United States Department of the Interior

U. S. GEOLOGICAL SURVEY
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August 21, 2002

Attention: Judi Hertz

RE: **35032 –** Response to ISRP comments.
Project title: **Assess the feasibility of reducing predation on juvenile salmonids in the Columbia River through operation of the hydropower system**

The ISRP identified two major concerns and other minor issues.

Major concerns:

1) *"hydropower system management actions that are foreseen are not clearly presented."*

Response: The proposed work is a **feasibility** study. Management actions that might prove fruitful (or not) are difficult to identify without doing at least some of the proposed work and exploring the range of response of species to hydropower change. We agree that it is very possible that *"some options"* (ISRP, p. 23) will turn out to be infeasible and will not blend well with the ongoing management of the hydropower system. We do not agree that it is possible to identify these options without doing some of the retrospective and modeling analyses that we propose. The ISRP seems to be asking for the answer before any of the work is done.

2) *"there is insufficient evidence concerning the exact mechanisms of life history disruption"*

Response: The ISRP provides a good response to this comment later in this paragraph when they state: "*We know that hydropower operations such as reservoir pool fluctuation and peaking flows can disrupt fisheries and aquatic life. This is primarily by dewatering redds/eggs after spawning, changes in velocities or depths thus altering physical habitat or changing water quality such as temperature, DO, TDG etc."* (ISRP comment, p. 23). This seems to summarize our general hypothesis and also our initial approach (physical habitat manipulation that would disrupt the early life history of predators). The first mechanism that we would model is spawning habitat of adult predators (Objective 2). There is considerable published and unpublished data on the spawning behavior of northern pikeminnow, smallmouth bass, and walleye, which we cite on page 18 of the proposal. We provided an example of how such data could be put into a model and used (table on p. 18), but actually constructing and testing such a model (mechanism) has not been done and is thus part of the proposal.

"The emphasis on early life stages may ignore some other potential management actions … such as shoreline habitat restoration"

Response: We agree that other options should be considered, such as the use of rip-rap by smallmouth bass mentioned by the ISRP as an example (p. 23). We proposed to begin development of "growth potential" models and "rearing habitat" models in later years (Task 2c). There is considerable data that could be used to develop movement and predator-prey encounter models that the ISRP seems to be referring to, and we have worked on many of these models (Petersen and DeAngelis 1992; 2000; DeAngelis and Petersen 2001; Petersen et al. 2000). Individual-based predator-prey models have been developed for northern pikeminnow and juvenile salmon by one of us, and this could be another useful approach for examining habitat in a complex system (Rose 2000). These types of models are, however, more complex. We are willing to discuss with the ISRP and the agencies if they believe that this would be a fruitful approach.

Minor issues

- Concentration of efforts below Bonneville Dam and ramifications of operational change.

  Response: Our emphasis on the reach below Bonneville Dam was based largely on the magnitude of predation that appears to be occurring there (see Figure 1; p. 7), and thus the potential magnitude of an operational benefit ("bigger bang for the buck"). Some of the requests of the ISRP in this paragraph, such as *"demonstration with hydraulic data"* and *"hydraulic models could be examined to see if this were feasible"*, seem to put the cart before the horse. Such efforts would require some fairly extensive testing with hydraulic models and different flow scenarios, which would be part of the research study. We are proposing to develop data and models that would be applicable over quite large reaches (and not just below Bonneville), rather that for one small area such as a tailrace elevation test. We believe that it is premature to decide at this point that none of these options would work or could be melded into the operational planning. No one knows yet what the options are – that is the point of the research. Last, Bonneville Power Administration funds many projects in the lower river, estuary, and nearshore ocean where there is even less opportunity for "operational changes" in the hydropower system that could have a positive effect. If the ISRP is going to be critical of our proposed efforts in the lower river, they should be equally critical of the many other research studies in the lower river, which does not appear to be the case.

