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Sockeye Salmon Stock Status and Escapement Goals in Southeast Alaska

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

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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)

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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TABLE OF CONTENTS

Page

LIST OF TABLES ii

LIST OF FIGURES ii

LIST OF APPENDICES ii

ABSTRACT 1

INTRODUCTION 1

STOCK STATUS 5

Harvest Estimation 5

Escapement Measurement 6

Stock Assessment Overview 8

- Yakutat Stocks 8
- Transboundary River Stocks 9
- Southeast Alaska Stocks 9

ESCAPEMENT GOALS AND ESCAPEMENT PERFORMANCE 9

Situk River 10

Lost River 11

Akwe River 12

Klukshu River (in the Alsek River System) 12

East Alsek-Doame Rivers 13

Chilkoot Lake 13

Chilkat Lake 15

Redoubt Lake 17

Taku River 18

Speel Lake 19

Tahltan Lake Sockeye Salmon 19

Mainstem Stikine River 20

Hugh Smith Sockeye Salmon 21

McDonald Lake Sockeye Salmon 21

STOCKS OF CONCERN 23

DISCUSSION 24

ACKNOWLEDGMENTS 24

REFERENCES CITED 25

APPENDIX A 29

LIST OF TABLES

Table **Page**

1. Escapement goals for sockeye salmon stocks or stock groups in Southeast Alaska and the Yakutat area.....9
2. Escapements for 13 sockeye systems with escapement goals in Southeast Alaska and the Yakutat area for the years 2003 to 2008.....10

LIST OF FIGURES

Figure **Page**

1. Sockeye salmon systems in Southeast Alaska and the Yakutat area that currently have established escapement goals.....2
2. Fishing districts in Southeast Alaska and the Yakutat area.....2
3. Commercial catch of sockeye salmon in Southeast Alaska (not including the Yakutat area) from 1878 to 2008.....4
4. Commercial harvests of sockeye salmon in the Yakutat area from statehood to 2008.....8
5. Escapements (weir counts) for Situk River sockeye salmon.....10
6. Escapement index (peak survey counts) for Lost River sockeye salmon.....11
7. Escapements (weir counts) for Klukshu River sockeye salmon.....12
8. Escapement index (peak aerial counts) for East Alsek-Doame River sockeye salmon.....13
9. Escapements (weir counts) for Chilkoot Lake sockeye salmon.....14
10. A regression relationship between Chilkat Lake weir counts and mark-recapture estimates using paired 1994 to 2007 observations.....15
11. Escapements (calibrated weir counts, 1976 - 1993; mark -recapture, 1994 - 2007, sonar counts 2008) for Chilkat Lake sockeye salmon.....17
12. Escapements (weir counts) for Redoubt Lake sockeye salmon.....18
13. Escapements (mark-recapture estimates) for Taku River sockeye salmon from 1984-2007.....18
14. Escapements (expanded weir counts) for Speel Lake sockeye salmon.....19
15. Escapements (weir counts) for Tahltan Lake sockeye salmon.....20
16. Escapements (estimated total escapement) for Mainstem Stikine River sockeye salmon in 1979-2007.....20
17. Escapements (weir counts) for Hugh Smith Lake sockeye salmon.....21
18. Escapements (expanded foot counts) for McDonald Lake sockeye salmon, 1982–2008.....23

LIST OF APPENDICES

Appendix **Page**

A1. Situk River sockeye salmon.....30
A2. Lost River sockeye salmon.....31
A3. Akwe River sockeye salmon.....32
A4. Klukshu River sockeye salmon.....33
A5. East Alsek-Doame River system sockeye salmon.....34
A6. Chilkoot Lake sockeye salmon.....35
A7. Weekly cumulative escapement goals for Chilkoot Lake.....36
A8. Chilkat Lake sockeye salmon.....37
A9. Redoubt Lake sockeye salmon.....38
A10. Taku River sockeye salmon.....39
A11. Speel Lake sockeye salmon.....40
A12. Speel Lake and surrounding area. Striped area denotes the hatchery Special Harvest Area (SHA).....41
A13. Tahltan Lake sockeye salmon.....42
A14. Stikine River drainage and surroundings, showing location of commercial, subsistence, and recreational fisheries.....43
A15. Mainstem Stikine sockeye salmon.....44
A16. Hugh Smith sockeye salmon.....45
A17. McDonald Lake sockeye salmon.....46

ABSTRACT

This work represents a review of escapement goals for sockeye salmon stocks (*Oncorhynchus nerka*) in the Southeast Alaska and Yakutat area. There are currently 13 escapement goals for sockeye producing systems in the Southeast Alaska and Yakutat area. Over the 5-year period, 2003-2007, escapements for these sockeye salmon stocks have been generally within or above their respective escapement goal ranges for at least four years; an exception is the sockeye salmon stock of McDonald Lake. Very weak sockeye salmon runs occurred throughout the area in 2008 and escapement goals were met for only 2 of the 13 stocks (Chilkat and Redoubt lakes). Hugh Smith Lake was classified as a *stock of management concern* in 2003. In response, the Board of Fisheries approved an action plan for the stock's recovery. Hugh Smith escapements were above the upper end of the goal range from 2003 to 2007, and the stock of concern designation has been removed. This year, the Alaska Department of Fish and Game recommends that the McDonald Lake sockeye salmon stock be classified as a *stock of management concern*. Annual escapements of sockeye salmon to McDonald Lake have been below the current escapement goal for 4 of 5 years and it is likely that reduced runs to McDonald Lake will continue for some time. An Action plan for the McDonald Lake stock needs to be developed and submitted to the Board of Fisheries for approval.

Key words: Sockeye salmon, *Oncorhynchus nerka*, escapement, escapement goals, escapement goal ranges, stock status, lakes, Chilkat Lake, McDonald Lake, stocks of concern.

INTRODUCTION

Sockeye salmon (*Oncorhynchus nerka*) that are harvested in Southeast Alaska and the Yakutat area originate from three sources: (1) transboundary rivers that flow through Canada and into Alaska (such as the Alsek, Taku, and Stikine rivers), (2) 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 1), and (3) 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. Long-term stock assessment information is available for several smaller producers in the Yakutat area, including the Lost, Italio, and East Alsek-Doame rivers; as well as 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), and because sockeye salmon are harvested primarily in mixed-stock fisheries, stock-specific harvest information is scarce, making it difficult to estimate 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 from early June through mid-September. Peak abundance occurs during the month of July. Spawn timing is also highly variable, but most spawning occurs 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). 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 1).

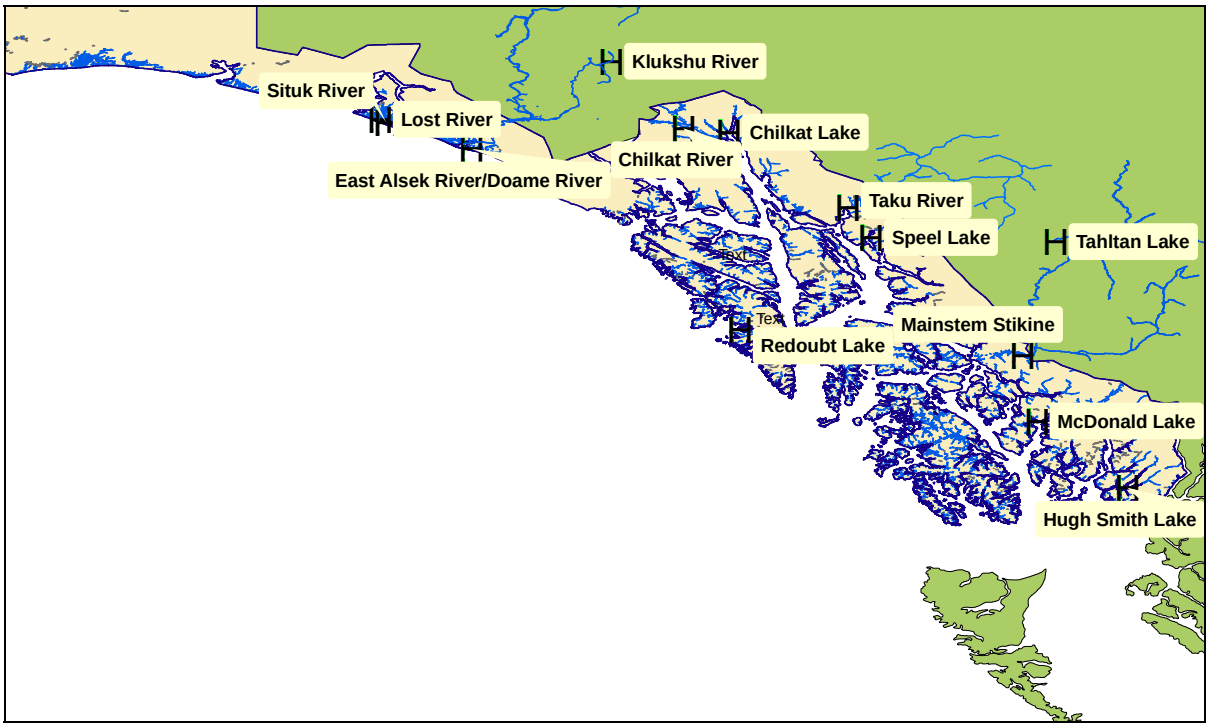

Figure 1.–Sockeye salmon systems in Southeast Alaska and the Yakutat area that currently have established escapement goals.

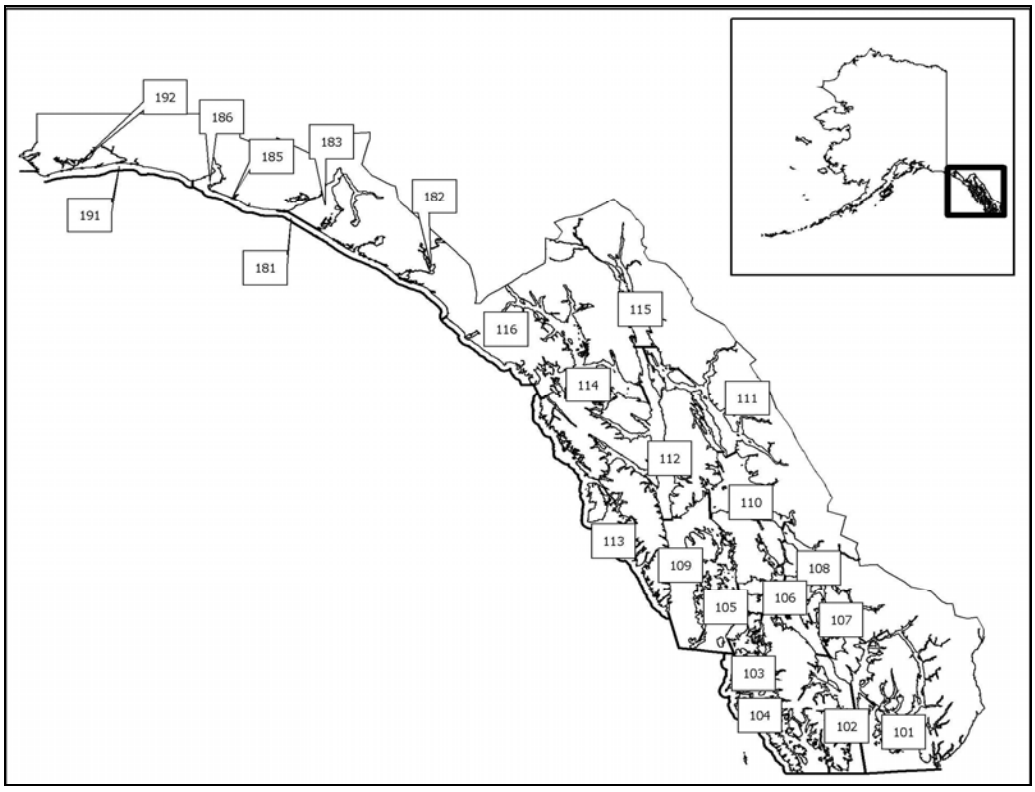

Figure 2.–Fishing districts in Southeast Alaska and the Yakutat area.

