

THE FIRST FOSSIL RECORD OF *AMPHISBAENA HETEROZONATA* FROM THE LATE PLEISTOCENE OF BUENOS AIRES PROVINCE, ARGENTINA

CARLOS AGUSTÍN SCANFERLA^{1,3}, RICARDO MONTERO² AND FEDERICO L. AGNOLIN¹

¹ Laboratorio de Anatomía Comparada y Evolución de los Vertebrados. Museo Argentino de Ciencias Naturales "Bernardino Rivadavia". Av. Angel Gallardo 470 (1405) Capital Federal, Argentina. E-mail: agustin_scanferla@yahoo.com.ar

² Instituto de Herpetología. Fundación Miguel Lillo-Conicet y Universidad Nacional de Tucumán. Miguel Lillo 251 (400), San Miguel de Tucumán, Argentina. E-mail: ueso@unt.edu.ar

³ Corresponding author.

ABSTRACT: We report the first fossil record of the living amphisbaenian *Amphisbaena heterozonata*, from the Late Pleistocene of Buenos Aires province, Argentina. The specimen consists of a nearly complete skeleton, including cranium, coming from the Late Pleistocene Luján Formation, at the Altos Verdes Lake, Buenos Aires province, Argentina. The specimen is referred to *Amphisbaena heterozonata* on the basis of several cranial and postcranial morphological features, including an enlarged second maxillary tooth. This specimen constitutes the first fossil record of a living species of the family Amphisbaenidae in South America, and also the first fossil record for *Amphisbaena heterozonata*.

KEY WORDS: *Amphisbaena heterozonata*, Late Pleistocene, Buenos Aires, Argentina

INTRODUCTION

Amphisbaenids are a group of limbless burrowing lizards distributed worldwide. These peculiar squamates are poorly represented in the fossil record (see Kearney, 2003). Particularly, in South America this record is also scarce and biased (Báez and Gasparini, 1979; Albino, 1996). Therefore, the presence of amphisbaenians in the Pleistocene of South America is restricted to a few records in Brazil, Argentina and Bolivia (de la Fuente, 1999; Gans and Montero, 1998; Hoffstetter, 1968). Among South American fossil amphisbaenids, the genus *Amphisbaena* is represented by few extinct species. These include the species *A. marelli* (Torres and Montero, 1998) from the Ensenadan age (Lower-Mid Pleistocene) of Buenos Aires (Argentina) and two extinct taxa that were found in Late Pleistocene deposits from Lagoa Santa, Brasil (i.e. *A. braenstruppi*, *A. laurenti*; Gans and Montero, 1998). However, up to now no extant species of amphisbaenids were documented in the fossil record of South America.

During a field trip to the Río Salado Basin (Buenos Aires Province, Argentina) an exquisitely preserved specimen of *Amphisbaena* was found together with extinct mammals in Late Pleistocene sediments. The aim of the present paper is to describe this new material.

MATERIAL AND METHODS

The specimen was found articulated and nearly complete. This material was compared with skeletons of most South American genera and most living Argentinian species (*Amphisbaena angustifrons*, *A. bolivica*, *A. heterozonata*, *Anops kingi*, *Cercolophia borelli*, and *Leposternon microcephalum*).

The anatomical terminology follows Hoffstetter and Gasc (1968), Montero and Gans (1999), and Gans and Montero (2006).

RESULTS

Geology

The specimen was found in the Lake Altos Verdes, located approximately 20 km to the west of the city of Castelli, Buenos Aires province, Argentina (Fig. 1).

