The Ecology Game

Islands have always provided scientists unique locations to learn about the natural world. Many of Charles Darwin’s key observations that led to his understanding of natural selection came from species living on the many islands that make up the Galapagos archipelago. For example, Darwin observed different species of finches were found on different islands and that the shape of the finches’ beaks corresponded to the type of food they consumed. Further research on the finches of the Galapagos by Drs. Peter and Rosemary Grant found that even within an island, changes in environmental conditions (i.e. drought, disease) could influence the adaptations observed in the finches.

Because islands are isolated from the mainland and each other by water and often long distances, they can be colonized by new species that have intentionally or unintentionally dispersed to an island. In biology, we call this the founder effect which is when a new population is established. A founding population is often small and has a different allele frequency than the original population. It is important to remember that every species that finds itself in a new habitat may not be ideally suited for the environmental conditions. Is the habitat, food, climate appropriate for the new species needs? Is there competition for any of these resources with species already living on the island? Large islands that are close to the mainland tend to support more species than small islands that are far from the mainland. As we discuss in class, we know that no two species can occupy the same ecological niche – basically two species cannot co-exist if they are competing for the same resource. While niches can overlap significantly between two species, they cannot be exactly alike. Any habitat has a limited number of species that can be supported by the available resources. We know that the most successful species are those with adaptations best suited to the environment in which they find themselves and those that can best utilize the available resources. These individuals are able to survive and reproduce on the island and a new population is established there. Occasionally, if there is a mismatch in the individual’s traits and the environment in which they are located or the environmental conditions change unfavorably the individual may no longer succeed in that environment. This can lead to local extinction which is also known as extirpation. An extirpated species can recolonize if environmental conditions become favorable.
Today, you will be playing the role of an individual of one of six different species on an ancient continent to the East in a game we call the Ecology Game. The object of the game is to cross the ocean, colonizing islands as you go; however, every species in the game has its own ecological needs and each island along the way has specific environmental conditions and the ability to support different numbers of species. If you are a successful colonizer, a population of your species will exist on the island even after you have moved on. Please note that in order to colonize and establish a new population in real life you would need a sexually mature male and female or a pregnant female; however, in this game we are simplifying this concept by using a model of a single individual. Every species will not be able to colonize every island successfully and you have to compete with the other species who are also trying to make it to the new continent. The islands are of varying sizes and a successful colonization may cover a small area or a large area depending on the size of the island. The winner is determined by a combination of the order that you reach the new continent and the island area (not how many islands, but how much island space) you have successfully colonized. Remember to think strategically! The Ecology Game is not always about speed, but thinking about your species, its ecological niche, and what we know about colonization and adaptation. Just because you are the first species to reach the new continent that does not mean you win the game. Think of today like an ecological game of chess!

Set up (per group – groups should have no more than 6 students)

- 1 board map
- 2 six-sided dice
- 1 cup of 6 species sticks
- 4 bags of colored game pieces (if groups are larger than 4 and additional game pieces are required use coins or see Manal for additional colored pieces)
- 6 species cards
- 24 island cards
- Environmental factor cards

To Begin

1. Each person in the group should draw a species stick out of the cup. You will play the role of an individual of this species for the entire game.
2. Read the associated species card. This will tell you about your ecological niche and any movement limitations you will have in the game.
3. Each player can place their colored game piece at any location on the mainland to start the game.
4. Roll the dice. The player with the highest roll will go first and play will move counterclockwise around the group.
To Play

1. Player 1 will roll both die. The sum of the numbers shown on the roll indicate how many squares the player can move. *You cannot move diagonally, but you can move vertically and horizontally and you can move forwards or backwards. Some species have limitations on the maximum number of moves they can make. If your roll exceeds the maximum number of moves for your species, you must stop at your maximum number. Every species can stop in the ocean. *

2. With each roll, player 1 will also draw an environmental factor card which may influence your movement along the way. This card may affect all players, a subset of players, or just the player drawing the card.

3. If you land on any part of an island, choose the island card and determine if your species can successfully colonize the island. If so, fill that player’s name/species name in the appropriate slot on the card (remember, some islands can only hold a few species) and place a colored game piece on the island to indicate that it has been colonized by you. *On the next turn, a species on an island can leave from any part of the island. *

4. Play continues in a counterclockwise fashion.

5. The game is complete for an individual species when they have reached the new continent. At this point, they no longer roll the dice and are no longer affected by environmental factor cards.

6. Play continues until all species have reached the new continent.

7. Calculate the winners using the formulas below.

Who Won?

- Each player’s score is determined by adding up the total area your species covered (including bonuses) and dividing by your finish place modifier.
  - 1st place = 1
  - 2nd place = 1.5
  - 3rd place = 2
  - 4th place = 2.5
- For example: If my species covers 144 units of land and I had a bonus of 25 units of land for a total of 169 and I came in second place My score = 122.7
  - (144 units covered + 25 bonus units) / 1.5 (finish place modifier) = 122.7 (final score)
Questions

1. What did the game clear up for you that you might not have understood fully about ecology and evolution?

2. Movement from the mainland to an island or from one island to another island represents what force that can cause a population to evolve?

3. If once your species has colonized an island and remains there and also becomes isolated from other populations over time, what possible outcome might occur given the passage of enough time?

4. When an island has multiple habitat types what does this say about the island’s ability to support populations of different species?
5. How suitable are small islands to support multiple species? Explain your answer.

6. Once colonizing an island, a species may thrive or fail there. Describe how a species can either thrive or fail using terms and ideas from lecture. To help you answer the question, draw how a population’s size will change over time if the species is K-selected.

Figure 1 is adapted from Wikimedia Commons material and this lab is licensed under a Creative Commons Attribution License (3.0).