

Chapter 9

The Bryophyte Flora of São Tomé and Príncipe (Gulf of Guinea): Past, Present and Future



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Abstract This chapter aims to present a review of the knowledge of the bryological flora for the São Tomé and Príncipe Islands (Gulf of Guinea). An updated catalogue is presented, as well as a brief overview of the first expeditions conducted by the University of Coimbra. The labels of the historical herbarium collections and correspondence were analyzed, which provides an important source of data contributing toward research in taxonomy and conservation of these oceanic islands. Since 2007, exploratory fieldwork was carried out in different habitats of this archipelago along an altitudinal gradient, aiming to improve the knowledge of the ecology and distribution patterns of its bryophyte flora. A total of 304 taxa of bryophytes (133 mosses, 164 liverworts and seven hornworts) are currently reported, of which 21 are endemic to São Tomé and Príncipe and 144 species are shared endemics with the African continent. Several vouchers, especially in the herbaria of the University of Lisbon and of the California Academy of Sciences, are still under study and will likely provide further insights and new discoveries.

Keywords Africa · Biodiversity · Bryophytes · Conservation · Expeditions · Herbaria

Introduction

Bryophytes are a group of land plants that includes mosses, liverworts, and hornworts, and with over 20,000 described species, they are the second most speciose group of higher plants, after angiosperms (Patiño and Vanderpoorten 2018; Song

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et al. 2021). Bryophytes are a common component of tropical forests and provide important ecosystem functions. In tropical regions during rainstorms numerous bryophyte species can quickly absorb (and retain) many times their dry weight in water. The absorbed water is then slowly released over time back into the environment, thereby reducing the erosive effects of heavy rain and allowing other plants and animals to benefit from the rain and the humid environment for a longer period (Pócs 1982). Bryophytes are widely distributed in terrestrial ecosystems (St Martin and Mallik 2017), and islands provide an exceptional natural laboratory for ecological and evolutionary research in this group of terrestrial plants that is often poorly studied. Oceanic tropical islands usually host amazing bryophyte diversity, including endemic species, especially in the montane forests favoured by ideal climatic conditions, such as frequent rainfall and permanent fog (Ah-Peng et al. 2012).

The first known bryophyte collections of São Tomé and Príncipe were made by Friedrich Welwitsch (1806–1872) in 1853 and 1860, as part of the expeditions supported by the Portuguese government to Angola (Dolezal 1974), followed by Charles Barter (1821–1859) and Gustav Mann (1836–1916), botanists with special interest in vascular flora (Sérgio and Garcia 2011). One of the greatest Portuguese mentors of Botany in Africa was Júlio Augusto Henriques (1838–1928) and he outlined a plan for studying the flora of São Tomé and Príncipe (Coutinho 1929–30). Throughout his life, Henriques remained deeply invested in understanding the botanical diversity of the archipelago, which motivated his tireless research as professor and director of the Botanical Garden of the University of Coimbra for more than 50 years. His initial interest in the botanical study of São Tomé and Príncipe was likely related to cultivation of the Cinchona tree (*Cinchona* spp.) and other medicinal plants at the Coimbra Botanical Garden (Perpétuo et al. 2012). At the age of 65, Henriques led an expedition to the island of São Tomé to study the island's flora, departing from Lisbon on June 23, 1903. The research based on this visit culminated in an important publication (Henriques 1917). During his stay in the archipelago, Henriques was received by the owners of many farms (*roças*), taking notes and obtaining important data on the natural history of the island. Fernandes (1980, 1986) noted that when Henriques planned the study of the flora of São Tomé and Príncipe in the 1880s, he implemented a set of measures that proved to be extremely important for the enrichment of the University of Coimbra herbarium (currently, *Herbário do Instituto Botânico de Coimbra, Coimbra, Portugal - COI*). First, he promoted and intensified the development of the Coimbra herbarium and trained qualified botany specialists. It was to this end that he appointed Adolpho Frederico Möller (1842–1920), a renowned collector of flora in Portugal and later in São Tomé and Príncipe (four months in 1885), and in turn Francisco Joaquim Dias Quintas (1864–1909) in botanical field studies in São Tomé and Príncipe. Second, Henriques sent material collected on these expeditions to the greatest bryologists at the time. Their results were published in the “*Boletim da Sociedade Broteriana*”, a scientific journal dedicated to Botany and co-published by the University of Coimbra and the Broterian Society (*Sociedade Broteriana*).

Herbarium Specimens and Associated Documentation

Numerous naturalists passing through or purposefully visiting São Tomé and Príncipe gathered biological collections, some of which were then published in different scientific outlets. The Austrian naturalist and explorer Friedrich Welwitsch visited São Tomé in 1853 and 1860, during stopovers at the beginning and end of his botanical survey of Angola (Sérgio and Garcia 2011). The major scientific expeditions during the nineteenth century were performed by Adolpho Möller in 1885 (Henriques 1917; Sérgio and Garcia 2011), Francisco Quintas from 1888 to 1889, and Francisco Newton (1864–1909) between 1885 and 1895 (Sérgio and Garcia 2011). Casual collections were made by different naturalists, for example, the French botanist Auguste Jean Baptiste Chevalier (1873–1956) in 1905 (Exell 1944).

In all these field studies, botanical collections were organized, and duplicates were distributed to different herbaria. These included COI, and the herbaria of the Museu Nacional de História Natural e da Ciência da Universidade de Lisboa, Lisbon, Portugal (LISU), of the Natural History Museum, London, United Kingdom (BM), of the Muséum National d’Histoire Naturelle de Paris, France (PC), of the Instituto de Investigação Científica Tropical - ULisboa (LISC), and of the Conservatoire et Jardin botaniques de la Ville de Genève, Geneva Switzerland (G), and the Brotherus Herbarium (H-BR) of the Finnish Museum of Natural History University of Helsinki, Finland (H) (Herbaria acronyms according to Thiers 2016). The original herbarium collections, details presented in field notes, draft descriptions of species, and the extensive correspondence between the collectors and the specialists that studied the biological material are a valuable source of data and a base for modern studies regarding São Tomé and Príncipe flora.

