IDAHO WATER USER SUPPLEMENTAL COMMENTS

UPPER SNAKE FLOW AUGMENTATION FOR SPRING/SUMMER CHINOOK AND STEELHEAD

FEBRUARY 27, 2001

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These comments are submitted on behalf of the Committee of Nine and the Idaho Water Users Association ("Idaho water users") in response to suggestions by Idaho Fish and Game ("IDFG") and National Marine Fisheries Service ("NMFS") that flow augmentation from the Upper Snake River ("Upper Snake") be used to benefit spring/summer chinook and steelhead.

The Committee of Nine is the official advisory committee for Water District 1, the largest water district in the State of Idaho. Water District 1 is responsible for the distribution of water among appropriators within the water district from the natural flow of the Snake River and storage from U.S. Bureau of Reclamation ("BOR") reservoirs on the Snake River above Milner Dam. The Committee of Nine is also a designated rental pool committee that has facilitated the rental of stored water to the BOR to provide water for flow augmentation pursuant to the 1995 Biological Opinion. The Idaho Water Users Association was formed in 1938 and represents about 300 canal companies, irrigation districts, water districts, agri-business and professional organizations, municipal and public water suppliers, and others. These comments have been prepared with the assistance of the scientists, biologists, and engineers who have been retained to address Upper Snake River issues involving the Endangered Species Act ("ESA").[1]

[1] Contributors include: Dr. James J. Anderson, School of Fisheries, University of Washington; Craig L. Sommers and David B. Shaw, ERO Resources Corporation; Dr. Richard A. Hinrichsen, Hinrichsen Environmental Services; Dr. William J. McNeil, retired professor of fisheries, Oregon State University.

I. Introduction

Originally, flow augmentation from the Upper Snake River basin was implemented to benefit multiple salmon runs. Water was released at various times during the late spring and summer.[2] In 1995, the focus of flow augmentation shifted to fall chinook, which migrate later in the season than spring and summer chinook and steelhead. Not only was this shift evident in terms of releases of augmentation water from the Upper Snake later in the season, but it also was evident in terms of flow/survival research. Moreover, this change in timing reflected the belief by the National Marine Fisheries Service (NMFS) and other fishery agencies that Upper Snake flow augmentation had potential to provide greater benefit to fall chinook than to the early migrating spring/summer chinook and steelhead. Recent analysis of flow and survival data has raised many doubts about the purported benefits of Upper Snake flow augmentation for fall chinook (Dreher et al. 2000; Idaho Water Users 2000). In response to those doubts, Idaho Fish and Game (IDFG) suggests that Upper Snake flow augmentation be shifted once again to benefit spring/summer chinook and steelhead ("spring migrants"). Similarly, the NMFS believes that there are benefits to spring migrants by using flow augmentation to meet flow targets. However, the Idaho water users can find no competent scientific evidence or scientific foundation that Upper Snake flow augmentation will provide any biological or physical benefit to spring migrants or any other listed species, no matter which part of the migration season it is used in.

II. IDFG Call for Early Season Flow Augmentation From the Upper Snake

Recently, IDFG called for early season releases from the Upper Snake to benefit spring migrants. In supplemental comments on the Draft BiOp,[3] IDFG stated:

[2] Upper Snake flow augmentation involves additional releases or reshaping of water from Brownlee Reservoir. A portion of the additional releases is provided from water obtained above Brownlee.

[3] Throughout this document, Draft BiOp refers to the Draft Biological Opinion – Operation of the Federal Columbia River Power System Including the Juvenile Fish Transportation Program and the Bureau of Reclamation's 31 Projects Including the Entire Columbia Basin Project, July 27, 2000.

> "As an interim measure, the action agencies should utilize flood control releases and other available storage from Dworshak and Brownlee reservoirs as necessary to achieve a flow objective of 100 kcfs at Lower Granite Dam during the spring migration period when migrants are present. [footnote omitted] This measure is premised on shifts in flood control operations at Brownlee and Dworshak. The action agencies also should manage existing flow augmentation volumes (approximately 1.9 maf) for summer migrants subordinate to flow augmentation operations during the spring migration period" (footnote discussed below; IDFG 2000b, p. 4).

