University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Mammalogy Papers: University of Nebraska State Museum

Museum, University of Nebraska State

11-1-1982

Karyotypic Relationships within the Short-Tailed Shrews, Genus *Blarina*

Sarah B. George
University of Utah, sgeorge@nhmu.utah.edu

Hugh H. Genoways
University of Nebraska - Lincoln, h.h.genoways@gmail.com

Jerry R. Choate
Fort Hays State University

Robert J. Baker
Texas Tech University, rjbaker@ttu.edu

Follow this and additional works at: https://digitalcommons.unl.edu/museummammalogy

 Part of the Biodiversity Commons, Terrestrial and Aquatic Ecology Commons, and the Zoology Commons

George, Sarah B.; Genoways, Hugh H.; Choate, Jerry R.; and Baker, Robert J., "Karyotypic Relationships within the Short-Tailed Shrews, Genus *Blarina*" (1982). *Mammalogy Papers: University of Nebraska State Museum*. 69.
https://digitalcommons.unl.edu/museummammalogy/69

This Article is brought to you for free and open access by the Museum, University of Nebraska State at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Mammalogy Papers: University of Nebraska State Museum by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

George, Genoways, Choate & Baker, Journal of Mammalogy (1982) 63(4).
Copyright 1982, American Society of Mammalogists. Used by permission.

KARYOTYPIC RELATIONSHIPS WITHIN THE SHORT-TAILED SHREWS, GENUS *BLARINA*

SARAH B. GEORGE, HUGH H. GENOWAYS, JERRY R. CHOATE, AND ROBERT J. BAKER

ABSTRACT.—Short-tailed shrews of the genus *Blarina* exhibit considerable geographic variation in both diploid number and fundamental number. Four chromosomal groups are recognized within the genus: *Blarina brevicauda*, FN = 48; 2N = 50, 49, or 48; *B. carolinensis*, FN = 45 or 44; 2N = 46, 39, 38, or 37; *B. c. peninsulae*, FN = 52; 2N = 52, 51, or 50; *B. hylophaga*, FN = 62, 61, or 60; 2N = 52. *B. c. peninsulae* also may be a distinct species, but exact determination must await location and analysis of a zone of contact with *B. carolinensis*.

The genus *Blarina* was last revised by Merriam (1895). He recognized three species in the subgenus *Blarina*, all of which were reduced later to subspecies of *Blarina brevicauda* (Bole and Moulthrop, 1942; Handley, 1979). Based on morphometric analyses, Genoways and Choate (1972) concluded that the subspecies *B. b. brevicauda* and what they termed *B. b. carolinensis* behaved as distinct species where their ranges met in Nebraska. Karyologic data subsequently obtained in Nebraska and Kansas (Genoways et al., 1977) supported the conclusion that these were distinct species (*B. brevicauda*—FN = 48, 2N = 50 or 49; "*B. carolinensis*"—FN = 62; 2N = 52). Karyotypes of short-tailed shrews from Ontario (Meylan, 1967) and Illinois (Lee and Zimmerman, 1969) were similar to those of *B. brevicauda* from Nebraska, although one specimen from Illinois had a diploid number of 48. Karyotypic data were not available from the remainder of the range of the genus. In light of this known karyotypic variability, the present study was designed to characterize the extent and nature of karyotypic variation from throughout the range of the genus *Blarina*.

METHODS

From 1978 to 1980, short-tailed shrews were collected in Sherman traps throughout the eastern United States and Canada. Localities and sample sizes are listed in Specimens Examined. Standard (non-differentially stained) metaphase chromosome preparations of bone marrow cells were obtained from fifty-two individuals using procedures described by Baker (1970). Diploid (2N) and fundamental (FN) numbers of specimens were determined (by SBG) and compared to delineate geographic patterns of variation. All shrews were prepared as standard museum specimens (skin and skull) and deposited in the Museum of the High Plains, Fort Hays State University, Hays, Kansas (MHP), or the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania (CM). Representative slides of karyotyped specimens are deposited at MHP, CM, and The Museum, Texas Tech University, Lubbock, Texas.

