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Mosses in the family Pottiaceae newly reported for the Republic of São Tomé and Príncipe, West Africa

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Abstract – Twelve mosses within nine genera of Pottiaceae, including *Anoectangium aestivum* (Hedw.) Mitt., *A. stracheyanum* Mitt., *Barbula* cf. *seramensis* H.Akiyama, *Chionoloma bombayense* (Müll.Hal.) P.Sollman, *Gymnostomiella erosula* (Müll.Hal. ex Dusén) Arts, *G. vernicosa* (Harv.) M.Fleisch., *Hydrogonium consanguineum* (Thwaites & Mitt.) Hilp., *H. orientale* (F.Weber) Kučera, *Hymenostylium recurvirostrum* (Hedw.) Dixon, *Hyophila involuta* (Hook.) A.Jaeger, *Leptodontium viticulosoides* (P.Beauv.) Wijk & Margad. and *Splachnobryum obtusum* (Brid.) Müll.Hal., are newly reported for São Tomé and Príncipe and eight of these species represent the first report for the Gulf of Guinea islands. Notes on habitat and distribution are provided.

Africa / bryophytes / distribution / Gulf of Guinea / Pottiaceae / São Tomé and Príncipe / tropics

Resumen – Doze musgos pertencentes a nove géneros de Pottiaceae, incluindo *Anoectangium aestivum* (Hedw.) Mitt., *A. stracheyanum* Mitt., *Barbula* cf. *seramensis* H.Akiyama, *Chionoloma bombayense* (Müll.Hal.) P.Sollman, *Gymnostomiella erosula* (Müll.Hal. ex Dusén) Arts, *G. vernicosa* (Harv.) M.Fleisch., *Hydrogonium consanguineum* (Thwaites & Mitt.) Hilp., *H. orientale* (F.Weber) Kučera, *Hymenostylium recurvirostrum* (Hedw.) Dixon, *Hyophila involuta* (Hook.) A.Jaeger, *Leptodontium viticulosoides* (P.Beauv.) Wijk & Margad. e *Splachnobryum obtusum* (Brid.) Müll.Hal., são indicados como novos para São Tomé e Príncipe e oito dessas espécies representam a primeira indicação para as ilhas do Golfo da Guiné. São fornecidas notas sobre o habitat e a sua distribuição.

África / Briófitos / Distribuição / Golfo da Guiné / Pottiaceae / São Tomé e Príncipe / Trópicos

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INTRODUCTION

During a month-long expedition to the Republic of São Tomé and Príncipe in the spring of 2010, 2012 and 2013, the second author has cumulatively made nearly 1900 bryophyte collections. In July of 2007 and 2008 the third author has cumulatively made nearly 6000 bryophyte collections in different regions of the two islands, including the south of the island of São Tomé, only accessible by sea.

Several papers have been published from the study of selected taxonomic groups within these collections (Sérgio & Garcia, 2009; Figueiredo *et al*., 2010; Enroth & Shevock, 2011; Müller *et al*., 2011; Sergio & Garcia, 2011; Ellis *et al*. (2012), Shevock *et al*., 2013; Pócs *et al*., 2015). Among these São Tomé and Príncipe collections, the pottiaceous mosses were identified to species by the first author. Shevock collections cited herein are at CAS with a duplicate set at L, and the Garcia collections reside at LISU with a duplicate set at L. We plan to place a synoptic set of duplicates at STPH once a permanent museum facility is established.

As is the case in most tropical countries, there is still much field sampling and inventory required to document its biodiversity especially among tiny and inconspicuous mosses. The two island oceanic nation of Sao Tomé and Príncipe is the second smallest country in Africa. It lies in the Gulf of Guinea nearly 220 km off the West African mainland with the southernmost portion of the island of São Tomé on the equator (Sérgio & Garcia, 2011). Both islands are of volcanic origin, millions of years old and were uninhabited when first discovered by Portuguese explorers in 1471. Although both islands soon became a tropical agricultural colony, much of the interior rain forest remained or was only minimally altered due to steepness of the terrain and excessively wet rain forest conditions less ideal for agricultural pursuits. Nonetheless, the actions of man led to many changes in the composition and structure of the island vegetation.

Lower rainforest areas were highly converted, cut, and transformed into first cacao then coffee plantations and many non-native trees now cover these altered slopes. The dry lowland northwest corner of São Tomé influenced by the rain shadow of the Pico de São Tomé (2024 m) experienced a long period of sugar cane production whereby the dry forests were completely converted. Although some of the mid-elevation forests are now reverting back to rainforest habitats, other portions of the islands are threatened by type conversion to oil palm plantations. Nonetheless, bryophytes are able to re-colonize many habitats containing both native and introduced forest trees such as *Ceiba pentandra* (L.) Gaertn. and species of *Erythrina* L. (Pócs *et al*., 2015).

