Fishery Manuscript No. 06-08

Review of Escapement and Abundance Information for Kuskokwim Area Salmon Stocks

by

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and

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Decembr 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

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December 2006

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This document should be cited as:
Molyneaux, D. M., and L. K. Brannian. 2006. Review of escapement and abundance information for Kuskokwim area salmon stocks. Alaska Department of Fish and Game, Fishery Manuscript No. 06-08, Anchorage.

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G) convened an Escapement Goal Review Team to review salmon escapement goals for the Arctic-Yukon-Kuskokwim Region in preparation for the January 2007 meeting of the Alaska Board of Fisheries. To support that effort, salmon escapement data and abundance information for the Kuskokwim Area were updated through 2005 and are represented here. From our review of Kuskokwim data we recommend biological escapement goals (BEG) for Chinook and sockeye salmon *Oncorhynchus tshawytscha* and *O. nerka* in the Middle Fork Goodnews River; sustainable escapement goals (SEG) for Chinook salmon in the George, Kwethluk, and Tuluksak Rivers; a revised SEG for Aniak River chum salmon *O. keta*; and that SEGs based on aerial surveys be discontinued for Chinook salmon in the Kwethluk and coho salmon *O. kisutch* in the Kanektok River.

This report also summarizes much of the historical salmon escapement information for the Kuskokwim Area, but in a manner that is intended to focus on the needs for assessing inter-annual trends for escapement goals. This intent is achieved through an extensive series of appendices that present historical escapement information in a standardized manner. The main body of appendices is preceded by narrative that provides context useful in interpreting the information in the appendices. In many cases data sets in the appendices are truncated in order to address standardization needs. As such, investigators seeking more complete information should consult master escapement files maintained by ADF&G, original aerial survey forms, and detailed project reports.

Key words: Pacific salmon, *Oncorhynchus*, escapement, escapement goal, Kuskokwim, stock status, Biological Escapement Goal, BEG, Sustainable Escapement Goal, SEG, aerial surveys, weirs, total run abundance, Parken Watershed Method, Habitat-based model, Shotwell-Adkison model.

INTRODUCTION

This report is a review of salmon *Oncorhynchus* sp. escapement data, abundance information, and escapement goals for the Kuskokwim Management Area, inclusive of both Kuskokwim River and Kuskokwim Bay. Most data sets are derived from aerial surveys or ground based tributary escapement monitoring projects such as weirs, counting towers and tributary sonar. Also presented are data sets from models that estimate historical total abundance of Kuskokwim River Chinook *O. tshawytscha* and chum salmon *O. keta*, and Goodnews River Chinook and sockeye salmon *O. nerka*. Most data sets were evaluated for possible development of escapement goals based on the State of Alaska's Sustainable Salmon Fisheries Policy (5 AAC 39.222, effective 2000, amended 2001) and Policy for Statewide Salmon Escapement Goals (5 AAC 39.223, 2001). These data were presented to an Alaska Department of Fish and Game (ADF&G) interdivisional Escapement Goal Review Team assigned to review escapement and other data and make escapement goal recommendations where appropriate. Formal meetings of this team were conducted on 26–27 April 2005 and 15–16 November 2005 to discuss and develop recommendations. Updates and preliminary recommendations were distributed through email. This report represents data interpretations and recommendations of the authors to the Escapement Goal Review Team. Final escapement goal recommendations (Brannian et al. 2006) will be made by the Escapement Goal Review Team to the Directors of the Divisions of Commercial and Sport Fisheries after the 2007 Alaska Board of Fisheries (BOF) meeting.

HISTORY OF ESCAPEMENT GOAL DEVELOPMENT

ADF&G is responsible for establishing escapement goals (5 AAC 39.222). Provisional salmon spawning escapement objectives were first established within the Kuskokwim Area in 1983 for specific aerial survey index areas, and for ground-based projects operated on the Kogrukluk, Aniak, and Middle Fork Goodnews Rivers (Buklis 1993). The spawning objectives were loosely based on the average historical escapement counts obtained in these systems beginning in 1959.

These spawning objectives represented the minimum escapement levels needed to maintain the salmon stocks at past levels of abundance. A few revisions and corrections were made to these original spawning objectives. Consistent with the escapement goal policy established by the Commissioner of ADF&G in October 1992, the established Kuskokwim Area escapement objectives in effect during 1992 were documented and established as the official biological escapement goals (Buklis 1993). These goals remained in effect from 1993 to 2000. A review of escapement goals was done prior to the 2001 BOF meeting based on 5 AAC 39.222 and 5 AAC 39.223 (2001).

Policy 5 AAC 39.222 (effective 2000, amended 2001) defines three types of escapement goals:

- Biological Escapement Goal (BEG) is the escapement that provides the greatest potential for maximum sustained yield. A BEG is the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted by the board. BEGs are developed from the best available biological information, and should be scientifically defensible on the basis of available biological information. BEGs are determined by the department and are expressed as a range based on factors such as salmon stock productivity and data uncertainty. The department is to seek to maintain evenly distributed salmon escapements within the bounds of a BEG.

- Sustainable Escapement Goal (SEG) is a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10 year period, used in situations where a BEG cannot be estimated due to the absence of a stock specific catch estimate. The SEG is the primary management objective for the escapement, unless an optimal escapement or inriver run goal has been adopted by the board, and will be developed from the best available biological information. The SEG will be determined by the department and will be stated as a range that takes into account data uncertainty. The department will seek to maintain escapements within the bounds of the SEG.

- Sustained Escapement Threshold (SET) is a threshold level of escapement, below which the ability of the salmon stock to sustain itself is jeopardized. In practice, SET can be estimated based on lower ranges of historical escapement levels, for which the salmon stock has consistently demonstrated the ability to sustain itself. The SET is lower than the lower bound of the BEG and lower than the lower bound of the SEG. The SET is established by the department in consultation with the board, as needed for salmon stocks of management or conservation concern.

BEG's and SEG's are the primary management objectives for escapement unless the board sets an optimal escapement goal (OEG) which takes into account socio-economic factors. BEGs are set to provide levels of escapement that will on average produce large returns with large harvestable surpluses. Escapements above or below these levels may be sustainable, but will on average produce less fish for harvest. SEGs are set to provide levels of escapement that will produce runs and harvests similar to what has occurred in the past. To date, escapement goals established in the Kuskokwim Area are SEGs because not enough data exists to determine total escapement or total return for a given stock.

Before adoption of the regulatory Escapement Goal Policy in 2001, all escapement goals established by ADF&G were termed biological escapement goals (ADF&G 2004). This nomenclature was modified after adoption of the policy in 2001, and replaced the BEG-only

escapement goal concept with the broader range of escapement goal types including the BEG, SEG, SET, and OEG as defined above.

ADF&G reviewed escapement goals again in 2004. Many goals were re-expressed in terms of a range and new goals were established (ADF&G 2004) in 2005. Within the Kuskokwim Area, SEGs were revised or established for 12 Chinook salmon stocks, 4 chum salmon stocks, 3 coho salmon *O. kisutch* stocks, and 3 sockeye salmon stocks (Table 1). SEGs were discontinued for 1 Chinook salmon stock, 4 chum salmon stocks, 2 coho salmon stocks, and 1 sockeye salmon stock.

STUDY AREA

The Kuskokwim Area includes the Kuskokwim River drainage, all waters of Alaska that flow into the Bering Sea between Cape Newenham and the Naskonat Peninsula, as well as Nelson, Nunivak, and St. Matthew Islands (Figure 1). For the purposes of this report, the area is divided into two components: Kuskokwim River and Kuskokwim Bay. Kuskokwim River includes all tributaries of the drainage and incorporates commercial fishing Districts 1 and 2. Kuskokwim Bay includes mainland coastal streams, excluding the Kuskokwim River, and incorporates commercial fishing District 4 near the community of Quinhagak, and District 5 of Goodnews Bay. Mainland streams north of the Kuskokwim River and streams of Nelson, Nunivak and St Matthew Islands are not typically surveyed for salmon and are not included in this review.

METHODS

DATA SOURCES

Available data for escapement, harvest, and age composition of each stock or combination of stocks were compiled from research reports, management reports, and unpublished historical databases. In addition, estimates of watershed area were obtained for selected rivers with Chinook salmon populations. We evaluated the type, quality, and amount of data for each stock to determine the adequacy of the data set for establishing an escapement goal. When applicable, the appropriate type of escapement goal as defined in 5 AAC 39.222 was also considered. If return estimates were not available because harvest and/or age were not consistently measured, the data were considered of fair to poor quality and not considered for BEG determination, but were instead evaluated using other methods to establish an SEG.

Aerial Surveys

Assessment of salmon escapement using aerial surveys flown with fixed-winged aircraft have been conducted in the Kuskokwim Area since the late 1950's, and form the most extensive escapement time series available. Water bodies are typically surveyed only one time each season and are intended to index relative abundance of salmon escapement, as opposed to providing an estimate of total escapement. As such, aerial survey counts are not expanded in any way. The program targets a standard set of streams and lakes distributed throughout the Kuskokwim Area that are surveyed as resources and conditions allow. Aerial surveys are, however, restricted to clear water streams and lakes, which exclude many salmon bearing waters in the upper Kuskokwim River drainage where water clarity is typically obscured by dissolved organics, glacier runoff, or sediment load. Our review includes many of the more commonly surveyed waters as reported by Burkey and Salomone (1999), and Schneiderhan (*Unpublished*). Survey

results from 1999 to present were retrieved from the original survey forms, which are currently unpublished.

Survey efforts occur during the period of peak spawning ground abundance for Chinook and sockeye salmon, which occurs between late July and early August. These species are targeted because they are generally most visible to the surveyor, which is assumed to result in more reliable enumeration. In addition, Chinook and sockeye salmon share similar timing in their period of peak abundance, which allows for more efficient use of the survey time. Chinook salmon surveys include streams throughout the Kuskokwim Area; however, surveys for sockeye salmon are focused on Kuskokwim Bay populations such as the Kanektok and Goodnews Rivers.

Chum salmon may be counted during Chinook and sockeye surveys, but because chum salmon are typically less discernable, the counts are not used to index chum salmon abundance. In addition, chum salmon have a more protracted run timing on the spawning grounds, which makes timing the surveys to peak abundance unreliable.

On occasion, aerial surveys are flown to assess coho salmon in late summer and fall, but rarely are these surveys adequate for indexing abundance. Most of the late season surveys that have been conducted occur well before peak coho salmon abundance on the spawning grounds. Overall, late season aerial surveys are logistically impractical because of weather, limited funding, and limited aircraft availability during the fall hunting season.

There are inconsistencies in the manner in which surveys have been conducted historically, so to enhance comparability we apply the following criteria to surveys selected for inclusion in our appendices:

- Surveys are conducted with fixed-winged aircraft, which is historically the most common method employed.
- Findings are limited to Chinook and sockeye salmon, which are typically the species targeted by surveyors.
- Surveys are completed between 17 July and 5 August, which approximates the period of peak spawning ground abundance for Chinook and sockeye salmon.
- Index totals for a given stream are for the same “Survey Areas”, which are formally defined reaches or segments of the water body as described by Schneiderhan (1988; e.g., Figure 2).
- Observers rated survey conditions as being good (rating = 1) or fair (rating =2) based on criteria related to survey method, weather and water conditions, time of survey, and spawning stage (Schniederhan 1988).
- Surveys counts are inclusive of carcasses.
- Finally, on a case by case basis, the above criteria can be overridden based on surveyor notes.

This final criterion recognizes that many aspects of aerial surveys are qualitative, and that consistency can vary depending on the surveyor experience and training, which varies both between surveyors and within individual surveyors as they gain experience and understanding of the context as to how the information is used.

Weirs, Counting Towers, and Tributary Sonar

Nine streams in the Kuskokwim Area currently have salmon escapements monitored with the aid of weirs or sonar deployment. Most of the streams have been monitored for fewer than 10 years, and in some cases the time series includes years in which the monitoring was done with counting towers instead of weirs. Operations typically include daily enumeration of salmon passage; collection of information to characterize the age, sex, and length composition of the escapement; and collection of basic environmental data such as water temperature and water level. These projects also serve as platforms to collect information for other studies such as characterizing stock-specific genetic profiles, determining stock-specific run timing in the Kuskokwim River, and providing marked to unmarked ratios used to estimate total salmon abundance for the Kuskokwim River.

Aniak River Sonar

Aniak River joins the Kuskokwim River near the community of Aniak at river mile 225, and the sonar site is located approximately 12 miles upstream of the confluence (Figure 1). The Aniak River supports spawning populations of Chinook, sockeye, chum, pink *O. gorbuscha*, and coho salmon. The sonar passage is unapportioned to species, so the counts serve as an index of chum salmon abundance. Chum salmon, however, dominate during most of the period when the sonar is operated, so the annual counts likely provide a reasonable proximity of chum salmon abundance. The overall dominance of chum salmon has generally been confirmed through periodic netting activities (Schneiderhan 1989; Vania 1998).

Salmon escapement monitoring began in the river with the use of non-configurable (Bendix) sonar equipment in 1980 (Schneiderhan 1981). A transducer was deployed from one bank and passage in the unensonified section of the river was estimated using an expansion factor (Schneiderhan 1989). From 1980 to 1995, the Aniak River sonar project counted on one side of the river. Based on aerial survey data and similar work done in other systems, an extrapolation factor of 1.5 was used to estimate full river passage. In 1984 a second sonar was used to determine the relative contributions of each bank and from this analysis, a correction factor of 1.62 was applied to the total counts from 1980–1994. Results from the 1995 sonar operations were considered unusable because of abnormalities in the operation that could not be resolved (Burkey et al. 1996), including the lack of documentation inherent with non-user configurable sonar. In 1996, the project was redesigned to incorporate user-configurable (BioSonics) sonar technology (Vania 1998). At the same time, the project was relocated to a site about a mile farther downstream where a transducer could be deployed from each bank to allow full channel ensonification, precluding the need for any expansion factor. Sonar operations from 1996 to 2002 remained essentially unchanged (McEwen 2005). Counting protocol changed in 2003 replacing 24-hour a day counting with three 4-hour sampling periods, which continued in 2004. Also initiated in 2003 was preparation to transition to a new dual frequency identification sonar (DIDSON), which replaced the dual-beam system in 2004 (McEwen 2005; Sandall and Pfisterer 2006).

ADF&G has typically treated the sonar count as an actual census of chum salmon and many reports refer to the sonar count as “numbers of chum salmon” (Francisco et al. 1995). Development of projects in other tributaries, however, such as in the George and Tatlawiksuk Rivers found an abundance of longnose suckers *Catostomus catostomus* migrating up the lower end of these streams during June and July (Stewart and Molyneaux 2005; Stewart et al. 2005). The occurrence of long nose suckers, in particular, was surprising because they were uncommon

at other locations such as the long operated Kogrukluk River weir. Around this same time, operations at the Aniak sonar project began to include collection of chum salmon age-sex-length data through the use of beach seining. Longnose suckers and species other than chum salmon were sometimes abundant and even dominant early in the season, and in some years pink salmon were common later in the season. Concern began to build that the unspeciated targets counted with the sonar may include longnose suckers and pink salmon, species whose abundance varied widely from year to year. Further, concern was that these non-chum salmon might actually even dominate the counts during certain segments of the season. These concerns continued until 2003 when studies were conducted to address the issue concurrent with the dual operation of BioSonics and DIDSON sonar equipment. The conclusion from these studies was that suckers, whitefish species *Coregonus sp.* and *Prosopium cylindraceum*, and pink salmon were not being identified as targets by the sonar, and that the historical sonar counts were likely inclusive of only medium to large-sized salmon, plus some of the larger but less common resident species such as rainbow trout *Oncorhynchus mykiss* and northern pike *Esox lucius*.

Past examination of the relationship of counts made using BioSonics and DIDSON equipment have shown that the BioSonics estimates are about 70% of those derived using DIDSON (Sandall and Pfisterer 2006). As the SEG in 2004 was based on data collected with BioSonics or Bendix equipment, we were concerned that it no longer was applicable to the new counting method. Thus we sought to use the relationship between BioSonics and DIDSON counts when equipment was operated concurrently to convert historic data in a manner to make it more comparable to DIDSON counts, and the converted data set provided the basis for a revised SEG range.

Conversion of historical counts (1980–2003) was a 3 step process. First run timing curves were updated to reflect only passage within the dates 26 June through 31 July. Next, any missing counts within these dates were estimated using the updated timing curves. Last, the relationship between historical daily passage and DIDSON passage was estimated and used to adjust the updated historical counts.

Total annual passage is reported for the target operational period of 26 June through 31 July. Counts obtained outside of this range were not used for cross year comparisons. Missing data within these target operational dates were estimated using average run timing obtained from the years 1996–2004. Years 1996, 2000, and 2002 were used to model early run timing; 1997, 2003, and 2004 for average run timing; and 1998 and 1999 served as the model for late run timing. Data missing between 26 June and 31 July were expanded by first determining the fraction of the run counted from the timing table. The overall run was estimated by dividing the observed counts by the fraction of the run sampled. The count for each missing day was computed by multiplying the fraction of the run that typically occurs on that day by the total estimated run size.

The hourly BioSonics counts from 1997 through 2003 were converted to equivalent DIDSON counts according to the following equations (C. Pfisterer, Commercial Fisheries Biologist, ADF&G, Fairbanks; personal communication):

Left bank:

$$DIDSON = 0.603 BioSonics^{1.115} \quad (1)$$

Right bank:

$$DIDSON = 0.614 BioSonics^{1.145} \quad (2)$$

The hourly DIDSON counts from 2004 and 2005 were converted to equivalent BioSonics counts by solving the previous equations for BioSonics:

Left bank:

$$BioSonics = \left(\frac{DIDSON}{0.603} \right)^{\frac{1}{1.115}} \quad (3)$$

Right bank:

$$BioSonics = \left(\frac{DIDSON}{0.614} \right)^{\frac{1}{1.145}} \quad (4)$$

The hourly counts for the BioSonics/Bendix and DIDSON were summed by day and standard least squares regression was used to determine a functional relationship of DIDSON as a function of Bendix or BioSonics counts. Because of the non-linear relationship, a second order equation was used and the intercept was forced through zero to prevent negative DIDSON counts at the low passage rates. The resulting equation was:

$$DIDSON = 6.527e\text{-}6 BioSonics^2 + 1.1971 BioSonics \quad (R^2=0.9982, p<0.0001) \quad (5)$$

The historical daily values from 1980 through 1995 were converted to DIDSON equivalent counts using this equation, then summed to provide season totals.

George River Weir

George River joins the Kuskokwim River at river mile 277 and the weir is located about 4 river miles upstream of the confluence (Figure 1). Salmon escapement monitoring began at the site in 1996 through the joint effort of Kuskokwim Native Association and ADF&G (Molyneaux et al. 1997). The original fixed-panel weir was replaced with a resistance board weir in 1999, which improved performance during high water events (Linderman et al. 2003; Stewart et al. 2005). The river has spawning populations of Chinook, chum, and coho salmon, and up to a few hundred sockeye and pink salmon are observed each year. Negligible salmon spawning is observed downstream of the weir. Picket spacing used in the weir panels enables complete enumeration of Chinook, chum, coho, and sockeye, but pink salmon counts are incomplete because of fish passing upstream between pickets. No weir-based escapement goals are established for any of these species on the George River.

Total annual passage is reported for the target operational period of 15 June through 20 September. Daily passages are estimated when operations fall short of this targeted period. Daily observed salmon passage during the first few days of operational period is typically less than 0.5% of the total annual passage for Chinook salmon and less than 0.1% for chum salmon. In all but a few instances, daily observed coho salmon passage during the final few days of operational period is less than 0.5% of the season total passage. Fish passage at the start of the operational period is sometimes dominated by longnose suckers, with annual counts typically including several thousand suckers, most of which pass upstream by mid-July. These same fish migrate back downstream in late summer.

Kogrukluk River Weir

The Kogrukluk River is a tributary of the Holitna River and has the most extensive history of salmon escapement monitoring in the Kuskokwim Area (Figure 1). The Holitna River joins the Kuskokwim at river mile 305, and the Kogrukluk River is located an additional 136 river miles upstream (Shelden et al. 2005). The weir is located less than 1 mile upstream from where the Kogrukluk River confluences with the Holitna River. Salmon escapement monitoring began in the Kogrukluk River drainage in 1969 with a counting tower located several miles upstream of the current weir site (Yanagawa 1972a), but operations did not extend long enough to include coho salmon. The tower site was upstream of Shotgun Creek, a productive salmon spawning area. ADF&G staff tried to install a weir near the tower site in 1971, but efforts were unsuccessful (Yanagawa 1972b), and counting tower operations continued through 1978 (Baxter 1976a, 1977; Kuhlmann 1973, 1974, 1975; Yanagawa 1972a, 1973). Weir operation at the current site, which is located downstream of Shotgun Creek, began in 1976 (Baxter 1976b), and the tower project was discontinued after 1978. Escapement numbers reported in our review only include those from the weir. Concurrent operation of the weir and tower in 1976, 1977, and 1978 may allow for estimating salmon passage at the weir site back to 1969, however, no expansion has yet been attempted. The annual operating period was extended in 1981 to include coho salmon.

The river has spawning populations of Chinook, sockeye, chum, pink, and coho salmon. All of these species also spawn downstream of the weir; in fact, extensive spawning occurs in the Holitna River for many miles downstream of the Kogrukluk River. Results of a radiotelemetry study indicated that 23% to 27% of the Chinook salmon, 2% to 9% of the chum salmon (Stroka and Reed 2005) and 8% (Chythlook and Evenson 2003) to 31% (Wuttig and Evenson 2002) of the coho salmon estimated within the Holitna drainage migrate upstream of the Kogrukluk weir. Picket spacing used in the weir enables complete enumeration of Chinook, sockeye, chum, and coho salmon, but pink salmon enumeration is incomplete because of fish passing upstream between pickets. The annual sockeye escapement is larger than any other stream where salmon monitoring occurs in the Kuskokwim River, and these sockeye salmon are likely riverine spawners, given the lack of lake habitat in the drainage.

Weir-based escapement goals are established for Kogrukluk River Chinook, chum, and coho salmon (Table 2). The coho salmon escapement goal is the only goal for this species in the entire Kuskokwim River drainage. The project does not have a formal target operational period, and the start and stop dates have varied widely over the 29 year history of the project. Counting typically begins by 25 June and few salmon have been observed passing prior to that date. Operations are typically discontinued about 10 September, and with few exceptions the daily observed coho salmon passage during the last few days of operation is fewer than 2% of the season total passage.

The patterns observed in the annual age, sex, and length composition of Kogrukluk River salmon sometimes differ markedly from what is observed at other weirs in the Kuskokwim Area. For example, female chum salmon often constitute less than 20% of the annual escapement at Kogrukluk River, while at other weirs half of the fish passed annually are females. Some of these anomalies may be a result of the extensive spawning that occurs downstream of the weir (Molyneaux and Folletti 2005). The collection of age and length data for sockeye salmon was discontinued in 1995 due to the occurrence of extensive scale reabsorption and the need to direct resources towards improved sampling of other species.

Kwethluk River Weir

Kwethluk River joins the Kuskokwim River at river mile 82 and the current weir is located about 52 river miles upstream of the confluence (Figure 1). The U.S. Fish and Wildlife Service (USFWS) operated a resistance board weir in that vicinity in 1992 (Harper 1998), but the project was discontinued because of concerns from local residents. The Association of Village Council Presidents and Kwethluk Joint Council operated a counting tower in that same vicinity from 1996 to 1999, but success was limited (Cappiello and Sundown 1998; Chris and Cappiello 1999; Hooper 2001). The weir project was re-established in 2001 as a cooperative venture between USFWS and the Organized Village of Kwethluk (Harper and Watry 2001; Roettiger et al. 2004, 2005). The river has spawning populations of Chinook, chum, pink, and coho salmon, and up to a few thousand sockeye salmon are observed each year. An unknown fraction of salmon spawning occurs downstream of the weir, but is thought to be modest in comparison with spawning upstream of the weir. Picket spacing used in the weir panels enables complete enumeration of Chinook, chum, coho, and sockeye, but pink salmon enumeration is incomplete because of fish passing upstream between pickets. No weir-based escapement goals are established for any of these species on the Kwethluk River.

The project does not have a formal target operational period. Counting typically begins by 25 June, which corresponds well with most early arriving Chinook and chum salmon. Operations are often discontinued between 10 and 15 September, and with some exceptions the daily observed coho salmon passage during the last few days of operation is fewer than 2% of the season total passage.

Kwethluk River has historically been one of the rivers where aerial surveys were periodically conducted to index Chinook salmon escapement. Aerial surveys are paired with weir escapement estimates for the years 2002, 2003, and 2004. The relationship between these two data sets was explored with a simple linear regression of log transformed data to develop expansion factors for estimating total annual Chinook salmon escapement from historical aerial survey counts. The expanded set of annual escapements was added to the data set used for exploring escapement goal recommendations.

Takotna River Weir

Takotna River joins the Kuskokwim River across from McGrath at river mile 467, and the weir is located about 52 river miles upstream of the confluence, near the community of Takotna (Figure 1). Salmon escapement monitoring began in that vicinity in 1995 with a counting tower located a few miles downstream of the current weir site (Molyneaux et al. 2000). The counting tower was operated by Iditarod Area School District (IASD) in consultation with ADF&G. The tower project was replaced in 2000 with the current resistance board weir, and project administration transferred from IASD to Takotna Tribal Council (Schwanke et al. 2001). Project objectives were broadened in 2000 to include assessment of coho salmon escapement. The river has spawning populations of Chinook, chum, and coho salmon, a few sockeye salmon are observed in most years, and on rare occasions a pink salmon is observed. An unknown fraction of salmon spawning occurs downstream of the weir, but is thought to be modest in comparison to upstream of the weir. Picket spacing used in the weir enables complete enumeration of Chinook, chum, coho, and sockeye salmon, but it is possible for pink salmon to pass between pickets undetected. No weir-based escapement goals are established for any of these species on the Takotna River.

Total annual passage is reported for the target operational period of 24 June through 20 September, although it is common for operations to begin prior to 24 June (Costello et al. 2005, 2006). Daily passages are estimated when operations fall short of this targeted period. With few exceptions, daily observed salmon passage during the first few days of the operational period is less than 0.5% of the total annual passage for both Chinook and chum salmon. Daily observed coho salmon passage during the final few days of the operational period is less than 0.5% of the season total passage. Fish passage at the start of the operational period is often dominated by longnose suckers, with annual counts typically a few thousand suckers or less, most of which pass upstream by mid-July. These same fish migrate back downstream in late summer.

Tatlawiksuk River Weir

Tatlawiksuk River joins the Kuskokwim River at river mile 350 and the weir is located about 3 river miles upstream of the confluence (Figure 1). Salmon escapement monitoring began at the site in 1998 through the joint effort of Kuskokwim Native Association and ADF&G (Linderman et al. 2004; Stewart and Molyneaux 2005). Operations in 1998 were incomplete and the original fixed-panel weir was replaced with a resistance board weir in 1999, which improved performance during high water events. The river has spawning populations of Chinook, chum, and coho salmon, and in some years a few sockeye and pink salmon are observed. Negligible salmon spawning is observed downstream of the weir. Picket spacing used in the weir enables complete enumeration of Chinook, chum, coho, and sockeye, but pink salmon counts are incomplete because of fish passing upstream between pickets. No weir-based escapement goals are established for any of these species on the Tatlawiksuk River.

Total annual passage is reported for the target operational period of 15 June through 20 September. Daily passages are estimated when operations fall short of this targeted period. Daily observed salmon passage during the first few days of operational period is less than 0.1% of the total annual passage for both Chinook and chum salmon. In all but a few instances, daily observed coho salmon passage during the final few days of the operational period is less than 1.0% of the season total passage. Fish passage at the start of the operational period is sometimes dominated by longnose suckers, with annual counts typically including several thousand suckers, most of which pass upstream by mid-July. These same fish migrate back downstream in late summer.

Tuluksak River Weir

Tuluksak River joins the Kuskokwim River at river mile 119 and the weir is located about 34 river miles upstream of the confluence (Figure 1). The USFWS operated a resistance board weir in that vicinity from 1991 to 1994 (Harper 1995a, b, c, 1997). The project was discontinued after 1994 because of concerns from some local residents, but re-established in 2001 as a cooperative venture between USFWS and Tuluksak Traditional Council (Gates and Harper 2002a, b; Zabkar and Harper 2004; Zabkar et al. 2005). The river has spawning populations of Chinook, chum, pink, and coho salmon. In addition, up to a few hundred sockeye salmon are observed each year. An unknown fraction of salmon spawning occurs downstream of the weir, but is thought to be modest in comparison with spawning upstream of the weir. Picket spacing used in the weir panels enables complete enumeration of Chinook, chum, coho, and sockeye, but pink salmon enumeration is incomplete because of fish passing upstream between pickets. No weir-based escapement goals are established for any of these species on the Tuluksak River.

The project does not have a formal target operational period. Counting typically begins by 25 June and few salmon have been observed passing prior to that date. Operations are typically

discontinued about 10 September, and with few exceptions the daily observed coho salmon passage during the last few days of operation is fewer than 2% of the season total passage.

Tuluksak River has historically been one of the rivers where aerial surveys were periodically conducted to index Chinook salmon escapement. Aerial surveys are paired with weir escapement estimates for the years 1991, 2003, 2004, and 2005. The relationship between these two data sets was explored with a simple linear regression of log transformed data to develop expansion factors for estimating total annual Chinook salmon escapement from historical aerial survey counts. The expanded set of annual escapements was added to the data set used for exploring escapement goal recommendations.

Kanektok River Weir

The Kanektok River is located south of the Kuskokwim River and flows westerly for 91 miles to where it empties into Kuskokwim Bay near the community of Quinhagak (Figure 1). Salmon escapement monitoring began with counting towers (1960–1962 and 1996–1999), (ADF&G 1960, 1961a, 1962a; Fox 1997; Menard and Caole 1999) and sonar (1982 through 1987) (Huttunen 1984, 1985, 1986, 1988; Schultz and Williams 1984) but these projects were judged unsuccessful due to logistical problems, poor visibility into the water column, site limitations or difficulties in species identification. In 1999, resources were redirected toward developing a resistance board weir (Burkey et al. 2001) that was first operated in 2001. Despite initial technical and logistical difficulties (Linderman 2000), the weir has demonstrated its ability to be a viable and accurate method to monitor salmon escapement in the Kanektok River (Linderman 2005a). Currently the weir is located at river mile 42. The Kanektok River has spawning populations of Chinook, chum, coho, sockeye and pink salmon. Significant spawning of all species occurs downstream of the weir. Picket spacing used in the weir enables complete enumeration of Chinook, sockeye, chum and coho salmon, but it is possible for pink salmon to pass between pickets. A large population of char *Salvelinus malma* also migrates through the weir and again the smaller fish pass between the pickets. No weir-based escapement goals are established for any of the salmon species on the Kanektok River.

The Kanektok weir project does not have a formal target operational period. Counting typically begins by 24 June and few salmon are observed until late June. Operations have been discontinued 19 or 20 September, although in 2001 the project operated for coho salmon through 2 October with 96% observed by 20 September.

The Kanektok River has historically been one of the rivers where aerial surveys were flown. Aerial survey counts have been consistently obtained for Chinook, chum, and sockeye salmon. This is also one of the few rivers with a time series of coho salmon surveys, although most of the surveys occur during the early half of the run. Aerial surveys have not been paired with weir escapements for enough years (2 Chinook, 1 chum salmon, and 0 coho salmon) to develop an expansion factor for estimating total annual escapement from historical aerial survey counts. An SEG from aerial survey data has been set for Chinook, chum, coho, and sockeye salmon (Table 2) in the Kanektok River to include area above and below the weir.

Middle Fork Goodnews River Weir

The Goodnews River is located south of the Kuskokwim River and flows west into Goodnews Bay near the community of Goodnews Bay north of Cape Newenham (Figure 1). Two major tributaries, the Middle Fork Goodnews River and South Fork Goodnews River, join the main stem a few miles

from its mouth. The mainstem Goodnews River is sometimes referred to as the North Fork Goodnews River upstream of the Middle Fork confluence. Salmon escapement monitoring began on the Middle Fork Goodnews River in 1981 as a counting tower and continued through 1990. Though generally successful, the tower was limited by difficulties in species apportionment and high labor costs (Menard and Caole 1999). In 1991, resources were directed towards developing a fixed-panel weir, which greatly reduced labor costs and improved species identification. The fixed panel weir, however, was susceptible to frequent high water levels that often exceeded the height of the panels, rendering the weir inoperable. In July of 1997, the fixed-panel weir was replaced with a resistance-board weir designed to withstand high water levels (Menard 1998). Use of the resistance-board weir has allowed the project to remain operational during high water events, and to operate into September, traditionally a period of high water level (Linderman 2005b). The river has spawning populations of Chinook, chum, coho, pink and sockeye salmon. The weir is located approximately 10 river miles upstream from the community of Goodnews Bay. Salmon spawn in both the Goodnews River main stem and the Middle Fork but few are thought to spawn in the South Fork. Picket spacing used in the weir enables complete enumeration of Chinook, sockeye, chum and coho salmon, but it is possible for pink salmon to pass between pickets.

The Middle Fork Goodnews River weir project does not have a formal target operational period. Counting typically begins between 11 June and 27 June and are considered here as complete counts for the earliest arriving species, Chinook salmon. Historically operations were discontinued by late July when the counting tower was used, between 18 and 23 August through 1996 when the fixed-panel weir was used, and since 1997 operations have continued until between 17 and 30 September to count coho salmon (Linderman 2005b). Weir-based escapement goals are established for Chinook, chum, coho, and sockeye salmon for the Middle Fork Goodnews River.

The Goodnews River has historically been one of the rivers where aerial surveys were flown. Counts have been consistently obtained for Chinook, chum and sockeye salmon. This is also one of the few rivers with a time series of paired observations with weir escapements and mainstem surveys. Total escapement for the Goodnews River is estimated by the relationship between the weir and aerial surveys on the Goodnews River mainstem and Middle Fork (Linderman 2005b). An SEG from aerial survey data has been set for Chinook and sockeye salmon (Table 2) in the Goodnews River.

Mark and Recapture Projects

Tagging studies were conducted on the Kuskokwim River in the 1960s. Findings included distance traveled by tagged fish and the number of days between release and recapture (ADF&G 1961b, 1962b, 1966), but stock-specific information and abundance information were lacking. The primary deficiencies of these studies were the inability to tag adequate numbers of fish and the absence of tributary or mainstem tag recovery projects.

More recently, the Bering Sea Fishermen's Association funded a chum salmon radiotelemetry study in 1995 with the objective of identifying temporal differences in stock-specific run timing as fish passed through the lower river commercial fishing district (Parker and Howard 1995). The project fell short of reaching this objective because, among other factors, too few chum salmon were tagged and receiver stations failed.

Two other recent initiatives used radiotelemetry and mark–recapture to estimate abundance of Chinook, chum, and coho salmon in the Holitna River drainage, and Chinook salmon in the Kuskokwim River upstream of the Aniak River confluence. Both projects employed a two-

sample mark–recapture approach. The Holitna study was initiated in 2001 to estimate Chinook, chum and coho abundance, and to assess the proportion of the Holitna runs monitored at Kogrukluk weir (Chythlook and Evenson 2003). Coho salmon were excluded from the Holitna study in 2003 and 2004, and abundance was only estimated for Chinook and chum salmon (Stroka and Brase 2004; Stroka and Reed 2005). The second initiative began in 2002 to estimate abundance of Chinook salmon in the Kuskokwim River upstream of the Aniak River using a two-sample mark–recapture approach (Stuby 2003, 2004, 2005, 2006). Chinook salmon were captured in the Kuskokwim River near Kalskag for tagging and recovery data were collected at all upriver weir projects (George, Kogrukluk, Tatlawiksuk, and Takotna). Aerial surveys were also conducted to further describe spawning distribution and to verify radio tag data recorded on ground receiver stations.

Since 2001 ADF&G and the Kuskokwim Native Association also operated a mark–recapture project for chum, coho, and sockeye salmon, but using spaghetti tag (2001–2004) and anchor tag (2005) deployment instead of radio tags (Kerkvliet and Hamazaki 2003; Kerkvliet et al. 2003; 2004; Pawluk et al. 2006a; b). Salmon were captured and tagged from the main stem Kuskokwim River near Kalskag and recovered at both main stem recovery locations, upriver tributary projects (Aniak, George, Kogrukluk, Tatlawiksuk, and Takotna rivers), and through voluntary tag recoveries in other tributaries (e.g., Holokuk River and Telaquana Lake). Findings included run timing of specific salmon stocks as they passed Kalskag, stock-specific travel speed, and estimates of total abundance upstream of Kalskag.

METHODS FOR SETTING BIOLOGICAL ESCAPEMENT GOALS

Data for a salmon stock were considered sufficient to attempt to estimate the escapement level with the greatest potential to provide for MSY, and to develop a BEG, if: 1) a sufficient time series of escapement and total return estimates were available, 2) spawning contrast was sufficiently large, and 3) the estimates were sufficiently accurate and precise. The only stocks of salmon in the Kuskokwim Area qualified under these criteria are the Chinook and sockeye salmon of the Middle Fork Goodnews River.

Middle Fork Goodnews River Chinook and Sockeye Salmon

Spawner-recruit data for Middle Fork Goodnews River Chinook and sockeye salmon were analyzed (T. Hamazaki, Commercial Fisheries Biometrician, ADF&G, Anchorage; personal communication) using a Ricker spawner-recruit model (Hilborn and Walters 1992) to estimate spawners (S_{msy}) at maximum sustained yield (MSY). If the analyses indicated significant autocorrelation among the residuals of the model, the methods recommended by Bernard et al. (2006) were used to alleviate bias in the parameter estimates. The BEG range was then estimated from the model by estimating the escapements of S_{msy} that produced 90% credible bounds.

Total runs of Middle Fork Goodnews River Chinook or sockeye salmon were estimated by adding estimates of escapements and harvests. The escapement data were obtained from Linderman (2005b) and represent counts of salmon at the Middle Fork Goodnews River tower (1981–1990) or weir (1991–2004). Salmon are harvested by subsistence, commercial and sport fishers primarily in Goodnews Bay and represent a stock mixture of salmon bound for streams throughout the Goodnews River drainage. Total return by brood year was estimated using age data collected from the commercial harvest in Goodnews Bay and escapement at the Middle Fork Goodnews River.

Salmon spawn in both the Middle Fork and main stem (referred to as the North Fork) of the Goodnews River (Figure 3). Linderman (2005b) estimates total drainage escapement of Chinook and sockeye salmon from weir counts and their relationship to aerial survey counts of both the Middle and North Fork tributaries. The percentage of the salmon observed by surveyors on the Middle Fork is calculated by comparing the aerial survey count above the weir site with the weir count through that date. The North Fork aerial survey count is then adjusted for observer efficiency to estimate the escapement in that river through the date of the survey. Expanding the aerial survey count of the entire Goodnews River to estimate total escapement based on this relationship assumes the surveyor was observing the same percentage of the fish throughout the survey area. The final estimate of North Fork escapement is then adjusted for the percentage of passage through the Middle Fork weir after the survey. Total estimated Goodnews River escapement was used to apportion catches to the Middle or North Fork rivers.

Harvest data published in the Kuskokwim Area annual management report series (Whitmore et al. 2005) were used in this analysis. Commercial fishing is only allowed in Goodnews Bay. Subsistence fishing occurs in the bay and Goodnews River, but primarily below the confluence with the Middle Fork Goodnews River and in salt water. Sport fishing occurs primarily throughout the Goodnews River drainage. All annual harvest were summed and assumed to be a mixture of Middle and North Fork Goodnews River salmon. Harvests of Middle Fork fish were estimated as a percent of the total harvest, and that percent was assumed to be equal to the percent the Middle Fork Goodnews weir/tower represented of the total escapement.

Age composition for each total annual run was determined using age data collected from Goodnews Bay commercial catch and Middle Fork escapements. The age data were collected at predetermined periods of the run or by commercial fishing period. Estimated annual age proportion was usually weighted by escapement abundance or commercial catch of each period. The method of weighting estimates are reported by Molyneaux and DuBois (1996) and most data through 2004 were obtained from Molyneaux and Folletti (2005). Chinook age data from 1983, 1984, and 1988 escapement samples, 1981–1989 commercial samples, and 1981–1984 sockeye commercial data were extracted from the Arctic-Yukon-Kuskokwim (AYK) salmon database (Brannian et al. 2005). Estimates derived from the database are not weighted.

When sample sizes are not met, or the distribution of those samples through time is not representative, the resulting age composition is not weighted by abundance (escapement or commercial catch; Molyneaux and Folletti 2005). Furthermore, in some years samples were not collected at all or only amounted to a few. Less than 50% of samples had complete data sets. For our analysis we used non-weighted data sets or substituted similar data in the analysis using the following criteria:

Case 1: Season total sample number is greater than 50 and unweighted raw data are available in the AYK salmon database. Unweighted age proportion was used. Following years were estimated using this method:

Chinook escapement data: 1983, 1984, 1988;
Chinook commercial catch data: 1981–1989;
Sockeye commercial catch data: 1981–1984.

Case 2: Season total sample number is greater than 50. Seasonal proportion was made using only available periods weighted (from Molyneaux and Folletti 2005). Following years were estimated in this method:

Chinook escapement data: 1992, 1994, 2004;
Chinook commercial catch data: 1990, 1993–1995, 1999;
Sockeye escapement data: 1986, 1988, 1991–1994, 1996, 1998–1999;
Sockeye commercial catch data: 1995–1996.

Case 3: Season total sample number is less than 50 and age proportion of either commercial or escapement of that year is available. Seasonal proportion was made based on either commercial catch or escapement of that year. Since age proportion of escapement and commercial catch differ (due to commercial catch net selectivity), escapement-commercial age proportion correction factor was developed. Following years estimated in this method:

Chinook escapement data: 1981–1982, 1985–1987, 1989, 1990, 1993, 1996, 1998, 1999, 2001.

Case 4: Data are missing and an average weighted age proportion was substituted. The following years were estimated using this method:

Chinook commercial catch data: 1996.

A brood table was constructed from the runs by year and the age composition of these runs for Chinook and sockeye salmon of the Middle Fork Goodnews River. Escapement age proportion was applied to Middle Fork Escapement data, and commercial catch age proportion was applied to subsistence, sports, and commercial catch data. 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.

A Ricker spawner-recruit model was applied for setting the Middle Fork Goodnews River BEG. For parameter estimation a log non-linear form of the Ricker model $\ln(R) = \ln(\alpha) + \ln(S) - \beta S + \varepsilon$ was fitted using Bayesian inference method, in which likelihood of ln(R) was assumed to have a normal distribution or R has a log-normal distribution. Prior distributions for ln(α) and β were assumed to have normal distributions. Furthermore the prior for β was assumed to be positive. The software, WinBUGS 1.4.1 (downloaded from http://www.mrc-bsu.cam.ac.uk/bugs/welcome.shtml), was used for Bayesian parameter estimation (T. Hamazaki, Commercial Fisheries Biometrician, ADF&G, Anchorage; personal communication). Following is the WinBUGS program code used for estimation.

```
model{ for (y in 1:17)
 {lnR[y] <- log(R[y])
 lnR[y] ~ dnorm(lnRmu[y],tau)
 lnRmu[y] <- lnalpha + log(S[y]) - beta*S[y]  }
 lnalpha_c <- lnalpha + (sigma * sigma / 2 )
 S_msy <- lnalpha_c / beta * (0.5 - 0.07*lnalpha_c)
 sigma <- 1 / sqrt(tau)
 beta ~ dnorm(0,1.0)I(0,)          # Non informative, positive;
 lnalpha ~ dnorm(0,1.0E-6)              # Non informative;
 tau ~ dgamma(0.001,0.001)            # Non informative;  }
```

Adjusted α and S_{msy} were calculated as $\alpha=\exp[\ln(\alpha)+\sigma^2/2]$, $S_{msy} = [\ln(\alpha)+\sigma^2/2][0.5-0.07(\ln(\alpha)+\sigma^2/2)]/\beta$, respectively (Hilborn 1985). The 90% confidential interval about S_{msy} was estimated by Bayesian 90% credible interval and used as the BEG range.

METHODS FOR SETTING SUSTAINABLE ESCAPEMENT GOALS

Two methods were used to evaluate potential SEGs. The first method follows the algorithm recommended by Bue and Hasbrouck (*Unpublished*) setting the SEG based on percentiles of historic escapement data. The second method applies only to Chinook salmon stocks and resulted from a meta-analysis developed by Parken et al. (2004) that relates spawners at MSY to watershed area (the habitat-based model).

SEGs were recommended from percentiles according to the following conventions for rounding off numbers. To be precautionary, all percentiles were rounded up to establish goal ranges. Percentile numbers in the 100's were rounded up to the nearest 10; percentile numbers in the 1,000's were rounded up to the nearest 100; percentile numbers in the 10,000's were rounded up to the nearest 1,000; percentile numbers in the 100,000's were rounded up to the nearest 10,000. For example, a percentile number of 5,826 would be rounded to 5,900; and a percentile number of 105,500 would be rounded up to 110,000.

Bue and Hasbrouck Model

Sustainable escapement goals were established following guidelines recommended by Bue and Hasbrouck (*Unpublished*), who suggested the following criteria to categorize SEGs based on the accuracy and amount of data available:

> **Excellent**: Escapement, harvest and age all estimated with relatively good accuracy and precision (e.g. 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 MSY.
>
> **Good**: Escapement, harvest, and age all estimated with reasonably good accuracy and/or precision (e.g. escapement estimated by capture-recapture experiment or multiple foot/aerial surveys); no age data or data is of questionable accuracy and/or precision; data may allow construction of brood table; data time series relatively too short to accurately estimate 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 (e.g. single foot/aerial survey) such that the index provides a fairly reliable measure of escapement; no harvest and age data.

In addition, Bue and Hasbrouck (*Unpublished*) suggested algorithm based criteria to estimate sustainable escapement goals (SEGs) for Upper Cook Inlet salmon stocks (Table 3).

These criteria were used to assess the available salmon escapement data and to make recommendations for SEGs. For a few stocks, a minimum SEG point threshold was established rather than a range (ADF&G 2004). Threshold SEG goals were only recommended in situations where a stock is managed incidentally to a targeted stock or in cases when a fishery has been prosecuted at very low levels such that there is no ability to “fish down” the stock to an optimal upper range.

Habitat-Based Model

The number of spawning Chinook salmon which produces MSY (S_{msy}) was estimated for select Chinook salmon stocks in the Kuskokwim area using a habitat-based model developed by Parken et al. (2004). Parken et al. (2004) conducted a meta-analysis comparing estimates of carrying capacity (S_c) and S_{msy} to watershed area for 13 stream-type (age 1. and older smolt) and 14 ocean-type (age 0. smolt) Chinook salmon stocks along the North Pacific coast, including stocks from the Yukon River and southeast Alaska. The model hypothesis is that physically larger drainages containing Chinook salmon also tend to have proportionally larger populations than smaller drainages that contain Chinook salmon. The relationship between S_c or S_{msy} and watershed area was found to fit an allometric power curve quite well. When data were log-log transformed and fit using linear regression separately for stream- and ocean-type Chinook stocks R values ranged from 0.87 to 0.88 for stream-type stocks and 0.83 and 0.82 for ocean-type (Witteveen et al. 2005). Chinook stocks were from watersheds ranging from 90 km^2 (King Salmon River in southeast Alaska) to over 130,000 km^2 (a portion of the Columbia River drainage). Chinook salmon of the Kuskokwim Area have a stream-type life history so the regression models developed for stream-type stocks were utilized in the analysis. From C. Parken (Canada Department of Fisheries and Oceans (DFO); personal communication) the relationship between watershed area and S_c is:

$$\ln(S_c) = 0.692564 \ln(\text{watershed area}) + 3.89361. \quad (1)$$

The relationship for S_{msy} is:

$$\ln(S_{msy}) = 0.6921884 \ln(\text{watershed area}) + 2.9172166. \quad (2)$$

Estimates of S_c and S_{msy} were calculated from equations 1 and 2 using watershed areas of selected Kuskokwim Rivers with Chinook salmon populations. The 95% confidence intervals were also calculated for S_{msy} from the log-log regression statistics.

The watershed area was estimated as km^2 upstream of the mouth or a weir as noted. In Parken's analysis, areas above known barriers (dams, natural falls, etc) were excluded; however, no such barriers are known to exist for the Kuskokwim Rivers in our review. Determination of watershed areas were made by the Division of Sport Fish using GIS software (ESRI ArcMap 9.1 with the Spatial Analyst extension). Input data sources included: (1) coordinates of weirs or river mouth, (2) National Elevation Dataset (NED), and (3) National Hydrography Dataset (NHD). Digitized USGS topographical maps (1:63,360 and 1:250,000-scale) were used to plot points at river mouths, and for manual quality control of watershed boundaries (J. Buckwalter, Sport Fish Biologist, ADF&G, Anchorage; personal communication).

CHINOOK SALMON TOTAL RUN RECONSTRUCTION MODEL

Data collected since 2002 are available to estimate the total run of Chinook salmon to the Kuskokwim River, and to compare their distribution in relation to our escapement monitoring projects. Recently collected data making this possible involves two radiotelemetry projects from which mark–recapture estimates of Chinook salmon abundance were made for the Kuskokwim River upstream of the Aniak River confluence (Stuby 2003, 2004, 2005, 2006), and for the Holitna River drainage (Stroka and Brase 2004; Stroka and Reed 2005). In addition, a high proportion of the radiotagged Chinook salmon were tracked to tributary streams, most thought to be final spawning locations.

Annual total run of Chinook salmon to the Kuskokwim River was estimated for 2002 through 2005 as total catch plus drainage-wide escapement upstream of the Eek River confluence. Total catch consists of commercial catch summed from fish tickets, subsistence harvest estimates from post season surveys and sport fish harvest estimated from a post season survey (Whitmore et al. 2005). Escapement was estimated each year from the 2002 through 2005 radio tag mark–recapture estimates coupled with the array of escapement projects in the drainage. These estimates represent all Chinook salmon migrating upstream of the Aniak River and major Chinook salmon tributaries downstream of Aniak River. Eek River was excluded because of its proximity downstream of nearly all commercial and subsistence fishing. Escapement estimates for the Aniak River and tributaries downstream of the Aniak River were estimated as the sum of weir counts on the Kwethluk and Tuluksak rivers, and expert opinion estimates for Aniak and Kisaralik. Chinook salmon abundance into the Aniak River is unknown beyond aerial survey counts. Based on general water shed size and expert opinion of ADF&G staff, Chinook salmon escapement into the Aniak River was estimated to be perhaps 50% of population estimates for the Holitna River. Total escapement into the Kisaralik River was estimated as being equal to the Kwethluk weir count. In 2005 the Kwethluk weir was not operated. Kwethluk Chinook salmon escapement was estimated from 2005 aerial survey counts and the historical relationship between aerial survey and weir counts.

CHUM SALMON TOTAL RUN RECONSTRUCTION MODEL

Shotwell and Adkison (2004) estimated historical total run abundance and escapement for Kuskokwim River chum salmon for the years 1976 through 2000 as a modeling exercise for data-limited situations. Their model uses a maximum likelihood statistical framework that incorporates an escapement index, subsistence harvest, commercial fishery catch and effort data, test-fish CPUE, and 3 years of whole-river sonar estimates of chum salmon passage. The model was developed using historical escapement records for the Kogrukluk River as the escapement index, assuming this tributary represents a constant fraction (estimated in the model as $1/13^{th}$) of the annual escapement for the entire Kuskokwim River drainage. Estimates of total annual run abundance and escapement were derived by combining the escapement index, weekly catch, weekly test-fish CPUE, and whole-river sonar estimates. The 3 years of whole-river sonar estimates served as an independent estimate of run abundance as was necessary to anchor model estimates. Total annual chum salmon abundance estimates include commercial and subsistence inriver harvest information as reported by Burkey et al. (2001). Subsistence estimates prior to 1985 require adjustment to account for incomplete species apportionment (Shotwell and Adkison 2004).

RESULTS AND DISCUSSION

We reviewed escapement histories for 59 salmon data sets representing 51 stocks (25 Chinook, 13 chum, 8 coho, and 5 sockeye salmon) of which 22 currently have established escapement goals (Table 1). We suggest establishing new escapement goals for 3 additional stocks, revising escapement goals for 3 stocks, and discontinuing escapement goals for 2 stocks (Table 2). Insufficient historical time series was the reason most often given for data sets reviewed for which no escapement goal was recommended (Table 4). Detailed findings are reported in the Appendices, with Kuskokwim River tributaries in Appendix A and Kuskokwim Bay rivers in Appendix B. Each of these sections is further arranged by species as Chinook salmon begins as Appendix A1 or B1, chum salmon as Appendix A2 or B2, coho salmon as Appendix A3 or B3, and sockeye salmon as Appendix A4 or B4; otherwise, streams are listed alphabetically for Kuskokwim River tributaries; Aniak (Appendix A1.1 and A2.1) to Tuluksak (Appendix A1.25

and A2.8) or Kuskokwim Bay rivers; Arolik (Appendix B1.1 and B4.1) to Salmon River (B1.7). Each stream listed in the appendix has a numeric "Map Code" that corresponds to the location of the stream in Figure 3. Supplemental information about historical harvests and escapements is reported in Appendix C.

Aerial surveys are flown throughout the Kuskokwim Area primarily to assess Chinook and sockeye salmon escapements, but these counts do not represent total escapement for these rivers. While aerial surveys provide a relatively inexpensive means of assessing salmon escapements over a broad geographic range, their quality is variable, as can be seen in comparisons with paired weir data in which R^2 range from 0.97 to 0.22 (e.g., Appendix A1.7, A1.16, and A1.25). Still, aerial surveys are often the only cost effective means of establishing a bench mark for assessing the adequacy of escapements. Developing escapement goals from aerial survey data, however, must be done with caution, trends interpreted with skepticism, and any resulting consideration of management actions corroborated with independent information. With these caveats in mind, aerial survey-based escapement goals are currently established on 10 Kuskokwim Area streams for Chinook salmon, 1 stream for chum salmon, 1 stream for coho salmon and 2 streams for sockeye salmon (Table 2). We do not intend to recommend additional escapement goals based on aerial survey data, but rather present these data for tracking abundance and distribution of these salmon species in the Kuskokwim River. We also intend to replace aerial survey-based goals with weir-based goals when sufficient data become available. Furthermore, we no longer use aerial survey methodology to track chum salmon abundance in the Kuskokwim River, and historical data are not included in this report. We do wish to emphasize, however, that aerial surveys do provide valuable insights to distribution and abundance that are perfectly acceptable for some applications and they will continue to be a necessary tool for salmon stock assessment in the Kuskokwim Area, indeed, there are areas where their application should be extended.

Ground-based escapement projects are currently operated on nine streams in the Kuskokwim Area, including one tributary sonar project and eight weirs, some of which historically originated as counting towers. Ground-based escapement counts for Kogrukluk River began at the current location in 1976, for the Aniak River in 1980, and for the Middle Fork Goodnews River in 1981. All other ground-based escapement projects began more recently: Tuluksak in 1991, Kwethluk in 1992, Takotna in 1995, George in 1996, Tatlawiksuk in 1998, and Kanektok in 2001. Currently, weir-based escapement goals have only been established on the Kogrukluk and Middle Fork Goodnews rivers, and a sonar-based escapement goal has been established on the Aniak River. For the other weirs the time series of data is not sufficient to apply the Bue and Hasbrouck method without inclusion of expanded aerial survey counts and corroboration from other escapement goal development models. We have presented weir counts of Chinook, chum, coho, and sockeye salmon for these shorter time series for review and to provide recommendations for future considerations.

The current array of ground-based escapement monitoring projects has a broad geographic distribution that sample widely separated salmon spawning aggregates, and this provides vital insight to sustainable salmon management in the Kuskokwim Area, particularly for the Kuskokwim River, which traverses nearly 1,000 miles from interior headwaters to the Bering Sea. Recent tagging studies conducted on Chinook, sockeye, chum and coho salmon all demonstrate differential stock-specific run timings with the general pattern of salmon stocks from upper river tributaries entering the Kuskokwim River earliest, while stocks from lower river

tributaries enter progressively later (Kerkvliet and Hamazaki 2003; Kerkvliet et al. 2003; 2004; Pawluk et al. 2006a; b; Stuby 2003, 2004, 2005, 2006). The temporal distribution of these stock-specific run timings overlap, sometimes broadly, and the degree of overlap varies between years; still, the difference between the midpoint of one stock and another of the same species can be several weeks. Concurrent with this phenomenon is the occurrence of extensive subsistence fisheries that tend to harvest more heavily from early arriving salmon, and commercial fisheries that have been focused variably over the years on early, middle or late segments of the overall salmon run. This mixture of different stock-specific run timings and uneven harvest distribution, produces the possibility of significant differential exploitation rates between stocks or stock aggregates. This situation mandates that managers develop and maintain a rigorous monitoring program capable of assessing the adequacy of escapements throughout the geographic range of each species; further, managers must monitor those escapements to assess for trends that may be detrimental to the overall vitality of salmon runs and species diversity. Establishment of escapement goals is part of that monitoring program because those goals provide the context from which we judge whether escapements are adequate or not. Indeed, those goals can influence the direction of activities well beyond fishery management, including mining, forestry, and road development to mention just a few. These are among the issues to be considered when deciding on both the number and distribution of escapement goals established in the Kuskokwim Area.

The current list of 22 escapement goals in the Kuskokwim Area falls short of what we believe is appropriate to the need, and efforts are underway to build the data sets required to address some of these needs. We have drawn on these developing data sets to recommend establishment of new escapement goals, and modification or replacement of others. We also recommend one goal be discontinued based on irregularities in how the goal was originally conceived. There remain, however, several gaps.

One information gap is a result of our concern that Upper Kuskokwim River Chinook salmon may be exposed to higher exploitation rates than spawning stocks from farther downstream. In support of defining those exploitation rates and ensuring sustainable fisheries management, one or two ground-based monitoring projects with associated escapement goals are needed for Upper river stocks. One candidate to address this gap is the Takotna River weir, which is currently operated to enumerate Chinook, chum, and coho salmon escapements (Appendix A1.21, A2.6, and A3.4). The Salmon River (Pitka Fork drainage), is another candidate stream and has more Chinook salmon than the Takotna River, but fewer of other species and currently no weir (Appendix A1.20). Recent radio-telemetry studies of Kuskokwim River Chinook salmon (Stuby 2006.) have revealed previously unknown spawning concentrations in the upper Hoholitna and Necons rivers (upper Stony River drainage) that should at least be periodically monitored through aerial surveys.

Another information gap concerns sockeye salmon in the Kuskokwim River, which currently have no escapement goals and very limited monitoring. There is, however, growing interest for increasing the commercial sockeye salmon harvest (Whitmore et al. *In prep*), so an escapement monitoring program complete with escapement goals is needed. Sockeye salmon abundance, run timing and spawning distribution have largely been a mystery in the Kuskokwim River. Of the locations monitored, only the Kogrukluk River in the upper Holitna River drainage, regularly reports numbers in the thousands (Appendix A4.1). An escapement goal was assigned to Kogrukluk River sockeye salmon in 1983, but revoked about 1995 because the species was thought to be incidental in the Kogrukluk and Holitna River drainages, which lack classic

sockeye lake habitat. Contrary to that view, preliminary findings from a recent radiotelemetry investigation are now highlighting the Holitna River basin as the major sockeye spawning area in the Kuskokwim River, and a substantial fraction of those fish migrate past the Kogrukluk River weir (S. Gilk, Commercial Fisheries Biologist, Anchorage, ADF&G; personal communication). Re-establishing a sockeye salmon escapement goal for Kogrukluk River weir may be a desirable measure pending final results of the current investigation. Other concentrations of sockeye salmon are being identified in the Aniak and upper Stony River drainages. The observed sockeye stocks have widely ranging temporal separations on both the run timing through the lower Kuskokwim River fisheries (Kerkvliet and Hamazaki 2003; Kerkvliet et al. 2003; 2004; Pawluk et al. 2006a; b), and on arrival to the spawning grounds.

There are escapement goal gaps with Kuskokwim River chum salmon as well. Currently goals for chum salmon have been established for the Aniak and Kogrukluk rivers, both associated with major chum salmon producing sub-basins; however, their adequacy falls short because they do not address the temporal spectrum of stock-specific run timings found in Kuskokwim River chum salmon (Kerkvliet and Hamazaki 2003; Kerkvliet et al. 2003; 2004; Pawluk et al. 2006a; b), and they do not include any representation of the fall chum salmon stocks that occur in the Kuskokwim River as a distinct race (Gilk et al. 2005). Addressing the issue of run timing differences can be achieved by establishing escapement goals for each of the existing weirs once adequate time series are available. In contrast, fall chum salmon are currently not monitored in any way and little is known about their abundance, distribution, or run timing, so resources should first be focused on resolving some of these issues before any consideration of fall chum salmon escapement goals. Another issue for chum salmon is that commercial interest in this species is currently very low, and subsistence harvest is waning (Whitmore et al. *In prep*), so establishing minimum SEG thresholds may be more appropriate than SEG ranges.

