Curtis Hughes

Matt Sharrow

Rob Etheridge

Quantitative and Qualitative Approaches to Study the Effects of Plains Pocket Gopher (*Geomys bursarius)* Mound building on Vegetation

ABSTRACT

The plains pocket gopher (*Geomys bursarius*), has been associated with higher levels of plant diversity in grassland areas. In order to test this prediction we conducted vegetative surveys on and off mound areas. We also counted and measured mounds along randomly chosen transects in order to get an idea of the amount of impacted area. Our results further supported this association by demonstrating the effects pocket gophers have on plant diversity. Higher plant diversity was found on or near mound areas versus off. .

INTRODUCTION

Geomys bursarius, the Plains Pocket Gopher, is a primarily subterranean species, which creates an underground burrow system for foraging and protection (Hazard 1982; Brekenridge 1929). These animals are primarily herbivores that prefer forbs and other grasses found in their preferred habitat, the mid-grass prairie. However, they are also associated with open woodlands and other open grassland areas. The underground tunnel system allows the pocket gophers to

remain hidden while foraging. Burrowing occurs with its front claws and incisors (Brekenridge 1929). The disturbance caused by the tunneling and mound building of pocket gophers have been documented to have both positive and negative effects on the immediate area (Tilman 1983). Areas with small disturbances such as mounds and tunnels are often associated with an increase in the overall shrub diversity (Eldridge 2004).

The purpose of this study was to examine the effect of gopher disturbance on vegetative diversity, by comparing on and off mound areas. Similar studies have shown that pocket gopher burrowing can cause changes in the vegetative community through selective foraging (Inouye et. al. 1987) and through excavation of soils of differing fertility than that on the surface (Williams et. al. 1986; Eldridge 2004). How will pocket gopher activity affect vegetative diversity between mound and non-mound areas in an old field in northern Minnesota? We hypothesize that pocket gophers will have a positive effect on vegetative diversity directly around the disturbed areas. Our objectives are to randomly analyze transects for gopher mounds, categorize and measure these mounds, assess the diversity in plant species around the mounds and pool the data enabling total and proportional numbers to be observed and compared.

METHODS

The study area for the project was located north of Itasca State Park Minnesota near the intersection of Highway 200 and 71 (47°15'N, 95°13'W). The site is comprised of an abandoned farm field that went into disuse over three decade ago after the pocket gophers started to inhabit the area. A number of new and old gopher mounds were observed, which made the site ideal to study vegetation effects related to gopher mound activity, since there has been time for the different effects to take place over a number of years.

In order to quantify if distinct patches of vegetation were associated with mound disturbance a randomly chosen transect was walked by twenty 21 research volunteers and 12 distinct patches of vegetation were recorded by each for a total of 252 patches. Each distinct patch of vegetation was labeled if it was associated with a new mound, abandoned mound, old mound or no mound. A new mound was classified as having fresh dirt on the surface and relatively no plants present. An abandoned mound was still easily recognizable, but did not have the fresh dirt and often had more vegetation growing on it. Old mounds were typically hard to recognize and were almost completely covered with vegetation and gravel.

To get an idea of the amount of area disturbed or impacted by the pocket gophers, mound surveys were taken along seventy transects that were twenty meters long. Each mound found was classified as new, abandoned or old. Each mound was also measured at its greatest diameter in order to get an idea of size.

Finally to test for a difference between vegetative diversity of mound and non-mound areas, plant species counts were taken at randomly chosen abandoned mounds and non-mound control areas within two to three meters of the mound. Plants were counted within half meter quadrats on and off mounds in order to quantify a difference between areas.

All of these surveys were taken in the same area at randomly chosen locations by seven different teams of three students. The distinct patches of vegetation data and the mound counts along the 20 meter transects were counted and proportions of each category were calculated. A chi-square goodness of fit test was used to see if there were unique vegetation patches on and off mounds. Then a paired t-test was used in order to quantify the difference between mound and non-mound vegetation patches.

Results

Distinct patches of vegetation were associated the majority of the time with gopher mounds (figure 1). Old mounds were found most, followed by abandoned mounds and finally new mounds (figure 3). Comparison of vegetation patches on and off mounds looking for unique vegetation patches was statistically significant ($X^2 = 70.1406$, df = 2, $P < 0.0001$). The number of plant species on abandoned mounds versus nearby non-mound areas was compared using a paired t-test. The number of plant species was higher on average than off mound areas (figure 2, mound = 5.471, control = 3.571, t = -6.153, df =138, P = 0.0001).

