

Dynamic simulation models – is R powerful enough?

Thomas Petzoldt ^a

The R system is increasingly accepted as one of the standard environments for ecological data analysis and modelling. An increasing collection of packages explicitly developed for ecological applications and a growing number of textbooks that use R to teach ecological modelling (Ellner and Guckenheimer, 2006; Bolker, 2008; Soetaert and Herman, 2009; Stevens, prep) are just an indicator for this trend.

The talk will focus on practical experience with implementing and using dynamic models in R as seen from a biological scientist's perspective. A series of concrete case studies was performed analysing particular aspects of ecological interactions. These are presented together with the applied modelling techniques, e.g. sensitivity analysis, parameter fitting, equilibrium analysis and Monte-Carlo simulation.

The example models are organized in an open collection of published models (package **simecolModels**¹) that cover the range from teaching demos up to the ecosystem level and from spatially aggregated to spatially resolved, for example:

- individual-based simulations of *Daphnia* population dynamics,
- differential equation models of phytoplankton-zooplankton-interactions and of toxin production,
- solid phase / fixed phase simulations in 1D, developed for organismic drift, that may also be useful for physico-chemical systems, i.e. chromatography.

We show how functions of existing packages (e.g. **stats**, **deSolve**, **simecol**, **FME** and **Sweave**) are combined to organize a consistent work flow from data analysis over modelling until publication. The power and the limits of different R implementations are discussed by considering questions like execution speed and implementation effort. It is demonstrated in which circumstances pure R implementations are sufficient and how C-functions can speed up simulations.

We conclude that R is a highly productive system for the dynamic modeller. We propose that it is time to establish a community around dynamic modelling in R and suggest steps in this direction.

References

- Bolker, B. (2008). *Ecological Models and Data in R*. Princeton University Press.
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- Stevens, M. H. H. (in prep.). *A Primer of Theoretical Population Ecology with R*. Springer.

^aTechnische Universität Dresden, Institute of Hydrobiology, 01062 Dresden, Germany, thomas.petzoldt@tu-dresden.de, <http://tu-dresden.de/Members/thomas.petzoldt>

¹<http://simecol.r-forge.r-project.org/>