

Occurrence and Distribution of the Ceratiomyxales (Myxomycetes) in Northeastern Brazil

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ABSTRACT

Order Ceratiomyxales, which belongs to subclass Ceratiomyxomycetidae, includes the exospore bearing Myxomycetes, solely comprising family Ceratiomyxaceae and genus Ceratiomyxa, with four species. Based on the literature, on herbarium collections, and on recent surveys carried out by the authors in different states and ecosystems, it was possible to determine the occurrence and distribution of *C. fruticulosa* (cosmopolitan), *C. morchella* and *C. sphaerosperma* (predominantly tropical or subtropical) in northeastern Brazil. Species descriptions and illustrations are presented, as well as a map of their geographical distribution in eight of the nine states of Northeast Brazil. This order is being recorded for the first time for the state of Sergipe. *Ceratiomyxa morchella* and *C. sphaerosperma* are being cited for the first time for the state of Paraíba.

Key words: *Ceratiomyxa*, floristic survey, taxonomy, chorology

INTRODUCTION

The Subclass Ceratiomyxomycetidae, with its single order, Ceratiomyxales, was proposed by G. W. Martin in 1961 to include the exospore bearing Myxomycetes (Martin and Alexopoulos, 1969). This group bears individually stalked spores over the surface of generally erect and ramified sporophores. Differently from the other representatives of this class, each spore originates a quadrinucleated myxamoeba at the moment of germination and, after taking a vermiform shape, it undergoes mitosis and yields eight haploid, flagellated cells (Gray and Alexopoulos, 1968). Its affinity with the Myxomycetes is controversial.

Some authors, such as Olive (1975), when considering the stalked exospores homologous to the sporocarps of *Ceratiomyxella* L. S. Olive and Stoian. and *Protosporangium* L. S. Olive and Stoian., include this taxon in the protostelids. In the taxonomical presentation of Martin et al. (1983), the single family Ceratiomyxaceae Schröt. has a single genus (*Ceratiomyxa* Schröt.), which today includes four species (Lado, 2001).

Lado (2001) notes that genus *Famintzinia* was proposed by F. A. Hazslinszky in 1877, and included a single species – *Famintzinia porioides* (Alb. and Schwein.) Hazsl. – based on *Ceratium porioides* Alb. and Schwein., presently a synonym of *Ceratiomyxa fruticulosa* (O. F. Mull.) T. Macbr.

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The author concludes that the generic name was validly published according to the standards of the International Code of Botanical Nomenclature in its article 42.1 and thus should have priority over *Ceratiomyxa*, proposed 22 years later by J. Schröter. New combinations were proposed based on these considerations: *Famintzinia fruticulosa* (O. F. Mull.) Lado, *F. hemisphaerica* (L. S. Olive and Stoian.) Lado, *F. morchella* (A. L. Welden) Lado, and *F. sphaerosperma* (Boedijn) Lado. Despite its validity, Lado et al. (2005) later admitted that this change would cause a lot of undesirable confusion, and proposed the name *Ceratiomyxa* to be maintained. Thus, this will be the name adopted in this study.

With a few exceptions (Gottsberger et al., 1992; Cavalcanti, 2002; Maimoni-Rodella, 2002; Putzke, 2002; Sobestiansky, 2005), surveys of myxomycetes biota carried out in different Brazilian states frequently mention the occurrence of *Ceratiomyxa*, almost always represented solely by *C. fruticulosa*, considered by Martin et al. (1983) the most common myxomycetes worldwide. Few authors cite the occurrence of *C. sphaerosperma* for Brazil, such as Martin and Alexopoulos (1969) and Farr (1976), who did not indicate the state or region. Although Farr (1985), Putzke (1996; 2002), Maimoni-Rodella (2002), and Cavalcanti (2002) cite the occurrence of Ceratiomyxales in four of the country's five regions, the articles and maps presently available do not provide complete indications of the distribution known for Brazil.

The aim of the present study is to record occurrence of the Ceratiomyxales in the different states of Northeast Brazil, adding knowledge of its species distribution around the world. The descriptions and illustrations are based on local material and subsidize better understanding of the possible variations of the fruiting bodies of *C. fruticulosa*, *C. morchella*, and *C. sphaerosperma*, which are part of myxomycetes biota of northeastern Brazil.