The regional geology of this area was described by Fidalgo *et al.* (1973). The best exposed profile is located at the north of the lake, composed of three well defined sections. The lower section is two meters wide (the base of the succession could not be observed). It is composed of indurated red clay compact sediments correlated to the La Chumbiada Member of the Luján Formation (Upper Pleistocene). At the top of this level, an erosive unconformity is present and separates it from

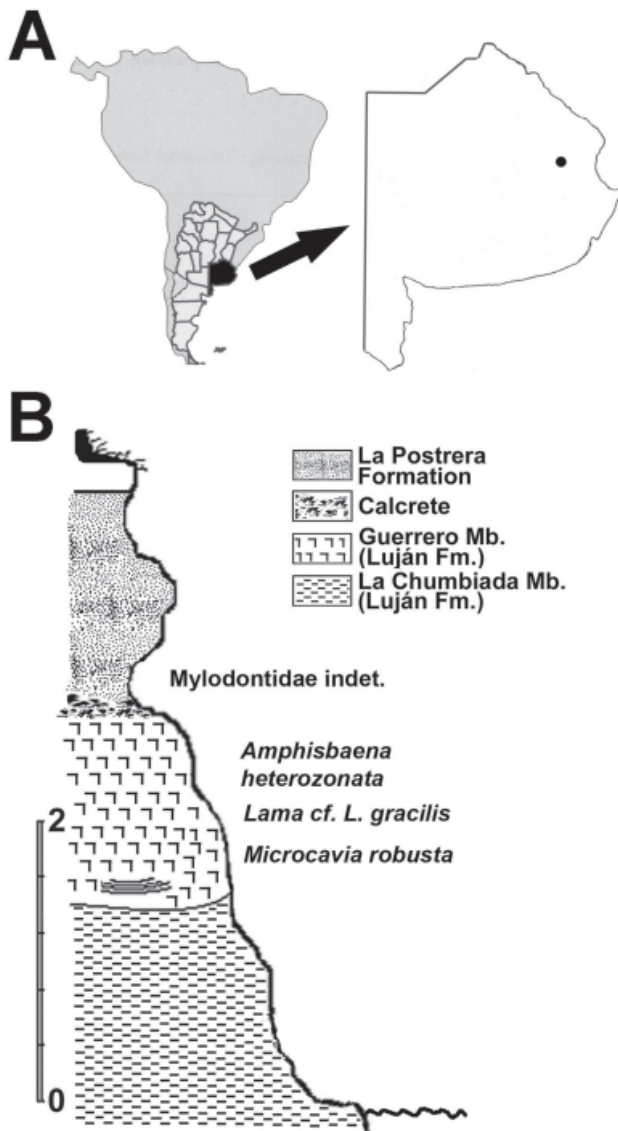


Figure 1: A, Location of Altos Verdes Lake, East of Buenos Aires Province, Argentina; B, Profile of the exposed sediments in the Altos Verdes Lake (North cliffs).

the mid-section. The latter is composed of a greenish sandy clay overlaid by a thin (40 cm thick) calcrete horizon. This section represents the Guerrero Member of the Luján Formation. The *Amphisbaena* specimen here described was found in this section, along with a fragmentary mandible of the extinct camelid *Lama cf. L. gracilis* (of small size and with well developed and anteroposteriorly compressed hammers in the anterior margin of molariforms; Menegaz, 2000) and isolated molars (M³) referable to the extinct caviomorph rodent *Microcavia robusta* (of large size, and with anteroposteriorly bulged prisms; Quintana, 1996). The upper section is consists of reddish-yellow silt, corresponding to

the eolian La Postrera Formation. The base of this Formation yielded dermal ossicles of an undetermined fossil ground sloth of the family Mylodontidae.

Fidalgo *et al.* (1973) assigned this fossiliferous succession to the Late Pleistocene. This age is corroborated herein by the presence of *Lama cf. L. gracilis*, *Microcavia robusta*, and Mylodontidae indet. All these taxa became extinct at the end of the Pleistocene (Cione and Tonni, 2005).

