

# EOHOLOCENE MALACOFAUNA (GASTROPODA, PULMONATA) FROM A CAVE OF NATIONAL PARK OF UBAJARA, CEARÁ STATE, BRAZIL

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## RESUMO

O Parque Nacional de Ubajara apresenta o mais significativo relevo cárstico do Estado do Ceará, composto por nove morros calcários onde se encontram 14 grutas. Entre estas grutas destaca-se a do Urso Fóssil, no Morro do Pendurado, na qual crânio e mandíbula de um urso *Arctotherium brasiliense* (Lund, 1840), foram encontrados em 1978. Nesta gruta recentemente foi coletado o primeiro registro de moluscos de idade eoholocênica do Estado do Ceará, que está reportado neste trabalho. Os espécimes são conchas de gastrópodes completas e fragmentadas, que foram retiradas durante escavação em uma das salas, denominada Sala da Entrada. O material estudado está depositado na coleção científica do Museu Dom José, Universidade Estadual Vale do Acaraú, e através de anatomia comparada e observação dos caracteres e feições de ornamentação, foi identificado como pertencente às famílias: Bulimulidae, Subulinidae e Odontostomidae. Os táxons de gastrópodes encontrados sugerem que a região da Ibiapaba não passou por mudanças drásticas pelo menos nos últimos 8.000 anos já que a fauna é semelhante à atualmente encontrada na área.

**Palavras chave:** Malacofauna, Eoholoceno, Estado do Ceará, Parque Nacional de Ubajara

## **ABSTRACT**

The National Park of Ubajara presents the more important karstic relief of the State of Ceará, composed by nine limestone hills where were 14 caves are found. Among them, the Urso Fóssil cave stands out in the *morro do Pendurado*, where the skull and mandible of the bear *Arctotherium brasiliense* (Lund, 1840) was found in 1978. In this cave the first mollusk record of the State of Ceará with Eoholocene age was recently collected, which is reported in this paper. These specimens are gastropods represented by complete or fragmented shells that were removed through an excavation in a room called Sala da Entrada; the studied material is deposited at scientific collection of the Museu Dom José, Universidade Estadual Vale do Acaraú. Comparing anatomical observation of the characters and ornamental features, they were identified as belonging to families: Bulimulidae, Subulinidae and Odontostomidae. The taxa of gastropods suggest that the region of Ibiapaba has not undergone drastic climatic changes at least from the past 8.000 years, once the fauna reported here is similar to that currently found in the area.

**Keywords:** Malacofauna, Eoholocene, Ceará State, National Park of Ubajara

## INTRODUCTION

The National Park of Ubajara (PNU) is located in the Ubajara Municipality, northwest Ceará State (Fig. 1). A portion of the area of the park is included in the Ibiapaba *Cuesta*, sheltering the largest and more important karstic relief of that State. The cited area is topographic relief with average altitudes around 900 m and with vegetation formation of humid forest, constituting a humid enclave inside Caatinga biome.

The speleological province of Ubajara region consists of nine limestone hills, which present 14 caves known at the moment. The morro do Pendurado is one of these hills, with two caves: Urso Fóssil and Pendurado.

The Urso Fóssil cave was discovered in 1978 for an expedition of the "Centro Excursionista Universitário da Universidade de São Paulo" (Lino *et al.*, 1978). This cave has 195 m in combined length, and has great paleontological importance for the Nequaternary of Ceará State, and for the region as a whole, because in it was found skull and mandible of a fossil bear, *Arctotherium brasiliense* (Lund, 1840) (Trajano and Ferrarezzi, 1994).

Northeastern Brazil is relatively rich in the presence of Pleistocene-Holocene vertebrate remains in caves (e.g. Cartelle, 1992, 1994, 1995, 1999; Cartelle and

Abuhid, 1994; Cartelle and Hartwig, 1996; Cartelle and Lessa, 1988; Lessa *et al.*, 1998). However, investigations concerning invertebrate remains in these caves are missing.

This study shows the first occurrences of Eoholocene mollusks from Ceará State collected in the first room of Urso Fóssil cave, known as Sala da Entrada (03° 49' 58" S 40° 53' 34" W).

Mollusk remains are common presence in cave environment, as their shells are easily preserved. These remains may be related to troglobian species (live effectively in caves) and/or related to shells that are carried by water flow. The first South American purely troglobian mollusk species was described relatively recently (Simone and Moracchioli, 1994; a hydrobiid), characteristically unpigmented, eyes-lacking, and smaller than their relatives. In this scenario, the study of the cave malacofauna, as the present one, is important to understand the local and adjacent ecosystems.

