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UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

NATIONAL WILDLIFE FEDERATION, *et al*.

Plaintiffs,

v.

NATIONAL MARINE FISHERIES
SERVICE, *et al.*
Defendants.

Civil No. 01-640-RE

2008 DECLARATION OF
CHRISTOPHER L. TOOLE, Ph.D.

I, Christopher L. Toole, declare and state as follows:

1. I am a fisheries biologist with the National Marine Fisheries Service (NMFS), in Portland, Oregon. I have worked for NMFS on the impacts of hydropower operations and other human activities on salmon and steelhead, since 1991. I currently work for the Northwest Regional Administrator on special assignments, including serving as the Northwest Region's Endangered Species Act (ESA) Section 7 Coordinator.

2. I have a Ph.D. in fisheries science from Oregon State University, awarded in 1994. I obtained a B.A. in biology from the University of California, Santa Barbara, in 1973, a B.S. in Fisheries Biology from Humboldt State University in 1975, and a masters degree in biology from Humboldt State University in 1978. My masters and doctoral research and peer-reviewed publications concern marine fisheries.

3. Prior to working for NMFS my professional experience, which began in 1973, included biological monitoring and research regarding effects of hydroelectric, fossil fuel, and nuclear power facilities on fish for an environmental consulting firm and for a private utility. I was also employed by the Oregon Fish Commission's Columbia River Investigations group as a seasonal aide and by the University of California Cooperative Extension (Sea Grant) as an advisor to the commercial fisheries and aquaculture industries and to local salmon and steelhead enhancement groups in northern California.

4. For NMFS, I have participated in each ESA consultation concerning the Federal Columbia River Power System (FCRPS) since Snake River sockeye salmon were listed for protection in 1991. There have been nine biological opinions issued by NMFS concerning comprehensive operations of the FCRPS, the most recent issued on May 5, 2008 (2008 Biological Opinion on Operation of the Federal Columbia River Power System, including the 11

Bureau of Reclamation Projects in the Columbia Basin [NOAA AR A.1]; hereafter 'BiOp'). During the most recent consultation, my principal assignment was to collect information, obtain analysis and scientific opinion from all relevant sources, and provide contributions for the drafting of the final biological opinion.

5. During the 2-1/2 years prior to completing the BiOp I participated in the remand collaboration, serving with Edward Bowles as co-chair of the Framework Work Group, which among other things produced a report on human-related mortality factors affecting salmon and steelhead[1] and identified and organized competing hypotheses regarding latent mortality for review by the Independent Scientific Advisory Board (ISAB)[2].

6. Previously, in this litigation, I provided declarations dated April 15, 2004, and June 16, 2005, concerning issues relevant to summary judgment and preliminary injunction motions. In preparation for this 2008 declaration, I have reviewed the declarations filed on behalf of the plaintiffs' motions for summary judgment by Edward Bowles, Steven Orzack, Jack Williams, Frederick Olney, and Patty Glick. I was assisted in preparation of this declaration by several NMFS scientists, by BPA staff, and by Dr. Richard Hinrichsen, who has also submitted a declaration on related issues.

7. The purpose of this declaration is to address technical issues raised by Mr. Bowles, Dr. Orzack, Mr. Olney, and Ms. Glick and the treatment of these issues in the BiOp. My declaration covers the following topics:

1. <u>NMFS Considered Abundance in Its Jeopardy Analysis</u>

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[1] NOAA AR B.0143 Interim Report: Relative magnitude of human-related mortality factors affecting listed salmon and steelhead in the interior Columbia River basin. May 4, 2006.

[2] *See* NOAA AR B.210 ISAB (Independent Scientific Advisory Board). 2007. Latent mortality report: review of hypotheses and causative factors contributing to latent mortality and their likely relevance to the "Below Bonneville" component of the COMPASS model. ISAB, Report 2007-1, Portland, Oregon, 4/6/2007.

2. The Best Available Scientific Information Does Not Indicate That There Is a Specific Time Period, Beyond Which Recovery of Columbia Basin Salmon and Steelhead Is Precluded

3. “Time to Recovery” Need Not Be Specified To Conduct NMFS’ Recovery Prong Analysis

4. In Its Recovery Prong Analysis, NMFS Consistently Used Data Sets Identical To Those Used By the Interior Columbia River Technical Recovery Team (“ICTRT”)

5. NMFS Considered Uncertainty in Its Jeopardy Analysis

6. Discounting Zeroes in the BRT Trend Analysis Had a Trivial Effect on Results

7. NMFS Appropriately Considered Climate Variability and Climate Change in Its Jeopardy Analysis

8. NMFS Considered the Relative Importance of Populations in Its Jeopardy Analysis

9. Analysis of Snake River Steelhead

10. Snake River Steelhead Return-per-Spawner (R/S) Estimates Provided Similar Information As That Which Would Result from Lambda With Hatchery-Origin Spawner Effectiveness Equal To 1.0

11. NMFS Considered All Indicators of Trend in Its Conclusions for Snake River Spring/Summer Chinook Salmon

12. NMFS Relied Primarily on a Quasi-Extinction Threshold (“QET”) of 50 Fish, But Also Considered Lower Levels Relevant To Short-Term Risk of Small Populations That Have Rebounded From Levels Below 50 Fish in the Past

13. NMFS Did Not Rely on an Assumption That Survival Improvements From Habitat Actions Would Occur Immediately

14. NMFS Used the ICTRT Aggregate Analyses for Snake River Steelhead, Rather Than Relied on Population-Specific Information for Only Three Populations, and Explained the Limitations of the Aggregate Approach

NMFS Considered Abundance In Its Jeopardy Analysis

8. Mr. Bowles states in paragraphs 15, 18, and 21 that NMFS did not consider abundance as a metric or standard in its status assessment, adopt abundance standards and metrics, or explain why it did not do so[3]. This is incorrect. NMFS considered abundance at each step of the jeopardy analysis.

9. Mr. Bowles, throughout his declaration, appears to be addressing his comments to the analysis of interior Columbia River species, since the comments refer to ICTRT products and all examples are from the interior Columbia basin. Therefore, my responses will also focus on interior Columbia River species.

10. NMFS' jeopardy analysis encompassed five steps, which are described on pages 1-10 through 1-14 of the BiOp. The first step is to define the biological requirements and current range-wide status of each listed species and designated critical habitat affected. Contrary to Mr. Bowles' assertion, NMFS explicitly described the status of each population of each listed species in terms of its recent abundance and compared the current abundance with the ICTRT's minimum abundance thresholds, which are described along with other ICTRT criteria as being the primary source for determining de-listing or long-term recovery goals. *See*, BiOp at 8.3-5 and 8.3-47 (the description of the abundance of Snake River spring/summer Chinook salmon and comparison to ICTRT minimum abundance thresholds on pages). As Mr. Bowles acknowledges,

NMFS also compared recent abundance to quasi-extinction abundance levels (e.g., BiOp pages 8.3-29, 8.3-32, 8.3-33, 8.3-36, and 8.3-38 for Snake River spring/summer Chinook) and conducted an analysis that explicitly calculated the base period probability of falling below quasi-extinction abundance levels in 24 years for those populations with adequate data (e.g., BiOp pages 8.3-7, 8.3-8, and 8.3-49). *See also* the Declaration of Richard Hinrichsen regarding the extinction risk analysis.

11. The second step in the jeopardy analysis is to consider the environmental baseline. NMFS also considered abundance at this step, concluding that abundance in the action area (which defines the geographic extent of the environmental baseline) was identical to range-wide abundance because the action area was so broad. *See* BiOp at page 8.3-10 (for Snake River spring/summer Chinook salmon).

12. The third step is to determine the effects of the prospective action on listed species and critical habitat. For the recovery prong of the jeopardy analysis, NMFS calculated expected changes in productivity and trends in abundance at this step by evaluating proportional changes in mean survival, as described on BiOp pages 7-7 through 7-12. This method "is consistent with the methods used during discussions in the *NWF v. NMFS* remand collaboration process resulting from Judge Redden's Order of October 7, 2005. It is also consistent with the approach used to evaluate recovery actions in the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead" (BiOp page 7-11).

