United States Department of the Interior

FISH AND WILDLIFE SERVICE

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Dear Dave,

Clarification is needed on information I provided to resource managers this summer. Please circulate this memo to members of FPAC and TMT.

The topics include: 1) the effect of 2002 Dworshak summer operations on survival of wild Snake River subyearlings; 2) the 2003 passage forecast at Lower Granite Dam for wild Snake River subyearlings; and 3) my thoughts on decreasing flows at some point in July or August to provide water for augmentation in September.

The Effect of 2002 Dworshak Summer Operations on Survival

In 2002, some of the Dworshak Reservoir water typically released for summer flow augmentation in July and August was saved and released in early September. The effect of this change in operations on survival of wild subyearling chinook salmon in the Snake River was assessed as generally described by Connor et al. (2003a).

Survival was calculated to the tailrace of Lower Granite Dam for four cohorts of wild subyearling chinook salmon in each of five years (1998-2002; Table 1). Cohorts are groups of fish. Cohort 1 passes Lower Granite Dam first, followed by fish from Cohort 2, 3, and then 4. Cohort 1 typically experiences the highest flows and coolest temperatures, whereas cohort 4 experiences the lowest flows and warmest temperatures.

I fit a regression model for predicting survival to the tailrace of Lower Granite Dam from flow and temperature measured in Lower Granite Dam tailrace during 1998-2002. The regression equation was Cohort survival = 87.5 + 0.03186 Flow -4.8285 Temperature (N = 20; R^2 = 0.86; $P < 0.0001$).

Table 1.—Estimates of survival probability (%±SE) to the tailrace of Lower Granite Dam for cohorts of wild subyearling chinook salmon, 1998-2002.

	Survival by year					
Cohort	1998	1999	2000	2001	2002	Cohort means
1	70.8±2.9	87.7±4.6	57.1±4.1	40.1±3.1	55.4±3.0	63.9
2	66.1±3.3	77.0±3.8	53.4±4.2	20.5±2.5	48.3±3.0	54.3
3	52.8±3.1	81.2±5.8	44.4±3.6	17.2±3.0	39.2±3.0	48.9
4	35.6±2.9	36.4±3.5	35.7±4.3	4.0±1.3	19.4±2.0	27.9
Annual means	56.3	70.6	47.7	20.5	40.6	

I predicted survival for each cohort using the flows and temperatures observed in the tail race of Lower Granite Dam during the time the majority of smolts from each of the 2002 cohorts were passing the dam (Prediction A; Table 2). I then predicted survival for each cohort using the flows and temperatures that were approximated to have occurred if flow augmentation would have begun earlier in July. This alternative scenario included increasing outflow at Dworshak Dam up to approximately 14,000 CFS on 3 July and maintaining this release level until 18 August, after which outflow was gradually decreased to 10,000 CFS by 31 August.

Predicted survival under the alternative scenario (Prediction B; Table 2) was slightly higher than predicted survival under the observed scenario (Prediction A; Table 2). Although the differences in survival are not statistically different, predicted mean survival is greater under the alternative scenario compared to the observed scenario for each cohort. From a decision-making perspective, this suggests that the alternative scenario has greater survival benefit than the observed scenario (Table 2).

I suggest that shifting water into September 2002 had little effect on survival of wild Snake River subyearlings because inflow to Dworshak Reservoir was higher than normal through the first two weeks of July.

Table 2.—Predicted survival (%±95% C.I.) to the tailrace of Lower Granite Dam for cohorts of wild subyearling fall chinook salmon tagged in the Snake River in 2002. Prediction A = predictions made for observed flow and temperature conditions and Prediction B = predictions had flow augmentation begun earlier.

