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Review of Salmon Escapement Goals in the Chignik Management Area, 2018

by

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February 2019

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)

Mathematics, statistics

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

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ABSTRACT

In February 2018, an interdivisional team of staff from the Alaska Department of Fish and Game reviewed existing Pacific salmon *Oncorhynchus* spp. escapement goals in the Chignik Management Area (CMA). The 6 CMA salmon escapement goals were last reviewed in 2015. In 2018, the team reviewed recent data to determine whether substantial new information existed to warrant analyzing and updating the goals. The team determined Chignik Chinook salmon warranted further review. No goal revisions were recommended by the review team. No goals were eliminated and none were added for systems currently without escapement goals.

Key words: Pacific salmon, *Oncorhynchus*, escapement goal, Chignik, Chignik Management Area, Chignik Lake, Black Lake, stock status

INTRODUCTION

This report documents the 2018 review of salmon escapement goals in the Chignik Management Area (CMA) based on the Alaska Board of Fisheries' (BOF) *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223). Recommendations from this review are made to the directors of the divisions of Commercial Fisheries and Sport Fish of the Alaska Department of Fish and Game (ADF&G), and are intended to take effect for salmon stocks returning in 2019. Salmon escapement goals in the CMA were last reviewed in 2015 (Schaberg et al. 2015).

Three important terms defined in the *Policy for the Management of Sustainable Salmon Fisheries* are listed below:

- *biological escapement goal* (BEG): the escapement that provides the greatest potential for maximum sustained yield (MSY);
- *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 or managed for; and
- *inriver run goal* (IRRG): a specific management objective for salmon stocks that are subject to harvest upstream of the point where escapement is estimated; the inriver run goal will be set in regulation by the BOF and is comprised of the SEG, BEG, or optimal escapement goal, plus specific allocations to inriver fisheries.

Since the inception of the *Policy for Statewide Salmon Escapement Goals* in 2001, escapement goals for the CMA have been reviewed 5 times (Witteveen et al. 2005, Witteveen et al. 2007, Nemeth et al. 2010, Sagalkin et al. 2013, Schaberg et al. 2015). These reviews correspond with area BOF meetings, which have historically been on a 3-year cycle; however, the CMA cycle was altered in 2014 and the review in 2015 only reflected 2 additional years of data (2013–2014). This review will incorporate the recent 3 years of escapement data, restoring the 3-year cycle.

In February 2018, the Salmon Escapement Goal Interdivisional Review Team (hereafter referred to as the team) was formed to review the existing CMA salmon escapement goals and recent escapements for stocks without escapement goals. The team included staff from the Division of Commercial Fisheries (CF) and the Division of Sport Fish (SF): Kevin Schaberg (CF), Tim McKinley (SF), Nicholas Sagalkin (CF), Heather Finkle (CF), M. Birch Foster (CF), Michelle Wattum (CF), Jeff Wadle (CF), Dawn Wilburn (CF), Ross Renick (CF), Bob Murphy (CF), Lisa Fox (CF), Cassandra Whiteside (CF), Lucas Stumpf (CF), Bill Templin (CF), Andrew Munro (CF), Jim Hasbrouck (SF), Tom Vania (SF), Dan Bosch (SF), Mark Witteveen (SF), Adam St. Saviour (SF), David Evans (SF), and Tyler Polum (SF).

For this review, the team 1) reviewed recent escapements to all stocks with escapement goals; 2) determined the appropriate goal type (BEG or SEG) for each CMA salmon stock with an existing goal, based on the quality and quantity of available data; 3) determined the most appropriate methods to evaluate the escapement goal ranges; 4) estimated the escapement goal for each stock and compared these estimates with the current goal; 5) determined if a goal could be developed for any stocks or stock-aggregates that currently have no goal; and 6) developed recommendations for each goal evaluated to present to the directors of the divisions of Commercial Fisheries and Sport Fish for approval.

MANAGEMENT AREA

The CMA comprises all coastal waters and inland drainages on the south side of the Alaska Peninsula, bounded by a line extending 135° southeast for 3 miles from a point near Kilokak Rocks (57°10.34′ N lat, 156°20.22′ W long) then due south to a line extending 135° southeast for 3 miles from Kupreanof Point at 55°33.98′ N lat, 159°35.88′ W long (Figure 1). The area is divided into 5 commercial fishing districts: Eastern, Central, Chignik Bay, Western, and Perryville districts. These districts are further divided into 14 sections and 38 statistical reporting areas.

The Chignik River is the major watershed in the CMA and consists of 2 interconnecting lakes (Black and Chignik lakes) with a single outlet river (the Chignik River) that empties into the estuary of Chignik Lagoon (Figure 2). All 5 species of Pacific salmon *Oncorhynchus* spp. return to the Chignik River; sockeye salmon *O. nerka* returns consist of an early run and a late run, and Chinook salmon *O. tshawytscha* are only monitored in the river. Pink *O. gorbuscha*, chum *O. keta*, and coho *O. kisutch* salmon also return to other streams throughout the CMA.

BACKGROUND

One Chinook salmon stock in the CMA has an established BEG and is located in the Chignik River. This goal was reviewed in 2013 and was left unchanged. Chinook salmon escapement is enumerated through the Chignik River weir. Recent reductions in age samples of the escapement have likely affected the overall age composition estimate. Harvest occurs during directed sport and subsistence fisheries and incidentally in commercial fisheries targeting sockeye, pink, and chum salmon.

Two sockeye salmon stocks in the CMA have established escapement goals. Both of these stocks return to the Chignik River watershed (Figure 2). The majority of the early run (Black Lake stock) enters the watershed from June to July and spawns in Black Lake and its tributaries (Pappas et al. 2003). The majority of the late run (Chignik Lake stock) enters the watershed in July and August, and typically spawns in Chignik Lake tributaries and Chignik Lake shoal areas (Pappas et al. 2003). Although the peak periods of passage for each stock are usually a month apart, there is a period of overlap when both stocks are entering the watershed.

Sockeye salmon bound for Black and Chignik lakes are harvested primarily in the commercial and subsistence fisheries. Escapement of both stocks is enumerated through the use of a weir outfitted with a video camera system as they transit Chignik River. In order to achieve escapement goals for the early and late runs simultaneously, inseason estimates of the numbers of each stock in the daily escapement are required. These estimates have been determined using various methods over time. Prior to 1980, time-of-entry relationships based on tagging studies and age groups were employed to divide the catch and escapement between the 2 runs (Dahlberg

1968). From 1980 to 2003, with the exception of 1982, stock separation was accomplished using scale pattern analysis (Witteveen and Botz 2004). Beginning in 2004, an estimate of the early-run escapement was based on weir counts through July 4. After July 4, the fish that passed upstream through the weir were assumed to be late-run fish.[1] This method was determined not to be significantly different ($P > 0.05$) than the scale pattern analysis method in estimating recruitment. Beginning in 2014, genetics were used to separate the early- and late-run stocks. In comparison to the transition date of July 4, logistic run timing during the overlap period suggest that utilizing inseason genetic information results in more biologically sound escapement-based management (Anderson et al. 2013; Foster 2013). During 2014 through 2017 the inseason use of genetics to estimate early- and late-run stock proportions demonstrated the variable timing of entry into Chignik River and presented the department with the challenge of applying these proportions for management purposes. The genetic based inseason estimates did not provide effective inseason adaptive management tools because of the time sensitive nature of fisheries management and the lag time of genetics results. In 2018, the central tendency of the genetic based logistic model was used to apportion escapement between the two runs inseason; however, genetic samples collected at the weir were used to inform postseason run reconstruction.[2]

Due to the late run timing of coho salmon returns to the CMA, there are no established coho salmon escapement goals. The vast majority of coho salmon escapement occurs after the Chignik River weir is pulled for the season and inclement fall weather precludes reliable aerial surveys for estimating escapement.

Pink salmon in the CMA are managed to achieve escapement goals based on the aggregates of index streams (Table 1; Figure 1). Separate areawide BEGs were established for odd and even years during the 2004 review (Witteveen et al. 2005) and amended to SEGs during the 2007 review (Witteveen et al. 2007). These aggregate goals were revised in 2015, and comprise the respective sums of aerial survey escapement estimates for 8 individual index streams (Schaberg et al. 2015).

Chum salmon in the CMA are managed to achieve an escapement goal based on aggregates of index streams, similar to pink salmon (Table 1; Figure 1). This aggregate SEG was revised in 2015, and comprises the respective sums of aerial survey escapement estimates for 6 individual index streams (Schaberg et al. 2015).

METHODS

During the review process, one Chinook, two sockeye, one chum, and two pink salmon escapement goals were evaluated (Table 1). We conducted our review similarly to the 2015 review (Schaberg et al. 2015), primarily examining recent (2015–2017) data and updating previous analyses. A formal meeting, via teleconference, to discuss and develop recommendations was held on February 1, 2018. The team also communicated on a regular basis by telephone and email.

Available escapement, harvest, and age data associated with each stock or combination of stocks to be examined were compiled from research reports, management reports, and unpublished

[1] Witteveen, M. J. Chignik River inseason run apportionment. Alaska Department of Fish and Game, Kodiak memorandum addressed to Denby S. Lloyd, dated May 28, 2004, unpublished memorandum.

[2] Foster, M. B. and Wilburn, D. M. Chignik inseason management 2018. Alaska Department of Fish and Game, Kodiak memorandum addressed to Nick Sagalkin, dated April 20, 2018, unpublished memorandum.

historical databases. Limnological and spawning habitat data were compiled for each system when available. The team evaluated the type, quality, and amount of data for each stock according to criteria described in Clark et al. (2014; Table 2). This evaluation was used to assist in determining the appropriate type of escapement goal to apply to each stock, as defined in the *Policy for the Management of Sustainable Salmon Fisheries* and the *Policy for Statewide Salmon Escapement Goals*.

ESCAPEMENT GOAL DETERMINATION

Biological Escapement Goal

In Alaska, most salmon BEGs are developed using Ricker (1954) spawner-recruit models (Munro 2018). BEG ranges, as defined in the *Policy for the management of sustainable fisheries*, are estimates of the number of spawners that provide the greatest potential for maximum sustained yield, abbreviated as S_{MSY}. Only the Chignik River sockeye and Chinook salmon stocks have data sufficient for this type of analysis, and of these stocks, only the Chinook salmon stock was identified for further review this cycle.

Sustainable Escapement Goal

Sustainable escapement goals (SEGs) for Area M salmon stocks were determined using the "4-tier Percentile Approach" of Bue and Hasbrouck (Unpublished) for goals implemented prior to 2014 and the Clark et al. (2014) "3-tier Percentile Approach" for goals reevaluated and implemented after 2014. The 3-tier Percentile Approach is based on the principle that escapements of a stock within some range of percentiles observed over the time series of escapements and associated harvest from fishing represents a proxy for maintaining escapements within a range that encompasses S_{MSY} (Clark et al. 2014).

The 3-tier Percentile Approach takes into account the measurement error of the data collection method (i.e., weirs and towers have lower measurement error than aerial or foot surveys), contrast of the escapement data (i.e., the ratio of highest observed escapement to the lowest observed escapement), and the average harvest rate of the stock. Based on these criteria Clark et al. (2014) recommended the following tiers to set an SEG range.

Tier	Escapement contrast	Measurement error	Harvest rate	SEG range
1	>8	High (aerial and foot surveys)	Low to moderate (<.40)	20th to 60th Percentile
2	>8	Low (weirs and towers)	Low to moderate (<.40)	15th to 65th Percentile
3	4-8	-	Low to moderate (<.40)	5th to 65th Percentile

CHINOOK SALMON

Escapement Goal Background and Previous Review

The Chignik River has the only Chinook salmon escapement goal established in the CMA (Table 1; Appendix A1). Chinook salmon escapement to the Chignik River is estimated using a weir outfitted with a video camera (Anderson et al. 2013). The escapement goal was first established in 1992 (1,750 to 3,000 fish; Nelson and Lloyd 2001) and changed to a BEG (1,450

to 2,700 fish) using a spawner-recruit model in 1994 (Nelson and Lloyd 2001). The BEG was changed to an SEG for 1 year in 2001 (Nelson and Lloyd 2001), then revised back to a BEG of 1,300 to 2,700 fish in 2002 (Witteveen et al. 2005). Since 2002 the goal has remained unchanged (Appendix A1: Witteveen et al. 2005; Witteveen et al. 2007; Nemeth et al. 2010; Sagalkin et al. 2013; Schaberg et al. 2015).

Stock Status

Since the establishment of the current BEG of 1,300 to 2,700 fish in 2002, escapements of Chignik River Chinook salmon have been within or above the escapement goal range in all years except 2013 and 2017 (Appendices A2 and A4).

2018 Review

With 14 more years of spawner-recruit data since the last analysis (Appendix A3), an updated analysis and review of the Chignik River Chinook salmon run was warranted. Total run was estimated from weir estimates (1978–2017), commercial harvests from Chignik Lagoon (1978–2017; statistical area 271-10) were obtained from fish tickets, subsistence harvests (1978–2017) were obtained from returned permits, and sport harvest above and below the weir (2005–2016) were obtained from guide log books. Sport harvest prior to 2005 was modelled as a function of average exploitation rate during 2005–2016 and total run. Age composition data (1993–2001 and 2013–2017) were obtained primarily by sampling the fish, but the commercial and sport fisheries were also sampled in some years. These data were assumed to represent the age composition of the run in each calendar year. Escapement, harvest, and age data were combined to reconstruct the Chignik River Chinook salmon run and create a brood table.

