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Structural Approach to Understanding Restoration Management Effects on Prairie Community Composition

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Introduction

Vegetation is an important part of the prairie ecosystem. It provides food and shelter for mammals and insects. A combination of living and nonliving factors affect vegetation and its growth, such as bison and fire. Bison and fire interact together in the prairie community to help create species diversity and richness (Collins et al. 2012). But these factors alone may not benefit the prairie community as much. By burning the prairie in the spring, it can increase grass species, but decrease the diversity and richness of the flowering plants because they with each other compete for sunlight (Collins et al. 2012, Knapp et al. 1999). Bison are grazers mostly feeding on grasses and without their grazing habits the built-up dead grass can provide fuel for the spring burning. If bison graze on the site after it is burned they eat the grasses that are abundant and flowering plants can grow increasing the species diversity and richness. The flowering plants are not very desirable to bison making them less likely to graze in that site (Collins et al. 2012). Bison do not graze aimlessly. They graze in two different patterns, distinct grazing patches (small area) and extensive grazing lawns (large area), bison tend to revisit sites throughout the season (Knapp et al. 1999). This study looks at understanding restoration management effects on the prairie community composition by using data from Robel pole measurements and Light level percentage.

Methods

The vegetation density data was taken using a Robel pole and a PAR Light Meter. There were 21 sites measured at Nachusa Grasslands in Franklin Creek, Illinois. For the Robel pole, at each site there were four spots measured that were picked at random by starting at the edge of the site and walking five steps to the first point and then five steps from there to the next point, etc. At each of the points there were four measurements taken (North, South, East, and West). For the PAR Light Meter, there were also four points measured at random by transecting the site and five steps in between each point. At each point there were two measurements taken one at ground level and then one at about waist level from the ground. The Robel pole was a 2-meter-tall pole with alternating black and white horizontal bars. Between the 10th and the 11th bars there was a 4-meter-long string attached to the pole and the other end of the string was attached to the top of a meter stick. The meter stick was considered eye level. To operate the Robel pole one person stood and held the pole straight up from the ground, and the other person held the meter stick straight up from the ground. Making sure the string was straight and bending down so that the top of the meter stick was eye level, the person looked towards the pole to see what the closest section was to the plants that was not obstructed. For example, if the plant tops were in the 8th section the measurement would be the 9th section because the plants ended in the 8th section. The section was then recorded on a data sheet. This was then repeat for each of the cardinal directions and for three more points. The PAR (Photosynthetically Active Radiation) Light Meter was used to measure the wavelengths of light that could penetrate through the plant matter when at ground level and the wavelengths when at waist level. The measurements were then recorded on a data sheet. This was then repeated three more times. The measurements for both the Robel pole and the PAR Light Meter were done once in June and once in July.

Results

The data was entered into an excel spreadsheet and a pivot table was created for both the Robel pole data and the PAR Light Meter data. The pivot tables gave the Robel mean, light above mean, and light below mean. A data frame was created it includes the Robel point measurements and averages, the sites, age of the site, if bison were present, if it was burned, light above and light below averages, and light level percentage. The percent was calculated because this gave a more consistent measurement throughout the sites since some site light measurements were taken at the beginning of the day and some were taken later in the day when the sun was at a different angle in the sky. From the data, four major graphs were made. They showed the effects of the bison and fire on the sites. The four graphs that were made included: Robel pole mean vs. Bison, Robel pole mean vs. Fire, Light level percentage vs. Bison, and Light level percentage vs. Fire. There are eight graphs total, four for each month of data. The data was also entered into RStudio so that the t-test could be used to find the p-value. A t-test shows a comparison between two averages and tells whether they are different from each other (statisticshowto.com). The p-values were used to tell how well the data supported the original objectives. Based on the p-values of the Bison graphs, the Bison play a more significant role than fire. These values include: June, Robel pole 0.05931, Light level percentage 0.6149; July, Robel pole 0.1213, Light level percentage 0.6638. Since these p-values are higher than 0.05 they show support for the original objectives. The fire graphs only show significances in the data from July. These values include: June, Robel pole 0.0002338, Light level percentage 0.006016; July, Robel pole 0.1545, Light level percentage, 0.2291. The p-values for June are much lower than 0.05, meaning that the values do not support the original objectives, but the p-values for July are much higher than 0.05 meaning that the p-values do support the original objectives.

