Fishery Manuscript No. 07-10

Review of Escapement Goals for Salmon Stocks in the Kodiak Management Area, Alaska

by

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December 2007

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)

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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December 2007

The Division of Sport Fish Fishery Manuscript series was established in 1987 for the publication of technically-oriented results of several years' work undertaken on a project to address common objectives, provide an overview of work undertaken through multiple projects to address specific research or management goal(s), or new and/or highly technical methods. Since 2004, the Division of Commercial Fisheries has also used the Fishery Manuscripts series. Fishery Manuscripts are intended for fishery and other technical professionals. Fishery Manuscripts are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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This document should be cited as:
Honnold, S.G., M.J. Witteveen, M.B. Foster , I. Vining, and J.J. Hasbrouck. 2007. Review of escapement goals for salmon stocks in the Kodiak Management Area, Alaska. Alaska Department of Fish and Game, Fishery Manuscript No. 07-10, Anchorage.

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ABSTRACT

In May 2007, an interdivisional team, including staff from the Divisions of Commercial Fisheries and Sport Fish, was formed to review existing Pacific salmon *Oncorhynchus* spp. escapement goals in the Kodiak Management Area (KMA). The KMA salmon escapement goals were last reviewed by the department in 2004. The 26 salmon escapement goals in the KMA were reviewed and the team decided to leave 16 goals unchanged, change four goals (one would be reclassified from a biological escapement goal [BEG] to a sustainable escapement goal [SEG]), eliminate one SEG range and five SEG thresholds, and establish three new SEG thresholds.

The team examined stock assessment data for two Chinook salmon *O. tshawytscha*, 12 sockeye salmon *O. nerka*, four coho salmon *O. kisutch*, six chum salmon *O. keta* aggregate, and two pink salmon *O. gorbuscha* aggregate stocks currently with goals. We concentrated our initial efforts on reviewing data from 2004 through 2006, determining if previous analyses (from our review in 2004) should be updated or if additional analyses were necessary, and identifying any management concerns with the current goals. For sockeye and coho salmon, we also examined stock assessment data for those systems whose goals were eliminated during the 2004 review to determine if the additional three years of data or other considerations might warrant reestablishing the goals.

The consensus of the team was to eliminate the current Pauls Bay drainage sockeye salmon SEG range of 10,000 to 30,000 due to the inability to accurately gauge escapement. The current Afognak Lake BEG range of 20,000 to 50,000 sockeye salmon should remain unchanged based on an updated spawner-recruit analysis. The team recommended changing the current early-run Karluk Lake sockeye salmon BEG range of 100,000 to 210,000 to a BEG range of 110,000 to 250,000 based on an updated spawner-recruit analysis, that was influenced by large runs in the last four years, of which some are not fully recruited. The Frazer Lake sockeye salmon BEG range of 70,000 to 150,000 should be changed to a BEG range of 75,000 to 170,000, based on an updated spawner-recruit analysis. The consensus of the team was to change the current Saltery Lake sockeye salmon BEG range of 15,000 to 30,000 to a SEG range of 20,000 to 50,000 based on a percentile analysis of aerial survey data. The team decided that using only aerial survey data in a percentile analysis was a more appropriate method because Saltery Lake sockeye escapement is currently estimated only by aerial survey and no age data are collected. Precautionary SEG thresholds were recommended for Little River and Uganik sockeye salmon stocks; these stocks are not actively managed and escapement trends can only be discerned from later season surveys of the lake systems. A SEG threshold of 3,000 fish should be established for the Little River sockeye salmon stock based on a risk analysis and a SEG threshold of 24,000 fish was recommended for the Uganik Lake sockeye salmon stock based on percentile analysis which was considered a more appropriate method than a risk analysis (the data did not fit well to a lognormal distribution and the stock is targeted for harvest). The team decided that the 25th percentile (24,000 fish) was the best value to use as a SEG threshold for Uganik Lake because the stock is likely highly exploited. The team recommended that a SEG range or threshold should not be reestablished for Akalura Lake sockeye salmon. The previous escapement goal for this stock was eliminated during the last review. Escapement (aerial survey) data are collected inconsistently and are of poor quality; there is no way to accurately gauge stock abundance without a weir.

The consensus of the team was to eliminate the chum salmon SEG thresholds for the Kodiak districts and to establish an island-wide aggregate SEG threshold of 151,000 chum salmon based on a percentile analysis. This recommendation was predicated on the lack of active management by district for chum salmon due to difficult survey conditions caused by the abundance of pink salmon. The team also recommended changing the chum salmon SEG threshold for the Mainland District from 153,000 to 104,000 based on a risk analysis that included recent year record low and record high escapement indices.

Key words: Pacific salmon, *Oncorhynchus*, escapement goal, Kodiak, Area K, stock status.

INTRODUCTION

This report documents the most recent review of the existing escapement goals for Kodiak Management Area (KMA) salmon stocks. KMA salmon escapement goals were last reviewed in 2004 (Nelson et al. 2005).

The sustainability of salmon stocks requires information as to the number of fish that are able to reach their spawning grounds (Hasbrouck and Edmundson 2007; Hilborn and Walters 1992).

The portion of a population that reaches the spawning grounds is typically referred to as the escapement and is affected by factors such as exploitation (harvest), predation, disease, and physical and biological changes in the environment. Escapement is measured by a variety of methods (e.g., weir and tower counts, foot and aerial surveys, mark-recapture experiments, and sonar estimates), which provide information to biologists in order to determine the number of salmon that can be removed from the population and the number that are necessary to reproduce to sustain the stock. The reproductive target is represented as an escapement goal and is usually based on the number of recruits produced from a number of spawners (spawner-recruit relationship) and/or specific habitat capacities (i.e., rearing and spawning areas). Specific methods used to determine escapement goals vary and, as new data become available, are modified and improved. Escapement goals, therefore, should be evaluated and revised on a regular basis.

REVIEW PROCESS AND DEFINITIONS

The Alaska Department of Fish and Game (ADF&G) adopted a Salmon Escapement Goal Policy in 1992 (Fried 1994), which categorized escapement goals (Hasbrouck and Edmundson 2007). The Alaska Board of Fisheries (BOF) adopted the Policy for the Management of Sustainable Salmon Fisheries (SSFP; 5 AAC 39.222) and the Policy for Statewide Salmon Escapement Goals (EGP; 5 AAC 39.223) into regulation during 2000-2001. These regulations were intended to ensure that the state's salmon stocks would be conserved, managed and developed using the sustained yield principle. Section (b)(2) of the EGP states that the BOF recognizes the responsibility of the department to:

"(2) establish biological escapement goals (BEG) for salmon stocks for which the department can reliably enumerate salmon escapement levels, as well as total annual returns;" and

"(3) establish sustainable escapement goals (SEG) for salmon stocks for which the department can reliably estimate escapement levels when there is not sufficient information to enumerate total annual returns and the range of escapements that are used to develop a BEG."

Section (f) of the SSFP provides the following detailed definitions:

"(3) "biological escapement goal" or "(BEG)" means the escapement that provides the greatest potential for maximum sustained yield; BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted; BEG will be developed from the best available biological information, and should be scientifically defensible on the basis of available biological information; BEG will be determined by the department and will be expressed as a range based on factors such as salmon stock productivity and data uncertainty; the department will seek to maintain evenly distributed salmon escapements within the bounds of a BEG;" 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 due to the absence of a stock specific catch estimate; the SEG is the primary management objective for the escapement, unless an optimal escapement or inriver run goal has been adopted by the board, and will be developed from the best available biological information; the SEG will be determined by the department and will be stated as a range that takes into account data uncertainty; the department will seek to maintain escapements within the bounds of the SEG."

In May 2007, a salmon escapement goal interdivisional review team was formed to evaluate the existing KMA salmon escapement goals. Team members from the Division of Commercial Fisheries were Steve Honnold, Dave Sterritt, Mark Witteveen, Jeff Wadle, Ivan Vining, M. Birch Foster, Joe Dinnocenzo, Geoff Spalinger, Jim McCullough, and Doug Eggers; participating from the Division of Sport Fish were Jim Hasbrouck, Bob Clark, Jack Erickson, and Donn Tracy. The purpose of the team was to 1) determine the appropriate goal type (BEG or SEG) for each KMA salmon stock with an existing goal, based on the quality and quantity of available data, 2) determine the most appropriate methods to evaluate the escapement goal ranges, 3) estimate the escapement goal for each stock and compare these estimates with the current goal, 4) determine if a goal could be developed for any stocks or stock-aggregates that currently have no goal, and, 5) develop recommendations for each goal evaluated and present these recommendations to the Directors of Commercial Fisheries and Sport Fish Divisions for approval. Formal meetings to discuss and develop recommendations were held on May 4 and August 9, 2007. The team also communicated on a regular basis by telephone and email.

The team examined stock assessment data for 2 Chinook salmon, 12 sockeye salmon, 4 coho salmon, 6 chum salmon aggregate, and 2 pink salmon aggregate stocks currently with goals (Table 1). Initial efforts were concentrated on reviewing data from 2004 through 2006, determining if previous analyses (from the review in 2004) should be updated or if additional analyses were necessary, and identifying any management concerns with the current goals. For sockeye and coho salmon, stock assessment data were also examined for those systems whose goals were eliminated during the 2004 review to determine if the additional three years of data or other considerations might warrant reestablishing the goals.

The team concluded that the three additional years of data would not affect the results of previous analyses for the following stocks: *Chinook salmon* - Karluk and Ayakulik rivers; *sockeye salmon* - Malina Lakes, Karluk Lake late run, Ayakulik River, Upper Station early run, Upper Station late run, Buskin Lake, and Pasagshak River; *coho salmon* - all stocks with and without goals (see previous review in Nelson et al. 2005); *pink salmon* - Kodiak Archipelago aggregate, Mainland District aggregate; and *chum salmon* - Alitak, Eastside, and Mainland districts aggregates (see additional information below). None of these stocks were determined to have any management concerns; thus, the consensus was to not reevaluate these escapement goals with the exception of the Karluk Lake sockeye salmon late-run stock; the team decided to reevaluate both Karluk Lake sockeye salmon stocks to address productivity of the system in total.

For the remaining KMA escapement goals, the team agreed to conduct further analyses of the data for each stock, estimate escapement goals, compare these estimates with the current goal, and then make recommendations to maintain (no change), change, or eliminate the current goal. For sockeye salmon stocks that had goals eliminated during the 2004 review, the team decided to analyze the data in order to recommend whether to reestablish an escapement goal. The team also recommended that a Kodiak island-wide aggregate chum salmon goal be developed because chum salmon management for the Kodiak Archipelago is similar to pink salmon management, which is based on an island-wide aggregate SEG.

During the review process, the team also noted the importance of the following terms, which are referred to in this document:

escapement: The number of fish that have escaped the fishery, have entered the fresh water, and are assumed to spawn.

total escapement: The estimate of escapement in which each fish is individually enumerated, typically using a counting weir.

index escapement: The estimate of escapement in which salmon are counted in groups, typically using aerial surveys. This estimate is calculated using the peak survey of a given stream in a given year as well as an estimate of carcasses and ancillary and qualitative data. This estimate is less accurate than a total escapement estimate.

STUDY AREA

The KMA comprises the waters of the western Gulf of Alaska (GOA) surrounding the Kodiak Archipelago, and along that portion of the Alaska Peninsula that drains into Shelikof Strait between Cape Douglas and Kilokak Rocks (Figure 1).

The archipelago is approximately 240 km (150 miles) long extending from Shuyak Island south to Tugidak Island. The Alaska Peninsula portion is about 256 km (160 miles) long and is separated from the archipelago by Shelikof Strait, which averages 48 km (30 miles) in width. Chirikof Island, located approximately 64 km (40 miles) south southwest of Tugidak Island, is also included in the KMA.

Salmon regulations define the KMA as all waters of Alaska south of a line extending from Cape Douglas (58° 51.10' N. lat.), west of 150° W long., north of 55° 30.00' N lat., and north and east of a line extending 135° southeast for three miles from a point near Kilokak Rocks at 57° 10.34' N lat., 156° 20.22' W long. (the longitude of the southern entrance of Imuya Bay), then due south (5 AAC 18.100).

The KMA is divided into seven commercial fishing districts: the Afognak, Northwest Kodiak, Southwest Kodiak, Alitak, Eastside Kodiak, Northeast Kodiak, and Mainland districts (Figure 1). These are further subdivided into a number of sections, each of which is composed of a number of smaller statistical areas, including terminal or special harvest areas for enhanced or rehabilitated salmon stocks. For commercial salmon fisheries, legal gear in various districts or sections can consist of purse seines, hand purse seines, beach seines, or set gillnets.

Commercial fisheries primarily target sockeye salmon from June through early July; some early chum salmon stocks may influence management in localized areas (Dinnocenzo et al. 2007). Pink salmon stocks are targeted from early July through mid-August, with some areas managed specifically for local sockeye or chum salmon stocks. Late-run sockeye, coho, and late returning chum salmon are targeted from mid-August through early September; coho salmon are the targeted species in later September into October.

METHODS

STOCK STATUS ASSESSMENT: ESCAPEMENT AND HARVEST DATA COLLECTION

The majority of sockeye salmon and all Chinook salmon escapement counts were obtained through the use of fish weirs (Table 1; Caldentey 2007). Weirs were used on six different spawning systems. The remainder of the sockeye salmon systems were monitored by aerial observation using small fixed-wing aircraft. Most pink, chum, and coho salmon escapement estimates were collected from fixed-wing aircraft surveys of bays and streams. Foot surveys were also conducted on a few streams, primarily along the Kodiak road system. Aerial and foot survey data were considered an index of the actual escapement. A "peak indexed escapement"

estimate was calculated postseason to provide information about the relative level of escapement. These indices measure escapement magnitude, which can be ranked across years, but do not represent the total number of fish in the escapement (Hasbrouck and Edmundson 2007).

Commercial catch data were compiled from ADF&G fish ticket information. Estimates of sport harvest were obtained from the Statewide Harvest Survey conducted annually by the Division of Sport Fish (Jennings et al. 2007 and Jennings et al. *in prep*,a-b).

ESCAPEMENT GOAL DETERMINATION

Available escapement, harvest, and age data associated with each stock or combination of stocks to be examined were compiled from research reports, management reports, and unpublished historical databases. Limnological and other habitat data were compiled for each system when available. The team evaluated the type, quality, and amount of data for each stock according to criteria described in Bue and Hasbrouck (*unpublished*). This evaluation was used to initially determine the appropriate type of escapement goal to apply to each stock, as defined in the SSFP and EGP. If a sufficient time series of escapement and total return estimates were available, if spawning contrast was sufficiently large, and if the estimates were sufficiently accurate and precise, then the data were considered sufficient to attempt to estimate the escapement level with the greatest potential to provide maximum sustained yield (MSY) and develop a BEG for the stock. This level of spawning escapement is identified as S_{msy} (Chinook Technical Committee 1999; Hilborn and Walters 1992; Quinn and Deriso 1999). If return estimates were not available because harvest and/or age were not consistently measured, then the data were considered to be of fair to poor quality. These data would not provide an accurate estimate of S_{msy} and subsequent BEG. As a result, these data were evaluated using other methods to establish an SEG.

Biological Escapement Goal

A BEG is typically based on MSY and estimated from spawner-recruit data (Hasbrouck and Edmundson 2007). Spawner-recruit data were analyzed using a Ricker (1954) stock-recruitment model to estimate S_{msy} and the BEG range surrounding S_{msy}. Results were not used if the model fit the data poorly or if model assumptions were violated. Hilborn and Walters (1992), Quinn and Deriso (1999), and the Chinook Technical Committee (CTC; 1999) provide good descriptions of the Ricker model and diagnostics to assess model fit. All Ricker models were tested and corrected for residual autocorrelation when necessary.

When auxiliary data were available (e.g., limnology and/or smolt abundance, age, and size) they were summarized and biological trends were compared to estimates of adult production. In cases where sufficient data existed but determining a scientifically defensible BEG was still not possible, other methods were used to establish an SEG.

Sustainable Escapement Goal

Methods used to develop SEGs included the percentile approach and risk analysis.

The percentile approach followed the methods of Bue and Hasbrouck (*unpublished*) whereby the contrast of the escapement data and the exploitation rate of the stock were used to select the percentiles of observed annual escapements to be used for estimating the SEG. Low contrast (<4) implies that stock productivity is known for only a limited range of escapements. According to this approach, percentiles of the total range of observed annual escapements that are used to estimate an SEG for a stock with low contrast should be relatively wide, in an attempt to improve

future knowledge of stock productivity. In cases where data contrast was less than 4 and the exploitation rate was low, the lower end of the SEG range was the 15th percentile of the escapement data and the upper end of the range was the maximum escapement estimate. Alternately, in cases where contrast was larger, the percentiles of observed annual escapements used to estimate an SEG were narrowed. For stocks with high contrast and at least moderate exploitation, the lower end of the SEG range was increased from the 15th to the 25th percentile as a precautionary measure for stock protection. The percentiles used at different levels of contrast were:

Escapement Contrast and Exploitation	SEG Range
Low Contrast (<4)	15th Percentile to maximum observation
Medium Contrast (4 to 8)	15th to 85th Percentile
High Contrast (>8); Low Exploitation	15th to 75th Percentile
High Contrast (>8); High Exploitation	25th to 75th Percentile

The risk analysis (Bernard et al. *unpublished*) was used to establish an SEG, in the form of a precautionary reference point (PRP), from a time series of observed escapement estimates using probability distributions. This method is based on estimating the risk of management error and is particularly appropriate in situations where a particular stock (or stock aggregate) is not "targeted" and observed escapement estimates are the only reliable data available. In essence, this analysis begins with estimating the probability of detecting escapement falling below the SEG in a predetermined number of consecutive years (*k*). For example, if we believe there is cause for concern when escapement falls below the SEG for 3 consecutive years, *k* would be equal to 3. Simultaneously, a second probability is estimated, that is the probability of taking action (e.g., closing a fishery to protect the stock) for three consecutive years when no action was needed. This analysis assumes that escapement observations follow a lognormal distribution and have a stationary mean (no temporal trend).

CHINOOK SALMON

The team reviewed the most recent data available for KMA Chinook salmon stocks (Table 1). Three additional years (2004 through 2006) of spawner-recruit data were available for Karluk and Ayakulik rivers Chinook salmon; however, the team concluded that these data would not substantially affect the results of a spawner-recruit analysis. Thus, there was consensus to not reevaluate these goals.

SOCKEYE SALMON

The team reviewed the most recent data available for KMA sockeye salmon stocks (Table 1). Two to three additional years of stock status data were available for most systems. The team concluded that data for Malina Lake, Karluk Lake late run, Ayakulik River, Upper Station early and late runs, Buskin Lake, and Pasagshak River sockeye salmon would not substantially affect the results of previous escapement goal analyses. Thus, there was consensus to not reevaluate these goals, except for the Karluk Lake late-run goal (see Introduction section). The initial assessment of the remaining sockeye salmon stocks in the KMA either suggested that reanalysis of the data might change the goals or that for systems with poor stock assessment data (sporadic

aerial surveys resulting in data of questionable quality) additional analyses were warranted to determine the need for an SEG threshold. For sockeye salmon stocks that had goals eliminated during the 2004 review, the team decided to analyze the data in order to recommend whether to reestablish an escapement goal.

Pauls Bay Drainage

The Pauls Bay drainage (includes Pauls, Laura and Gretchen Lakes) is located on the north end of Afognak Island and supports a small sockeye salmon run (Honnold and Edmundson 1993; Nelson et al. 2005; Schrof and Honnold 2003). The system drains into Pauls Bay; waters within and just outside the bay are desiginated part of the Pauls Bay and Northeast Afognak sections of the Afognak District (Dinnocenzo et al. 2007; Figures 1 and 2).

Escapement Goal Background and Previous Review

The first published escapement goal for Pauls Bay drainage was developed in 1988 and set at 20,000 to 40,000 sockeye salmon (Nelson and Lloyd 2001).

An escapement goal review of this system was conducted during 2004. All available stock assessment data were analyzed using the percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area method (Nelson et al. 2005). As a result of these analyses, the review team recommended changing the Pauls Bay drainage sockeye salmon SEG range to 10,000 to 30,000 fish (Table 1). The department implemented the new goal in 2005.

2007 Review

Sockeye salmon escapements to the Pauls Bay drainage were enumerated by tributary surveys from 1969 to 1977 and weir counts from 1978 to 2004 (Appendices A1 and A2). Occasional aerial surveys have been conducted from 1979 through 2006; however, they often missed the peak of the sockeye salmon run timing. Stock-specific harvest estimates for Pauls Bay drainage sockeye salmon were not available. Recent aerial survey estimates were examined to determine if a change in the escapement goal was justified. The percentile approach was performed with the additional two years of aerial survey data and one year of weir count data to see if there was a significant change in the recommended range.

Afognak Lake

Afognak Lake is located on the southeast side of Afognak Island and has supported one of the largest sockeye salmon runs on the island (Nelson et al. 2005; Schrof and Honnold 2003). The lake drains (via Afognak River) into Afognak Bay, which is located within the Southeast Afognak Section of the Afognak District (Dinnocenzo et al. 2007; Figures 1 and 2).

Escapement Goal Background and Previous Review

The first published escapement goal for Afognak Lake was developed in 1988 and set at 20,000 to 40,000 sockeye salmon (Nelson and Lloyd 2001).

An escapement goal review of this system was conducted during 2004. All available stock assessment data were analyzed using a spawner-recruit analysis, the percentile method, euphotic volume analysis, and smolt biomass as a function of zooplankton (Nelson et al. 2005). The review resulted in changing the Afognak Lake SEG range to a BEG range of 20,000 to 50,000 sockeye salmon (Table 1).

2007 Review

Weir counts were available from 1921 to 1933 and from 1978 to 2006 (Appendices B1-B3). Aerial surveys were conducted from 1966 through 1977 (except in 1968 and 1972). Stock-specific harvest estimates for Afognak Lake sockeye salmon were retrieved from the fish ticket database, assuming the majority of the Afognak Lake harvest was from Afognak Bay (statistical area 252-34) and combined with estimates of subsistence and sport harvest within Afognak Bay.

A spawner-recruit relationship was estimated using the 1982 through 2000 brood years (Appendix B4). Spawning stock and recruitment data were analyzed using a Ricker spawner-recruit model (Ricker 1954) with a multiplicative error structure (Quinn and Deriso 1999). If a Ricker spawner-recruit model was significant, then S_{msy} was estimated along with the range of escapements that would produce 90% to 100% of MSY. Residuals were examined for autocorrelation. The previous spawner-recruit analysis (Nelson et al. 2005) was unable to detect any effects from lake fertilization and stocking (Afognak Lake was fertilized from 1990 to 2000 and sockeye salmon fry were backstocked in 1991, 1993, and during 1996-1998) and we did not expect any change in our results with the three additional brood years added to the analysis. Smolt and limnological data collected since the last review did not reveal any significant trends or information to suggest significant changes in Afognak Lake.

