

Predicting species distribution: complementarity of food webs and hierarchical Bayesian spatial modelling

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Abstract: The spatial prediction of species distributions from survey data has been recognized as a significant component of conservation planning and the ecosystem-based approach to marine resources. A wide variety of statistical and machine-learning methods have been introduced, often in conjunction with geographic information systems (GIS) and remote-sensing. Guisan and Zimmermann (2000) provide an extensive review of these developments, identifying many of the alternative statistical approaches that may be used. Frequently, the purpose of the statistical modelling is to use the information about where a species occurs and the relationship with associated environmental factors to predict how likely the species is to occur in unsampled locations. Spatial prediction of species distributions is thus directly related to the concept of the environmental niche, a specification of a species' response to a suite of environmental factors. But it is known that environmental factors alone may not be sufficient to account for species distribution. Other ecological processes including competition, predation and the dynamics of the population may affect the spatial arrangement of a species, in addition to human activities. Here we compare two novel techniques that use different approaches to estimate species distributions: hierarchical Bayesian spatial models and the Ecospace new habitat capacity food web model. We use both techniques and compare results to assess the distribution of several commercial and non-commercial fish species in the South Catalan Sea, while exploring the complementarity of both approaches. Bayesian models have been used to estimate and predict the distribution of species using mainly environmental factors, and can include biological relationships and human activities, as Ecospace models do. The new Ecospace habitat capacity model combines species distributions with food web model dynamics.

References

Guisan, A. and Zimmermann, N.E. (2000) Predictive habitat distribution models in ecology. *Ecological Modelling*, 135: 147-186.