The annotated bryophyte catalogue by Sérgio and Garcia (2011) is a well-developed account of the historic collecting record and earlier species reports attributed to São Tomé and Príncipe. However, this publication does not list any members of the Pottiaceae from this country. Therefore we deemed it useful to provide these new records for this tropical country. A total of 109 collections were examined representing 12 taxa as new for the Republic of São Tomé and Príncipe. The abbreviations used for scientific names follow Brummitt and Powell (1992).

POTTIACEAE TAXA NEW FOR SÃO TOMÉ AND PRÍNCIPE

Anoectangium aestivum (Hedw.) Mitt.

São Tomé: along dirt road toward Cascata de São Nicolau, 00°16′51″N, 06°37′34″E, 20 Feb 2010, 850 m, *Shevock & Daniel 34152*; along road to summit of Muquinqui overlooking town of Guadalupe, 00°22′50″N, 06°38′46″E, 22 Feb 2010, 250 m, *Shevock, Daniel & Drewes 34242*.

Habitat: Along road banks, built wall of volcanic boulders in sun.

Distribution: This species occurs practically worldwide, including subantarctic South Georgia (Ochyra *et al*., 2002). *Anoectangium aestivum* is new for the Gulf of Guinea Islands. It has been previously reported from West Africa for Cameroon and Ivory Coast (O'Shea, 2006).

A. stracheyanum Mitt.

São Tomé: at Cascata de São Nicolau, 00°17′14″N, 06°37′26″E, 20 Feb 2010, 810 m, *Shevock & Daniel 34145*; Obô Natural Park along Pico de São Tomé Trail toward Pico Calvário above Lagoa Amélia, 00°16′45″N, 06°35′26″E, 25 Feb 2010, 1390 m, *Shevock, Daniel & Soares 34359*; .0.5 km from summit of Pico Calvário, 00°16′20″ N, 06°34′47″ E, 1 Mar 2010, 1400 m, *Shevock, Daniel & Alamo 34412*; between Pico Calvário to Estação Sousa, 00°16′07″N, 06°34′28″E, 11 Apr 2012, 1550 m, *Shevock & Nadel 39914*.

Habitat: On soil bank with volcanic clayey soil, vertical rock walls.

Distribution: New for the Gulf of Guinea Islands.

Barbula cf. seramensis H.Akiyama

São Tomé: Bom Sucesso, 0°17′18.91″N, 6°36′44.77″E. 30 Jun 2007, 1164 m, *Garcia ST6*; Sul da Ilha, Praia Piscina, 0°1′39.35″N, 6°30′43.07″E, 14 Jul 2007, 15 m, *Garcia ST100*.

Two collections were identified as this taxon and this material agrees with an isotype (L) studied by the first author from SE Asia (Akiyama 1996). *Barbula seramensis* is related to *Hydrogonium consanguineum* (Thwaites & Mitt.) Hilp. (*Barbula consanguinea* (Thwaites & Mitt.) A. Jaeger). The key provided in Akiyama (1996) to separate both species works well. The original description mentions no axillary gemmae and the first author did not find any either. Rhizoidal tubers are regularly present, although sometimes (very) scarce. They are pyriform shaped, not bulging, about 50 × 80 μm wide, greenish to brownish with age. The tubers are present on smaller rhizoids.

Habitat: On dry soil and fragments of rock.

Distribution: New for Africa.

Chionoloma bombayense (Müll. Hal.) P.Sollman

São Tomé: Pico de São Tomé: 0°16′8.05″N, 6°32′28.28″E, 6 Jul 2007, *Garcia ST66, ST68,* and 3 Jul 2008, 2024 m, *Garcia ST70.*

These plants are better known in the literature under the name *Pseudosymblepharis bombayensis* (Müll.Hal) P.Sollman. Species of *Chionoloma* Dixon are rarely encountered with capsules and the São Tomé populations of *C. bombayense* are also non-fruiting. The first author has studied many collections of this species worldwide and treats this genus as rather variable. *Chionoloma* is a very small pantropical genus especially related to *Trichostomum* Bruch and *Tortella* (Lindb.) Limpr.

Habitat: Talus with rocks, shaded, and on concrete.

Distribution: New for the Gulf of Guinea Islands. Reported previously from Cameroon (O'Shea 2006).

