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THE HONORABLE MICHAEL H. SIMON

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF OREGON

PORTLAND DIVISION

NATIONAL WILDLIFE FEDERATION, *et al.*,

Plaintiffs,

and

STATE OF OREGON,

Intervenor-Plaintiff,

v.

NATIONAL MARINE FISHERIES SERVICE *et al.*,

Defendants,

and

NORTHWEST RIVERPARTNERS, *et al.*,

Intervenor-Defendants.

Case No. 3:01-CV-00640-SI

DECLARATION OF KATHRYN KOSTOW IN SUPPORT OF THE STATE OF OREGON'S MOTION FOR SUMMARY JUDGMENT

I, Kathryn Kostow, state and declare as follows:

1. I am a conservation biologist with Oregon Department of Fish and Wildlife in Fish Division. I have worked for the State of Oregon since 1990 on projects related to various fish conservation and management issues, including fish population status assessment, hatchery risk assessment, hydropower risk assessment, fish biodiversity studies, harvest management and the Endangered Species Act.

2. During my employment with the state, I worked on two details with NOAA Fisheries (1996-1997 and 2001) on Endangered Species Act – related projects.

3. Prior to working for the state, I worked for the utility industry (1985-1989) on mitigation projects associated with the FCRPS dams and for the US Army Corps of Engineers (1983) on fish passage research at the four Snake River dams.

4. I have seven publications in scientific journals, as wells as numerous state and federal agency published reports. I have been an invited speaker at over 25 domestic and international workshops, symposia and conferences and I have been a guest lecturer at regional universities and community organizations. I provide peer reviews for numerous scientific journals, and for government agencies in the USA and internationally.

5. I have a Master of Science degree in Ecology and Evolution from the University of Minnesota, Minneapolis MN (1981) and a Bachelor of Science degree in Biology from the College of Idaho, Caldwell ID (1978).

6. I have worked with other ODFW staff analyzing the impact of the authorized operations and mitigation measures in the most recent iteration of the Biological Opinion: Endangered Species Act – Section 7(a)(2) Supplemental Biological Opinion, Consultation on Remand for Operation of the Columbia River Power System (2014 BiOp) (Jan. 17, 2004). The 2014 BiOp supplements the 2008 BiOp, as supplemented by the 2010 BiOp. In preparing this declaration, we reviewed these BiOps, the Supplemental Comprehensive Analysis (SCA) (May

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5, 2008), and other documents prepared by the federal defendants, the National Marine Fisheries Service (NOAA), the U.S. Army Corps of Engineers (the Corps) and the U.S. Bureau of Reclamation (BOR) (collectively "the Action Agencies"), as well as other documents in the administrative record and in the scientific literature.

7. I provide this declaration to assist the court in its review of the 2014 BiOp, to determine if the Agencies considered all relevant factors, to explain complex subjects in the record related to operations of the Federal Columbia River Power System (FCRPS) and the biological status and needs of Columbia and Snake River salmon and steelhead, and to reply to certain statements in declarations filed by defendants in this action.

8. *The Zabel declaration (paragraph 12) (ECF No. 2004) notes that some of the population models in Nigro's declaration are not peer-reviewed.* The calculations in the Nigro declaration simply demonstrate that, given some known number of smolts, and desiring some number of adults back (whether for population replacement or growth), a knowable SAR would be required while the observed SARs are too low. We agree that peer-review is important for published scientific papers. The models that Zabel refers to are simple algebra, where given a number of smolts (in this case, the output of a Ricker model where Smolt recruits = α * spawners * $exp^{(-\beta \text{ * spawners})}$), we solved for the SAR that would return either the parent abundance (replacement) or an abundance goal that represents some population growth (SAR = expected adult recruits / smolt recruits). The Ricker model has been peer-reviewed and is widely accepted in fisheries science; the algebra to solve for SAR is simple division. We would note that most of the analysis in the 2008, 2010 and 2014 FCRPS BiOps is also not peer-reviewed. Zabel also asserts that he could not reproduce Oregon's SAR figures. All of the data used by Oregon is publicly available. Oregon simply applied the Ricker Model and simple algebra to the data to produce its examples. We would note that Oregon could not reproduce most of the analysis in the 2008, 2010 and 2014 FCRPS BiOps.

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9. *The Zabel declaration (paragraph 13) (ECF No. 2004) notes a discrepancy in the data for Marsh Creek in Nigro's declaration.* The reason for the difference is that the Idaho data we obtained for Marsh Creek in fact reports SARs for two life histories in Marsh Creek. We used both life histories in Nigro Figure 8, but since SARs for one life history were mostly zero (*see* Ex. 5 to Zabel Decl. (ECF No. 2004) at 88, 97 (showing NRR life histories in Marsh Creek)), we dropped the "NRR" life history when plotting the SARs in Nigro Figure 9. Thus our results are optimistic representations of SAR for Marsh Creek. Further, as Zabel notes, these SARs were measured back to Bonneville Dam rather than back to Marsh Creek, as would be most appropriate for the point we are making. SARs back to Marsh Creek would be much lower than those shown for the reasons Zabel states; thus again our results are optimistic representations of SAR for this population; maybe highly optimistic.

10. To address Zabel's concern about the Idaho data—even though some of the same data appears to be used in Appendix C, 2014 FCRPS BiOp and in the 2015 Independent Scientific Advisory Board, Density Dependence and its Implications for Fish Management and Restoration Programs in the Columbia River Basin ("hereafter 2015 ISAB Report")—we instead use data from Oregon populations as examples in this current declaration.

11. For Marsh Creek, the observed SAR data are not used in the calculations in Nigro's figures 8 or 9, but simply compare observed SARs to those that would be needed for this population to replace itself or grow to a viable abundance. Since the SARs we plotted are already too low for the population to replace itself, much less grow, even lower SARs are even worse. As Zabel points out, the true SARs for Marsh Cr, a wild, wilderness area population in the Middle Fork Salmon, are much lower than what we depicted, indicating that this population really is in very poor condition. Since March Creek is a wilderness area population, the only actions that can benefit it is improvements in SAR through the FCRPS dams.

12. In Figure A, below, I re-plotted the data for all populations in Nigro Figure 8 to be consistent with Nigro Figure 9 and the Nigro appendix figures. For the Oregon tributaries, Nigro

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Figure 8 had used data to Lower Granite Dam, while the appendix figures used data to tributaries; now the new figure is also to tributaries (this change increased the number of smolts for these populations since there was mortality to Lower Granite Dam). We agree that representing smolts/parent and SARs from and to tributaries is the most appropriate approach, if sufficient data are available.

Figure A: Replacement figure for original Nigro Figure 8 to account for comments from Zabel declaration, paragraph 3.

13. *The Zabel declaration (paragraph 16)(ECF No. 2004) notes that Ricker curves typically have variance around them, suggesting that this variance would make it difficult to estimate an SAR needed to produce a particular adult abundance goal. Zabel also notes that the sample sizes for some populations are small, or at least that the available data are distributed primarily among low adult abundances.* Zabel's comment about variance being present is correct, but it can be dealt with using a simulation that takes variance into account when calculating the SARs. Figure B, below, demonstrates this ability, using the Minam as an

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example with a target abundance of 750 adults, with the line representing the simple required SAR curve, but with variance around the target curve calculated from 1000 simulations of the SARs given the variance in observed smolts/spawner, observed spawners, and observed SARs and covariance between smolts/spawner and spawners. This simulation indicates that SARs need to approximately double from the observed values (grey squares) in order to reach and maintain the target abundance. We expect that the inclusion of variance would typically make larger improvements in SAR necessary, compared to simple point estimates. However, in most of our examples, this variance is excluded from our discussion for purposes of simplicity. We agree that current sample sizes are small (although several of the data sets have been used in other publications regardless of their small size, including in the Copeland et al. 2014 publication attached as Exhibit 5 to the Zabel Declaration (ECF No. 2004)). The target S_{max} and SAR values should be recalculated periodically as the data sets are updated and enlarged. We also agree that for most Snake populations, the available data are primarily distributed among small adult abundances. This is not surprising, given the low observed SARs (as further demonstrated in below). It appears that SARs will need to be consistently increased if we want to be able to better populate the models with smolt production at larger spawner abundances.

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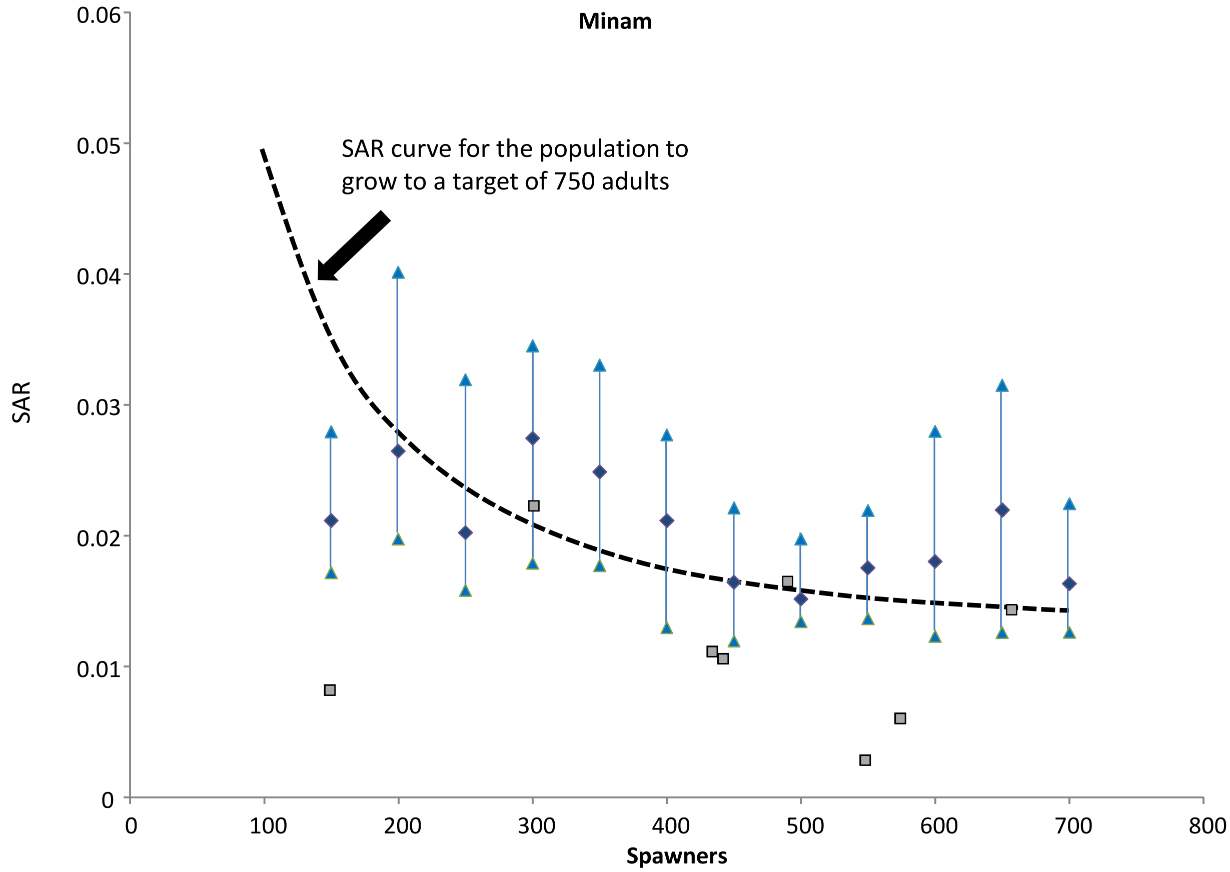

Figure B. An example of incorporating variance in the calculation of required SARs solving for a target abundance of 750 adults, using a smolt-recruits Ricker function for the Minam, along with variance in observed smolts/spawner, observed spawners, and observed SARs and covariance between smolts/spawner and spawners. Grey squares represent observed SARs. These results, based on 1000 simulations, indicate that, given the variance present, a doubling of SARs is required to stabilize the population at the target goal. (Ricker curve of smolt production not shown).

