The effect of water barriers on the homing ability of *Peromyscus maniculatus* and *Myodes gapperi*

BIOS 569: Practicum in Field Biology
Katie Anweiler
Advisor: Michael J. Cramer
2007

Abstract

Research has repeatedly shown that *Peromyscus* and *Myodes* have some homing ability. Deer-mice (*Peromyscus maniculatus*) and red-backed voles (*Clethrionomys gapperi*) were displaced 125m across Tenderfoot Creek, which served as a water barrier to homing efforts. About 40% of each species displaced crossed back to their home range. Most crossed over in a just a few days, while others remained in the area for over a week before returning to the home range. This relatively low return rate shows that the creek does indeed act as a partially effective water barrier, though not one impossible to cross. Those that attempted to home likely faced a greater risk of predation and a large energy loss. It is believed that all displaced animals had the ability to return home: research has shown that both species can swim and the release site was within the known home range of each individual. Rodents that did not return to the home grid likely were either killed in the attempt, viewed the risks of homing to be too high, or were not recaptured on the home grid.

Introduction

Home range, dispersal, and homing are important aspects of many small mammal populations. Observation has shown that many small mammals have the ability to return to their home ranges after displacement (Robinson & Falls, 1965). The mechanism by which they accomplish this feat has produced several hypotheses, but is still largely debated (Bovet, 1979). Mice and voles, which

establish specific home ranges and have been observed to have good homing abilities (Murie & Murie, 1931; Bovet, 1980), have often been the subject of studies examining the ability of homing in small mammals and the process by which these creatures return to their home ranges.

As juveniles, small mammals often disperse to establish home ranges (Myton, 1974), areas in which they travel to gather food, mate, and care for their young . Both *Peromyscus* and *Myodes* display a consistent behavior in regards to the establishment of home ranges and homing itself within each genus. *Myodes gapperi* home range means vary from .01 to .5 ha. (Meritt, 1981), whereas *Peromyscus* are found to have home ranges means .1 to .5 ha. in size (Wolfe & Linzey, 1977; Veal & Caire, 1979; Johnson & Armstrong, 1987; Hoffmeister, 1981; Lackey et al., 1985). Studies, then, that displace the rodents by a hundred meters or more place them outside their home range.

Peromyscus are generally believed to have a high homing ability (Stickel, 1968), as they are able to find their way back to a home range from up to one to two mile displacement, using visual and olfactory cues. The role that geological barriers, such as lakes and streams, have in this ability to home or disperse in not well known. In a study on dispersal by swimming, Sheppe (1965) shows that white-footed mice (*Peromyscus leucopus*) are fairly adept swimmers, and will cross water barriers from islands to return to their home range. Sheppe noted that the mice swam well in calm water, though not in choppy water, and made

surprisingly long swims; one mouse swam 765 ft to return to its home island. This research strongly suggests that white-footed mice have the ability to disperse and home despite water barriers. Though this study was concerned white-footed mice, similar behavior is expected from other *Peromyscus* species, specifically *Peromyscus maniculatus*. In a study by Furrer (1973), *P. maniculatus* were released across a canal. Though return results were low, a few individuals did in fact return to the home range, indicating that this propensity to settle or not return to the home range was not due to an inability to swim.

Many studies have additionally shown *Myodes* as adept homers. In a study by Bovet (1980), over half the *M. gapperi* displaced by 200m returned to their home ranges. A decreasing number of voles returned as distance increased, an occurrence which is consistently observed in homing experiments. An adaptive profile of *M. gapperi* reports that voles are capable of swimming, although they do little swimming (Dewsbury et al., 1982). However other sources state that red-backed voles swim longer and enter water more readily than *Peromyscus* (Getz, 1967).

