



MEMORANDUM

TO: Distribution

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DATE: March 13, 2018

SUBJECT: Outlook for the 2018
Deshka River Chinook
salmon run, and
accuracy of the 2017
forecast

The point estimate of the preseason forecast for the 2018 Deshka River Chinook salmon total run is 12,782 fish of all ages, below the low end of the sustainable escapement goal (SEG) of 13,000-28,000. The run is forecast to consist of 2,187 (17%) age-1.1, 6,905 (54%) age-1.2, 1,264 (10%) age-1.3, and 2,426 (19%) age-1.4 fish (Table 1). The 80% prediction interval for the total run forecast is 6,398 to 19,166 fish. This forecast estimate is 32% less than the ten-year (2008 – 2017) average run of 18,696 fish and 62% less than the long-term (1979 – 2017) average of 33,417 fish.

The recent 5-year (2012 – 2016) mean harvest of Deshka River Chinook salmon in marine and sport fisheries is 2,376 fish. This level of harvest was achieved with some restrictions in the sport and commercial fisheries. The Deshka Chinook sport fishery harvest (1,777) is estimated as the recent 5-year average, obtained from the statewide harvest survey. The marine harvest (599) is estimated from the 5-year average of the Deshka River proportion of Northern Cook Inlet aerial survey counts multiplied by the total Northern Cook Inlet marine harvest of Chinook salmon. If the recent 5-year mean combined sport and commercial harvest is realized, the 2018 escapement would approximate 10,406 fish of all ages, well below the sustainable escapement goal (SEG) of 13,000 – 28,000 fish.

The total run forecast for 2018 is the sum of individual forecasts. We examined three classes of models: sibling relationships, Ricker spawner-recruit relationships, and recent year moving averages. 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 2018 forecast were those with the minimum recent year's mean absolute deviation (MAD). Using these criteria, the 5-year moving average was used for the age 1.1 fish, and no other models were considered for this age class. The Ricker model (Ricker model using all brood years) was selected for age-1.2 fish; a sibling model incorporating the relationship between age-1.2 and 1.3 fish was selected for age-1.3 fish; and the 5-year moving average was selected for age-1.4 fish. Examination of the MAD for the individual models of age 1.3 fish reveals that the second lowest MAD, 1,985 for the 5-year moving average model, is extremely close to the lowest MAD, 1,674 for the sibling model. The difference in the forecast estimate for the two models is substantial, 8,772 fish. This highlights the uncertainty in

construction of this forecast (Table 1). In addition to these analyses, forecast estimates for age 1.3 and 1.4 fish were produced using methods outlined in Bernard and Jones (2014), which allows for examination of sibling relationships in a Bayesian framework. We include these model estimates here for consideration in the overall forecast (Table 1).

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. For this reason, past years forecasts have focused on age 1.2 – 1.4 fish. In recent years, there has been an increase in the number of jack's passing the weir, and efforts to increase the accuracy of counts for this age class are underway. The data available gives an index of abundance, and forecasting this age class is restricted to recent averages (Table 2).

The preliminary estimate of for last years (2017) Deshka River Chinook salmon total run is 12,409 fish age-1.2, 1.3, and 1.4 (Table 2). The forecast estimate of total run for 2017 was 17,813, a difference of 30%. The long term (1999 – 2017) relative average difference between the forecast total run and actual total run is 13% (Table 3). The 2017 actual total run was 34% less than the ten-year (2007 – 2016) average run of 18,677. Note that table 3 does not include comparisons for age 1.1 fish because forecasts are unavailable for past years for this age class.

The 2017 run completed the return of the 2010 brood year, a total return of 22,382 Chinook salmon (return per spawner = 1.23). This was similar to the 2009 brood year (return-per-spawner = 1.32).

There is uncertainty in the total 2018 Deshka River Chinook salmon forecast estimate. One pattern to this uncertainty is that the models tend to over-forecast when runs are declining and under-forecast when they are rebounding. The Deshka Chinook salmon forecast has ranged from 5% to 30% 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 2018 forecast gives the expectation of a run in the below average category.

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Table 1. – Forecast Chinook salmon abundance for the Deshka River in 2018 using various models, and the relative performance of each model to the previous 5 years of actual runs as measured by MAD (mean absolute deviation) and MD (mean deviation).

Model	Forecast 2018	Model chosen	5-year MAD	5-year MD
<u>Age 1.1</u>				
5-year moving average	2,187	*	NA	NA
<u>Age 1.2</u>				
5-year moving average	6,810 ^a		2,821	504
Sibling				
Ricker	6,905	*	2,515	640
<u>Age 1.3</u>				
5-year moving average	10,036		1,985	51
Sibling	1,264	*	1,674	1,638
Ricker	14,226		4,395	862
Bernard and Jones ^b	2,420		3,203	2,798
<u>Age 1.4</u>				
5-year moving average	2,426	*	652	-177
Sibling	1,621		663	-419
Ricker	4,119		4,569	4,569
Bernard and Jones ^b	1,189		1,523	429
Total forecast	12,782	(6,398 - 19,166, 80% CI)		

^aThere was no significant sibling relationship with 1.2 age fish.

