

SIMPSON'S INDEX LAB



INTRODUCTION

Biodiversity is defined as the total number of species living in an ecosystem. At present about 1.5 million species have been named, but this figure is not certain. It is impossible to know how many species actually exist because we have not explored every part of the biosphere yet. Most species are also less than 1mm long so they are easily overlooked. Human actions such as over exploitation, islandisation, habitat destruction, introduction of alien species as well as pollution have all contributed to a decrease in local and global biodiversity.

There are several reasons why we should want to maintain a high biodiversity on Earth. High biodiversity is an indication of the health of an ecosystem and if an ecosystem comes under stress from over exploitation or pollution, it will show low diversity. Once diversity is lost from an ecosystem it can't recover easily because species need to migrate back in from neighboring ecosystems or if the organism has become extinct, it is lost forever.

In order to measure biodiversity, scientists must take two factors into consideration: species richness and the relative abundance (evenness) of each species. Species richness is a measure of the number of different kinds of organisms present in a particular area. Evenness compares the similarity of the population size of each of the species present.

The Simpson's Diversity Index (inverse) is calculated as follows:

$$D = \frac{\sum n(n-1)}{N(N-1)}$$



D = Diversity

N = total number of individuals

n = numbers of each different species (relative abundance of each species)

Simpson's Diversity Index takes into account the number of species present, as well as the abundance of each species. The value of this index starts with 0 as the lowest possible figure. When using the Simpsons Index, the number you will calculate should be a value between zero and one with $0 \leq D \leq 1$. Values near zero indicate a highly diverse (heterogeneous) ecosystem and values near one indicate a less diverse (homogeneous) ecosystem. *The LOWER the value, the GREATER the diversity.*

A low value of D suggests a stable and ancient site and a high value of D could suggest pollution, recent colonization or agricultural management (disturbance of some sort). The index is normally used in studies of vegetation but can also be applied to comparisons of animals (or even all species) diversity.

Example of all calculations relating to Community Diversity

Species	Number (n)	n(n-1)	Putting the figures into the formula for Simpson's Diversity Index: Simpson's Diversity Index: $D = \frac{\sum n(n-1)}{N(N-1)}$ $D = \frac{2(2-1) + 20(20-1) + 3(3-1) + 3(3-1)}{28(28-1)}$
Beetles	2	2	
Spiders	20	380	
True-bugs	3	6	
erpillars/Sawflies	3	6	
Total (N)	28	394	

Species Richness = 4
(4 different species present)

Relative Species Evenness: Low
(20 vs 2 vs 3 vs 3)

Relative Level of Species Dominance: High
(One species dominates (spiders) with 20 individuals)

$$D = \frac{2 + 380 + 6 + 6}{756} = \frac{394}{756}$$

$$D = 0.52$$

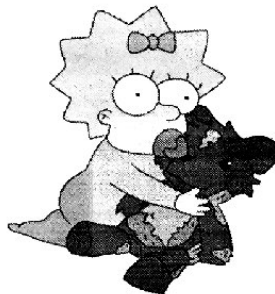
0 = Very High Diversity
1 = Very Low Diversity

PRE-LAB QUESTIONS:

1. Use Simpson's Diversity Index to determine which of the following 5 communities of 100 individuals is most diverse.
 - Community 1 contains 20 species with 5 individuals in the first species, and 1 individual in each of the remaining species.
 - Community 2 contains 5 species, but there are 20 individuals in each species.
 - Community 3 contains 2 species, with 50 individuals in each species.
 - Community 4 contains 2 species, with 99 individuals in one and 1 individual in the other.
 - Community 5 contains 10 species, with 91 individuals in one and 1 individual in the other 9 species.
2. Describe how species evenness compares among the five communities outlined in question 1. How does species evenness affect species diversity? Explain.

PROCEDURE:

1. **Individually** read the background material
2. **Individually** complete the Pre-lab questions
3. Partner off with someone in the class.
4. Prepare a data table that will assist in the data collection process. Remember that a well-designed data table can help this process immensely.
5. Each group of 3-4 will then partner up with one other group (7-8 total people).
6. Each group is responsible for sampling a parking lot (Student, Faculty) community. Hopefully there will not be much immigration or emigration (cars coming and going) during our sampling time. But, if you do notice some, use your best judgment.
7. Each group of 3-4 will **randomly** choose a section of the parking lot to sample (50 cars). The 50 cars in your sample **MUST BE adjacent** to each other, not interspersed throughout the lot. No individual car may be skipped, but if there are empty spaces between cars, you may still use them.
8. Your "species" will be based on the **make** of the automobile (e.g. Dodge, Honda, Chevy, etc.). If you are having difficulty classifying a "species", you must come to a decision as a team.
9. When complete, you will come together into your larger group and share the data collected from each lot with one another.
10. Individually calculate the Simpson's Diversity Index for each parking lot. It is YOUR responsibility to organize the data into a chart and do all of the calculations on your **OWN**. You may do calculations by hand or use a spreadsheet. You must provide an example of each calculation in your lab write-up.



