

## COMPARISON OF THE RELATIVE ABUNDANCE OF WHITE-FOOTED MICE IN FIELD AND FOREST HABITATS

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### ABSTRACT

The white-footed mouse, *Peromyscus leucopus*, is a habitat generalist abundant throughout Pennsylvania. The habitats it occupies vary widely in abiotic and biotic structure. We hypothesized that populations of *P. leucopus* in structurally complex forest habitats should be relatively more abundant than populations in structurally simple field habitats. We found a significant difference between the relative abundance of forest and field populations in the ridge and valley region of Pennsylvania. Field observations suggested that competition from meadow voles, *Microtus pennsylvanicus*, may impact the ability of *P. leucopus* to maintain abundant populations in field habitats. Possible effects of source and sink populations, predation, annual reproductive cycles, and exposure to weather extremes are also discussed.

*Keywords:* Habitat selection, relative abundance, *Peromyscus leucopus*, source/sink populations, white-footed mouse.

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### INTRODUCTION

The white-footed mouse (*Peromyscus leucopus*) is a habitat generalist widely distributed throughout North America, and is the most abundant rodent in Pennsylvania. Its adaptability allows it to be occur in many kinds of habitats.

According to M'Closkey and Lajoie (1975), the abundance of *Peromyscus* species varies with habitat type. Because of their relatively complex, three-dimensional structure, forested habitats offer a greater variety of microhabitats, food and shelter than fields. Therefore, we predicted that *P. leucopus* should be more abundant in forests than fields. The results of this survey will help to evaluate the impact of timber harvesting and other forms of development on *P. leucopus* populations. This knowledge can be used to better understand the population ecology of similar, less abundant species that may not be as readily available for study.

### FIELD SITE

Our study was conducted at the Juniata College Raystown Field Station and at Patrick Lodge in Rothrock State Forest (Fig. 1). Forest and field/forest transects were established at both locations. All transects were located in the Ridge and Valley region of Central Pennsylvania. Both forest transects were located in

temperate deciduous forests dominated by oak and hickory. Both field/forest transects were located in fields maintained by controlled burns or regular cutting. Transects in Rothrock State Forest were located at approximately 78.0° latitude and 40.75° longitude. Transects at the Juniata College Raystown Field Station were located at approximately 78.167° latitude and 40.333° longitude.

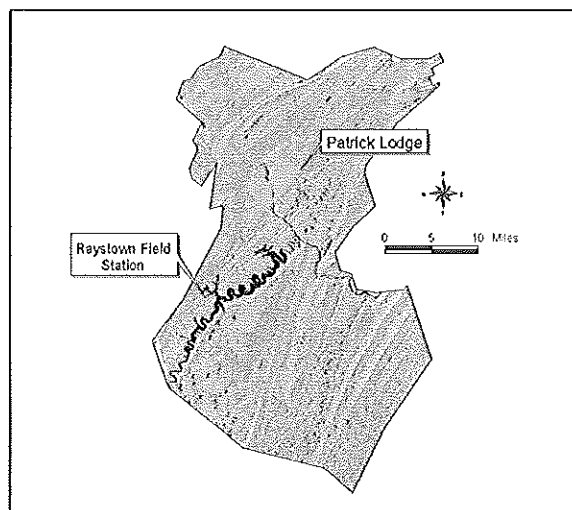


Figure 1. Location of field sites.

We conducted this study during March - April, 2000. *P. leucopus* populations have their lowest numbers at this time because of winter mortality and reduced or absent breeding. Mating starts in early March and continues until late October (Merritt, 1984).

## METHODS AND MATERIALS

We tested the hypothesis that forest populations of *P. leucopus* will be equally or less abundant than field/forest populations. We measured relative population abundance using a success of capture method. Our index of population abundance was the number of captured mice, relative to the number of traps used.

We conducted our study in primarily field habitat plots (not more than 100 meters from a forest) and in forest habitat plots (at least 200 meters from any field or clear-cut). We established 150-m transects through each plot at random starting points and directions. Along these transects we placed two traps at 5- m intervals, each baited with peanut butter, oats, and apples (D. Glazier and C. Yohn, personal communication). This spacing was followed in order to incorporate at least two home ranges of *P. leucopus*. Home ranges vary in size from .04 to 1.0 hectares (Merritt, 1984). Because *P. leucopus* is primarily nocturnal, we set Sherman Live Traps at dusk and processed captured individuals within a few hours of sunrise. We repeated this six times in each plot type in order to establish an accurate census.

We tested our data for normality using the Anderson-Darling Normality test. We tested our data for homogeneity of variance using Levene's Test. We tested for differences between the field/forest populations and the forest populations using a Mann Whitney U test and considered differences to be significant at  $P < 0.05$  (Minitab Inc., 1991).

## RESULTS

We compared the relative number of *P. leucopus* captures per trap per transect on three different occasions in both field and forest habitats. The count included both dead and live mice. We considered every night's capture in each habitat type as a unique point (see Figure 2).

