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UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

NATIONAL WILDLIFE FEDERATION, *et al*.

Plaintiffs,

v.

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

Civil No. 01-640-RE

2008 DECLARATION OF
RITCHIE J. GRAVES

I, Ritchie J. Graves, declare and state as follows:

1. I currently serve as Chief of the Federal Columbia River Power System (FCRPS) Branch for the National Marine Fisheries Service (NMFS) in the Northwest Region, which includes the states of Oregon, Washington, Idaho and Montana. I have been in this position since April, 2006. I have been employed by NMFS as a fishery biologist, working on the impacts of hydropower projects on salmon and steelhead, since 1993. My current responsibilities include managing FCRPS branch staff (biologists, engineers, and a hydrologist), participating as NMFS' senior technical staff in NMFS' regional forum process and related Corps of Engineers work groups, and developing information and recommendations relating to fish passage, water quality, and related facilities and operations at FCRPS dams.

2. I was awarded an M.A. in Zoology (Aquatic Ecology Emphasis) from the University of Montana in 1993. My masters research concerned the structure and dynamics of crayfish populations within Noxon Rapids Reservoir, Clark Fork River, Montana. I received a B.S. in biology from Centre College of Kentucky in 1989.

3. Prior to working in NMFS' Portland Office (beginning in March, 1997), I worked in NMFS' Smolt Monitoring Program at John Day Dam (1993-1997), primarily as the project biologist, supervising up to eight biological technicians and contractors. In this capacity, I was responsible for 1) collecting information on the number and condition (descaling, injury, etc.) of juvenile salmon and steelhead, and transmitting this information, along with dam operations information, to the Fish Passage Center, and 2) for preparing annual reports of this work. As a result of this work, over four field seasons, I personally evaluated 10s of thousands of individual Chinook, coho, and sockeye salmon and steelhead smolts for signs of injury.

4. In the summer of 1992, I was employed by the Montana Department of Fish,

Wildlife, and Parks as a fisheries fieldworker. This work involved collecting information to assess the losses of juvenile trout to irrigation diversions, estimating population structure and abundance of trout populations in tributaries of the Bitterroot River, and monitoring standard habitat metrics to assess changes to and quality of aquatic habitat in these same tributaries.

5. As Chief of the NMFS Hydropower Division’s FCRPS Branch, my principal responsibilities, as they relate to the 2008 Biological Opinion on Operation of the Federal Columbia River Power System, including the 11 Bureau of Reclamation Projects in the Columbia Basin (NOAA AR A.1) (hereafter 'BiOp'), was to manage FCRPS staff (including myself) in 1) collecting and analyzing relevant data, 2) developing and using the COMPASS model and 3) drafting portions of the draft and final biological opinion and supplemental comprehensive analysis (and appendices). Prior to this I have contributed to the development of several discrete technical issues in each ESA consultation concerning the FCRPS between 1998 and 2004.

6. Additionally, as a biologist for NMFS’ Hydropower Division, I have gained substantial experience assessing the effects of mainstem hydroelectric projects and developing actions to reduce or mitigate these impacts. In particular I have served as NMFS’ technical lead on the relicensing of the Hells Canyon hydroelectric project (since 1997) and in the development and implementation of the Wells, Rocky Reach, and Rock Island Anadromous Fish Agreements and Habitat Conservation Plans (2001 to 2005).

7. In preparation for this declaration, I have reviewed NMFS’ Supplemental Comprehensive Analysis, BiOp, and supporting materials for these documents; the declarations filed on behalf of the plaintiffs’ motions for summary judgment by Mr. Frederick Olney and Mr. Edward Bowles as well as the State of Oregon’s Concise Statement of Material Facts; and the

Independent Scientific Advisory Board's Snake River Spill-Transport Review (ISAB 2008-5, Sept. 16, 2008).

8. This declaration includes information provided and analyses prepared by Mr. Rich Domingue, Mr. Gary Fredricks, and Mr. Paul Wagner, of my staff. The purpose of this declaration is to address technical issues raised by Mr. Olney and Mr. Bowles concerning 1) certain claims about actions required by the 2008 FCRPS biological opinion, 2) questions regarding survival estimates (base to current or current to prospective adjustments) used in NMFS' analysis, 3) operational trade-offs between Snake River steelhead and Chinook salmon (and effects on other ESA-listed species), 4) Snake River fall Chinook, and 5) Snake River sockeye salmon.

I. 2008 HYDRO ACTIONS ARE CONTINUATIONS OF PAST ACTIONS

9. Mr. Olney and Mr. Bowles claim that the Prospective Actions relating to operation and configuration of the hydrosystem (primarily flow and spill operations and the development of surface passage routes), are either largely the same measures as proposed in the 2000 and 2004 FCRPS BiOps, or represent a retreat from the actions proposed in the 2000 and 2004 BiOps (Olney Decl. at 8-12, Bowles Decl. at 132-141). The apparent implications being that 1) the Prospective Actions proposed in the earlier BiOps were either harmful or insufficient and 2) that actions in the current BiOp will provide substantially less protection than those previously identified. I disagree with these implied characterizations of the Reasonable and Prudent Alternative (RPA) hydro actions.

A. Flow Management and Targets

10. Oregon claims that "The 2008 biological opinion dramatically reduces the amount of water available for flow augmentation in the summer, and provides no more flow augmentation in the spring than that provided in the 1999 proposed action" (Oregon's memo in support of motion for summary judgment, at 21-22). This statement is supported by the declarations of Mr. Bowles (Decl. at 132-136) and Mr. Olney (Decl. at 7-12). My response is applicable to concerns identified in these three documents and considers corrections to Mr. Ed Bowles declaration filed October 17, 2008.

11. Storage reservoir management aimed at increasing Columbia and Snake River flows during the juvenile salmon and steelhead outmigrations (April through August), broadly termed flow augmentation, was formalized in 1995 (1995 FCRPS BiOp, NOAA AR B-293 at 94-103). The flow augmentation program was aimed at increasing the probability of achieving specified flow objectives known to be beneficial in the two rivers during the migration season (NOAA AR B-291). At the time of its inception, the program was designed to benefit the three Snake River ESUs then listed under the ESA: SR fall Chinook salmon, SR sockeye, and SR spring/summer Chinook.[1] Both the array of Columbia basin ESUs listed under the ESA and NMFS' understanding of these species' needs has changed considerably since program inception. Further, with the listing of Kootenai River sturgeon and bull trout, broader ecosystem management concerns have affected the region's approach to water management. The salmon flow augmentation program included in the 2008 FCRPS BiOp reflects consideration of current flow-related ecosystem concerns throughout the basin as well as NMFS' current understanding

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[1] Information on the flow needs of sockeye salmon was extremely sparse and it was assumed that conditions beneficial to spring/summer Chinook salmon would beneficially affect sockeye.

of the needs of listed salmon and steelhead. The following list demonstrates NMFS' continued support and attention to the program.

12. First, since 1995, the Action Agencies have **increased** the volumes of water devoted to the program by over 300,000 AF in summer and variable amounts in spring.

(1) Implementation of the VARQ flood control strategy at Libby and Hungry Horse dams of Variable Q (VARQ) which allows for higher winter URC (Upper Rule Curves URC) providing increased spring flows during below average water years (implemented in 2000);

(2) Based on water supply forecast, additional draft of two feet or about 151,100 acre-feet, to elevation 1978 feet at Lake Roosevelt during below average water years, which increases summer flows (2000) for salmon migration;

(3) Draft of five feet from Banks Lake, 133,000 acre-feet (2000) for salmon migration;

(4) Requirement to be at April URC shifted from April 20 to April 10 (2000) to improve spring flows for salmon migration;

(5) Nov – April Bonneville flow operations to benefit Chum (2000);

(6) Operation of Libby for variable flood control draft on December 31 which improves probability of refill in dry years (2004);

(7) An additional 60,000 acre-feet from Upper Snake Reservoirs, also a part of the Nez Perce Agreement (2005);

(8) Increased draft of 27,000 acre-feet from Lake Roosevelt to benefit outmigrating salmon due to Washington's Columbia River Water

Management Plan – Lake Roosevelt Incremental Storage Releases Program (2008); and

(9) Revision of the drum gate maintenance schedule at Grand Coulee in some years to allow for less winter draft which increases spring flows in some years (requirement was to draft every year) (2008) for the salmon outmigration.

13. Second, in the 2008 BiOp, flows are **not** reduced (at all) during the main juvenile salmon spring migration period (SCA at 8-11 – 8-14). This is the period when the majority of juvenile salmonids (including sockeye) migrate in the Columbia and Snake rivers.

14. Further, several recent and prospective fish passage improvements have allowed us to make better use of available water to benefit fish, including: improved fish passage conditions at the dams (RSWs, TSWs, corner collectors, behavioral guidance, bypass systems) and improved management of water temperatures and total dissolved gas. Available water is managed through collaborative pre-season planning and in-season management teams, including state and tribal members. This allows defined operations in advance of the fish migration season to be adjusted in real-time in accordance with fish migration monitoring to make more water available when most beneficial for salmon.

15. Third, in the 2008 BiOp, there is a slight reduction in summer flows (2.2 percent at McNary in July and less than 5 percent in August) (SCA at 8-10-14). This reduction is due largely to the inclusion of the Montana portion of the Northwest Power and Conservation Councils (Council) 2003 Mainstem Amendments (Montana operation).[2] The Montana operation

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[2] ISAB Findings from the Reservoir Operations/Flow Survival Symposium, Dec 10, 2004: "All indications are that the down-river effects of the shifts in flow associated with the Council's Mainstem Amendments of 2003 will be small," but data are insufficient to assess how small the effects will be on anadromous fish. Montana resident fish

was reviewed by the ISAB (ISAB 2004, NOAA AR B207), discussed at length in the PWG, and accepted by parties of the Columbia Basin Fish Accords. These amendments are designed to improve habitat conditions for the ESA-listed bull trout and Kootenai River sturgeon. To a lesser extent, the decision by NOAA Fisheries to focus available flow augmentation water from the upper Snake basin on spring migrants (Graves et al. 2007, NOAA AR C.0599)[3] resulted in similar flow reductions (2.7% July, 4.8% August) at Lower Granite Dam. The rationale for this change is presented in Graves et al. (2007 *ibid.*) and is designed to focus the management of available water on those ESUs most likely to benefit from flow augmentation.

16. Fourth, Collaboration: Water management, including flow actions, were discussed at length in the PWG and associated technical groups. Adoption of the NPPC's mainstem amendments was on the PWG agenda or in the notes over 15 times. Also, I expect the RIOG (Regional Implementation Oversight Group, successor to PWG) will revisit flow issues in the future to implement the adaptive management provisions of the BiOp (RPA Table, pg 1-3, and 68) as needed.

17. Mr. Olney correctly notes that "the 2008 BiOp RPA describes a set of reservoir operations requirements that substantially continue the Action Agencies' prior flow management, but mischaracterizes NMFS' view of seasonal flow objectives as the "… low estimate of the flow that is likely to avoid high mortality" (Olney Decl. at 9).

18. The operations required by the 2008 BiOp RPA (which include the flexibility to make in-season adjustments through the Technical Management Team and longer-term changes

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would benefit, but data are insufficient to access how much benefit the operation would provide. The ISAB also acknowledged the benefits of lower flows to returning adult salmon.

[3] Memo from Ritchie Graves (NMFS), Paul Wagner, and Rich Domingue to Bruce Suzumoto (NMFS) and Bob Lohn RE: Staff recommendation to relax the regional priority on summer flow augmentation for the upcoming FCRPS biological opinion and request NWFSC review of this recommendation, 6/12/2007.

through adaptive management) reflect the evolution of storage reservoir management operations over time as disputes have been resolved and as information regarding the effectiveness of particular actions has been obtained. For example, since 1995, NMFS, the Action Agencies, and our regional co-managers have gained considerable experience in the storage and release of water within Dworshak reservoir to not only affect flows within the migration season, but to manage July, August, and September temperatures within the lower Snake River for migrating and rearing juvenile fall Chinook salmon as well as for migrating adult sockeye, summer and fall Chinook, and steelhead salmon.

19. Mr. Olney mischaracterizes NMFS' view of seasonal flow objectives. As Mr. Olney acknowledges (Olney Decl. at 111), recent in-river survival estimates indicate that high survival rates may occur even under fairly low flow conditions like 2007. NMFS' most recent summary of survival estimates (hatchery and wild combined) are provided in a September 8, 2008 memo from John Ferguson to Bruce Suzumoto.[4] The recognition of this relationship is reflected in the expected seasonal average flows used as the trigger for implementing maximum transport operations in the Snake River (Table 1) – which have decreased with evaluation in the Regional Forum as hydro improvements (both structural and operational) have been implemented. This indicates that fish may remain in the river at lower flows rather than be collected for barge transport.

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[4] Memorandum dated September 8, 2008 from J. Ferguson (Northwest Fisheries Science Center) to B. Suzumoto (NMFS Hydro Division) RE: Preliminary survival estimates for passage during the spring migration of juvenile salmonids through Snake and Columbia River reservoirs and dams, 2008. Attached as Exhibit 1 to this Declaration.

Table 1. Comparison of expected seasonal average spring flows used as triggers for implementing maximum spring transport operations in the Snake River reflecting improved survival at lower flows.