A Bayesian age-structured state-space model was fitted to the Chignik River Chinook salmon total run, escapement, and age composition data. The model used the methods described in Fleischman et al. (2013) and was set up with a Ricker spawner-recruit relationship, autoregressive lag-1 productivity and a Dirichlet age-at-maturity schedule. A trending age-at-maturity schedule component (A. Reimer, Sport Fish Biometrician ADF&G, personal communication) was also examined but had little influence on results and was not considered further.

The model was fitted in R (R Core Team, 2017) using multi-chain Monte Carlo (MCMC) techniques in the package rjags (Plummer 2016). MCMC samples were drawn from the joint posterior probability distribution of all unknowns in the model. For each of 2 Markov chains initialized, a 300,000-sample burn-in was discarded, after which each chain ran for an additional 100,000 iterations. After thinning by a factor of 10, a total of 20,000 samples were used to estimate the marginal posterior statistics. Gelman-Rubin convergence diagnostics (Brooks and Gelman 1998) along with visual inspections of trace plots of the various posterior statistics were used to assess convergence of the chains.

Medians of important spawner recruit statistics (e.g., S_{msy}, S_{max}, S_{eq}, Ricker alpha and beta parameters) were estimated. Credibility interval estimates were obtained for each reported statistic from the percentiles of the posterior distribution. Sustainable yield curves (Fleischman et al. 2013) and the fitted Ricker model were also plotted.

SOCKEYE SALMON

Escapement Goal Background and Previous Review

Chignik River sockeye salmon are the only sockeye salmon stocks in the CMA with escapement goals (Table 1). Sockeye salmon also return to several smaller stream systems in the CMA, but due to small run sizes and limited effort, escapement goals for these streams have not been established (Witteveen et. al. 2007). Although the peak periods of passage for Chignik River early- and late-run stocks are usually 1 month apart, the 2 runs overlap in late June and July (Templin et al. 1999). Escapement estimates for both runs are based on weir estimates with the addition of post-weir estimates for the late run that were modeled after the weir was removed in early September (Anderson et al. 2013).

Escapement goals for Chignik River sockeye salmon were originally established in 1968, and set at 350,000 to 400,000 fish for the early run and 200,000 to 250,000 fish for the late run (Dahlberg 1968). In 1998, the BOF established a September 1–15 management objective of 25,000 fish, supplemental to the lower bound of the late-run goal, to accommodate subsistence fishers upstream of the Chignik weir. In 2004, the numerical ranges of the goals were left in place, but the goals were reclassified as SEGs because scientifically-defensible estimates of S_{MSY} were not possible. Also in 2004, the BOF established an August management objective of 25,000 fish (in addition to the existing September management objective) to further provide subsistence opportunities upstream of the weir. In 2007, the late-run SEG was changed to 200,000 to 400,000 fish, and the two 25,000-fish management objectives were reclassified as inriver run goals (IRRG; Witteveen et al. 2007). Actual timing of adoption of the inriver goal is unclear from other documents as it was initially just a management objective that was expanded over 2 cycles (1989 and 2004), but was adopted as a formal inriver goal in 2007. In 2013 the early-run goal was changed from an SEG to a BEG and the range was increased to 350,000 to 450,000 fish and the IRRG was officially put into regulation (Sagalkin et al. 2013). In 2015 no changes were made to the Chignik sockeye salmon escapement goals (Schaberg et al. 2015); however, the BOF increased the inriver goal by 25,000 fish in September. The inriver run goals are currently 25,000 fish in August and 50,000 fish in September, for a total of 75,000 fish above lower bound of the late-run SEG.

Stock Status

The current Chignik River early-run escapement goal range (350,000 to 450,000) was established in 2013 and classified as a BEG. In the last 10 years, early-run escapements have been within or above (4 times) the goal every year. The late-run escapements have met the current SEG range (200,000 to 400,000), or have been above (1 time) the goal every year since implementation in 2008 (Appendix B). The IRRGs have not been met every year due to the time specific requirements, and lack of weir operation throughout the time IRRGs are in effect. The August component has been achieved in 10 of the last 12 years (not in 2011 or 2014) and the September IRRG has not been met since the escapement goal was updated in 2016 and was only achieved in 3 of the 9 years from 2007–2015 when it was from September 1-15.

2018 Review

Escapements in 2015–2017 exceeded or were within the range of the early-run BEG and the late-run SEG (Table 1; Appendices B2–B4). There was no compelling new information since the last review, and the team agreed that no further analysis was necessary in 2018.

PINK SALMON

Escapement Goal Background and Previous Review

Pink salmon escapement goals in the CMA were originally established in 1999, with separate goals for each of the five commercial salmon fishing districts (Figure 1, Witteveen et al. 2005). Annual escapement estimates are based on aerial surveys of fish in as many as 49 streams throughout the area. Escapements from 1984 to 2004 were estimated using area-under-the-curve methodology assuming a 15-day stream life (Johnson and Barrett 1988) and were referred to as estimated total escapement. During the 2004 escapement goal review, an investigation of the peak escapement counts versus the estimated total escapement revealed several inconsistencies in the database. Because the calculation inconsistencies resulted in unreliable estimates, the review in 2004 used peak escapement counts (Witteveen et al. 2005). Subsequently, fisheries management has relied on peak escapement counts to measure achievement of escapement goals, and all escapement goal reviews since 2004 have also used peak escapement counts.

Also in 2004, the goals for individual districts were removed and replaced with a single aggregate goal for the entire CMA developed using a stock-recruit analysis of peak aerial surveys for 49 streams throughout the 5 commercial fishing districts (Table 1; Figure 1). This aggregate goal was established as a BEG, with separate goal ranges for odd- and even-year returns of pink salmon (Witteveen et al. 2005). In 2007, the goals were reanalyzed using the yield analysis methods of Hilborn and Walters (1992). Due to lack of precision in aerial survey data, the goals were increased and reclassified as SEGs of 200,000 to 600,000 fish during even years and 500,000 to 800,000 fish for odd years (Witteveen et al. 2007). In the 2012 review, the team determined that the additional stock assessment data would not substantially affect the results of the previous escapement goal analyses. Thus there was consensus to not reevaluate the goals in 2012, and there was no change to the even- and odd-year Chignik pink salmon SEGs (Witteveen et al. 2009; Sagalkin et al. 2013). During the 2015 review, a restrictive set of criteria were applied to the peak aerial survey counts to allow for more consistency in the aggregate index based escapement goals. This resulted in a reduction of index streams from 49 to 8 (Schaberg et al. 2015). This also resulted in a reduction to the number of fish incorporated in the new indices, to which the 3-tier Percentile Approach (Clark et al. 2014) was applied. The aggregate pink salmon SEG for odd years (260,000 to 450,000 fish), and for even years (170,000 to 280,000 fish) were adopted starting in the 2016 season (Appendix C1; Schaberg et al. 2015).

Stock Status

Even-year pink salmon escapements from 1980–2004 were consistently high, averaging around 315,000 pink salmon annually. Even-year pink salmon aggregate escapements were within or exceeded the escapement goal range following the inception of the escapement goal in 2008 (Schaberg et al. 2015), although recent years of even-year returns have been among the lowest since 1980. The adoption of the revised SEG in 2016 has only been evaluated with one even year, and the 2016 escapement did not achieve the SEG (Table 1; Appendices C2 and C3).

Odd-year pink salmon escapement estimates were low in the early 1980s, with larger escapement observed beginning in 1989. Odd-year pink salmon escapement estimates were especially high between 1995 and 2007, averaging over 1 million pink salmon each year. With the inception of the SEG in 2008, odd-year escapement was above the upper bound of the current escapement goal range (Schaberg et al. 2015). The revised odd-year SEG, adopted in 2016, was exceeded in 2017 (Table 1; Appendices C2 and C3).

2018 Review

Stock-specific harvest estimates for Chignik pink salmon are not available. In 2018, recent escapement data (Appendices C2–C3) were examined to determine if a change in the escapement goal was justified. The team determined that this stock did not warrant further review.

CHUM SALMON

Escapement Goal Background and Previous Review

Chum salmon escapement goals in the CMA were originally established in 1999, with separate goals for each of the 5 commercial salmon fishing districts (Nelson and Lloyd 2001). Escapements from 1984 to 2004 were estimated using area-under-the-curve methodology assuming a 15-day stream life (Johnson and Barrett 1988) and were referred to as estimated total escapement. During the 2004 escapement goal review, an investigation of the peak escapement counts versus the estimated total escapement revealed several inconsistencies in the database. Because the calculation inconsistencies resulted in unreliable estimates, the review in 2004 used peak escapement counts (Witteveen et al. 2005). Subsequently, fisheries management has relied on peak escapement counts to measure achievement of escapement goals, and all escapement goal reviews since 2004 have also used peak escapement counts.

Chum salmon escapement goals were revised in 2004 to represent an aggregate goal for the entire CMA. This goal was developed using results of aerial surveys for 49 streams throughout the 5 commercial fishing districts (Figure 1). This single aggregate goal in 2004 was developed using the 4-tier Percentile Approach and risk analysis and was reclassified as a lower bound SEG (Witteveen et al. 2005). In 2007, the aggregate lower bound SEG was reanalyzed using a risk analysis (Bernard et al. 2009) and raised to 57,400 fish (Witteveen et al. 2007). In 2010 and 2013, the most recent escapements were reviewed and no change was recommended to the goal. During the 2015 review, a restrictive set of criteria were applied to the peak aerial survey counts to allow for more consistency in the aggregate index based escapement goals. This resulted in a reduction of index streams from 49 to 6 (Schaberg et al. 2015). This also resulted in a reduction to the number of fish incorporated in the new indices to which the 3-tier Percentile Approach (Clark et al. 2014) was applied. The aggregate chum salmon SEG range (45,000 to 110,000 fish) was adopted starting in the 2016 season (Table 1; Appendix D1; Schaberg et al. 2015).

Stock Status

Chum salmon aggregate escapements were above the lower-bound SEG from 2008-2015. With the revised SEG from 2016 and subsequent reduction in the number of streams included in the index, the chum salmon escapement in the CMA was within the SEG range in 2016 and 2017 (Table 1; Appendix D).

2018 Review

Stock-specific harvest estimates for Chignik chum salmon were not available. Recent escapement data (Appendices D2–D4) were examined to determine if a change in the escapement goal was justified. The team determined that this stock did not warrant further review.

RESULTS

CHINOOK SALMON

Escapement Goal Recommendation

The median of the posterior distribution of estimates of S_{MSY} for Chignik River Chinook salmon is 1,993 (95% credibility interval of 1,373 to 4,146 fish; Appendix A5). A return vs. spawner plot, along with the fitted model and credibility intervals, is presented in Appendix A6. The analysis suggests there is substantial positive autocorrelation ($\phi = 0.6$; Appendix A5). No major problems were encountered in assessment of convergence of the MCMC chains. The yield curves (Appendix A7) provide no compelling evidence to change the current goal of 1,300–2,700.

SUMMARY OF RECOMMENDATIONS

The team concluded that the 3 additional years of data since the 2015 review would not affect the existing escapement goals for the Chignik River early- and late-run sockeye, or chum and pink salmon stocks. There are no coho salmon escapement goals in the CMA because harvests are generally incidental to the sockeye salmon fishery and because the late run timing of coho salmon prevents reliable estimates of escapement. The team elected to further analyze the Chinook salmon escapement goal.

The final recommendation of the 2018 review team was to maintain the CMA Chinook salmon BEG of 1,300 to 2,700 fish.

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TABLES AND FIGURES

Table 1.–Escapements, escapement goals, and 2018 recommendations for salmon stocks in the Chignik Management Area (CMA).

Species	System	Data type [a]	Current escapement goal		Escapements			Escapement goal recommendation for 2018
			Type	Range	2015	2016	2017	
Chinook salmon	Chignik River	WC	BEG	1,300–2,700	1,958[b]	1,743[b]	1,137	No change
Sockeye salmon	Chignik River							
	Early run	WC	BEG	350,000–450,000	534,088	418,290	453,257	No change
	Late run	WC	SEG	200,000–400,000[c]	589,810	348,023	339,303	No change
Pink salmon								No change
	CMA aggregate – odd years	PAS	SEG	260,000–450,000	404,000		586,000	No change
	CMA aggregate – even years	PAS	SEG	170,000–280,000		68,100		No change
Chum salmon	CMA aggregate	PAS	SEG	45,000–110,000	123,400	69,900	96,900	No change

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

[b] This escapement reflects the weir count, discounting sport harvest above the weir.

[c] This lower bound does not include the inriver run goal of 75,000 fish.

Table 2.–General criteria used to assess quality of data in estimating CMA 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 with harvest apportioned to stock of origin); 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; harvest estimated by Statewide Harvest Survey or fish tickets); 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 only a fairly reliable measure of escapement; no harvest and age data.

