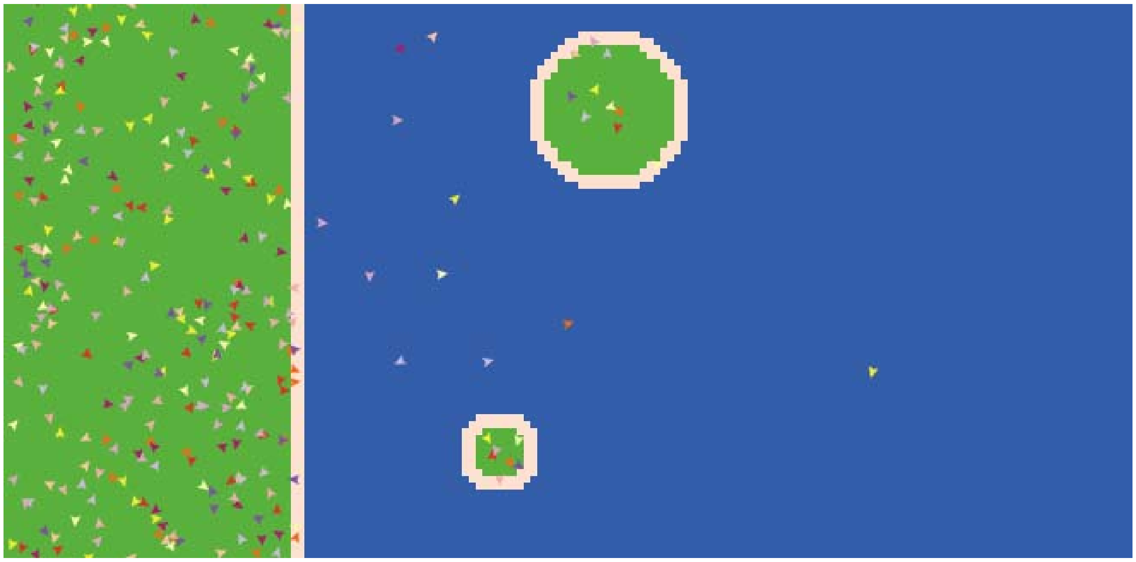
ISLAND BIOGEOGRAPHY EQUILIBRIUM



Model available at: **http://faculty.etsu.edu/jonestc/EducationalResources.htm**

INTRODUCTION

In conservation biology, islands are of particular concern because they have unusually high rates of extinction. Famous examples are the dodo bird of Mauritius, or many species of honey creepers (birds) in Hawaii. In general, islands have smaller populations and lower genetic diversity than the mainland (Frankham 1997), which makes them more prone to extinction. Islands are more susceptible to natural disturbance (e.g. hurricanes), but human activity has contributed by far to island extinction. Introduction of invasive species (e.g. rats) and disease, habitat destruction and development all make islands among the most threatened habitats on the planet.

MacArthur and Wilson (1963) developed a hypothesis/model that predicts equilibrium in biodiversity on islands. In their model, species colonize islands by migrating from the mainland at some rate, and the existing species on the islands go extinct at some rate. Island colonization of new species is a function of the island's distance from the mainland (colonization is more likely if the island is near), and the number of species already on the island (the more species, the less likely a colonizer will be a new species). The extinction rate is a function of the island's size (with larger islands having a lower rate), and also the number of species present (the more there are, the more likely one will go extinct). Simberloff and Wilson (1969) actually tested this model experimentally using small mangrove islands in southern Florida. They first fumigated the islands to remove all the arthropods, and then sampled the arthropod diversity over several years. Their results generally supported Macarthur & Wilson's model.

With this simulation you can explore the relationship of island size and distance from the mainland with the supported biodiversity. Also, you can compare these relationships using different taxa (e.g. birds or arthropods), and different habitat types (e.g. tropical forest or tundra).

HOW IT WORKS

Model basics- Modeled is a mainland population of ten different species, which have a certain probability of dispersing if they reach the ocean's edge. Once they are 'at sea' they wander randomly and have a taxon-specific probability of dying. If they make it to an island, they stay there and have an island size/ habitat type specific chance of dying. You can vary the number of islands (1 or 2), as well as the size of islands and their distance from the mainland. As species drift out to sea and find islands they will only increase the number of species on that island if that species was not currently there. However, all new migrants will increase the overall population size of the island (N).

Model vs. nature- Comparing the model to biological reality, there are far fewer individuals than you would find in nature, thus an individual represents some number of individuals of a species. The individuals do not actually breed in the model. On the mainland individuals are replaced as they disperse. These simplifications do not affect the principles illustrated by the model.

Monitored data include:

Isle-1-Spp	(the number of species on island 1)
Isle-2-Spp	(the number of species on island 2)
Isle-1-N	(the number of individuals on island 1)
Isle-1-N	(the number of individuals on island 2)

Graphed data include:

The number of species on each island

HOW TO USE IT

To start, set sliders:

Taxon = birds	Island-1-Dist = 25	Habitat-Type = Tropical
Mainland-Density = 20	Island-1-Size = 10	Isle- Mortality = 0.05
Prob-Disperse = 0.125	Island-2-Dist = 50	Run-Time = 3000
Island-Number = 2	Island-2-Size = 10	

Press the 'Set up' button and islands will appear and the mainland will be seeded with 'species'. Press 'Go' and the individuals will move around, and those at the shoreline will occasionally move out to sea. Notice that they will eventually die at sea if they don't make it to an island. If they do make it to an island they will stay there, until they die. Observe the rates islands are colonized and how individuals die at sea and on the islands.

Model parameters and their functions

<u>Species Variables</u>

Taxon	The general type of organism modeled (which have different abilities to disperse over water
Mainland-Density	The number of each species on the mainland (each species is represented by a different color)
Prob-Disperse	The likelihood an individual will head out to sea from the shore

<u>Island Variables</u>

Island-Number	The number of islands modeled (one or two)
Island-1-Dist	The distance of island 1 (upper island) from the mainland
Island-1 Size	The size of island 1
Island-2-Dist	The distance of island 2 (lower island) from the mainland
Island-2 Size	The size of island 2

<u>Ecological Variables</u>

Habitat-Type	The general type of habitat modeled, this affects the number of individuals a given area can support (based on primary productivity)
Isle-Mortality	The baseline likelihood an individual will die on an island in a given time period, this is affected by Habitat-Type

GENERAL QUESTIONS TO ASK

What is the relation of the average number of species on the islands to island size and distance?

Which taxon types are better colonizers than others?

    Thinking biologically, why might this be?

Which habitats support larger populations than others?

    Again thinking biologically, why might this be?

CREDITS AND REFERENCES

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