



FISH PASSAGE CENTER

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MEMORANDUM

TO: Pete Hassemer, IDFG

Michele DeHart

FROM: Michele DeHart

DATE: June 18, 2014

RE: Response regarding high SARs for 2008 outmigration

At the CSS Annual Review meeting on April 23, 2014, you asked a question regarding the conditions that may have led to the high smolt-to-adult return rates (SARs) observed for most fish from the 2008 juvenile migration year. Those SARs were higher than have been observed since the early 1990s, and generally met the Northwest Power and Conservation Council's SAR goal of being between 2%–6%. At the meeting there was a short discussion of the ocean and juvenile migration conditions that were experienced by the spring migrating fish. At this time we would like to take the opportunity to further elaborate and describe the conditions in more detail.

Coincident with your request, we received a request to review, in general, the juvenile migration factors that yield the highest SARs. The Snake River spring/summer Chinook data set (Fig. 1) was used to describe the conditions generally encountered by these fish over the time series of data available. That memo is attached for your review relative to your question.

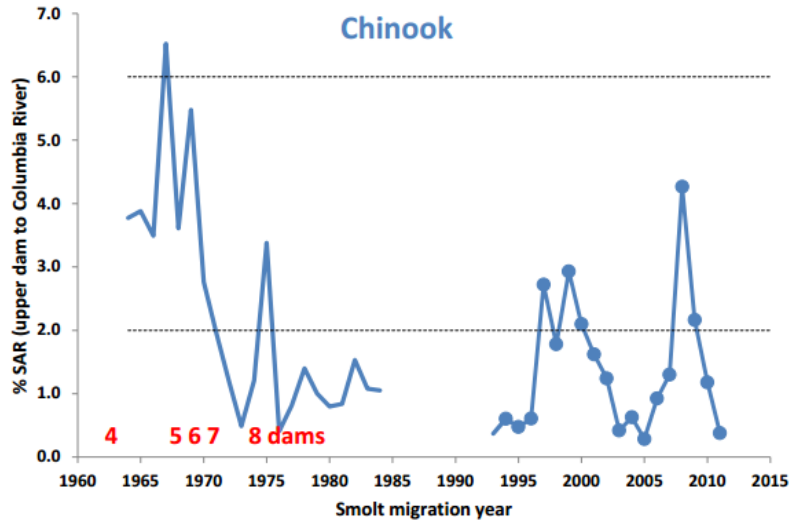


Figure 1. SARs from smolts at uppermost Snake River dam to Columbia River returns (including jacks) for wild Snake River spring/summer Chinook, 1964–2011. SARs based on run reconstruction (1964–1984 and 1993, solid line) and CSS PIT tags (1994–2001, dots and solid line).

2008 CONDITIONS

The specific conditions that took place in 2008 are described below in more detail than provided in the attached memo. Where appropriate we illustrated the conditions relative to the Snake River spring/summer Chinook juvenile migration.

1. Water Conditions

Water Year 2008 was near or above average throughout Columbia Basin. At The Dalles Dam, the observed runoff volume recorded between January and July of 2008 was 99.2 Maf, which was 92% of the average runoff volume between 1971 and 2000. At Lower Granite Dam, the observed runoff volume recorded between April and August of 2008 was 24.3 Maf, which was 106% of the 30-year average runoff volume (1971–2000). Biological Opinion (BiOp) flow objectives (Table 1) were met over the spring of 2008 at both Priest Rapids and McNary Dams, but were slightly less than objectives during the spring period at Lower Granite or missed during the summer period at McNary Dam.

Table 1. Spring and summer flow averages at Lower Granite, McNary, and Priest Rapids during their respective spring and summer Biological Opinion periods.

Project	2008			
	Spring Flow Objective	Spring Average	Summer Flow Objective	Summer Average
Lower Granite	100	98.7	52.5	57.0
McNary	260	286.7	200	172.8
Priest Rapids	135	167.6	Na	Na

2. Spill and Total Dissolved Gas Conditions

Spill during 2008 generally met the objectives of the 2008 Fish Operations Plan, within the constraints of research study requirements, managing to the dissolved gas criteria of 120% TDG in the tailraces of the dams and 115% in the forebays of the dams, as well as the requirements for minimum turbine operations at each project.

Snake River

Spill at all four of the lower Snake River projects was at or above the BiOp spill levels. Spill exceeded the BiOp during the period of high flow that occurred from about the middle of May through June. The pattern observed at the Snake River projects is shown for Lower Granite Dam in Figure 2. As shown in the figure a good portion of the yearling Chinook migration had been detected at Lower Granite Dam prior to the increased flow, but would have been passing through the other Snake River during the time period when spill was elevated.