MATERIAL AND METHODS

Northeastern Brazil comprises nine states and occupies an area approximately 1,548,672 km² large, between 18° 20' 07" S and 48° 45' 30" W (IBGE, 1985). Besides its extensive coast (ca. 3,000 km) along the Atlantic Ocean, the region also borders the states of Pará, Tocantins, Distrito

Federal, Minas Gerais, and Espírito Santo (Fig. 1). Variations in geographical relief are observed in this great area, in which altitudes inferior to 500 m prevail, but that also has areas 900-1000 m high in the Ibiapaba Highlands, Chapada do Araripe, and the Borborema Highlands, and 1200 m high in Chapada Diamantina (Araujo et al., 1998). Climatic conditions vary, with repercussions on the types of vegetation: approximately 788,064 km² are occupied by the *caatinga* biome, where physiognomic and floristic variations can be observed in the spiny caducifolious vegetation typical of semi-arid regions. The mean annual temperature is around 28°C, and mean annual rainfall is between 400 and 800 mm (Lemos and Rodal, 2002; Farias and Castro, 2004; Rocha et al., 2004). Although occupying smaller areas, islands of *cerrado* and *carrasco* vegetation also occur, especially in the states of Piauí and Ceará (Sampaio, 1995; Araujo et al., 1998; Lemos and Rodal, 2002). The climate is milder in the areas closer to the Atlantic Ocean, where the mean annual temperature is around 25°C, annual rainfall always surpasses 1000 mm and the air relative humidity is constantly high. Atlantic Forest fragments and associated ecosystems are found in the coastal region of the states of Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, and occasionally inward, especially in high altitudes.

In addition to bibliographical research, local herbariums were consulted for the survey of the Ceratiomyxales that occur in each state of Northeast Brazil. This was also complemented by collections carried out by the authors between 2002 and 2006 in the states of Alagoas, Paraíba, Pernambuco, Rio Grande do Norte, and Sergipe.

Species descriptions are presented based on the material collected and on herbarium exsiccates, along with illustrations of the sporocarps and microstructures, a list of selected specimens, and comments on their distribution in the different Brazilian states, ecosystems, and substrates.

For identification, the sporophores were analyzed under a stereomicroscope and then dyed with Amann blue and examined with an optical microscope (Teixeira, 1971). Measurements of spores and their stalks were taken with the aid of ocular micrometer (6x) and oil immersion lens (100x); values in parenthesis represent the extreme minimum and maximum recorded, pointing out the most common variation range for the species. The terms used to describe the taxa in general follow

Lado and Pando (1997), adopting the classification of Martin et al. (1983). The taxonomical presentation follows the alphabetical order of species.

The species geographical distribution in the northeastern region is based on information from the literature, from labels of exsiccates deposited in the visited herbariums, and from the specimens collected recently. The states are presented in alphabetic order, while the material examined is quoted in chronological order.

RESULTS AND DISCUSSION

Farr (1976) cited *C. fruticulosa* and *C. sphaerosperma* for Brazil in a monograph about Neotropical Myxomycetes without indicating locations, municipalities, or states. Some years later, Farr (1985) mentioned the occurrence of *C. morchella* for the Brazilian Amazon based on material collected by an expedition to the country's northern region. Thus, three species of *Ceratiomyxa* are included in the identification key for Brazilian myxomycetes presented by Putzke (1996) and adapted from Martin and Alexopoulos (1969), indicating the occurrence of *C. fruticulosa* for the Northeast and of *C. morchella* solely for the state of Amazonas; there is no mention of *C. hemisphaerica* L. S. Olive and Stoian.

Based on the characteristics of more than 300 exsiccates from different states, the descriptions of these three species are presented below, along with comments on their distribution in the country's northeastern region.

Ceratiomyxa J. Schröt. in Engler and Prantl, Nat. Pflanzfam. 1(1): 16. 1899.

Grouped sporophores, rarely sparse, aqueous in aspect when recently formed, whitish or yellowish when mature, 1-4 mm in total height. Peridium, capillitium, columella, and pseudocolumella absent. Smooth to almost smooth spores, globose, subglobose, oval, or ellipsoid, individually attached to a fingerlike stalk, both hyaline, distributed on the columns' surface, simple or branched, that rise directly from the substrate from an effuse base that serves as an hypothallus or cylindrical pedicel.

