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DO FLORIDA MICE (*Podomys floridanus*) CLIMB TO ESCAPE THREATS, OR DO THEY CLIMB ROUTINELY?

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INTRODUCTION

The Florida mouse (*Podomys floridanus*) is one of two mammals endemic to Florida (Jones and Layne 1993). Historically the Florida mouse was assigned to the genus *Peromyscus*, the deer mice, and the monotypic sub-genus *Podomys*; Carleton (1980) elevated *Podomys* to genus level based on multiple traits. In comparative studies the Florida mouse has been found to swim (King et al. 1968), to be unexceptional in nest building (Klein and Layne 1978) and digging (Layne and Ehrhart 1970) in a laboratory setting, to lack arboreal tendencies (King et al. 1968; Layne 1970), and to be closely tied to gopher tortoise (*Gopherus polyphemus*) burrows as the location for a secondary burrow system assumed to be wholly or in part of its own making (Layne 1990; Jones and Franz 1990). Layne (1990) has summarized the mix of behavioral attributes of the Florida mouse as shaping perhaps the most terrestrial of the regional peromyscines.

Here we describe and discuss the arboreal habits of Florida mice. Photographs of climbing deer mice grace the frontispiece or cover of two seminal works devoted to the genus *Peromyscus* (King 1968; Kirkland and Layne 1989). Vertical use of habitat structure is regarded as a potential way to avoid competition between or among co-occurring small mammals in otherwise horizontal space (e.g., Harney and Dueser 1987).

We report three examples of climbing by Florida mice in response to live trapping and experimental manipulations and review the implications of these and past studies of *Podomys* using vertical space.

RESULTS

Our first example of climbing by a Florida mouse was observed in sand pine scrub on the undeveloped portion of the campus of the University of Central Florida, Orange County, Florida. The observation in 1982 was made in the course of a food supplementation experiment when a pregnant, adult female Florida mouse was discovered in a feeding container attached to the bole of a sand pine (*Pinus clausa*) about 1.5 m above ground (Young and Stout 1986). This observation showed a near-term pregnant female could and would climb for a food resource; however, our example is subject to the criticism that the sunflower seeds served as a lure (Manville et al. 1992).

We observed our second example of climbing in sand pine scrub on the Atlantic coastal ridge at Jonathan Dickinson State Park near Hobe Sound, Florida. At that site, in the period from 1986 until 2014, we released 357 individual Florida mice on 690 occasions from a trapping grid and observed climbing behavior by one individual on two occasions (Fig. 1A). In the first instance, on 23 March 1999, an adult female upon



Figure 1.A) Florida mouse perched in a myrtle oak after release from a Sherman trap, Jonathan Dickinson State Park, Martin County, Florida, 23 March 1999. Photo by Tammy Naugle.

being released climbed on saw palmetto (*Serenoa repens*) to reach a myrtle oak (*Quercus myrtifolia*). This female climbed to a height of 3.6 m where it apparently slept for 17 min. The next movement of the animal retraced its path to the palmetto and to the ground and out of our view. In five min she returned to the myrtle oak and climbed to 1.8 m above the ground and remained in view for 25 min. The final retreat from view followed the same path to the ground as noted before. These actions seem like extreme examples of “freeze” behavior as described for *Peromyscus maniculatus bairdi*, a grassland deer mouse (Baker 1968). The grid was trapped again 12 and 13 April 1999. The same female was trapped and released on 12 April 1999 and remained on the ground without climbing while in view. On 13 April 1999, upon release she moved around the observer before climbing to a height of about 1.8 m on saw palmetto and promptly disappeared from view. For this population, the incidence of climbing is 0.29%. We have no ready explanation for this behavior. Use of the vertical structure of the habitat may be a result of resource limitations in some seasons. However, soft and hard mast is not available as a possible food source in the woody shrub cover in April. We speculate that climbing might be favored in spring to capture insects.

The third observation of climbing occurred within the Seminole State Forest, Seminole County, Florida 14 April 2012. Our traps were arranged as a transect in sandhill habitat heavily invaded by laurel oak (*Quercus laurifolia*). Captures of Florida mice ($n = 5$) were unexpected in the habitat and one individual upon release climbed straight up the bole of a laurel oak to sit briefly on a limb about 2 m off the ground (Fig. 1B). The animal returned to the ground, descending head down in a straight line within a few s, moved toward a nearby gopher tortoise burrow, and disappeared from sight. In a laboratory setting, Horner (1954) found *Peromyscus* to descend in a spiral course. The individual *Podomys* we observed did not spiral on the tree bole as it returned to the ground. We believe escape behavior best explained this observation.

