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Persistent spatial structuring of coastal ocean acidification in the California Current System

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The near-term progression of ocean acidification (OA) is projected to bring about sharp changes in the chemistry of coastal upwelling ecosystems. The distribution of OA exposure across these early-impact systems, however, is highly uncertain and limits our understanding of whether and how spatial management actions can be deployed to ameliorate future impacts. Through a novel coastal OA observing network, we have uncovered a remarkably persistent spatial mosaic in the penetration of acidified waters into ecologically-important nearshore habitats across 1,000 km of the California Current Large Marine Ecosystem. In the most severe exposure hotspots, suboptimal conditions for calcifying organisms encompassed up to 56% of the summer season, and were accompanied by some of the lowest and most variable pH environments known for the surface ocean. Persistent refuge areas were also found, highlighting new opportunities for local adaptation to address the global challenge of OA in productive coastal systems.

Eastern boundary current upwelling systems such as the California Current Large Marine Ecosystem (CCLME) represent one of the ocean's most productive biomes, sustaining one-fifth of the world's fisheries[1]. Broad-scale observations[2], and models[3] have highlighted the biogeochemical sensitivity of the CCLME to the rapid progression of ocean acidification (OA). This susceptibility reflects the central role of upwelling currents in connecting coastal waters with the dissolved inorganic carbon (DIC)-rich ocean interior, and the high potential for active carbon remineralization over productive continental shelves. Against this naturally-elevated DIC baseline, present day anthropogenic CO_2 burdens upwards of 60 μmol kg^{-1} have already resulted in declines of up to 0.12 and 0.5 in pH and Ω_{arag}, respectively[3,4]. Within the CCLME, model and broad-scale cruise surveys have further identified the nearshore as the region most strongly affected by present, and likely future, expression of OA[2–4] and is where the most frequent occurrences of severe shell dissolution in planktonic pteropods can already be found[5].

The nearshore waters (within 10 km of coast) of the CCLME contain crucial but vulnerable ecological and fishery habitats, encompassing nearly all U. S. West Coast kelp forests and marine reserves, as well as biologically diverse intertidal habitats where calcifying organisms often dominate ecological structure and function[6]. While science and management decisions such as the placement of marine reserves in the CCLME have been

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