The species of *Ceratiomyxa* have similar characteristics, and are distinguishable mainly by the spores' shape and size, as well as by the fingerlike stalks that support them. The fruiting body's habit should only be used as a

complementary characteristic in species recognition due to the great variations it may present according to the conditions under which sporulation occurred.

Ceratiomyxa is one of the Myxomycetes' genera that can be found in all continents. It comprises four species, which occur mainly in the tropical and subtropical regions of both hemispheres. These species grow preferentially in shady, humid forest environments, almost always with behaving as lignicolous and sporulating on wood in different levels of decay; occasionally they can be found on decomposing leaves and on the fruit of mono and dicotyledons, in areas with high humidity levels, such as near rivers or waterfalls. They rarely behave as a corticolous species, as referred by Liu (1983).

Ceratiomyxa fruticulosa (O. F. Mull.) T. Macbr., N. Amer. Slime-Moulds: 18. 1899. (Fig. 1-2)

Byssus fruticulosa O. F. Mull., Fl. Dan. 4 (12): 8. 1777.

Sporophores 1-2 mm in total height, sessile or rising from the substrate in branched columns, milky white, rarely creamy yellow. Ellipsoid or subglobose spores, hyaline, smooth (5.0) 6.0-8.6 (9.0) μm in diameter when subglobose or 5.1-6.5 x 9.0-14.0 μm when ellipsoid, individually attached to a fingerlike stalk that is uniform in length along the sporophore.

Distribution

With records for Brazil in the northern (Amapá, Amazonas, Pará, Roraima), northeastern (Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte), southeast (São Paulo) and south (Rio Grande do Sul, Santa Catarina) regions.

Selected exsiccates: Brazil. Alagoas

Marechal Deodoro, Companhia Industrial de Alagoas, 28/V/1985, Albuquerque, W. A. (UFP 6537); São José da Laje, Reserva Florestal da Usina Serra Grande, 26/X/2003, Nunes, A. T. F. (UFP 38088); Ibatiguara, Reserva Florestal da Usina Serra Grande, 08/IV/2003, Nunes, A. T. F. (UFP 38093). **Bahia:** Santa Terezinha, Serra da Jibóia, 16/II/2002, Santos, D. S. (HUEFS 61536). **Paraíba:** Areia, Reserva de Preservação Permanente Mata do Pau Ferro, Trilha do Cumbe, 02/VI/2005, Costa, A. A. A. et al. 15 (UFP 41.851); idem, Trilha das Flores, 03/VI/2005, Costa, A. A. A. et al. 33 (UFP 41865); idem, 26/VIII/2005, Costa, A. A. A. et al. (UFP 43088). João Pessoa, Mata do Buraquinho, Trilha Abraço,

24/VIII/2005, Ferreira, I. N. et al. (UFP 42547); Trilha Buriti II, 22/IX/2005, Ferreira, I. N. et al. (UFP 42551); Trilha Buriti, 22/IX/2005, Ferreira, I. N. et al. (UFP 42544). **Pernambuco:** Recife, Beberibe, 01/X/1951, Batista, A. C. (URM); Dois Irmãos, 27/V/1958, Farr, M. L. 1777 (URM); 18/IX/1981, Pôrto, K. C. (UFP 5654); 25/IV/2003, Rufino, M. U. L. (UFP 35828); Cabo de Stº Agostinho, Reserva Florestal de Gurjaú, Mata São Braz, 18/II/2003, Muniz-Tavares, H. F. (UFP 51344); Igarassu, Refúgio Ecológico Charles Darwin, 25/IV/2001, Cavalcanti, L. H. (UFP 31341). **Piauí:** Piripiri, Parque Nacional de Sete Cidades: Sambaíba, 27/XII/94, Mobin, M. (UFP 16489); Lagoa Seca, 22/III/95, Mobin, M. (UFP

16537); Teresina, Parque Zoobotânico, Cerradão, 27/III/1999, Parente-Ponte (UFP 27354); 10/IV/1999, Parente-Ponte (UFP 27355). **Rio Grande do Norte:** Baía Formosa, RPPN Mata Estrela, Trilha Pau-brasil, 12/IV/2005, Bezerra, A. C. C. (UFP 42577); Trilha Gameleira, 09/VI/2004, Bezerra, A. C. C. (UFP 50227); Natal, Parque Estadual Dunas do Natal, Trilha Perobinha, 14/IV/2005, Bezerra, A. C. C. (UFP 42579); Trilha Ubaia-doce, 09/XI/2005, Bezerra, A. C. C. (UFP 42587). **Sergipe:** Areia Branca, Parque Nacional Serra de Itabaiana, 10/IV/2003, Bezerra, M. F. A. (UFP 34526); 04/IV/2002, Bezerra, M. F. A. (UFP 34189).

