Plant Biology Lab: Investigating Ecosystems with Vegetation

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Abstract

The "Investigating Ecosystems with Vegetation" Lab will provide students the opportunity to actively engage in observational research. Students will practice field sampling techniques, interpret cover class results and coarse woody debris, and to utilize data collected to interpret the ecology of a specific ecosystem. In teams, students will sample from two areas, forest area and outside of a forest cover area (open canopy). Cover class data and coarse woody debris (CWD) will be collected to understand ecosystems. The Daubenmire method will be used to collect cover class data that include forbs, grasses, woody shrubs, and sedges. This tool is useful for a variety of educational levels because students can easily learn to identify classes of plants without species specific knowledge. The composition of the ground cover in a specific area can provide information about the specific ecosystem under investigation. This can include information about soil health, climate and other species that inhabit the sample area. Students will apply their findings to compare similar ecosystems in order to gather insight into the differences between them and to help monitor changing habitats. This lab can be adapted for an introductory course for both biology and non- biology majors or as an upper level biology course.

Introduction

Experiential learning has always been an integral part of higher education, but its role has been fortified by the paradigm shift in higher education toward more student centered, active learning (Roberts, 2015). Munge, Thomas, and Heck (2018) outline the benefits of Outdoor Field Work as a way of integrating experiential learning into a number of disciplines in higher education, particularly in the sciences. Outdoor field work integrates student centered, active learning strategies (problem-based or inquiry-based learning methods) to achieve learning outcomes such as, applying knowledge, analyzing and interpreting information, and thinking critically (Mogk & Goodwin, 2012).

Outdoor field work has always been shown to improve students' attitude and knowledge towards biology. Prokop, Tuncer, and Kvasnicak (2007) utilized outdoor field work to improve students' knowledge in ecology. Based on the results of their work, they found students engaged in the outdoor field work, as compared to those that participated in traditional labs, displayed a better understanding of ecology concepts like ecosystems and food webs. Additionally, students' attitudes toward biology, the natural environment, and a future career in biology was significantly greater when using field work. These findings support additional strengths of outdoor field work identified by Munge, Thomas, and Heck (2018). With students engaging in the unique experiences of outdoor field work, they will have additional contact between the instructor and their peers, providing a sense of belonging to their program of study and future careers.

Therefore, the purpose of this lab activity is to use outdoor field work as an experiential learning method to engage the students in observational research of a plant biology lab. By using an experiential learning method, the "observational" research will be more student driven because the students will need to think about what they are actually doing, which is the founding concept of outdoor fieldwork, learning by doing (Roberts, 2015).

Materials & Methods

Methods

The students will engage in observational research by inventorying a specific area. Information about a certain area will be collected without manipulating a particular variable. For this lab, students will take samples along four different 25 meter transects. Two of the transects will be in a forest area and two will be outside of a forest cover area (open canopy). In each of the sample transects students will collect cover class data and coarse woody debris (CWD) (Garrett Kluthe 2016).

To measure the amount of coarse woody debris students will walk along the transect. Any stem or branch greater than 1cm in size will be measured and recorded on the data sheet. The Daubenmire cover value will also be established along this transect. Four different 1 meter by 1 meter plots will be established at the 0 m-1 m, 5 m-6 m, 10 m-11 m 15 m-16 m and the 20 m-21 m along the transect. The cover class results will be recorded on the data sheets. Results will be collected for both ground cover estimates and coarse woody debris (CWD) (Daubenmire 1959, Garrett Kluthe 2017).

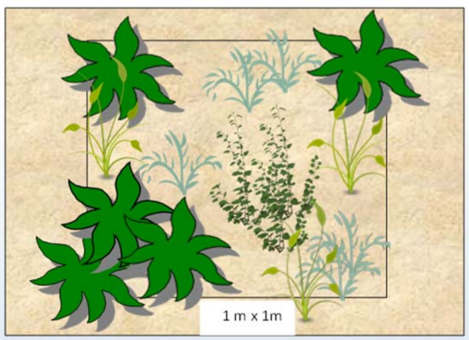

Figure 1. Each class of vegetation will be assigned a number based on the percentage of space covered in each plot. A value of 1 = 0-5%, 2 = 5-25%, 3 = 25-50%, 4 = 50-75%, 5 = 75-95%, 6 = 95-100%. The cover value numbers are recorded for each plot (Table 1).