Shortfalls in the adequacy of escapement goals for coho salmon is also an issue to be considered. Coho salmon generate the greatest per capita income to Kuskokwim River commercial fishermen (Whitmore et al. *In prep*), but judging the adequacy of annual escapement is based on one escapement goal for Kogrukluk River, which is tucked in the headwaters of the Holitna River basin. The Kogrukluk River accounts for about 8% (CI 1% to 15%) of the Holitna basin coho production (Chythlook and Evenson 2003), and probably less than 1% of the total Kuskokwim River coho salmon production. Addressing this gap can be achieved by establishing escapement goals for each of the existing weirs once adequate time series are acquired, or once corroborative models are available.

Finally, Kanektok River, which supports a burgeoning recreational fishery and directed commercial fisheries for Chinook, sockeye, and coho salmon, currently has only aerial survey-based escapement goals. A relatively new commercial fish processing facility located at the mouth of the Kanektok River suggests the expectation of expanding commercial harvest. Considering that a weir is being operated on this river, it would be preferable for the aerial survey-based goals to be replaced with weir-based goals once adequate time series accrue.

The new goals that we recommend herein have generally been directed at transitioning from aerial survey-based escapement goals to weir-based goals when possible. The Kuskokwim Area is currently fortunate to have an assortment of well distributed weir projects, all of which are at or nearing the minimum number of years needed to consider developing escapement goals. Funding for these weir projects, however, needs to be stabilized for long-term operation. Currently funding is tenuous for most of these projects and annual operational costs are typically

patched together through multiple funding sources. As a hedge against years when weirs are not operated, whether due to environmental conditions or otherwise, we recommend that efforts continue to gather paired data with aerial surveys, and to work towards measures that will help improve correlation between the two assessment methods, such as a training program for surveyors.

We have also advocated the adoption of escapement goals across multiple stocks within each species to address issues such as differences in stock-specific run timing and differential exploitation rates. We recognize, however, that this brings with it unresolved management issues; for example, if chronically low escapements in one tributary require conservation measures, yet escapements elsewhere are fully adequate, then what options do managers have to focus conservation measures on the one weak stock while minimizing harvest impacts on other stocks? Such questions may be addressed through development of management plans, projects that allocate harvests to stock of origin, and improved in-fishery monitoring projects. Still, concern over some of these types of issues should not deter managers and biologists from pursuing what is in the best long-term interest of sustainable salmon fisheries.

KUSKOKWIM AREA ESCAPEMENT GOAL RECOMMENDATIONS

BEG - Middle Fork Goodnews River Chinook

The current SEG for Chinook salmon in the Middle Fork Goodnews River was set in 2004 as 2,000 to 4,500 fish based on weir and counting tower escapement estimates from 1981 through 2003 (ADF&G 2004). Since 1981 escapements have been above the lower end of the range in 21 of 25 years and averaged 3,156 Chinook salmon (Appendix B1.6). We estimate annual exploitation of the entire Goodnews River Chinook stock to be low, averaging 33% from 1981 through 2004 (Appendix B1.5).

Escapements of brood years 1981 through 1997 have ranged from 1,395 to 6,022 Chinook salmon for a contrast of 4.3 (Appendix B1.5). Returns from these escapements have ranged from 1,952 to 9,062 fish, and the return per spawner has ranged from 0.6 to 3.8 fish. The point estimate of S_{msy} derived from the Bayesian inference was 1,813 Chinook salmon with 90% credible bounds of 1,454 to 2,845 fish. The S_{msy} range of 90% MSY was 1,188 to 2,561 fish. This BEG range is narrower and lower than the current SEG, but the two ranges overlap. A residual plot showed no noticeable temporal pattern. Durbin-Watson test for the first-order autoregressive error indices was 2.71 showing no significant autocorrelation. The Ricker model estimate of number of spawners at replacement was 4,503 fish. When the model was fit using least-squares the R^2 was 0.42 and the relationship was significant ($p=0.05$) (T. Hamazaki, Commercial Fisheries Biometrician, ADF&G, Anchorage; personal communication). Given that the average harvest is a low 33%, that the average return-per-spawner is 1.7 fish, and that a number of returns were below replacement, suggests that current escapements are near replacement level and that the Ricker model provides a sufficient estimate of S_{msy}.

The habitat-based model developed by Parken et al. (2004) produced results similar to the Ricker model approach described above (Appendix B1.6). The watershed area of the Middle Fork Goodnews River is 752 km^2. The habitat-based model estimate of S_{msy} from Equation 2 was 1,810 Chinook salmon, and the number of spawners at replacement from Equation 1 was 4,817 Chinook salmon.

Given our low estimate of annual exploitation, it appears that the existing SEG is derived from data near the spawner replacement level (Appendix B1.5). Furthermore, a number of brood years have had a return per spawner at levels less than replacement. We recommend a revision of the escapement goal, replacing the current SEG range of 2,000 to 4,500 Chinook salmon with a BEG range of 1,500 to 2,900 Chinook salmon based on the 90% credible bound for S_{msy} derived from our spawner-recruit analysis.

BEG - Middle Fork Goodnews River Sockeye

The current SEG for sockeye salmon in the Middle Fork Goodnews River was set in 2004 as 23,000 to 58,000 fish based on weir and counting tower escapement estimates from 1981 through 2003 (ADF&G 2004). From 1981 to 2005 escapements have been above the lower end of the range in 21 of 25 years and averaged 40,926 sockeye salmon. We estimate annual exploitation of the entire Goodnews River sockeye stock to be low, averaging 23% from 1981 through 2004 (Appendix B4.5).

Escapements of brood years 1981 through 1998 have ranged from 15,799 to 58,264 sockeye salmon for a contrast of 3.7 (Appendix B4.5). Returns from these escapements have ranged from 14,430 to 87,921 fish, and the return per spawner has ranged from 0.4 to 4.1 fish. The point estimate of S_{msy} derived from the Bayesian inference was 21,890 sockeye salmon with a 90% credible bound of 17,170 to 39,180 fish. The S_{msy} range of 90% MSY was 14,452 to 30,933 fish. This BEG range is narrower and lower than the current SEG, but the two ranges overlap broadly. A residual plot showed no noticeable temporal pattern. The Durbin-Watson test for first-order autoregressive error indices was 1.63 showing no significant autocorrelation. The Ricker model estimate of number of spawners at replacement was 53,963 fish. Given that the average harvest rate is low (23%), that the average return-per-spawner is 1.5 fish, and that a number of returns were below replacement, suggests that current escapements are near replacement level and that the Ricker model provides a sufficient estimate of S_{msy}. We recommend a revision of the escapement goal, replacing the current SEG range of 23,000 to 58,000 sockeye salmon with a BEG range of 18,000 to 40,000 sockeye salmon based on the 90% credible bound for S_{msy} derived from our spawner-recruit analysis.

SEG - George River Chinook

Prior to this review, an escapement goal had not been established for George River Chinook salmon (ADF&G 2004). The available time series of annual escapements now include 9 years of weir counts and 5 years from aerial survey index counts (Appendix A1.7). A paired weir and aerial survey data set is available for 4 years ($R^2 = 0.25$), and the relationship is defined as:

$$y = e^{(0.2974 \ln(x) + 5.5394)}, \quad (3)$$

where y is the total Chinook salmon escapement and x is the aerial survey index. Application of this equation was explored to expand one aerial survey index that could be added to the weir data set of total annual Chinook salmon escapements. In addition, the habitat-based model developed by Parken et al. (2004) was used to estimate S_{msy} and S_c for the entire George River watershed, which was determined to be 3,558 km^2 (Appendix A1.7). The weir is located 4 river miles upstream from where it confluences with the Kuskokwim River, but the entire watershed area was used in order to include spawning as well as rearing habitat that may influence the fit of the habitat-based model.

Following the guidelines of Bue and Hasbrouck (*Unpublished*), the George River Chinook data set is categorized as fair based on the accuracy and amount of data available, and the data set has low

contrast. The prescribed SEG range would be derived from the 15th percentile to the maximum observed value in the data set, which is 3,082 to 7,823 fish. The habitat-based model of Parken et al. (2004) suggests a S_{msy} of 5,309 fish (95% CI 2,738 to 10,295), and a S_c of 14,138 Chinook salmon. The estimate of S_{msy} from the habitat-based model is well within the SEG range suggested with the Bue and Hasbrouck method, and S_c is above that range as would be expected.

We recommend an SEG of 3,100 to 7,900 Chinook salmon for George River weir (Table 2; Appendix A1.7). Without corroboration we would not recommend the Bue and Hasbrouck method be used with only 9 years of data. In this instance, however, the range is supported by the habitat based model and we note that the one expanded aerial survey count (10th observation) does not change our recommendation. The years 2000 and 2002 fall below the lower end of the range and 1999 and 2001 are near the lower end of the range. All 4 of these years correspond with a period of low Chinook salmon escapements throughout the Kuskokwim River; the lowest years being 1999 and 2000, with rebuilding generally occurring steadily from 2001 through 2005. The trend in recovery of George River escapements varies a little from the drainage wide trend, but still shows a general increase in escapements since 1999 and 2000.

The low drainage-wide escapements in 1998, 1999, and 2000 contributed to the BOF classifying Kuskokwim River Chinook salmon as a "stock of concern", a finding that precipitated suspension of all commercial fishing in the Kuskokwim River during June 2000, 2001, 2002, and 2003; as well as the imposition of a subsistence fishing schedule that suspended subsistence fishing in the Kuskokwim River for 3 consecutive days each week in June according a step implementation plan (Burkey et al. 2000a). These measures were part of a rebuilding plan, and whether due to the plan or other influences, the Chinook salmon runs to the Kuskokwim River did improve markedly in 2004, and 2005 concurrent with little to no commercial harvest. Chinook salmon escapements to the George River in 2004 and 2005 were within the suggested SEG range. In accordance with the protocols of the Bue and Hasbrouck method, no years are above the suggested SEG due to the low contrast of historical escapements.

The George River is located approximately 18 km upstream of the community of Crooked Creek, where the human population is expected to increase several fold in association with development of the proposed Donlin Creek mine. George River is one of the nearest salmon bearing streams and will likely attract increased recreational and subsistence fishing effort from residents of Crooked Creek and the mine. These pending changes, and the need to ensure adequate management of the George River Chinook salmon stock, provide rational for establishing a SEG for the stock.

SEG - Kwethluk River Chinook

The current SEG of 580 to 1,800 Chinook salmon in the Kwethluk River was established in 2005 and is based on aerial survey index counts from 1960 to 2003 (ADF&G 2004; Table 2). Counts of Chinook salmon passing a tower or weir were only available for 5 years and were not used in the analysis leading to the current SEG range. Now, however, the available time series includes 7 years for weir or counting tower operation and 12 years of aerial survey index counts (Appendix A1.15 and A1.16). A paired weir and aerial survey data set is available for 3 years ($R^2 = 0.97$), and the relationship between weir/tower counts and aerial survey counts is:

$$y = e^{(0.874 \ln(x) + 2.586)}, \quad (4)$$

where y is the total Chinook salmon escapement and x is the aerial survey index. This equation was used to expand 9 aerial survey index counts to estimate total annual Chinook salmon escapement in years when the weir or counting tower was not operated. The resulting 16 years of total Chinook salmon escapement estimates for the Kwethluk River served as the basis for examining SEG recommendations with the Bue and Hasbrouck method. In addition, the habitat-based model developed by Parken et al. (2004) was used to estimate S_{msy} and S_c for the entire Kwethluk River watershed, which was determined to be 3,482 km^2 (Appendix A1.16). The area of the entire watershed was used to be inclusive of spawning as well as rearing habitat that may influence the fit of the habitat-based model. Unlike the George River, however, the Kwethluk River weir is located 52 river miles upstream of where it confluences with the Kuskokwim River.

Following the guidelines of Bue and Hasbrouck (*Unpublished*), the Kwethluk River Chinook data set is categorized as fair based on the accuracy and amount of data available, and the data set has a high contrast and moderate exploitation. The prescribed SEG range would be rounded from the 25th to 75th percentiles, which is 5,956 to 10,326 fish, inclusive of the entire tower, weir, and expanded aerial survey data set (n = 16). The estimate of S_{msy} from the habitat-based model is lower at 5,231 fish (95% CI 2,698 to 10,142), and S_c is 13,929 Chinook salmon. For comparison, applying only the weir and tower data set (n = 7) to the Bue and Hasbrouck guidelines would prescribe an even higher SEG range using the 15th and 85th percentiles of 7,028 to 15,887 fish.

We recommend an SEG of 6,000 to 11,000 Chinook salmon (Table 2; Appendix A1.16), which makes use of the entire tower, weir, and expanded aerial survey data set (n = 16). There are 4 years that fall below this range: 1968, 1976, 1982, and 2000. The year 1982 corresponds with a period of exceptionally low Chinook salmon escapements throughout the Kuskokwim River, which prompted fishery managers to restrict gillnets to mesh sizes of 6 inches or smaller in 1985, and to discontinue the directed Chinook salmon commercial fishery in 1987 (Whitmore et al. 2005). Likewise, low drainage-wide escapements in 2000 contributed to the BOF classifying Kuskokwim River Chinook salmon as a "stock of concern", a finding that precipitated suspension of all commercial fishing in the Kuskokwim River during June 2000, 2001, 2002, and 2003; as well as the imposition of a subsistence fishing schedule. These measures were part of a rebuilding plan, and whether due to the plan or other influences, the Chinook salmon runs to the Kuskokwim River did improve from 2003 to 2005 concurrent with little to no commercial harvest, and these 3 years show increasing escapements that are within or above our suggested SEG range for the Kwethluk River.

The estimate of S_{msy} of 5,231 Chinook salmon and 95% CI (2,698 to 10,142) from the habitat-based model of Parken et al. (2004) supports our choice for the SEG range. The point estimate of S_{msy} is just below the lower end of our recommended SEG and the upper end of the CI is close to the upper end of our recommended SEG. Similarly the S_c estimate of 13,929 fish (Appendix A1.16), is above the upper end of the SEG range as expected. We do acknowledge that the lower end of the CI is substantially lower than our SEG and lower than any historical estimates. In comparison, a Bue and Hasbrouck SEG based on weir and tower data only (n = 7) was substantially higher (7,100 to 16,000). In this instance we believe the recent data would lead to specifying a SEG too high and the lower end of CI for the habit-based model too low. Lastly, another factor in keeping the SEG above the habitat-based estimate of $S_{msy,}$ and even more so for the lower end of the CI, is the low percent of females estimated at the weirs. Sampling of Chinook salmon for age, sex, and length composition has occurred at the Kwethluk weir in 1992, 2000, and 2002 through 2004, and the percent of females has averaged only 19% (Molyneaux et al. 2006).

We also recommend discontinuing the aerial survey goal following adoption of the weir based goal. The preference is to have one goal per stock and an actual count is preferable to an index of abundance. The department monitors weir counts inseason and has the potential to project whether the SEG will be achieved. In contrast aerial surveys are collected after fisheries targeting this stock have finished.

SEG - Tuluksak River Chinook

There currently is no established escapement goal for Tuluksak River Chinook salmon (ADF&G 2004). The available time series of annual escapements include 9 years for weir operation and 11 years from aerial survey index counts (Appendix A1.24 and A1.25). A paired weir and aerial survey data set is available for 4 years ($R^2 = 0.22$), and the relationship between weir counts and aerial survey counts is:

$$y = e^{(0.2433 \ln(x) + 5.714)}, \quad (4)$$

where y is the total Chinook salmon escapement and x is the aerial survey index. We acknowledge the low R^2, and used this non-significant equation to expand seven aerial survey counts to estimate total annual Chinook salmon escapement in years when the weir was not operated. The resulting 16 years of total Chinook salmon escapement estimates for the Tuluksak River served as the basis for examining SEG recommendations with the Bue and Hasbrouck method. In addition, the habitat-based model developed by Parken et al. (2004) was used to estimate S_{msy} and S_c for the Tuluksak River watershed, which was determined to be 874 km^2 (Appendix A1.25). The entire Tuluksak River watershed was not used because the weir is upstream of a large tributary, the Fog River, with significant Chinook salmon spawning and we felt the comparison between values based on the Bue and Hasbrouck method and habitat-based model would not otherwise be comparable. Instead, the estimated watershed area only represents that part of the Tuluksak River drainage upstream of the weir, which is located 34 river miles upstream of where the Tulusak River confluences with the Kuskokwim River.

Following the guidelines of Bue and Hasbrouck (*Unpublished*), the Tuluksak River Chinook data set is categorized as fair based on the accuracy and amount of data available, and the data set has a medium contrast. The prescribed SEG range would be rounded from the 15^{th} to 85^{th} percentiles, which is 1,025 to 2,074 fish inclusive of the entire weir and expanded aerial survey data set ($n = 16$). The habitat-based model of Parken et al. (2004) suggests a S_{msy} of 2,009 (95% CI 1,036; 3,895) and a S_c of 5,347 Chinook salmon. The estimate of S_{msy} from the habitat-based model is well within that suggested with the Bue and Hasbrouck method and the low end of the SEG and the CI interval are also very close. Despite the low R^2 between paired weir and aerial survey counts, the result would be similar if only weir data were used ($n = 7$) and SEG based on the 15^{th} to 85^{th} percentiles of 1,010 to 2,566 fish.

We recommend an SEG of 1,000 to 2,100 Chinook salmon for the Tuluksak River as enumerated by the weir (Table 2; Appendix A1.25). The lower SEG value was not rounded up based on the rounding convention used for escapement goal recommendations because 6 years would have fallen below that lower SEG value (1,100, a 63^{th} percentile value instead of 85^{th}). Several years fall close to the lower end of the recommended lower SEG (1,000), including 3 in the mid-1980s when Chinook salmon escapements were low throughout the Kuskokwim River (Whitmore et al. 2005); however only 2 years actually fall below the SEG; 1991 and 2001. The lowest observed escapement was in 1991 when Chinook salmon escapements throughout the Kuskokwim River

were mediocre and it was the fourth consecutive year with record or near record Chinook salmon harvest (Appendix C1). During 2001 Chinook salmon escapements were generally beginning to rebuild after the exceptionally low escapement years of 1998, 1999, and 2000; however, the weir was not in operation during these 3 years and aerial surveys were not completed (Appendix A1.24 and A1.25).

There are 3 years above the suggested SEG range: 1993, 1994, and 2005 (Appendix A1.25). Again, 1993 and 1994 do not stand out as exceptionally high Chinook salmon escapement years in the Kuskokwim River; however, commercial bycatch of Chinook salmon was much reduced in these years due to conservation measures targeting chum salmon (Appendix C1; Whitmore et al. 2005). Chinook salmon escapements for stocks entering the Kuskokwim River late in the season, as is suspected for Tuluksak and other lower Kuskokwim River stocks, may have benefited from the reduced commercial fishing activity. As for 2005 being above the SEG, Chinook salmon runs began to increase markedly in 2004 and 2005 concurrent with little to no commercial harvest. This may provide an explanation as to why the Tuluksak River Chinook salmon escapement was above the suggested SEG in 2005, but the 2004 escapement was near the middle of our suggested range.

SEG - Aniak River Chum

The current SEG for Aniak River chum salmon was set in 2005 as 210,000 to 370,000 fish, based on the escapement index provided by Aniak River sonar from 1980 through 2003 (ADF&G 2004); however, the time series we report underwent two changes since that time. The first is conversion of the historical escapement time series to "DIDSON" units (Appendix A2.1). Improved target resolution provided by recent transition to DIDSON sonar technology resulted in increased fish detections over the previously used Bendix and BioSonics sonar technologies (C. Pfisterer, Commercial Fisheries Biologist, ADF&G, Fairbanks; personal communication). Concurrent operation of DIDSON and BioSonics sonar equipment in 2003 showed the level of difference in target detection is density dependent with DIDSON providing approximately 10 to 50% greater target detection with increasingly higher fish passage rates (Appendix A2.1). DIDSON equipment replaced BioSonics equipment beginning in 2004, and the historical time series used to index Aniak River chum salmon escapement (Appendix C4) was converted to "DIDSON" units (Appendix C5) in order to maintain comparability within the historical time series.

The second change we report is adoption of a standardized annual target operational period for Aniak River sonar of 26 June through 31 July (Appendix A2.1). Previously reported cumulative annual escapement indexes do not conform to any standardized span of days (Whitmore et al. 2005). Depending on field conditions, operations began as early as 16 June, to as late as 11 July; and end dates ranged from 23 July to 6 August. The standardized annual target operational period of 26 June through 31 July incorporates operations for 14 of the 25 years. The 11 remaining years required some daily passages to be estimated (Appendix C6). Estimated fraction of the resulting total annual escapement indexes for those 11 years ranged from 0.87% to 31.2% (Appendix A2.1).

Aniak River is one of only two locations in the Kuskokwim River with an escapement goal for chum salmon. That goal was revisited following institution of the two changes described above, and we suggest adoption of a new SEG range of 220,000 to 480,000 target counts (Table 2; Appendix A2.1). Our recommendation is based on revised annual escapement indexes from

1980 through 2005, and uses the Bue and Hasbrouck method, with high contrast in the historical escapement time series, and the assumption of at least a moderate historical exploitation rate. Our assumption about exploitation rate is supported by the findings of Shotwell and Adkison (2004), although we suspect their findings underestimate total annual chum salmon escapement in the Kuskokwim River, which would in turn lower their reported exploitation rates (Appendix A2.4).

Escapement indexes are below our recommended SEG for 7 years and above for 6 years (Appendix A2.1). Of those years that fall below the range, at least four (1992, 1993, 1999, and 2000) occur in years when chum salmon returns to the Kuskokwim River were widely reported as being particularly low (Whitmore et al. 2005). Of the years that are above the range, at least two (2004 and 2005) occur in years when run abundance was relatively high and exploitation rate low due to poor commercial markets for chum salmon.

SEG - Kanektok Coho

An SEG for coho salmon in the Kanektok River was recommended by ADF&G (2004), but with closer inspection we now recommend that this goal be discontinued (Appendix B3.1). Since 2001 a weir has been operated at river mile 42 of the Kanektok River that has provided passage counts of coho salmon until at least 18 September of each year (Appendix B3.2). Paired weir and aerial survey data are not available; still, the weir information has provided a greater understanding of run timing and abundance of Kanektok River coho salmon that provides a context for better interpreting the historical aerial survey information.

Three issues were identified in the data set used by ADF&G (2004) to set the Kanektok coho SEG in 2005 that provide compelling reasons for its discontinuation (Appendix B3.1). The data set is comprised of 7 aerial surveys flown between 1981 and 2000. First, a poor survey (rating of 3) was used in the analysis, with no obvious information to override the protocol of not including surveys rated as poor in escapement goal analysis. Second, the annual survey results that were used include a mix of one to four survey areas, which is contrary to standardization protocols we are trying to adhere to. It should be noted that coho salmon spawn below the weir and the weir is located just downstream of the boundary of survey areas 101 and 102. Third, given the timing of the surveys, most could not be considered peak timing as they ranged from 14 August to 1 October; a span of dates that encompasses 9% to 100% of the daily cumulative coho salmon passage during the years the weir was operated (Appendix B3.2).

We recommend that the SEG for Kanektok River coho salmon be discontinued. Annual operation of the Kanektok River weir is expected to continue, and we anticipate that a time series from the weir will eventually be available for developing an escapement goal. It should be recognized, however, that the logistical challenges of operating the Kanektok River weir are substantial and these challenges will continue to limit annual success. Also, ADF&G staff plans to fly aerial surveys late in September to improve our understanding of the portion of the coho stock spawning below the weir, and to provide paired observations with weir counts.

RUN RECONSTRUCTION

Kuskokwim River Chinook Salmon

Total run of Chinook salmon to the Kuskokwim River was estimated for 2002 through 2005, although the estimates include some unsubstantiated assumptions (Appendix A1.14). Estimated total abundance ranged from 207,711 in 2002 to 329,199 in 2004, and total escapement ranged from 140,532 in 2002 to 246,504 in 2004. Annual exploitation derived from these estimates

appears low, ranging from 25% in 2004 to 32% in 2002. Nearly all of that exploitation is from the subsistence fishery and most harvest is taken with gillnets hung with 8-inch or larger mesh size (Molyneaux et al. 2005).

While we have reasonable confidence in the harvest data and most escapement data used in our reconstruction, some elements of our escapement estimate are educated guesses. Chinook salmon stocks for the Kisaralik River are assumed to be comparable to escapements reported from the weir at the neighboring Kwethluk River, except in 2005 when the weir was not operated and escapement for the Kwethluk River was expanded from an aerial survey count. Aniak River is suspected to be a major contributor to annual Chinook salmon production, but the estimates we provide are little more than guesses. We do not know if we have over or underestimated abundance for the Kisaralik and Aniak rivers, which would affect our estimate of exploitation. We also acknowledge that our estimate of drainage wide escapement does not include Chinook salmon returning to minor-tributaries below Aniak, which would make our estimates of exploitation high.

Kuskokwim River Chum Salmon

Estimates of total historical chum salmon abundance for the Kuskokwim River as determined with the Shotwell-Adkison model are described in Appendix A2.4. Their model estimates total chum salmon run abundance between 1976 and 2000 as varying between 221,000 and 2,045,000 fish. We suspect they underestimate actual total annual chum salmon abundance for two reasons. First, the annual exploitation rates that we derive from the Shotwell-Adkison estimates range from 21 to 77%, the upper end of which appears exceptionally high given the fishing schedule and capacity of the fishing fleet. Second, the Aniak River alone averaged 89% of the Shotwell-Adkison total escapement estimates, based on use of revised Aniak River chum salmon escapement index as reported in Appendix A2.1. The Aniak River index does include some fraction of species other than chum salmon; still, the remaining balance is likely not sufficient to account for chum salmon escapement to other Kuskokwim River tributaries, especially the Holitna River sub-basin where chum salmon production is of the same magnitude as the Aniak River sub-basin. In 2002 and 2004, for example, abundance estimates of Holitna River chum salmon were 542,172 and 996,216 based on radiotelemetry studies (Stroka and Brase 2004, Stroka and Reed 2005), compared to counts from Aniak River sonar of 472,346 and 672,931 for those same years (Appendix A2.1). Furthermore, the range of Shotwell-Adkison total escapement estimates attributable to the Aniak River is 4 to 245%, which also suggests something being amiss.

The limited time series of tributary escapement information available for the model may explain some of these inconsistencies. As recommended by Shotwell and Adkison (2004), the more recently developed monitoring of escapement in multiple tributaries should be maintained to generate a longer, more substantive escapement time series.

Another potential factor contributing to the error in the model estimates is reliance on whole-river abundance estimates generated in 1993, 1994, and 1995 from a configurable sonar project near Bethel that at the time had been struggling to become operational since conception in 1988. The reliability of those estimates has long been questioned, and while formal documentation of skepticism may be lacking, the fact that the numbers are seldom referenced, and indeed the sonar program discontinued, provides some indication of the low confidence managers have in the abundance estimates that were generated from that sonar program. Indeed, the 1995 report to the

BOF for the Kuskokwim Area had to be revised when it was discovered that the estimated 306,000 chum salmon escapement generated from the whole-river sonar project was inadequate to account for the 305,000 fish (*unpublished*) counted in the Aniak River sub-basin alone (Burkey et al. 1996). Conventional wisdom at the time was that more resources were invested into generating the whole-river estimate than the Aniak River estimate, and back-up documentation was lacking for the Aniak River estimate. As a result the Aniak River project was listed as incomplete and results purged from all subsequent reports. News media around this time found an abundance of fodder regarding irregularities in whole-river sonar programs around the state (ADN 1994a, 1994b, 1994c, 1995; FDNM 1994). Still, these 3 years of estimates were the only data available to scale the index of total annual abundance that was required for the Shotwell and Adkison model. Shotwell and Adkison recognized these limitations and recommend that their model would benefit from a few years of improved estimates of total escapement or abundance as may be possible through use of mark–recapture, radiotelemetry, or perhaps an improved whole-river sonar program. Since their work, efforts have been undertaken to estimate chum salmon abundance with mark–recapture techniques including radiotelemetry, however, successful results have been limited (Kerkvliet et al. 2003; 2004; Stroka and Brase 2004; Stroka and Reed 2005).

RECOMMENDATIONS

The foundation of this review is escapement goals described in the report entitled *Escapement goal review of select AYK Region salmon stocks* (ADF&G 2004). Recommendations from the current review are as follows:

STOCK MONITORING

- Stabilize funding for the George, Kanektok, Kwethluk, Takotna, Tuluksak, and Tatlawiksuk River weirs to allow for establishment of escapement goals for all salmon species in order to address differences in stock-specific run timings and potentially unequal exploitation rates.
- Investigate using tributary escapement data sets in combination with estimates of total escapement and harvest in the Kuskokwim River to develop a model that can be used annually to estimate total abundance of Chinook, sockeye, chum and coho salmon in the Kuskokwim River from the tributary information currently being collected.
- Address gaps in Chinook salmon escapement monitoring by developing a weir or similar monitoring project in the Salmon River of the Pitka Fork drainage, and by including Necon and Hoholitna Rivers in our annual aerial survey program.
- Establish an escapement monitoring program for sockeye salmon, possibly through development of a weir at the outlet of Telaquana Lake in partnership with Lake Clark National Park and Preserve, and revisit the utility of developing a sockeye salmon escapement goal at Kogrukluk River weir pending the outcome of current sockeye salmon investigations.
- Determine run timing, abundance, and distribution of fall chum salmon, and then consider options for establishment of escapement monitoring.
- Collect paired weir-aerial survey data to enable expansion of aerial surveys in years when weirs are not operational

ESCAPEMENT GOAL RECOMMENDATIONS

- Middle Fork Goodnews Chinook salmon: revise the current SEG of 2,000 to 4,500 to a BEG of 1,500 to 2,900 fish.
- Middle Fork Goodnews Sockeye Salmon: revise the current SEG of 23,000 to 58,000 to a BEG of 18,000 to 40,000 fish.
- George River Chinook salmon: establish a weir based SEG of 3,100 to 7,900 fish.
- Kwethluk River Chinook salmon: discontinue the aerial survey based SEG and establish a weir based SEG of 6,000 to 11,000 fish.
- Tuluksak River Chinook salmon: establish a weir based SEG of 1,000 to 2,100 fish.
- Aniak River chum salmon: revise the current SEG of 210,000 to 370, 000 to an SEG of 220,000 to 480,000 to account for the enhanced resolution of the current DIDSON sonar technology and to standardize the time series to a target operational period of 26 June to 31 July.
- Kanektok River coho salmon: discontinue the aerial survey SEG

ACKNOWLEDGEMENTS

The authors would like to thank employees of the following agencies and organizations who worked long and irregular hours at various locations throughout the Kuskokwim Area collecting the escapement data presented in this report: employees of the Alaska Department of Fish and Game, Association of Village Council Presidents, Kuskokwim Native Association, McGrath Native Village Council, Native Village of Kwinhagak, Organized Village of Kwethluk, Orutsararmiut Native Council, Takotna Tribal Council, Tuluksak Traditional Council, and the U.S. Fish and Wildlife Service. The authors also thank Carl Pfisterer for producing conversions to the Aniak sonar data set, Chuck Parken for sharing his unpublished data used to develop the habitat-based model for estimating escapement goals, Jim Jasper for his assistance in updating and compiling the many appendices used in this report, and Elizabeth Smith for her editing and assistance with preparing the final manuscript. Toshihide Hamazaki should be acknowledged for his work preparing the spawner-recruit analysis for Middle Fork Goodnews River Chinook and sockeye salmon.

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TABLES AND FIGURES

Table 1.–Escapement goal review summary for the Kuskokwim Management Area in 2007.

	Salmon Species			
	Chinook	**Chum**	**Coho**	**Sockeye**
Stocks or data sets reviewed[a]	32	11	9	7
Current escapement goals (2005)	12	4	3	3
Revise[b]	1	1	0	1
Discontinue	1	0	1	0
Establish	3	0	0	0
No Revision	10	3	2	2
Total goals inclusive of recommendations (2007)	14	4	2	3
Stocks/data sets reviewed from which no escapement goal was revised, discontinued, established, or continued.	16	7	6	3

[a] Stocks for which there are some escapement data. Some stocks have more than one enumeration method resulting in multiple data sets, and are tabulated as different stocks/data sets.

[b] Two data sets for each species (Chinook and sockeye salmon) were reviewed for the recommendation to revise an SEG to a BEG; a weir data set upon which the existing SEG was based and a run reconstruction data set upon which a spawner-recruit analysis was prepared.

Table 2.–Summary of all Kuskokwim area salmon stocks with current and recommended escapement goals.

Stock Unit	Enumeration Method	Current Escapement Goal			Recommended Escapement Goal			Appendix Number
		Goal	Type	Year Estab.	Action	Goal	Type	
Chinook Salmon								
Aniak River	Aerial Survey	1,200–2,300	SEG	2005	Continue			A1.1
Cheeneetnuk River	Aerial Survey	340–1,300	SEG	2005	Continue			A1.3
Gagaryah River	Aerial Survey	300–830	SEG	2005	Continue			A1.5
George River	Weir	None			Establish	3,100–7,900	SEG	A1.7
Holitna River	Aerial Survey	970–2,100	SEG	2005	Continue			A1.9
Kisaralik River	Aerial Survey	400–1,200	SEG	2005	Continue			A1.12
Kogrukluk River	Weir	5,300–14,000	SEG	2005	Continue			A1.13
Kwethluk River	Aerial Survey	580–1,800	SEG	2005	Discontinue			A1.15
Kwethluk River	Weir	None			Establish	6,000–11,000	SEG	A1.16
Salmon River (Aniak drainage)	Aerial Survey	330–1,200	SEG	2005	Continue			A1.19
Salmon River (Pitka Fork)	Aerial Survey	470–1,600	SEG	2005	Continue			A1.20
Tuluksak River	Weir	None			Establish	1,000–2,100	SEG	A1.25
Goodnews River (North Fork)	Aerial Survey	640–3,300	SEG	2005	Continue			B1.2
Kanektok River	Aerial Survey	3,500–8,000	SEG	2005	Continue			B1.3
Middle Fork Goodnews River	Weir	2,000–4,500	SEG	2005	Revise	1,500–2,900	BEG	B1.5 and B1.6
Aniak River	Sonar	210,000–370,000	SEG	2005	Revise	220,000–480,000	SEG	A2.1
Kogrukluk River	Weir	15,000–49,000	SEG	2005	Continue			A2.3
Kanektok River	Aerial Survey	>5,200	SEG	2005	Continue			B2.1
Middle Fork Goodnews River	Weir	>12,000	SEG	2005	Continue			B2.3
Kogrukluk River	Weir	13,000–28,000	SEG	2005	Continue			A3.2
Kanektok River	Aerial Survey	7,700–36,000	SEG	2005	Discontinue			B3.1
Middle Fork Goodnews River	Weir	>12,000	SEG	2005	Continue			B3.3
Goodnews River (North Fork)	Aerial Survey	5,500–19,500	SEG	2005	Continue			B4.2
Kanektok River	Aerial Survey	14,000–34,000	SEG	2005	Continue			B4.3
Middle Fork Goodnews River	Weir	23,000–58,000	SEG	2005	Revise	18,000–40,000	BEG	B4.5 and B4.6

Table 3.–Criteria to estimate sustainable escapement goals by Bue and Hasbrouck (*Unpublished*).

Spawning 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] Relative range of the entire time series of escapement data calculated by dividing the maximum observed escapement by the minimum observed escapement.

Table 4.–Reviewed Kuskokwim area salmon stocks and data sets with no current or recommended escapement goal.

Stock	Appendix	Rationale for not Recommending an Escapement Goal
Chinook Salmon		
Bear Creek (aerial survey)	A1.2	Insufficient historical time series.
Eek River (aerial survey)	A1.4	Insufficient historical time series.
George River (aerial survey)	A1.6	Weir project exists and insufficient historical time series.
Hoholitna River (aerial survey)	A1.8	Insufficient historical time series.
Holokuk River (aerial survey)	A1.10	Existing middle river escapement goals considered adequate.
Kipchuk River (aerial survey)	A1.11	Existing middle river escapement goals considered adequate.
Kuskokwim River (run reconstruction)	A1.14	Insufficient historical time series and information gaps.
Oskawalik River (aerial survey)	A1.17	Existing middle river escapement goals were considered adequate.
Pitka Fork (aerial survey)	A1.18	Insufficient historical time series.
Takotna River (weir / tower)	A1.21	Insufficient historical time series.
Tatlawiksuk River (aerial survey)	A1.22	Insufficient historical time series.
Tatlawiksuk River (weir)	A1.23	Insufficient historical time series.
Tuluksak River (aerial survey)	A1.24	Weir project exists with a preferred time series for an escapement goal.
Arolik River (aerial survey)	B1.1	Insufficient historical time series.
Kanektok River (weir)	B1.4	Insufficient number of escapement estimates.
Salmon River (aerial survey)	B1.7	Insufficient historical time series.
George River (weir)	A2.2	Insufficient historical time series.
Kuskokwim River (run reconstruction)	A2.4	Underestimate actual abundance
Kwethluk River (tower and weir)	A2.5	Insufficient historical time series.
Takotna River (weir / tower)	A2.6	Insufficient historical time series.
Tatlawiksuk River (weir)	A2.7	Insufficient historical time series.
Tuluksak River (weir)	A2.8	Insufficient historical time series.
Kanektok River (weir)	B2.2	Insufficient historical time series.
George River (weir)	A3.1	Insufficient historical time series.
Kwethluk River coho salmon (weir)	A3.3	Insufficient historical time series.
Takotna River (weir)	A3.4	Insufficient historical time series.
Tatlawiksuk River (weir)	A3.5	Insufficient historical time series.
Tuluksak River (weir)	A3.6	Insufficient historical time series.
Kanektok River (weir)	B3.2	Insufficient historical time series.
Kogrukluk River (weir)	A4.1	Small stock; not known if representative of Kuskokwim River.
Arolik River (aerial survey)	B4.1	Insufficient historical time series.
Kanektok River (weir)	B4.4	Insufficient historical time series.

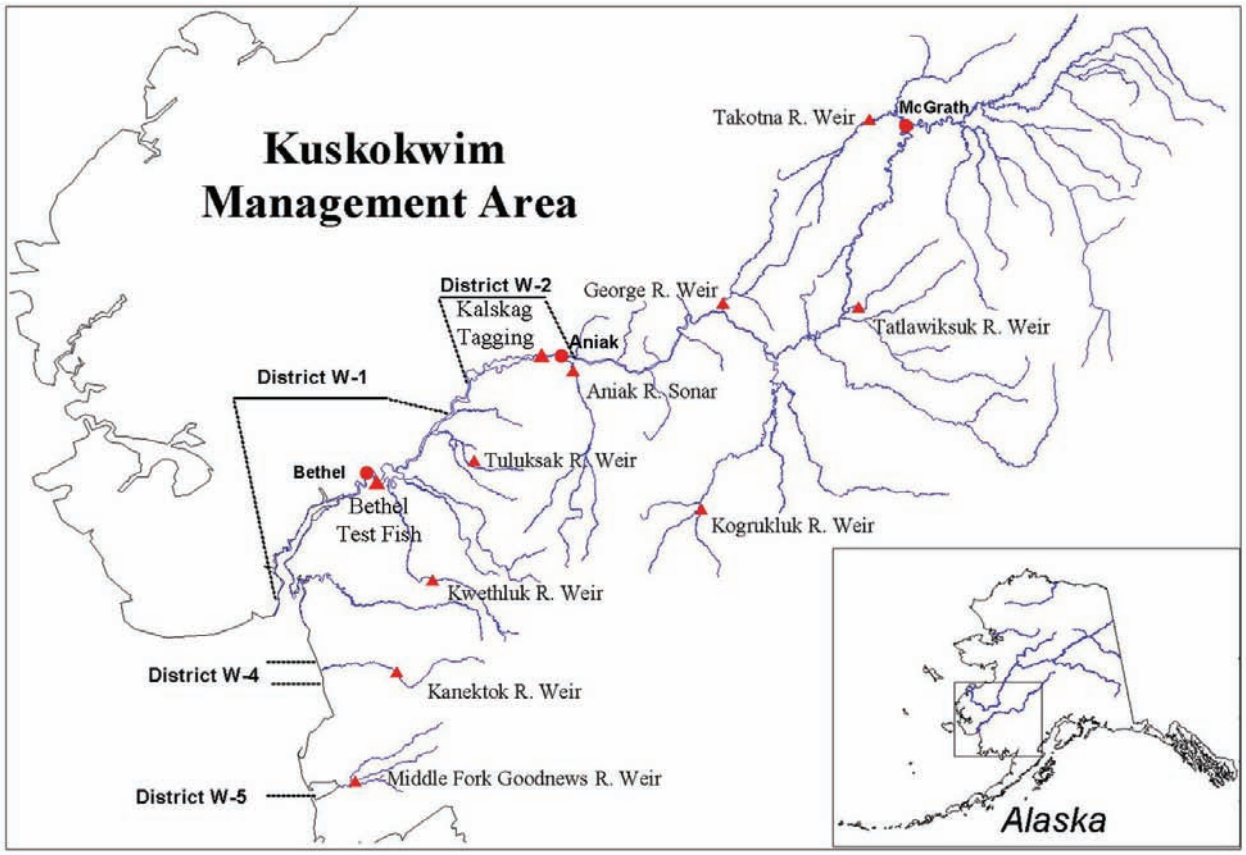


Figure 1.–Kuskokwim salmon management area with commercial fishing districts and project locations.

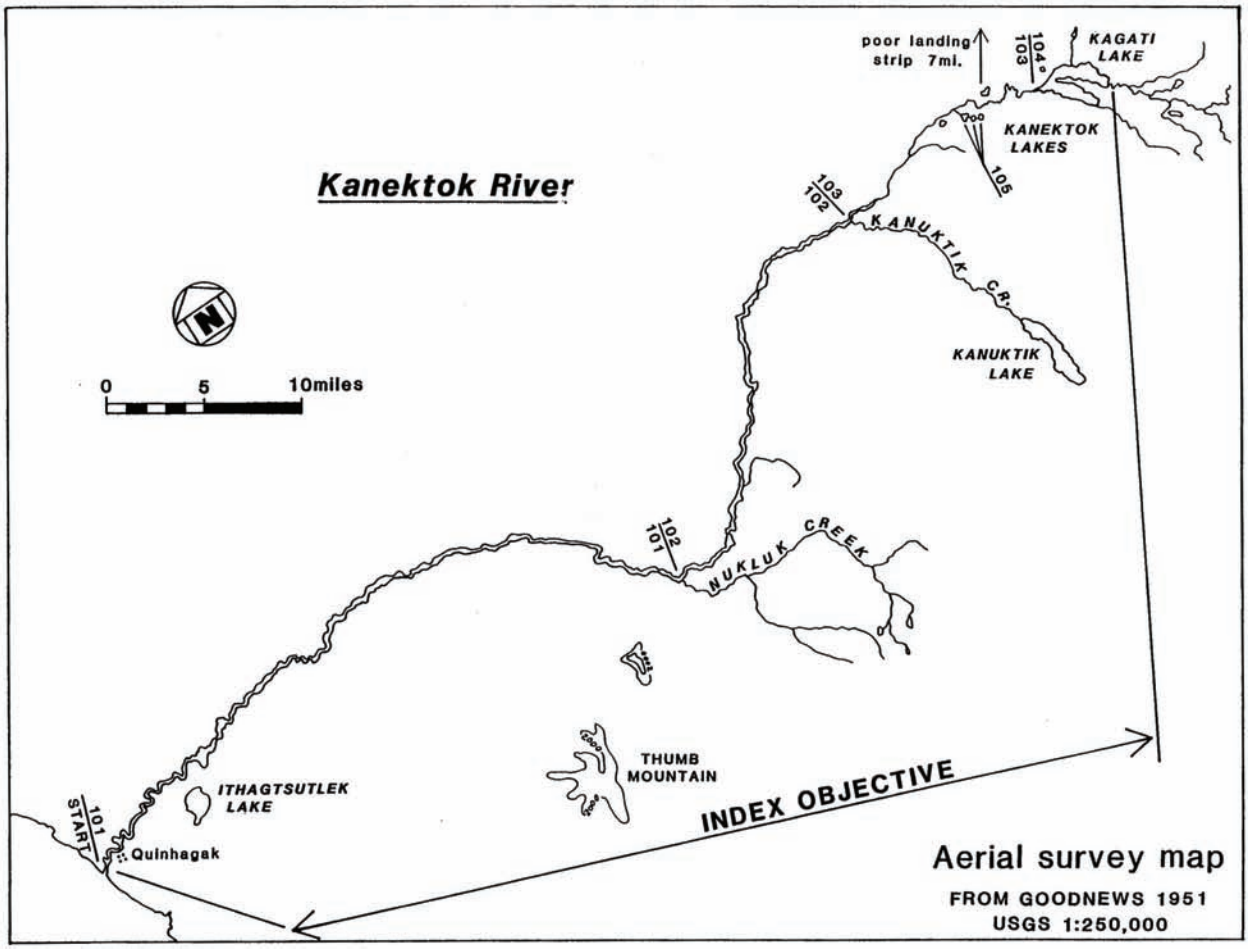


Figure 2.–Example aerial survey map with numeric survey areas listed.

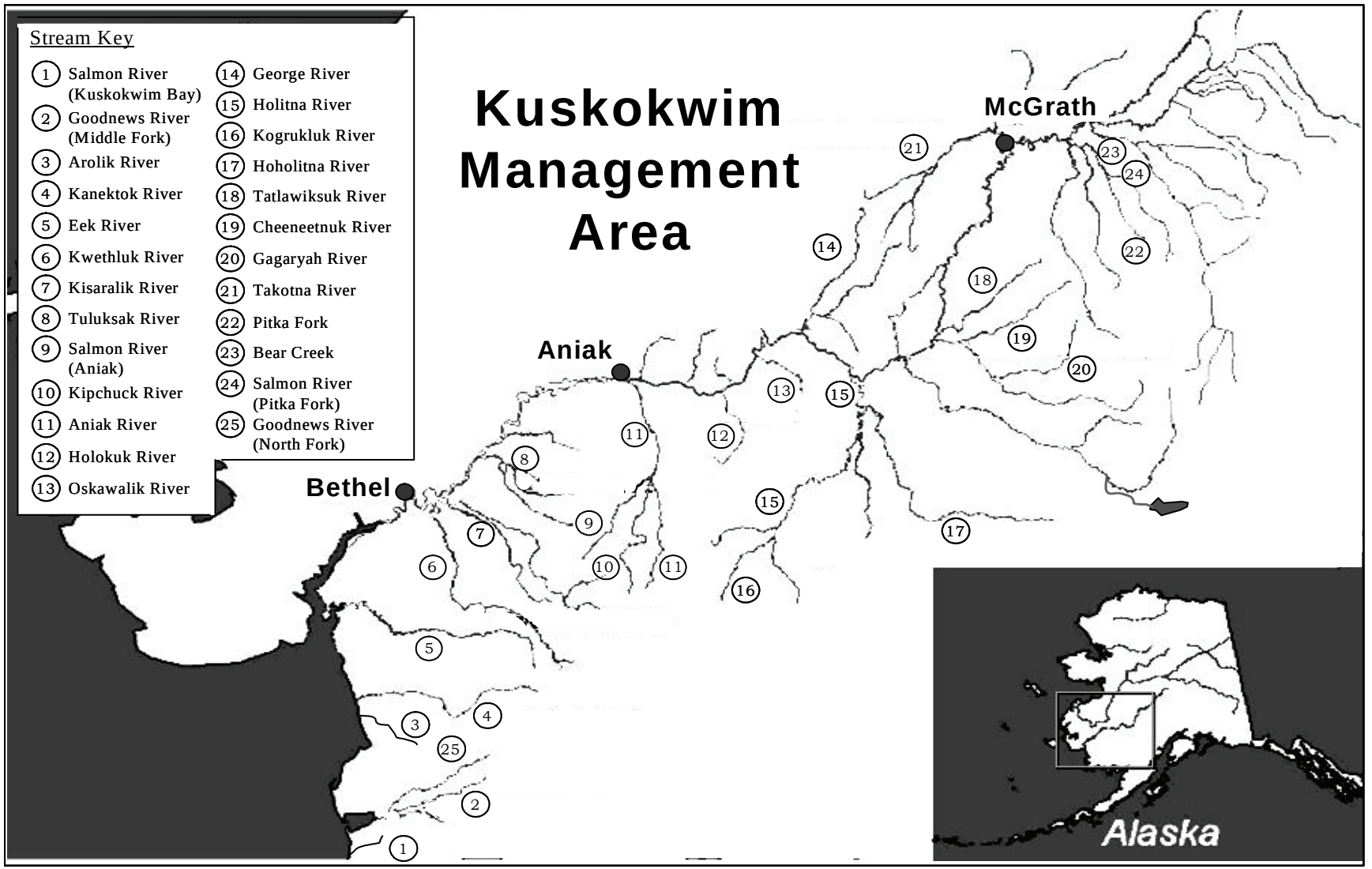


Figure 3.–Key to Kuskokwim Area salmon streams as referenced in appendices.

APPENDIX A1. KUSKOKWIM RIVER CHINOOK

Appendix A1.1.–Escapement goal for Aniak River Chinook salmon (aerial survey).

System: Aniak River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 11**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	1,200 to 2,300 (ADF&G 2004)
Escapement Goal Type:	Range
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	45
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	1,105 to 2,244 (through 2003)
Years within recommended SEG:	10 of 20 years within SEG range, 5 years below and 5 years above

Comments:

- 10 river miles from the enumeration point to the Kuskokwim River confluence.
- 191 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Portions of the lower Aniak River are within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 102, 103 and 104.
  4) Counts include carcasses
- The Aniak River is a popular location for subsistence and recreational activity due in part to the close proximity of Aniak (population 539) which serves as a local hub for communities in the middle Kuskokwim basin. The community is located on the Kuskokwim River, about 1 mile from the mouth of the Aniak River. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.

-continued-

System: Aniak River
Species: Chinook salmon
Stock Unit: not applicable
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960					1,881	2	18-Jul	
1961					497	2	29-Jul	
1962								
1963								
1964								
1965								
1966					2,184	2	24-Jul	
1967								
1968					2,203	2	23-Jul	
1969								
1970								
1971								
1972								
1973								
1974								
1975					202	2	31-Jul	
1976								
1977								
1978								
1979								
1980								
1981		6,840	2,104	130	9,074	3	4-Aug	Rating overruled
1982								
1983		1,251	624	34	1,909	2	30-Jul	
1984								
1985								
1986		17	359	48	424	2	28-Jul	
1987								
1988		538	300	116	954	2	24-Jul	
1989		1,211	766	132	2,109	2	26-Jul	
1990		309	872	74	1,255	1	19-Jul	
1991		918	408	238	1,564	2	23-Jul	
1992		1,155	1,046	83	2,284	2	20-Jul	
1993		1,057	1,499	131	2,687	1	21-Jul	
1994								
1995		1,005	1,972	194	3,171	1	20-Jul	
1996								
1997		800	1,256	131	2,187	2	22-Jul	
1998		643	1,169	118	1,930	2	1-Aug	
1999								
2000		364	315	35	714	2	27-Jul	
2001								
2002								
2003		1,255	2,024	235	3,514	1	25-Jul	
2004	207[a]	3,687	1,493	182	5,362	2	26-Jul	
2005								

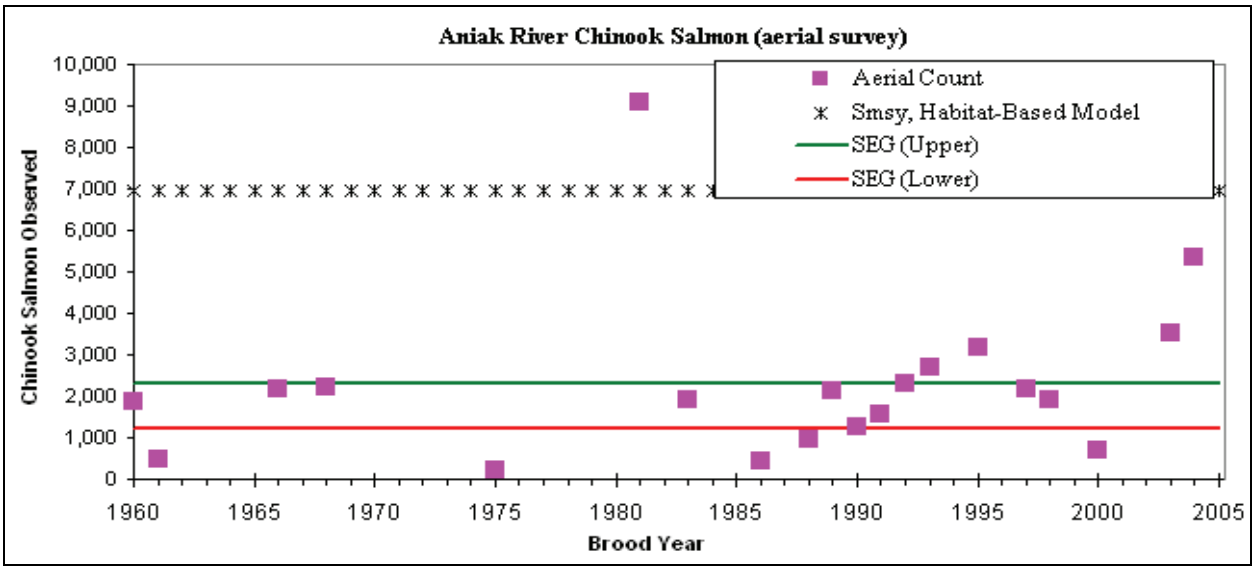
[a] Data were not used when calculating SEG range due to incomplete count of run.

-continued-

Appendix A1.1.–Page 3 of 4.

System: Aniak River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Aniak River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	2003
Number of Years	19
Average	2,144
Min	202
15th	649
25th	1,105
Median	1,930
75th	2,244
85th	2,832
Max	9,074
Contrast	45
Contrast Label	High
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	1,200
SEG Upper	2,300

Summary Habitat-Based Model		
Watershed Area (km^2)	5,270	
Start Point	Mouth	(Lat. 61°34.477' N Long. 159°29.360' W)
S_{msy}	6,968	
S_c	18,559	

Appendix A1.2.–Escapement goal for Bear Creek Chinook salmon (aerial survey).

System: Bear Creek
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 23**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Good
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	3
Criteria for SEG:	Low contrast
15th Percentile to Maximum:	175 to 367 (through 2005)
Years within recommended SEG:	not applicable

Comments:

- 16 river miles from the enumeration point (confluence with Swift River) to the Kuskokwim River confluence.
- 390 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Surveys must include entire stream
  4) Counts include carcasses
- Bear Creek Chinook salmon are assumed to be within a genetically distinct aggregate of spawning populations from the upper Kuskokwim River, although no samples have been specifically collected from this section of stream (W. D. Templin, Commercial Fisheries Gene Conservation Laboratory Geneticist, ADF&G, Anchorage; personal communication).
- Stuby (2005) and Pawluk et al. (2006a) both report that upper Kuskokwim River salmon tend to have earlier run timings through the lower Kuskokwim River than stocks that spawn in tributaries farther down stream. Managers can take actions to ensure adequate geographic distribution of escapement by regulating the temporal distribution of harvest in the lower Kuskokwim River. Trends in the subsistence harvest suggest that earlier running stocks may have a higher exploitation rate in the subsistence Chinook fishery.

-continued-

Appendix A1.2.–Page 2 of 4.

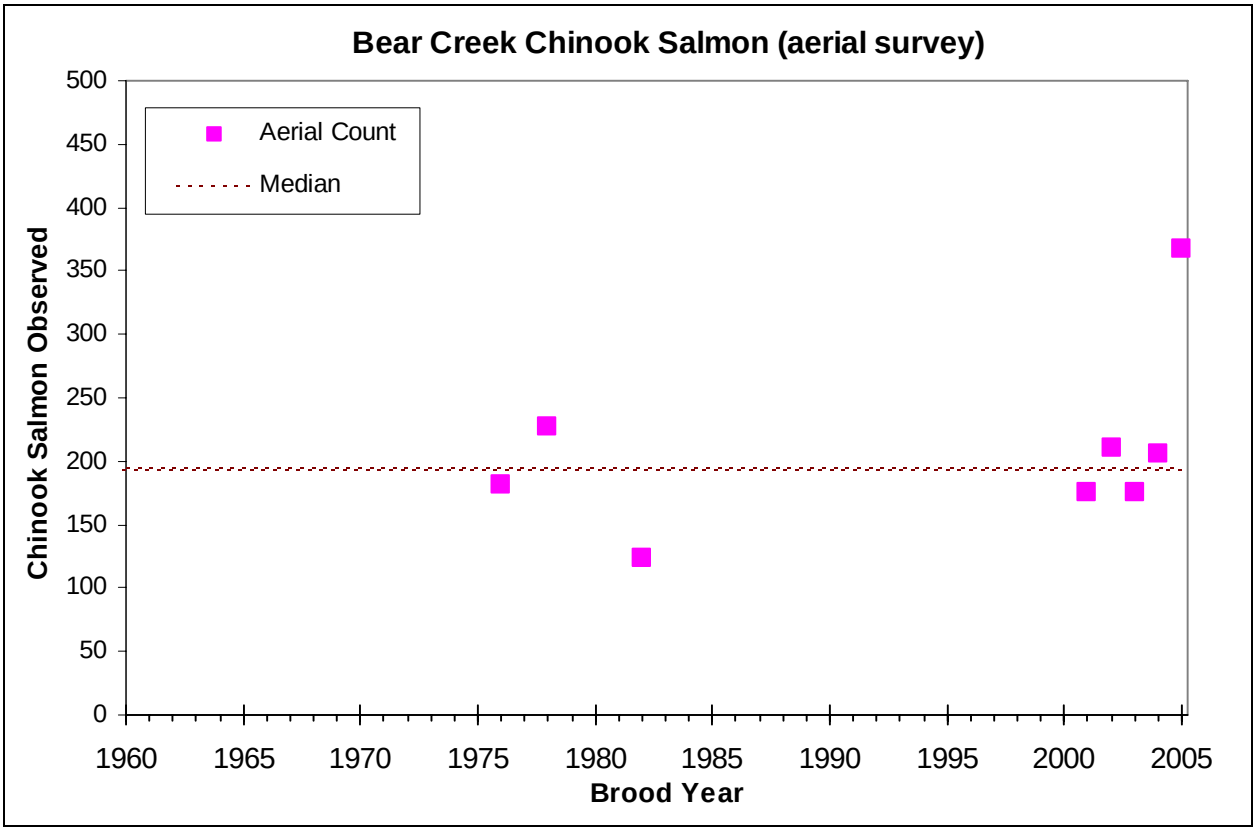
System: Bear Creek
Species: Chinook salmon
Stock Unit: not applicable
Data available for analysis of escapement goals.

Brood Year	Aerial Survey	Rating	Date of Survey	Comments
1960				
1961				
1962				
1963				
1964				
1965				
1966				
1967				
1968				
1969				
1970				
1971				
1972				
1973				
1974				
1975				
1976	182	1	25-Jul	
1977				
1978	227	2	25-Jul	
1979				
1980				
1981				
1982	123	2	28-Jul	
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998				
1999				
2000				
2001	175	1	27-Jul	
2002	211	1	22-Jul	
2003	176	1	20-Jul	
2004	206	1	20-Jul	
2005	367	2	20-Jul	

-continued-

System: Bear Creek
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Bear Creek
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	2005
Number of Years	8
Average	208
Min	123
15th	175
25th	176
Median	194
75th	215
85th	226
Max	367
Contrast	3
Contrast Label	Low
Exploitation	Mod. to High
Current Minimum Goal	None
Suggested SEG Lower	None
Suggested SEG Upper	None

Appendix A1.3.–Escapement goal for Cheeneetnuk River Chinook salmon (aerial survey).

System: Cheeneetnuk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code:** **19**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	340 to 1,300 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	6
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	315 to 1,246
Years within recommended SEG:	10 of 15 years within SEG range, 3 years below and 2 years above

Comments:

- 16 river miles from the enumeration point (confluence with Swift River) to the Kuskokwim River confluence.
- 390 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Survey or Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101 and 102
  4) Counts include carcasses
- The Cheeneetnuk River Chinook salmon escapement goal was established in order to improve the geographic distribution of goals. In addition, Chinook from this tributary is within a genetically distinct aggregate of spawning populations from the Swift River sub-basin (Templin et al. 2004). Chinook of the Swift River sub-basin are also represented by the Gagaryah River escapement goal.
- Stuby (2005) and Pawluk et al. (2006a) both report that upper Kuskokwim River salmon tend to have earlier run timings through the lower Kuskokwim River than stocks that spawn in tributaries farther down stream. Managers can take actions to ensure adequate geographic distribution of escapement by regulating the temporal distribution of harvest in the lower Kuskokwim River. Trends in the subsistence harvest suggest that earlier running stocks may have a higher exploitation rate in the subsistence Chinook fishery.

