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THE STATE of ALASKA
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# MEMORANDUM

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DATE: October 2, 2017

SUBJECT: Prince William Sound Management Area Escapement Goal Memo

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The purpose of this memo is to report our progress reviewing and recommending escapement goals for the Prince William Sound (PWS) Management Area. Escapement goals in this management area have been set and evaluated at regular intervals since statehood. This effort has resulted in many of the stocks having long-term historical datasets. All PWS escapement goals were last reviewed by the Alaska Department of Fish and Game (department) (Moffitt et al. 2014) during the 2014–2015 Alaska Board of Fisheries (board) cycle.

Between December 2016 and September 2017 an interdivisional salmon escapement goal review committee, including staff from the divisions of Commercial Fisheries and Sport Fish, reviewed

existing salmon escapement goals in the PWS management area. The review was based on the *Policy for the management of sustainable salmon fisheries* (5 AAC 39.222) and the *Policy for statewide salmon escapement goals* (5 AAC 39.223). Two important terms are:

> 5 AAC 39.222(f)(3) "biological escapement goal" or "(BEG)" means the escapement that provides the greatest potential for maximum sustained yield . . .;" and
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> 5 AAC 39.222(f)(36) "sustainable escapement goal" or "(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 or managed for . . .;"

The committee determined the appropriate goal type (BEG or SEG) for each salmon stock with an existing goal and considered other monitored, exploited stocks without an existing goal. Based on the quality and quantity of available data, the committee determined the most appropriate methods to evaluate the escapement goals. Due to the thoroughness of previous analyses by Bue et al. (2002), Evenson et al. (2008), Fair et al. (2008 and 2011), and Moffitt et al. (2014), this review re-analyzed only those goals with recent data that could potentially result in a different escapement goal from the last review, or those that should be eliminated or established.

Escapement goals were evaluated for PWS stocks using a variety of methods: (1) spawner-recruit analyses; (2) yield analyses; and/or (3) the recently updated percentile approach (Clark et al. 2014). The committee developed escapement goals for each stock, compared them with the current goal, and agreed on a recommendation to keep the current goal, change the goal, or eliminate the goal. The methods used to evaluate the escapement goals and the rationale for making subsequent recommendations will be described in a published report (Haught et al. *In prep*) available prior to the December 2017 PWS board meeting.

There were 29 existing escapement goals evaluated in PWS (Table 1). In addition, the committee also considered developing an escapement goal for Gulkana River king salmon.

**Copper River king salmon**

The lower bound SEG of 24,000 or more spawners was established in 2003 (Bue et al. 2002) to keep escapements near the historical average of 25,800 fish from 1980-2000, estimated using a catch-age model (Savereide 2001). Subsequent analyses with the catch-age model suggested the number of spawners that produce the maximum sustained yield (MSY), denoted as $S_{msy}$, was approximately 19,700 king salmon (Savereide and Quinn 2004). During this review a state-space model that simultaneously reconstructs runs and fits a spawner-recruit model to estimate total return, escapement, and recruitment of Copper River king salmon from 1980–2016 was completed (Savereide et al. *In prep*). The model uses harvest, age composition, and relative and

absolute measures of inriver run abundance to estimate parameters that describe the production relationship for this stock. Uncertainty from the run reconstruction is passed through to the spawner-recruit analysis and all relevant data are considered and automatically weighted by their precision. The model accommodates missing data, measurement error in the data, absolute and relative abundance indices, and changes in age at maturity. The state-space model, similar to the catch-age model, estimates $S_{msy}$ to be lower than the current lower bound SEG. The estimate of $S_{msy}$ from the state-space model is approximately 18,500. Based on these results the committee recommends an SEG range of 18,500 to 33,000 king salmon which has a high probability of producing sustainable yields.

**Gulkana River king salmon**

The committee reviewed king salmon escapement and production data from the Gulkana River for consideration of developing an escapement goal for this system. Escapements have been monitored in the Gulkana River since 2002 with a counting tower project in the upper river and have ranged from 1,620 to 6,290 king salmon. The counting tower enumerates approximately 50% of the spawning escapement and provides a good indicator of overall Copper River run strength; however, the time series of data is relatively short, especially given the variability in the proportion of the Gulkana River king salmon escapement enumerated at the tower. The committee recommended continued monitoring of the system until a sufficient time series of data is available to better understand how well the tower count indexes escapement.

