Environmental Science 101 July 7, 2005

Lab 4a, 10 Points

Lab 4b, 5 Points (in class)

Due by 13th July, 2005

Lab 4a: Reserves and Corridors

Objective

To explore the larger themes of urban ecology and biodiversity conservation in Portland. Specifically, you will examine how reserves and corridors are used to preserve urban biodiversity.

Overview

According to the species equilibrium model of MacArthur and Wilson, the number of species found on an island is determined by a balance of two factors: the immigration rate and the extinction rate. The model predicts that immigration and extinction rates (and thus species diversity) are, in turn, affected by two variables: the size of the island and its distance from a mainland. This model is now being applied to mainland species, as habitat fragmentation has yielded "habitat islands" on the mainland. Most wildlife sanctuaries are habitat islands surrounded by fragmented ecosystems. According to the species equilibrium model, the species diversity in these terrestrial patches or islands should be determined by their size and by their distance from other patches that serve as a source of colonists.

We shall explore the Species Equilibrium Model in further detail in Lab 4b.

Researches can used this model to estimate what size a nature preserve should be in a particular area to prevent it from losing species. The size of the preserve also depends on which species is being protected. Members of endangered species such as tigers and grizzly bears feed over a large home range. They need a much larger area of undisturbed habitat than many other species to preserve a viable population. For example, the average grizzly bear has a home range of 100-400 square miles.

Conservation biologists are also using this model to estimate how close a series of small wildlife reserves should be spaced to allow the possibility of immigration from one preserve to another if a species in one reserve becomes locally extinct. In addition, they are using the model to estimate the size and number of protected corridors needed to connect various reserves and encourage the spread of protected species among them.

The immediate challenge is to design reserves for wildlife that can sustain wildlife populations as human populations continue to increase outside the reserves. The basic design consists of a **core reserve** where human activities are limited and the maintenance of wildlife habitat and biodiversity are the primary goals. Surrounding the core are **buffer zones** where increasing amounts of human impacts are allowed, but which can also support many species of wildlife. Outside of the buffer zones, land use is primarily human-oriented and only very human-

tolerant wildlife species are found. Wherever possible, core reserves are connected by secure **corridor** habitats, which are also surrounded by buffer zones.
(http://www.wildlands.org/corridor/reserve.html)

Procedure

Choose a major wildlife area/park in the Portland area. The criteria for park selection should include selecting a large area that has smaller parks not more than a kilometer away. Chart this area out on a map. Determine the area and border length (edge length). Describe the general character of the park and estimate the percentage that is wild compared to the percentage that is maintained. For example what approximate percentage is designated to playing fields, roads, sidewalks, picnic area, mowed grass, dense underbrush, et al.

Find another wild area that is a distance of 1 kilometer or less from your chosen park. Map and describe the location of the smaller park in relation to the central park. Give the distance between parks. Also record the area and the edge length of the smaller park. Describe the possible pathways from one park to the other park.

Assignment

1 page describing exactly what you did during this lab (the procedure). At least one page describing your parks. At least 1 page answering questions (do this at your sites.) At least half a page of recommendations for maximizing biodiversity in Portland. Finally, attach your maps to your report.

Questions (answer in the field)

1a) What are the roads and natural process pathways such as stream, swales, gullies, et al. around the selected parks?

b) Assess the effects of the roads on your parks and on the immediate area. How big and how busy are the roads? What proportion of the wild area is bordering roads?

2) On your map indicate by drawing some contour 50 meters and 200 meters from the road. The 50 meter contour designates the area where a road can have a significant impact on the vegetation and wildlife. Do you notice this about your park? The 200 meter contour designates the distance that in theory should be less impacted by roads. Do you notice this about your park?

3a) Focusing on wildlife describe the barriers along the road. Are there ditches, a wall or other barriers? Is there a way for small animals to get around or across the road (culverts or overpasses)?

b) Describe the habitat for small mammals, such as mice, shrews or voles. How easy do you think it would be for a small mammal to get from one side of the park to the other? Describe the paths that these small mammals might take to go from the large park to the smaller park. How long are these paths and what are the barriers/hazards along the way?

