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Record of the giant sloth *Valgipes bucklandi* (Lund, 1839) (Tardigrada, Scelidotheriinae) in Rio Grande do Norte state, Brazil, with notes on taphonomy and paleoecology

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ABSTRACT

This paper presents the first record of the species *Valgipes bucklandi* in Rio Grande do Norte state, in the Brazilian Intertropical Region (BIR). This occurrence extends the distribution of this taxon in the BIR. Taphonomic information recovered from this finding indicated that the carcass was probably exposed in a hot and dry environment, whereas carbon isotope data revealed that *V. bucklandi* had a browser diet ($\delta^{13}C = -10.17‰$), living in more closed environments.

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1. Introduction

Giant sloths were animals exclusive to the fauna of the American continents. These animals emerged in Patagonia region, during the Oligocene, and then diversified and dispersed throughout South America and later to North America. In the Brazilian Intertropical Region (BIR) nine species of giant sloths are recognized, and they are classified into four families and subfamilies: Megatheriidae (Megatheriinae); Mylodontidae (Mylodontinae and Scelidotheriinae); Nothrotheriidae (Nothrotheriinae); and Megalonychidae. Their fossil remains are found in almost all states of Brazil (Cartelle, 1991; Cartelle and De Iuliis, 1995; Cartelle, 1999; Cartelle et al., 2008, 2009; De Iuliis et al., 2009).

The fossil material of the subfamily Scelidotheriinae found in Brazil is assigned to two different species: *Catonyx cuvieri* (Lund, 1839) and *Valgipes bucklandi* (Lund, 1839). The last one, until now, was recorded only in Minas Gerais, Bahia and Piauí states (Cartelle et al., 2009).

The main objectives of this paper are: to document the first occurrence of *V. bucklandi* in Rio Grande do Norte state; to discuss briefly some taphonomic aspects of the finding, and to present stable oxygen isotope data – aiming to provide data for paleoclimatological interpretations – and stable carbon isotope data – aiming to discuss the paleoecology of this species.

2. Material and methods

2.1. Study area

Caves in Rio Grande do Norte state occur in two speleological provinces: Apodí and Seridó (Virgens Neto and Petta, 2004). The Apodí province is located in the extreme west of the Potiguar Basin, where 198 caves are known, representing 90.41% of all caves of this state. The Vale do Apodí district, where Felipe Guerra municipality is located, bears 63.47% of the limestone caves in the state (Cruz et al., 2010).

Until now, the specimen reported here is the only fossil material found in the limestone cave named 'Descoberta' (UTM 647818E, 9384923N), in Felipe Guerra municipality. Currently, the specimen is housed at the collection of the Museu Camara Cascudo (MCC) of the Universidade Federal do Rio Grande do Norte (UFRN).

Descoberta cave exhibits a linear development of 170 m. The main conduit bears many skylights, with different sizes. The cave has two entrances in opposite sides of the main conduit. In an isolated area of the cave there is water accumulation.

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2.2. Stable isotope ratio ^{13}C & ^{18}O analyses

A bone sample of *V. bucklandi* from Rio Grande do Norte (RN) was analyzed to obtain its carbon and oxygen isotopic composition. These analyses were performed at the Center for Applied Isotope Studies of University of Georgia/EUA.

The bone was cleaned using ultrasonic bath. After cleaning, the dried bone was gently crushed into small fragments. The crushed bone was treated with diluted 1N acetic acid in order to remove its surface and secondary carbonates. Periodic evacuation insured that evolved carbon dioxide was removed from the interior of the sample fragments, and that fresh acid was allowed to reach even the interior micro-surfaces. The chemically cleaned sample was then reacted under vacuum conditions with 1N HCl to dissolve the bone mineral and release carbon dioxide from bioapatite. $\delta^{13}C$ and $\delta^{18}O$ samples were analyzed using a stable isotope ratio mass spectrometer MAT 252. The results were measured against Pee Dee Belemnite (PDB), with errors estimated to be less than 0.1‰.

3. Systematic paleontology

XENARTHRA Cope, 1889
TARDIGRADA Latham and Davies in Forster, 1795
MYLODONTOIDEA (Gill, 1872)
MYLODONTIDAE Ameghino, 1889
SCELIDOTHERIINAE Ameghino, 1904
V. bucklandi (Lund, 1839)

3.1. Material

Distal portion of a right humerus, MCC 2975-V.

