Article

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A checklist of the bryophytes from Amapá State, Northern Brazil

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ABSTRACT - (A checklist of the bryophytes from Amapá State, Northern Brazil). A checklist is a good base for gathering registers of biodiversity and supporting further studies. The aim of this paper is to present a checklist of the bryophytes from Amapá State, including the distribution data of the species. In total, 174 species (80 mosses and 94 liverworts) in 78 genera and 30 families are registered for Amapá State, northern Brazil, based on examined specimens and on a review of the literature. A table with the species, distribution data for all municipalities of Amapá State, and the first record for all species are presented.
Keywords: Amapá State flora, bryoflora, compilation of data, floristic study, taxonomy

RESUMO - (Uma lista das briófitas do Estado do Amapá, norte do Brasil). Uma lista é uma boa base para reunir registros de biodiversidade e apoiar novos estudos. O objetivo deste artigo é apresentar uma lista de verificação das briófitas do Estado do Amapá, incluindo os dados de distribuição das espécies. No total, 174 espécies (80 musgos e 94 hepáticas) em 79 gêneros e 30 famílias são registradas no Estado do Amapá, norte do Brasil, com base em espécimes examinados e em uma revisão da literatura. Uma tabela com as espécies, dados de distribuição para todos os municípios do Estado do Amapá e o primeiro registro para todas as espécies são apresentados.
Palavras-chave: brioflora, compilação de dados, estudo florístico, flora do Estado do Amapá, taxonomia

Introduction

The Amapá State presents several Amazonian physiognomies of high biological diversity mainly represented by dense Terra Firme forest, Várzea forest, mangrove, transition areas between forests, and savannah vegetation (IBGE 2004, Costa-Neto *et al.* 2006, ZEE 2008). The bryophyte flora in the State is still poorly known if compared to other States in Brazil (Lisboa *et al.* 2006, Oliveira-da-Silva & Ilkiu-Borges 2020), especially considering that it is one of the most preserved, with more than 72% of its territory divided into 19 conservation units (12 national, five States, and two municipal) (Drummond *et al.* 2008).

Herzog (1931) was the first work that made a study with bryophytes from the State of Amapá. He identified mosses and liverworts collected by von Lützelburg in northern Brazil, especially in the State of Amazonas and Pará. However, some collections of Herzog's study were cited as "Staat Pará: Rio Oyapock". The Oiapoque River is in the municipality of Oiapoque, in Amapá State, on the border with French Guiana. At the time of the publication of Herzog, the Amapá territory belonged to the Grão-Pará province (currently Pará State). Only in 1943, the Amapá State was separated from Pará and become a separate federal unit.

Oliveira-da-Silva & Ilkiu-Borges (2020) had already listed most studies on bryophytes in Amapá State (Crosby 1969, Grolle 1984, Yano 1981, 1982, 1984b, 1992, Yano *et al.* 1985, Yano & Lisboa 1988, Churchill 1998, Gradstein & Costa 2003, Lisboa *et al.* 2006, Gentil & Menezes 2011) discussing its advances in the State. In this study, they investigated the richness and composition of bryophytes of two Parks in Amapá, registering 63 new records for the State and three new records for the North region of Brazil. Also, they pointed out the need for more comprehensive studies on the bryophyte flora in the State.

A checklist is a good base for gathering registers of biodiversity, serving as a data basis for other studies. The bryophyte flora in Brazil is currently represented by 1.521 species, of which 18.1% are endemic, according to the BFG (2018). This number of species was reached through several studies carried out by different researchers, which enable to know the bryophytes that compose the flora of specific localities or geographic regions (*e.g.*, Gradstein & Costa 2003, Costa & Luizi-Ponzo 2010, Costa *et al.* 2011, Costa & Peralta 2015, BFG 2018), or on checklists (*e.g.*, Yano 1981, 1984, 1989, 1995, 1996, 2006, 2008, Peralta & Yano 2001, Câmara *et al.* 2005, Costa *et al.* 2005).

No comprehensive list with distribution data of bryophyte species is available for Amapá State, but the

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knowledge is spread in a few local studies (*e.g.*, Oliveira-da-Silva & Ilkiu-Borges 2020). This paper aims to fulfill this gap presenting a checklist of the bryophytes in Amapá State, including distribution data.

Material and methods

The checklist was based on the literature of bryophytes as guides, taxonomic revisions, and specific studies for Amapá already published, as follows: Herzog (1931), Crosby (1969), Yano (1981, 1982, 1984b, 1992), Grolle (1984), Yano *et al.* (1985), Yano & Lisboa (1988), Gradstein (1994), Churchill (1998), Gradstein & Costa (2003), Lisboa *et al.* (2006), Gentil & Menezes (2011), BFG (2018), Oliveira-da-Silva & Ilkiu-Borges (2020), and Macedo *et al.* (in press). The voucher cited for each species in table 1 was preferably the one examined by the authors.

Taxonomic classifications adopted are by Goffinet *et al.* (2009) and Crandall-Stotler *et al.* (2009) for Bryophyta and Marchantiophyta, respectively. The classification of Sematophyllaceae is following Carvalho-Silva *et al.* (2017), while for *Dibrachiella* and *Cryptolophocolea* we followed Shi *et al.* (2015) and Söderström *et al.* (2013), respectively.

Data on municipalities of Amapá are following the Instituto Brasileiro de Geografia e Estatística - IBGE (2019). They were standardized for all specimens in which locality was registered in the publication. Species classified as "common" present records in more than four municipalities in the State of Amapá.

