FISH PASSAGE CENTER

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TO: Russ Kiefer, IDFG

FROM: Michele DeHart

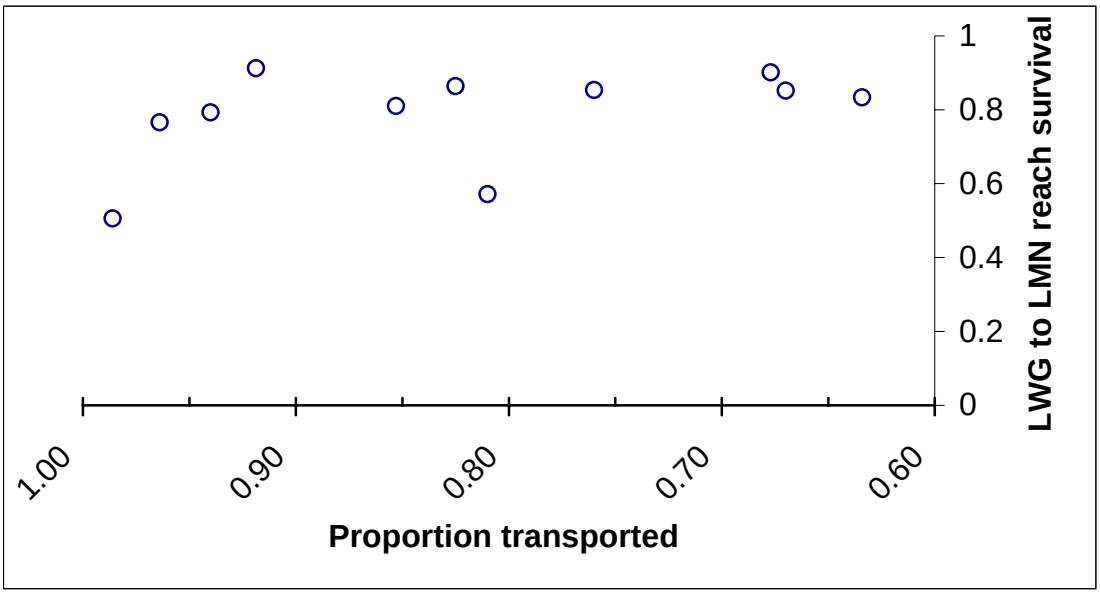
DATE: September 11, 2007

RE: The effect of transport on reach survival for steelhead smolts in water years 1996-2006

In response to your request, the FPC staff conducted an analysis of the effects of transport on the survival of the remaining population in river for steelhead smolts. This analysis attempted to identify the presence of a density dependent population mortality effect. We concluded that although there is some evidence of a density related effect, the inherent limitations of the data do not adequately describe this effect.

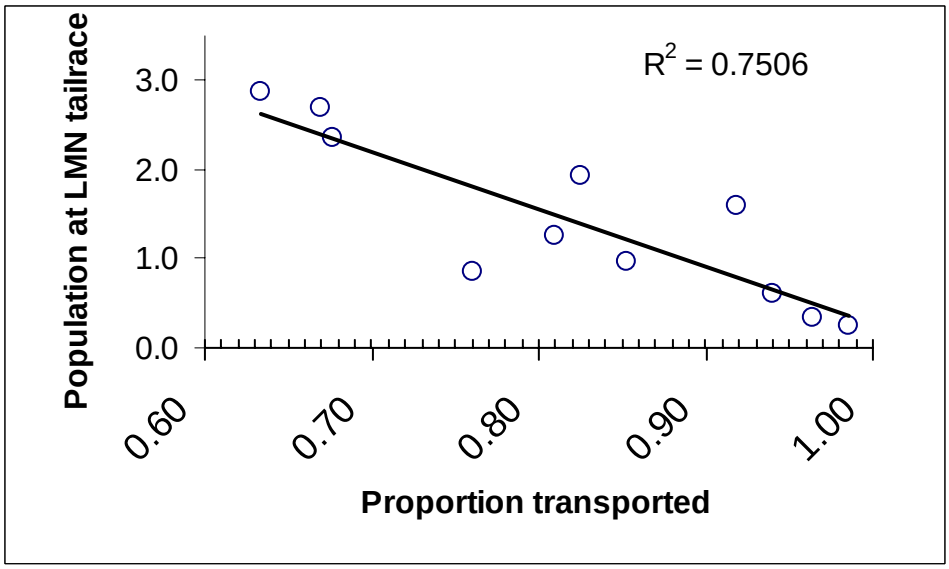
Estimates of the proportion of steelhead smolts (hatchery and wild) arriving at Lower Granite Dam (LGR) that were transported were calculated for 1996 to 2006 with the probabilistic model presented in FPC Annual Reports from 1998 to 2006 (see Appendix H in 2006). This method expresses the annual proportion of fish transported from LGR, Little Goose Dam (LGS), and Lower Monumental Dam (LMN) in LGR equivalents. The LGR to LMN reach survivals were estimated using the CSJ mark-recapture model on PIT tagged steelhead smolts released from above LWG for each year from 1996 to 2006. We plotted the proportion transported versus the reach survival (Figure 1). However, with these results it may be difficult to interpret the effect of differences in population size on survival within the LGR to LMN reach because the population of in river fish may vary in accordance with removals at LGR, LGS or MCN within that reach.

