MEMORANDUM

Department of Fish and Wildlife
Intra Departmental

Date: December 6, 2018
To: Files
From: Adam Storch
Subject: 2018 Willamette River Spring Chinook Run and 2019 Forecast

Summary of 2018 Willamette River Spring Chinook Return

The total 2018 Willamette River spring Chinook return to the Columbia River mouth is estimated to be 39,660 fish (Table 1). An estimated 10,099 of these were unmarked fish (~26%). The 2018 total return was 71% of forecast. The Clackamas River component was approximately 59% of forecast, with 2,657 spring Chinook returning to the Clackamas River compared to an expected 4,490 fish.

The total return of adipose-fin-marked hatchery fish to the Columbia River mouth in 2018 is estimated to be 29,561, compared to 44,760 fish expected. Counts at the Willamette Falls fishway indicate that 21,123 fin-marked hatchery fish and 5,419 unmarked fish passed the fish ladder. The full reconstruction of the 2018 return is shown in Table 2.

Table 1. 2018 forecasted and reconstructed return of Willamette River spring Chinook to Columbia River mouth.

	Columbia River Mouth Return				
	Age 3	Age 4	Age 5	Age 6	Total
2018 Forecast	**2,130**	**28,920**	**24,750**	**150**	**55,950**
95% CrI	970–3,680	11,300–47,240	10,000–44,820	0–300	
2018 Reconstructed Return	**2,219**	**26,760**	**10,605**	**76**	**39,660**

The forecast for 2018 assumed 20% of the return would be comprised of unmarked fish based on the average percentage of unmarked fish seen in the 2013–2017 returns. The actual unmarked rate for the full 2018 return is estimated to have been approximately 26%.

Table 2. Preliminary summary of the 2018 Willamette River spring Chinook return.

Catch	Age 3	Age 4	Age 5	Age 6	Total
SAF Commercial	0	177	280	0	457
LCR Sport (kept catch)	7	679	546	0	1,232
LCR Sport (release mortality)	0	16	12	0	28
L. Will. Sport Fishery kept catch	58	4,331	1,666	14	6,069
L. Will. Sport Fishery release mortality	2	109	42	0	153
Lower Clackamas Sport (kept catch)	0	5	2	0	7
Lower Clackamas Sport (rel. mortality)	0	1	0	0	1
Totals	67	5,318	2,548	14	7,947
Escapement					
Willamette Falls Count	1,999	17,682	6,805	56	26,542
Mortality Below Falls	1	76	29	0	106
Clackamas Hatchery swim-ins	12	61	17	0	90
Clackamas Hatchery transfers from N.F. Dam	0	48	14	0	62
Eagle Creek Hatchery Return	0	28	8	0	36
North Fork Dam, Passed Upstream	117	1,799	514	0	2,430
North Fork Dam, Recycled Downstream	0	12	3	0	15
Natural Spawn Bel. N.F. Dam	0	12	4	0	16
Sea Lion Predation	23	1,724	663	6	2,416
Totals	**2,152**	**21,442**	**8,057**	**62**	**31,713**
Run Entering Columbia	**2,219**	**26,760**	**10,605**	**76**	**39,660**
Run Entering Willamette	**2,212**	**25,888**	**9,767**	**76**	**37,943**
Run Entering Clackamas	**129**	**1,966**	**562**	**0**	**2,657**

Forecasted Willamette River Spring Chinook Return for 2019

Projections for Age-3 fish returning in 2019

The projected 2019 age-3 return was estimated as the product of the age-2 count at Willamette Falls in brood year 2016 and a cohort ratio predicted from a Bayesian implementation of a state-space model (i.e., Kalman Filter) where the process was a time-varying intercept for the linear regression of the logarithm of age-3 Columbia River return:age-2 Willamette Falls counts versus the logarithm of age-2 Willamette Falls counts. This approach produced an estimate of 2,290 (95% credible interval: 1,080–3,850) Age-3 fish returning to the Columbia River mouth.

Projections for Age-4 fish returning in 2019

Of the suite of models considered to predict the number age-4 Willamette River spring Chinook returning to the mouth of the Columbia River, the best was a state-space formulation of the linear regression of the logarithm of age-4 returns to the Columbia River mouth versus the logarithm of age-3 returns to the Columbia River mouth and the logarithm of an ocean productivity metric (i.e., the ranking of NOAA

ocean ecosystem indicators). In this application, the state or unobserved processes included a time-varying intercept and a time-varying slope for the age-3 predictor. The model predicts 30,690 (95% credible interval: 15,700–46,810) Age-4 fish returning to the Columbia River mouth in 2019.

Projections of Age-5 fish returning in 2019

The best model predicting age-5 returns of Willamette River spring Chinook to the Columbia River mouth in 2019 was again a state-space parameterization of the linear regression of the logarithm of age-5 returns versus the logarithm of age-3 returns, spring PDO (mean of May–August), spring transition date, and index of ichthyoplankton biomass and an index of copepod richness where the state process was a time-varying intercept. This model projects a 2019 age-5 return to the Columbia River mouth of 9,430 (95% credible interval: 1,750–19,410).

Projections for Age-6 fish returning in 2019

The projection for age-6 Willamette River spring Chinook returning to the Columbia River mouth in 2019 is 80 (95% credible interval: 0–170), estimated based on the running 5-year average age-6:age-5 cohort ratio.

2019 Clackamas River Forecasted Return

The best performing model predicting the total Clackamas River return applied the Kalman Filter method, where the state process was a time-varying intercept for the linear regression of the logarithm of the total return size versus of the sum of the prior two year's jack (age-3) returns. This produced a forecasted return of 2,800 (95% credible interval: 1,390–4,380) spring Chinook to the mouth of the Clackamas River.

2019 Forecast Summary

Table 3. 2019 projected Willamette basin (Clackamas included) spring Chinook return to Columbia River mouth and 95% credible intervals (95% CrI).

	Columbia River Mouth Return				
	Age 3	Age 4	Age 5	Age 6	Total
2019 Forecast	**2,290**	**30,690**	**9,430**	**80**	**42,490**
95% CrI	1,080–3,850	15,700–46,810	1,750–19,410	0–170	

The 2018 return included an estimated 26% unmarked fish. Using the most recent five-year average of unmarked fish (20%), the number of hatchery fish returning to the Columbia River mouth in 2019 is forecasted to be 33,980 (Table 4).

Table 4. 2019 projected Willamette basin (Clackamas included) spring Chinook **hatchery** fish return to Columbia River mouth and hatchery proportions of the 95% credible intervals (95% CrI) calculated for estimates of the total return (Table 3).

	Columbia River Mouth Return				
	Age 3	Age 4	Age 5	Age 6	Total
2019 Forecast	**1,830**	**24,550**	**7,540**	**60**	**33,980**
Prop (95% CrI)	860–3,080	12,560–37,450	1,400–15,530	0–140	

Hatchery Surplus Estimates

The harvestable surplus of the 2019 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 33,980 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 10,980 fish. Per the allocation schedule included in the FMEP 100% of this surplus is to be allocated to recreational fisheries with less than 1% allocated as incidental for other fisheries.