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## Occurrence of *Lycogala epidendrum* (Myxomycetes) in a mangrove environment in Brazil<sup>1</sup>

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**ABSTRACT:** (Occurrence of *Lycogala epidendrum* (Myxomycetes) in a mangrove environment in Brazil). The first record of *Lycogala epidendrum* (L.) Fries in Brazil was presented at the beginning of the 20<sup>th</sup> century based on material collected in the state of Santa Catarina (south region of the country). This species has been recorded in six of the nine states in the northeastern region, where it occurs in fragments of the Atlantic Rainforest, exhibiting lignicolous behavior, as well as in environments altered by humans. In a survey of the myxobiota of Maranhão state, northeast Brazil, aethalia were collected in the Araçagy mangrove, Raposa municipality (02°21' to 02°32' S and 44°00' to 44°12' W). This is the first time that *L. epidendrum* is reported for this type of environment. This was also the first record of a representative of Liceales (Myxogastromycetidae, Myxomycetes) in the myxobiota found in the state of Maranhão.

**Key words:** Maranhão, Liceales, myxobiota, Enteridiaceae.

**RESUMO:** (Primeiro registro de *Lycogala epidendrum* (Myxomycetes) em ambiente de manguezal no Brasil). No Brasil, o primeiro registro de *Lycogala epidendrum* (L.) Fries foi efetuado no início do século XX, baseado em material coletado no estado de Santa Catarina (Região Sul do país). Esta espécie foi registrada em seis dos nove estados da Região Nordeste, onde ocorre em fragmentos de Floresta Atlântica, comportando-se como lignícola, assim como em ambientes alterados pelo homem. No levantamento da mixobiota do estado do Maranhão, nordeste do Brasil, etálios foram coletados no manguezal de Araçagy, município de Raposa (02°21' a 02°32' S e 44°00' a 44°12' W). Esta é a primeira vez que *L. epidendrum* é registrada neste tipo de ambiente. Este é também o primeiro registro de um representante de Liceales (Myxogastromycetidae, Myxomycetes) no estado do Maranhão.

**Palavras-chave:** Maranhão, Liceales, mixobiota, Enteridiaceae.

### INTRODUCTION

The illustration of *Lycogala epidendrum* (L.) Fr. in the book by Pankow – dated 1654 – is the oldest known publication on myxomycetes (Martin & Alexopoulos 1969). It is also one of the few species in the class that appear in the first edition of *Species Plantarum* by Linnaeus – published in 1753 –, which was the starting point for the nomenclature of these microorganisms. Besides being one of the oldest known and described species, *L. epidendrum* is among those with worldwide distribution, occurring on different continents and in different ecosystems. Its aethalia are commonly found on the dead trunks of large trees, stumps and fallen branches, often associated to different groups of fungi (Dudka & Romanenko 2006). There are rare references for other microhabitats, such as turtle excrement (Ávila *et al.* 2005). *Lycogala epidendrum* also occurs in environments that have been altered by humans and its presence has been reported in sugarcane bagasse stored for industrial purposes as well as edible mushrooms crops (Cavalcanti *et al.* 1985, Santos & Cavalcanti 1995, Chung *et al.* 1998).

The aethalia of *L. epidendrum* fulfill practically all prerequisites indicated by Dudka & Romanenko (2006)

as favorable to an association with insects, especially species from Leiodidae and Sphindidae (Coleoptera), whose oral structures are adapted to fungivorous activity (Russel 1979, Lawrence & Newton 1980, Lawrence 1989, Betz *et al.* 2003, Wheeler & Miller 2005). There is evidence that, upon feeding, these beetles assist in the dispersion of the spores, which are either deposited on the body of the insect, or remain viable after being excreted (Dudka & Romanenko 2006).

The aethalia of *L. epidendrum* contain substances with antimicrobial and cytotoxic properties, such as the alkaloids isolated by Hashimoto *et al.* (1994) and Kamata *et al.* (2005), found to have anti-tumor action against breast cancer cells. Such substances may interact with other organisms found in the natural environment the species inhabits and contribute toward the success of spore germination as well as the formation and development of the plasmodia and fructification bodies.