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 and McPherson (2004) produced ADF&G's first report on stock status and escapement goals of sockeye salmon for the Southeast Alaska and Yakutat region. The report was updated the following year (DerHovanisian and Geiger 2005). This chapter represents an update concerning sockeye salmon, including changes in escapement goals recommended by ADF&G.

Sockeye salmon in Southeast Alaska and the Yakutat area are harvested by commercial, subsistence, and sport users with the commercial harvest being the dominant harvest sector. 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 3). Annual commercial catches in Southeast Alaska and the Yakutat area were consistently in excess of 2 million fish from 1902 to 1920, and 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 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.

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 (Clark et al. 2006) 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, though the timing varies from fishery to fishery, and substantial harvests of (*O. keta*), pink (*O. gorbuscha*), and coho (*O. kisutch*) salmon occur as well in the drift gillnet fisheries. During September and early October the drift gillnet fisheries target coho and fall-run chum salmon. There are five traditional drift gillnet fishing areas in Southeast Alaska: District 1 (Tree Point and Portland Canal), District 6 (Sumner and Clarence straits), District 8 (Stikine), District 11 (Taku-Snettisham), and District 15 (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.

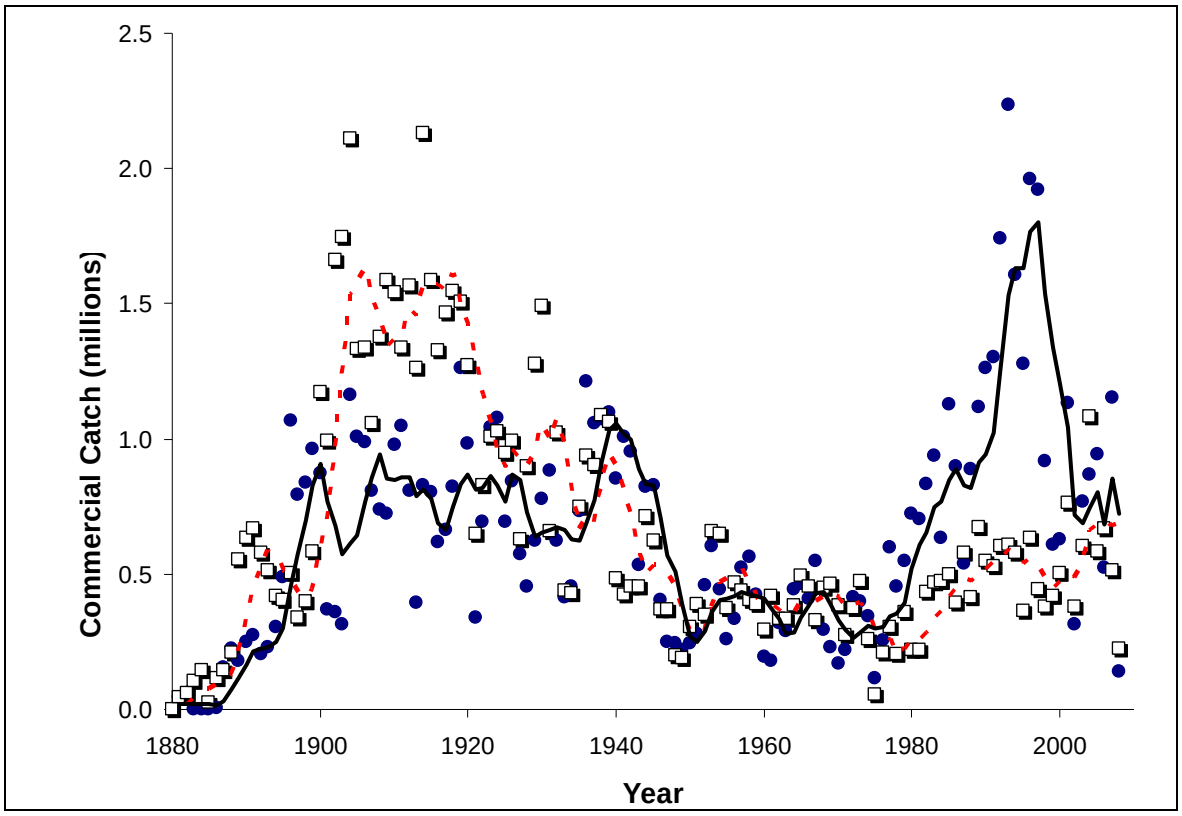

Figure 3.–Commercial catch of sockeye salmon in Southeast Alaska (not including the Yakutat area) from 1878 to 2008. Open squares show catch of sockeye salmon in northern Southeast Alaska, and dots show catch in southern Southeast Alaska. The curves show 5-year running averages. The solid curve is the estimated trend for southern Southeast Alaska, and the dashed curve is the estimated trend for northern Southeast Alaska.

Management of the District 1, 6, 8, and 11 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 6 and 8 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. U.S. - Canada harvest sharing of transboundary Taku River origin sockeye salmon in the District 11 fishery is dependent on the level of the enhanced return of sockeye salmon produced through the bilateral enhancement program. The District 15 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. 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.

[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.

Although purse seine fisheries are frequently the largest harvester of sockeye salmon in the region, the primary target of the seine fisheries are pink salmon and hatchery returns of chum salmon in hatchery terminal fisheries. The District 4 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 4 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 which 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 each species of 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 are usually underreported and underestimated. Probability-based surveys of subsistence harvest have been conducted for five 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; Conitz 2008a, 2008b, 2008c; Lewis and Cartwright 2002a, 2002b, 2002c; Woodey and Conitz 2008). Sport harvest is assessed by means of a household-based postal survey (e.g., Jennings et. al 2007).

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 patterns, 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 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 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 6, 8 and 11 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 count/mark recapture programs was developed for McDonald Lake, and expansions of foot surveys have been used to estimate escapements to this system since the mid-1980s (Heinl et al. 2008). Aerial surveys are used to index escapement trends throughout the region, particularly in Yakutat area.

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 Canadian Department of Fisheries and Oceans (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 experiments 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 between 2003 and 2005 to estimate total escapement and provide information on the relationship between ongoing index survey counts and total escapements; these included the East Alsek River (Waltemyer et al. 2005a, 2005b, and Smith et al. 2006a), Lost River (Waltemyer et al. 2005c) and Akwe and Italio rivers (Smith et al. 2006b).

In upper Lynn Canal, a fish-wheel based mark-recapture assessment program 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 11 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 mark-recapture assessment program. 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 11, 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[2] 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 in 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 in-season 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 Lake 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 meromictic 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. 2005, Eggers et al in prep). 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.

In 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

[2] Unpublished report by S. G. Taylor and J. Lum. Auke Creek Weir 2003 Annual Report, Operations, Fish Counts, and Historical Summaries. 2004. 26 pp [*in*] National Marine Fisheries Service, Auke Bay Laboratory, Juneau.

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. Other projects were located at Kanalku Lake (Admiralty Island), Hoktaheen Lake (Yakobi Island), Kutlaku Lake (Kuiu Island), Thoms Lake (Wrangell Island), and on the mainland at Thoms Lake and Neva Lake.

STOCK ASSESSMENT OVERVIEW

Geiger et al. (2004) reported stock status and escapement goal recommendations for 15 sockeye salmon systems in Southeast Alaska and the Yakutat area; and Geiger et al. (2005) provided an updated stock status and escapement goal recommendations for 13 systems. These goals form the basis of our review since the last 2005 stock assessment. The primary assessment tool for these stocks is 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 the appendices.

Yakutat Stocks

Escapements to the non-transboundary Yakutat sockeye systems have met or exceeded the current escapement goals every year from 2000 to 2007. Sockeye salmon harvests in the Yakutat area have declined since the early 1990s, with the 2008 harvest being the lowest since statehood. In spite of the limited fishing, escapements were not achieved for any of the sockeye salmon stocks in the Yakutat area in 2008 (Figure 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.

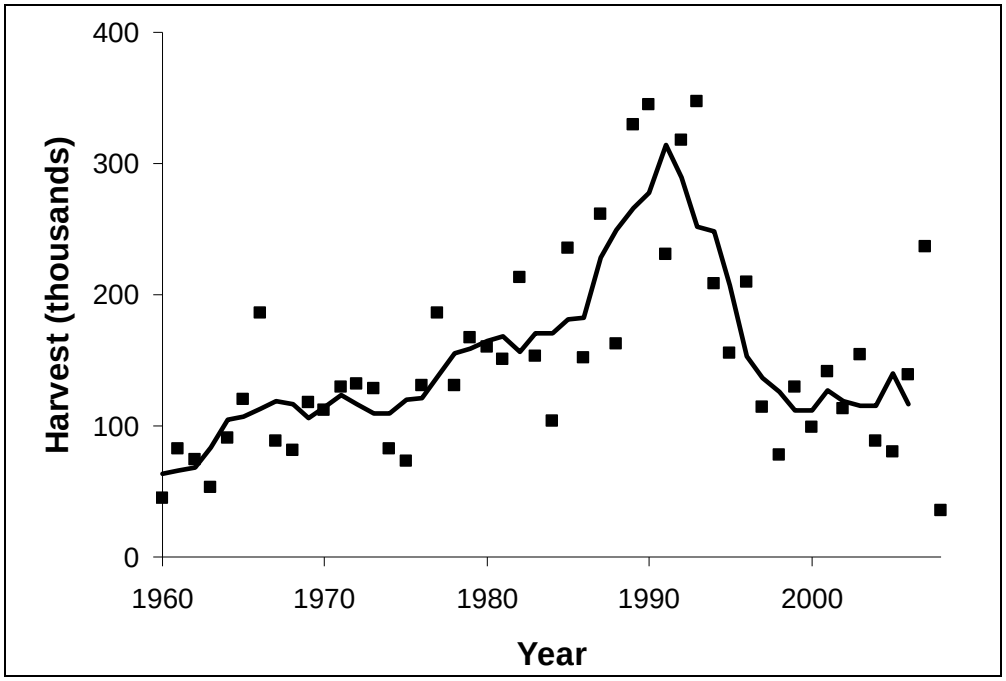

Figure 4.–Commercial harvests of sockeye salmon in the Yakutat area from statehood to 2008. The curve represents the 5-year running average.

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 2003. Harvests of sockeye salmon in the U.S. Alsek River fishery averaged 16,000 fish annually over the last decade (1998–2007), while the 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 the record harvest in 2001. Returns to Tahltan Lake in the Stikine River drainage have been highly variable in the past two decades. 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 2007.

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 salmon stocks in Southeast Alaska and the Yakutat area (Table 1). During ADF&G's review of existing escapement goals in 2005, updated goals were developed for three large sockeye salmon stocks in the region (McDonald, Chilkat and Chilkoot lakes) and ADF&G recommend eliminating the goal for the Akwe River. Updated stock assessments and revised escapement goal recommendations have been developed for McDonald Lake (Eggers et al. *in prep*) and Chilkat River (Eggers et al. *in prep*) sockeye salmon. Table 2 of this report includes escapement information collected since 2003 for sockeye salmon producing systems with escapement goals, including information for 2008, where available. Figures 5 through 18 of this report provide longer escapement histories for these stocks, and additional information on each system is presented in Appendices A1 through A17.

Table 1.–Escapement goals for sockeye salmon stocks or stock groups in Southeast Alaska and the Yakutat area.