^bBernard, D. R., and E. L. Jones III. 2014. Forecasting annual run size of Chinook salmon to the Taku River of Alaska and Canada. Alaska Department of Fish and Game, Fishery Manuscript No. 14-08, Anchorage.

Table 2. – Estimated number of Deshka River Chinook salmon by age class in the run for years 1979 – 2017.

Run Year	Number per Age Class					Total Run	Total Run
	1.1	1.2	1.3	1.4	1.5	age 1.2 - 1.4	all ages
1979	0	4,504	38,602	21,231	0	64,336	64,336
1980	0	3,962	20,206	15,451	0	39,619	39,619
1981	0	2,679	15,272	8,842	0	26,792	26,792
1982	0	5,601	19,388	18,526	0	43,515	43,515
1983	0	10,469	22,862	16,471	0	49,803	49,803
1984	0	7,747	21,417	16,405	0	45,569	45,569
1985	0	7,232	21,271	20,498	24	49,001	49,025
1986	40	19,192	23,705	15,979	106	58,876	59,022
1987	15	7,183	24,362	12,990	19	44,535	44,569
1988	495	6,415	13,260	31,447	1,017	51,122	52,633
1989	513	8,405	8,772	15,609	423	32,786	33,722
1990	474	8,768	22,338	19,974	189	51,079	51,743
1991	0	4,906	11,060	15,905	1	31,872	31,873
1992	3,041	5,848	8,952	10,566	15	25,367	28,423
1993	3	4,711	10,369	7,367	9	22,448	22,461
1994	4	1,730	4,584	4,305	101	10,620	10,724
1995	109	4,060	3,099	3,286	167	10,445	10,721
1996	11	7,109	5,572	2,014	0	14,694	14,706
1997	80	6,135	23,730	6,113	0	35,979	36,059
1998	0	10,866	15,777	10,444	117	37,087	37,205
1999	0	10,310	14,606	8,453	70	33,369	33,439
2000	4	4,654	33,202	4,416	0	42,272	42,276
2001	481	8,167	15,580	9,463	3	33,210	33,693
2002	534	8,842	18,849	5,263	0	32,955	33,488
2003	478	16,832	22,762	6,599	0	46,194	46,672
2004	670	12,068	44,249	10,057	0	66,373	67,044
2005	545	13,037	25,807	5,290	0	44,134	44,679
2006	0	8,746	21,195	8,509	0	38,450	38,450
2007	0	2,175	17,092	4,765	0	24,033	24,033
2008	0	1,513	3,668	4,479	0	9,660	9,660
2009	0	8,503	3,065	1,154	0	12,722	12,722
2010	200	4,668	15,605	1,934	0	22,208	22,408
2011	519	6,031	14,461	1,556	0	22,049	22,567
2012	669	8,809	4,182	2,453	0	15,444	16,113
2013	785	4,278	11,682	3,282	0	19,242	20,027
2014	1,550	7,046	7,108	2,197	0	16,351	17,901
2015	2,897	7,211	12,763	3,332	0	23,307	26,204
2016	4,029	11,021	8,948	1,787	0	21,756	25,785
2017	1,162	1,706	9,391	1,313	0	12,409	13,571

Table 3. – Accuracy of the Deshka River Chinook salmon outlook for the three major age classes, 1999–2017. Forecasts were not done in the past for age 1.1 fish.

Return year	Forecast difference by major age class (forecast-actual)						Relative Difference
	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	-24%
2000	33,337	42,273	3,508	-17,945	5,502	underforecast	-27%
2001	40,753	33,210	385	-5,768	12,926	overforecast	19%
2002	43,805	32,955	994	5,641	4,216	overforecast	25%
2003	41,041	46,193	-8,524	-969	4,341	underforecast	-13%
2004	60,833	66,383	-2,535	-927	-2,079	underforecast	-9%
2005	48,687	44,134	-4,692	2,924	6,321	overforecast	9%
2006	49,071	38,451	-628	12,056	-807	overforecast	22%
2007	37,007	24,033	6,592	4,117	2,266	overforecast	35%
2008	20,268	9,660	6,427	2,058	2,123	overforecast	52%
2009	20,593	12,722	1,024	4,148	2,699	overforecast	38%
2010	30,775	22,208	4,864	2,742	962	overforecast	28%
2011	21,080	22,049	270	-4,306	3,068	underforecast	-5%
2012	21,665	15,444	-4,181	9,419	983	overforecast	29%
2013	26,791	19,242	3,134	6,526	-2,111	overforecast	28%
2014	19,063	16,351	-549	1,454	1,806	overforecast	14%
2015	20,418	23,307	-984	-2,102	198	underforecast	-14%
2016	24,638	21,756	-4,195	3,885	3,192	overforecast	12%
2017	17,813	12,409	5,106	-992	1,289	overforecast	30%
Average relative difference, 1999-2017							13%