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Impact of Pine Barrens forest vegetation on population density of mice (small mammals) at Brookhaven National Laboratory

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Abstract

The abundance of vegetation, and how it varies across a landscape, may be decisive to habitat use by mice (small mammal) populations. This study addressed the relative importance of vegetation types and their abundance/heights to mice population density. During summer, we collected data on mouse populations and vegetation structure at 16 experimental sampling plots. We hypothesized that mice density would be higher in areas where the vegetation is taller than 35 centimeters. We have placed ten plots on the East side and six plots on the South side of Pine Barren forest of Brookhaven National laboratory. At each plot we set up a 35x35m grid and placed 64 traps (12x3x3) with flags at every 5 m inside of the grid. Over a period of 8 weeks, we have studied mice population densities twice in 1,024 trap/nights. Prior to trapping mice, we established a linear transect down the middle of each grid. Along these transects we measured the heights of litter, slash (woody debris), dead standing shrubs, and live standing shrubs. At each location we trapped mice, marked them with ear tags, and identified the sex. At locations 1, 3, 4, 7, 9, and 16, vegetation was taller than 1 foot. Fifty percent of the locations had vegetation heights greater than 1 foot. We captured 45-59 mice at each of these locations. Two sites were burned prior to trap studies, and 0-5 mice were catured after a week of trapping. This project has helped me understand the scientific method and its application better in a field based ecological experiment. Being a part of small mammals (mice) team project at BNL, I appreciate science better.

Introduction

The white- footed mouse (Peromyscus leucopus) is a habitat generalist and a permanent resident of shrub land, forest and grassland (Adler & Wilson, 1987). Observations show that it is found generally at higher densities in hardwood forests with a large volume of stumps and logs, and dense ground cover (Brannon, 2002). The spatial distribution of small mammal species is influenced by interaction of various factors including food availability, water and predators (Poulin et al., 2002). Climate change allows reservoir hosts and vectors to expand their range into new territories (Brownstein et al. 2005). In addition, fragmentation of forested landscapes due to human activities affects local biodiversity by favoring habitat generalists and species that experience high population densities and small home ranges. Although forest fragmentation generally reduces species diversity within remnant patches (Allan et al. 2003), numerous studies found that *P. leucopus* population densities increased as patch size decreased, indicating that their abundance is actually enhanced by forest fragmentation (Yahner 1992).

White-footed mice play an important role in the ecosystem. White-footed mice help spread various kinds of fungi by eating the sporing bodies and excreting spores. Forest trees' ability to take up nutrients is enhanced by the mycorrhizal associations formed by these fungi. For many temperate forest trees, these fungi have been shown to be an essential element in order for trees to prosper. White-footed mice also help control populations of some harmful insect pests, such as gypsy moths. They are active primarily at night and are secretive and alert, thus avoiding many predators. Undesirably, White-footed mice carry deer ticks, which spread Lyme disease. They also may be a reservoir

for Four-Corners disease, as their fecal matter can contain Hantavirus, the organism that causes this disease. White-footed mice may also act as seed predators of oaks and pines, hindering their growth and spread.

Our study objectives were: 1) to determine the relationship between mouse population density to vegetation height, (2) to increase the knowledge base of ecological studies of mice, (3) to provide information to National Resource Management at BNL for future management strategies on vegetation height and altering plant community characteristics and, (4) to identify the optimum vegetation height for mice population in undisturbed Pine Barren forest at BNL

Methods

Sixteen experimental sites were sampled over a four week period allowing each site to be studied twice over the eight week period. At each site, we established an 8x8 grid of Sherman traps spaced 5 meters apart, resulting in 64 traps per grid. Traps were baited with peanut butter/oat mixture. Cotton pads were placed under the bait to provide insulation overnight if the temperature plummeted.

To examine habitat preference in mice, 35 meter linear transects were conducted down the middle of each grid to estimate ground level vegetation heights (cm) within each plot. Litter, slash (woody debris), rooted dead standing, and rooted live standing heights (cm) were taken at every 5 meters of our linear transect. Each trap session was conducted over four consecutive nights. Traps were checked each morning; captured animals were weighed, sexed, and marked with individual ear tags. Recaptured individuals were noted. All attached ticks were removed and preserved. Program MARK Version 8.1, was used

for a parameter estimate of mice abundance at each site. The design model considers the time interval between trapping sessions as “open” and the time interval during trapping as “closed”. Furthermore, Program DENSITY Version 5.0 was used to estimate the density of mice population using the spatially unambiguous capture-recapture data collected (Efford 2012).