**PWS chum salmon**

A risk analysis method was used in 2005 to develop the current PWS chum salmon lower bound SEGs (Evenson et al. 2008) based on aerial surveys conducted on approximately 214 streams. As a result of budget reductions, the number of streams surveyed on an annual basis was reduced 37% to 134 in 2015. The committee determined that relatively high harvest rates during recent years justified the use of the 3-tier percentile approach (Clark et al. 2014) rather than the risk-analysis method. For this analysis the 3-tier percentile approach was applied to 134 streams surveyed annually since 1963. The committee recommends all PWS chum salmon lower bound SEGs be updated to reflect the reduction in the number of streams surveyed and switching from the risk analysis method to the 3-tier percentile approach (Table 1).

**PWS coho salmon**

The current escapement goals for Copper River Delta and Bering River coho salmon stocks were developed from peak aerial surveys using the percentile approach of Bue and Hasbrouck (unpublished). For this review both data sets were updated through 2016 and the 3-tier percentile approach (Clark et al. 2014) was applied. The results of updated analyses were similar to the current escapement goals. The escapement goal committee recommends the current goals remain unchanged.

**PWS pink salmon**

Since 1960, the department has conducted aerial surveys of select pink salmon streams in PWS to index the spawning escapement. There are approximately 1,000 pink salmon spawning systems in the PWS management area. The current escapement goals, established in 2011, were developed from aerial surveys of 214 streams surveyed since 1963 and represent approximately 20–25% of the anadromous streams in each district and 75–85% of the total spawning escapement (Fried 1994; Fried et al. 1998). However, due to recent budget reductions, in 2015 the number of streams surveyed was reduced 37% to 134 streams. For this review the committee updated the escapement time series through 2016 and applied the 3-tier percentile approach (Clark et al. 2014) to develop its recommendations (Table 1). The committee recommends revising both even- and odd-year PWS pink salmon goals using the 3-tier percentile approach applied to the reduced number of surveyed streams.

**PWS sockeye salmon**

For this review Bering River, Copper River Delta, Coghill River, and Eshamy River sockeye salmon analyses were updated and reviewed by the committee. The current escapement goals for Copper River Delta and Bering River sockeye salmon stocks were developed from peak aerial surveys using the percentile approach of Bue and Hasbrouck (unpublished). For this review both data sets were updated through 2016 and the 3-tier percentile approach (Clark et al. 2014) was applied. The results of updated analyses were similar to the current escapement goals. The current escapement goals for Coghill River and Eshamy River sockeye salmon were developed from spawner-recruit analyses (Fair et al. 2008, Fair et al. 2011). For this review both data sets were updated through 2016. The committee determined there was insufficient new information to warrant updating the escapement goal analysis for Upper Copper River sockeye salmon. The current SEG 360,000–750,000 was implemented in 2012 and underwent thorough review during the previous review cycles (Fair et al 2011 and Moffitt 2014). The addition of recent escapements to the time series would not likely result in recommendation to modify the current goal. The escapement goal committee recommends the current goals for these sockeye salmon stocks remain unchanged.

In summary, this comprehensive review resulted in recommendations to update all king, chum, and pink salmon escapement goals. The committee recommends no modifications be made to the existing coho and sockeye salmon escapement goals, and that no goals be eliminated or created at this time in PWS.

Oral and written reports (Haught et al. *In prep*) concerning escapement goal recommendations for stocks in the PWS management area will be presented to the board in December 2017. These reports will list all current and recommended escapement goals for the PWS management area, recent escapements, as well as detailed descriptions of the methods used to reach these

recommendations. Subsequent to the board meeting, a follow-up memorandum will be prepared to finalize escapement goals.

