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UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

NATIONAL WILDLIFE FEDERATION, et al.,

Civ. No. CV 01-00640-RE

Plaintiffs,

and

THIRD DECLARATION OF
GRETCHEN OOSTERHOUT, Ph.D.

STATE OF OREGON,

Intervenor-Plaintiff,

v.

NATIONAL MARINE FISHERIES SERVICE,

Defendants,

and

NORTHWEST IRRIGATION UTILITIES, PUBLIC
POWER COUNCIL, WASHINGTON STATE FARM
BUREAU FEDERATION, FRANKLIN COUNTY
FARM BUREAU FEDERATION, GRANT COUNTY
FARM BUREAU FEDERATION, STATE OF
WASHINGTON, and STATE OF IDAHO,

Intervenor-Defendants.

I, GRETCHEN OOSTERHOUT, declare and state as follows:

1. I am a system analyst by training and experience, and the principal of Decision Matrix, Inc. (DMI), a small consulting firm in the areas of decision analysis and risk assessment. I received a B.S. in 1985 and an M.S. in Mechanical Engineering in 1992 from Portland State University, with a specialty in diffusion process computer modeling. I received my Ph.D. in Systems Science, also from Portland State University, in 1996. My doctoral dissertation was on the use of computer simulation methods in public resource management decision making. I have taught graduate-level experimental design and reliability engineering courses and published over 50 formal reports on computer modeling and risk analysis in fields ranging from fisheries, ecology, reliability engineering, and diffusion processes to diabetes, cardiovascular disease, health care services, system failure analysis and reliability, game theory, and using models to prioritize research and monitoring plans. Attached to this Declaration as Exhibit A is a copy of my curriculum vitae.

2. Most of my professional work since I started my business has been in the area of fisheries and fish habitat risk assessment and decision analysis. For example, from 1998 – 2003 I provided decision structuring, modeling, and experimental design consulting to the Fisheries Technical Subcommittee working on Federal Energy Regulation Commission hydropower project relicensing on the Deschutes River. I led the committee through the process of developing a complex multi-attribute decision structure which is being used to prioritize fish passage alternatives and data needs. I also developed for this committee stochastic models of spring chinook and sockeye salmon populations to use in conjunction with the decision structure to analyze risks associated with re-introduction and restoration of spring chinook and sockeye populations, and to prioritize research efforts. These decision analysis and risk assessment

products have been widely peer reviewed, extensively validated, and user-tested as part of Fish and Wildlife Department coursework at Oregon State University.

3. Since 2001 I have provided similar modeling analysis, review, and decision assistance to groups working to resolve Klamath basin fish, wildlife, and agricultural issues. In the past several years I have also developed a variety of decision analyses for Columbia River InterTribal Fish Commission focused on ESA issues and equitable treatment. I developed the approach being used for decision analysis, monitoring, and model development for a management team that is designing a long-term monitoring, research, and modeling program for the Gulf of Alaska (the Gulf of Alaska Ecosystem Management Program, GEM: Exxon Valdez Oil Spill Trustee Council and Alaska Department of Fish and Game). I have also provided technical analyses and recommendations to this group on pink salmon, herring, and bioenergetics models applied to Prince William Sound. The chapter I wrote for that program has been reviewed and accepted for the GEM program monitoring and modeling plan by the National Research Council.

4. I have developed numerous decision analysis and computer modeling tools for habitat restoration efforts. I served for several years as a technical model validation expert for the World Forestry Center, helping the Umpqua Land Exchange Project (ULEP) consulting science team validate landscape-based habitat suitability models for the ULEP pilot study and EIS development. As part of this effort, I developed sensitivity analyses on multiple levels and scales, with the overall goal of achieving and communicating a better understanding of how model parameters, data sources, assumptions, error sources, and functional relationships interact and influence model performance and output. I also helped develop decision-structuring tools for use in an adaptive management approach to a Habitat Conservation Plan being developed for

Louisiana Pacific holdings in California. Similarly, I have developed multi-attribute GIS decision models for Clark County, Washington's watershed, which were used to prioritize data needs and research opportunities for fish passage improvements. I also have developed multi-attribute, GIS-based decision-analytic models of Oregon's coastal watersheds, emphasizing characteristics important to salmon such as species status and distributions, road densities, geomorphology, fire history, and precipitation.

5. In preparing this declaration, I have reviewed a number of documents including:

- BRT (Biological Review Team) 2003. Draft Report of Updated Status of Listed ESUs of Salmon and Steelhead – chinook. Draft report on stock status by the Biological Review Team, posted for public review on the Internet (http://www.salmonrecovery.gov/R_Analysis.shtml).
- BRT (Biological Review Team) 2003. Draft Report of Updated Status of Listed ESUs of Salmon and Steelhead – steelhead. Draft report on stock status by the Biological Review Team, posted for public review on the Internet (http://www.salmonrecovery.gov/R_Analysis.shtml). NOAA Fisheries, Seattle.
- Biological Review Team 2003c. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. Co-manager review draft downloaded from http://www.salmonrecovery.gov/R_Analysis.shtml. West Coast Salmon Biological Review Team, NOAA Fisheries.
- Cooney, T. 2004. Updated_BRT_population_and_dam_counts_Interior_ESUs_TCooney_1020041.xls, downloaded from http://www.salmonrecovery.gov/R_Analysis.shtml.
- Fisher, T., and R. Hinrichsen 2004. Preliminary Abundance-Based Trend Results for Columbia Basin Salmon and Steelhead ESUs. BPA, Portland.
- Lohn, D. R. 2004. Memorandum listing NOAA Fisheries' responses to comments received on Sept. 2004 draft Biological Opinion. NOAA Fisheries, Seattle. Downloaded from http://www.salmonrecovery.gov/R_biop_final.shtml.
- NMFS 2004. Endangered Species Act – Section 7 Consultation Biological Opinion. Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin (Revised and reissued pursuant to court order, NWF v. NMFS, Civ. No. CV 01-640-RE (D. Oregon)). NOAA's National Marine Fisheries Service, Seattle.
- NWFSC 2003. Final Report on the Technical Workshop on Population Trends and Extinction Metrics. Northwest Fisheries Science Center, NOAA Fisheries, Seattle. Downloaded from http://www.salmonrecovery.gov/R_Analysis.shtml.
- Toole, C. 2003. Preliminary Estimates of Updated "Indicator Metrics" Applied in the 2000 FCRPS Biological Opinion. Hydro Division, NOAA Fisheries Northwest Region, 500 N.E. Oregon Street, Portland, Oregon 97232-2737. Downloaded from http://www.salmonrecovery.gov/R_Analysis.shtml.

This declaration includes a number of footnotes that cite these and other source materials and also quote them in many cases. While the quotations in these footnotes make the declaration somewhat cumbersome in form, they provide an easier way to view the actual text of the source materials I cite.

I. CURRENT STATUS OF ESA-LISTED SALMON AND STEELHEAD

6. Even with adult returns for the past few years that are higher than recent averages for most (but not all) listed stocks, Columbia and Snake River salmon and steelhead still face an immediate and substantial threat to their continued existence. NMFS' scientists' most recent assessments of the long-term trends for Snake River steelhead¹, spring chinook², and fall Chinook,³ and Upper Columbia River chinook⁴ and steelhead⁵ (the upper basin ESUs) are

¹ "Population growth rate (λ) estimates showed a corresponding pattern. The median long-term λ estimate across the nine series was .998 assuming that natural returns are produced only from natural origin spawners and .733 if both hatchery and wild potential spawners are assumed to have contributed to production" (Biological Review Team 2003b, p. 9). Lambda (λ) is a measure of (in this case) the median long-term rate of change. A Lambda of 0.733 means the population is declining at a median rate of 26.7% per year.

² "The BRT reported that, through 2001, most populations experienced long-term declines, but short-term trends were positive for many populations. The short-term productivity trends for the majority of the natural production areas in the ESU are at or above replacement. Dam counts and preliminary spawner surveys also indicate higher than average abundance in 2002 and 2003. The recent 10-year average is approximately twice the previous 10-year average for combined hatchery and wild adults passing Lower Granite Dam. The BRT concluded that the natural component of the ESU had moderately high risk in the abundance and productivity VSP categories and comparatively low risk for spatial structure and diversity." (NMFS 2004, p. 8-5 to 8-9) (emphasis added).

³ "If hatchery spawners have been equally as effective as natural-origin spawners in contributing to brood year returns, the long-term λ estimate is 0.899 and the associated probability that λ is less than 1.0 is estimated as 98.7%. If hatchery returns over Lower Granite Dam are not contributing at all to natural production, the long-term estimate of λ is 1.024. The associated probability that λ is greater than 1.0 is 25.7%, under the assumption that hatchery effectiveness is 0." (Biological Review Team 2003a, p. 5).

⁴ "Most factors indicate high risk for the UCR spring chinook ESU, both range-wide and in the action area. Because there is only a single major population group and because its poor status both range-wide and in the action-area is caused largely by the effects of the FCRPS and USBR

discouraging. Although some ESUs have experienced short-term increases in adult returns, all ESA-listed ESUs are still experiencing a long-term population decline and remain at significant risk, especially in terms of abundance (number of adults) and productivity (reproductive success rate) (see Table 1) (attached) (see especially “BRT findings” column). The 2004 FCRPS BiOp itself shows that upper basin ESUs have fallen to such seriously low levels that only one major population group still exists for four of the 6 upper basin ESUs, and only one population exists for the other two.⁶

7. In NMFS’ last published report on the status of Upper Columbia River Steelhead before it issued the 2004 FCRPS BiOp, NMFS found that the level of survival improvement still required to achieve recovery targets was “high” and that “...the natural survival rate would have to increase nearly seven-fold to meet the indicator criteria under all assumptions and for all spawning aggregations” (Toole 2003, p. 8). NMFS’ assessment of this ESU in the 2004 FCRPS BiOp is no more encouraging (NMFS 2004, section 8.8). “Although its status has been improving recently, most factors indicate high risk for the UCR steelhead, both range-wide and in the action area. Because of the single major population group and poor action-area status, caused largely by effects of the FCRPS and USBR projects that are included in the hydro portion

projects that are included in the hydro portion of the environmental baseline (represented by the reference operation), tolerance for additional risk to this ESU is ‘low.’” (NMFS 2004, p. 8-16)

⁵ “[T]he natural survival rate would have to increase nearly seven-fold to meet the indicator criteria under all assumptions and for all spawning aggregations.” (Toole 2003, p. 8)

⁶ “Only one major population group exists for four ESUs: UCR spring chinook, UCR steelhead, SR sockeye, and SR fall chinook. The two UCR ESUs have only three or four populations each, and, with so few, a reduction in numbers, reproduction, or distribution of any one population is likely to represent a reduction for the major population group as a whole. Because there is only one major population group, the same effect is experienced by the ESU. The case is even more dramatic with SR sockeye and SR fall chinook, ESUs for which there is only one population, so the population, the major population group, and the ESU are equivalent.” (NMFS 2004, pp. 6-8 to 6-9)

of the environmental baseline (represented by the reference operation), tolerance for additional risk to this ESU is low.” (NMFS 2004, p. 8-25).

