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Escapement Goal Recommendations for Select Arctic-Yukon-Kuskokwim Region Salmon Stocks, 2013

by

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December 2012

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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ABSTRACT

An Alaska Department of Fish and Game review team convened to evaluate salmon escapement goals for Arctic-Yukon-Kuskokwim (AYK) Region in preparation for the January 2013 Alaska Board of Fisheries (board) meeting. The review team makes recommendations for sustainable (SEG) and biological (BEG) escapement goals to the directors of the 2 fisheries divisions, who ultimately establish the final goals. This report documents the review team's recommendations for escapement goals.

The Kuskokwim Management Area currently has 25 established escapement goals for 14 Chinook salmon, 4 chum salmon, 3 coho salmon, and 4 sockeye salmon stocks. The review team recommends establishment of a model-based drainagewide SEG for Kuskokwim River Chinook salmon; revisions to tributary SEGs for Chinook salmon in the Kwethluk, George, and Kogrukluk rivers; and elimination of the tributary SEG for Chinook salmon in the Tuluksak River. The review team also recommends elimination of the aerial survey-based SEG for chum salmon in the Kanektok River (Kuskokwim Bay) due to the unreliable nature of aerial survey assessments on this system.

The Yukon River Management Area currently has 15 established escapement goals for 6 Chinook salmon, 2 summer chum salmon, 6 fall chum salmon, and 1 coho salmon stocks. No changes are recommended for escapement goals in the Yukon Management Area.

The Norton Sound-Port Clarence Management Area currently has a total of 23 escapement goals for 5 Chinook salmon, 8 chum salmon, 3 coho salmon, 5 pink salmon, and 2 sockeye salmon stocks. The Kotzebue area currently has 6 escapement goals for chum salmon stocks. The review team recommends eliminating the aerial survey SEG for Chinook salmon on the Shaktoolik River due to the unreliable nature of aerial survey assessments on this system. No other changes are recommended for escapement goals in the Norton Sound-Port Clarence and Kotzebue management areas.

Key words: Pacific salmon, *Oncorhynchus* spp., escapement goal, Arctic-Yukon-Kuskokwim, stock status, Kuskokwim Management Area, Yukon Management Area, Norton Sound-Port Clarence Management Area, Kotzebue Management Area.

INTRODUCTION

This report presents escapement goal recommendations for salmon stocks of Kuskokwim, Yukon, Norton Sound-Port Clarence, and Kotzebue Sound Management areas (Figure 1). In the process of deciding upon these recommendations, detailed analyses were performed for Chinook salmon stocks in the Kuskokwim River and certain tributaries. Those analyses are published in a separate report (Hamazaki et al. 2012a). Escapement goals were evaluated and recommended based on policies adopted into regulation by the Alaska Board of Fisheries (board): the *Policy for the management of sustainable salmon fisheries* (SSFP: 5 AAC 39.222) and the *Policy for statewide salmon escapement goals* (*Escapement Goal Policy*: 5 AAC 39.223). These policies call for review of salmon escapement goals every 3 years in concert with the regulatory cycle for each management area, and provide process and criteria to be followed.

An ADF&G escapement goal review team comprising regional research coordinators and fisheries scientists from Divisions of Commercial Fisheries and Sport Fish conducted a review of available information and considered escapement goal recommendations in preparation for the January 2013 AYK Region board meeting. The review team directed the work of other staff and reviewed that work in the process of making escapement goal recommendations. Public collaborative meetings with the review team, department staff, guests from federal agencies, and members of nongovernmental organizations were conducted on November 14–15, 2011 and March 1–2, 2012 to develop assignments, review data and analyses, and discuss recommendations.

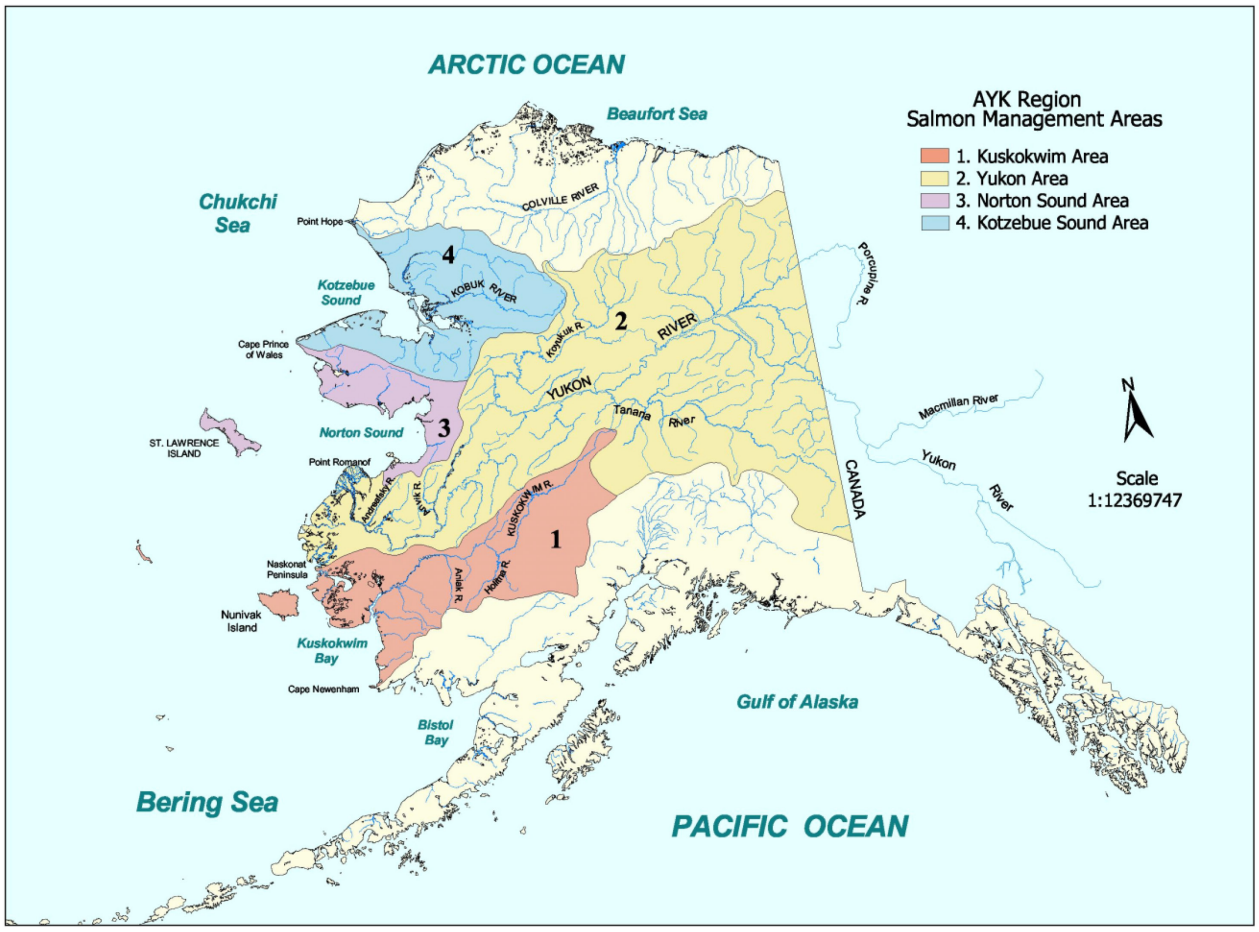

Figure 1.–Arctic-Yukon-Kuskokwim Region salmon management areas for the Division of Commercial Fisheries, ADF&G.

