INTRODUCTION
The Brazilian late Pleistocene record of snakes has been documented in the southeast and northeast regions, with several taxa correlated to the current Brazilian snake fauna, and mostly represented by the families Boidae, ‘Colubridae’, Viperidae, and Elapidae (Camolez & Zaher, 2010; Hsiou & Albino, 2009, 2010; Hsiou et al., 2012). Among the fossil remains, several specimens are attributed to the well-supported Neotropical boid clade (Burbrink, 2005; Noonan & Chippindale, 2006), represented by four extant South American genera: Epicrates Wagler, 1830, Corallus Daudin, 1803, Boa Linnaeus, 1758, and Eunectes Wagler, 1830 (see Camolez & Zaher, 2010; Hsiou et al., 2012). However, there is only a single record of snake for the late Pleistocene of the Brazilian Northern region, a viperid from southwestern Brazilian Amazonia (Hsiou & Albino, 2011).

In the present work we report the first record of Eunectes for Tocantins, northern Brazil. This large specimen is attributed to E. murinus Linnaeus, 1758, and provides improved insight into late Pleistocene paleoecology for the region.
LOCATION AND GEOLOGICAL SETTING

The material comes from a limestone cave, the Gruta do Urso, (12°35’0.08”S, 46°30’58.39”W) in the municipality of Aurora do Tocantins, State of Tocantins, Brazil (Figure 1A). The specimen was found in a thick sediment level that fills the corridor of the cave (Figure 1B). The age of the deposit is inferred based on representative taxa, such as Propraopus grandis Ameghino, 1881. Both of these taxa were found at the same level as the anaconda specimen, and also have the same color and preservation. Therefore, the deposit is interpreted to be of late Pleistocene age. The other taxa found are living species recorded during the Pleistocene as well; therefore, not suitable for determining a more specific age (e.g. Panthera onca Linnaeus, 1758).

The limestone of the Aurora do Tocantins region is part of the Speleological Province of the Bambuí Group, where the largest number of caves in Brazil has been found (Zampaulo & Ferreira, 2009). However, the area is still lacking geological studies. Online notes of CPRM (Companhia de Pesquisa de Recursos Minerais) about the geology of the municipality of Aurora de Tocantins report carbonate deposits of the Bambuí Group, which is Neoproterozoic in age (CPRM, 2006). The lower portion is represented by the Sete Lagoas Formation, which is composed of thick deposits of pelites, limestone and dolomites bearing stromatolites. The Sete Lagoas Formation is covered by siltstone and laminated siltstones of the Serra de Santa Helena Formation. These carbonate rocks are superimposed by dark calcarenites and marls, with organic material from the Lagoa do Jacaré Formation. Superimposed on the Bambuí Group are Cretaceous sediments of the Urucuia Formation. The fossil bearing level is composed of laminated reddish-grey (5YR5/2) loess-like sediment.

MATERIAL AND METHODS

The vertebra is partially covered by a concretion of calcium carbonate and due to the fragility of the specimen, it was not possible to prepare it more appropriately. It is housed at the UNIRIO (Rio de Janeiro, State of Rio de Janeiro, Brazil) fossil vertebrate collection. It comprises an almost complete mid-trunk vertebra (UNIRIO-NM 0001). Data were obtained on extant boid skeletons to compare and analyze the material (see Appendix). Osteological nomenclature and measurements follow Auffenberg (1963), Rage (1984), LaDuke (1991a,b), and Lee & Scanlon (2002). The description is based on the previous studies of Hsiou & Albino (2009, 2010). Systematic arrangement is based on Noonan & Chippindale (2006). Measurements are expressed in millimeters.

Vertebral measurements. *cl*, centrum length; *coh*, condyle height; *cow*, condyle width; *cth*, cotyle height; *ctw*, cotyle width; *naw*, neural arch width at interzygapophyseal ridge; *pr-pr*, distance between prezygapophyses; *pr-po*, distance between pre-and postzygapophyses of the same side; *prl*, prezygapophysis length; *prw*, prezygapophysis width; *zh*, zygosphene height; *zw*, zygosphene width.

Institutional abbreviations. *IB*, Instituto Butantan, São Paulo; *MCN.D*, Didactic Collection of Herpetology,

SYSTEMATIC DESCRIPTION

Suborder SERPENTES Linnaeus, 1758
Infraorder ALETHINOPHIDIA Nopcsa, 1923
Microorder MACROSTOMATA Müller, 1831
Superfamily BOOIDEA Gray, 1825
Family BOIDAE Gray, 1825

Eunectes Wagler, 1830

Type species. Eunectes murinus (Linnaeus, 1758).

