Z. Säugetierkunde **65** (2000) 369–374

http://www.urbanfischer.de/journals/mammbiol

ZEITSCHRIFT FÜR SÄUGETIERKUNDE
INTERNATIONAL JOURNAL OF MAMMALIAN BIOLOGY

WISSENSCHAFTLICHE KURZMITTEILUNGEN

A new subspecies of Miller's long-tongued bat (*Glossophaga longirostris*) from a semiarid enclave of the Venezuelan Andes

By P. J. Soriano, M. R. Fariñas, and María E. Naranjo

Departamento de Biología, Universidad de Los Andes, Mérida, Venezuela

Receipt of Ms. 22. 11. 1999
Acceptance of Ms. 05. 07. 2000

Key words: *Glossophaga longirostris*, Chiroptera, taxonomy, Andes, Venezuela

Miller's long-tongued bat, *Glossophaga longirostris* Miller, 1898 (Glossophaginae), inhabits the arid and semiarid regions of northern South America and some Caribbean islands (Webster and Handley 1986; Webster et al. 1998). In Venezuela, this bat species shows a continuous pattern of distribution in the coastal region, and it also inhabits the Llanos region in the states of Anzoátegui, Guárico and Apure, and northern portions of Bolívar and Amazonas. In these areas (Fig. 1), three of the six recognized subspecies (*G. l. longirostris* Miller, 1898, *G. l. major* Goodwin, 1958, and *G. l. campestris* Webster and Handley, 1986) were reported (Webster and Handley 1986; Webster et al. 1998).

An isolated population of this species inhabits the semiarid enclave of Lagunillas, located in the middle Chama river basin in the state of Mérida in the Andes of Venezuela (Fig. 1). This was not described by Webster and Handley (1986). The aim of this study was to investigate the status of this population in Venezuela by multivariate analysis techniques.

Material examined: For the analysis, 204 adult specimens of *G. longirostris* were selected, following the age criteria of Anthony (1988). Twenty-two of the specimens came from the Lagunillas, a semiarid enclave in the Venezuelan Andes, and were housed in the Colección de Vertebrados de la Universidad de Los Andes (CVULA). The other 182 specimens, according to the locality from which they were collected, were referred to the subspecies: *G. l. longirostris* (57 specimens), *G. l. major* (61 specimens), and *G. l. campestris* (64 specimens). All the specimens examined were housed in CVULA and the Museo de la Estación Biológica de Rancho Grande (EBRG).

Specimens examined: *Glossophaga longirostris* (Andean population): Estado Mérida (CVULA: I-174, I-387, I-388, I-2 797, I-2 799, I-2 800 to I-2 802, I-2 804, I-2 808, I-2 811, I-2 812, I-2 814, I-2 823, I-2 824, I-2 941, I-3 387, I-3 441, I-3 444, I-3 802, I-3 803, I-4 395). *Glossophaga longirostris campestris*: Estado Amazonas (EBRG: 3 390 to 3 403; 5 817, 5 819, 5 820, 5 815, 5 874, 5 875, 8 242, 8 243, 8 122); Estado Apure (EBRG: 5 750 to 5 754, 5 748, 5 749, 5 755 to 5 763, 5 765 to 5 779, 5 781): Estado Bolívar: (EBRG: 4 271 to 4 273, 17 395, 17 396, 17 413, 5 812, 5 813, 15 859). *Glossophaga longirostris major*: Estado Aragua (EBRG: 1 765, 1 766, 10 311); Estado Cojedes (EBRG: 20 790 to 20 794); Estado Guárico (EBRG: 5 838 to 5 843, 5 845, 5 847 to 5 855, 5 857 to 5 861, 5 836, 5 837, 5 831 to 5 833, 5 834); Estado Nueva Esparta (EBRG: 3 322, 3 323, 3 324 to 3 326, 3 350, 3 357, 5 801 to 5 806, 5 783); Estado Sucre (EBRG: 20 637, 20 638, 20 640, 20 641, 20 643, 5 797, 5 799, 5 800, 20 639); Estado Yaracuy (EBRG: 5 745 to 5 747). *Glossophaga longirostris longiros-*