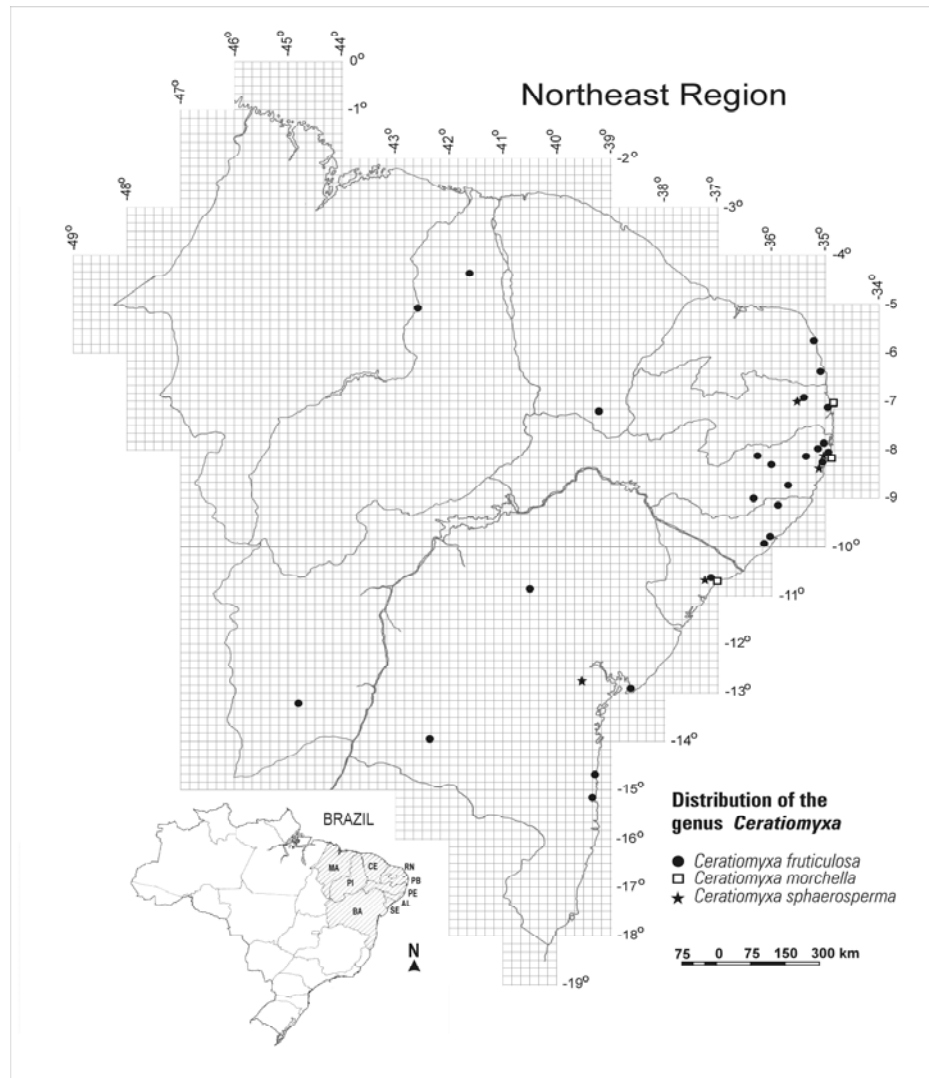


Figure 1 - Distribution map of *Ceratiomyxa* species in Northeast Region, Brazil.

Comments

Widely distributed worldwide. *C. fruticulosa* can be found in different latitudes and altitudes, both in cold, dry regions with a mean temperature of 17°C in the hottest months and mean annual rainfall between 300 and 350 mm (Novozhilov and Fefelov, 2001), or in tropical regions where the climate is hot and humid, with mean temperatures that always surpass 25°C and over 1500 mm rainfall each year (Schnittler et al., 2002).

