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Review of Salmon Escapement Goals in the Alaska Peninsula and Aleutian Islands Management Areas; A Report to the Alaska Board of Fisheries, 2010

by

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December 2009

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

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

FISHERY MANUSCRIPT NO. 09-09

REVIEW OF SALMON ESCAPEMENT GOALS IN THE ALASKA PENINSULA AND ALEUTIAN ISLANDS MANAGEMENT AREAS; A REPORT TO THE ALASKA BOARD OF FISHERIES, 2010

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The Fishery Manuscript series was established in 1987 by the Division of Sport Fish 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, and became a joint divisional series in 2004 with the Division of Commercial Fisheries. 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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TABLE OF CONTENTS

LIST OF TABLES iv

LIST OF FIGURES iv

LIST OF APPENDICES iv

ABSTRACT 1

INTRODUCTION 1

Study Area 2

Background 2

METHODS 3

Biological Escapement Goal Determination 4

Sustainable Escapement Goal Determination 4

Chinook Salmon 5

Escapement goal background and previous review 5

2009 review 5

Sockeye Salmon 5

Orzinski Lake 5

Escapement goal background and previous review 5

2009 review 5

Thin Point Lake 6

Escapement goal background and previous review 6

2009 review 6

Mortensens Lagoon 6

Escapement goal background and previous review 6

2009 review 6

Christianson Lagoon 6

Escapement goal background and previous review 6

2009 review 7

Swanson Lagoon 7

Escapement goal background and previous review 7

2009 review 7

North Creek 7

Escapement goal background and previous review 7

2009 review 8

Nelson River 8

Escapement goal background and previous review 8

2009 review 8

Bear Lake 8

Escapement goal background and previous review 8

2009 review 9

Sandy River 9

Escapement goal background and previous review 9

2009 review 9

Ilnik River 9

Escapement goal background and previous review 9

2009 review 9

Meshik River 10

Escapement goal background and previous review 10

2009 review 10

TABLE OF CONTENTS (Continued)

Page

Cinder River 10
Escapement goal background and previous review 10
2009 review 10
McLees Lake 11
Escapement goal background and previous review 11
2009 review 11
Coho Salmon 11
Thin Point Lake 11
Escapement goal background and previous review 11
2009 review 11
Nelson River 12
Escapement goal background and previous review 12
2009 review 12
Ilnik River 12
Escapement goal background and previous review 12
2009 review 12
Pink Salmon 12
South Peninsula 12
Escapement goal background and previous review 12
2009 review 13
Bechevin Bay 13
Escapement goal background and previous review 13
2009 review 13
Chum Salmon 13
South Peninsula 14
Escapement goal background and previous review 14
2009 review 14
North Peninsula 14
Escapement goal background and previous review 14
2009 review 14
RESULTS 14
Biological Escapement Goal Estimates 15
Sustainable Escapement Goal Estimates 15
Sockeye Salmon 15
Swanson Lagoon 15
Stock Status 15
Evaluation of Recent Data 15
Escapement Goal Recommendation 15
North Creek 15
Stock Status 15
Evaluation of Recent Data 16
Escapement Goal Recommendation 16
Meshik River 16
Stock Status 16
Evaluation of Recent Data 16
Escapement Goal Recommendation 16
Cinder River 17
Stock Status 17
Evaluation of Recent Data 17
Escapement Goal Recommendation 17

TABLE OF CONTENTS (Continued)

Page

McLees Lake 17
Stock Status 17
Evaluation of Recent Data 17
Escapement Goal Recommendation 18
Coho Salmon 18
Ilnik River 18
Stock Status 18
Evaluation of Recent Data 18
Escapement Goal Recommendation 18

DISCUSSION 18

REFERENCES CITED 19

TABLES AND FIGURES 21

APPENDIX A. SUPPORTING INFORMATION FOR THE SWANSON LAGOON SOCKEYE SALMON ESCAPEMENT GOAL 31

APPENDIX B. SUPPORTING INFORMATION FOR THE NORTH CREEK SOCKEYE SALMON ESCAPEMENT GOAL 35

APPENDIX C. SUPPORTING INFORMATION FOR THE MESHIK RIVER SOCKEYE SALMON ESCAPEMENT GOAL 39

APPENDIX D. SUPPORTING INFORMATION FOR THE CINDER RIVER SOCKEYE SALMON ESCAPEMENT GOAL 43

APPENDIX E. SUPPORTING INFORMATION FOR THE MCLEES LAKE SOCKEYE SALMON ESCAPEMENT GOAL 47

APPENDIX F. SUPPORTING INFORMATION FOR THE ILNIK RIVER COHO SALMON ESCAPEMENT GOAL 51

LIST OF TABLES

Table **Page**

1. Current escapement goals, escapements observed from 2006 through 2008, and escapement goal recommendations in 2009 for Chinook, sockeye, coho, pink, and chum salmon stocks of the Alaska Peninsula Management and Aleutian Islands Areas. 22
2. General criteria used to assess quality of data in estimating Area M salmon escapement goals. 24
3. Algorithm used to estimate Area M sustainable escapement goals (SEGs). 25

LIST OF FIGURES

Figure **Page**

1. Map of the Alaska Peninsula and Aleutian Islands Management Areas. 26
2. Map of the Alaska Peninsula Management Area with the commercial salmon fishing districts depicted. 27
3. Map of the Alaska Peninsula Management Area with the major sockeye, coho, and Chinook salmon systems depicted. 28
4. Map of Unalaska Island within the Aleutian Islands Management Area with McLees Lake depicted. 29

LIST OF APPENDICES

Appendix **Page**

A1. Description of stock and escapement goal for Swanson Lagoon sockeye salmon. 32
A2. Swanson Lagoon sockeye salmon escapement, 1970-2008. 33
A3. Swanson Lagoon sockeye salmon escapement, 1970-2008 and the current escapement goal range. 34

B1. Description of stock and escapement goal for North Creek sockeye salmon 36
B2. North Creek sockeye salmon escapement, 1970-2008. 37
B3. North Creek sockeye salmon escapement, 1970-2008 and current escapement goal range. 38

C1. Description of stock and escapement goal for Meshik River sockeye salmon. 40
C2. Meshik River sockeye salmon escapement, 1970-2008. 41
C3. Meshik River sockeye salmon escapement, 1970-2008 and current escapement goal range. 42

D1. Description of stock and escapement goal for Cinder River sockeye salmon. 44
D2. Cinder River and Mud Creek sockeye salmon escapement, 1970-2008. 45
D3. Cinder River and Mud Creek sockeye salmon escapement, 1970-2008 and current escapement goal range. 46

E1. Description of stock and escapement goal for McLees Lake sockeye salmon. 48
E2. McLees Lake sockeye salmon escapement, 1974-2008. 49
E3. McLees Lake sockeye salmon escapement, 1974-2008. 50

F1. Description of stocks and escapement goals for Ilnik River Coho salmon. 52
F2. Ilnik River coho salmon escapement, 1985-2008 53
F3. Ilnik River coho salmon escapement, 1985-2008 and current escapement goal range. 54
F4. Ilnik River coho salmon risk analysis results. 55

ABSTRACT

In February 2009, a Salmon Escapement Goal Interdivisional Review Team, including staff from Division of Commercial Fisheries and Division of Sport Fish, was formed to review Pacific salmon *Oncorhynchus sp*. escapement goals in the Alaska Peninsula and Aleutian Islands Management Areas (Area M). This review was based on the *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223). Of the 26 existing Area M salmon escapement goals evaluated, the team recommended changing 1 goal and leaving the other 25 goals unchanged. In addition, two escapement goals were established.

After a comprehensive review of the available data, the team recommended that no changes in the current sustainable escapement goals (SEGs) were warranted for 11 sockeye salmon *O. nerka* systems that include runs to Orzinski, Bear (early and late run), and Thin Point lakes; Mortensens, Christianson, and Swanson lagoons; North Creek; and Sandy, Ilnik, and Cinder rivers. There was also no change recommended for the one sockeye salmon biological escapement goal (BEG) at Nelson River. In addition, the team recommended no changes to the current SEGs for 6 chum salmon *O. keta* aggregates in the North and South Peninsula, 4 pink salmon *O. gorbuscha* aggregates in the South Peninsula and Bechevin Bay on the North Peninsula, and 2 coho salmon *O. kisutch* ,goals at Thin Point Lake and Nelson River. One Chinook salmon *O. tshawytscha* BEG (Nelson River) also did not warrant change.

The team recommended increasing the Meshik River sockeye salmon SEG from 20,000 to 60,000 fish to an SEG of 25,000 to 100,000 fish to account for adjacent streams (Red Bluff and Yellow Bluff creeks) that receive substantial escapement, but cannot be managed separately from Meshik River. The team also recommended creating a lower bound SEG of 9,000 fish for Ilnik River coho salmon and reestablishing an SEG of 10,000 to 60,000 sockeye salmon for McLees Lake during years when a weir is in operation.

Key words: Pacific salmon, *Oncorhynchus*, escapement goal, Area M, Alaska Peninsula, stock status.

INTRODUCTION

This report documents a review of the existing escapement goals for Alaska Peninsula and Aleutian Islands Management Areas (Area M) salmon stocks based on 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). The Alaska Board of Fisheries (BOF) adopted these policies into regulation in 2000 and 2001, respectively, to ensure that the state's salmon stocks would be conserved, managed, and developed using the sustained yield principle.

Two important terms defined in the SSFP are:

"*biological escapement goal* (BEG): the escapement that provides the greatest potential for maximum sustained yield (MSY); …" and,

"*sustainable escapement goal* (SEG): 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;…".

A report documenting the established escapement goals for stocks of five Pacific salmon species (Chinook *Oncorhynchus tshawytscha*, sockeye *O. nerka*, coho *O. kisutch*, pink *O. gorbuscha*, and chum *O. keta* salmon) spawning in the Kodiak, Chignik, Alaska Peninsula and Aleutian Islands Management Areas of Alaska was prepared in 2001 (Nelson and Lloyd 2001). Most of the escapement goals documented in the 2001 report were based on average escapement estimates and spawning habitat availability, and had been implemented in the early 1970s and 1980s.

During 2006, the 27 existing salmon escapement goals in Area M were reviewed. This review resulted in recommendations to change 5 goals: reclassify 4 goals as SEGs, maintain the current numerical goal ranges for 17 systems, and eliminate 1 goal (Honnold et al. 2007).

In February 2009, the Salmon Escapement Goal Interdivisional Review Team (hereafter referred to as the team) was formed to review the existing Area M salmon escapement goals. The team included staff from the Division of Commercial Fisheries (CFD) and Division of Sport Fish (SFD): Steve Honnold (CFD), Mark Witteveen (CFD), Heather Finkle (CFD), Birch Foster (CFD), Mary Loewen (CFD), Jack Erickson (SFD) Bob Murphy (CFD), Aaron Poetter (CFD), David Barnard (CFD), Jim Hasbrouck (SFD), and Donn Tracy (SFD).

The purpose of the team was to 1) determine the appropriate goal type (BEG or SEG) for each Area M 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 the divisions of Commercial Fisheries and Sport Fish for approval.

STUDY AREA

The Alaska Peninsula and Aleutian Islands combined commercial salmon fishery net registration area, collectively referred to as Area M, comprises two separate management areas: 1) the Alaska Peninsula Management Area and 2) the Aleutian Islands Management Area (Figure 1).

Alaska Peninsula Management Area includes all waters of Alaska from Cape Menshikof to Cape Sarichef and from a line extending from Scotch Cap through the easternmost tip of Ugamak Island, to a line extending 135^{o} southeast from Kupreanof Point (55^{o} 33.98' N lat., 159^{o} 35.88' W long.; 5 AAC 09.100). The area is divided into six commercial fishing districts: the Southeastern (comprising the Southeastern District Mainland and the Shumagin Islands), South Central, Southwestern, Unimak, Northwestern, and Northern Districts (5 AAC 09.200). Commonly, aggregates of these districts are referred to as the South Peninsula and North Peninsula (Figure 2). These districts are further subdivided into sections and smaller statistical areas.

The Aleutian Islands Management Area includes the waters of Alaska surrounding the Aleutian Islands west of Cape Sarichef and west of a line extending from Scotch Cap through the easternmost tip of Ugamak Island, including waters surrounding the Pribilof Islands, except the Atka-Amlia Islands Area described in 5 AAC 11.101 (5 AAC 12.100; Figure 1). Parts of the Aleutian Islands area are separated into four commercial fishing districts: the Akutan, Unalaska, Umnak, and Adak Districts. There is little commercial salmon fishing in the area and very few of the 458 known salmon streams are consistently monitored for escapement (Holmes 1997).