Presently, COI and LISU herbaria hold most of the bryophyte specimens cited in the bibliography for São Tomé and Príncipe, corresponding mostly to the collections of Friedrich Welwitsch, Möller, Quintas and Newton, in addition to the smaller collections of Júlio Henriques. However, duplicates of these collections are also found in other European herbaria (Sérgio and Garcia 2011). The bryological collections resulting from the expeditions organized by Júlio Henriques were studied by several experts. The liverworts were sent to Franz Stephani (1842–1927) between 1886 and 1913. The mosses were first sent to Carl Müller (1818–1889) in Halle (between 1885 and 1887) and later to Viktor Ferdinand Brotherus (1849–1929) in Helsinki (between 1889 and 1904). The letters that Henriques sent to Stephani and Brotherus (Biblioteca Digital de Botânica da Universidade de Coimbra 2021) list all the specimens exchanged. Thus, specimens originating from these collections were progressively divvied up and disseminated by several international herbaria at the discretion of the authors who studied them.

In this study, by cross-checking the LISU database referring to the aforementioned studied herbaria, we were able to confirm where the reference material and most of the respective nomenclatural types are currently located (Sérgio and Garcia 2011). Additionally, we also gathered and compared all available information on

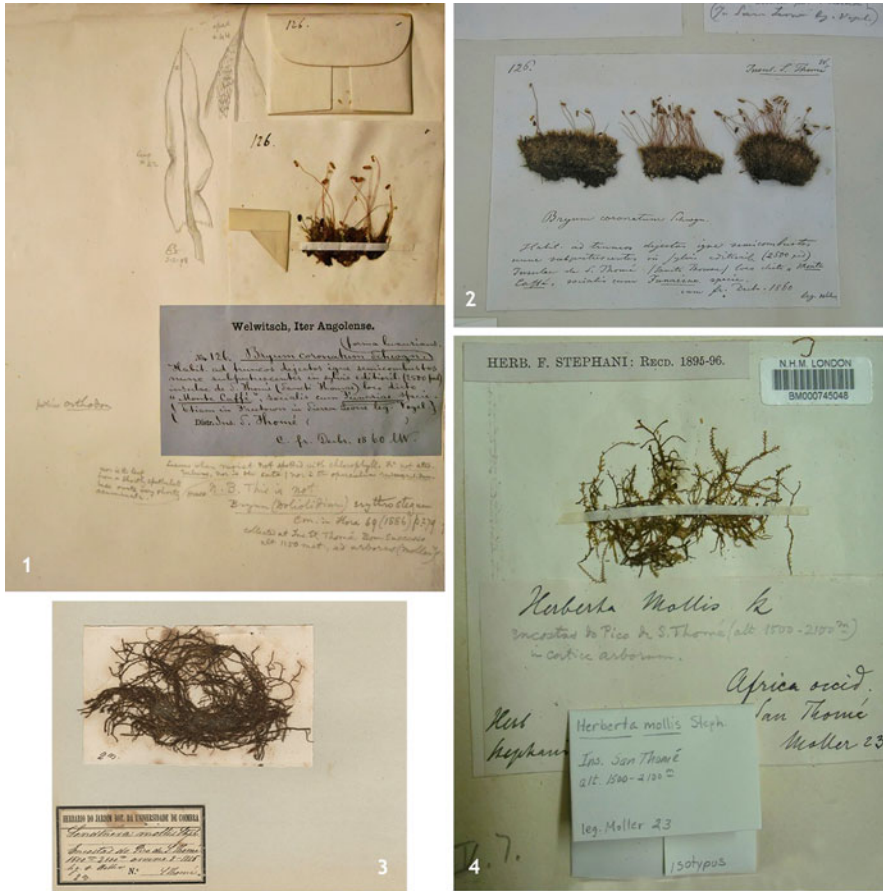


Fig. 9.1 Two specimens (1, 2) of *Bryum coronatum* Schwagr., corresponding to the same Welwitsch specimen (n° 126, Insula de S. Thomé loco called Monte Caffé) collected in December 1860, and (3, 4) *Sendtnera mollis* Steph. Typus, Slopes of Pico de São Tomé, 1500-2100 m, 1885, Adolpho Möller 23. (1) At BM herbarium with “Inter Angolense” labels, with original iconography; (2) At LISU herbarium without iconography but with a handwritten label by Welwitsch; (3) At COI herbarium with the Möller label; (4) At BM herbarium (BM000745048) of Stephani’s herbarium and handwritten data by the same author

where the voucher specimens from São Tomé and Príncipe are currently housed (e.g., Figs. 9.1 and 9.2).

Most of the material of each specimen in the COI herbarium is abundant and generally corresponds to isotypes found also in BM, G, H or PC. The labels in COI are generally not the original and must have been written by Möller or Quintas (Fig. 9.2), who organized the collections, with many duplicates sent to other herbaria. Arthur Wallis Exell (1901–1993) first landed on São Tomé Island in October 1932 to initiate a botanical expedition of the islands of the Gulf of Guinea (e.g., Fig. 9.3.1–2). He visited the four principal islands (São Tomé, Príncipe, Bioko

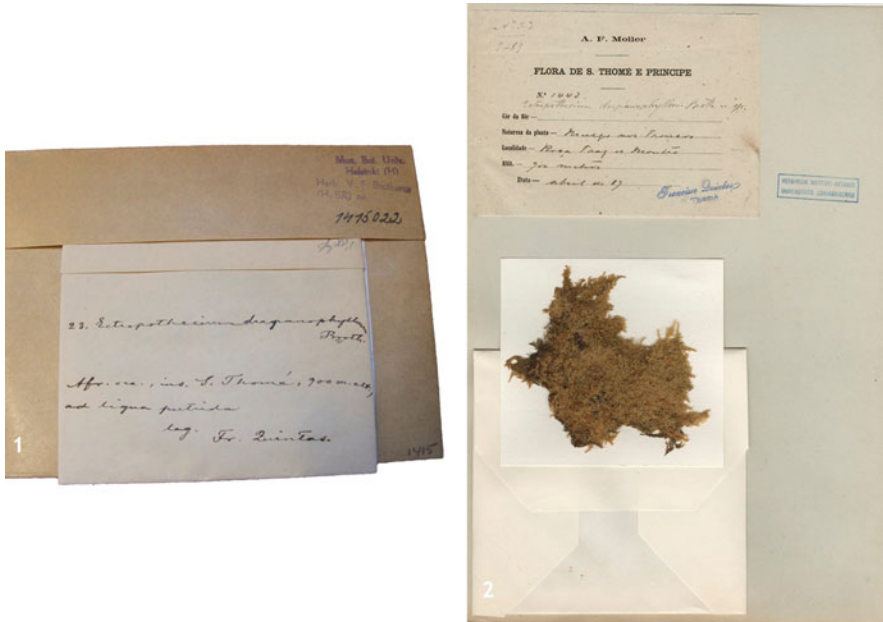


Fig. 9.2 Brotherus specimen identifications. Two specimens of *Ectropothecium drepanophyllum* corresponding to the same specimen from Quintas, n° 23: (1) Holotypus in H herbarium (H-BR1415-022) with Brotherus handwriting; (2) Isotypus in COI herbarium with a handwritten label from Quintas

and Annobón), and the results of this expedition were published in 1944, in the Catalogue of the Vascular Plants of São Tomé (Exell 1944).

