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TITLE: Spatial ecology and conservation of seabirds facing global climate change: a review

AUTHOR: ['David Grémillet', 'Thierry Boulinier']

ABSTRACT:

In this review we detail the impact of climate change on marine productivity, on marine environmental stochasticity and cyclicity, and on the spatio-temporal match-mismatch of seabirds and their prey.We thereby show that global warming has a profound bottom-up impact upon marine top-predators, but that such effects have to be studied in conjunction with the (top-down) impact of human fisheries upon seabird food resources.Further, we propose seabird ecological features, such as memory effects and social constraints, that make them particularly sensitive to rapid environmental change.We provide examples of how seabirds may nonetheless adapt when facing the consequences of climate change.We conclude that our understanding of the spatial ecology of seabirds facing environmental change is still rudimentary, despite its relevance for the conservation of these vulnerable organisms and for the management of marine ecosystems.We define the following research priorities.(1) Determine the factors affecting seabird distribution and movements at sea using biotelemetry, as well as colony dynamics on land.(2) Link seabird distribution patterns to those of their prey.(3) Determine further the role of historical and metapopulation processes in contributing to the dynamics of the spatial distribution of seabirds.(4) Assess phenotypic plasticity and the potential for microevolution within seabird spatial responses to climate change, since both will greatly affect the quality of modelling studies.(5) Adapt existing models to define and predict the impact of climate change onto seabird spatial dynamics.(6) Synthesize all gathered information to define marine protected areas and further conservation schemes, such as capacity reduction of fisheries.This research effort will require maintaining existing long-term monitoring programmes for seabirds, as well as developing new approaches to permit the integration of processes occurring at various scales, in order to be able to fully track the population responses of these long-lived vertebrates to environmental changes.

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