

**IDAHO WATER USERS' REPLY
TO THE
IDAHO FISH & GAME TECHNICAL REVIEW**

This paper is in reply to a technical review prepared by the Idaho Department of Fish and Game (IDFG) on April 25, 2001 (IDFG 2001). The IDFG technical review addresses supplemental comments on the Biological Opinion (BiOp) for the Federal Columbia River Power System (FCRPS) submitted by the coalition of Idaho Water Users that has been formed to address Snake River ESA issues.¹

Background

On October 20, 2000, IDFG submitted supplemental comments on the draft BiOp (IDFG 2000). In those comments, IDFG suggests that Upper Snake flow augmentation be shifted from use in the summer to purportedly benefit fall chinook, to use in the spring to allegedly aid spring/summer chinook and steelhead (“spring migrants”). Similarly, the BiOp establishes relatively high spring flow targets at Lower Granite Dam based on the belief by NMFS that there might be benefits to spring migrants from using flow augmentation during that period of the year (NMFS 2000). In response, the Water Users submitted supplemental comments on the BiOp opposing IDFG’s recommendation and countering NMFS’ belief (IWU 2001a). In summary, the Water Users’ supplemental comments stated:

“...Idaho water users can find no competent scientific evidence or scientific foundation that Upper Snake flow augmentation will provide any

¹ The coalition of Idaho Water Users is comprised of the Committee of Nine and the Idaho Water Users Association. 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.

biological or physical benefit to spring migrants or any other listed species, no matter which part of the migration season it is used in.

...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.

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. ...

...Scientific evidence is selectively used [by NMFS and IDFG] 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.” (IWU 2001a, cites omitted)

The Water Users continue to stand by those comments.

“Best Available Science”

Within the enormous volumes of paper being generated in the salmon debates, many opposing views are supposedly based on the “best available science.” The debate between IDFG or NMFS and the Water Users addressed in this paper is a clear example of this phenomenon — we are both claiming scientific support for directly opposite views of spring flow augmentation. Intuitively, it would seem that sound science would not

provide equal support to diametrically opposite opinions. In fact, as discussed below, that is true — the position taken by IDFG and NMFS with respect to spring flow augmentation from the Upper Snake is not supported by the best available science.

To provide context for the analysis of the opposing positions of IDFG/NMFS and the Water Users, it is helpful to review how science is supposed to work:

“Although it is counterproductive to reduce science to a stereotyped series of steps, we can identify the key ingredient of the scientific process: the hypothetico-deductive method. The first part of this term refers to hypothesis, which is a tentative answer to some question \exists an explanation on trial. ... The deductive in hypothetico-deductive method refers to how deductive reasoning is used to test hypotheses. ... In the scientific process, deduction usually takes the form of predictions about the results of experiments we should expect if a particular hypothesis (premise) is correct. We then test the hypotheses by performing the experiments to see whether or not the predicted results occur. ... [F]ive important points about hypotheses are evident:

Hypotheses are possible causes. ...

Hypotheses reflect past experience with similar questions. Sometimes hypotheses are described as educated propositions about cause. ...

Multiple hypotheses should be proposed whenever possible. Proposing alternative explanations that can answer a question is good science. If we operate with a single hypotheses, especially one we favor, we may direct our investigation toward a hunt for evidence in support of this hypotheses.

Hypotheses should be tested via the hypothetico-deductive method. ...

Hypotheses can be eliminated but not confirmed with absolute certainty.”
(Campbell 1993, underlined text is emphasized in original).

Thus, one of the most basic foundations of the scientific method is hypothesis testing. Green’s textbook on statistics for environmental biologists states:

“Colquhoun (1971) comments that ‘Most people need all the help they can get to prevent them from making fools of themselves by claiming that their favorite theory is substantiated by observations that do nothing of the sort. And the main function of that section of statistics that deals with tests of significance is to prevent people making fools of themselves.’ It is to prevent the reporting of nonsense that we apply hypothesis-testing statistics, not to prove that nonsense is really sense.

