ABUNDANCE AND DIVERSITY OF SMALL MAMMALS IN EXOTIC AND RESEEDED NATIVE GRASSLANDS AT OAKWOOD LAKES STATE PARK

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ABSTRACT

Relative abundance and diversity of small mammal populations in exotic and reseeded native grassland plots were evaluated during the fall of 2004 at West Oakwood Lakes Game Production Area, Brookings County, South Dakota. Exotic grassland plots were defined as areas dominated by smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*) dominated plots defined as reseeded native grassland. A total of 36 small mammals representing six species were captured over 727 operable trap nights in four grassland plots using Museum Special snap traps from 25 September to 1 October 2004. Shrew species (*Blarina* and *Sorex* spp.) comprised 57% and 73% of the total small mammal captures in the exotic and reseeded native plots respectively. Based on relative abundance there was significantly greater small mammal abundance in the exotic plots than in the reseeded native plots (x^2 = 35.04, p < 0.0001). Northern short-tailed shrew (*Blarina brevicauda*) (x^2 = 11.36, p = 0.0008) relative abundance was significantly greater in the reseeded native plots than in the exotic plots, whereas relative abundance of all other species, except the western harvest mouse (*Reithrodontomys megalotis*), were significantly greater in the exotic plots than in the reseeded native plots. Alpha diversity was significantly greater in the exotic plots than in the reseeded native plots (x^2 = 22.21, p = 0.035). However, Shannon-Wiener Index richness and evenness values were similar in the exotic and reseeded native plots. Our data indicates a higher relative abundance of small mammals and greater within habitat diversity in exotic grasslands than in reseeded native grasslands.

Keywords

Small mammals, reseeded native grasslands, exotic grasslands, relative abundance, snap traps, Brookings County, South Dakota

INTRODUCTION

Small mammals are a significant wildlife component affecting the overall biota of most grassland ecosystems (Batzli and Pitelka 1970, Schwartz and Schwartz 1981, Pendleton 1984, Wilson and Bromley 2001). Anthropogenic activities in grassland ecosystems have influenced and changed small mammal populations, and the response of small mammals to landscape changes is species specific and varies between habitat alterations. For example, Kaufman and Kaufman (1989) reported that deer mice (*Peromyscus maniculatus*) respond positively to the conversion of grassland to croplands, while western harvest mice (*Reithrodontomys megalotis*) responded negatively to the same activity. In eastern South Dakota, habitat alteration effects on small mammals have been evaluated in croplands (Pinkert et al. 2002, Terrall et al. 2002), shelterbelts (Barnes and Linder 1982), and in restored and native prairies (Kezar and Jenks 2004). However, little information is available on small mammal abundance and diversity evaluations comparing exotic and reseeded native grassland habitats. Before this study, Sand Lake National Wildlife Refuge was the only area in South Dakota with a comparative study of small mammal populations in tame and seeded native grasslands (Meeks and Higgins 1998). Therefore, the purpose of this study was to determine the abundance and diversity of small mammals in exotic and reseeded native grasslands and to determine if their occurrence varied in relation to vegetative characteristics of these two habitat types.

STUDY AREA

This study was conducted in the northwest corner of Brookings County in eastern South Dakota on the West Oakwood Lakes State Game Production Area (SE1/4 Sec 35 T112N R52W). The site is located in the Central Prairie Coteau region, in the cool moist prairie soil zone where average annual temperature ranges from 5º to 7.2ºC and average annual rainfall ranges from 45.6 to 55.2 cm (Westin and Malo 1978). Previous land use resulted in a patchwork of habitat types. Four study plots were chosen, of which, two were reseeded native plots dominated (> 50%) by big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), and Indiangrass (*Sorghastrum nutans*) and two were exotic grassland plots dominated (> 50%) by smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*) (Table 1). One native (Site 2) and one exotic plot (Site 1) were in close proximity to a 1/2 ha wildlife food plot containing corn with a foxtail barley (*Hordeum jubatum*) understory and a cultivated corn field, while the other native (Site 3) and exotic (Site 4) plots were in close proximity to a 1/2 ha semipermanent wetland.

Table 1. Percent composition of exotic and native plant species in the four 400m² grassland study plots at West Oakwood Lakes Game Production Area, Brookings County, SD, during 2004 based on laser point frame device measurements.