This project will address whether *Peromyscus maniculatus* or *Myodes gapperi* home better when faced with the obstacle of crossing a water barrier. As mentioned before, studies have been conducted on both species separately in regards to homing after a displacement event; however few studies have factored the effect of water barriers into this process. It could be that, if displaced into a

foreign area in which the organism faces less competition, predation, or more access to food, it would simply settle into the area in which it was placed. My hypothesis is that *Peromyscus* will return to the home grid in greater proportions than *Myodes*, demonstrating better homing abilities, despite the obstacle of the stream barrier. Additionally the homing abilities of *Peromyscus* and *Myodes* will be directly tested in the field.

Methods

Study Area. This experiment was performed on UNDERC property in the western Upper Peninsula of Michigan. The property is mostly composed of hardwood deciduous forest, though it also contains stretches of coniferous forests, and contains many lakes and streams.

Grid Establishment. A 40 x 90 m grid was established on Tenderfoot Creek, running its length along the side of the creek. Sherman traps were set up every 10m in 5 parallel rows which were also 10m apart. The grid was located in a mixed deciduous forest with moist, mossy ground and many downed trees. A release point was established directly across the creek (~125m away) at a location that had fairly consistent vegetation with that of the home grid. Both the release point and the beginning edge of the grid were located 10-20m from the shoreline of Tenderfoot Creek. Additionally, the grid was established 130 m into the forest away from a bridge that spans Tenderfoot Creek, in order to prevent rodents from crossing by the bridge (Fig. 1).

Trapping. *Peromyscus maniculatus* and *Myodes gapperi* were trapped and tagged from June 12th to July 15th on the home grid. Traps were baited with a mixture of oats and sunflower seeds, and checked the following morning before 9am. All *Peromyscus* and *Myodes* caught on the grid were tagged with numbered ear tags in both ears. Prior to being displaced, residency had to be established for each rodent. In order to insure that each rodent's home range was on the grid, all displaced rodents had to have been caught at least three times previously, or have been captured at least twice in five consecutive nights. After home range was established, each could be moved across the creek. Juveniles, which might have used displacement as an opportunity to disperse, were not displaced, nor were reproductive females, which may have been pregnant or nursing. *Peromyscus* were considered adult once they acquired a minimum weight of 18g, and *Myodes* were considered adult once they acquired a minimum weight of 23g. To avoid interference, all rodents were released singly from the same spot; no more than three were released in a night. They were released at twilight, in between 7 and 8pm, right before normal activity would commence for nocturnal species (Getz, 1959). Trapping was continued on the home grid at least one week after the last release in order to insure that all returning rodents were captured and recorded.

Statistical Analysis. A Pearson's Chi-Square test was performed to determine if *Peromyscus* was more likely than *Myodes* to cross the water barrier, and to analyze, within a genera, whether an individual was more likely to cross than not.

Results

The results of the movements of all displaced animals over the month in which they were collected was pooled and analyzed using Pearson's Chi-Square test. Overall 12 rodents were displaced, 7 *Peromyscus* and 5 *Myodes*. 3 *Peromyscus* (43%) and 2 *Myodes* (40%) returned to their home range, as shown by trapping on their home range grid (Table 1). This low sample size influenced the findings of the experiment. Statistical analysis showed that there was no difference between the species regarding whether they crossed back to their home range or not ($X^2 = 0.010$, $P = 0.921$). Individual *Peromyscus* were not more likely to cross than not ($X^2 = 0.143$, $P= 0.705$). Similar results were shown for *Myodes* ($X^2 = 0.200$, $P = 0.655$), though this could be explored more fully with a larger sample size. On average, *Peromyscus* crossed faster than *Myodes*, returning to their home range in just a few days after displacement. However the sample size of this experiment is too small to show this as a significant trend.