In Brazil, the earliest records are from the last century, when this species was cited as *C. mucida* (Pers.) Schröet. by Jahn (1904) for the Juruá River region, in the North; later, the species was recorded for the states of Amapá, Amazonas, Pará, and Roraima (Cavalcanti 1970, 2002; Cavalcanti et al., 1999). Torrend (1915; 1916) cited it for the first time for northeastern Brazil, for different localities in Bahia. With the recent records (Cavalcanti, 2002) its distribution is extended to all states except for Maranhão (Fig. 1). In this study it is being cited for the first time for the state of Sergipe, based on material collected from riverside forest areas in the Serra de Itabaiana National Park. In the state of Alagoas it was observed both on stored industrial material and in inland Atlantic Forest fragments (Cavalcanti et al., 1985; 2006). Despite its scarcity, samples UFP 27354 and UFP 27355, collected in Teresina, state of Piauí (Ponte et al., 2003), are typical fruiting bodies of *Ceratiomyxa fruticulosa* var. *flexuosa* Lister (Fig. 2h). In the same state it is also cited for the town of Piripiri, sporulating on *Copernicia prunifera* (Miller) H. E. Moore and *Astrocaryum vulgare* Mart. in a savanna environment and riverside forest (Mobin and Cavalcanti, 2000; Cavalcanti and Mobin, 2004). In southern Ceará this species was also found associated with palm trees and leaves in humid forest areas (Alves and Cavalcanti, 1996; Cavalcanti and Putzke, 1998). Some records were also made in areas of *caatinga* (Gottsberger, 1968) in Bahia and in savanna vegetation typical of coastal plateaus in Pernambuco and Paraíba, as well as in sugarcane plantations, stored industrial material, parks, gardens, and residences in the urban areas of some cities in Rio Grande do Norte, Paraíba, and Pernambuco (Cavalcanti, 2002). Nevertheless, *C. fruticulosa* has been predominantly recorded in Atlantic Forest remnants, in fragments covered with dense ombrophilous forest, open ombrophilous forest, or stationary semideciduous lowland forest, and in the submontane forests

regionally known as *brejos de altitude*. Cavalcanti et al. (2006) remark that this species is more frequent and abundant in the beginning of the rainy season in the analyzed fragments that are part of Pernambuco's Endemism Center.

Among the exsiccates of *C. fruticulosa* of the UFP herbarium collection from different states of the Northeast, some belong to the *arbuscula* (Berk. and Broome) Nann. - Bremek. variety (UFP 41865), with dendroid-like sporophores (Fig. 2a); others belong to the *porioides* (Alb. and Schwein.) G. Lister variety (UFP 42544), which, according to Hagelstein (1944), are only a response to the humidity conditions during sporulation (Fig. 2j). Some sporophores, such as the UFP 43088 exsiccate, have similar characteristics to those described to the *descendens* Emoto variety (Fig. 2e).

Ceratiomyxa morchella A. L. Welden, Mycologia 46 (1): 94. 1954. (Fig. 1 and 3)

Aqueous white to milky white sporophores when mature, roughly gregarious, 1.0-1.5 mm total height, subglobose to subcylindrical. Short pedicel, cylindrical, hyaline, or almost absent. Ovoid to elliptical spore, hyaline, smooth, 5.1-9.2 µm in diameter when ovoid or 5.0-6.0 x 9.0-10.0 µm when elliptical, individually attached to a fingerlike stalk that is uniform in length along the sporophore.

Distribution

With records for Brazil only in the northern (Amazonas, Roraima) and northeastern regions (Pernambuco).

Selected exsiccates: Brazil. Paraíba

João Pessoa, Mata do Buraquinho, Trilha Buriti, 22/IX/2005, Ferreira, I. N. et al. (UFP 42542); 22/IX/ 2005, Ferreira, I. N. et al. (UFP 52543); 22/IX/2005, Ferreira, I. N. et al. (UFP 42544); 22 /IX/ 2005, Ferreira, I. N. et al. (UFP 42545); 22 /IX/ 2005, Ferreira, I. N. et al. (UFP 42549).

