September 27, 2019

To Whom It May Concern,

In considering the Department of Ecology's interest in changing water quality standards to help Columbia Basin salmon and Salish Sea Orcas, allow me to begin with a little story.

A decade ago at one of our quarterly meetings, I suggested to Bonneville Power Administration (BPA) Administrator Stephen Wright that available science would suggest that increasing spill levels -- up to 120% Total Dissolved Gas (TDG) -- could reduce the mortality of salmon and steelhead in the Columbia River hydrosystem migration corridor. As per his usual response, he smiled and thanked me for my input, but increasing spill would not be a path that BPA would be pursuing. He told me that Washington's Department of Ecology (Ecology) limits spill to a lower TDG standard than I was promoting, and seeking a change in that rule was not something that his agency would be pursuing.

At that meeting, I gave to Mr. Wright and his staff the significant highlights of an affidavit to FERC from BPA's Jason Sweet. It was this event that essentially marks the beginning of the current rule-making process in which Ecology a decade later, is seeking public comment. The important question to now ask is, "What was the science then, and what has changed since then?"

A substantial document that Mr. Sweet referenced was "Adaptive Management Team Total Dissolved Gas in the Columbia and Snake Rivers: Evaluation of the 115 Percent Total Dissolved Gas Forebay Requirement". Although I find it odd that I can not easily locate Sweet's original affidavit on the internet, I do have my notes of it, and Mr. Sweet's supporting document is available on Oregon State's website.

Let us look now at the relevant salmon-related science therein.

Table 14. Summary of TDG Impacts in Shallow Water from Ecology Literature Review.

Dawley et al (1975)	Juvenile Chinook	116%	0.25 m
10% mortality in 11 days.			
Dawley et al (1975)	Juvenile Chinook and Steelhead	120%	0.25 m
50% mortality in 22 days (Chinook) 50% mortality in 30 hours (steelhead).			
Mesa et al (2000)	Juvenile Chinook and Steelhead	113%-120%	0.27 m
60% fin bubble in 22 days and 20% mortality in 1.7-5 days at 120%. No mortalities in 22 days at 113%.			
Mesa et al (1995)	Juvenile Chinook	120%	0.28 m
50% mortality in 60 hours. No (1995) mortalities in 22 days at 112%, but numerous other symptoms.			
Mesa et al (1996)	Juvenile Chinook	120%	0.28 m
43% mortality in 75 hours. At 110%, numerous other symptoms.			
Nebeker et al (1976)	Adult Sockeye	110-120%	0.7 m
At 110%, no signs. At 115%, first sockeye mortality in 21 days. At 120%, first mortality in 3 days.			
Newcolm (1974)	Juvenile Steelhead	110%	0.23 m
46% had gas bubble signs. Blood chemistry changes at 105%.			
Weitcamp (1977)	Juvenile Chinook	120-128%	Up to 4 m
When fish had access to deeper water, no mortalities within 20 days.			

Let us also consider the effect of higher %TDG on salmon prey while keeping in mind the underreported finding of Morace, Johnson & Nilsen that 20% of sub-yearling Chinook captured upstream of Portland had less than 1% lipid content. This implies a minimum of 20% delayed mortality of sub-yearling Chinook.

Nebecker et al ('76)	Daphnia	120%	0.25 m
50% mortality in 93 hours (compared to 10% morality in 170 hours at 110%			

Not limiting ourselves to the detrimental effects on salmon and steelhead themselves, we should also consider the effect of elevated %TDG on the predators of the migrating juvenile salmonids.

