Plains Pocket Gophers (*Geomys bursarius*) Increase Plant Diversity on Gopher Mounds

Andrew Kurpiewski, Katrina Marklevits, and Erin Treiber
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Abstract

The plains pocket gopher (*Geomys bursarius*) is a fossorial rodent that digs an extensive burrow which creates mounds of dirt on the surface. This study examines the effects of these mounds on the plant diversity of an abandoned agricultural field by a series of different measurements. These include the percentage of distinct vegetation patches associated with mounds, percent of 20 meter transects crossing mounds, and number of plant species on mounds compared to a nearby control area. We found that 14.64 % of the field was covered by gopher mounds. By comparing our mean plant diversity data with the Itasca Biological Station's similar previous studies, we found a significant difference in the short term plant diversity of gopher mounds.

Introduction

Geomys bursarius, the plains pocket gopher, is a member of family Geomyidae; a group of fossorial rodents. The plains pocket gopher lives primarily in tallgrass and midgrass prairie, from the Mississippi delta in Louisiana up through north western Minnesota. Like most fossorial animals, the plains pocket gopher spends much of its time constructing and living within an extensive system of burrows which it uses for foraging, food storage, rest, and reproduction (Hazard, 1982). The process of constructing these burrows displaces a great deal of dirt and debris resulting in a mound on the surface.

The process of tunneling by the plains pocket gopher affects nutrient resources, particularly nitrogen. When this gopher churns the soil, the nitrogen-rich surface material is mixed with the nitrogen-poor subsurface. This creates greater nitrogen variability in the soil and thus allows for different plant species with varying preferred nitrogen levels to take root and grow (Inouye et al. 1987).

Sherrod et al. (2005) studied plant diversity on and around mounds of the northern pocket gopher, *Thomomys talpoides*, and determined that plant species diversity increased with recent

mound activity. If this is true of a closely related species, then it seems likely that *G. bursarius* mound creation will also increase plant diversity on said mounds. However, not all studies have produced similar results. Rogers et al. (2001) produced findings which suggested species richness was temporarily decreased or remained unchanged in areas disturbed by gophers. We predict that the plains pocket gopher will increase plant diversity upon the gopher mounds when compared to the surrounding area. However, conflicting reports in the past prompt us to formulate a null hypothesis that the plains pocket gopher has no effect on plant diversity in relation to the surrounding area.

Methods

This experiment was conducted approximately two miles north of Itasca State Park, Minnesota in an abandoned agricultural field. Data were collected related to three different objectives: 1) to identify distinct patches of vegetation and testing for a correlation with gopher mounds, 2) to estimate the percentage of the field covered in gopher mounds by identifying the portion of 20 meter transects covered in gopher mounds, and 3) to compare the number of plant species on abandoned gopher mounds with control areas near mounds. Twelve observers split up into four teams and data were combined for analyzing the affect of the plains pocket gopher on varying vegetation.

To identify distinct patches of vegetation within the surrounding ground cover, each person tallied 12 distinct patches of vegetation for a total of 144 distinct patches. This was done by walking in a relatively straight line and stopping once the presence of distinct vegetation was encountered. The patches of distinct vegetation were investigated to determine if they were associated with a gopher mound or not. If the distinct patches were not associated with a gopher mound, they were tallied separately. If the distinct patches were associated with a gopher mound,

the age of the mound was determined by soil characteristics. New mounds had fresh soil on the surface and no plants present atop the mound. Abandoned mounds were classified by the presence of a mound with plants growing atop and also lacked evidence of recent digging. Old mounds were considered to be mound-shaped, but were mostly covered with vegetation and had gravel present in the soil structure. The old mounds also lacked evidence of recent digging.

The second objective was to identify the proportion of 20 meter transects covered in gopher mounds, which could be used to estimate the total proportion of the field covered in mounds. The mounds were also tallied and classified according to whether they were a new, abandoned, or old mound. Each team measured 10 transects for a class total of 40 transects. The directions of the transects were chosen randomly by tossing a flag overhead and using a measuring tape to measure 20 meters in the direction the flag was pointing. Each gopher mound passing through the measuring tape was measured with a meter stick at its greatest width and given an age classification.

To determine whether gopher mounds increased plant diversity, this study counted the number of plant species on a gopher mound and on a randomly chosen nearby off-mound control area. The control areas consisted of approximately 0.5 square meters of ground cover that lacked a mound. Each team counted plant species on 10 different mounds for a class total of 40 abandoned mounds and 40 control mounds.

