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Additions to the liverwort and hornwort flora of São Tomé and Príncipe II, with *Neurolejeunea*, a genus new to Africa

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## Additions to the liverwort and hornwort flora of São Tomé and Príncipe II, with *Neurolejeunea*, a genus new to Africa

Tamás PÓCS, Frank MÜLLER & James R. SHEVOCK

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### Introduction

Two oceanic islands in the Gulf of Guinea, São Tomé and Príncipe, today form the second smallest country in Africa. Located near the equator, the islands were uninhabited when discovered by the Portuguese in 1471 (SÉRGIO & GARCIA 2011), but it was not long after their discovery that the islands were developed as a Portuguese agricultural colony, including the transportation of labour through slavery from the African mainland. For over two centuries, São Tomé and Príncipe were known in Europe as the ‘Chocolate Islands’ because of the importance at that time of their cacao plantations. São Tomé at 857 km<sup>2</sup> is approximately 6.2 times as large as Príncipe at 139 km<sup>2</sup>, which is located approximately 146 km to its northeast.

In the drier parts of northern São Tomé, sugar cane was initially the dominant cultivated crop, and most of the native drier forest was likely to have been extirpated during the extensive conversion of land for sugar cane production. Today much of the drier portion of the island is reverting back to dry forest, although by non-native trees and shrubs. One of the most spectacular trees of the dry region in the rain shadow of Pico de São Tomé (2024 m) is the baobab, *Adansonia digitata* L. This native species was typical of the dry forest area described above, as throughout tropical Africa, but presumably was deliberately conserved because it was useful or because among many African tribes it was considered to be a sacred tree, whilst the rest of the forest was cut down.

The end of the Portuguese period occurred with independence granted in 1975, after which the well-run ‘roças’ (cacao and coffee plantations) fell rapidly into disrepair, and less effort was spent maintaining agricultural production for export. Many of the narrow roads built specifically to access areas for growing crops became paths and quickly reverted back to secondary forests. With this transformation of forest structure, bryophytes also responded and recolonized habitats. Today, bryophytes carpet both native and non-native forest species and at the highest elevations form bryophyte draped environments (Fig. 1A). Most of the population resides near the coastline on both islands, and bananas, mangoes, papayas, coconuts and breadfruit provide a stable supply of food. The population receives a large percentage of its protein from the sea through fishing.

HENRIQUES (1917) and EXELL (1944) provides the first floristic overviews of the islands and, although many areas had been highly altered during the previous century much of the interior remained basically inaccessible and little was known about the vascular flora and even less known regarding the bryophytes. The rugged interior, especially on São Tomé, remained relatively intact. Few trails exist into the higher mountains and access is difficult (Fig. 1B). No road circles either island. Bryophyte collecting in the island interior is exceedingly difficult due to limited road and trail access and steep and rugged terrain.

The interior hardwood tropical rain forests of both islands remain substantial due to steep slopes, limited road or trail access, high rainfall, and cooler temperatures that are not ideal for crop production (Fig. 1C). Among the most striking flowering plants is the endemic giant begonia, *Begonia baccata* Hook.f., with trunks up to 4 m tall and leaves approaching a metre wide (Fig. 1D). Higher up the mountain slopes between 500–800 m, cacao and coffee plantations transformed the forests along with an increasing array of non-native species. Many non-native trees were also introduced providing shade to both cacao and coffee, especially legume trees in the genus *Erythrina* L. Today they form large trees over wide areas as secondary hardwood forests and when in flower, hillsides from a distance are orange colored. The tallest woody plant on the islands is the probably introduced silk-cotton tree, *Ceiba pentandra* (L.) Gärtn. (Fig. 2A). *Ceiba* trees can form enormous buttresses several metres across that are commonly covered in leafy liverworts. Príncipe on the other hand was less developed. The amount of forest cover remaining on both islands is significant and apparently is increasing in size and structure. EXELL (1944) documents that the forests are rich in species of both Rubiaceae and Euphorbiaceae and a significant number of ferns are both epiphytic as well as forming extensive understory vegetation. In addition, orchids are exceedingly common and diverse for this portion of tropical Africa.

High species endemism on the islands is documented for many taxonomic groups. With financial support of the EU, efforts were focused to conserve this biodiversity by establishing the Obô Natural Park of São Tomé and Príncipe. Nearly 30 % of the land base of the country

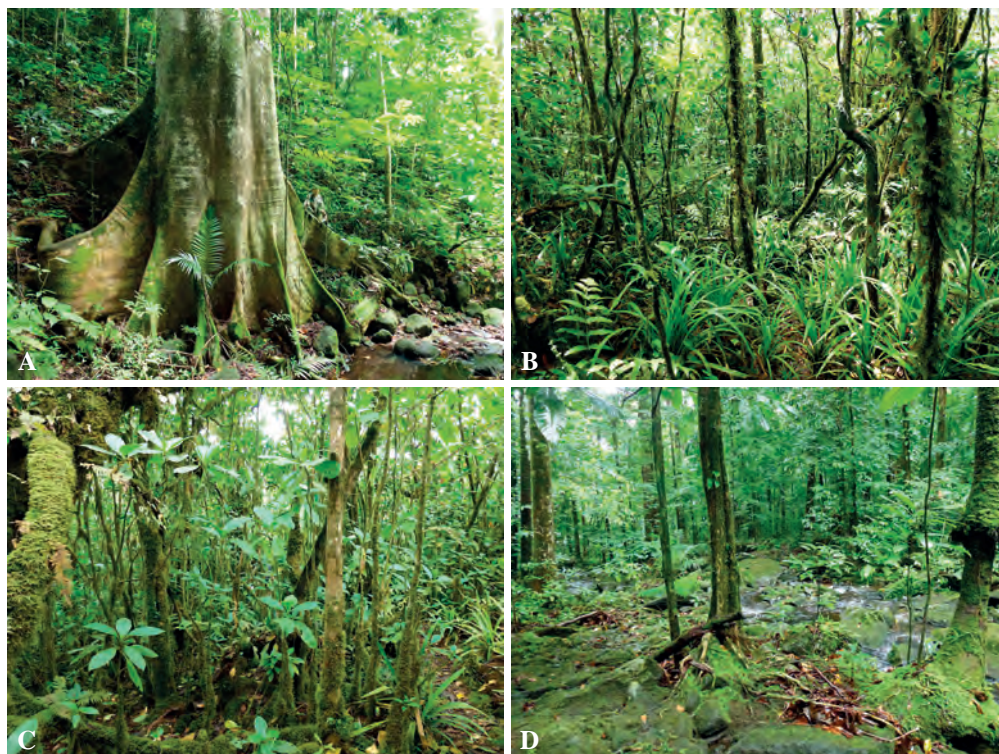


is placed within the park although limited infrastructure, staffing, funding and protection of the park and its forest resources currently exist. On São Tomé the Park boundary encompasses the highest peaks and best remaining rainforest (Fig. 1C). On Príncipe the southern half of the island, including the Pico de Príncipe (948 m), lies within the park boundary, and cloud-mist forests occur at significantly lower elevations than on São Tomé (Fig. 2B–C). The Pico Mesa in Príncipe is an exceptionally rich area for bryophytes even though the mesa is at only 500 m (Fig. 2D). Trail access is very limited into quality forests across Príncipe.



**Fig. 1:** Selected habitats of bryophytes on island of São Tomé, Parque Natural Obô de São Tomé. **A** – Forest slopes about Lagoa Amélia (1400 m), about 3 km along trail above Bom Sucesso. Enriched evergreen tropical forest draped in bryophyte cover. **B** – Dense mixed evergreen tropical cloud forest habitats dominated by liverworts. Steep and narrow ridges along the Pico de São Tomé trail (1700 m). Reaching the summit of the Pico de São Tomé is both strenuous and difficult. **C** – Along Pico de São Tomé trail at summit (2024 m) overlooking extensive tropical hardwood forests. Trees festooned in lichens (*Usnea* spp.) and bryophytes. **D** – Dense hardwood tropical forests at Lagoa Amélia (1400 m). Bryophytes attached to leaves and trunks of *Begonia baccata*, is the largest member of this genus in the world. Leaves of this *Begonia* can be a metre wide and mature plants commonly 3 m tall (Habitat photos made by Miko Nadel).

This is our second installment of new liverworts documented by voucher specimens for São Tomé and Príncipe (MÜLLER et al. 2011). Extensive areas on both islands remain poorly explored. We hope this account of recent discoveries on these islands will emphasize the need for continued field work that would eventually lead toward the development of a bryoflora of the country.



**Fig. 2:** Selected habitats of bryophytes on island of Príncipe, Parque Natural Obô de Príncipe. **A** – Disturbed low elevation hardwood forests dominated by introduced trees. The largest trees in Príncipe are *Ceiba pentandra*. Here the massive buttress of this *Ceiba* trunk is covered in liverworts. Note the third author at the far right buttress. **B** – Low statured evergreen hardwood forests on the Pico Mesa in Príncipe (500 m). Forest floor is saturated and carpeted in bryophytes. **C** – Small statured evergreen hardwood forest on the summit plateau of Pico de Mesa. Although this area is only 500 m in elevation, it is primarily a cloud forest environment that receives frequent precipitation. Habitat for *Heteroscyphus spectabilis* and *Bazzania decrescens* subsp. *molleri*. **D** – Perennial stream with rheophytic bryophytes over volcanic bedrock within a mixed evergreen tropical hardwood forest with palms, about mid-slope of Pico Mesa. Forests dominated by members of the Rubiaceae (Habitat photos made by Miko Nadel).

## Results

The following inventory of taxa lists new distributional records for the country of São Tomé and Príncipe, and for individual islands, that have not been previously published. The collections were made on two month-long expeditions during April–May, 2012 and 2013. Voucher specimens are conserved in the herbarium of the California Academy of Sciences (CAS), with duplicates in the herbarium of the Eszterházy College of Eger (EGR) and in the herbarium of the University of Dresden (DR). Duplicates in other herbaria are indicated behind the collection



numbers. All collections were made by the third author, and these were determined by T. Pócs (Frullaniaceae, Lejeuneaceae, Lepicoleaceae, Lepidoziaceae) and by F. Müller (Aneuraceae, Geocalycaceae, Jungermanniaceae, Metzgeriaceae, Plagiochilaceae, Radulaceae, Ricciaceae).

