The Effect of Evolution on Predator Prey RelationshipsSenior Research Project Computer Systems Lab 2009-2010

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Abstract

Simple predation prey simulations greatly simplify the problem by holding multiple variables constant, such as camouflage, predator vision, prey sensory, and other characteristics specifically attributed to the organisms involved. This project will consider prey and predator senses, as well as seasonal changes in the simulation and find the starting values that create a stable, oscillating ecosystem. It is concluded that those organisms more suited to the environment and climate changes will survive and pass its genetics to its children. However, both the prey and predator will evolve, canceling out the other's positive characteristics. Therefore the initial variables that establish a stable system in a non climate-changing system should in general apply to a similar climate-changing system.

Keywords: Predator Prey, Ecology, Agent Based Modeling

1 Introduction

This project involves writing a program that models a single predator, single prey system, where both the prey and the predator depend on a food source to survive. When reproducing, the new organism born will have a mix of attributes from both parents. Parents with strong characteristics will survive longer and reproduce more, creating even stronger children. This survival of the fittest system will somewhat affect the long-run distribution of the population, but what will be tested is how much the population will differ in the future when compared to a population that did not undergo climate changes or evolution.

2 Background

Two more complicated characteristics of the prey and predator are the Allee effect for the prey and prey choice for the predator. The Allee effect suggests that for smaller populations of prey, reproduction and chance of

survival both decrease. This effect disappears as population size increases. There are two models to predict the food of predators. These assume that prey size and prey abundance are the only availability factors of importance to predators. One model suggests that the predator consumes prey as they are encountered, and the other assumes that predators feed to maximize energy intake. These, along with other general characteristics will have to be considered when writing the program and analyzing results.

3 Development

Basic permanent characteristics of the predator include vision, color, life-expectancy, and metabolism. Characteristics that will change while it is alive include stealth, weight, and size. Each prey will have a permanent hearing, color, life-expectancy, and metabolism, while characteristics that can change are agility, weight and size. All organisms will have a set mate per year to reproduce with. The characteristics of the newborns are determined by choosing a random value between those of the parents. The environment currently consists of a meadow with constantly growing food in each patch, although trees and shrubs may be added in the future. Season changes are tracked, allowing for spring rains, summer heat, winter snow, and autumn leaves that serve better for some organism characteristics as opposed to others. In every step, each organism currently moves to a random spot in the 9 by 9 grid that surrounds it, checks for a possible reproduction chance, and then gathers or hunts for food.

4 Tests or Analysis

5 Expected Results

I expect to find that because both the prey and predator evolve, mild climate changes will not have an effect on the overall system, maintaining an oscillating graph like the one shown in figure 1. However, both species will have stronger characteristics on average to survive than what they started with because the weakest links die out without reproducing. It is only when one organism does not have the capability to evolve to become suited in the environment that the other will become dominant.

6 Discussion

7 Bibliography

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8 Appendices

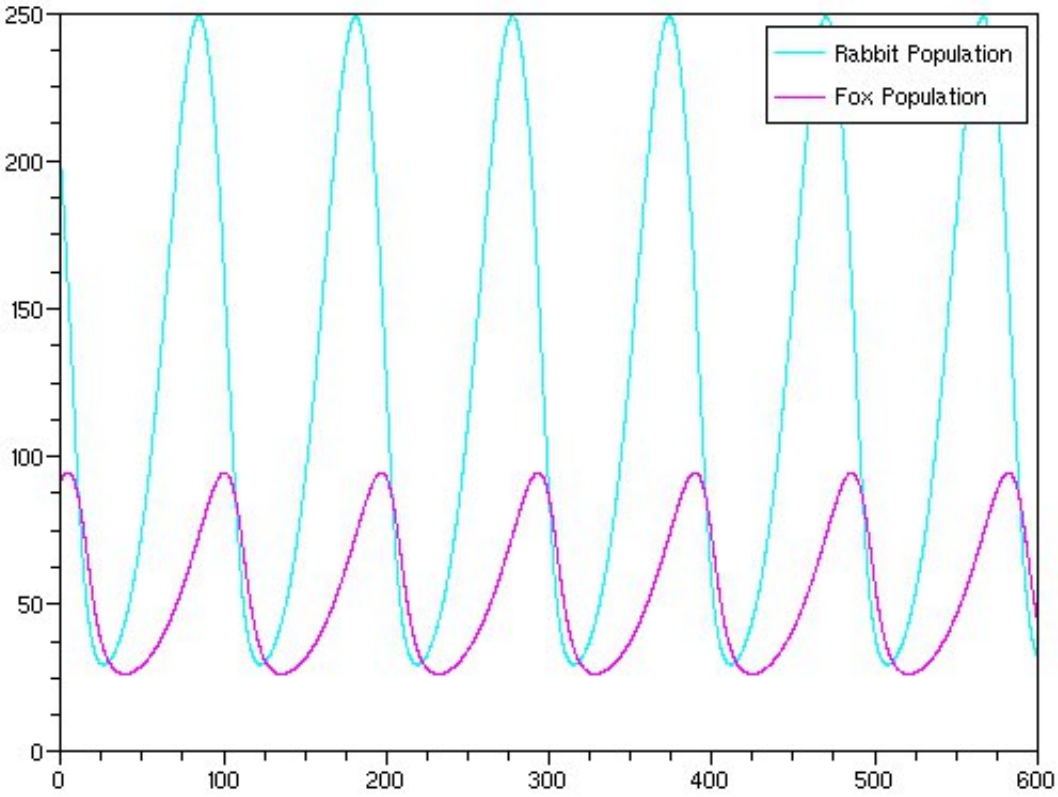

Figure 1: Expected Results with Evolution Incorporated