The currently known malacofauna from the National Park of Ubajara is represented by the following species: *Lamellaxis micra*, *Anostoma octodentata*, *Tomigerus clausus*, *T. cumingi*, *Psadara derbyi cearana*, *Orthalicus prototypus*, *Bulimulus durus*, *Solaropsis* sp., *Streptaxis intermedium* (Lino *et al.*, 1978; Leme, 1980, 1984; Salgado and Leme, 1990; IBAMA, 2002).

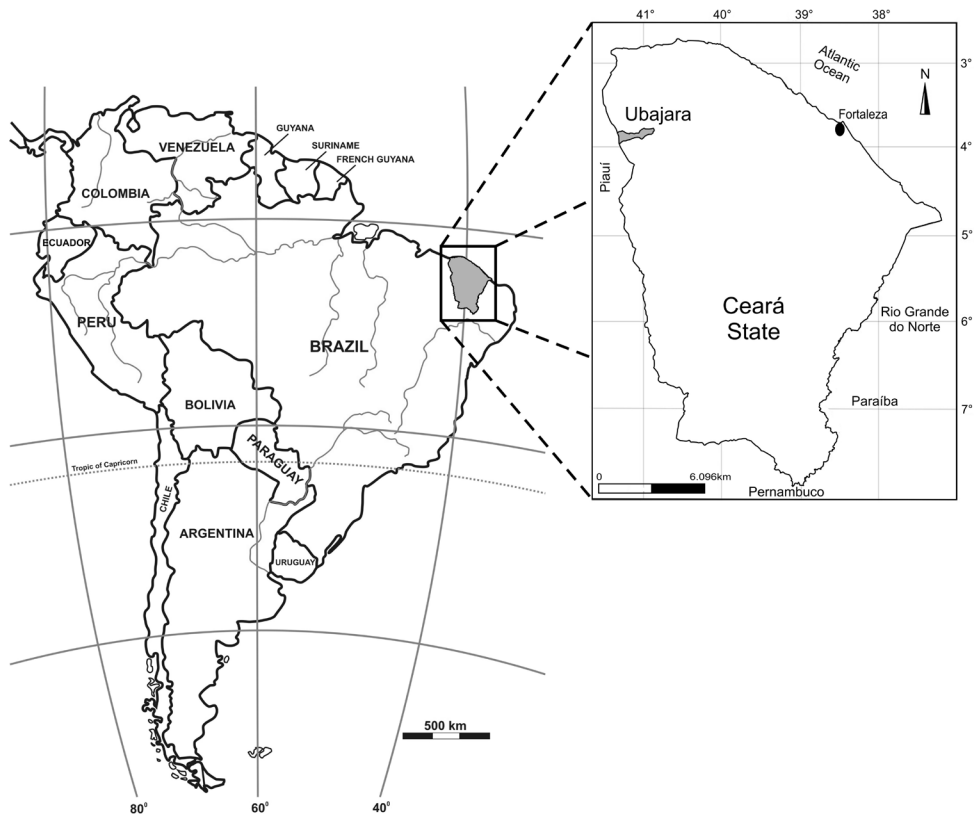


Figure 1. Location map of the National Park of Ubajara, State of Ceará, Northeast Brazil.

## MATERIAL AND METHODS

The specimens reported here were collected in 2009 and are deposited at the fossil scientific collection of the Museu Dom José (MDJ), Sobral, Ceará.

An area of approximately 2.25 m<sup>2</sup> was excavated in the Sala da Entrada of Urso Fóssil cave, reaching the depth of about 0.70 m. In this excavation, sediments and bioclasts samples were collected. The

samples were used for absolute dating by thermoluminescence technique made in the “Laboratório de Vidros e Datação da Faculdade de Tecnologia da Universidade de São Paulo”, in the city of São Paulo, Brazil. The biotic remains were identified in the Laboratório de Malacologia of the Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, (MCN/FZBRS), in the city of Porto Alegre, Brazil.

### **Geological Setting**

The limestone rock outcropping in the region correspond to Frecheirinha Formation, of the Ubajara Group, Neoproterozoic of the Jaibaras Basin (CPRM, 2003; Quadros, 1996). The Ubajara Group has discordant contact with the rocks of Serra Grande Group, Silurian-Devonian of the Parnaíba Basin (Nascimento *et al.*, 1981).

The geological section made inside the Sala da Entrada de Urso Fóssil cave provided information about unconsolidated accumulations of allochthonous and autochthonous origin, included in the following set from top to bottom (Fig. 2):

Level 1: with 0.15 m thickness, is composed by clayey calcareous sediments, light yellowish in color, containing small allochthonous fragments (0.5 – 1 cm) of amorphous and angular limestones, an a large amount of recent seeds and excrements.