BACKGROUND

Nelson River on the North Peninsula is the only Chinook salmon system in Area M with an escapement goal (Honnold et al. 2007; Table 1; Figure 3). Chinook salmon escapement at this system is primarily monitored by weir counts. There are no spawning stocks of Chinook salmon documented along the South Peninsula or Aleutian Islands.

A total of 13 sockeye salmon stocks (12 systems) in Area M have escapement goals in place (Honnold et al. 2007). Three of these stocks are located along the South Peninsula and ten are located along the North Peninsula (Table 1; Figures 2 and 3). All of these stocks directly affect the daily management of associated fisheries and five of these systems currently have weirs for direct enumeration of escapement. Escapements of the remaining stocks are monitored via aerial surveys.

Coho salmon are not monitored in many Area M streams due to the difficulty and expense of conducting surveys during late fall. However, there are escapement goals in place for two coho stocks (Honnold et al. 2007), one each on the North and South Peninsula (Table 1; Figure 3). There are no coho salmon escapement goals for the Aleutian Islands.

Pink salmon are generally a high volume commercial species in Area M and are managed as aggregates of streams by district or section. There are different odd- and even-year goals for each aggregate. A total of four stock-aggregate pink salmon escapement goals have been established in Area M (Table 1; Figure 3). These stock-aggregate goals comprise the respective sums of aerial survey escapement objectives for 165 individual index streams (Honnold et al. 2007; Nelson and Lloyd 2001). All but five of the index streams are located along the South Peninsula.

A total of six stock-aggregate escapement goals have been established for chum salmon in Area M (Table 1; Figure 3). These stock-aggregate goals comprise the respective sums of aerial survey escapement objectives for 136 individual index streams (Honnold et al. 2007; Nelson and Lloyd 2001). Sixty-seven of these index streams are located along the South Peninsula and 69 are found along the North Peninsula. There are no established chum salmon escapement goals for the Aleutian Islands.

METHODS

During the review process, escapement goals were evaluated for 1 Chinook, 14 sockeye, and 3 coho salmon stocks (Table 1). In addition, 4 pink and 6 chum salmon stock-aggregate goal ranges were reviewed (Table 1). We conducted our review similarly to the 2006 review (Honnold et al. 2007), primarily examining recent (2006-2008) data and updating previous analyses. We did not review or analyze data for most stocks in which goals were eliminated in 2006. We reviewed the McLees Lake sockeye salmon stock data even though the goal was eliminated in 2003 because the U.S. Fish and Wildlife Service (USFWS) has operated a weir at this system since 2001 and are interested in having the department develop an escapement goal, if appropriate. Formal meetings, via teleconference, to discuss and develop recommendations were held on February 26 and April 1, 2009. The team also communicated on a regular basis by telephone and email.

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 spawning 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*; Table 2). This evaluation was used to assist in determining the appropriate type of escapement goal to apply to each stock, as defined in the SSFP and EGP.

BIOLOGICAL ESCAPEMENT GOAL DETERMINATION

There were no Area M spawning stocks with BEGs that the team determined needed to be reviewed.

SUSTAINABLE ESCAPEMENT GOAL DETERMINATION

If total return estimates were not available because harvest or age were not consistently measured, then the data were considered of fair to poor quality. These data would not provide an accurate estimate of S_{msy} and subsequently, a BEG. As a result, these data were evaluated using other methods to establish an SEG. Methods used to develop SEGs included the percentile approach and risk analyses models.

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 escapement estimates to be used for estimating the SEG. Low contrast (<4) implies that stock productivity is known for only a limited range of escapements (Table 3). 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 escapement estimates used to estimate an SEG were narrowed to the 15th and 75th percentiles. 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 and the upper end of the SEG range remained at the 75th percentile.

The risk analysis method (Bernard et al. 2009) 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 3 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). If there is temporal trend, the method can still be used, but in a more deterministic way. A time series model is estimated from the data; then, new data are simulated from the time series model, assuming the error in the model is lognormal. Probability models are developed from the simulated data to estimate the chance of detecting the escapement falling below the SEG in a predetermined number of consecutive years, while simultaneously estimating the chance of taking action for the same number of consecutive years.

CHINOOK SALMON

Escapement goal background and previous review

Nelson River is located in the Nelson Lagoon Section of the Northern District of the Alaska Peninsula Management Area (Figures 2 and 3). Nelson River has the only Chinook salmon escapement goal currently established in Area M. Escapement has been counted almost every year since 1974 from either a tower (1974-1988) or a weir (1989-present). Since 1985, the tower or weir project ended when the sockeye salmon escapement was completed. This occurs before most of the Chinook salmon run has passed. In nearly all years, an aerial survey was conducted to count Chinook salmon downstream of the tower or weir on the day that, or a few days after, the weir or tower was removed. Stock-specific catch data are available from the Nelson Lagoon Section gillnet fishery due to the terminal nature of that fishery. The first published escapement goal for Nelson River was developed in 1985 and a range was set at 4,500 to 9,000 Chinook salmon based on weir and counting tower data collected from 1978 to 1984 (Nelson and Lloyd 2001). The goal was changed in 1993 to a range of 3,200 to 6,400 Chinook salmon based on aerial survey data collected from 1985 to 1992 (Nelson and Lloyd 2001). The SEG was modified in 2003 (Nelson et al. 2006) to a BEG of 2,400 to 4,400 fish using a Ricker spawner recruit curve (Ricker 1954) and corroborated with a habitat model (based on an unpublished oral report to the Chinook Technical Committee of the Pacific Salmon Commission, November 19, 2003 titled "A habitat-based method for developing escapement goals for Chinook salmon" by C. Parken). The BEG was corroborated in 2006 using a Ricker spawner recruit curve.

2009 review

Escapements since the last review were similar to those in the recent past (Table 1). There was no compelling information to suggest that any changes were necessary to the current BEG and the team agreed that no review was necessary in 2009.

SOCKEYE SALMON

Orzinski Lake

Escapement goal background and previous review

Orzinski Lake is located in the Northwest Stepovak Section of the Southeastern District (Figures 2 and 3). The first published escapement goal for Orzinski Lake was developed in 1980 and a range was set at 15,000 to 20,000 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys were used to estimate escapement into Orzinski Lake from 1968 through 1989 and a weir was used from 1990 through the present. An escapement goal review of this system was conducted during 2003. All available stock assessment data were analyzed using the percentile, euphotic volume, smolt biomass as a function of zooplankton biomass, and lake surface area methods, and these analyses reasonably corroborated the existing SEG and no change was warranted (Nelson et al. 2006). During the 2006 escapement goal review (Honnold et al. 2007), team staff examined escapement data using the percentile approach and determined there was no significant change in the estimate and the goal would remain the same.

2009 review

Stock-specific harvest estimates for Orzinski Lake sockeye salmon were not available. Recent escapement estimates and age compositions were examined to determine if a change in the

escapement goal was justified. Escapements since the last review were similar to those in the recent past (Table 1) and the team agreed that no further analysis was necessary.

Thin Point Lake

Escapement goal background and previous review

Thin Point Lake is located in the Thin Point Section of the Southwestern District (Figures 2 and 3). The first published escapement goal for Thin Point Lake was developed in the late 1980s and a range was set at 14,000 to 28,000 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into Thin Point Lake from 1968 to the present and a weir was used from 1994 to 1998.

An escapement goal review of this system was conducted during 2003. All available stock assessment data were analyzed using the percentile, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area methods (Nelson et al. 2006). The authors concluded that these analyses reasonably corroborated the existing SEG and no change was warranted (Table 1).

2009 review

Stock-specific harvest estimates for Thin Point Lake sockeye salmon were not available. Recent escapement data (Table 1) were examined to determine if a change in the escapement goal was justified and the team agreed that no further analysis was necessary.

Mortensens Lagoon

Escapement goal background and previous review

Mortensens Lagoon is located in the Mortensens Lagoon Section of the Southwestern District (Figures 2 and 3). The first published escapement goal range for Mortensens Lagoon was developed in the late 1980s and set at 3,200 to 6,400 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into Mortensens Lagoon from 1968 to the present and a weir was operated from 2001 to 2006.

An escapement goal review conducted during 2003 using the percentile, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area methods concluded that these analyses reasonably corroborated the existing SEG and no change was warranted (Nelson et al. 2006). During the subsequent 2006 escapement goal review the team utilized the percentile approach and also corroborated the 3,200 to 6,400 sockeye salmon SEG (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Mortensens Lagoon sockeye salmon were not available. Recent escapement data (Table 1) were examined to determine if a change in the escapement goal was justified and the team agreed that no further analysis was necessary.

Christianson Lagoon

Escapement goal background and previous review

Christianson Lagoon is located in the Urilla Bay Section of the Northwestern District (Figures 2 and 3). The first published escapement goal range for Christianson Lagoon was developed in the

1980s and set at 25,000 to 50,000 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into Christianson Lagoon from 1960 to the present.

An escapement goal review of this system conducted during 2003 using the percentile method (Nelson et al. 2006) concluded that the analysis reasonably corroborated the existing SEG and no change was warranted (Nelson et al. 2006). The subsequent 2006 escapement goal review team also utilized the percentile approach and corroborated the 25,000 to 50,000 sockeye salmon SEG (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Christianson Lagoon sockeye salmon were not available. Recent escapement data (Table 1) were examined to determine if a change in the escapement goal was justified. The escapement data from 2006-2008 (Table 1) were similar to the recent past so the team agreed that no further analysis was necessary.

Swanson Lagoon

Escapement goal background and previous review

Swanson Lagoon is located in the Swanson Lagoon Section of the Northwestern District (Figures 2 and 3). The first published escapement goal range for Swanson Lagoon was developed in 1990 and set at 8,000 to 16,000 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into Swanson Lagoon from 1960 to the present. The escapement goal review of this system conducted during 2003 using the percentile method concluded that because of data uncertainty and that the established SEG produced sufficient returns of escapement and harvest, no change in the SEG was warranted (Nelson et al. 2006). The subsequent 2006 escapement goal review also utilized the percentile approach and changed the goal to 6,000 to 16,000 sockeye salmon SEG (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Swanson Lagoon sockeye salmon were not available. Recent escapement data (Table 1) were examined to determine if a change in the escapement goal was justified. The team determined that this stock warranted further review and the percentile approach was performed with the additional 2006 to 2008 escapement data to see if there was a significant change in the estimate.

North Creek

Escapement goal background and previous review

North Creek is located in the Black Hills Section of the Northern District (Figures 2 and 3). The first published escapement goal for North Creek was developed in the late 1980s and a range was set at 4,400 to 8,800 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into North Creek from 1960 to the present. An escapement goal review of this system conducted during 2003 using the percentile method concluded that the analysis reasonably corroborated the existing SEG and no change was warranted (Nelson et al. 2006). During the 2006 escapement goal review, the team used the percentile approach and corroborated the 4,400 to 8,800 sockeye salmon SEG (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for North Creek sockeye salmon were not available. Recent escapement data (Table 1) were examined to determine if a change in the escapement goal was justified. The team determined that this stock warranted further review and the percentile approach was performed with the additional 2006 to 2008 escapement data to see if there was a significant change in the estimate.

Nelson River

Escapement goal background and previous review

Nelson River is located in the Nelson Lagoon Section of the Northern District (Figures 2 and 3). The first published escapement goal for Nelson River was developed in 1979 and set as an SEG with a range of 100,000 to 150,000 sockeye salmon (Nelson and Lloyd 2001). Tower counts were used to estimate escapement into Nelson River from 1962 to 1988 and a weir has been used from 1989 to the present. An escapement goal review of this system conducted during 2003 using the Ricker spawner-recruit model, percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area method recommended that the escapement goal should be reclassified as a BEG with a range from 97,000 to 219,000 sockeye salmon (Nelson et al. 2006). The 2006 escapement goal review analysis using the Ricker spawner-recruit model corroborated the 97,000 to 219,000 sockeye salmon BEG (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Nelson River sockeye salmon were available from 1970 to the present. Recent run data (Table 1) were examined to determine if a change in the escapement goal was justified. The run data from 2006-2008 were similar to the recent past so the team agreed that no further analysis was necessary.

Bear Lake

Escapement goal background and previous review

Bear Lake is located in the Bear River Section of the Northern District (Figures 2 and 3). The first published escapement goals for Bear Lake were developed in late 1960s and set as SEGs with ranges of 150,000 to 175,000 sockeye salmon for the early run; 50,000 to 75,000 sockeye salmon for the late run; and a total run SEG range of 200,000 to 250,000 sockeye salmon (Nelson and Lloyd 2001). Tower counts were used to estimate escapement into Bear River from 1964 to 1985 and a weir has been used from 1989 to the present.

