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RECENT BRACHIOPODS FROM SOUTH ATLANTIC OCEAN: FIRST OCCURRENCE OF THE LINGULIDAE AND ITS BIOGEOGRAPHIC IMPLICATIONS

Braquiópodes recentes do oceano Atlântico Sul: primeira ocorrência de Lingulidae e suas implicações biogeográficas

Felipe Augusto Correia Monteiro[1], Cristiane Xerez Barroso[2], Wilson Franklin Junior[3], Christian C. Emig[4], Helena Matthews-Cascon[2,3]

[1] Instituto Federal de Educação, Ciência e Tecnologia do Ceará (IFCE), Campus Jaguaribe, Jaguaribe, CE, Brasil. E-mail: felipe.monteiro@ifce.edu.br
[2] Laboratório de Invertebrados Marinhos do Ceará (Limce), Departamento de Biologia, Universidade Federal do Ceará (UFC), Fortaleza, CE, Brasil. E-mail: barrosocx@ufc.br
[3] Instituto de Ciências do Mar (Labomar), Universidade Federal do Ceará (UFC), Fortaleza, CE, Brasil. E-mail: wfranklinjr@gmail.com, helenamc@gmail.com
[4] BrachNet, Marseille, França. E-mail: brachNet@aliceadsl.fr

ABSTRACT

The brachiopod fauna of the South Atlantic is significantly abundant and appears to be predominantly composed of cosmopolitan species. However, until now there was no record of inarticulate brachiopods of the Family Lingulidae in this region. The present study describes the first occurrence of lingulid brachiopods in the South Atlantic. Seven specimens were collected on the continental shelf of the Maranhão state, Northeastern Brazil, Western South Atlantic. The individuals were identified as belonging to the genus *Lingula*. Although brachiopods have great dispersion capability durintg their larval phase, the hypothesis that these specimens arrived on the Brazilian coast as a result of human activities cannot be ruled out.

Keywords: *Lingula,* subfilo Linguliformea, "Inarticulata", inarticulate brachiopods, Brazil.

RESUMO

A fauna de braquiópodes do oceano Atlântico Sul é abundante, apesar de ser composta por poucas espécies de ampla distribuição geográfica. Contudo, até o presente, nenhum braquiópode inarticulado da família Lingulidae havia sido registrado nessa região. O presente estudo descreve pela

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primeira vez a ocorrência de braquiópodes lingulídeos para o Atlântico Sul. Sete espécimes foram coletados na plataforma continental do estado do Maranhão, Nordeste do Brasil, Atlântico Sul Ocidental. Os indivíduos foram identificados como pertencentes ao gênero Lingula. Embora braquiópodes possuam grande poder de dispersão em sua fase larval, a hipótese de que esses espécimes tenham chegado à costa brasileira como resultado de atividades humanas não pode ser descartada.

Palavras-chave: *Lingula, subfilo Linguliformea, "Inarticulata", braquiópodes inarticulados, Brasil.*

INTRODUCTION

Brachiopoda is a phylum of exclusively marine and sessile animals, recorded since the Cambrian period (Emig; Álvarez & Bitner, 2021). Once diverse in the seas of the Paleozoic Era, brachiopods today comprise about 404 living species, which correspond to a small fraction of the species already described for the group, since approximately 30,000 fossil species have been described (Emig; Bitner & Álvarez, 2013; Emig; Álvarez & Bitnes, 2021).

Among the living representatives, the inarticulate brachiopods of the subphylum Linguliformea are represented by two families - Discinidae and Lingulidae (Zezina, 2010; Emig; Bitner & Álvarez, 2013; Emig; Álvarez & Bitnes, 2021). Lingulidae is currently represented by two genera: *Lingula* and *Glottidia*. The first genus has seven species with global geographic distribution, except for American continental margins, where the five species of *Glottidia* are exclusively found (Emig, 1997b). To date, despite having a large geographic range size, no representative of Lingulidae has been reported to the South Atlantic Ocean, since both genera are restricted to the North Atlantic (Emig, 1997b).

