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Taxonomic Status of the Brush Mouse, *Peromyscus boylii cansensis* Long, 1961

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In the course of a study of mammals from southeastern Kansas and northeastern Oklahoma, the authors have collected specimens of the brush mouse, *Peromyscus boylii cansensis* Long, from its type locality and also from a place about 16 miles southwest of the type locality. The results of studies of these specimens, and of the holotype and paratypes of the subspecies, are presented and discussed herein.

Long (1961:101) named *Peromyscus boylii cansensis* from specimens obtained in Chautauqua and Cowley counties of Kansas. He thought it was geographically isolated from *Peromyscus boylii attwateri*, which is known from farther to the east in Kansas, as well as from southwestern Missouri and northwestern Arkansas, southwestward through Oklahoma to Texas (see Hall and Kelson, 1959:634). According to Long (1961:101-102), *cansensis* differs from *attwateri* as follows: less protuberant eyes; shorter tail (91 *versus* 103 per cent of length of head and body); darker pelage; and longer skull and nasals.

Methods and Materials

Fifty-six specimens of *Peromyscus boylii cansensis* were collected on 20 March 1966 from rocky bluffs along the Caney River, 1 mi. N, 2¼ mi. W Elgin, Chautauqua County, Kansas. These specimens and 27 specimens of *P. b. cansensis* (including holotype and paratypes) deposited previously in The University of Kansas Museum of Natural History were compared with 20 specimens of *P. b. attwateri* from southeastern Kansas, from Missouri and Arkansas, and from 3 mi. W Mason, Mason County, Texas (only 50 miles from the type locality of the subspecies). Three live specimens of *cansensis* (2 ♂, 1 ♀) from Chautauqua County and one live male of *attwateri* from Cherokee County, Kansas, all adults, were collected and examined for degree of protuberance of eyes. All specimens were examined and classified according to age. Criteria used for classification of age, as stated below, were modified slightly from those used by Hoffmeister (1951:1) for *Peromyscus truei*:

juvenile—M3 unworn;

young—lingual cusp of M3 worn; M1 and M2 showing
little or no wear;

- subadult*—M3 worn smooth; lingual cusps of M1 and M2 worn but labial cusps showing little or no wear;
adult—lingual cusps of M1 and M2 worn away and labial cusps showing considerable wear.

Unless noted otherwise, all measurements herein are in millimeters. The external measurements used were taken from fresh specimens prior to skinning by one or another of the three authors, and cranial measurements were taken by one of the authors (Phillips). Definitions of cranial dimensions used here, as well as techniques for taking them, are from Hall (1946: 672–685). All capitalized color nomenclature is from Ridgway (1912). Most specimens listed by us are deposited in The University of Kansas Museum of Natural History (KU). We thank E. Raymond Hall and J. Knox Jones, Jr., for the use of these specimens and for reviewing the manuscript. We also thank Horace A. Hays of the Department of Biological Sciences, Kansas State College (KSC) for loaning specimens of *P. boylii attwateri* in his care and for other assistance. Elmer C. Birney, Charles L. Douglas, and Joyce E. Genoways kindly assisted with various phases of the study.

Results

Measurements of tail vertebrae of our 59 specimens of *P. boylii cansensis* of all ages are given in a scatter diagram (see Figure 1). These specimens were collected 16 miles southwest of the type locality of *cansensis*. In adults, the tail (caudal vertebrae) is at least as long as the head and body; the average length of tail is 103 per cent of the length of head and body. In our two juveniles and in one subadult, the tail is longer than the head and body; in three subadults the tail is as long as the head and body; in 42 subadults the tail is shorter than the head and body.

Length of nasals was plotted against greatest length of skull (Figure 2). This scatter diagram, in which measurements of adults of *P. b. attwateri* from Texas, Missouri, Arkansas, and southeastern Kansas are included with measurements of adults of *cansensis*, shows that no distinction can be made between the two "subspecies" on the basis of length of nasals or greatest length of skull. Additional cranial measurements (mean, standard error of the mean, and range) of adults are presented in Table 1, from which it can be seen that adults of the four samples from four states are essentially the same size. Crania of *attwateri* from Texas are only slightly smaller than those of *cansensis* from Chautauqua and Cowley counties, Kansas. Mean of greatest length of skull in *attwateri* is 28.6 and in *cansensis* is 28.8, but the mean given for *attwateri* (28.6) is

larger than the mean of the type and paratypes of *cansensis* (28.3) given by Long (1961:102). Mean length of nasals of specimens from Texas is 10.4 and mean length of specimens from Kansas is 10.6. Here the mean for *attwateri* (10.4) is exactly the same as the mean for 11 specimens of *cansensis* that Long (1961:102) measured.

Examination of three live specimens of *cansensis* and one of *attwateri* revealed no difference in degree of eye protuberance, nor did examination of freshly skinned specimens reveal any such difference.

