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Preface

Theoretical ecology and mathematical modelling: Problems and methods

The Alcalá Second International Conference on Mathematical Ecology (AICME II) was held at the University of Alcalá de Henares (Madrid), Spain on September 5–9, 2003 (http://euromedbiomath.aicme.free.fr) as a follow up of the first AICME held in 1998. More than 250 participants from around the world attended this meeting. A wide spectrum of the main topics of Mathematical and Theoretical Ecology were presented during plenary and specialized scientific sessions.

The AICME Organizing Committee recommended a set of articles presented at the conference to compose special issues in several journals, including an issue in *Ecological Modelling*. Ten articles have been selected for this special issue in order to illustrate the following approach.

The complexity of ecosystems makes their study difficult and leads to the need for developing theories in which assumptions can be tested. These theories must be confronted with field and experimental data. In ecology, most of the theories are expressed in terms of mathematical models. In order to increase models efficiency, many authors tend to integrate more and more details and knowledge about the ecological systems they study. Among the various ecological factors, which need particular attention, we selected the three following ones: the stage or age structure of the population, its spatial structure and the individuals–population interaction.

An increasing biological knowledge of the life cycles of many populations, of their spatial distributions and of some of the factors responsible for these distributions is available. This knowledge is partially obtained at the individual level and partially at the population level and both represent relevant information, which should be integrated in mathematical models. Taking care of this complexity may have paradoxical consequences. On the one hand, a detailed description of relevant biological knowledge is necessary for a realistic representation of natural processes and, on the other hand, this usually leads to intractable mathematical models. An important approach in theoretical ecology consists in the development of methods that manage the trade-off between biological complexity and mathematical tractability.

The works presented in this issue are good examples of this approach. The issue starts with a nice example of a theoretical reflection on the relations between experiments, theory and models, in the context of enrichment of ecosystems (Jensen and Ginzburg). Then a set of original models are presented to illustrate the effects of structures on population dynamics and on communities composition (age/stage structure, Hunter and Caswell, Lebreton and Lopes et al.; spatial structure, Le Corff and Horwitz, Mistro et al. and Gaucel et al.), as well as the interaction between individuals and population levels (Zavala and Bravo de la Parra, and Lopes et al.). This issue is completed by a paper dealing with the comparison between two families of formalisms, IBM and PDE's models, for the same ecological problem, which concerns the effects of individual's behaviour on the population dynamics (Gómez Mourelo). Finally, a set of numerical methods for structured populations

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models are illustrated on various examples in the last paper (Abia et al.).

The Alcalá International Conferences on Mathematical Ecology would have never taken place without the extraordinary scientific and human support of our friend Ovide Arino. Ovide deceased on September 29, 2003, but will be alive forever in our memories.

List of papers

1. C.X.J. Jensen and L.R. Ginzburg, *Paradoxes or theoretical failures? The jury is still out*.
2. C. Hunter and H. Caswell, *The role of the vec-permutation matrix in multi-regional matrix population models*.
3. J.-D. Lebreton, *Age, stages, and the role of generation time in matrix models*.
4. C. Lopes, A.R.R. Péry, A. Chaumot and S. Charles, *Ecotoxicology and population dynamics: on the use of DEBtox models in a Leslie modelling approach*.
5. J. Le Corff and C.C. Horvitz, *Population growth vs. population spread of an ant-dispersed neotropical herb with a mixed reproductive strategy*.
6. D.C. Mistro, L.A.D. Rodrigues and A.B. Schmid, *A mathematical model for dispersal of a population of annual plants with seed bank*.
7. S. Gaucel, M. Langlais and D. Pontier, *Invading introduced species in insular heterogeneous environment*.
8. M.A. Zavala and R. Bravo de la Parra, *Scaling from leaf physiology to stand dynamics in Mediterranean forests: a mechanistic model for plant interactions in water limited environments*.
9. P. Gómez Mourelo, *From individual-based models to partial differential equations: an application to the upstream motion of elvers*.
10. L.M. Abia, O. Angulo and J.C. López-Marcos, *Age-structured population models and their numerical solution*.

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