# Lab 16: Terrestrial Ecology

## Purpose

To investigate the diversity of plants growing in a prairie community.

## Learning Objectives

At the conclusion of this exercise, students will be able to:

* Identify common prairie plants.
* Calculate the species diversity of a community.
* Construct a graph that displays scientific data.

## Why It’s Relevant

Much of the natural ecosystem of the midwestern United States is composed of temperate grassland (prairie). While much has been destroyed or modified, natural prairie still exists in protected areas and is actively being restored. These native ecosystems provide opportunities for hiking, fishing, birdwatching, and other outdoor activities. The native plants that thrive in these places have traditionally been used for a variety of purposes by humans. The College of DuPage is fortunate to have a sustained commitment to preserve some of these areas for their ecological value and for human enjoyment.

## Introduction

The tallgrass prairie is a temperate grassland biome that is native to much of Illinois. Compared to other grasslands around the world, the Illinois prairie is relatively “wet,” experiencing moderate amounts of rainfall and snowmelt throughout the year. This allows for the growth of taller grasses and other herbaceous plants than on prairies in the western United States. However, the biome is still a grassland, because there is generally not enough precipitation for trees and shrubs to thrive.

The College of DuPage manages several restored prairie communities, which benefit the community in a variety of ways. These include attracting a large population of pollinators, cleaning air and water, creating a habitat in which biodiversity can thrive, and providing an educational space for students and others to learn about ecology. The largest of these is the Russell R. Kirt prairie preserve (**Figure 16.1**). This important plant community is dominated by several species of grasses, compass plants, rosinweed, goldenrods, and several other non-woody native species. The prairie also houses a diverse community of mammals, birds, reptiles, amphibians, insects, and spiders. Finally, it includes a wetland portion (the “nature pond”), which supports wetland plants and fish, and is actively used by many of the vertebrates in the prairie.

One piece of information that ecologists collect from biological communities is their species diversity. Many different methods to assess species diversity have been developed over the years, but they all ask the same basic questions: How many different species of living things are found in an area? How does this compare to other areas? Is an area dominated by 1 or 2 species, or are many different species well represented in the same area? Often, species diversity measurements can be used to assess the health of a community, as high diversity tends to positively influence the productivity and resilience of an area.

The concept of species diversity contains two important components. The first is the total number of species present in the community. This is typically referred to as species richness. Communities with more species in them will produce higher species diversity measurements. The second is the idea of how well represented each species is within the community, often referred to as relative abundance. Communities that are dominated by a few species will produce lower species diversity measurements than communities that have a more even distribution of individuals. Species diversity equations account for both the richness and relative abundance of communities.

The purpose of today’s lab is to spend some time in the tallgrass prairie to learn about and experience the kinds of native organisms that dwell there. While doing so, you will collect some data with which to calculate species diversity, allowing you to ecologically compare different parts of the prairie.

## Procedure

Form a small group with several classmates (a group of 4 students is ideal) and obtain a 3 m x 3 m PVC frame. Head out to the Russell Kirt prairie. Once there, spend some time looking around to acquaint yourself with it. A winding path leads down the center of the preserve, which is bounded on 2 sides by roads, 1 side by the lawn behind the HSC building, and 1 side by the nature pond. Discuss a useful comparison of two areas within the preserve you could make by measuring species diversity with your team members. Ideas might include comparing areas of the prairie near the road (exposed to high levels of salt pollution in the winter) versus areas farther from the roads, or areas near the edge of the prairie versus areas farther away. Check your ideas with your instructor, who may offer additional ideas.

Once a comparison is agreed upon, write a hypothesis for your study.

Next, two team members should head to the first site at which data will be collected. Here, randomly select two areas for sampling by using the blind throw method (**Figure 16.2**). Stand with your back to the sampling area and toss an object (a ball, your keys, etc.) a few feet over your shoulder. Place the lower left-hand corner of the PVC frame at the point on the ground where the object struck. Every plant inside the frame will be considered to be inside your sampling plot.

Record each species located in the sample plot on a data sheet by identifying them and counting how many are represented within the plot. Use field guides, internet sources, or the iNaturalist app on your smartphone to assist with the identification. Make sure to learn what comprises one individual of each species—does the tuft of leaves in front of you represent one grass individual or many?

