Tropical Bryology 17: 39-45, 1999

New and interesting records of Brazilian bryophytes

Kátia C. Pôrto[1], S. Rob Gradstein[2], Olga Yano[3], Shirley R. Germano[1] and Denise P. da Costa[4]

[1] Departamento de Botânica, CCB, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego s/n, 50670-901 Recife, PE, Brasil.
[2] Systematisch-Geobotanisches Institut, University of Göttingen, Untere Karspüle 2, 73073 Göttingen, Germany.
[3] Instituto de Botânica, Caixa Postal 4005, 01051 São Paulo, SP, Brasil.
[4] Jardim Botânico do Rio de Janeiro, Rua Pacheco Leão, 915, 22.460-030 Rio de Janeiro, RJ, Brasil.

Abstract: This paper presents data on morphology, ecology and distribution of 16 species of bryophytes collected in Pernambuco, Brazil, that are interesting floristic records. *Notothylas orbicularis* (Schwein.) Sull. is new to Brazil, 11 species are new to the Northeast region of Brazil and 4 species are new to Pernambuco.

Resumo: Dados morfológicos, ecológicos e de distribuição geográfica são apresentados para 16 espécies de briófitas coletadas no Estado de Pernambuco, Brasil. *Notothylas orbicularis* (Schwein.) Sull. é registrada pela primeira vez para o Brasil, 11 espécies são novas para a região Nordeste e 4 para o Estado de Pernambuco.

The bryophyte flora of Pernambuco, Brazil, includes ca. 250 species (Yano 1981, 1984, 1989, 1995).

During a post-graduate course taught by Prof. Dr. S. R. Gradstein in August 1998, at the Federal University of Pernambuco, Recife, several excursions were made to gather bryophytes. Collections were mainly made in remnants of lowland and submontane rain forests.

In all, 135 species of bryophytes were identified, including several that constitute new records or otherwise interesting range extensions. The study sites are the following:

Municipality of Recife; Lat. 8º00'00"-8º07'00"S, Long. 34º52'30"W, sea level, Campus of the Federal University of Pernambuco.

Municipality of Bonito; Lat. 8º30'08"S, Long. 36º43'31"W, 680-720 m, Municipal Reserve (ca. 50 ha), submontane rain forest; inselberg.

Municipality of Brejo da Madre de Deus; Lat. 8º09'00"S, 36º22'15"W, 800, 950 m, Forest of Bituri Grande (ca. 50 ha), submontane rain forest; inselberg.

Municipality of Caruaru; Lat. 8º18'36"S, Long. 36º00'00"W, 820-950 m, Ecological Reserve of Brejo dos Cavalos (ca. 350 ha), submontane rain forest.

***Bryum roseolum* C. Muell.**, Linnaea 42: 287. 1879.

Description and illustration: Ochi (1981).

Specimens examined: Brazil, Pernambuco, Municipality of Brejo da Madre de Deus, live trunk, 10/VIII/1998, O. Yano *et al.* 25527 (SP 322370).

Distribution: Tropical and subtropical South America. Brazil - Bahia, Rio Grande do Sul and Rio de Janeiro. New to Pernambuco.

Comments: *Bryum roseolum* is a neotropical species, easily recognised by the robust plants, with stems of 2-4 rosettes, the leaves denticulate-spiny, strong costa, border cells long-linear with thick walls. Ochi (1981) reported that this species is the most robust of the subgenus *Rhodobryum* in the neotropics.

This species was found growing in large and dense tufts at the base of a tree trunk on steep banks at the edge of the forest.

***Bryum roseum* (Hedw.) Gaertn.**, Meyer & Scherb., Ökon. Techn. Fl. Wetterau 3(2): 104. 1802.

Description and illustration: Sharp *et al.* (1994).

Specimens examined: Brazil, Pernambuco, Municipality of Bonito, wet soil, 9/VIII/1998, S. R. Germano *et al.* s.n. (UFP 22361), live trunk, 9/VIII/1998, S. R. Germano *et al.* s.n. (UFP 22362).

Distribution: Tropical America, Europe, Africa, Asia. Brazil - Rio de Janeiro.

Comments: This species has a very wide distribution, occurring at both low and high elevations. In Brazil it was reported in Southern region. This is the first record of this species from the Northeast.

Bryum roseum is easily recognized by the robust plants with subterranean stolons, and 8-9(-10) mm long, obovate leaves, crowded in apical rosettes, spreading when moist, wrinkled-flexuose when dry; dioecious.