SYSTEMATIC PALEONTOLOGY

Squamata Oppel, 1811

Amphisbaenia Gray, 1844

Family Amphisbaenidae Bonaparte, 1831

Genus *Amphisbaena* Wagler, 1824

Amphisbaena heterozonata Burmeister, 1861

Referred material – MLP (Museo de Ciencias Naturales de La Plata, Buenos Aires, Argentina) 04-IX-1-1, nearly complete skull, axis, 16 anterior trunk vertebrae with articulated ribs, and 2 posterior trunk vertebrae (Figs. 2, 3).

Description

Skull – The fossil skull is separated in two fragments, one formed by the braincase and the other by the snout, part of the palate, and mandibles. Disarticulation of the skull in two main parts may be due to natural decomposition that happened prior to fossilization, as there is no evidence of fractures on the bones. However, some bones are only partially disarticulated or broken and spaces are filled with sediment. The strong development of the sagittal crest and the ascendant process of the occipital complex indicate that the specimen is an adult which may have reached its maximum size. If both disarticulated parts of the skull are placed in their original position, the length of the skull (from the tip of the snout to the posterior border of the occipital condyle) is approximately 12.8 mm. Therefore, its maximum length does not correspond to any of the largest Argentinean species, such as *Amphisbaena bolivica* (that has skull length up to 20 mm) or *A. angustifrons* (which has skull length up to 16 mm). Moreover, the snout of the fossil specimen lacks the acuminate shape or the sculptured nasal surfaces which characterize the adults of the latter two species.

The posterior part of the skull is formed by the occipital complex, parietal, frontal, parabasisphenoid, and tabulosphenoid. The quadrates and the prefrontals are

missing. The otic capsules of the occipital complex are broken, and the inner cavities are exposed. The strong occipital condyle is bilobed, whereas in *Leposternon*

