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MAJOR RESTRUCTURING OF MARINE FORESTS' DIVERSITY UNDER PROJECTED CLIMATE CHANGE

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Abstract:
Future climate change poses a major threat to global marine biodiversity. For marine forests that structure essential habitats for coastal species worldwide, climate change effects can be magnified into losses of ecosystem functioning, with direct consequences for the numerous ecological and economic services provided (Assis et al., 2022; 2017). To date, the direction and intensity of future net changes in the global patterns of marine forests' biodiversity remain unknown, precluding well-informed IPCC impact assessments, conservation and management strategies (Fragkopoulou et al., 2022). Here, we use machine learning species distribution modelling to forecast global changes in richness and community composition (i.e., persistence, extinction and turnover) of 115 kelp species (orders Desmarestiales, Laminariales and Tilopteridales) under contrasting Shared Socioeconomic Pathway (SSP) scenarios of climate change (decade 2090–2100): one aligned with the Paris Agreement climate forcing (SSP1-1.9) and another of substantially higher emissions (SSP5-8.5). Models anticipate a generalized trend of poleward shifts at the species level, particularly pronounced with SSP5-8.5, which translated into significant net changes in the global patterns of biodiversity. Maximum community composition changes (i.e., turnover) were projected in the Arctic and Northern Pacific Ocean due to an overall increase in species richness (average gains of 10.96 ± 9.47 species with SSP5-8.5), and in the temperate regions

of the North Atlantic Ocean and Northwest Pacific, as well as the Mediterranean Sea, Australia and New Zealand, due to major losses of suitable habitats (average losses of 3.59 ± 4.04 species with SSP5-8.5). Overall, we show that climate change can strongly restructure the global patterns of marine forests' biodiversity, however, broad compliance with the Paris Agreement may minimize potential knock-on effects on the productivity and functioning of temperate coastal environments. The projected patterns also pinpoint refugial areas for conservation that serve as baselines for well-informed management strategies in the face of future climate change.

Keywords: Marine biodiversity; Marine forests; Climate change; Distribution range shifts; Paris Agreement.

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