There are also numerous other specimens with labels based on the printed text of the work published by Carl Müller (1886a), such as the mosses collected by Adolpho Frederico Möller in 1885 and published in the Boletim da Sociedade Broteriana. We also verified the presence of specimens with original handwritten labels by Stephani and Brotherus in COI herbarium collections (Fig. 9.3.3–4), although some labels have two handwritings with the numbering of localities corresponding to Adolpho Möller manuscripts and the identifications handwritten by Stephani (Figs. 9.3.3–4 and 9.4) or Carl Müller.

The historical specimens from São Tomé and Príncipe archived in the Stephani collection in the herbarium of Genève (G) (Geissler 1982) have duplicates at COI. However, some taxa collected by Newton and Quintas were not returned to Coimbra, at least those studied after 1900. These correspond to the specimen references indicated in the most recent volumes of the Index Hepaticarum (Stephani 1901–1906, 1905–1909, 1909–1912, 1912–1917, 1917–1925). Likewise, there are a considerable number of specimens collected during Júlio Henriques career in the herbarium of Paris (PC), either included in the collections of Jules Cardot (1860–1934), Ferdinand Renauld (1837–1910) or Robert Potier de La Varde (1878–1961), that are often cited in revisionary studies of bryophyte genera.



Fig. 9.3 Arthur Exell (1, 2) and Francisco Quintas specimens (3, 4). (1) *Octoblepharum albidum*, Esperança, circa 350 ft., 1932, Exell 675 in the herbarium of Coimbra (COI); (2) *Hygrolejeunea pulcherrima*, Santa Maria, circa 4200 ft., 1932, Exell 197 in the London (BM) collections; (3) Isotypus of *Metzgeria thomeensis* (BM); (4) The same material in COI, isotypes. Both labels (3, 4) correspond to Stephani's manuscripts

At the Helsinki herbarium (H), a significant part of material from São Tomé was found in the Brotherus (H–BR) collections, particularly type specimens collected in this archipelago (Sérgio and Garcia 2011), corresponding almost exclusively to Quintas and Möller collections. However, some of the specimens originally studied by Brotherus are now at BM, PC or COI herbaria and were not found at H herbarium (e.g., *Leucobryum homalophyllum* Broth.). It should be noted that, contrary to Stephani, Brotherus returned all the material he studied to Coimbra, mostly with handwritten labels.

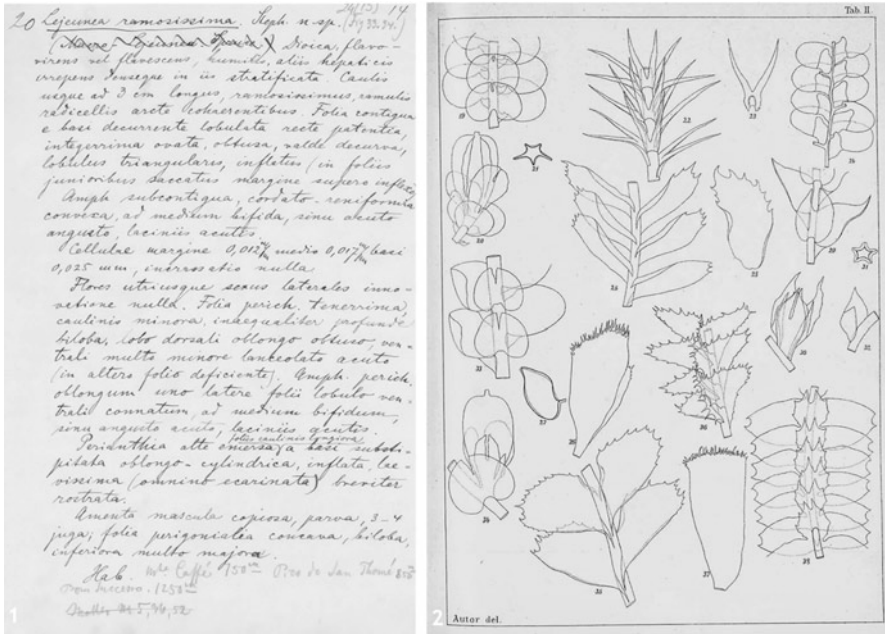


Fig. 9.4 (1) Original description of *Lejeunea ramosissima* Steph. included in the archives of the Botanical Institute of Coimbra Library as part of the letter dated 25 February 1886, and (2) Iconography of several species, including *L. ramosissima* Steph. (33 and 34) and *Sendtneria mollis* Steph. (22 and 23) by Stephani (1886)

Historical Correspondence

The correspondence between naturalists who studied bryophyte specimens collected by Möller, Quintas and Newton, is largely housed in the archives of the University of Coimbra at present. The documentation referring to Welwitsch’s correspondence, currently in Lisbon at the Museu Nacional de História Natural e da Ciência (MUHNAC) of the University of Lisbon, does not provide any mention of bryophytes, despite the existence of bryophyte herbarium specimens of Welwitsch’s expeditions in LISU herbarium (MUHNAC). Among this documentation are lists of the identified species and, in some cases, the original descriptions of species are also included.

Although it was not possible to study all Júlio Henriques’ correspondence in some foreign institutions (except for the one in the library of the University of Helsinki and in the Botanical Garden of Geneva), we analyzed the correspondence exchanged between him and several specialists that is filed at the University of Coimbra (Biblioteca Digital de Botânica da Universidade de Coimbra). Some important parts of this correspondence are transcribed below.

Correspondence from Júlio Henriques to Franz Stephani

Henriques' first letter referring sending material to Stephani, was on 8 January 1885. The first publication of Stephani concerning the liverworts of São Tomé (Stephani 1886) refers to the A. Moller 1885 collections, so the specimen identifications must have been rather hasty. It describes 19 new species, in addition to other taxa, such as those already described by Mitten from the Cameroon Mountains (Mitten 1863) (e.g., *Radula bipinnata* Mitt.). Among the first records for São Tomé and Príncipe there was, for example, *Lejeunea ramosissima* Steph. (Fig. 9.4), *Plagiochila integerrima* Steph., *Sendtnera mollis* Steph. and *Anthoceros pinnatus* Steph., all currently still considered as distinct species with valid names. In the letter of 25 February 1886, Stephani sent along a list referencing the figures with the iconographies that were included in the same publication of Stephani (1886).