The support for these comments is contained in a footnote to that paragraph:

> "The draft BiOp prioritizes flow augmentation for summer migrants at the expense of spring migrants. Available data does not support this priority. 1) Juveniles from three of the four Snake River ESUs migrate during spring (spring/summer chinook, sockeye and steelhead), whereas juveniles from only one Snake River ESU migrate during summer (fall chinook). 2) Based on survival and abundance trends, Snake River fall chinook are less imperiled than Snake River spring/summer chinook, steelhead and sockeye, particularly at the population level. 3) There is a statistically significant, positive relationship between flow and spawner-to-spawner ratios for wild Snake River spring/summer chinook (IDFG 2000; State of Idaho 2000; NMFS 2000), whereas this relationship has not been evaluated for fall chinook. Similarly, Snake River steelhead SARs are correlated with water travel time (Marmorek et al. 1998; NMFS 2000)…" (Id.)

While Idaho water users agree that the available data do not support using Upper Snake flow augmentation for summer migrants (fall chinook), we do not agree that there is any basis for using that flow augmentation for spring migrants. Each of the arguments used by IDFG, as well as arguments used by NMFS, to support early season flow augmentation are discussed in the following sections.

III. Early Season Upper Snake Flow Augmentation Has No Scientific Support

A. Summary

There is no clear scientific basis to support the claim that Upper Snake flow augmentation benefits spring migrant survival in any way. IDFG's arguments based on the degree of imperilment and the numbers of ESUs migrating at various seasons are only relevant if there is actually a survival benefit from flow augmentation. Such a benefit has not been documented. Although there may be a weak flow/survival relationship between years, no relationship has been found within a season. The relationships between spring/summer chinook survival and flow cited in the IDFG comments and the Draft BiOp are statistically unfounded. Those relationships are all compromised by confounding variables, the increasing number of dams over time, changing ocean conditions, and changes in the hydrosystem. Our discussion of the effects of changes in the number of dams, ocean conditions and hydrosystem changes are presented in comments on the Draft BiOp (Idaho Water Users 2000).

B. Imperilment and Numbers of ESUs

IDFG argues that flow augmentation should be used for spring migrants as opposed to summer migrants on the basis that three of the four listed ESUs migrate in the spring and these ESUs are more imperiled (IDFG 2000b, p.4). These arguments are only relevant if there are documented benefits to spring migrants from flow augmentation. As discussed below, there is no evidence that such benefits exist.

C. IDFG and NMFS Arguments for Flow Augmentation for Spring Migrants (Spring/Summer Chinook and Steelhead)

IDFG and NMFS use two basic lines of reasoning to support flow augmentation for spring migrants – correlations of flow with travel time or survival, and speculation on other benefits of more flow.

1. IDFG and NMFS Assert That Simple Correlations of Flow and Adult Returns Between Years Support Early Season Flow Augmentation

NMFS relies heavily on a strong correlation between smolt travel time and flow, and concludes that travel time is a function of flow (NMFS 2000a, pp. 12-17, 22). IDFG also relies on that correlation and additional "evidence" for a flow/survival relationship (IDFG 1999, Overview, p. 2; IDFG 2000a, pp. 51-59). IDFG presented correlations and a graph of spawner-to-spawner ratios for index stocks of Snake River spring/summer chinook versus Snake River flow and Lower Granite spill for brood years 1977-1995. The IDFG reports a significant correlation with both flow (r^2=0.54, p=0.001) and spill indices (r^2=0.46, p=0.004) (IDFG 1999, Overview, p. 2). Similarly, IDFG argues that water travel time, although a weak predictor of smolt-to-adult returns (SARs), is significant for spring/summer chinook and steelhead (IDFG 1999, p. II-7).

