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HABITAT PREFERENCE OF *PEROMYSCUS*

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ABSTRACT

Mice in the genus *Peromyscus* are widely distributed throughout North America. Two species, *Peromyscus leucopus* and *Peromyscus maniculatus*, are able to live in a variety of different habitats. Past researchers have found that in general these mice prefer to live in habitats characterized by forest or shrubby structure. We wanted to know whether or not *Peromyscus* in the vicinity of the Maya Lin Peace Chapel in Huntingdon PA had this same preference. To test the hypothesis that *Peromyscus* prefer to live in forest type habitats, we set up 100 Sherman live traps on a hillside near the Peace Chapel. Three habitat types were covered including grassy areas, shrub, and forest. Our results indicate that there is a definite preference of *Peromyscus* to be in shrub and forest type habitats. No mice were captured in grassy areas, three mice were captured in shrub areas, and two mice were captured in forested areas. It is probable that the protection offered by the overhanging coverage from aerial predators is the reason behind this preference.

Key words: Habitat preference, home range, Peace Chapel reserve, Peromyscus

INTRODUCTION

Mice in the genus *Peromyscus* are some of the most common and widely distributed mammals in North America (Linzey et.al., 2008). *Peromyscus leucopus,* the white-footed mouse, is probably the most abundant mouse in the eastern United States, and has a geographical range from southern Canada to southern Mexico (Linzey et.al, 2008). *Peromyscus maniculatus*, the deer mouse, is also a common mouse of Pennsylvania, and also has an extremely diverse geographical range, extending from mid- and northern Canada to the south of Mexico, and spanning from the east to the west coast of the United States (Linzey et.al, 2008). *P. maniculatus* is extremely robust and has been known to live in habitats ranging from tundra to swamps, forests, prairies and deserts (Linzey et.al, 2008). Both *P. maniculatus* and *P. leucopus* live in central Pennsylvania and are ecologically important for more than just being a food source for larger predators. Studies have demonstrated that *Peromyscus* populations are reservoirs for several diseases, including Hantavirus (Netski et. al., 1999) and *Borrelia burgdorferi*, the agent of Lyme disease, which migrated west from New England (Lord et. al., 1992).

Peromyscus leucopus is a brownish or grayish rodent commonly found in mixed deciduous and coniferous forests in the eastern United States. They range in length from 150-205 mm and weigh (on average) between 15-25 g (Rafinesque 1818). White-footed mice range from parts of Southern Canada and two-thirds of the Eastern United States down to Northern Mexico (Fig. 1) (Rose et. al., 2005). It is the most abundant rodent in Pennsylvania (Merritt 1987). Identification of *P. leucopus* is usually based upon external characteristics (Fig. 2), with the exception of identification and comparison to *P. maniculatus, P. polionotus,* and *P. gossypinus* (Hall, 1981).

*Figure 1. White-footed mouse (*Peromyscus leucopus*).). Smithsonian Institution National Museum of Natural History.*

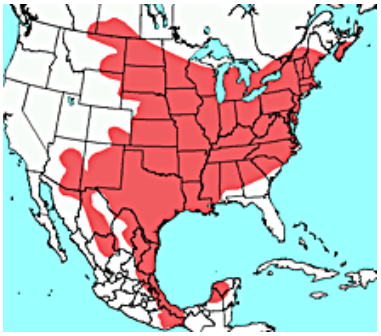

*Figure 2: Distribution of white-footed mouse (*Peromyscus leucopus) *Smithsonian Institution National Museum of Natural History.*