DISCUSSION

Prior studies have consistently found Florida mice to be deficient in climbing tendencies under a variety of laboratory tests (Horner 1954; King et al. 1968; Layne 1970). Mice of the genus *Peromyscus* in parallel trials with Florida mice showed considerable variation in climbing abilities, but were judged to be more willing to climb, and to have greater agility, than Florida mice (Horner 1954; King et al. 1968). Horner (1954) suggested that those forms with relatively longer tails and larger feet were superior in arboreal locomotion. Layne (1970) did not consider Florida mice to use their tails commonly in



Figure 1. B) Florida mouse on bole of laurel oak after release from a Sherman trap, Seminole State Forest, Seminole County, Florida, 15 April 2012. Photo by Jessica Buchy.

climbing, but rather placed emphasis on their plantar pads, the fleshy knobs on the underside of the feet. Florida mice exhibit considerable variation in the number of pads on their hind feet, with 20% deviating from the typical count of five (Stout and Keim 1981). Layne (1970) suggested that Florida mice from scrub habitat showed a tendency to have more or larger pads than individuals from sandhill habitats. Climbing advantages attributed to the pads would be more favorable in scrub habitat than in a habitat with grass and herb ground cover such as in sandhills.

Layne (1970) reported field and laboratory observations on the tendency of Florida mice to climb. In the laboratory, Florida mice did climb a wire mesh cone and walk on a horizontal bar. In these tests, individuals from sandhill habitat climbed significantly less than those from scrub ($p < 0.05$). A comparison of his field results with ours offers more insight: of 1833 observations of Florida mice released in sandhill habitat of Alachua County, Florida, 1% climbed trees or shrubs; none of 15 newly released mice was reported to climb in scrub habitat in Levy County, Florida.

Jones (1990) offers a number of observations on climbing by Florida mice in sandhills of north Florida. In T-maze tests of arboreality conducted in the field, some individuals climbed up to 8 m on oaks. In another experiment, the fluorescent powder trail of a male showed the individual climbed at least 36 cm up a snag of turkey oak (*Q. laevis*). Jones (1989) observed a released male climb 30 cm up a flag pawpaw (*Asimina incarnata*) to secure a ripe pawpaw. In Jones' experience, released Florida mice traveled to and entered gopher tortoise burrows nearly 100% of the time. In 2017, in habitat similar to that described by Jones (1990), Wes Boone (personal communication) observed climbing by a Florida mouse.

Packer and Layne (1991) offer further insights into climbing behavior of small mammals from habitats similar to those we have studied. They employed baits (peanut butter, white corn meal, and plastic particles) to assess microhabitat use by the small mammals. Based on the recovery of these markers in fecal samples, three Florida mice of 50 observations (6%) had foraged at the arboreal sites (1-1.5 m above ground) with the remainder ($n = 47$) from ground-level sources. Under laboratory conditions, some Florida mice climbed to store acorns ($n = 14$, 6.3%) in elevated (37 cm) nest boxes. Packer and Layne (1991) pooled data from all the trapping on the two grids in sandhill habitat and one grid in sand pine scrub to compare escape by climbing as we have done. Florida mice in sandhill ($n = 2,716$) climbed 0.1% of the time; no observations of climbing were reported for the scrub. Layne (1972) judged Florida mice to be largely non-arboreal and considered tail autotomy to be a potential advantage in escaping from predators, e.g., snakes.

The observations we record here were made incidental to routine mark-and-recapture live-trapping studies or field experiments under full daylight conditions of a naturally nocturnal animal (Layne 1971). Our experience with Florida mice is that pure escape behavior characterized by aggressive struggle, biting, and even vocalization is not routinely observed. Rather, Florida mice often remain relatively calm during processing and upon release will remain near the investigator while consuming food, e.g., scattered sunflower seeds before leaving the capture site. The climbing events we describe here appear to be isolated to a few individuals.

After more than 40 years of trapping in scrub habitats we have accumulated these three instances of climbing by Florida mice. Only two of these observations were made in sand pine scrub. Apparently all the published observations on climbing in natural settings by Florida mice have occurred in sandhill environs with the exception of those in Packer and Layne (1991). We conclude that Florida mice rarely climb to escape after routine processing in live trapping studies. In free ranging behavior, under nocturnal conditions, climbing may happen as opportunities for acquiring food occur. Climbing may also occur in response to threats at the ground level.

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