IMPACT OF CROP HARVEST ON SMALL MAMMAL POPULATIONS IN BROOKINGS COUNTY, SOUTH DAKOTA

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ABSTRACT

In the Midwest, agricultural cropland provides the majority of habitat available to small mammals. In some regions of the Midwest, cropland comprises as much as 70% of the landscape. Importance of these agricultural habitats to small mammals pre- and post-harvest is not well documented. The distribution of small mammals was studied in shelterbelt, grassland, and adjacent cropland habitats pre- and post-harvest in Brookings County, South Dakota from 20 September (before crop harvest) to 15 November 2001 (after crop harvest). Deer mice (*Peromyscus maniculatus*) (n=30) and white-footed mice (*Peromyscus leucopus*) (n= 29) were captured in relatively high numbers when compared to the other species: short-tailed shrews (*Blarina brevicauda*) (n=13), masked shrews (*Sorex cinereus*) (n=7), prairie voles (*Microtus ochrogaster*) (n=4), meadow voles (*Microtus pennsylvanicus*) (n=3), and northern grasshopper mice (*Onychomys leucogaster*) (n=2). Deer mice and white-footed mice were the only inhabitants of cropland. When compared to cropland, proportions of deer mice using the grassland and white-footed mice using the shelterbelt decreased after harvest. Competition among small mammals and predation risks from the short-tail shrew in grasslands and shelterbelts may force deer mice and white-footed mice into habitats such as cropland. Alternatively, the abundance of waste grain after harvest may explain the increased use of cropland. The prairie vole demonstrated a strong use of grassland, while the white-footed mouse used shelterbelt habitats. Cropland habitats adjacent to shelterbelts and grasslands likely provide a relatively stable food source for small mammal populations.

Keywords

Crop harvest, deer mice, *Peromyscus maniculatus,* small mammals, South Dakota.

INTRODUCTION

The majority of habitat available to small mammals in the Midwest is cropland. Opportunistic feeders that do not rely on herbaceous ground cover, such as deer mice (*Peromyscus maniculatus*) are more likely to inhabit cultivated

cropland (Stallman and Best 1996). Manson and Stiles (1998) suggested that old cropland fields experience intense seed predation by white-footed mice (*Peromyscus leucopus*). Others species, such as house mice (*Mus musculus*), move into cultivated fields as cover becomes available (Stallman and Best 1996).

Small mammals have been studied in wooded areas located along rivers and in shelterbelts in eastern South Dakota (Barnes and Linder 1982; Hallman and Butler 1992). Others have examined species diversity and abundance of small mammals utilizing cultivated fields in the Midwest, but few have studied the effects of crop harvest on habitat use (Stallman and Best 1996; Walker 1976). The purpose of this study was to determine the distribution of small mammals in habitats adjacent to and occupying pre- and post-harvested cropland. Study objectives were (1) to determine the small mammal abundance and species composition of a shelterbelt with an adjacent cornfield as well as grassland with an adjacent cornfield, (2) to determine small mammal habitat use and (3) determine if small mammals alter habitat use after crop fields are harvested.

STUDY AREA

To determine the impact crop harvest has on habitat use, a shelterbelt and a small grassland with adjacent cornfields were sampled. Both study areas were located in Brookings County, South Dakota. The shelterbelt/cornfield habitat was located at T 110 N, R 48 W, Section 26. The shelterbelt was about 2.3 ha in size and was composed of approximately 90% green ash (*Fraxinus pennsylvanicus*). The remaining 10% was made up of red cedars (*Juniperus virginiana*), cottonwood (*Populus* spp.), and tatarian honeysuckle (*Lonicera tatarica*). The understory was a mixture of brome grass (Bro*mus* spp.) and green ash seedlings. The adjacent cornfield was 14.2 ha. The grassland/cornfield habitat was located at T 109 N, R 48 W, Section 2. The grassland was 28.3 ha of primarily switch grass (*Panicum virgatum*). The adjacent cornfield was 36.4 ha in size.

METHODS

Sampling periods began on 20 September 2001 (before crop harvest) and 15 November 2001 (after crop harvest). Seven x seven trap grids were randomly placed within habitat types on study areas. We assumed that each trap sampled a radius of 4.55-m; hence, traps were placed with a 9.09-m distance between each trap. Our approach was designed to effectively sample 0.4047 hectares (1 acre). Based on the recommendations of Stickel (1946), we used mouse-sized snap traps (Victor®, Woodstream Corporation, Lititz, PA) baited with a combination of rolled oats and peanut butter (Beer 1964).