Little River

Little River Lake is located on the northwest side of Kodiak Island; the system empties into the waters of Shelikof Strait designated as the Central Section of the Northwest Kodiak District (Dinnocenzo et al. 2007; Figures 1 and 2).

Escapement Goal Background and Previous Review

The first published escapement goal for Little River Lake was developed in 1988 and set at 15,000 to 25,000 sockeye salmon (Nelson and Lloyd 2001).

An escapement goal review of this system was conducted during 2004. All available stock assessment data were analyzed using the risk analysis and the percentile method (Nelson et al. 2005). Despite estimating escapement goal ranges from the preceding analyses, the review team recommended eliminating the Little River sockeye salmon SEG due to unreliable escapement data (estimates were collected inconsistently) and the inability to actively manage escapements to this system. Both of these limitations were not expected to improve in the future. Thus, the elimination of the SEG was approved by the department and implemented in 2005.

2007 Review

Aerial surveys were used to estimate escapement into Little River from 1968 through 2006, a weir was used from 2001 through 2003 (Appendices C1 and C2). Stock-specific harvest estimates for Little River drainage sockeye salmon were not available. The percentile approach and a risk analysis were performed with the additional three years of aerial survey data.

Uganik Lake

Uganik Lake is located on the west side of Kodiak Island and is a moderate producer of sockeye salmon (Booth 1993). Uganik River flows from the lake into the East Arm of Uganik Bay, which is part of the Central Section of the Northwest Kodiak District (Dinnocenzo et al. 2007; Figures 1 and 2).

Escapement Goal Background and Previous Review

The first published escapement goal for Uganik Lake was developed in 1988 and set at 40,000 to 60,000 sockeye salmon (Nelson and Lloyd 2001).

An escapement goal review of this system was conducted during 2004. All available stock assessment data were analyzed using the percentile method, risk analysis, euphotic volume analysis, and smolt biomass as a function of zooplankton biomass (Nelson et al. 2005). Despite estimating escapement goal ranges from the preceding analyses, the review team recommended eliminating the Uganik Lake sockeye salmon SEG due to unreliable escapement data (estimates were collected inconsistently) and the inability to actively manage escapements to this system. Both of these limitations were not expected to improve in the future. Thus, the elimination of the SEG was approved by the department and implemented in 2005.

2007 Review

Aerial surveys were used to estimate escapement into Uganik Lake from 1974 through 2006, a weir was used from 1928 through 1932 and again from 1990 through 1992 (Appendices D1 and D2). Stock-specific harvest estimates for Uganik Lake drainage sockeye salmon were not available. The percentile approach was performed with the additional three years of aerial survey data. A risk analysis was initially considered; however, the escapement data were not lognormally distributed and the stock was considered to be targeted, which precludes using this method.

Karluk Lake

Karluk Lake is located on the west side of Kodiak Island and supports the largest sockeye salmon run in the KMA (Dinnocenzo et al. 2007; Wadle 2004). The lake's outlet stream, Karluk River, flows into the Shelikof Strait in the area designated as the Inner Karluk Section of the Southwest Kodiak District (Dinnocenzo et al. 2007; Figures 1 and 2). Two temporally distinct sockeye salmon runs utilize Karluk Lake (Barrett and Nelson 1994). The early-run returns from late May until mid July while the late-run returns from mid July through September.

Escapement Goal Background and Previous Review

BEGs of 150,000 to 250,000 fish for the early run and 400,000 to 550,000 fish for the late run were established for Karluk Lake sockeye salmon in 1992 based on spawner-recruit analysis (Nelson and Lloyd 2001).

An escapement goal review of this system was conducted during 2004. All available stock assessment data were evaluated using a spawner-recruit analysis, euphotic volume analysis, and smolt biomass as a function of zooplankton biomass (Nelson et al. 2005). The review resulted in changing the BEG ranges for the Karluk Lake sockeye salmon stocks to 100,000 to 210,000 for the early run and to 170,000 to 380,000 for the late run (Table 1).

2007 Review

Sockeye salmon escapements from Karluk Lake were enumerated by weir counts (Appendices E1-E5). These data were available from 1922 to 2006. Escapement assigned to the early run was estimated by including all counts prior to July 22 while escapement assigned to the late run was estimated by including all counts after July 21. Stock-specific harvest estimates were available for the Karluk Lake sockeye salmon fisheries from 1985 to 2006 (Appendices E2 and E3). An age marker analysis was used to estimate harvest attributable to Karluk Lake (Barrett and Nelson

1994) from the Uyak Bay (254-10, 20, 30, 40), Uganik Bay (253-11, 12, 13, 14), Viekoda Bay (253-31, 32, 33, 35), and Inner (255-10) and Outer (255-20) Karluk and Sturgeon (256-40) sections. Harvest attributable to the early run was estimated by including harvests prior to July 16 while harvest attributable to the late run was estimated by including harvests after July 15.

Spawner-recruit relationships were estimated for the early run and late run using the 1981 through 1999 brood years (Appendices E6 and E7). Spawning stock and recruitment data were analyzed using a Ricker spawner-recruit model (Eggers 2001; Hilborn and Walters 1992; Ricker 1954) with a multiplicative error structure (Quinn and Deriso 1999). If a Ricker spawner-recruit model was significant, then S_{msy} was estimated along with the range of escapements that would produce 90% to 100% of MSY. Residuals were examined for autocorrelation, temporal trends, potential bias due to lake fertilization and stocking (Karluk Lake was fertilized from 1986 to 1990 and sockeye salmon fry were backstocked into the Upper Thumb River from 1979 to 1987), and early versus late-run interactions.

Akalura Lake

Akalura Lake is located on the southwest side of Kodiak Island and supports a small sockeye salmon run (Wadle 2004). The lake drains into Olga Bay; waters adjacent to the confluence of the outlet creek are within the Inner Akalura Section of the Alitak District (Figures 1 and 2).

Escapement Goal Background and Previous Review

The first published escapement goal for Akalura Lake was developed in 1988 and set at 40,000 to 60,000 sockeye salmon (Nelson and Lloyd 2001).

An escapement goal review of this system was conducted during 2004. All available stock assessment data were analyzed using the percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, spawning habitat model, and smolt-per-spawner methods (Nelson et al. 2005). The review team estimated escapement goal ranges, but recommended eliminating the Akalura Lake sockeye salmon SEG due to unreliable escapement data (estimates were collected inconsistently) and the inability to actively manage escapements to this system. Both of these limitations were not expected to improve in the future. Thus, the elimination of the SEG was approved by the department and implemented in 2005.

2007 Review

Aerial surveys were used intermittently from 1968 through 2006 to estimate escapement into Akalura Lake; a weir has been utilized intermittently from 1923 to 2003, however, very few paired counts exist (Appendices F1 and F2). Stock-specific harvest estimates for Akalura Lake sockeye salmon were not available. The percentile approach was performed with the additional three years of aerial survey data.

Frazer Lake

Frazer Lake is located on the southwest side of Kodiak Island. Sockeye salmon were introduced into the previously barren lake from 1951 through 1971. The lake's outlet creek (Dog Salmon Creek) flows into Olga Bay; the Olga Bay and Dog Salmon Flats sections within the Alitak District are the nearest fisheries management areas (Figures 1 and 2). A fish pass was constructed in 1962 to allow sockeye salmon to migrate around the barrier falls and into the lake. Frazer Lake now supports one of the largest sockeye salmon runs in the Kodiak Archipelago (Dinnocenzo et al. 2007; Wadle 2004).

Escapement Goal Background and Previous Review

The Frazer Lake sockeye salmon escapement goal was 175,000 (initially did not have range) sockeye salmon during the 1950s through the 1970s when the run was in the development phase (Brennan 1998). In 1981, the Frazer Lake SEG range was increased to 350,000 to 400,000 sockeye salmon based upon rearing capacity and spawning habitat calculations (Nelson and Lloyd 2001). Since then, the goal has continually decreased; in 1986 the goal was lowered to 200,000 to 275,000 and in 1988 a BEG of 140,000 to 200,000 sockeye salmon was established.

An escapement goal review of this system was conducted during 2004. All available stock assessment data were analyzed using the spawner-recruit analysis, percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and spawning habitat model (Nelson et al. 2005). The review team recommended decreasing the Frazer Lake BEG range (140,000 to 200,000) to 70,000 to 150,000 sockeye salmon based on Ricker spawner-recruit analysis excluding data from years affected by fertilization (the lake was fertilized from 1988 to 1992). The recommendation was adopted by the department and the new BEG range went into affect in 2005.

2007 Review

Sockeye salmon escapements into Frazer Lake have been enumerated through the weir (fish pass) since 1956 (Appendices G1-G3). Stock-specific harvest estimates were available for the Frazer Lake sockeye salmon fisheries from 1966 to 2006. Both scale pattern analysis (SPA; Sagalkin 1999; Swanton 1992) and age marker analysis were used to estimate harvest attributable to Frazer Lake from the Cape Alitak Section (statistical areas 257-10, -20, -60, and -70), the Moser-Olga Bay Section (prior to 2000; statistical areas 257-40 and -41), the Moser Bay Section (after 2000; 257-43) and the Olga Bay Section (after 2000; 257-40), subject to run timing considerations.

Spawner-recruit relationships were estimated for the run by analyzing spawning stock and recruitment data from brood years 1966 to 1999 (Appendix G4) using a Ricker spawner-recruit model (Eggers 2001; Hilborn and Walters 1992; Ricker 1954) with a multiplicative error structure (Quinn and Deriso 1999). Two datasets were analyzed; one using all spawner-recruit data (1966-1999) and a second using spawner-recruit data not affected by fertilization of Frazer Lake (excluding brood year data from 1985 to 1991). If a Ricker spawner-recruit model was significant, then S_{msy} was estimated along with the range of escapements that would produce 90% to 100% of MSY. Residuals were examined for autocorrelation, temporal trends, and potential bias due to lake fertilization.

Saltery Lake

Saltery Lake is located southwest of the city of Kodiak and is one of the most productive sockeye salmon systems on the east side of Kodiak Island (Dinnocenzo et al. 2007; Honnold and Sagalkin 2001). The Inner Ugak Bay Section of the Eastside Kodiak District is the nearest fisheries management area to the confluence of the lake's outlet creek (Saltery Creek) and Ugak Bay (Figures 1 and 2). Saltery Lake is the primary brood source for the Kodiak Regional Aquaculture Association (KRAA) stocking project at Spiridon Lake.

Escapement Goal Background and Previous Review

The first published escapement goal for Saltery Lake was developed in 1988 and set at 20,000 to 40,000 sockeye salmon (Nelson and Lloyd 2001). In 2001, the Saltery Lake SEG was changed to a BEG of 15,000 to 30,000 fish and was based upon spawner-recruit, euphotic zone depth and volume, smolt biomass as a function of zooplankton biomass, smolt biomass as a function of lake rearing availability, and spawning habitat availability analyses (Honnold and Sagalkin 2001).

The escapement goal for the system was reviewed again during 2004. All available stock assessment data were analyzed using the spawner-recruit analysis, percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and spawning habitat model (Nelson et al. 2005). The review team recommended maintaining the Saltery Lake BEG of 15,000 to 30,000 sockeye salmon, based on a spawner-recruit analysis. However, the team suggested targeting S_{msy} (23,000) or the lower end of goal in the short term, citing decreased biomass of zooplankton in the lake.

2007 Review

Sockeye salmon escapements to Saltery Lake were enumerated by aerial and weir counts (Appendices H1 and H2). Aerial surveys were used to estimate escapement from 1976 through 1986, 1992, and 2004 through 2006. Escapement estimates via weir data were obtained from 1986 to 1991 and 1993 to 2003. Reliable stock-specific harvest estimates for Saltery Lake sockeye salmon were not available and since the weir was removed in 2004, no new age data were available. Due to the recent lack of weir data and no plans to reinstall a weir in the future, the percentile approach was performed using only aerial survey data, including the additional three years of data since the last escapement goal review.

COHO SALMON

The team reviewed the most recent data available for KMA coho salmon stocks (Table 1); three additional years of escapement data were available for Buskin, American, Olds and Pasagshak rivers coho salmon, including spawner-recruit data for the Buskin stock. The team concluded that these data would not substantially affect the results of previous escapement goal analysis. Thus, there was consensus to not reevaluate these goals.

PINK SALMON

The team reviewed the most recent data available for KMA pink salmon stocks (Table 1; Figure 1); three additional years of escapement data were available for Kodiak archipelago and Mainland district pink salmon. The team concluded that these data would not substantially affect the results of previous escapement goal analysis. Thus, there was consensus to not reevaluate theses goals.

CHUM SALMON

The team originally planned to only reevaluate the goals for the Northwest, Southwest, and Northeast Kodiak districts; however, during evaluation of the data, it was discovered that an Eastside Kodiak District stream was inadvertently omitted from the last analysis (Table 1; Figure 1). We decided to reanalyze all districts and also, after discussing with management staff, estimating an island wide aggregate chum salmon SEG threshold. The latter was based on the lack of active management by district for chum salmon due to difficult survey conditions caused by the abundance of pink salmon. Percentile analyses for the Northwest and Southwest districts

and risk analyses for the Alitak, Eastside, and Northeast districts resulted in no changes to the SEG thresholds. The team discussed the need for district SEG thresholds and agreed that SEG thresholds for the Mainland District and Kodiak (island-wide) with management objectives for the Kodiak districts would be consistent with the pink salmon goals. Methods specific to the Kodiak Island Aggregate and Mainland District stocks are outlined below.

Kodiak Island Aggregate

Escapement Goal Background and Previous Review

Chum salmon escapement goals by district were established in 1988 (Nelson and Lloyd 2001). The goals for Kodiak Island districts were derived from historic production trends and ranges were delineated as follows: Northwest District - 46,000 to 138,000, Southwest District - 25,000 to 75,000, Alitak District - 26,000 to 78,000, Eastside District - 35,000 to 105,000, and Northeast District - 8,000 to 24,000 chum salmon.

The Kodiak Island district chum salmon goals were reviewed in 2004 (Nelson et al. 2005). Aggregate peak index escapements by district from 1977 to 2004 were analyzed using either a risk analysis or the percentile method. The review team recommended the following SEG thresholds: Northwest District - 53,000, Southwest District - 7,300, Alitak District - 28,000, Eastside District - 50,000, and Northeast District - 9,000. The sum of these SEG thresholds is 147,300 chum salmon. The individual district SEG thresholds were adopted by the department as recommended and were implemented in 2005.

2007 Review

Chum salmon escapements in the five Kodiak Island chum salmon districts of the KMA were enumerated by weir counts and aerial surveys, depending on the river system (Appendix I). The aerial survey peak index escapement estimates and weir counts from 1977 to 2006 were combined by year as an island-wide aggregate. The percentile method was applied to these aggregate escapement estimates to estimate an island-wide chum salmon escapement goal.

Mainland District

Escapement Goal Background and Previous Review

The chum salmon escapement goal for the Mainland District was established in 1988 (Nelson and Lloyd 2001). The Mainland District escapement goal of 133,000 to 399,000 was derived from historic production trends.

During the review of KMA escapement goals in 2004 (Nelson et al. 2005), the Mainland District escapement goal was changed to an SEG of 153,000 chum salmon. This recommendation, which was adopted by the department and implemented in 2005, was based on a risk analysis.

2007 Review

Chum salmon escapements in the Mainland District of the KMA were enumerated by aerial surveys (Appendices J1 and J2). The aerial survey peak index escapement estimates from 1977 to 2006 were evaluated using a risk analysis to estimate a chum salmon escapement goal. For comparison, the percentile method was applied to these escapement estimates to estimate a Mainland District chum salmon escapement goal.

RESULTS

SOCKEYE SALMON

Pauls Bay Drainage

Stock Status

The current Pauls Bay drainage sockeye salmon SEG range is 10,000 to 30,000 (Table 1; Appendix A1). The system was stocked with indigenous juvenile sockeye salmon and fertilized during the 1990s to boosted production as a result of poor runs in the late 1980s (Appendices A1-A3). Weir enumeration of escapement was discontinued after 2004. Currently there are no plans to stock or fertilize the system again or fund weir operation. Aerial surveys conducted in the Pauls Bay drainage are extremely difficult and tend to underestimate sockeye salmon escapement; estimates in 2005 (700) and 2006 (150) were extremely low, well below the lower bound of the SEG range (Appendix A3).

Evaluation of Recent Data

An SEG for Pauls Bay drainage sockeye salmon was estimated according to the percentile approach using two sets of escapement estimates (Table 2; Appendices A1 and A2). The first SEG estimate was determined using survey (both tributary and aerial) estimates from 1969 to 2006. High contrast (153.8) in the survey estimates and low exploitation resulted in an SEG of 833 to 10,875 (15^{th} to 75^{th} percentiles). Weir counts from 1978 to 2004 were used for the second SEG estimate. High contrast (15.7) and low exploitation resulted in an SEG of 12,039 to 28,129 (15^{th} to 75^{th} percentiles).

Escapement Goal Recommendation

The team recommended eliminating the Pauls Bay drainage sockeye salmon SEG of 10,000 to 30,000 fish (Table 1). The high contrast in the aerial survey estimates from 1978 to 2006 occurred in the span of time that Pauls Lake weir estimates (1978 through 2004) were indicating remarkably consistent annual productivity. The lack of correlation and magnitude between survey and weir counts highlights the ineffectiveness of aerial surveys in the Pauls Bay drainage. There are no future plans to reestablish a weir on the system and with the absence of, there is no way to accurately gauge the escapement.

Afognak Lake

Stock Status

The current Afognak Lake sockeye salmon BEG range is 20,000 to 50,000 (Table 1; Appendix B1). The system was stocked with indigenous juvenile sockeye salmon and fertilized during the 1990s to boost production as a result of below average runs in the late 1980s (Appendices B2 and B3). Although sockeye salmon production has been low in recent years, there are currently no plans to stock or fertilize the system again. Escapements since the new BEG was implemented in 2005 were just within the goal range at 21,577 in 2005 and 22,933 in 2006 (Appendix B3). The returns for 1998 and 1999 brood years were the lowest in the 1978 to 2000 time series (Appendices B4 and B5). The decline was likely due to the high escapements in 1995 through 1997 (Appendices B2 and B3).

Evaluation of Recent Data

The contrast of the Afognak Lake escapement data was 440 (21 for all weir data and 9 for 1978-2006 weir data (Appendix B1), which was above the recommended minimum contrast of 4 (CTC 1999). Returns from escapements that were fully recruited since the last escapement goal review had little effect on the escapement goal range. The Ricker spawner-recruit regression was significant (p=0.01) and the S_{MSY} was estimated to be 35,000 with $S_{90\%MSY}$ range of 22,000 to 50,000 (Table 3; Appendix B5). No autocorrelation was found in the spawner-recruit model residuals.

Escapement Goal Recommendation

The team recommended no change to the Afognak Lake sockeye salmon BEG of 20,000 to 50,000 fish based on the updated Ricker spawner-recruit curve (Tables 1 and 3).

Little River

Stock Status

Currently no escapement goal exists for Little River sockeye salmon (Table 1; Appendix C1). There are no plans to reestablish the weir that was operated at Little River from 2001 to 2003. The visibility of sockeye salmon in Little River drainage is good and hence the quality of aerial survey estimates is above average. Paired weirs counts and aerial survey estimates during weir operation were highly correlated, yet the sample size is extremely small (Appendix C2). Aerial survey peak index escapement estimates since the previous escapement goal was eliminated in 2005 were 3,000 in 2005 and 3,500 in 2006 (Appendices C2 and C3).

Evaluation of Recent Data

An SEG for Little River sockeye salmon was estimated according to the percentile approach using two sets of escapement estimates (Table 2; Appendices C1 and C2). The first SEG estimate was determined using aerial survey estimates from 1968 to 2006. High contrast in the aerial survey estimates (219.6) and high exploitation of this stock resulted in a SEG range of 4,625 to 15,750 (25th to 75th percentiles). Weir counts from 2001- 2003 were used for the second SEG estimate. High contrast in the escapement estimates (18.5) and high exploitation of this stock resulted in a SEG range of 19,029 to 53,960 (25th to 75th percentiles).

Three different risk analyses were performed on the aerial survey escapement data from 1968 to 2006 (Table 4; Appendix C2). The first analysis used the ability to detect a 98% drop from the mean escapement in three consecutive years; the second analysis used a 95% drop from the mean, and the third analysis used a 79% drop from the mean. The 98% drop from the mean escapement was from the percent difference between the minimum escapement (230 sockeye) and the mean escapement. The 95% drop from the mean escapement was a value employed in other analyses (Nelson et al. 2005; Witteveen et al. 2005). The 79% drop from the mean was from the percent difference between the second lowest escapement (2,700 sockeye) and the mean escapement. An escapement threshold of 3,400 would provide for 0.4% chance of taking action three consecutive years when none was needed and a 0.4% chance a drop in escapement of 98% of the mean escapement would not be detected in 3 consecutive years. An escapement threshold of 5,000 would provide for 2.1% chance of taking action three consecutive years when none was needed and a 2.1% chance a drop in escapement of 95% of the mean escapement would not be detected in 3 consecutive years. An escapement threshold of 9,600 would provide for 14.6% chance of taking

action three consecutive years when none was needed and a 14.6% chance a drop in escapement of 79% of the mean escapement would not be detected in 3 consecutive years.

Escapement Goal Recommendation

The team recommended that a SEG threshold of 3,000 sockeye salmon be established for Little River based on the risk analysis (Tables 1 and 4). The outlet to Little River empties into the most important commercial sockeye salmon harvest section in the KMA, the Central Section of the Northwest Kodiak District. While the harvest of Little River sockeye salmon is no doubt incidental to the targeted harvest of Karluk Lake sockeye salmon and other much larger migrating sockeye salmon stocks, exploitation of the Little River stock is likely high. While no management actions can be made in season, aerial survey coverage should be maintained to keep intact this high quality dataset and gauge the sustainability of the stock.

Uganik Lake

Stock Status

Currently no escapement goal exists for Uganik Lake sockeye salmon (Table 1; Appendix D1). There are no plans to reestablish the weir that was operated at Uganik Lake from 1990 to 1992. In addition, it is not possible to actively manage escapements specific to this system. It is difficult to detect sockeye salmon, via aerial surveys, in this turbid glacially fed system until mid-July, when the darker colored sockeye salmon start moving onto the spawning grounds. Historical information demonstrates the importance of this sockeye salmon system for subsistence, recreational and commercial fisheries. Since the previous escapement goal was eliminated in 2005, aerial survey peak index escapement estimates were 7,500 in 2005 and 26,700 in 2006 (Appendices D2 and D3).