Hypothesis formulation is a prerequisite to the application of statistical tests. Statistical analysis can of course be used descriptively, as a kind of exploratory dissecting kit, but if this is the case then test statistics (such as t , F and X^2),

standard errors, or confidence limits are usually inappropriate. All of these concepts are implicitly related to tests of significance, and all such tests have meaning only when they are made against an a priori null hypothesis (usually designated H_0) which can never be proved correct but can be rejected with known risks of being wrong in doing so.” (Green 1979)

Thus, the core issue in this debate is evaluating the basic hypotheses surrounding flow augmentation as applied to the Upper Snake River, i.e., which of the following hypotheses is correct?

- Upper Snake flow augmentation would provide survival benefits to listed species of spring migrants (IDFG and NMFS hypothesis), or
- Upper Snake flow augmentation would not provide survival benefits to listed species of spring migrants (null and Water Users' hypothesis).

Both of these hypotheses can be evaluated by testing the null hypothesis — that there is no significant improvement in the survival of listed spring migrants from Upper Snake flow augmentation. The Water Users have performed this evaluation and found, despite years of research and Upper Snake flow augmentation, that there is no evidence to reject the null hypothesis. The Water Users detailed evaluation is found in their comments on the draft and final BiOp (IWU 2000; IWU 2001a) and comments on the draft NMFS White Paper on flow-survival (IWU 1999). Those comments are summarized below in response to the points made by IDFG in the technical review.

IDFG/NMFS Hypotheses

The correlations relied upon by IDFG, NMFS and other flow augmentation proponents as scientific support for flow augmentation are founded on tests of the hypothesis that year-to-year natural variations in flow are related to the survival of the listed species (IWU 2001a).² In some instances, this hypothesis has received relatively

²In fact, the null hypothesis that is tested is that year-to-year natural variations in flow are not related to the survival of listed species. To the extent that this null hypothesis is rejected, there is some relationship between year-to-year flow and survival although the relationship is highly confounded by other variables, e.g., temperature, turbidity, and smoltification (IWU 2001a). Although there is some evidence of a weak flow/survival relationship from flows that naturally vary between years (ignoring that other variables are related to flow), this evidence does not translate to a flow/survival relationship from artificial flow augmentation within a given year.

weak statistical support (IDFG 2001). However, although the results of testing this hypothesis may be of general scientific interest, those results do not directly inform policy and management decisions for the recovery of listed spring migrants, specifically the issue of Upper Snake flow augmentation, unless a correlation can also be drawn between natural variations of flows between years and artificial flow augmentation within a year.

A second, somewhat more relevant, hypothesis has also been tested ? that within-year natural variations in flow are related to the survival of the listed species. Although this hypothesis still lacks a connection between natural and artificial flow variation, the magnitude of the exogenous variables (e.g., temperature and turbidity) within a year are smaller than between years. As a result, within-year correlations are more likely to potentially represent possible effects of flow augmentation. This hypothesis has not received any statistical support. Notably, IDFG completely ignores this more relevant evidence that there is not a within-year flow/survival relationship for spring migrants.

The third, most relevant, hypothesis has NOT been tested ? that flow augmentation is related to the survival of the listed species. As the Water Users pointed out in their supplemental comments, this is a difficult hypothesis to test in a timely manner given the wide range of natural variation in flow between years (on top of which flow augmentation is a relatively small increment) and the several-year life cycle of the listed species.

There is a fourth, unspoken and largely untested hypothesis that IDFG and others apparently rely upon to make recommendations for Upper Snake flow augmentation ? that flow augmentation within a year creates river conditions similar to the natural flow variation between years. If so, a between-year flow/survival relationship would be valid for artificially augmented flows. In other words, survival benefits that may occur during a year of naturally higher flows as a result of abundant snowmelt would be duplicated by releases of water from Upper Snake reservoirs during the spring. This hypothesis is unlikely to be supported given: 1) the results of testing the second hypothesis described above, 2) the fact that the Water Users have been unable to correlate specific flow augmentation events with changes in temperature and turbidity using the available data,

and 3) the change in river velocity from Upper Snake FA is miniscule as a result of the large cross section of the reservoirs.

Specific Replies to IDFG Technical Review

Each italicized IDFG summary point is quoted from the technical review and is followed by the Water Users reply.

