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Short Communication

Lycogala flavofuscum (Liceales, Myxomycetes): a rare species in South America, rediscovered in Brazil after 100 years

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Abstract

In the second decade of the 20th century, *Lycogala flavofuscum* aethalia were collected in Brazil by Rev. Johannes Rick. Despite being easily observed in the field because of the size of the aethalia, the species was only found again in 2019, on a live trunk of *Sebastiania commersoniana* (branquilho, Euphorbiaceae) in the municipality of São Gabriel, Rio Grande do Sul, Brazil. The description and illustration of recently collected material, and data on exsiccates collected by Rick from Brazil, deposited at Herbarium BPI, are presented herein. Information on substrates, microhabitats, and geographic distribution of the species in the Neotropics is provided based on bibliographical sources and herbarium catalogs. Considering the large time interval between records and the restricted area of occurrence in the country, its inclusion as near threatened in the Brazilian Red List is recommended.

Key words: Neotropics, Pampa biome, red list, Reticulariaceae, slime mold.

Resumo

Na segunda década do século XX, etálios de *Lycogala flavofuscum* foram coletados no Brasil pelo Padre Johannes Rick. Apesar de facilmente observada em campo, devido ao tamanho dos etálios, a espécie só foi novamente encontrada em 2019, sobre tronco vivo de *Sebastiania commersoniana* (branquilho, Euphorbiaceae), no município de São Gabriel, Rio Grande do Sul, Brasil. Apresenta-se a descrição e ilustração do material recentemente coletado, e dados sobre as exsicatas coletadas por Rick provenientes do Brasil, depositadas no Herbário BPI. Com base em fontes bibliográficas e catálogos de herbários, são fornecidas informações sobre substratos, microhabitats e distribuição geográfica da espécie nos Neotrópicos. Considerando o amplo intervalo de tempo entre os registros e a restrita área de ocorrência no país, recomenda-se sua inclusão como quase ameaçada na Lista Vermelha do Brasil.

Palavras-chave: Neotrópicos , bioma Pampa, lista vermelha, Reticulariaceae, fungos mucilaginosos.

Reticulariaceae (Liceales, Myxomycetes) comprises 36 species distributed in the genera *Alwisia*, *Dictydiaethalium*, *Lycogala*, *Reticularia*, and *Tubifera* (Martin & Alexopoulos 1969; Martin *et al.* 1983; Lado 2005-2021). Aethalia or pseudoaethalia characterize approximately 80% of the species, and the majority exhibit pseudocapillitium and reticulated spores. In the delimitation of the family proposed by Leontyev *et al.* (2014a, 2019), the genus *Dictydiaethalium* was excluded, and the presence of capillitium was recognized in *Alwisia* and *Lycogala* species based on analyses by McHugh & Reid (2008) and Leontyev *et al.* (2014b, c).

Reticulariaceae species are distributed in both hemispheres and, according to the literature review for the period 1828–2008 carried out by Lado & Basanta (2008), at least 16 of them are present in

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20 neotropical countries, highlighting *Lycogala epidendrum* (L.) Fr. and *Tubifera microsperma* (Berk. & MA Curtis) GW Martin because of their wide distribution. In Brazil, the five genera of the family, represented by thirteen species, are present in all regions and phytogeographic domains of the country, and occur both in natural environments and in those altered by human activity (Cavalcanti & Brito Jr. 1990; Agra *et al.* 2020; Cavalcanti *et al.* 2020).

