

# Coprophilous myxomycetes of Brazil: first report

Maria de Fatima de Andrade Bezerra<sup>1</sup>,  
Wendell Medrado Teófilo da Silva<sup>2</sup>,  
Laise de Holanda Cavalcanti<sup>3</sup>

<sup>1</sup>Programa de Pós-graduação em Biologia de Fungos, Universidade Federal de Pernambuco (UFPE). Av. Prof. Moraes Rego s/n, Cidade Universitária, Recife-PE, 50.560-901, <sup>2</sup>Mestrando em Biologia de Fungos, UFPE. <sup>3</sup>Laboratório de Myxomycetes, Departamento de Botânica, Centro de Ciências Biológicas, UFPE

## Myxomycetes coprófilos de Brasil: primer reporte

**Resumen.** El propósito de este estudio fue identificar especies de mixomicetos que esporulan sobre heces de animales en Brasil. Se prepararon cámaras húmedas a partir de muestras de heces del "tapeti", conejo brasileño (*Sylvilagus brasiliensis*) y de caballo (*Equus caballus*), recolectadas en 14 excursiones realizadas en el Parque Nacional Serra de Itabaiana, Sergipe. El pH inicial de los cultivos en los que se registró esporulación osciló entre (3,8) 4,15 y 4,64 (5,55). Se obtuvieron 52 especímenes (62 cámaras húmedas, 34% positivas), con diez morfoespecies, distribuidas en las familias Cribrariaceae (*Cribraria* 4 especies), Physaraceae (*Physarum* 2 especies), Stemonitaceae (*Comatricha* 1 especie) y Trichiaceae (*Arcyria* 1 especie, *Hemitrichia* 1 especie, *Metatrichia* 1 especie). Los especímenes del material estudiado fueron depositados en el Herbario UFP. Todas las especies son nuevos registros de mixomicetos coprófilos para Brasil. Los registros de *Cribraria cancellata*, *C. microcarpa*, *Metatrichia vesparia* y *Physarum roseum* constituyen las primeras referencias a nivel mundial de estas especies en heces de herbívoros. *Cribraria mirabilis* se reporta por primera vez para Brasil.

**Palabras clave:** Conejo, caballo, heces.

**Abstract.** The aim of this work was to identify the species of myxomycetes associated with the dung of wild and domestic animals in Brazil. Moist chamber cultures were prepared with samples of the dung of the wild Brazilian rabbit (*Sylvilagus brasiliensis*) or horses (*Equus caballus*) collected during 14 field trips to the Serra de Itabaiana National Park, Sergipe State. Initial culture pH ranged from (3.8) 4.15 –4.64 (5.55). Fifty two specimens from 62 cultures (34% positivity) were obtained, representing ten morphospecies, distributed in the families Cribrariaceae (*Cribraria cancellata*, *C. microcarpa*, *C. violacea* and *Cribraria* sp.), Physaraceae (*Physarum cinereum* and *P. roseum*), Stemonitaceae (*Comatricha* aff. *mirabilis*) and Trichiaceae (*Arcyria cinerea*, *Hemitrichia minor* and *Metatrichia vesparia*). All species are new records of coprophilous myxomycetes in Brazil. The reports of *C. cancellata*, *C. microcarpa*, *M. vesparia* and *P. roseum* are the first records in the world of these species on the dung of herbivores. This is the first citation of *C. mirabilis* for Brazil.

**Key words:** Rabbit, horse, dung.

Received 3 March 2006; accepted 13 February 2008.

Recibido 3 de marzo 2006 ; aceptado 13 de febrero 2008.

Autor para correspondencia: M. F. Andrade Bezerra  
fatandrade@hotmail.com

## Introduction

Denizens of animal excrement are categorized as fimicolous or coprophilous, encompassing species found at distinct levels of degradation of the substrate. Denizens of the primary stage (fimicolous) occupy a substrate where fermentation is most active, while later denizens (coprophilous) of the secondary stage occupy a substrate characterized by the lack of fermentation [20, 3]. A third group, the subcoprophilous species, was proposed to indicate the species which need fecal material for nutrition, but do not develop directly on it, as happens in land fertilized with manure [20].

The first records on the development and sporulation of myxomycetes on feces of herbivores date to the 19th Century, from studies done in Europe [11]. Since then, several workers have mentioned the presence of these organisms on excrement of different animals, domesticated or wild, on almost all continents.

In the first comprehensive treatment of fimicolous myxomycetes [11], 80 species were listed, occurring in Europe, Asia, Africa and the Americas; beyond providing a general idea about species which can occur on feces of herbivores, the authors discussed certain taxa which can be considered predominantly or exclusively fimicolous. After 20 years, a second treatment was published [10], adding 22 species to the list of myxomycetes that occupy this microhabitat. Currently, 23 genera and about 100 species that sporulate on animal excrement are known, corresponding to a little more than 10% of the species recognized for the class Myxomycetes [15]. Considering that many of these species also occur on other substrates and are only occasionally found on feces of herbivores, Eliasson & Keller [10] concluded that only 15 of them could be treated as truly fimicolous, in the sense that records of them have, until now, been restricted to this microhabitat. It is worth pointing out that such species belong to three of the six orders of myxomycetes and two of

the three subclasses, indicating that the capacity to occupy this microhabitat is present in different evolutionary lines.