Results

In Amapá State, 174 species in 78 genera and 30 families of bryophytes were registered. Mosses were represented by 80 species, 39 genera, and 21 families, while liverworts were represented by 94 species, 39 genera, and nine families (table 1). None hornwort was recorded.

Lejeuneaceae Cavers and Calymperaceae Kindb. were the most diverse families found in the State of Amapá, with 73 and 23 species, respectively. The two families represented more than 55% of the most diversified families for the State (figure 1). Genera with a higher number of species were *Syrrhopodon* Schwägr. and *Lejeunea* Lib., with 12 and 11 species, respectively. The most common species of the mosses (recorded in four or more municipalities) were *Callicostella pallida* (Hornsch.) Ångström, *Calymperes erosum* Müll. Hal., *Microcalpe subsimplex* (Hedw.) W.R. Buck, *Octoblepharum albidum* Hedw., *Syrrhopodon ligulatus* Mont., *Taxithelium planum* (Brid.) Mitt., and *Trichosteleum papillosum* (Hornsch.) A. Jaeger, and of the liverworts were *Ceratolejeunea coarina* (Gottsche) Schiffn., *C. cornuta* (Lindenb.) Steph., *Cheilolejeunea oncophylla* (Ångstr.) Grolle & M.E. Reiner, and *Leptolejeunea elliptica* (Lehm. & Lindenb.) Schiffn.

Among 16 municipalities from Amapá, bryophytes were recorded only from seven ones. The municipality of Serra do Navio presented the highest number of species (109 spp.), followed by Macapá (77 spp.), Amapá (60 spp.), Oiapoque (42 spp.), Mazagão (14 spp.), Calçoene (9 spp.), and Laranjal do Jari (2 spp.) (figure 2).

Herzog (1931) was the first to record 13 species for the Amapá State, followed by Crosby (1969) (1 sp.), Yano (1982) (3 spp.), Yano *et al.* (1985) (1 sp.), Yano & Lisboa (1988) (37 spp.), Gradstein (1994) (1 sp.), Churchill (1998) (5 spp.), Lisboa *et al.* (2006) (43 spp.), Oliveira-da-Silva & Ilkiu-Borges (2020) (61 spp.), and Macedo *et al.* (in press) (9 spp.). According to all studies on bryophytes in Amapá, 175 species were registered in the State (figure 3). The studies carried out by Yano & Lisboa (1988), Lisboa *et al.* (2006), and Oliveira-da-Silva & Ilkiu-Borges (2020) registered 80% of the bryophyte records for the State.

Discussion

With about 70% of its territory included in legally protected areas, the Amapá State is the twentieth State (from 26 States) in the number of bryophyte species (Drummond *et al.* 2008, Costa & Peralta 2015). Although the bryoflora of Brazilian Amazon is being studied for over 200 years (Lisboa 1991), the bryophyte richness in Amapá is still poorly known despite the diversity of the biome where it is inserted, but it is notably low the number of studies carried out in this State, not including a great area of its territory. Amazonas and Pará States, although with larger territories, have many physiognomies that also occur in Amapá. However, these two States presented a much higher number of bryophyte species (466 and 332 species, respectively) and a great number of studies (*e.g.*, Costa *et al.* 2011, Costa & Peralta 2015, BFG 2018). Our results showed that Amapá presented almost as the number of species found in Rondônia (166 spp.), but studies in this State was punctual (Lisboa 1993, Cerqueira *et al.* 2015, Costa & Peralta 2015, Sobreira *et al.* 2019).

Macrocolura sagittistipula (Spruce) R.M. Schust. is excluded from the list of species of Amapá. Gradstein & Costa (2003) cited the species as occurring in Amazonas and Amapá States based on the study of Grolle & Zhu (2002), but the latter authors recorded this species in Amazonas only.

Yano & Lisboa (1988) registered *Mastigolejeunea auriculata* (Wilson & Hook.) Schiffn. [= *Thysananthus auriculatus* (Wilson & Hook.) Sukkharak & Gradst.] in Mazagão municipality, however, the specimen deposited in MG herbarium (MG109797!) proved to be *Thysananthus amazonicus* (Spruce) Steph.

Cheilolejeunea savannae L.P.C. Macedo *et al.* is a species from savanna vegetation recently described by Macedo *et al.* (2020). This species was referred as *C. discoidea* (Lehm. & Lindenb.) Kachroo & R.M. Schust. by Oliveira-da-Silva & Ilkiu-Borges (2020).

The most abundant families, Lejeuneaceae and Calymperaceae, were expected to be since many studies in the Amazon recorded these families as the richest (*e.g.*, Gradstein *et al.* 2001, Macedo & Ilkiu-Borges 2014, Cerqueira *et al.* 2017, Oliveira-da-Silva & Ilkiu-Borges 2018). The two richest genera (*Syrrhopodon* and *Lejeunea*) were also expected since they are well distributed in Brazil (Gradstein *et al.* 2001, Gradstein & Costa 2003, Costa & Peralta 2015). *Syrrhopodon* is a widely distributed genus in the tropics and subtropics and assembles acrocarpous plants morphologically diverse (Reese 1993), additionally, it is the fourth richest genera of mosses in Brazil (Costa & Peralta

Table 1. Checklist of bryophytes with the distribution in municipalities and reference of the first record of each species for Amapá State. AM: Amapá municipality; MC: Macapá; SN: Serra do Navio; OP: Oiapoque; CÇ: Calçoene; MZ: Mazagão; LJ: Laranjal do Jari; (n.v.): not seen.

