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Sockeye Salmon Stock Status and Escapement Goals in Southeast Alaska

by

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and

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December 2011

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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ABSTRACT

In Southeast Alaska and the Yakutat area, sockeye salmon (*Oncorhynchus nerka*) spawn in more than 200 coastal lakes and streams and in several large transboundary river systems (rivers that flow through Canada into Alaska). We have extensive stock assessment information and formal escapement goals for 13 systems, including most of the largest sockeye salmon producers in the region: three in the Yakutat area (Situk, Lost, and East Alsek-Doame rivers), six in the Southeast area (Chilkat, Chilkoot, Redoubt, Speel, Hugh Smith, and McDonald lakes), and four in transboundary rivers (Alsek-Klukshu, Taku, and mainstem Stikine rivers, and Tahltan Lake in the Stikine River drainage). Over the period 2003–2010, escapements to these 13 systems met or exceeded escapement goal ranges 74% of the time. No changes to existing sockeye salmon escapement goals were recommended in this stock status review; however, goals for the Alsek and Klukshu rivers are currently under review in the Pacific Salmon Treaty process. In 2009, the McDonald Lake run was identified as a stock of management concern, as defined by the State of Alaska's *Policy for Management of Sustainable Salmon Fisheries* (5 AAC 39.222). Sockeye salmon escapements to McDonald Lake have improved substantially over the past three years, and the department recommends that the stock of concern designation be removed. No additional stocks of sockeye salmon were identified that currently meet the criteria for stocks of concern as defined in the sustainable salmon fisheries policy.

Key words: Sockeye salmon, *Oncorhynchus nerka*, escapement, escapement goals, escapement goal ranges, stock status, Alsek River, Chilkat Lake, Chilkoot Lake, East Alsek River, Doame River, Hugh Smith Lake, Klukshu River, Lost River, McDonald Lake, Redoubt Lake, Situk River, Speel Lake, Stikine River, Tahltan Lake, Taku River, Pacific Salmon Treaty, stock of concern, transboundary rivers.

INTRODUCTION

Sockeye salmon (*Oncorhynchus nerka*) harvested in Southeast Alaska originate from three sources: (1) coastal Alaska lakes and rivers; (2) transboundary rivers that flow through Canada and into Alaska (e.g., the Alsek, Taku, and Stikine rivers); and (3) Canadian river systems whose returning adult salmon migrate through U.S. waters (e.g., the Nass and Skeena rivers). There are more than 200 sockeye-producing systems within the region (Baker et al. 1996), most of which are small producers, but their combined production is substantial (Van Alen 2000). Most sockeye salmon originate in lake systems, but some populations originate in riverine environments within the region's large mainland glacial rivers (Wood et al. 1987; Eiler et al. 1992). Run timing varies throughout the region and within individual stocks in several of the larger drainages. Sockeye salmon are available to commercial fisheries from early June to mid-September, and peak abundance occurs during the month of July. Spawn timing is also highly variable but most spawning occurs between early August and late October.

Sockeye salmon are harvested by commercial, subsistence, and sport users, with the commercial harvest being the largest. Commercial harvests of sockeye salmon averaged 1.3 million fish over the most recent 10-year period, 2001–2010 (Figure 1). This harvest was dominated by drift gillnet (43%), purse seine (37%), and set gillnet (10%) fisheries, with smaller harvests in troll fisheries (<1%), fisheries inside the Annette Island Reserve (2%), and hatchery cost-recovery fisheries (8%). The total ex-vessel value of the commercial sockeye salmon harvest averaged $8.2 million a year (range: $3.7–$13.9 million) over the same period. The annual reported harvest of sockeye salmon in subsistence and personal use fisheries averaged 45,000 fish over the last decade. The estimated annual sport harvest of sockeye salmon averaged 18,000 fish from 2001 to 2010 (Jennings et al. 2011).

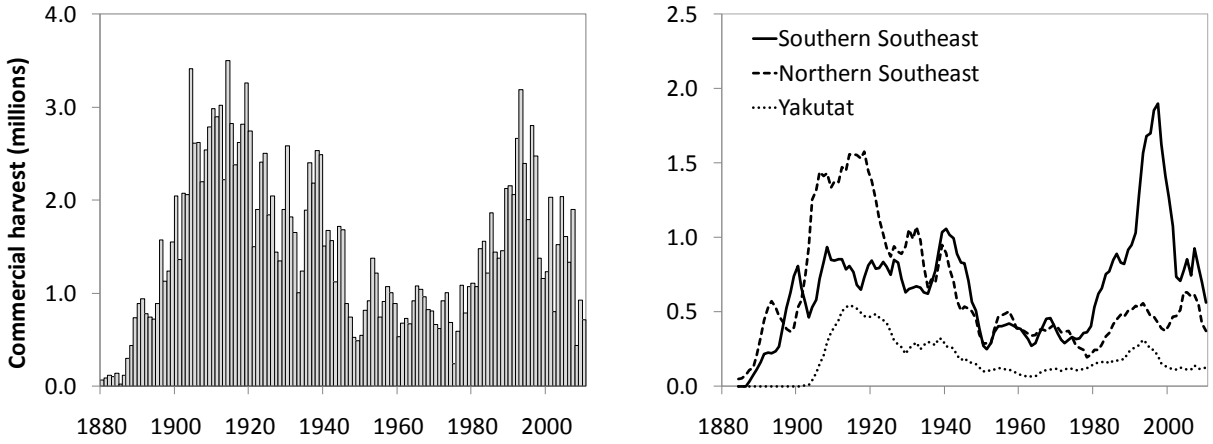

Figure 1.–Annual commercial harvest of sockeye salmon in Southeast Alaska (left), and 5-year running average trends in commercial harvest by subregion (right), 1880–2010. (Data prior to 1960 are from Byerly et al. 1999).

The sockeye salmon is often the primary species harvested in the Southeast Alaska commercial drift gillnet fisheries from mid-June through August, though substantial numbers of pink (*O. gorbuscha*), summer-run chum (*O. keta*), and coho (*O. kisutch*) salmon are also harvested. There are five traditional drift gillnet fishing areas in Southeast Alaska: District 1 (Tree Point), District 6 (Prince of Wales), District 8 (Stikine), District 11 (Taku-Snettisham), and District 15 (Lynn Canal; Figure 2). Each of the traditional fisheries harvests mixed stocks of sockeye salmon. In addition, Snettisham Hatchery sockeye salmon runs are harvested in a terminal drift gillnet fishery in Port Snettisham.

Management of most drift gillnet fisheries is governed by specific agreements with Canada in the Pacific Salmon Treaty, in addition to consideration of domestic stocks. The current treaty agreement specifies that the District 1 fishery will be managed to achieve an annual catch share of 13.8% of the annual allowable harvest[1] of the Canadian Nass River sockeye salmon run, and the district 6 and 8 fisheries will be managed to harvest 50% of the total allowable catch of transboundary Stikine River sockeye salmon runs. The treaty also specifies that the District 11 fishery will be managed to harvest 82% of the total allowable catch of wild transboundary Taku River sockeye salmon runs, to be adjusted based on the strength of sockeye salmon runs produced from joint U.S.-Canada Taku River sockeye salmon enhancement projects. The District 15 fishery, which targets sockeye salmon runs to the Chilkat and Chilkoot rivers, is the only Southeast Alaska drift gillnet fishery not directly affected by the Pacific Salmon Treaty.

A large portion of the annual sockeye salmon harvest is also taken incidentally in Southeast Alaska commercial purse seine fisheries, which are primarily managed to harvest pink salmon (Clark et al. 2006). The largest purse seine harvests of sockeye salmon traditionally occur in District 4, on the outer coast of southern Southeast Alaska (an average of 295,000 fish since 2001). Pacific Salmon Treaty provisions currently limit the total District 4 sockeye salmon harvest prior to statistical week 31 (approximately the last week in July) to 2.45% of the annual

[1] "Annual allowable harvest" and "total allowable catch" are terms defined in the Pacific Salmon Treaty that represent the harvestable surplus in excess of agreed upon escapement goals.

allowable harvest of the combined Canadian Nass and Skeena river sockeye salmon runs. The purse seine fishery at Hawk Inlet (District 12) is also limited to the harvest of 15,000 wild sockeye salmon in the month of July to conserve north-migrating stocks in accordance with the *Northern Southeast Seine Fishery Management Plan* (5AAC 33.366). 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 and Necker bays along the outside coast of northern Southeast Alaska.

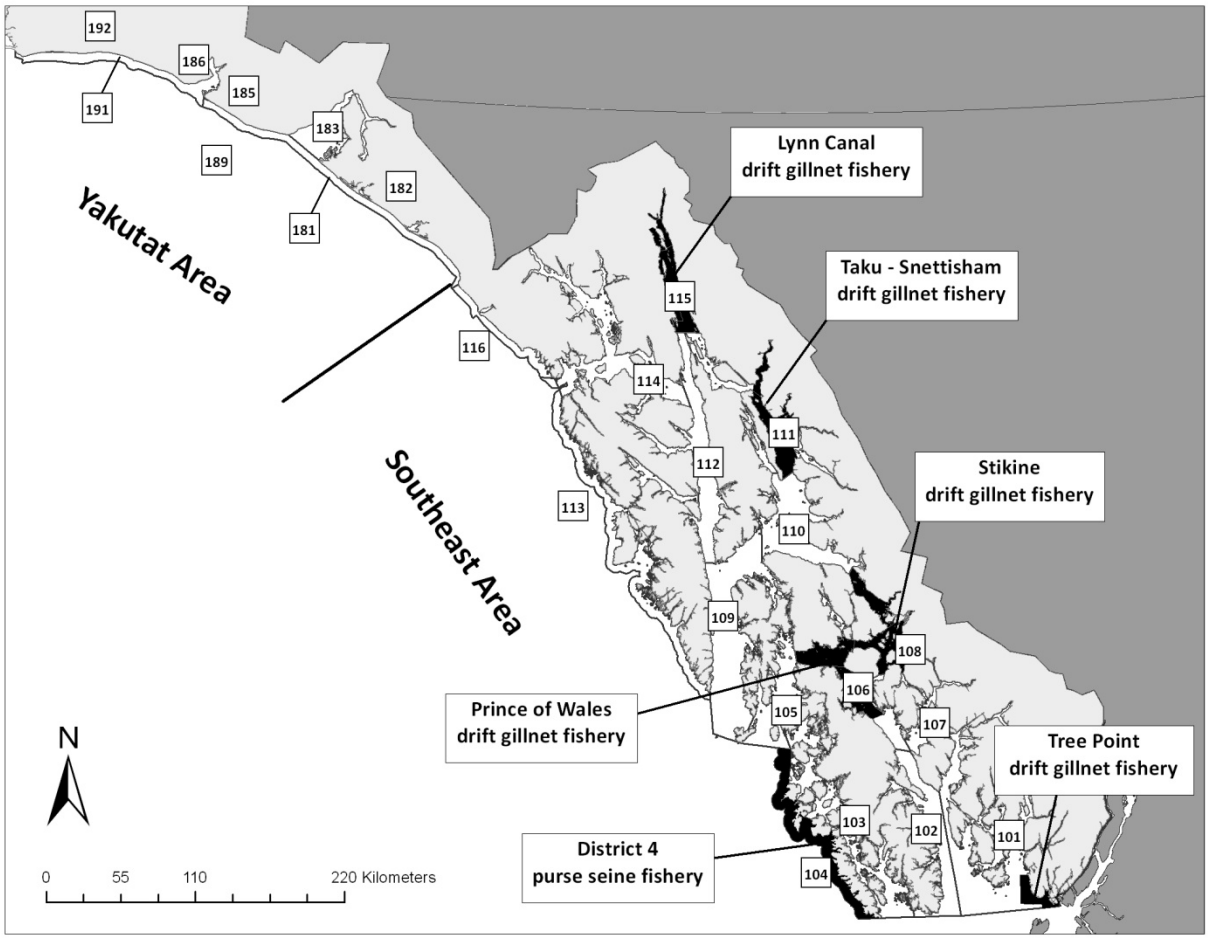

Figure 2.–Map of Southeast Alaska showing commercial fishing districts and fisheries identified in the text.

The sockeye salmon is the primary species targeted in Yakutat area[2] commercial set gillnet fisheries from June through August. Set gillnet gear is allowed only in the Yakutat area; moreover, set gillnets are the only net gear allowed for commercial harvest of salmon in the Yakutat area. The fisheries are typically confined to intertidal areas and ocean waters immediately adjacent to the mouth of streams draining into the Gulf of Alaska and are managed

[2] The "Southeast Alaska area" extends from Dixon Entrance to Cape Fairweather; the "Yakutat area" extends from Cape Fairweather to Cape Suckling.

inseason based on developing runs at each site. Commercial harvests in the Yakutat Bay set gillnet fishery, however, comprise mixed stocks returning to all the systems in the area.

Many of the region's sockeye salmon systems are monitored by the Alaska Department of Fish and Game (ADF&G), and monitoring efforts have been augmented by other agencies, including the U.S. Forest Service, National Marine Fisheries Service (NMFS), and the Canadian Department of Fisheries and Oceans (CDFO), as well as by non-governmental groups, including several tribal and aquaculture associations. A subset of the region's sockeye salmon systems have been examined intensively and over a long enough period of time to gain sufficient understanding of stock productivity to develop escapement goals (Figure 3; Table 1).