Characteristics that support endocoprofilia are not present in the sporocarps of myxomycetes Ing [13] and Eliasson & Keller [10] question whether these species are in fact endocoprofilous or if the members of this class inhabit feces secondarily, a situation they consider more probable. Nevertheless, works which document the occurrence of myxomycetes on feces of rabbit fed in a lab on *Medicago sativa* L. [27, 2], and that which obtained fructification of myxomycetes from a suspension of mite feces [14], prove that at least some species can behave as endocoprofilous.

In Brazil, several works refer to coprophilous microorganisms [4, 26, 23, 1], however, until now no study has included the myxomycetes. Cavalcanti *et al.* [7], despite not treating the fimicolous species, comment on the fertilization of nurseries with chicken manure which produced abundant fructification of *Fuligo cinerea* (Schwein.) Morgan, to the point of killed tomato seedlings, and could be characterized as subcoprophilous.

In consideration of the important role of coprophilous microorganisms in the functioning of ecosystems, participating in the decomposition and mineralization of herbivore feces or aiding the nutrition of coprophagous insects [2] and, at the same time, with the intent of widening knowledge about Brazilian myxobiota, the first records of coprophilous myxomycetes for the country are presented in this work.

## Material and methods

Moist-chamber cultures were prepared from samples of feces of horse (*Equus caballus* L.) and of tapeti, the Brazilian rabbit (*Sylvilagus brasiliensis* L.). Tapeti is a species in the Leporidae considered threatened with extinction; it inhabits fields, forests and savannas, and eats fruits, shoots and leaves.

The samples were collected in the Serra de Itabaiana National Park – PNSI, SE (10° 40' 52"S, 37° 25' 15"W, 4,389.76 ha, 180–670m alt.), in areas of savanna (ca. 250 m alt.) and in open fields on the summit of the mountain. According to the availability of material in the field, 62 moist-chambers were prepared (51 with rabbit feces and 11 with horse feces). Collections were made during 14 monthly excursions. After having the initial pH of the cultures recorded, the cultures were maintained at ambient light and temperature ( $\pm 28^{\circ}\text{C}$ ) levels and observed for a period of at least three to a maximum of six months. The cultures were considered positive when the appearance of plasmodia and/or sporocarps was observed. Ten moist-chambers that had been set up with rabbit feces, collected on different excursions and in which aborted plasmodia had been recorded, were maintained dried for eight–12 months, after which time they were re-hydrated and observed for three months. Identification of species was based on [12, 16, 18, 19]. Representative samples of the studied material were deposited in the myxomycetes collection of the Herbarium UFP, Department of Botany, Federal University of Pernambuco.

## Results and discussion

Ten morphospecies were recorded, distributed among six genera and four families, representing the subclasses Stemonitomycetidae and Myxogastromycetidae. All of the species constitute new records of coprophilous myxomycetes for Brazil, although they have already been recorded as occurring in other microhabitats in other parts of the country, with the exception of *Comatricha mirabilis* K. Benj. & Poitras. The three species in the Trichiaceae and the family Stemonitaceae also constitute new records for the state of Sergipe.

### Cribrariaceae

*Cribraria cancellata* (Batsch) Nann.-Bremek., Nederlandse Myxomyceten: 92. 1975.

Cosmopolitan, with records for Amazonas, Bahia, Ceará, Paraíba, Ceará, Paraíba, Paraná, Pernambuco, Piauí, Paraná, Rio de Janeiro, Roraima and São Paulo [6; 17; 22]. This species is very common and widely distributed in the world and in Brazil, being frequently found on rotting wood, acting like a lignicolous species. This is the first record, at a global level, of this species as fimicolous [10, 19]. Rabbit feces in which sporocarps of *C. cancellata* appeared were collected at the end of the dry season (April), in an area of savanna of the PNSI. During four months, only plasmodial tracks were observed in a moist-chamber that, re-humidified after nine months of dehydration, developed typical sporangia in a little more than seven weeks of cultivation.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 03/IX/2004, Bezerra, MFA 1121 (UFP).

*Cribraria microcarpa* (Schrad.) Pers., Syn. Meth. Fung.: 190. 1801, emend. Nann.-Bremek., Proc. Kon. Ned. Akad. Wetensch., C. 69 (3): 340. 1966.