RESULTS

Four chromosomal groups were identified within *Blarina* (Table 1). Group A is characterized by a fundamental number (FN) of 45 or 44 and diploid (2N) numbers of 46, 39, 38, or 37. Karyotypes of specimens from Louisiana, northern Florida, South Carolina, and southeastern Texas had all acrocentric autosomes (2N = 46, FN = 44; Fig. 1). Karyotypes of specimens from Memphis, Tennessee, however, were highly variable, exhibiting seven to ten biarmed autosomes (Fig. 2). Morphology of autosomes varied from small meta- or submetacentrics (three pairs common to all individuals; Fig. 2) to a large submetacentric (as in Fig. 2) to large subtelocentrics (not figured). Our sample of *Blarina* from Memphis is included within Group A because of the similarity in FN and the geographic proximity to coastal *Blarina*.

Group B is characterized by FN = 48 and 2N = 50, 49, or 48 (Table 1). Meylan (1967) concluded that this variation in diploid numbers is the result of a fission/fusion event between a pair of large acrocentric and a pair of small acrocentric chromosomes. A diploid number of

TABLE 1.—*Variation in the known karyotypes of* Blarina.

Localities	FN = 44, 45				FN = 48			FN = 52			FN = 62	61	60
	2N = 46	39	38	37	2N = 50	49	48	2N = 52	51	50	2N = 52		
Leon Co., Florida	1												
Lincoln Par., Louisiana	1												
Aiken Co., South Carolina	1												
Shelby Co., Tennessee		1	1	1									
Polk Co., Texas (M.D. Engstrom, personal communication)	1												
Barrow Co., Georgia					2								
Douglas Co., Kansas					1								
Central Illinois (Lee and Zimmerman, 1969)					46	6	1						
Aroostook, Co., Maine					4	1							
Cheshire Co., New Hampshire					4	2							
Roan Mountain, North Carolina and Tennessee					2	3							
Ontario (Meylan, 1967)					16	5							
Nebraska and Pennsylvania (Genoways et al., 1977)					6	4							
Westmoreland Co., Pennsylvania					4	3							
Bonaventure Co., Quebec						1							
Marshall Co., Tennessee					1								
Dade Co., Florida								6	6	2			
Highlands Co., Florida								1					
Ellis Co., Kansas (Genoways et al., 1977)											5		
Dundy and Otoe cos., Nebraska (Genoways et al., 1977)											4		
Garvin and Murray cos., Oklahoma												1	1

50 was found most often, whereas 2N = 48 has been found only in central Illinois (Lee and Zimmerman, 1969).

Group C is characterized by FN = 52 and 2N = 52, 51, or 50 (Table 1). A polymorphism apparently like that found in Group B was present in the population from Dade Co., Florida; as a result, diploid numbers in this group also varied (Figs. 3 and 4). Group C karyotypes differed from those of Group B in possessing an additional, small pair of metacentric autosomes.

Group D is characterized by FN = 62, 61, or 60 and 2N = 52 (Table 1). Specimens from Murray and Garvin counties, Oklahoma (Fig. 5), exhibited a polymorphism (one or both short arms in the fourth pair of biarms was missing) that resulted in fundamental numbers of 61 or 60.

DISCUSSION

After the taxon *carolinensis* was elevated to the level of species (Genoways and Choate, 1972), several authors examined additional contact zones between *B. brevicauda* and *B. carolinensis* morphometrically. Ellis et al. (1978) studied short-tailed shrews in Illinois and found no mensural overlap of the two taxa. J. Braun and M. Kennedy (pers. comm.) analyzed these taxa in Tennessee, as did Tate et al. (1980) in Virginia; both studies found no indication of morphometric overlap between the two species. It appears that these two forms do indeed represent valid species. In addition, George et al. (1981), in a morphometric study of *Blarina* from west of the Mississippi River, found two distinct groups, *B. carolinensis* in the Mississippi and Gulf lowlands and *B. hylophaga* to the west and north of these lowlands. Although some overlap in size was detected, there was no mensural overlap between adjacent populations of the two taxa. Thus morphometric studies indicate the existence of three distinct groups of *Blarina*.