In Brazil, the first record of *L. epidendrum* was described at the beginning of the 20<sup>th</sup> century by Jahn (1902) based on material collected in the state of Santa Catarina (south region of the country). Its distribution in the different macro-regions was presented by Cavalcanti

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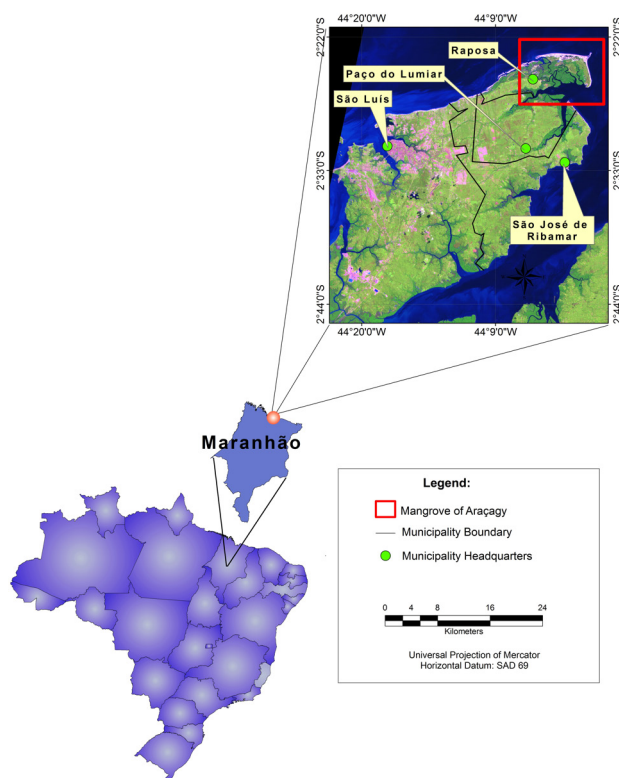
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& Brito Jr. (1990), who mentioned the few records of this species for the northern region and do not indicate its occurrence in the central-western region. The species is distributed in two states in the southeastern region, where was recorded in occasional collections since 1907 (Maimoni-Rodella 2002). *Lycogala epidendrum* has been recorded in six of the nine states in the northeastern region, where it occurs in fragments of the Atlantic Rainforest and highland forests, exhibiting lignicolous behavior, as well as in environments altered by humans, sporulating in sugarcane bagasse stored for industrial purposes (Cavalcanti 2002).

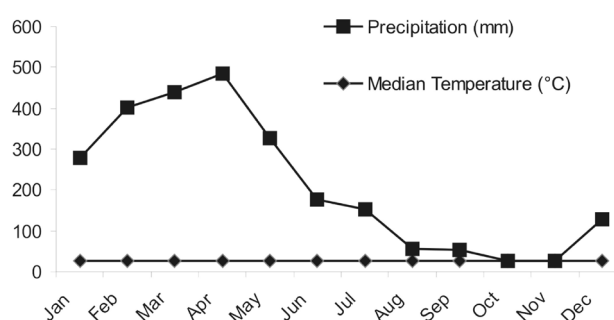
This paper reports the occurrence of *L. epidendrum* for the first time in a mangrove environment based on the collection of aethalia in the municipality of Raposa, São Luís Island, MA, and it is also the first record of a representative of the order Liceales in the state of Maranhão (northeastern Brazil).

## MATERIALS AND METHODS

São Luís Island encompasses the municipalities of São José de Ribamar, Paço do Lumiar, Raposa, and São Luís, the latter of which is the Maranhão state capital (Fig. 1). It has a rainy tropical climate, with a predominance of rains between January and April and average annual temperature oscillating around 28°C (Araujo *et al.* 2005). Figure 2 illustrates the normal climatological data of the city of São Luís for a 30-year period (1961 to 1990), provided by the National Meteorology Institute.



**Figure 1.** Location of Araçagy mangrove, municipality of Raposa, Maranhão state, Brazil.



**Figure 2.** Normal climatological data (1961-1990) from the São Luís Meteorological Station, National Meteorology Institute, regarding temperature and precipitation (São Luís municipality, state of Maranhão, Brazil).

