FISH PASSAGE CENTER

847 NE 19th Avenue, #250, Portland, OR 97232
Phone: (503) 833-3900 Fax: (503) 232-1259
www.fpc.org/
e-mail us at fpcstaff@fpc.org

MEMORANDUM

TO: Richard Scully
Steve Pettit

FROM: Michele DeHart, FPC

DATE: January 30, 2020

SUBJECT: Response to request regarding variability in salmon life-cycle survival

This memorandum is in response to two requests the FPC received to review a Power Point slide titled, "Where is variability in survival occurring?". The slide is part of a presentation by Brian Burke, NOAA Fisheries, on January 18, 2020 to the Idaho Governor's Task Force (Task Force). Our overall conclusion is that the NOAA plots on the slide are erroneous, misleading, and do not provide information on the factors that influence survival at various life stages. We reviewed the presentation posted on the Task Force web site and have the following comments.

- **The first graphic of in-river survival estimates from Lower Granite to Bonneville plotted against Smolt to Adult Return Rate (SAR) is erroneous and inconsistent with historical data.**

- **The second graphic, on the slide, showing Bonneville to Bonneville SARs plotted against Lower Granite to Lower Granite SARs, is an example of regressing two, highly correlated SARs against one another. This regression is misleading and does not provide information on the factors that influence SARs.**

- **Numerous studies and analyses have shown that freshwater factors influence survival at multiple life stages, including in-river survival, ocean survival and SARs.**

- **Comparisons among populations in the Columbia River Basin show that Water Transit Time and the number of powerhouse passage experiences (spill) are key drivers that explain patterns of survival.**

- **Numerous studies and analyses have shown that improved survival rates and SARs for Snake River spring/summer Chinook salmon will require reductions in Water Transit Time and/or the number of powerhouses encountered.**

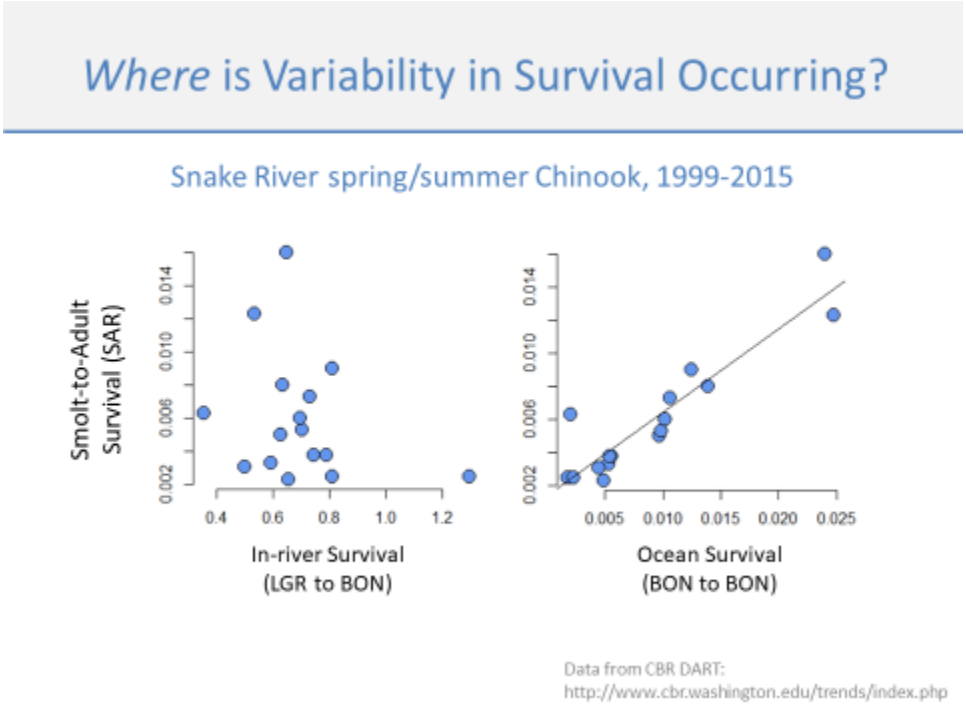

Figure 1. Slide 41 from January 18, 2020 presentation "NOAA's Estuarine and Ocean Salmon Research".