Cosmopolitan, with records for Bahia, Pernambuco, Piauí, and São Paulo states [6, 17]. *This species* is common in the PNSI, occurring in different seasons of the year, in diverse microhabitats, behaving commonly as a lignicolous slime mold, yet also developing on dead leaves of members of the Areaceae and Bromeliaceae and living stems of members of the Apocynaceae. Numerous sporocarps developed on horse feces collected during the dry season (October) on the mountain summit (659 m alt.), four to six weeks after placement in moist-chambers. While less abundant, sporulation after seven weeks of culture was also recorded on rabbit feces collected during the dry season (February) in the savanna. This is the first record for this species, on a global

level, on the feces of herbivores [10, 19].

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L. 05/IV/2003, *Bezerra, MFA 323* (UFP); idem, on feces of *Equus caballus* L., 02/XII/2002, *Bezerra, MFA 929* (UFP); idem, 25/XI/2002, *Bezerra, MFA 930* (UFP).

*Cribraria violacea* Rex, Proc. Acad. Nat. Sci. Philadelphia 43: 393. 1891.

Cosmopolitan, recorded in Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and São Paulo states [6, 17]. This species is poorly recorded in Brazil, though it has been noted from many different regions of the country. All 17 specimens obtained in the PNSI sporulated in the same moist-chamber, on rabbit feces from the savanna collected at the end of the dry season (April). On different occasions, they developed one to 15 sporocarps with the typical characteristics of the species, starting sporulation four months and two weeks after being set up in the moist-chambers, and going through a 16 successive fructifications in more than five months. In the same culture, simultaneous or alternate development of *M. vesparia* was observed. *Cribraria violacea* is the only representative of the Cribrariaceae with records from the feces of herbivorous animals [10].

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 12/I/2003, *Bezerra, MFA 94* (UFP); idem, 19/I/2003, *Bezerra, MFA 95* (UFP); idem, 29/I/2003, *Bezerra, MFA 96* (UFP); idem, 01/XI/2002, *Bezerra, MFA 894 - B* (UFP); idem, 08/XI/2002, *Bezerra, MFA 895 - A* (UFP); idem, 01/XII/2002, *Bezerra, MFA 896* (UFP); idem, 18/XI/2002, *Bezerra, MFA 897* (UFP); idem, 23/XI/2002, *Bezerra, MFA 898* (UFP); idem, 17/IV/2002, *Bezerra, MFA 899* (UFP); idem, 21/XI/2002, *Bezerra, MFA 910* (UFP); idem, 18/XII/2002, *Bezerra, MFA 911* (UFP); idem, 23/X/2002, *Bezerra, MFA 938* (UFP); idem,

07/XI/2002, *Bezerra, MFA 939* (UFP); idem, 31/VIII/2002, *Bezerra, MFA 940* (UFP); idem, 26/XII/2002, *Bezerra, MFA 941* (UFP); idem, 10/XII/2002, *Bezerra, MFA 949* (UFP); idem, 25/I/2003, *Bezerra, MFA 964* (UFP).

#### *Cribraria* sp.

In one of the four moist-chambers prepared with rabbit feces collected at the end of the dry season (March), sporangia developed that were similar in coloration to those of *C. violacea* but with globose sporotheca and that did not possess the deep calyculus typical of this species. In all seven collections obtained, sporulated in different seasons, the sporocarps tended to be smaller (0.7–0.8 mm tall), the stipes are shorter and less thin (0.50–0.60 mm long, 72.2–91.2 µm wide at the base, and 11.4–26.6 µm wide at the apex), the spores tend to have greater diameter (7.65–9.18 µm) and the peridial net has distinct characteristics (Figure 1a-c). *Cribraria violacea* and *Cribraria* sp. developed on rabbit feces, collected in a 100 m<sup>2</sup> area; however, the latter was obtained 11 months after the collection of the former species. Beyond the morphological characteristics, there also existed differences in the timing of sporulation. *Cribraria* sp. developed on substrates considerably less degraded by the passage of time as fructification started after ten days, much less than recorded for *C. violacea* (134 days), forming four to 12 sporocarps every one to ten days, during a period lasting for six weeks. Sporocarps developed on all surfaces of the substrate, while *C. violacea* preferentially sporulated on the filter paper.

Among the 42 species included in this genus, only *C. costata* Dhillon & Nann. Bremek., *C. elegans* Berk. & M. A. Curtis, *C. paucicostata* Nann.-Bremek., *C. violacea* Rex, *C. lepida* Meyl., *C. purpurea* Schrad., *C. zonatispora* Lado, Mosquera & Beltrán-Tej., and *C. fragilis* Lado & Estrada-Torres have a coloration similar to the studied specimens, but all of these differ in the other characters of taxonomic value, particularly in those associated with the calyculus and the

spores. Based on the information accumulated in the last 40 years on reproductive systems and biology of the myxomycetes, some authors are of the opinion that many species defined in morphological terms constitute in reality species complexes that consist of various combinations of biological species and multiple apomyctic lines [9]. As such, many commonly accepted morphospecies would be only morphotypic variations, differing from the principal taxon in only a few genes, or biotypic variations adapted to a specific part of the microhabitat [9, 25]. The authors who support this opinion recommend that new species should only be described after extensive study, based on several collections from different locations. Based on such considerations, the specimens *Bezerra MFA 324*, *Bezerra MFA 325*, *Bezerra MFA 326*, *Bezerra MFA 327*, *Bezerra 328*, *Bezerra MFA 329 - B*, and *Bezerra MFA 1036* were identified only to the level of genus, awaiting new data for the description of a probable new species.

