 22% spawning in Alaskan waters below Canyon Island (Eiler et al. *in prep*).

Based on the 1999 Pacific Salmon Treaty agreement, the management intent of the U.S. is to ensure a minimum above-border inriver run of 38,000 coho salmon with the following provisions: (1) no numerical limit on the Taku River coho salmon catch will apply in Canada during the directed sockeye salmon fishery (through Statistical Week 33); depending on inseason projections of above-border run size, directed Canadian harvests are: (2) 3,000 coho salmon for above-border runs less than 50,000 (3) 5,000 coho salmon for above-border runs between 50,000 and 60,000, (4) 7,500 coho salmon for above-border runs between 60,000 and 75,000, and (5) 10,000 coho salmon for above-border runs above 75,000.

The inriver run estimate past Canyon Island has exceeded 38,000 spawners in all years except 1997 when the estimate was only 35,035 fish, including an inriver catch of 2,690 fish and escapement estimate of 32,345 spawners (Table 3.2), despite timely implementation of extensive inseason restrictions in troll, gillnet, and sport fisheries. In the early 1990s, the Taku River coho run increased sharply and greatly exceeded the current management goal despite increased fishing effort in the District 111 gillnet fishery, which targets the stock in late August and September.

Since 1998, Taku inriver run estimates have ranged above the management goal by an increasing margin because of increasing run sizes associated with increasing smolt production estimates. Reduced exploitation associated primarily with decreased gillnet effort levels has also been a substantial factor. Fishing time during recent fall openings in District 111 has been limited to protect the Taku River chum stock, which has declined sharply from historical levels. Limited fishing time, combined with a lower number of participating vessels in recent years, has substantially reduced the exploitation rate of the gillnet fishery on the coho salmon stock. At the same time, the ability of the Canadian fishery to harvest Taku coho salmon within the river has been limited in most years by fall weather and other logistical and economic limitations associated with a remote fishing area.

The Chilkat River has produced nearly as many returning coho salmon as the Taku River, on average. Mark-recapture estimates for 4 years (1991, 1998, 2002 and 2003) were used to calibrate a standardized peak survey count in spawning areas. Recent total escapement estimates ranging from 64,500–205,400 in 2000–2005 (Table 3.2) met or exceeded the goal range of 30,000–70,000 spawners recommended by Ericksen and Fleischman (*in prep*).

SITKA AREA STOCKS

Ford Arm Lake is the only indicator stock in the Sitka area that has a long-term escapement database and an established *biological escapement goal* (Figure 3.5; Table 3.3). This stock is available along the coast from early July through early September and is harvested intensively by local directed commercial troll and marine sport fisheries, and incidentally to pink salmon in the Khaz Bay seine fishery. The goal range of 1,300–2,900 spawners has been achieved in 12 years and exceeded in 10 years during the 22-year history of the project (Figure 3.5). The goal has been exceeded more often since 1992.

Escapement to Black River, located north of Ford Arm Lake, has been surveyed once annually by helicopter since 1984. Escapement counts in this system were relatively low during 1986 to 1989, ranging from 181 to 312 spawners, but increased to a range from 690 to 1,965 spawners during 1990–2003. The 2004 count decreased again to 380 spawners.

The sum of peak escapement survey counts for five small streams near Sitka trended downward in the late 1980s but increased sharply in the early 1990s (Tables 3.1 and 3.3, Figure 3.5). The counts declined again from 1997 to 2000 before increasing in 2001-2004. Shaul and Tydingco (*in prep*) recommend a goal of 400-800 spawners for the aggregate count in the five 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. Their recommended goal has been achieved in every year except one (1987) and has been exceeded in 9 of the 10 most recent years.

SOUTHERN SOUTHEAST STOCKS

Hugh Smith Lake is the only full indicator stock in southern Southeast that has a long-term data series and an established escapement goal (Tables 3.1 and 3.4; Figure 3.6). However, Chuck Creek on the southern outside coast was recently added as a full indicator stock (McCurdy 2005 and *in prep*). Three total escapement counts for Chuck Creek from the 1980s (Shaul et al. 1991) are available for comparison with recent counts in 2001–2004.

Over the past 23 years, the escapement goal range of 500 to 1,100 spawners in Hugh Smith Lake (Clark et al. 1994) has been achieved nine times (Table 3.1; Figure 3.5). Escapements have been below the range only once (1989) and above it 13 times.

The Ketchikan area survey index of peak helicopter counts for 14 streams has followed a generally upward trend since 1987 with three consecutive counts above 10,000 spawners during 2001-2003 followed by a slightly lower count of 9,904 spawners in 2004 (Tables 3.1 and 3.4, Figure 3.5). Shaul and Tydingco (*in prep*) recommend a goal range of 4,250 to 8,500 spawners. During 1987–2004, escapements have fallen short of the proposed range once, within the range nine times and above the range eight times.

Weir counts at Chuck Creek, on the outer coast of southern Southeast, totaled 1,350 spawners in 2001 and 2,189 spawners in 2002, but declined to 614 spawners in 2003 and 606 spawners in 2004 (Table 3.1). Counts from 1982 to 1985 ranged from 956 to 1,238 spawners (Shaul et al. 1991). While recent escapements have been quite variable, average escapement in 2001–2004 (1,190 spawners) was similar to the average for 1982, 1983 and 1985 (1,070 spawners).

YAKUTAT STOCKS

Yakutat stocks are harvested primarily in commercial 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. *Biological escapement goals* exist for seven stocks in this area (Clark and Clark 1994), but comparable peak escapement surveys have been conducted relatively consistently in recent years on only three systems, the Lost, Situk, and Tsiu Rivers.

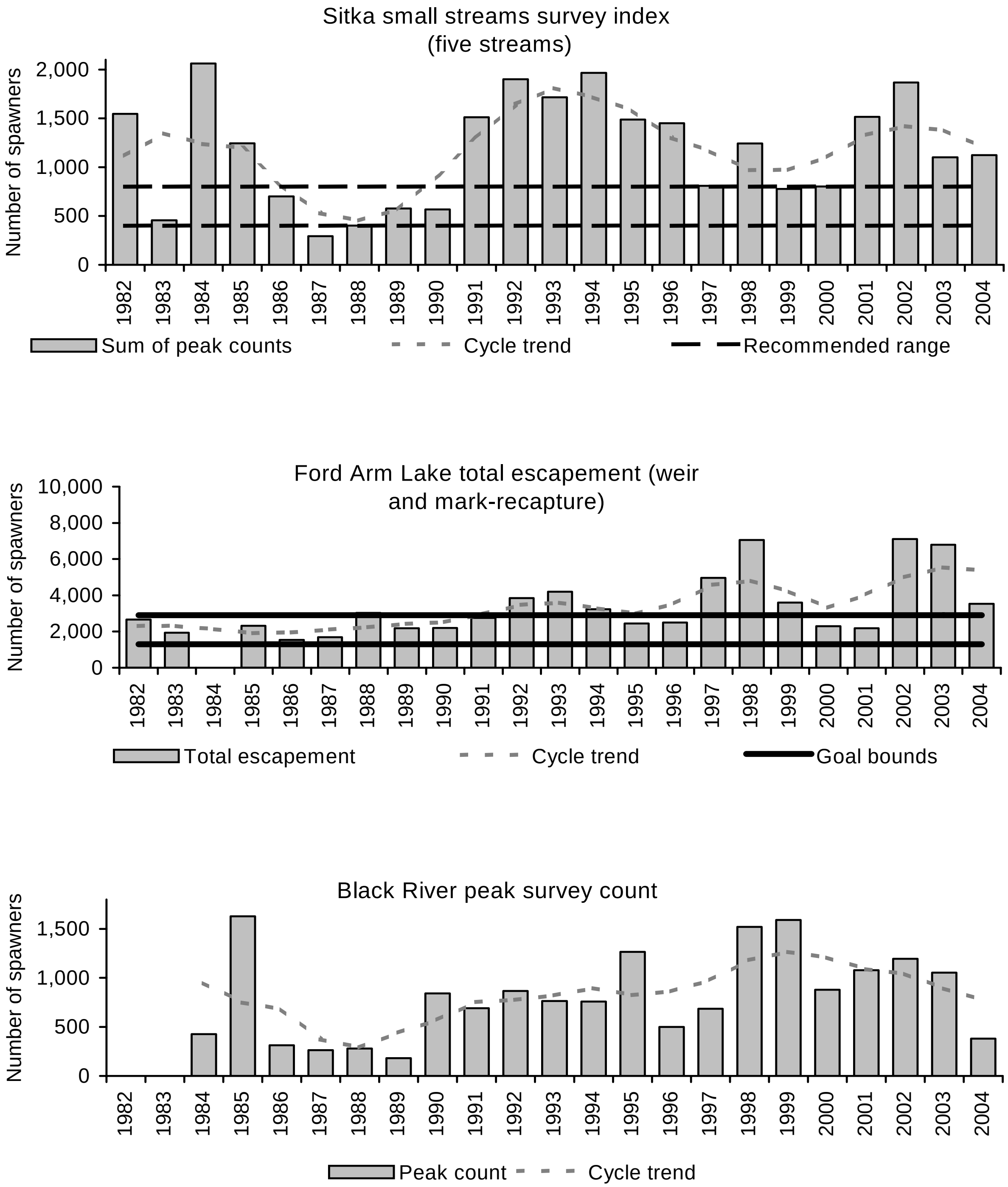


Figure 3.5–Coho salmon escapement estimates and indexes for streams in the Sitka area (District 113) and 3½-year moving average "cycle" trends.

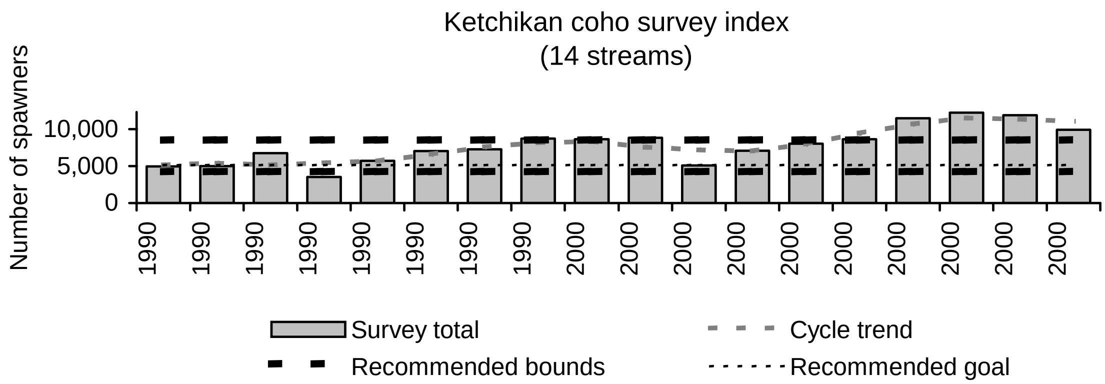
Table 3.3–Peak counts of coho salmon in the Sitka escapement survey index (sum of five streams), mark-recapture estimates of the Nakwasina River escapement, a helicopter survey count of the Black River escapement, and a combination of weir counts and mark-recapture estimates of the Ford Arm Lake escapement.[a]

Year	Starrigavan Creek	Sinitsin Creek	St. John's Creek	Nakwasina River	Eagle River	Sitka survey index	Nakwasina River m/r estimate	Black R. survey count	Ford Arm Lake (weir- m/r)
1982	317	46	***116***	***580***	***486***	1,545			2,662
1983	45	31	20	217	***144***	457			1,938
1984	385	160	154	715	***649***	2,063		425	
1985	193	144	109	408	***392***	1,246		1,628	2,324
1986	57	***72***	***53***	275	245	702		312	1,546
1987	36	21	***22***	47	167	293		262	1,694
1988	45	56	71	104	***127***	403		280	3,028
1989	101	76	89	129	***181***	576		181	2,177
1990	39	80	38	195	214	566		842	2,190
1991	142	186	107	621	454	1,510		690	2,761
1992	241	265	110	654	629	1,899		866	3,847
1993	256	213	90	***644***	513	1,716		764	4,202
1994	304	313	227	404	717	1,965		758	3,228
1995	274	152	99	626	336	1,487		1,265	2,445
1996	59	150	201	553	488	1,451		385	2,500
1997	55	90	68	300	296	809		686	4,965
1998	123	109	57	653	300	1,242		1,520	7,049
1999	167	48	25	291	***245***	776		1,590	3,598
2000	144	62	30	459	108	803	2,000	880	2,287
2001	133	132	80	753	417	1,515	2,992	1,080	2,178
2002	227	169	100	713	659	1,868	3,141	1,194	7,109
2003	95	102	91	440	373	1,101	2,063	1,055	6,789
2004	143	112	79	399	391	1,124	3,867	380	3,539
Average	156	121	89	443	371	1,179	2,813	812	3,366

[a] Total index is the sum of counts and interpolated values. Interpolated values are shown in shaded bold italic print.

Although the data series starts in 1972, the quality and comparability of peak survey counts in the Yakutat area are somewhat lower than other areas. Most aerial and foot surveys on these systems have been conducted early in the run to support inseason management of the set gillnet fisheries.

Utility of the peak survey counts in assessing historical escapement 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 in 2001–2004, although a peak count was not obtained for the Tsiu River in 2004. Escapement goals have been attained in most years (Table 3.5; Figure 3.7).



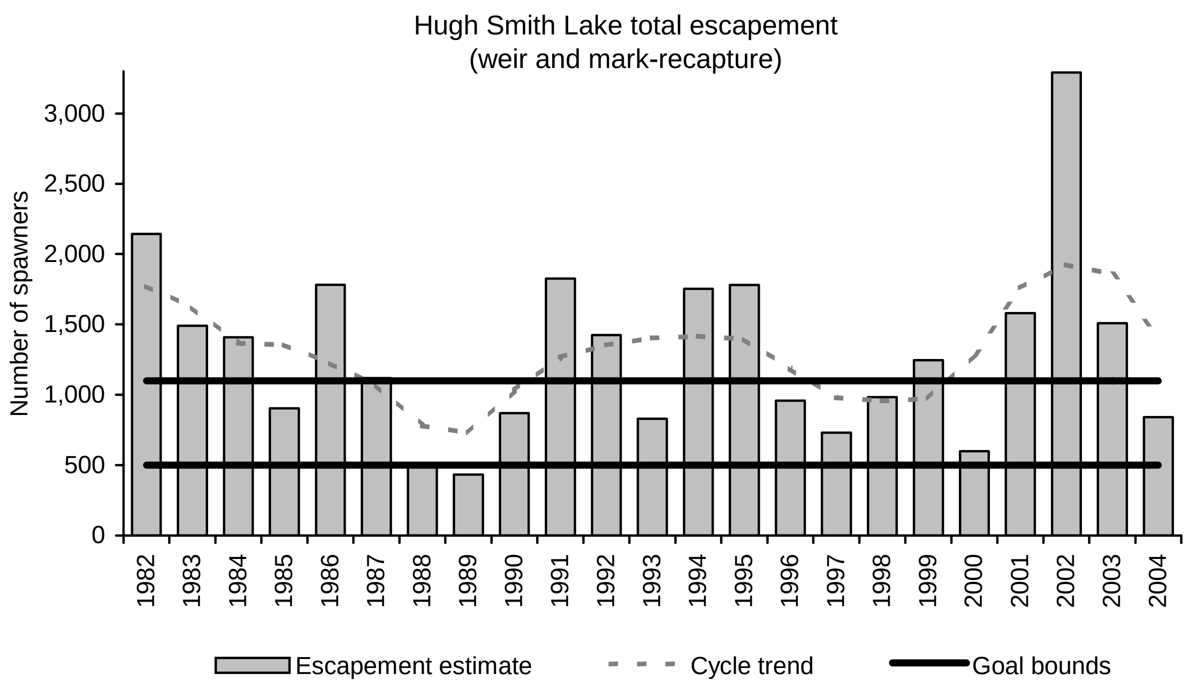


Figure 3.6–Sum of peak coho salmon escapement survey counts for 14 streams in the Ketchikan area (top figure) and coho salmon escapement counts and estimates for Hugh Smith Lake (bottom figure). Also shown are 3 1/2 year "cycle" trends, the current escapement goal for Hugh Smith Lake, and a recommended goal for Ketchikan surveyed streams (4,250–8,500 spawners).

Table 3.4–Peak coho salmon survey counts for 14 streams in the Ketchikan area and total adult coho salmon escapement to Hugh Smith Lake from 1987 to 2004. Combined survey count is the sum of counts and interpolated values. Interpolated values are show in shaded bold italic.

Year	Herman Creek	Grant Creek	Eulachon River	Klahini River	Indian River	Barrier Creek	King Creek	Choca Creek
1987	92	***88***	154	***62***	***387***	***98***	***304***	***145***
1988	72	150	205	20	300	50	175	150
1989	75	101	290	15	925	450	510	200
1990	150	30	235	150	***282***	***72***	35	***105***
1991	245	50	285	50	550	100	300	220
1992	115	270	860	90	675	100	250	150
1993	90	175	460	50	475	325	110	300
1994	265	220	755	200	560	175	325	225
1995	250	94	435	165	600	220	415	180
1996	94	92	383	40	570	230	457	220
1997	75	***85***	420	60	***371***	***94***	***292***	175
1998	94	130	460	120	304	50	411	190
1999	75	127	657	150	356	25	627	225
2000	135	94	600	110	380	72	620	180
2001	80	110	929	151	1,140	***212***	891	450
2002	88	138	1,105	20	940	70	700	220
2003	242	***197***	875	39	690	57	1,140	380
2004	150	230	801	170	935	250	640	180
Average	133	132	551	92	580	147	456	216

Year	Carroll River	Blossom River	Keta River	Marten River	Humpback Creek	Tombstone River	Combined survey count	Hugh Smith Lake (weir & m/r)
1987	180	700	800	740	650	532	4,933	1,118
1988	193	790	850	600	52	1,400	5,007	513
1989	70	1,000	650	1,175	350	950	6,761	433
1990	***139***	800	550	575	135	275	3,533	870
1991	375	725	800	575	671	775	5,721	1,826
1992	360	650	627	1,285	550	1,035	7,017	1,426
1993	310	850	725	1,525	600	1,275	7,270	830
1994	475	775	1,100	2,205	560	850	8,690	1,753
1995	400	800	1,155	1,385	82	2,446	8,627	1,781
1996	240	829	1,506	1,924	440	1,806	8,831	958
1997	140	1,143	571	759	32	847	5,063	732
1998	***255***	1,004	1,169	1,961	256	666	7,070	983
1999	425	598	1,895	1,518	520	840	8,038	1,246
2000	275	1,354	1,619	1,421	102	1,672	8,634	600
2001	173	1,561	***1,612***	1,956	506	***1,704***	11,475	1,580
2002	270	1,359	1,368	2,302	2,004	1,639	12,223	3,291
2003	***427***	1,940	1,934	1,980	214	1,745	11,859	1,510
2004	455	1,005	1,200	1,835	1,230	823	9,904	840
Average	287	994	1,118	1,429	497	1,182	7,814	1,238

SMOLT PRODUCTION

Smolt production estimates are available for 10 years or more for four systems while pre-smolt estimates in the summer prior to smolt emigration are available for Ford Arm Lake (Table 3.6). Estimates are listed by adult return year for the smolt emigration in the previous year.

A long-term downward trend in Auke Creek smolt production noted by Shaul et al. (2004) continued during the two most recent years (Table 3.6). A record low migration of 3,567 smolts was associated with the 2004 adult return, followed by 4,291 smolts for 2005. These numbers were substantially lower than decade averages of 7,323 smolts in the 1980s and 6,292 smolts in the 1990s as well as the more recent 2000–2003 average of 4,948 smolts. A robust trend (Geiger and Zhang 2002) indicates a linear rate of decline of about 1.5% per year or 38.4% (2,956 smolts) over the entire 26-year period. The decline in Auke Creek smolt production has occurred despite relatively level brood year escapements that have trended above the *biological escapement goal* (Figure 3.4, Table 3.2).

The decline in Auke Creek smolt production stands in contrast to other monitored wild coho salmon producing systems in northern Southeast. Although the two most recent smolt migrations from the Berners River were below average (Table 3.6), there is no apparent trend in smolt production from that system. The most recent estimate of 185,125 smolts that migrated from the Berners River in 2003, and returned as adults in 2004, was the median smolt estimate for the 15-year period of record (1990–2004).

In the Taku River, meanwhile, the two highest smolt production estimates on record of between 2.9-3.0 million smolts (Table 3.6) occurred in 2002 and 2003 (2003 and 2004 adult returns). Taku River smolt estimates declined from 1.1–1.5 million during 1992–1995 to 0.8–1.0 million in 1996–1998 before approximately tripling to 2.3–3.0 million in 2002–2004. The reason for the recent trend in estimates is unclear. However, beginning in 2000, Jones et al. (*in prep*) found that use of the simple Chapman's estimate produced smolt estimates that were biased low (~12% over five years) due to size selectivity in smolt tagging and applied a stratified estimate to account for this bias, accordingly.

Shaul et al. (2004) noted an upward trend in pre-smolt production in the Ford Arm Lake system and speculated that it may have resulted from increased carcass nutrient input. Estimated midsummer pre-smolt abundance in the Ford Arm Lake system trended upward from an average of 62,000 pre-smolts for returns in the 1980s to 82,100 in the 1990s, and 90,300 from 2000 to 2002. Estimates associated with the 2003 and 2004 returns of 77,100 pre-smolts and 101,600 pre-smolts, respectively, (Table 3.6) have maintained the recent pattern of higher average production compared with the 1980s and early 1990s.

Smolt production from Hugh Smith Lake has shown no evident long-term trend away from long-term average production of about 31,200 smolts during 1984–2004 (Table 3.6).

MARINE SURVIVAL

Marine survival rates for indicator stocks increased in the early 1980s and reached a peak in the early to mid-1990s before declining to more moderate levels from 1995 to 2004 (Table 3.7, Figure 3.8). The recent pattern in marine survival rates is also reflected in the wild coho salmon harvest in commercial fisheries (Figure 3.1).

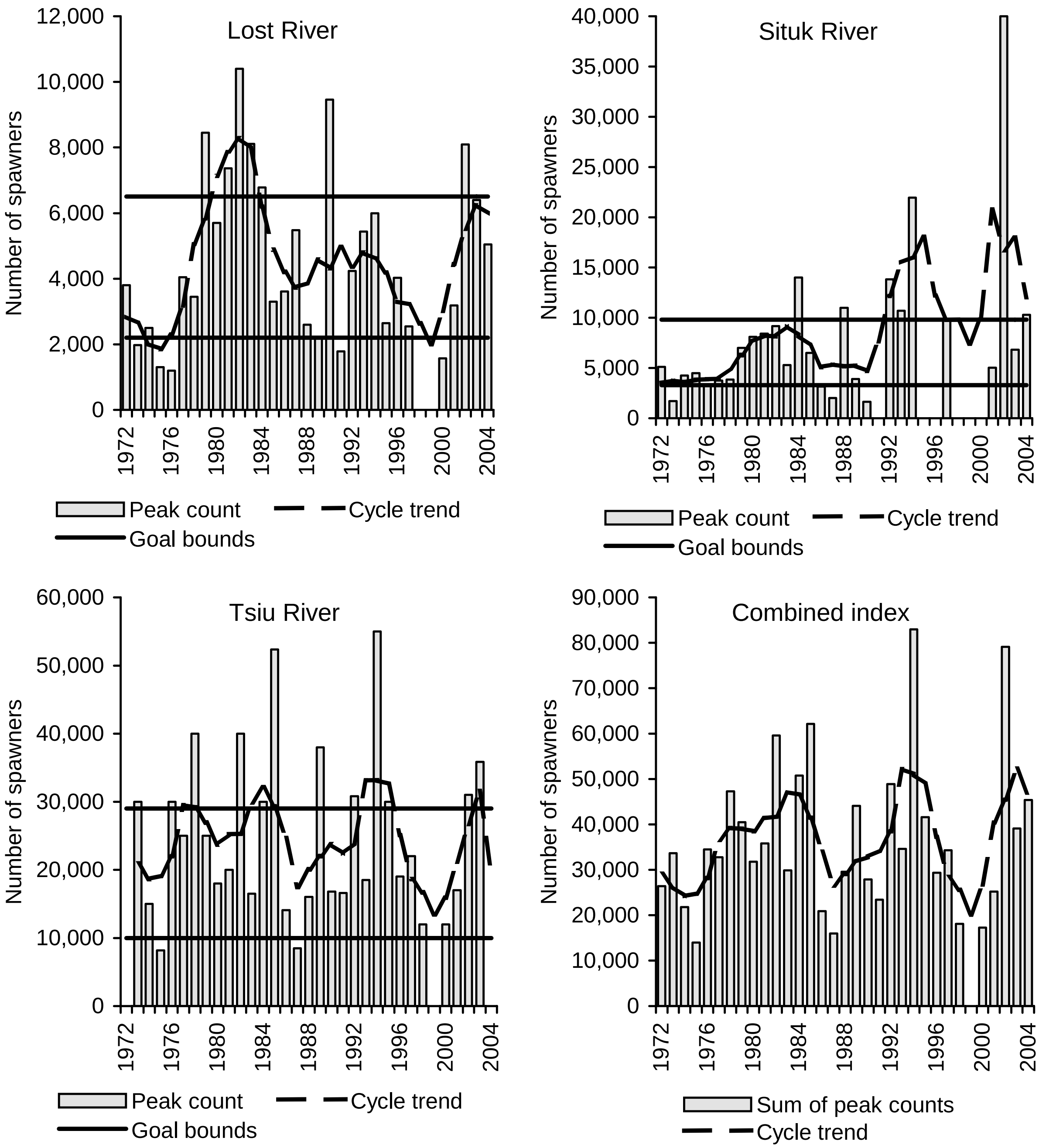


Figure 3.7–Peak coho salmon escapement survey counts for three systems in the Yakutat area and the combined count for all three systems from 1972 to 2004, with 3½-year moving average "cycle" trends. The total index includes interpolations for systems without counts in all years except 1999 (see Escapement Indicators section for a description of the method used).

Table 3.5–Yakutat area coho salmon peak escapement survey counts from 1972 to 2004.

Year	Lost River	Situk River	Tsiu River	Total count[a]
1972	3,800	5,100		26,361
1973	1,978	1,719	30,000	33,697
1974	2,500	4,260	15,000	21,760
1975	1,300	4,500	8,150	13,950
1976	1,200	3,280	30,000	34,480
1977	4,050	3,750	25,000	32,800
1978	3,450	3,850	40,000	47,300
1979	8,450	7,000	25,000	40,450
1980	5,700	8,100	18,000	31,800
1981	7,363	8,430	20,000	35,793
1982	10,400	9,180	40,000	59,580
1983	8,110	5,300	16,500	29,910
1984	6,780	14,000	30,000	50,780
1985	3,300	6,490	52,350	62,140
1986	3,610	3,162	14,100	20,872
1987	5,482	2,000	8,500	15,982
1988	2,600	11,000	16,000	29,600
1989	2,190	3,900	38,000	44,090
1990	9,460	1,630	16,800	27,890
1991	1,786		16,600	23,441
1992	4,235	13,820	30,800	48,855
1993	5,436	10,703	18,500	34,639
1994	6,000	21,960	55,000	82,960
1995	2,642		30,000	41,616
1996	4,030		19,000	29,361
1997	2,550	9,780	22,000	34,330
1998			12,000	18,116
1999				
2000	1,572		12,000	17,303
2001	3,190	5,030	17,000	25,220
2002	8,093	40,000	31,000	79,093
2003	6,396	6,814	35,850	39,127
2004	5,047	10,284		45,410
Average	4,603	8,335	24,772	36,835
Lower bound	2,200	3,300	10,000	
Upper bound	6,500	9,800	29,000	

[a] Total includes interpolations for systems without counts (see Escapement Indicators section for a description of the method used).

Table 3.6–Total coho smolt and pre-smolt production estimates for five wild coho salmon producing systems in Southeast Alaska by age .1 return year, 1980–2005.

Return Year	Auke Creek smolts	Berners River smolts	Taku River smolts	Ford Arm Lake pre-smolts	Hugh Smith Lake smolts
1980	8,789				
1981	10,714				
1982	6,967			78,682	
1983	6,849			65,186	
1984	6,901				51,789
1985	6,838			38,509	32,104
1986	5,852			46,422	23,499
1987	5,617			73,272	21,878
1988	7,014			88,649	36,218
1989	7,685			43,354	23,336
1990	7,011	163,998		55,803	26,620
1991	5,137	141,291		56,284	32,925
1992	5,690	187,688	1,080,551	61,724	23,326
1993	6,596	326,312	1,510,032	57,401	32,853
1994	8,647	255,519	1,475,874	83,686	48,433
1995	7,495	181,503	1,525,330	134,640	49,288
1996	4,884	194,019	986,489	91,843	22,413
1997	3,934	133,629	759,763	66,528	32,294
1998	6,111	139,959	853,662	80,567	37,898
1999	7,420	252,168	1,184,195	132,607	29,830
2000	5,233	181,271	1,387,399	62,444	19,902
2001	4,969	268,777	1,720,387	106,409	23,346
2002	5,980	264,599	2,292,949	101,860	36,497
2003	3,611	151,980	2,988,349	77,081	26,897
2004	3,567	185,125	2,941,525	101,579	23,074
2005	4,291	[a]	[a]	[a]	[a]
Average	6,300	201,856	1,592,808	77,479	31,163

[a] Estimates for these systems are unavailable pending mark-recovery sampling of returning adults in 2005.

Survival rates in the most recent 10-year period have followed relatively stable trends for most stocks at historically favorable average rates of 22% for Auke Creek, 15% for Berners River, 10% for the Taku River and 12% for Hugh Smith Lake. The reason for highly variable average survival rates among closely situated systems is unclear. Variation in smolt size among systems may play a role.

Auke Creek smolts are very large, for example. On the other hand, a high percentage of smolts from Auke Creek return as jacks, which are not counted in these survival calculations. Shaul et al. (2004) noted an inverse relationship between marine survival and stock size not only in the northern inside area (Auke Creek, Berners River, Taku River) but in the southern boundary area as well (Hugh Smith Lake, Lachmach River and Nass River) based on estimates reported in by the Joint Northern Boundary Technical Committee (2002).

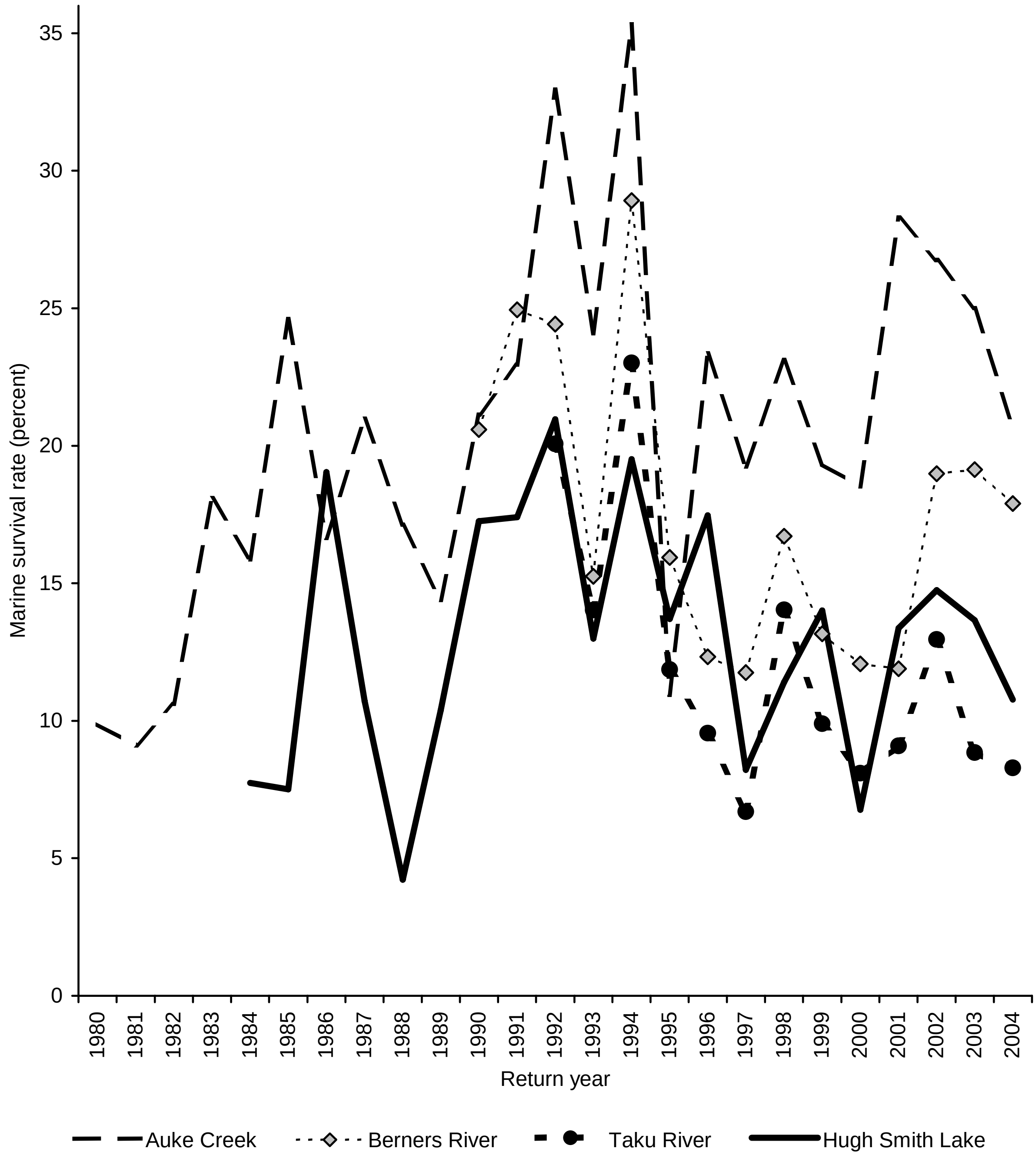


Figure 3.8–Estimated marine survival rate for coho salmon smolts from four indicator stocks in Southeast Alaska from 1980 to 2004.

Table 3.7–Estimated survival rate (percent) of coho salmon smolts and pre-smolts from five wild Southeast Alaska indicator stocks from the time of tagging until return to the fisheries.

Return Year	Auke Creek smolts	Berners River smolts	Taku River smolts	Ford Arm Lake pre-smolts	Hugh Smith Lake smolts
1980	9.9				
1981	9.1				
1982	10.6			6.0	
1983	18.1			9.5	
1984	15.9				7.7
1985	24.6			12.4	7.5
1986	16.6			8.8	19.0
1987	21.0			4.4	10.7
1988	17.1			6.7	4.2
1989	14.4			14.2	10.4
1990	21.1	20.6		9.5	17.3
1991	23.0	24.9		10.7	17.4
1992	33.0	24.4	20.1	15.1	21.0
1993	24.1	15.3	14.0	22.1	13.0
1994	35.3	28.9	23.0	13.7	19.5
1995	10.9	15.9	11.9	5.6	13.7
1996	23.4	12.3	9.6	6.5	17.5
1997	19.2	11.8	6.7	15.4	8.2
1998	23.1	16.7	14.0	19.9	11.4
1999	19.3	13.2	9.9	7.5	14.0
2000	18.5	12.1	8.1	12.9	6.8
2001	28.3	11.9	9.1	8.1	13.4
2002	26.8	19.0	13.0	14.8	14.7
2003	25.0	19.1	8.8	17.1	13.7
2004	21.0	17.9	8.3	11.9	10.8
Average	20.4	17.6	12.3	11.5	13.1

Survival of Ford Arm Lake pre-smolts has averaged a relatively high 11% (range 4–22%) over a 22-year period despite exposure to approximately 10 months of additional freshwater mortality after tagging before entering the marine environment. Survival of the Ford Arm stock improved from an average of 9% during 1982–1989 to 13% in the 1990s and remained at a 13% average during 2000–2004.