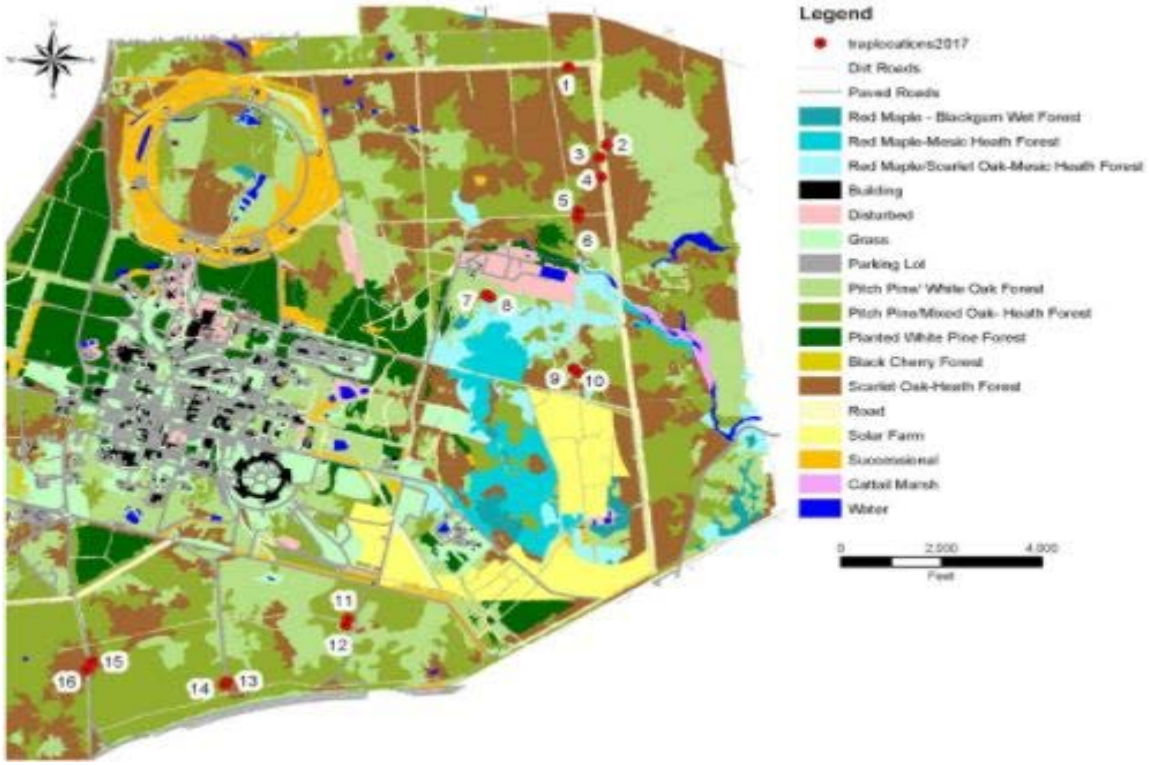

Fig 1. Map of BNL showing the 16 sites used in this study. GPS coordinates (Universal Traverse Mercator units) were used to locate the sites.

Results

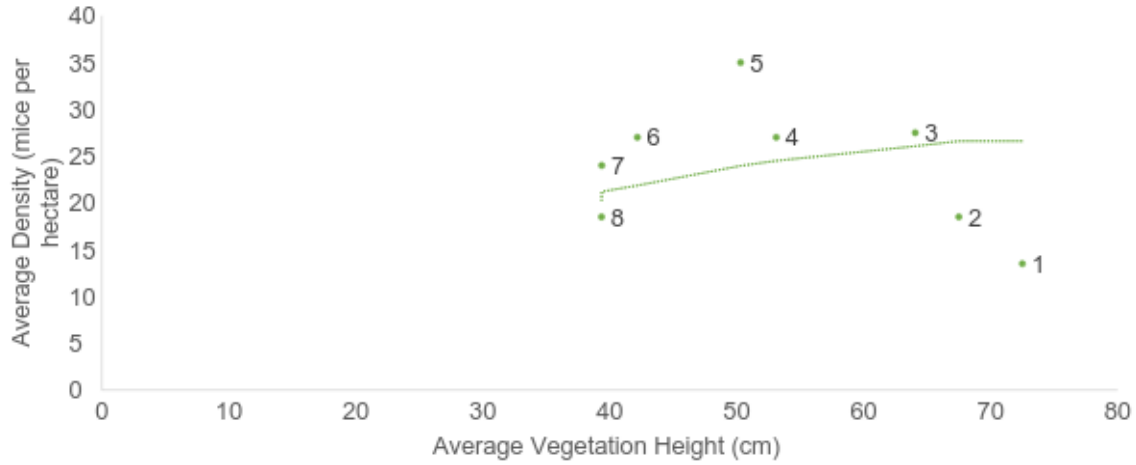

Fig2A. Density of mice in relation to vegetation heights greater than 35cm (1-8).

