Dynamic Complex Dinosaur Ecosystem Simulation

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Abstract

Ecosystems are based on the multiple interactions between the individual parts (the species and environment) coming together as a whole. Thus, in order to effectively evaluate changes on an ecosystem and to evaluate the end product of 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 small algorithms. The ecosystem must be run/simulated in order to be modeled by a computer. Major inside population 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 a dinosaur ecosystem set in the late Cretaceous Period? What can the applications be of such a simulation?

Background and Introduction

The purpose of my research project is to create a simulation of a many-species, non-static, many-variable ecosystem based on the dinosaurs. 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, and a real-world model. There are many applications such as recreating events involved with dinosaur-based research such as palentology. Other applications include dinosaur research and drawing conclusions based upon these simulations. 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 possibly be moved into Python for a more applicable and general programming language.

Procedure

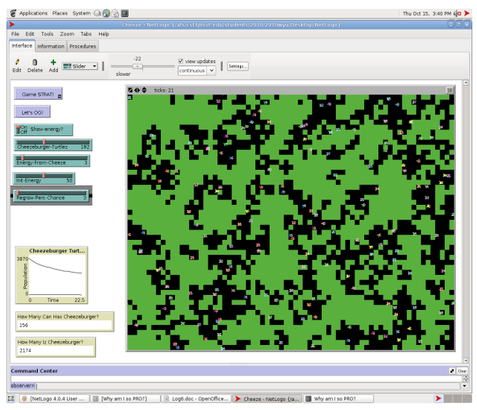
Using NetLogo, which will likely be turned into Python given time, I will be programming from the bottom, and expanding on the simple variables in order to create more complex variables. Eventually, there will be a complex dynamic ecosystem with a large amount of variables for optimum user control and definition of the ecosystem. At the end, the program (NetLogo) will be able to store data in a spreadsheet using the BehaviorSpace method. Currently, operating the simulation is as simple as sliding bars to provide integer values for inputs (dynamic variables), then setting up and running using the appropriate buttons. Next, I will evaluate the resulting data in comparison to conventional ecosystem behavior.

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 (5-10 species is the desired amount) and also control the populations. Next, expansion will occur by introducing a trait factor for each of the species. According to the theory of natural selection, this will be like a real-world ecosystem and 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) and a survivability factor. In addition, 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 or conventional ecosystems today, when certain stresses or variables are predominant (for example, the theory of natural selection). The simulation should run reasonably given its inputs and the characteristics known about the various species of dinosaurs.



An earlier version of the project with a simple ecosystem focus. The 'turtle' objects are a predator and a herbivore. Black patches signify empty grass lots.

A later version of the project with a focus on late Cretaceous dinosaur simulation. 2 of 4 species are displayed.