In support of flow targets and flow augmentation, IDFG and NMFS characterize these correlations as follows:

- "Available data indicate Snake River spring/summer chinook salmon can maintain current population levels, or even rebuild somewhat, when there are above average runoff conditions (e.g., high natural flow and uncontrolled spill) coupled with average or better ocean conditions (e.g., cool temperature and strong coastal upwelling)…(Figures 1 and 2). These favorable conditions also tend to narrow the wide gap in productivity between upriver and downriver indicator stocks (Figure 3). The same data indicate Snake River salmon can decline precipitously when runoff or ocean conditions are poor. The overall trend for salmon across the range of environmental conditions is downward. These environmental factors appear to influence adult returns and survival rates far more than any suite of management actions taken in recent years.

  Improved adult returns this year [2000] and projected for next year [2001] are largely the result of good runoff and ocean conditions. As long as these environmental conditions remain above average, Snake River salmon populations will likely persist or even rebuild slightly; allowing society some additional time to debate and experiment with management options. Conversely, if these environmental conditions do not remain above average (or potentially good runoff conditions are dampened by FCRPS operations[30]), then Snake River salmon populations will likely decline; making any additional delay risky for conservation and recovery of these fish. Basing recovery decisions on an expectation of above average environmental conditions is not a risk-averse approach to species conservation."

  footnote 30 "In 1999 and 2000, above average and average snowpack should have provided good spring runoff conditions, but inflexible FCRPS flood control operations coupled with cool or hot spring weather resulted in reduced flow and spill at critical times during the spring migration period (TMT minutes, 1999 and 2000; FPC 2000)."

  (IDFG 2000a, pp. 51,52; emphasis added)

- "Good outmigration conditions in 1982-84 from high natural flow and spill at mainstem dams apparently resulted in an upturn in salmon survival and adult returns in the mid 1980s (Figure 1). At the time, this upturn was often equated with management actions (e.g., Raymond 1988). Environmental conditions shifted in the late 1980s and early 1990s, demonstrating that Snake River salmon and steelhead had not actually turned the corner toward recovery from the management actions.

  There is risk of repeating this error again. Environmental conditions were once again above average during the late 1990s, resulting in an upturn in fish survival and abundance at the turn of the century. The BiOp credits much of this upturn to actions implemented with the 1995 and 1998 BiOps (BiOp, pages 6-75 and 6-76, Tables 6.3-1 and 6.3-2). In the BiOp, fish survival during the next five, eight and ten years will be used to determine if the RPA is successful or whether the breach alternative must be recommended. It is vital that the relative influence of environmental factors, such as above or below average natural runoff and ocean conditions, are factored out in the decision process. If decisions whether or not to breach are simply made based on annual population growth rates over a set number of years, then the breach decision is likely to pivot on ambient snowpack and ocean conditions" (IDFG 2000a, pp. 52, 53; emphasis added).
- "Less disparity between survival of comparable upriver and downriver indicator stocks when outmigration conditions are more favorable (e.g., high natural runoff and spill) (Figures 1 and 3) …" (IDFG 2000a, p. 57; emphasis added).
- "Prior to completion of the lower Snake River hydrosystem, Snake River stocks of spring/summer chinook generally performed as well or better than similar stocks originating below the four lower Snake River dams. Since completion of the lower Snake River hydrosystem, Snake River stocks perform much worse than their downriver counterparts (Marmorek et al. 1996; Schaller et al. 1999), except during years when smolts migrated with high natural flow and spill (Figures 1 and 3)" (IDFG 2000a, p. 59; emphasis added).
- "To summarize, there are several studies which indicate a relationship exists between river conditions when juveniles out-migrated and the rate at which adults returned from those juvenile year classes. Years of higher river flow produced higher rates of adult returns than low water years" (NMFS 2000c, p. 6-35; emphasis added).
- "A strong and consistent relationship exists between flow and travel time. Increasing flow decreases travel time. Thus, although no relationship appears to exist within seasons between flow and yearling migrant survival through the impounded sections of the Snake River, by reducing travel times, higher flows may provide survival benefits in other portions of the salmonid life cycle and in free-flowing sections of the river both upstream and downstream from the hydropower system. Snake River basin fish evolved under conditions where the travel time of smolts through the lower Snake and Columbia Rivers

was much shorter than presently exists. Thus, higher flows, while decreasing travel time, may also improve conditions in the estuary and provide survival benefits to juvenile salmonids migrating through the estuary or the Columbia River plume. By reducing the length of time the smolts are exposed to stressors in the reservoirs, higher flows also likely improve smolt condition upon arrival in the estuary" (NMFS 2000a, p. 22, emphasis added).