Figure 1 Reach survival (LGR to LMN) for steelhead vs. proportion transported for 1996-2006 (hatchery and wild fish combined).



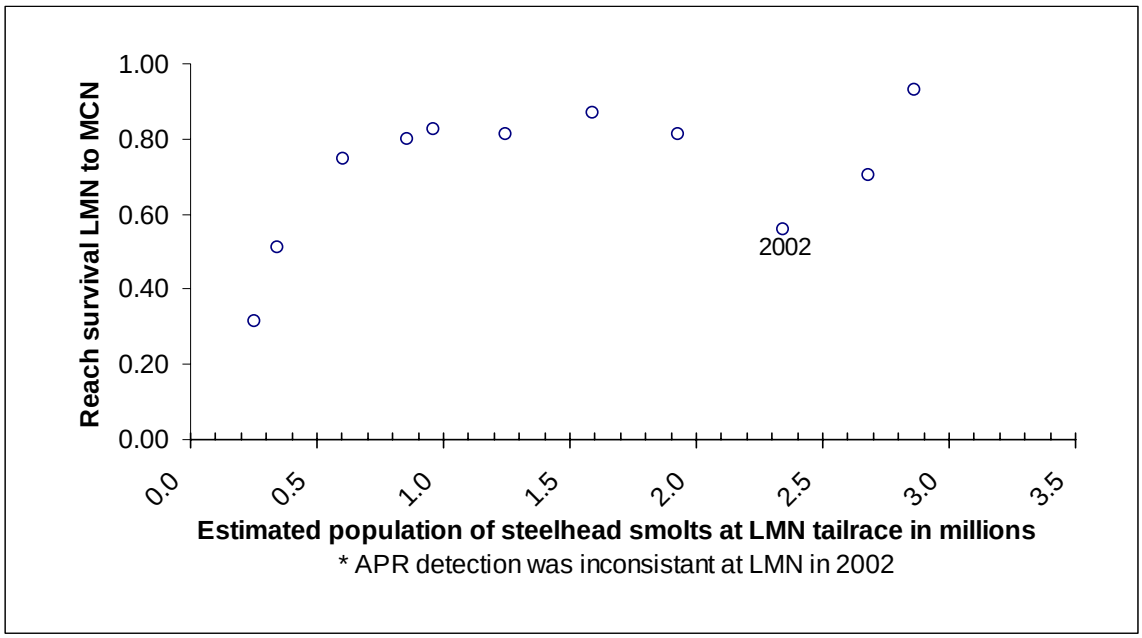
Since the hypothesis you present was based on population density, an estimate of steelhead smolt population size below Lower Monumental Dam was developed and compared to the LMN to MCN reach survival. The steelhead smolt population at LMN tailrace was calculated as: (number of fish collected at LMN) / (detection probability at LMN) – (number of fish transported from LMN). The detection probability at LMN and the LMN to MCN reach survival was estimated with same mark-recapture method as above. The relationship between proportion of steelhead transported and the population at the LMN tailrace appears linear and both would compare similarly to survival (Figure 2).

Figure 2. Estimated population of fish at the LMN tailrace vs. the proportion of fish transported 1996-2006 (hatchery and wild fish combined).



The size of the LMN tailrace population is plotted vs. the LMN to MCN reach survival in Figure 3. The reach survivals show a sharp increase with population size at very low population levels and "level off' at higher population numbers (because of inconsistent operation in PIT detection sampling equipment at LMN in April of 2002, the 2002 estimate here may be biased). So initially, this appears to show a consistent survival estimate at most population sizes with some density dependence at small population sizes. In the CSS 10-year retrospective summary report, the authors found, "limited evidence for density-dependent effects on the instantaneous mortality rates of steelhead" based on a comparative modeling-building exercise. However, caution should be used when relating the estimated population of fish at the LMN tailrace to the survival estimate of fish between LMN and MCN.

Figure 3. Population of steelhead at LMN tailrace vs. the subsequent reach survival 1996-2006 (hatchery and wild fish combined).



Many other factors could influence reach survival for emigrating juvenile steelhead (e.g. spill, average flow, water transit time, fish travel time, etc.). These variables are confounded with the estimate of the proportion of fish transported and subsequently the population at the LMN tailrace. For example, low spill could reduce the population in the LMN tailrace by making more fish available for transport; but, low spill conditions could also be paired with low flow and longer fish transit times that would result in a lower fish survival independent of the size of the population. In summary, while these data do not disprove a density dependent mortality hypothesis, it also is not possible to adequately describe an effect given the inherent limitations of these data.