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# Escapement Goal Recommendations for Select Arctic-Yukon-Kuskokwim Region Salmon Stocks, 2007

**by**

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**and**

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**REVISION**

02-15-2007

This report contains a revised upper limit (6,100) to the SEG for Niukluk River coho salmon on Table 9 and in Appendix B. The revised SEG is based correctly on the tower count of 4,713 coho salmon in 1995 whereas the previous value was based on a 1995 tower count of 4,173.

Changes to document are contained on:
Page 19
Page 40
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**December 2006**

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

## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

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

*FISHERY MANUSCRIPT NO. 06-07*

# ESCAPEMENT GOAL RECOMMENDATIONS FOR SELECT ARCTIC-YUKON-KUSKOKWIM REGION SALMON STOCKS, 2007

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# ABSTRACT

An Alaska Department of Fish and Game Escapement Goal Review Team (review team) was convened to review salmon escapement goals for the Arctic-Yukon-Kuskokwim Region in preparation for the January 2007 meeting of the Alaska Board of Fisheries. The review team made recommendations to the Regional Supervisors of the Divisions of Commercial Fisheries and Sport Fish, who in turn make recommendations to the directors of the two divisions. The review team recommended establishing three new escapement goals in the Kuskokwim Management Area, no new goals in the Yukon Management Area, and two new goals in the Norton Sound-Port Clarence and Kotzebue Management Areas. In addition they recommended revising three escapement goals in the Kuskokwim Management Area (one for Chinook salmon, one for chum salmon, and one for sockeye salmon), none in the Yukon Management Area, and five chum salmon goals in the Kotzebue Management Area. They also recommended discontinuing one aerial survey escapement goal in the Kuskokwim Management Area where that goal was recommended to be replaced with a weir goal. While most of the recommended new goals are sustainable escapement goals, spawner-recruit analyses were performed to recommend biological escapement goals for Kobuk and Noatak rivers chum salmon in the Kotzebue Management Area and Middle Fork Goodnews River Chinook and Sockeye salmon in the Kuskokwim Management Area. The escapement goal review team also made recommendations for specific stocks to be reviewed in detail prior to the 2010 Alaska Board of Fisheries meeting.



Key words: Pacific salmon, *Oncorhynchus*, escapement goal, Arctic-Yukon-Kuskokwim, stock status, Alaska Board of Fisheries.


# INTRODUCTION

This report makes recommendations for escapement goals for salmon stocks of the Kuskokwim (Kuskokwim River and Kuskokwim Bay), Yukon River, Norton Sound-Port Clarence, and Kotzebue Management Areas (Figure 1). In the process of coming to these recommendations, detailed analyses were performed for some stocks. Those analyses were published in separate reports (Eggers and Clark 2006; Estensen and Evenson 2006; Molyneaux and Brannian *In prep*) and the results are summarized here. 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* (Sustainable Salmon Policy: 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.

Escapement goals recommended in this report are the products of several collaborative meetings of the Arctic-Yukon-Kuskokwim (AYK) Region Escapement Goal Review Team (review team), Alaska Department of Fish and Game (ADF&G) staff, and guests from federal agencies, and various non-governmental organizations. The review team was co-chaired by Matt Evenson, Linda Brannian, and John Hilsinger and also included Doug Eggers and Dave Bernard. The review team helped direct the work of other staff and reviewed that work in the process of making escapement goal recommendations.

The review team was assigned to review escapement and other data and make escapement goal recommendations in preparation for the AYK Region regulatory meeting scheduled for January 2007. Formal meetings were conducted on April 25 to 26, 2005 and November 15 to 16, 2005 to discuss and develop assignments and recommendations. Draft analyses, updates, and preliminary recommendations were distributed and reviewed via e-mail. Participation in these meetings and review of analyses by representatives of non-governmental organizations, federal agencies, and the public was greatly appreciated. These recommendations, however, are only those of the review team and other ADF&G staff.


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

## ESCAPEMENT GOALS

The Sustainable Salmon Policy defines three types of escapement goals that are set by the department.

### Biological Escapement Goal (BEG)

*Biological Escapement Goal* (BEG) means the escapement that provides the greatest potential for maximum sustained yield (MSY); BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted; BEG will be developed from the best available biological information, and should be scientifically defensible on the basis of available biological information; 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)

*Sustainable Escapement Goal* (SEG) means 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)

*Sustained Escapement Threshold* (SET) means 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.

## CRITERIA FOR ESTABLISHING TYPE OF ESCAPEMENT GOAL

The majority of salmon stocks in the AYK Region do not have sufficient quantity or quality of data to develop BEG recommendations. For those stocks that have sufficient escapement information, but lack the data to estimate total returns, sustainable escapement goals (SEG) may be developed. Bue and Hasbrouck (Unpublished) suggested the following criteria for categorizing data needed to develop BEGs and SEGs depending 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 are of questionable accuracy and/or precision; *data may allow construction of brood table; data time series relatively short to accurately estimate MSY* (emphasis added).

**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.

BEGs are established to provide levels of escapement that will produce large returns with large harvestable surpluses on average. Escapements above or below these levels may be sustainable, but will on average produce less fish for people to catch. Few stocks in the AYK region have data that qualifies as “good” or “excellent” according to the Bue and Hasbrouck criteria above, which are needed in order to establish BEGs. Such data sets are available for Middle Fork Goodnews River Chinook and sockeye salmon, Anvik and Andreafsky rivers summer chum salmon, Chena and Salcha rivers Chinook salmon, Yukon fall chum salmon, Kwiniuk and Tubutulik rivers chum salmon, Norton Sound Subdistrict 1 (Nome) chum salmon, and Kotzebue area chum salmon. A major impediment to establishing more BEGs in the region is the difficulty of accurately apportioning harvest to river of origin in order to determine total return.

SEGs are set to provide levels of escapement that will produce runs and harvests similar to what has occurred in the past. Most escapement goals in the AYK Region are SEGs because the data fall into the fair and poor categories or because the time series of good and excellent quality data is too short to perform a reliable BEG analysis. Usually, inadequate data exists to determine total escapement or total return for a given stock. Great advances in stock assessment have been made in the AYK Region in recent years. More stocks have escapement assessed by weirs or towers, mark–recapture and sonar projects provide total abundance estimates for several stocks, and radiotelemetry provides valuable information on the distribution of salmon. Many of these projects have operated less than 10 years and sufficient data do not yet exist to develop escapement goals, but over the next 3 to 6 years these data should significantly improve the ability to set scientifically defensible escapement goals in the AYK Region that will provide for high levels of yield.

During its regulatory process, the board reviews BEGs, SEGs, and SETs, and with the assistance of the department, determines the appropriateness of establishing an optimal escapement goal.

## OPTIMAL ESCAPEMENT GOAL (OEG)

*Optimal Escapement Goal* (OEG) means 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 then provide an explanation of the reasons for establishing an OEG and provide, to the extent practicable, and 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.

No formal policy existed for setting escapement goals until 1992, when Commissioner Carl Rosier signed the first escapement goal policy into effect. This policy required that escapement goals be documented in written reports, which was first done for AYK Region by Buklis (1993). A review of Norton Sound escapement goals and recommendations for revisions was completed by Fair et al. (1999), but these revisions were never officially adopted.

Prior to adoption of the regulatory Escapement Goal Policy in 2001, all escapement goals established by the department for stocks in these areas were termed biological escapement goals. However, most of these goals did not meet the criteria for a BEG under the new policy definition. At the 2001 board meeting, only select stocks were reviewed and biological escapement goals were established consistent with the Sustainable Salmon Policy definitions and the Escapement Goal Policy process (Clark 2001a, b, c; Clark and Sandone 2001; Eggers 2001; Evenson 2002).

## ESCAPEMENT GOAL REVIEW 2004

In 2004, a review team reviewed all stocks with escapement goals and provided recommendations for continuing a goal, establishing a new goal consistent with the Sustainable Salmon Policy, or discontinuing a goal (ADF&G 2004). Under the new policy, escapement goals must be approved by the Directors of the Divisions of Commercial Fisheries and Sport Fish. Goals recommended at the January 2004 Alaska Board of Fisheries meeting were officially adopted by the Department in May 2005 (Appendix A). At least two escapement goal

recommendations were changed by the review team just prior to, or during, the 2004 board meeting. Therefore the recommendations contained in the 2004 escapement goal report (ADF&G 2004) do not accurately reflect the goals adopted by the Directors.

In preparation for the 2007 board meeting, the review team reviewed escapement and harvest data for 57 Kuskokwim Area stocks, 39 Yukon Area stocks, and 54 Norton Sound-Port Clarence and Kotzebue Area stocks. Of these 150 stocks, 72 had existing escapement goals that were reviewed, revised, or established in 2004/2005. Since only 2 years of additional data exist for those stocks since they were last reviewed (2004 and 2005), the review team focused it efforts on stocks for which there was sufficient additional data or a new analytical technique to warrant a through review and analysis. Among the stocks for which the review team assigned analyses, were stocks that have relatively few escapement counts from recent tower or weir projects, but have no escapement goal, or have a goal based on a different enumeration procedure, such as aerial survey counts. The team reviewed escapement data from these stocks to determine if a goal could be developed based on the current escapement monitoring method. In some cases, the number of escapement estimates was sufficient to define goals consistent with the Sustainable Salmon Policy and the Escapement Goal Policy. The team recognized the value of having a goal based on the more rigorous enumeration method and, in some cases, is recommending goals for these stocks. The team also used a watershed area method (Parken et al. 2004) of setting escapement goals for comparison with the Bue and Hasbrouck (Unpublished) method, which was used to set SEG ranges in 2005 and again in the current review. Finally, there were several stocks in the Kotzebue and Kuskokwim Management Areas where sufficient data were available to perform a detailed spawner-recruit analysis and recommend biological escapement goals.