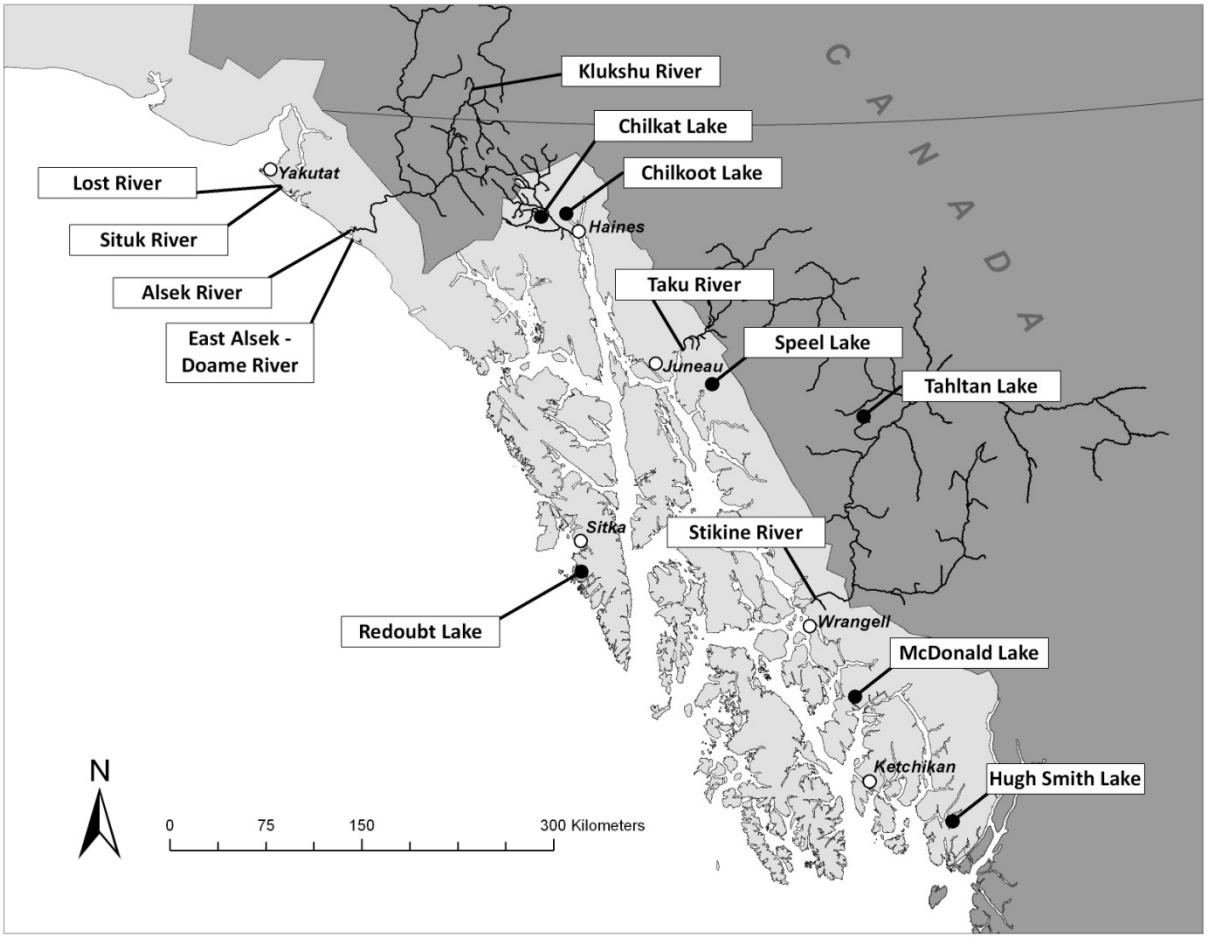

Figure 3.–Map of Southeast Alaska and adjacent Canada and sockeye salmon systems with formal escapement goals.

In 2000 and 2001, the Alaska Board of Fisheries adopted the *Policy for the Management of Sustainable Salmon Fisheries* (5AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223) into state regulation to ensure that the state's salmon stocks would be conserved, managed, and developed using the sustained yield principle. These policies require ADF&G to report on salmon stock status to the board on a regular basis, 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 the requirements of these policies, Geiger et al. (2004) produced ADF&G's first report on stock status and escapement goals of sockeye salmon for the Southeast Region. The report was subsequently updated by Geiger et al. (2005) and Eggers et al. (2008). This report provides an update concerning the status of sockeye salmon in the region through 2010.

STOCK ASSESSMENT

HARVEST

Commercial harvest data are compiled from ADF&G fish ticket information. Commercial harvest data provide estimates of the total harvest in a fishery, but not stock composition. Sport harvest is estimated by means of a household-based postal survey (Jennings et al. 2011). Subsistence and personal use harvests have traditionally been estimated by means of returned permits, though harvests in these categories are often underreported and underestimated as demonstrated by probability-based surveys at many locations in Southeast Alaska (Conitz and Cartwright 2005, Conitz 2008, Riffe et al. 2009, Walker 2009). By far, however, the largest removals are in the commercial fisheries.

The department conducts intensive stock identification programs in order to effectively manage harvested stocks and to implement the complex harvest sharing agreements of the Pacific Salmon Treaty. A variety of techniques, including analyses of scale patterns, brain parasites, egg diameters, tissues, and thermal otolith marking of hatchery releases are used to estimate contributions of the region's major producers to drift gillnet and southern purse seine fisheries (McPherson 1990; Jensen 2000; Van Alen 2000; TTC 2011; Wilcock et al. 2011). Stock identification programs provide harvest estimates for important stock groups useful for management purposes, but do not provide a high degree of resolution for individual Southeast Alaska wild stocks. This has limited the development of brood year tables necessary for stock-recruit analysis, particularly for the many 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 and very precise estimates of the contributions of hatchery sockeye are available for fisheries that harvest those stocks (e.g., the drift gillnet fisheries in districts 6, 8 and 11, and the Hawk Inlet purse seine fishery in northern Chatham Strait).

ESCAPEMENT

Yakutat Area

Sockeye salmon escapements to the Situk River have been measured with a weir since 1976, but most sockeye salmon systems that support directed fisheries in the Yakutat area have been assessed through aerial surveys since the early 1970s. From 2003 to 2005, mark-recapture studies were conducted to estimate total escapement and provide information on the relationship between ongoing index survey counts and total escapements at four systems: East Alsek River (Waltemyer et al. 2005a, b; Smith et al. 2006b), Lost River system (Waltemyer et al. 2005c), and Akwe and Italio rivers (Smith et al. 2006a).

Transboundary Rivers

Stock assessment in the transboundary Alsek, Taku, and Stikine rivers is conducted jointly by ADF&G, CDFO, and several Canadian First Nations groups, through the Transboundary Technical Committee of the Pacific Salmon Commission. Detailed overviews of transboundary river

escapement estimation projects are outlined in annual management plans (e.g., TTC 2011). These projects include estimation of drainagewide sockeye salmon escapements in the Taku and Stikine rivers based on mark-recapture studies and postseason run-reconstruction analyses of fishery data. Escapement estimates of individual tributary stocks in these rivers are also obtained from weir counts at Tahltan Lake (Stikine; since 1959), Klukshu River (Alsek; since 1976), and several Taku River systems, including Little Trapper Lake (since 1983), the Tatsamenie system (since 1985), Kuthai Lake (since 1992), and King Salmon Lake (since 2003). Drainagewide Alsek River escapements (1976–2008) were recently reconstructed by Eggers and Bernard (2011).

Southeast Area

There are many sockeye salmon runs in the Southeast area for which intermittent weir counts or survey information exists, but long-term monitoring projects have been maintained at only a small number. Sockeye salmon escapements have been measured with counting weirs at Chilkoot (since 1976), Redoubt (since 1982), Speel (since 1982), and Hugh Smith (since 1980) lakes. Escapements at McDonald Lake have been estimated from standardized foot surveys since 1980. Since 1967, escapements into Chilkat Lake have been measured by weir counts, mark-recapture studies, and dual-frequency identification sonar, or DIDSON (since 2008). Drainagewide Chilkat River sockeye salmon escapement has been estimated through a fish wheel-based mark-recapture program since 1994.

Long-term data have also been collected at two smaller systems for which formal escapement goals have not been developed. Sockeye salmon escapement at Ford Arm Lake, near Sitka, has been estimated from mark-recapture studies in conjunction with coho salmon studies since 1983. Escapements at Ford Arm Lake averaged 3,200 fish through 2009 (Shaul et al. *in prep*). Sockeye salmon escapements have been measured annually by NMFS at a weir on Auke Creek, near Juneau, since 1963. Escapements at Auke Creek averaged 3,341 sockeye salmon through 2006 (Echave 2009).

In 2001, ADF&G and federal and tribal cooperators launched short-term assessment projects on 19 sockeye-producing lakes in Southeast Alaska. 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 some cases, subsistence harvests were also directly estimated. Initial results from 12 projects operated by ADF&G were briefly summarized by Geiger et al. (2004).

ESCAPEMENT GOALS AND ESCAPEMENT PERFORMANCE

The status of sockeye salmon stocks in Southeast Alaska was judged primarily by performance in meeting established escapement goals. Formal escapement goals are established for 13 sockeye salmon systems in the Southeast region, including three Yakutat area stocks, four transboundary river stocks, and six Southeast area stocks (Tables 1 and 2; Eggers et al. 2008). Six of these goals are classified as *biological* escapement goals, five as *sustainable* escapement goals, and two as *optimal* escapement goals. Escapement goal classifications are defined in the *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) under Section (f):

> "(3) "*biological* escapement goal" or "(BEG)" means the escapement that provides the greatest potential for maximum sustained yield;" and

"(36) "*sustainable* escapement goal" or "(SEG)" means a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10 year period, used in situations where a BEG cannot be estimated or managed for; …will be stated as a range "(SEG Range)" or a lower bound "(Lower Bound SEG)"…;" and

"(25) "*optimal* escapement goal" or "(OEG)" means a specific management objective for salmon escapement that considers biological and allocative factors and may differ from the SEG or BEG; …adopted as a regulation by the board."

On average, escapements to these 13 systems met or exceeded escapement goals 74% of the time since 2003 (the year following the first regional sockeye salmon stock status report by Geiger et al. 2004; Table 3). Note that very weak sockeye salmon runs occurred throughout the region in 2008, and escapement goals were met for only one of 13 stocks in that year (Eggers et al. 2008).

No changes to existing sockeye salmon escapement goals were recommended during the current stock status review. New escapement goals recommended for Alsek and Klukshu sockeye salmon runs, however, are pending in the Transboundary Technical Committee of the Pacific Salmon Commission. Sockeye salmon escapement goals for the Situk River, East Alsek River, and Speel Lake were identified for review prior to the next Board of Fisheries meeting in 2015.

Table 1.–Southeast Region sockeye salmon escapement goals.

System	Enumeration method	Year established	Goal type	Escapement goal		Recommended change
				Lower	Upper	
Situk River	Weir	2003	BEG	30,000	70,000	No change
Lost River	Foot/Boat survey (index)	2009	Lower bound SEG	1,000	none	No change
Klukshu River	Weir	2000	BEG	7,500	15,000	No change
East Alsek-Doame	Aerial survey (index)	2003	BEG	13,000	26,000	No change
Chilkoot Lake	Weir, mark-recap.	2009	SEG	38,000	86,000	No change
Chilkat Lake	Sonar, mark-recap.	2009	BEG	70,000	150,000	No change
Redoubt Lake	Weir	2003	OEG	7,000	25,000	No change
Taku River	Mark-recap.	1985	SEG	71,000	80,000	No change
Speel Lake	Weir	2003	BEG	4,000	13,000	No change
Mainstem Stikine	Mark-recap.	1987	SEG	20,000	40,000	No change
Tahltan Lake	Weir	1993	BEG	18,000	30,000	No change
Hugh Smith Lake	Weir, mark-recap.	2003	OEG	8,000	18,000	No change
McDonald Lake	Expanded foot survey	2009	SEG	55,000	120,000	No change

Note: BEG = biological escapement goal; SEG = sustainable escapement goal; OEG = optimal escapement goal.

Escapement goals previously established for two Yakutat-area sockeye systems were rescinded in recent years. In 1995, ADF&G established *biological* escapement goals of 600–1,500 sockeye salmon for the Akwe River and 2,500–7,000 sockeye salmon for the Italio River, both based on peak aerial survey counts (Clark et al. 1995b). Smith et al. (2006a) provided a detailed overview of the status of these two systems. Geologic changes in 1985 resulted in increased water flow from a glacial tributary of the Akwe River, which in turn reduced water clarity and greatly limited the usefulness of aerial surveys in assessing escapements in that system. In 1986, the Italio River changed course and broke into the Akwe River lagoon; as a result, no directed set gillnet fisheries have taken place in the Italio since 1987. The Italio River escapement goal was rescinded in 2003 (Geiger et al. 2004) and the Akwe River goal was rescinded in 2006 (Geiger et al. 2005).

