Dynamic Complex Ecosystem Simulation / Modeling

Bill Yu
Computer Systems Lab 2009-2010

Abstract

Ecosystems are based on the multiple interactions between the many parts of a whole. In order to effectively evaluate changes on an ecosystem and to evaluate individual objects in an ecosystem, the ecosystem must be examined as a whole. This requires many species and many interactions and many variables - too many to be done by simple equations or algorithms. The ecosystem must be run/simulated in order to be modeled by a computer. Major inside changes in an ecosystem include evolution, adaptation, population fluctuation - chance events that effect the existing population, based on the existing ecosystem. On the other hand, major outside changes to an ecosystem include natural disasters, invasive species, new species - chance events that do not come from the existing population that do effect the ecosystem. How will these events effect an ecosystem?

Background and Introduction

The purpose of my research project is to create a simulation of a many-species, non-static, many-variable ecosystem. According to user preferences, many desired ecosystem simulations will be able to be run. This means that the simulation will include hypothetical situations, which will be applicable to real-life, but not necessarily a real-world model. This simulation will use a chance-based predator/prey ecosystem (for predation rates), reproduction algorithms for evolution, adaptation algorithms, trait accumulation, new species, and natural disasters. This will first be done in NetLogo to facilitate display/debugging/testing, then will be moved into Python for a more applicable and general programming language.

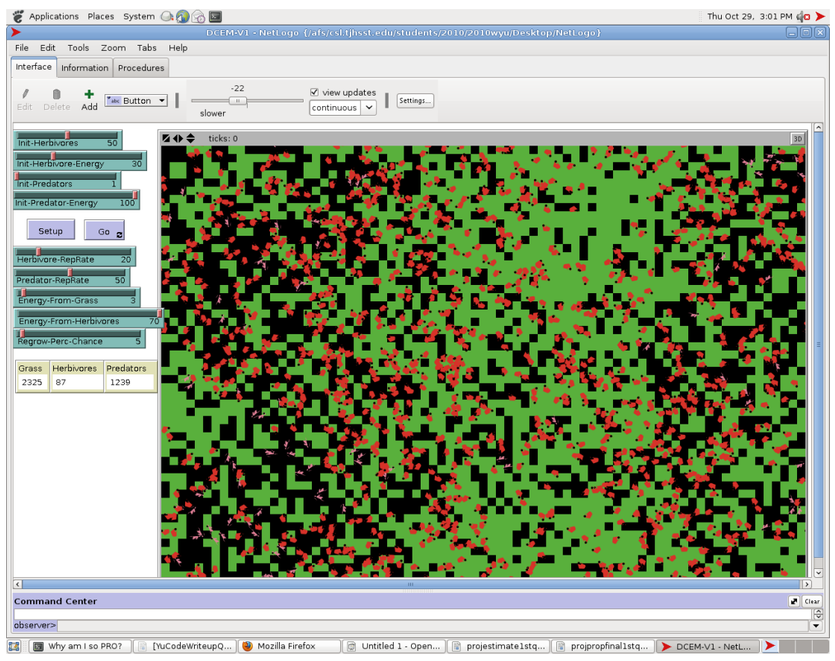

Fig. 1
Invasive
Species Effect

Discussion

In order for my program to achieve its working goals, it must implement at least a base set of variables that can be manipulated to the user's needs. The most basic of all my variables will be species - there will be producers, consumers, omnivores, etc. Ideally, it will be able to control the number of these species to a certain degree (5 species is the desired amount) and also control the populations. Next, expansion will occur by introducing a trait factor for each of thespecies. According to the theory of natural selection, this will (like a real-world ecosystem) continually improve the existing populations because those with unfavorable traits would become nonexistent. The trait passing algorithm will be based upon the Punnett square (a simple matrix). Next, a factor for species mutation and new species invasion or creation will implemented. This will be created by a random chance for the program to take a number of ghost classes and change them in accordance to the new species or mutated species. Last but not least, various natural disasters will be implemented, along with population characteristics. Natural disasters are the catastrophic events that effect the ecosystem, and the characterstics of the different species will mean that different natural disasters affect each species differently.

Results and Conclusions

The expected behavior / results of my simulation will probably be indicative of the normal standards of population behavior, when certain stresses or variables are predominant (for example, the theory of natural selection).

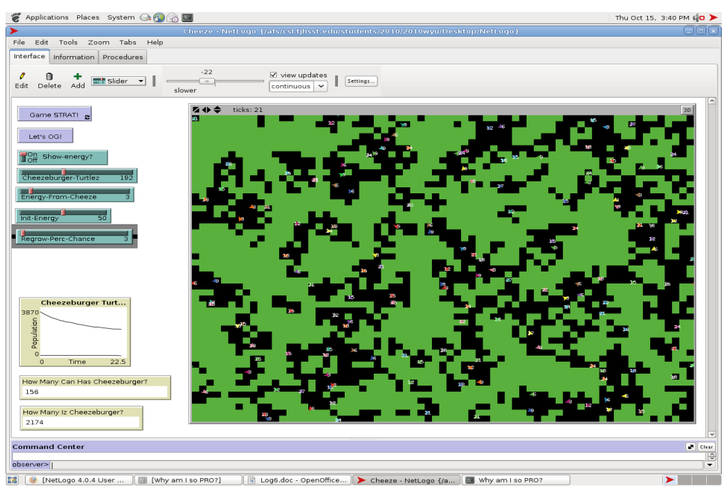

Fig. 2
Earlier Version,
Less Species