*Acrolejeunea emergens* (Mitt.) Steph.

**Príncipe:** Along dirt road within the Bom Bom Island Resort, 01°41'02.6"N, 07°24'13.0"E, 15 Apr 2012, 150 m alt., 40014 (BOL, CAS, DR, EGR, STPH); East Coast, along old unimproved road from Terreiro Velho toward Infante Henrique, in the vicinity of the volcanic formation known as 'Orgaos Basalticos', 01°34'57.0"N, 07°25'33.3"E, 20 Apr 2013, 100 m alt., 42161C (CAS, DR, EGR); Ilheu Caroco ou Bone Do Joquei (Jockey's Cap), 01°30'59.0"N, 07°25'46.8"E, 25 Apr 2013, 20 m alt., 42259 (CAS, DR, EGR, F). Secondary hardwood forest with scattered cacao and breadfruit, on buttress and trunk of large trees and on volcanic rock wall.

The species was recently reported as new for the Republic of São Tomé and Príncipe from the island of São Tomé (MÜLLER et al. 2011) and is now added for the island of Príncipe. Widespread Afro-American species occurring on bark in drier habitats.

*Archilejeunea abbreviata* (Mitt.) Vanden Berghen

**Príncipe:** Between Sundry and the airport in small watershed of the Ribeira Ize, 01°39'45.7"N, 07°24'10.0"E, 23 Apr 2012, 130 m alt., 40152A (CAS, DR, EGR); Obô Natural Park de Príncipe, Rio Banzu Basin, on slope below the peaks João Dias Father and Son along a tributary stream, 01°36'10.3"N, 07°22'15.5"E, 27 Apr 2012, 200 m alt., 40228 (CAS, DR, EGR, STPH); East Coast, along old unimproved road (now a trail) at Rio Chibala about 1 km south from the volcanic formation known as 'Orgaos Basalticos' toward Infante Henrique, 01°34'31.2"N, 07°25'15.0"E, 20 Apr 2013, 100 m alt., 42171 (CAS, DR, EGR); Obô Natural Park de Príncipe, along Ribeira Chimboto, south of old roça Infante Henrique and just north of Praia Seca and rocky point of Neves Ferreira, 01°33'03.4"N, 07°24'03.1"E, 25 Apr 2013, 15 m alt., 42270 (BOL, CAS, DR, EGR). On small hardwood branches, tree trunks and on volcanic boulders along small stream.

New for the Republic of São Tomé and Príncipe. Widespread in the lowland areas of tropical Africa.

*Archilejeunea autoica* Vanden Berghen

**Príncipe:** Obô Natural Park de Príncipe, on trail at saddle ridge below the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'53.3"N, 07°21'15.0"E, 28 Apr 2012, 425 m alt., 40263 (BOL, CAS, DR, EGR, STPH). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On tree trunk.

New for the Republic of São Tomé and Príncipe. Widespread in the lowland areas of tropical Africa.

*Bazzania decrescens* (Lehm. & Lindenb.) Trevis. subsp. *molleri* (Steph.) E.W.Jones

**Príncipe:** Obô Natural Park de Príncipe, on trail about the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'55.5"N, 07°21'34.7"E, 28 Apr 2012, 500 m alt., 40259 (CAS, DR, EGR); Obô Natural Park de Príncipe, along trail on rim of the Mesa in watershed of Ribeira Macoia above the old roça of Maria Correia, 01°34'53.4"N, 07°21'15.0"E, 19 Apr 2013, 500 m alt., 42143 (CAS, DR, EGR); *ibid.* 42153 (CAS, DR, EGR, MO); Obô Natural Park de Príncipe, along trail about mid-point between Terreiro Vehlo to Morro De Leste, 01°35'23.8"N, 07°24'24.0"E, 29 Apr 2013, 540 m alt., 42324 (CAS, DR, EGR, NY). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On tree trunk.

Historic report for Príncipe (Quintas, see SÉRGIO & GARCIA 2011) now confirmed. Afromontane taxon distributed mainly in West Africa; sporadic in southeast Africa.

*Caudalejeunea africana* (Steph.) Steph.

**Príncipe:** Between Sundry and the airport in small watershed of the Ribeira Ize, 01°39'45.7"N, 07°24'10.0"E, 23 Apr 2012, 130 m alt., 40152 (CAS, DR, EGR, STPH). On small hardwood branches along stream in secondary tropical forest.

New for the island of Príncipe. Widespread in tropical Africa.

*Caudalejeunea dusenii* Steph.

**São Tomé:** Obô Natural Park de São Tomé, along Do Fugido Trail off of the Pico São Tomé trail toward Morro Provaz in watershed below Lagôa Amelia, 00°17'21.8"N, 06°36'19.8"E, 4 May 2013, 1225 m alt., 42432B (CAS, DR, EGR). Mixed hardwood evergreen forest carpeted in bryophytes. On leaves of liana.



New for the Republic of São Tomé and Príncipe. Mainly a West African species with sporadic occurrence in East Africa.

***Caudalejeunea lehmanniana* (Gottsche) A.Evans**

**Príncipe:** Along dirt road from south-side of runway at airport to junction with road to Sundry, 01°39'22.7"N, 07°24'35.7"E, 23 Apr 2012, 170 m alt., 40159 (BOL, CAS, DR, EGR, STPH). Secondary mixed hardwood forest with palm understory. On hardwood trunk.

New for the Republic of São Tomé and Príncipe. An Afro-American species, in Africa the species is restricted in its distribution to West Africa.

***Ceratolejeunea cornuta* (Lindenb.) Steph.**

**São Tomé:** Above highway EN-2 between km markers 56 & 57, eastern coast between São João dos Angolares and Porto Alegre south of São Tomé, 00°05'48.5"N, 06°34'29.4"E, 3 Apr 2012, 15 m alt., 39689A (CAS, DR, EGR); Along highway EN-2, eastern coast north of Monte Mario and south of São Tomé, 00°05'08.0"N, 06°33'59.3"E, 3 Apr 2012, 45 m alt., 39707 (CAS, DR, EGR); Along highway EN-2, eastern coast north of Monte Mario near km marker 57, south of São Tomé, 00°05'25.8"N, 06°34'17.4"E, 3 Apr 2012, 25 m alt., 39714 (CAS, DR, EGR); Along end of road at Bom Baim from Trindade, 00°14'42.0"N, 06°37'59.1"E, 5 Apr 2012, 470 m alt., 39758 (BOL, CAS, DR, EGR, F). **Príncipe:** East Coast, along dirt road near intermittent stream crossing between Terreiro Velho and the volcanic formation called Two Fingers, 01°35'22.0"N, 07°25'19.0"E, 18 Apr 2012, 110 m alt., 40071 (CAS, DR, EGR, STPH); Along trail to Pico Papagaio above roça Santa Trindade along ridge section of trail above the rope area, 01°36'45.0"N, 07°23'28.4"E, 24 Apr 2012, 550 m alt., 40174 (BOL, CAS, DR, EGR, F, LISU); East Coast, along old unimproved road from Terreiro Velho toward Infante Henrique, at the volcanic formation known as 'Orgaos Basalticos', 01°34'52.4"N, 07°25'33.0"E, 20 Apr 2013, 100 m alt., 42165 (CAS, DR, E, EGR, MO, NY); Along dirt road from Gaspar to Sundry before bridge crossing of Ribeira Ize, 01°39'34.8"N, 07°23'42.3"E, 22 Apr 2013, 170 m alt., 42196 (CAS, DR, EGR); Obô Natural Park of Príncipe, along coastal path toward Rio São Tomé, 01°33'35.5"N, 07°21'06.0"E, 26 Apr 2013, 15 m alt., 42287 (CAS, DR, EGR). Mixed lowland tropical forest with ferns and cacao. On tree branches, especially *Theobroma*, on exposed roots of breadfruit trees and occasionally on volcanic boulders.

New for the Republic of São Tomé and Príncipe. Widespread Pantropical species.

***Cheilolejeunea intertexta* (Lindenb.) Steph.**

**Príncipe:** Along dirt road between the airport and the Bom Bom Island Resort, 01°40'50.4"N, 07°24'17.7"E, 16 Apr 2012, 150 m alt., 40032 (BOL, CAS, DR, EGR, LISU, STPH); Along dirt road toward Praia Banana just north of roça Belo Monte, 01°41'08.5"N, 07°26'38.3"E, 17 Apr 2012, 130 m alt., 40041 (CAS, DR, EGR, F); Along dirt road from Gaspar to Sundry before bridge crossing of Ribeira Ize, 01°39'34.8"N, 07°23'42.3"E, 22 Apr 2013, 170 m alt., 42200 (CAS, DR, EGR); *ibid.*, 01°39'32.3"N, 07°23'14.0"E, 22 Apr 2013, 180 m alt., 42209 (CAS, DR, EGR); Along unimproved dirt road from Sundry to Praia Sundry, 01°40'16.2"N, 07°23'09.1"E, 22 Apr 2013, 140 m alt., 42213 (CAS, DR, EGR). Mixed secondary hardwood forest. On buttress of *Ceiba pentandra*, coconut palms, and hardwood twigs.

New for the island of Príncipe. Widespread Palaeotropical species.

***Cheilolejeunea surrepens* (Mitt.) E.W.Jones**

**São Tomé:** Obô Natural Park, along Pico de São Tomé Trail along ridge between Estacho Sousa (camping site) and Pico de São Tomé near Mesa de São Tomé (saddle), 00°16'02.0"N, 06°32'54.0"E, 12 Apr 2012, 1785 m alt., 39954A (CAS, DR, EGR). Mixed hardwood tropical rain forest with tree ferns. On small diameter hardwood trunk.

