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MEMORANDUM

TO: Tom Lorz

FROM: Michele DeHart

DATE: March 13, 2009

RE: Comparing Yakima PIT tagged fish and acoustic/PIT tagged fish from 2006-2008

In response to your request, we've assembled a short review of the Welch acoustic tag research done with Chinook in the Yakima River from 2006-2008. The FPC staff attempted to acquire a copy of the annual reports for this project through the Pisces system, but the report was not completed or available. We requested the annual report from the BPA COTR, but the report and therefore the analysis was not available for review. The BPA, COTR advised that Welch et al. were preparing a publication. We were able to acquire the tag data and were able to compare survival rates. ***The comparisons in this review show that the Yakima double tagged fish are both larger than PIT tagged fish and had lower survival rates.*** These results corroborate with and are related to methodologies that were discussed in our review of the paper, "Survival of migrating salmon smolts in large rivers with and without dams"; Welch et al. PLOS Biology 2008. The review of that paper is available online at: http://www.fpc.org/documents/memos/186-08.pdf.

Table 1 Summary of data used for comparisons of Acoustic/PIT tagged fish and PIT tagged fish from 2006-2008 Yakima River releases. All releases were of hatchery spring Chinook.

Year	Group	rel_site	Coordinator	N	Release Notes
2006	Acoustic/PIT	YAKIM1	DTL	395	Released 5/19 & 5/21; below Prosser Dam
2006	PIT	YAKIM1	DWW	187	Released 5/30; at Prosser Dam
2007	Acoustic/PIT	YAKIM1	DTL	219	Released 5/18 & 5/11; at Prosser forebay
2007	PIT	YAKIM1	DWW	200	Released 5/28; at Prosser Dam
2008	Acoustic/PIT	CHANDL	DTL	499	Released 5/15; at Prosser Dam
2008	PIT	CHANDL	DWW	190	Released 5/14 & 5/16; at Prosser Dam

Here, we compared fish released near Prosser Dam that were double tagged with fish released only with PIT tags. Hatchery spring Chinook were double tagged with acoustic and PIT tags and then released in the Prosser Dam vicinity from 2006-2008 (Table 1). Our second group of fish consisted of releases of hatchery spring Chinook with a PIT tag. The PIT tagged fish were released at similar dates to the double tagged fish (Table 1) and at similar locations in each year. We used the Cormack Jolly Seber model and program MARK to analyze the PIT tag data from each group in order to compare survival.