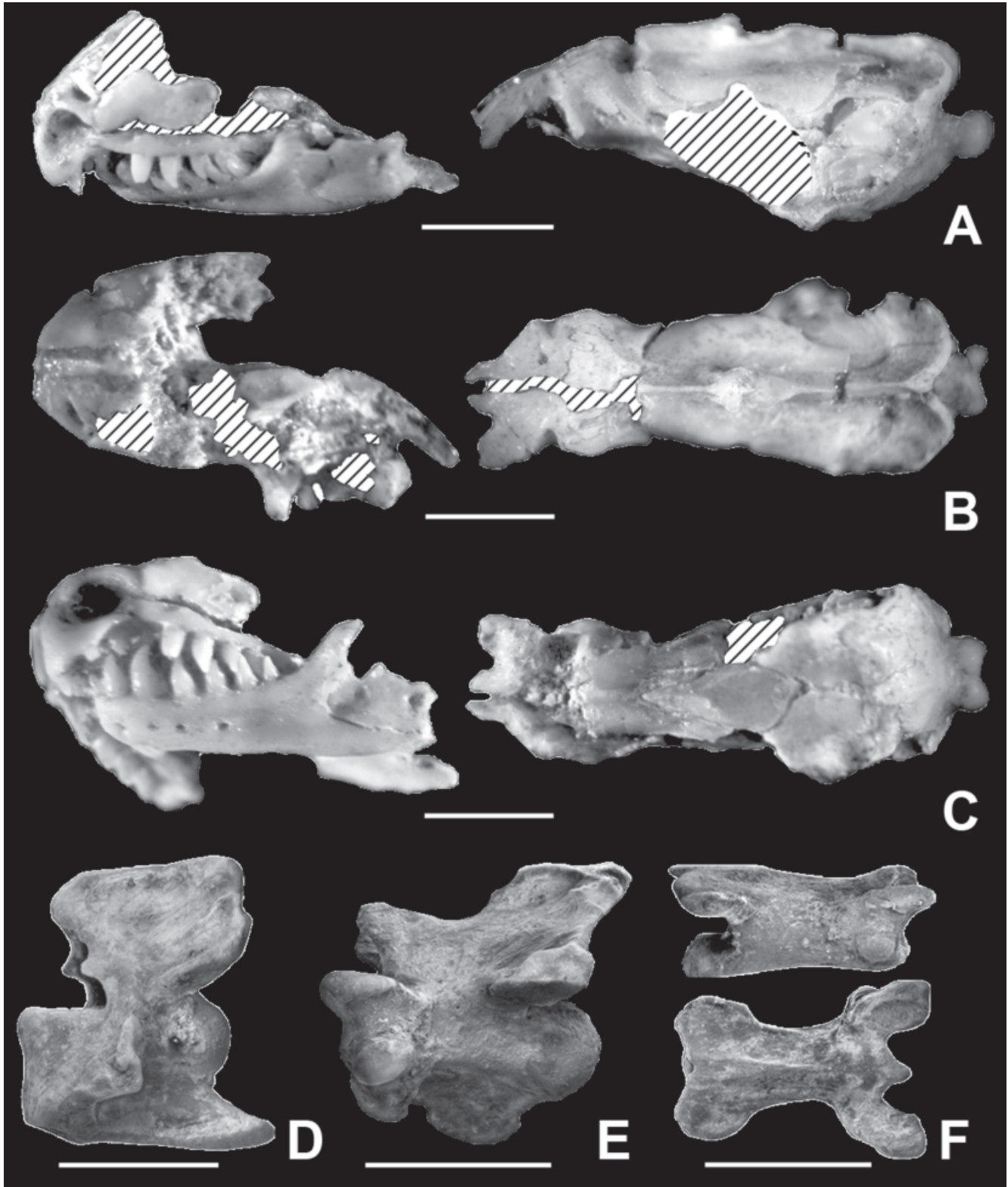


Figure 2: *Amphisbaena heterozonata* (MLP 04-IX-1-1). A, skull in lateral view; B, skull in dorsal view; C, skull in ventral view; D, axis; E, anterior trunk vertebra; F, posterior trunk vertebra. Scale bar 2 mm.

it is “U”-shaped (Kearney, 2003). The dorsal ascendant process of the occipital is well marked and prominent; the occipital crest flares posteriorly, dorsal to the foramen magnum. Ventrally, the elements-X are fused to the occipital complex, the presumptive area of those bones are bulged and well marked. The posterior processes of the parietal are broken, leaving most of the occipital complex dorsally exposed; the sagittal dorsal crest of the parietal is strongly marked, from the parietal medial notch to the anterior border of the parietal. In the middle of the sagittal crest a wide and well-marked knob (dorsal facet of sagittal crest) is projected posterodorsally. The anterior part of the parietal is broken just posterior to the interdigitated suture with the frontal; there are two anterior “fingers” that interdigitate with each frontal, a diagnostic feature of the family Amphisbaenidae. The medial suture between the paired frontals is slightly wavy and is secondarily widened. The dorsal exposure of the frontals is smooth, without a sculptured surface. The anterior border of the left frontal, that seems to be more complete, shows a deep indentation for the articulation with the nasal. Laterally, each frontal has a well-developed lateral process that contacts ventrally the tabulosphenoid; anterior to the lateral process there is the groove for the missing prefrontal. Ventrally, the parabasisphenoid seems to be fused with the ventral plate of the occipital complex, although there is a secondary fracture between them. The anterior rostrum of the parabasisphenoid overlaps the tabulosphenoid ventrally. The tabulosphenoid is wide and flat and shows two well-marked optic foraminae.

The anterior part of the skull is formed mainly by the nasals, maxillae, premaxilla, the articulated left mandible, and some fragments of the ectopterygoid, palatine, vomer and pterygoid. The septomaxillae, were not identified. The left nasal has a strong posterior process that articulates with the frontal. The anterior borders of the nasals are strongly bent ventrally and cover the nares that are directed ventrally. The dorsal process of the premaxilla projects between the nasals. The ventral plate of the premaxilla is strongly angled ventrally in relation to the maxilla; it bears five teeth, the medial one being the largest. The maxilla bears five teeth, of which the second is enlarged.