0044-3468/00/65/06 – 369 $ 15.00/0

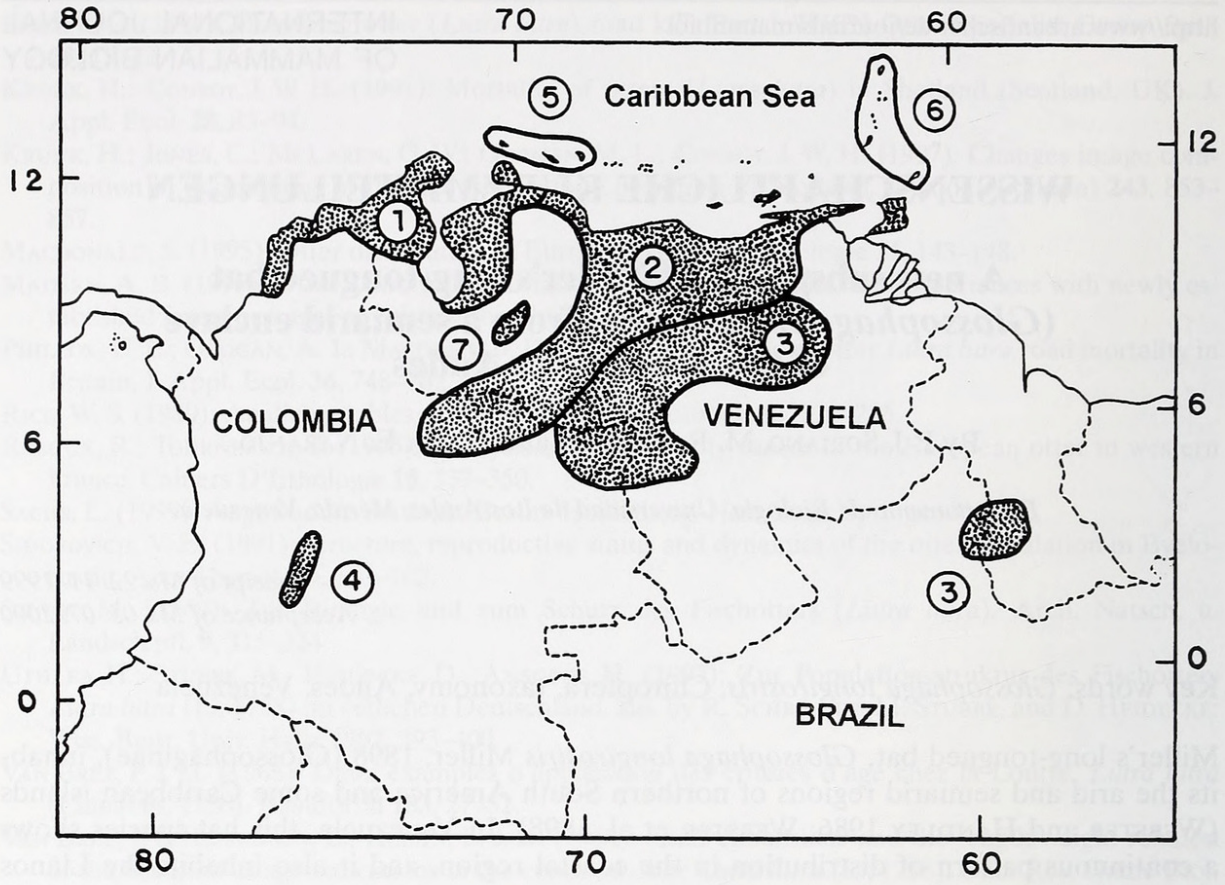

Fig. 1. Geographic distribution of the six previously accepted subspecies of *Glossophaga longirostris* and the isolated Andean population: (1) *G. l. longirostris*, (2) *G. l. major*, (3) *G. l. campestris*, (4) *G. l. reclusa*, (5) *G. l. elongata*, (6) *G. l. rostrata*, and (7) Andean isolated population. (modified from WEBSTER and HANDLEY 1986 and WEBSTER et al. 1998).