Previous studies demonstrate that the brachiopod fauna of the South Atlantic is significantly abundant and appears to be predominantly composed of cosmopolitan species (Amaral & Jablonski, 2005; Kowalewski *et al.*, 2002; Simões *et al.*, 2004; Marques, 2018; Emig; Bitner & Álvarez, 2013). Ten genera and 20 species are recorded from the Atlantic coast of Central and South America, distributed since Caribbean until Brazil, Uruguay and Argentina coasts (Zezina, 2008, 2010). However, studies on recent brachiopods in the Western South Atlantic Ocean are still scarce [e.g., Simões *et al.*, 2004; Marques, 2018, both with articulate brachiopod fauna (Subphylum Rhynchonelliformea); Emig, 2017] Thus, the present study aims to describe the first occurrence of Lingulidae for the South Atlantic Ocean.

MATERIAL AND METHODS

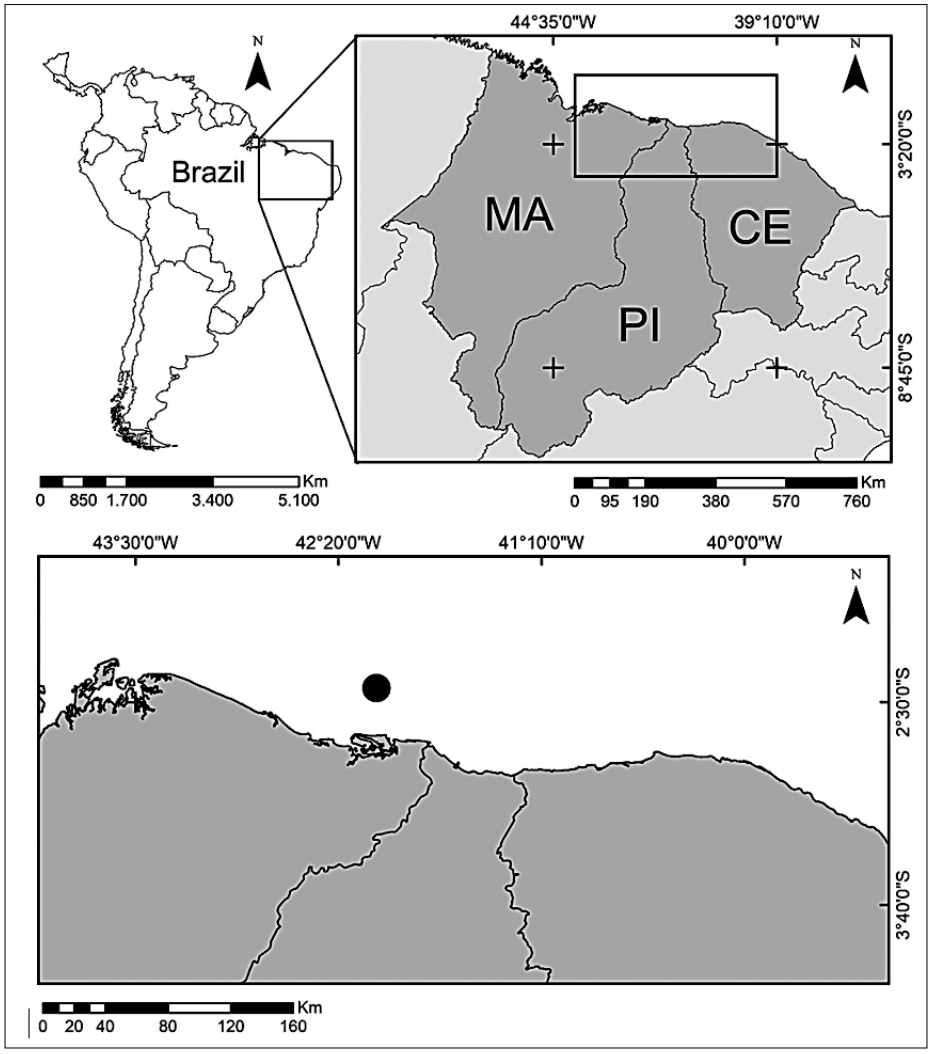
The material analyzed in the present study was collected by dredging carried out during field activities for the Instituto Nacional de Ciência e Tecnologia de Transferência de Materiais Continente-Oceano (INCT-TMCOcean) project, conducted by the Instituto de Ciências do Mar (Labomar), da Universidade Federal do Ceará (UFC), Brazil.