White-footed mice are primarily nocturnal but can be active at dawn and dusk (Zollaner et. al., 1999). *P. leucopus* are semi-arboreal and inhabit both brushy and woody regions (Lackey et. al., 1985). They spend most of their active periods on the ground (Madison, 1977). White-footed mice usually select nest sites above the ground, however, nests have been found near or at ground level in logs, rock piles, stumps, under trees, and in ground burrows (Mumford et. al., 1982). Highest densities of the white-footed mouse are found in brushy fields and woodlots containing large quantities of deciduous trees. Lowest densities are found in grassy fields (Hamilton et. al., 1979). Past studies comparing habitat preference at Raystown Field Station performed by Olsen et al. (2000) and Black et al. (2002) have also concluded that *P. leucopus* preferred forest habitats over fields. The average home range for the white-footed mouse is approximately 0.1ha. However, males normally have a larger area than females, and home ranges fluctuate seasonally (Maier, 2002). They may also be affected by food availability, age, and population density (Stickel, 1968). *P. leucopus* tend to feed on insects, starchy matter (such as mast and seeds), green vegetation, and fruit (Hamilton, 1941). The home range may also be influenced by moonlight, which may affect the white-footed mouse's perception and therefore influence their ability to find food (Zollaner et. al., 1999).

Another species of *Peromyscus* commonly found in Pennsylvania is *P. maniculatus*, or the deer mouse. Deer mice are very widespread, ranging from grasslands to forests and woodlands (Sullivan, 1995). It is the most widely distributed and abundant mammal in North America (Fig. 4) (Hygnstrom et al., 1994).

Figure 3. Deer mice (Peromyscus maniculatus). Smithsonian Institution National Museum of Natural History.

*Figure 4. Distribution of Deer Mouse (*Peromyscus maniculatus*). Smithsonian Institution National Museum of Natural History.*

Deer mice can vary in length from 120-155 mm and can weigh anywhere between 10-30 g (Wagner, 1845). Like all other individuals of the *Peromyscus* species, deer mice have white feet, white undersides, brown upper surfaces, and relatively long tails. The deer mouse's tail is more sharply bi-colored than that of the white-footed mouse (Fig. 3) (Hygnstrom et al., 1994)

Much like the white-footed mouse, deer mice are nocturnal animals that feed opportunistically upon any food source that is available, specifically seeds, nuts, fruit, berries, insects, and even other animal matter. As previously stated, deer mice will inhabit a variety of habitats, such as grasslands, shrub lands, woodlands, and forests. They are agile climbers, and will find shelter anywhere that is available (Wagner 1845). They construct their nests of an assortment of materials, such as stems, twigs, leaves, and roots and may be line with feathers, fur, or shreds of cloth. They primarily build nests underground in areas like the roots of trees, beneath logs, or in other rodents' burrows, but have also been known to facilitate aboveground sites such as hollow logs or fence posts. *P. maniculatus* occupies a home range that can be as small as 1/3 of an acre and as big as 4 acres or larger (Hygnstrom et al., 1994). Most studies have found that the size of the deer mouse's home range correlates with food availability and varies with the seasons; and there exists an inverse relationship between the population density of *P. maniculatus* and the size of the home range (Sullivan, 1995). They also use several home sites within the home range and will travel in between them, based on habitat changes and loss or gain of conspecific neighbors. Adults may also shift their home ranges in response to disturbances, and one adult female that was caught 4 times within a 75-foot radius shifted her home range as much as 1,000 feet (Sullivan, 1995).

Our study aimed to study the habitat preference and home range of *Peromyscus* at the Maya Lin Peace Chapel in Huntingdon, PA. Based on past research (e.g. Hamilton et. al., 1994; Olsen et. al., 2000) we expected that *Peromyscus* would prefer forested habitat over grass or shrub habitat. Forested habitat should be preferred because it offers a great deal of cover for the mice for protection against predators. We tested this hypothesis by setting Sherman live traps in grass, shrub, and forested areas near the Peace Chapel and using mark-recapture techniques to determine the density of mice in the area as well as in which areas they frequented.

FIELD SITE

We selected the area around the Juniata College Peace Chapel, Huntingdon, Pennsylvania as the site for our study. We chose to survey the habitat adjacent to the trail leading up to the Peace Chapel and next to the trail leading up to the area known as Meditation Point. The field site spanned three different habitats, our trap lines went from a grassy area to a shrubby area to grassy and forested habitat. The field site was located on a gentle hill with the grassy area in the low lying area and the forested habitat at the top of the incline, with shrubby habitat in between.