13. This proportional survival change method, however, does not predict expected abundance at specific times in the future. As explained on BiOp pages 7-27 and 7-28, such an approach would require a more complex model encompassing density dependence, such as the

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[3] Dr. Orzack makes similar assertions in his paragraphs 6 and 7.

matrix simulation model of ICTRT and Zabel (2007, AR B.197). That matrix model was used by the ICTRT "to analyze the expected changes in productivity and abundance over time for a few populations with sufficient data, following incremental changes in FCRPS hydro survival." (BiOp pages 7-27 and 7-28). NMFS did not use the matrix model for the main BiOp analysis because the model requires information that is only available for six populations out of the dozens addressed by the BiOp and because available model runs analyzed only one management action, while the RPA included several types of management actions.

14. While it was not possible to use the matrix model to predict future abundance for the suite of listed species and populations, NMFS did present three examples of the predictions of this model for future productivity (R/S) and abundance following changes in hydro survival (BiOp pages 7-27 through 7-29). The purpose was to show the expected pattern of abundance in the future as a result of changes in survival, rather than to attempt to predict the exact number of spawners at some point in the future. The example matrix model results showed that abundance is expected to increase with increasing productivity, which will in turn lead to greater density-dependent effects, and ultimately to a future reduction in productivity and a leveling of abundance.

15. Although NMFS did not attempt to explicitly model and predict future abundance for the reasons described above, NMFS did refer to the ICTRT and Zabel matrix model analysis to conclude that increased survival as a result of prospective actions would lead to increased abundance. For example, in reference to expected survival and productivity changes for Snake River spring/summer Chinook salmon, the BiOp states "all of the populations are likely to increase in abundance" for the Grande Ronde/Imnaha MPG (p. 8.3-30), "the abundance of spawners will increase" for the South Fork Salmon MPG (p. 8.3-32), and "population abundance

is expected to increase" for the Middle Fork Salmon MPG (p. 8.3-36). Thus, contrary to Mr. Bowles' assertions, NMFS did consider effects of the prospective actions on abundance.

16. The fourth step of the jeopardy analysis is to determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed action, environmental baseline, and cumulative effects. Again, contrary to Mr. Bowles' assertions, NMFS did consider abundance in reaching its conclusions. For example, in BiOp Section 8.3.7.1 titled "Potential for Recovery" and subtitled "It is likely that the Snake River spring/summer Chinook salmon ESU will trend toward recovery," NMFS sums up the factors it considered in reaching its conclusions, which include:

> The status of the species has been improving in recent years, compared to the base condition, ***and abundance is expected to increase in the future as a result of additional improvements***. (p. 8.3-42, emphasis added)
>
> However, *t**he majority of populations are likely to increase in abundance*** and enough populations are likely to be increasing to conclude that the ESU as a whole will be trending toward recovery. (p. 8.3-42, emphasis added)
>
> As discussed in Chapter 7, ***increased productivity will result in higher abundance***, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. (p. 8.3-42, emphasis added)

Section 8.3.7.1 (p. 8.3-40) also cites a strong monitoring program as part of the rationale for the conclusion that the Snake River spring/summer Chinook ESU will be trending toward recovery. Abundance monitoring is addressed in BiOp Chapter 7:

> NOAA Fisheries received comments on the 2007 Draft Biological Opinion suggesting adoption of an explicit abundance metric and abundance "performance standards." Discussions with some of the commenters clarified that they are primarily interested in tracking abundance during implementation of the Prospective Actions and comparing it to benchmarks such as the ICTRT's abundance viability thresholds, rather than recommending a prospective analysis of the probability of reaching a particular abundance level under the Prospective Actions. Reporting requirements during implementation of the Prospective Actions are described in Section 2 (Proposed Action) and/or Section 4 (RPA) of the biological opinions associated with each of the Prospective

> Actions, and it is anticipated that population status, including abundance, will be reported. (BiOp page 7-27)

The Best Available Scientific Information Does Not Indicate That There Is a Specific Time Period, Beyond Which Recovery of Columbia Basin Salmon and Steelhead Is Precluded.

17. In Paragraph 28, Mr. Bowles states that if a "population bottleneck" is maintained for a "prolonged period" the likelihood that the population will be able to recover is "jeopardized" by the loss of genetic variation caused by reduced population size. Mr. Bowles therefore suggests that NMFS' recovery prong is invalid because it did not take a time period to recovery into consideration.

18. Mr. Bowles' opinion on whether an action "jeopardizes" certain ESUs is a legal conclusion and as such I cannot comment on it. However, it is a well-known scientific principal that genetic risk is related to population size (e.g., McElhany et al. 2000 NOAA AR B.260, pages 58-61) and that uncertainty, hence risk in general, increases over time (e.g., discussion in the BiOp on page 7-18). The technical issue raised by Mr. Bowles is whether there is some particular abundance level associated with a genetic variation "bottleneck" and some particular time period, beyond which recovery is precluded, that NMFS should have evaluated in the BiOp.

19. Mr. Bowles implies in paragraph 29, that the ICTRT's minimum abundance thresholds, which range from 500-3000 fish, depending upon the population, define the abundance below which a genetic bottleneck occurs. This limited interpretation of the rationale for the minimum abundance thresholds is incorrect. The ICTRT clearly states that the abundance thresholds incorporate considerations beyond genetics. For example, the abundance thresholds "address genetic and spatial structure components of our general abundance and productivity objectives" (ICTRT 2007a, NOAA AR B.194, p. 24). The ICTRT's minimum abundance

thresholds also incorporate demographic risk considerations, which is one of the reasons the abundance thresholds vary among large and small populations. “Minimum abundance thresholds applied to the viability curves were based on demographic and genetic rationale provided by McElhany et al. (2000) and reflect estimates of the relative amount of historical spawning and rearing habitat associated with each population” (ICTRT 2007a, NOAA AR B.194 p. 29). As discussed in the BiOp in several places (e.g., Footnote 1 of page 8.3-5), NMFS considers the ICTRT’s minimum abundance thresholds and other viability criteria to be “primary sources of information for the development of delisting or long-term recovery goals” but not the basis for setting goals for “no jeopardy” determinations. Thus, Mr. Bowles’ assertion that the abundance thresholds inform a population bottleneck issue is wrong for two reasons: (1) the ICTRT abundance thresholds are not limited to the issue of genetic diversity and therefore are much broader in scope; and (2) the abundance thresholds inform the decision to delist the species (a much more stringent standard), not whether there is an adequate potential for recovery.

20. Moreover, the question of a time period beyond which recovery is precluded is difficult to evaluate. McElhany et al. (2000, NOAA AR B.260) include the following discussion in the viable salmonid populations paper:

> Although these and other papers certainly suggest that there is a relationship between genetic diversity and population fitness across a wide variety of organisms, there are notable exceptions where a lack of genetic diversity has not stopped a population from persisting or growing, at least in the short term. In the case of the elephant seal cited, for example, the species recovered from about 100 individuals in the late 1800’s to about 125,000 in 1989 (discussed in Caughley and Gunn 1996), despite its near lack of measurable genetic diversity. E. H. Bryant and co-authors have published a series of papers on the quantitative genetic effects of repeated bottlenecks in populations of houseflies and found that additive genetic variation in traits they measured generally was not reduced even by very severe bottlenecks (e.g., Bryant and Meffert 1990).

I do not cite this discussion to argue that genetic bottlenecks do not exist; it is cited only to show that it is difficult to generalize regarding what constitutes such a bottleneck and whether this would impair the ultimate ability of a population or species to recover.

21. Perhaps in part due to these difficulties, there is no analysis or recommendations in the ICTRT viability paper (ICTRT 2007a, AR B.194) regarding a maximum time period, beyond which reduced genetic diversity or any other factor would preclude recovery. Nor can I find such an analysis or recommendations in the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead (AR B.503) or in other draft or final recovery plans for Columbia basin salmon and steelhead[4]. In short, while it is of course important to achieve recovery as quickly as possible, the best scientific information available to NMFS did not indicate that there is a specific time period beyond which recovery of Columbia basin salmon and steelhead will be precluded because of loss of genetic variation or other factors.

“Time to Recovery” Need Not Be Specified To Conduct NMFS’ Recovery Prong Analysis

22. Dr. Orzack (par. 21-23) asserts, without explanation, that “from a scientific perspective...one must have some estimate of when the condition (recovery in the wild) is to be achieved” in order to determine whether the action will reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild. Mr. Bowles makes related assertions, stating for example in Paragraph 18 that NMFS must explain how its metrics are related to the likelihood of meeting a minimum abundance standard in a “foreseeable time frame.”