New for the Gulf of Guinea Islands. Palaeotropical species widespread in tropical Africa, rare in Asia.

***Cheilolejeunea trifaria* (Reinw., Blume et Nees) Mizut.**

**Príncipe:** East Coast, along dirt road near intermittent stream crossing between Terreiro Velho and the volcanic formation called Two Fingers, 01°35'22.0"N, 07°25'19.0"E, 18 Apr 2012, 110 m alt., 40072A (CAS, DR, EGR); Along dirt road just above Praia Grande southeast of Belo Monte at northeast corner of the island, 01°40'32.5"N, 07°27'07.6"E, 27 Apr 2013, 50 m alt., 42312 (CAS, DR, EGR, STPH). Secondary hardwood forest with palm understory. On hardwood trunk and volcanic boulders.

New for the island of Príncipe. Widespread Palaeotropical species.

***Cololejeunea cuneifolia* Steph.**

**Príncipe:** Obô Natural Park de Príncipe, Rio Banzu Basin, on steep slope between the peaks João Dias Father and Son, 01°36'02.5"N, 07°22'35.5"E, 27 Apr 2012, 240 m alt., 40225 (CAS, DR, EGR); Along trail to Pico Papagaio above roça Santa Trindade about 1/3 way below summit, 01°36'40.0"N, 07°23'30.0"E, 15 Apr 2013, 600 m alt., 42054A

(CAS, DR, EGR); Obô Natural Park de Príncipe, along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'04.7"N, 07°24'13.0"E, 17 Apr 2013, 150 m alt., 42114 (CAS, DR, EGR, STPH); Obô Natural Park de Príncipe, just above the mouth of the Rio São Tomé, 01°33'36.6"N, 07°21'17.2"E, 26 Apr 2013, 5 m alt., 42295A (CAS, DR, EGR); Obô Natural Park de Príncipe, along trail about mid point between Terreiro Vehlo to Morro De Leste, 01°35'23.8"N, 07°24'24.0"E, 29 Apr 2013, 540 m alt., 42328A (CAS, DR, EGR); Obô Natural Park de Príncipe, along Ribeira Chimboto, south of old roça Infante Henrique and just north of Praia Seca and rocky point of Neves Ferreira, 01°33'03.4"N, 07°24'03.1"E, 25 Apr 2013, 15 m alt., 42281 (CAS, DR, EGR). Mixed hardwood tropical rainforest. On fern fronds and leaves of small shrubs.

New for the Republic of São Tomé and Príncipe. Uncommon tropical African species.

***Cololejeunea iradieri* Infante & Heras**

**São Tomé:** Obô Natural Park de São Tomé, along Do Fugido Trail off of the Pico São Tomé Trail toward Morro Provaz near creek originating from Lagôa Amelia, 00°17'38.5"N, 06°36'01.0"E, 4 May 2013, 1175 m alt., 42446 (BOL, CAS, DR, EGR, STPH). Mixed hardwood evergreen forest covered in bryophytes. On fern leaves.

New for the Gulf of Guinea Islands. West African endemic species previously known only from the type, described from Rio Muni by INFANTE & HERAS (1999).

***Cololejeunea lanceolata* E.W.Jones**

**Príncipe:** Along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'04.7"N, 07°24'13.0"E, 17 Apr 2013, 150 m alt., 42121B (CAS, DR, EGR). Mixed tropical hardwood forest with palm understory. On leaves of Rubiaceae trees.

New for the Gulf of Guinea Islands. Uncommon West African endemic previously known only from Cameroon, Ghana, Nigeria and Sierra Leone (WIGGINTON 2009).

***Cololejeunea mocambiquensis* S.W.Arnell**

Fig. 3A

**Príncipe:** Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40111A (CAS, DR, EGR). Mixed hardwood tropical forest with palm understory. On fronds of *Crepidomanes melanotrichum* ferns over volcanic boulder.

New for West Africa. Previously known only from East and South Africa and from Madagascar (WIGGINTON 2009).

***Cololejeunea obtusifolia* (E.W.Jones) Tixier**

**Príncipe:** Along dirt road within the Bom Bom Island Resort, 01°41'02.6"N, 07°24'13.0"E, 15 Apr 2012, 150 m alt., 40015 (CAS, DR, EGR); Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40104 (CAS, DR, EGR); Obô Natural Park de Príncipe, Rio Banzu Basin, on steep slope between the peaks João Dias Father and Son, 01°36'02.5"N, 07°22'35.5"E, 27 Apr 2012, 240 m alt., 40225A (CAS, DR, EGR). Secondary hardwood forest with planted cacao and breadfruit. On leathery leaves of shrubs.

New for the Republic of São Tomé and Príncipe. Widespread tropical African species.

***Cololejeunea papilliloba* (Steph.) Steph.**

Fig. 3B

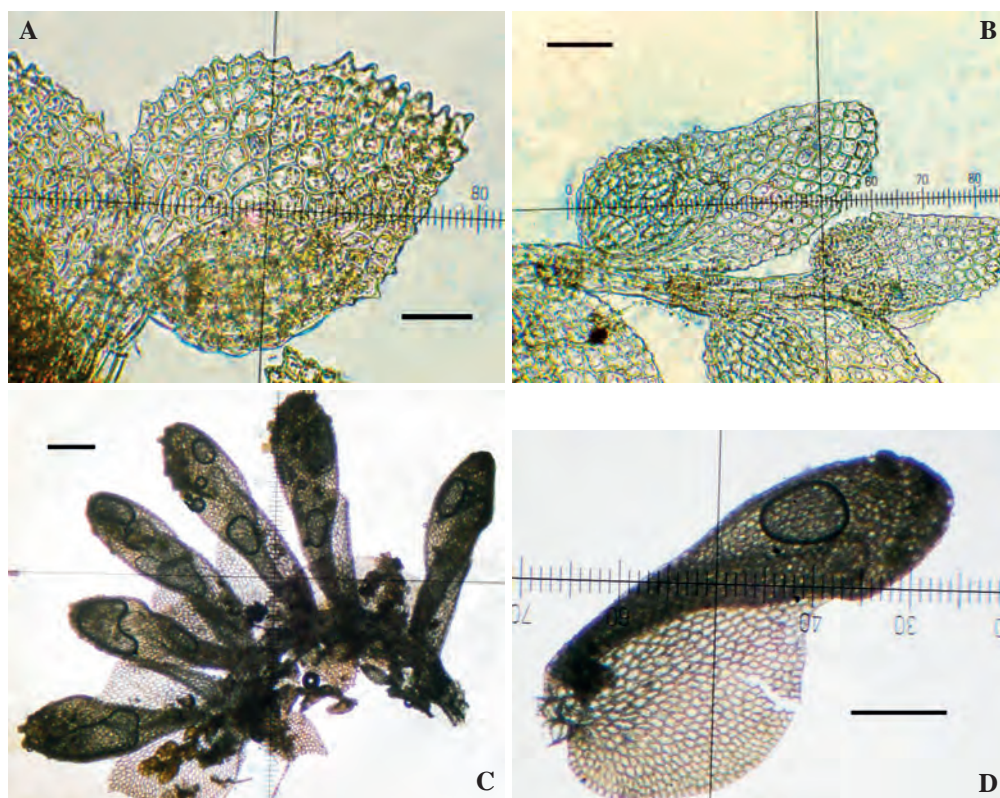
**São Tomé:** Along trail on ridge about 200 m beyond summit of Macambrara Radio Tower from Jardim Botânico de Bom Sucesso, 00°16'31.0"N, 06°36'13.5"E, 7 Apr 2012, 1350 m alt., 39814A (CAS, DR, EGR); Obô Natural Park, Pico de São Tomé Trail along ridge from Pico Carvalho to Estacho Sousa (camping site), 00°16'03.6"N, 06°34'27.4"E, 11 Apr 2012, 1500 m alt., 39923B (CAS, DR, EGR). Mixed hardwood tropical rain forest. On tree trunk and monocot leaves on forest floor.

New for the Republic of São Tomé and Príncipe. A Neotropical taxon, reported as new to Africa by MÜLLER & PÓCS (2007) from Bioko.

***Cololejeunea platyneura* (Spruce) A.Evans**

**São Tomé:** Obô Natural Park, Pico de São Tomé Trail along ridge from Pico Carvalho to Estacho Sousa (camping site), 00°16'03.6"N, 06°34'27.4"E, 11 Apr 2012, 1500 m alt., 39923A (CAS, DR, EGR). Mixed hardwood tropical rain forest. On monocot leaves on forest floor.

New for the Republic of São Tomé and Príncipe. Widespread Pantropic species.



**Fig. 3:** **A** – *Cololejeunea mocambiquensis* S.E. Arnell, leaf, ventral view, Príncipe J. Shevock 40111A. **B** – *Cololejeunea papilliloba* (Steph.) Steph., habit, ventral view, São Tomé J. Shevock 39923. **C** – *Colura obesa* Jovet-Ast, Habit and one leaf, ventral view, São Tomé J. Shevock 42248A. **D** – *Colura obesa* Jovet-Ast, leaf, ventral view, São Tomé J. Shevock 42248A. Scale bars: A – 20  $\mu$ m, B – 50  $\mu$ m, C–D – 250  $\mu$ m.

### *Cololejeunea pusilla* Steph.

**Príncipe:** Obô Natural Park de Príncipe, along trail about mid point between Terreiro Vehlo to Morro De Leste, 01°35'23.8"N, 07°24'24.0"E, 29 Apr 2013, 540 m alt., 42328C (CAS, DR, EGR). Mixed hardwood tropical rainforest. On fern fronds.

New for the Republic of São Tomé and Príncipe. More common in West Africa, uncommon in East Africa.

