SIMPSON DIVERSITY 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 is calculated as follows:**

D = Diversity

N = total number of individuals

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

http://sciencebitz.com/wp-content/uploads/2012/02/codecogseqn-2.png

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 1 as the lowest possible figure. When using the Simpsons Index, the number you will calculate should be a value between one and infinity. When comparing your values for D, ecosystems with higher values indicates a highly diverse ecosystem which is more stable. In contrast, low values for D are found in disturbed ecosystems with very little diversity such as a logged forest.

**PROCEDURE:**

1. Individually read the background information

2. Individually complete the pre-lab questions and chart

3. Get in groups of 3. No more, no less!

4. As a group, formulate a research question regarding projected diversity for the 3 parking lots. Think about how evenness and richness influence D value. This question along with a justification will be included in the Identifying the Context section of your lab write up.

5. Prepare a data table that will assist in the data collection process. Remember that a well-designed data table can help this process immensely (see example data table on next page).

6. Each person in your group is responsible for sampling a parking lot (Staff Lot 1, Staff Lot 2, or Student Lot) 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. Randomly choose a section of the parking lot to sample (approx. 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.

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. Steps 5 through 8 will be outlined in the Planning section of your lab write up (variables, materials, and procedure).

9. When complete, you will come together into your larger group and share the data collected from each lot with one another. You must record ALL data collected from your other group members.

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 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 Results, Analysis, and Conclusions section of your lab write up.

12. Answer the analysis questions as well as the discussion questions. This information will help you in the Discussion and Evaluation section of your lab write up.

Below is a sample data table for data collection.

**Staff Lot #1**

|  |  |  |
| --- | --- | --- |
| **Species** | **Number** | **Total Number** |
| Honda | IIIIIIIIIIII | 12 |
| Chevy | IIIII | 5 |
| Toyota | IIIIIIIIIIIII | 13 |
| BMW | II | 2 |
| Ford | IIIIIIIIII | 10 |
| Chrysler | IIII | 4 |
| Volkswagen | IIII | 4 |
|  | Total (N) | 50 |

Simpson Index: D = 50(49) / 12(11) + 5(4) + 13(12) + 2(1) + 10(9) + 4(3) + 4(3)

D = 5.78

Richness = 7

Relative Evenness = low

****Relative Dominance = high with Honda and Toyota being the dominant species**NAME:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block:\_\_\_\_\_\_\_ /80 SIMPSON’S LAB**

**Lab Partners: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_&\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**1. PRE-LAB QUESTIONS**: (SHOW your work)

* 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.

*WORK ANSWER*

|  |  |  |
| --- | --- | --- |
| Community #1 |  |  |
| Community #2 |  |  |
| Community #3 |  |  |
| Community #4 |  |  |
| Community #5 |  |  |

1. According to the above calculations, which community is most diverse?

2. Describe how species evenness compares among the five communities outlined in chart above.

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? Explain. *Relationship (circle one): inverse / direct*

**2. IDENTIFYING THE CONTEXT/RESEARCH QUESTION**:

**3. PLANNING:**

* Staple your raw data for each of the parking lot communities to this lab
* MUST ORGANIZE YOUR DATA INTO A DATA TABLE

**4. RESULTS, ANALYSIS, & CONCLUSION**:

* YOU MUST INCLUDE YOUR WORK FOR CALCULATING THE SIMPSONS INDEX FOR EACH PARKING LOT! CALCULATIONS MAY BE DONE IN THE SPACE PROVIDED OR ON A SEPARATE SHEET OF PAPER THAT YOU MUST ATTACH TO THIS LAB.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Staff Lot #1  (bus lot/trailers) | Staff Lot #2  (auditorium) | Student Lot |
| Simpson Index |  |  |  |
| Species Richness |  |  |  |
| Relative Evenness |  |  |  |
| Relative Level of Species Dominance |  |  |  |

*simspon diversity Calculations:*

Staff lot #1:

Staff lot #2:

student lot:

**5. Analysis Questions:**

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.

1. 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.
2. Did any species dominate in any community? If so, explain what might cause this dominance (be sure to relate it to environmental dominance).
3. Explain how immigration and emigration can affect species diversity and richness.

**6. DISCUSSION & EVALUATION:**

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

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

3. How could this lab be changed to make it better for future ESS classes?

**Simpson’s Index Lab - ESS Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lab Rubric**   **GRADE: \_\_\_\_\_ / 80**

**1**. **Pre-Lab Questions (19 pts TOTAL)**

* Chart with calculated Simpson Diversity Index with work shown– 10 points

1. Which community is most diverse? Provide calculations. – 3 points
2. Describe how evenness compares in the three communities. – 3 points
3. How does evenness affect diversity? Explain. – 3 points

**2**. **Identifying the Context (CXT)/Research Question (2 pts TOTAL)**

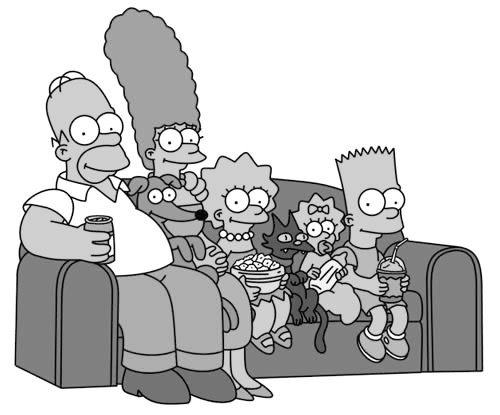
**3**. **Planning (PLA) (12 pts TOTAL)**

* + - Raw data for all 3 lots included – 6 points
    - Data is organized into a table – 6 points

**4. Results, Analysis, & Conclusion (RAC) (12 pts TOTAL)**

* + - Species Richness for each lot – 3 points
    - Simpson’s Diversity Index for each lot – 3 points
    - Relative Evenness for each lot – 3 points
    - Relative level of species dominance – 3 points

**5. Analysis Questions (20 pts TOTAL)**

1. Discuss the ecosystem metaphor. Why did we use cars rather than counting actual species in a real ecosystem? How do the cars in the parking lot represent species in an ecological community? – 4 points
2. Which parking lot community is most diverse? Support your conclusion with experimental data. – 4 points
3. If all "communities" were similar in make-up, which one would you conclude has most likely experienced some sort of human disturbance? Explain. – 4 points
4. Did any species dominate in any "community"? If so, explain. – 4 points
5. Explain how immigration and emigration can affect species diversity and richness. – 4 points

**6. Discussion & Evaluation (DEV) (15 pts TOTAL)**

1. Summarize your overall conclusions. – 5 points
   * + NO NEW INFORMATION IN YOUR CONCLUSION! ADDRESS YOUR RESEARCH QUESTION!
2. Thoroughly discuss the opportunities for error in your methods/calculations/conclusions. – 5 points
3. How could this lab be changed in the future? – 5 points

**Total Score**

OVERALL LAB COMMENTS: