Fishery Manuscript No. 06-03

Review of Salmon Escapement Goals in the Alaska Peninsula and Aleutian Islands Management Areas Report to the Alaska Board of Fisheries, 2004

by

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May 2006

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. 06-03

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May 2006

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This document should be cited as:
Nelson, P. A., J. J. Hasbrouck, M. J. Witteveen, K. A. Bouwens, and I. Vining. 2006. Review of salmon escapement goals in the Alaska Peninsula and Aleutian Islands Management Areas – Report to the Alaska Board of Fisheries, 2004. Alaska Department of Fish and Game, Fishery Manuscript No. 06-03, Anchorage.

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ABSTRACT

In September 2003 a Salmon Escapement Goal Interdivisional Review Team, including staff from the 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 48 existing Area M salmon escapement goals evaluated, the team recommended changing 20 goals, eliminating 12 goals, and leaving 16 goals unchanged. For the most part, the 20 changes to these goals were relatively minor in magnitude and the elimination of 12 goals would not have noticeable effects on future management decisions.

The team recommended that no changes in the current sustainable escapement goals (SEGs) were warranted for 11 sockeye salmon *O. nerka* systems including: Orzinski and Thin Point Lakes; Mortensens, Middle, Christianson, and Swanson Lagoons; North Creek; and Sandy, Ilnik, Meshik, and Cinder Rivers. In addition, the team recommended no changes to the current SEGs for five chum salmon *O. keta* aggregates in the South Peninsula. In all cases, there were not sufficient data for these systems or aggregates to develop a biological escapement goal (BEG) and managing for the current SEGs for these systems has continued to provide desired escapement levels as well as surplus production. Several methods were used to assess the current SEGs when sufficient data were available including the percentile approach, risk analysis, as well as spawning habitat, lake surface area, and limnology models.

The team recommended changing the current Nelson River Chinook salmon *O. tshawytscha* SEG of 3,200 to 6,400 to a BEG of 2,400 to 4,400 derived from a habitat-based model that was supported by a spawner-recruit model. Another recommendation was to change the current Nelson River sockeye salmon SEG of 100,000 to 150,000 to a BEG of 97,000 to 219,000 based on a spawner-recruit model and supporting limnology data. A spawning habitat model and supporting limnology models supported the team's recommendation to change the current Bear Lake early- and late-run sockeye salmon SEGs. Based on this recommendation, the SEG for the early run of 150,000 to 175,000 would change to an SEG of 176,000 to 293,000, and the late run SEG of 50,000 to 75,000 would change to an SEG 117,000 to 195,000.

Ricker spawner-recruit models corroborated the current aggregate even- and odd-year South Peninsula pink salmon *O. gorbuscha* escapement goals, and supported South Peninsula area-wide even- and odd-year BEGs. These two recommended BEGs would replace 10 (five even- and five odd-year) district/section-wide SEGs that would subsequently be considered management objectives. The team also recommended changing the current Bechevin Bay Section even-year pink salmon SEG of 33,200 to 66,400 to an SEG threshold of 31,000. A similar recommendation was made for Bechevin Bay Section odd-year pink salmon whereby the current SEG of 2,400 to 4,800 would change to an SEG threshold of 1,600.

Changes to two district-wide chum salmon SEGs were recommended based on Ricker spawner-recruit models. Based on this recommendation, the current Northwestern District chum salmon SEG of 223,600 to 447,200 would change to a BEG of 100,000 to 215,000, while the Northern District goal would stay the same but be reclassified as a BEG.

Based on the results of a risk analysis, the team recommended changing the current Nelson River coho *O. kisutch* salmon goal whereby the lower end of the current Nelson River coho salmon SEG of 18,000 would be considered an SEG threshold. With insufficient data to reasonably estimate an SEG for Thin Point coho salmon, the team also recommended keeping the lower end of the current SEG of 3,000 to be used as a threshold to alert managers of potential overharvest or changes in productivity.

The team recommended eliminating a number of SEGs: two for Chinook (Meshik and Cinder Rivers), three for sockeye (David's River late run, Ocean River, and McLees Lake), and five for coho salmon (Ocean, Ilnik, Meshik, Cinder Rivers and Mud Creek). The team also recommended eliminating the Unalaska District even- and odd-year pink salmon SEGs. These recommendations were based on the fact that there are currently no commercial fisheries, and very limited sport and subsistence effort, directed on these stocks. In addition, available escapement data were sporadic and not sufficient to justify the existing SEGs.

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 1990s.

In September 2003 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 (CF) and Division of Sport Fish (SF): Patricia Nelson (CF), Jim McCullough (CF), Mark Witteveen (CF), Ken Bouwens (CF), Bob Murphy (CF), Ivan Vining (CF), John H. Clark (CF), Jim Hasbrouck (SF), Bob Clark (SF), and Len Schwarz (SF).

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 Division of Commercial Fisheries and Division of Sport Fish for approval. During the review process, escapement goals were evaluated for 3 Chinook, 17 sockeye, and 7 coho salmon stocks (Tables 1 and 2). In addition, 14 pink and 7 chum salmon stock-aggregate goal ranges were reviewed (Tables 3 and 4). Formal meetings via teleconference, to discuss and develop recommendations, were held on September 26 and December 12, 2003 and January 16, 2004. The team also communicated on a regular basis by telephone and email.

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).

The 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° southeast from Kupreanof Point (55° 33.98' N lat., 159° 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 (minimum) known salmon streams are consistently monitored for escapement (Holmes 1997).

BACKGROUND

Escapement goals are currently established for three Chinook salmon systems in Area M (Nelson and Lloyd 2001), all of which are located along the North Peninsula (Table 1; Figure 3). Chinook salmon escapements at these systems are primarily monitored by aerial survey. There are no spawning stocks of Chinook salmon documented in the South Peninsula or Aleutian Islands.

A total of 17 sockeye salmon stocks (16 systems) in Area M have established escapement goals (Nelson and Lloyd 2001). Four of these stocks are located along the South Peninsula, 12 are located along the North Peninsula, and 1 is found on Unalaska Island (Table 1; Figures 3 and 4). A total of 14 of these stocks directly affect the daily management of associated fisheries and 6 of these systems currently have weirs for direct enumeration of escapement. Escapements of the remaining stocks are monitored by 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 established escapement goals for seven coho stocks (Nelson and Lloyd 2001), one of which is located on the South Peninsula and the remaining six are found on the North Peninsula (Table 2; Figure 3). There are no established 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, section, or area. Some areas have different odd- and even year-year goals. A total of seven stock-aggregate pink salmon escapement goals have been established in Area M (Table 3; Figure 2). These stock-aggregate goals comprise the respective sums of aerial survey escapement objectives for 165 individual index streams (Nelson and Lloyd 2001). All but five of the index streams are located along the South Peninsula or on Unalaska Island.

A total of seven stock-aggregate escapement goals have been established for chum salmon in Area M (Table 4; Figure 2). These stock-aggregate goals comprise the respective sums of aerial survey escapement objectives for 136 individual index streams (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

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. In addition, 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 (2001; Table 5). This evaluation was used to 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 (>4.0), 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 MSY and develop a BEG for the stock. This level of spawning escapement is identified as S_{msy} (Hilborn and Walters 1992; CTC 1999; Quinn and Deriso 1999). If return estimates were not available because harvest or age, were not consistently measured, then these data were considered 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 DETERMINATION

Chinook Salmon

The team determined that for Chinook salmon, only the Nelson River stock had potential BEG-quality data. Relatively good quality data on escapements, harvests, and ages were available. All other Chinook salmon stocks lacked reliable estimates or indices of escapement, age data from returns, and/or stock specific estimates of commercial harvest. Two independent approaches were used to estimate escapement of Chinook salmon that would produce MSY from the Nelson River. The first approach utilized a simple habitat-based meta-analysis of Chinook salmon that related watershed area to the productivity parameters estimated from 13 stream-type stocks across the North Pacific coast (Parken *Unpublished*). The team also decided to develop a brood table and fit a spawner-recruit model (Ricker 1954) for this stock, and compare the results of this analysis to those of the habitat-based model.

Habitat-Based Model

Productivity of Nelson River Chinook salmon was estimated from a meta-analysis developed by Parken (*Unpublished*). Parken compared and related watershed area to stock-recruit derived estimates of carrying capacity (S_{eq}) and S_{msy} for 13 stream-type (age 1. and older smolt) and 12 ocean-type (age 0. smolt) Chinook salmon stocks along the North Pacific coast, including stocks from interior and southeast Alaska. The premise behind the meta-analysis is that physically larger drainages that contain Chinook salmon also tend to have proportionally larger populations than smaller drainages that contain Chinook salmon. This analysis included the watershed area available to the spawning river and upstream, excluding areas upstream of natural barriers on

fifth order streams for large systems and fourth order streams for small systems, and upstream of man-made barriers. The relationship between S_{eq} and watershed area was found to fit an allometric power (log-log) model very well, with R values of 0.83 for ocean-type and 0.87 for stream-type Chinook with watersheds ranging from approximately 90 km^2 (King Salmon River in southeast Alaska) to over 130,000 km^2 (a portion of the Columbia River drainage). Similarly, the relationship between S_{msy} and watershed area fit an allometric power model equally well (R = 0.82 for ocean-type and 0.88 for stream-type stocks). The Nelson River stock of Chinook salmon has a stream-type life history so the relation developed for stream-type stocks was utilized in the analysis. From Parken (*Unpublished*), the relationship between watershed area and S_{eq} for the 13 stream-type stocks of Chinook salmon is:

$$\ln(S_{eq}) = 0.684 \cdot \ln(\textit{watershed area}) + 3.90 \quad (1)$$

The relationship for S_{msy} is:

$$\ln(S_{msy}) = 0.698 \cdot \ln(\textit{watershed area}) + 2.81 \quad (2)$$

Estimates of S_{eq} and S_{msy} were calculated from equations 1 and 2 using the watershed area of the Nelson River in square km. Standard errors and 95% confidence intervals were also calculated for S_{eq} and S_{msy} from the log-log regression statistics.

Spawner-Recruit Analysis

Spawner-recruit data for Nelson River Chinook salmon were analyzed using a mathematical spawner-recruit model (Ricker 1954) to estimate S_{msy}. If the analyses indicated significant autocorrelation among the residuals of the model, the methods of Noakes et al. (1987) and Pankratz (1991) were used to alleviate bias in the parameter estimates. The BEG range was then estimated from the model by estimating the escapements than S_{msy} that produced yields of 90% of MSY.

Total runs of Nelson River Chinook salmon were estimated by adding estimates of escapements and commercial harvests. Escapement data were obtained from the Westward Region CF salmon escapement database. Tower counts from 1974-1988, weir counts from 1989-2003, and aerial survey data from 1963-2003 were examined to determine the best estimate of escapement. For most years this was the cumulative tower or weir count and the aerial survey index that occurred downstream of the tower or weir on the same day sometime in late July shortly before the tower or weir were removed. Aerial survey indices were not expanded.

Commercial harvests were obtained from the Westward Region CF salmon catch database. Because stock specific harvests by the commercial fishery are not estimated, we used only those harvests that occurred in the Nelson Lagoon statistical area (313-30). David's River aerial survey escapement data were evaluated to determine the proportion of the annual escapement in the Nelson watershed that was in the Nelson River itself. The number of Nelson River Chinook salmon in the Nelson Lagoon commercial harvest was estimated by multiplying this proportion by the total Chinook salmon commercial harvest in the Lagoon. This ignores escapement into other rivers in the Nelson watershed (e.g., Caribou River) and potential commercial harvests in other statistical areas, and assumes all Chinook salmon harvested in Nelson Lagoon are destined for this watershed.

Sport and subsistence harvest were likely negligible and were not used to estimate run size. Because so few responses to the Division of Sport Fish Statewide Harvest Survey were from

anglers who fished at the Nelson River, we assumed that the recreational harvest was zero for all years. Similarly for subsistence harvests; information indicated subsistence harvest was very low when it occurred.

Age data collected from the commercial harvest from 1985-2003, obtained from the Westward Region CF adult salmon age database, were used to estimate the age composition of each annual total run. While these data may not absolutely represent the age composition of the stock, because most Chinook salmon were harvested incidentally in a drift gillnet fishery using small-meshed nets to target harvest of smaller sockeye salmon, the bias in estimates of S_{msy} and S_{eq} would likely be relatively small (S. Fleischman, ADF&G, Division of Sport Fish, Anchorage; personal communication).

A brood table was constructed from the runs by year and the age composition of these runs. Total return by age was estimated by multiplying total run by the proportional age composition of Chinook salmon sampled in the commercial harvest. Because age data were only available for the 1985-2003 runs, total returns could be estimated only for brood years 1981-1996. Age-specific returns were summed for each brood year to estimate total return by brood year. Return per spawner was then estimated as the total return of each brood year divided by the escapement for that brood year.

Spawner and total return data by brood year were then fit with a Ricker (1954) model. When linearized, Ricker's model becomes:

$$\ln(R_t / S_t) = \ln\alpha - \beta S_t + a_t \tag{3}$$

where R is return (i.e., production), S is the escapement that produces that return R, a is normally distributed "white noise" with mean 0 and variance σ^2, and t is the brood year. The two parameters in eq. 3 are $\ln\alpha$ and β, which when fitted to data have estimates $\hat{\ln\alpha}$ and $\hat{\beta}$. However, some secondary parameters, such as escapement that on average produces MSY are functions of α, not $\ln\alpha$. Hilborn (1985) points out that because of the log transformation of the data, $\alpha > \exp(\hat{\ln\alpha})$, and shows that the unbiased estimate of α, $\hat{\alpha}$, is:

$$\hat{\alpha} = \exp\left[\hat{\ln\alpha} + \frac{\hat{\sigma}^2}{2}\right] \tag{4}$$

Serial correlation among residuals was observed in the Nelson River Chinook salmon spawner-recruit relationship that implies an autoregressive (AR) process (Appendix A1). The AR process covered a lag of two years [AR(2)] such that $\varepsilon_t = \phi_1\varepsilon_{t-1} + \phi_2\varepsilon_{t-2} + a_t$ where ϕ_1 is the lag-one coefficient and ϕ_2 is the lag-two coefficient. Serial correlation in a spawner-recruit relationship, if ignored, can cause estimated parameters, such as the density-dependent parameter, to appear statistically significant when they are not. In addition, some adjustment to the estimated density-independent parameter from Ricker's fitted model is needed when residuals are serially correlated.

The linearized spawner-recruit model with residuals following an AR(2) process is (D. Bernard, ADF&G, Division of Sport Fish, Anchorage; personal communication):

$$\ln R_t = \ln \alpha + \ln S_t - \beta S_t + \phi_1 \varepsilon_{t-1} + \phi_2 \varepsilon_{t-2} + a_t \quad (5)$$

Taking expectations of both sides (to get the average R given a specific S) ultimately produces:

$$\mathrm{E}[R_t] = \left\{ \exp\left(\ln \alpha + \frac{\sigma^2}{2(1-\phi_1^2-\phi_2^2)} \right) \right\} S_t \exp(-\beta S_t) \quad (6)$$

From this relationship note that:

$$\alpha = \exp\left(\ln \alpha + \frac{\sigma^2}{2(1-\phi_1^2-\phi_2^2)} \right) \quad (7)$$

Unbiased estimates of the parameters were produced by:

$$\hat{\alpha} = \exp\left(\hat{\ln \alpha} + \frac{\hat{\sigma}^2}{2(1-\hat{\phi}_1^2-\hat{\phi}_2^2)} \right) \quad (8)$$

with $\hat{\sigma}^2$ being the mean square error from fitting eq. 5 to data.

Sockeye Salmon

The team identified only two sockeye salmon stocks from Area M with BEG-quality data: Nelson River and Bear Lake late-run sockeye salmon. Reliable escapement, harvest, and age data were available for both stocks. Limnology and spawning habitat data were available for Bear Lake and limited limnology data were available for Nelson River (Sapsuk Lake). The team also agreed that while stock specific catch data were not available for Sandy, Ilnik, and Bear Lake early-run stocks individually, it might be possible to develop an aggregate BEG for the three stocks combined, thereby reducing any potential catch allocation errors.

Escapement estimates from each system, based primarily on weir counts with the addition of postseason estimates, were obtained from the Westward Region CF salmon escapement database. Sockeye salmon commercial harvest data by area were obtained from the Westward Region CF salmon catch database of individual sales receipts (fish tickets). Sport and subsistence harvests were not included in total return estimates, but were considered minor components for these systems. Available age data were obtained from the Westward Region CF adult salmon age database. Contributions of Nelson River and Bear River late-run sockeye salmon stocks to the commercial harvests by area were estimated using documented methods, and individual brood tables were developed for Nelson River and the Bear River late run (Witteveen et al. 2005). An additional brood table was developed for Nelson River using average age composition data (1985-2003) to apportion the 1975-1984 runs to their respective brood years. Harvest estimates assigned to the Sandy, Ilnik and Bear Lake early-run aggregate were based on the assumption that all sockeye salmon caught in the Port Moller Bight, Bear River, Three Hills, and Ilnik Sections, prior to August 1, were returning to these systems. A single brood table was developed using aggregate catch, escapement, and age data.

Spawning stock and recruitment (return) from Nelson River, Bear River late run, and the three-stock aggregate were analyzed using a Ricker spawner-recruit model (Ricker 1954), with both additive and multiplicative error structures considered (Quinn and Deriso, 1999). If a significant Ricker spawner-recruit model was found, then S_{msy} was estimated along with the range of escapements that would produce 90% of MSY.

Model results were assessed using criteria in Hilborn and Walters (1992), Quinn and Deriso (1999), and the CTC (1999). Results were not used if the model was not significant ($P>0.05$) or the model assumptions or constraints were violated. Contrast in the escapement data (i.e., the maximum observed escapement divided by the minimum observed escapement) was also considered, because in situations where contrast is relatively low (<4.0) and there is appreciable measurement error in estimating escapement or total return, estimates from a spawner-recruit model may be biased (CTC 1999).

Pink Salmon

Stock specific catch data were not available for Area M pink salmon. However, the team felt that it would be reasonable to aggregate South Alaska Peninsula area pink salmon catches and escapements into a single brood table to estimate a spawner-recruit relationship. This analysis was based on the assumption that pink salmon harvested in the South Alaska Peninsula area originated from rivers located on the South Peninsula.

South Alaska Peninsula pink salmon total indexed escapement estimates were obtained from Peninsula area manager's data archives. These stock-aggregate escapement estimates were based on aerial surveys of particular streams that were repeated on an annual basis and were considered an acceptable index of escapements on an area-wide basis. A description of the method used for calculating indexed total escapement can be found in Shaul and Dinnocenzo (2003). South Alaska Peninsula area-wide commercial harvest data were obtained from the Westward Region Commercial Fisheries salmon catch database. Sport and subsistence harvests were not included in total return estimates, but were considered to represent negligible components.

Individual pink salmon spawner-recruit relationships were estimated for even years, odd years and even and odd years combined. Spawning stock and recruitment (return) data were analyzed using a Ricker spawner-recruit model (Ricker 1954), with both additive and multiplicative error structures considered. If a significant Ricker spawner-recruit model was found, then S_{msy} was estimated along with the range of escapements that would produce 90% of MSY.

Chum Salmon

Stock specific catch data were not available for Area M chum salmon; however, the team felt that it would be reasonable to aggregate North Alaska Peninsula chum salmon catches and escapements by district. These analyses were based on the assumption that chum salmon harvested in the Northwestern District originated from rivers within that district, while chum salmon harvested in the Northern District were bound for rivers from that district.

Chum salmon total indexed escapement estimates by district were obtained from Peninsula area manager's data archives. These district-wide escapement estimates were based on aerial surveys of particular streams that were repeated on an annual basis and were considered an acceptable index of escapement on an area-wide basis (Shaul and Dinnocenzo 2003). Commercial harvest data by district were obtained from the Westward Region CF salmon catch database. Sport and subsistence harvests were not included in total return estimates, but were considered to represent negligible components. Available chum salmon age data were obtained from the Westward Region CF adult salmon age database. Chum salmon sampled from Urilia Bay, Swanson Lagoon, Bechevin Bay, and Izembeck-Moffett Bay Sections (1985-1998) were used to represent Northwestern District returns and chum salmon sampled from Nelson Lagoon and Harbor-Strogonof catches (1985-2003) were used to represent the Northern District returns. These data were used to develop a single aggregate brood table for each district.

District-wide spawner-return data were analyzed using Ricker spawner-recruit models (Ricker 1954), with both additive and multiplicative error structures considered. If a significant Ricker spawner-recruit model was found, then S_{msy} was estimated along with the range of escapements that would produce 90% of MSY.

Coho Salmon

The team could not identify any coho salmon stocks from Area M with BEG-quality data.

SUSTAINABLE ESCAPEMENT GOAL DETERMINATION

This was the first time that data were reviewed for stocks with SEGs in Area M based on the SSFP and EGP. The team reviewed SEGs for two of three Chinook salmon (all except Nelson River for which a BEG was estimated), 16 of 17 sockeye salmon (all except Nelson River for which a BEG was developed), and all seven coho salmon stocks. Two pink salmon and five chum salmon aggregate SEGs were also evaluated. In addition, peak aerial survey data for nine Chinook salmon stocks, including the two stocks with SEGs, were examined to determine if escapements were correlated among systems. If the indices were related, it may be possible to develop potential new SEGs for additional stocks or aggregation of stocks.

Chinook Salmon

Meshik and Cinder River Chinook salmon escapement data were obtained from the Westward Region Commercial Fisheries salmon escapement database. Peak aerial survey counts were available since 1961 but peak surveys were not obtained during all years. Stock-specific harvest estimates and age data were not available for these stocks.

Chinook salmon peak aerial survey counts (1961-2003) from nine North Peninsula streams, obtained from the Westward Region CF salmon aerial survey database, were coalesced for analysis. In addition to these aerial survey data, counts of Chinook salmon from a tower (1974-1988) and weir (1989-2003) in the Nelson River were examined for similarity through time using cluster analysis (Everett 1980). This analysis was conducted to determine if escapements from systems that are geographically close were correlated, which may allow combining these systems together to develop an aggregate escapement goal. Similarity was measured as the product moment correlation between time series of peak aerial survey counts in the nine streams, including the tower/weir counts in the Nelson River.

Sockeye Salmon

Escapement tower and weir counts from Orzinski Lake (weir counts: 1990-2003), Bear River (tower counts: 1963-1985, weir counts: 1986-2003), Sandy River (weir counts: 1994-2003) and Ilnik River (weir counts: 1991-2003) were obtained from the Westward Region CF salmon escapement database. All other escapement estimates used to estimate SEGs for Area M sockeye stocks were based on expanded aerial survey counts. These estimates, obtained from annual management reports, represented the peak aerial survey estimate plus the total carcasses estimate (Shaul and Dinnocenzo 2003). Two basic approaches to setting SEGs were used; the percentile method of Bue and Hasbrouck (2001), and limnological and habitat based methods as described below.

A total of 15 sockeye salmon SEGs were estimated using the percentile method of Bue and Hasbrouck (2001) whereby the contrast of the escapement data (the ratio of the largest escapement to the smallest escapement) was used to modify the percentiles for estimating the SEG (Table 6). 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. Alternately, at larger contrast the percentiles of observed annual escapements used to estimate an SEG would be narrowed, to allow the SEG to include a wide range of escapements but not escapements from which yields may possibly be reduced (though yield information is generally not available). For stocks with high contrast and at least moderate exploitation, the lower end of the SEG range would be increased from the 15th to the 25th percentile as a precautionary measure for stock protection.

In addition, models were developed to assess sockeye salmon SEGs to Bear River, Ilnik River, Mortensens Lagoon, Middle Lagoon, Nelson River, Orzinski Lake, Sandy River, and Thin Point Lake using available limnology and spawning habitat data, as outlined below.

Light penetration data were collected from 1993 through 1995 from all the above systems (Honnold et al. 1996). Bouwens (2003) collected additional light penetration data from Bear Lake from 2000 through 2003. Annual average euphotic volume (EV) was estimated for each system (Koenings et al. 1987). Adult production based on EV (2,500 adults per EV unit) was estimated using equations from Koenings and Burkett (1987). Optimal escapement, assuming an exploitation rate of 0.67, was estimated from the adult production estimates. Escapement goal ranges were estimated by calculating values 25% higher and lower than the point estimates (i.e., 0.75 and 1.25 multiplied by the point estimate).

Zooplankton data were collected from 1993 through 1995 from all the above systems (Honnold et al. 1996). In addition, Bouwens (2003) collected zooplankton data from Bear Lake from 2000 to 2003. Zooplankton samples were processed using methods outlined in Thomsen et al. (2002). The expected production of smolts of a given size, based on zooplankton biomass, was estimated (Koenings and Kyle 1997). The average fecundity of Bear Lake sockeye (Ramstad 1998) was used in equations from Koenings and Burkett (1987) to estimate the optimal escapement to produce either 11.5-g (actual Bear Lake average) or 2-g (threshold) smolts. Because Bear Lake smolts are extremely large, a smolt size of 11.5-g was assumed to approach the maximum size of smolts the systems could produce. These smolt size-specific estimates were used to describe the escapement goal ranges.

Honnold et al. (1996) estimated adult sockeye salmon production based on lake surface area. Optimal escapement, assuming an exploitation rate of 0.67, was estimated from the adult production estimates. Escapement goal ranges were estimated by calculating values 25% higher and lower than the point estimates (i.e., 0.75 and 1.25 multiplied by the point estimate).

Honnold et al. (1996) estimated the spawning area capacity of Bear Lake. Because this estimate was considered an estimate of maximum capacity, this estimate was considered the high end of the escapement goal range based on this model. The point estimate was estimated assuming the high end of the escapement goal range was 25% greater than the point estimate. The low end of the range was estimated as 25% of the point estimate. Honnold et al. (1996) also estimated the spawning area capacity for the Nelson River drainage, but this value was believed to be biased extremely low (A. R. Shaul, ADF&G, Division of Commercial Fisheries, Kodiak, AK; personal communication) and was not used.

The existing escapement goals for each system were assessed against the results from each model. Because additional data were available for Bear Lake, estimates from the limnology

models, spawning area capacity and adult escapement data were used to calculate potential escapement goals to Bear Lake. These models provide total-run goal estimates only. Therefore, the total-run estimates were divided into the early-and late-run components targeting the same proportions between the two runs as the existing goals (72% early-run, 28% late-run).

Pink Salmon

Bechevin Bay Section pink salmon total indexed escapement estimates were obtained from annual management reports and a section-wide SEG threshold was estimated using a risk analysis that followed that of Bernard et al. (*In prep*).

The escapement time series (Appendix B18) was considered to be composed of two aggregate aerial surveys, one for odd years and one for even years. Escapements were the peak survey index each year. The escapement time series was first log-transformed and tested for normality using a one-sample Kolmogorov-Smirov test; the time series followed a lognormal distribution (P>0.15). The log-transformed escapement time series were then tested for serial correlation using diagnostics in Abraham and Ledolter (1983). There was no significant (P>0.05) serial correlation in escapements for odd years, however there was serial correlation for even years.

Based on these results odd-year escapements were modeled as lognormally distributed variables. The number of consecutive years that would cause a concern was set at three, the number of years between each regularly scheduled BOF meeting. Risk of an unwarranted restriction due to a management concern (π_k) was estimated directly from the log transformed mean (μ), standard deviation (σ), and number of consecutive years to warrant a concern (k = 3) for various values of an escapement threshold (X) as per Bernard et al. (*In prep*):

$$\hat{\pi}_k = \left\{ pr\left[(N : \hat{\mu}, \hat{\sigma}^2) \le \ln X \right] \right\}^k \tag{9}$$

The risk of detecting a drop in mean escapement was estimated in the same way as risk of an unwarranted restriction, except that the risk of not detecting ($1-\hat{\pi}_k$) was estimated and the mean escapement ($\hat{\mu}$) was changed by the desired percentage drop in mean to be detected with the threshold.

The risk during odd years was estimated for drops in mean escapement of 95% and 42%. The maximum percentage drop in mean escapement was based on the observed percent difference between the mean escapement and the minimum escapement (95% for Bechevin Bay odd-year spawning pink salmon). The 42% drop was based the current lower escapement goal for Bechevin Bay odd-year spawning pink salmon. Escapement thresholds were evaluated based on minimizing risk for triggering an unwarranted concern and an approximately equal risk of failing to detect the percentage drop in mean escapement as noted above.

For even years, a long escapement time series was simulated using the original escapements and the appropriate autoregressive model. Simulated escapements were appended onto the original escapement time series, so that a total of 1,004 escapements were available. This allowed for 1,000 possible sets of three consecutive years for tabulation of estimated risk. Risk was then estimated by summing the number of times three consecutive years of simulated escapements were below various escapement thresholds and dividing by 1,000.

Risk during even-year escapement was estimated for drops in mean escapement of 80% and 39%. The maximum percentage drop in mean escapement was based on the observed percent difference between the mean escapement and the second lowest escapement (80% for Bechevin

Bay) even-year spawning pink salmon. The minimum escapement was not used due to its very low magnitude (i.e., the second lowest escapement was over nine times greater). The 39% drop was based on the current lower escapement goal for Bechevin Bay even-year spawning pink salmon. Escapement thresholds were evaluated based on minimizing risk for triggering an unwarranted concern and an approximately equal risk of failing to detect the percentage drop in mean escapement as noted above.

Unalaska pink salmon peak escapement estimates were obtained from annual management reports. The team decided that these data were insufficient to perform further analyses.

Chum Salmon

South Peninsula chum salmon total indexed escapement estimates by district were obtained from annual management reports and district-wide SEGs were estimated using the percentile method of Bue and Hasbrouck (2001).

Coho Salmon

Thin Point Lake and Nelson River coho salmon peak aerial survey data were obtained from the Westward Region CF salmon aerial survey database. The method used to develop precautionary reference points, which we call SEG thresholds, for Nelson River coho salmon followed that of Bernard et al. (*In prep*). The escapement time series (Appendix B25) was considered to be composed of a single aggregate aerial survey. Escapements were the peak survey index each year. The escapement time series was first log-transformed and tested for normality using a one-sample Kolmogorov-Smirov test; the time series followed a lognormal distribution (P>0.15). The log-transformed escapement time series was then tested for serial correlation using diagnostics in Abraham and Ledolter (1983). There was no significant (P>0.05) serial correlation in escapements. Based on these results, escapements were modeled as lognormally distributed variables. The number of consecutive years that would cause a concern was set at three, the number of years between each regularly scheduled BOF meeting.

Risk of an unwarranted restriction due to a management concern (π_k) was estimated directly from the log-transformed mean (μ), standard deviation (σ), and number of consecutive years to warrant a concern (k = 3) for various values of an escapement threshold (X) as per Bernard et al. (*In prep*) fitting eq. 9 to the data.

Risk of detecting a drop in mean escapement was estimated in the same way as risk of an unwarranted restriction, except that the risk of not detecting ($1-\hat{\pi}_k$) was estimated and the mean escapement ($\hat{\mu}$) was changed by the desired percentage drop in the mean to be detected with the threshold. Risk was estimated for drops in mean escapement of 65% and 45%. The maximum percentage drop in mean escapement was based on the observed percent difference between the mean escapement and the minimum escapement: 45% for Nelson River coho salmon. Escapement thresholds were evaluated based on minimizing risk for triggering an unwarranted concern and an approximately equal risk of failing to detect the percentage drop in mean escapement as noted above.

Data from Thin Point Lake were considered to be insufficient to perform further analyses.

RESULTS

The comprehensive review of 48 existing Area M salmon escapement goals resulted in recommendations to change 20 SEGs (which included establishing two BEGs that would replace

10 existing SEGs), eliminate 12 SEGs, and leave 16 SEGs unchanged. Appendices A and B provide a description of each stock, or stock aggregate, current escapement goal of each stock, actual escapement estimates from 1970 to 2003, data used for analyses of escapement goals, and supplemental information used to evaluate each escapement goal. Appendix C1. provides the escapement data used for the Chinook salmon cluster analysis.

BIOLOGICAL ESCAPEMENT GOAL ESTIMATES

Chinook Salmon

Nelson River

Stock Status

The current Nelson River Chinook salmon escapement goal of 3,200 to 6,400 was adopted in 1993. Since the goal was implemented, estimated escapements have generally been within the escapement goal range. Only once since the goal has been implemented (1995) has the lower range of the current goal not been attained (Appendix A1). This stock is lightly exploited with incidental harvest in the commercial fisheries and minor sport fish take.

Habitat-Based Model

Watershed area of the Nelson River is 2,076 km^2 (Appendix A1). From watershed area, the estimate of S_{eq} from eq. 1 was 9,178 fish (SE = 1,061 fish; 95% confidence interval of 7,099 to 11,257 fish). The estimate of S_{msy} from equation 2 was 3,434 fish (SE = 506 fish; 95% confidence interval of 2,443 to 4,425 fish).

Spawner-Recruit Analysis

Escapements of brood years 1981 through 1996 have ranged from 1,800 fish in 1990 to 12,561 fish in 1983 for a contrast of 7.0 (Appendix A1). Resultant returns have ranged from 4,447 for the 1990 brood year to 11,132 for the 1987 brood year. The point estimate of S_{msy} was 3,080 fish with a computed 90% MSY range of 1,995 to 4,298 fish. The fitted Ricker curve crossed the replacement line at an escapement (S_{eq}) of 7,583 fish.

Escapement Goal Recommendation

Results from the two methods were fairly similar, with estimated S_{msy} and S_{eq} slightly larger for the habitat-based model that incorporates the watershed area of the entire drainage. In addition, both goals derived from these methods were lower than the existing goal. The team recommended a BEG range of 2,400 to 4,400 based on the 95% confidence interval for S_{msy} from the habitat-based model.

Sockeye Salmon

Nelson River

Stock Status

The current Nelson River sockeye salmon SEG of 100,000 to 150,000 was adopted in 1979 (Table 1; Appendix A2). Before the goal was implemented, escapements were generally below the SEG range. Since the goal was implemented, estimated escapements have been generally above the SEG range. All escapements estimated through weir counts were above the upper end of the SEG. Escapements above the upper goal range were due primarily to high numbers of "jacks" and low proportion of females. In addition, it has often been difficult for the fleet to harvest surplus fish despite extended fishery openings.

Spawner-Recruit Analysis

Ricker spawner-recruit models were fit to the Nelson River fully recruited brood year spawner-recruit data from 1981 to 1997. Over this period, sockeye salmon escapements averaged about 227,000 (range: 118,000 to 339,000) and total returns averaged about 508,000 sockeye salmon (range: 255,000 to 719,000). The model with additive error was not significant (P>0.05). The model with multiplicative error was significant (P=0.003). However, the contrast of the Nelson River escapement data was only 2.9, which was below the recommended minimum contrast of 4 (CTC 1999).

In addition, in an attempt to increase data contrast, Ricker spawner-recruit models were fit to the Nelson River fully recruited spawner-recruit data from brood years 1975 to 1997. Over this period, sockeye salmon escapements averaged about 225,000 (range: 101,000 to 352,000) and total returns averaged about 518,000 sockeye salmon (range: 191,000 to 847,000). The model with additive error was not significant (P>0.05). The model with multiplicative error was significant (P=0.0003). But, the contrast of the Nelson River escapement data increased to only 3.5, still below the recommended minimum contrast of 4 (CTC 1999). The S_{msy} was estimated at 153,000 sockeye salmon with a 90% MSY range of 97,000 to 219,000 while S_{eq} was estimated at 422,000 sockeye. No autocorrelation was found in the residuals of the model.

Euphotic Volume Analysis

Based on average EV, the adult production of Sapsuk Lake (the lake that supports Nelson River sockeye salmon) is expected to be roughly 603,000 sockeye salmon annually. An escapement goal range of 149,000 to 249,000 sockeye salmon was estimated based on EV for Nelson River (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

Depending on the size of the resultant smolt, the zooplankton model results in an estimated escapement goal range of 134,000 to 769,000 sockeye salmon for Nelson River (Table 8).

Lake Surface Area

Based on the surface area of Sapsuk Lake, Honnold et al. (1996) estimated the adult production of Sapsuk Lake to be roughly 480,000 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, an SEG range of 119,000 to 198,000 sockeye salmon was estimated for Nelson River (Table 9).

Escapement Goal Recommendation

Although the contrast in the escapement data from brood years 1975-1997 was slightly lower than recommended, the data time series is fairly long and of relatively good quality. The subsequent spawner-recruit model was significant with no autocorrelation in the residuals. The spawner-recruit model also suggested a maximum escapement (S_{eq}) of about 422,000 sockeye, which due to measurement error maybe an underestimate (Hilborn and Walters 1992). Limited limnology data also suggested that the Nelson River system is capable of supporting a higher level of sockeye salmon escapement than the current goal allows. The team recommended changing the current SEG to a BEG of 97,000 to 219,000 (Table 1).

Bear Lake Late Run

Stock Status

The current Bear Lake late-run sockeye salmon SEG of 50,000 to 75,000 was developed in the late 1960s (Table 1; Appendix A3). Before the goal was implemented, escapements were generally within or near the SEG range. However, estimated escapements have been above the SEG since 1978. Escapements above the upper goal range were due primarily to a high number of "jacks" and decreasing fishing effort toward the end of the run.

Spawner-Recruit Analysis

Ricker spawner-recruit models were fit to the Bear Lake fully recruited brood year spawner-recruit data from 1981 to 1995. Over this period, sockeye salmon escapements averaged about 163,000 (range: 83,000 to 263,000) and total returns averaged about 679,000 sockeye salmon (range: 318,000 to 1,188,000). The model with additive error was not significant ($P>0.05$). The model with multiplicative error was significant ($P=0.02$). However, the contrast of the Bear Lake escapement data was 3.2, which was below the recommended minimum contrast of 4 (CTC 1999), and though the model was significant ($P=0.02$), the P-value is relatively high for this type of model analysis.

Escapement Goal Recommendation

Given the lack of contrast in the escapement data, the team felt that it was not possible to estimate a BEG for Bear Lake late-run sockeye salmon at this time. Therefore, the team used several alternative approaches to estimate an SEG for both runs combined. The results of these approaches can be found in the Sustainable Escapement Goal Estimates section.

Sandy-Ilnik-Bear Lake Early Run Aggregate

Stock Status

Sandy and Ilnik Rivers, and Bear Lake sockeye salmon stocks are described individually in the Sustainable Escapement Goal Estimates section.

Spawner-Recruit Analysis

Ricker spawner-recruit models were fit to the aggregate with fully recruited brood year spawner-recruit data from 1991 to 1997. Neither model, with additive or multiplicative error, was significant ($P>0.05$). Furthermore, the contrast of the aggregate escapement data was well below the recommended minimum contrast of 4. In addition, there were only seven years (1991-1997 brood years) of escapement and return data available, which is less than the recommended minimum of 15 years (Chinook Technical Committee 1999).

Escapement Goal Recommendation

Given the lack of contrast in the escapement data and low number of fully recruited brood year return estimates, an estimate of an aggregate BEG for these sockeye salmon stocks was not yet possible. Therefore, the team used several alternative approaches to estimate individual SEGs for these systems. The results of these approaches can be found in the Sustainable Escapement Goal Estimates section.

Pink Salmon
South Peninsula

Stock Status

The South Peninsula pink salmon SEGs were adopted in 1992 (Table 3; Appendix A4). These goals were developed by district, section, or by an aggregate of sections. The combined escapement goal during even years totaled 1,864,600 to 3,729,300 and totaled 1,637,800 to 3,275,700 during odd years. Prior to the implementation of the goals, escapements generally fell within or near the lower end of the goal ranges. After the goals were implemented, escapements fell within or above the goal ranges. Odd-year escapements were above the goals more often than even-year escapements. Recent high escapements Peninsula-wide were likely due to poor market conditions and low effort rather than larger returns of pink salmon.

The current Southeastern District (Shumagin Islands Section and Southeastern District Mainland combined) pink salmon SEG of 562,600 to 1,125,300 during both even and odd years was adopted in 1992 (Table 3; Appendix A5). Aerial survey escapement estimates from 72 systems are used as an index for the total escapement in the Southeastern District. Since estimated total escapement has been calculated (1987), escapements generally fell within or above the SEG range.

The current South Central District pink salmon SEG of 687,200 to 1,374,400 during both even and odd years was adopted in 1992 (Table 3; Appendix A6). Aerial survey escapement estimates from 16 systems are used as an index for the total escapement in the South Central District. Prior to 1990, estimated escapements fell near the low end or below the SEG range. Since 1991, escapement estimates fell within or above the SEG range.

The current Southwestern District pink salmon SEG of 563,600 to 1,127,200 during even years and 378,000 to 756,000 during odd years was adopted in 1992 (Table 3; Appendix A7). Aerial survey escapement estimates from 45 systems are used as an index for the total escapement in the Southwestern District. Since estimated total escapement has been estimated (1987), escapements generally fell within or above the SEG range.

The current Unimak District pink salmon SEG of 51,200 to 102,400 during even years and 10,000 to 20,000 during odd years was adopted in 1992 (Table 3; Appendix A8). Aerial survey escapement estimates from 10 systems are used as an index for the total escapement in the Unimak District. Since estimated total escapement has been estimated (1987), escapements generally fell below the SEG range during even years and above the SEG range during odd years.

Spawner-Recruit Analysis

Ricker spawner-recruit models were fit to the South Peninsula aggregate pink salmon data from even brood years, 1976-2000, using additive and multiplicative error structures. The model with additive error was not significant ($P>0.05$). The model with multiplicative error was significant ($P=0.0008$); however the contrast of the even-year escapement data was 3.2, which was below the recommended minimum contrast of 4 (CTC 1999).

Ricker spawner-recruit models were fit to the South Peninsula aggregate pink salmon data from odd brood years, 1975-2001, using additive and multiplicative error structures. The model with additive error was not significant ($P>0.05$). The model with multiplicative error was significant ($P=0.009$; contrast =11.6) and resulted in an estimate of S_{msy} of 2.77 million spawners with an

escapement range of 1.75 to 4.00 million spawners, while S_{eq} was estimated at 7.84 million pink salmon (Appendix A4). No autocorrelation was found in the residuals.

Ricker spawner-recruit models were fit to the South Peninsula aggregate pink salmon data from brood years (odd and even years combined) 1968-2001 and 1975-2001 using additive and multiplicative error structures. Neither model fit, using the 1968-2001 data (P>0.05). The 1968-1974 brood years had several years with low to medium escapement and returns that were inconsistent with current escapement trends. This could be due to the climate regime shift that occurred in the mid to late 1970s (Adkison et al. 1996; Ebbesmeyer et al. 1991) or differences in management objectives. The additive error model that used the 1975-2001 data was not significant (P>0.05). The multiplicative error model using 1975-2001 data (contrast = 11.6) was significant (P=0.0001) and resulted in an estimate of S_{msy} of 2.33 million spawners with an escapement range of 1.52 to 3.29 million spawners while S_{eq} was estimated at 6.69 million pink salmon (Appendix A4). No autocorrelation was found in the residuals.

Escapement Goal Recommendation

The team felt that the results of the Ricker spawner-recruit models (odd and even years combined, 1975-2001) corroborated the current aggregate even- and odd-year South Peninsula pink salmon escapement goals. In addition, the team agreed that the South Peninsula stock-aggregate goals could be considered BEGs because, according to the spawner-recruit models, these ranges of escapements would provide the greatest potential to achieve MSY. The team recommended that the current South Peninsula district- and section-wide pink salmon goals remain the same but be considered management objectives rather than individual SEGs.

