Biodiversity in Leaf Litter

Introduction

Species diversity is a characteristic that is unique to a community level of biological organization. The biodiversity in different communities has been severely affected by human activities.

A community is said to have high species diversity if it has many species present in approximately equally abundant numbers. If it is composed of only a few species or if only a few species are abundant, then the biodiversity is considered to be low. If a community had 100 individuals distributed among 10 species then the maximum possible diversity would occur if there were 10 individuals in each of the 10 species. The minimum possible diversity would occur if there were 91 individuals belonging to one species and only 1 individual in each of the other nine species.

The number of species in a community is very important. There seems to be evidence that the greater the species diversity, the more stable the community. When diversity is low, the community is less stable. A community with low diversity is less able to rebound from severe disturbance such as pollution and habitat disruption.

The purpose of this lab is to measure the biodiversity of organisms found in a sample of leaf litter collected on campus. A Berlese funnel apparatus will be used to separate from the leaf litter the small organisms dwelling within it. The organisms will then be organizing into similar taxonomic categories and counted. Finally, the species diversity of the leaf litter sample will be calculated.

Materials

- Dissecting microscope
- Berlese funnel apparatus
- Plastic collection bag
- Leaf litter
- Methanol
- Identification key (internet)
- Petri dishes

Procedure

Week 1

1. Work in groups by lab table.
2. Go to the woods by Fenwick Library.
3. Collect a leaf litter sample as follows:
   a. on a patch of the forest floor, envision a square that is approximately 30cm on

each side (roughly 1 square foot)

b. from this area, collected all the leaf litter and the top layer of soil-like material (down to a depth of approximately 1.5cm, to the extent that you can remove it with your fingers) and place into your plastic collection bag

4. Return to the lab.
5. Obtain a Berlese funnel apparatus. Place a piece of marking tape on the plastic container and label it with your section number and lab table number.
6. Place a small volume of methanol in the bottom of the plastic container.
7. Place the funnel in the top of the plastic container and place the screen plug in the base of the funnel.
8. Place the leaf litter that you collected in the woods into the top of the funnel. As the leaf litter dries, from the top down, the organisms in the leaf litter will migrate downward (trying to stay in the moist litter) and will eventually fall into the methanol which will preserve them for later observation.

Week 2

1. Discard the leaf litter from the funnel of your Berlese apparatus. **PLEASE BE SURE THAT YOU DO NOT THROW AWAY THE SCREEN PLUG FROM THE BOTTOM OF THE FUNNEL!!!!!!!!!!**
2. Obtain a dissecting microscope from the wooden cabinet. If there are enough microscopes available (after making sure that each table has at least one microscope), additional microscopes can be obtained for your table so that the work of identifying the organisms from your leaf litter sample can be shared amongst the members of your lab table group.
3. Pour the methanol from the bottom of the container, which now contains the organisms from the leaf litter, into one or more petri dishes (depending on how many in your group will be assisting with identification).
4. Observe the organisms in the petri dish under a microscope. Separate the sample into piles of like organisms within the petri dish. Use the on-line "Hope College Leaf Litter Arthropod Dichotomous Key" at http://www.hope.edu/academic/biology/leaflitterarthropods/ to identify the type of organism in each pile.
5. Determine the total number of each type of organism

identified in your group's sample. Record this data in Table 1 in the column headed "absolute abundance"

6. If you encounter unfamiliar terms while using the key, go to "Introduction to Arthropod Characteristics" at http://www.missouri.edu/~bioscish/intro.html for assistance.

Data Analysis

1. Determine the relative abundance of each individual species and record in Table 1 (you determined the absolute abundance of each species by counting the number of individuals of each different species). Relative abundance compares the number of organisms of a particular species with the total number of organisms found in the sample. Relative abundance of a species in a sample is calculated by dividing the number of individuals of that species by the total number of individuals in the entire sample. An example calculation follows:

   Relative abundance = n_i / N

n_i = actual number of individuals of species i

N = the total number of individuals of all types collected in sample

Example data and calculations for relative abundance:

Species (i)	Absolute Abundance (n_i)	Relative Abundance (p_i)
1	50	50/85 = 0.588
2	25	25/85 = 0.294
3	10	10/85 = 0.118
# of different species = 3	N = 85	

2. Determine the diversity of your sample using **Simpson's Index of Diversity** and record in Table 1. The following example illustrates how to calculate Simpson's Index of Diversity:

$$D_s = 1 - (\sum n_i(n_i - 1) / N(N - 1))$$

Species (i)	Absolute Abundance (n_i)
Snail A	50
Snail B	25
Insect A	10
	N = 85

D_s = 1 - [{50(49) + 25(24) + 10(9)} / 85(84)]

D_s = 1 - 3140 / 7140

$D_s = 1 - 0.44$

$D_s = 0.56$

D_s values closer to 0 = low diversity

D_s = closer to 1 = greater diversity

3. Record your group's value for Simpson's Index of Diversity in Table 2 and on the transparency (or blackboard).

Record other groups' values for Simpson's Index of Diversity in your Table 2.

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Student Name: _____Lab Date: _____
Lab Instructor: _____ Lab Section: _____

Results (Data)

Table 1. Absolute and relative abundance by organism type for leaf litter sample for individual lab group.

Organism Type ("Species") (i)	**Absolute Abundance (n_i)**	**Relative Abundance (p_i)**
i =	N =	

i = total number of "species" N = total number of individuals in entire sample

**** If you cannot identify an organism call it type "A", "B", etc.**

Table 2. Simpson's Index of Diversity for leaf litter samples by lab group.

Lab Table #	1	2	3	4	5	6
Simpson's Index of Diversity						

Conclusions (Questions): *For full credit, these questions should be answered thoroughly, in complete sentences, in legible handwriting.*

For questions 1 -3, go to http://www.missouri.edu/~bioscish/ and read "Role of Leaf Litter Arthropods".

1. What percent of the biomass produced in a forest is returned to the soil?

2. How many times as much energy is stored in the soil and leaf litter of a forest as compared to the trees of a forest?

3. What is the estimated percentage of leaves and wood on the forest floor that is recycled as a result of the action of mites and springtails?

For question 4 go to http://www.kendall-bioresearch.co.uk/. In the green bar menu on the left side of the screen, find the drop down menu headed "Shortcut to the main groups of insects and other arthropods" and find the common name of the organism for which you need information.

4. Which two organisms (species) from your sample had the lowest relative abundance? On what do these two organisms feed (refer to the website)?

5. What percent of your sample did the mites and springtails make up collectively?

6. Which organism had the greatest absolute abundance? Which organism had the greatest relative abundance?

7. Which organism had the lowest absolute abundance? Which organism had the lowest relative abundance?

8. What was the Simpson's Index of Diversity for your sample? Does this indicate a low or high level of diversity? If the diversity is low, try to give some reasons why it might be low

9. Describe the differences in the Simpson's Index of Diversity amongst the different lab tables in your class. Was there a great deal of difference in the calculated index? Does this surprise you? All the leaf litter samples were collected within a fairly small area in the woods near Fenwick Library. If there were differences in the calculated index amongst the lab groups, speculate on reasons for this variation.