### *Cololejeunea zenkeri* (Steph.) E.W.Jones

**São Tomé:** Along trail on ridge just beyond summit of Macambrara Radio Tower from Jardim Botânico de Bom Sucesso, 00°16'33.3"N, 06°36'19.3"E, 7 Apr 2012, 1335 m alt., 39799D (CAS, DR, EGR). Mixed hardwood tropical rainforest. On fern fronds.

New for the island of São Tomé. Widespread tropical African species.

### *Colura hattoriana* Pócs

**Príncipe:** Along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'04.7"N, 07°24'13.0"E, 17 Apr 2013, 150 m alt., 42121E (CAS, DR, EGR). Mixed hardwood tropical forest with palm understory. On large Rubiaceae leaves.

New for the Republic of São Tomé and Príncipe. Known only from the Comoros, Malawi, Bioko, and Angola (WIGGINTON 2009, MÜLLER 2015).

*Colura obesa* Jovet-Ast

Fig. 3C, 3D

Rev. Bryol. Lichénol. 22: 273 (1954). Type: Madagascar, Massif de l'Anjanaharibe à l'ouest d'Andapa (Haute Andramonta), forêt ombrophile sur gneiss et granite, 500–700 m, H. Humbert, R. Capuron & G. Cours 12377, Dec. 1950 (PC).

**Syn. nov.:** *Colura benoistii* Jovet-Ast, Rev. Bryol. Lichénol. 22: 269 (1954). Type: Madagascar, Manjakotampo, R. Benoist s. n. 27 Oct. 1951 (PC).

**São Tomé:** West Coast, along trail beyond end of highway EN-1 about 4 km south of Santa Catarina, Rio Lemba and Roça Ponta Furada, 00°14'07.3"N, 06°28'02.0"E, 5 May 2013, 160 m alt., 42448A (CAS, DR, EGR). **Príncipe:** East Coast, along old unimproved road from Terreiro Velho toward Infante Henrique, in the vicinity of the volcanic formation known as 'Orgaos Basalticos', 01°34'57.0"N, 07°25'33.3"E, 20 Apr 2013, 100 m alt., 42161B (CAS, DR, EGR). Mixed secondary hardwood forest with palm understory. On branches and recently fallen hardwood trunk.

New for West Africa.

Studying seven specimens in EGR identified as *C. benoistii* or as *C. obesa* and comparing them with the type descriptions of both, it turned out that the two species are interconnected by gradual transitions. Such transitions have been shown in all characters considered by JOVET-AST (1954) to differentiate the species, including the size of leaves, the lobule shape, the number of inner and outer valve cells and the underleaf lobes. Both species were described by her from Madagascar.

If we consider, according to the original descriptions and illustrations of *Colura benoistii* (JOVET-AST 1954: 269–270), the characters of leaf length 2 mm (or at least 1.85 mm), the lobule widening abruptly into a rounded (almost globose) sac and the total number of valve cells more than 40, then only its type from Madagascar and to some extent one Réunion specimen (Arts s.n.) correspond to it.

The same way, to the original description of *Colura obesa* (JOVET-AST 1954: 273–274), with leaf length less than 1.8 mm, a gradually widening and obtuse-conical lobule sac with 29–31 valve cells, only its type from Madagascar and a specimen from Comores (Ndzuani Island, Pócs 9274/BM) matches. The other four specimens, one from Madagascar and from Réunion and two from São Tomé island show transitions in their different characters.

Table 1 shows the range of these characters in the studied specimens. Therefore the separation of the two taxa at the species level is untenable.

*Colura tenuicornis* (A.Evans) Steph.

**Príncipe:** Along trail to Pico Papagaio above roça Santa Trindade about 1/3 way below summit at vertical rock walls with seeps, 01°36'40.0"N, 07°23'30.0"E, 15 Apr 2013, 600 m alt., 42054E (CAS, DR, EGR). Mixed hardwood tropical forest with palm understory. On fern fronds.

New for the island of Príncipe. Widespread Pantropical species [see map 5 in JOVET-AST (1954)].

*Colura thomeensis* Pócs

**Príncipe:** Obô Natural Park de Príncipe, along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'06.6"N, 07°24'17.0"E, 17 Apr 2013, 120 m alt., 42102A (CAS, DR, EGR); Obô National Park de Príncipe, just above the mouth of the Rio São Tomé, 01°33'36.6"N, 07°21'17.2"E, 26 Apr 2013, 5 m alt., 42295B (CAS, DR, EGR). Mixed hardwood tropical forest with palm understory. On shrub leaves along intermittent streamlet.

New for the island of Príncipe. Endemic to the Gulf of Guinea Islands.

*Conoscyphus trapezioides* (Sande Lac.) Schiffn.

**Príncipe:** Obô Natural Park de Príncipe, along trail on rim of the Mesa in watershed of Ribeira Macoia above the old roça of Maria Correia, 01°34'53.4"N, 07°21'15.0"E, 19 Apr 2013, 500 m alt., 42146A (CAS, DR, EGR). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On hardwood branches.

New for the island of Príncipe. This species is known from São Tomé, but was hitherto unknown from Príncipe. The only record from São Tomé goes back to a historic collection made by Mann in 1861 [described by MITTEN (1863) as *Lophocolea devexa* Mitt., now a synonym of *Conoscyphus trapezioides*], but this species has not been rediscovered on the island. The Príncipe record is the first for the country in over 150 years. In West Africa the species is otherwise only known from Sierra Leone. Elsewhere in Africa,



**Table 1:** Comparison of characters of studied specimens of *Colura benoistii* Jovet-Ast and *Colura obesa* Jovet-Ast. Their sequence follows the gradual change between characters of the originally described two species. The last line summarizes the ratio of these characters.

| Properties   | Type of <i>Colura benoistii</i> Jovet-Ast | T. Arts: Réunion  | S. & T. Pócs: Madagascar, 04126/T | T. Pócs: Réunion, 08071/K | J. Shevock: São Tomé 42448/A | J. Shevock: São Tomé 42161/B | T. Pócs: Comores, 9274/BM | Type of <i>Colura obesa</i> Jovet-Ast |
|--|---|-------------------|-----------------------------------|---------------------------|------------------------------|------------------------------|---------------------------|---------------------------------------|
| Leaf length/width in mm                                | 2.0/1.2                                   | 2.0–2.5/0.9–1.2   | 1.7–1.85/0.75–1.0                 | 1.5–2.1/0.8–1.3           | 0.75–1.35/0.75–1.0           | 0.75–1.15                    | 1.6–1.7/0.75              | 1.2–1.5/0.7                           |
| Underleaf lobe length in mm                            | 0.4–0.5                                   | 0.4               | 0.32                              | 0.25–0.32                 | 0.25–0.3                     | 0.3                          | 0.3–0.4                   | 0.35                                  |
| Underleaf lobe base width, cells                       | 7–8                                       | 8–9               | 4–8                               | 4                         | 6–9                          | 5–8                          | 4–5                       | 4–5                                   |
| Number of outer/inner valve cells                      | 20/22                                     | ?                 | 18/23                             | 17–19/20–22               | 17–18/19–22                  | 15–18/19–20                  | 16/15                     | 13–16/15–16                           |
| Total number of valve cells                            | 42  | ?                 | 41                                | 37–41                     | 36–41                        | 35–41                        | 31                        | 29–31                                 |
| Leaf lobule sac widening                               | abrupt                                    | abrupt            | abrupt                            | abrupt                    | gradual                      | gradual                      | gradual                   | gradual                               |
| Leaf lobule apex                                       | rounded                                   | obtuse to conical | obtuse to apiculate               | obtuse                    | obtuse                       | obtuse                       | obtuse to apiculate       | obtuse to apiculate                   |
| <i>C. benoistii</i> /<br><i>C. obesa</i><br>characters | 7/0                                       | 4/1               | 4.5/2.5                           | 4/3                       | 3/4                          | 3/4                          | 0/7                       | 0/7                                   |

the species is reported from Madagascar, Malawi, Réunion, Seychelles, and Tanzania (WIGGINTON 2009) and outside Africa the species is known from tropical Asia, Oceania and Australia.

***Drepanolejeunea cultrella* (Mitt.) Steph.**

**Príncipe:** Obô Natural Park de Príncipe, on trail at saddle ridge below the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'53.3"N, 07°21'15.0"E, 28 Apr 2012, 425 m alt., 40265A (CAS, DR, EGR, STPH); Obô Natural Park de Príncipe, along trail on rim of the Mesa in watershed of Ribeira Macoia above the old roça of Maria Correia, 01°34'53.4"N, 07°21'15.0"E, 19 Apr 2013, 500 m alt., 42138A (CAS, DR, EGR). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On leaves of small shrubs and on leaves of monocots.

New for the island of Príncipe. Widespread tropical African species.

***Frullania apicalis* Mitt.**

**Príncipe:** East Coast, along old unimproved road from Terreiro Velho toward Infante Henrique, in the vicinity of the volcanic formation known as 'Orgaos Basalticos', 01°34'57.0"N, 07°25'33.3"E, 20 Apr 2013, 100 m alt., 42161 (CAS, DR, EGR, STPH). Mixed secondary hardwood forest with palm understory. On hardwood trunk and branches.

New for the island of Príncipe. Widespread tropical African species.

***Frullania depressa* Mitt.**

**São Tomé:** Bom Sucesso Botanical Garden and Obô Natural Park de São Tomé office, 00°17'19.4"N, 06°36'45.0"E, 3 May 2013, 1150 m alt., 42423 (CAS, DR, EGR, STPH). Mixed hardwood forest with planted trees. On small diameter hardwood stem.

New for the Gulf of Guinea Islands. Afromontane species, rare in West Africa.

***Frullania obscurifolia* Mitt.**

**Príncipe:** Between Sundy and the airport in small watershed of the Ribeira Ize, 01°39'51.0"N, 07°24'08.0"E, 23 Apr 2012, 180 m alt., 40136 (CAS, DR, EGR). Mixed secondary hardwood forest with palms. On coconut trunk.

New for the island of Príncipe. Widespread tropical African species.