Discussion

Contrary to the hypothesis that deer mice would exhibit better homing behavior than red-backed voles, analysis supports the idea that *Peromyscus* and *Myodes* return in equal proportions. The low return rates indicate that the majority of the rodents released did not in fact return to their home range. However, it is clear that homing was in fact possible. Rodents are thought to home either by a navigation mechanism (an innate physiological compass

mechanism or celestial navigation) or by recognition of landmarks within a known region (Bovet, 1980). A navigational mechanism would allow the rodent to return home even at great distances. Recognition of landmarks is thought to happen within a known area outside of the home range. Though this mechanism would then therefore have a spatial limit, the 125m that the rodents were displaced would be within this known area that they could recognize. Additionally, both *Peromyscus* and *Myodes* have been observed to swim, in which case the water barrier should be crossable (Furrer, 1973; Merrit, 1981 citing Getz, 1967).

So why did the majority of rodents not return to their home range? This may be first due to individual choice. If the environment is similar to or better than the home environment in regards to availability of food resources, amount of competition, and risk of predation, the rodent may very well determine that it is not worth the energy or risk to attempt a return to the home range. To cross the river barrier, the individual would have been more open to predation by fish as it swam in the water, and from flying predators which would see their prey much easier in the open area of a creek. Another possibility is that rodents who attempted to return faced predators and were eaten before they could return. Many predators known to occur in this habitat, such as minks and fishers, hunt along streams (Larivière, 1999), and a raccoon was captured on the trapping grid. One last possibility is that some displaced rodents did in fact return to their home

ranges but were not caught in the traps. The estimated recapture rate for the home grid was ~20%. This low rate is partly explained by the presence of predators on the home grid which interfered with several nights of trapping. Given this low rate, it is entirely possible that one or several rodents did in fact cross the water barrier and successfully returned but failed to be recaptured in their home grid. A longer trapping period after displacement would likely resolve this problem in future studies.

Another reason for the low return rate of mice is the presence of the stream itself. In order to evaluate the effectiveness of the stream as a barrier past homing success of *Peromyscus* and *Myodes* must be established. In a previous study on *Myodes*, 58% of voles returned from 200m displacement (Bovet, 1980), and 25% from 400m displacement (Bovet, 1980). In another previous study on *Peromyscus*, 75% of inexperienced *Peromyscus* returned from ~200m displacement (Furrer, 1973) and 67% from ~400m (Furrer, 1973). However in another similar study of mouse homing behavior, only 23% of *Peromyscus* returned after a 400m displacement (Broadbooks, 1961). Given this success rate of rodents who are not faced with a geographical barrier, it is probable that the creek served as a partially effective barrier. Though it did diminish the success rates of homing, it did not prevent *Peromyscus* and *Myodes* from returning all together. The small sample size of this experiment prevents strong conclusions from being drawn, however data clearly shows that *Peromyscus* and *Myodes* can

cross large water barriers in homing. Additionally it supports the idea that the species have a comparable homing ability. In future studies, a longer trapping period or trapping on a larger grid would enable stronger significant conclusions to be drawn.

Acknowledgements

This work was supported by Notre Dame Environmental Research Center, and funds provided by The Bernard J. Hank Family Endowment. My many thanks to Michael Cramer, who assisted greatly in experimental design and set up, field work, and analysis. Also to Megan Mohrman and Jessica Lee, who aided in experiment set up and trapping.

References Cited

Bovet, J. 1980. Homing behavior and orientation in the red-backed vole, *Clethrionomys gapperi*. *Canadian Journal of Zoology* 58: 754-760.

Dewsbury, D. A., Baumgarnder, D. J., Sawrey, D. K., Webster, D. G. 1982. The adaptive profile: comparative psychology of red-backed voles (*Clethrionomys gapperi*). *Journal of Comparative and Physiological Psychology* 96, 4: 649-660

Furrer, R. K. 1973. Homing of *Peromyscus maniculatus* in the channelled scablands of east-central Washington. *Journal of Mammalogy* 54, 2: 466-482.