Cohort	Prediction A	Prediction B
1	65 ± 8	67 ± 8
2	58 ± 6	60 ± 7
3	47 ± 5	49 ± 6
4	27 ± 6	31± 6

The 2003 Passage Forecast at Lower Granite Dam

Since 1999, I have provided resource managers with forecasts of passage at Lower Granite Dam for wild subyearling fall chinook salmon that were PIT tagged in the Snake River. The forecast procedures were developed and validated using data collected during 1993-1998 (Connor et al. 2000). Forecast performance was marginal during 1999-2002. In two years, forecasted passage was very similar to observed passage. In two years, forecasted passage was markedly later than observed passage. The same pattern (i.e., good performance 50% of the time) was reported by Connor et al. (2000).

I keep revisiting the analyses in the hopes of improving forecast performance (makes me glad I am not a TV weatherman). I made the 2003 forecast using one of the improved methods. The resulting 2003 forecast is given in Table 3. A forecasted passage histogram is given in Figure 1 (top) for comparison to observed passage up until 10 July (Figure 1; bottom). The forecast suggests that 53% of the wild Snake River subyearlings passed Lower Granite Dam by 30 June and that passage would be complete by 2 August (Table 3; Figure 1).

Two outcomes are possible since I have not completely refined forecasting. The forecast will make the run look more protracted than in reality, or the forecasted passage date histogram is accurate but should have a long skinny tail extending into August.

Table 3.-Abridged forecast of daily cumulative passage at Lower Granite Dam for wild subyearling chinook salmon PIT tagged in the Snake River in 2003.

Year	Date	Forecast	90% Forecast Limits	
			Lower	*Upper*
2003	18-May	0%	0%	11%
2003	22-Jun	26%	16%	37%
2003	30-Jun	53%	42%	64%
2003	6-Jul	70%	59%	81%
2003	15-Jul	91%	80%	100%
2003	2-Aug	100%	89%	100%

