MEMORANDUM

TO:	Distribution	DATE:	January 30, 2025
		SUBJECT:	Kenai River late-run Chinook salmon 2025 outlook
FROM:	Tony Eskelin, Research Biologist Northern Kenai Peninsula Division of Sport Fish, Region II		

The 2025 forecast for large (≥75 cm mideye-to-tail-fork-length [METF] or approximately ≥34 inches in total length) late-run Chinook salmon in the Kenai River is 8,742 fish. The 80% prediction interval (PI), based upon the variability between past forecasts and observed run size is 4,526–16,883 fish (Table 1). The forecasted run, without harvest, is expected to be well below the lower bound of the optimal escapement goal range of 15,000 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 6,930 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 4,583 age-5 fish, 4,158 age-6 fish, and 1 age-7 fish for a total large fish run forecast of 8,742 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 approximately equal to the recent 5-year average of 4,580 age-5 fish, whereas the forecast for age-6 fish is

considerably lower than the recent 5-year average of 7,316 age-6 fish (Table 3). The age-6 fish forecast has been consistently overforecasted 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 late run has been overforecast in 7 of 8 years (Figure 1). The 2024 forecast was for a total run of 13,639 large fish, while the estimated total run was 6,930 large fish, which was 6,709 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 late-run Chinook salmon forecast, and the relative fit of each model to the previous 5 years of estimated runs by age.

| Total age | Model | 2025 Forecast | Relative fit to previous 5 years | | | MAAPE weight |
			MD[a]	MAD[b]	MAAPE[c]	
Age-5	Exponential smoothing	4,655	435	2,034	0.40	0.36
	3-year geometric mean	5,257	1,312	2,699	0.49	0.30
	ARIMA time series	3,906	306	2,070	0.44	0.34
	MAAPE model average	**4,583**				
Age-6	Exponential smoothing	3,679	844	2,389	0.36	0.33
	3-year geometric mean	5,729	1,633	2,109	0.34	0.35
	ARIMA time series	2,898	855	2,565	0.38	0.32
	MAAPE model average	**4,158**				
Age-7	Exponential smoothing	1	127	138	0.73	0.40
	3-year geometric mean	1	142	183	0.49	0.60
	MAAPE model average	**1**				
2025 Total Forecast (80% PI)		**8,742 (4,526-16,883)**				

[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 late-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) late-run Kenai River Chinook salmon by age class and run year, 1986–2024.

Year	Number per age class			Total run	Escapement
	Age-5	Age-6	Age-7		
1986	34,466	31,223	3,509	69,188	49,197
1987	20,592	54,141	1,097	75,846	48,096
1988	2,562	55,787	12,268	70,691	42,003
1989	4,716	31,749	6,107	42,598	26,852
1990	3,317	27,309	1,821	32,514	24,496
1991	10,505	26,351	2,432	39,342	29,076
1992	7,883	42,345	1,367	51,689	37,788
1993	7,970	52,445	4,096	64,711	38,346
1994	6,355	49,284	3,075	58,798	31,400
1995	10,879	35,163	3,585	49,767	31,022
1996	15,406	28,968	503	44,874	30,453
1997	8,582	34,630	934	44,260	24,734
1998	6,907	34,244	1,644	42,828	33,381
1999	9,641	33,714	2,565	46,006	28,769
2000	12,269	29,152	1,270	42,826	26,331
2001	9,281	34,241	1,465	45,147	27,895
2002	11,468	44,847	2,542	58,965	42,940
2003	17,253	54,445	598	72,422	51,862
2004	23,730	71,804	1,643	97,329	70,617
2005	14,154	67,470	4,058	85,879	55,764
2006	9,983	43,687	6,140	59,872	40,911
2007	13,685	27,832	5,372	46,981	31,276
2008	9,305	31,914	3,937	45,202	30,001
2009	5,012	23,848	1,885	30,785	20,807
2010	9,006	11,689	1,743	22,502	13,425
2011	6,944	18,544	883	26,411	16,541
2012	9,914	12,985	1,099	24,038	23,427
2013	3,556	10,097	846	14,542	12,719
2014	4,799	7,574	390	12,776	11,584
2015	5,789	15,924	1,381	23,139	16,857
2016	11,202	12,562	1,241	25,023	15,652
2017	14,483	14,961	1,271	30,734	20,583
2018	7,597	10,572	146	18,364	17,405
2019	5,435	7,174	711	13,360	11,709
2020	2,716	9,066	401	12,226	11,854
2021	3,930	8,333	504	12,794	12,238
2022	7,126	6,952	0	14,078	13,911
2023	5,220	9,334	0	14,554	14,502
2024	3,906	2,898	0	6,930	6,906
Historical average	9,681	28,853	2,167	40,769	28,034
Recent 5-year average	4,580	7,316	181	12,116	11,882

Note: Estimated run size by age may not sum to total run 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) late-run Kenai River Chinook salmon forecasts and forecast for 2025.
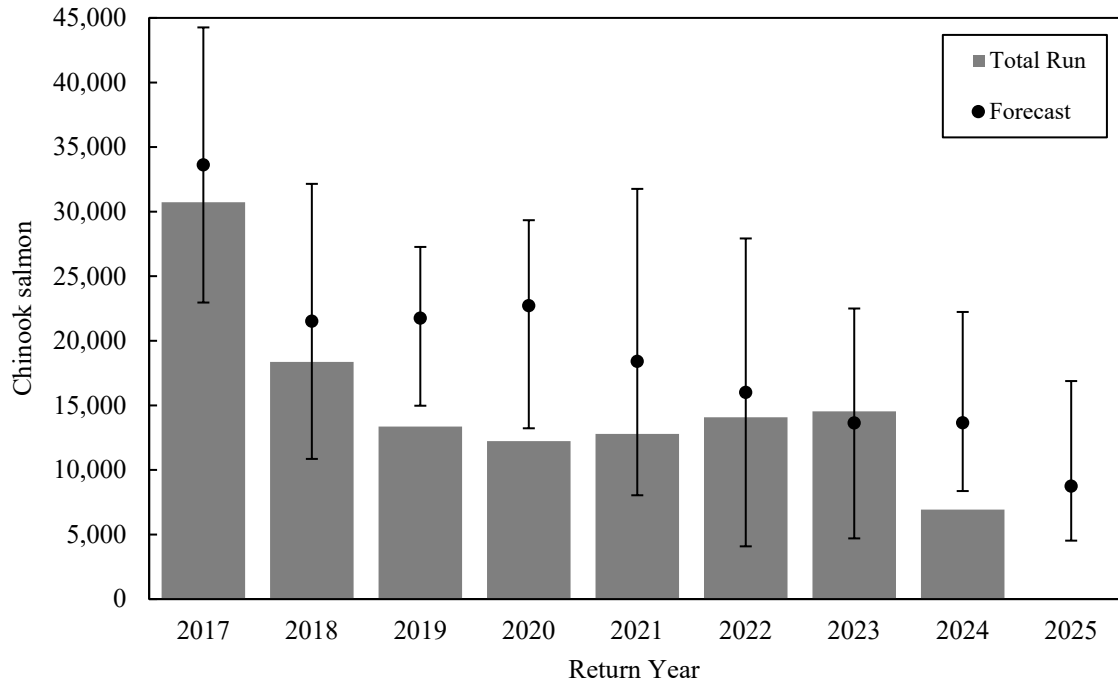
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