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MEMORANDUM

TO: Distribution

DATE: February 9, 2017

FROM: Nick DeCovich, Northern Cook Inlet Area Research Biologist
Division of Sport Fish, Region II

SUBJECT: Outlook for the 2017 Deshka Chinook salmon run, and accuracy of the 2016 outlook

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The point estimate of the preseason forecast for the 2017 Deshka River Chinook salmon total run is 17,813 2+ ocean age fish. The 80% prediction interval for the total run forecast is 11,865 to 23,761 fish. This forecast estimate is 5% less than the ten-year (2007 – 2016) average run of 18,755 fish and 47% less than the long-term (1979 – 2016) average of 33,509 fish. The anticipated 2017 harvest of Deshka River Chinook salmon in marine and sport fisheries is approximately 2,415 fish (2011 – 2015 mean). The Deshka Chinook sport fishery harvest is estimated as the recent five year average, obtained via the statewide harvest survey. The marine harvest is estimated as the Deshka River proportion of Upper Cook Inlet aerial survey counts multiplied by the total Upper Cook Inlet marine harvest of Chinook salmon. If realized, this harvest would result in a 2017 escapement of approximately 15,398 fish, within the sustainable escapement goal (SEG) of 13,000 to 28,000 fish.

The 2017 Deshka River Chinook salmon run is forecast to consist of 6,812 (38%) age-1.2, 8,399 (47%) age-1.3, and 2,602 (15%) age- 1.4 fish (Table 1). Inclusion of the five-year average number of age-1.1 fish would add 1,880 to the total of the 2017 Deshka Chinook salmon forecast. Counts of age- 1.1 jack Chinook salmon at the Deshka weir are considered a minimum, because an unknown number likely pass through the weir panels and go uncounted. In many years, zero to only a few hundred fish of this age class are counted thru the weir. However, those enumerated do count toward the escapement goal.

The total run forecast for 2017 is the sum of individual forecasts for the three major age classes (1.2, 1.3, and 1.4). Forecast abundance for each age class was calculated from models based on the relationship between adult returns and spawners or siblings from previous years. Models included simple linear regression, recent year averages, time series, and combinations thereof (Tables 1 and 2). The models chosen were those with statistically significant parameters that have the greatest past reliability (accuracy and precision). Specifically, the model estimates selected for each age class for inclusion in the 2017 forecast were those with the minimum recent 5-year median absolute deviation (MAD). Using these criteria, the Ricker AR1 model (Ricker model using all brood years and an autoregressive lag-1 term) was selected for age-1.2 fish; the 5-year median was selected for age-1.3 fish; and the 5-year average was selected for age-1.4 fish (Table 1). There is uncertainty in the individual age class forecasts, particularly

in the forecast of age 1.2 and age 1.3 fish. For both of these age classes, the models with the next lowest 5-year MAD forecasts approximately twice as many fish as the selected model.

The 2016 preliminary estimate of Deshka River Chinook salmon total run is 22,631 fish age-1.2, 1.3, and 1.4 (Table 3). The forecast estimate of total run for 2016 was 24,638, a difference of +9% (Table 4). The long term (1999 – 2016) relative average difference between the actual total run and forecast total run is 21%. The 2016 actual total run was 21% greater than the ten-year (2007 – 2016) average run of 18,755, but 32% less than the 1979 – 2016 average of 33,509 (data not shown).

The 2016 run completed the return of the 2009 brood year, a total return of 15,452 Chinook salmon (return per spawner = 1.3). This was less than one-half of the return-per-spawner from the 2008 brood year (return-per-spawner = 3.2). Though not as productive as the 2008 brood year, it is an improvement over the 5 year span (2003 – 2007) in which each brood year failed to replace itself (less than 1 return-per-spawner).

There is uncertainty in the total 2017 Deshka River Chinook salmon forecast estimate. Models typically used tend to over-forecast when runs are declining and under-forecast when they are rebounding.

The Deshka Chinook salmon forecast has ranged from 4% to 40% from the actual run in the past seven years. The best way to consider this salmon 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 average category.

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Table 1.-Forecast Chinook salmon abundance for the Deshka River in 2017 using various models, and the relative performance of each model to the previous 5 years of actual runs as measured by MAD (median absolute deviation) and MD (median deviation). Asterisks indicate age-specific forecasts selected for the total run forecast. See Table 2 for model descriptions.