The first graphic of in-river survival estimates from Lower Granite to Bonneville plotted against Smolt to Adult Return Rate (SAR) is erroneous and inconsistent with historical data.

Estimates of in-river survival in the NOAA plot were retrieved from the Columbia Basin Research website and are reported to represent hatchery spring Chinook salmon, calculated using the ROSTER program. The CSS has estimated and reported estimates of in-river survival from Lower Granite Dam to Bonneville Dam for five, hatchery spring Chinook stocks: Dworshak, Rapid River, Catherine Creek, Clearwater, and Sawtooth hatcheries. Compared to CSS estimates, the in-river survival data that are plotted are biased high in 1999, 2005, and especially 2015, which had an estimated survival of 130% and is erroneous (Figure 2). The estimates in these years are inconsistent with the historical data, and several of the other estimates also appear questionable. The SAR data plotted contain a mixture of transported and non-transported individuals.

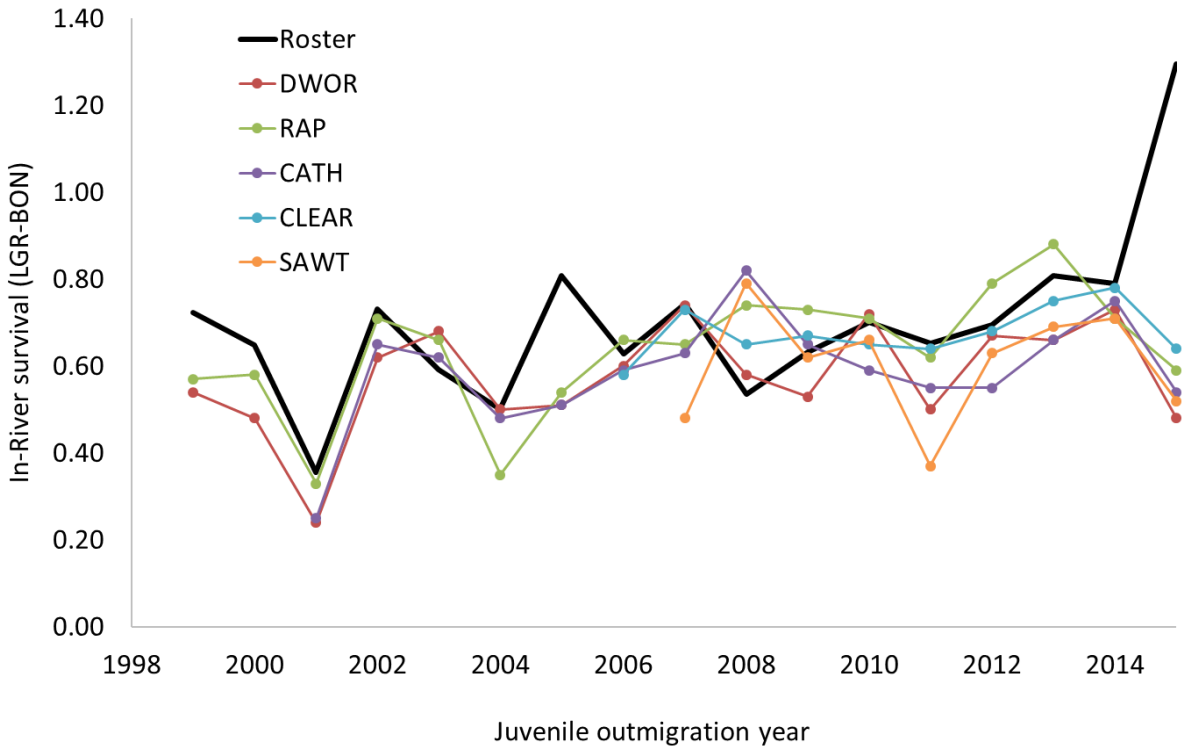

Figure 2. CSS estimates of in-river survival for five, hatchery spring Chinook salmon stocks: Dworshak (DWOR), Rapid River (RAP), Catherine Creek (CATH), Clearwater (CLEAR), and Sawtooth (SAWT) hatcheries. Also plotted are the ROSTER program estimates (Roster) that were used in Figure 1.