14. *The Toole declaration (paragraph 23) (ECF No. 2002) tries to equate the SAR analysis in the Nigro declaration to the R/S analysis in the FCRPS BiOp, and proposed our intent was the same.* The Nigro declaration does not discuss NOAA's adult-to-adult R/S estimates in this context. The R/S data in the BiOp and the smolt and SAR data in our figures are not even for the same brood years. The Nigro declaration simply demonstrates that, given some known number of smolts, and desiring some number of adults back, a knowable SAR would be required. Most of the current SARs are too low; therefore it would not be a surprise

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that SARs below replacement and R/S estimates below replacement would both be observed for the same population. However, the adult recruits / spawner (R/S) metric cannot differentiate between low freshwater tributary productivity (smolt recruits/spawner) and low survival after the smolts leave their tributary (low SAR), while Oregon's analysis is able to do so.

15. *The Zabel declaration (paragraph 16) (ECF No. 2004) argues that the use of S_{max} as a goal or reference point "has little precedent."* However 2015 ISAB Report specifically recommends that the region "[e]stablish biological spawning escapement objectives (reference points) based on recruitment models" (recommendation 2, page 143), and goes on to support ecosystem-based management. On page 127, the 2015 ISAB Report states that comparing escapement to capacity (which is determined from S_{max} and R_{max}) or exceeding capacity some of the time may be beneficial ecologically. Also targeting maximum recruitment (either the spawner abundance that produces maximum recruitment (S_{max}) or the maximum recruits themselves (R_{max}) may "maximize food and nutrient production" (page 31). A true and correct copy of excerpts of the 2015 ISAB Report is attached as Exhibit 1 to the Declaration.

16. *The Toole declaration (paragraph 20) (ECF No. 2002) argues that the Nigro declaration inappropriately emphasized habitat actions.* While I agree that the jeopardy analysis in the 2008 FCRPS BiOp addressed multiple factors, and that actions for "other Hs" are included in the RPA, the 2014 supplemental BiOp is strongly focused on tributary habitat. The 2015 ISAB Report on density dependence also is focused on these effects in tributary habitat (*see Ex. 1 to Zabel Declaration*). The multitude of fish accords signed with the various states and tribes are also focused on habitat. Oregon continues to support actions that improve tributary and estuary habitat, however improvements in survival through the FCRPS dams are needed, as demonstrated by the examples referenced by Toole and discussed below.

17. *The Toole declaration (section A, starting with paragraph 21) (ECF No. 2002) argues that the Nigro SAR analysis emphasizes recovery goals.* Oregon's SAR analysis emphasizes setting goals, then working toward them by increasing both productivity in

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freshwater and SARs as needed. This recommendation is echoed by the 2015 ISAB Report on density dependence (*See* Ex. 1 to Kostow Decl.) on the importance of setting goals; also see page 131 stating that "[p]otential actions include habitat restoration to improve survival to the smolt stage and hydrosystem improvements in the mainstem river as a means to increase SAR and thereby reduce the smolts per spawner needed to achieve replacement." Our analysis used several possible goals, including S_{max} and the ICTRT minimum viable abundances as examples. However, the Nigro declaration emphasizes that any goal (including replacement) could be used. The important point is the recognition of SARs in a density dependence context and how with a goal of some number of adults back (whether for population replacement or growth), a knowable SAR would be required.

18. *Zabel (page 3, paragraph 5) and Toole (starting page 7, paragraph 13) note that there is evidence of density dependence in interior populations that could explain declines in adult recruits / spawner*. Adult recruits / spawner are influenced by both fresh water productivity (production of smolts) and the survival of the smolts to adults. Reduced freshwater carrying capacity, rather than density dependence, might limit population growth. As explained in the 2015 ISAB Report (Ex. 1 to Zabel Decl. and Ex. 1 to Kostow Decl.), density dependence, itself, provides population resiliency when spawner abundance is perturbed to low numbers. Our analysis demonstrates that some populations (for example Secesh Cr., Minam and Marsh Cr.) appear to have current capacities (represented by R_{max} and S_{max}) that already exceed the ICTRT minimum viable goals provided that SARs were high enough (S_{max} , calculated from a smolt recruit model, exceeds the ICTRT minimum viable goal), but other populations (for example Pahsimeroi, Upper Grande Ronde and Catherine Cr.) appear to have capacities that are too low to support minimum viable populations. The conditions of these populations correspond to whether they are in wilderness or degraded habitats. *See* Figure C, below. All of the populations have recent average abundances below both the minimum viable abundances and S_{max} (red bars in Figure C).

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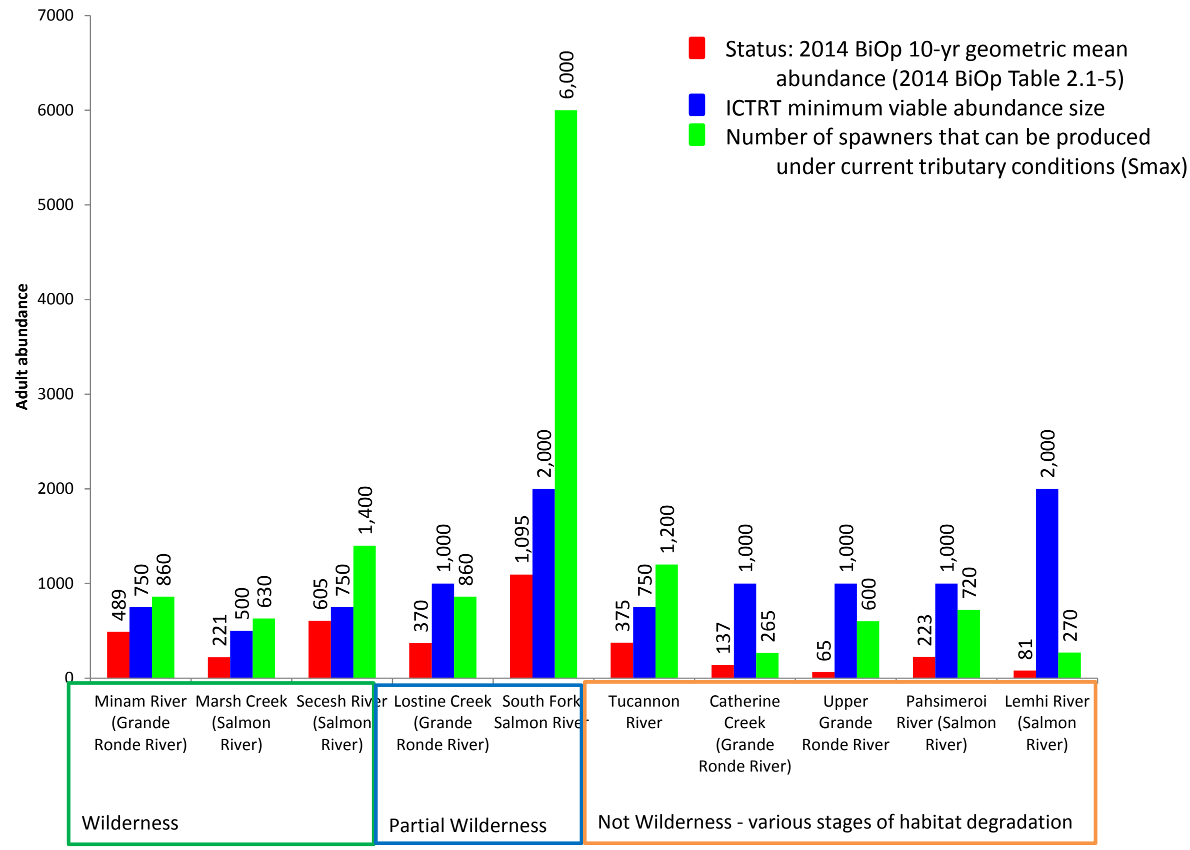

Figure C. A comparison of observed abundance (red bars) compared to the ICTRT minimum viable abundance (blue bars) and the number of spawners that produce the maximum number of smolt recruits (S_{max}) under current conditions based on Ricker productivity analyses (green bars), for ten Snake River spring/summer Chinook populations. The populations are arranged into "wilderness" (pristine habitats, no hatchery programs), "partial wilderness" (modest tributary habitat degradation and/or hatchery effects) and "not wilderness" (degraded habitat and/or hatchery programs present). When the green bar equals or exceeds the corresponding blue bar, the population is capable of achieving or exceeding the ICTRT minimum viable sizes with the current level of smolt production; that is, the tributary habitat is already capable of producing an adequate number of smolts for the population to replace itself or grow. If the green bar is less than the corresponding blue bar, tributary improvements are needed to produce enough smolts for the population to replace itself or grow. For all populations, the red bars are the lowest, indicating a) actual abundance is less than the minimum viable abundance, and b) even where smolt productivity is sufficient, the smolts are not surviving to adults at a sufficient rate to return enough adults to the basin for the populations to replace themselves or to grow. Data from Nigro Declaration, Appendix A.

19. The 2015 ISAB Report comments, on page 131, that:

> [M]ajor actions are necessary to increase the productivity of the population (SARs and smolts per spawner) in order to create a self-sustaining population at the current level of spawning salmon.
>
> Potential actions include habitat restoration to improve survival to the smolt stage and hydrosystem improvements in the mainstem

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> river as a means to increase SAR and thereby reduce the smolts per spawner needed to achieve replacement. Petrosky et al. (2001) show that dam construction in the Snake River Basin, rather than changing conditions in spawning and rearing habitats, was responsible for the decline in Chinook salmon productivity, suggesting that the greatest potential gains in productivity would stem from improvements in the hydrosystem. For example, if SAR improved to 2%, then only 50 smolts per spawner would be needed to reach replacement.

Oregon agrees with the ISAB that habitat actions, where capacity is currently the limiting factor, combined with increased SARs that reflect increases in hydropower system survival, are necessary for most of the interior salmon and steelhead populations.

20. *The Graves declaration (paragraph 23) (ECF No. 2005) and the Zabel declaration (paragraph 15) (ECF No. 2004) argue against Oregon's concern about latent mortality*. One of the concerns emphasized by Graves reflects his misunderstanding that Oregon intended for comparisons of SARs for up-stream and down-stream populations to demonstrate or measure latent mortality. Oregon simply stated that NOAA must explain why the recent SARs of interior Chinook and steelhead populations are lower than the SARs for all other populations for which we have found SAR data (see Figure D). Snake River SARs were higher in historic times (before 1970, as shown in Figure D, also see Figure I panel A). Oregon's point is that these patterns among SARs are indicative of the overall effects of the hydrosystem.