Discussion

Gopher activity is clearly associated with distinct patches of vegetation, which makes them an important element in maintaining high diversity in grassland areas (Figure 1). A large portion of the study areas has been impacted by gopher activity as was shown by the large amount of old mounds found in comparison to new mounds (Figure 3). These two figures indicate a high level of disturbance caused by gophers, which is related to plant diversity.

The number of plant species is higher on abandoned mounds compared with adjacent non-mound counterparts. This agrees with a number of previous studies involving the effects of pocket gopher activity on soil structure, soil texture, vegetative communities, succession, fertility, and habitat heterogeneity (Tilman 1983; Rogers et. al. 2001; Inouye et. al. 1987; Eldridge 2004). Pocket gopher underground tunneling and mound building activities cause a significant difference in chemical, hydrologic and soil structures from non impacted areas (Eldridge 2004). One cause for this change in the soil is the increase in filtration of precipitation for the area adjacent to the mounds. This structure change directly decreases runoff, and so perhaps gopher activity could be analyzed as a tool for reducing hydrologic outputs in water-

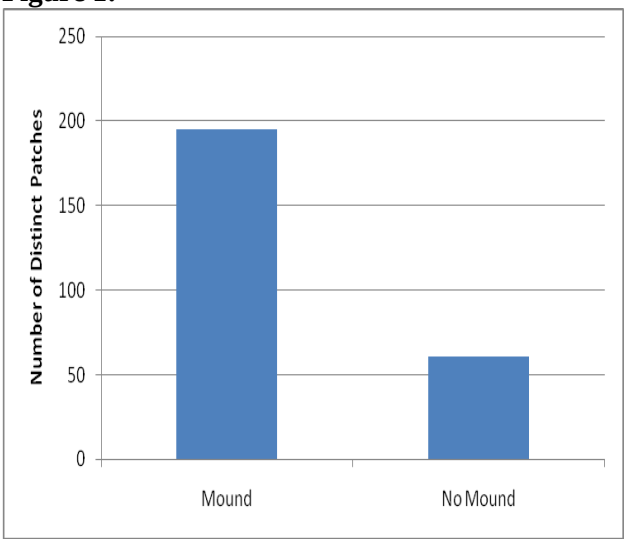
limited ecosystems that they inhabit. These and other direct effects of gopher mounds can have profound effects on the existing vegetative community (Grant et. al. 1980).

The small-scale disturbances created by pocket gophers are significant in affecting habitat heterogeneity and thus species richness in their habitat, which our results further supported (Gibson 1989). Gopher activity causes changes in the soil structure and their selective foraging preferences form a complex micro ecosystem effect that results in a more complex vegetative community. Pocket gophers have been shown to choose areas of habitat with high densities of relatively more advanced stages of succession like forbs and perennials, where they heavily impact the existing vegetative communities directly over the active burrows (Reichman and Smith 1985). The disturbance done is often to relatively later successional vegetative communities , which can retard the succession process by removal of dominant species biomass, changes in soil fertility often characterized by a reduction in above ground nitrogen levels, and the ensuing changes in light levels that accompany these two effects (Tilman 1983; Inouye et. al. 1987; Williams et. al. 1986). This disturbance helps to maintain a mixture of microsites in differing stages of succession through the exposure of bare ground as well as unique soil characteristics compared with non-mound areas (Reichman and Smith 1985). This is reflected in our study by the differing number of plant species between mound and adjacent non-mound areas. If our study had examined the species composition of mound and non-mound areas, it is likely that we would have found the species composition between the two reflected different successional stages. However, one study showed a decrease in plant species richness as a result of pocket gopher activity (Rogers et. al. 2001). Perhaps this was a result of the superior competitive ability during early successional stages of a few particular species. The rapid

vegetative recovery of the mounds in this particular study was dominated by the perennials that characterized the rest of the non-mound areas.