In order to give adequate time for public review, the review team committed to providing draft analyses and recommendations at least 1 month prior to the AYK Alaska Board of Fisheries meeting proposal deadline of April 10, 2006. In order to accomplish this, the review team focused on escapement goals for river systems that had accumulated sufficient data, or for which a more detailed review could be done because of the quantity, quality, and type of data available. These stocks were primarily in the Kotzebue and Kuskokwim Management Areas, although an escapement goal is also recommend for one Norton Sound-Port Clarence Management Area stock. No SETs are recommended for any stocks because the criteria for setting a SET suggest that it be estimated based on the lower ranges of historical escapement levels for which the stock has consistently demonstrated the ability to sustain itself. Lower escapement levels observed in the late 1990s and early 2000s began to provide full returns in 2004 and 2005 when the 4, 5, and 6-year old fish returned from the 1999 and 2000 escapements. These returns have generally been very good. This assessment will continue at least through 2009 when all the 6-year old fish will have returned from the 2003 escapement.

Throughout this report, stocks are listed by area from south to north. That is Kuskokwim Management Area comes first, followed by Yukon Management Area, and then the Norton Sound-Port Clarence and Kotzebue Management Areas. Within each management area, stocks are listed alphabetically by species first and within each species they are listed alphabetical by river system. For example, Chinook salmon come before chum salmon and among Chinook salmon systems; the Aniak River comes before the Cheeneetnuk River.

# METHODS

The escapement goal team evaluated the type, quality, and amount of data for each stock to determine the appropriate type of escapement goal as defined in the Sustainable Salmon Policy. Available data on escapement, harvest, and age composition for each stock were compiled from research reports, management reports, and unpublished historical databases. The following methods were used to set BEGs and SEGs.

## METHODS FOR SETTING BIOLOGICAL ESCAPEMENT GOALS

The analyses used to develop the BEGs during this review used various methods for reconstructing runs, but all used Ricker two parameter spawner-recruit models to estimate the escapement that produces maximum sustained yield (MSY). A range of escapements that produce 90% or more of MSY or represent the 90% credible bounds for spawners at MSY was used as the range for the BEG. For the remainder of stocks in the region, data were of insufficient quality or quantity to develop a BEG. In general, a relatively long series of escapement and total return estimates are needed. Optimal length of a data set can vary, but ideally, it would include several generations of fish, and variability, or contrast, in the numbers of spawners and the subsequent returns. Secondly, stock specific age composition and harvest data are necessary in order to develop a complete picture of the total returns from each brood year. Because many of the salmon fisheries in the region are mixed stock fisheries, it is rare that the exact contribution of a specific stock to subsistence, commercial, or sport harvests is known.

## METHODS FOR SETTING SUSTAINABLE ESCAPEMENT GOALS

Bue and Hasbrouck (Unpublished) suggested criteria to estimate sustainable escapement goals (SEGs) for Upper Cook Inlet salmon stocks (Table 1):

**Table 1**.–Criteria to estimate sustainable escapement goals by Bue and Hasbrouck (Unpublished).

| 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.

These criteria were used to assess the available salmon escapement data for all areas of the AYK Region and make recommendations for SEGs for many of those stocks where the data were not suitable for establishing BEGs. For a few stocks, a minimum SEG point threshold was recommended in 2005 rather than a range. Threshold SEG goals were only considered in situations where a stock is managed incidentally to a targeted stock, fishing power is low, or there is no apparent relationship between spawners and recruits (e.g. some Norton Sound pink salmon stocks).

Goals were established 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.

There is still considerable debate within the department and public as to methodologies for setting SEGs and what constitutes adequate justification for setting an SEG. The review team agreed that while the methodology used in Cook Inlet in 2001 (Bue and Hasbrouck Unpublished) has a high probability of replicating the returns historically observed for a stock, it is a descriptive method not based on a determination of the relationship between spawners and recruitment.

In order to help validate the results of the Bue and Hasbrouck method with regard to Chinook salmon, the department also employed the habitat-based model developed by Parken et al. (2004). This method uses the relationship between the escapement that produces MSY ($S_{MSY}$) and the size of watershed ($km^2$) to predict $S_{MSY}$. This model is based on approximately 13 stream-type (age-1 smolt and older) Chinook salmon stocks of varying drainage areas from California to Alaska for which spawner-recruit analysis was used to estimate $S_{MSY}$. The Parken method was not used to make recommendations, but rather to help validate recommendations made based on the Bue and Hasbrouck method.

The remainder of this report presents the review team's recommendations for escapement goals in each of the areas in the AYK Region. These recommendations will be discussed and considered at length up to and during the 2007 board meeting. Final approval of escapement goals will be made by the Directors of Divisions of Commercial Fisheries and Sport Fish following the 2007 board meeting.

## KUSKOKWIM MANAGEMENT AREA

In the Kuskokwim Management Area, which includes the Kuskokwim River and Kuskokwim Bay, there are currently 22 established escapement goals for 12 Chinook salmon, 4 chum salmon, 3 coho salmon, and 3 sockeye salmon stocks (Table 2). All existing goals were established in 2005 based on recommendations from ADF&G (2004). The review team has eight recommendations for escapement goals in 2007 based on analysis by Molyneaux and Brannian (*In prep*). We recommend that three existing goals be revised, two goals be discontinued, and three new goals be established.

We recommend revisions to existing goals for Middle Fork Goodnews River Chinook salmon, Aniak River chum salmon, and Middle Fork Goodnews River sockeye salmon (Table 3). The Middle Fork Goodnews River Chinook and sockeye salmon goal revisions are the result of spawner-recruit analyses and specifying a BEG instead of the existing SEG (Molyneaux and Brannian *In prep*). The Aniak River chum salmon goal revision reflects the differences in counts between split beam sonar and DIDSON technology.

The review team is recommending three new Chinook salmon goals based on weir counts at the George, Kwethluk, and Tuluksak rivers. These recommendations result from now having a number of years of escapement counts at relatively new weir projects to calculate an SEG which were corroborated by the habitat-based model estimate of $S_{MSY}$. We also recommend that the existing Kwethluk River Chinook salmon goal based on aerial survey counts be discontinued.

Our preference is for a goal that reflects a total count of Chinook salmon with accompanying information inseason on timing (weir) rather than a postseason peak aerial survey.

The review team is recommending that the SEG for coho salmon in the Kanektok River be discontinued. Molyneaux and Brannian et al. (*In prep*) reviewed the aerial survey data set upon which this goal was based (ADF&G 2004) in context with a weir that has operated since 2001. Poor and incomplete surveys were purged from the dataset leaving 7 surveys that were flown from August 14 to October 1 a span of dates that encompasses 9% to 100% of the daily cumulative coho salmon passage during years the weir was operated. There were no paired weir and aerial survey data. The range in number of coho salmon observed during these aerial surveys is more a function of the timing of the survey in relation to coho run timing than overall abundance and was therefore not a good foundation for developing a SEG using the Bue and Hasbrouck percentile method.

Thirty-two additional stocks in the Kuskokwim Management Area were reviewed (Table 4), but no goal was recommended. Reasons for not recommending a goal are detailed and generally include lack of sufficient data or a goal has been recommended using a different enumeration method. Molyneaux and Brannian (*In prep*) prepared a detailed review of Kuskokwim escapement data and presents analyses for Kuskokwim Management Area escapement goals.

**Table 2.–**Escapement goal 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 |
| Escapement Goal Recommendation: | | | | |
| Revise [b] | 1 | 1 | 0 | 1 |
| Discontinue | 1 | 0 | 1 | 0 |
| Establish | 3 | 0 | 0 | 0 |
| No Revision | 10 | 3 | 2 | 2 |
| Total Escapement Goals (2007) | 1 BEG<br>13 SEG | 0 BEG<br>4 SEG | 0 BEG<br>2 SEG | 1 BEG<br>2 SEG |
| Stocks/data sets for which no escapement goal was established | 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 were tabulated as different stocks.

[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 dataset upon which the existing SEG was based and a run reconstruction data set upon which a spawner-recruit analysis was prepared.

**Table 3.–**Summary of escapement goal recommendations for salmon stocks of the Kuskokwim Management Area for 2007.

| | Enumeration | Escapement Goal as of 2005 | | | Escapement Goal Recommendation | | |
|---|---|---|---|---|---|---|---|
| **Stock Unit** | **Method** | **Goal** | **Type** | **Year Estab.** | **Action** | **New or Revised Goal** | **Type** |
| **Chinook Salmon** | | | | | | | |
| Aniak River | Aerial Survey | 1,200–2,300 | SEG | 2005 | No Revision | | |
| Cheneetnuk River | Aerial Survey | 340–1,300 | SEG | 2005 | No Revision | | |
| Gagaraya River | Aerial Survey | 300–830 | SEG | 2005 | No Revision | | |
| George River | Weir | None | | | Establish | 3,100–7,900 | SEG |
| Goodnews River (Main Fork) | Aerial Survey | 640–3,300 | SEG | 2005 | No Revision | | |
| Holitna River | Aerial Survey | 970–2,100 | SEG | 2005 | No Revision | | |
| Kanektok River | Aerial Survey | 3,500–8,000 | SEG | 2005 | No Revision | | |
| Kisaralik River | Aerial Survey | 400–1,200 | SEG | 2005 | No Revision | | |
| Kogrukluk River | Weir | 5,300–14,000 | SEG | 2005 | No Revision | | |
| Kwethluk River | Aerial Survey | 580–1,800 | SEG | 2005 | Discontinue | | |
| Kwethluk River | Weir | None | | | Establish | 6,000–11,000 | SEG |
| Middle Fork Goodnews River | Weir | 2,000–4,500 | SEG | 2005 | Revise | 1,500–2,900 | BEG |
| Pitka Fork Salmon River | Aerial Survey | 470–1,600 | SEG | 2005 | No Revision | | |
| Salmon River (Aniak drainage) | Aerial Survey | 330–1,200 | SEG | 2005 | No Revision | | |
| Tuluksak River | Weir | None | | | Establish | 1,000–2,100 | SEG |

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**Table 3.–**Page 2 of 2.