Chum Salmon

Northwestern District

Stock Status

The current Northwestern District chum salmon SEG of 223,600 to 447,200 was adopted in 1992 (Table 4; Appendix A9). Escapements have increased since the early 1990s (when they were below the current SEG) and have fallen within the SEG range since 1994.

Spawner-Recruit Analysis

Ricker spawner-recruit models were fit to the Northwestern District chum salmon data from brood years 1980-1992 using additive and multiplicative error structures. The model with additive error was not significant (P>0.05). The model with multiplicative error was significant (P=0.013; contrast = 4.2) resulting in an estimate of S_{msy} of 154,000 spawners with an escapement range of 100,000 to 215,000, while S_{eq} was estimated at 378,000 chum salmon. There was no autocorrelation in the residuals.

Escapement Goal Recommendation

The team recommended changing the current Northwestern District chum salmon SEG of 223,600 to 447,200 spawners to a BEG of 100,000 to 215,000. This recommendation was based on the Ricker spawner-recruit model with multiplicative error.

Northern District

Stock Status

The current Northern District chum salmon SEG of 119,600 to 239,200 was adopted in 1992 (Table 4; Appendix A10). Escapements increased from below the SEG range in 1991 to well above the range in 1996. With the exception of 1997, there has been a linear decrease in escapements from 1996 to 2003, when the escapement again fell within the SEG range.

Spawner-Recruit Analysis

Ricker spawner-recruit models were fit to the Northern District chum salmon data from brood years 1982 through 1996 using additive and multiplicative error structures. The model with additive error was significant (P=0.041; contrast = 5.4) and resulted in an estimate of S_{msy} of 164,000 spawners with an escapement range of 107,000 to 228,000, while S_{eq} was estimated at 395,000 chum salmon. The model with multiplicative error was also significant (p=0.0006) and resulted in an estimate of S_{msy} of 163,000 spawners with an escapement range of 106,000 to 228,000. There was no autocorrelation in the residuals of either model.

Escapement Goal Recommendation

The team felt that the results of the Ricker spawner-recruit models corroborated the current Northern District chum salmon escapement goal and agreed that the goal could now be considered a BEG because this range of escapements provides the greatest potential to achieve MSY.

SUSTAINABLE ESCAPEMENT GOAL ESTIMATES

Chinook Salmon

North Peninsula Aggregate

Cluster Analysis of Count Data

The nine streams examined were North Creek, Black Hills Creek, Steelhead Creek, Nelson River (aerial and tower/weir data), David's River, King Salmon River, Bear River, Meshik River and Cinder River (Appendix C1). Time series of survey counts of Chinook salmon in the nine North Peninsula streams showed a pattern of similarity that appeared related to geographic distance (Figures 3 and 5). Streams closer together tended to have higher similarity than those farther away. Moreover, highest similarities occurred between the Cinder and Meshik rivers; North, Black Hills, and Steelhead creeks; and King Salmon and Bear rivers (Figure 3). Counts from the Nelson River (aerial and tower/weir data) and David's River did not appear to be similar to counts from the other streams. Although this approach did illustrate similarities in escapement trends related to distance that could have a bearing on monitoring of Chinook stocks on the North Peninsula, there have been no studies to calibrate aerial survey counts of Chinook salmon with estimates of escapements gained by other means (e.g., mark-recapture experiment, weir, tower). The team decided to not set any new SEGs from these systems due to a lack of directed fisheries on these stocks of Chinook salmon, a lack of calibration of aerial survey data from which to judge the level of exploitation and true escapement, and the surveys are conducted largely to index sockeye salmon escapement so likely are a poor index of Chinook salmon abundance among years in the time series.

Meshik River

Stock Status

The current Cinder River Chinook salmon SEG of 2,000 to 4,000 was adopted in 1993 (Table 1; Appendix B1). Aerial survey escapement estimates have been sporadic since 1961 and aerial survey coverage is considered poor due to poor weather conditions and infrequent surveys due to the remoteness of the area. Generally, escapement estimates have fallen below or within the SEG range, likely due to the poor aerial survey coverage. Also, this stock is lightly exploited with incidental harvest in the commercial fisheries and minor sport fish take.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock and very limited sport and subsistence effort on this stock. In addition, escapement data are sporadic, most aerial surveys are timed to coincide with sockeye migration timing rather than Chinook migration timing, and are not sufficient to develop an SEG. Therefore, the team recommended eliminating the current SEG.

Cinder River

Stock Status

The current Cinder River Chinook salmon SEG of 1,000 to 2,000 was adopted in 1993 (Table 1; Appendix B2). Aerial survey escapement estimates have been sporadic since 1961 and aerial survey coverage is considered poor due to poor weather conditions and infrequent surveys due to the remoteness of the area. Generally, escapement estimates have fallen below or within the SEG range, likely due to the poor aerial survey coverage. As with other systems, this stock is lightly exploited with incidental harvest in the commercial fisheries and minor sport fish take.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock, incidental harvests are small, and sport and subsistence effort on this stock is very limited. In addition, escapement data are sporadic and most aerial surveys are timed to coincide with sockeye migration timing rather than Chinook migration timing and are not sufficient to develop an SEG. Therefore, the team recommended eliminating the current SEG.

Sockeye Salmon

Orzinski Lake

Stock Status

The current Orzinski Lake sockeye salmon escapement goal of 15,000 to 20,000 was adopted in 1980 (Table 1; Appendix B3). Before the goal was implemented, escapement fell below the lower range in the early 1970s and was generally above the upper range in the late 1970s. The escapements estimated by weir counts (since 1990) were generally higher than estimates derived through aerial surveys. Factors contributing to the large escapements into Orzinski Lake in recent years include limitations on harvest opportunities in the management plan and a reduction in fishing effort.

Percentile Approach

A SEG for Orzinski Lake sockeye salmon was estimated according to the percentile algorithm using two sets of escapement estimates (Bue and Hasbrouck 2001). The first SEG estimate was determined using aerial survey estimates and weir counts from 1970-2003. High contrast in the escapement estimates and high exploitation of this stock resulted in an SEG of 14,000 to 28,750 (25^{th} to 75^{th} percentiles; Table 10). A second SEG estimate was based only on weir count data (1990-2003). Due to the reduced contrast (4.7), the 15^{th} to 85^{th} percentiles of the data resulted in an SEG of 21,175 to 40,142.

Euphotic Volume Analysis

Based on average EV, the adult production of Orzinski Lake is expected to be roughly 118,000 sockeye salmon resulting in an estimated SEG of 29,000 to 48,000 sockeye salmon (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

Depending on the size of the resultant smolt, the zooplankton model estimates an SEG of 14,000 to 80,000 sockeye salmon for Orzinski Lake (Table 8).

Lake Surface Area

Based on the surface area of Orzinski Lake, Honnold et al. (1996) estimated the adult production of Orzinski Lake to be roughly 33,000 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, an SEG of 8,000 to 14,000 sockeye salmon was estimated for Orzinski Lake (Table 9).

Escapement Goal Recommendation

According to area managers, aerial survey escapement estimates of Orzinski Lake sockeye salmon are comparable to weir count estimates. Although the variation in escapements in this time series often arose from varying exploitation rates from management actions rather than changes in stock productivity, the SEG of 14,000 to 28,750, estimated according to the percentile algorithm using the entire time series, reasonably corroborated the current escapement goal. Available limnology data were limited and did not point towards a common goal. Therefore, the utility of the recommendations from these models is limited, but suggest that Orzinski Lake is capable of supporting escapements similar to the current goal range. Moreover, managing for the current escapement goal has continued to result in desired escapement levels as well as surplus production. Based on these analyses the team decided that no change in the SEG is warranted at this time.

Thin Point Lake

Stock Status

The current Thin Point Lake sockeye salmon SEG is 14,000 to 28,000 (Table 1; Appendix B4). It is unknown exactly when this goal was adopted, although managers recollect managing for this goal since the late 1980s. The estimated escapements were generally below the goal range until 1987; at this point, escapements began increasing substantially. In recent years, the escapements at Thin Point Lake have been about 20,000 fish above the upper goal.

Percentile Approach

A SEG for Thin Point sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. High contrast in the escapement estimates and high exploitation of this stock resulted in an SEG of 7,475 to 22,325 (25^{th} to 75^{th} percentiles; Table 10).

Euphotic Volume Analysis

Based on average EV, the adult production of Thin Point Lake is expected to be roughly 78,000 sockeye salmon. A SEG of 19,000 to 32,000 sockeye salmon was estimated based on EV for Thin Point Lake (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

The zooplankton biomass for Thin Point Lake was very low. Depending on the size of the resultant smolt, the zooplankton model results in an estimated SEG of only 40 to 260 sockeye salmon for Thin Point Lake (Table 8). This model is probably not appropriate for Thin Point Lake because juvenile sockeye salmon are known to feed on non-zooplankton forage in shallow Alaska Peninsula lakes (Honnold et al. 1996; Bouwens and Finkle 2003).

Lake Surface Area

Based on the surface area of Thin Point Lake, Honnold et al. (1996) estimated the adult production of Thin Point Lake to be roughly 87,000 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, a SEG of 22,000 to 36,000 sockeye salmon was estimated for Thin Point Lake (Table 9). However, Honnold et al. (1996) suggested that this model may not be appropriate for shallow Alaska Peninsula lakes.

Escapement Goal Recommendation

Extremely high exploitation in the 1970s resulted in very low escapement levels. Once the current SEG was implemented, escapements increased, particularly during the last three years, despite continued high exploitation. It is unknown whether the variation in escapement estimates in this time series arose from varying exploitation rates from management actions or from changes in stock productivity. Available limnology data are limited; therefore, the utility of the recommendations from these models is also limited. Regardless, the EV and surface area models both estimate escapement goals similar to the current SEG and managing for the current SEG has continued to result in desired escapement levels as well as surplus production. Based on this information, the team did not feel that there was compelling evidence to change the existing SEG.

Mortensens Lagoon

Stock Status

The current Mortensens Lagoon sockeye salmon SEG of 3,200 to 6,400 was implemented in the late 1980s (Table 1; Appendix B5). In general, the historic escapements have fallen within the SEG range, although before the goals were in place, escapements were within or below the range, and after the goals were implemented the escapements were within or above the range.

Percentile Approach

A SEG for Mortensens Lagoon sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. High contrast in the escapement estimates and high exploitation of this stock resulted in a SEG of 3,153 to 5,975 (25^{th} to 75^{th} percentiles; Table 10).

Euphotic Volume Analysis

Based on average EV, the adult production of Mortensens Lake is expected to be roughly 10,000 sockeye salmon. A SEG of 2,000 to 4,000 sockeye salmon was estimated based on EV for Mortensens Lake (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

Depending on the size of the resultant smolt, the zooplankton model results in a SEG estimate of 400 to 2,300 sockeye salmon for Mortensens Lake (Table 8). However, this model is probably not appropriate for Mortensens Lake because juvenile sockeye salmon are known to feed on non-zooplankton forage in shallow Alaska Peninsula lakes (Honnold et al. 1996; Bouwens and Finkle 2003).

Lake Surface Area

Based on the surface area of Mortensens Lake, Honnold et al. (1996) estimated the adult production of Mortensens Lake to be roughly 3,300 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, a SEG of 800 to 1,400 sockeye salmon was estimated for Mortensens Lake (Table 9). However, Honnold et al. (1996) suggested that this model may not be appropriate for shallow Alaska Peninsula lakes.

Escapement Goal Recommendation

Although it is unknown whether the variation in escapement estimates in this time series arose from varying exploitation rates from management actions or from changes in stock productivity, the SEG estimated using the percentile approach corroborated the current escapement goal. Available limnology data are limited; therefore, the utility of the recommendations from these models is also limited. Generally, these limnology models may underestimate production in shallow lakes like Mortensens Lake. Regardless, the EV model estimated a SEG similar to the current SEG. Despite high levels of exploitation, the current SEG provides for sustainable yields and this level of escapement should continue to do so in the future. Based on the above information, the team felt that no change to the existing SEG was warranted.

Middle Lagoon

Stock Status

The current Middle Lagoon sockeye salmon SEG of 16,000 to 32,000 was implemented in the late 1980s (Table 1; Appendix B6). Escapements were generally lower before the SEG was in place, and have been increasing in the last two decades. However, poor visibility during aerial surveys and the tendency of these sockeye salmon to hold in the lagoon for extended periods may be significant factors in many of the low escapement estimates.

Percentile Approach

Although the sockeye salmon escapement estimates for Middle Lagoon are not considered reliable, a SEG for Middle Lagoon sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. Due to the high contrast in the escapement estimates and recent increased exploitation of this stock, the estimated SEG was 4,475 to 23,525 (25th to 75th percentiles; Table 10).

Euphotic Volume Analysis

Based on average EV, the adult production of Morzhovoi Lake (the lake that supports Middle Lagoon sockeye salmon) is expected to be roughly 43,000 sockeye salmon. A SEG of 11,000 to 18,000 sockeye salmon was estimated based on EV for Middle Lagoon (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

Depending on the size of the resultant smolt, the zooplankton model estimates a SEG of 29,000 to 165,000 sockeye salmon for Middle Lagoon (Table 8). However, this model is probably not appropriate for Morzhovoi Lake because juvenile sockeye salmon are known to feed on non-zooplankton forage in shallow Alaska Peninsula lakes (Honnold et al. 1996; Bouwens and Finkle 2003).

Lake Surface Area

Based on the surface area of Morzhovoi Lake, Honnold et al. (1996) estimated the adult production of Middle Lagoon to be roughly 68,000 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, a SEG of 17,000 to 28,000 sockeye salmon was estimated for Middle Lagoon (Table 9). However, Honnold et al. (1996) suggested that this model may not be appropriate for shallow Alaska Peninsula lakes.

Escapement Goal Recommendation

Due to the uncertainty of the aerial survey estimates and increased exploitation of this stock, the team was not comfortable with the SEG based on the percentile approach that was substantially lower (especially the low end) than the current SEG. Available limnology data were limited and did not point towards a common SEG. Generally, these limnology models may underestimate production in shallow lakes like Middle Lagoon. Managing for the current escapement goal has continued to result in desired escapement levels as well as surplus production that seems to be increasing in recent years. Therefore, the team did not feel that there was compelling evidence to change the existing SEG.

Christianson Lagoon

Stock Status

The current Christianson Lagoon sockeye salmon SEG of 25,000 to 50,000 was adopted in the 1980s (Table 1; Appendix B7). Before the late 1980s, escapements generally fell below the lower range of the goal, although in some years escapements were well in excess of the upper end of the goal. Estimated escapements were within the range most of the time after the SEG was implemented.

Percentile Approach

A SEG for Christianson Lagoon sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. High contrast in the escapement estimates and high exploitation of this stock resulted in a SEG of 24,200 to 45,600 (25^{th} to 75^{th} percentiles; Table 10).

Escapement Goal Recommendation

Escapement levels have remained relatively constant and according to area managers, escapement estimates based on aerial surveys of this system are reasonable. Although it is unknown whether the variation in escapement estimates in this time series arose from varying exploitation rates from management actions or from changes in stock productivity, the SEG estimate based on the percentile approach supports the current escapement goal. Managing for the current SEG has continued to result in desired escapement levels as well as surplus production, despite high sockeye mortality due to an extremely high number of bears. The team felt that no change to the existing SEG was warranted.

Swanson Lagoon

Stock Status

The current Swanson Lagoon sockeye salmon escapement goal of 8,000 to 16,000 was adopted in 1990 (Table 1; Appendix B8). Before the SEG was implemented, escapements generally fell either below or within the lower portion of the range; in some years, escapements were extremely low. Estimated escapements were within the SEG most of the time since 1990, although the general tendency was for escapements to fall near the lower end or below the range.

Percentile Approach

A SEG for Swanson Lagoon sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. The escapement estimates showed high contrast and exploitation of this stock has been low in recent years. The estimated SEG using this approach was 2,080 to 9,925 (15th to 75th percentiles; Table 10).

Escapement Goal Recommendation

According to area managers it is difficult to estimate escapement in this system using aerial surveys because inclement weather conditions typically result in poor visibility. Given the uncertainty of the escapement estimates, and the fact that the current escapement goal has continued to provide desired escapement levels as well as surplus production, the team felt that no change to the existing SEG was warranted.

North Creek

Stock Status

The current North Creek sockeye salmon SEG of 4,400 to 8,800 was adopted in the late 1980s (Table 1; Appendix B9). Escapements generally have increased from low levels in this system since the 1970s and 1980s, and have met or exceeded the SEG in recent years.

Percentile Approach

A SEG for North Creek sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. High contrast in the escapement estimates and high exploitation of this stock resulted in a SEG of 3,300 to 8,100 (25th to 75th percentiles; Table 10).

Escapement Goal Recommendation

Although it is unknown whether the variation in escapement estimates in this time series arose from varying exploitation rates from management actions or from changes in stock productivity, the SEG based on the percentile approach supports the current escapement goal. Moreover, the current SEG has resulted in an increasing trend in escapement levels during years of increasing exploitation. The team felt that no change to the existing SEG was warranted.

David's River late run

Stock Status

The current David's River sockeye salmon SEG of 6,400 to 12,800 was adopted in the late 1980s; however, estimated total escapement was estimated only from 1985 through 1997 (Table 1; Appendix B10). During that time, the estimated escapements were within the SEG range during only three years, above the SEG range during only one year, and fell below the SEG range during the remaining nine years.

Escapement Goal Recommendation

Managers have not had the capability to manage for escapements to this system inseason because turbid water makes it impossible to estimate escapement until the fish are on the spawning grounds at the end of the season. Also, the management of the neighboring sockeye systems has provided sustainable escapement for the David's River late-run sockeye salmon, as apparent from consistent near end-of-season escapement estimates from aerial surveys (Appendix B10). For these reasons, the team decided to eliminate the David's River late-run sockeye salmon escapement goal

Bear Lake

Stock Status

The current total Bear Lake sockeye salmon SEG of 200,000 to 250,000 was developed in the late 1960s (Table 1; Appendix B11). Before the goal was implemented, escapements were generally below the SEG range. Since the SEG was implemented, estimated escapements were usually above the SEG range. The magnitude of the estimated escapements was similar between tower and weir counts. Escapements above the SEG range were due primarily to a high number of "jacks" and decreasing fishing effort toward the end of the run.

Percentile Approach

A SEG for Bear Lake sockeye salmon was estimated according to the percentile algorithm using two sets of escapement estimates. The first SEG was determined using tower estimates and weir counts from 1970-2003. Medium contrast in the escapement estimates of this stock resulted in a SEG of 273,375 to 585,280 (15th to 85th percentiles; Table 10). A second SEG estimate was based only on weir count data (1991-2003). Due to the reduced contrast in the escapement data,

the 15th percentiles to the maximum estimate of the data resulted in a SEG estimate of 295,000 to 606,000.

Euphotic Volume Analysis

Based on average EV, the adult production of Bear Lake is expected to be roughly 1,131,000 sockeye salmon annually. If applied in proportion to existing goals, an early-run SEG range of 206,000 to 344,000 sockeye salmon and a late-run SEG range of 80,000 to 133,000, for a combined SEG range of 286,000 to 477,000 sockeye salmon, is appropriate based on the EV of Bear Lake (Tables 7 and 11).

Smolt Biomass as a Function of Zooplankton Biomass

If applied in proportion to existing goals, the smolt biomass model estimated an early-run SEG range of 160,000 to 266,000 sockeye salmon and a late-run SEG range of 107,000 to 178,000 sockeye salmon. A combined SEG range of 267,000 to 444,000 sockeye salmon, is appropriate based on the zooplankton biomass of Bear Lake assuming 11.5 g smolt (Tables 8 and 11).

Spawning Habitat Evaluation

Honnold et al. (1996) determined that the number of spawners that Bear Lake could support, based on spawning habitat, is about 488,000 sockeye salmon. If applied in proportion to existing goals, this equates to an early-run SEG of 176,000 to 293,000 and a late-run SEG of 117,000 to 195,000, for a combined SEG of 293,000 to 488,000 sockeye salmon (Table 11).

Lake Surface Area

Based on the surface area of Bear Lake, Honnold et al. (1996) estimated the adult production of Bear Lake to be roughly 2,500,000 sockeye salmon annually. If applied in proportion to existing goals, an early-run SEG of 371,000 to 619,000 sockeye salmon and a late-run SEG of 248,000 to 412,000, for a combined SEG of 619,000 to 1,031,000 sockeye salmon, is appropriate for Bear Lake based on surface area (Tables 9 and 11).

Escapement Goal Recommendation

Because the weir counts were believed to be comparable to tower counts, the team felt that it was reasonable to consider the 1970-2003 time series in the percentile algorithm. Due to medium escapement data contrast (4-8), this approach resulted in a SEG of 273,375 to 585,280. This estimate is similar to the SEG estimates from the models using limnology and spawning habitat data; however, it is unknown whether the escapement estimates in this time series represent management actions or stock productivity.

The spawning area model was determined by the team to be the most appropriate to establish the escapement goal to Bear Lake because Bear Lake is considered to be a spawning area limited system (Honnold et al. 1996). This is evidenced by the large size of smolt that emigrate from Bear Lake (Bouwens 2003). The SEGs estimated using spawning habitat model and lake surface area model are higher than the existing goal but are supported by the other models (Table 11) and are similar to the actual historic escapement levels that have continued to provide desired escapement levels as well as surplus production. Therefore, the team recommended changing the current SEG of 200,000 to 250,000 to a SEG of 293,000 to 488,000. In addition, based on the proportion that each run represents of the current SEGs, the team recommended changing the SEG for the early run to 176,000 to 293,000 and the SEG for the late run to 117,000 to 195,000.

Sandy River

Stock Status

The current total Sandy River sockeye salmon SEG of 40,000 to 60,000 was developed in 1994 (Table 1; Appendix B12). Prior to 1994, the goal was 20,000 to 30,000. During the early 1970s, escapements were generally below the current SEG range, but were within or above the SEG range during the late 1970s. Since 1980, estimated escapements were within the SEG range during seven years, above the SEG range during seven years and below the SEG range during 10 years. A cyclical pattern of escapement was apparent in the 1970s and 1980s The low overall escapement levels before the weir was installed were, in part, likely due to the Sandy River sockeye salmon's tendency to school up in the murky lake, making them difficult to enumerate with aerial surveys. Since the weir was installed in 1994, the counts are believed to be more accurate.

Percentile Approach

A SEG for Sandy River sockeye salmon was estimated according to the percentile algorithm using two sets of escapement estimates. The first SEG was determined using aerial survey estimates and weir counts from 1970-2003. High contrast in the escapement estimates and high exploitation of this stock resulted in a SEG of 29,625 to 61,225 (25th to 75th percentiles; Table 10). A second SEG estimate was based only on weir count data (1994-2003). Due to the reduced escapement data contrast, the 15th percentiles to the maximum estimate of the data resulted in a SEG of 43,150 to 125,000.

Euphotic Volume Analysis

Based on average EV, the adult production of Sandy Lake is expected to be roughly 133,000 sockeye salmon annually. A SEG of 33,000 to 55,000 sockeye salmon was estimated based on EV for Sandy River (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

Depending on the size of the resultant smolt, the zooplankton model results in a SEG estimate of 4,000 to 23,000 sockeye salmon for Sandy River (Table 8). However, this model is probably not appropriate for Sandy Lake because juvenile sockeye salmon are known to feed on non-zooplankton forage in shallow Alaska Peninsula lakes (Honnold et al. 1996; Bouwens and Finkle 2003).

Lake Surface Area

Based on the surface area of Sandy Lake, Honnold et al. (1996) estimated the adult production of Sandy River to be roughly 119,000 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, a SEG of 29,000 to 49,000 sockeye salmon was estimated for Sandy River (Table 9). However, Honnold et al. (1996) suggested that this model may not be appropriate for shallow Alaska Peninsula lakes.

Escapement Goal Recommendation

Because the weir counts are believed to be more accurate than the aerial survey estimates the team felt that it was more appropriate to consider the 1994-2003 time series in the percentile algorithm. However, because of the low escapement data contrast (3), this approach resulted in an upper end of the range that represented the maximum escapement estimate observed in the

time series. Alternately, limited limnology data did not support increasing the upper end of the goal above the current level. The current escapement goal has continued to provide desired escapement levels as well as surplus production. Therefore the team felt that no change to the existing SEG was warranted.

Ocean River

Stock Status

The current Ocean River sockeye salmon escapement goal of 5,000 to 10,000 was adopted in the late 1980s (Table 1; Appendix B13). Since 1960, escapements generally fell either below or well above the current escapement goals; only during the last few years of monitoring were the goals achieved regularly. However, the river is only surveyed intensely when it flows directly into the Bering Sea rather than its usual course through the Ilnik Lagoon. The last time this occurred was 1987, and Ocean River has not been surveyed since 1990.

Escapement Goal Recommendation

The team decided to eliminate the escapement goal for sockeye salmon at Ocean River because it is part of the Ilnik system and has not flowed directly into the Bering Sea since 1987.

Ilnik River

Stock Status

The current Ilnik River sockeye salmon SEG of 40,000 to 60,000 was developed in 1991 (Table 1; Appendix B14). Before the SEG was implemented, escapements were generally below the SEG range. Since the SEG was implemented, estimated escapements were within the SEG range during four years, above the goal during eight years and below the goal during one year. Low escapements estimates prior to 1991 are primarily due to turbid conditions throughout the system, hampering aerial surveys and may not have represented the actual escapements accurately. Since a weir was installed in 1991, it is believed that escapement estimates were more accurate.

Percentile Approach

A SEG for Ilnik River sockeye salmon was estimated according to the percentile algorithm using two sets of escapement estimates. The first SEG was determined using aerial survey estimates and weir counts from 1970-2003. High contrast in the escapement estimates and high exploitation of this stock resulted in a SEG of 28,200 to 71,250 (25th to 75th percentiles; Table 10). A second SEG estimate was based only on weir count data (1991-2003). Due to the reduced data contrast, the 15th percentiles to the maximum estimate of the data resulted in a SEG of 44,600 to 135,000.

Euphotic Volume Analysis

There are two lakes, Ilnik and Wildman, in the Ilnik River drainage, and both were considered together for the purposes of limnology analysis. However, few sockeye salmon utilize Wildman Lake because it is difficult for the adults to access the lake. Therefore, these estimates may be biased. Regardless, based on average EV, the adult production for the Ilnik River is expected to be roughly 143,000 sockeye salmon annually, which equates to a SEG range of 35,000 to 59,000 (Table 7).

Smolt Biomass as a Function of Zooplankton Biomass

Depending on the size of the resultant smolt, the zooplankton model results in an estimated a SEG range of 320,000 to 1,841,000 sockeye salmon for the Ilnik River (Table 8). This model is probably not appropriate for Ilnik Lake because juvenile sockeye salmon are known to feed on non-zooplankton forage in shallow Alaska Peninsula lakes (Honnold et al. 1996; Bouwens and Finkle 2003). However, the majority of the zooplankton were in Wildman Lake, which is lightly utilized by juvenile sockeye salmon. Therefore, this model likely overestimated the desired escapement levels for the Ilnik system.

Lake Surface Area

Based on the surface areas of Ilnik and Wildman Lakes, Honnold et al. (1996) estimated the adult production of Ilnik River to be roughly 89,000 sockeye salmon annually. Based on this production level and an exploitation rate of 0.67, a SEG range of 22,000 to 37,000 sockeye salmon was estimated for Ilnik River (Table 9). However, Honnold et al. (1996) suggested that this model might not be appropriate for shallow Alaska Peninsula lakes.

Escapement Goal Recommendation

Because the weir counts are believed to be more accurate than the aerial survey estimates the team felt that it was more appropriate to consider the 1991-2003 time series in the percentile algorithm. However, because of the low contrast of the data, this approach resulted in an upper end of the range representing the maximum escapement estimate observed in the time series. Although the zooplankton model suggests the system can support higher escapement levels, the vast majority of the zooplankton biomass was in Wildman Lake. Wildman Lake is difficult for sockeye salmon to access and most of the potential rearing resources are not utilized. Therefore, Ilnik Lake is the primary rearing area for juvenile sockeye salmon in the Ilnik River system. The EV and surface area models suggest the current goal is appropriate, and the current escapement goal has continued to provide desired escapement levels as well as surplus production. Therefore the team felt that no change to the existing SEG was warranted.

Meshik River

Stock Status

The current Meshik River sockeye salmon escapement goal is 10,000 to 20,000 fish (Table 1; Appendix B15). This goal was implemented in the late 1980s. Since 1970, estimated escapements were generally within or above the escapement goals and escapements have apparently increased in recent years. The high variability in the escapement estimates is likely due to the size and remoteness of the river system, resulting in sporadic aerial surveys conducted under variable conditions.

Percentile Approach

A SEG for Meshik River sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. High contrast in the escapement estimates and low exploitation of this stock resulted in a SEG of 12,600 to 51,500 (15th to 75th percentiles; Table 10).

Escapement Goal Recommendation

There are no significant lakes within the Meshik River system, and it is probably limited by the amount of available rearing habitat for juvenile sockeye salmon. Although the percentile approach suggests increasing the escapement goal, historic escapement data are sporadic and are probably not sufficient to perform an analysis to recalculate sockeye salmon escapement goals to the Meshik River. Escapements under current management with escapement goals from 10,000 to 20,000 have been sustainable; therefore, the team recommends no change to the existing SEG.

Cinder River

Stock Status

The current Cinder River sockeye salmon escapement goal is 6,000 to 12,000 fish (Table 1; Appendix B16). This goal was implemented in the late 1980s. Since 1970, estimated escapements were extremely variable, ranging from below the SEG range to well in excess of the SEG range. The high variability of the escapements is likely due to the size and remoteness of the river system, resulting in sporadic aerial surveys conducted under variable conditions.

Percentile Approach

A SEG for Cinder River sockeye salmon was estimated according to the percentile algorithm using aerial survey escapement estimates from 1970 to 2003. High contrast in the escapement estimates and low exploitation of this stock resulted in a SEG of 3,593 to 41,350 (15th to 75th percentiles; Table 10).

Escapement Goal Recommendation

There are no lakes within the Cinder River system, and it is probably limited by the amount of available rearing habitat for juvenile sockeye salmon. Although the percentile approach suggests increasing the upper bound of the escapement goal, historic escapement data are sporadic and are probably not sufficient to perform an analysis to recalculate sockeye salmon escapement goals to the Cinder River. Escapements under current management with escapement goals from 6,000 to 12,000 have been sustainable; therefore, the team recommends no change to the current goal.

McLees Lake

Stock Status

The current McLees Lake sockeye salmon SEG of 4,000 to 6,000 fish was adopted in 1993 (Table 1; Appendix B17). Before the SEG was implemented, escapements were generally below the SEG range. Since the goal was implemented the system was not surveyed during 10 years. During years when the system was surveyed, estimated escapements were generally below the SEG. From 2001-2003, paired aerial survey and weir counts were conducted and indicated that aerial surveys underestimated the abundance of sockeye salmon in the McLees Lake system.

Percentile Approach

A SEG for McLees Lake sockeye salmon was estimated according to the percentile algorithm using aerial survey peak count estimates from 1970 to 2003. High contrast in the escapement estimates and low exploitation of this stock resulted in a SEG of 1,089 to 3,725 (15th to 75th percentiles; Table 10).

Escapement Goal Recommendation

Although there is a significant subsistence fishery, there is very infrequent commercial fishery activity on this stock, and no management action has ever been implemented on the subsistence fishery. Funding and logistic limitations have prevented thorough aerial survey coverage of this system. The escapements estimated via weir counts in recent years have been much larger than escapements estimated via aerial surveys. It is likely, then, that the past escapements into McLees Lake have been larger than previously estimated. The weir project on McLees Lake is not funded by a stable funding source, and it is unlikely that reliable escapement estimates will be consistently available in the future. Therefore, the team recommended eliminating this SEG.

Pink Salmon

Bechevin Bay

Stock Status

The current Bechevin Bay Section pink salmon SEG of 33,200 to 66,400 during even years and 2,400 to 4,800 during odd years was adopted in 1992 (Table 3; Appendix B18). Aerial survey escapement estimates from five systems are used as an index for the total escapement in the Bechevin Bay Section. Since escapement has been estimated (1987), escapements for odd and even years have generally fallen below the SEG range during the late 1980s and early 1990s, but increased during the late 1990s. During the last two seasons however, escapement estimates have fallen below the SEG.

Risk Analysis

A Risk analysis for Bechevin Bay pink salmon was performed using peak escapement data from 1968-2003. The odd-year escapement data from 1969-2003 was not autocorrelated and not significantly different from a lognormal probability density function. A drop in the mean escapement of 42% led to a threshold of 4,900 pink salmon escapement. At this escapement level, there was an estimated risk of 37.6% that a drop in the mean escapement of 42% would not be detected during three consecutive years. A drop in the mean escapement of 95% led to a threshold of 1,600. At this escapement level, there was an estimated risk of 4.2% that a drop in the mean escapement of 95% would not be detected during three consecutive years.

The even-year Bechevin Bay pink salmon escapement data from 1968-2002 was autocorrelated. An autoregressive (AR) model covered a single time unit lag [AR(1)], though a single time unit is two years (even years only), was fit to the even-year escapement. There was no further autocorrelation detected in the residuals. A drop in the mean escapement of 39% led to a threshold of 55,000 pink salmon escapement. At this escapement level, there was an estimated risk of 41.3% that a drop in the mean escapement of 39% would not be detected during three consecutive years. A drop in the mean escapement of 80% led to a threshold of 31,000. At this escapement level, there was an estimated risk of 24.6% that a drop in the mean escapement of 80% would not be detected during three consecutive years.

Escapement Goal Recommendation

The Bechevin Bay Section is managed based on chum salmon escapement levels. There are currently no commercial fisheries directed on pink salmon in this section. Rather, pink salmon are coincidentally harvested while fishers target chum salmon. The team recommended a SEG threshold of 1,600 for odd years and 31,000 for even years. These thresholds could be used to alert managers to potential overharvest or changes in productivity. This seemed reasonable based

on the results of the risk analysis; and that both odd and even years have had years (>5 years) of escapement below these respective thresholds that produced positive returns.

Unalaska

Stock Status

The current Unalaska District pink salmon SEG of 368,000 to 736,000 during even years and 91,000 to 182,000 during odd years was adopted in 1992 (Table 3; Appendix B19). Aerial survey records date back to 1961, and since that time escapements have frequently fallen below the lower escapement goals; however, this is likely due to sporadic aerial survey coverage rather than actual low escapements.

Escapement Goal Recommendation

Although there is a subsistence and sport fishery for pink salmon in the Unalaska District, there is virtually no recent commercial effort on this stock. Funding and logistic limitations have prevented, and will continue to prevent, thorough aerial survey coverage of this system. Historic escapement data are sporadic and are not sufficient to perform an analysis to assess the Unalaska District pink salmon escapement goals. Therefore, the team recommended eliminating the current SEG.

Chum Salmon

Southeastern District

Stock Status

The current Southeastern District (which includes the Southeastern District Mainland and the Shumagin Islands Section) chum salmon SEG of 106,400 to 212,800 was adopted in 1992 (Table 4; Appendix B20). Aerial survey escapement estimates from 28 systems are used as an index for the total escapement in the Southeastern District. Prior to the implementation of this SEG, escapements frequently fell below the SEG range; however, since 1992 escapements have generally been within or above the SEG range.

Percentile Approach

A SEG for the Southeastern District chum salmon aggregate was estimated according to the percentile algorithm using aerial survey estimates from 1987 to 2003. Medium contrast in the escapement estimates of this aggregate resulted in a SEG of 82,910 to 235,139 (15th to 85th percentiles; Table 10).

Escapement Goal Recommendation

The SEG estimate from the percentile approach generally supports the current SEG range (106,400-212,800). Chum salmon escapements have been sustainable and surplus production has been available while managing for the current goal; therefore, the team recommended no change to the current SEG was warranted.

South Central District

Stock Status

The current South Central District chum salmon SEG of 89,800 to 179,600 was adopted in 1992 (Table 4; Appendix B21). Aerial survey escapement estimates from 13 systems are used as an

index for the total escapement in the South Central District. Escapements have generally fallen within the goal range since estimated total escapements have been estimated, beginning in 1987.

Percentile Approach

A SEG for the South Central District chum salmon aggregate was estimated according to the percentile algorithm using aerial survey estimates from 1987-2003. Low contrast in the escapement estimates of this aggregate resulted in a SEG of 92,230 to 274,400 (15th percentile to the maximum estimate; Table 10).

Escapement Goal Recommendation

The SEG estimates from the percentile approach generally support the current SEG range (89,800-179,600), although it does suggests increasing the upper range of the goal. The team felt that this is probably not desirable because an increase in the contrast in the data would not facilitate any further, more comprehensive, analysis because of our inability to apportion harvest in this fishery to the stock-of-origin. Chum salmon escapements have been sustainable and surplus production has been available while managing for the current goals; therefore, the team recommended that no change to the current SEG was warranted.

Southwestern District

Stock Status

The current Southwestern District chum salmon SEG of 133,400 to 266,800 was adopted in 1992 (Table 4; Appendix B22). Aerial survey escapement estimates from 23 systems are used as an index for the total escapement in the Southwestern District. Escapements have generally fallen within or above the goal range since estimated total escapements have been calculated beginning in 1987.

Percentile Approach

The South Central District chum salmon aggregate SEG was estimated according to the percentile algorithm using aerial survey estimates from 1987 to 2003. Low contrast in the escapement estimates of this aggregate resulted in a SEG of 157,074 to 401,150 (15th percentile to the maximum estimate; Table 10).

Escapement Goal Recommendation

The SEG estimates from the percentile approach generally support the lower end of the current SEG range (133,400-266,800), but suggests increasing the upper range of the goal. This is probably not desirable because an increase in the contrast in the data would not facilitate any further, more comprehensive, analysis because of our inability to apportion harvest in this fishery to the stock-of-origin and the lack of age information needed to construct a brood table. Chum salmon escapements have been sustainable and surplus production has been available while managing for the current goals; therefore, the team recommended no change to the current escapement goal.

Unimak District

Stock Status

The current Unimak District chum salmon escapement goal of 800 to 1,600 was adopted in 1992 (Table 4; Appendix B23). Aerial survey escapement estimates from three systems are used as an

index for the total escapement in the Southwestern District. Escapements have generally fallen slightly below or toward the low end of the goal range since estimated total escapements have been estimated beginning in 1987.

Percentile Approach

The Unimak District chum salmon aggregate SEG was estimated according to the percentile algorithm using aerial survey estimates from 1987-2003. High contrast in the escapement estimates and high exploitation of this aggregate resulted in a SEG of 450 to 1,000 (25th to 75th percentiles; Table 10).

Escapement Goal Recommendation

The SEG estimates from the percentile approach generally support the upper end of the current SEG range (800-1,600), but suggest decreasing the lower end. Chum salmon escapements have been sustainable and surplus production has been available while managing for the current goals; therefore, the team recommended no change to the current escapement goal.

Coho Salmon

Thin Point

Stock Status

The current Thin Point River coho salmon escapement goal is 3,000 to 6,000 fish (Table 2; Appendix B24). This goal was implemented in 1993. Estimated escapements were well below the current escapement goal prior to its implementation. Since 1992, escapement estimates have increased significantly and have exceeded the goals in recent years.

Escapement Goal Recommendation

Both commercial and subsistence fisheries are directed on this stock. However, escapement data for this stock is incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. With insufficient data to reasonably estimate a SEG for this system, particularly an upper end, the team recommended keeping the lower end of the current SEG of 3,000 to be used as a threshold to alert managers to potential overharvest or changes in productivity.

Nelson River

Stock Status

The current Nelson River coho salmon SEG is 18,000 to 25,000 fish (Table 2; Appendix B25). This goal was implemented in the early 1980s. Estimated escapements were relatively low in the 1970s and have generally been slightly below, within or above the SEG since 1980.

Risk Analysis

A risk analysis (Bernard et al. *In prep*) for Nelson River coho salmon was performed using peak escapement data from 1968-2003, with a missing value in 1982. The escapement data from 1968-2003 were significantly different from lognormal, uniform and normal probability density functions. The data also exhibited non-stationarity, therefore no test for autocorrelation was performed. It was decided to use a subset of the data representing the longest complete (no missing values) time series, 1983-2003. These data were not significantly different from a

lognormal density function. A variety of reductions from the mean escapement level were investigated (25% to 75%). Two specific reductions in escapement were further investigated, 45% and 64%. A drop in the mean escapement of 45% led to a threshold of 21,700 coho escapement. At this escapement level, there was an estimated risk of 9.4% that a drop in the mean escapement of 45% would not be detected during three consecutive years. A drop in the mean escapement of 64% led to a threshold of 18,000, which is the lower end of the current SEG. At this escapement level, there was an estimated risk of 1.3% that a drop in the mean escapement of 64% would not be detected during three consecutive years. The 18,000 coho escapement threshold would also provide an estimated risk of 29.3% that a drop in the mean escapement of 45% would not be detected during three consecutive years.

Escapement Goal Recommendation

Both commercial and subsistence fisheries are directed on this stock. However, escapement data for this stock is incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. The team recommended keeping the lower end of the current SEG of 18,000 to be used as a threshold to alert managers to potential overharvest or changes in productivity. This seemed reasonable based on the results of the risk analysis.

Ocean River

Stock Status

The current Ocean River coho salmon SEG of 6,000 to 13,000 was adopted in 1993 (Table 2; Appendix B26). Since 1968, aerial surveys of Ocean River have been extremely sporadic. Generally, escapement estimates have fallen below the SEG, likely due to the poor aerial survey coverage.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock; consequently, no fishery management decisions have been made for this stock in many years. There is also very limited sport and subsistence effort on this stock. In addition, escapement data for this stock are incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. Therefore, the team recommended eliminating the current SEG.

Ilnik River

Stock Status

The current Ilnik River coho salmon SEG of 10,000 to 19,000 was adopted in 1993 (Table 2; Appendix B27). Aerial survey escapement estimates are sporadic, often due to airplane availability, poor weather, or the frequent turbid conditions in the Ilnik River. Escapement estimates have generally been well below the SEG, likely due to the poor aerial survey coverage.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock; consequently, no fishery management decisions have been made for this stock in many years. There is also very limited sport and subsistence effort on this stock. In addition, escapement data for this stock are

incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. Therefore, the team recommended eliminating the current SEG.

Meshik River

Stock Status

The current Meshik River coho salmon SEG of 16,000 to 32,000 was adopted in 1993 (Table 2; Appendix B28). Aerial survey escapement estimates are sporadic; frequently there are seasons in which no surveys are conducted. Prior to implementation of the goal, escapement estimates generally fell below the current SEG. After the goal was implemented, escapement estimates have generally been above the SEG.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock; consequently, no fishery management decisions have been made for this stock in many years. There is also very limited sport and subsistence effort on this stock. In addition, escapement data for this stock are incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. Therefore, the team recommended eliminating the current SEG.

Mud Creek

Stock Status

The current Mud Creek coho salmon SEG of 6,000 to 12,000 was adopted in 1993 (Table 2; Appendix B29). Aerial survey escapement estimates were sporadic during the 1970s and 1980s. Recently, Mud Creek has been surveyed annually; however, survey coverage is still poor. Prior to implementation of the SEG, escapement estimates frequently fell below the SEG. After the goal was implemented, escapement estimates have generally been within or above the SEG.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock; consequently, no fishery management decisions have been made for this stock in many years. There is also very limited sport and subsistence effort on this stock. In addition, escapement data for this stock are incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. Therefore, the team recommended eliminating the current SEG.