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[4] Recovery plans do include an implementation planning time period, but these planning periods are based on practical considerations for implementing recovery actions and the time period for expecting biological benefits from those actions, rather than on an analysis of a maximum time period, beyond which recovery would be precluded for biological reasons.

23. Clearly, it is important for a species to recover as quickly as possible. Likewise, a time period is critical to an analysis of extinction risk, such as that included in the BiOp's survival prong analysis. However, the issue raised by Dr. Orzack and Mr. Bowles concerns recovery and the recovery prong of the jeopardy standard. The technical issue raised by the declarants is whether there is a mathematical or other scientific reason why a time period must be defined in order to evaluate the recovery prong of the jeopardy standard.

24. Just from a logical standpoint, one can determine *whether* a condition can be attained independently from calculating *when* that condition will be attained. The quantitative approach to NMFS' recovery prong analysis asks whether the actions in the BiOp, coupled with other actions in the environmental baseline and cumulative effects, are likely to lead to a rate of population change (e.g., lambda) that is greater than 1.0. The only temporal question related to this analysis is whether the species will go extinct before recovering, which is the subject of the survival prong of the BiOp's jeopardy analysis, or whether there is a maximum time period, beyond which recovery is precluded (*see* paragraphs 17-21 above, pointing out that the best available information does not support a particular time period).

25. Recovery planners have recognized that the likelihood of meeting recovery goals can be assessed without analyzing whether that will occur within a specific time period. For example, the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead, Appendix I (AR B.503, S.69), includes an analysis that compares the survival changes expected from actions proposed in the recovery plan to the survival changes identified by the ICTRT (2007c AR B.196) that, if achieved, would result in a 95% chance of meeting the ICTRT's abundance threshold and productivity viability criteria. These ICTRT criteria were adopted as delisting criteria in the Final Recovery Plan for Upper Columbia River Spring

Chinook Salmon and Steelhead. Time to recovery was not specified or necessary in order to conduct the Appendix I analysis and evaluate whether the suite of recovery plan actions would be likely to meet abundance and productivity delisting criteria. NMFS' recovery prong analysis uses the same proportional survival change methodology as the Upper Columbia River Recovery Plan's Appendix I (BiOp at page 7-11), and similarly does not require a time to recovery to evaluate whether there is an adequate potential for recovery.

In Its Recovery Prong Analysis, NMFS Consistently Used Data Sets Identical to Those Used By the Interior Columbia River Technical Recovery Team

26. Mr. Bowles, in paragraphs 35-50 and in paragraph 66, indicates that NMFS did not consistently choose base period years for calculating metrics indicative of the recovery prong of the jeopardy standard. He implies that NMFS selectively chose the years in each analysis to obtain a desired result; and he presents new analyses using alternative base period years, which yield a range of alternative results. Dr. Orzack in paragraph 17 states that NMFS' choice of base period years does not appear to be random and that if NMFS excluded specific years from the base period calculation, the BiOp needed to explain the rationale.

27. NMFS explained the choice of years used to calculate the base period metrics and explained the rationale for those choices in Chapter 7 (see details below). Briefly, NMFS went to great lengths to ensure that all metrics were calculated using data sets identical to those in use by the ICTRT. This included completely re-calculating all metrics between the draft and final BiOps after the ICTRT released updated data sets (NOAA AR B.78 and B.79). Further, the ICTRT had calculated average returns-per-spawner (R/S) and lambda in available drafts of their Current Status Summaries (AR B.193 and Attachment 3 of ICTRT 2007a, AR B.194) and NMFS ensured that the calculations in the BiOp were identical to those of the ICTRT, including the

choice of base period years. The ICTRT's draft Current Status Summaries did not, at the time, include the BRT trend metric, so the BRT trend base period years were chosen to match those of the Current Status Summary lambda calculations[5]. Mr. Bowles' inability to replicate some of the results is inexplicable since the data sets and model output are included in the administrative record.

28. The lambda calculations and BRT trend calculations primarily used the period from 1980 until the most recent year available in the ICTRT data set for base period calculations[6]. For R/S calculations, NMFS and the ICTRT used a time period that was close to 1980-present, but this varied among populations in order to include the 20 most recent brood years in the calculation. Choice of 1980 as a starting year is explained in NMFS' BiOp (p. 7-11):

> Apart from the precedent of the ICTRT's use of this time period, it also corresponds approximately with that considered in the 2000 FCRPS Biological Opinion. NOAA Fisheries considers this time period a reasonable representation of a long enough time period to encompass variability in climate and biological performance. Additionally, the 1980 through 1999 brood years is considered a sufficiently recent time period to include many of the major changes in management actions that have occurred in recent decades. (BiOp at page 7-11)

This time period was also the period considered in the ICTRT's survival gap analysis (ICTRT 2007c, NOAA AR B.196) and, as a result of its use in the ICTRT's gap analysis, it was the basis of the analysis of aggregate effects of recovery actions in the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead, Appendix I, (NOAA AR B.503, S.69).

29. To explain this further, details of the calculations and data sets used to derive each recovery prong metric are discussed below:

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[5] "To be consistent with the other two productivity metrics and to attempt to be as consistent as possible with recent management actions, the BRT's longer time period was set to 1980 as the earliest year." BiOp at page 7-26.

[6] NMFS also evaluated a shorter time period of 1990-present, results of which were

30. The average R/S metric was calculated using the 20 most recent brood years (or the most available, if less than 20) for each population. This approach matched identically the approach used to calculate average R/S in the draft ICTRT Current Status Summaries (ICTRT 2007d, NOAA AR B.193) and also matched the time periods and data used by the ICTRT to calculate intrinsic productivity and survival gaps (ICTRT 2007a, NOAA AR B.194; ICTRT 2007c, NOAA AR B.196). For the draft SCA and BiOp, the average R/S estimates presented by NMFS were provided directly by the ICTRT co-chair (Cooney and Matheson 2006, AR B.083). Because the ICTRT updated its data set between the draft and final BiOp, without completing a corresponding update of its Current Status Summaries, NMFS re-calculated average R/S using the same method and the updated data. The exact calculations for average R/S presented in the BiOp, showing the specific years included in each mean, are in Toole (2008, AR C.1096). Note that the ICTRT did not include years with very low spawner numbers (less than 5 spawners) in their R/S calculations because inclusion of these low values tends to bias R/S averages upward (ICTRT 2007a, AR B.194). NMFS also adopted this conservative approach -- removing these years from the average R/S estimates, and thereby lowering the average R/S estimates for some populations.

31. The methods used to generate lambda and BRT trend metrics are described in the BiOp on pages 7-24 through 7-26. Estimates of lambda and BRT trend used in the BiOp were generated using NOAA Fisheries' Salmon Population Analyzer (SPAZ) statistical model (McElhany and Payne 2006; NOAA AR B.258). This is the same statistical model used by NMFS' BRT (Good et al. 2005, NOAA AR B.155) and by the ICTRT for lambda estimates in the draft Current Status reports (ICTRT 2007d, NOAA AR B.193). The input files were text

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presented in the SCA Aggregate Analysis Appendix.

files in the format used by the statistical model, and the data were taken directly from the ICTRT data sets used in all BiOp analyses (Cooney 2007, 2008a; NOAA AR B.078 and B.079). The model output was included as Cooney (2008b,c,d; NOAA AR B.081, B.080, and B.082). Included in the model output is a model-generated listing of the years used in the analyses. Contrary to Mr. Bowles' assertion, all begin with 1980[7], indicating that there was no inconsistency in the starting years for this analysis. The ending years differed among populations because the most recent year available was not the same for every population.

32. Mr. Bowles produced alternative estimates for all of the recovery metrics in Tables 5-7. These estimates are based on various "what-if" analyses that explore the effect of choosing alternative time periods. NMFS explained its choice of time periods as those, for example, used by the ICTRT and incorporated into the Final Recovery Plan for Upper Columbia River Spring Chinook Salmon and Steelhead (*see* paragraph 29 above) but Mr. Bowles does not present similar rationale for his alternative time periods.