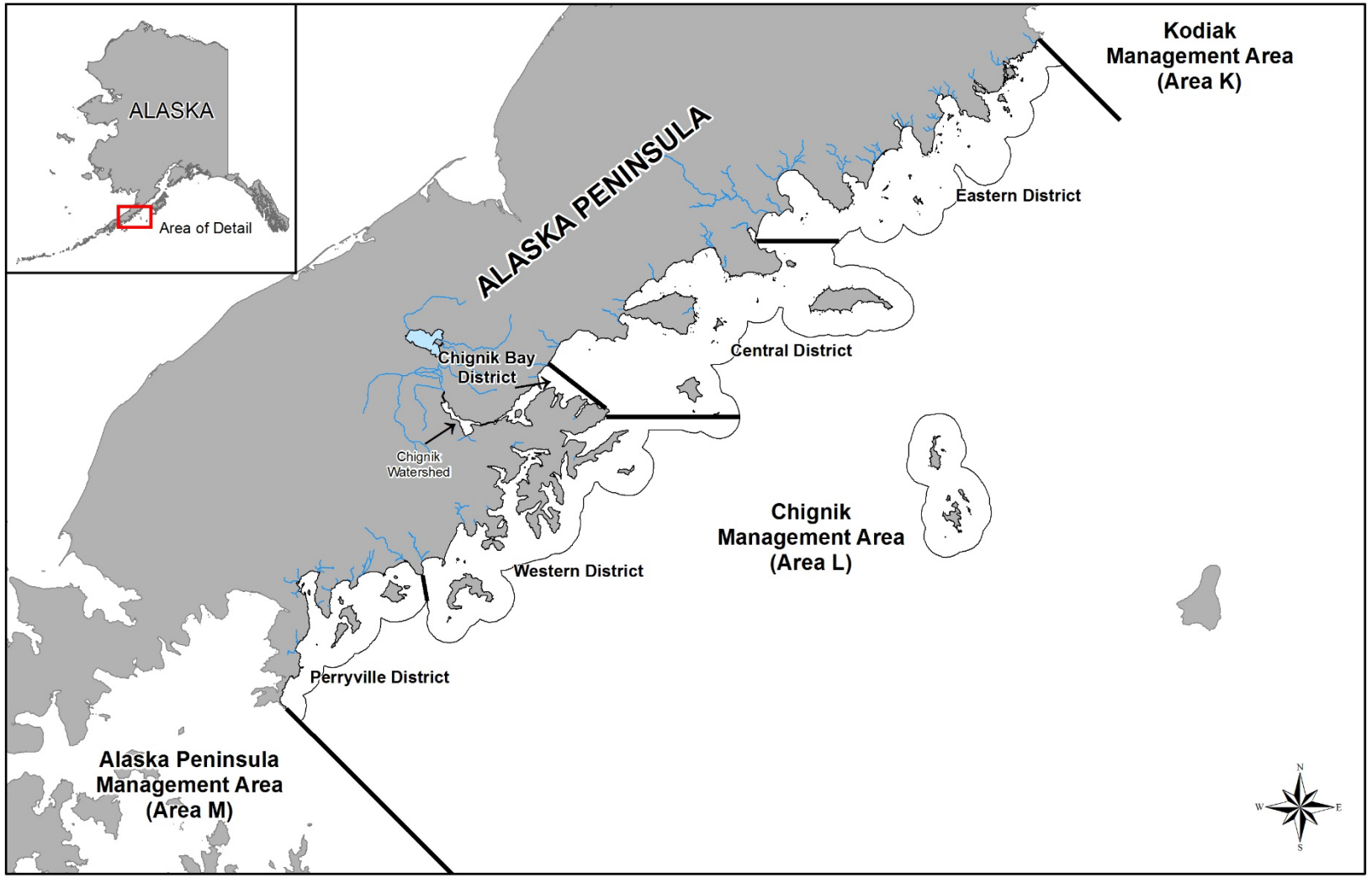


Figure 1.–The Chignik Management Area with the Eastern, Central, Chignik Bay, Western, and Perryville districts depicted.

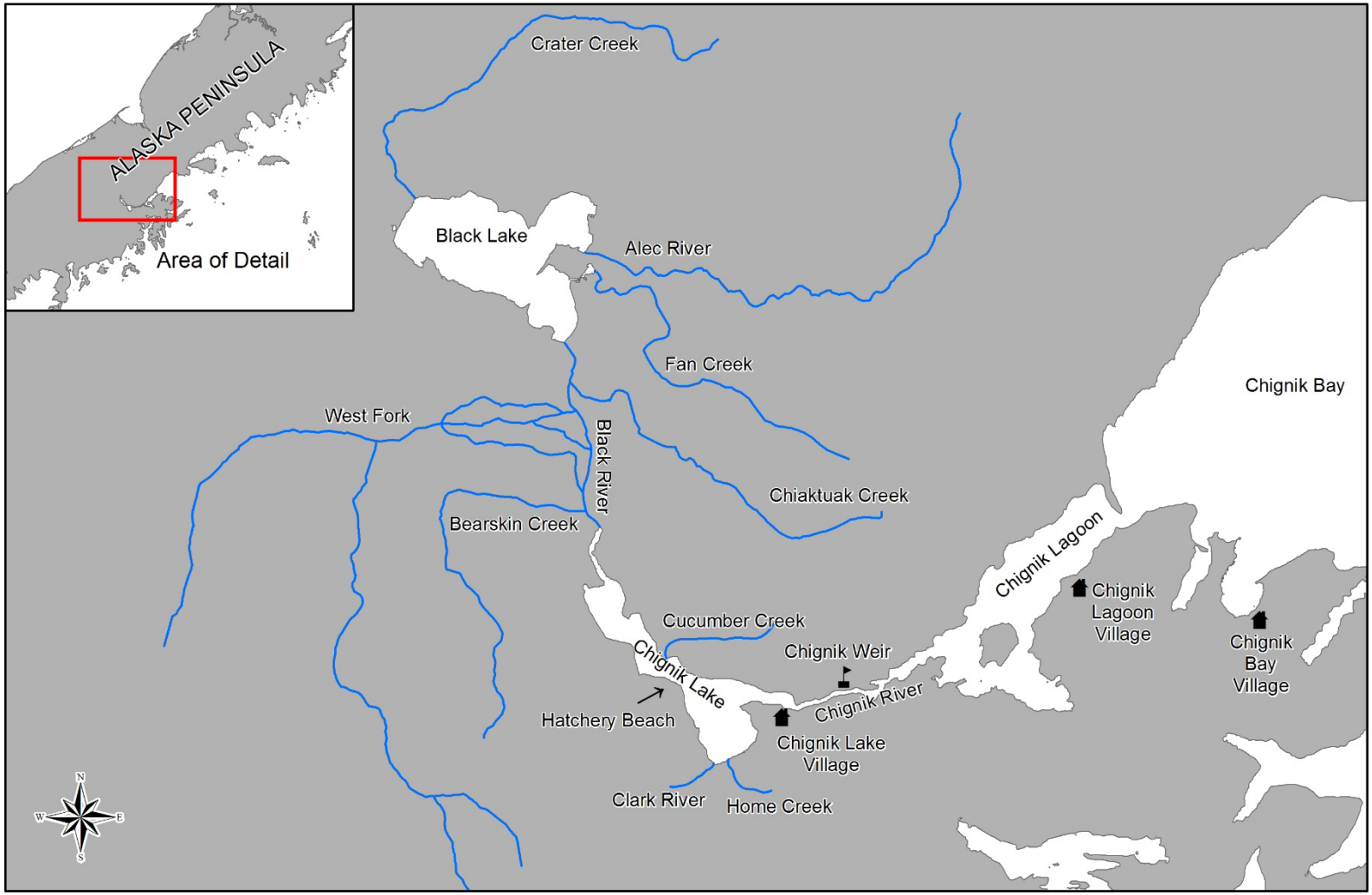


Figure 2.–The Chignik River watershed, showing Black and Chignik lakes, Black and Chignik rivers, and Chignik Lagoon.

APPENDIX A. SUPPORTING INFORMATION FOR THE CHIGNIK WATERSHED CHINOOK SALMON ESCAPEMENT GOAL

Appendix A1.–Description of stock and escapement goal for Chignik River Chinook salmon.

System:	Chignik River
Species:	Chinook salmon
Regulatory area:	Chignik Management Area
Management division(s):	Sport and Commercial
Primary fisheries:	Sport, Commercial, and Subsistence
Current escapement goal:	BEG: 1,300 to 2,700 fish (2002)
Recommended escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Weir, 1978 to present
Data summary:	
Data quality:	Good escapement and harvest data.
Data type:	Weir estimates, harvest estimates, age composition.
Data contrast:	1978 to 2017: 11.72
Methodology:	Bayesian age-structured state space model to estimate spawner-recruit parameters
Autocorrelation:	Substantial positive autocorrelation ($\phi = 0.6$)
Comments:	BEG has been achieved 2 of the past 3 years (2015 and 2016).

Appendix A2.–Chignik River Chinook salmon escapement and harvest information, 1978 to 2017.

System: Chignik River
Species: Chinook salmon

Year	Comm Harvest [a]	Subs Harvest [b]	Weir Estimate	Total Run	Sport Harvest [c]	Sport Harvest Below Weir [d]	Sport Harvest Above Weir [d]	Escapement [e]
1978	1,386	50	1,197	2,633	207			990
1979	856	14	1,050	1,920	207			843
1980	929	6	876	1,811	207			669
1981	2,006	0	1,603	3,609	207			1,396
1982	3,269	3	2,412	5,684	207			2,205
1983	3,560	0	1,943	5,503	207			1,736
1984	3,696	23	5,548	9,267	207			5,341
1985	1,810	1	3,144	4,955	207			2,937
1986	2,592	4	3,612	6,208	207			3,405
1987	1,931	10	2,624	4,565	207			2,417
1988	4,331	9	4,868	9,208	233			4,635
1989	3,532	24	3,316	6,872	181			3,135
1990	3,719	103	4,364	8,186	207			4,157
1991	1,993	42	4,545	6,580	207			4,338
1992	3,179	55	3,806	7,040	207			3,599
1993	5,240	122	1,946	7,308	207			1,739
1994	1,804	165	3,016	4,985	207			2,809
1995	3,008	98	4,288	7,394	207			4,081
1996	1,579	48	3,485	5,112	207			3,278
1997	1,289	28	3,824	5,141	207			3,617
1998	1,700	91	3,075	4,866	207			2,868
1999	2,101	243	3,728	6,072	207			3,521
2000	581	163	4,285	5,029	207			4,078
2001	1,142	171	2,992	4,305	207			2,785
2002	920	74	3,028	4,022	207			2,821
2003	2,834	0	6,412	9,246	207			6,205
2004	2,337	0	7,840	10,177				7,840
2005	2,442	0	6,486	8,567			361	6,125
2006	1,941	0	3,535	5,231			245	3,290
2007	641	0	2,000	2,443			198	1,802
2008	208	0	1,730	1,893		10	55	1,675
2009	496	0	1,680	2,173		50	53	1,627
2010	1,480	0	3,679	5,016		36	179	3,500
2011	1,382	0	2,728	3,861		8	257	2,471
2012	303	37	1,449	1,783		46	15	1,434
2013	545	10	1,253	1,745		15	68	1,185
2014	353	34	2,895	3,178		9	79	2,816
2015	1,572	37	2,054	3,520		3	109	1,945
2016	664	1	1,843	2,407		0	100	1,743
2017	410	4	1,137	1,547		[f]	[f]	1,137

[a] Commercial harvest is the commercial harvest of Chinook salmon from the Chignik Lagoon statistical area (271-10). This does not include personal use or test fishery harvest.

[b] Subsistence harvest is from Chignik Lagoon as reported on subsistence permit reports.

[c] Sport harvest in 1988 and 1989 was estimated from an onsite creel survey (Schwarz 1990). Recreational harvest in the remaining years is the average of 1988 and 1989.

[d] Beginning in 2005, sport fish harvest is estimated through guide logbooks.

[e] Escapement is weir count minus sport harvest.

[f] Data not available at the time of publication.

Appendix A3.–Chignik River Chinook salmon brood table by total age, 1978 to 2017.

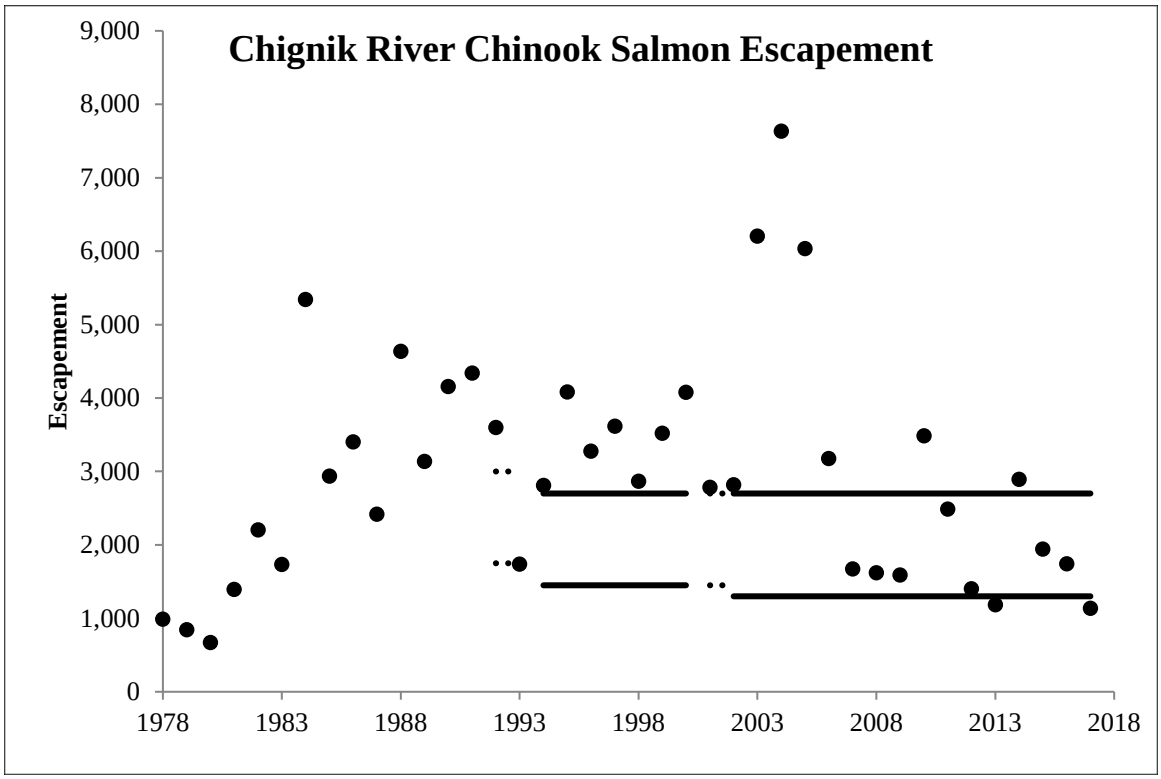
System: Chignik River
Species: Chinook salmon