The genus *Lycogala* currently includes seven species (Lado 2005-2021), that are widely distributed throughout both hemispheres, excluding *L. fuscoviolaceum* Onsberg, described in the 1970s, which is found in India (Onsberg 1972). They are easily detected in the field because of the dimensions and color of the aethalia, which are reddish-pink, coral, or orange when still immature and become grayish to ochraceous when mature, with a smooth surface or with scales. Some species of the genus, such as *L. epidendrum*, are widely distributed globally and are often collected in inventories carried out in different countries, while others, such as *L. flavofuscum* (Ehrenb.) Rostaf. have been recorded in Europe, the Americas, Asia, Africa, and Oceania, but the authors are almost unanimous in emphasizing that it is not commonly observed (Lister 1925; Skupienski 1934; Nannenga Bremekamp 1991; Neubert *et al*. 1993; Ing 1999; Kylin *et al.* 2013; Poulain *et al.* 2011). Some researchers such as Lister (1925) and Macbride & Martin (1934), for example, after listing its occurrence in Germany, Austria, France, England, Poland, Sweden, and countries in Asia, South Africa, North and South America, commented that *L. flavofuscum* is not a very common species despite its wide distribution. Neubert *et al.* (1993) reported that the few records made in Germany were in May and October, when temperatures are milder. Ing (1999) also commented that *L. flavofuscum* is present in temperate regions, but the records available until that date were old and scarce in Wales and Scotland, and it had not been observed in Ireland. In the Neotropics, *L. flavofuscum* has been recorded in Argentina, Brazil, Mexico, Panama, and Uruguay, which corresponds to less than 20% of the countries listed by Lado & Basanta (2008).

In Brazil, the genus *Lycogala* is well represented, with a record of 70% of the species accepted by Lado (2005-2021). *Lycogala epidendrum* is present in all regions and in almost all phytogeographic domains and is frequently recorded in the Atlantic rainforests. *Lycogala conicum* Pers. and *L. exiguum* Morgan, although less frequently, have also been recorded in all regions. *Lycogala confusum* Nann.- Bremek. *ex* Ing has records only in ombrophilous forests in the northeast (Pernambuco) and in the south (Rio Grande do Sul), whereas *L. flavofuscum* is only known to occur in the southern region of the country (Agra *et al.* 2020).

In her monograph on the Myxomycetes of the Neotropics, Farr (1976) mentioned the occurrence of *L. flavofuscum* in Brazil based on exsiccate deposited in the BPI Herbarium without indicating the registration number, collector, or place of collection. Lado & Basanta (2008) cited the species in Brazil based on the material reported by Farr (1976). Information extracted from the database maintained by the U.S. National Fungus Collections indicates that 80 exsiccates of *L. flavofuscum* are part of the collection, and those with numbers BPI 723177 and BPI834751 were collected in Brazil (Farr & Rossman 2021). Cavalcanti (2010) commented that, although the geographic coordinates of the exsiccate BPI 723177 indicate the city of São Gabriel, in Rio Grande do Sul as the collection site, they were probably not included in the original label, as well as the year of collection. The two samples were sent by Rev. J. Rick to the American mycologist Curtis Gates Lloyd, who identified the samples and deposited them in his private herbarium, which was transferred to the United States Department of Agriculture Mycology Collections in 1927 and incorporated into the collection of the USDA Agricultural Research Service US National Fungus Collections (Herbarium BPI), in Beltsville, Maryland.

Despite being easily observed in the field due to the size of the aethalia, after the first record of the species in Brazil (Lloyd 1920–1921), new reports of the occurrence of *L. flavofuscum* have not been published, even in well-explored biomes such as Atlantic Forest and the Cerrado. Moreover, it has not been mentioned in literature reviews and species lists published for different states and regions of Brazil (Farr 1960; Rodrigues & Guerrero 1990; Gottsberger *et al.* 1992; Cavalcanti & Fortes 1994; Hochgesand & Gottsberger 1996; Putzke 1996, 2002; Cavalcanti *et al.* 1999, 2006; Cavalcanti 2002; Maimoni-Rodella 2002; Sobestiansky 2005; Alves *et al.* 2010; Bezerra *et al.* 2014; Xavier de Lima & Cavalcanti 2017; Velloso *et al.* 2020).