To minimize the possibility of catching drifting animals, traps were set for three consecutive nights for before and after crop harvest capture periods. In both sampling periods traps were set no more than two hours before dusk,

checked, and re-baited on the following two days, and checked and removed on the third day. For each captured animal the trap number was recorded and species was determined in the laboratory.

Statistical analyses were conducted using an alpha level of 0.05. Chi-square tests (Bishop 1966) were used to test the hypothesis that small mammal use was equivalent among habitat types. For this portion of the analysis, small mammals captured in the cornfield were classified based on adjacent habitat (grassland or shelterbelt). Relative abundance was calculated as the total number of individuals caught per 1000 trap nights:

$$\text{Relative Abundance} = \frac{\text{Total captures in habitat type}}{\text{Total trap nights in habitat type}} \text{ X } 1000$$

Change in proportion of captured individuals before and after crop harvest also was evaluated using chi-square analyses (SAS Institute 1996).

RESULTS

Eighty-eight small mammals were captured in 1176 trap nights. Deer mice (n=30) and white-footed mice (n=29) were the most frequently captured (Table 1). Other species captured included short-tailed shrews (*Blarina brevicauda*) (n=13), masked shrews (*Sorex cinereus*) (n=7), prairie voles (*Microtus ochrogaster*) (n=4), meadow voles (*Microtus pennsylvanicus*) (n=3), and northern grasshopper mice (*Onychomys leucogaster*) (n=2). With the exception of one grasshopper mouse, deer mice and white-footed mice were the only species captured in cornfields. Habitat use was evident with white-footed mice and prairie voles (Table 1). White-footed mice were captured more often in shelterbelt than other habitats, collective shrews were captured more often in shelter and grassland habitats than in cornfields, and prairie voles were only captured in grassland habitat (Table 1). Relative abundance of deer mice, masked shrews, prairie voles, and meadow voles was generally higher in grassland/cornfield habitat whereas relative abundance of white-footed mice, short-tailed shrews, and grasshopper mice was generally higher in shelterbelt/cornfield habitat (Table 2).

There was no significant difference in the relative abundance of small mammals collected pre vs. post harvest in the grassland ($\chi^2 < 0.001$, df = 1, $P = 0.939$). However, relative abundance of small mammals collected in the shelterbelt was lower after harvest ($\chi^2 = 6.377$, df = 1, $P = 0.012$). In cornfields, deer mice and white-footed mice were the only species collected in sufficient numbers to test our hypothesis. Relative abundance of deer mice collected in the grassland was lower after harvest ($\chi^2 = 11.397$, df = 1, $P = 0.001$), but there was no significant difference in the proportion of deer mice collected in the shelterbelt after harvest ($\chi^2 < 0.001$, df = 1, $P > 0.95$). No white-footed mice were collected in the grassland; thus, comparisons could not be made. The proportion of white-footed mice collected in the shelterbelt was lower after harvest ($\chi^2 = 4.202$, df = 1, $P = 0.040$).

Table 1. Small mammals captured in shelterbelt/cornfield and grassland/cornfield habitats sampled with snap traps within Brookings County, South Dakota during the September–November 2001.

	SHELTERBELT/CORNFIELD HABITAT				
	Pre-Harvest		Post-Harvest		
Species	**Shelterbelt**	**Cornfield**	**Shelterbelt**	**Cornfield**	**Total**
Deer mice *(Peromyscus maniculatus)*	4	2	4	2	12
White footed mice *(Peromyscus leucopus)*	12	2	5	2	21
Grasshopper mice *(Onychomys leucogaster)*	0	0	1	1	2
Short tailed shrew *(Blarina brevicauda)*	5	0	4	0	9
Masked shrew *(Sorex cinereus)*	2	0	0	0	2
Total	*23*	*4*	*14*	*5*	*46*

	GRASSLAND/CORNFIELD HABITAT				
	Pre-Harvest		Post-Harvest		
Species	**Grassland**	**Cornfield**	**Grassland**	**Cornfield**	**Total**
Deer mice *(Peromyscus maniculatus)*	4	6	1	7	18
White footed mice *(Peromyscus leucopus)*	0	3	0	5	8
Short tailed shrew *(Blarina brevicauda)*	1	0	3	0	4
Masked shrew *(Sorex cinereus)*	4	0	1	0	5
Prairie vole *(Microtus ochrogaster)*	0	0	4	0	4
Meadow vole *(Microtus pennsylvanicus)*	2	0	1	0	3
Total	*11*	*9*	*10*	*12*	*42*

Table 2. Relative abundance (captures/1000 trap nights) of small mammals sampled with snap traps in two habitats adjacent to cornfields within Brookings County, South Dakota during the fall of 2001.