Bently et al (1981)	Pikeminnow	117.2%	0.25 m
32% mortality after 12 days (also observed behavior changes).			
Bouck et al (1976)	Various (salmonids and bass)	120%	1 m
No mortality after 12 days for bass. 50% mortality in 4 days for adult salmon.			
Colt et al (1985)	Juvenile catfish	115%	shallow
56% mortality in 35 days			
McInerny (1990)	Largemouth bass, bluegill & white bass	115-120%	up to 5-11 m
18-28% gas bubble signs depending on species.			
Richter et al (2006)	Resident fish	120%	Unknown depth
No gas bubbles found in 20 species.			
Weitcamp et al ('03)	Resident fish	120%	< 2 m
Only one fish found with gas bubbles			

The available science at the time, strongly suggests that elevated levels of Total Dissolved Gas, especially when extended over multiple days, has detrimental impacts on juvenile Chinook, Steelhead, adult Sockeye and on Daphnia, which is an important food source for Sockeye juveniles and adults. Notably, a high %TDG environment is also deadly for Pikeminnow, a voracious predator of juvenile salmon.

One might wonder why I, after seeing these scientific findings, would nonetheless propose an increase in spill to 120% TDG. For me, the important finding to notice is that Chinook and Steelhead typically travel more than 1 meter below the surface (Table 15) and thereby experience an environment with %TDG less than that which is monitored at the river surface

Table 15. Summary of Depth Distribution from Ecology Literature Review.

Abernathy et al (1997)	Juvenile Chinook and rainbow trout	Some observed < 1m while 70% of fish <3m
Beeman et al (1997)	Juvenile Steelhead	All fish 1.1m to 4.3m
Beeman et al (2006)	Juvenile Steelhead Juvenile Chinook	mean depth of 2 - 2.3m mean depth of 1.5 - 3.2m
Dawley (1986)	Juvenile Chinook	8-22% less than 3m
Dawley et al (1975)	Juvenile Chinook Junvenile Steelhead	46% less than 1.8m 29% less than 1.8m
Parametrix (1999) [studied on Clark Fork]	Pikeminnow	1% less than 1m
Smith (1974) [Lower Monumental reservoir]	Juvenile Chinook & Steelhead	28-46% less than 2m

Smith on the Lower Snake River reported in 1975, shortly after the completion of Lower Monumental a relevant site-specific result, more than half of the juveniles travel below 2 meters. Unsurprisingly, the Pikeminnow travels at depths matching their salmon prey. What more have we learned since then?

A decade ago, I felt that experimenting with an increase of spill to 120%TDG was worth trying. Salmon populations were much higher then than they are now, and valuable information could have been obtained if scientific designs were well conceived and implementation was well funded. But BPA did not commit those resources and now the clock of extinction is in its last moments. The starving Salish Sea Orcas are telling us that a once thriving salmon population -- millions upon millions arriving annually, big and fatty -- supported an abundant and vibrant ecosystem. One that is now unraveling at its seams.

Now comes a shocker.

I learned two weeks ago while meeting with BPA's Jason Sweet and Administrator Elliot Mainzer, that no biological monitoring occurred last year when %TDG levels were held high by court order for the entire juvenile migration season. Really?! I seriously hoped that Mr. Sweet's response was incorrect, but my inquiries to Ecology seem to have confirmed this incredible loss of opportunity.

For ten years, Ecology insisted to me in every phone call I made over those years, that protection of "other aquatic species" was a primary concern. This was held as sufficient justification for holding their water quality standards to 115% TDG. Then, when the opportunity arose for Ecology to reevaluate this reasoning, they passed. I am hearing that not a single biologist walked the shorelines of America's greatest river to observe and record what damage might have arisen from last year's spill regime. That is incomprehensible.

I hope that I have this story all very wrong. If the 115% TDG standard truly was to protect "other aquatic species", and not to protect abundant hydropower production, then one would expect some science -- any science -- to have taken place during last season's court ordered spill. Moreover, it is incomprehensible to now race to 125% TDG, without any scientific findings from last year's flow experiment at 120% TDG.

> The weight of all the evidence from available scientific studies clearly points to detrimental effects on aquatic life near the surface when TDG approaches 120%. Based on the information in this document, Ecology does not believe the overall benefits of additional spill versus additional risk of gas bubble trauma are sufficient for a rule revision.
>
> -- Washington Department of Ecology, Evaluation of 115%TDG Forebay Requirement, January 2009

Is this proposed change in Water Quality standards a political move or science-based? Considering the aforementioned, Ecology's holding fast to standards of 115% TDG appear to have been for political reasons, not for scientific reasons. Washington receives the bulk of BPA's power, AND at a price that is near the lowest electricity rates in the nation. Businesses come to Washington with these low power rates in mind. Was it science that insisted on keeping the 115% TDG standard over the past decade? I remain skeptical.