Table 2.–Southeast Region sockeye salmon escapement goals and escapements, 2003–2010.

	Escapement goal		Escapement							
System	Lower	Upper	2003	2004	2005	2006	2007	2008	2009	2010
Situk River	30,000	70,000	89,720	43,278	66,476	90,351	61,799	22,520	83,959	47,865
Lost River	1,000	none	3,057	1,123	1,476	1,018	180	200	ND	1,525
Klukshu River	7,500	15,000	32,120	13,721	3,167	12,890	8,479	2,741	5,509	18,546
East Alsek-Doame River	13,000	26,000	36,400	33,300	50,000	29,000	40,100	8,000	12,000	19,500
Chilkoot Lake	38,000	86,000	74,459	75,596	51,178	96,203	72,561	32,957	33,545	71,657
Chilkat Lake	70,000	150,000	113,000	119,000	84,000	73,000	68,000	71,735	150,033	61,906
Redoubt Lake	7,000	25,000	69,893	77,263	65,653	103,953	66,938	10,146	12,851	17,119
Taku River	71,000	80,000	160,366	106,688	120,053	146,151	87,764	70,442	71,200	87,899
Speel Lake	4,000	13,000	7,014	7,813	7,549	4,165	3,099	1,763	3,689	5,640
Mainstem Stikine River	20,000	40,000	57,972	36,748	34,788	27,603	20,865	16,802	24,575	25,164
Tahltan Lake	18,000	30,000	53,533	62,952	43,046	53,455	20,874	10,416	30,323	22,702
Hugh Smith Lake	8,000	18,000	19,568	19,734	23,872	42,112	33,743	3,588	9,483	15,646
McDonald Lake	55,000	120,000	110,633	28,759	61,043	31,357	29,086	20,700	51,000	72,500

Table 3.–Southeast Region sockeye salmon escapements compared to goals that were in place at the time of enumeration, 2003–2010.

	Year								
	2003 [a]	2004 [a]	2005 [a]	2006	2007	2008	2009 [b]	2010	Average
Stocks with goals	13	13	13	13	13	13	12	13	13
Number below goal	0	1	2	2	4	12	5	1	3
% below goal	0%	8%	15%	15%	31%	92%	42%	8%	26%
Number that met goal	3	6	5	4	5	1	4	10	5
% that met goal	23%	46%	38%	31%	38%	8%	33%	77%	37%
Number above goal	10	6	6	7	4	0	3	2	5
% above goal	77%	46%	46%	54%	31%	0%	25%	15%	37%

[a] Years 2003–2005 do not include the escapement goal for the Akwe River, which was rescinded in 2006.
[b] No data for Lost River sockeye salmon in 2009.

SITUK RIVER

The Situk River is located on the Yakutat forelands, approximately 15 km southeast of Yakutat, Alaska (Appendix A1). The river flows into the Situk-Ahrnklin Inlet, the site of the oldest and, historically, most productive set gillnet fishery in the Yakutat area (Woods and Zeiser 2010). Sockeye salmon escapements have been enumerated annually at an adult counting weir on the Situk River since 1976. Prior to 1987, ADF&G managed the Situk-Ahrnklin Inlet fisheries to achieve a Situk River escapement of 80,000–100,000 sockeye salmon (Thomason and Woods 1988). An escapement goal of 40,000–55,000 sockeye salmon was established in 1987 based on preliminary stock-recruit analysis by McPherson et al. (1987). The escapement goal was revised in 1995 to a *biological* escapement goal of 30,000–70,000 sockeye salmon based on a stock-recruit analysis by Clark et al. (1995a) and an updated analysis by Clark et al. (2002). Escapements met or exceeded the current escapement goal range in 15 of 16 years since 1995, and the escapement was below goal in 2008 (Figure 4).

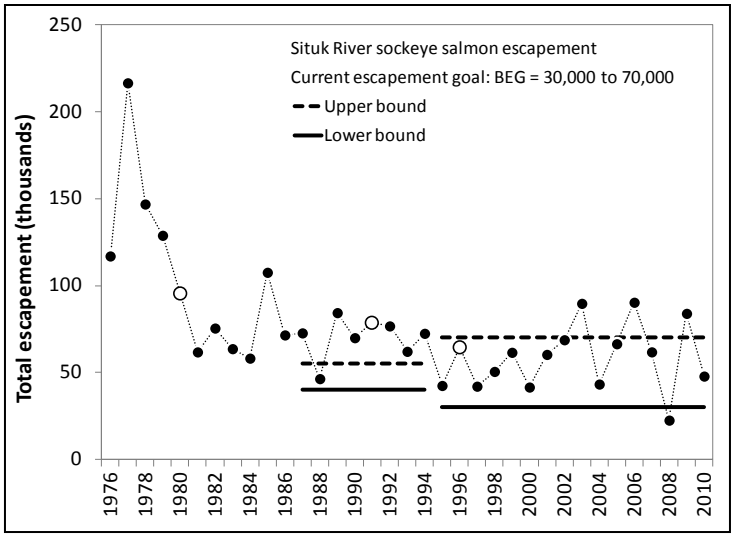

Figure 4.–Situk River sockeye salmon escapement (weir counts) and escapement goals, 1976–2010. Weir counts in 1980, 1991, and 1996 (open circles) were expanded (Clark et al. 2002) to account for flooding or early weir removal.

LOST RIVER

The Lost River is located on the Yakutat forelands, approximately 12 km southeast of Yakutat, Alaska (Appendix A2). What is commonly referred to as the "Lost River" sockeye run, is actually a small run of sockeye salmon that migrates less than 1.5 km up the Lost River, then migrates northwest into Tawah Creek, Coast Guard (or Summit) Lake, and Ophir Creek, which flows near the town of Yakutat. Sockeye salmon escapements have been assessed through boat and foot surveys since the early 1970s. In 1995, ADF&G established a *biological* escapement goal of 1,000–2,300 sockeye salmon counted on a peak survey in the Lost River tributaries, based on a stock-recruit analysis by Clark et al. (1995b).

Lost River sockeye salmon were harvested in a directed set gillnet fishery in the Lost River lagoon through the 1990s. Changes in the shoreline morphology at the Lost River mouth during the winter of 1998–1999, however, caused the river to flow directly into the Situk-Ahrnklin Inlet where fisheries are managed to harvest Situk River sockeye salmon (Burkholder 2000). Since 1999, an area from 100 to 500 yards on either side of the mouth of the Lost River has been closed to commercial fishing during the sockeye salmon run to conserve Lost River sockeye salmon, which are now harvested incidentally in the Situk-Ahrnklin set gillnet fishery (Woods and Zeiser 2010). In 2009, the escapement goal was changed to a *lower bound sustainable* escapement goal of 1,000 sockeye salmon counted on a peak survey, because this stock is no longer targeted in commercial fisheries (Eggers et al. 2008). Peak survey counts were above the current escapement goal in 11 of 16 years since 1995 and below goal in 2007 and 2008 (peak survey counts were not obtained in 1996, 1998, and 2009; Figure 5).

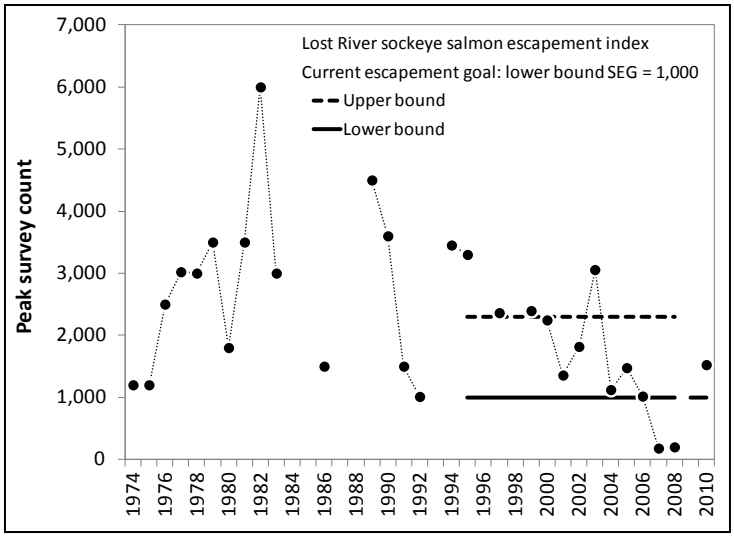

Figure 5.–Lost River sockeye salmon escapement index (peak survey counts) and escapement goals, 1974–2010. Peak survey counts were not obtained in 1984, 1985, 1987, 1988, 1993, 1996, 1998, and 2009.

KLUKSHU RIVER (IN THE ALSEK RIVER SYSTEM)

The Alsek River is a large transboundary river located on the mainland, approximately 80 km southeast of Yakutat, Alaska (Appendix A3). Alsek river sockeye salmon are harvested primarily in U.S. commercial set gillnet fisheries in Dry Bay, at the mouth of the Alsek River, and in Canadian recreational and traditional aboriginal fisheries that take place primarily in the upper Tatshenshini drainage. Sockeye salmon escapements to the Klukshu River, a major sockeye salmon-producing tributary, have been enumerated annually since 1976 at an adult counting weir just upstream of the confluence of the Klukshu and Tatshenshini rivers. The Klukshu weir is the principle tool for monitoring sockeye salmon stocks in the Alsek River (TTC 2011). In 1984, the Transboundary Technical Committee of the Pacific Salmon Commission established an interim Alsek River drainage escapement goal of 33,000–58,000 sockeye salmon, of which 12,000–35,000 were expected to enter the Klukshu River (TTC 1990). In 2000, a *biological* escapement goal of 7,500–15,000 sockeye salmon was established for the Klukshu River, based on a stock-recruit analysis (Clark and Etherton 2000; TTC 2000). Klukshu River spawning escapements met or exceeded the current escapement goal range in seven of the last 11 years since 2000, and were below goal in four years (Figure 6).

Eggers and Bernard (2011) recently conducted extensive run-reconstruction and escapement goal analyses for the Alsek and Klukshu for the years 1976–2008, and recommended *biological* escapement goals of 24,000–33,500 for the Alsek River, and 7,500–11,000 for the Klukshu River. The escapement ranges represented a 90–96% and 79–90% chance of achieving at least 90% of maximum sustained yield for the Alsek and Klukshu, respectively. Final approval of the Klukshu goal, or both goals, by the Transboundary Technical Committee is pending. The escapement goal analysis was reviewed and approved by the Canadian Centre for Science Advise Pacific (CSAP). As of April 2011, the bilateral Transboundary Technical Committee was "awaiting final review by CSAP before adopting recommendations" (TTC 2011).

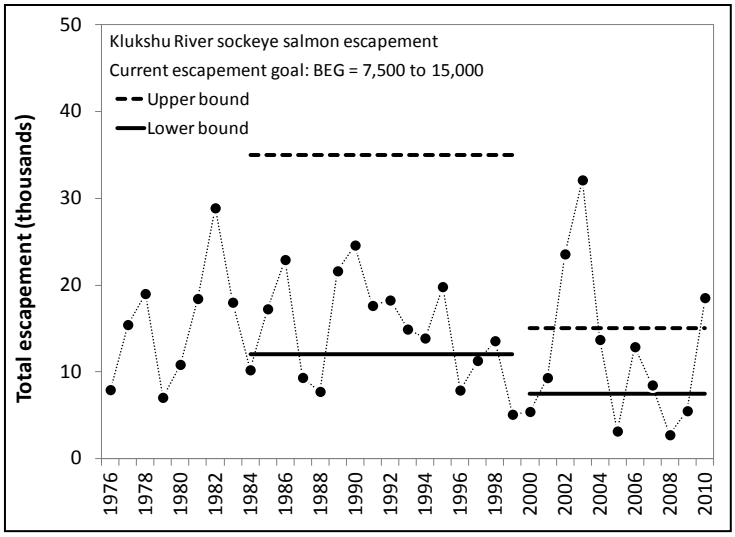

Figure 6.–Klukshu River sockeye salmon escapement (weir counts adjusted for upstream removals) and escapement goals, 1976–2010.

EAST ALSEK-DOAME RIVERS

The East Alsek River is located approximately 90 km southeast of Yakutat, Alaska, on the Alsek River flood plain (Appendix A4). Prior to the early 1900s, the East Alsek was a distributary channel of the transboundary Alsek River, but is now fed by clear-running groundwater and has no direct connection to the Alsek (Smith et al. 2006b). The Doame River, is a clear water system with two lakes, located just east of the East Alsek River. The Doame River once entered the Gulf of Alaska directly, but an earthquake in 1966 caused the river to flow west inside the beach line and it now empties into the East Alsek River, just upstream of the East Alsek River mouth (Clark et al. 2003). Sockeye salmon in the East Alsek-Doame River system are harvested in terminal set gillnet fisheries in the lower East Alsek River lagoon and in adjacent near-shore ocean waters. Sockeye salmon escapements have been assessed through aerial surveys since the early 1970s.