Brood Year	Escapement	Return by total age [a]					Total Return	Return/ Spawner
		3	4	5	6	7		
1978	990	84	877	1,880	4,023	231	7,095	7.17
1979	843	133	849	3,165	2,151	289	6,588	7.81
1980	669	129	1,430	1,692	2,695	213	6,159	9.21
1981	1,396	217	765	2,120	1,982	429	5,513	3.95
1982	2,205	116	958	1,559	3,998	320	6,951	3.15
1983	1,736	145	704	3,145	2,983	382	7,360	4.24
1984	5,341	107	1,421	2,347	3,554	307	7,735	1.45
1985	2,937	215	1,060	2,796	2,857	328	7,256	2.47
1986	3,405	161	1,263	2,247	3,056	289	7,016	2.06
1987	2,417	191	1,015	2,405	3,869	144	7,623	3.15
1988	4,635	154	1,086	2,054	1,900	579	5,774	1.25
1989	3,135	165	1,007	2,475	4,677	682	9,005	2.87
1990	4,157	89	322	1,070	2,726	0	4,207	1.01
1991	4,338	144	890	1,266	2,196	0	4,496	1.04
1992	3,599	178	438	1,797	1,448	213	4,073	1.13
1993	1,739	0	1,098	2,224	1,791	287	5,400	3.11
1994	2,809	50	955	2,040	1,940	177	5,162	1.84
1995	4,081	239	1,822	2,083	1,425	188	5,756	1.41
1996	3,278	206	575	1,033	1,746	431	3,992	1.22
1997	3,617	144	784	1,374	4,014	0	6,315	1.75
1998	2,868	891	621	3,158	1,957	140	6,766	2.36
1999	3,521	94	1,427	5,089	279	197	7,085	2.01
2000	4,078	216	2,740	2,511	1,136	87	6,690	1.64
2001	2,785	391	5,720	1,844	449	23	8,427	3.03
2002	2,821	279	1,813	1,007	252	22	3,372	1.20
2003	6,205	486	949	907	268	43	2,653	0.43
2004	7,840	149	624	1,094	665	34	2,567	0.33
2005	6,125	143	699	2,537	526	33	3,938	0.64
2006	3,290	143	1,685	2,207	314	26	4,376	1.33
2007	1,802	264	1,154	1,102	311	38	2,869	1.59
2008	1,675	197	273	907	552	0	1,929	1.15
2009	1,627	75	492	1,752	274	0	2,593	1.59
2010	3,500	78	514	2,260	478	103	3,432	0.98
2011	2,471	400	1,027	1,850	413			
2012	1,434	68	119	1,031				
2013	1,185	60	0					
2014	2,816	0						
2015	1,945							
2016	1,743							
2017	1,137							

[a] Age composition used to estimate return at age from 1980 to 1992 uses the average age composition from 1993 to 2000. Adequate samples from 1993 to 2005, 2013, and 2014 were used to estimate the age composition from 2006 to 2012 when data was not collected.

Appendix A4.–Annual escapements and escapement goals for Chignik River Chinook salmon, 1978 to present, with current and historical SEGs (dotted lines) and BEGs (solid lines).

System: Chignik River
Species: Chinook salmon



Appendix A5.–Posterior percentiles for important statistics of the Chignik River Chinook salmon Bayesian spawner-recruit analysis.[a]

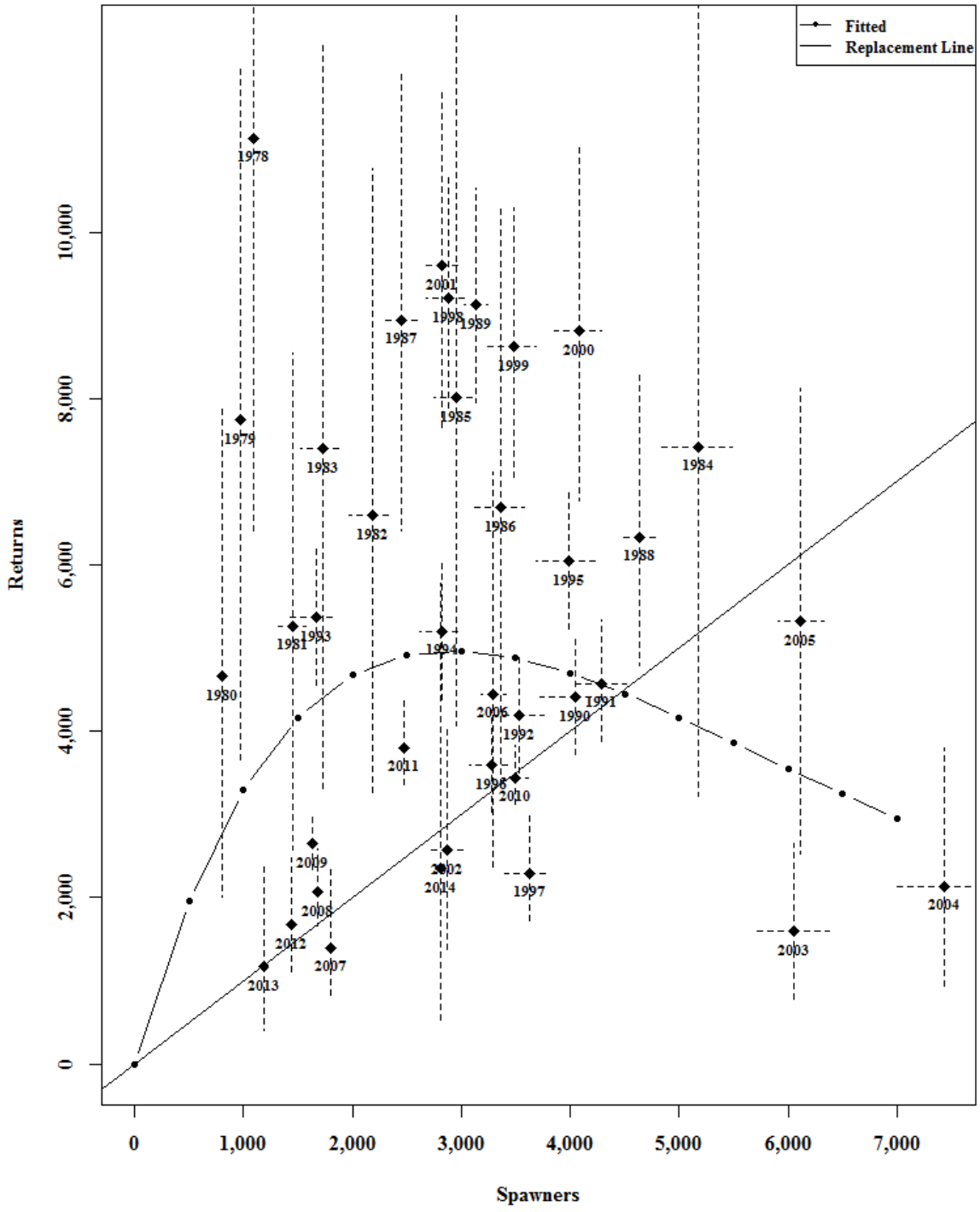
System: Chignik River
Species: Chinook salmon

Statistic	2.50%	50%	97.50%
S.eq	3,787	5,431	14,965
S.max	1,873	2,994	7,381
S.msy	1,373	1,993	4,146
U.msy	0.42	0.68	0.87
alpha	1.79	4.53	12.72
beta	0.00014	0.00033	0.00053
lnalpha	0.58	1.51	2.54
lnalpha.c	1.04	1.83	3.86
phi	0.18	0.61	0.95
pi[1]	0.04	0.06	0.09
pi[2]	0.17	0.22	0.27
pi[3]	0.34	0.40	0.46
pi[4]	0.22	0.28	0.34
pi[5]	0.02	0.04	0.06
sigma.red	0.52	0.77	1.84
sigma.white	0.41	0.59	0.85

[a] Node definitions are as defined in Fleischman et al. (2013)

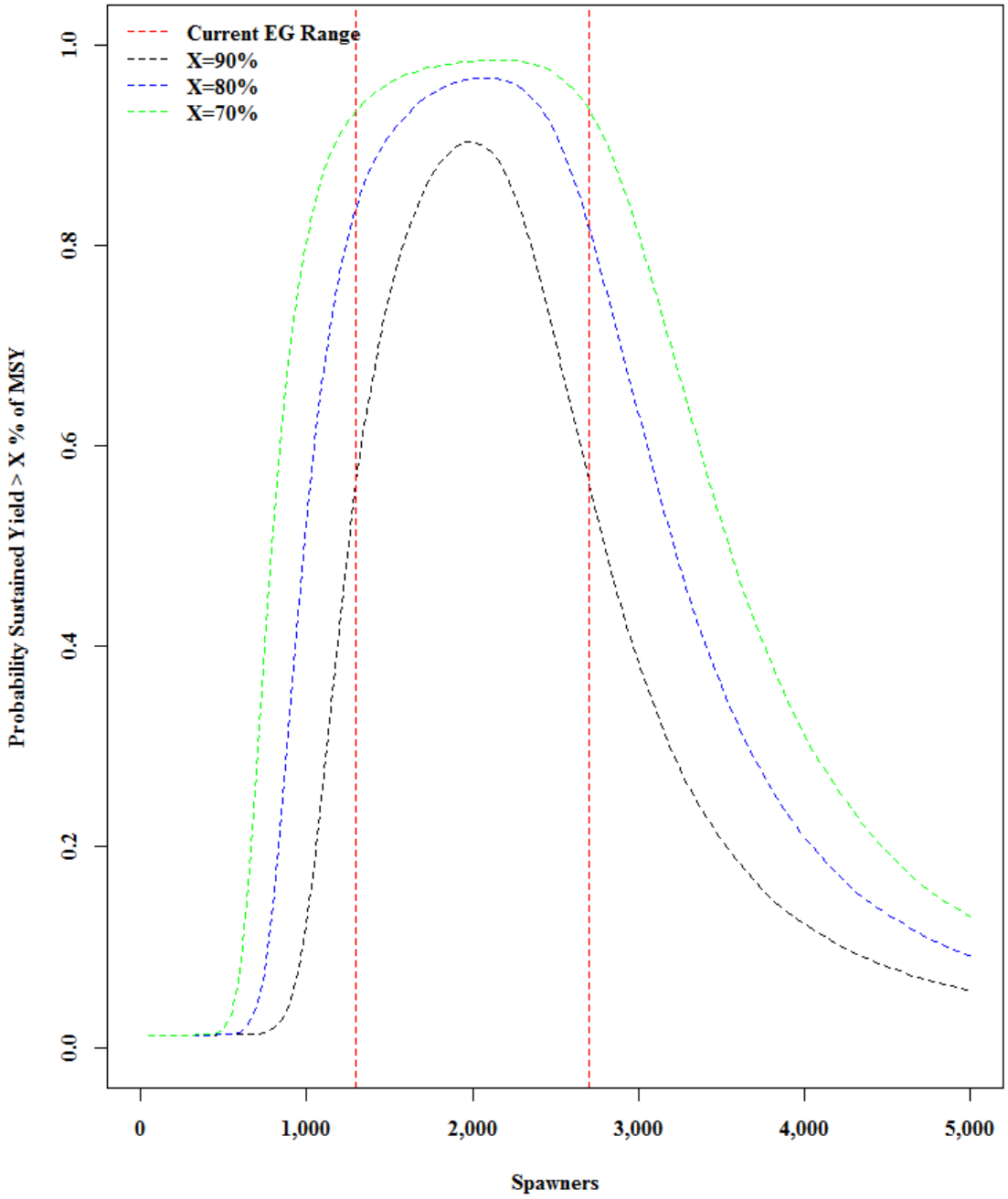
Appendix A6.–Chignik River Chinook salmon fitted Ricker relationship, R-S pairs and R = S; error bars are 90% credibility intervals.

System: Chignik River
Species: Chinook salmon



Appendix A7.–Chignik River Chinook salmon probability that sustained yield (SY) is greater than X% of maximum sustained yield (MSY).

