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Extinction 2: A Game That Examines Important Concepts in Evolutionary Ecology

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We have developed an on-line version of Extinction, a board game initially designed by Dr. Steven Hubbell, and most popular among our instructors and students. In Extinction 2, species battle to survive on the island of Darwinia. Darwinia is divided into several habitats. Any species can migrate into and reproduce in optimal habitats, and compete with or predate on neighboring species. That is if they are dealt the proper "genetic profile" to do so. A variety of important ecological and evolutionary topics are covered as students apply what they have learned to explain why their species succeeded or failed.

Keywords: on line game, species compete and prey, species with different mobilities and reproductive rates

Link to Original Poster:http://www.ableweb.org/volumes/vol-33/poster?art=49

Introduction

The board game "Extinction" was developed by Stephen Hubbell and for a while distributed by Carolina Biological. We used the game in our introductory courses for science and non-science majors. It was such a popular laboratory exercise, we were repairing spinners, replacing dice, and making our own environmental disaster cards, until the boards started to crack and we had to retire the game. We have developed an Internet version, which we call Extinction 2. It tries to capture as much of the flavor of the board game as possible.

Information for Students

In the game, the species with the largest number of individuals after a set time (determined by instructor), or the only species left on the island, wins. Each player in turn chooses whether his/her species competes or predates neighboring species. Each player may also choose for his/her species to migrate or mutate instead. Mutation allows a species that has been dealt a less than desirable profile at the beginning of the game to change genes. However, which genes or characteristics will be changed cannot be predicted, so a species' profile may not profit by mutation.

At the start of the game, each species is assigned a profile that dictates what type of predator it is and what type of predator it is protected from. The profile also specifies in which type of habitat a species can reproduce, its reproductive rate, mobility (for migration) and even its environmental tolerances. For example, some species may be fire tolerant. The game will also assign starting population numbers and locations for the different competing species found on the island of Darwinia.

There are also some parameters that can be set by an instructor. Instructors can vary the number of species (three or four) that are found on the island, whether species reproduce automatically and the number of choices available to a species during a round of play.

Navigation

Making a move, red starts the game. To compete or prey on a neighbor, click on a habitat containing your species and then move the cursor to a neighboring square or habitat containing another species. A line will be drawn between the two competing populations. If you plan to compete you will have to type a number in the new square. Competition goes to the species with the most numbers, so the number typed has to be one more than the number in that square at present. One predator can eat many prey so the game will automatically move one of your species, should predation prove successful, to the new habitat square.

To *migrate* divide your mobility by the number of squares and individuals you want to move. For example if my mobility is 20, I can move one individual 20 squares, 2 individuals 10 squares, 4 individual 5 squares, etc. It is a good idea to migrate if most of your species is found in non- optimal populations were no breeding can take place.

Mutation is a risky move, as you cannot predict the outcome. One (usually) or more (infrequently) aspects of your profile will be changed. However, the changes may or may not increase your numbers. You may lose the predator protection that is keeping a neighboring species from wiping out your populations. If, however, you have no mobility and are in habitats where you can't breed, it is probably a good idea to change genes and hope your mobility changes.

Reproduction can occur automatically and some species will reproduce every round and other every second or third round. The game will announce each time that you reproduce and keep count of the current number of your species. Your instructor may choose to let each player decide when its species reproduces. If that is the case, you may choose to reproduce, migrate or mutate every round and reproduction will appear as a choice in the menu below migrate. In either case, the number of individuals added by reproduction is determined by the number of your species in squares where they can reproduce x the species reproduction rate. Note that the maximum population of a habitat is 9, so if reproduction

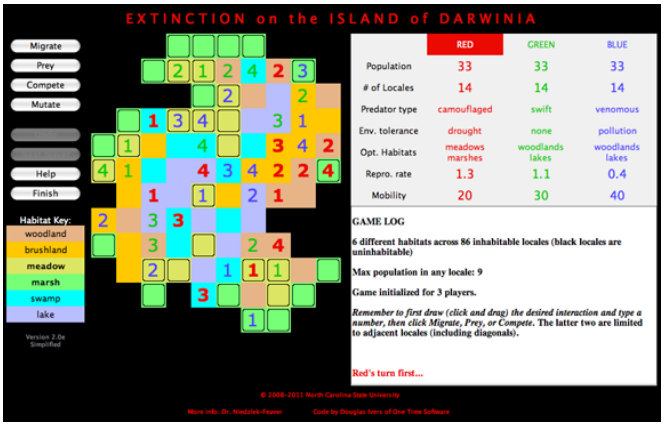

Figure 1. The applet places species in various habitats and assigns profiles at game's start

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produces a number larger than 9 in all optimal habitats, the excess young will perish.

