Differential Equation Article Review

Joel Aguirre

May 21, 1999

Abstract

This is a review of an article that uses a system of differential equations for mite predator-prey interaction modeling.

1. Introduction

This paper will review the system of equations used to model population. I will begin by presenting the system, explaining its application, and defining the variables.

2. The System

$$\begin{aligned} \frac{dH}{dt} &= r_1 H\left(1-\frac{H}{k}\right)-\frac{aPH}{H+b} \\ \frac{dP}{dt} &= \rho\frac{PH}{H+b}-\alpha P-\beta P^2, t>0 \end{aligned}$$

3. Applications

Pest predator-prey models are mainly used in agriculture. In this particular case, the authors examined spider mite populations in orchards. This system is particularly interesting because it is capable of exhibiting multiple stable states. According to the authors, there are many real ecosystems that possess multiple stable states, and studying mathematical models that exhibits this behavior can lead to insights about threshold and breakpoint behavior. This means that the system

is potentially capable of modeling population explosions and crashes as well as stable predator-prey relationships.

4. Variables

H = Prey density.
P = Predator density.
t = Time.
r_1 = Intrinsic growth rate of the prey.
ρ = Conversion efficiencey of the predator.
a = Maximum number of prey that can be eaten per predator per unit of time assuming unlimeted prey population.
b = Prey density need to achieve one half a.
K = Environmental carrying capacity for prey, where $K > b$.
α = Preditor per capita death rate.
β = Preditor competition for nonprey resources.

5. Conclusion

I found John B. Collings and David J. Wollkind's article, interesting. In there article, they go on to show the derivation of the model, give examples of different scenarios, and explain how temperature can be incorporated into this model. I hope that reading this review will motivate you to seek out this article.

6. Work Cited

Collings, John B., and Wollkind, David J. "A Global Analysis of a Temperature-Dependent Model System for a Mite Predator-Prey interaction." *Society for the Industrial and Applied Mathematics. 50.5(1990): 1348-72.*