System: Chignik River
Species: Chinook salmon



APPENDIX B. SUPPORTING INFORMATION FOR CHIGNIK RIVER WATERSHED SOCKEYE SALMON ESCAPEMENT GOALS

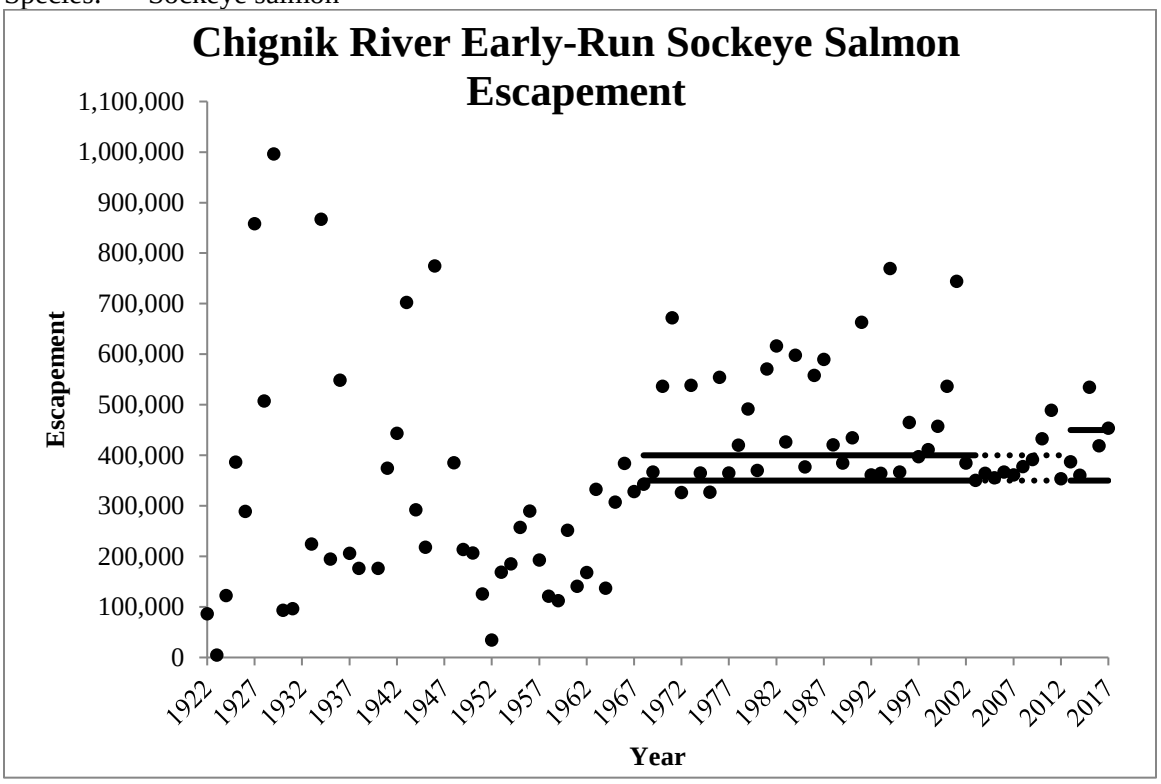
Appendix B1.–Description of stocks and escapement goals for Chignik River watershed sockeye salmon.

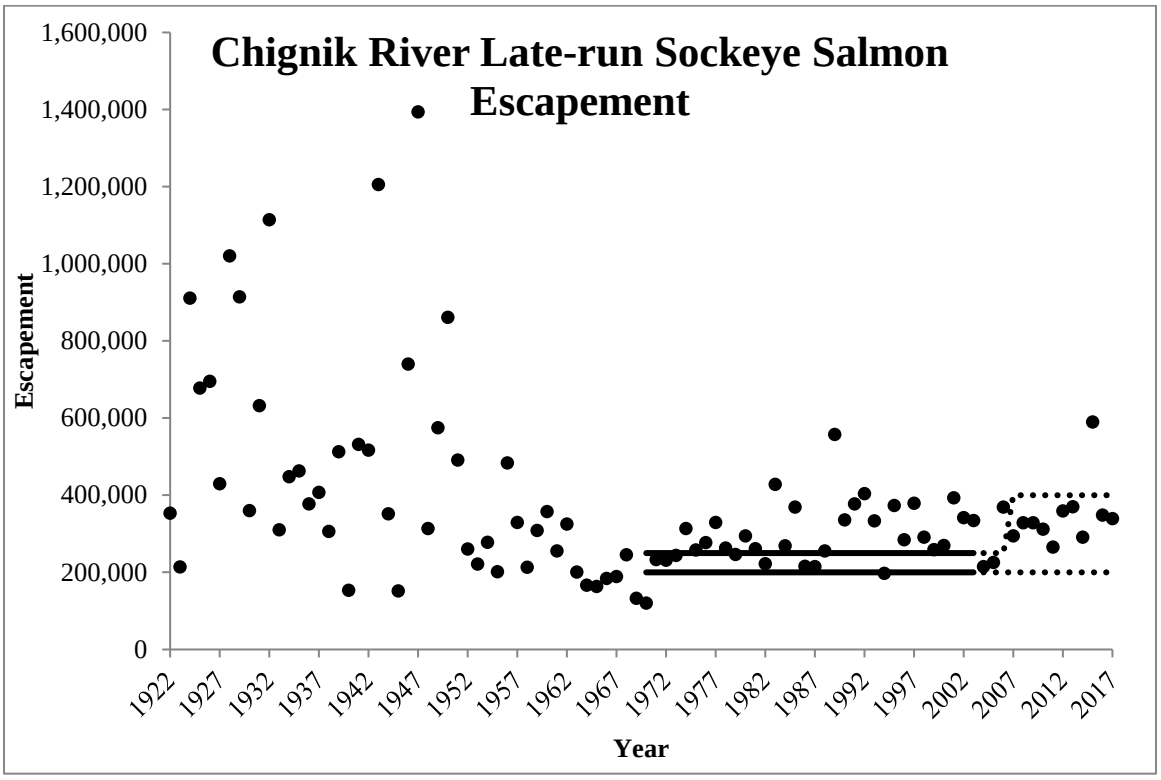
System: Chignik River
Species: Sockeye salmon

Regulatory area:	Chignik Management Area
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine
Current escapement goal:	Early-Run BEG: 350,000 to 450,000 fish (2014) Late-run SEG: 200,000 to 400,000 fish (2008)
Recommended escapement goal:	Early-Run BEG: No change Late-run SEG: No change
Optimal escapement goal:	None
Inriver run goal:	1998: 25,000 management objective for September 1-15 in addition to lower bound; 2004: In addition to the existing 25,000 September objective a 25,000 objective was added for August. 2008: The two management objectives were reclassified as inriver run goals but not added into regulation. 2013: IRRG added into regulation. 2015: An additional 25,000 sockeye salmon were added to the September inriver run goal, for a total of 50,000 fish in September. The August inriver run goal remained at 25,000 sockeye salmon.
Action points:	None
Escapement enumeration:	Weir 1922, 1923, 1925 to 1930, 1932, 1933, 1935 to 1937, 1939, 1949 to 1950, 1952 to present; run reconstruction in remaining years through professional observation and cannery records.
Data summary	
Data quality:	Fair
Data type:	Weir counts intermittently for 16 of the 29 years between 1922 and 1951 and from 1952 to present. Escapement age data available from 1955 to 1960, 1962 to 1969, and 1980 to 2009. Stock-specific harvest information was available for 1962 to 1969 and 1980 to 2009. Smolt outmigration data from 1994 to present. Limnology data from 2000 to present.
Contrast:	1922 to 2017: 514.2 (early run) 1978 to 2017: 2.2 (early run) 1922 to 2017: 11.6 (late run) 1978 to 2017: 2.8 (late run)
Methodology:	Ricker stock-recruit model, yield analysis, euphotic volume model, zooplankton biomass model, percentile approach
Autocorrelation:	None detected

Appendix B2.–Annual escapements for early- and late-run Chignik River sockeye salmon, 1922 to 2017, with current and historical SEGs (dotted lines) and BEGs (solid lines).

System: Chignik River
Species: Sockeye salmon





Appendix B3.–Brood table for early-run Chignik River Watershed sockeye salmon.

System: Black Lake (early run)
Species: Sockeye salmon

		Return ages																				
Year	Parent esc.	0.1	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	0.4	1.4	2.3	3.2	1.5	2.4	3.3	4.2	2.5	3.4	4.3	Total
1922	86,421	0	0	0	0	40,685	0	659,040	56,121	0	0	0	202,612	2,465	0	1,222	1,669	0	0	0	0	963,814
1923	4,642	0	0	0	0	18,213	0	172,343	53,445	0	0	2,677	132,776	410	0	436	59	0	0	0	0	380,359
1924	121,983	0	0	0	0	85,083	0	1,206,555	8,855	0	0	426	19,931	939	0	384	384	0	0	0	0	1,322,557
1925	386,364	0	0	0	0	1,529	0	54,164	9,924	0	0	384	50,707	937	0	17	0	0	0	0	0	117,662
1926	289,009	0	0	0	0	7,544	420	104,094	45,572	0	0	11,714	352,025	7,117	0	0	1,708	0	0	0	0	530,194
1927	857,881	0	0	0	0	99,929	66	2,375,878	85,253	0	0	721	107,239	165	0	3,699	4,234	0	0	0	0	2,677,184
1928	507,353	0	0	0	0	23,860	0	304,338	49,284	0	0	9,848	428,369	2,755	0	409	2,118	0	0	0	0	820,981
1929	995,832	0	0	0	0	9,910	0	918,487	58,777	0	0	5,626	60,214	865	0	144	144	0	0	0	0	1,054,167
1930	92,955	0	0	0	0	23,769	0	286,339	13,886	0	0	6,663	43,297	3,527	0	4	0	0	0	0	0	377,485
1931	96,201	0	0	0	0	33,685	943	923,763	46,710	0	0	28	122,389	0	0	655	58	0	0	0	0	1,128,231
1932	2,151,734	0	0	0	0	50,602	0	191,354	36,823	0	0	10,350	43,060	291	0	8,584	234	0	0	0	0	341,298
1933	223,913	0	0	0	0	62,079	0	247,818	7,609	0	0	138,675	164,540	0	0	625	54	0	0	0	0	621,400
1934	866,890	0	0	0	0	16,228	4	1,583,632	6,057	0	0	9,886	40,971	276	0	1,299	113	0	0	0	0	1,658,466
1935	194,636	0	0	10	0	68,710	0	235,971	7,188	0	0	20,562	85,058	572	0	1,508	130	0	0	0	0	419,709
1936	548,039	0	0	0	0	15,422	3	490,061	14,873	0	0	23,865	98,553	661	0	2,346	201	0	0	0	0	645,985
1937	205,613	0	0	9	0	32,001	7	567,984	17,179	0	0	37,146	153,156	1,026	0	960	82	0	0	0	0	809,550
1938	175,972	0	0	19	0	37,059	7	882,938	26,618	0	0	15,193	62,552	418	0	706	60	0	0	0	0	1,025,570
1939	1,142,852	0	0	22	0	57,563	12	360,712	10,840	0	0	11,171	45,926	307	0	2,470	209	0	0	0	0	489,232
1940	176,307	0	0	35	0	23,499	5	264,904	7,938	0	0	39,130	160,651	1,070	0	7,513	634	0	0	0	0	505,379
1941	374,420	0	0	14	0	17,246	3	926,890	27,697	0	0	119,048	488,137	3,247	0	1,196	101	0	0	0	0	1,583,579
1942	442,981	0	0	11	0	60,302	12	2,817,023	83,954	0	0	18,948	77,598	515	0	684	58	0	0	0	0	3,059,105
1943	701,859	0	0	36	0	183,156	37	447,919	13,315	0	0	10,839	44,522	297	0	499	38	0	0	0	0	700,658
1944	291,844	0	0	111	0	29,106	6	256,848	7,683	0	0	7,947	31,664	203	0	482	43	0	0	0	0	334,093
1945	217,882	0	0	18	0	16,715	3	183,734	5,143	0	0	7,619	31,784	216	0	275	27	0	0	0	0	245,534
1946	774,130	0	0	10	0	11,775	2	182,835	5,644	0	0	4,307	18,686	133	0	707	64	0	0	0	0	224,163
1947	2,386,733	0	0	7	0	11,988	2	106,718	3,550	0	0	11,150	46,809	320	0	525	43	0	0	0	0	181,112
1948	384,637	0	0	7	0	7,129	1	268,953	8,407	0	0	8,346	33,877	223	0	352	0	0	0	0	0	327,295
1949	213,269	0	0	4	0	17,688	4	195,878	5,713	0	0	0	89,095	0	0	0	152	0	0	0	0	308,534
1950	206,270	0	0	11	0	12,671	3	287,407	12,644	0	0	1,862	76,722	648	0	373	286	0	0	0	0	392,627
1951	125,126	0	0	8	0	46,798	0	448,360	3,404	0	0	2,319	124,345	0	0	455	0	0	0	0	0	625,689
1952	34,155	0	0	0	0	4,390	0	137,957	3,423	0	0	208	81,691	0	0	639	2,512	0	0	0	0	230,820
1953	168,375	0	0	0	0	1,024	32	154,589	17,848	0	0	1,625	180,887	252	0	0	1,350	0	0	0	0	357,607
1954	184,953	0	0	143	0	6,468	0	50,272	10,720	0	0	515	72,973	9	0	312	1,009	0	0	0	0	142,421
1955	256,757	0	0	783	0	30,302	0	430,793	3,476	0	0	339	88,693	109	0	0	0	0	0	0	0	554,495
1956	289,096	0	0	17	0	16,499	0	81,569	14,910	0	0	9	90,001	0	0	196	4,967	0	0	0	0	208,168
1957	192,479	0	0	0	0	6,559	161	117,979	10,507	0	0	52	210,686	3,641	0	21	906	0	0	0	0	350,512
1958	120,862	0	0	905	0	19,146	0	79,955	81,992	0	0	0	60,132	77	0	61	103	0	0	0	0	242,370

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Appendix B3.–Page 2 of 3.