Additional meetings were held between March and September 2012 with the Kuskokwim Salmon Management Working Group (Kuskokwim working group), other stakeholder groups, federal agency staff, and individuals to review analyses and consider recommendations for Kuskokwim River Chinook salmon. Escapement goal recommendations in this report are based, in part, on discussions during these meetings. However, the ADF&G review team alone determined the recommendations presented in this report.

The SSFP defines 3 types of escapement goals that can be established by the department. These are defined to be biological or sustainable escapement goals or sustainable escapement threshold as follows:

Biological Escapement Goal (BEG) is defined as an escapement range that provides the greatest potential for maximum sustained yield. A BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted. The BEG will be developed from the best available biological information and should be scientifically defensible on the basis of available biological information. A BEG will be determined by the department and will be expressed as a range based on factors such as

salmon stock productivity and data uncertainty. The department will seek to maintain evenly distributed salmon escapements within the bounds of a BEG.

Sustainable Escapement Goal (SEG) is defined as a level of escapement, indicated by an index or a range of escapement estimates that is known to have provided for sustained yield over a 5 to 10 year period. An SEG 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. An 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 defined as a threshold level of escapement, below which the ability of the salmon stock to sustain itself is jeopardized. In practice, an 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. An SET is established by the department, in consultation with the board, as needed, for salmon stocks of management or conservation concern. Currently, no SETs are established in the AYK Region, and none were recommended during this review.

Biological escapement goals are intended to provide levels of escapement that will on average produce large harvestable surpluses. Escapements above or below these levels may be sustainable, but will, on average, provide for a smaller harvestable surplus. Few stocks in AYK region have data and estimates that are considered adequate to establish BEGs.

Sustainable escapement goals are intended to provide levels of escapement that will produce runs and harvests similar to what has occurred in the past. Most escapement goals in AYK Region are SEGs because key data and estimates (e.g., stock-specific harvests) are missing or because a time series is too short. In cases like these, existing data and estimates are insufficient to determine total escapement or total return of the specific stock, and perform a reliable spawner-recruit analysis, even if data quality is good.

The quantity and quality of available data and estimates are rated as excellent, good, fair, or poor (Table 1). A BEG can usually only be developed when data are rated excellent or good, whereas an SEG may be developed with data rated good, fair, or poor. However, other criteria must also be considered and merely having some data meeting one of these ratings does not ensure that either a BEG or SEG can be developed, or is sensible.

Table 1.–Rating criteria for stock assessment data and estimates used in escapement goal determinations.

Rating	Description	Goal Type Supported
Excellent	Good accuracy and precision of all estimates (e.g., escapement estimated by a weir or hydroacoustics, harvest estimated by Statewide Harvest Survey or fish tickets); escapement, harvest, and age estimates available in sufficiently long time series; and escapement and return estimates in sufficient time series to construct a brood table and estimate MSY.	BEG
Good	Fair to good accuracy and precision of available estimates (e.g., escapement estimated by capture-recapture experiment or multiple foot/aerial surveys); escapement, harvest, and age estimates available, but may have gaps; time series may or may not be sufficient to allow construction of brood table.	BEG or SEG
Fair	Fair to good accuracy, but precision estimates missing or inadequate; escapement estimates or indices and harvest estimates available; age estimates missing or incomplete (e.g., not available from stock-specific harvest); available estimates and time series insufficient to estimate total return and construct brood table.	SEG (or none)
Poor	Fair accuracy in escapement count or index data (e.g., single foot/aerial survey); no harvest or age data; time series of escapement data may or may not be sufficient to allow estimate of SEG.	SEG (or none)

During its regulatory process, the board reviews the BEGs and SEGs that have been recommended by staff to the directors of the Divisions of Sport Fish and Commercial Fisheries, as well as any SETs. With the assistance of the department, they may also determine the appropriateness of establishing an optimal escapement goal:

Optimal Escapement Goal (OEG) is defined as a specific management objective for salmon escapement that considers biological and allocative factors and may differ from the SEG or BEG. An OEG will be sustainable and may be expressed as a range with the lower bound above the level of SET and will be adopted as a regulation by the board. The department will seek to maintain evenly distributed escapements within the bounds of the OEG. The board will provide an explanation of the reasons for establishing an OEG and, to the extent practicable with the assistance of the department, an estimate of expected differences in yield of any salmon stock, relative to maximum sustained yield, resulting from implementation of an OEG.

Prior to adoption of the regulatory *Escapement Goal Policy* in 2001, all escapement goals established by the department were termed biological escapement goals. However, most of these goals did not meet the criteria for a BEG under the new policy definition. Biological escapement goals consistent with the SSFP definitions and the *Escapement Goal Policy* process were established for the first time during the 2001 regulatory cycle (Clark 2001a-c; Clark and Sandone 2001; Eggers 2001; Evenson 2002).

Significant advances in stock assessment have been made in the AYK Region since 2000. The addition of weirs, towers, and mark–recapture studies have improved assessments of many stocks, and radio-telemetry projects conducted in the mid-2000s provided valuable information on the distribution of salmon. Sonar projects now routinely provide total abundance estimates for several stocks. The current escapement goals in the region reflect, in part, the information gained through these projects and programs. As these assessment projects continue, we expect to

be able to refine existing goals using spawner-recruit analyses in some cases, and maintain or add scientifically-defensible goals where a need is identified for existing or emerging fisheries.

Escapement goals have continued to be added or modified during each regulatory cycle in the AYK region. Most recently, in preparation for the 2010 board meeting, the escapement goal review team evaluated escapement and harvest information for 31 Kuskokwim Area stocks, 18 Yukon Area stocks, and 35 Norton Sound-Port Clarence Area and Kotzebue Area stocks (Volk et al. 2009). In the 2007 cycle, the review team considered a larger set of 57 Kuskokwim, 39 Yukon, and 54 Norton Sound-Port Clarence and Kotzebue area stocks (Brannian et al. 2006).