Pernambuco: Recife, Parque Estadual de Dois Irmãos, 13/V/2003, Rufino, M. U. L. (UFP 35830); 13/VI/2003, Rufino, M. U. L. (UFP 35818). **Sergipe:** Areia Branca, Parque Nacional Serra de Itabaiana, 14/VII/2002, Bezerra, M. F. A. (UFP 34353); 18/VI/2003, Bezerra, M. F. A. (UFP 35125); 13/V/2003, Bezerra, M. F. A. (UFP 35201); 26/XI/2003, Bezerra, M. F. A. (UFP 37762); 11/IX/2003, Bezerra, M. F. A. (UFP 37930).

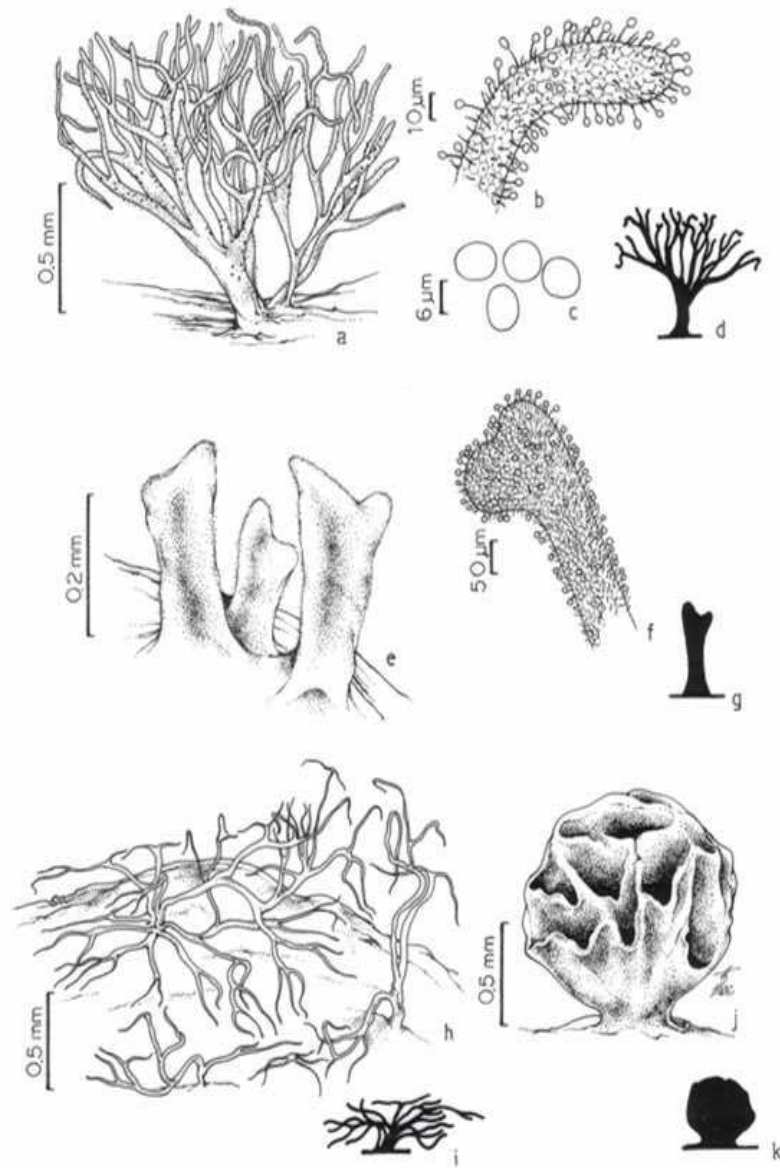


Figure 2 - *Ceratiomyxa fruticulosa* (O. F. Mull.) T. Macbr. a – Sporophores of var. *arbuscula* (Berk. and Broome) Nann. - Bremek.; b – Tip of branch with spores; c – Spores; d – Sporophore silhouette of var. *arbuscula*; e - Sporophores of var. *descendens* Emoto; f - Tip of branch of var. *descendens*; g - Sporophore silhouette of var. *descendens*; h - Sporophores of var. *flexuosa* Lister; i - Sporophore silhouette of var. *flexuosa*; j - Sporophore of var. *porioides* (Alb. and Schwein.) G. Lister; k - Sporophore silhouette of var. *porioides*.