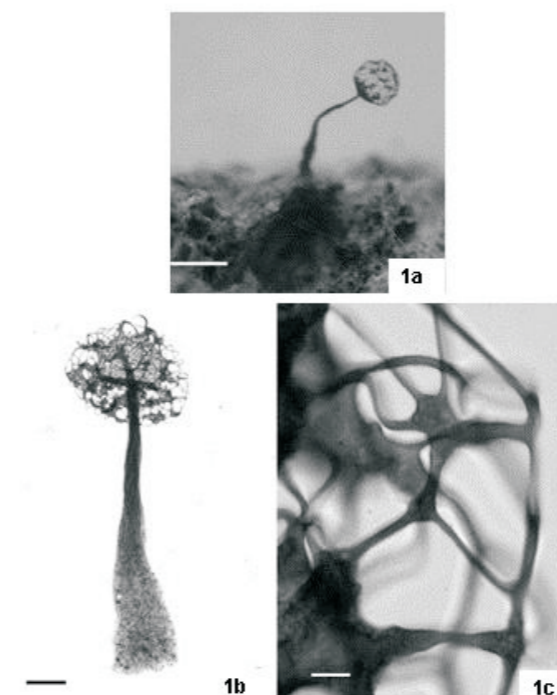


Figure 1. *Cribraria* sp. 1a. Sporocarps on rabbit excrements (*Sylvilagus brasiliensis* L.); 1b. Sporocarp in optic microscopy; 1c. Detail of the peridial net. Scales: 1a. = 0,4 mm; 1b = 50 µm; 1c =10 µm.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 26/III/2003, *Bezerra, MFA 324* (UFP); idem, 28/III/2003, *Bezerra, MFA 325* (UFP); idem, 30/III/2003, *Bezerra, MFA 326* (UFP); idem, 05/IV/2003, *Bezerra, MFA 327* (UFP); idem, 18/IV/2003, *Bezerra, MFA 328* (UFP); idem, 06/IV/2003, *Bezerra, MFA 329 - B* (UFP); idem, 27/IV/2003, *Bezerra, MFA 1036* (UFP).

#### Physaraceae

*Physarum cinereum* (Batsch) Pers., Neues Mag. Bot. 1: 89. 1794.

Cosmopolitan, with records from Amazonas, Bahia, Pernambuco, Minas Gerais, and Santa Catarina states [6; 17; 22]. The only specimen of *Physarum cinereum* obtained in the PNSI developed on rabbit feces collected in savanna in the rainy season (August), after a little more than four weeks of cultivation, is formed of abundant sporocarps with the typical characteristics of the species. This is the first citation of this species for the state of Sergipe.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 20/IX/2002, *Bezerra, MFA 934* (UFP).

*Physarum roseum* Berk. & Broome, J. Linn. Soc., Bot. 14: 84. 1873.

In Brazil, *P. roseum* has a restricted distribution, recorded only from Pernambuco and São Paulo states, being associated only with humid forest areas in the Northeast and Southeast, as a foliicolous or corticolous slime mold [6, 17]. In the first record for the state of Sergipe, this species was isolated in substrate obtained from savanna vegetation. This species is easily recognized by its pinkish coloration and only *Physarum pulcherrimum* Berk. & Ravenel has similar coloration, differing by the calcareous pedicel and columella that are absent in *P. roseum* [12]. Only one specimen, with the typical characteristics of the species, was obtained in the

PNSI, developing after 12 weeks of cultivation, from a plasmodium of blood-red color. In one of the moist-chambers prepared with rabbit feces collected during the dry season (January) in savanna areas, a plasmodium of the same coloration, typical of the species, was observed for some weeks, but it did not sporulate. This is the first record, on a global level, of the occurrence of *P. roseum* on the feces of herbivores.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 22/IV/2003, *Bezerra, MFA 932* (UFP).

#### Stemonitaceae

*Comatricha mirabilis* R. K. Benj. & Poitras, Mycologia 42(4): 515. 1950.