This species grew in dense populations on moist soil.

***Campylopus richardii* Brid.**, Mant. Musc. 73. 1819.

Description and illustration: Frahm (1991).

Specimens examined: Brazil, Pernambuco, Municipality of Bonito, on inselberg mixed with *Bryum roseolum* and *Campylopus pilifer* Brid., moist soil bank, 6/VIII/1998, S. R. Gradstein *et al.* s.n. (UFP 22382, 22383); on inselberg, 6/VIII/1998, O. Yano *et al.* 25478 (SP 322328).

Distribution: Widespread in tropical America (Frahm 1991). Brazil - Bahia, Espírito Santo, Minas Gerais, Paraná, Rio de Janeiro, Santa Catarina and São Paulo. New to Pernambuco.

Comments: *Campylopus richardii* is known from many localities throughout the Neotropics. This species ranges in altitude from 900 to 3.700 m. In Brazil it is found between 900-2.000 m in the northeastern, southeastern and southern parts of the country. This is the first record of *Campylopus richardii* from Pernambuco, and the lowest elevation thus far recorded for the species (700 m).

Campylopus richardii grows on seasonal wet rocks and cliffs and wet gravely soil, in environments with high rainfall and light intensities. All the previously collections are known from montane and upper montane areas, and collections below 900 m were unknown.

Campylopus richardii is a blackish plant, leaves with a sub-hyaline tip, upper laminal cells elongate-rectangular and pitted, basal lamina cells incrassate and colored, costa in transverse section with ventral stereids.

***Cephaloziella divaricata* (Smith.) Schiffn.**, in Engler & Prantl, Nat. Pflanzenfam. 1(3): 99. 1893.

Description and illustration: Fulford (1976).

Specimens examined: Brazil, Pernambuco, Municipality of Bonito, moist soil bank, 6/VIII/1998, S. R. Gradstein *et al.* s.n. (UFP 22364); *ibid.*, 6/VIII/1998, O. Yano *et al.* 25472 (SP 322324).

Distribution: Europe, North America, Central

and South America. Brazil - Rio de Janeiro. New to Pernambuco.

Comments: In Brazil this species has been recorded from Rio de Janeiro. It is the first report of this species in the Northeast of Brazil.

Cephaloziella divaricata is a very small and delicate plant, ca. 0,5 mm wide, with leaves hardly broader than the stem, bilobed to one-half the length and inserted transversely or slighly oblique; tiny underleaves are usually present; dioecious.

The species was found growing on a wet soil bank along the road, among other bryophytes.

***Colura tenuicornis* (A. Evans) Steph.**, Spec. Hep. 5: 942. 1916.

Description and illustration: Jovet-Ast (1953).

Specimens examined: Brazil, Pernambuco, Municipality of Caruaru, live trunk, 10/VIII/1998, K. C. Pôrto *et al.* s.n. (UFP 22366).

Distribution: Neotropical species. Brazil - Espírito Santo, Rio de Janeiro and São Paulo. New to Pernambuco.

Comments: This species is known from many localities throughout the Neotropics, ranging in altitude from 500-2.500 m. In Brazil it is found between 700-1.200 m in the southeast.

Colura tenuicornis grows on living leaves and tree trunks, frequently mixed with other hepatics, in humid forests. Almost all collections are known from submontane and montane areas. This is the first record of *Colura tenuicornis* from northeastern Brazil. It occurred in humid, submontane forest, with fog.

Small plants, pale green, lobe small, orbicular; lobule subcylindric or ovoid, prolonged in a tube, extending beyond the lobe, at apex with a long, linear beak; underleaves deeply bifid with divergent lobes; perianth obconical or obpyramidal, narrow to the base, with 5 horns.

***Cylindrocolea rhizantha* (Mont.) Schust.**, Nova Hedwigia 22: 175. 1971.

Description and illustration: Schuster (1980).

Specimens examined: Brazil, Pernambuco, Municipality of Bonito, moist soil bank, 6/VIII/1998, S. R. Gradstein *et al.* s.n. (UFP 22371); Municipality of Brejo da Madre de Deus, *ibid*., 10/VIII/1998, O. Yano *et al.* 25515 (SP 322359).

Distribution: North (USA), Central and South America. Brazil - Bahia and São Paulo. New to Pernambuco.

Comments: This is a tropical and subtropical species that grows as a corticolous and epixylic epiphyte in lowland and moderately high altitudes (Schuster 1980).