Correspondence from Júlio Henriques to Carl Müller

The correspondence sent by C. Müller from Halle to Henriques is very sparse and consists only of four letters between 1885 and 1887. C. Müller's second letter, dated 21 March 1886 (UC Digitalis 2021), is the most important as it includes a list of about 50 taxa, corresponding to the identification of the specimens cited in Müller (1886a, b). These specimens include more than 25 new species, some of them still recognized as species, as in the case of *Funaria acicularis* Müll.Hal and *Leucobryum leucophanoides* Müll.Hal.

Correspondence from Júlio Henriques to Viktor Ferdinand Brotherus

Sérgio and Garcia (2011) analyzed much of the correspondence between Henriques and Brotherus. Henriques' first letter dated 31 January 1889, refers to sending (on 24 January 1889) a package including mosses from São Tomé to Copenhagen and then to Helsinki. The exchange of bryological material continued and Henriques must have sent a second package that also included material from Portugal. In Brotherus's letter to Coimbra, sent on 19 August 1889, he states "*J'ai reçu en bon état, il ya quelque jours, la quaisse avec des mousses du Portugal et j'irais à leurs déterminations et révision aussitôt qu'il me sera possible. Les mousses de l'île S. Thomé de votre second envoi j'ai déjà examinés et vous communique le nom des espèces. Sont-elles aussi recueillies par M. Quintas?*" ["I received in good condition, a few days ago, the case with mosses from Portugal and I will make their identifications and revision as soon as possible. The mosses of the island S. Thomé of your second shipment I have already examined and communicated to

you the names of the species. Were they also collected by Mr. Quintas”?] (UC Digitalis 2021). The reprints referenced in these letters correspond to the 1890 article, published in the “Boletim da Sociedade Broteriana” (Brotherus 1890), where 29 new species are described, some still considered valid species, including several endemics, such as *Leucobryum homalophyllum* Broth. and *Ectropothecium drepanophyllum* Broth (Fig. 9.2).

Correspondence from Júlio Henriques to Francisco Quintas

Although there are no extant records of correspondence from Möller to Henriques, a set of letters from Quintas sent from São Tomé to Henriques in Coimbra are still extant (Biblioteca Digital de Botânica da Universidade de Coimbra 2021). From most of this correspondence, it is evident that Quintas kept Henriques apprised of his research and situation on the island, attaching lists of the material he sent to Coimbra.

Although there is no specific numbering for the bryophyte specimens, there were indications of the boxes that contained cryptogams. For instance, the attachment to the letter issued on 21 July 1888 (UC Digitalis 2021). In that same letter, he also mentioned that mushroom specimens were listed separately. There are many bryophyte specimens collected by Quintas, which correspond to about 70 different bryophyte taxa, some of them corresponding to new species, such as *Plagiochila flabellata* Steph., *P. amplifolia* Steph. Among the liverworts and numerous species of mosses (ca. 31) described as new by Brotherus in 1890, we have the examples of *Pilotrichella calomicra* Broth., *Porotrichum quintasii* Broth., *P. caudatum* Broth., *Trichosteleum dicranelloides* Broth., among other new taxa.

Correspondence from Francisco Newton to Júlio Henriques

Some correspondence between Henriques and Newton is available in the historical archives of MUHNAC, but none of these letters has any reference to bryophytes. In Coimbra University, there is a letter sent by Newton to Henriques about his 1885 upcoming mission to Africa. Based on this letter, dated 23 August 1885, Newton makes Henriques aware of certain material from Angola (UC Digitalis 2021). He also confirms in that letter that he proposed to make a stop at Príncipe Island and then São Tomé. Ultimately, Newton arrived in São Tomé on 24 September 1885 (Guedes 2021).

Strangely, most of the bryophyte material collected by Newton and found in the different herbaria (BM, FH, G, JE and M herbaria) corresponds to specimens collected in 1887 on Príncipe and only a few are indicated to be from São Tomé. In fact, in the different publications concerning Newton, specimens correspond to Príncipe Island, excluding two references corresponding to São Tomé, in Angolares (Stephani 1888a, b). It is also interesting to note that the bryophyte specimens

collected on Príncipe Island were only shipped in September of 1885 (Newton 1885), after this letter, but Newton should have sent more material later.

Apparently, Newton did not organize the numbering of his bryophyte specimens and the labels are very uninformative. The numbering of specimens was made when the plants arrived in Coimbra. However, it should be noted that based on Newton's collections, some liverwort species were described by Stephani (1888a, b), as *Microlejeunea africana* Steph., *Lejeunea newtonii* Steph. (now included in *Cheilolejeunea newtonii* Steph. ex Schiffn.), *Plagiochila thomeensis* Steph. (currently a synonym for *Plagiochila terebrans* Nees et Mont. ex Lindenb); *Cheilolejeunea principensis* Steph. (synonymized to *Cheilolejeunea serpentina* (Mitt.) Mizut.), and *Lophocolea newtonii* Steph. (synonymized to *Lophocolea martiana* Nees).

Historical Collecting Localities

Based on the data associated with the aforementioned collections, the location (exact or approximate) of the historical collecting activities by the first naturalists dedicated to the study of bryophytes in São Tomé Island was georeferenced (Fig. 9.5), and used as a starting point for the most recent fieldwork performed by the authors.

Exell's 1944 plant catalogue (Exell 1944) includes all the species known at the time and new reports of some taxa for the islands (Figueiredo 1994, 2005; Figueiredo and Gascoigne 2001), including diverse bryophytes. He was based in Vanhulst (Macambará), in the Roça Zampalma and collected most of the bryophyte material in this region. This bryophyte collection was the basis for two publications, in which about 40 taxa of liverworts and mosses are listed (Exell 1944). Most of Exell's specimens are stored in BM, except for some specimens that are kept at COI.

After the Exell expedition, other collections were obtained in 1956 by the French naturalist Théodore Monod (1902–2000) and C. A. Thorold (1906–1998) in São Tomé and Príncipe, mainly in Pico de Príncipe, during the “6th Conférence Internationale des Africanistes de l'Ouest” (Monod 1960). Most of this material is hosted in PC and was the basis of the publication of Potier de la Varde (1959). Arnaldo Roseira also collected in the islands between 1954 and 1958, corresponding to 79 specimens of three taxa in the PO herbarium (Universidade do Porto) (Costa 2020).