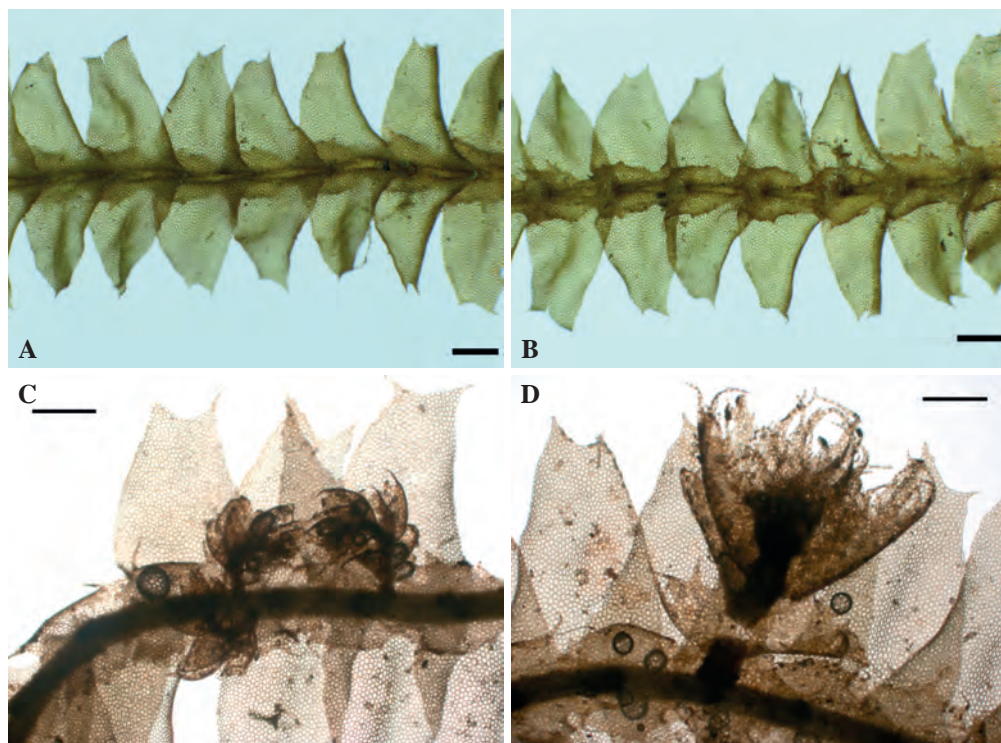
***Heteroscyphus spectabilis* (Steph.) Schiffn. [*Chiloscyphus thomeensis* Steph., *Isotachis perfoliata* Steph. non *Heteroscyphus perfoliatus* (Mont.) Schiffn.]** Fig. 4

**Príncipe:** Obô Natural Park de Príncipe, on trail about the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'55.5"N, 07°21'34.7"E, 28 Apr 2012, 500 m alt., 40254 (CAS, DR, EGR, LISU, STPH); *ibid.*, 40257 (BOL, CAS, DR, EGR, F); Obô Natural Park de Príncipe, along trail on rim of the Mesa in watershed of Ribeira Macoia above the old roça of Maria Correia, 01°34'53.4"N, 07°21'15.0"E, 19 Apr 2013, 500 m alt., 42142 (CAS, DR, EGR); *ibid.*, 42147 (CAS, DR, EGR); *ibid.*, 42151 (CAS, DR, EGR). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On hardwood trunk.

New for the island of Príncipe. This handsome liverwort belongs to the rarest species worldwide. It is restricted in distribution to Africa and was hitherto known only from São Tomé and Cameroon. In São Tomé the species was collected in 1885 by Moller at Bom Sucesso (SÉRGIO & GARCIA 2011) and was not found again since this time. The collections obtained from Cameroon date back to two specimens collected by Dusén in the 1890s (WIGGINTON 2004).

For over 100 years no additional material of the species was recorded anywhere. We can now report this species as new for Príncipe. These are the only sites where the species is recently known.

In the description of the species given in WIGGINTON (2004), based on a Dusén collection from the 1890s, the color of the plants is given as brown. This may be correct for old herbarium material, but the color of the freshly collected plants is olive-green. The sexual condition is given in WIGGINTON (2004) as 'probably dioicous', because androecia were not observed. In our material androecia as well as gynoecia are present and both are distributed on separate plants. Therefore the dioicous distribution of gametangia was confirmed by our material. This is also in accordance with the information given by STEPHANI (1909) in the description of *Chiloscyphus spectabilis*.



**Fig. 4:** *Heteroscyphus spectabilis* (Steph.) Schiffn. **A** – Shoot in dorsal view. **B** – Shoot in ventral view. **C** – Male shoot with androecia. **D** – Female shoot with perichaetium. All photos taken from Príncipe J. Shevock 40257. Scale bars: A–D – 500 µm.

***Lejeunea abyssinica* (Gola) Cufod. (*Lejeunea confusa* E.W.Jones)**

**São Tomé:** Along trail on ridge about 200 m beyond summit of Macambrara Radio Tower from Jardim Botânico de Bom Sucesso, 00°16'31.0"N, 06°36'13.5"E, 7 Apr 2012, 1350 m alt., 39814B (CAS, DR, EGR). **Príncipe:** Between Sandy and the airport in small watershed of the Ribeira Ize, 01°39'45.7"N, 07°24'10.0"E, 23 Apr 2012, 130 m alt., 40144 (CAS, DR, EGR, STPH); *ibid.*, 40147 (BOL, CAS, DR, EGR, LISU); *ibid.*, 40149 (CAS, DR, EGR, F); Obô Natural Park de Príncipe, Rio Banzu Basin, on slope below the peaks João Dias Father and Son along a tributary stream, 01°36'10.3"N, 07°22'15.5"E, 27 Apr 2012, 200 m alt., 40229 (CAS, DR, EGR); At beach at old roça of Maria Correia at base of the Mesa de Príncipe, 01°36'02.6"N, 07°21'10.7"E, 16 Apr 2013, 1 m alt., 42071 (CAS, DR, EGR, STPH). Mixed secondary hardwood to primary forests. On tree trunks, buttresses, exposed roots and on volcanic boulders.

New for the Republic of São Tomé and Príncipe. Tropical African species.

***Lejeunea brenanii* E.W.Jones**

**São Tomé:** Along dirt road near summit of Macambrara Radio Tower from Jardim Botânico de Bom Sucesso, 00°16'33.8"N, 06°36'19.3"E, 6 Apr 2012, 1250 m alt., 39785 (BOL, CAS, DR, EGR, LISU, STPH). Mixed secondary hardwood forest. On hardwood trunk.

New for the Gulf of Guinea Islands. West African endemic.

***Lejeunea eckloniana* Lindenb.**

**Príncipe:** On road just before reaching São Joaquim from Porto Real, 01°37'18.3"N, 07°22'56.2"E, 27 Apr 2012, 170 m alt., 40238 (BOL, CAS, DR, EGR, STPH). Mixed secondary hardwood forest with palm understory. On clayey volcanic soil.

New for the Gulf of Guinea Islands (reported in literature without a specimen). Widespread tropical African species.

***Lejeunea helenae* Pearson**

**Príncipe:** Along trail paralleling Praia Bom Bom just southwest of Bom Bom Island Resort, 01°41'24.0"N, 07°23'56.5"E, 16 Apr 2012, 3 m alt., 40018 (CAS, DR, EGR, STPH). Secondary hardwood forest of coastal strand. On coconut trunk.

New for the Republic of São Tomé and Príncipe. Tropical African species.

***Lejeunea ibadana* A.J.Harr. & E.W.Jones**

**São Tomé:** West Coast, along trail beyond end of highway EN-1 about 4 km south of Santa Catarina, Rio Lemba and Roça Ponta Furada, 00°14'07.3"N, 06°28'02.0"E, 5 May 2013, 160 m alt., 42449 (CAS, DR, EGR). **Príncipe:** Agua Grande watershed about 1 km from Praia Bom Bom, 01°41'03.7"N, 07°24'00.7"E, 18 Apr 2013, 40 m alt., 42127A (CAS, DR, EGR); *ibid.*, 01°41'23.0"N, 07°24'00.0"E, 18 Apr 2013, 15 m alt., 42134 (CAS, DR, EGR, STPH); Along dirt road just above Praia Boi east of Belo Monte at northeast corner of the island, 01°40'48.6"N, 07°27'41.3"E, 27 Apr 2013, 10 m alt., 42309 (BOL, CAS, DR, EGR). Secondary hardwood forest with either palm or cacao understory. On hardwood branches, rotten wood, lianas, and occasionally fused to the surface of volcanic rocks.

New for the Gulf of Guinea Islands. West and Central African species.

***Lejeunea lyratiflora* Steph.**

**São Tomé:** Obô Natural Park de São Tomé, along Do Fugido Trail off of the Pico São Tomé Trail toward Morro Provaz in watershed below Lagôa Amelia, 00°17'21.8"N, 06°36'19.8"E, 4 May 2013, 1225 m alt., 42432A (CAS, DR, EGR). Mixed hardwood tropical forest covered in bryophytes. On leaves of liana.

New for the Gulf of Guinea Islands. Relatively rare tropical African species more common at higher altitudes, usually occurs on the leaves of filmy fern.

***Lepidozia ubangiensis* Steph.**

**São Tomé:** Beyond end of highway EN-1 south of Santa Catarina, Rio Lemba and Roça Ponta Furada, along abandoned road now functioning as a trail, 00°14'11.7"N, 06°28'04.0"E, 13 Apr 2013, 220 m alt., 42012 (BOL, CAS, DR, EGR, F, LISU). **Príncipe:** Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40123 (CAS, DR, EGR, STPH); East Coast, along old unimproved road (now a trail) at a tributary of the Rio Chibala south from the volcanic formation known as 'Orgaos Basalticos' toward Infante

Henrique, 01°34'26.0"N, 07°25'13.0"E, 20 Apr 2013, 100 m alt., 42180 (CAS, DR, EGR); Bom Bom Island, along trail across small island to marine light beacon, 01°41'47.7"N, 07°24'09.5"E, 24 Apr 2013, 20 m alt., 42250 (CAS, DR, EGR); Obô Natural Park de Príncipe, along coastal path toward Rio São Tomé, 01°33'35.5"N, 07°21'06.0"E, 26 Apr 2013, 15 m alt., 42286 (BOL, CAS, DR, EGR). Mixed secondary to primary hardwood forest usually with palm understory. On volcanic soil bank over rocks.

