FISH PASSAGE CENTER

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MEMORANDUM

TO: Russ Kiefer, IDFG

FROM: Michele DeHart

DATE: February 3, 2010

RE: Lower Monumental bypass effects on Snake River Chinook and steelhead

In response to your request, FPC staff analyzed PIT-tag data to discern whether there was a measurable effect of the Lower Monumental (LMN) bypass on adult returns for Snake River spring/summer Chinook and steelhead out-migrating in 2006 and 2007. Specifically, you asked FPC staff to look only at Snake River Chinook and steelhead that were detected upstream of LMN prior to the implementation of transportation in each of these years. Below is a brief summary of our findings, followed by a more detailed explanation of the methods and results from these analyses.

- For this analysis we started with detected individuals at Little Goose Dam (LGS) and compared the LGS to LGR SAR's of two subgroups: those that were detected at LMN (*LMN detect* hereafter) and those that were not detected at LMN (*No LMN Detect*).
- Constraints on early season Chinook and steelhead migrants resulted in estimates of LGS to LGR SAR's that had relatively large confidence intervals. Therefore, detecting differences between SAR's of *LMN Detect* and *No LMN Detect* juveniles was difficult.
- The methodology we used to test for differences in SAR's is a conservative metric because in order to be detected at LMN, the *LMN Detect* group all survived from LGS to LMN. However, a portion of the *No LMN Detect* group may not have survived to LMN, which would also bias the SAR's of the *No LMN Detect* group low. Also, we are comparing bypassed fish (*LMN Detect*) to a group that includes turbine passed fish, possibly biasing the SAR's of the *No LMN Detect* group low.

- Using Snake River PIT-tagged spring/summer Chinook and steelhead, we detected a negative effect on SAR's for spring/summer Chinook bypassed at LMN in 2007. There was no bypass effect detected for spring/summer Chinook in 2006.
- Analyses of steelhead for both years were inconclusive.
- The 2009 Comparative Survival Study Annual Report found that comparisons of the C0 (undetected at LGR, LGS, and LMN) versus C1 (at least one detection at Snake River transportation projects) SAR's indicate that bypassed fish appear to have a lower SAR than undetected in-river migrants. The magnitude of these differences varies across years.

Methods:
Separate analyses were conducted for Snake River spring/summer Chinook and steelhead. To increase sample sizes, we were forced to combine juveniles that were released above Lower Granite Dam (LGR) and those that were released at LGR as part of a NOAA transportation study in 2006 and 2007. For the Chinook and steelhead that were released above LGR, we relied on PIT-tagged fish that are used in the "C1" group in the Comparative Survival Study (CSS). Hatchery and wild spring/summer Chinook and steelhead were combined for these analyses.

Your initial request was to use fish detected at LGR prior to the initiation of transportation in each of the years. However, in 2006, no PIT-tagged juveniles were released at LGR prior to the initiation of transportation. Therefore, we relied on those fish that were detected at Little Goose Dam (LGS) prior to the implementation of transportation as our starting juvenile population. Transportation at LGS began on April 24th in 2006 and May 8th in 2007. We excluded any transported fish or other removals at LGS or any downstream projects. For those juveniles detected at LMN, we only included those detections that occurred during the juvenile out-migration year of interest. Using this dataset, we estimated LGS to LGR smolt-to-adult return rates (SAR's) for Chinook and steelhead in each of the years. Chinook mini-jacks and jacks were not included in the estimated SAR's. The returns of PIT-tagged adult Chinook and steelhead for out-migration year 2007 are not complete. Therefore, these estimates of SAR's should be considered preliminary. Separate estimates of SAR's were calculated for those fish that were detected at LMN (*LMN Detect*) and those that were not detected at LMN (*No LMN Detect*) as juveniles. Finally, we conducted ratio tests to determine if there were differences between the SAR's of the *LMN Detect* group versus the *No LMN Detect* group. To do this, we calculated a test statistic θ where:

$$\theta = SAR_{\text{LMN detect}} \div SAR_{\text{No LMN Detect}} \quad (1)$$

A non-parametric bootstrap approach (e.g., resampling with replacement) was performed when calculating 90% confidence estimates around these measurements. The 90% confidence interval around the statistic θ in relation to the value 1 was used to indicate whether the *LMN Detect* SAR's differed significantly from the *No LMN Detect* SAR's. If the upper confidence bound on θ is less than one, then the *LMN Detect* fish resulted in a statistically lower SAR than the *No LMN Detect* fish. Conversely, if the lower confidence bound on θ is greater than one, then the *LMN Detect* fish resulted in a statistically higher SAR than the *No LMN Detect* fish.