The articulated left mandible is broken posteriorly and the articular portion of the compound bone of the mandible is missing. There is a strong coronoid process formed only by the coronoid bone. The dentary is complete and bears seven teeth, of which the third is

the largest. On the labial face there are four mental foraminae.

Postcranial material – The present comparison is made mainly at the generic level since interspecific vertebral identification in the genus *Amphisbaena* is not warranted due to the lack of information on such osteological complex.

The axis shows a well developed and posteroventrally oriented hypapophysis, a feature common to several species of *Amphisbaena*. Distally, the hypapophysis is spoon-shaped, and is transversely expanded, as also occurs in *Amphisbaena*. In *Anops* the acute hypapophysis is caudally directed. In 04-IX-1-1 the hypapophysis is connected to the pleurocentre 1, as in *A. angustifrons* and *A. heterozonata*, whereas in *A. bolivica* both structures are separated by a notch. Trunk vertebrae show smooth posterior margins, in contrast with the denticulate margin present in rhineurids and *Leposternon* (Kearney, 2003). Anterior trunk vertebrae exhibit low and poorly defined neural spines, whereas in *Anops* these structures are well developed and dorsoventrally extended. Trunk vertebrae are indistinguishable from other species of *Amphisbaena*, although they are smaller than in *A. bolivica*.

Ribs lack the proximal anteroventral process present in most rhineurids (Kearney, 2003), and exhibit well developed posterodorsal processes, as in most amphisbaenians.

DISCUSSION

The general morphology of the skull and the presence of an azygous and large tabulosphenoid define the specimen 04-IX-1-1 as an amphisbaenid (see Montero and Gans, 1999). The fossil clearly belongs to *Amphisbaena* (although this is probably a paraphyletic genus, not defined by exclusive synapomorphies), as it has a round snout (with no horizontal nor lateral compression). The vertebrae of the fossil specimen also retain several features common to most species of the genus *Amphisbaena*, such as: 1) axis hypapophysis distally spoon-shaped, transversely expanded and caudoventrally oriented, and 2) anterior trunk vertebrae with neural spines poorly developed. The large size of the specimen and its geographical provenance suggests that it should be closely related or belongs to the largest Argentinian species of *Amphisbaena* (*Am-*

phisbaena heterozonata, *A. bolivica*, and *A. angustifrons*; Montero, 1996), with which comparisons were made. The large second maxillary tooth and the general skull characteristics of the fossil are features shared (although not exclusively) with *Amphisbaena heterozonata*. Therefore, we conclude that the fossil specimen belongs to *Amphisbaena heterozonata*.

The specimen here reported constitutes the first fossil record of a living species of the family Amphisbaenidae in South America, and also the first fossil record for *Amphisbaena heterozonata*. Presently, *A. heterozonata* is distributed in Argentina throughout the territory north of the Río Negro province, and presents a wide range of environmental and geographic conditions (Montero, 1996). The present fossil record is within the current range of geographic distribution, and does not add any new data about chorological changes nor paleoambiental conditions during the Late Pleistocene. However, the material here reported is relevant because, to this day, only isolated and mostly undetermined fossil amphisbaenian specimens are known for South America.

RESUMEN

Aquí nosotros reportamos el primer registro fósil de la especie viviente *Amphisbaena heterozonata*, proveniente del Pleistoceno Superior de la provincia de Buenos Aires, Argentina. El espécimen consiste en un esqueleto incompleto, el cual incluye el cráneo, procedente del Pleistoceno Tardío de la Formación Luján, en la Laguna Altos Verdes, provincia de Buenos Aires, Argentina. El espécimen es asignado a *Amphisbaena heterozonata* sobre la base de numerosos caracteres, incluyendo el segundo diente maxilar de gran tamaño. Este constituye el primer registro fósil de una especie de la familia Amphisbaenidae, y el primer registro fósil de *Amphisbaena heterozonata*.