IDFG #1 *¾ Management actions and decisions are typically made in the face of scientific uncertainty, considering the potential benefits and risks. Empirical information is seldom black and white. In the case of flow augmentation for spring migrants, IDFG still interprets the empirical information and ecological relationships to indicate potential benefits far outweigh the risk of doing nothing, from a biological perspective. The Water Users seemingly attempt to make a case that until benefits can be proven, no spring flows should be provided to assist ESA listed spring summer chinook salmon, sockeye salmon, or steelhead.*

Water Users Reply *¾* The Water Users certainly agree that management decisions, especially those related to biological resources, typically have to be made in the face of uncertainty. However, this is no reason to abandon sound science. As explained in the “Best Available Science” section of this paper, statistical tests of valid data to test a hypothesis are specifically designed to evaluate scientific uncertainty. It is precisely because “empirical information is seldom black and white” that the scientific method was developed in the first place.

The bottom line is that there is no statistically valid basis for IDFG’s interpretation of the data. In particular, there is absolutely no evidence, or even a persuasive premise, that the “potential benefits [of Upper Snake flow augmentation] far outweigh the risk of doing nothing.” IDFG simply asserts a significant benefit/risk ratio with no relevant evidence of the benefits and no explanation or quantification of the risks or costs. As explained above, in the absence of scientific support developed from hypothesis testing, IDFG’s interpretations are speculation at best. Because research has been conducted and has found no significant relationship between natural flow variation and survival within a year, let alone artificial flow augmentation and survival, the null hypothesis that flow augmentation does not benefit survival of the species cannot be rejected; thus, the theory of benefits from Upper Snake flow augmentation is not scientifically supported.

IDFG is certainly correct; the Water Users do take the position that spring flow augmentation should not be provided because there is no evidence that significant survival benefits will result from Upper Snake flow augmentation. And contrary to the lack of evidence of biological risks from ceasing Upper Snake flow augmentation, there is abundant evidence that there will be significant costs to southern Idaho from continuing or increasing Upper Snake flow augmentation (IWU 2001b).

IDFG #2 ³/₄ *The Water Users do not dispute the IDFG and NMFS correlations between adult return rates and flows or velocities for spring migrants.*

Water Users Reply ³/₄ The Water Users do not dispute the simple IDFG and NMFS between-year correlations, but those relationships are largely irrelevant to the issue at hand ? Upper Snake flow augmentation. However, the Water Users do dispute, as discussed in the previous reply, that correlations of natural variations between years support the hypothesis that artificial flow augmentation provides survival benefits for listed species (IWU 2001a). Moreover, the Water Users also dispute that simple correlations of natural variations of flow with survival accurately reflect the ecological mechanisms at work. Thus, these simple correlations are not adequate to provide accurate recommendations for policy and management decisions.

IDFG #3 ³/₄ *The Water Users statement is incorrect that flow augmentation has no scientific support. Correlations give indirect scientific support when empirical, observed data are consistent with hypothesized effect (e.g., higher flows lead to better returns).*

Water Users Reply ³/₄ As discussed under the IDFG/NMFS Hypotheses section and in the previous two replies, the Water Users' statement that Upper Snake flow augmentation has no scientific support is absolutely correct. In particular, "indirect scientific support" cannot be accepted when specific relevant within-year flow survival relationships have been tested and found not to exist. It is deceptive (at best) for IDFG to continue to advocate the untested hypothesis it apparently relies upon ? that flow augmentation within a year creates river conditions similar to the natural flow variation between years in the face of currently available within-year analysis. The only hypothesis that is supported by data, albeit weakly, is that there is some correlation between survival and

naturally varying flows from year-to-year. And even that hypothesis is confounded by the relationship of flows to other variables known to affect fish survival (e.g., temperature, turbidity, and smoltification).

IDFG #4 ^{3/4} *The Water Users statement is accurate that correlation does not necessarily represent cause and effect (this is not the same as no scientific support; see #3).*

Water Users Reply ^{3/4} We agree.

IDFG #5 ^{3/4} *The Water Users attempt to establish an unreasonable burden of proof to demonstrate survival benefits from flow augmentation before calling for flow augmentation. They state that controlled experiments are typically required to identify a cause and effect relationship but then acknowledge that controlled experiments are not likely to provide useful information in a reasonable amount of time.*

Water Users Reply ^{3/4} It is not unreasonable to require scientific support for a measure that has been researched and for which no evidence of benefits has been found, especially where the measure involves significant, measurable costs to water users.