NOAA Calculated (Whenever Possible), Displayed, and Considered Uncertainty In Its Jeopardy Analysis

33. Mr. Bowles states in paragraph 51 that NMFS "apparently did not use confidence intervals when they considered the affects of various actions in the prospective stage of the analysis." He makes this point again in paragraphs 63, 198, and 204. His assertion is not correct.

34. NMFS calculated prospective 95% confidence limits for all three recovery prong metrics. The methods NMFS used to calculate these confidence limits are described on pages 7-23 and 7-24 for R/S, page 7-25 for lambda, and page 7-26 for the BRT trend. NMFS displayed

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[7] Estimates also began with 1990, as described in Footnote 6, above.

these confidence intervals graphically in the BiOp (e.g., Figure 8.3.6-1 on page 8.3-60 for Snake River spring/summer Chinook) and in tabular form in the SCA Aggregate Analysis Appendix (e.g., pages 6, 7, 11, 12, 16, and 17 for Snake River spring/summer Chinook salmon), for those populations for which adequate data were available.

35. NMFS considered and referred to these confidence limits in the effects analysis and conclusions. For Snake River spring/summer Chinook salmon, for example, NMFS stated in the BiOp:

> NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.3.6-1 and 8.3.6-2 and in Figures 8.3.6-1 through 8.3.6-4. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix [Aggregate Analysis Appendix] includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. (pages 8.3-27)
>
> The broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) suggests that other qualitative information should also be considered. (referring to Lower Snake River MPG on page 8.3-28)
>
> There is considerable uncertainty regarding the reliability of quantitative productivity estimates because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix). (referring to Grande Ronde/Imnaha MPG on page 8.3-30)
>
> There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) for two of the three populations. (referring to South Fork Salmon MPG on page 8.3-32)
>
> There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1 for most of the R/S estimates; Aggregate Analysis Appendix). (referring to Middle Fork Salmon MPG on page 8.3-34)

> For most of the populations with sufficient information for productivity estimates, there is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1, while lower 95% confidence intervals indicate productivity <1; Aggregate Analysis Appendix). (referring to Upper Salmon MPG on page 8.3-36)
>
> The mean results represent the most likely future condition, but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S, lambda, and the BRT trend are expected to be greater than 1.0 at the upper 95% confidence limits for all populations. R/S is expected to be less than 1.0 for most populations at the lower 95% confidence limits (SCA Aggregate Analysis Appendix; Figure 8.3.6-1). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions. (Page 8.3-42 in Section 8.3.7.1, which describes rationale for the conclusion that the Snake River spring/summer Chinook salmon ESU will trend toward recovery)

36. Additionally, NMFS calculated the probability that the prospective median population growth rate (lambda) would be greater than 1.0 and displayed these probabilities in the SCA Aggregate Analysis Appendix (e.g., page 42 for Snake River spring/summer Chinook salmon). NMFS explained that “this [probability of lambda greater than 1.0] metric was calculated only for lambda estimates, but because of the wide range of hatchery assumptions, the results are similar to those expected from both the R/S and BRT trend estimates.”

37. Mr. Bowles states in paragraph 54 that “we do not know from the information presented in the Biological Opinion what confidence interval for the Bear Valley R/S has a lower bound than 1.0, we do know that the 95% confidence bound for this metric fell below 1.0 so a wider confidence interval would be needed and we are less certain that the standard was met.” Apparently Mr. Bowles only looked at base period R/S estimates for this population. If he had looked at Figure 8.3.6-1 on BiOp pages 8.3-60 or Table 2 on page 6 of the Aggregate Analysis Appendix, he would have found that NMFS estimated the prospective 95% confidence limits for the Bear Valley population as 1.14-3.08, indicating that there is at least a 95% likelihood that the expected value will be greater than 1.0.

38. In paragraph 56, Mr. Bowles claims that the point estimates in the Aggregate Analysis Appendix do not match the point estimates in the BiOp, citing the Tucannon River population of Snake River spring/summer Chinook salmon as an example. Mr. Bowles is mistaken - the estimates do match. Mr. Bowles' example is based on comparing Table 8.3.6.1-1 in the BiOp, which describes prospective productivity estimates, with Table 1 in the Aggregate Analysis Appendix, which is clearly labeled as a table of prospective survival gaps. If Mr. Bowles had looked at Table 2 in the Aggregate Analysis Appendix, which is clearly labeled as a table of prospective productivity estimates, he would have seen that the estimate for the Tucannon population is 1.22 in each. The 0.82 estimate that he refers to in Table 1 of the Aggregate Analysis Appendix is 1.0÷1.22, which is the calculation of the survival gap, not a productivity estimate.

39. In paragraph 59, Mr. Bowles states that he was unable to replicate NMFS' estimates of R/S confidence intervals. NMFS used the same method of calculating 95% confidence intervals as that used by the ICTRT:

> Uncertainty associated with average R/S is calculated using the method of the ICTRT, which assumes a geometric distribution of R/S and calculates standard error and the t-statistic based on this distribution (Cooney and Matheson 2006). Cooney and Matheson (2006) also provide a formula for estimating 95% confidence intervals about the geometric mean from those statistics, which is applied in the SCA. A second method included in the Aggregate Analysis Appendix is bootstrap estimation techniques to calculate 95% confidence intervals (Hinrichsen 2008). This method generally results in wider confidence intervals than the ICTRT method, in part because it incorporates serial correlation in the estimates. However, to avoid confusion, only the ICTRT approach is applied in the SCA calculations for the jeopardy analysis. (BiOp pages 7-23 and 7-24)

Specifically, NMFS used the formula provided in Cooney and Matheson (2006, AR B083). The exact calculations are in the spreadsheets entered into the administrative record as AR C.1145. I cannot comment on the alternative estimates that Mr. Bowles refers to because he did not describe his methods (other than to say that they were “conventional”) or attach a spreadsheet or other documentation of the details of the analysis.

40. In paragraph 60 and Table 10 Mr. Bowles extended this analysis, but again I cannot comment on it without additional information, other than to say that Mr. Bowles must have used either a different statistical method than the ICTRT or he must have used a different data set than that in use by the ICTRT, since his estimates differ from those in the BiOp. Without any explanation of the methods employed, it is not possible to determine whether Mr. Bowles’ representations are accurate.

41. In paragraph 62 Mr. Bowles states that he was not able to replicate the confidence intervals for the lambda metric using information in the BiOp. I do not understand why he was not able to do so and no explanation is provided in his declaration. The method NMFS used is described in the BiOp on pages 7-24 and 7-25, which states that we used the Salmon Population Analyzer model (McElhany and Payne 2006, NOAA AR B.258) for the calculations. The relevant pages in McElhany and Payne (2006) describing the lambda statistics are 38-40, as well as some of the information on pages 7-11 and 49-53. The model output used in the BiOp is in Cooney (2008b,c; NOAA AR B.081 and B.080).

<u>Excluding Zeroes in the BRT Trend Analysis Had a Trivial Effect on Results</u>

42. In paragraph 65, Mr. Bowles states that it appears that NMFS dropped years with zero abundance from calculation of the BRT trend metric for two populations of Snake River spring/summer Chinook. He also states that calculation with the zeroes changed to 1’s would result in an 8% lower BRT trend for the Marsh Creek population and a 1% lower BRT trend for

the Sulphur Creek population. Dr. Orzack in paragraph 18 states that excluding zeroes biases the results.

43. NMFS used a standard modeling approach for this particular assessment (see BiOp at page 7-26). We assumed that the modeling software had transformed the zero values to 1 when estimating the BRT trend metric, but it did not. To ensure accuracy, NMFS re-ran the analysis for the Marsh and Sulphur Creek populations with 1's substituted for zeroes (Exhibit 1) and found that the mean base period estimate for Marsh Creek declined 1.3% (from 1.007 to 0.994) and the mean base period estimate for Sulphur Creek changed 1.2% (from 1.023 to 1.011). Mr. Bowles' Marsh Creek results indicating an 8% drop are not consistent with results based on the ICTRT data set used for the BiOp analysis. It appears that the difference may result from Mr. Bowles using an alternative data set.

44. Changing the zeroes to 1s in calculation of the BRT trend had a trivial effect on the BiOp analysis. First, the results discussed above are those for the base period only. When recent changes and the prospective actions are accounted for, the BRT trend results displayed in BiOp Table 8.3.6.1-1 and corresponding appendix tables would be 1.07 for Marsh Creek and 1.09 for Sulphur Creek (Exhibit 1). Furthermore, the results for the average R/S metric and the lambda metric remain unchanged, ranging from 1.15 to 1.35 for these populations.

