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Modelling future changes to the hydrological and thermal regime of unaltered streams using projected changes in climate to support planning for sensitive species management

Jennifer Rogers[1,2], Eric Stein[1], Marcus Beck[1,5], Kelly Flint[3], Alicia Kinoshita[3], Richard Ambrose[2,4]

[1]Biology Department, Southern California Coastal Water Research Project, Costa Mesa, CA
[2]Institute of the Environment and Sustainability, University of California Los Angeles, Los Angeles, CA
[3]Department of Civil, Construction and Environmental Engineering, San Diego State University, San Diego, CA
[4]Department of Environmental Health Sciences, University of California Los Angeles, Los Angeles, CA
[5]Tampa Bay Estuary Program, St. Petersburg, FL

Abstract
Climate change will alter stream habitats through precipitation and air temperature changes and potentially threaten species that rely on contemporary streamflow and stream temperature regimes. Habitat projections are therefore critical to inform management decisions. Past and ongoing research has improved streamflow and temperature modelling in ungauged regions, but no studies merge these advancements with climate modelling for regional streamflow and stream temperatures predictions that describe stream habitat change. Here, we predict change in streamflow and stream temperature at the reach scale using projections from downscaled global climate models (GCMs) and the 'business as usual' carbon emission scenario. We focus on unaltered streams in six southern California watersheds using data from baseline (1982–2014) and projected end-of-century (2082–2100). Stream temperature is projected to increase regionally, with high-elevation stream reaches increasing most rapidly. There is less consistency in the streamflow projections, but a spatial and temporal homogenization of stream flow characteristics was predicted, that is, flows become more similar across the region with less inter-annual variation. Additionally, there is a regional trend towards larger high flow magnitudes and more storm events. Despite the increased frequency and magnitude of storm events, high-elevation streams are predicted to become drier for a greater portion of the year. Conversely, low-elevation streams are predicted to have longer hydroperiods. Mapping future streamflow and stream temperatures at the reach scale can direct conservation efforts to streams that remain suitable, restoration to areas that decrease in suitability for target species, and support water policies that consider future stream condition.