An escapement goal review of this system conducted during 2003 using the Ricker spawner-recruit model, percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area method indicated that the escapement goal range should be increased to 293,000 to 488,000 sockeye salmon for the total Bear Lake run (176,000 to 293,000 for the early run; 117,000 to 195,000 for the late run; Nelson et al. 2006). The 2006 escapement goal review analysis also utilized the Ricker spawner-recruit model, percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area methods to analyze data; these methods corroborated the SEGs established in 2003 and no changes were made to the Bear Lake escapement goals (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates were not available for early-run Bear Lake sockeye salmon; therefore, recent escapement data (Table 1) were examined to determine if a change in the escapement goal was justified. Escapement and harvest data were examined for the late run; however, the three additional years of run data were not expected to change the results of the previous spawner-recruit analysis. The team agreed that no further analysis was necessary for the Bear Lake runs.

Sandy River

Escapement goal background and previous review

Sandy River is located in the Bear River Section of the Northern District (Figures 2 and 3). An aerial indexed total escapement goal range of 20,000 to 30,000 was developed in the 1970s (Nelson and Lloyd 2001). In 1994, a weir was established for Sandy River and the goal range was doubled to 40,000 to 60,000 to account for more complete counts made at the weir (Nelson and Lloyd 2001). An escapement goal review of this system conducted during 2003 using the percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area method concluded that because of data uncertainty and that the established SEG produced sufficient returns of escapement and harvest, no change in the SEG was warranted (Nelson et al. 2006). The 2006 escapement goal review using the percentile method with weir and aerial survey count data recommended changing the SEG range to 34,000 to 74,000 fish (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Sandy River sockeye salmon were not available. Recent escapement estimates (Table 1) and age compositions were examined to determine if a change in the escapement goal was justified. The run and age data from 2006-2008 were similar to the recent past so the team agreed that no further analysis was necessary.

Ilnik River

Escapement goal background and previous review

The Ilnik River is located in the Ilnik Section of the Northern District and consists of four distinct spawning populations: Ilnik River, Willie Creek, Ocean River, and Wildman Lake (Figures 2 and 3). The current SEG for the Ilnik River system was developed in 1991 and set at 40,000 to 60,000 sockeye salmon (Nelson and Lloyd 2001). Aerial surveys were used to estimate escapement into the Ilnik River system from 1960 through 1990 and a weir was used from 1991 through the present. An escapement goal review of this system conducted during 2003 using the percentile method, euphotic volume analysis, smolt biomass as a function of zooplankton biomass, and lake surface area method concluded that the current escapement goals had produced sufficient returns and found that no change was warranted (Nelson et al. 2006). The 2006 escapement goal review using the percentile method with weir count data corroborated the existing SEG (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Ilnik River sockeye salmon were not available. Recent escapement estimates (Table 1) and age compositions were examined to determine if a change in

the escapement goal was justified. The run and age data from 2006-2008 were similar to the recent past so the team agreed that no further analysis was necessary.

Meshik River

Escapement goal background and previous review

Meshik River is located in the Inner Port Heiden Section of the Northern District (Figures 2 and 3). The SEG range of 10,000 to 20,000 was initially established in the late 1980s and was based on average peak escapements (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into Meshik River from 1960 through the present. An escapement goal review of this system conducted during 2003 using the percentile method concluded that the analysis reasonably corroborated the existing SEG and no change was warranted (Nelson et al. 2006). Following the 2006 escapement goal review using the percentile method, it was recommended to increase the Meshik River SEG to 20,000 to 60,000 fish; this change was implemented to reflect increased aerial survey effort and the subsequent increased sockeye salmon escapement estimates (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Meshik River sockeye salmon were not available. Recent escapement estimates (Table 1) were examined with the percentile method to determine if a change in the escapement goal was justified. Given recent increases in fishing opportunity and the close proximity of the Red Bluff and Yellow Bluff creeks, which, due to a shared estuarine area cannot be managed independently of the Meshik River, the team examined the combined data from these three systems with the percentile method to better examine current escapement trends. Review of nearby Highland and Charles creeks, which also share the estuarine area, indicated escapement into these systems did not significantly contribute to the overall escapement and were not included in the analyses.

Cinder River

Escapement goal background and previous review

Cinder River is located in the Cinder River Section of the Northern District (Figures 2 and 3). The SEG range of 6,000 to 12,000 was initially established in the late 1980s and was based on average peak escapements (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into Cinder River from 1960 through the present. An escapement goal review of this system conducted during 2003 using the percentile method concluded that the analysis reasonably corroborated the existing SEG and no change was warranted (Nelson et al. 2006). Following the 2006 escapement goal review, also using the percentile method, it was recommended to increase the Cinder River SEG to 12,000 to 48,000 fish; this change was implemented to reflect increased aerial survey effort and the subsequent increased sockeye salmon escapement estimates (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Cinder River sockeye salmon were not available. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified. Nearby Mud Creek and Cinder River share the same outlet; therefore, Mud Creek cannot be managed independently of the Cinder River if a fishery were opened in the Cinder River Section. Therefore, the team examined whether annual escapement from the two streams

were correlated and if the combined data from these two systems, applied to the percentile method, would better reflect current escapement trends in the event of a directed fishery.

McLees Lake

Escapement goal background and previous review

McLees Lake is located in the Unalaska District within the Aleutian Islands Management Area (Figure 4). The first published escapement goal for McLees Lake was developed in 1993 and a range was set at 4,000 to 6,000 sockeye salmon based on spawning capacity (Nelson and Lloyd 2001). Aerial surveys have been used to estimate escapement into McLees on a limited basis from 1967 to 2003 and a weir has been operated by the USFWS since 2001. No sockeye salmon were observed during aerial surveys of McLees Lake until 1974. An escapement goal review of this system conducted during 2003 using the percentile method from aerial survey numbers concluded that with limited aerial survey estimates, few years of weir counts, and no history of management action ever exercised, the goal would be eliminated but reevaluated in three years (Nelson et al. 2006). In 2006, the McLees Lake system was reevaluated with the percentile approach and it was determined that no goal was justified; however, the McLees Lake sockeye salmon system would be reassessed pending the collection of additional stock assessment data (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for McLees Lake sockeye salmon were not available; there is little or no commercial activity on the stock and much of the limited harvest is taken by subsistence users from the Dutch Harbor/Unalaska area. Weir operation has occurred annually since 2001 with a high probability of continued funding into the future. Pending the operation of a weir and subsequent collection of reliable escapement data, the team determined that an escapement goal should be implemented if a weir will be operated; thus, a goal is warranted. The percentile approach was performed with the additional 2006 to 2008 escapement data.

COHO SALMON

Thin Point Lake

Escapement goal background and previous review

Thin Point Lake is located in the Thin Point Section of the Southwestern District (Figures 2 and 3). The first published escapement goal for Thin Point Lake coho salmon was developed in 1993 and a range was set at 3,000 to 6,000 fish (Nelson and Lloyd 2001). Aerial surveys were used to estimate coho salmon escapement into Thin Point Lake from 1968 through the present. An escapement goal review of this system conducted during 2003 resulted in the team recommendation to retain only the lower end (3,000) of the SEG to be used as a threshold to alert managers to potential overharvest or changes in productivity because of the lack of reliable escapement data (Nelson et al. 2006). The 2006 escapement goal review of the Thin Point coho salmon escapement goal was limited by data too poor and insufficient to estimate an SEG; therefore, no change was warranted for the SEG threshold (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Thin Point Lake coho salmon were not available. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified, but the team agreed that no further analysis was necessary.

Nelson River

Escapement goal background and previous review

Nelson River is located in the Nelson Lagoon Section of the Northern District (Figures 2 and 3). The first published escapement goal for Nelson River coho salmon was developed in the early 1980s and a range was set at 18,000 to 25,000 fish (Nelson and Lloyd 2001). Aerial surveys were used to estimate coho salmon escapement into Nelson River from 1968 through the present. An escapement goal review of this system conducted during 2003 using a risk analysis concluded that the lower end (18,000) of the existing goal was appropriate as a threshold (Nelson et al. 2006). The 2006 escapement goal review of the Nelson River coho salmon escapement goal was limited by data too poor and insufficient to estimate an SEG; therefore, no change was warranted for the SEG threshold (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates were not available for the Nelson River coho salmon fisheries. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified, but the team agreed that no further analysis was necessary.

Ilnik River

Escapement goal background and previous review

An Ilnik River coho salmon SEG of 10,000 to 19,000 was adopted in 1993 (Table 1; Appendix F). This goal was eliminated following the 2004 escapement goal review. Historical aerial survey escapement estimates were often sporadic, due to airplane availability, poor weather, or the frequent turbid conditions in the Ilnik River. Escapement estimates during that time were generally below the SEG, likely due to the poor aerial survey coverage. Sport fishing effort has recently increased and there has been some directed commercial fishing effort, upon which management decisions have been made. Aerial survey effort has increased in recent years and subsequent escapement estimates have also increased.

2009 review

Risk analysis was performed on Ilnik River coho salmon data from 1985 through 2008. Other tributaries in the Ilnik River system including Ocean River were considered to be part of the analyses; however, Ocean River escapement estimates were too sporadic and were therefore left out of the analyses.

PINK SALMON

Pink salmon escapement estimates in Area M are based on aerial surveys of spawning fish from fixed-wing aircraft. Each year since 1968, pink salmon have been counted during one or more flights along the Alaska Peninsula area (Figure 1). Total indexed escapement estimates were calculated by Area M management biologists, with estimation techniques outlined in Shaul and Dinnocenzo (2003).

South Peninsula

Escapement goal background and previous review

Even- and odd-year pink salmon escapement goals by district were first established in 1992 (Nelson and Lloyd 2001). The sum of the district escapement goal ranges for the South Peninsula was 1,864,600 to 3,729,300 fish in even-years and 1,637,800 to 3,275,700 fish in odd-

years. The difference between even and odd-year escapement goals was due to higher even-year escapement goals in the Southwestern and Unimak Districts.

Stock specific catch data are not available in this area. Because of this, during a 2003 review of escapement goals (Nelson et al. 2006), the district total indexed escapement estimates were aggregated into a single South Peninsula areawide escapement that was used, along with the total pink salmon catch of the South Peninsula, to develop a single Ricker spawner-recruit model (Ricker 1954). Ricker spawner-recruit models were developed from even-year, odd-year and combined even- and odd-year escapement and catch data. The model developed using the combined even- and odd-year escapement and catch data was considered the best model (Nelson et al. 2006). The results from this model corroborated the aggregate even-and odd-year goals (sum of the district escapement goal ranges), which were then designated BEGs (Nelson et al. 2006). The 2006 escapement goal review of South Peninsula pink salmon followed the same methods as the 2003 review with the addition of 2004 and 2005 data. No change was recommended to the escapement goal range; however, the goal was reclassified as an SEG because it was based on aerial survey data (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for South Peninsula pink salmon were not available. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified, but the team agreed that no further analysis was necessary.

Bechevin Bay

Escapement goal background and previous review

The Bechevin Bay Section (Figure 2) pink salmon escapement goals were established in 1992; the even-year goal range was 33,200 to 66,400 fish and the odd-year goal range was 2,400 to 4,800 fish (Nelson and Lloyd 2001). These escapement goals were changed during an escapement goal review in 2003, retaining only lower ranges of the escapement goals of 31,000 and 1,600 for even- and odd-years, respectively (Nelson et al. 2006).

In 2003, even- and odd-year pink salmon escapement goal estimates were calculated using a risk analysis approach (Nelson et al. 2006). This technique was developed for stocks that are caught incidentally during more dominant fisheries. The escapement goal is established to minimize the need to disrupt the more dominate fishery, while maintaining a sustainable population of the less dominant stock (Bernard et al. 2009). The 2006 escapement goal review of South Peninsula pink salmon followed the same methods as during the 2003 review with the addition of 2004 and 2005 data. No change was recommended to the escapement goal threshold (Honnold et al. 2007).

2009 review

Stock-specific harvest estimates for Bechevin Bay pink salmon were not available. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified, but the team agreed that no further analysis was necessary.

CHUM SALMON

Chum salmon escapement estimates in Area M are based primarily on aerial surveys of spawning fish as observed from fixed-wing aircraft. Total indexed escapement estimates were calculated by Area M management biologists, with estimation techniques outlined in Shaul and Dinnocenzo (2003).

South Peninsula

Escapement goal background and previous review

Chum salmon escapement goals, aggregated by district, were established in 1992 (Nelson and Lloyd 2001) and remained unchanged after the previous escapement goal review in 2003 (Nelson et al. 2006). The 2006 escapement goal review of South Peninsula chum salmon corroborated the original goals with the exception of Unimak District fish, which was changed from an SEG to an SEG threshold after review of risk analysis results (Honnold et al. 2007). The current chum salmon escapement goal ranges are: Southeastern District - 106,400 to 212,800 fish; South Central District - 89,800 to 179,600 fish; Southwestern District - 133,400 to 266,800 fish and Unimak District - 800 fish threshold (Table 1).