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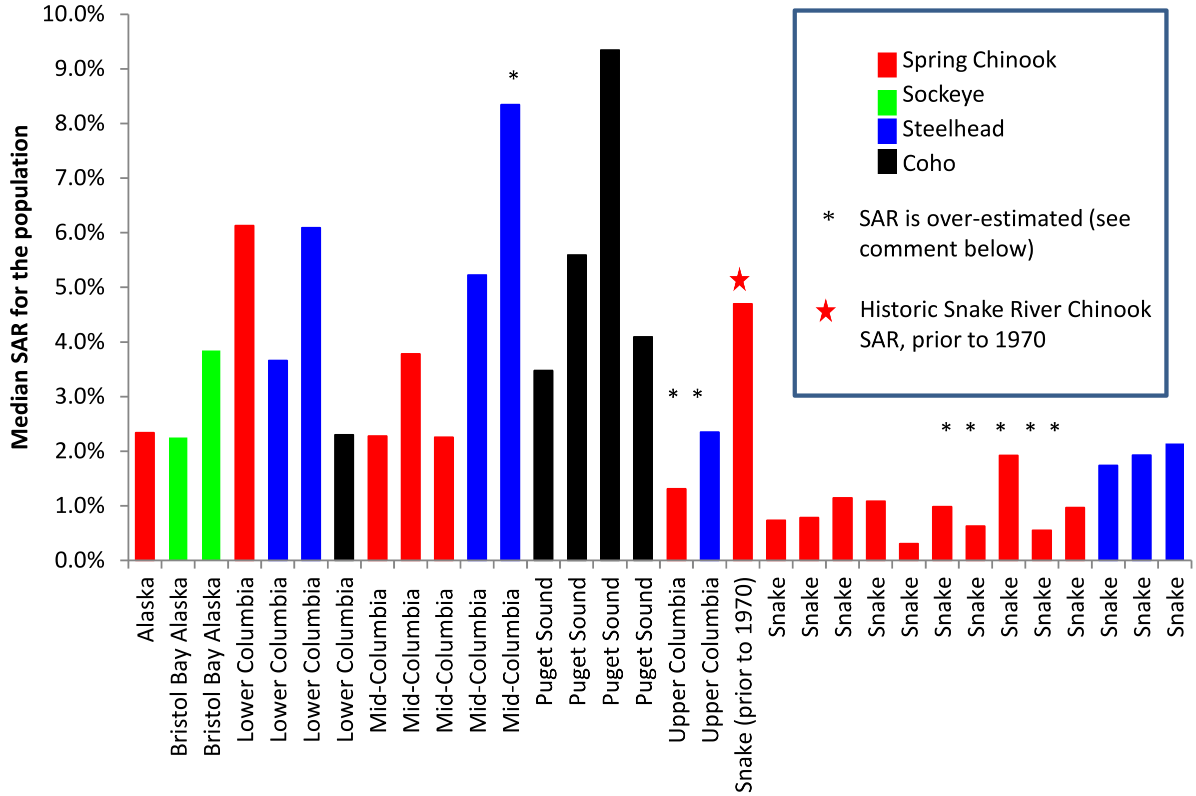

Figure D. Comparison of SARs across 31 salmon and steelhead populations, including four species and six geographic areas. ANOVA analysis (excluding historic Snake, marked by the star) indicates that geographic area contributes 41% of the variation in SARs, with the current SARs in Upper Columbia and Snake geographic areas lower than all other areas. Species identity contributes less to this pattern. Thus, for example steelhead and spring Chinook in the Snake have more similar SARs than do steelhead in the Snake compared to steelhead in the Mid or Lower Columbia. Note that SARs for those populations marked "*" are over-estimates (actual SAR would be lower) because the measurement is over less than the full smolt-adult period. In the Upper Columbia, SARs were measured only from McNary Dam (smolts) back to McNary Dam (adults), excluding the experience of juvenile and adult passage though up to five upper Columbia mainstem dams. In the Deschutes, SARs were measured from Bonneville (smolts) to Bonneville (adults). For some spring Chinook populations in the Snake, SARs were measured from the tributary (smolts) to Bonneville Dam (adults), excluding any adult mortality above Bonneville Dam (see Zabel declaration, paragraph 13 expressing this concern).

21. *The Graves declaration (ECF No. 2005), starting with paragraph 21, page 16, argues that comparing the SARs of Snake River populations to other populations is not valid.* Published papers on this subject (for example Schaller et al. 1999) find such comparisons valid. However, the regional pattern of SARs, showing the lowest SARs for inland Columbia Basin

ESUs remains unexplained by NOAA Fisheries. This pattern is broadly demonstrated in Figure D, which compares SAR data, from either PIT-tag data or run reconstructions, for 31 populations across six broad geographic areas and four species. 41% of the variation in SARs is explained by geographic distribution, with the SARs in inland Columbia River ESUs (both Snake and upper Columbia) lower than those in any other location regardless of species.

22. *The Zabel declaration (ECF No. 2004) (paragraph 15 page 9) references a 2007 ISAB review of post Bonneville survival that advised against continuing to try to measure absolute latent mortality in the absence of a "damless" condition and concludes it is not measurable.* However, Zabel omits reference to the ISAB's 2012 follow-up review and update. The ISAB found that "analyses demonstrate that fish bypass systems are associated with some latent mortality, but the factors responsible for latent mortality remain poorly understood and inadequately evaluated." Additionally, the ISAB called for further research to test alternative latent mortality hypotheses regarding: a) non-random sampling selection, and b) injury or stress caused by fish bypass systems (ISAB 2012-1). Zabel's concern may be more about the *measurement* of latent mortality, which we agree may be difficult, than on the evidence that latent mortality in fact occurs.

23. NOAA's own review of the effect of the FCRPS hydropower system evaluated the evidence for latent mortality and concluded that "*clearly some level of latent mortality exists*" (NOAA B467:NMFS048501). I agree with Williams et al. and other authors who have provided evidence that latent mortality due to experience in the FCRPS and the transportation program exists. I also agree that definitive measurement of the mortality associated with the FCRPS, or associated with any other specified factor, from juveniles below Bonneville to adults back to Bonneville, is difficult since intermediate measures of survival cannot be made. Oregon's emphasis on the low survival rate that SARs demonstrate is that survival through the FCRPS is the major limiting factor on population growth. Accounting for the full extent of the adverse effects of the FCRPS is a necessary factor in deciding upon the appropriate actions to include in

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a reasonable and prudent alternative. I also note, that in spite of the difficulty in measuring any specific contribution to mortality or survival below Bonneville Dam, NOAA does not hesitate to estimate and assign benefits to actions taken in estuary habitats or to actions to decrease predation below Bonneville Dam, even though, for the same reasons noted by Graves and Williams, such benefits cannot be measured any better than the level of latent mortality caused by the FCRPS.

24. *The Toole declaration (ECF NO. 2002), starting on page 28, paragraph 48, states that the "FWG Interim Report" (2014 NOOA B143) should be disregarded.* The FWG Interim Report was a collaborative product produced following the remand of the 2004 FCRPS Biological Opinion. It estimated the relative impact of the FCRPS to range from 35% to 74% of the human-caused mortality of Snake River salmon and steelhead. Toole argues that this report was never finished, and was only "interim". In any case, the findings in that report are consistent with the factors for decline determined by NOAA Fisheries in 1991 when the Snake ESUs were originally listed (*see* NOAA 273:NMFS023870 citing NMFS, 1991, Factors for Decline: A supplement to the notice of determination for Snake River spring/summer Chinook salmon under the Endangered Species Act). In that report, NOAA stated that hydropower development contributed to 80% of the loss of salmon and steelhead in the inland Columbia, with about half of that (40%) due to blockage by Chief Joseph and Hells Canyon dams, and the other half (40%) due to ongoing annual operations of the mainstem dams (page 7, paragraph c).

25. One likely contributor to latent mortality is the increase in travel time associated with impoundment of the mainstem Columbia River, and its effects on the timing of onset of hypo-osmoregulation [the adaption to salt water tolerance] during smoltification. On the Columbia River, impoundments flooded migration corridors, changing the cross-section of the river, slowing water velocity 4- to 10-fold and increasing fish travel times by about 20 days (*Raymond 1979*)(*see also* Figure G, below). This extended travel time disrupts smoltification. Smolting is a hormone-driven developmental process that is adaptive for downstream migration

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and ocean survival and growth in anadromous salmonids. Smolting includes increased salinity tolerance, increased metabolism, downstream migratory and schooling behavior, silvering and darkened fin margins, and olfactory imprinting (*Björnsson et al. 2011*.). A major physiological process of smoltification is the increase in hypo-osmoregulatory ability, which adapts the fish to transition from fresh water to life in seawater (*Wedemeyer et al. 1980*.). The coordination of smolt migration timing, the onset of hypo-osmoregulation, and the period of optimal estuary and near-ocean environmental conditions, appears to be crucial for the survival of salmon and steelhead (Figure E)(*McCormick et al. 1998*). Presumably the migratory timing of wild smolts is an adaptation to their river's prevailing environmental conditions. The change in the Columbia River flow patterns delivers some groups of juvenile salmon to the estuary later than is optimal for ocean survival (*Waples et al. 2007,Scheuerell et al. 2009*), prompting some NOAA scientists to recommend reducing juvenile travel time to the estuary by increasing springtime river flows (*Scheuerell et al. 2009*).

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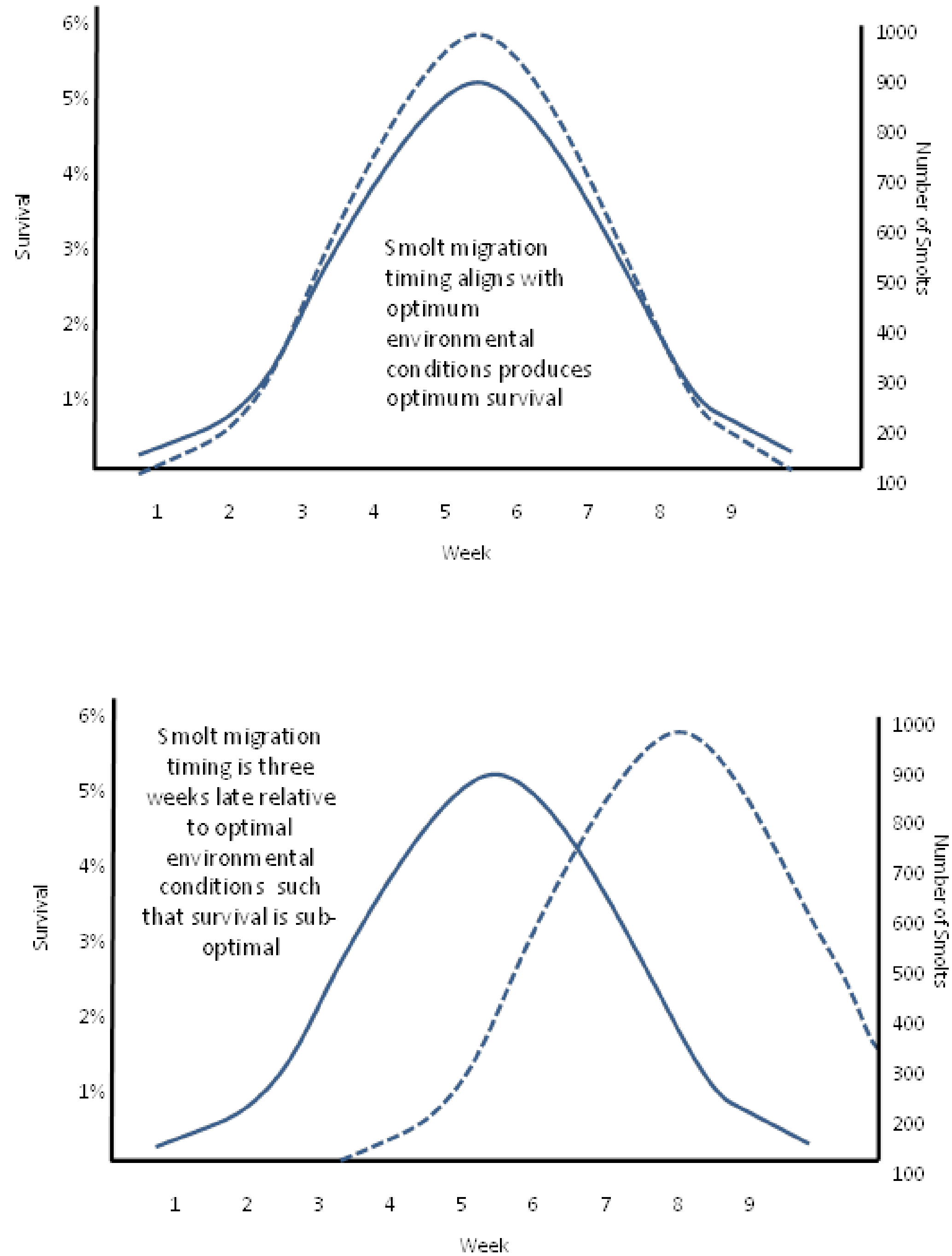

Figure E. A simple conceptual model of the relationship between optimal environmental conditions in the estuary and smolt migration timing. The solid line represents optimal environmental conditions. The dashed line represents smolt migration timing. Survival is optimal when smolt migration timing and optimal environmental conditions are aligned (top panel, survival, given the number of smolts and weekly survivals shown, = 3.2%). If smolt-migration timing is misaligned with environmental conditions, survival is lower (bottom panel, survival = 2.2%). Survivals are calculated as the array of smolts/week x survival/week, see McCormick et al. 1998, Figure 3 p.85 for further information.