| Stock Unit | Enumeration Method | Escapement Goal as of 2005 Goal | Type | Year Estab. | Escapement Goal Recommendation Action | New or Revised Goal | Type |
|---|---|---|---|---|---|---|---|
| **Chum Salmon** | | | | | | | |
| Aniak River | Sonar | 210,000–370,000 | SEG | 2005 | Revise | 220,000–480,000 | SEG |
| Kanektok River | Aerial Survey | >5,200 | SEG | 2005 | No Revision | | |
| Kogrukluk River | Weir | 15,000–49,000 | SEG | 2005 | No Revision | | |
| Middle Fork Goodnews River | Weir | >12,000 | SEG | 2005 | No Revision | | |
| **Coho Salmon** | | | | | | | |
| Kanektok River | Aerial Survey | 7,700–36,000 | SEG | 2005 | Discontinue | | |
| Kogrukluk River | Weir | 13,000–28,000 | SEG | 2005 | No Revision | | |
| Middle Fork Goodnews River | Weir | >12,000 | SEG | 2005 | No Revision | | |
| **Sockeye Salmon** | | | | | | | |
| Goodnews River (Main Fork) | Aerial Survey | 5,500–19,500 | SEG | 2005 | No Revision | | |
| Kanektok River | Aerial Survey | 14,000–34,000 | SEG | 2005 | No Revision | | |
| Middle Fork Goodnews River | Weir | 23,000–58,000 | SEG | 2005 | Revise | 18,000–40,000 | BEG |

**Table 4.–**Kuskokwim area stocks for which escapement goals were not established because of insufficient data or alternative enumeration methods.

| Stock | Rationale for not Establishing an Escapement Goal |
|---|---|
| **Chinook Salmon** | |
| Arolik River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Bear Creek (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Eek River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| George River (aerial survey) | Favored weir goal because of better precision and accuracy. |
| Hoholitna River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Holokuk River (aerial survey) | Existing middle river escapement goals were considered adequate. |
| Kanektok River (weir) | Insufficient number of escapement estimates. |
| Kipchuk River (aerial survey) | Existing middle river escapement goals were considered adequate. |
| Kuskokwim R. (run reconstruction) | Lacks sufficient historical escapement data; requires extensive additional field work and analysis. |
| Oskawalik River (aerial survey) | Existing middle river escapement goals were considered adequate. |
| Pitka Fork (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Salmon River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Takotna River (weir) | Lacks sufficient historical escapement, stock contribution data, and lack of corroboration by habitat-based model. |
| Tatlawiksuk River (aerial survey) | Lacks sufficient historical escapement, stock contribution data, and lack of corroboration by habitat-based model. |
| Tatlawiksuk River (weir) | Lacks sufficient historical escapement, stock contribution data, and lack of corroboration by habitat-based model. |
| Tuluksak River (aerial survey) | Favored weir goal because of better precision and accuracy. |
| **Chum Salmon** | |
| George River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Kanektok River (weir) | Insufficient number of escapement estimates. |
| Kuskokwim R. (run reconstruction) | Lacks sufficient historical escapement data; requires extensive additional field work and analysis. |
| Kwethluk River (tower and weir) | Lacks sufficient historical escapement and stock contribution data. |
| Takotna River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Tatlawiksuk River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Tuluksak River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| **Coho Salmon** | |
| George River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Kanektok River (weir) | Insufficient number of escapement estimates. |
| Kwethluk River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Takotna River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Tatlawiksuk River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| Tuluksak River (weir) | Lacks sufficient historical escapement and stock contribution data. |
| **Sockeye Salmon** | |
| Arolik River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Kanektok River (weir) | Insufficient number of escapement estimates. |
| Kogrukluk River (weir) | Small sockeye system not representative of the Kuskokwim River |

# YUKON RIVER MANAGEMENT AREA

In the Yukon River Management Area (Yukon area), which includes the entire Yukon River drainage, there are currently 17 established escapement goals for 7 Chinook salmon, 2 summer chum salmon, 7 fall chum salmon, and 1 coho salmon stocks (Table 5). Eleven of these goals are biological escapement goals based on spawner-recruit analyses. Six are sustainable escapement goals based on the Bue and Hasbrouck method. In addition, there are three goals for Canadian stocks, not listed here, that are established by the Yukon River Salmon Agreement. Annual escapement targets for these Canadian stocks (mainstem Yukon River Chinook salmon, mainstem Yukon River fall chum salmon, and Fishing Branch River fall chum salmon) are set annually by the Yukon River panel through negotiation based on rebuilding plans.

The review team is not recommending revisions to any of the Yukon River escapement goals at this time (Table 6). Summer chum salmon biological escapement goals for the Anvik and Andreafsky rivers and fall chum salmon biological escapement goals for the entire drainage were established in 2001 based on extensive spawner-recruit analyses and were re-analyzed in 2004 using updated data sets (ADF&G 2004). The addition of 2 years data does not warrant an additional reanalysis at this time. However apparent changes in the productivity of Anvik and Andreafsky River summer chum salmon make it especially worthwhile to review those goals in 2010. The review team recommends that all Yukon area escapement goals be extensively reviewed for the 2010 board meeting using the latest available analytical techniques. In particular, the fall chum salmon escapement goals need a full drainage wide reanalysis at that time with particular emphasis on reanalyzing the Sheenjek and Toklat rivers goals.

The Sheenjek River escapement of fall chum salmon has been monitored using a variety of sonar systems since 1981. The data utilizes expansions for timing of side-scan sonar deployment from 1981 to 1990. Two sonars were operated, one on each bank, from 1985 through 1987. Operations resumed based on a single right bank deployment with longer range side-scan units from 1988 to 2001. The project operated split-beam sonar on the right bank from 2002 through 2004 and in 2005 transitioned to two DIDSON sonars, one on each bank. This new technology appears to be a significant improvement over previous sonar configurations. Nearly 39% of the estimated total passage was counted on the left bank in 2005, and after a number of years of two bank operations, an evaluation may be necessary to characterize fish passage on the left bank and the possible effects on historical escapement counts. This review will occur during preparations for escapement goal analysis in 2010 for the Sheenjek River and its contribution to the fall chum salmon run as an aggregate for the Yukon River.

The Toklat River, a tributary of the Kantishna River, is monitored annually for fall chum salmon by a ground survey conducted in mid October. This survey has been hampered since 1999 by variable environmental conditions. Recently, warm weather in September has extended the glacial melt period such that the silt-laden river does not clear up and become surveyable until after peak spawning dates. Also, breaches in channels have altered the flow of the mainstem through some of the more productive habitat, obscuring fish and making counts impossible. When this happens, fish normally found in those habitat areas cannot be counted unless they happen to be displaced to other locations within the index areas. Final escapement estimates are generated from the survey counts using a migratory-time-density-curve developed from in depth work conducted on the Delta River (residence time averages 18 days). These changes in the surveying conditions have rendered the Toklat River survey unreliable, therefore the department plans to discontinue the ground survey in the future.

Further evidence of the problem with the Toklat survey estimates is the lack of correlation with the Kantishna River mark–recapture abundance estimates, conducted downriver and encompassing this spawning component. The Kantishna River mark–recapture project has identified some years in which an early run component exists which may be washed out, decomposed, or preyed upon prior to surveys being conducted. Due to the relationships between the related projects this information will be reanalyzed by 2010 as part of the escapement goal analysis for the Toklat River and the aggregate Tanana River.

An additional 22 stocks were reviewed (Table 7) but no goal is being recommended. Reasons for not recommending a goal are detailed and generally include lack of sufficient data or a goal has been recommended using a different enumeration method.

**Table 5.–**Escapement goal review summary for the Yukon River Management Area in 2007.

| | Salmon Species | | | |
|---|---|---|---|---|
| | **Chinook** | **Summer Chum** | **Fall Chum** | **Coho** |
| Stocks or data sets reviewed [a] | 12 [b] | 16 | 7 | 4 |
| Current Escapement Goals (2005) | 7 | 2 | 7 | 1 |
| Escapement Goal Recommendation: | | | | |
| Revise | 0 | 0 | 0 | 0 |
| Discontinue | 0 | 0 | 0 | 0 |
| Establish | 0 | 0 | 0 | 0 |
| No Revision | 7 | 2 | 7 | 1 |
| Total Escapement Goals (2007) | 2 BEG<br>5 SEG | 2 BEG<br>0 SEG | 7 BEG<br>0 SEG | 0 BEG<br>1 SEG |
| Stocks/data sets for which no escapement goal was established | 5 | 14 | 0 | 3 |

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

[b] Does not include Nulato River North and South Fork Chinook salmon aerial surveys added together (combined) as a separate stock.

**Table 6.–**Summary of escapement goal recommendations for the Yukon River Management Area in 2007.

| Stock Unit | Enumeration Method | Escapement Goal as of 2005 Goal | Type | Year Estab. | Escapement Goal Recommendation Action | New or Revised Goal | Type |
|---|---|---|---|---|---|---|---|
| **Chinook Salmon** [a] | | | | | | | |
| Andreafsky River (East Fork) | Aerial Survey | 960–1,700 | SEG | 2005 | No Revision | | |
| Andreafsky River (West Fork) | Aerial Survey | 640–1,600 | SEG | 2005 | No Revision | | |
| Anvik River | Aerial Survey | 1,100–1,700 | SEG | 2005 | No Revision | | |
| Chena River | Tower/Mark–recapture | 2,800–5,700 | BEG | 2001 | No Revision | | |
| Gisasa River | Aerial Survey | 420–1,100 | SEG | 2005 | No Revision | | |
| Nulato River (forks combined) | Aerial Survey | 940–1,900 | SEG | 2005 | No Revision | | |
| Salcha River | Tower/Mark–recapture | 3,300–6,500 | BEG | 2001 | No Revision | | |
| **Chum Salmon (Summer)** | | | | | | | |
| East Fork Andreafsky River | Weir | 65,000–130,000 | BEG | 2001 | No Revision | | |
| Anvik River | Sonar | 350,000–700,000 | BEG | 2005 | No Revision | | |
| **Chum Salmon (Fall)**[b] | | | | | | | |
| Yukon River Drainage | Multiple[c] | 300,000–600,000 | BEG | 2001 | No Revision | | |
| Tanana River | Mark–recapture | 61,000–136,000 | BEG | 2001 | No Revision | | |
| Delta River | Foot Survey | 6,000–13,000 | BEG | 2001 | No Revision | | |
| Toklat River | Foot Survey | 15,000–33,000 | BEG | 2001 | No Revision | | |
| Upper Yukon R. Tributaries[d] | Multiple[e] | 152,000–312,000 | BEG | 2001 | No Revision | | |
| Chandalar River | Sonar | 74,000–152,000 | BEG | 2001 | No Revision | | |
| Sheenjek River | Sonar | 50,000–104,000 | BEG | 2001 | No Revision | | |
| **Coho Salmon** | | | | | | | |
| Delta Clearwater River | Boat Survey | 5,200–17,000 | SEG | 2005 | No Revision | | |

[a] Does not include Canadian Chinook salmon border escapement goal, which is under the Yukon River Salmon Agreement and reviewed annually by the Yukon River Panel.