8. Only one major population of UCR steelhead remains, and although the last few years have seen higher adult returns, its long-term trajectory is still a fairly dramatic decline (population growth rates for sub-populations of 0.63 to 0.93, depending on assumptions, with a mean of 0.76 – or a 24% long-term decline since 1980) (Toole 2003, Table 13). Based on calculations I have made using current NMFS data (discussed more fully in section II), the long-term population growth rate (λ) calculated from 1980 – 2003 for this ESU overall is currently about 13% lower than when NMFS calculated it in the 2000 FCRPS BiOp.

9. The Snake River steelhead ESU faces a similarly serious decline. NMFS recently estimated an aggregate population growth rate of 0.73 to 0.87 (Toole 2003, Table 9), or a decline of 13% to 27% per year. This continued decline (which is approximately the same as the rate of decline NMFS calculated in 2000, see 2000 FCRPS BiOp at 9-221) is particularly discouraging since other ESUs have seen at least some improvement in long-term population trajectories from recent improved ocean survival. For the Snake River Steelhead ESU, I have calculated λ including the two years of data since NMFS’ last estimate. The population’s serious decline remains essentially unchanged (discussed more fully in section II) even with the most up-to-date data available.

II. UPDATED SURVIVAL IMPROVEMENTS NECESSARY TO AVOID JEOPARDY USING THE 2000 FCRPS BIOP FRAMEWORK.

10. In my previous declaration, I provided a set of calculations to show that the total survival improvements that would be necessary to avoid jeopardy were quite large for the 8 up-river “jeopardy” ESUs addressed in the 2000 FCRPS BiOp. Declaration of Gretchen Oosterhout, Ph.D. at ¶¶ 35-37, 39-45, Appendix & Table 1 (filed Sept. 23, 2002). Depending on

assumptions about the performance of hatchery fish, these needed survival improvements ranged from 72.4% for Snake River fall chinook to 440.0% for Snake River steelhead. Id. I also showed that the fraction of this survival improvement that would have to come from offsite mitigation measures, after taking into account the survival improvements NMFS calculated for the hydrosystem measures of the RPA in the 2000 FCRPS BiOp, ranged from 0% for one ESU (Snake River fall chinook) with the most favorable hatchery assumption, to 92.6% for Mid-Columbia steelhead with the least favorable hatchery fish assumption.⁷ Id.

11. I have updated those analyses from my earlier declaration using the most recent data available from the Remand website (<http://www.salmonrecovery.gov>). In order to be sure I was using the most current data, I recalculated the 1980-1999 growth rates that were reported in the 2000 FCRPS BiOp because the BRT revised some populations.⁸ I then used the “running sum” methods for calculating lambda as reported in the 2000 FCRPS BiOp Appendix A (p. A-2, referring to McClure et al. 2000c⁹ and Holmes in review)¹⁰ (also used in BRT 2003a, b, c). I

⁷ My declaration showed that the lowest estimates of the fraction of total survival improvement needed from offsite mitigation were: Snake River spring chinook 62.6%, Snake River fall chinook 0%; Upper Columbia River spring chinook 47.7%, Snake River steelhead 60.5%, Upper Columbia River steelhead 41.2%, and Mid-Columbia River steelhead 82.1%. Highest estimates of the fraction of total survival improvement needed from offsite mitigation were: Snake River spring chinook 79.4%, Snake River fall chinook 57.2%; Upper Columbia River spring chinook 68.7%, Snake River steelhead 88.6%, Upper Columbia River steelhead 87.3%, and Mid-Columbia River steelhead 92.6%. See Oosterhout Dec. ¶¶ at 39-45, Appendix & Table 1.

⁸ It was not always clear how the BRT defined spawner counts when it calculated λ , or which populations the BRT lumped together or how. My results, therefore, may be slightly different from those others obtained from different population definitions. However, the overall conclusions should not be very different. I used Cooney, T. 2004. Updated trend data sets for Interior Columbia basin ESUs. http://www.salmonrecovery.gov/remand/analysis_reports/updated_interior_brt_trend_data.pdf October 14.

⁹ McClure, M. M., B. L. Sanderson, E. E. Holmes, and C. E. Jordan. 2000c. A large-scale, multi-species risk assessment: anadromous salmonids in the Columbia River basin. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. Submitted to Ecological Applications as of the date of the BiOp, then published in 2003, vol. 13:964-989.

then calculated the most current population growth rates (λ s) using the most recent years' data (generally 1980-2003, Cooney 2004). I calculated the percent survival change between λ s calculated from 1980-1999 data, compared to λ s calculated from 1980-2003 data, using the equation to convert from λ s to survival ratios on page A-3 of the 2000 FCRPS BiOp. I then used these updated survival increases to adjust the total “% necessary change” in survival targets shown in the 2000 FCRPS BiOp (p. A-20) so that the total survival increase needed (per the 2000 FCRPS BiOp) would reflect all the most recent data available through the Remand website.

12. Finally, I adjusted the survival increases expected from hydrosystem actions described for the Updated Proposed Action (“UPA”) to account for survival increases due to additional years of data, and in order to estimate how much of the survival increase still needed to achieve the standards employed in the 2000 FCRPS BiOp would have to come from something other than hydrosystem actions. In order to do this, I had to make some assumptions about how much survival improvement to expect from the hydro portion of the new UPA as compared to the hydro portion of the 2000 RPA. The 2004 FCRPS BiOp states in several places that the hydro portion of the UPA is essentially the same as the hydrosystem measures of the 2000 RPA,¹¹ so I used survival improvements NMFS expected from the hydrosystem portion of

¹⁰ Cited there as: Holmes, E. E. In review. Estimating risks for declining populations: salmonids as an example. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. Submitted to Ecological Applications. Eventually published as: Holmes, E. E. 2001. Estimating risks in declining populations with poor data. Proceedings of the National Academy of Sciences 98:5072-5077, except without the formulas for dealing with hatchery fish.

¹¹ “The differences in flow rates between the reference operations and UPA were not significant. Therefore, the effect on water temperature or other water quality parameters was not expected to be large” (Lohn 2004, p. 1-31). “The UPA continues most of the uncompleted and ongoing actions in the 2000 Biological Opinion. It refines the actions of the RPA into a new set of Federal actions based on adaptive management principles” (NMFS 2004, p. 3-1). “To a large extent, the UPA continues the implementation of many of the actions contained in the 2000

the 2000 RPA to represent survival improvements expected to come from the hydrosystem portion of the UPA.

13. Finally, I had to assume something about what has caused survival increases reflected in the growth rates calculated with 1980-2003 data. If I assumed increased trends all came from hydrosystem measures, that assumption would not be consistent with the available scientific evidence (which suggests survival improvements have been significantly affected by recent improved ocean conditions)¹² and also would not be not consistent with the fact that many of the hydrosystem measures in the 2000 RPA have not been implemented because they were not proposed for completion until 2010.¹³

Biological Opinion.” (NMFS 2004, p. 3-1). “Proposed hydro operations are expected to have only a minor effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring, when SR spring/summer chinook salmon are in these areas. Again, this is because the proposed hydro operation will result in only slightly lower spring flows than in the reference operation, and water quality is unlikely to be affected.” (NMFS 2004, p. 6-57). “As NOAA Fisheries progressed into comparisons with potential future system configurations, many of the passage and survival estimates were by necessity based on best professional judgments for which there are no confidence interval estimates. Recognizing that this may be a weakness, since the confidence intervals for these point estimates sometimes varies widely, NOAA Fisheries used the same passage route point estimates for both the reference and the 2004 proposed operation. In this base case analysis (which established the initial gap), the degree of uncertainty regarding any particular point estimate was common to both sides of the operational comparisons. These survival or passage parameter point estimates were adjusted upward in the gap analyses of future 2010 and 2014 configurations of the proposed operations. These departures from common data points may add to the uncertainty associated with these future condition gap analyses.” (NMFS 2004, p. D-6). “The spring transport operation specified in the reference operation is similar to the UPA proposal.” (NMFS 2004, p. D-16)

¹² “In the last decade, evidence has shown recurring, decadal-scale patterns of ocean-atmosphere climate variability in the North Pacific Ocean. These oceanic productivity ‘regimes’ have correlated with salmon population abundance in the Pacific Northwest and Alaska. Survival rates in the marine environment are strong determinants of population abundance for Pacific salmon and steelhead.” (NMFS 2004, p. 4-3)

¹³ The 2000 FCRPS BiOp analyses nonetheless did assume all these improvements had occurred (see, e.g., 2000 FCRPS BiOp at 9-202) (“The simple analytical approach used in this biological opinion assumes that all survival changes are instantaneous”) (statement for Snake River spring/summer chinook, similar language for other ESUs), even while acknowledging most had

14. Despite these countervailing facts, if I assumed all survival increases that NMFS “expected” to come from the hydrosystem as a result of hydro measures in the 2000 FCRPS BiOp could still be attributed to the hydro action in the UPA, then it gave the UPA the benefit of the doubt and minimized the amount of survival improvement that would have to come from something other than hydrosystem measures. To err on the side of favoring the effectiveness of the UPA, I chose this approach.

15. The improvements in λ between the 1980-1999 dataset NMFS used in the 2000 FCRPS BiOp, and the 1980-2003 dataset I used for this analysis, correspond to an average change in life-cycle survival of about 30%, ranging from a decrease of 14% (Upper Columbia River steelhead) to an increase of 90% (Methow steelhead).

16. My re-calculation of survival improvements needed to avoid jeopardy using the analytic approach and standards of the 2000 FCRPS BiOp and the most up-to-date information available for salmon returns (generally through 2003) is summarized in Table 2 (attached). After including survival improvements attributable to the hydrosystem measures of the UPA as described above, when the survival increases seen in 2000-2003 are included in population growth rate calculations (λ), some ESUs do not require as large an improvement in survival rates to avoid jeopardy as NMFS calculated in 2000 would be necessary.

17. However, the survival improvements for even these ESUs – and certainly for other ESUs – that still would be necessary to avoid jeopardy under the analytic framework of the 2000 FCRPS BiOp, after taking into account survival improvements from the proposed hydrosystem measures of the UPA, would still be quite large. Assuming that ocean conditions

not (*see, e.g.*, BSRS, Vol. 2 at 6) (addressing flow, passage and diversions for 15 priority subbasins within 10-16 years), 81 (implementing hydrosystem measures by 2010); *id.*, Vol. 1 at 48 to 53 (implementing various “immediate” measures “over the course of 10 years”).

continue to be as good for another 43 years as they have been in recent years, and that any survival increases achieved through hydrosystem improvements are sustained, and that spawning and rearing habitat conditions do not further degrade, Wenatchee chinook still need a sustained life-cycle survival increase of 162% - 183% (more than double to nearly triple); UCR steelhead need 115% - 321.3% (more than double to more than quadruple the current survival); SR steelhead need 131% - 424% (more than double to more than quintuple the current survival). SRFC and SRSSC are in relatively better shape, assuming recent survival rates can be sustained as noted.

