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Bryophytes of Mona Island Natural Reserve, Puerto Rico

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Abstract. This checklist provides in addition to a list of mosses and hepatics, a key to the species. We report 17 moss species of which 9 are new to Mona Island and 3 are new records for Puerto Rico (*Fissidens minutus*, *Plaubelia sprengelii* and *Brymela callicostelloides*). This report represents a 35% increase to the moss flora of Mona Island. Thirteen hepatics are reported of which 8 are new records, representing an increase of 31%. Two new synonyms (*Bryum microdecurrens* = *Bryum coronatum*, *Riccia brittonii* = *Riccia elliottii*) are included. No hornworts are known for the island.

Resumen. Este listado en adición a la lista de musgos y hepáticas provee una clave para las especies. Reportamos 17 especies de musgos de los cuales 9 son nuevos para Isla de Mona y 3 son registros nuevos para Puerto Rico (*Fissidens minutus*, *Plaubelia sprengelii* y *Brymela callicostelloides*). Este reporte representa un aumento de un 35% en la flora muscinal de Isla de Mona. Trece hepáticas son reportadas de las cuales 8 son registros nuevos, representando un aumento de 31%. Dos nuevos sinónimos (*Bryum microdecurrens* = *Bryum coronatum*, *Riccia brittonii* = *Riccia elliottii*) se incluyen. No se conocen registros de antocerotes para la isla.

The Natural Reserve of Mona Island is a 5476 ha limestone plateau located 73.6 km from the west coast of Puerto Rico and 65 km east of Hispaniola (Fig. 1). Its vegetation is classified as a tropical dry forest and the annual rainfall is about 800 to 900 mm (Ewel & Whitmore, 1973). The island's vegetation in the last century was disturbed by activities of human settlements (pirates), guano extraction, introduction of goats and pigs and in this century by hunters. According to Sastre & Santiago (1996) during 1915-1918 N.L. Britton lobbied for the conservation of forested areas and as a

result of his effort in 1919 Mona Island and other forests were incorporated to form the Insular Forest System of Puerto Rico. Presently the Department of the Environment and Natural Resources is in charge of the island conservation and management plans.

The vegetation of Mona Island has been described by Britton (1915), Wadsworth and Gilormini (1945), Little (1953), Woodbury et al. (1977) and more recently by Cintrón & Rogers (1991). Mosses and liverworts were only listed in Britton's work, although Cintrón (1991) mentioned that „additional endemic species of