Cinder River

Stock Status

The current Cinder River coho salmon SEG of 3,000 to 6,000 was adopted in 1993 (Table 2; Appendix B30). Aerial survey escapement estimates are sporadic; frequently there are seasons in which no surveys are conducted. Escapement estimates generally fell below the SEG; however, in recent years there has been an increase in the estimates, possibly due to increased airplane availability late in the season.

Escapement Goal Recommendation

There are currently no commercial fisheries directed on this stock; consequently, no fishery management decisions have been made for this stock in many years. There is also very limited sport and subsistence effort on this stock. In addition, escapement data for this stock is incomplete because weather conditions often hamper completing the aerial surveys in season and aerial surveys cannot be flown in the fall during peak coho salmon escapement due to high cost and poor survey conditions. Therefore, the team recommended eliminating the current SEG.

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).

ADF&G formed an Escapement Goal Policy Implementation Team (EGPIT) in 2001, whose efforts should provide recommendations on the estimation of escapement goals. EGPIT and other such groups will hopefully provide a more theoretical framework to estimate escapement goals, especially SEGs and thresholds.

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.

While it was not possible to calculate stock specific harvest estimates in most cases, the team attempted, in a number of cases, to estimate aggregate escapement goals by geographic area, when appropriate, in an attempt to develop stock-aggregate BEGs. This technique provided the ability to estimate total production for the aggregate, which then allowed the estimation of S_{msy}. Obviously, this is less desirable than estimations of S_{msy} for individual systems, but it incorporated information that would not have been available otherwise. The total escapement range could then be re-apportioned back to the individual systems or smaller aggregates. This technique was successful in several instances during this review.

Because the percentile algorithm worked well in a previous escapement goal review of Upper Cook Inlet (Bue and Hasbrouck 2001), 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. However, Area M salmon escapements have often been the result of management actions rather than stock productivity. In addition, the percentile method is probably not desirable for Area M stocks

because an increase in data contrast would not facilitate any further, more comprehensive, analysis for most stocks due to an inability to apportion harvest to stock-of-origin.

In the absence of stock specific catch estimates, limnology data are often valuable information in calculating the ability of a watershed to support sockeye salmon. However, with the exception of the data on Bear Lake, the limnology data used in this report were limited because these data were only collected during three years. Further, the utility of these data was limited by the lack of appropriate models to assess sockeye salmon production in shallow lakes. The current available sockeye salmon production models were developed on "typical" sockeye salmon lakes; these are moderately sized, deep, and thermally stratified. The lakes on the Alaska Peninsula are unique in that they are often small, shallow, and highly mixed by persistent winds. These lakes are generally much more productive in actuality than is estimated by the standard production models. Regardless, limnology data were used to gain insight into the potential production level of Alaska Peninsula sockeye salmon systems.

This comprehensive review of the 48 existing salmon escapement goals in Area M resulted in recommendations to change 20 (which included establishing two BEGs that would replace 10 existing SEGs), eliminate 12, and leave 16 unchanged. For the most part, the 20 changes were relatively minor in magnitude and the eliminations would not have noticeable effects on future management decisions.

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TABLES AND FIGURES

Table 1.-Current and recommended Chinook and sockeye salmon escapement goals by spawning system in the Alaska Peninsula and Aleutian Islands Management Areas.

System	Current Escapement Goal Lower	Current Escapement Goal Upper	Goal Type	Year Adopted	Recommended Escapement Goal Lower	Recommended Escapement Goal Upper	Goal Type	Action
CHINOOK								
South Peninsula								
No spawning stocks reported								
North Peninsula								
Nelson River	3,200	6,400	SEG	1993	2,400	4,400	BEG	change
Meshik River	2,000	4,000	SEG	1993				eliminate
Cinder River	1,000	2,000	SEG	1993				eliminate
Aleutian Islands								
No spawning stocks reported								
SOCKEYE								
South Peninsula								
Orzinski Lake	15,000	20,000	SEG	1980	15,000	20,000	SEG	none
Thin Point Lake	14,000	28,000	SEG	late 1980s	14,000	28,000	SEG	none
Mortensens Lagoon	3,200	6,400	SEG	late 1980s	3,200	6,400	SEG	none
Middle Lagoon	16,000	32,000	SEG	late 1980s	16,000	32,000	SEG	none
North Peninsula								
Christianson Lagoon	25,000	50,000	SEG	1980s	25,000	50,000	SEG	none
Swanson Lagoon	8,000	16,000	SEG	1990	8,000	16,000	SEG	none
North Creek	4,400	8,800	SEG	late 1980s	4,400	8,800	SEG	none
David's River								
Late	6,400	12,800	SEG	late 1980s				eliminate
Nelson River	100,000	150,000	SEG	1979	97,000	219,000	BEG	change
Bear Lake								
Early	150,000	175,000	SEG	late 1960s	176,000	293,000	SEG	change
Late	50,000	75,000	SEG	late 1960s	117,000	195,000	SEG	change
Sandy River	40,000	60,000	SEG	1994	40,000	60,000	SEG	none
Ocean River	5,000	10,000	SEG	late 1980s				eliminate
Ilnik River	40,000	60,000	SEG	1991	40,000	60,000	SEG	none
Meshik River	10,000	20,000	SEG	late 1980s	10,000	20,000	SEG	none
Cinder River	6,000	12,000	SEG	late 1980s	6,000	12,000	SEG	none
Aleutian Islands								
McLees Lake	4,000	6,000	SEG	1993				eliminate

Table 2.-Current and recommended coho salmon escapement goals by spawning system in the Alaska Peninsula and Aleutian Islands Management Areas.

System	Current Escapement Goal Lower	Current Escapement Goal Upper	Goal Type	Year Adopted	Recommended Escapement Goal Lower	Recommended Escapement Goal Upper	Goal Type	Action
COHO								
South Peninsula								
Thin Point Lake	3,000	6,000	SEG	1993	3,000	none	SEG	change
North Peninsula								
Nelson River	18,000	25,000	SEG	early 1980s	18,000	none	SEG	change
Ocean River	6,000	13,000	SEG	1993				eliminate
Ilnik River	10,000	19,000	SEG	1993				eliminate
Meshik River	16,000	32,000	SEG	1993				eliminate
Mud Creek	6,000	12,000	SEG	1993				eliminate
Cinder River	3,000	6,000	SEG	1993				eliminate
Aleutian Islands								
No escapement goals established								

Table 3.-Current and recommended pink salmon escapement goals by area and district in the Alaska Peninsula and Aleutian Islands Management Areas.

	Current Escapement Goal						Recommended Escapement Goal					
	Even Year		Odd Year		Goal	Year	Even Year		Odd Year		Goal	
	Lower	Upper	Lower	Upper	Type	Adopted	Lower	Upper	Lower	Upper	Type	Action
PINK												
South Peninsula												
Shumagin Islands Section	137,000	274,000	137,000	274,000	SEG	1992	137,000	274,000	137,000	274,000	M.O.[a]	change
South Central District	687,200	1,374,400	687,200	1,374,400	SEG	1992	687,200	1,374,400	687,200	1,374,400	M.O.[a]	change
Southeastern District Mainland	425,600	851,300	425,600	851,300	SEG	1992	425,600	851,300	425,600	851,300	M.O.[a]	change
Southwestern District	563,600	1,127,200	378,000	756,000	SEG	1992	563,600	1,127,200	378,000	756,000	M.O.[a]	change
Unimak District	51,200	102,400	10,000	20,000	SEG	1992	51,200	102,400	10,000	20,000	M.O.[a]	change
South Peninsula Total	1,864,600	3,729,300	1,637,800	3,275,700	sum of SEGs		1,864,600	3,729,300	1,637,800	3,275,700	BEG	change
North Peninsula												
Bechevin Bay Section	33,200	66,400	2,400	4,800	SEG	1992	31,000	none	1,600	none		change
Northern District	No escapement goals established											
North Peninsula Total	33,200	66,400	2,400	4,800	sum of SEGs							
Aleutian Islands												
Unalaska District	368,000	736,000	91,000	182,000	SEG	1992						eliminate

[a] M.O. stands for management objective.

Table 4.-Current and recommended chum salmon escapement goals by area and district in the Alaska Peninsula and Aleutian Islands Management Areas.

	Current				Recommended			
	Escapement Goal		Goal	Year	Escapement Goal		Goal	
	Lower	Upper	Type	Adopted	Lower	Upper	Type	Action
CHUM								
South Peninsula								
Southeastern District	106,400	212,800	SEG	1992	106,400	212,800	SEG	none
South Central District	89,800	179,600	SEG	1992	89,800	179,600	SEG	none
Southwestern District	133,400	266,800	SEG	1992	133,400	266,800	SEG	none
Unimak District	800	1,600	SEG	1992	800	1,600	SEG	none
North Peninsula								
Northwestern District	223,600	447,200	SEG	1992	94,000	202,000	BEG	change
Northern District	119,600	239,200	SEG	1992	119,600	239,200	BEG	change
Aleutian Islands								
	No escapement goals established							

Table 5.-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 6.-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.

Table 7.-Average estimated optimal number of sockeye salmon spawners and resultant adult production by system, based on euphotic volume (EV).

System	Lake	Lake Type	EV (10^6 m^3)	Adult Production	Estimated Escapement[a] Low	High
Orzinski[b]	Orzinski	Intermediate	47	117,500	29,000	48,000
Thin Point[b]	Thin Point Lake	Shallow	31	77,500	19,000	32,000
Mortensens[b]	Mortensens	Shallow	4	10,000	2,000	4,000
Middle Lagoon[b]	Morzhovi	Shallow	17	42,500	11,000	18,000
Nelson[b]	Sapsuk	Deep	241	602,500	149,000	249,000
Bear[c]	Bear	Deep	521	1,131,000	286,000	477,000
Sandy[b]	Orzinski	Shallow	53	132,500	33,000	55,000
Ilnik[b]	Ilnik	Shallow	9	22,500	6,000	9,000
	Wildman	Intermediate	48	120,000	30,000	50,000
Ilnik Total			57	142,500	35,000	59,000

[a] Assuming 33% escapement, 67% harvest; low and high goal ranges are 0.75 and 1.25 multiplied by the point estimate of escapement.

[b] Data from 1993-1995 (Honnold et al. 1996).

[c] Data from 1993-1995 (Honnold et al. 1996) and 2000-2002 (Bouwens 2003).

Table 8.-Average zooplankton biomass, predicted smolt biomass, and optimal number of sockeye salmon spawners required to produce smolt of a given size, by system.

System	Lake	Zooplankton Biomass (mg/m^2)	Smolt Biomass (kg/km^2)	Optimum spawners	
				11.5-g smolt	2-g smolt
Orzinski	Orzinski[a,b]	189	399	14,000	80,000
Thin Point	Thin Point[a,b]	0.231	0	40	260
Mortensens	Mortensens[a,b]	55	116	400	2,300
Middle Lagoon	Morzhovi[a,b]	191	403	29,000	165,000
Nelson	Sapsuk[a,b]	994	2,097	134,000	769,000
Bear	Bear[c,d]	1,134	2,393	355,000	2,042,000
Sandy	Sandy[a,b]	15.4	32	4,000	23,000
Ilnik	Ilnik[a,b]	3	6	200	1,200
	Wildman[a,b]	2,642	5,575	320,000	1,840,000
Ilnik Total		2,645	5,581	320,000	1,841,000

[a] Zooplankton data from 1993-1995 (Honnold et al. 1996).

[b] The average smolt weight is unknown; it is assumed that 11.5-g approaches the maximum size of smolt for that system.

[c] Zooplankton data from 1993-1995 (Honnold et al. 1996) and 2000-2002 (Bouwens 2003).

[d] Bear Lake smolt are unusually large; 11.5 g is the estimated average smolt weight for that system (Bouwens 2003).

Table 9.-Average estimated optimal number of sockeye salmon spawners and resultant adult production by system, based on lake surface area.

System	Lake	Lake Type[a]	Surface Area[a] (km^2)	Potential Adult Production[a]	Estimated Escapement[b] Low	Estimated Escapement[b] High
Orzinski	Orzinski	Intermediate	6.0	33,000	8,000	14,000
Thin Point	Thin Point Lake	Shallow	15.9	87,450	22,000	36,000
Mortensens	Mortensens	Shallow	0.6	3,300	800	1,400
Middle Lagoon	Morzhovi	Shallow	12.3	67,650	17,000	28,000
Nelson	Sapsuk	Deep	11.0	480,000	119,000	198,000
Bear	Bear	Deep	25.6	2,500,000	619,000	1,031,000
Sandy	Orzinski	Sandy	21.6	118,800	29,000	49,000
Ilnik	Ilnik	Shallow	6.3	34,650	9,000	14,000
	Wildman	Intermediate	9.9	54,450	13,000	22,000
Ilnik Total			16.2	89,100	22,000	37,000

[a] From Honnold et al. (1996).
[b] Assuming 33% escapement, 67% harvest; low and high goal ranges are 0.75 and 1.25 multiplied by the point estimate of escapement.

Table 10.-Summary of the percentile analysis estimates for salmon escapement goals by system.

Stock	Species	Percentiles of escapement data used		Escapement goal estimates	
		Lower	Upper	Lower	Upper
Orzinski Lake (weir and aerial counts)	sockeye salmon	25th	75th	14,000	28,750
Orzinski Lake (weir counts)	sockeye salmon	15th	85th	21,175	40,142
Thin Point Lake	sockeye salmon	25th	75th	7,475	22,325
Mortensens Lagoon	sockeye salmon	25th	75th	3,153	5,975
Middle Lagoon	sockeye salmon	25th	75th	4,475	23,525
Chrisianson Lagoon	sockeye salmon	25th	75th	24,200	45,600
Swanson Lagoon	sockeye salmon	15th	75th	2,080	9,925
North Creek	sockeye salmon	25th	75th	3,300	8,100
Bear Lake (total run; weir and tower counts)	sockeye salmon	15th	85th	273,375	585,280
Bear Lake (total run; weir counts)	sockeye salmon	15th	maximum	295,000	606,000
Sandy River (weir and aerial counts)	sockeye salmon	25th	75th	29,625	61,225
Sandy River (weir counts only)	sockeye salmon	15th	maximum	43,150	125,000
Ilnik River (weir and aerial counts)	sockeye salmon	25th	75th	28,200	71,250
Ilnik River (weir counts only)	sockeye salmon	15th	maximum	44,600	135,000
Meshik River	sockeye salmon	15th	75th	12,600	51,500
Cinder River	sockeye salmon	15th	75th	3,593	41,350
McLees Lake	sockeye salmon	15th	75th	1,089	3,725
Southeastern District	chum salmon	15th	85th	82,910	235,139
South Central District	chum salmon	15th	maximum	92,230	274,400
Southwestern District	chum salmon	15th	maximum	157,074	401,150
Unimak District	chum salmon	25th	75th	450	1,000

Table 11.-Sockeye salmon escapement goal estimates and associated ranges for the early, late, and total run to Bear Lake.

	Early Run			Late Run			Total Run		
Method	Low	Point	High	Low	Point	High	Low	Point	High
EV[a,b]	206,000	274,000	344,000	80,000	106,000	133,000	286,000	381,000	477,000
Zooplankton[a,b]	160,000	213,000	266,000	107,000	142,000	178,000	267,000	355,000	444,000
Lake Surface Area[b]	371,000	495,000	619,000	248,000	330,000	412,000	619,000	825,000	1,031,000
Spawning Area[a,b,c]	176,000	234,000	293,000	117,000	156,000	195,000	293,000	390,000	488,000
Existing Goals	150,000	162,500	175,000	50,000	62,500	75,000	200,000	225,000	250,000
Actual Escapements[d,e]	172,000	231,000	283,000	83,000	152,000	263,000	273,000	383,000	606,000

[a] Low and high ranges were calculated as values 25% higher and lower than the point goals.
[b] Early and late run goals divided from total run goal estimates based on 1985 to 2002 escapement percentages (60% early run, 40% late run).
[c] High total run goal estimate based on spawning area capacity taken from Honnold et al. (1996). Based on communication with area managers, this value was believed to be a maximum estimate.
[d] Point estimates were the average 1985 to 2002 escapements for each run.
[e] The low and high values are the actual lowest and highest escapements since 1985.

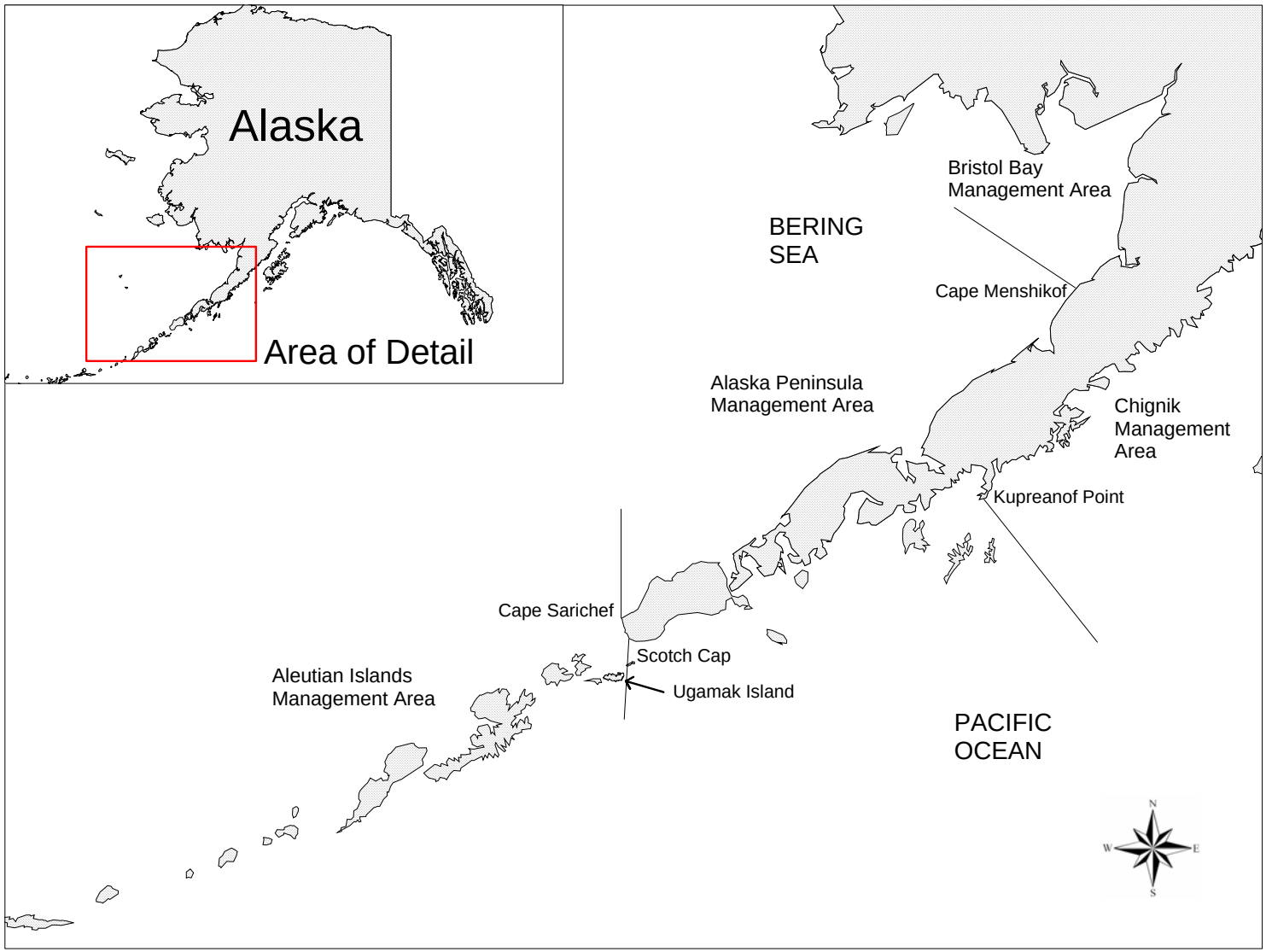


Figure 1.-Map of the Alaska Peninsula and Aleutian Islands Management Areas.

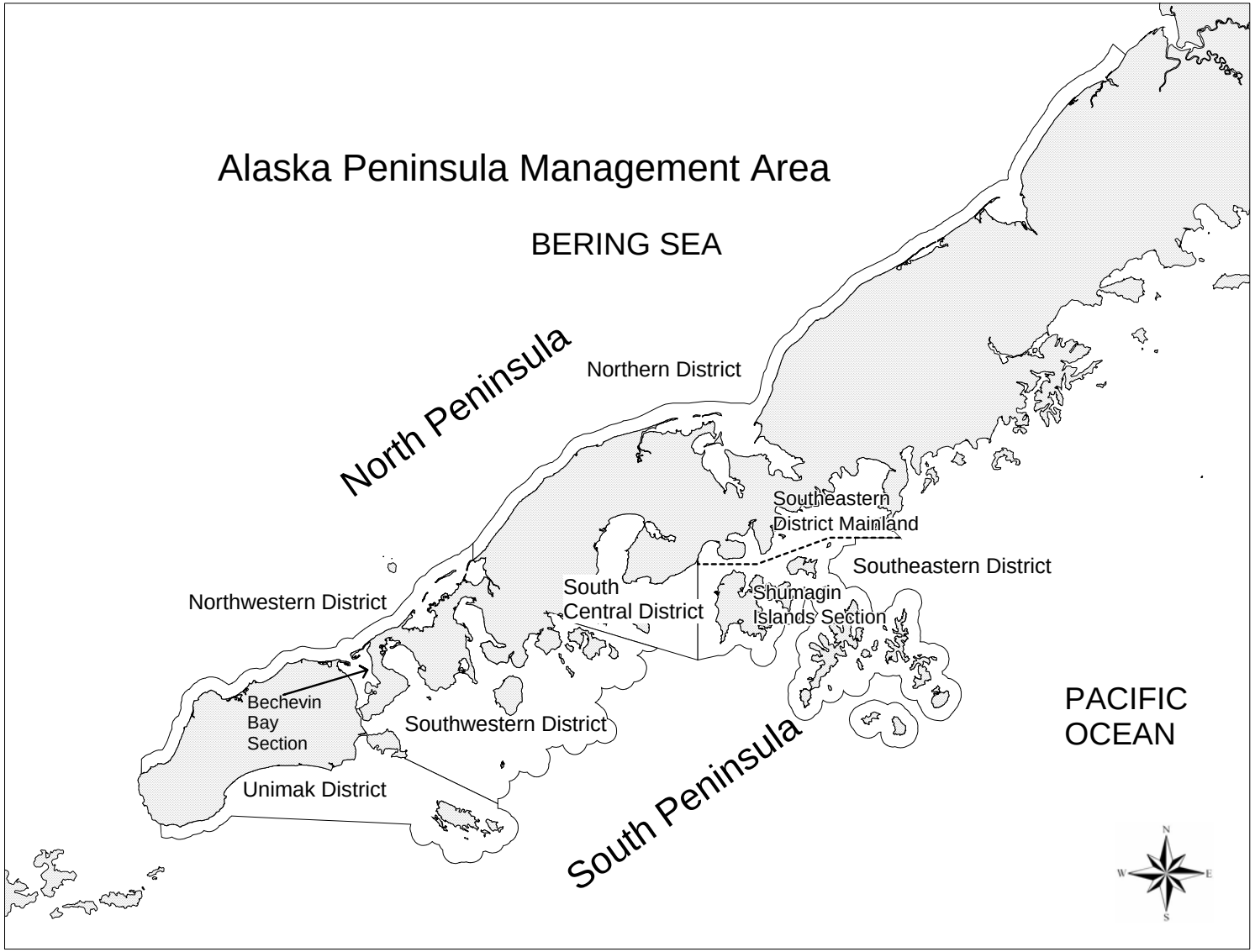


Figure 2.-Map of the Alaska Peninsula Management Area with the commercial salmon fishing districts depicted.

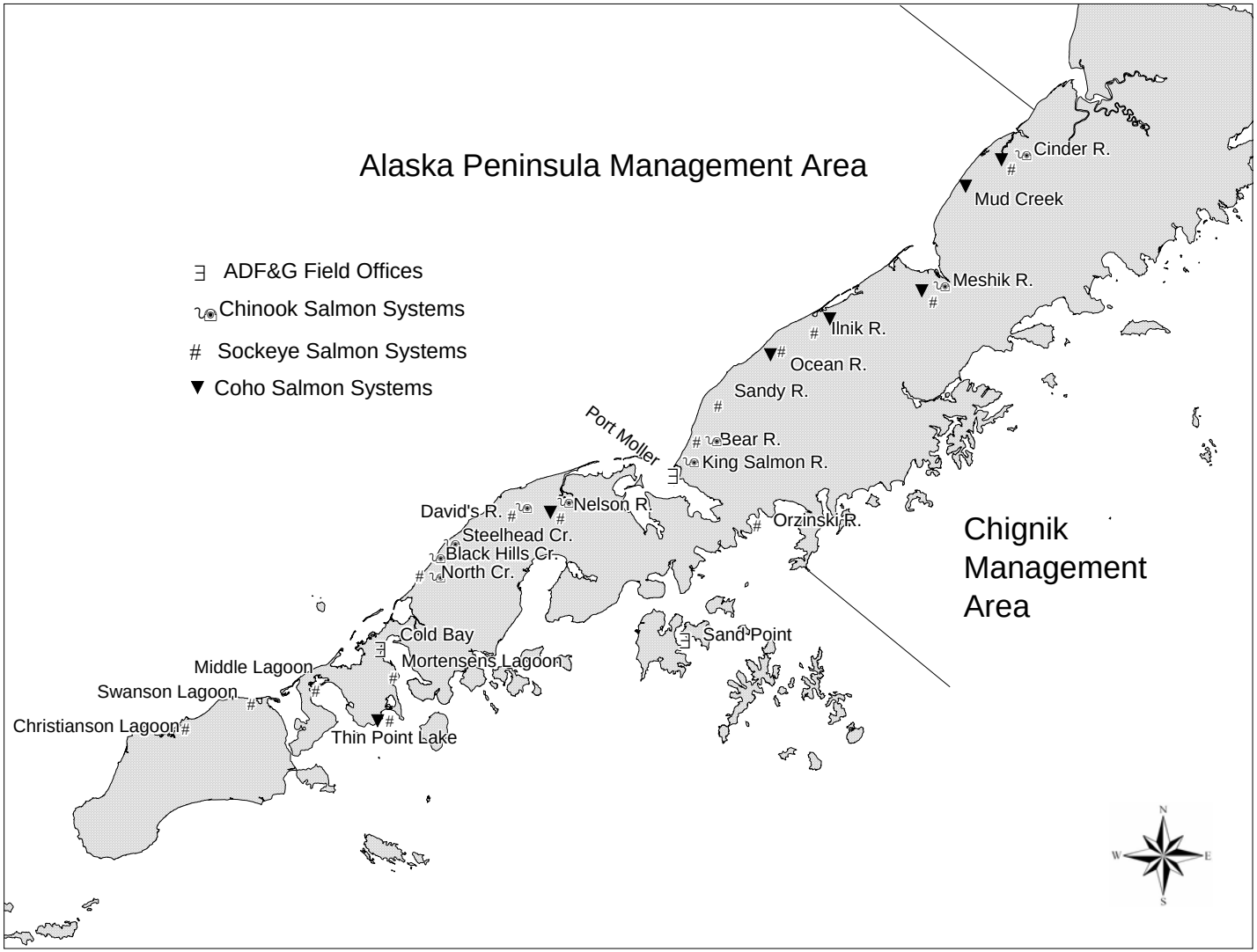


Figure 3.-Map of the Alaska Peninsula Management Area with the major sockeye, coho, and Chinook salmon systems depicted and the Chinook salmon systems used in the Cluster analysis.

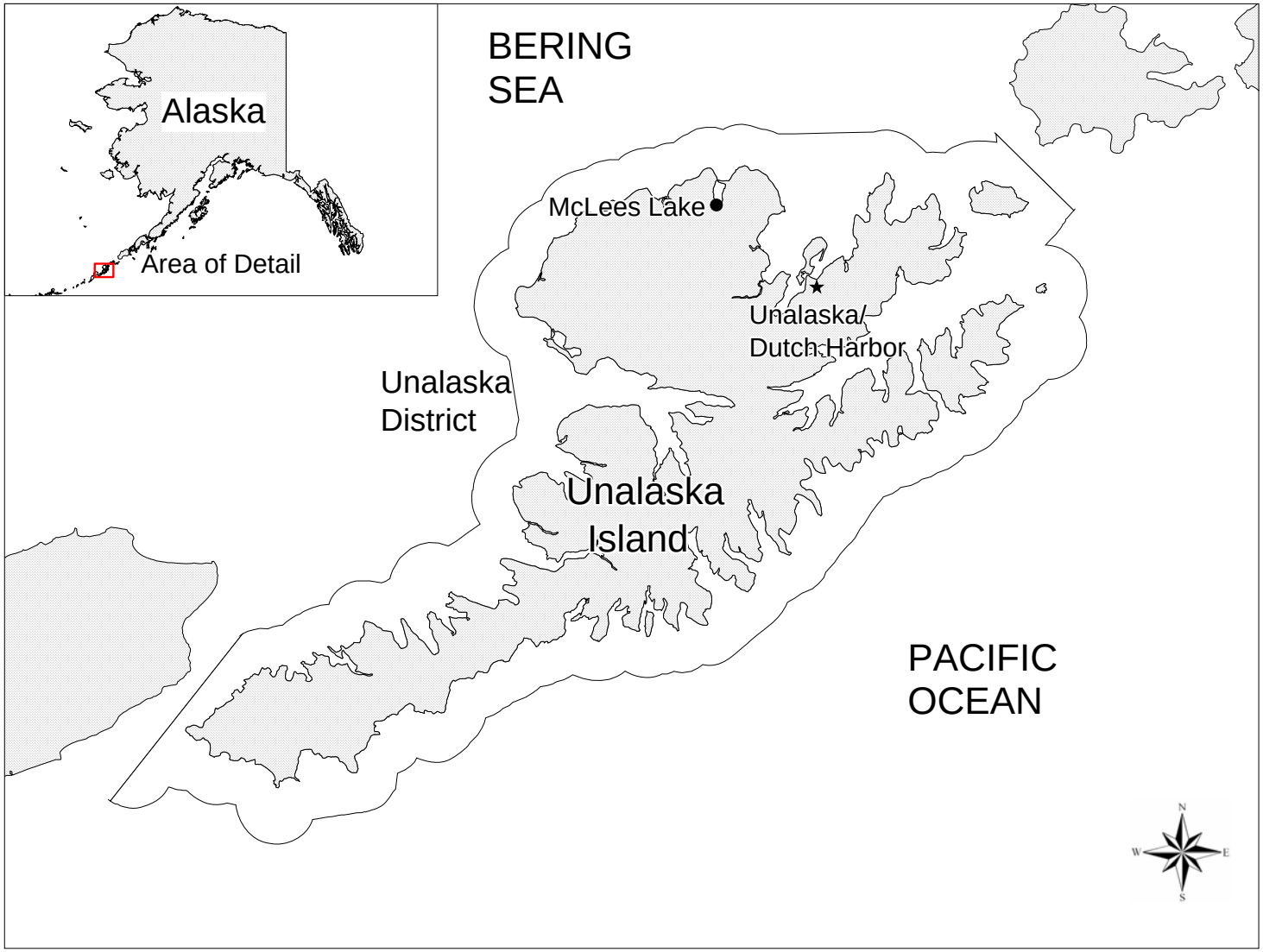
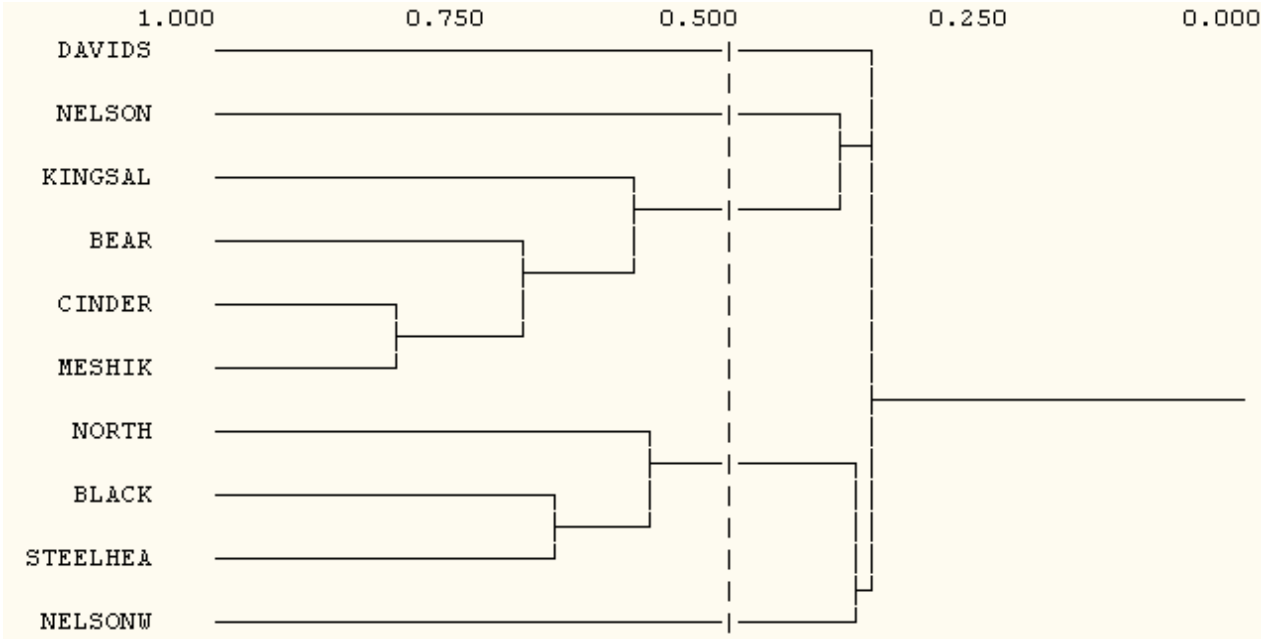


Figure 4.-Map of Unalaska Island within the Aleutian Islands Management Area with McLees Lake depicted.



Aerial survey counts are from the David's River (DAVIDS), Nelson River (NELSON), King Salmon River (KINGSAL), Bear River (BEAR), Cinder River (CINDER), Meshik River (MESHIK), North Creek (NORTH), Black Hills Creek (BLACK), and Steelhead Creek (STEELHEA). A combination of tower and weir counts are from the Nelson River (NELSONW). The dotted line indicates a similarity of 0.500.

Figure 5.-Cluster diagram of similarities (1.000 = most similar) of counts of Chinook salmon in nine North Peninsula streams, 1961-2003.

APPENDIX A. SUPPLEMENTAL INFORMATION USED TO ESTIMATE BIOLOGICAL ESCAPEMENT GOALS

Appendix A1.-Escapement goal for Nelson River Chinook salmon.

System: Nelson River

Species: Chinook salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set and drift gillnet
Previous escapement goal:	SEG: 3,200-6,400 (1993)
Recommended escapement goal:	BEG: 2,400-4,400
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1963 – present Tower counts, 1974 – 1987 Weir counts, 1989 – present
Data summary:	
Data quality:	Good for aerial survey, tower and weir counts
Data type:	Escapement either final tower or weir count, or sum aerial survey count conducted in late July with cumulative tower or weir count on that same day, from 1974 to 2003. Stock specific harvest information is available from 1970 to 2003. Harvest age data are available from 1985 to 2003.
Contrast:	7.0 for brood years used in analysis
Methodology:	Habitat-based meta-analysis, Ricker spawner-recruit model
Autocorrelation:	AR(2)
Criteria for BEG:	Habitat-based meta-analysis
Comments:	Habitat-based meta-analysis was supported by spawner-recruit model

-continued-

System: **Nelson River**

Species: **Chinook salmon**

Data available for analysis of escapement goals.

Run reconstruction for Nelson River Chinook salmon.

	Escapement									Commercial Harvest[c]		
	Nelson River						David's River					
		Cumulative count and aerial survey[b]										
Year	Count[a]	Date	Count	Aerial Survey	Total	Best estimate overall	Aerial Survey	Date	% Nelson	Total	Nelson River	Nelson Total Run
1974	1,092	27-Jul	258	425	683	1,092	50	21-Jul		2,225	1,987	3,079
1975	1,917	3-Aug	1,001	400	1,001	1,917	400	19-Jul		1,203	1,074	2,991
1976	3,045	2-Aug	2,032	1,200	3,232	3,232	220	4-Aug		2,220	1,982	5,214
1977	4,844					4,844				1,734	1,548	6,392
1978	3,901					3,901				3,350	2,991	6,892
1979	10,463	4-Aug	9,656	600	9,656	10,463				5,399	4,820	15,283
1980	4,506					4,506	400	12-Aug	0.92	8,706	7,996	12,502
1981	5,046					5,046	50	28-Jul		10,981	9,804	14,850
1982	6,503					6,503				13,488	12,042	18,545
1983	11,589	21-Jul	5,061	7,500	12,561	12,561	500	28-Jul	0.96	12,055	11,594	24,155
1984	5,412	7-Jul	1,683	800	2,483	5,412	240	22-Jul		7,801	6,965	12,377
1985	2,861	11-Jul	84	4,500	4,500	4,500	200	16-Aug	0.96	10,850	10,388	14,888
1986	758	20-Jul	707	4,050	4,757	4,757				4,849	4,329	9,086
1987	696	24-Jul	654	3,200	3,854	3,854	200	23-Jul	0.95	5,823	5,536	9,390
1988		9-Jul		1,300	1,873	1,873	400	7-Jul	0.82	6,474	5,335	7,208
1989	272	22-Jul	247	2,500	2,500	2,500	300	18-Jul	0.89	3,822	3,413	5,913
1990	215	13-Jul	137	1,800	1,800	1,800	400	13-Jul	0.82	3,573	2,923	4,723
1991	551	1-Aug	551	4,430	4,981	4,981	1,300	1-Aug	0.79	3,452	2,738	7,719
1992	490	21-Jul	490	1,830	2,320	2,320	700	21-Jul	0.77	2,787	2,141	4,461
1993		23-Jul		5,160	5,160	5,160	700	16-Jul	0.88	4,833	4,256	9,416
1994	1,372	22-Jul	1,352	3,200	4,552	4,552	450	10-Aug	0.91	3,509	3,193	7,745
1995	1,010	15-Jul	882	1,245	2,127	2,127	70	15-Jul	0.97	3,488	3,377	5,504
1996	1,039	21-Jul	1,007	2,960	3,967	3,967	150	21-Jul	0.96	2,308	2,224	6,191
1997	931	14-Jul	552	6,350	6,902	6,902	200	14-Jul	0.97	3,164	3,075	9,977
1998	2,900	22-Jul	2,809	2,000	4,809	4,809	750	22-Jul	0.87	2,715	2,349	7,158
1999	2,431	21-Jul	2,407	1,500	3,907	3,907	400	21-Jul	0.91	1,925	1,746	5,653
2000	3,654	17-Jul	3,591	300	3,891	3,891	500	17-Jul	0.89	1,387	1,229	5,120
2001	5,543	17-Jul	5,358	1,730	7,088	7,088	950	17-Jul	0.88	2,164	1,908	8,996
2002	4,349	17-Jul	3,730	3,020	6,750	6,750	750	17-Jul	0.90	1,312	1,181	7,931
2003	3,253	21-Jul	3,154	2,000	5,154	5,154	1,000	21-Jul	0.84			5,154

[a] Final count at tower during 1974-1987 and at weir during 1989-2003.

[b] Count is the cumulative tower or weir count depending on year and aerial survey is the index count downstream of the tower/weir site that occurred on the date shown in the table.

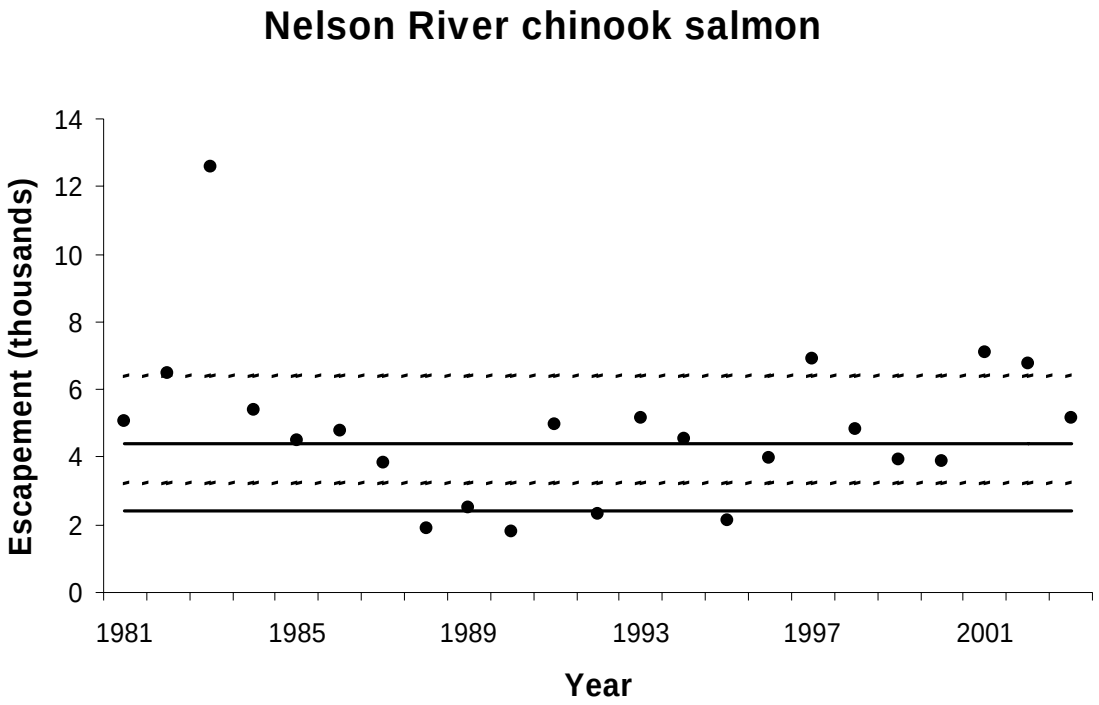
[c] Commercial harvest in the Nelson Lagoon (313-30) statistical area.

-continued-

System: **Nelson River**

Species: **Chinook salmon**

Observed escapement by year (solid circles), current SEG range of 3,200-6,400 (dashed lines), and recommended BEG range of 2,400-4,400 (solid lines).



-continued-

System: **Nelson River**

Species: **Chinook salmon**

Data available for analysis of escapement goals.

Brood table for Nelson River chinook salmon.