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26. *The Graves declaration (page 6, paragraph 12) is concerned about the flow data in the Nigro declaration Figure 1 and the fact that it stopped in 1985.* The purpose of the Nigro Figure 1 was to show the history of hydropower and dam construction in the Columbia Basin. The last major construction in the basin was Revelstoke Dam in 1984, therefore the graph ended in 1985.

27. *The Graves declaration (paragraphs 18 and 31) is critical that Oregon's support of flow and spill benefits include evidence from correlation analyses. The declaration further questions our use of geomeans and inclusion of July flows in the Nigro Figure 5 (also Nigro Appendix figures)*:

a. Regarding correlations: While we agree that correlation does not, by itself, confer causation, we note that all regression analyses involve identifying the relationship, but not causation, between a dependent variable and one or more independent variables. Regressions are a commonly-used analysis in biology. NOAA often uses them to support their own conclusions in the BiOps, (for example as evidence for density-dependence in *Zabel and Cooney 2013, Appendix C of the 2014 FCRPS BiOp,* and in *Zabel declaration attachment ISAB 2015-1; see figures in the full ISAB document V.1, V.3, V.4, V.5, etc.;* also *Tehan declaration paragraph 15,* in support of habitat benefits; also *Toole declaration Figure 1, page 10*). We could list additional examples.

b. Regarding the use of 4-yr running geomeans: Statistic filtering and smoothing of time series data (for example by using 4-year geomeans of adult recruit data) are used to decrease the effects of outlier data in a correlation or regression analysis. This approach may influence R^2 values, but does not affect the significance of the underlying relationship (Barner and Arce, 1998). We used geomeans in part because NOAA used geomeans in their own abundance trend analyses (see 2014 FCRPS BiOp, tables 2.1-5 and 2.1-6, pages 80-81, also examples in 2008 FCRPS BiOp such as Figure 8.3.2-1 page 8.3-6).

c. Regarding the inclusion of July flows: While recent flows peak in May and June historic flows peaked in June with significant flows continuing into August. In the 2015 ISAB Report, the ISAB compare historical and contemporary juvenile out-migration timing through the Columbia River estuary, demonstrating a change in timing and a loss of out-migration timing diversity (ISAB density dependence report, figure IV.4, page 72, showing out-migrants entering the Columbia River estuary into August and September). We agree with the conclusions in the 2015 ISAB report that the loss of out-migration timing diversity, and other life history diversity, represents an impact to the resiliency of the populations. Our Nigro

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figure 5 and appendix figures, included flow and abundance data from as early as the 1950s; therefore it was appropriate to include July flows.

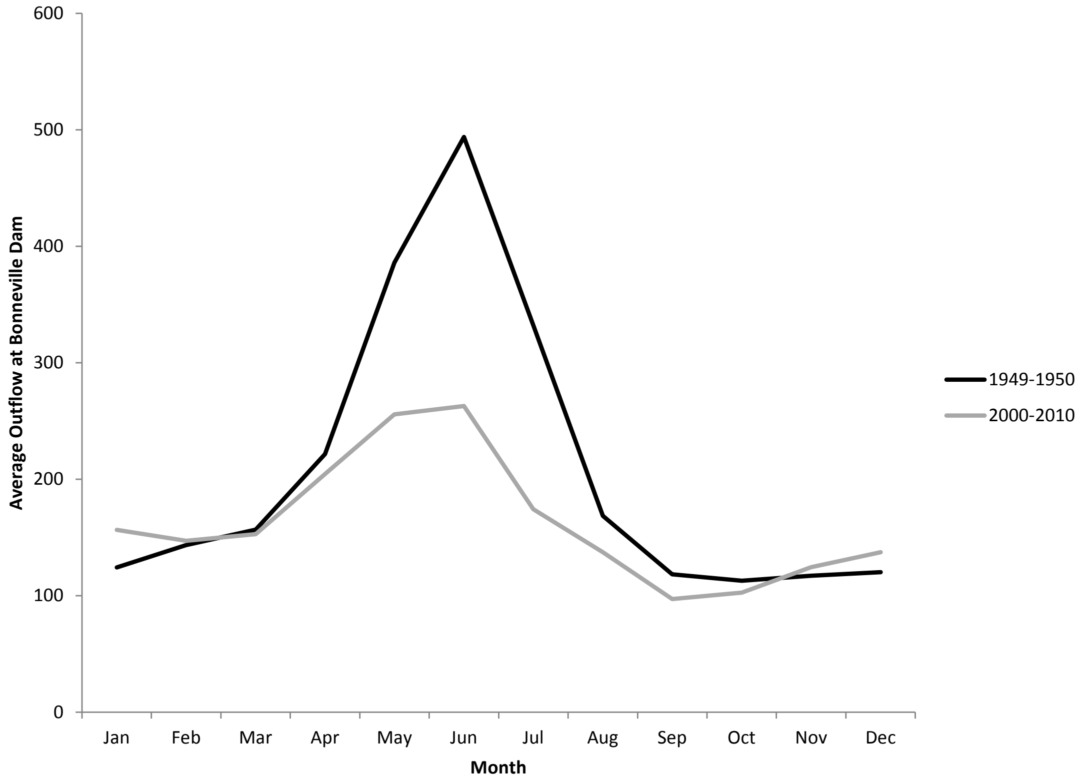

Figure F. A comparison of average monthly out-flow at Bonneville Dam, comparing 1949-1959 to 2000-2010. Contemporary July flows are decreased compared to historical July flows.

28. *The Graves declaration (page 10-11, paragraph 16)states that he is "confident that the hydrosystem, as currently configured and operated (with dam-specific spill levels for juvenile migrants), has substantially improved migration and passage conditions and increased the survival of migrating salmon and steelhead smolts compared to the 1970 to mid-1990 period. In support of his statement, Graves presents Figure 3.3-7 from page 366 of the 2014 BiOp, (as Graves Figure 4) which is intended to demonstrate improved survivals for subyearling (fall) Chinook.* Graves Figure 4 is a very misleading figure. It guides the eye from apparent low survivals in the late 1990s, to apparent high survivals in the late 2000s. However, the figure is a

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mix of release groups binned by two-week periods. As demonstrated in the 2014 CSS Annual Report, this approach to binning captures an in-season survival pattern where fish survival is highest in the earliest week of the season, declines over the season to lowest levels late in the season (McCann et al. 2014, page 70, Figure 3.4). This distinction is an important clarification to Graves Figure 4 since the early years in the figure include the latest season bins (open circles, from July) while in later years in the figure the earliest season bins are presented (blue circles, from May). This makes it *appear* that there is higher survival in later years, but the actual explanation is that data for different bins are presented across the years. Graves would have had to fit a significant regression to the time series for each individual season bin in order to make his point that there is an increased survival from 1997 to 2012.

29. *The Agencies claim that juvenile travel time and dam passage survival have significantly improved under the RPA. See Fed. MSJ at 52.* The Agencies cite Figure 18 from page 40 of the 2013 Comprehensive Evaluation to support this assertion. See NOAA B47:3296 (Figure 18). It is not evident that the data in the Comprehensive Evaluation Figure 18 represents statistically or biologically significant hydropower system survival improvements. Error data (standard deviations) are not provided, nor is any analysis that demonstrates a statistical significance between years provided. Other data indicates that NOAA is primarily focused on short time series in highly variable data sets. For example, a comparison of 2013 Comprehensive Evaluation Figure 18 with long-term water travel time (Figure G, below) demonstrates that water travel time increased from an historic average of 3.5 days (before 1967) to an average of 18.4 days (since 1968) (Figure G, below). An inspection of the water travel times since 1968 (Figure G, panel B) shows that annual travel times have been highly variable, with a non-significant increasing trend (toward longer travel times) ($R^2 = 0.007$). R^2 is a statistical measure of how close the data are to the fitted regression line. An $R^2 = 1.0$ indicates that the data exactly fit the line. Low R^2 values, such as those shown here, indicate the line is not a good fit to the data. Annual variation in travel time may be related to environmental conditions

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in the river. For example, the fastest travel time since 1972 occurred in 1997, at 10.2 days. 1997 was an exceptional flow year (*see* Figure G and Figure H). The relatively fast travel time in 2011 (13.2 days), which is the fast travel time year that was emphasized in Comprehensive Analysis Figure 18, also corresponds to an exceptional flow year (*see* Figure G and Figure H). In both 1997 and 2011, high flows were accompanied by high unplanned spill. As Figure G demonstrates, water travel time again increased in 2013 and 2014. NOAA does not explain this increase or how it figures into their argument in the 2013 Comprehensive Evaluation.

30. Work in the Comparative Survival Study (CSS) has demonstrated that water travel time (which is calculated from flow) and spill both contribute significantly to juvenile fish travel time (see McCann et al. 2014, page 70, figure 3.4). Water travel time can also be shown to be related to SARs (as measured for Snake River spring/summer Chinook from Lower Granite to Lower Granite) (Figure I), with more rapid travel time (fewer days) associated with higher SARs (Figure I(B)).

