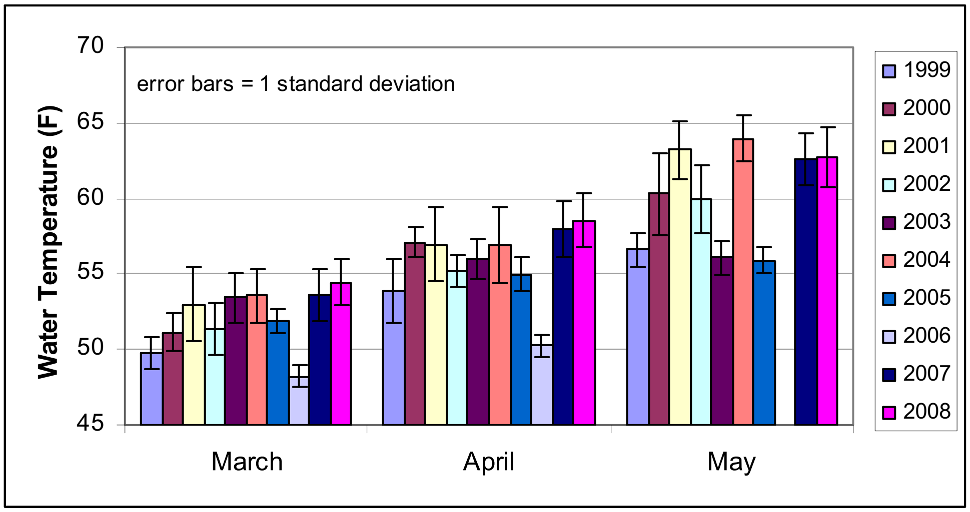

Figure 6-26. Lower American River water temperature during March, April, and May from 1999 through 2008 represented as the mean of the daily average at the Watt Avenue gage (Original data were obtained from http://cdec.water.ca.gov/).

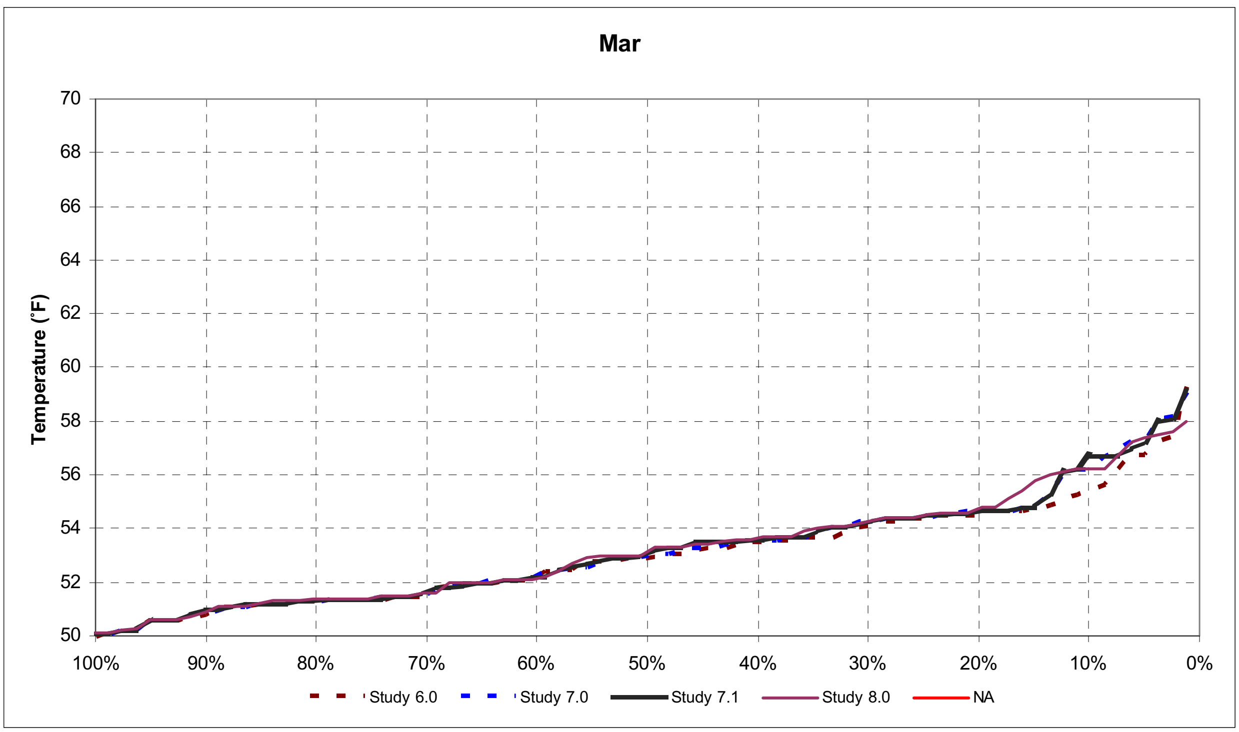

Figure 6-27. Exceedence plot of modeled water temperatures in the lower American River near the Sunrise area during March (CVP/SWP operations BA appendix I).

