Transactions of the Illinois State Academy of Science
(2014) Volume 107, pp. 47-49

received 2/12/14
accepted 11/18/14

Vegetation of Plains Pocket Gopher (*Geomys bursarius*) Mounds at Henry Allan Gleason Nature Preserve, Mason County, Illinois

[1]Gordon C. Tucker, [2]John E. Ebinger, and [3]William E. McClain
[1]Department of Biological Sciences, Eastern Illinois University, Charleston IL
[2]Emeritus Professor of Botany, Eastern Illinois University, Charleston IL 61920 (jeebinger@eiu.edu, corresponding author)
[3]Illinois State Museum, Springfield IL 62706 (wmcclain62@gmail.com)

ABSTRACT

Plant species importance on plains pocket gopher mounds was examined in mature and disturbed dry sand prairie at Henry Allan Gleason Nature Preserve, Mason County, Illinois. We found 21 vascular plant species in a mature dry sand prairie including eight that were covered during mound construction but subsequently grew through the mounds, and 13 species that probably germinated on mounds because their root-systems were mostly in the mounds. In a similar study in a disturbed dry sand prairie 11 species were recorded growing through mound with nine species growing on mounds. Most species encountered were native sand prairie species although three, *Mollugo verticillata*, *Salsola tragus*, and *Saponaria officinalis*, were exotics.

INTRODUCTION

The plains pocket gopher, *Geomys bursarius* (Shaw) is a fossorial rodent known as an important agent of soil disturbance in grassland communities. These animals excavate extensive foraging burrows while feeding on roots and whole plants pulled beneath the soil surface. They leave considerable volumes of disturbed soil behind in mounds mostly 0.39 to 0.5 m^2 in size (Fulk and Ebinger 1999). The impact on vegetation can be significant where pocket gophers densities are high, mostly in areas of relatively high vegetation density and loam to sandy soils (Reichman 1988, Rogers et al. 2001); this has also been noted as an effect of badger burrows in tall-grass prairie (Platt, 1975).. These disturbances are viewed as uncommon, irregular events that cause abrupt structural changes in plant communities by increasing plant diversity, decreasing plant production, and slowing succession (Reichman 1988).

Plains pocket gophers are common in sand deposits of Illinois. They are particularly abundant in Iroquois and Kankakee counties in the Kankakee Sands Area of northeastern Illinois, and in Mason and Cass counties in the Illinois River Sands Area (Schwegman 1973). These sand deposits cover approximately 3.4% of the land area of Illinois and most are located in the northern half of the state on glacial outwash plains resulting from erosion events associated with Wisconsin glaciations (Willman and Frye 1970). The purpose of this study was to determine plant species composition on pocket gopher mound in a mature dry sand prairie and a disturbed dry sand prairie at the Henry Allan Gleason Nature Preserve, Mason County, Illinois.

DESCRIPTION OF THE STUDY SITE

Located in the extreme northwest corner of Mason County, just southeast of the town of Goofy Ridge, and about 15 km northeast of Havana, Illinois (SE1/4 S6 T22N R7W, 40.3780°N, 89.9265°W, elevation 155 m), the Henry Allan Gleason Nature Preserve lies within the Illinois River Section of the Mississippi River and Illinois River Sand Areas Natural Division (Schwegman 1973). Plant communities present include: active blow-outs, stabilized blow-outs, low to high quality disturbed dry sand prairies, and mature dry sand prairies. The disturbed dry sand prairie was dominated by *Eragrostis trichodes*, *Heterotheca camporum*, and *Ambrosia psilostachya*; the mature dry sand prairie was dominated by *Schizachyrium scoparium*, *Tephrosia virginiana*, and *Opuntia humifusa* (McClain et al. 2005). Dedicated in 1970, the preserve is within the boundaries of Sand Ridge State Forest which covers 1012 ha (Marcum et al. 2013). At the time of dedication much of the 44.5 ha preserve had been heavily disturbed, some areas cultivated, some planted to pine plantations, and a few small remnants of mature dry sand prairie (White 1978). The most significant feature of the preserve is a large sand dune known locally as "Devil's Tower" which is 25 m tall and has a large blow-out near the summit. At the time of dedication most of the large dune had been planted in pine trees. When removed in 1978 many of the pines were 7 m tall with a dbh of 20-25 cm. The preserve has not been burned since 1999, and woody encroachment is becoming a problem with many small oak trees now growing on the sand prairie.