New for the Gulf of Guinea Islands. Hitherto known only from continental West Africa.

*Leptolejeunea astroidea* (Mitt.) Steph.

**Príncipe:** Along trail to Pico Papagaio above roça Santa Trindade about 1/3 way below summit at vertical rock walls with seeps, 01°36'40.0"N, 07°23'30.0"E, 15 Apr 2013, 600 m alt., 42054B (CAS, DR, EGR); Along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'04.7"N, 07°24'13.0"E, 17 Apr 2013, 150 m alt., 42121D (CAS, DR, EGR); Along the Rio Papagaio at trail between Bela Vista and Santa Joaquina, just above community of Bela Vista, 01°36'49.0"N, 07°24'39.8"E, 17 Apr 2013, 100 m alt., 42122B (CAS, DR, EGR); Obô Natural Park de Príncipe, just above the mouth of the Rio São Tomé, 01°33'36.6"N, 07°21'17.2"E, 26 Apr 2013, 5 m alt., 42295C (CAS, DR, EGR). Mixed hardwood tropical forest with palm understory. On shrub leaves, monocot leaves (*Thaumatococcus daniellii*), and fern fronds.

New for the Gulf of Guinea Islands. Hitherto known only from continental West and Central Africa.

*Leptolejeunea epiphylla* (Mitt.) Steph.

**Príncipe:** Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40104A (CAS, DR, EGR); Slopes along the Rio Papagaio about 1 km south of the village of Bella Vista above Santo Antonio along dirt road (now abandoned) below dam, 01°36'32.0"N, 07°24'42.5"E, 21 Apr 2012, 75 m alt., 40133 (BOL, CAS, DR, EGR, LISU, STPH); Along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'04.7"N, 07°24'13.0"E, 17 Apr 2013, 150 m alt., 42121C (CAS, DR, EGR); Along the Rio Papagaio at trail between Bela Vista and Santa Joaquina, just above community of Bela Vista, 01°36'49.0"N, 07°24'39.8"E, 17 Apr 2013, 100 m alt., 42122 (CAS, DR, EGR); Agua Grande watershed just inland of Praia Bom Bom, 01°41'23.0"N, 07°24'00.0"E, 18 Apr 2013, 15 m alt., 42132 (BOL, CAS, DR, EGR, F, LISU). Mixed hardwood tropical forest with palm understory. On shrub leaves and monocot leaves (*Thaumatococcus daniellii*).

New for the island of Príncipe. Widespread Palaeotropical species.

*Leptolejeunea maculata* (Mitt.) Schiffn.

**Príncipe:** Along dirt road within the Bom Bom Island Resort, 01°41'02.6"N, 07°24'13.0"E, 15 Apr 2012, 150 m alt., 40015A (CAS, DR, EGR); Along trail to Pico Papagaio above roça Santa Trindade about 1/3 way below summit at vertical rock walls with seeps, 01°36'40.0"N, 07°23'30.0"E, 15 Apr 2013, 600 m alt., 42054C (CAS, DR, EGR); Obô Natural Park de Príncipe, along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'06.6"N, 07°24'17.0"E, 16 Apr 2013, 120 m alt., 42102 (CAS, DR, EGR); Along the Rio Papagaio at trail between Bela Vista and Santa Joaquina, just above community of Bela Vista, 01°36'49.0"N, 07°24'39.8"E, 17 Apr 2013, 100 m alt., 42122A (CAS, DR, EGR). Secondary hardwood tropical forest among cacao and breadfruit through mixed hardwood forests with palm understory. On hardwood leaves, monocot leaves (*Thaumatococcus daniellii*), and fern fronds

New for the island of Príncipe. Palaeotropical species. Widespread in tropical Africa.

*Lopholejeunea subfusca* (Nees) Schiffn.

**São Tomé:** Along road between Trindade and Bom Baim at the junction of two streams with waterfalls becoming the Rio Abade, 00°15'15.5"N, 06°37'48.3"E, 5 Apr 2012, 500 m alt., 39744 (BOL, CAS, DR, EGR, LISU, STPH). Mixed hardwood tropical forest. On wet volcanic soil of vertical bank.

New for island of São Tomé. Widespread Pantropical species.

*Mastigolejeunea nigra* Steph.

**Príncipe:** Along sand bar spit between lagoon of Agua Grande and the ocean at Praia Bom Bom, 01°41'24.3"N, 07°23'59.4"E, 24 Apr 2013, 2 m alt., 42249 (CAS, DR, EGR). Coastal strip of coconut palms and tropical almond (*Terminalia*). On hardwood trunks.

New for the island of Príncipe. Widespread tropical African species.



***Mastigophora diclados*** (Brid. ex F.Weber) Nees

**Príncipe:** Obô Natural Park de Príncipe, on trail about the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'55.5"N, 07°21'34.7"E, 28 Apr 2012, 500 m alt., 40242 (CAS, DR, EGR). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On hardwood branch.

New for the island of Príncipe. Widespread Palaeotropical montane species.

***Metalejeunea cucullata*** (Reinw., Blume & Nees) Grolle

**Príncipe:** Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40115B (CAS, DR, EGR). Mixed hardwood forest with palm understory. On hardwood trunk.

New for West Africa, in Africa otherwise known only from the Indian Ocean Islands. Palaeotropical species.

***Metzgeria saxbyi*** Pearson

Fig. 6A

**Príncipe:** Obô Natural Park de Príncipe, along Rio Papagaio about 2 km above community of Bela Vista and above small dam site of abandoned hydropower plant, 01°36'06.6"N, 07°24'17.0"E, 16 Apr 2013, 120 m alt., 42097 (CAS, DR, EGR, STPH). Mixed hardwood forest with palm understory. On hardwood trunk.

New for the Republic of São Tomé and Príncipe. The species is endemic to Africa and hitherto known from Bioko, Cameroon, Ghana, Uganda, South Africa, and Swaziland (WIGGINTON 2009, PHEPHU & VAN ROOY 2011).

***Microlejeunea ankasica*** E.W.Jones

**São Tomé:** Beyond end of highway EN-1 south of Santa Catarina, Rio Lemba and Roça Ponta Furada, along abandoned road now functioning as a trail, 00°14'07.7"N, 06°28'10.0"E, 2 May 2012, 200 m alt., 40288C (CAS, DR, EGR). **Príncipe:** Along trail to Pico Papagaio above roça Santa Trindade about 1/3 way below summit at vertical rock walls with seeps, 01°36'40.0"N, 07°23'30.0"E, 15 Apr 2013, 600 m alt., 42048 (CAS, DR, EGR, STPH). Mixed hardwood forest with palm understory. On hardwood trunk and branches.

New for the Gulf of Guinea Islands. Rare West African endemic, only known from Ghana and Sierra Leone.

***Neurolejeunea breutelii*** (Gottsche) A.Evans var. *africana* Pócs, var. nov.

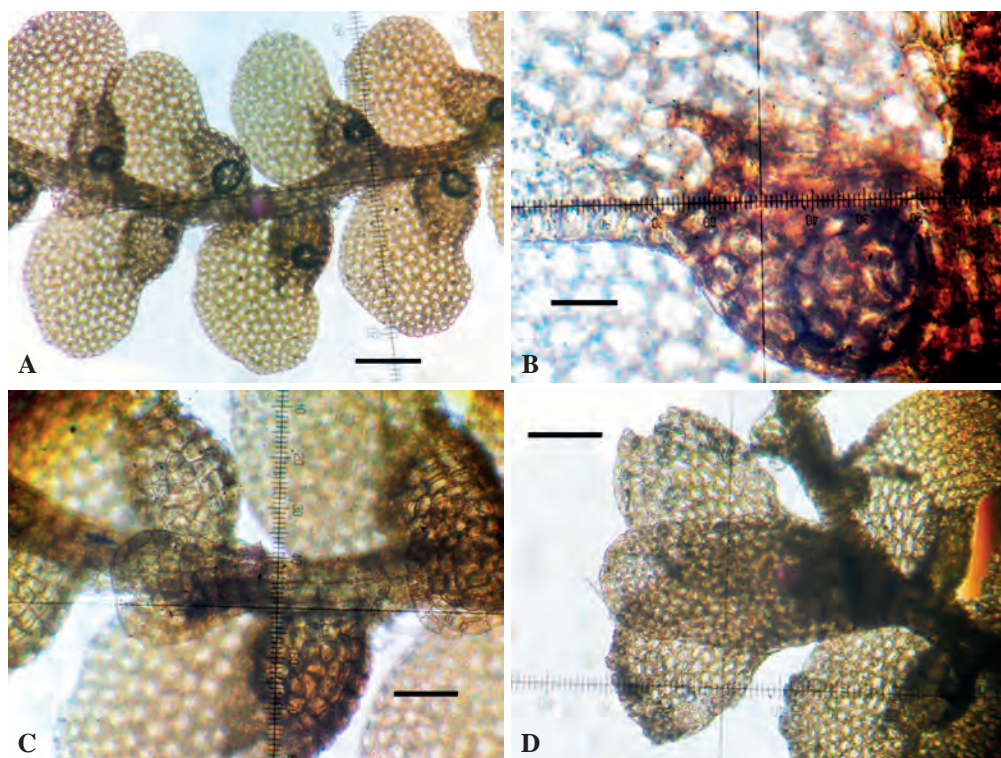
Fig. 5

**Diagnosis:** From typical *Neurolejeunea breutelii* (Gottsche) A.Evans var. *breutelii* differs by its ventral merophytes in 2–4 rows, by its flat, narrower, cuneate underleaves (only 6–10 cells wide, while 12–16 cells wide in var. *breutelii*) and by its elongate elliptic bracteole (obovate-suborbicular in var. *breutelii*).