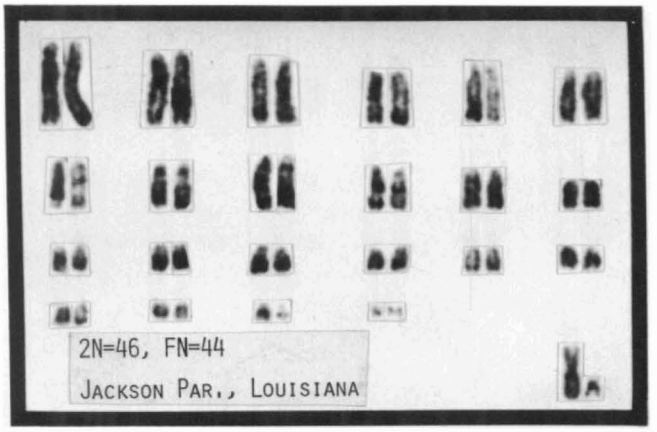

FIG. 1.—Karyotype of a *Blarina carolinensis* (Group A) from Ansley, Jackson Parish, Louisiana (CM 55227).

The pattern of chromosomal variation presented here generally is concordant with that of morphologic variation. Chromosomal Group A represents the species *Blarina carolinensis*, Group B represents the species *B. brevicauda*, and Group D represents the species *B. hylophaga*. In addition, a distinct chromosomal form (Group C) is found in peninsular Florida. Because morphometric variation in short-tailed shrews of Florida and adjacent states has not been analyzed, we are unable to compare morphologic and karyotypic variation between the groups in this region. However, karyotypes of the peninsular *Blarina* are so distinct from those of adjacent *B. carolinensis* that Group C may represent a distinct species. In addition, its karyotype and polymorphism are most similar to those of *B. brevicauda*, suggesting a close affinity to that species. Until contact zones (probably in northern Florida) are located and investigated, Group C provisionally is retained in *B. carolinensis*, and is referred to as *B. c. peninsulae* Merriam.

Specimens from the Mississippi River lowlands near Memphis, Tennessee, exhibited several polymorphisms, possibly Robertsonian, in their karyotypes and it is probable that additional polymorphisms will be found. We were unable to determine whether or not shrews with these polymorphic karyotypes grade into shrews from coastal populations which consistently exhibited fully acrocentric karyotypes. Because of the similarity in fundamental numbers between these two karyotypic forms, and the fact that Robertsonian polymorphism has been documented in a

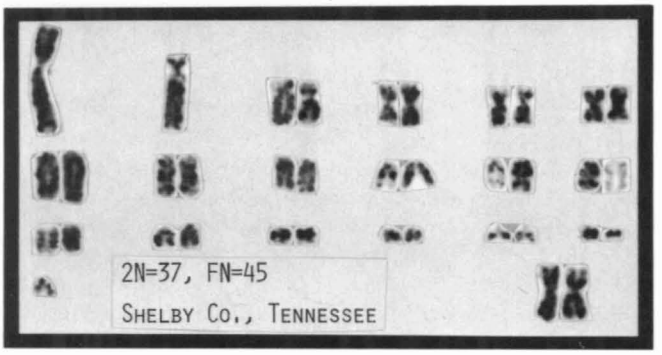

FIG. 2.—Karyotype of a *Blarina carolinensis* (Group A) from Meeman Biological Field Station, Memphis State University, Shelby Co., Tennessee (MHP 16054).

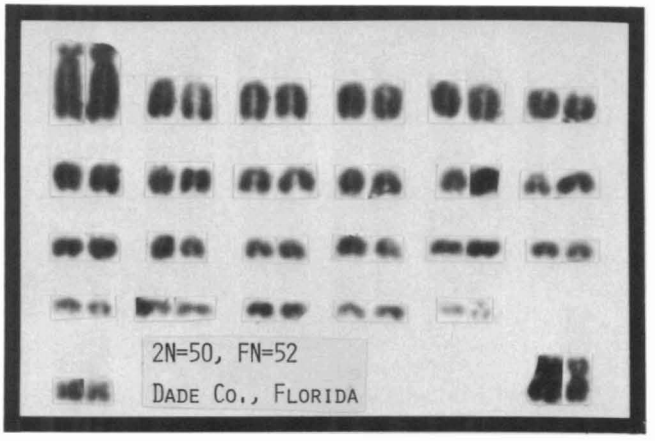

FIG. 3.—Karyotype of a *Blarina carolinensis peninsulae* (Group C) from 1 mi. W Chekika State Recreational Area, Dade Co., Florida (MHP 15246).

congener, *B. brevicauda*, we tentatively regard populations in the Mississippi River valley and on the coastal plains as *B. carolinensis*.