The climate of Mason County is continental with warm summers and cold winters. Annual precipitation is 96.0 cm with May having the highest rainfall (11.3 cm). Mean annual temperature is 10.8°C with July the hottest month (average of 24.6°C), the coldest January (-5.0°C). The average number of frost-free days is 173 (Midwestern Regional Climate Center 2013). The soils of the preserve are well drained Parkland sands. These are windblown sand deposits present as dunes and sheet-like layers between and bordering dunes (Willman and Frye 1970, Calsyn 1985).

METHODS

In September 2012, a disturbed dry sand prairie on the east flank of Devil's Tower was searched for plains pocket gopher mounds. The first 25 mounds that were separate, distinct entities (not overlapping another mound or mounds, or associated with a badger mound), created during the present spring and early summer were surveyed. Each mound was considered a plot and examined to determine the cover of each vascular plant species. Plant species encountered were divided into two groups, those covered during mound building that subsequently grew through the mound or were exposed by wind or precipitation; and

plants that germinated from seeds that had their root system mostly in the mound. Percent cover of each species was determined using Daubenmire cover class system (Daubenmire 1959) as modified by Bailey and Poulton (1968): class 1 = 0-1%; class 2 = 1-5%; class 3 = 5-25%; class 4 = 25-50%; class 5 = 50-75%; class 6 = 75-95%; class 7 = 95-100%. From these data, frequency (%), mean cover (%), relative frequency, relative cover, and Importance Value (relative frequency + relative cover) were determined. In September of 2013 a similar study was undertaken in a mature dry sand prairie on the east flank of a smaller dune.

Species identification is based on collection of vouchers by McClain et al. (2005) for a floristic inventory of the preserve. Nomenclature follows Mohlenbrock (2002). We encountered no additions to the flora of the preserve during the present study.

RESULTS

The common species associated with pocket gopher mounds in disturbed dry sand prairie were the perennials *Eragrostis trichoides* and *Opuntia humifusa* with importance values of 69.1 and 28.1 respectively. Both had grown through mounds from individuals covered at the time of mound excavated, or were exposed by wind or precipitation (Table 1). Nine additional perennial species that grew through mounds were encountered in much lower numbers, all with importance values of 8.0 or less. In contrast, the most common species growing through pocket gopher mounds on mature dry sand prairie were the perennials *Ambrosia psilostachya*, *Opuntia humifusa*, *Schizachyrium scoparium* and *Dichanthelium villosissimum* all with importance values of 11.9 and above (Table 2). The remaining species found growing through the mounds included four additional perennial species with importance values lower that 7.5, and included the exotic *Saponaria officinalis*.

Of the species encountered growing on the pocket gopher mounds in the disturbed dry sand prairie six were annuals and three were perennials. The most common were the annuals *Chenopodium desiccatum* and *Chamaecrista fasciculata* with importance values of 18.9 and 18.0 respectively, along with seedlings and small individuals of the perennial *Lespedeza capitata* (I.V. of 10.3) (Table 1). The remaining six species were not common and including a few seedlings and small plants of two perennial species, and four annuals including the exotic *Salsola tragus*. In contrast, the species found growing on the pocket gopher mounds in the mature dry sand prairie included 10 annual and two perennial species (Table 2). The most commonly encountered were the annual grass *Triplasis purpurea* (I.V. of 16.6), along with the annuals *Froelichia floridana*, *Conyza canadensis*, *Crotonopsis linearis*, *Chamaecrista fasciculata*, and young individuals of the perennial sedge *Cyperus schweinitzii*, all with importance values between 7.5 and 8.6. Five additional annual species were recorded, including the exotic *Mollugo verticillata*, along with seedlings of the perennial grass *Dichanthelium villosissimum*.

