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Morphometric Variation of Cotton Mice (*Peromyscus gossypinus*) and White-footed Mice (*P. leucopus*) in Kentucky

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ABSTRACT

We captured 151 white-footed mice (*Peromycus leucopus*) and 38 cotton mice (*P. gossypinus*) in Ballard and Carlisle counties, Kentucky, during 3600 trap nights. There were significant differences between the two species in body mass, hind foot length, condylobasal length, and length of the nasal bone for both adult males and females. Morphological characteristics often used to differentiate the two species were not always sufficient to do so accurately. Large white-footed mice may be misidentified as cotton mice.

INTRODUCTION

Cotton mice occur in southeastern United States from eastern Texas and Oklahoma east to Florida and north to Virginia (Jones and Birney 1988). With regard to body size, the largest of the three commonly recognized subspecies, *Peromyscus gossypinus megacephalus* (Rhoads 1894), is found at the northern periphery of the range. Cotton mice are uncommon in Kentucky, Missouri (Hall 1981), and the southernmost five counties of Illinois (Feldhamer et al. 1998; Hoffmeister 1989). The preferred habitat of cotton mice, "coincident with the location of rivers, streams, and other lowland areas" (McCarley 1963:787), includes swampy woodlands, bottomlands, lowland forests, and sites near swamps, sloughs, oxbow lakes, and areas with high water tables (Goodpaster and Hoffmeister 1952; Laerm and Boone 1994; Linzey et al. 1976; H. McCarley 1954a, 1954b, 1963; W.H. McCarley 1964; Pournelle 1952). Woody debris is used extensively (McCay 2000).

Cotton mice are sympatric throughout much of their range with white-footed mice (*P. leucopus*). The two species presumably diverged recently (Hooper 1968) and can be difficult to distinguish in the field. The purpose of our study was to compare morphometric characteristics of cotton mice from western Kentucky, where the species is considered to be threatened, with sympatric white-footed mice.

METHODS

Live trapping occurred from August 1998 through April 1999. Twelve sites were selected in Ballard and Carlisle counties, Kentucky (Bekiares 2000). Two Sherman live traps were set at each station, with stations established 10 m apart along a 500-m transect. Traps were set at two sites each week and checked between 0600 and 1000. Traps were set close to fallen logs, brush piles, stumps, pond edges, tree trunks, and on floating debris whenever possible to optimize trap success for *P. gossypinus*. Traps were baited with cracked corn and sunflower seeds and were set for three consecutive nights at each site, for a total of 300 trap nights per site. During summer, traps exposed to sunlight were covered with leaves to decrease the amount of heat absorbed by the trap prior to checking. During cold temperatures, traps contained polyester fiberfill bedding material.

The sex, age class (juvenile or adult, determined by pelage color), and wet body mass (nearest g) of captured animals were recorded. Individuals were then checked for a previous capture mark. If the animal was new, a hind foot measurement (mm) was taken. New captures were marked with a green permanent marker along the ventral surface (Schmid 1998). Marks could be observed for the duration of the three trap nights at each site.

Because *P. leucopus* and *P. gossypinus* are morphologically similar and difficult to distinguish in the field, initial size criteria of Hoffmeister (1977, 1989) were used to separate the species. Individuals with hind foot length ≥22 mm or body mass ≥26 g were tentatively identified as *P. gossypinus*. These animals

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were euthanized using cervical dislocation, placed on ice, and returned to the laboratory. Allozyme analyses (Bekiares 2000) were used to confirm species identification of animals collected. Other rodents, birds, and reptiles of non-interest were released at the capture site.

For animals removed from the field, standard external measurements (in mm) were made prior to dissection: total body length, tail length, ear length, and hind foot length. In addition, wet body mass (g) was recorded a second time using a triple-beam balance. Measurements (mm) of cleaned skulls included condylobasal length, length of the nasal bone, and length of the maxillary toothrow.

The computer program Statview was used to compute unpaired *t*-tests for comparisons of means, Z-tests for comparisons of proportions, and general descriptive statistics. Statistical tests were considered significant at $\alpha = 0.01$.

RESULTS

During 3600 trap nights we captured 197 individuals: 151 white-footed mice, 38 cotton mice, three rice rats (*Oryzomys palustris*), one Eastern chipmunk (*Tamias striatus*), and four leopard frogs (*Rana sphenocephala*). Seven of the *P. leucopus* were believed to be *P. gossypinus* upon capture and were removed from the field.

