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POCKET GOPHER (*GEOMYS BURSARIUS*) DISTURBANCE ON A TALLGRASS PRAIRIE IN CENTRAL NEBRASKA

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ABSTRACT

The amount of deposited soil from pocket gopher (*Geomys bursarius*) mounds was quantified on a tallgrass prairie. Five percent of the total surface area was covered by mounds and the rate of mound formation was highest in early October at 64.57 mounds/ha/day. Mound-building activity and air temperature were not significantly related.

† † †

The pocket gopher (*Geomys bursarius*) is a significant source of disturbance on rangeland ecosystems. This rodent is a fossorial herbivore that feeds mostly on below-ground vegetation (Huntly and Inouye 1988). Extensive burrow systems are produced, resulting in pocket gophers depositing large amounts of soil onto the surface in the form of mounds (Hobbs and Mooney 1991, Huntly and Inouye 1988). The most conspicuous effect gophers have on an ecosystem is the damage done to above-ground vegetation. According to Foster and Stubbendieck (1980), pocket gophers lower forage production in rangeland because the displaced soil buries and kills vegetation. This behavior creates areas of sparse vegetation, affecting the survivorship and fitness of plants (Davis et al. 1991). Reichman and Smith (1985) reported that gopher burrows reduced overlying vegetation by more than one-third. However, bare soil from mounds provides seedbeds for aggressive plant species (McDonough 1974) which can alter species composition (Spencer et al. 1985). As a long-term influence, mound soil can create a mosaic pattern of vegetation displaying various stages of secondary succession within the community (Grant et al. 1980).

Several authors have quantified the magnitude of excavated soil brought to the surface. Four months after the eruption of Mount St. Helens, gophers covered 2% of the ash-laden surface with soil (Anderson 1982). On a tallgrass prairie in Texas, Beuchner (1942) estimated that 806–15,859 kg of soil were deposited/ha/year by gophers (*Geomys breviceps*) and 0.4–8.3% of the surface was covered by mounds annually. On a subalpine range in Utah, *Thomomys talpoides* deposited 11,200 kg of soil/ha in 1941 (Ellison 1946). In Kansas, Downhower and Hall (1966) estimated that one pocket gopher can bring up to 1,814 kg of soil to the surface annually.

The purpose of this study was to analyze pocket gopher (*Geomys bursarius*) activity on a tallgrass prairie during the late summer and fall months. An attempt was made to quantify the amount of displaced soil caused by the excavation of burrows. Air-temperature was also measured to see if it had an effect on mound-building activity.

METHODS

The study was conducted from August through November of 1995 on the Lillian Annette Rowe Sanctuary, 13 km west of Kearney, Nebraska. The area is a tallgrass prairie with these dominant plants: *Andropogon gerardii*, *Carex* sp., *Panicum virgatum*, *Solidago* sp., *Sorghastrum nutans*, and *Spartina pectinata* (Nagel and Kolstad 1987). The prairie is burned every spring and hayed every summer; in this study haying occurred on 19 August. The study area consists mostly of Platte and loamy alluvium soil series with soil texture ranging from loam to sandy loam (Nagel and Kolstad 1987). Small ridges of recently deposited aeolian sand were interspersed throughout the study area (Nagel and Kolstad 1987). Gopher mounds existed only on these ridges during the summer. The soil in low areas between the ridges was too saturated with water for gophers to burrow through. However, gophers burrowed into the low areas as the soil dried out in October. A 0.6-ha site 100 m north of the Platte River was chosen to measure pocket gopher activity. The site is on a large ridge that parallels the river. Approximately 20% of the site consists of wet lowland.

At the beginning of the study, total surface area of all gopher mounds on the site was estimated. The site was divided into 10 quadrats marked with flags to assure uniform sampling of the area. Four mounds from each quadrat were randomly selected to represent the entire site. The lengths of the major and minor axis were measured because mounds were elliptical in shape. The formula for an ellipse was used to calculate the surface area each mound covered. Next, each quadrat was walked to count all mounds on the site. As the mounds were counted they were stomped until flat to keep track of mounds already counted and to make new mounds more conspicuous for future counts. I later returned to the site at various time intervals (see Table 1) and counted the new mounds that appeared, using the same procedure.

The mass and volume of displaced soil were studied as well. To calculate the average volume of the mounds, four fresh gopher mounds from each quadrat were randomly selected on 2 September. They were each measured to the nearest 0.1 L by removing all soil from the mounds and placing it in a calibrated bucket. Samples (100 ml) of soil from each mound were thoroughly oven-dried and weighed to the nearest 0.1 g with a top-loader balance. The volume of the soil was then converted to mass.