This is the first record of this species for Brazil. The type material of *C. mirabilis* sporulated in a moist-chamber prepared with goat feces, collected in the American state of Illinois [5]. In describing the new species, the authors commented that the sporocarp characters are completely different from those of *C. cylindrica* (Bilgram) T. Macbr. (= *Paradiachea cylindrica* (Bilgram) Hertel), *C. rispauddii* Hagelst. (= *P. rispauddii* (Hagelst.) Hertel) and *C. dictyospora* L. F. Celak. (*nomen dubium*, due to the lack of type material), the only species of the genus that also have reticulate spores. In the material from the PNSI, the sporangia are erect, brown, 1.0–1.2 mm tall, with short sporotheca – cylindrical to ovoid; with a circular, brown hypothallus, a portion of the pedicel dark brown, making up half of the total length of the sporocarp, continuing as a columella, almost until the apex of the sporotheca; the capillitium is very scant, arising from any point of the columella, made up of purplish brown, thin and pale near to the base filaments, ending in short branches, with simple or dichotomous branching; spore case dark brown; spores dark violet-brown, reticulate, 8.16 µm in diameter. The characters found, in the studied material, agree with the

description for *C. mirabilis* [5] except in the small diameter of the spores. In describing the new taxon, the authors compared it with *C. rispauddii* which possesses spores 9 µm in diam. or less and a more reticulate capillitium. The six specimens obtained at the PNSI developed in different moist-chambers, prepared with rabbit feces from the savanna, collected during the dry season (January, November) and in the rainy season (May). The sporocarps developed after three to 20 weeks of cultivation, producing between two and 17 sporangia per culture; in the material from the seventh and ninth harvests, sporulation happened on two or three times in the same moist-chamber, with a minimum time of three weeks of culture. *Physarum roseum* and *Metatrichia vesparia* were found associated with this species.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 18/XII/2002, *Bezerra, MFA 296* (UFP); idem, 01/IV/2003, *Bezerra, MFA 302* (UFP); idem, 16/IV/2003, *Bezerra, MFA 322* (UFP); idem, 12/I/2003, *Bezerra, MFA s/n*; idem, 18/I/2003, *Bezerra, MFA 883* (UFP); idem, 31/VII/2003, *Bezerra, MFA 1082 - A* (UFP).

#### Trichiaceae

*Arcyria cinerea* (Bull.) Pers., Syn. Meth. Fung.: 184. 1801.

Cosmopolitan, with a known distribution in all regions of Brazil, except the Central-West [6, 17, 22]. This is one of the most common and widely distributed species of myxomycetes, occurring as much in the tropics as in temperate or cold regions, developing on a great variety of substrates, especially fallen trunks and frequently found on feces of herbivores, especially horse and cow, in countries of Europe, Asia, and Africa, with the first record dating to 1876 in Denmark [11, 10]. Only three of the 62 cultures produced a few sporangia of this species, developing on rabbit feces collected in savanna during the rainy season (July, August) and in the dry season (October), after 12–14 weeks of culture. Sporangia of *P. cinereum* were associated with this species.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 24/X/2002, *Bezerra, MFA 1098* (UFP); idem, 24/IX/2002, *Bezerra, MFA s/n*; idem, 19/I/2003, *Bezerra, MFA s/n*.

*Metatrichia vesparia* (Batsch) Nann.-Bremek. ex G. W. Martin & Alexop., Myxomycetes: 143. 1969.

Cosmopolitan, with records for all the regions of Brazil, except the Central-West [6, 12, 17, 22]. In the PNSI, exemplars of this species were obtained in moist-chambers prepared with rabbit feces from the savanna collected at the beginning of the rainy season (April, May). *Metatrichia vesparia* sporulated on six different occasions in the same moist-chamber on material collected at the start of the rains (April); the first sporulation occurring at two months of cultivation and nine sporocarps were formed at intervals of one, three, or 12 weeks, for more than five months. Two of the five moist-chambers prepared with material collected during the rainy season (May) were positive, one of them developing sporocarps of *M. vesparia* after 11 weeks of cultivation; when substrate material submitted to eight months of dehydration was re-hydrated again, nine sporocarps of this species were observed within a little more than three weeks of cultivation. The second moist-chamber, observed during six months, did not produce any fructifications. However, following dehydration for a period of five months, sporocarps of *M. vesparia* were observed on the substrate two weeks after being re-hydrated. In all cases, the sporocarps, in groups of two to 16, appeared very typical, allowing for certain identification. These data constitute the first record, on a global scale, of *M. vesparia* as a coprophilous slime mold. Typical sporangia of *C. violacea* were associated with this species and appeared alternately or simultaneously with this species.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of

*Sylvilagus brasiliensis* L., 08/XI/2002, *Bezerra, MFA 895* (UFP); idem, 01/IX/2002, *Bezerra, MFA 959* (UFP); idem, 08/XI/2002, *Bezerra, MFA 881* (UFP); idem, 09/VI/2002, *Bezerra, MFA 1102* (UFP); idem, 01/XI/2002, *Bezerra, MFA 894 - A* (UFP); idem, 28/XI/2002, *Bezerra, MFA 880* (UFP); idem, 31/VII/2003, *Bezerra, MFA 1082 - B* (UFP); idem, 16/VIII/2003, *Bezerra, MFA 1122* (UFP); idem, 26/VIII/2003, *Bezerra, MFA 1123* (UFP).