Evaluation of Recent Data

An SEG for Uganik Lake sockeye salmon was estimated according to the percentile approach using two sets of escapement estimates (Table 2; Appendices D1 and D2). The first SEG estimate was determined using aerial survey estimates from 1974 to 2006. High contrast in the aerial survey estimates (31.4) and high exploitation of this stock resulted in a SEG range of 24,000 to 45,450 (25th to 75th percentiles). All weir counts were used for the second SEG estimate. High contrast in the escapement estimates (13.2) and high exploitation of this stock resulted in a SEG range of 13,915 to 66,417 (25th to 75th percentiles).

Escapement Goal Recommendation

The team recommended that a SEG threshold of 24,000 sockeye salmon be established for Uganik Lake based on the percentile analysis (Tables 1 and 2). Sockeye salmon returning to Uganik Lake must navigate through a gauntlet of both commercial gillnet and purse seine gear types, and thus exploitation is likely high. However, harvest of Uganik Lake sockeye is typically incidental to the targeted harvest of Karluk Lake and other much larger migrating sockeye salmon stocks. While no management actions can be made in season, aerial survey coverage should be maintained to keep intact this high quality dataset and to continue to gauge the sustainability of the stock.

Karluk Lake

Stock Status

Early Run

The Karluk Lake early-run sockeye salmon BEG of 100,000 to 210,000 was implemented beginning in the 2005 season (Table 1; Appendix E1). Sockeye salmon escapements since the escapement goal change were 283,860 during 2005 and 202,366 during 2006, one above the upper range of the new escapement goal and one within the range (Appendices E2 and E4). Migrating Karluk Lake bound sockeye salmon continue to be difficult to harvest. Since 1985, escapements have been within the current BEG range during only two years and have exceeded the goal during 20 years (Appendix E4).

Late Run

The Karluk Lake late-run sockeye BEG of 170,000 to 380,000 was also implemented beginning in the 2005 season (Table 1; Appendix E1). Escapements of late-run sockeye salmon to the Karluk Lake were 498,102 in 2005 and 288,007 in 2006, one above the upper range of the new escapement goal and one within the range (Appendices E3 and E5). Since 1985, escapements have been within the current BEG range five years and above the upper range during 17 years (Appendix E5).

Evaluation of Recent Data

Early Run

Recent large escapements increased the contrast in the escapement to 4.6 (Appendix E1), meeting the minimum recommended level to be used in spawner-recruit analysis (CTC 1999). Returns from escapements that were fully recruited since the last escapement goal review were the some of the largest in the data set and therefore had an effect on the spawner-recruit curve (Appendix E6). Using three additional data points over the last review resulted in an estimate of S_{msy} of 175,000 sockeye salmon, which was the higher than the previous estimate of 150,000 fish (Table 3; Appendix E8). The lower escapement range was estimated at 110,000 fish and the upper range was estimated at 250,000. No autocorrelation was found in the spawner-recruit model residuals.

Late Run

The recent Karluk Lake late-run escapements were more typical of historical late-run magnitude and the returns were above average, but within the range of what was seen historically (Appendices E3 and E5). The escapement contrast for the Karluk Lake late run was unchanged with recent escapements, but remains well above the recommended minimum of 4.0 for spawner-recruit analysis (CTC 1999) at 19.9 (Appendix E1). Returns from escapements that were fully recruited since the last escapement goal review were well above average, but were within the range of the rest of the data (Appendix E7). As a result, the addition of recent years' data points did not substantially affect the spawner-recruit curve; the S_{msy} was estimated at 272,000 sockeye salmon as compared to the S_{msy} estimated during the last review of 270,000 (Table 3; Nelson et al. 2005). The resulting escapement goal range of 172,000 to 392,000 sockeye salmon was also very similar to the previous analysis of 169,000 to 381,000 spawners. No autocorrelation was found in the spawner-recruit model residuals.

Escapement Goal Recommendation

The team recommended changing the current Karluk Lake early-run BEG of 100,000 to 210,000 to a BEG of 110,000 to 250,000 fish (S_{msy} = 175,000) based on the updated Ricker spawner-recruit curve (Tables 1 and 3). Recent returns from brood years that are not fully recruited indicate that the current level of production will continue for at least a few more brood years. The committee recommended leaving the Karluk Lake late-run BEG of 170,000 to 380,000 sockeye salmon unchanged since the updated spawner-recruit analysis was very similar to the previous estimate.

Several events relating to Karluk Lake sockeye salmon complicated analysis of the escapement goals. The estimated harvest assigned to Karluk prior to 1985 (completed brood year 1981) was considered by Barrett and Nelson (1995) to contain substantial errors. In addition, several Karluk Lake rehabilitation activities may have altered the natural state of the spawner-recruit relationship. From 1986 to 1990, Karluk Lake was fertilized to enhance juvenile sockeye salmon survival (Schrof and Honnold 2003). ADF&G also back stocked sockeye salmon fry into the Upper Thumb River in the Karluk Lake watershed after eggs were incubated at the Kitoi Bay Hatchery from 1979 to 1987. The data used for the spawner-recruit analysis includes 1981 to 1996 brood years (16 years) and the rehabilitation activities may have had an effect on brood years 1981 to 1995 (15 years). Recent smolt and limnological data collected since the last review, however, did not reveal any significant trends or information to suggest significant changes in Karluk Lake.

Akalura Lake

Stock Status

Currently no escapement goal exists for Akalura Lake sockeye salmon (Table 1; Appendix F1). There are no plans to reestablish the weir that was operated at Akalura Lake. In addition, it is not possible to actively manage escapements specific to this system. Akalura Lake is located in one of the most remote portions of Kodiak Island and thus aerial survey coverage is poor; furthermore, when surveys are conducted, visibility of sockeye salmon is poor. Aerial survey peak escapement estimates since the previous escapement goal was eliminated in 2005 were 7,500 in 2005 and 2,800 in 2006 (Appendices F1 and F2).

Evaluation of Recent Data

An SEG for Akalura Lake sockeye salmon was estimated according to the percentile approach using two sets of escapement estimates (Table 2; Appendix F1). The first SEG estimate was determined using aerial survey estimates from 1967 to 2006. High contrast in the aerial survey estimates (59.3) and high exploitation of this stock resulted in a SEG range of 2,800 to 8,000 (25th to 75th percentiles). The second SEG estimate was determined using weir count estimates from 1968 to 2003. High contrast in the weir count estimates (262.5) and high exploitation of this stock resulted in a SEG range of 6,287 to 27,554 (25th to 75th percentiles).

Escapement Goal Recommendation

The consensus of the team was that the available stock assessment data and other fishery information are not sufficient to reestablish an SEG for Akalura Lake sockeye salmon (Table 1; Appendix F). Conservation and monitoring of the minor sockeye systems of the Kodiak Island group, as well as major systems, is an important concept. Akalura Lake lies in Olga Bay,

between the commercial important sockeye salmon stocks of Frazer Lake and Upper Station. However, there are no future plans to reestablish the weir at Akalura Lake and without a weir there is no way to accurately gauge the escapement.

Frazer Lake

Stock Status

The current Frazer Lake sockeye salmon BEG range is 70,000 to 150,000 (Table 1; Appendix G1). Concerns over escapement and smolt production in the mid-1980s prompted fertilization of Frazer Lake from 1988 to 1992. Sockeye salmon escapements were within the BEG range in 2005 (136,948) and in 2006 (89,516; Appendices G2 and G3).

Evaluation of Recent Data

A Ricker spawner-recruit model was fit to the Frazer Lake fully recruited brood year spawner-recruit data from 1966 to 1999 (excluding the brood years of 1985 to 1991 where fertilization directly affected production; Appendix G4). The contrast of the Frazer Lake escapement data was 30.7 (Appendix G1), which was above the recommended minimum contrast of 4 (CTC 1999). The multiplicative error model was significant ($P<0.001$). The S_{msy} was estimated at 118,000 sockeye salmon with a 90% MSY range of 75,000 to 170,000 while S_{eq} was estimated at 326,000 sockeye salmon (Table 3; Appendix G5). No autocorrelation was detected in residual plots. Compared to the complete dataset (including brood years affected by fertilization) the S_{msy} was estimated at 138,000 sockeye salmon with a 90% MSY range of 87,000 to 200,000 while S_{eq} was estimated at 392,000 sockeye salmon (Table 3). Fertilization of Frazer Lake has not occurred for 15 years and there are no plans to reinstitute the project. Though the α and β parameter estimates are not significantly different between the two models, the results from the spawner-recruit model that exclude those brood years affected by fertilization is most appropriate.

Escapement Goal Recommendation

The team recommended changing the Frazer Lake sockeye salmon BEG range of 70,000 to 150,000 to a BEG range of 75,000 to 170,000 fish (Table 1). The addition of three more years of spawner-recruit data yielded little visible change in the spawner-recruit model; however, bias correction in the estimate of S_{msy} resulted in a significantly higher S_{msy} (118,000 compared to the 2004 estimate of 105,000) and upper range estimate (Table 3). The implications are that while little biological difference was detected since the last analysis, changes in statistical interpretation indicate an increase in the BEG would be appropriate.

Saltery Lake

Stock Status

The current Saltery Lake sockeye salmon BEG range is 15,000 to 30,000 (Table 1; Appendix H1). There are no plans to reestablish the weir that was operated from 1986 to 2003. Aerial survey coverage of Saltery Lake is good due to its proximity to Kodiak and, despite slight glacial turbidity in the lake; aerial estimates of sockeye salmon are of high quality. Aerial survey peak index escapement estimates since the previous escapement goal review in 2004 were 28,500 in 2005 and 28,000 in 2006 (Appendices H2 and H3).

Evaluation of Recent Data

An SEG for Saltery Lake sockeye salmon was estimated according to the percentile approach using two sets of escapement estimates (Table 2; Appendix H1). The first SEG estimate was determined using all aerial survey estimates. Medium contrast in the aerial survey estimates (6.7) resulted in a SEG range of 24,200 to 46,205 (15th to 85th percentiles). Weir counts from 1986 to 1991 and 1992 to 2003 were used for the second SEG estimate. Low contrast in the escapement estimates (3.4) resulted in a SEG range of 27,665 to 77,186 (15^{th} percentile to maximum).

Escapement Goal Recommendation

The team recommended changing the Saltery Lake sockeye salmon BEG range of 15,000 to 30,000 to a SEG range of 20,000 to 50,000 fish based on the percentile method using aerial survey data (Table 1). Saltery Lake sockeye salmon escapement has been estimated via aerial survey since 2003 and there are no plans to reinstate weir operation in the future. The current BEG was based on a spawner-recruit analysis using both weir and aerial survey data; the lower bound of the range was based on habitat data (Honnold and Sagalkin 2001; Nelson et al. 2005). The lower bound of the current goal is less than the lowest sockeye salmon escapement estimate in the dataset (weir or survey) of 18,000. Thus, the team concurred that increasing the lower bound was appropriate despite the previous assessment of habitat limitations.

CHUM SALMON

Kodiak Island Aggregate

Stock Status

The current Kodiak Island chum salmon SEGs by district are 53,000 for the Northwest Kodiak District, 7,300 for the Southwest Kodiak District, 28,000 for the Alitak District, 50,000 for the Eastside Kodiak District, and 9,000 for the Northeast Kodiak District (Table 1; Appendix I). These SEGs were based on aggregated peak index escapement estimates by district. District peak aerial escapement estimates since the last escapement goal review in 2004 were: Northwest Kodiak – 36,150 in 2005, 41,800 in 2006, Southwest Kodiak – 2,000 in 2005, 21,400 in 2006, Alitak – 47,100 in 2005, 10,600 in 2006, Eastside Kodiak – 49,300 in 2005, 328,700 in 2006, and Northeast Kodiak – 7,300 in 2005, and 16,500 in 2006 (Table 1). The low escapement estimates were likely due in part to large pink salmon returns, which made it difficult to see chum salmon in the rivers.

Evaluation of Recent Data

A Kodiak Island aggregate SEG for chum salmon was estimated using the percentile approach (Table 2; Appendix I). The chum salmon escapement data had medium contrast (6.0) so the 15% to 85% percentiles were used, which resulted in an escapement goal range of 151,000 to 449,000 chum salmon (Table 2).

Escapement Goal Recommendation

The team recommended eliminating the individual district chum salmon SEG thresholds and establishing an island-wide SEG threshold of 151,000 fish (Table 1). Chum salmon are not actively managed by district and are caught incidentally during the harvest of pink salmon. District management objectives would still be used concurrently with the Kodiak Island aggregate chum salmon SEG. This change for chum salmon would parallel and be consistent

with changes made to Kodiak Island pink salmon escapement goals during the previous review in 2004. As during the last review, the team's recommendation for the lower threshold rather than a range was based on the inability to develop a defensible upper end goal and the lack of biological necessity for an upper range (Nelson et al. 2005).

Mainland District

Stock Status

The current Mainland District chum salmon SEG is 153,000 (Table 1; Appendix J1). Since the last escapement goal review in 2004, peak aerial index escapement estimates were below the SEG in 2005 at 22,500 and above the SEG in 2006 at 346,140 (Table 1; Appendices J2 and J3).

Evaluation of Recent Data

An SEG for the Mainland District was estimated using a risk analysis. The percent difference between the mean and minimum peak escapement estimate was 90%. An SEG of 104,000 resulted in a 0.7% chance of unwarranted concern in three consecutive years, and 0.7% chance that a 90% drop in mean escapement would not be detected in three consecutive years (Table 4; Appendix J4). For the percentile method comparison, the Mainland District chum salmon escapement data had high contrast (20.1) and the 15% and 25% percentile estimates were about 109,000 and 136,000, respectively (Table 2).

Escapement Goal Recommendation

The team recommended changing the SEG threshold from 153,000 to 104,000 chum salmon (Table 1). At this level there is low empirical risk of unneeded action or mistaken inaction, since the peak aggregate escapement for the Mainland District has only been below 104,000 five years since 1977 and never in three consecutive years. As during the last review, the team's recommendation for the lower threshold rather than a range was based on the inability to develop a defensible upper end goal and the lack of biological necessity for an upper range (Nelson et al. 2005).

REFERENCES CITED

Barrett, B. M. and P. A. Nelson. 1994. Estimated run timing of selected sockeye salmon stocks on the west and east sides of Kodiak Island. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 4K94-6, Kodiak.

Barrett, B. M. and P. A. Nelson. 1995. Estimation of Karluk Lake early and late run sockeye returns based on scale age data, 1985-1994. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 4K95-44, Kodiak.

Bernard, D. R., J. J. Hasbrouck, and B. G. Bue. *Unpublished.* Using risk of management error to set precautionary reference points (PRPs) for non-targeted salmon stocks.

Booth, J. A. 1993. Migration timing and abundance of adult salmonids in the Uganik River, Kodiak National Wildlife, Alaska, 1990 and 1991. U.S. Fish and Wildlife Service, Kenai Fishery Assistance Office. Alaska Fisheries Progress Report Number 93-1. Kenai, Alaska.

Brennan, K. 1998. The Alitak Bay District commercial salmon fishery, 1998. Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 4K98-55, Kodiak.

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 Board of Fisheries, 2001, Anchorage.

REFERENCES CITED (Continued)

Chinook Technical Committee (CTC). 1999. Maximum sustained yield of biologically based escapement goals for selected chinook salmon stocks used by the Pacific Salmon Commission's Chinook Technical Committee for escapement assessment, Volume I. Pacific Salmon Commission Joint Chinook Technical Committee Report No. TCHINOOK (99)-3, Vancouver, British Columbia, Canada.

Caldentey, I. 2007. Kodiak Area Management salmon escapement cumulative counts, 1997-2006. Alaska Department of Fish and Game, Fisheries Management Report No. 07-16, Anchorage.

Dinnocenzo, J. G. Spalinger, and J. Wadle. 2007. Kodiak management area commercial salmon annual management report, 2006. Alaska Department of Fish and Game, Fisheries Management Report No. 07-25, Anchorage.

Eggers, D. M. 2001. Biological escapement goals for Yukon River fall chum salmon. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 3A01-10, Anchorage.

Fried, S. M. 1994. Pacific salmon spawning escapement goal for the Prince William Sound, Cook Inlet, and Bristol Bay areas of Alaska. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Special Publication No. 8, Juneau.

Hasbrouck, J. J. and J. A. Edmundson. 2007. Escapement goals for salmon stocks in Upper Cook Inlet, Alaska: report to the Alaska Board of Fisheries, January 2005. Alaska Department of Fish and Game, Special Publication No. 07-10, Anchorage.

Hilborn, R. and C.J. Walters. 1992. Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Chapman and Hall, New York, NY.

Honnold, S. G. and N. H. Sagalkin. 2001. A review of limnology and fishery data and a sockeye salmon escapement goal evaluation for Saltery Lake on Kodiak Island. Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K01-37, Kodiak.

Honnold, S. G. and J. A. Edmundson. 1993. Limnological and fisheries assessment of sockeye salmon (*Oncorhynchus nerka*) production in the Laura Lake system. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development, Regional Information Report 130, Kodiak.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2007. Participation, catch and harvest in Alaska sport fisheries during 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-40, Anchorage.

Jennings, G. B., K. Sundet, and A. E. Bingham. *In prep a.* Participation, catch and harvest in Alaska sport fisheries during 2005. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Jennings, G. B., K. Sundet, and A. E. Bingham. *In prep b.* Participation, catch and harvest in Alaska sport fisheries during 2006. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Nelson, P. A., and D. S. Lloyd. 2001. Escapement goals for Pacific salmon in the Kodiak, Chignik, and Alaska Peninsula/Aleutian Islands Areas of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K01-66, Kodiak.

Nelson P. A., M. J. Witteveen, S. G. Honnold, I. Vining, and J. J. Hasbrouck. 2005. Review of salmon escapement goals in the Kodiak Management Area. Alaska Department of Fish and Game, Fishery Manuscript No. 05-05, Anchorage.

Quinn II, T. J. and R. B. Deriso. 1999. Quantitative fish dynamics. Oxford University Press. New York, NY.

Ricker, W. E. 1954. Stock and recruitment. Journal of the Fisheries Research Board of Canada, 11: 559-623.

Sagalkin, N. 1999. Frazer Lake fish pass sockeye salmon smolt and adult research, 1997 and 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 4K99-59, Kodiak.

Schrof, S. T. and S. G. Honnold. 2003. Salmon enhancement, rehabilitation, evaluation, and monitoring efforts conducted in the Kodiak Management Area through 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K03-41, Kodiak.

REFERENCES CITED (Continued)

Swanton, C. O. 1992. Stock interrelationships of sockeye salmon runs, Alitak Bay District, Kodiak Island, Alaska. Masters Thesis, University of Washington, Seattle.

Wadle, J. 2004. Kodiak Management Area annual finfish management report, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, 4K04-01, Kodiak.

Witteveen, M. J., H. Finkle, P. A. Nelson, J. J. Hasbrouck, and I. Vining. 2005. Review of salmon escapement goals in the Chignik Management Area. Alaska Department of Fish and Game, Fishery Manuscript No. 05-06, Anchorage.

TABLES AND FIGURES

Table 1.–Current escapement goals, escapements observed from 2004 through 2006, and escapement goal recommendations in 2007 for Chinook, sockeye, coho, pink, and chum salmon stocks of the Kodiak Management Area, Alaska.

		Escapement	Current Escapement Goal				Escapements			
Species	System	Data[a]	Type	Lower	Point	Upper	2004	2005	2006	2007 Recommendation
Chinook										
	Karluk	WC	BEG	3,600	4,492	7,300	6,587	4,657	3,351	No Change
	Ayakulik	WC	BEG	4,800	6,638	9,600	24,423	7,849	2,937	No Change
Sockeye										
	Malina	PAS	SEG	1,000		10,000	20,000	1,000	6,400	No Change
	Pauls[b]	PAS	SEG	10,000		30,000	29,289	700	150	Eliminate Goal
	Afognak	WC	BEG	20,000	34,000	50,000	15,181	21,577	22,933	No Change
	Little River	PAS	None				16,000	3,000	3,500	Establish SEG threshold: 3,000
	Uganik Lake	PAS	None				83,600	7,500	26,700	Establish SEG threshold: 24,000
	Karluk									
	Early run	WC	BEG	100,000	175,000	210,000	393,468	283,860	202,366	Change to BEG: 110,000 to 250,000
	Late run	WC	BEG	170,000	270,000	380,000	326,466	498,102	288,007	No change
	Ayakulik	WC	SEG	200,000		500,000	275,238	251,906	87,780	No change
	Upper Station									
	Early run[c]	WC	SEG	30,000		65,000	78,487	60,349	24,997	No change
	Late run	WC	BEG	120,000	186,000	265,000	177,108	156,401	153,153	No change
	Akalura	PAS	None				1,500	7,500	2,800	No change
	Frazer	WC	BEG	70,000	105,000	150,000	120,664	136,948	89,516	Change to BEG: 75,000 to 170,000
	Buskin	WC	SEG	8,000		13,000	22,023	15,468	17,734	No change
	Pasagshak	FS	SEG	3,000		12,000	46,000	22,000	6,300	No change
	Saltery	PAS	BEG	15,000		30,000	54,000	28,500	28,000	Change to SEG: 20,000 to 50,000

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Table 1.–Page 2 of 2

		Escapement	Current Escapement Goal				Escapements			
Species	System	Data[a]	Type	Lower	Point	Upper	2004	2005	2006	2007 Recommendation
Coho										
	Buskin	WC	BEG	3,200		7,200	9,599	16,596	13,348	No change
	American	FS	SEG	400		900	753	339	2,033	No change
	Olds (Sid Olds)	FS	SEG	1,000		2,200	1,860	2,495	1,912	No change
	Pasagshak	FS	SEG	1,200		3,300	3,402	3,773	937	No change
Pink										
	Kodiak Archipelago	PAS	SEG	2,000,000		5,000,000	8,074,963	3,688,158	5,056,372	No change
	Mainland District	PAS	SEG	250,000		750,000	711,555	268,050	728,200	No change
Chum										
	N.W. Kodiak District	PAS	SEG	53,000			30,700	36,150	41,800	Eliminate. Part of Kodiak Archipelago aggregate
	S.W. Kodiak District	PAS	SEG	7,300			10,243	2,000	21,400	Eliminate. Part of Kodiak Archipelago aggregate
	Alitak District	PAS	SEG	28,000			25,906	47,100	10,600	Eliminate. Part of Kodiak Archipelago aggregate
	Eastside Kodiak District	PAS	SEG	50,000			58,750	49,300	328,700	Eliminate. Part of Kodiak Archipelago aggregate
	N.E. Kodiak District	PAS	SEG	9,000			2,156	7,300	16,500	Eliminate. Part of Kodiak Archipelago aggregate
	Kodiak Archipelago	PAS	None				127,755	141,850	419,000	Establish SEG Threshold: 151,000
	Mainland District	PAS	SEG	153,000			241,645	22,500	346,140	Change to SEG Threshold: 104,000

[a] PAS = Peak Aerial Survey, WC= Weir Count, FS=Foot Survey.