Recent Studies

Since the middle of the twentieth century and after the works of Exell, the study of bryophytes of São Tomé and Príncipe came to a halt. Only more recently has a new effort emerged through the project Bryotome (Sérgio and Garcia 2011). During this project, the first author carried out fieldwork in São Tomé and Príncipe in 2007 and

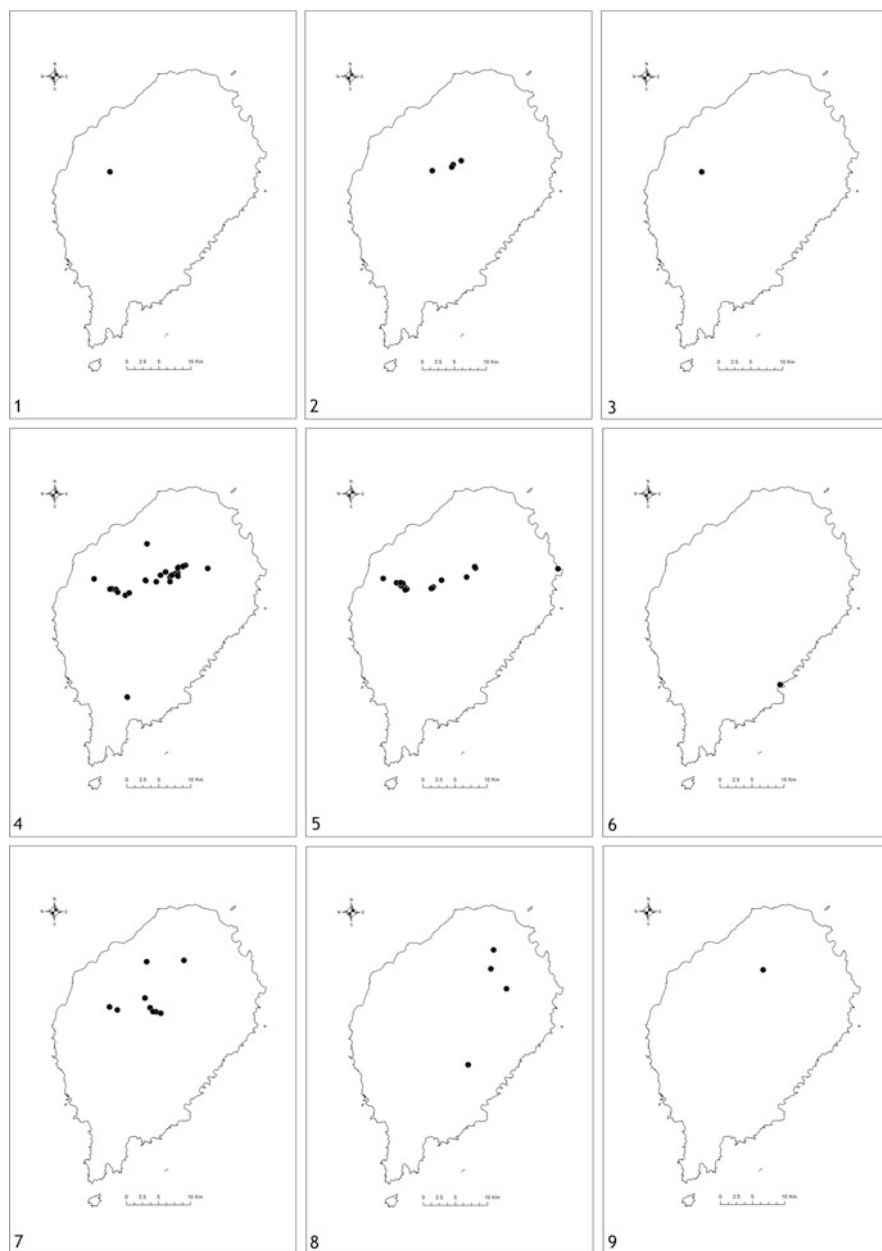


Fig. 9.5 Historical collecting localities of naturalists who collected bryophytes specimens on São Tomé Island from the mid-nineteenth century to mid-twentieth century: (1) Auguste Jean Baptiste Chevalier (1873–1956), (2) Arthur Wallis Exell (1901–1993), (3) Gustav Mann (1836–1916), (4) Adolpho Frederico Möller (1842–1920), (5) Théodore Monod (1902–2000), (6) Francisco Newton (1864–1909), (7) Francisco Joaquim Dias Quintas (1864–1909), (8) Charles Aubrey Thorold (1906–1998), (9) Friedrich Welwitsch (1806–1872)

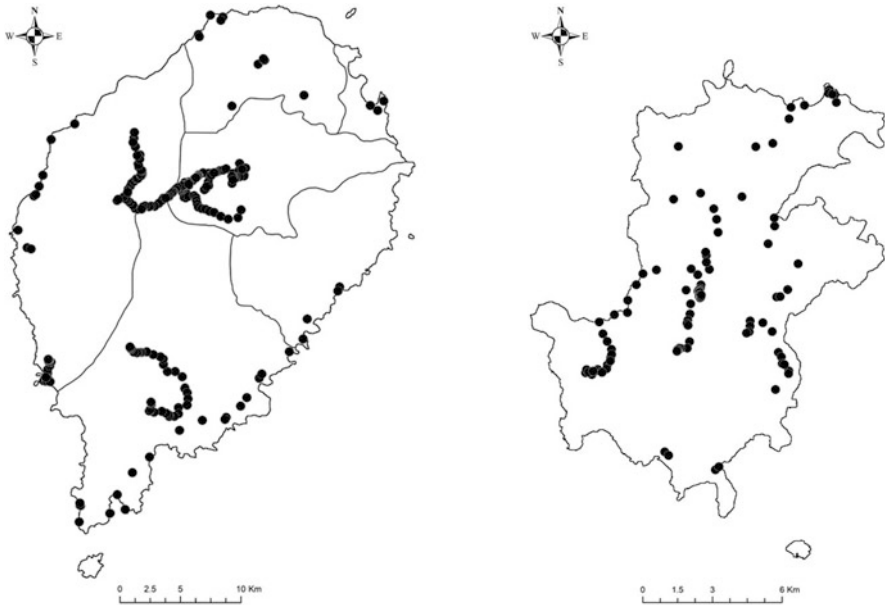


Fig. 9.6 Study localities in 2007, 2008, 2010, 2013 and 2016 for the enrichment of the University of Lisbon (LISU) and the California Academy of Science (CAS) herbaria

2008, collecting about 6000 specimens at various altitudes, including Pico de São Tomé. This project enabled the study of herbarium specimens, georeferencing historical specimens, planning new fieldwork more effectively, and studying different substrates (epiphytic, epiphyllous, rupicolous, terricolous and humicolous) to better determine specific microhabitats of species across the islands. In 2010, 2013 and 2016, expeditions sponsored by the California Academy of Sciences were carried out (Fig. 9.6). During these new expeditions, several species were discovered, including new records for the archipelago and the African continent, as well as species new to science (Figs. 9.7 and 9.8). One of the new species discovered was particularly interesting: *Dendroceros paivae* is distinct from most other species of the genus in its ecology, gametophyte, and sporophyte characters, resembling only the Bornean *D. foliicola* J. Haseg. In comparison to the type material of *D. foliicola*, *D. paivae* has a narrower sporophyte diameter. The thallus of *D. paivae* does not form rosettes, the cuticle is weakly papillose, and apices are plane to undulate, while *D. foliicola* forms rosette-like patches with strong crispate margins, even at branches apices, and the cuticle is slightly papillose (Garcia et al. 2012).