The East Alsek River sockeye salmon run has an interesting history of response to environmental changes resulting from rapid post-glacial uplift of the Alsek River flood plain. Smith et al. (2006b) summarized this history as: (1) colonization of the East Alsek in the early 1900s, (2) adaptation to the environment (e.g., large 0-check population), (3) population explosion in the 1970s–1980s, and (4) decline in the 1990s due to deteriorating habitat. Flow from the much larger Alsek River was diverted into the East Alsek River during periodic flood events (e.g., five documented floods between 1964 and 1981) that flushed the East Alsek River channel and maintained excellent spawning habitat (Faber 2008). Sockeye salmon production increased dramatically in the 1980s, and the annual commercial harvest in the East Alsek set gillnet fishery increased from an average of 25,000 fish in the 1970s to an average of more than 100,000 from 1981 to 1994 (Figure 7).

In 1995, ADF&G established a *biological* escapement goal of 26,000–57,000 sockeye salmon counted on peak aerial surveys in the East Alsek and Doame rivers, based on a stock-recruit analysis by Clark et al. (1995b). Sockeye salmon runs subsequently declined; escapements dropped below the escapement goal from 1999 to 2002 and the commercial fishery was closed (Woods

2004). This decline in production, which is closely tied to periodic flooding of the Alsek River, was the result of increased sedimentation and growth of aquatic vegetation, and subsequent reduction in available sockeye salmon spawning habitat through the 1990s (Smith et al. 2006b; Faber 2008). Flooding of the East Alsek River will become increasingly infrequent as the land is uplifted and the Alsek River becomes more deeply channelized (e.g., several major Alsek River floods since 1981 did not affect the East Alsek; Smith et al. 2006b), and spawning habitat in the East Alsek may continue to diminish through time (Faber 2008).

In 2003, as a result of deteriorated spawning habitat, the escapement goal was revised downward to a *biological* escapement goal of 13,000–26,000 sockeye salmon counted on a peak aerial survey (Clark et al. 2003). Estimates of available spawning habitat in the East Alsek in 2005 suggested that the river could support between 19,000 and 28,000 spawning sockeye salmon (Faber et al. 2006). That escapement range translates to peak aerial survey counts of approximately 13,000 to 19,000 fish based on the expansion factor of 1.5 used by Clark et al. (2003), a range comparable to the current escapement goal. Recent stock assessment work conducted to estimate escapements and verify this expansion factor met with mixed success (Waltemyer et al. 2005a, b; Smith et al. 2006b). Escapement indices met or exceed the current escapement goal range in six of the eight years since 2003, and were below goal in 2008 and 2009 (Figure 8).

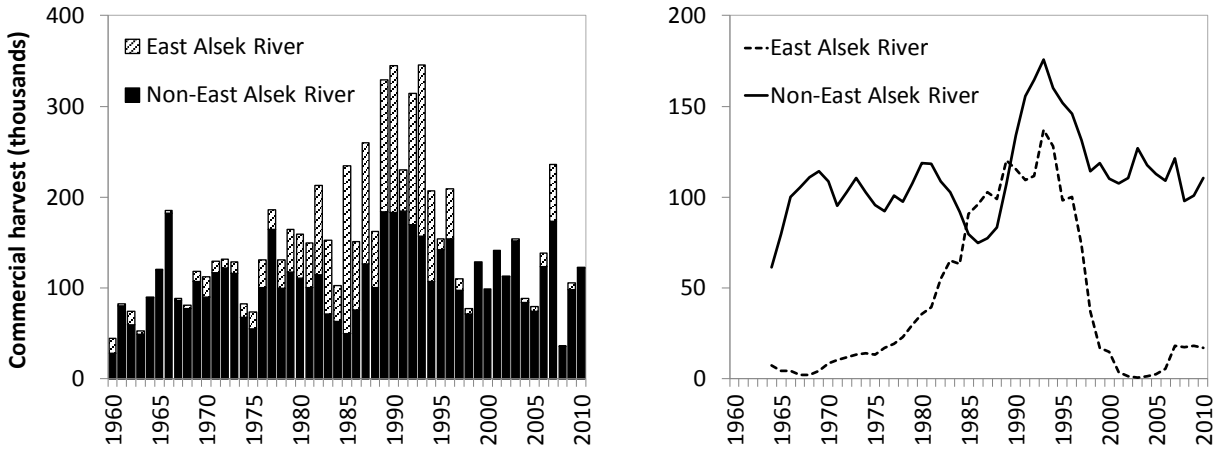

Figure 7.–Annual commercial set gillnet harvest of sockeye salmon in the Yakutat area broken out by East Alsek River and non-East Alsek River harvest (left), and 5-year running average trends in commercial harvest (right), 1960–2010.

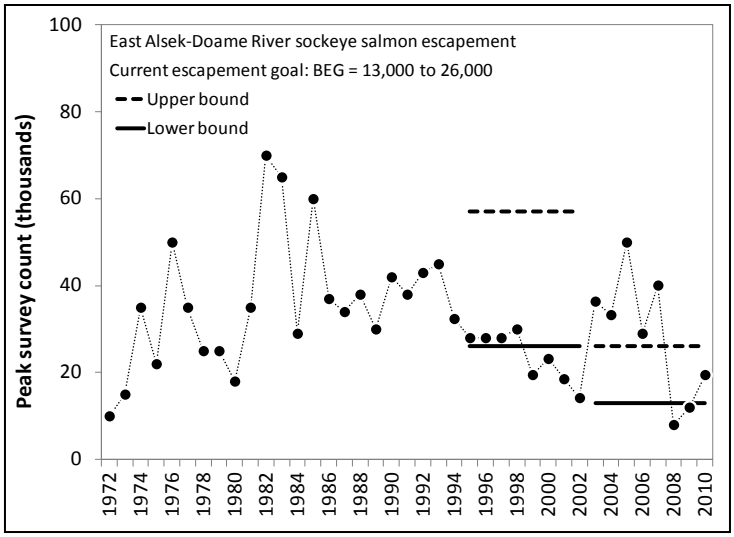

Figure 8.–East Alsek-Doame River sockeye salmon escapement index (peak aerial survey counts) and escapement goals, 1972–2010.

CHILKOOT LAKE

Chilkoot Lake is located on the mainland, approximately 13 km northeast of Haines, Alaska (Appendix A5). The Chilkoot drainage supports one of the larger runs of sockeye salmon in the region. Chilkoot Lake sockeye salmon are harvested primarily in the District 15 Lynn Canal drift gillnet fishery and in a subsistence fishery in Lutak Inlet. Sockeye salmon escapements have been enumerated annually at an adult counting weir in the Chilkoot River, below the outlet of the lake, since 1976. This stock was managed for informal escapement goals of 80,000–100,000 sockeye salmon starting in 1976, and 60,000–80,000 sockeye salmon starting in 1981 (Bergander et al. 1988; McPherson 1990). Those goals were based on limnological and limited stock-recruit analyses. In 1990, an escapement goal of 50,500–91,500 sockeye salmon was established based on an extensive stock-recruit analysis by McPherson (1990). The goal was divided into separate goals for early-runs (16,500–31,500) and late-runs (34,000–60,000). This goal was considered a *biological* escapement goal in 2003 (Geiger et al. 2004).

Chilkoot Lake underwent an extended downturn in production in the 1990s related to changes in the lake's rearing environment. The lake is glacially turbid and it is hypothesized that very warm summertime conditions increased the silt load in the lake, which reduced the euphotic volume and greatly reduced zooplankton abundance (Eggers et al. 2009b). The annual commercial harvest averaged 149,000 fish from 1976 to 1989, but declined to an average of 29,000 fish from 1996 to 2005 (Figure 9), due in part to conservative management, and escapements were below goal in six of seven years, 1994–2000 (Figure 10). An extremely low weir count in 1995 (7,200 fish) prompted ADF&G to verify weir counts with mark-recapture studies, which were conducted from 1996 to 2004, and 2007 (Kelley and Bachman 1999; Bachman and Sogge 2006; Eggers et al. 2009b). Mark-recapture estimates were greater than weir counts, consistent with the idea that weir counts likely under-represented total escapement, but differences between the two estimates were not consistent enough to calibrate weir counts.

Geiger et al. (2005) recommended maintaining essentially the same escapement goal, 50,000–90,000 sockeye salmon, but classified the goal as a *sustainable* escapement goal. In 2009, the escapement goal was changed to a *sustainable* escapement goal of 38,000–86,000 sockeye

salmon based on an updated stock-recruit analysis by Eggers et al. (2008, 2009b). The goal was considered a *sustainable* escapement goal, rather than a *biological* escapement goal, due to uncertainty in escapement levels based on weir counts. Eggers et al. (2009b) developed weekly escapement targets, based on historical run timing at the weir, rather than separate escapement goals for early- and late-run fish. The department continued to conduct mark-recapture studies in 2010 and 2011 in order to judge the accuracy of the weir count. Escapements were below the current escapement goal range in 2009, and within the goal in 2010 (Figure 10).

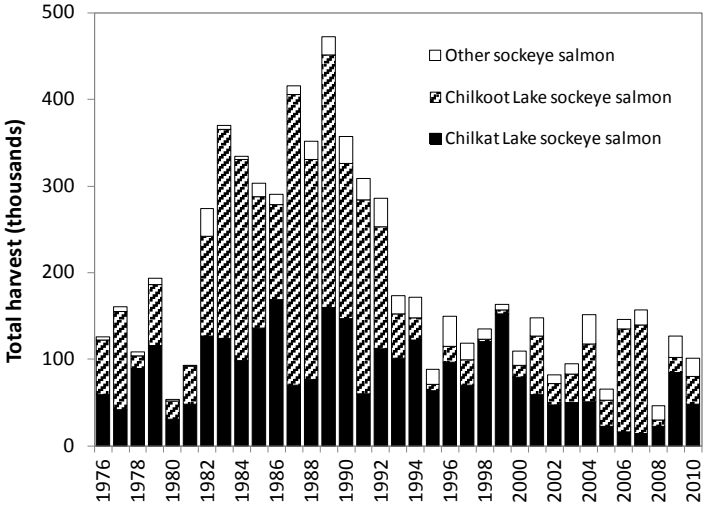

Figure 9.–Annual commercial harvest of sockeye salmon in the District 15 Lynn Canal drift gillnet fishery, 1976–2010. Post-season scale pattern analysis is used to estimate contributions of Chilkoot, Chilkat, and other (primarily Chilkat River mainstem spawners and Berners River stocks).

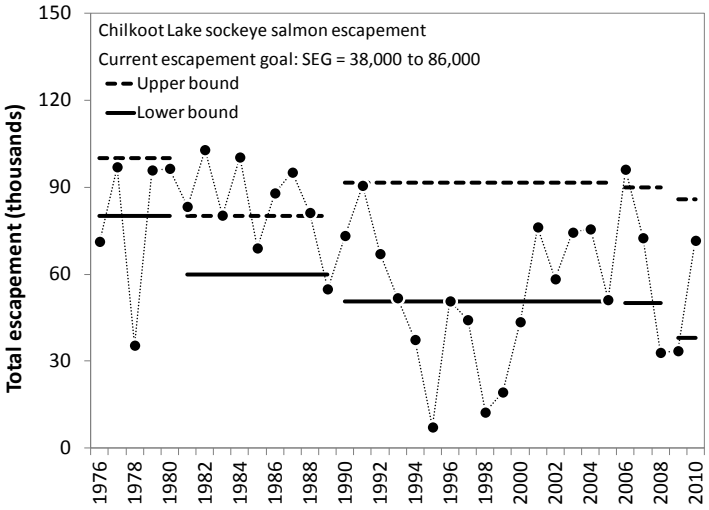

Figure 10.–Chilkoot Lake sockeye salmon escapement (weir counts) and escapement goals, 1976–2010.

CHILKAT LAKE

Chilkat Lake is located on mainland Alaska, in upper Lynn Canal, approximately 30 km northeast of Haines, Alaska (Appendix A6). The lake supports one of the largest sockeye salmon runs in the region and, along with Chilkoot Lake sockeye salmon, provides the majority of the sockeye salmon harvested in the District 15 Lynn Canal drift gillnet fishery (Figure 9). Escapements have been measured at an adult counting weir at the outlet of the lake, 1967–1995 and 1999–2007; through mark-recapture studies, 1994–2007 (in conjunction with fish wheels operated in the Chilkat River); and through DIDSON at the outlet of the lake, 2008–2010. This stock was managed for informal escapement goals of 60,000–70,000 sockeye salmon starting in 1976, then 70,000–90,000 sockeye salmon starting in 1981 (Bergander et al. 1988; McPherson 1990). Those goals were based on limnological and limited stock-recruit analyses. In 1990, an escapement goal of 52,000–106,000 sockeye salmon was established based on an extensive stock-recruit analysis by McPherson (1990). The goal was divided into separate goals for early-runs (14,000–28,000) and late-runs (52,000–78,000). This goal was considered a *biological* escapement goal in 2003 (Geiger et al. 2004).