Brood		Number by age in total return								Return/
Year	Escapement	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Total	Yield	Spawner
1981	5,046	39	893	1,380	5,439	885	0	8,636	3,590	1.7
1982	6,503	0	1,823	1,242	4,065	535	0	7,665	1,162	1.2
1983	12,561	20	1,406	830	2,987	487	0	5,730	-6,831	0.5
1984	5,412	31	1,410	1,002	3,098	1,127	0	6,667	1,255	1.2
1985	4,500	13	1,389	749	2,547	258	0	4,955	455	1.1
1986	4,757	0	380	2,326	1,589	312	0	4,607	-150	1.0
1987	3,854	10	1,608	1,589	7,109	815	0	11,132	7,278	2.9
1988	1,873	111	1,006	1,560	4,571	384	11	7,644	5,771	4.1
1989	2,500	19	434	1,063	3,319	1,193	0	6,029	3,529	2.4
1990	1,800	0	1,194	394	2,398	462	0	4,447	2,647	2.5
1991	4,981	102	1,406	1,655	6,000	288	0	9,452	4,471	1.9
1992	2,320	0	889	1,509	2,116	313	25	4,852	2,532	2.1
1993	5,160	45	1,900	1,223	1,911	498	147	5,725	565	1.1
1994	4,552	107	3,319	1,081	2,111	1,130	20	7,767	3,215	1.7
1995	2,127	211	2,197	929	3,436	716	0	7,489	5,362	3.5
1996	3,967	152	1,538	2,057	3,435	410	0	7,592	3,625	1.9
1997	6,902	18	2,034	1,380	1,484					
1998	4,809	192	2,161	859						
1999	3,907	219	1,698							
2000	3,891	703								
2001	7,088									
2002	6,750									
2003	5,154									

-continued-

System: **Nelson River**

Species: **Chinook salmon**

Data available for analysis of escapement goals.

Parameter estimates and other statistics from a Ricker stock-recruit model on Nelson River chinook salmon.

Statistic	Estimate	SE
α	3.9517	0.1154
$\ln(\alpha)$	1.3742	
β	0.000181	0.000023
$\phi(1)$	0.2953	0.2421
$\phi(2)$	-0.5422	0.2515
σ^2	0.0596	
S_{msy}	3,080	
R_{msy}	6,965	
MSY	3,885	
90% MSY	3,497	
$S_{90\%msy}$	1,995; 4,298	
S_{eq}	7,583	
μ^a	0.56	

[a] Exploitation rate at S_{MSY} estimated from the model.

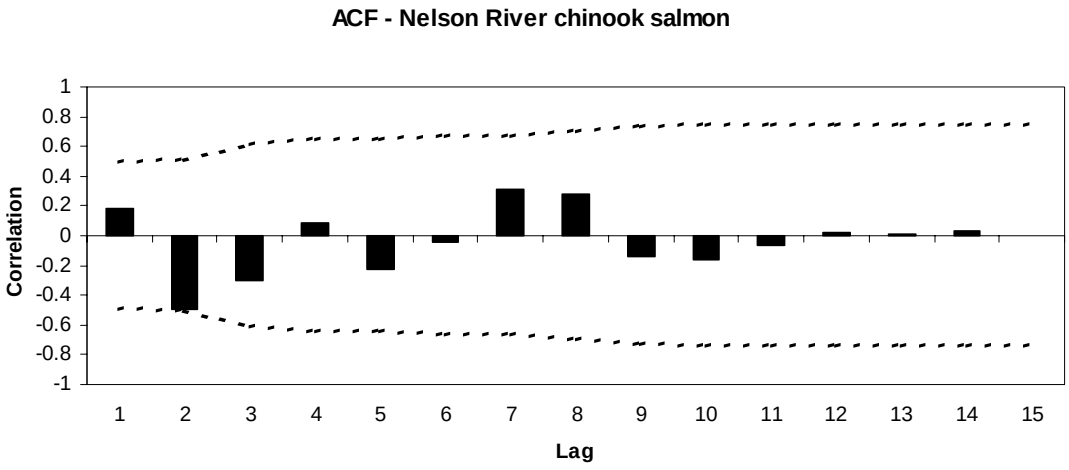
-continued-

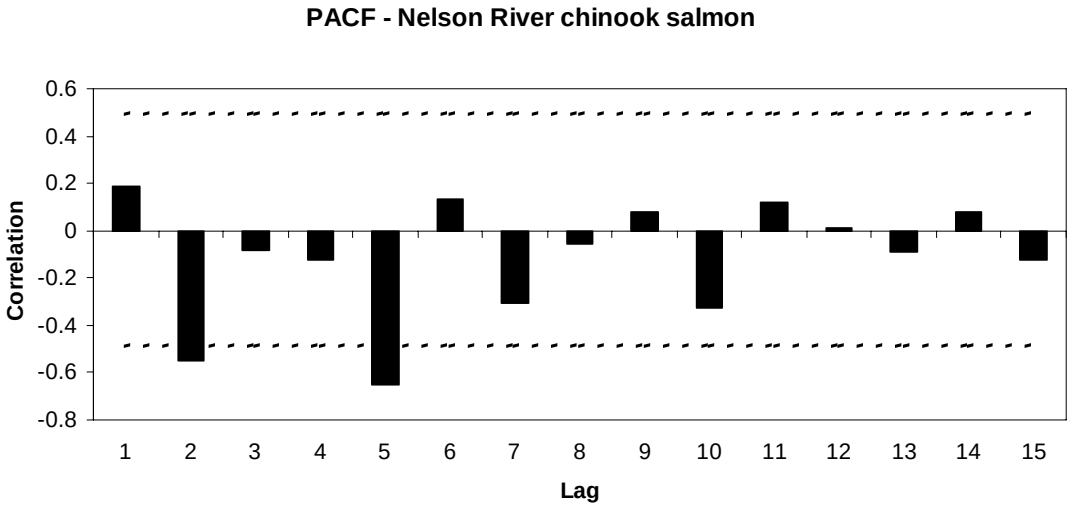
System: **Nelson River**

Species: **Chinook salmon**

Data available for analysis of escapement goals.

Autocorrelation function (ACF) and partial autocorrelation function (PACF) of residuals from a Ricker spawner-recruit model on Nelson River Chinook salmon.



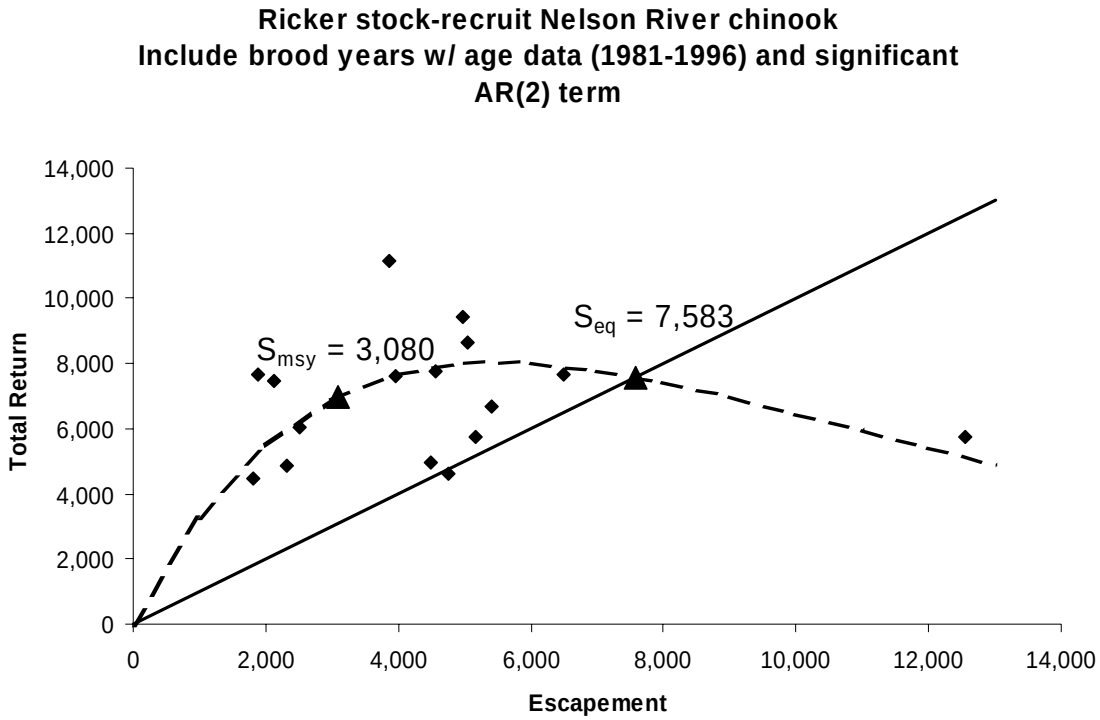


-continued-

System: **Nelson River**

Species: **Chinook salmon**

Ricker stock–recruit relationship, 1981-1996 brood years. The dashed line represents the Ricker curve and the solid line represents replacement.



Appendix A2.-Escapement goal for Nelson River sockeye salmon.

System: Nelson River

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 100,000 to 150,000 (1979)
Recommended escapement goal:	BEG: 97,000 to 219,000
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Tower counts, 1962 – 1988 Weir counts, 1989 – present
Data summary:	
Data quality:	Good for tower counts, excellent for weir counts
Data type:	Tower counts from 1962 to 1988 and weir counts from 1989 to 2003. Escapement age data are available from 1985 to 2003 and harvest age data are available from 1985 to 2003. Stock specific harvest information is available from 1970 to 2003.
Contrast:	3.5 (tower and weir), 2.8 (weir only)
Methodology:	Ricker spawner-recruit model, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area.
Autocorrelation:	None
Criteria for BEG:	Ricker spawner-recruit model
Comments:	Ricker curve using 1975-1997 brood years was significant using multiplicative error, increased escapement corroborated by limnology data.

-continued-

System: **Nelson River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

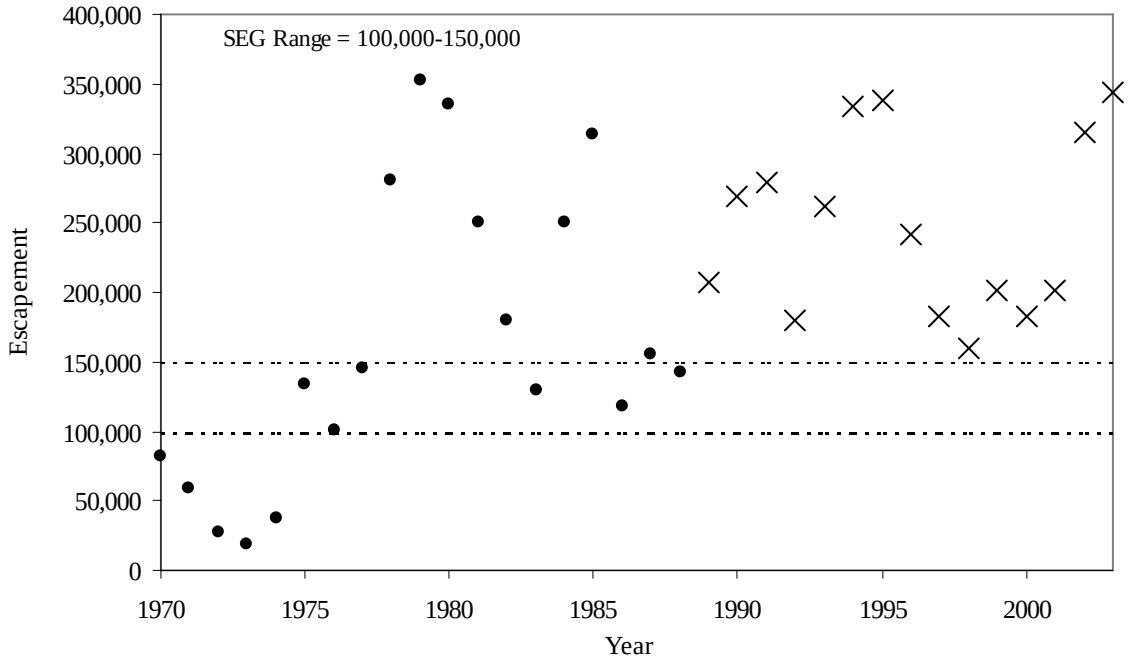
Year	Tower Escapement	Weir Escapement
1970	81,900	
1971	58,900	
1972	27,600	
1973	18,200	
1974	37,400	
1975	133,100	
1976	101,000	
1977	146,000	
1978	280,000	
1979	352,100	
1980	335,400	
1981	251,000	
1982	179,600	
1983	128,800	
1984	251,000	
1985	314,000	
1986	117,500	
1987	155,700	
1988	142,900	
1989		206,800
1990		269,200
1991		279,200
1992		179,700
1993		262,200
1994		333,400
1995		338,700
1996		241,600
1997		183,000
1998		159,810
1999		202,067
2000		182,694
2001		201,962
2002		315,689
2003		343,511

-continued-

System: **Nelson River**

Species: **sockeye salmon**

Observed escapement by year (solid circles for aerial surveys, Xs for weir counts) and current SEG range (dashed lines).



-continued-

System: **Nelson River**

Species: **sockeye salmon**

Data available for analysis of escapement goals

Nelson River sockeye salmon brood table (actual age compositions)

Year	Escapement	Ages																Total Return	Return/ Spawner
		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	1.5	2.4	3.3		
1978															101	2,942	779		
1979												5,620	322,104	542	0	701	170		
1980								299	107,873	492,648	0	131	185,282	202	0	239	44		
1981	251,000				1,759	36,372	46,924	72	41,812	47,275	0	660	13,678	35	0	59	0		
1982	179,600		314	65	5,608	11,464	2,635	67	45,490	143,389	0	123	125,841	1,572	0	963	8	337,539	1.88
1983	128,800	0	852	0	5,740	43,856	23,711	244	72,682	53,532	0	936	66,102	210	0	2,964	2,751	273,580	2.12
1984	251,000	0	624	6,638	1,912	59,603	12,678	206	59,696	276,557	154	449	275,013	10,624	0	17	0	704,171	2.81
1985	314,000	0	168	671	976	77,339	8,037	171	110,618	238,924	0	0	109,028	0	0	1,632	46	547,610	1.74
1986	117,500	40	187	353	4,370	33,650	13	0	188,884	175,014	0	7,801	140,116	285	0	1,817	1,979	554,509	4.72
1987	155,700	0	57	0	1,588	71,043	4,221	143	112	151,270	0	2,986	287,652	7,874	0	3,054	288	530,288	3.41
1988	142,900	0	574	3,357	3,441	132,457	9,261	0	126,716	257,895	0	4,422	129,241	2,311	0	1,025	1,051	671,751	4.70
1989	206,800	0	520	394	3,029	21,813	8,550	0	42,705	422,926	333	510	129,324	2,124	0	104	0	632,332	3.06
1990	269,200	0	274	0	1,836	39,391	15,830	47	104,895	490,010	0	770	66,012	0	0	0	388	719,453	2.67
1991	279,200	0	43	57	850	27,591	29,153	13	93,773	397,612	0	1,059	117,254	0	0	0	0	667,405	2.39
1992	179,700	177	372	367	7,022	101,543	16,002	35	88,011	138,846	0	270	65,466	1,950	0	0	323	420,384	2.34
1993	262,200	0	588	696	6,168	32,200	0	0	101,468	68,567	0	757	43,961	0	0	247	822	255,474	0.97
1994	333,400	0	0	66	1,784	56,338	25,719	0	55,711	278,510	0	187	64,812	2,238	0	396	850	486,611	1.46
1995	338,700	0	408	1,225	9053	40,189	8,048	45	40,011	159,412	0	443	59,776	0	0	427	1,805	320,842	0.95
1996	241,600	0	487	369	4,798	103,080	373	1,351	127,901	121,449	179	258	116,142	29,140	0	284	5,141	510,952	2.11
1997	183,000	0	28	336	11,403	40,783	5,776	0	36,770	364,391	234	781	188,100	3,880					
1998	159,810	0	5,419	603	8,105	49,739	8,673	0	88,210	248,385	1,082								
1999	202,067	0	23,892	284	13,776	47,362	104,402												
2000	182,694	234	10,599	2,296															
2001	201,962	2152																	
2002	315,689																		
2003	343,511																		

-continued-

System: **Nelson River**

Species: **sockeye salmon**

Data available for analysis of escapement goals

Nelson River sockeye salmon brood table (estimated age composition prior to 1984)

		Ages																Total	Return/
Year	Escapement	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	1.5	2.4	3.3	Return	Spawner
1975	133,100	40	2,059	1,185	7,125	77,575	20,946	220	105,364	273,654	109	1,638	153,461	3,387	2	594	567	647,927	4.87
1976	101,000	98	2,809	1,617	6,924	75,381	20,354	210	100,819	261,852	104	1,070	100,261	2,213	2	468	446	574,627	5.69
1977	146,000	133	2,729	1,571	6,625	72,130	19,476	137	65,869	171,077	68	842	78,910	1,742	2	538	513	422,362	2.89
1978	280,000	129	2,612	1,503	4,329	47,125	12,724	108	51,841	134,644	54	968	90,684	2,001	101	2,942	779	352,545	1.26
1979	352,100	124	1,706	982	3,407	37,089	10,014	124	59,577	154,735	62	5,620	322,104	542	0	701	170	596,957	1.70
1980	335,400	81	1,343	773	3,915	42,624	11,509	299	107,873	492,648	0	131	185,282	202	0	239	44	846,962	2.53
1981	251,000	64	1,543	888	1,759	36,372	46,924	72	41,812	47,275	0	660	13,678	35	0	59	0	191,141	0.76
1982	179,600	73	314	65	5,608	11,464	2,635	67	45,490	143,389	0	123	125,841	1,572	0	963	8	337,612	1.88
1983	128,800	0	852	0	5,740	43,856	23,711	244	72,682	53,532	0	936	66,102	210	0	2,964	2,751	273,580	2.12
1984	251,000	0	624	6,638	1,912	59,603	12,678	206	59,696	276,557	154	449	275,013	10,624	0	17	0	704,171	2.81
1985	314,000	0	168	671	976	77,339	8,037	171	110,618	238,924	0	0	109,028	0	0	1,632	46	547,610	1.74
1986	117,500	40	187	353	4,370	33,650	13	0	188,884	175,014	0	7,801	140,116	285	0	1,817	1,979	554,509	4.72
1987	155,700	0	57	0	1,588	71,043	4,221	143	112	151,270	0	2,986	287,652	7,874	0	3,054	288	530,288	3.41
1988	142,900	0	574	3,357	3,441	132,457	9,261	0	126,716	257,895	0	4,422	129,241	2,311	0	1,025	1,051	671,751	4.70
1989	206,800	0	520	394	3,029	21,813	8,550	0	42,705	422,926	333	510	129,324	2,124	0	104	0	632,332	3.06
1990	269,200	0	274	0	1,836	39,391	15,830	47	104,895	490,010	0	770	66,012	0	0	0	388	719,453	2.67
1991	279,200	0	43	57	850	27,591	29,153	13	93,773	397,612	0	1,059	117,254	0	0	0	0	667,405	2.39
1992	179,700	177	372	367	7,022	101,543	16,002	35	88,011	138,846	0	270	65,466	1,950	0	0	323	420,384	2.34
1993	262,200	0	588	696	6,168	32,200	0	0	101,468	68,567	0	757	43,961	0	0	247	822	255,474	0.97
1994	333,400	0	0	66	1,784	56,338	25,719	0	55,711	278,510	0	187	64,812	2,238	0	396	850	486,611	1.46
1995	338,700	0	408	1,225	9053	40189	8048	45	40,011	159,412	0	443	59,776	0	0	427	1,805	320,842	0.95
1996	241,600	0	487	369	4,798	103,080	373	1,351	127,901	121,449	179	258	116,142	29,140	0	284	5,141	510,952	2.11
1997	183,000	0	28	336	11,403	40,783	5,776	0	36,770	364,391	234	781	188,100	3,880				652,482	3.57
1998	159,810	0	5,419	603	8,105	49,739	8,673	0	88,210	248,385	1,082								
1999	202,067	0	23,892	284	13,776	47,362	104,402												
2000	182,694	234	10,599	2,296															
2001	201,962	2152																	
2002	315,689																		
2003	343,511																		

-continued-

System: **Nelson River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Parameter estimates and other statistics from a Ricker stock-recruit model on Nelson River sockeye salmon

Statistic	Estimate	SE
α	7.1578	1.8771
$\ln(\alpha)$	1.8860	0.2579
β	0.4660	0.1082
σ^2	0.1643	
S_{msy}[a]	1.5334	
R_{msy}[a]	5.3716	
MSY[a]	3.8382	
90% MSY[a]	3.4544	
$S_{90\%msy}$[a]	0.9742, 2.1948	
S_{eq}[a]	4.2236	

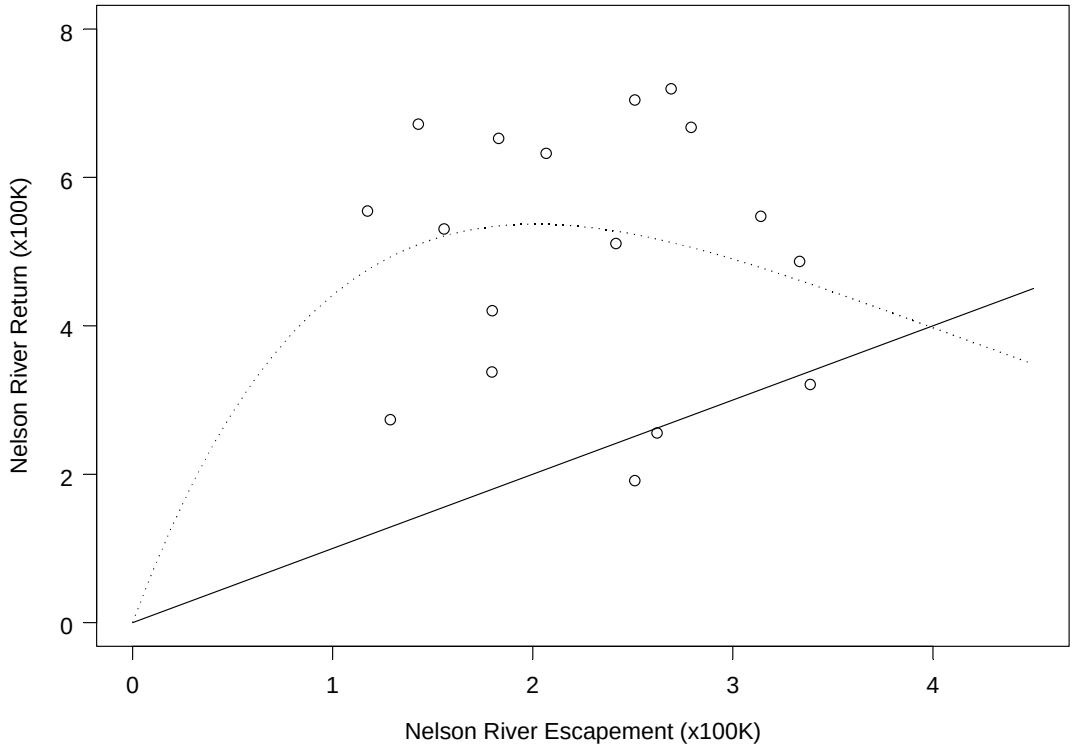
[a] Values in 100,000 of salmon

-continued-

System: **Nelson River**

Species: **sockeye salmon**

Ricker spawner-recruitment relationship, 1981-1997 brood years from weir counts only. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.

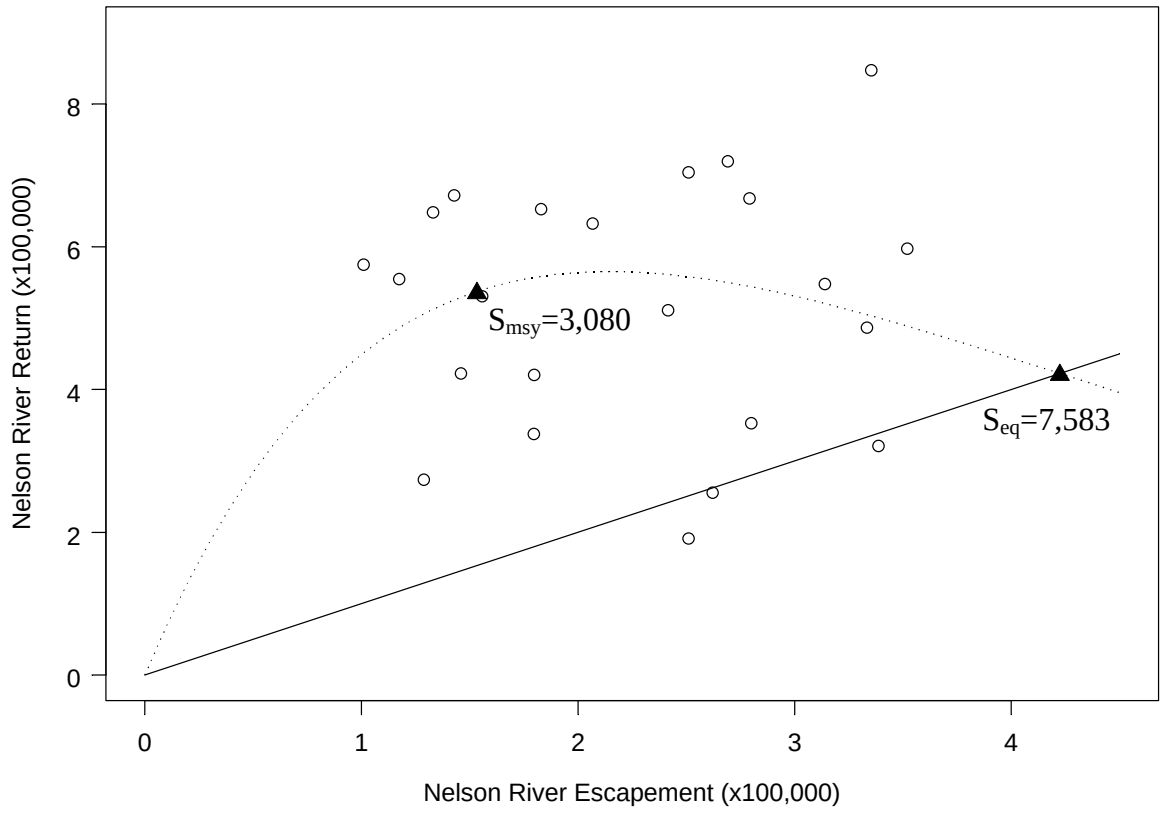


-continued-

System: **Nelson River**

Species: **sockeye salmon**

Ricker spawner-recruitment relationship, 1975-1997 brood years from weir and tower counts. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



Appendix A3.-Escapement goal for Bear Lake sockeye salmon late run.

System: Bear Lake late run

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift gillnet and purse seine
Previous escapement goal:	SEG: Late Run: 50,000 to 75,000 (late 1960s)
Recommended escapement goal:	SEG: Late Run: 81,000 to 135,000
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Tower counts, 1964 – 1985 Weir counts, 1986 – present
Data summary:	
Data quality:	Good for tower counts, excellent for weir counts
Data type:	Tower counts from 1964 to 1985, weir counts from 1986 to 2003. Escapement age data are available from 1985 to 2003 and harvest age data are available from 1985 to 2003 for the late run (after July 31). Stock specific harvest information is available for the late run from 1970 to 2003. No stock specific harvest information is available for the early run (prior to August 1).
Contrast:	3.2
Methodology:	Spawning area model
Criteria for SEG:	Low contrast, high exploitation
Comments:	Limnological data, 1993 – 1995 and 2001 – 2003. Smolt age and size data from grab samples are variably available from 1967 to 2003. Calculation of spawning area applies to total run, late run in separated (see Appendix B11).

-continued-

System: **Bear Lake late run**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

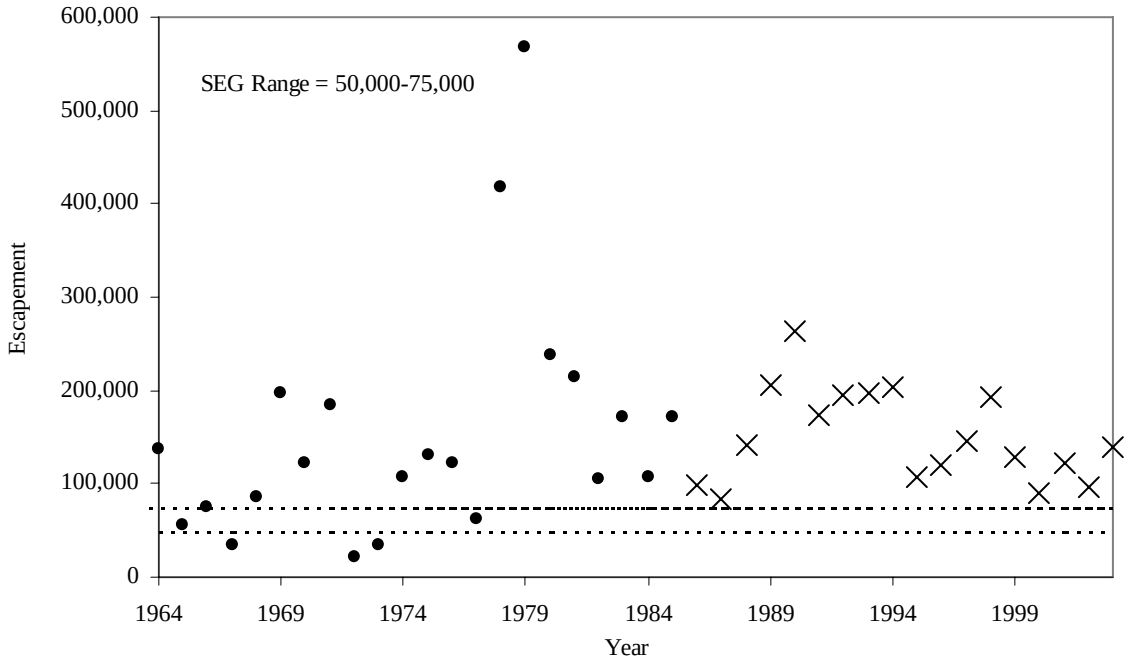
Year	Tower Counts	Weir Counts
1964	137,664	
1965	54,789	
1966	75,763	
1967	35,304	
1968	86,765	
1969	196,180	
1970	121,633	
1971	185,050	
1972	20,429	
1973	34,002	
1974	106,495	
1975	131,207	
1976	121,865	
1977	61,617	
1978	418,472	
1979	567,387	
1980	238,038	
1981	214,728	
1982	104,503	
1983	172,143	
1984	108,151	
1985	170,739	
1986		98,921
1987		83,395
1988		140,660
1989		204,804
1990		262,946
1991		173,913
1992		195,830
1993		197,988
1994		204,441
1995		107,961
1996		119,629
1997		145,311
1998		193,420
1999		127,890
2000		90,947
2001		122,505
2002		96,520
2003		139,844

-continued-

System: **Bear Lake late run**

Species: **sockeye salmon**

Observed escapement by year (solid circles for tower counts, Xs for weir counts) and current SEG range (dashed lines).



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System: **Bear Lake late run**

Species: **sockeye salmon**

Data available for analysis of escapement goals

Bear Lake Late Run Sockeye Salmon Brood Table

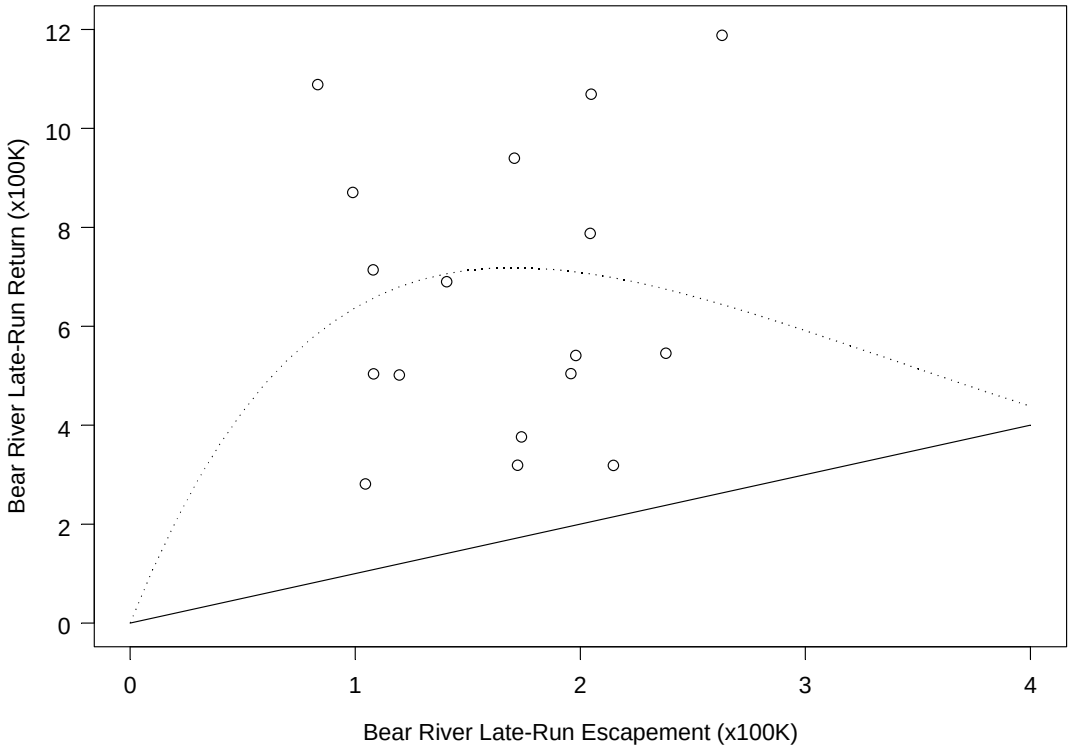
		Return Ages																	Total	Return/
Year	Escapement [a]	0.1	0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	1.5	2.4	3.3	3.4	Return	Spawner
1980	238,038							0	12,754	400,014	90	54	132,036	330	0	205	17	0	545,500	2.29
1981	214,728				1,134	43,049	9,594	0	6,463	210,579	0	2	47,413	18	0	41	93	0	318,386	1.48
1982	104,503		0	0	657	1,324	1,333	0	7,344	70,269	0	91	197,258	488	0	1,259	847	0	280,870	2.69
1983	172,143	0	0	0	147	5,044	176	0	16,802	134,380	0	488	160,027	2,093	0	89	0	0	319,246	1.85
1984	108,151	0	0	0	429	2,887	19,898	0	23,787	301,375	0	185	142,790	11,014	0	1,261	0	0	503,626	4.66
1985	170,739	0	0	1	592	24,407	14,756	0	138,603	538,445	0	1,058	217,073	38	0	2,789	2,074	0	939,836	5.50
1986	98,921	0	0	172	2,512	62,610	2,269	0	77,677	412,258	0	1,252	301,036	5,751	0	416	4,290	0	870,243	8.80
1987	83,395	0	0	0	910	77,886	17,721	57	19,211	451,063	1,000	321	490,594	25,598	0	1,909	2,341	0	1,088,611	13.05
1988	140,660	0	0	2,101	256	15,096	29,363	77	18,515	370,999	0	109	250,503	224	0	2,886	143	0	690,272	4.91
1989	204,804	0	0	2,599	1,932	6,504	40,756	0	52,714	638,148	0	2,223	322,645	1,191	0	439	67	0	1,069,218	5.22
1990	262,946	0	0	0	1,037	35,887	11,911	82	77,905	795,302	0	94	250,526	13,215	0	751	1,370	0	1,188,080	4.52
1991	173,913	0	0	1,123	211	39,738	15,637	90	32,615	192,725	146	979	91,586	1,564	0	0	1	0	376,415	2.16
1992	195,830	0	0	247	741	7,789	19,961	226	44,890	356,357	0	0	73,155	339	0	44	215	0	503,964	2.57
1993	197,988	0	189	122	7,940	6,631	30,910	1	6,601	366,291	123	184	114,578	5,819	0	100	1,299	32	540,788	2.73
1994	204,441	0	316	1,705	312	20,444	21,371	0	18,139	566,411	0	55	156,901	1,098	32	714	229	0	787,727	3.85
1995	107,961	0	24	1,279	497	30,943	27,553	0	47,482	455,680	0	860	147,895	32	0	1,111	250	0	713,606	6.61
1996	119,629	0	217	1,208	1,287	37,755	8,026	32	15,639	271,516	0	292	145,752	19,338						
1997	145,311	0	0	527	1,095	5,718	28,904	50	2,368	197,634	0									
1998	193,420	0	2,749	202	1,859	13,172	10,591													
1999	127,890	211	2,098	0																
2000	90,947	0																		
2001	122,505																			
2002	95,620																			
2003	139,844																			

-continued-

System: **Bear Lake late run**

Species: **sockeye salmon**

Ricker spawner-recruitment relationship, 1981-1995 brood years. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



Appendix A4.-Escapement goal for South Peninsula pink salmon.

System: South Peninsula

Species: pink salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet (with some area-specific restrictions)
Previous escapement goal:	SEG: Even year: 1,864,600 to 3,729,300 (1992) SEG: Odd year: 1,637,800 to 3,275,700 (1992)
Recommended escapement goal:	BEG: Even year: No change in escapement ranges BEG: Odd year: No change in escapement ranges
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 143 streams are used as an index for section-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. No stock specific harvest information is available.
Contrast (combined)	11.6 for 1975-2001 data used in Spawner-recruit analysis
Contrast (even):	3.2 (1976-2000)
Contrast (odd):	11.6 (1975-2001)
Methodology:	Ricker spawner-recruit model
Autocorrelation:	None
Criteria for BEG:	Ricker spawner-recruit model
Comments:	Ricker spawner-recruit models results corroborated the current aggregate even- and odd-year South Peninsula area-wide pink salmon escapement goals. These area-wide goals recommended to be BEGs.

-continued-

System: **South Peninsula**

Species: **pink salmon**

Data available for analysis of escapement goals.

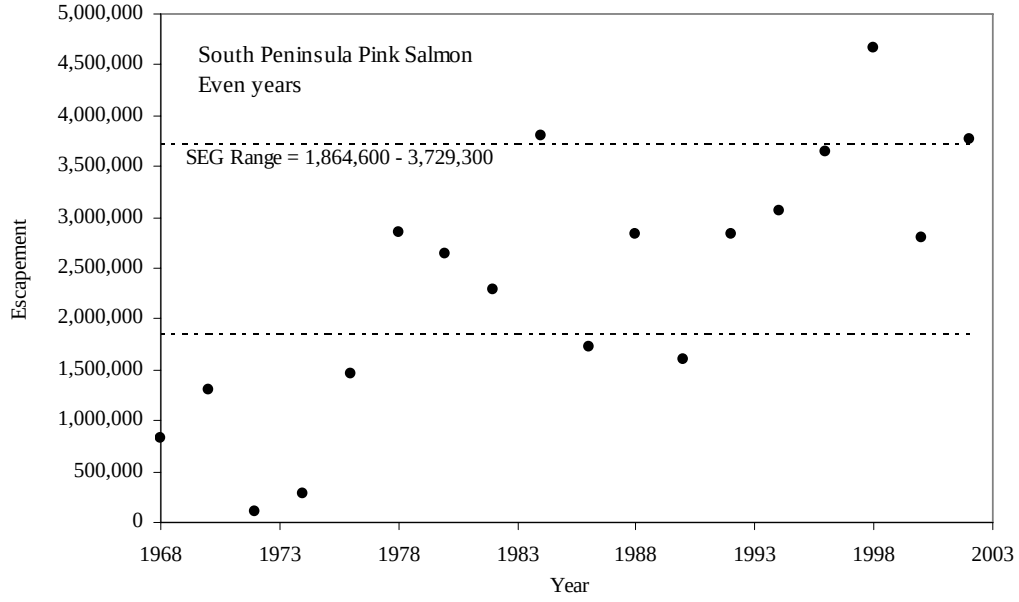
Year	Escapement (in millions)	Return (in millions)
1968	0.82	2.93
1969	2.47	2.24
1970	1.30	0.17
1971	0.70	0.15
1972	0.11	0.39
1973	0.11	0.61
1974	0.28	3.81
1975	0.55	4.17
1976	1.46	8.36
1977	2.68	9.10
1978	2.86	8.99
1979	2.63	7.11
1980	2.64	7.35
1981	2.31	3.62
1982	2.29	14.61
1983	0.85	5.94
1984	3.81	5.46
1985	1.61	2.73
1986	1.72	9.70
1987	1.54	8.96
1988	2.84	3.95
1989	1.87	12.94
1990	1.60	11.96
1991	2.95	12.84
1992	2.83	9.73
1993	2.99	22.54
1994	3.07	5.46
1995	6.41	6.95
1996	3.65	12.24
1997	5.24	13.44
1998	4.67	5.99
1999	5.02	6.95
2000	2.79	5.86
2001	2.97	9.56
2002	3.76	
2003	5.51	

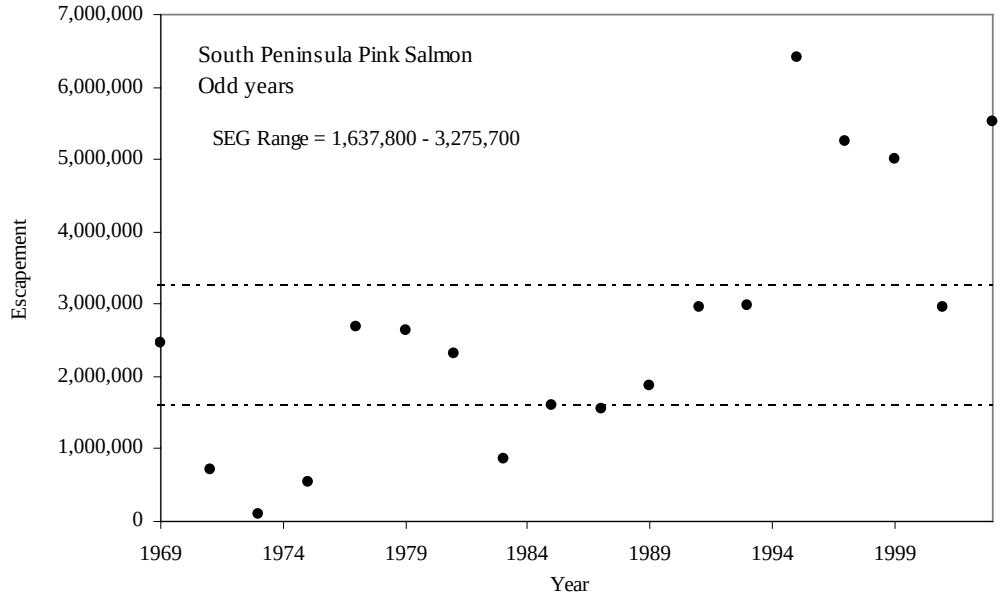
-continued-

System: **South Peninsula**

Species: **pink salmon**

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



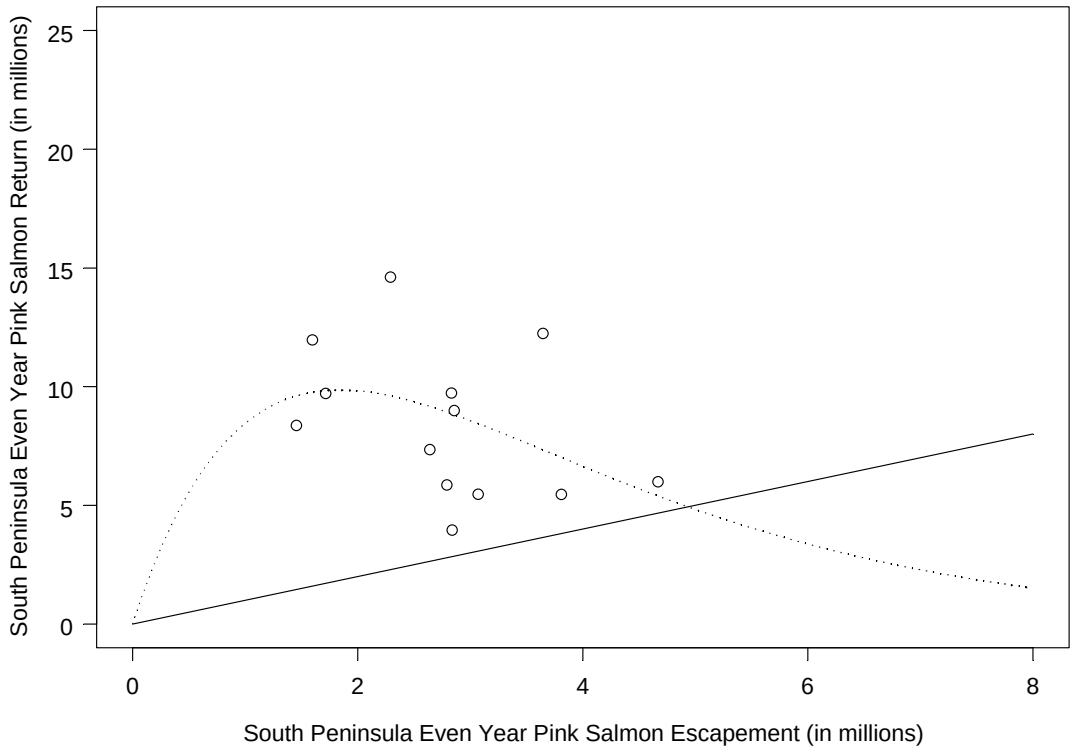


-continued-

System: **South Peninsula**

Species: **pink salmon**

Ricker stock-recruitment relationship, 1976–2000 even brood years. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



-continued-

System: **South Peninsula**

Species: **pink salmon**

Data available for analysis of escapement goals, odd brood year.