Locality and age. Gruta do Urso, Municipality of Aurora do Tocantins, southern State of Tocantins, northern Brazil. Late Pleistocene.

Description. The specimen is almost complete, and only lacks the right prezygapophysis, right paradiapophysis, and neural spine. Parts of the vertebra are covered in a concretion that varies in color from orange to tan. The lighter tan concretion is more like calcified sediment while the orange is a coating of what appears to be calcium carbonate with small crystals exposed. There is concretion within the cotyle and neural canal. The vertebra is large, wide, and shortened, with the vertebral centrum shorter than the neural arch width (cl < ctw). In anterior view, a wide and robust zygosphene is much wider than the cotyle (zw > ctw) and shows a slightly elevated dorsal edge in the middle. Only the left prezygapophysis is preserved; it is weakly inclined above the horizontal plane, with a small prezygapophyseal process that projects a little beyond the articular facets of the prezygapophyses. The neural canal is triangular. The cotyle is nearly circular (ctw ~ cth), and there are no paracotylar foramina on either side of the cotyle. Only the right paradiapophysis is preserved and it surpasses the ventral margin of the cotyle. It is robust and lateroventrally oriented. The dia- and parapophysial surfaces are well separated; the diapophyses are convex.

Referred specimen. One almost complete midtrunk vertebra (UNIRIO-NM 0001).

Locality and age. Gruta do Urso, Municipality of Aurora do Tocantins, southern State of Tocantins, northern Brazil. Late Pleistocene.

Description. The specimen is almost complete, and only lacks the right prezygapophysis, right paradiapophysis, and neural spine. Parts of the vertebra are covered in a concretion that varies in color from orange to tan. The lighter tan concretion is more like calcified sediment while the orange is a coating of what appears to be calcium carbonate with small crystals exposed. There is concretion within the cotyle and neural canal. The vertebra is large, wide, and shortened, with the vertebral centrum shorter than the neural arch width (cl < ctw). In anterior view, a wide and robust zygosphene is much wider than the cotyle (zw > ctw) and shows a slightly elevated dorsal edge in the middle. Only the left prezygapophysis is preserved; it is weakly inclined above the horizontal plane, with a small prezygapophyseal process that projects a little beyond the articular facets of the prezygapophyses. The neural canal is triangular. The cotyle is nearly circular (ctw ~ cth), and there are no paracotylar foramina on either side of the cotyle. Only the right paradiapophysis is preserved and it surpasses the ventral margin of the cotyle. It is robust and lateroventrally oriented. The dia- and parapophysial surfaces are well separated; the diapophyses are convex.

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Referred specimen. One almost complete midtrunk vertebra (UNIRIO-NM 0001).
and prominent, while the parapophysis is rather concave. In posterior view, although part of the neural arch roof is broken on the left side, it is slightly depressed. The posterior surface is covered in a thin layer of calcium carbonate, which partly obscures the zygantrum. The right postzygapophysis is slightly inclined dorsally. The condyle is nearly circular. In dorsal view, the neural arch is wider than it is long (pr-pr > pr-po). The articular facet of the prezygapophyses is broad and anterolaterally oriented. The anterior edge of the zygosphene is concave and shows a median tubercle projecting anteriorly and located above the roof of the neural canal. The interzygapophyseal ridge is curved and short. Although the neural spine is broken, it is apparently sharp anteriorly and wide posteriorly. In lateral view, the centrum is short, showing a well-defined haemal keel that reaches the precondylar constriction. In ventral view, the vertebral centrum is short and triangular. The haemal keel is well defined along the midline of the ventral surface of the centrum. It originates from the ventral edge of the cotyle.

**Measurements.** Cl, 25.31; nch, 7.82; ncw, 3.73; coh, 13.20; cow, 13.97; cth, 11.49; ctw, 12.15; naw, 23.75; pr-pr, 37.26; pr-po, 23.64; prl, 11.30; prw, 7.27; zh, 7.12; zw, 14.95.