For the purposes of this analysis, NMFS assumes that climate change could account for a 1-3°F increase in water temperatures within the time frame of the proposed action (see Appendix R of the CVP/SWP operations BA). If this level of warming occurs, mean water temperatures in the lower American River could range from about 51°F to 57°F in March, about 53°F to 62°F in April, and 59°F to 67°F in May (figure 6-30). Under these conditions, higher egg mortality and increased fitness consequences would occur for steelhead eggs and alevins that were spawned later in the spawning season (*e.g.*, spawned in March rather than January). This selective pressure towards earlier spawning and incubation would truncate the temporal distribution of spawning, resulting in a decrease in population diversity, and consequently a likely decrease in abundance.

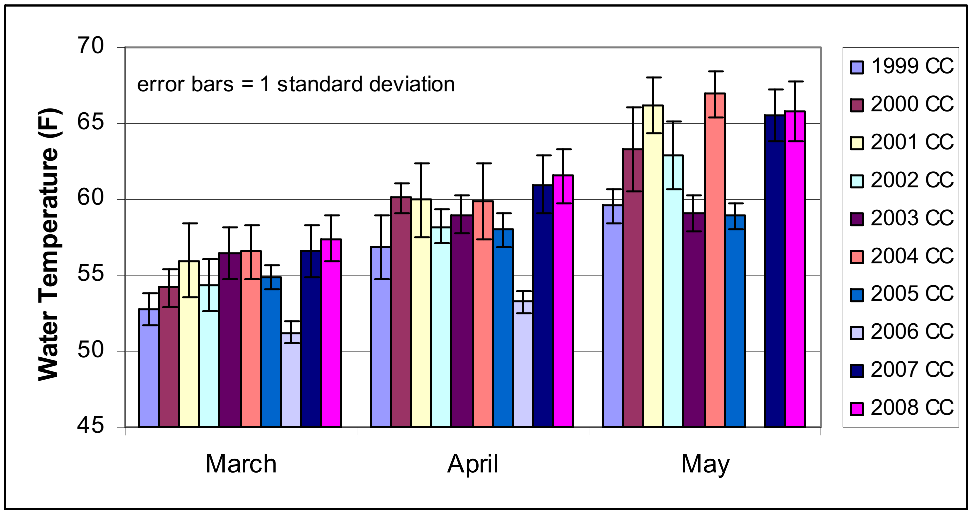

Figure 6-30. Lower American River water temperature during steelhead from 1999 through 2008 represented as the mean of the daily average at the Watt Avenue gage plus 3°F to incorporate potential climate change effects (see Key Assumptions in section 2). Years are labeled in the legend with "CC" to denote the intended application of this figure as an analysis of climate change effects. Original data were obtained from http://cdec.water.ca.gov/.

High water temperatures are a stressor to juvenile rearing steelhead in the American River, particularly during the summer and early fall. Unfortunately, assessing the response of American River steelhead juveniles to water temperatures is not straightforward, as no studies of the effects of temperature on Central Valley juvenile steelhead have yet been published in the primary literature (Myrick and Cech 2004). Myrick and Cech (2004) state that, "*The scarcity of information on the effects of temperature on the growth of juvenile steelhead from central valley systems is alarming, and should be rectified as quickly as possible.*"

The available information suggests that American River steelhead may be more tolerant to high temperatures than steelhead from regions further north (Myrick and Cech 2004). Cech and Myrick (1999) reported that when American River steelhead were fed to satiation at constant temperatures of 51.8°F, 59.0°F, and 66.2°F, growth rates increased with temperature, whereas Wurtsbaugh and Davis (1977) found that maximal growth of juvenile steelhead from North Santiam River in Oregon occurred at a cooler temperature (*i.e.*, 62.6°F). Both of these studies were conducted in a controlled laboratory setting with unlimited food availability. Under more