tris: Estado Falcón (EBRG: 15 979, 15 983, 20 620, 20 622 to 20 624, 20 625, 20 626, 20 627, 20 628, 2 107 to 2 111, 2 845, 2 846, 2 848, 3 700, 3 701, 5 977, 5 779 to 5 985, 5 993 to 5 997, 6 000 to 6 002, 6 006 to 6 013, 6 045, 6 046, 6 048, 6 050, 6 051). Estado Zulia: (EBRG: 5 975, 5 976, 5 988, 5 989, 5 992, 5 990, 5 991). Measurements: For each selected specimen we took the following eight cranial measurements (in mm): greatest length of skull, including incisors (GLS); postorbital width (POW); mastoid width (MW); breadth of braincase (BB); depth of braincase (DB); maxillary tooth row (MAX); width across upper canines (C1-C1); and width across upper second molars (M2-M2). All cranial measurements were taken with a Mitutoyo digital caliper, with an accuracy of 0.05 mm; with the exception of MAX which was taken by a graduated scale on the ocular lens of a stereoscopic microscope (Leica model Wild M8), with an accuracy of 0.05 mm.

Data treatments: Using the program NTSYS-PC (ROHLF 1993), we carried out a principal component analysis on the eight cranial measurements, based on a correlation matrix from logarithmically transformed data, with the aim to assure the homogeneity of variances (SOKAL and ROHLF 1981). This allowed us to determine the principal components and correlation diagrams between the morphometric variables and the principal components. The means of the variables of the four populations were compared by ANOVA. Likewise, we carried out a discriminant analysis, using the program STATISTICA (STAT SOFT INC. 1991), to determine which of the variables allow to discriminate among the four populations.

The analysis of principal components shows an intergradation among the specimens of the Venezuelan populations (Fig. 2); the Andean specimens (a) are located at the lower

