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Montana Fish, Wildlife & Parks

ADREC/MAINSTEM-01/COMMENT GIORGI PAPER/04

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March 8, 2002

Mark Walker
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851 SW Sixth Avenue
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Dear Mr. Walker;

Thank you for the opportunity to comment on the draft document entitled "Mainstem Passage Strategies In the Columbia River system: Transportation, Spill, and Flow Augmentation, dated January 31, 2002. We have excerpted portions of the document and included our comments regarding each portion of the text.

Page x Flow Augmentation

Flow augmentation (FA) is the intentional release of water from storage reservoirs for the purpose of increasing flows to enhance migratory conditions for juvenile and adult life stages of salmonids in the Snake and Columbia rivers. Flow augmentation provided to the upper Columbia River (downstream from Chief Joseph Dam) comes from large storage reservoirs such as Grand Coulee Dam and a complex of storage reservoirs that drain into it from Canada and Montana. In the Snake River flow augmentation is provided from Dworshak Dam and through the Hells Canyon Complex in Idaho. The foundation for prescribing such actions is based on two premises:

1. Increased water velocity → increases migration speed of smolts → increases survival.

2. Lowering water temperature (summer) → improves migratory and rearing conditions for both juvenile and adult salmonids → results in improved survival.

Comment:
The release of storage water from Montana reservoirs does not affect the water temperature and only minimally influences flow where anadromous fish populations exist. Selective withdrawal devices control water temperature in the discharge immediately downstream of Libby and Hungry Horse Dams and attempt to mimic the natural annual temperature regime in the Kootenai and Flathead Rivers downstream. Although selective withdrawal devices benefit resident fish immediately downstream, the effectiveness if temperature control does not continue beyond the next downstream impoundments, Kootenay Lake and Flathead Lake. Both are natural lakes that have sills, or shallow areas, upstream of the dams that cause warm surface waters to discharge into the rivers downstream. The thermal effects

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of Hungry Horse dam are further nullified by impoundments in the Clark Fork and Lake Pend Oreille above Albeni Falls Dam. Further downstream, Lake Roosevelt behind Grand Coulee Dam is nearly isothermal due to mixing and brief water retention time. Even though Grand Coulee dam has limited ability to select the depth of withdrawal, the thermal gradient in the pool is too slight to provide water temperature control in the Columbia River downstream. The extreme distance in river miles from reservoirs in Montana (hundreds of miles) and the subsequent solar/ambient heating and mixing erase any potential for thermal influence in the lower Columbia River. Releases from Montana projects thus do not contribute any change in thermal conditions in waters inhabited by anadromous fish.

The actual change in water velocity in the lower Columbia River associated with flow augmentation from headwater storage projects in Montana is minute. Modeling results show that when Montana Reservoirs are drafted for flow augmentation during summer, an unnatural second pulse following the natural spring freshet can result immediately downstream of the dams in the Flathead and Kootenai Rivers. This unnatural double pulse increases the width of the river varial zone during the biologically productive summer months. Intermittent wetting and drying of the riverbank causes the varial zone to be biologically unproductive, resulting in harm to resident fish populations immediately below the dams, including the endangered Kootenai white sturgeon and threatened bull trout. Empirical evidence shows that this flow pulse then flattens out and becomes undetectable as water flows through downstream impoundments. For this reason, the USFWS 2000 BiOp called for increased, but stabilized, summer minimum flows to benefit bull trout. If summer flow augmentation occurs at a constant rate throughout the July through September period, the double pulse can be eliminated. This stabilized flow continues downstream providing possible benefits to anadromous fish without causing negative impacts to listed resident fish.

Flow effects on smolt migration speed: For most spring- migrating species the evidence indicates that increased flow (water velocity) contributes to swifter migration speed. Information regarding fall chinook is equivocal.

- River discharge appears to be the most influential variable affecting migration speed of steelhead and sockeye salmon in the Snake and mid-Columbia rivers.
- Two factors, flow and the degree of smolt physiological development, explain the observed variation in the migration rate of yearling chinook salmon (except in the mid-Columbia where only smolt development has been identified as a predictor variable).
- At least four variables have been implicated as influencing the migration speed of sub-yearling (fall or summer/fall) chinook; flow, water temperature, turbidity and fish size. However, strong correlations among these predictor variables confound the ability to identify causative agents.

Comment:
Study results referenced in the document suggest that Fall Chinook, which would be the target species for flow augmentation during July through August, have not been demonstrated to respond to flow augmentation or as stated in the report, "information regarding fall chinook is equivocal". Of the four variables flow, temp, turbidity and fish size, flow augmentation from reservoirs in Montana can only marginally influence flow.