TOTAL STOCK ABUNDANCE

Total return abundance of the stocks, including catch and escapement, is the product of smolt production and marine survival. For the full indicator stocks, estimates of total escapement and harvest are shown in Tables 3.8–3.14 and Figures 3.9–3.10.

The three longest studied indicator stocks in inside areas of Southeast show similar patterns in abundance since the early 1980s. The Auke Creek, Berners River, and Hugh Smith Lake stocks all show relatively level long-term trends, with a period of high abundance in the early 1990s and a spectacular peak in 1994 (Figure 3.9, Tables 3.8, 3.9 and 3.11) that coincided with a similar peak in the commercial catch of wild coho salmon (Figure 3.1). Average returns to Hugh Smith Lake increased from about 3,400 fish in 1982–1989 to 5,100 fish in the 1990s but declined again to 3,200 fish in 2000–2004. However, escapements were strong during the latter period and the biological goal range of 500–1,100 spawners was met or exceeded each year. The 2002 escapement of nearly 3,300 spawners was by far the largest on record.

Estimated returns to the Taku River above Canyon Island increased substantially in 2002–2004 to levels approximating the 1992–1994 peak (Figure 3.10). However, exploitation rates were low and escapements increased far above the escapement threshold, reaching a peak of 219,400 spawners in 2002. The recent increase in abundance of Taku River coho salmon appears attributed to increased smolt production (Table 3.6) rather than an increase in marine survival (Table 3.7).

The Ford Arm Lake stock on the outer coast has followed an upward trend best described by a 5.2% exponential rate of increase in total adult run size leading to a tripling of abundance from 1982 to 2004 (Table 3.10). The increase in total run size has resulted from increases in both pre-smolt production and survival from pre-smolt to adult.

Return estimates for other indicator stocks, including Chilkat River (Table 3.13), Nakwasina River and Chuck Creek (Table 3.14) are too limited to infer trends. Recent estimated Chuck Creek returns of 1,488 adults in 2003 and 1,586 in 2004 were smaller than 1982–1985 returns averaging 3,000 adults (range 2,407–3,837). However, escapement counts of 1,350 in 2001 and 2,189 in 2002 suggest runs were strong in some recent years.

EXPLOITATION RATES

Most Southeast Alaska coho salmon stocks accumulate substantial exploitation rates in mixed-stock fisheries. Some inside stocks run a gauntlet of fisheries, from troll and marine sport fisheries along the outer coast, through net, sport and troll fisheries in corridor areas, and through intensive inside gillnet fisheries concentrated near some estuaries. In some cases, there are significant freshwater sport and subsistence harvests as well.

Shaul et al. (2004) pointed to reduced fishing effort and resultant exploitation rates after 2000 because of market and price pressures on the fisheries. However, that pattern appeared to be reversed in 2004 (Tables 3.15–3.20; Figures 3.11 and 3.12) in apparent response to improved prices, particularly in the troll fishery.

The Auke Creek stock has been exploited at a relatively low average rate of 41% (range 20% to 55%) during 1980 to 2004, owing mainly to lack of intensive net fishing in its migratory pathway during the fall (Figures 3.11 and 3.12; Table 3.15). The troll fishery has accounted for the majority of the harvest, exploiting the stock at an average rate of 30% (range 12% to 48%) with less than 5% each attributed to seine, gillnet, and sport fisheries. During 2000–2003, total exploitation rate estimate for this stock were consistently below average, ranging from 26–38%, but increased to 44% in 2004, the highest estimate since 1996 (Table 3.15). The troll fishery exploitation rate increased to 27% in 2004 from 18% in 2002 and 23% in 2003.

Table 3.8–Estimated harvest by gear type, escapement, and total run of coho salmon returning to Auke Creek from 1980 to 2004.

		Number of fish						
Year	Fishery sample size[a]	Troll	Seine	Drift gillnet	Sport	Total catch	Escapement	Total return
1980	15	117	0	29	24	170	698	868
1981	70	280	0	31	19	330	646	976
1982	45	149	117	24	2	292	447	739
1983	129	385	10	28	122	545	694	1,239
1984	124	372	8	13	51	444	651	1,095
1985	177	594	3	71	73	741	942	1,683
1986	110	421	2	60	37	520	454	974
1987	145	438	2	48	23	511	668	1,179
1988	145	306	12	72	55	445	756	1,201
1989	182	533	7	15	49	604	502	1,106
1990	168	635	15	57	78	785	697	1,482
1991	47	200	8	152	11	371	808	1,179
1992	53	603	10	196	46	855	1,020	1,875
1993	169	611	8	92	19	730	859	1,589
1994	330	1,064	224	218	112	1,618	1,437	3,055
1995	82	264	5	65	26	360	460	820
1996	160	446	11	133	36	626	515	1,141
1997	43	94	4	0	50	148	609	757
1998	157	437	17	43	54	551	862	1,413
1999	160	485	5	58	42	590	845	1,435
2000	103	228	6	23	29	286	683	969
2001	149	435	10	41	55	541	865	1,406
2002	125	288	8	77	51	424	1,176	1,600
2003	97	211	4	59	45	319	585	904
2004	62	199	47	71	15	332	416	748
Average		400	21	67	46	534	745	1,279

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

Troll fishery exploitation rates for the Berners River stock showed a similar pattern, increasing to 32% in 2004 from 17% in 2002 and 24% in 2003 (Figures 3.11 and 3.12; Table 3.16). The 2004 total exploitation rate estimate for the Berners River stock of 56% was the second highest since 2000, but lower than 65% in 2003 when the run was heavily harvested inside Berners Bay by the Lynn Canal gillnet fishery.

Exploitation rates on the Taku River run decreased from an average of 57% (range 48–72%) in 1992–1999 to 36% (range 26–46%) in 2000–2004 (Table 3.19). Marine sport and purse seine exploitation rates remained relatively unchanged, but exploitation by the primary harvesting fisheries (troll and drift gillnet) declined sharply. The average troll exploitation rate declined from 26% to 18% while the average gillnet exploitation rate decreased even more from 21% to 9%. Market conditions are believed to have played a role, particularly in the decline in gillnet

Table 3.9–Estimated harvest by gear type, escapement and total run of coho salmon returning to the Berners River from 1982 to 2004.

		Number of fish								
Year	Fishery sample size[a]	Troll	Seine	Drift gillnet	Sport	B.C. net	Cost recovery	Total catch	Escapement	Total run
1982	48	12,887	0	10,568	0	0	0	23,455	7,505	30,960
1983	125	17,153	0	6,978	65	0	0	24,196	9,840	34,036
1984									2,825	
1985	93	10,865	198	7,015	0	0	0	18,078	6,169	24,247
1986	157	13,560	0	8,928	395	0	0	22,883	1,752	24,635
1987	53	7,448	0	3,301	48	0	0	10,797	3,260	14,057
1988	102	5,926	181	6,141	0	0	0	12,248	2,724	14,972
1989	58	10,515	0	1,664	0	0	0	12,179	7,509	19,688
1990	471	14,851	141	7,352	369	0	0	22,713	11,050	33,763
1991	1,025	6,417	579	16,519	117	0	0	23,632	11,530	35,162
1992	701	15,337	344	14,677	192	0	0	30,550	15,300	45,850
1993	1,496	19,353	192	14,239	140	0	0	33,924	15,670	49,594
1994	2,647	27,319	1,686	27,907	891	5	0	57,808	15,920	73,728
1995	1,384	8,847	22	14,869	117	0	0	23,855	4,945	28,800
1996	601	10,524	380	6,434	412	0	0	17,750	6,050	23,800
1997	312	2,454	282	2,477	179	0	0	5,392	10,050	15,442
1998	613	10,427	435	5,716	380	0	0	16,958	6,802	23,760
1999	948	12,877	208	9,317	261	0	0	22,663	9,920	32,583
2000	693	5,362	145	5,296	196	0	6	11,005	10,650	21,655
2001	748	8,854	195	3,499	123	0	0	12,671	19,290	31,961
2002	788	8,671	228	13,014	471	0	0	22,384	27,700	50,084
2003	1,326	6,866	247	11,302	455	0	0	18,870	10,110	28,980
2004	756	10,608	90	7,301	217	0	0	18,216	14,450	32,666
Average		11,233	252	9,296	229	0	0	21,110	10,044	31,383

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

exploitation, which coincided with lower participation in the District 111 fishery. Also, weekly gillnet openings in District 111 were limited during much of the period to conserve the fall Taku River chum stock.

Troll fishery exploitation rate estimates for the Chilkat River during 2000–2005 averaged higher than estimates for the Taku River (25% compared with 18%) but displayed a similar pattern with the highest estimate in 2004 (Table 3.20). The estimate of 43% for the Chilkat River in 2004 was substantially higher than 2000–2003 average of 20% (range 18–24%). Chilkat River fish were also exploited more heavily by the drift gillnet fishery at rates ranging from 9–18% (average 13%) during 2000–2004 compared with 10% (range 7–12%) for the Taku run. The total exploitation rate estimate of 67% for the Chilkat River in 2004 was substantially higher than 2000–2003 estimates ranging from 32–39%.

The Ford Arm Lake stock has been harvested at moderate to high exploitation rates, primarily in the region's commercial troll fishery, which is most intensive in waters near this system. The

Table 3.10–Estimated harvest by gear type, escapement, and total run of coho salmon returning to Ford Lake from 1982 to 2004.

		Number of fish							
Year	Fishery sample size[a]	Alaska troll	Seine	Drift gillnet	Sport	Canadian troll	Total catch	Escapement	Total run
1982	38	1,948	106	0	0	0	2,054	2,662	4,716
1983	93	3,344	912	0	0	0	4,256	1,938	6,194
1984									
1985	49	2,438	0	0	0	0	2,438	2,324	4,762
1986	87	2,500	62	0	0	0	2,562	1,546	4,108
1987	71	1,456	79	0	0	0	1,535	1,694	3,229
1988	151	2,857	46	0	0	30	2,933	3,028	5,961
1989	221	3,777	185	0	0	0	3,962	2,177	6,139
1990	174	2,979	108	0	0	0	3,087	2,190	5,277
1991	193	3,208	44	10	0	0	3,262	2,761	6,023
1992	199	5,252	208	0	0	0	5,460	3,847	9,307
1993	349	7,847	443	0	201	0	8,491	4,202	12,693
1994	236	6,918	1,234	0	112	0	8,264	3,228	11,492
1995	91	3,577	1,468	0	0	0	5,045	2,445	7,490
1996	64	3,148	0	0	332	0	3,480	2,500	5,980
1997	241	4,883	0	0	373	0	5,256	4,965	10,221
1998	315	7,835	435	20	679	0	8,969	7,049	16,018
1999	145	5,872	66	0	441	0	6,379	3,598	9,977
2000	193	4,603	926	13	221	0	5,763	2,287	8,050
2001	131	5,818	115	0	480	0	6,412	2,178	8,590
2002	246	5,751	1,260	0	998	0	8,009	7,109	15,118
2003	225	4,154	504	0	1,770	0	6,428	6,789	13,217
2004	153	7,722	523	0	319	0	8,564	3,539	12,103
Average		4,449	397	2	269	1	5,119	3,366	8,485

[a]Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

exploitation rate by the troll fishery has averaged 53% since 1982 (Figure 3.11; Table 3.17) while intermittent seine harvests and increasing marine sport fishing have brought the long-term average exploitation rate by all fisheries up to 60%. The troll fishery exploitation rate dipped to a record low estimate of 31% in 2003, but the decrease was offset in large part by an exceptionally high marine sport exploitation rate of 13%, representing a harvest of 1,770 Ford Arm coho salmon based on recovery of 59 tags in the Sitka marine sport fishery. However, the 2003 all-gear exploitation rate of 49% was below the long-term average of 60%. The 2004 all-gear exploitation rate estimate of 71% was well above average and was primarily attributed to the high troll fishery exploitation rate of 64% with lower exploitation rates by the purse seine fishery (4%) and marine sport fishery (3%). Although the total exploitation rate dipped in 2003, the 2000–2004 average rate of 64% actually represented an increase compared with 55% in the 1980s and 61% in the 1990s. Over time, the Ford Arm Lake stock not only increased dramatically in abundance (Figure 3.9), it became more heavily exploited during a period when exploitation rates on most other stocks declined from 1990s levels. The stock forages in coastal waters throughout the summer and is, therefore, substantially more available to intensive hook-and-line fisheries in the vicinity of Sitka and Pelican compared with more migratory stocks. It has become one of the most heavily fished stocks by the expanding sport charter fishery with a

Table 3.11–Estimated harvest by gear type, escapement, and total run of coho salmon returning to Hugh Smith Lake from 1982 to 2004.

		Number of fish										
Year	Fishery sample size[a]	Alaska troll	Alaska seine	Alaska gillnet	Alaska trap	Alaska sport	B.C troll	B.C. net	B.C. sport	Total catch	Escapement	Total return
198	91	2,780	627	203	0	0	264	78	0	3,952	2,144	6,096
198	189	1,373	424	277	49	0	211	51	0	2,385	1,490	3,875
198	151	1,260	501	470	18	0	325	28	0	2,602	1,408	4,010
198	212	868	287	137	5	0	199	13	0	1,509	903	2,412
198	257	1,585	515	315	2	14	234	26	0	2,691	1,783	4,474
198	100	656	95	249	0	23	153	50	0	1,226	1,118	2,344
198	42	408	230	122	0	0	234	23	0	1,017	513	1,530
198	91	1,213	375	237	0	41	105	20	0	1,991	433	2,424
199	263	1,810	538	504	24	0	794	53	0	3,723	870	4,593
199	408	2,102	195	881	0	54	630	43	0	3,905	1,826	5,731
199	497	1,852	674	601	0	42	286	9	0	3,464	1,426	4,890
199	162	2,259	262	677	0	0	197	43	0	3,438	830	4,268
199	846	4,339	1,125	1,424	0	59	684	53	13	7,697	1,753	9,450
199	433	2,030	908	1,651	0	101	241	28	13	4,972	1,781	6,753
199	496	1,581	640	478	0	104	126	36	0	2,965	950	3,915
199	481	1,286	121	397	0	27	89	0	0	1,920	732	2,652
199	666	1,772	471	980	0	113	0	0	0	3,336	983	4,319
199	493	1,761	291	727	0	153	0	0	0	2,932	1,246	4,178
200	161	489	45	116	0	97	0	0	0	747	600	1,347
200	314	697	455	324	0	58	7	0	0	1,541	1,580	3,121
200	433	892	451	555	0	91	65	0	38	2,092	3,291	5,383
200	336	895	354	690	0	106	91	26	0	2,162	1,510	3,672
200	244	1,016	196	232	0	60	48	20	73	1,645	840	2,485
Average		1,518	425	532	4	50	217	26	6	2,779	1,305	4,084

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

recent 2001–2004 average estimated contribution of 892 fish (range 319–1,770 fish) to the marine sport fishery under an average exploitation rate of 7% (range 3–13%).

The Nakwasina River stock in Sitka Sound was exploited at an average estimated rate of 28% (range 19–38%) by all fisheries in 2000–2005 (Table 3.20). The troll fishery accounted for most of the catch with an average exploitation rate of 24% while the marine sport and purse seine fisheries followed with about 4% and 1%, respectively. The Nakwasina River stock appears substantially less available to the fisheries compared with the Ford Arm Lake stock located about 60 km to the north. The Ford Arm Lake stock was harvested at an average rate of 64% during the same period (52% troll, 6% seine, 6% marine sport). The two stocks are harvested mostly in the same locations but the Ford Arm Lake stock is less migratory, being present in nearly full abundance at the beginning of the summer troll fishery while the Nakwasina River stock begins entering the fishery in July but usually does not reach peak abundance until early to mid-September. Therefore, the Nakwasina River stock has less exposure to both hook and line fisheries throughout the summer and to purse seine fisheries that occur primarily in August.

Table 3.12–Estimated catch and escapement of coho salmon bound for the Taku River above Canyon Island from 1987 to 2004.

		Number of Fish							
Year	Fishery sample size[a]	Troll	Seine	Gillnet	Marine sport	Canadian inriver	Total catch	Escapement	Total return
1987						6,519		55,457	
1988						3,643		39,450	
1989						4,033		56,808	
1990						3,685		72,196	
1991						5,439		127,484	
1992	129	41,733	5,062	76,325	3,337	5,541	131,998	84,853	216,851
1993	121	61,129	2,675	31,440	2,513	4,634	102,392	109,457	211,849
1994	178	97,040	26,352	86,198	19,018	14,693	243,301	96,343	339,644
1995	201	45,042	1,853	56,820	7,857	13,738	125,310	55,710	181,020
1996	136	24,780	220	17,067	2,461	5,052	49,580	44,635	94,215
1997	66	8,823	550	1,490	4,963	2,690	18,516	32,345	50,861
1998	231	28,827	742	19,371	4,428	5,090	58,458	61,382	119,840
1999	252	36,229	2,881	7,507	4,170	5,575	56,361	60,844	117,205
2000	221	21,090	1,577	9,935	9,552	5,447	47,601	64,700	112,301
2001	344	31,992	2,066	11,378	3,278	3,099	51,813	104,460	156,272
2002	397	39,012	3,457	24,481	7,076	3,802	77,828	219,360	297,188
2003	195	38,081	3,812	28,953	6,665	3,717	81,228	183,038	264,266
2004	223	61,516	5,334	29,025	6,011	9,432	111,318	132,405	243,723
1992–2004 Average		41,177	4,352	30,768	6,256	6,347	88,900	96,118	185,018
1987–2004 Average		-	-	-	-	5,879	-	88,940	-

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

The Hugh Smith Lake stock is an example of a stock that traverses an extended gauntlet of mixed stock fisheries along the coast and is exposed to fisheries outside of state jurisdiction in Canada and around Annette Island. From 1982 to 1988, the Hugh Smith Lake stock was exploited at moderate rates for coho salmon, averaging 62% (Figures 3.11 and 3.12; Table 3.18). However, exploitation became markedly more intense during 1989 to 1999 at an average rate of 76% (range 68% to 82%) before decreasing sharply to 39–59% (average 51%) in 2000–2003. The primarily cause of the decrease was a decrease in the troll component. In 2004, however, the troll fishery exploitation rate increased substantially to 41% from 16–36% (average 25%) in 2000–2003 and the total exploitation rate in 2004 increased to 66%, near the long-term average of 67%. Following a period of dramatic fishery curtailment beginning in 1998, fisheries in British Columbia have begun to exploit the Hugh Smith Lake stock again. The most recent exploitation rate by British Columbia fisheries (6% in 2004) approached the pre-1998 average of 8%.

The Chuck Creek stock on the southern outside coast was exploited at a rate of 62% in 2004, compared with 59% in 2003 (Table 3.20). Based on a smaller number of tag recoveries, exploitation rate estimates from 1982–1985 were similar on average (62%; range from 49-75%) to more recent years. Most of the harvest of Chuck Creek coho salmon is taken in the troll and seine fisheries, although recent development of the sport charter fishery has resulted in significant sport exploitation rates estimated at 6% in 2003 and 5% in 2004.

ESCAPEMENT GOAL DEVELOPMENT

Biological escapement goals were established for the four long-term indicator stocks in 1994 using Ricker analysis (Clark et al. 1994). Using the same technique, Clark (1995) developed goals for the five surveyed roadside streams in the Juneau area while Clark and Clark (1994) developed escapement goals for seven streams in the Yakutat area. These *biological escapement goal* ranges are designed to maintain wild stocks at high levels of productivity, and to maintain yields near maximum. The goals represent a range of escapements that were estimated to produce 90% or more of *maximum sustained yield.*

The 1999 Pacific Salmon Treaty specifies a minimum objective for the number of coho salmon passing above Canyon Island in the Taku River. The current above-border minimum goal of 38,000 adults effectively translates to an effective sustainable escapement goal of about 35,000 spawners after projected minimal harvests in commercial, food, and test fisheries from an above-border run of that size. A *biological escapement goal* will be developed for this stock after production is realized from the extremely high escapements seen in 2002 and 2003. Including these levels of escapement in the *biological escapement goal* analysis will add needed contrast to the spawner-recruit dataset.

Over a decade of additional estimates of smolt or pre-smolt production and adult returns are available since escapement goals were developed for the main four long-term indicator stocks. However, research effort has been diverted from updating escapement goals for these systems to another problem. Shaul et al. (2004) presented information indicating that inaccurate aging of the freshwater growth period may be a serious obstacle to developing meaningful spawner-recruit relationships. A project was initiated in 1996 to evaluate and validate aging methodology for coho salmon. Recently, Berners River adults have been re-aged using several years of known-age samples as standards. A similar process is anticipated for the Hugh Smith Lake and Ford Arm Lake stocks. *Biological escapement goals* for these stocks will then be updated.

In order to improve stock assessment information on Yakutat area coho salmon stocks, ADF&G initiated an intensive research program in 2003, centered on stocks (Situk, Lost and Ahrnklin rivers) that contribute to fisheries in the Situk-Ahrnklin Lagoon. Commercial set gillnet, sport and subsistence fisheries operating in the lagoon and in the Situk River are the largest coho salmon fisheries in the Yakutat area. In 2004 and 2005 juvenile coho salmon were coded wire tagged on the three systems; tag recoveries in 2005 and 2006 will provide estimates of harvest rates and distribution. Total escapements to the systems are also being estimated to improve information on the relationship of peak survey counts to total escapement. An improved understanding of production from these systems is expected to translate into improved escapement goals for Yakutat coho salmon stocks in the future.

As a result of ADF&G's 2005 review of Southeast Alaska and Yakutat salmon escapement goals, proposed goals have been developed for several systems, including the Chilkat River and aggregates of streams that are surveyed in the Ketchikan and Sitka areas. In addition, Clark (*in prep*) revised goals for two Juneau roadside streams (Montana and Peterson Creeks) and recommended elimination of goals for the other three streams (Steep, Jordan and Switzer Creeks). Goals for three rivers in the Yakutat area (Kaliakh, East Alsek, and Akwe rivers) that are no longer consistently surveyed for coho salmon were also recommended for elimination.

Table 3.13–Estimated harvest by gear type, escapement and total run of coho salmon returning to the Chilkat River, 1987-2004.

Year	Fishery sample size[a]	Number of fish: Troll	Seine	Drift gillnet	Sport	Subsistence	Total catch	Escapement	Total run
1987								35,800	
1988								28,209	
1989								46,704	
1990								79,807	
1991								80,831	
1992								74,205	
1993								55,678	
1994								185,948	
1995								54,263	
1996								35,704	
1997								41,622	
1998								50,758	
1999								54,649	
2000	265	22,030	833	15,744	1,762	199	40,568	84,756	125,324
2001	251	30,624	673	13,709	2,911	126	48,043	103,958	152,001
2002	352	63,056	812	43,296	6,255	574	113,993	205,429	319,422
2003	426	51,794	1,268	26,305	6,372	494	86,233	134,340	220,573
2004	258	83,848	932	34,182	10,706	454	130,122	64,524	194,646
2000–2004 Average		50,270	904	26,647	5,601	369	83,792	118,601	202,393

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

CHILKAT RIVER

Ericksen and Fleischman (*in prep*) developed a goal for the Chilkat River based on peak survey counts over an 18-year period in standardized locations within the drainage (Table 3.2, Figure 3.4). They expanded historical index counts based on companion mark-recapture estimates of escapement to the entire Chilkat drainage in four years (1990, 1998, 2002, and 2003). A *biological escapement goal* range of 950–2,200 spawners with a point goal of 1,550 spawners was proposed for the sum of index counts. The recommended target for total system escapement estimates is 30,000 to 70,000 spawners, with a point goal of 50,000 spawners.

The recommended goal for the Chilkat River was based upon three different analyses (traditional multiplicative Ricker spawner-recruit, Bayesian age-structured spawner-recruit, and a "hockeystick" model developed by Bradford et al. (1999) using known freshwater production) that produced nearly identical point estimates. All analyses included the stock assessment information from survey counts, mark-recapture estimates, harvest and smolt estimates from coded-wire tagging of several broods and age-structure data. The goal represents a best estimate of the range required to provide for maximum sustained yield and is designed to produce at least 90% of maximum sustained yield while reflecting the uncertainty associated with the data.

Table 3.14–Estimated harvest by gear type, escapement and total run of coho salmon returning to Chuck Creek and the Nakwasina River from 1982 to 2004.

		Number of fish						
Year	Fishery sample size	Troll	Seine	Gillnet	Sport	Total catch	Escapement	Return
Chuck Creek								
1982	28	1,320	418			1,738	1,017	2,755
1983	11	551	618			1,169	1,238	2,407
1985	29	1,906	975			2,881	956	3,837
2001							1,350	
2002							2,189	
2003	192	539	252		83	874	614	1,488
2004	203	725	179		76	980	606	1,586
Average		1,008	488		80	1,528	1,139	2,415
Nakwasina River								
2000	34	1,089	70	0	60	1,219	2,000	3,219
2001	93	1,178	39	0	222	1,439	2,992	4,431
2002	48	598	0	0	133	731	3,141	3,872
2003	33	489	0	0	115	604	2,063	2,667
2004	97	1,381	63	0	200	1,645	3,867	5,512
Average		947	34	0	146	1,128	2,813	3,940

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

KETCHIKAN AND SITKA AGGREGATE SURVEY COUNTS

Shaul and Tydingco (*in prep*) propose goals for aggregate spawner counts in 14 streams in the Ketchikan area and five streams in the Sitka area (Tables 3.3 and 3.4; Figures 3.5 and 3.6). Lack of adequate stock specific information on age composition, harvest and survey efficiency prevented them from undertaking a conventional spawner-recruit analysis. Instead, they incorporated exploitation rate and marine survival estimates for nearby wild indicator stocks (Hugh Smith Lake for Ketchikan, Nakwasina River for Sitka) to estimate smolt production associated with the aggregate survey counts. They estimated habitat capacity as average smolt production associated with primary brood years having higher levels of escapement, indicating probable full seeding of available rearing habitat. Average productivity estimates for coho stocks based on literature were incorporated to estimate the number of smolts/spawner associated with *maximum sustained yield* and a range producing an even proportion (84% or more) of *maximum sustained yield* in which the upper goal bound was at least double the lower bound.

JUNEAU ROADSIDE SURVEY COUNTS

Clark (*in prep*) developed escapement goals for Montana and Peterson Creeks based on theoretical spawner-recruit analysis. He used Auke Creek exploitation rates to determine an equilibrium point for potential Ricker relationships and applied a range of probable alpha values

Table 3.15–Estimated percent harvest by gear type, escapement, and total run of coho salmon returning to Auke Creek from 1980 to 2004

Year	Fishery sample size[a]	Percentage of total run						
		Troll	Seine	Drift gillnet	Sport	Total catch	Escapement	Total return
1980	15	13.5	0.0	3.3	2.8	19.6	80.4	100.0
1981	70	28.7	0.0	3.2	1.9	33.8	66.2	100.0
1982	45	20.2	15.8	3.2	0.3	39.5	60.5	100.0
1983	129	31.1	0.8	2.3	9.8	44.0	56.0	100.0
1984	124	34.0	0.7	1.2	4.7	40.5	59.5	100.0
1985	177	35.3	0.2	4.2	4.3	44.0	56.0	100.0
1986	110	43.2	0.2	6.2	3.8	53.4	46.6	100.0
1987	145	37.2	0.2	4.1	2.0	43.3	56.7	100.0
1988	145	25.5	1.0	6.0	4.6	37.1	62.9	100.0
1989	182	48.2	0.6	1.4	4.4	54.6	45.4	100.0
1990	168	42.8	1.0	3.8	5.3	53.0	47.0	100.0
1991	47	17.0	0.7	12.9	0.9	31.5	68.5	100.0
1992	53	32.2	0.5	10.5	2.5	45.6	54.4	100.0
1993	169	38.5	0.5	5.8	1.2	45.9	54.1	100.0
1994	330	34.8	7.3	7.1	3.7	53.0	47.0	100.0
1995	82	32.2	0.6	7.9	3.2	43.9	56.1	100.0
1996	160	39.1	1.0	11.7	3.2	54.9	45.1	100.0
1997	43	12.4	0.5	0.0	6.6	19.6	80.4	100.0
1998	157	30.9	1.2	3.0	3.8	39.0	61.0	100.0
1999	160	33.8	0.3	4.0	2.9	41.1	58.9	100.0
2000	103	23.5	0.6	2.4	3.0	29.5	70.5	100.0
2001	149	30.9	0.7	2.9	3.9	38.5	61.5	100.0
2002	125	18.0	0.5	4.8	3.2	26.5	73.5	100.0
2003	97	23.3	0.4	6.5	5.0	35.3	64.7	100.0
2004	62	26.6	6.3	9.5	2.0	44.4	55.6	100.0
Average		30.1	1.7	5.1	3.6	40.5	59.5	100.0

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

to establish a goal range likely to encompass 90% or more of maximum sustained yield. His recommended goals are 400–1,200 spawners for Montana Creek and 100–250 spawners for Peterson Creek. These target ranges replace goals developed by Clark (1995*b*) of 200–500 spawners and 100–350 spawners, respectively. Montana and Peterson Creeks both have freshwater sport fisheries that can be actively managed for escapement goals. Clark (*in prep*) recommended that goals for three other Juneau Roadside streams without freshwater fisheries (Steep, Jordan and Switzer Creeks) be eliminated.

DISCUSSION

The results of this analysis lead us to the same conclusion reached by Shaul et al. (2004): Southeast Alaska coho salmon stocks are currently in excellent overall condition. We found no *stocks of concern* from a fishery management perspective. Stocks that have *biological escapement goals* have been within or above target ranges in the vast majority of cases. For most

Table 3.16– Estimated percent harvest by gear type, escapement and total run of coho salmon returning to the Berners River from 1982 to 2004.

Year	Fishery sample size[a]	Percent of total run: Troll	Seine	Drift gillnet	Sport	B.C. net	Cost recovery	Total catch	Escapement	Total run
1982	48	41.6	0.0	34.1	0.0	0.0	0.0	75.8	24.2	100.0
1983	125	50.4	0.0	20.5	0.2	0.0	0.0	71.1	28.9	100.0
1984										
1985	93	44.8	0.8	28.9	0.0	0.0	0.0	74.6	25.4	100.0
1986	157	55.0	0.0	36.2	1.6	0.0	0.0	92.9	7.1	100.0
1987	53	53.0	0.0	23.5	0.3	0.0	0.0	76.8	23.2	100.0
1988	102	39.6	1.2	41.0	0.0	0.0	0.0	81.8	18.2	100.0
1989	58	53.4	0.0	8.5	0.0	0.0	0.0	61.9	38.1	100.0
1990	470	44.0	0.4	21.8	1.1	0.0	0.0	67.3	32.7	100.0
1991	1,025	18.2	1.6	47.0	0.3	0.0	0.0	67.2	32.8	100.0
1992	701	33.5	0.8	32.0	0.4	0.0	0.0	66.6	33.4	100.0
1993	1,496	39.0	0.4	28.7	0.3	0.0	0.0	68.4	31.6	100.0
1994	2,647	37.1	2.3	37.9	1.2	0.0	0.0	78.4	21.6	100.0
1995	1,384	30.7	0.1	51.6	0.4	0.0	0.0	82.8	17.2	100.0
1996	601	44.2	1.6	27.0	1.7	0.0	0.0	74.6	25.4	100.0
1997	312	15.9	1.8	16.0	1.2	0.0	0.0	34.9	65.1	100.0
1998	613	43.9	1.8	24.1	1.6	0.0	0.0	71.4	28.6	100.0
1999	948	39.5	0.6	28.6	0.8	0.0	0.0	69.6	30.4	100.0
2000	693	24.8	0.7	24.5	0.9	0.0	0.0	50.8	49.2	100.0
2001	745	27.7	0.6	10.9	0.4	0.0	0.0	39.6	60.4	100.0
2002	787	17.3	0.5	26.0	0.9	0.0	0.0	44.7	55.3	100.0
2003	1,326	23.7	0.9	39.0	1.6	0.0	0.0	65.1	34.9	100.0
2004	756	32.5	0.3	22.4	0.7	0.0	0.0	55.8	44.2	100.0
Average		36.8	0.7	28.6	0.7	0.0	0.0	66.9	33.1	100.0

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

stocks, escapements peaked in the early to mid-1990s when runs were exceptionally strong and have reached relatively high levels again during 2001 to 2004 because of strong runs combined with lower exploitation rates for some stocks. Ocean conditions that favor survival of local coho salmon stocks in Southeast Alaska persisted through the 2004 return.

Improvement in salmon prices in 2004 helped reverse a decline in fishing effort in troll and net fisheries brought on by very depressed markets for salmon in 2002 and 2003. Troll fishery exploitation rates in particular increased markedly in 2004, reaching the highest level since the 1990s for most stocks. This development represents a relatively rapid if not complete reversal of the situation described by Shaul et al. (2004) in which exploitation rates had fallen to the point were very little active fishery management was needed.

Table 3.17–Estimated percent harvest by gear type, escapement, and total run of coho salmon returning to Ford Arm Lake from 1982 to 2004.

Year	Fishery sample size[a]	Percent of total run: Alaska troll	Seine	Drift gillnet	Sport	Canadian troll	Total catch	Escapement	Total run
1982	38	41.3	2.2	0.0	0.0	0.0	43.6	56.4	100.0
1983	93	54.0	14.7	0.0	0.0	0.0	68.7	31.3	100.0
1984									
1985	49	51.2	0.0	0.0	0.0	0.0	51.2	48.8	100.0
1986	87	60.9	1.5	0.0	0.0	0.0	62.4	37.6	100.0
1987	71	45.1	2.4	0.0	0.0	0.0	47.5	52.5	100.0
1988	151	47.9	0.8	0.0	0.0	0.5	49.2	50.8	100.0
1989	221	61.5	3.0	0.0	0.0	0.0	64.5	35.5	100.0
1990	174	56.5	2.0	0.0	0.0	0.0	58.5	41.5	100.0
1991	193	53.3	0.7	0.2	0.0	0.0	54.2	45.8	100.0
1992	199	56.4	2.2	0.0	0.0	0.0	58.7	41.3	100.0
1993	349	61.8	3.5	0.0	1.6	0.0	66.9	33.1	100.0
1994	236	60.2	10.7	0.0	1.0	0.0	71.9	28.1	100.0
1995	91	47.8	19.6	0.0	0.0	0.0	67.4	32.6	100.0
1996	64	52.6	0.0	0.0	5.6	0.0	58.2	41.8	100.0
1997	241	47.8	0.0	0.0	3.6	0.0	51.4	48.6	100.0
1998	315	48.9	2.7	0.1	4.2	0.0	56.0	44.0	100.0
1999	145	58.9	0.7	0.0	4.4	0.0	63.9	36.1	100.0
2000	193	57.2	11.5	0.2	2.7	0.0	71.6	28.4	100.0
2001	131	67.7	1.3	0.0	5.6	0.0	74.6	25.4	100.0
2002	246	38.0	8.3	0.0	6.6	0.0	53.0	47.0	100.0
2003	225	31.4	3.8	0.0	13.4	0.0	48.6	51.4	100.0
2004	153	63.8	4.3	0.0	2.6	0.0	70.8	29.2	100.0
Average		52.9	4.4	0.0	2.3	0.0	59.7	40.3	100.0

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

Although we identified no *stocks of concern* from a fishery management perspective, the Joint Northern Boundary Technical Committee (2002) described land-use practices in the region that have likely reduced habitat capability for coho salmon. Most habitat loss is a long-term ongoing process resulting from historical forestry practices that have resulted in loss and reduced recruitment of woody debris in stream channels. Problems have also been identified with improperly installed culverts that block fish passage under logging roads. These effects apply primarily to smaller streams in areas where timber has been harvested. Most wetland habitat that is essential to coho salmon production in larger mainland river systems is in nearly pristine condition.