18. Since there is no precedent for ocean survival rates to continue as high as they have been, and even extraordinary efforts could not halt freshwater habitat declines for many years, it is quite likely that the total survival increases required to meet the standard of the 2000 FCRPS BiOp for avoiding jeopardy, even using the most recent survival information, are substantially more than even the doubling to more than quintupling indicated by the current long-term trends of my revised calculations.

19. The stocks that will need the largest overall survival improvements are the ones for which the hydrosystem measures will provide the smallest portion of that improvement and for which the largest portion of survival improvement will have to come from non-hydrosystem mitigation measures – about 80% of the near-tripling in survival for Wenatchee spring chinook, 58% to 86% of the doubling to quintupling for Snake River steelhead, and 59% to 83% of the doubling to more than quadrupling for Upper Columbia River steelhead.

20. Moreover, under the analytic framework and assumptions employed in the 2000 FCRPS BiOp and employed in my re-calculation using the most up-to-date data, these increases would have to be achieved immediately and sustained through 2048 – even assuming the

hydrosystem measures were fully implemented and work as well as hoped, and that current excellent ocean survival rates persist another four decades.

21. My purpose in preparing and presenting these calculations of survival improvements using the most recent salmon return data is to provide a perspective on, and background information about, recent salmon and steelhead survival rates. This information is useful in understanding the scientific differences between the jeopardy analysis and framework NMFS employed in the 2000 FCRPS BiOp, and the analysis and framework it employs in the 2004 FCRPS BiOp. What my analyses show is that if NMFS had employed the same approach and framework in the 2004 FCRPS BiOp that it employed in 2000 for estimating the survival improvements necessary to avoid jeopardy, and if it had taken into account all of the available information on recent salmon and steelhead returns, such an analysis would show:

- (1) the survival improvements necessary to avoid jeopardy to the ESA-listed ESUs under the 2000 FCRPS BiOp analytic framework are still very large for most ESUs;
- (2) the fraction of these survival improvements that would be provided by the hydrosystem measures of the UPA is small for almost all of the ESUs and smallest for the ESUs that would require the largest overall survival improvement; and
- (3) because the 2004 FCRPS BiOp does not employ the analytic framework of the 2000 FCRPS BiOp, it is not possible to determine whether the off-site mitigation actions included in the UPA of the 2004 FCRPS BiOp are likely to provide the remaining survival improvements necessary to meet the jeopardy standard of the 2000 FCRPS BiOp.

III. NMFS USE OF MODELS IN THE 2004 FCRPS BIOP

22. NMFS employed two models in the 2004 FCRPS BiOp, one used by Fisher and Hinrichsen to estimate “current” population growth rates (Fisher & Hinrichsen 2004; NMFS 2004, p. 4-5), and the other the SIMPAS model employed to calculate the “gap” between the effects of the hydrosystem portions of the agency’s hypothetical reference operation and the effects of the hydrosystem portion of the UPA (NMFS 2004, Appendix D). The Fisher and

Hinrichsen method essentially fits a line through transformed abundance data from 1994 to 1999 and again from 2000 to 2003 in order to estimate and compare population growth trends over these brief periods (Fisher & Hinrichsen 2004, p. 1; NMFS 2004, p. 4-5). The SIMPAS model calculates point estimates for hydrosystem passage survival in terms of specific numbers of fish and NMFS uses these numbers to compare the differences in survival between the UPA and reference operation hydrosystem measures (NMFS 2004, Appendix D). NMFS calls this its “gap analysis” (NMFS 2004, e.g. 6-6).

A. NMFS’ Use of the SIMPAS Model Has Been Criticized.

23. NMFS uses the SIMPAS model in the 2004 FCRPS BiOp to determine whether the hydrosystem measures of the UPA will have a negative effect on any ESU as compared to the effects of the hypothetical hydrosystem reference operation. As NMFS acknowledges, the SIMPAS model has been widely criticized:

“A number of reviewers commented on the shortcomings of the SIMPAS model. For example, commenters stated that the model: is too simple; is not a life cycle model; was designed to be used in a qualitative rather than relative sense; used only point estimates of survival and passage efficiencies; did not use a time step function; underestimated spill passage at some dams; or overestimated survival for low flow conditions. To answer these concerns, NOAA Fisheries would first point out that the SIMPAS model is a deterministic analytical tool for use in comparing two or more system (or project) operations or system configuration changes to obtain relative differences in juvenile survival between the head of Lower Granite Pool and the head of the estuary. It is not a life cycle model, nor does it need to be to serve its intended purpose. The differential delayed survival factor “D” for fish transportation is used in the model only as a weighting mechanism to allow a fair recombination of in-river and transported juveniles in the reach below Bonneville Dam. The model is not typically used to determine absolute numbers of surviving juveniles below Bonneville Dam and is not used to estimate the absolute number of returning adults to the Columbia River.” (2004 FCRPS BiOp at D-5)

24. This paragraph generally captures most of the well-established criticisms of

SIMPAS (e.g., NMFS),¹⁴ and these criticisms have been extensively documented by, among others, the ISAB,¹⁵ CRITFC,¹⁶ IDFG, Nez Perce, ODFW, Shoshone Bannock Tribe, USFWS, and WDFW.¹⁷ The paragraph also captures NMFS' response to these criticisms. Table 3 (attached) lists the major substantive criticisms of the model (identifying their source), and identifies and summarizes NMFS' response to each.

25. The criticism that SIMPAS is too simple (#1 in Table 3) has been raised because SIMPAS is a very simple Excel table that does not account for complex, variable season-to-season and year-to-year impacts that are largely due to climate and the FCRPS. Inputs to SIMPAS are only seasonal averages¹⁸ often based on data from only a few years or even only one year (NMFS 2004, p. D-4). In the real world, impacts on fish vary greatly over days, months, and years, and accumulate as the fish move through the system. When a model restricts inputs to single-estimate parameters lumped across time periods, the cumulative impacts of, say, two bad years in a row, which can be substantial for such vulnerable populations, are effectively omitted, and can minimize the calculated impacts on fish.

26. The rationale NMFS offers for employing SIMPAS despite its limitations is that it

¹⁴ See the 2000 FCRPS BiOp Appendix on SIMPAS. (NMFS 2000 at D-2, D-9)

¹⁵ For example, ISAB 2001. Executive Summary Re: ISAB consultation recommendations on Council Staff's Draft Issue Paper: "Analysis of 2001 Federal Columbia River Power System Operations on Fish Survival." (ISAB 2001)

¹⁶ For example, CRITFC June 14, 2004 comments on the COE's and BPA's June 8, 2004 Amended Proposal for Federal Columbia River Power System Summer Juvenile Bypass Spill Options, as well as the June 14 comments by the State, Federal and Tribal Fishery Agencies Joint Technical Staff.

¹⁷ For a summary of state, federal, and tribal comments see June 14 comments on the COE's and BPA's June 8, 2004 Amended Proposal (Joint Technical Staff 2004b).

¹⁸ "For each species, model input includes: • Seasonal average flows and spill levels • Pool survival estimates including a predation adjustment factor • Average spill, sluiceway, and bypass guidance efficiency estimates • Average survival rates through various passage routes and reservoirs." (NMFS 2004, p. D-3)

is supposed to be a simple model because:

“NOAA Fisheries’ goal was to use the model as an analytical tool to provide reasonable relative survival differences between proposed operations or configuration changes and a reference, or baseline, operation, while maintaining a high degree of transparency to reviewers. Incorporating a large number of functional response curves (or submodels) to try to express temperature, predation, or dissolved gas functions defeats the purpose of a simple modeling approach and would have significantly increased the complexity and decreased the transparency of the model.” (NMFS 2004, p. D-5)

27. NMFS’ response identifies transparency and the need for a large number of functional response curves as reasons to use SIMPAS despite its simplicity. Providing transparency is important, but it does not require relying on a model that is too simple to appropriately address the questions (Hilborn and Mangel 1997). NMFS does not provide supporting documentation for its statement that it used SIMPAS in the 2004 FCRPS BiOp because it needed “a large number of functional response curves (or submodels).”

28. The criticism that SIMPAS is not a stochastic or life-cycle model (#2 in Table 3) is related to the “too simple” criticism #1. This concern has been raised repeatedly¹⁹ because stochastic life-cycle models allow inputs that represent the range of variability over the entire life-cycle that are characteristic of a complex system like the Columbia River and FCRPS, and they provide outputs in terms of probability distributions, not point estimates. Probabilistic output is the standard in conservation biology (e.g., Burgman et al. 1993; NRC 1995) because the question at hand in this field – and under the ESA – is often risk: the likelihood of a particular reduction in a species’ prospects of survival and recovery for example. The single point prediction (without even confidence intervals to indicate the range of results) produced by a deterministic model like SIMPAS sheds virtually no light on this fundamental question.

¹⁹ For example, just in the most recent draft BiOp, these concerns were raised by the Nez Perce Tribe, Colville Tribe, and State of Idaho (Lohn 2004, p. 1-29); State of Oregon (Lohn 2004, p. 1-33), Fish Passage Center and CRITFC (Lohn 2004, p. 1-34).

29. NMFS did conduct some sensitivity analyses to help address this concern, but sensitivity analyses for point estimates are not the scientific equivalent of incorporating ecological, climate, and seasonal variability into the analysis itself as stochastic models do.

30. In the paragraph quoted above (in my paragraph 23) where NMFS responds to this concern, NMFS says that SIMPAS is not deterministic, it is used to obtain relative differences, it is not a life-cycle model and does not need to be, that “D” is used only as a weighting mechanism, and it is not used to determine absolute numbers of juvenile or adult survivors (NMFS 2004, p. D-5).

31. NMFS states that it is acceptable to use the simpler model structure of SIMPAS because the question is about *relative* differences. But as CRITFC showed,²⁰ calculated differences (or non-differences) between scenarios using SIMPAS can be very sensitive to small changes in parameters and thus to even small variabilities that SIMPAS does not and cannot incorporate. Using a stochastic life-cycle model as reviewers suggested, rather than SIMPAS, would allow for more accurate and informative comparisons of “two or more system (or project) operations or system configuration changes to obtain relative differences in juvenile survival” because such a model can incorporate relevant factors about fish survival over the whole life-cycle, including their response to variability in hydrosystem operations and the environment as well as providing probability distributions representing ranges of responses to that variability, and thus probabilities of various outcomes.