	2000 FCRPS Biological Opinion	2004 FCRPS Biological Opinion	2008 FCRPS Biological Opininon
Expected Seasonal Average Flow for Triggering Max Transport Operation (No spill or bypass through the entire migration season)	< 85 kcfs	< 70 kcfs[5]	< 65 kcfs

20. Mr. Olney asserts that the measures NMFS identifies as having the potential to increase flows are similar to those identified in previous biological opinions, and further criticizes that the 2008 BiOp "does not include any measures to secure additional flows for the Snake River" (Olney Decl. at 10-11). Although Mr. Olney does not state why this is an issue, his assertion seems to be based on the assumption that substantial increases in summer flows (for which stored water has been primarily used in the past) would provide substantial increases in survival for subyearling fall Chinook.

21. In this assertion, Mr. Olney fails to recognize several important factors. First, Snake River fall Chinook salmon now exhibit a second life-history strategy (rearing in the Snake River throughout the summer, fall, and winter before continuing their ocean bound migration as yearlings), which was not previously expressed or recognized; also he does not consider that the propensity for juvenile fall Chinook to complete their sea-ward migration now declines sharply throughout the month of July (Cook et al. 2006, NOAA AR B.77).[6] That is, by mid-July juvenile Snake River fall Chinook have an increasing likelihood of delaying completion of their migration until the following spring. Increasing flows at this time is unlikely to substantially

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[5] The 2004 FCRPS BiOp also required maximum transport starting April 20 if expected seasonal flows were between 70 and 85 kcfs).

[6] Cook, C., G. McMichael, J. Vucelick, et al. 2006. Lower Monumental Reservoir juvenile fall Chinook salmon behavior studies. PowerPoint presentation to AFEP, November 13-16, 2006, 11/13/2006.

increase either migration rates or the survival of juveniles that are rearing. Second, Mr. Olney does not recognize that increasing flows from upstream of the Hells Canyon hydroelectric project would likely increase summer temperatures in the lower Snake River reservoirs to the detriment of rearing juveniles and migrating adults, thereby reducing the effectiveness of cold water releases from Dworshak Reservoir.

B. Spill and Transport Operations

22. Mr. Bowles suggests that NMFS did not take into account straying of transported fish and its impacts on ESA-listed species (Bowles Decl. at 119-129). This is not the case. NMFS directly considered the effects of straying on the survival and conversion rates of transported populations (see BiOp at 7.2.1.1 and 14 - Incidental Take Statement and in the SCA at Adult Survival Estimates Appendix). For example, the post-Bonneville survival relationships used in the COMPASS model were derived from fish that survived back to Lower Granite Dam – meaning that strays from both transported and in-river groups were not counted as successfully returning adults.

23. Mr. Bowles appears to believe that the potential impact of straying (by Snake River steelhead) is greatest for Mid-Columbia steelhead populations (Bowles Decl. at 120, 125-126, 128-129). I would generally agree that the potential impact is greatest for this ESU given that the apparent stray rates of transported Snake River steelhead are about 7% higher than those estimated for in-river migrants (SCA – Adult Survival Estimates Appendix) and there is documented straying into the Deschutes and John Day Rivers where Mid-Columbia steelhead populations reside. However, while the potential impacts of strays on this ESU, and on other

ESUs, was not addressed directly, it was considered implicitly in NMFS' consideration of limiting factors and current range-wide status for these ESUs (and their constituent populations).

24. As an example, any negative impacts to the productivity of Mid-Columbia steelhead populations that may have resulted (whatever their magnitude) from the straying[7] of Snake River steelhead attributable to the straying caused by historically high transport rates (1981 to 2000 out-migrations), would be reflected in the Base period productivity estimates. NMFS' COMPASS modeling indicates that transportation rates of Snake River steelhead (Prospective vs Current) should diminish slightly (by about 4 percent) under the BiOp RPA compared to the Current condition (SCA, Hydro Modeling Appendix pg 7 (not numbered) NOAA AR A.2).[8] NMFS made no attempt to quantify the potential improvement in productivity to the Mid-Columbia steelhead ESU from this action (Current to Prospective adjustment).

25. Mr. Bowles (Decl. at 111) also indicates that the SAR of PIT tagged in-river migrating fish may be biased low (compared to transported fish), because higher proportions of in-river migrants could be consumed by predators when their numbers are lower (after fish are removed for transportation). The biological basis for this theory (predator swamping) has, at least in part, been attributed as contributing to the increased survival estimates observed through specific river reaches in recent years. The available information (data and discussion in both the August 31, 2007 Ferguson memo cited by Mr. Bowles and in the September 8, 2008 Ferguson memo cited previously in this declaration (see paragraph 19 above) suggests that this effect is

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[7] Undoubtedly, not all of these fish survive to spawn, but either die of natural (without human influence) or unnatural causes - potentially including the existence and operation of the FCRPS, unreported or delayed mortality caused by fisheries, marine mammal predator attacks, etc.

[8] NMFS. 2008. Supplemental comprehensive analysis of the Federal Columbia River Power System and mainstem effects of the Upper Snake and other tributary actions. NMFS, Portland, Oregon, 5/5/2008.

being observed to some extent for steelhead (due to their increased vulnerability to avian predators), but far less so for spring/summer Chinook.

26. Mr. Bowles does not consider the potential longer term effects of management actions that increase the number of preferred prey available to avian predator colonies. For example, there is evidence to suggest that the nesting success rate of the Crescent Island tern colony was higher in 2007 (the year in which only about 41% of steelhead were transported (NOAA AR 0471), than in previous years. Roby et al. (2008)[9] "estimated that 74,000 steelhead, the highest point estimate for steelhead consumption in the last four years (2004 – 2006 point estimates ranged from 48,000 – 58,000 fish), were consumed despite the colony being smaller in 2007 than in previous years (355 pairs vs. 448 – 530 pairs). He also noted that during the period 5/22 – 7/2, steelhead consumption was substantially greater in 2007 (roughly 36,000 smolts) than in 2004 – 2006 (18,000 – 20,000 smolts). This higher steelhead consumption by Crescent Island terns later in the 2007 nesting season (corresponding to the terns' chick-rearing period) was the main difference resulting in higher steelhead consumption for the entire season, and presumably contributed to the higher tern nesting success observed in 2007. To the extent that this tern colony grows (increased nesting success) as a result of increased numbers of migrating juveniles, the potential benefits, over time, of predator swamping to juvenile salmonids in the Lower Monumental Dam to McNary Dam reach would be expected to diminish because there will be more predators relative to the number of in-river migrants.

27. Finally, NMFS recognize that predator-prey interactions are complex and predictions based on theoretical constructs – rather than on empirical data – may or may not

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[9] Roby, D.D., K. Collis, D.E. Lyons, Y.Suzuki, J.Y. Adkins, L. Reinalda, N. Hostetter, L. Adrean, A. Evans, M. Hawbecker, and S. Sebring. 2008. Evaluate the Impacts of Avian Predation on Salmonid Smolts from the Columbia and Snake Rivers: 2007 Final Season Summary – revised June 2008. Report to the U.S. Army Corps of Engineers, Walla Walla District.

prove accurate. NMFS does not disagree with Mr. Bowles that some predator swamping is likely to occur in a given year. However, we believe that the magnitude of this effect is likely to be offset by the relatively large differentials observed between the post-Bonneville survival of transported vs in-river migrating steelhead.

28. Mr. Olney notes that "the 2008 RPA largely continues the spring spill and transportation regime that has been in place since 1995 and that it "reduces spring spill and maximizes transportation between May 7 and May 20 each year, even in high flow years, and reduces summer spill volume as compared to spill volume under recent court ordered operations and the 2000 BiOp (Olney Decl. at 8). This is incorrect. The Action Agencies have documented the increasing spill levels from 1988 through 2006 (NOAA AR B89 at A-17-A20).

29. With respect to spring spill and transport operations at the three Snake River collector projects, NMFS did propose to eliminate involuntary spill for a 14 day period in May based on its assessment of the best science available concerning the smolt to adult returns (SARs) of juveniles that were either transported or left to migrate in-river to below Bonneville Dam. Based on this data (available returns from 1998 to 2003 outmigrations used in the COMPASS modeling – see Zabel Declaration) it is clear that both Snake River steelhead, and to a much lesser extent, Snake River spring/summer Chinook salmon are likely to return at higher rates if they are transported in mid- to late May, rather than left to migrate in-river. The Independent Scientific Advisory Board's (ISAB) Snake River Spill-Transport Review (ISAB 2008-5) agreed with NMFS' basic assessment of the currently available data, stating that "most existing data show that transportation in the late-April through May migration season benefits hatchery and wild Chinook, as well as hatchery and wild steelhead" (ISAB 2008, pg 1).[10]

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[10] Independent Scientific Advisory Board. 2008. Snake River Spill-Transport Review. September 16, 2008; ISAB 2008-5.

30. However, the ISAB advised that “whenever river conditions allow during the late April-May period, a strategy allowing for concurrent transportation and spill is prudent” and that “spill-transport operations like those of 2006 and 2007 should be continued long enough to determine how much influence such operational changes have on downriver migration and total adult returns” (ISAB 2008, pg 37). The basis for their recommendations included their finding that “recent structural and operational changes look promising to improve the survival success of in-river migrating spring/summer Chinook, steelhead, and sockeye…,” and their concerns regarding 1) potential effects of transport on Snake River sockeye and juvenile lamprey, 2) the potential threat of straying by returning adults (as a result of transportation) to other wild populations, and 3) the need for more studies to increase our collective understanding of the benefits, consequences, and optimal timing of transportation (ISAB 2008, pg 37-38). Thus, the ISAB recognized the substantial improvements made to the FCRPS mainstem projects and recommended a continuation of both spill and transport operations until additional information becomes available.

31. NMFS and the Action Agencies will consider the advice of the ISAB in the development of operations for the 2009 outmigration and will also consider what studies might be enacted to obtain the information. The BiOp’s RPA contains sufficient adaptive management and research, monitoring, and evaluation provisions to consider potential changes in operations for 2009 and to develop additional studies that address the information gaps identified by the ISAB. With respect to summer spill and transport operations for Snake River fall Chinook salmon at the four mainstem Snake River projects, NMFS articulated its understanding of the multiple life-histories of Snake River fall Chinook in the SCA (NOAA AR A.2), BiOp (NOAA AR A.1, Chapter 8.2), and in the accompanying Issue Summary Document (Snake River Fall

Chinook Life History & Management Actions, NOAA AR S13-17). NMFS did consider the likely small effect of terminating spill after August 1 if the number of collected fish at a given dam has dropped below 300 individuals for three consecutive days either on or after August 1. It also considered the added safeguard provision which specifies that spill would resume if the number of fish collected at a given dam subsequent to spill curtailment exceeds a 500 fish threshold for two consecutive days at that dam. It is important to note, that had this trigger been applied to the 2008 migration, spill would have continued through August 30 as the number of collected fish at Lower Granite did not fall below 300 until August 28 (Fish Passage Center data, accessed October 15, 2008). This provides additional evidence that the operation would work as intended, providing adequate protection for even small numbers of migrating juvenile fall Chinook salmon.

C. Surface Passage Routes

32. Mr. Olney correctly notes that NMFS has consistently directed the Action Agencies to pursue the development and installation of surface passage routes through its BiOps over the past eight years (Olney Decl. at 12). These structures are proving beneficial– especially so for steelhead (SCA at 5.1.2.1 and Williams et al. 2005, NOAA AR B.0538)[11] – and each of the eight mainstem dams will have an operational surface passage route in time for the 2009 outmigration. The ISAB (2008, pg 21-22) also credits these structures with contributing to the improved mainstem passage conditions and resultant increased survival estimates in recent years.

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[11] Williams, J.G., S.G. Smith, R.W. Zabel, et al. 2005. Effects of the federal Columbia River power system on salmonid populations, U. S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-63., 2/1/2005.

II. BASE TO CURRENT AND CURRENT TO PROSPECTIVE ADJUSTMENTS

A. Snake River Steelhead Adjustment

33. Mr. Olney correctly notes that NMFS' final base-to-current adjustment indicated a net decrease in survival of 3.4% (a multiplier of 0.966) for steelhead populations and then suggests that this is an error because it represents the base-to-current relative adjustment calculated from the system survival estimate – and did not include an assumption of SAR's for either in-river migrating or transported fish as was done for the other ESUs (Olney Decl. at 44-45). Mr. Olney goes on to calculate that the survival adjustment including "current" estimates of SARs for in-river migrants and transported fish (Olney Decl. at 46-47), and concludes that NMFS should have identified a net decrease of 10.2% for Snake River steelhead (a multiplier of 0.898) (Olney Decl. at 47).

34. Mr. Olney is incorrect in his assertion that this is a mistake and that this mistake carries over into other steps of the analyses. In preparing the final biological opinion, NMFS recalibrated the COMPASS model using additional PIT tag information (empirical survival estimates, etc.) before re-running the "current" operations scenario (see Mr. Rich Zabel's Declaration). NMFS did initially calculate the 10.2% net decrease in the base to current adjustment that Mr. Olney replicated. This result was quite different from the estimate modeled in the draft BiOp for Snake River steelhead (3.4% net decrease) and precipitated discussions between NMFS and Northwest Fisheries Science Center staff regarding what confidence NMFS should have that the "Current" estimates of post-Bonneville survival rates for transported and in-river migrating Snake River steelhead could serve as viable surrogates for the 20-year "Base" period (April 1, 2008 e-mail from R. Graves to R. Zabel and April 1, 2008 e-mail from R. Graves to C. Toole, both in AR disc 2 packet 2008-01-16_to_2008-04-22).