System	Additional Material in Appendix	Goal Type	Escapement Goal	Year Established	If Recently Revised, Previous Goal
Situk River	A1	BEG	30,000–70,000	1995	
Lost River	A2	SEG	1,000–2,300	1995	
Klukshu River	A4	BEG	7,500–15,000	2000	
East Alsek-Doame River	A5	BEG	13,000–26,000	2003	
Chilkoot Lake	A6, A7	SEG	38,000–86,000	2005	50,000 - 90,000
Chilkat Lake	A8	BEG	70,000–150,000	2008	80,000–200,000
Redoubt Lake	A9	OEG	10,000–25,000	2003	
Taku River	A10	SEG	71,000–80,000	1986	
Speel Lake	A11, A12	BEG	4,000 –13,000	2003	
Tahltan Lake	A13	BEG	18,000–30,000	1993	
Mainstem Stikine River	A15	SEG	20,000–40,000	1987	
Hugh Smith	A16	OEG	8,000–18,000	2003	
McDonald Lake	A17	SEG	55,000-120,000	2008	70,000–100,000

Table 2.–Escapements for 13 sockeye systems with escapement goals in Southeast Alaska and the Yakutat area for the years 2003 to 2008.

System	Units	Escapement Goal	2003	2004	2005	2006	2007	2008[a]
Hugh Smith Lake[a]	Total Fish	8,000–18,000	19,568	19,734	23,872	42,112	33,743	3,584
McDonald Lake	Total Fish	55,000–120,000	110,633	28,759	61,043	31,357	25,185	20,700
Mainstem Stikine R.	Total Fish	20,000–40,000	57,972	36,748	34,788	27,603	27,493	14,500
Tahltan Lake	Total Fish	18,000–30,000	53,533	62,952	43,046	53,455	20,874	10,646
Speel Lake	Total Fish	4,000–13,000	7,014	7,813	7,538	4,165	3,099	1,750
Taku River	Total Fish	71,000–80,000	160,366	106,688	120,053	146,151	81,800	70,442
Redoubt Lake	Total Fish	7,000–25,000	69,893	77,263	65,653	103,953	66,938	10,146
Chilkat Lake	Total Fish	70,000–150,000	113,000	119,000	84,000	73,000	68,000	71,700
Chilkoot Lake	Total Fish	38,000–86,000	74,515	75,634	51,254	96,254	72,561	32,957
East Alsek-Doame R.	Index units	13,000–26,000	36,400	33,300	50,000	29,000	40,100	8,000
Klukshu River	Total Fish	7,500–15,000	32,120	13,721	3,036	12,890	8,479	2,731
Lost River	Index units	1,000–2,300	3,000	1,100	1,500	1,018	180	146
Situk River	Total Fish	30,000–70,000	89,700	42,500	66,500	87,080	61,799	22,434

[a] Includes hatchery fish.

SITUK RIVER

ADF&G managed the Situk-Ahrnklin Inlet and inriver fisheries to achieve an escapement goal of over 100,000 spawners in the early 1980s and then managed the fishery to achieve 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). A more recent analysis for the Situk River using stock-recruit analysis data from the 1976 through 1997 brood years also resulted in a biological escapement goal of 30,000-70,000 sockeye salmon (Clark et al. 2002; Appendix A1). Escapements have been within or above the goal range every year since 1978 except 2008 (Figure 5).

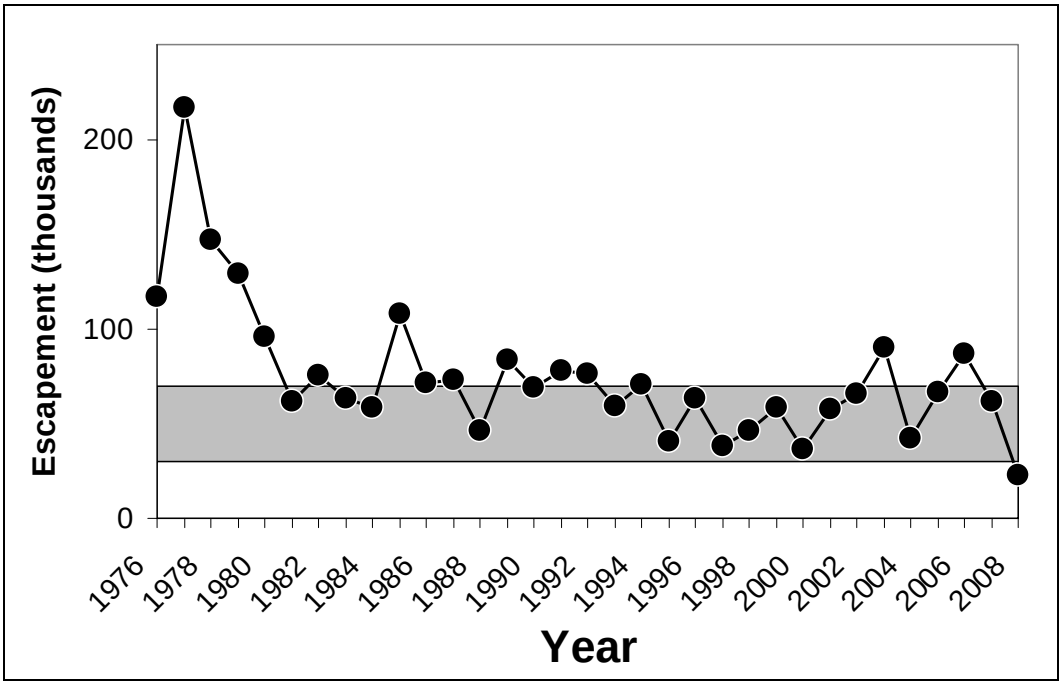

Figure 5.–Escapements (weir counts) for Situk River sockeye salmon. The gray area is the current biological escapement goal range of 30,000 to 70,000 spawners.

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 A2). Observed escapements were within or above the goal range from 1999 to 2006 and below the goal range the last two years (Figure 6). The Lost River system drained into its own lagoon before entering the Gulf of Alaska prior to the winter of 1999-2000. In that winter, the Lost River changed channels and now empties into the Situk-Ahrnklin lagoon. A commercial set gill net fishery took place in the Lost River lagoon prior to the year 2000 and having a biological escapement goal for the stock was an appropriate management target. Since 2000, the Lost River sockeye stock is harvested as a minor component of the catch in the Situk-Ahrnklin lagoon fishery where management actions are dictated by escapement trends for the Situk River sockeye stock. Because of the inability to target the fishery on Lost River sockeye salmon, ADF&G is changing the goal to a sustainable escapement goal expressed an escapement threshold. An analysis of escapement trends using the Bue and Hasbrouck method[3] produced an estimate of 1,100 to 3,000 as an appropriate sustainable escapement goal range. Because of the consistency of the lower end of the escapement goal between the two methods, ADF&G is recommending escapement goal of 1,000 Escapements have been above the escapement goal 8 of the last 10 years, and below the goal the last 2 years (Figure 6).

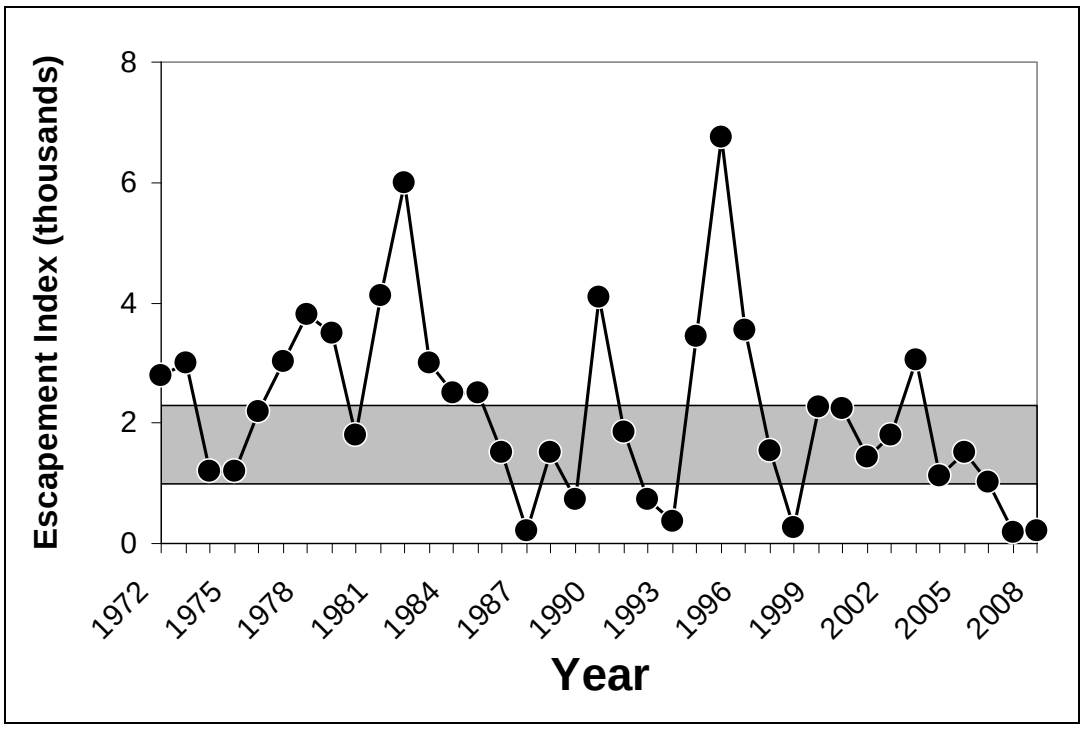

Figure 6.–Escapement index (peak survey counts) for Lost River sockeye salmon. The gray area is the sustainable escapement goal range of 1,000 to 2,300 index spawners.

[3] Bue, B. G., and J. J. Hasbrouck. *Unpublished*. Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

AKWE RIVER

Although ADF&G adopted a *biological escapement goal* of 600 to 1,500 peak aerial survey counts for this system in 1995, few peak counts were obtained for the river since the goal was established (Appendix A3). Because of the department's inability to reliably monitor escapements, the escapement goal was dropped in 2005.

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 A4). 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 one out of the last six years, within the goal range in three years and below the lower end of the goal in two of the last six years (Figure 7).

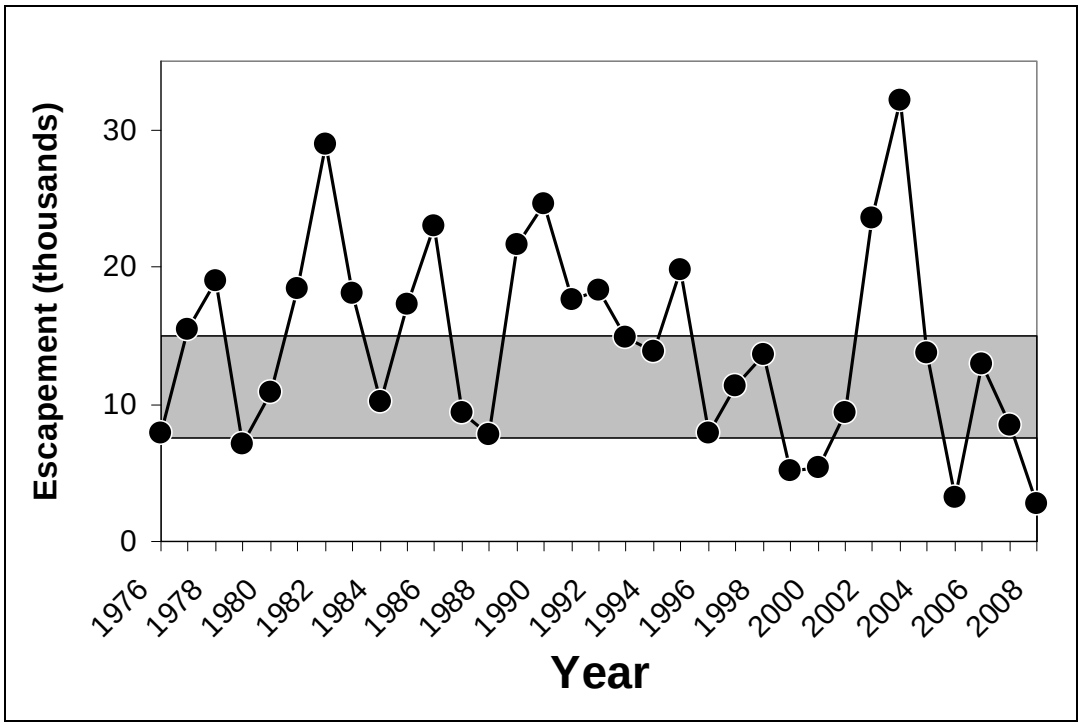

Figure 7.–Escapements (weir counts) for Klukshu River sockeye salmon. The gray area is the biological escapement goal range of 7,500 to 15,000 spawners.