Fig. 9.7 Liverworts and hornworts from São Tomé and Príncipe: (1, 2) *Dendroceros paivae* C.A. Garcia, Sérgio & J. C. Villarreal. (hornworts) at the type locality (LISU 237201) (Garcia et al. 2012); (3, 4) *Megaceros flagellaris* (Mitt.) Steph. (hornworts) growing on a tree trunk in the first known locality in São Tomé and Príncipe and the second one reported for the African Continent (LISU 237200); (5) *Anthoceros pinnatus* Steph. (hornworts); (6) *Phaeoceros carolinianus* (Michx.) Prosk. (hornworts); (7) *Colura* sp. (liverworts); (8) *Cyathodium cavernarum* Kunze (liverworts)



Fig. 9.8 Liverworts and mosses from São Tomé and Príncipe. (1) *Marchantia pappeana* Lehm. subsp. *pappeana* (liverworts). (2), *Plicanthus hirtellus* (F. Weber) R.M. Schust. (liverworts). (3), *Calymperes lonchophyllum* Schwägr. (mosses). (4), *Octoblepharum albidum* Hedw. (mosses). (5), *Orthostichella* sp. (mosses). (6), *Trematodon longicollis* Michx. (mosses). (7), *Macromitrium sulcatum* var. *sulcatum* (Hook.) Brid. (mosses). (8), *Calymperes palisotii* Schwägr. (mosses)

Diversity, Composition and Endemism

In recent years, several papers resulting from these last expeditions have been published. These included the study of secondary metabolism compounds (Figueiredo et al. 2010) and the description of new species and new genera of bryophytes (Enroth and Shevock 2011; Müller et al. 2011; Garcia and Sérgio 2012a, b, c, d, e; Shevock et al. 2013; Pócs et al. 2015; Sollman et al. 2016; Enroth and Shevock 2017a, b; Müller and Shevock 2018; Müller et al. 2019).

These works allowed revising the number of species and endemics for each island individually and for the two islands combined (Table 9.1 and Appendix). One hundred and forty-four species of bryophytes occurring on the islands are currently considered endemic to Africa, 21 of which are endemic to the archipelago, including seven liverworts or hornworts and 14 mosses. One of these species is the hornwort *Dendroceros paivae* C.A. Garcia, Sérgio & J. C. Villarreal. (hornworts), endemic to São Tomé Island (Garcia et al. 2012) and found only in a single location, in a very restricted area.

The known bryophyte species diversity of the islands has increased markedly as specimens of various families are critically examined. For example, prior to field-work by the authors, only three species of the moss genus *Fissidens* (Fissidentaceae) were reported (O’Shea 2006). Now, *Fissidens* Hedw. is the most species-rich bryophyte genus in the archipelago with 24 known species (Shevock et al. 2013). The liverwort genera, *Lejeunea* Lib. and *Plagiochila* (Dumort.) Dumort. are also quite diverse with 19 and 18 species respectively (Müller et al. 2011; Pócs et al. 2015). A similar story of species additions for the islands was provided in a recent study of the moss families Neckeraceae (Enroth and Shevock 2011, 2017a, b) and

Table 9.1 Bryophyte species diversity and endemism for each island individually and for the two islands combined

	Príncipe	São Tomé	P&ST
MARCHANTIOPHYTA and ANTHOCEROTOPHYTA			
Liverworts and hornworts			
Total species/taxa	108	138	171
Island endemism	4	4	7
African endemism	52	65	80
DIVISION BRYOPHYTA			
Mosses			
Total species/taxa	41	114	133
Island endemism	1	13	14
African endemism	16	59	64
TOTAL BRYOPHYTES			
Liverworts, hornworts and mosses			
Total species/taxa	149	252	304
Island endemism	5	17	21
African endemism	68	124	144

Liverworts and hornworts, according to Wigginton (2018), and mosses, according to O’Shea (2006)

Pottiaceae (Sollman et al. 2016). Ongoing work on the moss family Calymperaceae also has discovered several new species for these islands. We anticipate species additions for these islands will continue for many years to come. Most studies were carried out on existing trails to reach higher areas, and several regions have not yet been surveyed (Figs. 9.5 and 9.6) due to the difficult terrain. Additional species will likely be documented and discovered as more remote cloud forest environments can be systematically surveyed. Our updated summary for the bryoflora of the islands reveals the documented diversity has increased significantly since the last reports of the mosses (O'Shea 2006) and of the liverworts and hornworts (Wigginton 2018). Thus, the 304 bryophytes documented for the archipelago at this time are likely a vast underestimate of the true diversity (Appendix).

The species catalogue of the bryophyte flora of the islands of São Tomé and Príncipe presented in this work (Appendix) is based on all known published literature. All the literature on bryophytes of São Tomé and Príncipe Islands was surveyed, including liverworts, hornworts, and mosses. The delimitation of families follows the latest version of the Checklist of sub-Saharan Africa of Wigginton (2018) for liverworts and hornworts and O'Shea (2006) for mosses. Taxa are presented in alphabetical order of all the accepted names (including subspecies and varieties). Taxa with synonymies (homotypic and heterotypic synonyms) whose type locality corresponds to São Tomé and Príncipe are designated in a second column with respective authors and the year of publication for São Tomé and Príncipe. The most accurate information about the original description, as well as the relevant synonyms, were considered with general taxonomic criteria. The present table includes only records published up until June 2020 (unpublished data of the authors, including new species and localities, are not included). The catalogue is not a taxonomic document, and no new taxonomic nor nomenclatural acts are published here. Synopses of families and genera are placed alphabetically within each order.