2. NMFS Speculation On Other Benefits of Flow

In the quote immediately above, NMFS provides a speculative description of the possible benefits to fish survival from flow management, including improved estuary and Columbia River plume conditions, and reduced exposure to stressors. Elsewhere, NMFS suggests that there also may be survival benefits involving changes in velocity, turbidity, and temperature (NMFS 2000c, pp. 6-24, 6-34 to 6-36).

D. The Analyses by IDFG and NMFS Do Not Support Flow Augmentation for Spring Migrants

Below, we address the "evidence" used by IDFG and NMFS to support flow augmentation for spring migrants – correlations of flow with travel time or survival, and speculation on other benefits of more flow.

1. Simple Between-Year Correlations of Flow, Survival, or Travel Time Do Not Provide Scientific Support for Upper Snake Flow Augmentation

The primary analyses used by IDFG and NMFS to argue that flow augmentation will benefit spring/summer chinook are simple correlations of flow, survival, water travel time, and smolt travel time <u>between years</u>. Both IDFG and NMFS recognize that natural flow variations from one year to another reflect a different set of environmental variables than within-season flow increases created by artificial flow augmentation (see the quoted passages in Section III.C.1. above). However, IDFG and NMFS fail to explain how they make the leap from benefits in high runoff years to benefits from flow augmentation within a year. High runoff years represent a different set of environmental conditions (e.g., lower temperatures, higher turbidity, and much higher volumes) than can be achieved through flow augmentation, especially with respect to additional flow from the Upper Snake.

The literature presents diverse interpretations of observational data on variables that are statistically associated with the migratory behavior of juvenile salmonids. Statistical correlation between and among random variables is useful for making predictions and evaluating hypotheses. Of course, correlation does not necessarily represent causation (NMFS 2000a, p. 52). Controlled experiments are typically required to identify cause and effect relationships. In the case of the multiple variables that are related to flow, because the wide natural variation in those variables and the lengthy life cycle of the listed species, controlled experiments are not likely to provide useful information in a reasonable amount of time. Thus, it is important to focus on the ecological mechanisms that might explain correlations or render them spurious.

The onset and synchronization of smoltification and migration to sea are regulated by environmental variables — primarily increasing day length and temperature (Muir et al. 1992). These exogenous factors operate after juvenile salmonids attain a threshold size. Smoltification and migration to sea typically occur during a limited span of time, which is highly predictable and closely related to cyclical changes in day length (photoperiod) and water temperature. Temperature mediates the physiological response to photoperiod — inhibiting smoltification at cooler temperatures and stimulating smoltification at warmer temperatures. Other environmental factors such as lunar periodicity, barometric pressure, water turbidity and velocity, wind, and spring overturn in lakes may modulate migration activity within a given seasonal cycle (McNeil 1995).