-continued-

Appendix A1.3.–Page 2 of 5.

System: Cheeneetnuk River
Species: Chinook salmon
Stock Unit: not applicable

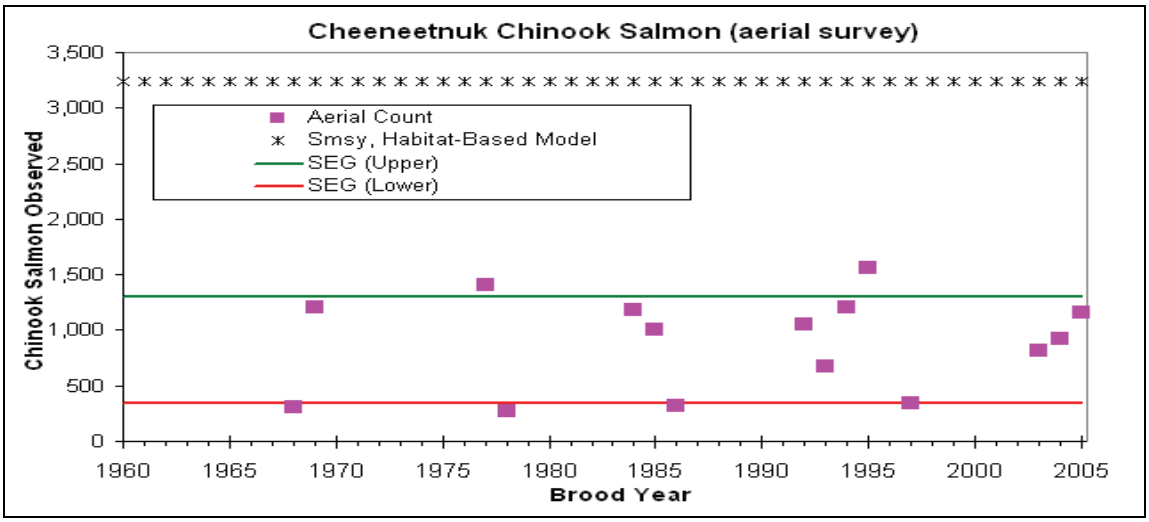
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968					309	2	24-Jul	
1969					1,201	2	25-Jul	
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977	1,150	257			1,407	2	22-Jul	
1978	180	88			268	2	29-Jul	
1979								
1980								
1981								
1982								
1983								
1984	511	666			1,177	1	23-Jul	
1985	927	75			1,002	2	26-Jul	
1986	289	28			317	2	26-Jul	
1987								
1988								
1989								
1990								
1991								
1992	529	521			1,050	1	27-Jul	
1993	338	340			678	1	29-Jul	
1994	610	596			1,206	1	29-Jul	
1995	909	656			1,565	1	26-Jul	
1996								
1997	173	172			345	2	30-Jul	
1998								
1999								
2000								
2001								
2002	442	288				1	25-Jul	
2003	307	503			810	1	22-Jul	
2004	365	553			918	1	22-Jul	
2005	378	777			1,155	1	22-Jul	

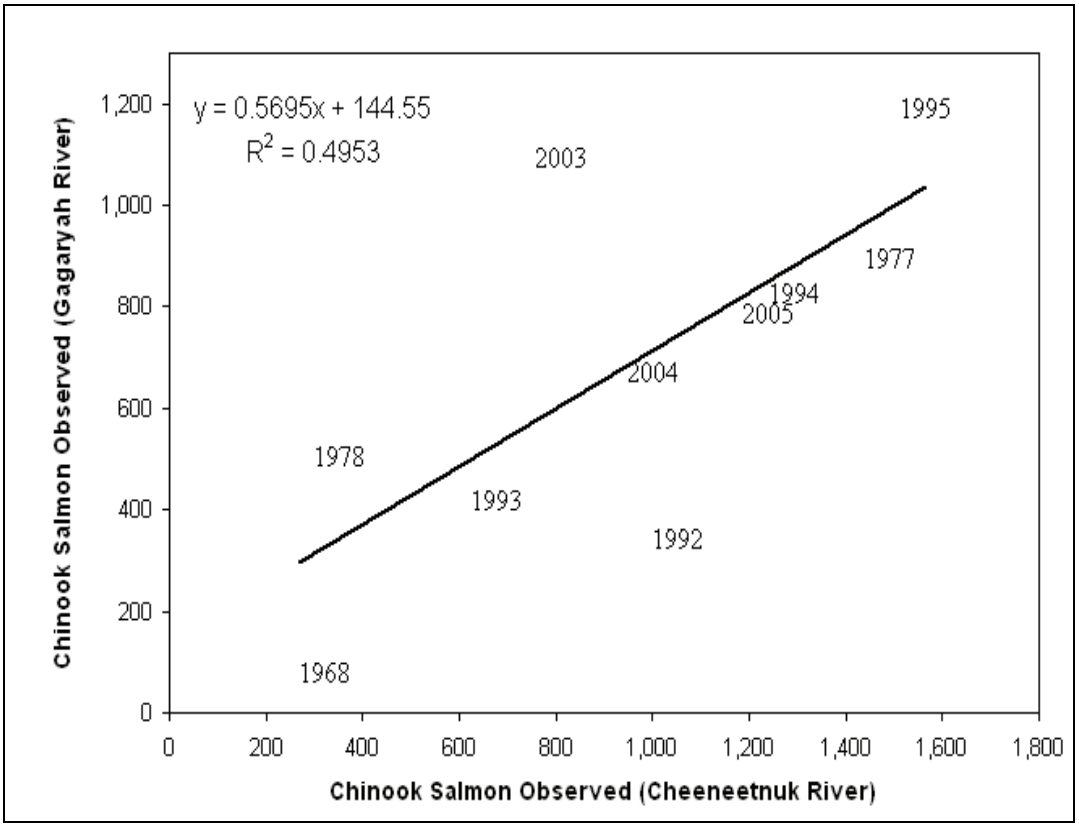
-continued-

System: Cheeneetnuk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



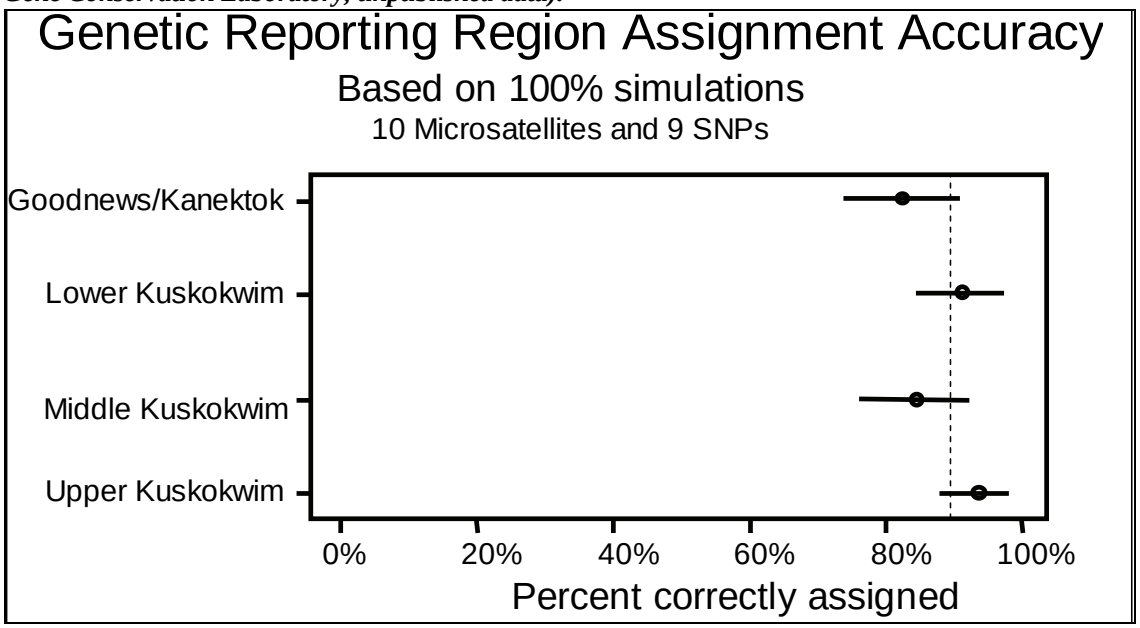
Comparison of paired annual aerial survey counts for the Cheeneetnuk and Gagaryah Rivers.

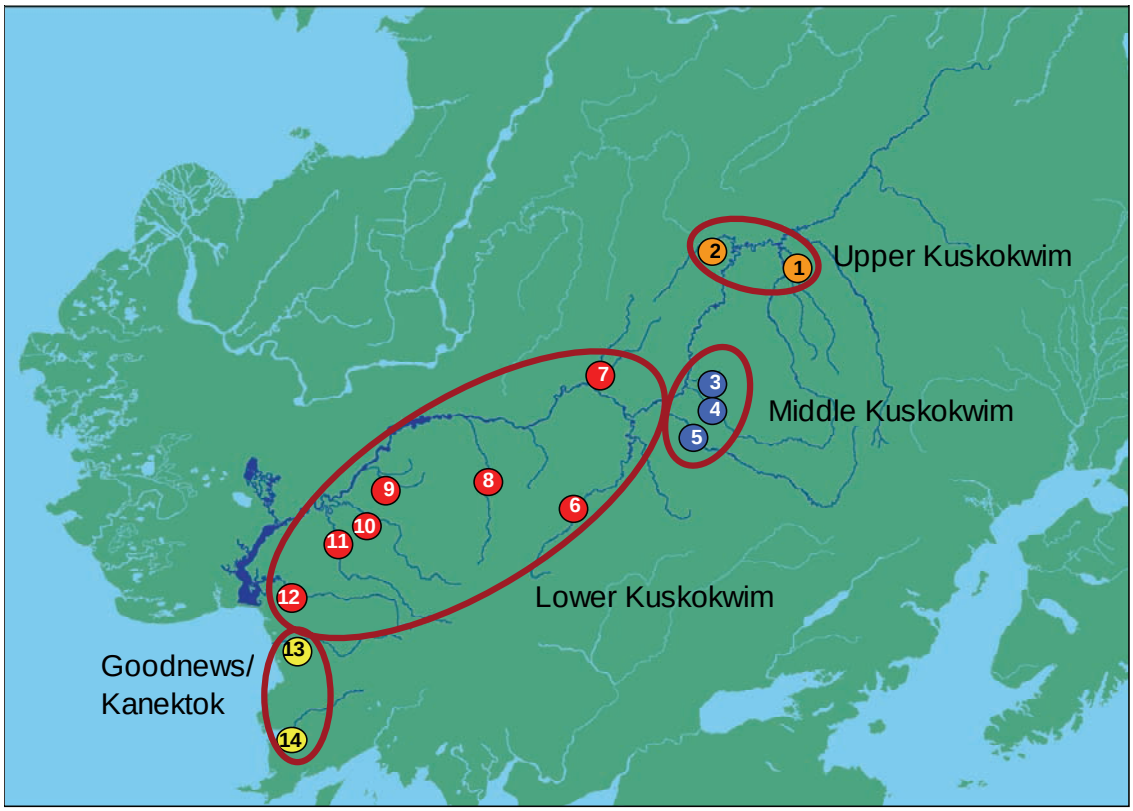


-continued-

System: Cheeneetnuk River
Species: Chinook salmon
Stock Unit: not applicable

Distinct Chinook salmon stock groupings of the Kuskokwim Area based on DNA markers (ADF&G, Gene Conservation Laboratory, unpublished data).





-continued-

System: Cheeneetnuk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	2003
Number of Years	13
Average	872
Min	268
15th	315
25th	345
Median	1,002
75th	1,201
85th	1,246
Max	1,565
Contrast	6
Contrast Label	Medium
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	340
SEG Upper	1,300

Summary Habitat-Based Model		
Watershed Area (km^2)	1,744	
Start Point	Mouth	(Lat. 61°48.751' N Long. 156°0.472' W)
S_{msy}	3,242	
S_c	8,630	

Appendix A1.4.–Escapement goal for Eek River Chinook salmon (aerial survey).

System: Eek River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 5**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	25
Criteria for SEG:	High contrast with at most low exploitation
15th to 75th Percentile:	704 to 2,126
Years within recommended SEG:	not applicable

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 8 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- SEG was not considered as additional aerial survey goals in the lower Kuskokwim River were deemed unnecessary.
- Eek River is within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 102, 103 and 104.
  4) Counts include carcasses
- The lower Eek River has a tidal influence.
- The Eek River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471) and the Yup'ik village of Eek (population 281). The village is located about 12 miles upstream from the Kuskokwim River confluence. Subsistence fishers commonly deploy short gillnets within the lower river in order to harvest salmon and whitefish. Salmon contribute 80 to 90 percent of residents annual diet (Community Profiles Database 2006). Professional guides for sport fishing and rafting tours operate on the river, but less so than in the Kwethluk and Kisaralik Rivers.

-continued-

System: Eek River
Species: Chinook salmon
Stock Unit: not applicable

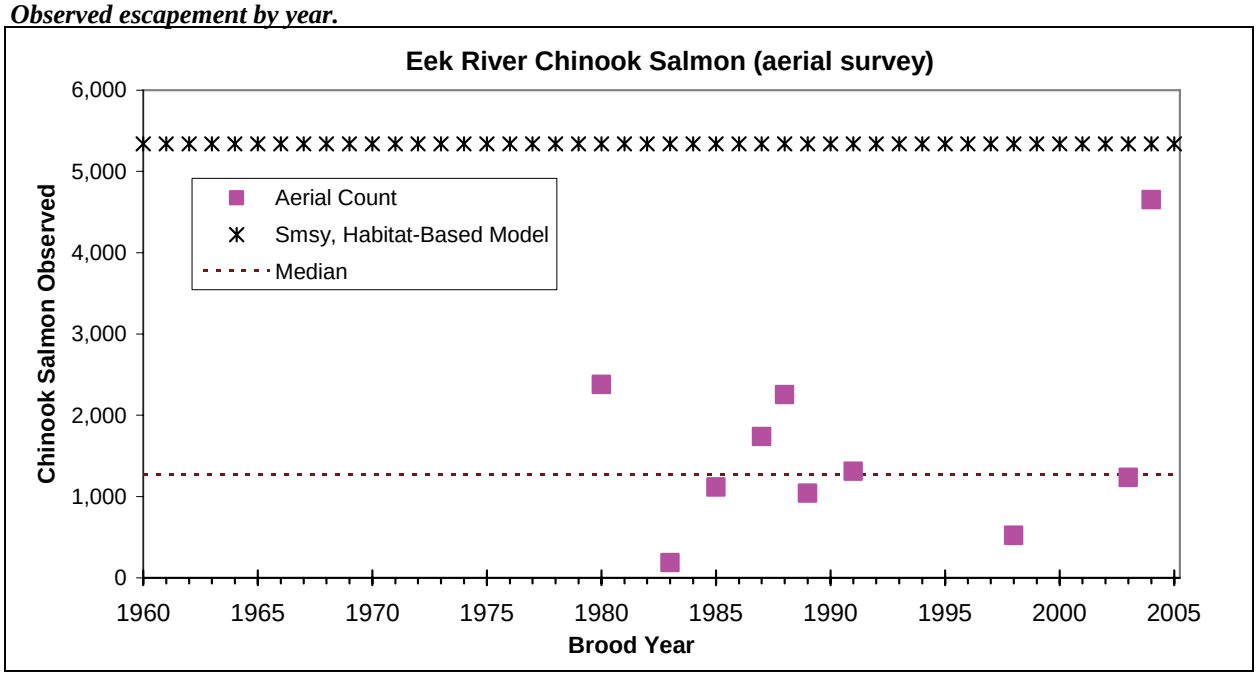
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980		1,555	330	493	2,378	2	22-Jul	Half of 102 not surveyed
1981								
1982								
1983		139	22	27	188	2	31-Jul	
1984								
1985		530	376	212	1,118	2	23-Jul	
1986								
1987		1,183	106	450	1,739	1	27-Jul	
1988		1,459	572	224	2,255	1	23-Jul	
1989		180	423	439	1,042	2	25-Jul	
1990								
1991		544	422	346	1,312	2	2-Aug	
1992								
1993								
1994								
1995								
1996								
1997								
1998		392	60	70	522	2	29-Jul	
1999								
2000								
2001								
2002								
2003		811	238	187	1,236	1	31-Jul	
2004		3,440	861	352	4,653			
2005								

-continued-

System: Eek River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Eek River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**10**
Average	**1,644**
Min	**188**
15th	**704**
25th	**1,061**
Median	**1,274**
75th	**2,126**
85th	**2,335**
Max	**4,653**
Contrast	**25**
Contrast Label	High
Exploitation	Low
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model	
Watershed Area (km^2)	**3,586**
Start Point	**Mouth** (Lat. 60°12.289' N Long. 162°15.485' W)
S_{msy}	**5,338**
S_c	**14,216**

Appendix A1.5.–Escapement goal for Gagaryah River Chinook salmon (aerial survey).

System: Gagaryah River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 20**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	300 to 830 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	15
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	297 to 830
Years within recommended SEG:	8 of 14 years within SEG range, 3 years below and 3 years above

Comments:

- 38 river miles from the enumeration point to the Kuskokwim River confluence.
- 432 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101 and 102
  4) Counts include carcasses
- The Gagaryah River Chinook salmon escapement goal was established in order to improve the geographic distribution of goals. In addition, Chinook from this tributary are likely within a genetically distinct aggregate of spawning populations from the Swift River sub-basin (W. D. Templin, Commercial Fish Geneticist, ADF&G, Anchorage; personal communication). Chinook salmon of the Swift River sub-basin are also represented by the Cheeneetnuk River escapement goal.
- Stuby (2005) and Pawluk et al. (2006a) both report that upper Kuskokwim River salmon tend to have earlier run timings through the lower Kuskokwim River than stocks that spawn in tributaries farther down stream. Managers can take actions to ensure adequate geographic distribution of escapement by regulating the temporal distribution of harvest in the lower Kuskokwim River. Trends in the subsistence harvest suggest that earlier running stocks may have a higher exploitation rate in the subsistence Chinook fishery.

-continued-

System: Gagaryah River
Species: Chinook salmon
Stock Unit: not applicable

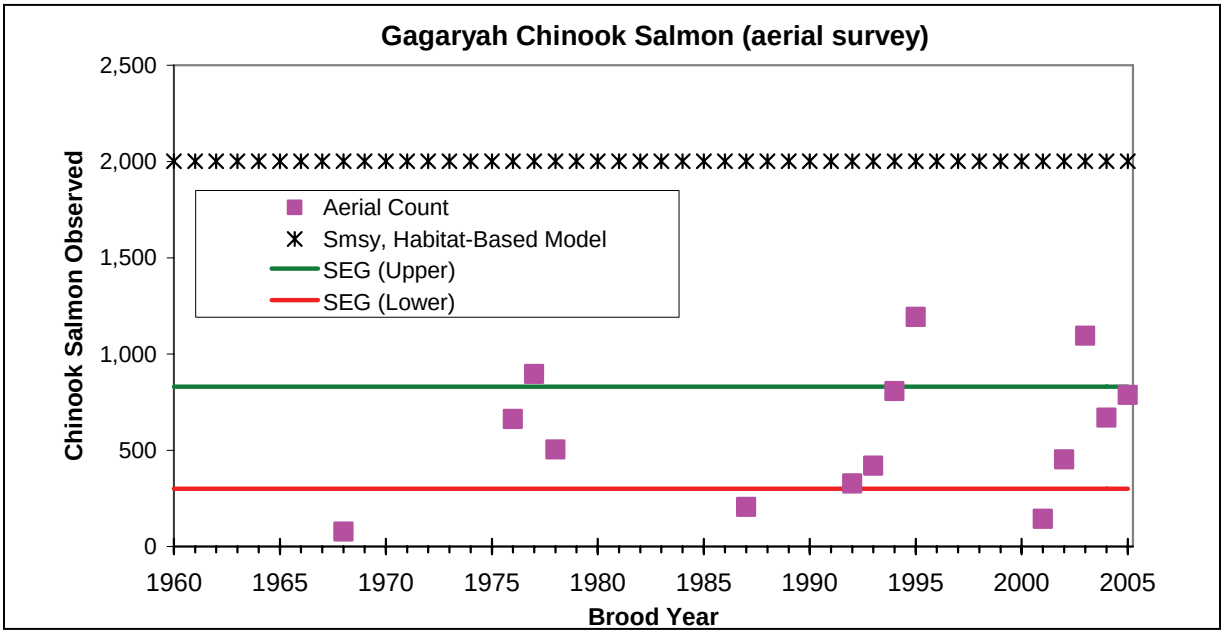
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968					78	2	24 Jul	
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976					663	1	25 Jul	
1977					897	1	23 Jul	
1978	423	81			504	1	29 Jul	
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987	205	0			205	1	26 Jul	
1988								
1989								
1990								
1991								
1992	279	49			328	1	27 Jul	
1993	363	56			419	1	29 Jul	
1994	597	210			807	1	29 Jul	
1995	823	370			1,193	1	26 Jul	
1996								
1997								
1998								
1999								
2000								
2001	132	11			143	1	29 Jul	
2002	310	142			452	1	25 Jul	
2003	821	274			1,095	1	22 Jul	
2004	496	174			670	1	22 Jul	
2005	647	141			788	1	22-Jul	

-continued-

System: Gagaryah River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Gagaryah River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**12**
Average	**565**
Min	**78**
15th	**183**
25th	**297**
Median	**478**
75th	**830**
85th	**966**
Max	**1,193**
Contrast	**15**
Contrast Label	High
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	**300**
SEG Upper	**830**

Summary Habitat-Based Model		
Watershed Area (km^2)	**869**	
Start Point	**Mouth**	(Lat. 61°37.170' N Long. 155°38.720' W)
S_{msy}	**2,002**	
S_c	**5,327**	

Appendix A1.6.–Escapement goal for George River Chinook salmon (aerial survey).

System: George River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 14**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	2
Criteria for SEG:	Low contrast
15th Percentile to Maximum:	660 to 1,169
Years within recommended SEG:	not applicable

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 277 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101, 102, 103 and 104.
  4) Counts include carcasses
- The George River is a popular subsistence and recreational location for residents of Crooked Creek, Georgetown, Red Devil and Sleetmute. There are local sport fish guiding services and river is periodically used by guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.
- Drainage has been subjected to variable levels of mining activity since about 1910.
- The George River weir is a cooperative project between ADF&G and Kuskokwim Native Association.

-continued-

System: George River
Species: Chinook salmon
Stock Unit: not applicable

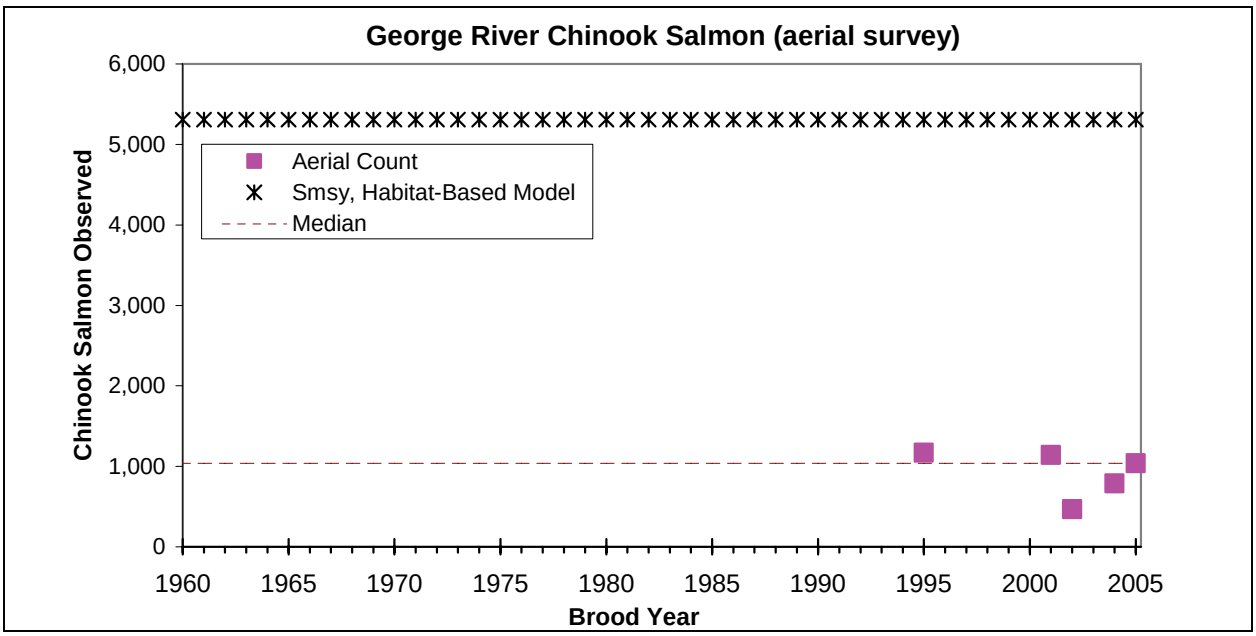
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987								
1988								
1989								
1990								
1991								
1992								
1993								
1994								
1995					1,169	2	28 Jul	
1996								
1997								
1998								
1999								
2000								
2001	64	904	112	63	1,143	1	28 Jul	
2002	63	291	94	21	469	1	23 Jul	
2003								
2004	236	394	126	32	788	2-3	24 Jul	
2005	179	456	381	24	1,040	2	23 Jul	

-continued-

System: George River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: George River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**5**
Average	**922**
Min	**469**
15th	**660**
25th	**788**
Median	**1,040**
75th	**1,143**
85th	**1,153**
Max	**1,169**
Contrast	**2**
Contrast Label	Low
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model

Watershed Area (km^2)	3,558	
Start Point	Mouth	(Lat. 61°53.828' N Long. 157°42.737' W)
S_{msy}	5,309	
S_c	14,138	

Appendix A1.7.–Escapement goal for George River Chinook salmon (weir).

System: George River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 14**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	SEG range: 3,100 to 7,900
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1996-1997, 1999-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts; no estimate in 1998
Contrast:	3
Criteria for SEG:	Low contrast
15th Percentile to Maximum:	3,082 to 7,823
Years within recommended SEG:	8 of 10 years within SEG range, 2 years below and 0 years above

Comments:

- 4 river miles from the enumeration point to the Kuskokwim River confluence.
- 281 river miles from the enumeration point to the mouth of the Kuskokwim River.
- The George River is a popular subsistence and recreational location for residents of Crooked Creek, Georgetown, Red Devil and Sleetmute. There are local sport fish guiding services, plus river is periodically used by guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.
- Drainage has been subjected to variable levels of mining activity since about 1910.
- The George River weir is a cooperative project between ADF&G and Kuskokwim Native Association.

-continued-

System: George River
Species: Chinook salmon
Stock Unit: not applicable

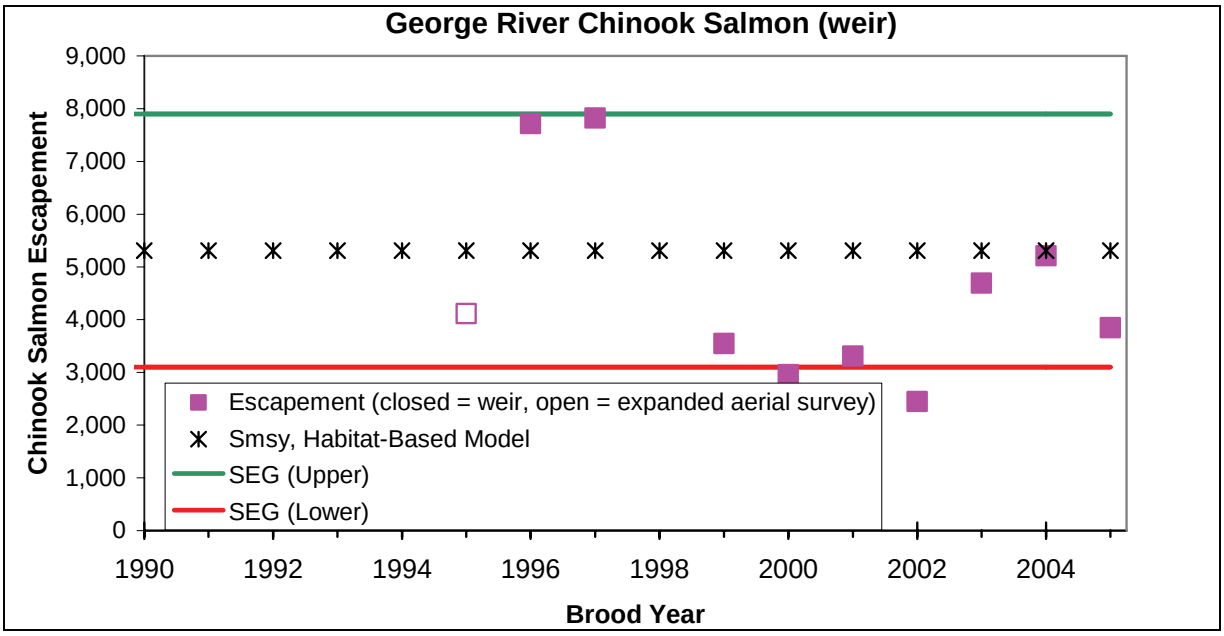
Data available for analysis of escapement goals.

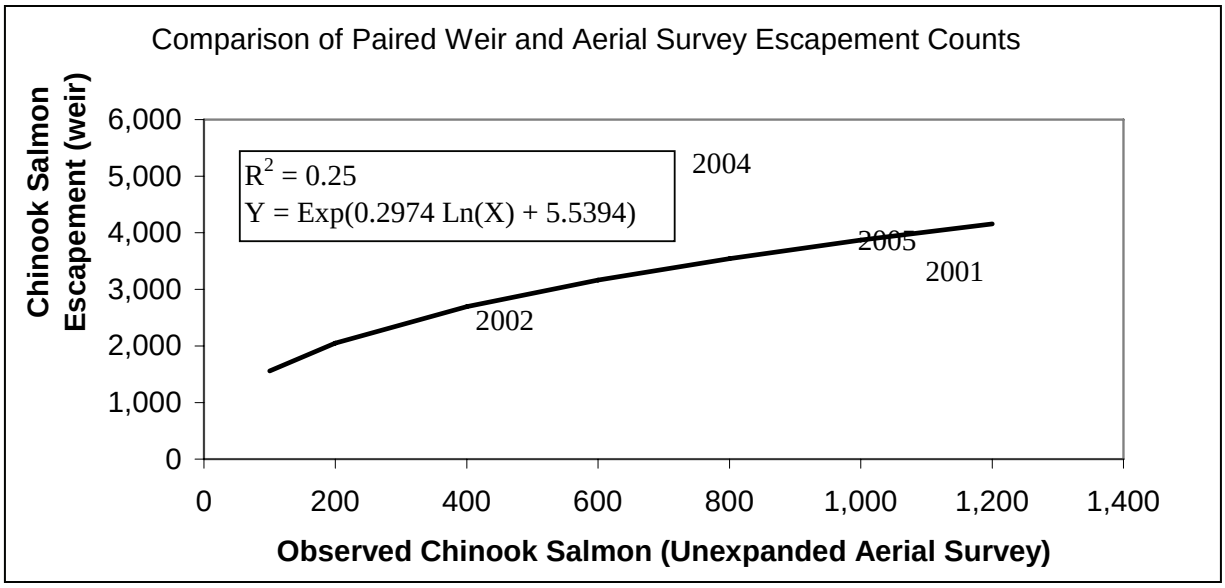
Brood Year	Escapement	Unexpanded Aerial Survey	Weir/Tower Counts &Aerial Expansion
1990			
1991			
1992			
1993			
1994			
1995		1,169	4,114
1996	7,716		7,716
1997	7,823		7,823
1998			
1999	3,548		3,548
2000	2,960		2,960
2001	3,309	1,143	3,309
2002	2,444	469	2,444
2003	4,693		4,693
2004	5,207	788	5,207
2005	3,845	1,040	3,845

-continued-

System: George River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and suggested SEG range (solid line).





-continued-

System: George River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	Weir Only **2005**	Weir w/Aerial Survey Expansion **2005**
Number of Years	**9**	**10**
Average	**4,616**	**4,566**
Min	**2,444**	**2,444**
15th	**3,030**	**3,082**
25th	**3,309**	**3,369**
Median	**3,845**	**3,980**
75th	**5,207**	**5,079**
85th	**7,214**	**6,838**
Max	**7,823**	**7,823**
Contrast	**3**	**3**
Contrast Label	Low	Low
Exploitation	Moderate	Moderate
Current Minimum Goal	**None**	**None**
Suggested SEG Lower	**3,100**	**3,100**
Suggested SEG Upper	**7,900**	**7,900**

Summary Habitat-Based Model		
Watershed Area (km^2)	**3,558**	
Start Point	**Mouth**	(Lat. 61°53.828' N Long. 157°42.737' W)
S_{msy}	**5,309**	
S_c	**14,138**	

Appendix A1.8.–Escapement goal for Hoholitna (upper) Chinook salmon (aerial survey).

System: Hoholitna River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 17**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Fair
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	14
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	49 to 116
Years within recommended SEG:	not applicable

Comments:

- 29 river miles from the enumeration point to the Kuskokwim River confluence.
- 334 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Counts include carcasses
- Chinook salmon spawn throughout much of the Hoholitna River, including areas upstream and downstream of the aerial survey area.
- The lower Hoholitna River drainage is the current focus of coal bed methane extraction interests.
- The Hoholitna River is a popular subsistence and recreational location for residents throughout the Kuskokwim River drainage. There are local sport fish guiding services that operate in the sub-basin, as well as guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.

-continued-

System: Hoholitna River
Species: Chinook salmon
Stock Unit: not applicable

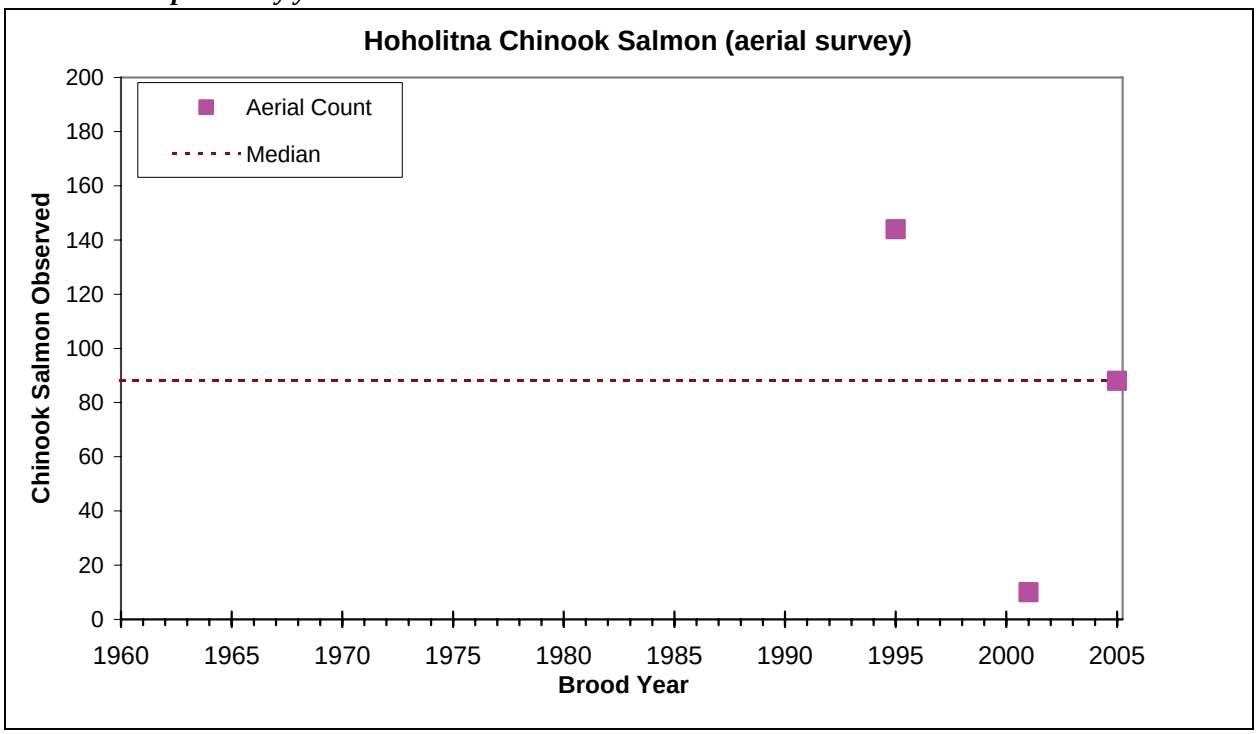
Data available for analysis of escapement goals.

Brood Year	Aerial Survey	Rating	Date of Survey	Comments
1960				
1961				
1962				
1963				
1964				
1965				
1966				
1967				
1968				
1969				
1970				
1971				
1972				
1973				
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995	144	2	27-Jul	
1996				
1997				
1998				
1999				
2000				
2001	10	2	27-Jul	
2002				
2003				
2004				
2005	88	2	25-Jul	

-continued-

System: Hoholitna River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Hoholitna River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**3**
Average	**81**
Min	**10**
15th	**33**
25th	**49**
Median	**88**
75th	**116**
85th	**127**
Max	**144**
Contrast	**14**
Contrast Label	High
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model		
Watershed Area (km^2)	**6,209**	
Start Point	**Mouth**	(Lat. 61°30.568' N Long. 156°59.262' W)
S_{msy}	**7,805**	
S_c	**20,790**	

Appendix A1.9.–Escapement goal for Holitna River Chinook salmon (aerial survey).

System: Holitna River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 15**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	970 to 2,100 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	9
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	964 to 2,040
Years within recommended SEG:	8 of 14 years within SEG range, 3 years below and 3 years above

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 305 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 102 and 103.
  4) Counts include carcasses
- Chinook salmon spawn throughout much of the Holitna River, including areas upstream of the aerial survey area. The Kogrukluk River weir is located immediately upstream of the survey area.
- Beginning in the early 1900's a small number of prospectors explored the upper Holitna River, but found only limited amounts of gold (Brown 1983). The area has also supported mercury mines, particularly in the Chukowan River drainage. The upper Holitna River drainage, inclusive of the Kogrukluk River, is the current focus of new mineral extraction interests.
- The Holitna River is a popular subsistence and recreational location for residents throughout the Kuskokwim River drainage. There are local sport fish guiding services that operate in the sub-basin, as well as guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.

-continued-

System: Holitna River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

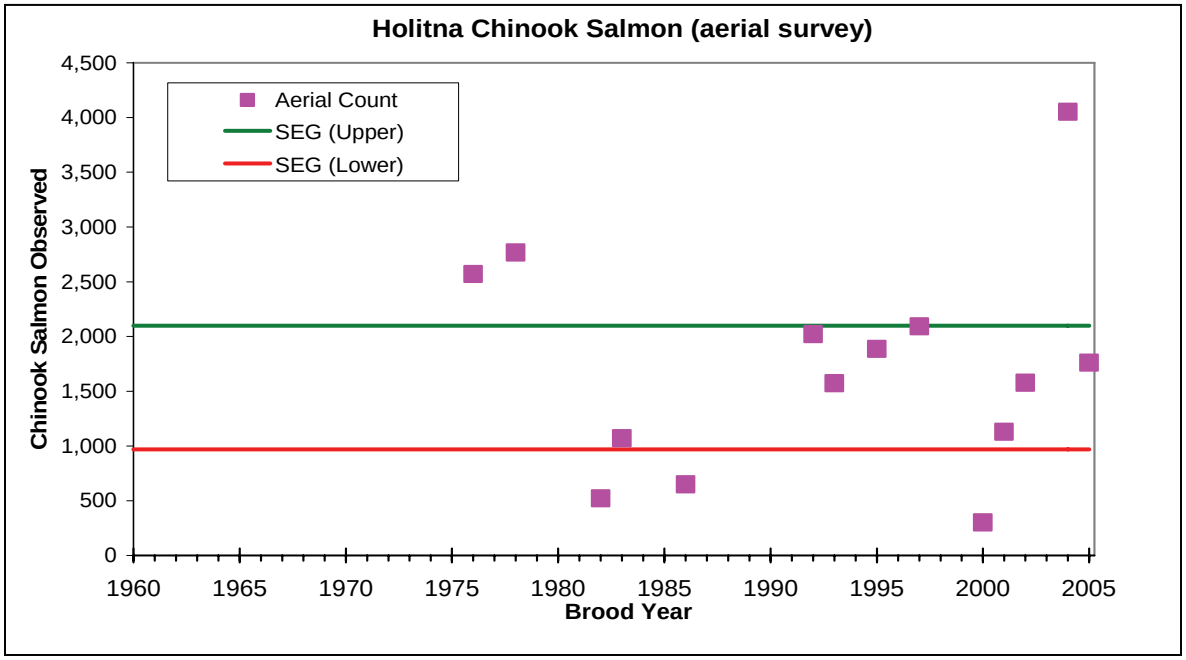
Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973							3-Aug	
1974								
1975								
1976	2,019	1,286	1,286	277	2,571	2	2-Aug	
1977								
1978	3,048	1,286	1,480	104	2,766	2	30-Jul	
1979								
1980								
1981								
1982	382	479	42	220	521	2	5-Aug	
1983	160	375	694	143	1,069	2	3-Aug	
1984								
1985								
1986		240	410		650	2	27-Jul	
1987								
1988								
1989								
1990								
1991								
1992		812	1,210		2,022	1	24-Jul	
1993		1,120	453	520	1,573	1	22-Jul	
1994								
1995		1,400	487	900	1,887	2	22-Jul	
1996								
1997		1,455	638		2,093	1	21-Jul	
1998								
1999		381	360			2	22-Jul	
2000		206	95	200	301	2	25-Jul	
2001	510	320	810	126	1,130	2	4-Aug	
2002		1,008	570	163	1,578	2	31-Jul	
2003								
2004	791	2,899	1,152		4,051	1	23-Jul	
2005		533	1227	1,035	1,760	2	25-Jul	

Shaded cells were not used when calculating SEG range due to incomplete count of run.

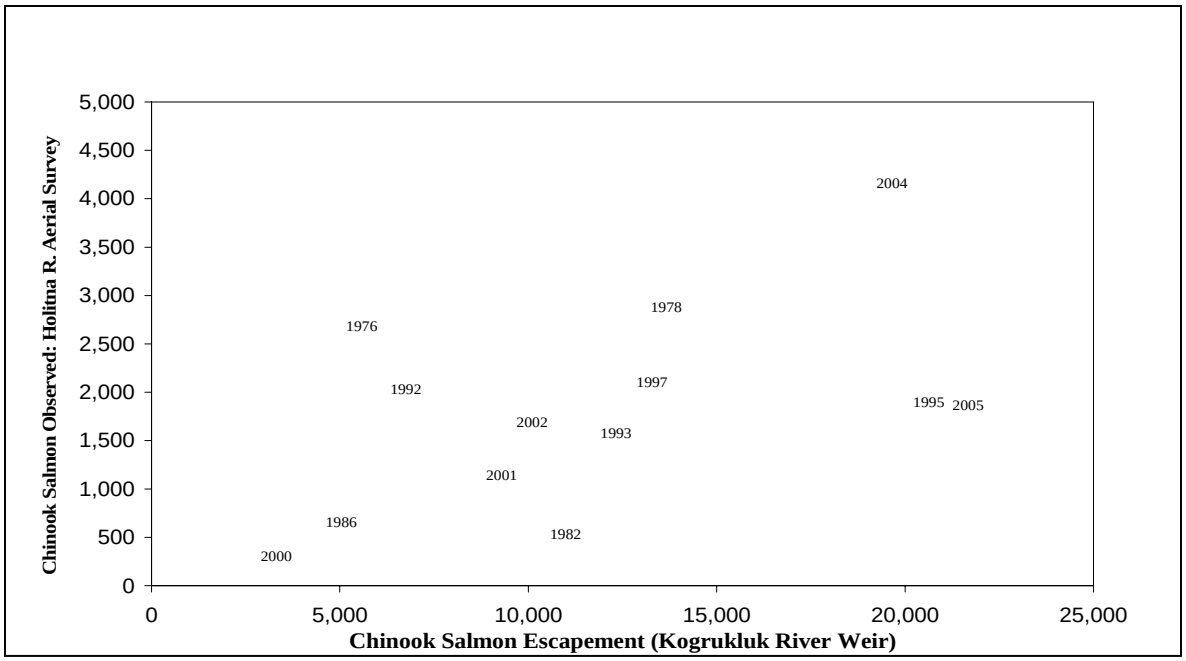
-continued-

System: Holitna River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



Comparison of paired annual aerial survey counts for the Holitna River and escapement estimates at Kogrukluk River weir.



-continued-

System: Holitna River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**12**
Average	**1,513**
Min	**301**
15th	**605**
25th	**964**
Median	**1,576**
75th	**2,040**
85th	**2,260**
Max	**2,766**
Contrast	**9**
Contrast Label	High
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	**970**
SEG Upper	**2,100**

Summary Habitat-Based Model		
Watershed Area (km^2)	**16,573**	
Start Point	**Mouth**	(Lat. 61°40.764' N Long. 157°10.188' W)
S_{msy}	**15,401**	
S_c	**41,037**	

Appendix A1.10.–Escapement goal for Holokuk River Chinook salmon (aerial survey).

System: Holokuk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 12**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	29
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	53 to 184
Years within recommended SEG:	not applicable

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 225 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- SEG was considered in 2004, but was deferred. There was concern about measurement error due to the small size of the stock, method of enumeration, and data quality. This stock was therefore not a good candidate for an additional aerial survey goal in the middle Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101 and 102
  4) Counts include carcasses
- The Holokuk River is a popular subsistence and recreational location for residents of Aniak (population 539) and Napaimiut (seasonal). There are local sport fish guiding services, plus the river is periodically used by guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities. This stream may be particularly vulnerable to over harvest given the relatively small size of the population.

-continued-

System: Holokuk River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

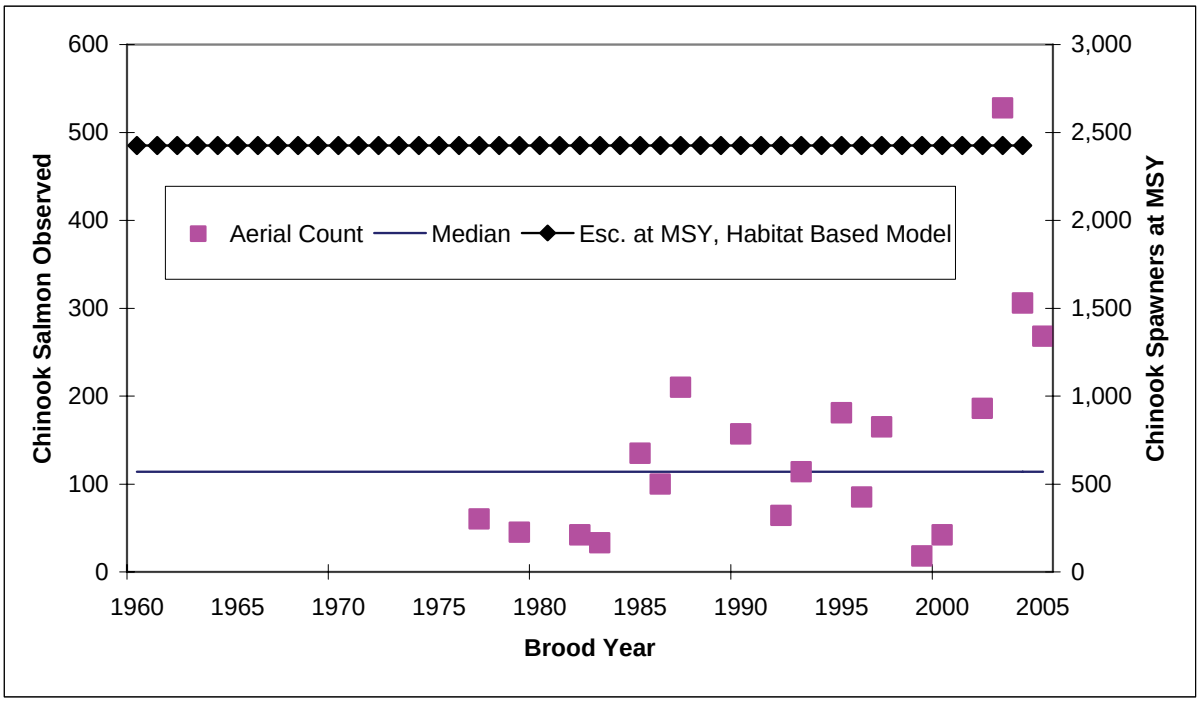
Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977					60	2	22-Jul	
1978								
1979					45	1	30-Jul	
1980								
1981								
1982	42	0			42	2	5-Aug	
1983	25	8			33	2	30-Jul	
1984								
1985	81	54			135	2	31-Jul	
1986					100	2	27-Jul	
1987	142	68			210	1	26-Jul	
1988								
1989								
1990	53	104			157	2	3-Aug	
1991								
1992	45	19			64	1	24-Jul	
1993	54	60			114	1	22-Jul	
1994								
1995	64	117			181	2	22-Jul	
1996	53	32			85	2	23-Jul	
1997	79	86			165	2	22-Jul	
1998								
1999	8	10			18	1	22-Jul	
2000	29	13			42	2	25-Jul	
2001								
2002	82	104			186	2	26-Jul	
2003	187	341			528	2	22-Jul	
2004	170	136	106	127	306	1	23-Jul	
2005	109	159	154	88	268	2	24-Jul	

Shaded areas not used for total because outside of standard survey areas.

-continued-

System: Holokuk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Holokuk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**19**
Average	**144**
Min	**18**
15th	**42**
25th	**53**
Median	**114**
75th	**184**
85th	**227**
Max	**528**
Contrast	**29**
Contrast Label	High
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model	
Watershed Area (km^2)	**1,147**
Start Point	**Mouth** (Lat. 61°32.105' N Long. 158°35.428' W)
S_{msy}	**2,425**
S_c	**6,456**

Appendix A1.11.–Escapement goal for Kipchuk River Chinook salmon (aerial survey).

System: Kipchuk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 10**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	20
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	479 to 1,309
Years within recommended SEG:	not applicable

Comments:

- 55 river miles from the enumeration point to the Kuskokwim River confluence.
- 273 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- SEG was considered in 2004, but deferred. Counts in the Kipchuk are significantly correlated with counts in the Aniak River which has an SEG. The Kipchuk River is a tributary of the Aniak River and did not broaden the geographic coverage of goals in the middle Kuskokwim River.
- Portions of the lower Aniak River are within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101, 102 and 103.
  4) Counts include carcasses
- The Aniak River is a popular location for subsistence and recreational activity due in part to the close proximity of Aniak (population 539) which serves as a local hub for communities in the middle Kuskokwim basin. The village is located on the Kuskokwim River, about 1 mile from the mouth of the Aniak River. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.

-continued-

System: Kipchuk River
Species: Chinook salmon
Stock Unit: not applicable

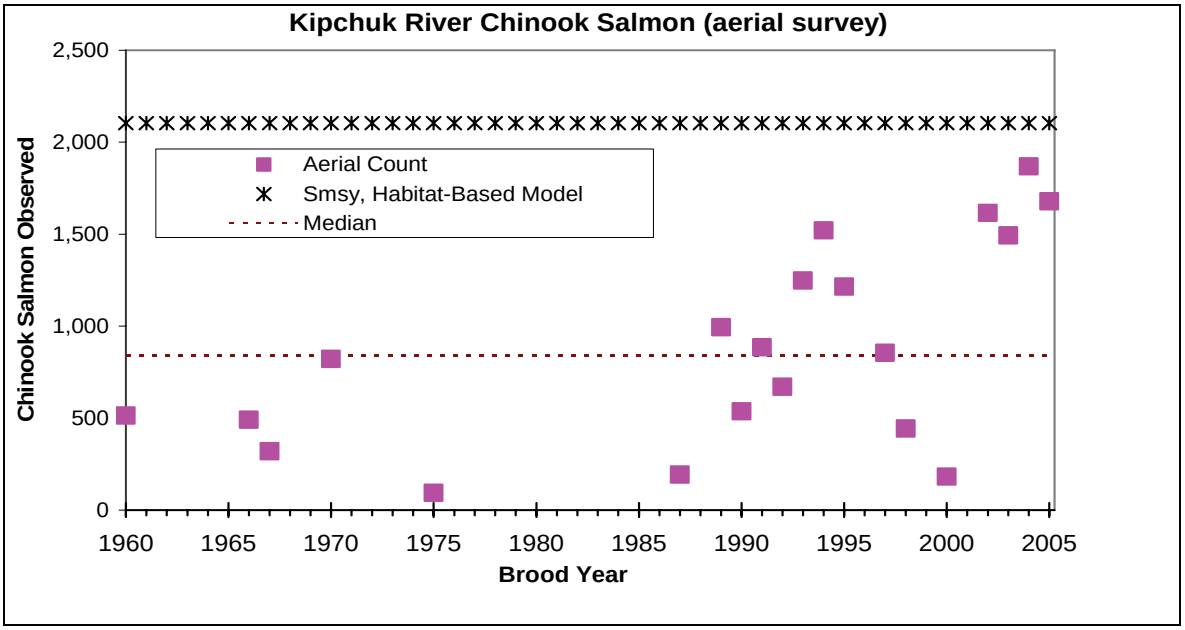
Data available for analysis of escapement goals.

Brood	Survey Areas				Index Area	Rating	Date of	Comments
Year	101	102	103	104	Total		Survey	
1960					513	1	16-Jul	
1961								
1962								
1963								
1964								
1965								
1966					491	1	27-Jul	
1967					319	2	23-Jul	
1968								
1969								
1970					821	2	24-Jul	
1971								
1972								
1973								
1974								
1975					94	2	31-Jul	
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987	31	79	83		193	2	27-Jul	
1988								
1989	511	302	181		994	1	26-Jul	
1990	207	94	236		537	1	19-Jul	
1991	519	145	221		885	2	23-Jul	
1992	451	65	154		670	2	20-Jul	
1993	732	231	285		1,248	1	21-Jul	
1994	885	195	440		1,520	1	26-Jul	
1995	770	92	353		1,215	1	20-Jul	
1996								
1997	563	72	220		855	1	21-Jul	
1998	348	73	22		443	1	1-Aug	
1999								
2000	97	54	31		182	2	27-Jul	
2001								
2002	974	224	417		1,615	1	30-Jul	
2003	1,022	321	150		1,493	1	25-Jul	
2004	1,346	361	161		1,868	1	28-Jul	
2005	1,348	101	230		1,679	2	28-Jul	

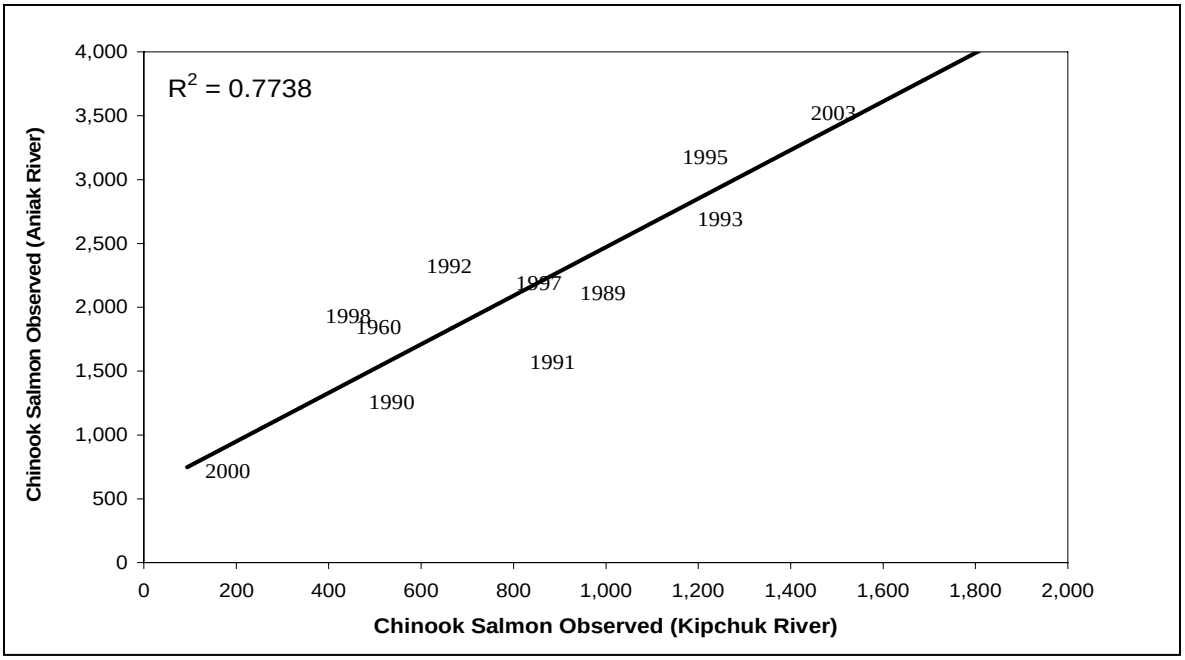
-continued-

System: Kipchuk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



Comparison of paired annual aerial survey counts for the Kipchuk River and main stem Aniak River.



-continued-

System: Kipchuk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years:	**20**
Average:	**882**
Min:	**94**
15th:	**300**
25th:	**479**
Median:	**838**
75th:	**1,309**
85th:	**1,534**
Max:	**1,868**
Contrast:	**20**
Contrast Label:	High
Exploitation:	Mod. to High
Current Minimum Goal:	**None**
Suggested SEG Lower:	**None**
Suggested SEG Upper:	**None**

Summary Habitat-Based Model		
Watershed Area (km^2)	**934**	
Start Point	**Mouth**	(Lat. 61°2.639' N Long. 159°10.483' W)
S_{msy}	**2,104**	
S_c	**5,600**	

Appendix A1.12.–Escapement goal for Kisaralik River Chinook salmon (aerial survey).

System: Kisaralik River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 7**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	400 to 1,200 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	38
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	397 to 1,139
Years within recommended SEG:	8 of 18 years within SEG range, 4 years below and 6 years above

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 94 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Kisaralik River is within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 102 and 103
  4) Counts include carcasses
- The Kisaralik River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471) and the Yup'ik villages of Akiak (population 346) and Akiachak (population 622), which are located along the mainstem Kuskokwim River. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream in order to harvest salmon and whitefish. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional sport fish and rafting tour guides operate on the river.