The specimens came from two samples obtained from a single point located on the continental shelf of Maranhão State, northeastern Brazil, South Atlantic Ocean (02º25'06" S; 42º06'57" W), about 40 km from the coast, at an average depth of 30 m (Figure 1). The animals were fixed in a 10% formalin solution buffered with sodium borate (borax) and,

subsequently, preserved in 70% ethanol. The individuals are deposited in the Marine Invertebrate Collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP) under MZUSP 611.

The specimens were observed and photographed with the aid of an Olympus CH30 optical microscope, Leica M60 and Nikon SMZ1000 stereoscopic microscopes, and Canon EOS 60D DSLR and BENQ G1 FI.8 coupled cameras.

Figure 1 – Map showing the brachiopod sampling site (black circle, 02º25'06" S; 42º06'57" W), located on continental shelf of Maranhão state (MA), northeastern Brazil



RESULTS

Phylum Brachiopoda Duméril, 1805
Subphylum Linguliformea Williams, Carlson, Brunton, Holmer et Popov, 1996
Class Lingulata Gorjansky et Popov, 1985
Order Lingulida Waagen, 1885
Superfamily Linguloidea Menke, 1828
Family Lingulidae Menke, 1828

Genus *Lingula* Bruguière, 1791

Lingula sp.
(Figures 2 and 3)

Examined material: Continental shelf of Maranhão State, NE Brazil (02º25'06" S; 42º06'57" W), about 40 km from the coast, 30 m depth, MZUSP 611, 7 spm (BPq. Prof. Martins Filho col., vii.2010).

Diagnosis: Shell elongated and oval in outline, sub-parallel lateral margins, anterior margin broad and rounded. Ventral valve with visceral area extending to midvalve. Dorsal valve with visceral area extending somewhat anterior to midvalve.

Description: Shell with length about 1.0 mm and width about 0.5 mm. Pedicle length varied, usually two to three times greater than the total length of the shell. Elongated shell, oval shaped, biconvex, with subparallel lateral margins, subequivalve. Rounded anterior margin. Dorsal valve with rounded posterior margin, poorly developed median extremity. Closely spaced adductor and anterior oblique muscles scars. Asymmetric oblique musculature arrangement; posterior adductor muscle present, unpaired.

Figure 2 – Photograph of *Lingula* sp. showing the shell and pedicle of one of the studied individuals, the substrate where it lives buried can be seen. Scale: 1.0 mm

Figure 3 – Detail of *Lingula* sp. in dorsal (A) and ventral (B) views of the shell and visceral mass through transparency. Scale: 0.5 mm

DISCUSSION

The specimens analyzed belong to the genus *Lingula*, which differ from *Glottidia* in the absence of a pair of divergent septa in its ventral valve, which serve as an insertion point for the oblique musculature, and median septum in its dorsal valve (Emig, 2003). Since the diagnostic characteristics of the species are based on adult specimens, and the animals studied are probably young forms (adults usually have shells over 20 mm in length) (Emig, 1997a), no specimen can be identified at species level.

There are two recorded species of *Lingula* to the Eastern Atlantic, in areas close to the African Northwest coast: *Lingula anatina* Lamarck, 1801 and *Lingula parva* Smith, 1872 (Emig, 1997b; Zezina, 2008, 2010). Thus, it is possible that lingulid brachiopods are more common and widely distributed in the South Atlantic, since they have planktotrophic larvae, with great dispersion capacity (Emig, 1997b). However, their lifestyle habits can make them inconspicuous. Typically, brachiopods live buried in the substrate, in tubes that can reach up to 20 times the size of the animal's shell and, when threatened, they can retract the pedicel in order to move further to the deepest parts of their shelter (Emig, 1997a). We also cannot rule out the hypothesis that the individuals found in the present study are young forms of *Lingula* species native to other regions, having arrived in the

Brazilian coast, intentionally or not, as a result of human activities (e.g., floating materials and ballast water).