Urbanization impacts are minor over most of the region, but we noted decreases in two Juneau roadside stocks that may have been related to the ongoing process of urban development. The declines appear unrelated to fishery effects on spawning escapement, but natural habitat changes and ecological shifts cannot be ruled out.

Table 3.18–Estimated harvest by gear type, escapement and total run of coho salmon returning to Hugh Smith Lake from 1982 to 2004.

		Percent of total run										
Year	Fishery sample size[a]	Alaska troll	Alaska seine	Alaska gillnet	Alaska trap	Alaska sport	B.C. troll	B.C. net	B.C. sport	Total catch	escapement	Total return
1982	91	45.6	10.3	3.3	0.0	0.0	4.3	1.3	0.0	64.8	35.2	100.0
1983	189	35.4	10.9	7.1	1.3	0.0	5.4	1.3	0.0	61.5	38.5	100.0
1984	151	31.4	12.5	11.7	0.4	0.0	8.1	0.7	0.0	64.9	35.1	100.0
1985	212	36.0	11.9	5.7	0.2	0.0	8.3	0.5	0.0	62.6	37.4	100.0
1986	257	35.4	11.5	7.0	0.0	0.3	5.2	0.6	0.0	60.1	39.9	100.0
1987	100	28.0	4.1	10.6	0.0	1.0	6.5	2.1	0.0	52.3	47.7	100.0
1988	42	26.7	15.0	8.0	0.0	0.0	15.3	1.5	0.0	66.5	33.5	100.0
1989	91	50.0	15.5	9.8	0.0	1.7	4.3	0.8	0.0	82.1	17.9	100.0
1990	263	39.4	11.7	11.0	0.5	0.0	17.3	1.2	0.0	81.1	18.9	100.0
1991	408	36.7	3.4	15.4	0.0	0.9	11.0	0.8	0.0	68.1	31.9	100.0
1992	497	37.9	13.8	12.3	0.0	0.9	5.8	0.2	0.0	70.8	29.2	100.0
1993	162	52.9	6.1	15.9	0.0	0.0	4.6	1.0	0.0	80.6	19.4	100.0
1994	846	45.9	11.9	15.1	0.0	0.6	7.2	0.6	0.1	81.4	18.6	100.0
1995	433	30.1	13.4	24.4	0.0	1.5	3.6	0.4	0.2	73.6	26.4	100.0
1996	496	40.4	16.3	12.2	0.0	2.7	3.2	0.9	0.0	75.7	24.3	100.0
1997	481	48.5	4.6	15.0	0.0	1.0	3.4	0.0	0.0	72.4	27.6	100.0
1998	666	41.0	10.9	22.7	0.0	2.6	0.0	0.0	0.0	77.2	22.8	100.0
1999	493	42.1	7.0	17.4	0.0	3.7	0.0	0.0	0.0	70.2	29.8	100.0
2000	161	36.3	3.3	8.6	0.0	7.2	0.0	0.0	0.0	55.5	44.5	100.0
2001	314	22.3	14.6	10.4	0.0	1.9	0.2	0.0	0.0	49.4	50.6	100.0
2002	433	16.6	8.4	10.3	0.0	1.7	1.2	0.0	0.7	38.9	61.1	100.0
2003	336	24.4	9.6	18.8	0.0	2.9	2.5	0.7	0.0	58.9	41.1	100.0
2004	244	40.9	7.9	9.3	0.0	2.4	1.9	0.8	2.9	66.2	33.8	100.0
Average		36.7	10.2	12.3	0.1	1.4	5.2	0.7	0.2	66.7	33.3	100.0

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

The Auke Creek stock has undergone a gradual but relatively steady decline in smolt production of about 1.5% of the year-zero reference point per year over the 26-year history of the indicator stock, for a total decline of 38%. The reason for the decline is unclear but does not appear related to a limitation in the number of spawners, as spawning escapement has not shown a corresponding trend. Shaul et al. (2004) reviewed hypotheses about habitat and species changes in the heavily developed system and their potential effect on smolt production.

Jordan Creek, located in a heavily developed section of the Mendenhall Valley, experienced a sharp drop in escapement beginning in 1995, with escapements falling under the goal existing at that time for five consecutive years. The decline was disproportionate with changes in escapement in other Juneau roadside streams. However, the goal was achieved in the following three years and a record count of 1,396 spawners occurred in 2002. This was followed two years later by a peak count of only 38 spawners in 2004. Shaul et al. (2004) concluded that the recent history of highly variable escapements in Jordan Creek, combined with widely disparate smolt counts in 2001 and 2002, suggested that survival and smolt production from the system had been particularly sensitive to environmental conditions.

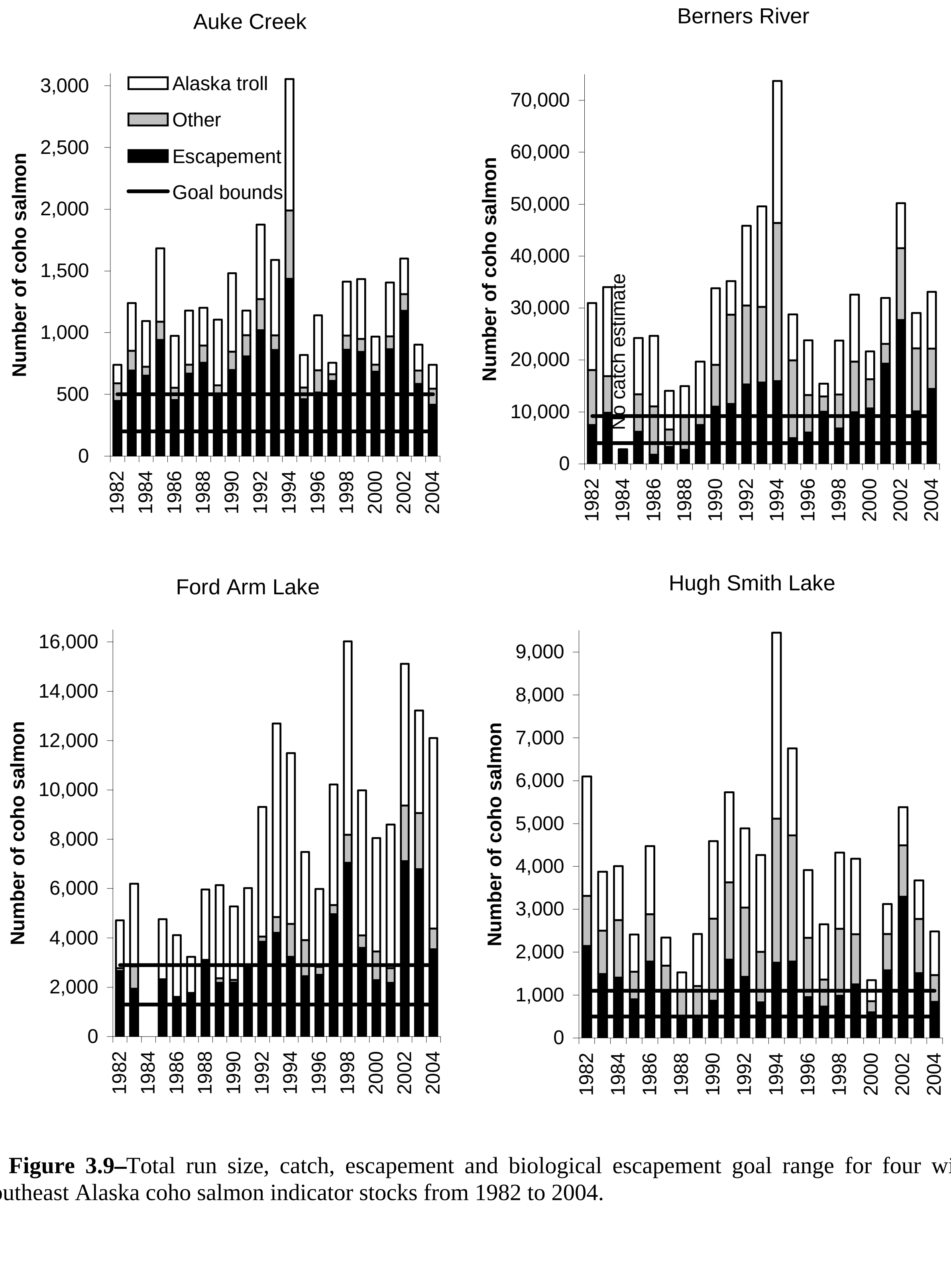


Figure 3.9–Total run size, catch, escapement and biological escapement goal range for four wild Southeast Alaska coho salmon indicator stocks from 1982 to 2004.

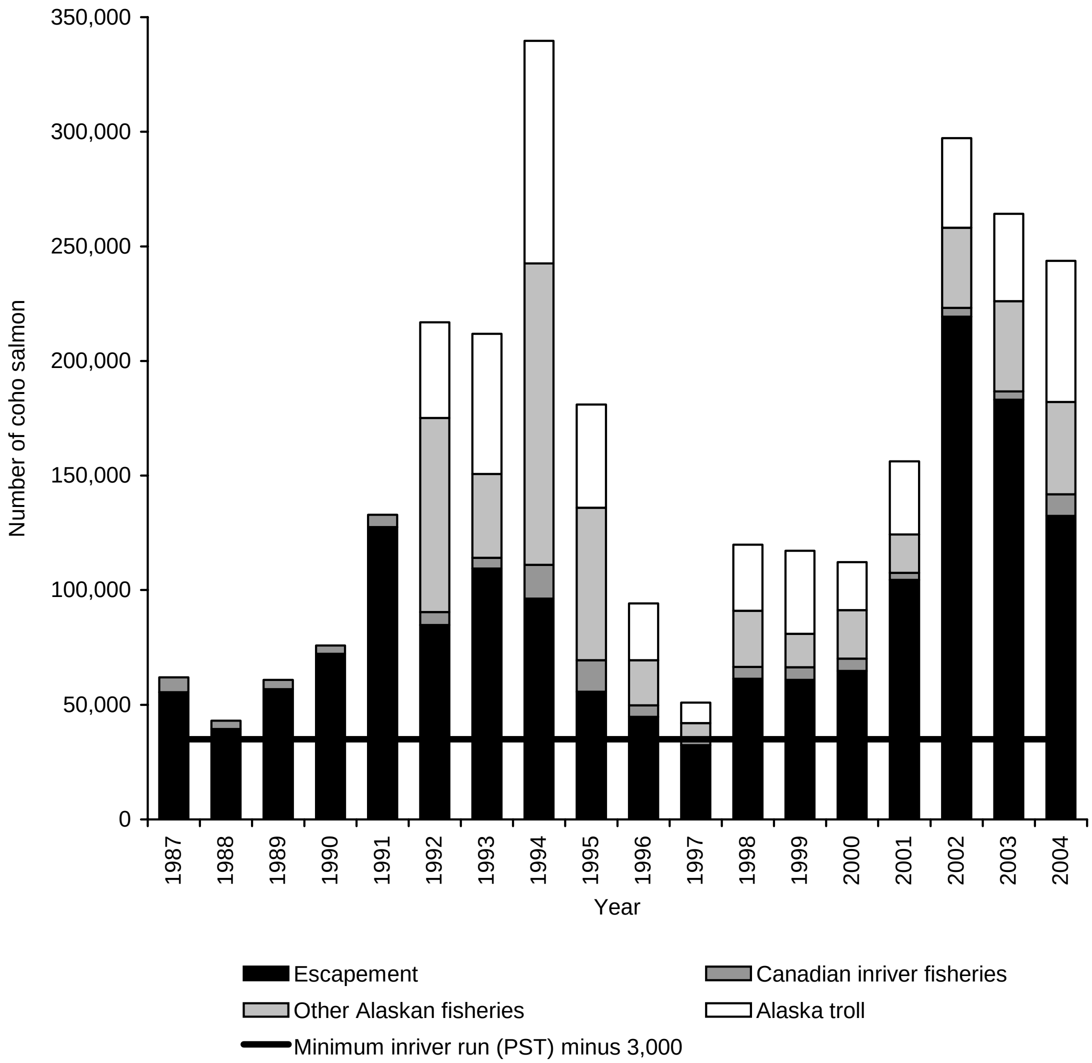


Figure 3.10–Total estimated run size, catch, and escapement of coho salmon bound for the Taku River above Canyon Island from 1987 to 2004. There are no catch estimates for 1987 to 1991.

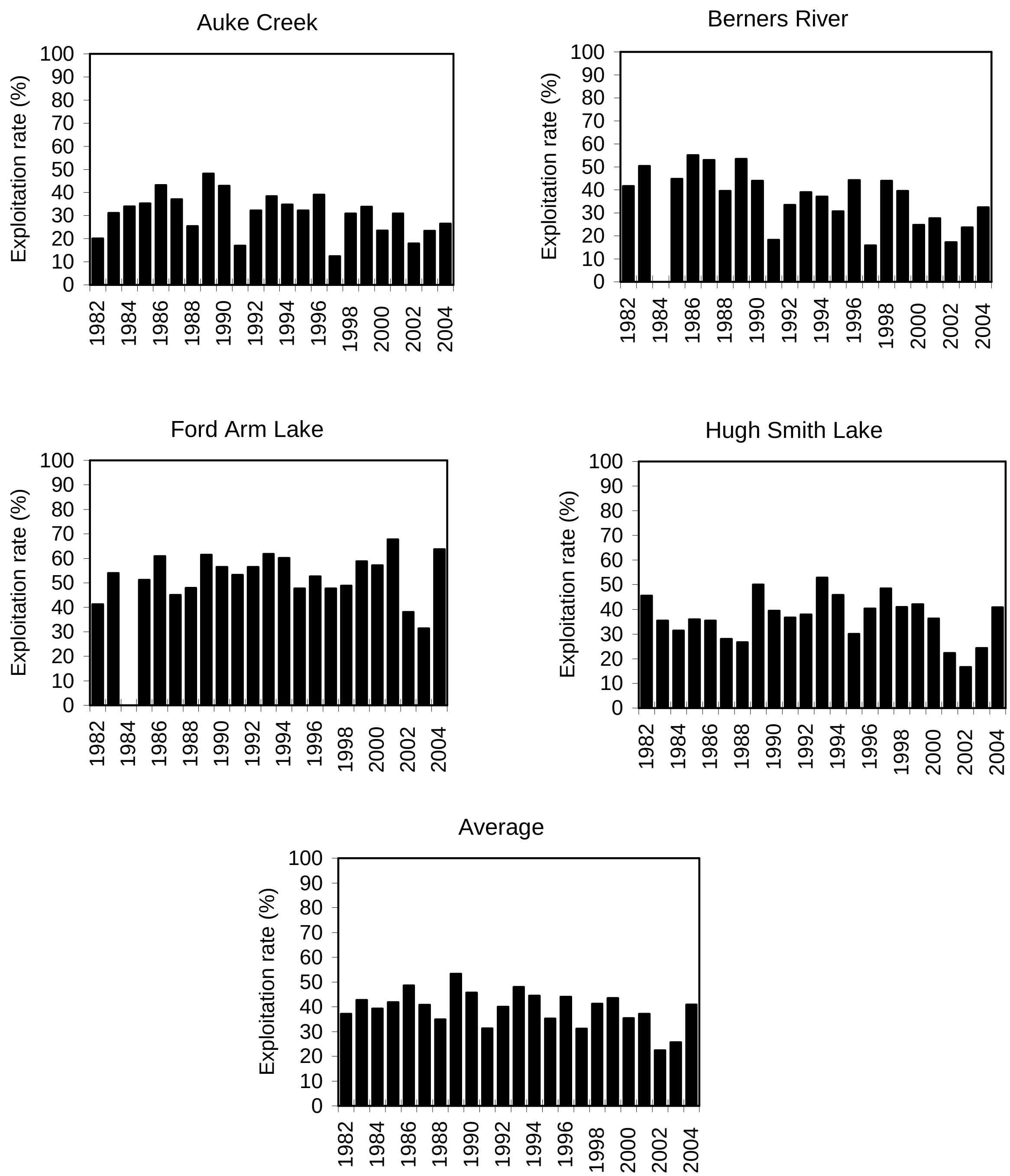


Figure 3.11–Estimated exploitation rates by the Alaskan troll fishery for four coded wire tagged Southeast Alaska coho stocks from 1982 to 2004.

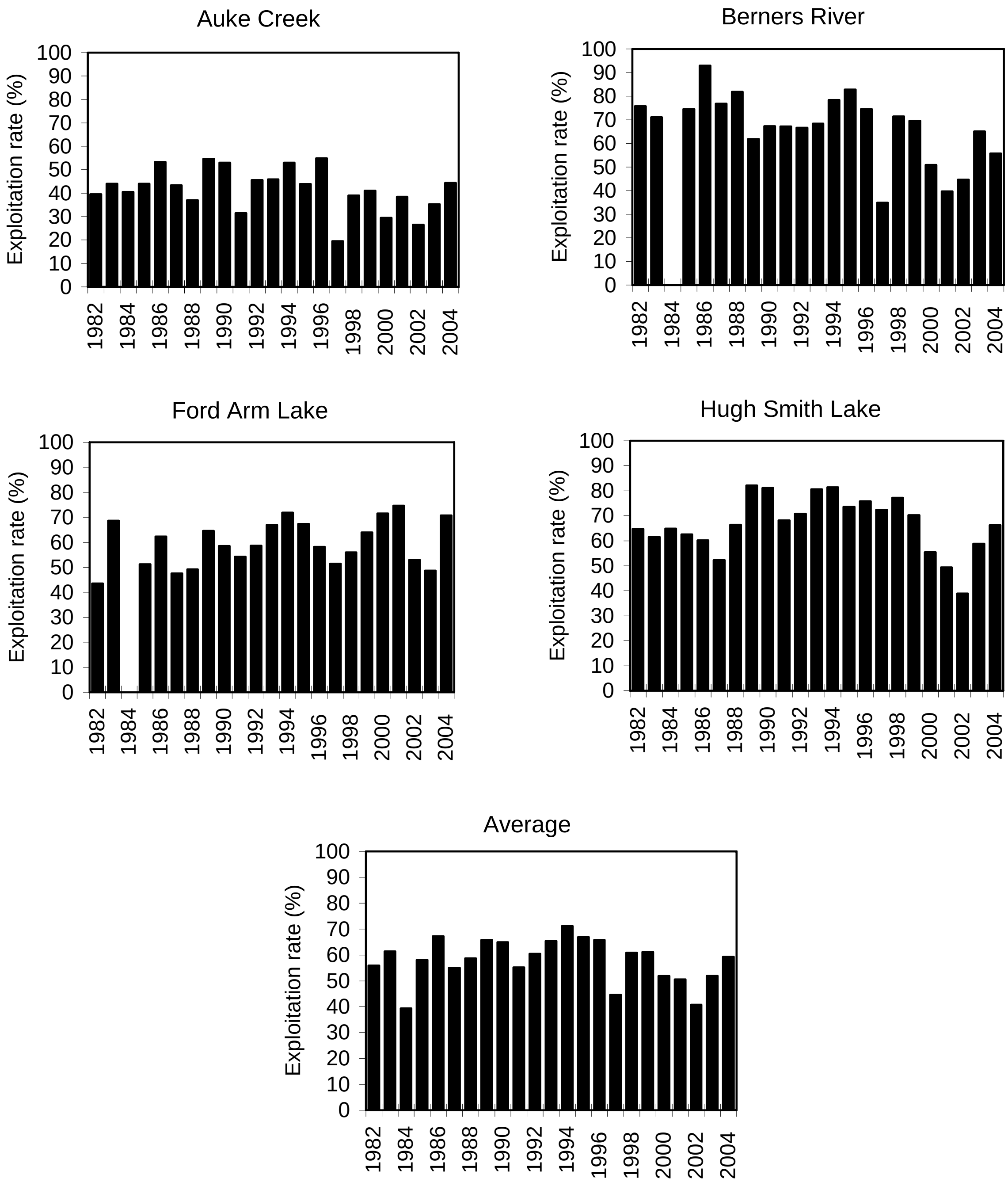


Figure 3.12–Estimated total exploitation rates by all fisheries for four coded wire tagged Southeast Alaska coho stocks from 1982 to 2004.

Table 3.19–Estimated percent of harvest by gear type, escapement, and total run of coho salmon returning to the Taku River above Canyon Island from 1992 to 2004.

		Percent of total run							
Year	Fishery sample size[a]	Troll	Seine	Gillnet	Marine sport	Canadian inriver	Total catch	Escapement	Return
1992	129	19.2	2.3	35.2	1.5	2.6	60.9	39.1	100.0
1993	121	28.9	1.3	14.8	1.2	2.2	48.3	51.7	100.0
1994	178	28.6	7.8	25.4	5.6	4.3	71.6	28.4	100.0
1995	201	24.9	1.0	31.4	4.3	7.6	69.2	30.8	100.0
1996	136	26.3	0.2	18.1	2.6	5.4	52.6	47.4	100.0
1997	66	26.3	0.2	18.1	2.6	5.4	52.6	47.4	100.0
1998	231	24.1	0.6	16.2	3.7	4.2	48.8	51.2	100.0
1999	252	30.9	2.5	6.4	3.6	4.8	48.1	51.9	100.0
2000	221	18.8	1.4	8.8	8.5	4.9	42.4	57.6	100.0
2001	344	20.5	1.3	7.3	2.1	2.0	33.2	66.8	100.0
2002	397	13.1	1.2	8.2	2.4	1.3	26.2	73.8	100.0
2003	195	14.4	1.4	11.0	2.5	1.4	30.8	69.3	100.0
2004	223	25.2	2.2	11.9	2.5	3.9	45.7	54.3	100.0
1992-2004 Average		23.2	1.8	16.4	3.3	3.8	48.5	51.5	100.0

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

Stocks that experienced a substantial increase in estimated freshwater production over the previous decade or more include Ford Arm Lake and the Taku River. Both are relatively pristine watersheds. Shaul et al. (2004) speculated that recent increases in nutrient loading from salmon carcasses likely contributed to increased pre-smolt production at Ford Arm Lake. However, we know of no evidence for a particular factor that likely resulted in increased smolt production from the Taku River.

Overall, we believe variation in smolt production and adult runs have been influenced primarily by environmental conditions rather than variations in escapement. Recent spawning escapements have been abundant by historical comparison in most streams, and escapement goals have usually been met or exceeded, suggesting that available rearing habitat has been fully seeded in most cases. Average marine survival rates for four long-term indicator stocks during 1995–2004 ranged from 10–22% with a mean-average of 15%. These averages are higher than average survival rates in the 1980s and the trend in the commercial harvest of wild coho salmon suggests that recent survival rates have averaged well above those that prevailed during the mid-1950s to early 1980s.

Exploitation rates increased substantially in 2004 following a period of low exploitation rates during 2000–2003 that were likely constrained by low fishing effort in response to low salmon prices. In particular, troll fishery exploitation rates increased in 2004 to a level for most stocks that was equal to or higher than average rates prior to 2000. Drift gillnet exploitation rates remained reduced from pre-2000 averages, in most cases, but marine sport exploitation rates have trended upward in response to increased participation by charter vessels and have reached as high as 5–13% for some stocks during 2000–2004.

Table 3.20–Estimated percent of harvest by gear type, escapement and total run of coho salmon returning to the Chilkat River, Nakwasina River and Chuck Creek, 1982-2004.

		Percent of total run							
Year	Fishery sample size[a]	Troll	Seine	Gillnet	Sport	Subsistence	Total catch	Escapement	Total return
Chilkat River									
2000	265	17.6	0.7	12.6	1.4	0.2	32.4	67.6	100.0
2001	251	20.1	0.4	9.0	1.9	0.1	31.6	68.4	100.0
2002	352	19.7	0.3	13.6	2.0	0.2	35.7	64.3	100.0
2003	426	23.5	0.6	11.9	2.9	0.2	39.1	60.9	100.0
2004	258	43.1	0.5	17.6	5.5	0.2	66.9	33.1	100.0
Average		24.8	0.5	12.9	2.7	0.2	41.1	58.9	100.0
Nakwasina River									
2000	34	33.8	2.2	0.0	1.9	0.0	37.9	62.1	100.0
2001	93	26.6	0.9	0.0	5.0	0.0	32.5	67.5	100.0
2002	48	15.4	0.0	0.0	3.4	0.0	18.9	81.1	100.0
2003	33	18.3	0.0	0.0	4.3	0.0	22.6	77.4	100.0
2004	97	25.1	1.1	0.0	3.6	0.0	29.8	70.2	100.0
Average		23.8	0.8	0.0	3.6	0.0	28.3	71.7	100.0
Chuck Creek									
1982	28	47.9	15.2	0.0	0.0	0.0	63.1	36.9	100.0
1983	11	22.9	25.7	0.0	0.0	0.0	48.6	51.4	100.0
1985	29	49.7	25.4	0.0	0.0	0.0	75.1	24.9	100.0
2003	192	36.2	16.9	0.0	5.6	0.0	58.7	41.3	100.0
2004	203	45.7	11.3	0.0	4.8	0.0	61.8	38.2	100.0
Average		40.5	18.9	0.0	2.1	0.0	61.5	38.5	100.0

[a] Fishery sample size pertains to the total observed number (not expanded) of coded wire tags recovered each year.

Accurate inseason assessment of abundance will continue to be the most important informational aspect of fishery management. However, fishery managers will need to continue to account for fluctuating fishing effort and harvesting efficiency in order to more closely achieve target escapement ranges, including *biological escapement goals* for the Chilkat River and streams near Ketchikan and Sitka.

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CHAPTER 4: PINK SALMON STOCK STATUS AND ESCAPEMENT GOALS IN SOUTHEAST ALASKA AND YAKUTAT

by

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PROJECT SPONSORSHIP

This work was partially financed by grants from the Anadromous Fish Conservation Act Program, administered by the National Oceanic and Atmospheric Administration, and from the Southeast Sustainable Salmon Fund.

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ABSTRACT

Pink salmon stocks in Southeast Alaska are at their highest abundance level since record keeping began in the late 1800s. Annual pink salmon harvests have been stable or increasing in both southern and northern Southeast Alaska since the mid-1980s, and the total pink salmon harvest in Southeast Alaska has averaged 49 million a year from 1995 to 2004. Escapement measures for pink salmon are at their highest level over the entire history of the series from 1960 to the present. *Biological escapement goals* for pink salmon were established for two Yakutat area streams in 1995, and three sub-regions in Southeast Alaska in 2003. In 2005, as part of a triennial review of the region's escapement goals, Alaska Department of Fish and Game staff recommended one change to existing escapement goals: the elimination of the escapement goal for one Yakutat area stream, Humpy Creek. There was very little fishing effort on this stock in the early 1990s, despite fisheries openings, and there has been no directed fishery since 1996. Because of the non-participation in the fishery, systematic surveys to estimate spawning escapement into Humpy Creek have not been conducted since the mid-1990s. Pink salmon escapements have annually met or exceeded escapement goals in the three Southeast Alaska sub-regions in all cases since 1993, and in 9 of the last 10 years in the Situk River. Of the 45 Southeast Alaska stock groups monitored by the Alaska Department of Fish and Game, only seven stocks measured small declining trends in pink salmon escapement survey measures over the last 21 years, none of which we consider biologically meaningful. At this time, there are no stocks of pink salmon in Southeast Alaska or the Yakutat area that can be considered *stocks of concern*, under the definition of the Board of Fisheries' Sustainable Salmon Fisheries Policy.

Key words: Pink salmon, *Oncorhynchus gorbuscha*, escapement, escapement goals, escapement index, stock status, Situk River, Humpy Creek, Yakutat, Southeast Alaska.

INTRODUCTION

Wild pink salmon (*Oncorhynchus gorbuscha)*, spawn in approximately 2,500 short, coastal streams in Southeast Alaska and support a large and valuable commercial fishing industry. Pink salmon comprised an average 72% of all the salmon harvested, by numbers of fish, in Southeast Alaska over the most recent 10-year period, 1995–2004. An average of 49 million fish per year were in the commercial fishery in Southeast Alaska over this same period, including an all-time high catch of 78 million fish in 1999. The exvessel value of the commercial pink salmon harvest averaged $21 million a year, and ranged between $8 and $32 million, making the pink salmon the most valuable species after the chum salmon (*O. keta*) in this part of Alaska. The majority of pink salmon harvested in Southeast Alaska commercial fisheries have been taken by purse seine gear (96%), while smaller portions were harvested in drift gillnet (3%), troll, and set gillnet (Yakutat area only) fisheries. Small numbers of pink salmon have been harvested in sport, personal use, and subsistence fisheries. Nearly all of the pink salmon harvested in Southeast Alaska are of wild origin. Hatchery-produced pink salmon have contributed an average of only 4% of the total annual harvest since the late 1970s.

Pink salmon stocks in Southeast Alaska are managed through extensive inseason monitoring of harvests, fishing effort, and developing escapements (Van Alen 2000; Zadina et al. 2004). *Biological escapement goals*[2] were established in 2003 for three large sub-regions of Southeast Alaska, and in 1995 for two of the larger producers of pink salmon in the Yakutat area (Clark 1995; Zadina et al. 2004). The escapement goals for Southeast Alaska were further divided into management targets for management districts and stock groups as an aid to management. Pink salmon escapement is assessed by means of aerial observations of the peak abundance in a series of over 700 streams in the region. These peak abundance counts are used to generate an

[2] Escapement goals that have a scientifically defendable basis, with the intent of producing maximum sustainable yield.

escapement measure from these key streams—but this measure should not be confused with an estimate of total escapement magnitude.

Below, we provide a brief review of stock assessment measures for pink salmon in Southeast Alaska and Yakutat area, assess the recent pink salmon escapement performance in relation to the index-based escapement goals, and examine recent trends in harvest and escapement.

DEFINITION OF PINK SALMON STOCKS

The vast majority of the pink salmon harvest in the region takes place in mixed-stock or passing-stock fisheries in the waters surrounding the Alexander Archipelago, from Dixon Entrance, north to Cross Sound, Icy Strait and Lynn Canal—what we refer to throughout the rest of this report as Southeast Alaska, as distinct from the Yakutat area. 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 1995). Management and assessment of Yakutat area pink salmon stocks has occurred consistently only for Humpy Creek and the Situk River, two of the larger pink salmon streams in the area (Clark 1995; Zadina et al. 2004).

Southeast Alaska pink salmon harvest statistics and escapement indices have commonly been divided into three sub-regions and other fisheries management divisions (management areas, districts, and stock groups). Because Southeast Alaska pink salmon are harvested primarily in mixed-stock fisheries, often some distance from spawning areas, it is not possible to allocate harvests of pink salmon to stock group of origin at any finer scale than sub-region. Therefore, the current *biological escapement goals* for Southeast Alaska pink salmon were established at the sub-region level (Zadina et al. 2004). These sub-regional goals were further divided into *management targets* for the 12 management districts and 45 stock groups where pink salmon are monitored, as an aid to assessing the spatial distribution of the pink salmon escapement across Southeast Alaska (Zadina et al. 2004). These management targets are not escapement goals under the definition of the Statewide Salmon Escapement Goal Policy (5 AAC 39.223).

MANAGEMENT AREAS

There are four management areas in Southeast Alaska (Juneau, Ketchikan, Petersburg, and Sitka), that are further divided into 15 districts (Districts 101–115, Appendix 4.A.1). Alaska Department of Fish and Game (ADF&G) fisheries managers are responsible for managing the fisheries and monitoring escapements of pink salmon in each of their respective management areas, and the districts or portions of the districts within their areas.

SUB-REGIONS

Marine tagging studies have repeatedly demonstrated that Southeast Alaska pink salmon stocks are strongly segregated into southern and northern areas or sub-regions (e.g., Rich 1927; Rich and Suomela 1929; Rich and Morton 1930; Nakatani et al. 1975; Hoffman 1983), and the commercial fisheries in each sub-region generally target pink salmon stocks that ultimately spawn in that sub-region. The Southern Southeast sub-region comprises pink salmon stocks from Sumner Strait and south (Districts 101–108), while the Northern Southeast sub-region comprises pink salmon stocks north of Sumner Strait (Districts 109–115). In 1998, the northern area was further divided into Northern Southeast Inside and Northern Southeast Outside sub-regions, as marine tagging studies also showed that pink salmon spawning on the outer coast of Chichagof and Baranof islands do not enter inside waters (Nakatani et al. 1975; Alexandersdottir 1987). The Northern Southeast Outside sub-region includes all waters of District 113 (excluding Peril Straits and Hoonah Sound subdistricts 113–51 through 59, which are considered part of the Northern Southeast Inside sub-region).

STOCK GROUPS

Southeast Alaska has also been divided into 52 smaller *stock groups* contained within the district boundaries (Zadina et al. 2004; Appendices 4.A.2–4.A.5). Each stock group represents a collection of streams that support pink salmon runs with similar migration routes and run timing, are managed as a unit, and are assumed to share similar productivity and exploitation rates (Van Alen 2000). Seven of the pink salmon stock groups have not been consistently monitored for pink salmon spawning escapements—the Annette Island stock group is managed exclusively by the Metlakatla Indian Community, and the state has no jurisdiction in that area, while six other stock groups are located in areas that do not have directed fisheries or are in remote areas where it would be cost prohibitive to conduct surveys on a regular basis: Suemez-Dall (Ketchikan area, Appendix 4.A.5), SW Baranof, W Kruz, and W Yakobi (Sitka area, Appendix 4.A.4), and Dundas Bay and Glacier Bay (Juneau area, Appendix 4.A.2). The remaining 45 stock groups, representing 12 districts, are actively managed and monitored for escapements.

STOCK STATUS

ESCAPEMENT MONITORING

Yakutat Area

Clark (1995a) reviewed available escapement data for Yakutat area streams from 1960 to 1994. Although spawning escapements had been surveyed for 20 streams, consistent survey data were limited to two of the more substantial producers in the area: the Situk River (ADF&G Stream Number 182-70-010) and Humpy Creek (ADF&G Stream Number 183-40-010). Each has supported a terminal set gillnet fishery, though the Situk fishery targets other species (Clark 1995) and the Humpy Creek fishery has not been active in recent years (Woods 2003). Escapements in the Situk River have been assessed with aerial and boat surveys and with a weir, although there is some spawning that occurs downstream from the weir.