Parameter estimates and other statistics from a Ricker stock-recruit model on South Peninsula aggregate of odd brood year pink salmon.

Statistic	Estimate	SE
α	8.1698	2.3513
ln(α)	1.9623	0.2821
β	0.2678	0.0865
σ^2	0.2763	
S_{msy}[a]	2.7737	
R_{msy}[a]	10.7820	
MSY[a]	8.0083	
90% MSY[a]	7.2075	
$S_{90\%msy}$[a]	1.7555, 3.9951	
S_{eq}[a]	7.8438	

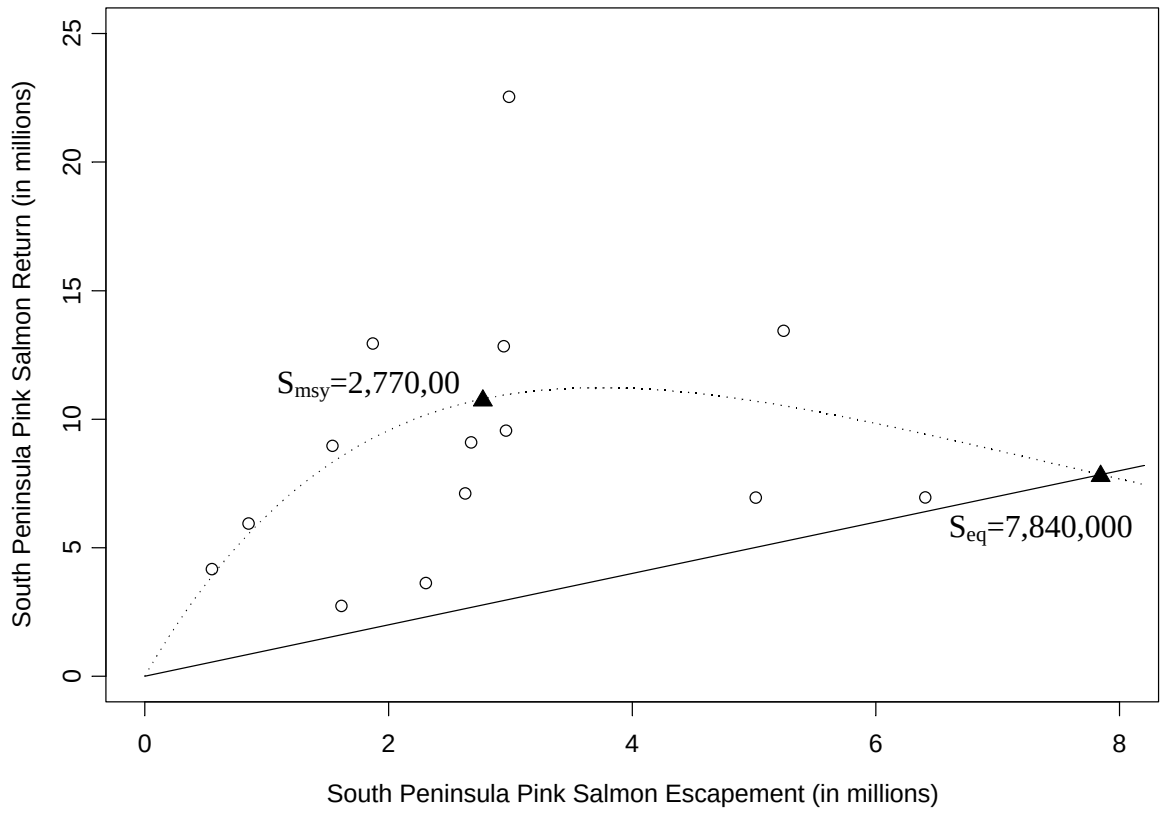
[a] Values in millions of salmon

-continued-

System: **South Peninsula**

Species: **pink salmon**

Ricker stock-recruitment relationship, 1975 – 2001 odd brood years. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



-continued-

System: **South Peninsula**

Species: **pink salmon**

Data available for analysis of escapement goals, all brood years.

Parameter estimates and other statistics from a Ricker stock-recruit model on South Peninsula aggregate of all brood year pink salmon.

Statistic	Estimate	SE
α	8.8229	1.9117
$\ln(\alpha)$	2.0655	0.2142
β	-0.3256	0.0690
σ^2	0.2238	
S_{msy}[a]	2.3285	
R_{msy}[a]	9.6259	
MSY[a]	7.2974	
90% MSY[a]	6.5676	
$S_{90\%msy}$[a]	1.4705, 3.3602	
S_{eq}[a]	6.6876	

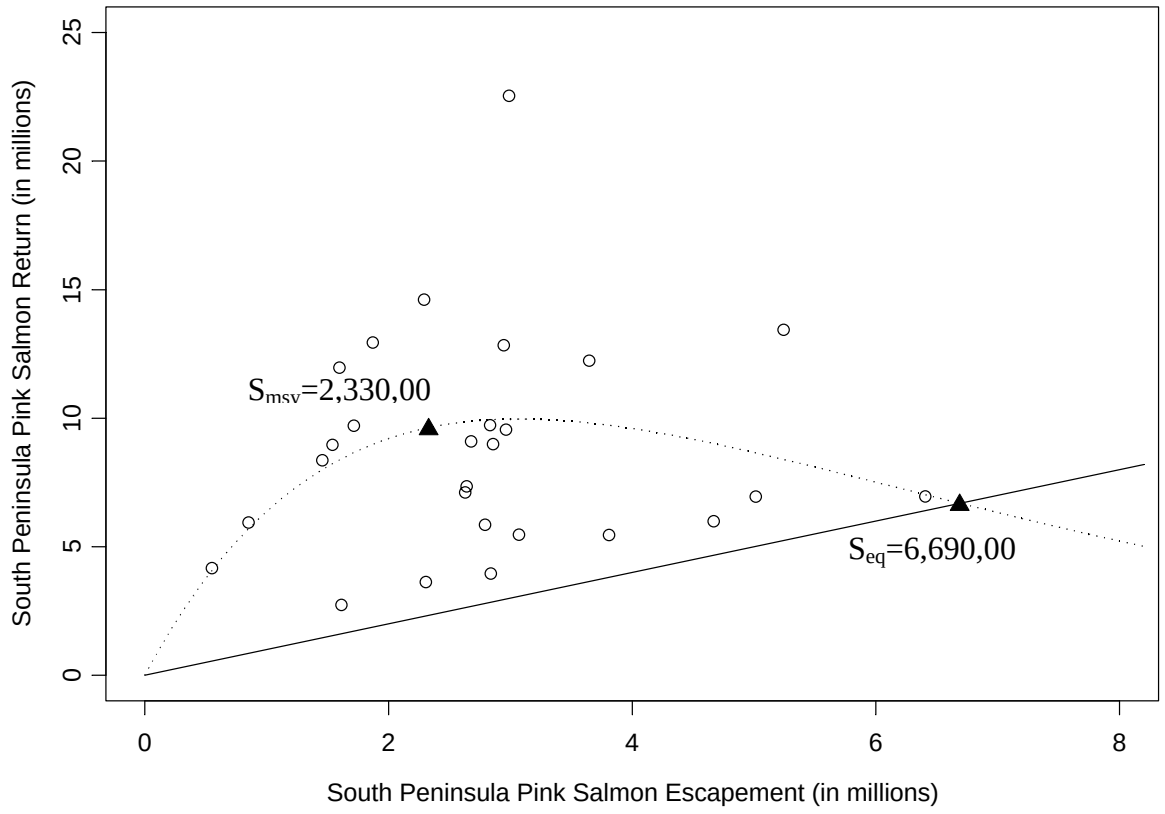
[a] Values in millions of salmon

-continued-

System: **South Peninsula**

Species: **pink salmon**

Ricker stock-recruitment relationship, 1975–2001 all brood years. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



Appendix A5.-Escapement goal for Southeastern District pink salmon.

System: Southeastern District (includes Shumagin Islands Section and Southeastern District Mainland)

Species: pink salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 562,600 to 1,125,300 (1992) Even- and odd-year goals are identical.
Recommended escapement goal:	Reclassified as a management objective based on total South Peninsula BEG; no change in escapement range (Appendix A.4)
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 72 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. Estimated escapement by district is not available prior to 1987. No stock specific harvest information is available.
Contrast:	4.5
Methodology:	Proportion of South Peninsula aggregate Ricker spawner-recruit model
Comments:	Recommend change to a management objective

-continued-

System: **Southeastern District**

Species: **pink salmon**

Data available for analysis of escapement goals.

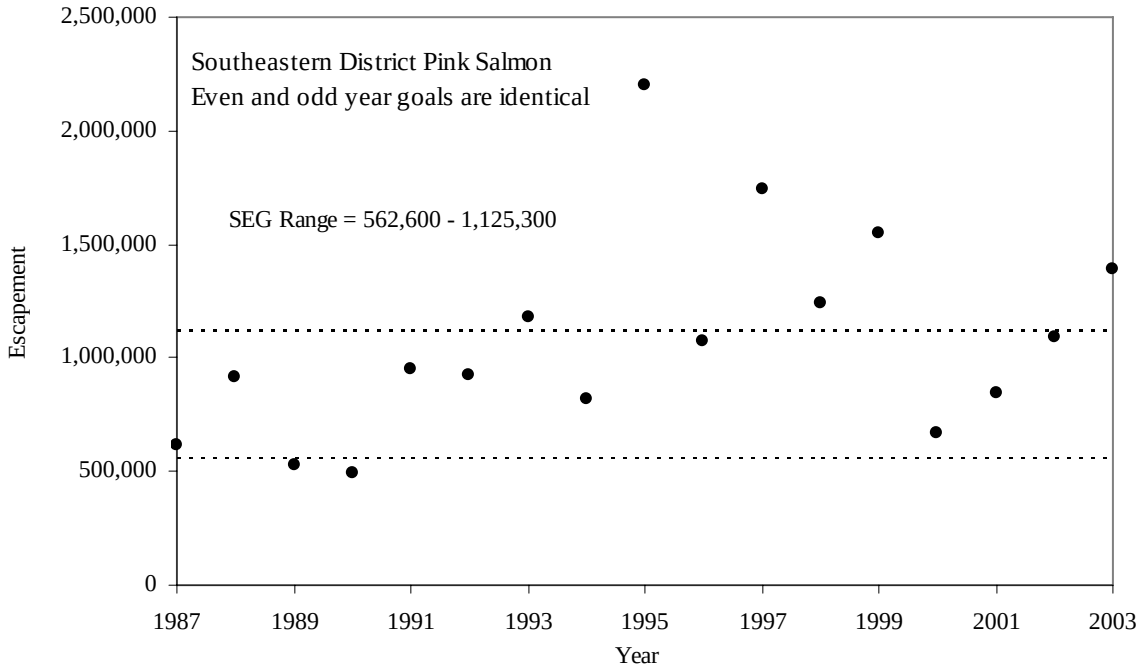
Year	Estimated Total Escapement Index
1987	612,400
1988	916,900
1989	532,375
1990	491,600
1991	948,825
1992	924,820
1993	1,178,700
1994	815,825
1995	2,200,350
1996	1,070,550
1997	1,745,175
1998	1,242,505
1999	1,551,880
2000	665,785
2001	847,120
2002	1,088,450
2003	1,390,920

-continued-

System: **Southeastern District**

Species: **pink salmon**

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



Appendix A6.-Escapement goal for South Central District pink salmon.

System: South Central District

Species: pink salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 687,200 to 1,374,400 (1992) Even- and odd-year goals are identical
Recommended escapement goal:	Reclassified as a management objective based on total South Peninsula BEG; no change in escapement range (Appendix A.4)
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 16 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. Estimated escapement by district is not available prior to 1987. No stock specific harvest information is available.
Contrast:	4.3
Methodology:	Proportion of South Peninsula aggregate Ricker spawner-recruit model
Comments:	Recommend change to a management objective

-continued-

System: **South Central District**

Species: **pink salmon**

Data available for analysis of escapement goals.

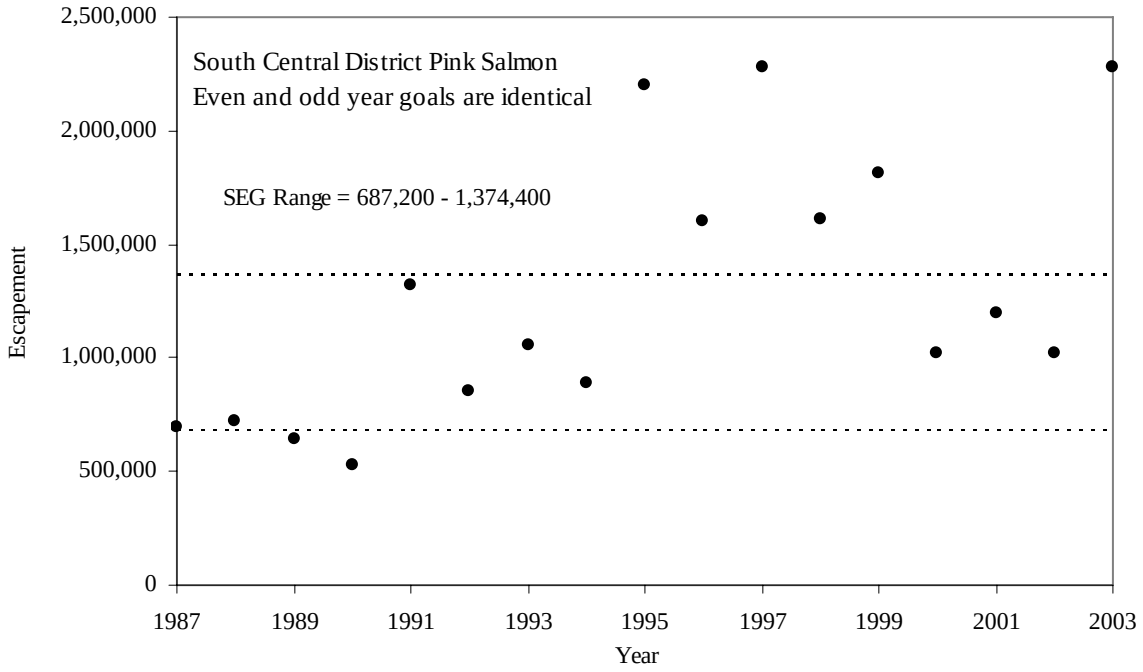
Year	Estimated Total Escapement Index
1987	692,000
1988	719,600
1989	646,850
1990	526,590
1991	1,319,600
1992	856,200
1993	1,053,500
1994	884,700
1995	2,204,100
1996	1,598,400
1997	2,276,200
1998	1,613,750
1999	1,811,200
2000	1,023,000
2001	1,193,000
2002	1,020,000
2003	2,283,200

-continued-

System: **South Central District**

Species: **pink salmon**

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



Appendix A7.-Escapement goal for Southwestern District pink salmon.

System: Southwestern District

Species: pink salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet (with some area-specific restrictions)
Previous escapement goal:	SEG: Even year: 563,600 to 1,127,200 (1992) SEG: Odd year: 378,000 to 756,000 (1992)
Recommended escapement goal:	Reclassified as a management objective based on total South Peninsula BEG; no change in escapement range (Appendix A.4)
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 45 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. Estimated escapement by district is not available prior to 1987. No stock specific harvest information is available.
Contrast (even):	3.1
Contrast (odd):	8.5
Methodology:	Proportion of South Peninsula aggregate Ricker spawner-recruit model
Comments:	Recommend change to a management objective

-continued-

System: **Southwestern District**

Species: **pink salmon**

Data available for analysis of escapement goals.

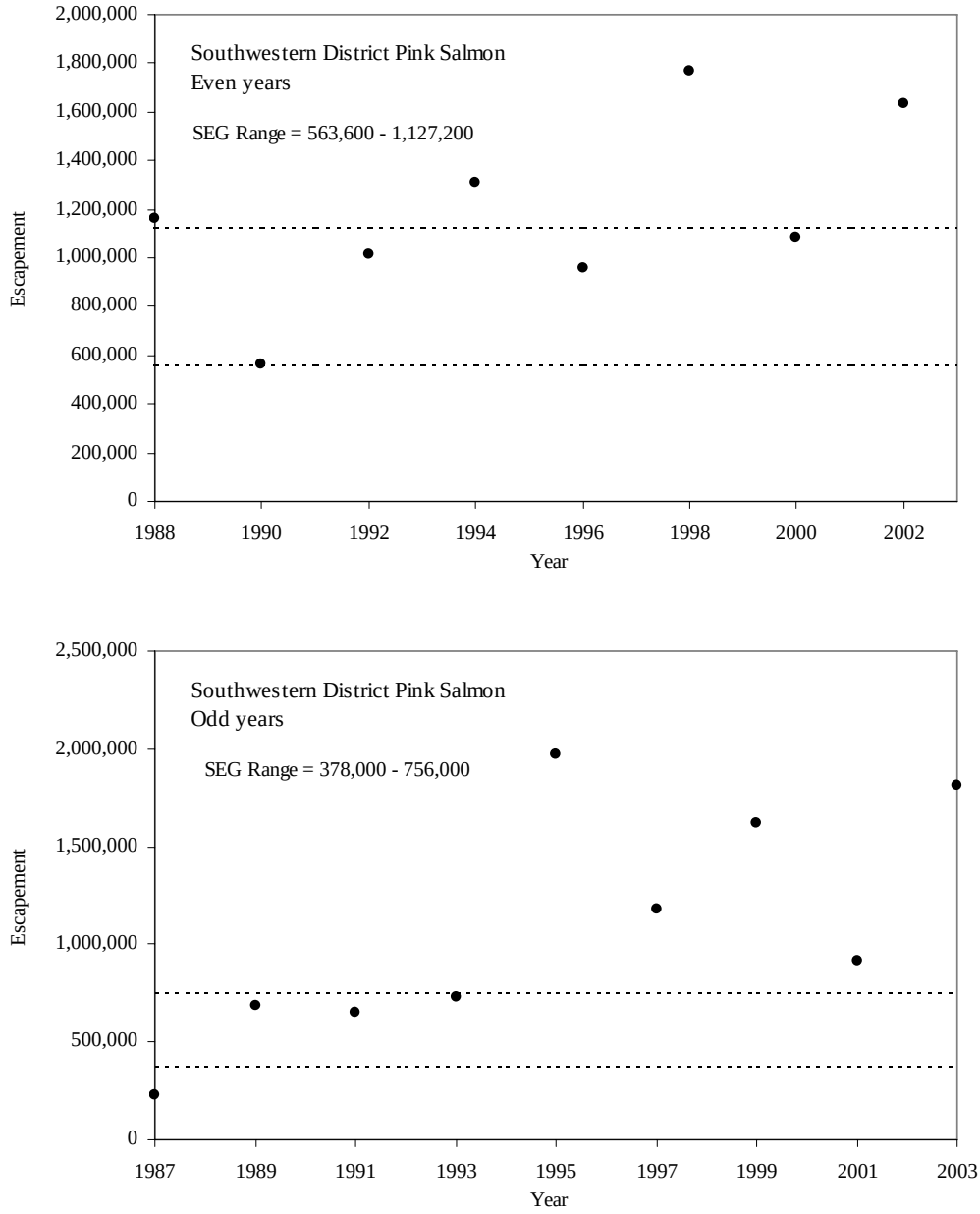
Year	Estimated Total Escapement Index
1987	230,800
1988	1,164,600
1989	682,240
1990	563,500
1991	649,220
1992	1,012,750
1993	727,440
1994	1,312,600
1995	1,971,600
1996	954,600
1997	1,178,200
1998	1,764,310
1999	1,622,230
2000	1,085,200
2001	919,116
2002	1,631,450
2003	1,811,500

-continued-

System: **Southwestern District**

Species: **pink salmon**

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



Appendix A8.-Escapement goal for Unimak District pink salmon.

System: Unimak District

Species: pink salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet
Previous escapement goal:	SEG: Even year: 51,200 to 102,400 (1992) SEG: Odd year: 10,000 to 20,000 (1992)
Recommended escapement goal:	Reclassified as a management objective based on total South Peninsula BEG; no change in escapement range (Appendix A.4)
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 10 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. Estimated escapement by district is not available prior to 1987. No stock specific harvest information is available.
Contrast (even):	3.5
Contrast (odd):	8.2
Methodology:	Proportion of South Peninsula aggregate Ricker spawner-recruit model
Comments:	Recommend change to a management objective

-continued-

System: **Unimak District**

Species: **pink salmon**

Data available for analysis of escapement goals.

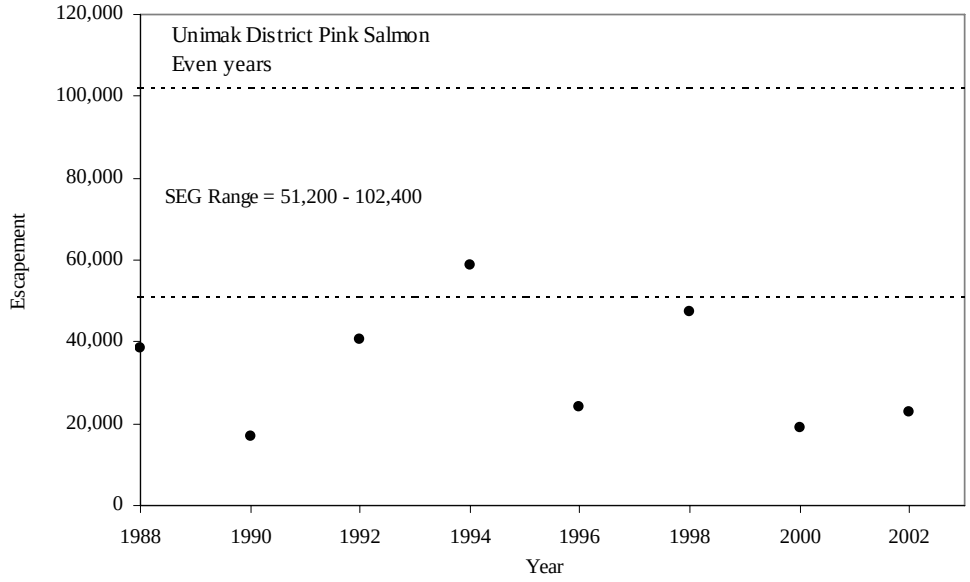
Year	Estimated Total Escapement Index
1987	5,300
1988	38,500
1989	9,400
1990	16,700
1991	29,200
1992	40,600
1993	30,500
1994	58,600
1995	30,250
1996	24,000
1997	43,700
1998	47,500
1999	30,000
2000	19,000
2001	5,900
2002	22,900
2003	25,600

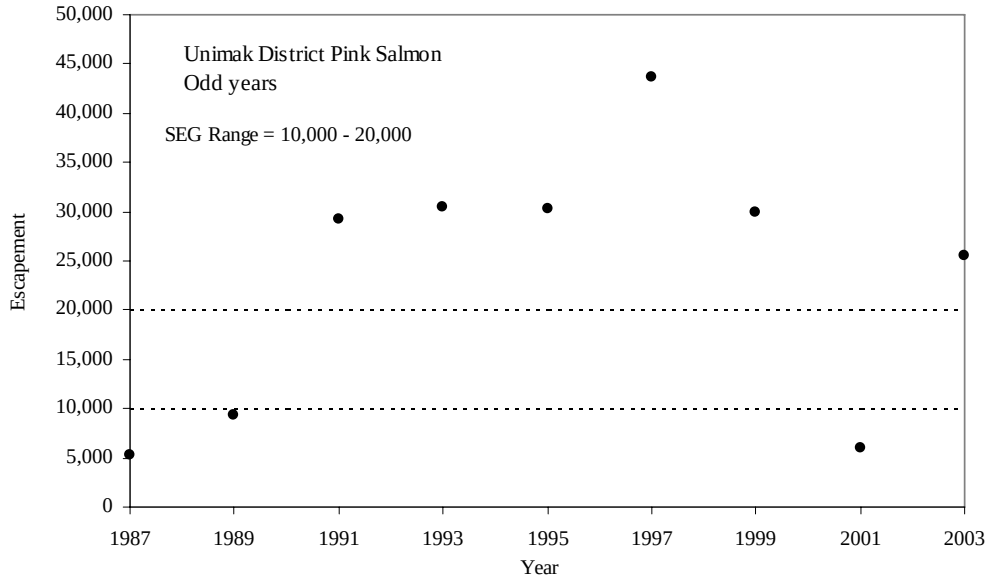
-continued-

System: **Unimak District**

Species: **pink salmon**

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





Appendix A9.-Escapement goal for Northwestern District chum salmon.

System: Northwestern District

Species: chum salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet (with some area-specific restrictions).
Previous escapement goal:	SEG: 223,600 to 447,200 (1992)
Recommended escapement goal:	BEG: 100,000 to 215,000
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 25 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1980-present. No stock specific harvest information is available.
Contrast:	4.2 for brood years 1980-1992 used in the spawner-recruit model
Methodology:	Ricker spawner-recruit
Autocorrelation:	None
Criteria for BEG:	Ricker spawner-recruit
Comments:	Ricker curve using multiplicative error was significant

-continued-

System: **Northwestern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

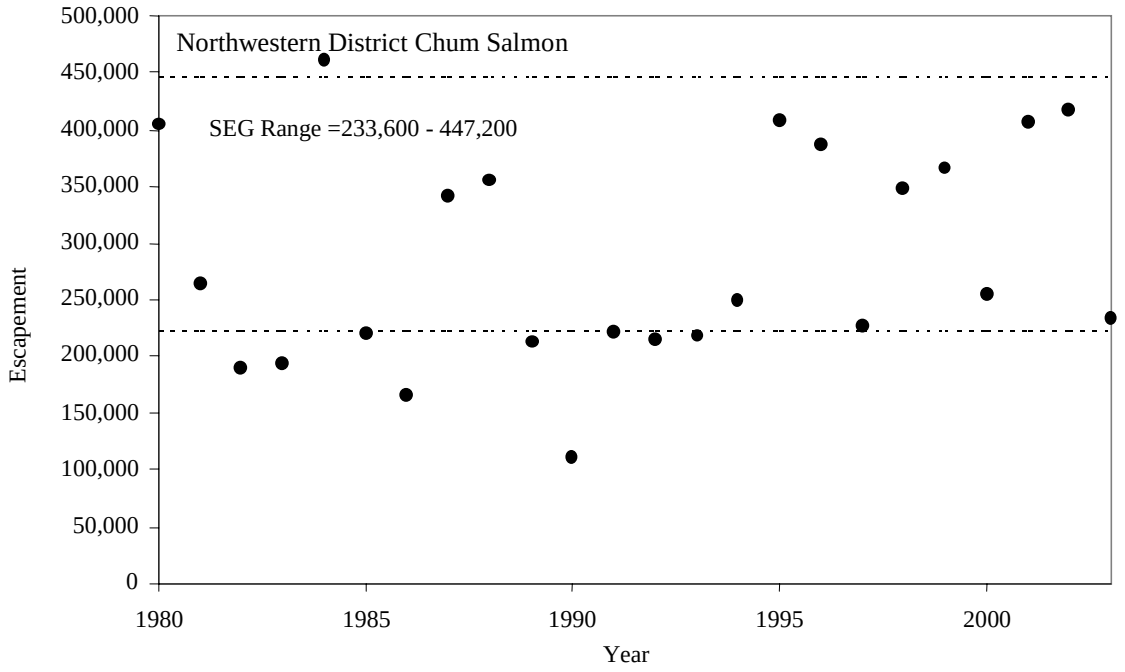
Year	Estimated Total Escapement Index
1980	405,300
1981	264,600
1982	190,200
1983	193,500
1984	460,900
1985	220,400
1986	165,700
1987	341,500
1988	356,200
1989	212,300
1990	110,905
1991	221,800
1992	215,300
1993	219,030
1994	249,420
1995	408,300
1996	386,730
1997	227,200
1998	349,000
1999	366,800
2000	255,800
2001	406,812
2002	417,100
2003	233,300

-continued-

System: **Northwestern District**

Species: **chum salmon**

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



-continued-

System: **Northwestern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

Northwestern District Chum Salmon Brood Table

Brood Year	Escap.	Ages 0.2	0.3	0.4	0.5	0.6	Total Return	Return/ Spawner
1980	405,300	8,088	373,348	173,489	3,228	0	558,153	1.4
1981	264,600	14,329	283,666	108,961	8,191	0	415,148	1.6
1982	190,200	5,756	166,266	157,713	7,198	0	336,933	1.8
1983	193,500	807	383,932	320,588	8,280	0	713,607	3.7
1984	460,900	4,915	204,899	52,292	1,144	265	263,515	0.6
1985	220,400	1,800	74,952	49,193	1,060	0	127,004	0.6
1986	165,700	218	89,615	122,400	8,013	0	220,246	1.3
1987	341,500	1,525	157,106	177,044	4,171	0	339,847	1.0
1988	356,200	3,709	134,474	102,086	1,086	0	241,354	0.7
1989	110,000	501	155,190	71,691	8,729	0	236,111	2.1
1990	110,905	5,956	189,365	110,570	2,749	0	308,640	2.8
1991	221,800	27,518	272,060	129,196	4,763	0	433,537	2.0
1992	215,300	43,646	255,644	105,744	5,943	0	410,977	1.9

-continued-

System: **Northwestern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

Parameter estimates and other statistics from a Ricker stock-recruit model on Northwestern District aggregate of chum salmon.

Statistic	Estimate	SE
α	3.6289	0.9616
$\ln(\alpha)$	1.2121	0.2605
β	0.3428	0.0912
σ^2	0.1536	
S_{msy}[a]	1.5449	
R_{msy}[a]	3.3014	
MSY[a]	1.7565	
90% MSY[a]	1.5809	
$S_{90\%msy}$[a]	1.0045, 2.1550	
S_{eq}[a]	3.7760	

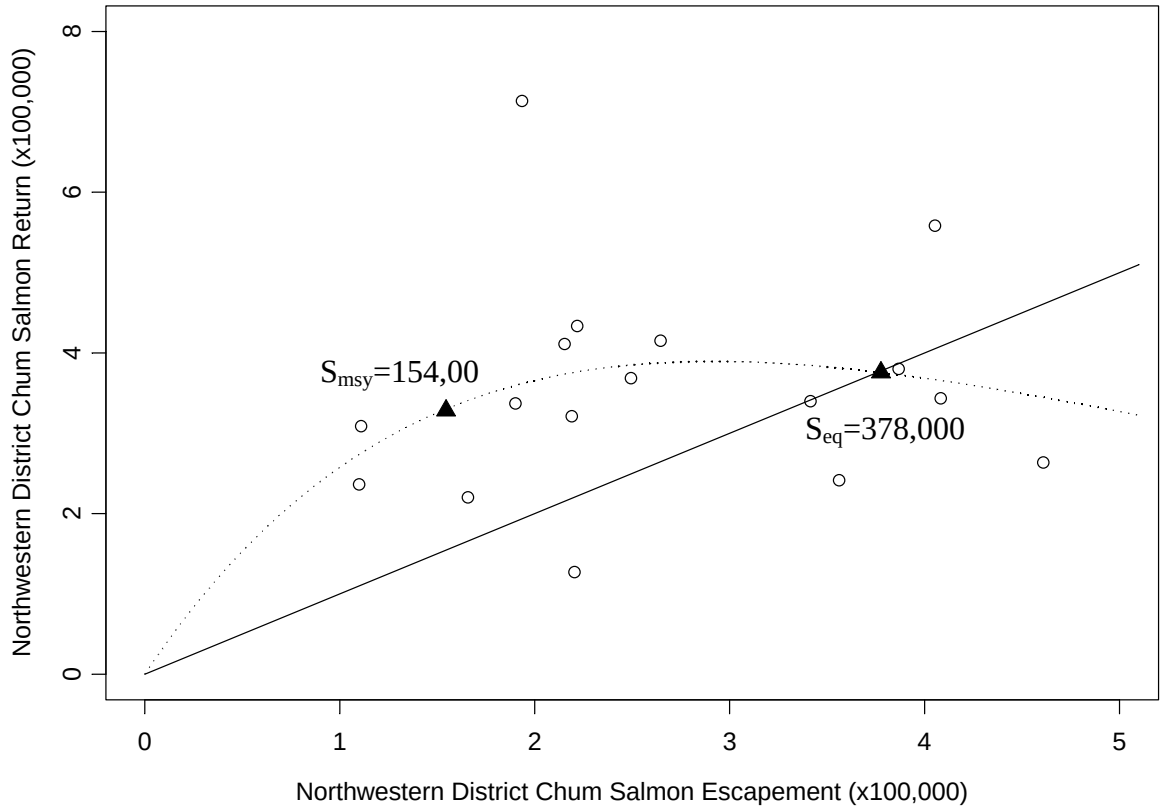
[a] Values in 100,000 of salmon

-continued-

System: **Northwestern District**

Species: **chum salmon**

Ricker stock-recruitment relationship, 1980-1992 brood years. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



Appendix A10.-Escapement goal for Northern District chum salmon.

System: Northern District

Species: chum salmon

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet (with some area-specific restrictions)
Previous escapement goal:	SEG: 119,600 to 239,200 (1992)
Recommended escapement goal:	BEG: no change in escapement range
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 44 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1982-present. No stock specific harvest information is available.
Contrast:	5.4
Methodology:	Ricker spawner-recruit model
Autocorrelation:	None
Comments:	Ricker spawner-recruit models corroborated the current Northern District chum salmon escapement goals. Current goals recommended as a BEG.

-continued-

System: **Northern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

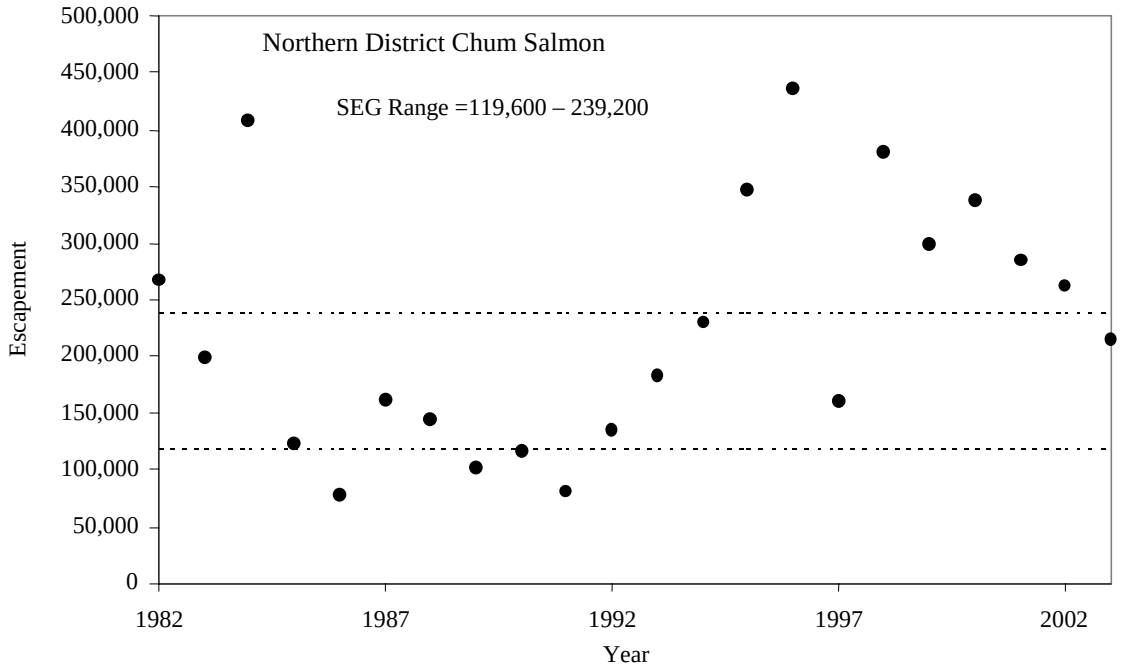
Year	Estimated Total Escapement Index
1982	267,500
1983	199,100
1984	409,300
1985	123,900
1986	77,900
1987	161,400
1988	144,100
1989	102,300
1990	115,530
1991	81,450
1992	136,400
1993	183,350
1994	230,800
1995	347,700
1996	436,400
1997	160,985
1998	380,350
1999	299,475
2000	338,900
2001	285,900
2002	262,710
2003	214,660

-continued-

System: **Northern District**

Species: **chum salmon**

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



-continued-

System: **Northern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

Northern District Chum Salmon Brood Table

		Ages					Total	Return /
Year	Escap.	0.2	0.3	0.4	0.5	0.6	Return	Spawner
1982	267,500	12,635	192,183	117,258	5,677	173	327,927	1.2
1983	199,100	5,708	184,131	98,524	10,813	0	299,176	1.5
1984	409,300	12,962	250,084	84,596	2,205	0	349,848	0.9
1985	123,900	4,604	137,205	81,999	623	0	224,432	1.8
1986	77,900	762	124,624	88,163	1,891	0	215,440	2.8
1987	161,400	2,243	116,482	73,614	2,610	0	194,949	1.2
1988	144,100	4,720	296,150	140,611	6,568	0	448,049	3.1
1989	102,300	1,630	124,299	117,726	9,360	616	253,631	2.5
1990	115,530	2,392	142,686	114,638	12,903	37	272,656	2.4
1991	81,450	7,478	219,017	68,671	1,448	0	296,614	3.6
1992	136,400	77,274	405,156	39,649	847	0	522,926	3.8
1993	183,350	9,262	166,355	50,508	405	0	226,531	1.2
1994	230,800	4,668	330,969	85,547	2,369	0	423,555	1.8
1995	347,700	35,544	250,452	56,059	4,218	0	346,273	1.0
1996	436,400	5,290	335,261	178,285	9,093		527,929	1.2
1997	160,985	8,297	160,940	84,492				
1998	380,350	3,754	177,867					
1999	299,475	20,459						
2000	338,900							
2001	285,900							
2002	262,710							
2003	214,660							

-continued-

System: **Northern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

Parameter estimates and other statistics from a Ricker stock-recruit model on Northern District aggregate of chum salmon.

Statistic	Estimate	SE
α	3.6354	0.6121
$\ln(\alpha)$	1.2413	0.1672
β	0.3256	0.0727
σ^2	0.0989	
S_{msy}[a]	1.6355	
R_{msy}[a]	3.4891	
MSY[a]	1.8556	
90% MSY[a]	1.6700	
$S_{90\%msy}$[a]	1.0657, 2.2751	
S_{eq}[a]	3.9546	

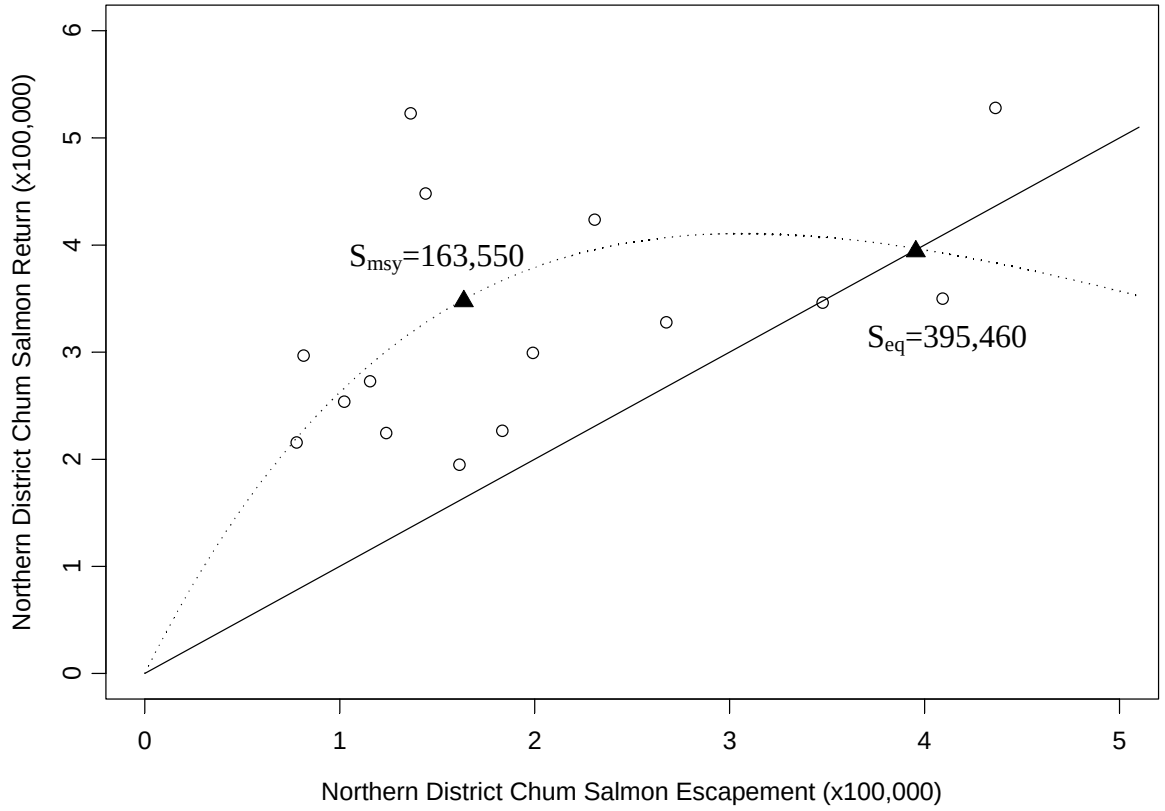
[a] Values in 100,000 of salmon

-continued-

System: **Northern District**

Species: **chum salmon**

Ricker stock – recruitment relationship, 1982-1996 brood years. The dotted line represents the multiplicative Ricker curve and the solid line represents replacement.



