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Bryophytes in Maranhão/Brazil: A New Area, a New Species List

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Abstract*—*Bryophytes were collected from a Cerrado fragment, located in the municipality of Caxias, Maranhão/Brazil. In the study area, 175 bryophytes were distributed in 12 families (10 mosses and two liverworts), 17 genera (15 mosses and two liverworts) and 23 species (21 mosses and two liverworts). Sematophyllaceae was the most representative family with four species (Trichosteleum subdemissum, Microcalpe subsimplex, Brittonodoxa subpinnata, and Taxithelium planum), followed by Dicranaceae, Fissidentaceae, and Pottiaceae with three species each. The species of bryophytes in the researched area colonized substrates, such as corticolous, terrestrial, rupicolous, epixylics and casmofites. The table shows the families, species, phytogeographic domains in Brazil and colonized substrates.

Keywords*—*Mosses, Liverworts, Biodiversity.

I. INTRODUCTION

The bryophytes are cryptogamic plants with heteromorphic alternation of generations (GRADSTEIN et al., 2001), represented by Anthocerotophyta, Marchantiophyta and Bryophyta (GLIME, 2013), being the second largest group of terrestrial plants after the angiosperms (BUCK; GOFFINET, 2000). They are predominantly terrestrial, with close dependence on water for sexual reproduction, since male gametes are flagellated (COSTA et al., 2010).

Brazil harbors tone of the last regions of forests, wetlands, and savannas, which are important for global climate stability and biodiversity conservation (KEHOE et al., 2019). The number of phytogeographical domains and environments makes Brazil, one of the countries that have an expressive diversity of mosses, liverworts, and hornworts, probably subsample because of the continental dimensions, with more species registered for the states of Rio de Janeiro (900 sp.), São Paulo (900 sp.), Minas Gerais (76 spp.), And for other states the number of species is lower.

The Brazil has a significant richness of bryophytes, most of which are of neotropical origin (GRADSTEIN et al., 2001), with a record of 1574 species for the country and 89 for the state of Maranhão (COSTA, PERALTA, 2015, BFG, 2018), corresponding to 5.6% of the total number of species known for Brazil.

The preservation of environments in tropical rainforestregions, whether in the Amazon Rainforest or in the Atlantic Rainforest region, as well as in vegetation

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of the Caatinga and Cerrado, which favors the development of bryophyte species, there are still unexplored areas that require intensified collections in the three groups of bryophytes to be known the real number of species for Brazil.

For Maranhão, collection efforts have been carried out by Santos (2010); Varão et al. (2011); Costa; Conceição (2014); Vieira et al. (2017); Silva et al. (2018); Costa et al. (2018); Oliveira et al. (2018a) and Oliveira et al. (2018b), to fill gaps in the knowledge of bryophytes.

The purpose of the study was to know the bryophytes, colonized substrates and Brazilian phytogeographical domains in the Buriti do Meio Municipal Environmental Protection Area, located in the municipality of Caxias, Maranhão, Brazil.

II. MATERIAL AND METHODS

The collections were carried out in the Buriti do Meio Municipal Environmental Protection Area, which covers an area of 58,347.30 ha, located 35 km from the urban perimeter of the municipality of Caxias/Maranhão (4º54'48,1"S- 43º06 ' 49.2" W).

Monthly collections were carried out by means of free walks and in all types of substrates available that the bryophytes could colonize. The methodology for the collection, herborization and preservation of the material followed Gradstein et al. (2001).