The main objective of this paper is to confirm the presence of *L. flavofuscum* in the Brazilian myxobiota, based on material recently collected in the municipality of São Gabriel, Rio Grande do Sul. In addition, its distribution in neotropical countries is presented and its inclusion in the Red List of Threatened Species in Brazil is recommended

The municipality of São Gabriel is located in southern Brazil (Fig. 1), 320 km from Porto Alegre, the capital of the state of Rio Grande do Sul, 320 km from the border with Argentina and 170 km from the border with Uruguay (Nakahori & Souza 2012), with a territorial area of 5.051.904 km^2. Of this area, approximately 80% is dominated by plains and depressions with few plateaus, resulting in an altitude range of approximately 400 m (Arruda & Cassol 2018). The climate is of the Cfa type (humid temperate climate with hot summer) according to the Köeppen classification (Moreno 1961). The monthly average temperature is 19.5 °C, with 24.9 °C being the average of maximum temperatures and 14.2 °C being the average of minimum temperatures. The average annual normal rainfall for 30 years, evaluated in the period 1976 to 2005, is 1,423.9 mm; rainfall is well distributed throughout the year with a minimum of 80.1 mm in August and a maximum of 146.6 mm in April (CEMETRS 2011).

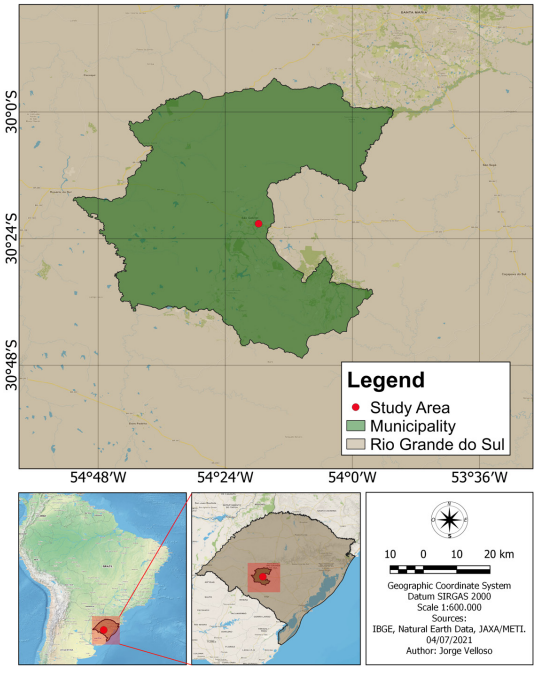

Figure 1 – Area of *Lycogala flavofuscum* occurrence in Brazil.

The gallery forest where the specimen collection was carried out is surrounded by grasslands typical of the steppe formations of the Brazilian Pampa, located in the area of the Ibicuí River Depression. This region is at an elevation of approximately 120 m in the Morro do Sabiá locality (30°21'10"S, 54°17'42"W) and is approximately 5 km from the center of the municipality (Fig. 2a-d). The soil is of the Alic Dark Red Podzolic Argisol type, and is moderately vulnerable to erosion, as it is located in an area of shield slope to the depression, where drainage increases (Arruda & Cassol 2018). Among the local flora, trees and shrubs of the Myrtaceae, Thymelaeaceae, Rutaceae, Malvaceae, and Euphorbiaceae families are common, especially native species typical of the region, such as *Daphnopsis racemosa* Griseb., *Eugenia uniflora* L., *Luehea divaricata* Mart. & Zucc., *Sebastiania commersoniana* (Baill.) LB Sm. & Downs, and *Zanthoxylum rhoifolium* Lam.

On excursions to the site from January 2019 to January 2021, the species was found only in February 2019, which corresponds to the hot and humid season in the region. Analysis of the collected material was performed at the Fungi Taxonomy Laboratory at the Federal University of Pampa (UNIPAMPA), and at the Myxomycetes Laboratory (LABMIX) at the Federal University of Pernambuco (UFPE). After identification (Farr 1976; Poulain *et al.* 2011; Lado 2005-2021), the specimens were dehydrated in an oven (40 °C) for 48 h and placed in the Bruno Edgar Irgang Herbarium of the Federal University of Pampa.