APPENDIX B. SUPPLEMENTAL INFORMATION USED TO ESTIMATE SUSTAINABLE ESCAPEMENT GOALS

Appendix B1.-Escapement goal for Meshik River Chinook salmon.

System: **Meshik River**

Species: **Chinook salmon**

Description of stock and escapement goals.

Regulatory area:	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set and drift gillnet
Previous escapement goal:	SEG: 2,000 to 4,000 (1993)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1961 – present
Data summary:	
Data quality:	Poor for aerial surveys; aerial survey coverage is sporadic.
Data type:	Fixed-wing aerial surveys from 1961 to present. No stock specific harvest information is available.
Data contrast:	176.0
Methodology:	None
Comments:	Recommended for elimination. Lack of a directed fishery and sporadic escapement estimates do not warrant an escapement goal.

-continued-

System: **Meshik River**

Species: **Chinook salmon**

Data available for analysis of escapement goals.

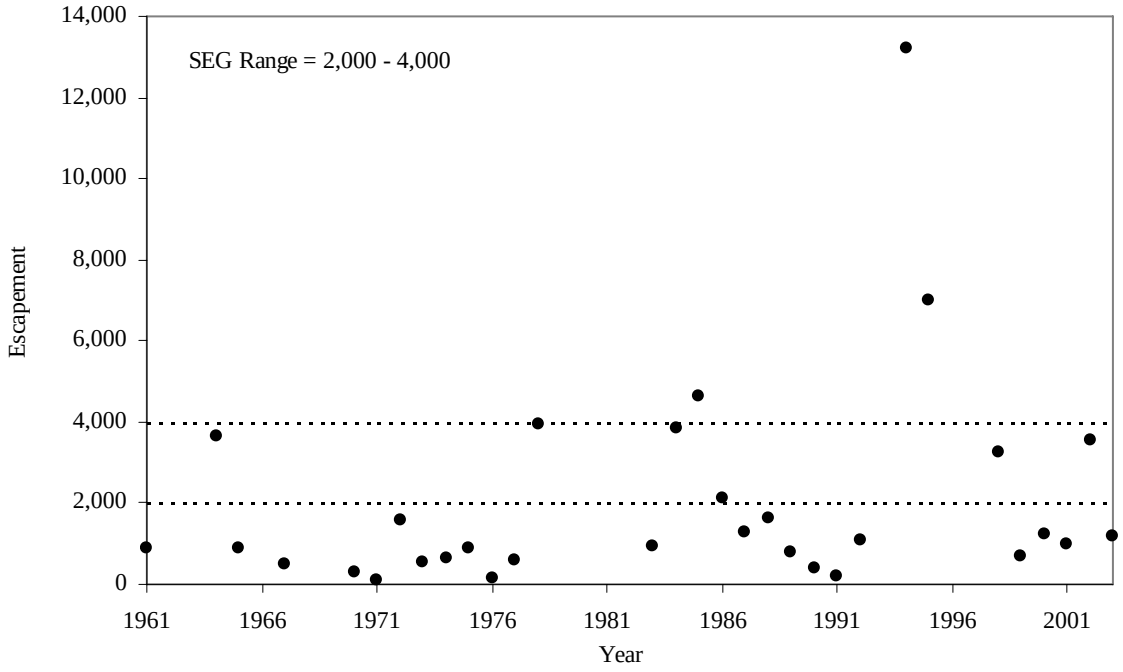
Year	Peak Escapement
1961	900
1962	
1963	
1964	3,650
1965	900
1966	
1967	500
1968	
1969	
1970	290
1971	75
1972	1,580
1973	550
1974	650
1975	885
1976	140
1977	610
1978	3,940
1979	
1980	
1981	
1982	
1983	950
1984	3,850
1985	4,650
1986	2,100
1987	1,275
1988	1,630
1989	793
1990	405
1991	200
1992	1,100
1993	
1994	13,200
1995	7,000
1996	
1997	
1998	3,250
1999	700
2000	1,250
2001	1,000
2002	3,570
2003	1,200

-continued-

System: **Meshik River**

Species: **Chinook salmon**

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



Appendix B2.-Escapement goal for Cinder River Chinook salmon.

System: Cinder River

Species: Chinook salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set and drift gillnet
Previous escapement goal:	SEG: 1,000 to 2,000 (1993)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1961 – present
Data summary:	
Data quality:	Poor for aerial surveys; aerial survey coverage is sporadic.
Data type:	Fixed-wing aerial surveys from 1961 to present. No stock specific harvest information is available.
Data contrast:	105.0
Methodology:	None
Comments:	Recommended for elimination. Lack of a directed fishery and sporadic escapement estimates do not warrant an escapement goal.

-continued-

System: **Cinder River**

Species: **Chinook salmon**

Data available for analysis of escapement goals.

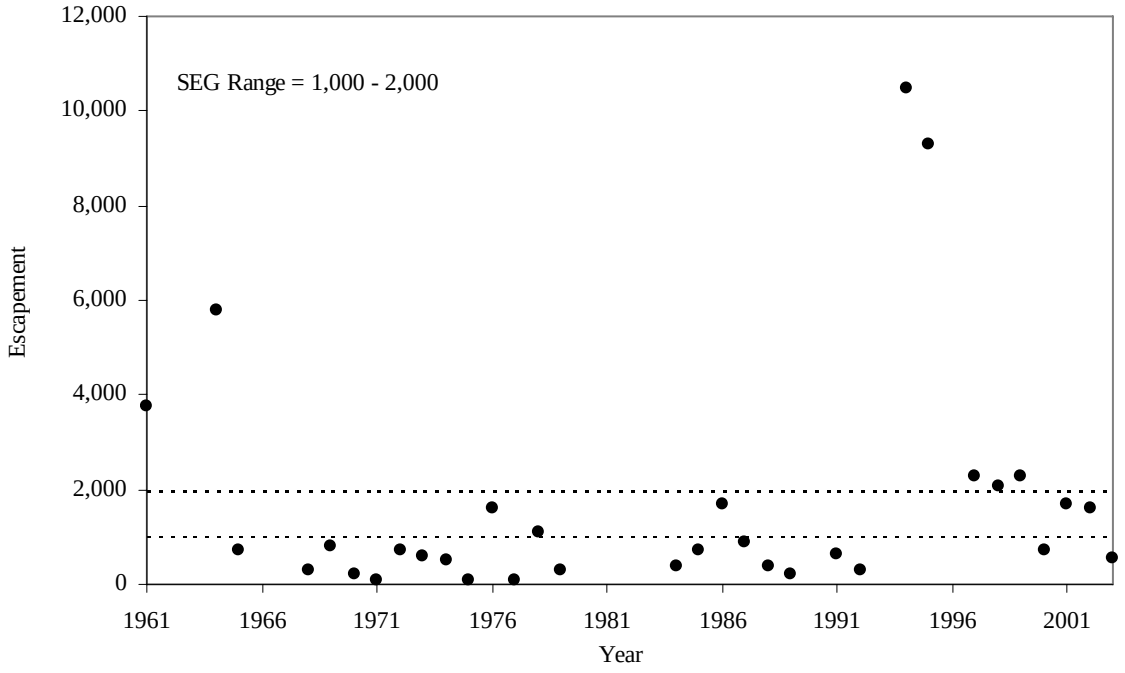
Year	Peak Escapement
1961	3,750
1962	
1963	
1964	5,800
1965	700
1966	
1967	
1968	300
1969	800
1970	200
1971	100
1972	700
1973	600
1974	500
1975	100
1976	1,600
1977	100
1978	1,100
1979	300
1980	
1981	
1982	
1983	
1984	400
1985	720
1986	1,700
1987	900
1988	400
1989	225
1990	
1991	640
1992	300
1993	
1994	10,500
1995	9,300
1996	
1997	2,280
1998	2,050
1999	2,300
2000	700
2001	1,700
2002	1,609
2003	550

-continued-

System: **Cinder River**

Species: **Chinook salmon**

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



Appendix B3.-Escapement goal for Orzinski Lake sockeye salmon.

System: Orzinski Lake

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 15,000 to 20,000 (1980)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1970 – 1989 Weir counts, 1990 – present
Data summary:	
Data quality:	Fair for aerial surveys, good for weir enumeration
Data type:	Fixed-wing aerial surveys from 1960 to 1989, weir counts from 1990 to present with escapement age data during weir counts. No stock specific harvest information is available.
Data contrast:	58.9 for aerial surveys, 4.7 for weir counts
Methodology:	Percentile, Euphotic volume analysis, smolt biomass as a function of zooplankton biomass, lake surface area
Criteria for SEG:	High contrast, high exploitation.
Percentiles:	25^{th} to 75^{th} for aerial surveys, 15^{th} to 85^{th} for weir counts
Comments:	SEG estimates based on percentile approach reasonably supported current goal. Limited limnology data suggests that current goals are appropriate; therefore there was no compelling evidence to change the current goal.

-continued-

System: **Orzinski Lake**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey	Weir Counts
1970	4,450	4,050	
1971	11,100	6,600	
1972	6,500	6,500	
1973	1,200	1,200	
1974	61,500	40,000	
1975	22,500	17,800	
1976	24,600	24,600	
1977	17,000	14,000	
1978	22,000	13,000	
1979	20,000	20,000	
1980	12,100	12,100	
1981	14,000	14,000	
1982	9,000	9,000	
1983	21,300	21,300	
1984	19,300	18,550	
1985	14,000	14,000	
1986	10,300	10,300	
1987	11,400	11,400	
1988	19,500	16,400	
1989	16,700	12,000	
1990			15,000
1991			40,000
1992			25,000
1993			24,700
1994			38,000
1995			30,000
1996			30,000
1997			35,000
1998			25,000
1999			15,000
2000			21,500
2001			31,200
2002			42,849
2003			70,689

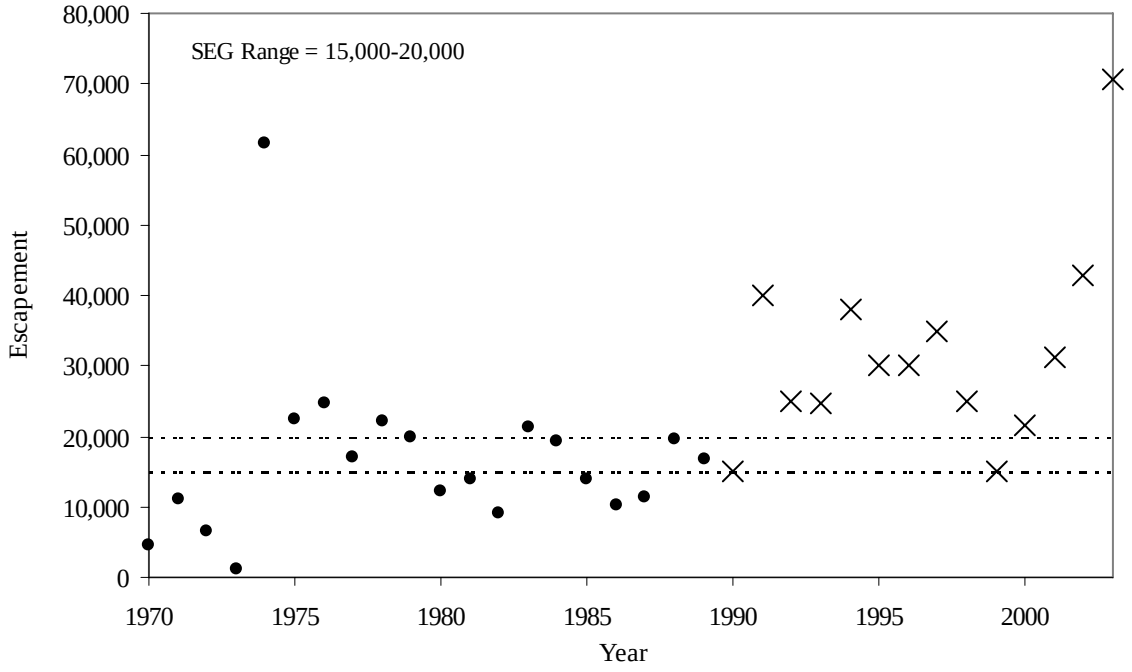
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Orzinski Lake**

Species: **sockeye salmon**

Observed escapement by year (solid circles for aerial surveys, Xs for weir counts) and current SEG range (dashed lines).



Appendix B4.-Escapement goal for Thin Point Lake sockeye salmon.

System: Thin Point Lake

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 14,000 to 28,000 (late 1980s)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968 – present Weir counts, 1994 –1998
Data summary:	
Data quality:	Fair for aerial surveys, poor for weir counts
Data type:	Fixed-wing aerial surveys from 1970 to present, weir counts from 1994 to 1998 with escapement age data during weir counts. Due to prolonged milling behavior in Thin Point Lagoon below the weir site, most of the yearly escapement was not counted past the weir; therefore, aerial survey counts are considered more accurate. No stock specific harvest information is available.
Data contrast:	72.9
Methodology:	Percentile, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area
Criteria for SEG:	High contrast, high exploitation
Percentile:	25^{th} to 75^{th}
Comments:	Limited limnology data suggests that current goals are appropriate; therefore there was no compelling evidence to change the current goal.

-continued-

System: **Thin Point Lake**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970	1,100	770
1971	1,300	800
1972	1,300	700
1973	700	700
1974	16,000	14,000
1975	6,100	4,900
1976	20,500	11,000
1977	17,700	5,000
1978	7,400	5,000
1979	6,900	3,000
1980	12,000	3,300
1981	7,500	2,300
1982	8,800	2,300
1983	6,500	2,400
1984	5,000	900
1985	7,500	4,100
1986	12,400	800
1987	8,700	3,000
1988	23,500	2,000
1989	21,500	1,700
1990	15,000	5,200
1991	35,800	2,800
1992	32,600	4,000
1993	22,600	2,000
1994	25,000	
1995	31,700	
1996	9,000	
1997	10,000	2,000
1998	21,000	
1999	20,500	2,400
2000	12,000	2,700
2001	47,900	3,400
2002	51,000	8,000
2003	40,000	11,200

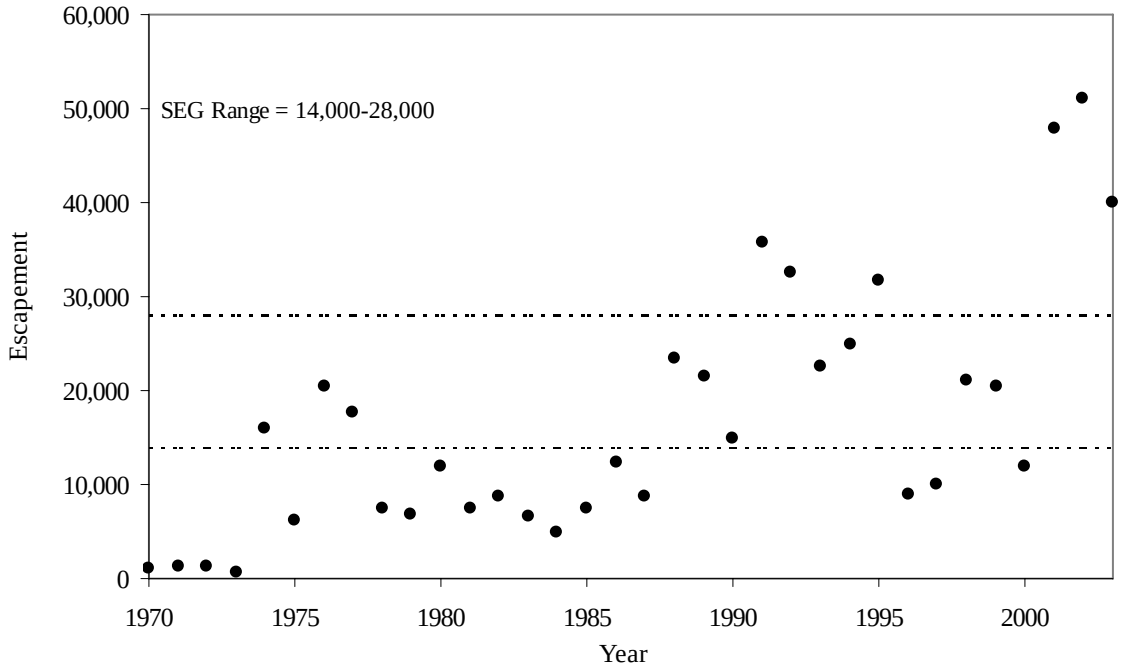
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Thin Point Lake**

Species: **sockeye salmon**

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



Appendix B5.-Escapement goal for Mortensens Lagoon sockeye salmon.

System: Mortensens Lagoon

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 3,200 to 6,400 (late 1980s)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1966 – present Weir counts, 2001 – present
Data summary:	
Data quality:	Poor for aerial surveys, good for weir counts
Data type:	Fixed-wing aerial surveys from 1970 to present, weir counts from 2001 to present with escapement age data during weir counts. No stock specific harvest information is available.
Data contrast:	20.9
Methodology:	Percentile, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area
Criteria for SEG:	High contrast, high exploitation
Percentiles:	25^{th} to 75^{th}
Comments:	SEG estimates based on percentile approach supported current goal. Limited limnology data suggests that current goals are appropriate; therefore there was no compelling evidence to change the current goal.

-continued-

System: **Mortensens Lagoon**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970	800	800
1971	800	800
1972	1,000	1,000
1973	1,250	1,250
1974	3,070	3,070
1975	4,000	4,000
1976	3,400	3,400
1977	5,700	5,700
1978	13,000	13,000
1979	5,900	5,900
1980	2,600	2,100
1981	3,800	2,800
1982	1,800	1,800
1983	5,750	3,400
1984	4,700	4,700
1985	4,400	2,800
1986	1,620	1,400
1987	4,000	3,200
1988	6,000	2,300
1989	4,300	2,400
1990	6,200	1,800
1991	7,100	7,050
1992	9,100	5,700
1993	6,400	4,000
1994	4,300	2,800
1995	8,300	7,900
1996	2,200	1,060
1997	5,200	1,300
1998	5,300	2,100
1999	3,600	1,500
2000	3,800	1,500
2001	9,100	5,500
2002	5,200	4,000
2003	16,743	6,500

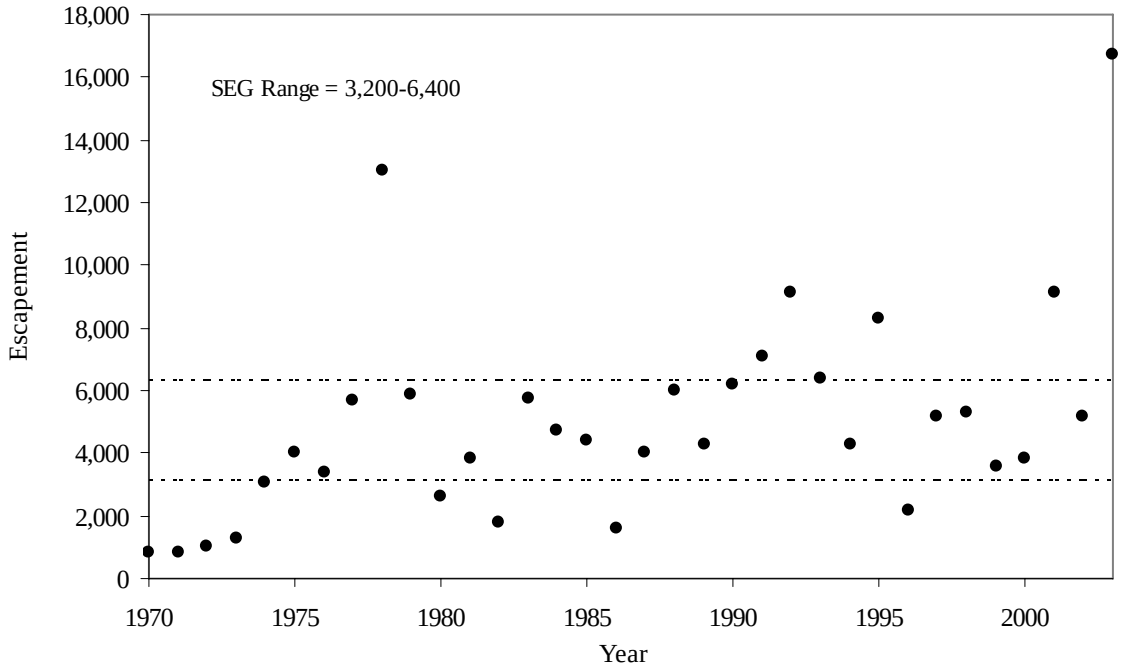
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Mortensens Lagoon**

Species: **sockeye salmon**

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



Appendix B6.-Escapement goal for Middle Lagoon (Morzhovoi Lake) sockeye salmon.

System: Middle Lagoon

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 16,000 to 32,000 (late 1980s)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present Weir counts 1995 and 1996
Data summary:	
Data quality:	Poor
Data type:	Fixed-wing aerial surveys from 1970 to present, intermittent in 1960s. No stock specific harvest information is available.
Data contrast:	91.2
Methodology:	Percentile, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area
Criteria for SEG:	High contrast, high exploitation
Percentiles:	25^{th} to 75^{th}
Comments:	Due to uncertain data, and the fact that current escapement levels have produced sufficient returns for escapement and harvestable surplus, no change is warranted.

-continued-

System: **Middle Lagoon**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970		0
1971		0
1972	500	160
1973	900	1,000
1974	15,000	5,000
1975	5,700	500
1976	3,200	1,060
1977	9,000	3,000
1978	4,900	1,620
1979	900	2,500
1980	3,000	2,000
1981	1,200	1,000
1982	5,800	2,000
1983	2,600	3,600
1984	900	900
1985	7,500	2,500
1986	16,200	5,400
1987	21,000	7,000
1988	7,200	5,700
1989	14,000	8,000
1990	40,300	14,100
1991	16,500	7,100
1992	9,300	5,500
1993	25,500	13,700
1994	29,100	10,300
1995	40,700	21,000
1996	11,600	3,900
1997	23,500	10,400
1998	20,500	10,000
1999	23,600	13,700
2000	14,400	6,000
2001	45,600	20,500
2002	39,000	23,000
2003	27,300	13,800

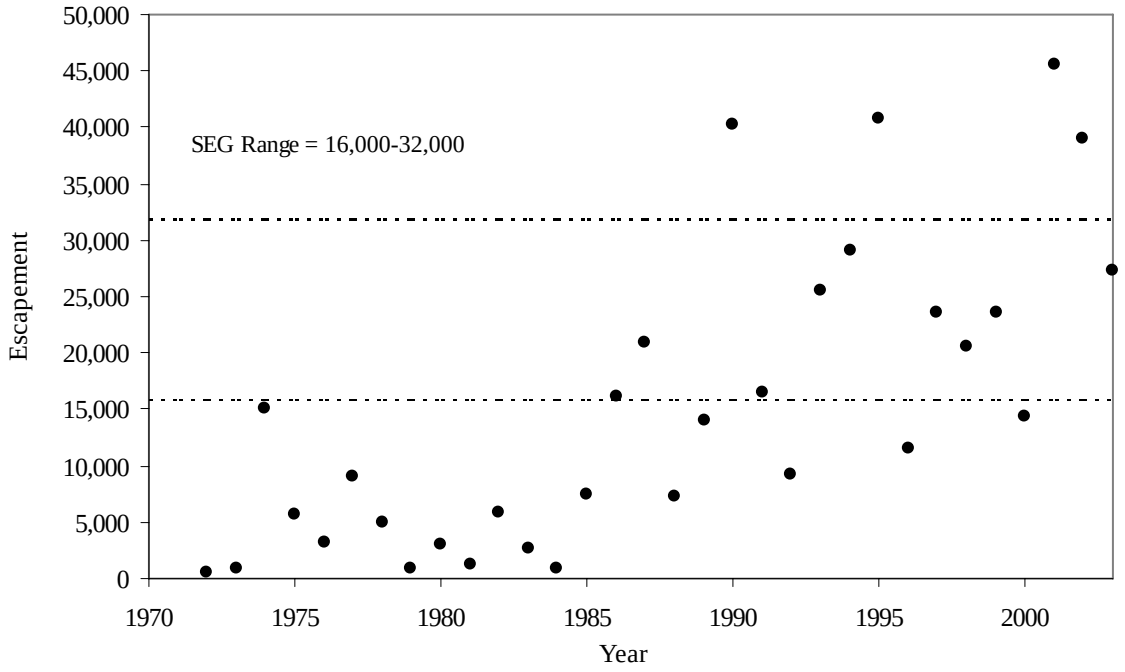
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Middle Lagoon**

Species: **sockeye salmon**

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



Appendix B7.-Escapement goal for Christianson Lagoon sockeye salmon.

System: Christianson Lagoon

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet
Previous escapement goal:	SEG: 25,000 to 50,000 (1980s)
Recommended escapement goal:	No change
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 1971 to present, intermittent during 1960s. No stock specific harvest information is available.
Data contrast:	24
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.

-continued-

System: **Christianson Lagoon**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1971	29,500	29,540
1972	3,900	4,330
1973	4,100	4,070
1974	3,100	3,050
1975	10,400	10,400
1976	19,400	21,035
1977	13,700	2,200
1978	10,200	10,150
1979	25,600	24,700
1980	75,300	60,700
1981	59,100	59,100
1982	25,500	25,500
1983	13,500	13,300
1984	63,000	63,000
1985	25,800	25,700
1986	36,800	36,800
1987	24,200	22,300
1988	29,700	29,700
1989	46,700	44,700
1990	45,600	43,600
1991	64,900	61,900
1992	28,000	27,500
1993	30,600	44,700
1994	37,800	37,800
1995	41,800	41,800
1996	25,600	18,260
1997	33,200	33,300
1998	38,600	34,800
1999	48,000	48,000
2000	49,400	45,000
2001	36,400	36,400
2002	42,700	54,700
2003	52,200	52,200

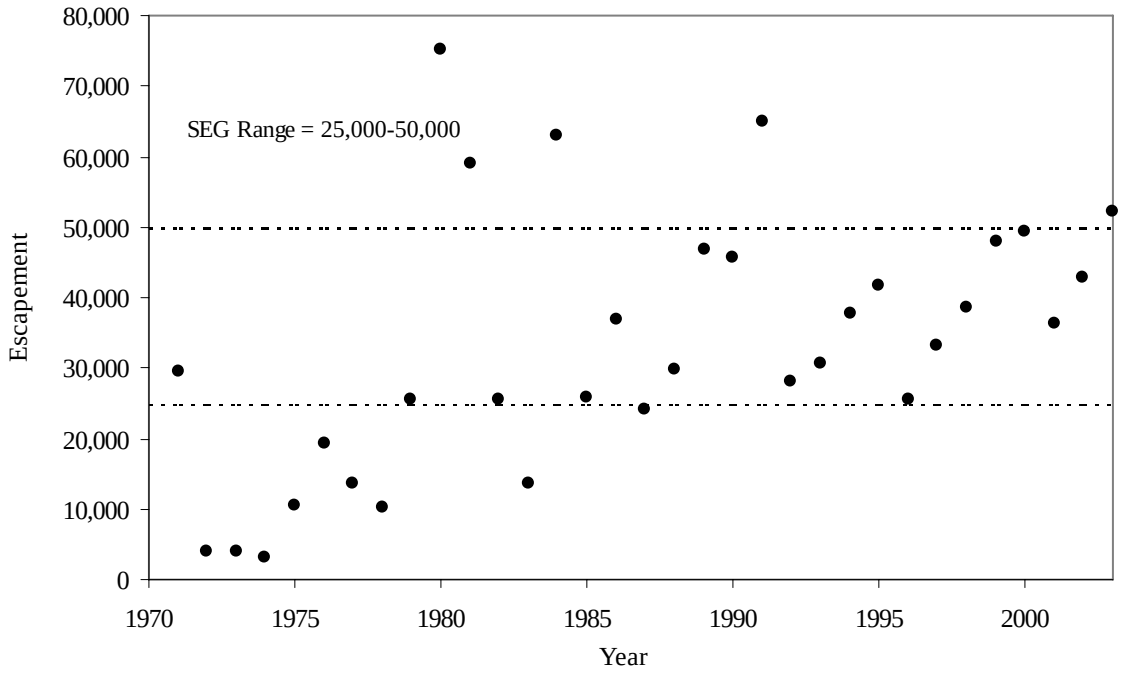
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Christianson Lagoon**

Species: **sockeye salmon**

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



Appendix B8.-Escapement goal for Swanson Lagoon sockeye salmon.

System: Swanson Lagoon

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet
Previous escapement goal:	SEG: 8,000 to 16,000 (1990)
Recommended escapement goal:	No change
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 1970 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:	Due to uncertain data, and the fact that current escapement levels have produced sufficient returns for escapement and harvestable surplus, no change is warranted.

-continued-

System: **Swanson Lagoon**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970	700	475
1971	300	50
1972	200	320
1973	100	50
1974	500	360
1975	1,400	70
1976	2,600	2,000
1977	12,000	10,700
1978	8,100	8,500
1979	8,400	6,600
1980	9,700	2,700
1981	600	500
1982	1,800	1,500
1983	300	300
1984	5,500	2,800
1985	3,400	3,100
1986	7,400	5,700
1987	9,600	8,700
1988	5,700	3,000
1989	5,500	2,700
1990	32,900	31,000
1991	11,200	10,000
1992	15,400	6,900
1993	7,600	5,800
1994	9,700	6,600
1995	10,300	7,000
1996	9,300	1,260
1997	7,800	2,000
1998	5,000	4,100
1999	7,900	5,700
2000	5,700	1,500
2001	10,600	8,600
2002	10,000	8,500
2003	16,100	15,800

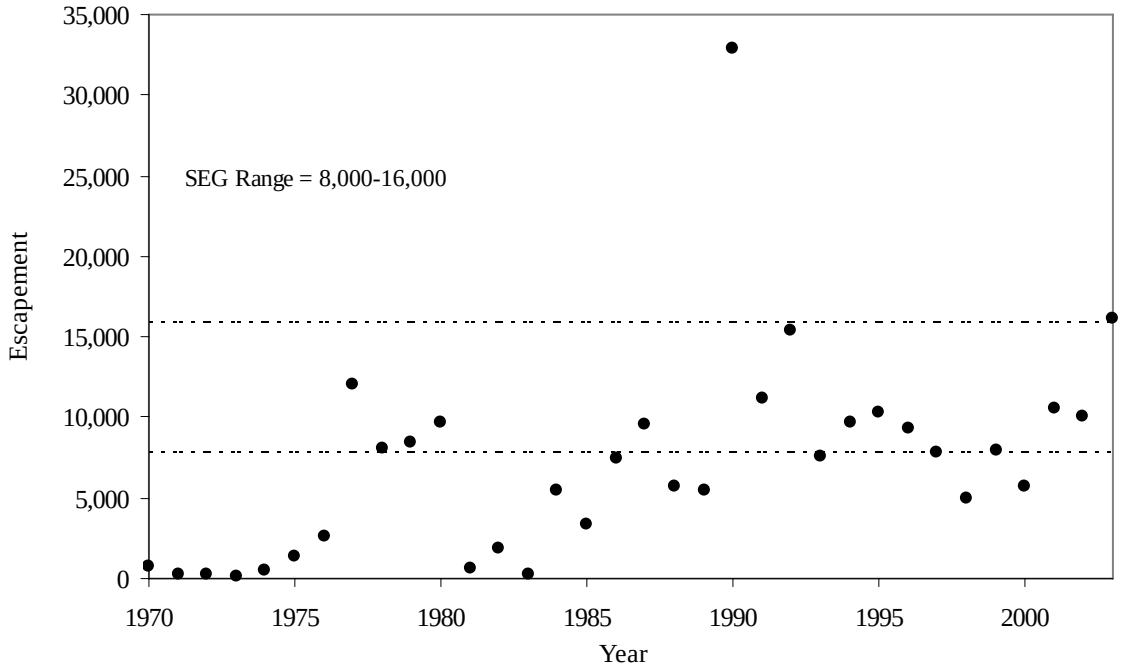
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Swanson Lagoon**

Species: **sockeye salmon**

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



Appendix B9.-Escapement goal for North Creek sockeye salmon.

System: North Creek

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 4,400 to 8,800 (late 1980s)
Recommended escapement goal:	No change
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 1970 to present. No stock specific harvest information is available.
Data contrast:	31.4
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.

-continued-

System: **North Creek**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970	600	600
1971		0
1972		0
1973		0
1974	1,800	1,800
1975	1,700	1,650
1976	7,100	7,000
1977	3,300	3,300
1978	500	500
1979	2,100	2,100
1980	3,400	3,350
1981		100
1982	5,800	5,800
1983	2,000	2,000
1984	500	500
1985	3,600	3,600
1986	2,100	2,100
1987	8,300	8,300
1988	6,300	6,300
1989	7,000	7,000
1990	4,300	5,100
1991	9,000	9,900
1992	15,700	15,700
1993	9,700	6,600
1994	4,600	4,600
1995	3,400	3,400
1996	8,000	8,000
1997	5,700	5,700
1998	6,700	6,700
1999	10,900	10,900
2000	8,100	8,100
2001	8,000	8,000
2002	10,100	10,100
2003	10,200	0

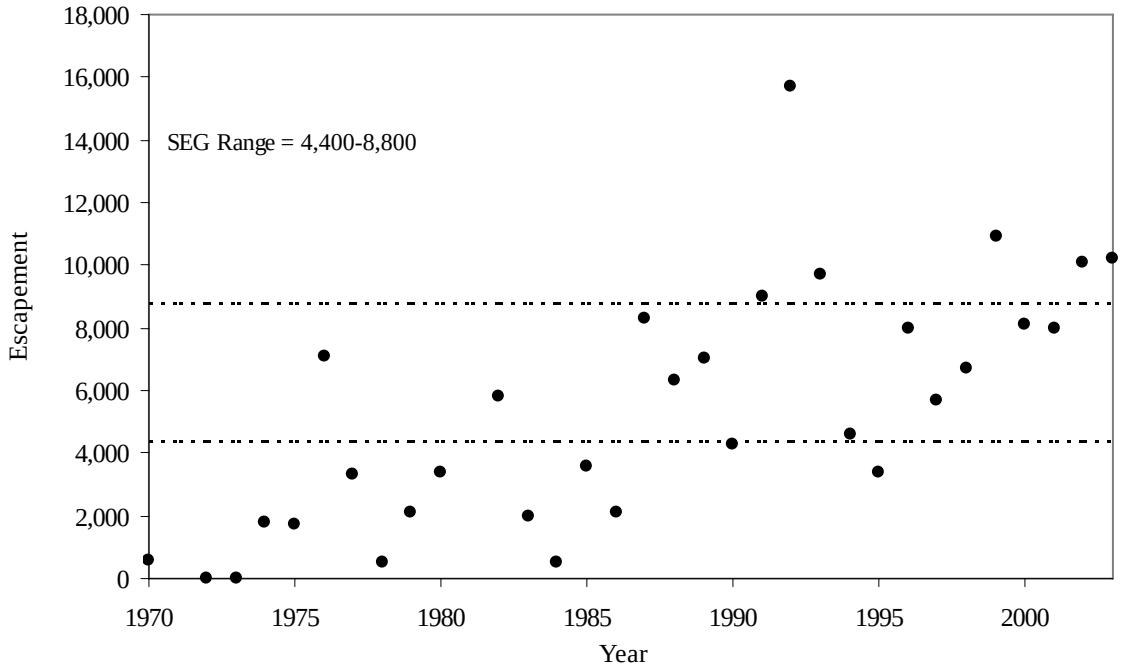
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **North Creek**

Species: **sockeye salmon**

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



Appendix B10.-Escapement goal for David's River late-run sockeye salmon.

System: David's River late-run

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set and drift gillnet
Previous escapement goal:	SEG: 6,400 to 12,800 (late 1980s)
Recommended escapement goal:	Eliminate goal
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 1970 to present. No stock specific harvest information is available.
Data contrast:	28.3
Methodology:	None
Comments:	Recommended for elimination. Inability to manage escapements specific to this system warrant elimination of goal.

-continued-

System: **David's River late-run**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970		140
1971		800
1972		300
1973		400
1974		1,280
1975		2,110
1976		2,550
1977		2,500
1978		5,000
1979		0
1980		2,100
1981		1,800
1982		800
1983		3,100
1984		2,500
1985	3,300	3,300
1986	2600	2,600
1987	9,400	9,400
1988	8,000	8,000
1989	2,040	2,040
1990	17,800	17,800
1991	4,300	4,300
1992	8,500	8,500
1993	4,950	4,550
1994	6,300	6,300
1995	4,700	3,700
1996	1,460	1,460
1997	2,500	2,500
1998		1,200
1999		8,000
2000		2,000
2001		2,400
2002		7,000
2003		4,700

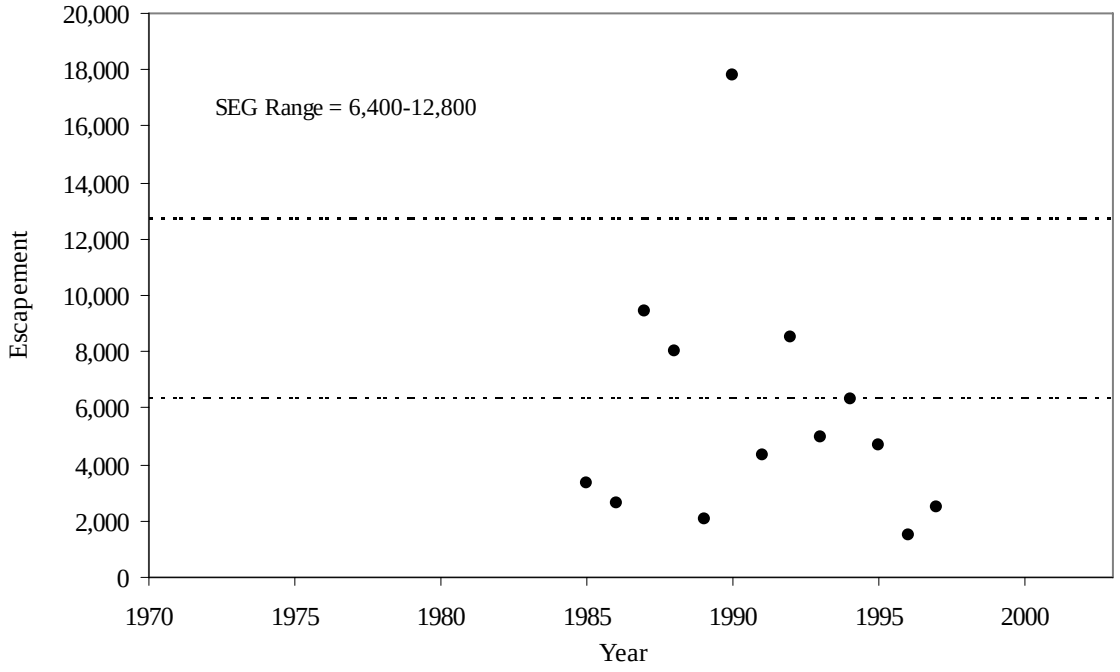
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **David's River late-run**

Species: **sockeye salmon**

Observed escapement by year during years that estimated total escapement was calculated (solid circles) and current SEG range (dashed lines).



Appendix B11.-Escapement goal for Bear Lake sockeye salmon.

System: Bear Lake

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and drift gillnet
Previous escapement goal:	SEG: Early Run: 150,000 to 175,000
	SEG: Late Run: 50,000 to 75,000
	SEG: Total Run: 200,000 to 250,000 (late 1960s)
Recommended escapement goal:	SEG: Early Run: 176,000 to 293,000
	SEG: Late Run: 117,000 to 195,000
	SEG: Total Run: 293,000 to 488,000
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Tower counts, 1964 – 1985
	Weir counts, 1986 – present
Data summary:	
Data quality:	Good for tower counts, excellent for weir counts
Data type:	Tower counts from 1964 to 1985, weir counts from 1986 to 2003. Escapement age data are available from 1985 to 2003 and harvest age data are available from 1985 to 2003 for the late run (after July 31). Stock specific harvest information is available for the late run from 1970 to 2003. No stock specific harvest information is available for the early run (prior to August 1).
Data contrast:	8.3
Methodology:	Spawning Habitat model, Percentile, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area.
Comments:	Limnological data, 1993 – 1995 and 2001 – 2003. Smolt age and size data from grab samples are variably available from 1967 to 2003. The Bear Lake system is considered spawner-limited and therefore the spawning habitat model was used to estimate the SEG.

-continued-

System: **Bear Lake**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

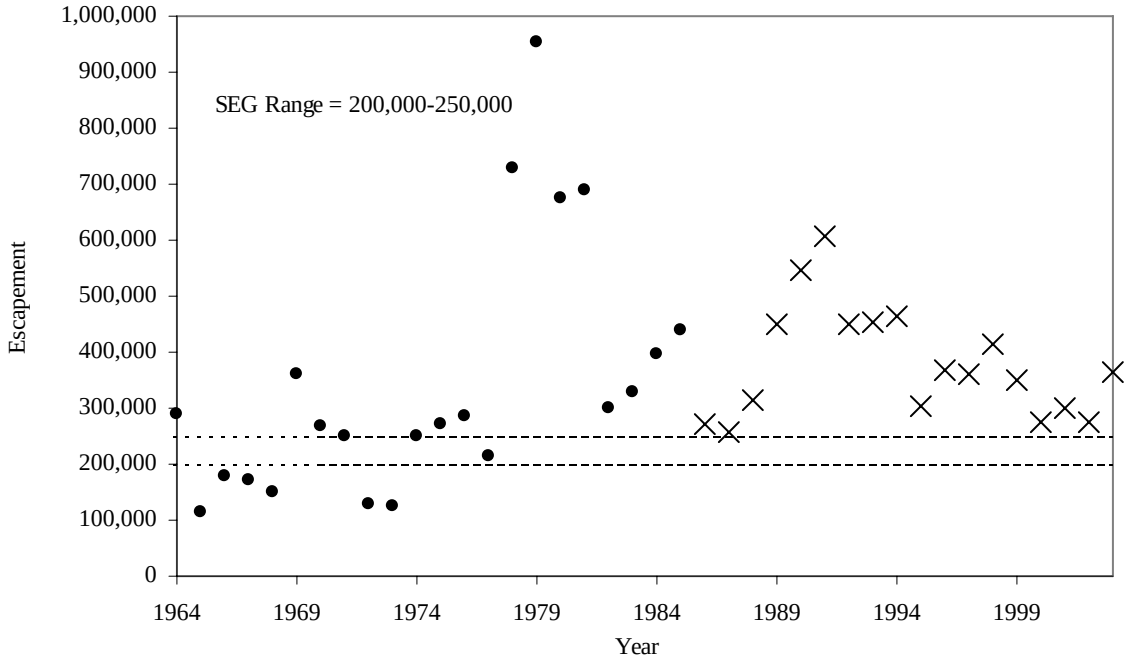
Year	Tower Counts	Weir Counts
1964	290,000	
1965	115,000	
1966	180,000	
1967	170,000	
1968	150,000	
1969	361,000	
1970	269,000	
1971	251,000	
1972	127,000	
1973	125,000	
1974	250,000	
1975	270,000	
1976	285,000	
1977	215,000	
1978	730,000	
1979	952,000	
1980	675,000	
1981	690,000	
1982	300,000	
1983	330,000	
1984	395,000	
1985	440,000	
1986		272,500
1987		258,000
1988		313,000
1989		451,000
1990		546,800
1991		606,000
1992		450,000
1993		452,000
1994		465,000
1995		305,000
1996		367,000
1997		360,000
1998		415,000
1999		350,000
2000		275,000
2001		300,000
2002		275,000
2003		366,000

-continued-

System: **Bear Lake**

Species: **sockeye salmon**

Observed escapement by year (solid circles for aerial surveys, Xs for weir counts) and current SEG range (dashed lines).



