Population Dynamics Using Multi Agent Modeling

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2005-2006
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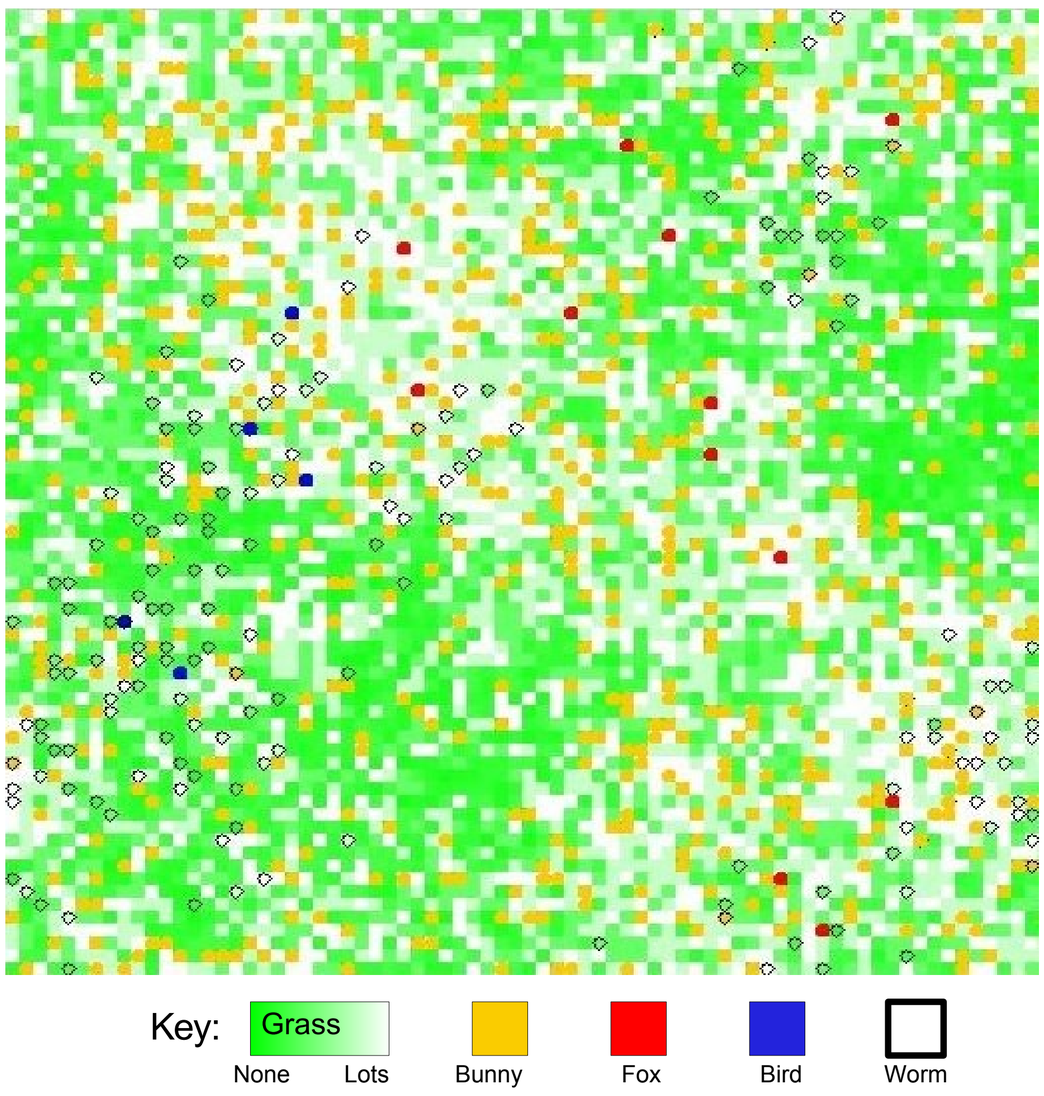
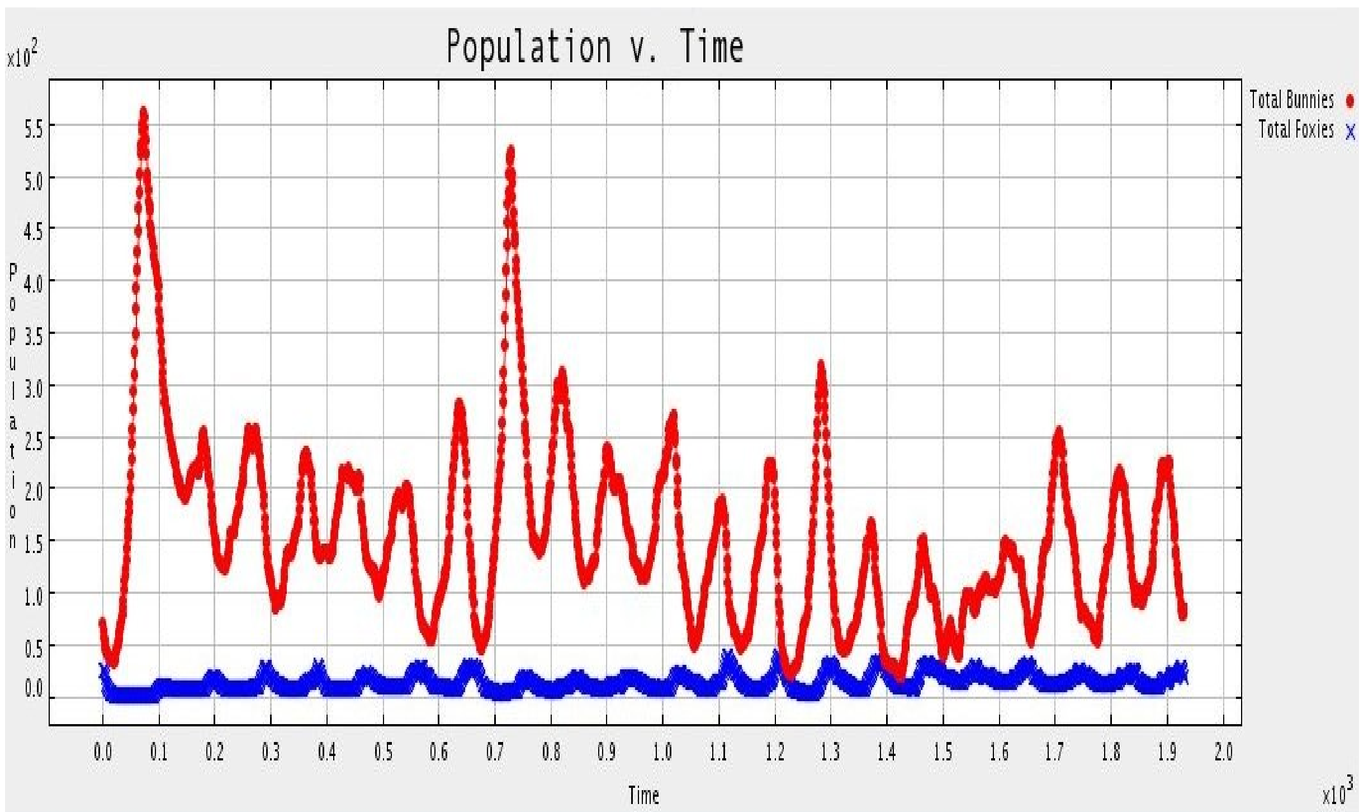
Most populations are modeled with a series of equations based on gathered data. In a stable, unchanging environment, populations usually experience periodic population growth and decay. This model seeks to model that same situation, but using multi agent modeling as opposed to equation based modeling. Multi agent modeling creates a simulation of the environment, with a "grass" unit that grows, "bunny" agents that eat the grass, and "fox" agents that eat the bunny. Each agent is programmed with a certain set of functions similar to the animals they are based on. They can move around, hunt, eat, and reproduce. There is a maximum number of agents that can fit in a given unit of the model. The characteristics of the agents (total population, reproduction rate, metabolism, vision, etc.) were tracked throughout each trial as a basis for comparison to the traditional models.