Tabela 1. Lista das briófitas com dados de distribuição geográfica nos municípios e referência do primeiro registro de cada espécie para o Estado do Amapá. AM: município de Amapá; MC: Macapá; SN: Serra do Navio; OP: Oiapoque; CÇ: Calçoene; MZ: Mazagão; LJ: Laranjal do Jari; (n.v.): não visto.

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
LIVERWORTS									
Aneuraceae									
Riccardia regnellii (Ångstr.) K.G.Hell		X	X					Yano & Lisboa [1988, as *Riccardia alata* (Steph.) K.G.Hell]	Gentil 513
Riccardia metzgeriformis (Steph.) R.M. Schust.		X						Yano & Lisboa (1988)	*Mori & Souza 17602* (n.v.)
Calypogeiaceae									
Calypogeia lechlerii (Steph.) Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 391
Frullaniaceae									
Frullania subtilissima (Nees ex Mont.) Lindenb.		X	X			X		Oliveira-da-Silva & Ilkiu-Borges (2020, as *Frullania exilis* Taylor)	Gentil 433
Frullania gibbosa Nees	X	X						Lisboa *et al.* (2006)	Macedo 1717
Frullania vitalii Yuzawa & S. Hatt.		X						Macedo *et al.* (in press)	Macedo 1672
Lejeuneaceae									
Archilejeunea fuscescens (Lehm.) Fulford		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 385
Acrolejeunea emergens (Mitt.) Steph.		X						Macedo *et al.* (in press)	Macedo 1723
Acrolejeunea torulosa (Lehm. & Lindenb.) Schiffn.		X				X		Macedo *et al.* (in press)	Macedo 2098
Caudalejeunea lehmanniana (Gottsche) A. Evans	X	X						Lisboa *et al.* (2006)	Gentil 94
Ceratolejeunea coarina (Gottsche) Schiffn.	X	X	X	X				Herzog (1931, as *Ceratolejeunea connata* Steph.)	Gentil 347
Ceratolejeunea cornuta (Lindenb.) Steph.	X	X	X	X				Herzog [1931, as *Ceratolejeunea megalophysa* (Spruce) Steph.]	Gentil 353
Ceratolejeunea cubensis (Mont.) Schiffn.		X	X	X				Herzog (1931)	Gentil 395
Ceratolejeunea desciscens (Sande Lac.) Schiffn.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 467
Ceratolejeunea guianensis (Nees & Mont.) Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 472
Ceratolejeunea minuta G. Dauphin			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 345
Ceratolejeunea rubiginosa Steph.	X							Lisboa *et al.* (2006)	*Costa Neto 1307* (n.v.)
Cheilolejeunea acutangula (Nees) Grolle			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 363
Cheilolejeunea adnata (Lehm.) Grolle	X							Lisboa *et al.* (2006)	Gentil 464
Cheilolejeunea clausa (Nees & Mont.) R.M. Schust.	X							Lisboa *et al.* (2006)	*Costa Neto 1491* (n.v.)

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
Cheilolejeunea savannae L.P.C. Macedo et al.		X	X					Oliveira-da-Silva & Ilkiu-Borges [2020, as *Cheilolejeunea discoidea* (Lehm. & Lindenb.) Kachroo & R.M.Schust.]	*Macedo 1600* (Paratype)
Cheilolejeunea holostipa (Spruce) Grolle & R.L. Zhu			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 497
Cheilolejeunea oncophylla (Ångstr.) Grolle & M.E. Reiner	X	X	X			X		Lisboa *et al.* (2006)	Gentil 113
C. rigidula (Mont.) R.M. Schust.	X	X	X					Lisboa *et al.* (2006)	Gentil 114
Cheilolejeunea trifaria (Reinw. *et al.*) Mizut.	X		X					Lisboa *et al.* (2006)	Gentil 504
Cololejeunea cardiocarpa (Mont.) A. Evans	X	X						Lisboa *et al.* (2006)	Gentil 204
Cololejeunea contractiloba A. Evans		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 192
Cololejeunea crenata (A. Evans) Pócs			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 491
Cololejeunea gracilis (Jovet-Ast) Pócs	X							Lisboa *et al.* (2006, as *Aphanolejeunea gracilis* Jovet-Ast)	*Costa Neto 1472* (n.v.)
Cololejeunea obliqua (Nees & Mont.) Schiffn.	X		X	X				Herzog [1931, as *Leptocolea scabriflora* (Steph) A.Evans]	Gentil 510
Cololejeunea sicaefolia (Gottsche) Pócs & Bernecker			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 528
Colura greig-smithii Jovet-Ast	X							Lisboa *et al.* (2006)	*Costa Neto 1499* (n.v.)
Cyclolejeunea chitonia (Lehm.) A. Evans			X	X				Herzog (1931)	Gentil 366
Cyclolejeunea convexistipa (Lehm. & Lindenb.) A. Evans			X	X				Herzog (1931)	Gentil 376
Cyclolejeunea foliorum (Nees) Grolle			X	X				Yano & Lisboa (1988)	Gentil 547
Cyclolejeunea luteola (Spruce) Grolle		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 347
Dibrachiella parviflora (Nees) X.Q. Shi *et al.*	X	X						Lisboa *et al.* (2006)	Gentil 88
Dibrachiella auberiana (Mont.) X.Q. Shi *et al.*	X							Lisboa *et al.* [2006, as *Achilejeunea auberiana* (Mont.) A.Evans]	*Costa Neto 1286* (n.v.)
Diplasiolejeunea brunnea Steph.	X		X					Lisboa *et al.* (2006)	Gentil 373
Diplasiolejeunea pellucida (Spreng.) Schiffn.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 388
Drepanolejeunea araucarae Steph.	X							Lisboa *et al.* (2006)	*Costa Neto 1291* (n.v.)
Drepanolejeunea crucianella (Taylor) A. Evans			X	X				Herzog (1931, as *Drepanolejeunea trifida* Steph.)	Gentil 471
Drepanolejeunea fragilis L. Söderstr.	X	X	X					Lisboa *et al.* (2006)	Gentil 433
Harpalejeunea oxyphylla (Nees & Mont.) Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 401
Harpalejeunea tridens (Besch. & Spruce) Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 415
Lejeunea adpressa Nees		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 101