Appendix B12.-Escapement goal for Sandy River sockeye salmon.

System: Sandy River

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and drift gillnet
Previous escapement goal:	SEG: 40,000 to 60,000 (1994)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – 1993 Tower counts, 1962 – 1964 Weir counts, 1994 – present
Data summary:	
Data quality:	Fair for aerial survey/tower counts, good for weir counts.
Data type:	Weir counts from 1994 to 2003 are available and escapement age information is available during weir counts. No stock specific harvest information is available.
Data contrast:	24.5 (aerial and weir), 3.3 (weir only)
Methodology:	Percentile, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area
Criteria for SEG:	Aerial survey and weir: high contrast and high exploitation, Weir counts: Low contrast, high exploitation,
Percentiles:	Aerial survey and weir counts: 25^{th} to 75^{th} Weir counts: 15^{th} to maximum
Comments:	Recent escapements have provided harvestable surplus; therefore, no change is warranted.

-continued-

System: **Sandy River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey	Weir Counts
1970	25,000	21,800	
1971	30,000	30,000	
1972	8,400	8,400	
1973	5,100	10,000	
1974	16,500	16,500	
1975	40,000	38,350	
1976	43,000	43,050	
1977	100,000	100,000	
1978	64,000	64,000	
1979	61,000	61,000	
1980	76,000	76,000	
1981	51,500	51,700	
1982	61,300	57,200	
1983	28,000	28,000	
1984	19,000	19,000	
1985	11,500	11,000	
1986	6,900	14,000	
1987	8,900	8,900	
1988	34,500	34,500	
1989	36,000	36,000	
1990	17,500	17,500	
1991	75,200	75,200	
1992	21,200	8,900	
1993	49,300	46,300	
1994			115,000
1995			125,000
1996			64,000
1997			38,000
1998			52,000
1999			58,000
2000			40,000
2001			51,000
2002			49,000
2003			66,000

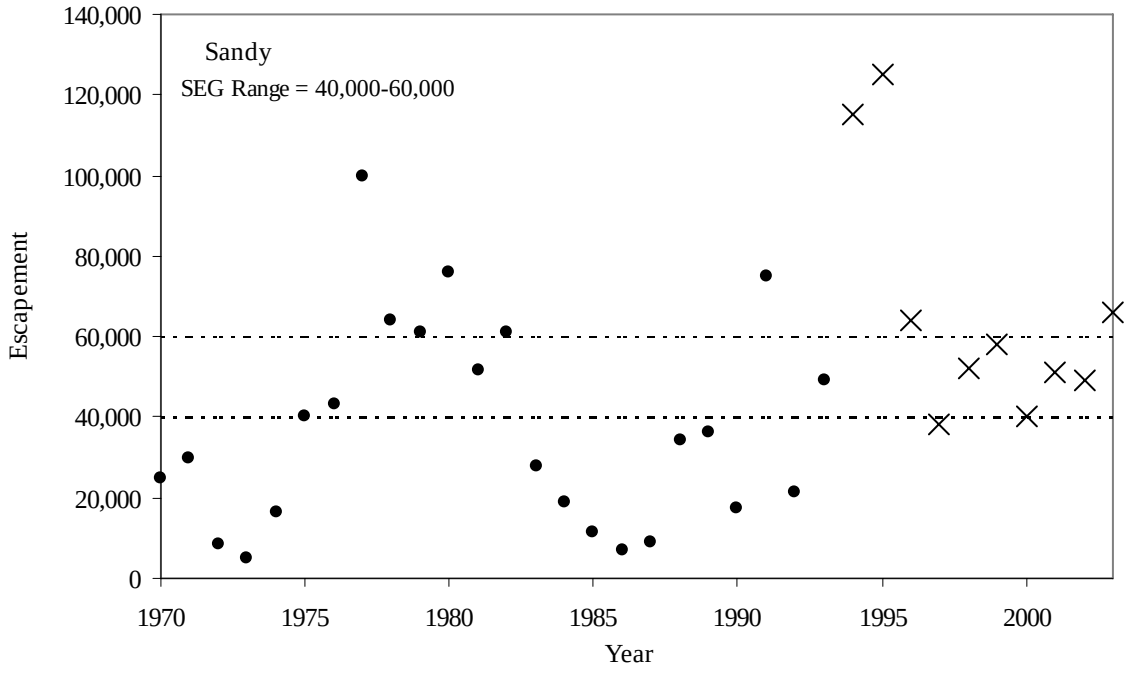
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Sandy River**

Species: **sockeye salmon**

Observed escapement by year (solid circles for aerial surveys, Xs for weir counts) and current SEG range (dashed lines).



Appendix B13.-Escapement goal for Ocean River sockeye salmon.

System: Ocean River

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 5,000 to 10,000 (late 1980s)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – 1990

Data summary:

Data quality:	Poor
Data type:	Fixed-wing aerial surveys from 1960 to 1990, missing data points throughout time period. No stock specific harvest information is available. The river is only surveyed intensely when it flows directly into the Bering Sea rather than its usual course through the Ilnik Lagoon. The last time this occurred was 1987.
Data contrast:	222.5
Methodology:	None
Comments:	Recommended for elimination; no goal necessary. Usually, this stock migrates concurrently with other Ilnik River stocks; the Ocean River has not directly flowed into the Bering Sea since 1987.

-continued-

System: **Ocean River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

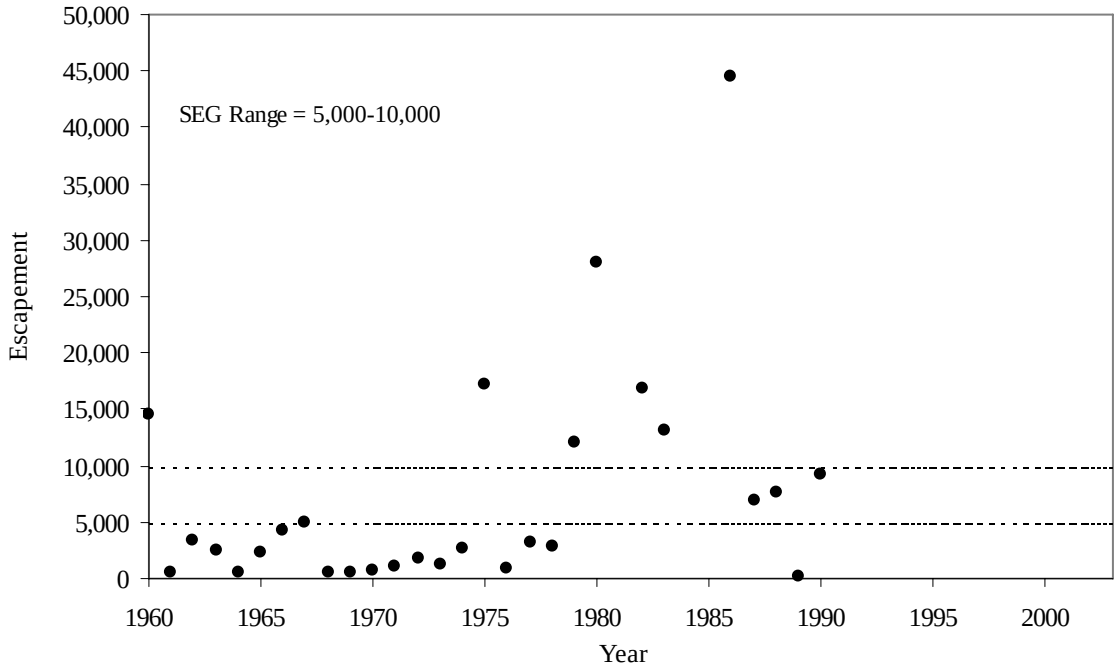
Year	Estimated Total Escapement [a]
1960	14,600
1961	600
1962	3,300
1963	2,500
1964	600
1965	2,300
1966	4,200
1967	5,000
1968	600
1969	500
1970	700
1971	1,000
1972	1,700
1973	1,200
1974	2,700
1975	17,200
1976	800
1977	3,200
1978	2,800
1979	12,000
1980	28,000
1981	
1982	16,900
1983	13,200
1984	
1985	
1986	44,500
1987	7,000
1988	7,700
1989	200
1990	9,200

-continued-

System: **Ocean River**

Species: **sockeye salmon**

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



Appendix B14.-Escapement goal for Ilnik River sockeye salmon.

System: Ilnik River

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 40,000 to 60,000 (1991)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – 1990 Weir count, 1991 – present
Data summary:	
Data quality:	Fair for aerial surveys, good for weir counts
Data type:	Fixed-wing aerial surveys from 1970 to 1990, intermittent during 1960s. Weir counts from 1991 to present with escapement age data available during weir counts. No stock specific harvest information is available.
Data contrast:	Weir counts and aerial survey: 10.3 Weir counts: 3.5
Methodology:	Percentile, Euphotic volume analysis, Smolt biomass as a function of zooplankton biomass, Lake surface area
Criteria for SEG:	Weir counts and aerial survey: high contrast, high exploitation Weir counts: low contrast, high exploitation
Percentiles:	Weir counts and aerial survey: 25^{th} to 75^{th} Weir counts: 15^{th} to maximum
Comments:	Current escapement levels have produced sufficient returns for escapement and harvestable surplus, no change is warranted.

-continued-

System: **Ilnik River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey	Weir Counts
1970	15,300	14,200	
1971	26,100	25,100	
1972	13,100	11,050	
1973	16,000	14,800	
1974	14,500	9,100	
1975	40,500	18,800	
1976	37,500	37,500	
1977	30,000	30,000	
1978	23,100	23,100	
1979	97,200	85,200	
1980	97,600	115,000	
1981	97,500	97,500	
1982	42,500	86,800	
1983	28,600	38,800	
1984	29,500	29,500	
1985	27,000	23,100	
1986	66,800	52,900	
1987	30,700	21,900	
1988	26,900	22,600	
1989	16,500	15,300	
1990	35,700	32,100	
1991			135,000
1992			45,000
1993			70,000
1994			75,000
1995			39,000
1996			62,000
1997			82,000
1998			50,000
1999			75,000
2000			95,000
2001			58,000
2002			43,000
2003			69,000

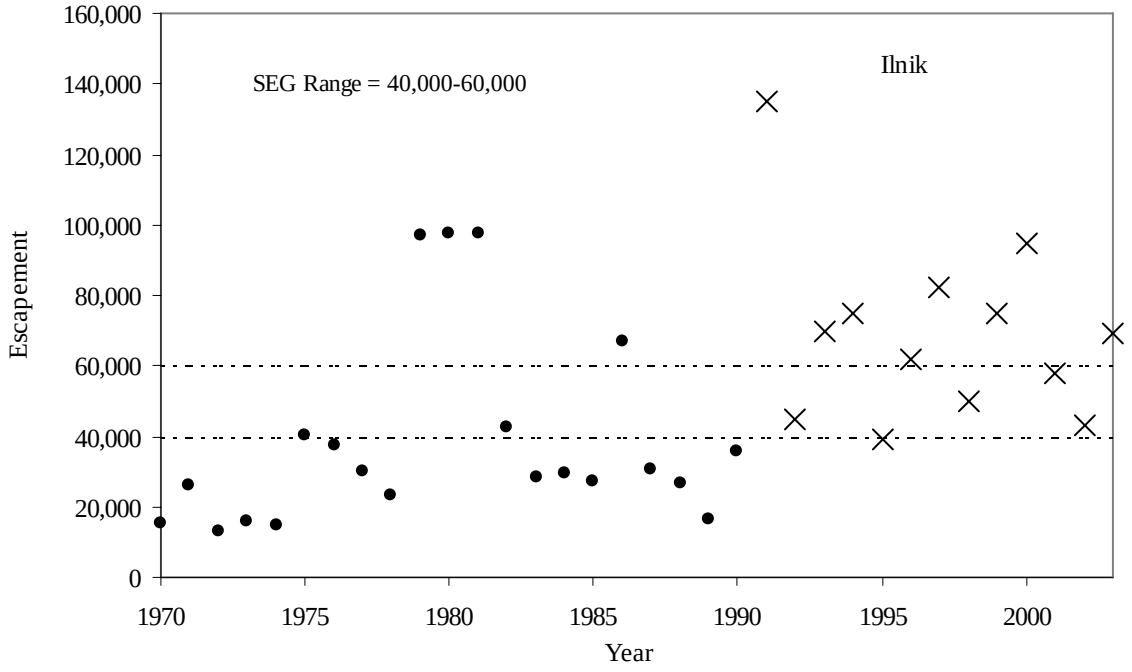
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Ilnik River**

Species: **sockeye salmon**

Observed escapement by year (solid circles for aerial surveys, Xs for weir counts) and current SEG range (dashed lines).



Appendix B15.-Escapement goal for Meshik River sockeye salmon.

System: Meshik River

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 10,000 to 20,000 (late 1980s)
Recommended escapement goal:	No change
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 1970 to present, missing data points throughout time period. No stock specific harvest information is available.
Data contrast:	131.4
Methodology:	Percentile
Criteria for SEG:	High contrast, low exploitation
Percentiles:	15^{th} to 75^{th}
Comments:	The Meshik River is considered to be rearing limited and current escapement levels have produced sufficient returns for escapement and harvestable surplus; therefore, no change is warranted.

-continued-

System: **Meshik River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970	13,100	4,750
1971	29,300	11,520
1972	3,700	3,700
1973	6,500	4,990
1974	1,200	980
1975	4,800	2,500
1976	25,500	21,650
1977	15,100	14,000
1978	17,900	14,860
1979	93,100	29,880
1980		15,000
1981		23,700
1982		13,725
1983	8,850	
1984	25,500	18,150
1985	26,500	9,500
1986		28,050
1987	26,300	26,275
1988	27,000	18,880
1989	5,700	6,010
1990	22,550	22,540
1991	19,480	19,480
1992	21,100	15,000
1993		0
1994	35,700	35,700
1995	67,600	52,030
1996	59,850	59,850
1997		12,600
1998	51,400	48,200
1999	62,200	33,100
2000	157,700	121,500
2001	100,500	100,500
2002	47,250	36,150
2003	94,000	83,600

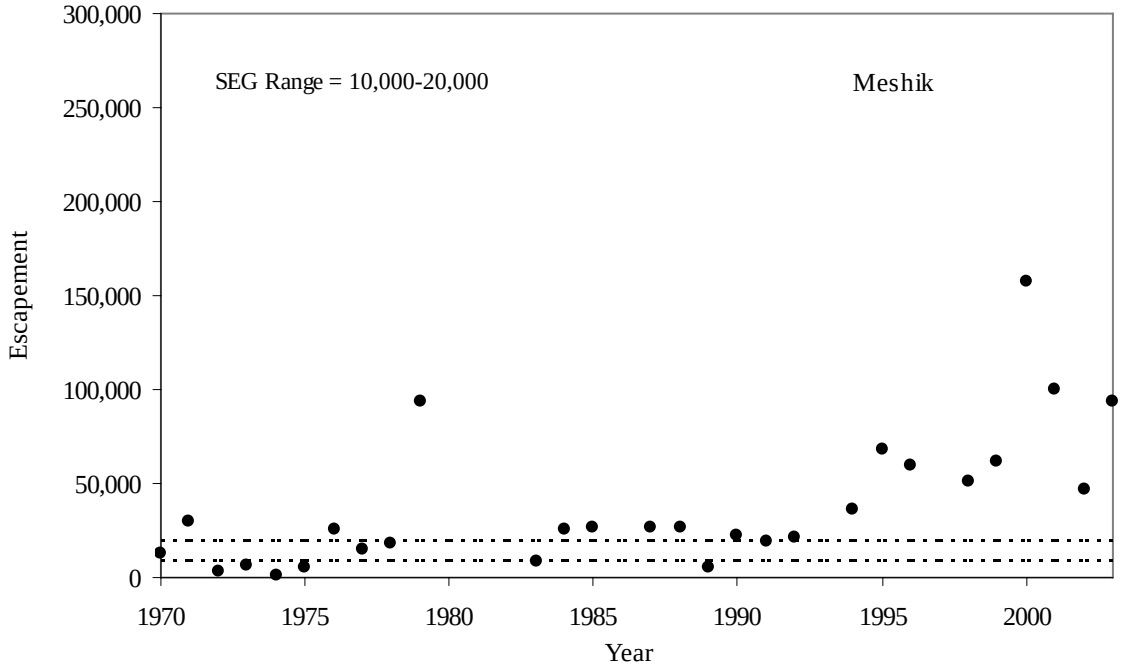
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Meshik River**

Species: **sockeye salmon**

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



Appendix B16.-Escapement goal for Cinder River sockeye salmon.

System: Cinder River

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 6,000 to 12,000 (late 1980s)
Recommended escapement goal:	No change
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 1970 to present, missing data points throughout time period. No stock specific harvest information is available.
Data contrast:	335.8
Methodology:	Percentile
Criteria for SEG:	High contrast, low exploitation
Percentiles:	15^{th} to 75^{th}
Comments:	The Cinder River is considered to be rearing limited and current escapement levels have produced sufficient returns for escapement and harvestable surplus; therefore, no change is recommended.

-continued-

System: **Cinder River**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Estimated Total Escapement [a]	Peak Aerial Survey
1970	950	925
1971	2,300	1,810
1972	450	330
1973	2,250	2,250
1974	1,300	1,280
1975	300	260
1976	8,500	5,800
1977		3,900
1978	3,300	2,900
1979	5,000	4,680
1980	23,400	23,360
1981	100,750	100,750
1982		
1983		
1984	10,350	10,325
1985	11,650	11,650
1986	25,650	25,650
1987	127	12,700
1988	1,800	1,810
1989	3,950	3,950
1990	11,850	11,830
1991	39,300	34,800
1992	11,300	11,300
1993		
1994	83,400	83,400
1995	47,500	43,000
1996		
1997	44,000	44,000
1998	57,000	42,900
1999	12,400	12,000
2000	51,000	48,800
2001		
2002	11,500	10,290
2003	88,700	88,700

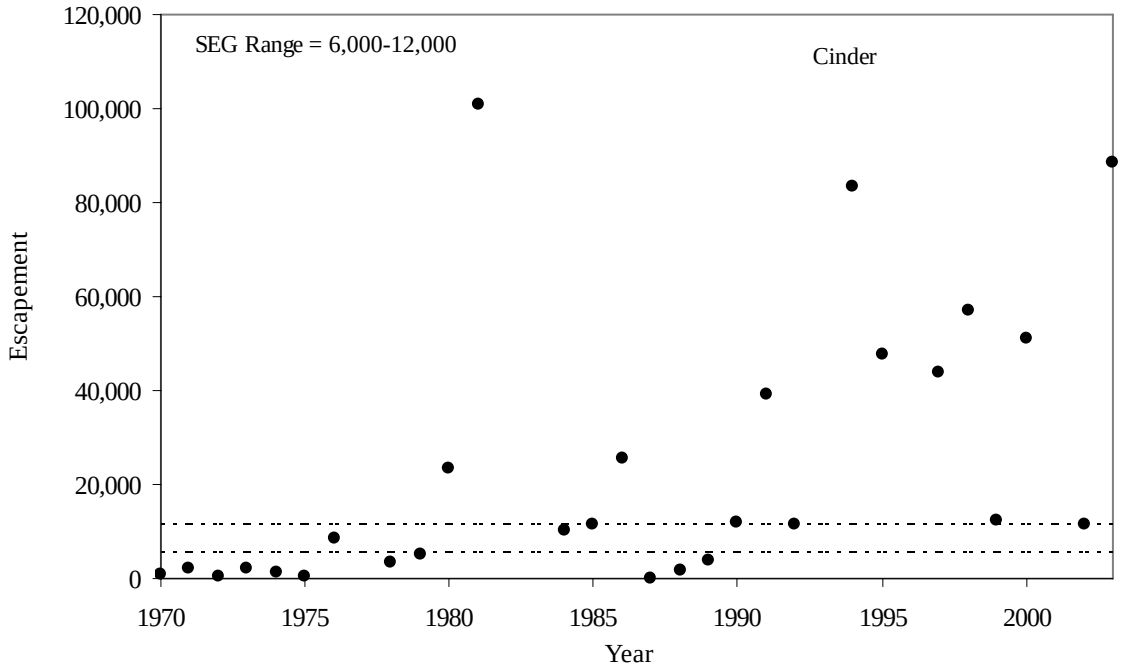
[a] The estimated total escapement represents the peak survey, enumeration of carcasses, as well as ancillary and qualitative data.

-continued-

System: **Cinder River**

Species: **sockeye salmon**

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



Appendix B17.-Escapement goal for McLees Lake sockeye salmon.

System: McLees Lake

Species: sockeye salmon

Description of stock and escapement goals.

Regulatory area	Aleutian Islands – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Subsistence, occasional commercial purse seine
Previous escapement goal:	SEG: 4,000 to 6,000 (1993)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1974– 2000 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:	65.0
Comments:	Recommended for elimination because of lack of reliable aerial survey data, poor prospects for accurate future estimates, and no directed commercial fishery.

-continued-

System: **McLees Lake**

Species: **sockeye salmon**

Data available for analysis of escapement goals.

Year	Peak Aerial Survey	Weir Counts
1970		
1971		
1972		
1973		
1974	3,000	
1975	5,600	
1976		
1977	500	
1978	2,200	
1979	1,100	
1980	3,400	
1981		
1982		
1983		
1984	300	
1985		
1986	1,900	
1987	1,500	
1988		
1989		
1990	2,500	
1991		
1992	6,500	
1993		
1994		
1995	1,550	
1996	2,700	
1997	1,100	
1998	3,500	
1999	1,025	
2000	4,400	
2001	3,400	45,866
2002	18,300	97,780
2003	19,500	101,793

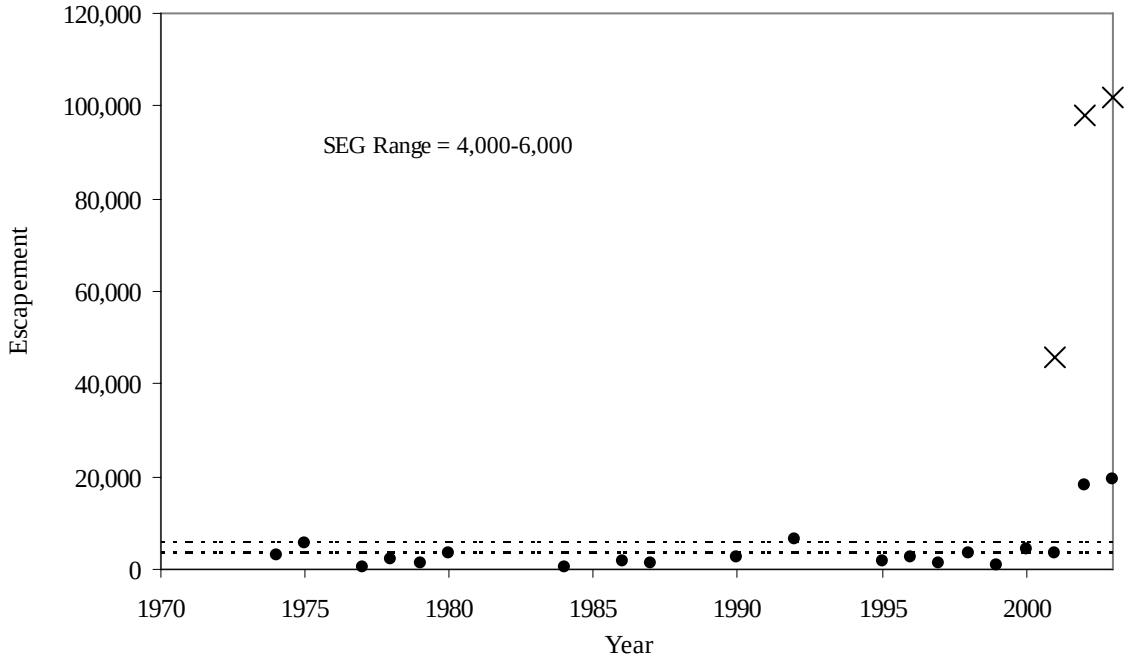
[a] The estimated total escapement represents the peak survey, enumeration o fcarcasses, as well as ancillary and qualitative data.

-continued-

System: **McLees Lake**

Species: **sockeye salmon**

Observed escapement by year (solid circles for aerial surveys, Xs for weir counts) and current SEG range (dashed lines).



Appendix B18.-Escapement goal for Bechevin Bay Section pink salmon.

System: Bechevin Bay Section

Species: pink salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region		
Management division:	Commercial Fisheries		
Primary fishery:	Commercial purse seine and set and drift gillnet		
Previous escapement goal:	SEG: Even year:	33,200 to 66,400 (1992)	
	SEG: Odd year:	2,400 to 4,800 (1992)	
Recommended escapement goal:	SEG Threshold:	Even year:	31,000
	SEG Threshold:	Odd year:	1,600
Optimal escapement goal:	none		
Inriver goal:	none		
Action points:	none		

Escapement enumeration: Aerial survey, 1960 – present. Since 1987, a total of 5 streams are used as an index for section-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.

Data summary:

Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. Indexed total escapement 1987-present. No stock specific harvest information is available.
Data contrast (even):	18.4
Data contrast (odd):	20.7
Methodology:	Risk analysis

Comments:

-continued-

System: **Bechevin Bay Section**

Species: **pink salmon**

Data available for analysis of escapement goals.

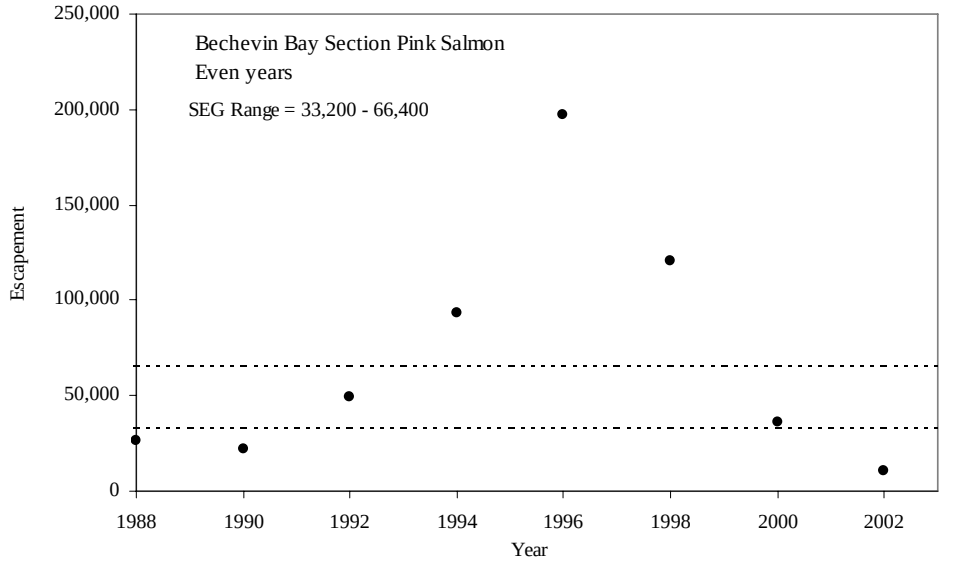
Year	Estimated Total Escapement Index
1987	1,100
1988	26,700
1989	1,900
1990	21,800
1991	1,200
1992	49,400
1993	700
1994	93,700
1995	5,000
1996	197,400
1997	4,000
1998	120,500
1999	14,500
2000	35,900
2001	6,100
2002	10,700
2003	800

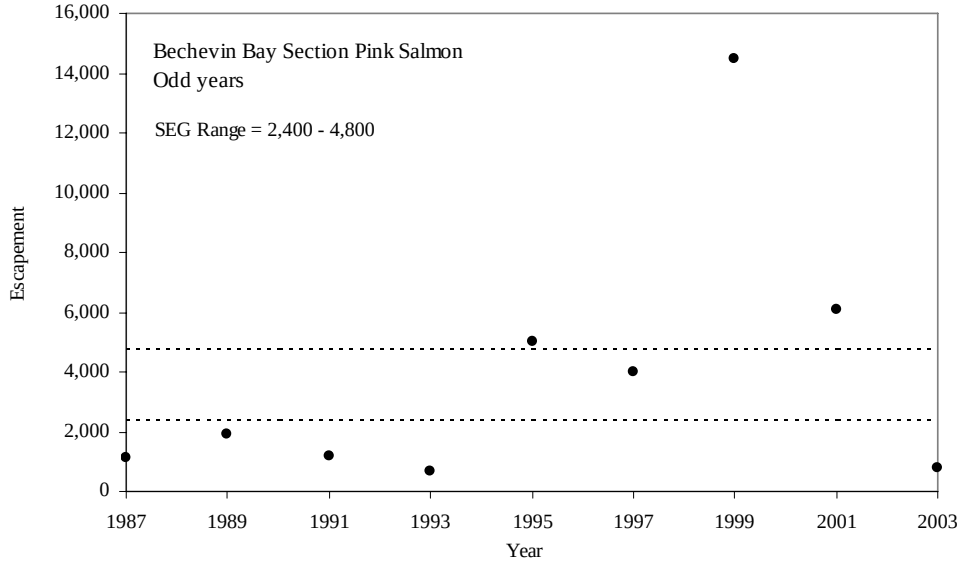
-continued-

System: **Bechevin Bay Section**

Species: **pink salmon**

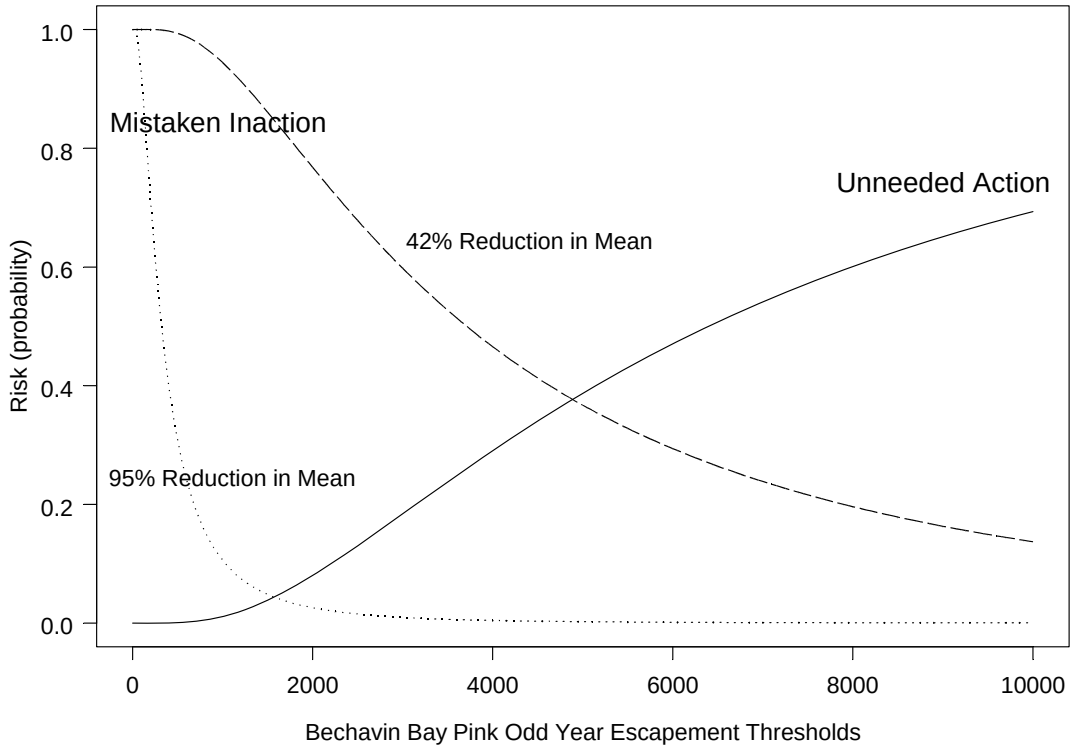
Observed escapement by year (solid circles for aerial surveys) and current SEG range (dashed lines).





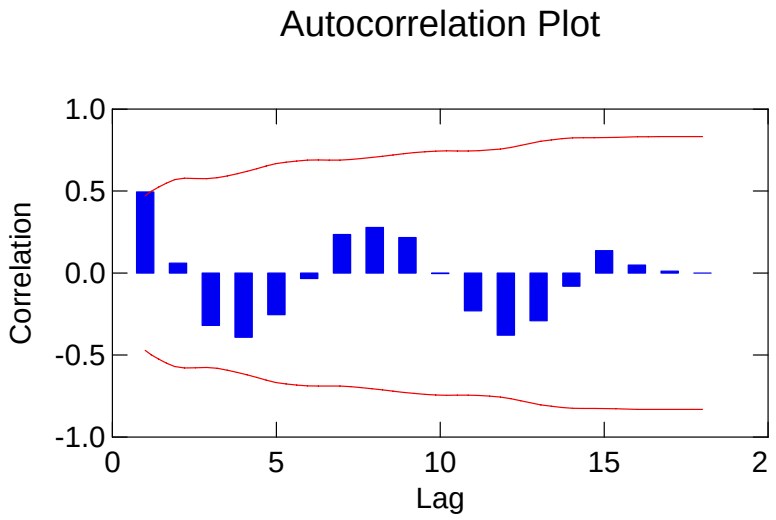
-continued-

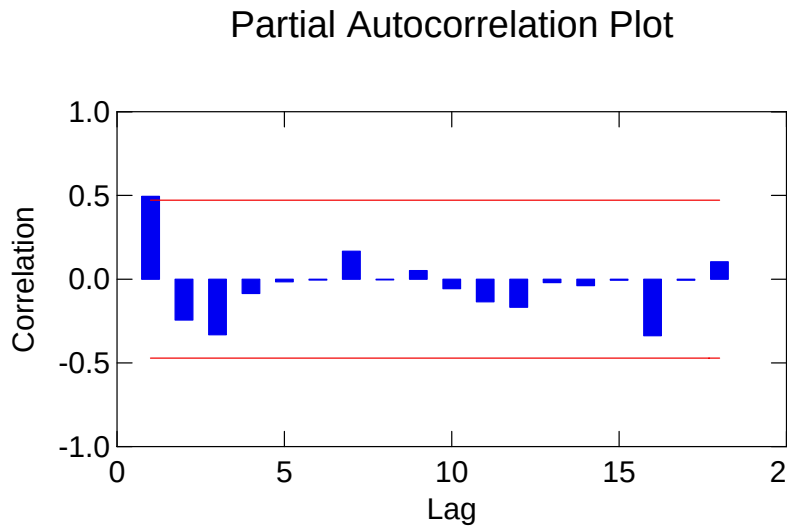
Bechevin Bay pink salmon odd year risk analysis.



-continued-

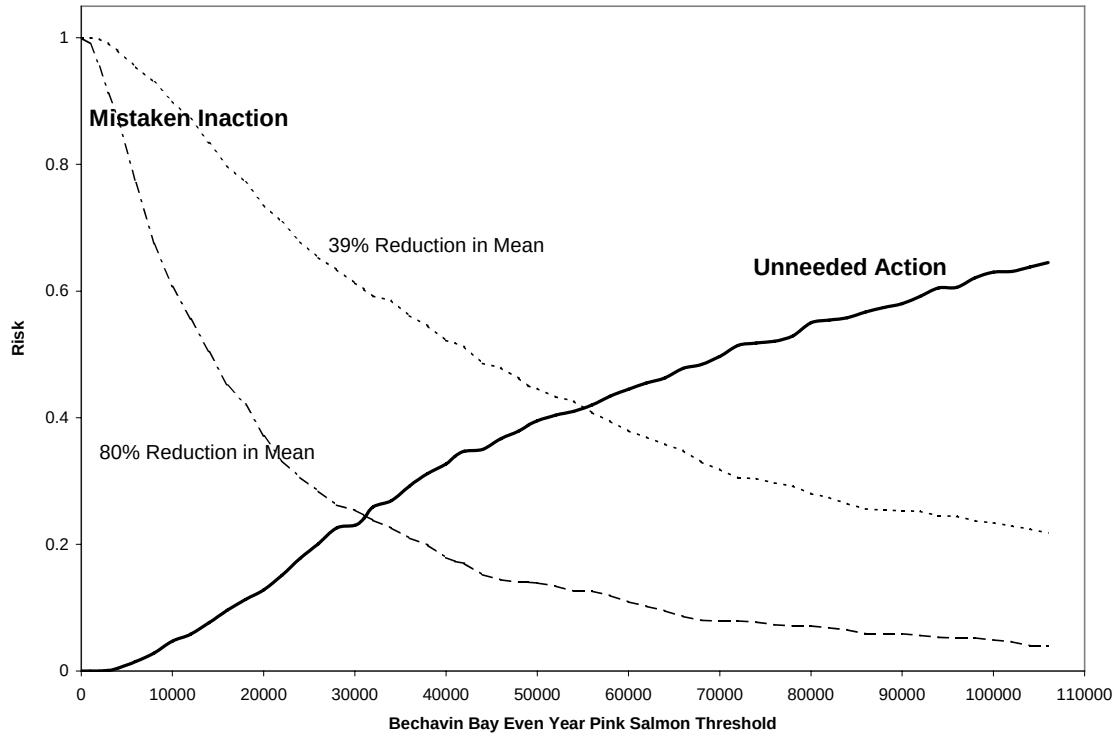
Bechevin Bay pink salmon even year test for autocorrelation.





-continued-

Bechevin Bay pink salmon even year risk analysis.



Appendix B19.-Escapement goal for Unalaska District pink salmon.

System: Unalaska District

Species: pink salmon

Description of stock and escapement goals.

Regulatory area	Aleutian Islands Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine.
Previous escapement goal:	SEG: Even year: 368,000 to 736,000 (1992) SEG: Odd year: 91,000 to 182,000 (1992)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, intermittently 1961 – present. Aircraft availability and remoteness of area has limited aerial survey coverage.
Data summary:	
Data quality:	Poor
Data type:	Fixed-wing aerial surveys from most years during 1961 to present.
Data contrast (even):	51.8
Data contrast (odd):	46.2
Methodology:	None
Comments	Recommended for elimination. Lack of a directed fishery and sporadic escapement estimates do not warrant an escapement goal.

-continued-

System: **Unalaska District**

Species: **pink salmon**

Data available for analysis of escapement goals.

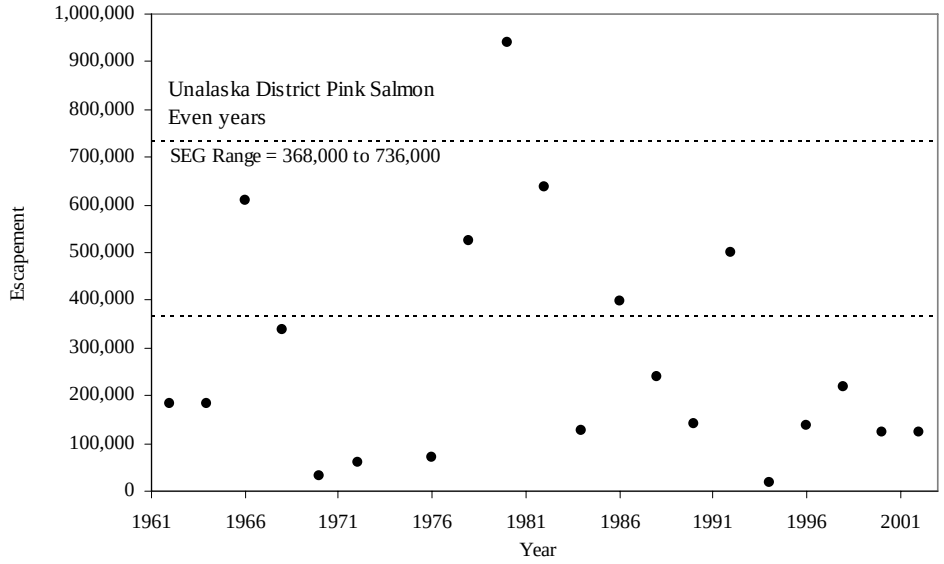
Year	Peak Escapements
1961	118,010
1962	181,500
1963	57,900
1964	182,000
1965	7,000
1966	608,500
1967	31,000
1968	337,450
1969	17,150
1970	31,520
1971	6,390
1972	58,660
1973	38,685
1974	0
1975	114,150
1976	72,090
1977	295,000
1978	523,600
1979	239,300
1980	941,012
1981	37,850
1982	636,600
1983	27,100
1984	127,100
1985	52,500
1986	396,700
1987	8,316
1988	238,400
1989	10,743
1990	139,310
1991	30,750
1992	498,250
1993	30,963
1994	18,177
1995	61,700
1996	135,695
1997	31,091
1998	217,400
1999	184,600
2000	125,000
2001	145,800
2002	125,000
2003	145,800

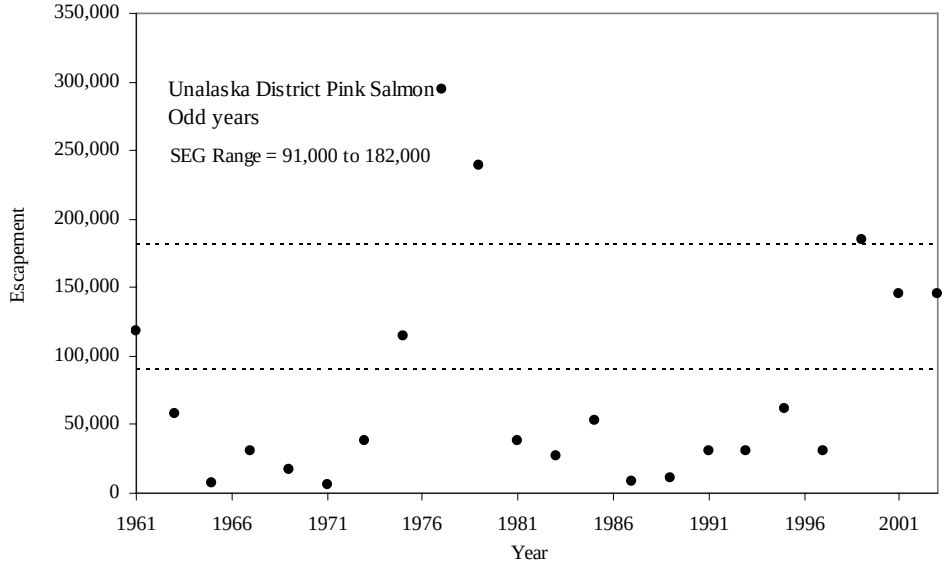
-continued-

System: **Unalaska District**

Species: **pink salmon**

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





Appendix B20.-Escapement goal for Southeastern District chum salmon.

System: Southeastern District (includes Shumagin Islands Section and Southeastern District Mainland)

Species: chum salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 106,400 to 212,800 (1992)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 28 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. No stock specific harvest information is available.
Data contrast:	7.0
Methodology:	Percentile
Criteria for SEG:	Low contrast, high exploitation
Percentiles:	15^{th} to maximum estimate
Comments:	No changes were recommended to this goal due to the lack of quality data and the observation that current escapement levels have produced sufficient escapements and harvestable surpluses.

