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A New Southern Distributional Limit for the Central American Rodent *Peromyscus stirtoni*

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Stirton's deer mouse, *Peromyscus stirtoni* Dickey, 1928, is a Central American endemic species with a discontinuous distribution in dry and seasonally dry lowland habitats ranging from southeastern Guatemala to western Nicaragua (Jones, 1990; Reid, 1997). In Nicaragua, *P. stirtoni* was known from seven specimens at three localities in the west-central portion of the country (Jones and Yates, 1983; Jones, 1990). Its southernmost record was from Los Cocos, Boaco Department. Our field work during 1998 and 2000 on Isla de Ometepe in Lake Nicaragua (= Lago Colcibolca), at least 80 km south of Los Cocos, yielded new, vouchered records of *P. stirtoni* that extend its southern distribution. Collecting in 2000 and 2001 by a separate group from the Royal Ontario Museum (ROM) yielded additional specimens from the same locality. Specimens were identified by comparison with identified museum specimens and by using characters and measurements outlined by Dickey (1928), Huckaby (1980), Jones and Yates (1983), and Jones (1990).

Mice of the genus *Peromyscus* inhabit a number of nearshore oceanic and lacustrine islands (e.g., Hall, 1981; Lomolino, 1993). Island populations typically are subsets of mainland species with broad geographic and habitat distributions. In contrast, the distribution of Stirton's deer mouse on the mainland is spotty, probably resulting from an ability for long-distance dispersal among scarce patches of favorable habitat, the fragmentation of a much broader prehistoric dis-

tribution, or a combination of vicariance and dispersal.

As in other areas, the distribution of *P. stirtoni* on Isla de Ometepe is restricted. All captures were made in Parque Natural "Peña Inculta La Cabuya," near Santo Domingo, Rivas Department. La Cabuya is a ca. 1190-hectare reserve that extends from 50–150 m elevation. It lies on a flattened ridge of sharp-edged, volcanic cobbles and boulders with little soil or leaf litter. The rocky terrain probably kept the area from being cleared for farming, as has happened in most lowland areas on Isla de Ometepe. Old-growth, high-canopied, evergreen dry tropical forest grows out of this volcanic rubble, the trees supported by roots intertwined amongst the rocks, reaching down to the shallow water table. The forest in the study area is dominated numerically by *Hura crepitans* (jabillo) and *Sterculia apetala* (camajondura), with fewer *Terminalia oblonga* (guayabón), *Ceiba pentandra* (ceiba), *Tabebuia rosea* (roble de sabana), *Bursera simaruba* (gumbolimbo), and *Stenmadenia donnell-smithii* (huevos de caballo). The understory contains many *Urera baccifera* (chichicaste) and *Luehea candida* (guácimo). Despite selective cutting of some trees (e.g., *Cedrela odorata* [cedro], for canoes), the forest appears mostly undisturbed. This impression was reinforced by the relative abundance of emballonurid and phyllostomid bats in La Cabuya (29 individuals of at least 7 species in a single net during 10 hours in 1998) and the lack of the common vampire bat, *Desmodus rotundus*, a species abundant (17% of captures in 1998) elsewhere on Isla de Ometepe before eradication efforts in early 2000.

We trapped for small mammals at five other sites on Isla de Ometepe within the ca. 30–975 m elevational range of *P. stirtoni*. Previous expeditions there in 1964 and 1968 sampled at least seven other localities (J. R. Choate, H. H. Genoways, T. E. Lawlor, J. D. Smith—unpublished field notes and catalogs, University of Kansas Natural History Museum [KU]). Although *Liomys salvini* (Salvin's spiny pocket mouse) and *Sigmodon hispidus* (hispid cotton rat) were present in disturbed rocky areas elsewhere on the island, the relatively undisturbed forest at La Cabuya was the only site where *P. stirtoni* was taken. Other workers have reported capturing *P. stirtoni* in disturbed habitats elsewhere in Central America (e.g., Peppers et al., 1999).

Peromyscus stirtoni appeared to be locally abundant

TABLE 1. Descriptive statistics for adult *Peromyscus stirtoni* from Isla de Ometepe and mainland Nicaragua. Statistics presented are mean ± *SD* and range. All measurements in millimeters, weight in grams. Cranial measurements are defined and illustrated by Musser et al. (1998).