2009 review

Stock-specific harvest estimates for South Peninsula chum salmon were not available. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified, but the team agreed that no further analysis was necessary.

North Peninsula

Escapement goal background and previous review

Chum salmon escapement goals, aggregated by district, were set in 1992 at ranges of 223,600 to 447,200 for the Northwestern District and 119,600 to 239,200 for the Northern District (Nelson and Lloyd 2001). Based on separate Ricker spawner-recruit analyses during the 2003 escapement goal review, the Northwestern District escapement goal was changed to a BEG of 100,000 to 215,000 fish and no change was recommended for the Northern District BEG (Nelson et al. 2006). The 2006 escapement goal review of North Peninsula chum salmon also used Ricker spawner-recruit models to analyze the available data. No changes were made to the goal ranges; however, the escapement goals were changed from BEGs to SEGs as aerial survey data were used to provide indices of escapement rather than total escapement estimates.

2009 review

Stock-specific harvest estimates for North Peninsula chum salmon were not available. Recent escapement estimates (Table 1) were examined to determine if a change in the escapement goal was justified, but the team agreed that no further analysis was necessary.

RESULTS

The comprehensive review of the 26 existing Area M salmon escapement goals resulted in recommendations to change 1 goal, leave 25 goals unchanged, and create 2 goals. The team determined that it was unnecessary to include the full data set for those systems which did not warrant review in 2009 and therefore, only the full data set and analyses for systems that warranted further analysis, elimination, addition, or change of an escapement goal are included in this report. Systems that did not warrant a change to their goals because either their escapement levels have consistently met their goals or have been comparable over the last three years and therefore, did not require further analysis are as follows: 9 sockeye salmon systems that include Orzinski, Bear (two stocks), and Thin Point lakes; Mortensens and Christianson lagoons; Nelson, Sandy, Ilnik rivers; and 6 chum salmon aggregates, 4 pink salmon aggregates, and 2 coho salmon goals at Thin Point Lake and Nelson River. One Chinook salmon biological escapement goal (Nelson River) also did not warrant change. The full data set and analyses are

presented for 5 sockeye salmon systems (North Creek, Cinder and Meshik rivers, Swanson's Lagoon, and McLees Lake) and 1 coho salmon system at Ilnik River.

BIOLOGICAL ESCAPEMENT GOAL ESTIMATES

No systems with BEGs warranted further analysis.

SUSTAINABLE ESCAPEMENT GOAL ESTIMATES

Sockeye Salmon

Swanson Lagoon

Stock Status

An escapement goal review of this system conducted during 2003 using the percentile method concluded that the analysis reasonably corroborated the previous SEG (8,000 to 16,000 fish) and no change was warranted (Nelson et al. 2006). Following the 2006 escapement goal review using the percentile method, it was recommended to change the Swanson Lagoon SEG to 6,000 to 16,000 fish; this change was implemented to adjust for the difficulty in estimating escapement because of inclement weather conditions and poor visibility in the lagoon (Honnold et al. 2007). Estimated escapements were generally within the SEG range during 1991 to 2003, although escapements were often near the lower end. With the exceptions of 2004 and 2007, escapements from 2004 to 2008 were below the lower SEG range of 6,000 fish (Appendices A1 to A3).

Evaluation of Recent Data

An SEG for Swanson Lagoon sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1990 to 2008 to address observed changes in escapement levels. The escapement estimates showed high contrast (329) and exploitation of this stock has been low in recent years. The estimated SEG range using this approach was from 5,400 to 11,000 fish for the 1990 to 2008 data (15th to 75th percentiles).

Escapement Goal Recommendation

According to area managers it is difficult to estimate escapement in this system using aerial surveys because of inclement weather conditions and poor visibility. Swanson Lagoon survey effort usually coincides with that of Christianson Lagoon which precludes surveys during the peak of the Swanson Lagoon run. Given the percentile method results, the team recommended maintaining the current SEG of 6,000 to 16,000 fish.

North Creek

Stock Status

The current North Creek sockeye salmon escapement goal of 4,400 to 8,800 fish (Table 1; Appendix B1) was established in the late 1980s based on aerial survey estimates. Escapement goal reviews in 2003 and 2006 using the percentile method supported the current escapement goal range and concluded no change to the SEG was warranted. Although the water clarity of North Creek compromises inseason escapement estimates, the upper reaches of the system where fish spawn provide good post-season estimates. Since 1990, escapement estimates in 10 years have exceeded the upper range of the goal, with the largest estimated escapements occurring in 2005, 2007, and 2008 (Appendices B2 and B3).

Evaluation of Recent Data

An SEG for North Creek sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1974 to 2008 to address recent observed changes in escapement levels. The escapement estimates showed high contrast (90) and exploitation of this stock is relatively high. The estimated SEG range using this approach was from 3,400 to 9,525 fish for the 1974 to 2008 data (25th to 75th percentiles).

Escapement Goal Recommendation

With the addition of 2006 to 2008 escapement estimates, the percentile method still supported the established escapement goal. Team members believe the current goal range works well and allows for future fishery changes, therefore the team recommended maintaining the current SEG of 4,400 to 8,800 fish.

Meshik River

Stock Status

The current Meshik River sockeye salmon escapement goal is 20,000 to 60,000 fish (Table 1; Appendix C1). This goal was implemented in 2006. Since the early 1980s, estimated escapements were generally within or above the escapement goals and escapement estimates have apparently increased in recent years due to increased aerial surveying effort. In 2007, the BOF allowed additional fishing time in the Inner Port Heiden Section, which would affect escapement to the Meshik River. The current Meshik River sockeye salmon escapement goal does not consider escapement to Red Bluff and Yellow Bluff creeks, which contribute a substantial number of fish to the total escapement transiting the Port Heiden area (generally on the order of 25%) and cannot be managed separately from Meshik River sockeye salmon escapement.

Evaluation of Recent Data

An SEG for Meshik River sockeye salmon was estimated and compared to an SEG for the combined escapements of the Meshik River, Red Bluff Creek, and Yellow Bluff Creek according to the percentile algorithm using aerial survey escapement estimates from 1990 to 2008. High contrast in the escapement estimates (131 for Meshik alone and 367 for combined river systems) and low exploitation of this stock resulted in an SEG of 27,000 to 94,000 fish for the Meshik River alone and an SEG of 29,000 to 108,000 fish for the combined escapements (15th to 75th percentiles; Table 1; Appendices C2 and C3).

Escapement Goal Recommendation

With the inclusion of the Red Bluff and Yellow Bluff creeks escapement, the upper range of the 75th percentile of escapement increased substantially, suggesting the need for increasing the upper and lower bounds of the escapement goal. Because of the increased aerial surveying effort and the need to account for the contribution of Red Bluff Creek and Yellow Bluff Creek sockeye salmon escapement, the team recommended changing the Meshik River escapement goals from an SEG of 20,000 to 60,000 fish to an SEG of 25,000 to 100,000 fish.

Cinder River

Stock Status

The current Cinder River sockeye salmon escapement goal is 12,000 to 48,000 fish (Table 1; Appendix D1). This goal was implemented in late 2006. Since 1970, estimated escapements were extremely variable, ranging from below the SEG range to well in excess of the SEG range. Aerial survey effort has increased in recent years to both the Cinder River and Mud Creek, which share the same outlet and cannot be managed separately. Escapement estimates are available for Mud Creek only from 2003-2008, during which four of the five largest escapements to Cinder River have occurred with Mud Creek contributing approximately 5% to 48% of the total escapement to both systems. Past escapement goal reviews have not included Mud Creek escapement with Cinder River escapement.

Evaluation of Recent Data

An SEG for Cinder River sockeye salmon was estimated and compared to an SEG for the combined escapements of the Cinder River and Mud Creek according to the percentile algorithm using aerial survey escapement estimates from 1990 to 2008. High contrast in the escapement estimates (968 for Cinder alone and 12 for combined river systems) and low exploitation of this stock resulted in an SEG of 12,000 to 83,000 fish for the Cinder River alone, and an SEG of 90,000 to 138,000 fish for the combined escapements (15th to 75th percentiles; Table 1; Appendices D2 and D3).

Escapement Goal Recommendation

With the inclusion of the Mud Creek escapement, the upper range of the 75th percentile of escapement increased substantially, suggesting the need for increasing the upper and lower bounds of the escapement goal. However, because of the inconsistent relationship between the two streams, the lack of sufficient years of aerial survey data from Mud Creek, and absence of a directed fishery, the team recommended not changing the Cinder River escapement SEG of 12,000 to 48,000 fish. The team recommended revisiting the goal when future years of directed aerial survey data are available.

McLees Lake

Stock Status

Currently, no escapement goal exists for McLees Lake sockeye salmon. The first published escapement goal for McLees Lake was developed in 1993 and set at 4,000 to 6,000 sockeye salmon based on spawning capacity (Nelson and Lloyd 2001); however, this goal was eliminated in 2003 (Appendix E1). With consistent weir operation since 2001, sockeye salmon escapement counts have averaged about 43,000; however, they have varied considerably (Appendices E2 and E3). Honnold et al. (1996) estimated sockeye salmon production potential at McLees Lake based on surface area (22,000 fish) and the EV model (36,800 fish).

Evaluation of Recent Data

An SEG for McLees Lake sockeye salmon was estimated according to the percentile algorithm using weir escapement estimates from 2001-2008. High contrast in the escapement estimates (8) and low exploitation of this stock using data from 2001-2008 resulted in an SEG of 12,000 to 59,000 fish for the 2001 to 2008 data (15th to 75th percentiles; Appendix E2 and E3). These figures were compared to the historical goal and estimates of production potential.

Escapement Goal Recommendation

From the time the weir was first installed at McLees Lake in 2001 until 2004, the average sockeye salmon annual escapement was 71,000 fish. The magnitude of production from a lake the size of McLees was unexpected. Since that time (2005-2008) the average annual escapement has only been 14,000 fish prompting conservation concerns. Our knowledge of McLees Lake sockeye salmon is limited and thus a wide escapement goal range, representative of our uncertainty about this stock, would be appropriate. The team recommended reestablishing the McLees Lake sockeye salmon escapement goal to an SEG of 10,000 to 60,000 fish.

With reliable collection of escapement data via the weir, reestablishment of an SEG is needed. In the absence of weir operations, aerial surveys would be the only method of indexing the escapement. Geographic limitations and poor quality survey data historically would preclude the need for a goal in this situation. Therefore the SEG of 10,000 to 60,000 fish will apply during years when the weir at McLees Lake is operated, with no SEG in the absence of a weir.

Coho Salmon

Ilnik River

Stock Status

There is currently no escapement goal for Ilnik River coho salmon; however, increased sport fishing effort and consistent commercial effort in recent years has resulted in increased aerial survey effort, better escapement estimates, and the renewed need for an escapement goal. Recent escapement estimates have been well above the previously established goal of 10,000 to 19,000, (eliminated in 2004) averaging 23,000 during 2006-2008 (Appendix F1 through F3; range: 19,000 to 27,000 fish).

Evaluation of Recent Data

Ilnik River coho salmon escapement data from 1985 to 2008 were assessed with the percentile and risk analysis methods. The percentile method using the 15^{th} to 75^{th} percentiles yielded an SEG range of 6,600 to 27,500 fish. The risk analysis yielded an SEG threshold of 8,700 fish (Appendix F4).

Escapement Goal Recommendation

With the increase of sport fishery harvest and the use of coho salmon catch per unit effort data to make management decisions, the team recommended an SEG threshold of 9,000 fish based on the risk analysis for Ilnik River.

DISCUSSION

Establishing prudent escapement goals is an evolving process, not only because each year provides more data, but also because methods to determine such goals are becoming more standardized and well documented. The SSFP and EGP are important steps in this evolution. Ideally, escapement goals should be based in part on ecological theory, principles of sustained yield, and empirical observations (Ricker 1954).

The methodologies used in this escapement goal evaluation were limited by the available data. Stock-specific catch data were not available for any stocks in Area M, with the exception of Nelson River Chinook and sockeye salmon, and Bear Lake late-run sockeye salmon. Further, because of the geographic location of the Alaska Peninsula and the large number of stocks

present throughout the commercial fishing season, it is likely that stock-specific data will never be available. While six systems in Area M currently have weirs for direct enumeration of escapement and are easily accessible for collection of representative age data, escapement estimates for the remaining systems are determined via aerial survey observations. Aerial survey escapement estimates will always be inaccurate and imprecise due to weather conditions, differences between observers, and logistical limitations. Therefore, while these estimates are valuable for assessing large-scale changes in production, it will probably never be possible to reliably estimate robust production parameters from these data.