The 2013 review cycle focused on evaluation of existing goals (i.e., those established in the 2010 cycle) to determine where updates were needed, consideration of a smaller number of stocks without existing goals, and consideration of possible goals for several drainagewide or aggregate stock groups.

METHODS

The review team began with escapement goals established following the 2010 cycle, which included 25 Kuskokwim area stocks, 15 Yukon area stocks, and 29 Norton Sound-Port Clarence and Kotzebue area stocks (Volk et al. 2009). The team also reviewed information on stocks for which escapement goals were considered, but not recommended during the 2010 cycle, primarily due to lack of sufficient escapement and stock contribution data (Volk et al. 2009). Of these, the review team decided to further consider 19 Kuskokwim area stocks, 8 Yukon area stocks, and 17 Norton Sound-Port Clarence and Kotzebue area stocks for the 2013 cycle. The stocks under review included several instances where escapement goals were considered for drainagewide or aggregate stocks alongside specific tributary or other contributing stocks. Additionally, several stocks with existing goals assessed by aerial surveys were also considered for possible goal revisions based on weir or tower assessment data.

For stocks with existing goals, the review team looked for any significant changes in stock assessment methods, fisheries, and trends or patterns in the data series for each stock that would warrant a reanalysis of the goal. They also reviewed management needs and how each escapement goal was utilized in management and how well it performed. For stocks without existing goals, the review team evaluated available data from each to determine whether they met established escapement goal criteria. Stock assessment criteria included having sufficient data and sufficient contrast in the data between high and low abundance. Only stocks having at least 10 years' continuous assessments, extending across several generations of fish, met the minimum criterion for sufficient data. Available data type and quality were also matched to the guidelines for the type of goal being considered (SEG or BEG; Table 1). For stocks to meet the criterion for sufficient contrast, the highest and lowest observed escapements generally needed to differ by a factor of 4 or more. Management criteria included the existence of a significant fishery on the stock during the time period for which data exist; consistent prosecution of the fishery over that time period; and timing of the assessment such that it could inform inseason management decisions.

Data, previous analyses, and estimates for these stocks were obtained from published research and management reports, the AYK database management system (AYKDBMS, http://www.adfg.alaska.gov/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx), and unpublished staff data sources. Information summaries and status reports were presented and

discussed at 2 meetings with the review team and department staff, guests from federal agencies, and members of nongovernmental organizations (November 14–15, 2011 and March 1–2, 2012).

Many of the salmon fisheries in the AYK Region are mixed stock fisheries, from which accurate estimates of stock-specific contribution to subsistence, commercial, and sport harvests are rarely available, precluding development of BEGs. Primarily for this reason, the majority of the existing escapement goals in the region are SEGs developed using the percentile method.[1] The method is applied to stocks that meet at least the minimum requirement for escapement data, but are lacking in information on stock-specific harvests. An algorithm is used to assign escapement goal ranges based on observed contrast in the spawning escapements and a qualitative measure of exploitation by the fishery (Table 2).

Table 2.–Description of the percentile method algorithm used to set SEGs.

Spawning Contrast [a]	SEG Range
Low (<4)	15^{th} percentile – Maximum
Medium (4–8)	15^{th} and 85^{th} percentile
High (>8) and at most low exploitation	15^{th} and 75^{th} percentile
High (>8) and at least moderate exploitation	25^{th} and 75^{th} percentile

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

For development of BEGs, a sufficiently long series of escapement and total return estimates, good contrast in numbers of spawners and subsequent returns, and stock-specific age composition and harvest data are needed (Table 1). For those AYK Region stocks on which BEGs could be developed, escapement goal analyses have traditionally used a Ricker two parameter spawner-recruit model (Hilborn and Walters 1992) to estimate the escapement that produces maximum sustained yield (S_{MSY}). The BEG was set as the range around S_{MSY} corresponding to escapements that have the highest probability of achieving MSY (e.g., escapements that produce 90% or more of MSY, or represent the 90% credible bounds for spawners at MSY).

Escapement goal analysis has been further developed within ADF&G, in recent years, using Bayesian methods in which the basic Ricker spawner-recruit model parameters are estimated in the framework of a state-space model. These models explicitly incorporate missing observations and uncertainty as functional parameters, whereas the traditional Ricker model treats the spawner and recruitment estimates as being observed without error. State-space models have been shown to provide less biased estimates of population parameters and reference points than traditional stock-recruit methods (Su and Peterman 2012).

[1] This method was originally documented in an unpublished report to the Alaska Board of Fisheries by B.G. Bue and J. J. Hasbrouck (*Escapement goal review of salmon stocks of Upper Cook Inlet*). The method has been used widely by the department across the state, and has been slightly modified over time.

A Bayesian state-space spawner-recruit model was used to estimate the fall chum salmon escapement goal for the Yukon River drainage in the 2010 cycle (Fleischman and Borba 2009). A Bayesian spawner-recruit analysis was conducted for Chinook salmon stocks in Chena and Salcha rivers during the 2013 cycle review, in order to correct variance estimates and review appropriateness of the existing escapement goals. For Kuskokwim River Chinook salmon, a time series of historical run size and age composition were estimated using run reconstruction models that incorporated all available data sets, many of which were of short duration or had missing data (Schaberg et al. 2012; Bue et al. 2012). These data, which were not available in previous escapement goal reviews, were analyzed in the framework of a state-space spawner-recruit model. Parameter estimates from the state space model provided quantitative information about stock productivity and capacity, which was used to guide selection of a drainagewide escapement goal.

The review team acknowledged questions and even some controversy concerning both traditional and newly-emerging methodologies for setting escapement goals, and what constitutes adequate justification for setting or revising an SEG or BEG. They pointed out that an SEG set using the percentile method is intended to replicate recently observed escapements for a stock, but that in many cases, recent low escapements can be adequately explained once the underlying relationship between escapement and subsequent recruitment is better understood. Recently developed run reconstruction and state-space Bayesian modeling methods enable analysts to bring together data from various sources to help strengthen estimates and present a more comprehensive picture of stock productivity over time. These methods represent significant conceptual and technical improvements over the traditional Ricker model for determining S_{MSY} and a BEG range. Finally, even when adequate data are available to estimate a BEG, choosing an SEG rather than a BEG can allow for incorporation of other important factors in managing a fishery, such as ensuring consistent subsistence harvest levels annually.

The remainder of this report presents the review team's recommendations for escapement goals in each area within the AYK Region. These recommendations have been, and will continue to be, discussed and considered at length up to and during the 2013 board meeting. Final approval of escapement goals will be made by the directors of divisions of Commercial Fisheries and Sport Fish following the 2013 board meeting.