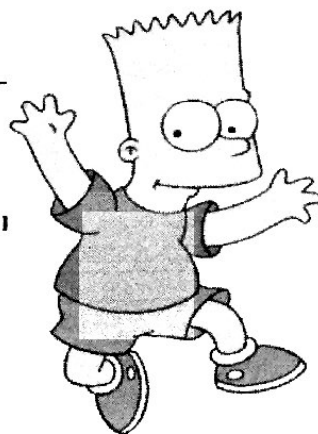
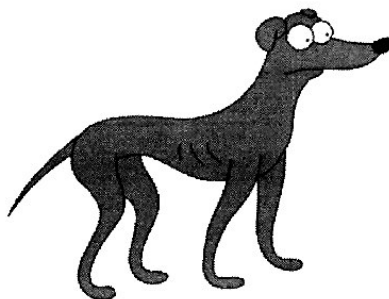
11. Individually determine the Species Richness, Relative Species Evenness, and Relative Level of Species Dominance for each lot. These, along with the Diversity calculations, will be included in the Data Processing/Presentation section of your lab write up.



NAME: _____

/45

Lab Partner



&

HYPOTHESIS: _____

PRE-LAB QUESTIONS: (SHOW your work)

WORK

ANSWER

	<i>WORK</i>	<i>ANSWER</i>
Community #1		
Community #2		
Community #3		
Community #4		
Community #5		

2. Describe how species evenness compares among the five communities outlined in question 1.

Community #1 is more or less diverse than community #2: more / less

Community #2 is more or less diverse than community #3: more / less

Community #3 is more or less diverse than community #4: more / less

Community #4 is more or less diverse than community #5: more / less

Community #5 is more or less diverse than community #1: more / less

3. How does species evenness affect species diversity? *Relationship (circle): inverse / direct*

Explain:

DATA COLLECTION & CALCULATIONS:

****ATTACH YOUR RAW DATA FOR EACH OF THE PARKING LOT COMMUNITIES TO THIS LAB****

YOU MUST INCLUDE YOUR WORK FOR CALCULATING THE SIMPSONS INDEX FOR EACH PARKING LOT ON THIS ATTACHED SHEET!

DATA PROCESSING/PRESENTATION:

	Student Lot	Faculty Lot
Simpson's Index		
Species Richness		
Relative Evenness		
Relative Level of Species Dominance		

ANALYSIS:

1. **Discuss the ecosystem metaphor. Why have we used cars rather than counting actual species in a real ecosystem? How do the cars in the parking lot represent species in an ecological community?**

2. **Which of the three communities is most diverse? Support your conclusion with experimental data.**

3. Various human disturbances can cause diversity to change. Based on your data, if all three communities were similar in species composition, which one would you conclude has most likely experienced some sort of human disturbance? Explain.

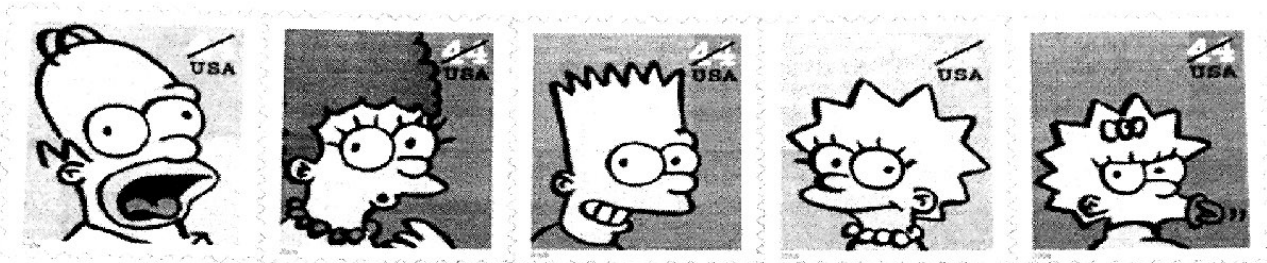
4. Did any species dominate in any community? If so, explain what might cause this dominance (be sure to relate it to environmental dominance). *Dominate Species:* _____

Because: _____

5. Explain how immigration and emigration can affect species diversity and richness.

CONCLUSION/EVALUATION: - YOU DO NOT NEED TO ANSWER THESE AS QUESTIONS, BUT YOU DO NEED TO ADDRESS THEM IN YOUR CONCLUSION FOR YOUR LAB REPORT

Summarize your overall conclusions. REMEMBER: NO NEW INFO IN THE CONCLUSION & ADDRESS YOUR HYPOTHESIS!



7. **Thoroughly discuss the opportunities for error in your methods/calculations/conclusions.**

8. **How could this lab be expanded upon?**