-continued-

System: Kisaralik River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

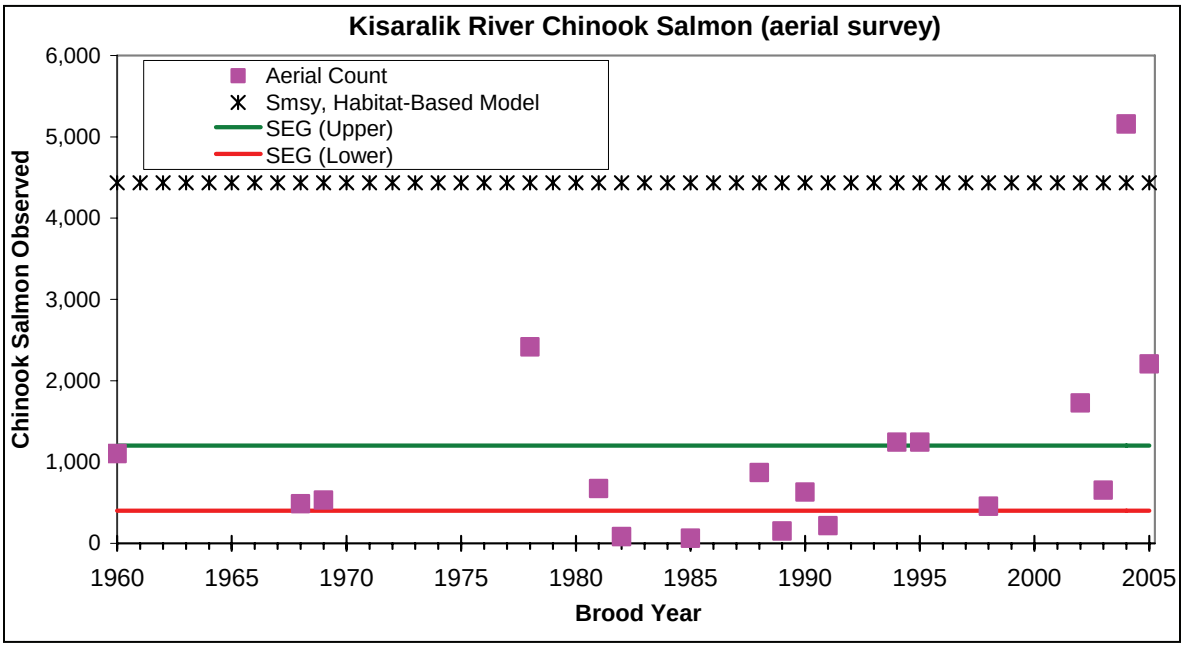
Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960					1,104	2	17-Jul	
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968					487	2	22-Jul	
1969					531	2	24-Jul	
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978		1,090	1,327		2,417	2	27-Jul	
1979								
1980								
1981		612	60		672	2	22-Jul	
1982		33	48		81			
1983								
1984								
1985		45	18		63	2	31-Jul	
1986								
1987								
1988		813	56		869	2	2-Aug	
1989		91	61		152	2	27-Jul	
1990		246	385		631	1	18-Jul	
1991		145	72		217	1	5-Aug	
1992								
1993								
1994		943	300		1,243	2	27-Jul	
1995		305	938		1,243	1	28-Jul	
1996								
1997								
1998		438	19		457	2	23-Jul	
1999								
2000								
2001								
2002		1,181	546		1,727	1	29-Jul	
2003		480	174		654	2	28-Jul	
2004	1,756	4,313	844		5,157	1	29-Jul	
2005	1,906	1,916	290		2,206	2	29-Jul	

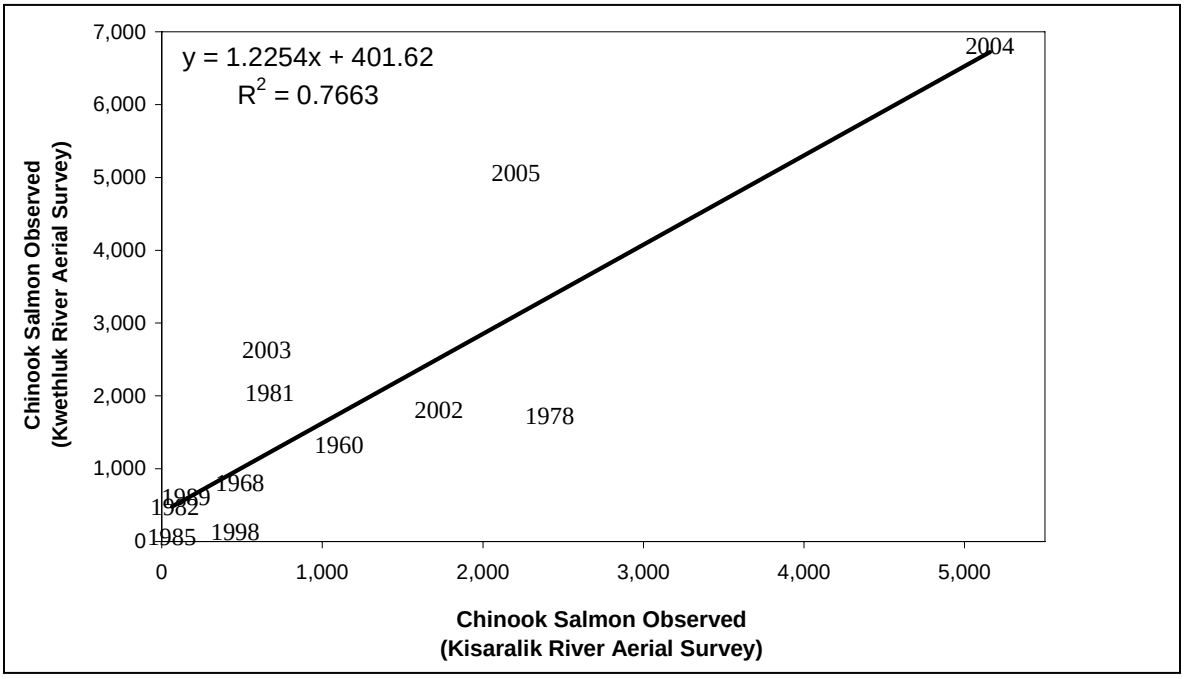
Shaded cells were not used when calculating SEG range due to incomplete count of run.

-continued-

System: Kisaralik River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).





-continued-

System: Kisaralik River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**16**
Average	**784**
Min	**63**
15th	**168**
25th	**397**
Median	**643**
75th	**1,139**
85th	**1,243**
Max	**2,417**
Contrast	**38**
Contrast Label	High
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	**400**
SEG Upper	**1,200**

Summary Habitat-Based Model

Watershed Area (km^2)	**2,743**	
Start Point	**Mouth**	(Lat. 60°51.442' N Long. 161°14.374' W)
S_{msy}	**4,435**	
S_c	**11,809**	

Appendix A1.13.–Escapement goal for Kogrukluk River Chinook salmon (weir).

System: Kogrukluk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 16**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	5,300 to 14,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1976, 1978-1979, 1981-1982, 1984-1986, 1988-2005
Summary:	
Data Quality:	Fair
Data Type:	Weir counts
Contrast:	6
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	5,277 to 13,960
Years within recommended SEG:	16 of 26 years within SEG range, 4 years below and 6 years above

Comments:

- 136 river miles from the enumeration point to the Kuskokwim River confluence.
- 441 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Kogrukluk River is a tributary of the upper Holitna River. Chinook salmon spawn throughout much of the Holitna River, including areas downstream of the Kogrukluk River weir.
- Beginning in the early 1900's a small number of prospectors explored the upper Holitna River, but found only limited amounts of gold (Brown 1983). The area has also supported mercury mines, particularly in the Chukowan River drainage. The upper Holitna River drainage, inclusive of the Kogrukluk River, is the current focus of new mineral extraction interests.
- The Holitna River is a popular subsistence and recreational location for residents throughout the Kuskokwim River drainage. Local sport fish guiding services operate in the sub-basin, as well as guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities. Approximately 50 new remote recreational cabin staking areas are expected to be made available in the upper Kogrukluk River drainage by the Alaska Department of Natural Resources during 2006.

-continued-

System: Kogrukluk River
Species: Chinook salmon
Stock Unit: not applicable

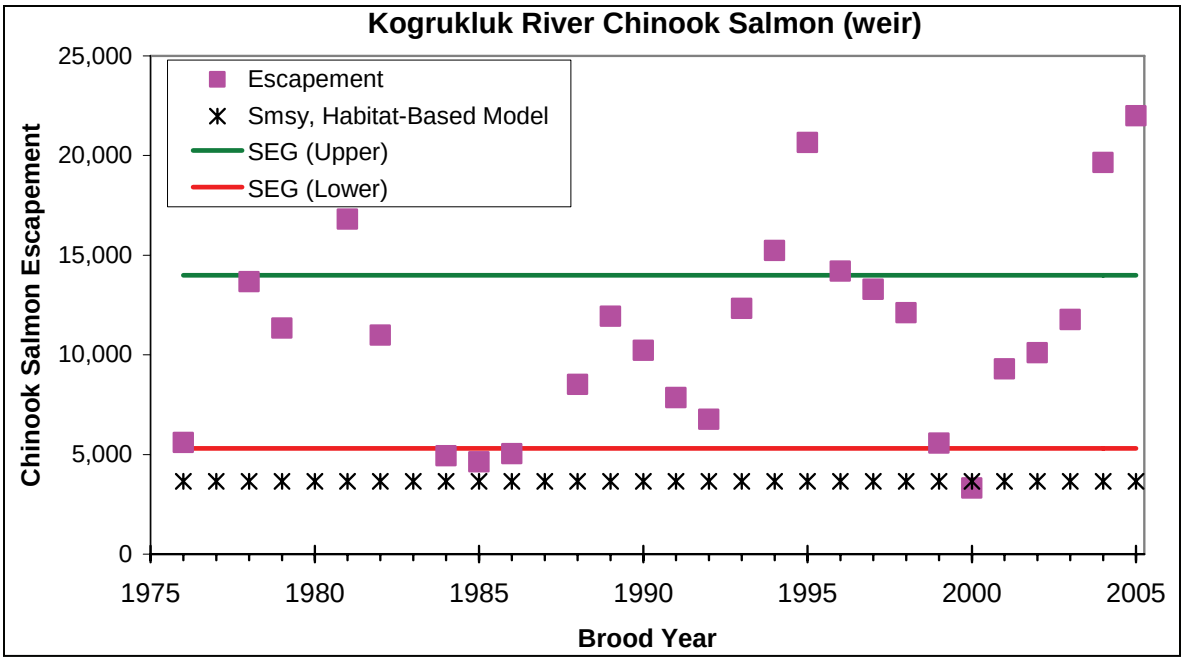
Data available for analysis of escapement goals.

Brood Year	Escapement
1976	5,600
1977	
1978	13,667
1979	11,338
1980	
1981	16,809
1982	10,993
1983	
1984	4,928
1985	4,619
1986	5,038
1987	
1988	8,520
1989	11,940
1990	10,218
1991	7,850
1992	6,755
1993	12,333
1994	15,227
1995	20,651
1996	14,199
1997	13,285
1998	12,107
1999	5,570
2000	3,310
2001	9,298
2002	10,104
2003	11,771
2004	19,651
2005	22,000

-continued-

System: Kogrukluk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Kogrukluk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**24**
Average	**10,255**
Min	**3,310**
15th	**5,277**
25th	**6,466**
Median	**10,606**
75th	**12,571**
85th	**13,960**
Max	**20,651**
Contrast	**6**
Contrast Label	Medium
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**5,300**
SEG Upper	**14,000**

Summary Habitat-Based Model

Watershed Area (km^2)	**2,073**	
Start Point	**Mouth**	(Lat. 60°50.976' N Long. 157°51.155' W)
S_{msy}	**3,653**	
S_c	**9,727**	

Appendix A1.14.–Escapement goal for Kuskokwim River Chinook salmon (run reconstruction).

System: Kuskokwim River
Species: Chinook salmon
Stock Unit: not applicable

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Reconstruction from weir and mark-recapture estimates

Summary:

Data Quality:	Fair
Data Type:	Weir counts, aerial survey counts, mark recapture population estimates, harvests from commercial, subsistence, and sport fisheries.

Comments:

- Eek River is located essentially downstream of the commercial fishing area, so is excluded from the run reconstruction (Figure 1).
- Sources for 2002 to 2004 subsistence harvest is Whitmore et al. (*in prep*).
- Subsistence harvest is estimated for 2005 as the 1990-99 average.
- Sport harvest is estimated for 2004-05 as the 2001-03 average.
- Source for escapement estimates upstream of Aniak River is Stuby et al. (2005).
- Escapement for the Aniak River is a guess based on the size of the drainage and subjective observations.
- 2005 Kwethluk River escapement is not a weir count but an expanded aerial survey count. Expansion is based on the historic relationship between weir and aerial counts.
- Escapement for the Kisaralik River is a estimated to be equal to the Kwethluk River weir based on the observations of staff that fly aerial surveys of both systems.

-continued-

System: Kuskokwim River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

Run Component	Enumeration Method	2002	2003	2004	2005
Harvest					
Subsistence		66,807	67,788	80,065	68,213
Commercial		72	158	2,300	4,825
Sport		300	401	330	330
Total Harvest		67,179	68,347	82,695	73,368
Escapement					
Kwethluk River	Weir	8,502	14,474	28,605	22,217 [a]
Kisaralik River	***Estimate*** [b]	8,500	14,500	28,600	22,200
Tuluksak River	Weir	1,346	1,064	1,479	2,653
Aniak River	***Estimate*** [c]	21,451	21,007	40,981	36,345
Mainstem Upstream of Aniak River	Radiotelemetry[d]	100,733	103,161	146,839	144,953
Total Escapement		140,532	154,206	246,504	228,368
Total Abundance Statistics					
Total Abundance		207,711	222,553	329,199	301,737
Annual Exploitation (Maximum)		32%	31%	25%	24%

[a] Kwethluk River escapement in 2005 was estimated as an expanded aerial survey count.

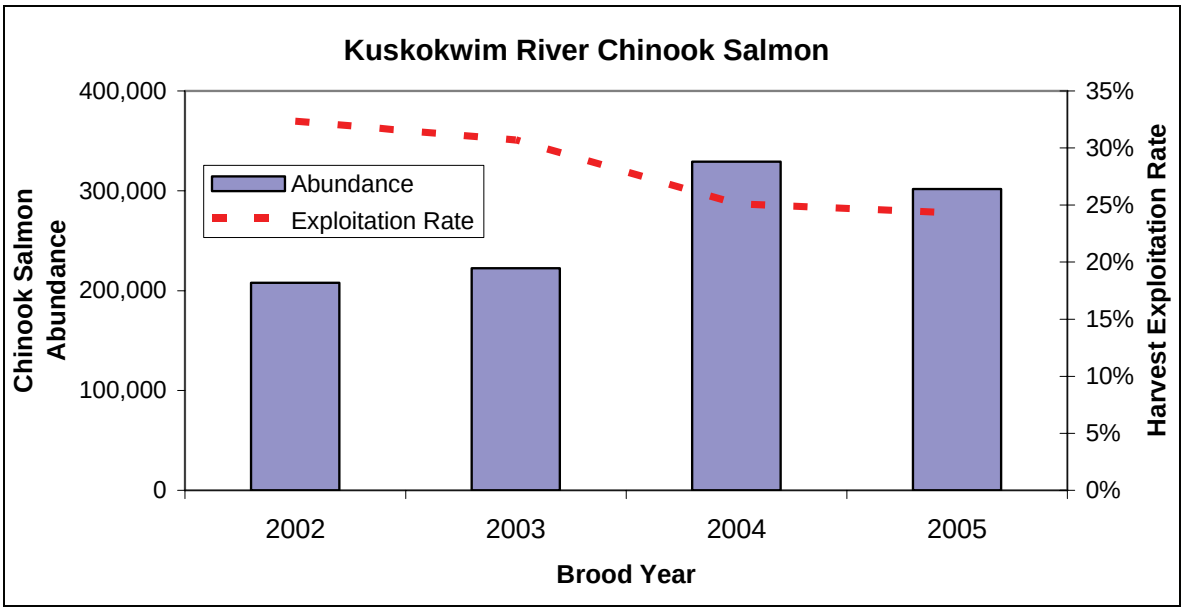
[b] Chinook salmon escapement into the Kisaralik is estimated to be equal to the Kwethluk River weir count.

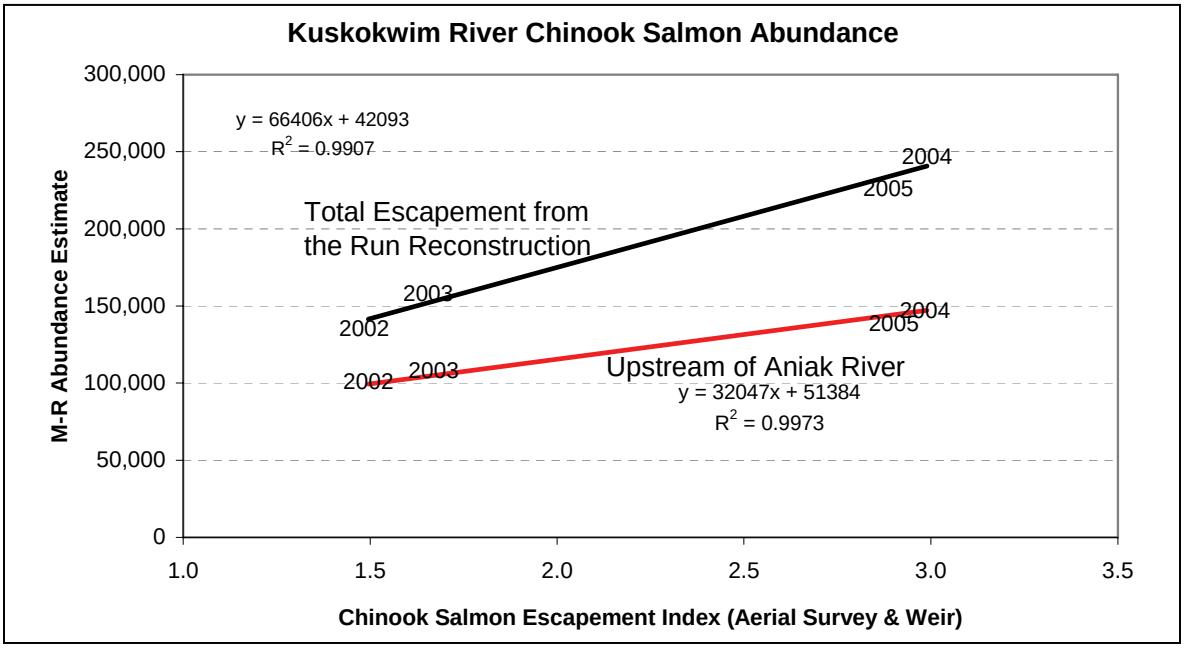
[c] Chinook escapement into the Aniak is estimated as 50% of the radiotelemetry estimate for the Holitna River based on subjective judgement.

-continued-

System: Kuskokwim River
Species: Chinook salmon
Stock Unit: not applicable

Estimated abundance and exploitation rate by year.





-continued-

System: Kuskokwim River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005** Abundance	**2005** Escapement
Number of Years	**4**	**4**
Average	**265,300**	**192,402**
Min	**207,711**	**140,532**
15th	**214,390**	**146,685**
25th	**218,842**	**150,787**
Median	**262,145**	**191,287**
75th	**308,602**	**232,902**
85th	**316,841**	**238,343**
Max	**329,199**	**246,504**
Contrast	**2**	**2**
Contrast Label	Low	Low
Exploitation	Moderate	Moderate
Current Minimum Goal	**None**	**None**
Suggested SEG Lower	**None**	**None**
Suggested SEG Upper	**None**	**None**

Appendix A1.15.–Escapement goal for Kwethluk River Chinook salmon (aerial survey).

System: Kwethluk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 6**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	580 to 1,800 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	Discontinue and replace with SEG for the weir
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 82 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Kwethluk River is within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 102, 103 and 104.
  4) Counts include carcasses
- The lower Kwethluk River has a tidal influence.
- The Kwethluk River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471), plus the Yup'ik village of Kwethluk (population 693). The village is located about 1 mile upstream from the Kuskokwim River confluence. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream in order to harvest salmon and whitefish. Observers have reported as many as dozen gillnets in the lower Kwethluk River during the height of the Chinook run. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.

- Data have changed from that reviewed in ADF&G (2004). The survey in 1998 was found to be rated as unacceptable (3) and will not be included in this review. The survey in 1985 included comments that do not support the rating of "good" and indicate turbid waters and problems observing Chinook salmon and will also not be expanded and included in the analysis of weir data. Lastly, two surveys were conducted in 1989 on the same day. Comments indicated which one's Chinook counts should be used. The correct value has been placed the table (next page).

-continued-

System: Kwethluk River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

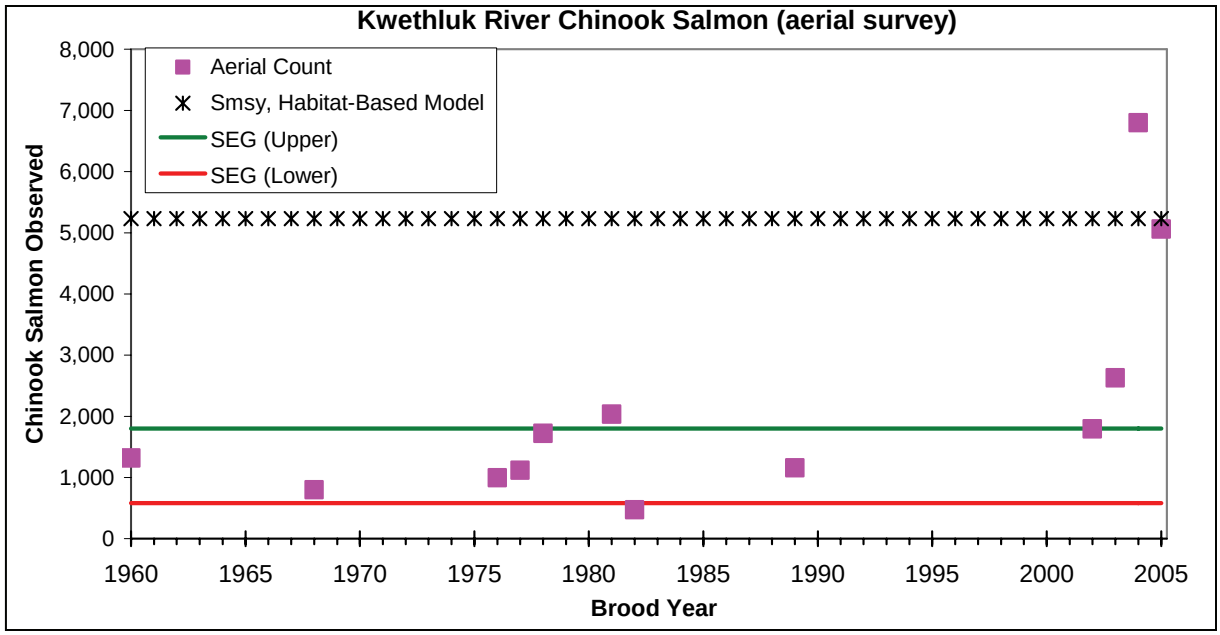
Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960					1,320		18-Jul	
1961								
1962								
1963								
1964								
1965								
1966				516		2	21-Jul	
1967								
1968					800	2	22-Jul	
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976					997	2	3-Aug	
1977		614	426	76	1,116	2	20-Jul	
1978		510	766	446	1,722	2	27-Jul	
1979								
1980								
1981		144	1,805	85	2,034	3	22-Jul	
1982		155	285	31	471	2	23-Jul	
1983								
1984								
1985		11	35	5		2	2-Aug	
1986								
1987								
1988		132	490			2	2-Aug	
1989		304	712	141	1,157	2	26-Jul	
1990		213	990			1	20-Jul	
1991		212	606			2	2-Aug	
1992								
1993								
1994								
1995								
1996								
1997								
1998		71	28	27		3	29-Jul	
1999								
2000								
2001								
2002		915	750	130	1,795	2	29-Jul	
2003		1,016	1,235	377	2,628	2	1-Aug	
2004		3,989	2,126	686	6,801			
2005		2,566	1,896	597	5,059	2	30-Jul	

Shaded cells were not used when calculating SEG range (for the weir).

-continued-

System: Kwethluk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Kwethluk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**12**
Average	**2,158**
Min	**471**
15th	**928**
25th	**1,086**
Median	**1,521**
75th	**2,183**
85th	**3,479**
Max	**6,801**
Contrast	**14**
Contrast Label	High
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	**580**
SEG Upper	**1,800**

Summary Habitat-Based Model	
Watershed Area (km^2)	**3,482**
Start Point	**Mouth** (Lat. 60°48.773' N Long. 161°27.062' W)
S_{msy}	**5,231**
S_c	**13,929**

Appendix A1.16.–Escapement goal for Kwethluk River Chinook salmon (tower and weir).

System: Kwethluk River

Stock Unit: not applicable **Map Code: 6**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	Aerial survey count: 580 to 1,800 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	SEG of 6,000 to 11,000
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1992, 2000 to 2004; tower 1996 and 1997; otherwise, expanded aerial surveys.
Summary:	
Data Quality:	Fair
Data Type:	Weir and tower counts, and expanded aerial surveys.
Contrast:	10
Criteria for SEG:	High contrast
25th to 75th Percentile:	5,956 to 10,326
Years within recommended SEG:	9 of 16 years within SEG range, 4 years below and 3 years above

Comments:

- 52 river miles from the enumeration point to the Kuskokwim River confluence.
- 134 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Three paired data set of weir and aerial survey counts were used to expand historical aerial surveys to estimate total escapement.
- Kwethluk River is within the Yukon Delta National Wildlife Refuge.
- The weir is a cooperative project between USFWS and the Organized Village of Kwethluk; the tower was operated by the Association of Village Council Presidents and Kwethluk IRA Council.
- The Kwethluk River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471) and the Yup'ik village of Kwethluk (population 693). The village is located about 1 mile upstream from the Kuskokwim River confluence. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream in order to harvest salmon and whitefish. Observers have reported as many as a dozen gillnets in the lower Kwethluk River during the height of the Chinook run. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.

- Discovery of gold in nearby streams in 1909 attracted prospectors to the Kwethluk River basin, but yields were low and most prospectors were gone by 1911. One placer deposit in the upper Kwethluk basin was worked until World War II (Community Profiles Database 2006). Kwethluk River also served as an access route to gold fields in the upper Eek River basin (Brown 1983).
- The lower Kwethluk River has a tidal influence.

-continued-

System: Kwethluk River

Stock Unit: not applicable

Data available for analysis of escapement goals.

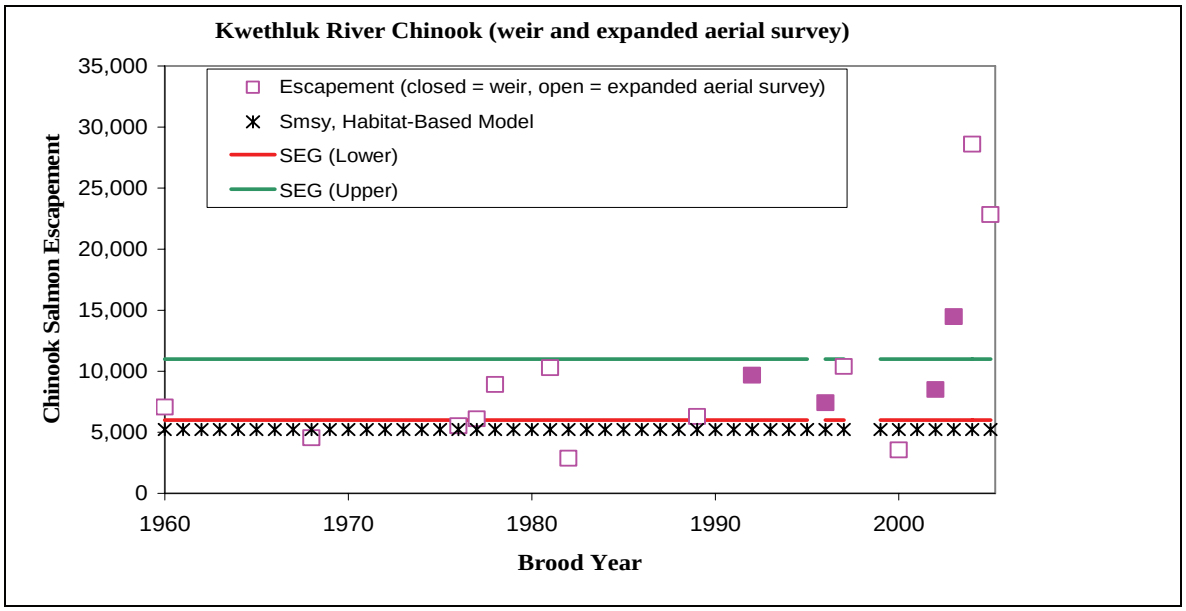
Brood Year	Escapement Weir/Tower	Unexpanded Aerial Survey	Weir/Tower Counts &Aerial Expansion
1960		1,320	7,062
1961			
1962			
1963			
1964			
1965			
1966			
1967			
1968		800	4,560
1969			
1970			
1971			
1972			
1973			
1974			
1975			
1976		997	5,526
1977		1,116	6,099
1978		1,722	8,908
1979			
1980			
1981		2,034	10,303
1982		471	2,871
1983			
1984			
1985			
1986			
1987			
1988			
1989		1,157	6,294
1990			
1991			
1992	9,675		9,675
1993			
1994			
1995			
1996	7,415		7,415
1997	10,395		10,395
1998			
1999			
2000	3,547		3,547
2001			
2002	8,502	1,795	8,502
2003	14,474	2,628	14,474
2004	28,605	6,801	28,605
2005		5,059	22,836

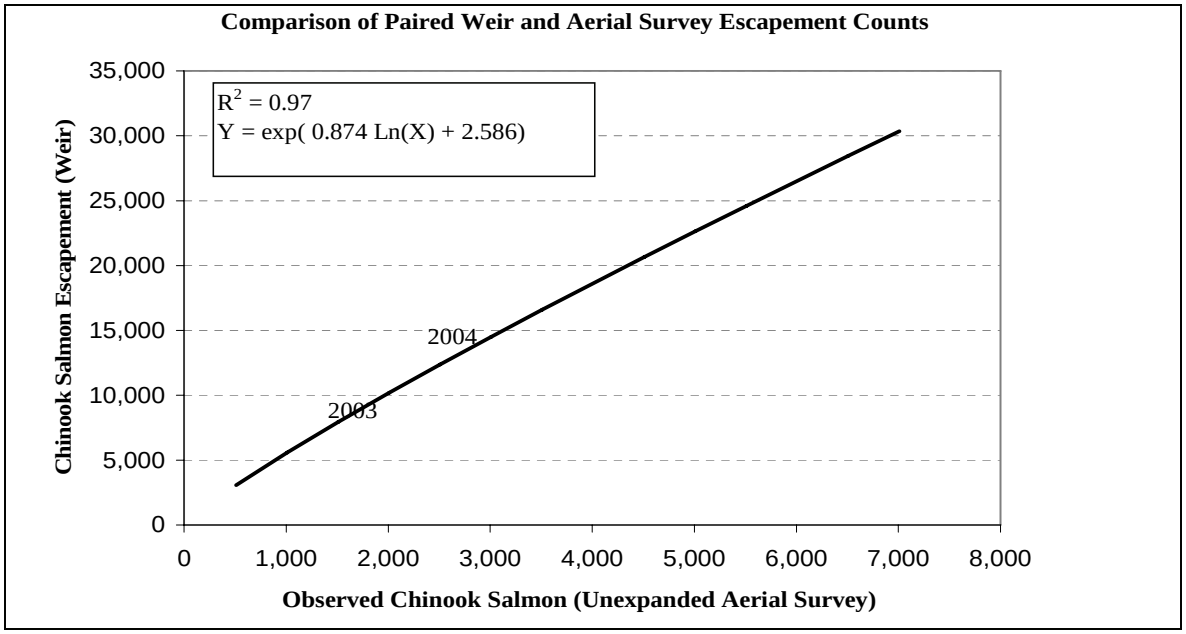
-continued-

System: Kwethluk River

Stock Unit: not applicable

Observed escapement by year.





-continued-

System: Kwethluk River

Stock Unit: not applicable

Summary Statistics through:	Weir Only **2005**	Weir w/Aerial Survey Expansion **2005**
Number of Years	**7**	**16**
Average	**11,802**	**9,817**
Min	**3,547**	**2,871**
15th	**7,028**	**4,801**
25th	**7,959**	**5,956**
Median	**9,675**	**7,959**
75th	**12,435**	**10,326**
85th	**15,887**	**13,454**
Max	**28,605**	**28,605**
Contrast	**8**	**10**
Contrast Label	Medium	High
Exploitation	Moderate	Moderate
Current Minimum Goal	**None**	**None**
Suggested SEG Lower	**7,100**	**6,000**
Suggested SEG Upper	**16,000**	**11,000**

Summary Habitat-Based Model		
Watershed Area (km^2)	**3,482**	
Start Point	**Mouth**	(Lat. $60^{o}48.773'$ N Long. $161^{o}27'.062'$ W)
S_{msy}	**5,231**	
S_c	**13,929**	

Appendix A1.17.–Escapement goal for Oskawalik River Chinook salmon (aerial survey).

System: Oskawalik River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 13**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	18
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	103 to 326
Years within recommended SEG:	not applicable

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 247 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- SEG was considered in 2004, but was deferred. There was concern about measurement error due to the small size of the stock, method of enumeration, and data quality. This stock was therefore not a good candidate for an additional aerial survey goal in the middle Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101, 102 and 103
  4) Counts include carcasses
- The Oskawalik River is a popular subsistence and recreational location for residents of Aniak (population 539) and Crooked Creek (population 114). There are local sport fish guiding services, plus the river is periodically used by guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities. This stream may be particularly vulnerable to overharvest given the relatively small size of the run and proximity to the Donlin Creek mine access sites.

-continued-

System: Oskawalik River
Species: Chinook salmon
Stock Unit: not applicable

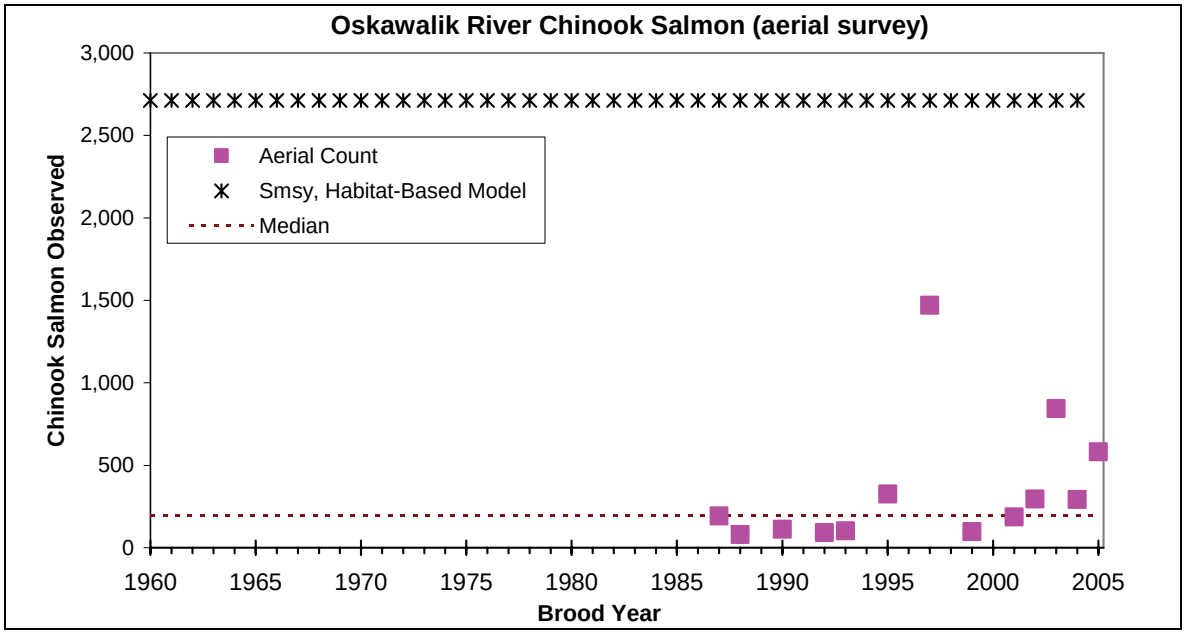
Data available for analysis of escapement goals.

Brood Year	Survey Areas				Index Area Total	Rating	Date of Survey	Comments
	101	102	103	104				
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987					193	2	30-Jul	
1988	24	31	25		80	2	20-Jul	
1989								
1990	44	57	12		113	2	3-Aug	
1991								
1992	20	70	1		91	1	24-Jul	
1993	56	29	18		103	1	22-Jul	
1994								
1995	144	98	84		326	2	22-Jul	
1996								
1997	649	487	334		1,470	2	29-Jul	
1998								
1999	39	48	11		98	2	22-Jul	
2000								
2001	93	56	37		186	2	28-Jul	
2002	88	176	31		295	2	24-Jul	
2003	229	406	209		844	2	22-Jul	
2004	98	127	68		293	1	23-Jul	
2005	182	211	189		582	2	23-Jul	

-continued-

System: Oskawalik River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Oskawalik River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**13**
Average	**360**
Min	**80**
15th	**97**
25th	**103**
Median	**193**
75th	**326**
85th	**634**
Max	**1,470**
Contrast	**18**
Contrast Label	High
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model	
Watershed Area (km^2)	**1,348**
Start Point	**Mouth** (Lat. 61°44.715' N Long. 158°10.788' W)
S_{msy}	**2,712**
S_c	**7,218**

Appendix A1.18.–Escapement goal for Pitka Fork Chinook salmon (aerial survey).

System: Pitka Fork
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 22**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey
Contrast:	5
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	159 to 472
Years within recommended SEG:	not applicable

Comments:

- 579 river miles from the enumeration point to the mouth of the Kuskokwim River.
- The mouth of Pitka Fork is located at Latitude 62°56.163' N, Longitude 154°45.055' W.
- The section of stream surveyed extends from Latitude 62°46.28' N, Longitude 154°28.66' W upstream to Latitude 62°40.35' N, Longitude 154°23.28' W.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) The entire survey area must be surveyed
  4) Counts include carcasses
- Pitka Fork Chinook salmon are assumed to be within a genetically distinct aggregate of spawning populations from the upper Kuskokwim River, although no samples have been specifically collected from this section of stream (Templin et al. 2004).
- Stuby (2003) and Linderman et al. (2003) both report that upper Kuskokwim River salmon tend to have earlier run timings through the lower Kuskokwim River than stocks that spawn in tributaries farther down stream. Managers can take actions to ensure adequate geographic distribution of escapement by regulating the temporal distribution of harvest in the lower Kuskokwim River. Trends in the subsistence harvest suggest that earlier running stocks may have a higher exploitation rate in the subsistence Chinook fishery (Stuby 2003).

-continued-

System: Pitka Fork
Species: Chinook salmon
Stock Unit: not applicable

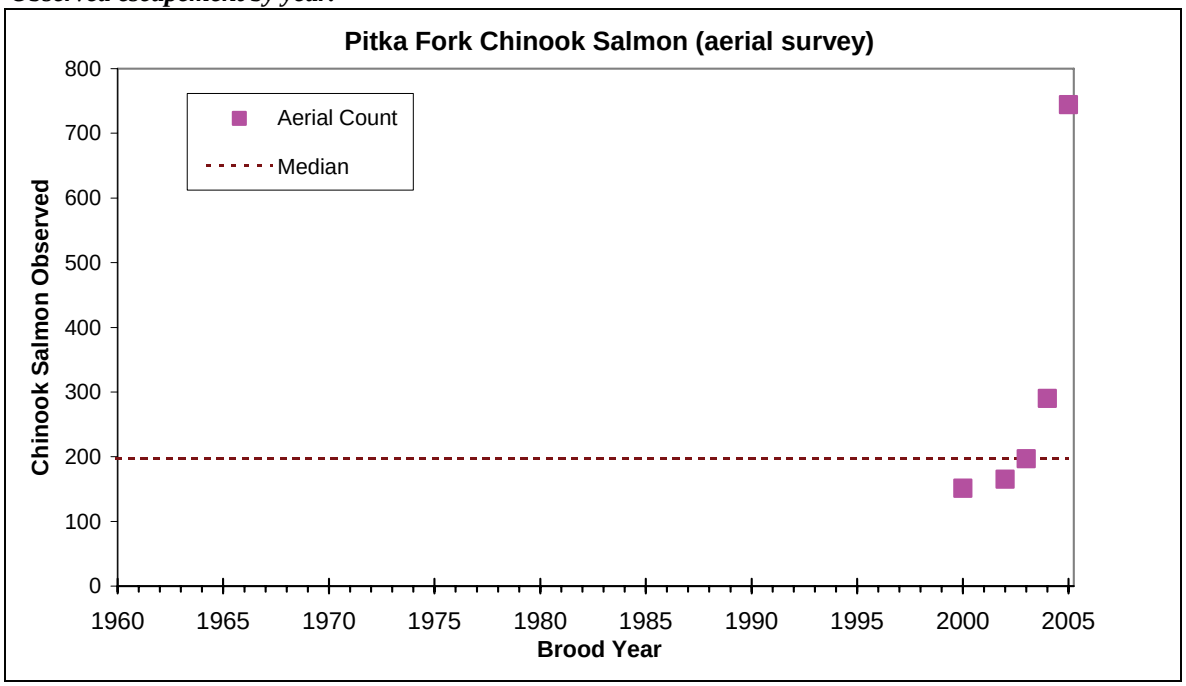
Data available for analysis of escapement goals.

Brood Year	Aerial Survey	Rating	Date of Survey	Comments
1960				
1961				
1962				
1963				
1964				
1965				
1966				
1967				
1968				
1969				
1970				
1971				
1972				
1973				
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998				
1999				
2000	151	1	26-Jul	
2001				
2002	165	1	22-Jul	
2003	197	1	20-Jul	
2004	290	2	19-Jul	
2005	744	2	20-Jul	

-continued-

System: Pitka Fork
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Pitka Fork
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**5**
Average	**309**
Min	**151**
15th	**159**
25th	**165**
Median	**197**
75th	**290**
85th	**472**
Max	**744**
Contrast	**5**
Contrast Label	Medium
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model

Watershed Area (km^2)	**1,802**	
Start Point	**Mouth**	(Lat. 62°56.163' N Long. 154°45.055' W)
S_{msy}	**3,316**	
S_c	**8,829**	

Appendix A1.19.–Escapement goal for Salmon River (Aniak sub-basin) Chinook salmon (aerial survey).

System: Salmon River (Aniak sub-basin)
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 9**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	330 to 1,200 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	83
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	329 to 1,134
Years within recommended SEG:	12 of 25 years within SEG range, 6 years below and 7 years above

Comments:

- 54 river miles from the enumeration point to the Kuskokwim River confluence.
- 245 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Portions of the lower Aniak River are within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101, 102 and 103.
  4) Counts include carcasses
- The Aniak River is a popular location for subsistence and recreational activity due in part close proximity of Aniak (population 539) which serves as a local hub for communities in the middle Kuskokwim basin. The village is located on the Kuskokwim River, about 1 mile from the mouth of the Aniak River. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.

-continued-

System: Salmon River (Aniak sub-basin)
Species: Chinook salmon
Stock Unit: not applicable

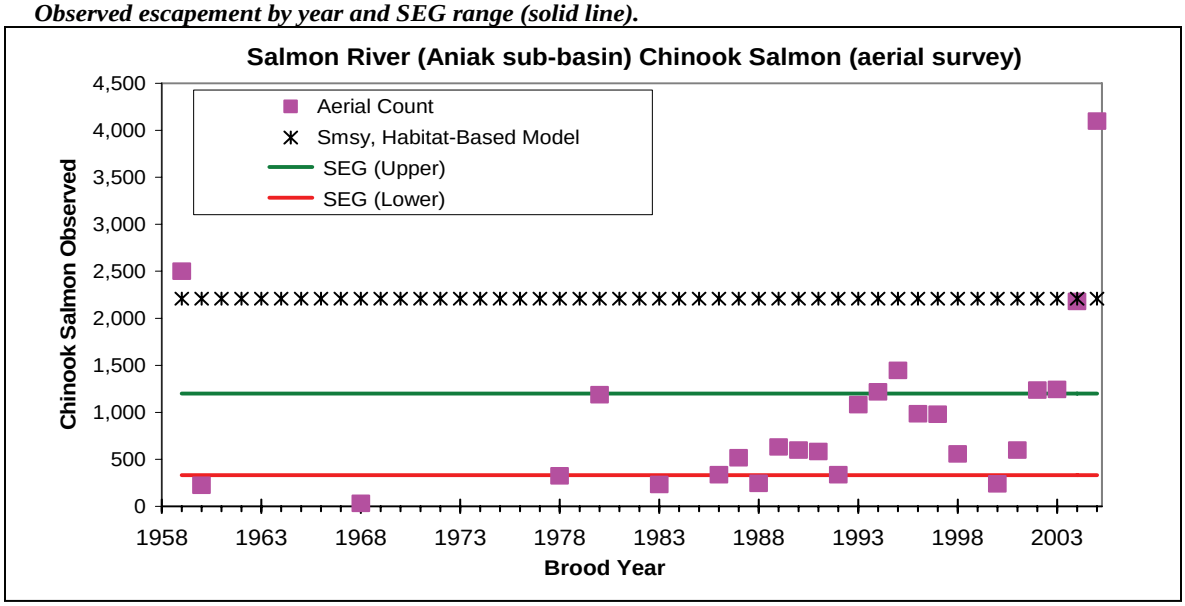
Data available for analysis of escapement goals.

Brood	Survey Areas				Index Area	Rating	Date of	Comments
Year	101	102	103	104	Total		Survey	
1959					2,500	2	22-Jul	
1960					223	1	17-Jul	
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968					30	2	23-Jul	
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978	119	119	84		322	2	18-Jul	
1979								
1980	885	262	39		1,186	2	23-Jul	
1981								
1982								
1983	136	83	12		231	2	29-Jul	
1984								
1985								
1986	282	54	0		336	2	28-Jul	
1987	459	57	0		516	1	27-Jul	
1988	184	60	0		244	2	18-Jul	
1989	478	88	65		631	1	26-Jul	
1990	138	320	138		596	1	19-Jul	
1991	300	198	85		583	2	23-Jul	
1992	240	95	0		335	2	20-Jul	
1993	773	232	77		1,082	1	21-Jul	
1994	612	397	209		1,218	1	26-Jul	
1995	911	392	143		1,446	1	20-Jul	
1996	553	267	165		985	2	22-Jul	
1997	665	268	47		980	2	21-Jul	
1998	408	143	6		557	1	1-Aug	
1999								
2000	151	27	60		238	2	22-Jul	
2001	327	166	105		598	2	28-Jul	
2002	332	392	512		1,236	2	30-Jul	
2003	491	546	205		1,242	1	25-Jul	
2004	1,250	727	200		2,177	2	27-Jul	
2005	3,552	378	167		4,097	2	28-Jul	

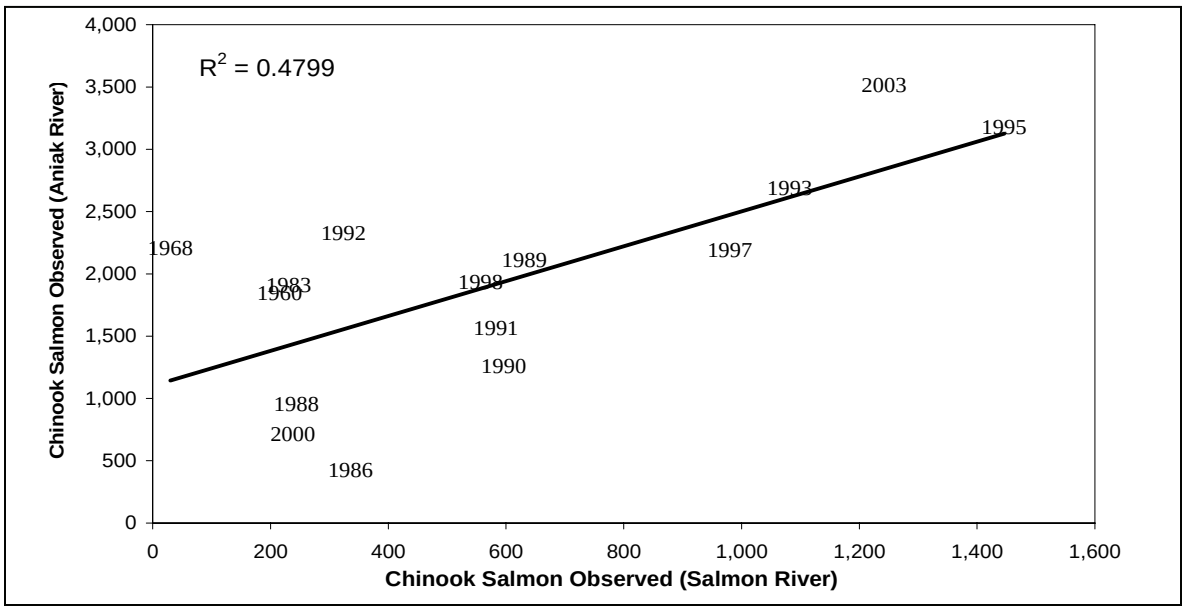
-continued-

System: Salmon River (Aniak sub-basin)
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



Comparison of paired annual aerial survey counts for the Salmon River (Aniak sub-basin) and main stem Aniak River.



-continued-

System: Salmon River (Aniak sub-basin)
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**23**
Average	**753**
Min	**30**
15th	**240**
25th	**329**
Median	**596**
75th	**1,134**
85th	**1,231**
Max	**2,500**
Contrast	**83**
Contrast Label	High
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	**330**
SEG Upper	**1,200**

Summary Habitat-Based Model

Watershed Area (km^2)	**1,003**	
Start Point	**Mouth**	(Lat. 61°3.883' N Long. 159°10.927' W)
S_{msy}	**2,209**	
S_c	**5,881**	

Appendix A1.20.–Escapement goal for Salmon River (Pitka Fork) Chinook salmon (aerial survey).

System: Salmon River (Pitka Fork)
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 24**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	470 to 1,600 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	7
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	467 to 1,588
Years within recommended SEG:	14 of 21 years within SEG range, 3 years below and 4 years above

Comments:

- 38 river miles from the enumeration point to the Kuskokwim River confluence.
- 579 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 102, 103 and 104
  4) Counts include carcasses
- A weir was operated on the South Fork of the Salmon River in 1981 and 1982 from approximately mid June to late July. Most of the passage was composed of Chinook salmon.
- The Salmon River is a popular subsistence and recreational location for residents of McGrath (population 407) and Nikolai (population 120). Subsistence fishers used fish fences on the river to harvest salmon until the early 1960's when the practice was banned. Most subsistence harvest is know taken with rod and reel gear.
- The Salmon River Chinook salmon are within a genetically distinct aggregate of spawning populations from the upper Kuskokwim River (Templin et al. 2004).
- Stuby (2003) and Linderman et al. (2003) both report that upper Kuskokwim River salmon tend to have earlier run timings through the lower Kuskokwim River than stocks that spawn in tributaries farther down stream. Managers can take actions to ensure adequate geographic distribution of escapement by regulating the temporal distribution of harvest in the lower Kuskokwim River. Trends in the subsistence harvest suggest that earlier running stocks may have a higher exploitation rate in the subsistence Chinook fishery (Stuby 2003).

-continued-

System: Salmon River (Pitka Fork)
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

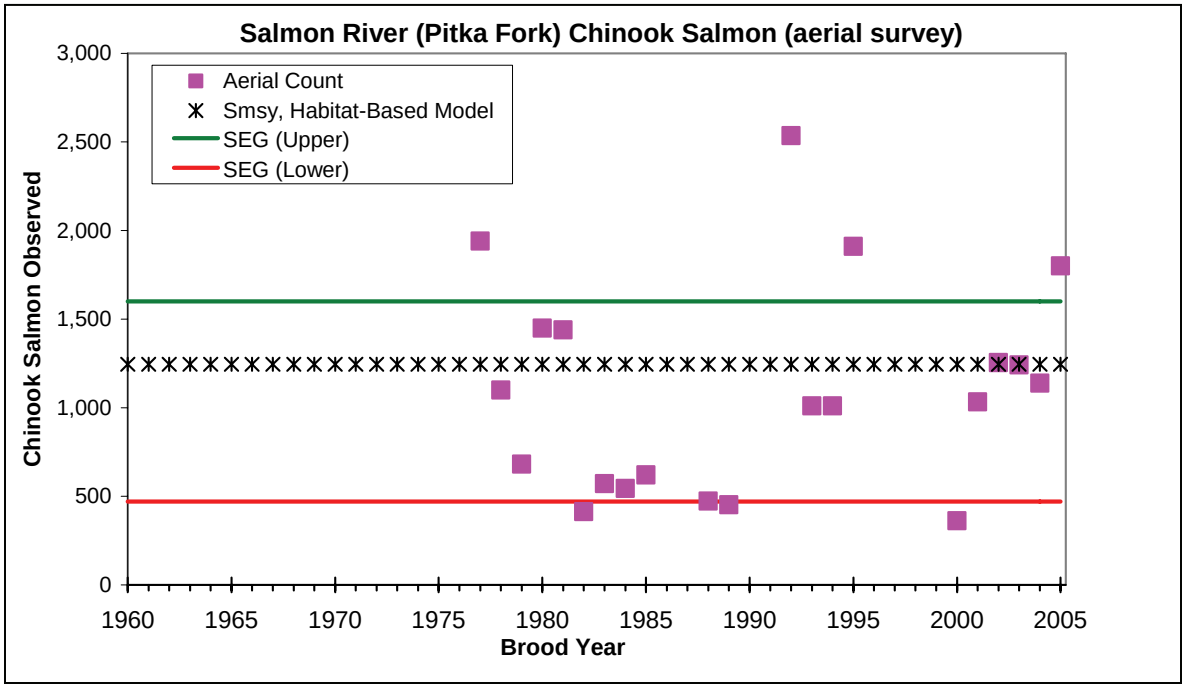
Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977		443	150	1,347	1,940	1	23-Jul	
1978		38	27	1,035	1,100	1	25-Jul	
1979		56	469	157	682	1	4-Aug	
1980					1,450			
1981	35	425	31	983	1,439	3a	5-Aug	
1982	6	63	66	284	413	2	28-Jul	
1983		59	155	358	572			
1984	32	43	3	499	545	2	23-Jul	
1985	5	15	4	601	620	2	26-Jul	
1986								
1987								
1988	28	32	39	402	473	2	25-Jul	
1989	0	53	9	390	452	2	27-Jul	
1990								
1991								
1992	19	895	266	1,375	2,536	1	28-Jul	
1993	2	158	191	661	1,010	1	30-Jul	
1994	0	137	24	849	1,010	1	30-Jul	
1995	0	287	32	1,592	1,911	1	28-Jul	
1996								
1997								
1998								
1999								
2000	15	107	57	198	362	1	26-Jul	
2001	0	264	77	692	1,033	1	27-Jul	
2002	21	359	4	892	1,255	1	22-Jul	
2003	149	272	34	935	1,241	1	20-Jul	
2004	0	118	60	960	1,138	1	20-Jul	
2005	8	520	116	1,165	1,801	2	20-Jul	

[a] 1981 counts were used in calculating SEG because rating of "poor" was overruled due to qualitative comments made in survey.
Shaded cells were not used when calculating SEG range due to incomplete count of run.

-continued-

System: Salmon River (Pitka Fork)
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Salmon River (Pitka Fork)
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**19**
Average	**1,055**
Min	**362**
15th	**467**
25th	**559**
Median	**1,010**
75th	**1,347**
85th	**1,588**
Max	**2,536**
Contrast	**7**
Contrast Label	Medium
Exploitation	Mod. to High
From ADF&G (2004)	
SEG Lower	**470**
SEG Upper	**1,600**

Summary Habitat-Based Model

Watershed Area (km^2)	**438**	
Start Point	**Mouth**	(Lat. 62°53.504' N Long. 154°34.548' W)
S_{msy}	**1,245**	
S_c	**3,313**	

Appendix A1.21.–Escapement goal for Takotna River Chinook salmon (weir / tower).

System: Takotna River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 21**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower 1995 to 1999; weir 2000 to 2005
Summary:	
Data Quality:	Fair
Data Type:	Weir / tower counts; no estimates in 1995, 1996, 1998, 1999 and 2003
Contrast:	4
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	347 to 710
Years within recommended SEG:	not applicable

Comments:

- 52 river miles from the enumeration point to the Kuskokwim River confluence.
- 467 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The weir is a cooperative project between ADF&G and Takotna Tribal Council.
- Salmon stocks in the Takotna River are thought to be in a rebuilding phase following decades of near absence, as was reported by several individuals who lived in the area during the 1940's through 1970's (Schwanke et al. 2001).
- The distribution of juvenile coho and Chinook salmon appears limited mostly to Fourth-of-July Creek, Big Creek and those water of the mainstem Takotna River downstream of Fourth-of-July Creek (Clark and Molyneaux 2003)
- Most salmon spawning occurs in Fourth-of July Creek, Big Creek and the mainstem Takotna River as far downstream as the community of Takotna. Small numbers of adult and juvenile coho salmon have been found in Moore Creek (Clark and Molyneaux, 2003).
- Gold mining and prospecting occurred throughout the Takotna River drainage. There are claims and intermittently active placer mines around Yankee Creek, Moore Creek, Lincoln Creek, Nixon Fork and the Candle Hills. Tailing piles are visible at Moore Creek, but they are mostly overgrown with vegetation. Plans are underway to renew mining operations at Moore Creek.
- The Takotna River is a popular location for subsistence and recreational activity especially for residents of Takotna and McGrath who used the river to access hunting areas. Subsistence salmon fishers set gillnets in the mouth of the Takotna River, across from McGrath, plus various homesteaders set gillnets within the drainage for whitefish and salmon.

-continued-

System: Takotna River
Species: Chinook salmon
Stock Unit: not applicable

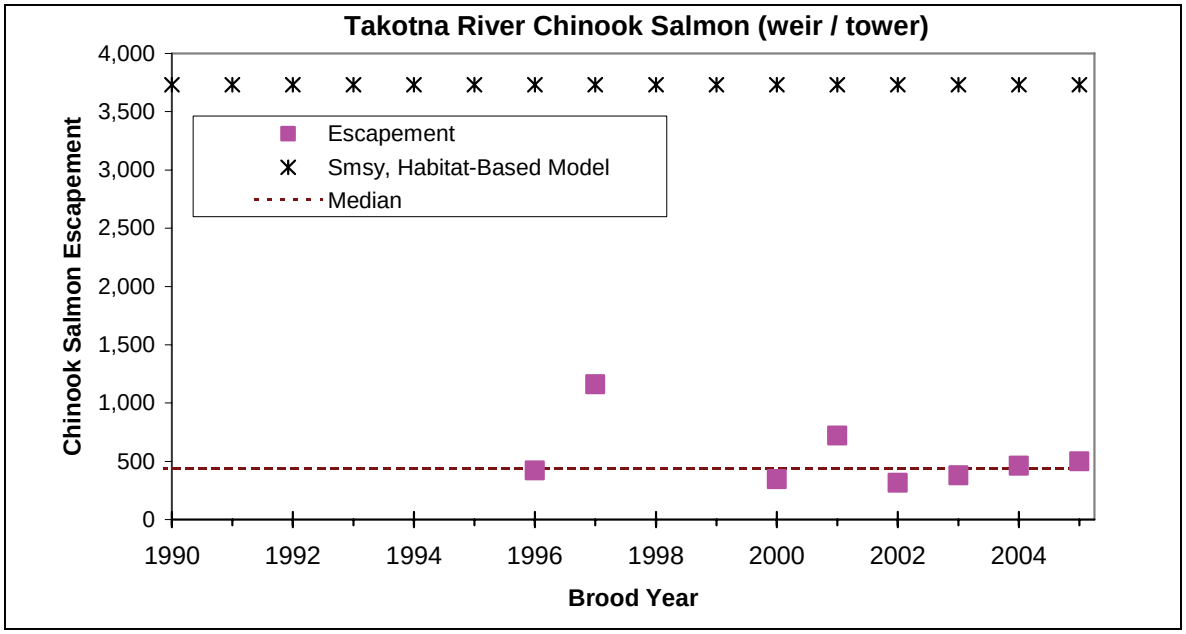
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	422
1997	1,161
1998	
1999	
2000	345
2001	721
2002	316
2003	378
2004	461
2005	499

-continued-

System: Takotna River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Takotna River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**8**
Average	**538**
Min	**316**
15th	**347**
25th	**370**
Median	**442**
75th	**555**
85th	**710**
Max	**1,161**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model	
Watershed Area (km^2)	**2,138**
Start Point[a]	**Weir** (Lat. 62°58.177' N Long. 156°5.801' W)
S_{msy}	**3,731**
S_c	**9,935**

[a] A start point of the weir was used for the habitat-based estimate of S_{msy}. Between the weir and the mouth is a major tributary which contains Chinook salmon (Nixon Fork).

Appendix A1.22.–Escapement goal for Tatlawiksuk River Chinook salmon (aerial survey).

