

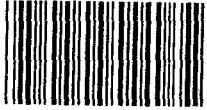
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**Effects of Recreational Trails on Small M**

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Mammals**

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## EFFECTS OF RECREATIONAL TRAILS ON SMALL MAMMALS

2000 Final Report to the City of Boulder Open Space Department

Whitney Johnson, Department of E.P.O Biology, University of Colorado at Boulder

**Abstract**--Anthropogenic habitat loss and fragmentation alter the spatial distribution of habitats and resources for native animals. Shifts in these habitats and resources may affect many demographic processes, including animal movement patterns (Ims 1995; Andreassen et al. 1998). My research investigates the extent to which recreational trails fragment native grassland habitat, thereby affecting movement patterns of small mammals (Rodentia: Muridae). If movement is affected by trails, then trails may effectively fragment the landscape for these small mammals. I trapped small mammals with Sherman live-traps and quantified home range size at one study area with a replicate trail and control site. I compared home range size between a site with recreational trails and a site without trails (control). I also measured movements of small mammals by using fluorescent pigments and an Ultraviolet lamp. I found that home range size did not differ between the trail and control site at Marshall Mesa. There was also no difference in net displacement of travel paths between the trail and control site. However, low sample size from the summer drought no doubt affected my results. The management implications of this study are significant. If trails do in fact block movements of small mammals, then a trail network could decrease gene flow within and among the population. Fragmentation also may reduce potential habitat for dispersal, as well as decrease availability to water and food. Fragmentation may ultimately lead to smaller population size within each fragment, and increased vulnerability to population decline and extinction (Bennett, 1990; Fahrig and Merriam, 1994). Reducing survival could cascade into the higher trophic levels that utilize these animals as prey items. The results of this study can assist managers in planning future trail networks or expansions. Armed with a better understanding of how trails impact the movements of small mammals, managers can mitigate some of these effects.

### BACKGROUND INFORMATION

An increasing number of people utilize the outdoors for recreational purposes (Knight & Gutzwiller 1995), particularly in the American west (Riebsame 1997). How recreational trails affect the surrounding environment is relatively unknown, however. Most trail related studies have dealt with the direct short-term effects on wildlife from recreation--nest abandonment and parasitism, flush response, exotic species invasions, and erosional impacts of different user groups (Boyle and Samson, 1985; Seney and Wilson, 1989; Tyser and Worley, 1992; Fenyvesi and Norton, 1994; Miller and Knight, 1995; Knight and Miller, 1996). My study differs in that I am looking at the possible fragmentation effect of trails on the surrounding landscape by looking at the use of space by small mammals.

The use of space by animals--usually measured in home range and movement pattern--can be an indicator of disturbance within a landscape (Diffendorfer et al., 1995;

Ims et al., 1993). If there is a change in the animal's home range or movement pattern, then this may signify a disturbance in the landscape. By studying the movement of small mammals in relation to trail networks, I will be able to see if trails create such an environmental disturbance as to create barriers to dispersal. If trails are not a barrier to dispersal, they might alter the habitat use of small mammals, increase predation risk, or cause an area to become sink habitat.

Trail corridors may fragment the landscape similar to road corridors. Road corridors have been shown to act as a barrier to movement for some species (Mader, 1984; Mader et al., 1990). Small mammals and ground beetles were shown to become isolated on opposite sides of a paved and gravel roads (Mader et al., 1990). This fragmentation of habitat may reduce potential habitat for dispersal, as well as decrease availability to water and food. Fragmentation may ultimately lead to smaller population size within each fragment, and increased vulnerability to population decline and extinction (Bennet, 1990; Fahrig and Merriam, 1994). Reduced survival could cascade into the higher levels of the food web that utilize these animals as prey items.

Small mammals are more abundant in shrub-dominated areas (Morris, 1984; Kaufman et al., 1988; Stapp, 1997). Deer mice (*Peromyscus maniculatus*) have been shown to focus their movements around shrubs (Stapp and VanHorne, 1997). Deer mice were also found to more or less "b-line" between shrubs in areas where shrubs were scarce. Paths were most tortuous (i.e., the path is very complex and convoluted) with an intermediate amount of shrubs and the least tortuous when shrub cover was high (Stapp and VanHorne, 1997). Shrubs provide protection from predators and may provide a source of food (Kaufman et al., 1983). The most concealed route, or the path with the greatest opportunity to hide from predators, seems to be the path of choice. Mice tend to use horizontal structure such as downed logs, branches, and rocks to facilitate movement. Using horizontal structure may be more energy efficient, allow faster travel, and facilitate remembering routes to and from dens and food sources (McMillan and Kaufman, 1995). Although mice prefer to travel along downed logs and rocks rather than on bare ground (Graves, et al., 1988), my preliminary data suggests that deer mice may occasionally use recreational trails as nighttime runways for their ease of travel.

