Community Ecology-Instructor Version

**OBJECTIVES**

By the end of this lab, students will be able to:

* Understand how forest edges affect biodiversity and their large scale implications on community structure
* Perform fundamental field sampling techniques
* Quantify biodiversity using the Shannon-Wiener diversity index
* Use t-tests and data visualizations to compare diversity between forest edge and interior and test hypotheses
* Understand how sample size affects data analysis and experimental conclusions

**INTRODUCTION**

 Some of the biggest concerns we have about the world today – effects of climate change, habitat loss, species extinctions – require a wide lens to study. Often, the questions asked about these topics consider complex species interactions. A biological **community** is an interacting group of two or more species in a common area. Communities can be observed on a small scale (e.g., a single decomposing log) or at a much larger magnitude (e.g., an entire forest), and they can be terrestrial or aquatic.

There are several ways a community could be quantified. For example, **richness** is a measure of the number of unique species in a community, **abundance** is the number of individuals of each species, and **evenness** is the relative abundance of a species to the total number of individuals. **Diversity**, a metric for understanding a community, takes into consideration both species richness and evenness. One of the most common methods to calculate community diversity is called the **Shannon-Wiener diversity index (*H’*)**. In general, a diverse community is more stable, functions more efficiently, better recovers from natural disasters, and is more aesthetically pleasing compared to less diverse communities.

In this activity, you will explore a nearby forest community and record species abundance and richness in the edge and interior. Using t-tests, you will be able to determine if the diversity significantly differs between these locations.

**METHODS**

***Hypotheses***

The question posed by this survey is: *Does Shannon-Wiener diversity differ between forest edge and forest interior?*

1. With this question in mind, identify the null and alternative hypotheses. *(1 point)*

 H0: No difference in the Shannon-Wiener diversity index between the forest edge and forest

interior

Ha: There is a significant difference in the Shannon-Wiener diversity index between the forest

edge and forest interior

***Data Collection***

See the data sheet for details on how to collect data and tables to record your data in.

**RESULTS**

***General Community Characteristics***

1. What is the species richness in each of your plots? *(1 point) – number of species they had*

|  |  |
| --- | --- |
| **Forest Edge** | **Forest Interior** |
| Quadrat 1  |  | Quadrat 1  |  |
| Quadrat 2 |  | Quadrat 2 |  |

1. Which of your quadrats was the most even? Explain. *(1 point) should be whichever data is most similar*

***Calculating the Shannon-Wiener Diversity Index***

The equation used to calculate the Shannon-Wiener diversity index is:

$$H^{'}= -\sum\_{}^{}p\_{i}ln(p\_{i})$$

where *pi* is the proportion of individuals of each species and *ln* is the natural logarithm. In natural communities, the value of *H’* typically ranges from 1.5 to 3.5. The higher the value of *H’*, the more diverse the community.

1. Using the Module Data Template Excel Workbook, calculate the Shannon-Wiener Diversity Index for each of your 4 plots. Pay attention to the name of each worksheet in the lower left-hand corner. Report these values in the class data set on the board. *(1 point)*

Answers vary based on data collected

***Statistical Analysis: Group Data t-test***

We will first look at the descriptive statistics and run a two-tailed t-test on just your group’s data before comparing to the whole class.

1. In the “My Data Summary” worksheet, compile your 4 diversity index values into the table. Calculate the average and standard error of the *H’* for both habitats and record below. *(1 point)*
	1. Edge:

|  |  |
| --- | --- |
| *H’* Quadrat 1 |  |
| *H’* Quadrat 2 |  |
| Average |  |
| Standard Error |  |

* 1. Interior:

|  |  |
| --- | --- |
| *H’* Quadrat 1 |  |
| *H’* Quadrat 2 |  |
| Average |  |
| Standard Error |  |

* 1. What are your initial conclusions looking at the data? *(1 point)*
1. Create a bar graph with standard error bars comparing the Shannon Diversity in the forest versus the edge. Include the graph here. What is your initial interpretation of this graph? *(4 points)*
2. What do the error bars on the graph represent? What do the error bars tell you about the data?

Error bars represent the mean +/- the calculated standard error. They are in turn a visual representation of the amount of variation in the data set. Larger error bars=more varitation

1. Run a two-tailed t-test to compare Shannon Wiener Indices between the two habitats. What is the p-value? *(1 point)*

May or may not get something significant

1. Based on your p-value above, what can you conclude? Be sure to refer to your null and alternative hypotheses when drawing your conclusions. *(2 points)*

***Statistical Analysis: Class Data t-test***

Now it is time to work with the class data. We will largely be repeating what you did with your own data, but we will of course have more data to work with.

1. Select the “Class Data Summary” worksheet and type in the *H’* values your classmates have posted on the board. Then, calculate the average and standard error of the *H’* for each habitat and report below. *(1 point)*
	1. Edge:

Average *H’* = \_\_\_\_\_\_\_\_\_\_

Standard error = \_\_\_\_\_\_\_\_\_\_

* 1. Interior:

Average *H’* = \_\_\_\_\_\_\_\_\_\_

Standard error = \_\_\_\_\_\_\_\_\_\_

* 1. What are your initial conclusions looking at the data? *(1 point)*

1. Compare the means and standard errors from your group’s data (question #5) to the class data (question #9) for both edge and interior. Are they similar or different? What does this tell you about the two data sets? *(1 point)*

Answers will vary but students should include something about the effect of sample size

1. Create a bar graph with standard error bars comparing the Shannon Diversity in the forest versus the edge. Include the graph here. What is your initial interpretation of this graph? *(4 points)*

1. What do the error bars tell you about the data?

Answers should be consistent with #7 above. Students should comment on variation in the data

1. Did the error bars get larger or smaller? Is this consistent with what you would expect to happen with the larger class data set? Why or why not?

Answers contingent on data, but the expectation is that error bars will get smaller with a larger (class) data set.

1. Run a two-tailed t-test to compare Shannon Wiener Indices between the two habitats. What is the p-value? *(1 point)*
2. Based on your p-value above, what can you conclude? Be sure to refer to your null and alternative hypotheses when drawing your conclusions. *(2 points)*

Should be consistent with the null & alternative hypotheses in #1 above
Potentially the p-value will get smaller because of the larger sample size, but doesn’t always happen

1. Compare the p-values you generated for the group data and the class data when comparing the Shannon Wiener Diversity Indices between the two environments. Are there any major differences between the two? Which data set is more appropriate to use and why? *(2 points)*

More data is appropriate

1. Did we see an edge effect? Why or why not? What may be happening in the environment to cause the differences or similarities we saw? *(2 points)*

If edge effect is stated to be seen, this should be consistent with the data collected (i.e. significance for interior, but no significance for edge)If theres no difference, should be saying how they are similar conditions. If different, can talk about sunlight, water, disturbance, etc.

1. Describe two large-scale implications from what you have learned through these analyses today. *(2 points)*