[b] Does not include Canadian fall chum salmon border escapement goal or Fishing Branch River goal, which are under the Yukon River Salmon Agreement and reviewed annually by the Yukon River Panel.

[c] Includes foot surveys, sonar, and mark–recapture.

[d] Includes Chandalar, Sheenjek, and Fishing Branch rivers. Per footnote above, Fishing Branch River not listed.

[e] Includes sonar and weir.

**Table 7.–**Yukon River area stocks for which escapement goals were not established because of insufficient data or alternative enumeration methods.

| Stock | Rationale for not Establishing an Escapement Goal |
|---|---|
| **Chinook Salmon** | |
| Andreafsky River (East Fork, weir) | Utilize aerial survey goal until additional number of escapement estimates are collected. |
| Gisasa River (weir) | Insufficient number of escapement estimates. |
| Chena River (aerial survey) | Goal established for tower and mark–recapture estimates. |
| Nulato River (mainstem, tower/weir) | Project no longer operates. |
| Salcha River (aerial survey) | Goal established for tower and mark–recapture estimates. |
| **Chum Salmon (Summer)** | |
| Chena River (aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Chena River (tower) | Counts are incomplete, no stock apportionment. |
| Gisasa River (weir) | Insufficient number of escapement estimates. |
| Gisasa River (aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Clear/Caribou Creek (aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Clear Creek (tower) | Insufficient number of escapement estimates. |
| Kaltag River (aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Nulato River (mainstem, tower/weir) | Project no longer operates. |
| Nulato River (North Fork, aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Nulato River (South Fork, aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Salcha River (aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Salcha River (tower) | Counts are incomplete and lacks stock contribution data. |
| Tozitna River (aerial survey) | Aerial surveys are not reflective of summer chum salmon abundance and are no longer conducted. |
| Yukon River (mainstem, Pilot Station sonar) | Requires extensive reanalysis due to change in historical relationship (2 times) with Anvik River escapement. |
| **Coho Salmon** | |
| Andreafsky River (East Fork, weir) | Insufficient number of escapement estimates. |
| Nenana River (aerial survey) | Insufficient number of escapement estimates for entire system. |
| Yukon River (mainstem, Pilot Station sonar) | Incomplete run assessment would require extensive analysis to determine feasibility. |

# NORTON SOUND-PORT CLARENCE AND KOTZEBUE MANAGEMENT AREAS

A total of 32 escapement goals exist in the Norton Sound-Port Clarence and Kotzebue Management Area for 5 Chinook salmon, 17 chum salmon, 3 coho salmon, 5 pink salmon, and 2 sockeye salmon stocks (Table 8). Biological escapement goals exist for 3 stocks including Norton Sound Subdistrict 1 (Nome) chum salmon and Kwiniuk and Tubutulik rivers chum salmon (Table 8). These goals were established in 2001 based on extensive spawner-recruit analyses (Clark 2001b, c). In 2004 they were reanalyzed using updated data sets and no changes were recommended in the ranges (ADF&G 2004), although the goals for individual Subdistrict 1 (Nome) rivers were clarified as being SEGs rather than BEGs. Addition of 2 years data available since 2004 did not warrant reanalysis. All other goals are sustainable escapement goals. Many of these goals were first recommended in 1999 (Fair et al. 1999), but were never officially established as escapement goals until 2005 (Appendix A) when the Directors approved them as SEGs.

The review team is recommending an escapement goal be established for Niukluk River coho salmon using the Bue and Hasbrouck method now that a sufficient number of years of tower counts exist (Table 9; Appendix B). We also recommend that the Niukluk and Ophir River SEG based on aerial surveys be discontinued (Table 9; Appendix C). The aerial survey SEG will be replaced by the tower based SEG. The Niukluk tower project provides a total count of coho salmon. Daily counts and historical performance can be used inseason to project fulfillment of the goal and migration run timing.

Eggers and Clark (2006) completed an extensive spawner-recruit analysis for Kotzebue District chum salmon in the Noatak and Kobuk River drainages. Based on that analysis we are recommending establishing a BEG for the entire Kotzebue area (Noatak and Kobuk rivers combined) of 196,000 to 421,000 chum salmon and revising the 5 individual Noatak and Kobuk drainage SEGs.

An additional 23 stocks were reviewed but no goals were recommended (Table 10). Reasons for not recommending a goal are detailed and generally include lack of sufficient data or a goal has been recommended using a different enumeration method. A separate report was prepared that provides a detailed escapement goal review for the Unalakleet River Chinook salmon stock (Estensen and Evenson 2006), however that report recommends no changes to the existing sustainable escapement goals. Another stock that was reviewed, but no goal is recommended is the Pilgrim River sockeye salmon (weir). While excellent data on escapement and age composition are being collected (Burkhart and Dunmall In prep; Dunmall 2004, 2005), the weir has operated only since 2003 and complete numbers are available for only the 1998 and 1999 brood years.

**Table 8.–**Escapement goal review summary for the Norton Sound-Port Clarence and Kotzebue Management Areas in 2007.

| | Salmon Species | | | | |
|---|---|---|---|---|---|
| | **Chinook** | **Chum** | **Coho** | **Pink** | **Sockeye** |
| Stocks or data sets reviewed [a] | 8 | 18 | 16 | 11 | 4 |
| Current Escapement Goals (2005) | 5 | 17 | 3 | 5 | 2 |
| Escapement Goal Recommendation: | | | | | |
| Revise | 0 | 5 | 0 | 0 | 0 |
| Discontinue | 0 | 0 | 1 | 0 | 0 |
| Establish | 0 | 1 | 1 | 0 | 0 |
| No Revision | 5 | 12 | 3 | 5 | 2 |
| Total Escapement Goals (2007) | 0 BEG<br>5 SEG | 4 BEG<br>14 SEG | 0 BEG<br>3 SEG | 0 BEG<br>5 SEG | 0 BEG<br>2 SEG |
| Stocks/data sets for which no escapement goal was established | 3 | 0 | 12 | 6 | 2 |

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

**Table 9.–**Summary of escapement goal recommendations for salmon stocks of the Norton Sound-Port Clarence and Kotzebue Management Areas in 2007.

| | Enumeration | Escapement Goal as of 2005 | | | Escapement Goal Recommendation | | |
|---|---|---|---|---|---|---|---|
| **Stock Unit** | **Method** | **Goal** | **Type** | **Year Estab.** | **Action** | **New or Revised Goal** | **Type** |
| ***Norton Sound-Port Clarence Management Area*** | | | | | | | |
| **Chinook Salmon** | | | | | | | |
| Fish R./Boson Cr. | Aerial Survey | >100 | SEG | 2005 | No Revision | | |
| Kwiniuk River | Tower | 300–550 | SEG | 2005 | No Revision | | |
| North River (Unalakleet R.) | Tower | 1,200–2,600 | SEG | 2005 | No Revision | | |
| Old Woman R. (Unalakleet R.) | Aerial Survey | 550–1,100 | SEG | 2005 | No Revision | | |
| Shaktoolik River | Aerial Survey | 400–800 | SEG | 2005 | No Revision | | |
| **Chum Salmon** | | | | | | | |
| Bonanza River | Expanded Aerial Survey | 2,300–3,400 | SEG | 2005 | No Revision | | |
| Eldorado River | Expanded Aerial Survey | 6,000–9,200 | SEG | 2005 | No Revision | | |
| Flambeau River | Expanded Aerial Survey | 4,100–6,300 | SEG | 2005 | No Revision | | |
| Kwiniuk River | Tower | 10,000–20,000 | BEG | 2001 | No Revision | | |
| Niukluk River (Fish R.) | Tower | >30,000 | SEG | 2005 | No Revision | | |
| Nome River | Weir | 2,900–4,300 | SEG | 2005 | No Revision | | |
| Old Woman R. (Unalakleet R.) | Aerial Survey | 2,400–4,800 | SEG | 2005 | No Revision | | |
| Sinuk River | Expanded Aerial Survey | 4,000–6,200 | SEG | 2005 | No Revision | | |
| Snake River | Weir | 1,600–2,500 | SEG | 2005 | No Revision | | |
| Solomon River | Expanded Aerial Survey | 1,100–1,600 | SEG | 2005 | No Revision | | |
| Subdistrict 1 (Nome, all systems) | Multiple | 23,000–35,000 | BEG | 2001 | No Revision | | |
| Tubutulik River | Expanded Aerial Survey | 8,000–16,000 | BEG | 2001 | No Revision | | |