Species	**Grassland/Cornfield Relative Abundance**	**Shelterbelt/Cornfield Relative Abundance**
Deer mouse *(Peromyscus maniculatus)*	30.61	20.41
White-footed mouse *(Peromyscus leucopus)*	13.61	35.71
Short-tailed shrew *(Blarina brevicauda)*	6.80	15.31
Masked Shrew *(Sorex cinereus)*	8.50	3.40
Prairie Vole *(Microtus ochrogaster)*	6.80	0.00
Meadow Vole *(Microtus pennsylvanicus)*	5.10	0.00
Grasshopper mouse *(Onychomys leucogaster)*	0.00	3.40

DISCUSSION

Deer mice and white-footed mice occurred most frequently in adjacent cornfields, indicating that this habitat is important to small mammals in eastern South Dakota. Species such as the deer mouse and white-footed mouse are adapted for such habitats (Stallman and Best 1996, Sietman et al. 1994). Stallman and Best (1996) suggested that deer mice are the only permanent resident in cropland habitats because they can exist in areas without herbaceous ground cover by using extensive burrows, which reduces risk of predation. Deer mice used cropland habitats when adjacent to both the grassland and shelterbelt habitats. Deer mice in the grassland/cornfield habitat may have been affected by crop harvest because relative abundance in the grassland was lower after harvest. Deer mice in the shelterbelt/cornfield habitat were not significantly affected by crop harvest.

Although the association of the white-footed mouse with woody vegetation is well documented (Sietman et al. 1994, Burt and Grossenheider 1964), the species also can occur in grasslands (Manson and Stiles 1998). White-footed mice exhibited a strong association for the shelterbelt habitat, but also occurred in cornfields. Corn stubble likely functioned structurally to allow co-occurance of white-footed mice with other small mammals. White-footed mice were not captured in switch grass habitat, but occurred frequently in the adjacent cornfield (before and after harvest). This suggests that white-footed mice avoid habitats with a large amount of herbaceous ground cover. Proportion of white-footed mice in the shelterbelt decreased after harvest, suggesting attraction to post-harvest cropland. This may be the result of increased waste grain and/or competition, either through active exclusion or resource exploitation in the shelterbelt habitat (Manson and Stiles 1998).

Shrews occurred in shelterbelt and grassland habitats, but were not captured in the adjacent cornfields. Romansky (1970) found that short-tailed shrews had an affinity for wooded areas. However, Burt and Grossenheider (1964) stated that short-tail shrews were not restricted to a particular habitat. Short-tail shrews can be an important predator on small animals, and can directly influence deer mouse populations (Eadie 1944). Masked shrews prefer moist habitats such as forests, open country, riparian, and upland habitats (Spencer and Pettus 1966, Yahner 1992, Walker 1976, Romanaky 1970). Hoff et al. (1989) captured masked shrews in marsh and grassland habitats but not in cornfield habitat. Shrew population estimates may be underestimated because snap traps are not as effective in catching these species as are live or pitfall traps (Fowle and Edwards 1954, Mengak and Guynn 1987, Briese and Smith 1974, Wiener and Smith 1972). If populations were underestimated, a risk of predation for deer and other mice could have affected distributions of small mammals.

Voles (prairie and meadow) were associated with the grassland habitat. Prairie voles generally occur in open prairies with dense vegetation and a well-developed litter layer (Walker 1976, Heideman et al. 1983, Sietman et al. 1994). Meadow voles feed primarily on plant shoots, roots, and some monocot seeds (Manson and Stiles 1998) in associated grasslands (Grant 1971, Manson and

Stiles 1998, Morris 1969, Romansky 1970, Walker 1976). Few voles were captured in our study and no voles were captured in cornfield habitats.

Deer mice and white-footed mice frequently used cornfields adjacent to shelterbelt and grassland habitats before and after harvest, suggesting they were permanent inhabitants of cultivated fields. Cropland habitats adjacent to shelterbelts and grasslands likely provide a relatively stable food source for small mammal populations. Because small mammals are an important food source for avian and mammalian predators, availability of small mammal populations likely affect predation rates on other species.

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