Computational Ecology as an Emerging Science

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Abstract

It has long been recognized that numerical modelling and computer simulations can be used as a powerful research tool to understand, and sometimes to predict, the tendencies and peculiarities in the dynamics of populations and ecosystems. It has been, however, much less appreciated that the context of modelling and simulations in ecology is essentially different from those that normally exist in other natural sciences. In our paper, we review the computational challenges arising in modern ecology in the spirit of computational mathematics, i.e. with our main focus on the choice and use of adequate numerical methods. Somewhat paradoxically, the complexity of ecological problems does not always require the use of complex computational methods. This paradox, however, can be easily resolved if we recall that application of sophisticated computational methods usually require clear and unambiguous mathematical problem statement as well as clearly defined benchmark information for model validation. At the same time, many ecological problems still do not have mathematically accurate and unambiguous description and available field data are often very noisy, and hence it can be hard to understand how the results of computations should be interpreted from the ecological viewpoint. In this scientific context, the computational ecology has to deal with a new paradigm: conventional issues of numerical modelling such as convergence and stability become less important than the qualitative analysis that can be provided with the help of computational techniques. We discuss this paradigm by considering computational challenges arising in several specific ecological applications.

Keywords: computational ecology; predictive modelling; conceptual modelling

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