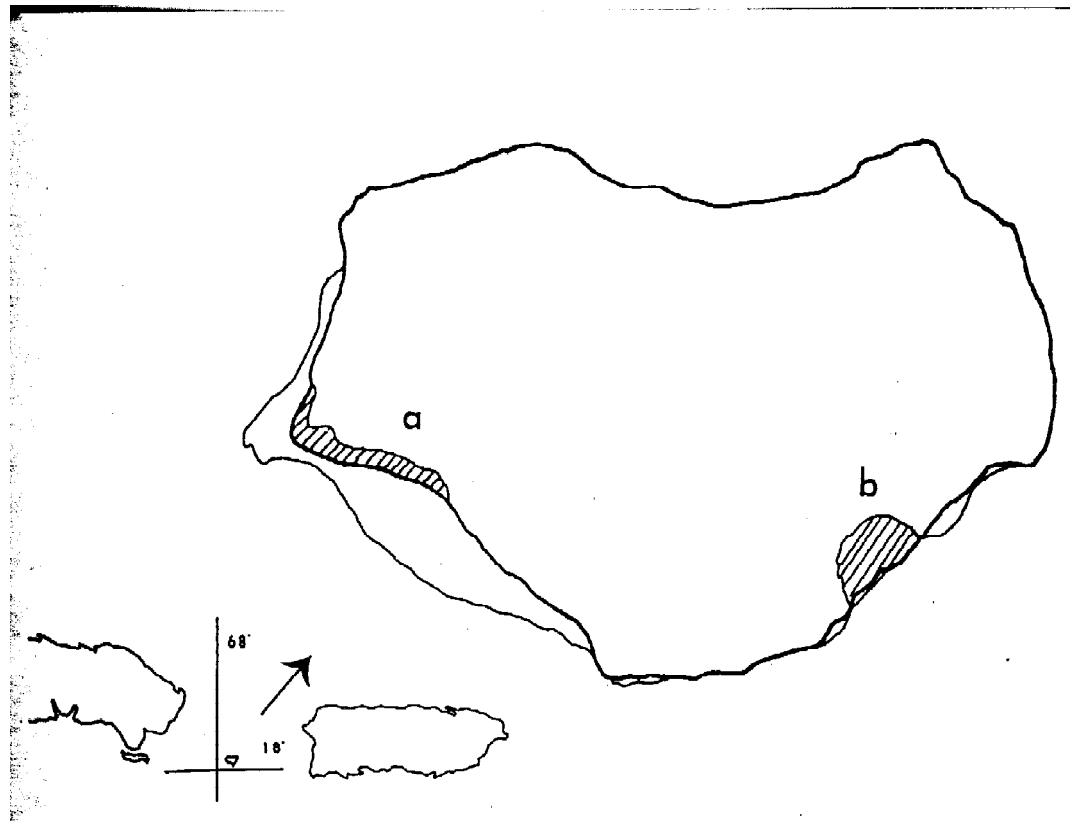


Figure 1. Collecting sites (Cliffside Forest, a and Plateau Shrub Forest, b) in Mona Island Natural Reserve, Puerto Rico.

mosses and fungi have been described, but these groups have not been studied extensively“ probably in reference to species of *Riccia* described by Howe from Mona (Britton, 1915).

Ten vegetation types or plant communities were recognized by Cintrón and Rogers (1991): Plateau Forest, Plateau Shrub, Depression Forest, Cactus Low Shrub Forest, Cactus Forest, Coastal Lowland Forest (closed and open canopies; mangroves), Coastal Shrub Forest, Cliffside Forest, Plantation (Mahogany and Casuarina) and Disturbed/Successional Forest. There are about 400 species of vascular plants and 20% of the flora is considered threatened (Cintrón, 1991).

The island was visited in February of 1996 by Dr. William R. Buck, Dr. Richard Harris (New York Botanical Garden) and the authors to collect bryophytes and lichens of the most accessible and wet areas of the island: the Plateau Shrub and the Cliffside Forest (Fig. 1). The collections made were deposited in the cryptogamic herbarium of the University of Puerto Rico at Mayagüez Campus (MAPR) and at the New York Botanical Garden (NY).

Puerto Rico's moss flora consists of 284 taxa (Sastre & Buck, 1993); Gradstein (1989) reported 232 hepatics and five hornworts. For Mona Island, Britton (1915) and Sastre & Buck (1993) reported six species of mosses in five

	Families	Genera	Species
A. Mosses			
N. L. Britton (1915)	4	5	6
Crum and Steere (1957)	1	2	2
Sastre and Buck (1993)	4	5	6
Reyes and Sastre (1997)	10	12	17
B. Liverworts			
N. L. Britton (1915)	2	5	7
Pagán (1939)	2	3	4
Reyes and Sastre (1997)	3	8	1

Table 1. Number of families, genera and species of mosses and liverworts for Mona Island Natural Reserve, Puerto Rico.

genera and four families, while Crum & Steere (1957) had reported only two species of the genus *Calymperes* (Table 1). In this paper we report 17 species to the island flora, of which nine are new records for Mona Island: *Fissidens minutus*, *Fissidens steerei*, *Fissidens zollingeri*, *Plaubelia sprengelii*, *Splachnobryum obtusum*, *Pireella cymbifolia*, *Brymela callicostelloides*, *Sematophyllum galipense* and *Chryso-hypnum diminutivum* and three are new records for Puerto Rico: *Fissidens minutus*, *Plaubelia sprengelii* and *Brymela callicostelloides* (Appendix I). *Fissidens* is the most conspicuous genus with four species and the Pottiaceae the most diverse family (four genera).

For the hepatic flora Britton (1915), reported seven species of liverworts and Pagán (1939) reported four species (Table 1). We report 13 species to the island flora, of which eight are new records for the island: *Frullanoides corticalis*, *Lejeunea cladogyna*, *Lejeunea laetevirens*, *Lejeunea minutiloba*, *Lejeunea trinitensis*, *Caudalejeunea lehmanniana*, *Cheilolejeunea rigidula* and *Cololejeunea minutissima*. *Lejeunea* is the most diverse genus (four species) and the Lejeuneaceae the most diverse family (six genera), following the pattern for the tropics where the Lejeuneaceae are the

most conspicuous of the hepatic groups (Appendix I). These figures change the moss flora of Puerto Rico to 287 taxa but the hepatic flora stays as reported by Gradstein (1989).