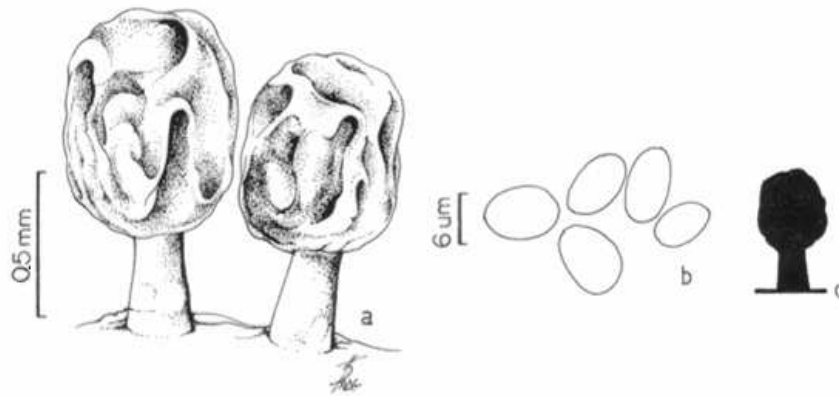


Figure 3 - *Ceratiomyxa morchella* A. L. Welden. a – Sporophores; b – Spores; c – Sporophore silhouette.

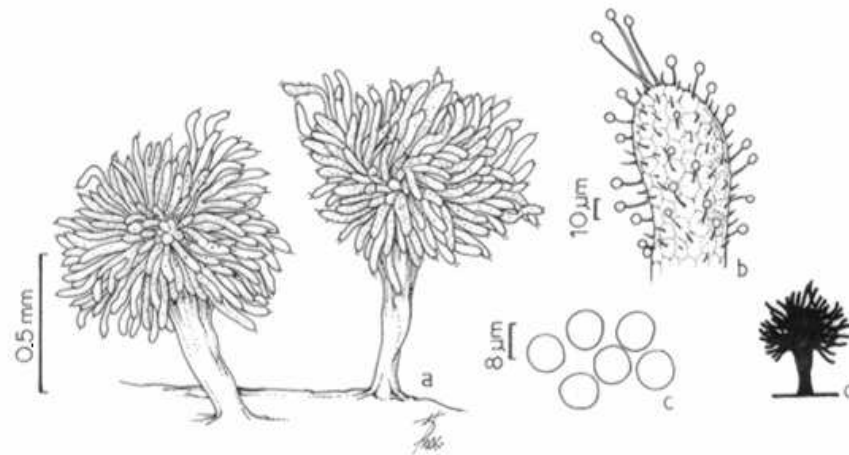


Figure 4 - *Ceratiomyxa sphaerosperma* Boedijn. a – Sporophores; b – Tip of branch with long fingerlike stalks; c – Spores; d – Sporophore silhouette.

Comments

The occurrence of this species in Brazil has been known for over two decades (Farr, 1985), and it had been collected in the states of Amazonas and

Roraima (Cavalcanti, 2002), but it was only recorded recently for the northeastern region. In this region it was found in Atlantic Forest areas in Pernambuco, in fragments covered with stationary

semideciduous forest and dense ombrophilous forest (Cavalcanti, 2002; Cavalcanti et al., 2006). In this study it is being cited for the first time for the states of Sergipe (where it occurs in riverside forest in the Areia Branca municipality), and Paraíba (in an area of dense ombrophilous forest in the Areia municipality, *agreste* region, and Mata do Buraquinho Reserve, in the João Pessoa municipality). In the UFP herbarium collection, *C. morchella* is represented by 12 exsiccates, all of them collected from dead fallen trunks in very humid areas, near rivers and creeks. Although it has been recorded in different times of the year, it can be considered rare in the region.

Ceratiomyxa sphaerosperma Boedijn, Misc. Zool. Sumatr. 24: 1. 1927. (Fig. 1 and 4).

Sparse sporophores, gregarious, milky white, 1.0-1.5 mm total height, rising from the substrate by means of a 1 mm high stalk, with the sporogenous branches grouped at the apex. Globose to subglobose spores, hyaline, smooth, (6.0)7.5-9.0(11.0) μm in diameter, attached to a fingerlike, hyaline stalk that is uniform in size laterally (10-13 μm) and perceptibly longer at the branches' apex (30-40 μm).