²⁰ As I explained in an earlier declaration, CRITFC showed that “...making one small change to the SIMPAS analysis presented by NMFS (increasing reservoir mortality at the Dalles from 2% to 3%, a change within the bounds of uncertainty for just that one reservoir), resulted in a 37% (561 fish) additional loss of Snake River fall chinook migrants above the Action Agencies’ Snake River fall chinook loss estimates (Joint Technical Staff 2004b at 3).” Second Declaration of Gretchen Oosterhout, Ph.D. (“Oosterhout Spill Dec.”) at ¶ 52 (filed July 16, 2004).

32. Criticism #3 in Table 3 (that the benefits assumed for RSWs in SIMPAS modeling are too speculative) is based on concerns that there is very little data about survival rates for RSWs, that current data show spill is as effective or more effective than RSWs, that the limited data for RSWs at Lower Granite Dam cannot be used to extrapolate to other projects because migrant behavior changes the further the fish get downstream, and that overall, the assumed benefits of RSW installations are speculative. These concerns were expressed by the Fish Passage Center, the State of Alaska, and CRITFC (see footnote 46). NMFS responds to this concern by stating that it "...calls on the Action Agencies to 'evaluate juvenile project-specific passage survival both before and after configuration and/or operational modifications'" (see footnote 46). This statement is not an analysis or statement of reasons for assuming the survival improvements from RSWs will occur as NMFS' gap analysis does.

33. Finally, the most substantive issue raised in Table 3 is #4, the overall failure of SIMPAS to take uncertainty and errors into account. As I said in my spill declaration, Oosterhout Spill Dec. at ¶¶ 50-53, SIMPAS includes no accounting for uncertainty and produces no estimate of uncertainty, which is contrary to the prevailing practice in conservation biology modeling (Burgman et al. 1993, NRC 1995). Research has repeatedly shown that predictions based on point estimates of historical averages tend to produce overly optimistic conclusions because they underestimate the impacts of uncertainty, ignore the potential for errors, and fail to take into explicit account the well-documented unexpectedness and variability of natural systems (Burgman et al. 1993; Glickman and Gough 1990; Hilborn and Walters 1992).

34. As I also said in my spill declaration, Oosterhout Spill Dec. at ¶ 65, because SIMPAS does not incorporate uncertainty or variability it cannot provide conservative estimates of risk without a credible external correction factor. I quoted the ISAB (ISAB 2001 at 2):

“...it is not appropriate to develop a long-range management plan just on the basis of results from assuming that these uncertain estimates are true. “Best science” under these circumstances would explore the results from a range of assumptions corresponding to the range of the uncertainty. “Best professional judgment” under these circumstances would recommend a course of action that was predicted to perform acceptably throughout the range of predicted possible outcomes. “Precautionary” best professional judgment would be sensitive to plausible worst cases within the range of predicted possible outcomes.”

35. I also pointed out in paragraph 66 of my spill declaration that the Action Agencies agreed, quoting COE and BPA 2004, Appendix A at 3:

“Risk and uncertainty can be mitigated further by erring on the side of fish in the offset calculations and in the extent of biological offsets that are implemented. For instance, implementing offsets that are estimated to increase survival by 10,000 adult returns can alleviate the risk and uncertainty of implementing an operation that is estimated to decrease survival by 5,000 adult returns.”

In the 2004 FCRPS BiOp, NMFS also acknowledges uncertainty and appears to recognize a responsibility to err on the side of the fish:

“Available science is unable to resolve significant uncertainty in all parts of this analysis. NOAA Fisheries must identify and acknowledge the full range of scientific uncertainty in reaching its final conclusion. Where scientific gaps remain, NOAA Fisheries is expected to provide the benefit of the doubt to the listed species (ESA Section 7 Consultation Handbook, p. 1-6). A key question is whether or not the uncertainty is greater in the analysis of the presumed positive effects of non-hydro offsets compared to presumed negative effects of hydro operations, or if the level of uncertainty is comparable. Therefore, NOAA Fisheries has taken a conservative approach to estimate the benefit of the proposed action.” (NMFS 2004, p. 8-3)

36. One rationale offered by NMFS for not using modeling that account for uncertainty is that the point estimates in SIMPAS are based on a wide range of data (NMFS 2004, p. D-4). The SIMPAS model, however, cannot use *ranges* of data because it relies entirely on *average* values. Even if these average values are derived from a “wide range of data” once the data are averaged, the *range* of the data is lost. NMFS says that “To address these limitations, the NOAA Fisheries staff used all the most recent empirical passive integrated transponder (PIT)-tag reach survival information collected from 1994 through 2003 to evaluate a

wide range of fish passage and environmental conditions for yearling and subyearling chinook and steelhead. Because water conditions during this 10-year period ranged from low flow (in 2001) to high flow (1997), this approach demonstrated the modeled variation in juvenile passage survival resulting from different environmental (and the resulting operational) conditions” (NMFS 2004, p. D-2). SIMPAS, however, does not model the “wide range of fish passage and environmental conditions,” it can only model the *average* values calculated from of those ranges. Modeling an average value and modeling a range of values are scientifically different: the former provides a single number with no indication of the range that single number represents, whereas the latter provides, for example, high and low end results, and can be used to provide much more, e.g., seasonal and cumulative effects of seasonal and year-to-year variability.

B. NMFS Use of the New Fisher and Hinrichsen Model in the 2004 FCRPS BiOp.

37. The SIMPAS model was not, and could not be, used to evaluate the current growth rates of ESA-listed salmon and steelhead populations. Instead, NMFS relied on the 2004 Status Review (which analyzed data through 2001),²¹ an update of that review that included data through 2003 (Cooney 2004²²), and the Fisher and Hinrichsen analyses of most recent year

²¹ A citation is not provided in this section of the 2004 FCRPS BiOp to clarify which BRT report is referred to, but the only BRT report cited in the “Literature cited” chapter of the opinion is “BRT (Biological Review Team) 2003 Draft status review update for West Coast steelhead from Washington, Idaho, Oregon, and California. National Marine Fisheries Service, West Coast Steelhead BRT, Seattle, WA.” This appears to be a reference to a report on NMFS’ website entitled “Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead,” 2/19/03, from <http://www.nwfsc.noaa.gov/trt/brtrpt.htm>, specifically the chapter on steelhead (Biological Review Team 2003. Draft Report of Updated Status of Listed ESUs of Salmon and Steelhead – steelhead. Draft report on stock status by the Biological Review Team posted for public review on the Internet (http://www.salmonrecovery.gov/R_Analysis.shtml)).

²² The only reference provided in the 2004 FCRPS BiOp for this update was to an Excel workbook that did not have trend or other population growth rate analysis but did have abundance and age structure data in it (“Cooney, T. 2004. Updated trend data sets for Interior Columbia basin ESUs”).

returns (NMFS 2004, p. 4-3). Although the BRT status review did include analyses of population growth trends and performance measures as laid out in the 2000 FCRPS BiOp to track progress under the 2000 FCRPS BiOp RPA (Biological Review Team 2003a, b, c), the numerical population growth trends reported in the 2004 FCRPS BiOp are not from these BRT reports.

38. Instead, although NMFS refers to the 2004 Status Review's trend calculations (through 2001) as being generally "increasing" or "decreasing," the only productivity trend estimates the 2004 FCRPS BiOp actually reported were calculated using a method that NMFS states has not been reviewed,²³ and using a different set of data. This analysis, the Fisher and Hinrichsen analysis, is discussed below. NMFS represents this new method as being the same as that used by the BRT ("Their [Fisher and Hinrichsen] methods were taken from those used by NOAA Fisheries' BRT (2003)" (NMFS 2004, p. 4-5)). A comparison of the Fisher and Hinrichsen methods²⁴ and the BRT methods section²⁵ shows that these two reports did not use the same methods.

http://www.salmonrecovery.gov/remand/analysis_reports/updated_interior_brt_trend_data.pdf October 14).

²³ "Neither the BRT nor the Interior TRT has reviewed Fisher and Hinrichsen (2004) or Fisher (2004)" 2004 FCRPS BiOp at 4-5.

²⁴ "Fisher and Hinrichsen (2004) provided a preliminary evaluation of the effects of recent natural-origin spring chinook returns on past geometric mean abundance levels and population trends. The latter were calculated as the slope of the regression line for the (log transformed) index of abundance over time." (NMFS 2004, p. 4-5)

²⁵ The BRT draft status review, like other BRT analyses since the 2000 FCRPS BiOp, did not use the Fisher and Hinrichsen geometric mean method, but instead used λ : "A multi-step process based on methods developed by Holmes (2001), Holmes and Fagan (2002) and described in McClure et al. (in press) was used to calculate estimates for λ , its 95% confidence intervals, and its probability of decline [$P(\lambda < 1)$]" (Biological Review Team 2003c, p. 17).

1. *NMFS' Prior Assessment of the Methods Used in the 2000 FCRPS BiOp.*

39. As NMFS scientists have explained, statistical and simulation models, ranging from various methods for fitting lines through spawner or recruits/spawner data, to relatively more complex life-cycle models, are widely used for quantifying current population trends in order to inform decisions about current and future risk (CRI 2000; Holmes 2000; 2001; 2004; McClure et al. 2000; Burgman et al. 1993; NRC 1995). When employed properly, models can be the best available science; when employed improperly, they are useless at best and can be misleading.

40. NMFS scientists have provided a considerable volume of analysis to support using the methodology discussed in paragraphs 10-21 above and employed in the 2000 FCRPS BiOp jeopardy analysis as the best practical indicator of population growth trends and risk.²⁶

The multitude of papers towards this end includes white papers or other “grey” literature such as:

Appendix A from the 2000 FCRPS BiOp,

CRI 1999. CRI assessment of management actions aimed at Snake River salmonids. Cumulative Risk Initiative, Northwest Fisheries Science Center NMFS - NOAA, Seattle, WA.

Biological Review Team 2003. Draft Report of Updated Status of Listed ESUs of Salmon and Steelhead - chinook. Draft report on stock status by the Biological Review Team posted for public review on the Internet (http://www.salmonrecovery.gov/R_Analysis.shtml). NOAA Fisheries.

Biological Review Team 2003. Draft Report of Updated Status of Listed ESUs of Salmon and Steelhead - steelhead. Draft report on stock status by the Biological Review Team posted for public review on the Internet (http://www.salmonrecovery.gov/R_Analysis.shtml). NOAA Fisheries.

²⁶ Even though the methods themselves have been widely reviewed, some of the scientific criticisms that have been raised about these methods have not been fully addressed (for example, see NWFSC 2003, in particular sections by Hinrichsen (pp. 3.1 – 3.9), Paulsen (pp. 3.10-3.14), Ryding (pp. 3.15-3.23). In addition, of course, these models still may be put to uses for which they are not scientifically appropriate.