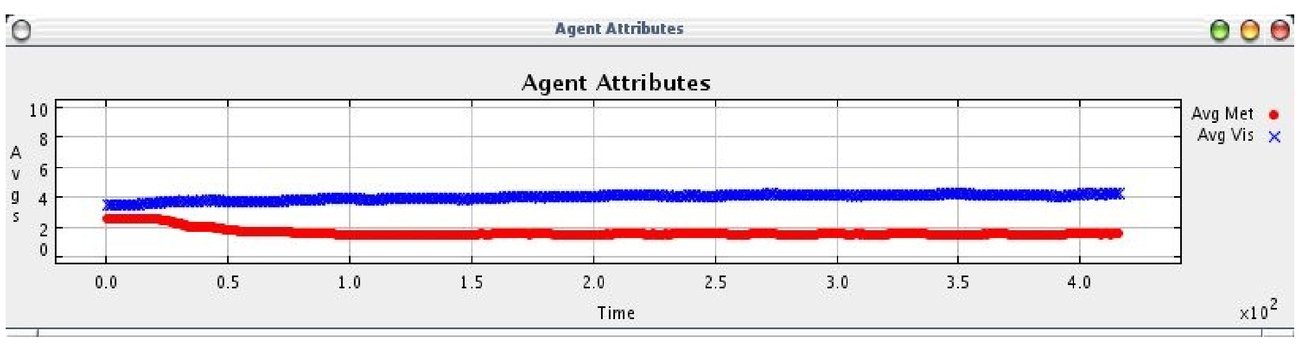


Results



The multi agent model managed to replicate the general pattern predicted for predator prey population. The model did not precisely mimic the predicted pattern, as the multi agent model allows for some randomness. The model can simulate the population dynamics of the species for many generations, and provide for their long term stability. The model also tracks the population's characteristics, such as average life span, maturity age, vision, metabolism, and birthrate, as well as the capability to find any of these traits for any one age group, such as the birth rate of only mature agents, or the metabolism of all newborn agents.

In addition to replicating the general pattern, the multi agent model successfully tracked several characteristics of the populations of agents. Below, you can see that in the single agent model, the agents adapted to their environment by increasing their field of vision and decreasing their metabolism over time.



Methodology

This project was programmed in Java based Repast. The shell of the program was taken from the open source model of a sugarscape environment. From there, the methods of the agents were modified to exhibit different behaviors of the agents, depending on the type of agent. Additional traits, such as birthrates, life expectancies, and maturity ages were added to each agent. The agents move and eat methods were modified to reflect their real life counterparts. The Space class (the class that contains environmental features) was modified to hold several agents at once, and to keep track of different types of resources.