	Isla de Ometepe	Mainland
	external measurements	
	(*n* = 7)	(*n* = 6)
length of head and body (HB)	102 ± 7	103 ± 5
	(94–111)	(97–109)
length of tail (LT)	87 ± 7	96 ± 7
	(75–95)	(86–107)
relative tail length (LT/HB × 100)	85 ± 4%	93 ± 10%
	(79–90)	(79–107)
length of hind foot (LF)	23 ± 0.5	23 ± 1
	(23–24)	(22–24)
	weight	
	(*n* = 7)	(*n* = 4)
	29 ± 4	31 ± 3
	(23–35)	(28–35)
	cranial measurements	
	(*n* = 7)	(*n* = 7)
occipitonasal length (ONL)	30.0 ± 1.5	29.5 ± 0.6
	(28.0–31.8)	(28.6–30.2)
greatest zygomatic breadth (ZB)	14.1 ± 0.6	13.8 ± 0.4
	(13.2–14.6)	(13.0–14.1)
interorbital breadth (IB)	5.0 ± 0.1	4.9 ± 0.1
	(4.8–5.2)	(4.7–5.1)
breadth of zygomatic plate (BZP)	2.3 ± 0.2	2.4 ± 0.2
	(2.0–2.5)	(2.2–2.6)
crown length of maxillary toothrow (CLM1–3)	4.2 ± 0.1	3.9 ± 0.1
	(4.0–4.4)	(3.7–4.1)
length of incisive foramina (LIF)	5.5 ± 0.4	5.8 ± 0.3
	(5.3–6.4)	(5.4–6.2)

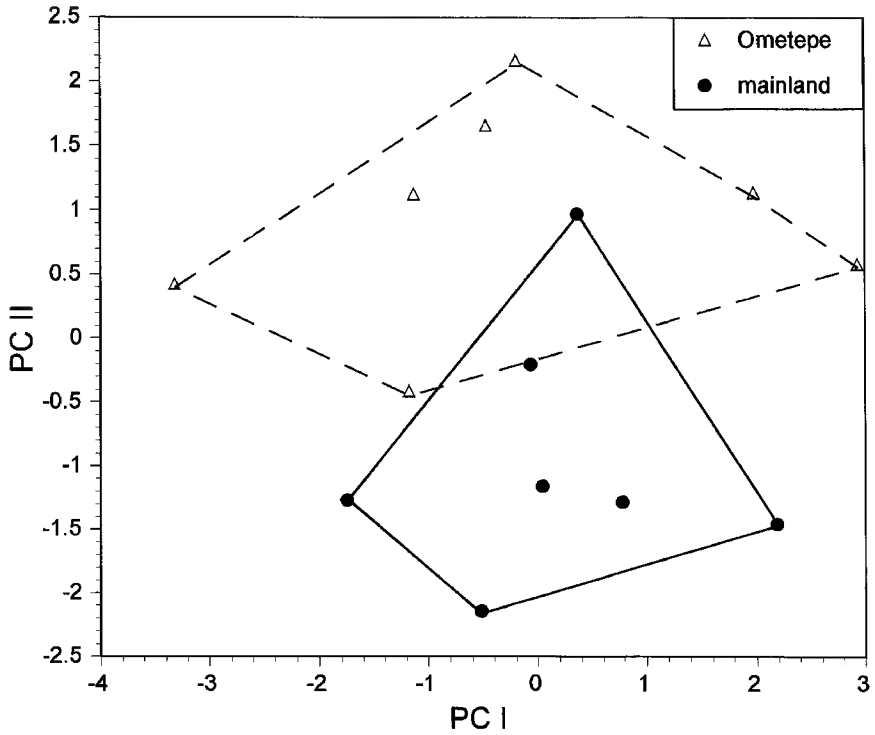

FIG. 1. Plot of scores on PC I and PC II from PCA of adult *Peromyscus stirtoni* from Isla de Ometepe and mainland Nicaragua.

in 1998, but less abundant in subsequent years. We captured 10 *P. stirtoni* and 5 *Lionys salvini* using 30 Sherman traps at La Cabuya on the nights of 9 June and 11 June 1998 (60 total trapnights). We kept two adult males, two adult females, and one subadult female *P. stirtoni* as vouchers. On the night of 15 June 2000, we captured one adult male *P. stirtoni* in 30 Sherman traps set at La Cabuya. Specimens from La Cabuya in the ROM include two adult females, one juvenile female, and one juvenile male from 17 February 2000, and an adult female from 23 February 2001.

Reproductive data from the individuals captured on Isla de Ometepe are informative but represent only two short portions of the year. None of the females was gravid but three captured from 17–23 February were lactating, and one of the two females captured on 12 June had enlarged teats suggestive of recent lactation. This last individual had an extensive nematode infestation of the mouth, pharynx, and esophagus. The adult males from June had abdominal testes, measuring 5 × 3, 5 × 3, and 12 × 6 mm. Individuals in paler gray juvenile pelage were captured on 17 February and 10 June.

Initial comparisons of selected cranial variables from specimens we collected in 1998 suggested that individuals from La Cabuya might be larger than those on the mainland, possibly corresponding to the "island rule" of biogeography (Lomolino, 1985). To test this possibility, we used Minitab Release 8 to carry out principal components analysis (PCA) of a correlation matrix of six log-transformed cranial variables (Table 1; Musser et al., 1998) from seven adult *P. stirtoni* from Isla de Ometepe and seven adults from the mainland. These samples represent the total number of adults (as determined by complete adult pelage and

TABLE 2. Factor loadings for PC I and PC II from PCA of six cranial variables from samples of *P. stirtoni* from Isla de Ometepe and mainland Nicaragua. Variables are listed in descending order by their loadings on PC I. Abbreviations of measurements are explained in Table 1.

