Addendum to Carlson et al. "Managing Natural Resources For Adaptive Capacity: The Central Valley Chinook Salmon Portfolio"

We here respond to the four critical points made by the DSP Review Panel regarding our proposal:

1. The proposal considers only fall-run Central Valley Chinook salmon, whereas the true portfolio effect should be considered among all four runs.

Our response: Our initial focus on fall-run Chinook stems from the fact the this run currently makes up the vast majority of the catch, is most directly tied to the recent closure, and has the most extant population segments (spawning rivers) and thus made the most sense for a first look at the spatial aspects of the portfolio effect. Nevertheless, we agree that the true portfolio effect includes all four runs, as well as the stocks within each run. We will extend our empirical analyses to the level of runs as suggested by the panel.

2. One covariate proposed for use in modeling is water levels in the Delta, but it was unclear exactly what variable would be used here. This needs to be considered more carefully.

Our response: Our plan is to make an initial exploration of multiple measures of water levels and use model selection tools (AIC, BIC, etc.) to pick those which best explain existing variation in values of the Sacramento adult return index 3 years later relative to releases and water levels in the current year (i.e., year that smolts outmigrate),.

3. The genetic modeling for outmigration timing was not clearly described and its usefulness was questioned, especially since it considers only two stocks, as a stylized model, rather than the nine rivers originally discussed. The Panel was concerned that the model would be sensitive to this simplification, and was concerned how general the results could be from two stocks relative to the actual situation in the Central Valley. Likewise, the focus on outmigration timing as the sole determinant seems to fall short, since other aspects of the life history are also likely to be important.

Our response: This criticism boils down to a question of modeling philosophy. As described by pioneering theoretical biologists such as Levins (1966, "The strategy of model building in population biology") and May (2004, "The uses and abuses of mathematics in biology"), all modeling endeavors face an inevitable tradeoff between generality/tractability, realism, and precision. The goal of our modeling approach is not precise forecasts, but rather a deeper understanding of the short-term and long-term tradeoffs in a stylized system representative of Central Valley Chinook (CVC), accounting for the key elements relevant to potential portfolio effects and multiple anthropogenic influences. Therefore, we purposefully choose a stylized model for tractability. Already with the coupled economic-ecological dynamics, with temporal heterogeneity and joint population-genotype-phenotype dynamics in two populations, the

model is quite complex. The proposed research would be the first to embed such a quantitative genetic model in a decision theoretic framework enabling us to characterize key tradeoffs in the management of CVC. While additional complexity would add realism (e.g., additional streams or additional evolving traits) it would also reduce our ability to characterize the drivers of the model outcomes. The basic understanding achieved from this stylized approach can be very effective in a management context (see the May 2004 paper mentioned above for examples from disease management) as is our intention for CVC. Logical subsequent steps include exploring how multiple sources of variability and selection pressure interact, but such extensions are best pursued in an incremental fashion once foundational dynamics are understood.

4. The two subtasks about making the time series data available needs to be reconsidered because of issues about data security.

<u>Our response:</u> The time series data of estimated run size are already publicly available. Any tools we develop would be available to specific people at CDFG or other scientists upon request, and we would be sure to work with them to make sure they were understood/implemented appropriately.