The geographic distribution (Fig. 6) of *Blarina carolinensis* Bachman includes the Gulf and Atlantic coastal lowlands as far north as North Carolina, and extends into south-central Virginia on the Piedmont, with isolated pockets along the coast of Virginia (Tate et al., 1980). The distribution also extends northward in the Mississippi River valley (Fig. 6) to southeastern Missouri on the west side of the Mississippi River (George et al., 1981) and into southern Illinois on the east side of the Mississippi River (Ellis et al., 1978). *Blarina carolinensis peninsulae* is restricted to peninsular Florida (Fig. 6). The northernmost specimen known to possess a karyotype of *B. c. peninsulae* is from Highland County. No specimens were examined between Highland County and Leon County; therefore, the northernmost limit of the karyotypic form is approximated (dashed line in Fig. 6).

Blarina brevicauda (Say) has a geographic range extending across the northern half of the distribution of the genus. Differing from the distribution figured in Hall (1981), this species

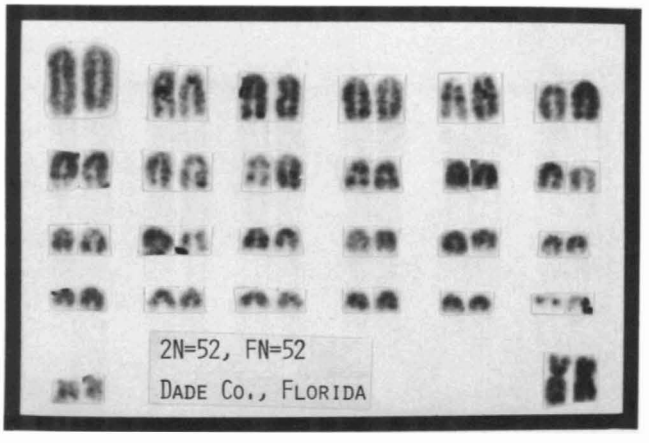

FIG. 4.—Karyotype of a *Blarina carolinensis peninsulae* (Group C) from 1 mi. W Chekika State Recreational Area, Dade Co., Florida (CM 55229).

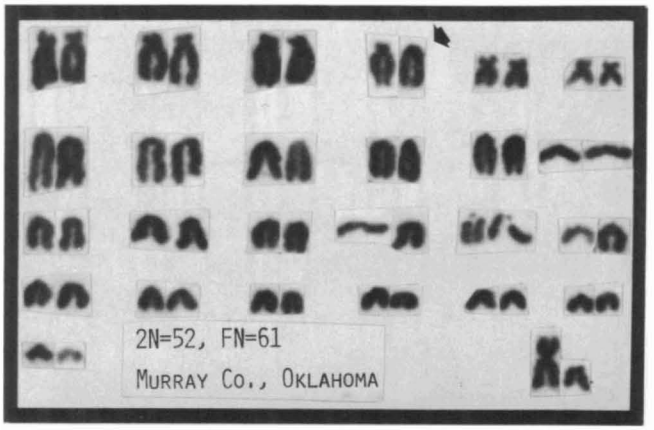

FIG. 5.—Karyotype of a *Blarina hylophaga* (Group D) from 1.3 mi. S, 2.2 mi. W (by road) Davis, Murray Co., Oklahoma (MHP 17703). Arrow indicates the heteromorphic pair.

extends into central Tennessee (J. Braun and M. Kennedy, pers. comm.; this study), northeastern Georgia (this study), and as far south as Columbus, Georgia, east of the Chattahoochee River (T. W. French, pers. comm.; Fig. 6). Polymorphic diploid numbers were found in all populations where sample sizes were greater than two. In the polymorphic populations, the wholly acrocentric karyotype (2N = 50) occurred with the highest frequency (Table 1).

