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MEMORANDUM

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DATE: April 1, 2024

SUBJECT: Prince William Sound Escapement Goal Memorandum

This memorandum summarizes the Alaska Department of Fish and Game (department) review of Prince William Sound (PWS; including the Copper River drainage) escapement goals and associated committee findings for escapement goals. Escapement goals in this management area have been set and evaluated at regular intervals since statehood. All PWS escapement goals were last reviewed by the department (Joy et al. 2021a) during the 2021–2022 Alaska Board of Fisheries (board) cycle.

Between October 2023 and February 2024, an interdivisional salmon escapement goal review committee, including staff from the divisions of Commercial Fisheries and Sport Fish, met and reviewed existing salmon escapement goals in the PWS management area.

The department recognizes the importance of releasing escapement goal findings earlier in the year so the public may submit proposals to the board relative to goal escapement goal changes before the deadline of Wednesday, April 10, 2024. Thus, department staff completed their review on an accelerated timeline, and developed findings for PWS salmon escapement goals (Table 1).

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 used:

> 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 . . .;"

Accordingly, the committee also determined the appropriate goal type (BEG or SEG) for each salmon stock with an existing goal. Based on the quality and quantity of available data, the committee determined the most appropriate methods to evaluate the escapement goals.

Escapement goals were evaluated for PWS salmon stocks using a variety of methods: 1) spawner-recruit analyses, 2) yield analyses, and/or 3) the percentile approach (Clark et al. 2014). After reviewing escapements since the previous cycle (Table 2), the committee decided which escapement goals should be reanalyzed. The updated analysis results were then compared with the current escapement goal, and agreed on whether to keep the current goal, change the goal, eliminate the goal, or adopt a new goal. The methods used to evaluate the escapement goals and the rationale for making subsequent changes will be described in a published report (Morella et al. *In prep*) available prior to the December 2024 PWS regulatory meeting.

There are 29 established escapement goals in the PWS area (Table 1). This memorandum discusses 8 goals that were updated with current data to determine if a change was warranted. **Committee findings are for all goals to remain unchanged, and no new goals were proposed.**

Copper River King Salmon

The current SEG of 21,000–31,000 spawners was established in 2022 using a state-space model (Joy et al. 2021b) that simultaneously reconstructs runs and fits a Ricker spawner-recruit model to estimate total return, escapement, and recruitment of Copper River king salmon. 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. The model accommodates missing data, measurement error in the data, absolute and relative abundance indices, and changes in age at maturity.

During this review, the state-space model was updated with 5 additional years of escapement data (2019–2023). The time series of escapements never failed to replace themselves, so there is little information to accurately understand the density-dependent effects of large escapements. In this situation, the Ricker model provided the best estimate of S_{MSY}, but the estimates remain potentially sensitive to additional (large escapement) data. The results indicate escapements between 21,000 and 31,000 will still produce sustained yields and are more likely to produce maximum sustained yield. **Based on these results, the committee's findings are for the Copper River king salmon SEG to remain unchanged at 21,000–31,000 fish.**

Copper River Sockeye Salmon

The current SEGs for the Upper Copper River (UCR; 360,000–750,000; Fair et al. 2011) and Copper River Delta (CRD; 55,000–130,000; Bue et al. 2002) stocks were established using the percentile approach and percentile ranges as described in Bue and Hasbrouck (*unpublished*).

During this review, the data sets for both stocks were updated through 2023 and a Bayesian Ricker stock-recruitment model was used to estimate S_{MSY} and evaluate the current goals. Preliminary harvest and escapement estimates were used for 2023. Copper River sockeye salmon spawning escapements were combined (UCR and CRD) due to our inability to allocate the commercial harvests to stock or area of origin. The updated time series of escapements in this analysis include the two brood years that failed to replace themselves (2012 and 2015). The results show that good yields are being realized from escapements within the current SEG ranges, and these ranges are likely to produce maximum sustained yield. **Based on these results, the committee's findings are for the SEG of 360,000–750,000 for the UCR stock and 55,000–130,000 for the CRD stock to remain unchanged.**

PWS Chum Salmon

The percentile approach (Clark et al. 2014) was used in 2017 to determine the five current PWS chum salmon lower bound SEGs (Haught et al. 2017; Table 1) based on aerial surveys conducted annually since 1963. Due to high measurement error, lack of evidence that maximum sustained yield can be easily attained given the complicated nature of management in this mixed-stock fishery, and lack of evidence that larger escapements have reduced productivity, it was recommended that all PWS chum salmon goals be lower bound SEGs at the 20th percentile (Table 1).