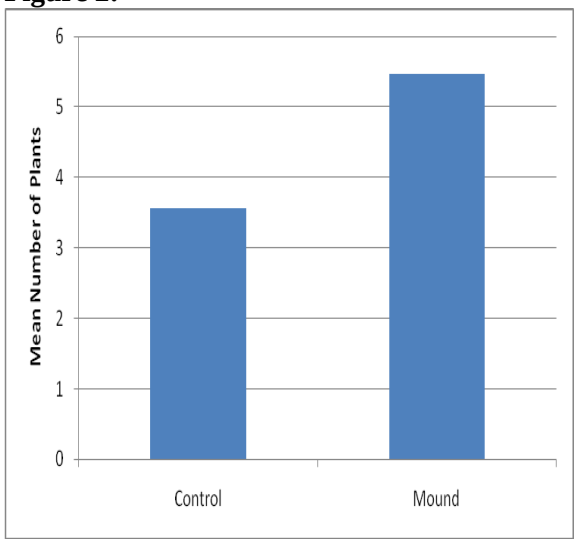
Pocket gophers can decimate the vegetation above the active burrows, which can create edge effects within the relatively more monotonous field they inhabit. This edge effect can create competition-induced waves that emanate throughout the vegetative communities in which the gophers reside (Reichman et. al. 1993). Although some effort has been expended for this purpose in previous studies, future studies could further analyze the particular changes in species composition of the vegetative communities affected by gophers. Furthermore, the edge effects and decreased succession rates accompanied by gopher activity in an ecosystem could be useful biological tools for wildlife and habitat management. Many cervids such as *Alces alces* and *Odocoileus virginianus* prefer and thrive in edge and mixed communities as a result of their need for mature forest cover coupled with open grass and shrub habitat to forage (Hazard 1982). The same phenomenon is characteristic of some carnivores such as *Vulpes vulpes* (Hazard 1982). Pocket gophers could be used as a management tool for maintaining early succession habitat adjacent to more mature forest settings for the benefit of many economically important species.

Figure 1:



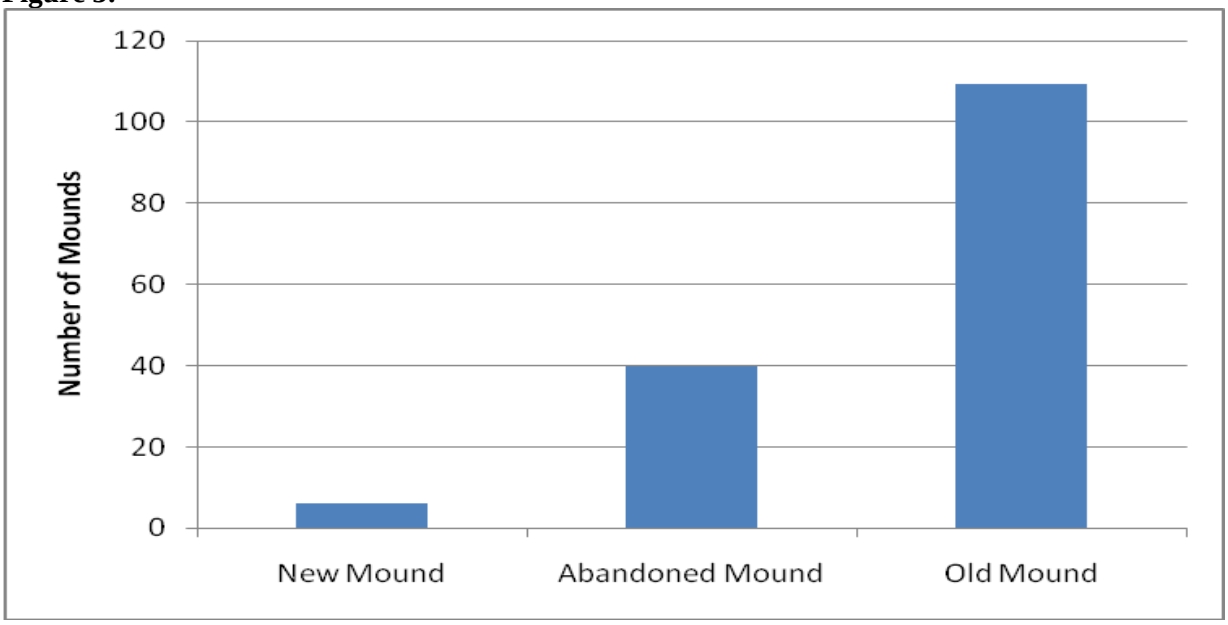
Distinct patches of plants were located with in the study area. The majority of distinct patches were found on a mound area.

Figure 2:



Different species of plants were counted on and off mounds. I higher mean number of plants were found on mounds versus off.

Figure 3:



Transects were surveyed for new, abandoned and old mounds. The majority of mounds found were old, followed by abandoned and finally new. This demonstates that a large majority of the area has been impacted.

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