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
Lejeunea aphanes Spruce			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 501
Lejeunea asperrima Spruce			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 531
Lejeunea boryana Mont.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 537
Lejeunea cerina (Lehm. & Lindenb.) Lehm. & Lindenb.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 532
Lejeunea controversa Gottsche		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Macedo 1899
Lejeunea flaccida Lindenb. & Gottsche	X							Lisboa *et al.* [2006, as *Taxilejeunea lusoria* (Lindenb. & Gottsche) Steph.]	*Costa Neto 1486* (n.v.)
Lejeunea flava (Sw.) Nees			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 502
Lejeunea glaucecens Gottsche		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020, as *Lejeunea caulicalyx* (Steph.) M.E.Reiner & Goda)	Gentil 112
Lejeunea immersa Spruce		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 454
Lejeunea laetevirens Nees & Mont.	X	X	X					Lisboa *et al.* (2006)	Gentil 135
Lepidolejeunea involuta (Gottsche) Grolle	X		X					Lisboa *et al.* (2006)	Gentil 348
Leptolejeunea elliptica (Lehm. & Lindenb.) Schiffn.	X	X	X	X				Herzog (1931)	Macedo 2091
Lopholejeunea subfusca (Nees) Schiffn.	X	X	X					Lisboa *et al.* (2006)	Gentil 503
Metalejeunea cucullata (Reinw. *et al.*) Grolle			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 410
Microlejeunea epiphylla Bischl.	X	X	X					Lisboa *et al.* (2006)	Gentil 497
Myriocoleopsis minutissima R.L. Zhu *et al.* ssp. *minutissima*		X				X		Macedo *et al.* (in press)	Macedo 1525
Neurolejeunea breutelii (Gottsche) A. Evans			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 358
Odontolejeunea lunulata (F. Weber) Schiffn.	X		X	X				Herzog (1931)	Gentil 371
Odontolejeunea rhomalea (Spruce) Steph.				X				Gradstein (1994)	*von Lützelburg 20199* (n.v.)
Otigoniolejeunea huctumalcensis (Lindenb. & Gottsche) Y.M. Wei *et al.*			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 352
Pictolejeunea picta (Steph.) Grolle			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 540
Prionolejeunea aemula (Gottsche) A.Evans			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 500
Prionolejeunea denticulata (F. Weber) Schiffn.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 351
Prionolejeunea mucronata (Sande Lac.) Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 348
Prionolejeunea muricatoserrulata (Spruce) Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 372
Pycnolejeunea contigua (Nees) Grolle			X			X		Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 433

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
Rectolejeunea versifolia (Schiffn.) L. Söderstr. & A. Hagborg	X		X					Lisboa *et al.* (2006)	Gentil 389
Stictolejeunea squamata (F. Weber) Schiffn.			X	X				Herzog (1931)	Gentil 355
Symbiezidium barbiflorum (Lindenb. & Gottsche) A. Evans		X	X	X				Herzog (1931)	Gentil 372
Symbiezidium transversale (Sw.) Trevis.	X	X		X				Yano & Lisboa (1988)	*Mori et al. 17147* (n.v.)
Thysananthus amazonicus (Spruce) Steph.						X		Yano & Lisboa [1988, as *Mastigolejeunea auriculata* (Wilson & Hook.) Schiffn.]	*Mori & Cardoso 17481* (n.v.)
Thysananthus innovans (Spruce) Sukkharak & Gradst.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Macedo 1640
Xylolejeunea crenata (Nees & Mont.) X.-L. He & Grolle	X	X	X					Lisboa *et al.* (2006)	Gentil 434
Lepidoziaceae									
Protocephalozia sp.		X						Macedo *et al.* (in press)	Macedo 1639
Zoopsidella serra (Spruce) R.M. Schust.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 378
Lophocoleaceae									
Lophocolea liebmanniana Gottsche			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 447
Cryptolophocolea martiana (Nees) L. Söderstr. *et al.*			X	X				Yano & Lisboa (1988, as *Lophocolea martiana* Nees)	Gentil 540
Cryptolophocolea perissodonta (Spruce) L. Söderstr.		X						Yano & Lisboa [1988, as *Lophocolea perissodonta* (Spruce) Steph.]	*Mori et al. 17259* (n.v.)
Metzgeriaceae									
Metzgeria aurantica Steph.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 384
Plagiochilaceae									
Plagiochila aerea Taylor			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 537
Plagiochila disticha (Lehm. & Lindenb.) Lindenb.		X	X					Yano & Lisboa (1988)	Gentil 360
Plagiochila montagnei Nees		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 205
Plagiochila gymnocalycina (Lehm. & Lindenb.) Mont. & Nees		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 242
Plagiochila raddiana Lindenb.		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 353
Plagiochila rutilans Lindenb.		X						Yano & Lisboa (1988)	*Mori & Souza 17602* (n.v.)
Plagiochila subplana Lindenb.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 346
Radulaceae									
Radula flaccida Lindenb. & Gottsche			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 349
Radula javanica Gottsche	X		X	X				Yano & Lisboa [1988, as *Radula complanata* (L.) Dumort.]	*Mori et al. 17221* (n.v.)