The species was found growing on soil in a humid ditch along the road, in association with *Fossombronia brasiliensis* Steph.

Cylindrocolea rhizantha is a tiny plant, less than 0,5 mm wide, with leaves bilobed to half their length, inserted obliquely, succubous, with sharp lobes terminating in one cell; underleaves are lacking; long-cylindrical perianth, 3 to 4 plicate above, the mouth broad, truncate and ellipsoidal capsule; autoecious.

***Diplasiolejeunea unidentata* (Lehm. & Lindenb.) Schiffn.**, Bot. Jahrb. Syst. 23: 583. 1879.

Description and illustration: Reyes (1982).

Specimens examined: Brazil, Pernambuco, Municipality of Bonito, on living leaves, 6/VIII/1998, O. Yano *et al.* 25470 (SP 322323).

Distribution: Neotropical. Brazil – São Paulo. New to Pernambuco.

Comments: In Brazil this species has been recorded from São Paulo. This is the first report for the Northeast region.

Diplasiolejeunea unidentata is distinguished by the flat, opaque and pale-green plants, ca. 1,4 mm wide, with imbricate leaves, broadly ovate or suborbicular lobes; lobule inflated, apical tooth 3-5 cells long, 2-3 cells wide at the base, proximal tooth inconspicuous; underleaves distant and subimbricate, with lobes obtuse, sometimes subacute or, rarely, acute; dioecious.

This species is closely allied to *D. rudolphiana* Steph., but the latter is autoecious, and usually presents the apical and proximal teeth well developed.

The species was found growing as epiphyllous in loose patches, closely appressed to the substrate.

***Fossombronia brasiliensis* Steph.**, Spec. Hep. 1: 382. 1900.

Description and illustration: Schuster (1992).

Specimens examined: Brazil, Pernambuco,

Municipality of Bonito, moist soil bank, 6/VIII/1998, S. R. Gradstein s/n (UFP 22370, 22371); *ibid.*, 6/VIII/1998, O. Yano *et al.* 25473 (SP 322325).

Distribution: South and Central America, southeastern USA. Brazil - São Paulo. New to Pernambuco.

Comments: *Fossombronia brasiliensis* is a widespread neotropical species which was known in Brazil from São Paulo. This is the first report for the Northeast region.

This species is relatively robust, sparsely dichotomous branched with deep purple or magenta rhizoids, with subquadrate, imbricate to contiguous, succubous leaves and with brown spores, 40-45(-50) mm in diameter, with distinct, irregular reticulations.

This species was found growing on humid loamy soil, along road, together with *Cylindrocolea rhizantha*, *Cephaloziella divaricata* and *Philonotis uncinata* (Schwaegr.) Brid.

A unique morphological feature of the plants are the numerous rounded, fleshy, green propagules with small leaves, produced in abundance on the dorsal side of the stems. Reports of leafy propagules in the genus *Fossombronia* are very rare; assexual reproduction is, and in general, by tubers (Paton 1974, Schuster 1992).

***Lophocolea bidentula* (Nees) Fulf.**, Mem. N. Y. Bot. Gard. 11:439. 1976.

Description and illustration: Fulford (1976).

Specimens examined: Brazil, Pernambuco, Municipality of Brejo da Madre de Deus, live trunk, 9/VIII/1998, S. R. Germano *et al.* s.n. (UFP 22365); *ibid*., 10/VIII/1998, O. Yano *et al.* 25522 (SP 322365).

Distribution: Brazil - Rio Grande do Sul, Santa Catarina and São Paulo. New to Pernambuco.

Comments: *Lophocolea bidentula* is an interesting hepatic endemic to southern and southeastern Brazil; previously it was known from three localities: Brazil, without locality (type); São Paulo, Morroprando (Decker 803, 803[a]); São Paulo, Itapetininga, ca. 550 m (Schiffner 2149, type of *Lophocolea evansii* Schiffner); Santa Catarina, São Francisco, at sea level; Rio Grande do Sul, Gramado, ca. 800 m.

Most collections are from montane areas with high rainfall, at altitudes between 500-1000 m, only in Santa Catarina is the species is found at sea level. This is the first record from northeastern Brazil.

Lophocolea bidentula it is a rather robust plant, the leaf margin has 1-2 short teeth, the apex is broad, emarginate, the leaf-cell cuticle is faintly verruculose. The plants grow as shade epiphytes on soil, shaded rock or decaying wood in environments with high rainfall. The species ranges in altitude from sea level to 950 m.