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 18**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	2
Criteria for SEG:	Low contrast
15th Percentile to Maximum:	273 to 424
Years within recommended SEG:	not applicable

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 353 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101 and 102.
  4) Counts include carcasses

-continued-

Appendix A1.22.–Page 2 of 4**.**

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable

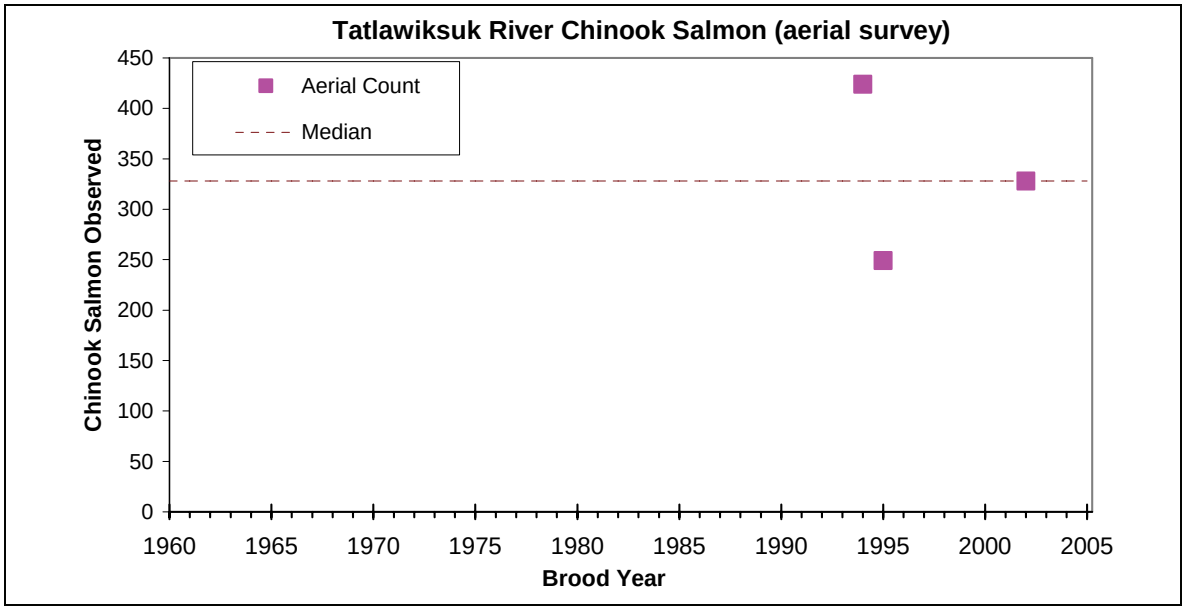
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Weir Counts	Comments
1960									
1961									
1962									
1963									
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971									
1972									
1973									
1974									
1975									
1976									
1977									
1978									
1979									
1980									
1981									
1982									
1983									
1984									
1985									
1986									
1987									
1988									
1989									
1990									
1991									
1992									
1993									
1994	199	225			424	2	31 Jul		
1995	26	223			249	2	28 Jul		
1996									
1997									
1998									
1999								1,490	
2000								817	
2001								2,010	
2002	111	217			328	2	25 Jul	2,237	
2003								1,683	
2004								2,833	
2005								2,918	

-continued-

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**3**
Average	**334**
Min	**249**
15th	**273**
25th	**289**
Median	**328**
75th	**376**
85th	**395**
Max	**424**
Contrast	**2**
Contrast Label	Low
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model		
Watershed Area (km^2)	**2,108**	
Start Point	**Mouth**	(Lat. 61°55.081' N Long. 156°14.735' W)
S_{msy}	**3,695**	
S_c	**9,839**	

Appendix A1.23.–Escapement goal for Tatlawiksuk River Chinook salmon (weir).

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 18**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1999-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts
Contrast:	4
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	1,423 to 2,842
Years within recommended SEG:	not applicable

Comments:

- 3 river miles from the enumeration point to the Kuskokwim River confluence.
- 350 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The Tatlawiksuk River weir is a cooperative project between ADF&G and Kuskokwim Native Association.
- Andrew Gusty of Stony River recalls his father and grandfather operating a fish trap near the current weir site on the Tatlawiksuk River.

-continued-

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable

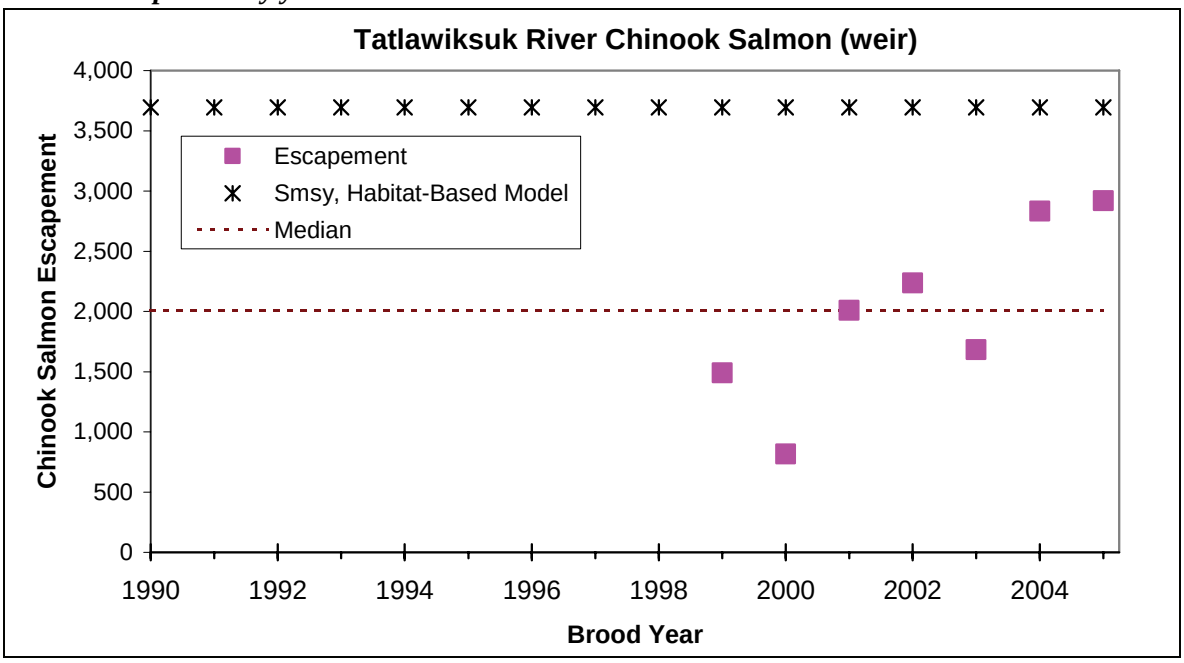
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	1,490
2000	817
2001	2,010
2002	2,237
2003	1,683
2004	2,833
2005	2,918

-continued-

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Tatlawiksuk River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**7**
Average	**1,998**
Min	**817**
15th	**1,423**
25th	**1,587**
Median	**2,010**
75th	**2,535**
85th	**2,842**
Max	**2,918**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model

Watershed Area (km^2)	**2,108**	
Start Point	**Mouth**	(Lat. 61°55.081' N Long. 156°14.735' W)
S_{msy}	**3,695**	
S_c	**9,839**	

Appendix A1.24.–Escapement goal for Tuluksak River Chinook salmon (aerial survey).

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 8**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	>400 aerial survey count (1983) (Buklis 1993) discontinued after 2000 (Burkey et al. 2000a)
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Poor
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	13
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	194 to 556
Years within recommended SEG:	not applicable

Comments:

- 0 river miles from the enumeration point to the Kuskokwim River confluence.
- 119 river miles from the enumeration point (stream mouth) to the mouth of the Kuskokwim River.
- Tuluksak River is within the Yukon Delta National Wildlife Refuge.
- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101 and 102.
  4) Counts include carcasses
- The Tuluksak River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471), and the Yup'ik village of Tuluksak (population 461). The village is located at the mouth of river. Subsistence fishers commonly deploy short gillnets within the lower river to harvest salmon and whitefish
- Discovery of placer gold in 1907 triggered a stampede to the area, but most prospectors were gone by 1909 (Brown 1983). In 1921, the New York-Alaska Company (NYAC) began a more ambitious venture with a five hundred ton dredge. By 1955, the company had about 80 people working in the Tuluksak area on a seasonal basis and operated three gold dredges, a hydroelectric plant, two draglines and seven tractors. Several other companies also actively mined in the Tuluksak basin. NYAC ceased operation following a fire in 1965, but a new owner, Tuluksak Dredging Company, resumed dredge mining in 1972. To date, the NYAC placer district has produced more than 500,000 oz of placer gold (Calista Corporation 2003).
- During 2005 and 2006 Tonogold Resources, Inc. conducted drilling, surface sampling, and a mapping program to explore the possibility of mining for gold near the Tuluksak River. A final report is expected near the end of 2006 and exploration is projected to continue into 2007 (Tonogold Resources, Inc. 2006).

-continued-

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

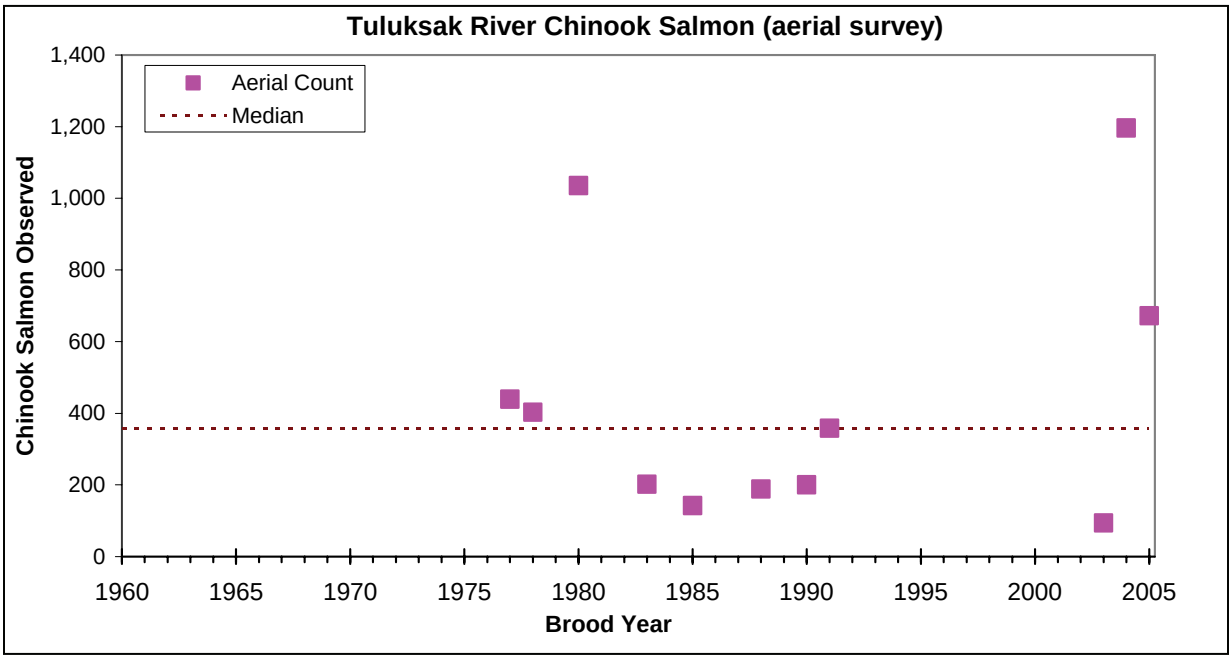
Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977	424	15			439	1	21-Jul	
1978					403	2	18-Jul	
1979								
1980	975	60			1,035	2	23-Jul	
1981								
1982								
1983	131	71			202	1	29-Jul	
1984								
1985	135	7			142	1	25-Jul	
1986								
1987								
1988					188	2	28-Jul	
1989								
1990					200	1	18-Jul	
1991	344	14			358	1	24-Jul	
1992								
1993								
1994								
1995								
1996								
1997	173					2	28-Jul	
1998	230					2	23-Jul	
1999								
2000								
2001								
2002								
2003	89	5			94	2	28-Jul	
2004	1,196	0			1,196			
2005	670	2			672	2	28-Jul	

Shaded cells were not used when calculating SEG range due to incomplete count of run.

-continued-

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**11**
Average	**448**
Min	**94**
15th	**165**
25th	**194**
Median	**358**
75th	**556**
85th	**854**
Max	**1,196**
Contrast	**13**
Contrast Label	High
Exploitation	Mod. to High
Previous Minimum Goal	**400**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model

Watershed Area (km^2)	**2,310**	
Start Point	**Mouth**	(Lat. 61°5.716' N Long. 160°58.663' W)
S_{msy}	**3,937**	
S_c	**10,483**	

Appendix A1.25.–Escapement goal for Tuluksak River Chinook salmon (weir).

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 8**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	aerial survey (1983) (Buklis 1993); discontinued after 2000 (Burkey et al. 2000a)
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	SEG of 1,000 to 2,100
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir
Summary:	
Data Quality:	Fair
Data Type:	Weir counts: no estimates in 1995 to 2000
Contrast:	4
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	1,025 to 2,074
Years within recommended SEG:	11 of 16 years within SEG range, 2 years below and 3 years above

Comments:

- 35 river miles from the enumeration point to the Kuskokwim River confluence.
- 119 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Tuluksak River is within the Yukon Delta National Wildlife Refuge.
- The weir is a cooperative project between USFWS and Tuluksak Tribal Council.
- Tuluksak River is a popular location for subsistence activity due in part close proximity of the Yup'ik village of Tuluksak (population 461), which is located near the mouth of the Tuluksak River. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream to harvest salmon and whitefish. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling and Dolly Varden trout (personal observation; Brown 1983).
- Discovery of placer gold in 1907 triggered a stampede to the area, but most prospectors were gone by 1909 (Brown 1983). In 1921, the New York-Alaska Company (NYAC) began a more ambitious venture with a five hundred ton dredge. By 1955, the company had about 80 people working in the Tuluksak area on a seasonal basis and operated three gold dredges, a hydroelectric plant, two draglines and seven tractors. Several other companies also actively mined in the Tuluksak basin. NYAC ceased operation following a fire in 1965, but a new owner, Tuluksak Dredging Company, resumed dredge mining in 1972. To date, the NYAC placer district has produced more than 500,000 oz of placer gold (Calista Corporation 2003).
- During 2005 and 2006 Tonogold Resources, Inc. conducted drilling, surface sampling, and a mapping program to explore the possibility of mining for gold near the Tuluksak River. A final report is expected near the end of 2006 and exploration is projected to continue into 2007 (Tonogold Resources, Inc. 2006).

-continued-

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable

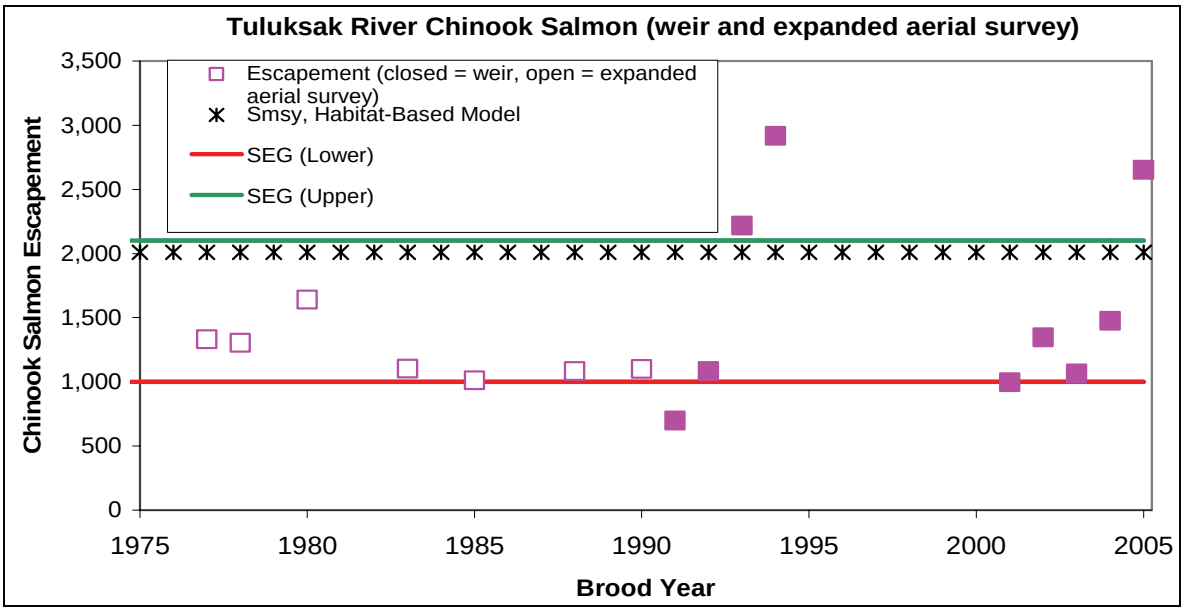
Data available for analysis of escapement goals.

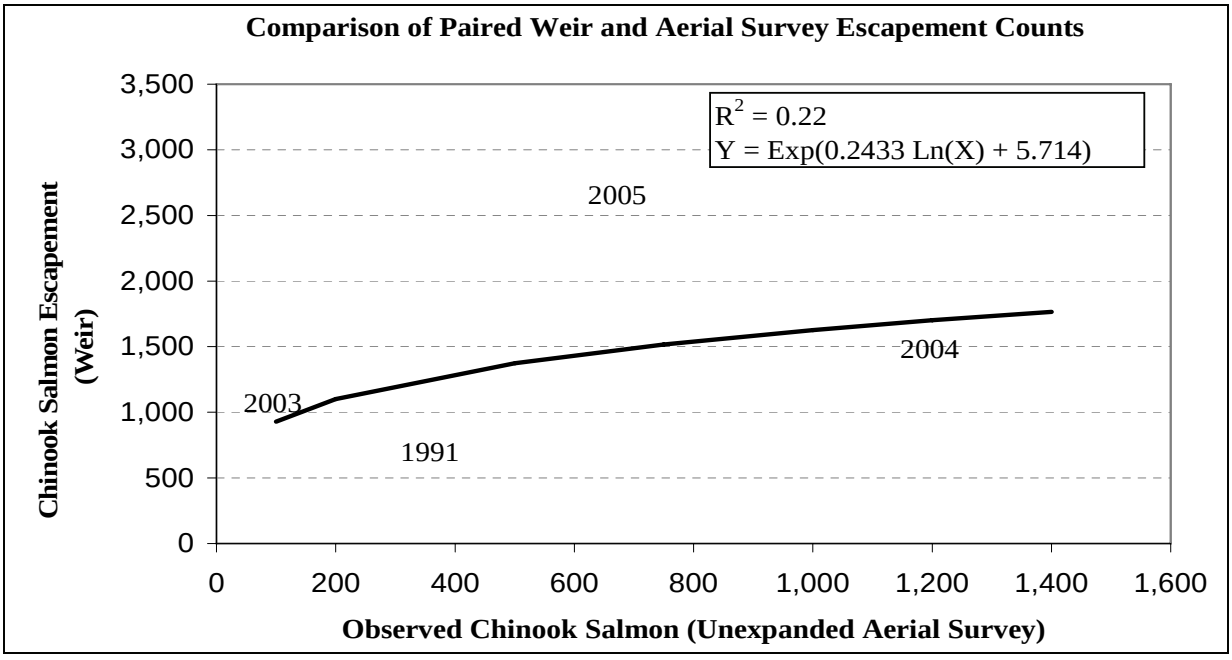
Brood Year	Escapement	Unexpanded Aerial Survey	Weir Counts & Aerial Expansion
1975			
1976			
1977		439	1,332
1978		403	1,304
1979			
1980		1,035	1,640
1981			
1982			
1983		202	1,102
1984			
1985		142	1,012
1986			
1987			
1988		188	1,083
1989			
1990		200	1,100
1991	697	358	697
1992	1,083		1,083
1993	2,218		2,218
1994	2,917		2,917
1995			
1996			
1997			
1998			
1999			
2000			
2001	997		997
2002	1,346		1,346
2003	1,064	94	1,064
2004	1,475	1,196	1,475
2005	2,653	672	2,653

-continued-

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and suggested SEG range (solid line).





-continued-

System: Tuluksak River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	Weir Only **2005**	Weir w/Aerial Survey Expansion **2005**
Number of Years	**9**	**16**
Average	**1,606**	**1,439**
Min	**697**	**697**
15th	**1,010**	**1,025**
25th	**1,064**	**1,078**
Median	**1,346**	**1,203**
75th	**2,218**	**1,516**
85th	**2,566**	**2,074**
Max	**2,917**	**2,917**
Contrast	**4**	**4**
Contrast Label	Medium	Medium
Exploitation	Moderate	Moderate
Current Minimum Goal	**None**	**None**
Suggested SEG Lower	**None**	**1,000** [a]
Suggested SEG Upper	**None**	**2,100**

[a] This value was not rounded up based on the rounding convention used for escapement goal recommendations. If the convention was used the lower SEG would be 1,100 with 6 observations falling below that value (a 63rd percentile value instead of 85th).

Summary Habitat-Based Model

Watershed Area (km^2)	**874**	
Start Point	**Weir**	(Lat. 61°2.641' N Long. 160°35.049' W)
S_{msy}	**2,009**	
S_c	**5,347**	

APPENDIX A2. KUSKOKWIM RIVER CHUM

Appendix A2.1.–Escapement goal for Aniak River chum salmon (sonar index).

System: Aniak River
Species: Chum salmon
Stock Unit: summer **Map Code: 11**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	≥250,000 (1983 to 2003; Buklis 1993); 210,000 to 370,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	SEG range of 220,000 to 480,000
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Sonar count unapportioned to species, but believed to be mainly chum salmon.
Summary:	
Data Quality:	Fair
Data Type:	Bendix sonar (1980 to 1994), BioSonics sonar (1996 to 2003), and DIDSON (2004 and 2005)
Contrast:	105
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	219,770 and 477,544
Years within recommended SEG:	12 of 25 years within SEG range, 7 years below and 6 years above

Comments:

- 10 river miles from the enumeration point to the Kuskokwim River confluence.
- 201 river miles from the enumeration point to the mouth of the Kuskokwim River.
- The Aniak River sub-basin is a major chum salmon producer for the Kuskokwim River and the sonar counts are mostly chum salmon, but river also produces Chinook, sockeye, pink and coho salmon as well as migrating populations of longnose suckers, sheefish and various species of whitefish. Resident species include rainbow trout, grayling and northern pike.
- Indices represent unapportioned counts between the dates of 26 June and 31 July.
- Pawluk et al. (2006a) reported that the run timing of Aniak River chum salmon through the Kalskag-Aniak portion of the Kuskokwim River was later than stocks spawning farther upstream, which has implications in the temporal management of salmon harvest in the lower Kuskokwim River.

-continued-

System: Aniak River
Species: Chum salmon
Stock Unit: summer

Data available for analysis of escapement goals. [a]

Brood Year	BioSonics/ Bendix	DIDSON Conversion[b]	% Increase w/ DIDSON	% of Index Estimated
1980	1,094,094	1,600,032	46.2%	2.32%
1981	500,348	649,849	29.9%	0.00%
1982	408,397	529,758	29.7%	0.00%
1983	135,442	166,452	22.9%	8.66%
1984	251,771	317,688	26.2%	0.00%
1985	217,376	273,306	25.7%	0.00%
1986	177,808	219,770	23.6%	15.90%
1987	165,523	204,834	23.7%	2.32%
1988	380,094	485,077	27.6%	0.00%
1989	236,998	295,993	24.9%	18.49%
1990	198,939	246,813	24.1%	0.00%
1991	287,816	366,687	27.4%	0.00%
1992	71,439	87,467	22.4%	0.00%
1993	12,708	15,278	20.2%	0.00%
1994	366,276	474,356	29.5%	0.87%
1995				
1996	316,767	402,195	27.0%	8.66%
1997	231,807	289,654	25.0%	0.00%
1998	278,534	351,792	26.3%	0.00%
1999	173,363	214,429	23.7%	5.02%
2000	144,157	177,384	23.0%	0.00%
2001	323,076	408,830	26.5%	31.21%
2002	370,272	472,346	27.6%	2.32%
2003	372,559	477,544	28.2%	0.87%
2004	518,117	672,931	29.9%	0.00%
2005	828,257	1,151,505	39.0%	0.00%

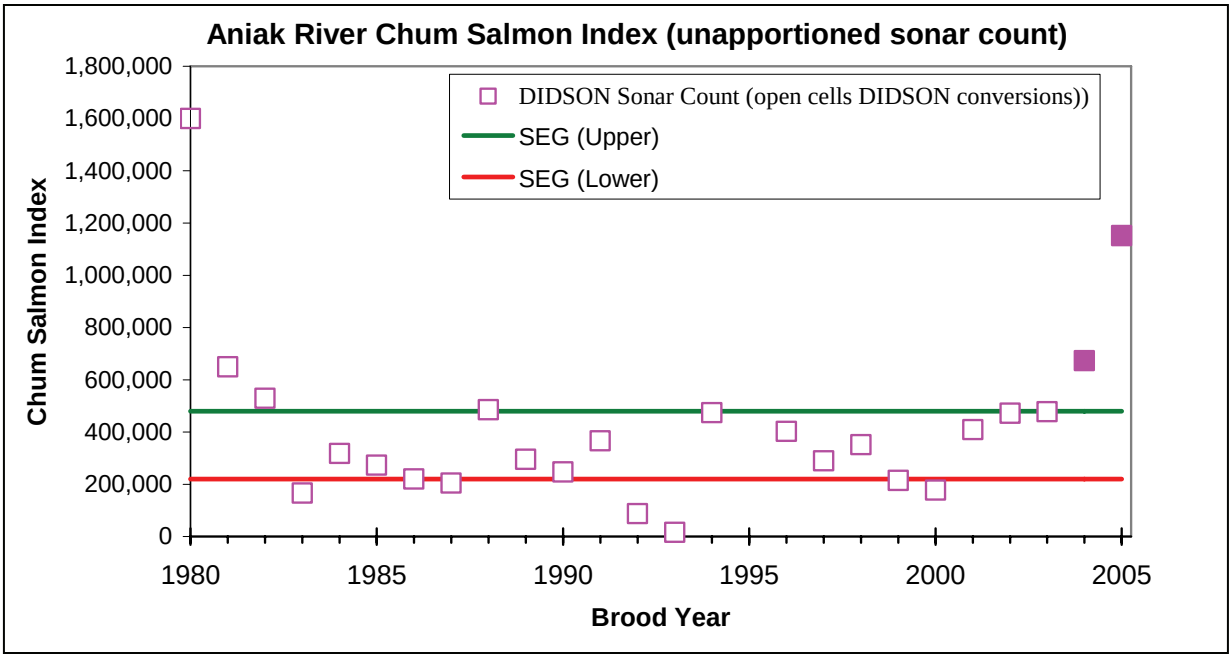
[a] BioSonics/Bendix counts are for the target operational period 26 June to 31 July. Counts may differ from those previously reported.

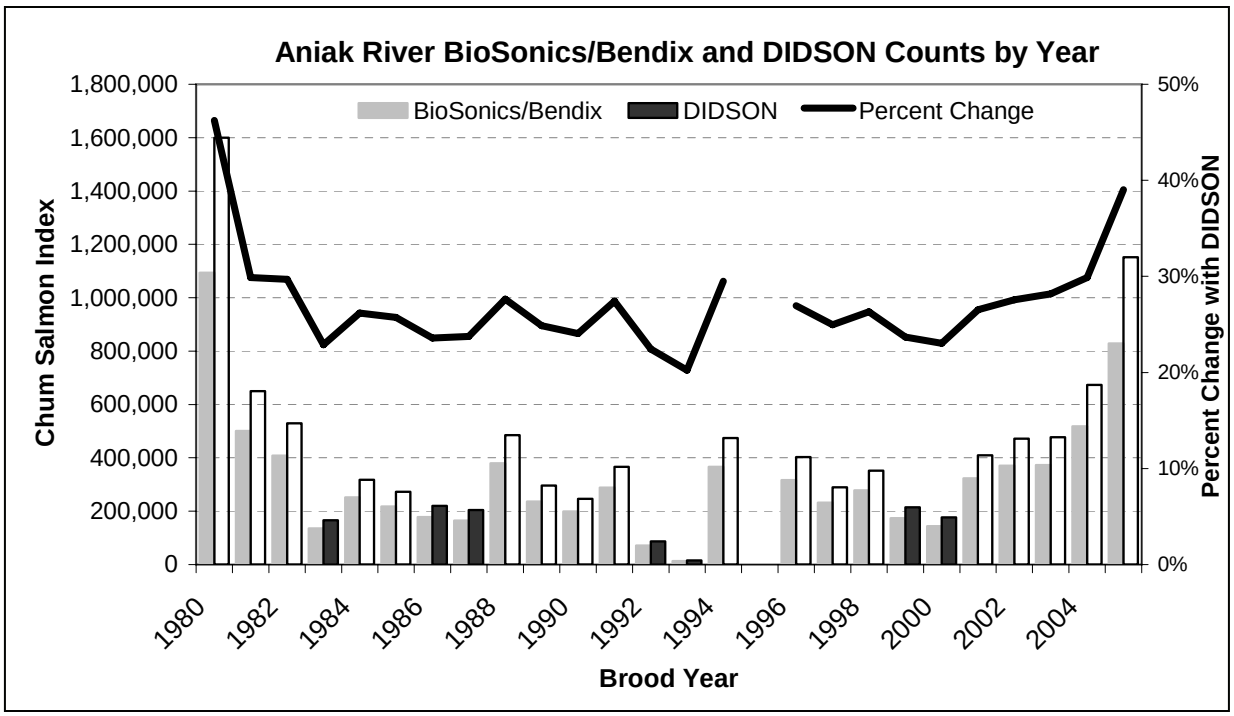
[b] Counts from 1980 to 2003 were collected using Bendix or BioSonics equipment. Counts were collected using DIDSON beginning in 2004.

-continued-

System: Aniak River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year and suggested SEG range (solid line).





-continued-

System: Aniak River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2005**
Number of Years:	**25**
Average:	**422,079**
Min:	**15,278**
15th:	**193,854**
25th:	**219,770**
Median:	**351,792**
75th:	**477,544**
85th:	**577,794**
Max:	**1,600,032**
Contrast:	**105**
Contrast Label:	High
Exploitation:	Mod. to High
Previous Minimum Goal:	**250,000**
Current SEG Lower:	**210,000**
Current SEG Upper:	**370,000**
Suggested SEG Lower:	**220,000**
Suggested SEG Upper:	**480,000**

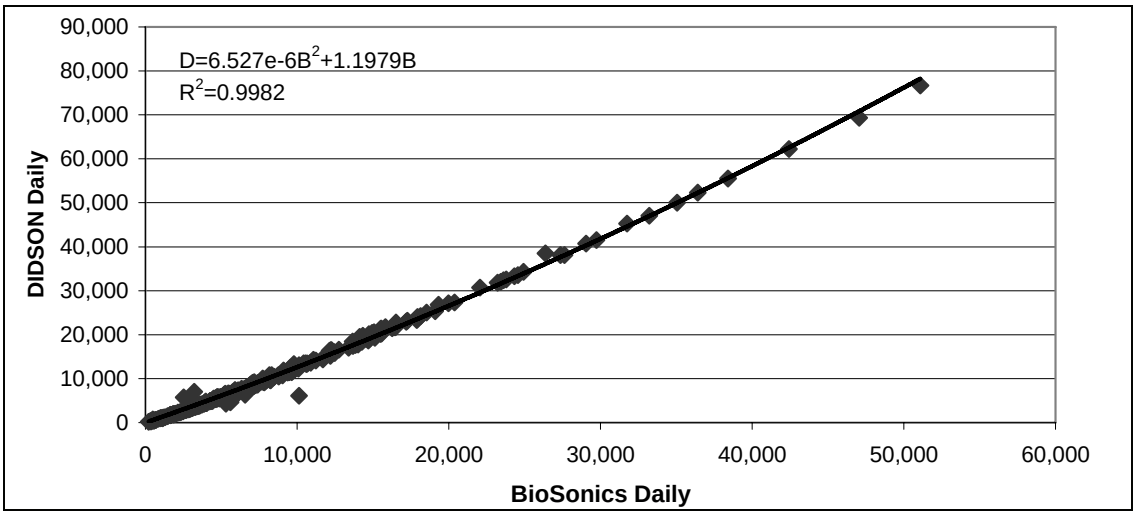


Figure 1. Relationship between estimated BioSonics Daily passage and observed DIDSON daily passage from 1997 – 2005, with the line forced through zero to prevent negative DIDSON estimates.

Appendix A2.2.–Escapement goal for George River chum salmon (weir).

System: George River
Species: Chum salmon
Stock Unit: summer **Map Code: 14**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1996-1997, 1999-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts; no estimate in 1998
Contrast:	10
Criteria for SEG:	High contrast with at most low exploitation
15th to 75th Percentile:	6,034 to 14,828
Years within recommended SEG:	not applicable

Comments:

- 4 river miles from the enumeration point to the Kuskokwim River confluence.
- 281 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The George River is a popular subsistence and recreational location for residents of Crooked Creek, Georgetown, Red Devil and Sleetmute. There are local sport fish guiding services and the river is periodically used by guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.
- Drainage has been subjected to variable levels of mining activity since about 1910.
- The George River is a cooperative project between ADF&G and Kuskokwim Native Association.
- Linderman et al. (2003) reported that the run timing of George River chum salmon through the Kalskag-Aniak portion of the Kuskokwim River was later than stock spawning farther upstream, which has implications in the temporal management of salmon harvest in the lower Kuskokwim

-continued-

System: George River
Species: Chum salmon
Stock Unit: summer

Data available for analysis of escapement goals.

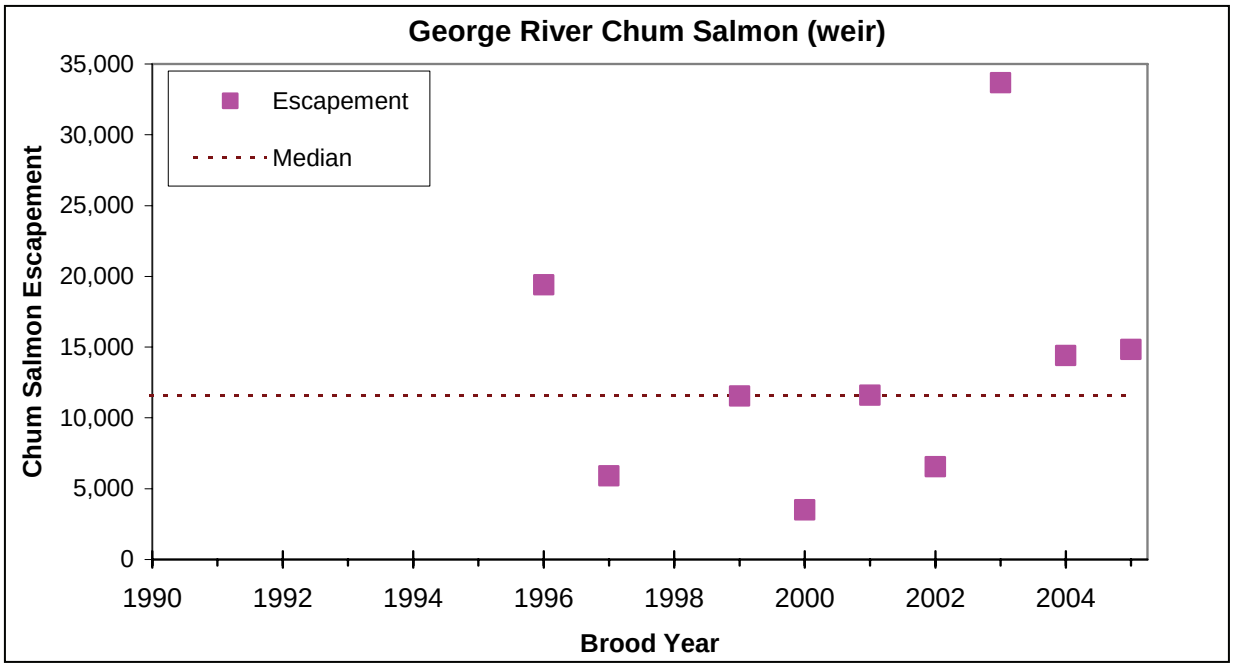
Brood Year	Escapement
1996	19,393
1997	5,907
1998	
1999	11,552
2000	3,492
2001	11,601
2002	6,543
2003	33,666
2004	14,409
2005	14,828

[a] Estimate; season incomplete as of this writing.

-continued-

System: George River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year.



-continued-

System: George River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2005**
Number of Years	**9**
Average	**13,488**
Min	**3,492**
15th	**6,034**
25th	**6,543**
Median	**11,601**
75th	**14,828**
85th	**18,480**
Max	**33,666**
Contrast	**10**
Contrast Label	High
Exploitation	Low
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A2.3.–Escapement goal for Kogrukluk River chum salmon (weir).

System: Kogrukluk River
Species: Chum salmon
Stock Unit: summer **Map Code: 16**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	15,000 to 49,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1976,1978-1979,1981-1982,1984-1986,1988-2005
Summary:	
Data Quality:	Fair
Data Type:	Weir counts; no estimates in 1977, 1980, 1983 and 1987.
Contrast:	8
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	14,213 to 48,329
Years within recommended SEG:	17 of 26 years within SEG range, 5 years below and 4 years above

Comments:

- 136 river miles from the enumeration point to the Kuskokwim River confluence.
- 441 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Kogrukluk River is a tributary of the upper Holitna River. Chum salmon spawn throughout much of the Holitna River, including areas downstream of the Kogrukluk River weir.
- Beginning in the early 1900's a small number of prospectors explored the upper Holitna River, but found only limited amounts of gold (Brown 1983). The area has also supported mercury mines, particularly in the Chukowan River drainage. The upper Holitna River drainage, inclusive of the Kogrukluk River, is the current focus of new mineral extraction interests.
- The Holitna River is a popular subsistence and recreational location for residents throughout the Kuskokwim River drainage. There are local sport fish guiding services that operate in the sub-basin, as well as guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.
- Chum salmon age-sex-length composition in the Kogrukluk River is atypical of other monitored sites.
- Linderman et al. (2003) reported that the run timing of Kogrukluk River chum salmon through the Kalskag-Aniak portion of the Kuskokwim River earlier than nearly every other stock, which has implications in the temporal management of salmon harvest in the lower Kuskokwim River.

-continued-

System: Kogrukluk River
Species: Chum salmon
Stock Unit: summer

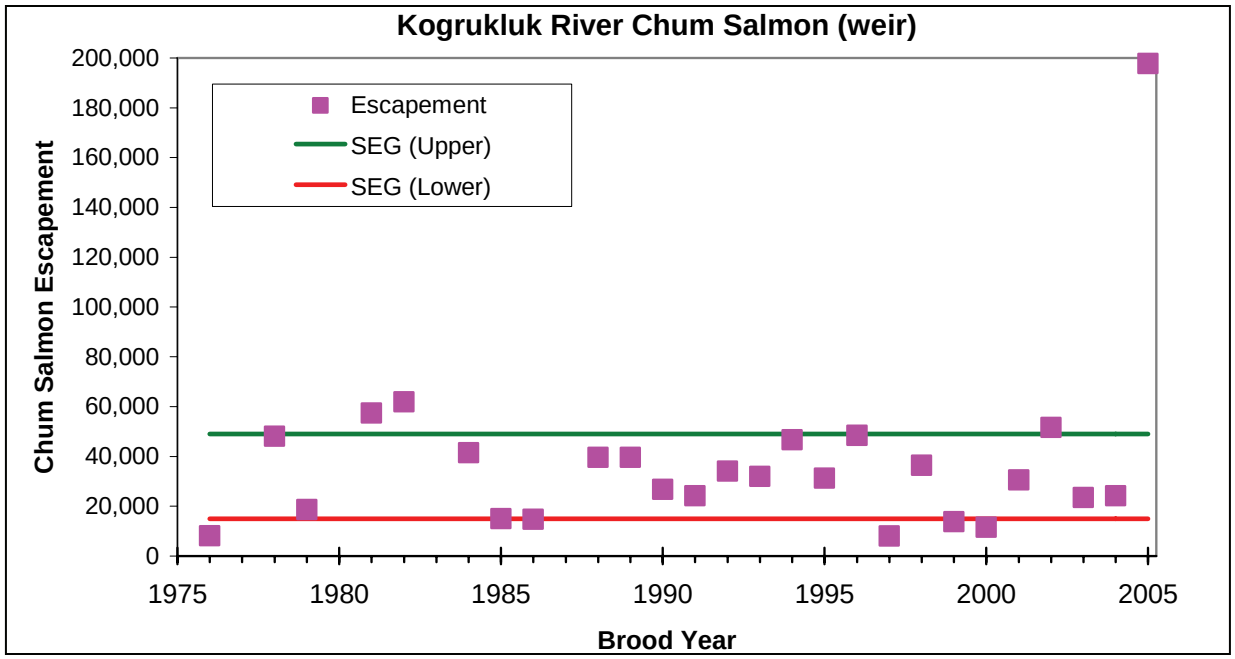
Data available for analysis of escapement goals.

Brood Year	Escapement
1976	8,117
1977	
1978	48,125
1979	18,599
1980	
1981	57,374
1982	61,859
1983	
1984	41,484
1985	15,005
1986	14,693
1987	
1988	39,543
1989	39,547
1990	26,765
1991	24,188
1992	34,104
1993	31,901
1994	46,635
1995	31,265
1996	48,478
1997	7,958
1998	36,441
1999	13,820
2000	11,491
2001	30,570
2002	51,570
2003	23,413
2004	24,201
2005	197,723

-continued-

System: Kogrukluk River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year and SEG range (solid line).



-continued-

System: Kogrukluk River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2003**
Number of Years	**24**
Average	**31,789**
Min	**7,958**
15th	**14,213**
25th	**17,701**
Median	**31,583**
75th	**42,772**
85th	**48,319**
Max	**61,859**
Contrast	**8**
Contrast Label	Medium
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**15,000**
SEG Upper	**49,000**

Appendix A2.4.–Escapement goal for Kuskokwim River chum salmon.

System: Kuskokwim River
Species: Chum salmon
Stock Unit: not applicable

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Differences between total run reconstruction estimates (from Shotwell and Adkison 2004) and observed
Summary:	
Data Quality:	Fair
Data Type:	Statistical model using weir counts, commercial harvest and effort, subsistence harvest, test fish CPUE, and whole river sonar passage estimates

Comments:

- Abundance and escapement estimates were produced by tying together Kogrukluk River weir escapements, commercial harvest, commercial effort, test fish CPUE, and whole river sonar within a maximum likelihood statistical framework (Shotwell and Adkison 2004).
- Upper and lower bounds for abundance estimates constitute a 95% confidence interval.
- Subsistence harvest is calculated as total harvest minus commercial harvest to account for incomplete historical speciation of the subsistence harvest estimates.

-continued-

System: Kuskokwim River
Species: Chum salmon
Stock Unit: not applicable

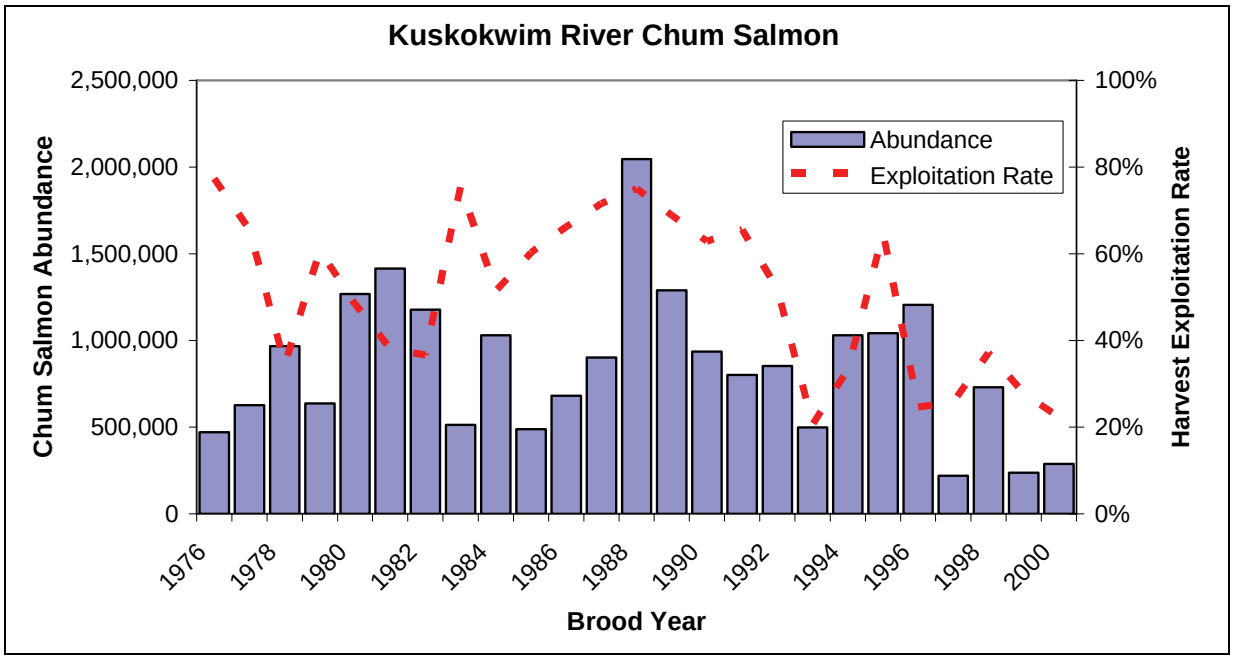
Data available for analysis of escapement goals.

Brood Year	Abundance Estimate	Lower Bound	Upper Bound	Escapement Estimate	Commercial Harvest	Subsistence Harvest	Exploitation Rate	Lower Bound	Upper Bound
1976	472,000	430,000	515,000	107,000	177,864	187,136	77%	71%	85%
1977	627,000	542,000	721,000	216,000	248,721	162,279	66%	57%	76%
1978	968,000	718,000	1,247,000	636,000	248,656	83,344	34%	27%	46%
1979	637,000	538,000	746,000	250,000	261,874	125,126	61%	52%	72%
1980	1,267,000	1,017,000	1,578,000	654,000	483,751	129,249	48%	39%	60%
1981	1,416,000	1,075,000	1,836,000	876,000	418,677	121,323	38%	29%	50%
1982	1,178,000	894,000	1,534,000	746,000	278,306	153,694	37%	28%	48%
1983	514,000	462,000	564,000	126,000	276,698	111,302	75%	69%	84%
1984	1,031,000	838,000	1,252,000	501,000	423,718	106,282	51%	42%	63%
1985	488,000	410,000	571,000	194,000	199,478	94,522	60%	51%	72%
1986	681,000	593,000	772,000	230,000	309,213	141,787	66%	58%	76%
1987	901,000	798,000	1,005,000	256,000	574,336	70,664	72%	64%	81%
1988	2,045,000	1,836,000	2,255,000	511,000	1,381,674	152,326	75%	68%	84%
1989	1,290,000	1,129,000	1,465,000	401,000	749,182	139,818	69%	61%	79%
1990	936,000	798,000	1,086,000	348,000	461,624	126,376	63%	54%	74%
1991	801,000	692,000	920,000	276,000	431,802	93,198	66%	57%	76%
1992	853,000	690,000	1,038,000	412,000	344,603	96,397	52%	42%	64%
1993	499,000	438,000	505,000	396,000	43,337	59,663	21%	20%	24%
1994	1,030,000	905,000	1,059,000	687,000	271,115	71,885	33%	32%	38%
1995	1,043,000	931,000	1,077,000	369,000	605,918	68,082	65%	63%	72%
1996	1,205,000	877,000	1,567,000	908,000	207,877	89,123	25%	19%	34%
1997	221,000	160,000	287,000	164,000	17,026	39,974	26%	20%	36%
1998	730,000	556,000	927,000	459,000	207,809	63,191	37%	29%	49%
1999	237,000	171,000	305,000	171,000	23,006	42,994	28%	22%	39%
2000	288,000	203,000	385,000	224,000	11,570	52,430	22%	17%	32%

-continued-

System: Kuskokwim River
Species: Chum salmon
Stock Unit: not applicable

Estimated abundance and exploitation rate by year.



-continued-

System: Kuskokwim River
Species: Chum salmon
Stock Unit: not applicable

Summary Statistics through:	**2005** Abundance	**2005** Escapement
Number of Years	**25**	**25**
Average	**854,320**	**404,720**
Min	**221,000**	**107,000**
15th	**481,600**	**184,800**
25th	**514,000**	**224,000**
Median	**853,000**	**369,000**
75th	**1,043,000**	**511,000**
85th	**1,229,800**	**667,200**
Max	**2,045,000**	**908,000**
Contrast	**9**	**8**
Contrast Label	High	High
Exploitation	Moderate	Moderate
Current Minimum Goal	**None**	**None**
Suggested SEG Lower	**None**	**None**
Suggested SEG Upper	**None**	**None**

Appendix A2.5.–Escapement goal for Kwethluk River chum salmon (tower and weir).

System: Kwethluk River
Species: Chum salmon
Stock Unit: summer **Map Code: 6**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	aerial survey (1983) (Buklis 1993); discontinued 2001(Burkey et al. 2000b)
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1992, 2000 to 2004; tower 1996 and 1997.
Summary:	
Data Quality:	Fair
Data Type:	Weir; no estimates in 1993-1995, 1998, 1999, 2001 or 2005
Contrast:	4
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	11,433 to 39,438
Years within recommended SEG:	not applicable

Comments:

- 52 river miles from the enumeration point to the Kuskokwim River confluence.
- 134 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- Kwethluk River is within the Yukon Delta National Wildlife Refuge.
- The weir is a cooperative project between USFWS and the Organized Village of Kwethluk; the tower was operated by the Association of Village Council Presidents and Kwethluk IRA Council.
- The Kwethluk River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471) and the Yup'ik village of Kwethluk (population 693). The village is located about 1 mile upstream from the Kuskokwim River confluence. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream in order to harvest salmon and whitefish. Observers have reported as many as dozen gillnets in the lower Kwethluk River during the height of the Chinook run. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.
- Discovery of gold in nearby streams in 1909 attracted prospectors to the Kwethluk River basin, but yields were low and most prospectors were gone by 1911. One placer deposit in the upper Kwethluk basin was worked until World War II (Community Profiles Database 2006). Kwethluk River also served as an access route to gold fields in the upper Eek River basin (Brown 1983).
- The lower Kwethluk River has a tidal influence.

-continued-

System: Kwethluk River
Species: Chum salmon
Stock Unit: summer

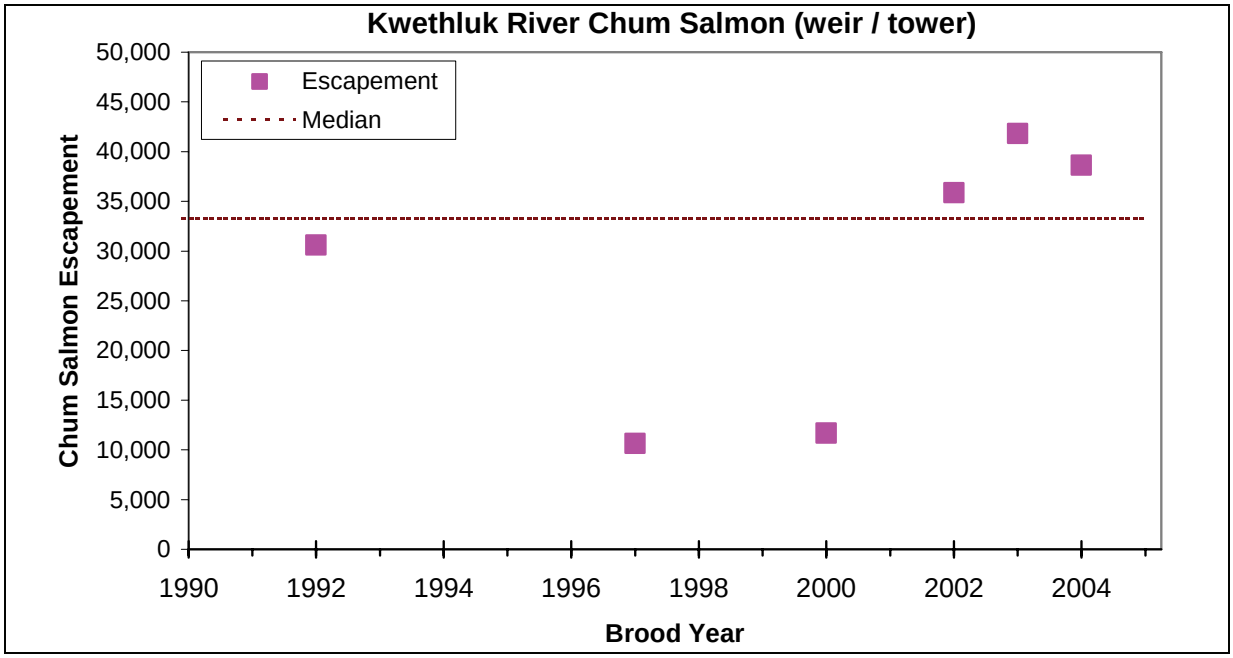
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	30,595
1993	
1994	
1995	
1996	
1997	10,659
1998	
1999	
2000	11,691
2001	
2002	35,854
2003	41,812
2004	38,646
2005	

-continued-

System: Kwethluk River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year.



-continued-

System: Kwethluk River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2004**
Number of Years	**6**
Average	**28,210**
Min	**10,659**
15th	**11,433**
25th	**16,417**
Median	**33,225**
75th	**37,948**
85th	**39,438**
Max	**41,812**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A2.6.–Escapement goal for Takotna River chum salmon (weir / tower).

System: Takotna River
Species: Chum salmon
Stock Unit: summer **Map Code: 21**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower 1995 to 1999; weir 2000 to 2005
Summary:	
Data Quality:	Fair
Data Type:	Weir / tower counts; no estimates in 1995, 1996, 1998, and 1999
Contrast:	5
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	1,637 to 5,362
Years within recommended SEG:	not applicable

Comments:

- 52 river miles from the enumeration point to the Kuskokwim River confluence.
- 519 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The weir is a cooperative project between ADF&G and Takotna Tribal Council.
- Salmon stocks in the Takotna River are thought to be in a rebuilding phase following decades of near absence, as was reported by several individuals who lived in the area during the 1940's through 1970's (Schwanke et al. 2001).
- Most salmon spawning occurs in Fourth-of July Creek, Big Creek, and the mainstem Takotna River as far downstream as the community of Takotna (Clark and Molyneaux 2003).
- Gold mining and prospecting occurred throughout the Takotna River drainage. There are claims and intermittently active placer mines around Yankee Creek, Moore Creek, Lincoln Creek, Nixon Fork and the Candle Hills. Tailing piles are visible at Moore Creek, but they are mostly overgrown with vegetation. Plans are underway to renew mining operations at Moore Creek.
- The Takotna River is a popular location for subsistence and recreational activity especially for residents of Takotna and McGrath who use the river to access hunting areas. Subsistence salmon fishers set gillnets in the mouth of the Takotna River, across from McGrath, plus various homesteaders set gillnets within the drainage for whitefish and salmon.
- Linderman et al. (2003) reported that the run timing of Takotna River chum salmon through the Kalskag-Aniak portion of the Kuskokwim River was earlier than stock spawning farther downstream, which has implications in the temporal management of salmon harvest in the lower Kuskokwim River.

-continued-

System: Takotna River
Species: Chum salmon
Stock Unit: summer

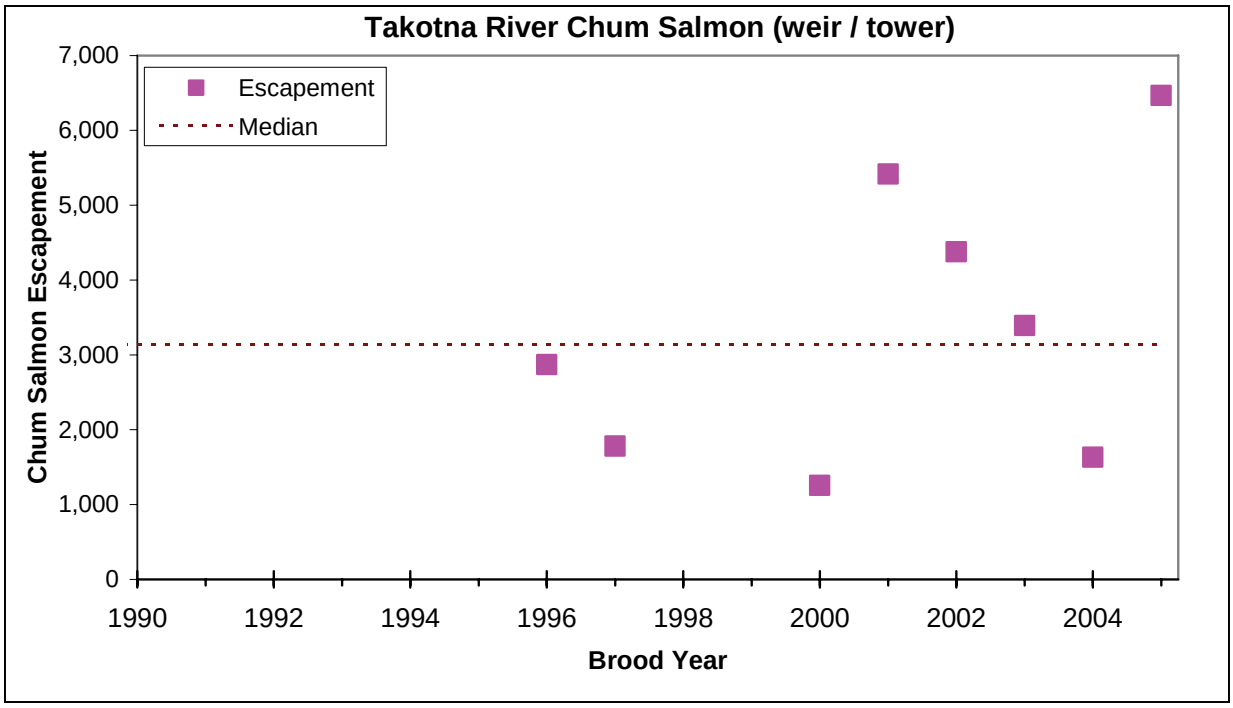
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	2,872
1997	1,779
1998	
1999	
2000	1,254
2001	5,414
2002	4,377
2003	3,393
2004	1,630
2005	6,467

-continued-

System: Takotna River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year.



-continued-

System: Takotna River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2005**
Number of Years	**8**
Average	**3,398**
Min	**1,254**
15th	**1,637**
25th	**1,742**
Median	**3,133**
75th	**4,636**
85th	**5,362**
Max	**6,467**
Contrast	**5**
Contrast Label	Medium
Exploitation	Low
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A2.7.–Escapement goal for Tatlawiksuk River chum salmon (weir).

System: Tatlawiksuk River
Species: Chum salmon
Stock Unit: summer **Map Code: 18**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1999-2002, 2004-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts; no estimate in 2003
Contrast:	8
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	8,960 to 32,337
Years within recommended SEG:	not applicable

Comments:

- 3 river miles from the enumeration point to the Kuskokwim River confluence.
- 353 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The Tatlawiksuk River weir is a cooperative project between ADF&G and Kuskokwim Native Association.
- Andrew Gusty of Stony River recalls his father and grandfather operating a fish trap near the current weir site on the Tatlawiksuk River.
- Linderman et al. (2003) reported that the run timing of Tatlawiksuk River chum salmon through the Kalskag-Aniak portion of the Kuskokwim River was later than stocks from tributaries located farther upstream, but earlier than stocks from tributaries located farther downstream.

-continued-

System: Tatlawiksuk River
Species: Chum salmon
Stock Unit: summer

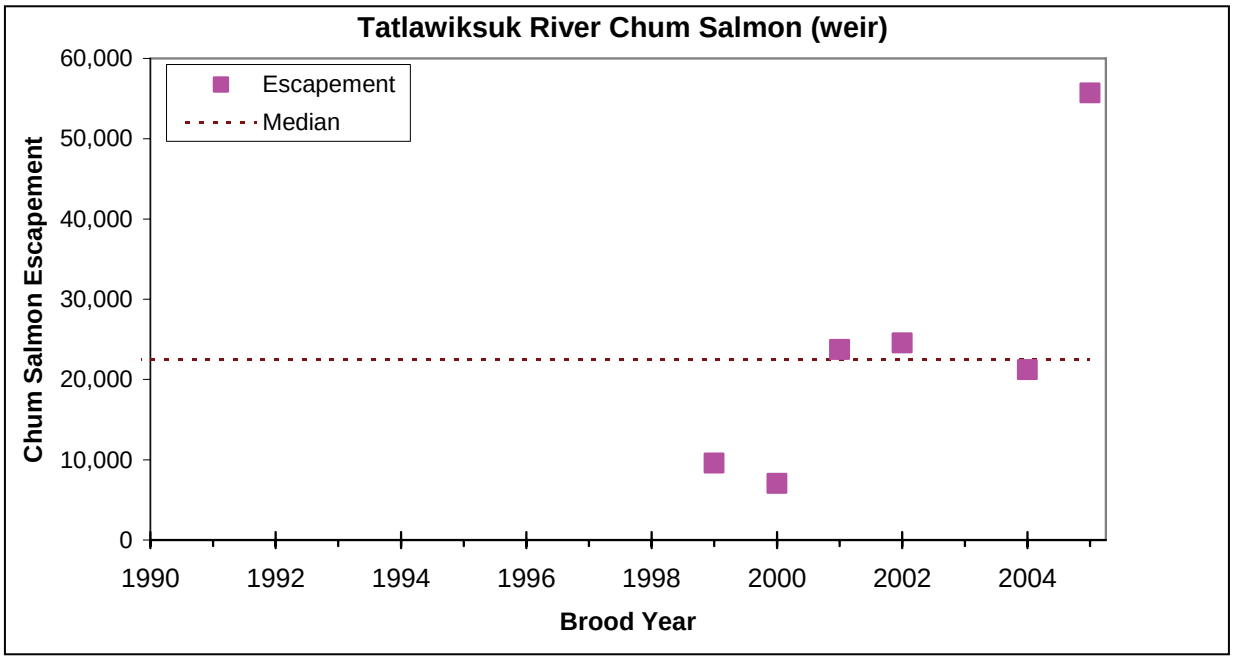
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	9,599
2000	7,044
2001	23,718
2002	24,542
2003	
2004	21,245
2005	55,720

-continued-

System: Tatlawiksuk River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year.



