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Small Mammal Abundance and Diversity on Conservation Reserve Lands, North-Central Montana

Abstract

We evaluated four types of agricultural lands—crop/fallow, rangeland, Conservation Reserve Program (CRP) with a heavy cover, and CRP with a light cover—in north-central Montana for small mammal abundance and diversity. Abundance and diversity were measured by trapping small mammals in each land class during fall, 1995, using live, snap, and pitfall traps. Trapping was conducted using an unbalanced, factorial design resulting in 2464 trapnights yielding 304 individuals representing three genera. We experienced a lower catch rate ($\underline{P} < 0.1$) on rangeland than either type of CRP or cropland. Diversity was least in cropland, greatest in heavy CRP, and intermediate in light CRP and rangeland. As an agricultural land practice, CRP is important to small mammals and could be used as a tool to improve small mammal diversity and abundance on agricultural lands.

Key Words: small mammals, Conservation Reserve Program, CRP, Diversity, Shannon Index, *Sorex, Microtus, Peromyscus*

Introduction

The Conservation Reserve Program is a federal program included in the 1985 Federal Food Security Act (16 USC 3831-3840); farmers are paid federal subsidies to retire cropland from agricultural production for 10 or 15 years. Only croplands that were highly erodible, contributed to a serious water problem, or provided substantial environmental benefits have been eligible for enrollment since 1986. Retired lands can be placed back into production at contract maturity or sooner dependent upon "Early Out" programs (Glenn Patrick, pers. comm.). Producers were required to establish an approved vegetative ground cover on enrolled lands, typically perennial grasses and grass/forb mixes. Enrolled lands may not be harvested for grass seed production and or be hayed or grazed except under U.S. Department of Agriculture declared emergencies. The Conservation Reserve Program has been credited with saving soil resources and expanding wildlife habitat while improving air and water quality and enhancing wetlands (Books 1994).

Research involving the benefits of CRP lands to wildlife has been directed primarily at migratory waterfowl (Luttschwager et al. 1994), upland game birds (Riley 1995), neo-tropical migrant land birds (King and Savidge 1995, Patterson and Best 1996), and deer (Gould and Jenkins 1993, Selting 1994). However, few data are available on the value of CRP to other taxa, especially small mammals. This study was undertaken to compare the use by small mammals of CRP lands, conventional crop/fallow lands and rangeland. Several studies have compared CRP to other agricultural land classes (Luttschwager et al. 1994, King and Savidge 1995, Hall and Willing 1994) for use by wildlife species; studies examining differences among various CRP stands are lacking. Structure and composition of plant species in CRP

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stands are not uniform. Some stands are dense and tall, while others contain shorter vegetation with exposed ground between plants. This may preclude some small mammal species from using various stands of CRP. We determined differences in four land classes based on relative abundance of small mammals, diversity of genera of small mammals, and described the associations of abundance and habitat parameters during fall, 1995.

Study Area And Methods

Small mammal abundance and diversity were sampled in four land classes in north-central Montana about 20 km west of Conrad in Pondera and Teton counties. The land classes were divided into heavy CRP, light CRP, crop/fallow, and rangeland. Only fields larger than 20 ha were sampled. All CRP fields sampled were enrolled for six to eight years. The CRP land classes were separated on the basis of vegetative cover. We measured percent live plant material, dominant species composition, and average height of the stand. Heavy CRP was defined as: having a cover class (Daubenmire 1958) of ≥ 4, average height ≥ 30 cm, ≥ 50 percent live plant matter. Light CRP was defined as having a cover class of ≤ 5, average height ≤ 30 cm, and ≤ 50 percent live plant matter. Crop/fallow lands consisted of barley. Only rangeland that was lightly spring grazed or ungrazed for the entire growing season was included. Three replicates approximately 20 km apart were located so that all four land classes in each replicate were less than 2.5 km apart. Dominant species composition was determined in all fields sampled, and five cover and height measurements (Daubenmire 1958) were taken along with five estimates of percentage live plant material.

Small mammals were trapped with Victor mouse snap traps, Sherman live traps and pitfal[1] traps. A pitfall trap consisted of an open-ended 3 lb coffee can buried in the ground to its upper edge and filled to 30 percent capacity with a 10 percent solution of non-toxic RV antifreeze and water. Traps were evenly distributed in two transects in each land class. Transects were indiscriminately located ≥ 100 m from the nearest edge and approximately 100 m apart from one another. Each transect consisted of eight stations 10 m apart. Each station contained two snap traps and one live trap spaced 1 m apart in a triangle. Pitfall traps were placed at every other station.