Data were compiled and analyzed using the statistical methods of unpaired t-test and Chi-Square goodness-of-fit test. In addition, data from previous similar studies at the Itasca Biological Station were used to observe the long-term effects of the pocket gopher on plant species diversity.

Results

A total of 144 distinct patches of vegetation were observed in the abandoned field. No mounds were associated with 38% of the distinct vegetation patches. The patches associated with mounds included 4% new mounds, 28% abandoned mounds, and 30% old mounds (Figure 1). Chi-Square analysis determined that the vegetation patches associated with gopher mounds were significantly different from the vegetation not associated with mounds (χ^2=9; df=1; $p<0.05$).

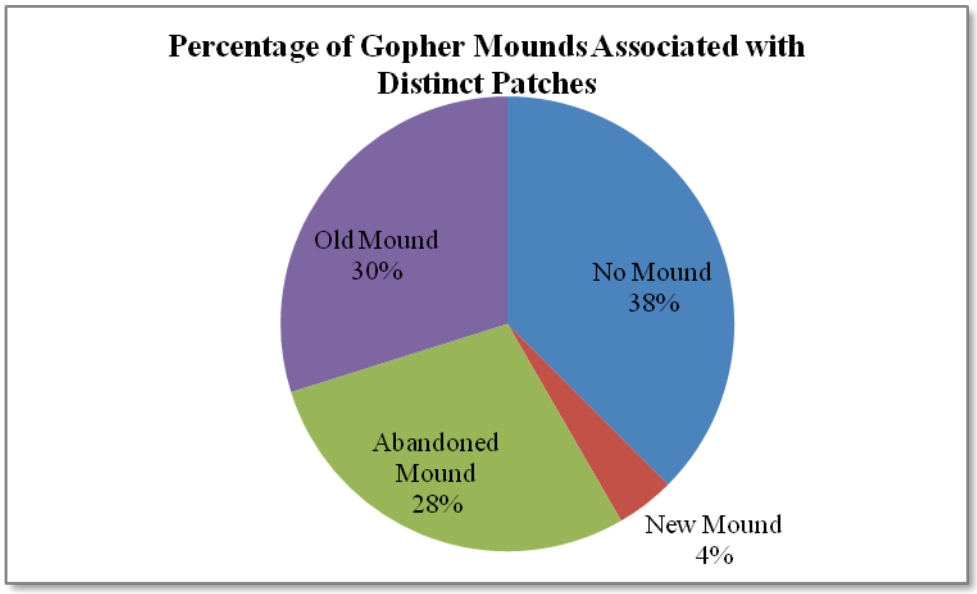

Figure 1. Percentage of distinct vegetation patches associated with pocket gopher mounds or no mounds. Observations were taken in an abandoned agricultural field in Clearwater County, MN in June, 2008.

Data was collected from the forty 20-m transect and the percentage of the field covered by pocket gopher mounds was determined to be 14.64%. The total percentage included new mounds (0.26%), abandoned mounds (2.04%), and old mounds (12.34%).

The number of plant species on the gopher mounds was 4.850 ± 1.819 and the number in the control areas was 2.725 ± 1.386 (Figure 2). An unpaired t-test confirmed that there was a

significant difference between the number of species on the mounds compared with the control areas ($t = 5.861$, $df = 78$, $p<0.0001$). Data were obtained from the same field for twelve of the past nineteen years. The mean number of plant species on gopher mounds in previous years was 5.01 ± 0.951 and the control areas contained 3.07 ± 0.57 different species (Figure 3a). The t-tests from previous years demonstrated a significant difference between the mound and control areas. The t-test for 2006 ($p>0.05$) was the only year that did not show a significant difference (Figure 3b).