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 A5). Escapements have been within or above the goal range every year since 1973, except 2008 when escapement was below the goal range (Figure 8). Mapping and physical habitat analysis of the spawning grounds in the East Alsek River by University of Alaska and Glacier Bay National Park and Preserve fishery scientists produced an estimate of 19,000 to 28,000 fish as the number of spawning sockeye that the East Alsek River can support (Faber et al. 2005), an escapement goal range estimate very close to the current escapement goal range that was developed through stock-recruit analysis (Farber 2008).

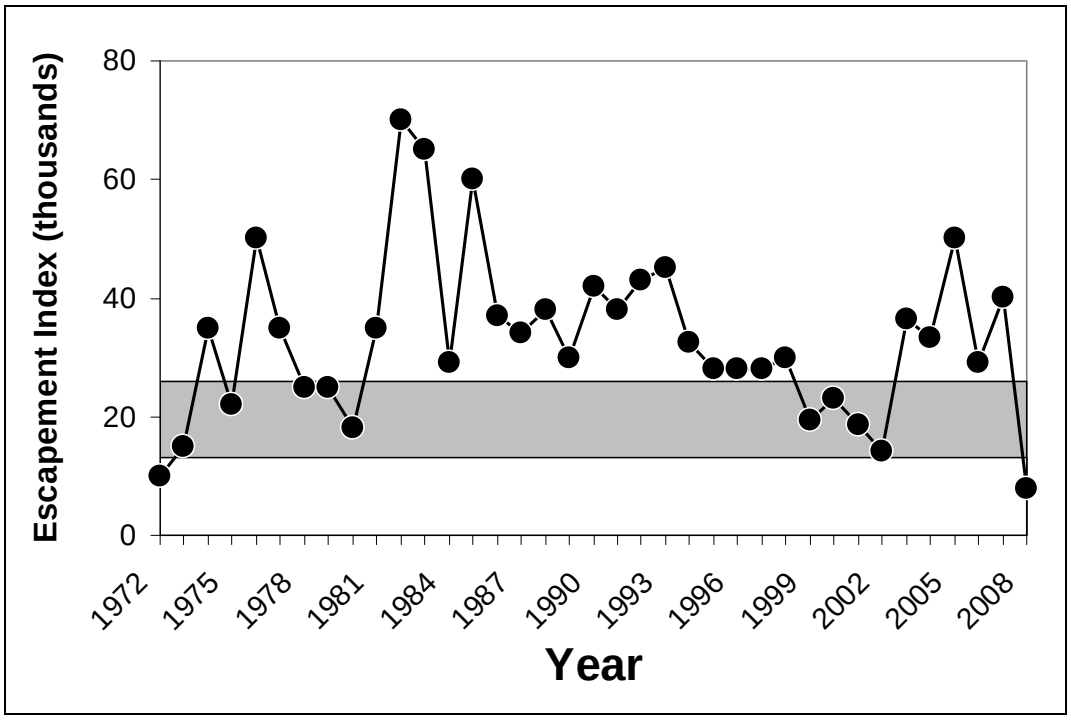

Figure 8.–Escapement index (peak aerial counts) for East Alsek-Doame River sockeye salmon. The gray area is the biological escapement goal range of 13,000 to 26,000 index spawners.

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 for the 1976-1984 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 experiments were conducted from 1996-2004 (Bachman and Sogge 2006, Bachman and Eisenman (*in prep*.). Because spawning in Chilkoot Lake occurs primarily in beach areas, the

recapture event sampling was difficult. Mark recapture estimates in those years were somewhat consistent the conclusion of the investigations was that the weir counts but because of technical and logistic issues with mark-recapture estimates, the weir counts were likely biased low. However, differences between mark-recapture estimates and weir counts were not consistent enough for development of a calibration.

Chilkoot Lake underwent an extended downturn in production in the 1990s. The commercial catch of Chilkoot Lake sockeye salmon averaged about 149,000 fish from 1976 to 1989, but the 1996 - 2005 average harvest was only about 27,000 fish. Harvest increased in 2006. An updated stock-recruit analysis using total run estimates based on weir counts (1976-2002 brood years) was conducted by Eggers et al. (*in prep*.). Production for this stock is cyclical, with persistent low production for the 1989-1995 brood years. A Ricker stock-recruit model with an auto regressive term fit the data well and provided statistically meaningful reference points for the stock. The range of escapements that is expected to produce 90% or more of maximum sustained yield were slightly lower than the current escapement goal range based on McPherson (1990). We recommend an escapement goal range of 38,000 to 86,000, although we are now classifying this as a *sustainable escapement goal* (Appendix A6) due to the likely bias in escapement estimates based on weir counts. We further recommend weekly escapement targets, based on historical run timing (Appendix A7). The escapement has been within the previous escapement goal range seven out of the last eight years, with the escapement below the lower end of the range in 2008 (Figure 9).

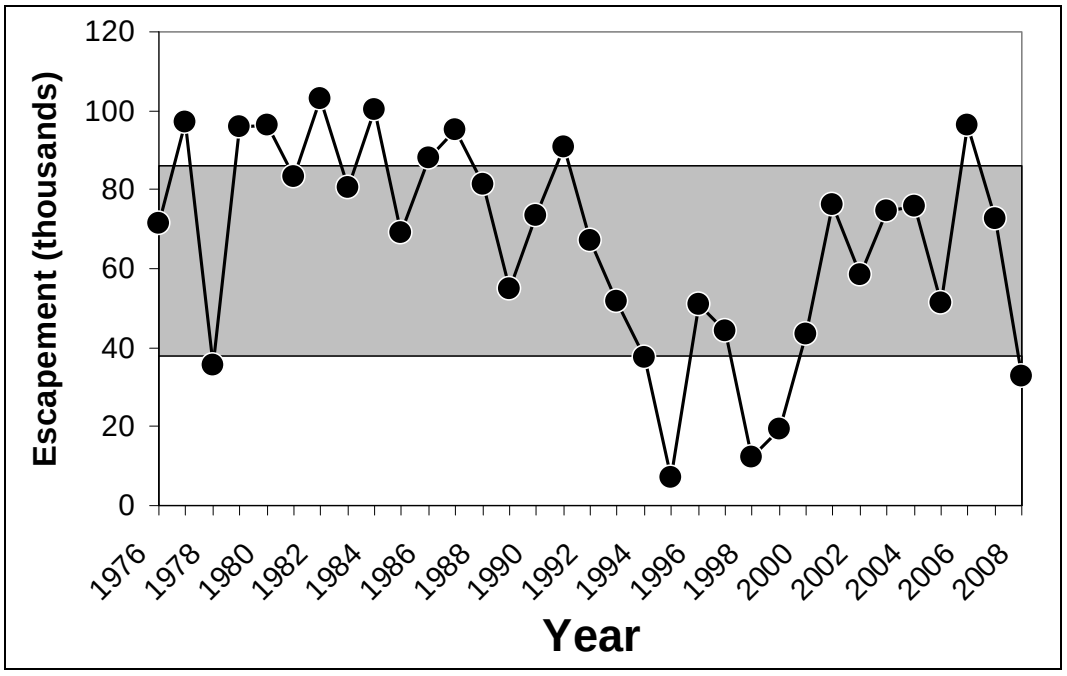

Figure 9.–Escapements (weir counts) for Chilkoot Lake sockeye salmon. The gray area is the sustainable escapement goal range of 38,000 to 86,000 spawners.

CHILKAT LAKE

McPherson (1990) developed a scale pattern analysis program that permitted stock-specific estimates of harvest for both Chilkat and Chilkoot lakes in the District 15 fishery using archival scale collections. Total runs were estimated and brood tables were constructed based on the catch by stock and age and Chilkat and Chilkoot weir counts by age (McPherson 1990). Escapement goals for both Chilkat and Chilkoot lakes were then developed using Ricker stock-recruitment analyses. The initial escapement goal (an overall escapement goal of 52,000 to 106,000 for Chilkat Lake based on the Chilkat Lake weir counts, with a separate goal for early and late runs) established for Chilkat River was based on McPherson's (1990) analysis.

The assessment of Chilkat River escapement based on the Chilkat River weir counts were discontinued in 1996 and replaced by total escapement estimates based on Chilkat River mark-recapture experiments. A number of years of paired weir counts and mark-recapture estimates enabled the calibration (Figure 10) of the historical weir counts. Accordingly the Chilkat escapement goal was revised to 80,000 to 200,000 spawners combined from the early- and late-runs (Der Hovansian and Geiger 2005).

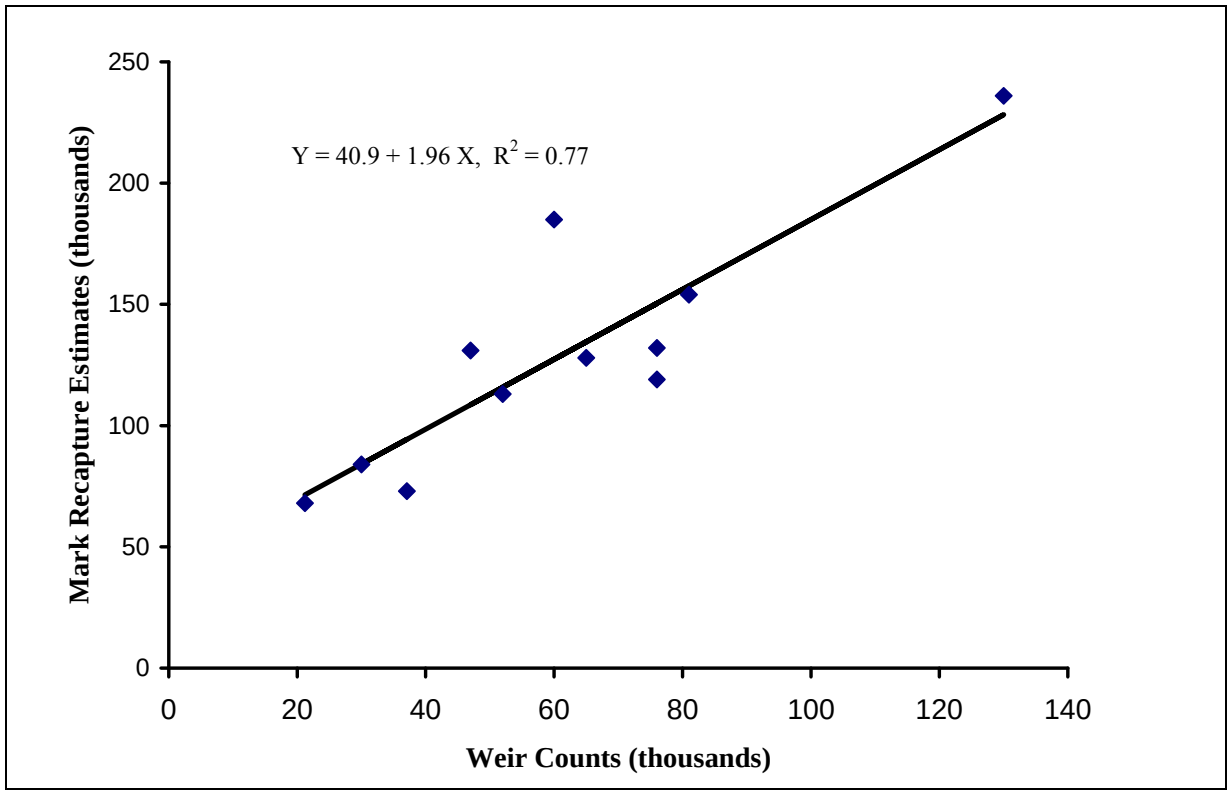

Figure 10.–A regression relationship between Chilkat Lake weir counts and mark-recapture estimates using paired 1994 to 2007 observations.