Final Remarks

The known bryoflora of São Tomé and Príncipe includes at least 304 species. Based on our ongoing studies and the number of specimens still awaiting critical study, this number will increase in the coming years as the diversity of this group becomes more comprehensively documented. The apparently low number of known species may be explained by the logistical and practical difficulties of carrying out fieldwork in dense forests and in areas of rough terrain, a reality that affects most of the scientists working in the region. Bryophytes are also generally very small plants, and many species occur in small populations. Therefore, during fieldwork some species can easily be overlooked or may occupy exceedingly specialized microhabitats that are difficult to find (e.g., fine twigs in the tree canopy). Further difficulty originates from the fact that the taxonomy of different bryophyte families is not well developed in the tropics, and world experts in bryophyte taxonomy are also starting to become

scarce, especially those dedicated to the study of tropical species. Many bryophyte species reported from Africa are known only from type specimens or based on a handful of collections. Almost 45 bryophyte taxa reported for São Tomé and Príncipe have not been resampled since the nineteenth century. For a large number of bryophyte species, the ecology and habitat specificity are not well known or not known at all, and also the distribution patterns, elevational range, and abundance for most species remain to be determined.

The threats affecting forest habitats in São Tomé and Príncipe, such as habitat destruction or competition by invasive species, may affect the survival of bryophytes. One major threat to biodiversity conservation in the archipelago, particularly to the cryptogamic communities, forest structure, and habitat diversity along the altitudinal gradients is deforestation, especially that associated with the plantations of oil palm *Elaeis guineensis* Jacq. In the Emolve region (southern region of São Tomé), there is a monoculture of more than 600 ha of oil palm that is expected to continue growing, which would result in a significant loss in biodiversity (bryophytes and other taxonomic groups), especially to forests at lower elevations. By contrast, ancestral *roças* (old colonial farms), with *Coffea* spp. and *Theobroma cacao* L. plantations, seem to preserve a high diversity of bryophyte species, mainly epiphytic taxa.

New bryological studies are urgently needed, especially in areas that have never been surveyed. Together with the recently collected material that is currently being studied by the coauthors and other colleagues, these new surveys will continue to increase our knowledge of distributions, species diversity and the particularities of bryophyte endemism in the country. A more comprehensive and updated species list will be essential to inform a future IUCN Red List assessment of bryophytes from São Tomé and Príncipe and to designate priority areas for conservation.

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Appendix

Updated catalogue of bryophytes from São Tomé and Príncipe Islands. A: African endemics. E: Island endemism.

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
DIVISIONS				
Marchantiophyta and Anthocerotophyta				
Liverworts and Hornworts				
<i>Acrolejeunea emergens</i> (Mitt.) Steph. var. <i>emergens</i>		X	X	2015/ 2011
<i>Aneura pinguis</i> (L.) Dumort. sens. lat.		X	X	1956/ 1886
<i>Aneura latissima</i> Spruce		X	X	1888/ 2011
<i>Anthoceros pinnatus</i> Steph.	<i>Anthoceros pinnatus</i> Steph. 1886		A	1886
<i>Bazzania decrescens</i> subsp. <i>molleri</i> (Steph.) E.W.Jones	<i>Mastigobryum molleri</i> Steph. 1886	X	X	2015/ 1886
<i>Bazzania nitida</i> (F.Weber) Grolle			X	2011
<i>Brachiolejeunea laxifolia</i> (Taylor) Schiffn.	<i>Brachiolejeunea thomeensis</i> Steph. 1912		X	1912
<i>Calypogeia fissa</i> (L.) Raddi			X	1970
<i>Calypogeia peruviana</i> Nees et Mont.			X	1976
<i>Caudalejeunea africana</i> (Steph.) Schiffn.		X	X	2011
<i>Caudalejeunea dusenii</i> Steph.			A	2015
<i>Caudalejeunea hanningtonii</i> (Mitt.) Schiffn.		A	A	2000/ 2000
<i>Caudalejeunea lehmanniana</i> (Gottsche) A.Evans		X		2015
<i>Ceratolejeunea cornuta</i> (Lindenb.) Steph.		X	X	1960/ 2015
<i>Ceratolejeunea floribunda</i> Steph.	<i>Ceratolejeunea floribunda</i> Steph. 2013 1913		E	1913
<i>Cheilolejeunea intertexta</i> (Lindenb.) Steph.	<i>Cheilolejeunea newtonii</i> Steph. ex Schiffn. 1893	X		2015/ 1893
<i>Cheilolejeunea montagnei</i> (Gottsche) R.M.Schust.	<i>Euosmolejeunea thomeensis</i> Steph. 1914		X	1863
<i>Cheilolejeunea rigidula</i> (Nees ex Mont.) R.M.Schust.	<i>Cheilolejeunea principensis</i> Steph. ex Paris 1888	X		1888
<i>Cheilolejeunea surrepens</i> (Mitt.) E. W.Jones			X	2015

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Cheilolejeunea trifaria</i> (Reinw. et al.) Mizut.	<i>Lejeunea grandistipula</i> Steph. 1886	X	X	2015/1886
<i>Chiloscyphus difformis</i> (Nees) J.J. Engel et R.M.Schust.	<i>Lophocolea molleri</i> Steph. 1886		X	1886
<i>Cololejeunea africana</i> (Steph.) R. M.Schust.	<i>Physocolea africana</i> Steph. 1915		A	1916
<i>Cololejeunea cuneifolia</i> Steph.		A		2015
<i>Cololejeunea iradieri</i> Infante et Heras			A	2015
<i>Cololejeunea lanceolata</i> E.W.Jones		A		2015
<i>Cololejeunea leloutrei</i> (E.W.Jones) R.M.Schust.			A	1960
<i>Cololejeunea mocambiquensis</i> S. W.Arnell		A		2015
<i>Cololejeunea obliqua</i> (Nees et Mont.) Schiffn.	<i>Cololejeunea crenatiflora</i> Steph. 1891	X	X	2011/1891
<i>Cololejeunea obtusifolia</i> (E.W. Jones) Tixier		A		2015
<i>Cololejeunea papilliloba</i> Steph.		X		2015
<i>Cololejeunea platyneura</i> (Spruce) A.Evans			X	2015
<i>Cololejeunea pusilla</i> Steph.		A		2015
<i>Cololejeunea zenkeri</i> (Steph.) E.W. Jones		A	A	2000/2015
<i>Colura calderae</i> Pócs			A	2011
<i>Colura digitalis</i> (Mitt.) Steph.		A	A	1958/1953
<i>Colura hattoriana</i> Pócs			A	2015
<i>Colura obesa</i> Jovet-Ast		A	A	2015
<i>Colura tenuicornis</i> (A.Evans) Steph.		X	X	2015/1958
<i>Colura thomeensis</i> Pócs		E	E	2015/2011
<i>Conoscyphus trapezioides</i> (Sande Lac.) Schiffn.	<i>Lophocolea devexa</i> Mitt. 1863	X	X	2015/1863
<i>Cryptolophocolea martiana</i> (Nees) L.Söderstr., Crand.-Stotl. et Stotler subsp. <i>martiana</i>	<i>Lophocolea newtonii</i> Steph. 1907	X	X	1953
<i>Cyathodium cavernarum</i> Kunze			X	1952
<i>Dendroceros crispatus</i> Nees			X	1863
<i>Dendroceros herasii</i> M.Infante			A	2010
<i>Dendroceros paivae</i> C.Garcia, Sérgio & J.C. Villarreal			E	2012