		Return ages																			
Year	Parent esc.	0.1	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	0.4	1.4	2.3	3.2	1.5	2.4	3.3	4.2	2.5	3.4	4.3	Total
1959	112,226	0	0	1,522	0	31,039	142	148,403	13,872	0	0	402	144,581	874	0	58	54	0	0	0	0	340,946
1960	251,567	0	0	124	0	55,546	221	610,591	32,598	0	0	6,221	65,418	49	0	606	3,383	0	0	0	0	774,756
1961	140,714	0	0	276	0	14,301	1	387,053	3,483	0	0	536	164,278	486	0	1,020	209	0	0	0	0	571,645
1962	167,602	0	0	698	0	8,379	0	257,371	25,726	0	0	3,194	395,626	1,524	0	954	0	0	0	0	0	693,473
1963	332,536	0	0	0	0	29,538	173	448,298	17,628	0	0	905	199,104	0	0	2,506	551	0	0	0	0	698,703
1964	137,073	0	0	37	0	13,311	3,735	190,971	133,203	0	0	3,809	409,974	414	0	0	271	0	0	0	0	755,726
1965	307,192	0	0	394	0	102,570	421	1,535,858	80,851	0	0	3,332	201,220	271	0	497	22,731	0	0	0	0	1,948,144
1966	383,545	0	0	1,631	0	65,254	378	990,567	15,248	0	0	2,193	225,659	28	0	0	2,607	0	0	0	0	1,303,566
1967	328,000	0	0	2,728	0	16,157	163	99,357	6,078	0	0	13,958	100,607	1,600	0	0	0	0	0	0	0	240,647
1968	342,343	0	0	271	0	12,997	0	1,011,407	4,705	0	0	2,337	174,675	2,118	0	0	1,777	0	0	0	0	1,210,286
1969	366,589	0	0	0	0	13,272	160	301,917	68,349	0	0	1,403	89,900	519	0	0	2,359	0	0	0	0	477,879
1970	536,257	0	0	0	0	18,672	282	208,452	8,724	0	0	4,835	201,464	650	0	0	3,601	0	0	0	0	446,681
1971	671,668	0	0	615	0	23,659	0	838,898	70,719	0	0	3,771	442,122	374	0	108	2,367	0	0	0	0	1,382,632
1972	326,320	0	0	0	0	33,147	0	412,671	16,042	0	0	4,280	443,366	441	0	1,141	1,863	0	0	0	0	912,950
1973	538,462	0	0	0	0	19,112	0	761,907	95,637	0	0	0	362,660	1,156	0	493	2,288	0	0	0	0	1,243,252
1974	364,603	0	0	50	0	51,566	167	198,938	87,361	0	0	0	290,322	848	0	6	807	0	0	0	0	630,065
1975	326,563	0	0	0	0	22,505	1,459	37,917	87,312	0	0	1,163	209,658	772	0	405	35	0	0	0	0	361,227
1976	553,754	0	0	721	0	23,692	377	1,057,596	20,277	0	0	836	138,230	0	0	0	457	0	0	0	0	1,242,186
1977	364,557	0	0	92	0	79,837	6	1,727,820	13,002	0	0	7,231	349,895	0	0	2,671	919	0	0	0	0	2,181,473
1978	419,732	0	0	408	0	56,426	3,133	498,425	57,526	0	0	6,581	464,129	0	0	0	554	0	0	0	0	1,087,183
1979	491,467	0	0	1,270	0	439,889	772	2,784,428	57,539	0	0	1,335	61,781	0	0	326	411	0	0	0	0	3,347,752
1980	369,580	0	0	289	108,326	86,359	1,778	655,708	144,088	0	0	1,025	726,425	1,630	0	697	299	0	0	0	0	1,726,624
1981	570,210	0	0	717	3,094	161,169	1,444	934,785	73,946	0	0	3,891	729,684	557	0	1,202	213	0	0	0	0	1,910,702
1982	616,117	0	1,212	444	2,766	178,831	1,922	1,577,372	120,249	0	0	1,939	365,273	0	0	482	0	0	0	0	0	2,250,490
1983	426,178	0	0	0	20,583	75,756	2,650	230,229	42,568	0	213	340	217,407	0	0	2,178	574	0	0	0	0	592,498
1984	597,713	0	296	4,015	1,198	46,004	2,436	314,542	42,209	0	0	2,212	298,044	707	0	746	2,155	0	0	0	0	714,564
1985	376,578	700	213	523	434	40,206	659	336,101	54,805	0	794	21,637	329,169	1,405	0	1,057	9,254	0	0	0	0	796,956
1986	557,772	425	421	1,538	5,180	311,828	0	1,783,119	60,949	16	16	2,652	227,622	12,166	0	5,673	1,422	0	0	0	0	2,413,027
1987	589,299	0	1,197	2,119	1,028	173,143	992	692,978	77,196	60	779	9,285	460,926	3,334	0	5,859	33,825	0	0	86	0	1,462,807
1988	420,580	0	0	1,877	507	73,541	1,704	494,878	110,142	211	0	5,587	950,452	1,946	0	828	436	0	0	0	0	1,642,109
1989	384,001	0	60	6,877	5,719	195,391	2,468	1,038,206	138,038	0	979	3,408	269,650	1,042	0	2,079	18,160	0	0	46	18	1,682,141
1990	434,550	0	1,224	481	38,096	143,872	5,554	457,814	186,919	0	481	6,314	633,235	18	0	3,065	8,750	0	0	27	0	1,485,849
1991	662,660	0	1,719	508	2,038	108,027	301	1,279,480	40,630	0	1,140	1,110	131,139	679	0	641	3,667	0	0	0	0	1,571,079
1992	360,681	0	1,626	641	125,081	53,481	2,490	363,023	71,273	21	314	1,552	324,846	9,958	0	0	4,878	0	0	0	0	959,184
1993	364,261	0	3,666	128	7,695	42,118	1,432	225,957	139,814	0	198	983	516,162	2,001	0	1,172	436	0	0	0	0	941,762
1994	769,465	0	166	861	0	103,599	1,430	1,183,383	222,344	0	0	11,226	517,513	56	0	618	96	0	0	0	0	2,041,293
1995	366,496	0	1,663	1,496	28,367	511,526	0	1,399,909	20,350	0	0	7,136	85,675	0	0	2,234	2,776	0	0	0	0	2,061,132

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Appendix B3.–Page 3 of 3.

Year	Parent Esc.	Return Ages																			
		0.1	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	0.4	1.4	2.3	3.2	1.5	2.4	3.3	4.2	2.5	3.4	4.3	Total
1996	464,748	0	9,594	524	91,050	69,098	0	1,111,890	11,046	0	762	12,284	335,617	1,060	0	801	2,399	0	0	0	0	1,646,125
1997	396,668	0	953	0	7,925	49,609	677	459,184	51,638	0	110	2,955	208,648	191	0	0	0	0	0	0	0	781,890
1998	410,659	0	164	683	3,038	188,296	4	532,566	38,305	0	0	1,015	111,141	0	0	3,659	7,399	0	0	0	0	886,270
1999	457,424	0	1,660	81	15,979	98,359	910	630,749	70,220	0	0	734	176,623	0	0	0	2,128	0	0	0	0	997,443
2000	536,139	0	1,030	244	10,185	257,222	297	1,101,146	49,689	0	0	8,102	150,557	0	0	3,513	0	0	0	0	0	1,581,986
2001	744,015	0	5,364	0	59,606	77,174	0	523,867	31,580	0	0	10,669	164,276	0	0	2,738	0	0	0	0	0	875,274
2002	384,088	0	0	0	6,231	55,979	0	248,106	1,416	0	1,717	4,421	62,354	0	0	0	0	0	0	0	0	380,224
2003	350,004	0	4,532	0	58,353	90,847	0	416,783	17,263	0	0	235	103,322	0	0	0	15	0	0	0	0	691,350
2004	363,800	0	13,304	0	51,252	45,346	0	604,316	47,109	0	1,720	3,104	150,795	0	0	2,845	0	0	0	0	0	919,792
2005	355,091	0	0	171	17,163	94,309	0	834,023	11,240	0	0	0	525,008	6,180	0	0	17,839	0	0	0	0	1,505,934
2006	366,497	0	1,250	0	14,447	184,384	362	2,308,564	127,623	0	0	51,774	539,542	0	0	3,659	7,399	0	0	0	0	3,239,005
2007	361,091	0	2,670	0	25,090	37,792	2,692	399,491	34,547	0	1,729	1,499	363,829	0	0	1,017	252	0	0	0	0	870,608
2008	377,579	0	0	0	15,023	511,577	0	1,936,705	0	0	0	5,805	75,848	0	0	0	2,128	0	0	0	0	2,547,086
2009	391,476	0	0	0	4,803	48,525	0	101,131	43,042	0	340	0	201,244	1,717	0	0	4,061	0	0	1,339	0	406,203
2010	432,535	0	0	0	0	178,577	641	594,126	101,423	0	0	1,054	345,331	1,054	0	2,994	5,521	0				
2011	488,930	0	0	3,480	1,396	255,286	1,134	842,270	75,495	0	0	7,180	366,937	123								
2012	353,441	0	0	3,461	442	115,327	430	642,002	29,337	0	0											
2013	386,782	0	0	516	43,283	44,339	562															
2014	360,381	0	4,224	915																		
2015	534,088	0																				
2016	418,290																					
2017	453,257																					

Appendix B4.–Brood table for late-run Chignik River Watershed sockeye salmon.

System: Chignik Lake (late run)
Species: Sockeye salmon

		Return ages																			
Year	Parent esc.	0.1	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	0.4	1.4	2.3	3.2	1.5	2.4	3.3	4.2	2.5	3.4	4.3	Total
1922	352,807	0	0	0	0	43,667	0	382,956	73,351	0	0	0	991,979	14,972	0	2,886	4,175	0	0	0	0	1,513,986
1923	213,781	0	0	0	0	74,884	218	410,194	245,187	0	0	2,360	577,390	1,111	0	1,647	2,376	0	0	0	0	1,315,367
1924	910,521	0	0	0	0	126,685	1,819	1,003,422	8,350	0	0	1,115	102,217	5,830	0	425	55	0	0	0	0	1,249,918
1925	677,566	0	0	0	0	3,736	0	51,222	195,414	0	0	332	427,580	7,817	0	5,367	456	0	0	0	0	691,924
1926	695,314	0	0	0	0	25,764	919	279,018	304,619	0	0	3,461	879,220	3,821	0	55	2,246	0	0	0	0	1,499,123
1927	429,525	0	0	207	0	113,952	1,499	951,950	100,633	0	0	744	203,942	1,586	0	1,225	5,557	0	0	0	0	1,381,295
1928	1,020,520	0	0	0	0	40,063	0	353,506	77,224	0	0	12,047	300,603	3,129	0	1,042	1,618	0	0	0	0	789,232
1929	914,307	0	0	0	0	16,254	0	584,561	38,873	0	0	5,675	361,557	1,165	0	2,192	1,251	0	0	0	0	1,011,528
1930	359,405	0	0	0	0	26,688	0	426,128	41,867	0	0	6,177	344,419	16,565	0	2,065	0	0	0	0	0	863,909
1931	631,986	0	0	0	0	30,856	2,454	296,899	138,440	0	0	3,747	264,858	0	0	2,678	635	0	0	0	0	740,567
1932	1,113,859	0	0	0	0	24,809	0	475,759	46,764	0	0	8,530	185,288	2,049	0	13,674	1,502	0	0	0	0	758,375
1933	310,088	0	0	0	0	35,679	0	311,946	35,705	0	0	48,795	321,467	0	0	1,267	301	0	0	0	0	755,160
1934	447,642	0	0	0	0	19,716	90	708,212	33,934	0	0	4,066	88,027	969	0	4,299	1,026	0	0	0	0	860,339
1935	462,469	0	0	69	0	37,642	308	148,352	16,893	0	0	13,842	299,288	3,284	0	4,082	976	0	0	0	0	524,736
1936	376,838	0	0	0	0	9,342	43	504,624	57,326	0	0	13,186	284,707	3,117	0	9,326	2,233	0	0	0	0	883,904
1937	406,618	0	0	33	0	31,723	145	480,250	54,435	0	0	30,220	651,642	7,116	0	2,664	639	0	0	0	0	1,258,867
1938	305,827	0	0	111	0	30,143	137	1,099,657	124,382	0	0	8,660	186,504	2,032	0	1,128	270	0	0	0	0	1,453,024
1939	512,754	0	0	106	0	68,919	315	314,851	35,542	0	0	3,674	79,035	859	0	5,420	1,305	0	0	0	0	510,026
1940	152,957	0	0	244	0	19,705	90	133,474	15,039	0	0	17,705	380,481	4,130	0	10,049	2,422	0	0	0	0	583,339
1941	531,904	0	0	70	0	8,342	38	642,782	72,293	0	0	32,912	706,532	7,654	0	2,225	537	0	0	0	0	1,473,385
1942	516,621	0	0	30	0	40,124	183	1,194,007	134,060	0	0	7,305	156,659	1,695	0	4,662	1,112	0	0	0	0	1,539,837
1943	1,205,418	0	0	143	0	74,442	340	264,830	29,686	0	0	15,007	324,527	3,562	0	5,405	1,321	0	0	0	0	719,263
1944	351,212	0	0	266	0	16,492	75	547,139	62,179	0	0	18,110	385,087	4,101	0	2,886	711	0	0	0	0	1,037,046
1945	151,326	0	0	59	0	34,405	157	652,782	72,138	0	0	9,784	207,054	2,186	0	1,246	315	0	0	0	0	980,126
1946	739,884	0	0	121	0	40,246	183	351,541	38,531	0	0	4,401	91,579	937	0	1,531	371	0	0	0	0	529,441
1947	1,393,990	0	0	147	0	21,549	98	156,343	16,644	0	0	5,048	108,068	1,165	0	1,316	333	0	0	0	0	310,711
1948	313,319	0	0	80	0	9,390	42	182,792	20,430	0	0	4,658	96,858	989	0	826	0	0	0	0	0	316,065
1949	574,715	0	0	36	0	11,360	52	165,402	17,581	0	0	1,766	103,345	0	0	496	650	0	0	0	0	300,688
1950	861,070	0	0	41	0	9,924	45	199,966	31,411	0	0	2,206	245,826	407	0	2,903	1,820	0	0	0	0	494,549
1951	490,899	0	0	38	0	33,082	0	618,729	13,748	0	0	7,046	242,042	0	0	1,028	0	0	0	0	0	915,713
1952	260,540	0	0	0	0	22,213	0	258,747	30,836	0	0	986	229,563	0	0	3,932	8,403	0	0	0	0	554,680
1953	221,408	0	0	0	0	9,167	428	125,399	32,350	0	0	470	396,916	1,935	0	934	5,424	0	0	0	0	573,023
1954	277,912	0	0	547	0	2,848	0	39,658	75,361	0	0	771	418,442	804	0	1,661	5,069	0	0	0	0	545,161
1955	201,409	0	0	369	0	32,187	0	303,988	32,708	0	0	168	363,162	1,252	0	0	0	0	0	0	0	733,834
1956	483,024	0	0	1,330	0	12,515	0	106,327	36,113	0	0	435	221,169	0	0	1,349	4,781	0	0	0	0	384,019
1957	328,779	0	0	0	0	17,746	622	232,393	109,475	0	0	351	332,661	2,104	0	1,189	1,319	0	0	0	0	697,861
1958	212,594	0	0	1,459	0	50,630	0	23,204	139,797	0	0	0	419,108	980	0	93	432	0	0	0	0	635,703