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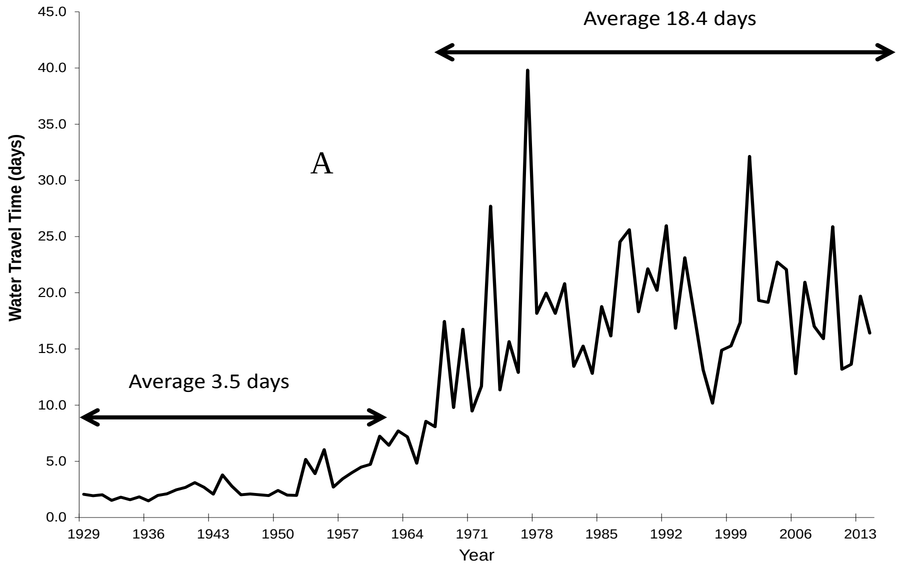

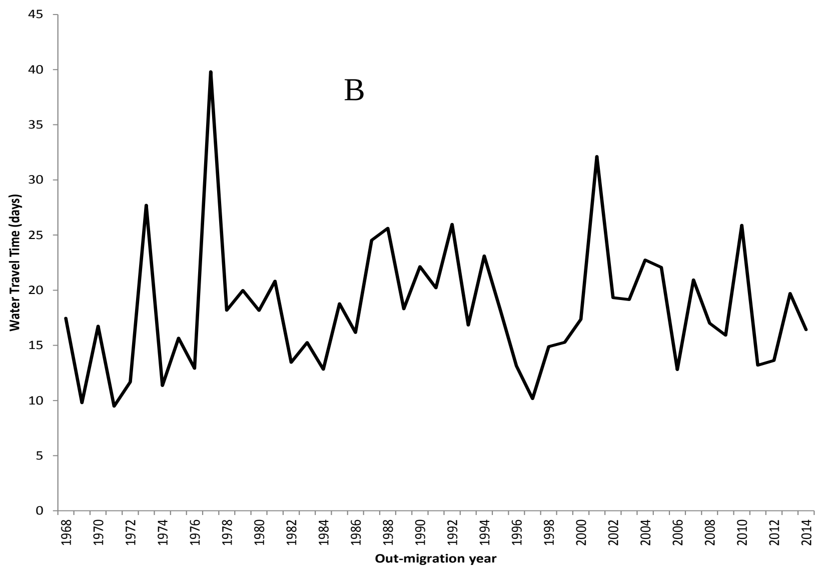

Figure G Panel A: Water travel time from Lewiston to Bonneville, 1929 – 2014. From Nigro declaration, Figure 3, page 6. Panel B: An enlargement of the period 1968 – 2014.

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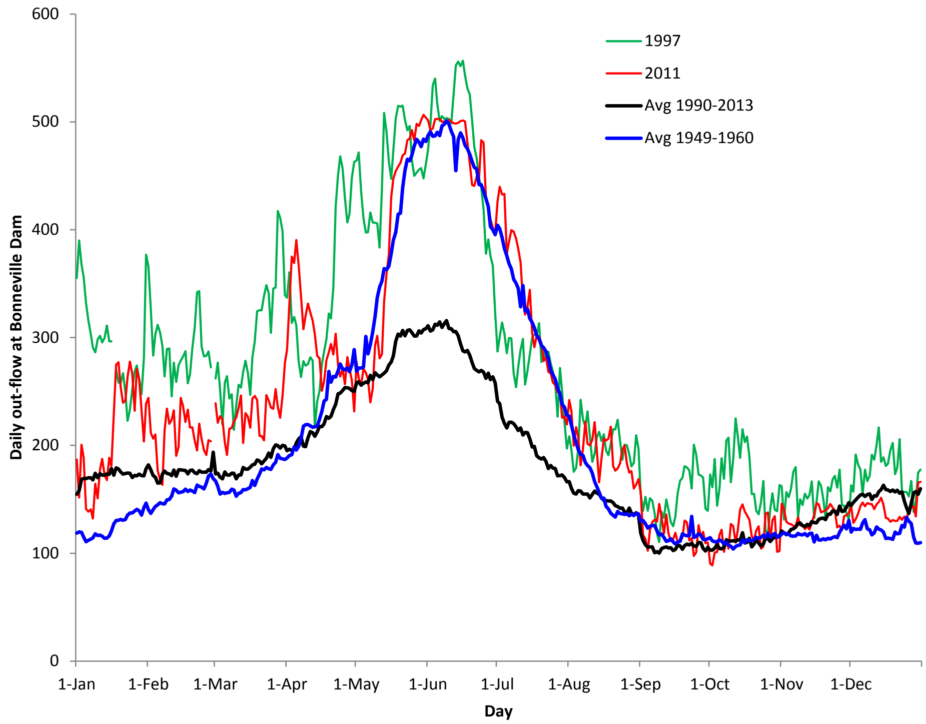

Figure H. Daily average outflow in kcfs at Bonneville Dam, comparing an average from 1949-1960 (blue line), to an average from 1990 to 2013 (black line), and two exceptional high flow years since 1990: 1997 and 2011. High unplanned spill also occurred in 1997 and 2011. Flow and spill data from DART http://www.cbr.washington.edu/dart/query/river_graph_text

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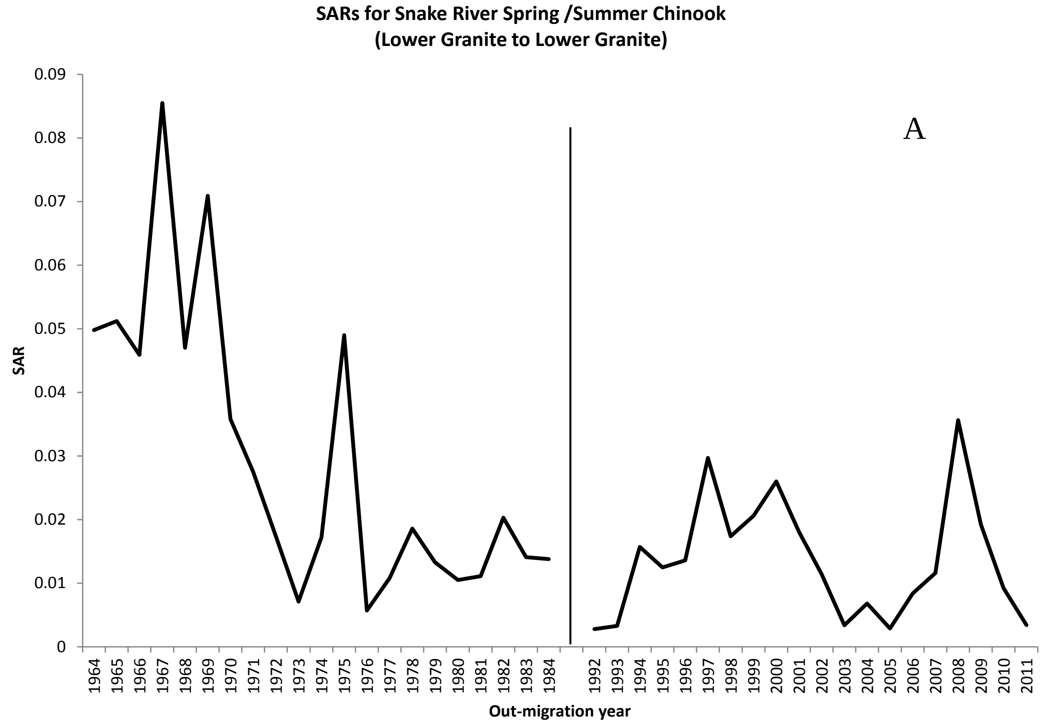

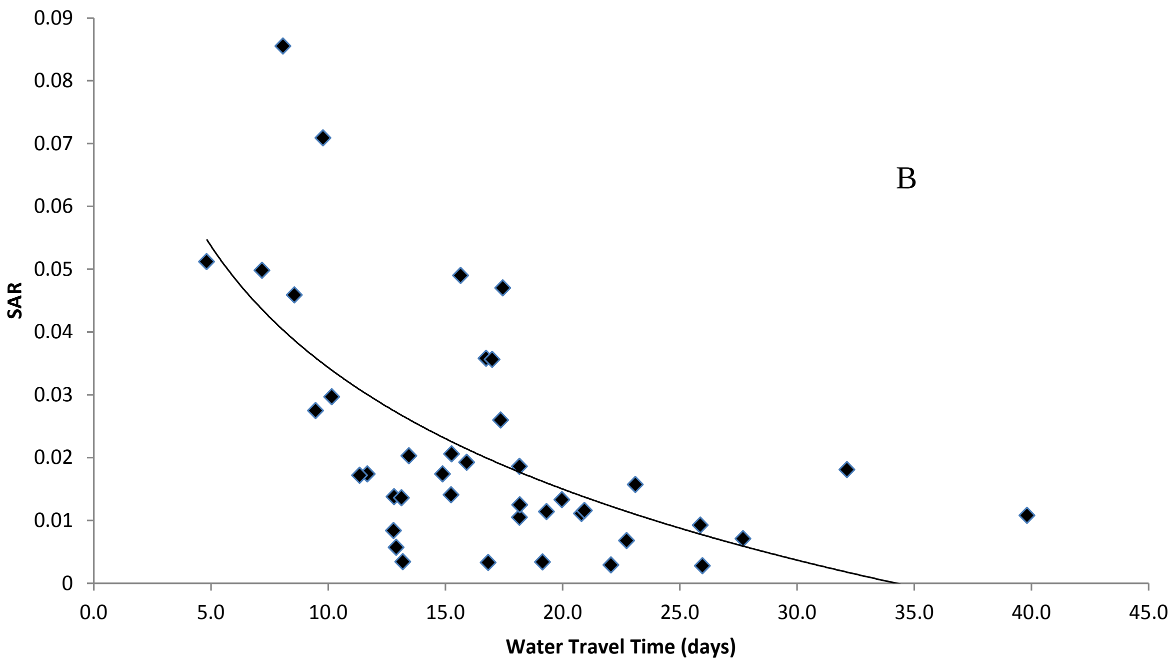

Figure I. Panel A demonstrates changes in SARs over time (comparing the period 1964-1984 to 1992-2011). Panel B presents a log regression of Water travel time and SAR, demonstrating the statistical relationship between the metrics. SAR data are not available for more historic time periods, or for the period 1985-1991. Older SAR data from Petrosky et al. 2001; Water travel time from Nigro Declaration, Figure 3, page 6; Recent SAR data from McCann et al. 2014.

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31. *The Graves declaration (paragraph 26) argues that our concern about the effects of changes in the transportation and spill programs on the Snake, as expressed in the 2014 FCRPS BiOp, would not have the effects we described*: It appears that Graves inappropriately transferred concerns that the Nigro declaration expressed for the Snake River Dams to the lower Columbia mainstem dams, and is also confusing the details of the 2014 FCRPS BiOp with the 2015 Fish Operating Plan (FOP). The differences between the 2014 FCRPS BiOp RPA 29 Table 2 (also see AA 2014) and the 2015 FOP are for the four Snake River dams, where the 2014 BiOp included spring to summer spill program transition dates that were up to 20 days earlier than what is in the 2015 FOP. The spring-to-summer transition for Lower Monumental decreases spill from 20-29 kcfs to 17 kcfs; while the same transition for Lower Granite decreases spill from 20 kcfs to 18 kcfs. Graves argues that Oregon's concerns about juvenile fish transportation strategies and planned spill levels are "not true" (Paragraph 26) yet he appears to recognize the reduced spill levels. When transportation is implemented, flow over spillways is reduced, which directs more flow to the turbine routes (bypass and turbines). At present, there is nothing to prevent the Action Agencies from deciding in 2016 to adhere to the 2014 FCRPS BiOp spill parameters, as compared to 2015 FOP.

