



MEMORANDUM

TO: Distribution

DATE: February 9, 2017

SUBJECT: Kenai River late run
Chinook salmon 2017
outlook

FROM: Robert Begich *RWB*
Division of Sport Fish, Region II

The outlook for the late run of Kenai River Chinook salmon in 2017 is below average, with a large fish (≥ 75 cm METF) forecast of approximately 33,613 fish. If realized, this run will: rank the 10th lowest measured (23rd out of 32 years); be approximately 38% greater than the large fish abundance of the 2016 run; and, be 74% of the 1986–2016 average of approximately 45,489 large fish. Individual brood years used for this forecast are comprised only of Chinook salmon ≥ 75 cm MEFT. Data for the 1979-2008 brood years was estimated from an age-structured state-space spawner-recruit model (Fleischman and Reimer 2017). The 2017 forecasted run exceeds the upper end of the newly recommended large fish sustainable escapement goal (SEG) of 13,500 to 27,000 fish.

The forecast of large fish is the sum of individual age-specific forecasts of abundance for Chinook salmon ≥ 75 cm METF only which are primarily ages 5, 6 and 7. Forecast abundance for each age class (Table 1) was calculated from several models based on relationships between adult returns (ages 5, 6, and 7) or siblings from previous years (Table 2). Sibling models from previous year's returns typically used to forecast age-5 and age-6 fish were not used due to bias in the estimates of small fish abundance historically. The model estimates selected for each age class for inclusion in the 2017 large fish forecast were those that had the minimum mean absolute deviation (MAD) in 2012 – 2016 hindcasts-of-forecasts, as compared to the actual runs in those years. In recent forecasts of Kenai River Chinook salmon run size, models with the smallest MAD have provided the best forecast accuracy.

For age-5 fish ≥ 75 MEFT, the recent 5-year mean model was selected (a run of 7,063 fish). The forecast is less than the 2016 run of this age class (12,251) and is less than the long-term average of age-5 fish (10,739).

For age-6 fish the 5-year mean sibling model estimate of 25,632 fish was selected. This forecast of age-6 fish is considerably larger than the runs of this age class since 2009 (9,989-18,615), however the 2017 age-6 forecast is less than the historical mean run of 32,272 age-6 fish.

For age-7 fish, the 5-year mean sibling model was selected (a run of 918 fish). If realized, this would be less than the runs of this age class in 2014-2016, and would be similar to the 2011 run.

There is much uncertainty in the 2017 run forecast estimate. The 80% prediction interval for the 2017 run forecast of large fish is 22,961 to 44,264 fish. Also, the 2016 hindcast of this forecast method was for a total run of approximately 20,864 fish, while the preliminary estimated total run was approximately 25,555 large fish. 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 2017 forecast gives the expectation of a run in the below average category, that may be slightly larger than the 2016 run of large fish.

To help frame the 2017 late-run forecast in more familiar terms, an additional run forecast was prepared that includes Chinook salmon of all sizes. The 2017 run forecast for all sizes of late-run Kenai River Chinook salmon is 43,710 fish. There is great uncertainty in age-specific forecasts of abundance for small fish (< 75 cm METF) primarily age-3 and -4 due to bias in the annual estimates of small fish abundance historically. Traditional forecast models of total run size of Kenai River Chinook salmon have shown substantial bias relative to actual numbers of small fish in the run. The 10,097 small fish in this year's forecast was estimated by the ratio from the recent 3-year average size composition by age for Chinook salmon < 75 cm MEFT of the inriver run which indicates there are approximately 3 large fish for each small fish.

Table 1.– Chinook salmon forecasts in 2017 for large (≥ 75 cm METF) Kenai River late run using several models, and the relative fit of hindcasts-of-forecasts of each model to the previous 5 years of actual runs. Shaded boxes indicate forecasts with the lowest associated MAD and hence were selected to be part of the total run forecast for each age class. Transparent boxes indicate the lowest MAD for each age class. See Table 2 for a description of each model.

Model	Forecast 2017	MAD ^a	5-year MAPE ^a	MD ^b
Age-5				
Mean	10,939	4,787	92%	4,337
5-year mean	7,063	2,423	39%	322
Median	9,814	3,752	71%	2,937
Forecast estimate	7,063			
Age-6				
Mean	32,710	22,412	192%	22,412
5-year mean	11,861	6,147	52%	5,196
Median	30,752	19,624	170%	19,624
Mean sibling	38,221	8,508	71%	8,416
5-year mean sibling	25,632	4,047	33%	1,791
Median sibling	33,493	6,382	52%	5,614
Most recent sibling	23,103	4,651	40%	1,770
Forecast estimate	25,632			
Age-7				
Mean	2,614	1,856	219%	1,856
5-year mean	975	1,063	121%	896
Median	1,992	1,277	154%	1,277
Mean sibling	918	248	26%	-5
5-year mean sibling	965	315	32%	86
Median sibling	807	249	24%	-114
Most recent sibling	958	394	34%	124
Forecast estimate	918			
TOTAL RUN FORECAST	33,613			

^amean absolute deviation

^bmean absolute percent error

^cmean deviation

Table 2.—Description of models used in forecasting the 2017 large (≥ 75 cm METF) Kenai River Chinook salmon late run.

Model	Description
Mean	Mean using all brood years ^a
5-year mean	Mean of the 2012-2016 run for the specified age class.
Median	Median return of all brood years
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-1981-2011 for 5 year olds, 1980-2010 for 6 year olds, 1979-2009 for 7 year olds.

Literature Cited:

Fleischman, S. J., and A. M. Reimer. 2017. Spawner-recruit analyses and escapement goal recommendations for Kenai River Chinook salmon. Alaska Department of Fish and Game, Fishery Manuscript Series No. 17-02, Anchorage.

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