KUSKOKWIM MANAGEMENT AREA

In the Kuskokwim Management Area, which includes the Kuskokwim River and Kuskokwim Bay drainages, 25 established escapement goals for 14 Chinook salmon, 4 chum salmon, 3 coho salmon, and 4 sockeye salmon stocks were reviewed. Additionally, information from 7 Chinook, 6 chum, 5 coho, and 2 sockeye salmon stocks without existing escapement goals was reviewed (Table 3). Included in the Chinook salmon stocks reviewed was the Kuskokwim River drainagewide stock, which has no existing or previously set escapement goal. The same Kanektok River Chinook and chum salmon stocks were each considered on the basis of two different assessment methods, aerial survey (existing goal) and weir (no existing goal).

Table 3.–Kuskokwim area stocks reviewed for escapement goals during the 2013 cycle.

Stocks with Existing Goals	Assessment Method	Type	Year Established	Goal
Chinook salmon (14)				
Aniak River	Aerial survey	SEG	2005	1,200–2,300
Cheneetnuk River	Aerial survey	SEG	2005	340–1,300
Gagaraya River	Aerial survey	SEG	2005	300–830
George River	Weir	SEG	2007	3,100–7,900
Holitna River	Aerial survey	SEG	2005	970–2,100
Kisaralik River	Aerial survey	SEG	2005	400–1,200
Kogrukluk River	Weir	SEG	2005	5,300–14,000
Kwethluk River	Weir	SEG	2007	6,000–11,000
Pitka Fork Salmon River	Aerial survey	SEG	2005	470–1,600
Salmon R. (Aniak Drainage)	Aerial survey	SEG	2005	330–1,200
Tuluksak River	Weir	SEG	2007	1,000–2,100
Goodnews River (Main Fork)	Aerial survey	SEG	2005	640–3,300
Middle Fork Goodnews River	Weir	BEG	2005	1,500–2,900
Kanektok River	Aerial survey	SEG	2005	3,500–8,000
Chum salmon (4)				
Aniak River	Sonar	SEG	2007	220,000–480,000
Kogrukluk River	Weir	SEG	2005	15,000–49,000
Middle Fork Goodnews River	Weir	SEG	2005	>12,000
Kanektok River	Aerial survey	SEG	2005	>5,200
Coho salmon (3)				
Kogrukluk River	Weir	SEG	2005	13,000–28,000
Kwethluk River	Weir	SEG	2010	>19,000
Middle Fork Goodnews River	Weir	SEG	2005	>1,200
Sockeye salmon (4)				
Kogrukluk River	Weir	SEG	2010	4,400–17,000
Goodnews River (Main Fork)	Aerial survey	SEG	2005	5,500–19,500
Middle Fork Goodnews River	Weir	BEG	2005	18,000–40,000
Kanektok River	Aerial survey	SEG	2005	14,000–34,000
Selected stocks without goals[a]				
Chinook salmon (7)				
Kuskokwim River (drainagewide)	Run reconstruction			
Bear Creek	Aerial survey			
Eek River	Aerial survey			
Hoholitna River	Aerial survey			
Pitka Fork	Aerial survey			
Arolik River	Aerial survey			
Kanektok River	Weir			
Chum salmon (6)				
George River	Weir			
Kwethluk River	Tower/weir			
Takotna River	Weir			
Tatlawiksuk River	Weir			
Tuluksak River	Weir			
Kanektok River	Weir			

-continued-

Table 3.–Page 2 of 2.

Stocks with Existing Goals	Assessment Method	Type	Year Established	Goal
Coho salmon (5)				
George River	Weir			
Takotna River	Weir			
Tatlawiksuk River	Weir			
Tuluksak River	Weir			
Kanektok River	Weir			
Sockeye salmon (2)				
Arolik River	Aerial survey			
Kanektok River	Weir			

[a] Stocks without goals were selected for review during the 2013 cycle based upon the existence of a fishery harvesting that stock and availability of assessment information. This is not an exhaustive list of all stocks within the Kuskokwim area.

Most Kuskokwim area Chinook salmon stocks are assessed annually with indices of escapement, after the run has passed through the main subsistence, commercial, and sport fishing areas. Therefore, the escapement goals provide only a postseason measure of success for fishery managers.

The review team recommended establishing a new, drainagewide goal (SEG) for Kuskokwim River Chinook salmon. A BEG range was initially estimated using a Bayesian state-space spawner-recruit model; however, other criteria besides high probability of achieving MSY were also incorporated, so the recommendation is for an SEG rather than a BEG (Hamazaki et al. 2012a; Table 4). To properly align tributary Chinook salmon goals and assessments with the new drainagewide goal, the review team recommended revising weir-based Chinook salmon SEGs on the Kwethluk, George, and Kogrukluk rivers and eliminating the weir-based Chinook salmon SEG on the Tuluksak River. Evidence had accumulated since these 4 SEGs were established in 2007 that the goals did not adequately represent abundance patterns over time, nor would they likely be consistent with the estimated drainagewide spawner-recruitment relationship and recommended escapement goal. When the existing goals were set, escapement data series for the Kwethluk, George, and Tuluksak rivers included less than 10 years' continuous data collected with consistent assessment methods. In reviewing the appropriateness of these goals, a Parken habitat model (Molyneaux and Brannian 2006; Parken et al. 2006) analysis of the Kwethluk Chinook salmon stock was examined and indicated that the existing goal was likely too high. Likewise, recent work on a habitat model estimate for the Tuluksak stock was discussed in the review meetings, and the evidence suggested that habitat loss would result in a lower escapement goal for this tributary (Riverscape Analysis Project, University of Montana Flathead Lake Biological Station, http://rap.ntsg.umt.edu/). In order to form new, more representative SEGs for the Kwethluk, George, and Kogrukluk rivers Chinook salmon stocks, the review team decided to base them on the average proportion of drainagewide escapement contributed by each tributary stock. The goal recommendations were determined by multiplying the upper and lower bounds of the recommended drainagewide goal by the average proportional escapement in each tributary (tributary escapement divided by total drainage escapement). Detailed methods and results from the modeling and decision-making process for Kuskokwim drainagewide and tributary Chinook salmon goals are presented in a separate report (Hamazaki et al. 2012a).

Other Chinook salmon goals on Kuskokwim River tributaries and goals on the Goodnews and Kanektok rivers, which drain into Kuskokwim Bay, appear to be adequate and performing acceptably. Most of these goals are assessed with aerial surveys, long after the runs have passed through the fisheries. For this reason, and also because most escapement time series were not yet long enough, no other new goals were recommended for Kuskokwim area Chinook salmon stocks (Table 4).