Table 1. Frequency (%), mean cover (% of total area), relative frequency, relative cover, and importance value (IV) for species encountered in the fall of 2012 on plains pocket gopher (*Geomys bursarius*) mounds in a disturbed sand prairie at Henry Allan Gleason Nature Preserve, Mason County, Illinois. The species are divided into two groups, those that were originally covered by the mounds and have grown through the mound and plants that germinated from seeds on the mounds and have their root system mostly in the mound. (*exotic species)

Species	Frequency %	Mean Cover	Relative Frequency	Relative Cover	Importance Value
Growing through mounds					
Eragrostis trichodes	96	8.34	18.3	50.8	69.1
Opuntia humifusa	76	2.24	14.5	13.6	28.1
Aster oblongifolius	28	0.44	5.3	2.7	8.0
Tradescantia ohiensis	28	0.24	5.3	1.5	6.8
Physalis heterophylla	4	0.60	0.8	3.6	4.4
Dichanthelium villosissimum	16	0.08	3.1	0.5	3.6
Asclepias verticillata	16	0.08	3.1	0.5	3.6
Ambrosia psilostachya	8	0.14	1.5	0.9	2.4
Koeleria macrantha	8	0.14	1.5	0.9	2.4
Paspalum bushii	8	0.04	1.5	0.2	1.7
Calamovilfa longifolia	4	0.02	0.8	0.1	0.9
Growing on mounds					
Chenopodium desiccatum	48	1.60	9.2	9.7	18.9
Chamaecrista fasciculata	52	1.34	9.9	8.1	18.0
Lespedeza capitata	44	0.32	8.4	1.9	10.3
Croton glandulosus	24	0.32	4.6	1.9	6.5
Euphorbia corollata	20	0.10	3.8	0.6	4.4
**Salsola tragus*	12	0.26	2.3	1.6	3.9
Silene antirrhina	16	0.08	3.1	0.5	3.6
Commelina erecta	8	0.04	1.5	0.2	1.7
Conyza canadensis	8	0.04	1.5	0.2	1.7
Totals		16.46	100.0	100.0	200.0
Bare ground and litter		82.20			

DISCUSSION

The disturbed dry sand prairie has high species diversity with 30 species found in survey plots of McClain et al. (2005). The most important species encountered by McClain et al. (2005) were *Eragrostis trichodes*, *Heterotheca camporum*, *Ambrosia psilostachya*, *Rhus aromatica*, and *Opuntia humifusa*. All but five species found growing through or on the pocket gopher mound in the present study were encountered in the disturbed dry sand prairie by McClain et al. (2005). These species were *Tradescantia ohiensis*, *Koeleria macrantha*, *Lespedeza capitata*, *Salsola tragus* and *Silene antirrhina*, all of which are known from disturbed dry sand prairies on the preserve. As expected, the species with high importance values growing through the mounds (*Eragrostis trichodes* and *Opuntia humifusa*), were among the dominants in the 2005 study.

McClain et al. (2005) reported 17 species in their study plots of the mature dry sand prairie, with *Ambrosia psilostachya*, *Opuntia humifusa*, *Schizachyrium scoparium* and *Dichanthelium villosissimum* having the highest importance values. These are the same species that we found commonly growing through the pocket gopher

mounds. Except for the exotic *Saponaria officinalis* the remaining species we found growing through the mounds were also reported for the mature dry sand prairie by McClain et al. (2005). In contrast, we found nine species growing on pocket gopher mounds not reported for plots in the mature dry sand prairie study by McClain et al. (2005). These annual species are commonly associated with disturbance, but we rarely find them growing in the open sand between dominant perennials of a mature dry sand prairie.

Pocket gopher mounds and burrows help maintain early successional species in mature dry sand prairies. It appears that intermediate levels of disturbance allow annual and some early successional perennials to become established. Competition for light, nutrients, and moisture prevents their continued existence except in areas of recent disturbances. Over time, the mostly perennial dominant species gradually exclude annuals from mature dry sand prairies. However, pocket gopher activity provides open habitat, increased species diversity and slowing the successional processes.