[b] Pauls Lake sockeye salmon escapement was estimated with a weir in 2004 and by peak aerial survey in 2005 and 2006.

[c] Upper Station early run has the only optimal escapement goal (OEG; 25,000) in the KMA established by the BOF in 1999.

Table 2.–Results of percentile analyses used to estimate sustainable escapement goals (SEG) ranges for Pauls Bay drainage, Little River, Uganik Lake, Akalura Lake, and Saltery Lake sockeye salmon and for Kodiak Island Aggregate and Mainland District chum salmon.

System	Pauls Bay		Little River		Uganik Lake	
Description	*Surveys*	*Weir*	*Survey*	*Weir*	*Survey*	*Weir*
Species	Sockeye	Sockeye	Sockeye	Sockeye	Sockeye	Sockeye
Minimum	150	3,237	230	3,994	3,100	6,777
15th Percentile	833	12,039	3,775	13,015	17,280	10,087
25th Percentile	2,375	13,301	4,625	19,029	24,000	13,915
Median	4,415	20,043	11,250	34,064	33,000	25,361
Mean	7,177	20,813	12,992	37,305	35,741	38,308
75th Percentile	10,875	28,129	15,750	53,960	45,450	66,417
85th Percentile	12,750	31,502	23,882	61,918	52,000	68,842
Maximum	23,070	50,933	50,500	73,856	97,300	89,304
Contrast (max/min)	153.8	15.7	219.6	18.5	31.4	13.2
Number of years	20	27	38	3	31	8

System	Akalura Lake		Saltery Lake		Kodiak Aggregate	Mainland District
Description	*Survey*	*Weir*	*Survey*	*Weir*	*Survey*	*Survey*
Species	Sockeye	Sockeye	Sockeye	Sockeye	Chum	Chum
Minimum	1,350	442	18,000	22,705	120,277	22,500
15th Percentile	2,075	3,216	24,200	27,665	151,042	108,930
25th Percentile	2,725	6,287	27,000	30,237	189,437	135,588
Median	4,500	10,247	30,800	38,314	230,848	210,150
Mean	12,200	20,205	39,183	42,378	304,356	216,006
75th Percentile	7,875	27,554	43,725	52,592	370,293	258,938
85th Percentile	19,548	40,011	46,205	58,582	448,764	346,179
Maximum	80,000	116,029	120,000	77,186	722,702	453,148
Contrast (max/min)	59.3	262.5	6.7	3.4	6.0	20.1
Number of years	22	26	15	17	30	30

Table 3.–Results of stock-recruitment models used to estimate maximum sustained yield (MSY) and 90% MSY escapement ranges for Afognak Lake, Karluk Lake, and Frazer Lake sockeye salmon.

				Parameters				MSY Escapement		
Stock	Model	Structure	n	lna	lna'	b	P-value	Estimate	Lower	Upper
Afognak Sockeye	1982-2000 Ricker	$\ln R_i/S_i = a - bS_i$	19	1.286	1.733	0.187	1.30E-02	35,000	22,000	50,000
Karluk early Sockeye	1981-1999 Ricker	$\ln R_i/S_i = a - bS_i$	19	1.640	1.710	0.004	1.35E-03	175,000	110,000	250,000
Karluk late Sockeye	1981-1999 Ricker	$\ln R_i/S_i = a - bS_i$	19	1.980	2.090	0.003	2.69E-06	272,000	172,000	392,000
Frazer Sockeye	1966-1999 (excl. 1985-1991) Ricker	$\ln R_i/S_i = a - bS_i$	27	1.576	1.969	0.006	2.75E-05	118,000	75,000	170,000
Frazer Sockeye	1966-1999 Ricker	$\ln R_i/S_i = a - bS_i$	34	1.671	2.110	0.005	7.291E-06	138,000	87,000	200,000

Table 4.–Results of risk analyses used to establish a sustainable escapement goal (SEG) in the form of precautionary reference point (PRP), for Little River sockeye salmon and Mainland District chum salmon.

			Lognormal Fit			Risk Probability		
			Natural Log					
Stock	Percent of Mean	n	Mean	Standard Deviation	P-value	Mistaken Inaction	Unneeded Action	Escapement Threshold
Little River Sockeye Salmon	79%	38	9.1045	0.9899	0.4709	0.146	0.146	9,600
	95%					0.021	0.021	5,000
	98%					0.004	0.004	3,400
Mainland Chum Salmon	90%	30	12.1194	0.6565	0.4993	0.007	0.007	104,000

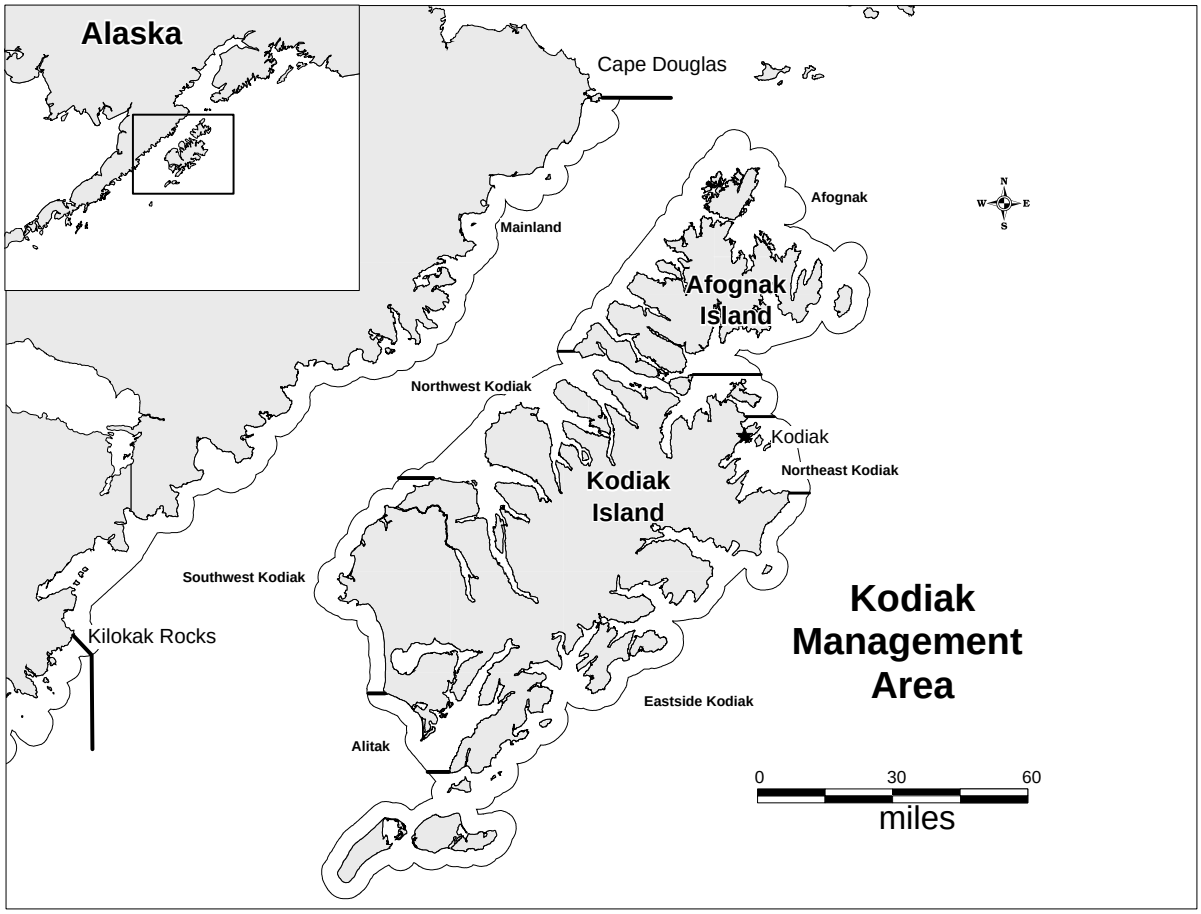


Figure 1.–The Kodiak Management Area showing the commercial salmon fishing districts.

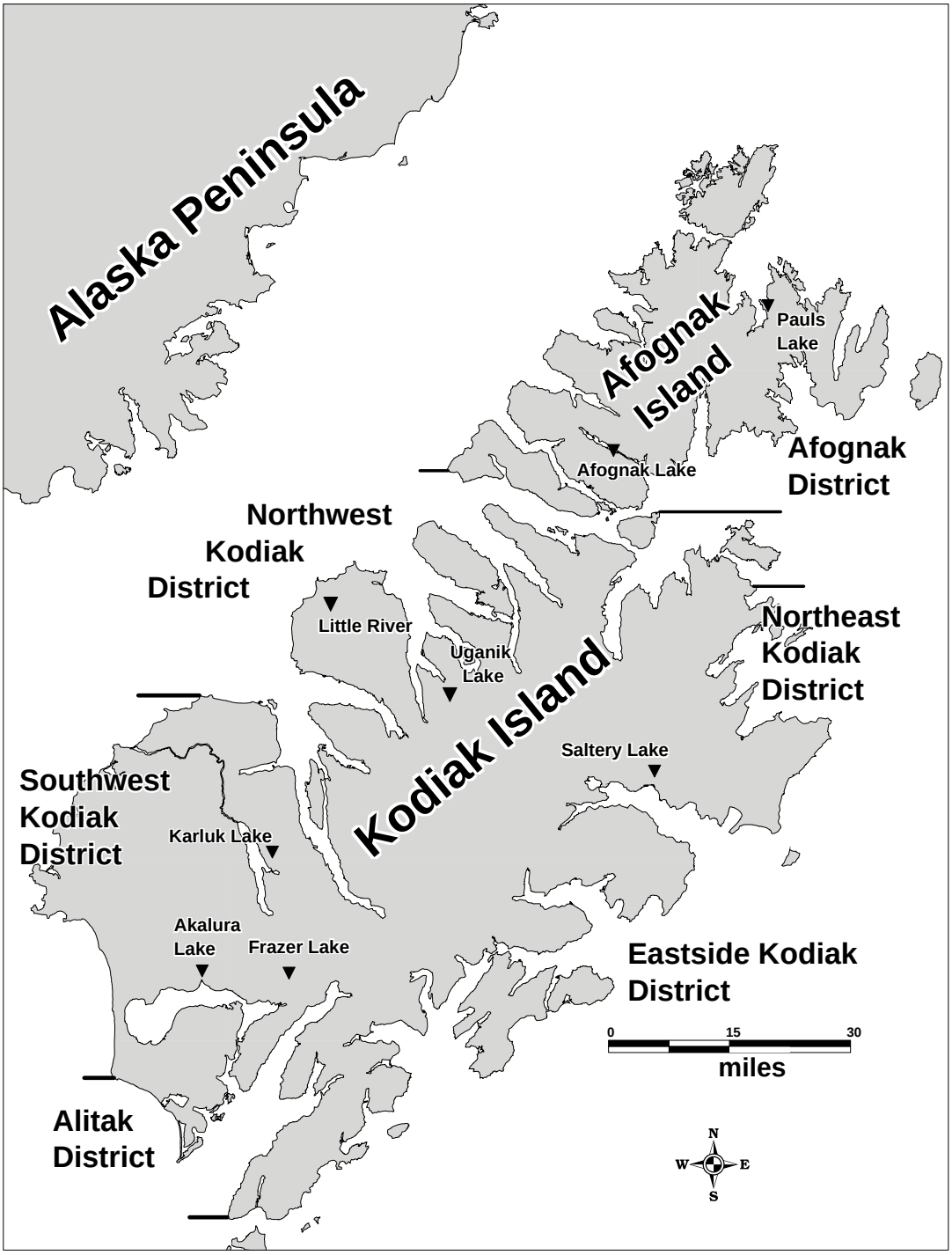


Figure 2.–Map of the Kodiak Management Area showing locations of sockeye salmon systems.

APPENDIX A. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR PAULS BAY DRAINAGE SOCKEYE SALMON

Appendix A1.–Description of stock and escapement goal for Pauls Bay drainage sockeye salmon.

System: Pauls Bay drainage
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area:	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	None
Current escapement goal:	SEG: 10,000 – 30,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Tributary surveys: 1969-1977 Weir counts: 1978-2004 Aerial surveys: 1979-1982, 1985, 1987, 1989-1991 2005, 2006
Data summary:	
Data quality:	Fair for tributary surveys, excellent for weir counts, poor for aerial surveys
Data type:	Tributary surveys from 1969 to 1977, weir counts from 1978 to 2003. Escapement age data are available from 1992 to 2002 and cursory harvest age data are available from 1970 to 2004.
Data contrast:	Tributary surveys: 5.0 Weir data: 15.7 Aerial surveys: 153.8
Methodology:	Percentile
Recommendation:	Eliminate current SEG
Comments:	Laura Lake was stocked with indigenous juvenile sockeye salmon from 1994 through 1996 and 1999 and was fertilized from 1993 through 2001. Since funding for the weir was cut, only aerial surveys are available and are ineffective. There is little or no commercial fishing effort on this stock any longer.

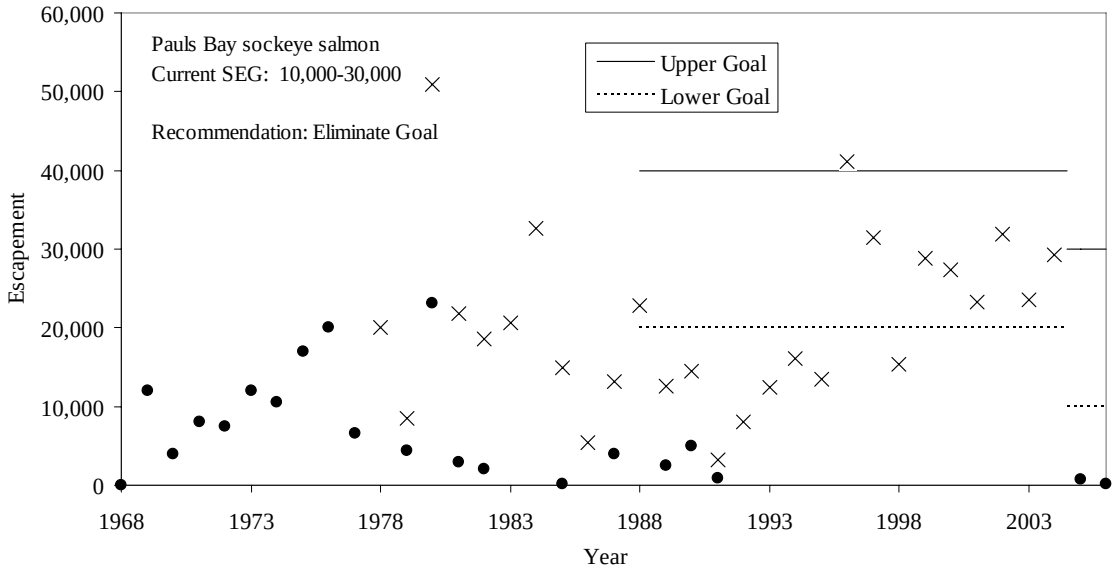
Appendix A2.–Pauls Bay drainage sockeye salmon escapement, 1968-2006.

System: Pauls Bay drainage
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Peak Tributary Survey	Aerial Survey	Weir Counts
1968	0		
1969	12,000		
1970	4,000		
1971	8,000		
1972	7,500		
1973	12,000		
1974	10,500		
1975	17,000		
1976	20,000		
1977	6,650		
1978			20,043
1979		4,415	8,415
1980		23,070	50,933
1981		3,000	21,806
1982		2,000	18,574
1983			20,625
1984			32,659
1985		200	14,941
1986			5,402
1987		4,000	13,122
1988			22,794
1989		2,500	12,605
1990		5,000	14,510
1991		856	3,237
1992			8,033
1993			12,442
1994			16,100
1995			13,480
1996			41,145
1997			31,456
1998			15,343
1999			28,884
2000			27,373
2001			23,230
2002			31,911
2003			23,594
2004			29,289
2005		700	
2006		150	

Appendix A3.–Pauls Bay drainage sockeye salmon escapement, 1968-2006 and escapement goal ranges.

System: Pauls Bay drainage
Species: sockeye salmon
Observed escapement by year (solid circles for tributary and aerial surveys and Xs for weir counts).



APPENDIX B. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR AFOGNAK LAKE SOCKEYE SALMON

Appendix B1.–Description of stock and escapement goal for Afognak Lake sockeye salmon.

System: Afognak Lake
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area:	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine
Current escapement goal:	BEG: 20,000-50,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Weir counts: 1921-1933; 1978-2006 Aerial surveys: 1966-1977
Data summary:	
Data quality:	Excellent for weir enumeration 1978-2006; fair for weir counts 1921-1933 and aerial surveys; good for harvest and age data.
Data type:	Weir counts from 1978-2006 with escapement age data during weir counts, 1985-2006. Fixed-wing aerial surveys from 1966 to 1977. Commercial, subsistence, sport fish harvest data from Afognak Bay (252-34) from 1978-2006.
Data contrast:	Weir and aerial data, all years: 440
	Weir data, all years: 21
	Recent weir data, 1978-2006: 9
	Recent weir data from pre-fertilization years, 1978-1993: 3
Methodology:	Ricker spawner-recruit model
Recommendation:	No change to current BEG
Comments:	Afognak Lake was stocked with indigenous juvenile sockeye salmon in 1991, 1993, and from 1996 through 1998; the lake was fertilized from 1990 through 2000. The results from the Ricker analysis, including the most recent data since the last review did not appreciably change S_{msy} or the 90% range around $S_{msy.}$

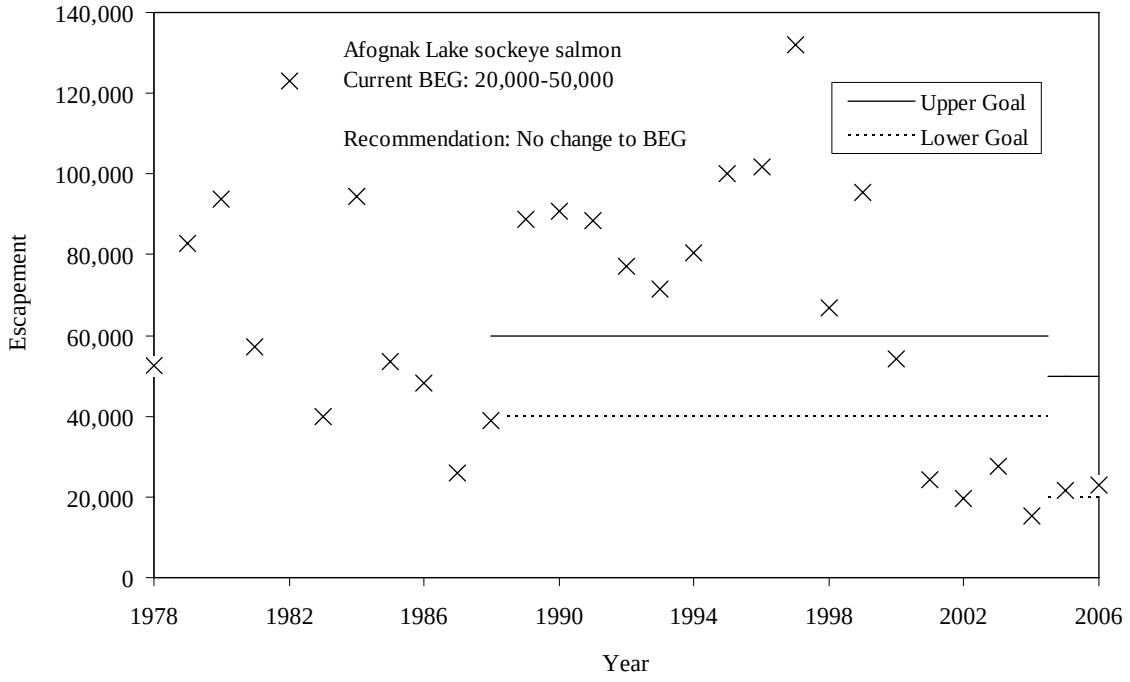
Appendix B2.–Afognak Lake sockeye salmon escapement, 1921-2006.

System: Afognak Lake
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Weir Counts	Peak Aerial Survey	Year	Weir Counts
1921	37,653		1980	93,861
1922	0		1981	57,267
1923	8,025		1982	123,055
1924	10,317		1983	40,049
1925	11,000		1984	94,463
1926	22,250		1985	53,563
1927	7,491		1986	48,328
1928	20,862		1987	25,994
1929	25,428		1988	39,012
1930	6,238		1989	88,825
1931	30,515		1990	90,666
1932	23,574		1991	88,557
1933	36,144		1992	77,260
1966		950	1993	71,460
1967		550	1994	80,570
1968		-	1995	100,131
1969		2,600	1996	101,718
1970		7,500	1997	132,050
1971		2,200	1998	66,869
1972		-	1999	95,361
1973		300	2000	54,064
1974		4,300	2001	24,271
1975		10,000	2002	19,520
1976		29,000	2003	27,766
1977		51,300	2004	15,181
1978	52,701		2005	21,577
1979	82,703		2006	22,933

Appendix B3.–Afognak Lake sockeye salmon escapement, 1921-2006 and escapement goal ranges.

System: Afognak Lake
Species: sockeye salmon
Observed escapement by year (Xs for weir counts)

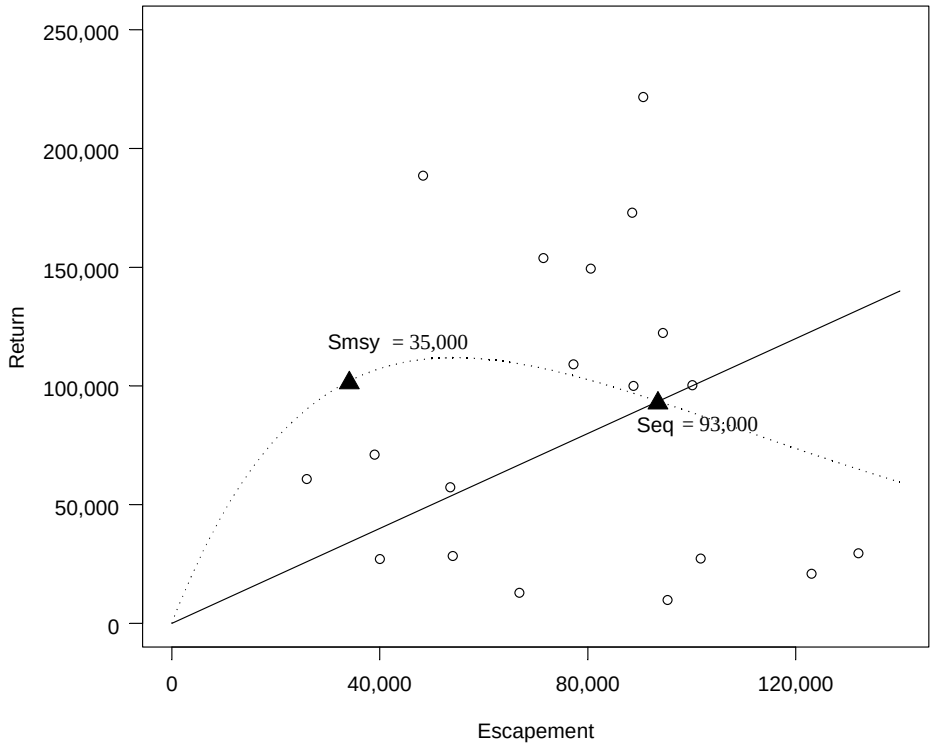


Appendix B4.–Afognak Lake sockeye salmon brood table.

