WRLCM for supporting RPA analysis and workplan development

14 July 2017

Noble Hendrix, QEDA Consulting, LLC

The winter-run life cycle model (WRLCM) is a useful tool for evaluating alternative management actions because it can integrate those actions over multiple salmon cohorts and multiple hydrological conditions (e.g., water year types), while capturing the dynamics of the full salmon life cycle. For example, to evaluate the potential effects of improving access to the Yolo bypass, the WRLCM was modified to reflect improved access via proposed notching of the Fremont Weir (Yolo Alt) while holding all other factors constant. The WRLCM was run with the baseline conditions (Base) and compared to the Yolo Alt with respect to spawner abundance to show the accumulating benefits of the modification to the winter-run population (Figure 1).

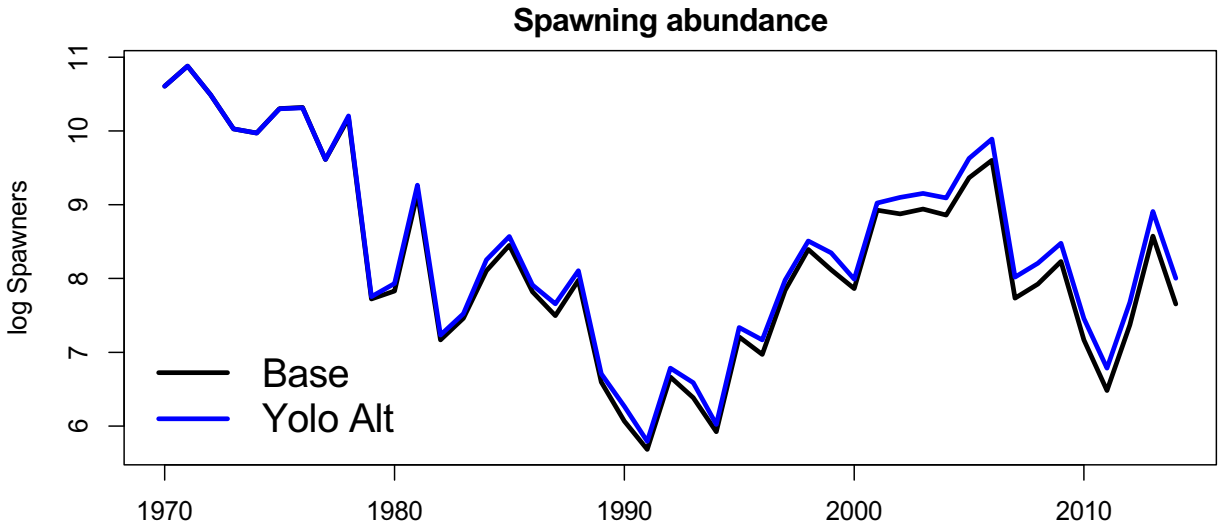

Figure 1. WRLCM outputs of historical winter-run natural origin log escapement (Base) to an action that alters the entrance to Yolo bypass (Yolo Alt).

Shasta temperature RPA

We can use the WRLCM to evaluate the population level effects of Shasta RPA objectives for thermal mortality in the egg to fry life-history stage. In particular, if thermal mortality objectives can be specified for different water year types, the WRLCM can evaluate the proposed mortality objectives versus baseline mortality rates. This analysis could be completed for the 1970 - 2015 historical period (similar to the Yolo analysis in Figure 1). In addition, the analysis could be completed for a series of future hydrological scenarios to evaluate the RPA performance over multiple assumptions of climate conditions.

In addition, to evaluate an adaptive management response to consecutive dry years, an approach could be defined in which the survivals of a given year could be used to set the criteria for the subsequent year. Such an adaptive management approach could be evaluated in the

WRLCM relative to a baseline condition in a similar framework as the water-year based thermal mortality objectives.

Reintroduction of winter-run to Shasta tributaries

A reintroduction module has been developed for the WRLCM, and it has been parameterized with collection and survival rates for juveniles and adults. Initial estimates of the rates were quantified by specifying low, high, and most-likely values for each rate. While there are many combinations of these rates, only some combinations will lead to a sustainable winter-run population. We are currently evaluating the combinations of collection and survival rates that lead to equivalent or improved population abundance and productivity relative to baseline. In our initial work, the baseline is the observed natural escapement over the 1970 - 2015 period; however, this analysis can also be conducted under the same future climate conditions specified in the Shasta RPA analysis above.

Additional potential applications

- Developing a short-term forecasting version of the WRLCM
- Evaluating restoration alternatives thru modeling changes in capacity, fry survival, smolt survival, etc.
- Evaluating monitoring design improvements by simulating new data streams such as Knights Landing abundance estimate and Chipps Island abundance estimates
- Evaluate real time management by defining triggers that initiate management actions to modify survival and movement rates.