Because the percentile algorithm worked well in a previous escapement goal review of Upper Cook Inlet (Bue and Hasbrouck *Unpublished*), the team agreed that this approach should be attempted for all systems in Area M without BEG-quality data. In many cases, the SEG results from this approach corroborated current goals that have provided for sustainable yields. Because Area M salmon escapements have often been the result of management actions rather than stock productivity, data evaluation using other methods besides the percentile algorithm is recommended when possible for future Area M escapement goal reviews.

This comprehensive review of the 26 existing salmon escapement goals in Area M resulted in recommendations to change 1 goal, leave 25 goals unchanged, and create 2 goals. For the most part, the changes were relatively minor and should not have noticeable effects on future management decisions.

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TABLES AND FIGURES

Table 1.–Current escapement goals, escapements observed from 2006 through 2008, and escapement goal recommendations in 2009 for Chinook, sockeye, coho, pink, and chum salmon stocks of the Alaska Peninsula Management and Aleutian Islands Areas.

System	Escapement Data[a]	Current Escapement Goal Type (BEG, SEG)	Range			Escapements 2006	2007	2008	2009 Recommendation
Chinook Salmon									
Nelson River	WC/PAS	BEG	2,400	to	4,400	2,516	2,492	5,012	No change
Sockeye Salmon									
Orzinski Lake	WC	SEG	15,000	to	20,000	18,000	10,643	36,839	No change
Thin Point Lake	PAS	SEG	14,000	to	28,000	11,510	21,550	18,900	No change
Mortensens Lagoon	PAS	SEG	3,200	to	6,400	14,688	6,200	5,600	No change
Christianson Lagoon	PAS	SEG	25,000	to	50,000	41,505	48,075	114,000	No change
Swanson Lagoon	PAS	SEG	6,000	to	16,000	376	9,200	5,500	No change
North Creek	PAS	SEG	4,400	to	8,800	7,530	16,800	38,000	No change
Nelson River	WC	BEG	97,000	to	219,000	215,000	180,000	141,600	No change
Bear Lake									
Early	WC	SEG	176,000	to	293,000	262,995	206,233	125,526	No change
Late	WC	SEG	117,000	to	195,000	182,005	224,767	195,474	No change
Sandy River	WC	SEG	34,000	to	74,000	48,000	44,700	32,200	No change
Ilnik River	WC	SEG	40,000	to	60,000	75,000	79,000	44,300	No change
Meshik River	PAS	SEG	20,000	to	60,000	114,010	45,400	61,250	Change: SEG 25,000-100,000
Cinder River	PAS	SEG	12,000	to	48,000	52,100	123,000	96,800	No change
McLees Lake	WC/PAS	None				12,936	21,428	8,661	Create: SEG 10,000 - 60,000[b]
Coho Salmon									
Thin Point Lake	PAS	SEG	3,000			9,750	9,000	3,200	No change
Nelson River	PAS	SEG	18,000			19,000	19,000	24,000	No change
Ilnik River	PAS	None				27,000	19,000	22,000	Create: SEG Threshold 9,000

-continued-

Table 1.–Page 2 of 2.

System	Escapement Data[a]	Escapement Goal Type (BEG, SEG)	Range			Escapements 2006	2007	2008	2009 Recommendation
Pink Salmon									
South Peninsula Total -even years	PAS	SEG	1,864,600	to	3,729,300	2,862,250		3,338,370	No change
South Peninsula Total -odd years	PAS	SEG	1,637,800	to	3,275,700		2,680,213		No change
Bechevin Bay Section-even years	PAS	SEG	31,000			116,075		11,900	No change
Bechevin Bay Section-odd years	PAS	SEG	1,600				16,800		No change
Chum Salmon									
Southeastern District	PAS	SEG	106,400	to	212,800	405,300	201,451	277,450	No change
South Central District	PAS	SEG	89,800	to	179,600	119,600	126,000	140,450	No change
Southwestern District	PAS	SEG	133,400	to	266,800	231,935	398,010	171,250	No change
Unimak District	PAS	SEG	800			7,915	1,200	2,800	No change
Northwestern District	PAS	SEG	100,000	to	215,000	193,460	335,450	241,750	No change
Northern District	PAS	SEG	119,600	to	239,200	382,583	243,334	228,537	No change

[a] PAS = Peak Aerial Survey; WC= Weir Count.

[b] McLees Lake sockeye salmon SEG will be in effect if a weir is in place; there will be no goal if a weir is not operated.

Table 2.–General criteria used to assess quality of data in estimating Area M salmon escapement goals.

Data Quality	**Criteria**
Excellent	Escapement, harvest, and age all estimated with relatively good accuracy and precision (i.e., escapement estimated by a weir or hydroacoustics; harvest estimated by Statewide Harvest Survey or fish tickets); escapement and return estimates can be derived for a sufficient time series to construct a brood table and estimate S_{msy}.
Good	Escapement, harvest, and age estimated with reasonably good accuracy and/or precision (i.e., escapement estimated by capture-recapture experiment or multiple foot/aerial surveys); no age data or data of questionable accuracy and/or precision; data may allow construction of brood table; data time series relatively short to accurately estimate S_{msy}.
Fair	Escapement estimated or indexed and harvest estimated with reasonably good accuracy, but precision lacking for one, if not both; no age data; data insufficient to estimate total return and construct brood table.
Poor	Escapement indexed (i.e., single foot/aerial survey) such that the index provides a fairly reliable measure of escapement; no harvest and age data.

Table 3.–Algorithm used to estimate Area M sustainable escapement goals (SEGs).

Escapement Data Contrast[a]	SEG Range
Low (<4)	15th percentile - Maximum
Medium (4 - 8)	15th and 85th percentile
High (>8) and at most low exploitation	15th and 75th percentile
High (>8) and at least moderate exploitation	25th and 75th percentile

[a] Contrast of the entire series of escapement data estimated by dividing the maximum observed escapement by the minimum observed escapement.

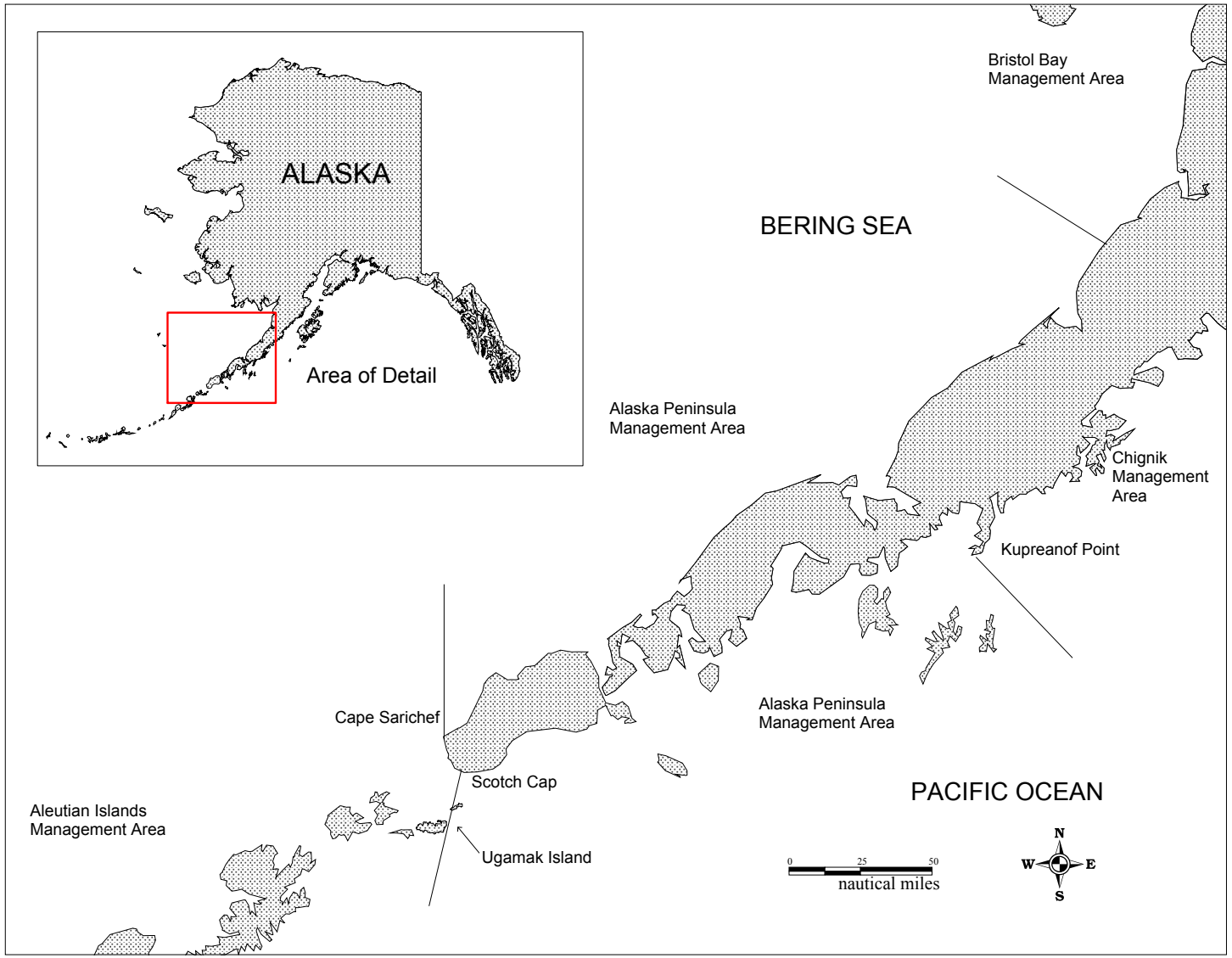


Figure 1.–Map of the Alaska Peninsula and Aleutian Islands Management Areas.

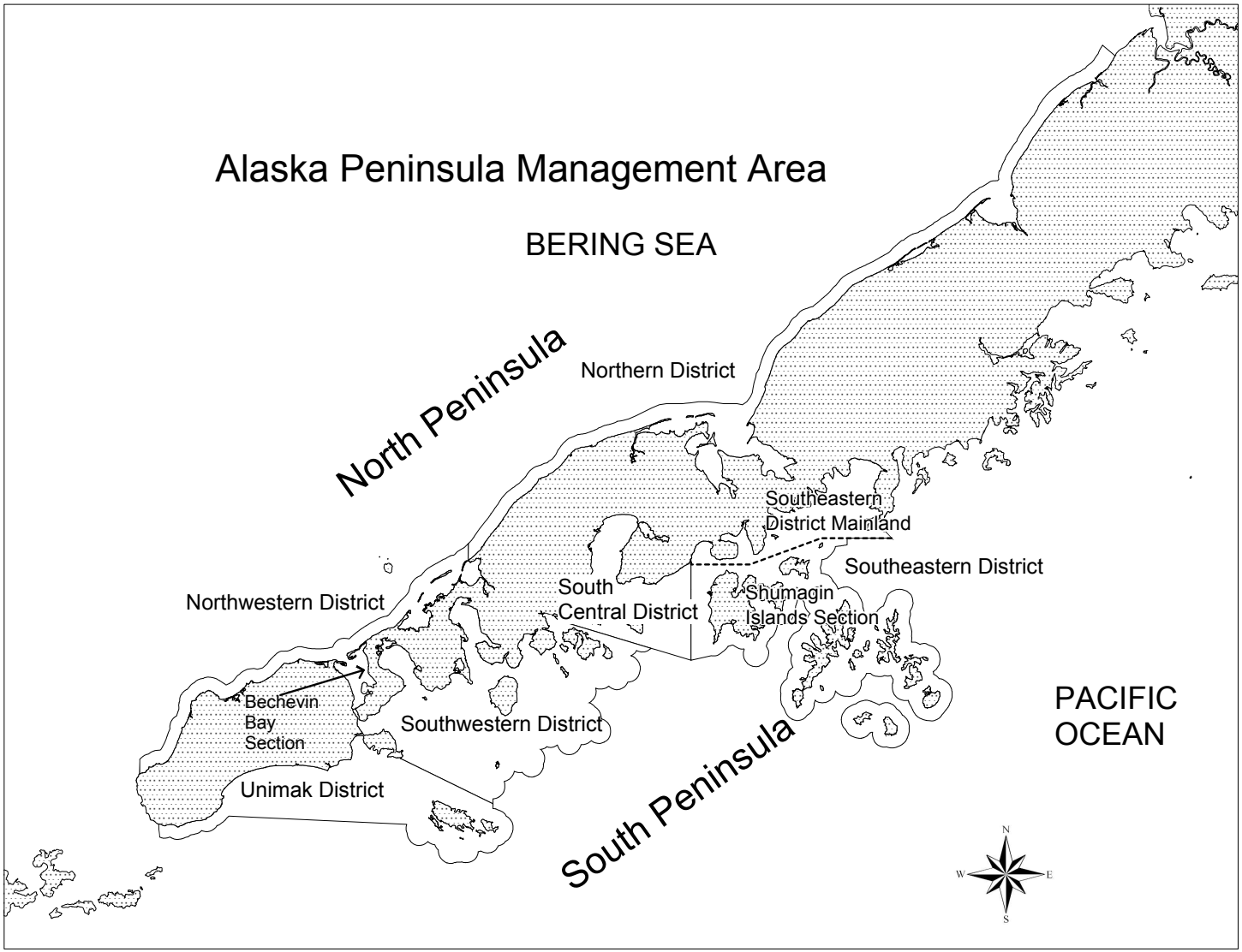


Figure 2.–Map of the Alaska Peninsula Management Area with the commercial salmon fishing districts depicted.

