Simulation of Evolutionary Role of Predation

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Abstract

In this experiment we have simulated the predator - prey relationship using a computer simulation software called NetLogo 3.1.4 and studied some aspects of prey evolution.

0.1 Introduction:

If looked upon naively, predation seems to only have a detrimental effect on the prey population. It's true that predation leads to decline in prey population size, but predation plays an important role in evolution too. Co-evolution of predator and prey is an important aspect of predation. The organism preyed upon continuosly evolves strategies for predation avoidance but the predator co-evolves to strike back. In this work we have simulated the predator prey relationship using the module Bug Hunt Speed[1] from a Java based software named NetLogo 3.1.4. However this module had some inherent inconsistencies which has been discussed later on.

0.2 Experimental Work:

Using the Bug Hunt Speed[1] module from NetLogo 3.1.4 we simulated an ecosystem consisting of "bugs" running around with different speeds and the user being a part of the ecosystem as a predator hunting down the "bugs". Different predation strategies were used to nab the bugs. The decisive trait of the bugs which determined their predation rate was their speed. However the coloration of the bugs was correlated with their speeds. So by looking at their coloration the predator can determine whether it is slow or fast moving. Different predation strategies led to differential shifts in the frequency distribution of the speed of the bugs, indicating evolution of the prey. However the evolution of the predator was somewhat arbitrary, represented by the gradual changes in the predation strategies to hunt more bugs efficiently. The predator was not truely evolving in the biological sense of the term, only its predation strategies were changing with time. The following strategies were used for predation:

1. Predator stays static and waits for the prey to come near it.

2. Predator runs around randomly and kills any prey it manages to get hold of.

3. Predator moves uniformly in a fixed circle and eats any prey it encounters in it's path.

4. Predator selectively catches only the slow moving ones.

5. Predator selectively avoids bugs of a particular color.

0.3 Results:

0.3.1 Limitations.

As stated earlier the Bug Hunt Speed module had too many bugs (not the prey bugs!) in the program which imposed certain limitations on our results. They have been enlisted below:

1. The bugs of a particular speed though extinct, was still shown as being caught continuously.

2. The bugs were moving in perfect straight lines, so it was very easy to predict their motion.

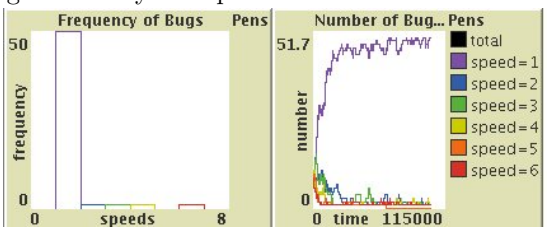
3. There was no mutations to replenish bugs of a particular speed once they are extinct.

0.3.2 Results and Inferences:

The prey responded to different predation strategies by shifts in the frequency distribution of their speeds.

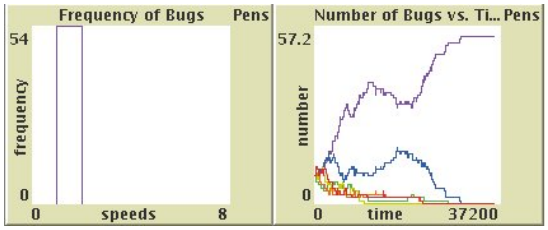
0.3.2.1 Predator remains static:

In this case it was found that the faster moving bugs were encountering the predator more often than slow moving bugs. This led to survival of bugs with only low speeds after some time.



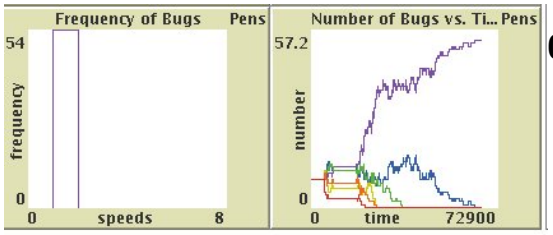
0.3.2.2 Predator runs randomly:

The effect was same as in the previous case. The faster bugs were being finished off.



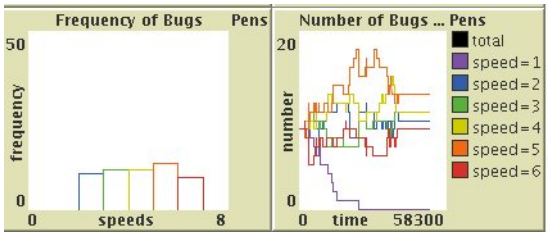
0.3.2.3 Predator moves uniformly in a fixed circle:

This strategy too had the same effect as before.



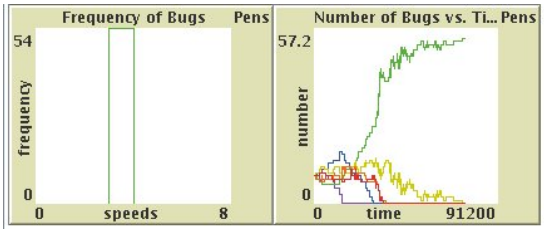
0.3.2.4 Predator selectively hunts down slow ones:

In this case the slower moving bugs were selected against, leading to the following frequency distribution.



0.3.2.5 Predator selectively avoids bugs of a certain color:

Since the colors are corelated with speed of the bugs, it is possible for the predator to determine the speed of a bug by it's color. In this case the predator avoided green bugs which had medium velocities. The result was selection in favour of green bugs.



0.4 Acknowledgments:

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0.5 References:

1. Wilensky, U. (2005). NetLogo Bug Hunt Speeds model.; http://ccl.northwestern.edu/netlogo/models/BugHuntSpeeds.; Center for Connected Learning and Computer-Based Modeling,; Northwestern University, Evanston, IL.