Efforts to update the escapement goal using standard stock-recruit methods has been hindered by lake stocking and inaccurate weir counts (Geiger et al. 2005). In the 1980s, it was believed that Chilkat Lake was spawning-area limited and, based on assessments of lake productivity, capable of rearing an additional 10–12 million sockeye fry annually beyond what was naturally produced (Eggers et al. 2010). The lake was stocked with 2–4 million fry annually from 1994 to 1997, and in 2001. An additional 300,000 fry were produced annually from incubation boxes from 1989 to 1998, and in 2003. Also during that period, mark-recapture studies in 1994 and 1995 suggested that weir counts were considerably biased. From 1996 to 1998, the escapement was estimated solely from mark-recapture studies, followed by weir counts in conjunction with mark-recapture studies from 1999 to 2007. In 2006, the escapement goal was revised to a *sustainable* escapement goal of 80,000–200,000 sockeye salmon—the intent of this change was to provide an escapement level in mark-recapture units that was approximately the same as the previous weir-based escapement goal (Geiger et al. 2005).

In 2009, the escapement goal was revised to a *biological* escapement goal of 70,000–150,000 sockeye salmon (Eggers et al. 2008, 2010). Eggers et al. (2010) converted historical weir counts to total escapement and developed a stock-recruit model with spawner density, auto correlation, and fry-plant terms that accounted for bias in assessing wild stock production due to the added production from enhancement. This analysis suggested that production is rearing limited and clearly demonstrated that fry plants, in conjunction with moderate to high wild-stock escapements, depressed wild smolt production. The current escapement goal is very close to the escapement goal based on the prior stock-recruit analysis by McPherson (1990). McPherson's weir-based escapement goal of 52,000–106,000 converts to 75,000–153,000 using the weir-to-total escapement relationship in Eggers et al. (2010). Total escapement is currently measured with DIDSON at the outlet of the lake. Escapements were above the current escapement goal range in 2009, and below goal in 2010 (Figure 11).

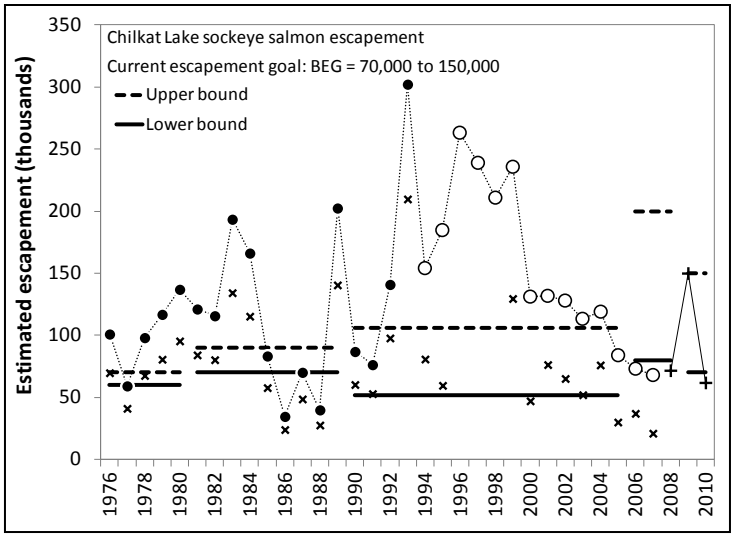

Figure 11.–Chilkat Lake sockeye salmon escapement estimates and escapement goals, 1979–2010. The current escapement goal is a biological escapement goal (BEG) range of 70,000–150,000 sockeye salmon counted at the outlet of the lake with DIDSON sonar. Escapement goals from 1976 to 2005 were based on weir counts (×). Escapement goals from 2006 to 2010 were based on total escapement estimated from mark-recapture (open circles), mark-recapture-based expanded weir counts (solid circles), and DIDSON sonar (+).

REDOUBT LAKE

Redoubt Lake is located on Baranof Island, approximately 19 km south of Sitka, Alaska (Appendix A7). Redoubt Lake sockeye salmon are harvested primarily in terminal subsistence and sport fisheries and, to a lesser extent, mixed stock commercial fisheries in Sitka Sound. Sockeye salmon escapements have been enumerated annually at an adult counting weir at the outlet of the lake in all but one year since 1982. In 2003, ADF&G recommended a *biological* escapement goal of 10,000–25,000 sockeye salmon based on a stock-recruit analysis (Geiger 2003; Geiger et al. 2004). In 2003, the Board of Fisheries adopted a management plan for Redoubt Lake and set an *optimal* escapement goal of 7,000–25,000 sockeye salmon (5 AAC 01.760 *Redoubt Bay and Lake Sockeye Salmon Fisheries Management Plan*). The management plan provides guidelines for allocating Redoubt Lake sockeye salmon between subsistence, sport, and commercial fisheries based on projected inseason run strength.

Redoubt Lake was intensively fertilized during most years when stock-recruit observations were made (1984–1987 and 1990–1995). Lake fertilization was discontinued from 1996 through 1998, but a less intensive fertilization program has been conducted annually by the USFS since 1999, using different delivery mechanisms and application levels. A recent assessment of the lake fertilization projects and subsequent effect on freshwater production and adult recruitment of sockeye salmon was limited by lack of data from non-fertilized years (Beauchamp and Overman 2004). Escapements greatly exceeded the escapement goal range from 2003 to 2007, and were within the goal range from 2008 to 2010 (Figure 12).

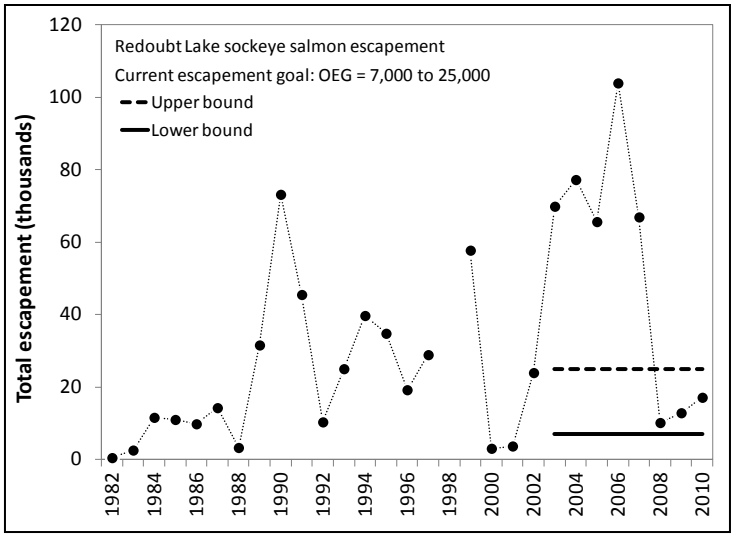

Figure 12.–Redoubt Lake sockeye salmon escapement (weir counts) and escapement goal, 1982–2010. The weir was not operated in 1998.

TAKU RIVER

The Taku River is a large transboundary river located on the mainland, approximately 30 km northeast of Juneau, Alaska (Appendix A8). Taku River sockeye salmon are harvested primarily in directed commercial drift gillnet fisheries in Alaska's District 11 and in Canadian inriver fisheries. Sockeye salmon escapements have been estimated through joint U.S.-Canada mark-recapture studies since 1984. In 1985, the Transboundary Technical Committee of the Pacific Salmon Commission established an escapement goal of 71,000–80,000 sockeye salmon in Canadian spawning areas of the Taku River drainage (TTC 1986). The escapement goal was based on professional judgment and the technical committee considers it an interim goal until a scientifically-based goal is developed (TTC 2011); ADF&G considers the goal to be a *sustainable* escapement goal (Geiger et al. 2004). Escapements met or exceeded the escapement goal range in 24 of 26 years since 1985, and were below goal in 1998 and 2008 (Figure 13).

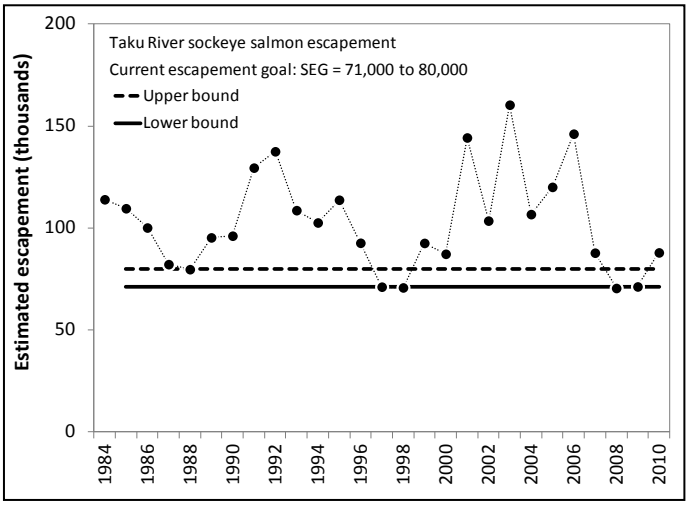

Figure 13.–Taku River sockeye salmon escapement (mark-recapture estimates) and escapement goal, 1984–2010.

SPEEL LAKE

Speel Lake is located on mainland Alaska, in Speel Arm of Port Snettisham, approximately 50 km southeast of Juneau, Alaska (Appendix A9). Speel Lake sockeye salmon are primarily harvested in mixed stock commercial drift gillnet fisheries in District 11. Escapements have been enumerated annually at an adult counting weir at the outlet of the lake in all but two years since 1983 (the weir has been operated by Douglas Island Pink and Chum, Inc. since 1996). This stock was managed for informal escapement goals of 10,000 sockeye salmon in the 1980s, then for 5,000 sockeye salmon starting in 1992 (Riffe and Clark 2003). In 2003, ADF&G established a *biological* escapement goal of 4,000–13,000 sockeye salmon based on a stock-recruit analysis of the 1983–1996 brood years by Riffe and Clark (2003). Speel Lake harvests have been estimated annually in conjunction with ADF&G stock separation programs to allocate harvests in the District 11 gillnet fisheries. Speel Lake escapements, however, had to be estimated due to early removal of the weir over most of the escapement series. Since 2002, the weir has been operated annually into late September, which will provide a better base to re-calibrate old weir counts and update the escapement goal. Escapements met the current escapement goal range in five of eight years since 2003, and were below goal from 2007 to 2009 (Figure 14).

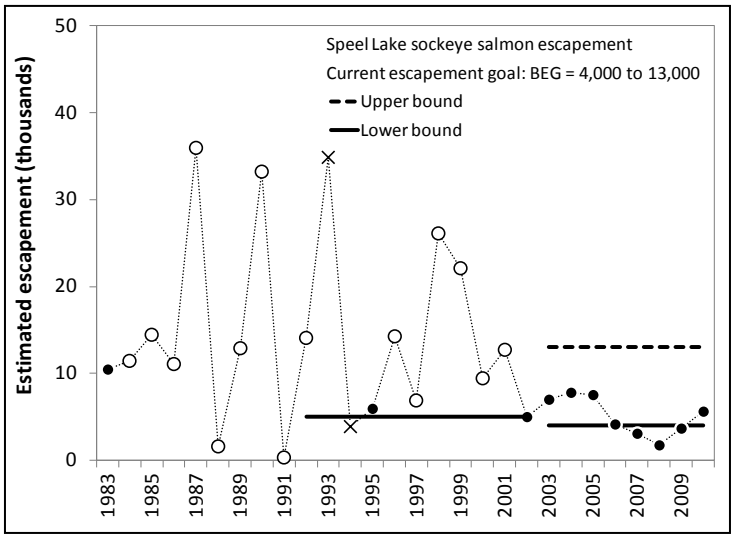

Figure 14.–Speel Lake sockeye salmon escapement (expanded weir counts) and escapement goals, 1983–2010. Weir counts in 1985–1992 and 1996–2001 (open circles) were expanded to account for early weir removal, and no weir counts were made in 1993–1994; escapements in those years (×) were estimated by expanding the estimated harvest by the average harvest rate (Riffe and Clark 2003).

MAINSTEM STIKINE RIVER

The Stikine River is a large transboundary river located on the mainland, approximately 15 km north of Wrangell, Alaska (Appendix A10). The mainstem Stikine stock includes all Stikine River sockeye salmon populations aside from wild and hatchery runs at Tahltan and Tuya lakes (TTC 2011). Mainstem Stikine sockeye salmon are harvested primarily in Alaska commercial drift gillnet fisheries (in districts 6 and 8) and Canadian inriver fisheries. Escapements have been estimated through postseason run-reconstruction analysis of fishery data by the Transboundary Technical Committee of the Pacific Salmon Commission. In 1987, the technical committee

established an interim escapement goal of 20,000–40,000 sockeye salmon for mainstem Stikine stocks based on professional judgment (TTC 1987, 1990). This goal has not been updated and ADF&G considers it to be a *sustainable* escapement goal (Geiger et al. 2004). Escapements met or exceeded the escapement goal range in 20 of 24 years since 1987 and were below goal in four years, most recently in 2008 (Figure 15).