***Notothylas orbicularis* (Schwein.) Sull.**, Musci Alleghan. 69. 1846.

Description and illustration: Schuster (1992).

Specimens examined: Brazil, Pernambuco, Municipality of Brejo da Madre de Deus, moist soil, 10/VIII/1998, O. Yano *et al.* 25502 (SP 322346), *ibid.*, 5/VIII/1998, S. R. Gradstein *et al.* s.n. (UFP 22357); *ibid.*, 5/VIII/1998, K. C. Pôrto *et al.* s.n. (UFP 22358)

Distribution: Tropical Africa, Japan, eastern North America and western Europe. New to Brazil.

Comments: *Notothylas orbicularis* is a monoecious species, with thalli radiately expanded, lacunose, a small fusiform-ellipsoidal capsule, with plicate involucre, and weakly developed columella; spores delicately vermiculate, yellowish, 38-40 μm, pseudoelaters present, yellowish, with spiral thickenings.

This species was found growing gregarious or in isolated rosettes on damp basic, mineral soil in a coffee plantation.

Notothylas vitalii Udar & Singh, a very common species in the Northeast of Brazil (Bahia, Fernando de Noronha, Maranhão, Pernambuco), is easily distinguished from *N. orbicularis* by its larger size, the 5-8 mm long sporophytes and the lack of pseudoelaters.

***Plagiochila corrugata* (Nees) Nees & Mont.**, Ann. Sci. Nat. Bot. Sér. 2(5). 1836.

Description and illustration: Lindenberg (1844).

Specimens examined: Brazil, Pernambuco, Municipality Brejo da Madre de Deus, live branch, 9/VIII/1998, S. R. Germano *et al.* s.n. (UFP 22374); *ibid*., 9/VIII/1998, D. P. Costa *et*

al. s.n. (UFP 22375); fallen fine branch, 9/VIII/1998, K. C. Pôrto *et al.* s.n. (UFP 22376); Municipality of Caruaru, live branch, 11/VIII/1998, O. Yano *et al.* 25542 (SP 322385).

Distribution: Brazil - Espírito Santo, Pernambuco as *P. tortuosa* Gott. (Pôrto 1990), Rio Grande do Sul, Rio de Janeiro, Santa Catarina and São Paulo. Probably widespread in tropical America.

Comments: This species is easily and immediately recognized by the strongly imbricate and crispate-undulate ventral leaf margins. The species is a member of *Plagiochila* sect. *Crispatae* Carl and is probably widespread in the Neotropics. The taxonomy of the species is very poorly known; it seems that the species has been described under many different names in the various regions of the Neotropics. For example, *P. crispata* Gott. and *P. fastigata* Lindenb. from Mexico, *P. tortuosa* Gott. from Venezuela and Brazil, *P. ulophylla* Nees & Mont. from Brazil, and *P. undata* Sull. from the USA are all very similar to *P. corrugata* and may be synonyms. A careful revision of the taxonomy of this complex, including study of the types, is needed, to determine the status of all these names. At any rate, *P. corrugata* is the oldest name in this group and would thus have priority. Therefore, it is preferable to use this name for the time being for this plant.

P. corrugata has been reported previously from Pernambuco by Pôrto (1990) as *P. tortuosa*. The species is very common in relatively dry, on semi-decidous submontane forests.

***Plagiochila gymnocalycina* (Lehm. & Lindenb.) Mont.**, in d'Orbigny, Voy. Amer. Mér. 7, Bot. (2): 81. 1939.

Description and illustration: Lindenberg (1844).

Specimens examined: Brazil, Pernambuco, Municipality of Bonito, live branch, 6/VIII/1998, S. R. Germano *et al.* s.n. (UFP 22373).

Distribution: Brazil - Rio de Janeiro, Santa Catarina and São Paulo. New to Pernambuco. Widespread in the neotropics.

Comments: This species is characterized by the purely intercalate branching, narrowly elongate leaves with few, conspicuous teeth along the upper half of the ventral leaf margin, and particularly, the narrowly elongate perianth, terminal on a somewhat denuded stem portion, not surrounded by large bracts. The species is widespread in neotropical lowland to lower montane rain forests and has probably also been described under many different names, as is the case with *P. corrugata*. The plant grows generally in moister habitats than *P. corrugata*.