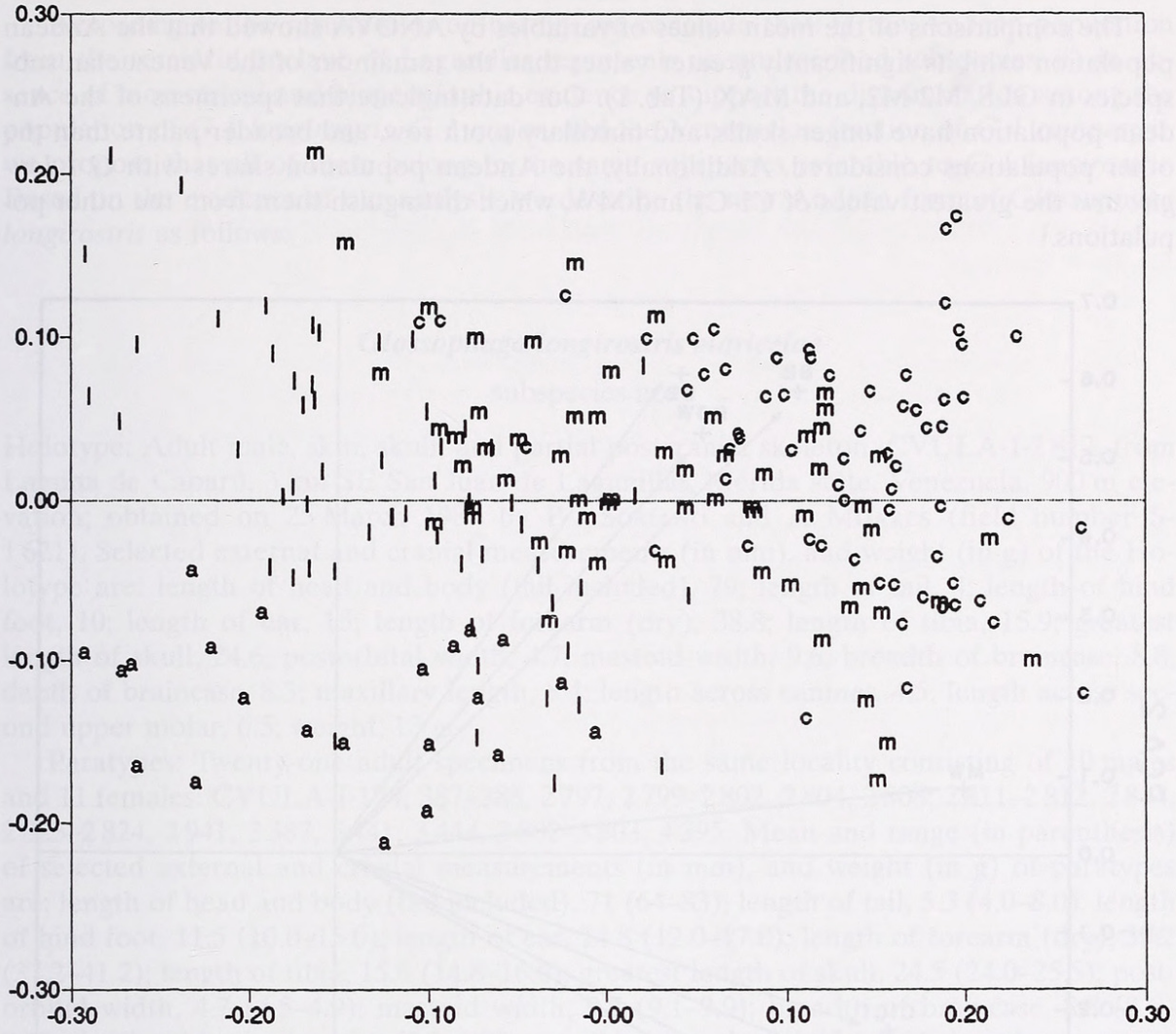

Fig. 2. Disposition diagram of the specimens used in the first plane of the principal components analysis. Each specimen of the Andean population and the previously accepted subspecies are abbreviated as follow: a = Andean population, c = *G. l. campestris*, l = *G. l. longirostris*, m = *G. l. major*.

left extreme of this figure. The correlation diagram of the morphometric variables and the two first principal components (Fig. 3), showed an increase from right to left in all the variables. This result agrees with what LEBART et al. (1979) called a size effect, and indicates that the largest specimens are placed at the left of the plane. In addition, two groups of variables can be observed: the first, conformed by the measurements related with the cranial length (GLS and MAX) and the measurements related with palate width (C1-C1 and M2-M2). The second group is typified by the measurements related with braincase volume (BB, POW and DB).

The small values showed by the angles between each vector pair inside each group in figure 3 indicate a high correlation between these variables. Likewise, we can infer independence between the two described groups by the magnitude of the angle between both (close 90°). On the other hand, the mastoid width (MW) was strongly correlated only with the first principal component, but weakly correlated with the groups described before, which indicates that this variable increases to the same proportion for the specimens of all populations studied. In other words, separation between specimens of the Andean population from those of the remaining Venezuelan subspecies (Fig. 2) is generated simultaneously by the two groups of variables previously described.

The comparisons of the mean values of variables by ANOVA showed that the Andean population exhibits significantly greater values than the remainder of the Venezuelan subspecies in GLS, M2-M2, and MAX (Tab. 1). Our data indicate that specimens of the Andean population have longer skulls, and maxillary tooth row, and broader palate than the other populations considered. Additionally, the Andean population shares with *G. l. longirostris* the greatest values of C1-C1 and MW, which distinguish them from the other populations.