Model	Forecast 2017	Selected	5-year MAD	5-year MD
Age 1.1				
5-Year average	1,799	*	NA	NA
Age 1.2				
5-year average	7,670		2,549	-1,981
5-year median	7,420		2,600	-2,309
Standard Sibling 1992 on	14,779		1,966	1,704
Standard Log Sibling 1992 on	11,133		2,187	1,822
Standard Ricker	7,664		2,368	-1,094
Ricker AR1	6,812	*	1,622	-456
Age 1.3				
5-yr average	9,317		3,580	1,587
5-yr median	8,399	*	2,829	-728
Standard Sibling	23,472		6,559	6,559
Standard Log Sibling	23,070		5,186	5,186
Log Sibling AR1/MA1	17,053		3,080	2,332
Standard Ricker	14,283		4,936	3,618
Ricker AR1	16,142		6,012	2,521
Age 1.4				
5-year average	2,602	*	652	-177
5-year median	2,559		663	-419
Standard Sibling	6,926		4,569	4,569
Standard Sibling 1990 on	3,792		1,487	1,328
Standard Log Sibling	4,938		2,790	2,583
Standard Ricker	5,631		2,393	2,393
Ricker AR1	2,414		869	317
Total forecast	17813	(11865 - 23,761, 80% CI)		

Table 2.- Brief description of statistical models used in forecasting the Deshka River Chinook salmon run for 2017.

Model	Description
5-year average	Arithmetic mean of the natural log of the 2012 - 2016 total run. Done in Excel software.
5-year median	Median of the natural log of the 2012 - 2016 total run. Done in Excel software.
Standard Sibling	Sibling regression using all years of runs (1974-2012 brood years).
Standard Sibling 19XX on	Sibling regression using runs with the escapement counted by weir. Exact year (XX) to begin data set depends upon age class being modeled, through 2012 brood year. Runs from 1990 are the first counted by weir, runs prior to those years had the escapement estimated by expanding the aerial index. Done in Excel software.
Standard Log Sibling	Sibling regression using natural log of all years of runs (1974-2012 brood years). Done in Excel software.
Standard Log Sibling 19XX on	Sibling regression using natural log of runs. XX is exact year to begin data set, through 2012 brood year. Runs from 1990 are the first counted by weir, runs prior to those years had the escapement estimated by expanding the aerial index . Done in Excel software.
Log Sibling AR1/MA1	Sibling regression using natural log of all runs (1974-2012 brood years) and lag 1 autoregressive and moving average terms. Done in SAS software.
Standard Ricker	Ricker-style regression using all brood years (1974-2012). Done in SAS software.
Ricker AR1	Ricker-style regression using all brood years (1974-2012) and an autoregressive lag-1 term. Done in SAS software.

Table 3.-Accuracy of the Deshka River Chinook salmon outlook for the three major age classes 1999 - 2016.

			Forecast difference by major age class (forecast-actual)			
Return year	Forecast Run	Actual Run	Age 1.2	Age 1.3	Age 1.4	overall effect
1999	26,810	33,371	-4,374	-363	-1,824	underforecast
2000	33,337	42,273	3,508	-17,945	5,502	underforecast
2001	40,753	33,210	385	-5,768	12,926	overforecast
2002	43,805	32,955	994	5,640	4,216	overforecast
2003	41,041	46,193	-8,524	-969	4,341	underforecast
2004	60,833	66,383	-2,537	-933	-2,080	underforecast
2005	48,687	44,134	-4,692	2,924	6,321	overforecast
2006	49,071	38,451	-628	12,056	-808	overforecast
2007	37,007	24,032	6,592	4,117	2,266	overforecast
2008	20,268	9,656	6,428	2,060	2,124	overforecast
2009	20,593	12,721	1,024	4,148	2,699	overforecast
2010	30,775	22,207	4,864	2,742	962	overforecast
2011	21,080	22,049	270	-4,306	3,068	underforecast
2012	21,665	15,444	-4,181	9,419	983	overforecast
2013	26,791	19,242	2,936	5,986	-2,262	overforecast
2014	19,063	16,348	-604	1,461	1,858	overforecast
2015	20,418	23,216	-846	-2,149	197	underforecast
2016	24,638	22,631	-4,768	3,657	3,119	overforecast

Table 4. Model percent difference, calculated as model-observed / observed, i.e. model was X% greater or less than observed.

Return Year	% per Age Class 1.2	1.3	1.4	Relative Difference 1.2,1.3,1.4 Total	Absolute Difference 1.2,1.3,1.4 Total
1999	-42%	-2%	-22%	-20%	20%
2000	75%	-54%	125%	-21%	21%
2001	5%	-37%	137%	23%	23%
2002	11%	30%	80%	33%	33%
2003	-51%	-4%	66%	-11%	11%
2004	-21%	-2%	-21%	-8%	8%
2005	-36%	11%	119%	10%	10%
2006	-7%	57%	-9%	28%	28%
2007	303%	24%	48%	54%	54%
2008	425%	56%	47%	110%	110%
2009	12%	135%	234%	62%	62%
2010	104%	18%	50%	39%	39%
2011	4%	-30%	197%	-4%	4%
2012	-47%	225%	40%	40%	40%
2013	73%	56%	-64%	39%	39%
2014	-9%	21%	87%	17%	17%
2015	-12%	-17%	6%	-12%	12%
2016	-41%	40%	168%	9%	9%
Average	41%	29%	71%	21%	30%
Min	-51%	-54%	-64%	-21%	4%
Max	425%	225%	234%	110%	110%