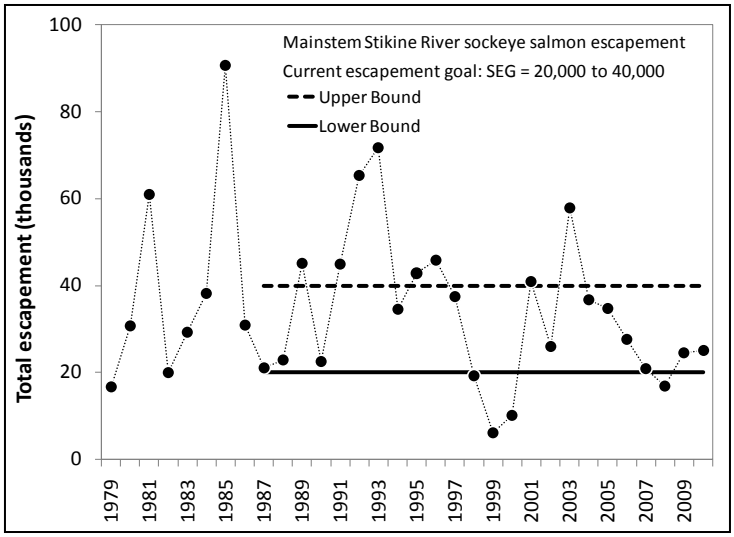

Figure 15.–Mainstem Stikine River sockeye salmon escapement (estimated total escapement) and escapement goal, 1979–2010.

TAHLTAN LAKE

Tahltan Lake is the largest producer of sockeye salmon in the transboundary Stikine River drainage (Appendix 11). The lake is located in Canada, approximately 170 km north of Wrangell, Alaska. Tahltan sockeye salmon are harvested primarily in Alaska commercial drift gillnet fisheries (in Districts 6 and 8) and Canadian inriver fisheries. Sockeye salmon escapements have been enumerated annually at an adult counting weir at the outlet of the lake since 1959.

In 1987, the Transboundary Technical Committee of the Pacific Salmon Commission established an interim escapement goal of 20,000–40,000 sockeye salmon based on professional judgment (TTC 1987, 1990). In 1993, the technical committee revised the escapement goal to 18,000–30,000 sockeye salmon (TTC 1993) based on recommendations and analysis conducted by CDFO staff and the Pacific Stock Assessment Review Committee (Humphreys et al. 1994). ADF&G recognized this goal to be a *biological* escapement goal in 2003 (Geiger et al. 2004). The escapement goal represents a mix of naturally spawning fish and a maximum of approximately 4,000 fish used for hatchery broodstock for stocking into Tahltan and Tuya lakes under the bilateral enhancement program specified in the Pacific Salmon Treaty. Escapements have fluctuated widely: escapements met or exceeded the current escapement goal range in 11 years since 1993 and were below goal in seven years, most recently in 2008 (Figure 16).

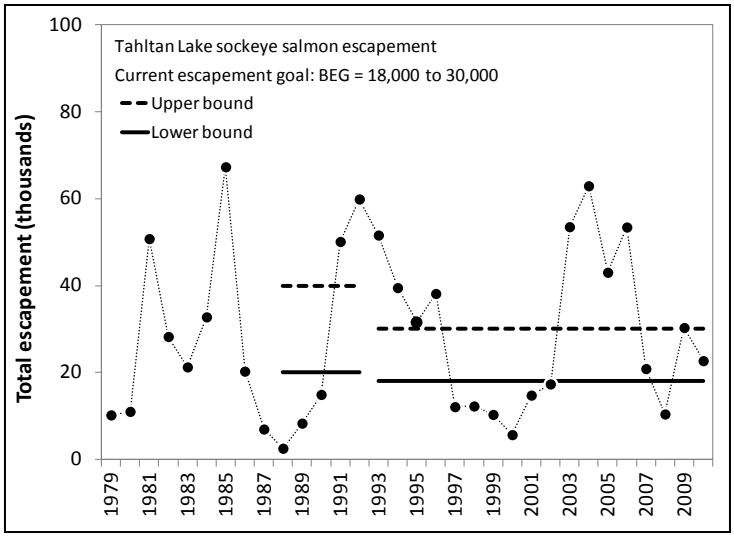

Figure 16.–Tahltan Lake sockeye salmon escapement (weir counts) and escapement goals, 1979–2010.

HUGH SMITH LAKE

Hugh Smith Lake is located on mainland Alaska, approximately 65 km southeast of Ketchikan, Alaska (Appendix A12). Hugh Smith sockeye salmon are harvested in mixed stock commercial net fisheries in the Northern Boundary area of Alaska and Canada. Sockeye salmon escapements have been enumerated annually at an adult counting weir at the outlet of the lake since 1980. An "interim" escapement goal of 15,000–35,000 sockeye salmon, based on professional judgment, was established for Hugh Smith Lake as early as 1993 (ADF&G 1993). Escapements were below goal for 10 consecutive years from 1993 to 2002, and the stock was formally designated as a *stock of management concern* by the Board of Fisheries in 2003 (Geiger et al. 2005). The board set an *optimal* escapement goal of 8,000 to 18,000 sockeye salmon (5 AAC 33.390) based on escapement goal analyses outlined in Geiger et al. (2003). The board adopted an action plan[3] that included fishery restrictions to reduce harvests in nearby District 1 drift gillnet and purse seine fisheries.

The *optimal* escapement goal includes spawning salmon of both wild and hatchery origin. Unfed fry, fed fry, and pre-smolt were stocked in the lake in 15 years between 1986 and 2003. Most of these stocking projects were thought to be unsuccessful (Geiger et al. 2003); however, large numbers of adults from the last pre-smolt stocking project returned from 2003 to 2007, and escapements exceeded the upper bound of the escapement goal range in each of those years (Figure 17). In addition, studies based on otolith-marked sockeye salmon from that stocking project showed that management measures outlined in the action plan were appropriately timed and located to reduce harvests on the stock (Heinl et al. 2007). As a result of improved escapements, the Hugh Smith Lake sockeye salmon run was removed from stock of concern status in 2006 (Geiger et al. 2005). Studies conducted at the lake indicated that although recent pre-smolt stocking efforts increased adult returns, they were ineffective in boosting long-term production (Clark et al. 2006; Piston 2008). Stocking efforts were suspended for at least one life

[3] *Hugh Smith Lake Sockeye Salmon Action Plan, 2003.* Final Report to the Alaska Board of Fisheries, RC-106, February 2003.

cycle to allow further study of the program (Clark et al. 2006). Escapements have steadily improved from a low of 1,138 in 1998, and escapements of wild fish were within the current escapement goal range in five of the last six years, and below goal in 2008 (Figure 17).

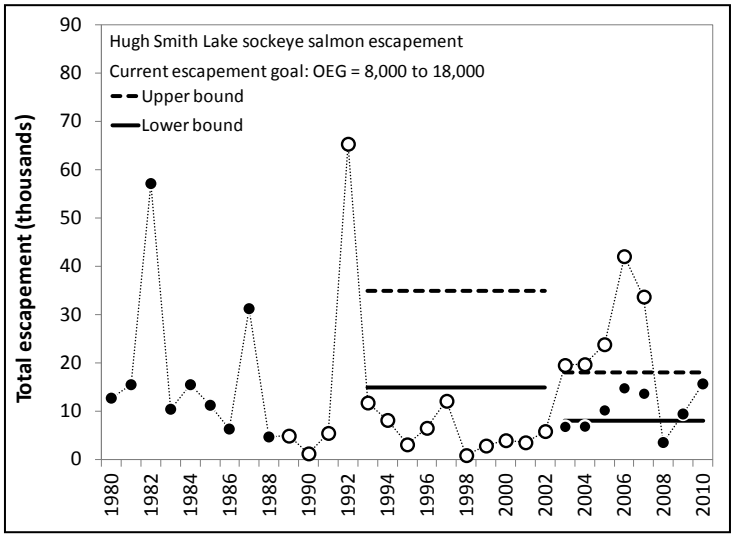

Figure 17.–Hugh Smith Lake sockeye salmon escapements (weir counts) and escapement goals, 1980–2010. The current *optimal* escapement goal includes both wild and hatchery-stocked fish. Black circles denote escapements of wild fish and open circles denote escapements that represent a combination of wild and hatchery-stocked fish. Estimates of the contributions of wild and hatchery-stocked fish are available for 2003–2007, but not prior years.

MCDONALD LAKE

McDonald Lake, located on the mainland, approximately 65 km north of Ketchikan, supports one of the largest runs of sockeye salmon in southern Southeast Alaska (Appendix 13). McDonald Lake sockeye salmon are harvested in mixed stock commercial net fisheries in the Northern Boundary area of Alaska and Canada (Geiger et al. 2004). Sockeye salmon escapements have been estimated from calibrated foot survey counts conducted since 1980. An escapement goal of 85,000 sockeye salmon was established in 1989 based on the euphotic volume habitat model of Koenings and Burkett (1987). In 1993, the escapement goal was changed to a range of 65,000–85,000 sockeye salmon based on an undocumented spawner-recruit analysis; the goal was considered a *biological* escapement goal in 2003 (Geiger et al. 2004). In 2006, the escapement goal was changed to a *sustainable* escapement goal of 70,000–100,000 sockeye salmon based on a simple yield analysis (Geiger et al. 2005; Johnson et al. 2005). The goal was considered a *sustainable* escapement goal due to uncertainty in estimated escapements and harvests.

McDonald Lake was the target of a long-term enhancement project carried out via lake fertilization from 1982 to 2004 (Johnson et al. 2005). The lake was also stocked with sockeye fry in 1989 (3.5 million) and 1990 (1.0 million). The sockeye salmon run was strong over most of the enhancement period: estimated escapements averaged more than 100,000 fish in the 1980s and 1990s, sockeye salmon were harvested in terminal purse seine fisheries in Yes Bay, West

Behm Canal, when runs were forecasted to be in excess of the escapement goal, and the personal use harvest averaged 6,000 fish. McDonald Lake sockeye salmon were also used as a brood source for stocking projects at five other sites in southern Southeast Alaska.

The McDonald Lake run underwent a decline in recruitment over the past decade, despite nutrient enhancement, and estimated escapements fell below escapement goals in six of seven years between 2002 and 2008 (Figure 18). The causes of this decline are unknown, and the affect of lake fertilization on freshwater production and adult recruitment is difficult to assess due to lack of information collected prior to enhancement (Olson 1989; Johnson et al. 2005).

In 2009, the escapement goal was changed to a *sustainable* escapement goal of 55,000–120,000 based on a stock-recruit analysis by Eggers et al. (2009a). Total runs were reconstructed using recalibrated escapements (Heinl et al. 2009) and an assumed commercial harvest rate of 41%, based on several years of coded-wire-tagging studies conducted in the 1980s. The goal was considered a *sustainable* escapement goal, rather than a *biological* escapement goal, due to uncertainty regarding the affects of lake fertilization on stock productivity, as essentially all adult returns in the stock-recruit time series experienced nutrient enhancement during the lake residence portion of their life history. Because sockeye salmon escapements did not meet the new *sustainable* escapement goal in four of five years from 2004 to 2008 (Figure 18), the stock was formally designated as a *stock of management concern* by the Board of Fisheries in 2009. Escapements were just below the current escapement goal range in 2009, and within the goal range in 2010.

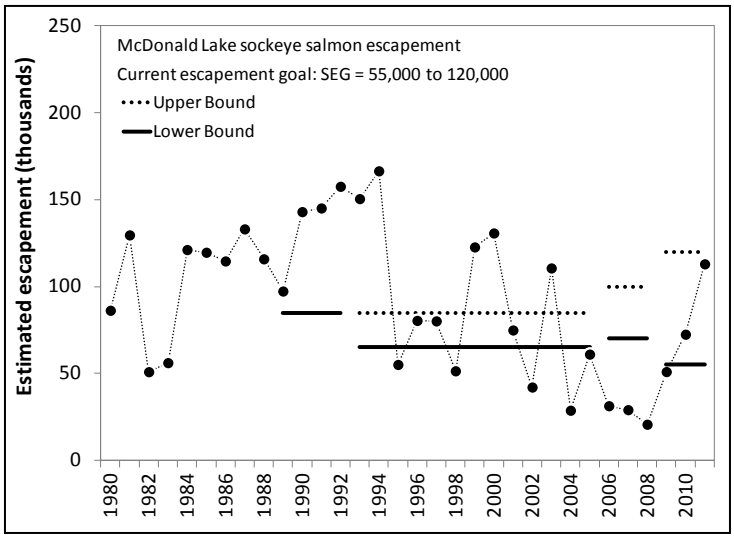

Figure 18.–McDonald Lake sockeye salmon escapements (expanded foot surveys) and escapement goal ranges, 1980–2011.

STOCKS OF CONCERN

The McDonald Lake sockeye salmon run is currently the only salmon run formally identified as a stock of concern in Southeast Alaska. No additional stocks of sockeye salmon currently meet the criteria for stocks of concern as defined by the sustainable salmon fisheries policy.

MCDONALD LAKE STOCK OF CONCERN

The McDonald Lake sockeye salmon run was formally designated as a *stock of management concern* by the Board of Fisheries in 2009 after the current escapement goal was not met in four of five years, 2004–2008. A management concern is defined in the Policy for the Management of Sustainable Salmon Fisheries as "a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG [sustainable escapement goal], BEG [biological escapement goal], OEG [optimal escapement goal], or other specified management objectives for a fishery" (5 AAC 39.222 (f)(21)). The policy further defines "chronic inability" as "the continuing or anticipated inability to meet escapement thresholds over a four to five year period" (5 AAC 39.222 (f)(5)).