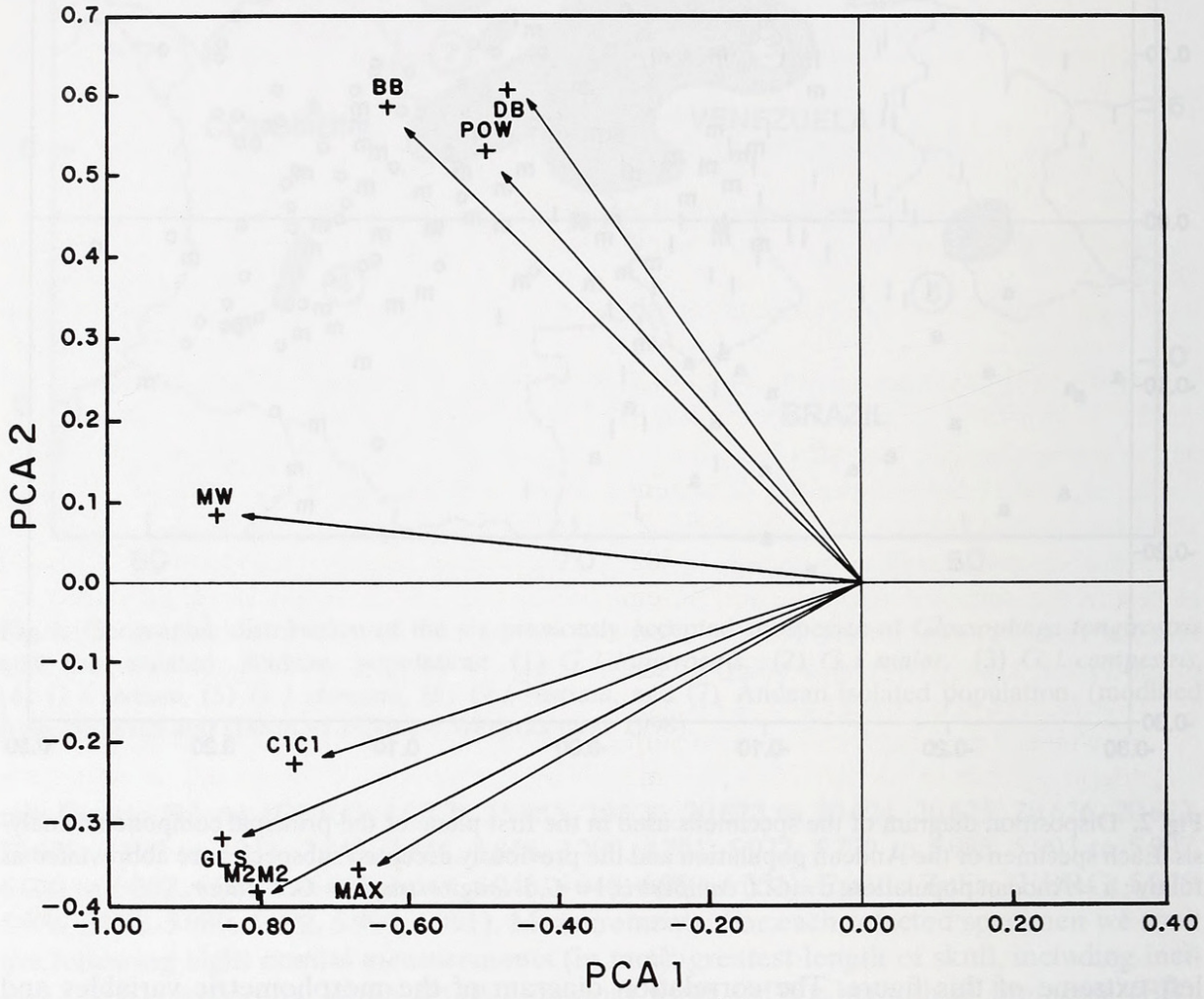

Fig. 3. Correlation diagram between the morphometric variables and the two first pnncipal components. Correlation of all the variables with the principal components were highly significant ($p > 0.005$).