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
MOSSES									
Bartramiaceae									
Philonotis hastata (Duby) Wijk. & Marg.		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 266
Brachytheciaceae									
Squamidium nigricans (Hook.) Broth.				X	X			Yano & Lisboa (1988)	*Mori & Cardoso 17293* (n.v.)
Zelometeorium patulum (Hedw.) Manuel		X						Yano & Lisboa (1988)	Gentil 512
Bryaceae									
Bryum coronatum Schwägr.		X				X		Macedo et al. (in press)	Macedo 1534
Calymperaceae									
Calymperes afzelii Sw.	X							Lisboa *et al.* (2006)	*Costa Neto 1467* (n.v.)
Calymperes erosum Müll. Hal.	X	X	X	X		X		Yano & Lisboa (1988)	Gentil 275
Calymperes lonchophyllum Schwägr.		X	X	X				Yano & Lisboa (1988)	Gentil 350
Calymperes nicaraguense Renauld & Cardot					X			Yano & Lisboa (1988)	Mori 17413
Calymperes palisotii Schwägr.	X	X				X		Churchill (1998)	Gentil 185
Calymperes platyloma Mitt.					X			Churchill (1998)	*Mori & Cardoso 17293* (n.v.)
Calymperes rubiginosum (Mitt.) Reese			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 430
Octoblepharum albidum Hedw.		X	X	X		X		Yano (1982)	Gentil 79
Octoblepharum cocuiense Mitt.		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 85
Octoblepharum cylindricum Schimp.				X				Herzog (1931)	*von Lützelburg 20312* (n.v.)
Octoblepharum pulvinatum (Dozy & Molk.) Mitt.	X						X	Yano (1982)	*Egler & Irwin 46455* (n.v.)
Syrrhopodon cryptocarpus Dozy & Molk.	X	X	X					Lisboa *et al.* (2006)	Gentil 114
Syrrhopodon cymbifolius Müll. Hal.	X		X					Lisboa *et al.* (2006)	Gentil 436
Syrrhopodon disciformis Dusén			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 510
Syrrhopodon flexifolius Mitt.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 518
Syrrhopodon hornschuchii Mart.		X	X	X				Yano & Lisboa (1988)	Gentil 452
Syrrhopodon incompletus Schwägr. var. *incompletus*		X	X	X				Yano & Lisboa (1988)	Gentil 118
Syrrhopodon incompletus var. *berteroanus* (Brid.) W.D. Reese		X	X	X				Churchill (1998)	*Mori & Cardoso 17124* (n.v.)
Syrrhopodon leprieurii Mont.		X						Yano & Lisboa (1988)	*Rosário 212* (n.v.)
Syrrhopodon ligulatus Mont.	X	X	X		X			Yano & Lisboa (1988)	Gentil 142
Syrrhopodon prolifer Schwägr.	X							Lisboa *et al.* (2006)	*Costa Neto 1279* (n.v.)
Syrrhopodon rigidus Hook. & Grev.			X					Churchill (1998)	Gentil 369

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
Syrrhopodon simmondsii Steere	X		X					Lisboa *et al.* (2006)	Gentil 379
Dicranaceae									
Dicranella hilariana (Mont.) Mitt.		X						Macedo *et al.* (in press)	Macedo 1736
Fissidentaceae									
Fissidens guianensis Mont.	X	X	X					Lisboa *et al.* (2006)	Gentil 412
Fissidens lagenarius Mitt. var. *muriculatus* (Mitt.) Pursell			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 438
Fissidens ornatus Herzog		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 326
Fissidens pellucidus Hornsch.		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 439
Fissidens prionodes Mont.		X	X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 328
Fissidens radicans Mont.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 512
Fissidens submarginatus Bruch		X						Macedo *et al.* (in press)	Macedo 1732
Fissidens zollingeri Mont.	X							Lisboa *et al.* (2006)	*Costa Neto 1305* (n.v.)
Hookeriaceae									
Crossomitrium patrisiae (Brid.) Müll. Hal.	X		X	X				Herzog (1931)	Gentil 401
Hypnaceae									
Chrysohypnum diminutivum (Hampe) W.R. Buck		X	X	X				Yano & Lisboa (1988)	Gentil 410
Ectropothecium leptochaeton (Schwägr.) W.R. Buck			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 361
Rhacopilopsis trinitensis (Müll. Hal.) E. Britton & Dixon				X				Yano & Lisboa (1988)	*Mori & Cardoso 17108* (n.v.)
Vesicularia vesicularis (Schwägr.) Broth.			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 371
Leucobryaceae									
Campylopus surinamensis Müll. Hal.		X				X		Macedo et al. (in press)	Macedo 2174
Leucobryum martianum (Hornsch.) Müll. Hal.		X	X				X	Yano (1982)	Gentil 417
Ochrobryum subulatum Hampe			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 378
Leucomiaceae									
Leucomium strumosum (Hornsch.) Mitt.		X		X				Yano & Lisboa (1988)	Macedo 2006
Neckeraceae									
Neckeropsis disticha (Hedw.) Kindb.	X							Lisboa *et al.* (2006)	*Costa-Neto 1301* (n.v.)
Neckeropsis undulata (Hedw.) Reichardt			X	X				Yano & Lisboa (1988)	Gentil 556
Orthotrichaceae									
Groutiella tomentosa (Hornsch.) Wijk & Margad.	X							Lisboa *et al.* (2006)	*Costa-Neto 1490* (n.v.)
Macromitrium cirrosum (Hedw.) Brid.		X		X				Churchill (1998)	*Mori et al. 17541* (n.v.)
Macromitrium punctatum (Hook. & Grev.) Brid.		X		X				Yano & Lisboa (1988)	*Rosário 193* (n.v.)