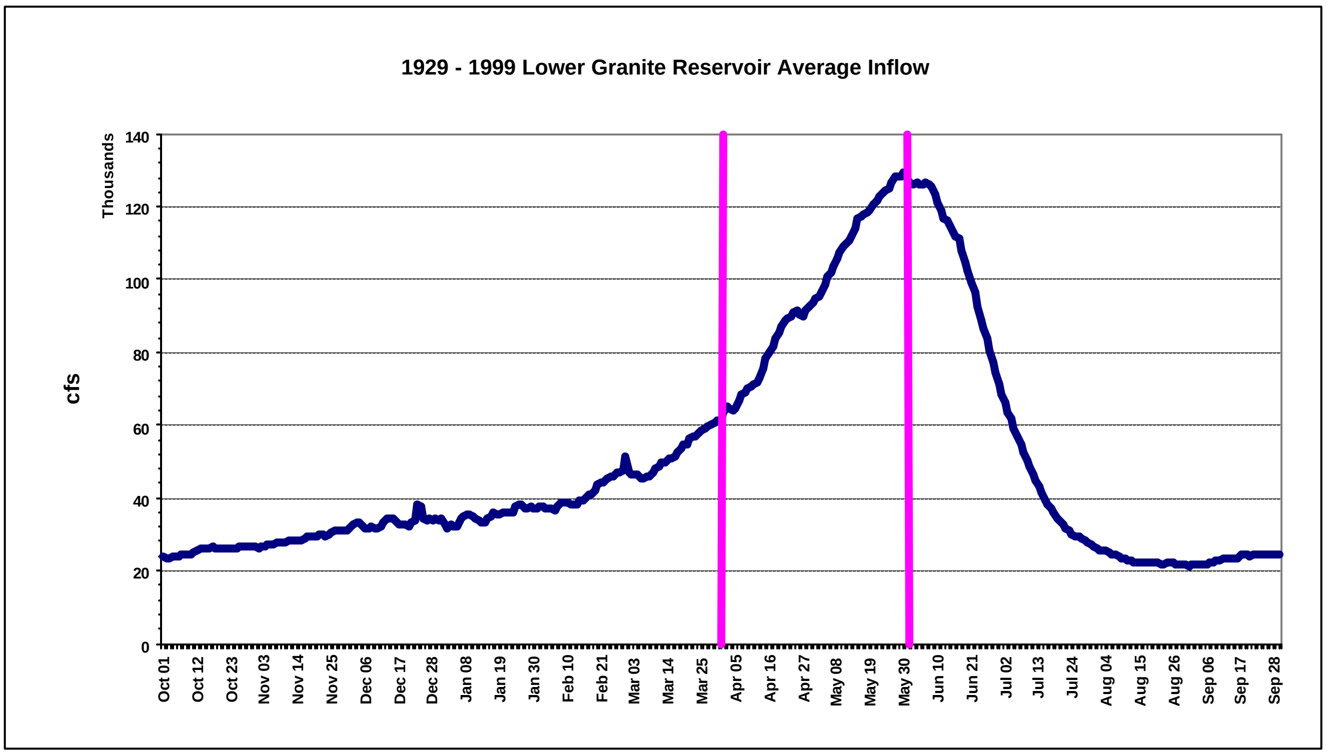
In other words, statistical associations between smolt migration speed or survival and flow may be coincidental where variables related to flow exhibit collinearity or multiple collinearity. [4] As discussed in our comments on the Draft BiOp, flow, temperature, photoperiod, turbidity, and velocity are all collinear (Idaho Water Users 2000). It is incumbent on NMFS and IDFG to look beyond simple correlations of flow and survival in order to examine the ecological implications of each environmental variable.

[4] Collinear means that the predictor variables (e.g., temperature, flow, travel time, and time of year) are highly correlated with each other. Thus, any correlation of the variables to the dependent variable (salmon survival) is confounded by the other variables.

NMFS puts much emphasis on the impacts of flow on travel time and assumes that decreased travel time confers benefits to survival even though NMFS' own research shows there is no relationship between travel time and survival. Furthermore, transportation research clearly shows that transported fish arriving later in the season do better than fish transported earlier (Hinrichsen et al. 1997; NMFS 2000d). To the extent that flow augmentation speeds fish to the transport facilities, it decreases their survival to adults.

In particular, correlation of flow to smolt travel time appears to be invalid due to the collinear relationship between flow and time of year (photoperiod). The average annual hydrograph for the Snake River at Clarkston for the period 1929-1999 is shown in Figure 1. As seen in that figure, there is a consistent increase in flow over time during the spring migration season of chinook and steelhead smolts (approximately April 1 to June 1). Both flow and photoperiod increase synchronously over the period. Thus, conclusions concerning flow as the variable controlling travel time are highly speculative.