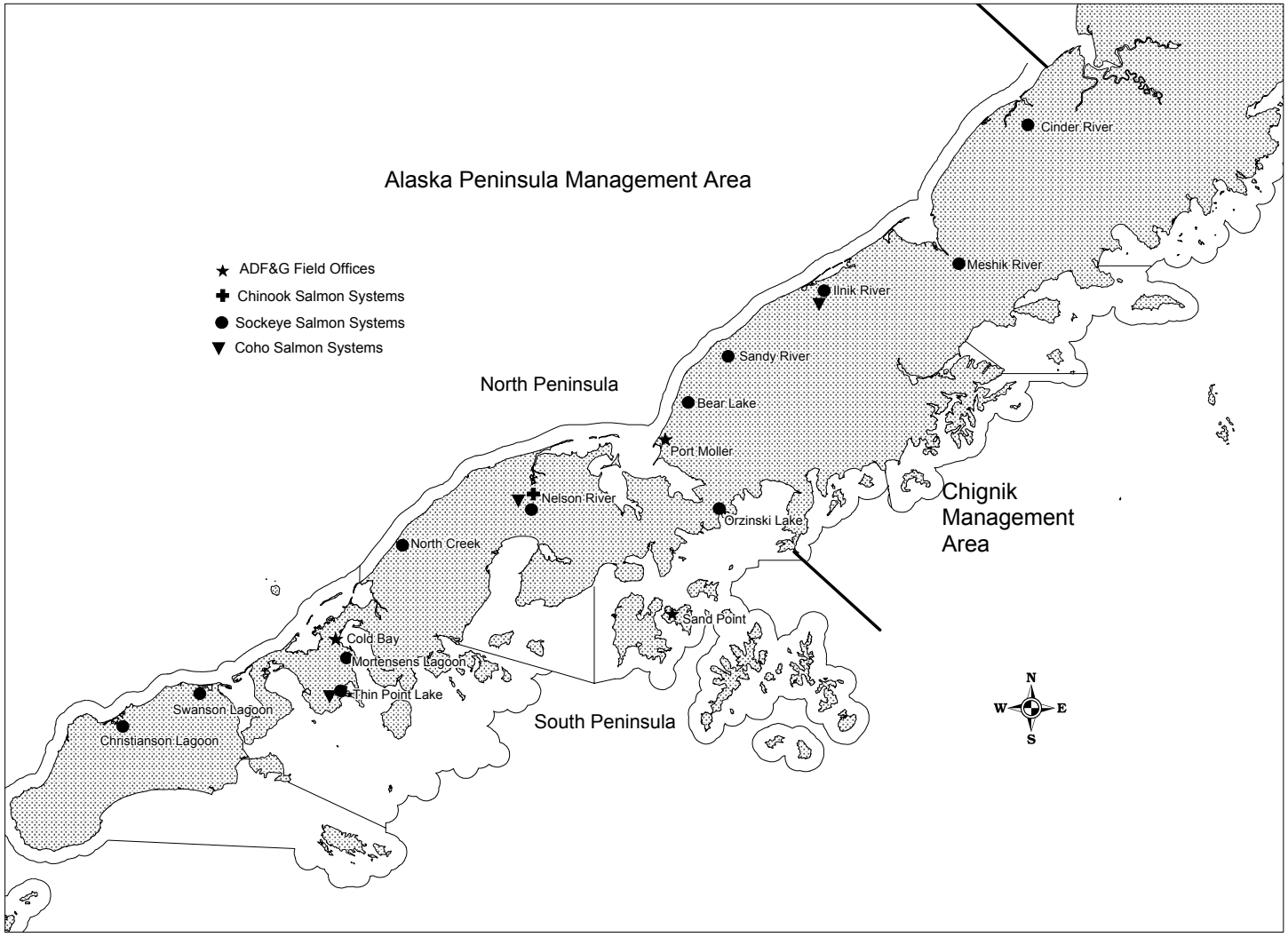


Figure 3.–Map of the Alaska Peninsula Management Area with the major sockeye, coho, and Chinook salmon systems depicted.

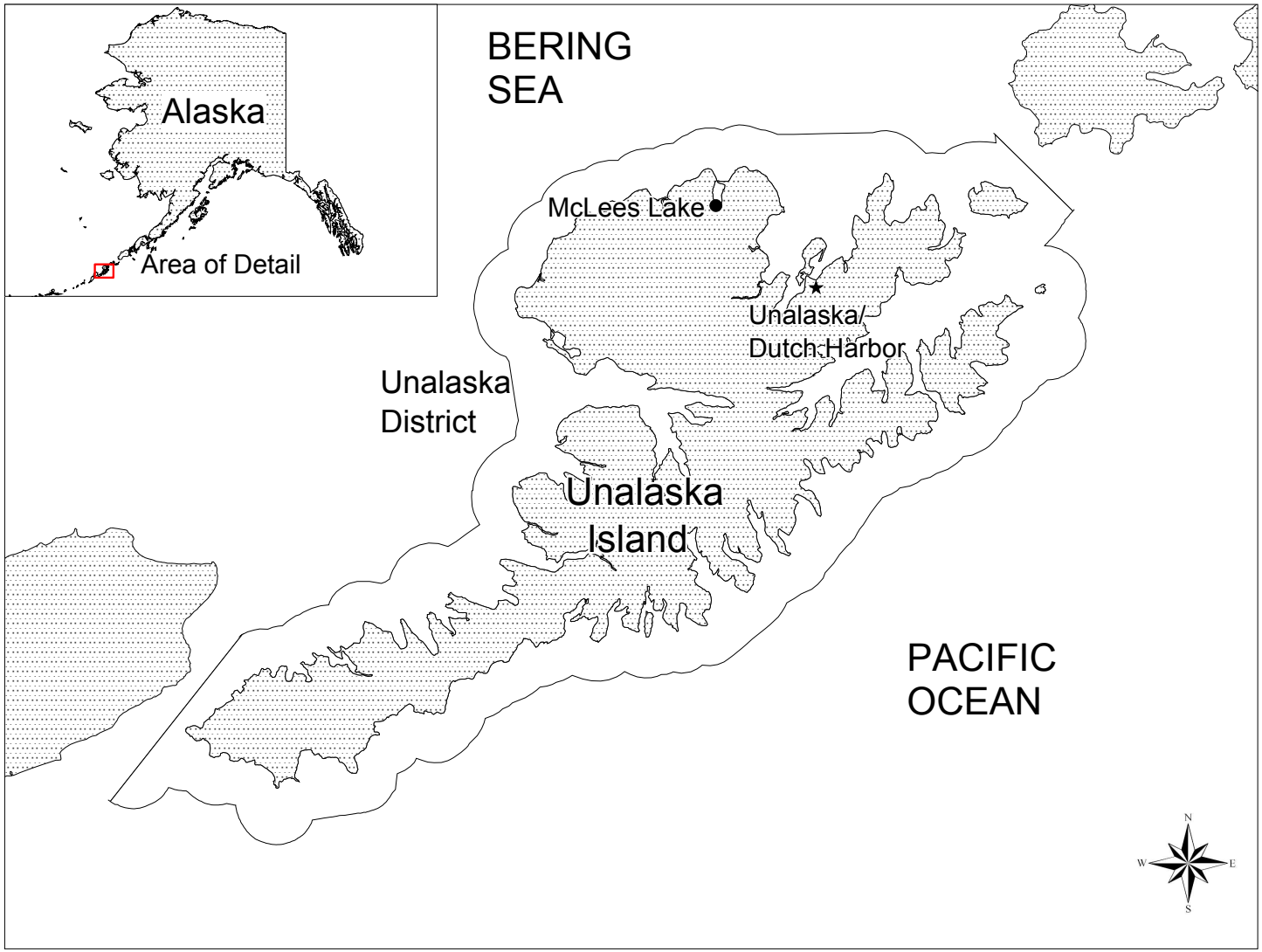


Figure 4.–Map of Unalaska Island within the Aleutian Islands Management Area with McLees Lake depicted.

APPENDIX A. SUPPORTING INFORMATION FOR THE SWANSON LAGOON SOCKEYE SALMON ESCAPEMENT GOAL

Appendix A1.–Description of stock and escapement goal for Swanson Lagoon sockeye salmon.

System: Swanson Lagoon.

Species: Sockeye salmon.

Description of stock and escapement goal.

Regulatory area:	Alaska Peninsula Management Area – Westward Region.
Management division:	Commercial Fisheries.
Primary fishery:	Commercial purse seine and set and drift gillnet.
Current escapement goal:	SEG: 6,000 to 16,000 (2006).
Recommended escapement goal:	no change recommended.
Optimal escapement goal:	none.
Inriver goal:	none.
Action points:	none.
Escapement enumeration:	Aerial survey, 1960 – present.
Data summary:	
Data quality	Poor.
Data type	Fixed-wing aerial surveys from 1960 to present. No stock specific harvest information is available.
Data contrast	329.0.
Methodology	Percentile.
Criteria for SEG	High contrast, low exploitation.
Percentiles	15^{th} to 75^{th}.
Comments	SEG estimates based on percentile approach supported current goal.

System: Swanson Lagoon.

Species: Sockeye salmon.

Data available for analysis of escapement goal.

Year	Index Escapement [a]
1970	700
1971	300
1972	200
1973	100
1974	500
1975	1,400
1976	2,600
1977	12,000
1978	8,100
1979	8,400
1980	9,700
1981	600
1982	1,800
1983	300
1984	5,500
1985	3,400
1986	7,400
1987	9,600
1988	5,700
1989	5,500
1990	32,900
1991	11,200
1992	15,400
1993	7,600
1994	9,700
1995	10,300
1996	9,300
1997	7,800
1998	5,000
1999	7,900
2000	5,700
2001	10,600
2002	10,000
2003	16,100
2004	24,300
2005	3,500
2006	376
2007	9,200
2008	5,500

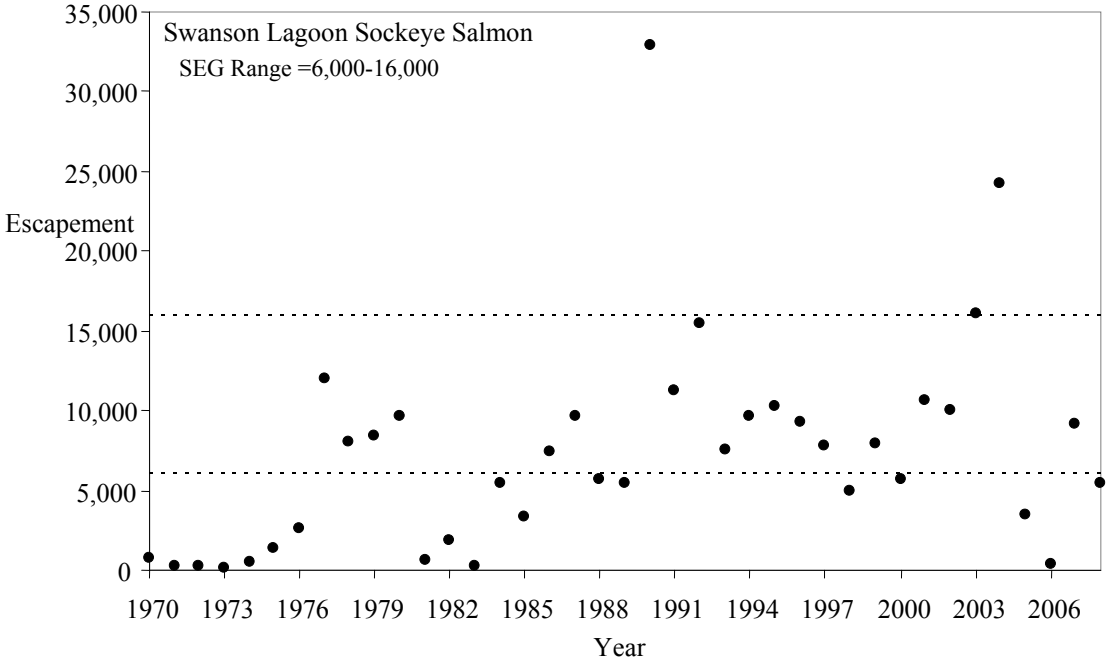
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

Appendix A3.–Swanson Lagoon sockeye salmon escapement, 1970-2008 and the current escapement goal range.

