MEMORANDUM

Department of Fish and Wildlife
Intra Departmental

Date: December 9, 2020
To: Files
From: Adam Storch
Subject: 2020 Willamette River Spring Chinook Run and 2021 Forecast

Summary of 2020 Willamette River Spring Chinook Return

The total Willamette River spring Chinook return to the Columbia River mouth during 2020 is estimated to be 47,327 fish (Table 1). An estimated 13,559 of these fish were unmarked (~29%). The 2020 reconstructed return was 110% of forecast. The Clackamas River component was approximately 169% of forecast, with 5,033 spring Chinook returning to the Clackamas River compared to an expected 2,980 fish.

The total return of adipose-fin-marked hatchery fish to the Columbia River mouth in 2020 is estimated to be 33,768, compared to 33,000 fish expected. Counts at the Willamette Falls fishway indicate that 26,320 fin-marked hatchery fish and 8,692 unmarked fish passed the fish ladder. The full reconstruction of the 2020 return is shown in Table 2.

Table 1. 2020 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
2020 Forecast	**2,680**	**29,780**	**10,860**	**110**	**43,430**
95% CrI	1,230–4,430	11,260–46,230	1,820–22,780	0–253	
2020 Reconstructed Return	**1,362**	**36,828**	**9,137**	**0**	**47,327**

The forecast for 2020 assumed 34% of the return would be comprised of unmarked fish based on the average percentage of unmarked fish seen in the 2015–2019 returns. The actual unmarked rate for the full 2020 return is estimated to have been approximately 29%.

Table 2. Preliminary summary of the 2020 Willamette River spring Chinook return.

Catch	Age 3	Age 4	Age 5	Age 6	Total
SAF Commercial	0	188	124	0	312
LCR Sport (kept catch)	18	97	4	0	119
LCR Sport (release mortality)	0	25	0	0	25
L. Will. Sport Fishery (kept catch)	39	4,546	1,267	0	5,852
L. Will. Sport Fishery (release mortality)	2	175	49	0	226
Lower Clackamas Sport (kept catch)	0	0	0	0	0
Lower Clackamas Sport (rel. mortality)	0	0	0	0	0
Grand Ronde Will. Falls platform (kept catch)	0	0	0	0	0
Totals	59	5,031	1,444	0	6,534
Escapement					
Willamette Falls Count	1,124	26,500	7,388	0	35,012
Mortality Below Falls	1	79	22	0	102
Clackamas Hatchery swim-ins	11	164	5	0	180
Clackamas Hatchery transfers from N.F. Dam	8	137	4	0	149
Eagle Creek Hatchery Return	5	438	13	0	456
North Fork Dam, Passed Upstream	150	3,971	121	0	4,242
North Fork Dam, Recycled Downstream	0	4	0	0	4
Natural Spawn Bel. N.F. Dam	0	2	0	0	2
Sea Lion Predation	4	502	140	0	646
Totals	**1,303**	**31,797**	**7,693**	**0**	**40,793**
Run Entering Columbia	**1,362**	**36,828**	**9,137**	**0**	**47,327**
Run Entering Willamette	**1,344**	**36,518**	**9,009**	**0**	**46,871**
Run Entering Clackamas	**174**	**4,716**	**143**	**0**	**5,033**

Forecasted Willamette River Spring Chinook Return for 2021

Projections for Age-3 fish returning in 2021

The projected 2021 age-3 return was estimated as the product of the age-2 count at Willamette Falls in brood year 2018 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 prediction of 2,350 (95% credible interval: 1,030–3,720) Age-3 fish returning to the Columbia River mouth.

Projections for Age-4 fish returning in 2021

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 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 32,820 (95% credible interval: 8,190–69,830) Age-4 fish returning to the Columbia River mouth in 2021.

Projections of Age-5 fish returning in 2021

The best model predicting age-5 returns of Willamette River spring Chinook to the Columbia River mouth in 2021 was again a state-space parameterization of the linear regression of the logarithm of age-5 returns versus the logarithm of age-4 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 2020 age-5 return to the Columbia River mouth of 17,140 (95% credible interval: 4,310–32,480).

Projections for Age-6 fish returning in 2021

The projection for age-6 Willamette River spring Chinook returning to the Columbia River mouth in 2021 is 90 (95% credible interval: 0–235), estimated based on the running 5-year average age-6:age-5 cohort ratio.

2021 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 4,640 (95% credible interval: 2,420–7,300) spring Chinook to the mouth of the Clackamas River.

2021 Forecast Summary

Table 3. 2021 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
2021 Forecast	**2,350**	**32,820**	**17,140**	**90**	**52,400**
95% CrI	1,030–3,720	8,190–69,830	4,310–32,480	0–235	

The 2020 return included an estimated 29% unmarked fish. Using the most recent five-year average of unmarked fish (27%), the number of hatchery fish returning to the Columbia River mouth in 2021 is forecasted to be 38,260 (Table 4).

Table 4. 2021 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
2021 Forecast	**1,720**	**23,960**	**12,510**	**70**	**38,260**
Prop (95% CrI)	750–2,720	5,980–50,980	3,150–23,710	0–170	

Hatchery Surplus Estimates

The harvestable surplus of the 2021 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 38,260 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 15,260 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.