Very few studies have attempted to:

- Quantify the volume and shape of water provided specifically for flow augmentation.
- Translate that incremental increase in flows to changes in water velocity and temperature.
- Predict the change in smolt travel time and survival attributable to those increases.
- Identify whether populations of interest (e.g. ESA stocks) have encountered or been influenced by flow augmentation.

The last such evaluation treated information through the 1995 water year, and only for the Snake River. Given the community's sensitivity to this controversial management action, a holistic comprehensive updated evaluation seems prudent, and long overdue. The scope of future evaluations need to more fully address the balance of benefits and risks between anadromous and resident fish resources.

Comment:
Drafting of Montana reservoirs was called for by the BIOP in 1995 and this report confirms Montana's concern that research has not validated the predicted benefits to anadromous fish that might result from flow augmentation from Montana reservoirs. Accounting solutions should be developed to track and validate that water management actions in the headwaters actually improve conditions for anadromous fish in the lower Columbia River.

The amount of flow augmentation and the release schedule from Montana reservoirs should be based on the best available science for each target species (resident or anadromous) and weighted for the greatest benefit to all species. Montana has recommended that storage reservoir operation first prioritize listed species in the immediate vicinity of, and directly affected by, the federal dams. Specifically, the benefit of flow augmentation should be physically measurable where the target species live (e.g. demonstrable change in flow, velocity or water temperature). The measurable change in environmental condition should then be correlated to biological response (e.g. growth potential, food production, reproductive success, disease resistance or survival). Empirical evidence should outweigh theory or inference.

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For chinook salmon, SARs for transport and control groups typically rise and fall in unison (Table 1.3, Figures 1.5 and 1.6). This suggests some factor(s) common to all passage groups influence absolute survival through to returning adult. This pattern seems less evident prior to 1997 when there were fewer returning adults (Table 1.2, Figure 1.2). Recent literature suggests climatological, marine-based processes are plausible mechanisms (Hare et al. 1999).

The inriver SARs showed no relationship to flow.

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We conclude that there is no evidence here of a meaningful relationship.

Comment:
Flow Augmentation appears not to be the primary factor that influences SAR because transport and inriver control groups react in unison. This should be considered when dam operations are designed to achieve the greatest benefit to all ESA listed, and unlisted, fish populations.

Page 20
The conventional position is that marine conditions have entered a phase conducive to fostering survival of northwest salmonid stocks (Hare et al. 1999).

Page 25
Survival from smolt to returning adult (SAR) for hatchery and wild spring summer chinook has increased substantially since 1993, and has been increasing steadily from 1997-1999, reaching SAR levels in 1999 that approach and in some cases exceed the 2% minimum recovery threshold for wild stocks as identified in PATH (Figures 1.5 and 1.6). This suggests that neither transport nor inriver migration conditions may be a bottleneck to recovery, when marine-based survival is at some adequate level.

Comment:

In contrast, the survival and recovery of resident fish species are not influenced by marine conditions; their environmental conditions in the reservoirs and rivers downstream are highly controlled by dam operations. Libby Dam is the only project that can be operated to improve conditions for the endangered Kootenai white sturgeon, so operations for white sturgeon should be the highest priority for fish-related operations at Libby Dam. While other species are showing signs of an improving trend, the white sturgeon population is still failing to show evidence of significant natural recruitment. Threatened bull trout exist above and below Hungry Horse and Libby Dams and operations should be prioritized accordingly. Since other factors dramatically affect anadromous fish species and since weak or equivocal relationships are the only existing justification for flow augmentation, priority should be given to species directly influenced by the Montana dams.

Fortunately, the operations needed to recover listed resident fish in the USFWS 2000 BiOp (including VARQ flood control, sturgeon tiered flows and higher stabilized summer flows for bull trout) will also benefit anadromous fish as water released for sturgeon and bull trout continues downstream.

Page 61 Flow Augmentaiton
Biological Window--There is another aspect to the premise that has been argued as well. Apart from mortality incurred during passage through the hydrosystem, it has been suggested that migration delay may impair survival of smolts at seawater entry. The conceptual model holds that smolts are swept seaward by river currents, and historically the timing of seawater entry was dictated by the shape and intensity of the hydrograph, and this in turn was synchronized with a "biological window". And thus, slower migration associated with impoundments has disrupted the natural timing of ocean-entry, potentially placing smolts at a disadvantage. This theoretical window has two aspects; the ecological/environmental condition of estuarine and marine waters, and the physiological preparedness for smolts to adapt to seawater. As yet there has been no definitive convincing research conducted on this topic. However, the community is now embarking on a new era of estuarine/marine research that may offer insight on these matters.