	Loadings	
Variable	PC I	PC II
ONL	−0.568	0.089
ZB	−0.504	0.248
IB	−0.061	0.667
BZP	−0.466	−0.301
CLM1–3	−0.204	0.464
LIF	−0.401	−0.424
eigenvalue:	2.7113	1.7699
proportion of variation explained:	45.2%	29.5%

fully erupted, worn dentition) currently available from Nicaragua. The resulting plot of specimens on PC I and PC II (Fig. 1) indicates modest separation between the two samples along PC II. This distribution in part reflects the tendency of the island sample to have a broader zygomatic plate, longer maxillary toothrow, and shorter incisive foramen (Table 2). Although these results provide a tantalizing suggestion of morphological divergence, the low sample sizes preclude drawing firm conclusions about the distinctiveness of the two groups. There is little difference in overall size as measured by PCA (PC I in Fig. 1), head-and-body length (Table 1), weight, or cranial variables (e.g., for ONL, Mann-Whitney $U = 33$; $n_1 = n_2 = 7$; $P > 0.10$). In fact, the overall size variation exhibited by the sample from La Cabuya is greater than that exhibited by the mainland sample, which includes mice from three departments of Nicaragua (Fig. 1). The longer relative tail length (Table 2) of the mainland mice is not statistically significant (Mann-Whitney $U = 32.5$; $n_1 = 7$, $n_2 = 6$; $P > 0.05$).

Subfossil remains of Stirton's deer mouse reported from cave sediments further south in Guanacaste Province, Costa Rica (Woodman, 1988), were dated recently at 2855 ± 50 yrs B.P. (NSF-Arizona AMS Laboratory sample number AA35317). These remains were recovered from a region that still lacks a complete survey of its modern mammalian fauna, and it is possible that *P. stirtoni* still occurs there. The above records emphasize the incompleteness of our knowledge of the distribution and status of many small mammals in Nicaragua (and throughout much of Central America) and the continued need for basic biological surveys and for samples adequate to characterize populations of poorly known species.

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Literature Cited

Dickey, D. R. 1928. Five new mammals of the genus *Peromyscus* from El Salvador. Proc. Biol. Soc. Wash. 41:1-6.

Hall, E. R. 1981. Mammals of North America. 2nd ed. John Wiley & Sons, New York, 2: 601–1181.

Huckaby, D. G. 1980. Species limits in the *Peromyscus mexicanus* group (Mammalia: Rodentia: Muroidea). Contrib. Sci. Nat. Hist. Mus. Los Angeles County, 326:1–24.

Jones, J. K., Jr. 1990. *Peromyscus stirtoni*. Mammalian Species 361:1–2.

Jones, J. K., Jr., and T. A. Yates. 1983. Review of the white-footed mice, genus *Peromyscus*, of Nicaragua. Occas. Pap. Mus., Texas Tech Univ. 82:1–15.

Lomolino, M. V. 1985. Body size of mammals on islands: the island rule reexamined. Amer. Nat. 125: 310–316.

Lomolino, M. V. 1993. Winter filtering, immigrant selection and species composition of insular mammals of Lake Huron. Ecography 16:24–30.

Musser, G. G., M. D. Carleton, E. M. Brothers, and A. L. Gardner. 1998. Systematic studies of Oryzomyine rodents (Muridae, Sigmondontinae): diagnoses and distributions of species formerly assigned to *Oryzomys "capito."* Bull. Amer. Mus. Nat. Hist. 236: 1–376.

Peppers, J. A., J. G. Owen, and R. D. Bradley. 1999. The karyotype of *Peromyscus stirtoni* (Rodentia: Muridae). Southwest. Nat. 44:109–112.

Reid, F. A. 1997. A field guide to the mammals of Central America and Southeast Mexico. Oxford University Press, New York, 334 pp.

Woodman, N. 1988. Subfossil remains of *Peromyscus stirtoni* (Mammalia: Rodentia) from Costa Rica. Rev. Biol. Trop. 36:247–253.

Appendix 1: Specimens Examined

Peromyscus stirtoni (18).—NICARAGUA: Boaco: Los Cocos, 220 m, 14 km S Boaco (KU 115570–115572). Managua: 8 km (by road) N Las Maderas, 380 m (KU 106797, 106798). Matagalpa: 11 mi SE Dario (KU 71541, 71542). Rivas: Parque Natural "Peña Inculta de La Cabuya," 50 m, 1 km NNW Santo Domingo, Isla de Ometepe (KU 157735–157739,158892; ROM 112210–112213, 112731).