Management Actions

In 2007 and 2008, and prior to the formal stock of concern designation, ADF&G implemented a series of fishery restrictions in the closest mixed stock commercial net fisheries in Sumner and Clarence straits to allow more sockeye salmon to escape to McDonald Lake (Bergmann et al. 2009). Those fishery restrictions were based on coded-wire-tagging studies conducted in the 1980s, which showed this stock was harvested primarily in the District 6 drift gillnet fishery, with peak weeks of harvest from mid-July to early August; the next largest portions of the run were harvested in purse seine fisheries in districts 1, 2, and 4 (Johnson et al. 2005).

Management actions taken in 2007 and 2008 were incorporated into a formal action plan (Bergmann et al. 2009) that was approved by the Board of Fisheries in 2009 and carried out through 2011. The action plan included time restrictions in the District 6 drift gillnet fishery and area closures in purse seine fisheries in Sumner and upper Clarence straits during a three-week period from mid-July to early August (statistical weeks 29–31; Appendices A14 and A15). In addition, terminal purse seine fisheries targeting McDonald Lake sockeye salmon in Yes Bay, West Behm Canal, have not been conducted since 2001, and bag limits in the McDonald Lake personal use fishery were gradually reduced from a daily bag limit of 50 fish per person in 2002, to an annual limit of 20 fish per person since 2007.

From 2007 to 2009, ADF&G conducted a genetic stock identification project to estimate the proportions of McDonald Lake sockeye salmon in the fisheries affected by the action plan and determine if the timing of management restrictions was appropriate. Results from that project showed that McDonald Lake sockeye salmon accounted for a large portion of the sockeye salmon harvest during the action plan weeks in the District 6 drift gillnet fishery and district 1 and 7 purse seine fisheries (e.g., 20% or more of the sockeye salmon harvest during many weeks of the action plan), and that fisheries actions were generally well timed. The results of this sampling project will be published by the ADF&G Gene Conservation Laboratory.

Updated Stock Status and Stock of Concern Recommendation

The department recommends that the stock of concern designation be removed for the McDonald Lake sockeye salmon run as a result of improved escapements over the past three years. In 2009, the escapement of 51,000 was just short of the lower bound of the sustainable escapement goal range (55,000–120,000). The escapement of 72,500 sockeye salmon in 2010 fell within the escapement goal range, and the escapement of 113,000 in 2011 was near the upper bound of the escapement goal range (Figure 18). The fall fry population resulting from the 2009 escapement (800,000) was twice the average fall fry population from 2005 to 2009. The habitat in the

McDonald Lake watershed is considered pristine (e.g., there has been virtually no logging in the drainage) and there are no habitat-related concerns identified for this stock (Bergmann et al. 2009).

The department will continue to monitor escapement, collect biological data, and estimate rearing fry populations at the lake. In addition, a multi-year project will be conducted (beginning in 2011) to sample commercial net fisheries and escapement for otolith-marked McDonald Lake sockeye salmon. In 2007, Southern Southeast Regional Aquaculture Association (SSRAA) was permitted by ADF&G to conduct a lake stocking program at McDonald Lake, one of the purposes of which was to put otolith-marked smolt into the lake so they could be tracked through the fisheries when they returned as adults. SSRAA conducted egg-takes at McDonald Lake for three years, 2007–2009, otolith-marked and reared the fry at Burnette Inlet Hatchery, and released them back to the lake as full-term smolt in the springs of 2009–2011. Results from the otolith sampling project will provide additional information about the contribution and time and area distribution of hatchery-stocked fish in district 1–8 commercial net fisheries, estimates of the proportion of wild and hatchery-stocked fish in the escapement, and estimates of the harvest rate on hatchery-stocked fish.

DISCUSSION

Southeast Alaska sockeye salmon escapements in the 13 monitored systems reported here have generally been within or above escapement goal ranges since 2003 (the year following the first regional sockeye salmon stock status report by Geiger et al. 2004). Escapement goal performance was poorest from 2007 to 2009, and escapement goals were not achieved for >30% of stocks with goals during that period (Table 3). Sockeye salmon runs have since improved: only one system was below goal in 2010, and preliminary information for 2011 likewise shows only one system below goal.

Sockeye salmon runs in Southeast Alaska were notably poor in 2008. The total commercial harvest of 436,000 sockeye salmon in that year was one of the smallest since the late 1800s, and escapement goals in place at the time were met for only one system (Redoubt Lake). Juveniles of the dominant age class (i.e., fish that spent three years in saltwater) migrated to sea in 2005 during a summer of anomalously warm water temperatures in the northeastern Pacific Ocean. Very poor runs of pink salmon in 2006 and summer-run chum salmon in 2008 were also the product of fry that migrated to sea in 2005. Unusual migratory predators and competitors documented in nearshore Gulf of Alaska waters in 2005 (Orsi et al. 2006) and higher energetic demands related to warmer ocean temperature potentially contributed to poor marine survival rates of Southeast Alaska salmon that migrated to sea in that year (Wertheimer et al. 2011).

Regionwide commercial harvests of sockeye salmon increased to recent historical peaks in the 1980s and 1990s, and averaged 2.0 million fish annually (Figure 1). The harvest increased most dramatically in southern Southeast Alaska, due in part to increased sockeye salmon production from spawning channels on the Canadian Skeena River as cited by Van Alen (2000). Harvests in southern Southeast Alaska declined over the last decade, but remain similar to high levels in the early 1990s and well above lower levels in the 1950s–1970s.

Sockeye salmon harvests in northern Southeast Alaska have also increased from a low point in the late 1970s, and have been fairly stable over the last three decades (Figure 1). Within northern Southeast Alaska, the annual commercial harvest of sockeye salmon in the Lynn Canal drift gillnet fishery has trended lower over the last two decades following very high harvests (and

higher harvest rates) of Chilkoot and Chilkat lake sockeye salmon in the 1980s (Figure 9; Eggers et al. 2009b, 2010). In the last decade, early-season fishing effort has changed from targeting wild stock sockeye salmon in upper Lynn Canal to targeting large hatchery chum salmon runs at release sites in lower Lynn Canal. Fisheries actions to conserve Chilkoot Lake sockeye salmon in the 1990s, and Chilkat Lake sockeye salmon more recently, have made for challenging management of the Lynn Canal fishery (Eggers et al. 2009b).

Annual commercial harvests in the Yakutat area reached a recent historical peak of nearly 350,000 sockeye salmon in 1993 (Figure 7), due largely to tremendous increase in production in the East Alsek River (Smith et al. 2006b). Yakutat area sockeye salmon harvests have otherwise been stable for five decades, and the recent reduction in sockeye salmon production in the East Alsek, presumably due to hydrological changes in that watershed (Faber 2008), is the greatest contributing factor to lower harvests since the mid-1990s (Figure 7). The loss of glacial ice in the Yakutat Ice field and adjacent areas since the end of the Little Ice Age in the late 1700s is among the fastest measured in North America (Larsen et al. 2007), and the regional rate of isostatic rebound is presently the highest documented on the planet (up to 32 mm/year; Larsen et al. 2005). In addition to changes to the East Alsek River, recent geologic and hydrologic changes in the Lost (Burkholder 2000), Italio and Akwe (Smith et al. 2006a), and Doame (Clark et al. 2003) rivers have also affected sockeye salmon stock assessment and management in the Yakutat area.

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APPENDIX

Appendix A1.–Situk River sockeye salmon.

System: **Stock unit:**	**Situk River** **Situk River sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	Terminal commercial set gillnet fishery.
Secondary fisheries:	Recreational and subsistence fisheries.
Escapement goal:	*Biological* escapement goal 30,000–70,000 (1995, 2003).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Weir counts, 1976 to present.
Escapement goal summary:	
Data in analysis:	Weir estimates, harvest estimates, age composition.
Data quality:	Good.
Data contrast:	5.2 (1976–1997).
Escapement goal model:	Ricker model.
Brood years in model:	22 (1976–1997).
Parameter estimates:	α-parameter = 4.04 (adjusted); $1/\beta \approx 92{,}000$ (β-parameter $=1.09\times10^{-5}$); σ^2-parameter = 0.13.
Basis for escapement goal range:	Escapement range is 0.8 to 1.6 times the escapement predicted to provide *maximum sustained yield*.
Documentation:	Clark, J. H., S. A. McPherson, and A. Burkholder. 1995a. Biological escapement goal for Situk River sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 1J95-22, Douglas. 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, Special Publication No. 02-03, Anchorage.
Comments:	Current escapement goal met in 15 of 16 years since 1995.

Appendix A2.–Lost River sockeye salmon.

System: **Stock unit:**	**Lost River** **Tawah Creek/Coast Guard Lake/Ophir Creek sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	Mixed stock commercial set gillnet fishery.
Secondary fisheries:	Recreational and subsistence fisheries.
Escapement goal:	*Lower bound sustainable* escapement goal 1,000 counted on peak survey count (2003).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Foot and boat surveys, 1974 to present.
Escapement goal summary:	
Data in analysis:	Peak survey counts, harvest estimates, age composition.
Data quality:	Poor (harvest estimates, age composition) to fair (escapement counts).
Data contrast:	33.3 (1972–2002).
Escapement goal model:	Percentile method.
Brood years in model:	22 (1974–1997).
Basis for escapement goal:	25^{th} percentile of peak survey counts, 1972–2007.
Documentation:	Clark, J. H., A. Burkholder, and J. E. Clark. 1995b. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J95-16, Douglas. Eggers, D. M., J. H. Clark, R. L. Bachman, and S. C. Heinl. 2008. Sockeye salmon stock status and escapement goals in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 08-17, Anchorage.
Comments:	Current escapement goal met in 11 of 16 years since 1995 (no data for three years).

Appendix A3.–Klukshu River sockeye salmon.

System: **Stock unit:**	**Alsek River** **Klukshu River sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game and Department of Fisheries and Oceans Canada; joint management through Pacific Salmon Commission.
Primary fishery:	U.S. commercial set gillnet and Canadian inriver aboriginal fisheries.
Secondary fisheries:	U.S. subsistence and Canadian inriver recreational fisheries.
Escapement goal:	*Biological* escapement goal 7,500–15,000 (2000).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Weir counts, 1976 to present.
Escapement goal summary:	
Data in analysis:	Weir estimates, harvest estimates, age composition.
Data quality:	Fair (harvest estimates) to good (escapement estimates).
Data contrast:	4.1 (1976–1992).
Escapement goal model:	Ricker model.
Brood years in model:	17 (1976–1992).
Parameter estimates:	α-parameter = 4.59; $1/\beta \approx 15{,}800$ (β-parameter = 6.33×10^{-5}); σ^2-parameter not available.
Basis for escapement goal range:	Escapement range is 0.8 to 1.6 times the escapement predicted to provide *maximum sustained yield*.
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 1J00-24, Douglas.
Comments:	Current escapement goal met in 7 of 11 years since 2000.

Appendix A4.–East Alsek-Doame River system sockeye salmon.

System: **Stock unit:**	**East Alsek and Doame rivers** **East Alsek and Doame river sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	Terminal commercial set gillnet fishery.
Secondary fisheries:	Recreational and subsistence fisheries.
Escapement goal:	*Biological* escapement goal 13,000–26,000 counted on peak aerial survey (2003).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Sum of peak aerial counts in East Alsek and Doame rivers, 1972 to present.
Escapement goal summary:	
Data in analysis:	Peak aerial survey counts, harvest estimates, age composition.
Data quality:	Fair (escapement and age composition) to good (harvest estimates).
Data contrast:	7.0 (1972–1990); 1.6 (1991–1997).
Escapement goal model:	Ricker model for brood years 1972–1990; separate stock-recruit analysis for brood years 1991–1997 (0.43 times estimate of replacement).
Brood years in model:	19 (1972–1990); 7 in current model (1991–1997).
Parameter estimates:	α-parameter = 5.72 (adjusted); $1/\beta \approx 85{,}500$ (β-parameter = 4.96×10^{-5}); σ^2-parameter not available.
Basis for escapement goal range:	For brood years 1972–1990, range of escapements expected to produce at least 90% of estimated *maximum sustained yield*. For 1991–1997, escapement range is 0.8 to 1.6 times the escapement predicted to provide *maximum sustained yield*.
Documentation:	Clark, J. H., A. Burkholder, J. E. Clark. 1995b. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 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. Alaska Department of Fish and Game, Special Publication No. 03-04, Anchorage.
Comments:	Current escapement goal is for unflushed (i.e., less productive) habitat. Current escapement goal met in 6 of 8 years since 2003.

Appendix A5.–Chilkoot Lake sockeye salmon.

