

The Influence of *Geomys bursarius* on the Plant Diversity of an
Abandoned Field

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Abstract

Geomys bursarius (Plains Pocket Gophers) have been shown to significantly alter the vegetation within their habitat. The purpose of our experiment was to study the short and long term effects pocket gophers have on the diversity of vegetation. The percentage of gopher mounds to total area was 9.82 %. Of those mounds 32.9% were abandoned mounds. The mean number of species on the mound was 6.7, and off the mound was 3.183. The difference in number of species on and off mounds prove to be statistically significant with a $p < 0.0001$. From this evidence we concluded that gopher activity does affect the diversity of plant species in the field by creating unique nutrient rich patches of soil.

Introduction

Plains Pocket Gophers (*Geomys Bursarius*) are fossorial mammals whose habitat consists of prairies and open grassy areas (Hazard 1982). A large portion of their lives are spent underground creating burrows which they use for shelter and foraging. Through their burrowing and foraging activities pocket gophers create disturbances in the prairie which alters the vegetation of the landscape (Mielke, 1977). Gopher mounds cause an overall decrease in the plant biomass at the site (Reichman and Smith, 1985) however, they have been shown to increase the number of plant species observed. Previous studies suggest that nitrogen levels (Inouye et al, 1987) and soil nutrients (Litoar et al, 1996) play a significant role in the species richness due to the gopher excavation activity.

Our study strives to examine the short and long term effects of gopher activity on a field in northern Minnesota. Through a comparison between vegetation on and off the mounds we determined the short term effects of mound building on the vegetation of the field. We assessed the long term impacts of gopher activity through a comparison of our

own data with papers written about the field throughout the last two decades. We predicted an increase in plant diversity due to continual gopher activity.

Materials and Methods

We collected the data for this experiment in a small abandoned field a few miles north of Itasca state park in Clearwater County, Minnesota. Along with a larger group of students we disbursed throughout the field, and individually walked a straight transect across the field. As we walked along the transect we identified distinct patches of vegetation. We defined the patch as distinct if the vegetation varied in density, height, or variety of species. Once identified as distinct we noted whether the patch corresponded to a gopher mound (new, abandoned, or old) or not. We identified new mounds by the presence of fresh dirt. Abandoned mounds were still recognizable as mounds but had no trace of fresh digging. Typically old mounds are completely covered with vegetation, so we classified it as old if gravel was present.

Next, with two other group members, we stretched a 20-m tape measure in a randomly chosen direction. We determined the direction by throwing a flag over our shoulder from a random point. We secured the tape measure and separately tallied the new, old, and abandoned gopher mounds intersecting with the transect. We measured the greatest total width of each mound with a meter stick.

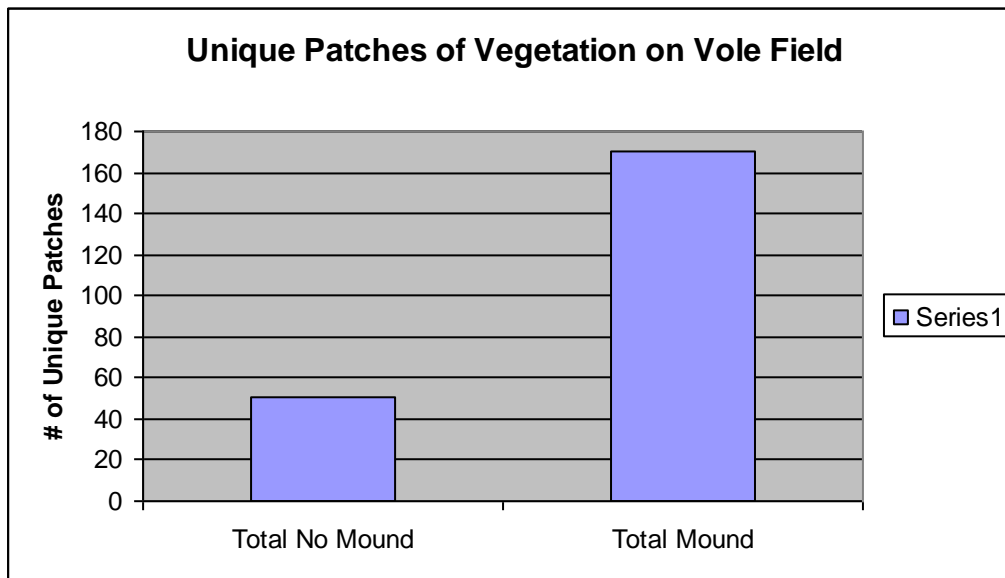
Finally we found ten abandoned gopher mounds and for each one counted the number of plant species on the mound. We then measured roughly 2 m in a randomly chosen direction, and counted the number of plant species in a 0.5 m quadrat not associated with a gopher mound.