The statistic above represents a conservative measure of bypass effects on SARs. The fish detected and bypassed at LMN (*LMN Detect*) would be expected to have a higher SAR than fish

not seen at LMN (*No LMN Detect*). This is because the *LMN Detect* group only includes fish that survived to LMN and the *No LMN Detect* group includes fish that have not survived to LMN in addition to those who survived to LMN but were not detected. Additionally, the inclusion of turbine passed fish in the *No LMN Detect* group would potentially lessen the SAR's for this group. So, this analysis presents a conservative measure of a negative bypass effect, since the SAR's for the *No LMN Detect* group will be biased low.

Results:

The LGS to LGR SAR's for this analysis are shown in Figure 1. Relatively few PIT-tagged adults returned from these years which resulted in wide confidence intervals for the SAR estimates. Migration year 2006 results for Chinook indicated slightly higher SAR's for *LMN Detect* juveniles than for *No LMN Detect* juveniles (Figure 1). However, ratio tests revealed that these differences were not significant, as the lower confidence bound for 2006 Chinook was less than one (Figure 2). Migration year 2007 results for Chinook indicated lower SAR's for the *LMN Detect* juveniles than for the *No LMN Detect* juveniles (Figure 1). Ratio tests revealed that the *No LMN Detect* juveniles had significantly higher SAR's than the *LMN Detect* juveniles (Figure 2). This indicates that there was a measureable negative LMN bypass effect in 2007 for Chinook.

Migration year 2006 results for steelhead indicated slightly lower SAR's for *LMN Detect* juveniles than for *No LMN Detect* juveniles (Figure 1). However, migration year 2007 results for steelhead indicated slightly higher SAR's for the *LMN Detect* juveniles than for *No LMN Detect* juveniles (Figure 1). Ratio tests for both of these years revealed that neither of these differences were significant and, therefore, there is no evidence of a LMN bypass effect on steelhead (Figure 2).

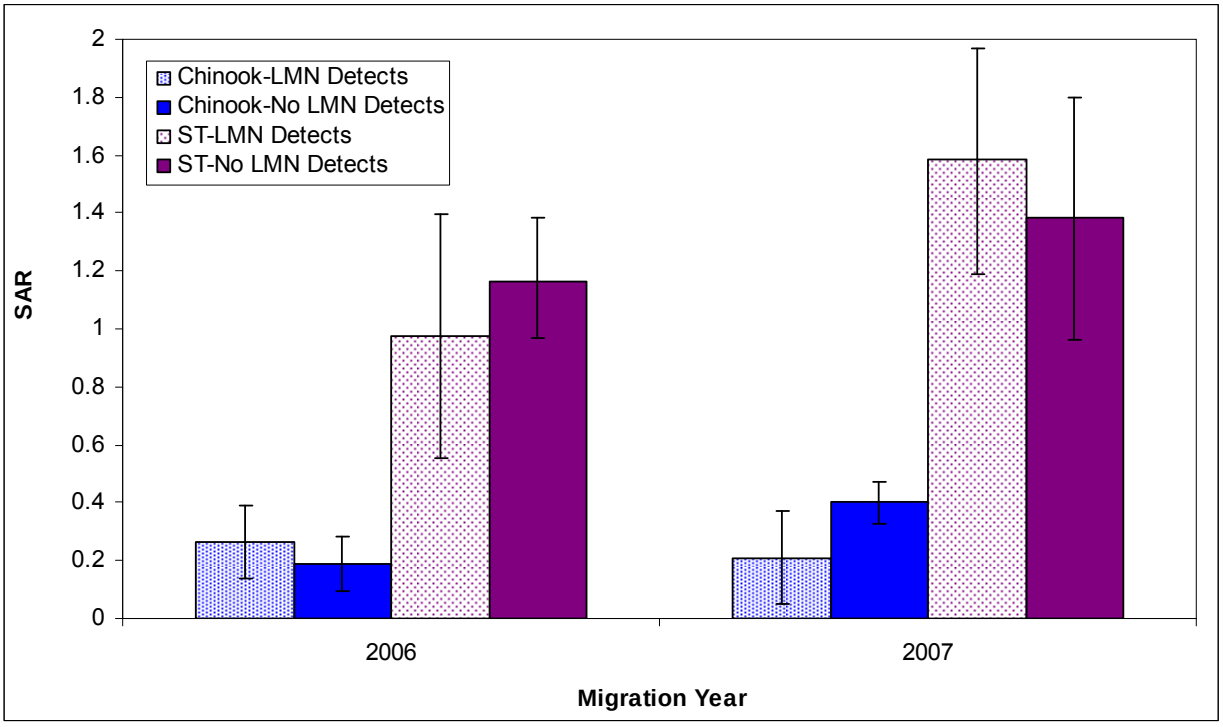

Figure 1. LGS to LGR SAR's for Chinook and steelhead out-migrating in 2006 and 2007 that were detected at LGS as juveniles and not transported. Different SAR's are shown for those that were subsequently detected at LMN (LMN Detects) and those that were not detected at LMN (No LMN Detects). All SAR estimates are shown with 90% non-parametric bootstrapped confidence intervals.