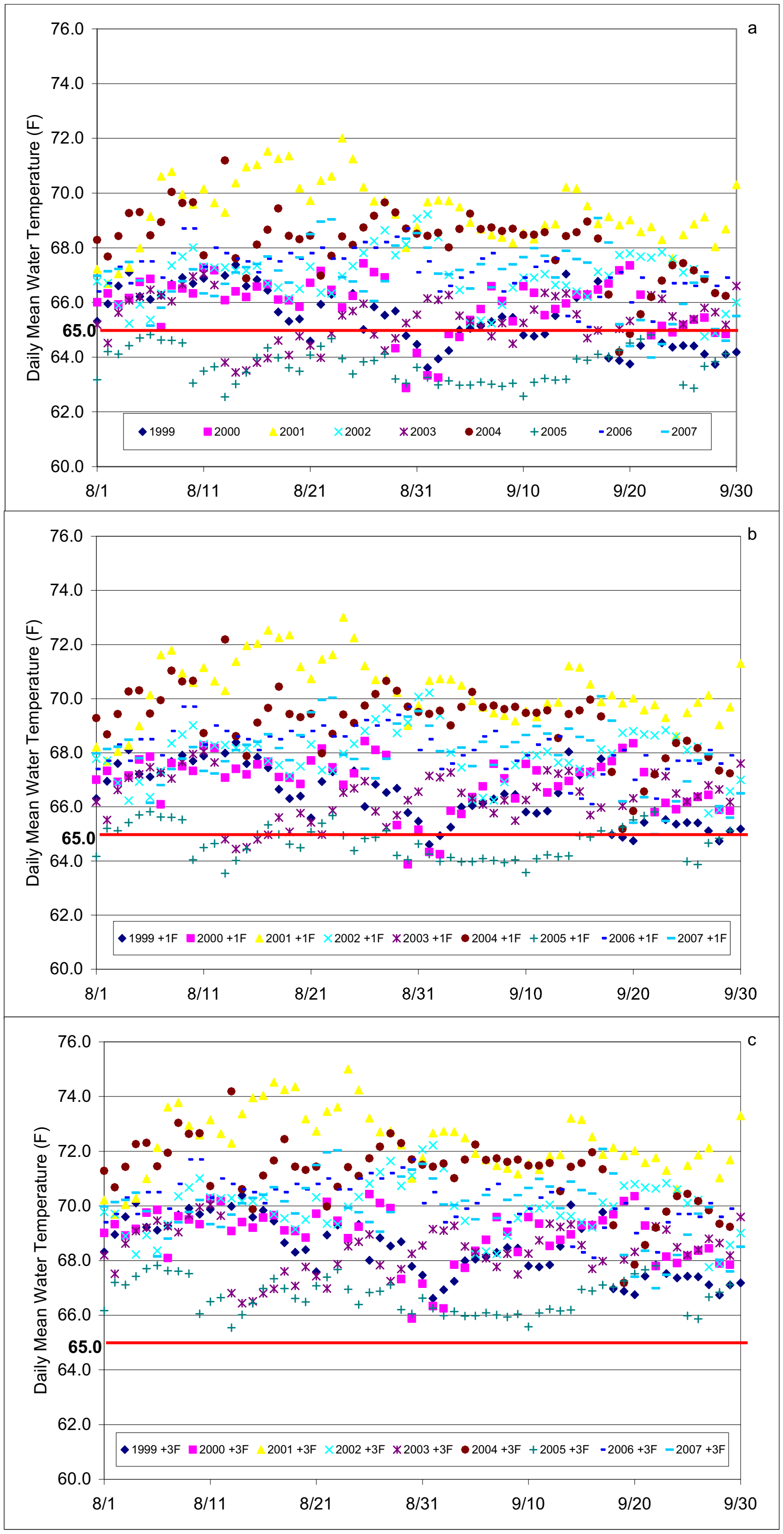

Figure 6-32 a, b, and c. Lower American River water temperature during August and September from 1999 through 2007 represented as the daily mean at the Watt Avenue gage (a). Figures b and c show these same water temperatures plus 1°F and 3°F, respectively, to incorporate potential climate change effects (see Key Assumptions in Chapter 2). The 65°F line is indicated in red because visible symptoms of thermal stress in juvenile steelhead are associated with exposure to daily mean water temperatures above 65°F. Data were obtained from http://cdec.water.ca.gov/.