NMFS Appropriately Considered Climate Variability and Climate Change In Its Jeopardy Analysis

45. Mr. Bowles in paragraph 72 says that NMFS attributed increased abundance in recent years solely to management actions at BiOp 8.3-45. Mr. Bowles is incorrect. NMFS did not claim that base period patterns of abundance resulted solely from management actions. *See,* for example, the discussion of patterns of environmental variation and their biological effects in

the Environmental Baseline section of the BiOp (SCA pages 5-59 to 5-57, incorporated by reference into the BiOp at Chapter 5). His interpretation also is contrary to the plain language of the sentence in the BiOp that he cites, which only addresses *future* increases in abundance resulting from the prospective management actions: "...and abundance is expected to increase *in the future* as a result of additional improvements." NMFS did consider ongoing and future management actions that would be expected to modify the abundance, productivity, and extinction risk observed during the base period. NMFS clearly describes that its base-to-current and prospective survival change multipliers, like those used in the survival gap analysis of the ICTRT (2007, NOAA AR B.196) are based solely on management actions that have changed (for better or worse) from the average base period actions:

> As indicated by the ICTRT (2007c), some factors such as hydro operations and configuration have continued to change over that time period, and if the current management actions continue into the future, the projected biological performance will be different from that predicted from base period patterns alone. The ICTRT (2007c) includes an analysis that adjusts productivity estimates to reflect current hydro operations and configuration. The ratio between current hydro survival and the average hydro survival during the base period is calculated as an adjustment factor.
>
> For the jeopardy analysis, adjustment factors are calculated for all ongoing and completed management activities that are likely to continue into the future. The product of these life-stage specific adjustment factors represents the "base-to-current survival adjustment factor." A similar process is used to estimate the survival changes likely to occur as a result of the Prospective Actions and cumulative effects, and to calculate the product of the changes as the "current-to-prospective survival adjustment factor."
> (BiOp page 7-11)

46. Ms. Glick's declaration provides a detailed 29-page overview of various effects of climate change, including specific effects on salmon and steelhead, citing dozens of studies in the primary literature. NMFS had taken nearly all of this information into account because the BiOp relied primarily upon the ISAB's (2007, NOAA AR B.211) 136-page review and interpretation of the same body of primary literature and NMFS summarized the key elements of

the findings of the ISAB review in various sections of the BiOp. The BiOp's Environmental Baseline chapter (incorporation by reference of the SCA pages 5-63 to 5-67) and Methods Chapter (pages7-12 to 7-14 and 7-32 to 7-34) address most, if not all, of the topics raised in Ms. Glick's declaration, but in summary form rather than at the level of detail of her declaration. For example, in the Environmental Baseline section of the BiOp (incorporated by reference from SCA pages 5-63 to 5-67), NMFS presents 15 bulleted descriptions of likely effect of continued global warming on Pacific Northwest salmon and steelhead, most of which correspond to specific topics in Ms. Glick's declaration.

47. Ms. Glick at paragraph 17 and footnote 24 provides six citations for studies "that have projected future impacts of climate change specifically on Columbia/Snake salmonid populations." Four of those six studies were already incorporated and cited in ISAB (2007, NOAA AR B.211). Others are consistent with information cited elsewhere in the BiOp, including the Crozier et al. (2007, NOAA AR B.097) study.

48. Ms. Glick mentions several effects of climate change that have been occurring for 20-50 years or more. For example, she cites a warming trend in the world's oceans since the mid-1950's (paragraph 10), a 1.5 degree rise in air temperature over the past century (paragraph 13), increased heavy precipitation events over the past 50 years (paragraph 14), shifts in species distributions over the past 30 years (paragraph 21), and increased water temperature in the Columbia and Fraser Rivers over the last 50 years (paragraph 21). The implication is that NMFS neglected to account for these factors and her declaration fails to mention that some of these factors were discussed explicitly in the BiOp and all of these effects are captured in NMFS' base period analysis.

49. Ms. Glick summarizes by recommending a precautionary approach in paragraphs 27-29. NMFS includes such an approach in the BiOp's RPA by requiring proactive actions recommended by the ISAB to reduce impacts of climate change (*see* BiOp pages 8-17 to 8-23), requiring monitoring and review of new information on climate change as the BiOp is implemented, and by describing an adaptive management process that will incorporate modifications if necessary to respond to unanticipated effects of climate change or other factors on the effectiveness of RPA actions. Significant RPA measures related to monitoring climate change and considering it as part of adaptive management follow:

Table 1: Presenting Excerpts from BiOp Appendix Entitled RPA Table, NOAA AR A-1

RPA Actions Considering Implications of, Or Evaluating, Climate Change		
RPA no.	**Title**	**Language**
1.	Implementation Plans	The Implementation Plans will take into account pertinent new information on **climate change** and effects of that information on limiting factors and project prioritization.
2.	Annual Progress Reports	Annual progress reports will include a summary of the annual forecast review and also summarize any new, pertinent **climate change** information or research.
3.	Comprehensive RPA Evaluations	Physical and biological factors will include new information on **climate change** and its effects on listed salmon and steelhead.
7.	Forecasting and Climate Change/Variability	The Action Agencies will hold annual forecast performance reviews looking at in-place tools for seasonal volume forecasts and to report on the effectiveness of experimental or developing/emerging technologies and procedures. As new procedures and techniques become available and are identified to have significant potential to reduce forecast error and improve the reliability of a forecast, the Action Agencies will discuss the implementation possibilities with regional interests. The purpose is to improve upon achieving upper rule curve elevations by reducing forecasts errors and thereby providing for improved spring flows. The Action Agencies will work collaboratively with other agencies and research institutions to investigate the impacts of possible **climate change** scenarios to the Pacific Northwest and listed salmon and steelhead. Focus areas will cover 1) modeling the hydrology and

RPA Actions Considering Implications of, Or Evaluating, Climate Change		
RPA no.	**Title**	**Language**
		operations of the Columbia River system using possible future **climate change** scenarios, 2) investigating possible adaptation strategies for the system, 3) monitoring the hydrologic system for trends, cycles, and changes, and 4) staying abreast of research and studies that address climate cycles, trends, and modeling.
35	Tributary Habitat Implementation 2010-2018 – Achieving Habitat Quality and Survival Improvement Targets	Projects will identify location, treatment of limiting factor, targeted population or populations, appropriate reporting metrics, and estimated biological benefits based on achieving those metrics. Pertinent new information on **climate change** and potential effects of that information on limiting factors will be considered.
37	Estuary Habitat Implementation 2010-2018— Achieving Habitat Quality and Survival Improvement Targets	Projects will identify location, treatment of limiting factor, targeted ESU/DPS or ESUs/DPSs, appropriate reporting metrics, and estimated biological benefits based on the achieving of those metrics. Pertinent new information on **climate change** and potential effects of that information on limiting factors will be considered.

NMFS Considered the Relative Importance of Populations in Its Jeopardy Analysis

50. In paragraph 202, Mr. Bowles claims that NMFS did not consider the relative importance of populations in its jeopardy analysis. NMFS did consider the ICTRT's recommendations for the status of populations and MPGs within a species that would be associated with long-term viability of the species, but it did not adopt the ICTRT's recommendations as a formulaic requirement for avoiding jeopardy:

> Consistent with this, NOAA Fisheries evaluated all information at the population and MPG level in its ESU level determination, including the TRT products and other relevant scientific information (NMFS 2006h). Both the Willamette/Lower Columbia and Interior Columbia TRTs, when considering long term recovery goals, recommended that for an ESU/DPS to be considered at low risk of extinction (and therefore viable), all MPGs in that ESU/DPS should be at low risk.
>
> Based on these TRT recommendations, other information and the two guidance memos cited above, NOAA Fisheries considered the population level analyses described earlier in this chapter in assessing the trend of each MPG. For this jeopardy analysis, NOAA Fisheries considered an MPG to have a trend toward recovery if a sufficient number of populations within the MPG have a trend toward recovery.