Brood Year	Escap.	Age 0.1	0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	4.1	2.4	3.3	Total Return	Return/ Spawner
1978	52,701															0	0	0	0.0
1979	82,703											241	5,307	0	0	0	0	5,549	0.1
1980	93,861							0	32,258	8,905	0	113	4,423	0	0	0	0	45,700	0.5
1981	57,267				0	16,451	0	0	41,056	3,176	0	0	4,280	0	0	0	0	64,962	1.1
1982	123,055		0	17	113	5,557	113	0	14,082	775	0	0	376	0	0	0	0	21,034	0.2
1983	40,049	0	0	340	0	9,997	302	0	10,140	4,686	0	0	1,717	0	0	35	0	27,216	0.7
1984	94,463	0	0	1,615	54	24,946	1,324	0	47,376	22,487	0	340	24,186	0	0	0	0	122,329	1.3
1985	53,563	36	98	276	0	10,643	2,918	0	26,660	10,075	0	0	6,592	0	0	66	0	57,363	1.1
1986	48,328	0	0	8,068	35	54,981	720	0	108,895	4,976	0	431	10,444	0	0	0	0	188,550	3.9
1987	25,994	0	0	777	0	20,966	314	0	25,318	3,220	100	0	9,837	178	0	0	0	60,711	2.3
1988	39,012	0	0	473	0	18,761	8,419	0	23,785	9,672	57	78	9,737	80	0	0	0	71,062	1.8
1989	88,825	0	0	17,934	0	8,377	13,517	0	35,862	10,504	158	254	13,415	0	0	397	0	100,418	1.1
1990	90,666	0	0	12,989	0	31,138	4,216	0	97,222	18,583	0	397	56,936	175	0	0	199	221,855	2.4
1991	86,819	0	281	9,731	278	37,577	1,445	0	96,397	4,512	0	48	22,651	0	0	0	0	172,920	2.0
1992	75,370	0	0	3,936	175	20,247	4,704	0	71,102	3,097	0	367	5,417	0	0	0	0	109,045	1.4
1993	68,782	0	0	35,201	0	40,184	10,235	0	48,274	10,440	223	331	8,931	648	0	0	683	155,149	2.3
1994	79,380	0	0	7,890	0	7,899	7,010	74	12,863	57,922	74	0	52,635	2,543	0	0	206	149,118	1.9
1995	98,609	0	0	18,706	0	52,619	719	0	11,946	4,545	0	0	11,462	0	76	0	0	100,071	1.0
1996	100,266	0	0	1,466	0	1,898	265	0	6,828	931	4,238	0	998	6,831	0	0	3,992	27,446	0.3
1997	129,481	0	30	1,579	0	3,221	1,798	0	6,788	5,157	171	0	8,408	787	0	186	875	28,999	0.2
1998	65,809	0	0	401	0	207	667	0	238	7,296	0	3	4,228	0	0	0	0	13,040	0.2
1999	94,011	0	0	20	0	6,409	67	0	2,998	291	0	0	295	0	0	0	0	10,080	0.1
2000	52,648	0	0	1,173	0	6,975	26	0	18,670	498	0	36	2,199	0	0	0	0	29,577	0.6
2001	23,940	0	0	177	165	2,271	143	0	5,176	608	0	8	1,175	0	0				
2002	19,334	0	0	721	20	14,769	0	0	11,399	425	0								
2003	27,448	0	0	580	0	6,913	70												
2004	15,181	0	0	1,080															
2005	20,281	0																	
2006	21,488																		
																	10-year average (1991-2000):	79,545	1.0

Appendix B5.– Fitted Ricker curve, line of replacement, and actual data for Afognak Lake sockeye salmon.

System: Afognak Lake
Species: sockeye salmon
Ricker stock-recruitment relationship, 1982 – 1999. The dashed line represents the Ricker curve, and the solid straight line represents replacement.



APPENDIX C. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR LITTLE RIVER SOCKEYE SALMON

Appendix C1.–Description of stocks and escapement goals for Little River sockeye salmon.

System: Little River
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Current escapement goal:	None
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1968-2006 Weir counts: 2001-2003
Data summary:	
Data quality:	Fair for aerial surveys, good for weir counts
Data type:	Aerial surveys from 1968- 2006 and weir counts from 2001-2003. No age data or stock-specific harvest information are available.
Data contrast:	Aerial survey: 219.6 Weir data: 18.5
Methodology:	Percentile and risk analysis
Recommendation:	Establish SEG Threshold: 3,000
Comments:	Escapement cannot be reliably estimated until late in the season, which precludes any management actions. The committee agreed that a SEG threshold would be prudent for the Little River stock based on the risk analysis.

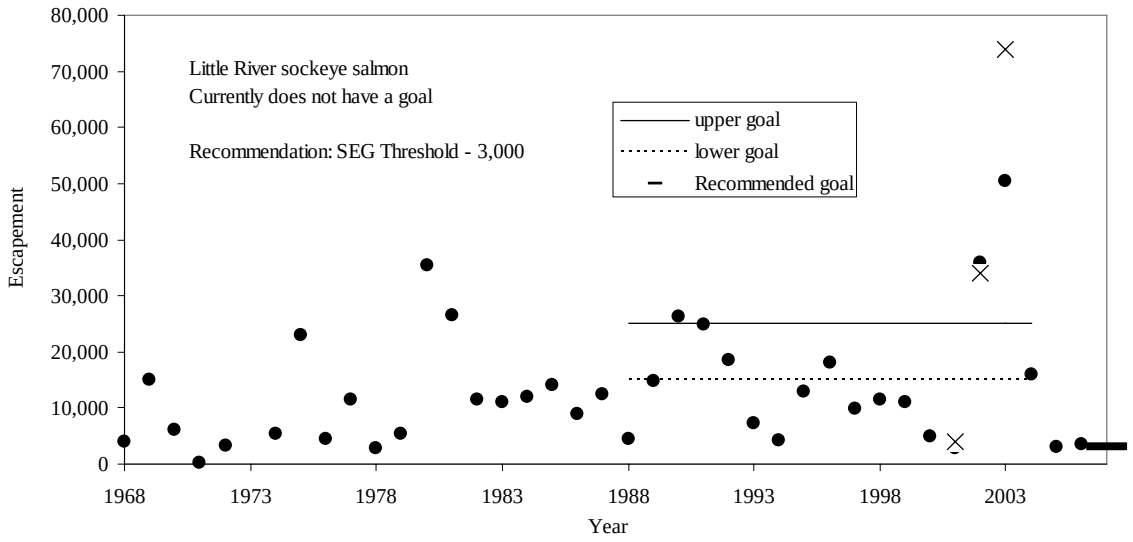
Appendix C2.–Little River sockeye salmon escapement, 1968-2006.

System: Little River
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Peak Tributary Survey	Weir Counts
1968	4,000	
1969	15,000	
1970	6,000	
1971	230	
1972	3,289	
1973		
1974	5,500	
1975	23,000	
1976	4,500	
1977	11,500	
1978	2,800	
1979	5,500	
1980	35,500	
1981	26,500	
1982	11,500	
1983	11,000	
1984	12,000	
1985	14,000	
1986	9,000	
1987	12,500	
1988	4,500	
1989	14,700	
1990	26,300	
1991	24,960	
1992	18,500	
1993	7,200	
1994	4,200	
1995	13,000	
1996	18,000	
1997	9,800	
1998	11,500	
1999	11,000	
2000	5,000	
2001	2,700	3,994
2002	36,000	34,064
2003	50,500	73,856
2004	16,000	
2005	3,000	
2006	3,500	

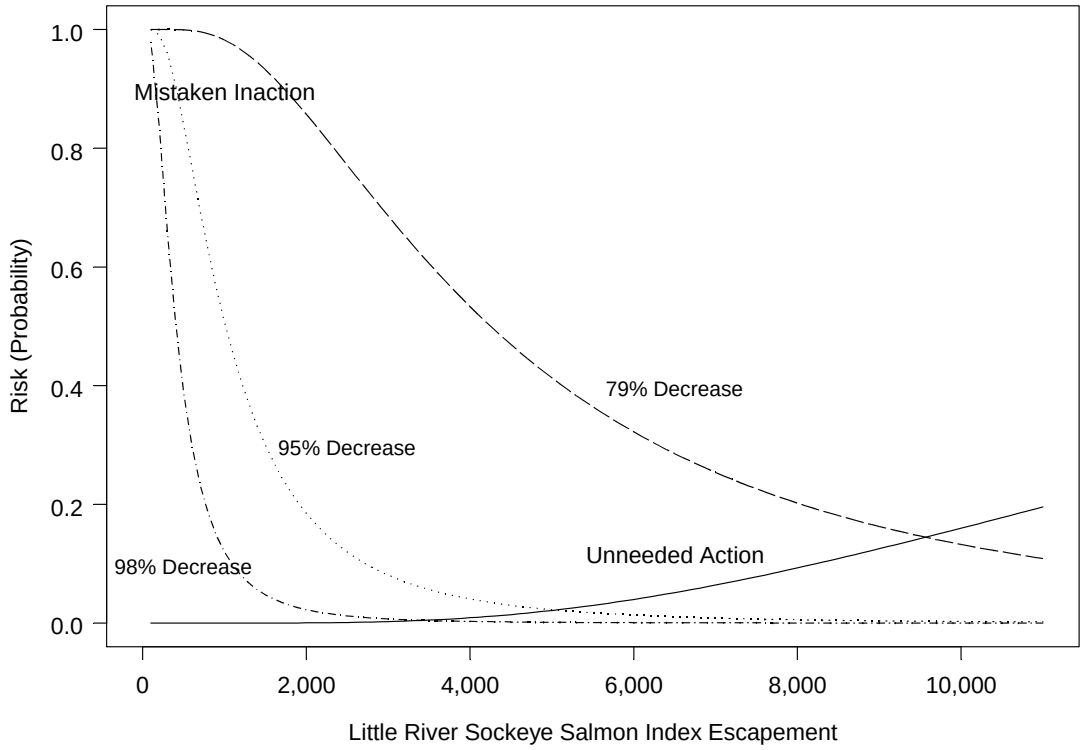
Appendix C3.–Little River sockeye salmon escapement, 1975-2006 and escapement goal ranges.

System: Little River
Species: sockeye salmon
Observed escapement by year (Xs for weir counts and solid circles for aerial surveys).



Appendix C4.–Risk analysis for Little River sockeye salmon, 1968-2006 using aerial survey data.

System: Little River
Species: sockeye salmon
Little River sockeye salmon, 1968-2006 risk analysis (solid line the risk of unneeded action and dashed line the risk of mistaken inaction).



APPENDIX D. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR UGANIK LAKE SOCKEYE SALMON

Appendix D1.–Description of stock and escapement goal for Uganik Lake sockeye salmon.

System: Uganik Lake
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Current escapement goal:	None
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Weir counts: 1928-1932, 1990-1992. Aerial surveys: 1974, 1976-1977, 1979-2006.
Data summary:	
Data quality:	Fair for aerial surveys (glacially fed lake has variable water visibility); good for weir enumeration.
Data type:	Fixed-wing aerial surveys, 1974, 1976-1977, 1979-2006, and weir escapement estimates from 1990 to 1992 that include some escapement age data. No stock-specific harvest information is available.
Data contrast:	Peak aerial surveys (1974-2006): 31.4. Weir counts (1990-1992): 13.2
Methodology:	Percentile
Recommendation:	Establish SEG Threshold: 24,000
Comments:	There is currently no timely means of estimating escapement into this system. There is not a weir operation or plans for one in the future. The committee agreed that a SEG threshold would be prudent for the Uganik Lake stock based on the results of the percentile method.

Appendix D2.–Uganik Lake sockeye salmon escapement, 1928-2006.

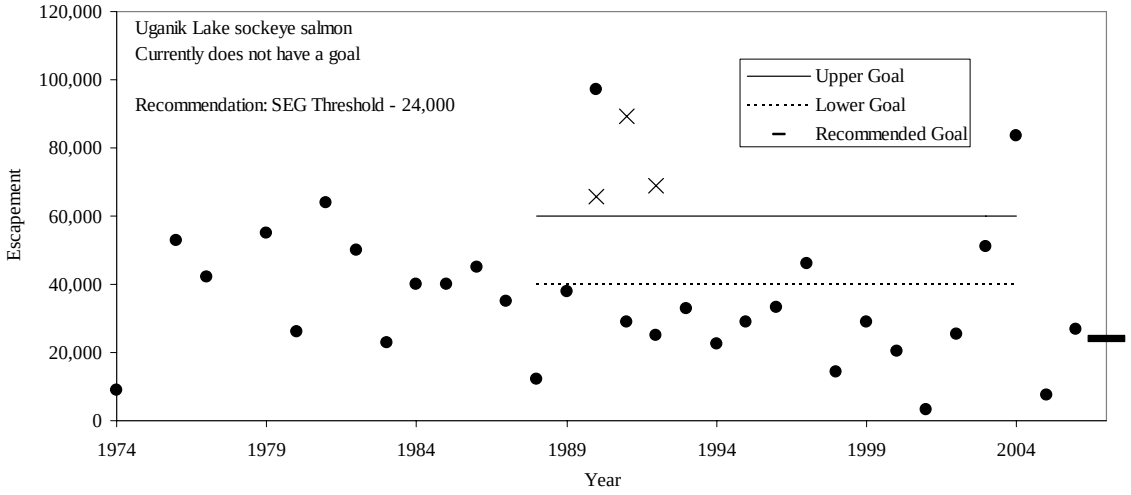
System: Uganik Lake
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Peak Tributary Survey	Weir Counts
1928		15,282
1929		24,913
1930		9,814
1931		6,777
1932		25,808
1974	9,000	
1976	53,000	
1977	42,000	
1979	55,000	
1980	26,000	
1981	64,000	
1982	50,000	
1983	23,000	
1984	40,000	
1985	40,000	
1986	45,000	
1987	35,000	
1988	12,000	
1989	38,000	
1990	97,300	65,551
1991	29,100	89,304
1992	25,000	69,015
1993	33,000	
1994	22,600	
1995	29,000	
1996	33,200	
1997	45,900	
1998	14,250	
1999	29,000	
2000	20,310	
2001	3,100	
2002	25,400	
2003	51000	
2004	83,600	
2005	7,500	
2006	26,700	

Note: All data from ADF&G database except 1928 to 1932 from Booth (1993). Weirs operated during variable timeframes. No data available for 1975 and 1978.

Appendix D3.–Uganik Lake sockeye salmon escapement, 1974-2006 and escapement goal ranges.

System: Uganik Lake
Species: sockeye salmon
Observed escapement by year (solid circles for peak aerial surveys and Xs for weir counts).



APPENDIX E. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR KARLUK LAKE SOCKEYE SALMON

Appendix E1.–Description of stock and escapement goals for Karluk Lake sockeye salmon.

System: Karluk Lake
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area:	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Previous escapement goal:	Early run - BEG: 100,000-210,000 (2005)
	Late run - BEG: 170,000-380,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Weir counts: 1922-2006
Data summary:	
Data quality:	Good
Data type:	Weir counts from 1922 to 2006. Age compositions and stock-specific harvest 1985-2006. Rough estimates of harvest attributed to both runs combined, 1922-2006. Smolt outmigration estimates 1961-68, 1980-84, 1991-92, and 1999-2006. Limnology information 1981-2006.
Data contrast:	Weir data 1981-2006: early (4.6), late (19.9)
Methodology:	Ricker spawner-recruit
Recommendations:	Change early run to BEG: 110,000 to 250,000 No change to current late run BEG
Comments:	Large returns to the early run increased the escapement goal estimate for the early run and the committee recommended increasing the range to 110,000 to 250,000 fish. The late run returns were similar to previous years and the committee recommended leaving the goal unchanged. Brood years 1981-1995 may be affected by fertilization (1986-1990) and egg stocking (1979-1987).

Appendix E2.–Karluk Lake early-run sockeye salmon escapement, 1981-2006.

System: Karluk Lake early run
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Weir Counts	Commercial Harvest
1981	97,937	
1982	122,705	
1983	215,620	
1984	288,422	
1985	316,688	28,326
1986	358,756	116,191
1987	354,094	77,156
1988	296,510	35,236
1989	349,753	2
1990	196,197	32,021
1991	243,069	28,135
1992	217,152	245,012
1993	261,169	308,579
1994	260,771	188,452
1995	238,079	283,333
1996	250,357	509,874
1997	252,859	134,480
1998	252,298	116,473
1999	392,419	182,577
2000	291,351	266,485
2001	338,799	303,664
2002	456,842	167,038
2003	451,856	372,761
2004	393,468	396,088
2005	283,860	245,800
2006	202,366	272,537

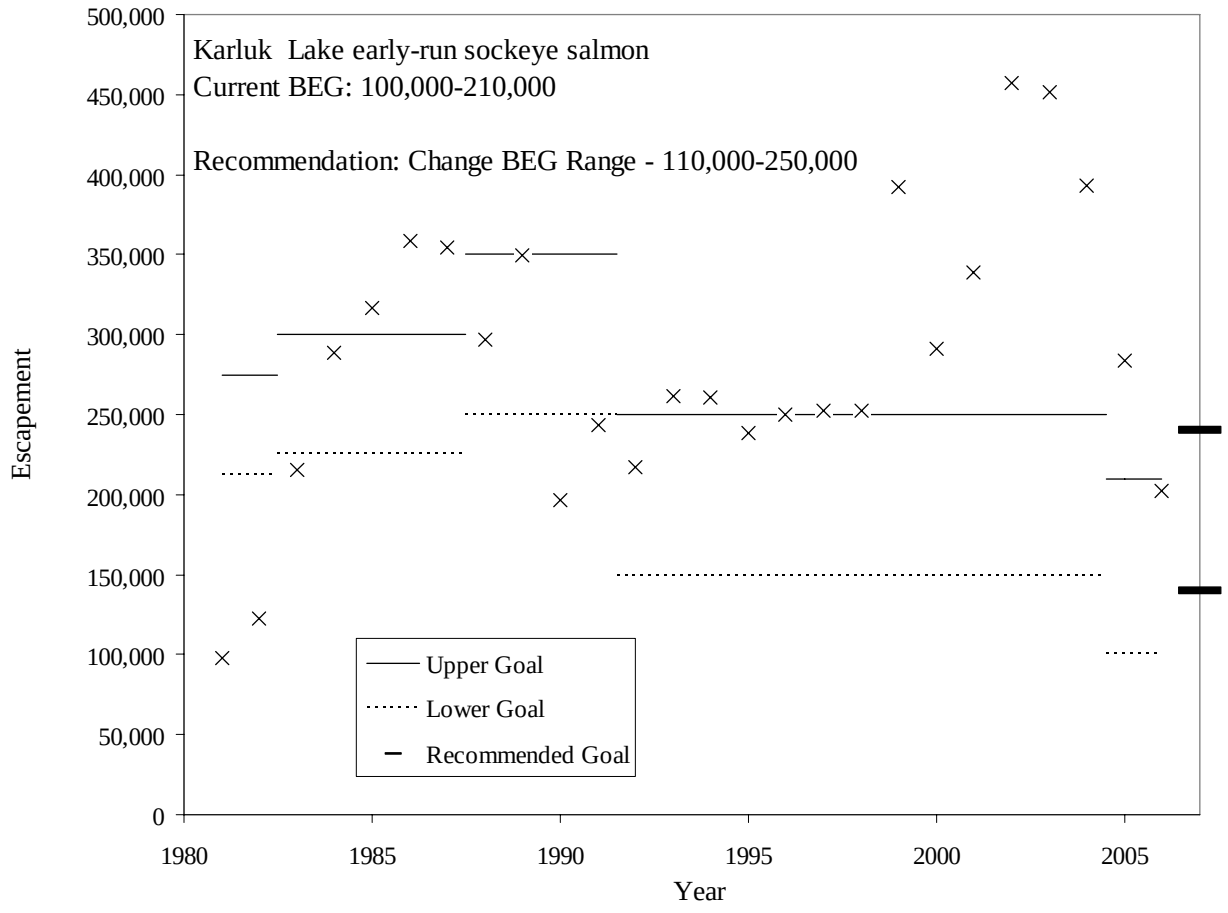
Appendix E3.–Karluk Lake late-run sockeye salmon escapement, 1981-2006.

