

A STOCHASTIC MODEL OF THE ISLE ROYALE BIOME*

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ABSTRACT. A stochastic model employing an event-consequence technique is developed for a three-species interaction. If the system is in some state \mathbf{x}^1 at time t , the elapsed time to the next event is chosen by means of a Poisson distribution $\exp[-\tau \sum_{\mathbf{x}^2} g(\mathbf{x}^1, \mathbf{x}^2, t)]$. The type of event (birth, death, predation, etc.) is then chosen from the distribution: $g(\mathbf{x}^1, \mathbf{x}^2, t) / \sum_{\mathbf{x}^2} g(\mathbf{x}^1, \mathbf{x}^2, t)$ where g is some non-negative function. Thus the classical system of differential equations is replaced by a set of transition probabilities $P_{t, t+\delta t}(\mathbf{x}^1 \rightarrow \mathbf{x}^2) = g(\mathbf{x}^1, \mathbf{x}^2, t)\delta t + o(\delta t)$. The set of states and transition probabilities incorporates the age structure of the three species (17 for the moose, 9 for the wolf, 1 for the plant). This discrete space-continuous time model is applied to the data from the Isle Royale National Park studies of Allen, Mech, etc. An estimate of the predictive ability of this simulation is made after considering the statistical uncertainty of the model and the model's goodness of fit.

A code, called BIOTAI, exists in Fortran, which will process a general n -species stochastic model.

1. **Introduction.** The purpose is to develop a Monte Carlo simulation of population interactions in a biome to provide a close fit to existing real data, as well as provide a rational basis for quantitative predictions.

Hopefully with the development of better simulations the effects of human decision and reactions on the biome can be made more beneficial.

A realistic model leads to a better understanding and hence assessment of methods of chemical and biological manipulation of a biome.

A simulation of a 3-species interaction of the type where X preys on Y which feeds on Z with on further interaction is described. There are a total of 27 age groups. The introduction of further species into the simulation is possible. Perhaps, the introduction of additional parameters and species would be desirable. In the present paper as with the Dixon-Cornwell paper [4] the application is the 3-species system of Isle Royale, where moose are the only large herbivore, wolves the only large predator and birch, aspen, aquatic plants, etc., comprise the third category (plants).

The model developed in this paper is used to simulate the 3-species

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