> NOAA Fisheries has determined that it may not be necessary for all of the populations to have a trend toward recovery in order for an MPG to have a trend toward recovery, and likewise, it may not be necessary for all of the MPGs to have a trend toward recovery in order for the ESU/DPS as a whole to be on such a trend. In other words, there is more than one combination of populations and MPGs at various risk levels and trends that constitutes an ESU/DPS on a trend toward recovery. In making this determination, NOAA Fisheries considered all factors, including the importance of each population in the ESU/DPS, the strength of each population, and the presence of safety net programs. (BiOp page 7-50)

51. Evidence that NMFS considered the ICTRT viability scenarios in its analysis can be found for Snake River spring/summer Chinook salmon, for example, at BiOp pages 8.3-28 (Lower Snake MPG), 8.3-30 (Grande Ronde/Imnaha MPG), 8.3-32 (South Fork Salmon MPG), 8.3-34 (Middle Fork Salmon MPG), 8.3-36 (Upper Salmon MPG), 8.3-56 and 8.3-58 (showing ICTRT viability scenarios for all MPGs). NMFS' conclusions also demonstrate that the relative importance of populations was an important consideration. For example,

> Therefore, all important populations identified by the ICTRT are expected to have lambda (HF=0) and BRT trend greater than 1.0 for all five MPGs, but key populations in two of the five MPGs have expected lambda (HF=1) less than 1.0. (BiOp page 8.3-41)

52. Mr. Olney, in paragraphs 93-95, raises another population weighting issue. He appears to argue that in reaching its conclusions, NMFS should have treated B-run steelhead as a major population group, contrary to the ICTRT's recommendations, since he does not understand how the performance of A-run populations can help to offset performance of B-run populations. While NMFS did not adopt the ICTRT's viability scenarios as a requirement for reaching a no-jeopardy conclusion, as described above, examination of Table 8.5.6.1-1 (pages 8.5-59 and 8.5-60) shows how performance of A-run and B-run populations can be substituted in some cases to meet the ICTRT's recommendations. For example, within the Salmon River MPG, the ICTRT's scenario calls for viability of one out of three A- and B-run populations (Panther Creek [A], Secesh [B], and North Fork [A]) and viability of 2 out of six populations comprised of five A-run (Little Salmon, Lemhi,

Phsimeroi, East Fork Salmon, and Upper Mainstem) and one B-run (Lower Middle Fork) populations. In these cases the viability criteria can either be met with A-run or B-run populations, or a combination of both.

Analysis of Snake River Steelhead

53. In paragraph 29 Mr. Olney points out that the text describing base period lambda and BRT trend in Table 8.5.2-1 does not match the numbers in the table. It appears that this language was inadvertently left unchanged from an earlier draft. However, the numbers in the table were correct, those numbers were applied to the prospective analysis, and the resulting prospective estimates and associated text are correct, so this language had no effect on the overall analysis.

Snake River Steelhead Return-per-Spawner (R/S) Estimates Provided Similar Information As That Which Would Result from Lambda With Hatchery-Origin Spawner Effectiveness Equal To 1.0

54. In paragraphs 30-34 Mr. Olney points out that NMFS was not able to calculate lambda for Snake River steelhead under the assumption that the effectiveness of hatchery-origin spawners is equal to that of natural-origin spawners (HF=1) because the data set used for the analysis included only natural-origin spawners. NMFS used the ICTRT data set for aggregate A- and B-run steelhead analyses, and this data set does include only the wild component of the run (hatchery fish have already been factored out). Snake River steelhead results presented in the BiOp for lambda with the HF=1 assumption are actually repeated results for lambda with the HF=0 assumption, except for three A-run populations modeled explicitly. NMFS does not have lambda results with the HF=1 assumption for most Snake River steelhead populations so generic

references to “lambda” should instead refer to “lambda with the HF=0 assumption” and references to lambda with the HF=1 assumption should be struck. This would have no effect on lambda results for about half of the A-run populations and six out of eight B-run populations because these populations either have no hatchery influence or were modeled explicitly, incorporating hatchery percentages. For the remaining populations there would be little effect on the analysis in the BiOp since HF=1 lambda estimates are similar to R/S estimates for populations with a significant hatchery influence (BiOp p. 7-24), and NMFS’ Snake River steelhead recovery prong analysis and conclusions focused on R/S results:

> Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, 11 of which are described in Section 8.5.5.4, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.
>
> As described in Section 8.5.6, with implementation of the Prospective Actions, R/S, lambda, and the BRT trend are expected to be greater than 1.0 for three of the four of the populations in the Imnaha and Grande Ronde MPGs for which the ICTRT developed population-specific base period estimates (Table 8.5.6-1 and Figure 8.5.6-1). For the fourth population, Grande Ronde Upper Mainstem, estimates were either greater than 1.0 or were very close (0.99). A-run populations and 2-4 of the eight B-run populations (depending on prospective harvest assumptions) are expected to have R/S greater than 1.0, based on average A- and B-run base productivity. This equates to R/S greater than 1.0 for 18-20 of the 24 populations with estimates. The 4-6 populations with estimates less than 1.0 are all composed of B-run steelhead and are components of the Clearwater and Salmon River MPGs. R/S is expected to be greater than 1.0 for all of the important populations identified by the ICTRT in the other three MPGs in this DPS.
>
> Populations for which R/S is expected to be greater than 1.0 generally have estimates that are considerably greater than 1.0 (mean approximately 1.20). By providing additional benefits to stronger populations, the Prospective Actions help offset problems with poorly performing populations, supporting the viability of the DPS as a whole. (BiOp page 8.5-45)

NMFS Considered All Indicators of Trend in Its Conclusions for Snake River Spring/Summer Chinook Salmon

55. Mr. Olney in paragraph 36 states that NMFS does not consider information based on R/S and lambda (HF=1) when characterizing base period trends; rather, it relies solely on more favorable information derived from the BRT trend and lambda (HF=0). The partial sentence that Mr. Olney quotes is part of a larger paragraph which, when viewed in its entirety, clearly shows that NMFS considered all metrics when reaching its conclusion and considered the context of the BRT trend and lambda (HF=0) results:

> In summary, abundance of natural-origin and total spawners has been stable or increasing for most SR spring/summer Chinook populations over the last 20 full brood years, based on lambda (HF=0) and BRT trend estimates, generally >1.0. For many populations, this stability or increase has been at least partially dependent on production from naturally spawning hatchery fish, the progeny of which (F2 generation) are considered natural-origin fish in these calculations. For most populations, natural survival rates have not been sufficient for spawners to replace themselves, as indicated by average R/S and lambda (HF=1) estimates <1.0. The presence of hatchery-origin natural spawners does not explain, in its entirety, the differences among the three metrics, as evidenced by populations in the Middle Fork Salmon MPG which are not affected by hatcheries. As described in Chapter 7, each metric requires different types of information and assumptions, and each encompasses a somewhat different time period. (BiOp page 8.3-7)

NMFS Relied Primarily on a Quasi-Extinction Threshold ("QET") of 50 Fish, But Also Considered Lower Levels Relevant To Short-Term Risk of Small Populations That Have Rebounded From Levels Below 50 Fish in the Past

56. Mr. Olney in paragraphs 41-43 and 102 questions NMFS' consideration of QET levels below 50 fish (in each year of a four-year period). He argues that, while NMFS demonstrated that some populations of Snake River spring/summer Chinook salmon have dropped below 50 fish for four years in a row and rebounded, other salmon populations have dropped below 50 fish and not rebounded. He states that "...it is also true that every salmon and

steelhead population that has become extinct has, necessarily, fallen below 50 fish for four years in a row and failed to survive."

57. This argument is difficult to understand since every species that becomes extinct necessarily falls below all levels above one fish, including 100, 50, 30, 10, and 2 fish. This argument does not shed light on why 50 is a better number than a number either lower or higher. The example of coho salmon that he provides indicates, for example, that two years at over 150 fish followed by two years at 17-18 fish were the last returns before that run became extinct. On the other hand, the Sulphur Creek population of Snake River spring/summer Chinook that NMFS displays on page 7-17 of the BiOp first dropped below 50 fish four years running over 20 years ago and it has not gone extinct in the ensuing years. NMFS also cited seven other populations of Snake River spring/summer Chinook in the Middle Fork Salmon MPG that have gone below a 50 fish quasi-extinction level and returned to higher abundances. These populations are more relevant to NMFS' consideration of an appropriate QET level for short-term risk of Middle Fork Salmon MPG populations.