35. From these conversations two factors unique to Snake River steelhead were identified that suggested that "Current" estimates would not be suitable surrogates for calculating a "Base" survival estimate including SARs for transported and in-river migrating juveniles. First, compared to Snake River spring/summer Chinook salmon, Snake River steelhead display larger survival differentials between transported and in-river migrants which makes them disproportionally sensitive to small changes to the proportion of fish transported. Second, compared to the other species analyzed, Snake River steelhead are highly sensitive to relatively small changes in the timing of fish to below Bonneville Dam (either via transport or in-river migration).[12] That is, fish arriving earlier below Bonneville tend to be more likely to return as adults.

36. Ultimately, NMFS determined that due to these factors, use of the "Current" post-Bonneville survival estimates for surrogates during the 20-year "Base" period could not be supported and that a more credible alternative would be to use a comparison of "Base" and "Current" system survival estimates (the proportion of fish arriving at Lower Granite Dam that survived to below Bonneville Dam from both transport and in-river migration) to estimate the base-to-current adjustment. This is consistent with the approach taken for mid-Columbia River steelhead populations, except that none of these individuals are transported.

37. Unfortunately, NMFS failed to add this rationale (see Declaration at 34 above), which should have been included as footnote 2 in the "steelhead table" as identified by Mr. Olney, to the final tables provided in the SCA - Hydro Modeling Appendix (NOAA AR A.2). However, while this over-site obviously caused unnecessary confusion, it is not an error and the quantitative analysis for Snake River steelhead is accurate from NMFS' perspective.

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[12] NOTE: This would also likely be a factor for Upper Columbia River steelhead and mid-Columbia River steelhead except that a relatively small proportion of these ESUs were transported during the Base period at McNary

38. Mr. Olney raises this issue again in his discussion of NMFS' evaluation of short-term extinction risk (see Olney Decl. at 99). His assessment, based on the assumption that there should have been a 10.2% decrease rather than a 3.4% decrease base-to-current hydro adjustment for steelhead, and his claims based on this assumption, is also in error for the reasons provided above.

B. Kelt Reconditioning Plan Adjustment

39. Mr. Olney provides three primary criticisms of RPA 33 (Olney Decl. at 86-92), which requires the Action Agencies to develop, in cooperation with regional salmon managers, and to then implement, a Snake River steelhead kelt management plan that would result in an estimated 6% improvement in B-run steelhead population productivity. Mr. Olney appears to miss the key point of the RPA (and Snake River Steelhead Kelt Appendix analysis in the Supplemental Comprehensive Analysis) which is that the Action Agencies must achieve a 6% improvement through a combination of actions in order to be compliant with RPA 33. The analysis is primarily a tool for assuring that there is realistic potential for achieving this survival goal.

40. First, Mr. Olney correctly notes that the period of no voluntary spill assessed in the Supplemental Comprehensive Analysis - Snake River Steelhead Kelt Appendix (May 15 to about June 3) does not match that described in the final biological opinion (May 7 to May 20). This is a correct observation, but one which does not change the basic nature of issue under consideration (i.e., regardless of the dates there will be about two weeks of no voluntary spill at the Lower Granite and Little Goose dams). He further alleges that this cessation in spill would

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dam only, and virtually no transport of these stocks occurred under "Current" conditions.

result in poorer survival of in-river migrants than NMFS considered – thus reducing the corresponding survival benefit assessed by NMFS in the final biological opinion (Olney Decl. at 87). The shift in timing does not fundamentally change the likely survival of the population of B-run steelhead kelts nor is NMFS' assessed benefit for in-river migrants (< 0.1%) an important consideration in the overall analysis – which overall indicates that a substantial number of female kelts will need to be reconditioned (not left to migrate in-river) in order to achieve the necessary 6% benefit.

41. Second, Mr. Olney suggests that NMFS' assumption that 100% of the kelts collected at Lower Granite and Little Goose Dams would be suitable for reconditioning is incorrect and that applying a conservative culling rate of 20% would reduce the potential benefit of reconditioning from the 4.45-8.90% range to 3.56 – 7.12% (Olney Dec. at 88). It is noteworthy that the 6% survival improvement still falls within this range, though granted, at the higher end. Also, other actions could be taken through the development of a kelt management plan to increase the number of female kelts in "good" or "fair" condition that are collected, if necessary to achieve the 6% survival improvement. For example, female kelts could also be collected at Lower Monumental Dam or in tributary streams after spawning.

42. Third, Mr. Olney highlights NMFS' consideration that the actual success of reconditioned kelts spawning in the wild is unknown (Olney Dec. at 89). NMFS recognized this by cutting the assumed success rate of the long-term reconditioned kelts to 50% (see Long Term Conditioning Equation on Page 4 of the SCA – Snake River Steelhead Kelt Appendix).

43. Mr. Olney correctly notes that a plan must be developed, that several challenges will need to be overcome, and that there is considerable scientific uncertainty involved (Olney Dec. at 90, 91, and 92). I generally agree with these statements. However, none of these

concerns, which NMFS fully acknowledged in its analysis (SCA - Snake River Steelhead Kelt Appendix AR A.2), suggests that these issues cannot be resolved to the benefit of B-run steelhead populations.

44. Mr. Olney also notes that NMFS assumes a higher relative effectiveness for reconditioned wild female kelts (50-100%) than for hatchery fish in other analyses (0-100%) (Olney Decl. at 92). It is generally accepted that fish reared in hatcheries are typically less fit than are their wild counterparts (SCA - Artificial Propagation for Pacific Salmon Appendix, AR A.2). It is reasonable to assume that wild females (which have already successfully spawned in the natural environment) would be relatively more effective at successfully spawning a second time than would hatchery fish spawning for the first time.

C. Avian Predation Adjustments

45. Mr. Olney (Olney Decl. at 77 and 78) asserts that NMFS intended to reduce the adjustments for actions taken to reducing tern predation by 50% to account for potential compensatory mortality (2008 BiOp at 7-48), but failed to do so in the analysis. This is not true. NMFS did consider applying a 50% decrement as suggested by Roby et al., 2003, however, as explained in section 8.3.5.6 of the 2008 BiOp (and referred to in the other applicable species specific sections), NMFS determined that "as a result of the small incremental reduction in survival that results from reducing predation by terns nesting on East Sand Island, consideration of compensatory mortality does not significantly alter the estimated benefits of this action" and so did not apply the theoretical adjustment suggested by Roby et al., 2003.

46. Mr. Olney asserts that NMFS did not correctly account for juvenile estuarine predation by double-crested cormorants in its Current-to-Prospective analysis (Olney Decl. at

76). Mr. Olney is wrong in this assertion. It appears that double-crested cormorant populations have stabilized at around 12,400 breeding pairs in the estuary between 2003 and 2006 (Fredricks 2008).[13] Initial assessments of "Current" cormorant consumption rates in the estuary indicate they may be consuming an average of about 7% of steelhead (range of 1 to 12%), 3% of yearling Chinook salmon (range of 0 to 6%) and 3% of subyearling Chinook salmon (range of 1 to 6%). NMFS did not make any Current to Prospective adjustment because it was not willing to assume that BiOp RPA 46 would result in any substantial reductions to current levels of cormorant predation. This is not to say that management actions resulting from the effort to implement RPA 46 are unlikely to have positive effects in the future, but rather that the potential effects of these future actions were deemed too speculative to receive quantitative credit in the BiOp. Because no further quantitative benefit was assigned in the Current-to-Prospective adjustment, the analysis carries forward the current predation rates for the term of the BiOp.

47. Mr. Olney also asserts that NMFS did not correctly account for juvenile estuarine predation by double-crested cormorants in its Base-to-Current analysis (Olney Decl. at 76). Mr. Olney is only partially correct in this assertion. A review of our analysis indicates that NMFS, inadvertently, did not fully account for the increasing numbers of cormorants in the estuary from the 1980s through the 1990s in its Base-to-Current adjustment.[14] The post-Bonneville survival module of the COMPASS model used to estimate Current SARs does include two years of data from the "Base" period for steelhead (1999 and 2000) and three years of data for yearling

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[13] Fredricks 2008. Memo from Gary Fredricks (NMFS) to Ritchie Graves (NMFS) dated October 20, 2008. Attached as Exhibit 2 to this Declaration.

[14] The issue of Base-to-Current adjustments for estuary populations of cormorants was not raised in comments provided to NMFS regarding the October 31, 2007 draft BiOp. The comments NMFS received relating to cormorants were focused on the likely effectiveness of prospective measures to reduce avian predation or on concerns about the potential future impacts of populations upstream of Bonneville Dam.

Chinook (1998-2000). However, these years would represent some of the highest predation estimates that likely would have occurred during the Base period.

48. NMFS has begun assessing potential cormorant predation rates during the Base period (roughly the 1981 to 2000 out-migrations). Prior to about 1997, when avian studies resulting from NMFS' 1995 biological opinion began to be implemented, information regarding the number and size of cormorant colonies is relatively sparse and information regarding salmonid consumption rates is even sparser. NMFS' preliminary assessment indicates that steelhead consumption rates in the Base period were lower than in the Current period, meaning that juvenile survival has been reduced between the two periods.

49. Both yearling and subyearling Chinook salmon have probably been affected similarly and to a similar degree.

50. It should be noted that NMFS is in the process of reviewing these numbers and these estimates are very preliminary and have not been vetted with our co-managers or with the avian predation researchers. Also, Base consumption estimates that included the 1980s would show lower average consumption rates – translating into larger differences between the Base and Current periods than shown here. NMFS intends to raise the Base-to-Current adjustment issue through the adaptive management provisions in the BiOp for further evaluation and assessment, and participate with regional co-managers in the development of actions to address this source of mortality.

D. Consideration of Survival Metrics and Standards

51. Mr. Bowles claims that "no quantitative life-stage survival metrics or standards were actually considered in the final 2008 FCRPS Biological Opinion" (Bowles Decl. at 32).

This is not correct. The BiOp requires the Action Agencies to meet both an Adult Performance Standard and a Juvenile In-river Survival Performance Metric (see BiOp, RPA Table, pg 72-74, NOAA AR A.1) to ensure that adult survival levels through the mainstem FCRPS projects are maintained or improved through the life of the BiOp and that the in-river survival of juveniles is increasing as expected through the implementation of relevant RPA actions. In addition, expected levels of take for migrating juvenile and adult salmon and steelhead are provided in the Incidental Take Statement (see BiOp – Chapter 14, NOAA AR A.1).

IV. SNAKE RIVER FALL CHINOOK SALMON

52. Mr. Olney suggests that "historic data indicates that the 90% point of passage for wild fall Chinook salmon occurred on August 31 and sometimes extended into September" (Olney Decl. at 140). This statement is simply not true. Historically, (pre 1960s) the entire population of Snake River fall Chinook migrated past the vicinity of Little Goose Dam by mid- to late June (C.0599)[15]. Thus, no juveniles were likely present in July, August, or September historically. The more recent migration timing referred to by Mr. Olney is most likely an effect of 1) the altered thermal regime of present spawning areas (e.g., the Hells Canyon Reach and the lower Clearwater River) compared to historical core spawning areas (e.g., the Marsing Reach upstream of the Hells Canyon hydroelectric project), 2) some delays for actively migrating fish through the lower Snake River, and 3) the fact that juveniles are now using the lower Snake

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[15] Graves, R., P. Wagner, and R. Domingue. 2007. Memo to B. Suzumoto and B. Lohn dated June 12, 2007 re: Staff recommendation to relax the regional priority on summer flow augmentation for the upcoming FCRPS biologicial opinon and request NWFSC review of this recommendation. Page 2 of this document summarizes a discussion of Krcma and Raleigh 1970 and Mains and Smith 1964 in NMFS' 1/24/2006 preliminary 10(j) recommendations for the Idaho Power Company's Hells Canyon hydroelectric project (FERC No. 1971) to the Federal Energy Regulatory Commission.

River reservoirs as rearing habitat since Dworshak Dam began releasing water to reduce summer temperatures in this reach. (C.0599)

53. Both Mr. Olney and Mr. Bowles suggest that large numbers of hatchery released fish have “skewed” the apparent migration timing making it appear that proportionally fewer fish including wild fish migrate in August (Bowles Decl. at 138, Olney Decl. at 142). They further claim that NMFS did not consider this effect in its analysis. This also is in error. For example, in the Issue Summary Document (Snake River Fall Chinook Life History & Management Actions – cited by Mr. Bowles) NMFS includes a graphic showing the change in observations of trapped and PIT tagged wild fish (Figure 1) that were later detected at Lower Granite Dam. It is clear from this graphic that far more than 95% of the wild Snake River migrants had also passed Lower Granite Dam prior to August 1 in every year between 2002 and 2007.[16] In addition, NMFS did consider the behavior of, and effects of operations on, juvenile fall Chinook salmon emigrating from the Clearwater River: “when the slower-growing and later-migrating juvenile fall Chinook salmon from the Clearwater River have generally ceased migrating and have instead begun to rear within the reservoirs (primarily in late July, August, and September), maintaining adequate rearing temperatures, rather than flows, is of primary importance.” See also, discussion of PIT tag detections at Lower Granite and McNary dams of fall Chinook PIT tagged in both the Snake and Clearwater Rivers (C.0599).