Results

It was found that across the field area approximately 9.82% of it was covered in gopher mounds. Of this area, 63.6% of the mound space belonged to old mounds, 32.9% was abandoned mounds, and only 1.68% was new mounds. This area is compared to previous studies' data indicating an increase in *Geomys* activity over that past 12 years (Graph 4).

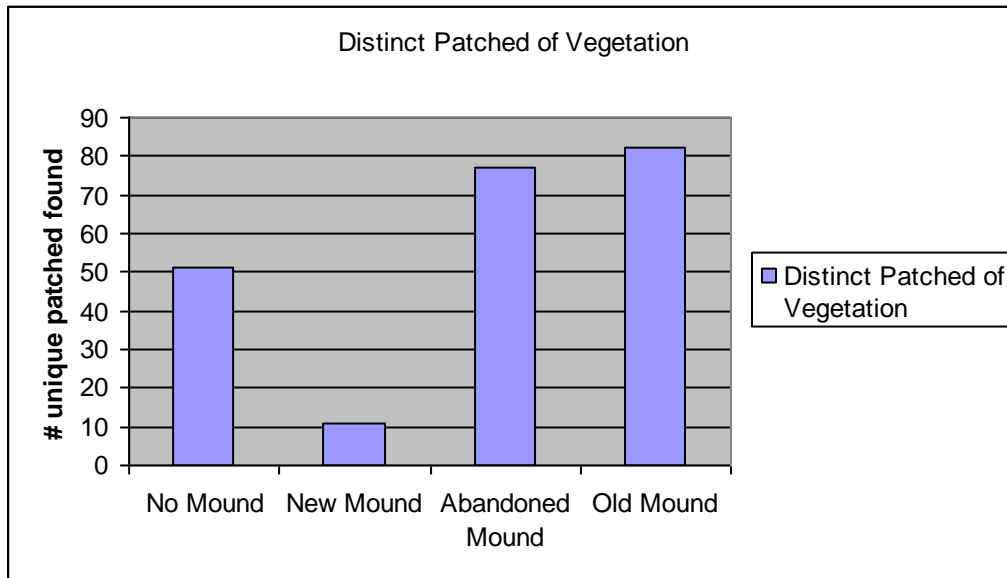
Of the unique patches measured across 21 straight-line transects, 77% were associated with a gopher mound, leaving the 23% found on the undisturbed grassland. Of the three mound types, field observations indicate that abandoned mounds almost always contained the most plant diversity on their surface. Old mounds were typically covered in the common grass species found off mounds with one or two unique plant species, and new mounds contained little or no vegetation on their surface.

Graph 1



Graph 1: Bar graph depicting the ratio of unique vegetation patches found either on a gopher mound or on the surrounding undisturbed land.

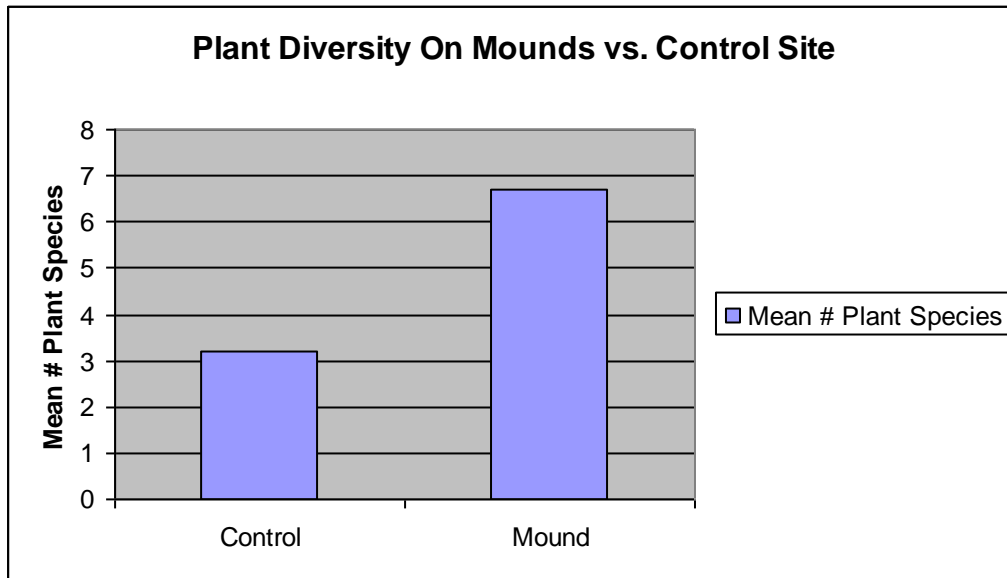
Graph 2



Graph 2: graph comparing the number of unique vegetation patches found on each specific type of mound along with the control areas. The smallest number of unique plant species found was on new mounds. The largest number was found to be on old mounds.