Existing chum salmon escapement goals in the Kuskokwim area are SEGs based on sonar, weir, and aerial survey counts (Table 3), and assessments are completed only after most of these runs have passed through the fisheries. Aerial survey assessment of the existing goal for Kanektok River chum salmon has been inadequate due to difficult weather conditions, aircraft availability, and uncertainty in the relationship of survey to peak spawning timing. Therefore, the review team recommended eliminating this goal (Table 4). Limited information on total chum salmon abundance, run timing of specific stocks, and stock composition of harvests precludes the establishment of a drainagewide chum salmon goal on the Kuskokwim River. Exploitation on chum salmon is probably low, but has varied, and could be affected by the high priority placed upon Chinook salmon management in the river. The review team decided that further work towards a whole river chum salmon goal was needed, but recommended no other changes to existing chum salmon goals for the current cycle (Table 4).

No changes were recommended for coho and sockeye salmon goals in the Kuskokwim area (Table 4). Existing goals were set in 2005 and 2010 and have performed adequately. Goals may be warranted for those coho salmon stocks without goals which have weir-based assessments, and for the Kwethluk and Kanektok sockeye salmon stocks (Table 3). However, available information for the 2013 review cycle was minimal and the review team recommended waiting until more information becomes available in the next cycle before recommending any new goals.

Table 4.–Summary of escapement goal recommendations for Kuskokwim Management Area salmon stocks for 2013.

Stock Unit	Assessment Method	Most Recent Escapement Goal			Recommendation for 2013		
		Goal	Type	Year Established or Last Revised	Action	New or Revised Goal	Type
Chinook Salmon							
Kuskokwim River and tributaries							
Kuskokwim River (entire drainage)	Run reconstruction[a]				Establish goal	65,000–120,000	SEG
Aniak River	Aerial Survey	1,200–2,300	SEG	2005	No change		
Cheeneetnuk River	Aerial Survey	340–1,300	SEG	2005	No change		
Gagarayah River	Aerial Survey	300–830	SEG	2005	No change		
George River	Weir	3,100–7,900	SEG	2007	Revise goal	1,800–3,300	SEG
Holitna River	Aerial Survey	970–2,100	SEG	2005	No change		
Kisaralik River	Aerial Survey	400–1,200	SEG	2005	No change		
Kogrukluk River	Weir	5,300–14,000	SEG	2005	Revise goal	4,800–8,800	SEG
Kwethluk River	Weir	6,000–11,000	SEG	2007	Revise goal	4,100–7,500	SEG
Pitka Fork Salmon River	Aerial Survey	470–1,600	SEG	2005	No change		
Salmon River (Aniak Drainage)	Aerial Survey	330–1,200	SEG	2005	No change		
Tuluksak River	Weir	1,000–2,100	SEG	2007	Eliminate goal		
Kuskokwim Bay							
Kanektok River	Aerial Survey	3,500–8,000	SEG	2005	No change		
Middle Fork Goodnews River	Weir	1,500–2,900	BEG	2005	No change		
North (Main) Fork Goodnews R.	Aerial Survey	640–3,300	SEG	2005	No change		
Chum Salmon							
Kuskokwim River and tributaries							
Aniak River	Sonar	220,000–480,000	SEG	2007	No change		
Kogrukluk River	Weir	15,000–49,000	SEG	2005	No change		
Kuskokwim Bay							
Kanektok River	Aerial Survey	>5,200	SEG	2005	Eliminate goal		
Middle Fork Goodnews River	Weir	>12,000	SEG	2005	No change		
Coho Salmon							
Kuskokwim River and tributaries							
Kogrukluk River	Weir	13,000–28,000	SEG	2005	No change		
Kwethluk	Weir	>19,000	SEG	2010	No change		
Kuskokwim Bay							
Middle Fork Goodnews River	Weir	>12,000	SEG	2005	No change		
Sockeye Salmon							
Kuskokwim River and tributaries							
Kogrukluk River	Weir	4,400–17,000	SEG	2010	No change		
Kuskokwim Bay							
Goodnews River (Main Fork)	Aerial Survey	5,500–19,500	SEG	2005	No change		
Middle Fork Goodnews River	Weir	18,000–40,000	BEG	2007	No change		
Kanektok River	Aerial Survey	14,000–34,000	SEG	2005	No change		

[a] Run reconstruction is conducted postseason, and uses a model to estimate total return from harvest and escapement monitoring projects.

YUKON MANAGEMENT AREA

In the Yukon Management Area, which includes the U.S. portion of the Yukon River drainage and coastal waters between Point Romanof and the Naskonat Peninsula, 15 established escapement goals for 6 Chinook salmon, 2 summer chum salmon, 6 fall chum salmon, and 1 coho salmon stocks were reviewed. Additionally, information from 1 Chinook, 2 summer chum, 1 fall chum, and 2 coho salmon stocks without existing escapement goals was reviewed (Table 5). Included in the potential new goals considered were Yukon River drainage-wide goals for summer chum and coho salmon.

Table 5.–Yukon area stocks reviewed for escapement goals during the 2013 cycle.

Stocks with Existing Goals	Assessment Method	Type	Year Established	Goal
Chinook salmon (6)				
East Fork Andreafsky River	Weir	SEG	2010	2,100–4,900
West Fork Andreafsky River	Aerial survey	SEG	2005	640–1,600
Anvik River	Aerial survey	SEG	2005	1,100–1,700
Nulato River	Aerial survey	SEG	2005	940–1,900
Chena River	Tower	BEG	2001	2,800–5,700
Salcha River	Tower	BEG	2001	3,300–6,500
Summer chum salmon (2)				
East Fork Andreafsky River	Weir	SEG	2010	>40,000
Anvik River	Sonar	BEG	2005	350,000–700,000
Fall chum salmon (6)				
Yukon River (drainagewide)	Run reconstruction (multiple inputs)	SEG	2010	300,000–600,000
Tanana River	Run reconstruction (multiple inputs)	BEG	2001	61,000–136,000
Delta River	Foot survey	BEG	2001	6,000–13,000
Upper Yukon Tributaries	Run reconstruction	BEG	2001	152,000–312,000
Chandalar River	Sonar	BEG	2001	74,000–152,000
Sheenjek River	Sonar	BEG	2001	50,000–104,000
Coho salmon (1)				
Delta Clearwater R.	Boat survey	SEG	2005	5,200–17,000
Stocks without goals[a]				
Chinook salmon (1)				
Gisasa River	Weir			Aerial survey-based goal was eliminated in 2010
Summer chum salmon (2)				
Yukon River (drainagwide)	Run reconstruction, sonar			
Salcha River	Aerial survey, tower			
Fall chum salmon (1)				
Toklat River	Foot survey			Goal was eliminated in 2010
Coho salmon (2)				
Nenana River	Aerial survey			
Yukon River (drainagewide)	Run reconstruction, sonar			

[a] Stocks without goals were selected for review during the 2013 cycle based upon the existence of a fishery harvesting that stock and availability of assessment information. This is not an exhaustive list of all stocks within the Yukon area.

