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Comparing Two Methods to Determine Nest Location of Golden Mice (*Ochrotomys nuttalli*)

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ABSTRACT

Fluorescent powder tracking was compared with radiotelemetry to locate nests used by golden mice (*Ochrotomys nuttalli*), a semi-arboreal species. Fluorescent powder was not a successful method for determining nest location or movement patterns for golden mice. Many golden mice immediately climbed trees, whereas white-footed mice remained on the ground. Weather conditions can negatively affect the success of powder tracking. Although radiotelemetry successfully determined the locations of occupied nests, precise estimates of movements within a microhabitat could not be made.

Key words: fluorescent powder, golden mouse, *Ochrotomys nuttalli*, *Peromyscus leucopus*, radiotelemetry, white-footed mouse

INTRODUCTION

Fluorescent powder has been used for tracking fish (Phinney and Matthews, 1969), woodcocks (*Scolopax minor*; Steketee and Robinson, 1995), reptiles (Ireland, 1973; Fellers and Drost, 1989; Blankenship et al., 1990), and several species of small mammals (Lemen and Freeman, 1985; McShea and Gilles, 1992; Hovland and Andreassen, 1995; Menzel et al., 2000). This method has several advantages compared to radiotelemetry, including low cost, no need for constant monitoring, ability to trace exact movements of animals through microhabitats (Steketee and Robinson, 1995), and not hindering animal movement (McShea and Gilles, 1992). Disadvantages of powder tracking include inability to tell change of direction or the number of times a route was traveled (Fellers and Drost, 1989), difficulty in distinguishing different powder colors under a black light (Fellers and Drost, 1989), and a tendency for the powder to be washed away by precipitation (Morzillo, 2001). It has also been suggested that prolonged exposure to fluorescent powder may result in decreases in activity (Mikesic and Drickamer, 1992), respiratory distress (Stapp et al., 1994), and long-term environmental contamination (Halfpenny, 1992). Past studies using this method focused on exclusively terrestrial species, the only exceptions being woodcock chicks that had not yet fledged (Steketee and Robinson, 1995) and fish (Phinney and Matthews, 1969).

Golden mice occur throughout the southeastern United States, including the southernmost counties of Illinois. Golden mice are semi-arboreal, having semi-prehensile tails and "well-developed abdominal musculature" (Bohall-Wood and Layne, 1986:18) to assist them in balancing on thin branches and vines (Linzey and Packard, 1977; Bohall-Wood and Layne, 1986; Packer and Layne, 1991). Along with feeding platforms, two structures are closely associated with golden mouse ecology – ground and arboreal nests (Goodpaster and Hoffmeister, 1954; Linzey and Packard, 1977).

Arboreal nests occur at heights ranging from ground level to > 10 m, but most are between 1.5 and 4.5 m above the ground (Barbour, 1942; McCarley, 1958; Packard and Garner, 1964; Blus, 1966; Linzey and Packard, 1977; Frank and Layne, 1992). Arboreal nests are often constructed in greenbrier (*Smilax* spp.), honeysuckle (*Lonicera japonica*), sumac (*Rhus* spp.), and grapevines (*Vitis spp*.; Blus, 1966; Linzey, 1968; Linzey and Packard, 1977; Feldhamer and Paine, 1987; Packer and Layne, 1991; Frank and Layne, 1992, Wagner et al., 2000). Blus (1966) reported 13.1 m as the average distance between arboreal nests. From the same study, distances of 42.7 m and 54.9 m separated pairs of nests used by two other individuals. Ground nests have been associated with fallen logs (Easterla, 1968) or under leaf litter (Packer and Layne, 1991). Packer and Layne (1991) also suggest that, although semi-arboreal, *Ochrotomys* do more foraging on the ground than other species of mice. The objective of this study was to determine whether fluorescent powder could be used to locate arboreal and ground nests used by golden mice. Trail length and behavior of powdered golden mice were also compared to powdered white-footed mice (*Peromyscus leucopus*) to determine whether differences in microhabitat use existed.

MATERIALS AND METHODS

The study area was within Jackson County, Illinois. Areas initially surveyed for golden mice were selected based on those used by Wagner (1998) and from past small mammal surveys (Feldhamer and Paine, 1987; Furtak-Maycroft, 1991). Study sites were located from late November 1998 through early March 1999 while leaves were absent and arboreal nests were easy to locate. Sites selected for fieldwork were located on land owned by Southern Illinois University Carbondale (Touch of Nature Environmental Center) and on public land within Giant City State Park.

From January to August 1999, fluorescent powder (Radiant Color®, Inc.) was used in an attempt to follow individual golden mice from point of capture to occupied arboreal or ground nests. Adult mice were captured in Sherman live traps, held by the scruff of the neck, weighed, and dipped in powder. The animal's dorsal, ventral, and posterior surfaces were covered. This method was chosen, rather than dropping mice into a bag of powder and shaking them vigorously, because past studies suggest that the latter method may lead to respiratory distress (Stapp et al., 1994). Mice were released at point of capture. Trails were located and followed at night using a black light. Flags were placed along trails for measurement, in meters, the following day.