Level 2: with thickness of about 0.35 m, is composed of clayey sediment, light gray in color, containing allochthonous fragments of limestone (above 2 cm), some small geodes and fragments (approximately 10 cm) of stalactites and others speleothems, showing at times, concentration

of iron oxide. Contains, in the top, high concentration of two types of seeds which are still undetermined; to the bottom of the layer, some complete shells and numerous shell fragments are accumulated; carbonized shells of smaller size, and other well-preserved, showing color and brightness. There are small excrements covered by powdered unconsolidated carbonate. At about 20 cm from the top of this layer sediment samples were collected for thermoluminescence dating (in PVC pipe) and below, for recovery of palynomorphs. It was also collected, in this level, four species of gastropods (reported in this paper) and numerous bone fragments of Didelphimorphia, Xenarthra and Rodentia.

Level 3: with 0.20 m thick, is composed by clayey sediment, containing smaller autochthonous fragments of limestone and very large and angular calcareous blocks. In this layer occurs one type of shell with well-preserved color and brightness; numerous carbonized fragments of shells and several small bone fragments. As in layer 2, sample to thermoluminescence dating was also collected, and bioclasts of vertebrates of the following orders Squamata, Didelphimorphia, Xenarthra, Rodentia and Artiodactyla were found.

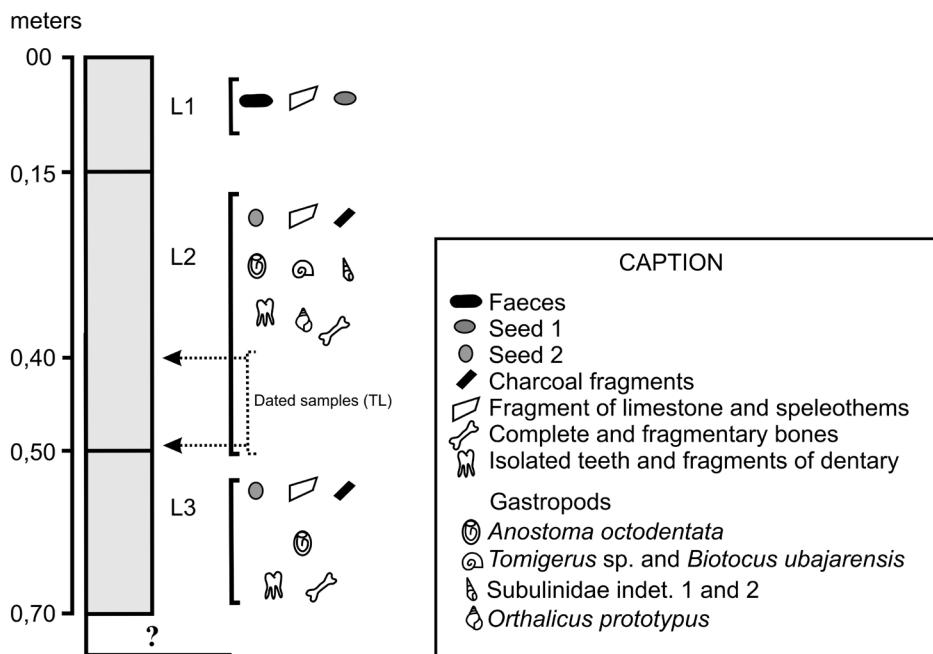


Figure 2. Stratigraphic section showing the L1, L2 and L3 levels and associated fossil contents.

## RESULTS

Sediment samples from two stratigraphic layers (2 and 3, 40 and 50 cm below the surface respectively) of the Sala da Entrada were collected and dated for thermoluminescence (TL) resulting in  $8.000 \pm 990$  years BP and  $8.200 \pm 980$  years BP. Associated with these levels where the shells of gastropods were found, osteological and dental

material also occurs. Some samples were prepared for palynomorphical analysis, but palynomorph records were not found.

The Eoholocene malacofauna from Urso Fossil cave belongs to following families of Pulmonata gastropods: Bulimulidae, Subulinidae and Odontostomidae (Table 1; Fig. 3).

Table 1- Eoholocene malacofauna from *Urso Fossil* cave.