I studied the nocturnal space use of deer mice in areas with high trail use. Deer mice are commonly thought to be more disturbance-adapted than other species of small mammals. However, Pasitschniak-Arts (1998) found that deer mice did not prefer edges in a fragmented prairie landscape in Canada. Deer mice may not be representative of all small mammals, but if deer mice are affected by the presence of trails then it is likely that many other small mammals will be affected by trails.

## METHODS

My study areas consisted of a test site and a control site. The Greenbelt Mesa Trail test site consisted of an irregular grid of 161 traps within 0.5-ha that encompassed a network of trails. At each study area, the control site consisted of the same irregular grid, same number of traps, and same size area as the test site but contained no trails. There was 5-m spacing between traps at both sites. I trapped at the two sites (trail and control site) two separate times throughout the summer, checking traps daily for a period of 7

days. I marked and recaptured small mammals with Sherman live traps. The small mammals were individually marked by shaving a small amount of hair on their backs with dog grooming clippers (Johnson, *in press*). I released the animals at the site of capture, recording the site and date of capture in order to learn the animal's movement pattern. Data collected from the grid traps were used to characterize home range size for each individual. I estimated home range size using the minimum convex polygon method.

I also used the fluorescent pigment method to more directly study individual movement patterns of small mammals (Lemen and Freeman 1985; Jike et al. 1988). The fluorescent pigment method is an excellent way to detect the exact movements of the individual within its home range (Jike et al. 1988) and is a strong indicator of habitat use (Lemen and Freeman, 1985). As with the grid trapping, small mammals were trapped in Sherman live traps. I used one of four colors--blue, red, orange, and green--of fluorescent pigments (Radiant Color, Inc. Richmond, CA) to mark as many individuals as I caught each night. The mice were then released at the capture trap to use the surrounding landscape (Fig. 4). The next night I tracked the movements of each mouse with a high power UV lamp (Raytech rechargeable UV lamp) which illuminates traces of the fluorescent pigment that the animal left as it rubbed up against grass, shrubs, and trees.

I estimated habitat use by measuring each travel path's net displacement (Stapp, 1997). In order to calculate net displacement, I followed all small mammal travel paths until I could no longer discern the travel path and then measured the straight-line distance from start to end. To more directly study habitat use, I adapted the method of Stapp and VanHorne (1997) which quantified shrub use of deer mice (*Peromyscus maniculatus*) in short grass steppe. Following the powder trail left by each individual, I marked every 1-m point of the path for 30-m (for a total of 30 points) and classify the location of each point. For example, I marked whether a point is under a shrub, on bare ground, on a log, on a recreational trail, etc. Using a random numbers table I chose 30 random points and identify the location of each point. The random points were located in the same 0.5-ha grid area. I then measured the distance from each random point to the nearest shrub, tree, and recreational trail. I also measured the distance from each 1-m point on the mouse path to the nearest shrub, tree, and recreational trail.

## RESULTS AND DISCUSSION

There was no significant difference between home range size at the trail site and control site at Greenbelt Mesa (Fig. 1;  $P < 0.39$ ). Vegetation dispersion seemed to be the controlling landscape characteristic influencing home range size and the movement of deer mice. Mice did not seem to see trails as a barrier to movement. Three out of 8 deer mice crossed one trail at least once within their home range at the Greenbelt Mesa Trail site. Two out of 9 deer mice actually used a recreational trail as a nighttime runway at the Greenbelt Mesa Trail site.

Net displacement indirectly measures an animal's use of an area. A travel path's net displacement is the result of the actual distance traveled by the animal divided by the straight-line distance from the start to the end of the travel path. Higher use of an area will result in larger net displacement values; lower use will result in lower values. There

was no difference in net displacement between the trail and control site at Greenbelt Mesa (Fig. 2;  $P < 0.43$ ); deer mice seemed to use areas with trails and without trails in a similar manner. However, the sample size for net displacement was low (9 and 5 at the trail and control site, respectively), showing a need for further investigation. I was unable to trap mice at two sites starting at the beginning of July, and I lost 90% of the mice at the Greenbelt Mesa Trail site all possibly due to drought.