Weir counts were available for the Situk River for 12 years between 1971 and 1989, and for every year since 1995. Escapements into Humpy Creek have been assessed by foot, boat, and aerial surveys, although these assessments have been limited since the early 1990s. Clark (1995*a*) compared weir counts in the Situk River to peak aerial and boat counts, and assumed a 3-fold conversion factor to scale peak survey counts to the total escapement; this 3-fold conversion factor was then used to extrapolate total escapement estimates for Humpy Creek (Appendix 4.B.1).

Southeast Alaska

The methods used to monitor pink salmon escapements and calculate annual indices of spawning abundance in Southeast Alaska were described by Hofmeister (1998), Van Alen (2000), and Zadina et al. (2004). With the current method, area management biologists annually estimate the peak pink salmon abundance in 718 pink salmon index streams (selected from over 2,500 known pink salmon spawning streams in the region). This assessment is made via aerial surveys, conducted at intervals during most of the migration period. Most pink salmon stocks in Southeast

Alaska do not show persistent trends of odd- or even-year dominance, and for simplicity, escapement indices of both brood lines were combined (Van Alen 2000; Zadina et al. 2004).

Individual observers track absolute abundance within the streams, but each observer tends to count at his or her own rate, or "bias" (Dangel and Jones 1988; Jones et al. 1998; Bue et al. 1998). In 1995, raw stream survey counts were modified in an attempt to standardize as much observer bias as possible—not by removing bias, but rather by adjusting all observer counts within each of the four ADF&G management areas to the same bias level (Hofmeister 1998; Van Alen 2000). Only stream surveys conducted by key personnel, termed *major observers* were used in the index; a major observer being defined as an individual who had flown more than 100 surveys per year in more than four years. Each major observer's counts in a given management area were converted to the counting rate of the area management biologist, whose conversion rate was set at 1.0. These observations were statistically adjusted so the estimates of the number of fish were comparable among observers within the same management area (Hofmeister 1998). The largest count for the year was then retained for each stream in the survey and termed the *peak-adjusted count* for each stream. The index for each stock group was made up of the peak-adjusted counts, summed over this standard set of index streams, for a particular area.

If a particular index stream was missing escapement counts for any given year, an iterative EM algorithm (McLachlan and Krishnan 1997) was used to interpolate the missing value. Interpolations were based on the assumption that the expected count for a given year was equal to the sum of all counts for a given stream, divided by the sum of all counts over all years for all the streams in the unit of interest (i.e., row total times column total divided by grand total)—in this case, the unit of interest is the stock group, and interpolations for missing values were made at the stock group level. This method is based on an assumed multiplicative relation between yearly count and unit count, with no interaction.

This method of assessing the escapement does not actually provide an estimate of the total escapement of pink salmon in Southeast Alaska. In the past, ADF&G has multiplied the escapement indices by 2.5 to approximate the total escapement. For example, we found the statement, "an expansion factor of 2.5 was applied to the escapement index to convert the index to an estimate of total escapement," (Hofmeister and Blick 1991), and similar statements, several places in published material. The 2.5 multiplier was originally intended to convert peak escapement counts to an estimate of what was actually present at the time of the survey (Dangel and Jones 1988; Jones et al. 1998; Hofmeister 1990). Another important factor to consider in relating total run size to index series of escapement is the relationship between the total fish that spawn and die and the number of fish that are present in the creek at the time of the "peak observation" (Bue et al. 1998). This factor has not been well studied for systems in Southeast Alaska (Zadina et al. 2004). The 718 streams in the current index represent only about 1/3 of the region's 2,500 pink salmon streams. Thus, the 2.5 multiplier does not take into account fish that were not present at the time of the survey and streams that were not surveyed. Finally, the majority of aerial surveys, particularly prior to about 1970, were conducted to monitor inseason development of salmon escapements for management purposes, not to estimate total escapements (Jones and Dangel 1981; Van Alen 2000). There is no simple way to convert the current index series to an estimate of total escapement in Southeast Alaska. Moreover, escapement indices are clearly much less than total escapements (Hofmeister 1990; Van Alen 2000; Zadina et al. 2004).

ESCAPEMENT GOALS

Yakutat Area

Clark (1995*a*) used Ricker-type stock-recruit analyses to identify escapement levels that he expected to produce maximum sustainable yield for the Situk River and Humpy Creek. He used a model-based approach to apportion the harvest in the Yakutat Bay set gillnet fisheries to stock of origin, using relative abundance of inshore returns of the two stocks. Clark organized his analysis by even- and odd-year brood lines, and recommended pink salmon escapement goal ranges for the Situk River of 42,000 to 105,000 in even years, and 54,000 to 200,000 in odd years, based on total weir counts, and escapement goal ranges for Humpy Creek of 3,300 to 8,000 in even years, and 7,000 to 18,000 in odd years, based on peak aerial or foot surveys.

Escapements to the Situk River have been above the escapement goal ranges, for both odd- and even-year brood lines combined, in 22 of the past 44 years, and below the lower bound of the biological escapement goal ranges in only 8 of the past 44 years (Figure 4.1; Appendix 4.B.1).

Fishing effort directed at Humpy Creek pink salmon has been sporadic. Despite scheduled commercial set gillnet fishery openings from 1991 to 1996, there was little actual fishing effort and few fish of any species harvested. There has not been a directed fishery on Humpy Creek pink salmon since 1996 (Woods 2003), and because of the low effort, and low numbers of fish in the creek, systematic surveys to estimate spawning escapement into Humpy Creek have also not been conducted since the mid-1990s (Gordon F. Woods, ADF&G, Yakutat, personal communication). Therefore, we recommend that the *biological escapement goals* for Humpy Creek pink salmon be eliminated.

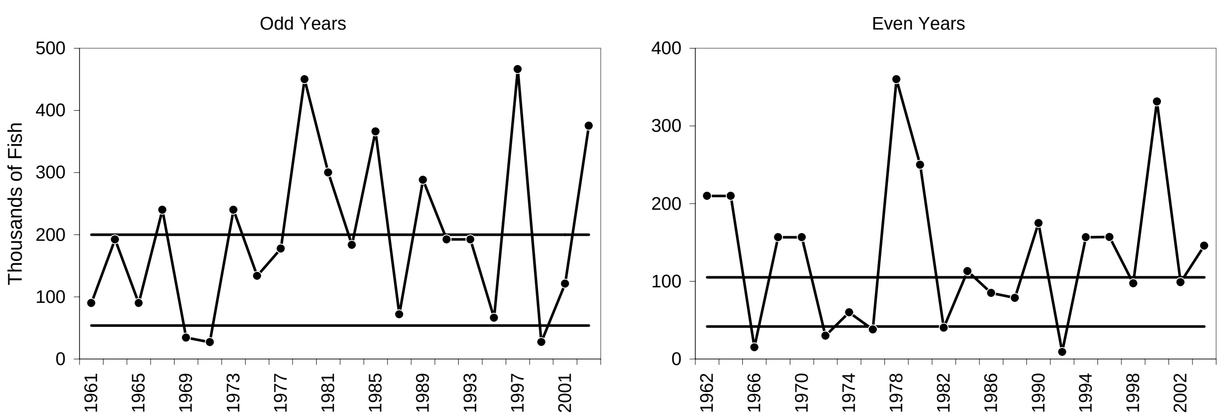

Figure 4.1–Annual odd- and even-year pink salmon escapements to the Situk River, Yakutat area, 1961–2004. The horizontal solid lines show the current biological escapement goal ranges of 54 thousand–200 thousand in odd years, and 42 thousand–105 thousand in even years.

Southeast Alaska

The first pink salmon index escapement goals for Southeast Alaska were set at 5 million for southern Southeast and 3 million for northern Southeast (Valentine et al. 1970). The goals were not the result of a formal statistical analysis; they were instead based on the observation that in southern Southeast, escapement indices of less than 4 million had produced fair to poor returns, escapements in excess of 4 million generally produced good returns, and a southern Southeast escapement index that exceeded 5 million (1966) resulted in the largest return in many years.

The pattern of returns in northern Southeast was more variable than in southern Southeast and the index goal was set at 3 million. Escapement goals were adjusted upward in later years based on analyses of the catch and index of escapement (Durley and Seibel 1972; Jones and Hofmeister 1981). From 1991 to 2002, the index goals were set at 4.8 million for northern Southeast, and a range of 6–9 million for southern Southeast (Hofmeister and Blick 1991).

The current *biological escapement goals* for Southeast Alaska pink salmon were adopted by ADF&G in 2003 (Zadina et al. 2004). Escapement goals are often formed by means of the Ricker analysis (Hilborn and Walters 1992; Quinn and Deriso 1999); however, because the pink salmon index escapement measures that are available for Southeast Alaska represent an unknown fraction of the total escapement, a Ricker analysis is not possible without making some unproven and possibly ill-advised assumptions. Zadina et al. used a "tabular approach" (Hilborn and Walters 1992) to assess yield as a function of escapement level, using a range of hypothesized expansions of escapement index to total escapement. That approach provided a range of highest potential yields, on which the current *biological escapement goals* are based: 4.0 million to 9.0 million index spawners in the Southern Southeast sub-region, 2.5 million to 5.5 million in the Northern Southeast Inside sub-region, and 0.75 million to 1.75 million in the Northern Southeast Outside sub-region.

Pink salmon escapement goals have been met annually for all sub-regions in Southeast Alaska, from 1993 to 2004 (Appendix 4.B.2). The current escapement goal has been met in the Southern Southeast sub-region each year, 1989–2004, and the upper range of the goal (9.0 million index spawners) was exceeded in 6 of the past 10 years (Figure 4.2). The current escapement goal for the Northern Southeast Inside sub-region has also been met annually, 1989–2004 (Figure 4.3). The current escapement goal for Northern Southeast Outside sub-region has been met annually, 1994–2004, and the upper range of the escapement index goal (1.75 million index spawners) was exceeded in 7 of 8 years from 1997 to 2004 (Figure 4.4). Data for the 2005 season were not yet available for this report, but preliminary review of the raw survey data suggests that the escapement goals were met or exceed for all three sub-regions in 2005.

TRENDS IN ESCAPEMENT MEASURES

Pink salmon escapements in Southeast Alaska have been well distributed across the region. Since 1991, the escapement indices have generally been within or above management target ranges for most of the districts (Table 4.1; Appendix 4.B.3) and for most pink salmon stock groups in Southeast Alaska (Table 4.2; Appendices 4.B.4–4.B.7).

Salmon populations, like populations of most living things, do not remain constant through time—salmon recruitment is strongly influenced by oceanographic and other processes that cause the populations to periodically increase or decrease (Quinn and Marshall 1989; Beamish and Bouillon 1993; Adkison et al. 1996; Mantua et al. 1997, and many others). Although Southeast Alaska salmon populations have exhibited various historical trends, we are most interested in detecting recent changes, and in particular, we would like to determine if a recent decline in a specific stock is meaningful or not.

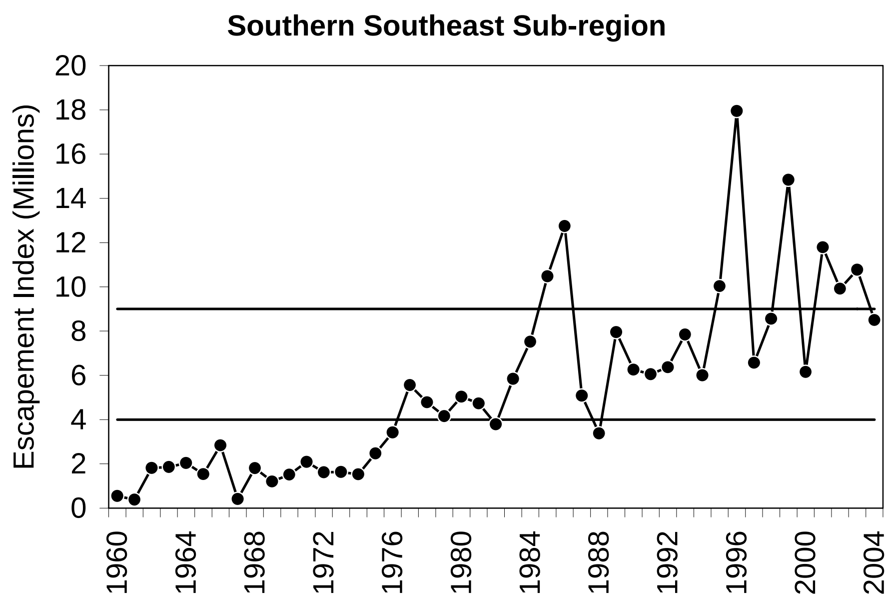

Figure 4.2–Annual pink salmon escapement index for the Southern Southeast sub-region, 1960–2004. The horizontal solid lines show the current escapement goal range of 4.0 million to 9.0 million index spawners.

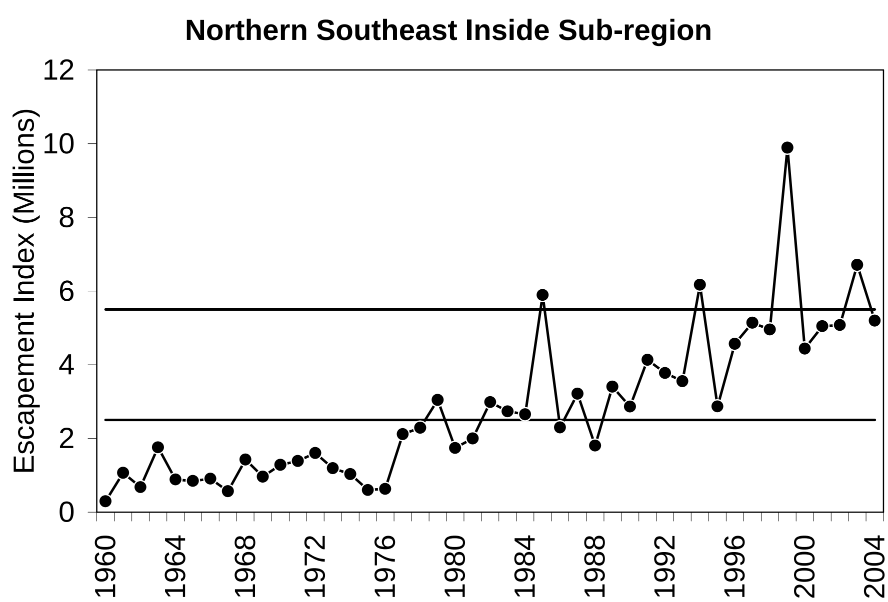

Figure 4.3–Annual pink salmon escapement index for the Northern Southeast Inside sub-region, 1960–2004. The horizontal solid lines show the current escapement goal range of 2.5 million to 5.5 million index spawners.

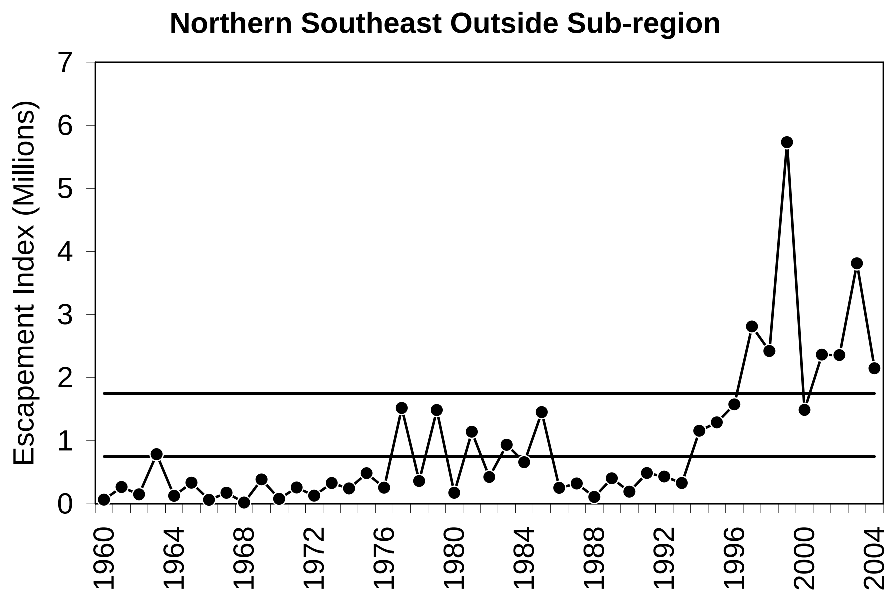

Figure 4.4–Annual pink salmon escapement index for the Northern Southeast Outside sub-region, 1960–2004. The horizontal solid lines show the current escapement goal range of 0.75 million to 1.75 million index spawners.

We used a non-parametric approach described by Geiger and Zhang (2002), to assess trends over the most recent 21 years of escapement index values. This method employs a simple regression that is robust to outliers that are common to data series of widely fluctuating salmon populations, and provides a means of relating stock decline to an underlying population level, so that the decline can be put into some kind of context. We regressed escapement on time using a resistant regression line, and we used the estimated *y*-intercept of this regression line as a back-cast estimate of what the underlying population level was at the start, or "year zero," of the series. The slope of the line was a robust estimate of the stock's decline (or increase) relative to the year-zero reference point. Geiger and Zhang (2002) suggested that a decline be considered *biologically meaningful* when the estimated underlying annual decline was more than 3% of the back-cast year-zero reference point over a 21-year series. A sustained 21-year, overall decline that is 3% of the back-cast year-zero reference point would result in the stock declining by more than 60%.

Not surprisingly, pink salmon escapement index values have shown increasing trends for all three sub-regions of Southeast Alaska over the most recent 21-year period, 1984–2004. Both odd- and even-year brood lines of Situk River pink salmon have also shown increasing trends over the past 21-years of escapements (by brood line). Of the 45 Southeast Alaska pink salmon stock groups, only seven showed declining trends since 1984, none of which we considered to be biologically meaningful. The stock groups with the largest declines in survey data were East Dall (1.4% of the year-zero reference point), Moira (1.5%), Stikine (2.3%), and Portage Bay (2.7%, Figure 4.5).

As noted by Zadina et al. (2004), several of the stock groups in the area of Icy Strait (District 114) and on the outer coast north of Kruzof Island (District 113) show much stronger runs in odd

Table 4.1–Southeast Alaska pink salmon escapement indices and target ranges by district (in millions), and years for which the escapement index for each district was above (+), below (-), or within (blank cells) the management target range, 1991–2004.

District	101	102	103	105	106	107	108	109	110	111	112	Inside 113	114	115	Outside 113
Management Target															
Lower	1.33	0.40	1.13	0.33	0.40	0.40	No	0.40	0.65	0.32	0.40	0.40	0.32	No	0.75
Upper	3.00	1.10	2.55	0.65	0.85	0.85	Target	0.85	1.45	0.73	0.85	0.90	0.73	Target	1.75
1991	1.65	0.63	1.97	0.59	0.50	0.58	0.12	1.03	1.02	0.30	1.26	0.31	0.21	0.00	0.49
1992	2.78	0.87	1.45	0.18	0.22	0.81	0.06	0.87	1.18	0.41	0.77	0.38	0.11	0.06	0.43
1993	2.12	0.90	2.92	0.61	0.62	0.66	0.01	0.88	0.61	0.15	1.03	0.52	0.34	0.03	0.33
1994	1.78	0.63	2.00	0.43	0.63	0.50	0.03	1.40	1.37	0.98	1.41	0.53	0.30	0.19	1.16
1995	3.82	0.91	3.42	0.51	0.63	0.73	0.01	0.85	0.31	0.21	0.88	0.11	0.50	0.02	1.29
1996	6.01	3.10	6.64	0.87	0.67	0.63	0.03	1.86	0.52	0.76	1.06	0.33	0.05	0.00	1.58
1997	2.32	0.81	1.77	0.62	0.51	0.53	0.01	1.04	0.70	0.71	1.71	0.30	0.65	0.03	2.81
1998	3.10	1.15	2.75	0.34	0.65	0.54	0.03	1.39	0.83	0.77	1.31	0.50	0.10	0.06	2.42
1999	2.79	1.72	3.45	2.83	3.19	0.79	0.06	2.72	1.86	0.82	2.41	0.84	1.14	0.10	5.73
2000	1.89	1.12	1.77	0.58	0.32	0.46	0.01	1.68	0.87	0.33	0.88	0.62	0.06	0.01	1.49
2001	4.35	1.15	3.26	1.04	1.00	0.88	0.12	1.07	1.03	0.49	1.05	0.44	0.80	0.17	2.36
2002	3.25	1.68	3.14	0.68	0.60	0.56	0.01	1.56	1.16	0.48	1.11	0.53	0.19	0.04	2.36
2003	3.70	1.34	2.98	0.89	0.88	0.83	0.16	1.15	1.67	0.54	1.55	1.35	0.41	0.04	3.81
2004	2.48	0.74	3.49	0.63	0.56	0.56	0.04	1.29	1.28	0.49	1.36	0.53	0.23	0.03	2.15
1991								+		-	+	-	-		-
1992				-	-			+				-	-		-
1993			+					+	-	-	+				-
1994								+		+	+		-		
1995	+		+					+	-	-	+	-			
1996	+	+	+	+				+	-	+	+	-	-		
1997								+			+	-			+
1998	+	+	+					+		+	+		-		+
1999		+	+	+	+			+	+	+	+		+		+
2000		+			-			+			+		-		
2001	+	+	+	+	+	+		+			+		+		+
2002	+	+	+	+				+			+		-		+
2003	+	+	+	+	+			+	+		+	+			+
2004			+					+			+		-		+
Years Below Range	0	0	0	1	2	0		0	3	3	0	5	8		3
Years Within Range	8	7	5	8	9	13		0	9	7	1	8	4		4
Years Above Range	6	7	9	5	3	1		14	2	4	13	1	2		7

years than in even years. The escapement indices for Homeshore and North Chichagof stock groups in Management District 114 have consistently come in under the lower bound of the management target ranges during even years (Tables 4.1 and 4.2). Geiger and Zhang trend analysis of the most recent 15 years of pink salmon escapement indices for the odd- and even-year brood lines for these stock groups have been stable, or trending upward, in much the same way as most of the other pink salmon stock groups in Southeast Alaska.

Table 4.2–Southeast Alaska pink salmon escapement target ranges by stock group (in millions), and years for which the escapement index for each stock group was above (+), below (-), or within (blank cells) the management target range, 1991–2004.

				Year														Management Target	
Stock Group	Area Office	Sub-region	District	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Lower	Upper
Portland	Ketchikan	SSE	101			+		+	+		+	+		+	+	+	+	0.17	0.37
E Behm	Ketchikan	SSE	101		+			+	+					+	+	+		0.84	1.89
W Behm	Ketchikan	SSE	101				-		+		+			+				0.33	0.74
Kasaan	Ketchikan	SSE	102						+		+	+	+	+	+	+		0.34	0.93
Moira	Ketchikan	SSE	102	-					+	-	+	+					-	0.06	0.17
E Dall	Ketchikan	SSE	103	-				+	+						+		+	0.16	0.36
Hetta	Ketchikan	SSE	103					+	+			+	+		+			0.30	0.68
Klawock	Ketchikan	SSE	103			+		+	+		+	+	-	+	+	+	+	0.52	1.17
Sea Otter Sound	Ketchikan	SSE	103	-					+	-			-	+		+	+	0.15	0.33
Affleck Canal	Petersburg	SSE	105		-				+		-	+	+	+	+		+	0.20	0.38
Shipley Bay	Petersburg	SSE	105	+	-	+				+		+		+	-	+		0.14	0.27
Burnett	Petersburg	SSE	106		-	-		-	+			+		+	+		-	0.10	0.20
Ratz Harbor	Petersburg	SSE	106		-					-		+	-			+		0.10	0.21
Totem Bay	Petersburg	SSE	106			+	-					+		+			+	0.07	0.15
Whale Pass	Petersburg	SSE	106		-		+					+	-	+	-	+		0.13	0.28
Anan	Petersburg	SSE	107		+													0.32	0.68
Union Bay	Petersburg	SSE	107		-			+	+	-		+	-	+		+		0.08	0.17
E Baranof	Sitka	NSEI	109	+	-		+		+	+	+	+		+	+	+	+	0.07	0.14
Eliza Harbor	Petersburg	NSEI	109	+	+	+	+		+	+	+	+	+				+	0.08	0.18
Saginaw Bay	Petersburg	NSEI	109	+			+		+	+	+	+	+	+	+	+	+	0.07	0.15
SE Baranof	Sitka	NSEI	109			+		+	+	+	+	+	+				-	0.05	0.11
Tebenkof	Petersburg	NSEI	109		+	+	+	+	+		+	+	+	+	+	+	+	0.13	0.27
Farragut Bay	Petersburg	NSEI	110	+				-				+					+	0.01	0.03
Houghton	Petersburg	NSEI	110			-	+	-	-	-		+				+		0.40	0.89
Portage Bay	Petersburg	NSEI	110			-	-	-	-	-	-	+	-	-	-		+	0.04	0.08
Pybus/ Gambier	Petersburg	NSEI	110			-		-				+					+	0.20	0.45
Seymour Canal	Juneau	NSEI	111	-	-	-		-		+		+						0.18	0.41
Stephens	Juneau	NSEI	111			-	+	-	+		+	+	-					0.14	0.32

-continued-

Table 4.2–page 2 of 2

				Year														Management Target	
Stock Group	Area Office	Sub-region	District	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Lower	Upper
Freshwater Bay	Juneau	NSEI	112			+	+	+	+	+	+	+		+	+	+	+	0.06	0.13
Kelp Bay	Sitka	NSEI	112	+		+	+	-	+	+	+	+	+	+	+	+	+	0.03	0.06
Lynn Canal	Juneau	NSEI	112		+		+	+	-	+		+		+	+	+	+	0.02	0.04
SW Admiralty	Juneau	NSEI	112	+		+	+		+		+	+	+	+	+	+	+	0.08	0.17
Tenakee	Juneau	NSEI	112	+	+	+	+	+	+	+	+	+	+	-	+		+	0.18	0.37
W Admiralty	Juneau	NSEI	112				+	+		+	-	+	-	+	-	+	+	0.04	0.08
Hoonah Sound	Sitka	NSEI	113	-	-			-	-	-						+		0.40	0.90
Lisianski	Sitka	NSEO	113	-	-		-		-	+	-	+	-	+		+		0.07	0.17
Portlock	Sitka	NSEO	113	-	-	-		+		+		+	+	+	+	+	+	0.03	0.08
Salisbury Sound	Sitka	NSEO	113	-	-		-	+				+			+	+	+	0.16	0.36
Sitka Sound	Sitka	NSEO	113	-	-	-			+	+	+	+	+	+	+	+	+	0.21	0.50
Slocum Arm	Sitka	NSEO	113		-	-				+		+		+		+		0.21	0.48
W Crawfish	Sitka	NSEO	113	-		-	+		+	-	+	+			+	+	+	0.01	0.03
Whale Bay	Sitka	NSEO	113	-	+	-	+		+		+	+			+	+	+	0.05	0.12
Homeshore	Juneau	NSEI	114	-	-	-			-		-	+	-	+	-			0.05	0.10
N Chichagof	Juneau	NSEI	114	-	-		-		-		-	+	-	+	-		-	0.28	0.62

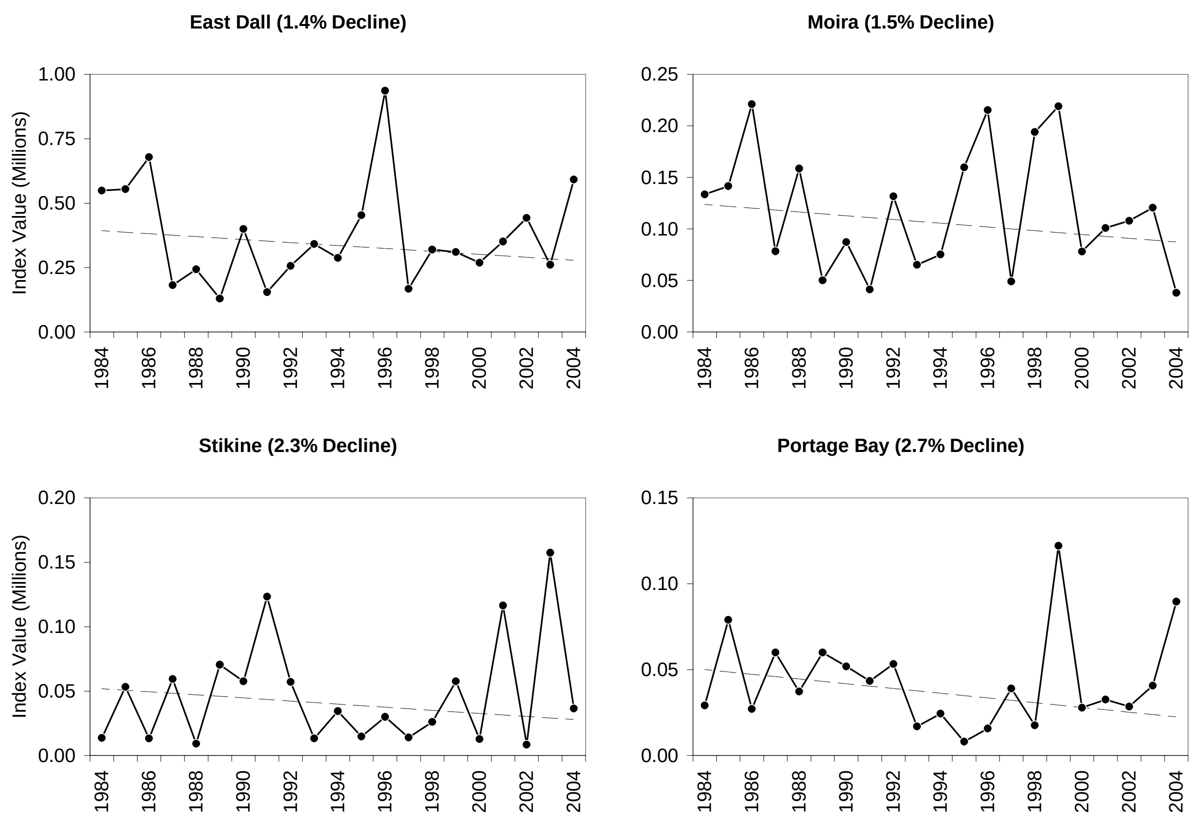

Figure 4.5–Pink salmon stock groups with the largest estimated declines in escapement index values per year over the most recent 21-years, 1984–2004. The dotted line is found by the “resistant regression,” and the slope of the line is a robust estimate of the annual decline relative to the size of the escapement at the beginning of the series.

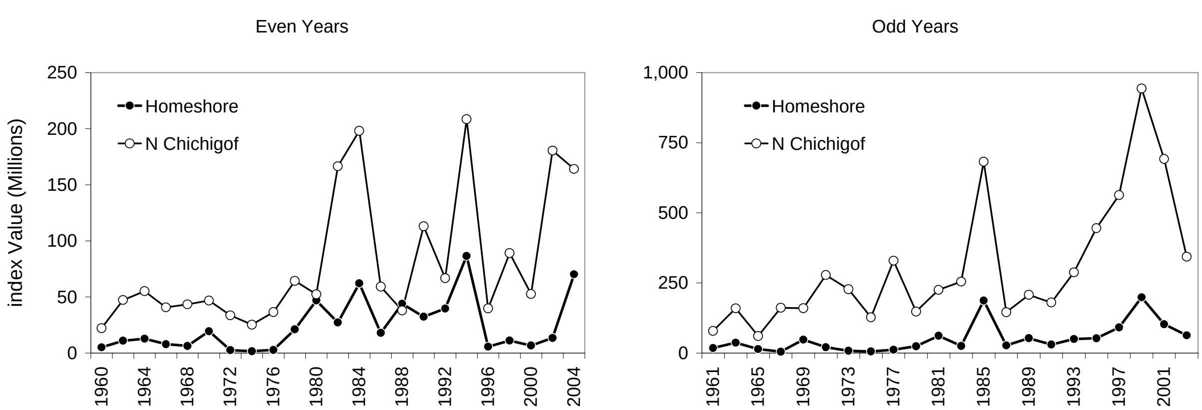

Figure 4.6–Annual odd- and even-year pink salmon escapement indices for the Homeshore and North Chichigof Island stock groups in Management District 114, Southeast Alaska, 1960–2004.

The even-year broodline for the Homeshore stock group showed a slight decreasing trend of 1.6% of the year-zero reference point, which does not meet our criteria for a biologically meaningful decline. During the last two decades ADF&G fisheries managers have limited directed fishing on even-year stocks in the Homeshore, North Chichagof, and Lisianski areas to attempt to allow even year runs to increase (Andy McGregor, ADF&G, Juneau, personal communication). Brood line dominance has been documented in throughout of the distribution of pink salmon, but underlying reasons for the pattern are not well understood (Heard 1991).

DISCUSSION

The status of pink salmon in Southeast Alaska and Yakutat continues to be biologically very favorable, particularly in Southeast Alaska, and no pink salmon stocks in either area can currently be considered *a stock of concern* under the definition of the Sustainable Salmon Policy (5 AAC 39.222). The commercial catch is currently at a sustained all-time high level in Southeast Alaska (Figure 4.7), even when considering the commercial catch history that extends back to the 19th century. The catch level has been more stable since the mid 1990s than at any time since statehood (Figure 4.8). The escapement indices, which extend back to statehood in Southeast Alaska, are at their all-time highest levels too. The salmon harvests in the three sub-regions are either increasing or at least stable (Figures 4.9–4.11). Many harvests during the past 10 years could have been higher—as indicated by the high escapements (Figures 4.2–4.4). However, processor capacity—not stock abundance—has now become the limit on high harvests.

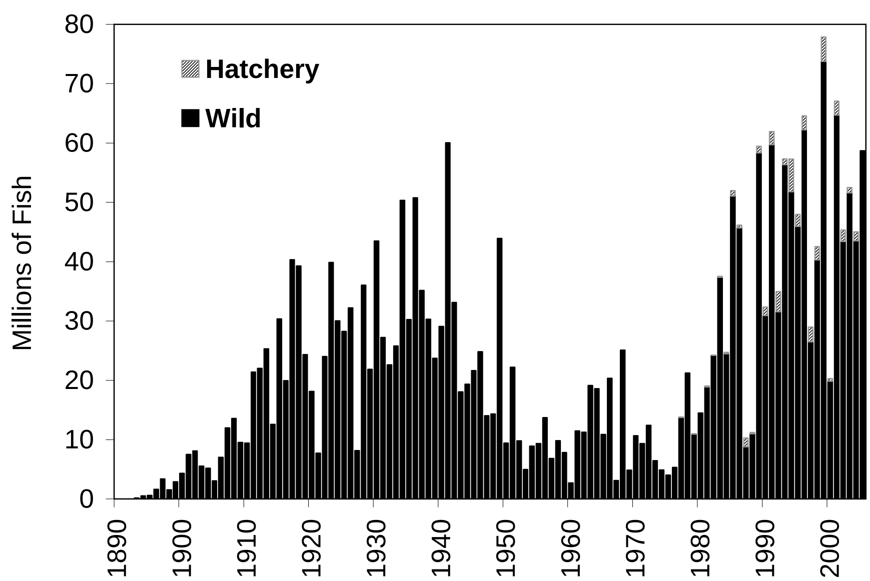

Figure 4.7–Annual harvest of wild and hatchery-produced pink salmon in Southeast Alaska, 1890–2005. Data prior to 1960 are from Byerly et al. 1999.