<u>NMFS Did Not Rely on an Assumption That Survival Improvements From Habitat Actions Would Occur Immediately</u>

58. Mr. Olney asserts in paragraph 85 that NMFS assumes that all habitat actions and associated biological responses will occur immediately, "on day one of the 2008 BiOp." This is incorrect. As described on pages 7-17 and 7-18:

> Short-term extinction risk with the Prospective Actions in place is estimated with a range of adjustment factors. While many of these actions will occur in the near future and have near-term biological effects, others will take longer to implement and have a biological impact. Because the analysis is based on a single time step and because the exact timing of Prospective Actions and attainment of biological effects is unknown, two adjustment factors are considered: A conservative approach assumes that extinction risk will not be influenced by any improvements associated with Prospective Actions. Only actions that

> are implemented already and that are captured in the base-to-current adjustment factor, as described in Section 7.1.1, are included in this calculation. A more optimistic assumption is that all Prospective Actions and all effects of those actions expected to occur within the next 10 years will affect the short-term risk of extinction. This approach includes Prospective Actions that will be implemented quickly, but is also optimistic because it includes actions that may not result in biological improvements for up to 10 years. The true extinction risk associated with the Prospective Actions is expected to be somewhere between these two extremes.

This treatment is also clearly explained in the full citation from NMFS' table of key assumptions, which Mr. Olney partially references:

> *All actions are implemented and biological responses occur in a single time step.* This assumption will underestimate short-term extinction risk; therefore, risk is bounded by the assumption that no Prospective Actions will help to reduce risk (only continuation of current actions), as well as the more optimistic assumption that all Prospective Actions will be implemented within a time period that will influence the risk of short-term extinction. (BiOp at page 7-30)

59. For the recovery prong, the single time step in the analysis does mean that all biological effects are treated as occurring at once (instantaneously), but the BiOp makes clear that the time period associated with the productivity estimates begins with full implementation of the actions, rather than immediately:

> It is important to understand that the proportional change approach applied in this analysis (and the others described above) has a single time step. This means that the analysis assumes that all survival changes occur instantaneously and that average life-cycle survival is immediately affected. For the extinction risk analysis, two alternatives for considering implementation of Prospective Actions were considered, as described below in Section 7.1.1.1. However, for productivity estimates, the time period associated with the estimates begins with full implementation of the expected survival changes. The best way to think of the productivity estimates is that they represent the initial productivity following achievement of the expected survival rate changes resulting from the Prospective Actions. (BiOp page 7-12)

NMFS Used the ICTRT Aggregate Analyses for Snake River Steelhead, Rather Than Relied on Population-Specific Information for Only Three Populations, and Explained the Limitations of the Aggregate Approach

60. Mr. Olney in paragraphs 26 and 38 describes one of the limitations of using the ICTRT's aggregate Snake River steelhead data sets to represent Snake River steelhead populations and claims that NMFS did not adequately describe this uncertainty.

61. NMFS had three choices for analyzing Snake River steelhead: rely only on data available for three specific populations, additionally rely on ICTRT aggregate estimates for combined A-run and B-run steelhead (the approach used in the Comprehensive Analysis), or use the population-specific data coupled with application of the aggregate data to specific A- and B-run populations. NMFS chose the third approach because it would allow specific habitat actions to be applied to specific populations in the analysis and it would allow a better overview of the conditions expected for each major population group (since A-run and B-run populations are mixed within MPGs; *see* paragraph 52 above).

62. NMFS described the use of the aggregate data (BiOp page 8.5-5) and cited the ICTRT's detailed description of the production of that data set and associated uncertainties (ICTRT 2007c). Additionally, throughout the analysis, NMFS ensured that the results presented for each population or MPG were accompanied by text such as: "As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run population estimates, coupled with Prospective Actions that are specific to each population." (BiOp page 8.5-32) In the final conclusions, NMFS also included this "important caveat" on the results: "As described above, population-specific productivity is available for only four populations in the MPG – the remaining

population estimates are extrapolations of average A- and B-run estimates from the ICTRT." (BiOp page 8.5-46).

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 24 2008, in Portland, Oregon.

Christopher L. Toole

EXHIBIT 1

DECLARATION OF CHRISTOPHER TOOLE

Summary Statistics
Marsh Creek

	Mean	Lower 95% CI	Upper 95% CI
Base Period Estimate with Zeroes	1.007	0.921	1.002
Base Period Estimate with 1's	0.994	0.896	1.102
Ratio 1's:0's	0.98709		
Absolute Difference	-1.30%		
Mean Prospective Estimate With Zeroes in Table 8.3.6.3-1	1.083		
Mean Prospective Estimate With 1's (estimate with 0's * ratio)	1.069		

Summary Statistics
Sulphur Creek

	Mean	Lower 95% CI	Upper 95% CI
Base Period Estimate with Zeroes	1.023	0.939	1.114
Base Period Estimate with 1's	1.011	0.901	1.134
Ratio 1's:0's	0.98827		
Absolute Difference	-1.20%		
Mean Prospective Estimate With Zeroes in Table 8.3.6.3-1	1.101		
Mean Prospective Estimate With 1's (estimate with 0's * ratio)	1.088		

Marsh Creek Analysis for base period using Salmon Population Analyzer Model
Substituting 1's for 0's

Name:	marsulp rerun
Type:	Basic_Statistics `
Data set:	marshsprfeb08 w 1 for 0.txt

Year	Spawners	Fraction \	Wild	Hatchery	Catch	Age	2	3	4	5	6	Survival	Regime
1980	16	1	16	0	0	0	0	0.021	0.325	0.652	0	-99	-99
1981	115	1	115	0	8	0	0	0	0.625	0.375	0	-99	-99
1982	71	1	71	0	6	0	0	0.021	0.325	0.652	0	-99	-99
1983	59	1	59	0	5	0	0	0.021	0.325	0.652	0	-99	-99
1984	107	1	107	0	11	0	0	0.021	0.325	0.652	0	-99	-99
1985	196	1	196	0	14	0	0	0	0.423	0.577	0	-99	-99
1986	178	1	178	0	14	0	0	0.032	0.353	0.614	0	-99	-99
1987	271	1	271	0	23	0	0	0.005	0.433	0.563	0	-99	-99
1988	395	1	395	0	61	0	0	0	0.097	0.903	0	-99	-99
1989	80	1	80	0	8	0	0	0.001	0.352	0.647	0	-99	-99
1990	103	1	103	0	14	0	0	0.005	0.466	0.529	0	-99	-99
1991	71	1	71	0	7	0	0	0.018	0.252	0.73	0	-99	-99
1992	114	1	114	0	9	0	0	0.032	0.599	0.369	0	-99	-99
1993	218	1	218	0	16	0	0	0.002	0.152	0.847	0	-99	-99
1994	9	1	9	0	0	0	0	0.021	0.325	0.652	0	-99	-99
1995	1	1	1	0	0	0	0	0.021	0.325	0.652	0	-99	-99
1996	18	1	18	0	0	0	0	0.035	0.656	0.309	0	-99	-99
1997	107	1	107	0	7	0	0	0.049	0.488	0.463	0	-99	-99
1998	164	1	164	0	9	0	0	0.02	0.02	0.9	0	-99	-99
1999	1	1	1	0	0	0	0	0.021	0.325	0.652	0	-99	-99
2000	65	1	65	0	3	0	0	0	0.957	0.043	0	-99	-99
2001	348	1	348	0	57	0	0	0.019	0.933	0.046	0	-99	-99
2002	336	0.99	332.64	3.36	48	0	0	0	0.515	0.476	0	-99	-99
2003	606	1	606	0	62	0	0	0.01	0.01	0.95	0	-99	-99

data Options

Correct for hatchery fish? TRUE

End Year 2006 (=all available years)

Calculate pre-catch spawners? FALSE

Weight Mean Age? FALSE

Start Year 1980

Relative success of hatchery fish 1

Results:

Time Series Period 1980 - 2003

Years of Spawner Data 24

Exp Trend in Ln (NatSpawners) With CI 0.994 (0.896 - 1.102)

Probability Trend in Ln Nat Spawners > 0 0.4498

Marsh Creek Analysis for base period using Salmon Population Analyzer Model
Re-Run of Original Analysis with 0's censused in model