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No model could be developed that was satisfactory for explaining the observed travel time of yearling chinook in the mid-Columbia, from RIS to MCN Dam. How much change in smolt travel time do these models predict per unit flow? To depict this we offer one example. Using the Berggren and Filardo (1993) bivariate flow-based model for Snake River yearling chinook, Giorgi (1993) predicted the change in travel time attributable to incremental increases in river discharge. He demonstrated that when base flows were low, the proportionate change in travel time was highest. For example, as Snake River flow increased from 40 to 50 kcfs, the average travel time per project decreased from 5.0 to 4.2 days, whereas when flows increased from 100 to 110 kcfs, travel time decreased by only 1/10 of a day, from 2.7 to 2.6. Clearly the most dramatic responses would be expected in low flow years.

Giorgi et al. (1994) examined a data set for freeze-branded sub- yearling chinook migrating through the John Day Pool. Using data from 1981-1983, they failed to find a consistent relationship between smolt travel time and any of the three-predictor variables (flow, water temperature or release date). They characterized the migratory patterns as a complicated mix of rearing and migratory behavior, often punctuated by extensive upstream excursions of several kilometers. They also noted that strong correlations among the predictor variables limited analytical opportunities for confidently identifying causative agents affecting travel time.

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In the mid-Columbia system Giorgi et al. (1997) found that the size of sub- yearling
chinook was the best predictor of migration speed between Rock Island and McNary Dams. In their multiple regression analysis using four years (1992-1995) of PIT-tag data, no environmental variable was identified as being influential.

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Over the last decade they have adopted the PIT-tag as the preferred tool for documenting migration. However, not since the work of Berggren and Filardo (1993) has there been a comprehensive multi-year analysis of factors affecting smolt travel time reported by the FPC.

Similarly, the NMFS has been calculating and reporting smolt travel time estimates on an annual basis since 1993. They, too, have not yet formally analyzed the data to assess the factors affecting smolt travel time.

Comment:
Given that the minute changes in velocity, the actual change in smolt migration speed associated with flow augmentation from reservoirs in Montana has not been measured. Conversely, stage/velocity relationships and varial zone effects of dam operation in the Flathead and Kootenai Rivers have been well documented. Dam operations at Hungry Horse and Libby Dams should prioritize ESA listed fish species in the immediate vicinity of the federal dams and flow augmentation for anadromous fish recovery should be managed to produce lower levels of risk to resident fish stocks.

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3.1.2 Flow and Smolt Survival

Translating river flow, or smolt migration rate, into smolt survival is the critical issue underpinning the rationale for providing flow augmentation.

3.1.3 Recent Estimates of Smolt Survival

Yearling Chinook Salmon and Steelhead--In the NMFS (2000) White Paper on smolt survival and flow, the authors summarized two decades of yearling chinook survival estimates and flow indices. Using annual survival and flow indices, they failed to identify a relationship between the two variables.

NMFS (2000b) also examined the PIT-tag data (1995-1998) in greater detail and plotted the survival of individual release groups against corresponding flow indices for both yearling chinook and steelhead (Figures 3.4 and 3.5). No relationship was apparent. They plotted the same survival estimates against the median travel time of each group and found no relationship with migration rate. They did, however, identify a strong consistent inverse relationship between travel time and flow for yearling chinook salmon. They suggest that in the absence of a flow or migration rate-survival relationship, some other benefits may be provided by the swifter migration as mediated by increased flow levels. They speculate that higher flows may improve estuary and Columbia River plume conditions and associated survival through those zones, but offered no empirical evidence for such.

Comment:
NMFS should recognize the limited evidence for flow augmentation demonstrated by their own work and other researchers and manage flow augmentation to benefit all ESA listed fish populations including white sturgeon, bull trout and other native species of special concern including westslope cutthroat trout, burbot and redband trout. If an estuary effect is found, numerous other storage projects closer to the estuary are more logical choices to influence this habitat. Using storage closer to this environment has a higher probability of actually influencing estuarine conditions.

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3.3 Flow Augmentation Evaluations

None of the information presented thus far constitute analyses of the effectiveness of flow augmentation. Establishing general relationships between flow and either migration speed or survival certainly provides a rationale for entertaining flow augmentation as a strategy to improve survival. However, an evaluation of the biological benefits of providing additional water in any particular year has many facets and requires a more focused analysis. In 1996, BPA funded a flow augmentation evaluation study (Giorgi and Schlecte 1997) and directed the investigators to address four key objectives:

1. Determine the volume and timing of water that was drafted from storage reservoirs and provided above base flows, which could be identified as flow augmentation for anadromous fish.
2. Estimate the extent to which flow augmentation increased water velocity or decreased water temperature as compared to base conditions.
3. Predict the magnitude of fish responses in terms of smolt migration speed or survival, as attributable to that incremental change in environmental conditions (flow, temperature).
4. Identify the degree to which populations of interest (ESA- listed stocks) were exposed to FA events.