**Type of var. *africana*:** Príncipe Island, slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of the road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 110 m alt. Hardwood tropical forest with palm understory. On small hardwood trunk in filtered light. J.R. Shevock, M. Nadel & M. Patacho 40115 (holotype: CAS, isotypes: DR, EGR). It grows together with *Cheilolejeunea serpentina*, *Metalejeunea cucullata* and *Radula appressa*.

**Discussion:** The genus and species are new for Africa. *Neurolejeunea* (Spruce) Schiffn. hitherto was considered a typical Neotropical genus not occurring outside the Americas. It is characterized by its blackish brown or blackish green color due to the darkish pigmented cell walls, *Lejeunea* type branching, inflated lobules bordered by narrow rectangular cells, usually reduced first tooth and large, falcate second tooth, entire, orbicular to cuneate underleaves (GRADSTEIN 1994). Four species are allocated into two sections, one with ocelli, forming a row in the lobe (sect. *Neurolejeunea*) and one without ocelli (sect. *Aneurolejeunea*). *Neurolejeunea breutelii* belongs to the latter section, together with the rare and very closely related *Neurolejeunea sastreana* Gradst. It is distinguished from *N. sastreana* by the lack or rudimentary occurrence of the inflated first tooth.

*Neurolejeunea breutelii* is a very widespread and variable Neotropical species occurring from the southeastern United States to Rio Grande do Sul in Brazil (GRADSTEIN 1994). Its African occurrence suggests one colonization by long range air dispersal, but as a speciation has taken place at the variety level, this could have happened relatively long ago. Its isolated occurrence is reminiscent of the only



**Fig. 5:** *Neurolejeunea breutelii* (Gottsche) Schiffn. var. *africana* Pócs, **var. nov.** **A** – Habit. **B** – Lobule. **C** – Underleaves. **D** – Female perichaetium. All photos taken from type, Príncipe J. Shevock 40115A. Scale bars: A, D – 100µm, B – 25µm, C – 50µm.

native African bromeliad, *Pitcairnia feliciana* (A.Chev.) Harms & Mildbr., which is endemic to West Africa on sandstone inselbergs of the Fouta Djallon highlands in middle Guinea and whose closest relatives probably occur on rock outcrops situated in the Brazilian rainforest (POREMBSKI & BARTHOLOTT 1999).

***Notoscyphus lutescens* (Lehm. & Lindenb.) Mitt.**

**São Tomé:** Along dirt road near São Luis west of Bemposta, 00°18'21.3"N, 06°36'34.5"E, 8 May 2013, 900 m alt., 42498 (BOL, CAS, DR, EGR, STPH). Secondary hardwood forest. Volcanic clayey soil of roadbank.

New for the Gulf of Guinea Islands. A Palaeotropical species scattered throughout tropical and southern Africa (WIGGINTON 2004, 2009, MÜLLER 2015).

***Plagiochila africana* Steph.**

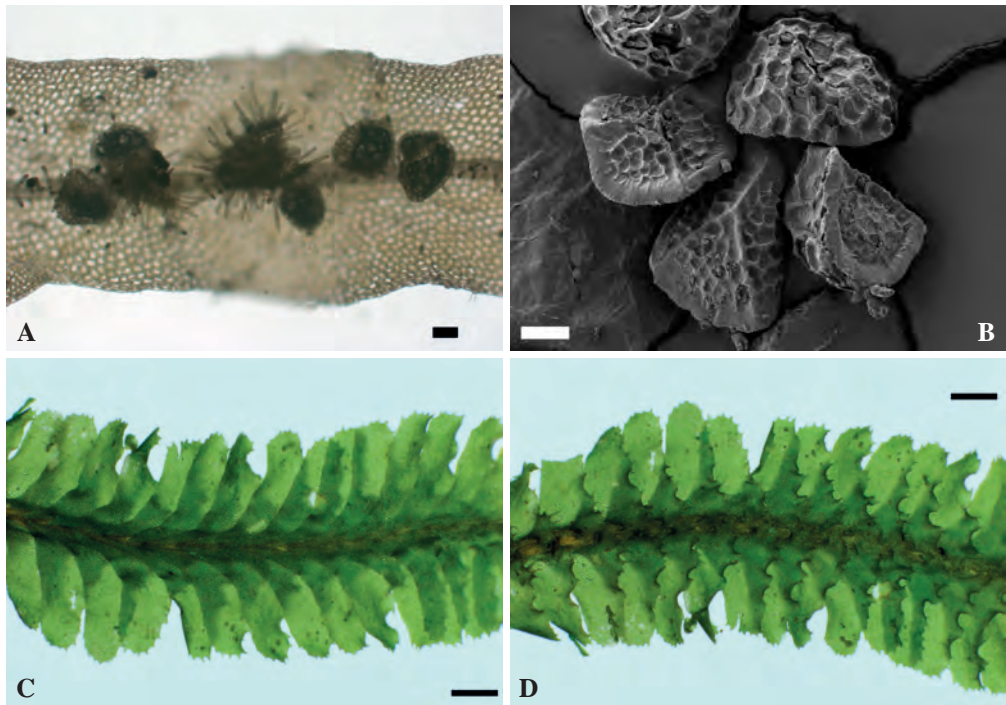
Fig. 6C–D

**Príncipe:** Obô Natural Park de Príncipe, just above the mouth of the Rio São Tomé, 01°33'36.6"N, 07°21'17.2"E, 26 Apr 2013, 5 m alt., 42293 (BOL, CAS, DR, EGR, STPH). Mixed tropical hardwood forest with palm understory. On volcanic boulders along streamlet.

New for the Republic of São Tomé and Príncipe. The species is confined to West Africa and was hitherto known from Bioko, Central African Republic, Cameroon, Ghana, Guinea, Ivory Coast, Nigeria, Rio Muni, and Sierra Leone (WIGGINTON 2009).

***Plagiochila heterostipa* Steph.**

**Príncipe:** Along trail at Pico Papagaio above roça Santa Trindade along summit ridge, 01°36'38.6"N, 07°23'32.0"E, 15 Apr 2013, 680 m alt., 42064 (CAS, DR, EGR, STPH); Along dirt road from Gaspar to Sundy before bridge cross-



**Fig. 6:** **A** – *Metzgeria saxbyi* Pearson, thallus underside with male and female branchlets, Príncipe J. Shevock 42097. **B** – *Riccia lanceolata* Steph., scanning micrographs of spores, Príncipe J. Shevock 42219. **C** – *Plagiochila africana* Steph., shoot in dorsal view, Príncipe J. Shevock 42293. **D** – *Plagiochila africana* Steph., shoot in ventral view, Príncipe J. Shevock 42293. Scale bars: A – 100  $\mu$ m, B – 20  $\mu$ m, C–D – 500  $\mu$ m.

sing of Ribeira Ize, 01°39'34.8"N, 07°23'42.3"E, 22 Apr 2013, 170 m alt., 42199 (CAS, DR, EGR). Mixed tropical hardwood forest with palm understory. On hardwood trunk.

New for the Gulf of Guinea Islands. An African endemic, widely distributed in tropical Africa.

***Radula ankefinensis* Gottsche ex Steph.**

**São Tomé:** Obô Natural Park de São Tomé, along Do Fugido Trail off of the Pico São Tomé trail toward Morro Provaz in watershed below Lagôa Amelia, 00°17'21.8"N, 06°36'19.8"E, 4 May 2013, 1225 m alt., 42432 (CAS, DR, EGR). Mixed tropical hardwood forest covered in bryophytes. On leaves of liana.

New for the island of São Tomé. An Afro-montane species, in West Africa hitherto known only from Cameroon and Bioko. The species was recently reported as new for the Republic of São Tomé and Príncipe from the island of Príncipe (MÜLLER et al. 2011) and is now added for the island of São Tomé.

***Radula stenocalyx* Mont.**

**Príncipe:** Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40117 (CAS, DR, EGR, STPH); Obô Natural Park de Príncipe, on trail at saddle ridge below the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'53.3" N, 07°21'15.0" E, 28 Apr 2012, 425 m alt., 40265 (CAS, DR, EGR); Obô Natural Park de Príncipe, along trail on rim of the Mesa in watershed of Ribeira Macoia above the old roça of Maria Correia, 01°34'53.4"N, 07°21'15.0"E, 19 Apr 2013, 500 m alt., 42138 (CAS, DR, EGR). Mixed tropical hardwood forest with palm understory. On moist volcanic boulders.

New for the island of Príncipe. An Afro-American species, widely distributed in tropical Africa. Based on an old record, the species is already known from São Tomé (SÉRGIO & GARCIA 2011), but was hitherto unknown from Príncipe.



***Riccardia amazonica* (Spruce) Schiffn. ex Gradst.**

**Príncipe:** Along 3-way road junction between São Joaquim, Santa Trindade and Montalegre, 01°37'39.7"N, 07°23'38.6"E, 19 Apr 2012, 245 m alt., 40095 (CAS, DR, EGR); Off of dirt road at entrance gate of Bom Bom Island Resort, 01°41'26.5"N, 07°24'09.8"E, 14 Apr 2013, 15 m alt., 42025 (BOL, CAS, DR, EGR, STPH); Obô Natural Park de Príncipe, slopes above the Rio Papagaio on old trail toward Pico Papagaio at junction trail between Bela Vista and Santa Joaquina, 01°36'37.0"N, 07°24'03.0"E, 17 Apr 2013, 200 m alt., 42118 (CAS, DR, EGR); Agua Grande watershed about 1 km from Praia Bom Bom, 01°41'03.7"N, 07°24'00.7"E, 18 Apr 2013, 40 m alt., 42130 (CAS, DR, E, EGR); East Coast, along old unimproved road (now a trail) at a tributary of the Rio Chibala south from the volcanic formation known as 'Orgaos Basalticos' toward Infante Henrique, 01°34'26.0"N, 07°25'13.0"E, 20 Apr 2013, 100 m alt., 42174 (CAS, DR, EGR); Obô Natural Park de Príncipe, along small unnamed stream just above Praia Rei below the mesa of Ocinho de Cão, 01°36'05.0"N, 07°20'32.3"E, 26 Apr 2013, 5 m alt., 42302 (CAS, DR, EGR); Along trail toward Santa Joaquina via Porto Real, northeast base of Pico Papagaio, 01°36'44.2"N, 07°23'58.1"E, 1 May 2013, 200 m alt., 42374 (CAS, DR, EGR, LISU). Mixed tropical hardwood forest. On rotten wood (logs, stump, branches); less common on clayey volcanic soil.