The second graphic of the slide, shows Bonneville to Bonneville SARs plotted against Lower Granite to Lower Granite SARs is an example of regressing two, highly correlated SARs against one another. This regression is misleading and does not provide information on the factors that influence SARs.

Regression is a tool for evaluating the effect of a causative factor (termed an independent variable) on a measured response (termed a dependent variable). However, in the case of NOAA's second graphic both variables are measured responses (SARs) and there is no causative factor being evaluated. The two SARs are highly correlated ($r = 0.95$) and both SARs are counts of the number of adults returning from numbers of smolts. The differences between the two SARs are minor: one enumerates smolts and adults at Lower Granite Dam and the other enumerates smolts and adults at Bonneville Dam. This regression is misleading because it treats the Bonneville-based SARs as if it were a causative factor that influences the Lower Granite-based SARs. The more appropriate interpretation is that the two SARs are both dependent variables that are similarly responding to the similar set of freshwater and marine factors that influence SARs. The plot provides no information on the relative importance of freshwater or marine factors on SARs.

Numerous studies and analyses have shown that freshwater factors influence survival at multiple life stages, including in-river survival, ocean survival and SARs.

We have shown in analyses of effects of powerhouse passage (CSS Annual Reports 2010 and 2016) that the number of powerhouse passages relates to BON-BON SARs. Numerous other analyses have similarly shown that patterns of variation in ocean survival rates and SARs are associated with freshwater outmigration conditions, hydropower development, and powerhouse passage experiences (Raymond 1988, Schaller and Petrosky 2007, Petrosky and Schaller 2010, Haeseker et al. 2012, Schaller et al. 2014, McCann et al. 2017). These studies have shown that while marine conditions are also important, the data indicate that freshwater factors, flow and spill (number of powerhouse encounters) explain a substantial proportion of the variation in survival rates and SARs.

Comparisons among populations in the Columbia River Basin show that Water Transit Time and the number of powerhouse passage experiences are key drivers that explain patterns of survival.

Snake River spring Chinook salmon and steelhead experience long water transit times and greater numbers of powerhouse passage events than other populations in the basin that encounter fewer dams. To explore the effects of water transit times and the number of powerhouse passage events on the patterns of survival in the basin, we summarized in-river, ocean, and SAR data for wild spring/summer Chinook salmon from the Snake, Yakima, and John Day rivers (Figure 3). The highest survival rates and SARs were for populations and in years that had the fastest water transit times and the fewest number of powerhouse passage experiences. Water transit times and powerhouse passage events therefore appear to be key drivers that explain patterns of in-river survival, ocean survival, and SARs for wild spring/summer Chinook salmon stocks in the Columbia River Basin.

Numerous studies and analyses have shown that improved survival rates and SARs for Snake River spring/summer Chinook salmon will require reductions in Water Transit Time and/or the number of powerhouses encountered.

Numerous studies have concluded that improvements in survival rates and SARs will likely require actions that reduce water transit times and/or increase spill proportions to reduce powerhouse passage events (Petrosky and Schaller 2010, Haeseker et al. 2012, Schaller et al. 2014, McCann et al. 2017). Data from among populations in the Columbia River Basin suggest that achieving SARs that average 4% will require water transit times of less than five days and/or less than one powerhouse passage experience during outmigration (Figure 3). Decades of data from Snake River spring/summer Chinook salmon have shown that the freshwater conditions that they have experienced have resulted in SARs that are far below the 4% average SAR goal.