Occurrence records of *L. flavofuscum* (country, locality, environment type, substrate, collection year, collector, and determinant) were obtained from online databases such as DiscoverLife (<https://www.discoverlife.org>), SpeciesLink (<specieslink.net>), Flora of Brazil (<floradobrasil.jbrj.gov.br>), and Global Biodiversity Information Facility (<https://www.gbif.org>), complemented with information on the species found in exsiccates from Herbaria AH, BPI, FH, CESUES, BCMEX, and IBUG (acronyms according to Thiers, continuously updated) and classic monographs of myxomycetes, book chapters, and articles. Distribution maps of the species in the Neotropics and Brazil were assembled using the QGIS software on a Google Satellite basemap.

The criteria and guidelines of the International Union for Conservation of Nature (IUCN 2012), version 4.0, were used to classify the conservation status of the species in Brazil.

Lycogala flavofuscum (Ehrenb.) Rostaf. *in* Fuckel, Jahrb. Nassauischen Vereins Naturk. 27-28:68. 1873.
≡ *Diphtherium flavofuscum* Ehrenb., Sylv. myc. berol. 27. 1818.
≡ *Reticularia flavofusca* (Ehrenb.) Fr., Syst. mycol. 3(1):88. 1829. Fig. 2e

Aethalia grouped, subglobose to pulvinate, 2.1–3 cm in diam.; cortex thick, silvery gray to ochraceous, almost smooth; hypothallus white, well-developed; pseudocapillitium consisting of colorless, branched, nearly smooth to wrinkled, papillose tubules, primary tubules 30–58 µm diam., secondary tubules 10–18 µm in diam., with free and rounded ends; spores in mass beige, hyaline to slightly olivaceous by transmitted light, reticulated over most of the surface, 5.6–6.1 µm diam.
Examined material: São Gabriel, Morro do Sabiá, 30°21'10''S, 54°17'42''W, on the dead part of a living trunk of *Sebastiania commersoniana* (branquilho), 13.II.2019, *J.R.P. Velloso* 093 (HBEI 045).

The taxonomic characters of diagnostic value of this species are the large pulvinated aethalia, with 1–7(–10) cm in diameter, thick, crusty peridium, regularly wrinkled, almost smooth, and a pseudocapillitium with thick filaments, 10–80 µm diam., covered by papillae up to 1 µm (Lister 1925; Farr 1976; Eliasson & Sunhede 1980; Lado & Pando 1997). Lister (1925) noted that large, isolated vesicles filled with granular material, measuring between 50 and 100 µm diam., dispersed among the spores, are frequently seen under the microscope. These were not observed in the material collected in São Gabriel.

Aethalia are smaller in groups and larger when isolated, reaching up to 10 cm in certain environments (Macbride & Martin 1934; Nannenga-Bremekamp 1991). Farr (1976), in the description of *Lycogala* species occurring in the Neotropics, mentioned aethalia of 2–7 cm, spores of 5–6 µm diam., and a colorless pseudocapillitium, which is almost smooth to papillose. Poulain *et al.* (2011) described the species as having slightly smaller aethalia, 1.8–4 cm, slightly larger spores, 5–6.5(–7) µm diam. and pale beige verrucose to minutely spinulose pseudocapillitium. The examined material presents aethalia closer to what is described by Poulain *et al.* (2011), but the pseudocapillitium and spores are similar to Farr's description.

The color of the plasmodium, usually voluminous, was described by Macbride & Martin (1934) as light pink (brick-red in var. *argentea*), becoming yellowish when the sporulation process starts, during which the aethalium initially white, gradually become yellowish, appearing silvery gray to ochraceous when mature. The type material of *Diphtherium flavofuscum*, basonym of *L. flavofuscum*, was not clearly indicated in the original description presented by Ehrenberg (1818), who mentions the color changes of aethalium. Fries (1829), in his proposal for the inclusion of the species in the *Reticularia* genus, provided more details about the morphology of the aethalium and pseudocapillitium and also described the color changes during the process of maturation of aethalia: "*Color primo albus, dein flavo-umbrinus, interdum maculatus, ...*". Lloyd (1920–1921) stated that in American samples of *L. flavofuscum*, he never observed the yellow or yellowish coloration, either light or dark, mentioned by the species author, which gave rise to the specific epithet, nor the brown-ochraceous or brown-purple color used by Lister (1925). The aethalia collected recently in São Gabriel were already in full maturation, showing a silvery gray to ochraceous color.