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
Phyllodrepaniaceae									
Phyllodrephanium falcifolium (Schwägr.) Crosby			X	X	X			Yano & Lisboa (1988)	Gentil 369
Pilotrichaceae									
Callicostella merkelii (Hornsch.) A. Jaeger	X							Lisboa *et al.* (2006)	*Costa Neto 1486* (n.v.)
Callicostella pallida (Hornsch.) Ångström	X	X	X	X				Yano & Lisboa (1988)	Gentil 390
Lepidopilum affine Müll. Hal.	X							Lisboa *et al.* (2006)	*Costa Neto 1301* (n.v.)
Lepidopilum scabrisetum (Schwägr.) Steere			X	X				Yano & Lisboa (1988)	Gentil361
Lepidopilum surinamense Müll. Hal.		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 240
Pilotrichum evanescens (Müll. Hal.) Crosby		X						Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 177
Pilotrichum bipinnatum (Schaegr.) Brid.			X					Crosby (1969)	Gentil 512
Pottiaceae									
Splachnobryum obtusum (Brid.) Müll. Hal.	X							Lisboa *et al.* (2006)	*Costa Neto 1277* (n.v.)
Pterobryaceae									
Henicodium geniculatum (Mitt.) W.R. Buck	X	X						Yano & Lisboa [1988, as *Leucodontopsis geniculata* (Mitt.) H.A. Crum & Steere]	*Mori & Cardoso 17556* (n.v.)
Orthostichopsis tetragona (Hedw.) Broth.	X			X				Yano & Lisboa (1988)	*Mori & Cardoso 17137* (n.v.)
Pylaisiadelphaceae									
Isopterygium subbrevisetum (Hampe) Broth.	X							Lisboa *et al.* (2006)	*Costa Neto 1468* (n.v.)
Isopterygium tenerum (Sw.) Mitt.	X	X	X					Lisboa *et al.* (2006)	Gentil 88
Pterogonidium pulchelium (Hook.) Müll. Hal.	X							Lisboa *et al.* (2006)	*Costa Neto 1305* (n.v.)
Taxithelium concavum (Hook.) J. Florsch.	X							Lisboa *et al.* (2006)	*Costa Neto 1478* (n.v.)
Taxithelium planum (Brid.) Mitt.	X	X	X	X	X			Yano & Lisboa (1988)	Gentil 351
Taxithelium pluripunctatum (Renauld & Cardot) W.R.Buck			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 404
Sphagnaceae									
Sphagnum palustre L.				X				Yano et al. (1985)	*Egler 1448* (n.v.)
Sphagnum perichaetiale Hampe				X				Yano & Lisboa (1988, as *Sphagnum erythrocalyx* Hampe)	*Froés 26752* (n.v.)
Sematophyllaceae									
Acroporium pungens (Hedw.) Broth.				X	X			Yano & Lisboa (1988)	*Mori & Cardoso 17292* (n.v.)
Brittonodoxa subpinnata (Brid.) W.R.Buck *et al.*	X		X					Lisboa *et al.* (2006)	Gentil 497
Microcalpe subsimplex (Hedw.) W.R.Buck		X	X	X	X	X		Yano & Lisboa (1988)	Gentil 92

continue

Table 1 (continued)

Family/Species	Municipalities of Amapá State							First record for Amapá State	Voucher
	AM	MC	SN	OP	CÇ	MZ	LJ		
Trichosteleum papillosum (Hornsch.) A. Jaeger	X	X	X	X	X	X		Yano & Lisboa (1988)	Gentil 520
Trichosteleum sentosum (Sull.) A. Jaeger			X					Oliveira-da-Silva & Ilkiu-Borges (2020)	Gentil 528
Trichosteleum subdemissum (Besch.) A. Jaeger	X	X	X					Lisboa *et al.* (2006)	Gentil 359
Vitalia caespitosa (Hedw.) P.E.A.S. Câmara *et al.*						X		Yano & Lisboa [1988, as *Sematophyllum caespitosum* (Hedw.) Mitt.]	*Mori et al. 17491* (n.v.)
Stereophyllaceae									
Pilosium chlorophyllum (Hornsch.) Müll. Hall.		X	X	X				Yano & Lisboa (1988)	Gentil 153
Pelekium involvens (Hedw.) Touw		X						Yano & Lisboa (1988)	*Rosário s.n.* (MG99129)
Pelekium scabrosulum (Mitt.) Touw	X	X	X					Lisboa *et al.* (2006)	Gentil 269
Pelekium schistocalyx (Müll. Hal.) Touw	X							Lisboa *et al.* (2006)	*Costa Neto 1298* (n.v.)
Total	60	77	109	42	9	14	2		