54. Mr. Olney seems to argue on the one hand that Snake River fall Chinook salmon have little genetic diversity because of hatchery practices and low numbers of returning adults in the early 1990s, but on the other hand that there is important genetic diversity that could be lost if the August spill is curtailed as contemplated in the biological opinion (Olney Decl. at 142). As

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[16] In 2008, the 95th passage percentile date was estimated as August 5 (Source: Columbia River DART – Passage Prediction with Historical Timing Plot accessed on October 7, 2008).

noted in the BiOp (Section 8.2.3.1) the recent expression of a historically non-existent life history strategy by Snake River fall Chinook (i.e., those fish now observed rearing during the late summer and fall within the lower Snake River reservoirs) indicates that this ESU retains sufficient genetic diversity (phenotypic plasticity) to take advantage of the positively altered (cooler than historical) rearing conditions within the Snake River reservoirs provided by the operation of Dworshak Dam.

55. Thus, the claim that the elimination of spill for the small numbers of fish moving past individual dams in August will somehow "reduce genetic diversity" of the ESU (Olney Decl. at 142) is questionable at best, given 1) the true historic early summer migration patterns (see discussion above), 2) the increasing propensity for these fish to cease migrating after mid-July (thus, only a relatively small fraction of the juveniles exhibiting the "stream-type" life history strategy of rearing within the Snake River reservoirs are actually passing a dam during this period), and 3) that the great majority of even these few fish migrating past the dams will survive dam passage and continue rearing either in the next downstream reservoir or, if transported, in the lower Columbia River and estuary.[17] (BiOp at 5.1.2.1, Issue Summary: Snake River Fall Chinook Life History & Management Actions, NOAA AR S. 77, and C.0599).

56 Mr. Bowles (Bowles Decl. at 137) suggests that NMFS' primary rational for summer spill curtailment is that the effects on the ESU would be minimal because the proportion of fish migrating during August in recent years (2005-07) was only <1.2% compared to 5.9% for 1997-2004" and that analyses in the 2008 BiOp "do not consider existing analyses of the effects of spill, flow…, and temperature on survival of subyearling fall Chinook in recent years"

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[17] The FCRPS biological opinion provides flexibility for managers to modify summer transport operations to accommodate research, conditions at the collection facilities, or to achieve performance standards, or as a result of new information from research (see RPA Action 30 and Table 3, footnote 1).

(Bowles Decl. at 141). These statements are untrue. NMFS considered the historic distribution and migration timing, the propensity for late migrating juveniles to cease migrating, the likely survival of these juveniles through a dam, and the 300 fish trigger / 500 fish trigger for terminating or reinstating August spill (BiOp at 5.1.2.1 and 8.1.1.2, Issue Summary: Snake River Fall Chinook Life History & Management Actions, and C.0599) as well as the current and prospective productivity of the ESU (which should improve due to the prospective hydro actions being implemented, but for which NMFS assigned no quantitative credit) (BiOp 8.2.5).

57. Mr. Bowles, based on Figure 19 of his declaration, appears to agree with NMFS that only fall Chinook juveniles from the Clearwater River are present in any numbers at the Snake River projects in August. Thus, we would agree that the summer spill operations implemented starting in 2005, that the BiOp proposes to continue, are beneficial to juveniles migrating between early June (when subyearling numbers exceed 50% of the collected fish) and August (until fewer than 300 fish are collected for three consecutive days) (BiOp RPA 29 and 30) – i.e., the vast majority of the ESA-listed hatchery produced fish, naturally produced fish from the Snake River proper, and a substantial fraction of the Clearwater fish that will pass the Snake River projects prior to the cessation of spill. Mr. Bowles' arguments are thus constrained to the relative importance of the fraction of Clearwater fish migrating in August for which spill operations would not be provided.

58. The key disagreement relating to summer spill centers on the relative importance of a fairly small numbers of Clearwater River fish passing one or more Snake River projects in August to the productivity and survival of the entire Snake River fall Chinook ESU. NMFS does not disagree that the August "migrants" can contribute disproportionally to adult returns, as Mr. Bowles depicts in Table 16 (Bowles Decl. at 140). This is to be expected given that these

individuals, if they can successfully rear in the Snake River reservoirs, are quite large when they migrate as yearling the following spring, and so are much better able to avoid predators than are their subyearling counterparts; and is supported by the December 10, 2007 FPC memo (Figure 2) that Mr. Bowles cites[18] showing that a high proportion of returning adults (from Clearwater River releases of naturally produced fish) are detected out-migrating in March, April, and May as yearlings. It is also noteworthy that Mr. Bowles fails to display (in Table 16) the rest of the information provided in the Table 1 of the December 10, 2007 FPC memo – which indicates that juveniles transported in August have also contributed disproportionally to adult returns between 1999 and 2005.

59. From a productivity viewpoint, the relevant facts are that there are very few fish passing the Snake River dams in August, these fish are predominantly from the Clearwater River, the adult returns of these fish are likely to be high (compared to actively migrating subyearling Chinook salmon) whether or not spill is provided, the trigger for terminating spill guarantees that it will continue (or be reinstated if numbers increase after termination) as long as even small numbers of fish are passing the dams, and these fish make up a very small proportion of a relatively robust population of fish that has experienced a substantial increase in numbers over the past decade while supporting substantial harvest.

V. SNAKE RIVER SOCKEYE

60. Both Mr. Olney and Mr. Bowles suggest that NMFS did not adequately consider the potential risks of transportation to Snake River fall sockeye salmon (Olney Decl. at 122 and Bowles Decl. at 130). They go on to cite evidence supporting their contention: use of

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[18] It appears that the FPC memo Mr. Bowles cites is actually dated December 10, not December 3, 2008.

spring/summer Chinook as a surrogate, (Olney Decl. at 122), quotation from Williams et al. 2005 regarding little apparent benefit of transport (Olney Decl. at 123 and Bowles Decl. at 130), deviation from "spread-the-risk" approach taken for fall Chinook salmon (Olney Decl. at 123), that recent analysis indicates that high returns of sockeye in 2008 were associated with better in-river conditions and reduced transport rates (Olney Decl. at 124 and Bowles Decl. at 131), potential for impaired homing ability, increased straying, fallback, and mortality as a result of transport (Olney Decl. at 125), and potential for differential mortality upstream of Lower Granite Dam due to increased energy reserves and increased mortality due to fallback and exposure to elevated temperatures (Olney Decl. at 127-128).

61. It is important to understand that the severe paucity of information, due to tagging technology constraints (in the case of acoustic tags)[19] and to our present inability to tag sufficient numbers of juveniles to generate accurate SAR estimates (in the case of PIT tags) virtually eliminates the ability to directly assess – through controlled studies - the potential impacts or benefits of operational changes to this species. The ISAB (2008) recognized that much more information was necessary to assess the potential impacts of transport and dam operations on Snake River sockeye. Until more robust information becomes available for Snake River sockeye, it is appropriate for NMFS to use Snake River spring/summer Chinook salmon as a surrogate for assessing the potential effects of various operations at the collector projects.

62. Mr. Olney and Mr. Bowles also cite Williams et al. (2005) as indicating sockeye may not respond well to transportation. The full quotation is actually: "Low numbers of returning adults suggest that transportation provides little if any benefit to Snake River sockeye

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[19] The latest generation of smaller acoustic tags offers some hope that juvenile sockeye can be tagged without affecting their behavior or survival to the extent that there can be greater confidence in the results of studies using these tags. NMFS, in BiOp, acknowledges that information is needed and requires the Action Agencies, in RPA 52, to specifically expand PIT-tagging of juvenile sockeye to provide this information in the future.

salmon. ***Moreover, based on PIT-tag data, the alternative of in-river migration looks poor***" (Williams et al. 2005, pg 67 – emphasis added). This is based upon analysis earlier in the document showing that the Smolt to Adult returns (based on fish PIT tagged between 1990 and 2001) was 0.4% (2/478) for transported fish and 0.03% (1/3,925) for in-river migrating fish (Williams et al. 2005, pg 12).[20] Based on this data, the implication that in-river migrants return as adults at higher rates is not supportable, nor is it appropriate to use data from such small numbers of returning adults (three total) as justification either for or against transportation.

63. Mr. Olney suggests that NMFS should have followed a "spread-the-risk" approach similar to that taken for Snake River fall Chinook. While it is true that substantial uncertainties exist for fall Chinook salmon, they can be managed without regard for other species (juvenile migrants) because they are the only out-migrants during the summer. This is not the case of sockeye salmon, which migrate as smolts during the spring period with spring/summer Chinook salmon, coho salmon, and steelhead. NMFS chose not to follow this approach because of its concern that large reductions in transport rates of Snake River steelhead could substantially reduce the proportion of returning steelhead adults (BIOP 11.1.2 NOAA AR A.1 and Science Summary NOAA AR S. 77).

64. Mr. Olney and Mr. Bowles suggest that the high returns of sockeye to the mid-Columbia and Snake rivers in 2008 were a result of good in-river conditions in 2006 and 2007 (and reduced transport rates), increased hatchery fish releases, and improved ocean conditions (Bowles Decl. at 131). NMFS agrees that structural and operational improvements at the mainstem hydroelectric projects are providing improved passage conditions that result in

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[20] Note: NMFS' Northwest Fisheries Science Center is currently reviewing sockeye survival and return rate information. This information is expected to be informative for upcoming discussions focused on 2009 operations and developing sockeye studies to fill information gaps identified by the ISAB (2008).

improved survival rates. Also, NMFS agrees that increasing numbers of hatchery released fish (especially those released as smolts) are contributing to the larger adult returns we enjoyed in 2008. However, NMFS believes that ocean conditions have been primarily responsible for the large improvements noted in the Smolt Monitoring Program memoranda cited by Mr. Olney and Mr. Bowles. NMFS' Northwest Fisheries Science Center is currently developing additional data to generate a longer record of sockeye SAR estimates that should allow more refined analyses of several of these environmental factors. When completed, NMFS will share these results with the Action Agencies and co-managers as input in the development of 2009 dam and transport operations and future areas of study.

65. Mr. Olney is correct that NMFS often uses Snake River spring/summer Chinook salmon as a surrogate for Snake River sockeye salmon when available information is insufficient to make separate assessments based on studies of sockeye. As Mr. Olney notes, NMFS did indicate that there is some potential that sockeye salmon may exhibit conversion rate losses that are similar to those observed for Chinook salmon (i.e., reduced conversion rates of about 7% - SCA, Adult Survival Estimates Appendix) – which would include all of the potential impacts noted by Mr. Olney (Decl. at 125). However, NMFS noted the potential effect, but did not believe it was prudent to specifically extrapolate the expected take that might result from transporting sockeye in this instance. Increased smolt production should allow future research (BiOp RPA actions 52 and 55) that will define the likely effects of transportation on Snake River sockeye.

66. Mr. Olney (Decl. at 127 and 128) discusses the potential for differential mortality due to transport upstream of Lower Granite Dam. At present there is no information to suggest that this is likely the case. However, through implementation of BiOp RPA actions 42, 52, and

55, additional information should become available that will assist in assessing this potential effect.

67. Mr. Bowles suggests (Bowles Decl. at 130) that sockeye may be vulnerable to descaling during collection at Snake River dams. Anectodal information does suggest that sockeye smolts are more prone to descaling that other spring migrants. The descaling rates of in-river migrating sockeye appear to increase the further downstream the fish are sampled (PSMFC report for JDA and BON). However, because only those fish traveling through bypasses are available for observation, whether these individuals are descaled as a result of passage through the bypass in which the observation is made or from bypasses, turbines, and spillways at upstream projects is unknown.

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

Ritchie J. Graves

EXHIBIT 1

DECLARATION OF RITCHIE J. GRAVES

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northwest Fisheries Science Center
Fish Ecology Division
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

September 8, 2008

MEMORANDUM FOR: F/NWR5 - Bruce Suzumoto

FROM: F/NWC3 - John W. Ferguson John W. Ferguson

SUBJECT: Preliminary survival estimates for passage during the spring migration of juvenile salmonids through Snake and Columbia River reservoirs and dams, 2008

This memorandum summarizes conditions in the Snake and Columbia Rivers and preliminary estimates of survival of PIT-tagged juvenile salmonids passing through reservoirs and dams during the 2008 spring outmigration. We also provide preliminary estimates of the proportion of Snake River migrants that were transported from Snake River dams in 2008. Our complete detailed analyses and report for spring migrants will be available by the end of the year. In past years, changes in the database between the time of our annual summer memo and the publication of our final report have sometimes resulted in differences of up to 3 or 4% in estimated survival.

Summary of Research

For survival studies funded by BPA in 2008, NOAA Fisheries PIT tagged about 18,250 river-run hatchery steelhead, about 15,320 wild steelhead, and about 9,330 wild yearling Chinook salmon for release into the tailrace of Lower Granite Dam. From studies funded by the USACE, we used about 122,000 hatchery yearling Chinook salmon PIT tagged by NOAA Fisheries at Lower Granite Dam for evaluation of "extra" or "latent" mortality related to passage through Snake River dams.

Survival estimates provided in this memorandum are derived from PIT-tag data from fish PIT tagged by or for NOAA Fisheries, as described above, along with fish PIT tagged by others within the Columbia River Basin.