-continued-

System: Tatlawiksuk River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2005**
Number of Years	**6**
Average	**23,645**
Min	**7,044**
15th	**8,960**
25th	**12,511**
Median	**22,482**
75th	**24,336**
85th	**32,337**
Max	**55,720**
Contrast	**8**
Contrast Label	Medium
Exploitation	Low
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A2.8.–Escapement goal for Tuluksak River chum salmon (weir).

System: Tuluksak River
Species: Chum salmon
Stock Unit: summer **Map Code: 8**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	aerial survey (1983) (Buklis 1993); discontinued 2001(Burkey et al. 2000b)
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1991-1994, 2001-2005
Summary:	
Data Quality:	Fair
Data Type:	Weir counts; no estimates in 1995 to 2000
Contrast:	5
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	10,203 to 18,602
Years within recommended SEG:	not applicable

Comments:

- 35 river miles from the enumeration point to the Kuskokwim River confluence.
- 154 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- Tuluksak River is within the Yukon Delta National Wildlife Refuge.
- The weir is a cooperative project between USFWS and Tuluksak Tribal Council.
- Tuluksak River is a popular location for subsistence activity due in part to the close proximity of the Yup'ik village of Tuluksak (population 461), which is located near the mouth of the Tuluksak River. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream to harvest salmon and whitefish. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling and Dolly Varden trout (personal observation; Brown 1983).
- Discovery of placer gold in 1907 triggered a stampede to the area, but most prospectors were gone by 1909 (Brown 1983). In 1921, the New York-Alaska Company (NYAC) began a more ambitious venture with a five hundred ton dredge. By 1955, the company had about 80 people working in the Tuluksak area on a seasonal basis and operated three gold dredges, a hydroelectric plant, two draglines and seven tractors. Several other companies also actively mined in the Tuluksak basin. NYAC ceased operation following a fire in 1965, but a new owner, Tuluksak Dredging Company, resumed dredge mining in 1972. To date, the NYAC placer district has produced more than 500,000 oz of placer gold (Calista Corporation 2003).
- During 2005 and 2006 Tonogold Resources, Inc. conducted drilling, surface sampling, and a mapping program to explore the possibility of mining for gold near the Tuluksak River. A final report is expected near the end of 2006 and exploration is projected to continue into 2007 (Tonogold Resources, Inc. 2006).
- Habitat-based escapement goals for Tuluksak River chum have recently been published as a master's thesis by University of Alaska Fairbanks graduate student John O'Brien. John's work should be considered to determine an escapement goal recommendation in the next cycle review (O'Brien 2006) .

-continued-

System: Tuluksak River
Species: Chum salmon
Stock Unit: summer

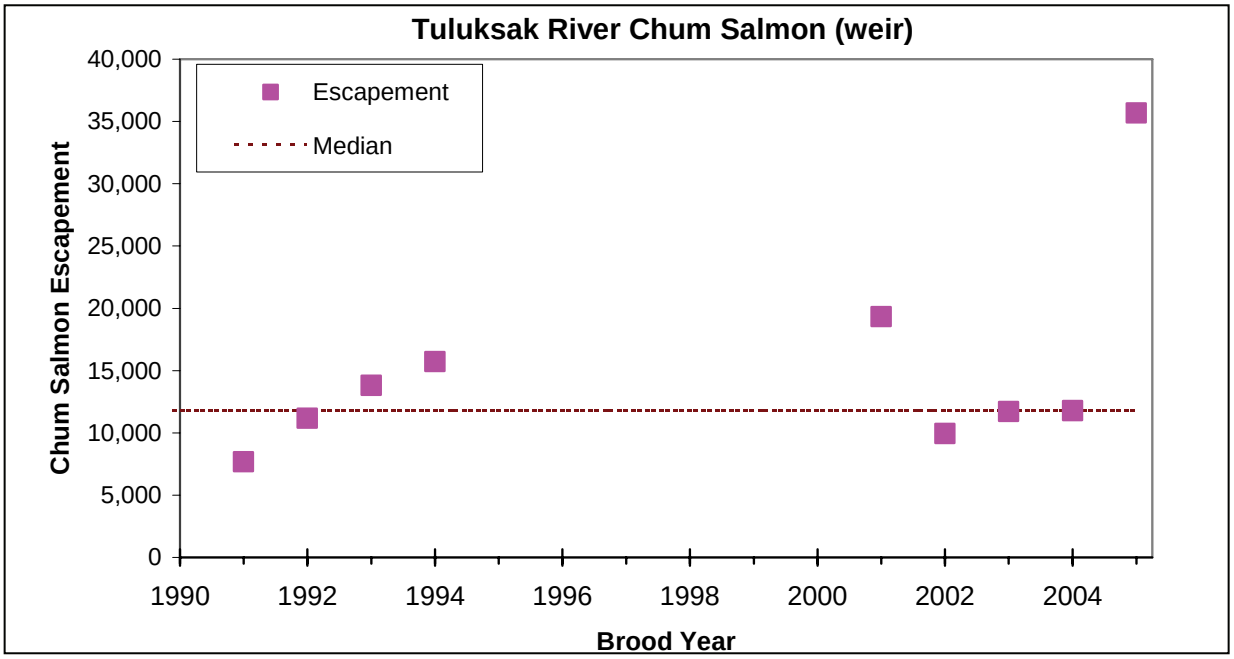
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	7,675
1992	11,183
1993	13,804
1994	15,724
1995	
1996	
1997	
1998	
1999	
2000	
2001	19,321
2002	9,958
2003	11,724
2004	11,796
2005	35,696

-continued-

System: Tuluksak River
Species: Chum salmon
Stock Unit: summer

Observed escapement by year.



-continued-

System: Tuluksak River
Species: Chum salmon
Stock Unit: summer

Summary Statistics through:	**2005**
Number of Years	**9**
Average	**15,209**
Min	**7,675**
15th	**10,203**
25th	**11,183**
Median	**11,796**
75th	**15,724**
85th	**18,602**
Max	**35,696**
Contrast	**5**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

APPENDIX A3. KUSKOKWIM RIVER COHO

Appendix A3.1.–Escapement goal for George River coho salmon (weir).

System: George River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 14**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1997, 1999-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts; no estimate in 1998
Contrast:	5
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	8,236 to14,303
Years within recommended SEG:	not applicable

Comments:

- 4 river miles from the enumeration point to the Kuskokwim River confluence.
- 281 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The George River is a popular subsistence and recreational location for residents of Crooked Creek, Georgetown, Red Devil and Sleetmute. There are local sport fish guiding services and river is periodically used by guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.
- Drainage has been subjected to variable levels of mining activity since about 1910.

-continued-

System: George River
Species: Coho salmon
Stock Unit: not applicable

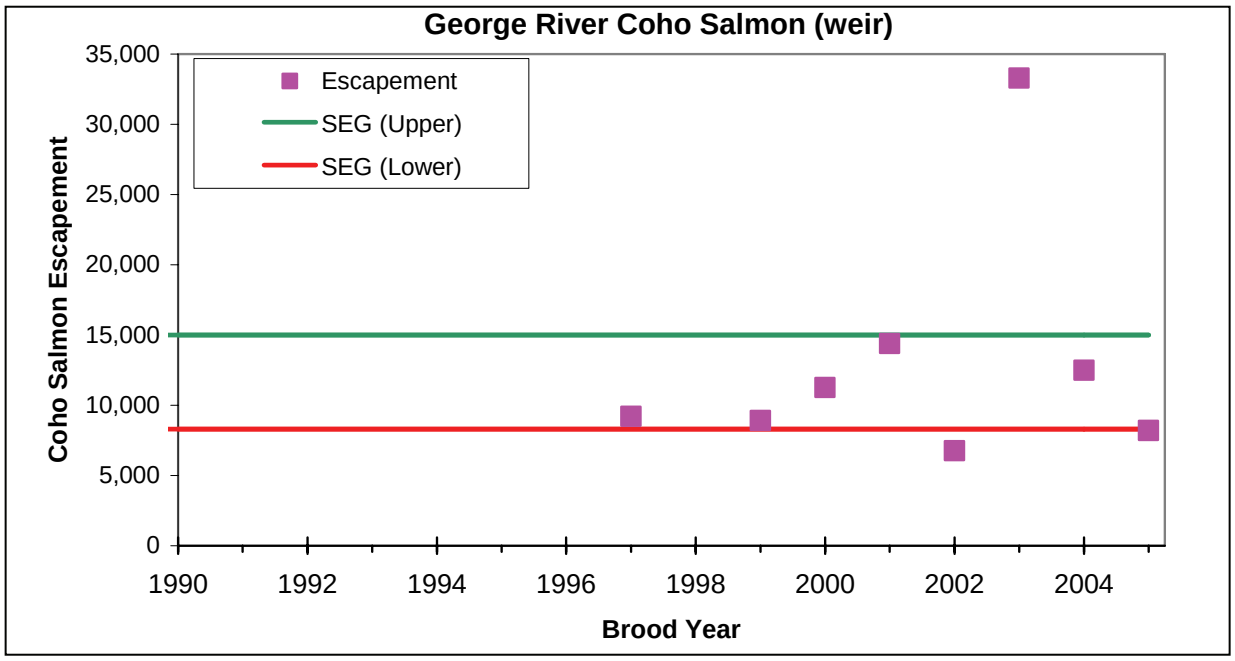
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	9,210
1998	
1999	8,914
2000	11,262
2001	14,398
2002	6,759
2003	33,280
2004	12,499
2005	8,200

-continued-

System: George River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year and suggested SEG range (solid line).



-continued-

System: George River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**8**
Average	**13,065**
Min	**6,759**
15th	**8,236**
25th	**8,736**
Median	**10,236**
75th	**12,974**
85th	**14,303**
Max	**33,280**
Contrast	**5**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**8,300**
Suggested SEG Upper	**15,000**

Appendix A3.2.–Escapement goal for Kogrukluk River coho salmon (weir).

System: Kogrukluk River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 16**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	13,000 to 28,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1981-1988, 1990-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts; no estimates in 1989.
Contrast:	12
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	12,835 to 27,795
Years within recommended SEG:	12 of 23 years within SEG range, 6 years below and 5 years above

Comments:

- 136 river miles from the enumeration point to the Kuskokwim River confluence.
- 441 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Kogrukluk River is a tributary of the upper Holitna River. Coho salmon spawn throughout much of the Holitna River, including areas downstream of the Kogrukluk River weir.
- Beginning in the early 1900's a small number of prospectors explored the upper Holitna River, but found only limited amounts of gold (Brown 1983). The area has also supported mercury mines, particularly in the Chukowan River drainage. The upper Holitna River drainage, inclusive of the Kogrukluk River, is the current focus of new mineral extraction interests.
- The Holitna River is a popular subsistence and recreational location for residents throughout the Kuskokwim River drainage. There are local sport fish guiding services that operate in the sub-basin, as well as guides from other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.

-continued-

System: Kogrukluk River
Species: Coho salmon
Stock Unit: not applicable

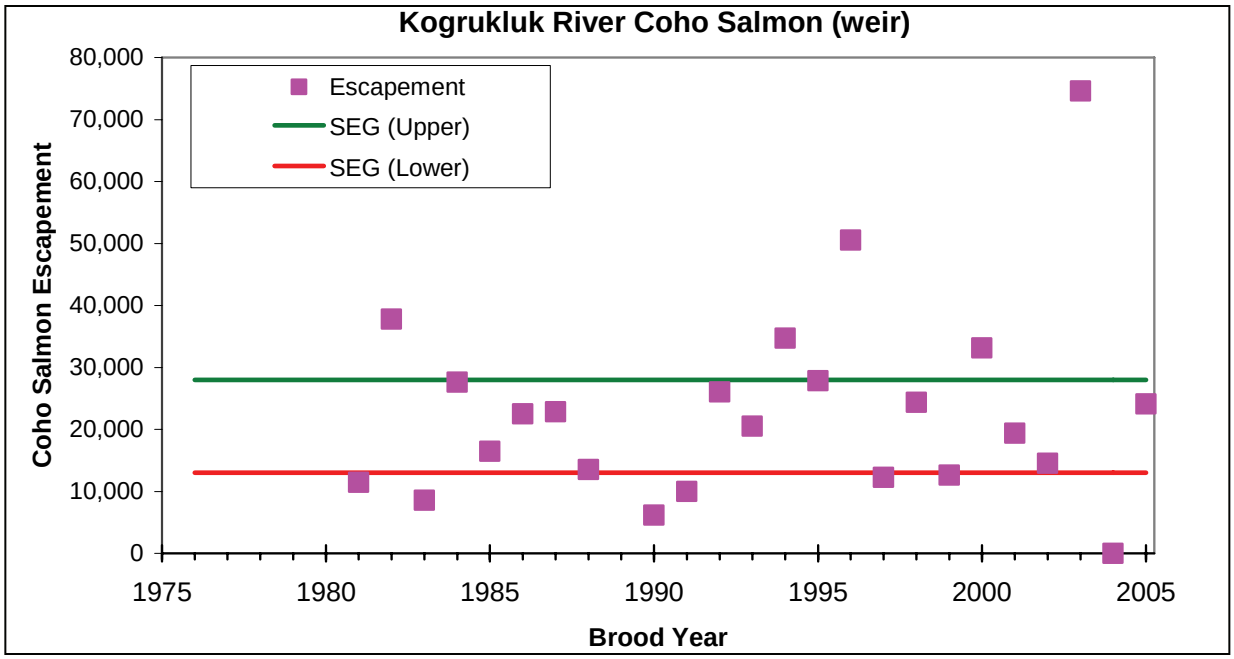
Data available for analysis of escapement goals.

Brood Year	Escapement
1976	
1977	
1978	
1979	
1980	
1981	11,455
1982	37,796
1983	8,538
1984	27,595
1985	16,441
1986	22,506
1987	22,821
1988	13,512
1989	
1990	6,132
1991	9,964
1992	26,057
1993	20,517
1994	34,695
1995	27,862
1996	50,555
1997	12,238
1998	24,348
1999	12,609
2000	33,135
2001	19,387
2002	14,516
2003	74,604
2004	
2005	24,116

-continued-

System: Kogrukluk River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Kogrukluk River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**22**
Average	**23,967**
Min	**6,132**
15th	**11,572**
25th	**12,835**
Median	**21,512**
75th	**27,795**
85th	**34,461**
Max	**74,604**
Contrast	**12**
Contrast Label	High
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**13,000**
SEG Upper	**28,000**

Appendix A3.3.–Escapement goal for Kwethluk River coho salmon (weir).

System: Kwethluk River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 6**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1992, 2000, 2002-2004
Summary:	
Data Quality:	Fair
Data Type:	Weir counts; no estimates in 1993-1999, 2001 or 2005
Contrast:	5
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	22,873 to 75,109
Years within recommended SEG:	not applicable

Comments:

- 52 river miles from the enumeration point to the Kuskokwim River confluence.
- 134 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- Kwethluk River is within the Yukon Delta National Wildlife Refuge.
- The weir is a cooperative project between USFWS and the Organized Village of Kwethluk; the tower was operated by the Association of Village Council Presidents and Kwethluk IRA Council.
- The Kwethluk River is a popular location for subsistence and recreational activity due in part to the close proximity of Bethel (population 5,471) and the Yup'ik village of Kwethluk (population 693). The village is located about 1 mile upstream from the Kuskokwim River confluence. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream in order to harvest salmon and whitefish. Observers have reported as many as dozen gillnets in the lower Kwethluk River during the height of the Chinook run. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling, rainbow trout and Dolly Varden trout (personal observation; Brown 1983). Professional guides for sport fishing and rafting tours operate on the river.
- Discovery of gold in nearby streams in 1909 attracted prospectors to the Kwethluk River basin, but yields were low and most prospectors were gone by 1911. One placer deposit in the upper Kwethluk basin was worked until World War II (Community Profiles Database 2006). Kwethluk River also served as an access route to gold fields in the upper Eek River basin (Brown 1983).
- The lower Kwethluk River has a tidal influence.

-continued-

System: Kwethluk River
Species: Coho salmon
Stock Unit: not applicable

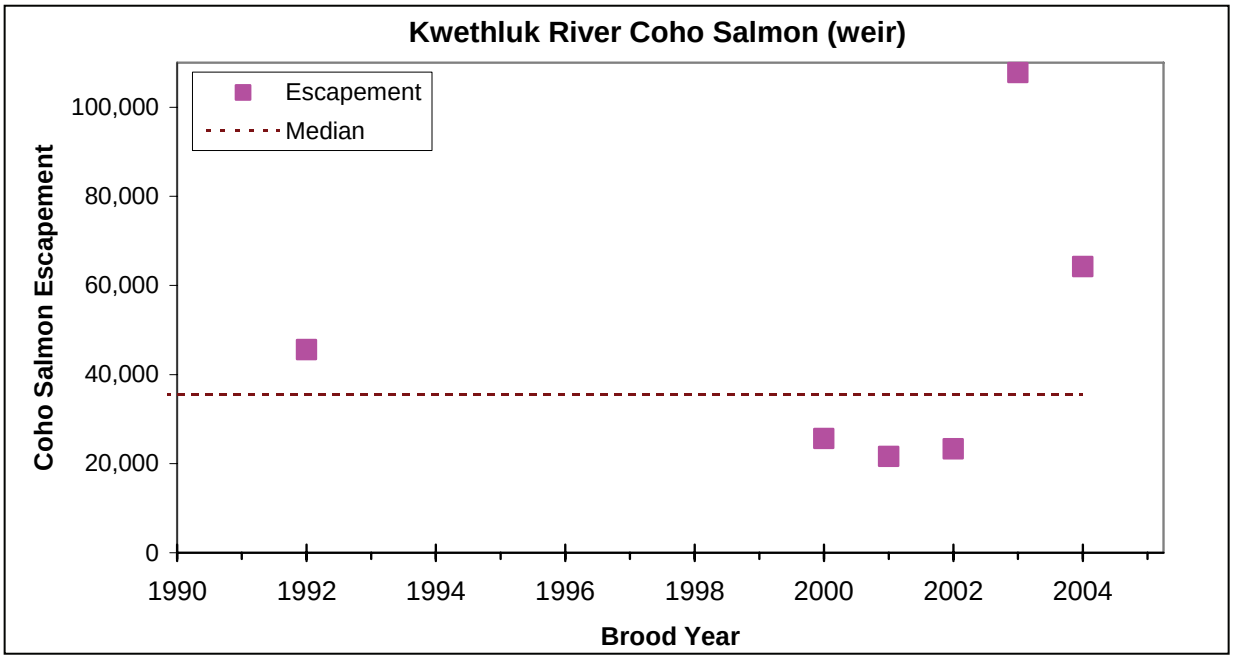
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	45,605
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	25,610
2001	21,596
2002	23,298
2003	107,789
2004	64,216
2005	

-continued-

System: Kwethluk River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Kwethluk River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2004**
Number of Years	**6**
Average	**48,019**
Min	**21,596**
15th	**22,873**
25th	**23,876**
Median	**35,608**
75th	**59,563**
85th	**75,109**
Max	**107,789**
Contrast	**5**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A3.4.–Escapement goal for Takotna River coho salmon (weir).

System: Takotna River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 21**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 2000 to 2005
Summary:	
Data Quality:	Fair
Data Type:	Weir counts
Contrast:	3
Criteria for SEG:	Low contrast
15th Percentile to Maximum	2,509 to 7,147
Years within recommended SEG:	not applicable

Comments:

- 52 river miles from the enumeration point to the Kuskokwim River confluence.
- 519 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The weir is a cooperative project between ADF&G and Takotna Tribal Council.
- Salmon stocks in the Takotna River are thought to be in a rebuilding phase following decades of near absence, as was reported by several individuals who lived in the area during the 1940's through 1970's (Schwanke et al. 2001).
- The distribution of juvenile coho and Chinook salmon appears limited mostly to Fourth-of-July Creek, Big Creek and those water of the mainstem Takotna River downstream of Fourth-of-July Creek (Clark an Molyneaux 2003)
- Most salmon spawning occurs in Fourth-of July Creek, Big Creek and the mainstem Takotna River as far downstream as the community of Takotna. Small numbers of adult and juvenile coho salmon have been found in Moore Creek (Clark and Molyneaux 2003).
- Gold mining and prospecting occurred throughout the Takotna River drainage. There are claims and intermittently active placer mines around Yankee Creek, Moore Creek, Lincoln Creek, Nixon Fork and the Candle Hills. Tailing piles are visible at Moore Creek, but they are mostly overgrown with vegetation. Plans are underway to renew mining operations at Moore Creek.
- The Takotna River is a popular location for subsistence and recreational activity especially for residents of Takotna and McGrath who used the river to access hunting areas. Subsistence salmon fishers set gillnets in the mouth of the Takotna River, across from McGrath, plus various homesteaders set gillnets within the drainage for whitefish and salmon

-continued-

System: Takotna River
Species: Coho salmon
Stock Unit: not applicable

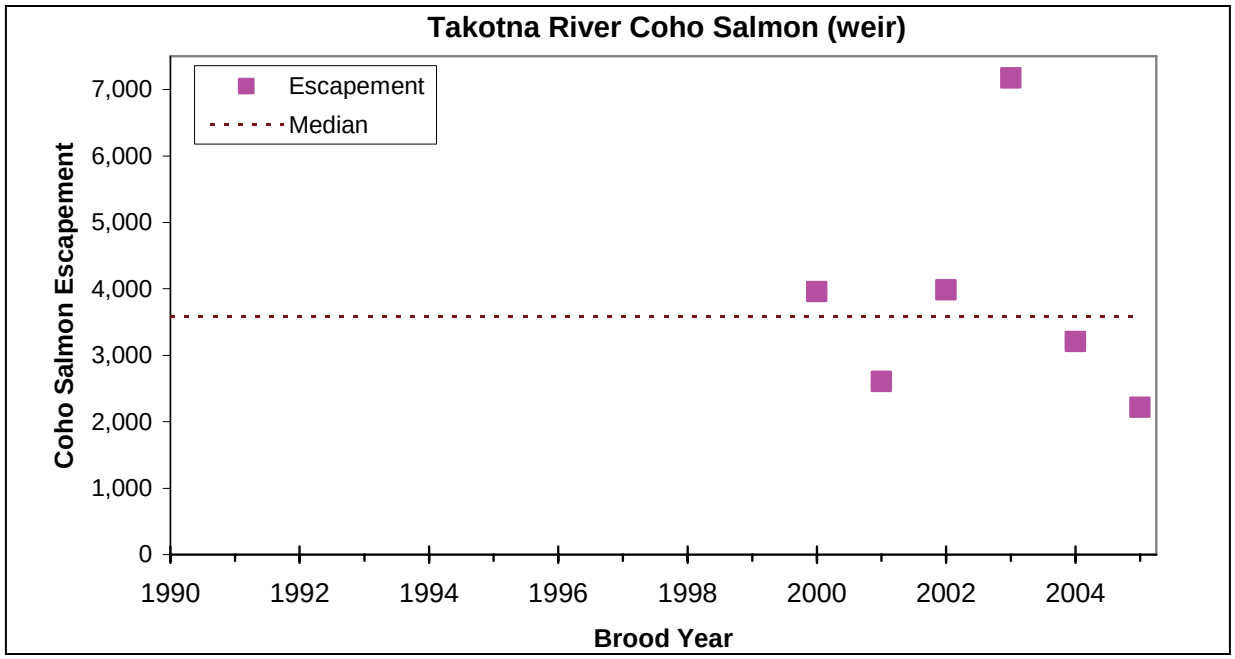
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	3,957
2001	2,606
2002	3,984
2003	7,171
2004	3,207
2005	2,216

-continued-

System: Takotna River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Takotna River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**6**
Average	**3,857**
Min	**2,216**
15th	**2,509**
25th	**2,756**
Median	**3,582**
75th	**3,977**
85th	**4,781**
Max	**7,171**
Contrast	**3**
Contrast Label	Low
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A3.5.–Escapement goal for Tatlawiksuk River coho salmon (weir).

System: Tatlawiksuk River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 18**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1999, 2001-2002, 2004-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts; no estimate in 2000 and 2003
Contrast:	5
Criteria for SEG:	Medium contrast
15th 85th Percentile:	5,879 to 13,371
Years within recommended SEG:	not applicable

Comments:

- 3 river miles from the enumeration point to the Kuskokwim River confluence.
- 353 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- The Tatlawiksuk River weir is a cooperative project between ADF&G and Kuskokwim Native Association.
- Andrew Gusty of Stony River recalls his father and grandfather operating a fish trap near the current weir site on the Tatlawiksuk River.

-continued-

System: Tatlawiksuk River
Species: Coho salmon
Stock Unit: not applicable

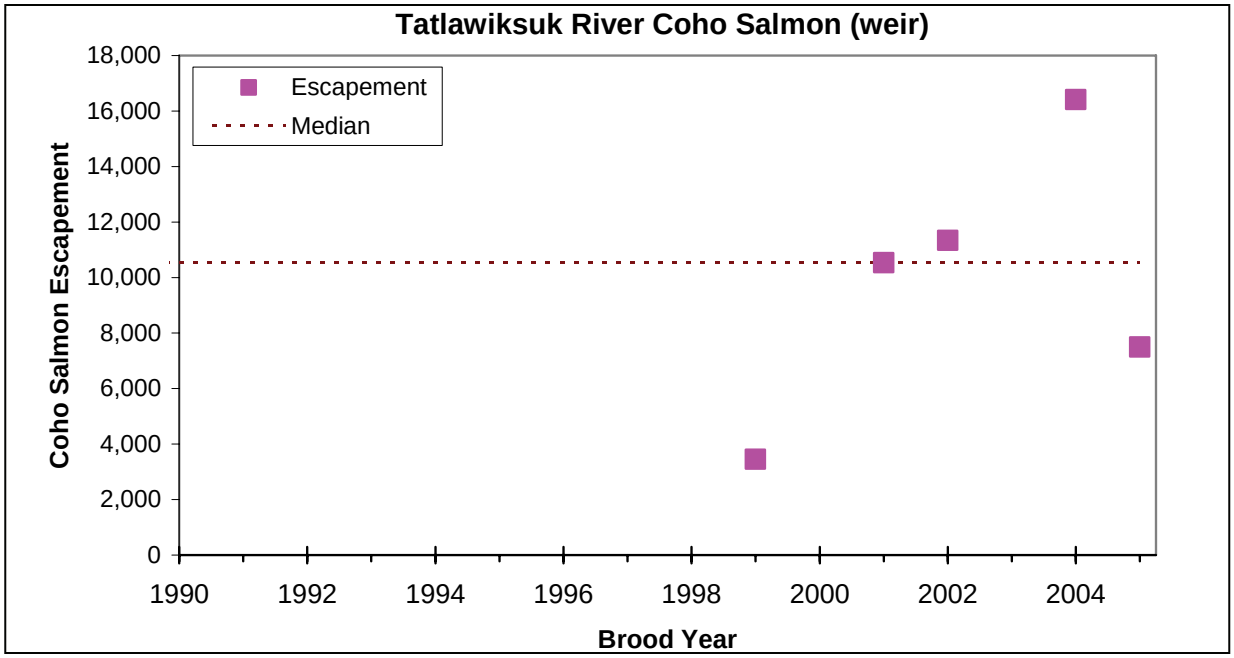
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	3,455
2000	
2001	10,539
2002	11,345
2003	
2004	16,410
2005	7,495

-continued-

System: Tatlawiksuk River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Tatlawiksuk River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**5**
Average	**9,849**
Min	**3,455**
15th	**5,879**
25th	**7,495**
Median	**10,539**
75th	**11,345**
85th	**13,371**
Max	**16,410**
Contrast	**5**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix A3.6.–Escapement goal for Tuluksak River coho salmon (weir).

System: Tuluksak River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 8**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	not applicable
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1991-1994, 2001-2005
Summary:	
Data Quality:	Fair
Data Type:	Weir counts; no estimates in 1995 to 2000
Contrast:	9
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	7,952 to 20,336
Years within recommended SEG:	not applicable

Comments:

- 35 river miles from the enumeration point to the Kuskokwim River confluence.
- 154 river miles from the enumeration point to the mouth of the Kuskokwim River.
- SEG was considered, but deferred until the next cycle review due to the limited data set.
- Tuluksak River is within the Yukon Delta National Wildlife Refuge.
- The weir is a cooperative project between USFWS and Tuluksak Tribal Council.
- Tuluksak River is a popular location for subsistence activity due in part to the close proximity of the Yup'ik village of Tuluksak (population 461), which is located near the mouth of the Tuluksak River. Subsistence fishers commonly deploy short gillnets within the lower few miles of the stream to harvest salmon and whitefish. Subsistence and recreational fishers use rod and reel gear to harvest resident species including Arctic grayling and Dolly Varden trout (personal observation; Brown 1983).
- Discovery of placer gold in 1907 triggered a stampede to the area, but most prospectors were gone by 1909 (Brown 1983). In 1921, the New York-Alaska Company (NYAC) began a more ambitious venture with a five hundred ton dredge. By 1955, the company had about 80 people working in the Tuluksak area on a seasonal basis and operated three gold dredges, a hydroelectric plant, two draglines and seven tractors. Several other companies also actively mined in the Tuluksak basin. NYAC ceased operation following a fire in 1965, but a new owner, Tuluksak Dredging Company, resumed dredge mining in 1972. To date, the NYAC placer district has produced more than 500,000 oz of placer gold (Calista Corporation 2006).
- During 2005 and 2006 Tonogold Resources, Inc. conducted drilling, surface sampling, and a mapping program to explore the possibility of mining for gold near the Tuluksak River. A final report is expected near the end of 2006 and exploration is projected to continue into 2007 (Tonogold Resources, Inc. 2006).

-continued-

System: Tuluksak River
Species: Coho salmon
Stock Unit: not applicable

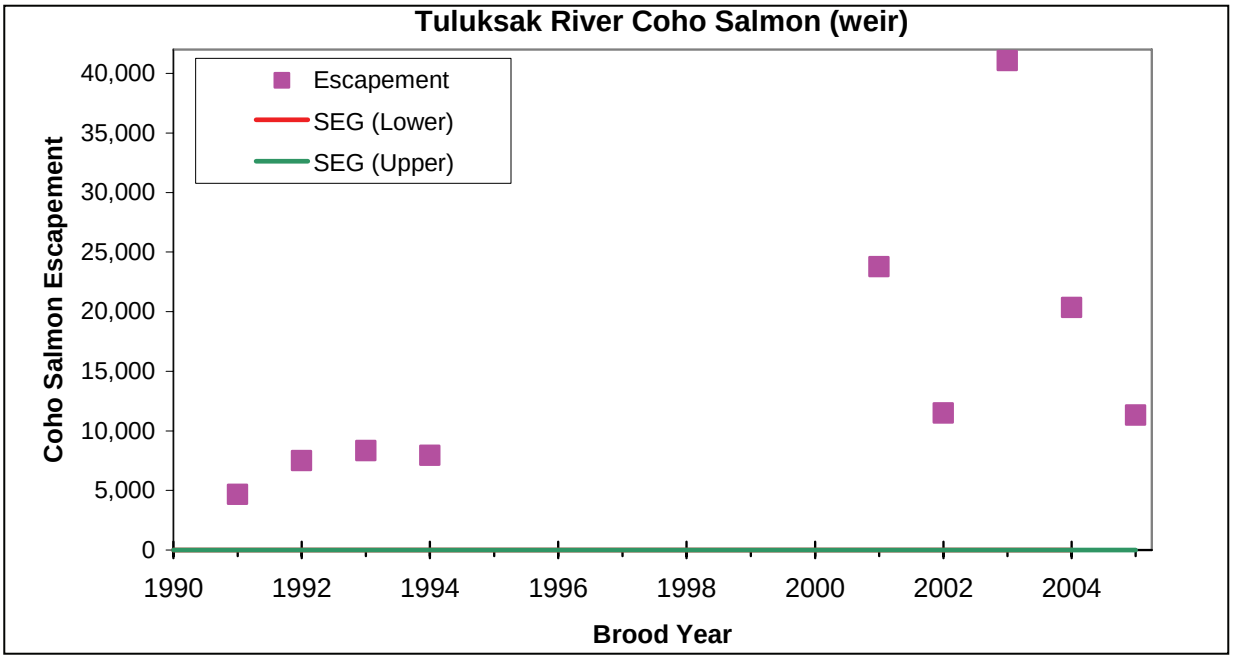
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	4,651
1992	7,501
1993	8,328
1994	7,952
1995	
1996	
1997	
1998	
1999	
2000	
2001	23,768
2002	11,487
2003	41,071
2004	20,336
2005	11,324

-continued-

System: Tuluksak River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year and suggested SEG range (solid line).



-continued-

System: Tuluksak River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**9**
Average	**15,158**
Min	**4,651**
15th	**7,591**
25th	**7,952**
Median	**11,324**
75th	**20,336**
85th	**23,082**
Max	**41,071**
Contrast	**9**
Contrast Label	High
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

APPENDIX A4. KUSKOKWIM RIVER SOCKEYE

Appendix A4.1.–Escapement goal for Kogrukluk River sockeye salmon (weir).

System: Kogrukluk River
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 16**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	≥2,000 (1983) (Buklis 1993); discontinued approx. 1995, but not well documented (Burkey et al. 1999)
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1976,1978-1979,1981-1982,1984-1986,1988-2005
Summary:	
Data Quality:	Fair
Data Type:	Weir counts; no estimates in 1977, 1980, 1983 and 1987.
Contrast:	23
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	4,275 to 15,088
Years within recommended SEG:	not applicable

Comments:

- 136 river miles from the enumeration point to the Kuskokwim River confluence.
- 441 river miles from the enumeration point to the mouth of the Kuskokwim River.
- Kogrukluk River is a tributary of the upper Holitna River, and is atypical sockeye habitat in that it does not include any large lakes. Most Kogrukluk River sockeye are believed to spawn and rear in sloughs. More sockeye, however, are observed at the Kogrukluk River weir than any other escapement monitoring location in the Kuskokwim River basin. The Stony River sub-basin is believed to be the major sockeye producing system in the Kuskokwim River drainage, but escapement monitoring is limited to sporadic annual aerial surveys
- SEG threshold was considered, but rejected because 1) sockeye are not actively managed in the Kuskokwim River, 2) Kogrukluk River sockeye are believed to be a minor component of the annual Kuskokwim River sockeye run, and 3) Kogrukluk River are not thought to be a good index of the Kuskokwim River sockeye run. However, preliminary findings of an ongoing radio telemetry study identifiy the Holitna River as contributing approximately 70 percent of the total sockeye salmon spawning population in the Kuskokwim River. These findings indicate that the Kogrukluk River may be a reasonable indicator of overall sockeye salmon escapement and should be revisited for consideration of escapement goal development (S. E. Gilk, Commercial Fish Biologist, ADF&G, Anchorage; personal
- In 2004 the BOF formally established a limited guideline commercial harvest level of 0 to 50,000 sockeye for the Kuskokwim River (Whitmore et al. in prep).
- The Holitna River is a popular subsistence and recreational location for residents throughout the Kuskokwim River drainage. There are local sport fish guiding services that operate in the sub-basin, as well as guides other areas. Recreational rod and reel fishing is expected to increase with the development of the Donlin Creek mine and the anticipated increase in human populations in nearby communities.
- Beginning in the early 1900's a small number of prospectors explored the upper Holitna River, but found only limited amounts of gold (Brown 1983). The area has also supported mercury mines, particularly in the Chukowan River drainage. The upper Holitna River drainage, inclusive of the Kogrukluk River, is the current focus of new mineral extraction interests.

-continued-

System: Kogrukluk River
Species: Sockeye salmon
Stock Unit: not applicable

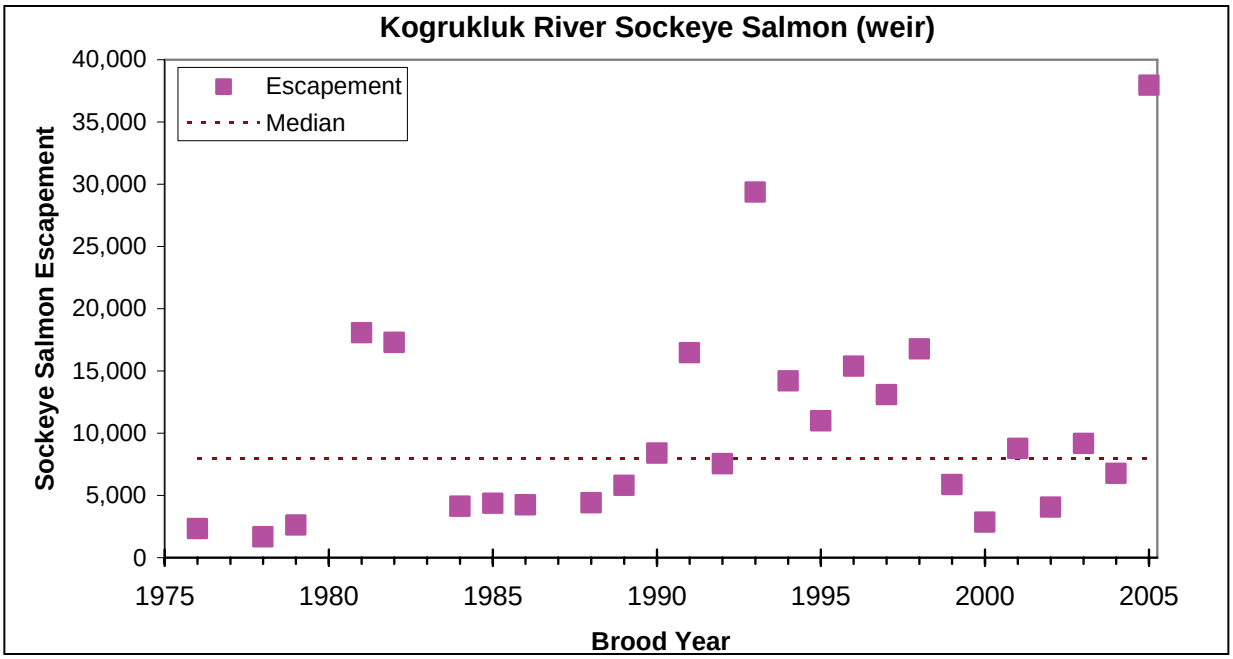
Data available for analysis of escapement goals.

Brood Year	Escapement
1976	2,326
1977	
1978	1,670
1979	2,628
1980	
1981	18,077
1982	17,297
1983	
1984	4,133
1985	4,359
1986	4,247
1987	
1988	4,402
1989	5,810
1990	8,407
1991	16,455
1992	7,539
1993	29,366
1994	14,192
1995	10,996
1996	15,386
1997	13,078
1998	16,773
1999	5,864
2000	2,865
2001	8,776
2002	4,050
2003	9,164
2004	6,775
2005	37,939

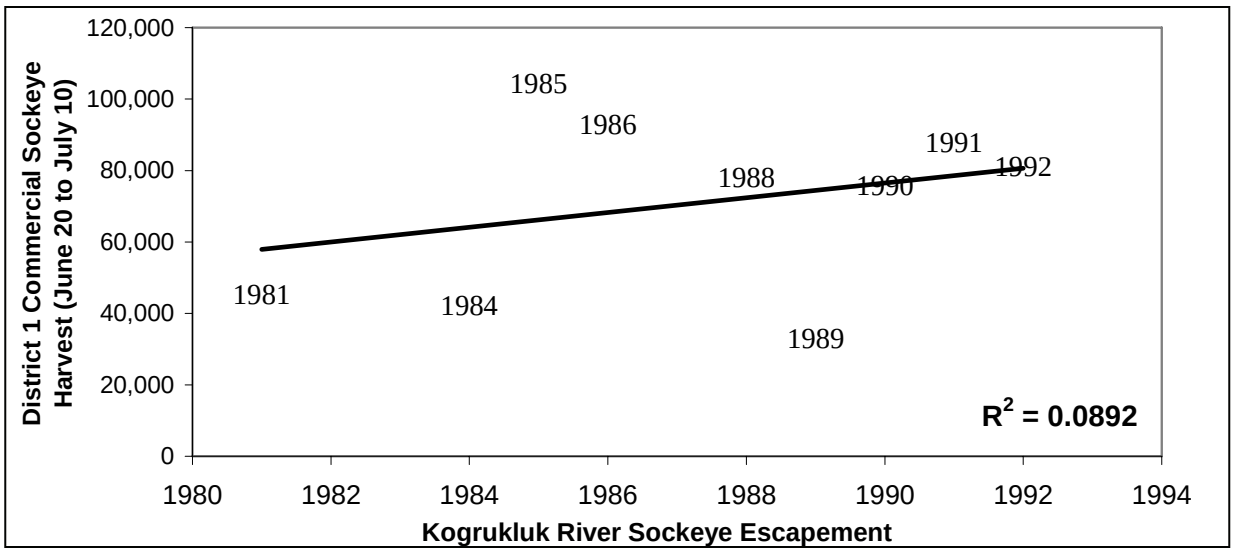
-continued-

System: Kogrukluk River
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year.



Weir counts compared to selected measures of annual commercial sockeye harvest.



-continued-

System: Kogrukluk River
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**26**
Average	**10,484**
Min	**1,670**
15th	**3,754**
25th	**4,275**
Median	**7,973**
75th	**15,088**
85th	**16,904**
Max	**37,939**
Contrast	**23**
Contrast Label	High
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

APPENDIX B1. KUSKOKWIM BAY CHINOOK

Appendix B1.1.–Escapement goal for Arolik River Chinook salmon (aerial survey).

System: Arolik River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 3**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey
Summary:	
Data Quality:	Fair
Data Type:	Peak aerial survey counts with fixed winged aircraft; abundance index
Contrast:	5
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	1,057 to 3,339
Years within recommended SEG:	not applicable

Comments:

- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101, 102, 103 and 104.
  4) Counts include carcasses

-continued-

System: Arolik River
Species: Chinook salmon
Stock Unit: not applicable

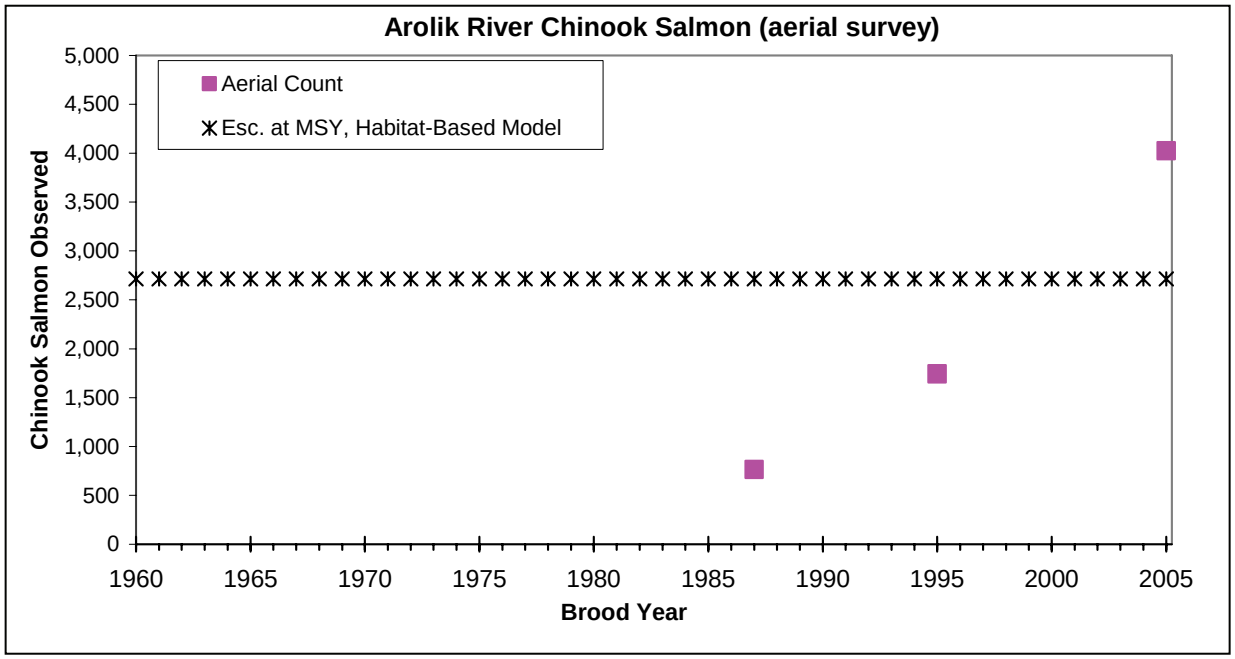
Data available for analysis of escapement goals.

Brood Year	Survey Areas 101	102	103	104	Index Area Total	Rating	Date of Survey	Comments
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977	2,740		1,829	668		2	21-Jul	
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987	764	0	0	0	764	2	27-Jul	
1988								
1989								
1990								
1991								
1992								
1993								
1994	2	465	40			1	6-Aug	
1995	1,604	0	78	60	1,742	1	22-Jul	
1996	611		429	30		2	23-Jul	
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005	1,430	2,196	398	0	4,024	2	1-Aug	

-continued-

System: Arolik River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Arolik River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**3**
Average	**2,177**
Min	**764**
15th	**1,057**
25th	**1,253**
Median	**1,742**
75th	**2,883**
85th	**3,339**
Max	**4,024**
Contrast	**5**
Contrast Label	Medium
Exploitation	Mod. to High
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model		
Watershed Area (km^2)	**1,350**	
Start Point	**Mouth**	(Lat. 59°41.655' N Long. 161°52.851' W)
S_{MSY}	**2,715**	
S_C	**7,227**	

Appendix B1.2.–Escapement goal for Goodnews River (north fork) Chinook salmon (aerial survey).

System: Goodnews River (north fork)
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 25**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	640 - 3,300 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey
Summary:	
Data Quality:	Fair
Data Type:	• Seventeen fixed-wing aircraft aerial surveys since 1980, • commercial harvest information since 1968, • commercial harvest age class information since 1990.
Contrast:	6.2
Criteria for SEG:	Medium contrast
25th - 75th percentile:	643 - 3,286
Years within recommended SEG:	11 of 18 years within SEG range, 3 years below and 4 years above

Comments:

- This goal represents an index, not an estimate of the actual number of spawners. Commercial harvest and age class information is for the entire drainage. It is not specific for stocks originating in the Goodnews River.

-continued-

System: Goodnews River (north fork)
Species: Chinook salmon
Stock Unit: not applicable

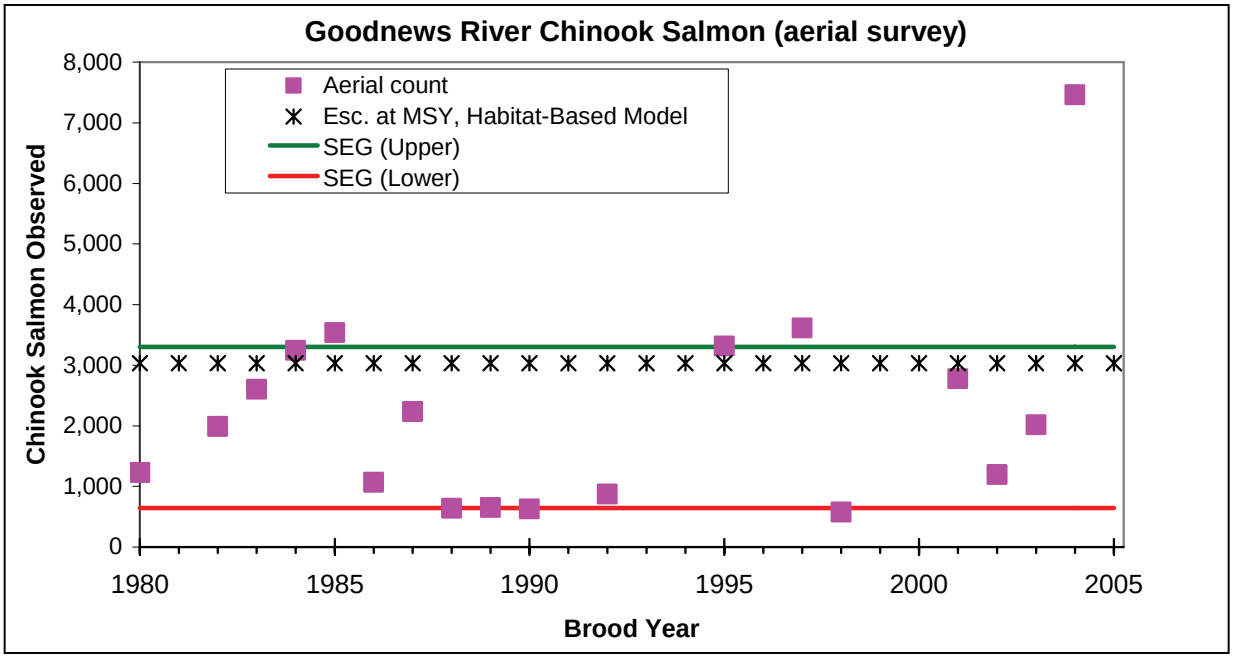
Data available for analysis of escapement goals.

Brood Year	Aerial Survey
1980	1,228
1981	
1982	1,990
1983	2,600
1984	3,245
1985	3,535
1986	1,068
1987	2,234
1988	637
1989	651
1990	626
1991	
1992	875
1993	
1994	
1995	3,314
1996	
1997	3,611
1998	578
1999	
2000	
2001	2,779
2002	1,195
2003	2,015
2004	7,462
2005	

-continued-

System: Goodnews River (north fork)
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Goodnews River (north fork)
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**17**
Average	**1,893**
Min	**578**
15th	**643**
25th	**875**
Median	**1,990**
75th	**2,779**
85th	**3,286**
Max	**3,611**
Contrast	**6**
Contrast Label	Medium
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**640**
SEG Upper	**3,300**

Summary Habitat-Based Model		
Watershed Area (km^2)	**1,582**	
Start Point	**Mouth**	(Lat. 59°7.787' N Long. 161°28.042' W)
S_{MSY}	**3,030**	
S_C	**8,067**	

Appendix B1.3–Escapement goal for Kanektok River Chinook salmon (aerial survey).

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	3,500 - 8,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey
Summary:	
Data Quality:	Fair
Data Type:	• Twenty-four fixed-wing aircraft aerial surveys since 1962, • escapement information from a counting tower 1997, from a weir in 2002 and 2003 • commercial harvest information since 1960, • commercial harvest age class information since 1990, • escapement age class information from 1997, 2002, and 2003.
Contrast:	23.6
Criteria for SEG:	High contrast with at least moderate exploitation
25th - 75th percentile:	3,510 - 7,971
Years within recommended SEG:	12 of 26 years within SEG range, 6 years below and 8 years above.

Comments:

- This goal represents an index, not an estimate of the actual number of spawners. District 4 is an intercept fishery. Commercially harvested salmon are bound for other drainages, such as the Kuskokwim River drainage (Baxter 1970). As a result, commercial harvest information is not exclusive to Kanektok River Stocks.

-continued-

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable

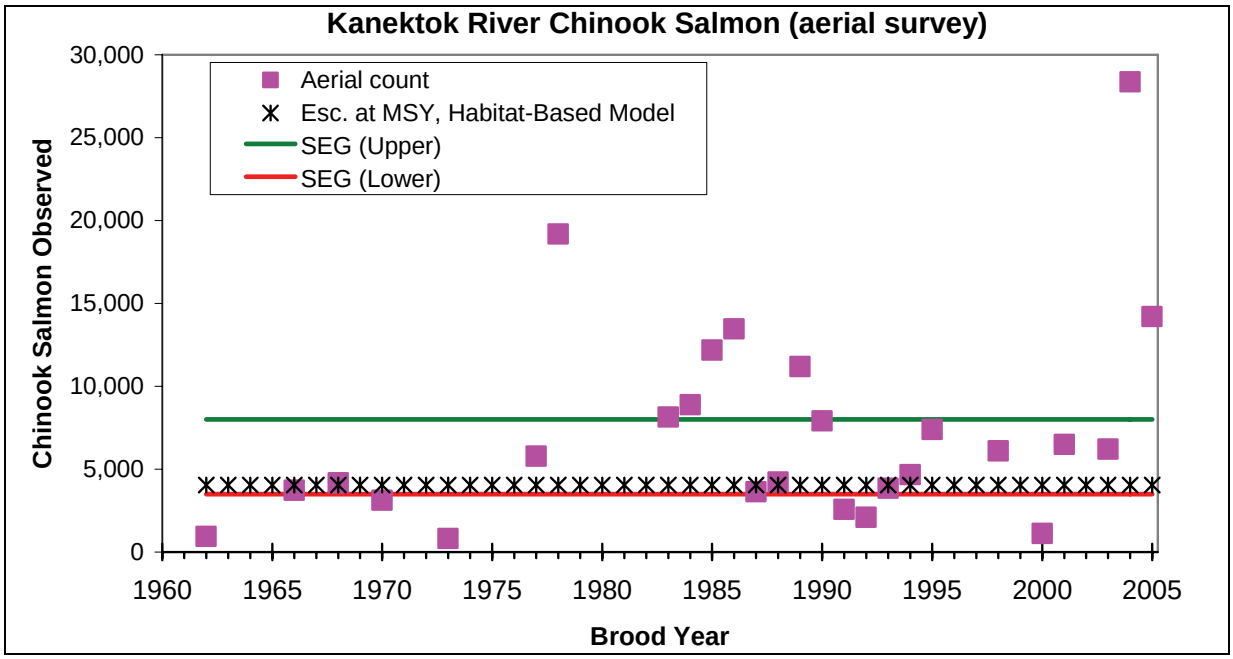
Data available for analysis of escapement goals.

Brood Year	Escapement	
	Aerial survey	Tower/weir
1962	935	
1963		
1964		
1965		
1966	3,718	
1967		
1968	4,170	
1969		
1970	3,112	
1971		
1972		
1973	814	
1974		
1975		
1976		
1977	5,787	
1978	19,180	
1979		
1980		
1981		
1982		
1983	8,142	
1984	8,890	
1985	12,182	
1986	13,465	
1987	3,643	
1988	4,223	
1989	11,180	
1990	7,914	
1991	2,563	
1992	2,100	
1993	3,856	
1994	4,670	
1995	7,386	
1996		
1997		16,731
1998	6,107	
1999		
2000	1,118	
2001	6,483	
2002		5,343
2003	6,206	8,231
2004	28,375	19,528
2005	14,202	

-continued-

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**24**
Average	**6,160**
Min	**814**
15th	**2,308**
25th	**3,510**
Median	**5,229**
75th	**7,971**
85th	**10,150**
Max	**19,180**
Contrast	**23.6**
Contrast Label	High
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**3,500**
SEG Upper	**8,000**

Summary Habitat-Based Model	
Watershed Area (km^2)	**2,403**
Start Point	**Mouth** (Lat. 59°44.928' N Long. 161°55.720' W)
S_{MSY}	**4,047**
S_C	**10,775**

Appendix B1.4.–Escapement goal for Kanektok River Chinook salmon (weir count).

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 2002-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts
Contrast:	4
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	6,638 to 17,151
Years within recommended SEG:	not applicable

Comments:

- Weir is 42 miles from the mouth of the Kanektok River.
- Substantial spawning occurs below the weir.

-continued-

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable

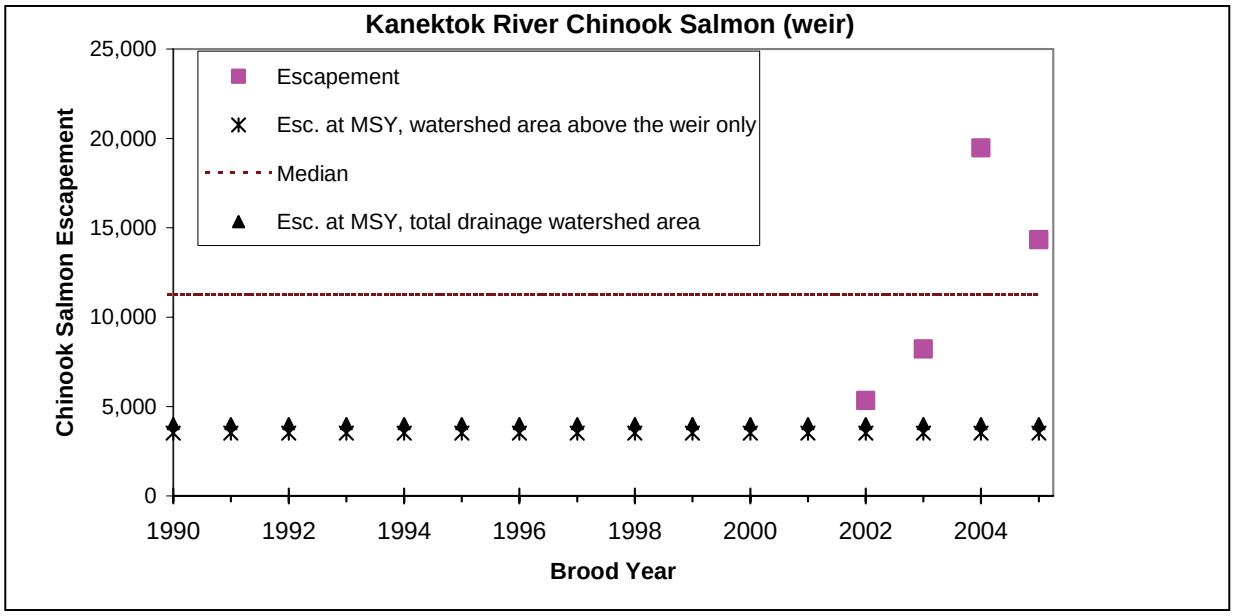
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	
2002	5,343
2003	8,221
2004	19,459
2005	14,331

-continued-

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Kanektok River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**4**
Average	**11,839**
Min	**5,343**
15th	**6,638**
25th	**7,502**
Median	**11,276**
75th	**15,613**
85th	**17,151**
Max	**19,459**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Summary Habitat-Based Model[a]

Watershed Area (km^2)	**1,965**	
Start Point	**Weir**	(Lat. 59°46.005' N Long. 161°3.571' W)
S_{MSY}	**3,521**	
S_C	**9,373**	
Watershed Area (km^2)	**2,403**	
Start Point	**Mouth**	(Lat. 59°44.928' N Long. 161°55.720' W)
S_{MSY}	**4,047**	
S_C	**10,775**	

[a] A significant number of Chinook salmon spawn below the weir making it difficult to compare with any one habitat-based model input.

Appendix B1.5.–Escapement goal for Middle Fork Goodnews River Chinook salmon (spawner-recruit).

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 2**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	2,000 to 4,500 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	BEG of 1,500 to 2,900
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower/weir 1981-2005

Summary:

Data Quality:	Good
Data Type:	Tower/weir counts, aerial surveys, harvest, escapement ASL, commercial ASL
Contrast	4
Criteria for BEG	90% Credible Bounds for Smsy 1,454 to 2,845 Smsy range for 90% MSY: 1,188 to 2,561 Smsy: 1,813 for spawner-recruit and 1,810 from the habitat-based model Medium contrast with at least moderate exploitation
Years within recommended BEG	9 of 24 years within BEG range, 1 below and 14 above.