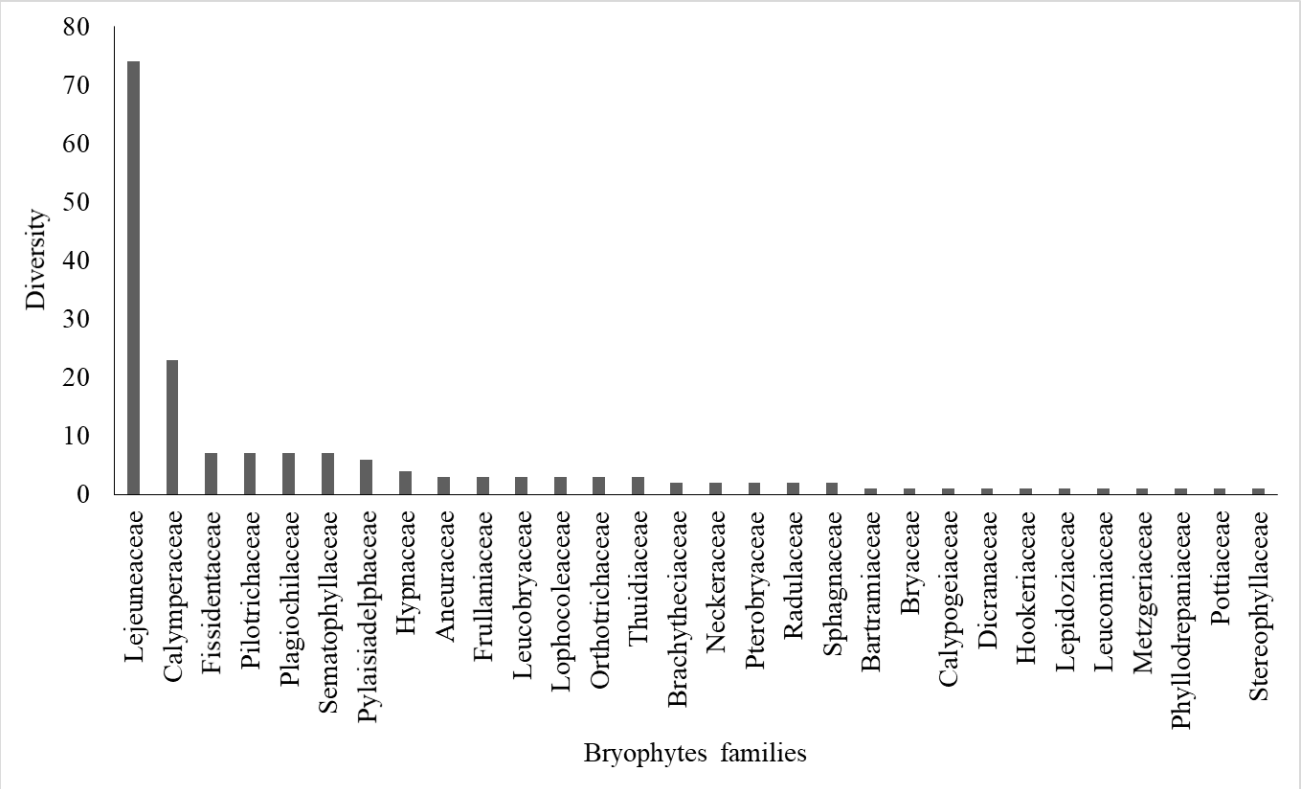

Figure 1. Species diversity by bryophyte families in the Amapá State.

Figura 1. Diversidade de espécies por famílias de briófitas no Estado do Amapá.