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Table 1.–Summary of current and recommended escapement goals for salmon stocks in the Prince William Sound management area, 2017.

| | Current Escapement Goal | | | Recommended Escapement Goal | | | |
|---|---|---|---|---|---|---|---|
| System | Goal | Type | Year Adopted | Goal | Type | Data | Action |
| **King Salmon** | | | | | | | |
| Copper River | 24,000 | LB SEG | 2003 | 18,500–33,000 | SEG | Mark-Recapture | Establish SEG Range |
| **Chum Salmon** | | | | | | | |
| Eastern District | 50,000 | LB SEG | 2006 | 79,000 | LB SEG | Aerial Surveys | Change to LB SEG |
| Northern District | 20,000 | LB SEG | 2006 | 28,000 | LB SEG | Aerial Surveys | Change to LB SEG |
| Coghill District | 8,000 | LB SEG | 2006 | 10,000 | LB SEG | Aerial Surveys | Change to LB SEG |
| Northwestern District | 5,000 | LB SEG | 2006 | 7,000 | LB SEG | Aerial Surveys | Change to LB SEG |
| Southeastern District | 8,000 | LB SEG | 2006 | 11,000 | LB SEG | Aerial Surveys | Change to LB SEG |
| **Coho Salmon** | | | | | | | |
| Copper River Delta | 32,000–67,000 | SEG | 2003 | | | | No Change |
| Bering River | 13,000–33,000 | SEG | 2003 | | | | No Change |
| **Pink Salmon** | | | | | | | |
| Eastern District (even year) | 250,000–580,000 | SEG | 2012 | 203,000–328,000 | SEG | Aerial Surveys | Change in Range |
| Eastern District (odd year) | 310,000–640,000 | SEG | 2012 | 346,000–863,000 | SEG | Aerial Surveys | Change in Range |
| Northern District (even year) | 140,000–210,000 | SEG | 2012 | 96,000–127,000 | SEG | Aerial Surveys | Change in Range |
| Northern District (odd year) | 90,000–180,000 | SEG | 2012 | 111,000–208,000 | SEG | Aerial Surveys | Change in Range |
| Coghill District (even year) | 60,000–150,000 | SEG | 2012 | 37,000–110,000 | SEG | Aerial Surveys | Change in Range |
| Coghill District (odd year) | 60,000–250,000 | SEG | 2012 | 54,000–233,000 | SEG | Aerial Surveys | Change in Range |
| Northwestern District (even year) | 70,000–140,000 | SEG | 2012 | 52,000–93,000 | SEG | Aerial Surveys | Change in Range |
| Northwestern District (odd year) | 50,000–110,000 | SEG | 2012 | 64,000–144,000 | SEG | Aerial Surveys | Change in Range |
| Eshamy District (even year) | 3,000–11,000 | SEG | 2012 | 1,000–4,000 | SEG | Aerial Surveys | Change in Range |
| Eshamy District (odd year) | 4,000–11,000 | SEG | 2012 | 5,000–31,000 | SEG | Aerial Surveys | Change in Range |
| Southwestern District (even year) | 70,000–160,000 | SEG | 2012 | 62,000–105,000 | SEG | Aerial Surveys | Change in Range |
| Southwestern District (odd year) | 70,000–190,000 | SEG | 2012 | 112,000–231,000 | SEG | Aerial Surveys | Change in Range |
| Montague District (even year) | 50,000–140,000 | SEG | 2012 | 36,000–72,000 | SEG | Aerial Surveys | Change in Range |
| Montague District (odd year) | 140,000–280,000 | SEG | 2012 | 143,000–330,000 | SEG | Aerial Surveys | Change in Range |
| Southeastern District (even year) | 150,000–310,000 | SEG | 2012 | 88,000–153,000 | SEG | Aerial Surveys | Change in Range |
| Southeastern District (odd year) | 270,000–620,000 | SEG | 2012 | 286,000–515,000 | SEG | Aerial Surveys | Change in Range |

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Table 1.–Page 2 of 2.

| System | Current Escapement Goal | | | Recommended Escapement Goal | | | |
|---|---|---|---|---|---|---|---|
| | Goal | Type | Year Adopted | Goal | Type | Data | Action |
| **Sockeye Salmon** | | | | | | | |
| Upper Copper River | 360,000–750,000 | SEG | 2012 | | | Sonar | No Change |
| Copper River Delta | 55,000–130,000 | SEG | 2003 | | | Aerial Surveys | No Change |
| Bering River | 15,000–33,000 | SEG | 2012 | | | Aerial Surveys | No Change |
| Coghill Lake | 20,000–60,000 | SEG | 2012 | | | Weir | No Change |
| Eshamy Lake | 13,000–28,000 | BEG | 2009 | | | Weir | No Change |