	RESEEDED NATIVE		EXOTIC	
Species	**Site 2**	**Site 3**	**Site 1**	**Site 4**
Kentucky bluegrass (*Poa pratensis*)	12.5	0	10.0	37.5
Smooth brome (*Bromus inermis*)	17.5	0	90.0	52.5
Sweetclover (*Melilotus* spp.)	0	0	0	10.0
Big bluestem (*Andropogon gerardii*)	45.0	27.5	0	0
Indiangrass (*Sorghastrum nutans*)	22.5	65.0	0	0
Switchgrass (*Panicum virgatum*)	0	7.5	0	0
% Native grass species	67.5	100	0	10
% Exotic grass species	30.0	0	100	90

METHODS

To reduce edge effects, one 20 m X 20 m trap grid covering an area of 400 m² was placed in the center of each plot (Terrall et al. 2002). Two Museum Special regular-sized snap traps baited with a mixture of oatmeal, peanut butter, and bacon grease (Higgins et al. 1997) were placed at 0, 5, 10, and 15 m on the first and third lines of the grid and at 5, 10, 15, and 20 m on the second and fourth lines of the grid. Trapping was conducted for seven consecutive nights from 25 September to 1 October 2004 for a total of 896 trap nights. Traps were checked daily after sunrise and reset or baited as needed before sunset. All captures were bagged and cross-referenced to data sheets by date, grassland plot, and trap number. The specimens were then frozen for later identification in the lab.

Vegetation measurements were taken to determine plant community characteristics within the two grassland types. The total number of plant species found within trap grids was used as a measure of plant species richness. Vegetation visual obstruction readings (VORs) (Robel et al. 1970) were taken at 5 m intervals along four 20 m transects adjacent to and parallel of the trap grid lines. Laser point frame device measurements (Alexander et al. 2004) were taken at 2 m intervals along the same 20 m transects to determine plant species composition.

Relative abundance of small mammals was calculated per 1000 trap nights for the total number of captures per operable trap night (Pinkert et al. 2002). An operable trap night was defined as any trap containing a small mammal specimen or any trap that was not sprung (Higgins et al. 1997). Chi-square analysis was used to determine if differences occurred in the proportion of individual species and total number of captures occurring between the two grassland types. Analysis of variance was used to determine if differences occurred in mean cover height between the two grasslands and regression analysis was used to determine if any relationships existed between vegetation characteristics and capture success. All

statistical analyses were conducted using STATISTX 8, using an alpha level of 0.05. Small mammal species diversity values were determined using Biodiversity Pro software to calculate richness and evenness values based on Shannon-Wiener Index and Alpha Diversity Indices of the small mammal population.

RESULTS

A total of 36 small mammals representing six species was captured over 727 operable trap nights in the four grassland plots (Table 2). Northern short-tailed shrews (*Blarina brevicauda*) (n = 14) were the most abundant species captured followed by prairie voles (*Microtus ochrogaster*) (n = 9), pygmy shrews (*Sorex hoyi*) (n = 5), masked shrews (*Sorex cinereus*) (n = 4), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) (n = 3), and a western harvest mouse (n = 1). Sixty-four percent of the total captures were shrew species (*Blarina* and *Sorex* spp.) and 25% were prairie voles. A total of 21 small mammals was captured in the exotic grasslands whereas 15 small mammals were captured in the reseeded native grasslands. Northern short-tailed shrews (n = 7) were the most abundant captures in the reseeded native grasslands, whereas northern short-tailed shrews and prairie voles were captured in similar abundance (n = 7) in the exotic grasslands (Table 2).

Total small mammal relative abundance was significantly greater in the exotic plots than in the reseeded native plots. (x^2 = 35.04, df = 1, p < 0.0001). Relative abundance of northern short-tailed shrews (x^2 = 11.36, df = 1, p = 0.0008) was significantly greater in the reseeded native plots than in the exotic plots, whereas relative abundance of prairie voles (x^2 = 44.00, df = 1,

Table 2. Small mammals captured in reseeded native and exotic grassland plots at West Oakwood Lakes State Game Production Area in Brookings County, South Dakota from 25 September to 1 October 2004 with Museum Special snap traps.