During this review, the reliability of using aerial surveys to estimate chum salmon escapement in the presence of large pink salmon runs was examined. In recent years, largely due to weather, there have been fewer aerial surveys overall, specifically during times when peak chum salmon escapement historically occurs, and in any given survey, fewer streams are surveyed. Inconsistent survey coverage coupled with an increase in wild pink salmon stream abundance, particularly in odd years, has led to uncertainty in the ability to accurately apportion chum salmon and pink salmon in streams. The committee's findings are, therefore, that the SEGs for all districts remain

unchanged at this time, while department staff work to improve the aerial assessment of chum salmon and increase/prioritize aerial survey coverage of chum salmon streams.

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Table 1.–Summary of current escapement goals for salmon stocks in the Prince William Sound management area, 2024.

System	Current escapement goal			Data	Action
	Goal	Type	Year adopted		
King salmon					
Copper River	21,000–31,000	SEG	2022	Mark-recapture	No change
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	15,000–24,000	SEG	2022	Aerial surveys	No change
Coghill Lake	20,000–75,000	SEG	2022	Weir	No change
Eshamy Lake	13,000–28,000	BEG	2009	Weir	No change
Coho salmon					
Copper River Delta	32,000–50,000	SEG	2022	Aerial surveys	No change
Bering River	13,000–25,000	SEG	2022	Aerial surveys	No change
Chum salmon					
Eastern District	79,000	LB SEG	2018	Aerial surveys	No change
Northern District	28,000	LB SEG	2018	Aerial surveys	No change
Coghill District	10,000	LB SEG	2018	Aerial surveys	No change
Northwestern District	7,000	LB SEG	2018	Aerial surveys	No change
Southeastern District	11,000	LB SEG	2018	Aerial surveys	No change
Pink salmon					
Eastern District (even year)	203,000–328,000	SEG	2018	Aerial surveys	No change
Eastern District (odd year)	346,000–863,000	SEG	2018	Aerial surveys	No change
Northern District (even year)	96,000–127,000	SEG	2018	Aerial surveys	No change
Northern District (odd year)	111,000–208,000	SEG	2018	Aerial surveys	No change
Coghill District (even year)	37,000–110,000	SEG	2018	Aerial surveys	No change
Coghill District (odd year)	54,000–233,000	SEG	2018	Aerial surveys	No change
Northwestern District (even year)	52,000–93,000	SEG	2018	Aerial surveys	No change
Northwestern District (odd year)	64,000–144,000	SEG	2018	Aerial surveys	No change
Eshamy District (even year)	1,000–4,000	SEG	2018	Aerial surveys	No change
Eshamy District (odd year)	5,000–31,000	SEG	2018	Aerial surveys	No change
Southwestern District (even year)	62,000–105,000	SEG	2018	Aerial surveys	No change
Southwestern District (odd year)	112,000–231,000	SEG	2018	Aerial surveys	No change
Montague District (even year)	36,000–72,000	SEG	2018	Aerial surveys	No change
Montague District (odd year)	143,000–330,000	SEG	2018	Aerial surveys	No change
Southeastern District (even year)	88,000–153,000	SEG	2018	Aerial surveys	No change
Southeastern District (odd year)	286,000–515,000	SEG	2018	Aerial surveys	No change

Note: SEG = Sustainable escapement goal. BEG = Biological escapement goal. LB SEG = Lower-bound sustainable escapement goal.

Table 2.–Prince William Sound king, chum, coho, pink, and sockeye salmon escapement goals and escapements, 2013 to 2022.