Will the future look different? Ecology needs to show real science that can point to salmon and steelhead survival at higher rates during last year's spill experiment. In the submitted comments to Ecology from the "Save Our Dams" fountainhead, Northwest River Partners, suggesting that we should wait for last year's juvenile migrants to return as adults before the science can begin. This is preposterous.

The small survival benefits of last year's increased spill (if any) will be significantly confounded by the great variability of ocean conditions in an immense ocean, where salmon and steelhead spend half of their life. To legitimately say that we must wait for the science, one would need to develop (now) the statistical design for teasing out this subtle change in survival due to increased spill. But where are those tools?

Why do I say that last year's increased spill has "small survival benefits"? Until I saw the NOAA Fisheries memo from Zabel to Graves, I had hoped that survival benefits might be apparent in the data of last year. But they are not, at least not in the immediately available survival/mortality data measured within the hydropower migration corridor.

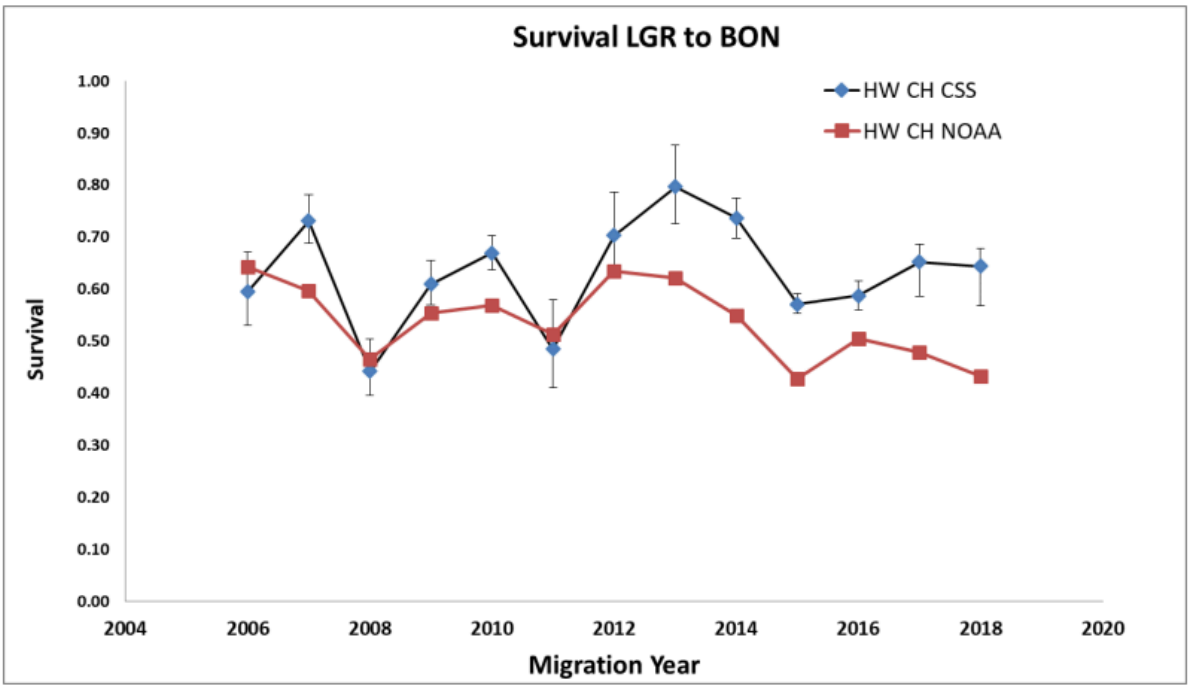


Figure 1. Estimated survival from Lower Granite Dam to Bonneville Dam for hatchery and wild spring/summer Chinook of Snake River origin. CSS spring/summer Chinook included only fish marked above Lower Granite Dam, while NOAA reach estimates include fish either detected or marked at Lower Granite Dam (for survival LGR to MCN), combined with fish detected at McNary Dam (for survival MCN to BON); the two reaches were then combined to generate the LGR to BON estimates. Error bars represent 95% confidence intervals (non-parametric).