Toole, C. 2003. Preliminary Estimates of Updated “Indicator Metrics” Applied in the 2000 FCRPS Biological Opinion. Hydro Division, NOAA Fisheries Northwest Region, 500 N.E. Oregon St., Portland, Oregon 97232-2737, Portland.

Holmes, E. E. 2004. Beyond theory to application and evaluation: diffusion approximations for population viability analysis. In press in *Ecological Applications*.

And peer-reviewed publications such as:

Fagan, W. F., E. E. Holmes, J. J. Rango, A. Folarin, J. A. Sorensen, J. E. Lippe, and N. E. McIntyre. 2003. Cross-validation of quasi-extinction risks from real time series: an examination of diffusion approximation methods. Pre-print.

McClure, M., E. Holmes, B. Sanderson, and C. Jordan. 2003. A large-scale, multi-species risk assessment: anadromous salmonids in the Columbia River Basin. *Ecological Applications* 13: 964-989.

Holmes, E. E. and W. F. Fagan. 2002. Validating population viability analysis for corrupted data sets. *Ecology* 83: 2379-2386.

Holmes, E. E. 2001. Estimating risks in declining populations with poor data. *Proceedings of the National Academy of Science* 98: 5072-5077.

41. NMFS scientists have argued that the methods used in the 2000 FCRPS BiOp, and for tracking population growth rates and changes in these since then (up to the 2004 FCRPS BiOp), are appropriate because:

“Diffusion approximation approaches for estimation of risk metrics are grounded in theoretical work on stochastic population processes (reviewed in Holmes and Fagan 2002 and Holmes 2004). These methods are one of the basic quantitative tools in population viability analysis and are featured in two current books on quantitative methods for analyzing population data (Lande et al. 2003, Morris and Doak 2003). The long-term rate of population growth is termed λ and is one of the most commonly used risk metrics within the field of conservation biology.” (NWFSC 2003, p. 2.14)

Others agreed. Independent reviewers commissioned by NMFS to evaluate different methods for estimating current population trends and extinction metrics stated that:

“Our conclusions are that the DA²⁷ approach has been rigorously evaluated, has undergone better scientific peer review than any current methods used for threatened species assessment, and provides the best available approach for objectively estimating and comparing population status for salmonids. Although some further work may still be helpful, these methods are very strong and should be accepted as the current standard.” (Deutschman and Heppell in NWFSC 2003, p. 4.3)

2. *NMFS Uses Different Methods to Assess Population Trends in the 2004 FCRPS BiOp.*

42. NMFS did not use the above methods to calculate the current long-term salmon and steelhead ESU growth rates using the most up-to-date data in the 2004 FCRPS BiOp, even though the 2004 Status Review cited there did report results using these methods for data available through 2001. (Biological Review Team 2003a, e.g., p. 5 for Snake River fall chinook or p. 10 for Snake River spring chinook, or p. 21 for Upper Columbia River spring chinook).

43. NMFS’ explanation for limiting or eliminating its reliance on the methods for evaluating current population trends it has been using appears to be that: “[t]he previous analysis depended upon a prospective, range-wide evaluation of the likelihood of survival and recovery, projecting species survival rates up to 100 years in the future under reasonable scenarios of activities that would affect survival and recovery. This analysis required an estimation of the beneficial and harmful effects of future Federal and non-Federal actions.” (NMFS 2004, p. 1-5)

44. NMFS use of the methods in the 2000 FCRPS BiOp for calculating current population trends is laid out clearly in Appendix A to that Opinion. (NMFS 2000). Appendix A indicates that step 1 consisted of “1) Define the recent population trend, based on adult returns from 1980 through the most recent year available.” (NMFS 2000, p. A-4). A later step required NMFS to “Compare the change in survival resulting from the proposed action with the necessary

²⁷ “DA” is Diffusion Approximation, the method used by NMFS to estimate current population growth rates in the 2000 BiOp and for status reviews since then (e.g., Biological Review Team 2003a, b; NWFSC 2003; Toole 2003).

change defined in step 2.” (NMFS 2000, p. A-4) It is important to recognize that the metric which was the focus of the modeling in appendix A, λ , is only an estimate of current population trends.

45. As lines fit through spawner counts (albeit using sophisticated statistical techniques), current trend estimates do not and could not represent future activities. Expressing future risks if the current population trend continues is simply a mathematical projection of the current population growth rate (or rate of decline) into the future (NMFS 2000 p. A-7), and does not require or involve any assumption about actions that *specifically* will or won't occur in the future. Without assessing future risk based on current conditions, efforts to identify and conserve threatened and endangered species would be scientifically almost impossible.

46. In the 2000 FCRPS BiOp NMFS compared its calculation of current population growth rates to a growth target that NMFS concluded would be sufficient to avoid jeopardy (see, for example, the table headings summarizing the analysis of effects for each ESU in the 2000 BiOp, e.g., p. 9-201 for Snake River spring chinook, 9-206 for Snake River fall chinook, etc.: “1980-to-current λ ,” “Additional change in survival needed to achieve 50% recovery in 48 years”). Setting this growth rate target also did not require a “prospective” analysis of future conditions. It simply required NMFS to select a target that it believed would avoid an appreciable reduction in both survival and recovery.

47. NMFS also evaluated whether the RPA and other offsite measures it considered in the 2000 FCRPS BiOp would change (improve) the current population growth rates for each ESU enough to meet the targets it set as the survival and recovery components of its jeopardy standard. At this step NMFS undertook an analysis that was “ultimately qualitative,” (e.g., NMFS 2000 p. 9-15: “NMFS has determined that the offsite measures described in this RPA, as

enhanced and modified through the 1- and 5-year planning process, and together with the measures identified in the Basinwide Recovery Strategy, are sufficient to achieve the biological requirements of the listed ESUs and, thus, sufficient to avoid jeopardy and adverse modification of critical habitat. This determination is made with full consideration of the additional increments of improvement needed, as reported in Table 9.2-4. However, NMFS determination is ultimately qualitative, informed (to the extent possible) by this standardized quantitative analysis.). This step – assessing the likely future impacts of a proposed action quantitatively or qualitatively – is required for any evaluation of the effects of any action that has not yet occurred. Moreover, only the portion of this analysis in the 2000 FCRPS BiOp that evaluated the expected future benefits of the hydrosystem measures of the RPA involved NMFS’ methods for calculating long-term population growth rates, and then only to translate survival improvements NMFS had calculated for these hydrosystem measures using other analytic tools into a change in growth rates.

C. NMFS Employs a Short Time-Series of Survival Data in a New Study It Cites in the 2004 FCRPS BiOp.

48. NMFS scientists also have put considerable effort into providing a scientific basis for the use of 1980-to-most-recent-year data in evaluating current population status until the 2004 FCRPS BiOp where the agency places significant emphasis on the recent unreviewed analysis by Fisher and Hinrichsen (identified above) that employs a much shorter time series (NMFS 2004, p. 4-5).

49. Spawner and redd count data tends to exhibit trends that look more or less cyclic, for reasons believed by most researchers (including NMFS) to do primarily with climate,

especially ocean cycles (e.g., p. 4-3²⁸ and 5-50²⁹). Because of this, calculated or apparent trends are sensitive to the start and end points of quantitative or qualitative analysis. Therefore, as NMFS scientists and others have pointed out,³⁰ it is widely recognized that the choice of time period to use for assessing current status is an important factor. The 2004 FCRPS BiOp itself acknowledges that it is the periods of low survival that will constrain recovery.³¹ In order to assess the most current trends, however, NMFS emphasizes in the 2004 FCRPS BiOp an analysis

²⁸ “In the last decade, evidence has shown recurring, decadal-scale patterns of ocean-atmosphere climate variability in the North Pacific Ocean. These oceanic productivity ‘regimes’ have correlated with salmon population abundance in the Pacific Northwest and Alaska. Survival rates in the marine environment are strong determinants of population abundance for Pacific salmon and steelhead.” (NMFS 2004, p. 4-3)

²⁹ “For example, large-scale climatic regimes, such as El Niño, affect changes in ocean productivity. Much of the Pacific Coast was subject to a series of very dry years during the first part of the 1990s and since 2000. In the latter 1990s, severe flooding adversely affected some stocks. For example, the low return of Lewis River bright fall chinook salmon in 1999 is attributed to flood events during 1995 and 1996. Among the known variations in ocean conditions are the phenomena termed El Niño and the Pacific Decadal Oscillation (PDO).” (NMFS 2004, p. 5-50)

³⁰ One of NWFSC’s leading modelers has said that “. . . selection of a reasonable time frame is very important. The following considerations should generally be kept in mind when selecting the time frame to use: a) more data is better, b) the time frame should be representative of historical trends, i.e. not be dominated by ‘good’ or ‘bad’ conditions and not dominated by an isolated perturbation and c) for the sake of uniformity and comparison, the time frame should be consistent across stocks. . . . My initial analysis suggested that 1976-present would generally be a better time frame to use, although this does suffer from dam effects in the early years for some stocks. The 1984-present data could also be used to avoid the 1978-82 period, however, a strong argument can be made that this overly emphasizes a period characterized by bad ocean conditions” (Eli Holmes in NWFSC 2003, p. 2-18). Another NWFSC scientist developed some examples of how sensitive λ is to choice of time period, concluding that “These generally indicate that the shorter the time period, the greater the uncertainty regarding the estimate of λ .” (Toole 2003, p. 8)

³¹ “Recent evidence suggests that marine survival of salmonids fluctuates in response to the PDO’s 20- to 30-year cycles of climatic conditions and ocean productivity (Cramer et al. 1999). Ocean conditions that affect the productivity of Northwest salmonid populations appear to have been in a low phase of the cycle for some time and to have been an important contributor to the decline of many stocks. The survival and recovery of these species will depend on their ability to persist through periods of low natural survival” (NMFS 2004, p. 5-52).

by Fisher and Hinrichsen that uses a time frame that is much shorter than the 1980 to present time-series NMFS has used in the past.³² The Fisher and Hinrichsen analysis models a shorter time period that begins in the worst period of adult returns (1990s) and ends in the best period (2001-2003).

50. NMFS says that the Fisher and Hinrichsen analyses are intended to show how recent higher returns affect previous population estimates.³³ The Fisher and Hinrichsen analysis does not do this because it only focuses on the most recent years (1990 at the earliest), which constitute at most half a climate cycle, and hence it is not comparable to the previous NMFS estimates using a longer time series that more likely covered a full climate cycle.