Lab 4b: Island Ecology

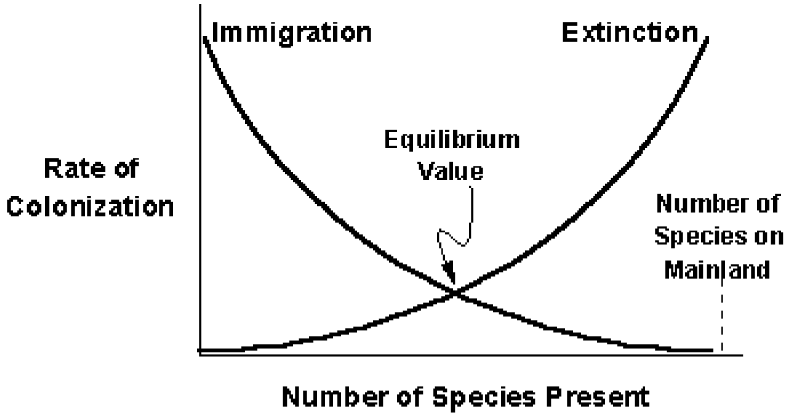
Objective

The objective of this lab is to investigate island ecology, focusing on population dynamics as determined by immigration, emigration and steady state.

Overview

Island species, many of them endemic species found nowhere else on earth, are especially vulnerable to extinction; most have no other place to go, and few have evolved defenses against predators or diseases accidentally or deliberately introduced onto islands. Roughly, half the plants and animals known to have become extinct since 1600 were island species, even though islands make up only a small fraction of the earth's surface. Almost 900 bird species-10% of the world's known bird species-exits on only one island.

In the 1960's MacArthur and Wilson began studying communities on islands to discover why large islands tend to have more species of a certain category than do small islands. To explain this phenomenon they proposed the species equilibrium model or the theory of island biogeography. According to this model the number of species found on an island is determined by a balance between two factors: the immigration rate and the extinction rate. The model predicts that at some point the rates of immigration and extinction will reach an equilibrium point that determines the island's average number of different species (species diversity).



The model also predicts that immigration and extinction rates (and thus species diversity) are, in turn, affected by two variables: the size of the island and its distance from a mainland. According to the model, a small island tends to have lower species diversity than a large one for two reasons: First, a small island is hard for potential immigrants to find-and thus should have a lower immigration rate than a larger island. Second, because a small island normally has fewer resources and less diverse habitats, it should have a higher extinction rate (competitive exclusion) than a larger island.

Another prediction of this model is that an island's distance from a mainland source of new species is important in determining its species diversity. Assume that we have two islands of

about equal size and that all other factors are roughly the same. According to this model, the island closest to a mainland source of immigrant species will have a higher immigration rate and, thus, a higher species diversity.

Materials

Masking tape and meter sticks, islands (4", 6", and 8" pots), variety of objects for tossing.

Procedure

Each group will set up the following simulated islands:

Three types of islands will be represented: small, medium and large. These islands are to be arranged as follows: three sets of islands, one group at 1 meter, the second group at 2 meters and the third group at 3 meters. Measure the appropriate distance and mark with masking tape. The tape marks the mainland, which is the original source of species.

Make your predictions (hypotheses) as to what your expected results will be (i.e. number of species colonizing each habitat type based on size and distance).

To simulate immigration toss a variety of objects at the islands. Each type of object represents a different species, and each object will be marked with a symbol representing male or female.

Make a table (Table 1) of the number of individuals of each species that landed on each island. Pool all trials together. Species which dispersed with only 1 gender to any of the islands do not count, but should be noted in the write up.

	Near Islands			**Middle Islands**			**Far Islands**		
species	small	medium	large	small	medium	large	small	medium	large

The following questions are to be completed in class as a group assignment.

1) Your predictions about the migration of species to the different islands

2) Compile the data into a chart (as given above) and create the following graphs:

a) The number of species present on each of the islands (y-axis) vs. distance from the mainland source (x-axis). The graph will have three lines, one for large, one for medium, and one for small islands.
b) Did we prove Wilson's hypothesis? What does our graph say about distance from mainland and size of island in relation to biodiversity?

3) Note the number of individuals of each species where only one gender was dispersed onto the islands. Present this in a tabular form as well.

The results will be discussed in class.

Include the following points in your report

Lab 4a

Presentation: Proper heading and subheadings (0.25)
Grammar, spelling, complete sentences (0.5)
Research depth (0.25)

Names of selected parks (0.5)

Location on a map (0.5)

Description of park (for both smaller and larger park) (2x1.5) :
Edge length (0.5)
Estimation of wild and maintained area (0.5)
Type of habitat and natural vegetation (0.5)

Possible corridors (1)

Methodology/Procedure (0.5)

Questions (1x3)

Recommendations for maximizing biodiversity in Portland (0.5)

Lab 4b

To be submitted as a single group assignment in class on Monday, 11th July.

Question 1 (1)

Question 2 (1.5x2)

Question 3 (1)

Note: Make sure you turn in **all** assignments by **13th July**. None will be accepted after that.