System: Swanson Lagoon.

Species: Sockeye salmon.

Observed escapement by year (solid circles) and current SEG range (dashed lines).



APPENDIX B. SUPPORTING INFORMATION FOR THE NORTH CREEK SOCKEYE SALMON ESCAPEMENT GOAL

Appendix B1.–Description of stock and escapement goal for North Creek sockeye salmon.

System: North Creek.

Species: Sockeye salmon.

Description of stock and escapement goal.

Regulatory area:	Alaska Peninsula Management Area – Westward Region.
Management division:	Commercial Fisheries.
Primary fishery:	Commercial drift and set gillnet.
Current escapement goal:	SEG: 4,400 to 8,800 (late 1980s).
Recommended escapement goal:	No change recommended.
Optimal escapement goal:	none.
Inriver goal:	none.
Action points:	none.
Escapement enumeration:	Aerial survey, 1960 – present.
Data summary:	
Data quality	Poor.
Data type	Fixed-wing aerial surveys from 1960 to present. No stock specific harvest information is available.
Data contrast	90.0.
Methodology	Percentile.
Criteria for SEG	High contrast, high exploitation.
Percentiles	25^{th} to 75^{th}.
Comments	SEG estimates based on percentile approach supported current goal.

Appendix B2.–North Creek sockeye salmon escapement, 1970-2008.

System: North Creek.

Species: Sockeye salmon.

Data available for analysis of escapement goal.

Year	Index Escapement [a]
1970	600
1971	
1972	
1973	
1974	1,800
1975	1,700
1976	7,100
1977	3,300
1978	500
1979	2,100
1980	3,400
1981	
1982	5,800
1983	2,000
1984	500
1985	3,600
1986	2,100
1987	8,300
1988	6,300
1989	7,000
1990	4,300
1991	9,000
1992	15,700
1993	9,700
1994	4,600
1995	3,400
1996	8,000
1997	5,700
1998	6,700
1999	10,900
2000	8,100
2001	8,000
2002	10,100
2003	10,200
2004	15,000
2005	45,000
2006	7,530
2007	16,800
2008	38,000

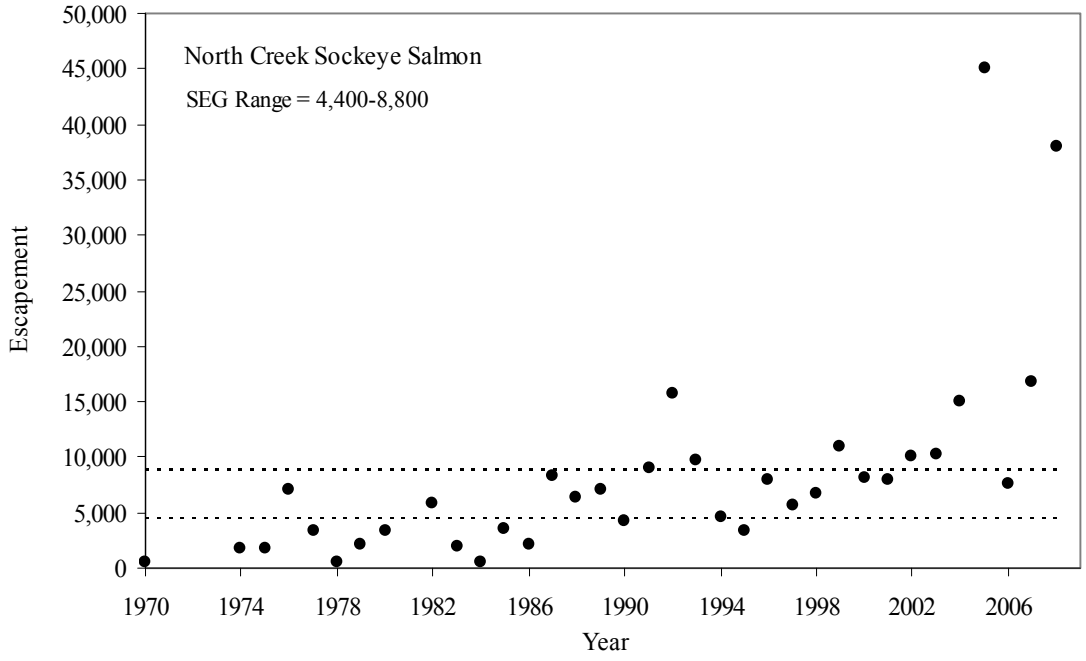
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

Appendix B3.–North Creek sockeye salmon escapement, 1970-2008 and current escapement goal range.

System: North Creek.

Species: Sockeye salmon.

Observed escapement by year (solid circles) and current SEG range (dashed lines).



APPENDIX C. SUPPORTING INFORMATION FOR THE MESHIK RIVER SOCKEYE SALMON ESCAPEMENT GOAL

Appendix C1.–Description of stock and escapement goal for Meshik River sockeye salmon.

System: Meshik River.

Species: Sockeye salmon.

Description of stock and escapement goal.

Regulatory area:	Alaska Peninsula Management Area – Westward Region.
Management division:	Commercial Fisheries.
Primary fishery:	Commercial drift and set gillnet.
Current escapement goal:	SEG: 20,000 to 60,000 (2006).
Recommended escapement goal:	SEG: 25,000 to 100,000.
Optimal escapement goal:	none.
Inriver goal:	none.
Action points:	none.
Escapement enumeration:	Aerial survey, 1970 – present.
Data summary:	
Data quality	Poor.
Data type	Fixed-wing aerial surveys from 1960 to present, missing data points throughout time period. .1990 to present includes increased aerial survey effort. .No stock-specific harvest information is available.
Data contrast	131.4 (Meshik only), 367.4 (Meshik, Red Bluff, and Yellow Bluff combined).
Methodology	Percentile.
Criteria for SEG	High contrast, low exploitation.
Percentiles	15^{th} to 75^{th}.
Comments	Inclusion of aerial survey counts of Red Bluff and Yellow Bluff creeks recommends changing SEG to 25,000 to 1000,000 to reflect better quality aerial surveys since 1990, and the inability to manage Meshik River separately from these creeks in event of increasing fishery pressure.

Appendix C2.–Meshik River sockeye salmon escapement, 1970-2008.

System: Meshik River.

Species: Sockeye salmon.

Data available for analysis of escapement goal.

Year	Meshik mainstem Index Escapement [a]	Yellow Bluff & Red Bluff Index Escapement [a]	combined Meshik system Index Escapement [a]
1970	13,100		
1971	29,300		
1972	3,700		
1973	6,500		
1974	1,200		
1975	4,800		
1976	25,500		
1977	15,100		
1978	17,900		
1979	93,100		
1980			
1981			
1982			
1983	8,850		
1984	25,500		
1985	26,500		
1986			
1987	26,300		
1988	27,000		
1989	5,700		
1990	22,550	3,650	26,200
1991	19,480	5,300	24,780
1992	21,100	11,300	32,400
1993			
1994	35,700	10,000	45,700
1995	67,600	18,000	85,600
1996	59,850	100	59,950
1997		500	500
1998	51,400	6,300	57,700
1999	62,200	12,500	74,700
2000	157,700	26,000	183,700
2001	100,500	11,500	112,000
2002	36,150		36,150
2003	94,000	20,000	114,000
2004	82,200	20,000	102,200
2005	96,100	15,000	111,100
2006	114,010	24,000	138,010
2007	45,400	11,500	56,900
2008	61,250	22,000	83,250

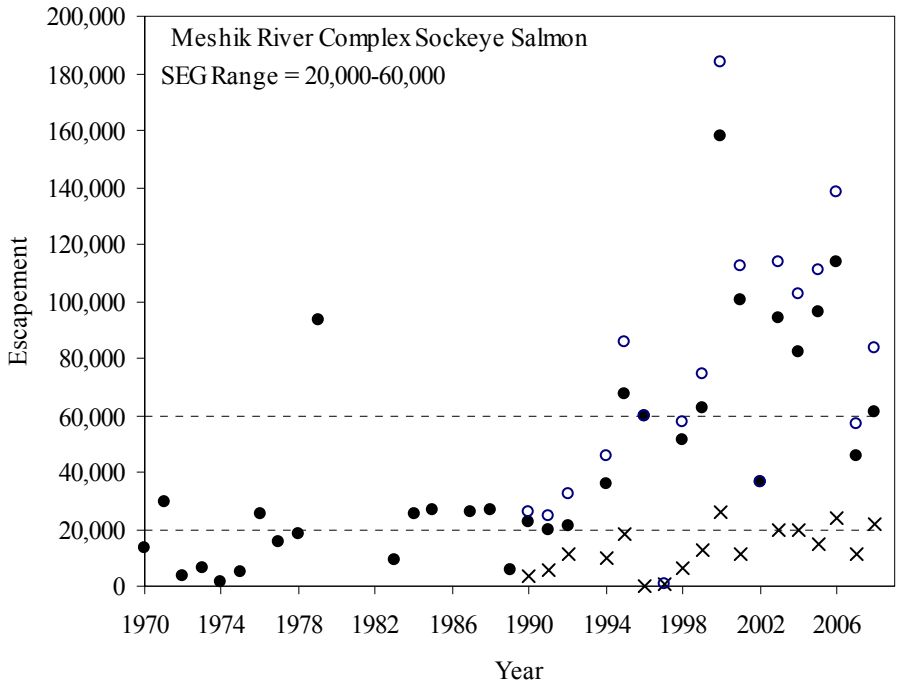
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

Appendix C3.–Meshik River sockeye salmon escapement, 1970-2008 and current escapement goal range.

System: Meshik River complex.

Species: Sockeye salmon.

Observed escapement by year (solid circles for Meshik mainstem only; Xs for Red Bluff and Yellow Bluff creeks; open circles for combined Meshik, Red Bluff, Yellow Bluff creeks) and current SEG range (dashed lines).



APPENDIX D. SUPPORTING INFORMATION FOR THE CINDER RIVER SOCKEYE SALMON ESCAPEMENT GOAL

Appendix D1.–Description of stock and escapement goal for Cinder River sockeye salmon.

System: Cinder River.

Species: Sockeye salmon.

Description of stock and escapement goal.

Regulatory area:	Alaska Peninsula Management Area – Westward Region.
Management division:	Commercial Fisheries.
Primary fishery:	Commercial drift and set gillnet.
Current escapement goal:	SEG: 12,000 to 48,000 (2006).
Recommended escapement goal:	no change recommended.
Optimal escapement goal:	none.
Inriver goal:	none.
Action points:	none.
Escapement enumeration:	Aerial survey, 1970 – present.
Data summary:	
Data quality	Poor.
Data type	Fixed-wing aerial surveys from 1960 to present, missing data points throughout time period. 1990 to present includes increased aerial survey effort. No stock-specific harvest information is available.
Data contrast	968 (Cinder only), 12.3 (Cinder River and Mud Creek combined).
Methodology	Percentile.
Criteria for SEG	High contrast, low exploitation.
Percentiles	15^{th} to 75^{th}.
Comments	Aerial surveys from 1990 to present represent better quality aerial surveys. SEG recommended using the percentile method from those years, using only Cinder River escapements due to an insufficient number of years of aerial survey data for Mud Creek. PEGRT review team recommended reanalyzing the combined goal when future years of additional aerial survey data for Mud Creek are available.

Appendix D2.–Cinder River and Mud Creek sockeye salmon escapement, 1970-2008.

System: Cinder River and Mud Creek.

Species: Sockeye salmon.

Data available for analysis of escapement goal.

