MEMORANDUM

Department of Fish and Wildlife
Intra Departmental

Date: December 11, 2017
To: Files
From: Adam Storch
Subject: 2017 Willamette River Spring Chinook Run and 2018 Forecast

Summary of 2017 Willamette River Spring Chinook Return

The total 2017 Willamette River spring Chinook return to the Columbia River mouth is estimated to be 53,653 fish (Table 1). An estimated 12,666 of these were unmarked fish (24%). The 2017 total return was 134% of forecast. The Clackamas River component was approximately 56% of forecast, with 4,527 spring Chinook returning to the Clackamas River compared to an expected 8,100 fish.

The total return of adipose-fin-marked hatchery fish to the Columbia River mouth in 2017 is estimated to be 40,987, compared to 32,550 fish expected. Counts at the Willamette Falls fishway indicate that 30,291 fin-marked hatchery fish and 6,337 unmarked fish passed the fish ladder. The full reconstruction of the 2017 return is shown in Table 2.

Table 1. 2017 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
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
2017 Reconstructed Return	**2,879**	**31,711**	**18,550**	**513**	**53,653**

The forecast for 2017 assumed that 19% of the return would be comprised of unmarked fish based on the average percentage of unmarked fish seen in the 2012–2016 returns. The actual unmarked rate for the full 2017 return is estimated to have been 24%.

Table 2. Preliminary summary of the 2017 Willamette River spring Chinook return.

Catch	**Age 3**	Age 4	Age 5	Age 6	Total
SAF Commercial	25	825	407	57	1,314
LCR Sport (kept catch)	16	845	383	15	1,259
LCR Sport (release mortality)	0	6	3	0	9
L. Will. Sport Fishery kept catch	172	4,699	2,372	23	7,266
L. Will. Sport Fishery release mortality	4	100	50	0	154
Lower Clackamas Sport (kept catch)	0	52	34	0	86
Lower Clackamas Sport (rel. mortality)	0	10	7	0	17
Totals	217	6,537	3,256	95	10,105
Escapement					
Willamette Falls Count	2,442	22,648	11,432	106	36,628
Mortality Below Falls	6	177	89	1	273
Clackamas Hatchery swim-ins	21	63	211	22	317
Clackamas Hatchery transfers from N.F. Dam	15	42	141	14	212
Eagle Creek Hatchery Return	12	37	124	13	186
North Fork Dam, Passed Upstream	113	767	2,563	256	3,699
North Fork Dam, Recycled Downstream	0	1	3	0	4
Natural Spawn Bel. N.F. Dam	0	1	5	0	6
Sea Lion Predation	53	1,438	726	6	2,223
Totals	**2,662**	**25,174**	**15,294**	**418**	**43,548**
Run Entering Columbia	**2,879**	**31,711**	**18,550**	**513**	**53,653**
Run Entering Willamette	**2,838**	**30,035**	**17,757**	**441**	**51,071**
Run Entering Clackamas	**161**	**973**	**3,088**	**305**	**4,527**

Forecasted Willamette River Spring Chinook Return for 2018

Projections for Age-3 fish returning in 2018

The projected 2018 age-3 return was estimated as the product of the age-2 count at Willamette Falls in brood year 2015 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 method produced an estimate of 2,130 (95% credible interval: 970–3,680) Age-3 fish returning to the Columbia River mouth.

Projections for Age-4 fish returning in 2018

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 28,920 (95% credible interval: 11,300–47,240) Age-4 fish returning to the Columbia River mouth in 2018.

Projections of Age-5 fish returning in 2018

The best model predicting age-5 returns of Willamette River spring Chinook to the Columbia River mouth in 2018 was again a state-space parameterization of the linear regression of the logarithm of age-5 returns versus the logarithm of age-3 returns and the logarithm age-4 returns, where the state process was a time-varying intercept. This model projects a 2018 age-5 return to the Columbia River mouth of 24,750 (95% credible interval: 10,000–44,820).

Projections for Age-6 fish returning in 2018

The projection for age-6 Willamette River spring Chinook returning to the Columbia River mouth in 2018 is 150 (95% credible interval: 0–300), estimated based on the running 5-year average age-6:age-5 cohort ratio.

2018 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 4,490 (95% credible interval: 2,360–6,860) spring Chinook to the mouth of the Clackamas River.

2018 Forecast Summary

Table 3. 2018 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
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	

The 2017 return included an estimated 24% 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 2018 is forecasted to be 44,760 (Table 4).

Table 4. 2018 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
2018 Forecast	**1,700**	**23,140**	**19,800**	**120**	**44,760**
Prop (95% CrI)	780–2,940	9,040–37,790	8,000–35,860	0–240	

Hatchery Surplus Estimates

The harvestable surplus of the 2018 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 44,760 fish the escapement goals for Willamette Falls and the Clackamas River are 22,000 and 3,300 fish, respectively. This results in a harvestable surplus of 19,460 fish. Per the allocation schedule included in the FMEP these fish are to be shared 85%/15% for recreational and commercial fisheries, respectively.