# Appendix D

Water Year 2021 Winter-Run Chinook Temperature-Dependent Mortality Estimate *Prepared by the Southwest Fisheries Science Center (SWFSC), October 24th, 2021*

This document provides hindcast estimates of temperature-dependent mortality (TDM) for water year 2021. River temperature was generated using the RAFT model with data assimilation and associated TDM estimates using the SWFSC stage-independent temperature mortality model (Martin et al. 2017). Additionally, since the RAFT model showed a bias in predicting temperature during the peak month of observed spawning in June and July, TDM was also estimated using observed water temperatures at the CDEC gauges (KWK, SAC, CCR, and BSF) and linearly interpolating in space between gauge locations.
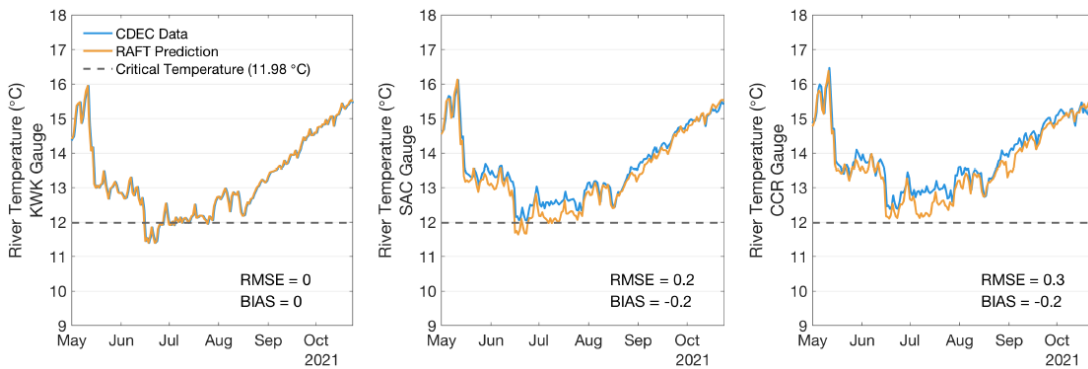


Figure 1: Differences in daily mean river temperature between CDEC data and the RAFT hindcast model at the KWK, SAC, and CCR gauge. Note: RAFT model error statistics, bias and root mean square error (RMSE), are displayed.
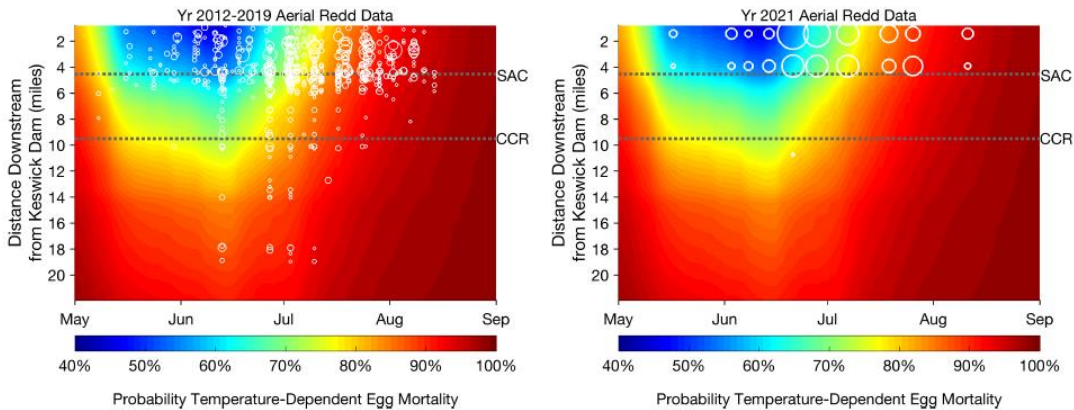


Figure 2: Estimated temperature-dependent egg survival produced by the SWFSC stage-independent model under a 2012-2019 redd distribution (left plot) and 2021 redd distribution (right plot). Note: redd distribution shown as white circles, scaled to the number of redds observed during the aerial survey.

Table 1: Estimated TDM under two spatial and temporal redd distribution using output from the RAFT model and linear interpolation of observed gauge data. TDM estimates were generated for the SWFSC stage-independent temperature mortality model by running the following parameter conditions, $T_{crit}$ = 11.98 °C, $b_T$ = 0.023 °C$^{-1}$ day$^{-1}$.

| Redd distribution (years) | Method to estimate river temperature | Mean Annual TDM (%) |
|---|---|---|
| 2012-2019 | RAFT Model | 77 |
| 2021 | RAFT Model | 70 |
| 2021 | Linear interpolation of observed gauge data | 75 |

Reference: Martin, B. T., Pike, A., John, S. N., Hamda, N., Roberts, J., Lindley, S. T. and Danner, E. M. (2017), Phenomenological vs. biophysical models of thermal stress in aquatic eggs. Ecology Letters 20: 50–59. doi:10.1111/ele. 12705