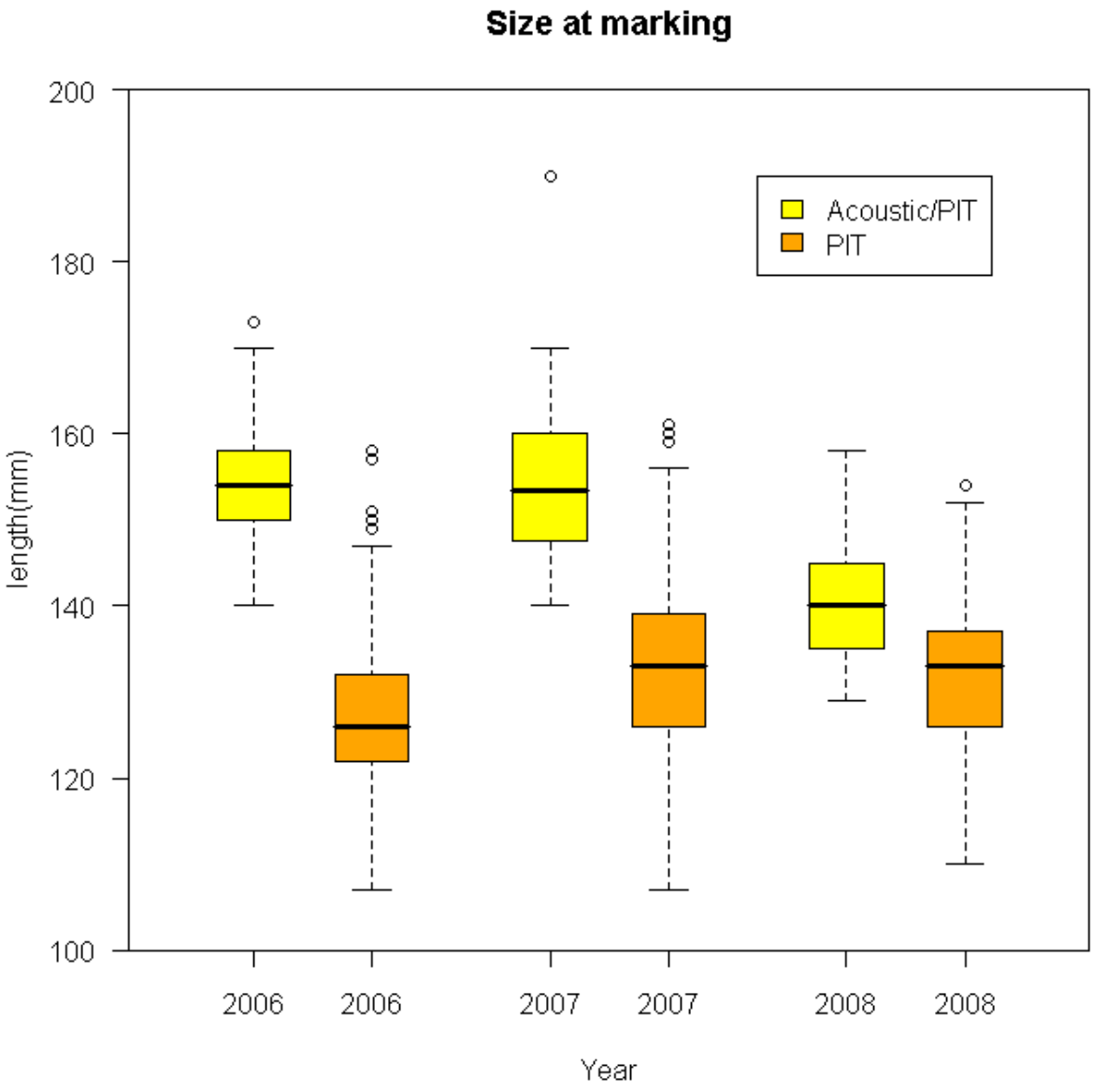

Figure 1 Length at marking for fish tagged with both acoustic and PIT tags (Acoustic/PIT) and fish tagged with only PIT tags (PIT). The Acoustic/PIT tagged fish were significantly larger than PIT tagged fish for 2006, 2007, and 2008 (using a t-test, or Kolmogorov-Smirnov test).

Fish that were marked with Acoustic and PIT tags were significantly larger than their PIT tagged counterparts (Figure 1). Across years the double tagged fish were 27mm, 21mm, and 7.5 mm larger in 2006, 2007, and 2008 respectively. If larger fish have better survival rates, then one would hypothesize that the larger Acoustic/PIT tagged fish would have higher survival rates than PIT tagged fish if there is no bias between the two.