Graph	June (P-values)	July (P-values)
Robel Pole mean vs. Bison	0.05931	0.1213
Robel Pole mean vs. Fire	0.0002338	0.1545
Light level percentage vs. Bison	0.6149	0.6638
Light level percentage vs. Fire	0.006016	0.2291

This project, Structural Approach to Understanding Restoration Management Effects on Prairie Community Composition, was about looking at plant growth to see how bison and fire can affect the composition of the prairie community. Overall, the study has shown that fire and bison influence the plants in the prairie. Not only does the data show this but also the physical look of the prairie. Based on the data, the original objectives are supported by most of the values, but some of the values do not support the original objectives. Looking at the p-values for Robel pole vs. fire and Light level percentage vs. fire, they are lower than 0.05 and do not support the original objective. The p-value for Robel pole vs. bison graph could either support or not support the original objectives, although since this value is closer to 0.06 it is in favor of supporting the original objectives.

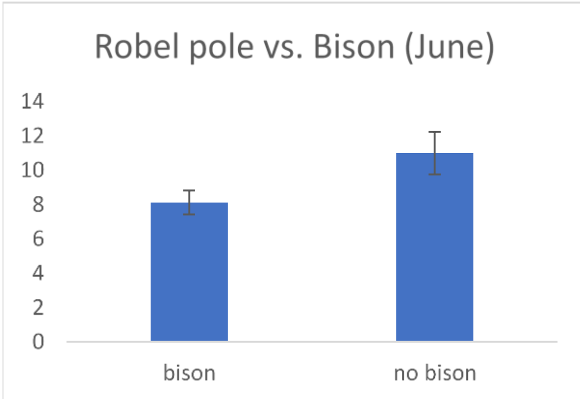
The Student Engagement Fund program has impacted my academic experience in different ways. It has given me the chance to take part in my own study, has helped me understand more about the process that is taken when a study is started, and has given me the opportunity to work with the Graduate students on their studies. It has also given me the chance to gain more knowledge about the prairie and the benefits that fire, bison, and insects have, through the papers I have read in preparation for the project. Through the study, Structural Approach to Understanding Restoration Management Effects on Prairie Community Composition, I got the chance to go in the field and learn how a Robel Pole and a PAR Light Meter are used and what kind of measurements are taken. From the data that was collected during June and July, I was able to sit down with my Professor and a Graduate Student and learn about the analysis process. Through my analysis on the data collected, I was able to see the effects that fire and bison have on the vegetation. Being able to work with the Graduate students has given me the opportunity to connect some of the information from my data and also from lectures to studies that have been going on.

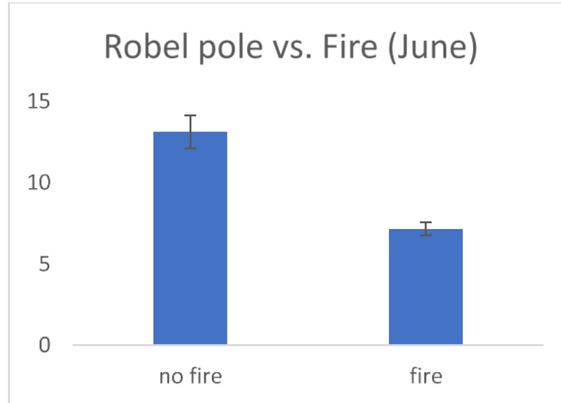
Work Cited

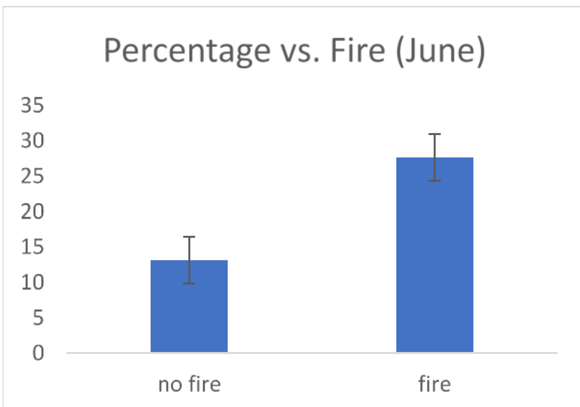
S. (2018, June 25). T Test (Student's T-Test): Definition and Examples. Retrieved August 5, 2018, from http://www.statisticshowto.com/probability-and-statistics/t-test/

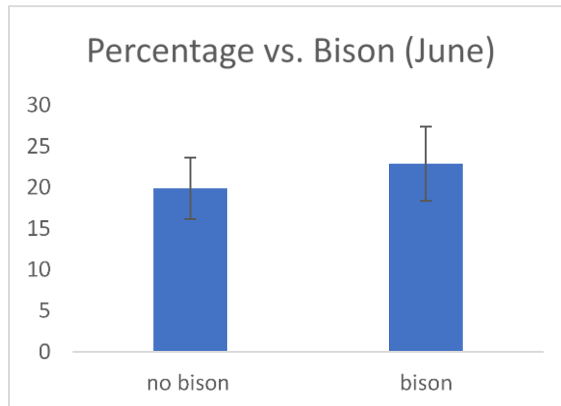
Knapp, Alan K., et al. "The keystone role of bison in North American tallgrass prairie: Bison increase habitat heterogeneity and alter a broad array of plant, community, and ecosystem processes." *BioScience* 49.1 (1999): 39-50.