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		Return ages																			
Year	Parent esc.	0.1	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	0.4	1.4	2.3	3.2	1.5	2.4	3.3	4.2	2.5	3.4	4.3	Total
1959	308,645	0	0	3,286	0	18,094	907	109,204	81,669	0	0	117	197,975	738	0	689	187	0	0	0	0	412,866
1960	357,230	0	0	146	0	24,455	491	122,278	8,273	0	0	1,314	210,883	141	0	1,618	12,824	0	0	0	0	382,423
1961	254,970	0	0	718	0	1,899	799	109,935	18,702	0	0	220	401,732	2,698	0	5,335	2,420	0	0	0	0	544,458
1962	324,860	0	0	123	0	4,312	0	44,074	69,811	0	0	998	692,188	1,074	0	1,109	0	0	0	0	0	813,689
1963	200,314	0	0	0	0	5,536	1,300	103,116	68,605	0	0	29	243,939	0	0	1,529	883	0	0	0	0	424,937
1964	166,625	0	0	88	0	6,607	4,550	24,880	65,639	0	0	713	140,826	960	0	194	5,776	0	0	0	0	250,233
1965	163,151	0	0	1,636	0	25,157	5,547	162,041	59,008	0	0	361	614,234	971	0	650	94,754	0	0	0	0	964,359
1966	183,525	0	0	1,715	0	14,784	942	284,131	28,590	0	0	455	407,966	2,419	0	0	16,843	0	0	0	0	757,845
1967	189,000	0	0	510	0	5,845	726	77,202	30,658	0	0	653	449,704	2,591	0	1,299	0	0	0	0	0	569,188
1968	244,836	0	0	863	0	3,781	0	107,958	19,045	0	0	616	564,765	15,102	0	2,471	27,626	0	0	0	0	742,226
1969	132,055	0	0	0	0	1,155	990	82,331	262,259	0	0	751	447,837	6,691	0	0	14,980	0	0	0	0	816,992
1970	119,952	0	0	0	0	17,648	11,648	25,381	138,710	0	0	1,181	413,207	10,933	0	0	17,736	0	0	0	0	636,444
1971	232,501	0	0	1,452	0	14,182	11,586	166,200	367,841	0	0	211	1,694,467	3,656	0	2,930	17,355	0	0	0	0	2,279,880
1972	231,270	0	0	0	0	26,952	2,190	107,681	85,848	0	0	29	799,853	32,588	0	21	3,974	0	0	0	0	1,059,136
1973	243,729	0	0	0	0	5,157	9,586	86,674	184,713	0	0	0	888,233	3,246	0	1,240	5,754	0	0	0	0	1,184,603
1974	313,343	0	0	3,945	0	19,441	2,438	42,549	208,999	0	0	0	730,297	2,132	0	2,526	10,257	0	0	0	0	1,022,585
1975	257,675	0	0	0	0	25,210	6,263	95,379	248,864	0	0	547	1,107,896	3,421	0	5,569	2,026	0	0	0	0	1,495,175
1976	276,793	0	0	470	0	59,598	947	456,314	85,677	0	0	2,145	431,387	0	0	2,852	9	0	0	0	0	1,039,399
1977	328,916	0	0	232	0	34,852	3,341	134,257	51,802	0	0	1,757	1,181,013	0	0	1,423	83	0	0	0	0	1,408,760
1978	262,815	0	0	472	0	14,469	5,028	218,660	281,558	0	0	1,017	397,067	865	0	1,315	264	0	0	0	0	920,715
1979	246,318	0	0	1,752	0	175,512	5,358	397,619	42,026	0	0	990	255,735	701	0	1,245	547	0	0	0	0	881,486
1980	294,481	0	0	2,083	9,889	17,500	9,188	157,118	297,626	0	0	434	437,119	2,649	0	920	353	0	0	0	0	934,879
1981	261,239	0	0	1,452	813	90,365	3,932	233,599	70,055	0	0	472	312,253	101	0	560	92	0	0	0	0	713,694
1982	221,611	0	114	2,585	1,217	52,358	3,885	210,914	94,527	0	0	764	561,643	121	0	1,377	0	0	0	0	0	929,505
1983	428,034	0	0	0	2,193	8,510	3,195	117,670	91,650	0	92	240	1,009,599	796	0	11,640	98	0	196	0	0	1,245,879
1984	268,495	0	127	840	501	26,884	8,247	148,351	290,786	0	0	2,901	1,479,377	1,997	0	8,370	6,089	0	0	0	0	1,974,470
1985	369,260	59	92	506	169	18,640	13,904	201,663	165,790	0	812	4,466	371,001	1,081	0	3,134	3,235	0	0	0	0	784,552
1986	215,547	183	57	2,789	15,514	185,179	754	432,882	146,017	71	71	1,426	437,925	6,388	0	10,620	1,999	0	0	290	0	1,242,165
1987	214,444	0	6,931	435	872	59,254	7,545	465,482	193,580	185	351	6,211	949,903	6,215	0	5,074	55,342	0	0	77	0	1,757,457
1988	255,177	0	0	2,134	918	55,582	2,506	300,257	96,409	77	0	1,745	188,577	2,915	0	8,044	5,331	0	0	236	243	664,974
1989	557,174	0	466	8,533	8,382	147,864	3,336	246,145	80,583	374	213	2,698	1,035,071	5,454	0	10,527	80,612	125	0	39	0	1,630,422
1990	335,860	0	502	391	6,079	24,794	1,216	352,035	175,776	0	185	2,106	429,703	1,114	0	1,910	15,593	0	0	222	0	1,011,625
1991	377,438	0	275	199	1,509	99,477	1,734	306,111	91,207	0	187	555	467,217	2,840	0	4,811	4,435	0	0	0	0	980,557
1992	403,755	0	509	1,387	24,392	17,719	11,162	209,851	195,817	4,117	83	2,266	553,227	54,833	0	1,056	19,565	0	0	0	0	1,095,984
1993	333,116	0	588	406	4,058	30,338	20,806	155,323	299,921	0	65	1,936	1,018,014	4,750	0	1,094	78	0	0	0	0	1,537,377
1994	197,444	0	85	972	0	65,572	6,927	449,431	303,639	0	0	3,365	428,662	193	0	2,415	2,122	0	0	0	0	1,263,383
1995	373,425	0	487	1,961	5,536	177,134	0	287,466	34,515	128	0	4,408	790,224	2,733	0	9,682	11,729	0	0	0	0	1,326,004

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		Return ages																			
Year	Parent Esc.	0.1	0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	0.4	1.4	2.3	3.2	1.5	2.4	3.3	4.2	2.5	3.4	4.3	Total
1996	284,389	0	1,250	77	42,250	42,681	190	755,131	37,554	0	283	7,338	488,256	3,524	0	3,725	6,975	0	0	0	0	1,389,234
1997	378,950	0	2,699	128	3,890	35,497	2,161	221,341	91,023	0	275	1,935	598,081	2,429	0	3,779	2,789	0	0	218	0	966,245
1998	290,469	0	219	1,939	2,094	67,102	161	238,666	38,619	0	0	443	161,660	460	0	277	592	0	0	0	0	512,232
1999	258,542	0	660	78	7,877	50,524	2,172	131,351	39,710	0	0	1,974	111,636	109	0	2,265	1,554	0	0	0	0	349,910
2000	269,086	0	236	838	3,725	59,500	1,669	551,058	17,973	0	0	10,263	463,675	0	0	11,913	2,729	0	0	0	0	1,123,579
2001	392,903	0	0	316	13,049	13,614	922	383,305	48,615	0	1,608	22,155	441,534	482	0	6,749	0	0	0	0	0	932,349
2002	341,132	0	0	394	11,402	36,890	0	350,418	28,709	0	1,130	3,538	317,174	343	1,230	3,105	1,735	0	0	0	0	756,068
2003	334,119	0	816	804	20,583	61,186	241	301,317	62,734	0	0	4,106	549,704	0	0	3,715	3,212	0	0	0	0	1,008,419
2004	214,459	0	8,236	530	56,510	43,626	621	367,978	188,016	0	0	2,113	589,976	0	0	7,796	10,222	0	0	0	0	1,275,627
2005	225,366	0	386	0	11,064	97,493	1,001	432,922	61,749	0	0	2,336	333,777	30,086	0	2,884	33,560	0	0	6,746	0	1,014,004
2006	368,996	0	1,430	733	15,995	75,181	3,162	239,752	202,954	185	0	4,793	976,710	1,006	0	12,944	48,392	0	0	0	0	1,583,237
2007	293,883	0	2,507	2,498	15,469	19,113	682	60,123	94,193	0	0	0	796,083	0	0	4,390	793	0	0	0	0	995,851
2008	328,479	0	1,477	2,538	960	215,567	567	354,386	50,681	0	0	1,667	405,521	0	0	0	7,440	0	0	0	0	1,040,804
2009	328,586	0	0	1,856	88	35,219	1,752	116,554	230,688	0	2,653	1,687	874,765	4,891	0	478	4,191	0	0	245	0	1,275,068
2010	311,291	0	0	3,485	391	71,559	19,809	469,001	143,690	0	0	955	449,064	1,129	0	13,841	6,350	0				1,179,273
2011	264,887	0	0	7,789	508	99,462	12,004	588,276	73,251	0	0	5,746	349,449	267								
2012	358,948	0	0	5,438	1,402	45,030	2,143	213,849	40,571	0	0											
2013	369,319	0	391	1,375	8,200	54,765	5,450															
2014	291,228	0	900	3,491																		
2015	589,810	0																				
2016	348,023																					
2017	339,303																					

APPENDIX C. SUPPORTING INFORMATION FOR CHIGNIK MANAGEMENT AREA PINK SALMON ESCAPEMENT GOALS

Appendix C1.–Description of stock and escapement goal for Chignik pink salmon.

System: Entire CMA
Species: Pink salmon

Regulatory area	Chignik Management Area
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine
Current escapement goal:	SEG (even years): 170,000 to 280,000 (2016) SEG (odd years): 260,000 to 450,000 (2016)
Recommended escapement goal:	SEG (even years): No change SEG (odd years): No change
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial survey, 1980 to present
Data summary	
Data quality:	Poor
Data type:	Fixed-wing aerial surveys from 1980 to present. Data used in analysis represents indicator streams and years from each district with a complete survey dataset from 1980 to present. No stock-specific harvest information is available.
Data Contrast:	Even years: 5.8; Odd Years: 5.5
Methodology:	Percentile
Criteria for SEG:	Moderate contrast, low exploitation
Percentiles:	20th to 60th
Comments:	Data from 1980 to 2017 were used from systems with complete survey histories, in years with a majority of systems surveyed, and indicator streams selected based on contribution to district and area-wide escapement estimates. Eight area-wide systems were chosen to represent an indexed escapement goal: Aniakchak River 272-605, Main Creek 272-702, Chiginagak Bay East 272-905, Kumlium Creek 272-501, North Fork River 272-514, Ivan River 273-722, Ivanof River 275-406, Humpback Creek 275-502.

Appendix C2.–Chignik pink salmon peak aerial survey counts (PAS), in selected indicator streams 1980–2017.