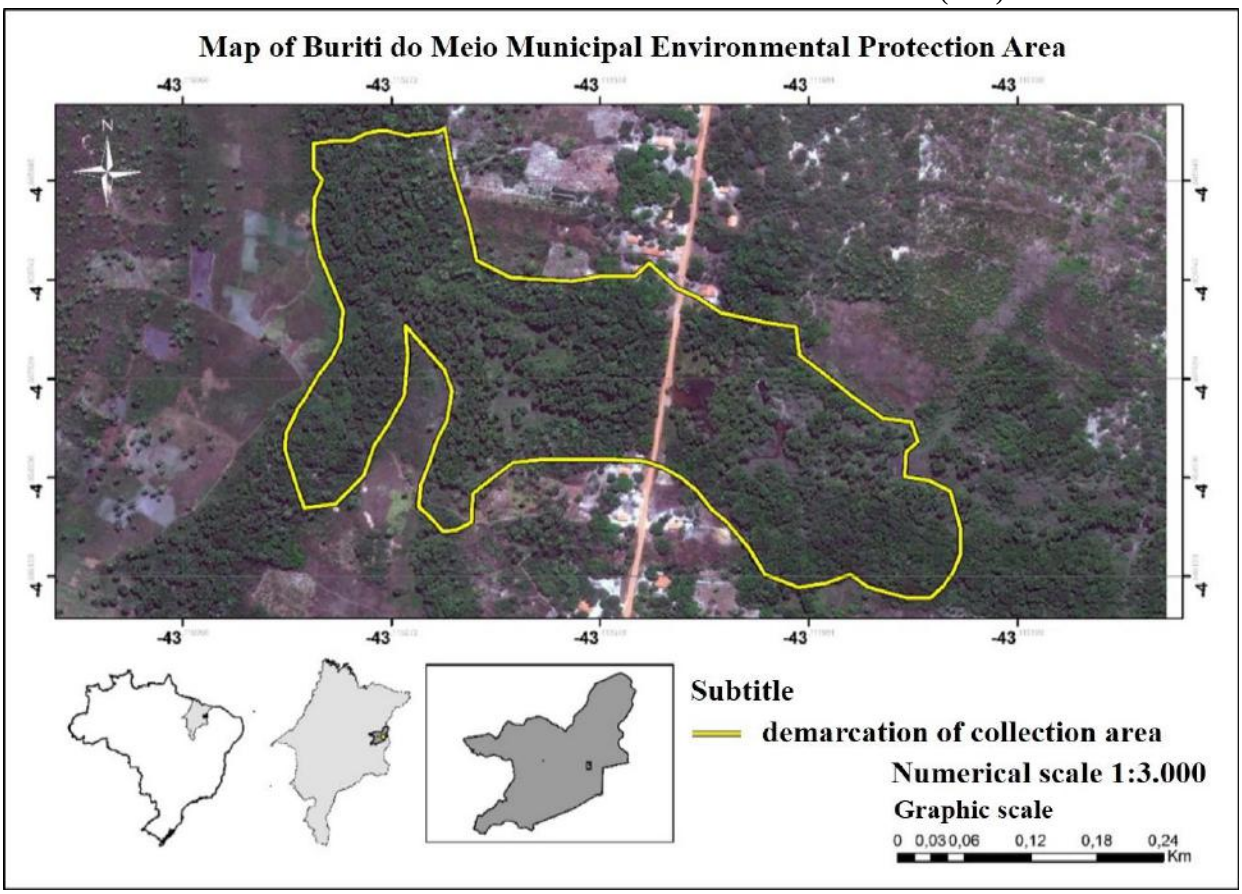

Fig.1: Location map of the Environmental Protection Area of Buriti do Meio, where the collections of Bryophytes were carried out. Source: IBGE/2013.

For the identification of the species the references of Schuster (1980), Gradstein; Buskes (1985), Frahm (1991); Gradstein (1989, 1994), Sharp et al. (1994), Buck (1998), Ilkiu-Borges (2000), Reiner-Drehwald (2000), Gradstein et al. (2001), and Gradstein; Costa (2003) Chamber; Costa (2006), Camera (2008), Ballejos; Bastos (2009), Yano; Peralta (2009).

The classification system adopted was Crandall-Stotler et al. (2009) for liverworts and Goffinet et al. (2009) for mosses. Robbins (1952) was used for the substrates of the species, where they were classified in corticolous, epixylics, epiphyllous, rupicolous, and terrestrial. The distribution in the Brazilian phytogeographical domains for the species was based on the Flora do Brasil 2020.

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III. RESULTS AND DISCUSSION

In the study area, 175 bryophytes were collected, distributed in 13 families (11 mosses and two liverworts), 17 genera (15 for mosses and two for liverworts) and 23 species (21 for mosses and two for liverworts/table 1).

As for the number of species per family presented in the study, Sematophyllaceae was the most representative with four species (*Trichosteleum subdemissum, Microcalpe subsimplex, Brittonodoxa subpinnata, Taxithelium planum*), followed by Dicranaceae (*Campylopus heterostachys, Campylopus savannarum, Campylopus surinamensis*); Fissidentaceae (*Fissidens submarginatus, Fissidens flaccidus, Fissidens angustifolius*) and Pottiaceae (*Hyophilla involuta, Hyophiladelphus agrarius, Splachnobryum obtusum*) three species each.The Sematophyllace family is one of the largest families of mosses, comprising about 40 genera and approximately 800 species (MORAES, 2006; GRADSTEIN et al., 2008).