Subadults from Chautauqua County are Dark Mouse Gray to Dark Neutral Gray on the upper parts and Ochraceous-Buff on the sides; adults are Buckthorn Brown to Dresden Brown on the upper parts and Ochraceous-Tawny on the sides. Upper parts of the holotype of *cansensis*, which was in process of molting from subadult to adult pelage when prepared, are Mummy Brown. Winter pelage of adults from Texas is slightly paler than that of specimens from Kansas. This is due to Light Buff tips on hairs of the dorsum of mice from the southern locality.

Figure 1. Comparative measurements, in millimeters, of adults (open circles), subadults (open circles) and juveniles (half-closed circles) of *Peromyscus boylii* from Chautauqua County, Kansas. Numbers indicate more than one specimen represented by circle.

Even so, the general coloration of the upper parts of adults of *P. boylii* from Texas is near (16l) Mummy Brown.

Discussion

During late subadulthood, and perhaps in early adulthood, the length of the tail in *P. boylii* increases more rapidly, or for a longer time, or both, than does the length of the head and body. Osgood (1909:148) indicated that in *P. b. attwateri* the tail is 104 per cent of the length of head and body. Shorter tail (mean length) in the holotype and paratypes was one character used by Long (1961:101) to distinguish *cansensis* from *attwateri*. He thought that in *cansensis* the tail was only 91 per cent of the length of head and body. Actually, this was because Long included 15 subadults in his sample of 26 individuals. As can be seen in Figure 1, inclusion of measurements of subadults with those of adults in a sample of *P. boylii* could result in an erroneous impression of relative length of tail in either age category. The tail in *P. boylii* does not reach maximum length until after the length of the head and body has done so (see Figure 1).

Figure 2. Measurements, in millimeters, of adults of the nominal subspecies *Peromyscus boylii cansensis* (solid circles) and of *P. b. attwateri* (open circles). Circles that are one-half solid represent one specimen of each subspecies. Numbers indicate more than one specimen represented by a circle.

We have shown that crania of adults of *attwateri* and *cansensis* are essentially the same size. The generally accepted criterion as stated by Mayr *et al.* (1953:142) is that two populations represent different subspecies if the difference between the means of their measurements is more than twice the sum of the standard errors. On this basis, it can be seen (Table 1) that there are no noteworthy differences between our samples of *attwateri* and *cansensis*. Furthermore, analysis of measurements (see Table 1) does not reveal any trend in geographic variation that justifies placing specimens of *Peromyscus boylii* from south-central Kansas in a subspecies different from *P. b. attwateri*.

There is some geographic variation in color of *P. boylii attwateri*. Populations in eastern Kansas and eastern Oklahoma on the one hand are darker than those 530 miles southwest in the more arid south-central Texas. On the basis of dark color, Bangs (1896:137) gave the name *Peromyscus bellus* to specimens of brush mice from east-central Oklahoma. Osgood (1909:149) realized that northern populations of *attwateri* were slightly darker than southern populations. He pointed out that the name *bellus* had been given to specimens representing the extreme differentiation from *Peromyscus boylii rowleyi* (Allen), the subspecies found farther southward; but this differentiation already is well established at the type locality of *attwateri*. Furthermore, Osgood (*loc. cit.*) stated that the recognition of both *attwateri* and "*bellus*" would make *attwateri* an extremely slight and practically indefinable intermediate between *rowleyi* and "*bellus*." Recognition of *cansensis* would have the same effect on *attwateri* as would recognition of "*bellus*." In fact, we do not know of any feature on the basis of which *cansensis* differs from *attwateri* except in slightly darker average color.

It has been demonstrated adequately that the occurrence of *P. boylii* depends on the presence of suitable habitat (Blair, 1938:521 and 1939:122; Brown, 1964:189–202; and others). Because steep, rocky bluffs are lacking in much of Kansas, Long (1961:103) suggested that brush mice from cliffs along tributaries of the Caney River in Chautauqua and Cowley counties are isolated from populations of *P. b. attwateri* in Oklahoma and southeastern Kansas by more than 80 miles of grassland. Actually, suitable habitat for *P. boylii* occurs from Chautauqua County, Kansas, for a considerable distance southward into Oklahoma in the drainage area of the Caney River system. Specimens of *attwateri* have been obtained by one of the authors (Choate) from cliffs overlooking a tributary of the Caney River about 25 miles south of the type locality of *cansensis*. It seems, therefore, that populations of *P. boylii* in south-central Kansas are less effectively isolated from populations of brush

Table 1. Cranial measurements of adults of *Peromyscus boylii*.

