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DISTRIBUTION AND RELATIVE ABUNDANCE OF SMALL MAMMALS IN THE ILLINI FOREST PLANTATION, URBANA, ILLINOIS

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ABSTRACT: The abundance and distribution of small mammals were analyzed for correlation with the vegetational characteristics of their habitat. Positive correlations were found for the number of mammals trapped per area trapped versus the total ground cover ($r = .67$, $P < .05$) and for the number of mammal species versus total ground cover ($r = .73$, $P < .05$). The habitat preferences of the three species trapped (short-tailed shrews *Blarina brevicauda*, white-footed mice *Peromyscus leucopuus*, and meadow voles *Microtus pennsylvanicus*) showed a distinct distributional pattern for the species in relation to their habitats. The management of forest-tree plantations to achieve high densities during the seedling stage and the use of silvicultural practices that promote high shrub densities are suggested as inexpensive and natural control measures for injurious microtine rodents. Seedlings must be permitted to reach a sufficient height to remove the risk of the shrubs overtopping them.

Habitat selection by small mammals is a well-documented fact [Getz 1970, Grant 1971, Miller and Getz 1977, Richens 1974, Thompson 1965, Williams 1955]. However, studies concerning the number and distribution of small mammals in diverse habitats within a small geographical area are not very common. Experimental forest plantations offer the necessary diversity of habitat on the requisite scale.

This study was designed to examine the number of individuals and the species of small mammals present in distinct types of habitats in an experimental forest plantation. General comparisons were drawn between the data obtained for this study and those collected by other investigators within the same general area in the past. Recommendations are made for the natural control of rodent pests in the initial years of forest plantings to reduce damage to seedlings. Some questions that arose during the investigation are presented as possibilities for future research.

STUDY AREA

The Illini Forest Plantation is an area of approximately 13 hectares located on the southern edge of Urbana, Illinois. The surrounding areas are farm land, urban development, or other University study facilities, such as those used for dairy production, plant pathology, and so on. Because of this pattern of land use, the plantations provide the only area of good wildlife cover on the campus of the University of Illinois at Urbana-Champaign.

The soils of the area are classified as silt loams or silty clay loams of loessal origin. The drainage classification as well as the suitability of the soils for different land uses vary widely [Alexander *et al.* 1974]. This, along with the type and density of the tree canopy, has largely determined the composition of the shrub and herb layer found in each stand.

Seven separate areas were chosen as sampling sites (Figure 1). All of the sampled areas had not been disturbed by thinning, weeding, and the like for at least the last 15 years [J.J. Jokela, personal communication]. All sampled areas were planted between 1951 and 1955. The areas varied in size from 0.11 to 0.42 hectare. Three of the plots had been planted with coniferous species using a spacing of 1.8 meters between trees and rows. The hardwood species were originally planted on two plots at spacings of 2.4 meters between trees and rows. Severe mortality in the stands of shortleaf pine (*Pinus echinata* Mill.) and loblolly pine (*Pinus taeda* L.) due to lack of winter hardiness have reduced them to an open, park-like habitat with 247 and 255 trees per hectare, respectively (Table 1). The vegetative cover on these two plots is typical of habitats in old fields [Bazzaz 1968].

METHODS AND MATERIALS

Vegetational data were obtained from sample plots spaced at intervals along transects. The spacing between plots was proportional to the area of the sample site. The total ground cover was calculated as the mean percentage of the area covered by living and dead plant material between 0 and 5 centimeters above the ground. Vegetational sampling was carried out between October 9, 1977, and November 4, 1977.

Trapping commenced on October 28, 1977, and was completed on November 23, 1977. In each sample area, a number of Sherman-type traps were placed in proportion to

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the area, ranging from 8 to 24 traps. In this way, equal trapping intensity was achieved on each area sampled. The traps were placed in a circle with one trap in the center, after the method suggested by Stickel [1946]. The area trapped was adjusted to be proportional to the area of the sample site by varying the diameter of the circle. Trap centers were randomly selected. The only stipulation was that no trapping area was to extend closer than 3.05 meters to the edge of the plot. The traps were checked at least once a day, just after dawn; and if weather conditions dictated, they were also checked just after dusk. Trapping was continued for 3 days on each sample site.