Family	Species	Specimens	Stratigraphic level and age
Bulimulidae	<i>Orthalicus prototypus</i> Pilsbry, 1899	MDJ Mc-003 (figure 1A)	Level 2: 8.000 ± 990 BP
Bulimulidae	<i>Tomigerus</i> sp. Spix, 1827	MDJ Mc-001 (figure 1F)	Level 2: 8.000 ± 990 BP
Subulinidae	Subulinidae indet. 1	MDJ Mc-006 (figure 1D)	Level 2: 8.000 ± 990 BP
Subulinidae	Subulinidae indet. 2	MDJ Mc-007 (figure 1E)	Level 2: 8.000 ± 990 BP
Odontostomidae	<i>Biotocus ubajarensis</i> (Leme, 1980)	MDJ Mc-002 a-f (figure 1G)	Level 2: 8.000 ± 990 BP
Odontostomidae	<i>Anostoma octodentata</i> Waldheim, 1807	MDJ Mc-004 a-b and MDJ Mc-005 (figure 1B-C)	Levels 2 and 3: 8.000 ± 990 BP and 8.200 ± 980 BP

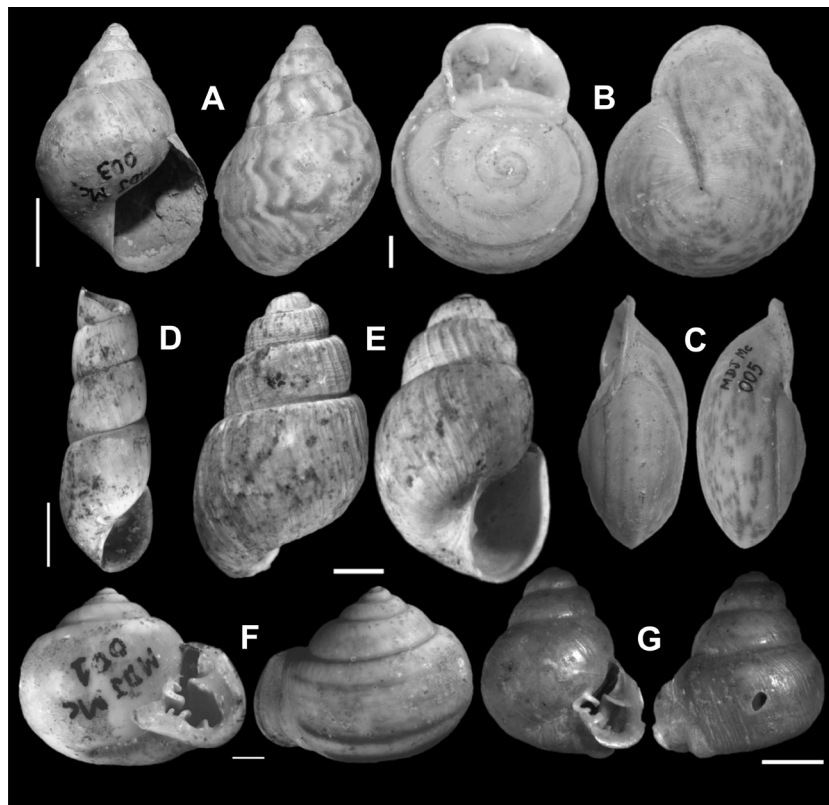


Figure 3. A. *Orthalicus prototypus*, MDJ Mc-003, Escala: 10 mm; B-C. *Anostoma octodentata*, MDJ MC-005, Escala: 5 mm; D-E. Subulinidae indet., MDJ Mc-006 e 007, Escalas: 2 mm; F. *Biotocus ubajarensis*, MDJ Mc-002b, Escala: 2 mm; G. *Tomigerus* sp., MDJ Mc-001, Scale bars 2 mm.

## DISCUSSION

The sedimentation of the Sala da Entrada in the level of 0.50 m depth proved to be of Holocene age, with clayey and organic deposits, represented by clasts and bioclasts of allochthonous and autochthonous origin deposited by hydrological (pluvial), aerial (with the exception of bioclasts) and gravitational agents. The ages obtained for the sediment samples are correlated (layers 2 and 3) with the bioclasts found on them.

The mollusks shown here indicate wet environment, and together with others taxa of the mammals reported for the same area (Oliveira, 2010; Oliveira *et al.*, in press), support the conclusion that the Ibiapaba region did not undergo drastic changes that could interfere with their ecological dynamics at least from the past 8.000 years, once the mollusk is similar to that currently found in the area.

The Ibiapaba well as other high altitude wetlands has an important ecological function as a regional refuge for species more specialized and sensitive flora and fauna (Oliveira, 2010). The studied area is a humid enclave inside of Caatinga biome and shows a relative diversity on terrestrial malacofauna associated to the cave environment. The three families lived there at about 8.000 years BP.

Given the lack of zoological and taxonomic studies in the area sampled, the data presented here representing a contribution to the knowledge of local mollusk, also indicates the need for more detailed studies.

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