**Remarks.** The specimen UNIRIO-NM 0001 is assigned to the genus *Eunectes* on the basis of the following features: large size, slightly depressed neural arch, robust and moderately thick zygosphene with a prominent median tubercle (Hsiou & Albino, 2009). Moreover, the taxonomic assignment of the specimen described above to Boidae is based on the following combination of vertebral characters shared with the genera of extant Neotropical boines: robust, high, short and wide vertebrae; although incomplete, the neural spine is apparently well developed; relatively thick zygosphene; low inclination of the articular facet of the prezygapophysis (less than 15º); short prezygapophyseal process; vertebral centrum short; marked precondylar constriction; haemal keel well developed in the mid-trunk vertebrae instead of a hypapophysis (Rage, 2001; Lee & Scanlon, 2002; Szyndlar & Rage, 2003; Albino & Carlini, 2008).

**Figure 3.** Current geographic distribution of the snake *Eunectes murinus* in South America (in gray). 1, *Eunectes murinus*, late Pleistocene, Gruta do Urso cave, State of Tocantins; 2, *Eunectes* sp., Quaternary, found in the Buraco do Japões cave, State of Mato Grosso do Sul, at the municipality of Bonito; 3, *Eunectes murinus*, Quaternary, found in Lapa dos Brejões cave, State of Bahia, at the municipality of Morro do Chapéu. Records 2 and 3 were assigned by Camolez & Zaher (2010).
FIRST RECORD OF EUNECTES MURINUS (SQUAMATA, SERPENTES)

DISCUSSION

Fossils of the genus Eunectes have been reported from the Miocene of Colombia, Venezuela, and Brazil (Hoffstetter & Rage, 1977; Hecht & LaDuke, 1997; Hsiou & Albino, 2009, 2010), and also from the late Pleistocene of Bahia and Mato Grosso do Sul states (Camolez & Zaher, 2010). From those, only the record from the late Pleistocene of Bahia and the one presented here could be attributed to E. murinus, because of their unique larger size (mainly based on the proportions of the vertebrae, i.e. el, pr-pr, and pr-po). According to Camolez & Zaher (2010) there are no differences in the dorsal vertebrae of Eunectes species; however, subtle differences could be observed in the postcloacal vertebrae.

The extant Eunectes murinus is a typical Neotropical taxon, occurring between latitudes of 10°N and approximately 30°S. This species can be found from very humid to dry climates, but always in association with aquatic environments, occurring in the lowlands of South America east of the Andes, from the island of Trinidad, the Orinoco River Basin, Amazon, Guianas, and the upper courses of the basins of the rivers Paraguay, Paraná and São Francisco, with the southernmost distribution in northeastern Paraguay (Henderson et al., 1995; Waller et al., 1995). Hence, the record of an E. murinus fossil in the Gruta do Urso indicates that the environment around this cave included a large body of water, like a river, lake, or flooded savanna during the late Pleistocene. In addition, the aquatic component is further represented by fragments of caimans (Crocodileia, Alligatoridae), mainly isolated osteoderms, in association with the E. murinus fossil.

According to Cione & Tonni (1999, 2005) this region of South America was open and dry during the late Pleistocene. Two species associated with the Eunectes murinus fossil from Gruta do Urso cave, Catagonus stenocephalus (Lund in Reinhardt, 1880) and Propraoopus grandis Ameghino, 1881, may also suggest an open and dry environment for the region during the late Pleistocene. The inferred dry climate interpretation is quite different from the current humid Cerrado where the caves of the region of Aurora do Tocantins occur. Thus, if the late Pleistocene arid interpretation is correct, the climate has changed dramatically to a more humid environment during the Holocene. Such a change may have had a dramatic impact on some inferred xerophytic species (e.g. C. stenocephalus and P. grandis), and could have contributed to their extinction. In contrast, it is possible that such a climatic change would have a positive impact on E. murinus populations due to increased aquatic environments coinciding with higher humidity.

CONCLUSIONS

An exceptionally large snake vertebra was collected in late Pleistocene sediments from the Gruta do Urso cave in northern Brazil. The vertebral morphology and proportions of the vertebra permitted identification of this specimen as Eunectes murinus. This is the first record of E. murinus for the late Pleistocene of Northern Brazil, and the occurrence indicates the presence of a large body of water, like a river, lake, or flooded savanna. Previous interpretations of this region during the late Pleistocene suggest an arid environment, but the occurrence of E. murinus confirms a significant aquatic component as well.

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REFERENCES


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**Appendix.**

Comparative material examined in this study:

*Boa constrictor constrictor*, MCN.D. 335, 343, 344, 347, 351; *Corallus hortulanus*, MCN-PV.DR. 0001; *Epicrates cenchria*, MCN-PV.DR. 0002; *Epicrates crassus*, MCN-PV.DR. 0003; *Eunectes murinus*, MCN.D. 306-316-319-342.