51. NMFS also relies on the Fisher and Hinrichsen analyses as the basis for statements such as “The slope of the trend for the natural-origin population increased 17% (from 0.97 to 1.14) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least for the short-term, the natural-origin population has been increasing” (NMFS 2004, p. 4-5 for Snake River spring chinook, similar statements for fall chinook and steelhead ESUs). Similarly, “However, recent adult returns and short-term productivity trends that are at or above replacement indicate reduced range-wide risk, at least in the short term, and thus some tolerance for additional short-term risk” (NMFS 2004, p. 8-7) for

³² “Fisher and Hinrichsen (2004) provided a preliminary evaluation of the effects of recent natural-origin spring chinook returns on past geometric mean abundance levels and population trends. The latter were calculated as the slope of the regression line for the (log transformed) index of abundance over time. They assessed whether the geomean was greater when calculated from the most recent data (beginning in 2001) compared to a base period (1996-2000) and whether the trend was greater when counts for 2001-2003 were added to the 1990-2000 data series” (NMFS 2004, p. 4-5).

³³ “Fisher and Hinrichsen (2004) provided a preliminary evaluation of the effects of recent natural-origin spring chinook returns on past geometric mean abundance levels and population trends” (NMFS 2004, p. 4-5 for Snake River spring chinook, similar statements for fall chinook and steelhead ESUs).

Snake River spring chinook, similar statements for other ESUs}.

52. These statements about what the Fisher and Hinrichsen analyses show are not scientifically accurate because their analysis does not actually capture changes to long-term population growth trends. This is because, while returns in 2000-2003 were up for most ESUs, and the 1990s saw some of the worst returns on record, analyses that compare the last four years, to even the last 14 years, are strongly affected by the nonstationarity³⁴ characteristic of these shorter data sets. This nonstationarity is due to the apparent climate regime shift around 1998-2000 (NWFSC 2003, p. 4.10). Basing an analysis on a comparison of data from the trough at the start point and the peak at the end point of this short period will show a maximum increase, whereas a line fit through the longer period of data capturing a whole cycle will tend to capture more accurately the long-term population trend and thus the population risk this trend poses.

IV. NMFS' "NET EFFECTS ANALYSIS" IN THE 2004 FCRPS BIOP

53. NMFS "net effects" analysis in the 2004 FCRPS BiOp, which first attempts to identify the difference in effects between the hydrosystem measures of the UPA and those of the "reference operation," and then to determine whether any negative effects of the UPA can be mitigated to have no net effects or a positive effect on the ESA-listed ESUs, is the central scientific analysis of effects in the 2004 FCRPS BiOp. It proceeds as follows. First, NMFS uses the SIMPAS model to determine quantitatively whether the hydrosystem elements of the UPA will have a net negative effect on any ESU as compared to the effects of the hypothetical hydrosystem reference operation (NMFS 2004, Appendix D). Second, for any ESU for which

³⁴ Stationarity in a dataset requires that the average stock-recruitment relationship be constant over time, or that "one must assume that no underlying change occurred while the data were collected" (Hilborn and Walters 1992). Short datasets that are part of longer term repetitive cycles may look stationary, but when longer term cyclic behavior is apparent, to truly be stationary, a longer dataset is generally needed to represent the whole cycle rather than just an increasing or decreasing subset of it.

NMFS finds a net negative effect from the hydro measures of the UPA, it then assesses qualitatively whether the UPA's offsite measures in tributaries and the estuary can, over time, mitigate the net negative effect of the UPA's hydrosystem measures to the point of "no net effect" or a beneficial effect by 2014 (NMFS 2004, Appendix E and Chapter 6).

54. This second step relies on the mathematically simple assumption that an adverse effect on survival in one life stage can be offset by a comparable increase in survival in another life stage.³⁵ Based on this assumption, NMFS assesses qualitatively whether the off-site measures of the UPA can compensate for the negative effects of the UPA's hydro measures and concludes for each ESU that they can – at least by 2014. (NMFS 2004, p. 6-99, 6-109, 6-116, etc.)

55. I have described above at paragraphs 23-36 criticism of NMFS' use of the SIMPAS model to determine the gap between the hydrosystem effects of the UPA and the reference operation, NMFS' response to this criticism, and the relationship between the criticism and the response. In this section, I explain that the second step of NMFS' analysis of net effects is not consistent with established methods for making comparisons among measures, and that its key assumption for making these tradeoffs does not appear to take into account basic features of population dynamics.

A. NMFS' Methods for Evaluating Whether Negative Hydrosystem Impacts Could Be Offset by Offsite Measures.

56. The method that NMFS developed for evaluating whether negative impacts from

³⁵ "For the jeopardy analysis, the underlying assumption in the net effects determination is that a relative (i.e., proportional) change in a factor relevant to VSP characteristics in one life stage can be offset by a comparable proportional change in another life stage. This can be demonstrated quantitatively for survival rates, as shown in Tables 6.2a and 6.2b, since cumulative survival through successive life stages is multiplicative. NOAA Fisheries also assumes that it can be applied to qualitative assessments of the benefits of habitat modifications affecting different life stages." (NMFS 2004, p. 6-6)

the hydrosystem measures of the UPA could be offset by offsite tributary mitigation is described as follows:

“The question of whether there is potential to improve anadromous salmonid population status through improvements to habitat conditions in tributary environments was considered in the context of the four Viable Salmon Population (VSP) criteria: abundance, productivity, diversity, and distribution. To address this question by ESU, NOAA Fisheries qualitatively evaluated trends in population status and associated tributary habitat condition and considered the potential to address identified habitat limitations sufficiently to elicit a response in population status. NOAA Fisheries also considered changes in population distributions within ESUs. As a first cut, NOAA Fisheries ascribed qualitative rankings (very high, high, medium, low, and very low) to population and habitat parameters, based on the magnitude of the observed or potential change. NOAA Fisheries coarsely translated qualitative rankings in order to compare habitat improvement potential against quantitative estimates of hydropower mortality. Staff derived the conversions qualitatively from both the observed declines in population status from the reference period to the present and from the estimated potential to improve population status from tributary non-hydro offsets.” (NMFS 2004, p. E3-1)

57. Specifically, the steps in producing these rankings for tributary habitat were

(NMFS 2004, p. E3-1 to E3-3):

1. Evaluate population abundance and distribution trends by comparing current counts to historical counts.
2. Evaluate habitat conditions relative to historical conditions.
3. Evaluate limiting factors and ranked according to relative impacts on populations.
4. Integrate first three steps to evaluate relative restoration potential, taking into account “legal, social, political, or economic constraints.”
5. Coarsely translate those qualitative rankings to compare to proportional estimates of hydropower survival increases, based on observed declines and potential for improvement.

58. The specific steps were a little different for estuary habitat, but the overall approach of ranking and rating different limiting factors and translating estuary rankings to proportional estimates of hydropower survival increases is similar.³⁶

³⁶ “To rate the importance of each limiting factor, the Science Center developed a simple rating system that ranked each factor as having a high, medium, or low ability to improve the status of anadromous salmon populations. Inferences were drawn regarding how each limiting factor affects an ESU, based upon the life history type of that ESU and how staff believed the factor

59. Both the tributary and the estuary analyses use a combination of “rankings” and “ratings,” and absolute and relative estimates of both. *Rankings* – which order a list of things compared to each other – by definition are always relative, and are subject to well-known cognitive biases (see, for example (Russo & Shoemaker 1989; von Winterfeldt & Edwards 1986)). *Ratings* assign scores or points to attributes (Anderson 2002; Keeney 1992; Keeney & Raiffa 1976; von Winterfeldt & Edwards 1986). Ratings can be additive and independent, so that it is possible to add up scores across attributes in order to evaluate tradeoffs in formal decision analysis. Rankings are not additive and independent and thus cannot be used to evaluate tradeoffs between, for example, one set of one kind of actions according to their rankings, and another set of another kind of actions according to their rankings (Keeney 1992; von Winterfeldt & Edwards 1986).

60. NMFS’ approach to determining whether the offsite measures of the UPA will mitigate the negative effects of the hydrosystem measures of the UPA involves making tradeoffs between incommensurable rankings, not equivalent ratings. An example that illustrates how relative rankings were used is:

“For example, if some portion of the tern’s predation consists of salmonids predestined to die as a result of illness or poor condition, the survival improvements modeled above would need to be reduced accordingly to better estimate the survival improvements from tern relocation. Toxics and habitat were ranked low relative to tern predation. Since tern predation converted to a medium tributary rank, it is reasonable to assume that these lower relative estuary ranks of habitat and toxics would carry through conversion to tributary ranking and result in tributary ranks of low (~2%).” (NMFS 2004, p. E3-11)

61. Then NMFS mixes these relative ranking methods with rating methods.

would affect the life history strategies that characterized that life history type. Thus, the limiting factors for all stream type ESUs were ranked similarly, while those for ocean-type ESUs were ranked similarly. Ratings were developed by considering each factor relative to other estuarine factors within an ESU.” (NMFS 2004, p. E3-7)

“Therefore, potential survival improvement to ocean-type ESUs from eliminating tern predation would scale to a tributary low (~2%), while potential improvement from addressing habitat and toxics would scale to tributary ratings of medium and low, respectively. Survival improvements from estuary non-hydro offsets would not exceed a value comparable to tributary ranks of L (tern predation) + M (toxics) + M (habitat).” (NMFS 2004, p. E3-12)

NMFS ultimately combines this mix of rankings and ratings to support offsetting hydrosystem impacts with offsite mitigation measures.

62. NMFS also uses absolute and relative measures of effects interchangeably. For example, the “rankings” applied to population abundance (step 1) were absolute,³⁷ whereas the “rankings” applied to the effectiveness of various habitat and hydrosystem measures were relative to each other.³⁸ This approach uses different scales that are not interchangeable (Keeney 1992; von Winterfeldt & Edwards 1986). Whenever different scales are used to represent multiple attributes, and then used to evaluate tradeoffs, it is crucial that the functions used are indeed equivalent (Keeney 1992; von Winterfeldt & Edwards 1986). If they are not, then the analysis produces an often-overlooked apples-to-oranges comparison problem.

63. For example, some measures discussed in the 2004 FCRPS BiOp involve absolute ratings (with no reference scale, e.g., 586 adult spawners for population abundance (NMFS 2004, p. E3-2)) and others are relative (e.g., a qualitative ranking of “high” indicates that some estuary limiting factor is relatively more limiting than a “medium” ranking). These rankings are then scaled to very broad ranges of juvenile survival increases relative to current survival rates (NMFS 2004, p. E3-10). Because the absolute and relative scales are fundamentally different,

³⁷ “Estimates of low, medium, and high potential were based on absolute, rather than relative, differences between current and historical population status for NOAA Fisheries’ preliminary analysis.” (NMFS 2004, p. E3-2)

³⁸ “Qualitative estimates of estuary potential were derived from the relative impact of each limiting factor on each VSP parameter relative to other limiting factors at the ESU scale.” (NMFS 2004, p. E3-10)

tradeoffs based on comparing these measures would be inconsistent with the body of science discussed above.

