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MEMORANDUM

TO: Distribution

DATE: January 30, 2025

SUBJECT: Kenai River early-run Chinook salmon 2025 outlook

FROM: Tony Eskelin, Research Biologist
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The 2025 forecast for large (≥75 cm mideye-to-tail-fork-length [METF] or approximately ≥34 inches in total length) early-run Chinook salmon in the Kenai River is 1,531 fish. The 80% prediction interval (PI), based upon the variability between past forecasts and observed run size is 671–3,493 fish (Table 1). The forecasted run, without harvest, is expected to be well below the lower bound of the optimal escapement goal range of 3,900 fish. When considering missed escapements estimates as an indicator of stock health, it is important to remember that the department establishes escapement goals to produce the maximize yield and a management reference point designed to ensure sustainability would be lower than the lower bound of the yield-based escapement goals. The 2024 estimated total run of 1,365 large fish was the lowest run on record. The 2025 run is forecast to be the 2nd lowest on record.

This forecast is the sum of individual age-specific (total age 5, 6, and 7) model averaged forecasts of abundance calculated from three models based on recent age-specific run sizes (3-year geometric mean, ARIMA time series, and exponential smoothing; Table 2). The sibling relationship and Ricker models were also tested for model significance but performed poorly and were not utilized for this forecast. Hindcasts by age were produced for each return year as one-step-ahead predictions (forecasts) using the estimates from prior years. The variability among forecasted and estimated total runs for each model was assessed using the mean deviation (MD), mean absolute deviation (MAD), and mean absolute arctangent percent error (MAAPE) with the MAAPE being the primary diagnostic. The 5-year MAAPEs were model averaged to produce each age-specific forecast. The MAAPE model average for each age class is the average of the forecast from each model weighted by the normalized inverse MAAPE from each model.

The 2025 forecast is for 1,166 age-5 fish, 364 age-6 fish, and 1 age-7 fish for a total large fish run forecast of 1,531 fish (Table 1). Age-4 fish were not considered for this forecast and the return of large age-4 fish is likely to be zero or extremely small. The forecast for age-5 fish is near the recent 5-year average of 1,283 fish (Table 3). The forecast for age-6 fish is well below the recent 5-year

average and if realized would be the second lowest age-6 fish return on record. The age-6 fish forecast has been consistently overforecast and the source of the most error in recent forecasts. The age-7 forecast is inconsequential. None of the models forecast many age-7 fish, and no age-7 fish have been sampled since 2021. It is possible that a small number of age-7 fish have returned but have not been sampled due to the difficulty in detecting a small population in the sampling program.

There is considerable uncertainty in the 2025 forecast. Since 2017, the early run has been overforecast in 6 of 8 years (Figure 1). The 2024 forecast was for a total run of 2,630 large fish, while the estimated total run was 1,365 large fish, which was 1,265 fish less or approximately half the forecast. The 2025 forecast gives the expectation of a total run that is poor and likely one of the lowest on record.

Table 1.–2025 large (≥75 cm METF) Kenai River early-run Chinook salmon forecast, and the relative fit of each model to the previous 5 years of estimated runs by age.

			Relative fit to previous 5 years			
Total age	Model	2025 Forecast	MD[a]	MAD[b]	MAAPE[c]	MAAPE weight
5	Exponential smoothing	1,200	286	800	0.53	0.33
	3-yr geometric mean	1,108	656	836	0.54	0.33
	ARIMA time series	1,190	267	803	0.54	0.33
	MAAPE model average	**1,166**				
6	Exponential smoothing	297	287	412	0.51	0.34
	3-yr geometric mean	569	470	608	0.62	0.28
	ARIMA time series	273	266	347	0.45	0.38
	MAAPE model average	**364**				
7	Exponential smoothing	1	22	43	1.1	0.33
	3-yr geometric mean	1	120	120	1.27	0.29
	ARIMA time series	1	29	45	0.97	0.38
	MAAPE model average	**1**				
2025 Total Forecast (80% PI)		**1,531 (671-3,493)**				

[a] mean deviation, [b] mean absolute deviation, [c] mean absolute arctangent percent error

Table 2.–Description of models used for the 2025 large (≥75 cm METF) Kenai River early-run Chinook salmon forecast.