For yearling Chinook salmon from Snake River Basin hatcheries, estimated survival to Lower Granite Dam tailrace has been stable since 1998 (Table 1, Figure 1). In that period mean survival for index groups (release groups that most represent production releases from hatcheries that we have tracked for multiple years, Dworshak, Kooskia, Lookingglass/Imnaha Weir, Rapid River, McCall/Knox Bridge, Pahsimeroi, and Sawtooth) has ranged from 63.5% in 1998 to 69.7% in 2000 (2005 was an exception; mean survival was 54.9% that year, and was more variable among hatcheries than in other recent years). Mean survival to Lower Granite Dam tailrace for the index hatchery release groups was 60.2% in 2008.

Estimated survival for Snake River yearling Chinook salmon (hatchery and wild combined) in 2008 was higher than the 6-year average (2002-2007) in every reach except John Day-to-Bonneville Dam, although not all mean survival estimates were higher than previous individual years (Table 2, Figures 2 and 3). Mean estimated survival for yearling Chinook salmon from Lower Granite Dam tailrace to McNary Dam tailrace in 2008 was 78.1% (95% CI: 75.9, 80.3%). Though this estimate is not significantly[1] different from any year in 2002-2007, it was the second highest estimate in our data series for the Lower Granite-to-McNary reach. Mean estimated survival in 2008 from McNary Dam tailrace to Bonneville Dam tailrace was 53.7% (95% CI: 44.5, 62.9%). This estimate is one of the lowest we have seen for McNary to Bonneville and is statistically significantly lower than all other years in our series except 2001 and 2004. Mean estimated survival for yearling Chinook salmon from Lower Granite Dam tailrace to Bonneville Dam tailrace in 2008 was 41.9% (95% CI: 34.6, 49.2%). Estimated survival for the Lower Granite project (head of reservoir to tailrace) was 99.2%, based on fish PIT tagged at and released from the Snake River trap. Combining this estimate with the estimate from Lower Granite Dam tailrace to Bonneville Dam tailrace provides an in-river survival estimate for yearling Chinook salmon traveling through the entire hydropower system (all 8 projects) in 2008 of 41.6% (95% CI: 34.2, 49.0%).

For Snake River steelhead (hatchery and wild combined), mean estimated survival in 2008 was higher than the 6-year average in every reach, although not all mean survival estimates were higher than previous individual years (Table 3, Figures 2 and 3). Mean estimated survival for steelhead from Lower Granite Dam tailrace to McNary Dam tailrace in 2008 was 71.6% (95% CI: 68.7, 74.5%). This estimate was significantly higher than those from 2001, 2002, and 2003, and higher but not significantly so than those from 2006 and 2007. Mean estimated survival in 2008 from McNary Dam tailrace to Bonneville Dam tailrace was 63.9% (95% CI: 60.6, 67.2%). The 2008 McNary-to-Bonneville estimate was significantly higher than those from 2001 and 2004, but not statistically different from other years. Mean estimated survival from Lower Granite Dam tailrace to Bonneville Dam tailrace was 45.8% (95%

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[1] Significance informally assessed by examining whether confidence intervals overlap.

CI: 42.9, 48.7%). Estimated survival for the Lower Granite project (head of reservoir to tailrace) was 99.5%, based on fish PIT tagged at and released from the Snake River trap. Combining this estimate with the estimate from Lower Granite Dam tailrace to Bonneville Dam tailrace provides an in-river survival estimate for steelhead traveling through the entire hydropower system (all 8 projects) in 2008 of 45.5% (95% CI: 42.2, 48.8%).

For PIT-tagged hatchery yearling Chinook salmon originating from the upper Columbia River in 2008, estimated survival from McNary Dam tailrace to Bonneville Dam tailrace was 59.3% (95% CI: 37.3, 81.2%; see Table 4). This is the lowest point estimate we have seen for this group in the McNary to Bonneville reach (2002-2007, no estimate possible in 2005 or 2006); although great uncertainty in the estimate means that the 2008 survival estimate is not statistically different from any of the previous years. The 2008 McNary-to-Bonneville survival estimate was affected by a low estimate from John Day Dam tailrace to Bonneville Dam tailrace (49.6%). The estimated survival for John Day-to-Bonneville was the lowest seen for that reach in the group of estimates from 2002-2007, and it was significantly lower than all but the 2007 estimate.

Survival probabilities for PIT-tagged steelhead originating from the upper Columbia River in 2008 could be estimated only from point of release to McNary Dam tailrace (Table 5). Low detection probabilities in the Lower Columbia, combined with relatively small numbers of fish released, made survival estimation impossible downstream of McNary Dam. Estimated survival from release to McNary Dam tailrace was 51.9%, which was very similar to previous years. For fish released from upper Columbia River hatcheries, we cannot estimate survival in reaches upstream from McNary Dam (other than the overall reach from release to McNary Dam tailrace) because of limited PIT-tag detection capabilities at Mid-Columbia River PUD dams.

Our preliminary estimates of the proportion transported of non-tagged wild and hatchery spring-summer Chinook salmon smolts are 54.3% and 45.3%, respectively. For steelhead, the estimates are 50.5% and 46.6% for wild and hatchery smolts, respectively. These estimates represent the proportion of smolts that arrived at Lower Granite Dam that were subsequently transported, either from Lower Granite Dam or from one of the downstream collector dams. Survival estimates presented here are based on PIT-tagged fish that remained in-river. These fish either passed through turbines or spillways, or were intentionally returned to the river after detection in bypass systems. The estimates presented here are applicable only to the non-tagged smolts that remained in-river.

Discussion

Snake River flow volume was near average throughout April 2008 (Figure 4), but increased to above average for most of May, due to the late season thaw of the above average snowpack. The large influx of cold melt water also made water temperatures in April and May in the Snake River the coldest seen in the 8 most recent years (Figure 6). Compared to recent water years, the overall flow volume and seasonal pattern of flow in 2008 were most like 1998 and 2003. However, water temperatures in 2008 were colder than either of those years.

Mean spill as a percentage of flow at the Snake River Dams in 2008 was among the highest in recent years and remained high throughout the season (Figure 5). Spill percentages in 2008 were much like those in 2007 until mid-May, when a sharp increase in flow corresponded with an increase in spill. In contrast, spill percentages dropped off in May of 2007. The combination of high spill, cold water, and average flow early followed by high flow in May distinguished 2008 from other recent water years.

Within the season, estimated survival for daily groups of yearling Chinook salmon from Lower Granite Dam to McNary Dam did not vary much (Figure 7), but there was a slight decline from mid April until the end of May. A moderate increase in flow in early May corresponded with the peak of the passage index at Lower Granite Dam. This increase in flow presumably flushed out most of the juvenile migrants, and then the remaining migrants were pushed out by the large increase in flow that occurred in the middle of May.

The estimated proportion of smolts transported in 2008 is greater than in 2007, particularly for Chinook salmon. The primary reason is that smolts migrated later in 2008 than in 2007. Transportation began at about the same time at all dams in both years, but in 2008 a smaller proportion of fish passed the dams before transport was initiated. In particular, for wild Chinook salmon in 2007, there was a very large peak of passage at Lower Granite Dam around April 20, a time when no smolts were being collected and transported. No such peak in passage occurred in 2008. Another difference between 2007 and 2008 is the larger discrepancy between the percentages for hatchery and wild fish of the same species, especially for Chinook salmon. For Chinook salmon, it appears that more wild fish were transported than their hatchery counterparts in 2008 because they were more likely to be collected (higher detection probability) on any given day. For steelhead, the cause seems to be more related to a slightly earlier migration of hatchery than of wild fish.

The most notable finding reported in this memo is the low estimated survival from McNary Dam to Bonneville Dam for Snake

River Chinook salmon. This lower-river estimate has two component estimates; a very high estimate from McNary to John Day, and a very low estimate from John Day to Bonneville. We suspect that there are two reasons for the low estimate of survival for the overall reach and for the pattern observed in the two components: (1) survival in the John Day-to-Bonneville reach truly was lower than in past years; (2) violation(s) of assumptions of the single-release recapture model occurred, resulting in overestimation of survival from McNary to John Day and underestimation from John Day to Bonneville.

First, we discuss possible explanations for lower actual survival. High flow in the Lower Columbia resulted in a large accumulation of debris at Bonneville Dam. In particular, debris on the juvenile bypass intake screens reportedly resulted in increased fish descaling and direct mortality, especially for Chinook salmon. This problem was most pronounced during the first three weeks of May. The screens were removed from all of the second powerhouse units from 23 May until 19 June. Over the same period, the proportion of flow entering the powerhouses increased. Removal of the screens and increased turbine flow would have resulted in more fish passing through turbines, a passage route usually associated with relatively higher mortality. The combination of debris-related direct and indirect mortality followed by increased passage mortality could have contributed to low estimated survival in the John Day-to-Bonneville reach for Chinook salmon of both Columbia and Snake River origin. Steelhead are more likely to pass through the spillway or corner collector, and were probably less affected than Chinook salmon.

There is anecdotal evidence that the number of gulls preying on smolts in the tailraces of both John Day Dam and The Dalles Dam were the highest seen in recent years. The new temporary spillway weirs (TSW's) at John Day Dam are suspected to have altered the hydrodynamics in the tailrace and created an upwelling in the center of the spillway downstream of the avian predation barriers. Predation by gulls was concentrated in that zone. It is also possible that the change in hydrodynamics created zones of increased predation by fish in John Day Dam tailrace. Higher predation at The Dalles Dam and in the tailrace of John Day Dam could have further reduced survival from John Day to Bonneville.

However, an increased level of mortality between John Day and Bonneville is not enough by itself to cause the pattern of high estimated survival from McNary to John Day and low estimated survival from John Day to Bonneville for Chinook salmon. The two survival estimates are statistically correlated (negatively), and truly low survival in combination with small sample sizes does make such a pattern more likely to occur by chance. However, the estimates had relatively high precision. In fact, for Chinook salmon, the mean point estimate for McNary to John Day was actually greater than 1.0 with a standard error so small that the lower limit of a 95% confidence interval on true survival is greater than 1.0. Moreover, the pattern of a high estimate for McNary-to-John Day and a low estimate for John Day-to-Bonneville also occurred for Snake River steelhead and for yearling Chinook from the upper Columbia River.

The observed pattern is consistent with the occurrence of differential mortality downstream of John Day Dam between those fish detected at John Day Dam and those not detected (sometimes referred to as "post-detection mortality"). This would occur if fish leaving the juvenile bypass facility were more likely to pass into zones of increased predation than were non-bypassed fish. It is possible that the hydrodynamics in the tailrace of John Day caused differential post-detection mortality. If detected fish at John Day Dam incurred greater mortality immediately after detection (i.e., in the tailrace before remixing with non-detected fish, or in the bypass system itself), the result would be an underestimate of the detection probability at John Day Dam, and a resultant overestimate of the survival probability from McNary Dam to John Day Dam.

If mortality downstream of Bonneville Dam were equal for fish detected at Bonneville and those not detected then the resultant survival probability from McNary to Bonneville Dam is unbiased; only the two component estimates are biased, the first too high and the second too low. However, if mortality between Bonneville Dam and the area of the PIT trawl were also higher for fish detected at Bonneville Dam than for those not detected, then this would have further biased downward the estimated survival from John Day to Bonneville Dam, and would also have underestimated the true overall survival from McNary to Bonneville Dam. This may have happened, for example, if detected fish were more damaged (descaled) by accumulated debris at Bonneville Dam than were non-detected fish.

Unfortunately, it is not possible to use the detection-history data to statistically detect differential post-detection mortality. We can only speculate this might have occurred in 2008 based on the pattern of observed survival estimates and anecdotal evidence regarding conditions in the lower dam tailraces. Yet-to-be completed analyses of a dam passage study at John Day dam and of bird predation data may shed light on the situation.

cc: F/NWC3 - Faulkner
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Table 1. Mean estimated survival and standard error (s.e.) for yearling Chinook salmon released at Snake River Basin and Upper Columbia River hatcheries to Lower Granite Dam tailrace (LGR) and McNary Dam tailrace (MCN), 2006 through 2008.

	2006		2007		2008	
Hatchery	Survival to LGR (s.e.)	Survival to MCN (s.e.)	Survival to LGR (s.e.)	Survival to MCN (s.e.)	Survival to LGR (s.e.)	Survival to MCN (s.e.)
Dworshak	0.853 (0.007)	0.560 (0.008)	0.817 (0.007)	0.662 (0.004)	0.737 (0.011)	0.534 (0.016)
Kooskia	0.716 (0.041)	0.513 (0.078)	0.654 (0.015)	0.523 (0.019)	0.624 (0.020)	0.419 (0.047)
Lookingglass (Catherine Cr.)	0.309 (0.007)	0.246 (0.017)	0.340 (0.007)	0.285 (0.009)	0.455 (0.008)	0.378 (0.028)
Lookingglass (Grande Ronde)	0.559 (0.081)	0.209 (0.043)	0.495 (0.022)	0.396 (0.024)	0.416 (0.016)	0.352 (0.050)
Lookingglass (Imnaha River)	0.639 (0.014)	0.428 (0.031)	0.682 (0.010)	0.582 (0.010)	0.694 (0.008)	0.521 (0.022)
Lookingglass (Lostine River)	0.409 (0.085)	0.272 (0.083)	0.594 (0.013)	0.482 (0.016)	0.600 (0.012)	0.480 (0.036)
McCall (Johnson Cr.)	0.326 (0.017)	0.236 (0.023)	0.319 (0.024)	0.260 (0.014)	0.329 (0.030)	0.315 (0.052)
McCall (Knox Bridge)	0.634 (0.006)	0.502 (0.014)	0.554 (0.007)	0.474 (0.006)	0.578 (0.007)	0.408 (0.013)
Rapid River	0.764 (0.004)	0.586 (0.008)	0.748 (0.004)	0.616 (0.005)	0.801 (0.004)	0.594 (0.012)
Entiat	---	0.520 (0.031)	---	0.321 (0.035)	---	---
Winthrop	---	0.423 (0.029)	---	0.492 (0.022)	---	0.574 (0.074)
Leavenworth	---	0.554 (0.014)	---	0.594 (0.011)	---	0.567 (0.022)

Table 2. Mean estimated survival and standard error (s.e.) through various reaches of the Snake and Columbia River hydropower system for yearling Chinook salmon originating in the Snake River, 2002 through 2008. Hatchery and wild fish combined.

