Appendix 9M

Salmonid Salvage Analysis Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the Salmonid Salvage analysis. This appendix is organized in two main sections as follows:

- Section 9M.1: Salmonid Salvage Analysis Methodology and Assumptions
  - The Salmonid Salvage analysis uses the statistical relationship published in Zeug and Cavallo (2014) to estimate the proportion of Chinook Salmon juveniles predicted to be salvaged each month from January through June. This section briefly describes the approach and assumptions of the Salmonid Salvage analysis.
- Section 9M.2: Salmonid Salvage Analysis Results
  - This section presents the results of the Salmonid Salvage analysis. Results are presented in a series of figures showing the proportion of Chinook Salmon salvaged in each month.

9M.1 Salmonid Salvage Analysis Methodology and Assumptions

9M.1.1 Salmonid Salvage Analysis Methodology

Predicted monthly salvage from January through June for each scenario was estimated using statistical relationships reported in Zeug and Cavallo (2014). In that analysis, salvage at the CVP and SWP was modeled as a function of physical, biological, and hydrologic variables. The data set used for the Sacramento River was comprised of over 700 releases between 1993 and 2007, which was made up of approximately 30 million individual Chinook Salmon. Three of the four Chinook Salmon races were represented (winter, fall, and late-fall runs) in the model. The salvage of San Joaquin River origin Chinook Salmon was also modeled. However, the range of data used to construct the San Joaquin River statistical model was significantly narrower than the range of flows and exports represented in the scenarios examined in this report. Thus, only the Sacramento River model was used to predict salvage of Sacramento River-origin Chinook Salmon races.

The statistical model presented in Zeug and Cavallo (2014) included several predictors that were not well supported by the data (not found to be significant in their analysis) or were not relevant for the prediction function used in this analysis. For example, a variable of "ocean recoveries" was used by Zeug and

Cavallo (2014) to quantify the effect of salvage on future recoveries in the ocean. This variable not relevant to the evaluation goals of the scenarios proposed herein. Thus, the statistical model was refitted using only significant and relevant predictor variables that included exports, river inflow, and fish size.

The resulting predictions of salvage probability were performed using average flow and export values in January, February, March, April, May, and June for each scenario. These flow and export values were model outputs from DSM2 and CalSim II hydrologic models. Fish size was fixed at 80 millimeter. The statistical model constructed by Zeug and Cavallo (2014) produced an estimated count of fish salvage with an offset variable that equals the number of fish in each release. To obtain a probability, the estimated count was divided by an offset variable. The probability of salvage was calculated for each week and then averaged for each month. The probability of salvage calculated by the model is independent of the number of fish available for salvage. Thus, a high probability of salvage may not be important if few fish are migrating through the delta at that time.

9M.1.2 Salmonid Salvage Analysis Scenario Assumptions

The Junction Entrainment analysis includes the following assumptions:

- The salvage model is applicable to spring-run Chinook Salmon, although only winter, fall, and late fall run Chinook Salmon were used to construct the statistical model.
- Exclusion of non-significant or irrelevant variables has little or no effect on predicted salvage.
- Hatchery fish used in the coded wire tag experiments are salvaged at a similar rate as natural-origin fish.

9M.2 Salmonid Salvage Analysis Results

The following scenario comparisons are presented in Figures 9M.1 through 9M.5, comparing the proportion of Chinook Salmon salvaged in each month over the 82-year CalSim II simulation period:

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

9M.3 Reference

Zeug SZ, Cavallo BJ. 2014. "Controls on the Entrainment of Juvenile Chinook Salmon (Oncorhynchus tshawytscha) into Large Water Diversions and Estimates of Population-level Loss." *PLoS ONE* 9(7): e101479. Doi:10.1371/journal.pone.0101479