Figure 1



In contrast, an analysis of tagged juvenile hatchery spring chinook based on smolt migration through Lower Granite Reservoir from 1987 through 1995 concludes that photoperiod provides a better basis to predict travel time than flow, and that travel time can be predicted by flow only because of the collinear relationship between flow and time.[5]

In response to these same comments by the Idaho water users, NMFS responded by stating:

> "We do acknowledge that smoltification level (for which photoperiod is likely a surrogate) is important in determining migration rate, and we elaborate on this point in the new version of the White Paper. This does not diminish the fact that no study has failed to find a travel time/flow relationship for Snake River spring chinook salmon." (NMFS 2000b, p. 2)

On the contrary, in our original comments on the draft White Paper, we list studies that have failed to find a travel time/flow relationship (Idaho Water Users 1999). As noted in the preceding paragraph, Appendix B to those Idaho Water User comments concludes that migration speed is not related to flow alone. In addition, the final White Paper discusses studies that found little or no relationship between flow and travel time (NMFS 2000a).

Regardless of the relationship of flow to smolt travel time, the more relevant issue is the relationship of flow to smolt survival. As noted in the White Paper, recent research has not found a significant relationship between seasonal flow and survival for spring migrants, let alone a relationship between flow augmentation and survival (NMFS 2000a; Skalski 1998).

The additional "evidence" offered by IDFG, in the form of correlations of flow/survival and water travel time/survival, suffers from the same problem with confounding variables.

To reiterate, NMFS and IDFG must further evaluate potential collinear effects among variables before arriving at firm conclusions for yearling migrants. Confounding effects

[5] See Idaho Water Users 1999, Attachment B.

appear to exist from collinearity between flow and other environmental variables such as water temperature and turbidity. In addition, the relationship of survival to other independent variables such as the physiological state of the juveniles, size of the juveniles, predation, competition, and ocean conditions should be explored. Careful analysis of the mechanisms, uncertainties, and quantification of the effects of these variables is necessary before calling for Upper Snake flow augmentation to benefit spring migrants.

E. Flow Augmentation is Ineffectual at Best

Even if additional research determines that salmonid survival could be improved with Upper Snake River flow augmentation, quantitative estimates demonstrate that flow augmentation, even at maximum levels, is ineffective. As noted by IDFG, a small relationship between year-to-year flow or water travel time and SAR is evident in some stocks.[6] However, even if the year-to-year relationship could be achieved within a given year using flow augmentation, the resulting benefits to the listed species are likewise small. The minimal potential benefits are especially evident when considered in terms of the actual range of flow increases that are possible with flow augmentation.

Consistent results reflecting minimal potential benefits from annual flow changes emerge from several analyses. For example, the theoretical effect of flow augmentation on Snake River spring/summer chinook and steelhead SARs can be estimated through relationships of flow, water travel time (WTT), and SAR. Flow augmentation of 427 kaf from the Upper Snake decreases WTT between Lower Granite and Bonneville by one-half day (Dreher, 1998, p. 12). Based on the correlation of SAR to WTT in Table 15 of the White Paper, this would only result in a change in SAR of about 0.04 for both steelhead and spring/summer chinook.

[6] As discussed in Section III.D.1, the correlation of survival with annual flows is not likely to equate to significant changes in survival from flow augmentation within a season.

In other examples, augmentation of 1 MAF from the Upper Snake River could provide an 8 kcfs increase in flow over a two-month season.[7] A recent study determined that an 8 kcfs flow change might result in a change in SAR from 0.010 to 0.011 for four fall chinook stocks (Anderson et al. 2000). Similarly, using a mean flow of 150 kcfs in the mainstem Columbia River and the data in the White Paper, an 8 kcfs increase might equate to a change in SAR for Upper Columbia wild steelhead of 0.0155 to 0.0164. Only in the NMFS analysis for Marsh Creek spring chinook is there any discernable correlation of year-to-year flow to survival (NMFS 2000a). For that stock, the slope of the regression was relatively large with a change in the spawner/recruit ratio from 1.0 to 1.4 using an 8 kcfs increase on a 75 kcfs base. However, with respect to this one possible exception, if the Marsh Creek relationship were causative and widespread, the strength of the correlation would be evident in tremendous and obvious success from the past flow augmentation program. Instead, the continued decline of the stocks during the flow augmentation program is more in accordance with an insignificant or null effect of flow augmentation on adult survival.