P. gymnocalycina is rather similar to *P. simplex* (Sw.) Lindenb., differing mainly by the more conspicuous teeth on the leaf (Heinrichs *et al.* 1998). If the two species prove to be synonyms, then *P. simplex* is older and therefore correct name for the species. Further taxonomic study is needed.

***Pycnolejeunea macroloba* (Nees & Mont.) Schiffn.**, Nat. Pflanzenfam. 1(3): 124. 1893.

Illustration: Kachroo & Schuster (1961).

Specimens examined: Brazil, Pernambuco, Municipality of Brejo da Madre de Deus, live trunk, 10/VIII/1998, O. Yano *et al.* 25505, 25511 (SP 322349; SP 322355); *ibid*., 10/VIII/1998, K. C. Pôrto *et al.* s.n. (UFP 22363).

Distribution: Neotropical. Brazil - Amazonas. New to Pernambuco.

Comments: This species is known from Amazoniam region. This is the first record of this species for Northeastern Brazil.

Pycnolejeunea macroloba is characterized by the pale whitish green plant color; leaves rounded, with few and large ocelli; underleaves bifid, usually 2,5-3,0 times as wide as stem; sinus acute; lobule large, 4-5(6) times as long as broad, with a large sinus rather oblique in relation to the posterior margin of lobe, unidentate, the hyaline papilla proximal to the base of the tooth; ventral merophytes 2 cells wide; autoecious.

This species was found growing on live tree trunk in semi-dry habitats.

***Riccia subdepilata* Jovet-Ast**, Cryptog., Bryol. Lichénol. 12(3): 228. 1991.

Description and illustration: Jovet-Ast (1991).

Specimens examined: Brazil, Pernambuco State, Municipality of Recife, moist soil, 5/VIII/1998, D. P. Costa *et al.* s.n. (UFP 22379); *ibid*., 5/VIII/1998, K. C. Pôrto *et al.* s.n. (UFP 22380);

ibid., 5/VIII/1998, O. Yano *et al.* 25419 (UFP 22381; SP 322274).
Distribution: Brazil – Bahia. New to Pernambuco.
Comments: This species was found in a garden on the University Campus, growing on humid clay soil together with *Anthoceros* sp. and *Notothylas vitalii*. The species was previously known only the type collection, growing on moist soil in caatinga vegetation (Jovet-Ast 1991).

Riccia subdepilata usually forms complete green rosettes, with sparse hyaline cilia at the apex of thallus margin; spores brown and large, 84-96(-100) μm in diameter, reticulate, with a flat triangular area at the level of the pores.

***Trematodon longicollis* Michx.**, Flora Bor. Am. 2: 289. 1803.
Description and illustration: Sharp *et al.* (1994).
Specimens examined: Brazil, Pernambuco, Municipality of Brejo da Madre de Deus, on soil near inselberg, 9/VIII/1998, K. C. Pôrto s.n. (UFP 20368).
Distribution: Very widespread.
Brazil - Espírito Santo, Paraná, Rio Grande do Sul, Rio de Janeiro, Rondônia, Santa Catarina and São Paulo. New to Pernambuco.
Comments: The species is widely distributed in the world, however is extremely rare in Europe, occuring in the Mediterranean region; usually grows on soil at lowland and moderate elevations. This is the first record of this species from the Northeast of Brazil.

The species can be easily recognized by its small size, long-lanceolate leaves, long seta, cylindrical curved capsule with sulcae when dry and, especially, the long narrow neck of the same length as the capsule; differentiated peristome. The capsules are green when young, turning orange when mature and brown when dry.

Trematodon vaginatus C. Muell. also occuring in the Northeast of Brazil and can be distinguished from *T. longicollis* by its vaginate leaf bases, subulate and strongly tubulose apex; cylindrical and pale-fuscous or sometimes yellow capsule.

Trematodon longicollis was collected growing in short tufts on moist soil on steep banks.

***Wijkia flagellifera* (Broth.) Crum**, The Bryologist 74: 172. 1971.
Description and illustration: Buck (1998).
Specimens examined: Brazil, Pernambuco, Municipality of Caruaru, decaying trunk, 10/VIII/1998, D. P. Costa *et al.* s.n. (UFP 22369).
Distribution: Central and South America. Brazil - Espírito Santo, Minas Gerais, Rio Grande do Sul, Rio de Janeiro, Santa Catarina and São Paulo. New to Pernambuco.
Comments: *Wijkia flagellifera* is a mainly neotropical species, common in the south and southeast of Brazil. This is the first record for the Northeast region.
This species is easily recognized by the medium-sized plants; stems creeping, subpinnately branched, with erect and ascending branches; stem and branch leaves differentiated, costa very short or absent, alar cells inflated and colored; asexual propagules are frequently borne on flagellate branches, arising from branch leaf axils; the leaves of the flagellate branches are appressed, lanceolate, serrulate, smaller than branch leaves.