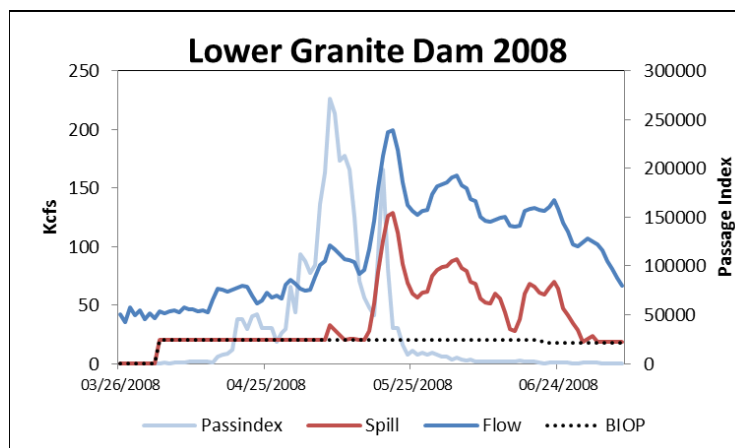


Figure 2. Lower Granite Dam flow, spill, and BiOp spill together with the yearling Chinook passage index.

Middle Columbia

Spill at McNary and Bonneville dams was at or above the BiOp spill levels. Spill at The Dalles and John Day dams met the BiOp spill levels. As seen from the graph (Figure 3) the passage index data suggest that the majority of juvenile migrants would have been passing through the middle Columbia River during this period of higher flows and spill.

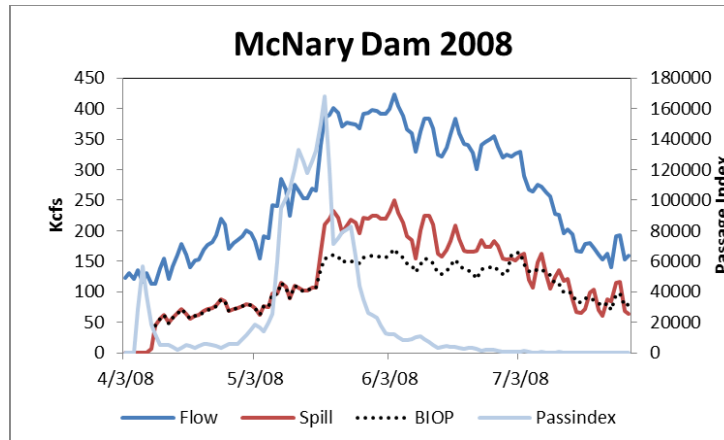


Figure 3. McNary Dam flow, spill, BiOp pill together with the yearling Chinook passage index.

Total Dissolved Gas and GBT

High flow and spill levels, together with unit outages that limited hydraulic capacity, resulted in total dissolved gas concentration that at times exceed 130 percent, and often exceeded 125%. However, while gas bubble trauma was detected in fish coincident with the TDG increases, the percentage of fish detected with GBT did not exceed the action criteria (Fish Passage Center 2008 Annual Report, Appendix C).

3. Juvenile Survival and Spill Percentage

The most consistent data over the longest time period for assessing the in-river juvenile fish survival is the Lower Granite to McNary Dam PIT-tagged spring Chinook time series between 1998 and 2013. The juvenile survival estimates for spring Chinook from the Snake River migrating from Lower Granite to McNary Dam for 2008 averaged 74.7%, and were somewhat higher than the overall average between 1998 and 2013 of 73% (Figure 4).

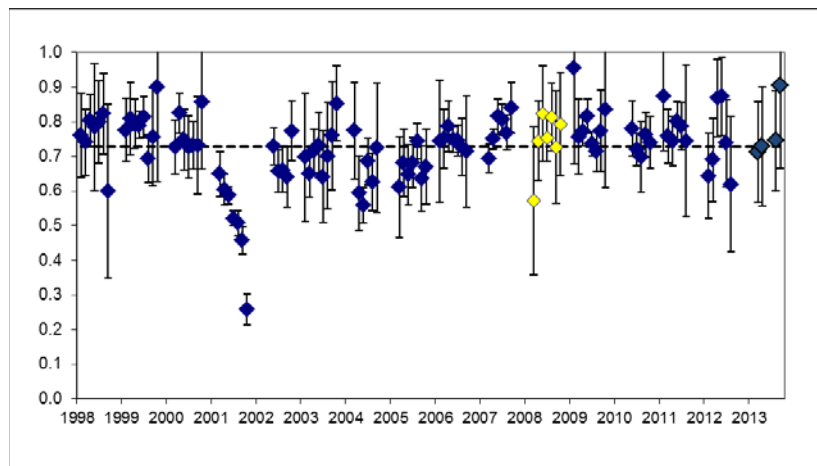


Figure 4. Juvenile PIT-tag survival estimates for yearling Chinook migrating between Lower Granite and McNary dams for each year from 1998 to 2013. The 2008 juvenile survival estimates are highlighted in yellow.