As in any ecosystem, *environmental change* sometimes occurs. When this happens, the game will announce the type of disaster and how many of your numbers, if any, have been killed. Note that, as in the real world, larger populations are at greater risk. So you can minimize your losses by keeping the populations of each square small and spreading your individuals over a large number of squares.

Help and undo buttons are self explanatory, but do not press the finish button until the game is over (or you wish to stop playing). When the button is pressed, a certificate appears at the bottom of the log to verify that you have completed at least X rounds (default is 7, but an instructor can change this number) of the game. At this point, you may wish to review the log before closing Extinction. Try to determine which moves caused your species numbers to increase or decrease. Was it your superior predatory skills that determined your success or was it those pesky neighbors with better reproductive rates that did you in?

Notes for the Instructor

For a copy of the game, please contact **mnfeaver@nscu.edu** for download instructions. Game will be downloaded as an OER zip file, containing instructions, and the html file and java applet that constitutes the game.

The game will come with several html files and one java applet. The html file used determines which "version" of the game an instructor may wish to use. For example, in one version a player has to choose whether its species migrates or competes or predates or mutates at each turn. In other versions, each player can make two choices for his or her species, before choosing to relinquish a turn to another player, compete or predate, and mutate or reproduce or migrate. In the latter version, each species also has control over when it reproduces, although it must choose to reproduce or migrate or change genes each round of play.

For those that wish, instructions are also provided that inform instructors how to change several parameters in the html code, essentially converting one version into another. We also give permission to the more adventurous to modify the java applet as desired for education purposes. Extinction 2 also may be distributed as desired for educational use. We ask only that you acknowledge NCSU's contribution to your work and keep us informed with regard to any successful modifications that would benefit other educators (mnfeaver@ncsu.edu). As with any software product, North Carolina State, the programmer or the authors cannot be responsible for any damages occurring from the code as delivered to or modified by the user.

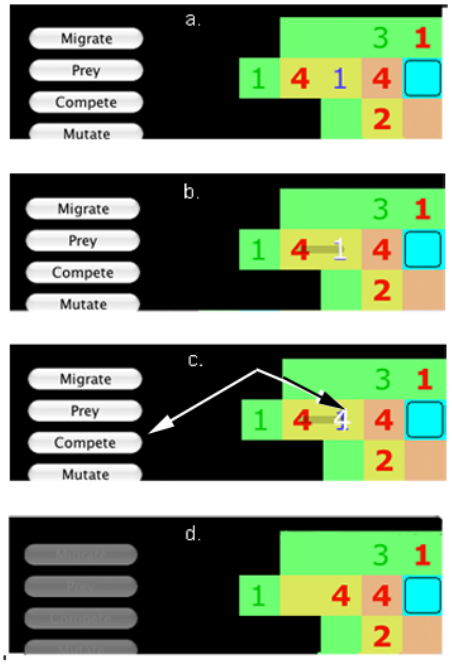

Figure 2. A move. a. A segment of the board before species red competed with species blue. b. A player initiated competition by clicking on the red population that will compete with its neighbor. The cursor was then dragged to the habitat of the population to be challenged. c. To be successful in competition, the species attempting to compete must have and move greater numbers into the new habitat than at present found there. A four was typed indicating that four red individuals will move into the habitat containing one blue resident, and before the player clicked on compete. d. Changes that occur in numbers and locations after competition.

We have used the game in the classroom and our distance courses. We tell our distance students to concentrate in a three species game on one species and let the others just migrate to new habitats their rounds. Surprisingly this does not always ensure as expected the success of the chosen species. Those environmental disasters that target large populations will sometimes bring decrease population numbers in a chosen species just before students are told to finish a game. Or despite repeated attempts to change genes, the chosen species continues to be characterized by very low mobility or reproductive rate throughout the game.

You can customize the experience for your students by asking them all to mutate or migrate in a certain round and then analyze the effects of these moves on their and other species. This game can be used to have students review and apply concepts several important evolutionary concepts by questions students must answer as homework or in discussion at the end of class. Below are questions we have used in our distance and classroom courses.

Sample Questions

Write a short essay that answers the following questions:

1. Based on the profile of your species, what animal (plant) might it have been at the beginning of the game? What animal (plant) might it have mutated into after _ (depends on how many rounds you wish them to play) rounds? Could any species be considered a k-selected or r-selected species? Could any species be used as an example of the problem with this concept? Explain your answers.
2. After mutation, did your species do better or worse? What new characteristic had the most effect, negative or positive, on its success during the last _ (instructors choice) rounds? Explain your answer.
3. Think about how your species performed during the game. If you won the game, what strategy worked best to increase the numbers of your species? If you lost, what went wrong? What aspects of the game do you think are the most realistic and most unrealistic compared to real ecosystems?

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About the Authors

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