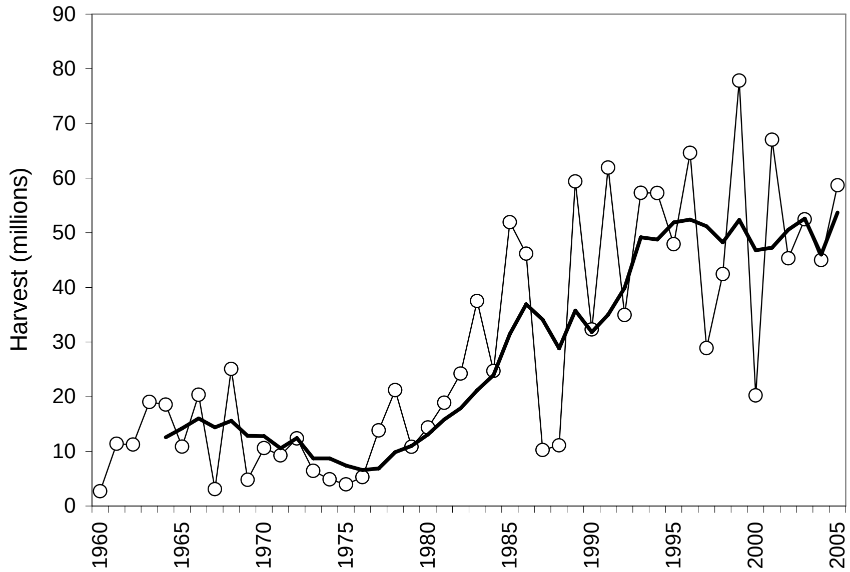

Figure 4.8–Annual harvest of pink salmon in Southeast Alaska, 1960–2005. The solid line shows the 5-year running average of the harvest. The catch for 2005 was current as of 19 September 2005.

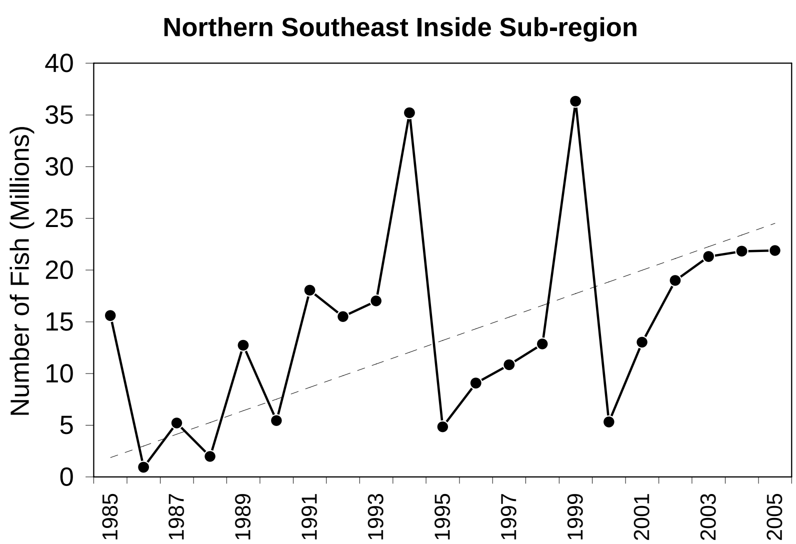

Figure 4.9–Annual harvest of pink salmon in the Northern Southeast Inside sub-region, 1985–2005. The dotted line is found by the "resistant regression," and the slope of the line is a robust estimate of the annual change relative to the size of the harvest at the beginning of the series; in this case the harvest has increased dramatically over the most recent 21 years, 1985–2005. The catch for 2005 was current as of 19 September 2005.

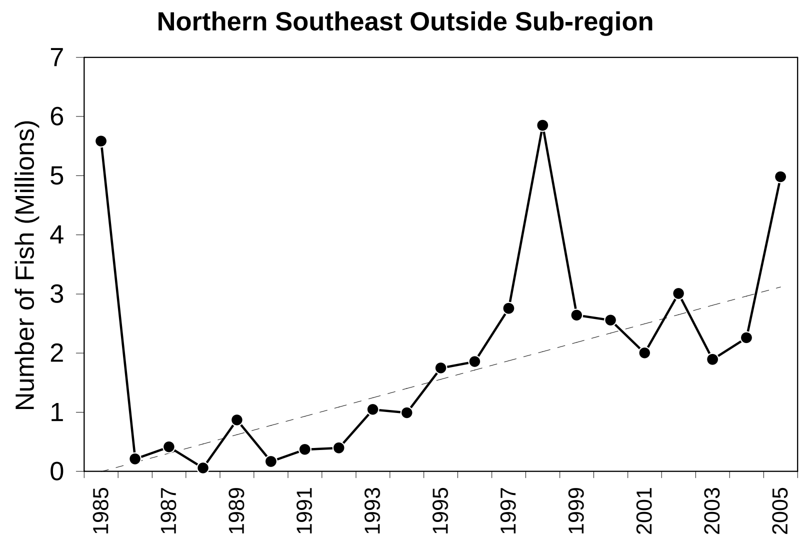

Figure 4.10–Annual harvest of pink salmon in the Northern Southeast Outside sub-region, 1985–2005. The dotted line is found by the “resistant regression,” and the slope of the line is a robust estimate of the annual change relative to the size of the harvest at the beginning of the series; in this case the harvest has increased dramatically over the most recent 21 years, 1985–2005. The catch for 2005 was current as of 19 September 2005.

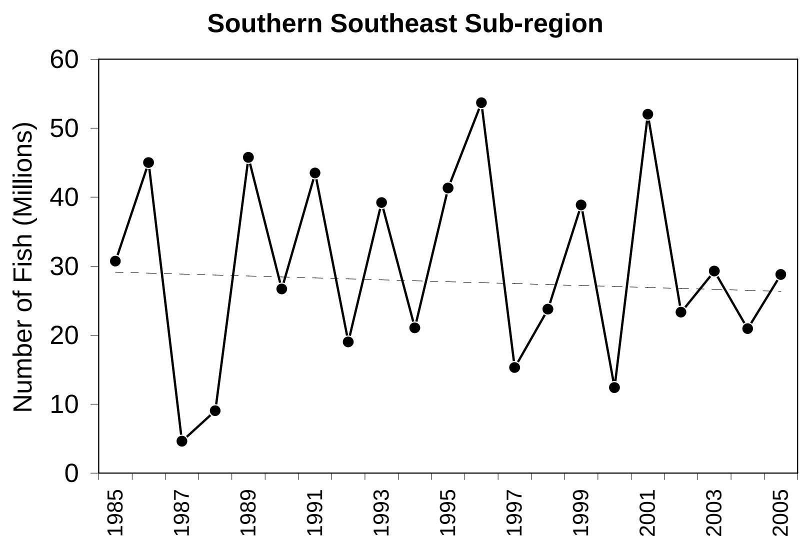

Figure 4.11–Annual harvest of pink salmon in the Southern Southeast sub-region, 1985–2005. The dotted line is found by the “resistant regression,” and the slope of the line is a robust estimate of the annual change relative to the size of the harvest at the beginning of the series; in this case an annual decrease of 0.5% over the most recent 21 years, 1985–2005. The catch for 2005 was current as of 19 September 2005.

As pointed out by Zadina et al. (2004), our measures of escapement are imperfect, but we believe they are fully adequate to assess the health of this resource. Considering the difficulty measuring such dispersed salmon production, substantial improvements to the monitoring program would only lead to modest improvements in the quality of the stock assessment information—which is not true for other species of salmon in Southeast Alaska. The consistency of all of our indicators gives us confidence in our assessment of pink salmon stock status. This is especially true of the consistency and sustainability of the harvest. We will continue to improve the escapement estimation process, and try to better understand the relationship between the current escapement index and total escapement in the region. ADF&G received funding from the Southeast Sustainable Salmon Fund, starting in 2002, to increase the aerial survey coverage of the region. In addition, there are ongoing research programs to assess individual observer counting rates, their relationship to other observers, and the relationship of adjusted peak counts to the total spawning population for individual streams. Even so, we have more than adequate information to report a favorable stock status for pink salmon in Southeast Alaska.

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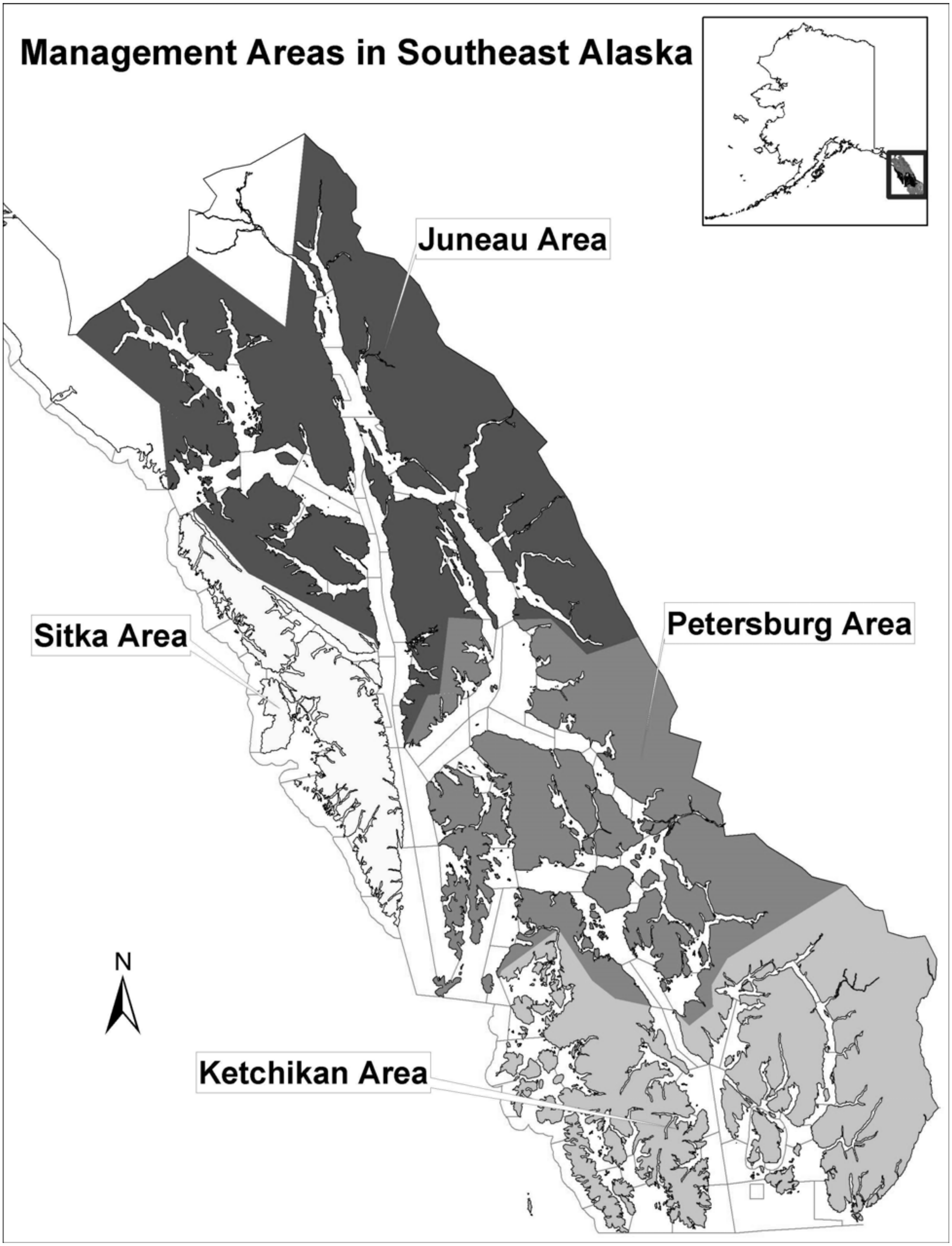
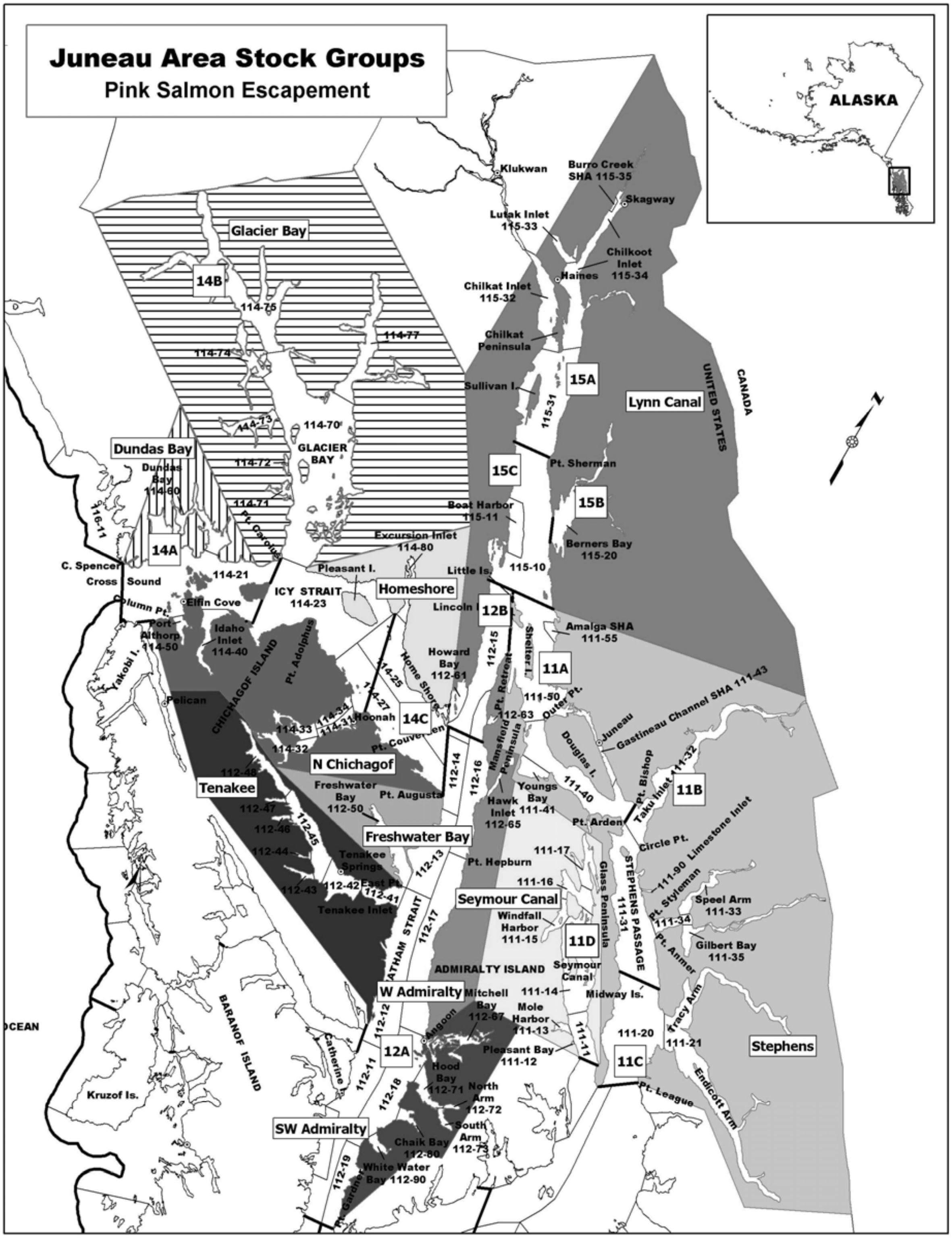
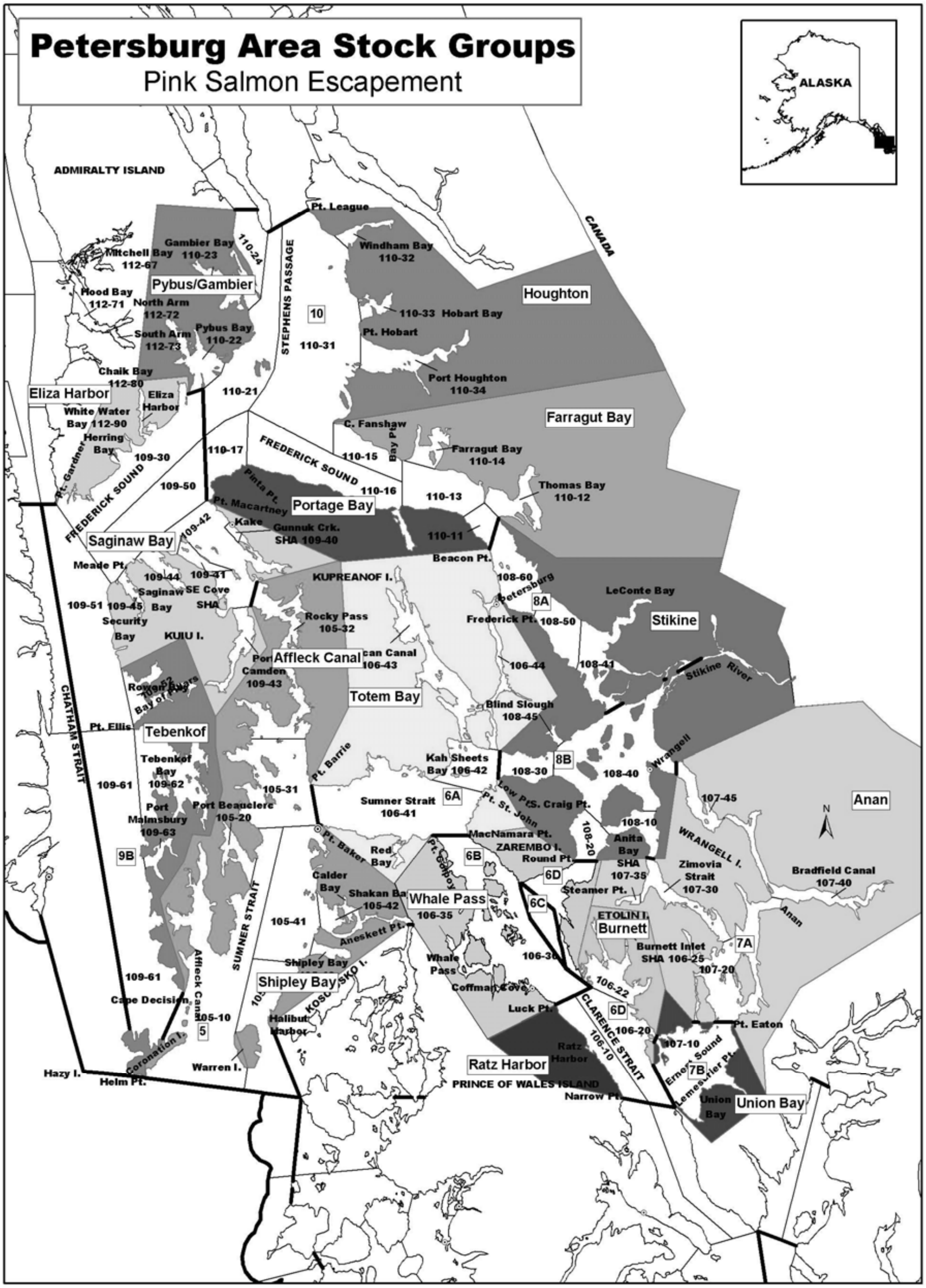
APPENDIX 4.A



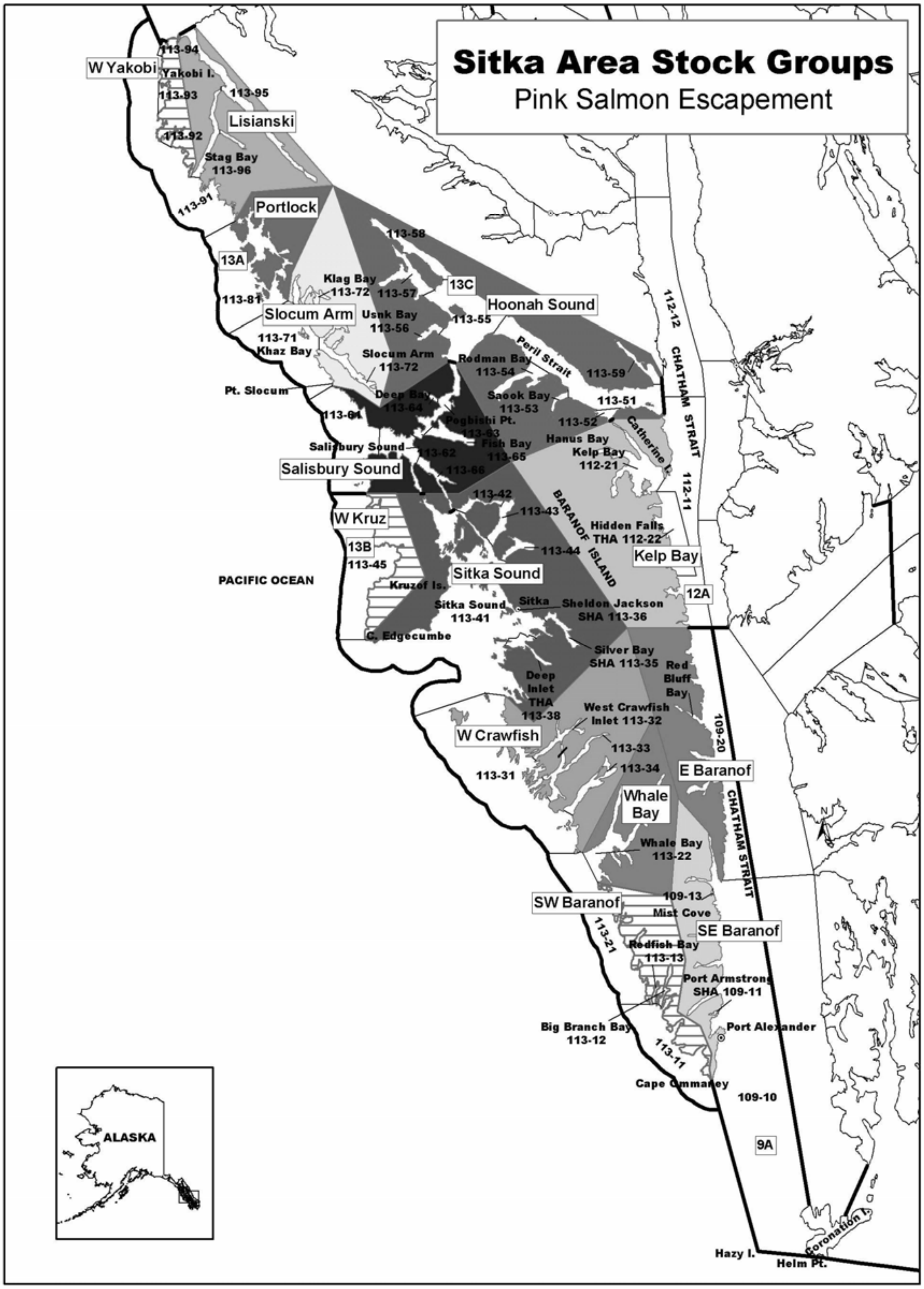
Appendix 4.A.1.–ADF&G salmon management areas in Southeast Alaska.



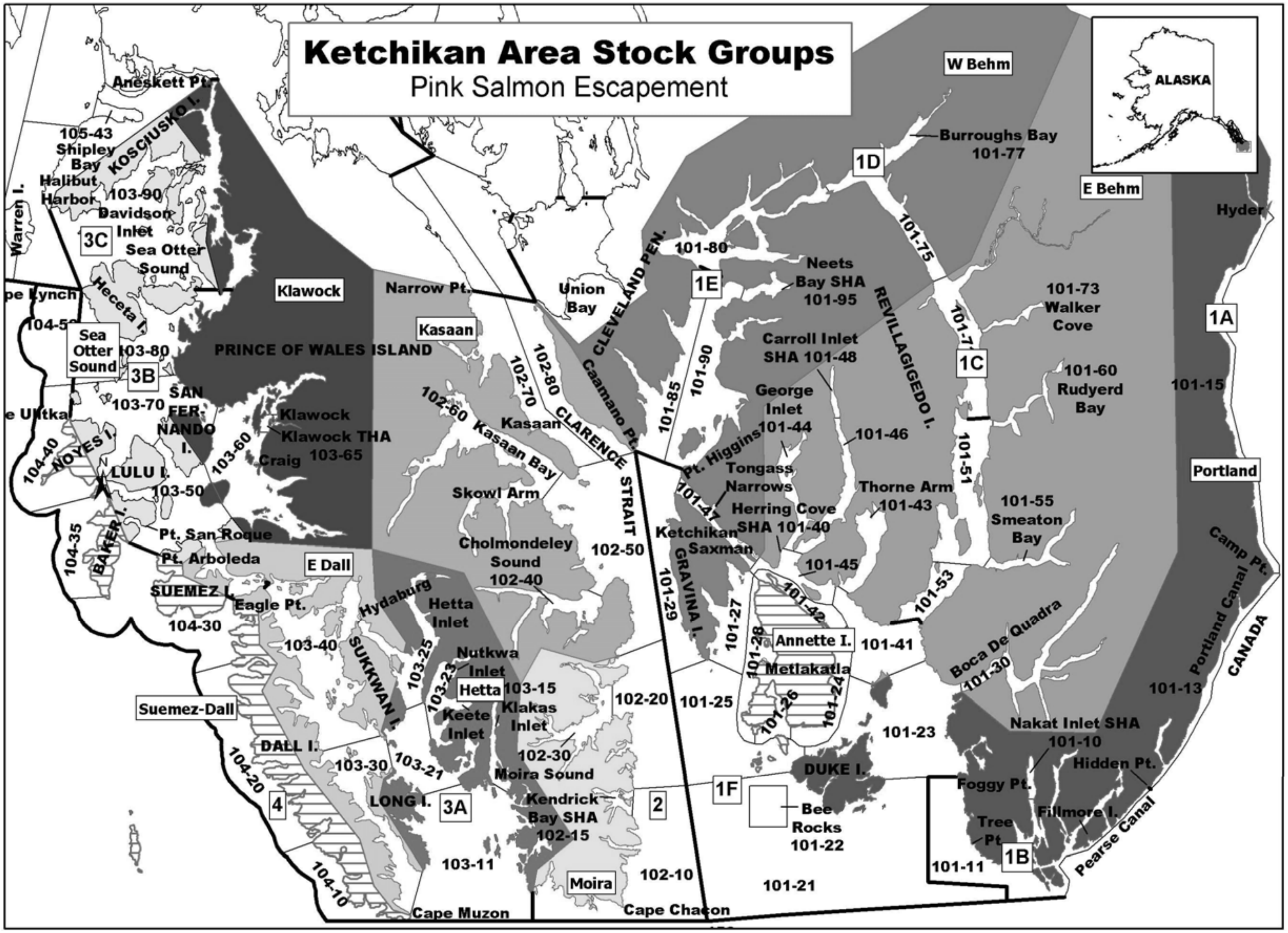
Appendix 4.A.2.–The ADF&G Juneau salmon management area and associated pink salmon escapement stock groups. Diagonal hatched stock groups indicate areas with no index streams or escapement targets.



Appendix 4.A.3.–The ADF&G Petersburg salmon management area and associated pink salmon escapement stock groups.



Appendix 4.A.4.–The ADF&G Sitka salmon management area and associated pink salmon escapement stock groups. Diagonal hatched stock groups indicate areas with no index streams or escapement targets.



Appendix 4.A.5.–The ADF&G Ketchikan salmon management area and associated pink salmon escapement stock groups. Diagonal hatched stock groups indicate areas with no index streams or escapement targets.

APPENDIX 4.B

Appendix 4.B.1–Estimated escapement of pink salmon to the Situk River, Yakutat area, 1961–2004.

	Situk River			Humpy Creek		
Year [a]	Count	Type	Estimated Total Escapement [b]	Count	Type	Estimated Total Escapement
1961	30,000	Aerial	90,000	25,000	Foot	75,000
1962	70,000	Aerial	210,000	23,000	Foot	69,000
1963	192,359	Extrapolated	192,359	63,278	Extrapolated	63,278
1964	70,000	Aerial	210,000	11,000	Foot	33,000
1965	30,000	Aerial	90,000	3,000	Foot	3,000
1966	5,000	Aerial	15,000	n/a	Extrapolated	28,186
1967	80,000	Aerial	240,000	63,278	Extrapolated	63,278
1968	n/a	Extrapolated	156,735	n/a	Extrapolated	28,186
1969	11,500	Aerial	34,500	29,169	Foot	29,169
1970	n/a	Extrapolated	156,735	n/a	Extrapolated	28,186
1971	27,184	Weir	27,184	63,278	Foot	63,278
1972	10,000	Boat	30,000	1,630	Foot	4,890
1973	80,000	Boat	240,000	3,969	Foot	3,969
1974	20,000	Boat	60,000	2,000	Foot	6,000
1975	44,600	Boat	133,800	39,000	Foot	39,000
1976	38,081	Weir	38,081	4,672	Foot	14,016
1977	177,712	Weir	177,712	36,000	Foot	36,000
1978	120,000	Boat	360,000	5,000	Foot	15,000
1979	450,000	Weir	450,000	45,000	Foot	45,000
1980	250,000	Weir	250,000	10,000	Foot	30,000
1981	300,000	Weir	300,000	210,000	Foot	210,000
1982	40,300	Weir	40,300	8,700	Foot	26,100
1983	183,577	Weir	183,577	90,000	Foot	90,000
1984	113,161	Weir	113,161	16,000	Foot	48,000
1985	366,000	Weir	366,000	225,000	Foot	225,000
1986	85,000	Boat	85,000	10,233	Foot	30,699
1987	24,000	Boat	72,000	6,000	Aerial	6,000
1988	78,753	Weir	78,753	10,000	Aerial	30,000
1989	288,246	Weir	288,246	60,600	Foot	60,600
1990	175,000	Boat	175,000	13,800	Foot	41,400
1991	n/a	Extrapolated	192,359	24,150	Foot	24,150
1992	3,000	Boat	9,000	4,500	Foot	13,500
1993	n/a	Extrapolated	192,359	39,000	Aerial	39,000
1994	n/a	Extrapolated	156,735	11,000	Aerial	33,000
1995	66,273	Weir	66,273	3,800	Aerial	11,400
1996	157,012	Weir	157,012	8,500	Aerial	25,500
1997	466,267	Weir	466,267	n/a		
1998	97,392	Weir	97,392	n/a		
1999	27,386	Weir	27,386	n/a		
2000	331,510	Weir	331,510	n/a		
2001	121,267	Weir	121,267	n/a		
2002	98,790	Weir	98,790	n/a		
2003	375,333	Weir	375,333			
2004	145,914	Weir	145,914			

[a] Data for 1961-1994 are from Clark (1995).

[b] Aerial and foot surveys were expanded by 3.0 to estimate total escapement (Clark 1995).

Appendix 4.B.2–Southeast Alaska pink salmon escapement indices and biological escapement goal (BEG) ranges by sub-region (in millions), 1960–2004.

Sub-region	Southern Southeast	Northern Southeast Inside	Northern Southeast Outside
BEG Lower Range	4.00	2.50	0.75
BEG Upper Range	9.00	5.50	1.75
1960	0.54	0.29	0.07
1961	0.38	1.07	0.26
1962	1.82	0.68	0.15
1963	1.86	1.76	0.79
1964	2.04	0.88	0.13
1965	1.54	0.85	0.33
1966	2.83	0.91	0.06
1967	0.41	0.57	0.17
1968	1.81	1.42	0.02
1969	1.20	0.96	0.39
1970	1.51	1.28	0.08
1971	2.09	1.39	0.26
1972	1.62	1.60	0.13
1973	1.63	1.19	0.33
1974	1.53	1.03	0.24
1975	2.47	0.60	0.48
1976	3.42	0.63	0.25
1977	5.56	2.12	1.52
1978	4.78	2.29	0.36
1979	4.16	3.05	1.49
1980	5.03	1.74	0.17
1981	4.73	2.00	1.14
1982	3.79	2.99	0.42
1983	5.84	2.74	0.93
1984	7.52	2.65	0.66
1985	10.48	5.89	1.45
1986	12.75	2.30	0.25
1987	5.08	3.21	0.32
1988	3.38	1.81	0.11
1989	7.95	3.41	0.40
1990	6.26	2.86	0.19
1991	6.05	4.13	0.49
1992	6.37	3.78	0.43
1993	7.84	3.55	0.33
1994	6.00	6.17	1.16
1995	10.03	2.87	1.29
1996	17.95	4.57	1.58
1997	6.57	5.14	2.81
1998	8.56	4.96	2.42
1999	14.83	9.89	5.73
2000	6.15	4.44	1.49
2001	11.79	5.05	2.36
2002	9.92	5.08	2.36
2003	10.78	6.71	3.81
2004	8.50	5.20	2.15

Appendix 4.B.3–Pink salmon escapement index series and target ranges by management district (in millions), 1960–2004.