System: Karluk Lake late run
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Weir Counts	Commercial Harvest
1981	124,769	
1982	41,702	
1983	220,795	
1984	131,846	
1985	679,260	168,328
1986	528,415	297,042
1987	412,157	170,019
1988	282,306	127,721
1989	758,893	3,476
1990	541,891	990,660
1991	831,970	1,097,830
1992	614,262	442,692
1993	396,288	235,361
1994	587,258	106,325
1995	504,977	361,535
1996	323,969	187,717
1997	311,902	127,114
1998	384,848	302,166
1999	589,119	414,885
2000	445,393	211,546
2001	524,739	347,790
2002	408,734	457,285
2003	626,854	965,484
2004	326,466	332,464
2005	498,102	423,573
2006	288,007	282,441

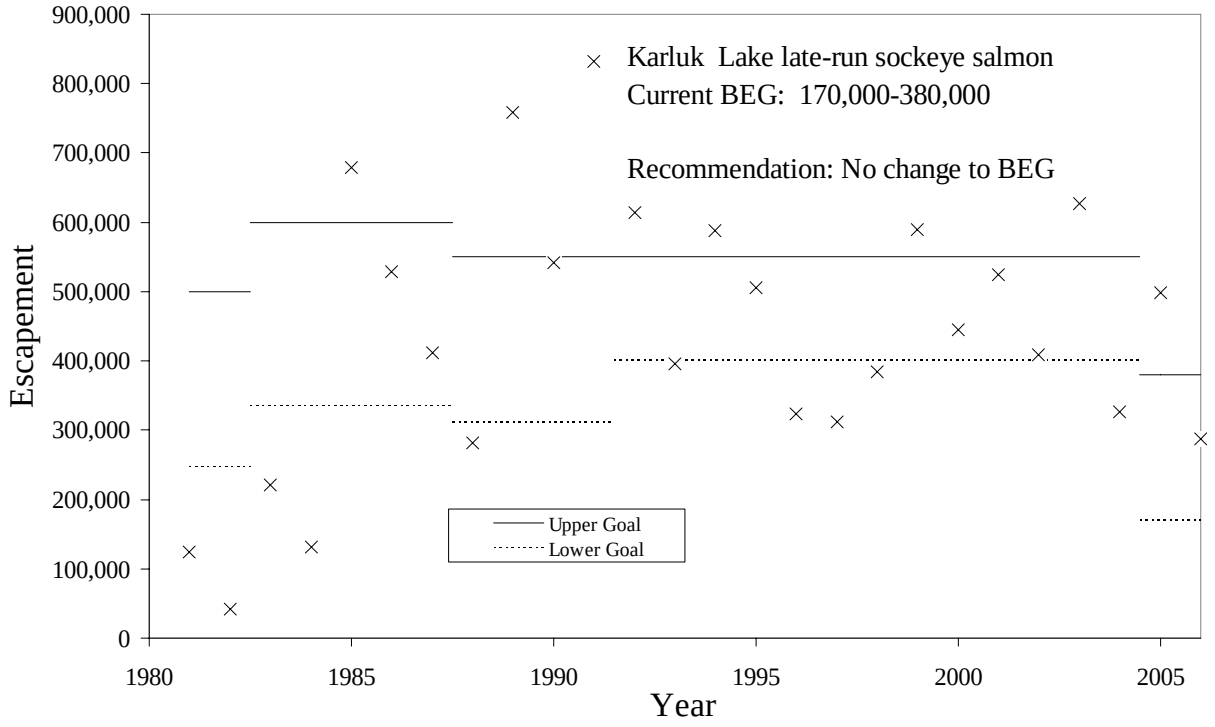
Appendix E4.–Karluk Lake early-run sockeye salmon escapement, 1981-2006 and escapement goal ranges.

System: Karluk Lake early run
Species: sockeye salmon
Observed escapement by year (Xs).



Appendix E5.–Karluk Lake late-run sockeye salmon escapement, 1981-2006 and escapement goal ranges.

System: Karluk Lake late run
Species: sockeye salmon
Observed escapement by year (Xs).



Appendix E6.- Karluk Lake early-run sockeye salmon brood table.

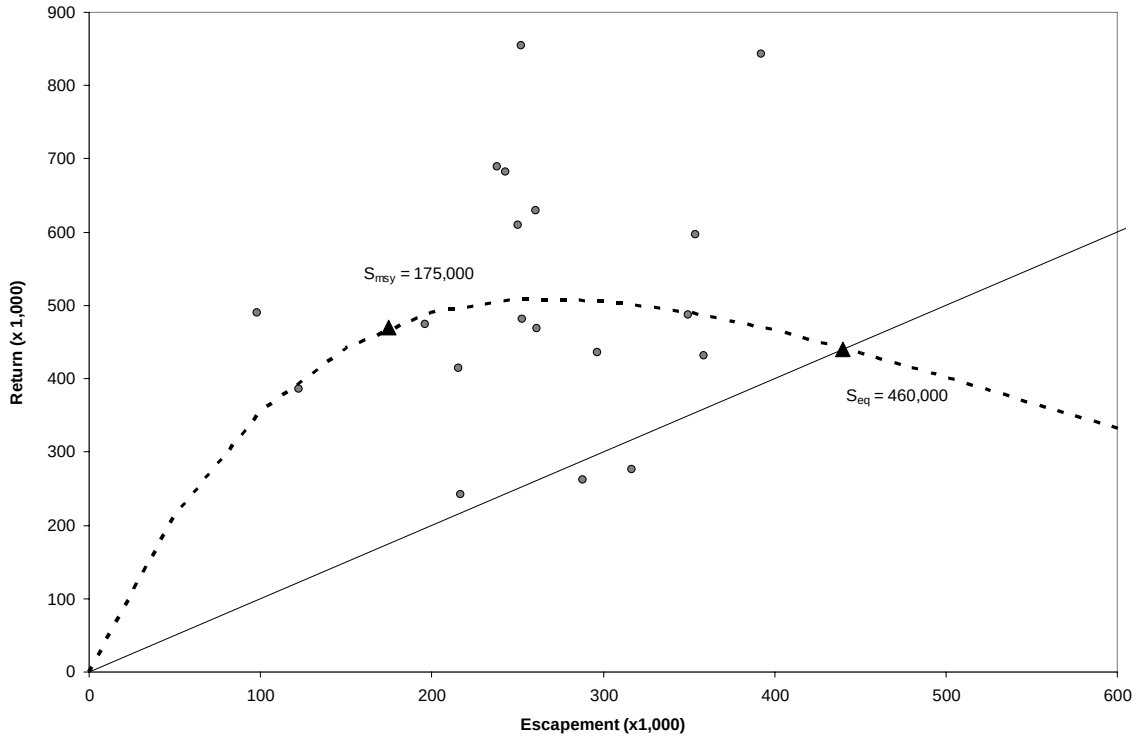
Brood		Age																		Total	Return/
Year	Escap.	0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	4.1	2.4	3.3	4.2	3.4	4.3	4.4	Return	Spawner
1976	204,037																			0		
1977	185,312																	0	0	0		
1978	248,741														0	10,989	0	0	0	0		
1979	212,872										0	50,484	45,654	0	641	14,673	0	0	0	0		
1980	132,396						0	11,635	193,760	4,085	0	103,899	60,395	0	0	37,689	0	0	0	0		
1981	97,937			0	8,558	18,604	0	3,735	278,831	1,672	0	117,158	38,129	0	272	22,433	0	0	0	0		
1982	122,705	0	1,244	841	4,650	5,466	0	21,058	197,293	4,169	0	93,560	37,079	0	0	20,728	0	0	0	320		
1983	215,620	0	143	564	8,159	7,032	0	14,244	149,947	1,728	0	183,829	33,945	0	337	14,082	0	0	0	0	414,009	1.9
1984	288,422	0	0	0	4,090	8,393	0	5,830	97,537	738	0	94,258	30,589	0	908	19,634	0	0	0	0	261,977	0.9
1985	316,688	0	0	24	4,258	2,842	0	3,969	72,857	3,010	0	88,599	57,934	0	1,955	40,331	0	38	30	0	275,847	0.9
1986	358,756	24	0	337	6,152	2,201	346	6,443	87,691	4,031	94	129,381	131,218	0	479	61,223	1,508	235	113	0	431,475	1.2
1987	354,094	427	0	1,456	958	2,884	0	8,503	114,504	19,876	416	44,051	337,905	0	285	60,244	2,309	690	1,969	0	596,477	1.7
1988	296,510	0	0	0	8,383	6,297	0	9,708	84,322	13,770	0	37,096	202,729	0	320	70,357	231	39	2,906	0	436,159	1.5
1989	349,753	0	1,621	0	8,492	7,624	0	13,979	104,564	5,517	0	167,751	101,296	0	1	69,709	5,362	0	1,713	0	487,630	1.4
1990	196,197	0	181	0	18,149	2,780	0	50,649	79,156	6,586	652	146,751	97,063	0	269	70,863	760	0	0	0	473,858	2.4
1991	243,069	0	1,224	1,062	26,661	12,015	0	83,430	326,422	7,087	0	127,809	81,364	809	107	12,113	2,476	0	247	0	682,826	2.8
1992	217,152	0	2,669	4	9,627	9,642	0	13,159	52,730	14,935	0	42,891	58,375	0	769	36,603	0	79	0	0	241,483	1.1
1993	261,169	2	1,534	350	3,309	18,252	0	7,718	226,377	2,275	0	128,158	35,029	0	1,752	42,563	437	288	0	0	468,044	1.8
1994	260,771	0	1,017	0	8,956	7,266	0	41,179	294,780	1,857	427	182,133	54,148	0	587	33,887	1,781	1,042	0	0	629,059	2.4
1995	238,079	0	218	0	23,268	13,106	0	33,004	231,809	3,463	0	245,934	83,559	0	1,405	52,470	835	492	0	0	689,563	2.9
1996	250,357	0	0	0	2,063	5,959	0	2,217	253,847	2,326	0	215,129	84,029	0	61	42,035	0	1,461	114	0	609,241	2.4
1997	252,859	0	0	1,838	3,930	11,696	0	6,691	233,964	3,274	0	131,879	63,748	0	0	24,066	0	0	0	0	481,086	1.9
1998	252,298	0	574	0	4,258	19,885	0	5,410	531,206	4,517	532	168,024	104,530	715	0	14,578	0	0	0		854,229	3.4
1999	392,419	0	898	0	15,382	28,948	0	33,620	432,204	10,393	76	192,314	80,270	0	0	48,461	0					
2000	291,351	0	939	0	9,611	4,286	0	3,393	223,141	6,013	129	109,252	78,082	0								
2001	338,799	0	0	0	3,223	6,573	0	1,102	216,151	5,644												
2002	456,842	0	78	0	4,894	11,188																
2003	451,856	0	0																			
2004	393,468																					
2005	283,860																					
2006	202,366																					
																				10-year average (1989-1998):	561,702	2.3

Appendix E7.– Karluk Lake late-run sockeye salmon brood table.

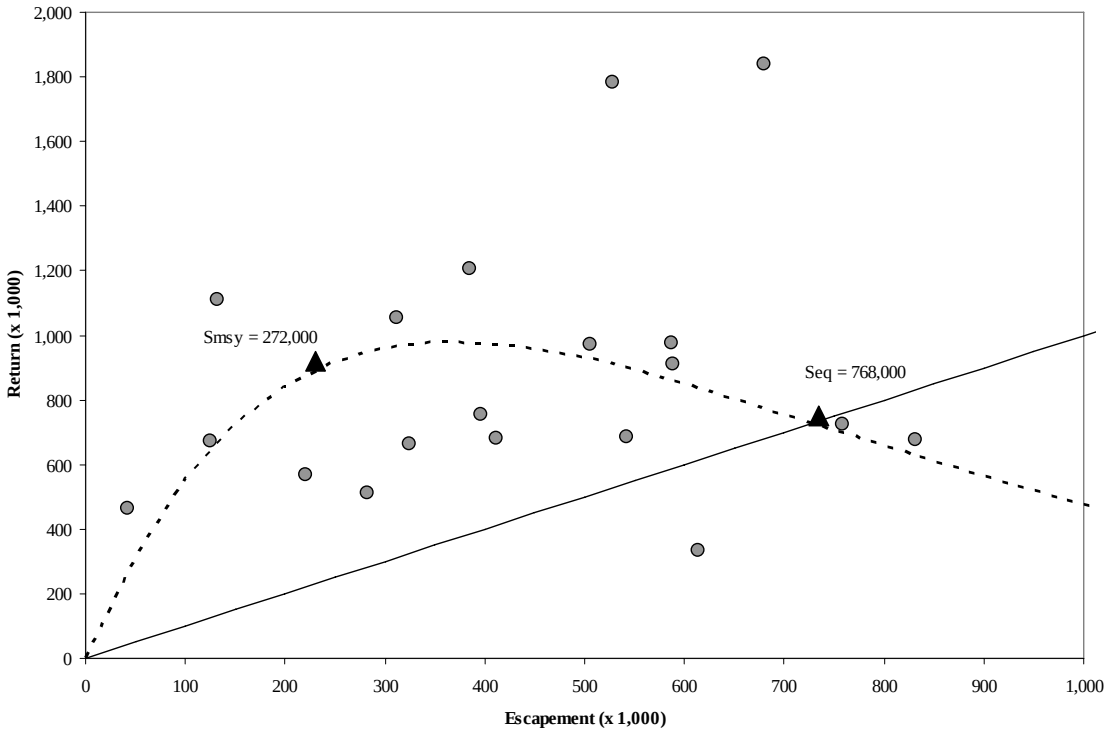
Brood		Age																	Total	Return/
Year	Escap.	0.1	0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	4.2	3.4	4.3	Return	Spawner
1976	319,459																				
1977	366,936																	0	0		
1978	112,194														0	6,728	0	0	0		
1979	248,908											0	54,171	167,426	0	85,143	0	0	0		
1980	14,227							0	446	596,053	4,476	0	156,074	177,587	1,190	25,537	0	0	0		
1981	124,769				0	5,158	13,129	0	0	402,872	2,521	0	187,293	49,557	0	14,077	0	0	0		
1982	41,702		0	0	0	0	1,261	0	5,239	290,631	606	0	110,997	34,711	0	19,631	0	0	0		
1983	220,795	0	0	0	4,079	4,160	12,830	0	480	241,803	1,268	31	213,452	42,156	2,070	47,370	0	0	0		
1984	131,846	0	885	0	0	445	6,246	0	30,516	424,123	0	937	303,542	271,018	471	71,764	651	0	0	1,110,598	8.4
1985	679,260	169	0	0	1,084	30,165	212	189	60,235	784,914	494	595	493,743	421,972	462	43,998	0	42	0	1,838,274	2.7
1986	528,415	0	893	0	15,519	39,109	978	105	57,974	835,214	1,162	0	114,862	655,219	563	60,240	325	147	1,623	1,783,933	3.4
1987	412,157	106	5,976	201	17,067	24,703	1,737	0	550	226,552	2,373	0	23,389	320,723	79	54,451	1,600	0	0	679,507	1.6
1988	282,306	0	2,531	111	2,424	4,649	1,512	0	3,127	189,196	7,249	0	71,078	212,649	0	16,740	0	0	9	511,274	1.8
1989	758,893	0	3,555	799	3,717	5,909	12,607	0	3,302	308,439	6,233	0	151,212	214,110	0	12,030	950	0	0	722,863	1.0
1990	541,891	0	3,591	971	6,292	16,995	3,241	0	10,310	447,371	1,085	18	52,479	80,226	591	62,392	1,095	0	64	686,721	1.3
1991	831,970	0	7,113	340	2,879	16,292	3,023	0	8,568	340,535	4,731	52	191,311	85,334	952	13,107	659	111	0	675,007	0.8
1992	614,262	0	1,567	1,923	0	3,880	6,759	0	12,234	57,188	5,043	0	76,196	138,987	513	28,379	0	0	0	332,669	0.5
1993	396,288	0	0	1,501	2,860	3,550	17,168	0	11,541	412,758	1,362	36	202,913	75,591	0	23,523	0	0	0	752,802	1.9
1994	587,258	0	0	198	1,192	24,718	4,323	0	17,261	616,350	1,008	0	159,094	109,890	551	41,274	821	128	0	976,808	1.7
1995	504,977	0	1,156	0	3,219	48,766	8,685	0	1,839	353,857	5,252	0	390,880	129,216	424	28,253	405	284	1,384	973,619	1.9
1996	323,969	0	540	633	0	2,970	108	0	469	283,071	2,817	0	149,445	139,820	0	83,431	0	0	934	664,238	2.1
1997	311,902	0	0	407	0	1,473	21,821	0	291	494,043	18,682	0	268,631	235,707	0	12,330	0	421	0	1,053,807	3.4
1998	384,848	0	0	136	0	586	33,787	1,399	2,716	923,141	8,407	0	78,063	143,454	0	12,558	0	0	284	1,204,530	3.1
1999	589,119	0	0	0	0	25,117	41,401	0	7,645	403,399	3,410	85	154,603	210,642	0	65,446	0				
2000	445,393	155	669	51	3,376	6,049	270	0	1,126	531,303	2,955	0	292,380	55,025							
2001	524,739	0	0	0	0	2,543	5,375	0	2,611	132,216	3,786										
2002	408,734	0	0	62	2,790	3,319	12,383														
2003	626,854	0	0	208																	
2004	326,466	0																			
2005	498,102																				
2006	288,007																				
																10-year average (1989-1998):				804,306	1.8

Appendix E8–Fitted Ricker curve, line of replacement, and actual data for Karluk Lake early-run sockeye salmon.

System: Karluk Lake early run
Species: sockeye salmon
Ricker stock-recruitment relationship, 1981 – 1999. The dashed line represents the Ricker curve, and the solid straight line represents replacement.



Appendix E9.– Fitted Ricker curve, line of replacement, and actual data for Karluk Lake late-run sockeye salmon.



APPENDIX F. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR AKALURA LAKE SOCKEYE SALMON

Appendix F1.–Description of stock and escapement goal for Akalura Lake sockeye salmon.

System: Akalura Lake
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area:	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Current escapement goal:	None
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Weir counts: 1923-1942, 1944-1946, 1948-1950, 1952-1958, 1968-1972, 1974-1977, 1986-1997, 2000-2003 Aerial surveys: 1967, 1978-1985, 1998-2006
Data summary:	
Data quality:	Poor for aerial surveys, unknown for weir counts prior to 1970, good for weir enumeration after 1970
Data type:	Fixed-wing aerial surveys, weir escapement estimates from 1986 to 1997 include some escapement age data. No stock-specific harvest information is available.
Data contrast:	Weir data (1968-2003): 262.5 Aerial surveys (1967-2006): 59.3
Methodology:	Percentile
Recommendation:	No change
Comments:	Stock assessment data and other fishery information are not sufficient to reestablish an SEG for Akalura Lake sockeye salmon.

Appendix F2.–Akalura Lake sockeye salmon escapement, 1923-2006.

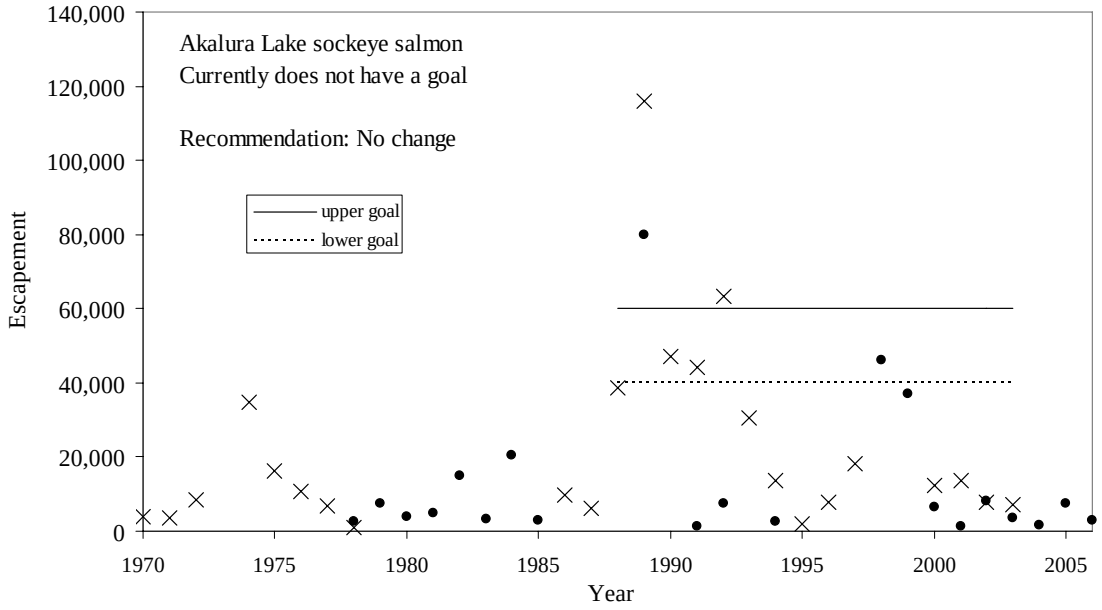
System: Akalura Lake
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Peak Aerial Survey[a]	Weir Counts[a]
1923		15,855
1924		19,867
1925		40,910
1926		105,142
1927		87,949
1928		72,550
1929		18,094
1930		9,907
1931		30,186
1932		67,544
1933		90,448
1934		69,614
1935		85,024
1936		94,507
1937		252,469
1938		97,417
1939		59,447
1940		73,507
1941		46,229
1942		48,521
1943		
1944		54,628
1945		105,077
1946		48,018
1947		
1948		39,856
1949		19,888
1950		6,180
1951		
1952		16,793
1953		23,917
1954		3,445
1955		2,128
1956		1,828
1957		1,411
1958		5,658
1959		
1960		
1961		
1962		
1963		
1964		
1965		
1966		
1967	2,000	
1968		442
1969		539
1970		3,992
1971		3,618
1972		8,591
1973		
1974		34,812
1975		16,127
1976		10,693
1977		6,800
1978	2,500	1,014
1979	7,500	
1980	4,000	
1981	5,000	
1982	15,000	
1983	3,300	
1984	20,350	
1985	3,000	
1986		9,800
1987		6,116
1988		38,618
1989	80,000	116,029
1990		47,181
1991	1,400	44,189
1992	7,500	63,296
1993		30,692
1994	2,700	13,681
1995		2,010
1996		7,898
1997		18,140
1998	46,000	
1999	37,000	
2000	6,500	12,425
2001	1,350	13,772
2002	8,000	7,635
2003	3,500	7,220
2004	1,500	
2005	7,500	
2006	2,800	

[a] Weir counts and peak aerial surveys are from ADF&G database (Rbase) for all years except: 1923-1929 from Edmundson et al. (1994), 1969,1970 from Blackett (1971); weir counts used to estimate escapement when available; aerial survey count was used for 1978 because it was substantially higher than weir count.

Appendix F3.–Akalura Lake sockeye salmon escapement, 1970-2006 and escapement goal ranges.

System: Akalura Lake
Species: sockeye salmon
Observed escapement by year (solid circles for aerial surveys, Xs for weir counts).



APPENDIX G. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR FRAZER LAKE SOCKEYE SALMON

Appendix G1.–Description of stock and escapement goal for Frazer Lake sockeye salmon.

System: Frazer Lake
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area:	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet (with some area-specific restrictions)
Previous escapement goal:	BEG: 70,000 – 150,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	Escapement through the Dog Salmon Creek weir:
	95,000 – 190,000
Escapement enumeration:	Weir counts (1956-2006)
Data summary:	
Data quality:	Excellent
Data type:	Escapement counts from fish pass (1956-2006) and through the Dog Salmon weir (1985-2006). Harvest information obtained through fish tickets and catch apportionment (1966-2006).
Data contrast:	Weir data, all years (1956-2006): 80,973
	Weir data, years after run established (1978-2006): 12
	Weir data, years after run established, excluding fertilization effected years (1978-1991, 2003): 12
Methodology:	Ricker spawner-recruit model (brood years 1966-1999, excluding years affected by fertilization; contrast of escapement data used in model was 30.7)
Recommendation:	Change BEG: 75,000 to 170,000
Comments:	The addition of 3 years of data and bias correction in the estimate of S_{msy} resulted in a higher escapement goal.

Appendix G2.–Frazer Lake sockeye salmon escapement, 1956-2006.