64. The most obvious problems for using ranking methods to justify offsetting one kind of action with another is that a ranking only indicates that one thing is better or worse than another within a category; it does not indicate how much worse a ranking of “low” is than a ranking of “medium;” and rankings of “low” and “medium” in one category will generally be on different scales than similar rankings in another category; only ratings can be made comparable through weighting methods (Keeney 1992; von Winterfeldt & Edwards 1986).

65. NMFS did attempt to deal with the relationship between its rankings for habitat attributes and its quantitative assessment of measures affecting hydrosystem survival by defining a “translation” table (see footnote 40). As NMFS acknowledges, such translations do not reconcile the conflicts between all of the relative and absolute ratings and rankings defined in Appendix E.³⁹ The complex descriptions of the multiple relative and absolute ratings and rankings methods applied to many different kinds of measures in different ways that NMFS uses can hide the fact that the different rating and ranking systems are incompatible.

66. The way NMFS translates the tributary habitat rankings into potential hydropower effects (and hence offsets) is to assign substantial hydropower benefits to relatively much smaller tributary or estuary habitat “offsets.”⁴⁰ There is, for example, such a broad range in these

³⁹ “Professional judgment is required to determine the net effect, because it is not possible to evaluate the effects of all activities quantitatively or in identical units (e.g., quantitative survival estimates for the effects of hydro operations for some ESUs must be compared with qualitative changes in habitat condition for off-site actions). Not all actions will occur over identical time periods, so the timing of effects must also be considered.” (NMFS 2004, p. 6-5)

⁴⁰ “As described previously, qualitatively derived estimates of tributary potential were converted into categorical rankings in order to compare against hydropower mortality. The categorical rankings define the potential to increase the % survival of juveniles in each population as follows:

“rankings” that a habitat action expected to eventually deliver a 2.1% increase in survival (presumably relative to current survival at some life stage, but the reference frame is not defined) could, in theory, be traded off for a hydrosystem action expected to immediately decrease survival (presumably relative to current survival at some life stage, but the reference frame is not defined) by 24%; a habitat action expected to deliver only an eventual 25% increase in survival could be traded off for a hydrosystem action expected to immediately change the population by 100%. Defining “low,” “high,” etc. quantitatively does not resolve this problem because the scales across categories of actions are inconsistent, the relative framework is undefined, and the ranges of survival changes are very broad. Finally, changes to hydrosystem operations can have immediate impacts on survival, while changes in habitat can take many years to provide benefits and the effects are much more difficult to predict.

B. NMFS Assumes in Its “Net Effects” Analysis Is That Tradeoffs Between Salmon Life Stages Are Equivalent.

67. Once NMFS calculates the negative effects of the hydrosystem measures of the UPA for each ESU as compared to the reference operation using the SIMPAS model, and defines a method for calculating tradeoffs between hydrosystem and offsite mitigation, it evaluates qualitatively whether the off-site measures of the UPA can mitigate these negative effects so that by 2014 there is at least no net negative effect from the UPA. The fundamental assumption behind this analysis is that survival at each salmon life stage can be multiplied with survival at any other life stage, so that a 2% decrease in survival in one life stage can be offset by a 2%

“Very Low (VL) - ~0% change in survival

“Low (L) - $0 < 2\%$

“Medium (M) - 2 – 24%

“High (H) - 25- 100%

“Very High (VH) - $> 100\%$ ” (NMFS 2004, p. E3-1).

increase in survival in another.⁴¹

68. This assumption necessarily is based on the view that survival rates across all stages of the salmon lifecycle are additive and independent. Spawner-recruit data illustrates a problem with this assumption: if this offset reasoning were valid, substantial reductions in harvest should have increased populations proportionately, but instead the populations continued to plummet.⁴² Even recognizing that over-harvesting has been one of the factors leading to ESA listing, and that reducing harvest impacts probably helped prevent even steeper declines, greatly reducing harvest rate impacts on wild fish did not produce dramatic population increases because there are multiple factors affecting salmon survival rates that are not independent from one another and that operate on different life stages.

69. The mathematical offset assumption that NMFS employs to determine whether off-site mitigation can compensate for hydrosystem impacts is not consistent with principles of population dynamics and ecology (e.g., Burgman et al. 1993; Hilborn 1997; Hilborn & Walters 1992; Ludwig et al. 1993; NRC 1995). Population growth is not linear, particularly at very small and very large densities: at its most simplistic, it is exponential with carrying capacity

⁴¹ “This can be demonstrated quantitatively for survival rates, as shown in Tables 6.2a and 6.2b, since cumulative survival through successive life stages is multiplicative” (NMFS 2004, p. 6-6). The tables illustrate the assumption that reducing the number of adults due to FCRPS operations by 10% can be offset by increasing the number of smolts from their offspring by 10%.

⁴² NMFS’ offset analysis assumes that the population will respond proportionately and directly over its life-cycle to any change in survival at any life stage, but the data don’t show such linearity (additivity). For example, Upper Columbia River spring chinook wild harvest rates were cut around 1974 from a 1960-1973 average of 48% to a 1974-1987 average of 9%, a proportional survival increase of 75% (Updated_BRT_population_and_dam_counts_Interior_ESUs_TCooney_1020041.xls, downloaded from http://www.salmonrecovery.gov/R_Analysis.shtml). Instead of populations increasing by 75% as the offset analysis assumption would require, the average returns decreased by 58%.

limitations, as represented by the familiar Ricker or Beverton-Holt recruitment equations so widely used for simple modeling of exploited fish populations (e.g., Deriso et al. 2001; Eggers 1993; Jensen 1996; Myers et al. 1998; Piorkowski 1997; Ricker 1954, 1975; Ricker 1976; Schnute & Kronlund 1996; Walters 1990). There is no basis in these or other recognized textbooks for using a simple additive formula to model populations small enough to be at risk under the ESA that does not account for density dependence (particularly for decompensation effects that accelerate population declines at low population densities, which are by definition a feature of threatened or endangered populations), compensatory or decompensatory growth mechanisms, and ecological relationships between upstream and downstream survival rates.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed this 10 day of February, 2005, at Eagle Point, Oregon.

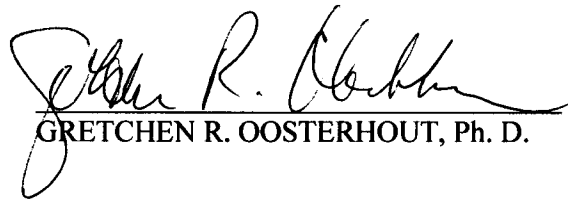

GRETCHEN R. OOSTERHOUT, Ph. D.

Table 1. Comparison of BRT, Status Review, and Fisher & Hinrichsen status estimates (from beginning of 2004 BiOp, pp. 4-3 to 4-23).

ESU	BRT findings status (VSP range-wide biological requirements)	2004 status review (indicator of current range-wide status: spawners returning to natural production areas)	Recent counts status (Fisher and Hinrichsen)
SRSSC	"...moderately high risk that the abundance and productivity criteria were not currently being met and a low risk that the spatial structure and diversity criteria were not currently being met" (4-4).	"Due to the severe declines in the populations since the 1960s and the short-term nature of the recent high returns, long-term productivity trends remain below replacement for all natural production areas, despite the recent increases. However, the short-term productivity trends for the majority of the natural production areas in the ESU are at or above replacement, which is a positive sign." (4-4).	"The slope of the trend for the natural-origin population increased 17% (from 0.97 to 1.14), when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least for the short-term, the natural-origin population has been increasing. Hatchery fish constituted 69% of the return during the recent period compared to an average of 60% during 1990-2000 (Fisher 2004)" (4-5).
SRFC	"moderately high risk for all VSP categories" (4-6).	"Depending upon the assumption made about the likelihood of the progeny of hatchery fish returning as productive adults, long- and short-term trends in productivity are at or above replacement. Thus, NOAA Fisheries proposed to retain the current listing of this species as threatened (i.e., likely to become an endangered species within the foreseeable future) even though it is not likely to go extinct in the near future" (4-6).	Geometric mean abundance of naturally-produced 3,462 during 2001-2003, compared to 694 in 1996-2000 (a 398% increase). The slope of the population trend increased 8.0% (from 1.16 to 1.24) when the data for 2001-2003 were added to the 1990-2000 series. For the short-term, the population has been increasing. Approximately 64% of the aggregate run at Lower Granite Dam was hatchery fish in 2001-2003, compared to 67% during 1990-2000 (4-7, not a quote).

Upper Columbia River spring chinook	"BRT's assessment of risk for the four VSP categories reflects strong concerns regarding abundance and productivity and comparatively less concern for ESU spatial structure and diversity" (4-7).	"...the within-ESU hatchery programs do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). Protective efforts...did not alter NOAA Fisheries' assessment that the ESU is in danger of extinction or likely to become so in the foreseeable future. Actions under the 2000 FCRPS Biological Opinion...do not as yet substantially reduce the ESU's extinction risk. Artificial propagation practices within the geographic range of the ESU do not fully support the conservation and recovery of UCR spring-run chinook. In particular, NOAA Fisheries is concerned that the non-ESU Entiat National Fish Hatchery has compromised the genetic integrity of the native natural population of spring-run chinook in the Entiat basin" (4-8).	"...at least in the shortterm, the aggregate population and the natural-origin populations in the Entiat and Wenatchee subbasins have been increasing" (4-8).
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UWR chinook	"...moderately high risks for all VSP categories" (4-9).	"Collectively, artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance and spatial structure but neutral or uncertain effects on ESU productivity and diversity. Protective efforts, as evaluated pursuant to the PECE, did not alter the assessments of the BRT and the Artificial Propagation Evaluation Workshop participants that the ESU is "likely to become endangered within the foreseeable future."" (4-9).	"geometric mean aggregate abundance of UWR chinook salmon in the Clackamas and McKenzie rivers is equal to 12,530 for 2001-2003 compared to 3,041 in 1996-2000, a 312% increase. The slope of the aggregate population trend increased 15.2% (from 0.89 to 1.02) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short-term, the aggregate population has been increasing." (4-10).
LCR Chinook	"moderately high risk for all VSP categories" (4-10).	"hatchery programs do not substantially reduce the risk of the ESU in-total" (4-11).	"Fisher and Hinrichsen (2004) compared the aggregate abundance of 41,450 during 2001 to a geomean of 11,135 for the years 1996-2000, a 272% increase. The slope of the aggregate population trend increased 6.6% (from 0.76 to 1.03) when the count for 2001 was added to the 1990-2000 data series, reversing the decline and indicating that, at least in the short-term, the aggregate population is increasing" (4-12).

