

Quantitative ecology and evolutionary biology: integrating models with data

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Abstrak

This book presents an integrative approach to mathematical and statistical modelling in ecology and evolutionary biology. After an introductory chapter, the book devotes one chapter for movement ecology, one for population ecology, one for community ecology, and one for genetics and evolutionary ecology. Each chapter starts with a conceptual section, which provides the necessary biological background and motivates the modelling approaches. The next three sections present mathematical modelling approaches, followed by one section devoted to statistical approaches. Each chapter ends with a perspectives section, which summarizes the key messages and discusses the limitations of the approaches considered. To illustrate how the very same modelling approaches apply in different fields of ecology and evolutionary biology, the book uses movement models as a building block to construct single-species models of population dynamics, the models of which are further expanded to models of species communities and to models of evolutionary dynamics. In all chapters, the book starts by making assumptions at the level of individuals, leading to individual-based simulation models. To derive analytical insights and to compare the behaviours of different types of models, the book shows how the individual-based models can be simplified, e.g. to yield models formulated directly at the population level. The book has a special emphasis on the integration of models with data. To achieve this, it applies statistical methods to data generated by mathematical models, and thus asks to what extent does the data contain signals of the underlying mechanisms.