Comments:

- Drainage-wide escapement is estimated by expanding aerial survey counts. The expansion factor is calculated as the Middle Fork aerial survey counts above the weir divided by Middle Fork tower/weir counts.
- The expansion factor varies from year to year.
- Aerial surveys have not been consistently flown over all drainages and years.
- Commercial and escapement ASL data have missing years.
- South Fork Goodnews River is excluded from analysis as its contribution to overall escapement is considered to be negligible.
- Smsy estimated from the habitat-based model was 1,810 and spawners at replacement was 4,817

-continued-

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

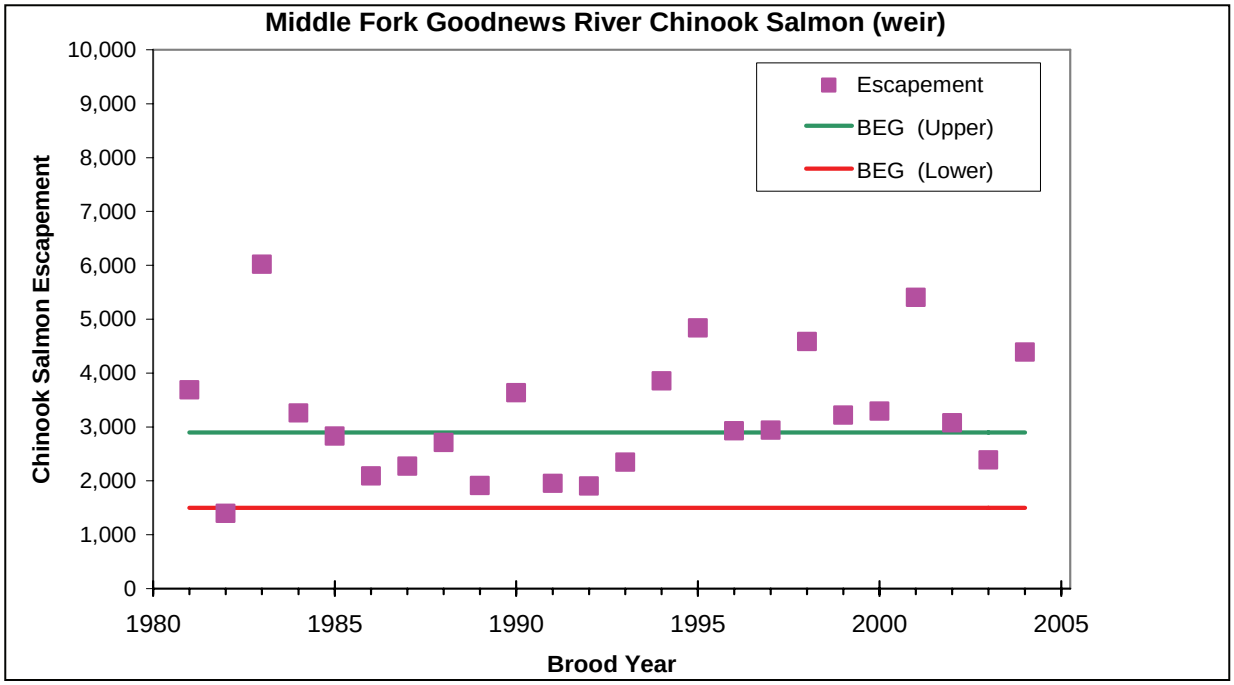
	Goodnews R. Escapement		Harvest				Total Run Goodnews	
Brood Year	Middle Fork	North Fork	Subsistence	Commercial	Sport	Middle Fork[a]	River	Annual Exploitation
1981	3,688	7,766	1,409	7,190		2,769	20,053	0.43
1982	1,395	2,937	1,236	9,476		3,450	15,044	0.71
1983	6,022	14,398	1,066	14,117	31	4,487	35,634	0.43
1984	3,260	8,743	629	8,612		2,510	21,244	0.43
1985	2,831	7,979	426	5,793	323	1,713	17,352	0.38
1986	2,092	4,094	555	2,723		1,109	9,464	0.35
1987	2,272	4,490	816	3,357		1,402	10,935	0.38
1988	2,712	5,419	310	4,964		1,759	13,405	0.39
1989	1,915	2,891	467	2,966	68	1,395	8,307	0.42
1990	3,636	7,656	682	3,303		1,283	15,277	0.26
1991	1,952	4,521	682	912	29	489	8,096	0.20
1992	1,903	1,854	252	3,528		1,915	7,537	0.50
1993	2,349	4,727	488	2,117	104	899	9,785	0.28
1994	3,856	7,866	657	2,570	175	1,119	15,124	0.22
1995	4,836	9,865	552	2,922	55	1,161	18,230	0.19
1996	2,930	5,977	526	1,375	213	695	11,021	0.19
1997	2,937	7,216	449	2,039	164	767	12,805	0.21
1998	4,584	3,797	718	3,675	590	2,725	13,364	0.37
1999	3,221	6,565	871	1,888	414	1,044	12,959	0.24
2000	3,295	6,458	601	4,442	319	1,812	15,115	0.35
2001	5,404	8,128	853	1,519	285	1,061	16,189	0.16
2002	3,076	4,096	857	979	429	971	9,437	0.24
2003	2,389	4,985	649	1,412	681	888	10,116	0.27
2004	4,388	12,512	954	2,565		914	20,419	
Average								0.33

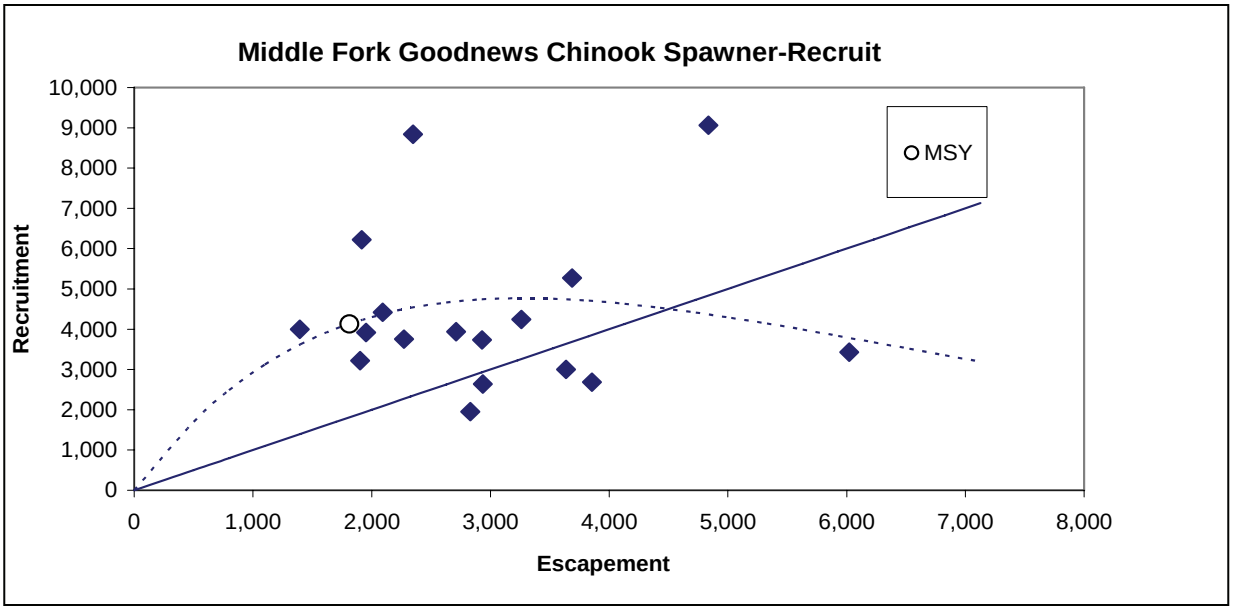
[a] Represents total harvest estimated to be of Middle Fork origin

-continued-

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and suggested BEG range (solid line).





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System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Brood Table for Middle Fork Goodnews River Chinook Salmon. Only highlighted data were used in spawner-recruit analysis.

		Number by Age in Total Return								
Year	Escapement	2	3	4	5	6	7	8	Total Return	Return/ Spawner
1981	3,688	0	5	1,038	1,625	2,034	565	0	5,268	1.4
1982	1,395	0	29	376	1,093	2,310	188	0	3,995	2.9
1983	6,022	0	15	388	1,068	1,708	247	7	3,433	0.6
1984	3,260	0	16	528	1,249	2,196	249	0	4,238	1.3
1985	2,831	0	0	154	805	882	111	0	1,952	0.7
1986	2,092	0	14	1,647	829	1,740	188	0	4,417	2.1
1987	2,272	0	26	474	1,265	1,397	589	0	3,751	1.7
1988	2,712	0	0	657	838	2,399	46	1	3,940	1.5
1989	1,915	0	40	810	1,590	3,589	193	0	6,222	3.2
1990	3,636	0	17	335	998	1,642	11	0	3,003	0.8
1991	1,952	0	65	1,364	1,035	1,179	276	0	3,918	2.0
1992	1,903	0	0	725	362	2,041	92	0	3,220	1.7
1993	2,349	0	30	2,129	4,062	2,555	60	0	8,836	3.8
1994	3,856	0	25	791	552	1,085	235	0	2,687	0.7
1995	4,836	0	142	1,046	3,163	4,564	146	0	9,062	1.9
1996	2,930	0	23	762	1,273	1,535	142	0	3,736	1.3
1997	2,937	0	36	345	1,034	1,182	41	0	2,638	0.9
1998	4,584	0	52	1,325	1,310	1,020	0	0	3,706	
1999	3,221	0	8	560	1,244	0	0	0	1,812	
2000	3,295	0	82	2,872	0	0	0	0	2,954	
2001	5,404	0	124	0	0	0	0	0	124	
2002	3,076	0	0	0	0	0	0	0	0	
2003	2,389	0	0	0	0	0	0	0	0	
2004	4,388	0	0	0	0	0	0	0	0	
Average										1.7

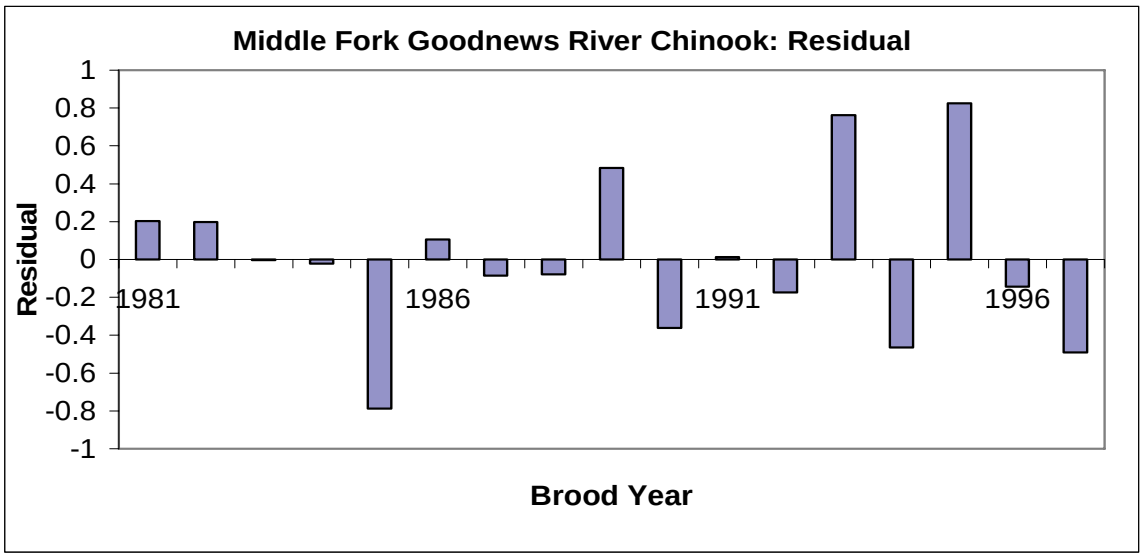
-continued-

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Parameter estimates and other statistics from a Ricker spawner-recruit model for Middle Fork Goodnews River Chinook Salmon

Statistic	Estimate	SE
α	3.969 [a]	
$\ln(\alpha')$	1.279 [b]	0.031
β	3.06E-04	9.79E-05
σ^2	0.1990	
S_{msy}	1,813	
90% Credible bound for S_{msy}	1,454; 2,845	
R_{msy}	4,131	
MSY	2,318	
S_{msy} range for 90% MSY	1,188; 2,561	
$S_{replacenent}$	4,503	
Contrast	4.3	
Durbin-Watson	2.71	

[a] Adjusted per Hilborn (1985) to account for log transformation of spawner-recruit data.
[b] Represents the estimate from the Bayesian fit model.



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System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2004**
Number of Years	**24**
Average	**3,206**
Min	**1,395**
15th	**2,015**
25th	**2,330**
Median	**3,007**
75th	**3,730**
85th	**4,496**
Max	**6,022**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current (ADF&G 2004):	
SEG Lower	**2,000**
SEG Upper	**4,500**
Suggested BEG (Lower)	**1,500**
Suggested BEG (Upper)	**2,900**

Appendix B1.6.–Escapement goal for Middle Fork Goodnews River Chinook salmon (weir)**.**

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 2**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial gillnet and subsistence
Previous Escapement Goal:	2,000-4,500 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	BEG of 1,500 to 2,900 (see Appendix B1.5)
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower/weir 1981-2005
Summary:	
Data Quality:	Good
Data Type:	• Tower/weir counts since 1981, • Commercial harvest information since 1968, • Commercial harvest age class information since 1981, • Escapement age class information since 1983.
Contrast:	4.3
Criteria for BEG:	90% Credible Bounds for Smsy 1,454 to 2,845 Smsy range for 90% MSY: 1,188 to 2,561 Smsy: 1,813 for spawner-recruit and 1,810 from the habitat-based model Medium contrast with at least moderate exploitation
Years within recommended BEG:	9 of 25 years within BEG range, 1 year below and 15 years above

Comments:

- Commercial harvest and age class information represents the entire drainage. It is not specific for stocks originating in the Middle Fork Goodnews River.

-continued-

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

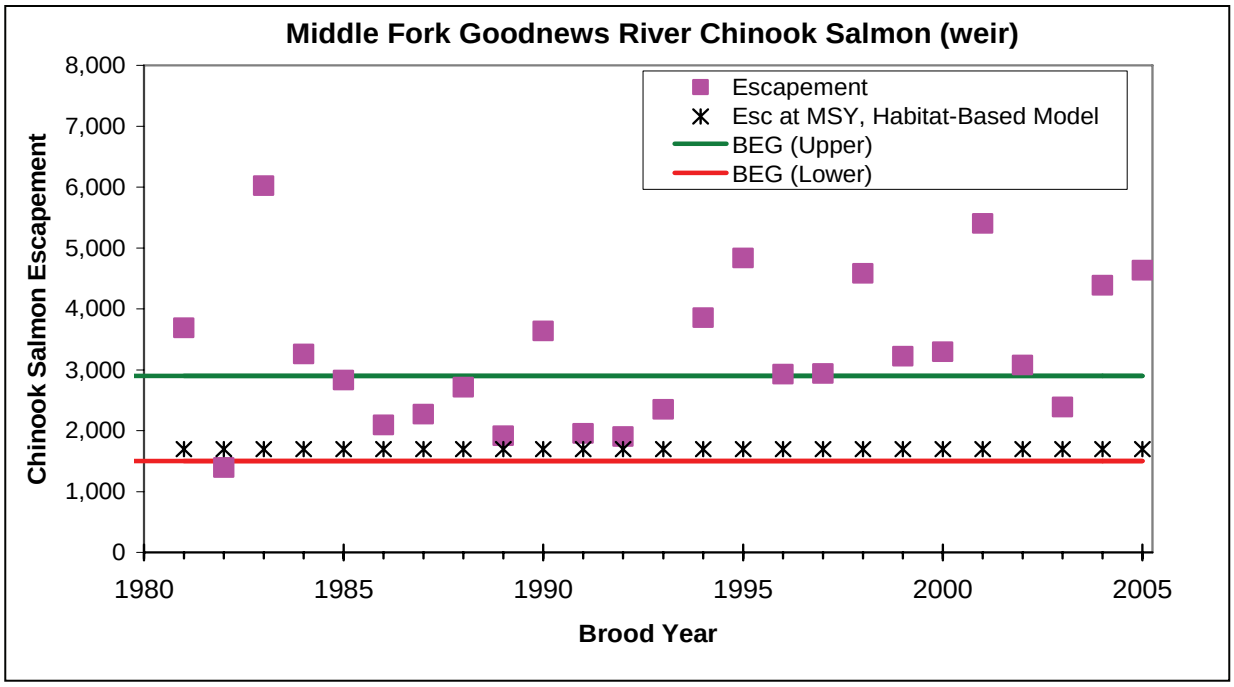
Data available for analysis of escapement goals.

Brood Year	Escapement
1981	3,688
1982	1,395
1983	6,022
1984	3,260
1985	2,831
1986	2,092
1987	2,272
1988	2,712
1989	1,915
1990	3,636
1991	1,952
1992	1,903
1993	2,349
1994	3,856
1995	4,836
1996	2,930
1997	2,937
1998	4,584
1999	3,221
2000	3,295
2001	5,404
2002	3,076
2003	2,389
2004	4,388
2005	4,633

-continued-

System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year and suggested BEG range.



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System: Middle Fork Goodnews River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**23**
Average	**3,155**
Min	**1,395**
15th	**1,994**
25th	**2,311**
Median	**2,937**
75th	**3,662**
85th	**4,366**
Max	**6,022**
Contrast	**4.3**
Contrast Label	Medium
Exploitation	Moderate
Current (ADF&G 2004)	
SEG Lower	**2,000**
SEG Upper	**4,500**
Suggested BEG (Lower)	**1,500**
Suggested BEG (Upper)	**2,900**

Summary Habitat-Based Model		
Watershed Area (km^2)	**752**	
Start Point	**Mouth**	(Lat. $59^{o}7$.739' N Long. 161^{o}27.889' W)
S_{MSY}	**1,810**	
S_C	**4,817**	

Appendix B1.7.–Escapement goal for Salmon River Chinook salmon (aerial survey).

System: Salmon River
Species: Chinook salmon
Stock Unit: not applicable **Map Code: 1**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Fair
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	-
Criteria for SEG:	-

Comments:

- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Counts include carcasses

-continued-

System: Salmon River
Species: Chinook salmon
Stock Unit: not applicable

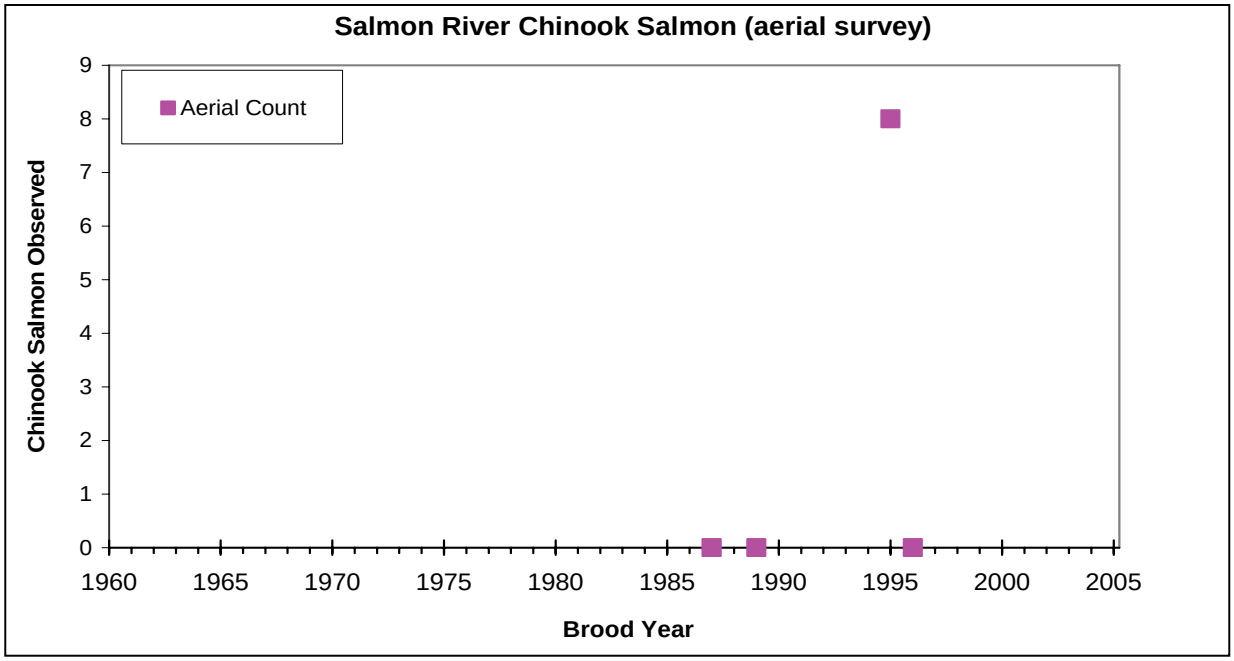
Data available for analysis of escapement goals.

Brood Year	Index Area Total	Rating	Date of Survey	Comments
1960				
1961				
1962				
1963				
1964				
1965				
1966				
1967				
1968				
1969				
1970				
1971				
1972				
1973				
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987	0	2	28-Jul	
1988				
1989	0	1	11-Jul	
1990				
1991				
1992				
1993				
1994				
1995	8	1	22-Jul	
1996	0	1	9-Jul	
1997				
1998				
1999				
2000				
2001				
2002				
2003				
2004				
2005				

-continued-

System: Salmon River
Species: Chinook salmon
Stock Unit: not applicable

Observed escapement by year.



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System: Salmon River
Species: Chinook salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**4**
Average	**2**
Min	**0**
15th	**0**
25th	**0**
Median	**0**
75th	**2**
85th	**4**
Max	**8**
Contrast	**-**
Contrast Label	**-**
Exploitation	Low
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

APPENDIX B2. KUSKOKWIM BAY CHUM

Appendix B2.1.–Escapement goal for Kanektok River chum salmon (aerial survey).

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	>5200 (ADF&G 2004)
Escapement Goal Type:	SEG Threshold
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey
Summary:	
Data Quality:	Good
Data Type:	• Nineteen fixed-wing aircraft aerial surveys since 1966, • escapement information from a counting tower 1997, from a weir in 2002 and 2003, • commercial harvest information since 1960, • commercial harvest age class information since 1984, • escapement age class information from 1997, 2002, and 2003.
Contrast:	55.9
Criteria for SEG:	High contrast with at least moderate exploitation
15th percentile:	5,199
Years above SEG threshold:	16 of 19 years above SEG threshold

Comments:

- A SEG threshold was established as chum salmon are not targeted in the District W-4 commercial fishery. Thus, managing within a range is not practical. This goal represents an index, not an estimate of the actual number of spawners. District 4 is an intercept fishery. Commercially harvested salmon are bound for other drainages, such as the Kuskokwim River drainage (Baxter 1970). As a result, commercial harvest information is not exclusive to Kanektok River stocks.

-continued-

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable

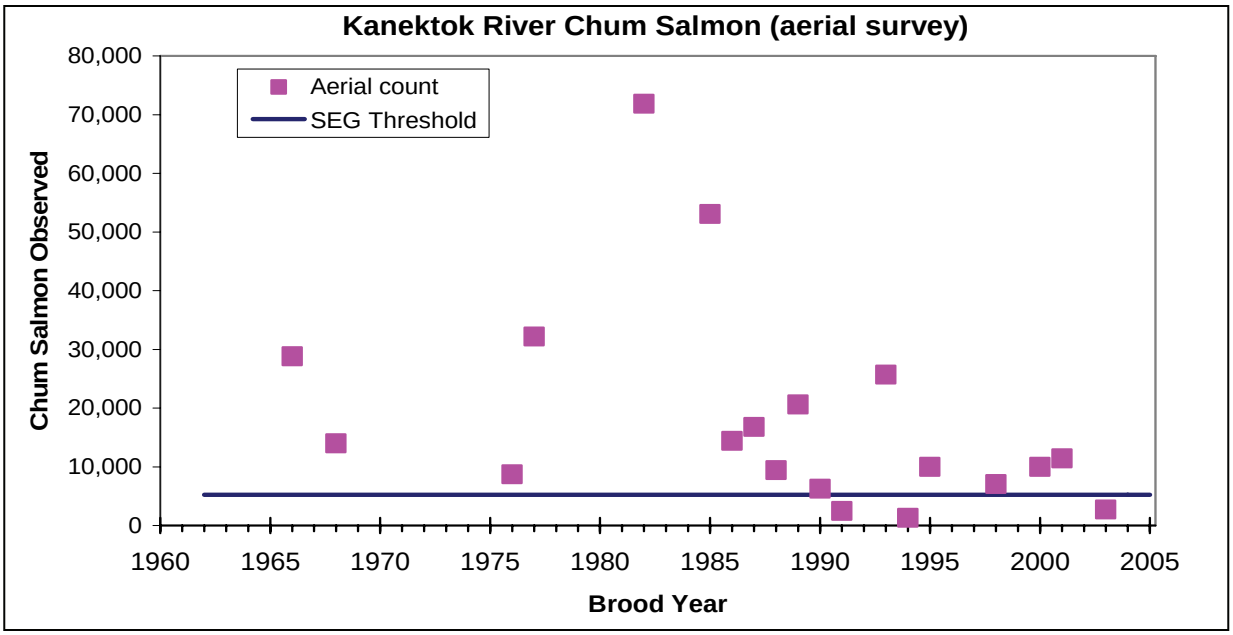
Data available for analysis of escapement goals.

Brood Year	Escapement	
	aerial survey	tower/weir
1962		
1963		
1964		
1965		
1966	28,800	
1967		
1968	14,000	
1969		
1970		
1971		
1972		
1973		
1974		
1975		
1976	8,697	
1977	32,157	
1978		
1979		
1980		
1981		
1982	71,840	
1983		
1984		
1985	53,060	
1986	14,385	
1987	16,790	
1988	9,420	
1989	20,583	
1990	6,270	
1991	2,475	
1992		
1993	25,675	
1994	1,285	
1995	10,000	
1996		
1997		51,180
1998	7,040	
1999		
2000	10,000	
2001	11,440	
2002		42,014
2003	2,700	40,066
2004		46,444
2005		

-continued-

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable

Observed escapement by year and SEG threshold.



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System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**19**
Average	**18,243**
Min	**1,285**
15th	**5,199**
25th	**7,869**
Median	**11,440**
75th	**23,129**
85th	**29,807**
Max	**71,840**
Contrast	**55.9**
Contrast Label	High
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**>5,200**
SEG Upper	**None**

Appendix B2.2.–Escapement goal for Kanektok River Chum salmon (weir count only).

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 2002-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts
Contrast:	1
Criteria for SEG:	low contrast
15th to Maximum:	40,945 to 53,580
Years within recommended SEG:	not applicable

Comments:

- Weir is 42 miles from the mouth of the Kanektok River.
- Substantial spawning occurs below the weir.

-continued-

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable

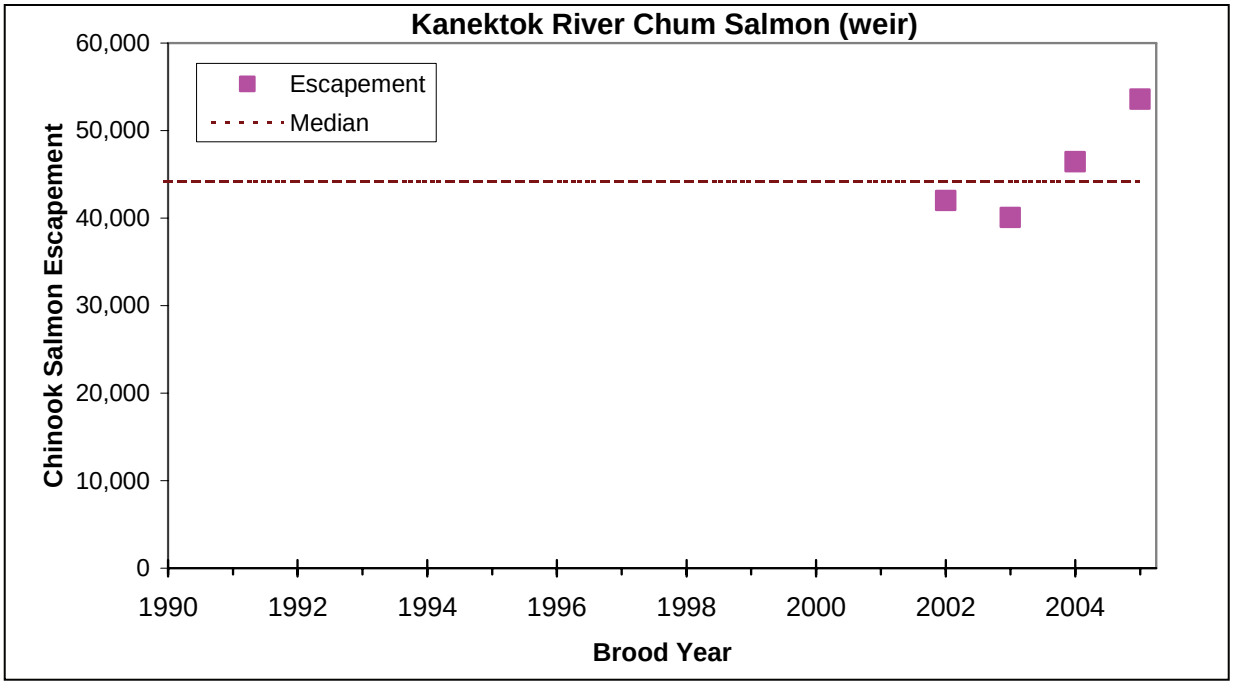
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	
2002	42,014
2003	40,071
2004	46,444
2005	53,580

-continued-

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Kanektok River
Species: Chum salmon
Stock Unit: not applicable

Summary Statistics through:	**2004**
Number of Years	**4**
Average	**45,527**
Min	**40,071**
15th	**40,945**
25th	**41,528**
Median	**44,229**
75th	**48,228**
85th	**50,369**
Max	**53,580**
Contrast	**1**
Contrast Label	Low
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix B2.3.–Escapement goal for Middle Fork Goodnews River chum salmon (weir).

System: Middle Fork Goodnews River
Species: Chum salmon
Stock Unit: not applicable **Map Code: 2**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	>12,000 (ADF&G 2004)
Escapement Goal Type:	SEG Threshold
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower/weir 1981-2005
Summary:	
Data Quality:	Good
Data Type:	• Tower/weir counts since 1981, • commercial harvest information since 1968, • commercial harvest age class information since 1984, • escapement age class information since 1990.
Contrast:	6.3
Criteria for SEG:	Medium contrast
15th percentile:	11,630
Years above recommended SEG:	21 of 25 above SEG threshold

Comments:

- A SEG threshold was established as chum salmon are not targeted in the District W-4 commercial fishery, thus managing within a range is not practical. Commercial harvest and age class information is for the entire drainage. It is not specific for stocks originating in the Middle Fork Goodnews River.

-continued-

System: Middle Fork Goodnews River
Species: Chum salmon
Stock Unit: not applicable

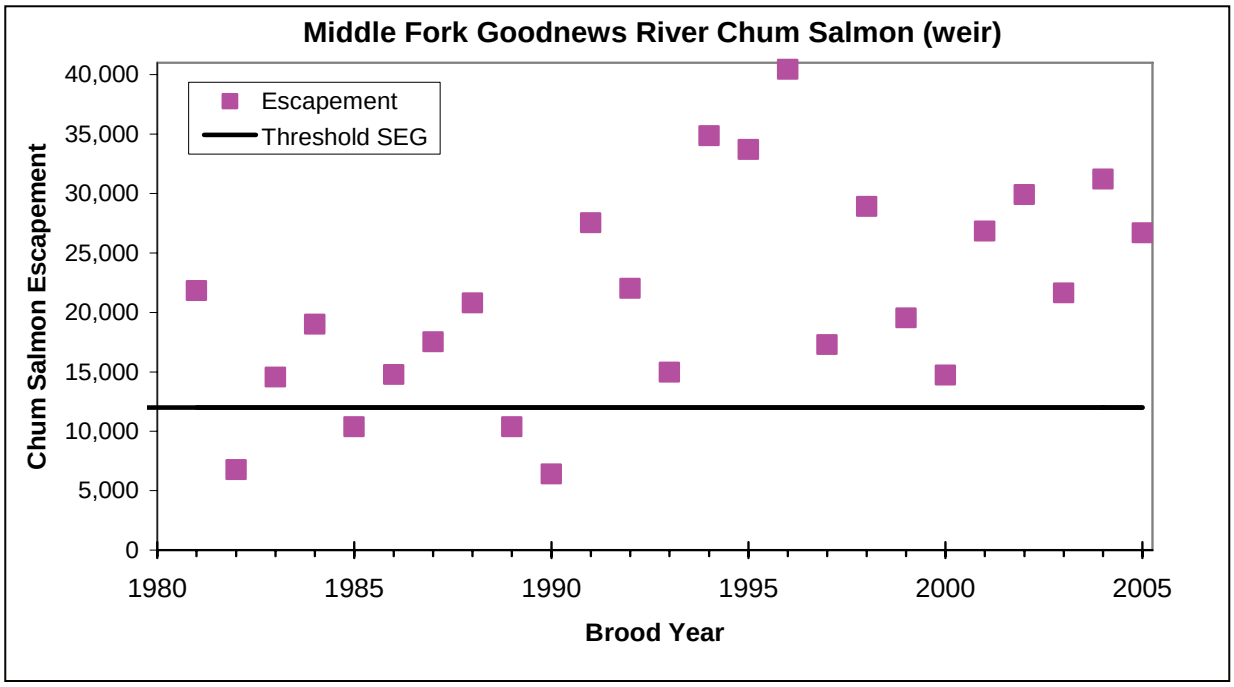
Data available for analysis of escapement goals.

Brood Year	Escapement
1981	21,827
1982	6,767
1983	14,548
1984	19,003
1985	10,367
1986	14,764
1987	17,517
1988	20,799
1989	10,380
1990	6,410
1991	27,525
1992	22,023
1993	14,952
1994	34,849
1995	33,699
1996	40,450
1997	17,296
1998	28,905
1999	19,533
2000	14,720
2001	26,829
2002	29,905
2003	21,637
2004	31,218
2005	26,690

-continued-

System: Middle Fork Goodnews River
Species: Chum salmon
Stock Unit: not applicable

Observed escapement by year and SEG threshold.



-continued-

System: Middle Fork Goodnews River
Species: Chum salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**23**
Average	**20,639**
Min	**6,410**
15th	**11,630**
25th	**14,742**
Median	**19,533**
75th	**27,177**
85th	**29,605**
Max	**40,450**
Contrast	**6.3**
Contrast Label	Medium
Exploitation	Moderate
From ADF&G (2004):	
SEG Lower	**>12,000**
SEG Upper	**None**

APPENDIX B3. KUSKOKWIM BAY COHO

Appendix B3.1.–Escapement goal for Kanektok River coho salmon (aerial survey).

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	7,700 to 36,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	Discontinue due to early timing of surveys
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality: Poor; surveys occurred too early in the run.

Data Type:
- Seven fixed-wing aircraft aerial surveys since 1981,
- weir escapement information from 2001, 2002, and 2003,
- commercial harvest information since 1960,
- commercial harvest age class information since 1990,
- escapement age class information from 1997, 2001, 2002, and 2003.

Comments:
- This goal represents an index, not an estimate of the actual number of spawners.
- District 4 is an intercept fishery, so salmon harvested in the District are bound for other drainages such as the Kuskokwim River drainage (Baxter 1970). As a result, commercial harvest information is not exclusive to Kanektok River Stocks.
- A weir was established at river mile 42 of the Kanektok River in 2000, and the project has periodically been operated through mid-September to early October to enumerate coho salmon. The mid-point of the coho has typically been late August to early September. In contrast, the aerial surveys on which the current escapement goal is based usually occur 6 and 26 August when the cumulative daily passage was observed to be less than 43 percent at the weir. Consequently, it is recommended that the current escapement goal be discontinued.
- The current escapement goal is based on an inconsistent mix of annual observations that include 1 to 4 of the Survey Areas, which negatively effect applicability of the goal.
- The data presented here have been thoroughly reviewed and are the most accurate representation of actual survey timing and totals.

-continued-

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

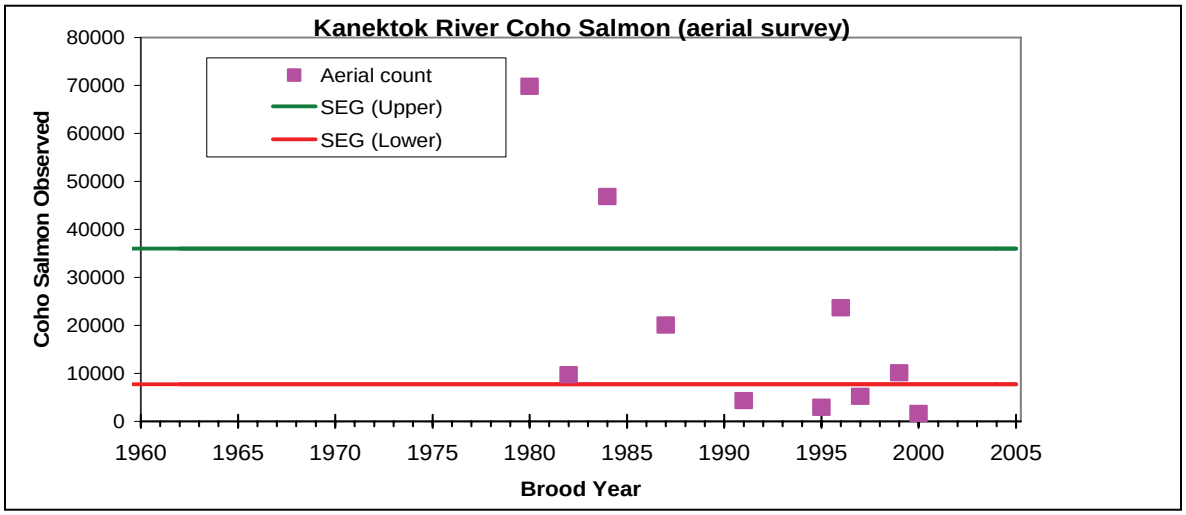
Brood Year	Survey Areas				Index Area Total	Rating	Date of Survey
	101	102	103	104			
1962							
1963							
1964							
1965							
1966							
1967							
1968							
1969							
1970							
1971							
1972							
1973							
1974							
1975							
1976							
1977							
1978							
1979							
1980	67,831	1,284	200	500	69,815	2	22-Aug
1981							
1982	8,990	710			9,700	2	6-Aug
1983							
1984	42,030	4,800			46,830	3	26-Aug
1985							
1986							
1987	18,060	1,790	206	0	20,056	1	20-Aug
1988							
1989							
1990							
1991	4,330	0	0		4,330	2	14-Aug
1992							
1993							
1994							
1995	2,900				2,900	2	18-Aug
1996	15,411	5,210	2,885	150	23,656	2	11-Sep
1997	321	3,768	803	300	5,192	1	1-Oct
1998							
1999	9,010	1,015	95		10,120	2	24-Aug
2000	700	925			1,625	3	22-Aug
2001							
2002							
2003							
2004							
2005							

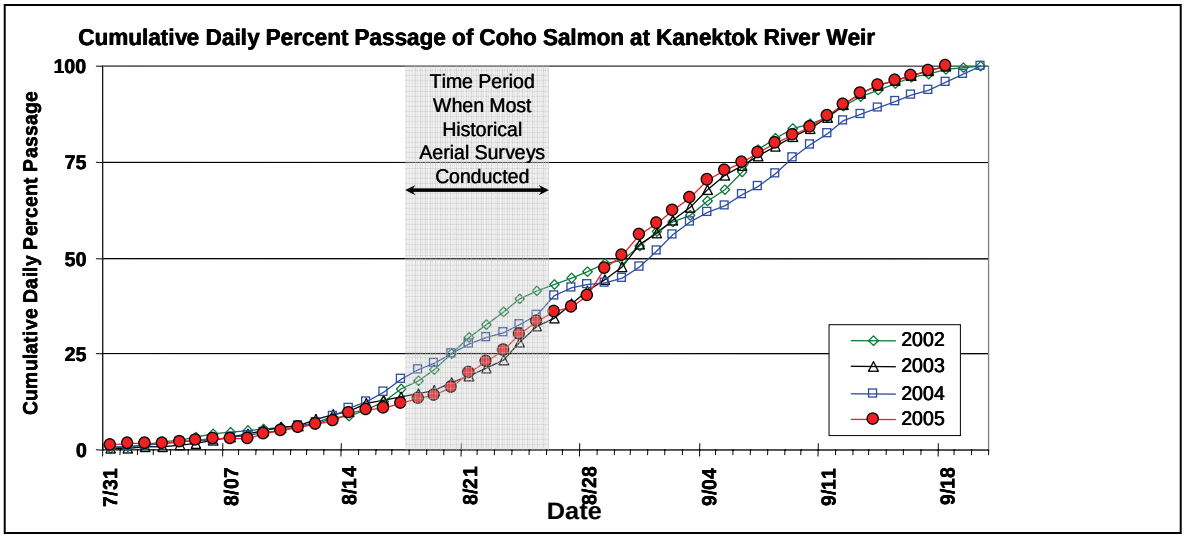
Shaded years were not used when calculating SEG

-continued-

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).





-continued-

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**10**
Average	**16,958**
Min	**321**
15th	**1,470**
25th	**3,258**
Median	**9,000**
75th	**17,398**
85th	**33,641**
Max	**67,831**
Contrast	**211.3**
Contrast Label	High
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**7,700**
SEG Upper	**36,000**

Appendix B3.2.–Escapement goal for Kanektok River coho salmon (weir count only).

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 2001-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts
Contrast:	4
Criteria for SEG:	Medium contrast
15th to 85th Percentile:	25,759 to 78,600
Years within recommended SEG:	not applicable

Comments:

- Weir is 42 miles from the mouth of the Kanektok River.
- Substantial spawning occurrs below the weir.

-continued-

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable

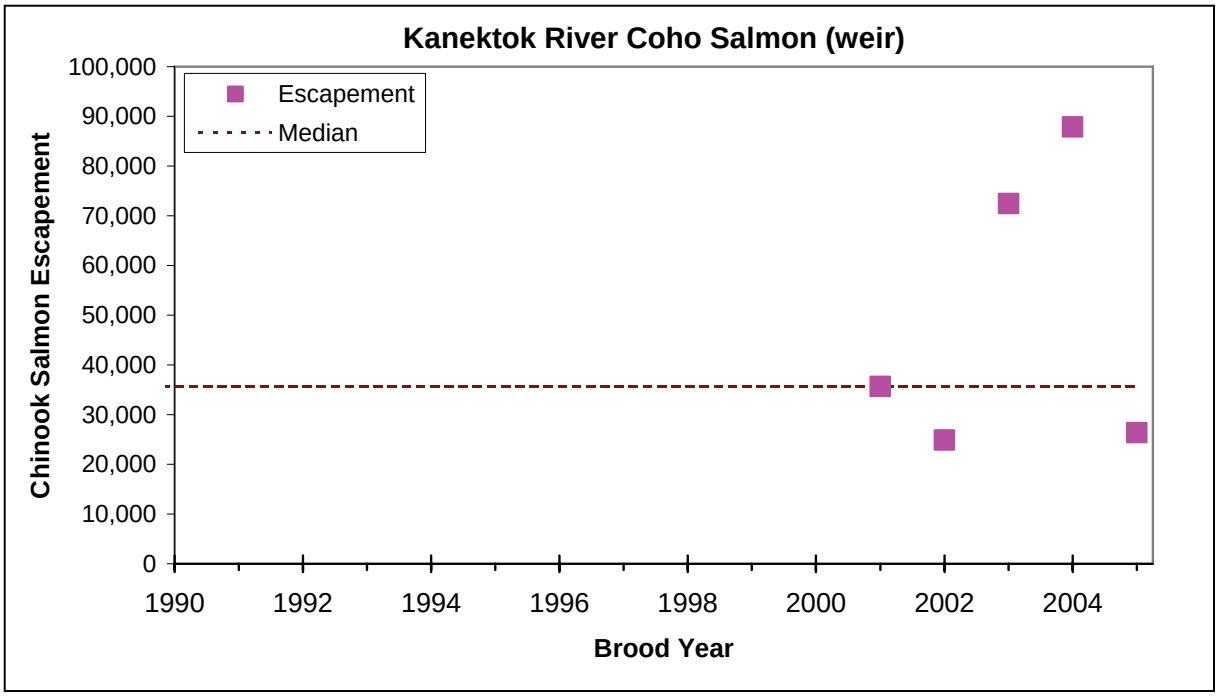
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	35,677
2002	24,883
2003	72,448
2004	87,828
2005	26,343

-continued-

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Kanektok River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2,004**
Number of Years	**5**
Average	**49,436**
Min	**24,883**
15th	**25,759**
25th	**26,343**
Median	**35,677**
75th	**72,448**
85th	**78,600**
Max	**87,828**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

-continued-

Appendix B3.3.–Escapement goal for Middle Fork Goodnews River coho salmon (weir).

System: Middle Fork Goodnews River
Species: Coho salmon
Stock Unit: not applicable **Map Code: 2**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	>12,000 (ADF&G 2004)
Escapement Goal Type:	SEG Threshold
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 1997-2005
Summary:	
Data Quality:	Good
Data Type:	• Seven years of weir counts, • commercial harvest information since 1968, • commercial harvest age class information since 1990, • escapement age class information since 1997.
Contrast:	5.5
Criteria for SEG:	Medium
15th percentile	11,352
Years above recommended SEG:	7 of 9 above SEG threshold

Comments:

- The District W-5 commercial fishery typically finishes before the mid-point of the coho salmon run at the weir. Thus, managing for a range is not practical. With limited data, the threshold serves as lower bound until there is enough information to develop a range (next review in 2010).

-continued-

System: Middle Fork Goodnews River
Species: Coho salmon
Stock Unit: not applicable

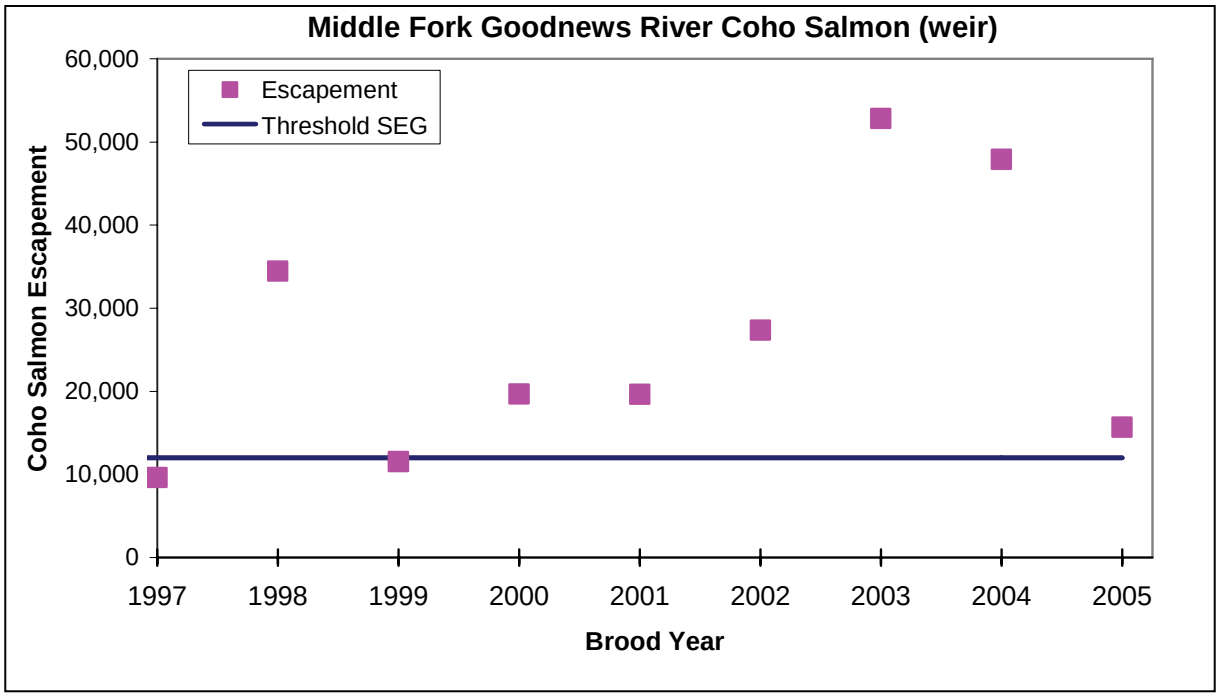
Data available for analysis of escapement goals.

Brood Year	Escapement
1981	
1982	
1983	
1984	
1985	
1986	
1987	
1988	
1989	
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	9,611
1998	34,441
1999	11,545
2000	19,676
2001	19,626
2002	27,364
2003	52,810
2004	47,916
2005	15,683

-continued-

System: Middle Fork Goodnews River
Species: Coho salmon
Stock Unit: not applicable

Observed escapement by year and SEG threshold.



-continued-

System: Middle Fork Goodnews River
Species: Coho salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**7**
Average	**25,010**
Min	**9,611**
15th	**11,352**
25th	**15,586**
Median	**19,676**
75th	**30,903**
85th	**36,278**
Max	**52,810**
Contrast	**5.5**
Contrast Label	Medium
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**>12,000**
SEG Upper	**None**

APPENDIX B4. KUSKOKWIM BAY SOCKEYE

Appendix B4.1.–Esacpement goal for Arolik River sockeye salmon (aerial survey).

System: Arolik River
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 3**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey

Summary:

Data Quality:	Fair
Data Type:	Peak aerial survey count with fixed winged aircraft; abundance index
Contrast:	27
Criteria for SEG:	High contrast with at least moderate exploitation
25th to 75th Percentile:	3,182 to 21,205
Years within recommended SEG:	not applicable

Comments:

- Criteria for inclusion of aerial survey data points:
  1) Surveyor Rating of 1 or 2 (Fair to Good)
  2) Surveys must have been flown between July 17 and August 5 (inclusive)
  3) Must include Survey Areas 101, 102, 103 and 104.
  4) Counts include carcasses

-continued-

System: Arolik River
Species: Sockeye salmon
Stock Unit: not applicable

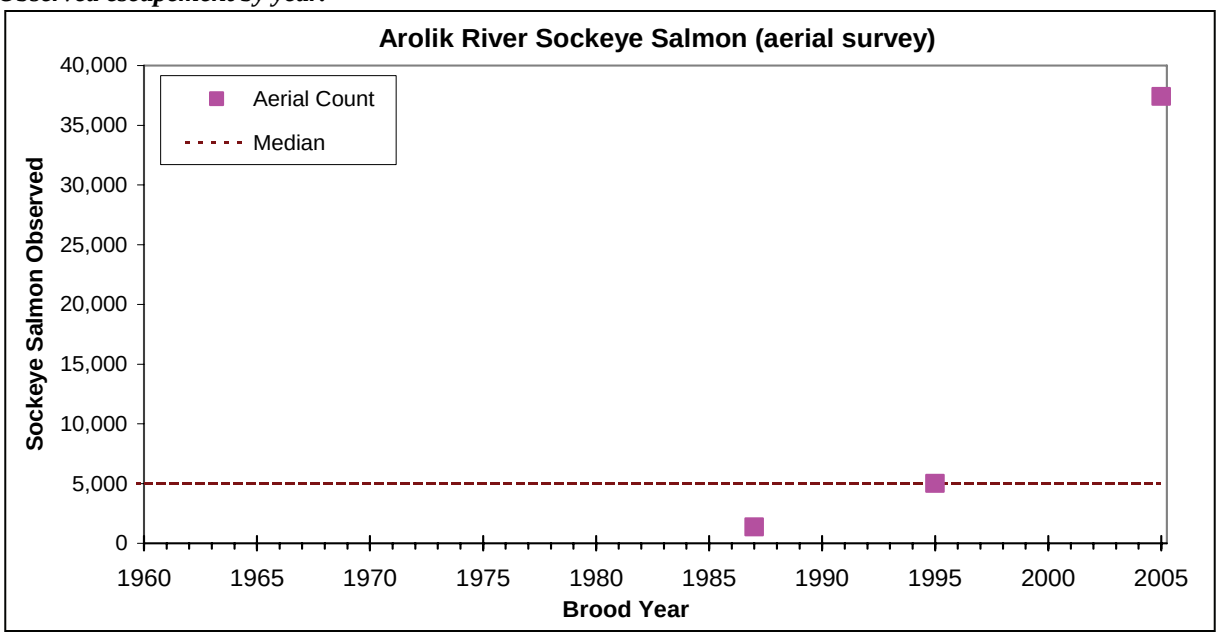
Data available for analysis of escapement goals.

Brood	Survey Areas				Index Area	Rating	Date of	Comments
Year	101	102	103	104	Total		Survey	
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969								
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977	2,456		1,982	342		2	21-Jul	
1978								
1979								
1980								
1981	5,110					2	24-Jul	
1982								
1983								
1984								
1985								
1986								
1987	1,363	0	0	0	1,363	2	27-Jul	
1988								
1989								
1990								
1991								
1992								
1993								
1994	150	3,070	140			1	6-Aug	
1995	4,320	0	400	280	5,000	1	22-Jul	
1996		2,000	220	80		2	23-Jul	
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005	12,145	22,570	1,920	775	37,410	2	1-Aug	

-continued-

System: Arolik River
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Arolik River
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2005**
Number of Years	**3**
Average	**14,591**
Min	**1,363**
15th	**2,454**
25th	**3,182**
Median	**5,000**
75th	**21,205**
85th	**27,687**
Max	**37,410**
Contrast	**27**
Contrast Label	High
Exploitation	Mod. to High
Current Minimum Goal	**None**

Appendix B4.2.–Escapement goal for Goodnews River (north fork) sockeye salmon (aerial survey).

System: Goodnews River (north fork)
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 25**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	5,500 to 19,500 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey
Summary:	
Data Quality:	Fair
Data Type:	• Sixteen fixed-wing aircraft aerial surveys since 1980, • commercial harvest information since 1968, • commercial harvest age class information since 1990.
Contrast:	28.8
Criteria for SEG:	High contrast with at least moderate exploitation
25th - 75th percentile:	5,266 to 19,317
Years within recommended SEG:	8 of 17 years within SEG range, 4 years below and 5 years above

Comments:

- This goal represents an index, not an estimate of the actual number of spawners. Commercial harvest and age class information is for the entire drainage. It is not specific for stocks originating in the Goodnews River.

-continued-

System: Goodnews River (north fork)
Species: Sockeye salmon
Stock Unit: not applicable

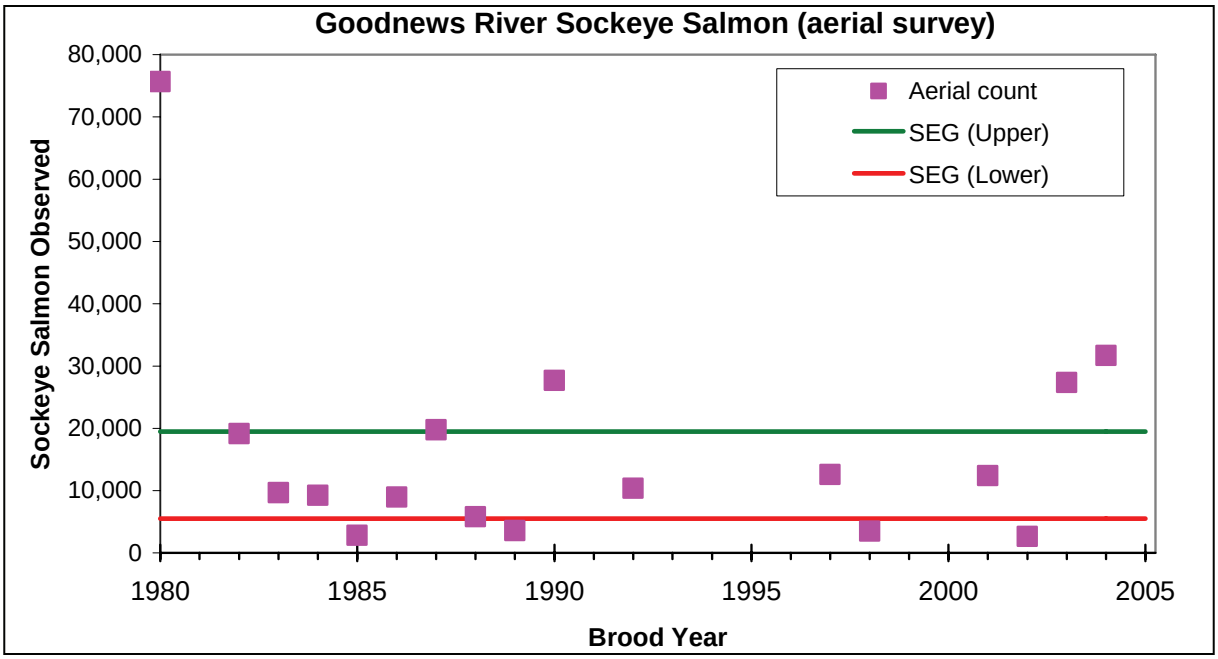
Data available for analysis of escapement goals.

Brood Year	aerial survey
1980	75,639
1981	
1982	19,160
1983	9,650
1984	9,240
1985	2,843
1986	8,960
1987	19,786
1988	5,820
1989	3,605
1990	27,689
1991	
1992	10,397
1993	
1994	
1995	
1996	
1997	12,610
1998	3,497
1999	
2000	
2001	12,383
2002	2,626
2003	27,380
2004	31,695
2005	

-continued-

System: Goodnews River (north fork)
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Goodnews River (north fork)
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**16**
Average	**15,705**
Min	**2,626**
15th	**3,524**
25th	**5,266**
Median	**10,024**
75th	**19,317**
85th	**25,482**
Max	**75,639**
Contrast	**28.8**
Contrast Label	High
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**5,500**
SEG Upper	**19,500**

Appendix B4.3.–Escapement goal for Kanektok River sockeye salmon (aerial survey)**.**

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	14,000 to 34,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	No Revision
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Peak aerial survey
Summary:	
Data Quality:	Good
Data Type:	• Twenty-four fixed-wing aircraft aerial surveys since 1966, • escapement information from a counting tower 1997, from a weir in 2002 and 2003, • commercial harvest information since 1960, • commercial harvest age class information since 1990, • escapement age class information from 1997, 2002, and 2003.
Contrast:	23.9
Criteria for SEG:	High contrast with at least moderate exploitation
25th - 75th percentile:	13,969 - 33,714
Years within recommended SEG:	12 of 24 years within SEG range, 6 years below and 8 years above

Comments:

- This goal represents an index, not an estimate of the actual number of spawners. District 4 is an intercept fishery. Commercially harvested salmon are bound for other drainages, such as the Kuskokwim River drainage (Baxter 1970). As a result, commercial harvest information is not exclusive to Kanektok River Stocks.

-continued-

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable

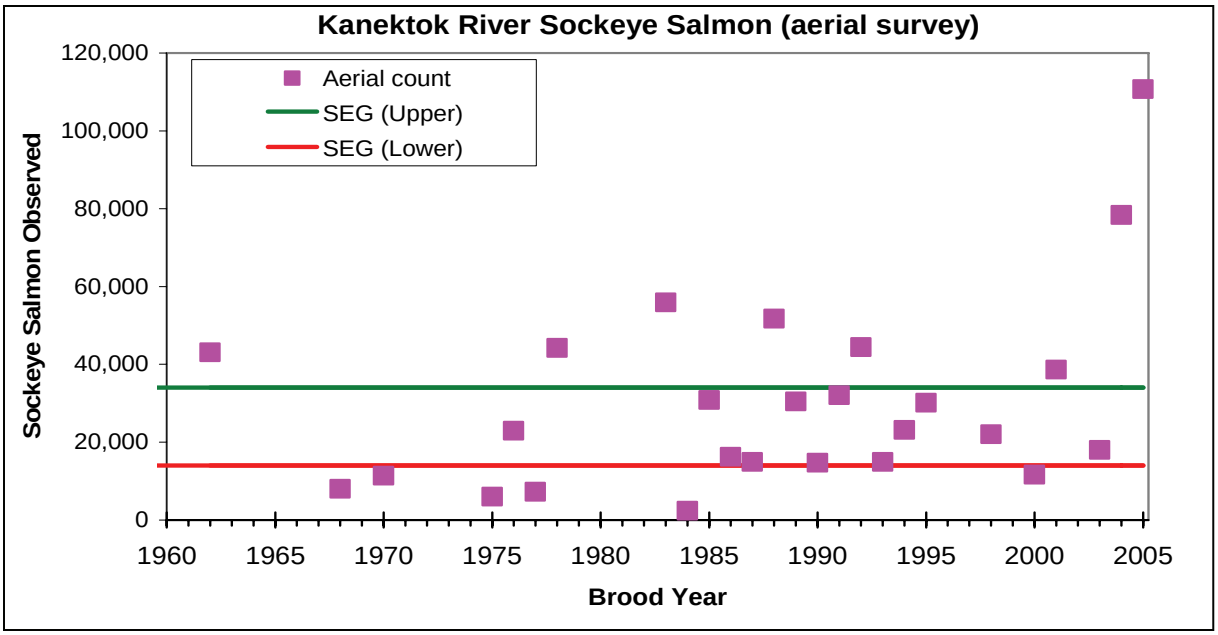
Data available for analysis of escapement goals.

Brood Year	Escapement	
	aerial survey	tower/weir
1962	43,108	
1963		
1964		
1965		
1966		
1967		
1968	8,000	
1969		
1970	11,375	
1971		
1972		
1973		
1974		
1975	6,018	
1976	22,936	
1977	7,244	
1978	44,215	
1979		
1980		
1981		
1982		
1983	55,940	
1984	2,340	
1985	30,840	
1986	16,270	
1987	14,940	
1988	51,753	
1989	30,440	
1990	14,735	
1991	32,082	
1992	44,436	
1993	14,955	
1994	23,128	
1995	30,090	
1996		
1997		96,348
1998	22,020	
1999		
2000	11,670	
2001	38,610	
2002		58,367
2003	18,010	127,471
2004	78,380	102,443
2005	110,730	

-continued-

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year and SEG range (solid line).