Year	Cinder River Index Escapement [a]	Mud Creek Index Escapement [a]	Combined Index Escapement [a]
1970	950		
1971	2,300		
1972	450		
1973	2,250		
1974	1,300		
1975	300		
1976	8,500		
1977			
1978	3,300		
1979	5,000		
1980	23,400		
1981	100,750		
1982			
1983			
1984	10,350		
1985	11,650		
1986	25,650		
1987	127		
1988	1,800		
1989	3,950		
1990	11,850		
1991	39,300	8,100	47,400
1992	11,300	1,200	12,500
1993			
1994	83,400		83,400
1995	47,500		47,500
1996			
1997	44,000		44,000
1998	57,000		57,000
1999	12,400		12,400
2000	51,000		51,000
2001	51,204		51,204
2002	11,500		11,500
2003	88,700	14,000	102,700
2004	55,050	3,000	58,050
2005	96,100	45,000	141,100
2006	52,100	49,000	101,100
2007	123,000	19,000	142,000
2008	96,800	33,000	129,800

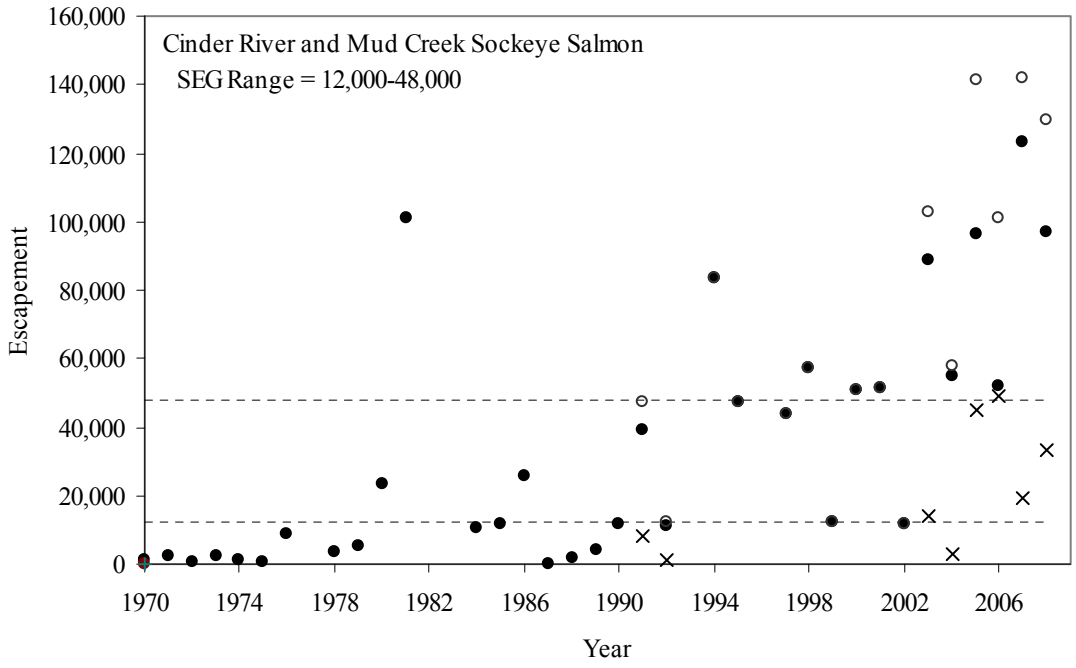
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

Appendix D3.–Cinder River and Mud Creek sockeye salmon escapement, 1970-2008 and current escapement goal range.

System: Cinder River and Mud Creek.

Species: Sockeye salmon.

Observed escapement by year (solid circles for Cinder River only; Xs for Mud Creek only; open circles for combined) and current SEG range (dashed lines).



APPENDIX E. SUPPORTING INFORMATION FOR THE MCLEES LAKE SOCKEYE SALMON ESCAPEMENT GOAL

Appendix E1.–Description of stock and escapement goal for McLees Lake sockeye salmon.

System: McLees Lake.

Species: Sockeye salmon.

Description of stock and escapement goal.

Regulatory area	Aleutian Islands – Westward Region.
Management division:	Commercial Fisheries.
Primary fishery:	Commercial purse seine.
Current escapement goal:	None (eliminated in 2004).
Recommended escapement goal:	SEG: 10,000 to 60,000 (weir only).
Optimal escapement goal:	none.
Inriver goal:	none.
Action points:	none.
Escapement enumeration:	Aerial survey, 1974– 2003.
	Weir counts, 2001 – present.
Data summary:	
Data quality	Fair for aerial survey counts, good for weir counts.
Data type	No stock specific harvest information is available.
Data contrast	349.8.
Methodology	Percentile.
Criteria for SEG	High contrast, low exploitation.
Percentiles	15^{th} to 75^{th}.
Comments	With continued weir operation and thus reliable collection of escapement data reestablishment of a goal is needed. In the absence of weir operations, aerial surveys would be the only method of indexing the escapement. Geographic limitations and poor survey data quality historically would preclude the need for a goal in this situation. The team recommends an SEG of 10,000 to 60,000 sockeye salmon in years that the weir is in place.

Appendix E2.–McLees Lake sockeye salmon escapement, 1974-2008.

System: McLees Lake.

Species: Sockeye salmon.

Data available for analysis of escapement goal.

Year	Peak Aerial Survey[a]	Weir Counts
1974	2,500	
1975	5,600	
1976		
1977	900	
1978	2,020	
1979	1,100	
1980	3,400	
1981		
1982	291	
1983		
1984	300	
1985		
1986	1,900	
1987	1,500	
1988		
1989		
1990	2,500	
1991		
1992	6,500	
1993		
1994	16,500	
1995	2,850	
1996	2,700	
1997	11,000	
1998	5,800	
1999	1,025	
2000	4,400	
2001	34,000	45,866
2002	58,000	97,780
2003	14,500	101,793
2004		40,328
2005		12,097
2006		12,936
2007		21,428
2008		8,661

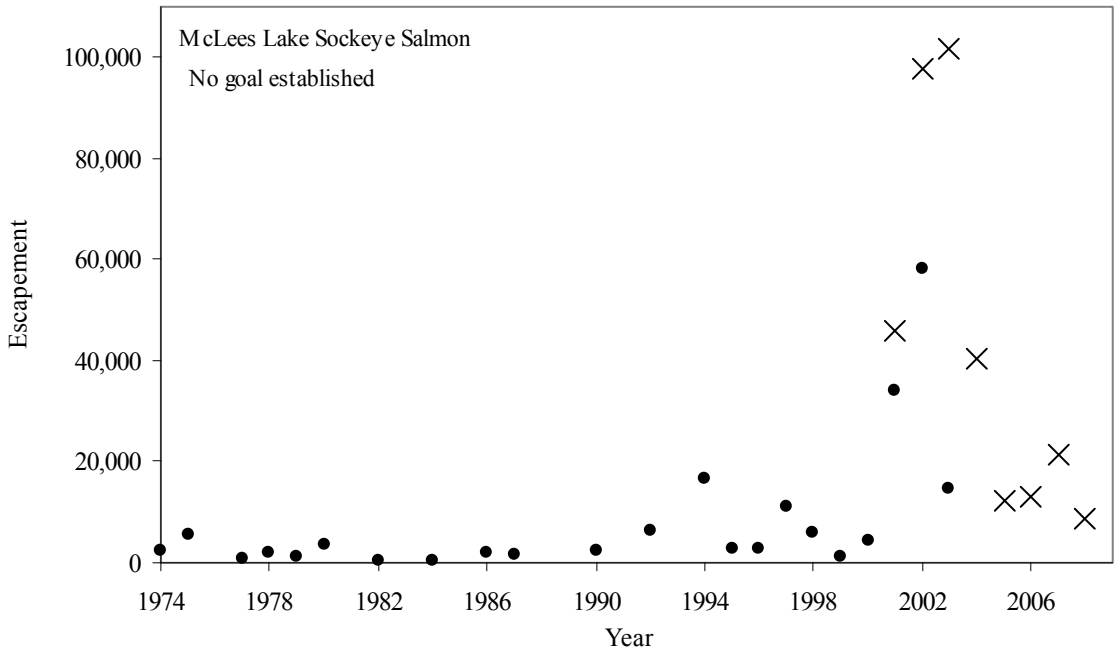
[a] The 1994 peak survey estimate of 16,500 pink salmon was changed to sockeye salmon based on qualitative information concerning the aerial surveyor, timing, and historic species identified in the lake.

Appendix E3.–McLees Lake sockeye salmon escapement, 1974-2008.

System: **McLees Lake.**

Species: **Sockeye salmon.**

Observed escapement by year (solid circles for aerial surveys; Xs for weir counts).



APPENDIX F. SUPPORTING INFORMATION FOR THE ILNIK RIVER COHO SALMON ESCAPEMENT GOAL

Appendix F1.–Description of stocks and escapement goals for Ilnik River coho salmon.

System: Ilnik River.

Species: Coho salmon.

Description of stocks and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region.
Management division:	Commercial Fisheries.
Primary fishery:	Commercial, Sport.
Current escapement goal:	None (eliminated in 2004).
Recommended escapement goal:	SEG Threshold of 9,000.
Optimal escapement goal:	none.
Inriver goal:	none.
Action points:	none.
Escapement enumeration:	Aerial survey, sporatic 1969-1984, consistent 1985-2008.
.	
Data summary:	
Data quality	Fair for aerial survey counts.
Data type	No stock specific harvest information is available.
Contrast	45.0.
Methodology	Risk Analysis.
Autocorrelation	None.
Comments	An SEG threshold of 9,000 is recommended.

Appendix F2.–Ilnik River coho salmon escapement, 1985-2008.

System: Ilnik River.

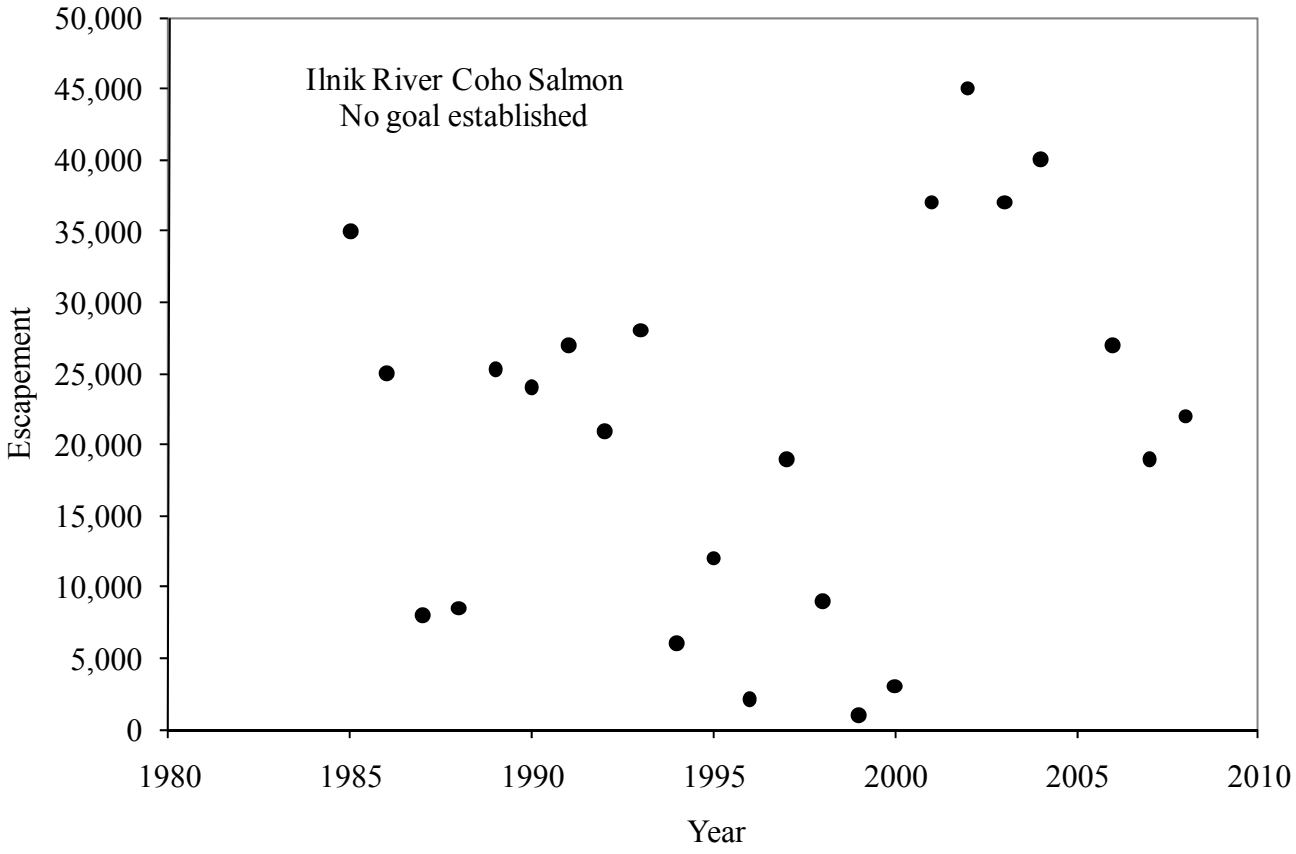
Species: Coho salmon.

Year	Peak Escapement
1985	35,000
1986	25,000
1987	8,000
1988	8,500
1989	25,300
1990	24,000
1991	27,000
1992	20,900
1993	28,000
1994	6,000
1995	12,000
1996	2,100
1997	19,000
1998	9,000
1999	1,000
2000	3,000
2001	37,000
2002	45,000
2003	37,000
2004	40,000
2005	
2006	27,000
2007	19,000
2008	22,000

System: Ilnik River.

Species: Coho salmon.

Observed escapement by year (solid circles for aerial surveys).



Appendix F4.–Ilnik River coho salmon risk analysis results.