Yukon area Chinook salmon escapement goals do not include the goal for escapement or passage at the U.S.-Canada border, because that goal is set by the Yukon River Panel according to the terms of the *Yukon River Salmon Agreement*. For Chinook salmon stocks in the U.S. portions of the drainage, escapement assessments in the lower river are limited. The Pilot Station sonar project provides a measure of total run abundance from Pilot Station upwards, and towers on the Chena and Salcha rivers provide good assessment for the Tanana River in the middle portion of the drainage. Aerial surveys are conducted in a few other tributaries but their accuracy is questionable. Weir and aerial survey counts, in general, are obtained after most of the run has passed through the fisheries, at least on the lower river, so have limited utility for inseason management. The review team considered whether to recommend eliminating the aerial survey-based Chinook salmon goals on the West Fork Andreafsky, Anvik, and Nulato rivers due to these limitations. According to radiotelemetry data, Anvik River contribution to the overall Yukon Chinook salmon escapements is about 5.5% and Nulato River about 2.4% (Spencer et al. 2006). Review of aerial survey data showed no major problems or gaps and because these data, however limited, provide some information on lower river Chinook salmon stocks, the review team decided to recommend continuing those goals (Table 6). The aerial survey-based Chinook salmon goal on the Gisasa River, contributing about 1.2% of overall Chinook salmon escapement, was eliminated in the 2010 cycle (Volk et al. 2009). A new weir-based goal for this tributary was considered, but not recommended for the 2013 cycle because existing data barely met time series length and contrast criteria, and a goal would have little or no utility for management. With respect to Chinook salmon goals in the Chena and Salcha rivers, over half of observed escapements since 1985 have exceeded their respective upper bound (although not so for the Chena River stock since 2006; Savereide 2012). Management to keep these escapements below their upper bounds would be constrained by the recent years' priority on achieving minimum Canadian border passage, the effect of which has sharply limited fishing effort below the Tanana River. Fishing power within the Tanana River itself is likely insufficient to enable managers to keep escapements below the upper goal bound by increasing fishing. After considering an updated analysis, the review team recommended not changing the 2 goals (Table 6), but they suggested that ADF&G further consider effects on Alaska Chinook salmon stocks of managing primarily for Canadian Yukon stocks. Finally, the review team and other ADF&G staff have received comments suggesting they consider escapement goals specific to female Chinook salmon and Chinook salmon age-5 and older. However, necessary assumptions for determining such goals are not well established at present and managing for them would not be logistically feasible.

After reviewing available information for Yukon River summer chum salmon stocks, the review team recommended no changes to existing goals and no new goals (Table 6). A drainagewide escapement goal for summer chum salmon is needed, but the necessary analysis, including a run reconstruction based on Pilot Station sonar and other available data, has not yet been completed. A proposed radio telemetry mark–recapture project would contribute valuable information to any run reconstruction.

Table 6.–Summary of escapement goal recommendations for Yukon River Management Area for 2013.

Stock Unit	Assessment Method	Most Recent Escapement Goal			Escapement Goal Recommendation for 2013		
		Goal	Type	Year Established or Last Revised	Action	New or Revised Goal	Type
Chinook salmon[a]							
Andreafsky River (East Fork)	Weir	2,100–4,900	SEG	2010	No change		
Andreafsky River (West Fork)	Aerial Survey	640–1,600	SEG	2005	No change		
Nulato River (forks combined)	Aerial Survey	940–1,900	SEG	2005	No change		
Anvik River	Aerial Survey	1,100–1,700	SEG	2005	No change		
Chena River	Tower/Mark-Recapture	2,800–5,700	BEG	2001	No change		
Salcha River	Tower/Mark-Recapture	3,300–6,500	BEG	2001	No change		
Chum Salmon (Summer)							
East Fork Andreafsky River	Weir	>40,000	SEG	2010	No change		
Anvik River	Sonar	350,000–700,000	BEG	2005	No change		
Chum Salmon (Fall)[b]							
Yukon R (drainagewide)[c]	Multiple[d]	300,000–600,000	SEG	2010	No change		
Tanana River	Expanded Foot Survey	61,000–136,000	BEG	2001	No change		
Delta River	Foot Survey	6,000–13,000	BEG	2001	No change		
Upper Yukon R. Tributaries[e]	Multiple[f]	152,000–312,000	BEG	2001	No change		
Chandalar River	Sonar	74,000–152,000	BEG	2001	No change		
Sheenjek River	Sonar	50,000–104,000	BEG	2001	No change		
Coho Salmon							
Delta Clearwater River	Boat survey	5,200–17,000	SEG	2005	No change		

[a] The Canadian border Chinook salmon escapement goal was established under the *Yukon River Salmon Agreement* and is reviewed annually by the Yukon River Panel. It is not included as part of this summary.

[b] The Canadian fall chum salmon border escapement goal and the Fishing Branch River goal, which are under the *Yukon River Salmon Agreement* and reviewed annually by the Yukon River Panel, are not included in this summary.

[c] This goal includes all Alaska and Canadian stocks.

[d] Includes foot survey, weir, sonar, and aerial survey counts.

[e] Includes Chandalar, Sheenjek, and Fishing Branch rivers. Per footnote 2 above, Fishing Branch River is not listed as an individual goal.

[f] Includes sonar, weir, and aerial survey counts.

Fall chum salmon escapement goals do not include goals for mainstem Yukon River passage at the Canadian border or escapement in the Fishing Branch River. Both of these goals are set by the Yukon River Panel according to the terms of the *Yukon River Salmon Agreement*. The fall chum salmon drainagewide escapement goal does include all U.S. and Canadian stocks and is a BEG based on a run reconstruction and Bayesian spawner-recruit analysis completed for the 2010 review cycle. Assessment projects in some tributaries were expected to be discontinued eventually, and tributary escapements estimated by genetic proportions of these stocks in the Pilot Station sonar counts (Fleischman and Borba 2009). Projections for Tanana River abundance are made on this basis, but the actual assessment of the Tanana River escapement goal is made on the basis of a regression relationship with the Delta River survey count. The history of the run reconstruction, escapement goal, and current assessments were reviewed, and the review team considered whether the goal on the Tanana River should be continued since it has no independent assessment. Ultimately, it decided to recommend leaving the Tanana fall chum salmon goal in place, along with all other Yukon River fall chum salmon goals, and it did not reconsider the Toklat River fall chum goal that was eliminated in the 2010 cycle. The review team also recommended continuing unchanged the only coho salmon escapement goal in the Yukon area, and did not recommend any new goals due to insufficient information (Table 6). A radio telemetry mark–recapture project for Yukon River coho salmon has been proposed in the past and would provide important information that may make a run reconstruction and better escapement estimates possible in the future.