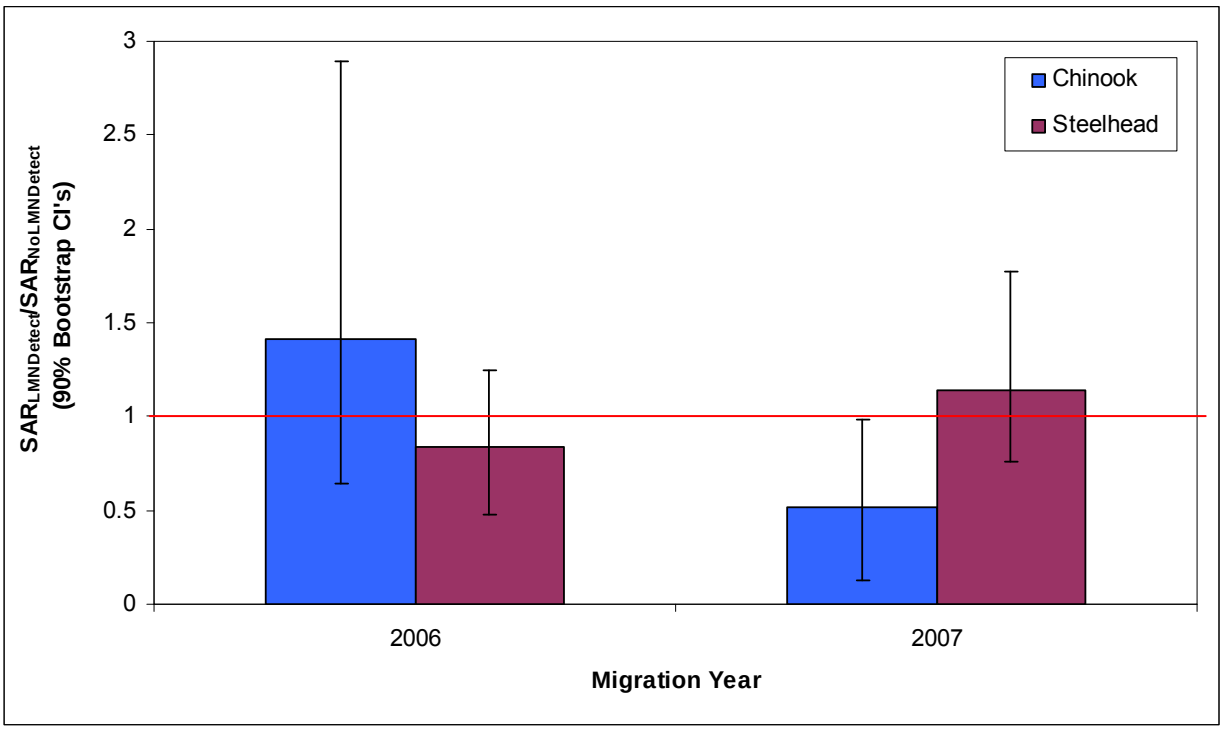

Figure 2. Ratio test of LGS to LGR SAR's for LMN Detect and No LMN Detect Chinook and steelhead. The horizontal red line denotes equality between groups (value of 1).

Literature Cited:

Tuomikoski, J., J. McCann, T. Berggren, H. Schaller, P. Wilson, S. Haeseker, C. Petrosky, E. Tinus, T. Dalton, and R. Ehlke. 2009. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and Summer Steelhead, 2009 Annual Report. BPA Contract #19960200. http://www.fpc.org/documents/CSS/2009%20CSS%20Annual%20Report-Final.pdf

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DATA REQUEST FORM

Request Taken By: Brandon R. Chockley **Date:** 9-Jan-2010

Data Requested By:
Name: Russ Kiefer **Phone:**
Address: **Fax:**
Email:

Data Requested:
Can we estimate a bypass effect D LMN for CH1 & ST on SARs? Are SARs of detected D LMN different from SARs of non-detected D LMN for fish passing prior to transport (206-207)

Data Format: **Hardcopy** ☐ **Text** ☐ **Excel** ☐

Delivery: **Mail** ☐ **Email** ☐ **Fax** ☐ **Phone** ☐

Comments:

Data Compiled By: **Date:** 3-Feb-2010

Request # 3