-continued-

**Table 9.–**Page 2 of 2.

| Stock Unit | Enumeration Method | Escapement Goal as of 2005 Goal | Type | Year Estab. | Escapement Goal Recommendation Action | New or Revised Goal | Type |
|---|---|---|---|---|---|---|---|
| **Coho Salmon** | | | | | | | |
| Kwiniuk River | Aerial Survey | 650–1,300 | SEG | 2005 | No Revision | | |
| Niukluk River | Tower | None | | | Establish | 2,400–6,100 | SEG |
| Niukluk R./Ophir R. | Aerial Survey | 950–1,900 | SEG | 2005 | Discontinue | | |
| North River (Unalakleet R.) | Aerial Survey | 550–1,100 | SEG | 2005 | No Revision | | |
| **Pink Salmon** | | | | | | | |
| Kwiniuk River (all years) | Tower | >8,400 | SEG | 2005 | No Revision | | |
| Niukluk River (all years) | Tower | >10,500 | SEG | 2005 | No Revision | | |
| Nome River (even year) | Weir | >13,000 | SEG | 2005 | No Revision | | |
| Nome River (odd year) | Weir | >3,200 | SEG | 2005 | No Revision | | |
| North River (Unalakleet R. all years) | Tower | >25,000 | SEG | 2005 | No Revision | | |
| **Sockeye Salmon** | | | | | | | |
| Salmon Lake | Aerial Survey | 4,000–8,000 | SEG | 2005 | No Revision | | |
| Glacial Lake | Aerial Survey | 800–1,600 | SEG | 2005 | No Revision | | |
| ***Kotzebue Management Area*** | | | | | | | |
| **Chum Salmon** | | | | | | | |
| Kotzebue (all areas) | Expanded Aerial Survey | None | | | Establish | 196,000–421,000 | BEG |
| Noatak/Eli Rivers | Aerial Survey | 64,000–128,000 | SEG | 2005 | Revise | 42,000–91,000 | SEG |
| Salmon River (Kobuk R. drainage) | Aerial Survey | 3,200–6,400 | SEG | 2005 | Revise | 3,300–7,200 | SEG |
| Squirrel River (Kobuk R. drainage) | Aerial Survey | 7,200–14,400 | SEG | 2005 | Revise | 4,900–10,500 | SEG |
| Tutuksuk River (Kobuk R. drainage) | Aerial Survey | 1,200–2,400 | SEG | 2005 | Revise | 1,400–3,000 | SEG |
| Upper Kobuk and Selby Rivers | Aerial Survey | 8,000–16,000 | SEG | 2005 | Revise | 9,700–21,000 | SEG |

**Table 10.–**Norton Sound-Port Clarence and Kotzebue Management Areas stocks for which escapement goals were not established because of insufficient data or alternative enumeration methods.

| Stock | Rationale for not Establishing an Escapement Goal |
|---|---|
| **Chinook Salmon** | |
| Niukluk River (aerial) | Small Chinook salmon system-not representative of Fish River drainage. |
| Niukluk River (tower) | Small Chinook salmon system-not representative of Fish River drainage. |
| Unalakleet River (run reconstruction) | Lacks sufficient historical escapement data. |
| **Chum Salmon** | |
| None | |
| **Coho Salmon** | |
| Bonanza River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Eldorado River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Eldorado River (tower/weir) | Project no longer operates during the coho migration. |
| Flambeau River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Kwiniuk River (tower) | Insufficient number of escapement estimates |
| Nome River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Nome River (weir) | Insufficient number of escapement estimates. |
| North River (tower) | Lacks sufficient historical escapement and stock contribution data. |
| Sinuk River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Snake River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Solomon River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Tubutulik River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| **Pink Salmon** | |
| Bonanza River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Eldorado River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Sinuk River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Snake River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Solomon River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| Tubutulik River (aerial survey) | Lacks sufficient historical escapement and stock contribution data. |
| **Sockeye Salmon** | |
| Glacial Lake (weir) | Insufficient number of escapement estimates. |
| Pilgrim River (weir) | Insufficient number of escapement estimates. |

# EFFECT OF 2007 ESCAPEMENT GOAL RECOMMENDATIONS ON STOCKS OF CONCERN

ADF&G will develop its recommendations for stocks of concern designations after the 2006 fishing season and prior to adoption of goals recommended in this report. Stock of concern definitions are given in the Sustainable Salmon Policy, and currently there are 8 stocks listed as stocks of concern (see Table 11). Stocks of concern will not be evaluated with the goals recommended in this report; however, for most of the stocks currently listed, there will be no recommended revisions, discontinued goals, or new goals that would affect Departmental analysis.

Several goal changes have been recommended for Kuskokwim River Chinook and chum salmon stocks with yield concerns. SEGs are being recommended for George River and Tuluksak River Chinook salmon. We also recommend that the Kwethluk Chinook SEG be based on weir counts instead of aerial survey data (i.e. aerial SEG discontinued and weir SEG recommended). These goals will not change our assessment of the general pattern of escapement throughout the Kuskokwim River. Escapements were still low in regard to these goals during the time period that formed the basis for our initial stock of concern recommendation (1998–2000). Escapements since that period have improved throughout the drainage and also when compared against newly recommended goals. We also recommend a revision of the SEG for Aniak River chum salmon. The revision results in an increase of the lower end of the SEG of 10,000 fish and does not change our assessment of periods with low and high abundance. The pattern of meeting or exceeding the lower end of the SEG does not change between the current and recommended goal and thus would not affect our recommendations for stock of concern status.

**Table 11.–**Arctic-Yukon-Kuskokwim salmon stocks of concern designated in 2004 and escapement goal recommendations for 2007.

| AYK Region Stocks of Concern Designated in 2004 by Alaska Board of Fisheries | | | |
|---|---|---|---|
| **Area/Stock** | **Salmon Species** | **Level of Concern** | **Escapement Goal Recommendations for 2007** |
| Kuskokwim River | Chinook | Yield | 1 discontinued, and 3 established goals |
| | Chum | Yield | 1 revised goal |
| Yukon River | Chinook | Yield | No new, discontinued, or revised goals |
| | Chum (Summer) | Management | No new, discontinued, or revised goals |
| | Chum (Fall) | Yield | No new, discontinued, or revised goals |
| Norton Sound | | | |
| Subdistrict 1 | Chum | Management | No new, discontinued, or revised goals |
| Subdistrict 2 and 3 | Chum | Yield | No new, discontinued, or revised goals |
| Subdistrict 5 and 6 | Chinook | Yield | No new, discontinued, or revised goals |

No SETs are recommended for any stocks because the criteria for setting a SET suggest that it be estimated based on the lower ranges of historical escapement levels for which the stock has consistently demonstrated the ability to sustain itself. Lower escapement levels observed in the

late 1990s and early 2000s began to provide full returns in 2004 and 2005 when the 4, 5, and 6-year old fish have returned from the 1999 and 2000 escapements. These returns have generally been very good. This assessment will continue at least through 2009 when all the 6-year old fish will have returned from the 2003 escapement.

# RECOMMENDATIONS FOR 2010 ESCAPEMENT GOAL REVIEW

Throughout the course of this review, the review team identified stocks that were not suitable for intensive review and analysis at this time, either because of insufficient information, insufficient staff time to conduct the required level of analysis, or because a detailed analysis was conducted in 2004. These stocks, including Yukon River fall chum salmon, Yukon River summer chum salmon, Kuskokwim River Chinook salmon, Kuskokwim River chum salmon, Kuskokwim River coho salmon and Norton Sound Subdistrict 1 chum salmon, were felt to be a priority for thorough analysis and review prior to the 2010 Alaska Board of Fisheries meeting.

Yukon River fall chum salmon requires a full run reconstruction analysis using the methods developed by Shotwell and Adkison (2004). This analysis should also focus on solving the problems identified here with Sheenjek and Toklat fall chum salmon escapement counts. Similar methods should be used to conduct a full run reconstruction for Yukon summer chum salmon to develop drainage wide and tributary escapement goals and estimate harvest rates.

Run reconstruction analysis for Kuskokwim River Chinook salmon is being funded by the AYK Sustainable Salmon Initiative and will be complete before the 2010 board meeting. Funding is being sought to update the original work by Shotwell and Adkison (2004) for Kuskokwim chum salmon using mark–recapture population estimates rather than Kuskokwim mainstem sonar estimates to scale the analysis. These analyses should provide drainage wide and tributary escapement goals and harvests rates.

Kuskokwim River coho salmon stocks monitored by weirs were considered for SEGs during this review. Because the number of years operated ranged from 5 to 9 years no recommendations were made. Coho salmon stocks monitored at the Tuluksak (9) and George River weirs should be reviewed again in 2010 when sufficient years and contrast may support the setting of SEGs,

Finally, the Norton Sound Subdistrict 1 (Nome) area river systems are also a priority for review leading up to 2010. These goals were set in 2001 and reanalyzed using the updated data through 2004. By 2010, there will be significant additional weir counts and age composition data that make it worthwhile to reanalyze these systems. Pilgrim River sockeye salmon runs have increased greatly since 2003, the same year a resistance board weir was first operated. Excellent escapement and age composition data are currently available for 3 years (2003 through 2005). By the 2010 review, there will be 8 years of data, which while minimal for these predominantly 5 year old fish, will make a more detailed review worthwhile.

In addition the review team recognizes the value of expanding the list of stocks considered in the escapement goal review and considering new models or population components. In order to be considered for an escapement goal, a stock should at a minimum have a consistent data set of escapement counts or indices. The review team recognizes that adding a number of systems/stocks to the review list for the next review cycle including: Inglutalik River Chinook salmon, Pilgrim River Chinook and coho salmon, Pikmiktalik River chum and coho salmon,

Goodpaster Chinook salmon, and Aniak River Chinook salmon is a worthwhile endeavor. Some of these stocks will have a time series of data too limited to set goals even in 2010, but including them will help prepare the data for future evaluations. The review team also recognizes the need to formulate Chinook salmon escapement goals in terms of older Chinook (older than 2-ocean age) which should be considered during the next review.

As the current review continues, the department, with input from the public and other agencies, may identify other stocks as priorities for reanalysis for the 2010 board meeting.

## ACKNOWLEDGEMENTS

The review team would like to thank staff members from ADF&G Divisions of Commercial Fisheries and Sport Fish and the U.S. Fish and Wildlife Service for their efforts in this process. The review team would also like to thank representatives of Kawerak, Inc., Association of Village Council Presidents, Tanana Chiefs Association, Bering Sea Fishermen's Association, Norton Sound Economic Development Corporation, and the public for attending the meetings and providing review comments. We also wish to acknowledge Gary Todd for preparing the Niukluk coho salmon data presented in Appendix B.

The review team also wishes to thank those employees of the Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. National Park Service, Association of Village Council Presidents, Bering Sea Fishermen's Association, Kawerak, Inc., Kuskokwim Native Association, McGrath Native Village Council, Native Village of Kwinhagak, Organized Village of Kwethluk, Orutsararmiut Native Council, Takotna Tribal Council, Tanana Chiefs Conference, Tuluksak Traditional Council, Yukon River Drainage Fisheries Association and other agencies and organizations who worked long and irregular hours at various locations throughout the AYK Region collecting the data used in this review.

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# APPENDIX A

**Appendix A.–**Escapement goal recommendations which were approved in 2005 by Directors of the Divisions of Commercial Fisheries and Sport Fish.

