



MEMORANDUM

TO: Distribution

DATE: February 9, 2017

SUBJECT: Kenai River early run
Chinook salmon 2017
outlook

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The outlook for the early run of Kenai River Chinook salmon in 2017 is below average, with a large fish (≥ 75 cm METF) forecast of approximately 6,526 fish. If realized, this run will rank the 8th lowest measured (25th out of 32 years), be nearly identical to large fish abundance of the 2016 run, and be less than the 1986–2016 average of approximately 9,300 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 only for Chinook salmon ≥ 75 cm MEFT (Fleischman and Reimer 2017). The 2017 forecasted run exceeds the upper end of the newly recommended large fish sustainable escapement goal (SEG) of 2,800 to 5,600 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 ages (6, 7) (Table 2). Several 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 was selected (a run of 2,036 fish). Although the forecast approximates the 2014 and 2015 runs of this age class, it is less than one-half of the estimated size of the 2016 run of age-5 fish (4,290).

For age-6 fish the 5-year mean sibling model estimate of 4,408 fish was selected. Historically age-6 fish are the predominant age class for early-run Kenai River Chinook salmon. This forecast of age-6 fish is larger than the actual runs of this age class since 2008, but is only approximately three-quarters of the historical mean.

For age-7 fish, the 5-year mean model was selected (a run of 82 fish). If realized, this would approximate the actual run of this age class in 2016 and would be similar to runs since 2012.

There is much uncertainty in the 2017 forecast estimate. The 80% prediction interval for the 2017 run forecast of large fish is 3,505 to 9,549 fish. The 2016 hindcast of this forecast method was for a total run of approximately 3,294 large fish, while the preliminary estimated total run was approximately 6,600 large fish, over twice the forecast. 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 that may be below average and similar to the 2016 run.

To help frame the 2017 early-run forecast in more familiar terms, an additional run forecast was prepared that includes Chinook salmon of all sizes. The 2017 total run forecast for all sizes of early-run Kenai River Chinook salmon is 11,188 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 additional 4,662 small fish in this year's forecast was estimated by the average ratio of the recent 3-year size composition by age for Chinook salmon < 75 cm MEFT of the inriver run which indicates there are approximately 1.4 large fish for each small fish.

Table 1.—2017 Chinook salmon forecasts for large (≥ 75 cm METF) Kenai River early run using several models, and the fit 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	5-year		
	2017	MAD ^a	MAPE ^b	MD ^c
Age-5				
Mean	3,168	1,664	166%	1,200
5-year mean	2,036	1,349	110%	5
Median	2,738	1,398	134%	765
Forecast estimate	2,036			
Age-6				
Mean	6,153	5,009	390%	5,009
5-year mean	1,634	1,102	100%	971
Median	6,034	4,659	363%	4,659
Mean sibling	8,999	2,147	123%	2,147
5-year mean sibling	4,408	430	25%	367
Median sibling	7,207	1,327	75%	1,327
Most recent sibling	4,190	582	33%	433
Forecast estimate	4,408			
Age-7				
Mean	439	396	491%	396
5-year mean	82	29	37%	25
Median	297	301	375%	301
Mean sibling	115	57	66%	34
5-year mean sibling	124	39	46%	3
Median sibling	108	52	61%	27
Most recent sibling	247	96	116%	51
Forecast estimate	82			
TOTAL RUN FORECAST	6,526			

^amean absolute deviation

^bmean absolute percent error

^cmean deviation

Table 2.--Description of models used in forecasting the large (≥ 75 cm METF) Kenai River Chinook salmon early 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.

^a1981-2011 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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