Wijkia flagellifera is closely related to *W. costaricensis* (Bartram) Crum, but the latter species has broader and shorter-tipped, 0,5-1,0 x 0,4-0,8(-1,0) mm leaves.

This interesting species grows on branches and tree trunks, occasionally on old wood, usually in humid forests about 1000-1900 m. The specimens collected were growing on decaying trunk in submontane rain forest.

Acknowledgements

The authors are very grateful to Deutscher Akademischer Austauschdienst - DAAD and to Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq, for financially supporting for the visit of Prof. Dr. S. R. Gradstein to the Federal University of Pernambuco.

References

Buck, W. R. 1998. Pleurocarpous mosses of the West Indies. Memoirs of the New York Botanical Garden 82: 1-400

Frahm, J. P. 1991. Dicranaceae: Campylopodioideae, Paraleucobryoideae. Flora Neotropica Monograph 54: 1-237.

Fulford, M. H. 1976. Manual of the leafy Hepaticae of Latin America. Part IV. Memoirs of the New York Botanical Garden 11(4): 393-535.

Heinrichs, J., Gradstein, S. R. & Grolle, R. 1998. A revision of the neotropical species of *Plagiochila* Lindenb. (Hepaticae) described by Olov Swartz. Journal of the Hattori Botanical Laboratory 85: 1-32.

Jovet-Ast, S. 1953. Le genre *Colura*. Hepatiques Lejeuneaceae, Diplasiae. Revue Bryolologique et Lichénologique 22: 206-312.

Jovet-Ast, S. 1991. *Riccia* (Hépatiques, Marchantiales) d'Amérique Latine. Taxons des sous-genre *Riccia*. Cryptogamie, Bryologie Lichénolologie 12(3): 189-370.

Kachroo, P. & Schuster, R. M. 1961. The genus *Pycnolejeunea* and its affinities to *Cheilolejeunea*, *Euosmolejeunea*, *Nipponolejeunea*, *Tuyamaella*, *Siphonolejeunea* and *Strepsilejeunea*. Journal of the Linnean Society, Botany 56: 475-511.

Linbenberg, B. G. 1844. Monographia Hepaticarum generis *Plagiochilae*. Bonnae, Sumptibus Henry Cohen. 164p.

Ochi, H. A. 1981. A revision of the Neotropical Bryoideae, Musci. The Journal of the Faculty of Tottori University, Natural Science 29: 49-154.

Paton, J. A. 1974. *Fossombronia fimbriata* sp. nov. Journal of Bryology 8: 1-4.

Pôrto, K. C. 1990. Bryoflores d'une forêt de plaine et d'une forêt d'altitude moyenne dans l'état de Pernambuco (Brésil). Analyse floristique. Cryptogamie, Bryologie Lichénologie 13(3): 187-219.

Reyes, D. M. 1982. El género *Diplasiolejeunea* en Cuba. Acta Botanica Academiae Scientiarum Hungaricae 28(1-2): 145-180.

Schuster, R. M. 1980. The Hepaticae and Anthocerotae of North America, Vol. IV. New York: Columbia University Press. 1334p.

Schuster, R. M. 1992. The Hepaticae and Anthocerotae of North America, Vol. VI. Chicago: Field Museum of Natural History. 937p.

Sharp, A. J.; Crum, H. & Echel, P. M. 1994. The moss flora of Mexico. Memoirs of the New York Botanical Garden 69(1-2): 1-1113.

Yano, O. 1981. A checklist of Brazilian mosses. Journal of the Hattori Botanical Laboratory 50: 279-456.

Yano, O. 1984. Checklist of Brazilian liverworts and hornsworts. Journal of the Hattori Botanical Laboratory 56: 481-548.

Yano, O. 1989. An additional checklist of Brazilian bryophytes. Journal of the Hattori Botanical Laboratory 66: 371-434.

Yano, O. 1995. A new additional annotated checklist of Brazilian bryophytes. Journal of the Hattori Botanical Laboratory 78: 137-182.