The diversity of vegetation found on abandoned mounds had a mean value of 6.7 +/- 0.227 species/mound. The mean diversity on randomly chosen non-mound (control) areas was 3.183 +/- 0.131 species/mound. The data provides evidence that there is a statistically significant difference in vegetation diversity between gopher mounds and the surrounding prairie (DF=118, t-value = -13.406, P<0.001). We can therefore reject the null hypothesis that there is no difference in plant diversity between non-mound control areas and abandoned mounds and conclude that there is an increase in diversity on mounds versus off.

Graph 3



Graph 3: Comparison of the mean value of plant species found either on an abandoned mound or on a non-mound control area. The difference between means was found to be 3.517

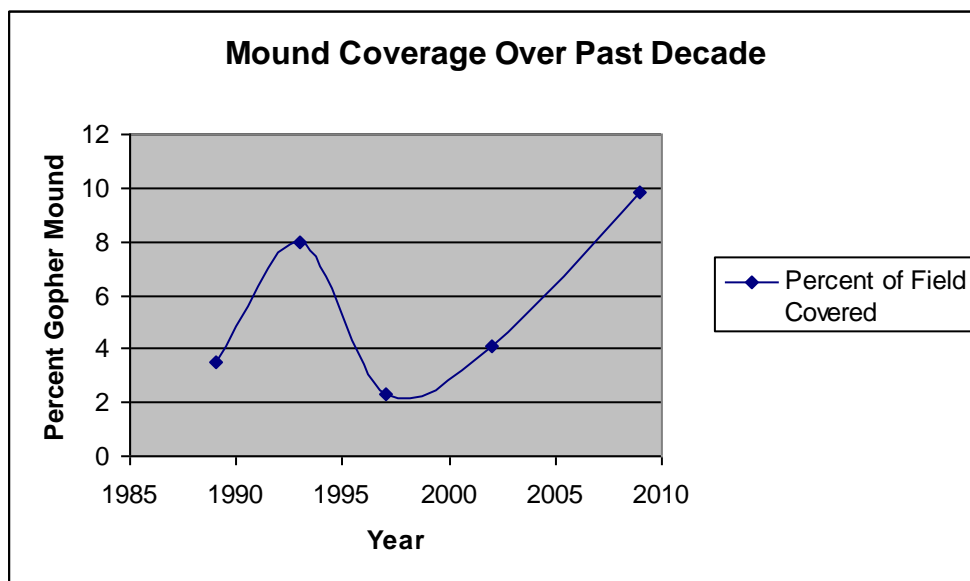
Discussion

The purpose of this study was to examine the effects of gopher mound building on the vegetation of an abandoned field. Our data suggests that through their mound building, gophers do alter the species composition of the landscape within their range. The species composition varies depending on the stage of the mound: new, abandoned, or old. Graph 2 dissects the general results of Graph 1 showing the number of unique vegetation patches on all three types of mounds. Of all the site categories, the smallest number of patches was found on new mounds. Although this is parallel with the observation that new mounds on average held the smallest plant diversity, it is not necessarily a correlation due to their small sample size on the field. Likewise, the largest number of unique patches was found on old mounds, yet this is not in support of the

observation that abandoned mounds on average hold the greatest plant diversity. This data likely supports the fact that old mounds are in the largest number on this field.

We found that compared to previous years (Niksich et al, 2002.) the percentage of mound coverage in the field has increased (Graph 4). Between 1993 and 1997 there was a decrease in the percent coverage of gopher mounds followed by an increase from 2002 to the present. Severe weather was the primary factor behind this. In 1995 a large windstorm struck Clearwater and 12 other counties in Minnesota. This windstorm destroyed 129,000 acres of timber and blew down 1000 trees in the Itasca area including the study area (NOAA Satellite and Information Service, 2009). As a result, the forest surrounding the study area changed drastically from old growth cedar and pine to mixed deciduous forest. This change in regime influenced the drainage rate of the field which in turn may have caused a decrease in the gopher population.

Graph 4



Graph 4: Timeline graph of % field coverage by gopher mounds. Note Significant drop between 1993 and 1997.

We also found that plant diversity on abandoned mounds was significantly higher than that of the control areas adjacent to the mounds. The short term effect of gopher mounds on the field is a decrease in plant biomass. The mounds create a barren environment in which new or buried seeds take hold, and begin growing. Pocket gophers, transferring new soil to the surface, add nutrients to the soil allowing new plant species to grow.

The long term impact of gopher mounds would be increased speciation of the specific location preventing a monocultural environment. Most of the new vegetation consists of forbs which constitute a large part of the gopher's diet. However, in order to ascertain if mound building is a method used to sustain food supply, more studies would need to be conducted focusing on the foraging habits of the gophers. These studies could examine return rate to previously abandoned mounds. Also, further studies should be done looking at the long term effects of the vegetation change on species that share the same habitat with the gophers.

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