Gymnostomiella erosula (Müll.Hal. ex Dusén) Arts

São Tomé: West Coast along highway EN-1 between km road markers 40-41, 00°16′43″N, 06°28′56″E, 2 Mar 2010, 10 m, *Shevock & Daniel 34444*.
Habitat: On volcanic moist rock wall at stream cascade along road near sea level.
Distribution: New for the Gulf of Guinea Islands. *Gymnostomiella erosula* is reported for the Gulf of Guinea region only from Cameroon. All *Gymnostomiella* identifications were made following the publications of Arts (1998) and González-Mancebo *et al*., (2010). All São Tomé collections of *Gymnostomiella* were obtained in a relatively small area along the west coast of the island.

G. vernicosa (Harv.) M.Fleisch.

São Tomé: West Coast along highway EN-1 between km road markers 40-41, 00°16′43″N, 06°28′55″E, 13 Apr 2013, 10 m, *Shevock, Nadel & Daniel 42023* and between km road markers 41-42, 00°16′27″N, 06°28′50″E, 7 May 2013, 5 m, *Shevock 42481*.
Habitat: On volcanic rock wall along stream and on dripping vertical rock wall along road bank near sea level.
Distribution: New for the Gulf of Guinea Islands. The only other report for *G. vernicosa* in tropical Africa is reported as var. *tererum* (Müll.Hal. ex Dusén) Arts from the Central African Republic (O'Shea, 2006). Recently this variety was synonymized by González-Mancebo *et al*., (2010).

Hydrogonium consanguineum (Thwaites & Mitt.) Hilp.

Príncipe: dirt road at Nova Estrella southeast of Santo Antonio, 01°36′51″N, 07°25′38″E, 9 Mar 2010, 200 m, *Shevock, Daniel & Drewes 34609*; village of Bela Vista south of Santo António along Rio Papagaio, 01°37′11″N, 07°24′50″E, 11 Mar 2010, 40 m, *Shevock, Daniel & Drewes 34686*; Bom Bom Resort, 01°41′28″N, 07°24′09″E, 15 Apr 2012, 10 m, *Shevock 40002*; dirt road to Praia Banana from overlook of roça Belo Monte, 01°41′13″N, 07°26′35″E, 17 Apr 2012, 110 m, *Shevock & Nadel 40037,* just south of roça Belo Monte, 01°40′49″N, 07°26′31″E, 17 Apr 2012, 145 m, *Shevock & Nadel 40042*; **São Tomé**: Cascata de São Nicolau, 00°17′14″N, 06°37′27″E, 20 Feb 2010, 810 m, *Shevock & Daniel 34138*; Omali Lodge Resort between airport and city of São Tomé, 00°21′38″N, 06°42′49″E, 31 Mar 2012, 5 m, *Shevock 39654*; Upper Contador Valley above town of Neves, 00°17′11″N, 06°34′14″E, 9 Apr 2012, 570 m, *Shevock & Nadel 39857*; below Radio Tower at Macambrara, 00°16′33″N, 06°36′19″E, 17 Mar 2010, 1310 m, *Shevock, Daniel & Soares 34792*.
Habitat: Fourteen collections (not all cited above) were obtained from compacted clayey volcanic soil and on boulders in sun.
Distribution: New for the Gulf of Guinea islands. This is a widespread and pantropical species. It is frequently referred by its alternate name *Barbula consanguinea.* Axillary gemmae are constantly present. They differ distinctly from those present in the following species.

H. orientale (F.Weber) Kučera

Príncipe: at roça Santa Trindade site at Pico Papagaio trailhead, 01°37′11″N, 07°23′28″E, 15 Apr 2013, 320 m, *Shevock, Nadel, Daniel & Rocha 42069*.
Habitat: On wall of building with concrete in cut-over forest with agriculture.
Distribution: Known from Bioko in the Gulf of Guinea Islands and in neighboring Cameroon, Gabon and Nigeria (O'Shea, 2006). This species is better known in the literature as *Barbula indica* (Hook.) Spreng. We use this name based on the work of Kučera *et al*. (2013).

Hymenostylium recurvirostrum (Hedw.) Dixon

São Tomé: São Nicolau site 0.9 km south of Casada de São Nicolau, 00°16′51″N, 06°37′34″E, 20 Feb 2010, 850 m, *Shevock & Daniel 34153*; Nova Moka below Jardim Botânico do Bom Sucesso, 00°17′13″N, 06°37′59″E, 27 Feb 2010, *Shevock & Daniel 34378*.

Habitat: on built volcanic rock wall along cultivation and buildings in sun.
Distribution: New for the Gulf of Guinea Islands. This species occurs nearly worldwide, although it is absent from Australia and New Zealand, but recently it was recorded from subantarctic Îles Crozet (Ochyra *et al*., 2012). The first author views this taxon as rather variable. See especially the publications of Zander (1977) and Cano and Jiménez (2013).

