



MEMORANDUM

Department of Fish and Wildlife
Intra Departmental

Date: December 12, 2016

To: Files

From: Adam Storch

Subject: 2016 Willamette River Spring Chinook Run and 2017 Forecast

Summary of 2016 Willamette River Spring Chinook Return

The final 2016 Willamette River spring Chinook return is estimated at 49,768 total fish to the Columbia River mouth (Table 1). An estimated 11,598 of these were unmarked fish (23%). The 2016 total return was 71% of forecast. The Clackamas River component was approximately 30% less than forecasted, with 5,789 spring Chinook returning to the Clackamas River compared to an expected 8,300.

The total return of adipose-fin-marked hatchery fish in 2016 is estimated at 38,170 fish at the Columbia River mouth, compared to 57,360 fish expected. Counts at the Willamette Falls fishway indicate that 25,463 fin-marked hatchery fish and 7,015 unmarked fish passed the fish ladder. The full reconstruction of the 2016 return is shown in Table 2.

Table 1. 2016 Willamette River forecasted and actual return (to Columbia River mouth).

	Columbia River Mouth Return				
	Age 3	Age 4	Age 5	Age 6	Total
2016 Forecast	1,400	40,300	28,200	200	70,100
Minimum	1,400	35,400	20,400	200	57,400
Maximum	1,400	47,900	35,300	200	84,800
2016 Actual Return	2,543	16,952	30,148	125	49,768

The forecast for 2016 assumed that 18% of the return would be comprised of unmarked fish, based on the average percentage of unmarked fish seen in the 2011–2015 returns. The actual unmarked rate for the full 2016 return is estimated to have been 23%.

Table 2. Preliminary summary of the 2016 Willamette River spring Chinook return.

Catch	Age 3	Age 4	Age 5	Age 6	Total
LCR Commercial	0	97	257	7	361
LCR Commercial (release mortality)	0	6	17	1	24
Select Area Commercial	0	136	425	0	561
LCR Sport (kept catch)	4	267	1,103	15	1,389
LCR Sport (release mortality)	0	6	13	0	19
L. Will. Sport Fishery (kept catch)	99	2,117	3,615	15	5,846
L. Will. Sport Fishery (release mortality)	2	52	90	0	144
Lower Clackamas Sport (kept catch)	3	15	27	0	45
Lower Clackamas Sport (rel. mortality)	0	1	2	0	3
Totals	108	2,697	5,549	38	8,392
Escapement					
Willamette Falls Count	2,161	11,169	19,070	78	32,478
Mortality Below Falls	4	92	158	1	255
Clackamas Hatchery swim-ins	65	348	640	0	1,053
Clackamas Hatchery transfers from N.F. Dam	6	224	413	0	643
Eagle Creek Hatchery Return	14	70	128	0	212
North Fork Dam, Passed Upstream	121	1,225	2,256	0	3,602
North Fork Dam, Recycled Downstream	14	73	136	0	223
Natural Spawn Bel. N.F. Dam	1	3	4	0	8
Sea Lion Predation	49	1,051	1,794	8	2,902
Totals	2,435	14,255	24,599	87	41,376
Run Entering Columbia	2,543	16,952	30,148	125	49,768
Run Entering Willamette	2,539	16,440	28,333	102	47,414
Run Entering Clackamas	224	1,959	3,606	0	5,789

Forecasted Willamette River Spring Chinook Return for 2017

Projections for Age-3 fish returning in 2017

In recent years, a regression of the observed Age-2:Age-3 cohort ratios versus Age-2 returns has been used to estimate the cohort ratio and forecast the return of Age-3 (jack) spring Chinook. For 2017, this method produces a point estimate of 2,100 Age-3 fish returning to the Columbia River mouth. Alternative methodologies have not proven to be useful in explaining variation in projected returns, therefore no alternative forecasts are provided.

Projections for Age-4 fish returning in 2017

A regression of natural log-transformed age-3 returns versus natural log-transformed age-4 returns plus incorporation of an ocean productivity variable (the ranking of NOAA ocean ecosystem indicators) predicts 27,100 age-4 fish will return and is used as the 2017 abundance forecast of age-4 spring Chinook at the Columbia River mouth. The minimum and maximum projections from the suite of models applied for the age-4 component are 26,100 (using a log-log formulation of the cohort relationship between age-2+age-3 combined versus age-4 returns) and 41,300 (using the five-year running average of the age-4:age-3 cohort ratio).

Projections of Age-5 fish returning in 2017

For 2017, an average of the output of the best-fit models (largest R^2 -values) predicts a return of 10,800 age-5 spring Chinook to the Columbia River mouth. The minimum and maximum forecasts from the suite of models applied are 6,400 (using the five-year running average of the age-5:age-4 cohort ratio) and 20,900 (using an additive model with the natural logarithm of age-4 for returns and age-5 returns at time t-1 as explanatory variables)

Performance of the age-5 predictor models is hindered by the recent change in age structure of the run. Over the past ten years, the run has become age-4 dominant whereas in the past the run would vary between age-4 dominant, age-5 dominant, or a 50/50 mix. The 2017 projection is less than the recent five-year average age-5 return.

Projections for Age-6 fish returning in 2017

The age-6 component makes up a very small portion of annual returns and, as a result, is difficult to correlate with prior year returns of the same cohort, but also contributes minimally to forecast errors. The 2017 projection is 190 spring Chinook to the Columbia River mouth, based on the running 5-year average age-6:age-5 cohort ratio.

2017 Clackamas River Forecasted Return

Using a linear model with the sum of the prior two year's jack (age-3) returns as the predictor variable and total return size as the response produces a projected 8,100 spring Chinook returning to the mouth of the Clackamas River. Age-specific forecasts are not presented here but were calculated based on the average proportions of each age in Clackamas returns.

2017 Forecast Summary

Table 3. 2017 Projected Willamette basin spring Chinook return to Columbia River mouth and minimum and maximum forecasts based on the suite of models applied.

	Columbia River Mouth Return				
	Age 3	Age 4	Age 5	Age 6	Total
2017 Forecast	2,100	27,100	10,800	190	40,190
Minimum	2,100	26,100	6,400	190	34,790
Maximum	2,100	41,300	20,900	190	64,490

The 2016 return included an estimated 23% unmarked fish. Using the most recent five-year average of unmarked fish (19%), the number of hatchery fish returning to the Columbia River mouth in 2017 is forecasted to be 32,550 (Table 4).

Table 4. 2017 Projected Willamette basin (Clackamas included) spring Chinook **hatchery** fish return to Columbia River mouth and minimum and maximum forecasts based on the suite of models applied.

	Columbia River Mouth Returns (hatchery fish only)				
	Age 3	Age 4	Age 5	Age 6	Total
2017 Forecast	1,700	22,200	8,700	150	32,550
Minimum	1,700	21,100	5,200	150	28,150
Maximum	1,700	33,500	16,900	150	52,250

Hatchery Surplus Estimates

The harvestable surplus of the 2017 return of hatchery fish is calculated by subtracting the hatchery fish escapement goals specified in the Willamette River Spring Chinook Fisheries Management and Evaluation Plan (FMEP) from the total forecasted hatchery component of the return. Based on the FMEP, at a total hatchery-fish run size of 32,550 fish the escapement goals for Willamette Falls and the Clackamas River are 20,000 and 3,000 fish, respectively. This results in a harvestable surplus of 9,550 fish. Per the allocation schedule included in the FMEP these fish are to be shared 100%/<1% for recreational and commercial fisheries, respectively.