*Hemitrichia minor* G. Lister, J. Bot. 49: 62. 1911.

Recorded in Pernambuco and Rio Grande do Norte states [6]. This species is included in the list of coprophilous myxomycetes [10], yet it has also been recorded in other microhabitats, such as bark and wood, which would cause it to be regarded as corticolous and lignicolous [8]. In the PNSI, *H. minor* was recorded in the savanna area, sporulating in the same moist-chamber on rabbit feces collected at the end of the dry season (March), after 22 and 34 days, where the genus *Cribraria* was also represented. In each case, the fructifications were scarce, consisting of two to four sporangia.

Examined material: BRAZIL. Sergipe: Areia Branca, Serra de Itabaiana National Park, on feces of *Sylvilagus brasiliensis* L., 06/IV/2003, *Bezerra, MFA 329 - A* (UFP); idem, 18/IV/2003, *Bezerra, MFA 330* (UFP).

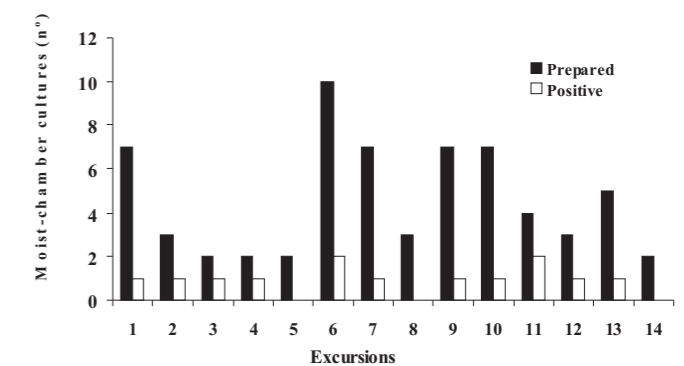


Figure 2. Number of moist chambers set up and the number of positive cultures prepared with feces of rabbit (*Sylvilagus brasiliensis* L.) and horse (*Equus caballus* L.) collected during 14 field trips (Serra de Itabaiana National Park, Sergipe State, Brazil).

### Time of sporulation and pH of the substrate

In the project reported herein, a low percentage of cultures developed plasmodia and/or sporocarps (34%) in all of the moist-chambers prepared with feces of rabbit and of horse (Figure 2). Still, this value is higher than those obtained by other authors, such as Stephenson [24], who set up 129 moist-chambers with feces of white-tailed deer, *Odocoileus virginianus* Zimmermann, and obtained only five species in 15% of the cultures. The author wondered whether the low percentage of sporulation and the fact that many plasmodia aborted could result from the high pH levels found (5.6–8.2; mean 7.0). In fact, in the present work, the initial pH of the moist-chambers where sporulation of ten species occurred, was more acidic (3.8–5.5; mean 4.6) and produced a high percentage of sporulation (Table 1).

In more recent work carried out in the steppes and deserts of Russia [21] a high percentage (72%) of positive moist-chambers was obtained, with 23 species, growing on feces of hare, cow, horse, sheep, and several species of rodents. This authors did not cite the pH of the cultures, but did comment which was the least productive substrate, with lower diversity and species richness. Comparing the list

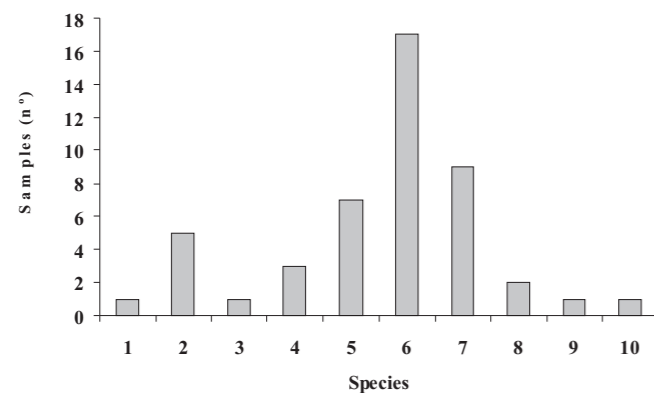


Figure 3. Species abundance of myxomycetes obtained from feces of rabbit (*Sylvilagus brasiliensis* L.) and horse (*Equus caballus* L.) from Serra de Itabaiana National Park, Sergipe State, Brazil. 1: *Arcyria cinerea*, 2: *Comatricha mirabilis*, 3: *Cribraria microcarpa* (horse), 4: *Cribraria microcarpa* (rabbit), 5: *Cribraria* sp., 6: *Cribraria violacea*, 7: *Metatrichia vesparia*, 8: *Hemitrichia minor*, 9: *Physarum cinereum*, 10: *Physarum roseum*.