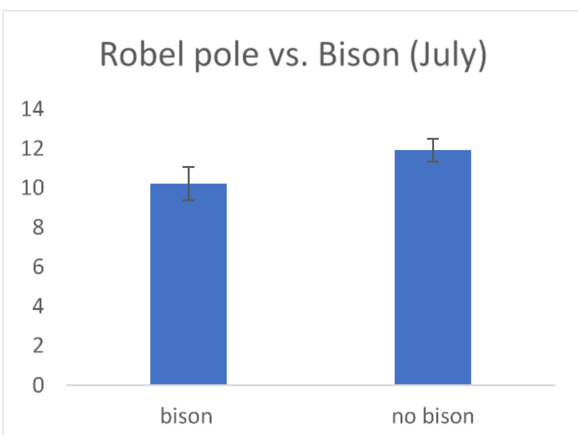
Collins, Scott L., and Laura B. Calabrese. "Effects of fire, grazing and topographic variation on vegetation structure in tallgrass prairie." *Journal of Vegetation Science* 23.3 (2012): 563-575.

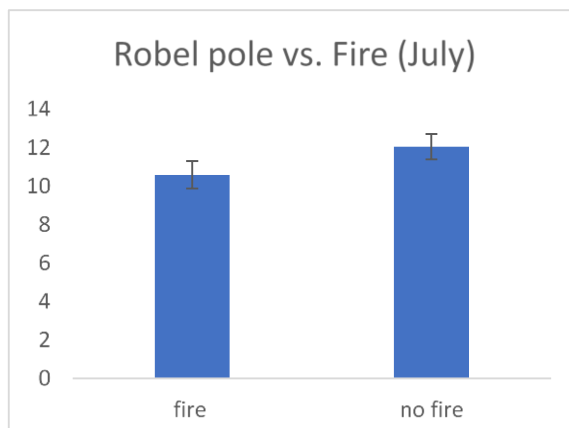

Robel pole vs. Bison (June)
14
12
10
8
6
4
2
0
bison
no bison

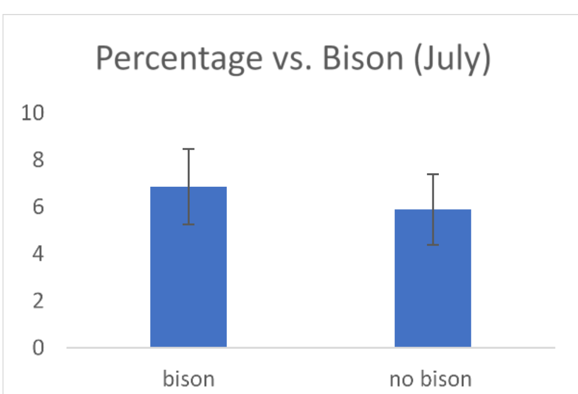

Robel pole vs. Fire (June)
15
10
5
0
no fire
fire

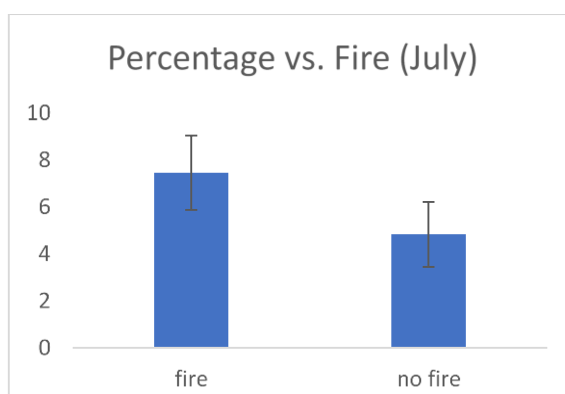

Percentage vs. Fire (June)
35
30
25
20
15
10
5
0
no fire
fire


Percentage vs. Bison (June)
30
25
20
15
10
5
0
no bison
bison


Robel pole vs. Bison (July)
14
12
10
8
6
4
2
0
bison
no bison


Robel pole vs. Fire (July)
14
12
10
8
6
4
2
0
fire
no fire


Percentage vs. Bison (July)
10
8
6
4
2
0
bison
no bison


Percentage vs. Fire (July)
10
8
6
4
2
0
fire
no fire