Last summer I found that home range size was significantly smaller at the trail site than at the control site at the South Mesa Trail. However, I cannot say with reasonable certainty that home range size decreased at the South Mesa Trail site because of the presence of recreational trails. Home range size decreased at the Greenbelt Mesa Trail site, but not significantly due to high variation in home range size (Fig. 1). Vegetation physiognomy plays a significant role in determining space use of deer mice (Stapp, 1997; Stapp and VanHorne, 1997). Physiognomy may be more important to small mammal habitat use than the presence of recreational trails. In order to test this hypothesis and get a better idea of how recreational trails affect small mammal space use, I will use fluorescent pigments to track the individual movements of deer mice in the presence of trails in the summer of 2001.

**Table 1.** Species composition at Greenbelt Mesa

<b>Species</b>	<b>Trail site</b>	<b>Control Site</b>
deer mice ( <i>Peromyscus maniculatus</i> )	22 (100%)	16 (84%)
hispid pocket mice ( <i>Chaetodipus hispidus</i> )	0	1 (6%)
mexican woodrat ( <i>Neotoma mexicana</i> )	0	2 (12.5%)
<b>Total individuals:</b>	<b>22</b>	<b>19</b>

Figure 1. Greenbelt Mesa Trail mean MCP home range.

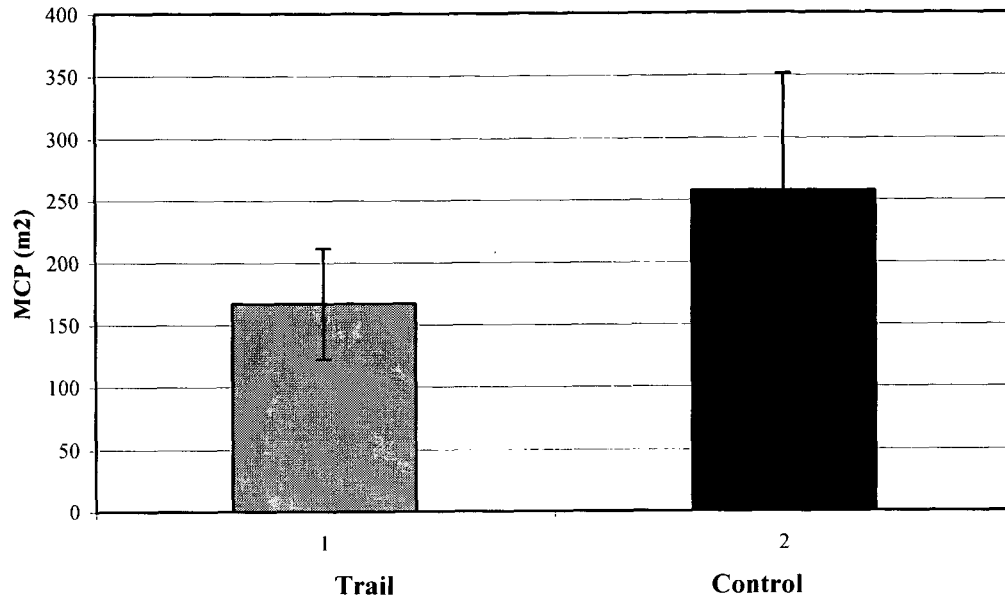
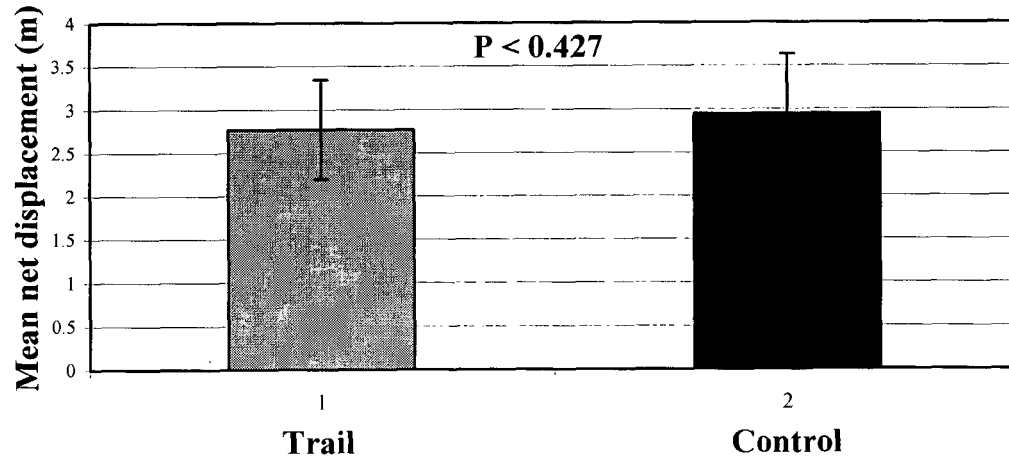


Figure 2. Greenbelt Mesa Trail Mean net displacement.



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