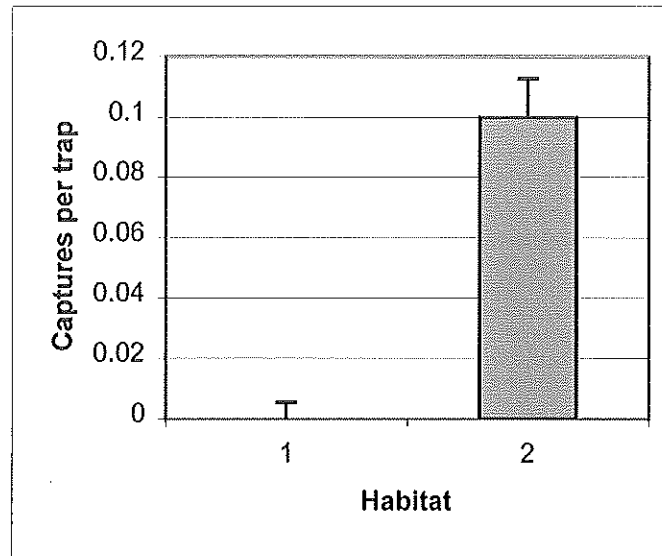


Figure 2. Comparison of the relative population abundance of *Peromyscus leucopus* between field (one) and forest (two) habitats. Error bars indicate  $\pm 1$  SE.

Our data did not have a normal distribution ( $A^2 = 1.599$ ,  $N = 6$ ,  $P < 0.001$ ), but the variances were not significantly different between our habitat samples ( $F = 1.471$ ,  $N = 12$ ,  $P = 0.253$ ). We found a highly significant difference in captures per trap between habitat types ( $U = 21.5$ ,  $N = 6$ ,  $P = 0.0045$ ).

## DISCUSSION

Our findings agree with those of M'Closkey and Lajoie in southern Ontario (1975). *P. leucopus* populations are more abundant in forest habitats than they are in field habitats. There are many possible explanations for this pattern. First, abiotic attributes of the habitats could influence *P. leucopus* distribution. Field habitats have a greater exposure to environmental extremes such as temperature, wind, and precipitation. Additionally, forest habitats have a greater diversity of micro-habitats because of a greater three-dimensional structure. This more complex structure may allow for a greater range of choices in shelter and food. There are also biotic attributes of the two habitats that might influence the colonizing ability of *P. leucopus*. For instance, open field habitats probably offer greater risks of predation from birds of prey, whereas the diverse structure of the forest may provide more shelter from such predation.

During our study, we captured three meadow voles (*Microtus pennsylvanicus*) in the field habitat, but did not capture any in the forest. Since *M. pennsylvanicus* utilizes many of the same resources as *P. leucopus*, perhaps it competitively inhibits the abundance of these mice. Studies conducted by Anthony, Niles, and Spring (1981) agree with this observation. They showed that at high levels, *M. pennsylvanicus* was a more effective competitor than other *Microtus* and *Peromyscus* species. However, studies conducted

by Dueser and John (1986) show that it is habitat structure that primarily determines relative abundance and not competition, which seems to play a relatively minor role.

It should be noted, however, that our study was conducted at the very end of the winter season. *P. leucopus* populations are at their lowest levels and under physical stress during this time of the year. It is possible that environmental factors lower *P. leucopus* field populations to such an extent during the winter months that the effects of competition from *M. pennsylvanicus* are magnified. However, observed populations of *M. pennsylvanicus* are so low that it is doubtful that they have a large effect on field populations of *P. leucopus*. Either way, the combined abiotic and biotic factors are the most likely candidates for explaining the habitat difference in *P. leucopus* abundance that we observed.

Observations of *P. leucopus* have been made during the summer and fall at the field sites we studied (C. Yohn, personal communication). It is likely that forest habitats support stable source populations which continually re-colonize environmentally buffeted, nearby field habitats. Studies performed by Adler and Wilson (1987) support this hypothesis. Their studies showed that less fluctuating forest populations often serve as sources of re-colonization for more widely oscillating field populations. By this account, it should be noted that although we found a highly significant difference in habitat selection, this might not be the case throughout the year.

Our findings have implications for conservation biology. During land development or timber harvesting, it is important to consider that populations of *P. leucopus* may be sources or sinks. Although field populations may seem healthy during the summer months, environmental stress during winter necessitates the existence of nearby stable forest populations. If this is not considered during land development, populations of *P. leucopus* and its predators could be seriously impacted.

The strength of our conclusions is limited by small sample sizes. During statistical analysis, it was necessary to incorporate pseudo-replication in order to draw conclusions. Although our data suggest the same outcomes as many other studies, further replication should be conducted in order to verify this.

Further study might address the hypotheses proposed above. The effects of predation, competition, and abiotic factors on field and forest populations need to be directly assessed in order to draw any conclusions about the habitat differences in *P. leucopus* population density that we observed. The annual cycles of populations in fields and forests should also be explored to test the source-sink hypothesis. It is possible that *P. leucopus* shows different types of habitat selection throughout the year. Finally, to draw more reliable inferences, more field and forest habitats should be surveyed.

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