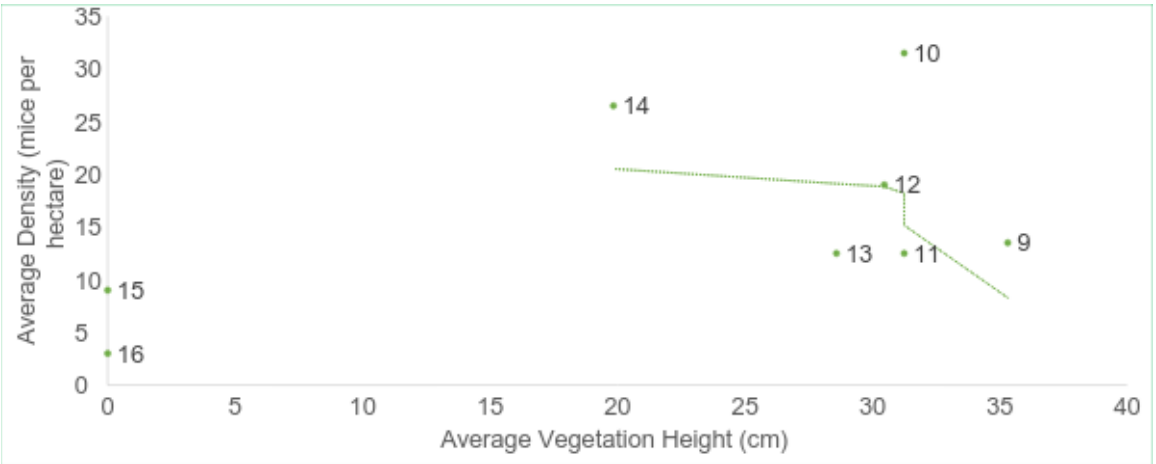

Fig2B. Density of mice in relation to vegetation heights less than 35cm (9-16).

Using program DENSITY for calculation, the basic linear regression in Figure 2A showed that there was a significant relationship between the density of mice to heights of vegetation at sites 1-8 (Fig2A;R^2= 0.13, t(14) = 5.68, p=0.05, n=8). Conversely, using the

same program for Figure 2B, there was no significant correlation between density of mice and heights of vegetation at sites 9-16 (Fig2B; $R^2 = 0.28$, $t(14) = 1.02$, $p=0.13$, $n=8$)

Discussion

The white-footed mouse ranges in color from grayish-brown to reddish-brown on its dorsal side and face while its ventral side and legs are white. Its average mass is 0.81 oz but can range from 0.5 oz to 1 oz. Other members of the Peromyscus family all have smiliar looks or ranges but can be differentiated by either tail length or mass. *Peromyscus leucopus* is a plentiful disperser and colonizer, and a single mating pair may establish a successful population upon entering a new habitat. They have been found to expand their range at an astonishing rate: approximately 15 km/year in the Great Lakes region and 10 km/year in southern Québec (V. Millien, pers. comm.) but their local movements may get hindered by various landscape barriers including agricultural fields, water, and roads. Other studies indicate, however, that *P. leucopus* shows high levels of dispersal regardless of their habitat. Since the white-footed mouse is primarily nocturnal, its main predators are those that are active between dusk and dawn. Snakes, owls, bobcats, weasels, and foxes are common predators of the white-footed mouse. The primary diet of the white-footed mouse is seeds, grains, small fruits, and small insects.

Our study indicates mice optimum habitat is dense shrub-land. At sites with vegetation higher than 35cm, more mice were captured over the one week span of trapping at that

site. As the vegetation height decreased to below 35cm, mouse populations plummeted. Low vegetation heights are subject to change overtime due to growth. Population size in areas of low vegetation will change subsequently to vegetation growth and mice reproduction. Contrarily, mouse populations may decrease in areas with vegetation higher than 35cm due to vegetation fragmentation. Predation affects low population of mice in areas lacking dense vegetation.

Acknowledgments

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