Management District	101	102	103	105	106	107	108	109	110	111	112	Inside 113	114	115	Outside 113
Management Target:															
Lower	1.33	0.40	1.13	0.33	0.40	0.40	No	0.40	0.65	0.32	0.40	0.40	0.32	No	0.75
Upper	3.00	1.10	2.55	0.65	0.85	0.85	Target	0.85	1.45	0.73	0.85	0.90	0.73	Target	1.75
1960	0.21	0.07	0.19	0.05	0.01	0.02	0.00	0.03	0.06	0.04	0.09	0.04	0.03	0.01	0.07
1961	0.09	0.03	0.09	0.05	0.05	0.05	0.02	0.15	0.08	0.16	0.31	0.24	0.10	0.02	0.26
1962	0.67	0.14	0.54	0.19	0.08	0.20	0.00	0.12	0.15	0.09	0.19	0.05	0.06	0.01	0.15
1963	0.77	0.34	0.49	0.07	0.04	0.12	0.02	0.15	0.08	0.32	0.65	0.32	0.20	0.04	0.79
1964	0.79	0.26	0.55	0.05	0.24	0.13	0.01	0.19	0.13	0.11	0.22	0.16	0.07	0.02	0.13
1965	0.37	0.19	0.73	0.11	0.07	0.06	0.00	0.26	0.06	0.12	0.10	0.22	0.08	0.02	0.33
1966	1.06	0.49	0.86	0.11	0.13	0.18	0.01	0.21	0.12	0.21	0.19	0.14	0.05	0.00	0.06
1967	0.21	0.02	0.07	0.05	0.02	0.03	0.00	0.10	0.05	0.05	0.14	0.02	0.17	0.04	0.17
1968	0.80	0.32	0.28	0.14	0.12	0.13	0.03	0.27	0.24	0.34	0.33	0.20	0.05	0.00	0.02
1969	0.50	0.29	0.24	0.05	0.05	0.07	0.00	0.14	0.08	0.05	0.32	0.16	0.21	0.01	0.39
1970	0.75	0.13	0.37	0.06	0.06	0.13	0.01	0.14	0.19	0.29	0.44	0.13	0.07	0.01	0.08
1971	0.47	0.39	0.77	0.10	0.16	0.19	0.01	0.18	0.16	0.19	0.37	0.13	0.30	0.07	0.26
1972	0.70	0.18	0.46	0.06	0.06	0.16	0.00	0.16	0.18	0.71	0.33	0.18	0.04	0.01	0.13
1973	0.65	0.22	0.38	0.12	0.11	0.15	0.01	0.03	0.23	0.21	0.38	0.04	0.24	0.05	0.33
1974	0.58	0.21	0.48	0.04	0.10	0.12	0.00	0.05	0.10	0.38	0.31	0.16	0.03	0.01	0.24
1975	0.63	0.50	0.72	0.13	0.16	0.32	0.00	0.09	0.03	0.11	0.20	0.03	0.13	0.01	0.48
1976	0.78	0.52	1.05	0.09	0.37	0.61	0.00	0.11	0.08	0.07	0.22	0.11	0.04	0.01	0.25
1977	2.32	0.62	1.24	0.18	0.29	0.89	0.02	0.39	0.15	0.28	0.66	0.22	0.34	0.08	1.52
1978	1.98	0.42	1.46	0.24	0.25	0.43	0.00	0.34	0.36	0.17	0.90	0.42	0.09	0.02	0.36
1979	1.06	0.62	1.49	0.25	0.27	0.41	0.06	0.65	0.57	0.45	0.84	0.30	0.17	0.07	1.49
1980	1.88	0.60	2.04	0.11	0.09	0.30	0.00	0.27	0.36	0.18	0.64	0.16	0.10	0.03	0.17
1981	1.85	0.47	1.89	0.27	0.11	0.12	0.02	0.29	0.32	0.21	0.67	0.19	0.29	0.03	1.14
1982	1.34	0.35	1.39	0.10	0.21	0.35	0.04	0.61	0.56	0.48	0.85	0.25	0.19	0.04	0.42
1983	2.13	0.97	2.02	0.22	0.14	0.35	0.02	0.37	0.27	0.55	0.92	0.28	0.28	0.06	0.93
1984	3.55	0.77	2.67	0.15	0.12	0.25	0.01	0.51	0.35	0.57	0.63	0.30	0.26	0.03	0.66
1985	3.40	0.90	3.83	0.66	0.83	0.81	0.05	0.98	0.94	0.91	1.55	0.30	0.87	0.35	1.45
1986	4.39	1.50	4.82	0.64	0.71	0.67	0.01	0.64	0.27	0.21	0.94	0.16	0.08	0.00	0.25
1987	2.20	0.46	1.74	0.13	0.20	0.29	0.06	0.46	1.03	0.66	0.55	0.23	0.17	0.11	0.32
1988	1.21	0.46	1.10	0.13	0.19	0.27	0.01	0.42	0.42	0.17	0.52	0.16	0.08	0.04	0.11
1989	2.57	0.72	2.83	0.35	0.53	0.88	0.07	0.70	0.98	0.33	0.88	0.22	0.26	0.04	0.40
1990	1.74	0.93	2.36	0.36	0.46	0.37	0.06	0.49	1.02	0.15	0.67	0.25	0.15	0.13	0.19
1991	1.65	0.63	1.97	0.59	0.50	0.58	0.12	1.03	1.02	0.30	1.26	0.31	0.21	0.00	0.49
1992	2.78	0.87	1.45	0.18	0.22	0.81	0.06	0.87	1.18	0.41	0.77	0.38	0.11	0.06	0.43
1993	2.12	0.90	2.92	0.61	0.62	0.66	0.01	0.88	0.61	0.15	1.03	0.52	0.34	0.03	0.33
1994	1.78	0.63	2.00	0.43	0.63	0.50	0.03	1.40	1.37	0.98	1.41	0.53	0.30	0.19	1.16
1995	3.82	0.91	3.42	0.51	0.63	0.73	0.01	0.85	0.31	0.21	0.88	0.11	0.50	0.02	1.29
1996	6.01	3.10	6.64	0.87	0.67	0.63	0.03	1.86	0.52	0.76	1.06	0.33	0.05	0.00	1.58
1997	2.32	0.81	1.77	0.62	0.51	0.53	0.01	1.04	0.70	0.71	1.71	0.30	0.65	0.03	2.81
1998	3.10	1.15	2.75	0.34	0.65	0.54	0.03	1.39	0.83	0.77	1.31	0.50	0.10	0.06	2.42
1999	2.79	1.72	3.45	2.83	3.19	0.79	0.06	2.72	1.86	0.82	2.41	0.84	1.14	0.10	5.73
2000	1.89	1.12	1.77	0.58	0.32	0.46	0.01	1.68	0.87	0.33	0.88	0.62	0.06	0.01	1.49
2001	4.35	1.15	3.26	1.04	1.00	0.88	0.12	1.07	1.03	0.49	1.05	0.44	0.80	0.17	2.36
2002	3.25	1.68	3.14	0.68	0.60	0.56	0.01	1.56	1.16	0.48	1.11	0.53	0.19	0.04	2.36
2003	3.70	1.34	2.98	0.89	0.88	0.83	0.16	1.15	1.67	0.54	1.55	1.35	0.41	0.04	3.81
2004	2.48	0.74	3.49	0.63	0.56	0.56	0.04	1.29	1.28	0.49	1.36	0.53	0.23	0.03	2.15

Appendix 4.B.4–Escapement index series and management targets for the pink salmon stock groups in the Juneau Management Area (in millions), 1960–2004.

Stock Group	Seymour Canal	Stephens	Freshwater Bay	Lynn Canal	SW Admiralty	Tenakee	W Admiralty	Homeshore	N Chichagof	Lynn Canal
Management Area	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau
Subregion	NSEI[1]	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI
District	111	111	112	112	112	112	112	114	114	115
Number of Streams	14	35	15	6	17	19	14	10	23	9
Management Target:										
Lower	0.18	0.14	0.06	0.02	0.08	0.18	0.04	0.05	0.28	No Target
Upper	0.41	0.32	0.13	0.04	0.17	0.37	0.08	0.10	0.62	
1960	0.02	0.02	0.01	0.00	0.02	0.04	0.01	0.01	0.02	0.01
1961	0.08	0.08	0.05	0.02	0.06	0.14	0.03	0.02	0.08	0.02
1962	0.05	0.05	0.03	0.01	0.03	0.08	0.02	0.01	0.05	0.01
1963	0.16	0.16	0.10	0.03	0.12	0.28	0.06	0.04	0.16	0.04
1964	0.06	0.05	0.03	0.01	0.04	0.10	0.02	0.01	0.06	0.02
1965	0.06	0.06	0.01	0.00	0.01	0.03	0.01	0.01	0.06	0.02
1966	0.10	0.10	0.03	0.02	0.07	0.03	0.04	0.01	0.04	0.00
1967	0.02	0.02	0.02	0.01	0.02	0.02	0.06	0.00	0.16	0.04
1968	0.29	0.05	0.05	0.01	0.08	0.12	0.03	0.01	0.04	0.00
1969	0.03	0.02	0.04	0.02	0.09	0.07	0.08	0.05	0.16	0.01
1970	0.24	0.06	0.09	0.02	0.10	0.17	0.05	0.02	0.05	0.01
1971	0.15	0.03	0.06	0.04	0.07	0.08	0.06	0.02	0.28	0.07
1972	0.36	0.35	0.05	0.01	0.07	0.15	0.02	0.00	0.03	0.01
1973	0.12	0.10	0.05	0.03	0.03	0.18	0.07	0.01	0.23	0.05
1974	0.35	0.03	0.06	0.01	0.03	0.18	0.01	0.00	0.03	0.01
1975	0.05	0.05	0.04	0.01	0.02	0.08	0.03	0.01	0.13	0.01
1976	0.05	0.01	0.04	0.01	0.02	0.13	0.01	0.00	0.04	0.01
1977	0.15	0.13	0.18	0.07	0.11	0.18	0.08	0.01	0.33	0.08
1978	0.11	0.07	0.15	0.03	0.07	0.54	0.06	0.02	0.06	0.02
1979	0.22	0.22	0.20	0.07	0.20	0.17	0.14	0.02	0.15	0.07
1980	0.08	0.10	0.05	0.05	0.18	0.29	0.04	0.05	0.05	0.03
1981	0.04	0.16	0.05	0.04	0.10	0.27	0.10	0.06	0.23	0.03
1982	0.23	0.25	0.10	0.05	0.21	0.36	0.06	0.03	0.17	0.04
1983	0.26	0.30	0.07	0.07	0.22	0.45	0.07	0.03	0.25	0.06
1984	0.37	0.20	0.10	0.02	0.15	0.24	0.06	0.06	0.20	0.03
1985	0.43	0.48	0.21	0.09	0.27	0.66	0.21	0.19	0.68	0.35
1986	0.13	0.08	0.10	0.01	0.17	0.60	0.02	0.02	0.06	0.00
1987	0.29	0.37	0.09	0.03	0.11	0.18	0.08	0.03	0.15	0.11
1988	0.08	0.10	0.07	0.02	0.09	0.28	0.02	0.04	0.04	0.04
1989	0.17	0.16	0.11	0.06	0.20	0.30	0.12	0.05	0.21	0.04
1990	0.04	0.11	0.11	0.03	0.20	0.26	0.05	0.03	0.11	0.13
1991	0.09	0.21	0.11	0.03	0.19	0.75	0.08	0.03	0.18	0.00
1992	0.13	0.29	0.12	0.04	0.16	0.37	0.05	0.04	0.07	0.06
1993	0.11	0.05	0.15	0.02	0.18	0.52	0.07	0.05	0.29	0.03
1994	0.23	0.75	0.27	0.07	0.23	0.59	0.13	0.09	0.21	0.19
1995	0.12	0.08	0.22	0.04	0.11	0.39	0.10	0.05	0.45	0.02
1996	0.29	0.46	0.13	0.02	0.29	0.49	0.05	0.01	0.04	0.00
1997	0.44	0.27	0.29	0.11	0.13	0.86	0.16	0.09	0.56	0.03
1998	0.31	0.46	0.15	0.02	0.52	0.49	0.03	0.01	0.09	0.06
1999	0.44	0.38	0.26	0.21	0.44	0.98	0.21	0.20	0.94	0.10
2000	0.20	0.13	0.08	0.02	0.26	0.42	0.01	0.01	0.05	0.01
2001	0.29	0.20	0.24	0.19	0.24	0.14	0.09	0.10	0.69	0.17
2002	0.22	0.26	0.16	0.05	0.21	0.60	0.02	0.01	0.18	0.04
2003	0.36	0.19	0.18	0.06	0.40	0.23	0.16	0.06	0.34	0.04
2004	0.31	0.18	0.20	0.05	0.42	0.43	0.19	0.07	0.16	0.03

Note: NSEI = Northern Southeast Inside sub-region.

Appendix 4.B.5–Escapement index series and management targets for the pink salmon stock groups in the Petersburg Management Area (in millions), 1960–2004.

Stock Group	Affleck Canal	Shipley Bay	Burnett	Ratz Harbor	Totem Bay	Whale Pass	Anan	Union Bay	Stikine	Eliza Harbor	Saginaw Bay	Tebenkof	Farragut Bay	Houghton	Portage Bay	Pybus/Gambier
Management Area	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg
Subregion	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI
District	105	105	106	106	106	106	107	107	108	109	109	109	110	110	110	110
Number of Streams	33	12	9	4	13	11	27	8	6	13	16	40	4	19	7	18
Management Target:																
Lower	0.20	0.14	0.10	0.10	0.07	0.13	0.32	0.08	No Target	0.08	0.07	0.13	0.01	0.40	0.04	0.20
Upper	0.38	0.27	0.20	0.21	0.15	0.28	0.68	0.17		0.18	0.15	0.27	0.03	0.89	0.08	0.45
1960	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.04	0.00	0.01
1961	0.03	0.02	0.00	0.02	0.02	0.01	0.04	0.01	0.02	0.02	0.02	0.03	0.00	0.02	0.01	0.05
1962	0.16	0.03	0.00	0.02	0.03	0.02	0.16	0.04	0.00	0.00	0.02	0.06	0.00	0.09	0.01	0.04
1963	0.02	0.05	0.01	0.00	0.01	0.03	0.12	0.01	0.02	0.03	0.02	0.05	0.00	0.04	0.00	0.03
1964	0.05	0.00	0.16	0.07	0.00	0.00	0.10	0.03	0.01	0.05	0.07	0.06	0.00	0.08	0.01	0.04
1965	0.05	0.06	0.02	0.00	0.02	0.03	0.06	0.00	0.00	0.03	0.07	0.10	0.00	0.05	0.00	0.01
1966	0.05	0.06	0.02	0.03	0.03	0.06	0.14	0.04	0.01	0.08	0.02	0.08	0.00	0.08	0.01	0.03
1967	0.02	0.03	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.00	0.01	0.03	0.00	0.03	0.01	0.01
1968	0.07	0.07	0.05	0.00	0.04	0.03	0.12	0.01	0.03	0.09	0.04	0.08	0.00	0.14	0.03	0.07
1969	0.02	0.03	0.00	0.03	0.02	0.00	0.06	0.01	0.00	0.01	0.02	0.04	0.00	0.07	0.00	0.01
1970	0.04	0.02	0.01	0.01	0.02	0.02	0.12	0.01	0.01	0.04	0.01	0.03	0.00	0.12	0.01	0.06
1971	0.03	0.07	0.02	0.04	0.02	0.09	0.16	0.03	0.01	0.02	0.02	0.03	0.00	0.13	0.01	0.01
1972	0.05	0.01	0.03	0.02	0.00	0.01	0.15	0.02	0.00	0.02	0.03	0.03	0.00	0.11	0.01	0.06
1973	0.02	0.10	0.03	0.01	0.00	0.06	0.12	0.03	0.01	0.01	0.00	0.01	0.00	0.13	0.01	0.09
1974	0.02	0.02	0.02	0.01	0.00	0.06	0.09	0.02	0.00	0.01	0.00	0.01	0.00	0.06	0.00	0.03
1975	0.03	0.11	0.04	0.01	0.01	0.10	0.27	0.05	0.00	0.01	0.01	0.03	0.00	0.01	0.00	0.01
1976	0.06	0.03	0.10	0.05	0.01	0.22	0.53	0.08	0.00	0.00	0.01	0.08	0.00	0.04	0.00	0.04
1977	0.09	0.09	0.12	0.07	0.03	0.08	0.76	0.13	0.02	0.05	0.05	0.19	0.01	0.07	0.01	0.06
1978	0.14	0.10	0.05	0.08	0.04	0.08	0.35	0.08	0.00	0.04	0.04	0.15	0.01	0.19	0.02	0.14
1979	0.11	0.14	0.06	0.05	0.09	0.07	0.35	0.05	0.06	0.08	0.14	0.20	0.01	0.29	0.01	0.25
1980	0.07	0.04	0.04	0.01	0.02	0.02	0.23	0.08	0.00	0.07	0.05	0.07	0.00	0.21	0.02	0.13
1981	0.17	0.11	0.02	0.04	0.03	0.02	0.09	0.02	0.02	0.05	0.06	0.05	0.01	0.25	0.02	0.04
1982	0.07	0.03	0.01	0.09	0.06	0.05	0.28	0.07	0.04	0.08	0.17	0.15	0.02	0.39	0.03	0.11
1983	0.15	0.07	0.02	0.06	0.02	0.03	0.27	0.08	0.02	0.04	0.09	0.11	0.00	0.19	0.03	0.05
1984	0.10	0.05	0.03	0.02	0.02	0.05	0.19	0.06	0.01	0.10	0.12	0.14	0.01	0.24	0.03	0.07
1985	0.34	0.32	0.12	0.23	0.24	0.23	0.63	0.18	0.05	0.16	0.27	0.36	0.05	0.53	0.08	0.29
1986	0.46	0.18	0.12	0.20	0.14	0.25	0.37	0.30	0.01	0.09	0.23	0.25	0.02	0.13	0.03	0.09
1987	0.05	0.08	0.03	0.02	0.11	0.03	0.23	0.06	0.06	0.13	0.16	0.08	0.03	0.72	0.06	0.23
1988	0.11	0.02	0.05	0.07	0.04	0.03	0.18	0.10	0.01	0.08	0.06	0.19	0.01	0.27	0.04	0.11
1989	0.11	0.24	0.08	0.14	0.12	0.19	0.69	0.19	0.07	0.17	0.24	0.17	0.04	0.63	0.06	0.25
1990	0.32	0.04	0.11	0.07	0.05	0.23	0.22	0.15	0.06	0.20	0.05	0.13	0.01	0.71	0.05	0.25
1991	0.24	0.36	0.10	0.11	0.13	0.16	0.46	0.13	0.12	0.27	0.31	0.22	0.04	0.70	0.04	0.25
1992	0.12	0.06	0.05	0.02	0.08	0.07	0.74	0.06	0.06	0.33	0.12	0.27	0.02	0.79	0.05	0.31
1993	0.29	0.32	0.08	0.12	0.28	0.14	0.58	0.09	0.01	0.26	0.11	0.28	0.03	0.39	0.02	0.18
1994	0.26	0.16	0.16	0.11	0.06	0.30	0.40	0.11	0.03	0.25	0.35	0.45	0.03	0.93	0.02	0.38
1995	0.28	0.23	0.08	0.19	0.11	0.24	0.48	0.25	0.01	0.17	0.07	0.30	0.00	0.17	0.01	0.13
1996	0.62	0.25	0.26	0.15	0.07	0.19	0.41	0.22	0.03	0.31	0.34	0.64	0.02	0.16	0.02	0.32

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Stock Group	Affleck Canal	Shipley Bay	Burnett	Ratz Harbor	Totem Bay	Whale Pass	Anan	Union Bay	Stikine	Eliza Harbor	Saginaw Bay	Tebenkof	Farragut Bay	Houghton	Portage Bay	Pybus/Gambier
Management Area	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg
Subregion	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI	NSEI
District	105	105	106	106	106	106	107	107	108	109	109	109	110	110	110	110
Number of Streams	33	12	9	4	13	11	27	8	6	13	16	40	4	19	7	18
Management Target:																
Lower	0.20	0.14	0.10	0.10	0.07	0.13	0.32	0.08	No Target	0.08	0.07	0.13	0.01	0.40	0.04	0.20
Upper	0.38	0.27	0.20	0.21	0.15	0.28	0.68	0.17		0.18	0.15	0.27	0.03	0.89	0.08	0.45
1997	0.30	0.32	0.11	0.07	0.13	0.20	0.47	0.06	0.01	0.29	0.16	0.19	0.02	0.36	0.04	0.29
1998	0.20	0.15	0.17	0.16	0.10	0.23	0.40	0.14	0.03	0.27	0.24	0.37	0.02	0.45	0.02	0.35
1999	0.96	1.87	0.78	0.81	0.98	0.63	0.60	0.20	0.06	0.74	0.52	0.66	0.07	1.10	0.12	0.56
2000	0.44	0.14	0.14	0.06	0.08	0.05	0.40	0.06	0.01	0.40	0.49	0.53	0.02	0.46	0.03	0.36
2001	0.58	0.46	0.24	0.17	0.27	0.31	0.58	0.30	0.12	0.18	0.22	0.38	0.02	0.71	0.03	0.28
2002	0.55	0.14	0.21	0.16	0.14	0.09	0.42	0.14	0.01	0.18	0.54	0.59	0.02	0.74	0.03	0.37
2003	0.32	0.57	0.18	0.26	0.14	0.30	0.66	0.17	0.16	0.15	0.25	0.56	0.02	1.31	0.04	0.29
2004	0.47	0.17	0.08	0.17	0.18	0.13	0.45	0.11	0.04	0.28	0.32	0.35	0.06	0.63	0.09	0.50

Note: SSE = Southern Southeast sub-region; NSEI = Northern Southeast Inside sub-region.

Appendix 4.B.6–Escapement index series and management targets for the pink salmon stock groups in the Sitka Management Area (in millions), 1960–2004.

Stock Group	E Baranof	SE Baranof	Kelp Bay	Hoonah Sound	Lisianski	Portlock	Salisbury Sound	Sitka Sound	Slocum Arm	W Crawfish	Whale Bay
Management Area	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka
Subregion	NSEI[1]	NSEI	NSEI	NSEI	NSEO	NSEO	NSEO	NSEO	NSEO	NSEO	NSEO
District	109	109	112	113	113	113	113	113	113	113	113
Number of Streams	2	4	4	19	5	3	8	13	7	1	4
Management Target:											
Lower	0.07	0.05	0.03	0.40	0.07	0.03	0.16	0.21	0.21	0.01	0.05
Upper	0.14	0.11	0.06	0.90	0.17	0.08	0.36	0.50	0.48	0.03	0.12
1960	0.01	0.01	0.01	0.04	0.00	0.01	0.00	0.01	0.00	0.01	0.03
1961	0.05	0.04	0.02	0.24	0.04	0.05	0.06	0.06	0.03	0.01	0.02
1962	0.02	0.01	0.01	0.05	0.01	0.02	0.02	0.02	0.06	0.00	0.01
1963	0.04	0.01	0.06	0.32	0.18	0.08	0.25	0.17	0.10	0.00	0.00
1964	0.01	0.00	0.02	0.16	0.04	0.01	0.02	0.01	0.04	0.00	0.00
1965	0.03	0.02	0.03	0.22	0.11	0.01	0.05	0.09	0.07	0.00	0.00
1966	0.02	0.01	0.01	0.14	0.01	0.01	0.01	0.02	0.01	0.00	0.01
1967	0.04	0.03	0.01	0.02	0.02	0.01	0.04	0.06	0.04	0.00	0.00
1968	0.06	0.00	0.04	0.20	0.00	0.00	0.01	0.00	0.00	0.00	0.00
1969	0.04	0.03	0.02	0.16	0.03	0.01	0.14	0.10	0.06	0.01	0.03
1970	0.03	0.04	0.02	0.13	0.01	0.00	0.02	0.01	0.03	0.00	0.01
1971	0.06	0.05	0.05	0.13	0.05	0.00	0.06	0.09	0.05	0.00	0.01
1972	0.03	0.05	0.03	0.18	0.00	0.00	0.01	0.00	0.11	0.00	0.00
1973	0.01	0.00	0.02	0.04	0.02	0.01	0.03	0.18	0.08	0.00	0.00
1974	0.01	0.03	0.02	0.16	0.01	0.00	0.01	0.06	0.08	0.02	0.06
1975	0.02	0.02	0.02	0.03	0.03	0.01	0.08	0.21	0.11	0.01	0.03
1976	0.00	0.02	0.01	0.11	0.01	0.01	0.02	0.06	0.13	0.00	0.01
1977	0.06	0.04	0.03	0.22	0.15	0.02	0.28	0.75	0.21	0.02	0.08
1978	0.03	0.08	0.03	0.42	0.03	0.01	0.08	0.11	0.09	0.01	0.04
1979	0.07	0.16	0.06	0.30	0.21	0.17	0.32	0.51	0.25	0.01	0.02
1980	0.02	0.06	0.03	0.16	0.02	0.01	0.05	0.03	0.04	0.01	0.03
1981	0.05	0.08	0.12	0.19	0.19	0.09	0.31	0.38	0.13	0.02	0.03
1982	0.09	0.12	0.08	0.25	0.03	0.02	0.14	0.12	0.08	0.02	0.02
1983	0.06	0.06	0.04	0.28	0.20	0.11	0.17	0.28	0.11	0.02	0.04
1984	0.08	0.07	0.07	0.30	0.04	0.02	0.15	0.25	0.08	0.06	0.06
1985	0.12	0.07	0.10	0.30	0.26	0.07	0.36	0.55	0.13	0.02	0.08
1986	0.05	0.02	0.03	0.16	0.04	0.01	0.03	0.10	0.05	0.01	0.02
1987	0.08	0.01	0.06	0.23	0.06	0.03	0.02	0.10	0.09	0.01	0.01
1988	0.07	0.01	0.05	0.16	0.02	0.01	0.02	0.01	0.03	0.00	0.01
1989	0.09	0.02	0.09	0.22	0.08	0.04	0.03	0.01	0.23	0.00	0.02
1990	0.07	0.04	0.03	0.25	0.01	0.01	0.04	0.01	0.10	0.00	0.02
1991	0.16	0.06	0.11	0.31	0.03	0.02	0.14	0.06	0.22	0.00	0.02
1992	0.07	0.08	0.03	0.38	0.01	0.02	0.03	0.02	0.13	0.01	0.20
1993	0.10	0.12	0.09	0.52	0.08	0.01	0.17	0.02	0.05	0.00	0.01
1994	0.25	0.09	0.11	0.53	0.03	0.05	0.13	0.29	0.42	0.04	0.20
1995	0.13	0.19	0.02	0.11	0.15	0.09	0.43	0.24	0.29	0.02	0.09
1996	0.33	0.24	0.08	0.33	0.03	0.08	0.26	0.71	0.31	0.05	0.14
1997	0.27	0.13	0.16	0.30	0.54	0.29	0.27	1.04	0.57	0.01	0.10
1998	0.23	0.28	0.10	0.50	0.06	0.06	0.31	1.33	0.21	0.07	0.38
1999	0.56	0.25	0.32	0.84	0.95	0.29	1.48	1.62	1.19	0.04	0.17
2000	0.14	0.12	0.09	0.62	0.04	0.13	0.25	0.51	0.41	0.03	0.11
2001	0.20	0.10	0.15	0.44	0.65	0.17	0.17	0.69	0.57	0.02	0.11
2002	0.19	0.07	0.07	0.53	0.15	0.12	0.44	0.97	0.27	0.08	0.32
2003	0.14	0.06	0.52	1.35	0.34	0.36	0.45	1.59	0.82	0.05	0.21
2004	0.29	0.05	0.08	0.53	0.09	0.17	0.38	0.87	0.27	0.10	0.29

Note: NSEI = Northern Southeast Inside sub-region; NSEO = Northern Southeast Outside sub-region.

Appendix 4.B.7–Escapement index series and management targets for the pink salmon stock groups in the Ketchikan Management Area (in millions), 1960–2004.

Stock Group	E Behm	Portland	W Behm	Kasaan	Moira	E Dall	Hetta	Klawock	Sea Otter Sound
Management Area	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan
Subregion	SSE[1]	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE
District	101	101	101	102	102	103	103	103	103
Number of Streams	41	16	34	30	12	32	15	48	18
Management Target:									
Lower	0.84	0.17	0.33	0.34	0.06	0.16	0.30	0.52	0.15
Upper	1.89	0.37	0.74	0.93	0.17	0.36	0.68	1.17	0.33
1960	0.13	0.03	0.05	0.06	0.01	0.03	0.01	0.14	0.01
1961	0.06	0.01	0.02	0.03	0.00	0.01	0.02	0.04	0.01
1962	0.46	0.11	0.10	0.13	0.00	0.07	0.14	0.27	0.06
1963	0.42	0.17	0.17	0.17	0.17	0.07	0.04	0.33	0.05
1964	0.33	0.16	0.31	0.22	0.05	0.15	0.13	0.16	0.10
1965	0.16	0.16	0.05	0.16	0.03	0.15	0.16	0.26	0.17
1966	0.56	0.19	0.30	0.43	0.05	0.06	0.18	0.36	0.25
1967	0.11	0.03	0.07	0.02	0.00	0.01	0.02	0.03	0.01
1968	0.33	0.36	0.10	0.27	0.05	0.02	0.05	0.10	0.11
1969	0.29	0.09	0.12	0.27	0.02	0.03	0.08	0.12	0.01
1970	0.54	0.05	0.16	0.12	0.01	0.05	0.06	0.25	0.01
1971	0.23	0.06	0.17	0.34	0.05	0.03	0.24	0.42	0.08
1972	0.40	0.11	0.19	0.15	0.02	0.03	0.13	0.25	0.05
1973	0.43	0.17	0.05	0.14	0.08	0.02	0.09	0.16	0.12
1974	0.44	0.02	0.12	0.13	0.08	0.07	0.16	0.18	0.07
1975	0.42	0.08	0.13	0.39	0.10	0.08	0.23	0.23	0.18
1976	0.49	0.12	0.18	0.42	0.10	0.21	0.19	0.50	0.14
1977	1.28	0.51	0.53	0.51	0.11	0.17	0.25	0.61	0.20
1978	1.17	0.34	0.47	0.39	0.04	0.23	0.29	0.72	0.23
1979	0.48	0.04	0.53	0.57	0.05	0.22	0.27	0.82	0.18
1980	1.13	0.14	0.61	0.48	0.12	0.37	0.60	0.90	0.18
1981	1.11	0.34	0.39	0.39	0.08	0.30	0.41	0.99	0.18
1982	0.80	0.09	0.45	0.29	0.05	0.20	0.44	0.58	0.17
1983	1.46	0.23	0.44	0.85	0.12	0.22	0.47	1.08	0.25
1984	2.15	0.49	0.91	0.64	0.13	0.55	0.57	1.34	0.20
1985	1.74	0.53	1.14	0.76	0.14	0.55	0.74	2.20	0.33
1986	3.16	0.40	0.84	1.28	0.22	0.68	1.18	2.55	0.42
1987	1.28	0.49	0.43	0.39	0.08	0.18	0.60	0.86	0.09
1988	0.91	0.17	0.14	0.30	0.16	0.24	0.40	0.38	0.08
1989	1.09	0.68	0.80	0.67	0.05	0.13	0.51	1.96	0.24
1990	0.97	0.10	0.66	0.84	0.09	0.40	0.72	0.98	0.25
1991	1.03	0.21	0.40	0.59	0.04	0.15	0.54	1.13	0.14
1992	1.90	0.21	0.68	0.73	0.13	0.26	0.31	0.62	0.27
1993	1.27	0.46	0.39	0.83	0.07	0.34	0.66	1.70	0.22
1994	1.25	0.22	0.31	0.55	0.08	0.29	0.51	0.91	0.29
1995	2.59	0.54	0.69	0.75	0.16	0.45	0.98	1.67	0.31
1996	4.65	0.42	0.94	2.89	0.22	0.94	1.86	3.02	0.83
1997	1.44	0.27	0.62	0.76	0.05	0.17	0.46	1.03	0.11
1998	1.71	0.54	0.85	0.95	0.19	0.32	0.66	1.62	0.16
1999	1.66	0.42	0.71	1.50	0.22	0.31	1.39	1.43	0.32
2000	1.22	0.28	0.38	1.04	0.08	0.27	1.07	0.29	0.14
2001	2.98	0.52	0.85	1.05	0.10	0.35	0.50	1.92	0.49
2002	2.01	0.57	0.66	1.57	0.11	0.44	1.00	1.43	0.27
2003	2.56	0.46	0.68	1.22	0.12	0.26	0.48	1.74	0.50
2004	1.46	0.42	0.60	0.70	0.04	0.59	0.64	1.91	0.35

Note: SSE = Southern Southeast sub-region.

CHAPTER 5: CHUM SALMON STOCK STATUS AND ESCAPEMENT GOALS IN SOUTHEAST ALASKA

by

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ABSTRACT

The annual harvest of chum salmon in Southeast Alaska commercial fisheries averaged more than 12 million fish per year over the most recent 10-year period, 1995–2004. Hatchery-produced fish comprised an average of 75% of this recent harvest. Estimated harvests of wild chum salmon appear to have rebounded somewhat from an historic average low of about 1 million fish per year in the 1970s, to an average of 3 million fish per year over the most recent 10-year period, 1995–2004. There are currently no chum salmon stocks in Southeast Alaska with information of sufficient quality to establish formal escapement goals. Examination of 21 years of peak survey estimates for 82 chum salmon index streams showed that escapements of most wild-stock chum salmon appear to be stable or increasing: 60 (73%) index streams exhibited stable or increasing trends, while 22 (27%) exhibited declines (8 of which we considered biologically meaningful). The stock status of five other systems or areas were updated using a variety of information including multiple foot surveys, fish wheel catches, and near-terminal area harvests: Fish Creek (Hyder), Tenakee Inlet, Cholmondeley Sound, Taku River, and Chilkat River. Although declines in Chilkat and Taku fall-run chum salmon warrant attention, the Alaska Department of Fish and Game does not recommend any chum salmon stocks in Southeast Alaska be considered as candidates for *stock of concern* status under the Sustainable Salmon Fisheries Policy, primarily because of a lack of reliable escapement measures.

Key words: Chum salmon, *Oncorhynchus keta*, escapement, escapement goals, escapement index, stock status, Chilkat River, Cholmondeley Sound, Disappearance Creek, Fish Creek, Lagoon Creek, Taku River, Taku Inlet, Lynn Canal, Tenakee Inlet.

INTRODUCTION

Chum salmon *Oncorhynchus keta* are known to spawn in approximately 1,500 streams in Southeast Alaska. Annual commercial harvests of chum salmon in Southeast Alaska were historically at high levels in the early to mid-1900s, then gradually declined to their lowest levels in the 1960s and 1970s (at which time fishing was fairly restricted). Chum salmon harvests increased dramatically in the 1990s. However, much of this increase is due to the production of hatchery fish by Southern Southeast Regional Aquaculture Association (SSRAA) at Nakat Inlet, Earl West Cove, Neets Bay, Anita Bay and Kendrick Bay; by Northern Southeast Regional Aquaculture Association (NSRAA) at Hidden Falls and Deep Inlet; by Douglas Island Pink and Chum, Inc. (DIPAC) at Amalga Harbor, Gastineau Channel and Limestone Inlet; and through combined DIPAC/NSRAA releases at Boat Harbor; and Kake Nonprofit Fisheries Corporation (KNFC) releases at Gunnuck Creek and Southeast Cove. Hatchery fish accounted for an average of 75% of the commercial harvest of chum salmon over the 10 years from 1995 to 2004. Over that same 10-year period, the total exvessel value of the commercial chum salmon harvest averaged $27 million a year (range: $15 million–$42 million), and the chum salmon harvest was more valuable than the harvest of any other species in 7 of those 10 years. Chum salmon are harvested primarily in commercial net fisheries (see Appendix 4.A, in Chapter 4 of this volume for extensive detail on ADF&G management districts for the commercial fisheries), and to a lesser extent by commercial troll fisheries, as well as sport, personal use, and subsistence fisheries.

The Sustainable Salmon Fisheries Policy (5 AAC 39.222) requires the Alaska Department of Fish and Game (ADF&G) to conduct an assessment of the status of salmon stocks in Southeast Alaska and Yakutat. The Policy for Statewide Escapement Goals (5 AAC 39.223) directs ADF&G to document existing salmon escapement goals, to establish goals when the department can reliably estimate escapement levels, and to perform an analysis when these goals are created or modified. The first assessment of Southeast Alaska and Yakutat chum salmon was conducted by Heinl et al. (2004). They did not identify any chum salmon stocks in Southeast Alaska and Yakutat for which existing information was sufficient to establish escapement goals. The vast majority of the available information about the region's chum salmon escapements comes from aerial surveys, often obtained in conjunction with aerial surveys directed primarily at estimating numbers of spawning pink salmon. ADF&G has long-term, standardized survey programs to estimate an index of spawning abundance for only a handful of chum salmon streams. In addition, 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 far from their spawning grounds.