- *"In addition to depth changes the authors suggest velocity changes might disrupt target predators" "What is the range…" "What evidence …" "not cause impacts on salmon"*

  We do not believe that water velocity alone (unless it is excessive) can be used to limit predator spawning success or predator distributions, thus we proposed using a multivariate modeling approach that includes numerous physical variables (Objective 2). Water velocity has been shown to be an important predictor variable for smallmouth bass and northern pikeminnow in a variety of studies (Edwards et al. 1983; Faler et al. 1988; Shively et al. 1996; Martinelli and Shively 1997;

Petersen et al. 2000; and others). One of us has recently (1998) radio-tagged smallmouth bass and northern pikeminnow in the free-flowing Hanford Reach and the lower Snake River and developed predictive models (logistic regressions) of adult habitat use. At the end of this letter is a summary table of the model and the odds ratio versus velocity, which shows the importance of velocity to adult bass and pikeminnow. Velocity was significant in three of the four models developed. A copy of the manuscript that summarizes this data in more detail is available to the ISRP if necessary.

We cited many peer-reviewed studies in our proposal about the role of water velocity for spawning, egg survival, and juvenile survival for each of the three predators:

- Northern pikeminnow: *"Pikeminnow spawn in the main channel and tributaries, but not backwater areas because of low velocities*." " *Larvae ... recruit to shallow low-velocity shorelines…" Enhanced growth and survival of age-0 northern pikeminnow in shoreline rearing areas has been associated with … comparatively low flows …*" See page 4 in original proposal. Principal references – Beamesderfer 1992; Barfoot et al. 1999; Gadomski et al. 2001.
- Smallmouth bass: *"High (> 0.20 m/s) or variable flows during egg and larval rearing have been shown to result in nest failures or low production of free-swimming larvae"*. See page 4 in the original proposal. Principal references: Lukas and Orth 1995; Peterson and Kwak (1999); Sabo and Orth 1994.
- Walleye: *"eggs may be particularly vulnerable to water level fluctuations (Corbett and Powles 1986)*." *"Walleye larvae in Lake Erie were found to have low survival during periods of high discharge because increased suspended sediments and turbulence damaged fish (Mion et al. 1998)." "… warmer temperatures have been linked to recruitment success because more rapid development of walleye eggs results in decreased vulnerability to spring storms*." See pages 5-6 in original proposal. Principal references: Corbett and Powles 1986; Mion et al. 1998.

- *"Years have been spent fine-tuning…", "possible conflicts should be addressed.. "*

Response: We do not disagree, but we believe it is premature to start justifying operational changes when we don't even have an idea what change we are talking about. Conflicts with other needs are likely and managers will have to weigh the pros and cons if these studies result in recommended changes to the hydrosystem. The ISRP seems here to be taking the viewpoint that operations within the system are "fixed" and can't be changed. We do not believe that it is our place as independent researchers to start justifying one option over another (especially when we don't yet know what we'd suggest) – a research proposal is not the place for that effort.

- "*What potential consequences to power generation might emerge?"*

Response: See the above response.

- *"In summary … ideas are not sufficiently developed"*

Response: The proposal is for feasibility work, thus some ideas and models are not developed to the detail that the ISRP desires. The proposal was developed in direct response to an RPA (105) and at the request of BPA representatives. This proposal would lay the groundwork and build the datasets necessary to test more detailed hypotheses concerning hydropower system operation.

Thank you for the opportunity to reply to the comments.

Sincerely,

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Table and Figure from: **Craig A. Barfoot**[*1] **and James H. Petersen**. Manuscript in preparation. Behavior and habitat use models for northern pikeminnow and smallmouth bass in two large, free-flowing rivers.

Table . Logistic regression model estimates for northern pikeminnow and smallmouth bass resource selection models for the Snake River and the Hanford Reach (Columbia River) study areas during 1998. *P* = probability.

Northern pikeminnow Variable	Coefficient (SE)	*P*	Smallmouth bass Variable	Coefficient (SE)	*P*
Snake River					
Intercept	1.56 (0.34)	< 0.05	Intercept	2.43 (0.40)	< 0.05
Season	- 1.02 (0.30)	< 0.05	Season	- 1.18 (0.31)	< 0.05
Distance	- 0.03 (0.01)	< 0.05	Depth	- 0.50 (0.14)	< 0.05
Velocity	- 0.51 (0.10)	< 0.05	Distance	- 0.04 (0.02)	< 0.05
Cobble	0.07 (0.42)	> 0.05	Velocity	- 0.36 (0.10)	< 0.05
Boulder	0.84 (0.35)	< 0.05	Cobble	0.84 (0.39)	< 0.05
Bedrock	0.56 (0.73)	> 0.05	Boulder	0.82 (0.36)	< 0.05
			Bedrock	2.11 (0.58)	< 0.05
Log-likelihood = 311.63			Log-likelihood = 330.75		
Hanford Reach, Columbia River					
Intercept	0.31 (0.31)	> 0.05	Intercept	1.11 (0.45)	< 0.05
Season	- 0.54 (0.23)	< 0.05	Season	- 0.72 (0.34)	< 0.05
Gravel	- 0.42 (0.39)	> 0.05	Velocity	- 0.98 (0.14)	< 0.05
Cobble	- 0.49 (0.30)	> 0.05	Cover	1.11 (0.34)	< 0.05
Boulder	- 0.86 (0.34)	< 0.05	Heavy cover	1.75 (0.57)	< 0.05
Bedrock	0.33 (0.55)	> 0.05			
Cover	- 0.01 (0.31)	> 0.05			
Heavy cover	1.12 (0.53)	< 0.05			
Log-likelihood = 599.30			Log-likelihood = 292.62		