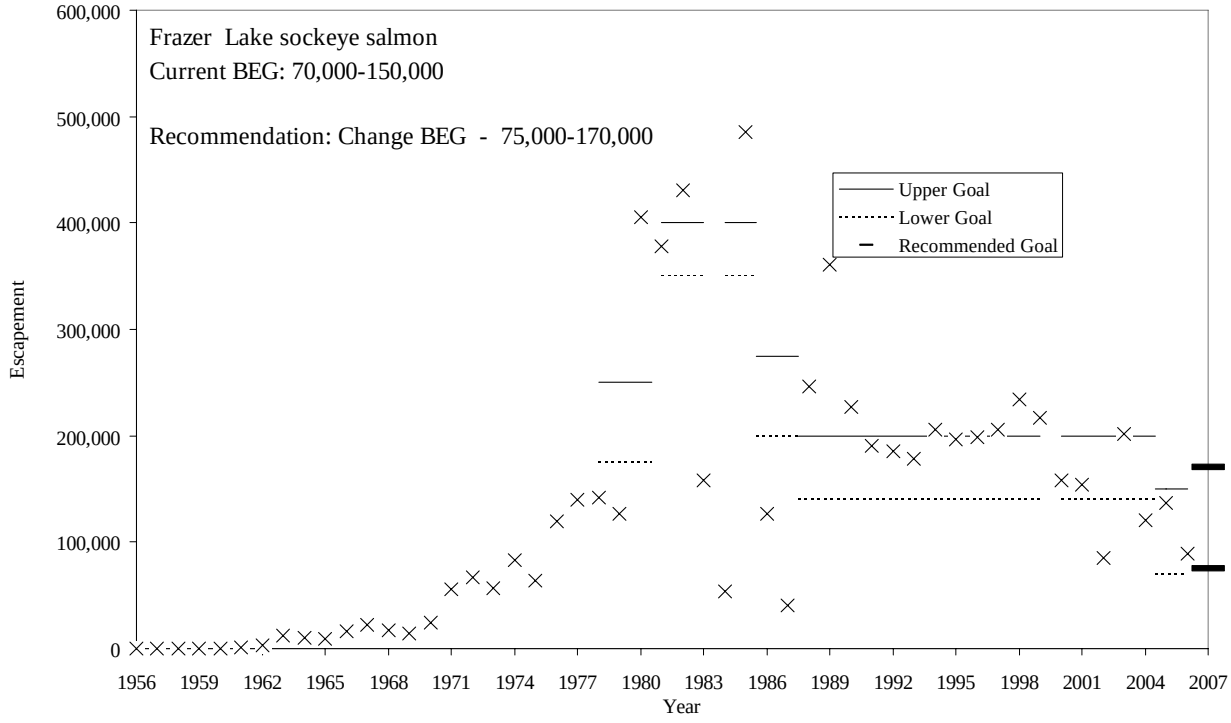
System: Frazer Lake
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Weir Counts
1956	6
1957	165
1958	71
1959	62
1960	440
1961	873
1962	3,090
1963	11,857
1964	9,966
1965	9,074
1966	16,456
1967	21,834
1968	16,738
1969	14,041
1970	24,039
1971	55,366
1972	66,419
1973	56,255
1974	82,609
1975	64,199
1976	119,321
1977	139,548
1978	141,981
1979	126,742
1980	405,535
1981	377,716

Year	Weir Counts	Run Size
1982	430,423	
1983	158,340	196,323
1984	53,524	67,377
1985	485,835	637,871
1986	126,529	178,205
1987	40,544	57,582
1988	246,704	458,461
1989	360,373	1,070,871
1990	226,707	979,833
1991	190,358	1,268,145
1992	185,825	418,773
1993	178,391	751,405
1994	206,071	650,045
1995	196,323	952,377
1996	198,695	700,913
1997	205,264	416,419
1998	233,755	606,343
1999	216,565	357,079
2000	158,044	394,705
2001	154,349	403,372
2002	85,317	110,225
2003	201,679	313,914
2004	120,664	712,251
2005	136,948	625,937
2006	89,516	117,900

Appendix G3.–Frazer Lake sockeye salmon escapement, 1956-2006 and current escapement goal ranges.

System: Frazer Lake
Species: sockeye salmon
Observed escapement by year (Xs for weir counts).

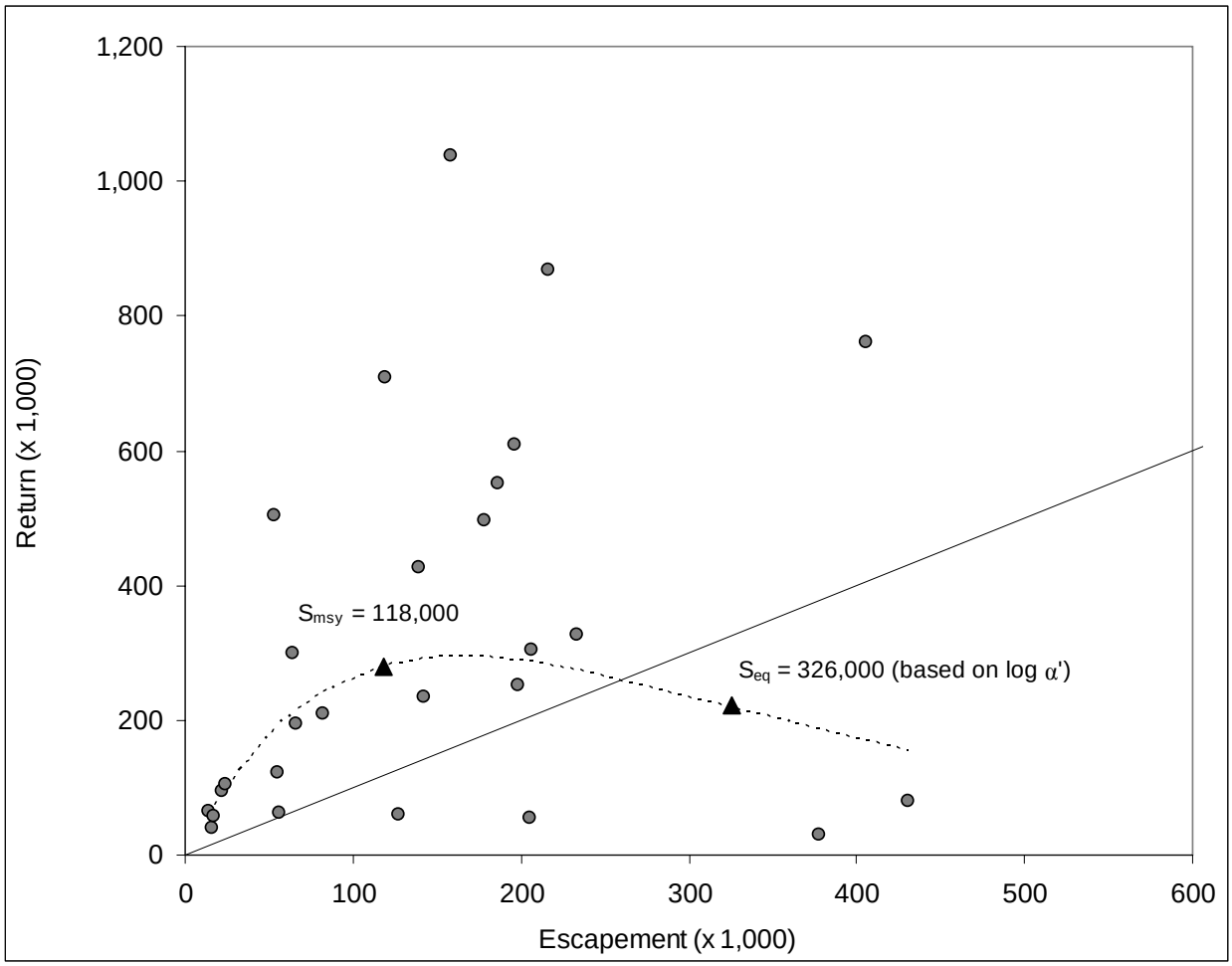


Appendix G4.–Frazer Lake sockeye salmon brood table.

Brood		Age																Total	Return/
Year	Escap.	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	4.1	2.4	4.2	3.3	3.4	Return	Spawner
1966	16,456	0	0	0	11,820	1,732	7,580	16,149	0	0	2,629	0	0	0	0	0	0	39,910	2.4
1967	21,834	0	1,118	0	38,626	395	38,395	11,553	0	0	5,114	0	0	0	0	0	0	95,202	4.4
1968	16,738	0	461	0	15,565	899	15,228	14,998	0	0	10,757	0	0	0	0	0	0	57,910	3.5
1969	14,041	0	138	0	14,654	5,229	9,306	30,137	0	0	6,007	0	0	0	0	512	0	65,984	4.7
1970	24,039	0	2,241	0	17,672	16,989	1,687	51,299	0	0	9,351	3,074	0	0	0	1,691	0	104,005	4.3
1971	55,366	0	512	0	1,417	6,345	769	92,226	0	0	20,151	0	0	0	0	0	0	121,419	2.2
1972	66,419	0	742	0	10,888	11,016	8,032	91,876	0	0	71,167	345	0	0	0	0	0	194,066	2.9
1973	56,255	0	256	0	2,677	5,637	4,825	31,706	345	0	15,969	0	0	0	0	0	0	61,415	1.1
1974	82,609	0	10,850	0	53,591	9,305	28,713	75,084	154	461	30,407	461	0	0	0	0	0	209,026	2.5
1975	64,199	0	1,034	0	22,571	8,906	20,732	173,687	0	0	72,701	0	0	0	0	0	0	299,631	4.7
1976	119,321	0	2,150	0	223,444	8,753	73,677	257,625	0	0	143,383	0	0	0	0	393	0	709,424	5.9
1977	139,548	0	2,764	0	73,189	2,928	92,211	107,917	0	0	146,064	393	0	0	0	0	0	425,466	3.0
1978	141,981	0	7,807	0	162,130	507	24,148	22,970	0	0	16,844	0	0	0	0	638	0	235,043	1.7
1979	126,742	0	507	0	1,374	982	2,965	24,323	0	0	26,791	0	0	0	0	2,165	0	59,106	0.5
1980	405,535	0	0	0	6,064	16,305	7,654	589,393	0	0	141,065	684	0	46	0	52	0	761,264	1.9
1981	377,716	0	876	0	12,120	0	2,455	7,748	0	172	5,239	0	0	0	0	862	0	29,471	0.1
1982	430,423	0	1,276	0	23,647	431	28,624	3,735	24	754	10,870	10,812	0	0	0	0	0	80,172	0.2
1983	158,340	0	10	26	8,935	9,729	13,438	380,531	1,604	0	586,833	0	0	0	0	36,986	0	1,038,092	6.6
1984	53,524	0	1,001	0	5,771	33,628	7,437	386,832	0	0	67,142	2,046	0	0	0	0	0	503,856	9.4
1985	485,835	0	192	0	16,502	4,399	49,290	53,978	151	0	22,578	9,032	0	1,595	0	2,694	0	160,412	0.3
1986	126,529	1,393	67,475	0	727,658	40,794	230,893	972,290	0	0	168,815	9,129	0	0	0	8,584	0	2,227,031	17.6
1987	40,544	0	1,787	1,851	3,019	26,596	3,902	187,581	0	0	159,822	104	0	156	0	882	0	385,701	9.5
1988	246,704	0	1,886	0	21,073	7,793	30,096	210,586	133	0	64,565	20,510	0	16	0	7,994	0	364,652	1.5
1989	360,373	0	16,191	208	327,929	12,847	153,078	373,277	5,752	0	300,182	145,325	0	0	0	40,754	0	1,375,543	3.8
1990	226,707	0	1,096	0	18,217	12,986	33,393	400,750	1,678	0	210,744	15,341	0	455	0	9,340	0	704,000	3.1
1991	190,358	0	621	0	2,031	57,463	1,728	330,834	302	0	105,361	630	0	0	0	0	0	498,970	2.6
1992	185,825	0	3,545	0	20,513	78,168	27,471	211,959	4,666	0	185,148	18,141	0	0	0	2,209	0	551,819	3.0
1993	178,391	0	2,529	45	12,677	41,759	56,178	291,218	4,831	0	64,155	17,867	0	256	0	5,830	0	497,344	2.8
1994	206,071	0	2,056	0	23,034	17,688	39,741	112,849	1,048	0	77,546	15,427	0	187	0	15,733	0	305,309	1.5
1995	196,323	0	10,106	0	59,574	39,574	77,223	152,287	1,251	0	251,356	11,284	0	815	0	5,387	0	608,857	3.1
1996	198,695	0	20,062	0	41,983	22,276	81,667	32,786	26	1,641	50,325	101	0	191	0	201	0	251,259	1.3
1997	205,264	0	626	0	8,327	1,639	9,831	14,560	231	630	15,665	2,251	0	0	0	0	77	53,837	0.3
1998	233,755	0	367	0	1,374	24,808	14,710	87,861	16,454	0	57,957	88,617	0	366	0	33,880	0	326,394	1.4
1999	216,565	0	1,152	0	3,507	136,968	77	481,220	0	0	241,075	1,299	0	496	0	2,090	97	867,981	4.0
2000	158,044	0	35,476	0	68,494	15,072	219,630	107,018	0	521	58,178	330	0	547	233	289			
2001	154,349	0	814	0	21,700	557	5,639	3,657	23,842	131	11,476	29,633	293						
2002	85,317	0	335	0	5,659	14,124	5,844	27,492	11,173										
2003	201,679	0	3,365	0	8,565	58,042													
2004	120,664	0	14,757																
2005	136,949																		
2006	89,516																		
2007	120,185																		
																	10-Year Average (1990-1999):	466,577	2.3

Appendix G5.–Fitted Ricker curve, line of replacement, and actual data for Frazer Lake sockeye salmon, 1966-1999 brood years.

System: Frazer Lake
Species: sockeye salmon
Ricker stock – recruitment relationship, 1966-1999 brood years, excluding years that Frazer Lake was fertilized, 1985 to 1991. The dotted line represents the Ricker curve and the solid line represents replacement.



APPENDIX H. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR SALTERY LAKE SOCKEYE SALMON

Appendix H1.–Description of stock and escapement goal for Saltery Lake sockeye salmon.

System: Saltery Lake
Species: sockeye salmon
Description of stock and escapement goals

Regulatory area:	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine
Current escapement goal:	SEG: 15,000 – 30,000 (2001)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1976-1986, 1992, 2004-2006 Weir counts: 1986 -1991, 1993-2003
Data summary:	
Data quality:	Fair for aerial surveys, excellent for weir counts
Data type:	Aerial surveys from 1976 - 1986, 1992, 2004 – 2006, weir counts from 1986 - 1991 and 1993 - 2003. Harvest data are available from 1976 - 2006.
Data contrast:	All available data 1976-2003: 6.7 Weir data 1976-2003: 3.4
Methodology:	Percentile (using aerial survey data)
Recommendation:	Change to SEG: 20,000 to 50,000
Comments:	Saltery Lake sockeye salmon escapement has been estimated via aerial survey since 2003 and there are no plans to reinstate weir operation in the future.

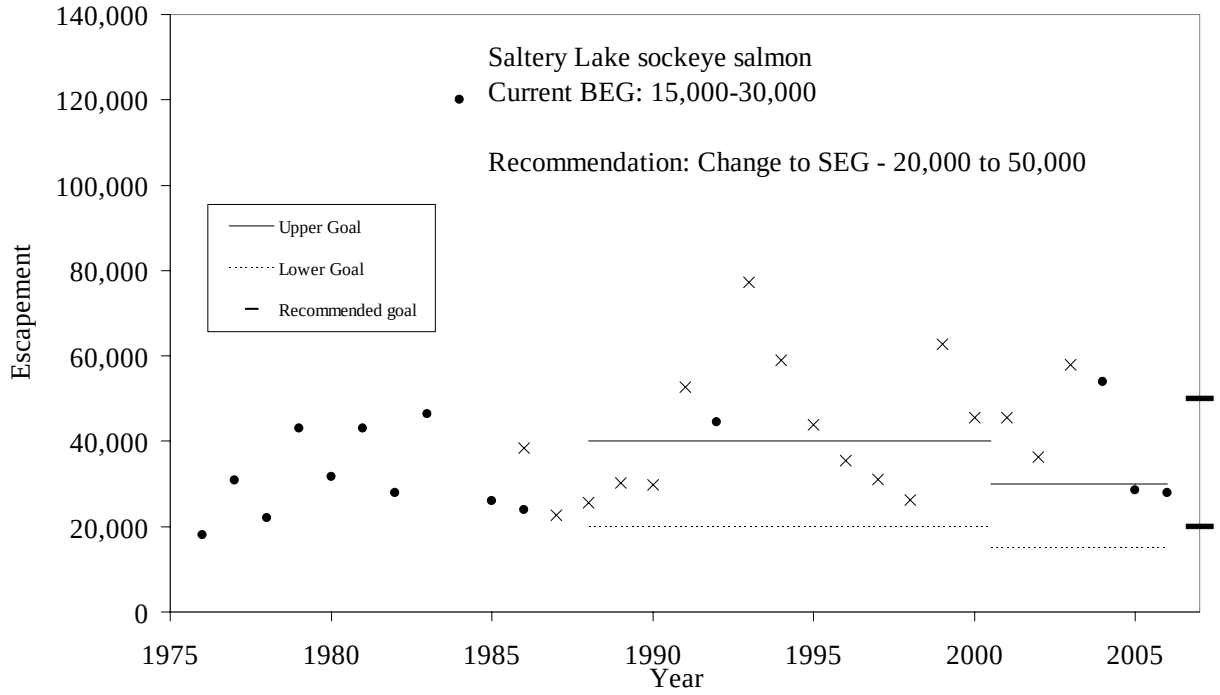
Appendix H2.–Saltery Lake sockeye salmon escapement, 1976-2006.

System: Saltery Lake
Species: sockeye salmon
Data available for analysis of escapement goals

Year	Peak Tributary Survey	Weir Counts
1975		
1976	18,000	
1977	30,800	
1978	22,000	
1979	43,000	
1980	31,600	
1981	43,000	
1982	28,000	
1983	46,400	
1984	120,000	
1985	26,000	
1986	24,000	38,314
1987		22,705
1988		25,654
1989		30,237
1990		29,767
1991		52,592
1992	44,450	
1993		77,186
1994		58,975
1995		43,859
1996		35,488
1997		31,016
1998		26,263
1999		62,821
2000		45,604
2001		45,608
2002		36,336
2003		57,993
2004	54,000	
2005	28,500	
2006	28,000	

Appendix H3.–Saltery Lake sockeye salmon escapement, 1976-2006 and escapement goal ranges.

System: Saltery Lake
Species: sockeye salmon
Observed escapement by year (Xs for weir counts, solid circles for aerial counts).



APPENDIX I. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR CHUM SALMON ON THE KODIAK ARCHIPELAGO

Appendix I1.–Description of stocks and escapement goals for Northwest Kodiak District chum salmon.

System: Northwest Kodiak District
Species: chum salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Current escapement goal:	SEG: 53,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1967-2006
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys with peak surveys from 1967-2006. Harvest information from 1970-2006.
Data contrast:	Aerial surveys 1967-2006: 167
Methodology:	Island-wide percentile approach
Recommendation:	Eliminate the current SEG threshold
Comments:	The committee recommends adopting an island-wide SEG threshold

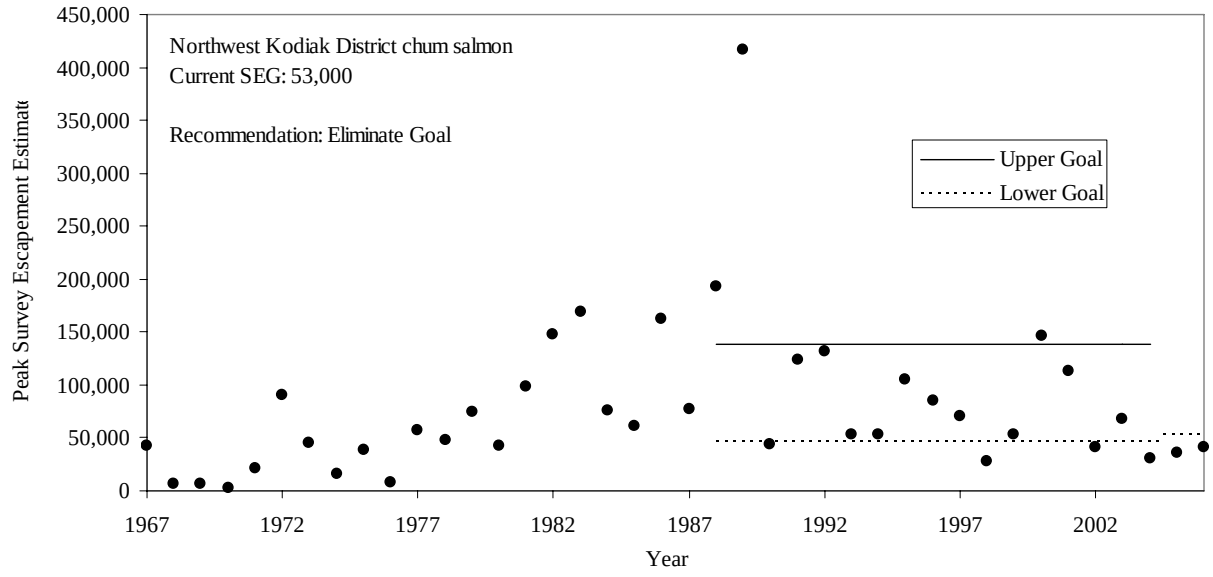
Appendix I2.–Northwest Kodiak District chum salmon peak aerial surveys, 1967-2006 and commercial harvest, 1970-2006.

System: Northwest Kodiak District
Species: chum salmon
Data available for analysis of escapement goals

Year	Aggregate Peak Aerial Survey	Harvest	Year	Aggregate Peak Aerial Survey	Harvest
1967	43,000		1987	76,950	228,783
1968	6,800		1988	192,550	536,483
1969	6,445		1989	417,100	34
1970	2,500	115,772	1990	43,920	167,773
1971	21,000	128,609	1991	123,503	283,582
1972	90,340	174,577	1992	131,710	225,973
1973	45,848	45,872	1993	53,825	219,003
1974	15,600	29,849	1994	52,950	250,938
1975	38,350	33,796	1995	104,800	574,665
1976	8,000	67,993	1996	84,900	248,993
1977	57,602	108,802	1997	70,900	181,730
1978	47,700	111,408	1998	28,250	121,412
1979	75,200	58,231	1999	53,300	189,509
1980	43,050	90,174	2000	145,800	302,753
1981	99,100	232,110	2001	112,550	317,701
1982	147,700	412,671	2002	41,200	204,303
1983	169,225	366,163	2003	67,700	262,436
1984	75,600	135,013	2004	30,700	477,039
1985	61,600	214,752	2005	36,150	229,454
1986	162,890	497,530	2006	41,800	353,342

Appendix I3.–Northwest Kodiak District chum salmon peak aerial surveys, 1967-2006 and escapement goal range.