Traps were checked daily and small mammals were collected for three or four days. Trap success was reported as number of captures per 100 trap nights for each replicate. Small mammal specimens were identified to species and counted. All shrews (*Sorex* spp.) were divided into two groups for analysis due to difficulty in determining species from skulls damaged during trapping. The groups defined were the masked shrew (*S. cinereus*) group and the vagrant shrew (*S. vagrans*) group. All other individuals were identified to species level; however, voles (*Microtus* spp.) were lumped due to small sample sizes.

Differences in trap success for all small mammals and for individual genera among land classes were determined by an analysis of variance (ANOVA) and a Bonferroni multiple comparison test (Neter et al. 1990). Significance was determined at $\underline{P}<0.10$. Relative diversity was determined using the Shannon diversity index.

Results

Heavy CRP had the highest average percent cover and height. Light CRP and rangeland yielded similar percent cover while barley stubble was the lowest (Table 1).

Table 1. *Mean and standard deviation of vegetative characteristics (percent vegetative cover, percent live plant material, and height) of fields sampled (n=15) in the four land classes examined.*

	LAND CLASSES			
Characteristic	Rangeland	Cropland/fallow	Heavy CRP	Light CRP
% vegetative cover	55.3 (19.1)[a]	25.8 (21.4)	77.5 (11.0)	60.2 (25.8)
% live plant material	54.0 (10.5)	1.7 (2.9)	62.0 (11.8)	21.7 (7.0)
height(cm)	15.5 (5.1)	17.3 (4.8)	61.8 (11.7)	35.0 (15.8)

[a] mean (standard deviation)

Alfalfa (*Medicago sativa*) was a major component of heavy CRP with a variety of grass species consisting of crested wheatgrass (*Agropyron cristatum*), slender wheatgrass (*A. elongatum*), intermediate wheatgrass (*A. intermedium*), and/or smooth brome (*Bromus inermus*) comprising the balance in each field sampled. All light CRP fields sampled lacked alfalfa and were primarily composed of one or two dominant grass species (smooth brome and crested wheatgrass). All rangeland sites sampled were similar in composition, consisting primarily of blue gramma grass (*Bouteloua gracilis*), western wheatgrass (*A. smithii*), Junegrass (*Koeleria macrantha*), and fringed sagewort (*Artemisia frigida*).

We captured 304 individuals, representing prairie voles (*Microtus ochrogaster*), meadow voles (*M. pennsylvanicus*), deer mice (*Peromyscus maniculatus*) and shrews (*Sorex* spp.), over 2464 trapnights (Table 2). Because of missing data, captures representing 264 animals and 2240 trapnights were used for analyses. Deer mice were found in all land types sampled and was the only species captured in crop/fallow. Most captures of deer mice were in heavy and light CRP. Voles occurred predominantly in the heavy CRP. Neither shrew group was found in crop/fallow, but both occurred in the other land classes. Only adult shrews were captured; both adults and juveniles of the other genera were represented. The vagrant shrew group

Table 2. *Number of captures per 100 trapnights and total captures of small mammals in rangeland, cropland/fallow, heavy CRP and light CRP land types.*

	LAND CLASSES			
Species	Rangeland	Cropland/fallow	Heavy CRP	Light CRP
Deer mice	0.125 (7)[a]	0.679 (38)	1.161 (65)	1.590 (89)
Masked shrew group	0.018 (1)	0	0.107 (6)	0.143 (8)
Vagrant shrew group	0.018 (1)	0	0.286 (16)	0.089 (5)
Voles	0.018 (1)	0	0.464 (26)	0.018 (1)
Total	0.179 (10)A[b]	0.679 (38)B	2.018 (113)B	2.018 (103)B

[a] Captures/100 trapnights (total captures)

[b] Like letters represent no significant ($P > 0.10$) difference between land classes; different letters represent a significant ($P < 0.10$) difference between land classes.

predominated in the heavy CRP (Table 2).

We found a significant difference (P = 0.001, F = 15.73, d.f. = 3) in the total number of animals captured per night among land classes. Rangeland produced significantly fewer captures than heavy or light CRP and cropland; there were no differences among the other field types in the number of captures per night (Table 2). Within genera, there were differences among field types in the number of captures per night only for the vagrant shrew group (P = 0.05, F = 9.27, d.f. = 2); more animals were found in heavy than in light CRP. Heavy CRP yielded the greatest species diversity index (H′ = 0.528), followed by rangeland (H′ = 0.208), light CRP (H′ = 0.206), and crop/fallow (H′ = 0.0).

Discussion

The majority of captures were in CRP lands. We trapped slightly more animals in the heavy CRP than the light for each species except deer mice. Small mammal capture rate was the same for heavy and light CRP and cropland; rangeland had the lowest capture rate. The duration of trapping was short in relation to seasonal small mammal population fluctuations, but trapping was thought to be representative of the season that provided the greatest abundance of small mammals (Krebs and Myers 1974). However, seasonal and annual sampling may have revealed different results. Both CRP types provided greater vertical structure and cover. Increased cover reduces predation of small mammals (Erlinge 1987). Additionally, King and Savidge (1995) reported vegetative cover and structure to be more important than plant diversity in determining bird densities.