-continued-

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**24**
Average	**24,798**
Min	**2,340**
15th	**9,519**
25th	**13,969**
Median	**22,478**
75th	**33,714**
85th	**43,717**
Max	**55,940**
Contrast	**23.9**
Contrast Label	High
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**14,000**
SEG Upper	**34,000**

Appendix B4.4.–Escapement goal for Kanektok River sockeye salmon (weir count only)**.**

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 4**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	none
Escapement Goal Type:	not applicable
Recommended Escapement Goal:	none
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Weir 2001-2005

Summary:

Data Quality:	Fair
Data Type:	Weir counts
Contrast:	4
Criteria for SEG:	Medium contrast
15th to Maximum:	78,392 to 190,576
Years within recommended SEG:	not applicable

Comments:

- Weir is 42 miles from the mouth of the Kanektok River.
- Substantial spawning occurs below the weir.

-continued-

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable

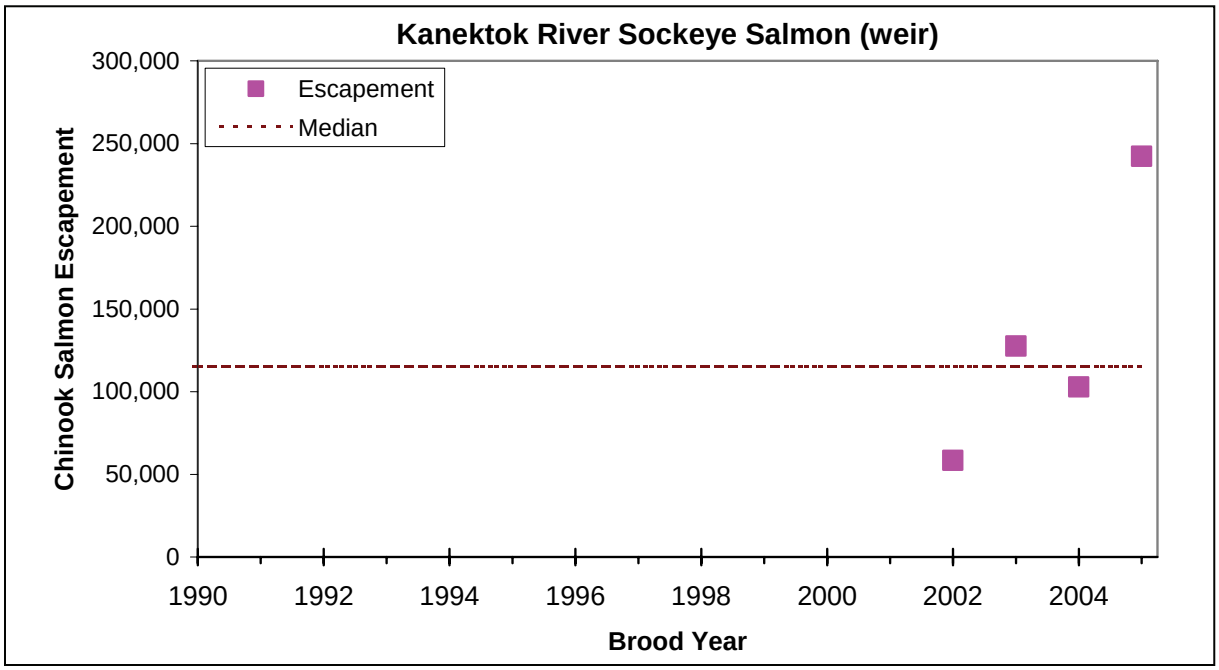
Data available for analysis of escapement goals.

Brood Year	Escapement
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	
2002	58,367
2003	127,471
2004	102,867
2005	242,208

-continued-

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year.



-continued-

System: Kanektok River
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2,005**
Number of Years	**4**
Average	**132,728**
Min	**58,367**
15th	**78,392**
25th	**91,742**
Median	**115,169**
75th	**156,155**
85th	**190,576**
Max	**242,208**
Contrast	**4**
Contrast Label	Medium
Exploitation	Moderate
Current Minimum Goal	**None**
Suggested SEG Lower	**None**
Suggested SEG Upper	**None**

Appendix B4.5.–Escapement goal for Middle Fork Goodnews River sockeye salmon (spawner-recruit).

System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 2**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	23,000 to 58,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	BEG Range of 18,000 to 40,000
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower/weir 1981-2005
Summary:	
Data Quality:	Good
Data Type:	Tower/weir counts, aerial surveys, harvest, escapement ASL, commercial ASL
Contrast:	3.7
Criteria for BEG:	90% Credible Bounds for Smsy 17,170 to 39,180 Smsy range for 90% MSY: 14,452 to 30,933 Smsy: 21,890 for spawner-recruit model Low contrast with at least moderate exploitation
Years within recommended BEG:	12 of 24 years within BEG range, 1 below and 11 above.

Comments:

- Drainage-wide escapement is estimated by expanding aerial survey counts from the Goodnews River (north fork) added to Middle Fork tower or weir counts. The expansion factor is calculated as the Middle Fork tower/weir count divided by Middle Fork aerial survey counts above the weir (Linderman 2005b).
- The expansion factor varies from year to year.
- Aerial surveys have not been consistently flown over all drainages and years.
- Commercial and escapement ASL data have missing years and years with small sample sizes.
- South Fork Goodnews River is excluded from analysis as its contribution to overall escapement is considered to be negligible.

-continued-

System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

	Goodnews R. Escapement		Harvest				Total Goodnews	Annual
Brood Year	Middle Fork	North Fork	Subsistence	Commercial	Sport	Middle Fork[a]	R. Run	Exploitation
1981	49,108	100,029	3,511	40,273		14,417	192,921	0.23
1982	56,255	114,587	2,754	38,877		13,708	212,473	0.20
1983	25,813	69,955	1,518	11,716	14	3,571	109,016	0.12
1984	32,053	67,213	964	15,474		5,308	115,704	0.14
1985	24,131	50,481	704	6,698	75	2,418	82,089	0.09
1986	51,069	93,228	942	25,112	122	9,264	170,473	0.15
1987	28,871	51,989	955	27,758	266	10,347	109,839	0.26
1988	15,799	38,319	1065	36,368		10,928	91,551	0.41
1989	21,186	35,476	869	19,299	146	7,595	76,976	0.26
1990	31,679	64,528	905	35,823		12,094	132,935	0.28
1991	47,397	96,544	900	39,838	163	13,468	184,842	0.22
1992	27,268	52,501	905	39,194		13,707	119,868	0.33
1993	26,452	54,325	572	59,293	69	19,627	140,711	0.43
1994	55,751	115,405	652	69,490	80	22,874	241,378	0.29
1995	39,009	80,749	787	37,351	53	12,440	157,949	0.24
1996	58,264	120,606	763	30,717	143	10,301	210,493	0.15
1997	35,530	23,462	609	31,451	142	19,395	91,194	0.35
1998	47,951	14,693	508	27,161	672	21,694	90,985	0.31
1999	48,205	99,727	872	22,910	661	7,965	172,375	0.14
2000	42,197	73,845	1,028	37,252	132	13,968	154,454	0.25
2001	22,495	137,364	914	25,654	164	3,762	186,591	0.14
2002	21,127	31,476	1,050	6,304	149	3,013	60,106	0.12
2003	44,387	55,877	672	29,423	0	13,323	130,359	0.23
2004	55,926	52,646	960	20,922		11,272	130,454	0.17
Average								0.23

[a] Represents total harvest estimated to be of Middle Fork origin

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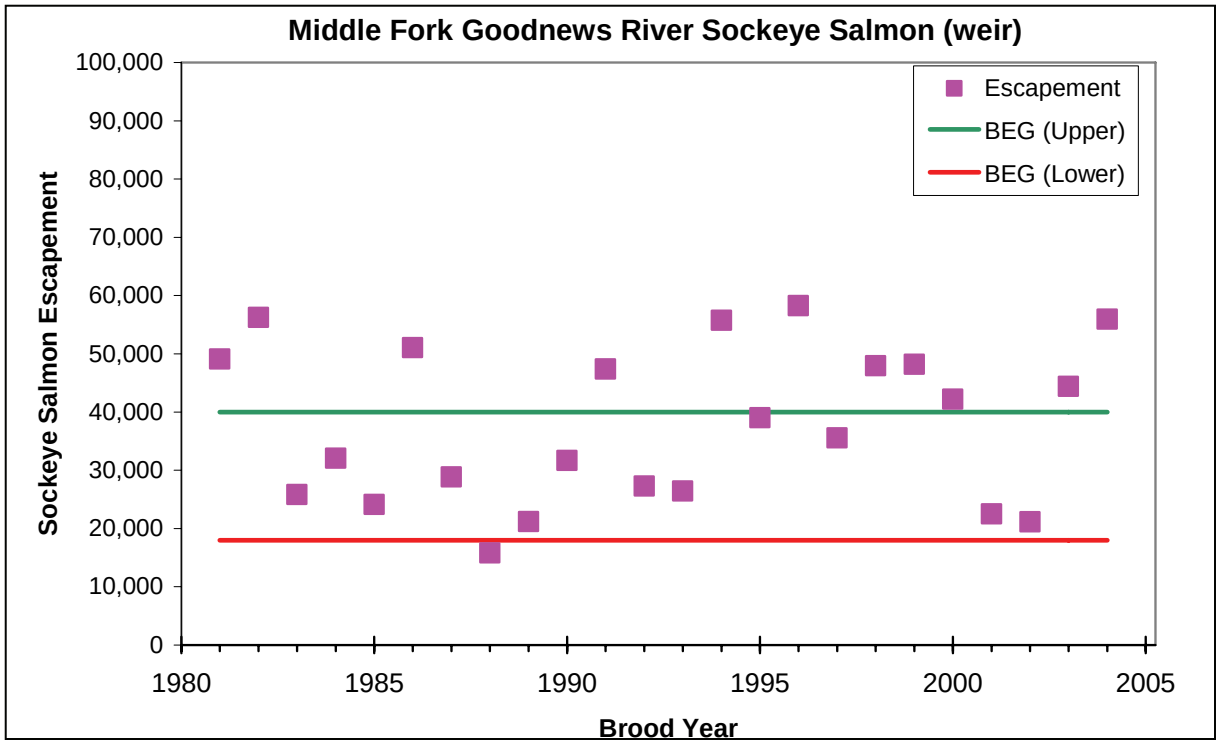
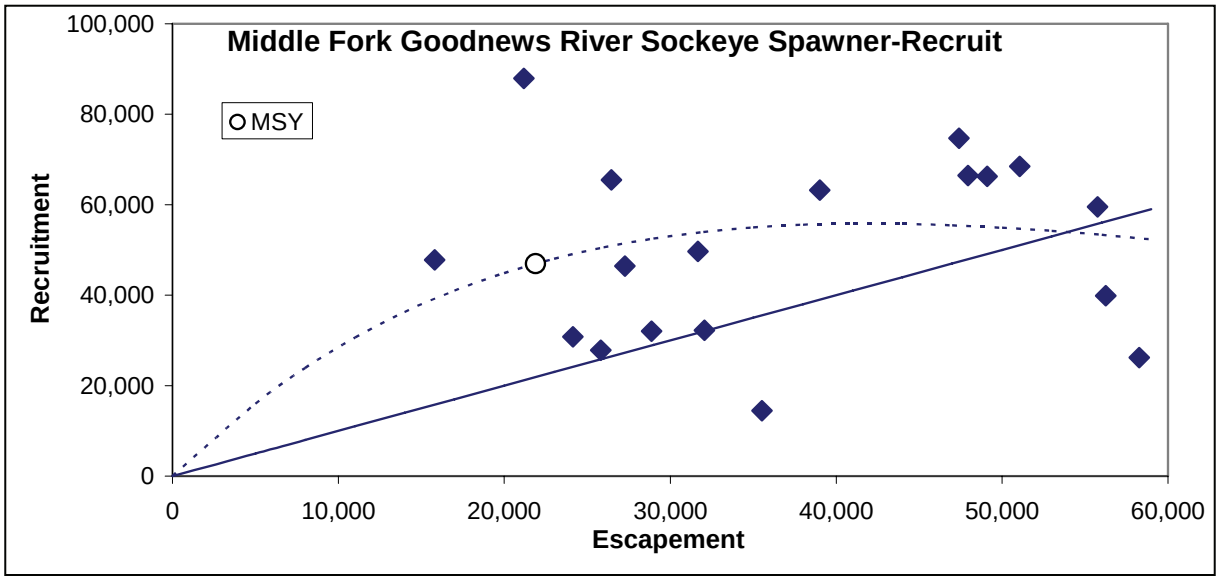
System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year and suggested BEG range (solid line).





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System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Brood Table for Middle Fork Goodnews River Sockeye Salmon. Only highlighted data were used in spawner-recruit analysis.

		Number by Age in Total Return					Total	Return/
Year	Escapement	3	4	5	6	7	Return	Spawner
1981	49,108	53	8,218	56,829	1,155	11	66,266	1.3
1982	56,255	40	3,513	35,347	964	0	39,864	0.7
1983	25,813	0	2,716	23,166	1,937	0	27,819	1.1
1984	32,053	0	2,574	25,279	4,362	0	32,214	1.0
1985	24,131	11	1,587	26,587	2,482	113	30,780	1.3
1986	51,069	0	12,287	52,720	3,307	141	68,454	1.3
1987	28,871	539	5,400	22,563	3,537	29	32,068	1.1
1988	15,799	256	13,792	28,262	5,459	0	47,769	3.0
1989	21,186	1,204	13,824	68,742	4,133	19	87,921	4.1
1990	31,679	318	4,396	40,874	3,804	258	49,650	1.6
1991	47,397	0	6,445	60,204	8,010	65	74,724	1.6
1992	27,268	0	4,487	35,387	6,423	145	46,442	1.7
1993	26,452	42	11,085	50,372	4,011	0	65,510	2.5
1994	55,751	149	12,808	44,275	2,331	0	59,562	1.1
1995	39,009	0	7,747	51,254	4,162	72	63,237	1.6
1996	58,264	0	2,594	21,348	2,281	0	26,222	0.5
1997	35,530	0	773	9,483	4,174	0	14,430	0.4
1998	47,951	0	12,289	48,542	5,612	0	66,443	1.4
1999	48,205	0	5,007	40,651	0	0	45,658	
2000	42,197	0	20,946	0	0	0	20,946	
2001	22,495	0	0	0	0	0	0	
2002	21,127	0	0	0	0	0	0	
2003	44,387	0	0	0	0	0	0	
2004	55,926	0	0	0	0	0	0	
Average								1.5

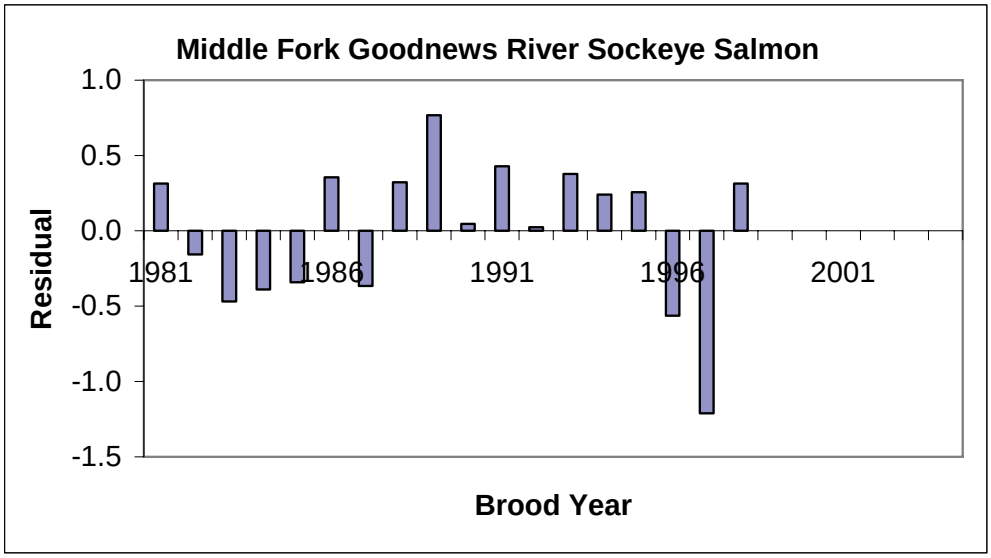
-continued-

System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Parameter estimates and other statistics from a Ricker spawner-recruit model for Middle Fork Goodnews River Sockeye Salmon

Statistic	Estimate	SE
α	3.612 [a]	
ln(α')	1.157 [b]	0.0079
β	2.38E-05	1.99E-07
σ^2	0.25462	
S_{msy}	21,890	
90% Credible bound for S_{msy}	17,170; 39,180	
R_{msy}	46,963	
MSY	25,073	
S_{msy} *range for 90% MSY*	14,452; 30,933	
$S_{replacenent}$	53,963	
Contrast	3.7	
Durbin-Watson	1.63	

[a] Adusted per Hilborn (1985) to account for log transformation of spawner-recruit data.
[b] Represents the estimate from the Bayesian fit model.



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System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2004**
Number of Years	**24**
Average	**37,830**
Min	**15,799**
15th	**23,231**
25th	**26,292**
Median	**37,270**
75th	**48,431**
85th	**53,644**
Max	**58,264**
Contrast	**3.7**
Contrast Label	Low
Exploitation	Moderate
Current (ADF&G 2004):	
SEG Lower	**23,000**
SEG Upper	**58,000**
Suggested BEG (Lower)	**18,000**
Suggested BEG (Upper)	**40,000**

Appendix B4.6.–Escapement goal for Middle Fork Goodnews River sockeye salmon (weir).

System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable **Map Code: 2**

Description of stock and escapement goals.

Regulatory Area:	Kuskokwim Area
Management Division:	Commercial Fisheries
Primary Fishery:	Commercial and subsistence
Previous Escapement Goal:	23,000 to 58,000 (ADF&G 2004)
Escapement Goal Type:	SEG
Recommended Escapement Goal:	BEG 18,000-40,000 (see Appendix B4.5)
Optimal Escapement Goal:	none
Inriver Goal:	none
Action Points:	none
Escapement Enumeration:	Tower/weir 1981-2005
Summary:	
Data Quality:	Good
Data Type:	• Tower/weir counts since 1981, • commercial harvest information since 1968, • commercial harvest age class information since 1981, • escapement age class information since 1984.
Contrast:	3.7
Criteria for SEG:	90% Credible Bounds for Smsy 17,170 to 39,180 Smsy range for 90% MSY: 14,452 to 30,933 Smsy: 21,890 for spawner-recruit model Low contrast with at least moderate exploitation
Years within recommended BEG:	12 of 25 years within SEG range, 1 year below and 12 years above

Comments:

- Commercial harvest and age class information represents the entire drainage. It is not specific for stocks originating in the Middle Fork Goodnews River.

-continued-

System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Data available for analysis of escapement goals.

Brood Year	Escapement
1981	49,108
1982	56,255
1983	25,813
1984	32,053
1985	24,131
1986	51,069
1987	28,871
1988	15,799
1989	21,186
1990	31,679
1991	47,397
1992	27,268
1993	26,452
1994	55,751
1995	39,009
1996	58,264
1997	35,530
1998	47,951
1999	48,205
2000	42,197
2001	22,495
2002	22,000
2003	44,387
2004	56,466
2005	113,809

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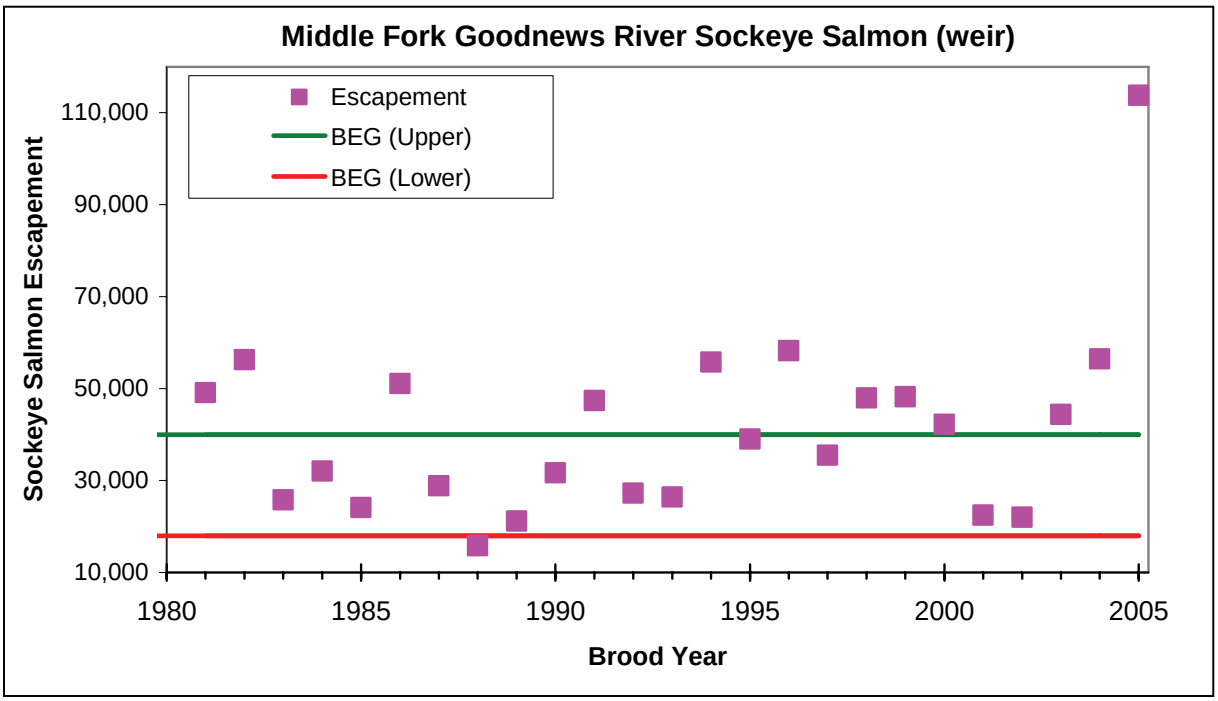
System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Observed escapement by year and suggested BEG range.



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System: Middle Fork Goodnews River
Species: Sockeye salmon
Stock Unit: not applicable

Summary Statistics through:	**2003**
Number of Years	**23**
Average	**37,081**
Min	**15,799**
15th	**22,986**
25th	**26,133**
Median	**35,530**
75th	**48,078**
85th	**50,481**
Max	**58,264**
Contrast	**3.7**
Contrast Label	Low
Exploitation	Moderate
From ADF&G (2004)	
SEG Lower	**23,000**
SEG Upper	**58,000**
Suggested BEG (Lower)	**18,000**
Suggested BEG (Upper)	**40,000**

APPENDIX C. SUPPLEMENTAL INFORMATION

Appendix C1.–Historical utilization of Chinook, chum, coho, and sockeye salmon in the Kuskokwim River.

	Chinook Salmon			Chum Salmon			Coho Salmon			Sockeye Salmon		
Year	Commercial Harvest[a]	Subsistence Harvest[b]	Total Utilization	Commercial Harvestd	Subsistence Harvest[b]	Total Utilization	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest[a]	Subsistence Harvest[b]	Total Utilization
1960	5,969	18,887	24,856	0	301,753 [e]	301,753	2,498					
1961	18,918	28,934	47,852	0	179,529 [e]	179,529	5,044					
1962	15,341	13,582	28,923	0	161,849 [e]	161,849	12,432					
1963	12,016	34,482	46,498	0	137,649 [e]	137,649	15,660					
1964	17,149	29,017	46,166	0	190,191 [e]	190,191	28,613					
1965	21,989	24,697	46,686	0	250,878 [e]	250,878	12,191					
1966	25,545	49,325	74,870	0	175,735 [e]	175,735	22,985					
1967	29,986	59,913	89,899	148	208,445 [e]	208,593	56,313					
1968	34,278	32,942	67,220	187	275,008 [e]	275,195	127,306					
1969	43,997	40,617	84,614	7,165	204,105 [e]	211,270	83,765			322		
1970	39,290	69,612	108,902	1,664	246,810 [e]	248,474	38,601			117		
1971	40,274	43,242	83,516	68,914	116,391 [e]	185,305	5,253			2,606		
1972	39,454	40,396	79,850	78,619	120,316 [e]	198,935	22,579			102		
1973	32,838	39,093	71,931	148,746	179,259 [e]	328,005	130,876			369		
1974	18,664	27,139	45,803	171,887	277,170 [e]	449,057	147,269			136		
1975	22,135	48,448	70,583	184,171	176,389 [e]	360,560	81,945			23		
1976	30,735	58,606	89,341	177,864	223,792 [e]	401,656	88,501			2,971		
1977	35,830	56,580	92,410	248,721	198,355 [e]	447,076	241,364			9,379		
1978	45,641	36,270	81,911	248,656	118,809 [e]	367,465	213,393			733		
1979	38,966	56,283	95,249	261,874	161,239 [e]	423,113	219,060			1,054		
1980	35,881	59,892	95,773	483,751	165,172 [e]	648,923	222,012			360		
1981	47,663	61,329	108,992	418,677	157,306 [e]	575,983	211,251			48,375		
1982	48,234	58,018	106,252	278,306	190,011 [e]	468,317	447,117			33,154		
1983	33,174	47,412	80,586	276,698	146,876 [e]	423,574	196,287			68,855		
1984	31,742	56,930	88,672	423,718	142,542 [e]	566,260	623,447			48,575		
1985	37,889	43,874	81,763	199,478	94,750	294,228	335,606			106,647		
1986	19,414	51,019	70,433	309,213	141,931 [e]	451,144	659,988			95,433		
1987	36,179	67,325	103,504	574,336	70,709	645,045	399,467			136,602		
1988	55,716	70,943 [c]	126,659	1,381,674	151,967 [c]	1,533,641	524,296			92,025		
1989	43,217	81,175	124,392	749,182	139,672	888,854	479,856	52,918	532,774	42,747	35,224	77,971
1990	53,504	85,976	139,480	461,624	126,509	588,133	410,332	44,791	455,123	84,870	36,276	121,146
1991	37,778	85,556	123,334	431,802	93,077	524,879	500,935	50,331	551,266	108,946	52,984	161,930
1992	46,872	64,794	111,666	344,603	96,491	441,094	666,170	40,168	706,338	92,218	32,066	124,284
1993	8,735	87,513	96,248	43,337	59,394	102,731	610,739	31,737	642,476	27,008	49,347	76,355
1994	16,211	93,243	109,454	271,115	72,022	343,137	724,689	33,050	757,739	49,365	37,159	86,524
1995	30,846	96,435	127,281	605,918	67,861	673,779	471,461	36,277	507,738	92,500	27,791	120,291
1996	7,419	78,063	85,482	207,877	88,966	296,843	937,299	32,741	970,040	33,878	34,213	68,091
1997	10,441	81,577	92,018	17,026	39,970	56,996	130,803	29,032	159,835	21,989	40,097	62,086
1998	17,359	81,264	98,623	207,809	63,537	271,346	210,481	24,864	235,345	60,906	35,425	96,331
1999	4,705	73,194	77,899	23,006	43,601	66,607	23,593	25,003	48,596	16,976	46,677	63,653
2000	444	64,893	65,337	11,570	51,696	63,266	261,379	33,786	295,165	4,130	41,783	45,913
2001	90	73,610	73,700	1,272	49,874	51,146	192,998	28,505	221,503	84	48,601	48,685
2002	72	66,807	66,879	1,900	69,019	70,919	83,463	32,780	116,243	84	25,499	25,583
2003	158	67,788	67,946	2,760	43,320	46,080	283,878	35,240	319,118	279	34,452	34,731
2004	2,300	85,086	87,386	20,248	52,374	72,622	428,473	35,735	464,208	8,435	32,433	40,868
2005	4,784	68,213	72,997	68,977	46,036	115,013	142,485	26,487	168,972	28,154	33,878	62,032

[a] Districts 1 and 2; also includes harvests in District 3 from 1960 to 1965.

[b] Estimated subsistence harvest expanded from villages surveyed.

[c] Beginning in 1988, estimates are based on a new formula so data since 1988 is not comparable with previous years.

[d] Districts 1 and 2 only; no chum harvests were reported in District 3.

[e] Includes small numbers of small Chinook, sockeye and coho salmon.

Appendix C2.–Historical utilization of Chinook, chum, coho, and sockeye salmon in District W4.

	Chinook Salmon			Chum Salmon			Coho Salmon			Sockeye Salmon		
Year	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest[a]	Subsistence Harvest[b]	Total Utilization
1960	0			0			3,000			5649		
1961	4,328			18,864			46			2308		
1962	5,526			45,707			0			10313		
1963	6,555			0			0			0		
1964	4,081			707			379			13422		
1965	2,976			4,242			0			1886		
1966	278			2,610			0			1030		
1967	0	1,349	1,349	8,087			1,926			652		
1968	8,879	2,756	11,635	19,497			21,511			5884		
1969	16,802			38,206			15,077			3,784		
1970	18,269			46,556			16,850			5,393		
1971	4,185			30,208			2,982			3,118		
1972	15,880			17,247			376			3,286		
1973	14,993			19,680			16,515			2,783		
1974	8,704			15,298			10,979			19,510		
1975	3,928			35,233			10,742			8,584		
1976	14,110			43,659			13,777			6,090		
1977	19,090	2,012	21,102	43,707			9,028			5,519		
1978	12,335	2,328	14,663	24,798			20,114			7,589		
1979	11,144	1,420	12,564	25,995			47,525			18,828		
1980	10,387	1,940	12,327	65,984			62,610			13,221		
1981	24,524	2,562	27,086	53,334			47,551			17,292		
1982	22,106	2,402	24,508	34,346			73,652			25,685		
1983	46,385	2,542	48,927	23,090			32,442			10,263		
1984	33,663	3,109	36,772	50,422			132,151			17,255		
1985	30,401	2,341	32,742	20,418	901	21,319	29,992	67	30,059	7,876	106	7,982
1986	22,835	2,682	25,517	29,700	808	30,508	57,544	41	57,585	21,484	423	21,907
1987	26,022	3,663	29,685	8,557	1,084	9,641	50,070	125	50,195	6,489	1067	7,556
1988	13,883	3,690	17,573	29,220	1,065	30,285	68,605	4317	72,922	21,556	1261	22,817
1989	20,820	3,542	24,362	39,395	1,568	40,963	44,607	3,787	48,394	20,582	633	21,215
1990	27,644	6,013	33,657	47,717	3,234	50,951	26,926	4,174	31,100	83,681	1,951	85,632
1991	9,480	3,693	13,173	54,493	1,593	56,086	42,571	3,232	45,803	53,657	1,772	55,429
1992	17,197	3,447	20,644	73,383	1,833	75,216	86,404	2,958	89,362	60,929	1,264	62,193
1993	15,784	3,368	19,152	40,943	1,008	41,951	55,817	2,152	57,969	80,934	1,082	82,016
1994	8,564	3,995	12,559	61,301	1,452	62,753	83,912	2,739	86,651	72,314	1,000	73,314
1995	38,584	2,746	41,330	81,462	686	82,148	66,203	2,561	68,764	68,194	573	68,767
1996	14,165	3,075	17,240	83,005	930	83,935	118,718	1,467	120,185	57,665	400	58,065
1997	35,510	3,433	38,943	38,445	600	39,045	32,862	1,264	34,126	69,562	556	70,118
1998	23,158	4,041	27,199	45,095	1,448	46,543	80,183	1,702	81,885	41,382	1,490	42,872
1999	18,426	3,167	21,593	38,091	1,810	39,901	6,184	2,021	8,205	41,315	1,639	42,954
2000	21,229	3,106	24,335	30,553	912	31,465	30,529	1,088	31,617	68,557	1,341	69,898
2001	12,775	2,923	15,698	17,209	747	17,956	18,531	1,525	20,056	33,807	914	34,721
2002	11,480	2,475	13,955	29,252	1,839	31,091	26,695	1,099	27,794	17,802	855	18,657
2003	14444	3,898	18,342	27,868	1,129	28,997	49,833	2,047	51,880	33,941	1,622	35,563
2004	25,465	3,726	29,191	25,820	1,112	26,932	82,398	1,209	83,607	34,627	1,086	35,713
2005	24,079	3,083	27,162	13,565	915	14,480	53,201	1,443	54,644	68,665	1,633	70,298

Appendix C3.–Historical utilization of Chinook, chum, coho, and sockeye salmon in District W5.

	Chinook Salmon			Chum Salmon			Coho Salmon			Sockeye Salmon		
Year	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest	Subsistence Harvest	Total Utilization	Commercial Harvest[a]	Subsistence Harvest[b]	Total Utilization
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968							5,458					
1969	3,978			5,006			11,631			6,256		
1970	7,163			12,346			6,794			7,144		
1971	477			301			1,771			330		
1972	264			1,331			925			924		
1973	3,543			15,781			5,017			2,072		
1974	3,302			8,942			21,340			9,357		
1975	2,156			5,904			17,889			9,098		
1976	4,417			10,354			9,852			5,575		
1977	3,336	574	3,910	6,531			13,335			3,723		
1978	5,218			8,590			13,764			5,412		
1979	3,204	338	3,542	9,298			42,098			19,581		
1980	2,331	690	3,021	11,748			43,256			28,632		
1981	7,190	1,409	8,599	13,642			19,749			40,273		
1982	9,476	1,236	10,712	13,829			46,683			38,877		
1983	14,117	1,066	15,183	6,766			19,660			11,716		
1984	8,612	629	9,241	14,340			71,176			15,474		
1985	5,793	426	6,219	4,784	704	5,488	16,498	221	16,719	6,698	704	7,402
1986	2,723	555	3,278	10,355	943	11,298	19,378	8	19,386	25,112	943	26,055
1987	3,357	816	4,173	20,381	955	21,336	29,057	43	29,100	27,758	955	28,713
1988	4,964	310	5,274	33,059	1,065	34,124	30,832	1162	31,994	36,368	1065	37,433
1989	2,966	467	3,433	13,622	861	14,483	31,849	907	32,756	19,299	861	20,160
1990	3,303	539	3,842	13,194	1,282	14,476	7,804	1,646	9,450	35,823	1,123	36,946
1991	912	917	1,829	15,892	827	16,719	13,312	1,828	15,140	39,838	1,282	41,120
1992	3,528	374	3,902	18,520	835	19,355	19,875	1,353	21,228	39,194	827	40,021
1993	2,117	708	2,825	10,657	770	11,427	20,014	1,226	21,240	59,293	835	60,128
1994	2,570	784	3,354	28,477	253	28,730	47,499	512	48,011	69,490	770	70,260
1995	2,922	883	3,805	19,832	418	20,250	17,875	305	18,180	37,351	253	37,604
1996	1,375	415	1,790	11,093	609	11,702	43,836	352	44,188	30,717	418	31,135
1997	2,039	449	2,488	11,729	508	12,237	2,983	397	3,380	31,451	609	32,060
1998	3,675	718	4,393	14,155	872	15,027	21,246	331	21,577	27,161	508	27,669
1999	1,888	871	2,759	11,562	1,205	12,767	2,474	582	3,056	22,910	872	23,782
2000	4,442	703	5,145	7,450	974	8,424	15,531	517	16,048	37,252	1,205	38,457
2001	1,519	895	2,414	3,412	226	3,638	9,275	616	9,891	25,654	974	26,628
2002	979	857	1,836	3,799	407	4,206	3,041	297	3,338	6,304	1,050	7,354
2003	1412	737	2,149	5,593	176	5,769	12,658	1,319	13,977	29,423	783	30,206
2004	2,565	954	3,519	6,014	257	6,271	23,690	1,617	25,307	20,922	960	21,882
2005	1,947	868	2,815	2,556	209	2,765	11,558	839	12,397	24,153	1,233	25,386

Appendix C4.–Historical daily observed and estimated sonar counts for Aniak River chum salmon. Counts are not converted to DIDSON units.

Date	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
06/15		609											12
06/16		282											86
06/17		284											97
06/18		596											96
06/19		962		420	1,947								165
06/20		1,479		262	1,230								143
06/21		2,035	2,631	544	640			1,016					228
06/22	509	2,119	1,711	1,055	1,319	535		1,728				157	791
06/23	382	5,553	358	1,273	2,234	784		2,430	1,379	1,245	225	126	1,301
06/24	293	9,226	606	1,191	1,175	1,354		6,702	2,422	1,084	481	94	2,906
06/25	280	11,228	2,686	912	1,340	822	1,137	625	3,779	2,449	2,454	94	1,785
06/26	698	7,713	8,072	928	5,547	680	711	1,548	7,770	1,727	2,685	220	2,906
06/27	1,798	8,949	5,706	1,221	9,049	993	4,508	3,162	6,663	2,925	1,924	534	6,073
06/28	1,351	10,622	6,595	1,515	7,933	1,762	6,478	3,136	6,076	3,414	1,671	408	8,157
06/29	2,210	21,050	5,976	2,112	3,794	1,638	1,775	2,409	4,356	3,080	1,813	1,809	3,110
06/30	7,245	10,639	8,800	2,430	2,581	1,653	2,680	915	6,568	2,055	3,173	3,809	3,878
07/01	12,048	13,874	13,981	2,882	4,032	2,078	2,045	1,351	15,552	4,712	3,566	4,299	1,605
07/02	15,941	12,621	20,765	2,427	10,060	1,702	2,398	441	9,574	6,555	2,469	3,800	3,253
07/03	31,684	10,156	18,776	2,817	17,284	4,215	4,048	3,613	13,388	8,321	2,061	5,578	1,991
07/04	44,416	13,201	20,687	7,646	18,714	3,481	5,162	4,364	15,066	7,427	2,248	6,397	3,352
07/05	22,675	30,396	14,795	5,869	3,734	3,182	3,495	10,041	18,045	12,648	2,966	9,082	2,534
07/06	41,538	22,426	14,805	7,661	3,080	5,721	2,740	5,489	9,868	12,709	4,334	8,659	2,858
07/07	22,230	16,062	12,803	6,313	5,417	4,671	3,846	6,111	7,164	5,104	5,133	8,998	2,095
07/08	15,030	12,892	16,804	4,886	8,364	7,255	5,401	3,820	12,471	8,645	6,828	17,919	1,609
07/09	33,874	13,976	32,351	4,844	5,463	5,729	3,478	4,406	16,524	7,617	5,224	10,381	1,217
07/10	34,932	9,957	15,422	8,784	6,608	5,955	6,971	6,026	14,797	6,642	7,805	9,306	2,833
07/11	38,235	19,817	16,103	6,078	8,947	5,955	4,959	10,873	12,073	7,414	5,345	12,773	4,533
07/12	40,477	19,284	15,649	4,350	10,349	7,839	6,805	12,271	12,517	7,260	7,363	11,614	6,853
07/13	48,709	11,460	12,811	6,161	12,519	4,849	4,887	4,534	11,526	6,385	4,983	10,814	4,319
07/14	27,396	15,575	24,107	5,231	10,282	4,635	6,489	7,984	12,507	8,565	6,001	11,641	875
07/15	26,458	11,381	15,413	3,854	19,072	7,412	5,570	5,620	16,077	12,238	5,406	5,952	630
07/16	37,743	14,013	10,259	4,372	11,664	14,707	7,658	5,906	13,064	11,163	7,180	6,234	1,670
07/17	46,687	13,072	13,065	3,916	7,761	12,338	4,926	7,169	17,454	10,018	7,194	15,273	881
07/18	76,746	10,195	14,578	2,598	8,157	7,563	4,465	5,756	14,936	8,374	8,480	14,676	183
07/19	68,443	13,112	8,563	4,042	2,827	5,966	3,958	4,303	10,917	6,295	6,536	20,248	139
07/20	52,585	11,986	7,723	3,156	5,372	7,021	5,531	6,279	10,543	5,163	5,175	19,295	32
07/21	35,859	13,903	4,909	2,477	6,556	7,078	8,769	4,535	8,067	3,075	6,759	18,902	311
07/22	39,003	17,002	7,256	3,256	6,290	18,515	11,025	2,788	11,307	2,397	7,551	8,017	130
07/23	43,999	18,450	3,878	2,176	4,150	20,274	4,375	3,404	9,775	7,886	4,989	6,299	136
07/24	41,678	19,487	4,617	2,586	4,325	5,238	9,729	5,292	11,475	3,355	4,031	4,525	96
07/25	43,413	13,286	4,147	2,033	4,771	5,818	4,654	1,811	8,775	6,143 [a]	6,747	4,186	107
07/26	29,466	14,209	5,811	1,826	2,997	4,712	4,035 [a]	3,926	5,206	5,378 [a]	8,092	4,333	408
07/27	16,430	12,936	4,915	1,790	3,865	7,059	3,847 [a]	3,179	8,278	5,128 [a]	11,293	4,428	279
07/28	25,411	11,829	3,912	1,473	3,689	4,301	4,990 [a]	2,696	6,624	6,652 [a]	7,575	6,791	240
07/29	24,336	9,202	4,572	4,290 [a]	2,195	6,173	5,632 [a]	3,731	4,640	7,507 [a]	8,655	2,199	44
07/30	17,956	6,979	4,771	4,298 [a]	2,440	3,646	5,643 [a]	2,796	6,414	7,521 [a]	9,203	3,769	1,013
07/31	25,394 [a]	8,638	4,998	3,144 [a]	1,881	5,564	4,127 [a]	3,842 [a]	4,039	5,501 [a]	6,481	4,648	1,089
08/01		8,361	3,255								9,417	4,491	909
08/02		8,119									8,184	4,366	894
08/03		11,086									5,998	5,967	1,123
08/04		9,526									6,562	5,151	979
08/05		11,003										5,905	1,066
08/06													251
Total Estimate	1,095,558	582,816	419,643	141,099	261,654	220,870	178,945	178,023	387,675	241,776	232,260	314,166	84,270
Total 6/26-7/31	1,094,094	500,348	408,397	135,442	251,771	217,376	177,808	165,523	380,094	236,998	198,939	287,816	71,439
	2.32%	0.00%	0.00%	8.66%	0.00%	0.00%	15.90%	2.32%	0.00%	18.49%	0.00%	0.00%	0.00%

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Appendix C4.

Date	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
06/15	2												
06/22	56			2,668	852								1,394
06/23	74			3,583	1,091								7,484
06/24	26			3,468	2,673	400							7,063
06/25	19			2,155	3,011	497						514	5,709
06/26	44	3,202 [a]		2,056	2,753	1,176	1,516 [a]	1,656	2,824 [a]	5,310	3,257 [a]	3,774	4,338
06/27	15	19,600		6,784	3,178	1,830	2,748 [a]	1,641	5,121 [a]	5,607	5,906	12,108	5,508
06/28	71	3,086		8,468	4,590	2,136	1,635 [a]	1,014	3,047 [a]	6,572	2,868	16,954	6,625
06/29	284	4,231		4,552	3,485	2,626	2,796 [a]	680	5,210 [a]	6,872	2,816	17,224	9,652
06/30	144	13,787		10,142	2,344	3,467	354	480	3,768 [a]	9,144	1,858	13,297	12,107
07/01	604	8,025		1,195	2,466	5,201	1,304	1,461	4,330 [a]	10,423	3,108	14,142	5,005
07/02	1,798	1,814		10,866	2,920	5,217	1,933	1,826	3,377 [a]	15,069	3,586	5,982	13,455
07/03	527	1,297		10,273	7,041	4,710	1,651	4,735	6,641 [a]	7,818	5,286	11,266	25,335
07/04	288	3,792		21,035	11,698	4,648	1,700	5,262	10,983 [a]	9,217	9,728	16,656	19,072
07/05	663	7,443		17,102	9,746	3,290	2,604	4,480	9,395 [a]	17,925	9,540	12,747	23,200
07/06	55	6,875		12,001	6,982	3,988	3,567	4,954	7,764 [a]	15,820	9,768	10,160	23,628
07/07	31	4,216		9,147	5,998	5,468	4,525	4,286	9,059 [a]	7,263	7,146	25,962	33,531
07/08	7	18,623		12,227	5,922	7,182	4,828	4,457	10,314 [a]	11,064	13,950	21,426	32,008
07/09	136	14,664		13,680	3,991	7,737	4,741	6,941	10,448 [a]	9,775	16,500	23,146	38,150
07/10	915	13,392		5,664	2,479	6,979	5,868	8,329	8,565 [a]	19,321	14,732	19,040	52,307
07/11	400	25,135		2,972	7,199	6,979	5,301	5,563	8,175	15,479	7,020	22,336	45,267
07/12	439	18,209		6,096	10,895	6,979	6,335	7,686	9,113	15,551	9,880	24,310	30,179
07/13	238	14,742		9,341	6,104	6,979	5,325	8,082	14,127	9,179	15,494	26,618	38,563
07/14	539	21,169		5,233	3,672	6,979	3,926	3,849	13,816	9,643	23,208	27,738	76,652
07/15	237	27,027		7,908	3,444	5,919	5,254	3,270	12,266	14,818	12,746	24,134	55,505
07/16	648	16,237		6,595	7,117	7,077	5,260	3,369	12,286	18,532	7,780	27,330	41,546
07/17	358	13,563		4,416	6,813	9,794	6,689	3,747	14,337	15,566	7,806	16,902	47,057
07/18	264	19,181		6,853	9,369	15,526	5,904	4,013	12,143	15,515	6,868	23,782	34,280
07/19	176	14,528		9,245	11,236	14,951	6,355	5,242	10,119	8,354	14,688	30,946	27,172
07/20	411	11,315		17,002	7,417	15,186	7,870	5,219	16,525	7,242	17,896	27,541	50,058
07/21	206	5,862		16,137	14,804	16,409	5,925	4,045	14,488	9,597	17,950	29,416	69,363
07/22	258	6,765		11,742	12,444	16,271	4,647	5,041	11,912	9,619	12,198	21,134	62,221
07/23	489	7,025		11,830	8,344	14,271	8,089	6,131	10,568	7,145	14,014	21,622	38,123
07/24	758	3,560		8,166	5,948	12,480	10,041	5,376	9,428	5,797	13,390	23,153	40,735
07/25	107	2,776		6,873	5,752	9,038	10,613	4,233	8,796	9,482	10,120	16,888	32,571
07/26	329	1,618		5,359	3,264	8,247	6,313	3,022	9,575	5,619	13,844	10,698	21,691
07/27	194	7,379		3,017	4,724	9,650	3,575	4,378	8,758	6,559	10,088	11,283	32,377
07/28	527	8,028		5,351	8,482	8,234	5,926	3,509	8,437	6,013	7,846	17,507	33,285
07/29	203	6,742		10,034 [a]	6,921	7,155	6,189	1,903	7,266	6,605	13,682	18,518	24,264
07/30	167	6,272		10,053 [a]	6,738	7,826	5,998	2,020	5,229	8,163	17,202	12,654	19,332
07/31	177	5,096		7,352 [a]	5,527	6,929	6,059	2,260	4,867	8,594	8,790	14,536	27,343
08/01	149	5,096			6,791		5,174						
Total Estimate	13,870	391,364		329,545	262,522	279,431	186,823	144,157	323,076	370,272	372,559	673,445	1,173,155
Total 6/26-7/31		366,276		316,767	231,807	278,534	173,363	144,157	323,076	370,272	372,559	672,931	1,151,505
Percent Estimated	0.00%	0.87%		8.66%	0.00%	0.00%	5.02%	0.00%	31.21%	2.32%	0.87%	0.00%	0.00%

[a] Daily counts were estimated.

Appendix C5.–Historical daily observed and estimated sonar counts (DIDSON units) for Aniak River chum salmon.

Date	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
06/15		732											14
06/16		338											103
06/17		340											116
06/18		716											115
06/19		1,159		504	2,357								197
06/20		1,786		315	1,483								171
06/21		2,464	3,197	654	769			1,223					274
06/22	611	2,568	2,068	1,271	1,591	642		2,089				188	951
06/23	459	6,854	430	1,536	2,709	943		2,949	1,665	1,502	270	151	1,569
06/24	352	11,607	728	1,436	1,416	1,634		8,321	2,940	1,306	578	113	3,537
06/25	336	14,273	3,265	1,098	1,617	988	1,371	751	4,620	2,973	2,979	113	2,159
06/26	840	9,627	10,095	1,118	6,845	818	855	1,870	9,701	2,088	3,263	264	3,537
06/27	2,175	11,243	7,047	1,473	11,375	1,196	5,532	3,853	8,271	3,560	2,329	641	7,516
06/28	1,630	13,461	8,184	1,829	9,914	2,130	8,034	3,821	7,519	4,166	2,020	490	10,205
06/29	2,679	28,108	7,392	2,560	4,639	1,979	2,146	2,924	5,342	3,751	2,193	2,189	3,789
06/30	9,021	13,483	11,047	2,949	3,135	1,998	3,258	1,101	8,150	2,489	3,867	4,657	4,744
07/01	15,380	17,876	18,023	3,507	4,936	2,518	2,477	1,631	20,208	5,789	4,355	5,271	1,940
07/02	20,754	16,159	27,689	2,945	12,712	2,058	2,909	529	12,067	8,133	2,997	4,646	3,966
07/03	44,506	12,839	24,792	3,427	22,654	5,166	4,955	4,413	17,207	10,420	2,497	6,885	2,411
07/04	66,081	16,951	27,575	9,541	24,704	4,249	6,358	5,351	19,529	9,257	2,726	7,930	4,088
07/05	30,518	42,442	19,152	7,256	4,564	3,878	4,266	12,686	23,741	16,195	3,610	11,417	3,077
07/06	61,021	30,146	19,166	9,560	3,751	7,067	3,331	6,771	12,456	16,278	5,314	10,862	3,477
07/07	29,854	20,925	16,406	7,823	6,681	5,738	4,703	7,563	8,916	6,284	6,321	11,307	2,538
07/08	19,479	16,528	21,973	6,009	10,476	9,034	6,660	4,672	15,954	10,844	8,484	23,561	1,944
07/09	48,067	18,016	45,585	5,956	6,738	7,077	4,245	5,404	21,577	9,503	6,436	13,138	1,467
07/10	49,810	12,574	20,027	11,025	8,201	7,365	8,667	7,456	19,155	8,244	9,747	11,713	3,447
07/11	55,344	26,303	20,982	7,522	11,240	7,365	6,100	13,796	15,414	9,240	6,589	16,366	5,564
07/12	59,182	25,528	20,345	5,334	13,096	9,792	8,454	15,682	16,016	9,041	9,174	14,793	8,515
07/13	73,833	14,585	16,417	7,628	16,020	5,962	6,010	5,565	14,674	7,915	6,131	13,718	5,295
07/14	37,716	20,240	32,671	6,445	13,007	5,692	8,048	9,980	16,002	10,739	7,424	14,829	1,053
07/15	36,263	14,478	20,013	4,714	25,221	9,238	6,874	6,938	20,946	15,637	6,667	7,362	758
07/16	54,510	18,068	12,977	5,362	14,860	19,029	9,556	7,302	16,764	14,186	8,937	7,722	2,019
07/17	70,153	16,774	16,765	4,790	9,691	15,774	6,059	8,923	22,897	12,656	8,955	19,819	1,061
07/18	130,377	12,891	18,851	3,157	10,205	9,433	5,479	7,111	19,347	10,489	10,628	18,986	220
07/19	112,564	16,829	10,737	4,948	3,439	7,378	4,843	5,275	13,856	7,799	8,108	26,932	167
07/20	81,040	15,296	9,640	3,845	6,623	8,732	6,825	7,779	13,355	6,359	6,374	25,543	39
07/21	51,348	17,916	6,037	3,007	8,134	8,805	11,007	5,566	10,088	3,745	8,395	24,974	373
07/22	56,651	22,253	9,036	3,970	7,794	24,417	14,000	3,391	14,379	2,909	9,417	10,023	155
07/23	65,342	24,323	4,744	2,637	5,084	26,969	5,366	4,153	12,332	9,853	6,139	7,804	163
07/24	61,263	25,822	5,670	3,141	5,304	6,454	12,272	6,522	14,605	4,092	4,935	5,555	115
07/25	64,305	17,067	5,080	2,462	5,864	7,190	5,717	2,191	11,015	7,605 [a]	8,379	5,129	128
07/26	40,965	18,339	7,181	2,209	3,649	5,789	4,939 [a]	4,804	6,413	6,631 [a]	10,121	5,314	490
07/27	21,443	16,588	6,045	2,165	4,728	8,781	4,705 [a]	3,875	10,363	6,314 [a]	14,360	5,432	334
07/28	34,655	15,084	4,786	1,778	4,508	5,273	6,140 [a]	3,277	8,222	8,257 [a]	9,449	8,436	288
07/29	33,017	11,575	5,613	5,259 [a]	2,661	7,643	6,954 [a]	4,560	5,699	9,360 [a]	10,857	2,666	52
07/30	23,614	8,678	5,864	5,270 [a]	2,961	4,454	6,967 [a]	3,401	7,952	9,379 [a]	11,577	4,607	1,221
07/31	34,629 [a]	10,834	6,150	3,830 [a]	2,276	6,867	5,055 [a]	4,699 [a]	4,945	6,787 [a]	8,038	5,709	1,313
08/01		10,472	3,968								11,859	5,512	1,094
08/02		10,157									10,241	5,354	1,076
08/03		14,082									7,420	7,381	1,353
08/04		12,003									8,142	6,343	1,179
08/05		13,971										7,301	1,284
08/06													301
Total Count	1,601,790	753,371	543,414	173,264	329,629	277,514	221,141	220,168	494,302	301,774	288,301	399,142	102,962
Total 6/26-7/31	1,600,032	649,849	529,758	166,452	317,688	273,306	219,770	204,834	485,077	295,993	246,813	366,687	87,467
	2.16%	0.00%	0.00%	8.63%	0.00%	0.00%	15.82%	2.29%	0.00%	18.36%	0.00%	0.00%	0.00%

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Date	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
06/15	2												
06/22	67			3,242	1,025								1,394
06/23	88			4,376	1,315								7,484
06/24	31			4,233	3,249	480							7,063
06/25	23			2,612	3,666	597						514	5,709
06/26	53	3,903 [a]		2,490	3,347	1,418	1,831 [a]	2,002	3,436 [a]	6,545	3,971 [a]	3,774	4,338
06/27	18	25,986		8,427	3,873	2,214	3,341 [a]	1,983	6,306 [a]	6,922	7,302	12,108	5,508
06/28	85	3,759		10,612	5,636	2,588	1,976 [a]	1,221	3,711 [a]	8,155	3,489	16,954	6,625
06/29	341	5,185		5,588	4,254	3,191	3,400 [a]	818	6,418 [a]	8,540	3,425	17,224	9,652
06/30	173	17,756		12,820	2,844	4,232	425	576	4,606 [a]	11,499	2,248	13,297	12,107
07/01	726	10,033		1,441	2,994	6,407	1,573	1,764	5,309 [a]	13,195	3,786	14,142	5,005
07/02	2,175	2,194		13,787	3,554	6,427	2,340	2,209	4,119 [a]	19,533	4,380	5,982	13,455
07/03	633	1,565		12,995	8,758	5,787	1,996	5,818	8,243 [a]	9,764	6,514	11,266	25,335
07/04	346	4,636		28,086	14,906	5,709	2,055	6,483	13,944 [a]	11,596	12,271	16,656	19,072
07/05	797	9,278		22,395	12,295	4,012	3,164	5,497	11,830 [a]	23,570	12,022	12,747	23,200
07/06	66	8,544		15,316	8,682	4,881	4,356	6,094	9,694 [a]	20,584	12,324	10,160	23,628
07/07	37	5,166		11,503	7,420	6,745	5,554	5,254	11,387 [a]	9,045	8,893	25,962	33,531
07/08	8	24,572		15,623	7,323	8,940	5,936	5,468	13,050 [a]	14,053	17,981	21,426	32,008
07/09	163	18,970		17,609	4,885	9,659	5,826	8,629	13,228 [a]	12,333	21,542	23,146	38,150
07/10	1,102	17,213		6,994	3,010	8,678	7,254	10,430	10,738 [a]	25,581	19,064	19,040	52,307
07/11	480	34,233		3,618	8,962	8,678	6,533	6,866	10,229	20,106	8,731	22,336	45,267
07/12	527	23,977		7,545	13,826	8,678	7,851	9,592	11,458	20,207	12,472	24,310	30,179
07/13	285	19,078		11,759	7,555	8,678	6,564	10,107	18,225	11,545	20,127	26,618	38,563
07/14	648	28,283		6,447	4,487	8,678	4,804	4,707	17,797	12,158	31,316	27,738	76,652
07/15	284	37,143		9,881	4,203	7,319	6,474	3,987	15,676	19,184	16,329	24,134	55,505
07/16	779	21,171		8,184	8,856	8,804	6,482	4,110	15,703	24,441	9,715	27,330	41,546
07/17	430	17,448		5,417	8,464	12,358	8,305	4,580	18,516	20,228	9,749	16,902	47,057
07/18	317	25,378		8,516	11,796	20,172	7,300	4,912	15,509	20,157	8,535	23,782	34,280
07/19	211	18,781		11,632	14,284	19,369	7,876	6,459	12,790	10,463	19,003	30,946	27,172
07/20	493	14,390		22,253	9,244	19,697	9,832	6,430	21,578	9,018	23,528	27,541	50,058
07/21	247	7,246		21,030	19,164	21,414	7,327	4,952	18,725	12,097	23,605	29,416	69,363
07/22	309	8,403		14,966	15,917	21,219	5,708	6,205	15,196	12,127	15,583	21,134	62,221
07/23	587	8,737		15,085	10,450	18,425	10,117	7,590	13,388	8,892	18,069	21,622	38,123
07/24	912	4,347		10,217	7,356	15,966	12,686	6,629	11,873	7,164	17,210	23,153	40,735
07/25	128	3,376		8,541	7,106	11,360	13,448	5,188	11,041	11,945	12,791	16,888	32,571
07/26	395	1,955		6,607	3,979	10,323	7,822	3,680	12,068	6,937	17,835	10,698	21,691
07/27	233	9,195		3,673	5,805	12,168	4,366	5,369	10,992	8,138	12,749	11,283	32,377
07/28	633	10,037		6,597	10,630	10,306	7,328	4,284	10,571	7,439	9,801	17,507	33,285
07/29	244	8,373		12,676 [a]	8,603	8,905	7,664	2,303	9,048	8,197	17,612	18,518	24,264
07/30	201	7,770		12,702 [a]	8,368	9,775	7,420	2,446	6,442	10,213	22,538	12,654	19,332
07/31	213	6,274		9,160 [a]	6,820	8,614	7,498	2,741	5,984	10,777	11,034	14,536	27,343
08/01	178	6,274			8,436		6,373						
Total Count	16,671	505,139		417,746	327,439	352,869	230,952	177,384	408,830	472,346	477,544	673,445	1,173,155
Total 6/26-7/31	15,278	474,356		402,195	289,654	351,792	214,429	177,384	408,830	472,346	477,544	672,931	
Percent Estimated	0.00%	0.82%		8.59%	0.00%	0.00%	4.92%	0.00%	30.82%	2.28%	0.83%	0.00%	0.00%

[a] Daily counts were estimated.

Appendix C6.–Run timing used to estimate chum salmon passage during inoperable periods for Aniak River sonar project

Date	Early	Average	Late
6/26	1.11	0.87	0.42
6/27	2.79	2.46	1.08
6/28	4.60	3.40	1.85
6/29	5.92	5.02	2.79
6/30	8.04	6.18	2.12
7/01	9.48	7.52	3.45
7/02	12.54	8.57	4.98
7/03	15.54	10.62	6.32
7/04	20.03	14.02	7.67
7/05	24.69	16.93	9.06
7/06	28.67	19.33	10.85
7/07	31.39	22.14	13.21
7/08	34.84	25.33	15.97
7/09	38.93	28.56	18.79
7/10	43.29	31.21	21.83
7/11	46.34	34.00	24.69
7/12	50.25	37.68	27.87
7/13	54.04	41.29	30.74
7/14	56.43	45.33	33.18
7/15	59.46	48.18	35.84
7/16	62.71	51.28	38.71
7/17	65.83	53.81	42.50
7/18	68.66	56.96	47.08
7/19	71.71	61.46	51.69
7/20	75.54	65.53	56.81
7/21	79.22	70.76	61.55
7/22	82.63	74.72	65.88
7/23	86.07	78.28	70.90
7/24	88.78	81.51	76.19
7/25	91.43	84.10	81.03
7/26	93.26	86.37	84.43
7/27	95.23	88.53	87.25
7/28	97.21	91.34	90.53
7/29	97.39	94.51	93.69
7/30	99.22	97.68	96.92
7/31	100.00	100.00	100.00