System: Northwest Kodiak District
Species: chum salmon
Observed escapement by year (solid circles for aerial surveys).



Appendix I4.–Description of stocks and escapement goals for Southwest Kodiak District chum salmon.

System: Southwest Kodiak District
Species: chum salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Previous escapement goal:	SEG: 7,300 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1967-2006
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys with peak surveys from 1967- 2006. Harvest information from 1970-2006.
Data contrast:	Aerial surveys 1967-2006: 108.2
Methodology:	Island-wide percentile approach
Recommendation:	Eliminate the current SEG threshold
Comments:	The committee recommends adopting an island-wide SEG threshold

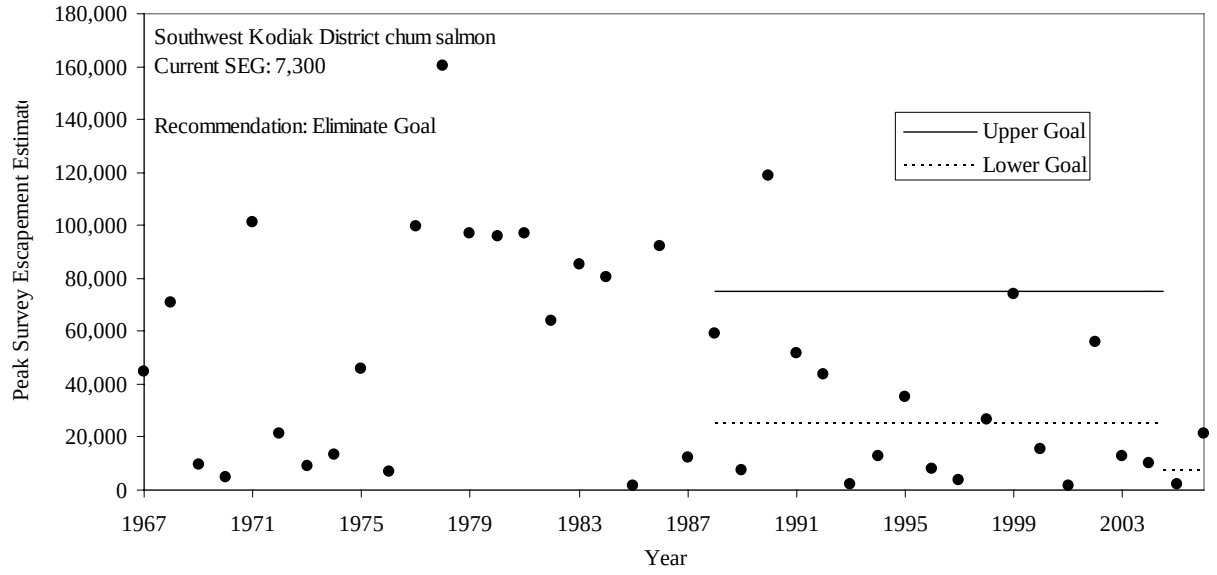
Appendix I5.–Southwest Kodiak District chum salmon escapement, 1967-2006 and commercial harvest, 1970-2006.

System: Southwest Kodiak District
Species: chum salmon
Data available for analysis of escapement goals

Year	Aggregate Peak Aerial Survey	Harvest	Year	Aggregate Peak Aerial Survey	Harvest
1967	45,000		1987	12,200	25,321
1968	71,000		1988	58,900	28,716
1969	9,500		1989	7,279	19
1970	5,000	10,782	1990	118,657	32,355
1971	101,000	138	1991	51,765	33,763
1972	21,500	6,644	1992	43,874	59,592
1973	9,120	496	1993	1,978	46,896
1974	13,500	2,679	1994	12,538	58,075
1975	45,574	209	1995	35,191	96,766
1976	7,132	9,653	1996	7,757	80,218
1977	99,446	1,352	1997	3,778	12,033
1978	160,339	16,000	1998	26,596	52,081
1979	97,141	632	1999	73,850	71,630
1980	96,108	38,943	2000	15,697	69,010
1981	97,000	1,518	2001	1,482	50,937
1982	63,675	29,471	2002	55,838	23,988
1983	85,189	920	2003	12,900	28,503
1984	80,172	24,228	2004	10,243	69,870
1985	1,502	11,053	2005	2,000	7,451
1986	92,218	56,580	2006	21,400	17,397

Appendix I6.–Southwest Kodiak District chum salmon peak aerial surveys, 1967-2006 and escapement goal ranges.

System: Southwest Kodiak District
Species: chum salmon
Observed escapement by year (solid circles for aerial surveys) and current SEG range (dashed lines).



Appendix I7.–Description of stocks and escapement goals for Alitak District chum salmon.

System: Alitak District
Species: chum salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Previous escapement goal:	SEG: 28,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1967-2006
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys with peak surveys from 1967- 2006. Harvest information from 1970-2006.
Data contrast:	Aerial surveys 1967-2006: 38
Methodology:	Island-wide percentile approach
Recommendation:	Eliminate the current SEG threshold
Comments:	The committee recommends adopting an island-wide SEG threshold

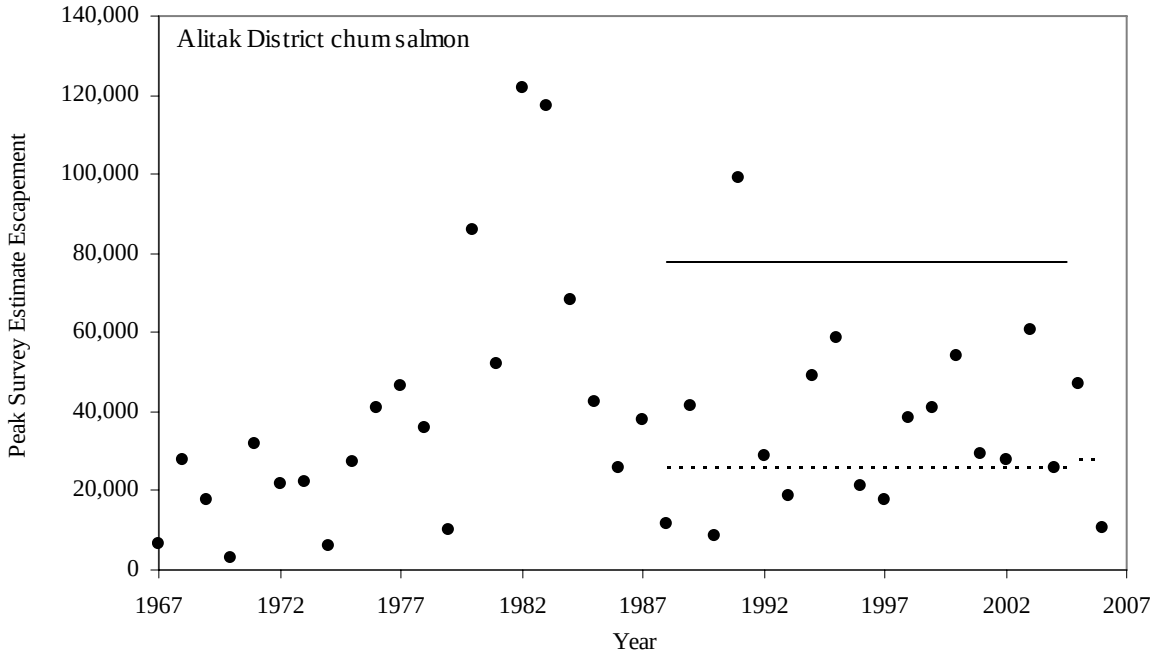
Appendix I8.–Alitak District chum salmon peak aerial surveys, 1967-2006 and commercial harvest, 1970-2006.

System: Alitak District
Species: chum salmon
Data available for analysis of escapement goals

Year	Aggregate Peak Aerial Survey	Harvest	Year	Aggregate Peak Aerial Survey	Harvest
1967	6,735		1987	38,000	59,727
1968	28,000		1988	11,600	93,401
1969	17,785		1989	41,599	19,919
1970	3,200	93,320	1990	8,721	50,306
1971	31,700	191,437	1991	99,187	83,017
1972	21,570	95,135	1992	28,772	34,599
1973	22,100	24,408	1993	18,912	53,639
1974	6,000	23,939	1994	48,827	112,196
1975	27,240	2,853	1995	58,661	105,224
1976	41,041	68,132	1996	21,381	65,272
1977	46,500	70,969	1997	17,474	85,775
1978	36,059	72,166	1998	38,656	40,554
1979	10,165	22,462	1999	40,778	79,000
1980	86,075	67,659	2000	53,843	67,223
1981	52,310	61,513	2001	29,086	52,560
1982	121,900	101,543	2002	27,642	10,198
1983	117,317	107,786	2003	60,525	31,908
1984	68,075	84,924	2004	25,906	38,356
1985	42,268	84,760	2005	47,100	22,847
1986	25,634	75,643	2006	10,600	46,919

Appendix I9.–Alitak District chum salmon peak aerial surveys, 1967–2006 and escapement goal ranges.

System: Alitak District
Species: chum salmon
Observed escapement by year (solid circles for aerial surveys).



Appendix I10.–Description of stocks and escapement goals for Eastside Kodiak District chum salmon.

System: Eastside Kodiak District
Species: chum salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Current escapement goal:	SEG: 50,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1967-2006
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys with peak surveys from 1967- 2006. Harvest information from 1970-2006.
Data contrast:	Aerial surveys 1967-2006: 53
Methodology:	Island-wide percentile approach
Recommendation:	Eliminate the current SEG threshold
Comments:	The committee recommends adopting an island-wide SEG threshold

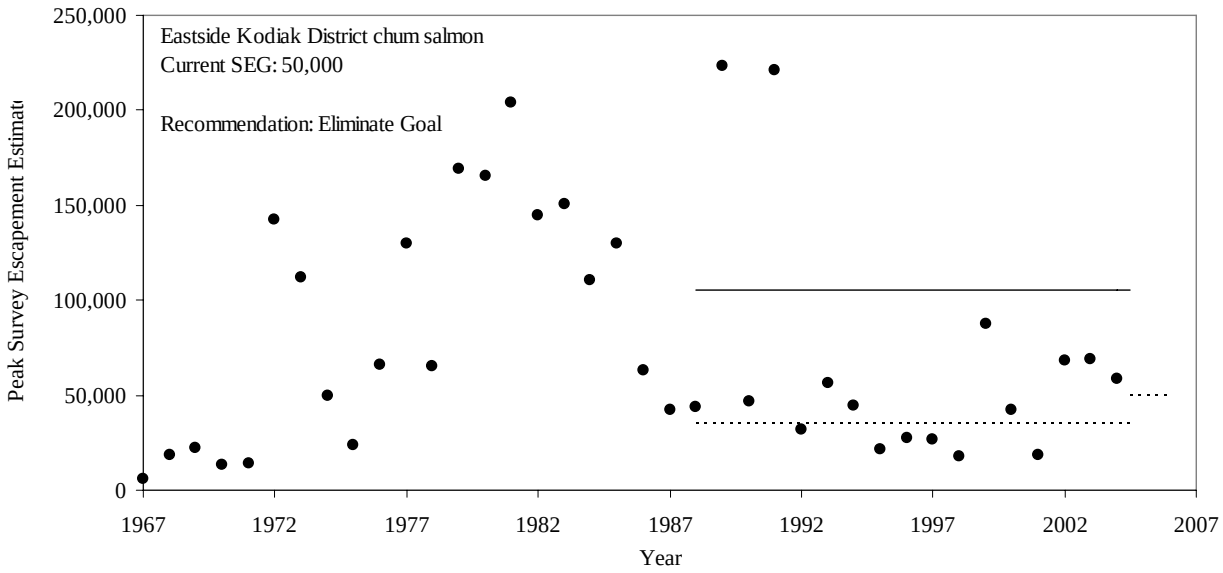
Appendix I11.–Eastside Kodiak District chum salmon peak aerial surveys, 1967-2006 and commercial harvest, 1970-2006.

System: Eastside Kodiak District
Species: chum salmon
Data available for analysis of escapement goals

Year	Aggregate Peak Aerial Survey	Harvest	Year	Aggregate Peak Aerial Survey	Harvest
1967	6,225		1987	42,600	90,606
1968	18,600		1988	44,080	216,093
1969	22,300		1989	223,645	0
1970	13,150	280,976	1990	46,870	86,743
1971	14,050	677,127	1991	220,951	306,857
1972	142,315	600,173	1992	32,085	184,350
1973	112,380	143,588	1993	56,650	107,900
1974	49,860	106,118	1994	44,170	168,128
1975	23,725	18,418	1995	21,353	321,838
1976	66,250	251,937	1996	27,365	42,924
1977	129,775	322,497	1997	26,525	134,584
1978	65,139	349,116	1998	17,925	27,138
1979	169,495	172,886	1999	87,705	179,946
1980	165,510	348,124	2000	42,100	218,195
1981	204,070	479,621	2001	18,750	179,601
1982	144,720	321,418	2002	68,400	181,857
1983	150,657	304,875	2003	68,700	80,898
1984	110,360	158,942	2004	58,750	51,869
1985	129,500	43,858	2005	49,300	61,897
1986	62,973	57,267	2006	328,700	245,895

Appendix I12.–Eastside Kodiak District chum salmon peak aerial surveys, 1967-2006 and escapement goal ranges.

System: Eastside Kodiak District
Species: chum salmon
Observed escapement by year (solid circles for aerial surveys) and current SEG range (dashed lines).



Appendix I13.–Description of stocks and escapement goals for Northeast Kodiak District chum salmon.

System: Northeast Kodiak District
Species: chum salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Previous escapement goal:	SEG: 9,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1967, 1969-2006
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys with peak surveys from 1967, 1969-2006. Harvest information from 1970-2006.
Data contrast:	Aerial surveys 1967-2006: 112.7
Methodology:	Island-wide percentile approach
Recommendation:	Eliminate the current SEG threshold
Comments:	The committee recommends adopting an island-wide SEG threshold

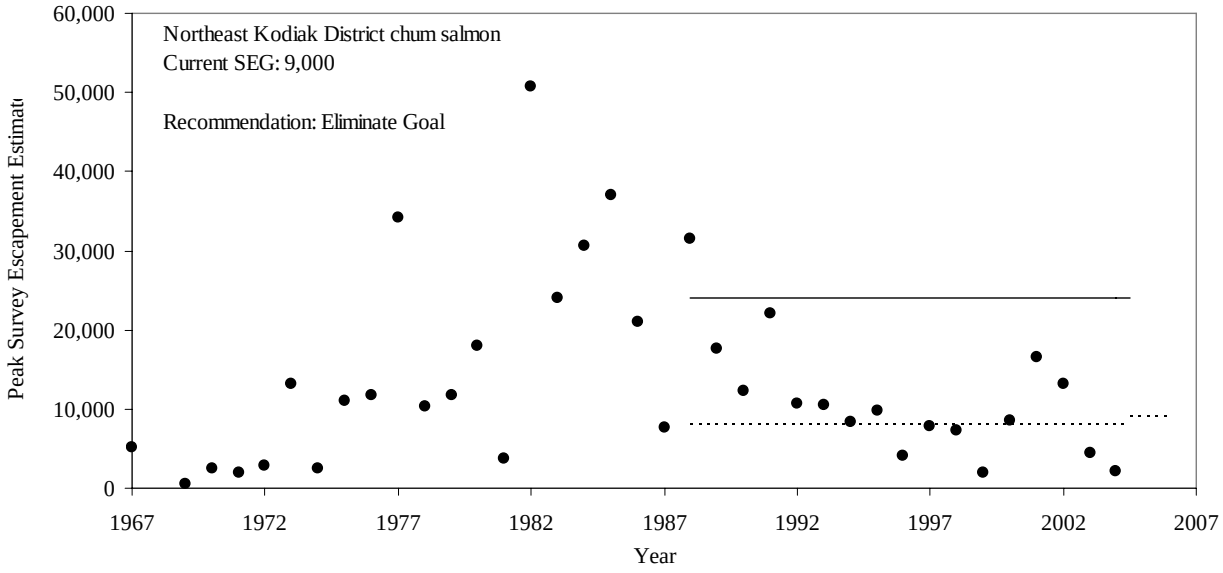
Appendix I14.–Northeast Kodiak District chum salmon peak aerial surveys, 1967-2006 and commercial harvest, 1970-2006.

System: Northeast Kodiak District
Species: chum salmon
Data available for analysis of escapement goals

Year	Aggregate Peak Aerial Survey	Harvest	Year	Aggregate Peak Aerial Survey	Harvest
1967	5,224		1987	7,643	29,413
1968			1988	31,501	71,680
1969	450		1989	17,679	0
1970	2,500	38,288	1990	12,300	5,683
1971	2,007	56,144	1991	22,116	27,217
1972	2,920	15,823	1992	10,605	17,226
1973	13,215	1,589	1993	10,422	2,994
1974	2,500	5,095	1994	8,450	18,631
1975	10,950	2,230	1995	9,843	33,595
1976	11,835	34,515	1996	4,100	2,333
1977	34,200	42,714	1997	7,808	29,741
1978	10,261	31,757	1998	7,250	902
1979	11,750	6,324	1999	2,031	15,077
1980	17,900	35,397	2000	8,600	10,075
1981	3,710	41,887	2001	16,600	1,334
1982	50,715	36,488	2002	13,200	16,519
1983	24,100	11,805	2003	4,500	15,112
1984	30,600	10,804	2004	2,156	24,638
1985	37,110	20,364	2005	7,300	1,459
1986	21,002	11,223	2006	16,500	17,987

Appendix I15.–Northeast Kodiak District chum salmon peak aerial surveys, 1967-2006 and escapement goal ranges.

System: Northeast Kodiak District
Species: chum salmon
Observed escapement by year (solid circles for aerial surveys)



APPENDIX J. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR MAINLAND DISTRICT CHUM SALMON

Appendix J1.–Description of stocks and escapement goals for Mainland District chum salmon.

System: Mainland District
Species: chum salmon
Description of stock and escapement goals

Regulatory area	Kodiak Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set gillnet
Previous escapement goal:	SEG: 153,000 (2005)
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial surveys: 1967-2006
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys with peak surveys from 1967- 2006. Harvest information from 1970-2006.
Data contrast:	Aerial surveys 1967-2006: 64.7
Methodology:	Risk Analysis and Percentile for comparison
Recommendation:	Change the current SEG threshold to 104,000
Comments:	At this level there is low empirical risk of unneeded action or mistaken inaction, since the peak aggregate escapement for the Mainland District has only been below 104,000 five years since 1977 and never in three consecutive years.

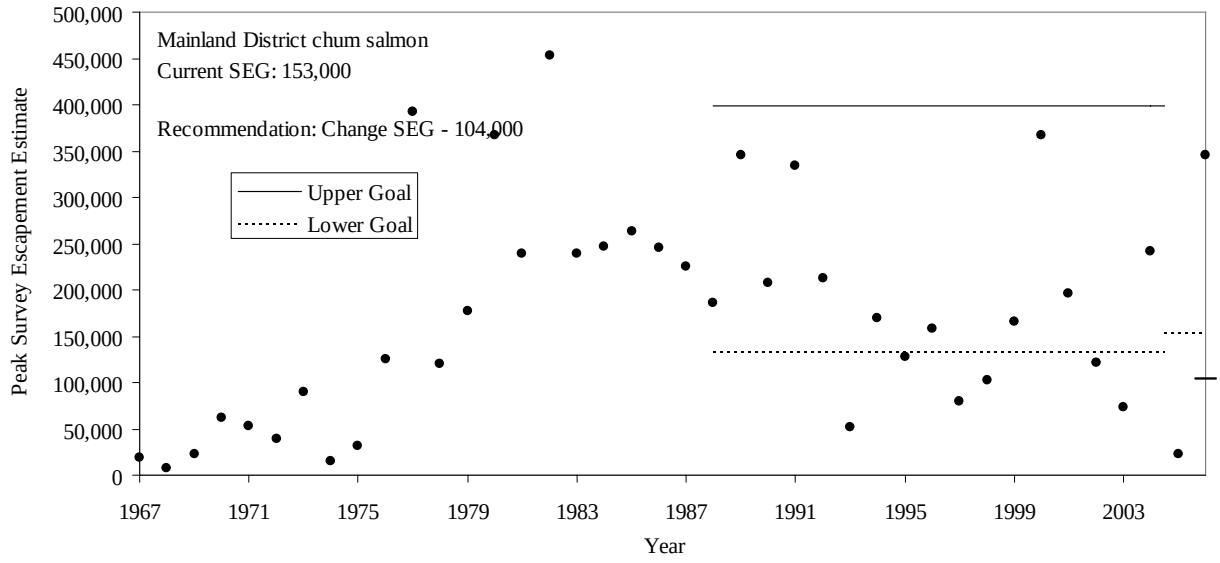
Appendix J2.–Mainland District chum salmon peak aerial surveys, 1967-2006 and commercial harvest, 1970-2006.

System: Mainland District
Species: chum salmon
Data available for analysis of escapement goals

Year	Aggregate Peak Aerial Survey	Harvest	Year	Aggregate Peak Aerial Survey	Harvest
1967	19,250		1987	225,600	231,232
1968	7,000		1988	185,800	392,154
1969	22,200		1989	346,200	0
1970	61,500	271,272	1990	207,200	200,648
1971	53,710	373,979	1991	334,100	222,548
1972	38,800	192,965	1992	213,100	114,080
1973	89,450	90,651	1993	51,790	84,237
1974	15,300	57,526	1994	169,100	90,965
1975	31,720	9,423	1995	127,900	100,874
1976	125,910	214,567	1996	158,650	40,358
1977	392,440	426,419	1997	80,300	34,928
1978	119,850	152,548	1998	103,050	25,264
1979	177,310	73,137	1999	166,200	210,072
1980	367,250	413,884	2000	367,650	195,024
1981	238,850	437,784	2001	196,100	208,445
1982	453,148	316,010	2002	120,975	89,677
1983	238,810	273,858	2003	73,800	204,526
1984	246,450	220,760	2004	241,645	149,393
1985	263,100	48,189	2005	22,500	49,902
1986	245,175	400,469	2006	346,140	187,139

Appendix J3.–Mainland District chum salmon peak aerial surveys, 1967-2006 and escapement goal ranges.

System: Mainland District
Species: chum salmon
Observed escapement by year (solid circles for aerial surveys).



Appendix J4.–Risk analysis for Mainland District chum salmon.

System: Mainland District

Species: chum salmon

Mainland District chum salmon risk analysis (solid line the risk of unneeded action and dashed line the risk of mistaken inaction).