Table 1. Comparison of the characters used in the study among the Andean population and the previously accepted subspecies of *Glossophaga longirostris*. Parentheses show the standard error. Values that have no letter in common are significantly different (ANOVA, $p < 0.05$).

Character	Andean Population	*G. l. longirostris*	*G. l. major*	*G. l. campestris*
GLS	24.6 (0.07) a	23.8 (0.06) b	23.0 (0.05) c	22.4 (0.05) d
POW	4.7 (0.02) a	4.8 (0.02) b	4.7 (0.02) a	4.6 (0.02) a
MW	9.5 (0.04) a	9.6 (0.03) a	9.4 (0.03) b	9.2 (0.02) c
BB	8.8 (0.03) a	9.1 (0.03) b	8.9 (0.03) a	8.8 (0.02) a
DB	8.6 (0.04) a	8.6 (0.03) a	8.5 (0.03) a	8.5 (0.02) a
MAX	8.4 (0.09) a	8.1 (0.04) b	7.9 (0.03) c	7.7 (0.03) d
C1-C1	4.5 (0.04) a	4.5 (0.02) a	4.2 (0.02) b	4.1 (0.02) c
M2-M2	6.4 (0.04) a	6.1 (0.02) b	5.8 (0.02) c	5.7 (0.02) d

According to the results showed herein, we conclude that: i) the Andean population from the semiarid enclave of Lagunillas represents an undescribed subspecies, ii) in absence of biometrical and biogeographic evidence to support the discrimination among the population of *G. l. longirostris*, *G. l. major*, and the Venezuelan fraction of *G. l. campestris*, we propose that all of them belong to the same subspecies referable to *G. l. longirostris*. Based on the evidence of our analysis, we describe the new Andean form of *Glossophaga longirostris* as follows:

Glossophaga longirostris maricelae

subspecies nov.

Holotype: Adult male, skin, skull, and partial postcranial skeleton, CVULA-I-2 812, from Laguna de Caparú, 3 km SE San Juan de Lagunillas, Mérida state, Venezuela, 900 m elevation; obtained on 25 March 1987 by P. J. Soriano and A. Mijares (field number S-1 621). Selected external and cranial measurements (in mm), and weight (in g) of the Holotype are: length of head and body (tail included), 79; length of tail, 4; length of hind foot, 10; length of ear, 15; length of forearm (dry), 38.8; length of tibia, 15.9; greatest length of skull, 24.6; postorbital width, 4.7; mastoid width, 9.6; breadth of braincase, 8.8; depth of braincase, 8.5; maxillary length, 8.4; length across canines, 4.5; length across second upper molar, 6.5; weight, 13 g.

Paratypes: Twenty-one adult specimens from the same locality consisting of 10 males and 11 females: CVULA-I-174, 387–388, 2 797, 2 799–2 802, 2 804, 2 808, 2 811–2 812, 2 814, 2 823–2 824, 2 941, 3 387, 3 441, 3 444, 3 802–3 803, 4 395. Mean and range (in parenthesis) of selected external and cranial measurements (in mm), and weight (in g) of paratypes are: length of head and body (tail included), 71 (64–83); length of tail, 5.3 (4.0–8.0); length of hind foot, 11.5 (10.0–15.0); length of ear, 14.8 (12.0–17.0); length of forearm (dry), 39.2 (37.2–41.2); length of tibia, 15.6 (14.8–16.6); greatest length of skull, 24.5 (24.0–25.5); postorbital width, 4.7 (4.5–4.9); mastoid width, 9.5 (9.1–9.9); breadth of braincase, 8.8 (8.6–9.1); depth of braincase, 8.6 (8.2–8.9); maxillary length, 8.4 (7.4–9.8); length across canines, 4.5 (4.1–4.9); length across second upper molar, 6.4 (6.0–6.7); weight, 13.7 (11.0–17.5).