Snake River steelhead	"moderate risk for the abundance, productivity, and diversity VSP categories and comparatively lower risk in the spatial structure category" (4-13)	"The majority of long-term population growth rate estimates for the nine available series were below replacement. The majority of short-term population growth rates (through 2001) were marginally above replacement or well below replacement, depending upon the assumption made regarding the effectiveness of hatchery fish in contributing to natural production" (4-13)	"at least in the short term, the natural-origin run has been increasing" (4-14).
Upper Columbia River steelhead	"high risk for productivity and comparatively lower risk for abundance, diversity, and spatial structure" (4-15)	"recent 5-year mean abundances (through 2001) for naturally spawned populations in this ESU were 14 to 30% of their interim recovery target abundance levels" (4-15), but "hatchery programs collectively mitigate the immediacy of extinction risk for the UCR steelhead ESU in-total in the short term, but the contributions of these programs to the long-term survival and recovery of the species is uncertain" (4-16)	"Fisher and Hinrichsen's (2004) preliminary estimate of the geometric mean of natural-origin UCR steelhead was 3,643 during 2001-2003 compared to 1,146 in 1996-2000, a 218% increase. The slope of the natural-origin population trend increased 9.2% (from 0.97 to 1.06,) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating, at least in the short term, that the run size has been increasing" (4-16).

Mid-Columbia River steelhead	"the relatively abundant and widely distributed resident fish in the ESU reduce risks to overall ESU abundance but provide an uncertain contribution to ESU productivity, spatial structure, and diversity" (4-17).	"NOAA Fisheries' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total" (4-17).	"In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of naturalorigin MCR steelhead equal to 17,553 during 2001-2002 compared to 7,228 in 1996-2000, a 143% increase. The slope of the population trend for natural-origin fish increased 6.2% (from 0.99 to 1.05) when the data for 2001-2002 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the natural-origin population has been increasing" (4-18).
UWR steelhead	"moderate risks for each of the VSP categories" (4-18).	Ambiguous	"In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of naturalorigin UWR steelhead at Willamette Falls equal to 9,541 during 2001-2004 compared to 3,961 in 1996-2000, a 141% increase. The slope of the population trend increased 10.4% (from 0.93 to 1.02) when the data for 2001-2004 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the natural-origin population has been increasing" (4-19).

LCR steelhead	"moderate risks in each of the VSP categories" (4-19).	"some anadromous populations in the LCR steelhead ESU, particularly summer-run steelhead populations, had shown encouraging increases in abundance in the 2 to 3 years ending 2001. However, population abundance levels remained small (no population had a recent 5-year mean abundance greater than 750 spawners)... hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total" (4-20)	"In their preliminary report, Fisher and Hinrichsen (2004) estimated that the aggregate abundance of LCR steelhead was equal to 4,429 during 2001 compared to 6,333 during the period 1996- 2000, a 30% decrease in abundance. The slope of the aggregate population trend declined by 0.8% (from 0.93 to 0.92) when the 2001 count was added to the 1990-2000 data series" (4-20).
LCR chum	"high risks for each of the VSP categories" (4-21)	"that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total" (4-21).	"In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of the aggregate number of CR chum salmon in two index areas (Grays River and Hamilton and Hardy creeks) equal to 1,776 during 2001-2003 compared to 2,114 in 1996-2000, a 16% decrease. The slope of the aggregate population trend decreased 1.5% (from 1.02 to 1.00) when the data for 2001-2003 were added to the 1990-2000 series" (4-21).

Snake River sockeye	"extremely high risks for all four VSP categories" (4-23).	"The consideration of artificial propagation does not substantially mitigate the BRT's assessment of extreme risks to ESU abundance, productivity, spatial structure, and diversity" (4-23).	"In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of aggregate numbers of SR sockeye salmon equal to 14 during 2001-2004 compared to 4 in 1996- 2000, a 211% increase. However, because returns were higher in 2001 and 2002 than in 2003, the slope of the aggregate population trend decreased 3.7% (from 1.26 to 1.22) when the data for 2001-2004 were added to the 1990-2000 series" (4-23).
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Table 2. Summary of Recalculations of survival improvements needed to avoid jeopardy using methods of 2000 BiOp.

		% survival increase needed as of 2000		% survival increase needed, adjusted as of 2004		Fraction total change expected, RPA		Fraction total change expected, other	
		Low ^a	High	Low ^b	High	Low	High	Low	High
SRSSC	Bear	15.75	15.75	0	0	1.00	1.00	0.00	0.00
	Imnaha	102.14	114.99	85.61	105.92	0.39	0.33	0.61	0.67
	Johnson	7.61	7.61	0	0	1.00	1.00	0.00	0.00
	Marsh	45.19	45.19	2.59	2.56	1.00	1.00	0.00	0.00
	Minam	36.83	65.36	26.51	51.56	1.00	0.64	0.00	0.36
	Poverty	11.51	16.41	11.89	18.82	1.00	1.00	0.00	0.00
	Flats								
	Suphur	13.26	13.26	0	0	1.00	1.00	0.00	0.00
SRFC	Aggregate	72.42	114.13	36.18	77.71	1.00	0.75	0.00	0.25
UCRSC	Wenatchee	233.6	247.3	161.82	182.60	0.17	0.21	0.83	0.79
	Methow	155.9	176.5	69.88	86.92	0.90	0.61	0.10	0.39
	Entiat	142.6	199.3	93.09	154.95	0.49	0.32	0.51	0.68
SRSteel	Aggregate	154.40	440.00	130.62	423.45	0.42	0.14	0.58	0.86
UCRSteel ^c	Aggregate	100.30	307.30	114.57	321.27	0.41	0.17	0.59	0.83
Ave or GM		83.96	135.62	53.16	109.67	0.75	0.63	0.25	0.37
Min		7.61	7.61	0	0	0.17	0.14	0.00	0.00
Max		233.64	440.00	161.82	423.45	1.00	1.00	0.83	0.86

Note a. “Low” and “High” are defined in footnotes to the tables for these ESUs taken from the 2000 FCRPS BiOp, Chapter 9.7.

Note b. “Low” corresponds to λ calculated consistent with the 2000 FCRPS BiOp (see Appendix A) assuming hatchery fish effectiveness = 0.2, and “high” assumes hatchery fish effectiveness = 0.8.

Note c. The fraction “wild” was not provided for 1980-1985 in the source data used to perform these calculations (Updated_BRT_population_and_dam_counts_Interior_ESUs_TCooney_1020041.xls, downloaded from Remand website). Thus, I used the average of 1985-2003 after determining that there was no significant trend in fraction “wild.”

Table 3. Summary of major criticisms of SIMPAS Model, and NMFS' responses

Criticism	Example sources	Response
(1) SIMPAS is too simple to capture the complexities it is being used to quantify	CRITFC, Fish Passage Center, State of Oregon ¹	It is simple on purpose. ²
(2) It is not a stochastic or life-cycle model	State of Oregon (See footnote 1).	SIMPAS does not need to be a life-cycle model. ³
(3) The benefits assumed for RSWs in SIMPAS modeling are too speculative	CRITFC, Fish Passage Center, state of Alaska, SOS ⁴	NMFS “calls on” Action Agencies to evaluate passage survival (see footnote 4).
(4) It does not take uncertainty or error into account appropriately	CRITFC, ⁵ Oregon, Fish Passage Center ⁶	SIMPAS does not take uncertainty or error into account ⁷ .

¹ “SIMPAS was designed to compare alternatives in a qualitative sense, not a relative sense. [49] • SIMPAS is too simple to capture the complexities it is being used to quantify. [8, 14, 49] • SIMPAS is not stochastic system-wide or life-cycle-wide and provides no measure of error or uncertainty surrounding its parameters. [32] • The model needs a time-step component to capture the variability across the migration season. [49].

“Response: See Section 1.2.2 of Appendix D in the final Opinion for a discussion of these Concerns” (Lohn 2004, p. 1-33). Section 1.2.2 in Appendix D is cited further here.

² “NOAA Fisheries would first point out that the SIMPAS model is a deterministic analytical tool for use in comparing two or more system (or project) operations or system configuration changes to obtain relative differences in juvenile survival between the head of Lower Granite Pool and the head of the estuary” (NMFS 2004, p. D-5).

³ “It is not a life cycle model, nor does it need to be to serve its intended purpose” (NMFS 2004, p. D-5).

⁴ “3.7.12 Comments: • Additional studies are needed to validate input and output on survival rates for RSWs vs. spill. (Current data show spill is better). [49] • Results for RSWs at Lower Granite Dam cannot be used to extrapolate for other projects, because migrant behavior changes the further the fish get downstream. [49] • Benefits of RSW installations are speculative. [8, 27, 30, 49].

Response: In response to these comments and concerns, NOAA Fisheries has included a term and condition in Section 10.5.2.1 of the Incidental Take Statement that calls on the Action Agencies to “evaluate juvenile project-specific passage survival both before and after configuration and/or operational modifications [at mainstem FCRPS projects] to ensure that these modifications result in improved passage survival.” (Lohn 2004, p. 1-36).

⁵ “Point estimates imply data are precise, but there is high uncertainty around each input parameter. [49] Response: This comment is addressed in the Opinion in Appendix D, Section 1.2.2” (Lohn 2004, p. 1-34). “Comment: • Many inputs are based on numbers that showed no statistical difference when evaluated against a control. [49] Response: NOAA Fisheries addressed this comment in the Opinion in Section 1.2.2 of Appendix D. NOAA Fisheries used the best available data for model input fish passage and survival data. If several years of passage data were available, the average of those years was used. If only one year of data was available, NOAA Fisheries used the point estimate for test condition of the study” (Lohn 2004, p. 1-34).

⁶ “3.10.10 Comment: • Variability associated with estimates of exploitation rates, consumption rates, changes in size structure, and estimates of relative predation likely preclude statistical differences between current and proposed actions. At best, benefits will not occur for years. [32].

Response: NOAA Fisheries concurs with this comment and included this concern in Sections 5.3.1.2 and 6.3.2.4 of the Opinion” (Lohn 2004, p. 1-45).

“Comment: • Survival through the estuary is unknown, so survival benefits to be gained from estuary improvements are highly speculative. [8].

“Response: NOAA Fisheries acknowledges the uncertainty surrounding salmonid survival through the estuary. However, NOAA Fisheries believes that it used the best available science to approach the effect of the action on salmonid survival in the estuary. This approach is described in Appendix E” (Lohn 2004, p. 1-46).

⁷ “The juvenile survival rates shown, as well as the input passage parameters, are point estimates, i.e., confidence intervals are not calculated or implied” (NMFS 2004, p. D-4). “Although there may be some uncertainty about the accuracy of the resulting pool and dam survival estimates, NOAA Fisheries determined that the model output for 1994 through 2003 was reasonable and produced useful pool survival estimates” (NMFS 2004, p. D-5). “NOAA Fisheries concurs with this comment and included this concern in Sections 5.3.1.2 and 6.3.2.4 of the Opinion” (Lohn 2004, p. 1-45).

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