# STATE OF ALASKA
## DEPARTMENT OF FISH AND GAME

## MEMORANDUM

***TO:*** Doug Mecum
Director
Commercial Fisheries Division
Juneau
AND
Kelly Hepler
Director
Sport Fish Division
Anchorage

***DATE:*** May 18, 2005

***PHONE:*** 267-2115 (Sandone)
459-7229 (Roach)

***FAX:*** 267-2442 (Sandone)
456-2259 (Roach)

***FILE:*** Mecum0513_BEG

***FROM:*** Gene J. Sandone
AYK/CF Regional Supervisor
Anchorage
AND
Don Roach
AYK/SF Regional Supervisor
Fairbanks

***SUBJECT:*** Recommended Escapement Goals for Selected AYK Salmon Stocks

An oral and written report concerning escapement goals, both Biological Escapement Goals (BEGs) and Sustainable Escapement Goals (SEGs), for numerous stocks in all areas of the Arctic-Yukon-Kuskokwim (AYK) Region were presented to the Alaska Board of Fisheries in January 2004. Accordingly, the ADF&G AYK BEG committee recommends that the salmon escapement goals, outlined in the attached modified tables from the AYK salmon escapement goal report, (ADF&G 2004) be formally accepted and established by ADF&G. Please note that the recommendations to discontinue escapement goals (EO) for the Old Woman/Unalakleet chum salmon stock (2400–4800) and Shaktoolik Chinook salmon stock (400–800) within the Norton Sound Area in the final AYK escapement goal report (ADF&G 2004) were changed at the board meeting to "No Revision" instead. The current recommendation for these stocks remain “No Revision”, as indicated in the attached modified tables.

Summary information for all Yukon Area salmon stocks for which escapement goals were determined or discontinued is presented in Table 2 (attached) of the AYK Escapement Goal report. Within the Yukon Area, data from nine Chinook salmon stocks, five summer chum salmon stocks, seven fall chum salmon stocks and one coho salmon stocks for which escapement goals were determined or discontinued were examined. Recommendations from the AYK escapement goal committee regarding these 22 stocks follow.

-continued-

- Establish:
  - Chinook salmon: one SEG (Nulato River Chinook salmon);
- Discontinue:
  - Chinook salmon: two SEGs (Two tributary Chinook SEGs were replaced with a single, drainage-wide Chinook salmon SEG for the Nulato River); and
  - summer chum salmon: three aerial survey SEGs;
- Revise:
  - Chinook salmon: 4 aerial survey SEGs,
  - summer chum salmon: one BEG (Anvik River), and
  - coho salmon: one boat survey SEG;
- No Revision:
  - Chinook salmon: 2 BEGs:
  - summer chum salmon: 1 BEG; and
  - fall chum salmon: 7 BEGs.

Note that Table 2 also includes interim escapement goals for fall chum salmon stocks in the Canadian portion of the Yukon River drainage. The Yukon River Panel, not ADF&G, set these goals. Because it is inappropriate for ADF&G to unilaterally set escapement goals for Canadian salmon stocks, we are not suggesting, nor seeking your approval for the establishment of escapement goals for any Canadian salmon stock. They are only included in the table for clarification.

Summary information for all Kuskokwim Area salmon stocks for which escapement goals were determined or discontinued is presented in Table 5 (attached) of the AYK Escapement Goal report. Note that the Kuskokwim Area includes rivers that drain into Kuskokwim Bay, as well as, the Kuskokwim River drainage Within the Kuskokwim Area, data from 13 Chinook salmon stocks, eight summer chum salmon stocks, five coho salmon stocks, and four sockeye salmon stocks for which escapement goals were determined or discontinued were examined. Recommendations from the AYK escapement goal committee regarding these 30 stocks follow:

- Establish:
  - Chinook salmon: two aerial survey SEGs; and
  - coho salmon: one weir SEG;
- Discontinue:
  - Chinook salmon: one aerial survey SEG (redundant with a weir SEG);
  - summer chum salmon: four aerial survey SEGs (redundant with sonar or weir SEG)
  - coho salmon: two aerial survey SEGs (redundant with weir SEG); and
  - sockeye salmon: two aerial survey SEG.
- Revise:
  - Chinook salmon: eight aerial survey SEGs and two weir SEGs;
  - summer chum salmon: one sonar SEG, one aerial survey SEG, and 2 weir SEGs;
  - coho salmon: one weir SEG and one aerial survey SEG;
  - sockeye salmon: one aerial survey SEGs and one weir SEG;
- No Revision:
  - none.

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Summary information for all Norton Sound Area salmon stocks for which escapement goals were determined or discontinued is presented in Table 8 (attached) of the AYK Escapement Goal report. Simply changing the type of the goal from an EO to and SEG was not considered a revision. Within the Norton Sound Area, data from six Chinook salmon stocks, six pink salmon stocks, two sockeye salmon stocks, 13 summer chum salmon stocks, and three coho salmon stocks for which escapement goals were determined or discontinued were examined. Additionally, data from four chum salmon stocks in the Kotzebue Area were also examined. Recommendations from the AYK escapement goal committee regarding the 30 Norton Sound Area salmon stocks were as follows:

- Establish:
  - pink salmon: one weir and one tower SEG; and
  - chum salmon: one tower SEG;
- Discontinue:
  - Chinook salmon: two aerial survey EOs;
  - pink salmon: one tower EO (tower does not operate)
  - chum salmon: one aerial survey EO (redundant with weir SEG)
- Revise:
  - Chinook salmon: one aerial survey SEG and one tower SEG;
  - Pink salmon: two tower SEGs;
  - summer chum salmon: five aerial survey SEGs, and 2 weir SEGs (all chum salmon goals were revised from a BEG to an SEG);
- No Revision:
  - Chinook Salmon: one aerial survey SEG and one tower SEG;
  - Pink salmon : one weir SEG;
  - Sockeye salmon: two aerial survey SEGs;
  - Chum salmon: one multiple method BEG, one tower SEG, one aerial survey SEG and one aerial survey BEG.

These “no revision” recommendations include the previously mentioned Old Woman/Unalakleet chum salmon stock and the Shaktoolik Chinook salmon stock in the Norton Sound Area. No revision was also recommended for the four Kotzebue Area salmon stock escapement goals, except for the change of referring to these goals as SEGs instead of EOs.

The purpose of this memo is to formally request your approval to establish the escapement goals, as outlined in the attached modified tables of the AYK Escapement Goal Report (Tables 2, 5, and 8).

-continued-

Approved:

_____ _____
Doug Mecum Date
Director Commercial Fisheries Division, ADF&G

_____ _____
Kelly Hepler Date

Director Sport Fish Division, ADF&G

cc: Bernard, Borba, Brannian, F.Bue, J.H.Clark, R.A.Clark, Dubois, Eggers, Evenson, Hamachan, Hayes, Hilsinger, Linderman, Menard, Molyneaux, Pfisterer, Swanton, Todd, Whitmore

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Table 2. Summary of all Yukon River area salmon stocks for which escapement goals were determined or discontinued.

| | Enumeration | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| **Stock Unit** | **Method** | **Goal** | **Type** | **Year Estab.** | **Action** | **Goal** | **Type** |
| **Chinook Salmon** | | | | | | | |
| East Fork Andreafsky River | Aerial Survey | >1,500 | EO[a] | 1992 | Revise | 960–1,700 | SEG |
| West Fork Andreafsky River | Aerial Survey | >1,400 | EO | 1992 | Revise | 640–1,600 | SEG |
| Anvik River | Aerial Survey | >1,300 | EO | 1992 | Revise | 1,100–1,700 | SEG |
| N. F. Nulato River | Aerial Survey | >800 | EO | 1992 | Discontinue | | |
| S. F. Nulato River | Aerial Survey | >500 | EO | 1992 | Discontinue | | |
| Nulato River (both forks combined) | Aerial Survey | None | | | Establish | 940–1,900 | SEG |
| Gisasa River | Aerial Survey | >600 | EO | 1992 | Revise | 420–1,100 | SEG |
| Chena River | Tower/M–R | 2,800–5,700 | BEG | 2001 | No Revision | 2,800–5,700 | BEG |
| Salcha River | Tower/M–R | 3,300–6,500 | BEG | 2001 | No Revision | 3,300–6,500 | BEG |
| **Summer Chum Salmon** | | | | | | | |
| East Fork Andreafsky River | Weir | 65,000–130,000 | BEG | 2001 | No Revision | 65,000–130,000 | BEG |
| East Fork Andreafsky River | Aerial Survey | 35,000–70,000 | BEG | 2001 | Discontinue | | |
| West Fork Andreafsky River | Pop. Estimate | 65,000–130,000 | BEG | 2001 | Discontinue | | |
| West Fork Andreafsky River | Aerial Survey | 35,000–70,000 | BEG | 2001 | Discontinue | | |
| Anvik River | Sonar | 400,000–800,000 | BEG | 2001 | Revise | 350,000–700,000 | BEG |

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Table 2. Page 2 of 2.

| Stock Unit | Enumeration Method | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| | | Goal | Type | Year Estab. | Action | Goal | Type |
| **Fall Chum Salmon** | | | | | | | |
| Yukon R Drainage | Multiple[b] | 300,000–600,000 | BEG | 2001 | No Revision | 300,000–600,000 | BEG |
| Yukon R. Mainstem (Canada) | M–R | >80,000 | TO | 1990 | Negotiated | >65,000[d] | TO[c] |
| Tanana River | M–R | 61,000–136,000 | BEG | 2001 | No Revision | 61,000–136,000 | BEG |
| Delta River | Foot Survey | 6,000–13,000 | BEG | 2001 | No Revision | 6,000–13,000 | BEG |
| Toklat River | Foot Survey | 15,000–33,000 | BEG | 2001 | No Revision | 15,000–33,000 | BEG |
| Upper Yukon R. Tributaries | Multiple | 152,000–312,000 | BEG | 2001 | No Revision | 152,000–312,000[e] | BEG |
| Chandalar River | Sonar | 74,000–152,000 | BEG | 2001 | No Revision | 74,000–152,000 | BEG |
| Sheenjek River | Sonar | 50,000–104,000 | BEG | 2001 | No Revision | 50,000–104,000 | BEG |
| Fishing Branch River | Weir | 50,000–120,000 | TO[f] | 1987 | Negotiated | >15,000[e] | TO[f] |
| **Coho Salmon** | | | | | | | |
| Delta Clearwater River | Boat Survey | >9,000 | SEG | 1992 | Revise | 5,200–17,000 | SEG |

[a] EO refers to an escapement objective determined by the Department that has not been reviewed since adoption of the PMSSF.

