THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Fish and Game

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MEMORANDUM

TO: Distribution

DATE: December 20, 2019

FROM: Robert Begich, Fishery Biologist III
Division of Sport Fish, Region II

SUBJECT: Kenai River early run Chinook salmon 2020 outlook

The outlook for the early run of Kenai River Chinook salmon in 2020 is below average, with a large fish (≥ 75 cm mideye-to-tail-fork-length [METF] or approximately ≥ 34 inches in total length) forecast of 4,794 fish. The 2020 forecasted total run of large fish is within the optimum escapement goal of 3,900 to 6,600 fish however, below the 1986-2019 average total run of approximately 9,100 large fish and is less than the recent 5-year average total run of 5,110 fish (Table 1). If realized, the 2020 run will rank as the 8th lowest (28th out of 35 years) and be slightly larger (577 fish) than the preliminary estimate of the 2019 total run of 4,216 large fish. The 80% prediction interval for the 2020 run of large fish is 2,422 to 7,165 fish.

The forecast of large fish is the sum of individual age-specific (age5, 6 and 7) forecasts of abundance. Forecast abundance for each age class was calculated from models based on historical adult returns by age class (mean, median), recent age-specific run size (5-year mean) or sibling ratios from previous years (mean sibling, 5-year mean sibling, median sibling, most recent sibling) (Table 2). The model estimates selected for each of the age classes for inclusion in the 2020 large fish forecast had minimum values for two or more of the follow statistics: mean absolute deviation (MAD), mean absolute percentage error (MAPE) and mean deviation (MD) in 2015 – 2019 hindcasts, as compared to the actual runs in those years (Table 3). In recent forecasts of Kenai River Chinook salmon run size, forecast estimates with the smallest estimates of each statistic and / or lowest MAPE have provided the best accuracy between observed and forecasted runs by age over recent years.

The forecast for age-5 fish is 2,667 based on the median return year for brood years 1981–2015 (Table 3). The forecast of this age class is close to the estimated size of the 2019 run of age-5 fish (2,503) (Table 1). The five-year mean (2015-2019) composition of age 5-large fish was about 61% of the early-run of large fish. Even though both the MAD and MAPE for the median forecast run model out-performed models for the mean and 5-year mean, the difference of each to the run size forecasted by the median model is relatively small, less than 500 fish (Table 3).

The 5-year mean model estimate of 1,844 age-6 fish was selected. This forecast of age-6 fish is slightly larger (364 fish) than the preliminary estimate of the 2019 run of age-6 fish (1,480 fish). For this age class the 5-year mean model forecast was the least variable; however, the difference in the forecasted run size of 6-year fish for the most recent sibling and 5-year mean sibling models vary by at most only 165 fish from the run size forecasted by the 5-year mean model (Table 3).

The most recent sibling model had the lowest MAPE and was selected a run of 283 age-7 fish (Table 3). If realized, this would be similar to the 2019 run of 7-year fish (233) which was the largest return estimated for this age class since 2006 (Table 1).

The 2019 forecast was for a total run of approximately 3,167 large fish, while the preliminary estimated observed total run was approximately 4,216 large fish; about 25% percent (1,049 fish) greater than forecasted. The error in the 2019 forecast was due to under-forecasting production of age-6 and to a lesser extent age-7 fish from the 2013 and 2012 brood years, respectively. The 2020 early run of large Kenai River Chinook salmon primarily originates from the 2014 and 2015 brood year escapements (Table 1). The best way to consider this large fish forecast is in terms of 3 broad categories: approximately average run, below average run or above average run. The 2020 forecast gives the expectation of a run in the below average category.

Table 1. Estimated number of early-run Kenai River Chinook salmon > 75 cm METF by age class and year, 1986 - 2019.