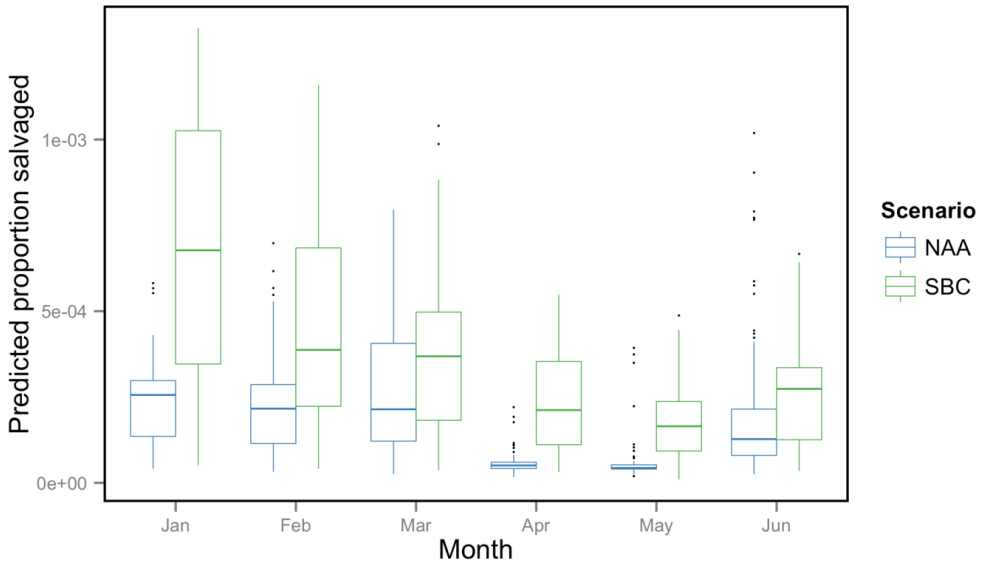

Figure 9M.1 Proportion of Chinook Salmon Salvaged in Each Month under the No Action Alternative (NAA) Compared to the Second Basis of Comparison (SBC)

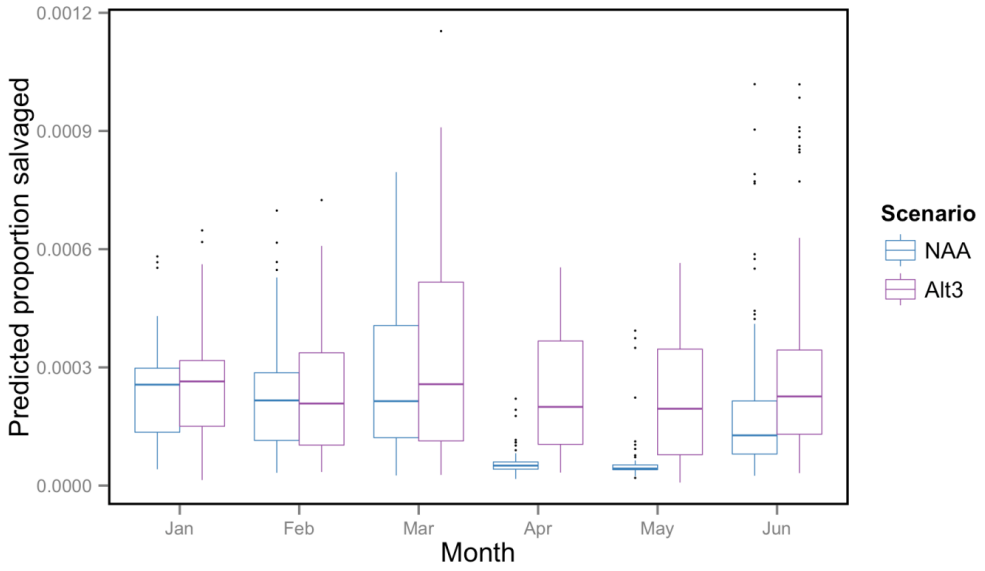

Figure 9M.2 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 3 (Alt 3) Compared to the No Action Alternative (NAA)

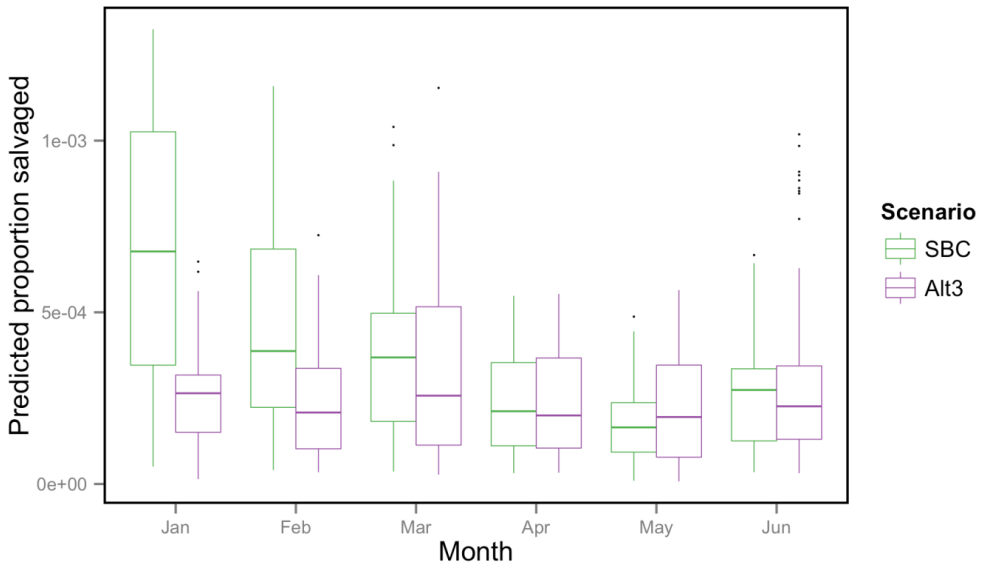

Figure 9M.3 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 3 (Alt 3) as Compared to the Second Basis of Comparison (SBC)

