

A Deterministic Model of Predator-Prey-Parasite Interaction in the Northeastern United States

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Abstract

Occurrences of Lyme Disease have drastically increased since the advent of the disease in the 1970s. Currently much research focuses on controlling Lyme through ticks, the vector for the disease. Ticks feed on White Tailed Deer which have recently reached surprisingly high numbers in the Northeast. It is thought that reducing deer populations will effectively decrease tick populations and thus the threat of Lyme. Consequently many towns have considered or begun implementing ambitious deer culling programs.

Coyotes have recently migrated into the Northeast from the the Plains. It is thought that coyotes, who prey on deer, may have been attracted by the abundant prey supply. It is questioned whether the coyotes will act to replace the wolf as a natural control on deer population. We constructed a deterministic model to represent the current deer and coyote population dynamics and used this model to investigate the longterm interaction of coyotes and deer. Further, we explored the potential for coyotes to act as a biological control on the deer populations and aid deer culling programs. The model and predictions for both populations were checked against estimates found in the literature and it was found that significant human intervention would be needed to successfully control deer. Numerical simulations of the model and possible culling programs are provided to help highlight the system dynamics and guide culling policies.