

The effects of distance from a yellow-bellied marmot burrow on plant diversity

Abstract

Mammal mounds have been found to have diverse effects on vegetation. The area around yellow-bellied marmot (*Marmota flaviventris*) burrows was examined for different morphospecies and plant cover to find if diversity decreased near a burrow. Morphospecies were identified to family to look for trends in species composition. The number of morphospecies was found to decrease nearer to a burrow and plant cover was significantly lower immediately next to a burrow. Of the 13 plant families found, the number of morphospecies within Poaceae and Fabaceae experienced a moderately significant decrease near the burrow, and Asteraceae experienced a significant decrease. This may be due to herbivory or because marmots like to excavate burrows where plants with more structural support grow to help maintain the solidarity of the burrow.

Introduction

Burrowing animals often disturb the vegetation they occupy. Burrows may turn soil (Neave and Abrahams 2001) and increase microbial activity (Ayarbe 2000). However, the effect of the disturbance on plant diversity differs with each type of animal. Bison wallows create a moist lowland environment for plants. Badger (*Meles meles*) mounds are recolonized by grasses and plants found in disturbed areas, and vegetation grows back quickly on gopher mound and ant hills (Gibson 1989). Areas with vole (*Microtus*) mounds were found (Fehmi and Bartholome 2002) to have more plant species than areas without them. However, the presence of gopher (*Geomyidae*) mounds in a prairie community was found to have a weak negative effect on plant diversity (Rogers et al year). I aim to study the effect of marmot burrows on plant diversity.

Marmots are a burrowing rodent species that have been found to mostly negatively affect vegetation growth. Plant cover increases with distance from a woodchuck (*Marmota monax*) burrow and diversity is greatest at intermediate distances

from the burrow (English and Bowers 1999) The burrows I examined for changes in plant diversity were excavated by yellow-bellied marmots (*marmota flaviventris*), who weigh around 1-5 kg. Plant biomass was found (Johnson 2001) to decrease near the burrow. Besides the disturbance of an unearthed area, herbivory may affect the plants in the area.

If the grazing of yellow-bellied marmots affects plant diversity, the differences in composition may be predicted by the plants they eat. Marmots consume 2-6.4% of the vegetation (Armitage, 1979). Dandelions (*Taraxacum officinale*), an introduced species growing in disturbed areas, are their preferred food, and are more abundant near their burrow than further away. The plants they next prefer to eat are cow parsnip (*heracleum lanatum*), cinquefoil, and grass (Armitage, 1979). They also like clover and choose areas that contain a disproportionate amount of it (Stallman and Holmes 2002). Lathyrus and cinquefoil are more abundant further from a burrow, but they may eat cinquefoil because it is abundant overall (Johnson, 2001). They consume only the flowers of bluebells (*Mertensia ciliate*), columbine (*Aquilegia caerulea*), lupine (*lupinus floribundus*), and *Delphinium barbeyi*. The last three contain alkaloids, unfavorable secondary compounds. Marmots do not eat fireweed (*Epilobium angustifolium*) which contains tannins, toxic to animals (Armitage, 1979). They will not eat dried plants because they gain all their water from vegetation (Armitage, 1991), which may be a reason they prefer to eat forbs over grasses, sedges, and rushes (Stallman and Holmes 2002).

The purpose of this study was to find if distance from a burrow affects plant abundance and species diversity, in an attempt to understand how resistant different species of plants are to disturbance and how marmots interact with their habitat.

Materials and Methods

The experiment was conducted south of Gothic, Colorado, at 2938 m, in an area composed of small mounds covered by grasses and flowers. It is a main colony site of yellow-bellied marmots. Two 9 meter transects were set out at random directions from each of four burrows. At every 3 meters along a transect, a 1 x 1 m plot was set out and the percent cover and number of morphospecies of plants was recorded. Samples were taken of unknown plants and they were separated into morpho species and most of them were identified to family name.

A regression analysis of the number of morpho species at increasing distances from the burrow was calculated using JMP. ANOVA tests were used to compare percent bare ground among plots and the number of species in a plant family at different distances from a burrow for all the plant families observed. The Sorenson index of similarity was used to calculate the percent similarity of species composition between plots 0 and 3, 3 and 6, and 6 and 9. $P < 0.05$ was interpreted as significant and $0.1 > p > 0.05$ as moderately significant.