The state of Maranhão has some areas of semi-arid *caatinga* in its eastern portion, Amazonian vegetation in the western portion, flood plains in the central region, and savannah vegetation from the southern portion extending to the northeastern portion, as well as *restinga* and mangroves along the coast (Silva *et al.* 2008a).

The states of Pará and Maranhão concentrate nearly 85% of Brazilian mangroves, characterized by a poverty of vegetal species, but considerable variation in structure, influenced by hydrological and topographical conditions (Menezes *et al.* 2008). Three species of *Rhizophora* (Rhizophoraceae) occur in the region. The broadest distribution has been shown to *R. mangle* L., whereas *R. racemosa* G.F.W. Meyer and *R. harrisonii* Leechman are less broadly distributed, occurring in the state of Maranhão only in the estuary of Preguiça River, where the latter is dominant. *Avicennia germinans* (L.) L. and *A. schaueriana* Stapf. & Leechman ex Moldenke (Avicenniaceae) are common in the region; the former tolerates conditions of greater salinity. *Laguncularia racemosa* (L.) C.F. Gaertn. (Combretaceae) occupies the edges of vegetation, open areas and riverbanks in saline and brackish areas of the mangrove (Menezes *et al.* 2008).

The Araçagy mangrove is located on the northeastern extremity of São Luís Island (02°21' to 02°32' S and 44°00' to 44°12' W) and extends through three municipalities – São José do Ribamar, Paço do Lumiar, and Raposa (Fig. 1). In Raposa (where the myxomycete collection in the present study was carried out), the mangrove is basically composed of *R. mangle* (red mangrove), *A. schaueriana* (“siriba” mangrove), and *L. racemosa* (white mangrove)(Fig. 3).

In an excursion at the beginning of the rainy season (February/March) in 2008, *L. epidendrum* sporocarps were collected in the Araçagy mangrove, with part of the substrate on which they were adhered. The specimen was transported to the Myxomycete Laboratory of the Universidade Federal de Pernambuco in the city of Recife (Pernambuco state, Brazil) where it was analysed, herborized, and deposited in the UFP Herbarium, following the methodology described by Bezerra *et al.* (2007b). The aethalia were identified based on the descriptions



**Figure 3.** Araçagy mangrove environment in which the presence of *Lycogala epidendrum* (L.) Fr. was recorded (Raposa municipality, Maranhão state, Brazil). Photograph: L.A.N.N. Agra.

by Farr (1976), adopting the nomenclature proposed by Lado (2001), and documented with photographs taken in stereomicroscope. The coloration of the aethalia and spores was based on the Watling (1969) color chart. The first record published for each state is indicated in the distribution of the species in Brazil.

## RESULTS AND DISCUSSION

*Lycogala epidendrum* (L.) Fr., *Syst. Micol.* 3: 80. 1829 (Fig. 4)

*Lycoperdon epidendrum* L., Sp. Pl.: 1184. 1753.

Aethalium 2.5-4.0 mm in diam., subglobose, hazel color (27 Hazel); hypothallus conspicuous, membranous; peridium thick, persistent, dehiscence apical, with yellowish vesicles distributed on the surface, which are not divided into chambers. Pseudocapillitium abundant, light yellow (52 Buff) to hyaline; filaments tubular, ramified, clavate at the ends, surface wrinkled and margins crenulated, some connected to the inner face of the peridium, (6-) 6.5-9.0 (-11)  $\mu\text{m}$  in diam.; spores in mass light yellow (52 Buff), hyaline under transmitted light, globose, partially reticulated by bands, 6.3-7.0  $\mu\text{m}$  in diam.

*Specimen examined:* BRASIL. MARANHÃO: **Raposa**, Araçagy mangrove, lignicolous on *Rhizophora mangle*, 29 February 2008, Agra *et al.* 35 (UFP 55386).

*Habitat:* Broadly distributed on all types of dead wood (Farr 1976, Lado & Pando 1997). In Brazil, *L. epidendrum* occurs in rainforests, mixed forests, savannahs, cultivated areas and vegetal matter stored for industrial purposes (Hochgesand & Gottsberger 1996, Cavalcanti 2002).