One specimen from Lawrence, Kansas, had a diploid number of 50 and a fundamental number of 48 (Table 1). Genoways et al. (1977) found no specimens with this chromosomal complement in Kansas. They did, however, find specimens with the chromosomal complement of *Blarina hylophaga* in southeastern Nebraska. These chromosomal data are consistent with the findings of Moncrief et al. (in press), that the two species (*B. brevicauda* and *B. hylophaga*) are sympatric in northeastern Kansas, southern Iowa, and northern Missouri (hatched area in Fig. 6).

The geographic range of *Blarina hylophaga* Elliot includes the southern Great Plains (Fig. 6) from southern Nebraska and southern Iowa (Bowles, 1975; Hall, 1981; Moncrief et al., in press) to southern Oklahoma (George et al., 1981), and extends into central and southwestern Missouri (Hall, 1981; Moncrief et al., in press) and northwestern Arkansas (George et al., 1981).

Although this study has identified major evolutionary units within the genus, gaps remain in the distributional records of karyotypes and several isolated populations of *Blarina* have yet to be examined karyotypically. These include populations in Aransas Co., Texas (now referred to as *B. hylophaga plumbea*; George et al., 1981; Fig. 6), on Martha's Vineyard and Nantucket islands, Massachusetts (*B. brevicauda aloga* and *B. b. compacta*, respectively; Hall, 1981), and in the Fort Myers area of Florida (*B. carolinensis shermani*; Hall, 1981; Fig. 6). Other areas in need of investigation have been signalled in this study. Interactions between *B. c. peninsulae* and adjacent *B. carolinensis* should be evaluated karyotypically and morphometrically at sympatric localities, as should interactions between the karyotypically aberrant *B. carolinensis* at Memphis and adjacent conspecifics. Joint karyotypic and ecological studies at zones of contact between established species should be carried out to evaluate species interactions in sympatry. Finally, electrophoretic and chromosomal banding studies are needed to evaluate evolutionary relationships of these taxa, which in turn may allow a confident reconstruction of their historical zoogeography.

SPECIMENS EXAMINED

Blarina brevicauda (28).–**QUEBEC:** 4.5 mi. N, 0.5 mi. E St. Elezear de Bonaventure, Bonaventure Co., 1 (CM 62506). **GEORGIA:** 5 mi. NE Winder, Barrow Co., 2 (University of Georgia, field numbers M377,

