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Targeting climate diversity in conservation planning to build resilience to climate change

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Abstract. Climate change is raising challenging concerns for systematic conservation planning. Are methods based on the current spatial patterns of biodiversity effective given long-term climate change? Some conservation scientists argue that planning should focus on protecting the abiotic diversity in the landscape, which drives patterns of biological diversity, rather than focusing on the distribution of focal species, which shift in response to climate change. Climate is one important abiotic driver of biodiversity patterns, as different climates host different biological communities and genetic pools. We propose conservation networks that capture the full range of climatic diversity in a region will improve the resilience of biotic communities to climate change compared to networks that do not. In this study we used historical and future hydro-climate projections from the high resolution Basin Characterization Model to explore the utility of directly targeting climatic diversity in planning. Using the spatial planning tool, Marxan, we designed conservation networks to capture the diversity of climate types, at the regional and sub-regional scale, and compared them to networks we designed to capture the diversity of vegetation types. By focusing on the Conservation Lands Network (CLN) of the San Francisco Bay Area as a real-world case study, we compared the potential resilience of networks by examining two factors: the range of climate space captured, and climatic stability to 18 future climates, reflecting different emission scenarios and global climate models. We found that the climate-based network planned at the sub-regional scale captured a greater range of climate space and showed higher climatic stability than the vegetation and regional based-networks. At the same time, differences among network scenarios are small relative to the variance in climate stability across global climate models. Across different projected futures, topographically heterogeneous areas consistently show greater climate stability than homogenous areas. The analysis suggests that utilizing high-resolution climate and hydrological data in conservation planning improves the likely resilience of biodiversity to climate change. We used these analyses to suggest new conservation priorities for the San Francisco Bay Area.

Key words: abiotic diversity; biodiversity; climate adaptation; climate change; impact; MARXAN; protected areas; resilience; San Francisco Bay Area; systematic conservation planning; terrestrial.

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