Table 1. List of families and species of bryophytes occurring in the Buriti do Meio Environmental Protection Area, Caxias/Maranhão, Brazil; Geographical distribution in Brazil; substrates colonized by the species (Co: Corticolous; Ep: Epixylic; Ru: Rupicolous;Ca: Casmofites and Te: Terrestrial).

Family	Species	Phytogeographic Domain	Substrates
Bryaceae	*Bryum apiculatum* Schwägr.	Caatinga, Cerrado, Atlantic Rainforest	Te, Co, R
Bartramiaceae	*Philonotis uncinata* (Schwägr.) Brid.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	R, Te
Calymperaceae	*Octoblepharum albidum* Hedw.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	Ep, Co, R
	Calymperes palisotii Schwägr.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest	Co, Te
Dicranaceae	*Campylopus heterostachys* (Hampe) A. Jaeger	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest	R, Te.
	Campylopus savannarum (Müll.Hal.) Mitt.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pantanal	Te, R
	Campylopus surinamensis Müll. Hal.	Amazon Rainforest, Cerrado, Atlantic Rainforest, Pantanal	Te, Ep
Fissidentaceae	*Fissidens submarginatus* Bruch	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	Te
	Fissidens flaccidus Mitt.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	Te, Cas
	Fissidens angustifolius Sull.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	Co
Hypnaceae	*Isopterygium tenerum* (Sw.) Mitt.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	Ep
	Isopterygium tenerifolium Mitt.	Amazon Rainforest, Cerrado, Atlantic Rainforest	Ep
Pottiaceae	*Hyophilla involuta* (Hook.) A. Jaeger	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pampa, Pantanal	Ep
	Hyophiladelphus agrarius (Hedw.) R.H. Zander	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest	Ep e Co
Pterobryaceae	*Orthostichopsis praetermissa* W.R. Buck	Amazon Rainforest, Cerrado, Atlantic Rainforest	Co
Rhachitheciaceae	*Zanderia octoblepharis* (A. Jaeger) Goffinet	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest	Te, Co, e R
Sematophyllaceae	*Trichosteleum subdemissum* (Besch.) A. Jaeger	Amazon Rainforest, Cerrado, Atlantic Rainforest	Co e Ep
	Microcalpe subsimplex(Hedw.) W.R. Buck	Cerrado	Co, Ep, R

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	Brittonodoxa subpinnata (Brid.) W.R. Buck, P.E.A.S. Câmara & Carv. –Silva	Cerrado	Co, Ep
	Taxitheliumplanum (Brid.) Mitt.	Amazon Rainforest, Cerrado, Atlantic Rainforest, Pantanal	Co
Splachnobryaceae	*Splachnobryumobtusum* (Brid.) Müll. Hal.	Amazon Rainforest, Cerrado, Atlantic Rainforest, Pantanal	Te
Lepidoziaceae	*Zoopsidella macella* (Steph.) R.M. Schust.	Amazon Rainforest, Caatinga, Cerrado	Co
Lejeuneaceae	*Lejeunea trinitensis* Lindenb.	Amazon Rainforest, Caatinga, Cerrado, Atlantic Rainforest, Pantanal	Co

In relation to the genera, *Campylopus* Brid. was the most representative, with three species (*C. heterostachys*, *C. savannarum* and *C. surinamensis*), and the genus *Campylopus* has approximately 165 species in the world (FRAHM, 1999, STECH, 2004) and 30 species for Brazil and only four species to Maranhão (Flora do Brasil, 2020).

The species of bryophytes in the researched area colonized substrates, such as corticolous, terrestrial, rupicolous, epixylics and casmofites. It was observed that the largest number of species colonized the corticolous substrate in the study area.

The interest of bryophytes in colonizing these substrate is justified by the availability of favorable habitats and microclimates, where live trunks are the most available substrates for colonization, followed by decomposing trunks and earthlings that are limited in their development, by the accumulation of as well as the low illumination at ground level (RICHARDS, 1984; PORTO, 1992; GRADSTEIN et al., 2001; CARMO; PERALTA, 2016).

In relation to the distribution of the collected species, bryophytes occur in all Brazilian phytogeographic domains, where the Amazon had the highest number of species, followed by the Cerrado, Atlantic Rainforest, Pantanal and Pampa.

IV. CONCLUSION

The research provided information on the bryophytes of the state of Maranhão/Brazil, with emphasis on a Cerrado fragment from the municipality of Caxias/MA. The 23 bryophyte species registered in the research represent 25.8% of the species known for Maranhão, which indicates that new studies should be encouraged to register species in new areas not yet exploited to fill knowledge gaps for the plant group.

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