Data Collection

The Daubenmire cover value allows the amount of cover in a measured area of different classes of vegetation to be calculated (Daubenmire 1959). Those used for the purpose of this lab will be forbs, grasses, sedges and woody plants. It is not necessary to be able to identify each species in a sample area but instead, be able to identify what class each species would occupy. **Forbs** are non woody, herbaceous plants that have broad, web veined leaves. They can have many different forms but are easily distinguishable from sedges and grasses. **Sedges** have flat narrow leaves and have angular stems. You can actually feel the edge on the stem. The stems do not have joints. **Grasses** have a hollow jointed stem. The leaves have parallel veins. **Woody plants** will have a woody covering on the stems.
"Sedges have edges; rushes are round; grasses are hollow right up from the ground."

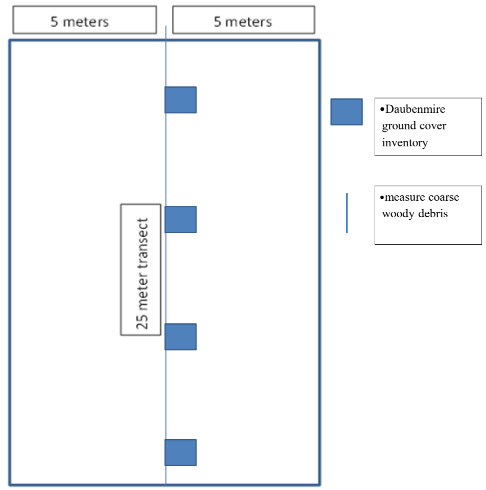

Figure 2. Sampling plot highlighting the transect and the 1m x 1m plots for estimating the Daubenmire ground cover. Using a meter tape, select a level location and lay down the tape along a line the runs 25 m. Be sure that the area is consistently the same across the transect line. For example, the forest transect needs to stay within the forest and not close to the edges.

Figure 3. The 25 m transect runs through a continuous environment parallel to the slope . The tape can remain in place while collecting data along this transect (A and B). Different classes of vegetation can be identified in the 1 m x 1 m plot (C and D). The amount of cover occupied by each class is recorded on the field inventory sheet (Table 1).

Results

CWD											
Total CWD											
	1	2	3	4	%	%	%	%	=	avg	T
Forbs											
Grasses											
Sedges											
woody											

Table 1. Daubenmire value are recorded for each plot. The % cover number is transferred to a percentage number that is used for statistical analysis between sites.. This translates to 1 = 2.5, 2 = 15, 3 = 37.5, 4 = 62.5, 5 = 85, and 6 = 97.5. Statistical analyses can be utilized to determine differences and similarities in ecosystems.

Discussion

The composition of the ground cover in a specific area can provide information about the ecosystem under investigation, including soil health, climate , community composition, and disturbance in the sample area. Comparing similar ecosystems can provide insight into differences and help monitor a changing habitat. Comparing different ecosystems can give insight into various influences that can impact the sample area and give insight into what other organisms or influences contribute to the ecosystem.

Utilizing outdoor field work as a vehicle to actively engage students in observational research can provide more opportunities for improving pedagogical practices of the instructors and collaboration among the students. Because the components and methodology of this lab do not require extensive, prior knowledge of plant species, this lab can be modified for use in both introductory and upper level plant biology or ecology course for science or non- science majors. The outdoor field work will help to improve disciple specific learning outcomes as well as generic learning outcomes such as teamwork, critical thinking, and communication skills (Arrowsmith et.al. 2011).

References

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