In the 1980s, using Koenings' Euphotic Volume model (Koenings and Burkett 1987), ADF&G limnologists concluded that the Chilkat Lake system was capable of rearing an additional 10 million sockeye fry, beyond what was naturally produced. They believed the lake was "spawning area limited" (from a series of unpublished memoranda and planning documents) and concluded "zooplankton densities were great enough to feed an additional 10 to 12 million fry annually over what the lake is capable of producing naturally, regardless of the number of adult sockeye getting into the lake." Consequently, they recommended that Chilkat Lake be used as a site for lake stocking. Eggs and milt were harvested from sockeye salmon returning to the lake, and fry were stocked in the lake in the summer after hatching. An average of about 3 million fry were stocked annually in Chilkat Lake from 1994–1997 and again in 2001. Additional programs occurred to enhance sockeye production in Chilkat Lake; from 1989–1998 and again in 2003, incubation boxes alongside Chilkat Lake were seeded with sockeye eggs. In the spring following incubation, an average of 300,000 fry emerged annually into Chilkat Lake.

Eggers et al. (in press) updated assessments of Chilkat River sockeye salmon and assembled estimated escapements, harvests, and age compositions of sockeye salmon returning to the Chilkat Lake drainage during the years 1976-2007. Historical weir counts (1976-1993) were converted to total escapement estimates based upon the relationship between mark recapture estimates and total escapement estimates (Figure 10). The estimates of hatchery and wild smolt outmigrations and various estimates of age composition were used to reconstruct annual runs of Chilkat Lake sockeye salmon, and developed brood tables consisting of estimated annual escapements and resultant age-specific recruits for the 1979–2002 brood years. Further, estimates of the numbers of age specific smolt produced from the 1987, 1988, and 1994-2000 brood years were developed for this stock. These data were used to develop a hierarchy of Ricker-type stock-recruit and stock-smolt relationships to examine the effect of spawner density, auto-correlation, and fry plants on subsequent Chilkat sockeye salmon recruits and smolts (Eggers et al. *in prep*).

The highest order model with the spawner density, auto correlation, and fry plant terms was selected as the best model. While this model was not the most parsimonious (i.e., minimum Akeike Information Criterion (AIC)), it was selected because it accounted for the bias in assessing wild stock production due to the added production from enhancement that occurred from 1989 to 2003 and was, therefore, the most meaningful biological model (Appendix A8).

Analysis of the production of wild and enhanced smolts, clearly demonstrated that the fry plants depressed the wild smolt production, and further, the fry plants generally occurred in the face of relatively high wild stock escapements. This suggests that production is rearing limited, and that fry plants in the face of moderate to high wild stock escapement resulted in decreased wild smolt production. However, comparisons of the stock-recruit model uncorrected for fry plants to the stock-recruit model corrected for fry plants demonstrated significant increased returns from brood years with fry plants. The increased returns from the enhancement activities more than compensated for the reduced wild smolt production (Eggers et al in press).We recommend a biological escapement goal of 70,000-150,000 spawners measured as total escapement. Total escapement is currently measured via Didson sonar at the Chilkat weir site. The range of 70,000 to 150,000 for the biological escapement goal is the predicted range of escapements that will, on average produce 90% or more of maximum sustained yield from the Chilkat sockeye salmon stock. The analysis that produced this range was based on the brood year 1979-2002 stock-recruit model that corrected for the bias in production due to enhancement (c.f. Eggers et al. *in prep*).

Escapements for Chilkat sockeye salmon have generally been within or above the recommended biological escapement goal range (Figure 11). The escapement has not been below goal for any 5-year perioid, which is the indicator of stock concern as specified in the Sustainable Salmon Fisheries Policy. There were a few years in the mid to late-1990s when the trend in escapement was above the BEG range. This indicates the Chilkat sockeye salmon stock is healthy and somewhat underutilized in some years.

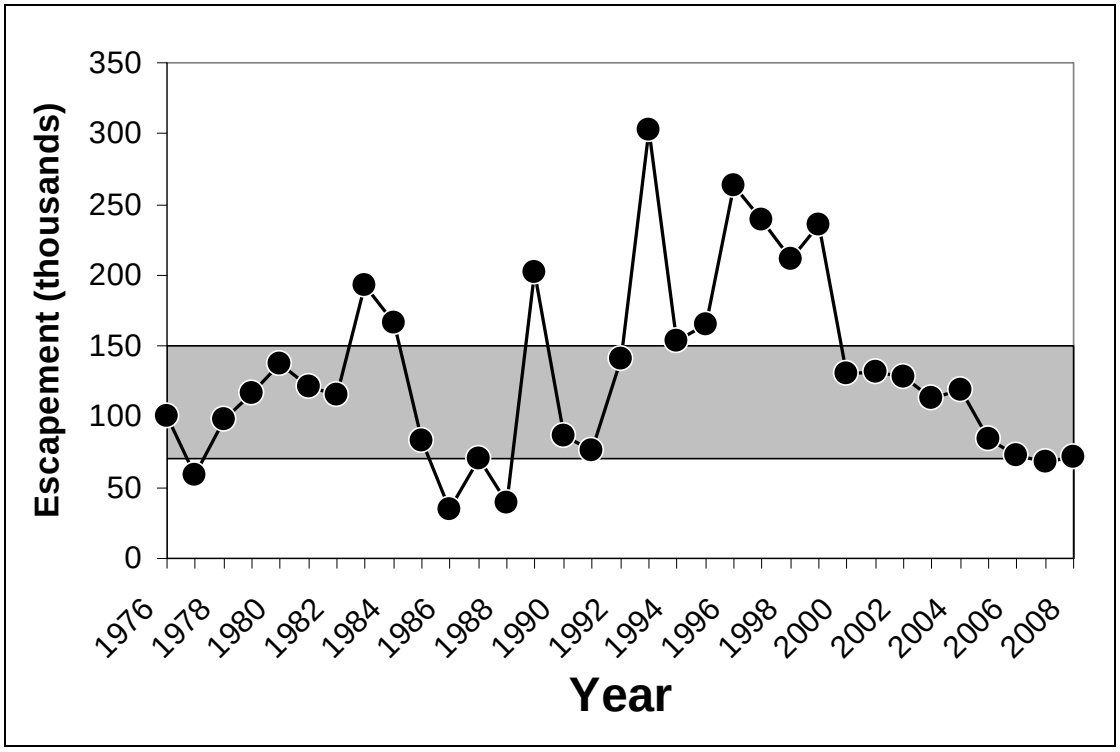

Figure 11.–Escapements (calibrated weir counts, 1976 - 1993; mark -recapture, 1994 - 2007, sonar counts 2008) for Chilkat Lake sockeye salmon. The gray area is the newly recommended biological escapement goal range of 70,000 to 150,000 spawners.

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 A9). In 2003 the Board of Fish established an optimal escapement goal of 7,000 to 25,000 spawners. Escapements have been within the escapement goal range one of the last five years (2008), and above the upper end of the goal range four of the last five years (Figure 12).

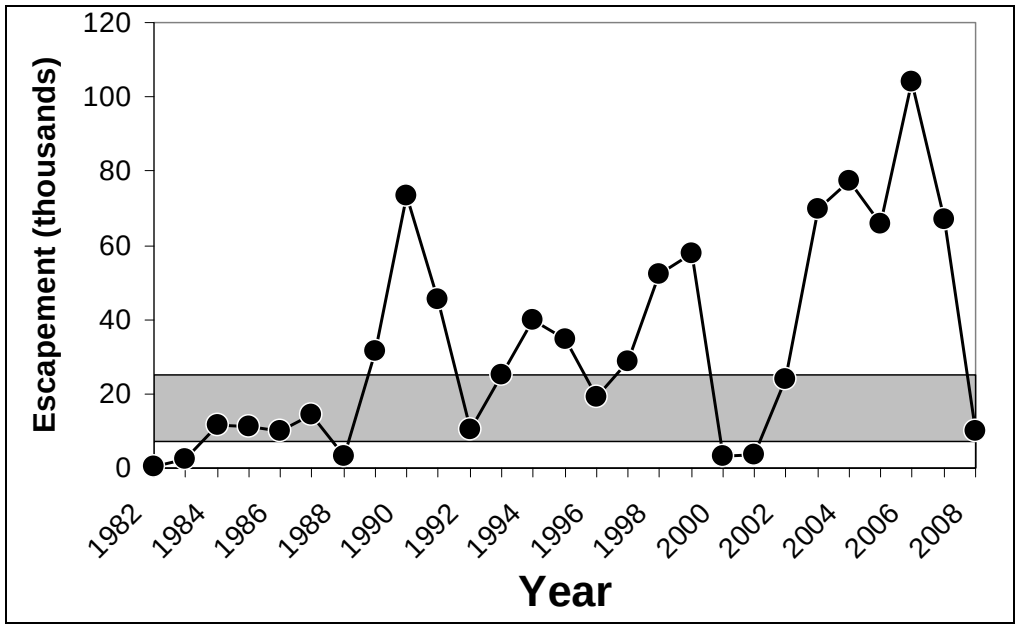

Figure 12.–Escapements (weir counts) for Redoubt Lake sockeye salmon. The gray area is the optimal escapement goal range of 7,000 to 25,000 spawners.

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 A10). 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 were above the upper end of the escapement goal range in four of the last five years and slightly below the lower end of the range in 2008 (Figure 13).

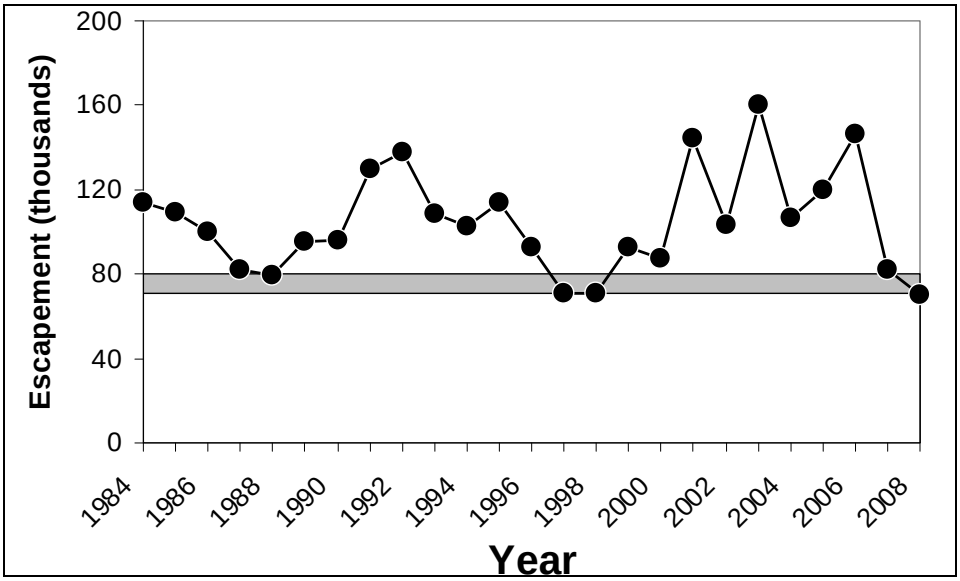

Figure 13.–Escapements (mark-recapture estimates) for Taku River sockeye salmon from 1984-2007. The gray area is the sustainable escapement goal range of 71,000 to 80,000 spawners.