Getz, L. L. 1967. Influence of water balance and microclimate on the local distribution of the redback vole and the white-footed mouse. *Ecology* 48, 2: 276-286

Hoffmeister, D. F. 1981. *Peromyscus truei. Mammalian Species* 161: 1-5

Johnson, D. W., Armstrong, D. M. 1987. *Peromyscus crinitus. Mammalian Species* 287: 1-8.

Lackey, J. A., D. G. Huckaby, B. G. Ormiston. 1985. *Peromyscus leucopus*. *Mammalian Species* 247: 1-10.

Larivière, S. 1999. *Mustela vison. Mammalian Species* 608: 1-9.

Merritt, J. F. 1981. *Clethrionomys gapperi*. *Mammalian Species* 146: 1-9.

Murie, O. J., Murie, A. 1931. Travels of *Peromyscus*. *Journal of Mammalogy* 12, 3: 200-209.

Myton, B. 1974. Utilization of space by *Peromyscus leucopus* and other small mammals. *Ecology* 55, 2: 277-290.

Robinson, W. L., Falls, J. B. 1965. A study of homing of meadow mice. *American Midland Naturalist* 73, 1: 188-224.

Sheppe, E. 1965. Dispersal by swimming in *Peromyscus leucopus*. *Journal of Mammology* 46, 2:336-337.

Stickel, L. F. 1968. An experiment on *Peromyscus* homing. US Fish and Wildlife Service, Patuxent Research Refuge, Laurel , Maryland.

Veal, R., Caire, W. 1979. *Peromyscus eremicus*. *Mammalian Species* 118: 1-6.

Wolfe, J. L., Linzey, A. V. 1977. *Peromyscus gossypinus. Mammalian Species* 70: 1-5.

Wolff, J. O. 1989. Social behavior: advances in the study of *Peromyscus*. Texas Tech University Press, Lubbock, Texas.

Table 1- Success Rates of Displaced Species

Numbers of each species displaced and returned. Percentage of those that successfully homed.

Species	**Displaced**	**Homers**	**Non-homers**	**% Successful Homing**
Peromyscus maniculatus	7	3	4	43%
Myodes gapperi	5	2	3	40%
Total	12	5	7	

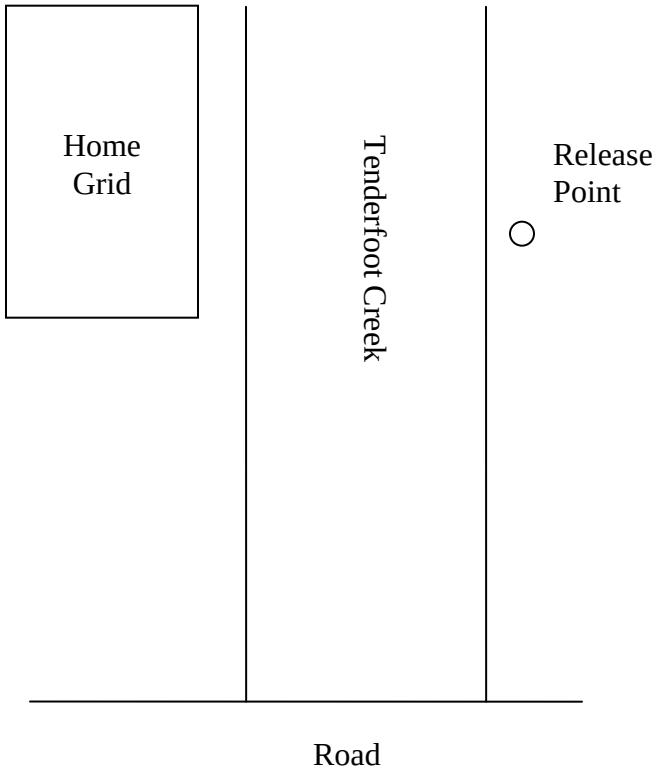

Figure 1- Diagram of Trapping Location

Diagram shows the location of the trapping grid relative to the release point, creek, and road.