
End-of-century habitat model forecasts suggest potential redistributions of marine predators around the Prince Edward Islands, southern Indian Ocean

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Abstract

One of the most important effects of climate change is the redistribution of biodiversity and this is occurring rapidly in marine systems. Marine top predators are regarded as ocean sentinels because they occupy high trophic levels and therefore integrate environmental signals into their behaviour and demography. They also play an important functional role in ecosystems. Projections of the future distribution of these predators can: 1) indicate future potential biodiversity patterns and rearrangements, such as changes in community structure; 2) form the basis for hypotheses about the future structure and functioning of marine communities; and 3) generate spatial scenarios for conservation and management planning.

We used tracking data from 14 species (3 seals, 10 seabirds and 1 cetacean, totalling 538 tracks) to model the habitat use of top predators around the Prince Edward Islands in the southern Indian Ocean. Using ensembles of 5 machine learning algorithms, we modelled habitat preference as a response to 4 static environmental covariates and 11 dynamic environmental covariates obtained from the Max Planck Institute Earth System Model, an IPCC-class climate model. To forecast the potential distribution of the predators in 2070-2099, we used the climate model projections that assume the 'business as usual' greenhouse gas emissions scenario RCP8.5.

Analogous climates are projected to predominantly shift to the south-east and south-west. Species potential range shifts varied in direction and magnitude, but overall shifted slightly

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to the south-west. Cluster analyses indicated potential changes in future community composition. Overlap scores – indicating areas of common use among the predators – were higher and more concentrated at $\sim 47^{\circ}$ S. This means that marine predator biodiversity will likely be redistributed, and that some areas might be more intensively utilized by multiple predator species in the future. This would affect ecological processes that require consideration in terms of conservation and management.