SPEEL LAKE

The Speel Lake sockeye escapement has been monitored with a weir in all but two years since 1983. The stock was 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 A11). Estimated escapements were within this range for three of the last five years and below the lower end of the escapement goal range in two (2007-2008) of the last five years (Figure 14).

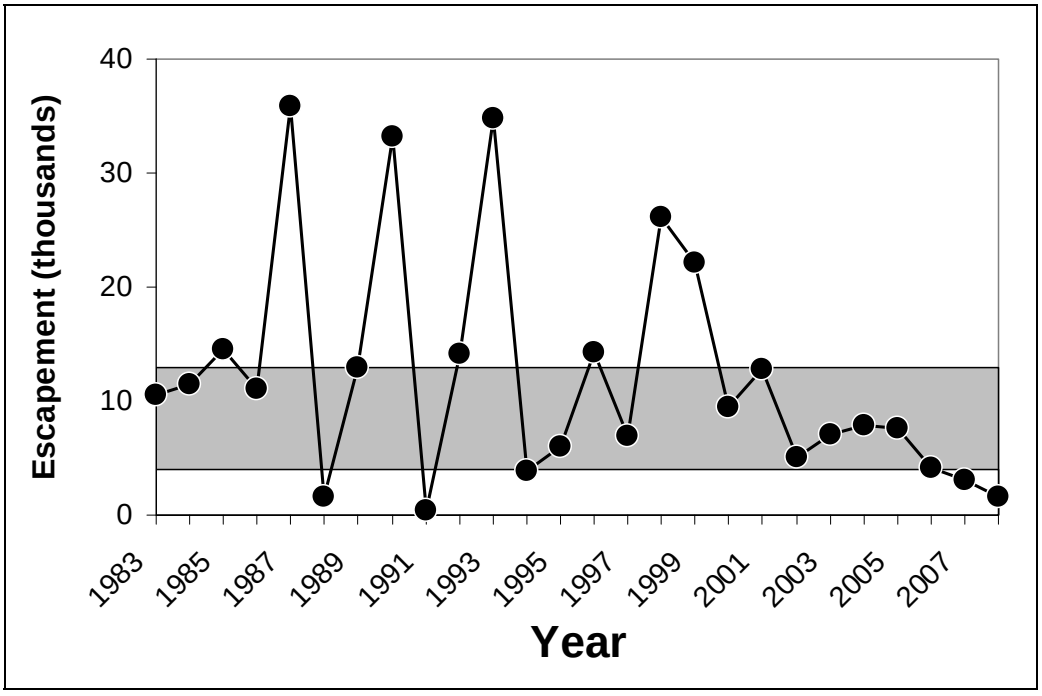

Figure 14.–Escapements (expanded weir counts) for Speel Lake sockeye salmon. The gray area is the biological escapement goal range of 4,000 to 13,000 spawners.

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 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 A13). The escapement was above the upper end of the goal range in 2003 through 2006, within the escapement goal range in 2007, and below the lower end of the goal range in 2008 (Figure 15).

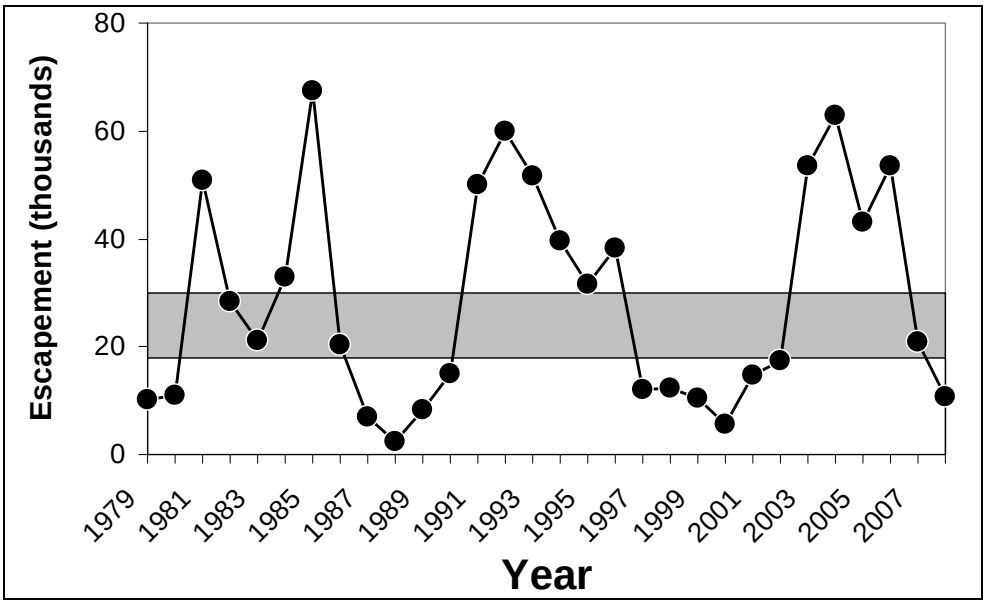

Figure 15.–Escapements (weir counts) for Tahltan Lake sockeye salmon. The gray area is the biological escapement goal range of 18,000 to 30,000 spawners.

MAINSTEM STIKINE RIVER

The Transboundary Technical Committee established an escapement goal range of 20,000 to 40,000 spawners in 1987 for the mainstem Stikine sockeye salmon stock, 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" (Transboundary Technical Committee 1990). We consider the goal to be a sustainable escapement goal (Appendix A15). Escapements were within the goal range in four of the past five years (Figure 16).

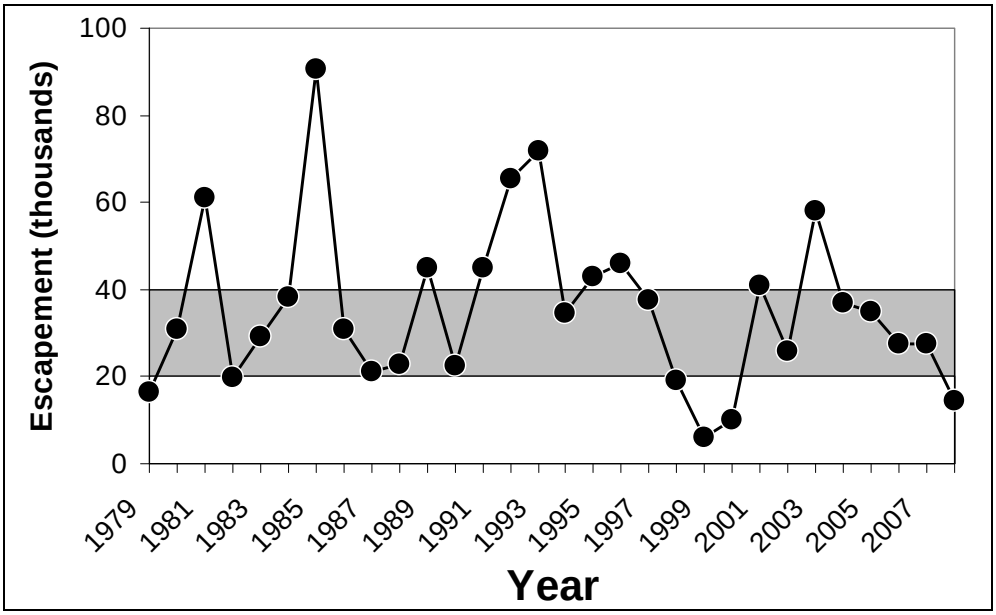

Figure 16.–Escapements (estimated total escapement) for Mainstem Stikine River sockeye salmon in 1979-2007. The gray area is the sustainable escapement goal range of 20,000 to 40,000 spawners.

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 optimal escapement goal of 8,000 to 18,000 based on the analysis outlined in Geiger et al. (2003; Appendix A16). This goal includes both naturally produced and hatchery stocked fish. The escapement has been above the upper end of the escapement goal range in four of the last five years, but below the lower end of the goal range in 2008 (Figure 17). This stock was listed as a *stock of management concern* in 2003 (c.f. Geiger et al. 2003) and was subsequently removed from the list in 2006.

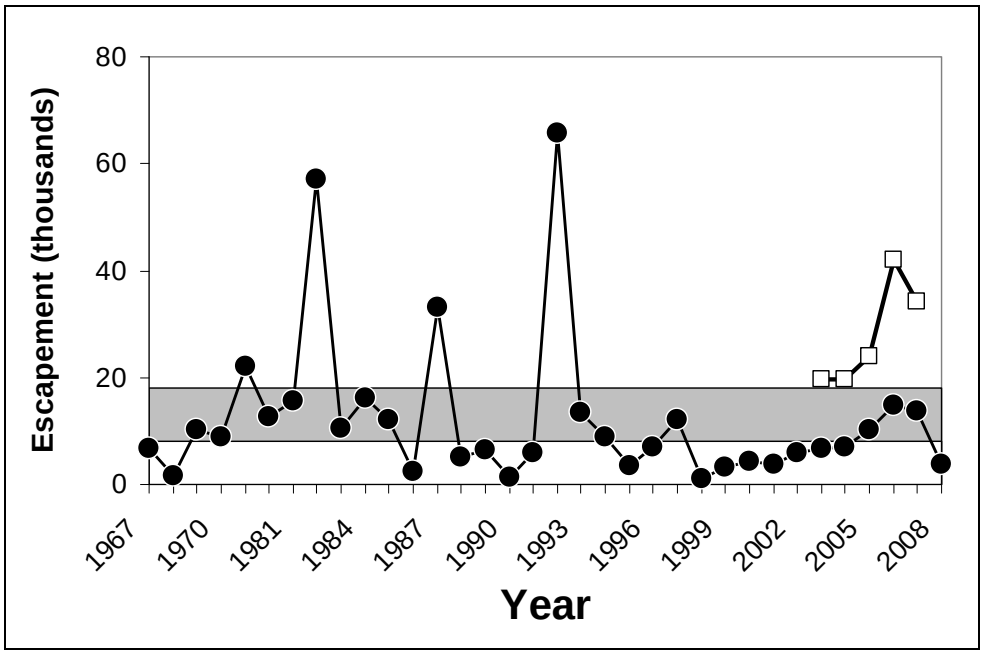

Figure 17.–Escapements (weir counts) for Hugh Smith Lake sockeye salmon. The gray area is the optimal escapement goal range of 8,000 to 18,000 spawners. The dots connected by the solid line are estimated escapements of naturally spawned sockeye salmon. The open squares connected by the dashed line are the combination of escapements of both naturally spawned and hatchery stocked fish. The escapement goal includes both naturally-produced and stocked fish. Note that no data are available from 1972 through 1979.

MCDONALD LAKE SOCKEYE SALMON

McDonald Lake, located on the Southeast Alaska mainland, approximately 70 km north of Ketchikan, has been considered the largest sockeye salmon producing system in southern Southeast Alaska (Geiger et al. 2004). Like most other major sockeye salmon systems in Southeast Alaska, the McDonald Lake run has a history of commercial exploitation and hatchery operation during the late 19th and early 20th centuries (Roppel 1982). Runs were thought to exceed 100,000 sockeye salmon in 1909 and 1911, and more than 200,000 in 1910 (Johnson et al. 2005).