The extreme air-temperatures for each day were measured by the Kearney Municipal Airport. The average temperature for each time interval on Table 1 was computed by summing the means of the extreme temperatures for that interval and then dividing by the number of days in the interval. A correlation analysis was used to see if temperature had an effect on gopher activity.

A rough population estimate was calculated. The average number of mounds/ha/day obtained during the study and mounds/gopher/day data from other authors were used in the calculation. Reid et al. (1966) found gophers to produce 4.1 signs/gopher/day in a three year study and Spencer et al. (1985) reported 0.92 mounds/gopher/day in May. Data from Miller and Bond (1960) averaged 2.4 mounds/gopher/day in late August and early September.

Table 1. Mound production and air-temperature (C).

	Average number of mounds/day/ha	Average temp.	Temp. range
19 Aug–27 Aug	32.5	25	19–30
28 Aug–2 Sep	24.5	25	19–30
3 Sep–6 Sep	30.0	23	17–29
7 Sep–13 Sep	36.6	17	10–23
14 Sep–27 Sep	45.9	14	7–20
28 Sep–4 Oct	64.6	17	11–23
5 Oct–11 Oct	55.0	14	5–23
12 Oct–18 Oct	53.6	15	6–24
19 Oct–25 Oct	41.0	7	0–14
26 Oct–5 Nov	46.4	3	-3–8
6 Nov–9 Nov	36.7	5	-3–12
10 Nov–20 Nov	48.5	6	-1–12

RESULTS AND DISCUSSION

The population density of gophers at the site was estimated at 11–48 gophers/ha. There were 4,400 mounds/ha at the beginning of the study and the average area each mound covered was 0.114 m^2. Therefore, 5.0% of the study area was covered by mounds. Results of other authors are similar. In Colorado, gopher (*Thomomys talpoides*) mounds covered 2.5% to 8% of the total surface area on a shortgrass prairie (Grant et al. 1980) and mounds produced by *Geomys attwateri* covered 9.9% on a annually burned prairie in Texas (Spencer et al. 1985). Steuter et al. (1995) estimated that gopher mounds covered 4.8–8.4% of the surface on a sandhills prairie in northern Nebraska.

The average number of mounds formed was 44.26 mounds/ha/day. The average volume of gopher mounds was 2.82 L and the average mass was 4.23 kg. Grant et al. (1980) calculated a very similar mound mass of 4.5 kg. From 19 August to 20 November (93 days), 17,411 kg of soil were deposited per hectare. If this rate of activity was constant throughout the year, 68,332 kg of soil would be deposited/ha/year and it would only take 5.4 years to cover an entire hectare once with gopher mounds. However, these estimates may be misleading. Downhower and Hall (1966) found that mound-building activity varies greatly throughout the year. The same authors reported high activity in autumn but no activity while the soil was frozen in winter. Mound production by *Thomomys bottae* slows during the dry summer months (Howard and Childs 1959) and increases in late August (Miller and Bond 1960). My estimates are much higher than Beuchner's (1942) and Ellison's (1946) but lower than Spencer et al. (1985), whose estimate was 102,854 kg of soil deposited/ha/year.

It appears that as colder autumn months approached, gophers became more active. However, mound-building activity and average temperature were not significantly related (r = -0.38, t = 1.30, N = 12, $P > 0.05$). Downhower and Hall (1966) stated that an optimal temperature may exist at which gophers are most active. Benedix (1994) believed that although pocket gophers (*Geomyidae*) are buffered from temperature changes above the surface, their pattern of activity is still environmentally controlled. In Florida, Hickman and Brown (1973) found no correlation between monthly mean temperatures and *Geomys pinetis* activity. However, they found a high rate of mound-building activity during the 3 coldest months of the study.

High activity from 19 August to 27 August was most likely caused by cutting of hay before the study. Apparently heavy machinery collapsed several burrows, forcing gophers to deposit more soil onto the surface as they repaired the tunnels.

Table 1 shows that mound activity rose steadily from late August to late September. Activity reached a peak of 64.57 mounds/ha/day in early October and then dropped. Buechner's (1946) findings were similar, and he believed that the highest level of mound activity occurs around October. At this time gophers could be busy caching food. Gophers cache food in deep burrows during seasons when certain plants are dormant (Downhower and Hall 1966). At my site the first frost occurred on 21 September and then many forbs began to wilt. Soon mound activity rose sharply, possibly caused by the gophers' need to cache food before it became scarce.

Much of the tallgrass prairie along the Platte River has been cultivated or overgrazed (Nagel and Kolstad 1987), leaving only a few isolated prairies, such as the one on the Rowe Sanctuary, intact. This study has shown that pocket gopher disturbance can be intense on these prairies. It is fortunate that the influence mound-building has on other ecosystems is well documented. However, more work needs to be completed regarding the impact *Geomys bursarius* has on tallgrass prairies.

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