Since the object of the study was to determine the relative population of small mammals within each sample site, no attempt was made to estimate the actual population on each site. This would have involved some type of mark-recapture technique or snap-trapping on line transects [Delaney 1974, Golley *et al.* 1975, Overton 1971, Stickel 1946, Stickel 1954].

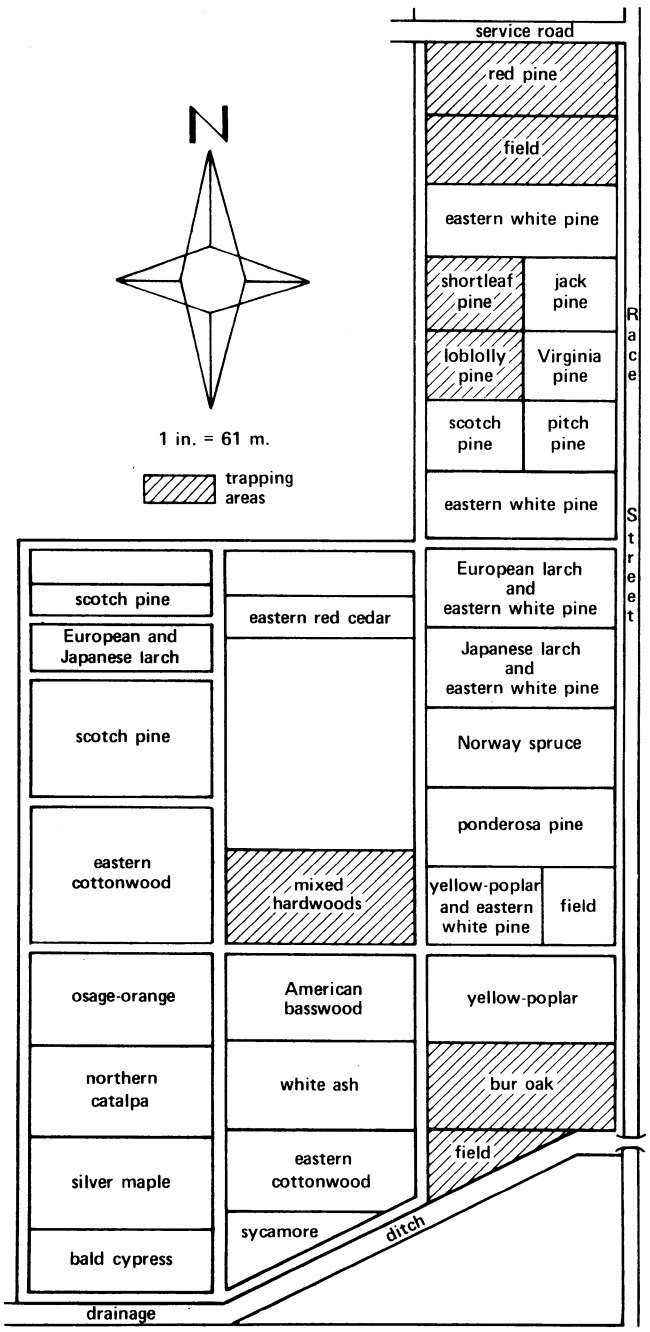

Figure 1. Location of trapping areas in the Illini Forest Plantation.

RESULTS AND DISCUSSION

An examination of the vegetative data (Table 1) reveals that the major species in the herb and shrub layer are native or naturalized "weed" species [Jones 1971, A.G. Jones, personal communication]. However, as expected, the density of the herbaceous understory resulting from natural succession has declined greatly since the time of initial planting [Jokela and Lorenz 1959, A.G. Jones, personal communication].

Nineteen small mammals were caught in 318 trap nights (Table 2), an average of 1 animal caught for 16.67 trap nights. Three species were represented in the catch: short-tailed shrews (*Blarina brevicauda* Say.), meadow voles (*Microtus pennsylvanicus* Ord), and white-footed mice (*Peromyscus leucopus* Rafineque). No house mice (*Mus musculus* Linnaeus), prairie voles (*Microtus ochragaster* Wagner), or deer mice (*Peromyscus maniculatus* Wagner), which were trapped by Hoffmeister (unpublished) in September of 1971, were caught.