Similarly the average percentage of spill for individual cohorts of spring Chinook migrating during this time period in 2008 was 41.8%, while the average between 1998 and 2013 was 35.8%. Again, fish experienced above average conditions (Figure 5).

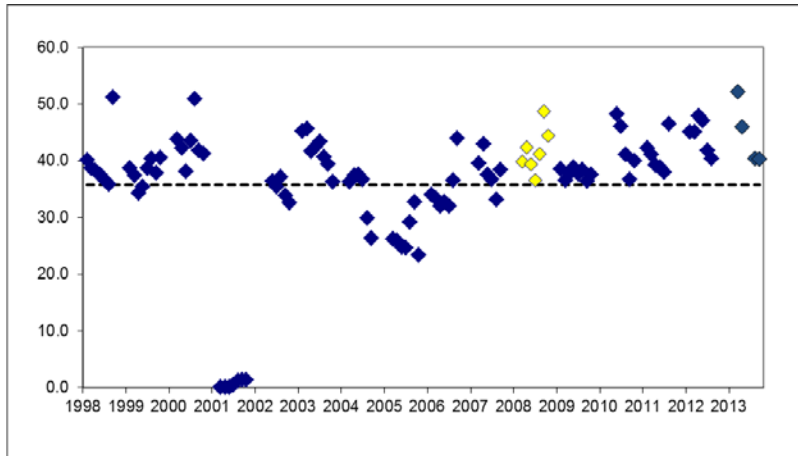


Figure 5. Average spill percentages experienced for each cohort of yearling Chinook migrating between Lower Granite and McNary dams for each year from 1998 to 2013. The 2008 average spill percentages are highlighted in yellow.

4. Ocean Conditions

The importance of ocean conditions in determining salmon survival is generally believed to occur soon after juvenile salmonids enter the ocean (Ricker 1976; Mueter et al. 2002; Pypers et al. 2005). Schaller et al. (2014) explored the relation between salmon survival and several ocean indices to evaluate how variation during the year of ocean entry influenced survival rate. Both broad scale and near shore factors were investigated. Table 2 shows the variation in some of the ocean parameters over the years 1998 to 2009. As can be observed in Table 2, ocean conditions for 2008 were extremely good, with a cool ocean phase (PDO of -1.37) and moderately strong spring upwelling.

Table 2. Observed variability in some important broad scale and near shore ocean indices for years 1998 to 2009.

YEAR	MAY PDO	AprUP45n
1998	0.7	9
1999	-0.68	31
2000	-0.05	0
2001	-0.3	0
2002	-0.63	17
2003	0.89	-17
2004	0.88	1
2005	1.86	-10
2006	0.48	1
2007	-0.1	0
2008	-1.37	9
2009	-0.88	25
2010	0.62	0
2011	-0.37	-1
2012	-1.26	-16
2013	0.08	16

The NOAA Northwest Fisheries Science Center also compiled information on a suite of various ocean parameters over a 16-year time period (1998–2013). Those indices are used to produce rank scores within the years of data, which are then used to generate a color-coding of ocean ecosystem indicators. The 2008 migration year is associated with the highest relative ranking for ocean conditions in the 16 years observed (<http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/g-forecast.cfm#>).

5. Summary

What we note in the attached memo is that the in-river migration factors that yield high juvenile survival, and limit delayed mortality, provide the best conditions to produce good SARs when considering the impact of ocean variability. The 2008 juvenile migration year occurred in average flow conditions in the Snake River and above average conditions in the Middle Columbia River. Above average spill conditions were observed. These river conditions translated to a juvenile spring/summer Chinook survival across the Lower Granite Dam to McNary Dam river reach that was above the average for the years 1998 to 2013. Good in-river migration conditions (higher flow and spill), higher juvenile survival, and high ranked ocean conditions (cooler ocean conditions and increased spring upwelling) worked together to produce the best SARs observed since the early 1990s. There are several studies that have demonstrated that the life-cycle survival, SAR, and marine survival rates for Snake River spring/summer Chinook and steelhead were strongly related to both ocean conditions and seaward migration conditions through the Federal Columbia River Power System (Schaller et al. 2007; Petrosky and Schaller 2010; Haeseker et al. 2012; Hall and Marmorek 2013; Schaller et al. 2014).

The fact that, while the magnitude of the SARs differed, most groups of fish exhibited similar increases in SARs for 2008 is not surprising. The Comparative Survival Study (CSS) has shown that populations of Chinook and steelhead throughout the Columbia Basin demonstrate a high degree of inter-regional correlation in SARs. This inter-regional correlation indicates that common environmental factors are influencing survival rates from outmigration to the estuary and ocean environments (Tuomikoski et al., 2013). That is to say, when fish have shared experiences they respond similarly. Consequently, the shared conditions for fish from the 2008 migration resulted in relatively high SARs for most groups migrating that year.

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