Only data from adults were used in morphological analyses because of the differences in juvenile sizes. Another consideration is that females collected in late summer and autumn may be pregnant. We collected only six pregnant females and chose to remove them from analyses. As expected, adult *P. leucopus* were significantly smaller than *P. gossypinus* for four of the eight measurements examined. For males, *P. leucopus* were significantly smaller than *P. gossypinus* in body mass, hind foot length, condylobasal length, and nasal length (Table 1). Female *P. leucopus* were smaller than female *P. gossypinus* for the same four measurements.

DISCUSSION

Most of the mean values for morphological characteristics of white-footed mice in our study represent a biased sample. Only those *P. leucopus* tentatively identified as *P. gossypinus* in the field were used for all measurements and represented the largest individuals. Only the hind foot and body mass measurements represent an unbiased sample because data were obtained on all animals captured in the field, not just those presumed to be *P. gossypinus*. We expect that the other four characteristics measured (total length, tail length, ear length, and maxillary toothrow length) also would be significantly smaller in an unbiased sample of *P. leucopus*.

Cotton mice in this study were significantly larger than six specimens reported from Horseshoe Lake Conservation Area, Alexander County, Illinois (Feldhamer et al. 1998). It is possible that the Illinois specimens were large *P. leucopus* misidentified as *P. gossypinus*. More likely, we suspect they may have been hybrids between the two species. Barbour and Davis (1974) suggested hybrid cotton mice occurred in Kentucky. Other investigators have also noted hybridization between the two species (Lovecky et al. 1979; McCarley 1954b; St. Romain 1976; although see Bradshaw 1968), with hybrids exhibiting intermediate-sized morhological characters.

Boone (1995) analyzed morphometric data for cotton mice from throughout their range. Using only adults, we compared his data to our data from Kentucky. For all morphological traits considered in both studies, Kentucky specimens, from the periphery of the range, were significantly larger ($P < 0.01$; see Bekiares 2000). This is consistent with the clinal size relationship noted by Boone (1995) for cotton mice throughout their range.

Hoffmeister (1977, 1989) created a scattergram based on morphological characters to distinguish between cotton mice and white-footed mice. He used hind foot length × nasal bone length on the x-axis, and condylobasal length × maxillary toothrow length on the y-axis. Measurements of cotton mice group to the right of a line running approximately through (0, 134) and (275, 0). In our study, specimens "on the line" were white-footed mice, based on allozyme data (Bekiares 2000).

Use of morphological measurements may need to be more conservative for differentiating white-footed mice and cotton mice on the periphery of their range in Kentucky, Illinois, and Missouri. That is, "questionable" specimens on or near the right side of the de-

Table 1. Differences (*t*-test; * = $P \leq 0.01$) in mean values of morphological characteristics between specimens of adult *Peromyscus gossypinus* and *P. leucopus* from Ballard and Carlisle counties, Kentucky, — collected between August 1998 and April 1999. Variation is reported as standard error.

Characteristic	*P. gossypinus*	*P. leucopus*	T_{cal} value
Male body mass (g)	30.97 ± 1.20 n = 17	22.95 ± 0.45 n = 57	7.65*
Female body mass (g)	33.18 ± 1.04 n = 21	24.69 ± 1.01 n = 33	−5.62*
Male total length	170.82 ± 3.61 n = 17	159.00 ± 5.21 n = 4	1.49
Female total length	179.57 ± 1.12 n = 21	174.00 ± 7.77 n = 3	1.42
Male tail length	74.47 ± 2.53 n = 17	66.25 ± 206 n = 4	1.52
Female tail length	77.90 ± 1.03 n = 21	82.67 ± 5.04 n = 3	−1.48
Male hind foot length	22.71 ± 0.27 n = 17	17.62 ± 0.27 n = 68	8.98*
Female hind foot length	22.81 ± 0.20 n = 21	18.01 ± 0.33 n = 35	−9.34*
Male ear length	18.76 ± 0.31 n = 17	18.00 ± 0.41 n = 4	1.14
Female ear length	18.86 ± 0.51 n = 21	17.00 ± 3.06 n = 3	1.09
Male condylobasal length	28.05 ± 0.27 n = 17	25.56 ± 0.59 n = 4	4.00*
Female condylobasal length	28.39 ± 0.14 n = 21	27.03 ± 0.55 n = 3	3.34*
Male nasal length	11.41 ± 0.21 n = 17	9.61 ± 0.28 n = 4	3.99*
Female nasal length	11.22 ± 0.16 n = 21	10.03 ± 0.21 n = 3	2.75
Male maxillary toothrow	3.94 ± 0.08 n = 17	3.77 ± 0.19 n = 4	0.93
Female maxillary toothrow	3.98 ± 0.06 n = 21	3.73 ± 0.02 n = 3	1.62

marcation line of Hoffmeister (1977, 1989) should be considered *P. leucopus*.

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