System: **Stock unit:**	**Chilkoot Lake** **Chilkoot Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	District 15 commercial drift gillnet fishery.
Secondary fisheries:	Recreational and subsistence fisheries.
Escapement goal:	*Sustainable* escapement goal 38,000–86,000 (2009).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	If the Chilkoot River weir count is less than 4,500 sockeye salmon through 13 June, section 15-A will be closed, and 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. This date was picked so as to occur prior to the first news release announcing the general opening of the Southeast region drift gillnet fishery.
Escapement measure:	Weir counts, 1976 to present.
Escapement goal summary:	
Data in analysis:	Weir counts, harvest estimates, age composition.
Data quality:	Fair (escapement estimates) to good (harvest estimates).
Data contrast:	14.3 (1976–2002).
Escapement goal model:	Ricker with autoregressive term.
Brood years in model:	27 (1976–2002).
Parameter estimates:	α-parameter = 5.35 ("bias adjusted" value = 8.7); $1/\beta \approx 171{,}000$ (β-parameter = 5.8×10^{-6}); $\phi = 0.64$; σ^2-parameter = 0.57.
Basis for escapement goal range:	Range of escapements expected to produce at least 90% of estimated *maximum sustained yield*, rounded to the nearest 5,000 spawners.
Documentation:	Eggers, D. M., X. Zhang, R. L. Bachman, and M. M. Sogge. 2009b. Sockeye salmon stock status and escapement goals for Chilkoot Lake in Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 09-63, Anchorage.
Comments:	Current escapement goal not met in 2009 and met in 2010.

Appendix A6.–Chilkat Lake sockeye salmon.

System: **Stock unit:**	**Chilkat River** **Chilkat Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	District 15 commercial drift gillnet fishery.
Secondary fisheries:	Recreational and subsistence fisheries.
Escapement goal:	*Biological* escapement goal 70,000–150,000 (2009).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Total escapement based on calibrated weir counts, fish wheel-based mark-recapture estimates, and DIDSON sonar counts.
Escapement goal summary:	
Data in analysis:	Escapement estimates, harvest estimates, age composition.
Data quality:	Good.
Data contrast:	8.5 (1979–2002).
Escapement goal model:	Autoregressive Ricker model with fry plant term.
Brood years in model:	24 (1979–2002).
Parameter estimates:	α-parameter = 2.7 ("bias adjusted" value = 3.55); $1/\beta \approx 265{,}000$ (β-parameter = 3.8×10^{-6}); σ^2-parameter = 0.42.
Basis for escapement goal range:	Range of escapements expected to produce at least 90% of estimated *maximum sustained yield*, rounded to nearest 5,000 spawners.
Documentation:	Eggers, D. M., R. L. Bachman, and J. Stahl. 2010. Stock status and escapement goals for Chilkat Lake sockeye salmon in Southeast Alaska. Alaska Department of Fish and Game, Fishery Manuscript No. 10-05, Anchorage.
Comments:	Current escapement goal exceeded in 2009 and not met in 2010.

Appendix A7.–Redoubt Lake sockeye salmon.

System: **Stock unit:**	**Redoubt Lake** **Redoubt Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game, U.S. Forest Service.
Primary fishery:	Recreational and subsistence fisheries.
Secondary fisheries:	Mixed stock District 13 commercial net fisheries.
Escapement goal:	*Biological* escapement goal 10,000–25,000 (2003).
Optimal escapement goal:	*Optimal* Escapement Goal 7,000–25000 (2003).
Inriver goal:	None.
Action points:	*Redoubt Bay and Lake Sockeye Salmon Fisheries Management Plan* (5 AAC 01.760).
Escapement measure:	Weir counts, 1982 to present.
Escapement goal summary:	
Data in analysis:	Weir estimates, subsistence and sport harvest estimates, age composition.
Data quality:	Good.
Data contrast:	160.5 (1982–1996).
Escapement goal model:	Ricker stock-recruit analysis.
Brood years in model:	15 (1982–1996).
Parameter estimates:	α-parameter = 4.30 ("bias adjusted" value = 8.55); $1/\beta \approx 23{,}000$ (β-parameter $=4.3 \times 10^{-5}$); σ^2-parameter = 1.29.
Basis for escapement goal range:	Range of escapements expected to produce at least 90% of estimated *maximum sustained yield*, rounded to the nearest 2,500 spawners. 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.
Comments:	Optimal escapement goal met in 8 of 8 years since 2003.

Appendix A8.–Taku River sockeye salmon.

System: **Stock unit:**	**Taku River** **Drainagewide Taku River sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game and Department of Fisheries and Oceans Canada; joint management through Pacific Salmon Commission.
Primary fishery:	Alaska District 11 commercial drift gillnet fishery; inriver Canadian commercial gillnet fishery.
Secondary fisheries:	Recreational, subsistence, personal use, and Canadian aboriginal fisheries.
Escapement goal:	*Sustainable* escapement goal 71,000–80,000 (1985).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Mark-recapture estimate, 1984 to present.
Escapement goal summary:	
Data type:	Escapement estimates, harvest estimates, age composition.
Data quality:	Good.
Escapement goal model:	Professional judgment; set in 1985 by the Transboundary Technical Committee of the Pacific Salmon Commission.
Documentation:	TTC (Transboundary Technical Committee). 1986. Report of the Canada/United States Transboundary Technical Committee. Pacific Salmon Commission Report TCTR 86-1, Vancouver.
Comments:	Current escapement goal met in 24 of 26 years since 1985.

Appendix A9.–Speel Lake sockeye salmon.

System: **Stock unit:**	**Speel Lake** **Speel Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	Mixed stock District 11 commercial drift gillnet fishery.
Secondary fisheries:	Port Snettisham commercial drift gillnet terminal harvest area.
Escapement goal:	*Biological* escapement goal 4,000–13,000 (2003).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Weir counts, 1983 to present.
Escapement goal summary:	
Data in analysis:	Weir estimates, harvest estimates, age composition.
Data quality:	Fair (escapement estimates) to good (harvest estimates). Weir counts prior to 2002 provided partial escapement estimates; weir counts since 2002 complete and will provide basis for re-evaluation of goal.
Data contrast:	100.1 (1983–1996).
Escapement goal model:	Ricker stock-recruit analysis.
Brood years in model:	14 (1983–1996).
Parameter estimates:	α-parameter = 17.22 (adjusted); $1/\beta \approx 9{,}100$ (β-parameter =0.00011); σ^2-parameter = 1.089.
Basis for escapement goal range:	Range of escapements expected to produce at least 80% of estimated *maximum sustained yield*.
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 1J03-34, Juneau.
Comments:	Current escapement goal met in 5 of 8 years since 2003.

Appendix A10.–Mainstem Stikine River sockeye salmon.

System: **Stock unit:**	**Stikine River** **Drainagewide Stikine River sockeye salmon (excluding wild and hatchery runs at Tahltan and Tuya lakes)**
Management jurisdiction:	Alaska Department of Fish and Game and Department of Fisheries and Oceans Canada; joint management through Pacific Salmon Commission.
Primary fishery:	Alaska Districts 6 and 8 commercial drift gillnet fisheries; inriver Canadian commercial gillnet fishery.
Secondary fisheries:	Alaska mixed stock commercial purse seine fisheries; inriver recreational, subsistence, and Canadian aboriginal fisheries.
Escapement goal:	*Sustainable* escapement goal 20,000–40,000 (1987).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Post-season run reconstruction by the Transboundary Technical Committee of the Pacific Salmon Commission, 1979 to present.
Escapement goal summary:	
Data type:	Escapement estimates, harvest estimates, age composition.
Data quality:	Good.
Escapement goal model:	Professional judgment; set in 1987 by the Transboundary Technical Committee of the Pacific Salmon Commission.
Documentation:	TTC (Transboundary Technical Committee). 1987. Stikine River sockeye salmon management plan, 1987. Pacific Salmon Commission Report TCTR (87)-2, Vancouver.
Comments:	Current escapement goal met in 20 of 24 years since 1987.

Appendix A11.–Tahltan Lake sockeye salmon.

System: **Stock unit:**	**Stikine River** **Tahltan Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game and Department of Fisheries and Oceans Canada; joint management through Pacific Salmon Commission.
Primary fishery:	Alaska district 6 and 8 commercial drift gillnet fisheries; inriver Canadian commercial gillnet fishery.
Secondary fisheries:	Alaska mixed stock commercial purse seine fisheries; inriver recreational, subsistence, and Canadian aboriginal fisheries.
Escapement goal:	*Biological* escapement goal 18,000–30,000 (1993).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Weir counts, 1959 to present.
Escapement goal summary:	
Data in analysis:	Weir estimates, harvest estimates, age composition.
Data quality:	Good.
Data contrast:	9.7 (1975–1987).
Escapement goal model:	Ricker stock-recruit analysis.
Brood years in model:	13 (1975–1987).
Parameter estimates:	α-parameter = 1.44; $1/\beta \approx 33{,}300$ (β-parameter = 3.0×10^{-5}); σ^2-parameter not available.
Basis for escapement goal range:	Escapement goal range based on professional judgment.
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 No. 2227.
Comments:	Escapement goal includes 4,000 sockeye salmon for broodstock for hatchery supplementation. Current escapement goal met in 11 of 18 years since 1993.

Appendix A12.–Hugh Smith Lake sockeye salmon.

System: **Stock unit:**	**Hugh Smith Lake** **Hugh Smith Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	Mixed stock commercial purse seine and drift gillnet fisheries in southern Southeast Alaska.
Secondary fisheries:	Subsistence fishery.
Escapement goal:	*Biological* escapement goal, 8,000–18,000 (2003).
Optimal escapement goal:	*Optimal* escapement goal 8,000–18,000 (2003). The optimal goal includes returns of hatchery-stocked fish.
Inriver goal:	None.
Action points:	None.
Escapement measure:	Weir counts, 1980 to present.
Escapement goal summary:	
Data in analysis:	Escapement estimates, some harvest estimates, age composition of escapement, smolt estimates.
Data quality:	Poor (harvest estimates) to good (escapement and smolt estimates).
Data contrast:	
Escapement goal model:	Risk analysis, Beverton-Holt juvenile production model, theoretical stock-recruit analysis.
Brood years in model:	22 (1980–2001).
Basis for escapement goal range:	Combination of 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 1J03-05, Douglas.
Comments:	Optimal escapement goal met in 7 of 8 years since 2003.

Appendix A13.–McDonald Lake sockeye salmon.

System: **Stock unit:**	**McDonald Lake** **McDonald Lake sockeye salmon**
Management jurisdiction:	Alaska Department of Fish and Game.
Primary fishery:	Mixed stock commercial purse seine and drift gillnet fisheries in southern Southeast Alaska.
Secondary fisheries:	Terminal commercial purse seine fishery in Yes Bay; personal use and recreational fisheries.
Escapement goal:	*Sustainable* escapement goal 55,000–120,000 (2009).
Optimal escapement goal:	None.
Inriver goal:	None.
Action points:	McDonald Lake action plan (Bergmann 2009).
Escapement measure:	Weir counts 1982, 1983, 1984; mark-recapture 2005–2007; expanded foot survey estimates 1980 to present.
Escapement goal summary:	
Data in analysis:	Escapement estimates, some harvest estimates, age composition of escapement.
Data quality:	Good escapement estimates; poor harvest estimates.
Data contrast:	4.0 (1980–2001).
Escapement goal model:	Ricker stock-recruit with fry-plant term.
Brood years in model:	22 (1980–2001).
Parameter estimates:	α-parameter = 1.42 ("bias adjusted" value = 1.63); $1/\beta \approx 212{,}000$ (β-parameter = 4.71×10^{-6}); σ^2-parameter = 0.42.
Basis for escapement goal range:	Range of sustained escapements expected to produce at least 90% of estimated *maximum sustained yield*, rounded to nearest 5,000 spawners.
Documentation:	Eggers, D. M., S. C. Heinl, and A. W. Piston. 2009a. McDonald Lake sockeye salmon stock status and escapement goal recommendations, 2008. Alaska Department of Fish and Game, Fishery Data Series No. 09-31, Anchorage.
Comments:	Current escapement goal not met in 2009 and met in 2010 and 2011.

Appendix A14.–Commercial fisheries management restrictions outlined in the McDonald Lake action plan and implemented through 2011.

Area	Gear	Period[a]	Year implemented	Restriction
District 6	Drift gillnet	Statistical weeks 29–31	2007–2011	Open for a maximum of two days.
District 1	Purse seine	Statistical weeks 29–31	2007–2011	Western shore of Gravina Island (in subdistrict 101-29) closed north of the latitude of Cone Point.
District 2	Purse seine	Statistical weeks 29–32	2009–2011	Western shore of the Cleveland Peninsula (subdistrict 102-80) closed within 3 nautical miles of the shoreline.
District 5	Purse seine	Statistical weeks 29–31	2009–2011	Northwest corner of Prince of Wales Island (in subdistrict 105-41) closed between Point Baker and the Barrier Islands.
District 6	Purse seine	Statistical weeks 29–31	2009–2011	West side of Etolin Island closed between Point Stanhope and the latitude of Round Point, and east side of Prince of Wales Island closed between Luck Point and Narrow Point (subdistrict 106-30).
District 7	Purse seine	Statistical weeks 29–31	2009–2011	Section 7-B closed (subdistrict 107-10). If pink salmon runs are extremely strong, the northern portion of section 7-B, north of Union Point may be open during statistical week 31. If this occurs, restrictions may occur in that area south of Union Point into statistical week 32 to reduce the overall interception of sockeye salmon

[a] Statistical weeks 29–31 are approximately mid-July to early August.

Appendix A15.–Commercial fishing districts in southern Southeast Alaska, and areas in districts 1 through 7 delineated for time and area restrictions in the McDonald Lake action plan.