-continued-

System: **Southeastern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

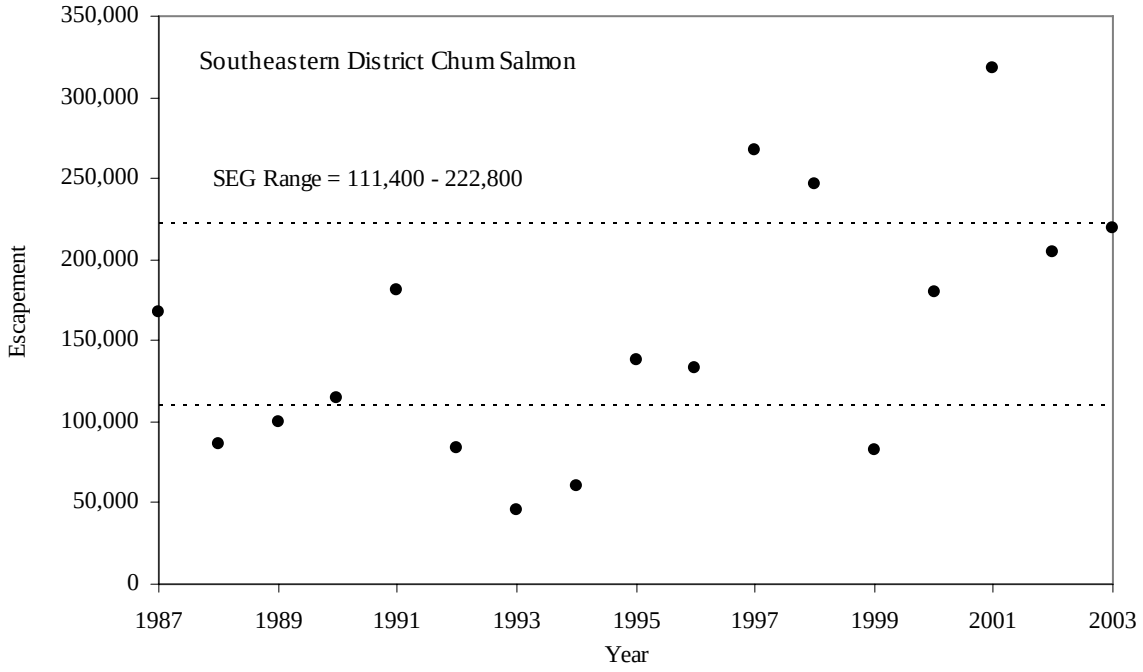
Year	Estimated Total Escapement Index
1987	167,300
1988	85,700
1989	99,650
1990	114,595
1991	181,365
1992	83,450
1993	45,550
1994	59,800
1995	137,650
1996	133,600
1997	267,650
1998	246,025
1999	82,550
2000	179,950
2001	318,300
2002	204,150
2003	218,810

-continued-

System: **Southeastern District**

Species: **chum salmon**

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



Appendix B21.-Escapement goal for South Central District chum salmon.

System: South Central District

Species: chum salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial set gillnet and purse seine
Previous escapement goal:	SEG: 89,800 to 179,600 (1992)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 13 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.

Data summary:

Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. No stock specific harvest information is available.
Data contrast:	3.5
Methodology:	Percentile
Criteria for SEG:	Low contrast, high exploitation.
Percentiles:	15^{th} to maximum estimate
Comments:	No changes were recommended to this goal due to the lack of quality data and the fact that current escapement levels have produced sufficient escapements and harvestable surpluses.

-continued-

System: **South Central District**

Species: **chum salmon**

Data available for analysis of escapement goals.

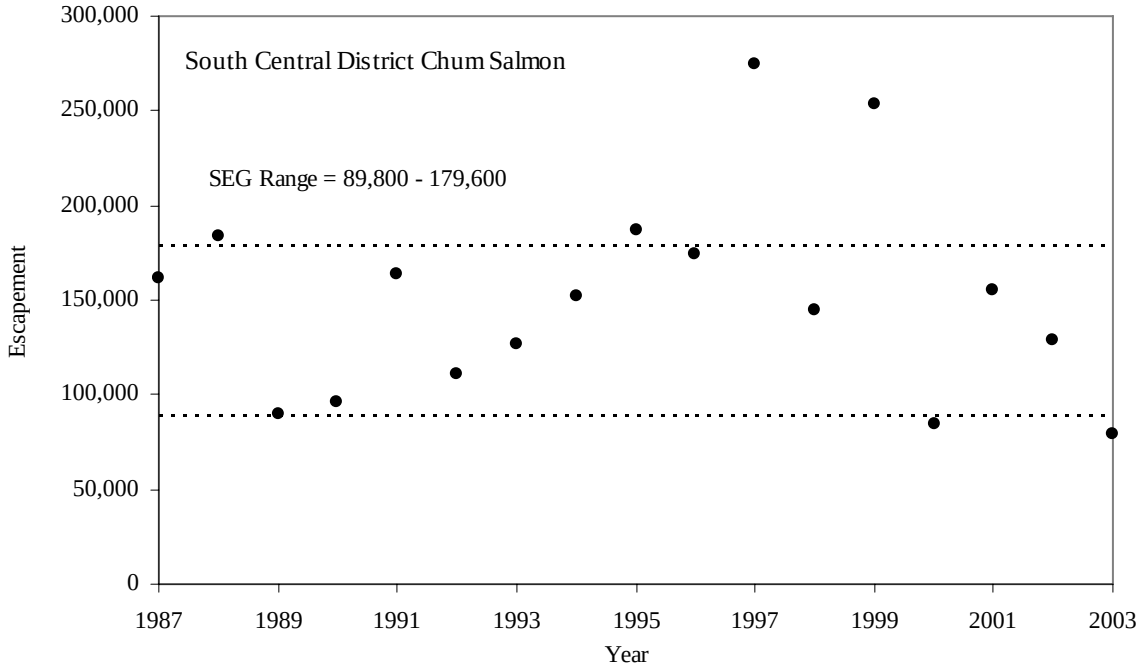
Year	Estimated Total Escapement Index
1987	161,900
1988	183,400
1989	89,530
1990	96,280
1991	163,990
1992	110,640
1993	126,800
1994	151,900
1995	187,100
1996	173,800
1997	274,400
1998	144,300
1999	253,500
2000	84,100
2001	155,500
2002	129,400
2003	79,000

-continued-

System: **South Central District**

Species: **chum salmon**

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



Appendix B22.-Escapement goal for Southwestern District chum salmon.

System: Southwestern District

Species: chum 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 (with some area-specific restrictions)
Previous escapement goal:	SEG: 133,400 to 266,800 (1992)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of 23 streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. No stock specific harvest information is available.
Data contrast:	3.3
Methodology:	Percentile
Criteria for SEG:	Low contrast, high exploitation
Percentiles:	15^{th} to maximum estimate
Comments:	No changes were recommended to this goal due to the lack of quality data and the fact that current escapement levels have produced sufficient escapements and harvestable surpluses.

-continued-

System: **Southwestern District**

Species: **chum salmon**

Data available for analysis of escapement goals.

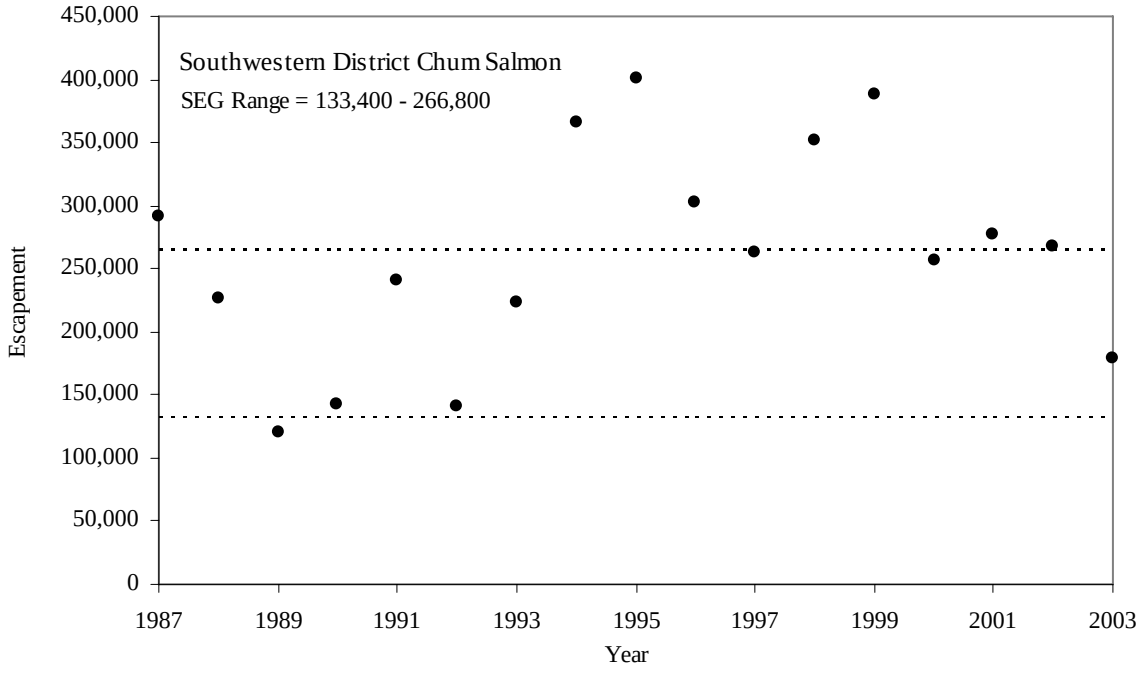
Year	Estimated Total Escapement Index
1987	291,100
1988	226,200
1989	120,830
1990	142,770
1991	241,600
1992	141,000
1993	224,080
1994	365,900
1995	401,150
1996	302,100
1997	263,700
1998	351,410
1999	388,130
2000	257,225
2001	277,021
2002	268,000
2003	178,530

-continued-

System: **Southwestern District**

Species: **chum salmon**

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



Appendix B23.-Escapement goal for Unimak District chum salmon.

System: **Unimak District**

Species: **chum salmon**

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine and set and drift gillnet
Previous escapement goal:	SEG: 800 to 1,600 (1992)
Recommended escapement goal:	No change
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1960 – present. Since 1987, a total of three streams are used as an index for district-wide escapement. Total estimated escapement for individual streams was calculated assuming a 21-day stream life of all fish within a stream, plus all fish observed in saltwater near the mouth during the last survey of the season.
Data summary:	
Data quality:	Fair
Data type:	Fixed-wing aerial surveys from most years during 1960 to present. Indexed total escapement 1987-present. No stock specific harvest information is available.
Data contrast:	16.5
Methodology:	Percentile
Criteria for SEG:	High contrast, high exploitation
Percentiles:	25^{th} to 75^{th}
Comments:	No changes were recommended to this goal due to the lack of quality data and the fact that current escapement levels have produced sufficient escapements and harvestable surpluses.

-continued-

System: **Unimak District**

Species: **chum salmon**

Data available for analysis of escapement goals.

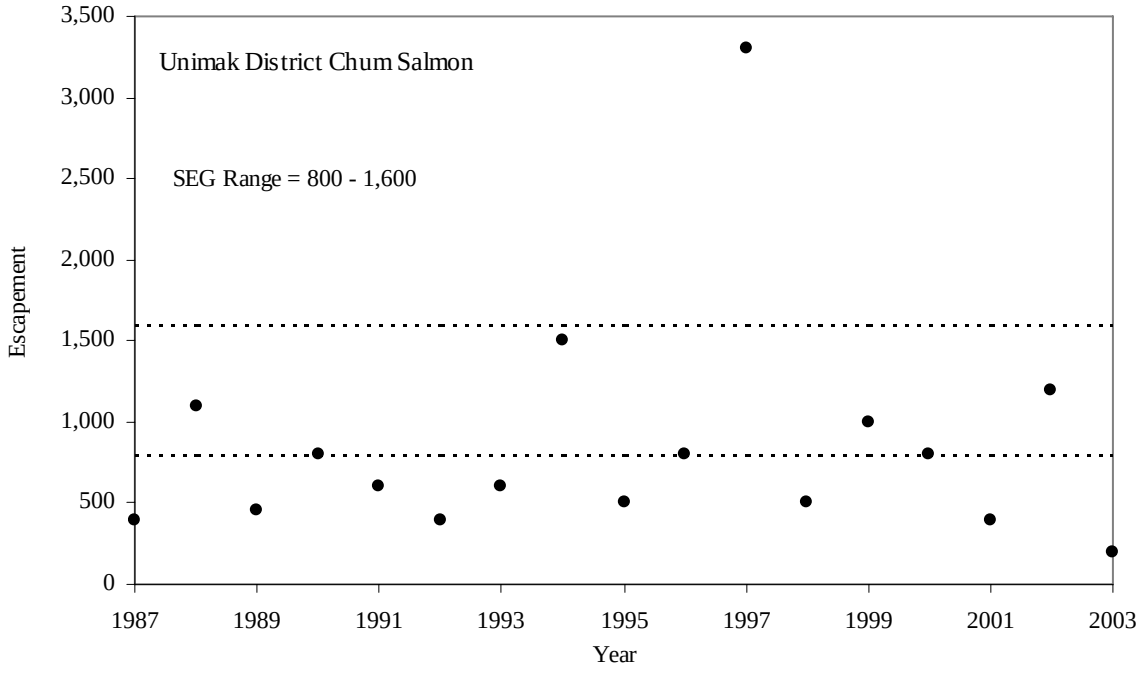
Year	Estimated Total Escapement Index
1987	400
1988	1,100
1989	450
1990	800
1991	600
1992	400
1993	600
1994	1,500
1995	500
1996	800
1997	3,300
1998	500
1999	1,000
2000	800
2001	400
2002	1,200
2003	200

-continued-

System: **Unimak District**

Species: **chum salmon**

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



Appendix B24.-Escapement goal for Thin Point Lake coho salmon.

System: Thin Point Lake

Species: coho salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 3,000 to 6,000 (1993)
Recommended escapement goal:	SEG threshold: 3,000
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968– present.
Data summary:	
Data quality:	Fair for aerial survey counts.
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	280.0
Methodology:	None
Comments:	Lack of late season estimates resulted in recommendation of a threshold rather than a range.

-continued-

System: **Thin Point Lake**

Species: **coho salmon**

Data available for analysis of escapement goals.

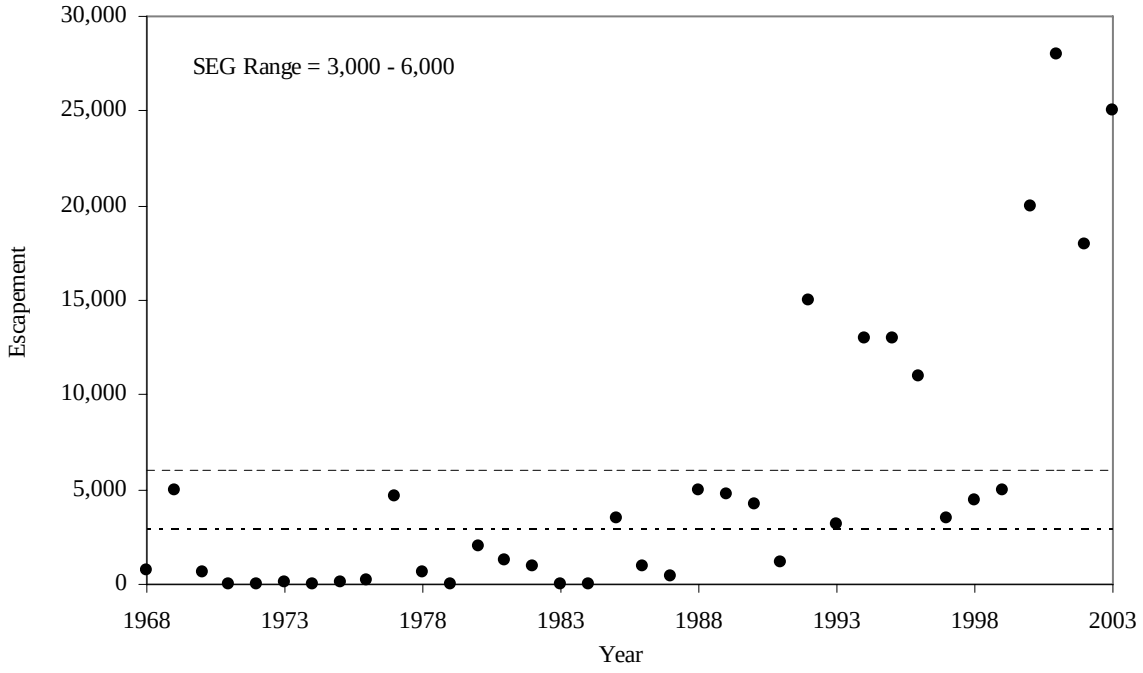
Year	Peak Escapement
1968	700
1969	5,000
1970	600
1971	0
1972	0
1973	100
1974	0
1975	100
1976	200
1977	4,700
1978	600
1979	0
1980	2,000
1981	1,300
1982	900
1983	0
1984	0
1985	3,500
1986	1,000
1987	400
1988	5,000
1989	4,800
1990	4,200
1991	1,200
1992	15,000
1993	3,200
1994	13,000
1995	13,000
1996	11,000
1997	3,500
1998	4,400
1999	5,000
2000	20,000
2001	28,000
2002	18,000
2003	25,000

-continued-

System: **Thin Point Lake**

Species: **coho salmon**

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



Appendix B25.-Escapement goal for Nelson River coho salmon.

System: Nelson River

Species: coho 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
Previous escapement goal:	SEG: 18,000 to 25,000 (early 1980s)
Recommended escapement goal:	SEG threshold: 18,000
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968– present
Data summary:	
Data quality:	Fair for aerial survey counts.
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	31.7
Methodology:	Risk analysis
Comments:	Lack of late season estimates resulted in recommendation of a threshold. The lower end of the current goal was deemed appropriate based on the Risk analysis.

-continued-

System: **Nelson River**

Species: **coho salmon**

Data available for analysis of escapement goals.

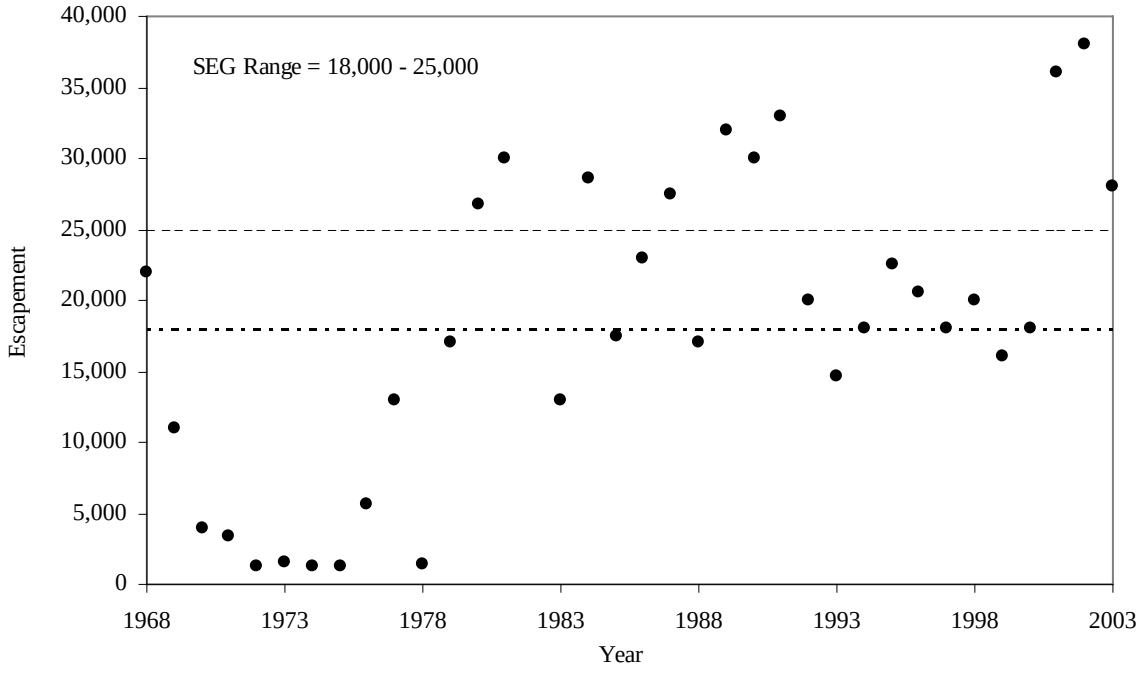
Year	Peak Escapement
1968	22,000
1969	11,000
1970	3,900
1971	3,400
1972	1,210
1973	1,500
1974	1,200
1975	1,200
1976	5,700
1977	13,000
1978	1,425
1979	17,000
1980	26,700
1981	30,000
1982	
1983	13,000
1984	28,630
1985	17,500
1986	23,000
1987	27,500
1988	17,000
1989	32,000
1990	30,000
1991	33,000
1992	20,000
1993	14,600
1994	18,000
1995	22,500
1996	20,500
1997	18,000
1998	20,000
1999	16,000
2000	18,000
2001	36,000
2002	38,000
2003	28,000

-continued-

System: **Nelson River**

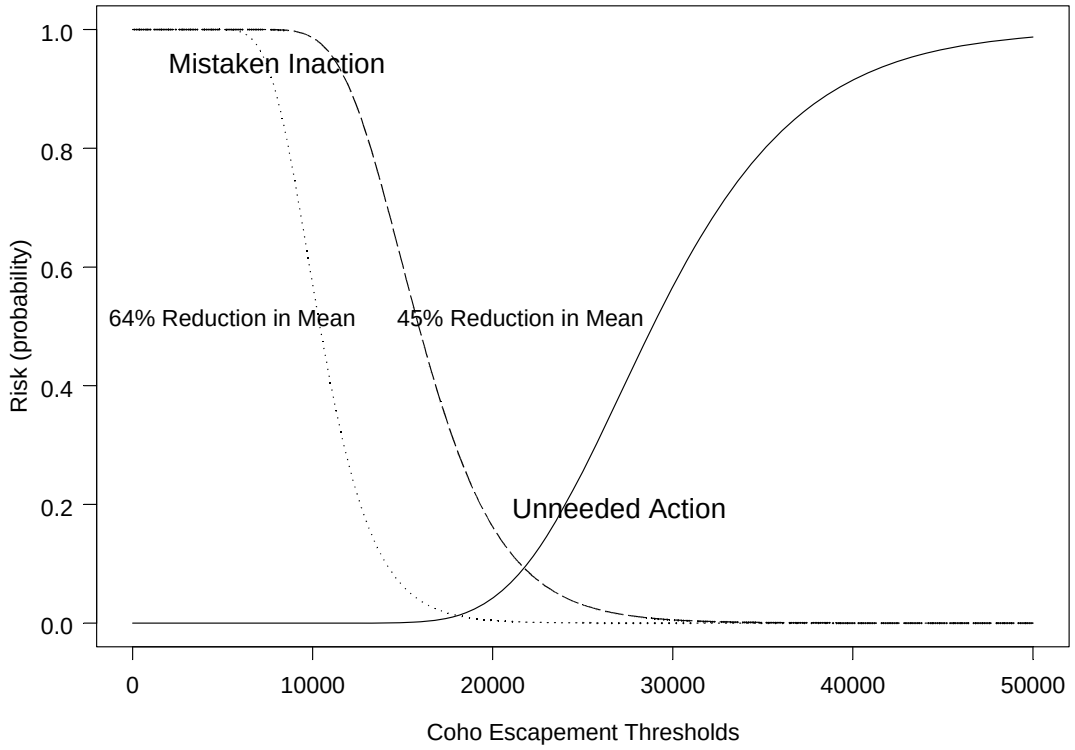
Species: **coho salmon**

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



-continued-

Nelson River coho salmon risk analysis.



Appendix B26.-Escapement goal for Ocean River coho salmon.

System: Ocean River

Species: coho salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 6,000 to 13,000 (1993)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, sporadically from 1968– present
Data summary:	
Data quality:	Poor for aerial survey counts
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	35.0
Methodology:	None
Comments	Recommended for elimination due to lack of a directed fishery and sporadic escapement estimates.

-continued-

System: **Ocean River**

Species: **coho salmon**

Data available for analysis of escapement goals.

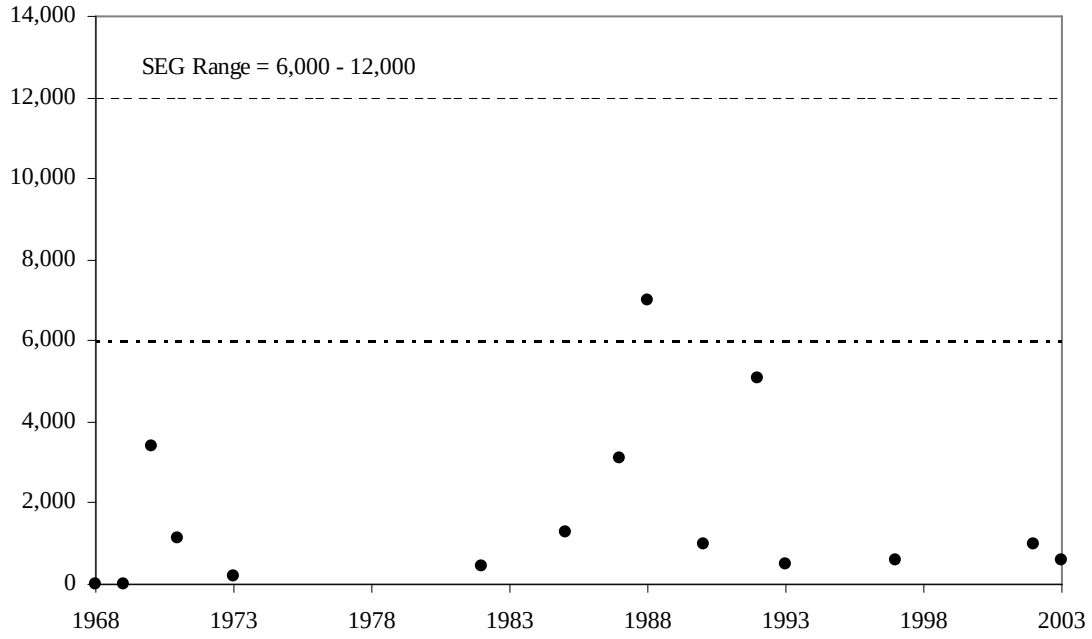
Year	Peak Escapement
1968	0
1969	0
1970	3,400
1971	1,120
1972	
1973	200
1974	
1975	
1976	
1977	
1978	
1979	
1980	
1981	
1982	450
1983	
1984	
1985	1,300
1986	
1987	3,100
1988	7,000
1989	
1990	1,000
1991	
1992	5,100
1993	500
1994	
1995	
1996	
1997	600
1998	
1999	
2000	
2001	
2002	1,000
2003	600

-continued-

System: **Ocean River**

Species: **coho salmon**

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



Appendix B27.-Escapement goal for Ilnik River coho salmon.

System: Ilnik River

Species: coho salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 10,000 to 19,000 (1993)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968– present
Data summary:	
Data quality:	Poor for aerial survey counts
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	90.0
Methodology:	None
Comments:	Recommended for elimination due to lack of a directed fishery and sporadic escapement estimates.

-continued-

System: **Ilnik River**

Species: **coho salmon**

Data available for analysis of escapement goals.

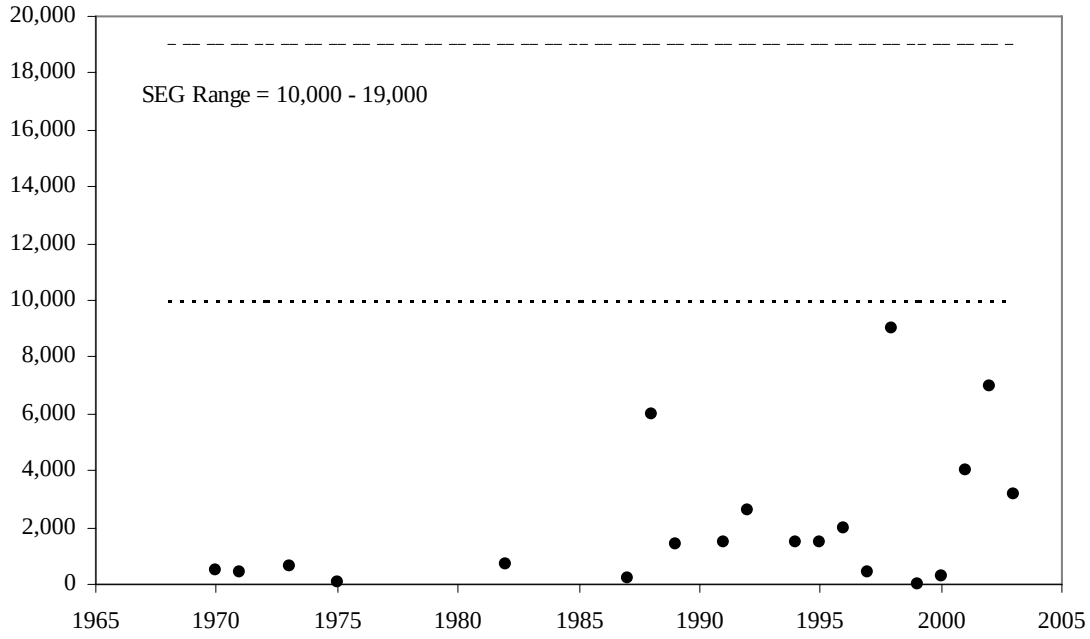
Year	Peak Escapement
1968	0
1969	0
1970	500
1971	410
1972	0
1973	650
1974	0
1975	100
1976	0
1977	0
1978	0
1979	0
1980	0
1981	
1982	725
1983	0
1984	0
1985	0
1986	0
1987	200
1988	6,000
1989	1,400
1990	0
1991	1,500
1992	2,600
1993	0
1994	1,500
1995	1,500
1996	2,000
1997	400
1998	9,000
1999	0
2000	300
2001	4,000
2002	7,000
2003	3,200

-continued-

System: **Ilnik River**

Species: **coho salmon**

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



Appendix B28.-Escapement goal for Meshik River coho salmon.

System: Meshik River

Species: coho salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 16,000 to 32,000 (1993)
Recommended escapement goal:	Eliminate Goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968– present
Data summary:	
Data quality:	Poor for aerial survey counts.
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	6,000.0
Methodology:	None
Comments:	Recommended for elimination due to lack of a directed fishery and sporadic escapement estimates.

-continued-

System: **Meshik River**

Species: **coho salmon**

Data available for analysis of escapement goals.

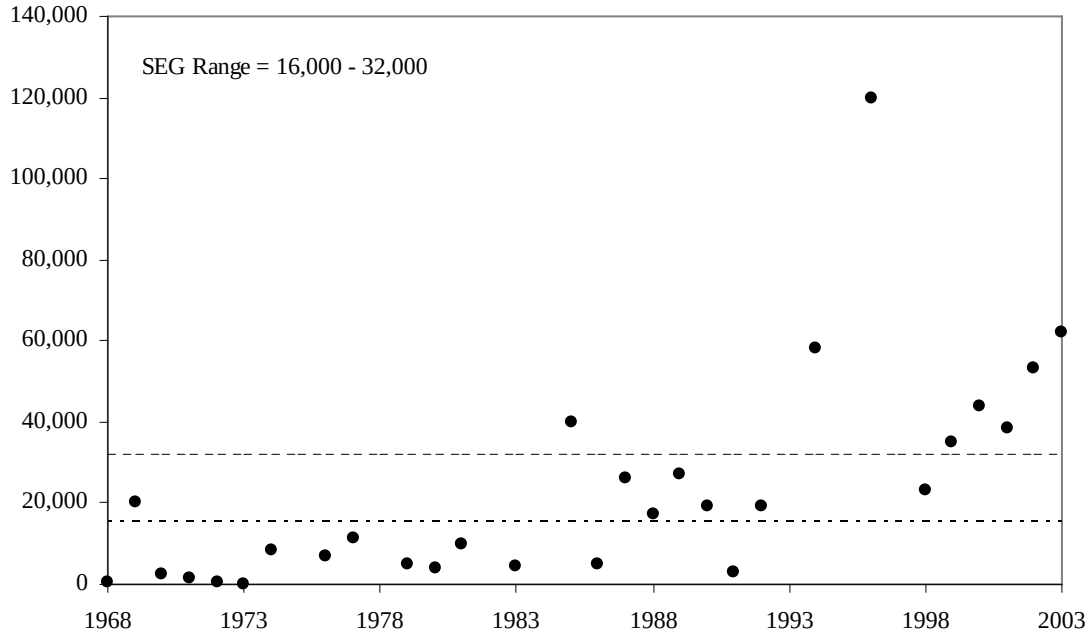
Year	Peak Escapement
1968	500
1969	20,100
1970	2,521
1971	1,435
1972	400
1973	20
1974	8,500
1975	0
1976	7,000
1977	11,200
1978	0
1979	5,000
1980	4,000
1981	10,100
1982	0
1983	4,500
1984	0
1985	39,700
1986	5,000
1987	25,925
1988	17,500
1989	27,000
1990	19,000
1991	3,000
1992	19,330
1993	0
1994	58,000
1995	0
1996	120,000
1997	0
1998	23,050
1999	35,000
2000	44,000
2001	38,500
2002	53,000
2003	62,000

-continued-

System: **Meshik River**

Species: **coho salmon**

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



Appendix B29.-Escapement goal for Mud Creek coho salmon.

System: Mud Creek

Species: coho salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 6,000 to 12,000 (1993)
Recommended escapement goal:	Eliminate goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968– present
Data summary:	
Data quality:	Poor for aerial survey counts.
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	80.0
Methodology:	None
Comments:	Recommended for elimination due to lack of a directed fishery and sporadic escapement estimates.

-continued-

System: **Mud Creek**

Species: **coho salmon**

Data available for analysis of escapement goals.

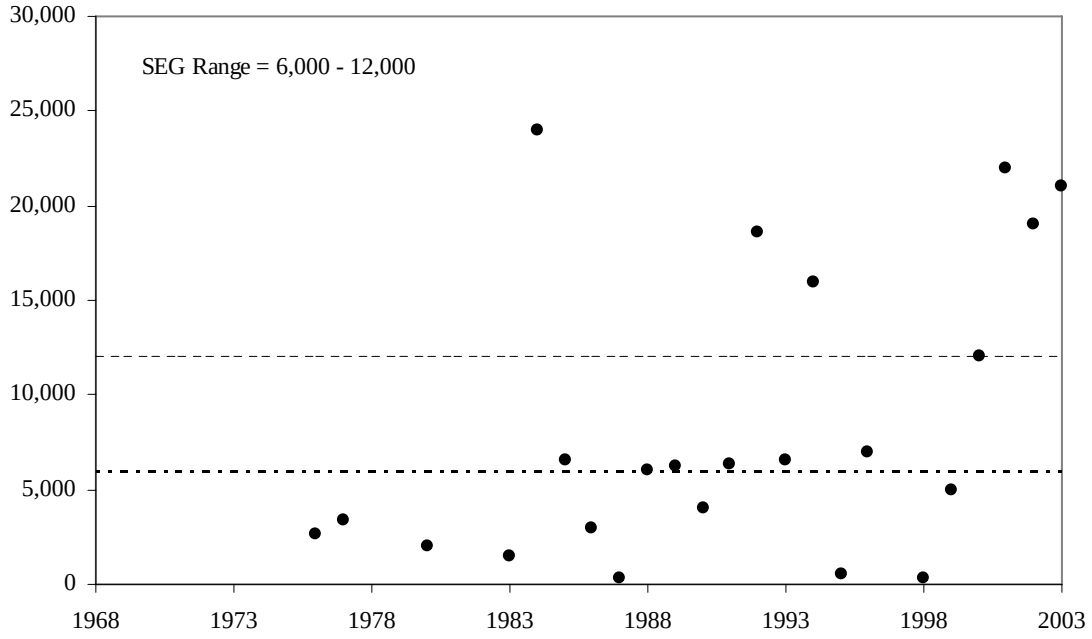
Year	Peak Escapement
1968	
1969	
1970	
1971	
1972	
1973	
1974	
1975	
1976	2,600
1977	3,400
1978	
1979	
1980	2,000
1981	
1982	
1983	1,500
1984	24,000
1985	6,600
1986	3,000
1987	300
1988	6,000
1989	6,200
1990	4,000
1991	6,300
1992	18,600
1993	6,500
1994	16,000
1995	500
1996	7,000
1997	
1998	300
1999	5,000
2000	12,000
2001	22,000
2002	19,000
2003	21,000

-continued-

System: **Mud Creek**

Species: **coho salmon**

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



Appendix B30.-Escapement goal for Cinder River coho salmon.

System: Cinder River

Species: coho salmon

Description of stock and escapement goals.

Regulatory area	Alaska Peninsula Management Area – Westward Region
Management division:	Commercial Fisheries
Primary fishery:	Commercial drift and set gillnet
Previous escapement goal:	SEG: 3,000 to 6,000 (1993)
Recommended escapement goal:	Eliminate Goal
Optimal escapement goal:	none
Inriver goal:	none
Action points:	none
Escapement enumeration:	Aerial survey, 1968– present
Data summary:	
Data quality:	Poor
Data type:	Fixed-wing aerial surveys from most years during 1968 to present. No stock specific harvest information is available.
Data contrast:	11,000.0
Methodology:	None
Comments:	Recommended for elimination due to lack of a directed fishery and sporadic escapement estimates.

-continued-

System: **Cinder River**

Species: **coho salmon**

Data available for analysis of escapement goals.

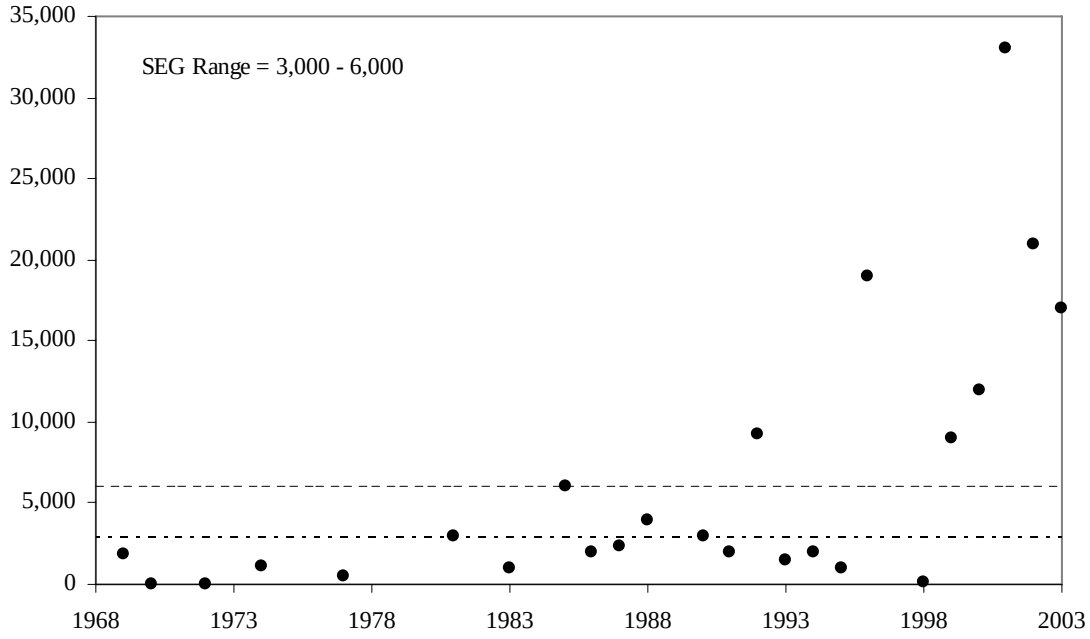
Year	Peak Escapement
1968	0
1969	1,800
1970	3
1971	0
1972	15
1973	0
1974	1,100
1975	0
1976	0
1977	500
1978	0
1979	0
1980	0
1981	3,000
1982	0
1983	1,000
1984	0
1985	6,000
1986	2,000
1987	2,400
1988	3,900
1989	0
1990	3,000
1991	2,000
1992	9,300
1993	1,500
1994	2,000
1995	1,000
1996	19,000
1997	
1998	100
1999	9,000
2000	12,000
2001	33,000
2002	21,000
2003	17,000

-continued-

System: **Cinder River**

Species: **coho salmon**

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



APPENDIX C. ESCAPEMENT DATA USED FOR CHINOOK CLUSTER ANALYSIS

Appendix C1.-Escapement data used for Chinook cluster analysis.

Aerial survey escapement indices for Alaska Peninsula chinook salmon stocks used in correlation analysis.

Year	North Creek	Black Hills Creek	Steelhead Creek	Nelson River	Nelson Weir[a]	David's River	King Salmon River	Bear River	Meshik River	Cinder River
1961	12		12			20				
1962										
1963			20	4,000		75				
1964	500		25	6,700						
1965	600	1,500	1,750	7,200						
1966	300	800	500	1,000		14				
1967	630	500		3,500						
1968	1,300	750	400	2,500		500	1,000			250
1969	40	300	800	4,400		500	400		830	
1970	400	830	600	328		30	138	3	241	137
1971		670	200	300		315	12		140	14
1972	150	450							1,673	767
1973	85	165	320	200			20	50	2,505	600
1974	220	150	10	900	1,092	50	250	250	880	500
1975	155	75	100	400	1,917	400	200	200	892	589
1976	200		150	1,400	3,045	220	250	10	2,033	1,600
1977		200	480		4,844	20			2,590	140
1978	2,000	1,000	700	3,901	3,901		100		5,485	1,000
1979	150	500	500	600	10,463		20			300
1980	250	180	75		4,506	400	100			
1981		300	500		5,046	50	1,200	850	1,000	
1982	450	800	750		6,503		420	200	440	
1983	500	1,300	1,800	12,400	11,589	500	1,225	147	950	1,512
1984	450	1,100	1,400	800	5,412	240	270	75	3,850	300
1985	1,000	1,200	1,000	4,500	2,861	200	85	600	3,400	700
1986	800	1,300	900	4,710	758		500	340	1,965	1,670
1987	1,400	1,400	800	3,200	696	200	45	310	1,535	900
1988	600	1,100	1,600	1,300		400	200	570	195	285
1989	75	400	125	2,500	272	300	300		598	165
1990	300	500	400	1,800	215	400	400	270	475	131
1991		200	130	11,170	551	1,300	200	200	300	640
1992	70	700	100	1,830	490	700	200	400	700	300
1993	300	700	900	5,080		1,000	800	400		
1994	75	800	1,000	3,000	1,372	450		1,200	13,100	10,500
1995	30	400	900	2,000	1,010	70	1,200	1,200	6,001	9,300
1996	1,000	900	1,100	2,880	1,039	150	700	1,300		
1997	600	550	650	6,350	931	200	1,100	1,200	2,250	
1998	400	600	1,000	2,500	2,900	750	700	800		2,050
1999		550	750	1,500	2,431	400	500	1,300	700	2,300
2000	300	500	900	300	3,654	500	650	350	1,120	700
2001		550	950	1,730	5,543	950	600	400	900	1,690
2002	400	700	1,200	3,020	4,349	750	800	900	3,570	2,259
2003		600	1,600	2,000	3,253	1,000	400	600	1,200	550

[a] Final count at tower during 1974-1987 and at a weir during 1989-2003.