*Distribution in Brazil:* There are records for Alagoas (Cavalcanti *et al.* 1985), Amazonas (Jahn 1904), Bahia (Torrend 1915), Paraíba (Cavalcanti & Araujo 1985), Paraná (Gottsberger *et al.* 1992), Pernambuco (Farr 1960), Rio de Janeiro (Torrend 1915), Rio Grande do Norte (Bezerra *et al.* 2007a), Rio Grande do Sul (Rodrigues & Guerrero 1990), Roraima (Cavalcanti *et al.* 1999), Santa

Catarina (Jahn 1902), São Paulo (Sydow & Sydow 1907), and Sergipe (Bezerra *et al.* 2007b).

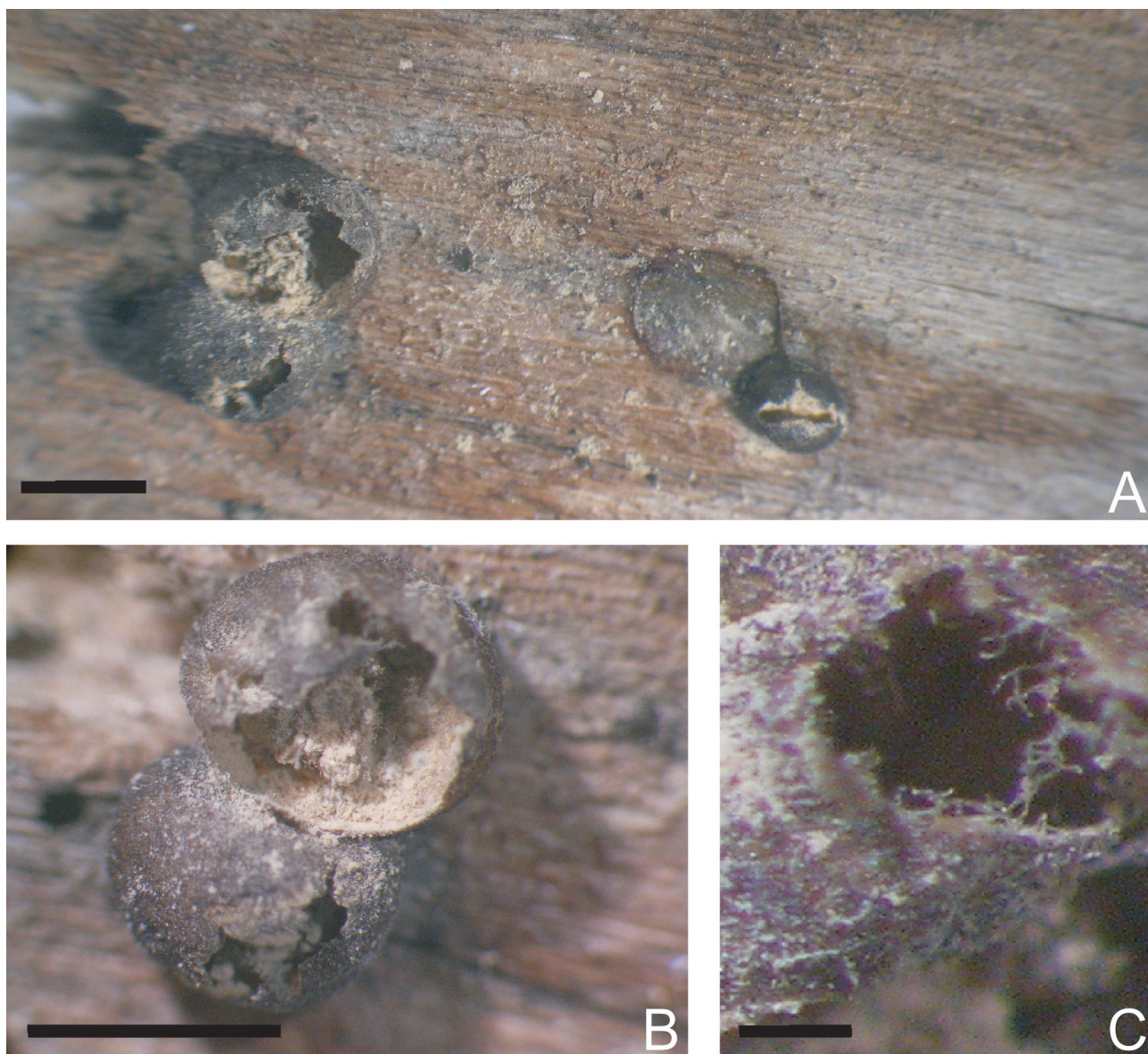
*Comments:* The aethalia of the specimen studied varied somewhat in size, with the lower limit overlapping the upper limit for *Lycogala exiguum* Morgan. However, the characteristics emphasized by Farr (1976), particularly pseudocapillitium filaments of a greater diameter with conspicuous transversal fold, spores of a greater diameter, and vesicles with no peridium chambers, indicate the specimen belongs to *L. epidendrum*. Similarities between the two species have also been observed by Cavalcanti & Brito Jr. (1990) in specimens collected in Brazil, with *L. epidendrum* aethalia ranging from 2.5 to 4.0mm.