Hyophila involuta (Hook.) A.Jaeger

Príncipe: valley of the Rio Banzu below the Picos of João Dias Father and Son, 01°36′13″N, 07°23′10″E, 10 Mar 2010, *Shevock & Daniel 34665*; between Terreiro Velho and the volcanic formation called Two Fingers, 01°35′55″N, 07°25′02″E, 18 Apr 2012, 175 m, *Shevock & Nadel 40076*; slopes of the Rio Papagaio south of the village of Bel Vista, 01°36′17″N, 07°24′24″E, 21 Apr 2012, 100 m, *Shevock, Nadel & Patacho 40131*; road to Sundi from Gaspar at bridge crossing of Agua Candumbo Stream, 01°39′39″N, 07°23′39″E, 26 Apr 2012, 165 m, *Shevock & Nadel 40216*; along road between São Joaquim toward Porto Real, 01°37′14″N, 07°23′05″E, 23 Apr 2012, 170 m, *Shevock & Szuts 42233*. **São Tomé**: road EN-15 at junction of two waterfalls of Rio Abade 13.7 km from Trindade and 1.2 km from Bombaim, 00°15′14″N, 06°37′47″E, 21 Feb 2010, 550 m, *Shevock & Daniel 34212*; highway EN-1 near km road marker 25 north of Neves, 00°21′49″N, 06°34′12″E, 22 Feb 2010, 15 m, *Shevock, Daniel & Drewes 34237*; Nova Moka along road to Jardim Botânico do Bom Sucesso, 00°17′26″N, 06°37′58″E, 27 Feb 2010, 920 m, *Shevock & Daniel 34385*; road EN-2 at Praia Micando between km markers 31-32 south of city of São Tomé, 00°10′05″N, 06°40′43″E, 1 Apr 2012, 5 m, *Shevock & Nadel 39666*; road EN-2 at São João dos Angolares about 34 km south of the city of São Tomé, 1 Apr 2012, 20 m, *Shevock & Nadel 39679*; roça Bombaim, 00°14′42″N, 06°37′59″E, 5Apr 2012, 470 m, *Shevock & Nadel 39763*; at end of highway EN-1 south of Santa Catarina and just south of roça Ponta Furada, 00°13′57″N, 06°28′23″E, 8 Apr 2012, 140 m, *Shevock & Nadel 39836*; Contador Valley above Neves at hydroelectric plant, 00°20′05″N, 06°32′46″E, 9 Apr 2-012, 110 m, *Shevock & Nadel 39845*.
Habitat: Thirty collections (not all cited above) were obtained from a wide variety of substrates ranging from blacktop, concrete retaining walls, volcanic rocks, with many collections along drainage ditches and streams. Some populations are obligate rheophytes.
Distribution: Known previously from Bioko in the Gulf of Guinea Islands. As would be expected, this species is rather commonly distributed in tropical regions. Recently all African taxa of this genus were revised by the first author (Sollman, 2013) and accepted only two species of *Hyophila* as occurring on the African continent.

Leptodontium viticulosoides (P.Beauv.) Wijk & Margad.

São Tomé: Obô Natural Park. Along Pico de São Tomé Trail about summit of Pico Calvário, 00°16′11″N, 06°34′35″E, 1 Mar 2010, 1565 m, *Shevock, Daniel & Alamo 34419*; near Mesa de São Tomé (saddle) just below summit of Pico de São Tomé, 00°16′10″N, 06°32′47″E, 12 Apr 2012, 1870 m, *Shevock & Nadel 39961*; trail to summit of Pico de São Tomé, 00°16′13″N, 06°32′43″E, 12 Apr 2012, 1930 m, *Shevock & Nadel 39967*.
Habitat: On hardwood branches, fallen hardwood branches and tree fern trunks in mossy cloud forests environments above 1550 m.
Distribution: Known for Bioko in the Gulf of Guinea Islands and in Cameroon. This is a widespread species occurring on several continents.

Splachnobryum obtusum (Brid.) Müll.Hal.

São Tomé: City of São Tomé near the football field, 0°20′6.70″N, 6°44′05.27″ E, 11 Jul 2008, 8 m, *Garcia ST214;* Road for Cascata de São Nicolau, near Nova Moka. 0°17″17.14″N, 6°37′36.89″E, 4 Jul 2007, 976 m, *Garcia ST31*.
Habitat: On soil and on shade and humid road rocks.

Distribution: Known from Bioko in the Gulf of Guinea islands and in several countries in tropical West Africa. A widespread species occurring on several continents.

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