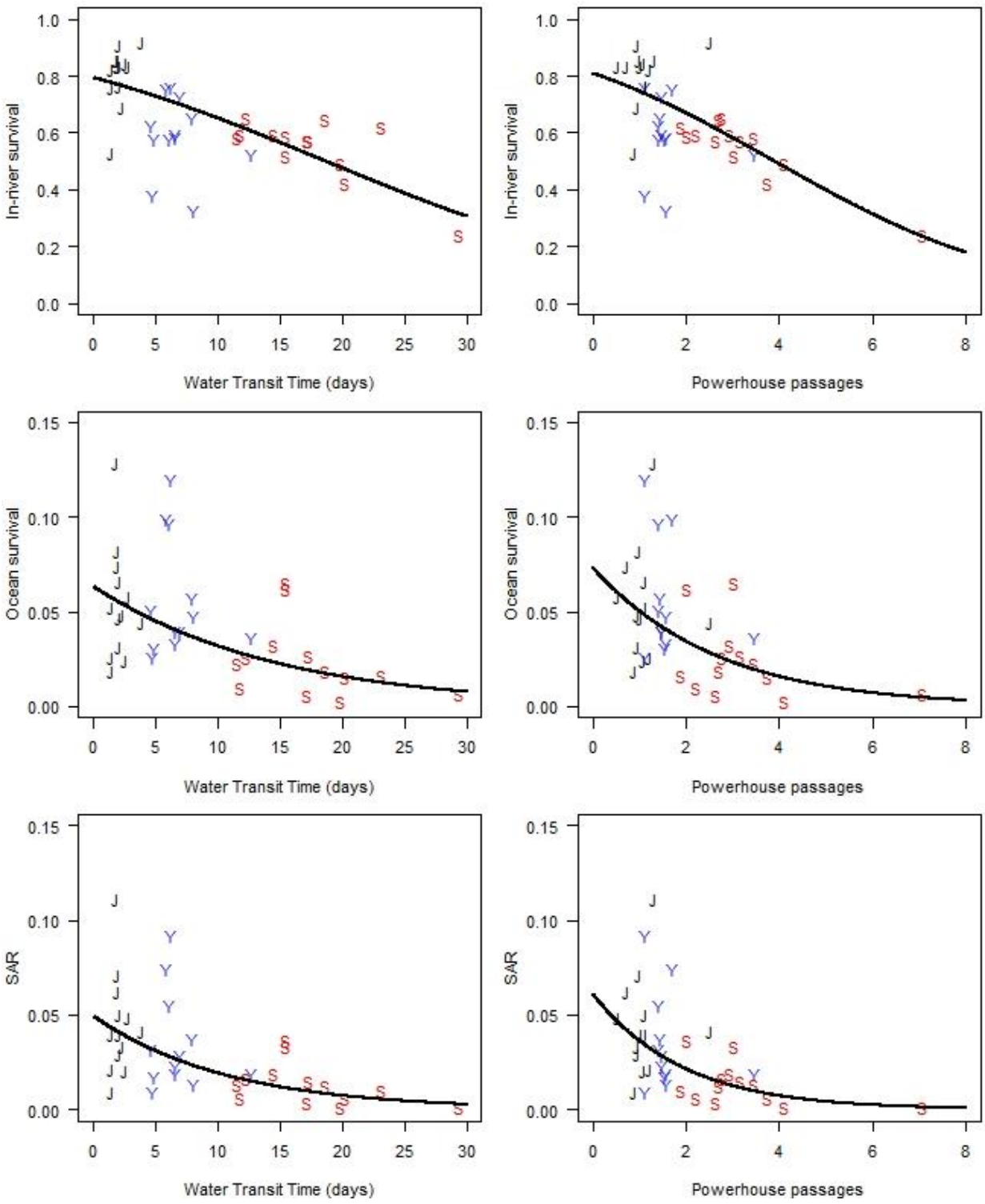

Figure 3. Associations between water transit time (left column) and powerhouse passage events (right column) and in-river survival (top row), ocean survival (middle row), and SARs (bottom row) for wild spring/summer Chinook salmon from the Snake (S), Yakima (Y), and John Day (J) rivers.

References:

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