Measurements	Mason County, Texas N=4		Arkansas and Missouri N=16		Cherokee Co., Kansas N=11		Chautauqua, Cowley cos., Kansas N=17	
	$\bar{X}$	SE $\bar{X}$	Range	$\bar{X}$	SE $\bar{X}$	Range	$\bar{X}$	SE $\bar{X}$
	2 ♂ ♂	2 ♀ ♀	11 ♂ ♂	5 ♀ ♀	5 ♂ ♂	6 ♀ ♀	11 ♂ ♂	6 ♀ ♀
Greatest length of skull	28.6±0.61	(27.8–29.0)	28.5±0.10	(27.9–29.0)	28.4±0.13	(27.8–29.1)	28.8±0.10	(27.8–29.85)
Condylobasal length	27.9±0.26	(27.1–28.4)	27.8±0.11	(27.1–28.2)	27.7±0.11	(27.0–28.4)	28.0±0.14	(27.0–29.0)
Zygomatic breadth	14.2±0.61	(13.9–14.4)	14.3±0.06	(13.8–14.7)	14.2±0.13	(13.7–14.5)	14.6±0.10	(14.3–15.1)
Interorbital constriction	4.5±0.03	(4.5–4.6)	4.6±0.04	(4.2–4.9)	4.5±0.03	(4.3–4.6)	4.6±0.03	(4.2–4.8)
Length of nasals	10.4±0.11	(10.2–10.6)	10.5±0.05	(10.1–10.7)	10.4±0.09	(9.8–10.9)	10.6±0.09	(9.8–11.1)
Length of maxillary tooth-row	4.0±0.02	(4.0–4.1)	3.9±0.02	(3.7–4.0)	3.9±0.09	(3.7–4.0)	4.0±0.03	(3.8–4.2)
Length of mandibular tooth-row	4.2±0.17	(4.0–4.3)	4.1±0.02	(3.8–4.2)	4.1±0.03	(4.0–4.3)	4.2±0.03	(4.0–4.4)
Mastoid breadth	9.5±0.08	(9.4–9.8)	9.6±0.05	(9.3–10.6)	9.5±0.06	(9.3–9.8)*	9.8±0.05	(9.5–10.0)

* N=5

mice in Oklahoma than formerly was supposed. It is likely that all populations of brush mice in Kansas had a common area of origin in eastern Oklahoma.

Long (1961:101) considered lesser protuberance of eyes in *cansensis* to be a character of taxonomic worth distinguishing *cansensis* from *attwateri*. In two adult males of *cansensis* that we captured on 18 June 1966 and sacrificed on 22 August 1966 and in one adult male of *attwateri* that we captured on 19 June 1966 and sacrificed on 22 August 1966, we could not detect any difference in the protuberance of the eyes in life or when the specimens were skinned. Difference in protuberance of eyes conceivably could be related to a difference in nutritional or hormonal physiology, either in captive individuals or in wild individuals living in different environments, but might well fluctuate in the lifetime of the same individual. If such were the case, the difference hardly would be of subspecific worth.

The revised synonymy of *Peromyscus boylii attwateri* J. A. Allen is as follows:

- 1895. *Peromyscus attwateri* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:330, November 8. Type locality, Turtle Creek, Kerr County, Texas.
- 1906. *Peromyscus boylei attwateri*, V. Bailey, Proc. Biol. Soc. Washington, 19:57, May 1.
- 1896. *Peromyscus bellus* Bangs, Proc. Biol. Soc. Washington, 10:137, December 28. Type locality, Stilwell, Adair County, Oklahoma.
- 1905. *Peromyscus boylei laceyi* V. Bailey, N. Amer. Fauna, 25:99, October 24. Type locality, Turtle Creek, Kerr County, Texas.
- 1961. *Peromyscus boylii cansensis* Long, Univ. Kansas Publ., Mus. Nat. Hist., 14:101, December 29. Type locality, 4 mi. E Sedan, Chautauqua County, Kansas.

Specimens examined (116, KU unless otherwise noted).—KANSAS: 5 mi. S, 2 mi. E Dexter, Cowley Co., 1; 3½ mi. W Cedar Vale, in Cowley Co., 1; Cedar Creek, 3 mi. W Cedar Vale, in Cowley Co., 13; sec. 18, T. 34 S, R. 8 E, Cowley Co., 2; 4 mi. E Sedan, Chautauqua Co., 9; 2 mi. N Peru, Chautauqua Co., 1; 1 mi. N, 2¼ mi. W Elgin, Chautauqua Co., 58; Shimmerhorn Park, 2 mi. S Galena, Cherokee Co., 13 (3 KSC). MISSOURI: N bank Elk River, ½ mi. N, 4 mi. W Noel, McDonald Co., 1; 4 mi. N Branson, Taney Co., 1. ARKANSAS: 1 mi. S

Winslow, Washington Co., 1; 3 mi. S Winslow, Washington Co., 2; 4 mi. SE Marcella, Stone Co., 1; Ozark, Franklin Co., 4; 6 mi. N, 3 mi. E Mena, Polk Co., 4. TEXAS: 3 mi. W Mason, Mason Co., 4.

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