

## SacPas Fish Model: Temperature timeseries metrics

28 September 2023

The historical, and/or forecast temperature profiles at various locations on the Sacramento River are shown in the timeseries plot after the Egg-to-Fry model is run.

Two particular events, in the autumn, that indicate that the river's thermal regime is changing: the day when the temperature gradient flips, and the day when the temperatures go below the  $T_{crit}$  threshold.

**Gradient Flip:** In the summer, water at KWK begins to warm as it moves downstream in response to air temperature. There is a gradient in temperature from upstream to downstream. As air temperatures cool in the autumn, eventually this process decays and reverses so that the water begins to cool as it flows downstream. This is the gradient flip and is identified as the first day on or after October 1, when this cooling pattern between the Keswick Dam (KWK) gage and the Balls Ferry (BSF) gage is observed for 7 days.

**Threshold Day:**  $T_{crit}$  is the temperature above which temperature dependent mortality (TDM) is significant. In the summer, water temperatures frequently exceed this value. As the autumn progresses, water passing KWK cools and eventually is less than  $T_{crit}$ . After October 1, when temperatures are below  $T_{crit}$  for 7 days, that day identified as the threshold crossing day for  $T_{crit}$ .

**Fig. 1 Example:** Fall aerial redds development in 2020 are shown in Fig. 1. The temperature gradient flipped over on 7 November, for 7 or more days, and the temperatures dropped below  $T_{crit}$  (11.82 °C) on 19 December for 7 or more days. Note that there were earlier gradient-flip and threshold-crossing events, for fewer than 7 days.

Temps: Data 2020      Redds: Fall Aerial 2020

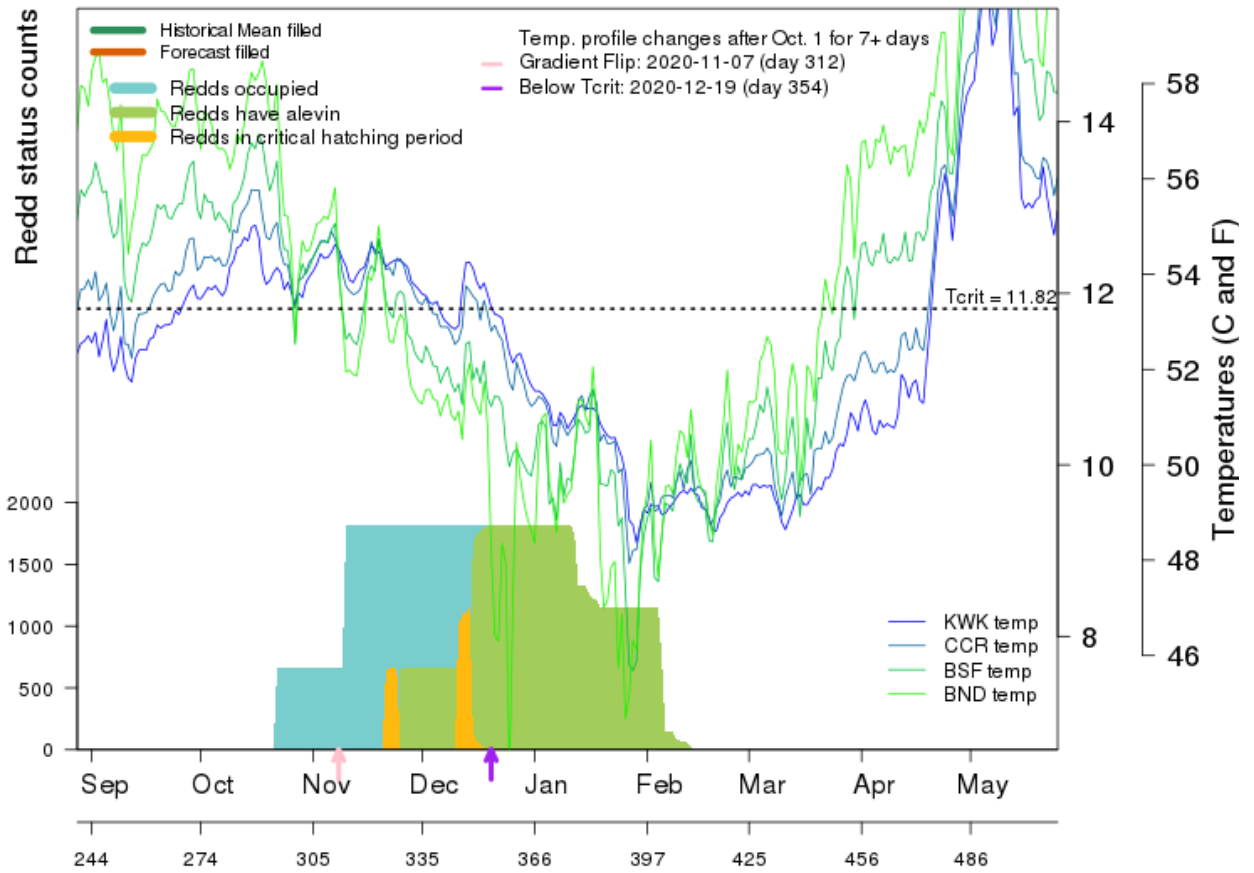


Figure 1 Example output showing the threshold crossing and gradient flip.