Several correlations were run between the total number of mammals trapped per area and (1) the total ground cover, (2) the total number of vegetational species found, and (3) the density of the stand. The total number of small-mammal species on each area was also tested for correlation with the same three vegetational factors. Good correlations, considering the small sample size, were found for [(total mammals per area trapped) + 1.0] versus ln total ground cover ($r = .67$, $P < .05$) and ln [(total number of mammal species) + 1.0] versus ln total ground cover ($r = .73$, $P < .05$). (see Figure 2.) The number 1.0 was added as an arbitrary constant to the total mammals per area trapped and the total number of mammal species so that the natural logarithm could be taken for all values, even those which were initially zero [Steel and Torrie 1960]. These figures show a fairly high degree of correlation between the total ground cover and the total number of species and individuals on the sample sites. These results agree in theory with the findings of Miller and Getz [1977], who worked with correlations of abundance of individual species with various habitat factors in Connecticut and Vermont.

Qualitatively, the data (Table 2) show that the three small-mammal species tended to divide up the available habitat according to their own preferences. Short-tailed shrews were found mainly in dry, open, grassy areas with dense ground cover (total ground cover, 0 to 5 centimeters, 98 to 99 percent). Meadow voles sought open, grassy areas which tended to be moister than those frequented by the shrews. White-footed mice preferred hardwood stands with

Table 1. Summary of the Vegetation Analysis

Stand (area, ha.)	Gound cover, at 0.5 cm. (percent)	Stand density (stems/ha.)	Major understory species (% total freq.)	No. of species
Red pine *Pinus resinosa* Ait (.31)	22.5	2,990	*Phytolacca americana* *Arctium minus* *Medicago sativa* (82.5)	7
Field I (.31)	99.0	0	*Carex spp.* (2 spp.) (97.1)	9
Shortleaf pine *Pinus echniata* Mill. (.15)	98.0	247	*Carex spp.* (2 spp.) *Rudbeckia hirta* *Pastinaca sativa* (94.3)	10
Loblolly pine *Pinus taeda* L. (.15)	98.0	255	*Carex spp.* (2 spp.) *Toxicodendron radicans* *Rosa multiflora* (97.5)	13
Bur oak *Quercus macrocarpa* Michx. (.35)	31.3	1,680	*Prunus serotina* *Carex spp.* (2 spp.) *Rubus flagellaris* *Pastinaca sativa* *Toxicodendron radicans* (88.1)	15
Field II (.11)	99.0	0	*Carex spp.* (2 spp.) *Pastinaca sativa* (99)	4
Mixed hardwoods (.42)	33.0	1,680	*Rubus flagellaris* *Carex spp.* (2 spp.) *Daucus carota* *Rubus occidentalis* *Rhus typhina* *Prunus serotina* *Toxicodendron radicans* (88)	15

Table 2. Summary of Trapping Data

Stand	No. of mammals	No. of species	Species caught	Trap area (m^2)
Red pine	0	0		58
Field I	1	1	1 *Blarina brevicauda*	58
Shortleaf pine	3	2	2 *Blarina brevicauda*	29
Loblolly pine	4	2	1 *Microtus pennsylvanicus* 2 *Blarina brevicauda* 2 *Peromyscus leucopus*	29
Bur oak	3	1	3 *Peromyscus leucopus*	65
Field II	4	1	4 *Microtus pennsylvanicus*	26
Mixed hardwood	4	1	4 *Peromyscus leucopus*	78
Totals	19	3		343

less ground cover at 0 to 5 centimeters than the preferred habitats of the meadow vole or short-tailed shrew. These types of habitat preferences agree with those found by other investigators [Hoffmeister 1972, Miller and Getz 1977, Richens 1974].

Microtine rodents can cause large amounts of damage to young trees in plantations in the midwest [Jokela and Lorenz 1959]. The voles feed on the cambial layer of the young trees in the winter and can effectively girdle many trees [Jokela and Lorenz 1959], especially when they are at a population peak [Krebs *et al.* 1973].

