

## Schrepel, Eric

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**From:** Fritsch, Mark  
**Sent:** Thursday, December 17, 2009 8:30 AM  
**To:** Merrill, Erik  
**Cc:** F&W Plus; F&W State Staff; Schrepel, Eric  
**Subject:** Response for Accord proposal #2008-109-00, Resident Fish Research, Monitoring and Evaluation (RM&E)

**Attachments:** 121609Power Calculations for Rainbow Trout Movements.docx; 121609Power Calculations for Rainbow Trout Movements.pdf; 121009CCTResident RMEdecltr.doc

Erik,

Please find attached a file (pdf and word) that was received from Bonneville yesterday. The response is from the Confederated Tribes of the Colville Reservation for Project #2008-109-00, *Resident Fish Research, Monitoring and Evaluation (RM&E)*.

The response is intended to address the condition that the Council placed on the proposal on December 9, 2009 (please see attached decision letter - word). This recommendation was based on the ISRP review of the proposal (ISRP document 2009-44) and the request that a statistical power analysis demonstrating that the proposed sample sizes for the radio-tagging components will be sufficient to achieve project objectives. The ISRP requested that this analysis be reviewed by the ISRP before beginning the radio-tagging.

If you have any questions, please let me know.



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# Power Calculations for Rainbow Trout Movements

To:  
Bret Nine  
Confederated Tribes of the Colville Reservation  
Nespelem, Washington 99155

From:  
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The acoustic-tag data on rainbow trout movements could be summarized and analyzed by an  $R \times C$  contingency table of the form:

		Initial Tagging Location		
		Fluvial – Tributary	Fluvial – Mainstem	Adfluvial
Subsequent Movement	Tributary			
	Mainstem			
	Lake			

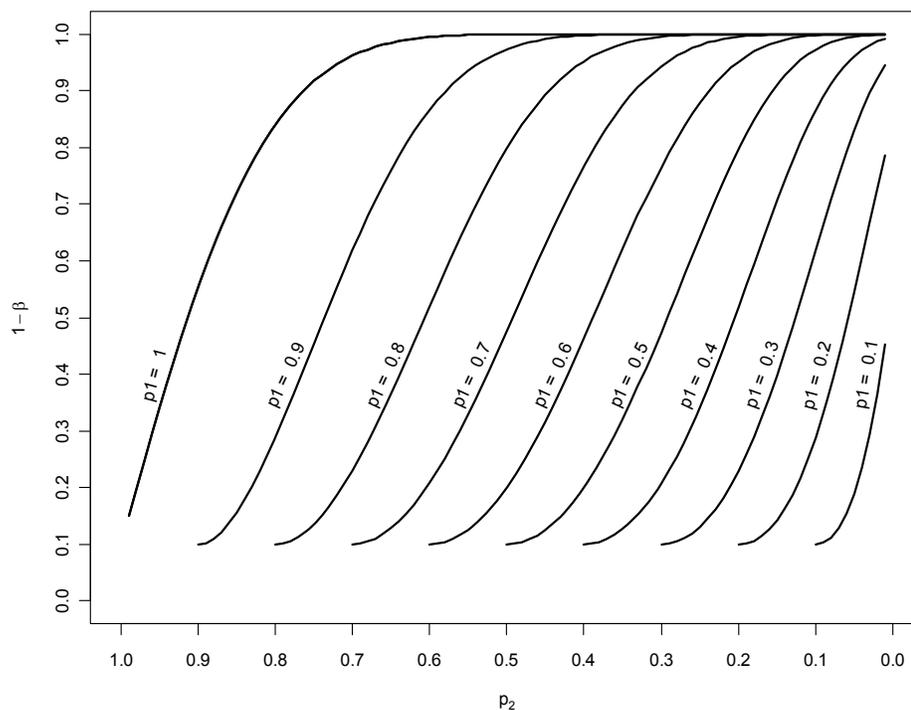
A chi-square test of homogeneity could be used to test whether the location where a fish was captured, tagged, and released has an effect on where it eventually resides and/or spawns. The null hypothesis ( $H_0$ ) is there is no difference in the relocation distributions for the three tagging groups. The alternative hypothesis ( $H_a$ ) is there is heterogeneity in those relocation distributions. The chi-square test has four degrees of freedom (df).

Power calculations for the  $R \times C$  analysis can only be performed if a specific distribution under the alternative hypothesis of heterogeneity is identified. With no prior knowledge of what to expect and four degrees of freedom, there are unlimited possibilities to consider.

In order to make the power calculations tractable, a one-df comparison between two tagging groups with just two relocation areas for fish to move to will be considered (i.e.,  $2 \times 2$  contingency table). Again, without knowing possible outcomes under  $H_a$ , no one or few specific alternatives are adequate for power calculations. Instead, I considered a wide range of alternatives (Figure 1). Statistical power ( $1 - \beta$ ) to reject the null hypothesis of homogeneity ( $H_0: p_1 = p_2$ ) at an  $\alpha$ -level of  $\alpha = 0.10$ , two-tailed, was calculated where one tag group has a probability of  $p_1$  of moving to a location, and the other tag group has a probability of  $p_2$  of moving to that same location. Values of  $p_1$  considered were 1.0, 0.9, 0.8, . . . , 0.2, 0.1, while  $p_2 < p_1$  (Figure 1) when tag release sizes for both groups were  $n = 30$ .

Examination of Figure 1 indicates that differences between movement probabilities  $p_1$  and  $p_2$  need to be between 0.15 and 0.30 in order for there to be a statistical power of  $1 - \beta \geq 0.80$ . In other words, moderate differences in behavior will be discernible. Since the fish with different life histories are expected to behave quite differently, it is quite possible the proposed tag release sizes ( $n = 30$ ) will be adequate. If behavioral differences are more subtle, the suggested release sizes will likely be inadequate. I would anticipate the full  $3 \times 3$  table will be more sensitive than the  $2 \times 2$  contingency table considered for mathematical expediency here.

Additional power calculations can be performed for difference values of tag release sizes ( $n$ ) at your request.



**Figure 1.** Statistical power ( $1 - \beta$ ) at  $\alpha = 0.10$ , two-tailed, to detect a difference between probabilities of movement  $p_1$  and  $p_2$  for two groups of acoustic-tagged fish of size  $n = 30$  each. Diagonal lines are the probability of movement for group 1 to a location ( $p_1$ ); horizontal axis is the probability of movement for group 2 ( $p_2$ ) to the same area ( $p_2 \leq p_1$ ).