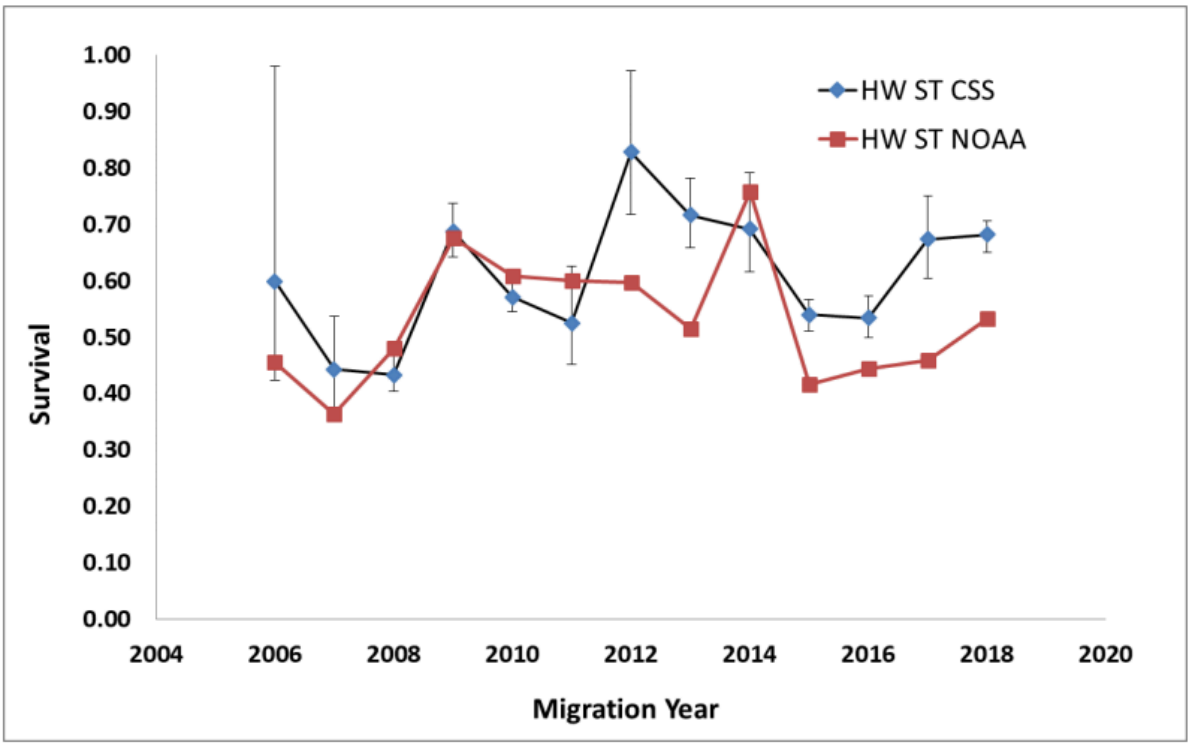


Figure 2. Estimated survival from Lower Granite Dam to Bonneville Dam of hatchery and wild steelhead from the Snake River. CSS steelhead included only fish marked above Lower Granite Dam, while NOAA reach estimates include fish either detected or marked at Lower Granite Dam (for survival LGR to MCN), combined with fish detected at McNary Dam (for survival MCN to BON); the two reaches were then combined to generate the LGR to BON estimates. Error bars represent 95% confidence intervals (non-parametric).

Months later I was briefly enlivened by the Fish Passage Center (FPC) analysis displayed alongside NOAA's findings (Figure 1 and 2 of previous page). While NOAA Fisheries found juvenile survival to be a bit worse last year -- near the worst on record for Chinook -- the FPC methodology found little if any survival differences in last year's increased spill regime as compared to the previous year.

