Spatial Ecology and Evolution: Integrating Theory and Data

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Abstract

Research in ecological modelling can be broadly classified into forward and inverse approaches. Forward approaches are those in which the researcher makes assumptions about the underlying mechanisms and uses mathematical or simulation models to ask what are the consequences of those assumptions. In contrast, with inverse approaches the aim is to find out the mechanisms that have generated patterns observable in empirical data, often using statistical methods. In recent years, the dichotomy between the forward ("mathematical ecology") and inverse ("statistical ecology") approaches has started to diminish, partly thanks to methods (e.g. Bayesian state-space models) that enable the merging of these two approaches, and partly thanks to the appreciation of a deeper integration between ecological theory and data. One driver for the development of new modelling approaches has been the recognition that in observational studies of ecology and evolutionary biology, the process of interest is seldom observed directly, and thus inference relies on data that are indirect and influenced by an observation process. I exemplify modern approaches in ecological modelling through a number of case studies that relate to animal movement and population dynamics in spatially heterogeneous environments, to evolutionary dynamics generated by random genetic drift or natural selection, and to the dynamics of interactive species communities.

Suggested Readings

O. Ovaskainen and J. Soininen, *Making more out of sparse data: hierarchical modeling of species communities.* Ecology 92, pp. 289–295 (2011). http://www.esajournals.org/doi/abs/10.1890/10-1251.1

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http://www.marine-vectors.eu/pdf/Patterson_etal_TREE_2008_StateSpaceModelsOfAnimasSpatialMovements.pdf

M. Karhunen et alli, *DRIFTSEL: an R package for detecting signals of natural selection in quantitative traits.* Molecular Ecology Resources 13, pp. 746–754 (20130.

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