Diagnosis: This new subspecies is characterized by having the longest and widest rostrum known for the species, as is indicated by its greater values for GLS, MAX, and M2-M2. Likewise, it has a lower value for BB among the Venezuelan populations.

Comparisons: *G. l. maricelae* is distinguished from the other Venezuelan subspecies by having longer skull and maxillary tooth row, broader palate, and less voluminous braincase.

Distribution: This subspecies is endemic of the semiarid enclave located in the middle basin of the Chama river and the Nuestra Señora river basin, Venezuela, between Estanques village at 500 m above sea level and El Morro village at 2 000 m, showing the highest elevational range and altitudinal record known for the species.

Habitat and ecology: This isolated population inhabits the thorn shrub area known as Lagunillas pocket, and is the main pollinator and seed disperser of the columnar cacti *Stenocereus griseus*, *Subpilocereus repandus*, and *Pilosocereus tillianus* (Soriano et al. 1991; Sosa and Soriano 1996). This population shows a bimodally polyestrous reproductive pattern with two extended reproductive peaks throughout the year (Sosa and Soriano 1996).

Etymology: We wish to dedicate the name of this subspecies in honor to the late Maricela Sosa, who studied the feeding and reproductive ecology of this population. The subspecific name is a matronym in the genitive case, singular and of feminine gender.

Acknowledgements

We thank F. Bisbal, curator of mammals at the Rancho Grande Biological Station Museum (Museo de la Estación Biológica de Rancho Grande, EBRG) in Maracay, who lent us the material of *G. longirostris* under his care. Partial financial support was received from Consejo de Desarrollo Científico, Humanístico y Tecnológico de la Universidad de Los Andes (CDCHT-ULA, Grant C-872-97-01-A), and Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT, Grant RP-VII-240056). E. La Marca, C. Rengifo, and an anonymous referee helped with the correction of an early version of this study.

References

Anthony, E. L. P. (1988): Age determination in bats. In: Ecological and behavioral methods for the study of bats. Ed. by T. H. Kunz. Washington, D C.: Smithsonian Institution Press. Pp. 47–58.

Lebart, L.; Morineau, A.; Fenelon, J.-P. (1979): Traitement des donnés statistiques. Paris: Dunod.

Rohlf, F. J. (1993): NTSYS-PC, Numerical Taxonomy and Multivariate Analysis System. New York: Applies Biostatistics Inc. N.Y.

Sokal, R. R.; Rohlf, F. J. (1981): Biometry. San Francisco: W. H. Freeman and Company.

Soriano, P. J.; Sosa, M.; Rossell, O. (1991): Hábitos alimentarios de *Glossophaga longirostris* Miller (Chiroptera: Phyllostomidae) en una zona árida de los Andes venezolanos. Rev. Biol. Trop. **39**, 267–272.

Sosa, M.; Soriano, P. J. (1996): Resources availability, diet and reproductive pattern of *Glossophaga longirostris* (Mammalia: Chiroptera) in an arid zone of the Venezuelan Andes. J. Trop. Ecol. **12**, 805–818.

Stat Soft Inc. (1991): Statistica: Tulsa: Complete Statistical System.

Webster, W. D.; Handley, C. O. Jr. (1986): Systematics of Miller's long-tongued bat, *Glossophaga longirostris*, with description of two new subspecies. Occas. Pap., The Museum, Texas Tech Univ. **100**, 1–22.

Webster, W. D.; Handley, C. O. Jr.; Soriano, P. J. (1998): *Glossophaga longirostris.* Mamm. Spec. **576**, 1–5.

Authors' address: Pascual J. Soriano, Mario R. Fariñas, and Maria E. Naranjo, Departamento de Biología, Facultad de Ciencias, Universidad de Los Andes, Mérida 5101, Venezuela.