Whomever's analysis is correct, this slight benefit will be undetectable in the data when they return as adults several years from now and the many variables of ocean life are compounded. If benefits from spill were detectable, one would expect such benefits to be in the survival studies made within the hydrosystem migration corridor. Last year's result is one year of result, it revealed little. Several more years of the current spill regime, would add statistical significance to any scientifically supportable findings. The hypothesis needs evidence of support. Last year did not, but the next year or the one following just might. Why not give that a try? What is the hurry here? Aimlessly moving to help the fish by increasing season-long spill to 125% TDG might actually be inflicting harm. The time for such experiments has long past.

Rushing ahead with new standards but without good science in hand will only reveal Ecology as being the politically motivated agency that they appear to have been over the past decade. I am confident that there are individuals inside Ecology that truly care about the ecology. But I have learned over the years that decision-making does not always follow the staff's opinion. Substantial pressure is being placed on Governor Inslee to do something, anything, for the starving Salish Sea Orcas. One need only notice this week's protest on the Capitol steps for a recent call to action. The costumed advocates at the Orcas Task Force feigning starvation to the news cameras are yet another.

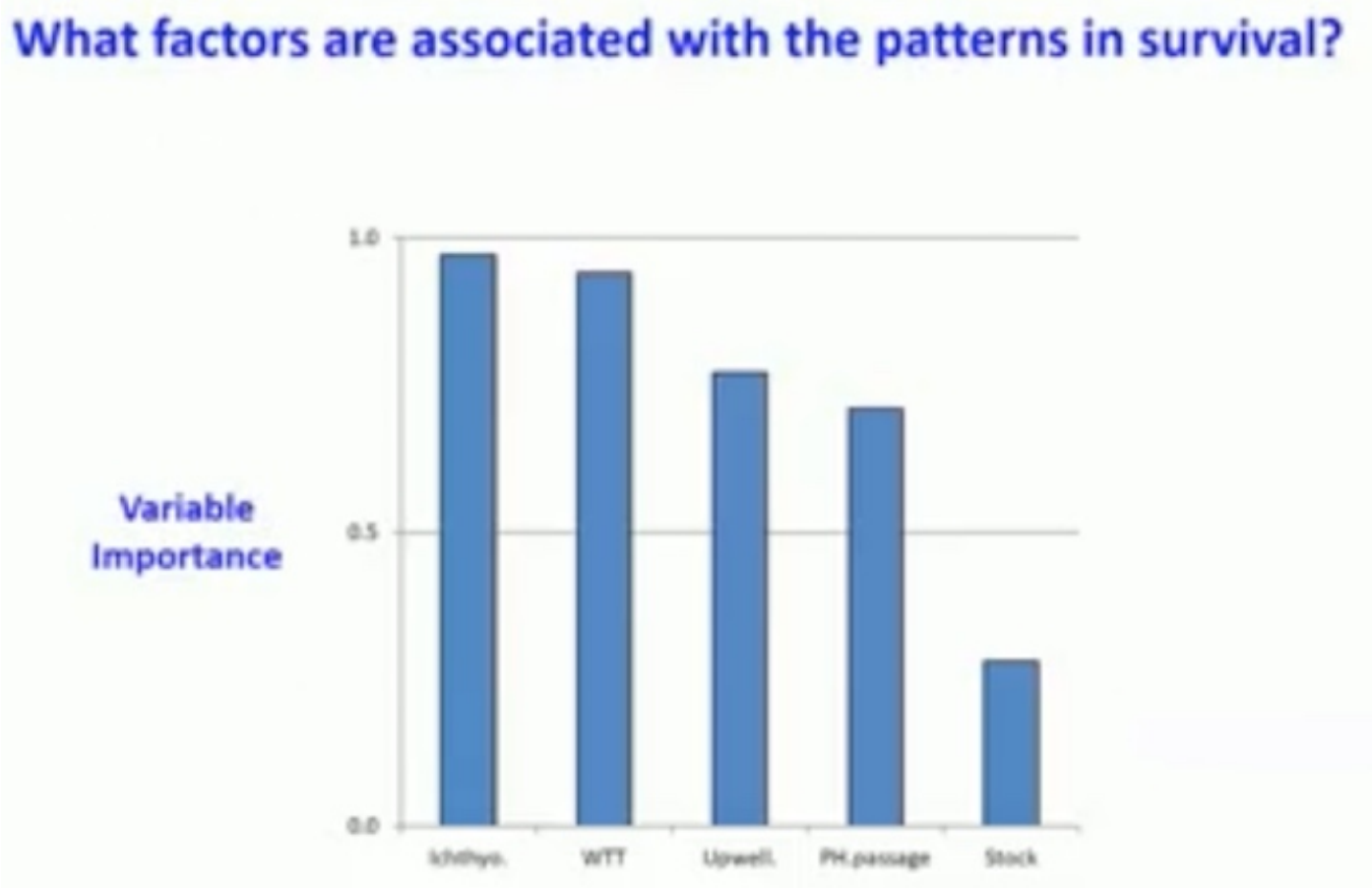
What does the science say about spill? A regression model, using an enormous amount of salmon and environmental data, shows Ichthyoplankton Abundance as the most important indicator of future salmon survival (see graphic next page). Nearly equal in importance is the Water Travel Time of the hydrosystem. Third in line, and a step down from the first two in importance, is Ocean Upwelling. Fourth in importance and statistically significant, is the number of Powerhouse passages a juvenile salmon would likely encounter. Repeating for emphasis, Ichthyoplankton Abundance and Water Travel Time are the most important indicators of salmon survival in the data that has thus far been considered.