Deer mice occurred most frequently in light CRP and was the only species captured in crop/fallow. Kaufman et al. (1988) described habitat use of deer mice negatively related to the amount of litter and positively related to the amount of exposed soil and grass. Two of the three light CRP fields sampled had lower percent cover as did all the stubble fields. We captured fewer deer mice in heavy CRP, which had a higher percent cover, than we did in light CRP. Houtcooper (1977) suggested that deer mice made and used tunnels in stubble fields and that these tunnels provided cover, thereby enhancing use of the stubble fields. Travers et al. (1988) and Brillhart and Kaufman (1989) found increased use of open areas on bright nights compared to dark nights. All of our trapping effort was conducted on relatively cloudless, moonlit nights. However, Wolfe and Summerlin (1989) found that trapping was not affected by lighting conditions but by animals focusing on bait in traps. If deer mice only respond to the presence of bait, our results would indicate a clear difference in relative use. If our results were influenced by lighting conditions and not by the presence of bait, they still emphasized the importance of cover, probably as it relates to predation.

Additionally, deer mice often use open areas, feeding primarily on insects, seeds, grains, and fruits (Baker 1968, Kaufman and Kaufman 1989). Our results support these findings. More of the larger seeds are available in stubble and perhaps more seeds and fruits are found on the ground in light CRP than heavy CRP due to less support of fruiting stems by herbaceous growth and shelling of seed heads by wind.

Voles are reported to prefer fields with abundant herbaceous growth (Krebs and Myers 1974, Birney et al. 1976). Birney et al. (1976) described a threshold under which voles occurred in low densities, but suggested the threshold was very likely site-dependent. However, those sites that were not grazed and received ample moisture produced the greatest densities of voles. The capture rate of voles during this study was higher in heavy

CRP than any other field type, supporting results discussed by Birney et al. (1976).

Voles feed primarily on stems, leaves, roots, seeds, and succulent plants. Heavy CRP had more forb cover than did light CRP and the shade provided by plants may have extended green growth (Selting 1994). Krebs and Myers (1974) described grazing effects of microtines, which resulted in the reduction of grasses and the increase of flowering plants, such as forbs, and the effect of grazing may have enhanced the observed plant composition.

Shrews do not generally occur in grasslands but are associated with fallow fields or wet sites (Schwartz and Schwartz, 1981). We captured only one shrew in rangeland and none in cropland. The CRP types may provide more suitable cover and a greater abundance of invertebrate foods. Caterpillars were often observed feeding on snap trap baits suggesting that shrews were captured while consuming caterpillars. Caterpillars were observed feeding on the peanut butter/oats bait only in the CRP types. Our trap type success for shrews differs from Allen et al. (1994) who caught more shrews in pitfall traps; we showed no difference in trap type success for any species.

Heavy CRP yielded the greatest small mammal diversity in this study along with a greater number of plant species and greater amount of cover. Light CRP and rangeland had similar diversity and both had comparable amounts of cover. In general, CRP benefits other classes of vertebrates and seems to serve the same function among these classes as it has for small mammals, cover. Gould and Jenkins (1993) found CRP enhanced habitat in an agricultural landscape by serving as cover. Luttschwager et al. (1994) emphasized the importance of cover provided by CRP plantings by suggesting at least 25 percent be left in a block for cover for ducks. King (1991) and Patterson and Best (1996) found more bird species nesting in CRP than in row crops. Additionally, the lack of physical disturbance and human activity may have contributed to the greater diversity and abundance of small mammals we found in heavy and light CRP land classes .

Age of CRP lands may play an important role in the diversity of small mammal communities. Hall and Willig (1994) found no differences in mammalian diversity among sites ≤ 3 years old. The CRP fields that they sampled may have characteristics similar to our light CRP. We found that diversity was increased two fold in heavy CRP. We hypothesize that this may be, in part, related to the presence of nitrogen-fixing alfalfa.

Conclusions

We documented the use of CRP lands by small mammals. The results may be used to develop recommendations to influence diversity of small mammals on enrolled lands. Additionally, abundance and diversity of predators that utilize small mammals as prey may be enhanced. This study revealed the current role of the program in maintaining or enhancing populations of small mammals, and could influence the future of the program by providing documentation of small mammal use of habitats under differing agricultural land uses and histories. CRP fields that incorporated alfalfa into the vegetative cover provided the greatest amount of vertical cover and percent cover, and should be considered when seeding newly enrolled CRP lands to provide a continued source of a limiting nutrient.

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