32. The Graves declaration (paragraph 35) states that "*NMFS believes that transporting 50% or less of the Snake River juvenile salmon and steelhead smolts is consistent with the ISAB's (2008-5, pg 3) continued recommendation to "spread the risk."*" Mr. Graves points out that actual transportation fractions have been less than called for in the 2008 FCRPS BiOp. The 2014 FCRPS BiOp at Table 3.3-3 (page 370) shows that during 2008-2013 63.7% of juvenile wild spring Chinook salmon were expected to be transported annually; actual percentages were 22.7% to 54.3%. The 2014 FCRPS BiOp at Table 3.3-4 (page 370) shows that during 2008-2013 74.3% of juvenile wild steelhead were expected to be transported annually; actual percentages were 28.4% to 50.5%. Mr. Graves concludes in paragraph 37 that "*The planning dates in the 2014 Supplemental BiOp April 21 to 25 or no later than May 1 are*

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consistent with the ISAB's recommendation." At paragraph 38, Mr. Graves expresses that "*that these substantially reduced transport rates (compared to earlier years in the Base Period) should substantially reduce the impacts of transportation on both Snake River and mid-Columbia ESUs/DPSs*" and that the 2014 FCRPS BiOp has a "*much smaller increase in transportation rates that would result from the modified actions in the 2014 Supplemental BiOp*." Rather than relying on annual reviews of the "*prior years' transportation information annually in the Technical Management Team and in the Regional Implementation and Oversight Group forum to consider whether adjustments in transportation operations should be implemented each year*", the FCRPS BiOp should explicitly assure transport does not begin prior to May 1. As Mr. Graves notes, this reflects regional consensus on this issue; it should be so stated in the FCRPS BiOp.

33. *The Graves declaration (paragraph 28) argues that curtailment of spill as early as August 1 is not as large a concern as we state:* The 2015 ISAB Report on density dependence (*Ex. To Zabel Declaration*,) includes a figure (*Figure IV.4, page 72*) comparing and contrasting the run timing diversity of Chinook salmon historically and recently. More diverse life histories make species more resilient. There is also evidence from historical flow data (see Figure F) that historical July and August flows were higher than contemporary flows during those months. It appears that Graves is focused on the recent, depleted life history diversity with regards to migration timing. The ISAB argues, and we would agree, that a return to greater life history diversity would be beneficial to inland Chinook salmon. The spill program needs to be implemented consistently with allowing the expression of this diversity.

34. *The Graves declaration (paragraph 29) argues that Nigro's discussion about uniform vs bulk patterns fails to consider biological effects including "edge effects" and "high surface to perimeter ratio."* These purported biological effects are not previously discussed in the 2014 FCRPS BiOp. Graves seems to have concern about edge effects and high surface to perimeter ratios everywhere uniform spill patterns occur. However, a uniform spill pattern, where spill is distributed across the spillway as opposed to limited to a single spill bay, is

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currently part of the Fish Passage Plan (http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/2015/index.html). Although uniform pattern is prioritized at some projects more than others, the implementation of uniform vs bulk spill patterns has been discussed most for Lower Monumental dam. Bulk spill has been prioritized at Lower Monumental even though it limits system operations while creating fish passage problems that could be avoided by using uniform pattern (for examples see RCC Water Quality Program 2009; SOR 2011-02 see http://www.nwd-wc.usace.army.mil/tmt/sor/2011/dispositions.html#03; FPC Memos April 25, 2011, December 9, 2011, February 24, 2012; April 18, 2012, October 7, 2013; December 3, January 27, 2014, and May 2, 2014). Bulk spill at Lower Monumental dam causes the system to hit total dissolved gas limits at a lower spill volume, thus decreasing the amount of water that can be spilled (for examples see RCC Water Quality Program 2009; FPC Memo December 9, 2011; Pickett and Harding, 2002). In addition bulk spill is more likely to introduce eddies in the tailrace, which are associated with egress delays that disorient migrating fish. Empirical information does not support the claim that smolts would have a higher likelihood of injury or mortality when passing spillways under uniform vs bulk spill operations (Axel et al. 2010; Hockersmith et al. 2010).

35. *The Graves declaration (paragraph 39) argues that NMFS does not represent dam passage metrics as system survival of salmon:* The 2014 FCRPS BiOp requires "*the Action Agencies to achieve an average dam passage survival rate (across the four lower Snake and four lower Columbia River dams)*" (section 3.3.3.2 page 358). This language establishes the idea that the average of individual dam survivals is somehow a system performance standard. This idea is echoed by NOAA's defender-partners who have been given to believe that the individual dam passage metrics are the same as system survival rates. The Inland Ports and Navigation Groups Memo (page 9) state that "*The average survival rate for summer migrating fish is now 93% and the spring migrating fish survive at a 96% rate*." This language does not say that the average per dam survival rate is 93% as one part of a lower system-wide survival, or that the per dam

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mortality rate compounds across up to eight dams. Further, the federal caucus' public website states that "surface passage routes such as spillway weirs are yielding survival rates of 95% or better" at every one of the eight federal dams on the lower Snake and Columbia Rivers, also implying that these are system-wide rates (http://www.salmonrecovery.gov/Hydro/Structuralimprovements/Surfacepassage.aspx March 16 2015). Also, the Tweit Declaration (paragraph 21) represents dam "performance standards" as representing system survival, although it recognizes the contribution of spill to increased juvenile survival. Thus it appears that NOAA's approach to reporting passage metrics is confusing, at a minimum. Oregon realizes that this confusion may be largely public perception. NOAA is aware of the difference between dam survival and system survival. In-river survival to Bonneville is only one part of the total hydrosystem mortality. Latent mortality caused by the hydrosystem occurs below Bonneville Dam (probably when juveniles enter the ocean), while adult mortality caused by the hydropower system occurs after adults return to Bonneville Dam and migrate upriver through the hydrosystem to their natal tributary. All three sources of hydropower mortality affect SARs and need to be taken into consideration.

36. *The Graves' declaration (paragraph 42) argues that Nigro's claim about biased performance standard testing results caused by a difference between actual and planned test conditions is unfounded.* Graves claims that flow during testing was not biased because flow levels were a matter of chance. However, low water years are the years of primary concern for fish survival. The tests performed to date did not explore how fish passage was affected under low flow conditions. Instead tests occurred during moderate to high flow years that included unplanned spill, yet the results are assumed to also apply to low flow years. The testing design could have instead incorporated regionally defined low–moderate–high flow years. Graves further implies that the ecological factors in the vicinity of the dams are the "primary" reason for survival differences among performance standard tests, particularly for test failures during low flow conditions (Graves paragraph 45 and 46, stating that the presence of avian predators

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explained failed tests). The primary point, however, is that those tests that were performed under lower flow year conditions failed.

37. *The Toole declaration (page 33, paragraph 58) states that "although all individual populations in the Snake River spring/summer Chinook ESU are considered to be at "high risk", the overall risk for the ESU is considered "moderate", apparently citing NOAA's recent 5-year status review*. This statement seems inconsistent to us and we cannot reconcile a status of "high risk" for all populations within an ESU with an overall "moderate risk" for the ESU. Our understanding of the 5-year status review (NMFS 2011a) is that the status of the Snake River spring/summer Chinook ESU has not changed since the previous status review. "*The overall viability ratings for all populations in the SR spring/summer Chinook salmon ESU remain at high risk after the addition of more recent year abundance and productivity data. Under the approach recommended by the ICTRT, the overall rating for an ESU depends on population-level ratings nested by MPG*." (NMFS 2011a, page 26). Some risk factors, for example, Spatial Structure and Diversity, are ranked as "moderate" for some MGPs in this ESU. However, due to low abundance and low productivity, NOAA concluded on page 27: "*Population-level status ratings remain at high risk across all MPGs in the ESU*."

38. *The Tehan declaration, starting with Section III, page 12, argues that, contrary to statements in the Nigro declaration, NOAA takes climate change into account when estimating habitat benefits:* However, the declaration proceeds through subsequent paragraphs to give examples of the uncertainty of effective habitat restoration actions under climate change. The examples range from unanticipated events that caused habitat actions to be reprioritized (paragraph 21) or that cause benefits of habitat actions to be downgraded (paragraph 23). The declaration agrees that the effects of climate change on freshwater productivity and on limiting factor functions cannot be quantified (paragraphs 26 and 30). Throughout these paragraphs, NOAA seems to be agreeing that the benefits of the habitat actions are highly uncertain, but that somehow or other everything will be sorted out.

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39. *The Tehan declaration argues that, contrary to statements in the Nigro declaration, habitat actions are reasonably certain to occur (Section IV, starting on page 19):* The Tehan declaration argues that their own "*more nuanced*" (paragraph 34) analysis disagrees with the Nigro Appendix B, but does not provide any details in support of their argument, merely stating that "*NMFS has a high degree of confidence*" in it (paragraph 37). The Tehan declaration then proceeds to argue that it is reasonable to expect actions will change and lists numerous reasons for delays, changes and uncertainties (paragraphs 38-39, with further examples in subsequent paragraphs; also see specific examples in paragraph 48), and that if the actions produce fewer benefits than anticipated, the Action Agencies will have to find replacement actions (paragraph 44). NOAA also leaves the identification of supplemental actions to the Action Agencies (see paragraph 54) and agrees, but finds it reasonable, that the benefits of habitat actions "*may take years, even decades, to be realized*" (paragraph 62). Later the Tehan declaration recognizes the difficulty of detecting significant habitat benefits (paragraph 77). Oregon does not debate any of these points, but we argue that they decrease the certainty that the benefits of habitat actions will actually occur and cast the final resolution of habitat actions and benefits into an uncertain future. This is an additional reason that Oregon emphasizes changes in dam operations that will provide more certain and more timely benefits for the species.

40. *The Tehan declaration (paragraphs 75-76) attempts to establish a connection between HQIs and the Action Agency "summary metrics" of habitat actions.* While the HQIs, as described by Tehan (paragraph 76), conceptually have something to do with biology, their derivation remains unexplained. The "HQIs" appear to be developed behind closed doors by the Action Agencies (see paragraph 12 in Tehan's declaration). Neither Tehan, nor the 2014 FCRPS BiOp explains the methodology by which the summary metrics that are reported by the Action Agencies (for example, acres of wetland protected) become the "HQIs".

41. *NOAA indicates that "the RPA contains numerous actions that are "improving the functioning of the juvenile migration corridor" and, more broadly, "substantially improving*

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the functioning of many PCEs" [Fed page 59; NOAA B47:3287; Toole Decl. ¶¶ 38-43 (Table 1); Graves Decl. ¶¶ 16-18. This overstates the direct actions that apply specifically to Hydro improvements. Many of the actions are plans or RM&E that have not been completed or implemented (see AA 2014 Hydro RPA15-33). Planned actions in a report or research that characterizes observations do not provide a direct benefit and should not be characterized as an action that improves function. Other actions described in the Hydro RPA's either have not worked or have been eliminated from further consideration. For example turbine operation optimization has been eliminated largely related to cost considerations.

42. *The Graves declaration (paragraph 16) expresses confidence that substantial improvements in the hydropower system have been made since the implementation of the 2008 FCRPS BiOp*. Many of the improvements to the hydropower system were implemented prior to the 2008 FCRPS BiOp. According to the 2008 FCRPS BiOp, actions taken approximately between 2000 and 2006 were expected to provide benefits in the base-to-current time frame of the jeopardy analysis, while actions taken after 2008 were expected to provide benefits in the current-to-prospective time frame. Among the benefits that were in place before the 2008 FCRPS BiOp:

a) Turbines, powerhouse bypasses, and traditional spill bays were part of the original design of each project, and have changed little since project completion.
b) Spill has been used to benefit juvenile fish passage since before the 2008 FCRPS BiOp. Additional measures contributing to a "voluntary" spill program have been in place since the early 2000's, and many of the projects maintain a spill plan largely unchanged since before the 2008 FCRPS BiOp.
c) Gas abatement measures have not changed since the early 1990s.
d) Configuration and Operational Plans (COP's) are RPA directives that have done little to improve function directly. Many of the COP's have been delayed or held up because of Dam Performance Standard testing or other operation and maintenance.
e) Transportation began as a management measure in 1975 (ISAB 1998-2), but following guidance from the ISAB, transportation with spill, regardless of flow level, was an action that began before the 2008 FCRPS BiOp.