Several authors such as Nannenga-Bremekamp (1991), Neubert *et al.* (1993), and Ing (1999) commented that the species can be confused with *Reticularia lycoperdon* Bull., but the two are clearly distinguished by the color of the spore print. Lloyd (1920–1921) analyzed the figures by Ehrenberg (1818) and concluded that one is likely *R. lycoperdon* because of its yellowish color, while the other, silvery gray, would correspond to the new species. It has also been pointed out by authors such as Macbride & Martin (1934) and Farr (1976) the strong similarity shared by the large and smooth sporocarps of *L. flavofuscum* with those of gasteromycetes; thus, it is possible that some specimens collected in Brazil during the beginning of the 20th century are deposited in herbaria, such as the PACA, in Rio Grande do Sul, incorrectly identified as *Reticularia* or even as Gasteromycetes, which makes it necessary to review collections.

When mentioning the distribution of *L. flavofuscum*, Rostafinski (1875) only reported that the species was collected by himself in Warsaw, Poland; Calvin in Brittany, western France; Ehrenberg in Berlin, Germany; De Bary in Halle, Germany; and Wallroth in Thuringia, in east-central Germany. He did not mention the substrates from which these materials were collected. According to Fries (1829), the substrate of the material type, not indicated in the diagnosis, was dead tree trunk,

Figure 2 – a-e. Area of collection and substrate where *Lycogala flavofuscum* was recorded in Morro do Sabiá, São Gabriel, RS – a-b. gallery forest; c. trunk of *Sebastiania commersoniana* (branquilho), a native species from Brazil, typical of the region; d. area on the *S. commersoniana* tree, where aethalia were collected; e. mature aethalia (*JRP Velloso* 93, II.2019, HBEI 045).

in Germany. In the different countries where *L. flavofuscum* occurs, plant species of economic value, mainly timber, such as those of the genera *Acer*, *Alnus*, *Betula*, *Carpinus*, *Cupressus*, *Fagus*, *Fraxinus, Liriodendron, Malus, Picea, Populus, Quercus*, *Salix*, *Tilia*, and *Ulmus*, were cited as substrates, occasionally on prepared timber and even shop fronts (Fries 1829; Lister 1925; Skupienski 1934; Macbride & Martin 1934; Ing 1999; Lizárraga *et al.* 2008a; Farr & Rossman 2021).

Aethalia of *L. flavofuscum*, usually isolated, are found inside or on the surface of tree stumps, fallen or standing dead trunks, and often in dead parts of old living trees (Fries 1829; Lister 1925; Skupienski 1934; Nannenga-Bremekamp 1991; Neubert *et al*. 1993; Lizárraga *et al.* 2008b). Skupienski (1934) comments that, as mentioned by authors from other countries, his few collections of the species in Poland were obtained from trunks of living trees, between 1.5 and 4 m above the ground. According to Farr (1976), the plasmodium sometimes moves up on living tree trunks to fruit; however, considering the distance from the ground to the place where the aethalia are commonly found, always more than 1 m, the entire life cycle must certainly occur in the tree trunk. The specimen obtained in the gallery forest of Morro do Sabiá sporulated over a dead part of a living trunk of *S. commersoniana*, approximately 1.5 m above the ground (Fig.2 a-d). Therefore, even sporulating on the trunk of live trees, *L. flavofuscum* should be considered lignicolous as it does not develop in the bark but in dead parts resulting from falling branches or other types of accidents, as illustrated in Figure 2d, from the portion of the trunk of *S. commersoniana* where the sample was obtained.