New for the island of Príncipe. A widely distributed Afro-American species, widespread in West Africa. REEB & BARDAT (2014) have found differences between African and American material. For the African populations therefore the name *Aneura stephanii* Besch. should be reintroduced.

***Riccardia erosa* (Steph.) E.W.Jones**

**Príncipe:** East Coast, along dirt road near stream crossing between Terreiro Velho and the volcanic formation called Two Fingers, 01°35'26.2"N, 07°25'19.4"E, 18 Apr 2012, 100 m alt., 40069 (CAS, DR, EGR, STPH); Along dirt road of compacted volcanic clay to Sundy from Gaspar west of junction of dirt road to airport, 01°39'19.0"N, 07°23'54.0"E, 26 Apr 2012, 165 m alt., 40208 (CAS, DR, EGR); Along dirt road from Gaspar to Sundy after bridge crossing of Ribeira Ize, 01°39'32.3"N, 07°23'14.0"E, 22 Apr 2013, 180 m alt., 42207 (CAS, DR, EGR, STPH); Along dirt road from São Joaquim toward Porto Real, 01°37'14.0"N, 07°23'05.0"E, 23 Apr 2013, 170 m alt., 42232 (BOL, CAS, DR, EGR). Mixed tropical hardwood forest with palm understory. On rotten hardwood logs and infrequently on clayey volcanic soil.

New for the island of Príncipe. A tropical African species, known from Cameroon, Congo-Brazzaville, Ethiopia, Madagascar, São Tomé, and Tanzania.

***Riccardia longispica* (Steph.) Pearson**

**Príncipe:** Obô Natural Park de Príncipe, on trail about the summit plateau of Pico Mesa accessed via the abandoned roça of Maria Correia, 01°34'55.5"N, 07°21'34.7"E, 28 Apr 2012, 500 m alt., 40258 (BOL, CAS, DR, EGR, LISU, STPH); Obô Natural Park de Príncipe, along trail toward the Mesa along Ribeira Macoia above the old roça of Maria Correia, 01°35'19.0"N, 07°21'29.0"E, 16 Apr 2013, 350 m alt., 42090 (CAS, DR, EGR, F); Obô Natural Park de Príncipe, along trail on rim of the Mesa in watershed of Ribeira Macoia above the old roça of Maria Correia, 01°34'53.4"N, 07°21'15.0"E, 19 Apr 2013, 500 m alt., 42140 (CAS, DR, E, EGR, F, MO); Obô Natural Park de Príncipe, along trail about mid-point between Terreiro Vehlo to Morro De Leste, 01°35'43.5"N, 07°24'35.0"E, 29 Apr 2013, 430 m alt., 42343 (CAS, DR, EGR). Dwarf mixed hardwood tropical cloud forest with abundant bryophyte cover. On wet rotten wood and litter on forest floor.

New for the Republic of São Tomé and Príncipe. Scattered throughout tropical Africa; in West Africa known from Bioko, Cameroon, and Rio Muni. The records given in MÜLLER et al. (2011) for São Tomé are based on misidentifications and refer to *Riccardia limbata*.

***Riccia discolor* Lehm. et Lindenb.**

**Príncipe:** Along dirt road (trail) to Praia Banana from overlook north of roça Belo Monte, 01°41'12.6"N, 07°26'35.0"E, 17 Apr 2012, 110 m alt., 40035 (CAS, DR, EGR, F, STPH); Along dirt road toward Praia Banana between roça Belo Monte and Paciencia north of Picao, 01°40'41.3"N, 07°26'20.7"E, 17 Apr 2012, 100 m alt., 40046 (BOL, CAS, DR, EGR, LISU). Disturbed secondary hardwood forest. On compacted volcanic clayey soils.

New for the Republic of São Tomé and Príncipe. More or less widespread in the African savannah zone, otherwise known from tropical Asia and Australia.

***Riccia lanceolata* Steph.**

Fig. 6B

**Príncipe:** Along edge of buildings in the community of the old roça of Sundy, 01°40'11.4"N, 07°22'58.7"E, 22 Apr 2013, 160 m alt., 42219 (CAS, DR, EGR). Disturbed secondary hardwood forest. On compacted volcanic clayey soils.

New for the Gulf of Guinea Islands. An African endemic, scattered in the African savannah zone.



***Schiffneriolejeunea occulta* (Steph.) Gradst.**

**São Tomé:** Beyond end of highway EN-1 south of Santa Catarina, Rio Lemba and Roça Ponta Furada, along abandoned road now functioning as a trail, 00°14'07.7"N, 06°28'10.0"E, 2 May 2012, 200 m alt., 40288A (CAS, DR, EGR). **Príncipe:** Along dirt road off of road above entrance gate of Bom Bom Island Resort, 01°40'54.4"N, 07°24'04.5"E, 14 Apr 2013, 75 m alt., 42033 (CAS, DR, EGR). Secondary tropical hardwood forest. On hardwood trunk and exposed roots.

First confirmed record for the Gulf of Guinea Islands. A specimen from São Tomé at G, although labelled as *Acrolejeunea occulta* (= *Schiffneriolejeunea occulta*), requires confirmation (SÉRGIO & GARCIA 2011). An African endemic, restricted to West Africa.

***Stictolejeunea balfourii* (Mitt.) E.W.Jones**

**Príncipe:** Slopes along the Rio Papagaio about 2 km south of the village of Bella Vista above Santo Antonio beyond end of road (now abandoned) about 200 m above dam, 01°36'11.5"N, 07°24'22.7"E, 21 Apr 2012, 110 m alt., 40111B (CAS, DR, EGR). Mixed tropical hardwood forest with palm understory. Fronds of *Cepidomanes melanotrichum* over volcanic boulders.

New for the Republic of São Tomé and Príncipe. Uncommon Pantropical species, in Africa restricted to its western part and to the Indian Ocean islands.

***Taxilejeunea pulchriflora* Pearson**

**Príncipe:** Along trail to Pico Papagaio above roça Santa Trindade about 1/3 way below summit at vertical rock walls with seeps, 01°36'40.0"N, 07°23'30.0"E, 15 Apr 2013, 600 m alt., 42055B (CAS, DR, EGR); Obô Natural Park de Príncipe, along trail between Terreiro Vehlo to Morro De Leste, slopes below the summit ridge, 01°35'10.8"N, 07°24'19.0"E, 29 Apr 2013, 700 m alt., 42335 (BOL, CAS, DR, EGR, LISU, STPH). Mixed tropical hardwood forest with palm understory. On fern fronds over vertical wet volcanic rock wall.

New for the Gulf of Guinea Islands. Uncommon tropical African species.

***Telaranea coactilis* (Spruce) J.J.Engel & G.L.S.Merr.**

**São Tomé:** Along trail on ridge about 200 m beyond summit of Macambrara Radio Tower from Jardim Botânico de Bom Sucesso, 00°16'31.0"N, 06°36'13.5"E, 7 Apr 2012, 1350 m alt., 39822 (BOL, CAS, DR, EGR). Mixed tropical hardwood forest. On rotten wood and humus.

New for the island of São Tomé. A tropical Afro-American disjunct [see GRADSTEIN et al. (1983) under *Arachniopsis diacantha* (Mont.) Howe and note in MÜLLER et al. (2011)].

## Discussion

SÉRGIO & GARCIA (2011) in their catalogue of the bryophytes of São Tomé and Príncipe reported 129 species of liverworts and hornworts for the country, 104 for São Tomé and 48 for Príncipe. In our first instalment to the liverwort and hornwort flora of São Tomé and Príncipe (MÜLLER et al. 2011) we reported 18 species of liverworts and hornworts as new for the Republic of São Tomé and Príncipe. Of this total, 16 species are new for São Tomé, and 13 species new for Príncipe. Further additions to the liverwort and hornwort flora were made by INFANTE (2010), PÓCS (2011), ELLIS et al. (2012) and GARCIA et al. (2012). The liverwort and hornwort flora for the country is reported in previous papers to have 155 species, 128 for São Tomé and 61 for Príncipe.

The present installment brings the following new records:

- 4 species new for the island of São Tomé,
- 18 species new for the island of Príncipe,
- 18 species new for the Republic of São Tomé and Príncipe,
- 16 species new for the Gulf of Guinea Islands,
- 3 species new for West Africa,
- 1 species new for Africa.

The species number of liverworts and hornworts for São Tomé and Príncipe is therefore increased to 191 species and that of the individual islands to 148 for São Tomé and to 106 for Príncipe.

The species numbers of the individual islands of the Gulf of Guinea corresponds with the area of the islands: Bioko at 1017 km<sup>2</sup> has 163 species (WIGGINTON 2009), followed by São Tomé at 857 km<sup>2</sup> with 148 species, Príncipe at 139 km<sup>2</sup> with 106 species and Annobon at 17 km<sup>2</sup> with 36 species (WIGGINTON 2009).

The results of this and our previous installment (MÜLLER et al. 2011) indicate that with further field work and exploration, additional bryophyte species are very likely to be found. More systematic field inventory sampling in Príncipe and at the higher altitudes of São Tomé would be a profitable enterprise and further define the distribution of Gulf of Guinea bryophytes.

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