Importantly, the regression modeling that Ecology is relying upon for raising %TDG standards, is the very same model that reveals LSR dam breaching as being the most beneficial for Salmon and Steelhead.

Governor Inslee's Orca Task Force learned (webinar on YouTube) that NOAA Fisheries was able to use their ocean indicators to account for 41% of salmon survival. Shortly thereafter, a representative from FPC revealed that 90% of salmon survival could be accounted for if Water Travel Time and Powerhouse Passage were included in the regression analysis. NOAA Fisheries was telling us only half the story. While many in the Save Our Dams movement chant, "It's the Ocean, stupid" (e.g. Northwest Fish letter), it turns out that the freshwater migration is equally important for salmon and steelhead survival. Freshwater migration matters.

Increased spill does not improve Water Travel Time but increased spill does decrease the odds of a juvenile encountering multiple life-threatening powerhouse passages. Increased spill does decrease the amount of time juvenile salmonids spend in the hydrosystem migration corridor, but only up to one day is saved. In contrast, LSR dam breaching would speed their ocean-bound journey immensely and this is precisely why salmon biologists have been recommending breach for the past two decades.

Removing the earthen berms of the four Lower Snake River dams greatly reduces the Water Travel Time. Increased spill improves the odds of powerhouse passage. Neither of these influences Ichthyoplankton Abundance or Ocean Upwelling. Increasing ocean acidity from heightened carbon dioxide seems to only be making matters worse. Calls from the Public Power Council to wait for more studies of life in the ocean are little more than a fool's errand. The salmon supported ecosystem is collapsing in front of us, and right now.