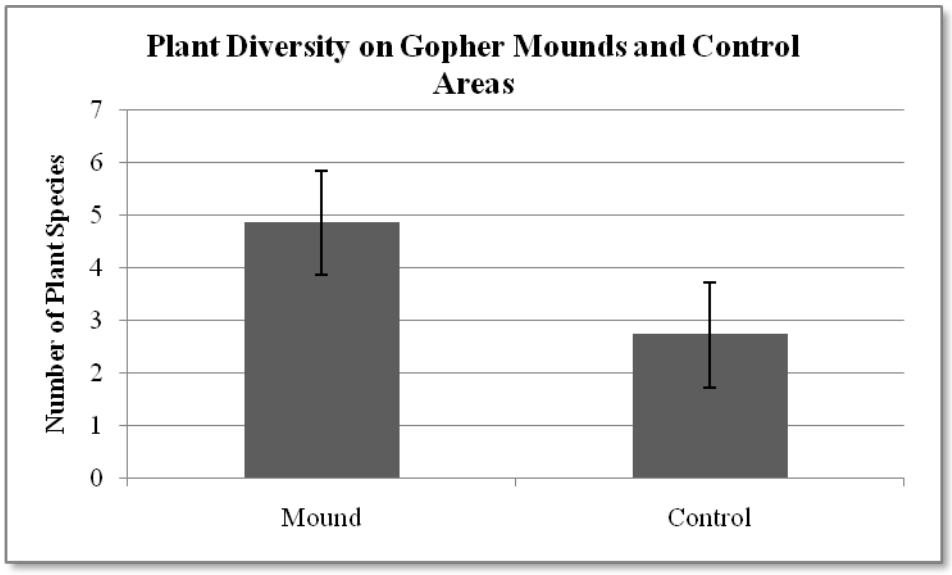

Figure 2. Comparison of plant diversity of pocket gophers mounds and control areas in abandoned agricultural field in Clearwater County, MN. Data was collected during June, 2008 and unpaired t-test revealed significant difference ($p<0.0001$). Error bars represent one standard deviation.

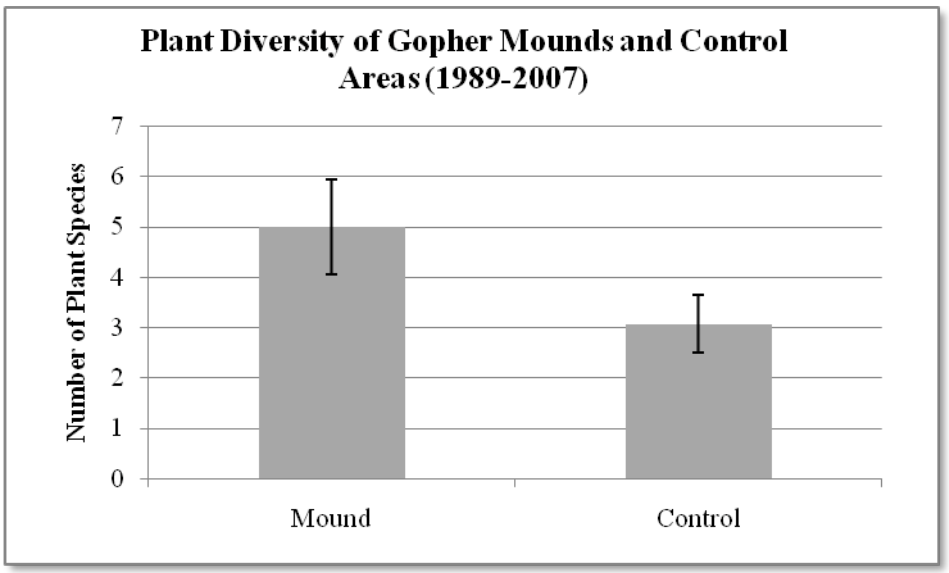

Figure 3a. Comparison of plant diversity of pocket gophers mounds and control areas in an abandoned agricultural field in Clearwater County, MN. Data collected from available studies between 1989 and 2007. Available yearly data located in Figure 3b. Error bars represent one standard deviation.