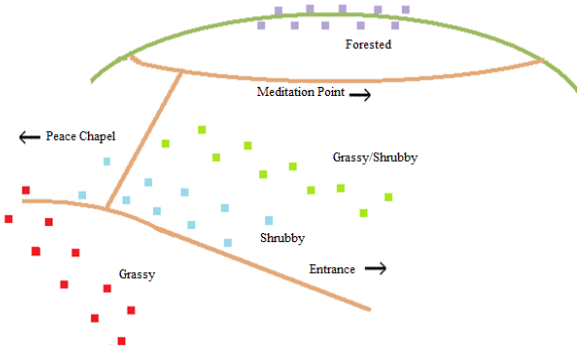

Figure 5. Diagram of field site. Dotted lines represent transect lines of ten traps each. The red dots represent grassy habitat, the blue dots represent shrubby habitat, the green dots represent a mix of grassy (lower transect line) and shrubby (higher transect line), and the purple transect line represents forested habitat.

MATERIALS & METHODS

Sherman live traps were set up in sets of four transect lines, containing ten traps each. Transect lines were set up horizontally across the incline. A combination of peanut butter and corn was used to bait the traps. Previous studies have shown that *P. leucopus* tends to be an opportunistic eater and will consume a wide variety of foods (Anderson et. al., 2009). We began our collection period on the twenty-seventh of March 2010 and continued to the eleventh of April 2010. At the onset of our study traps were checked twice a day, once in the morning and once in the afternoon. However we reduced our visits to the traps to only a morning visit, due to an increase in temperature, and concern of disturbing the traps too much. Traps were checked at approximately 8 a.m. each morning to ensure that the mice would not be stressed too long from being kept in the traps, or overheated in the course of the day.

When a mouse was captured, it was weighed using a spring mass scale. After being weighed the mice were measured for body length from nose to the base of the tail, tail length. The sex of the mouse was also determined for each mouse captured. Once all

data was collected, the mouse was released at the site where it was captured. The trap was then cleaned out, re-baited, and reset at its previous location. At the end of the study, tape measures were used to determine the distance between traps in order to chart out the relative location of each trap. Population size for the area was estimated using the Lincoln index. The Lincoln index was defined as the number of mice marked (M) multiplied by the number of mice caught the second time (n), divided by the number of mice that were marked and recaptured (m).

RESULTS

Results indicate that the *Peromyscus* spp. preferred shrub and forest habitat. Three individuals were caught in shrub-dominated habitat, while two were caught in forest habitat (Fig. 6). Furthermore, of the five individuals that were caught, fourteen recaptures were made in shrub habitat, and three were made in forest (Figure. 7).

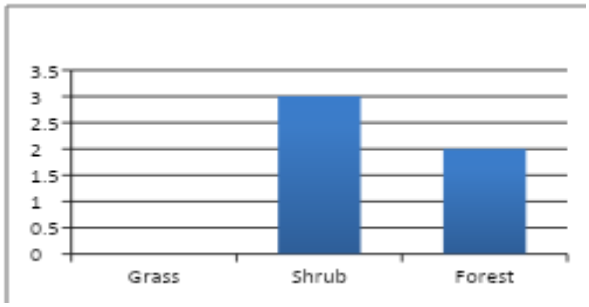

Figure 6. Number of Peromyscus *spp. individuals caught in each type of habitat.*

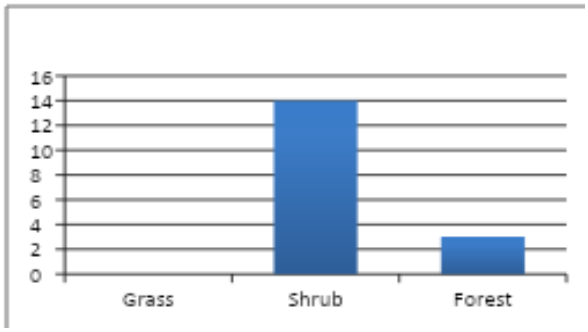

Figure 7. Total number of Peromyscus *spp. captured in each habitat type.*

Based on the Lincoln index for mark and recapture studies, we determined that at most there could be six mice living in our study area, or as few as two earlier on in the study. On Day 9 based on the captures made the Lincoln index calculated is infinite, because no mouse was recaptured that day making the denominator of the index zero.