[b] Based on Eggers (2001) recommended drainage-wide BEG. The drainage-wide BEG is the sum of the Tanana River drainage, the Upper Yukon River Tributaries, and the mainstem Yukon River in Canada BEGs, adjusted upwards by approximately 25,000 to provide a rough correction for unmonitored escapement within the Yukon River drainage. Actual management targets may change somewhat from year to year depending on U.S./Canada Panel decisions on border passage.

[c] Escapement or passage goal established as a treaty obligation (TO) by the U.S./Canada JTC, not ADF&G., and are included for clarification only.

[d] For 2003, the Yukon River Treaty Panel negotiated an annual goal of >65,000 fall chum salmon based on three cycle rebuilding to 80,000 fish.

[e] Based on Eggers (2001) recommended Upper Yukon Tributaries BEG of 152,000–312,000 fall chum salmon. Actual management objective may be somewhat different due to the difference between the Eggers (2001) recommendation and the U.S./Canada JTC-established interim escapement goals for Canadian-origin fall chum salmon stocks in the Fishing Branch River.

[f] For 2003 the Yukon River Treaty Panel negotiated an annual goal of >15,000 chum salmon based on predicted returns from parent year escapements.

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Table 5. Summary of all Kuskokwim area salmon stocks for which escapement goals were determined or discontinued.

| | Enumeration | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| **Stock Unit** | **Method** | **Goal** | **Type** | **Year Estab.** | **Action** | **Goal** | **Type** |
| Chinook Salmon | | | | | | | |
| Kwethluk River | Aerial Survey | >1,200 | SEG | 2001 | Revise | 580–1,800 | SEG |
| Kisaralik River | Aerial Survey | >1,000 | SEG | 2001 | Revise | 400–1,200 | SEG |
| Aniak River | Aerial Survey | >1,500 | SEG | 2001 | Revise | 1,200–2,300 | SEG |
| Salmon River (Aniak drainage) | Aerial Survey | >600 | SEG | 2001 | Revise | 330–1,200 | SEG |
| Holitna River | Aerial Survey | >2,000 | SEG | 2001 | Revise | 970–2,100 | SEG |
| Kogrukluk River | Weir | >10,000 | SEG | 2001 | Revise | 5,300–14,000 | SEG |
| Cheneetnuk River | Aerial Survey | None | | | Establish | 340–1,300 | SEG |
| Gagaraya River | Aerial Survey | None | | | Establish | 300–830 | SEG |
| Pitka Fork Salmon River | Aerial Survey | >1,300 | SEG | 2001 | Revise | 470–1,600 | SEG |
| | | | | | | | |
| Kanektok River | Aerial Survey | >5,800 | EO[a] | 1992 | Revise | 3,500–8,000 | SEG |
| Goodnews River (Main Fork) | Aerial Survey | >1,600 | EO | 1992 | Revise | 640–3,300 | SEG |
| Middle Fork Goodnews River | Aerial Survey | >800 | EO | 1992 | Discontinue | | |
| Middle Fork Goodnews River | Weir | >3,500 | EO | 1992 | Revise | 2,000–4,500 | SEG |

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Table 5. Page 2 of 3.

| Stock Unit | Enumeration Method | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| | | Goal | Type | Year Estab. | Action | Goal | Type |
| Chum Salmon | | | | | | | |
| Aniak River | Aerial Survey | >10,000 | EO | 1992 | Discontinue | | |
| Aniak River | Sonar | >250,000 | EO | 1992 | Revise | 210,000–370,000 | SEG |
| Holitna River | Aerial Survey | 12,000 | EO | 1992 | Discontinue | | |
| Kogrukluk River | Weir | >30,000 | SEG | 2001 | Revise | 15,000–49,000 | SEG |
| Kanektok River | Aerial Survey | >30,500 | EO | 1992 | Revise | >5,200 | SEG |
| Main Fork Goodnews River | Aerial Survey | >17,000 | EO | 1992 | Discontinue | | |
| Middle Fork Goodnews River | Aerial Survey | >4,000 | EO | 1992 | Discontinue | | |
| Middle Fork Goodnews River | Weir | >15,000 | EO | 1992 | Revise | >12,000 | SEG |

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Table 5. Page 3 of 3.

| Stock Unit | Enumeration Method | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| | | Goal | Type | Year Estab. | Action | Goal | Type |
| Coho Salmon | | | | | | | |
| Kogrukluk River | Weir | 25,000 | SEG | 2001 | Revise | 13,000–28,000 | SEG |
| Kanektok River | Aerial Survey | 25,000 | EO | 1992 | Revise | 7,700–36,000 | SEG |
| Main Fork Goodnews River | Aerial Survey | 15,000 | EO | 1992 | Discontinued | | |
| Middle Fork Goodnews River | Aerial Survey | 2,000 | EO | 1992 | Discontinued | | |
| Middle Fork Goodnews River | Weir | None | | | Establish | >12,000 | SEG |
| Sockeye Salmon | | | | | | | |
| Kanektok River | Aerial Survey | 15,000 | EO | 1992 | Revise | 14,000–34,000 | SEG |
| Mainstem Goodnews R. (and lakes) | Aerial Survey | 15,000 | EO | 1992 | Revise | 5,500–19,500 | SEG |
| Middle Fk. Goodnews R (and lakes) | Aerial Survey | 5,000 | EO | 1992 | Discontinue | | |
| Middle Fk. Goodnews River | Weir | 25,000 | EO | 1992 | Revise | 23,000–58,000 | SEG |

[a] EO refers to an escapement objective determined by the Department that has not been reviewed since adoption of the PMSSF.

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Table 8. Summary of all Norton Sound Area salmon stocks for which escapement goals were determined or discontinued.

| | Enumeration | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| **Stock Unit** | **Method** | **Goal** | **Type** | **Year Estab.** | **Action** | **Goal** | **Type** |
| Chinook Salmon | | | | | | | |
| Fish R./Boson Cr. | Aerial Survey | 100–250 | EO[a] | 1999 | Revise | >100 | SEG |
| Kwiniuk River | Tower | 300–550 | EO | 1999 | No Revision | 300–550 | SEG |
| Shaktoolik River | Aerial Survey | 400–800 | EO | 1999 | No Revision | 400–800 | SEG |
| Old Woman R. (Unalakleet R.) | Aerial Survey | 550–1,100 | EO | 1999 | Discontinue | | |
| North River (Unalakleet R.) | Aerial Survey | 250–500 | EO | 1999 | Discontinue | | |
| North River (Unalakleet R.) | Tower | 1,200–2,400 | EO | 1999 | Revise | 1,200–2,600 | SEG |
| Pink Salmon | | | | | | | |
| Nome (even year) | Weir | 13,000 | EO | 1999 | No Revision | >13,000 | SEG |
| Nome River (odd year) | Weir | None | | | Establish | >3,200 | SEG |
| Niukluk River (all years) | Tower | 8,400 | EO | 1999 | Establish | >10,500 | SEG |
| Kwiniuk River (all years) | Tower | 12,500 | EO | 1999 | Revise | >8,400 | SEG |
| Shaktoolik River | Tower | 48,000 | EO | 1999 | Discontinue | | |
| North River (Unalak. R. all years) | Tower | 8,500 | EO | 1999 | Revise | >25,000 | SEG |
| Sockeye Salmon | | | | | | | |
| Salmon Lake | Aerial Survey | 4,000–8,000 | EO | 1999 | No Revision | 4,000–8,000 | SEG |
| Glacial Lake | Aerial Survey | 800–1,600 | EO | 1999 | No Revision | 800–1,600 | SEG |

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Table 8. Page 2 of 3.

| Stock Unit | Enumeration Method | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| | | Goal | Type | Year Estab. | Action | Goal | Type |
| Chum Salmon | | | | | | | |
| Nome Subdistrict 1 (all systems) | Multiple | 23,000–35,000 | BEG | 2001 | No Revision | 23,000–35,000 | BEG |
| Sinuk River | Exp Aerial Survey | 4,000–6,200 | BEG[b] | 2001 | Revise | 4,000–6,200 | SEG |
| Nome River | Weir | 2,900–4,300 | BEG[b] | 2001 | Revise | 2,900–4,300 | SEG |
| Bonanza River | Exp Aerial Survey | 2,300–3,400 | BEG[b] | 2001 | Revise | 2,300–3,400 | SEG |
| Snake River | Tower/weir | 1,600–2,500 | BEG[b] | 2001 | Revise | 1,600–2,500 | SEG |
| Solomon River | Exp Aerial Survey | 1,100–1,600 | BEG[b] | 2001 | Revise | 1,100–1,600 | SEG |
| Flambeau River | Exp Aerial Survey | 4,100–6,300 | BEG[b] | 2001 | Revise | 4,100–6,300 | SEG |
| Eldorado River | Exp Aerial Survey | 6,000–9,200 | BEG[b] | 2001 | Revise | 6,000–9,200 | SEG |
| Fish River | Aerial Survey | 23,200–46,400 | EO | 1999 | Discontinue | | |
| Niukluk River (Fish R.) | Tower | None | | | Establish | >30,000 | SEG |
| Kwiniuk River | Tower | 10,000–20,000 | BEG | 2001 | No Revision | 10,000–20,000 | BEG |
| Tubutulik River | Exp Aerial Survey | 8,000–16,000 | BEG | 2001 | No Revision | 8,000–16,000 | BEG |
| Old Woman R. (Unalakleet R.) | Aerial Survey | 2,400–4,800 | EO | 1999 | No Revision | 2,400–4,800 | SEG |

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Table 8. Page 3 of 3.

| Stock Unit | Enumeration Method | Previous Escapement Goal | | | Escapement Goal Determination | | |
|---|---|---|---|---|---|---|---|
| | | Goal | Type | Year Estab. | Action | Goal | Type |
| ***Kotzebue Area*** | | | | | | | |
| Noatak/Eli Rivers | Aerial Survey | 64,000–128,000 | EO | 1999 | No Revision | 64,000–128,000 | SEG |
| Upper Kobuk and Selby Rivers | Aerial Survey | 8,000–16,000 | EO | 1999 | No Revision | 8,000–16,000 | SEG |
| Salmon River (Kobuk R. drainage) | Aerial Survey | 3,200–6,400 | EO | 1999 | No Revision | 3,200–6,400 | SEG |
| Tutuksuk River (Kobuk R. drainage) | Aerial Survey | 1,200–2,400 | EO | 1999 | No Revision | 1,200–2,400 | SEG |
| Squirrel River (Kobuk R. drainage) | Aerial Survey | 7,200–14,400 | EO | 1999 | No Revision | 7,200–14,400 | SEG |
| **Coho Salmon** | | | | | | | |
| Niukluk R./Ophir R. | Aerial Survey | 950–1,900 | EO | 1999 | No Revision | 950–1,900 | SEG |
| Kwiniuk River | Aerial Survey | 650–1,300 | EO | 1999 | No Revision | 650–1,300 | SEG |
| North River (Unalakleet R.) | Aerial Survey | 550–1,100 | EO | 1999 | No Revision | 550–1,100 | SEG |

[a] EO refers to an escapement objective determined by the Department that has not been reviewed since adoption of the Sustainable Salmon Policy.