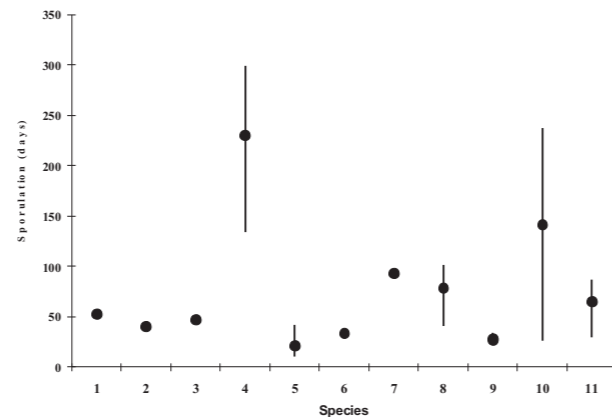


Figure 4. Sporulation time of species of myxomycetes cultures prepared with feces of rabbit (*Sylvilagus brasiliensis* L.) and horse (*Equus caballus* L.) from Serra de Itabaiana National Park, Sergipe State, Brazil. 1: *Cribraria cancellata*, 2: *Cribraria microcarpa* (horse), 3: *Cribraria microcarpa* (rabbit), 4: *Cribraria violacea*, 5: *Cribraria* sp., 6: *Physarum cinereum*, 7: *Physarum roseum*, 8: *Arcyria cinerea*, 9: *Hemitrichia minor*, 10: *Metatrichia vesparia*, 11: *Comatricha aff mirabilis*.

presented by the authors, 60% of the species recorded in the PNSI are present, but only *Arcyria cinerea* and *Physarum cinereum* were recorded on feces of herbivores. *Cribraria violacea* and *Metatrichia vesparia* are distinguished as the most abundant species and only *Cribraria microcarpa* sporulated on the two types of substrate analyzed (Figure 3, Table 1).

Sporocarps of some species, like *Cribraria* sp., were observed after only ten days of cultivation, continuing to sporulate in the same moist-chamber for 30 more days (Figure 4, Table 1) [5]. The majority of species, however, needed a longer period of time for sporulation, even when cultivated on feces of different animals, such as *C. microcarpa* (horse, 37 days; rabbit, 48 days); these results corroborate the findings of other authors [12, 25], likely being a characteristic behavior of coprophilous myxomycetes.

This group of organisms sporulates in the last stage of degradation of the substrate [3], being noted more for the abundance (number of sporocarps) rather than the richness of the species, which could be related as much to the fermentation process of the substrate as to alterations in other microenvironmental factors, such as pH.

### Acknowledgements

The authors thank the management of the Serra de Itabaiana National Park, in Areia Branca, SE; to Valdineide Santana and Marleno Costa, for the facilities made available during the collection period; to CNPq, for the doctoral grant awarded to M. F. A. Bezerra and for the Productivity in Research grant awarded to L. H. Cavalcanti; and to the biologists of the Laboratório de Myxomycetes at UFPE, Alessandra Alencar Parente, Andréa Carla Caldas Bezerra, Clebson Firmino da Silva, and Nicola Bruna Alves, for their technical assistance in this work.

### References

- Alves, M.H., S.F.B. Trufem, A. Milanez, I., 2002. Táxons de *Mucor* Fresen. (Zygomycota) em fezes de herbívoros, Recife, PE, Brasil. *Revista Brasileira de Botânica* 25: 147-160.
- Angel, K., D. T. Wicklow, 1975. Relationships between coprophilous fungi and fecal substrates in a Colorado grassland. *Mycologia* 67: 63-75.
- Barrasa, J. M., G. Moreno, 1980. Contribución al estudio de hongos que viven sobre materias fecales (2º aportación). *Acta Botanica Malacitana* 6: 111-148.
- Batista, A. C., O. Fischman, C. T. Vasconcelos, I.G. Rocha, 1961a. Leveduras e outros fungos das fezes de ovinos, caprinos, suínos, galináceos e animais cativos, no Recife. *Boletim do Instituto de Micologia da Universidade de Recife*, 327:1-27.
- Benjamin, R. K., A.W. Poitras, 1950. An addition to the Myxomycete genus *Comatricha*. *Mycologia* 42: 514-518.
- Cavalcanti, L. H., 2002. Biodiversidade e distribuição de mixomicetos em ambientes naturais e antropogênicos no Brasil: espécies ocorrentes nas Regiões Norte e Nordeste. In: Araújo, E.L., A.N. Moura, E.V.S.B. Sampaio, L.M.S. Gestinari, J.M.T. Carneiro (eds.), Biodiversidade, conservação e uso sustentável da flora do Brasil. Universidade Federal Rural de Pernambuco, Sociedade Botânica do Brasil, Recife, pp.209-216.
- Cavalcanti, L. H., E.J. Santos, M.I.L. Silva, I.M.A. Pinto, 1985. Myxomycetes em cana-de-açúcar (*Saccharum officinarum* L.). Anais da VIII Reunião Nordestina de Botânica, Sociedade Botânica do Brasil, Recife, Brasil, pp. 215-221.
- Cavalcanti, L. H., 1974. O gênero *Perichaena* Fries em Pernambuco. *Rickia* 6: 99-117.