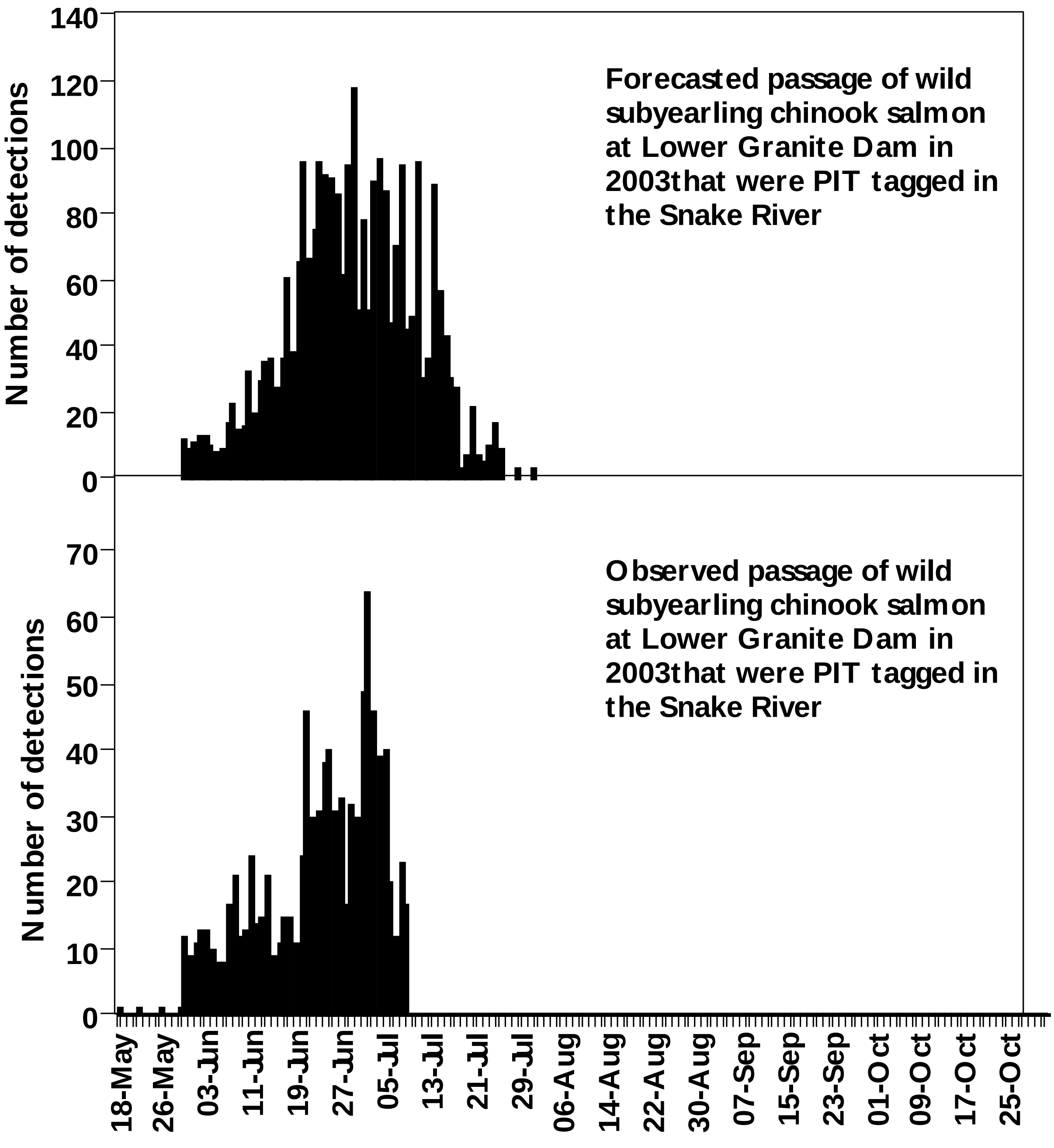

Figure 1.-Forecasted passage date histogram for wild Snake River subyearling chinook salmon at Lower Granite Dam in 2003 (top) compared to observed passage of PIT-tagged wild Snake River subyearlings at Lower Granite Dam in 2003 (bottom).

Thoughts on Releasing water in September

Releasing water in July and August is supported by five peer-reviewed analyses (Connor et al. 1998, 2002, 2003a, 2003b; Smith et al. in press). These papers focus mainly on Snake River fish, but also show benefits of flow augmentation for juveniles from the Clearwater River.

Releasing water in September is not supported by any peer-reviewed analysis on juvenile or adult fall chinook salmon from the contemporary spawning areas in the Snake River basin.

Therefore, I suggest that releasing the water in July in August is the option supported by the "Best Available Science" and the alternative most likely to help recover the Snake River fall chinook salmon ESU listed under the Endangered Species Act.

Some offer that water should be released in September to increase survival of September migrants because September migrants have high smolt-to-adult return rates (SARs). Though the existing evidence for high SARs for September migrants is exciting, the method for this analysis hasn't been written down or peer reviewed. I suggest that it would be premature to use this information as a basis for releasing water in September. Managers need to know: 1) what the 95% C.I.s are on the SAR estimates; 2) the assumptions and limitations of the analyses; and 3) why data collected on PIT-tagged hatchery juveniles represents SARs for wild untagged juveniles? *Managers also need to consider that reducing August flows will reduce the number of juveniles that survive through August to become September migrants.*

Another idea is that water should be released in September to help adult fall chinook salmon and steelhead. Dr. Chris Peery and his crew found evidence for decreases in body temperature and perhaps some behavioral effects associated with September releases. These are interesting results, but what managers really need to know is does releasing water in September increase the viability of fall chinook salmon spawners, their gametes, or their offspring?

Now don't get me wrong, releasing Dworshak water in September might indeed help fall chinook salmon juveniles and adults. My point is that the potential benefits of this September water have not been proven by conclusive empirical analyses.

In closing, I think submitting an SOR advocating the use of the water in July and August was the scientific thing to do. If we advocate the September releases in 2003, we will deviate from scientific management. The problem I see with this deviation is the precedence it sets for future years. In the future, spring run off into Dworshak Reservoir will not always extend into July (e.g., 2002) and passage at Lower Granite Dam by wild Snake River subyearlings won't always be complete by early August (e.g., 2003).

Keep up the good work,

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Fishery Biologist

References

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