Once you have finished with your first sample plot, repeat the procedure in a second plot in the same general location as your first. Choose an area with similar parameters that is at least 10 feet away from where you sampled initially. Pool the results of the two plots together for the location.

While the first two team members are sampling the two plots at the first location, the other two should follow the same procedure in the second location. Choose plot sites in the same random fashion and collect data from two sample plots in the same way.

When all sampling is completed, the team members should come together to calculate the species diversity of the two locations in the prairie. To do this, use the Shannon Diversity Index equation shown below. First, add the total number of all individuals in all species together to calculate the grand population. Then, calculate the proportion of the sample represented by each species by dividing the number of individuals of each species by the grand population of the sample. Finally, input the proportions of each species into the Shannon Diversity equation and calculate by hand (or find an online calculator for the equation). Show your work by plugging your data into the formula (**Figure 16.3**).

In the equation, p represents the community proportion represented by a species, while the capital letters in subscript represent individual species (species #1 in your sample is represented as “A,” species #2 by “B,” etc.). The total number of species in your sample will determine how many expressions the Shannon Diversity equation has. For example, if your sample contained four species, the below equation will run to letter “D.” However, if your sample contained 8 species, then it will run to letter “H.”

Fig: 16.3 Shannon Species Diversity = -(pA ln pA + pB ln pB + pC ln pC +….)

Once you have completed the species diversity calculations for both of your locations, compare the two. Was your hypothesis supported or not? Write a concluding sentence underneath your original hypothesis that summarizes your results.

Finally, construct a bar graph that compares the species diversity of the two study locations. Make sure to properly label both of the axes.

## Alternate Procedure for Online Courses

Four plots on the College of DuPage prairie preserve have historically been sampled using the methodology described in the procedure of this lab. The four plots represent different areas of the preserve with respect to their distance from the campus pond and the road running alongside the preserve (**Table 16.1**).

**Table 16.1. Four sample plots within the Russell Kirt Prairie Preserve with location characteristics**

|  |  |  |
| --- | --- | --- |
| Plot Number | Distance From Pond | Distance From Road |
| 1 | Near | Far |
| 2 | Near | Near |
| 3 | Far | Far |
| 4 | Far | Near |

The number of individuals of each prairie plant species counted in each of the four plots is listed in the [attached spreadsheet](https://cod.pressbooks.pub/app/uploads/sites/175/2025/05/Lab-16-Additional-Spreadsheet-4-sampled-plots.xlsx) [.xls, 18 kb]. Develop a research question that you could answer about species diversity in the nature preserve by choosing one of the two location variables listed in **Table 16.1**. Write a hypothesis for your analysis that includes a prediction on what you expect the outcome will be. Which of the two areas do you expect will have higher species diversity?

Next, analyze the data in the attached spreadsheet. Pool data from similar plots in your study together and calculate species diversity (**Figure 16.3**) for two different location types. For example, if you chose to analyze road distance, then pool the results from the two plots near the road and the two far from the road together and calculate one species diversity value for each.

Create a bar graph comparing the calculated species diversity levels between the two locations you decided to study. Write a concluding statement that summarizes your findings and either accepts or rejects the hypothesis you wrote earlier.

Finally, read through the introduction section of this lab and answer the summary questions below. Submit your answers to the summary questions as well as the bar graph you created and the concluding statement.

## Summary Questions

1. Use the Shannon Diversity Index to calculate the owl diversity of a nature preserve containing 1000 total birds. 250 of these are great-horned owls, 500 are screech owls, and the remaining 250 are barred owls.
2. Compare (in 1-2 sentences) the following two salamander communities in terms of species richness and relative abundance. The first column lists the species of salamanders and columns 2 and 3 list the number of individuals located in the two communities.

|  |  |  |
| --- | --- | --- |
| **Species** | **Community 1** | **Community 2** |
| Tiger salamander | 350 | 112 |
| Red-backed salamander | 25 | 100 |
| Blue-spotted salamander | 10 | 78 |
| Mudpuppy | 0 | 109 |
| 2-lined salamander | 0 | 87 |
| Marbled salamander | 0 | 90 |

1. In the study you completed today on the prairie (or virtually), which of the two locations you chose had a higher species diversity? Suggest at least two plausible reasons why the diversity levels differed between the two locations.