In the literature review of the neotropical myxobiota presented by Lado & Basanta (2008), which included all territories between Mexico and Tierra del Fuego, as the northern and southern limits, respectively, records of *L. flavofuscum* occurrence are presented for Argentina, Brazil, Mexico, Panama, and Uruguay. In the survey of literature and herbarium collections carried out in this study regarding the distribution of this species in the Neotropics, citations for the same countries were found, primarily based on sparse, old collections; data on occurrence localities, climate and vegetation of the species in the five countries are presented in Figure 3 and Table 1.

In the Neotropics, the oldest record is from 1906 and was compiled by Roland Thaxter at the Santa Catalina Agricultural School in Lavallol,

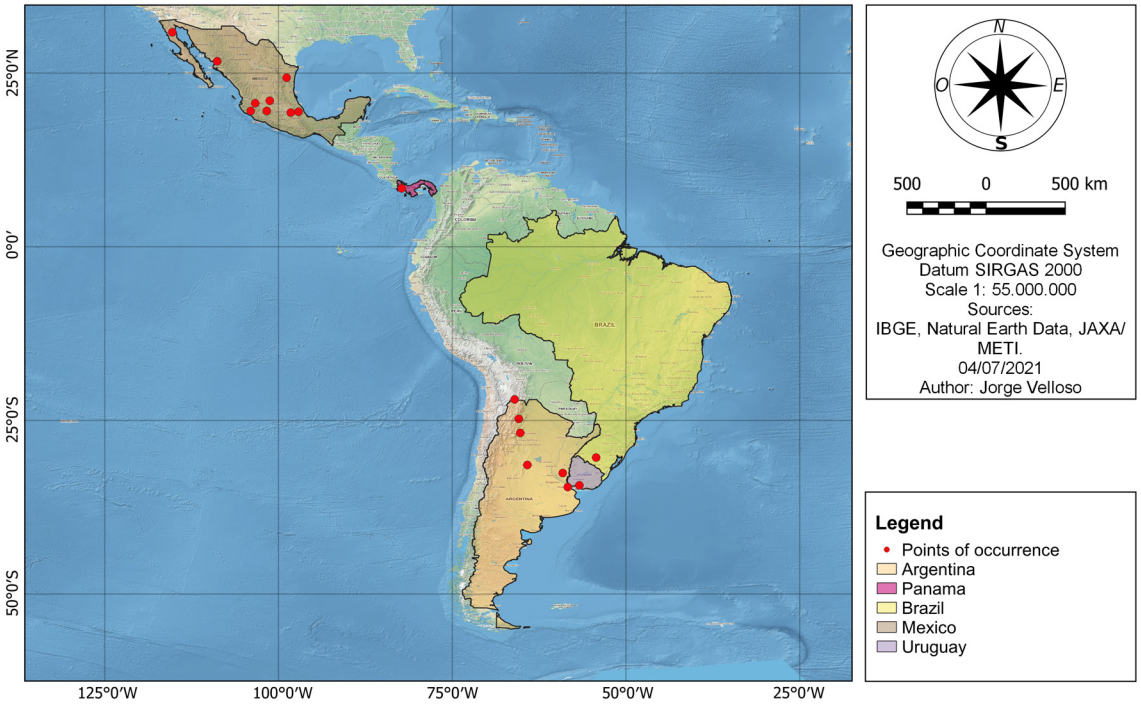

Figure 3 – Known distribution of *Lycogala flavofuscum* in the Neotropics.

Table 1 – Elevation and climatic data of localities with records of *Lycogala flavofuscum* in the Neotropics. Period 1906 to 2021. * Köppen's classification.