Name: marsulp rerun
Type: Basic_Statistics `
Data set: marshsprfeb08.txt

Year	Spawners	Fraction W	Wild	Hatchery	Catch	Age	2	3	4	5	6	Survival	Regime
1980	16	1	16	0	0	0	0	0.021	0.325	0.652	0	-99	-99
1981	115	1	115	0	8	0	0	0	0.625	0.375	0	-99	-99
1982	71	1	71	0	6	0	0	0.021	0.325	0.652	0	-99	-99
1983	59	1	59	0	5	0	0	0.021	0.325	0.652	0	-99	-99
1984	107	1	107	0	11	0	0	0.021	0.325	0.652	0	-99	-99
1985	196	1	196	0	14	0	0	0	0.423	0.577	0	-99	-99
1986	178	1	178	0	14	0	0	0.032	0.353	0.614	0	-99	-99
1987	271	1	271	0	23	0	0	0.005	0.433	0.563	0	-99	-99
1988	395	1	395	0	61	0	0	0	0.097	0.903	0	-99	-99
1989	80	1	80	0	8	0	0	0.001	0.352	0.647	0	-99	-99
1990	103	1	103	0	14	0	0	0.005	0.466	0.529	0	-99	-99
1991	71	1	71	0	7	0	0	0.018	0.252	0.73	0	-99	-99
1992	114	1	114	0	9	0	0	0.032	0.599	0.369	0	-99	-99
1993	218	1	218	0	16	0	0	0.002	0.152	0.847	0	-99	-99
1994	9	1	9	0	0	0	0	0.021	0.325	0.652	0	-99	-99
1995	0	1	0	0	0	0	0	0.021	0.325	0.652	0	-99	-99
1996	18	1	18	0	0	0	0	0.035	0.656	0.309	0	-99	-99
1997	107	1	107	0	7	0	0	0.049	0.488	0.463	0	-99	-99
1998	164	1	164	0	9	0	0	0.02	0.02	0.9	0	-99	-99
1999	1	1	1	0	0	0	0	0.021	0.325	0.652	0	-99	-99
2000	65	1	65	0	3	0	0	0	0.957	0.043	0	-99	-99
2001	348	1	348	0	57	0	0	0.019	0.933	0.046	0	-99	-99
2002	336	0.99	332.64	3.36	48	0	0	0	0.515	0.476	0	-99	-99
2003	606	1	606	0	62	0	0	0.01	0.01	0.95	0	-99	-99

data Options

Correct for hatchery fish? TRUE
End Year 2006 (=all available years)
Calculate pre-catch spawners? FALSE
Weight Mean Age? FALSE
Start Year 1980
Relative success of hatchery fish 1

Results:

Time Series Period 1980 - 2003
Years of Spawner Data 24
Exp Trend in Ln (NatSpawners) With CI 1.007 (0.921 - 1.102)
Probability Trend in Ln Nat Spawners > 0 0.5666

Sulphur Creek Analysis for base period using Salmon Population Analyzer Model
Substituting 1's for 0's

Name: marsulp rerun
Type: Basic_Statistics `
Data set: sulphursprfeb08 w 1 for 0.txt

Year	Spawners	Fraction \ Wild		Hatchery	Catch	Age	2	3	4	5	6	Survival	Regime
1980	11	1	11	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1981	43	1	43	0	3	0	0	0	0.625	0.375	0	-99	-99
1982	17	1	17	0	1	0	0	0.084	0.297	0.619	0	-99	-99
1983	45	1	45	0	4	0	0	0.084	0.297	0.619	0	-99	-99
1984	1	1	1	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1985	62	1	62	0	4	0	0	0	0.423	0.577	0	-99	-99
1986	388	1	388	0	32	0	0	0.032	0.353	0.614	0	-99	-99
1987	68	1	68	0	5	0	0	0.005	0.433	0.563	0	-99	-99
1988	606	1	606	0	94	0	0	0	0.136	0.864	0	-99	-99
1989	43	1	43	0	4	0	0	0.001	0.352	0.647	0	-99	-99
1990	172	1	172	0	23	0	0	0.005	0.466	0.529	0	-99	-99
1991	213	1	213	0	23	0	0	0.018	0.252	0.73	0	-99	-99
1992	21	1	21	0	1	0	0	0.016	0.568	0.416	0	-99	-99
1993	264	1	264	0	20	0	0	0.002	0.147	0.851	0	-99	-99
1994	1	1	1	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1995	4	1	4	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1996	23	1	23	0	1	0	0	0.035	0.656	0.309	0	-99	-99
1997	42	1	42	0	3	0	0	0.049	0.488	0.463	0	-99	-99
1998	141	1	141	0	8	0	0	0	0.035	0.893	0	-99	-99
1999	1	1	1	0	0	0	0	0.084	0.297	0.619	0	-99	-99
2000	13	1	13	0	0	0	0	0	0.957	0.043	0	-99	-99
2001	95	1	95	0	15	0	0	0.04	0.931	0.027	0	-99	-99
2002	169	1	169	0	24	0	0	0	0.542	0.458	0	-99	-99
2003	178	1	178	0	18	0	0	0	0.033	0.967	0	-99	-99

data Options

Correct for hatchery fish? TRUE
End Year 2006 (=all available years)
Calculate pre-catch spawners? FALSE
Weight Mean Age? FALSE
Start Year 1980
Relative success of hatchery fish 1

Results:

Time Series Period 1980 - 2003
Years of Spawner Data 24
Exp Trend in Ln (NatSpawners) With CI 1.011 (0.901 - 1.134)
Probability Trend in Ln Nat Spawners > 0 0.5791

Sulphur Creek Analysis for base period using Salmon Population Analyzer Model
Re-Run of Original Analysis with 0's censused in model

Name: marsulp rerun
Type: Basic_Statistics `
Data set: sulphursprfeb08.txt

Year	Spawners	Fraction W	Wild	Hatchery	Catch	Age	2	3	4	5	6	Survival	Regime
1980	11	1	11	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1981	43	1	43	0	3	0	0	0	0.625	0.375	0	-99	-99
1982	17	1	17	0	1	0	0	0.084	0.297	0.619	0	-99	-99
1983	45	1	45	0	4	0	0	0.084	0.297	0.619	0	-99	-99
1984	0	1	0	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1985	62	1	62	0	4	0	0	0	0.423	0.577	0	-99	-99
1986	388	1	388	0	32	0	0	0.032	0.353	0.614	0	-99	-99
1987	68	1	68	0	5	0	0	0.005	0.433	0.563	0	-99	-99
1988	606	1	606	0	94	0	0	0	0.136	0.864	0	-99	-99
1989	43	1	43	0	4	0	0	0.001	0.352	0.647	0	-99	-99
1990	172	1	172	0	23	0	0	0.005	0.466	0.529	0	-99	-99
1991	213	1	213	0	23	0	0	0.018	0.252	0.73	0	-99	-99
1992	21	1	21	0	1	0	0	0.016	0.568	0.416	0	-99	-99
1993	264	1	264	0	20	0	0	0.002	0.147	0.851	0	-99	-99
1994	0	1	0	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1995	4	1	4	0	0	0	0	0.084	0.297	0.619	0	-99	-99
1996	23	1	23	0	1	0	0	0.035	0.656	0.309	0	-99	-99
1997	42	1	42	0	3	0	0	0.049	0.488	0.463	0	-99	-99
1998	141	1	141	0	8	0	0	0	0.035	0.893	0	-99	-99
1999	0	1	0	0	0	0	0	0.084	0.297	0.619	0	-99	-99
2000	13	1	13	0	0	0	0	0	0.957	0.043	0	-99	-99
2001	95	1	95	0	15	0	0	0.04	0.931	0.027	0	-99	-99
2002	169	1	169	0	24	0	0	0	0.542	0.458	0	-99	-99
2003	178	1	178	0	18	0	0	0	0.033	0.967	0	-99	-99

data Options

Correct for hatchery fish? TRUE
End Year 2006 (=all available years)
Calculate pre-catch spawners? FALSE
Weight Mean Age? FALSE
Start Year 1980
Relative success of hatchery fish 1

Results:

Time Series Period 1980 - 2003
Years of Spawner Data 24
Exp Trend in Ln (NatSpawners) With CI 1.023 (0.939 - 1.114)
Probability Trend in Ln Nat Spawners > 0 0.706