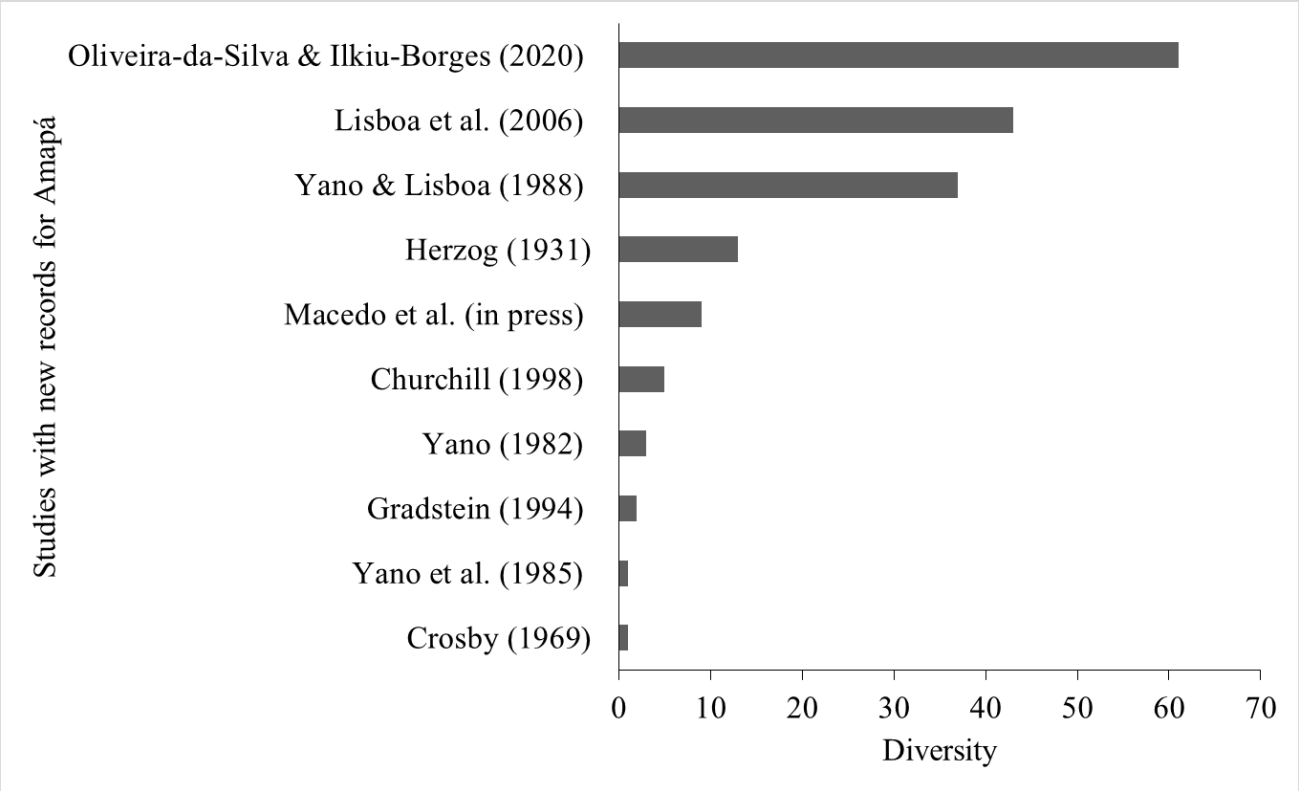

Figure 2. Localization map of Amapá State with number of species record from State municipalities.

Figura 2. Mapa de localização do Estado do Amapá com número de espécies registradas nos municípios do Estado.

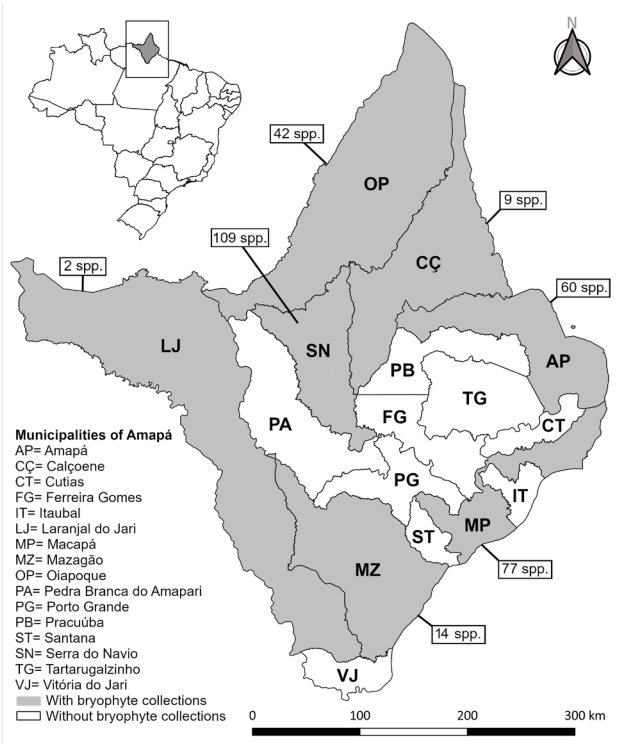

Figure 3. Measurement of new records by study of bryophytes in the State of Amapá.

Figura 3. Medida de novos registros por estudo de briófitas no Estado do Amapá.

2015). *Lejeunea* is the more complex and the largest genus of liverworts in Brazil (Reiner-Drehwald 2007, Costa & Peralta 2015) and well distributed in the neotropical region (Gradstein *et al.* 2001).

The most common species of our list were already expected to be found in Amapá due to their wide distribution in the Amazon and frequent occurrence in various ecosystems from humid rainforests to open environments (Santos & Lisboa 2003, Brito & Ilkiu-Borges 2013, Moura *et al.* 2013, Tavares-Martins *et al.* 2014, Pantoja *et al.* 2015, Cerqueira *et al.* 2017, BFG 2018, Oliveira-da-Silva & Ilkiu-Borges 2018). Among these species, only *Ceratolejeunea coarina* was not reported in Marajó island (Brito & Ilkiu-Borges 2013), a large continental island neighbor to Amapá State.

The municipalities of Serra do Navio and Macapá harbored the largest number of bryophytes (figure 2). These results are due to intensive inventories of bryophytes in specific areas from Amapá, such as the studies conducted by Oliveira-da-Silva & Ilkiu-Borges (2020) in two municipal natural parks of upland Amazon forest in these two municipalities and by Lisboa *et al.* (2006) in coastal areas of the Amapá municipality with collections in different phytophysiognomy such as várzea, mangrove, transition forest, and other vegetation types (figure 3).

There are still large areas lacking investigation works on bryophytes, such as the municipality of Laranjal do Jari. Alone, this municipality covers 30,783 km^2 which represents more than 20% of the territory of Amapá (IBGE 2019) and comprises important conservation units such as the National Park of Tumucumaque Mountains (Drummond *et al.* 2008).

However, only *Octoblepharum pulvinatum* (Dozy & Molk.) Mitt. and *Leucobryum martianum* (Hornsch.) Müll. Hal. were registered in this municipality.

It is expected that with further expeditions to unexplored and important areas of Amapá, such as Parque Nacional Montanhas do Tumucumaque, Reserva Extrativista do Rio Jari and Floresta Nacional do Amapá, the number of species may considerably increase. The results reinforced the need for more comprehensive studies on the bryoflora from Amapá.

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Author Contributions

Fúvio Rubens Oliveira-da-Silva: Contribution in the concept and design of the study; to data collection; to data analysis and interpretation; to manuscript preparation; to critical revision, adding intellectual content.

Luciana Priscila Costa Macedo: Contribution to data collection; to manuscript preparation; to critical revision, adding intellectual content.

Anna Luiza Ilkiu-Borges: Contribution in the concept and design of the study; to manuscript preparation; to critical revision, adding intellectual content.

Conflicts of interest

There is no conflict of interest.

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