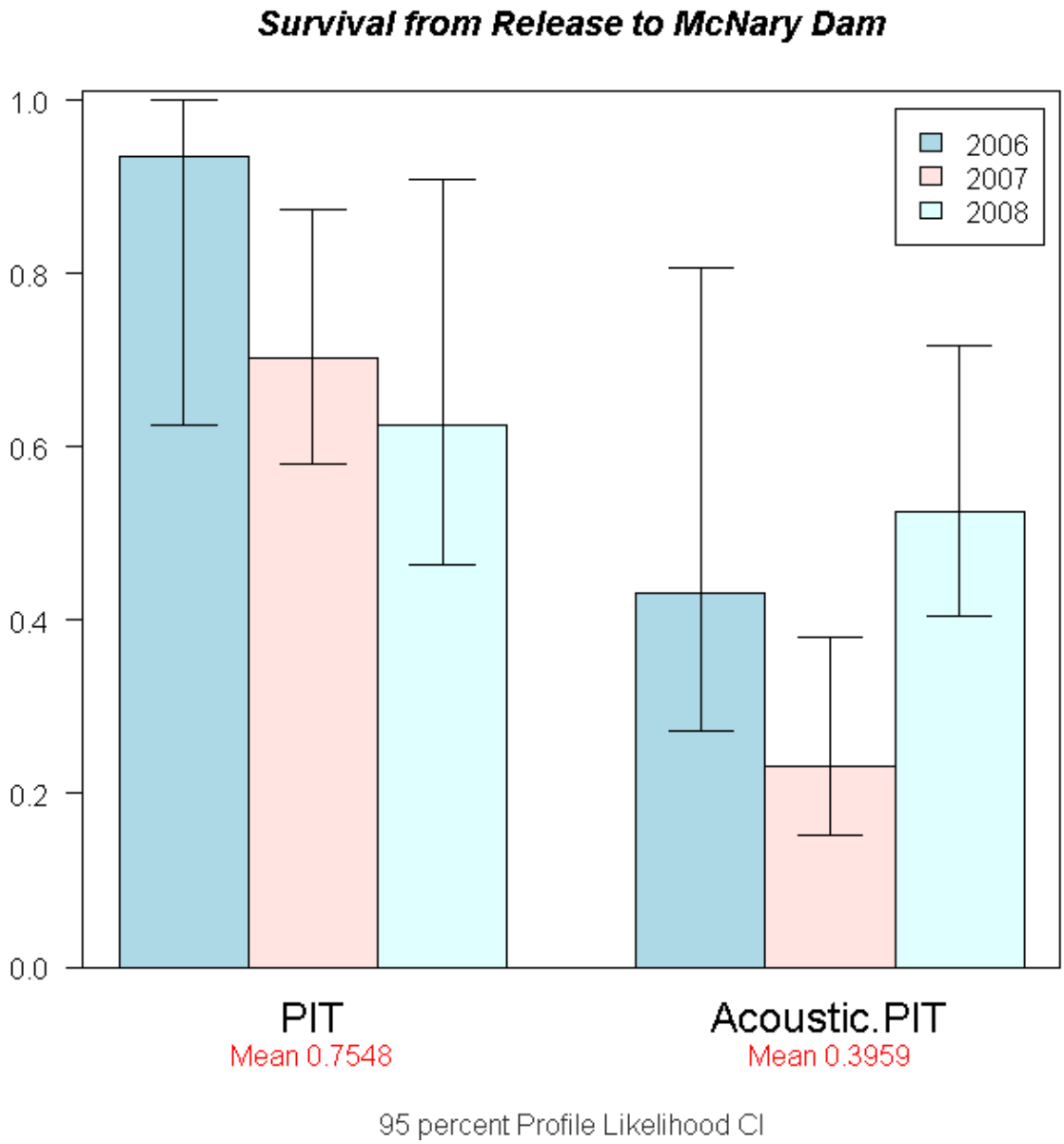

Figure 2 Survival from release to McNary Dam for PIT tagged and Acoustic/PIT tagged fish. The 95% profile likelihood confidence intervals from program MARK are shown. Shown in red are the mean survival value for each type of PIT tagged fish (PIT and Acoustic/PIT).

The sample sizes available for analysis were small (Table 1) but survival estimates from Prosser Dam to McNary dam were stable and are shown in Figure 2. Despite being large in size, the point estimate for double tagged fish are always lower than PIT tagged fish and *significantly* lower in 2007. Program MARK allows for comparisons in models that combine both groups of

fish within each year (*e.g.* PIT = Acoustic/PIT) vs. models that treat each group separately (*e.g.* PIT ≠ Acoustic/PIT). In this case, the model with each group treated separately had an AIC score that was 43.9 lower than the model with PIT and Acoustic/PIT fish combined. This corroborates that there is a difference in survival between the Acoustic/PIT and PIT tagged groups.

This comparison of survival rates for releases in the Yakima River strengthens the results of our previous memo which presented evidence of a negative bias in survival estimates when using these acoustic tags. Also, during the double tagged 2006 release in the Yakima, one fish was observed at the adult ladder in Priest Rapids Dam 84 days after release at Prosser Dam with no other detections anywhere (PIT tag no. 3D9.1BF2537CF4). This may indicate that some of the larger double tagged fish may have held over and this may have contributed to lower survival estimates. However, this is anecdotal evidence at best. Regardless, this does not change the result that the survival rates from the double tagged fish appear to be biased low.