CONCLUSION

The present study brings the first record of lingulid brachiopods to the South Atlantic Ocean. The identification of the material was limited due to the small size of the specimens. However, they could be properly classified as belonging to the genus *Lingula*. The future collection of more material with the possibility of identification at a species level will allow for more robust discussions about the occurrence of this genus in the Western South Atlantic.

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REFERENCES

Amaral, A.C.Z. & Jablonski, S. Conservation of marine and coastal biodiversity in Brazil. *Conservation Biology*, v. 19, p. 625-631, 2005. https://doi.org/10.1111/j.1523-1739.2005.00692.x.

Emig, C.C. Ecology of the inarticulated brachiopods, p. 473-495, *in* Kaesler, R.L. (ed.). *Treatise on invertebrate paleontology. Part H. Brachiopoda*. Geological Society of America and University of Kansas. 560 p. Boulder, Colorado; Lawrence, Kansas, v. 1, 1997a, 560 p.

Emig, C.C. Biogeography of the inarticulated brachiopods. p.497-502, *in* Kaesler, R. L. (ed.). *Treatise on invertebrate paleontology*. *Part H. Brachiopoda*. Geological Society of America and University of Kansas. Boulder, Colorado; Lawrence, Kansas, v. 1, 1997b, 560 p.

Emig, C.C. Proof that *Lingula* (Brachiopoda) is not a living-fossil, and emended diagnoses of the Family Lingulidae. *Carnets de Géologie* (CG2003_L01), 2003. https://doi.org/10.4267/2042/303.

Emig, C.C. Atlas of Antartic and sub-Antartic Brachiopoda. *Carnets de Géologie*, Book 2017/03 (CG2017_B03), 93 p., 2017. https://doi.org/10.4267/2042/62545.

Emig, C.C.; Bitner, M.A. & Álvarez, F. Phylum Brachiopoda, p.75-78, *in* Zhang, Z.-Q. (ed.). Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness (Addenda, 2013). *Zootaxa*, *Magnolia Press*, 82 p. Auckland, v. 3703, n. 1, 2013. http://dx.doi.org/10.1017/s1755691008075130.

Emig, C.C.; Álvarez, F. & Bitner, M.A. *Brachiopoda Database*. 2021. Available at: http://paleopolis.rediris.es/brachiopoda_database/. Acessed on: 20 mar. 2021.

Kowalewski, M.; Simões, M.G.; Carroll, M. & Rodland, D.L. Abundant brachiopods on a tropical, upwelling-influenced shelf (Southeast Brazilian Bight, South Atlantic). *Palaios*, v. 17, n. 3, p. 277-286, 2002. https://doi.org/10.1669/0883-1351(2002)017<0277:ABOATU>2.0.CO;2.

Marques, R.C. Brachiopods from Canopus Bank (Southwestern Atlantic, Brazil). *Marine Biodiversity*, v. 48, n. 3, p. 1591-1594, 2018. https://doi.org/10.1007/s12526-016-0583-1.

Simões, M.G.; Kowalewski, M.; Mello, L.H.C.; Rodland, D.L. & Carroll, M. Recent Brachiopods from the Southern Brazilian Shelf: palaeontological and biogeographical implications. Palaeontology, v. 47, n. 3, p. 515-533, 2004. https://doi.org/10.1111/j. 0031-0239.2004.00383.x.

Zezina, O.N. Biogeography of the recent brachiopods. *Paleontological Journal*, v. 42, n. 8, p. 830-858, 2008. https://doi.org/10.1134/S0031030108080078.

Zezina, O.N. Check-list of Holocene brachiopods annotated with geographical ranges of species. *Paleontological Journal*, v. 44, n. 9, p. 1176-1199, 2010. https://doi.org/10.1134/S0031030110090030.