Table 1. Lincoln index for the number of Peromyscus *spp in our field site where M is the number of animals marked, n is the number caught the second time, and m is the number of marked animals recaught. The row with an asterisk indicates that the mouse tagged 94 may be the same as the one with tag 37. We believe the 37 tag fell off of the mouse. This would change the Lincoln index for the 14th capture because it means that we re-caught 3 mice instead of only 2.*

Recapture	M	n	m	Lincoln Index
1	1	2	1	2
4	2	1	1	2
5	2	1	1	2
7	2	1	1	2
8	2	1	1	2
9	2	1	0	Infinite
10	3	1	1	3
11	3	1	1	3
12	3	1	1	3
13	3	2	1	6
14	4	3	2	6
14*	4	3	3	4
15	4	2	2	4

Since several of the mice we caught were recaptured multiple times we were able to track changes in body mass, and body length, as shown in Fig. 8 for the mice tagged 177 (caught 5 times) and 178 (caught 8 times). Furthermore in those two mice, body length was plotted against body mass as well (Fig. 9). Mouse 178 showed some increase in body mass with little to no increase in body length. A plot

of length vs. mass shows that as body mass increased there was a slight decrease in body length for mouse 178. Mouse 177 showed a trend of increasing body mass and length. A plot showing the locations of each trap where mice 177 and 178 were caught (Fig. 10) shows that mouse 178 moved around the field site more than mouse 177.

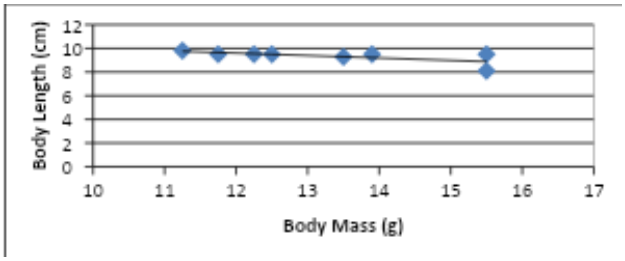

Figure 8. Graphs showing body mass and length measured during our mark and recapture study for mice tagged 178 (top) and 177 (bottom).

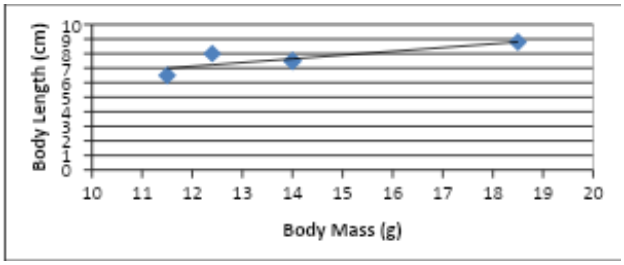

Figure 9. Length vs. mass plotted for mouse 178 (top) and mouse 177 (bottom).