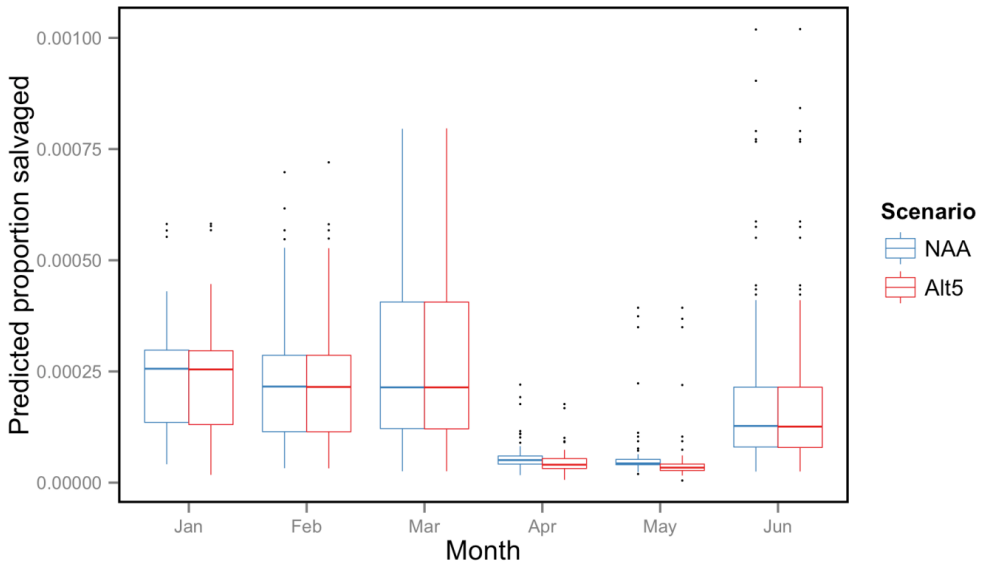

Figure 9M.4 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 5 (Alt 5) as Compared to the No Action Alternative (NAA)

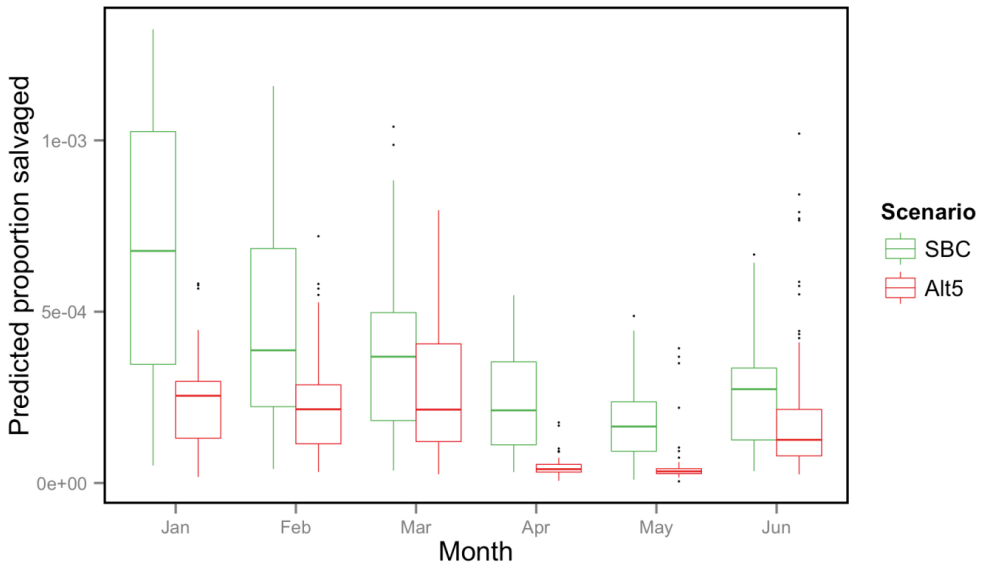

Figure 9M.5 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 5 (Alt 5) as Compared to the Second Basis of Comparison (SBC)

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