SIMULATING TEMPERATURE MANAGEMENT UNDER CLIMATE CHANGE AT DETROIT LAKE, OR

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A previously calibrated two-dimensional hydrodynamic and water-quality model (CE-QUAL-W2) of Detroit Lake, in western Oregon, was used in conjunction with inflows derived from Precipitation-Runoff Modeling System (PRMS) hydrologic models to examine in-lake and downstream water temperature effects under future climate conditions. Current and hypothetical operations and structures at Detroit Dam were imposed on boundary conditions derived from downscaled Global Circulation Models in base (1990-1999) and future (2059-2698) periods. Compared with the base period, future air temperatures were about 2°C warmer year-round. Higher air temperature and lower precipitation in future scenarios resulted in a 23% reduction in mean annual PRMS-simulated discharge and a 1°C increase in mean annual estimated stream temperatures flowing into the lake compared to the base period. Simulations incorporating current operational rules and minimum release rates at Detroit Dam to support downstream habitat, irrigation, and water supply during key times of year resulted in lower future lake elevations. Importantly, the lower future lake levels resulted in about half as many days with the water surface above the dam's spillway crest compared to historical frequencies. Managing temperature downstream of Detroit Dam depends on being able to blend warmer water from the lake's surface with cooler water from deep in the lake, and the spillway is an important release point near the lake's surface. Annual average in-lake and release temperatures from Detroit Lake warmed 1.1 °C and 1.5 °C from base to future periods under present-day dam operational rules and fill schedules. Beginning the refill of the lake 30 days earlier, reducing minimum release rates (to keep more water in the lake so as to be able to use the spillway), and installing a floating surface withdrawal were actions that were tested with the model and showed potential for mitigating against future warming of release temperatures from Detroit Dam during the critical autumn spawning period for endangered salmonids.