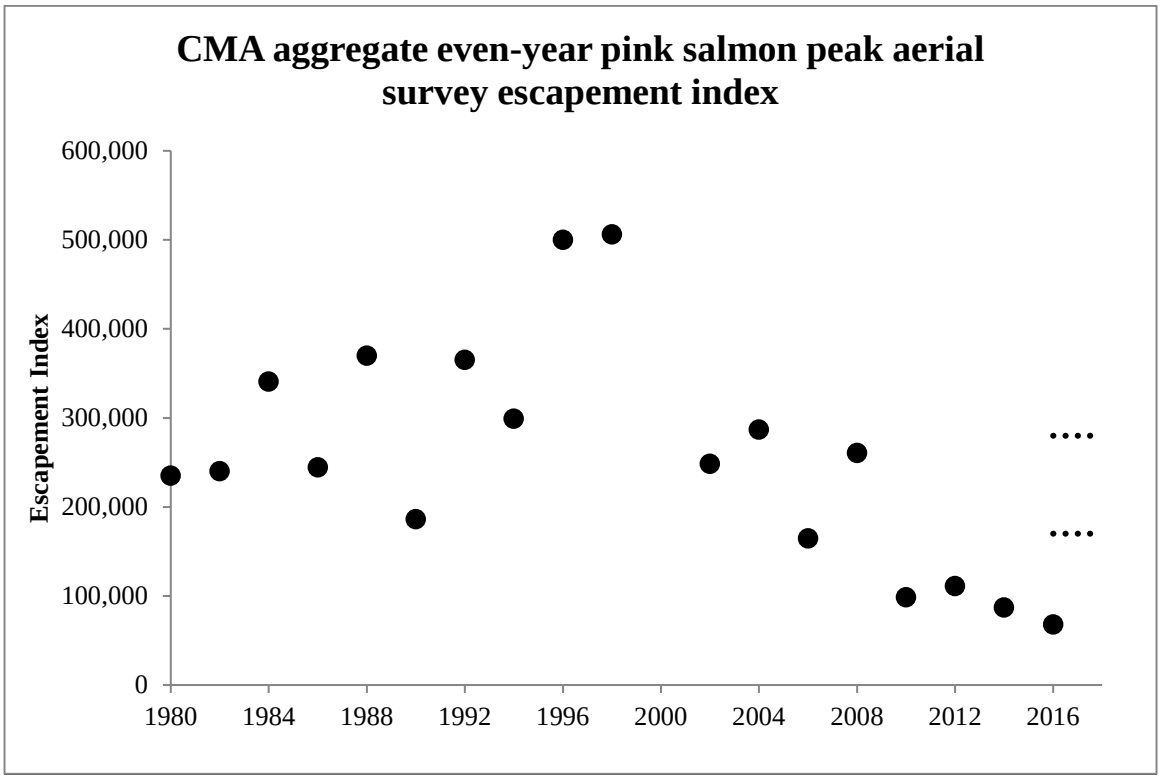
System: Chignik Management Area
Species: Pink salmon

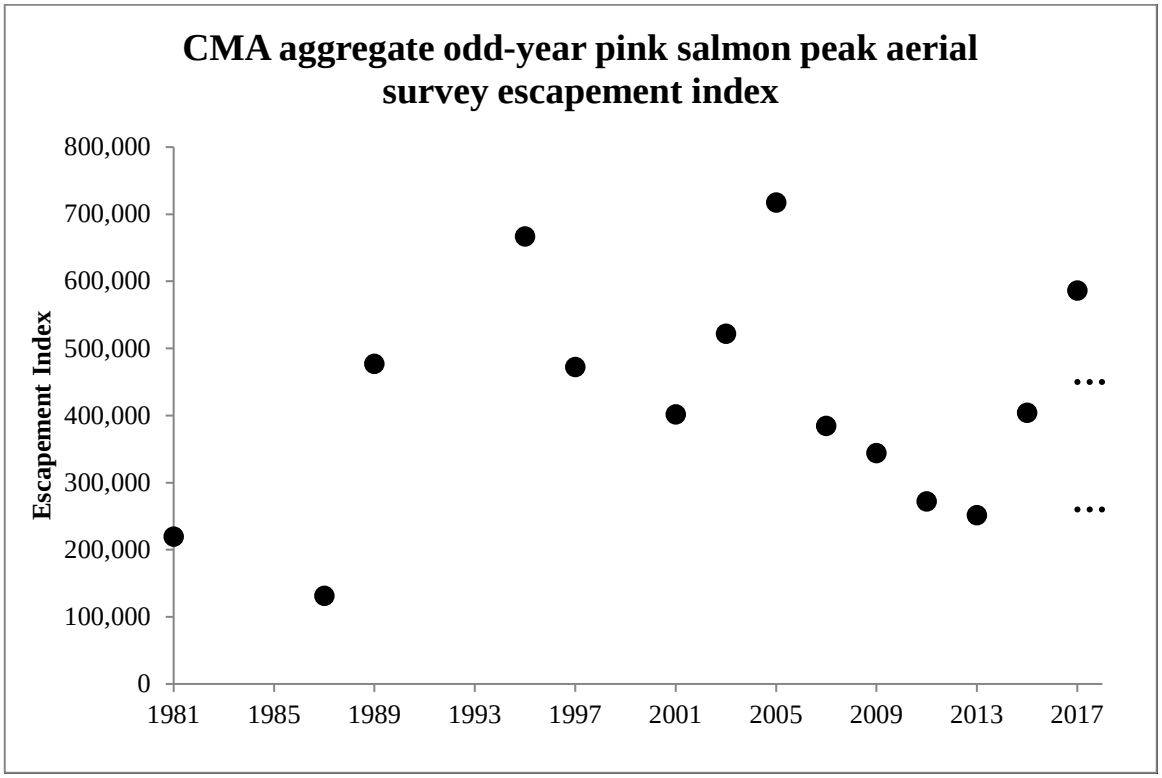
Year	Ivanof River	Humpback Creek	Ivan River	Kumlium Creek	North Fork River	Aniakchak River	Main Creek	Chiginagak Bay East	Index Total
1980	38,000	10,000	28,000	2,500	38,500	40,000	50,000	28,000	235,000
1981	18,000	39,000	80,000	35,000	14,000	2,700	5,800	25,000	219,500
1982	2,700	3,500	21,000	900	12,000	130,000	36,000	34,000	240,100
1983	20,000	8,500	12,000	-	-	1,000	9,000	3,100	-
1984	61,000	15,000	98,000	3,000	25,000	28,400	8,500	102,000	340,900
1985	150,000	20,000	20,000	-	4,500	-	13,600	15,000	-
1986	5,400	2,000	9,600	30,000	27,000	1,500	85,000	84,000	244,500
1987	16,900	15,500	12,800	46,900	5,500	2,500	11,100	20,000	131,200
1988	91,000	24,000	39,000	22,000	58,000	52,000	33,000	51,000	370,000
1989	161,000	51,000	32,000	63,000	23,000	5,000	53,000	89,000	477,000
1990	35,000	5,000	12,800	2,500	21,000	15,000	48,000	47,000	186,300
1991	150,300	96,300	42,200	115,300	-	-	-	5,700	-
1992	43,110	25,290	31,400	9,800	38,300	96,600	25,600	95,140	365,240
1993	80,170	123,300	17,300	82,000	24,500	-	25,500	10,000	-
1994	53,000	40,000	30,000	20,000	31,000	60,000	30,000	35,000	299,000
1995	145,000	100,000	120,000	114,000	45,000	70,000	66,000	7,000	667,000
1996	159,000	44,000	75,000	5,000	40,000	125,000	47,000	5,000	500,000
1997	35,000	46,000	92,000	125,000	33,000	68,000	70,000	3,500	472,500
1998	125,000	20,000	70,000	13,000	32,000	150,000	90,000	6,000	506,000
1999	130,000	14,000	14,000	107,000	45,000	1,000	31,900	-	-
2000	25,000	12,000	51,000	-	27,000	197,000	28,000	23,000	-
2001	32,000	24,000	71,000	150,000	20,000	41,000	12,000	52,000	402,000
2002	8,000	10,500	53,000	14,000	8,000	93,900	27,000	34,000	248,400
2003	38,000	19,000	20,000	117,000	52,000	102,000	30,000	144,000	522,000
2004	37,000	20,000	37,000	14,000	40,000	100,000	19,000	20,000	287,000
2005	72,000	82,300	150,000	175,000	27,500	140,400	69,000	1,100	717,300
2006	7,000	50,000	20,000	3,500	11,300	57,600	14,400	1,000	164,800
2007	100,000	35,000	56,000	37,000	54,000	29,500	64,000	9,000	384,500
2008	51,200	22,000	50,000	10,500	14,000	68,100	33,000	12,000	260,800
2009	65,550	24,200	89,100	51,300	15,300	44,300	32,200	22,300	344,050
2010	2,000	4,800	4,500	600	4,500	51,000	21,000	10,000	98,400
2011	37,000	42,000	30,000	52,000	22,000	31,000	29,000	29,000	272,000
2012	3,000	20,000	14,400	1,200	32,400	20,000	15,000	5,000	111,000
2013	10,000	18,900	37,600	75,000	6,700	38,000	18,600	47,000	251,800
2014	3,840	11,000	36,600	3,500	8,500	2,800	7,900	13,100	87,240
2015	53,600	21,200	39,200	136,000	15,700	65,300	37,000	36,000	404,000
2016	15,300	2,900	14,100	1,900	9,500	7,100	7,500	9,800	68,100
2017	106,000	44,200	76,900	153,100	81,300	44,100	57,700	23,000	586,300

Note: Systems not successfully surveyed in a survey year are indicated with "-". If 1 or more systems in a survey year were not successfully surveyed, the Index Total was not calculated and is noted as "-".

Appendix C3.–Chignik pink salmon escapement (PAS), 1980–2017 and the current escapement goal.

System: Chignik Management Area
Species: Pink salmon





APPENDIX D. SUPPORTING INFORMATION FOR THE CHIGNIK MANAGEMENT AREA CHUM SALMON ESCAPEMENT GOAL

Appendix D1.–Description of stocks and escapement goal for chum salmon in the entire CMA.

System: Entire CMA
Species: Chum salmon

Regulatory area	Chignik Management Area
Management division:	Commercial Fisheries
Primary fishery:	Commercial purse seine
Current escapement goal:	SEG: 45,000 to 110,000 (2016)
Recommended escapement goal:	No change
Optimal escapement goal:	None
Inriver goal:	None
Action points:	None
Escapement enumeration:	Aerial survey, 1981 to present
Data summary:	
Data quality:	Poor
Data type:	Fixed-wing aerial surveys from 1981 to present. Data used in analysis represents indicator streams and years from each district with a complete survey dataset from 1981 to present. No stock-specific harvest information is available.
Contrast:	10.1
Methodology:	3-tier Percentile Approach
Criteria for SEG:	High contrast, low exploitation
Percentiles:	20th to 60th
Comments:	Data from 1981 to 2017 were used from systems with complete survey histories, in years with a majority of systems surveyed, and indicator streams selected based on contribution to district and area-wide escapement estimates. Six area-wide systems were chosen to represent an indexed escapement goal; Aniakchak River 272-605, Small Nakililok River 272-804, Chiginagak River 272-903a; Central District: North Fork River 272-514; Portage Creek 273-842; Ivanof River 275-406.

Appendix D2.–Chignik chum salmon peak aerial survey counts (PAS), in selected indicator streams 1981–2017.

System: Chignik Management Area
Species: Chum salmon

Year	Small Nakalilok River	Aniakchak River	Chiginangak River	North Fork River	Portage Creek	Ivanof River	Total Index
1981	5,500	20,000	16,000	15,000	16,800	9,000	82,300
1982	-	47,000	8,500	2,000	6,000	6,100	-
1983	3,200	2,665	8,700	-	5,500	4,000	-
1984	32,000	42,000	34,850	10,500	12,600	38,000	169,950
1985	-	2,500	-	-	2,200	10,000	-
1986	1,000	500	2,000	5,000	2,500	6,700	17,700
1987	2,500	1,700	15,700	3,700	6,400	4,745	34,745
1988	1,600	17,000	9,400	12,100	7,200	23,000	70,300
1989	4,100	2,500	3,400	1,200	1,600	4,000	16,800
1990	9,800	8,000	7,800	700	6,100	20,000	52,400
1991	4,100	5,600	-	2,900	18,700	167,500	-
1992	11,160	50,100	4,300	54,000	3,120	14,000	136,680
1993	3,000	7,500	-	8,000	7,200	21,000	-
1994	5,000	40,000	3,000	1,200	6,000	65,000	120,200
1995	400	50,000	2,000	15,000	5,000	65,000	137,400
1996	7,000	50,000	2,000	9,000	5,000	65,000	138,000
1997	12,000	7,500	30,000	5,000	15,000	56,000	125,500
1998	7,500	50,000	5,000	4,000	7,000	65,000	138,500
1999	15,000	6,900	3,000	2,000	1,600	6,000	34,500
2000	25,000	39,400	5,000	8,000	2,000	6,000	85,400
2001	10,000	46,000	31,000	2,000	600	53,000	142,600
2002	27,000	17,100	24,000	4,000	4,800	10,000	86,900
2003	7,000	15,000	4,000	13,000	1,500	28,000	68,500
2004	15,000	100,000	10,000	7,600	-	10,000	-
2005	-	15,600	-	75,000	9,000	500	-
2006	4,000	8,420	8,800	1,200	1,000	18,000	41,420
2007	8,700	10,500	4,200	2,000	14,500	100,000	139,900
2008	1,100	24,900	-	-	14,240	76,800	-
2009	32,000	19,000	14,800	9,600	3,900	29,000	108,300
2010	12,000	3,500	19,125	4,000	2,000	62,000	102,625
2011	38,000	6,000	18,000	12,000	3,000	42,000	119,000
2012	5,000	5,000	3,000	3,600	2,200	7,500	26,300
2013	8,500	8,000	1,400	5,000	6,000	81,000	109,900
2014	1,100	6,300	1,720	1,000	8,600	28,000	46,720
2015	30,100	29,000	12,000	12,500	7,500	32,300	123,400
2016	8,500	6,400	19,600	4,000	5,400	26,000	69,900
2017	24,700	16,500	9,300	12,400	6,000	28,000	96,900

Note: Systems not successfully surveyed in a survey year are indicated with "-". If 1 or more systems in a survey year were not successfully surveyed, the Index Total was not calculated and is noted as "-".

Appendix D3.–Chignik chum salmon aggregate indexed peak aerial survey (PAS) 1982–2017.

System: Chignik Management Area
Species: Chum salmon