NORTON SOUND-PORT CLARENCE AND KOTZEBUE MANAGEMENT AREAS

The Norton Sound-Port Clarence and Kotzebue Management Areas include all waters from Point Romanof to Point Hope, and St. Lawrence Island. In the Norton Sound-Port Clarence Management Area, 23 established escapement goals for 5 Chinook salmon, 8 chum salmon, 3 coho salmon, 5 pink salmon, and 2 sockeye salmon stocks were reviewed. In the Kotzebue Management Area, 6 existing chum salmon escapement goals were reviewed. In addition, information was reviewed from 1 Chinook salmon, 10 coho salmon, 6 pink salmon, and 2 sockeye salmon stocks without existing goals in the Norton Sound-Port Clarence Management Area (Table 7). The coho salmon stock in the Unalakleet River was considered for a new goal which would be assessed by means of tower counts on the North River tributary, replacing the existing aerial survey goal. Likewise, the review team considered whether aerial survey based sockeye salmon goals on Salmon and Glacial lakes should be replaced with weir based goals (Table 7).

Chinook salmon are primarily produced in the southeastern portion of Norton Sound. In recent years, new assessment projects have been implemented, including sonar on the Shaktoolik River and a weir on the Unalakleet River, but datasets from these projects are not yet long enough to permit robust escapement goal evaluation. Some of the older assessment projects were located in tributaries and mainstem assessments were not available (or datasets are still too short for setting escapement goals), so the goals were essentially indices of escapement. Evaluating escapement goal performance is also challenging in this area because most subsistence fishing takes place in marine waters on mixed stocks. The review team decided that existing Chinook salmon goals on Boston Creek, and Kwiniuk, North, and Old Woman rivers goals were still appropriate (Table 8). It considered a new goal on the Tubutulik Chinook salmon stock on the basis of a relationship between it and the Kwiniuk River stock, but determined that relationship was weak and therefore did not recommend a goal for the Tubutulik stock. It likewise decided that replacing the tower-based goal on the North River to a drainagewide goal on the Unalakleet

River based on a weir and run reconstruction was premature. Finally, the team recommended eliminating the Chinook salmon goal on the Shaktoolik River due to the difficulties in obtaining reliable aerial survey counts on this system. This stock is harvested primarily in marine fisheries and is managed with the Unalakleet River stock as a mixed-stock fishery. The new sonar project on the Shaktoolik River is expected to eventually provide better escapement data from which a new goal could be developed in the future.

Table 7.–Norton Sound-Port Clarence and Kotzebue area stocks reviewed for escapement goals during the 2013 cycle.

Stock with Existing Goals	Assessment Method	Type	Year Established	Goal
Chinook salmon (5)				
Fish R./Boston Cr. (Niukluk R.)	Aerial survey	SEG	2005	>100
Kwiniuk River	Tower	SEG	2005	300–550
North (Unalakleet) River	Tower	SEG	2005	1,200–2,600
Shaktoolik River	Aerial survey	SEG	2005	400–800
Old Woman (Unalakleet) River	Aerial survey	SEG	2005	550–1,100
Chum salmon (8)				
Nome Subdistrict One	Multiple	BEG	2001	23,000–35,000
Eldorado River	Aerial survey	SEG	2001	6,000–9,200
Nome River	Weir	SEG	2001	2,900–4,300
Snake River	Tower/weir	SEG	2001	1,600–2,500
Niukluk River	Tower	SEG	2010	>23,000
Kwiniuk River	Tower	BEG	2001	10,000–20,000
Tubutulik River	Aerial survey	BEG	2001	8,000–16,000
Old Woman (Unalakleet) River	Aerial survey	SEG	2005	2,400–4,800
Coho salmon (3)				
Niukluk River	Tower	SEG	2010	2,400–7,200
Kwiniuk River	Aerial survey	SEG	2005	650–1,300
North (Unalakleet) River	Aerial survey	SEG	2005	550–1,100
Pink salmon (5)				
Kwiniuk River (all)	Tower	SEG	2005	>8,400
Niukluk River (all)	Tower	SEG	2005	>10,500
Nome River (even)	Weir	SEG	2005	>13,000
Nome River (odd)	Weir	SEG	2005	>3,200
North (Unalakleet) River (all)	Aerial survey	SEG	2005	>25,000
Sockeye salmon (2)				
Salmon Lake	Aerial survey	SEG	2005	4,000–8,000
Glacial Lake	Aerial survey	SEG	2005	800–1,600
Kotzebue area chum salmon (6)				
Kotzebue (all areas)	Aerial survey	BEG	2007	196,000–421,000
Noatak/Eli rivers	Aerial survey	SEG	2007	42,000–91,000
Salmon River	Aerial survey	SEG	2007	3,300–7,200
Squirrel River	Aerial survey	SEG	2007	4,900–10,500
Tutuksuk River	Aerial survey	SEG	2007	1,400–3,000
Upper Kobuk and Selby rivers	Aerial survey	SEG	2007	9,700–21,000
Stocks Without Goals[a]				
Chinook salmon (1)				
Unalakleet River	Run reconstruction			
Coho salmon (10)				
Kwiniuk River	Tower			
North (Unalakleet) River	Tower			
Bonanza River	Aerial survey			
Eldorado River	Aerial survey			

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Stock with Existing Goals	Stock with Existing Goals	Stock with Existing Goals
Nome River	Aerial survey	
Sinuk River	Aerial survey	
Snake River	Aerial survey	
Solomon River	Aerial survey	
Tubutulik River	Aerial survey	
Pink salmon (6)		
Bonanza River	Aerial survey	
Eldorado River	Aerial survey	
Sinuk River	Aerial survey	
Snake River	Aerial survey	
Solomon River	Aerial survey	
Tubutulik River	Aerial survey	
Sockeye salmon (2)		
Salmon Lake/Pilgrim R	Weir	
Glacial Lake	Weir	

[a] Stocks without goals were selected for review during the 2013 cycle based upon the existence of a fishery harvesting that stock and availability of assessment information. This is not an exhaustive list of all stocks within the Norton Sound-Port Clarence and Kotzebue areas.

Data and escapement goal performance for the Nome Subdistrict aggregate chum salmon stock and its component stocks, and other Norton Sound area chum salmon stocks were reviewed and no changes were recommended for any of these escapement goals (Table 8). The team noted that the goal for the Niukluk River stock was changed in 2010 on the basis of a risk analysis, and that a risk analysis is currently being performed for the Nome Subdistrict aggregate stock. The team recommended that Nome Subdistrict chum salmon goals be re-evaluated after that risk analysis has been completed.