	Current Goal Range			Initial	Escapement									
System	Lower	Upper	Type	Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
KING SALMON														
Copper River	21,000	31,000	SEG	2022	29,013	20,709	26,764	12,485	33,655	42,202	35,145	21,587	18,431	32,006
CHUM SALMON														
Eastern District	79,000		LB SEG	2018	146,349	90,445	104,437	116,685	76,836	109,598	56,846	103,849	58,965	64,365
Northern District	28,000		LB SEG	2018	40,475	27,385	41,253	10,410	33,437	18,407	11,690	23,542	20,404	26,014
Coghill District	10,000		LB SEG	2018	14,086	9,491	14,929	976	13,210	13,617	3,437	8,998	2,395	8,629
Northwestern District	7,000		LB SEG	2018	4,995	5,041	7,060	3,954	7,118	15,563	3,258	7,405	6,979	13,372
Southeastern District	11,000		LB SEG	2018	33,678	29,362	44,095	13,919	26,330	10,164	19,451	26,909	46,391	12,944
COHO SALMON														
Copper River Delta	32,000	50,000	SEG	2022	34,630	44,040	42,065	76,200	43,760	53,800	36,420	36,445	45,485	30,340
Bering River	13,000	25,000	SEG	2022	18,820	26,475	15,550	26,150	30,650	26,525	10,015	25,825	19,450	4,685

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Table 2.- Page 2 of 2.

System	Current Goal Range Lower	Current Goal Range Upper	Type	Initial Year	Escapement 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
PINK SALMON														
Eastern District (even year)	203,000	328,000	SEG	2018		250,381		594,778		309,325		206,152		353,187
Eastern District (odd year)	346,000	863,000	SEG	2018	1,266,630		1,440,254		557,545		445,075		729,369	
Northern District (even year)	96,000	127,000	SEG	2018		95,134		134,460		111,174		105,226		161,748
Northern District (odd year)	111,000	208,000	SEG	2018	299,054		708,920		395,437		195,169		464,350	
Coghill District (even year)	37,000	110,000	SEG	2018		60,921		63,986		70,881		88,401		73,971
Coghill District (odd year)	54,000	233,000	SEG	2018	625,991		775,488		181,153		153,129		300,227	
Northwestern District (even year)	52,000	93,000	SEG	2018		66,350		168,272		111,194		77,828		292,892
Northwestern District (odd year)	64,000	144,000	SEG	2018	201,836		438,944		250,989		91,267		368,406	
Eshamy District (even year)	1,000	4,000	SEG	2018		12,167		NA		16,594		7,250		14,937
Eshamy District (odd year)	5,000	31,000	SEG	2018	12,145		68,988		2,836		1,402		17,925	
Southwestern District (even year)	62,000	105,000	SEG	2018		73,104		NA		81,100		64,470		200,057
Southwestern District (odd year)	112,000	231,000	SEG	2018	337,952		644,158		172,930		33,340		339,920	
Montague District (even year)	36,000	72,000	SEG	2018		23,136		NA		135,208		84,238		143,917
Montague District (odd year)	143,000	330,000	SEG	2018	365,807		559,994		205,252		25,385		242,151	
Southeastern District (even year)	88,000	153,000	SEG	2018		141,845		107,769		293,275		138,330		137,692
Southeastern District (odd year)	286,000	515,000	SEG	2018	1,137,736		1,529,543		372,960		290,452		544,906	
SOCKEYE SALMON														
Upper Copper River	360,000	750,000	SEG	2012	860,253	864,958	930,061	513,546	465,539	478,701	721,033	362,445	511,274	521,313
Copper River Delta	55,000	130,000	SEG	2003	75,705	64,205	66,665	51,550	56,950	58,470	61,825	55,620	87,075	55,075
Bering River	15,000	24,000	SEG	2022	23,900	14,985	21,705	16,390	19,115	13,300	17,630	15,685	13,774	7,095
Coghill Lake	20,000	75,000	SEG	2022	17,231	21,836	13,684	8,708	50,462	62,295	32,247	53,901	101,083	34,092[a]
Eshamy Lake[b]	13,000	28,000	BEG	2009	NA	NA	NA	NA	NA	NA	NA	NA	7,001[a]	19,325

Note: BEG = biological escapement goal; SEG = sustainable escapement goal; LB SEG = lower-bound SEG; OEG = optimal escapement goal; NA = data not available.

[a] Incomplete survey, remote video, or weir count.

[b] Eshamy River weir was not operated 2013–2020. A pilot project to assess the use of video for monitoring starting in 2013 has not provided a comparable total escapement estimate.