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Title: Influence of Solar Exposure on Stream Water Temperature: Implications for Conservation

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Abstract:
Stream water temperature is determined by a complex interplay of prevailing meteorology, local riparian canopy structure as it affects solar exposure, streambed morphology, and surface and subsurface flow patterns. We examined spatio-temporal variation in temperature regimes with respect to conservation of aquatic organisms of San Francisquito Creek (San Francisco Peninsula, California). Analyses synthesized measurements of meteorology from nearby weather stations, water temperature from a network of sensors, riparian canopy structure and solar exposure from hemispherical (fisheye) photography, stream morphology from field characterization and geographic information system (GIS) analysis, and stream flow and water temperature from gauging stations. We modeled stream temperature dynamics based on energy balance, with a focus on energy input from solar radiation. Water temperature co-varied with air temperature, with diurnal and seasonal lags. Stream reaches with high solar exposure displayed relatively high temperature variability (up to 5° C differential from baseline), whereas shaded reaches displayed only modest temperature variability (0.5-1.0° C differential). Subsurface flow through gravel beds decreased temperature (2-3° C decrease). Management of stream habitat to include a diversity of suitable temperature regimes is essential for conservation of species such as steelhead trout (*Oncorhynchus mykiss*), which requires relatively cool conditions, and California red-legged frog (*Rana aurora draytonii*) and western pond turtle (*Clemmys marmorata*), which require warmer conditions. This approach can be applied to a broad spectrum of streams for habitat assessment, for stream conservation and restoration to accommodate diverse habitat needs, and for examination of potential impacts of climate change.