Country	Locality	Elevation (m)	Type of climate*	Temperature (°C)	Pluviosity (mm)
Argentina	Buenos Aires	25	Cfa	17.3	1,112
	Córdoba	414	Cfa	17.1	944
	Entre Ríos	...	Cfa	19	1,352
	Salta	1,152	Cfa	16.5	1,416
	Tucuman	449	Cfa	18.5	2,149
Brazil	São Gabriel	120	Cfa	19.5	1,423.9
Mexico	Baja California	578	BSh	…	200
	Chiapas	...	Aw	…	…
	Ciudad de Mexico	2,240	Cwb	16	1,058
	Guanajuato	2,060	Cwb	17.3	779
	Jalisco Guadalajara	1,553	Csa	20.9	860
	Michoacan	1,921	Cwb	15	1,653
	Sonora	592	Bwh / Bsh	24	…
	Tamaulipas	126	BSh	18.2	576
	Tlaxcala	2,425	Cwb	14.1	1,032
Panama	Chiquiri	257	Aw / As	…	…
Uruguay	San José	45	Cfa	18.4	1,316

Lomas de Zamora, Buenos Aires, Argentina, deposited at the Cryptogamic Herbarium of Harvard University and analyzed by Sturgis (1916). Digilio (1946) cited collections carried out in Cordoba, in 1918, and in the city of Villaguay, province of Entre Ríos, in 1919, on dead branches, both listed by C. Spegazzini in one of his articles on myxomycetes from Argentina, published in 1926. Crespo & Lugo (2003) added the provinces of Salta and Tucuman, north of the country, to the species distribution area in Argentina, based on collections carried out in the 1980s and the 1990s.

Farr (1976) and Lado & Basanta (2008), based on Martin (1936), included Panama in the known distribution area for *L. flavofuscum*, without year or collection locality information. In the summer of 1935, G.W. Martin spent six weeks on the west coast of Panama and carried out most collections in the Chiquiri River valley at an altitude of 1,600–1,800 m (Martin 1936), being Chiquiri the only province with a record of the species in the list of fungi prepared by Piepenbring (2006) for the country.

Despite not being located in the tropical zone, but presenting subtropical characteristics, Uruguay was included in the lists by Farr (1976) and Lado & Basanta (2008). Specimens of *L. flavofuscum* were collected in 1933 by W.G. Herter in San José, in the southwest of the country, and the species was again recorded three decades later, in 1967, by N. Garcia-Zorron (Lado 2018).

In Mexico, *L. flavofuscum* is widely distributed, from Baja California and Sonora, in the north, on the US border, to the south, in Chiapas, on the Guatemala border, and its occurrence is also referred to Ciudad de Mexico, Guanajuato, Jalisco, Michoacan, Tamaulipas, and Tlaxcala (Ogata *et al.* 1994; Lizárraga *et al.* 2008a, b; Lado 2018). Collections in Mexico were carried out over long periods, with the oldest obtained in the late 1960s in an urban environment and a coniferous forest (Villarreal 1990). In the first study on the myxobiota of the state of Sonora, *L. flavofuscum* was collected on decaying wood in riparian forest on the outskirts of the city of Arizpe (Pérez-Silva *et al.* 2001). Other collections were carried out in different localities,

such as Michoacán and Sierra de Alamos, in tropical deciduous and subdeciduous forest, secondary vegetation of shrubs and herbs, and coniferous forest at altitudes of 300–650 m (Lizárraga *et al*. 2008a, b). In Baja California, a 1,300 km long peninsula known worldwide for its rich biodiversity and levels of endemism, *L. flavofuscum* has records in the two states and was found for the first time in the vicinity of the San Telmo stream, a few kilometers from San Quintin (Illana *et al.* 2000; Moreno *et al.* 2001); and in 1993, aethalia were found in the Serra of São Pedro Mártir, on decaying wood of *Salix lasiolepis* Benth., with exsiccate deposited in the BCMEX herbarium (Lado 2018). In 2005 and 2006, samples were obtained from two localities in the Serra de Alamos in areas of tropical deciduous and subdeciduous forest, *Quercus* sp., and secondary herbaceous shrub vegetation, with exsiccates deposited in the herbaria AH and CESUES (Lizárraga *et al.* 2008a,b).

