Generalised, parsimonious, individual-based computer models of ecological systems

by

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Signature____________________________________

Date________________________________________
I would like to express my deepest thanks and appreciation to the many people who provided me with help and encouragement during my research. These people include:

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DEDICATION

To my wife Robyn and my children Ben, Ian and Chesca.
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Abstract

Generalised, parsimonious, individual-based computer models of ecological systems

by William John Chivers

The original contribution of this thesis is to demonstrate the use of a generalised and parsimonious approach to building individual-based computer models of ecological systems with the objective of advancing our mechanistic understanding of these systems.

Two models are presented; the first, a model of predator-prey interaction, produces the expected non-linear dynamics and illustrates the importance of the timing of variable updating and individual variation for the persistence of the populations. This model is applied to two near-exclusive, cycling predator-prey systems, those of the Canadian lynx and snowshoe hare and the Fennoscandian mustelid predators and their microtine prey. The reproduction of the patterns found in the empirical data of these systems by the model suggests that the underlying mechanism of these predator-prey systems may be more simple than is suggested by other more complex models reported in the literature.

The second model describes a system similar to that of a grazing herbivore in a two-dimensional space. The emergence of complex behaviour resulting from the use of space in the model, including metapopulation-like local extinction and re-population and the effects of corridors and edge qualities on the species are demonstrated. The inclusion of a graphical display of the two-dimensional space in the computer interface to the model reveals important details of system behaviour not evident in the population means, including herding behaviour. The latter is dependent on herbivore mobility and the re-growth of resources in an heterogeneous environment, and emerges in the absence of social behaviour. The problem of detecting herding behaviour automatically is addressed, including the development of qualitative and quantitative definitions of herding in the model.
PUBLICATIONS FROM THIS RESEARCH

The research reported in this thesis has been published in the following fully-refereed journal articles:


The research reported in this thesis has been presented at the following refereed conferences:


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