Below, I provide an update of the Heinl et al. (2004) report on the status of chum salmon in Southeast Alaska. This update will be presented in two parts: 1) an overview of trends in Southeast Alaska chum salmon streams, based on trends in escapement survey measures, and 2) an overview and update of chum salmon systems that have been monitored more intensely, support directed fisheries, or warrant more attention (Fish Creek summer chum, Tenakee Inlet summer chum, Cholmondeley Sound fall chum, Taku River fall chum, and Chilkat-Klehini River fall chum).

OVERALL STOCK STATUS

HARVEST

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 in the region. The annual total harvest of wild chum salmon in Southeast Alaska was roughly estimated by simply subtracting the estimated contribution of hatchery fish to the common property fisheries from the total commercial harvest of chum salmon. Much of the contribution of hatchery chum salmon is taken in terminal fisheries near hatcheries or remote release sites. The annual estimated contributions of hatchery fish to the commercial fisheries were obtained from ADF&G Alaska salmon enhancement program annual reports (e.g., Farrington 2004; White 2005; and previous reports in that series). The estimated hatchery contribution was not yet available for the 2005 season. Although harvest levels are assumed to be known without substantial error, there is certainly some error in these estimates.

Hatchery operators are required to provide ADF&G with estimates of the total number of adult fish harvested for cost recovery purposes and broodstock, and to provide estimates of the contribution of their fish to the common property fisheries, broken out by gear group. A variety of methods have been used to assemble this information. DIPAC has used thermal otolith marks for over a decade to identify chum salmon harvested in commercial fisheries in Lynn Canal and Taku Inlet (Rick Focht, DIPAC, Juneau, personal communication). SSRAA has used coded wire tags to identify their fish in southern Southeast Alaska commercial fisheries, but has recently switched to thermal otolith marks (Gary Freitag, SSRAA, Ketchikan, personal communication). NSRAA has consulted with ADF&G commercial fisheries management biologists in the Sitka management area to determine where and when their fish are harvested in northern Southeast Alaska and to estimate contribution to the common property fisheries (Chip Blair, NSRAA, Sitka, personal communication). Fish harvested in terminal harvest areas were assumed to be 100% hatchery fish. Incubation facilities for the three largest chum salmon producers in the region, NSRAA, SSRAA and DIPAC, are now upgraded to permit thermal marking of almost all of their chum salmon releases. In 2004, 83% of all chum salmon released from hatcheries in Southeast Alaska were thermal marked (Bruce White, ADF&G, Juneau, personal communication).

Annual commercial harvests of chum salmon in Southeast Alaska were historically at high levels in the early 1900s (maximum, 9.4 million in 1918), then steadily declined to their lowest levels in the 1970s when the average annual harvest was 1.4 million (minimum, 600 thousand in 1969). The annual harvest increased dramatically in the 1990s, with an all-time maximum harvest of 16 million fish in 1996 (Figure 5.1). This recent increase was due largely to the production of hatchery fish, which have accounted for an average of 75% of the commercial harvest of chum salmon over the 10 years from 1995 to 2004, with a peak contribution of 12.7 million fish in 2000. Although not as high as harvests of the 1910s to the 1940s, annual commercial harvests of wild chum salmon have increased considerably since the mid-1970s, and averaged 3 million fish over the last 10 years, 1995–2004 (Figure 5.2).

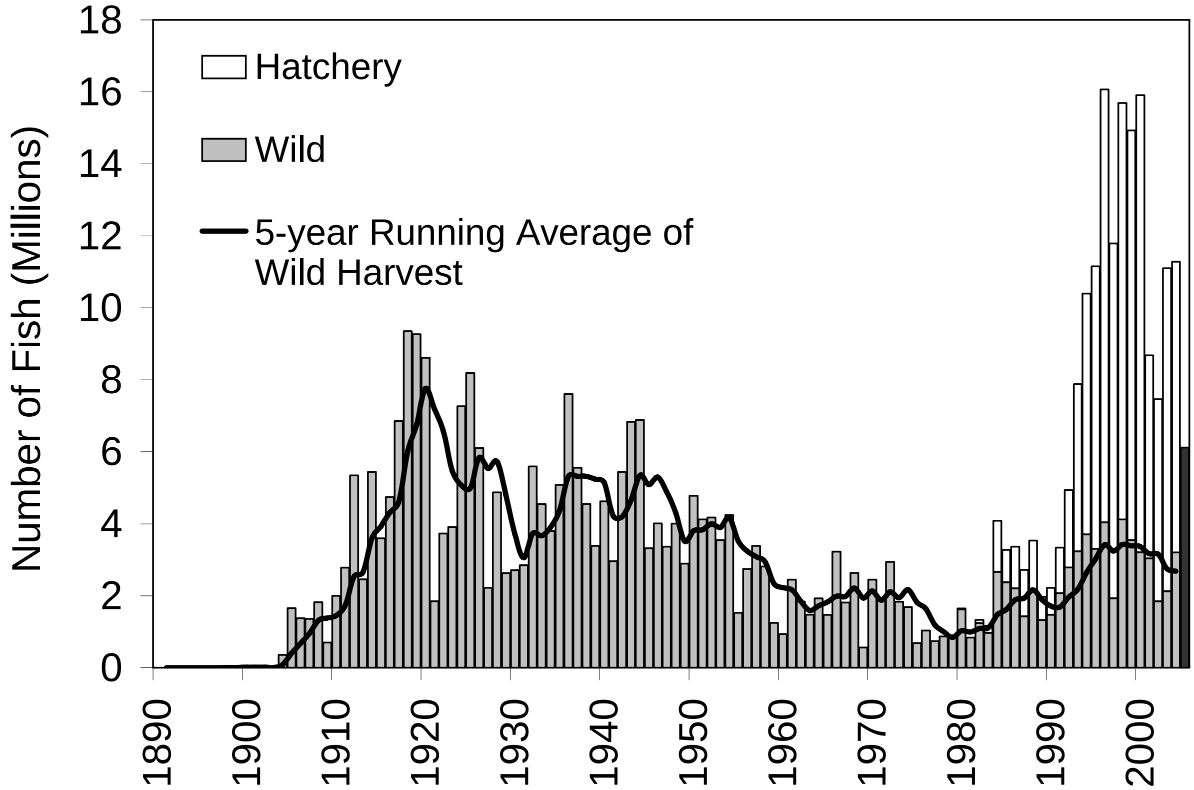

Figure 5.1–Annual harvest of chum salmon in Southeast Alaska from 1890 to 2005, showing the harvest of both hatchery-produced and wild chum salmon. (2005 catch as of 18 September 2005; hatchery contribution not available.)

ESCAPEMENT

There are about 1,200 streams and rivers in Southeast Alaska for which ADF&G has a record of at least one adult chum salmon count, in at least one year, since 1960. The survey types include foot, boat, and helicopter surveys, and weir counts. The vast majority of those 1,200 streams do not have a long time series of survey information—probably because most are not significant producers of chum salmon, and survey effort has been directed at the more productive chum salmon streams. In their review of available ADF&G chum salmon escapement survey observations from 1960 to 2002, Heinl et al. (2004) identified 82 streams which had sufficient information to be useful for assessing trends in spawning populations: 76 summer-run chum salmon streams and six fall-run chum salmon streams. I have updated this index through the

2004 season; complete 2005 survey data were not available at the time of this writing (Appendix 5.A.1).

Heinl et al. (2004) also pointed out the many limitations to the usefulness of these survey counts. Aerial escapement surveys are conducted by ADF&G Commercial Fisheries Division management staff, primarily to estimate escapements of pink salmon *O. gorbuscha* in conjunction with management of the purse seine fishery. The purse seine fishery is generally directed at pink salmon. Thus, most estimates of chum salmon have been obtained incidentally to surveys conducted for the purpose of managing the pink salmon fishery. Chum salmon are most easily observed early in the season when there are few pink salmon in the streams. Large numbers of pink salmon in a stream will mask chum salmon escapements in many areas (Van Alen 2000). Perhaps the primary limitation is that these subjective, raw survey estimates can only be used as is, in that we have no way to standardize them or adjust them to account for bias among observers. The maximum escapement measures used here can only be considered a relative indicator of escapement level, as the escapement level has changed from year to year. The analysis of escapement survey measures and estimated wild harvest presented here is intended primarily to provide a broad, region-wide gauge of the overall abundance of spawning chum salmon in Southeast Alaska.

TRENDS IN HARVEST AND ESCAPEMENT

Salmon populations, like populations of most living things, do not remain constant through time—salmon recruitment is strongly influenced by oceanographic and other processes that cause the populations to periodically increase or decrease (Quinn and Marshall 1989; Beamish and Bouillon 1993; Adkison et al. 1996; Mantua et al. 1997, and many others). Although Southeast Alaska salmon populations have exhibited various historical trends, we are most interested in detecting recent changes, and in particular, we would like to determine if a recent decline in a specific stock is meaningful or not.

I used a non-parametric approach described by Geiger and Zhang (2002) to assess trends over the most recent 21 years of catch and escapement index values. This method employs a simple regression that is robust to outliers that are common to data series of widely fluctuating salmon populations, and provides a means of relating stock decline to an underlying population level, so that the decline can be put into some kind of context. I regressed escapement (and catch) on year using a resistant regression line, and used the estimated *y*-intercept of this regression line as a back-cast estimate of what the underlying population level was at the start, or "year zero," of the series. The slope of the line was a robust estimate of the stock's decline (or increase) relative to the year-zero reference point. Geiger and Zhang (2002) suggested that a decline be considered *biologically meaningful* when the estimated underlying annual decline was more than 3% of the back-cast year-zero reference point over a 21-year series. A sustained 21-year, overall decline that is 3% of the back-cast year-zero reference point would result in the stock declining by more than 60%.

In the previous chum salmon stock status report, Heinl et al. (2004) simply summed the raw annual survey counts over all 82 index streams to assess trends in chum salmon spawning populations from 1982 to 2002. For the current analysis, I converted the index values to stream-specific ranks over time (Conover 1999, p. 269–271). This was done to make the analysis more robust to statistical outliers and to prevent atypical values in index streams that support very large populations of chum salmon from driving the estimated trend in the index as a whole.

Changing the units of the index from numbers of fish to a rank value also removes the appearance that the result is an estimate of total escapement, rather than a series that is appropriately used to gauge the relative rank of each year's escapement. I ranked the annual escapement measure for each of the 82 index streams from 1 to 21 over the most recent 21-year period, 1984–2004, then weighted each stream by its median value over the 21-year period. I examined trends in the ranked survey data using the Geiger and Zhang (2002) method for the entire weighted index as a whole, for the weighted index broken out by management district, and for each of the individual index streams.

Taken as a whole, the combined 82-stream chum salmon index showed an increasing trend of 2.3% of the year-zero reference point per year over the most recent 21 years, 1984–2004 (Figure 5.2). Heinl et al. (2004) reported a slightly larger increase in chum salmon escapement for the 21-year period from 1982 to 2002, but the indices were calculated differently between the two analyses. Using the same Geiger and Zhang (2002) method to assess trends in the annual harvest of wild chum salmon showed a similar increase of 3.8% of the year-zero reference point per year over the most recent 21 years, 1984–2004 (Figure 5.2).

The trend for escapement survey data for most management districts was generally stable or increasing, with the exception of the District 107, 108, and 109 indices, which showed declining trends in survey data over the past 21 years (Table 5.1). District 101 streams also showed a decline of 0.3% of the year-zero reference point per year—which is essentially stable.

A total of 60 (73%) of the chum salmon index streams were stable or increasing, while 22 (27%) exhibited declining trends in survey measures over the most recent 21-year period, 1984–2004 (Appendix 5.A.1). The number of streams exhibiting declining trends is double the total of 11 streams that exhibited declining trends in the 2003 stock status report (Heinl et al. 2004). Eight of those streams exhibited declines of greater than 3% of the year-zero reference point per year, which we considered to be *biologically meaningful* declines:

1. Tombstone Creek (ADF&G stream number 101-15-019),
2. Port Camden South Head (ADF&G stream number 109-43-006),
3. Port Camden West Head (ADF&G stream number 109-43-008),
4. Sample Creek (ADF&G stream number 109-62-014),
5. Dry Bay Creek (ADF&G stream number 110-13-004),
6. East of Snug Cove Creek (ADF&G stream number 110-23-040),
7. Clear River (ADF&G stream number 112-21-005), and
8. St. James Bay NW Side (ADF&G stream number 115-10-042).

Four of these eight index streams also showed declines in the 2003 stock status report: Tombstone, Port Camden West Head, Port Camden South Head, and Clear River (Heinl et al. 2004). Conversely, two streams that exhibited *biologically meaningful* declines in the 2003 report no longer exhibited declines of greater than 3% of the year-zero reference point: Hidden Inlet (ADF&G Stream Number 101-11-101), and Tyee Head East (ADF&G Stream Number 109-30-016).

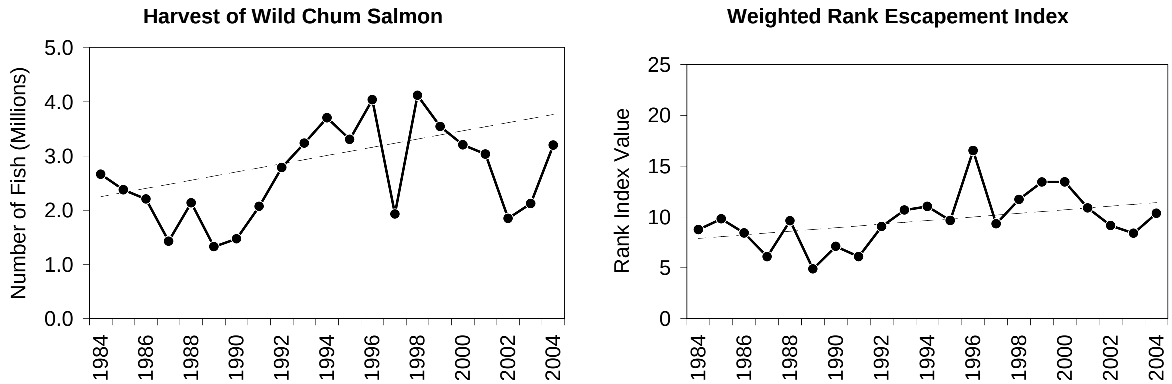

Figure 5.2–Annual estimated commercial harvest and overall escapement index of wild chum salmon in Southeast Alaska, 1984–2004. The dashed line is found by the "resistant regression," and the slope of the line is a robust estimate of increase or decline relative to the size of the harvest or escapement index at the beginning of the series. These data show annual increase of 3.8% the year-zero reference point per year in the harvest, and 2.3% in the escapement. The 2005 data were not available at the time of this writing.

EXAMINATION OF SPECIFIC STOCKS

The following section provides a review of available information on several stocks or groups of stocks of chum salmon in Southeast Alaska that were reported on by Heinl et al. (2004). Specifically included are stock groups that support directed commercial fisheries, stocks with better assessment information, and stocks that appear to have experienced declines in production in recent years.

FISH CREEK SUMMER CHUM SALMON

The summer-run chum salmon at Fish Creek (ADF&G Stream Number 101-15-085), in Portland Canal, near Hyder, has been studied by the National Marine Fisheries Service since the early 1970s (Helle 1984; Helle and Hoffman 1995, 1998). ADF&G conducted a coded-wire tagging study there from 1988 to 1995 (Heinl et al. 2000) to determine the harvest rate and distribution of this stock in the commercial fisheries of both Alaska and Canada. Harvest data do not exist for other years, and there is not sufficient information to establish a formal biological escapement goal for Fish Creek chum salmon. Foot surveys have been conducted for many years at Fish Creek (Helle and Hoffman 1998), and a rough estimate of the total escapement has been estimated annually from a series of three foot surveys conducted over the course of the season (Heinl et al. 2000). Estimated escapements of Fish Creek chum salmon have been highly variable, ranging from 3 thousand (1997) to 93 thousand (2004), and show a downward (but not *biologically meaningful*) trend over the most recent 21 years, 1985–2005 (Figure 5.3).

TENAKEE INLET SUMMER CHUM SALMON

Tenakee Inlet, located along the Chatham Strait shoreline of Chichagof Island (District 112), is among the largest producers of wild summer chum salmon in the Alexander Archipelago, and supports one of the few directed commercial purse seine fisheries on wild summer-run chum salmon in Southeast Alaska. Early season management of the Tenakee Inlet commercial purse seine fishery is based primarily on chum salmon returns from late June through early July (thereafter, management emphasis for the fishery switches to pink salmon).

Table 5.1–Median escapement survey counts (in thousands) of chum salmon, by year and ADF&G district, 1982–2004.

District	101	102	107	108	109	110	111	112	113	114	115
Number of Index Streams	8	2	2	1	9	12	9	19	6	9	5
1982	0.5	NA	2.8	0.8	0.7	0.1	0.5	0.5	0.5	1.2	2.5
1983	2.2	3.5	14.1	0.8	0.7	0.2	0.2	2.9	2.3	2.3	0.8
1984	6.0	14.0	8.7	3.5	2.1	1.1	1.8	1.8	17.0	3.3	0.8
1985	5.4	18.5	10.3	1.8	1.7	0.6	2.4	2.5	3.8	4.0	1.7
1986	3.3	14.0	1.2	1.1	4.5	0.6	0.9	2.0	3.3	3.1	0.6
1987	5.0	22.1	5.3	1.0	1.6	0.6	0.4	1.0	3.5	2.2	0.8
1988	18.8	18.6	6.5	1.3	1.2	3.4	0.6	1.6	3.5	1.0	0.8
1989	5.8	17.4	14.0	0.4	1.3	0.5	0.3	1.0	1.6	0.9	0.2
1990	2.8	15.2	1.7	4.1	1.0	1.5	0.6	1.5	3.3	1.8	0.8
1991	5.0	23.0	14.9	0.3	1.8	0.7	0.2	1.0	1.2	1.5	0.9
1992	7.6	18.3	7.8	0.7	2.0	0.9	0.7	4.0	1.6	2.7	0.5
1993	5.5	29.0	16.4	0.9	1.1	1.3	0.5	6.0	1.8	4.1	0.8
1994	7.8	21.4	2.3	0.7	0.6	1.0	3.5	2.5	3.0	3.4	1.9
1995	6.5	17.5	5.5	0.6	1.2	0.5	0.7	4.2	2.7	4.3	0.1
1996	12.0	30.8	15.3	2.5	3.2	2.2	6.6	21.0	5.4	9.2	5.7
1997	4.5	15.4	NA	1.4	2.0	0.8	1.3	5.3	8.0	5.6	0.5
1998	10.0	29.3	3.6	NA	1.1	0.6	3.3	3.1	2.5	4.0	1.1
1999	5.0	50.0	14.0	NA	1.4	0.7	1.6	9.5	8.0	6.5	0.6
2000	7.5	15.8	7.2	2.3	2.2	2.9	2.3	9.0	28.5	4.0	0.3
2001	8.0	22.5	8.0	0.8	1.0	1.1	1.2	3.8	9.2	6.1	6.0
2002	3.0	15.0	2.5	0.9	0.3	1.1	3.0	8.0	4.3	4.5	2.9
2003	5.4	37.5	3.1	0.6	0.5	0.9	1.2	3.7	5.0	3.0	5.0
2004	5.0	30.0	3.1	0.8	2.0	2.5	3.8	4.1	7.6	3.1	1.9
Estimated Year-Zero Level, 1984–2004[a]	8	2	13	13	12	6	5	7	8	6	7
Robust Estimate of Annual Decline	0.0	-0.7	0.2	0.4	0.2	-0.2	-0.3	-0.4	-0.1	-0.4	-0.1
Decline as percent of Year-Zero Level	0.3%	---	1.7%	2.8%	1.2%	---	---	---	---	---	---
Increase as percent of Year-Zero Level	---	43.7%	---	---	---	3.2%	6.3%	5.2%	1.9%	6.9%	0.8%

[a] Decline as a percent of the year-zero reference point shows the size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series, based on ranked index values. Districts 107 and 108 show declines of 1.5% and 2.9% respectively; all other Districts showed stable or increasing trends over the most recent 21-years, 1984–2004.

Chum salmon harvests in the purse seine fishery in Tenakee Inlet have increased substantially since the late 1970s. Catches averaged 58 thousand chum salmon in the 1980s but increased to an average of 152 thousand in the 1990s, including two years when catches exceeded 300 thousand (Figure 5.4). Catches declined from 2001 to 2003, but were higher in 2004 and 2005. Increased chum salmon production at the Hidden Falls hatchery may have contributed to the increase in commercial harvest of chum salmon at Tenakee Inlet. Stock composition estimates of chum salmon catches at Tenakee Inlet are not available, but it is possible that catches in the outer portions of the inlet have included Hidden Falls Hatchery chum salmon that sagged into the inlet on their return migration to the hatchery.

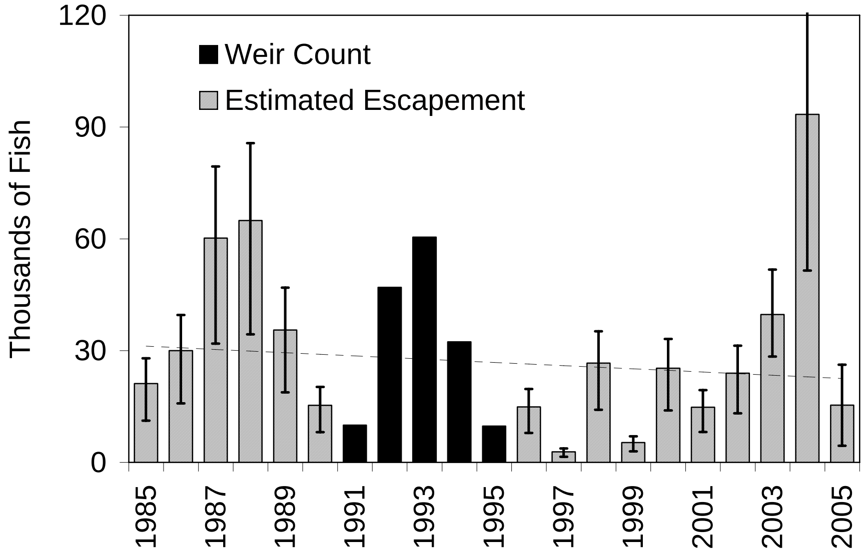

Figure 5.3–Annual estimated escapements and weir counts of chum salmon in Fish Creek (ADF&G stream number 101-15-085), 1985–2005. Vertical lines represent the 95% prediction range for estimated escapements. The dashed line represents a "resistant regression." The slope of the line is a robust estimate of increase or decline relative to the size of the harvest at the beginning of the series (Geiger and Zhang 2002); these data show an annual decline of 1.4% of the year-zero reference point.

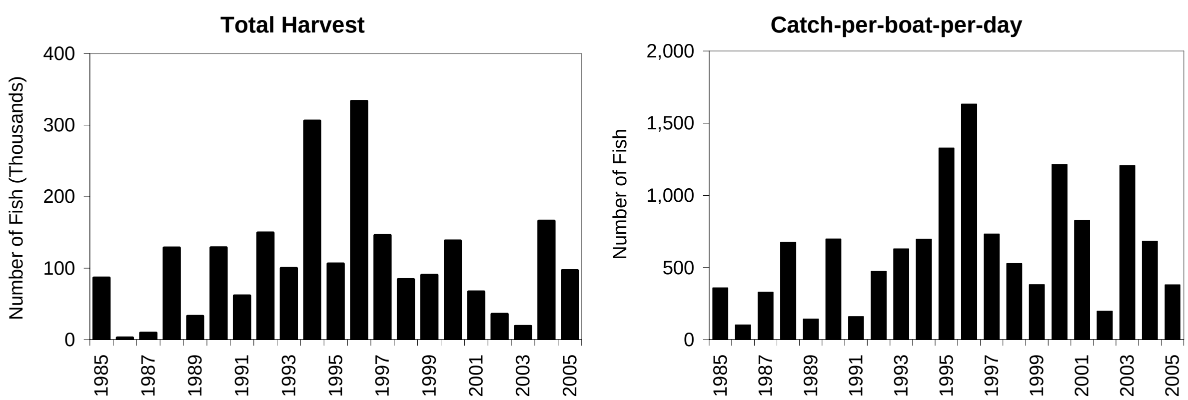

Figure 5.4–Annual harvest and catch-per-boat-per-day of chum salmon in the Tenakee Inlet commercial purse seine fishery, 1985–2005 (Management District 112; Subdistricts 41, 42, and 45).

Aerial surveys are the primary method for monitoring escapements to eight of the major Tenakee Inlet chum salmon systems: Kadashan River, Saltery Bay, Seal Bay, Long Bay Head, Big Goose, Little Goose, West Bay Head and Tenakee Inlet Head (Appendix 5.A.1). Median survey counts to those systems over the past 21 years range from 1,000 chum salmon in Little Goose Creek, to 10,000 chum salmon in Long Bay Head. Aerial survey data show a large increase in the annual peak estimates for all of the chum salmon index streams in the inlet, with the exception of Big Goose Creek. A weighted rank escapement index for those streams shows an increasing trend in survey data over the most recent 21 years, 1985–2005 (Figure 5.5).

CHOLMONDELEY SOUND FALL CHUM SALMON

Cholmondeley Sound located on the eastern side of Prince of Wales Island, in southern Southeast Alaska (Subdistrict 102-40), supports an annual commercial purse seine fishery on fall chum salmon. This fishery targets chum salmon returns to Disappearance Creek (ADF&G stream number 102-40-043) and Lagoon Creek (ADF&G stream number 102-40-060). Harvests of fall chum salmon in Cholmondeley Sound increased from an average of 44 thousand fish in the 1970s and 1980s to an average of 122 thousand fish a year from 1991 to 2004, including a peak catch of 359 thousand in 1998 (Figure 5.6).

Aerial surveys are used to monitor escapements to Disappearance and Lagoon creeks (Heinl et al. 2004). Peak survey estimates have ranged from 16 thousand to 50 thousand fish in Disappearance Creek and 4 thousand to 50 thousand fish in Lagoon Creek (Appendix 5.A.1). weighted rank escapement index for those streams shows an increasing trend in survey data over the 21 years, 1985–2005 (Figure 5.7). In 2005, the abundance of fall chum salmon at Cholmondeley Sound was poor, and the fishery was quickly closed after only one opening was conducted. Although the total harvest has dropped in recent years, the escapement and commercial harvest measures indicate that these stocks have been stable over the past two decades.

CHILKAT RIVER FALL CHUM SALMON

The Chilkat River drainage, near Haines, supports one of the largest fall chum salmon runs in the region. Most of the spawning takes place in the mainstem and side channels of the Chilkat River (ADF&G Stream Number 115-32-025) and its major tributary, the Klehini River (ADF&G Stream Number 115-32-046). Chilkat River fall chum salmon stocks are primarily harvested in the Lynn Canal (District 115) commercial drift gillnet fishery. Harvests and fisheries performance measures for the Chilkat River fall chum stock declined during the 1990s (Figure 5.8). Catches have been lower in recent years, due in part to fishery restrictions specifically implemented to protect this stock by reducing effort in the fishery (Bachman 2005).

The chum salmon escapement to the Chilkat River drainage was historically monitored via aerial surveys; however, ADF&G considers historic aerial surveys of the drainage to be unreliable primarily due to the highly glacial nature of the system. Fish wheels operated by ADF&G on the river since 1994 have provided some evidence that escapements have improved since the mid-1990s (Figure 5.9). From 2002 to 2005, ADF&G conducted in-river mark-recapture studies 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 total spawning population estimate in 2002 was 206 thousand fish (Bachman 2005), and in 2003 and 2004 estimates were 166 thousand and 329 thousand fish (Randy Bachman, ADF&G unpublished data).

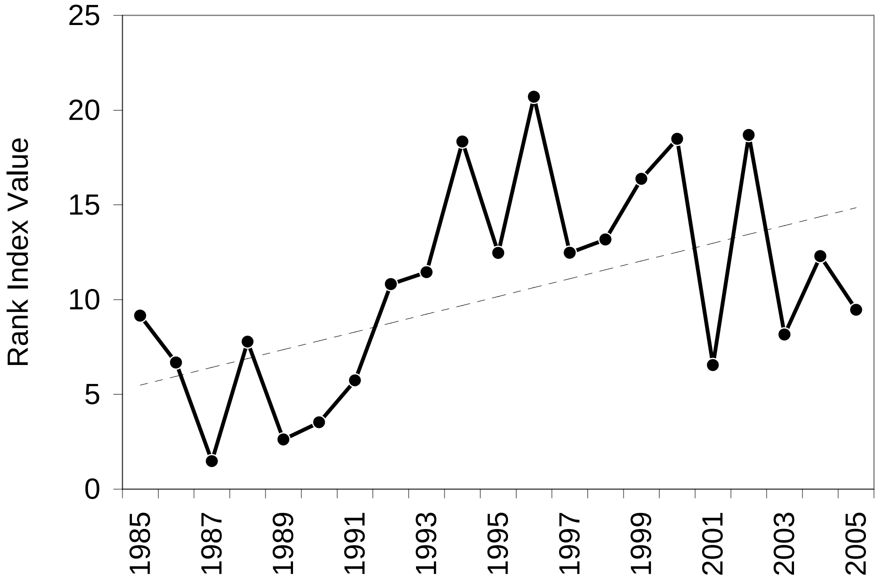

Figure 5.5–Weighted rank index of annual peak aerial survey estimates of chum salmon in eight Tenakee Inlet (Management District 112; Subdistricts 42, 44, 46, 47, and 48) chum salmon streams, 1985–2005. The dashed line represents a "resistant regression," and the slope of the line is a robust estimate of increase or decline relative to the size of the escapement index at the beginning of the series (Geiger and Zhang 2002).

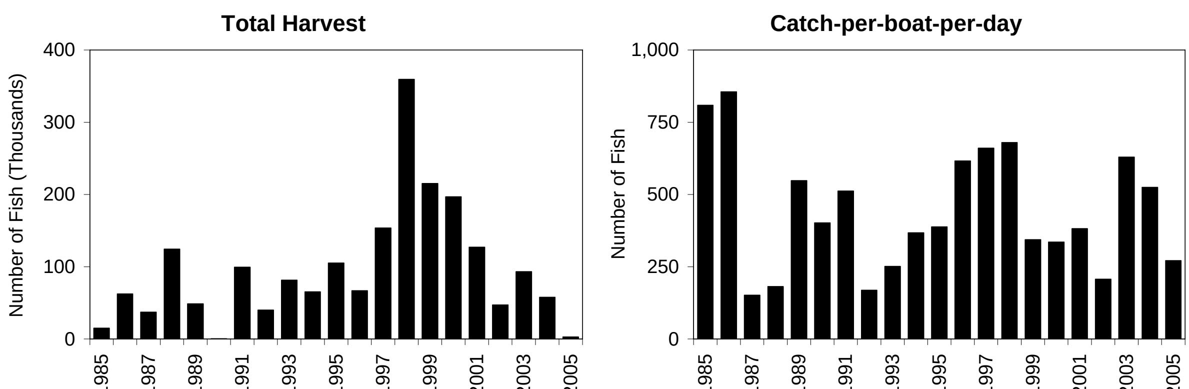

Figure 5.6–Annual harvest and catch-per-boat-per-day of chum salmon in the Cholmondeley Sound commercial fall chum salmon purse seine fishery, 1985–2005 (Subdistrict 102-40).

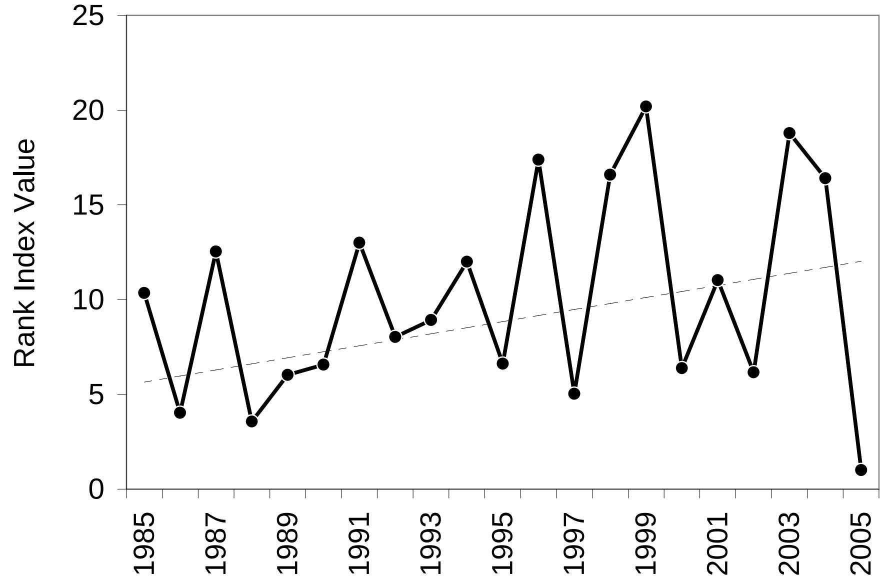

Figure 5.7–Weighted rank index of annual peak aerial survey estimates of chum salmon in Disappearance Creek (ADF&G stream number 102-40-043) and Lagoon Creek (ADF&G stream number 102-40-060), Cholmondeley Sound, 1985–2005. The dashed line represents a "resistant regression," and the slope of the line is a robust estimate of increase or decline relative to the size of the escapement index at the beginning of the series (Geiger and Zhang 2002).

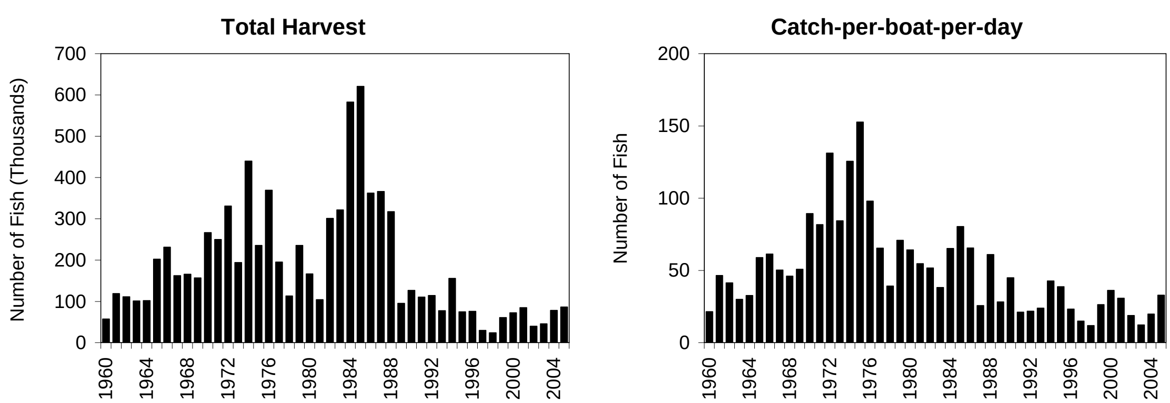

Figure 5.8–Annual harvests and catch-per-boat-per-day of fall-run chum salmon in the Lynn Canal (Management District 115) commercial drift gillnet fishery, 1960–2005. All chum salmon harvested in Statistical Week 32 (average mid-week date 6 August) and later are considered fall-run fish.