Reach	2002	2003	2004	2005	2006	2007	Mean 2002-07	2008
Snake Trap-LGR	0.953 (0.022)	0.993 (0.023)	0.893 (0.009)	0.919 (0.015)	0.952 (0.011)	0.943 (0.028)	0.942 (0.014)	0.992 (0.018)
LGR-LGO	0.949 (0.006)	0.946 (0.005)	0.923 (0.004)	0.919 (0.003)	0.923 (0.003)	0.938 (0.006)	0.933 (0.005)	0.939 (0.006)
LGO-LMO	0.980 (0.008)	0.916 (0.011)	0.875 (0.012)	0.886 (0.006)	0.934 (0.004)	0.957 (0.010)	0.925 (0.017)	0.948 (0.011)
LMO-MCN	0.837 (0.013)	0.905 (0.017)	0.818 (0.018)	0.903 (0.010)	0.887 (0.008)	0.876 (0.012)	0.871 (0.015)	0.878 (0.016)
MCN-JD	0.907 (0.014)	0.893 (0.017)	0.809 (0.028)	0.771 (0.021)	0.881 (0.020)	0.920 (0.016)	0.864 (0.024)	1.076 (0.022)
JD-BON	0.840 (0.079)	0.818 (0.036)	0.735 (0.092)	1.028 (0.132)	0.944 (0.030)	0.824 (0.043)	0.865 (0.043)	0.501 (0.052)
LGR-MCN	0.757 (0.009)	0.731 (0.010)	0.666 (0.011)	0.732 (0.009)	0.764 (0.007)	0.783 (0.006)	0.739 (0.017)	0.781 (0.011)
MCN-BON	0.763 (0.079)	0.728 (0.030)	0.594 (0.074)	0.788 (0.092)	0.842 (0.021)	0.763 (0.044)	0.746 (0.034)	0.537 (0.047)
LGR-BON	**0.578** **(0.060)**	**0.532** **(0.023)**	**0.395** **(0.050)**	**0.577** **(0.069)**	**0.643** **(0.017)**	**0.597** **(0.035)**	**0.554** **(0.035)**	**0.419** **(0.037)**
Snake Trap-BON	**0.551** **(0.059)**	**0.528** **(0.026)**	**0.353** **(0.045)**	**0.530** **(0.063)**	**0.612** **(0.016)**	**0.563** **(0.037)**	**0.523** **(0.036)**	**0.416** **(0.038)**

Table 3. Mean estimated survival and standard error (s.e.) through various reaches of the Snake and Columbia River hydropower system steelhead originating in the Snake River, 2002 through 2008. Hatchery and wild fish combined.

Reach	2002	2003	2004	2005	2006	2007	Mean 2002-07	2008
Snake Trap-LGR	0.895 (0.015)	0.932 (0.015)	0.948 (0.004)	0.967 (0.004)	0.920 (0.013)	1.016 (0.026)	0.946 (0.017)	0.995 (0.018)
LGR-LGO	0.882 (0.011)	0.947 (0.005)	0.860 (0.006)	0.939 (0.004)	0.956 (0.004)	0.887 (0.009)	0.912 (0.017)	0.935 (0.007)
LGO-LMO	0.882 (0.018)	0.898 (0.012)	0.820 (0.014)	0.867 (0.009)	0.911 (0.006)	0.911 (0.022)	0.882 (0.014)	0.962 (0.014)
LMO-MCN	0.652 (0.031)	0.708 (0.018)	0.519 (0.035)	0.722 (0.023)	0.808 (0.017)	0.852 (0.030)	0.710 (0.048)	0.776 (0.017)
MCN-JD	0.844 (0.063)	0.879 (0.032)	0.465 (0.078)	0.595 (0.040)	0.795 (0.045)	0.988 (0.098)	0.761 (0.079)	0.954 (0.059)
JD-BON	0.612 (0.098)	0.630 (0.066)	-----	-----	0.813 (0.083)	0.579 (0.059)	0.658 (0.053)	0.694 (0.022)
LGR-MCN	0.536 (0.025)	0.597 (0.013)	0.379 (0.023)	0.593 (0.018)	0.702 (0.016)	0.694 (0.020)	0.583 (0.048)	0.716 (0.015)
MCN-BON	0.488 (0.090)	0.518 (0.015)	-----	-----	0.648 (0.079)	0.524 (0.064)	0.544 (0.035)	0.639 (0.017)
LGR-BON	**0.262** **(0.050)**	**0.309** **(0.011)**	**-----**	-----	**0.455** **(0.056)**	**0.364** **(0.045)**	**0.347** **(0.041)**	**0.458** **(0.015)**
Snake Trap-BON	**0.234** **(0.045)**	**0.288** **(0.012)**	**-----**	-----	**0.418** **(0.052)**	**0.369** **(0.047)**	**0.327** **0.041)**	**0.455** **(0.017)**

Table 4. Mean estimated survival and standard error (s.e.) through reaches of the lower Columbia River hydropower system for yearling Chinook salmon originating in the upper Columbia River, 2004 through 2008. All estimates are for hatchery fish only.

Reach	2004	2005	2006	2007	2008
Release-MCN	0.505 (0.018)[a]	0.546 (0.048) [b]	0.499 (0.039) [b]	0.512 (0.050) [b]	0.503 (0.015)[c]
MCN-JD	0.741 (0.038)	0.801 (0.056)	0.861 (0.060)	0.919 (0.049)	1.200 (0.080)[c]
JD-BON	0.840 (0.111)	NA	NA	0.780 (0.166)	0.496 (0.097)[c]
MCN-BON	0.622 (0.063)	NA	NA	0.709 (0.157)	0.593 (0.112)[c]

a. mean of estimates for fish released from Entiat, Winthrop, and Leavenworth hatcheries, and fish from Methow hatchery released in Twisp and Chewuch acclimation ponds.

b. mean of estimates for fish released from Entiat, Winthrop, and Leavenworth hatcheries.

c. pooled estimates for fish released from East Bank, Leavenworth, Wells, and Winthrop hatcheries.

Table 5. Mean estimated survival and standard error (s.e.) through reaches of the lower Columbia River hydropower system for steelhead originating in the upper Columbia River, 2004 through 2008. All estimates are for hatchery fish only.

Reach	2004	2005	2006	2007	2008
Release-MCN	0.383 (0.018)[a]	0.449 (0.080)[a]	0.497 (0.057)[b]	0.467 (0.058)[c]	0.519 (0.017)[d]
MCN-JD	0.786 (0.059)	0.749 (0.047)	0.826 (0.092)	0.799 (0.038)	NA
JD-BON	0.623 (0.168)	0.755 (0.167)	NA	0.459 (0.019)	NA
MCN-BON	0.496 (0.124)	0.533 (0.119)	NA	0.392 (0.059)	NA

a. mean of estimates for fish from Chelan, East Bank, Ringold, Wells, and Winthrop hatcheries released at various locations.

b. mean of estimates for fish from Turtle Rock hatchery released in Chiwawa and Wenatchee rivers and in Nason Creek.

c. mean of estimates for fish from Chelan and East Bank hathceries released in the Wenatchee River and fish from Turtle Rock hatchery released in Chiwawa and Wenatchee rivers and in Nason Creek.

d. pooled estimates for fish from Winthrop hatchery, East Bank hatchery released in the Wenatchee River, and fish from Turtle Rock hatchery released in Chiwawa and Wenatchee rivers and in Nason Creek.

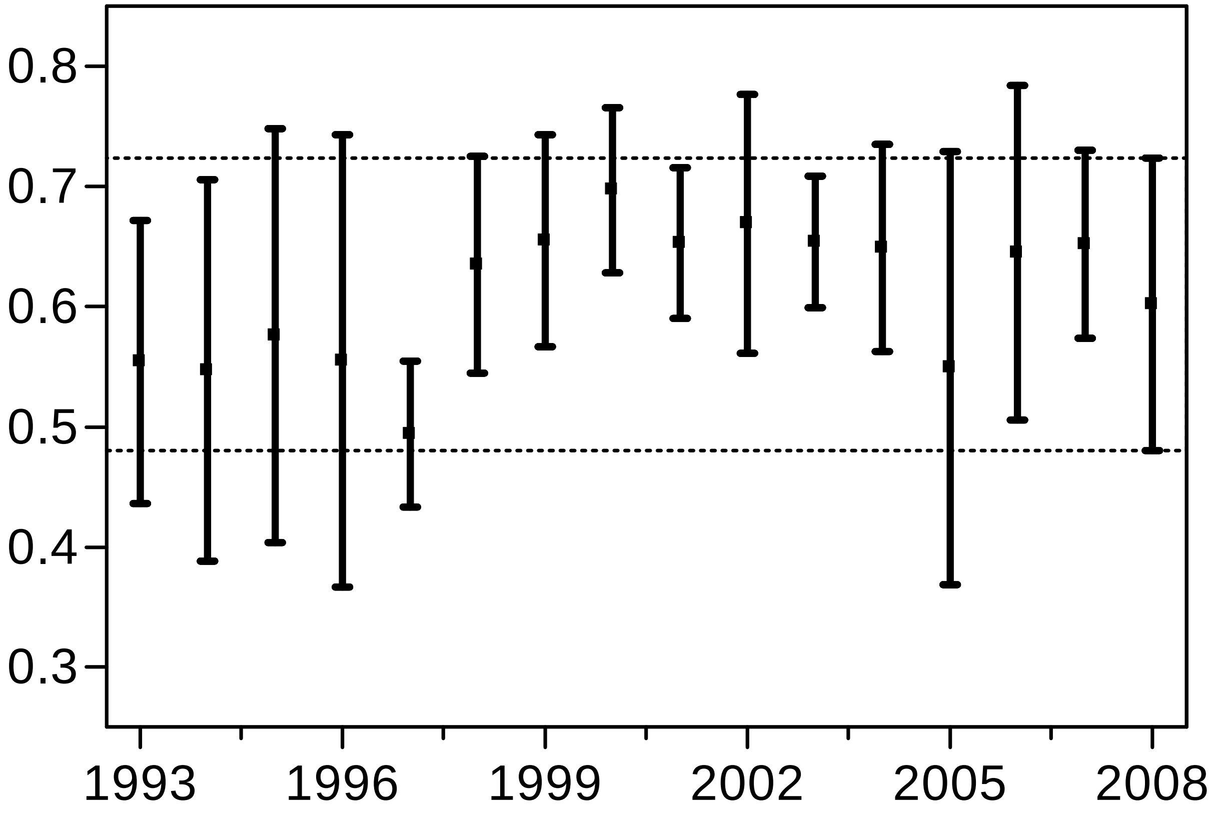

Figure 1. Annual average survival estimates for PIT-tagged yearling Chinook salmon released from Snake River Basin hatcheries, 1993-2008. Hatcheries used for average (index groups) are those with PIT-tag releases through a long series of years. Vertical bars represent 95% confidence intervals. Horizontal dashed lines are the 2008 confidence interval endpoints and are shown for comparison to other years.