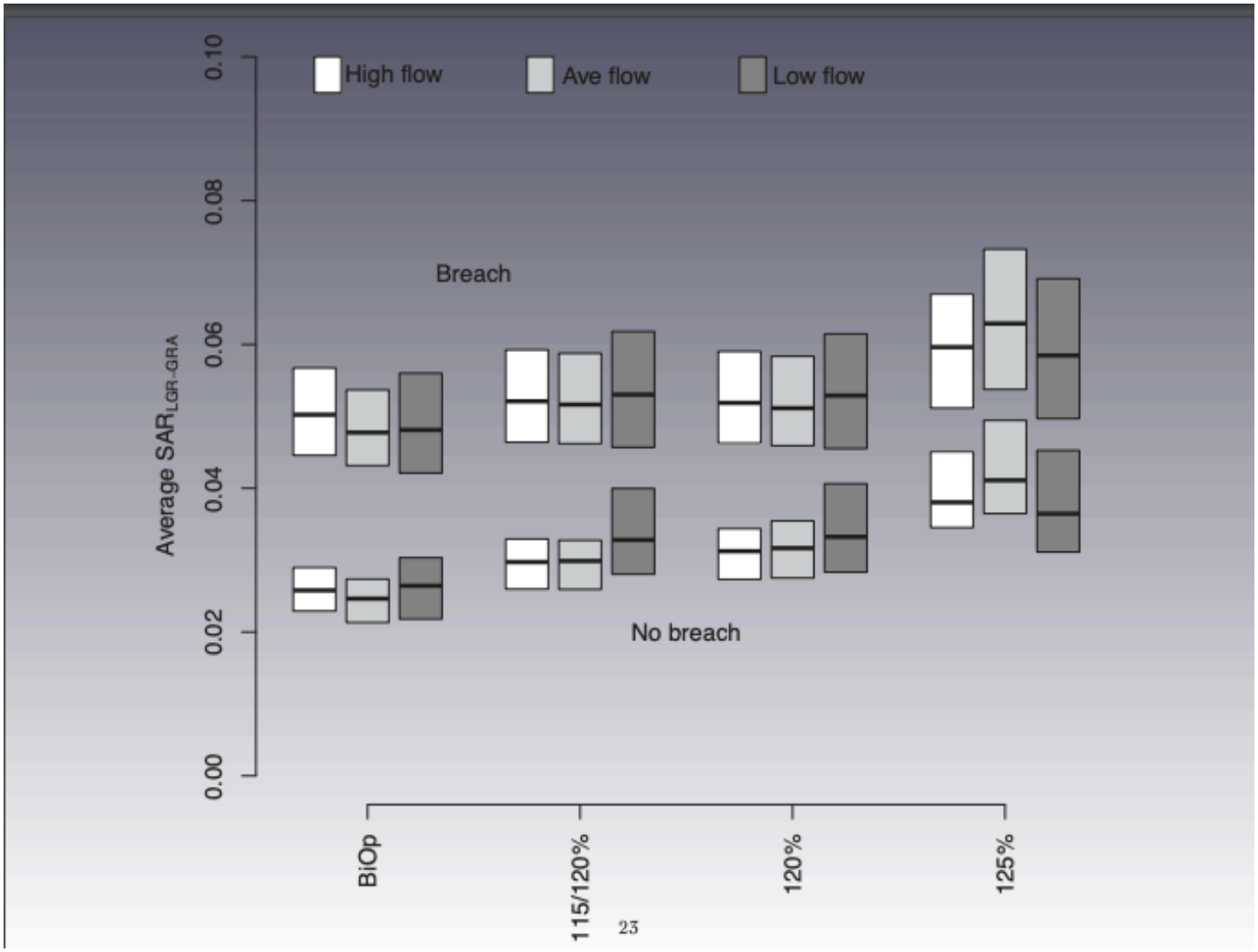
As an aside, LSR dam breaching was found to be the Environmentally Preferred Alternative in the previous NEPA process. Politics then set that Alternative 4 on the back burner for being "not necessary at this time."

> Summary of "Improving Salmon Passage" -- Final Environmental Impact Statement excerpt:
>
> Overall, PATH results indicate that the chance of meeting NMFS survival and recovery criteria for the four listed species under Alternative 1 would likely be the same or slightly better than Alternatives 2 and 3. Alternative 4 provides the highest probability of meeting the survival and recovery criteria under the PATH analysis. Both the CRI and PATH analyses indicate that further improvements in the hydrosystem passage system are unlikely to recover listed Snake River stocks unless there is an improvement in juvenile fish survival downstream of Bonneville Dam, either through such factors as improved fish conditions or improved timing of entry into the ocean. However, PATH does not address whether it is necessary to breach the dams. NMFS 2000 Biological Opinion on Federal Columbia River Power System operations indicated the need for improvements in all areas of impact: harvest, hatcheries, habitat, and hydrosystem. The Biological Opinion states: "Although breaching is not essential to implementation of the initial actions called for in the Reasonable and Prudent Alternative (RPA) which constitute a non-breach approach, the RPA requires that the Action Agencies prepare for the possibility that breaching or other hydropower actions could become necessary."