3.2. Description

The fossil material comprises part of the diaphysis, and all the distal portion of the humerus. The fragment displays characteristics of a Scelidotheriinae humerus, as described by Dantas and Zucon (2007) and Cartelle et al. (2009). It can be referred to *V. bucklandi* based on the presence of an entepicondylar foramen, although it is partially obstructed. It was also observed the presence of a bone crest, which confirms the attribution to this species (Fig. 1A–C).

3.3. Discussion

The material was collected with no field data, so that only one observation regarding taphonomy is possible to be made, based on its preservation. In posterior view, several longitudinal fractures parallel to the collagen fibers are observed. This is a characteristic feature of mechanical weathering. These marks were made, probably, when the bone was out of the cave, in a hot and dry environment (Shipman, 1981).

This climate type occurred in the northeastern region of Brazil between 93 and 47 ka, as indicated by the ^{18}O data collected in stalactites of caves in Bahia state (Wang et al., 2004; Barreto, 2010), and by the stable oxygen isotopes data of a bone of *V. bucklandi* (UGAMS 11763, $^{18}O = -1.74‰$). This bone was possibly fossilized during this period, when the predominant vegetation belonged to the Dry Tropical Forest (De Oliveira et al., 1999; Behling et al., 2000).

V. bucklandi is an endemic species of the Brazilian Intertropical Region recently described by Cartelle et al. (2009). Unfortunately, little is known about its paleoecology.

Phylogenetic analyses provided by Gaudin (2004) and Cartelle et al. (2009) for Scelidotheriinae showed that the species *C. cuvieri* and *V. bucklandi* are morphologically close to *Scelidotherium leptocephalum*. Some authors (Bargo et al., 2000, 2006; Vizcaíno et al., 2001) attributed for the latter species digging habits and a browser diet, based on sprouts, fruits and roots.

Analyses with stable carbon isotopes are frequently used to elucidate the diet of mammals (MacFadden et al., 1999, 2005; Sánchez et al., 2004; Dantas et al., 2013). The values of carbon isotopes are enriched by 12–14‰ in medium to large-sized animals (Cerling and Harris, 1999). A pure C_3 feeder presents mean values

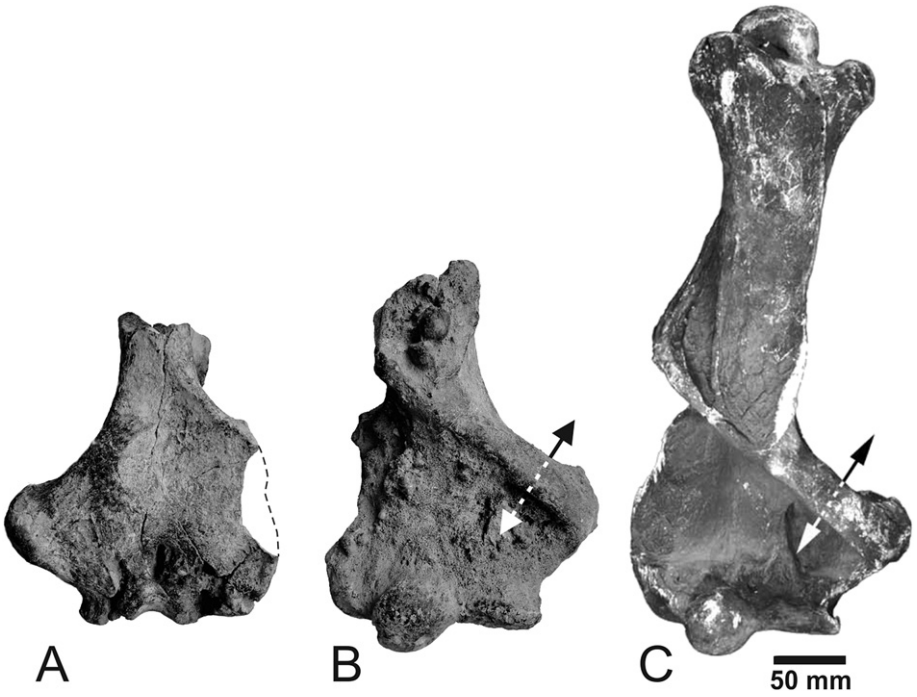

Fig. 1. Distal portion of the right humerus of *Valgipes bucklandi* MCC 2975-V in (A) posterior view and (B) anterior view; (C) anterior view of the right humerus of *Valgipes bucklandi* MCL 22453 (modified from Cartelle et al., 2009).