From September 1999 to June 2000, nests were located using radiotelemetry. Bat transmitters, modified with a collar (0.45 g, LB-2, Holohil Systems Ltd., Ontario, Canada; total weight with collar 2.0 g), and small mammal radio transmitters (1.5 g, SOM 2012

MVS, Wildlife Materials, Inc., Carbondale, IL) were attached around the neck of each golden mouse. Confirmation of mouse presence was made by visual observation of each arboreal nest, or hole for ground nests, by pinpointing the signal location. At some nests, either the antenna of the radiocollar or the mouse was visible. The Wilcoxon matched-pairs signed-ranks test (Siegel, 1956) was used to determine body mass of collared mice to determine if the collar was inhibiting the ability of the individual to acquire resources necessary to maintain adequate health.

RESULTS

Sixty-nine powder trails of 26 individuals (10 golden mice, 16 white-footed mice) were followed. Thirty-four trails were those of golden mice and 35 were those of white-footed mice. There was no significant difference in trail length between the sexes of each species (golden mice: $t = 0.413$, $p = 0.6872$; white-footed mice: $t = 0.903$, $p = 0.3844$) so trails were analyzed based on species only. Lengths of golden mouse powder trails (mean = 3.5 m) were significantly longer than *Peromyscus* trails (mean = 1.7 m; $t = 3.647$; $p < 0.001$).

Of the golden mouse powder trails followed, a rainstorm washed one away. A second non-linear trail extended for 2.8 m before the individual was found dead. The other 32 golden mouse powder trails fit into one of two categories: either > 2.5 m in length or < 2.5 m in length. Eighteen trails (range 0.3 m to 12.0 m) extended along the ground and then disappeared up into trees. There was no sign of the powder trails continuing within a 5 m radius of any of the trees. One powder trail continued along the ground for 6.1 m before ending > 1 m from woody stems that could be used for climbing. However, this dead end was not a result of predation because the individual was livetrapped and powdered again the next day. Another trail extended 6.8 m through forest undergrowth and dead-ended in tall grass along the side of a dirt road. The nesting location of this mouse was later revealed, through telemetry, to be across the dirt road near the point of capture. Only the longest trail followed (12 m) ended within 3 m of an arboreal nest in which the same mouse was observed using radiotelemetry. Because only one powder trail ended near a nest, we were not able to determine nest location or use by individual golden mice using this technique.

Of the 14 golden mouse powder trails followed for < 5 m, only one extended 1 m from the release site into a hole that may have been a ground nest. However, this trail was followed in late February when the ground was frozen. Upon returning in April to dig up the hole, no evidence of nesting material was uncovered. The remainder of the trails extended to the nearest tree.

None of the 35 *Peromyscus* powder trails ended in trees. Twenty-eight trails were < 2.5 m (range 0.3 to 2.2 m) and ended at a hole. Two others ended at openings in fallen logs. No visible trails emerged from these holes or logs. Of the remaining five trails (range 2.5 to 4.7 m), one ended far from any woody structures (this mouse was not captured again) and the other four disappeared among vines that surrounded trees.

Of the 20 golden mice radiocollared (11 males and 9 females), a Wilcoxon matched-pairs signed-ranks test indicated no significant change in individual body masses ($p > 0.05$)

before collar attachment and after collar removal. Movement did not seem hindered, and mice were able to climb trees and move about the undergrowth freely. One female was noticeably pregnant when her radiocollar was removed. Using radiotelemetry, mice were easily located in nests during daylight hours. Difficulty in determining signal direction existed during precipitation and near extremely thick understory.

DISCUSSION

Whittaker et al. (1991) suggested yellow and orange were the most effective colors for powder tracking meadow voles (*Microtus pennsylvanicus*) in Minnesota. We found green, pink, blue, and purple did not work well and used yellow or orange to follow mice when only one or two individuals were powdered at a time.

The significant difference in length between powder trails of golden mice versus white-footed mice may suggest a behavioral difference in use of habitat. The golden mouse trails were significantly longer, and most extended to a nearby tree. White-footed mouse trails generally ended at a hole in the ground. Although golden mice forage on the ground, they may use arboreal paths when traveling to and from nests. By differing in the extent of vertical habitat used, these two species may reduce potential interspecific competition.

Of the 34 golden mouse powder trails followed, only 1 ended within 3 m of a nest later documented through telemetry as being occupied by that particular individual. By comparing powder trails to telemetry locations, it appeared that powder trails were limited to core activity areas. As golden mice were released after powdering, they may have taken an arboreal route back to their nests. Once there, they groomed powder off themselves before the next activity period. This limited the number of other visible trails that could be followed.

There was also a drought during this study. Over 80 days elapsed without precipitation between June and October 1999. During this time, the ground became dry and dusty and much of the ground vegetation wilted. We were unable to locate powder trails. It is suggested that the dry conditions inhibited powder from sticking to the soil or surviving undergrowth. Therefore, weather conditions reduced the effectiveness of this method (Morzillo, 2001).

Stapp et al. (1994) suggested mice were susceptible to pneumonia because of powder inhalation. Mikesic and Drickamer (1992) found reduced activity in house mice (*Mus musculus*) covered in fluorescent powder after 6 hours. If reduced activity resulted in our study, it was not apparent. Most of the powdered golden mice were later used for radiotelemetry.

No significant change in body mass suggests that movement of individual mice was not negatively affected by wearing the radiocollars. Mice were able to climb trees and enter and leave nests while wearing radiocollars. Occupied ground and arboreal nests were easily located. One particular female mouse had its foot caught in the collar upon release. She was recaptured 10 days later with her foot still tangled in the collar, but had been in three different arboreal nests.

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