The occurrence of *L. epidendrum* in the area of study includes Liceales and the family Enteridiaceae in the known myxobiota for the state of Maranhão, which only had records of Physarales, with the families Didymiaceae and Physaraceae. Considering the information furnished by Torrend (1915), Cavalcanti (2002), Silva & Bezerra (2005), and Silva *et al.* (2008), the number of known genera and species for the state rises to four and five, respectively, making it quite clear that further studies are needed on the myxobiota in Maranhão.

No publication was found in the literature reporting the occurrence of *Lycogala* species in mangroves, thereby indicating that this is the first time that *L. epidendrum* is reported for this type of environment. The four aethalia that made up the fructification body were found on a dead branch still attached to the trunk of a living tree (*R. mangle*) approximately 2.5 m above the ground in a relatively well-preserved portion of the mangrove. Termite nests were observed on the same trunk, principally on the dead branch, where it is quite likely that the development of the plasmodium also occurred.

Myxomycetes employ different strategies in different environments, behaving either as r-strategists, which invest in a high reproduction rate and occupy ephemeral habitats or those with accentuated seasonality, or as k-strategists, which inhabit environments with little daily or seasonal variation (Everhart & Keller 2008). In k-selected populations, the individuals are larger, live longer, mature later, have a long reproduction time, and produce few and large sporocarps. All species of the genus *Lycogala* exhibit these characteristics.

The two strategies can be found in the same site, with r-strategists inhabiting the bark of the trunk of living trees and exhibiting corticolous behavior and k-strategists developing on dead trunks and exhibiting lignicolous behavior. In mangroves, the continual change in tide level favors the selection of r-strategists and one may expect to find occupation in the cortex of the highest part of living trees as well as in the aerial litter. However, nearly all records of myxomycetes in mangroves have been made on fallen dead trunks, thereby classifying the species as lignicolous (Kohlmeyer 1969, Lee & Baker 1973, Nieves-Rivera & Stephenson 2004, Trierveiler-Pereira *et al.* 2008). The specimen obtained in the area studied can be considered lignicolous, since it developed and



**Figure 4.** *Lycogala epidendrum* (L.) Fr. A. Fructification on the original substrate (*Rhizophora mangle* L. wood); B. Aethalia after dehiscence of the peridium; C. Pseudocapillitium attached to the peridium. Bar: Fig. 4A and 4B = 4 mm. Fig. 4C = 1.5 mm.

sporulated on decomposing wood, corresponding to the usual behavior of *Lycogala* species. The instability of the environment due to tide cycles was compensated by the fact that development and sporulation occurred 2.5 m above the soil.

Despite their importance, ecological data documenting the separation of niches in myxomycetes, such as those presented by Rojas *et al.* (2008), are very scarce. The authors cited carried out a study on three macroscopic species of *Ceratiomyxa* (Ceratiomyxaceae, Ceratiomyxales) and found that *C. fruticulosa* (O. F. Müll.) T. Macbr. had the broadest niche, probably for being a cosmopolite species. Similar studies could clarify the niche range for *L. epidendrum* and other currently recognized species for the genus.

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