More recently, McDonald Lake was the target of a long-term enhancement project initiated by the ADF&G in the late 1970s, and carried out via lake fertilization from 1982 to 2004. Over most of the enhancement period, runs of sockeye salmon to McDonald Lake were strong, with

estimated escapements averaging over 90,000 fish per year. The stock was actively managed during the 1990s, and fish that were expected to be in excess of the escapement goal were harvested in near terminal purse seine fisheries in upper west Behm Canal. The peak harvest was 150,000 sockeye salmon in 1993. The McDonald Lake stock has supported the largest personal-use fishery in southern Southeast Alaska, with a maximum reported harvest of more than 10,000 fish in 1994. McDonald Lake sockeye salmon were also used as a brood source for stocking projects at a number of other sites in southern Southeast Alaska (Johnson et al. 2005). Over the past five years, however, the sockeye salmon run to McDonald Lake has declined, despite lake fertilization. Estimated escapements were below the escapement goal range from 2004 to 2008.

An undocumented escapement goal range of 65,000 to 85,000 sockeye salmon was established in 1993, and this goal was adopted as a biological escapement goal in 2003 (Geiger et al. 2004). ADF&G established a new goal range of 70,000 to 100,000 as a sustainable escapement goal based on the analysis of Johnson et al. (2005.).

ADF&G has recently completed a project to improve the escapement estimation at McDonald Lake. The escapement to McDonald Lake was formerly estimated through a series of foot surveys that were calibrated to weir counts in 1983 and 1984 (Johnson et al. 2005). Mark-recapture estimates of escapement conducted in 2005–2007 and weir counts from 1981, 1983, and 1984 have enabled the ADF&G to re-cast the estimated escapement to McDonald Lake based on peak annual foot survey (Heinl et al. 2008). A stock-recruit analysis based on brood tables from reconstructed total runs using the recalibrated escapements and assuming a constant distant water mixed-stock commercial fishery harvest rate of 41%. The assumed harvest rate of 41% is based on coded-wire tag studies conducted in the mid- and late-1980s. These data were subsequently used to develop a hierarchy of Ricker-type stock-recruit relationships which examined the effect of spawner density, auto-correlation, and fry plants on recruits (Eggers et al. *in prep*).

The hierarchal model with the spawner density and fry plant terms was selected as the best model. While this model was not the most parsimonious (i.e., minimum AIC) it was selected because it accounted for the bias in assessing wild stock production due to the added production from the stocking of fry that occurred in 1989 and 1990 and therefore, was, the most biologically meaningful model (Appendix A17).

We recommend a sustainable escapement goal of 55,000 to 120,000 spawners. Total escapement is currently estimated based on calibrated foot survey counts (c.f. Eggers et al. in prep.) The escapement goal is the escapement range that is predicted, on average, to produce 90% or more of maximum sustained yield from the brood year 1979-2002 stock-recruit analysis that includes fry plants as a variable. This goal is defined as a sustainable escapement goal because McDonald Lake was fertilized continuously over the extent of the stock-recruit data set and as a consequence, production implicit in the stock-recruit model reflects a fertilized condition that is no longer the case for McDonald Lake.

The formerly very productive McDonald Lake sockeye salmon stock has recently undergone a reduction in recruitment, and the escapement goal was met only 1 out of the last 5 years (Figure 18). In addition fall fry abundance has been very low, since 2005 (Eggers et al. in prep), and runs will likely be depressed for some time. Currently, we view this downturn as a continuing anticipated inability to maintain escapements; therefore, the McDonald Lake sockeye salmon run is considered a stock of management concern under the Sustainable Fishery Policy.

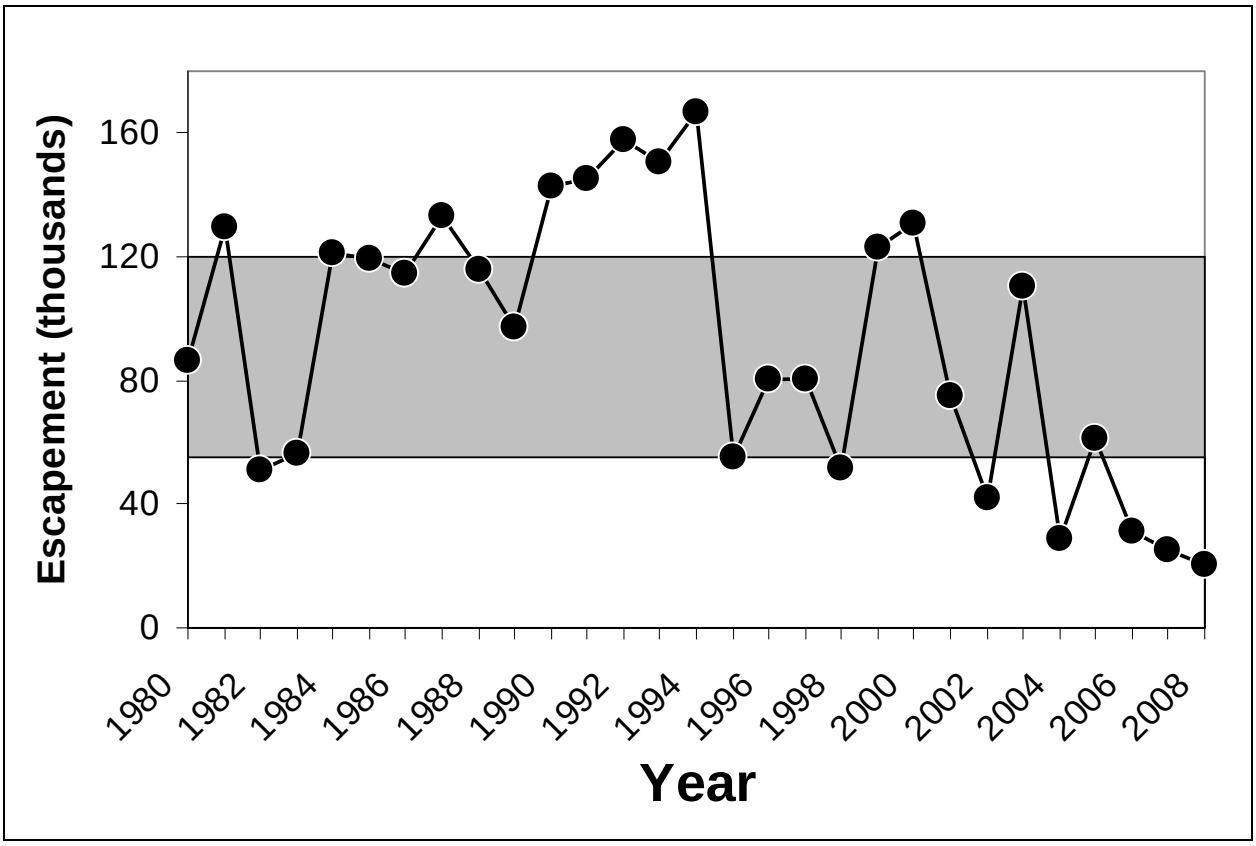

Figure 18.–Escapements (expanded foot counts) for McDonald Lake sockeye salmon, 1982–2008. The gray area is the recommended sustainable escapement goal Of 55,000 to 120,000 spawners.

STOCKS OF CONCERN

The McDonald Lake sockeye salmon stock has recently undergone a reduction in recruitment. The escapement goal for McDonald Lake was not met in four of the last five years. In addition fall fry abundance based on hydro-acoustic surveys has been very low since 2005 and indicates low runs will persist for several years. Because of the continuing and anticipated inability to maintain escapement to meet the escapement goal this sockeye salmon stock meets the criteria for a stock of management concern under the Alaska Sustainable Salmon Fishery Policy.

Coded-wire tagging studies in the 1980s showed that this stock was harvested primarily in the District 6 drift gillnet fishery, with the next largest portions of the run harvested in the District 1, 2, and 4 purse seine fisheries. This stock was also harvested in a terminal purse seine fishery at Yes Bay in 1991–1993 and 1996–2001. McDonald Lake sockeye salmon were also harvested in a personal use fishery in Yes Bay.

The ADF&G has implemented a multi-year, genetic stock identification project to help clarify areas of potential catch of McDonald Lake sockeye salmon in 2007 and 2008. Weekly samples were collected from the District 6 drift gillnet fishery and from the District 1 purse seine fishery. These data, once analyzed, will be used to update the coded-wire tagging studies and provide improved information about the time and area distribution of McDonald Lake sockeye salmon in those fisheries.

The ADF&G has already implemented a series of management actions designed to allow more McDonald Lake sockeye salmon to escape to McDonald Lake. In 2007 and 2008, the District 6 drift gillnet fishery was restricted to two-day openings for three weeks from mid-July to early August; in addition, the western portion of Sumner Straight was closed to fishing during the middle week of that conservation period in 2007. In 2007 and 2008, the District 1 purse seine fishery along the Gravina Island shoreline (north of the latitude of Cone Point) was closed to fishing from mid-July to early August. In addition to these measures for sockeye salmon conservation, overall purse seine fishing time in Southern Southeast was very limited during the 2006 and 2008 seasons due to poor runs of pink salmon. The Yes Bay terminal purse seine fishery has not been conducted since 2001. Finally, the bag limits in the McDonald Lake Personal Use fishery have been stepped down from a daily bag-limit of 50 fish per person, to an annual limit of 20 fish per person.

DISCUSSION

Along with escapements, sockeye yields have generally been maintained in Southeast Alaska over two decades. Although run strength of McDonald Lake sockeye in southern Southeast Alaska has decreased since 2000, sockeye salmon 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.

The overall situation in the sockeye salmon fisheries in Southeast Alaska looks to be similar to the one described by the last Southeast Alaska sockeye salmon stock status review (Geiger et al., 2005). Escapement goals in the monitored systems have been generally within, or even above the escapement goal ranges over the period 2003-2007. The principal exception is McDonald Lake where escapement goals have not been met since 2003. It should be noted that the 2008 run of sockeye salmon was weak everywhere in Southeast Alaska, with escapement goals met only for 2 of 13 systems currently monitored. The 2008 sockeye run to the Yakutat areas was particularly weak, with the 2008 catch being the lowest since Alaska statehood.

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.

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APPENDIX A

Appendix A1.–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. 1995a. 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 produces the *maximum sustainable yield.*

Appendix A2.–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* being changed to ***Sustainable Goal***
Basis for Goal:	Stock-recruit analysis using brood years 1972 to 1983, 1986, and 1988 Bue and Hasbrouck (unpublished report to the Alaska Board of Fisheries 2002) sustained escapement goals analysis = 1,100 to 3,00
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 Number 1J95-16. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	1,000 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), $1/\beta \approx 3{,}600$ (β-parameter = 0.000279)

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

Appendix A3.–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 (Dropped as goal in 2005)*
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. 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 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 yield*

Appendix A4.–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 was predicted to provide maximum sustained yield.*

Appendix A5.–East Alsek-Doame River system sockeye salmon.

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. 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 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. Faber, D., C. Soiseth, C. Murdoch and J. Wardell. 2005. Evaluation of habitat and growth trends for East Alsek River sockeye salmon (*Oncorhynchus nerka*) in Glacier Bay National Preserve, Alaska. Annual Data Summary-2005. Available from Glacier Bay National Park and Preserve, P.O. Box 294, Gustavus, Alaska. 55pp.
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 yield.

Appendix A6.–Chilkoot Lake sockeye salmon.

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 2002
Documentation:	Eggers, D.M., Zhang, X., R.L. Bachman, M.M. Sogge. *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 38,000 to 86,000 sockeye salmon, with weekly cumulative catch goals in Appendix Table 2.6.1.
Escapement Measures:	Weir counts, 1976 to present

Stock-Recruit Analysis Summary

Model: Ricker with autoregressive term. Number of years in model: 27

Ratio of highest escapement to lowest escapement: 33.3

Parameter estimates: α-parameter = 5.35 ("bias adjusted" value is 8.7), $1/\beta \approx 171{,}000$ (β-parameter = 5.85×10^{-6}), $\phi = 0.64$; σ^2-parameter = 0.57

Basis of range of escapement goal: Range of sustained escapements expected to produce at least 90% of *maximum sustained yield*, rounded to the nearest 5,000 spawners.