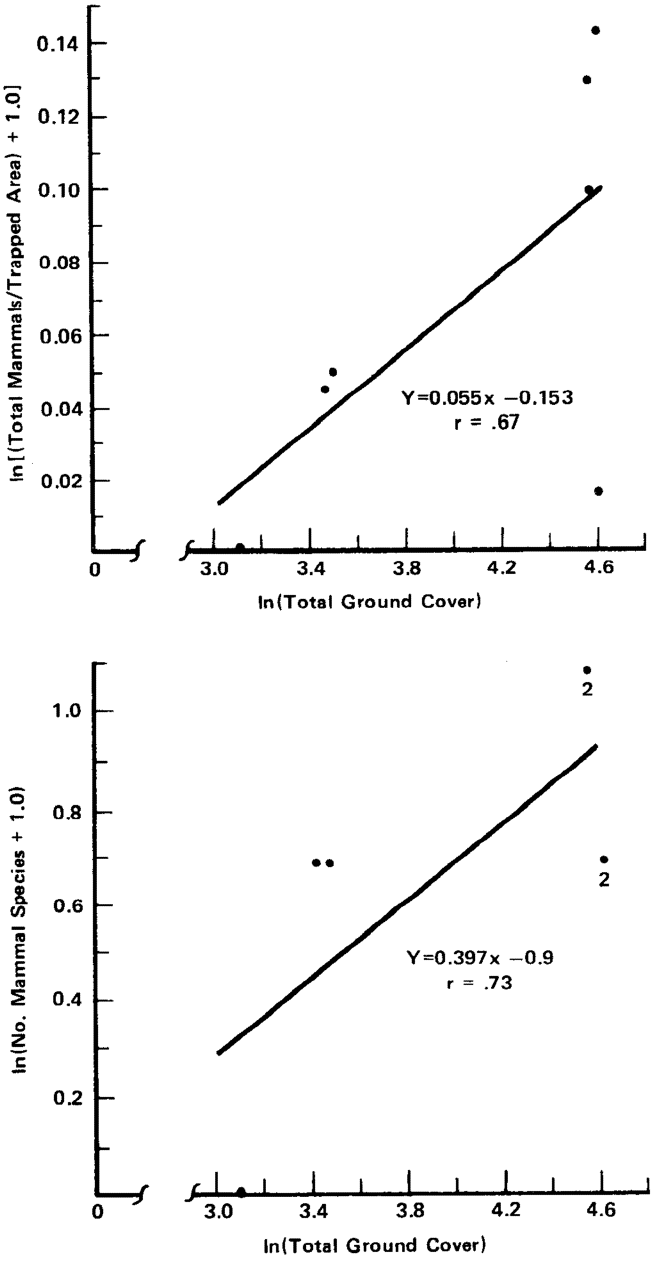

Figure 2. Relationship between total mammals per trapped area with total ground cover and total mammalian species with total ground cover.

If either the stand or a shrubby understory can be kept very dense, a dense herb layer can be prevented from developing. This was the case in the red pine stand, which had a very dense growth of pokeweed (*Phytolacca americana*) at about 1.5 meters above the ground. No mammals were caught in this stand. Due to their habitat preferences, one should not expect large numbers of microtine rodents to develop in this area. At extremely high densities, however, voles will utilize a less-suitable habitat to a small degree [Grant 1971].

Effective management to maintain a dense stand of young seedlings followed by a dense stand of shrubs, when the shrubs are no longer competing with the seedlings for light, may be effective in controlling microtine rodents without expensive and environmentally degradating control measures, such as the use of rodenticides and clean cultivation. The assumptions are that the tree species can tolerate the shrub layer and/or crowding and that such conditions will not reduce economic returns below those which would have accrued with no protective measures.

COMMENTS

Some interesting questions pertaining to the small-mammal population of the Illini Forest Plantation were raised during the investigation. First, what caused the transition from a microtine population consisting primarily of prairie voles in the past [Jokela and Lorenz 1959, Getz, personal communication] to the current population which is mainly meadow voles? Second, what effect does hunting by mammalian predators such as feral house cats (*Felis catus* Linnaeus) and avian predators such as great horned owls (*Bubo virginianus*) have on the small-mammal population? Third, what are the inter-specific relationships between the small mammals in these stands? Since each of these questions poses several subquestions, much fruitful research remains to be done concerning the population dynamics of small mammals in the Illini Forest Plantations.

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