Revision of the 2 existing aerial survey based escapement goals for coho salmon in the Norton Sound area was considered because in each case, a new goal could potentially have been estimated using recent tower count data. For the Kwiniuk River stock, 10 years' count data were available, but the relationship between tower and aerial survey counts was not statistically significant and the team did not recommend revising the goal in the 2013 cycle. Even fewer years' count data were available for the North River stock, but the review team considered whether a relationship between tower and aerial survey counts could be used to extrapolate the tower count series back in time. Some tower counts were incomplete, however, and the decision was ultimately made to not recommend revising the North River coho salmon goal in the 2013 cycle. The tower-based coho salmon goal on the Niukluk River was revised in the 2010 review cycle to account for sport and subsistence harvest upstream of the tower and was not considered for revision again in 2013. The review team also considered whether an escapement goal could be established for the Nome Subdistrict aggregate coho salmon stock. Coho salmon harvests have been substantial in recent years, including commercial harvest on mixed stocks and subsistence and sport harvest, mostly in individual systems. Weirs on the Nome and Snake rivers could potentially provide assessment data for the aggregate stock or be used to estimate escapement in the other systems based on relationships with aerial survey data. However, the weir data did not appear to have a strong relationship with aerial survey data from the other systems in this subdistrict, and the review team did not recommend new goals for the aggregate or any individual coho stocks (Table 8).

Table 8.–Summary of escapement goal recommendations for Norton Sound-Port Clarence and Kotzebue Management Areas for 2013.

Stock Unit	Assessment Method	Most Recent Escapement Goal			Escapement Goal Recommendation for 2013		
		Goal	Type	Year Established or Last Revised	Action	New or Revised Goal	Type
Norton Sound/Port Clarence Management Area							
Chinook Salmon							
Fish R./Boston Cr. (Niukluk R.)	Aerial survey	>100	SEG	2005	No change		
Kwiniuk River	Tower	300–550	SEG	2005	No change		
Tubutulik River	Aerial survey	none			No change		
North River (Unalakleet R.)	Tower	1,200–2,600	SEG	2005	No change		
Old Woman R. (Unalakleet R.)	Aerial survey	550–1,100	SEG	2005	No change		
Shaktoolik River	Aerial survey	400–800	SEG	2005	Eliminate goal		
Chum Salmon							
Nome Subdistrict 1 Aggregate	Multiple	23,000–35,000	BEG	2001	No change		
Eldorado River	Expanded aerial survey	6,000–9,200	SEG	2005	No change		
Nome River	Weir	2,900–4,300	SEG	2005	No change		
Snake River	Tower/weir	1,600–2,500	SEG	2005	No change		
Kwiniuk River	Tower	11,500–23,000	OEG	2001	No change		
Niukluk River (Fish R.)	Tower	>23,000	SEG	2010	No change		
Old Woman R. (Unalakleet R.)	Aerial survey	2,400–4,800	SEG	2005	No change		
Tubutulik River	Expanded aerial survey	8,000–16,000	BEG	2001	No change		
Coho Salmon							
Kwiniuk River	Aerial survey	650–1,300	SEG	2005	No change		
Niukluk River	Tower	2,400–7,200	SEG	2010	No change		
North River (Unalakleet R.)	Aerial survey	550–1,100	SEG	2005	No change		
Pink Salmon							
Kwiniuk River (all years)	Tower	>8,400	SEG	2005	No change		
Niukluk River (all years)	Tower	>10,500	SEG	2005	No change		
Nome River (even year)	Weir	>13,000	SEG	2005	No change		
Nome River (odd year)	Weir	>3,200	SEG	2005	No change		
North River (Unalakleet. R. all years)	Tower	>25,000	SEG	2005	No change		
Sockeye Salmon							
Salmon Lake	Aerial survey	4,000–8,000	SEG	2005	No change		
Glacial Lake	Aerial survey	800–1,600	SEG	2005	No change		

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Table 8.–Page 2 of 2.

Stock Unit	Assessment Method	Most Recent Escapement Goal			Escapement Goal Recommendation for 2013		
		Goal	Type	Year Established or Last Revised	Action	New or Revised Goal	Type
Kotzebue Management Area							
Chum Salmon							
Kotzebue (all areas)	Expanded aerial survey	196,000–421,000	BEG	2007	No change		
Noatak/Eli rivers	Aerial survey	42,000–91,000	SEG	2007	No change		
Salmon River (Kobuk R. drainage)	Aerial survey	3,300–7,200	SEG	2007	No change		
Squirrel River (Kobuk R. drainage)	Aerial survey	4,900–10,500	SEG	2007	No change		
Tutuksuk River (Kobuk R. drainage)	Aerial survey	1,400–3,000	SEG	2007	No change		
Upper Kobuk and Selby rivers	Aerial survey	9,700–21,000	SEG	2007	No change		

The review team considered the possibility of revising sockeye salmon escapement goals on the Salmon Lake/Pilgrim River and Glacial Lake stocks, changing from aerial survey to weir-based assessments. Salmon Lake was fertilized intermittently from the 1990s through about 2007 to stimulate sockeye salmon production, but fertilization program results were inconclusive and did not show clear evidence for a lasting increase or decrease or no change in productivity (Hamazaki et al. 2012b). A run reconstruction was conducted using data series starting in 1994, with a conversion factor to generate simulated weir estimates from aerial survey counts for the earlier years. The reconstruction results were used in a spawner-recruit analysis and S_{msy} was estimated to be about 12,000 fish. Glacial Lake was never fertilized. The relationship between aerial survey and weir counts was poor on that stock, but harvest rates are very low. The review team did not recommend revision of either sockeye salmon goal (Table 8).

Information for Norton Sound area pink salmon stocks indicated high escapements, in general, relative to harvest levels. Pink salmon are an important subsistence resource in the area, but the commercial fishery is limited by market availability. The review team recommended no revisions to existing Norton Sound pink salmon goals and no new goals.

No revisions were recommended for escapement goals on Kotzebue area chum salmon stocks, which were all established in 2007 (Table 8).

EFFECT OF 2013 ESCAPEMENT GOAL RECOMMENDATIONS ON STOCKS OF CONCERN

The department developed recommendations for stocks of concern designations at the end of the 2012 fishing season, prior to adoption of goals recommended in this report. Stocks of concern definitions are given in the SSFP and currently, 4 stocks meet criteria for stocks of concern (Table 9). Stocks of concern will continue to be evaluated with existing goals; no recommendations are being made to add, revise, or eliminate escapement goals on stocks currently listed.

Table 9.–Arctic-Yukon-Kuskokwim Region salmon stocks of concern designated in 2010 and recommendations for 2013.

		Level of Concern				
Area/Stock	Salmon Species	September 2000	January 2004	February 2007	January 2010 (Current Status)	October 2012 Recommendation
Norton Sound Area						
Subdistrict 1	Chum	Management	Management	Changed to Yield	Yield	Continue
Subdistricts 2 and 3	Chum	Yield	Yield	Yield	Yield	Continue
Subdistricts 5 and 6	Chinook	NA	Yield	Yield	Yield	Continue
Yukon Area						
Yukon River	Chinook	Yield	Yield	Yield	Yield	Continue

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