In Brazil, despite being registered by Lloyd (1920–1921), the collection locality of *L. flavofuscum* has not been indicated; it is only known that the author conducted his investigation based on material sent by Rev J. Rick. Considered the father of Brazilian mycology, Rick carried out numerous collections in the southern states of the country, and much of his collection is preserved at the PACA Herbarium in the state of Rio Grande do Sul, where he settled after his arrival from Europe until his death in 1946. No other specimens were found in the material deposited in Brazilian herbaria. Considering the period of activity of J. Rick (1903–1946) and the date of Lloyd's publication, it is possible to place the year of collection of the two specimens between 1915 and 1919. The two exsiccates examined by Lloyd, currently at Herbarium BPI, were updated with coordinates that indicate the location and state where they were collected. The label of exsiccate 723177 shows São Gabriel, Rio Grande do Sul, while exsiccate 834751 shows municipality of Vila Rica, on the triple border of Mato Grosso with Pará and Tocantins in central Brazil, according to the coordinates contained in GBIF, based on the University of Arkansas database (2021). There was certainly a mistake in placing the coordinates because no record of Rick's travels to the Midwest of the country have been found, nor are there records that he received material from that region. Hence, it is the most likely that both were collected by Rick in Rio Grande do Sul and are even duplicates. Thus, the municipality of Vila Rica was not included as one of the points of occurrence of the species in Brazil in the maps in Figures 1 and 3.

Based on the data obtained in the present study on the distribution of *L. flavofuscum* in the Neotropics, it can be seen that the species occurs in places with different altitudinal ranges, from below 150 m, such as Buenos Aires and São Gabriel, to above 2,000 m, such as Mexico City and Guanajuato (Tab. 1). In most localities, the climate is of group C (temperate), with abundant rainfall that is well distributed throughout the year, well-defined winter and summer, with 40% of the region being humid temperate with hot summer (Cfa), 23% being humid temperate with dry winter (Cwb), and 14% being humid temperate with dry and hot summers (Csa). The warm climates of the steppes (Bsh) and arid (Bwh) are observed in some localities in Mexico (Tab. 1). There was no evidence of a preference for the type of vegetation, as the species has records both in urban environments (Sturgis 1916; Pérez-Silva *et al.* 2001; Villarreal 1990), altered by man, as an artificial forest of casuarina and eucalyptus (Lado 2018), coniferous forests (Villarreal 1990), deciduous and subdeciduous broadleaved forests, and shrub-herbaceous vegetation (Lizárraga *et al.* 2008a,b). The annual rainfall range is also wide, from 200 mm (Baja California, Mexico) to 2,149 mm annually (Tucumán, Argentina). As seen in Table 1, the areas of occurrence of *L. flavofuscum* in South America (Argentina, Brazil, and Uruguay) share a Cfa-type climate, with a great altimetric variation (25 m to 1,152 m) and vegetation types, while in Mexico, they share warm to semi-arid climates and are located at high altitudes (500 m to 2,425 m); the groupings, at the two extremes of the Neotropics, can be seen in the distribution map of the species in the Neotropics of Figure 3.

The data presented here confirm that the geographical distribution area of *L. flavofuscum* includes southern Brazil, but it is rare and limited, as far as everything indicates, to the Pampa biome. The rediscovery of the species in the same region and phytogeographic domain suggests that its restricted distribution area could be explained by the predominant climate in the southern region, which is different from the types found in other regions of the country.

In the analysis described in this paper, it was found that, although apparently generalist and very easily observed in the microhabitats it occupies, *L. flavofuscum* is rarely collected in the Neotropics, with years of interval between collections, most

often with only one registration by locality. In the IUCN Red List for Fungi, the inclusion of *L. flavofuscum* was proposed in 2017, and is still under analysis. This fact, associated with the long time interval between records of its presence in the field as well as the restricted distribution area in the Brazilian territory, suggests that the species could be included in the Red List of Fungi in Brazil under the category of near threatened.

Inventories focused on species of Reticulariaceae are recommended, with attention to areas that are already legally protected to discover more populations of *L. flavofuscum* and promote knowledge about its distribution in the Brazilian territory.

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