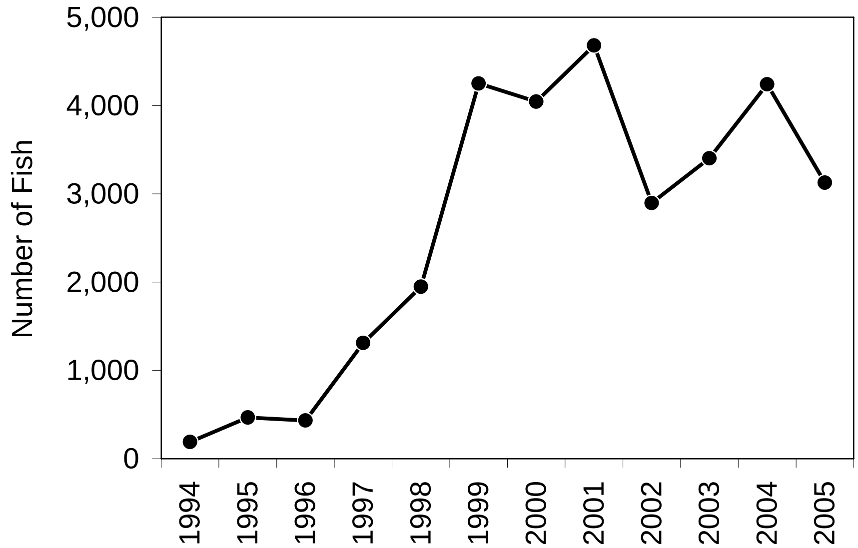

Figure 5.9–Annual fish wheel catches of chum salmon on the Chilkat River, 1994–2004. (2005 survey data were not available.)

The preliminary 2005 estimate was about 134 thousand fish (Randy Bachman, ADF&G, Haines, personal communication). Assuming all chum salmon harvested in the Lynn Canal drift gillnet fishery from Statistical Week 32 (average mid-week date 6 August) through the end of the fishing season are bound for the Chilkat River, harvest rates on Chilkat River chum salmon in the Lynn Canal fishery from 2002 to 2005 varied from 16% to 39%.

Given the limited amount of reliable escapement information and current lack of an escapement goal, ADF&G did not recommend Chilkat River chum salmon as a candidate stock of concern, as identified in the Sustainable Salmon Fisheries Policy (Heinl et al. 2004).

TAKU RIVER FALL CHUM SALMON

The transboundary Taku River (ADF&G Stream Number 111-32-032) supports a fall run of chum salmon that spawns in Canada. Taku River fall chum salmon stocks are primarily harvested in the Alaska Taku Inlet (Subdistrict 111-32) commercial drift gillnet fishery, but these fish are also harvested incidentally in the Canadian inriver coho salmon drift gillnet fishery. The harvest of fall-run Taku River chum salmon in District 111 increased in the 1970s, and averaged 54,000 fish in the 1970s and 1980s. Beginning in the late 1980s, however, the harvest declined steadily to very low levels, and over the past 10 years the harvest in District 111 averaged only 8% (4,200 fish) of the 1970s to 1980s average (Figure 5.10). Catches have been lower in recent years, due in part to fishery restrictions specifically implemented to protect this stock by reducing effort in the fishery. Fish wheel counts, the only escapement indicator for the Taku River, also declined in the early 1990s and have since remained stable at lower levels (Figure 5.11).

Fish wheel counts, the only escapement indicator for the Taku, also declined in the early 1990s and have since remained stable at lower levels (Figure 5.11).

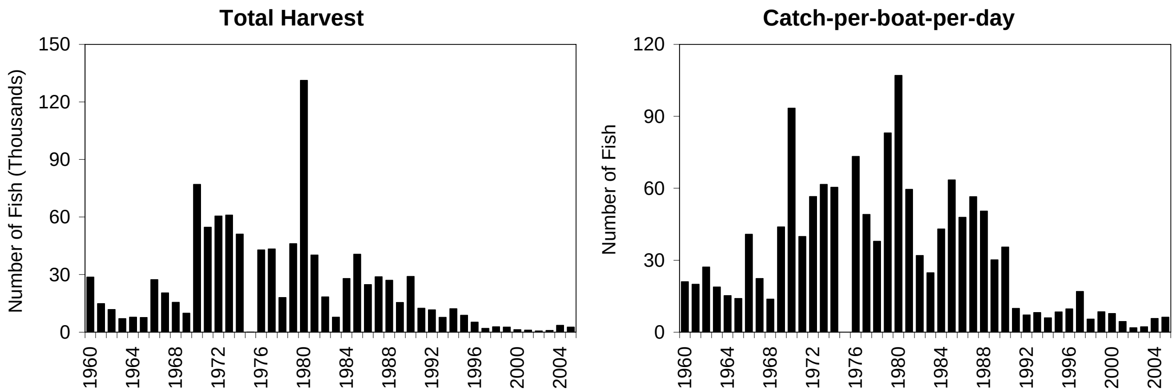

Figure 5.10–Annual harvests and catch-per-boat-per-day of fall-run chum salmon in the Taku Inlet (Management District 111-32) commercial drift gillnet fishery, 1960–2005. All chum salmon harvested in Statistical Week 34 (average mid-week date 20 August) and later are considered fall-run fish.

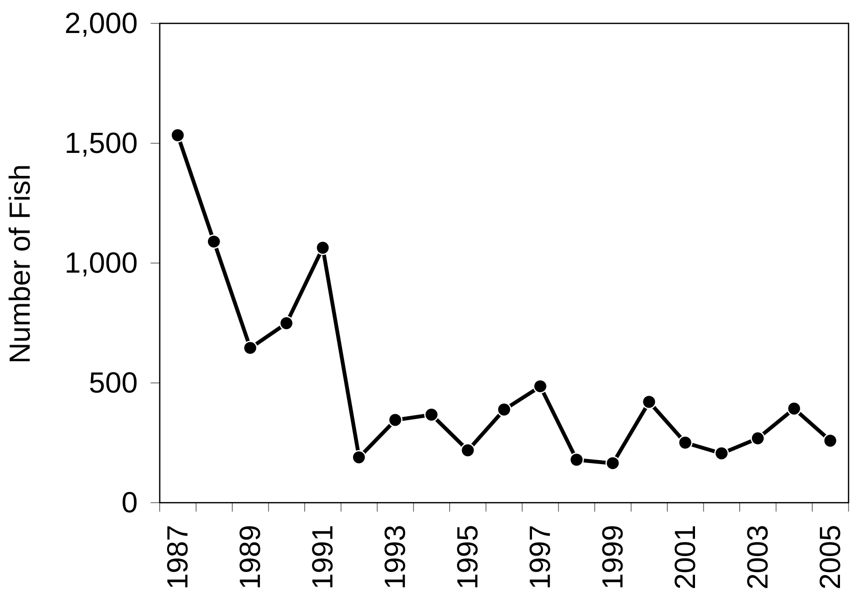

Figure 5.11—Annual fish wheel catches of chum salmon on the Taku River, 1987–2005.

In the future, ADF&G intends to continue to limit harvest of this stock through conservative fishery management. ADF&G conducted a radio-telemetry study in 2004 to identify the primary chum salmon spawning areas within the Taku River drainage (James Andel, ADF&G, Douglas, personal communication). The department has also worked cooperatively with the University of Alaska and the National Marine Fisheries Service, Auke Bay Lab, to assess marine survival of chum salmon fry in the Taku Inlet-Stephens Passage area. Among other things, these studies will examine predator-prey relationships, and near-shore marine interactions of wild and hatchery chum salmon. These studies are ongoing and results have not yet been published. Given the current lack of reliable escapement information and lack of a meaningful escapement goal, ADF&G did not recommend Taku River chum salmon as a candidate stock of concern (Heinl et al. 2004).

ESCAPEMENT GOALS

At this time, there are currently no chum salmon stocks in Southeast Alaska with sufficient information to establish formal escapement goals under the Sustainable Salmon Fisheries Policy (5 AAC 39.222). The quality of existing escapement and stock-specific production measures would need to be significantly improved to develop meaningful and technically supportable escapement goals for specific streams or areas.

DISCUSSION

The analysis of escapement survey measures and estimated wild harvest presented here was intended primarily to provide a broad, region-wide gauge of the overall abundance of chum salmon in Southeast Alaska. The majority of the Southeast Alaska chum salmon stocks for which we have reasonable survey information appear to be stable or increasing over the past two decades (Figure 5.2, Appendix 5.A.1). Likewise, annual harvests of wild chum salmon appear to have increased since the 1970s (Figures 5.1 and 5.2). Even so, chum salmon harvest levels and total population levels have not rebounded to nearly the same degree as pink salmon (Zadina et al. 2004) and wild coho salmon (*O. kisutch*; Shaul et al. 2004), and are still well below harvest levels of the early 20th century (Van Alen 2000). Other recent stock status assessments of Southeast Alaska chum salmon have also noted that most stocks for which we have sufficient information appear to be stable or exhibit increasing trends (Baker et al. 1996; Van Alen 2000; Heinl et al. 2004).

This region-wide analysis of escapement survey measures also points to some areas where chum salmon streams have exhibited declines in peak survey estimates over the past 21 years (e.g., District 101, 107, 108 and 109, Table 5.1). It should be noted, however, that the majority of these survey measures have not been collected or synthesized in a standardized manner and do not represent total escapements. At best, this analysis has identified stocks that may warrant more attention, particularly the chum salmon streams in Port Camden (District 109), which showed some of the largest declines in escapement measures, and also exhibited declines in the last chum salmon stock status report (Heinl et al. 2004).

The declines in survey measures in some areas have clearly been a result of the increased abundance of pink salmon, rather than real declines in chum salmon abundance. The increase in the pink salmon population has masked the abundance of chum salmon and greatly limited ADF&G's ability to estimate numbers of chum salmon in many or most streams in Southeast Alaska (Van Alen 2000). As an example, the high abundance of pink salmon in mainland areas of District 101 has made it impossible to estimate numbers of chum salmon in some of the index streams there; no surveys were obtained for the Marten River over the past three years, and no surveys were obtained for King Creek or the Wilson River over the past two years (Appendix 5.A.1). The inability to separate chum salmon from pink salmon has also become a problem recently in the Sitka area, where pink salmon runs have exhibited substantial increases over the past 15 years (Zadina et al. 2004).

The Chilkat and Taku rivers were historically two of the largest fall chum salmon producers in the region (Heinl et al. 2004; Bachman 2005). Reasons for the decline of both stocks in the 1980s

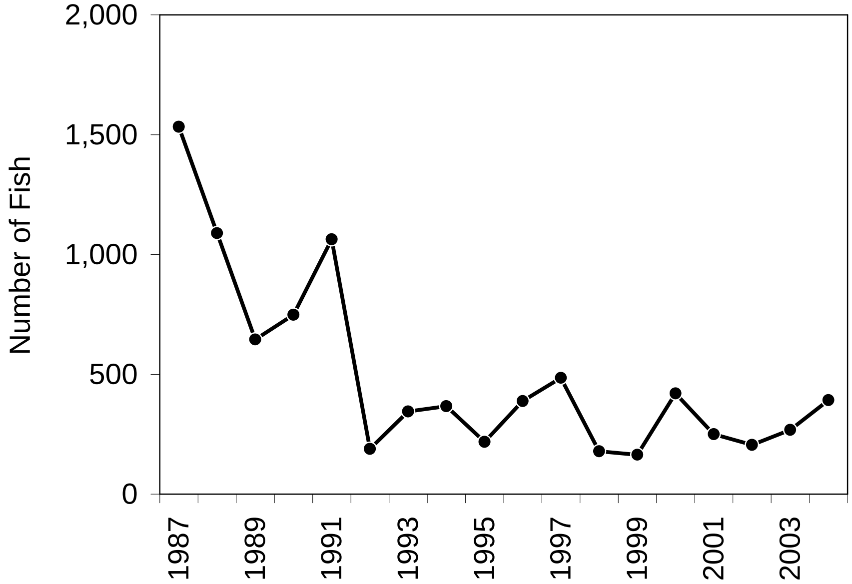

Figure 5.12–Annual fish wheel catches of chum salmon on the Taku River, 1987–2004. (2005 survey data were not available.)

are not well understood, but could include a combination of natural changes in spawning habitat, over-fishing, interactions with other species of fish, and interactions with the increased production of hatchery fish. The decline in both stocks is also interesting in light of the fact that chum salmon stocks in Tenakee Inlet and Cholmondeley Sound were stable, or even exhibited increasing trends over the same time period, despite supporting directed purse seine fisheries (Heinl et al. 2004).

As already noted, we currently do not possess information of sufficient quality to establish *biological escapement goals* for chum salmon in Southeast Alaska. The general lack of quality information about escapements and stock specific harvests is not a problem that is likely to change any time soon without significant, long-term cost and effort. We could develop *sustainable escapement goals* the stocks, or groups of stocks, for which escapements and harvests have been monitored most intensively, and ADF&G will examine this matter prior to the next Board of Fisheries meeting in 2009. The recent studies to estimate the spawning population of Chilkat River chum salmon will be used to develop a reliable and greatly needed index of annual abundance (Bachman 2005), and could potentially be useful for developing an escapement goal for that stock.

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APPENDIX 5.A

Appendix 5A.1–Peak escapement index series for select chum salmon streams in Southeast Alaska, 1982–2004. (2005 survey data not yet available.)

District	101	101	101	101	101	101	101	101	102	102	107	107
Area	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Ketchikan	Petersburg	Petersburg
Survey Type	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Fall	Fall	Summer	Summer
Stream No.	101-11-101	101-15-019	101-30-030	101-30-060	101-45-078	101-55-020	101-55-040	101-71-04K	102-40-043	102-40-060	107-40-025	107-40-049
Stream Name	Hidden Inlet	Tombstone	Keta River	Marten River	Carroll Creek	Wilson River	Blossom	King Creek	Disappearance Creek	Lagoon Creek	Oerns Creek	Harding River
1982	550	550	3,000	300	8,000	500	200	500			280	5,300
1983	3,600	18,500	800	500	3,500	300				3,500		14,100
1984	800	9,250	16,500	300	11,000		4,100	6,000		14,000	1,080	16,400
1985	1,400	5,000	30,000	1,200	5,850	10,700	8,000	5,000	26,000	11,000	590	20,000
1986	430	10,000	46,000	1,000	600	10,000		3,300	16,000	12,000		1,200
1987	1,500	12,800	10,100	1,000	5,000				32,500	11,700	1,300	9,300
1988	1,400	20,000	47,000	17,500	44,000	28,000	5,000	10,000	21,000		490	12,520
1989	500	12,100	11,000			10,800	800	300	19,800	15,000	4,000	24,000
1990	650	4,400	30,000			10,000	1,100	800	22,000	8,300	530	2,800
1991	150	5,500	11,000		5,000	5,000	5,000	300	25,000	21,000	700	29,000
1992	500	2,600	20,000	6,000	13,000	10,000	4,000	9,200	21,000	15,500	150	15,500
1993		22,800	28,000	3,500	5,500	5,000	3,500	7,000	29,000		800	32,000
1994	1,500	7,500	40,100	2,500	3,200	23,000	8,000	15,000	22,700	20,000	50	4,500
1995	5,000	5,000	20,000	950	25,000	800	12,000	8,000	20,000	15,000	900	10,000
1996	2,700	5,200	90,000	4,000	30,000		12,000	12,000	38,000	23,500	1,600	29,000
1997	160	5,500	15,000	1,500	3,500	18,000	1,500	10,000	18,000	12,800		
1998	4,300	8,000	43,000	10,100	8,500	10,000	10,000	35,000	32,500	26,000	1,100	6,000
1999	800	3,000	20,000	1,000	10,000	5,000	5,000	8,000	50,000	50,000	2,900	25,000
2000	600	4,000	22,000	1,000	14,000	16,000	2,000	11,000	21,500	10,000	500	13,800
2001	3,800	4,000	45,000	200	20,000	15,000	12,000	4,000	22,000	23,000	1,000	15,000
2002	700	3,000	20,000		2,000	9,000	5,000	1,500	22,000	8,000	50	5,000
2003	1,200	5,400	16,000						45,000	30,000	200	6,000
2004	550	14,000	8,000		2,500		5,000		30,000	30,000	30	6,200
Robust Estimate of Annual[a] Decline												
Decline as percent of Year-Zero Level		4.3%	2.9%			2.9%					2.4%	1.6%
Increase as percent of Year-Zero Level	0.0%			0.0%	1.3%		1%	4.6	14.6%	27.3%		

[a] Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)

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Appendix 5A.1–(Page 2 of 7)

District	108	109	109	109	109	109	109	109	109	109	110	110
Area	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg
Survey Type	Foot	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Fall	Fall	Summer	Summer	Fall	Summer	Summer	Summer	Summer	Summer
Stream No.	108-41-010	109-30-016	109-43-006	109-43-008	109-44-037	109-44-039	109-45-013	109-45-017	109-52-007	109-62-014	110-13-004	110-22-004
Stream Name	North Arm Creek	Tyee Head East	Port Camden S Head	Port Camden W Head	Saginaw Bay S Head	Saginaw Creek	Salt Chuck - Security	Lookout Point Cr Sec B	Rowan Creek	Sample Creek	Dry Bay Creek	Amber Creek - N Arm Pybus
1982	840	700	3,800	1,550	350	650	12,000	30	50	200		40
1983	812		771	680		150	4,830			150	50	50
1984	3470		6,800	3,200	2,590	400	19,000	500	500	1,600	1,000	300
1985	1826	400	8,700	3,500	2,600		21,000	350	500	700	1,700	160
1986	1068	7,000	8,200	6,070	1,300	350	12,000	1,150	1,300	4,500	700	500
1987	1040	6,100	7,400	1,550	1,600	600	11,200	600	150	500	500	250
1988	1280	13,500	4,100	3,250	500	500	15,500	350	700	1,200	500	300
1989	404	4,000	4,700	2,350	300	50	8,410	1,000	1,300	800	350	
1990	4095	10,000	3,000	960		50	20,040	800	100		2,400	850
1991	265	600	3,100	1,800			6,000	200			90	200
1992	708	8,500	2,900		600	1,000	19,300			600	300	
1993	926	7,500	5,100	1,700	1,100	300	7,400	800	900	500	1,400	500
1994	740	4,500	3,800	1,150	600	300	4,900	400	300	300		
1995	570	23,300	2,000	1,200	1,540	50	14,000	950	1,200	1,100	250	600
1996	2530	18,000	3,400	1,350	3,200	3,300	19,000	2,000	650	2,000	1,800	1,200
1997	1420	1,950	2,000	1,500	300		5,400	300	2,000		800	50
1998		1,050	3,600	2,200	1,100	1,000	31,500	900	2,000	300	250	500
1999		6,300	920	600	3,000		20,000		1,400	400		800
2000	2280	34,000	1,400	1,100	3,000	800	12,500		3,200	300	1,000	2,100
2001	820	400			400	1,000	3,500		2,100			450
2002	881	100	300	150			6,000	400			125	
2003	606	2,500	131	545			8,700	300			300	
2004	800	4,100	1,700	1,600	500	1,400	13,100		4,700	2,200	1,200	600
Robust Estimate of Annual[a]												
Decline as percent of Year-Zero Level	2.8%	2.4%	4.6%	4.5%	1.9%		1.7%	2.1%		4.3%	3.1%	
Increase as percent of Year-Zero Level						8.9%			220.0%			13.0%

a Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)

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Appendix 5.A.1–(Page 3 of 7)

District	110	110	110	110	110	110	110	110	110	110	111	111
Area	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Petersburg	Juneau	Juneau
Survey Type	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer
Stream No.	110-22-012	110-22-014	110-23-008	110-23-010	110-23-019	110-23-040	110-32-009	110-33-013	110-34-006	110-34-008	111-13-010	111-15-024
Stream Name	Donkey Creek	Cannery Cove - Pybus Bay	Johnston Creek	Bowman Creek	Snug Cove - Gambier Bay	East of Snug Cove	Chuck River -Windham B	Lauras Creek	Glen Creek	Sanborn Creek	Mole River	Windfall Harbor W
1982	1,600	220	10	20	150	30		2,000	50	1,200	400	300
1983	1,300	150	600	80			25	200		350	150	
1984	2,600	1,000	2,500	400	750	1,200	700	3,500	1,200	1,900	400	1,500
1985	1,455	150	400			600		900	700	400	500	
1986	450	350	600	500	700	1,500	300	1,500	500	900	300	300
1987	3,300	1,515	800	400	300			700	405	2,000		200
1988	6,300	3,350	8,000	3,460	2,300	4,300	2,600	3,520	900	3,400	700	350
1989	600		400	100		150		500	600	500		
1990	2,800	700	2,000	400	950	1,650	600	1,500		2,400	500	200
1991	1,200	100	700		450	1,150	30	1,050	900	1,000	200	100
1992	1,500	1,500	500		700	150	1,000	1,800	800	900	300	700
1993	6,000	2,700	1,200	500	800	800	1,000	1,400	1,600	2,900	200	250
1994	3,900	2,400		250			500	1,500	850	950	4,000	200
1995	7,900	1,600	550	300	180	320	400	800	500	1,600	340	20
1996	13,000	4,800	7,200	2,000	800	1,200	7,100	2,320	500	14,300		3,000
1997	11,000	1,800	500	300	600		2,000	180	3,000	1,000		
1998	12,000	2,900	600			400		500	725	1,000		3,000
1999	10,500	3,400	600	400	450	800	300	900	100	700	6,000	1,100
2000	15,000	6,200	2,700	1,100	900	1,100	3,050	4,800	4,000	8,200	2,010	600
2001	4,500	2,800	1,050	500	1,000	400	1,100	1,300	500	2,500	875	2,500
2002	2,100	1,525			400	900	200		1,800	1,200	3,100	1,950
2003	2,500	1,300						350	700	1,095	500	4,000
2004	8,100	5,200	2,100	900	1,300	400	3,000	2,800	3,000	7,300	8,000	
Robust Estimate of Annual[a]												
Decline as percent of Year-Zero Level						3.7%		1.9%		1.2%		
Increase as percent of Year-Zero Level	9.4%	39.1%	0.8%	21.3%	3.1%		3.9%		2.3%	0%	12.4%	14.4%

[a] Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)

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Appendix 5A.1–(Page 4 of 7)

District	111	111	111	111	111	111	111	112	112	112	112	112
Area	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Lynn Canal	Juneau	Sitka	Sitka	Juneau
Survey Type	Aerial	Aerial	Aerial	Aerial	Aerial	Foot	Foot	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer
Stream No.	111-15-030	111-16-040	111-17-010	111-33-010	111-41-005	111-50-010	111-50-069	112-15-062	112-19-010	112-21-005	112-21-006	112-42-025
Stream Name	Pack Creek	Swan Cove Creek	King Salmon River	Prospect Creek - Speel	Admiralty Creek	Peterson Ck Favor C	Fish Creek-Douglas I	Robinson Creek	Wilson River	Clear River - Kelp Bay	Ralphs Creek	Kadashan Creek
1982	950	350	500	500	450		1219	500	200	5,000	3,000	
1983	100		300	75	520		1466	3,200		8,000	6,000	
1984	1,000	2,100	4,150	800	5,100		3380	550	3,800	4,000	1,000	
1985	2,400	300	3,200		1,500	2675	6683	500	160	2,000	5,000	3,000
1986	700	1,000	4,750	500	1,000		2047	1,200	500	12,000	4,200	1,800
1987	1,000	200	2,000	200	500	1901	281	500	400	23,000		
1988	300	600	1,300	1,750	250	3366	609	350	350	25,000	100	7,600
1989			300	50	200	874	1187	400	500	1,000	3,000	1,000
1990	600	550	1,050	300	800	1980	1486	1,200	500	8,000	2,000	2,100
1991	200	100	1,300	200	200		2194	1,000		2,000		1,000
1992	600		1,300	400	200	760	1839	1,000	1,900	4,000	1,100	2,000
1993	800		1,000	400	500	32	639	1,800	6,000	3,500	4,000	3,500
1994	3,500	1,200	5,800	500	500	6766	3943	1,500	2,000	5,000	2,000	6,200
1995	800		2,200	600	200	3862	2941	400	2,200	8,000	10,800	3,600
1996	8,000	900	9,000		900	13050	6595	2,750	5,600	5,000	6,000	43,000
1997	6,500	200	3,400	321	50	1325	1890	4,000	500	12,000	7,000	3,500
1998	8,000	2,000	7,100	5,000	700	3675	849	1,000	3,100	3,000	6,000	3,000
1999	4,000	500	3,500	500		1700	1570	2,000	4,000	15,000	18,600	2,500
2000	2,600	625	4,110	2,250	300	9630	7915	1,350	5,700	3,600	7,400	10,800
2001	1,500	100	1,150	1,000	5,500	5940	815		2,000	5,500	6,500	700
2002	5,000	1,000	2,800	3,000	3,500	3230	146	4,750	3,100	3,000	9,000	19,000
2003	17,000	500	4,000	400	600	6400	1150	3,200	10,000			5,700
2004	12,500	1,000	5,000	1,100		2,528		1,000	3,000	3,000	5,600	10,000
Robust Estimate of Annual[a] Decline as percent of Year-Zero					0.7%		1.5%			3.4%		
Increase as percent of Year-Zero Level	24.4%	1.5%	7.6%	24.4%		6.8%		29.0%	33.3%		28.4%	12.0%

[a] Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)

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Appendix 5.A.1–(Page 5 of 7)

District	112	112	112	112	112	112	112	112	112	112	112	112
Area	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau
Survey Type	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer
Stream No.	112-44-010	112-46-009	112-47-010	112-48-015	112-48-019	112-48-023	112-48-035	112-50-020	112-50-030	112-65-024	112-72-011	112-73-024
Stream Name	Saltery Bay Head	Seal Bay Head	Long Bay Head	Big Goose Creek	Little Goose Creek	West Bay Head Creek	Tenakee Inlet Head	Kennel Creek	Freshwater Creek	Greens Creek	Weir Creek N Arm Hood	Weir Creek S Arm Hood
1982		2,800	5,000	3,000	10	1,000	300	140	250		450	500
1983	12,300	7,700	12,000	14,100		2,000	4,000	500	600	500	700	500
1984	250	6,200	8,430	7,600		1,600	1,000	1,400	600	1,800	1,800	1,600
1985	400	5,000	7,000	10,050	100	15,300	1,900	2,000	2,000	4,000	5,000	2,500
1986	1,000	4,500	10,000	10,000	50	2,000	1,050	2,200	750	6,500	1,300	3,000
1987	300	1,000	1,000	1,300		1,000	1,100	450		1,750	630	1,800
1988	200	6,200	6,000	5,400	130	4,300	1,925	1,100	300	800	1,600	500
1989	500	1,000	1,200	2,100		1,800	1,300	500	300	500	700	400
1990	200	2,700	2,200	3,050	100	500	1,500	4,050	300	4,150	1,000	500
1991	1,000	5,500	3,200	5,000		2,000	2,000	2,050	100	200	1,000	200
1992	1,100	9,300	10,100	8,300	200	8,400	6,100	3,150	1,000	600	8,300	4,300
1993	1,050	7,000	7,100	19,700	1,000	10,500	9,200	8,900	1,650	1,000	7,700	2,200
1994	2,800	19,000	42,500	39,200	1,500	29,510	18,000	1,300	1,300	1,100	2,300	500
1995	2,000	7,000	10,000	22,000	500	7,900	13,000	4,200	6,000	900	650	1,500
1996	32,700	89,000	105,000	84,000	2,000	57,000	103,000	39,300	2,600	11,500	22,000	13,000
1997	3,500	5,700	19,900	9,400	1,400	15,000	11,000	7,000	500	2,000		4,900
1998	400	11,000	15,000	10,000	7,700	23,000	6,700	2,700		500	500	550
1999	1,100	20,000	28,000	21,000	2,150	32,000	15,000	3,300		1,200	13,000	6,000
2000	10,500	22,500	28,500	25,000	4,800	42,000	15,000	3,000		2,300	3,000	16,500
2001	4,150	5,000	2,275	2,935	1,000	5,200	10,000	5,000	1,000	1,500	3,900	3,600
2002	21,000	55,000	42,000	23,000	7,500	23,500	28,500	2,950	4,750	1,450	8,000	4,050
2003	700	7,600	4,000	1,100	5,000	5,000	12,000	1,000	500	3,000	500	500
2004	4,100	12,000	10,700	4,500	800	20,000	5,500	2,000	2,400	2,150	2,300	2,500
Robust Estimate of Annual[a]												
Decline as percent of Year-Zero Level										1.2%		
Increase as percent of Year-Zero Level	63.9%	94.7%	10.6%	3.4%	78.3%	69.2%	33.3%	6.2%	14.3%		4.7%	6.2%

[a] Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)

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Appendix 5A.1–(Page 6 of 7)

District	112	112	113	113	113	113	113	113	114	114	114	114
Area	Juneau	Juneau	Sitka	Sitka	Sitka	Sitka	Sitka	Sitka	Juneau	Juneau	Juneau	Juneau
Survey Type	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Foot	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer
Stream No.	112-80-028	112-90-014	113-22-015	113-32-005	113-53-003	113-72-005	113-73-003	113-81-011	114-23-070	114-25-010	114-27-030	114-31-013
Stream Name	Chaik Bay Creek	Whitewater Creek	Whale Bay Gr Arm Hd	W Crawfish NE Arm Hd	Saook Bay West Head	Sister Lake SE Head	Lake Stream Ford Arm	Black River	Mud Bay River	Homeshore Creek	Spasski Creek	Game Creek
1982	1,600	300	3,900	400	400	3,000		500	500		800	2,500
1983	2,000	2,550	2,500	500			2000	10,000	400	550	500	8,000
1984	6,900	3,000	1,500	30,000	1,500	41,500		17,000	220	600	3,250	12,200
1985	2,500	2,000	2,000	2,500	5,000	11,000	450	15,000			3,500	4,300
1986	8,300	2,000	5,500	18,000	1,000	3,500	400	3,000		515	2,300	3,900
1987	2,000	700	4,000	4,100	500	3,000	651	5,000	150		500	8,000
1988	6,500	1,800	6,500	3,500	3,500	5,000	1033	3,000	100	150	950	5,600
1989	2,000	2,000	1,300	500		4,000	1610	8,000		100	910	1,500
1990	1,500	1,700	4,000	3,000	3,500	11,000	959	2,500		300	2,500	2,000
1991	500		200	50	2,000	15,000	1456	1,000	200	600	1,500	2,300
1992	11,200	5,000	4,000	1,000	2,000	10,000	1140	500	50	700	3,000	3,000
1993	23,600	9,900	500	2,000		5,000	1559		2,000	1,100	3,700	11,900
1994	6,500	2,500	3,400	3,000	500	4,000	3000	1,000	300	2,200	4,600	3,400
1995	6,300	4,100	7,550	5,000	100	4,000	1416	300	300	4,000	3,200	4,800
1996	21,000	4,500	4,200	10,500	6,600	9,000	1271	1,000	1,100	1,050	9,700	35,100
1997	8,100	3,000	11,000	6,000	1,700	10,000	2955	20,000	1,000	200	4,500	9,000
1998	5,000	2,000	1,300	7,000	4,000	1,000	2631	2,400	200	400	4,200	4,000
1999	10,000	8,950	5,000	8,000		8,000	1697	9,000	3,500	500	2,000	7,000
2000	21,700	5,300	27,000	33,000	6,700	30,000	844	31,000	350	500	900	4,100
2001	12,000	1,700	18,300	8,900	9,500	1,000	5900	23,000	4,500	1,300	9,500	12,100
2002	10,750	1,500	1,000	3,500	5,500	5,000	1927	6,000	2,250	1,100	9,400	2,000
2003	3,800	3,700	5,000	2,300		2,000	6700	6,000		800	3,500	15,000
2004	13,000	4,200	10,100	13,000	3,500	5,000	1,560	30,000	3,100	2,200	4,000	5,000
Robust Estimate of Annual[a]												
Decline as percent of Year-Zero Level												
Increase as percent of Year-Zero Level	25.4%	8.6%	4.0%	7.6%	13.6%	0.0%	76.7%	4.9%	180.0%	16.9%	10.0%	1.5%

[a] Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)

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Appendix 5.A.1–(Page 7 of 7)

District	114	114	114	114	114	115	115	115	115	115
Area	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau	Juneau
Survey Type	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial
Run-timing	Summer	Summer	Summer	Summer	Fall	Summer	Summer	Summer	Summer	Summer
Stream No.	114-32-004	114-33-023	114-34-010	114-40-035	114-80-020	115-10-042	115-10-046	115-10-080	115-20-010	115-20-052
Stream Name	Seagull Creek	Neka River	Humpback Creek	Trail River	Excursion River	St James Bay NW Side	St. James River	Endicott River	Berners River	Sawmill Crk - Berners R.
1982	220	2,500	2,300	370	1,640	400				4,580
1983	1,550	24,500	2,250	3,000	3,300	825	5,000			250
1984	2,400	10,550	4,000	1,650	7,750	800	60	500	800	2,500
1985	5,300	7,000	3,700	500	4,025	2,910	100		5,400	400
1986	500	12,500	4,500	400	9,150	700	360	210	1,070	600
1987	2,300	8,000	2,500	500	2,000	1,000		400	600	1,500
1988	600	4,000	550	2,500	3,700	1,900	492	2,563	406	800
1989	200	2,800	800	500	2,050	350		5,000	100	100
1990	110	11,000	1,500	200	5,100	750	150	4,600	500	1,150
1991	1,200	4,400	2,800	7,400	900	1,100		900		430
1992	1,200	9,700	4,400	400	2,700	600	200	2,550	220	450
1993	4,100	12,500	5,500	800	8,200	700	250	1,500	800	1,150
1994	1,700	9,300	6,300	300	4,300	600		800	4,000	3,050
1995	1,700	9,700	4,600		6,140	105			125	
1996	7,000	24,800	27,000	500	9,200	850	2,400	10,000	5,900	5,700
1997	7,800	9,500	5,600	1,400	34,400	300	200		770	1,000
1998	300	8,600	4,000	500	8,000	100		2,000	1,025	1,100
1999	3,000	20,000	6,500	8,000	10,000	50	510	1,900	780	
2000	1,250	29,000	7,400	4,000	17,000	550	72	200	250	2,979
2001	3,000	23,000	6,050	200	17,750		6,000	1,100	10,000	
2002	4,500	11,500	4,350	6,500	4,680	2,800	1,200	3,000	3,400	
2003	600	16,000	2,500	1,000	6,300		5,000	16,100		550
2004	800	7,400	2,500	1,300	5,200	1,800		2,400	1,950	1,000
Robust Estimate of Annual[a]										
Decline as percent of Year-Zero Level						3.3%				
Increase as percent of Year-Zero Level	7.5%	33.3%	11.1%	13.6%	14.1%		33.3%	1.4%	8.7%	2.1%

[a] Decline as a percent of year-zero level shows the annual size of a stock decline (or increase) relative to the size of the stock trend at the beginning of the series. (Blank cells denote lack of sufficient survey data.)