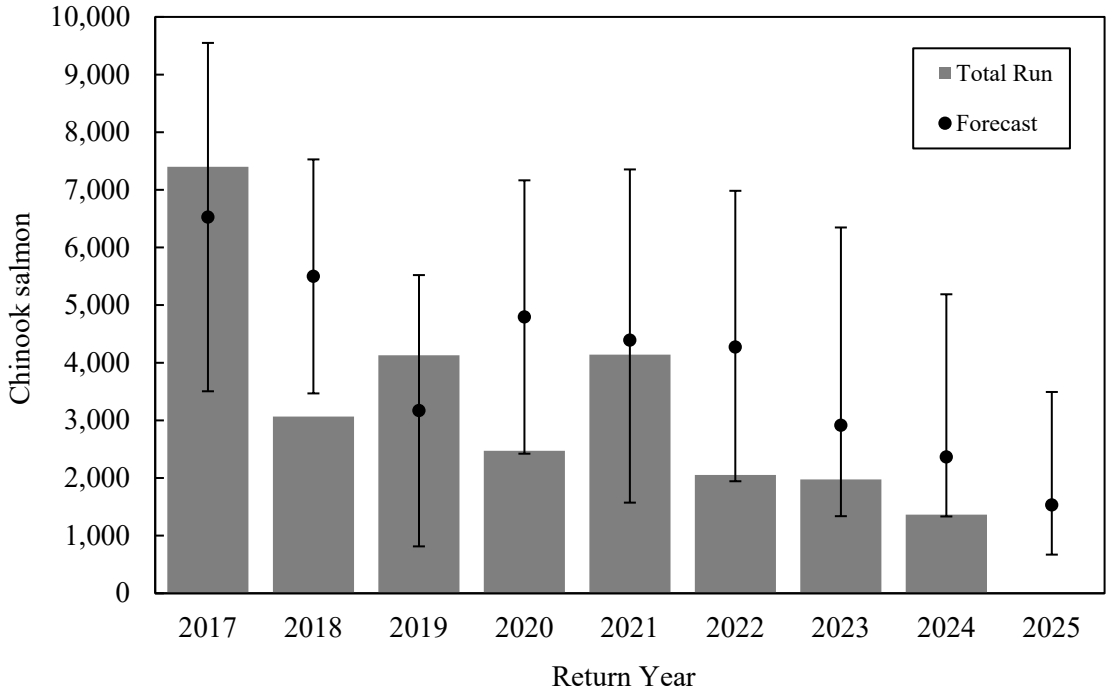
Model	Description
Exponential smoothing	Weighted moving average on the natural log of abundance for the specified age class.
3-year geometric mean	Geometric mean of the 2022–2024 returns for the specified age class.
ARIMA time series	Autoregressive integrated moving average (ARIMA) analysis on the natural log of abundance for the specified age class.

Table 3.–Estimated number of large (≥75 cm METF) early-run Kenai River Chinook salmon by age class and run year, 1986–2024.

	Number per age class				
Year	Age-5	Age-6	Age-7	Total run	Escapement
1986	7,598	6,823	1,574	16,013	8,320
1987	7,771	12,457	576	20,808	7,109
1988	2,586	15,740	2,352	20,673	5,773
1989	1,513	9,647	1,282	12,430	4,184
1990	3,248	9,124	970	13,401	11,344
1991	4,648	9,968	819	15,495	13,475
1992	3,484	9,839	879	14,266	11,881
1993	4,401	12,382	690	17,577	8,442
1994	2,009	10,272	704	12,970	4,792
1995	2,319	9,943	706	12,947	3,228
1996	2,033	6,038	217	8,279	1,853
1997	3,337	6,699	128	10,171	3,433
1998	2,833	3,677	277	6,827	5,269
1999	6,769	5,199	56	12,048	4,617
2000	5,361	6,457	72	11,974	9,917
2001	4,534	9,738	375	14,738	12,306
2002	3,719	4,494	390	8,649	7,776
2003	3,911	10,803	229	14,976	12,168
2004	7,251	12,817	1,140	21,328	18,323
2005	4,345	11,120	639	16,153	12,545
2006	2,505	6,702	519	9,785	5,780
2007	3,500	3,658	115	7,305	4,493
2008	3,125	3,463	158	6,799	3,539
2009	1,460	3,500	108	5,098	3,835
2010	2,591	1,607	62	4,278	3,082
2011	2,601	3,652	104	6,385	5,212
2012	1,168	1,984	58	3,232	2,948
2013	620	872	48	1,556	1,541
2014	1,810	679	47	2,552	2,541
2015	2,450	1,601	126	4,197	4,172
2016	4,017	2,275	82	6,399	6,328
2017	4,542	2,724	37	7,333	6,678
2018	1,975	1,066	26	3,088	2,934
2019	2,299	1,604	228	4,162	4,055
2020	796	1,656	20	2,495	2,443
2021	2,243	1,805	94	4,171	4,024
2022	896	1,155	0	2,051	2,047
2023	1,390	585	0	1,975	1,975
2024	1,092	273	0	1,365	1,365
Historical average	3,199	5,746	408	9,383	6,045
Recent 5-year average	1,283	1,095	23	2,411	2,371

Note: Estimated run size by age may not sum to total run for because the numbers given by age and total run in 1986–2021 are the medians of the posterior distribution of the state-space model, and also extremely low numbers of large age-4 fish are not included by age in this table but are included in total run estimates.

Figure 1.– Performance of recent large (≥75 cm METF) early-run Kenai River Chinook salmon forecasts and forecast for 2025. Error bars show 80% prediction intervals.



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