Distribution

Typically tropical species, with records for Brazil only in the northern (Amazonas, Pará, Roraima) and northeastern regions (Pernambuco).

Selected exsiccates: Brazil. Paraíba

Areia, Reserva de Preservação Permanente Mata do Pau Ferro, Trilha das Flores, 03 /VI/ 2005, Costa, A. A. A. et al. (UFP 41886); 03 /VI/ 2005, Costa, A. A. A. et al. (UFP 41895). **Pernambuco:** Cabo de Santo Agostinho, Reserva Florestal de Gurjaú, 12/VIII/2003, Muniz-Tavares, H. F. (UFP 51342); 12/VIII/2003, Muniz-Tavares, H. F. (UFP 51355). **Sergipe:** Areia Branca, Parque Nacional Serra de Itabaiana, 14/V/2003, Bezerra, M. F. A. (UFP 35221). **Bahia:** Santa Terezinha, Serra da Jibóia, 16/II/2002, Santos, D. S. (HUEFS 61567).

Comments

According to Martin and Alexopoulos (1969), *C. sphaerosperma* might only be a form of *C. fruticulosa*, with which it may be confounded due to the fruiting body's general aspect. This species is distinguishable from the other species in the genus due to the branches that support the spores grouped at the end of a sort of stipe (Fig. 4a). Also, the fingerlike stalks that support the spores

are remarkably longer at the columns' apices (Fig. 4b). Farr (1960) remarks that her specimen n° 1777, collected from the Dois Irmãos State Park (Recife, Pernambuco) and deposited in the URM herbarium, although identified as *C. fruticulosa*, shares some characteristics with *C. sphaerosperma*. Presently, records have been confirmed for this conservation unit and for other areas located in Pernambuco's humid forest zone (Fig. 1), in fragments covered by stationary semideciduous forest and dense ombrophilous forest in the Recife and Cabo de Santo Agostinho municipalities (Cavalcanti, 2002; Cavalcanti et al., 2006). Exsiccate 61567, which belongs to the HUEFS herbarium, records this species in Bahia; it was collected in 2002 in the Jibóia Mountain (700-800 m high), in the Santa Terezinha municipality – a dense ombrophilous forest enclave in a region of *caatinga*. In this study it is being cited for the first time for the states of Sergipe, Areia Branca municipality and Paraíba, Areia municipality (Fig. 1), where it occurs in areas of ombrophilous forest and in *brejos de altitude*.

Five exsiccates of this species can be found in the UFP Herbarium – all typical. They were collected from the states of Paraíba, Pernambuco, and Sergipe at the end of the dry season and the beginning of the rainy season, on dead trunks (fallen or erect). Among these exsiccates, three were found on decomposing fruits of Tiliaceae (*Apeiba*) and Moraceae (*Artocarpus*), in lowland and submontane humid forest.

CONCLUSIONS

The data available show that Ceratiomyxales is well represented in Northeast Brazil – the only species that is unknown for the Brazilian myxomycete biota is *C. hemisphaerica*. The most widespread species is *C. fruticulosa*, while *C. morchella* and *C. sphaerosperma* are limited to humid forest areas and have only been recorded in Atlantic Forest fragments, both in lowland coastal forests and in submontane forests. In general, the three species studied behave as lignicolous, and preferentially colonize decaying wood in humid and shady areas inside forests, although *C. fruticulosa* also grows in drier and sunnier environments.

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RESUMO

A ordem Ceratiomyxales, pertencente à subclasse Ceratiomyxomycetidae, reúne os representantes exosporados dos Myxomycetes, compreendendo apenas a família Ceratiomyxaceae e o gênero *Ceratiomyxa*, com quatro espécies. Com base na literatura, coleções de herbário e coletas recentes realizadas pelos autores em diferentes estados e ecossistemas, foi possível estabelecer a ocorrência e distribuição na região Nordeste do Brasil de *C. fruticulosa*, cosmopolita, *C. morchella* e *C. sphaerosperma*, predominantemente tropicais ou subtropicais. São apresentadas descrições e ilustrações das espécies, bem como mapa de distribuição geográfica em oito dos nove estados situados no Nordeste do país. A ordem está sendo referida pela primeira vez para o estado de Sergipe. *C. morchella* e *C. sphaerosperma* constituem primeira referência para o estado da Paraíba.

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