According to Sastre & Buck (1993) Mona Island is richer than Guánica and Caja de Muertos both with dry vegetation types. The moss flora of Mona as it stands now represents 6% of the Puerto Rican moss flora, an increase of 35%. The hepatic flora shows an increase of 31%, but since we do not have distribution of hepatics by forest we do not know how Mona compares with other dry areas. No hornworts are known for the island. Most bryophyte species were found in the Cliffside Forest which is protected from wind action by a plantation of *Casuarina*.

Families

Gen
Spe

3

Acknowledgments

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- Appendix I.** Checklist of bryophytes for Mona Island Natural Reserve, Puerto Rico. Families are listed in phylogenetic order and species in alphabetical order. New records are marked with an asterisk. Citations without collections number were reported by previous authors.

Musci

Fissidentaceae

Fissidens allenianus Bruggemann-

Nann. & Pursell

**Fissidens minutus* Thwait. & Mitt.

W. R. Buck 29993, 30006, 30013, 30042 (NY)

**Fissidens steerei* Grout

I. Sastre-DJ 2550, 2557 (MAPR); C. M. Reyes 3 (MAPR)

**Fissidens zollingeri* Mont.

C. M. Reyes 3a (MAPR)

Calymperaceae

Calymperes palisotii Schwaegr. subsp. *richardii* (C. Müll.) Edwards

N. L. Britton, Cowell & Hess 1727, 1795 (NY)

Calymperes tenerum C. Müll. var. *edamense* Fleisch.

N. L. Britton, Cowell & Hess 1860 (NY); W. R. Buck 30018 (NY)

Pottiaceae

Hyophiladelphus agrarius (Hedw.)

Zander

N. L. Britton, Cowell & Hess 1682, 1759, 1809 (NY) (Cited by Britton, 1915, as *Tortula agraria* Hedw.); W. R. Buck 29938, 30017 (NY); S. Escorcía 22, 30 (MAPR); I. Sastre-DJ 2544, 2545, 2555 (MAPR); C. M. Reyes 1 (MAPR)

**Plaubelia sprengelii* (Schwaegr.)

Zander

W. R. Buck 29996, 30035 (NY); I. Sastre-DJ 2549, 2556 (MAPR)

Trichostomum brittonianum Zander

N. L. Britton, Cowell & Hess 1750 (NY); (Cited by Sastre & Buck, 1993, as *Weissia flavescens* (E. G. Britton in N. L. Britt. & Millsp.) Reese)

Trichostomum sinaloense (Bartr.)

Zander

(Cited by Britton, 1915, as *Hyophila guadalupensis* Broth.)

Splachnobryaceae

**Splachnobryum obtusum* (Brid.) C.

Müll.

W. R. Buck 29974 (NY)

Bryaceae

Bryum coronatum Schwaegr.

Bryum microdecurrens E.G. Britton, **syn. nov.** *Bull. Torrey Bot. Club* 42:5.1915. Mona Island, between Sardinera and Ubero on wet soil. N. L. Britton, Cowell & Hess 1751, 1753 (holotype NY)

Previously also reported from Arecibo by W. C. Steere in 1940 (Sastre & Santiago, 1996b)

Pterobryaceae

**Pirella cymbifolia* (Sull.) Card.

W. R. Buck 29998 (NY); C. M. Reyes 8, 10 (MAPR); previously only known from Río Abajo by W. C. Steere in 1939 (Sastre & Santiago, 1996a)

Callicostaceae

**Brymela callicostelloides* (Herz. & Thér.) Buck

C. M. Reyes 5 (MAPR)

Thuidiaceae

Cyrto-hypnum involvens (Hedw.) Buck & Crum

N. L. Britton, Cowell & Hess 1682, 1694 (NY) (Cited by Britton (1915) as *Thuidium involvens* (Hedw.) Mitt.); W. R. Buck 29995, 30016 (NY); I. Sastre-DJ 2548 (MAPR); C. M. Reyes 4, 6, 12 (MAPR); S. C. Escorcia 25, 31 (MAPR)

Sematophyllaceae

**Sematophyllum galipense* (C. Müll.) Mitt.

W. R. Buck 30040 (NY)

Hypnaceae

**Chryso-hypnum diminutivum* (Hampe)

Buck

W. R. Buck 30014 (NY)

Hepaticae

Frullaniaceae

Frullania ericoides (Nees) Mont.