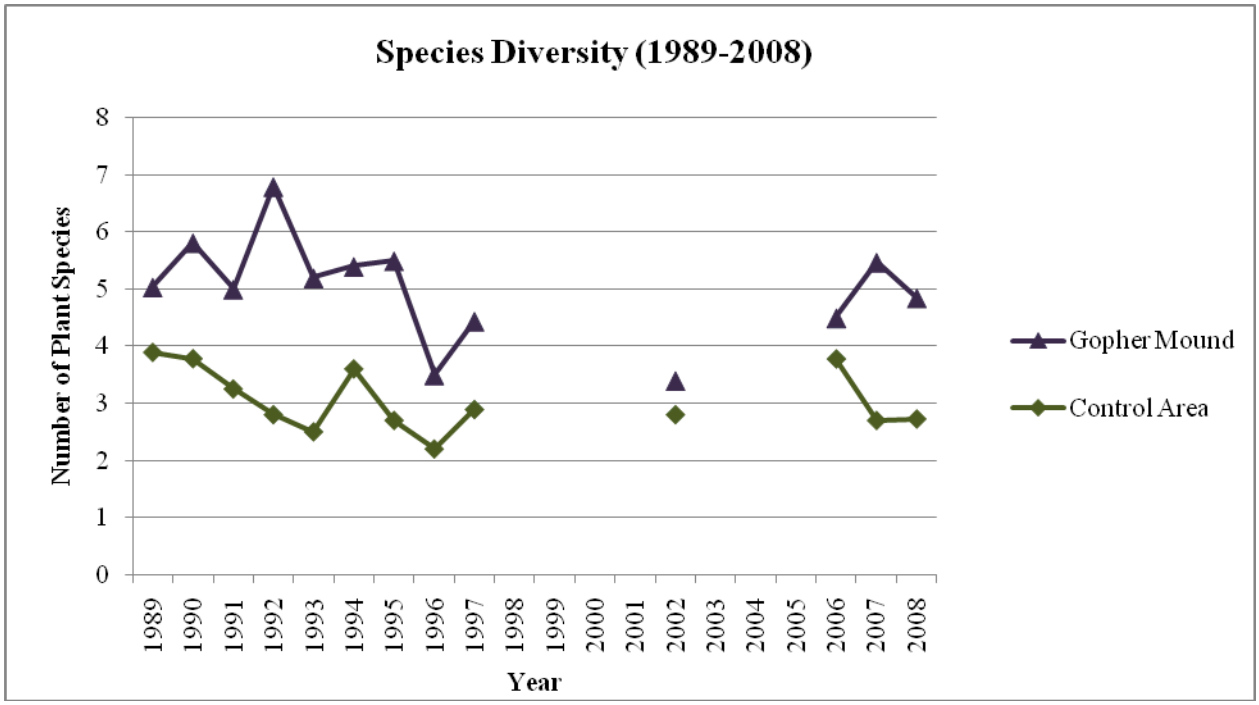

Figure 3b. Comparison of plant diversity of pocket gophers mounds and control areas in an abandoned agricultural field in Clearwater County, MN. Data collected from available studies between 1989 and 2008. Mean values of plant diversity for mounds and control shown for each individual year including current study. All values show significant difference ($p<0.05$), except 2006 ($p>0.05$).

Discussion

The data we collected throughout this experiment supported our hypothesis that gopher mounds increase plant diversity atop the mound when compared to the off-mound control area. We rejected our null hypothesis based on the fact that we found a significant difference in plant diversity on the gopher mounds in relation to the surrounding area (Figure 2). These findings were also supported by similar studies (Inouye et al. 1987, Huntly and Reichman 1994).

The construction of gopher mounds had a short term affect on plant diversity in the agricultural field (Figure 3b). Our data shows a significant increase of plant diversity on gopher mounds compared to control areas. This illustrates that pocket gophers, although they may be considered a pest, are capable of increasing plant diversity and temporarily altering the composition of the nutrients in the soil (Inouye et al. 1987).

Our results indicate a long term change in the effects of gopher mounds on plant diversity. As Figure 1 shows, a significant portion of the distinct plant patches surveyed were based upon a gopher mound. However, Foster and Stubbendieck (1980) found that there is a plant succession on gopher mounds as they get older, where perennial grasses replaced annuals. It is possible then that gophers can only increase the diversity of a field by continuously churning the soil, and that in their absence a field will revert to a less diverse, perennial dominated area. More insight into the long term effects of gopher mounds would be gained by tracking plant diversity on the same gopher mounds over a period of years.

Some of the sources of error in this experiment may be due to how we used the field and how we determined distinct patches of vegetation. The field may not have been correctly represented because each group chose an area without concern for overlap or complete coverage of the field. This error could have been minimized by sectioning off the field and collecting a

more representative sampling of distinct vegetation patches. Error could also be due to the lack of experience in mound and vegetation identification ability. Old gopher mounds may be underrepresented and considered to not be a gopher mound at all because sometimes it is difficult to distinguish between the two.

In the future more intensive data would be helpful in examining how the plains pocket gopher affects plant diversity and vegetation growth. One aspect that may need more in depth research is determining the types of vegetation found on the gopher mounds and what kind of nutrients these plants require to live. These data would help us to compare the effectiveness of the plains pocket gopher in relation to agricultural lands that are in operation today. Comparing similar fields with gophers and fields without gophers would also be a beneficial piece of data in this experiment that could be related to agricultural use and how the land prospers in the presence and absence of gophers.

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