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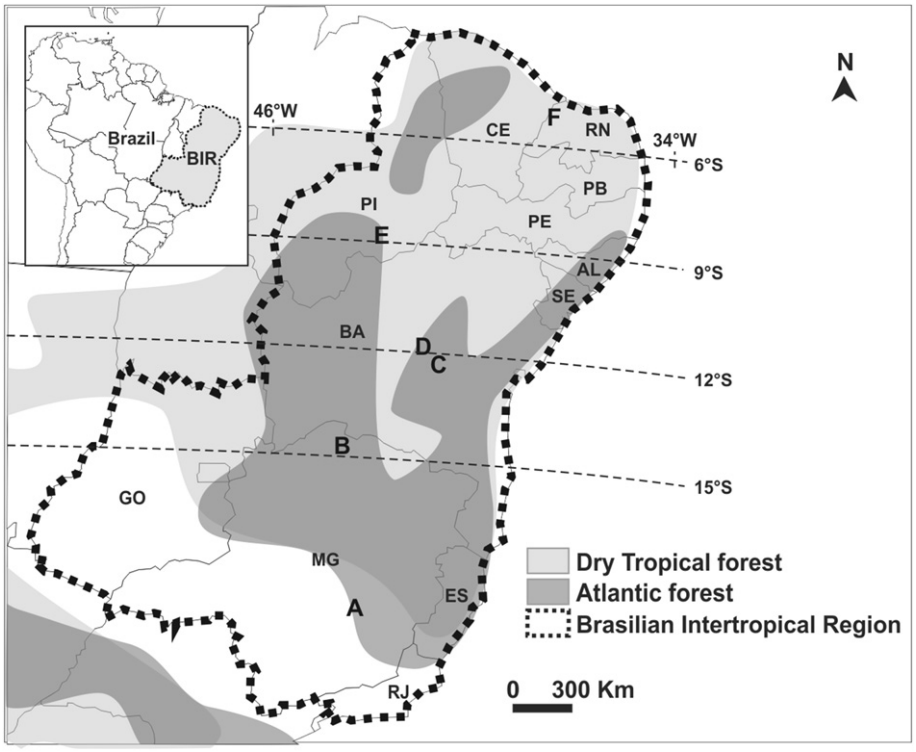

Fig. 2. Comparison of the occurrence points of *V. bucklandi* with the potencial distribution maps of Atlantic forests and dry tropical forests in the Brazilian Intertropical Region at 21 ka. A – Lagoa Santa/MG; B – São João das Missões/MG; C – Nova Redenção/BA; D – Iraquara/BA; E – São Raimundo Nonato/PI; F – Felipe Guerra/RN.

of −13‰. Less negative values indicate a mixed feeder on C_3/C_4 plants, and a C_4 grass feeder exhibits mean values of 1‰.

Our analyses of stable carbon isotopes confirm a browser diet for *V. bucklandi* (UGAMS 11763, $^{13}C = -10.17‰$), and, tentatively, we attributed the same diet and habits for the species *C. cuvieri*.

The record of *V. bucklandi* in Rio Grande do Norte state shows that the range of this taxon is wider than previously documented (Fig. 2). Comparison between the occurrence areas of this species and the potential distribution maps generated for the Atlantic forest (Carnaval and Moritz, 2008) and for the Dry Tropical Forest (savannah or steppic savannah; Werneck et al., 2011) at 21 ka, points that this species probably lived in closed habitats, such as the Atlantic Forest (Fig. 2). The only exception to this distribution is the occurrence in Rio Grande do Norte state. This species probably inhabited the region between 93 and 47 ka and, perhaps, this area was dominated by the Atlantic Forest during this period.

Thus, we present a new record of *V. bucklandi* for the Brazilian Intertropical Region, with an age estimated between 93 and 47 ka; and point that the species was a browser adapted to closed environments, in this case the Atlantic Forests.

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