	RESEEDED NATIVE		EXOTIC		
Species	**Site 2**	**Site 3**	**Site 1**	**Site 4**	**Total**
Masked Shrew *(Sorex cinereus)*	2	0	2	0	4
Northern Short-tailed Shrew *(Blarina brevicauda)*	5	2	0	7	14
Prairie Vole *(Microtus ochrogaster)*	2	0	0	7	9
Pygmy Shrew *(Sorex hoyi)*	2	0	3	0	5
Thirteen-lined Ground Squirrel *(Spermophilus tridecemlineatus)*	0	1	0	2	3
Western Harvest Mouse *(Reithrodontomys megalotis)*	0	1	0	0	1
Totals	11	4	5	16	36

p < 0.0001), pygmy shrews (x^2 = 29.00, df = 1, p < 0.0001), masked shrews (x^2 = 23.00, df = 1, p < 0.0001) and thirteen-lined ground squirrels (x^2 = 15.00, df = 1, p = 0.0001) were significantly greater in the exotic plots than in the reseeded native plots. Data for the western harvest mouse was insufficient to test for a difference in relative abundance; however the only capture occurred in a reseeded native plot (Table 3).

Based on the Alpha Diversity index values, diversity within the habitats was significantly greater in the exotic plots (1.535) than in the reseeded native plots (1.085) (x^2 = 22.21, df = 12, p = 0.035). Shannon-Wiener Index diversity values were similar between the reseeded native (1.523) and exotic (1.505) plots whereas the Shannon-Wiener Index evenness values were slightly greater in the exotic plots (0.935) than in the reseeded native plots (0.850).

VORs indicated a significantly greater mean vegetation height-density in the reseeded native plots compared to the exotic plots (F = 17.68, p = 0.0009) and at snap trap locations (F = 28.46, p < 0.0001). Species richness varied slightly between the grassland types. Plant species richness was nearly equal between the reseeded native plots (n = 13) and the exotic plots (n = 12) however, forbs were absent in the reseeded native plots whereas five forb species were present in exotic plots (Table 4).

Regression analysis indicated a positive correlation between the number of captures and mean VORs in the exotic plots (F = 4.94, p = 0.0679, R^2 = 0.45), however; there was no apparent relationship in the reseeded native plots (F = 1.53, p = 0.2699, R2 = 0.24). Based on mean VORs for the entire plot, the greatest number of small mammal species (n = 16) were captured in the exotic grassland plot with a mean VOR of 29.1 cm and the least number of captures (n = 4) occurred in the reseeded native grassland plot with a mean VOR

Table 3. Relative abundance (captures / 1000 operable trap nights) of small mammals sampled with Museum Special snap traps in reseeded native and exotic grassland plots at West Oakwood Lakes Game Production Area in Brookings County, SD from 25 September to 1 October 2004.

Species	Reseeded Native	Exotic	Total
Masked Shrew *(Sorex cinereus)*	10	13	23
Northern Short-tailed Shrew *(Blarina brevicauda)*	35	34	69
Prairie Vole *(Microtus ochrogaster)*	10	34	44
Pygmy Shrew *(Sorex hoyi)*	10	19	29
Thirteen-lined Ground Squirrel *(Spermophilus tridecemlineatus)*	5	10	15
Western Harvest Mouse *(Reithrodontomys megalotis)*	5	0	5
Totals	75	110	185

Table 4. List of plant species present at West Oakwood Lakes Game Production Area in Brookings County, SD within the 400 m² grassland study plots, 2004.

	RESEEDED NATIVE		EXOTIC	
Species	**Site 2**	**Site 3**	**Site 1**	**Site 4**
Big bluestem *(Andropogon gerardii)*	X	X		
Indiangrass *(Sorghastrum nutans)*	X	X		
Switchgrass *(Panicum virgatum)*	X	X		
Yellow foxtail *(Setaria glauca)*	X			
Kentucky bluegrass *(Poa pratensis)*	X		X	X
Smooth brome *(Bromus inermis)*	X		X	X
Timothy *(Phleum pratense)*				X
Canada goldenrod *(Solidago canadensis)*				X
Canada thistle *(Cirsium arvense)*	X	X		X
Heath aster *(Aster ericoides)*				X
Prairie coneflower *(Ratibida columnifera)*				X
Stiff goldenrod *(Solidago rigida)*				X
Sweetclover (*Melilotus* spp.)		X	X	X
Wild rose *(Rosa arkansana)*		X		
Total number of species	7	6	3	9

of 52.5 cm. Based on mean VOR values at trap locations, the greatest number of captures in the exotic plots occurred at 30 cm (n = 7) and in the reseeded native plots at 40 cm (n = 3) (Figure 1).