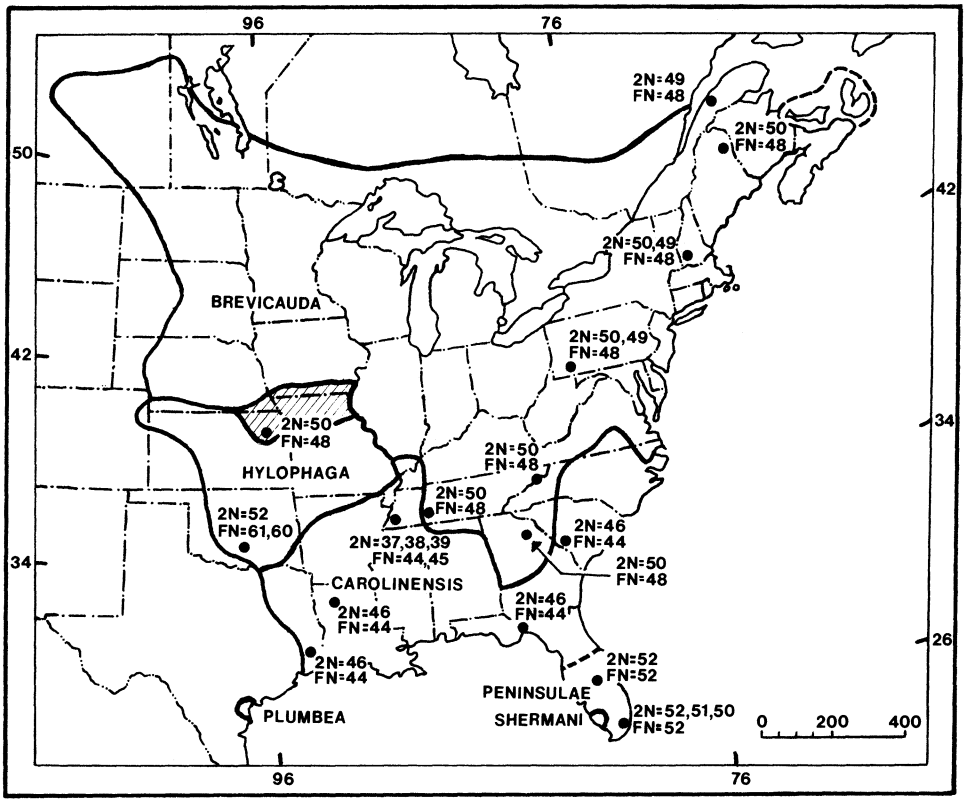

FIG. 6.—Map of the geographic distribution of the three species of *Blarina*. Karyotypes reported in this paper are indicated on the map. Detailed distributional limits of the species are based upon morphological data.

M378). **KANSAS:** 2 mi. N, 1⅘ mi. E Lawrence, Douglas Co., 1 (MHP 17879). **MAINE:** 2.7 mi. S, 0.8 mi. E Presque Isle, Aroostook Co., 5 (CM 62522–24, MHP 16371, 16375). **NEW HAMPSHIRE:** 1½ mi. N, 2½ mi. W Winchester, Cheshire Co., 2 (CM 62533, MHP 16385); 1½ mi. N, 1½ mi. E Winchester, Cheshire Co., 2 (CM 62535, 62739); 3 mi. S, 2 mi. W Winchester, Cheshire Co., 2 (CM 62741–42). **NORTH CAROLINA:** Roan Mountain, 6½ mi. N, 2 mi. E Bakersville, Mitchell Co., 1 (MHP 15220); Roan Mountain, 6 mi. N, 3¼ mi. E Bakersville, Mitchell Co., 1 (CM 55203). **PENNSYLVANIA:** 3 mi. S Rector, Westmoreland Co., 3 (CM 62517, 62519, 62727); 1¼ mi. S, 2½ mi. E Stahlstown, Westmoreland Co., 4 (MHP 16388–90, 16392). **TENNESSEE:** Roan Mountain, 4¾ mi. S, 1½ mi. W Roan Mountain, Carter Co., 1 (MHP 15236); 6 mi. S, ¾ mi. W Roan Mountain, Carter Co., 1 (CM 64735); 6½ mi. S, 2 mi. W Roan Mountain, Carter Co., 1 (CM 64737); Henry Horton State Park, Marshall Co., 1 (CM 64739).

Blarina carolinensis (7).–**FLORIDA:** Holland, Leon Co., 1 (CM 59687). **LOUISIANA:** Ansley, Jackson Parish, 1 (CM 55227). **SOUTH CAROLINA:** 2 mi. N, 1½ mi. W Jackson, Aiken Co., 1 (CM 55226). **TENNESSEE:** Meeman Biological Field Station, Memphis State University, Shelby Co., 3 (CM 64743; MHP 16050, 16054). **TEXAS:** 3.4 mi. N, 4 mi. W Segno, Polk Co., 1 (M. D. Engstrom, pers. comm., Texas A&M AK 1669).

Blarina carolinensis peninsulae (15).–**FLORIDA:** 1 mi. W Chekika State Recreational Area, Dade Co., 14 (CM 55229, 59691–92, 59699–703, 59706–07, 59709, 59711–12; MHP 15246); 6 mi. S Lake Placid, Highland Co., 1 (CM 59686).

Blarina hylophaga (2).–**OKLAHOMA:** 1.3 mi. S, 2.2 mi. W (by road) Davis, Murray Co., 1 (MHP 17703); 3 mi. N, 2 mi. W (by road) Davis (Murray Co.), Garvin Co., 1 (MHP 17880).