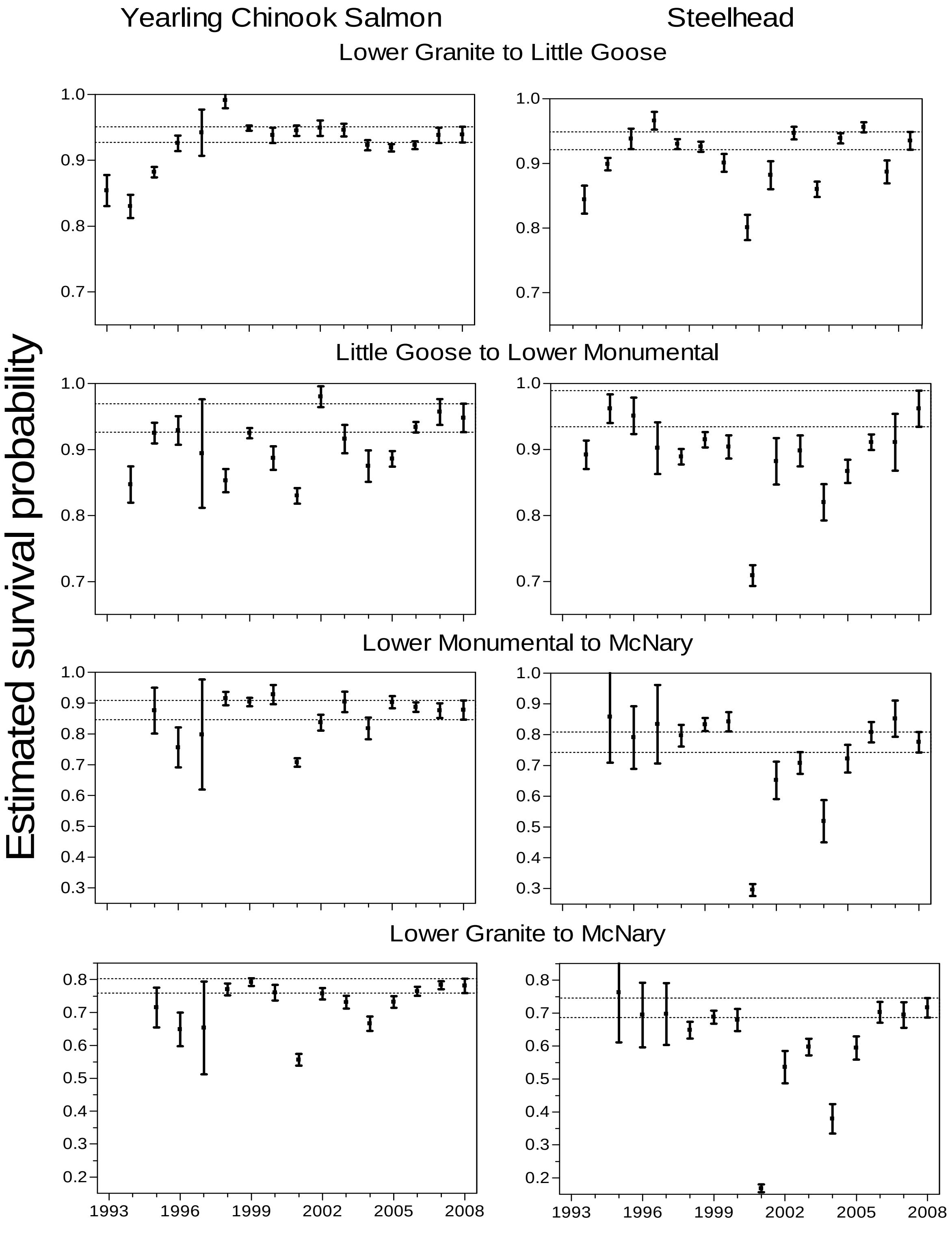

Figure 2. Annual average survival estimates for PIT-tagged yearling Chinook salmon and steelhead, hatchery and wild fish combined. Vertical bars represent 95% confidence intervals. Horizontal dashed lines are 95% confidence interval endpoints for 2008 estimates.

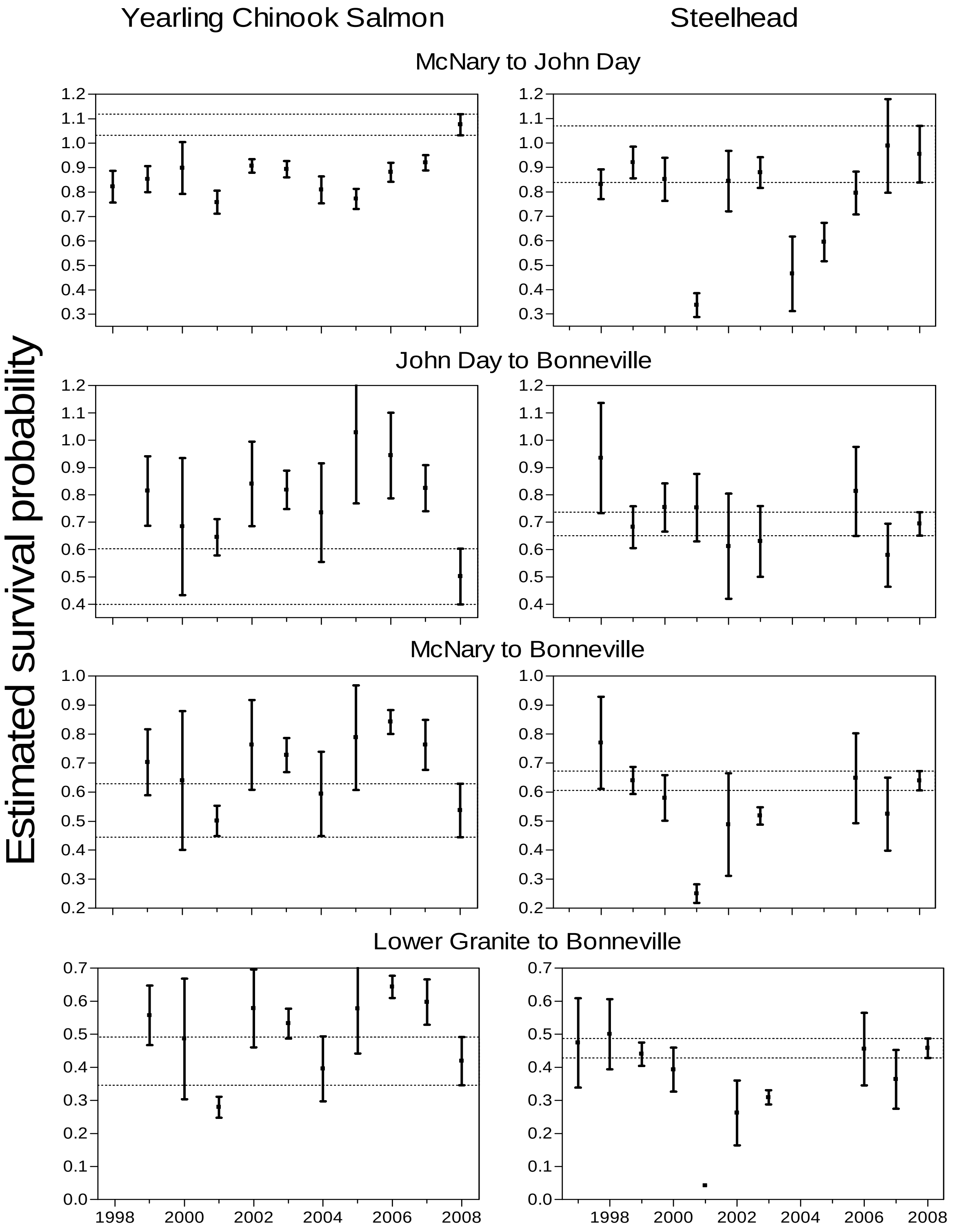

Figure 3. Annual average survival estimates for PIT-tagged yearling Chinook salmon and steelhead, hatchery and wild fish combined. Vertical bars represent 95% confidence intervals. Horizontal dashed lines are 95% confidence interval endpoints for 2008 estimates.

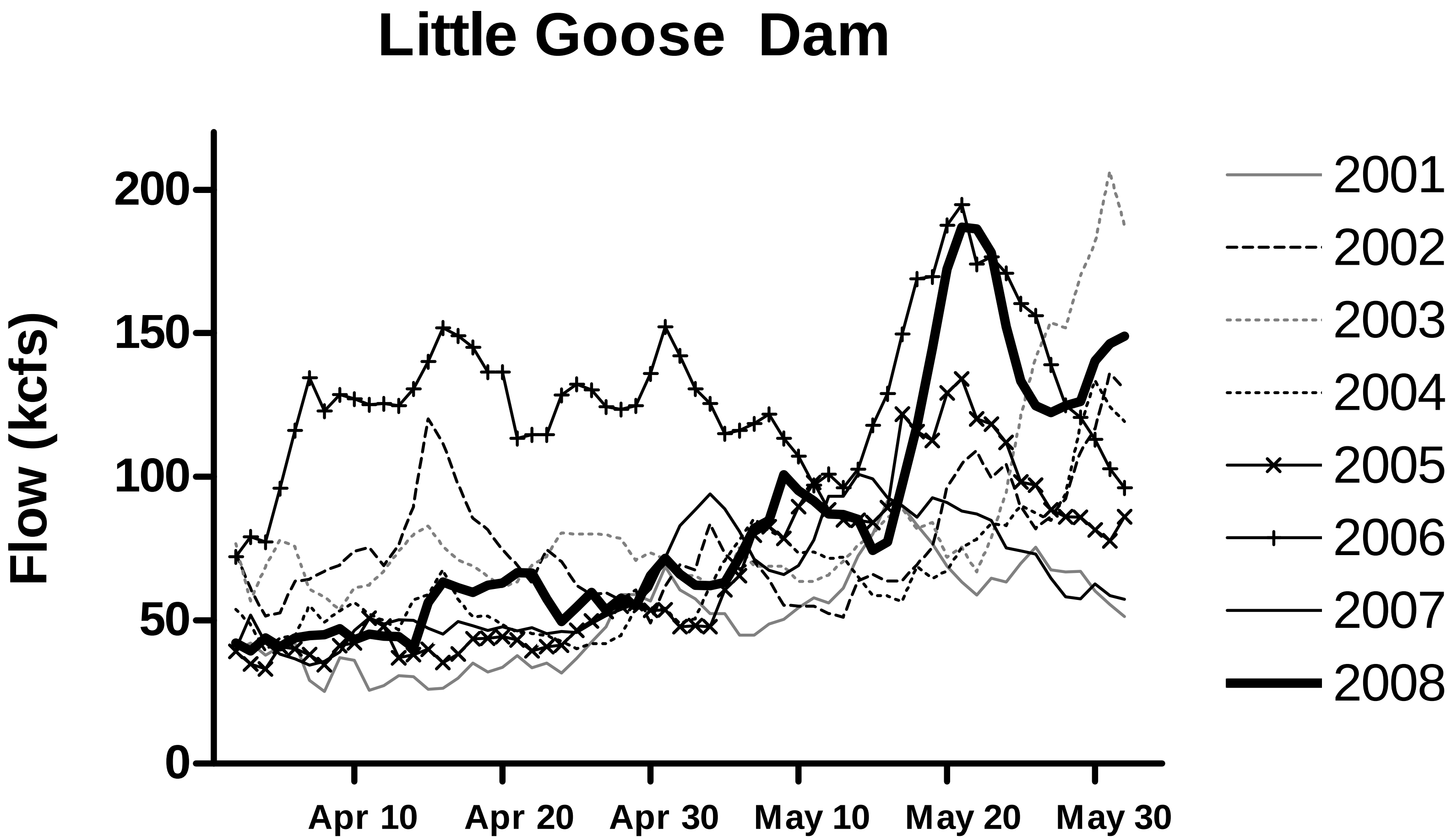

Figure 4. Snake River flow (kcfs) measured at Little Goose Dam during April and May, 2001-2008.

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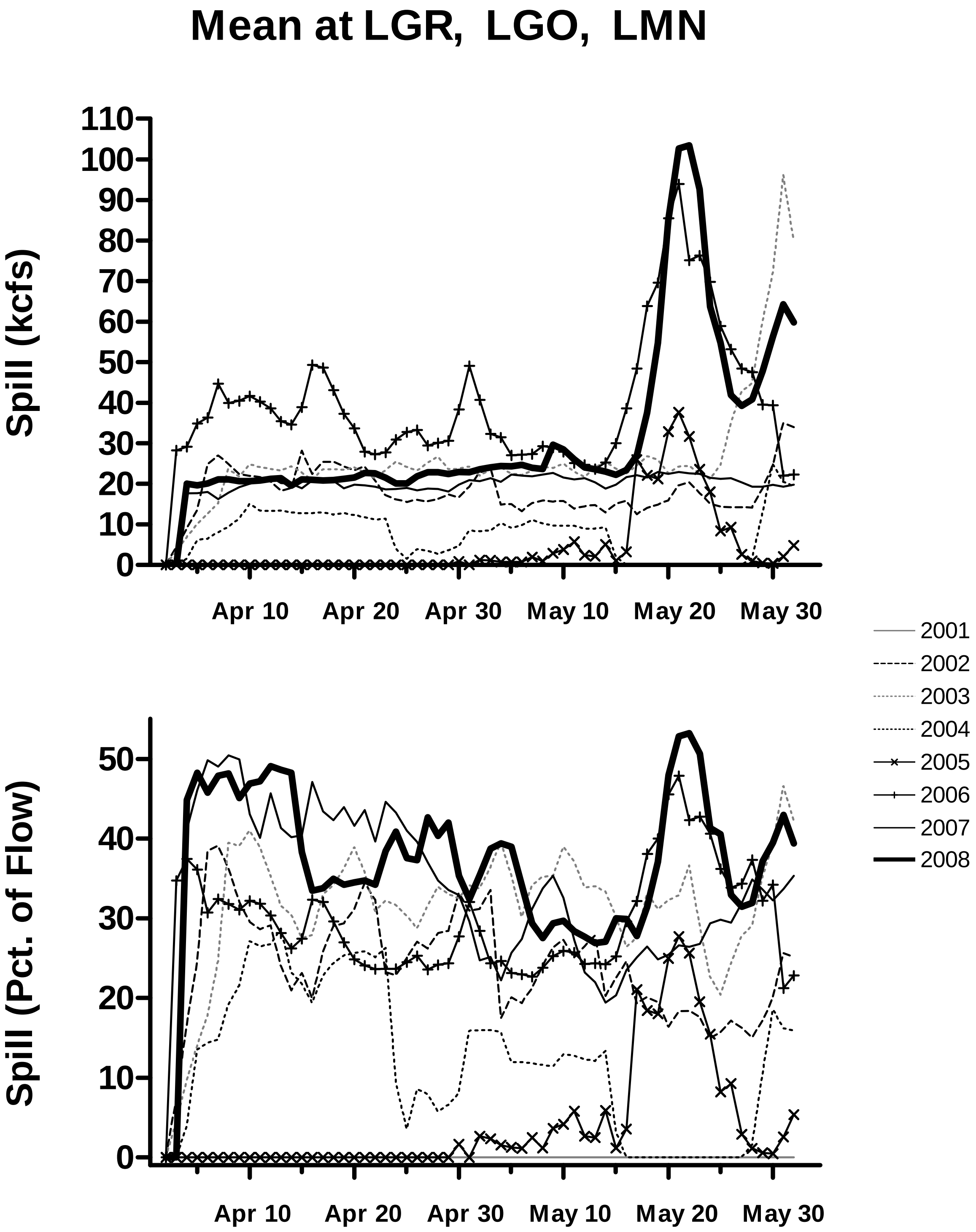

Figure 5. Mean spill (top=kcfs; bottom=percentage of total flow) at Snake River dams during April and May, 2001-2008.