Comment:
A fifth objective should be investigated: Determine the effects of non-seasonal releases from storage reservoirs on ESA listed resident fish populations and other native resident fish species of special concern.

Page 72 & 73
Surprisingly, few, if any, comprehensive evaluations of flow augmentation have been published, which address all or even most of the issues identified above.

The NMFS BO is deficient in this regard as well. BO specifies volumetric (in Maf) standards for flow augmentation, and prescribes seasonal flow (kcfs) targets. However, no quantitative analysis describing the change in water velocity, smolt speed or survival benefits is offered that can be attributed to providing the... (SIMPAS) used in the BO lacks an explicit flow-survival function or any flow-related mechanisms to affect survival through reservoirs. As a consequence, that model, as currently configured, is incapable of predicting the change in survival attributable to flow augmentation.

Comment:
The current approach to anadromous fish recovery efforts in the lower Columbia River poses risks to other non-anadromous fish species in the headwaters and should be reevaluated .

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Benefits and Risks to other species–Drafting flow augmentation water from storage reservoirs alters conditions within the storage reservoirs and in the tributaries connecting with the Columbia and Snake rivers. These processes in turn have effects on resident fish inhabiting those waters. This introduces a broad and complex facet attending the implementation of flow augmentation. It is beyond the scope of this paper to treat this topic in detail, but we identify key issues. Risks associated with flow augmentation were broached by the Independent Scientific Group's publication "Return to the River". Therein they expressed uncertainty regarding the magnitude of a flow-survival, and the strategy to use non-seasonal flow augmentation in an attempt to force subyearling chinook from the mainstem (ISG 1996). In their words,
"Underscoring these substantial uncertainties in flow augmentation rationale is the fact that summer drawdowns in upstream storage reservoirs, for example Hungry Horse Reservoir in Montana, to accomplish summer smolt flushing in the lower Columbia river has direct and potentially negative implications for nutrient mass balance and food web productivity in Flathead Lake, located downstream from Hungry Horse. "
The issue they raise involves balancing expected benefits to anadromous fish against ecosystem function and potential risk to other native species. The Kootenai River white sturgeon inhabit waters downstream from Libby Dam, and are listed under the ESA. Paragamian and Kruse (2001) found that river temperature and river stage (sensitive to flow) were the best predictors of female sturgeon migrating to spawning areas in the Kootenai River. Part of the recovery effort for this species involves drafting water from Libby reservoir at strategic times during the spring. Depending on the magnitude

and timing of the water releases, these actions could compete against or enhance flow augmentation that targets anadromous salmonids in the Columbia River. Clearly a complex array of water management activities has evolved in the Columbia Basin. The net balance among competing and complementary strategies is uncertain. Apart from the System Operation Review conducted in the early 1990s, we have not encountered a comprehensive multidisciplinary evaluation of flow augmentation, which attempts to assess and quantify the full suite of benefits and risks to anadromous and resident fish species and their habitat. The tendency has been for groups to focus on the species under their jurisdiction, or within their geographic zone.

Comment:
It is important to further clarify the impacts on Kootenai white sturgeon. Flow augmentation in July and August for anadromous fish occurs during the emergent and larval life stages of Kootenai River White Sturgeon. These stages have proved to be the most elusive period or least understood in the sturgeon life history. It appears that very little recruitment has occurred for this species despite the verification of fertile eggs in the river. Unless flow augmentation occurs at a constant rate over the July through September period, the velocity and stage of the river can fluctuate unnaturally during the most critical early life stage. Significant effort and investments have been made to create a more normative hydrograph during spring and summer. Flow fluctuations during the summer months should be curtailed at Libby dam until the ESA listed Kootenai River White sturgeon show significant signs of recovery.

We have recommended specific tiered spring flows for white sturgeon, a sliding scale for reservoir refill date based on water availability to avoid forced spills, and variable stabilized summer flows to benefit bull trout. All of these strategies were included in the USFWS 2000 Biological Opinion and were designed to benefit listed fish species throughout the Columbia Watershed.

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Holistic evaluations of FA effectiveness–A multi- faceted, comprehensive evaluation of the biological benefits and risks associated with flow augmentation is advisable. Wherever possible, quantitative analyses should be undertaken. The effort will require physical and smolt passage modeling. Updating certain tools will be required, given the abundance of passage and survival information collected since the models used in PATH were constructed and validated. To fully address concerns regarding anadromous fish and resident fish will require a significant effort. But without such an effort it is not clear how the region can determine if the status quo as prescribed in the FCRPS is an effective water management strategy for measurably improving salmon survival.

Comment:
We agree with this assessment.

Sincerely,

Brian Marotz
Fisheries Program Officer