Acknowledgments

We thank M. D. Engstrom for allowing us to use his karyotype of *Blarina* from Texas, M. L. Arnold, R. K. Barnett, and S. L. Williams for assistance with karyotyping, and the following persons for aiding in the collection of specimens: D. L. Carnahan, L. E. Carroll, J. Z. Deal, J. E. Genoways, M. L. Genoways, T. H. Genoways, L. L. Johnson, C. A. Jones, J. A. Junge, G. K. Launchbaugh, D. C. Lovell, N. D. Moncrief, M. P. Moulton, M. A. Ports, M. L. Sexson, P. A. Seyfarth, and M. J. Smolen. Innumerable others assisted in various ways related to field work; these included C. H. Carter, J. N. Layne, M. L. Kennedy, and R. T. Shropshire. J. Storey and R. Van Hook (Oak Ridge National Laboratories) made their time and facilities available to us. We also thank L. S. Ellis, many colleagues at the University of New Mexico, especially D. J. Hafner, A. M. Parkinson, R. M. Sullivan, T. L. Yates, and an anonymous reviewer for their suggestions and comments on this and earlier drafts of this manuscript. This study was supported by two grants from the National Science Foundation (DEB 77-12283 to HHG and DEB 77-13120 to JRC) and by a Theodore Roosevelt Memorial Grant (to SBG).

Literature Cited

Baker, R. J. 1970. Karyotypic trends in bats. Pp. 65–96, *in* Biology of bats (W. A. Wimsatt, ed.). Acad. Press, New York, 1:1–406.

Bole, B. P., Jr., and P. N. Moulthrop. 1942. The Ohio Recent mammal collection in the Cleveland Museum of Natural History. Sci. Publ., Cleveland Mus. Nat. Hist., 5:83–181.

Bowles, J. B. 1975. Distribution and biogeography of mammals of Iowa. Spec. Publ. Mus., Texas Tech Univ., 1:1–184.

Ellis, L. S., V. E. Diersing, and D. F. Hoffmeister. 1978. Taxonomic status of short-tailed shrews (*Blarina*) in Illinois. J. Mamm., 59:305–311.

Genoways, H. H., and J. R. Choate. 1972. A multivariate analysis of systematic relationships among populations of the short-tailed shrew (genus *Blarina*) in Nebraska. Syst. Zool., 21:106–116.

Genoways, H. H., J. C. Patton, III, and J. R. Choate. 1977. Karyotypes of shrews of the genus *Cryptotis* and *Blarina* (Mammalia: Soricidae). Experientia, 33:1294–1295.

George, S. B., J. R. Choate, and H. H. Genoways. 1981. Distribution and taxonomic status of *Blarina hylophaga* Elliot (Insectivora: Soricidae). Ann. Carnegie Mus., 50:493–513.

Hall, E. R. 1981. The mammals of North America. John Wiley and Sons, New York, 1:xv + 1–600 + *90*.

Handley, C. O., Jr. 1979. Mammals of the Dismal Swamp: a historical account. Pp. 297–357, *in* The Great Dismal Swamp (P. O. Kirk, Jr., ed.). Univ. Press Virginia, Charlottesville, 427 pp.

Lee, M. R., and E. G. Zimmerman. 1969. Robertsonian polymorphism in the cotton rat, *Sigmodon fulviventer*. J. Mamm., 50:333–339.

Merriam, C. H. 1895. Revision of the shrews of the American genera *Blarina* and *Notiosorex*. N. Amer. Fauna, 10:1–34.

Meylan, A. 1967. Formules chromosomiques et polymorphisme Robertsonien chez *Blarina brevicauda* (Say) (Mammalia: Insectivora). Canadian J. Zool., 45:1119–1127.

Moncrief, N. D., J. R. Choate, and H. H. Genoways. In press. Morphometric and geographic relationships of short-tailed shrews (genus *Blarina*) in Kansas, Iowa, and Missouri. Ann. Carnegie Mus.

Tate, C. M., J. F. Pagels, and C. O. Handley, Jr. 1980. Distribution and systematic relationship of two kinds of short-tailed shrews (Soricidae: *Blarina*) in south-central Virginia. Proc. Biol. Soc. Washington, 93:50–60.

Museum of the High Plains, Fort Hays State University, Hays, KS 67601; Section of Mammals, Carnegie Museum of Natural History, 5800 Baum Blvd., Pittsburgh, PA 15216; The Museum and Department of Biological Sciences, Texas Tech University, Lubbock, TX 79409 (present address of George: Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM 87131). *Submitted 17 October 1980. Accepted 4 March 1982.*