N. L. Britton, Cowell & Hess 1725, 1796, 1800, 1860a (NY) (Cited by Britton, 1915, as *Frullania squarrosa* Nees); W. R. Buck 30028 (NY); C. M. Reyes 14, 15, 17 (MAPR)

Lejeuneaceae

**Caudalejeunea lehmanniana* (Gott.) Evans

S. C. Escorcia 20, 29 (MAPR)

**Cheilolejeunea rigidula* (Nees ex Mont.) Schust. A. Nieves s.n. (MAPR)

**Cololejeunea minutissima* (Sm.) Schiffn.

W. R. Buck 30011 (NY)

Frullanoides bahamensis (Evans) van Slag.

N. L. Britton, J. F. Cowell & W. E. Hess 1798, 1853 (NY) (Cited by Britton, 1915, as

Brachiolejeunea bahamensis Evans)

**Frullanoides corticalis* (Lehm. & Lindenb.) van Slag.

C. M. Reyes 18 (MAPR); previously known from Vieques Island, eastern part of Puerto Rico, collected by Schäfer 2989 (Gradstein, 1994)

**Lejeunea cladogyna* Evans

I. Sastre-DJ 2551, 2552 (MAPR)

**Lejeunea laetevirens* Nees & Mont.

W. R. Buck 30041 (NY); S. C. Escorcia 27, 28, 32 (MAPR); I. Sastre-DJ 2547, 2553, 2559 (MAPR); C. M. Reyes 16 (MAPR)

**Lejeunea minutiloba* Evans

W. R. Buck 30043 (NY); C. M. Reyes 5, 7, 11 (MAPR)

**Lejeunea trinitensis* Lindenb.

W. R. Buck 30005, 30031 (NY); S. C. Escorcia 24, 26 (MAPR); I. Sastre-DJ 2554 (MAPR); C. M. Reyes 2, 9 (MAPR)

Mastigolejeunea auriculata (Wils.) Schiffn.

N. L. Britton, Cowell & Hess 1680, 1681, 1690, 1693 (NY); W. R. Buck 30032, 30047 (NY); I. Sastre-DJ 2558 (MAPR); C. M. Reyes 13 (MAPR)

Ricciaceae

Riccia elliotii Steph.

Riccia brittonii Howe, **syn. nov.** Mona Island, between Sardinera and Ubero,

N. L. Britton, Cowell & Hess 1749a (holotype NY). We compared the type material with collections of *R. elliotii* and consider *R. brittonii* to fall within the variation of *R. elliotii*.

I. Sastre-DJ 2546 (MAPR)

Riccia violacea Howe

N. L. Britton, Cowell & Hess 1749b (NY)

Appendix II. Key to the Bryophytes of Mona Island Natural Reserve, Puerto Rico.

General Key

1. Plants thallose or foliose, if foliose two lateral leaves and a ventral leaf present (except *Cololejeunea* in this flora). Leaf cells isodiametric or hexagonal; oil bodies present. Sporophyte with hyaline seta and capsule without peristome

Key I (Liverworts)

1. Plants foliose, leaves radially oriented if it appears dorsoventrally would have 3 or more

rows of leaves. Leaf cells linear, quadrate or rhomboid; oil bodies absent. Sporophyte with colored seta and capsules mostly with peristome

Key III (Mosses)

Key I - Liverworts

1. Plants foliose

3

1. Plants thallose

Riccia L. 2

2. Thallus green with margins violet and with long papillae

R. violacea Howe

2. Thallus pale green to bluish green, margins not violet and papillae absent

R. elliotii Steph.

3. Plants large, reddish to purple with a ventral lobule free from lobe

Frullania ericoides (Nees) Mont.

3. Plants small, green to brownish with a ventral lobule attached to lobe

Key II (Lejeuneaceae)

Key II - Lejeuneaceae

1. Underleaves absent

Cololejeunea minutissima (Sm.) Schiffn.

1. Underleaves present

2

2. Underleaves holostipous (entire)

3

2. Underleaves schizostipous (divided)

6

3. Lobules with one short apical tooth

4

3. Lobules with more than two teeth

Frullanoides Raddi 5

4. Plants brown with age, forming depressed mats; leaves imbricate, convolute when dry, underleaves imbricate

Mastigolejeunea auriculata (Wils.) Schiffn.

