MEMORANDUM

Department of Fish and Wildlife
Intra Departmental

Date: December 11, 2019
To: Files
From: Adam Storch
Subject: 2019 Willamette River Spring Chinook Run and 2020 Forecast

Summary of 2019 Willamette River Spring Chinook Return

The total Willamette River spring Chinook return to the Columbia River mouth during 2019 is estimated to be 29,314 fish (Table 1). An estimated 10,097 of these fish were unmarked (~34%). The 2019 reconstructed return was 69% of forecast. The Clackamas River component was approximately 96% of forecast, with 2,692 spring Chinook returning to the Clackamas River compared to an expected 2,800 fish.

The total return of adipose-fin-marked hatchery fish to the Columbia River mouth in 2019 is estimated to be 19,217, compared to 33,980 fish expected. Counts at the Willamette Falls fishway indicate that 13,598 fin-marked hatchery fish and 7,019 unmarked fish passed the fish ladder. The full reconstruction of the 2019 return is shown in Table 2.

Table 1. 2019 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
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	
2019 Reconstructed Return	**2,022**	**17,163**	**9,884**	**245**	**29,314**

The forecast for 2019 assumed 21% of the return would be comprised of unmarked fish based on the average percentage of unmarked fish seen in the 2014–2018 returns. The actual unmarked rate for the full 2019 return is estimated to have been approximately 34%.

Table 2. Preliminary summary of the 2019 Willamette River spring Chinook return.

Catch	Age 3	Age 4	Age 5	Age 6	Total
SAF Commercial	4	162	133	30	329
LCR Sport (kept catch)	5	121	75	0	201
LCR Sport (release mortality)	0	7	5	0	12
L. Will. Sport Fishery (kept catch)	62	2,682	1,676	39	4,459
L. Will. Sport Fishery (release mortality)	3	128	80	2	213
Lower Clackamas Sport (kept catch)	0	0	0	0	0
Lower Clackamas Sport (rel. mortality)	0	1	0	0	1
Grand Ronde Will. Falls platform (kept catch)	0	1	1	0	2
Totals	74	3,102	1,970	71	5,217
Escapement					
Willamette Falls Count	1,734	11,748	6,968	167	20,617
Mortality Below Falls	1	34	22	1	58
Clackamas Hatchery swim-ins	34	88	31	0	153
Clackamas Hatchery transfers from N.F. Dam	5	37	13	0	55
Eagle Creek Hatchery Return	4	14	5	0	23
North Fork Dam, Passed Upstream	156	1,684	594	0	2,434
North Fork Dam, Recycled Downstream	0	1	1	0	2
Natural Spawn Bel. N.F. Dam	4	15	5	0	24
Sea Lion Predation	10	440	275	6	731
Totals	**1,948**	**14,061**	**7,914**	**174**	**24,097**
Run Entering Columbia	**2,022**	**17,163**	**9,884**	**245**	**29,314**
Run Entering Willamette	**2,013**	**16,873**	**9,671**	**215**	**28,772**
Run Entering Clackamas	**203**	**1,840**	**649**	**0**	**2,692**

Forecasted Willamette River Spring Chinook Return for 2020

Projections for Age-3 fish returning in 2020

The projected 2020 age-3 return was estimated as the product of the age-2 count at Willamette Falls in brood year 2017 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 2,680 (95% credible interval: 1,230–4,430) Age-3 fish returning to the Columbia River mouth.

Projections for Age-4 fish returning in 2020

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 29,780 (95% credible interval: 11,260–46,230) Age-4 fish returning to the Columbia River mouth in 2020.

Projections of Age-5 fish returning in 2020

The best model predicting age-5 returns of Willamette River spring Chinook to the Columbia River mouth in 2020 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 10,860 (95% credible interval: 1,820–22,780).

Projections for Age-6 fish returning in 2020

The projection for age-6 Willamette River spring Chinook returning to the Columbia River mouth in 2020 is 110 (95% credible interval: 0–253), estimated based on the running 5-year average age-6:age-5 cohort ratio.

2020 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 2,980 (95% credible interval: 1,470–4,720) spring Chinook to the mouth of the Clackamas River.

2020 Forecast Summary

Table 3. 2020 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
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	

The 2019 return included an estimated 34% unmarked fish. Using the most recent five-year average of unmarked fish (24%), the number of hatchery fish returning to the Columbia River mouth in 2019 is forecasted to be 33,000 (Table 4).

Table 4. 2020 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
2020 Forecast	**2,040**	**22,630**	**8,250**	**80**	**33,000**
Prop (95% CrI)	930–3,370	8,560–35,130	1,380–17,310	0–192	

Hatchery Surplus Estimates

The harvestable surplus of the 2020 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 33,000 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 10,000 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.