The IDFG criticism of the Water User reference to controlled experiments is taken out of context. The Water Users are not calling for controlled experiments. The comment was merely made in reference to how certainty over causation could be achieved. In its entirety, the paragraph in the Water Users supplemental comments reads:

“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. 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.” (IWU 2001, citation omitted)

Thus, we agree that correlation can be useful for evaluating hypotheses. As we point out above, correlations relative to the potentially most relevant hypothesis ? that natural flow variations within a year affect survival ? reject that premise.

IDFG #6 ^{3/4} *The Water Users emphasis on ecological mechanisms is incomplete in a few key regards. The ISG's Return to the River document provides a valuable diagram that better describes mechanisms how flow may indirectly influence juvenile survival rates and adult return rates.*

Water Users Reply ^{3/4} Again, the issue is flow augmentation, not simply that various ecological mechanisms are related to flow. It is ironic that IDFG criticizes the Water Users for not considering other ecological mechanisms and then fails to provide support for most of the hypotheses of ecological mechanisms that flow augmentation will benefit. For example, IDFG offers no discussion of the extent that Upper Snake flow augmentation will:

- Flood riparian areas, which may increase fish food production;
- Increase zooplankton production, which may increase fish feeding and growth;
- Decrease heating of water, which may improve survival;
- Decrease predation; or
- Increase net spill survival (after subtracting direct spill mortalities and gas bubble trauma).

Indeed, it is implausible that any foreseeable levels of spring flow augmentation from the Upper Snake would have any significant effect on these mechanisms.

The primary mechanism that IDFG dwells on is smolt travel time. The Water Users have fully addressed this issue in their comments on the BiOp:

- There is no evidence that there is a relationship between travel time and survival;
- Photoperiod is a better predictor of travel time than flow, and it is likely that travel time can be predicted by flow primarily because of the collinear relationship between flow and photoperiod;
- Some studies have failed to find a travel time/flow relationship; and
- Assuming higher water velocity would reduce travel time, Upper Snake flow augmentation is futile to mitigate the river velocity reductions resulting from dams on the lower Snake and Columbia Rivers (IWU 2000, IWU 2001a).

IDFG #7 ^{3/4} *The Water Users discussion of mechanisms is deficient in discussing the issue of fish condition as a result of migration delay, and the ultimate effect on adult returns. Flows and flow augmentation have the effect of partially mitigating this hydrosystem impact for spring migrants.*

Water Users Reply — The Water Users recognize that the work by Congleton and others on the possible impacts of fish condition and survival due to hydrosystem passage delay is a potentially important area of research for understanding how the freshwater experience may affect ocean survival. However, IDFG's statement that the way to offset smolt hydrosystem passage delay is through "more, not less" flow augmentation ignores the fact that Upper Snake flow augmentation has no discernable impact on fish travel time to the estuary. Using the CRiSP model calibrated with PIT-tag data, doubling Hells Canyon flows decreases smolt arrival at Bonneville Dam by a few hours. Whatever the hypothetical effect of a two to five week delay from hydrosystem impacts, the benefit of decreasing passage time by a few hours is entirely insignificant. Moreover, the model results are consistent with the fact that Upper Snake flow augmentation has little impact on flow velocity or other river attributes.

IDFG #8 ^{3/4} *The ISG's Return to the River description of how flow may influence survival rates of juveniles and adult return rates points to inherent problems with attempting to define in-season flow/survival relationships as recommended by the Water Users. Given the potential pathways of effects, even if a statistical relationship were defined for spring migrants, one would not expect it to represent a total picture of the flow/survival relationship.*

Water Users Reply ^{3/4} At this point IDFG appears to admit that there is no statistical relationship between flow and survival of spring migrants. Still, the agency argues that there are various "pathways" through which flow may affect survival. But that is not the issue — fish need flow, the Water Users do not dispute that. The Water Users also do not dispute that fish generally do better in high runoff years. The issue is Upper Snake flow augmentation and there is no evidence that there is any past or future benefit to spring migrants from such augmentation.

IDFG essentially argues that the Water Users should accept the potential benefits of Upper Snake flow augmentation and provide "more, not less" water as an article of faith.