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f) Management of fish predators began in the 1990's in both the Columbia and Snake rivers and more likely function as a maintenance action (keep predator populations in check—assuming no compensatory responses) not increasing improvements.

43. Attached as Appendix A is a true and correct copy of figures that I generated to further explain and demonstrate the relationship between smolt-to-adult returns and productivity in the tributary to reach a target population of adult recruits.

44. Attached as Appendix B is a true and correct copy of the literature cited in this declaration.

44. Attached as Exhibit 1 is a true and correct copy of the Independent Scientific Advisory Board, Density Dependence and its Implications for Fish Management and Restoration Programs in the Columbia River Basin, Feb. 25, 2015.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on April 6, 2015.

Kathryn Kostow

KATHRYN KOSTOW

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Appendix A

The following figures show the methods for calculating Ricker models, and for calculating SARs from the Ricker models.

Ricker models can be used to study the relationship between parents (Spawners) and their offspring (Recruits). In the 2008 FCRPS biop, one of the metrics used to measure the status of populations was Adult Recruits / Spawner (R/S). Adult offspring ("Recruits") are the number of offspring that are produced and survive to adulthood. Population growth (productivity) is measured as the number of adult offspring produced per parent (Spawner). Currently, populations are not replacing themselves (i.e., recruits-per-spawner is less than one indicating that the number of adult off spring (Recruits) is less than the number of their parents (Spawners)). In order to increase productivity, it is necessary to increase the number of adult offspring.

Production of adult offspring is a function of (1) the number of smolts produced in the tributary; and (2) the survival of the smolts to adulthood (SAR), which includes migration through the mainstem. Or. MSJ at 34. The following figures demonstrate how population productivity, measured as Smolt Recruits / Spawner, can be combined with a target number of adult offspring to calculate SARs needed to achieve the target (where SAR = adult offspring / Smolt Recruits).

These figures use unpublished ODFW data for spawners, smolts and SAR for the spring Chinook population in the Minam River, Snake River spring/summer Chinook ESU.

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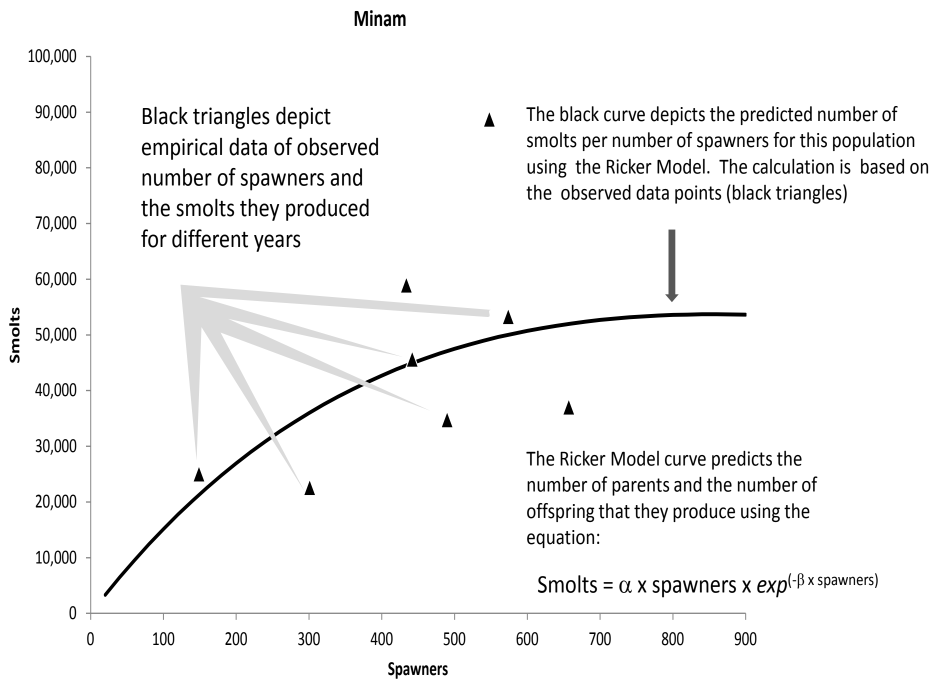

Figure J. The Ricker Model graph here shows the number of smolts per spawner (i.e., production in the tributary) for Minam River. The black triangles are observed data points from the brood years 1999 to 2006.

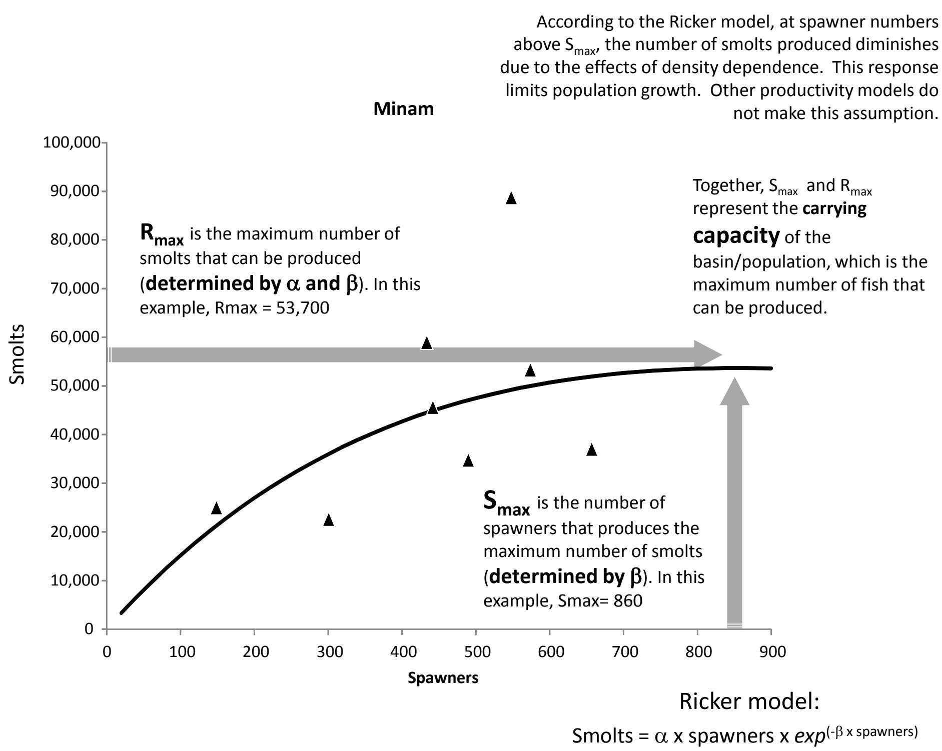

Figure K. The Ricker curve shows R_{max} (the maximum number of smolts that can be produced) and S_{max} (the number of spawners that produces the maximum number of smolts (R_{max})). S_{max} and R_{max} represent the carrying capacity of the basin or population. Carrying capacity is the population abundance that environment is capable of supporting given the availability of food, habitat, water, and other necessities.

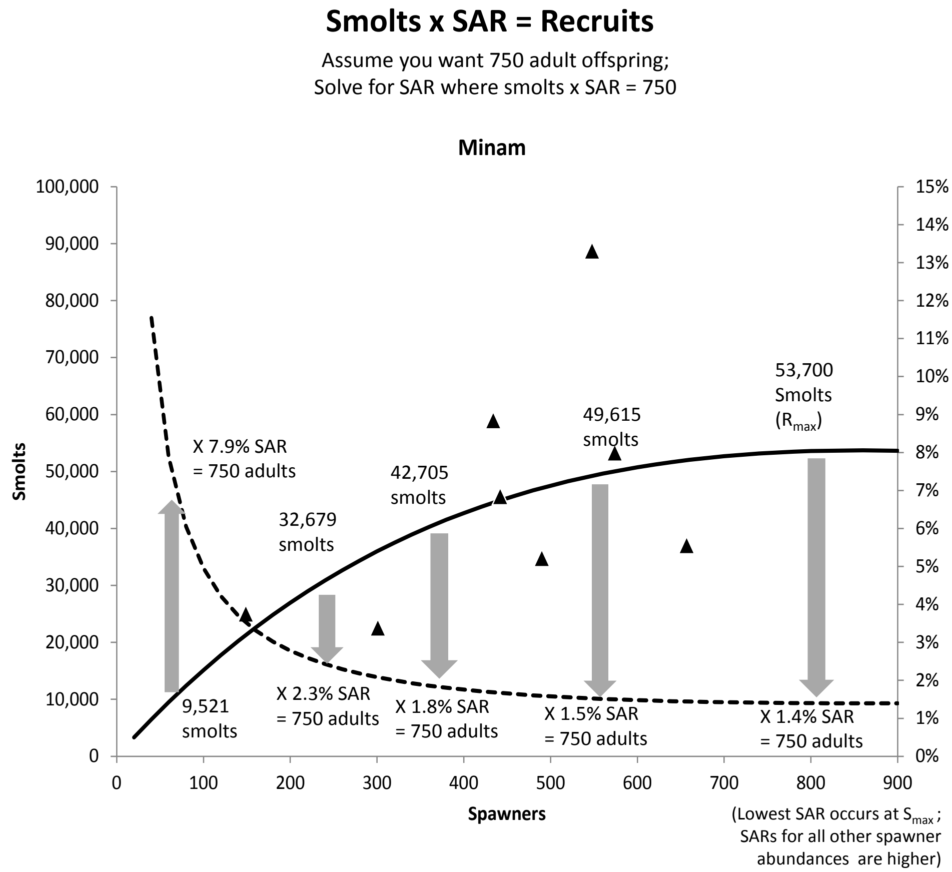

Figure L. Using the Ricker Curve Model (which depicts the number of smolts produced given a number of spawners, i.e., productivity in the tributaries), one can calculate the smolt-to-adult survival (SAR) needed to either replace the parent population or, if the population is currently too small, to increase the population. See Or. MSJ at 34. In this graph, The Ricker Model Curve (solid black line) shows the relationship between smolts (left y-axis) and spawners (x-axis). The dashed line shows the number of SARs needed to grow to target population of adult offspring. In this example, we use an example target population of 750, the ICTRT minimum abundance threshold for this population; however any target abundance could be used. The lowest SAR of 1.4% corresponds with the R_{max} (maximum number of smolts) of 53,700. Where the number of smolts is lower, the corresponding SAR must be higher in order to reach the target population of 750 adult offspring.