4. Plants light green, forming appressed mats; leaves loosely imbricate, convolute when dry, underleaves

distant

Caudalejeunea lehmanniana (Gott.) Evans

5. Lobules with 4 teeth, mostly 1-2 cells long

F. corticalis (Lehm. & Lindenb.) van Slag.

5. Lobules with 5-6 teeth, mostly 3-4 cells long

F. bahamensis (Evans) van Slag.

6. Lobules with a long tooth more than

4 cells long and 1 cell wide

Lejeunea trinitensis Lindenb.

6. Lobule tooth smaller

7

7. Underleaf margin usually with a tooth

Lejeunea laetevirens Nees & Mont.

7. Underleaf margin without a tooth

8

8. Leaves cells with large trigones

Cheilolejeunea rigidula (Nees ex Mont.) Schust.

8. Leaves cells with smaller trigones

Lejeunea Lib. 9

9. Plants forming depressed patches or mats.

Underleaves larger than twice the stem width, lobules not dimorphic, uniformly reduced to minute basal folds, oil bodies homogeneous (more than 10 per cell)

L. minutiloba Evans

9. Plants forming loose, decumbent mats.

Underleaves smaller than 1.5 times the stem width, lobules dimorphic forming a small inflated broadly ovoid sac, oil bodies segmented or compound (7-8 or fewer per cell)

L. cladogyna Evans

Key III - Mosses

1. Plants flattened with leaves in two rows

Fissidens Hedw. 2

1. Plants flattened or radial. Leaves in 3 or more rows

5

2. Leaves bordered with elongated cells; lamina cells large and hexagonal

F. zollingeri Mont.

2. Leaves not bordered with elongated

- cells; lamina cells rounded-hexagonal
3
3. Cells pluripapillose
F. minutus Thwait. & Mitt.
3. Cells mammillose
4
4. Leaves less than 1.0 mm, long lanceolate to oblong-ovate
F. steerei Grout
4. Leaves 1.0 mm or more long, oblong-ligulate
- F. allenianus* Bruggemann- Nann. & Pursell
5. Plants forming turfs, mostly growing erect, sporophyte produced apically (acrocarpous)
6
5. Plants forming mats, mostly growing parallel to the substrate, sporophyte produced laterally (pleurocarpous)
13
6. Leaf base with large hyaline cells (cancellinae)
Calymperes Sw. ex Weber 7
6. Leaf base without large hyaline cells (cancellinae)
8
7. Leaf margins serrate at shoulders; intramarginal cells rectangular (teniolae) at shoulders. Gemmiferous leaves distinctly narrowed at the apex; gemmae on a receptacle
- C. palisotii* (C. Müll.) Edwards
7. Leaf margins entire, intramarginal cells not differentiated. Gemmiferous leaves not narrowed at the apex; gemmae all around the apex
C. tenerum Fleisch.
8. Leaf cells thin walled, oblong hexagonal or rhomboidal
9
8. Leaf cells rectangular to subquadrate
10
9. Leaves oblong-lanceolate to lanceolate, apex acute, costa long excurrent
- Bryum coronatum* Schwaegr.
9. Leaves elliptic to lingulate, apex rounded obtuse, costa ending below the apex
- Splachnobryum obtusum* (Brid.) C. Müll.
10. Costa percurrent or ending several cells below apex
- Plaubelia sprengelii* (Schwaegr.) Zander
10. Costa short excurrent sometimes ending in apiculus
11
11. Leaf cells smooth
Hyophiladelphus agrarius (Hedw.) Zander
11. Leaf cells papillose on both surfaces
Trichostomum Bruch 12
12. Leaf cells with 4-6 bifid papillae
Trichostomum sinaloense (Bartr.) Zander
12. Leaf cells densely pluripapillose with multifid papillae
- Trichostomum brittonianum* Zander
13. Costa single
14
13. Costa double, short double or absent
15
14. Leaf cells smooth
Pirella cymbifolia (Sull.) Card.
14. Leaf cells pluripapillose
Cyrto-hypnum involvens (Hedw.) Buck & Crum
15. Costa double, well developed, extending beyond mid-leaf
- Brymela callicostelloides* (Herz. & Thér.) Buck
15. Costa short, double or absent
16
16. Costa absent, alar cells inflated, leaf cells smooth
- Sematophyllum galipense* (C. Müll.) Mitt.
16. Costa short, alar cells quadrate, leaf cells prorulose
- Chryso-hypnum diminutivum* (Hampe) Buck