	Total Age in Years					
Year	4	5	6	7	Total Run	Escapement
1986		6,648	6,108	1,387	14,143	6,562
1987		6,874	11,037	437	18,348	4,660
1988		2,226	13,367	1,944	17,537	2,668
1989		1,267	8,020	1,072	10,359	2,663
1990		1,901	5,354	570	7,825	5,523
1991		2,042	6,556	526	9,124	6,830
1992		2,624	7,243	647	10,514	7,902
1993		3,235	8,824	509	12,568	3,108
1994		1,873	9,349	555	11,777	3,448
1995		2,268	9,570	609	12,447	1,692
1996		2,099	6,157	229	8,485	1,940
1997		3,139	6,429	131	9,699	2,898
1998		3,188	4,214	317	7,719	5,918
1999		5,846	4,566	59	10,471	2,808
2000		3,791	4,956	65	8,812	6,580
2001		2,754	5,943	240	8,937	6,455
2002		4,108	4,902	432	9,442	8,489
2003		3,783	10,469	229	14,481	11,735
2004		6,249	11,092	994	18,335	15,319
2005		4,131	10,672	611	15,414	11,529
2006		2,709	7,331	565	10,605	6,072
2007		3,923	4,412	150	8,485	5,151
2008		3,457	4,012	135	7,604	4,138
2009		1,474	3,835	126	5,435	4,034
2010		2,534	1,648	73	4,255	3,012
2011		2,621	3,812	110	6,543	5,196
2012		1,138	2,168	70	3,376	2,977
2013		548	1,069	71	1,688	1,601
2014		1,881	754	55	2,690	2,621
2015		2,324	1,897	82	4,303	4,198
2016		4,243	2,244	80	6,567	6,478
2017	123	4,899	2,380	0	7,402	6,725
2018		1,844	1,217	0	3,061	2,909
2019		2,503	1,480	233	4,216	4,128
Average	123	3,122	5,679	392	9,196	5,234
Recent 5-Year Average	123	3,163	1,844	79	5,110	4,888

Table 2.–Models used in forecasting the 2020 large (≥ 75 cm METF) Kenai River Chinook salmon early-run.

Model	Description
Mean	Mean return for the specified age class using all brood years[a]
5-year mean	Mean of the 2015-2019 run for the specified age class.
Median	Median return for the specified age class of all brood years[a]
Mean sibling	Mean of sibling ratios (age/age minus 1) for all returns multiplied by the return of age minus 1 siblings.
5-year mean sibling	Mean of sibling ratios (age/age minus 1) for previous 5 brood years multiplied by the return of age minus 1 siblings.
Median sibling	Median of sibling ratios (age/age minus 1) for all returns multiplied by return of age minus 1 siblings.
Most recent sibling	Most recent sibling ratio (age/age minus 1), multiplied by the return of age minus 1 siblings.

[a]1981-2014 for age-5 fish, 1980-2013 age-6 fish, 1979-2012 for age-7 fish.

Table 3.–The 2020 Kenai River early-run Chinook salmon forecasts for large (≥ 75 cm METF) fish using several models, and the fit of each model to the previous 5 years of actual runs. Transparent boxes indicate the lowest MAD, MAPE, and MD for each age class forecast. Shaded boxes indicate forecasts that were selected to be part of the total run forecast for each age class. See Table 2 for a description of each model.

Model	Forecast 2020	5-year MAD[a]	5-year MAPE[b]	5-year MD[c]
		Age-5		
Mean	3,122	1,140	39%	34
5-year mean	3,164	1,494	43%	-905
Median	2,667	1,050	31%	-459
Forecast estimate	**2,667**			
		Age-6		
Mean	5,679	4,277	249%	4,227
5-year mean	1,844	347	20%	-79
Median	5,155	3,972	233%	3,972
Mean sibling	4,901	4,500	277%	4,500
5-year mean sibling	1,795	1,243	82%	1,243
Median sibling	4,077	3,270	205%	3,270
Most recent sibling	2,008	1,013	62%	604
Forecast estimate	**1,844**			
		Age-7		
Mean	392	342	478%	342
5-year mean	79	65	74%	-14
Median	231	182	273%	181
Mean sibling	85	99	148%	16
5-year mean sibling	101	98	129%	3
Median sibling	76	95	137%	9
Most recent sibling	283	99	58%	-11
Forecast estimate	**283**			
TOTAL RUN FORECAST	**4,794**			

[a]mean absolute deviation

[b]mean absolute percent error

[c]mean deviation

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