Results

Species diversity increased away from a burrow ($\text{Adj } R^2 = 0.942$, $P = 0.0195$). Percent bare ground did not decrease away from the burrow ($\text{Adj } R^2 = 0.0272$, $P =$

0.4071). However, in the ANOVA test, the groupings of 0, 3, 6, and 9 meters were found to be significantly different in respect to percent bare ground ($\text{Adj } R^2 = 0.555$, $P = 0.005$). The plot immediately next to the burrow had more bare ground than the other three plots.

There were 13 families and 69 morphospecies found in all the plots combined. The variation in the plant families Onagraceae ($\text{Adj } R^2 = -0.07875$, $P = 0.8637$), Linaceae ($\text{Adj } R^2 = -0.07181$, $P = 0.8196$), Apeaceae ($\text{Adj } R^2 = -0.06897$, $P = 0.8013$), Polygonaceae ($\text{Adj } R^2 = -0.03333$, $P = 0.5796$), Rosaceae ($\text{Adj } R^2 = -0.04385$, $P = 0.6332$), Chinenopoaceae ($\text{Adj } R^2 = -0.01693$, $P = 0.4897$), Violaceae ($\text{Adj } R^2 = 0$, $P = 0.4074$), Polemoniace ($\text{Adj } R^2 = 0$, $P = 0.4074$), Rubinceae ($\text{Adj } R^2 = 0.054991$, $P = 0.2113$) and Ranunculaceae ($\text{Adj } R^2 = 0.800055$, $P = 0.1527$) between plots was found to be non significant. There was a moderately significant increase in the number of species within the plant families Poaceae ($\text{Adj } R^2 = 0.140585$, $P = 0.0654$) and Fabaceae ($\text{Adj } R^2 = 0.140585$, $P = 0.0654$) as distance from a burrow increased. There was a significant increase in the number of species within the plant family Asteraceae ($\text{Adj } R^2 = 0.226258$, $P = 0.0169$) as distance from a burrow increased.

Calculated from the Sorenson index of similarity, there was 23% similarity between transects 0 and 3, 31% similarity between transects 3 and 6, and 38% similarity between transects 6 and 9.

Discussion

The total number of morphospecies increased as distance from the burrow increased. However, the number of morphospecies in a family did not change with distance from burrow for most of the families. The plant families Poaceae and Fabaceae

showed a moderately significant decrease in the number of morphospecies, and the family Asteraceae significantly decreased. Percent bare ground increased, consistent with the previous findings discussed.

Bobaks, relatives of marmots, mostly eat plants from the families Fabaceae and Asteraceae (Ronkin and Tokarsky 1993). The plants may be more present away from the burrows rather than near them because marmots may have consumed them. Or, they may be present in larger numbers away from the burrow because marmots chose their burrow on the outskirts of a patch. Marmot food plants are often distributed in clumps (Stallman and Holmes 2002).

Herbivory cannot explain the decrease in the number of species in the family poaceae because marmots do not consume grasses. In studies with woodchuck burrows, Kentucky bluegrass (*Poa pratensis*) and *Festuca elatior* increased but orchard grass (*Dactylis glomerata*), in the same family as the other two, decreased in density (English and Bowers 1994). Grasses easily colonize disturbed areas and perhaps one type of grass out-competed another, making grasses no less abundant near a burrow but rather less diverse. Grasses may not grow close to a burrow because marmots choose to dig burrows in places that have the support of hardier plants. Nest burrows are within cracked rocks or under rocks or under logs, bushes, or roots, to help support the structure of a burrow. They are also near cover to reduce predation (Armitage, 1991). If the abundance of each morphospecies was gathered, then it may generate a clearer picture. Some species within a family may be more resistant to disturbance than others.

The percent similarity between plots increased as distance from the burrow increased, showing that the environment away from the burrow is more homogeneous.

None of the plots were over 50% similar. This could be because the environment overall is not homogeneous. The soil may differ greatly throughout the area. Although I chose burrows within the same locality, the vegetation was obviously different around the different burrows. The soil around burrow #2 was darker and there were larger plants and shrubs. Most areas with marmot burrows are rocky, but some areas are drier. Burrow #1 had direct sun and rocks. Burrow #3 contained a disproportionate amount of fireweed (*Epilobium angustifolium*). The burrows may also differ in the amount of use they have from marmots and how long they have been active. Burrows may be nest burrows with multiple entrances or escape burrows with only one entrance (Armitage, 1991). Burrow #4 was a nest burrow but the other burrows may not have been. Other activities of marmots, such as trampling on vegetation and defecating, may affect the area. Future studies could look at soil samples at increasing distances from a burrow as a possible factor of affecting vegetation.

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