- Clark, J., 2004. Reproductive systems and taxonomy in the myxomycetes. *Systematics and Geography of Plants* 74: 209-216.
- Eliasson, U. H., H.W. Keller, 1999. Coprophilous Myxomycetes: updated summary, key to species, and taxonomic observation on *Trichia brunnea*, *Arcyria elaterensis* and *Arcyria stipata*. *Karstenia* 39:1-10.
- Eliasson, U. H., N. Lundqvist, 1979. Fimicolous Myxomycetes. *Botaniska Notiser* 132: 551-568.
- Farr, M. L., 1976. *Flora Neotropica*. New York: Organization for Flora Neotropica. New York Botanical Garden, New York (Monograph, 16).
- Ing, B., 1994. The Phytosociology of Myxomycetes. *New Phytology* 126: 175-201.
- Keller, H., D.W. Smith, 1978. Dissemination of Myxomycete spores through the feeding activities (ingestion-defecation) of an acarid mite. *Mycologia* 70:1239-1241.
- Lado, C., 2001. Nomenclature. A nomenclatural taxabase of Myxomycetes. *Cuadernos Trabajo Flora Micológica Ibérica* 16: 1-222.
- Lado, C., F. Pando, 1997. Myxomycetes, I. Ceratiomyxales, Echinosteliales, Liceales, Trichiales. *Flora Micológica Ibérica* 2. Consejo Superior de Investigaciones Científicas, Madrid.
- Maimoni-Rodella, R. C., 2002. Biodiversidade e distribuição de mixomicetos em ambientes naturais e antropogênicos no Brasil: espécies ocorrentes nas Regiões Sudeste e Centro-Oeste. In: Araújo, E.L., A.N. Moura, E.V.S.B. Sampaio, L.M.S. Gestinari, J.M.T. Carneiro (eds.), Biodiversidade, conservação e uso sustentável da flora do Brasil. Universidade Federal Rural de Pernambuco, Sociedade Botânica do Brasil, Recife, pp. 217-220.
- Martin, G. W., C.J. Alexopoulos, 1969. *The Myxomycetes*. University of Iowa Press, Iowa.
- Mitchell, D. W., 2002. *Myxomycetes - Inventory and Keys on CD-ROM*. Privately Published by the author.
- Moreno, G., J.M. Barrasa, 1977. Contribución al estudio de hongos que viven sobre materias fecales (1º aportación). *Acta Botanica Malacitana* 3: 5-33.
- Novozhilov, Y. K., I.V. Zemlianskaia, M. Schnittler, K.A. Fefelov, 2003. An annotated checklist of the Myxomycetes of the Northwestern Caspian Lowland. *Mikologiya i Fitopatologiya* 37: 53-65.
- Putzke, J., 2002. Myxomycetes na Região Sul do Brasil. In: Araújo, E.L., A.N. Moura, E.V.S.B. Sampaio, L.M.S. Gestinari, J.M.T. Carneiro (eds.), Biodiversidade, conservação e uso sustentável da flora do Brasil. Universidade Federal Rural de Pernambuco, Sociedade Botânica do Brasil, Recife, pp. 221-223.
- Schoenlein-Crusius, I. H., S.F.B. Trufem, S.M.M. Malatinsky, A. Ninomiya, M.F.R. Antunes, 1996. Mucorales (Zygomycotina) from soil affected by excrement of birds in the "Parque Estadual das Fontes do Ipiranga", São Paulo, Brazil. *Revista Brasileira de Botânica* 19:7-10.
- Stephenson, S. L., 1989. Distribution and ecology of Myxomycetes in temperate forests. III Patterns of occurrence on bark surface of living trees, leaf litter, and dung. *Mycology* 81: 608-621.
- Stephenson, S. L., M. Schnittler, C. Lado, A. Estrada-Torres, D.W. Basanta, J.C. Landolt, Y.K. Novozhilov, J. Clark, D.L. Moore, F.W. Spiegel, 2004. Studies of neotropical mycetozoans. *Systematics and Geography of Plants* 74: 87-108.
- Trufem, S. F. B., 1984. Mucorales do Estado de São Paulo. 4. Espécies coprófilas. *Rickia* 11: 53-64.
- Wicklow, D. T., V. Moore, 1974. Effect of incubation temperature on the coprophilous fungal succession. *Transactions of the British Mycological Society* 47: 511-530.