That is unacceptable to the Water Users after sending 3.5 million acre-feet of water out of the Upper Snake River Basin over the past 10 years for flow augmentation, with no apparent benefit.

IDFG #9 ^{3/4} *The Water Users correctly point out that observed benefits from high runoff years may not be the same as could be achieved by flow augmentation. Flow augmentation cannot turn a poor runoff year into a high runoff year, or recreate the velocities of a natural river.*

Water Users Reply ^{3/4} The Water Users actually go a step further — observed benefits from high runoff years are not the same as could be achieved by flow augmentation. IDFG is absolutely correct: “flow augmentation cannot turn a poor runoff year into a high runoff year, or recreate the velocities of a natural river.”

IDFG #10 ^{3/4} *Flow augmentation could provide incremental flow improvements of a few thousand cubic feet per second under all conditions. Flow augmentation should be viewed within the context of a man-caused mitigation action to recreate more natural conditions because society took the natural river away for other uses.*

Water Users Reply ^{3/4} In terms of Snake and Columbia River spring flows, “a few thousand cubic feet per second” is a de minimis increase ? less than 3% of the spring flow target at Lower Granite Dam, about 1% of the spring flow target at McNary Dam and about 0.8% of the average discharge of the Columbia River at Beaver Army Terminal for the spring augmentation period. However, the annual loss of hundreds of thousands of acre-feet of water supply to southern Idaho in order to supply that flow is not a de minimis impact to the Water Users and others that rely on that supply for irrigation, power, municipal supplies, recreation and other beneficial uses. Moreover, it is not clear why Idaho water users must attempt to provide mitigation for the lower river basin where, as IDFG puts it, “society took the natural river away for other uses.”

IDFG #11 ^¾ *The Water Users argument that flow augmentation is ineffectual at best acknowledges some potential incremental benefits. The estimated benefits are in the range of 10% relative survival improvement, which are [sic] greater than NMFS credits to the hydro actions in the 2000 RPA relative to the 1995 BiOp actions. Estimated benefits are also far less than the 3-fold improvement needed for recovery of Snake River spring/summer chinook.*

Water Users Reply ^¾ IDFG misstates and grossly misrepresents the Water Users' analysis. We introduced our view that flow augmentation is ineffectual at best by stating:

“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. 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.” (IWU 2001b, footnote omitted)

Thus, in order to provide perspective, we used NMFS' relationships to compute the survival benefit from year-to-year natural variations in flows. The result was a change in SAR for steelhead and spring/summer chinook of four one-hundredths (0.04) for 427 kaf of Upper Snake flow augmentation. As we have discussed above, the flow/survival relationships from year-to-year correlations do not exist for natural flow variations within a year, making a flow/survival relationship for flow augmentation extremely improbable. Thus, a de minimis improvement of a SAR of 0.04 greatly exceeds the probable benefit from Upper Snake flow augmentation in the spring, it is more likely close to zero.

IDFG mistakenly uses the Water User statistics for fall chinook (possible 10% increase in SAR from 0.010 to 0.011 using 1 MAF) to argue that this is greater than the incremental survival improvement for spring migrants that NMFS credits to the additional measures in its 2000 BiOp.

Ironically, IDFG concludes the technical review with a comparison of the small potential survival benefit of flow augmentation with the survival estimates under the hydrosystem RPAs in the NMFS 2000 BiOp. The IDFG comparison is ironic because the overall

survival for juvenile mainstem passage under the 2000 RPAs is actually less than the survival from current operations under the 1995 BiOp. The 2000 RPAs pass more fish in-river, a strategy embraced by the state fish and wildlife agencies and the tribes, which negates the demonstrated benefits of transportation and thus lowers survival compared to current operations (NMFS 2000).

Conclusion

Using data, statistical analysis, and models to evaluate Upper Snake flow augmentation, the Water Users find no scientific basis for survival benefits to spring migrants or other listed species. IDFG and NMFS rarely address these quantitative analyses and continue to counter with qualitative and speculative arguments for flow augmentation based upon the effects of natural flow variations between years. While the Water Users will continue in good faith to address issues raised by IDFG and NMFS, the debate needs to be based in science, not belief or speculation.

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