ACKNOWLEDGMENTS

We wish to thank Marcelo Reguero for allowing us to study the material housed at the Museo de La Plata. We also want to thank Lucas Pomi for critically reading the manuscript and Eduardo Belloso for geological support.

LITERATURE CITED

- ALBINO, A.M. 1996. The South America fossil Squamata (Reptilia: Lepidosauria); pp 185-202. In: G. Arratia (Ed.), Contribution of South America to Vertebrate Paleontology. Müncher Geowissenschaften Abhandlungen (A), 30. München, Germany. Verlag Dr. Friedrich Pfeil.
- BÁEZ, A. AND Z. GASPARI. 1979. The South American herpetofauna: An evaluation of the fossil record; pp. 29-54. In: W.E Duellman (Ed.), The South American herpetofauna: its origin, evolution and dispersal. Monograph 7(2). Museum of Natural History (University of Kansas), Kansas.
- CIONE, A.L. AND E.P. TONNI. 2005. Bioestratigrafía basada en mamíferos del Cenozoico Superior de la provincia de Buenos Aires, Argentina. In: RE de Barrio, RO Etcheverry, MF Caballé and EL Lambías (eds.): Geología y recursos minerales de la provincia de Buenos Aires, Relatorio del XVI Congreso Geológico Argentino, La Plata, Capítulo XI:183-200.
- DE LA FUENTE, M. 1999. A review of the Pleistocene reptiles of Argentina: Taxonomic and palaeoenvironmental considerations. Quaternary of South America and Antarctic Peninsula, 12:109-136.
- FIDALGO, F., O. DE FRANCESCO AND U. COLADO. 1973. Geología superficial de las hojas Castelli, J.M. Cobo y Monasterio (Pcia. de Buenos Aires). V Congreso Argentino Geológico Argentino Resúmenes 4:27-39.
- GANS, C. AND R. MONTERO. 2006 (*in press*). An atlas of amphisbaenian skull anatomy. In: Adler K (ed.) Biology of Reptilia, Vol. 20. Society for the Study of Amphibians and Reptiles.
- GANS, C. AND R. MONTERO. 1998. Two new fossil amphisbaenids (Reptilia: Squamata) from the Pleistocene of Lagoa Santa (Minas Gerais, Brasil). Steenstrupia, 24(1):9-22.
- HOFFSTETTER, R. AND J-P. GASC. 1968. Vertebrae and Ribs of Modern Reptiles; pp. 258-490. In: C. Gans and T. Parsons (Eds.), Biology of the Reptilia 4. Academic Press, New York.
- HOFFSTETTER, R. 1968. Ñuapua, un gisement de vertébrés pleistocenes dans le chaco Bolivien. Bulletin du Muséum National d'Histoire Naturelle, serie 2, 40(4):823-836.
- KEARNEY, M. 2003. Systematics of the Amphisbaenia (Lepidosauria: Squamata) based on morphological evidence from recent and fossil forms. Herpetological Monographs, 17:1-74.
- MENEGAZ, A.N. 2000. Los camélidos y cérvidos del Cuaternario del sector Bonaerense de la Región Pampeana. Doctoral Thesis, Universidad Nacional de La Plata. 1-146.
- MONTERO, R. 1996. Lista de localidades de Amphisbaenia de la República Argentina. Cuadernos de Herpetología, 10(1-2):25-45.
- MONTERO, R. AND C. GANS. 1999. The head skeleton of *Amphisbaena alba* (Linnaeus). Annals of the Carnegie Museum, 68(1):15-80.
- QUINTANA, C.A. 1996. Diversidad del roedor *Microcavia* (Caviomorpha, caviidae) de América del sur. Mastozoología Neotropical 3(1):63-86.
- TORRES, S. AND R. MONTERO. 1998. *Leiosaurus marellii* Rusconi 1937 is a South American Amphisbaenid. Journal of Herpetology, 32(4):602-604.

Submitted 07 July 2006
Accepted 10 August 2006