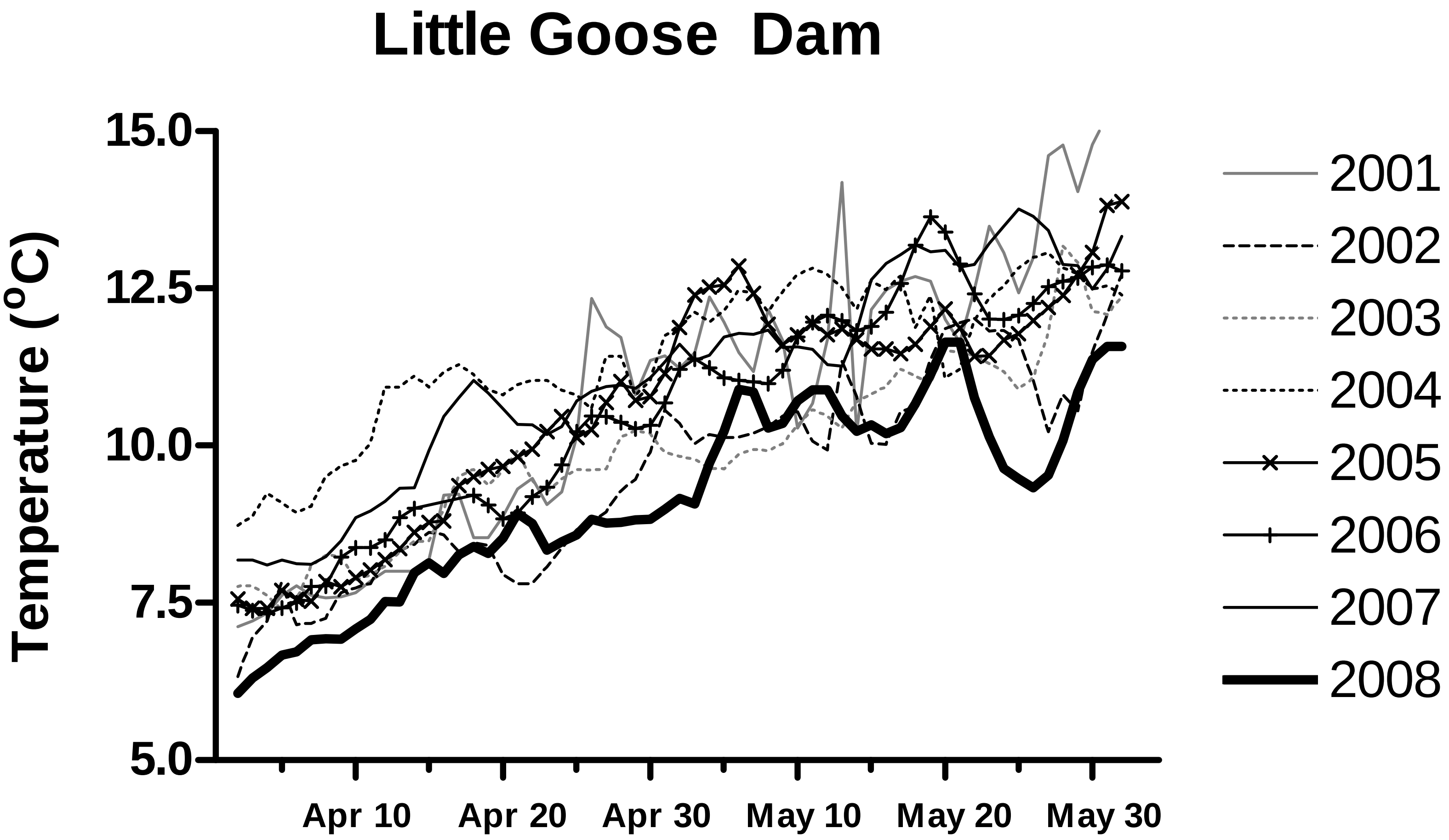

Figure 6. Snake River water temperature (°C) measured at Little Goose Dam during April and May, 2001-2008.

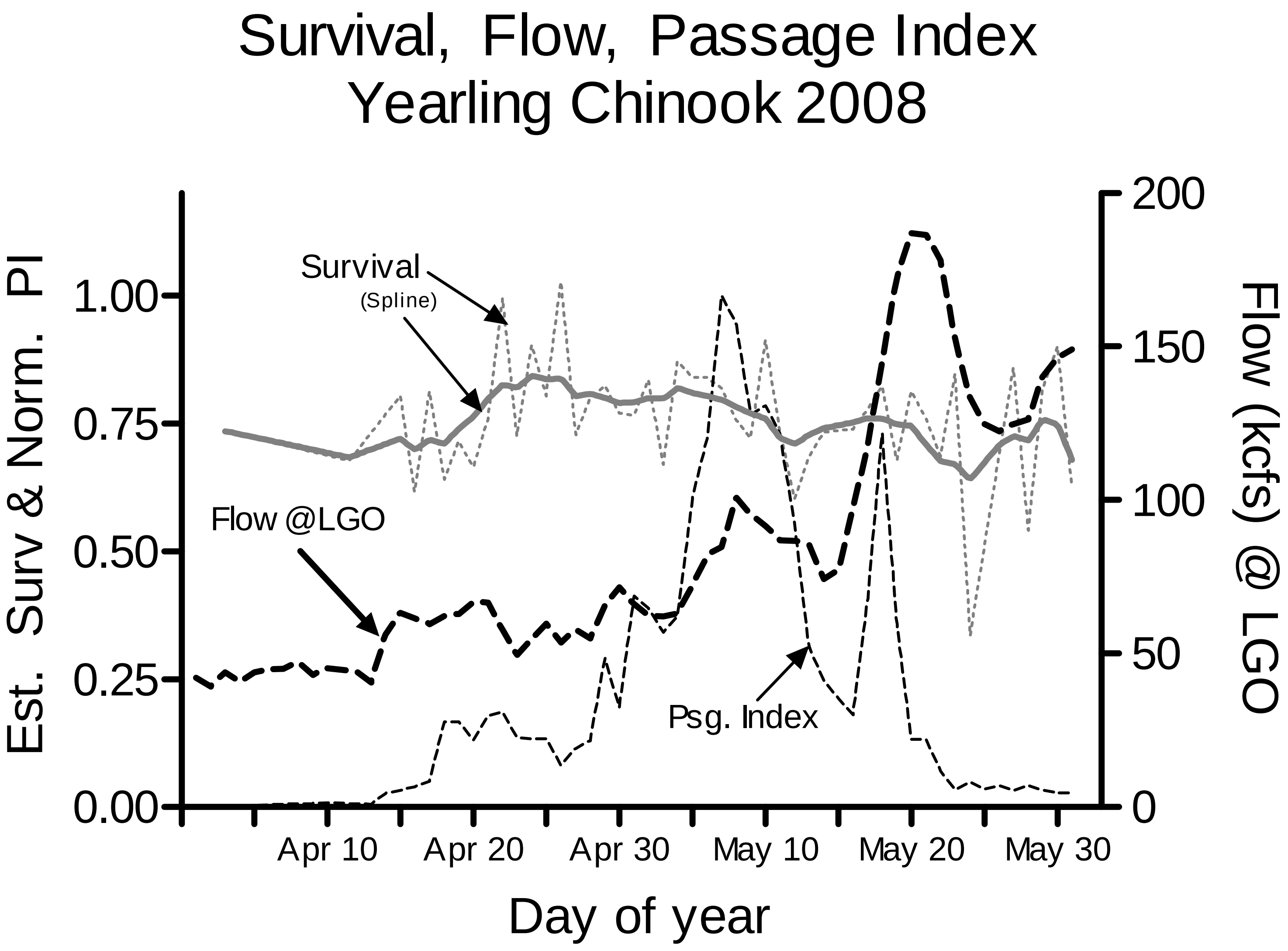

Figure 7. Estimated survival probability for yearling Chinook salmon from Lower Granite Dam to McNary Dam, flow volume at Little Goose Dam, and passage index at Lower Granite Dam (normalized: peak day = 1.0) by day of year, 2008. A curve showing a spline smooth of estimated survival is included.

EXHIBIT 2

DECLARATION OF RITCHIE J. GRAVES

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
PORTLAND OFFICE
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232-1274

October 20, 2008 F/NWO3

MEMO FOR: Ritchie Graves
FROM: Gary Fredricks GF
SUBJECT: Double-crested Cormorant Smolt Predation in the Columbia River Estuary

With Mike Langeslay's help, I calculated some species specific estimates of double-crested cormorant consumption in the Columbia River estuary. The consumption estimates are from Ken Collis of Real Time Research, one of the principal investigators of the avian predation work in the estuary. He emailed me a spreadsheet with species specific and total cormorant consumption levels in millions of fish. The data in Table 1 are the best estimate consumption levels for each species in the years where data exist (they are still working on 2007). It should be noted that the total smolt consumption levels shown for these same data in Roby et al. 2008, (Figure 43) have quite wide confidence limits due to the difficulty in obtaining cormorant consumption estimates.

Table 1. Number of smolts (in millions) consumed by double crested cormorants in the Columbia River estuary. Data from Collis, 2008.

Year	Chinook 1	Chinook 0	Steelhead	Coho	Total
2003	1.03	0.88	1.36	1.91	5.18
2004	0.52	3.79	0.86	1.20	6.38
2005	0.08	2.39	0.15	0.26	2.89
2006	3.14	0.63	1.69	4.82	10.28
Average	1.19	1.92	1.02	2.05	6.18

In order to understand how these consumption rates relate to the total population of smolts available, species specific population levels for the estuary were necessary. For these I used the Northwest Fisheries Science Center annual population estimate memos (Ferguson 2003 – 2006) that provide species specific estimates of the total Columbia River population that arrives in the estuary at Tongue Point. I used the transport scenarios in the memos that best fit the operations for each year. For 2003, I used the transport with spill estimate for the spring migrant estimates and full transport (without spill) for the summer subyearling chinook estimate. For 2004, I used the transport with spill estimate for both the spring and summer migrant estimates. For 2005, I used the full transport scenario for the spring migrant estimates and transport with spill for the summer estimate. For 2006, I used the transport with spill scenario for both the spring and summer migrant estimates. These estimates are listed in Table 2. It is important to note that these estimates are made pre-season based on whatever data is available regarding wild and hatchery production and survival and therefore could be quite different from what actually happened.

Table 2. Number of smolts (in millions) arriving at Tongue Point in the Columbia River estuary. Data from Ferguson, 2003 – 2006.

Year	Chinook 1	Chinook 0	Steelhead	Coho	Total
2003	36.9	59.5	14.5	*	--------
2004	33.8	60.5	13.7	*	--------
2005	38.5	81.2	13.7	26.4	159.8
2006	38.8	89.8	14.3	22.6	165.5
Average	37.0	72.8	14.1	--------	--------

* No data in the reports for these years.

Using the data in tables 1 and 2, the proportion of smolts consumed by the cormorant colony during these years was calculated and presented in Table 3.

Table 3. Proportion of smolts consumed by double crested cormorants in the Columbia River estuary. Calculated from data in Tables 1 and 2.

Year	Chinook 1	Chinook 0	Steelhead	Coho	Total
2003	0.03	0.01	0.09	--------	--------
2004	0.02	0.06	0.06	--------	--------
2005	0.00	0.03	0.01	0.01	0.02
2006	0.08	0.01	0.12	0.21	0.06
Average	0.03	0.03	0.07	--------	--------

Using steelhead as an example, we can estimate that between 1% and 12%, with an average of 7%, of the steelhead arriving in the estuary are consumed by double-crested cormorants. The large amount of seasonal variation in these estimates may be due to factors such as alternate prey availability and nesting success (all of the estimates were made in conjunction with the nesting colony at East Sand Island) (Roby et al. 2008).

To help put these data in perspective of the years where we do not have specific consumption data, the total cormorant colony size expressed in numbers of active nests for the years 1997 through 2007 is shown in Table 4. These data were taken from Roby, 2008.

Table 4. Annual Columbia River estuary double-crested cormorant nesting population size in number of active nests (all colonies combined).

1997*	1998*	1999	2000	2001	2002	2003	2004	2005	2006	2007
6,163	7,080	6,561	7,162	8,270	10,280	10,846	12,480	12,287	13,814	13,771

* In 1997 and 1998 were last years cormorants nested on Rice Island in large numbers. The Rice Island nests comprised 19 to 11%, respectively, of the totals presented here.

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