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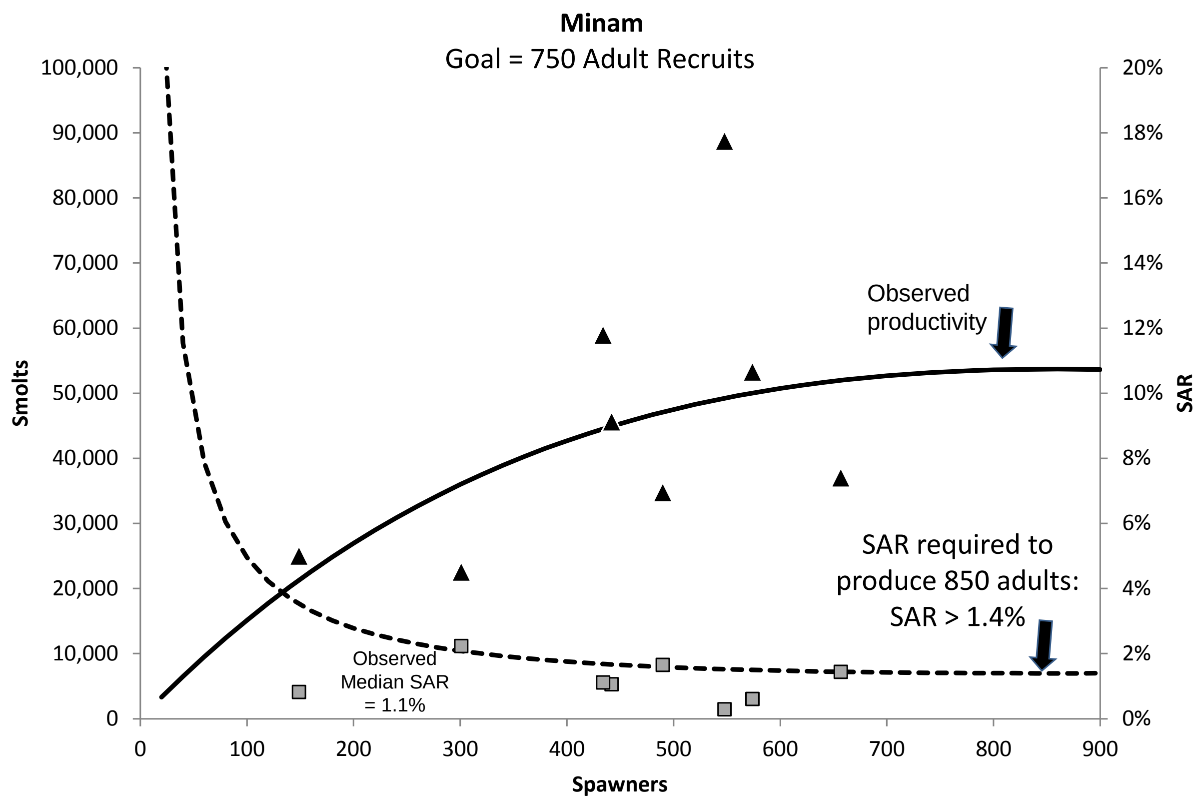

Figure M. The squares are the observed SARs for the brood years 1999 to 2006. The SARs are all below the line needed to achieve a target adult population of 750.

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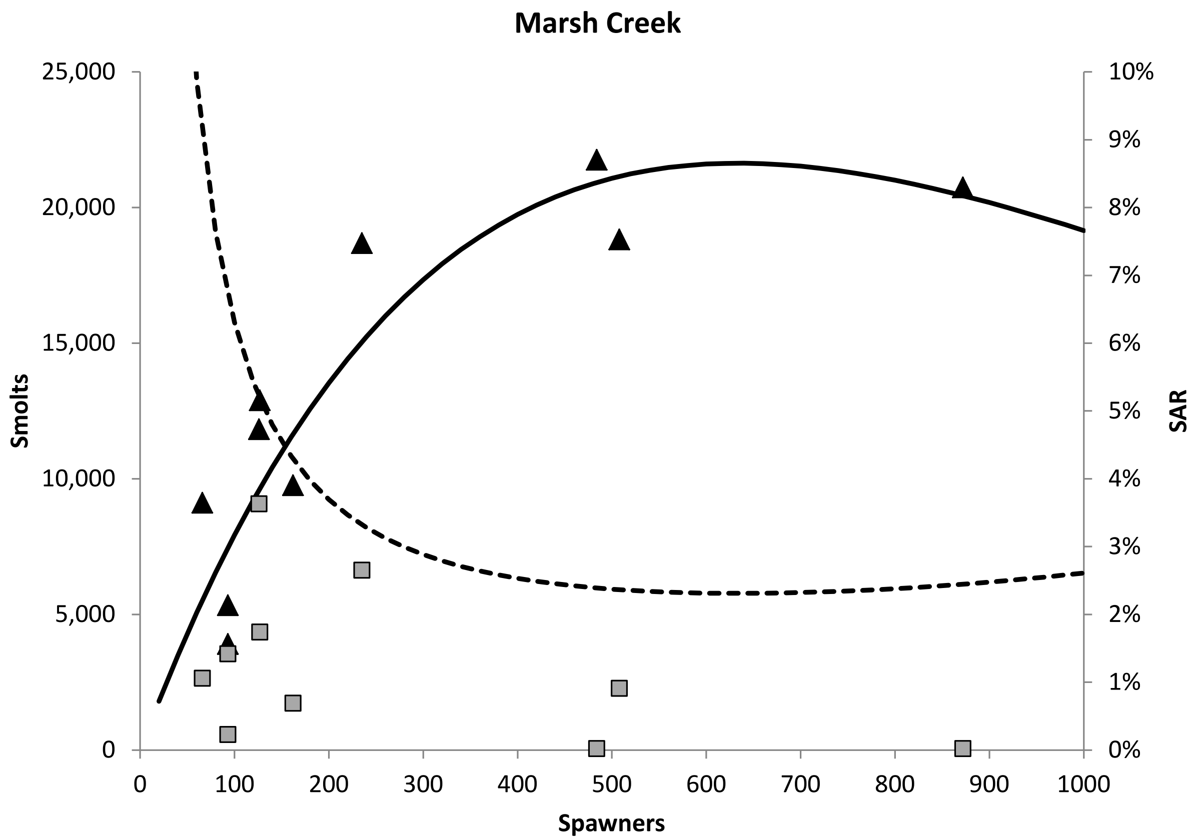

Figure N. SAR calculations (dashed line) for Marsh Creek, a Snake River spring Chinook population, using a Ricker model (black line). Solving for the goal of 500 adult recruits. Reproduced from Nigro Declaration Figure 9.

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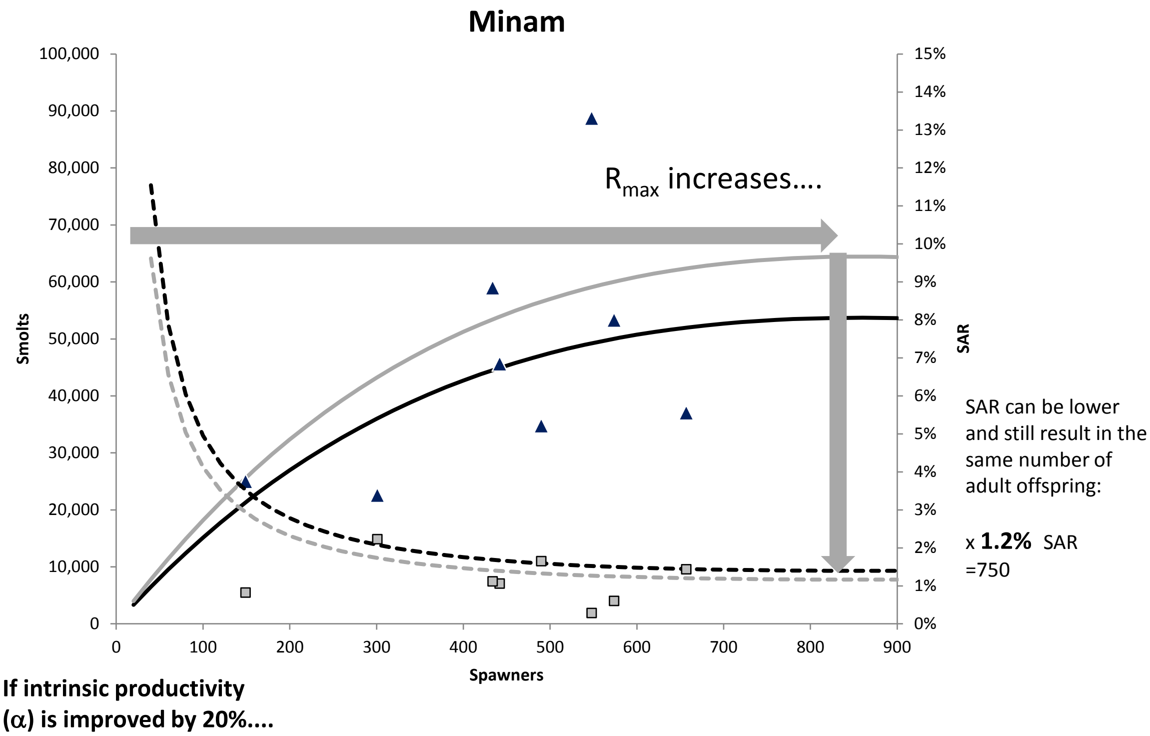

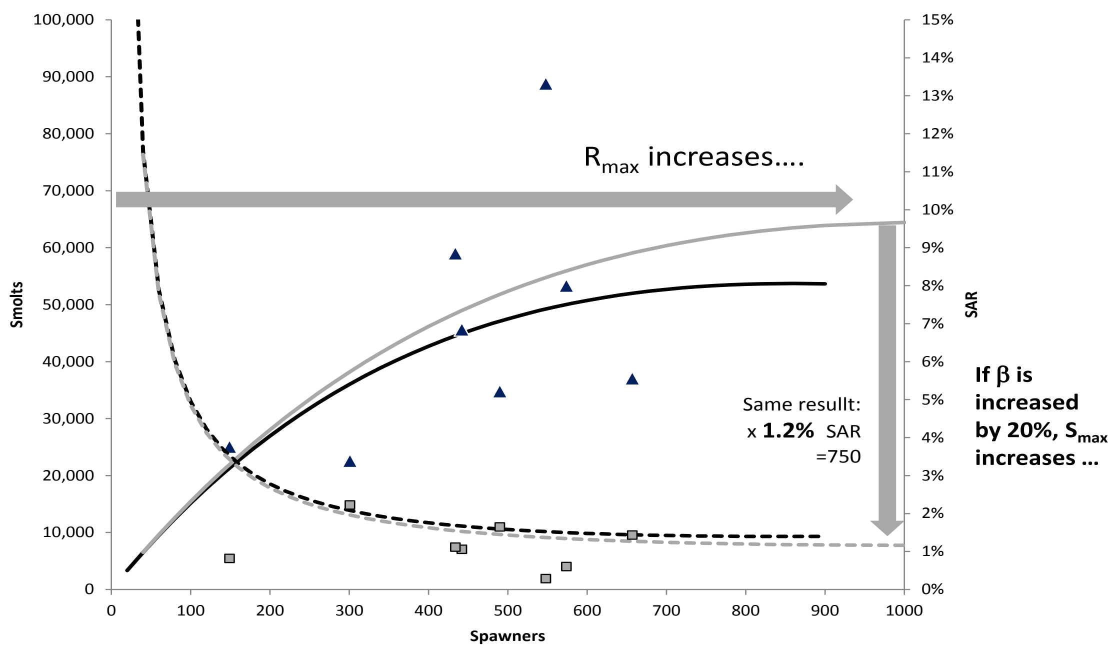

Figure O. The number of adult returns cannot be increased by simply increasing the R_{max} without also increasing SAR. These charts show that even if the R_{max} is increased by 20%, by increasing either α or β in the Ricker model, the corresponding SAR that is required decreases only from 1.4% to 1.2%, in order to reach a target population of 750.

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Appendix B

References - April 6, 2015

Coding: {Administrative Record Numbers are enclosed in brackets like these.},{Nigro decl.}refers to references in a declaration, and {} means we have not found an Administrative Record Number.

Action Agencies (AA). 2013. Endangered Species Act Federal Columbia River Power System: 2013 Comprehensive Evaluation Section 1. {NOAA B47:NMFS003253}

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