1. NMFS Speculation on Other Benefits of Flow

Idaho water users addressed the speculation about other hypothesized benefits of flow augmentation in detail in comments on the Draft BiOp (Idaho Water Users 2000). In summary, no reliable evidence was found that historical flow from the Upper Snake has been significantly altered or that Upper Snake flow augmentation can provide benefits to velocity, turbidity, temperature, conditions in the estuary or ocean plume, or fish survival.

2. Recent Smolt Transportation Analysis by NMFS

The Fish Ecology Division of the NMFS Northwest Fisheries Science Center recently reported on comparisons of inriver-migrant SARs to transported smolt SARs in 1995, 1996 and 1998 (Schiewe 2000). In addition to comparisons of SARs between inriver-migrant and transported fish, inriver-migrant SARs were correlated with Snake River flows for 1995 and 1998.

[7] Of course, flow augmentation with 427 kaf can only provide about 27 days of a flow increase of 8 kcfs and a corresponding decrease in potential SAR changes.

During the April-May time period when smolts were PIT tagged at Lower Granite Dam, 1995 flow varied from about 55,000 cfs to over 120,000 cfs, and 1998 flow varied from about 55,000 cfs to over 130,000 cfs. Generally, flows were lower during the beginning of the PIT tagging and increased until after the PIT tag data ends. The peak flow for 1995 was about 150,000 cfs and occurred about 12 days after the PIT tag data ends, and 1998 peak flow was over 215,000 cfs and occurred about 10 days after the PIT tag data ends.

The correlations of flow with survival yielded no relationship between Snake River flow and inriver-migrant SARs in either 1995 or 1998. Lower Snake River flow varied significantly during the periods in which the smolts were PIT tagged but did not correlate with inriver-migrant SARs. The researchers found these results to be consistent with trends documented for juveniles over the past several years. Additionally, the researchers found the inriver-migrant SARs were highly variable through time in 1995 and trended downward in 1998. The analysis also leads to the observation that the highest inriver-migrant SARs in 1998 resulted from smolts released during the period of lowest flow of any smolts released in 1998.

IV. Conclusion

Except for the unsupported statement that early season flow augmentation from the Upper Snake would be beneficial to spring/summer chinook and steelhead, the Idaho water users agree with IDFG's comments on the draft White Papers prepared by NMFS:

> "Similar to the transportation white paper, the flow augmentation paper fails to provide a useful context from which to assess the role of flow augmentation in salmon and steelhead conservation and recovery. Upper basin salmon and steelhead evolved and prospered in part by utilizing the natural hydrograph to aid smolt migration. The spring freshet, coupled with slope-driven water velocities provided the means to migrate 400 to 900 miles successfully. Development of the FCRPS had a huge impact on water velocity and a lesser impact on flow, temperature and turbidity. Water velocity in the lower Snake River is now approximately 10 times slower than occurred prior to construction of the lower Snake River dams.
>
> The white paper should address how flow augmentation has addressed the dramatic changes in the fish's migration ecosystem caused by development of the FCRPS. To what extent has the flow augmentation program improved water velocity, temperature and turbidity? As described in Dreher (1998), there has been very little improvement in water velocity." (IDFG 1999, cover letter, p. 3).

The same can be said for the IDFG comments on the Draft BiOp and the 2000 FCRPS Biological Opinion, December 21, 2000, itself. The analyses by IDFG and NMFS fail to address how Upper Snake flow augmentation can aid the conservation and recovery of spring/summer chinook and steelhead. Without an analysis that demonstrates survival benefits, calls for early season Upper Snake augmentation from Brownlee are unsupportable.

The NMFS and IDFG policies on flow are largely policy positions. Scientific evidence is selectively used and where science does not support their policy, the agencies use speculation couched as scientific evidence. NMFS and IDFG must address the entire body of scientific evidence on flow instead of selectively citing only observations that support their policy. For NMFS and IDFG to develop a credible analysis of flow augmentation, they must take a balanced approach including evidence both pro and con on the impacts of flow augmentation. Moreover, the agencies need to address the issues of collinearity in variables related to flow, the mechanisms through which flow affects fish survival, and the minimal benefits, if any, that can be achieved within the practical limits of flow augmentation, especially with respect to calls for additional water from the Upper Snake.

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