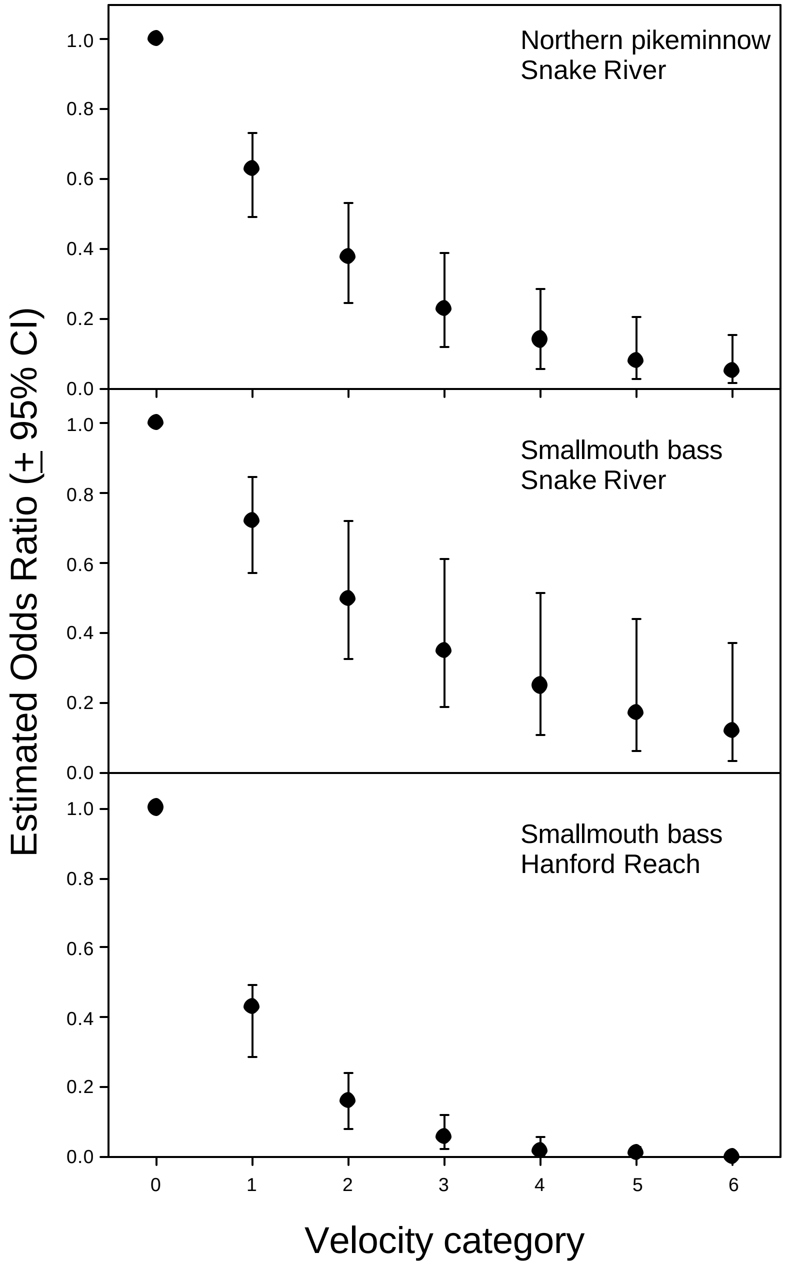

Figure 7. Estimated odds ratios for water velocity categories in resource models for northern pikeminnow and smallmouth bass. Odds ratios are comparable to velocity category 0 where odds = 1.0 .