Appendix A7.–Weekly cumulative escapement goals for Chilkoot Lake.

Statistical Week	Weekly Goal	Cumulative Goal	Cumulative Lower Bound	Cumulative Upper Bound
23	597	597	378	856
24	2,440	3,038	1,924	4,354
25	4,215	7,253	4,594	10,396
26	3,567	10,821	6,853	15,509
27	2,337	13,157	8,333	18,859
28	2,794	15,951	10,103	22,865
29	5,027	20,979	13,286	30,069
30	6,951	27,930	17,689	40,032
31	8,759	36,689	23,236	52,587
32	7,944	44,632	28,267	63,973
33	5,207	49,840	31,565	71,437
34	4,430	54,270	34,371	77,787
35	3,007	57,277	36,275	82,097
36	1,972	59,248	37,524	84,923
37	752	60,000	38,000	86,000

Appendix A8.–Chilkat Lake sockeye salmon.

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:	*Biological Escapement Goal*
Basis for the Goal:	Stock Recruit Analysis, 1979 - 2002 brood years.
Documentation:	Eggers, D.M. R.L. Bachman, and J. Stahl. in prep. Stock status and escapement goals for Chilkat Lake sockeye salmon in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries Fishery Manuscript Series, Anchorage 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 of 70,000 to 150,000 adult sockeye salmon, measured with mark-recapture methods.
Escapement Measures:	Total escapement based on calibrated weir counts, fish wheel-based mark-recapture estimates, and DIDSON sonar weir counts.

Stock-Recruit Analysis Summary

Model: Ricker autoregressive term and with fry plant term

Number of years in model: 24

Ratio of highest escapement to lowest escapement: 6.65

Parameter estimates: α-parameter = 2.7 ("bias adjusted" value is 3.55), $1/\beta \approx 265{,}000$ (β-parameter = 3.8×10^{-6}), $\phi = 0.48$; σ^2-parameter = 0.42

Basis of range of escapement goal: Range of sustained escapements expected to produce at least 90% of *maximum sustained catch*, rounded to the nearest 5,000 spawners.

Appendix A9.–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:	*Optimal 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: 6.70

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 2,500 spawners.

Appendix A10.–Taku River sockeye salmon.

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 A11.–Speel Lake sockeye salmon.

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

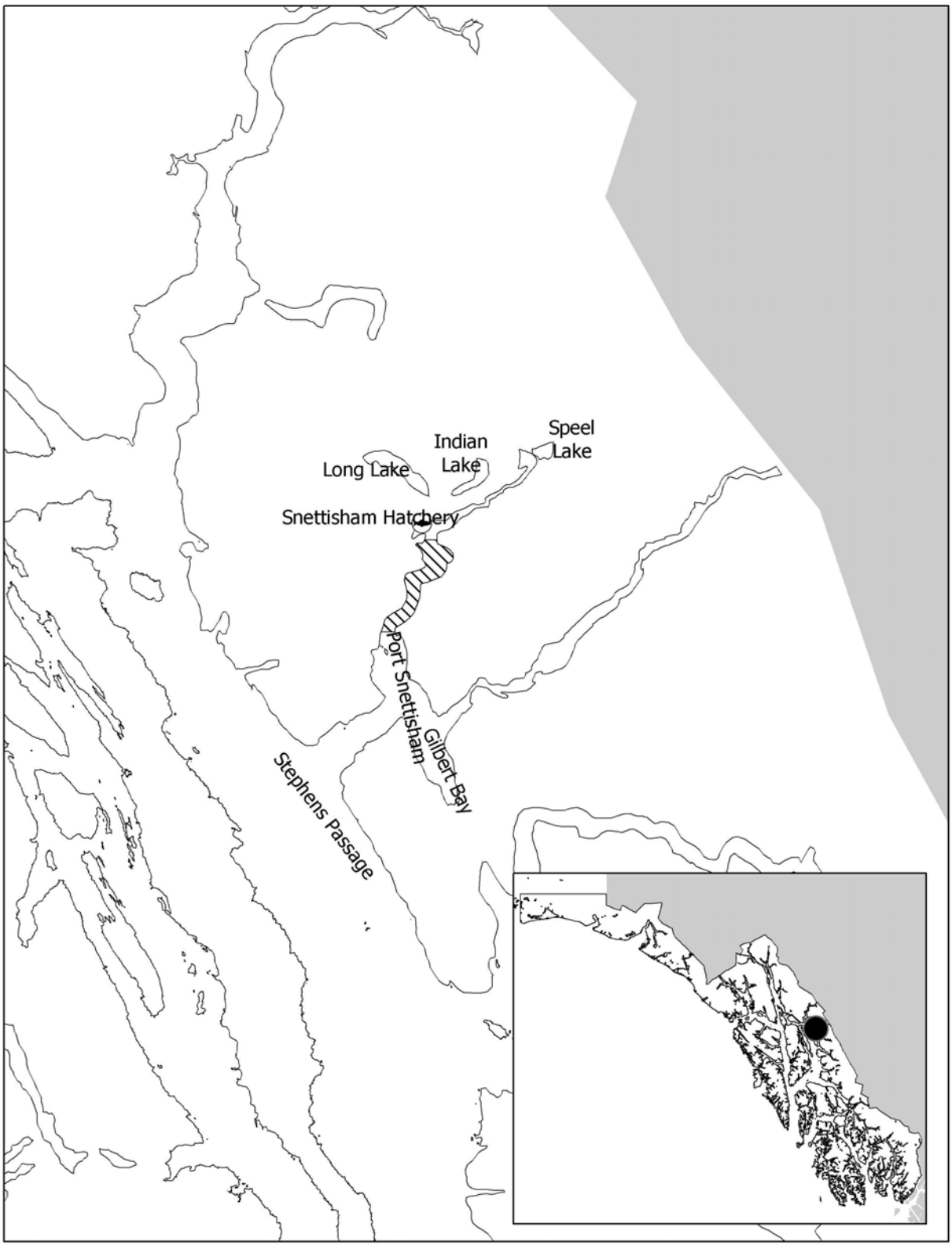
Model: Ricker

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*



Appendix A12.–Speel Lake and surrounding area. Striped area denotes the hatchery Special Harvest Area (SHA).

Appendix A13.–Tahltan Lake sockeye salmon.

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 6 and 8 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

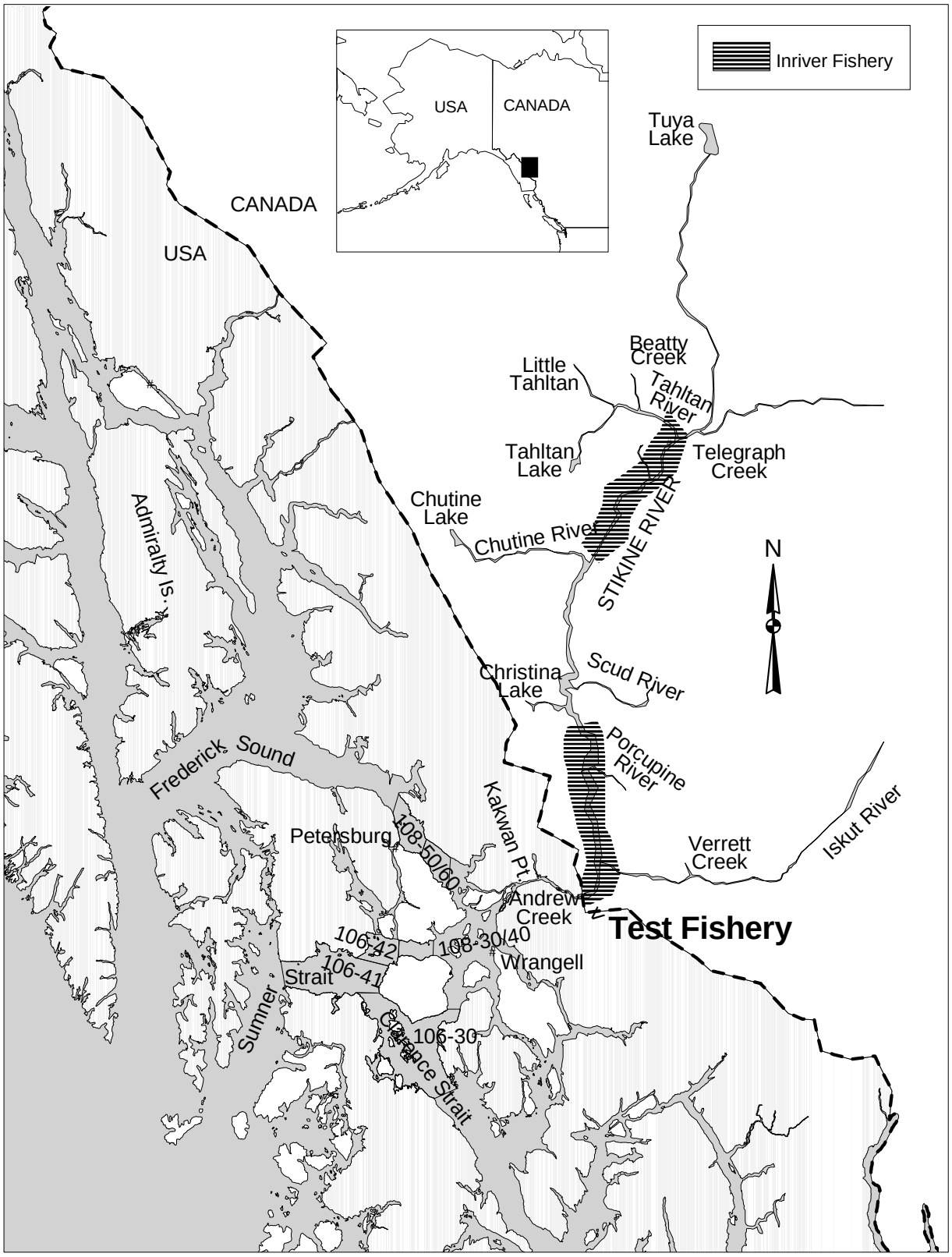
Model: Ricker

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: Professional judgment



Appendix A14.–Stikine River drainage and surroundings, showing location of commercial, subsistence, and recreational fisheries.

Appendix A15.–Mainstem Stikine sockeye salmon.

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 6 and 8 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:	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 A16.–Hugh Smith sockeye salmon.

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:	Optimal 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

Stock-Recruit Analysis Summary
Not applicable

Appendix A17.–McDonald Lake sockeye salmon.

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:	Stock Recruit Analysis, 1979 - 2002 brood years.
Documentation:	Eggers, D.M., S.C. Heinl, and A.W. Piston. *In prep* McDonald Lake sockeye salmon stock status and escapement goal recommendations, 2008. Alaska Department of Fish and Game, Alaska Department of Fish and Game, Fishery Data Series, Anchorage. The previous goal documented in: Johnson, T. A., S. C. Heinl, and H. J. Geiger. 2005. McDonald Lake: Stock Status Report. Alaska Department of Fish and Game, Fishery Manuscript No. 05-07, Anchorage.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	55,000 to 120,000 fish
Escapement Measures:	A series of standard foot surveys, expanded to an estimate of total escapement based on historic paired peak count estimates and total escapement based on weir count or mark - recapture experiment.

Stock-Recruit Analysis Summary

Model: Ricker with fry plant term. Number of years in model: 22. Ratio of highest escapement to lowest escapement: 3.3. Parameter estimates: α-parameter = 1.43 ("bias adjusted" value is 1.63), $1/\beta \approx$ 212,000 (β-parameter = 4.71×10^{-6}), σ^2-parameter = 0.42. Basis of range of escapement goal: Range of sustained escapements expected to produce at least 90% of *maximum sustained catch*, rounded to the nearest 5,000 spawners.