Yes, you read that correctly. Doing nothing (Alternative 1: Business as Usual) would be better than the selected Preferred Alternative. Meanwhile, Lower Snake River dam breaching (Alternative 4) "provides the highest probability of meeting the survival and recovery criteria under the PATH analysis."

The intrigue does not end there. Ecology's webinar PowerPoint (slide 17) would have us believe that the "Largest fish benefit will come from spill up to 125% TDG." Was this misrepresentation intentional?

The FPC's Comparative System Survival (CSS) cited by the webinar, includes Robert Lessard's presentation at the CSS Annual meeting in April 2018. The graphic that he presented (next page) has been seen repeatedly in the salmon community. It would is doubtful that Ecology has not seen this until now.



Note first that this graphic displays an average result of several different tributaries of the Lower Snake River. The individual tributary estimates are included in the CSS Appendix but enough can be gleaned from the graphic here on display.

Smolt-to-Adult ratios for Idaho's ESA-listed salmonids have held below 1% SAR for decades. This is in contrast to the 2% SAR starting point of the displayed graphic, so one should consider the increase in SARs as an appropriate guide. For example, increasing spill to a 125%TDG brings a less than twofold improvement in SAR.

Meanwhile, breaching the LSR dams with no change in spill does better for the salmon than merely allowing for greater spill. The reason for this is straightforward and can be seen in the previous graphic of Relative Variable Importance. Improving Water Travel Time is the most important action that we can make if we truly wish Idaho's salmon and steelhead to recover.

The vast majority of Governor's Orca Task Force readily saw this important fact: LSR dam breaching would improve the runs of Idaho's Salmon and Steelhead. With Washington Farm Bureau and river port representatives included in the politically diverse Orca Task Force, a consensus could not be established for recommending LSR dam breaching and a compromise position was reached instead.

By overcoming significant protests from the LSR dam protectors, the Task Force has successfully brought three independent consultancy firms to interview and evaluate concerns of those that may be affected by LSR dam breaching. It is no coincidence that their report is set for release in February 2020, just before the federal government's Columbia River System Operations (CRSO) report that is giving a "hard look" at LSR dam breaching.

Why is Ecology rushing forward to raise %TDG water quality standards? It really makes no sense to me, especially because Ecology has not added in findings to the science literature beyond what they reported in their "Evaluation of the 115 Percent Total Dissolved Gas Forebay Requirement" of January 2009. Forgive me if I have missed some recent additions to this decade-old report, but one would assume that last week's PowerPoint webinar presentation would have included new findings had their been any.

Before moving fast forward into rule-making changes, at the least we should ask the FPC to include 2018 and 2019 data to their study of Relative Variable Importance. Including last two years' data will address a major deficiency already recognized by FPC; relevant %TDG data is sparse in the data set.

> The majority of the observations were collected under TDG levels of less than 120%, which is the current tailrace limit. However, a number of observations were collected under involuntary spill levels where the TDG levels were above 120% and up to a maximum of 135%.
>
> -- Chapter 3, page 72 Comparative Survival Study 2018 Annual Report

Moving forward without supporting science -- looking at juvenile survival through the hydrosystem migration corridor over the next several years, funding controlled studies that repeat of overlap previous laboratory findings -- seems to be irrational, unjustified, arbitrary and capricious. But maybe I have missed something. I look forward to your reply to my well-founded concerns.

Sincerely,

Scott Levy
bluefish.org
promoting an open and honest dialogue concerning the plight of Idaho's wild Salmon and Steelhead.