[b] There was some confusion about whether the 2001 goals were BEGs or SEGs. The Subdistrict 1 escapement goal report refers to them as "escapement targets". This table clarifies that they are SEGs.

# APPENDIX B

**Appendix B.–**Escapement goal for Niukluk River coho salmon (tower count).

**System: Niukluk River**
**Species: Coho salmon**
**Stock Unit: not applicable**

***Description of stock and escapement goals.***

| | |
|---|---|
| Regulatory Area: | Norton Sound Area |
| Management Division: | Commercial Fisheries |
| Primary Fishery: | Subsistence, sport and commercial |
| | |
| Previous Escapement Goal: | none |
| Escapement Goal Type: | N/A |
| Recommended Escapement Goal: | SEG of 2,400 - 6,100 |
| Optimal Escapement Goal: | none |
| Inriver Goal: | none |
| Action Points: | none |
| | |
| Escapement Enumeration: | Counting tower 1995-2005 |
| | |
| Summary: | |
| Data Quality: | Fair |
| Data Type: | Counting tower, limited aerial surveys. |
| Contrast: | 10 |
| Criteria for SEG: | High contrast, low exploitation (approx. 15%) |
| 15th - 75th Percentile | 2,396 - 6,052 |
| Years within recommended SEG: | 6 of 11, 3 above and 2 below |

Comments:

Analysis includes estimated 1998 tower count, tower did not operate full season.
Reported harvest (15% average) is probably low.
Limited ASL data, years 1996, 1997, 2002 and 2005.

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**System: Niukluk River**
**Species: Coho salmon**
**Stock Unit: not applicable**

***Data available for analysis of escapement goals.***

| Brood Year | Tower Count |
|---|---|
| 1995 | 4,713 |
| 1996 | 12,781 |
| 1997 | 3,994 |
| 1998 | 4,195[a] |
| 1999 | 4,260 |
| 2000 | 11,382 |
| 2001 | 3,468 |
| 2002 | 7,391 |
| 2003 | 1,282 |
| 2004 | 2,064 |
| 2005 | 2,727 |

[a] Estimated tower total of 4,195; 20 % of historical run counted by 13 August, count was 839.

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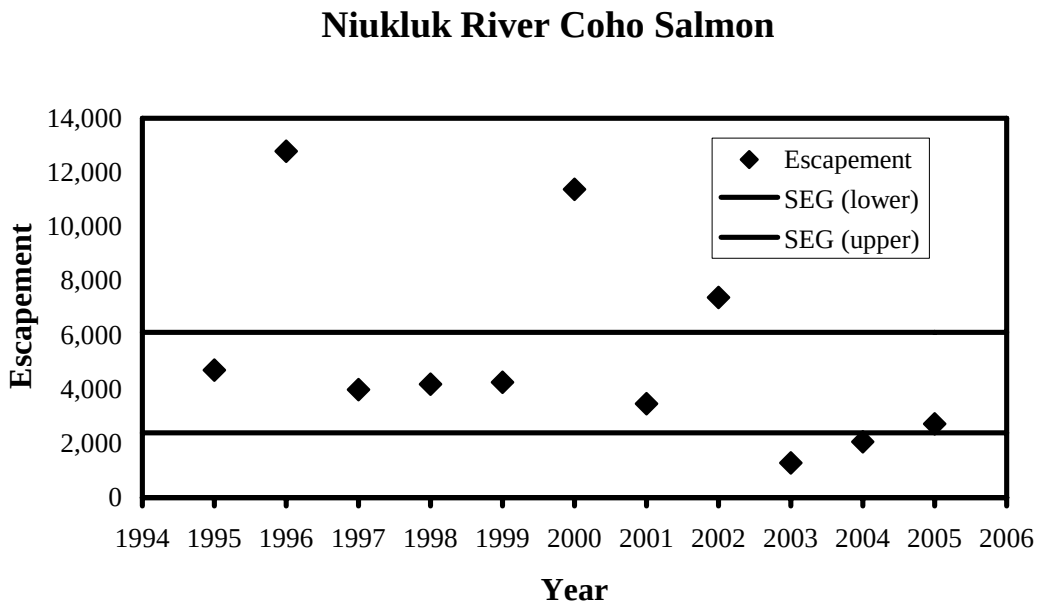
**System: Niukluk River**
**Species: Coho salmon**
**Stock Unit: not applicable**

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



# APPENDIX C

**Appendix C.–**Escapement goal for Niukluk and Ophir Rivers coho salmon (aerial).

**System: Niukluk and Ophir Rivers**
**Species: Coho salmon**
**Stock Unit: not applicable**

***Description of stock and escapement goals.***

| | |
|---|---|
| Regulatory Area: | Norton Sound |
| Management Division: | Commercial Fisheries |
| Primary Fishery: | Subsistence, sport, and commercial |
| Previous Escapement Goal: | 950–1,900 ADF&G (2004) |
| Escapement Goal Type: | SEG |
| Recommended Escapement Goal: | Discontinue |
| Optimal Escapement Goal: | none |
| Inriver Goal: | none |
| Action Points | none |
| Escapement Enumeration: | Aerial surveys |
| Summary: | |
| Data Quality | Poor |
| Data Type | Aerial surveys 1984–2004 (intermittent). No stock specific ASL data available. |
| Contrast | - |
| Criteria for SEG | - |
| 15th–85th Percentile | - |
| Years within recommended SEG | - |
| Comments | |

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**System: Niukluk and Ophir Rivers**
**Species: Coho salmon**
**Stock Unit: not applicable**

***Data available for analysis of escapement goals.***

| Brood Year | Aerial Survey Counts | | | Tower count |
|---|---|---|---|---|
| | Niukluk | Ophir | Total | |
| 1984 | 998 | 1,338 | 2,336 | |
| 1985 | 109 | 223 | 332 | |
| 1986 | | | | |
| 1987 | 176 | 81 | 257 | |
| 1988 | 621 | 474 | 1,095 | |
| 1989 | 112 | 70 | 182 | |
| 1990 | 170 | 194 | 364 | |
| 1991 | 1,178 | 60 | 1,238 | |
| 1992 | 812 | 224 | 1,036 | |
| 1993 | 2,104 | 14 | 2,118 | |
| 1994 | 274 | 197 | [a] | |
| 1995 | 2,136 | 15 | 2,151 | 4,713 |
| 1996 | 2,047 | 1,271 | 3,318 | 12,781 |
| 1997 | 983 | | | 3,994 |
| 1998 | 593 | 116 | 709 | 4,195 |
| 1999 | 619 | 61 | 680 | 4,260 |
| 2000 | 3,812 | 120 | 3,932 | 11,382 |
| 2001 | 809 | 162 | 971 | 3,468 |
| 2002 | 1,122 | 125 | 1,247 | 7,391 |
| 2003 | 146 | | | 1,282 |
| 2004 | 828 | 125 | 953 | 2,064 |
| 2005 | | | | 2,727 |

[a] Shaded cells not used when calculating an SEG.

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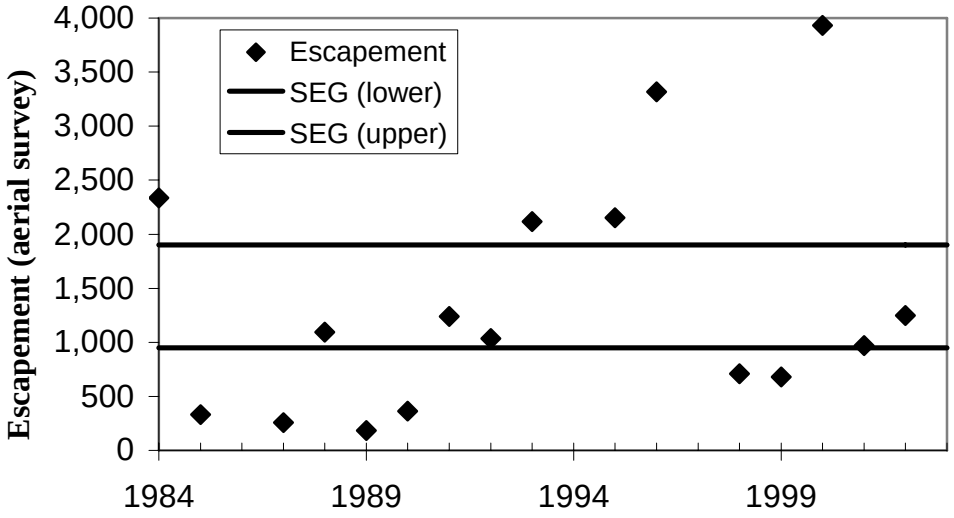
**System: Niukluk and Ophir Rivers**
**Species: Coho salmon**
**Stock Unit: not applicable**

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




**Comparison of Paired Tower and Aerial Survey Escapement Counts**