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Nonlinear Analysis: Real World Applications 6 (2005) 591–592
Nonlinear Analysis
Real World Applications
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Editorial
Introduction to the Special Issue

This special issue of Journal of Nonlinear Analysis, Series B: Real World Applications is dedicated to the memory, scientific accomplishments, and leadership of the late Professor Ovide Arino.

The Second Alcala International Conference on Mathematical Ecology (AICME2) was held in the historic venue of Alcalá de Henares (Madrid), Spain on 5–9 September, 2003. The conference was organized by many with dynamic leadership provided by Rafa Bravo de la Parra and Ovide Arino. This issue covers a spectrum of papers presented at AICME2 that focused on modeling, analysis, and theory of dynamic populations. Many of the papers included in the issue are unified by the theme of model approaches that represent populations as individuals with traits (such as age, size, proliferation stage, etc.) that change over time and/or space.

The important, rapidly evolving area of individual-based models (IBMs) provides for representation of each member of the population as a discrete entity and to incorporate a number of individual traits but at the expense of computational complexity. Another more traditional approach that allows inclusion of individual variability is the state-structured approach. Here the states (usually age or size) are continuous independent variables and the population model equations represent densities of individuals in these states. On occasion, the age-structured model can be approximated by a system of equations with a discrete or continuous delay that might represent the length of a specific age interval, such as the age of the juvenile or the adult class.

The issue begins with one of the last works by Ovide Arino, done with Ovide's flare and his manner of instructive collaboration. It is illustrative of the mathematical side of Ovide's academic interests. The paper, authored by M'barek Adioui, O. Arino and N. El Saadi, establishes the biologically significant requirements (existence, uniqueness, and positivity) of an integro-differential advection–diffusion model of spatial aggregation of phytoplankton in the ocean.

This paper is followed by others that employ analytical approaches and addresses a wide variety of models of populations, competitive communities, and predator–prey systems. Vladas Skakauskas models a population structured by age and sex, and focuses on the role of parental care of offspring in population dynamics. The existence of separable solutions is studied for time-independent vital rates and macro-moments are derived for age-independent vital rates. The paper by Yasuhisa Saito and Yasuhiro Takeuchi develops

1468-1218/$ - see front matter
doi:10.1016/j.nonrwa.2004.12.008

a continuous model of a predator–prey system, where the predator population is structured into juvenile and adult cohorts by using a discrete delay parameter. They investigate the dynamics of a predator–prey system in which the prey consumes the predator's juveniles. Mostofa Adimy and coauthors consider stability and bifurcation of a dynamic model, a differential equation with delay, of a population of pluripotent stem cells, which are involved in the production of blood in the bone marrow. They show that a distributed delay representing cell cycle duration can destabilize the system. The analytical techniques section concludes with a paper by Jean-Luc Gouze and Gonzalo Robledo who address the important practical problem of the control of two species competition in a chemostat modeled by nonmonotone uptake functions. The authors generalize previous work on the topic and present sufficient conditions on the chemostat dilution rate that ensure the global asymptotic stability of a unique equilibrium species coexistence equilibrium.

The next grouping of papers addresses the immense diversity of research needs in the area of IBMs. Theoretical concerns such as those in the paper by David Cope, who addresses the question "What will be the effect on the population dynamics predicted by an IBM of using discrete classes to represent individuals rather than modeling individuals as unique entities?" are presented. Because of the complexity of the problems of IBMs, the majority of the analyses, by necessity, utilize simulations. Sami Souissi and his coauthors describe and illustrate a new simulation platform (Mobidyc) for studying IBMs that represent ecological systems in space and time. Their illustrative example presented is about *Eurytemorea affinis*, the dominant copepod in most estuaries in the Northern hemisphere. Tanya Kostova and Tina Carlsen employ a spatially explicit IBM simulation tool (SERDYCA) to investigate the role of the habitat on rodent dynamics. Their simulations suggest that inhomogeneities can increase the average time to extinction of the prairie vole.

These papers are followed by applications to problems in fisheries and agriculture. Kjartan Magnusson et al. simulate the spawning migrations of capelin in the North Atlantic by employing an advection–diffusion equation where advection is governed by environmental fields for temperature, food density, and oceanic currents. They also indicate a simpler model based on transition/migration matrices that produce similar results. Marta Ginovart et al. develop an IBM (INDISIM-SOM) representing microbial activity in soils. They consider the dynamics of carbon and nitrogen as it relates to soil organic matter and document the model-data agreement. Annemarie Breukers and coauthors compare state variable and IBM approaches to modeling the prevalence and dispersal of brown rot disease in the Dutch potato production chain. They conclude that the IBM is a convenient technique for policy application to a deleterious bacterial disease.

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