Table 2. Frequency (%), mean cover (% of total area), relative frequency, relative cover, and importance value (IV) for species encountered in the fall of 2013 on plains pocket gopher (*Geomys bursarius*) mounds in a mature sand prairie at Henry Allan Gleason Nature Preserve, Mason County, Illinois. The species are divided into two groups, those that were originally covered by the mounds and have grown through the mound and plants that probably germinated from seeds on the mounds and have their root system mostly in the mound. (*exotic species)

Species	Frequency %	Mean Cover	Relative Frequency	Relative Cover	Importance Value
Growing through mounds					
Ambrosia psilostachya	88	1.54	18.5	22.4	40.9
Opuntia humifusa	60	1.00	12.6	14.6	27.2
Schizachyrium scoparium	68	0.84	14.3	12.2	26.5
Dichanthelium villosissimum	36	0.36	6.7	5.2	11.9
Eragrostis trichodes	16	0.28	3.4	4.1	7.5
Tephrosia virginiana	12	0.26	2.5	3.8	6.3
Eragrostis spectabilis	4	0.02	0.9	0.3	1.2
**Saponaria officinalis*	4	0.02	0.9	0.3	1.2
Growing on mounds					
Triplasis purpurea	24	0.80	5.0	11.6	16.6
Froelichia floridana	20	0.30	4.2	4.4	8.6
Conzya canadensis	24	0.22	5.0	3.2	8.2
Crotonopsis linearis	24	0.22	5.0	3.2	8.2
Cyperus schweinitzii	24	0.22	5.0	3.2	8.2
Chamaecrista fasciculata	16	0.28	3.4	4.1	7.5
Chenopodium desiccatum	16	0.10	4.0	1.5	5.5
Croton glandulosus	12	0.16	2.5	2.3	4.8
Dichanthelium villosissimum	8	0.06	2.6	0.9	3.5
**Mollugo verticillata*	4	0.12	0.9	1.8	2.7
Aristida desmantha	8	0.04	1.7	0.6	2.3
Diodia teres	4	0.02	0.9	0.3	1.2
Totals		6.86	100.0	100.0	200.0
Bare ground and litter		85.0			

LITERATURE CITED

Bailey, A. W. and C. E. Poulton. 1968. Plant communities and environmental relationships in a portion of Tillamook burn, northwestern Oregon. Ecology 49: 1-13.

Calsyn, D. E. 1995. Soil survey of Mason County, Illinois. U.S.D.A. National Resources

Conservation Service and Illinois Agricultural Experiment Station, U.S. Government Printing Office, Washington DC.

Daubenmire, R. 1959. A canopy coverage method of vegetation analysis. Northwest Science 33: 43-64.

Fulk, B. A. and J. E. Ebinger. 1999. Vegetation of badger (*Taxidea taxus*) and plains pocket gopher (*Geomys bursarius*) mounds in the sand areas of West-central Illinois. Erigenia 17:26-29.

Marcum, P. B., L. R. Phillippe, D. T. Busemeyer, W. E. McClain, M. A. Feist, and J. E. Ebinger. 2013. Vascular flora of the Sand Ridge State Forest, Mason County, Illinois. Transactions of the Illinois State Academy of Science 106:39-46.

McClain, W. E., L. R. Phillippe, and J. E. Ebinger. 2005. Floristic assessment of the Henry Allan Gleason Nature Preserve, Mason County, Illinois. Castanea 70:146-154.

Midwestern Regional Climate Center (Havana, Illinois). 2013. http://mcc.sws.uiuc.edu

Mohlenbrock, R. H. 2002. Vascular flora of Illinois. Southern Illinois University Press, Carbondale, Illinois.

Platt, W.J. 1975. The colonization and formation of equilibrium plant species associations on badger disturbances in a tall-grass prairie. Ecological Monographs 45: 285-305.

Reichman, O. J. 1988. Comparison of the effects of crowding and pocket gopher disturbance on

Mortality, growth and seed production of *Berteroa incana*. American Midland Naturalist

120:58-69.

Rogers, W. E., D. C. Harrnett, and B. Elder. 2001. Effects of plains pocket gopher (*Geomys bursarius*) disturbances on tallgrass-prairie plant community structure. American Midland Naturalist 145:344-357.

Schwegman, J. E. 1973. Comprehensive plan for the Illinois Nature Preserves Commission: part 2. The Natural Divisions of Illinois. Illinois Nature Preserves Commission, Rockford, Illinois.

White, J. 1978. Illinois natural areas inventory technical report. Volume I. Survey methods and results. Illinois Natural Areas Inventory, Urbana, Illinois.

Willman, H. B. and J. C. Frye. 1970. Pleistocene stratigraphy of Illinois. Illinois State Geological Survey Bulletin 94:1-204.