DISCUSSION

We captured a greater relative abundance and diversity of small mammals in grassland plots composed of exotic plant species which averaged shorter and less dense than nearby plots composed primarily of seeded native warm season plant species. Meeks and Higgins (1998) also reported a higher capture rate and greater species richness in tame grassland sites dominated by brome grass than in reseeded native grasslands at Sand Lake National Wildlife Refuge in Brown County, SD. The exotic grassland plots also contained more forb species than the reseeded native plots. Our findings support Hayslett and Danielson (1994) who reported that small mammal populations are influenced by vegetation structure more than plant community composition, and Kaufman and Fleharty (1974) who suggested that small mammals select habitat types based on plant life forms, especially the presence of forbs, rather than specific plant species.

The species composition and the relative abundance of the small mammals we captured were similar to the results of other studies in eastern South Dakota grasslands, except we did not capture any white-footed (*Peromyscus leucopus*) or

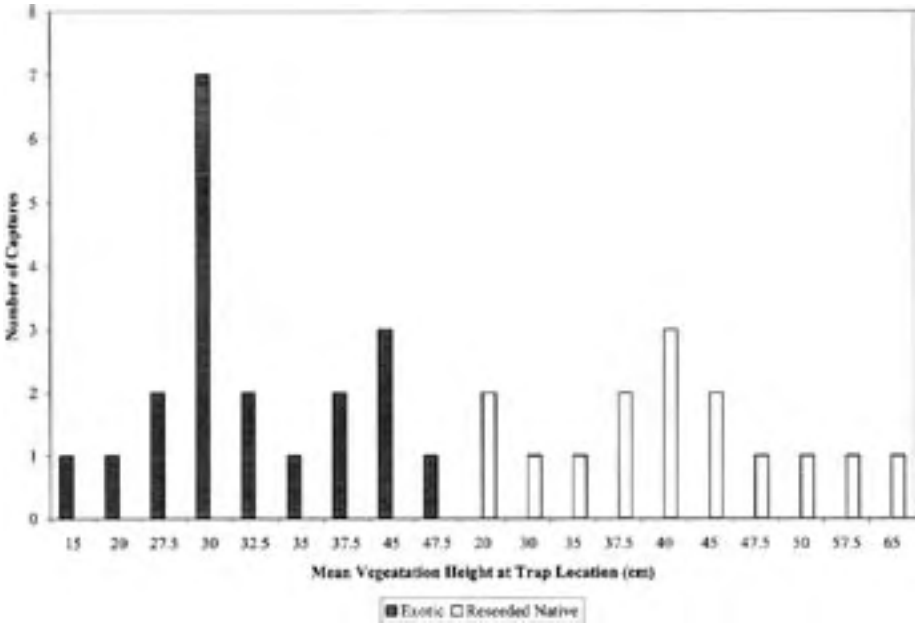

Figure 1. Relationship between the numbers of captures (y-axis) and the mean vegetation-height readings (VORs) at trap locations (x-axis) in exotic and reseeded native grassland plots at West Oakwood Lakes State Game Production Area in Brookings County, SD, 2004.

deer mice and we captured prairie voles instead of meadow voles (*Microtus pennsylvanicus*) (Higgins et al. 1997, Meeks and Higgins 1998). Our results showed a high proportion of shrews and prairie voles compared to other species, which was similar to Terrall et al. (2002) and Kezar and Jenks (2004). However, the large number of pygmy shrews we found was unusual; for example, Kezar and Jenks (2004) found only one pygmy shrew in native and one in restored prairies whereas other studies in eastern South Dakota grasslands have no record of this species in their captures. The pygmy shrew is believed to occur throughout eastern South Dakota (Higgins et al. 2002), but it seems to favor moist prairies and riparian woodlands. We captured this species in the native and exotic plots in close proximity to a corn field and a wildlife food plot. The fact that our survey occurred in fall may have contributed to the higher proportion of captures of pygmy shrews.

Overall the total relative abundance of small mammals was significantly greater in the exotic grassland plots than in the reseeded native grassland plots. Vegetation structure on the exotic grassland plots had significantly lower mean cover height, a higher number of forb species, and overall greater plant species richness values all of which likely contributed to the greater abundance and diversity of small mammal populations in the exotic grassland plots.

ACKNOWLEDGEMENTS

Support for this study was provided by South Dakota State University. We thank the South Dakota Department of Game, Fish, and Parks for providing the use of the study area and Matt R. Gardner for assistance with field work.

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