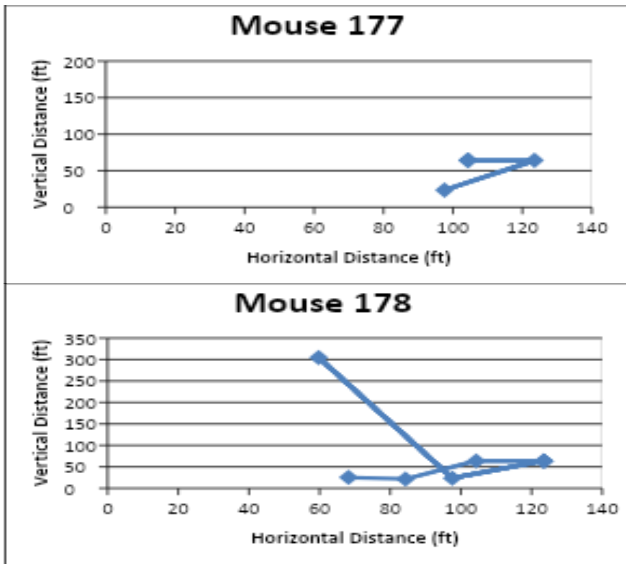

Figure 10. Plot showing the location of each trap where mouse 177 (top) and mouse 178 (bottom) were caught within the field site. The line connecting the points represents the order in which the mice were caught at each trap. For some points the mice were caught multiple times.

DISCUSSION

Despite having a small number of individuals captured in this study, a clear preference is exhibited by *Peromyscus*. No mice were caught in areas with only grass for structure, which is an observation that conforms to previous studies done by Hamilton et. al. (1994) and Olsen et. al. (2000). However, several mice were caught in shrub and forest habitats. The data suggest that the mice have a preference for both shrub dominated and forest dominated areas, perhaps because they both provide adequate amounts of cover to hide from predators. These results agree with the findings of Hamilton and Whitaker (1979), who showed that the lowest densities of *P. leucopus* were in the open grassy fields, and their highest densities occurred in the shrubby areas. When looking solely at number of catches in each habitat type we see a much higher number of captures in the shrub habitat.

Although the amount of data collected was small, we were able to calculate an estimated population size based on the Lincoln index for our experimental site. Towards the end of the study the numbers for population size given by the Lincoln index were likely more accurate, as trapping efficiency increased.

Looking at our most frequently captured mice, numbers 177 and 178, we were able to track body mass, body length, and tail length data collected throughout the course of the study (Figure 8). Both mice showed some increase in body mass over the two weeks of data collection. However, only mouse 177 showed any real increase in body length, while mouse 178 remained relatively constant. One possibility is that mouse 177 is a juvenile, leading to a higher rate of growth than mouse 178, which may have been an adult. In the plot of body length vs. body mass it seems as if mouse 178 increased in mass without increasing in size, meaning that he was getting fatter, while mouse 177 increased in both length and mass, meaning that she was getting larger.

Based on the location of the traps where the mice were caught it seems that mouse 178 had a much larger home (foraging) range than mouse 177. While 178 at one point crossed the boundary of

grassy area to forage approximately halfway up the hill, mouse 177 remained at the base of the hill in shrubby coverage. Since the only capture of 178 halfway up the hill was the first capture we cannot be certain whether or not he came from the top of the hill down, or if he wandered up from the bottom of the hill. Because he went down to the bottom afterwards, and then remained there, it is likely that that is where he originally came from. It is unclear exactly why 178 would increase his range, but it could be related to the cold weather and the need to find food. In general, this finding is consistent with the findings of Maier (2002), who showed that male *Peromyscus spp.* have greater home ranges than females, as males will have greater home ranges in order to find as many mates as possible.

There were two issues that arose in this study, and that may have confounded our results. First, it is possible that the mice captured in the wooded habitat were actually the same mouse. The second time a mouse was captured in the woods it had a tear in its ear where a tag may have ripped out. Because of this, our total estimated population size would be reduced to 4, with only one mouse caught in the woods. Second, it is possible that our two most frequent captured mice may have learned to tolerate being handled in exchange for a reward of peanut butter every night. If this is the case, it could indicate that mice were not any more active in the shrub habitat than in the wooded habitat were it not for the learned behavior. This study could be improved upon in the future by both using multiple other similar sites, as well as by expanding the scope, including a larger area covered by more traps. Using multiple sites would allow for a more robust exploration of habitat preference in *Peromyscus*. By expanding the scope we would be able to better understand the extent of the home ranges used by the mice.

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