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Dibrachiella africana</i> (Steph.) X.Q. Shi, R.L.Zhu et Gradst.		A		2000
<i>Dibrachiella autoica</i> (Vanden Berghen) X.Q. Shi, R.L.Zhu et Gradst.		A		2015
<i>Diplasiolejeunea cavifolia</i> Steph.	<i>Lejeunea cavifolia</i> Steph. 1886		X	1886
<i>Drepanolejeunea capulata</i> (Taylor) Steph.			A	2011
<i>Drepanolejeunea cultrella</i> (Mitt.) Steph.	<i>Drepanolejeunea molleri</i> Steph. 1913	A	A	2015/ 1913
<i>Drepanolejeunea physifolia</i> (Gottsche) Pearson	<i>Prionolejeunea fissistipula</i> Steph. 1913	A	A	1960/ 1913
<i>Dumortiera hirsuta</i> (Sw.) Nees		X	X	1960/ 1886
<i>Folioceros incurvus</i> (Steph.) D.C. Bharadwaj		A	A	1888/ 1889
<i>Fossombronina indica</i> Steph.		X		2019
<i>Fossombronina</i> sp.		X		2011
<i>Frullania angulata</i> Mitt. var. <i>angulata</i>	<i>Frullania angulata</i> Mitt. 1863; <i>F. subatrata</i> Steph. 1911; <i>F. cordifolia</i> Steph. 1911		A	1863
<i>Frullania apicalis</i> Mitt.	<i>Frullania laceriloba</i> Steph. 1911	A	A	2015/ 1911
<i>Frullania apiculata</i> (Reinw. et al.) Nees			X	2011
<i>Frullania caffraria</i> Steph.	<i>Frullania molleri</i> Steph. 1894 (Probably synonym)		X	1894
<i>Frullania diptera</i> (Lehm.) Drège			A	1886
<i>Frullania ericoides</i> (Nees) Mont.		X	X	1886/ 1863
<i>Frullania obscura</i> (Sw.) Mont.	<i>Frullania thomeensis</i> Steph. 1910		X	1910
<i>Frullania obscurifolia</i> Mitt.		X	X	2015/ 2004
<i>Frullania purpurea</i> Steph.			X	1976
<i>Frullania rio-janeirensis</i> (Raddi) Ångstr.	<i>Frullania africana</i> Steph. 1891	X	X	1976/ 1891
<i>Frullania serrata</i> Gottsche var. <i>serrata</i>			X	1886
<i>Frullania spongiosa</i> Steph.		X	X	2011/ 2011
<i>Fuscocephaloziopsis connivens</i> subsp. <i>fissa</i> (Steph.) Váňa et L. Soderstr.		X	X	1988/ 1988
<i>Herbertus dicranus</i> (Taylor ex Gottsche, Lindenb. et Nees) Trevis.	<i>Sendtnera mollis</i> Steph. 1886	X	X	2011/ 1886

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Heteroscyphus dubius</i> (Gottsche) Schiffn.		X		1888
<i>Heteroscyphus spectabilis</i> (Steph.) Schiffn.	<i>Isotachis perfoliata</i> Steph. 1886 <i>Chiloscyphus thomeensis</i> Steph. 1893 nom. nud.?	A	A	2015/ 1886
<i>Lejeunea abyssinica</i> (Gola) Cufod.		A	A	2015/ 2015
<i>Lejeunea acuta</i> Mitt.		A	A	2019/ 1960
<i>Lejeunea anisophylla</i> Mont.		X	X	2011/ 2011
<i>Lejeunea brenanii</i> E.W.Jones			A	2015
<i>Lejeunea cf. obtusata</i> Gottsche			X	2011
<i>Lejeunea conformis</i> Nees et Mont.			A	2011
<i>Lejeunea eckloniana</i> Lindenb.		X		2015
<i>Lejeunea flava</i> (Sw.) Nees		X	X	1888/ 1960
<i>Lejeunea grossecristata</i> (Steph.) E. W.Jones	<i>Hygrolejeunea grossecristata</i> Steph. 1896; <i>Taxilejeunea longirostris</i> Steph. 1914		A	1896
<i>Lejeunea helenae</i> Pearson		X		2015
<i>Lejeunea ibadana</i> A.J.Harr. et E.W. Jones		A	A	2015/ 2015
<i>Lejeunea jungneri</i> (Steph.) Steph.		A		1901
<i>Lejeunea lyratiflora</i> Steph.			A	2015
<i>Lejeunea papilionacea</i> Prantl			X	2011
<i>Lejeunea phyllobola</i> Nees et Mont.		X		2011
<i>Lejeunea pulchraflora</i> (Pearson) G.E. Lee, Bechteler, Pócs, Schäfer-Verw. & Heinrichs		X		2015
<i>Lejeunea ramosissima</i> Steph.	<i>Lejeunea ramosissima</i> Steph. 1886	X	X	1996/ 1886
<i>Lejeunea setacea</i> (Steph.) Steph.		A	A	1969/ 1969
<i>Lejeunea tuberculosa</i> Steph.		X		2011
<i>Lepidozia succida</i> Mitt.		A	A	2011/ 1891
<i>Lepidozia ubangiensis</i> Steph.		A	A	2015
<i>Leptolejeunea astroidea</i> (Mitt.) Steph.		A		2015
<i>Leptolejeunea epiphylla</i> (Mitt.) Steph.	<i>Leptolejeunea quintasii</i> Steph. 1891	X	X	2015/ 1891
<i>Leptolejeunea maculata</i> (Mitt.) Schiffn.	<i>Lejeunea thomeensis</i> Steph. 1886; <i>Drepanolejeunea gomphiae</i> Steph. 1913	X	X	2015/ 1886

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Lopholejeunea nigricans</i> (Lindenb.) Schiffn.		X	X	2011/ 2011
<i>Lopholejeunea subfusca</i> (Nees) Schiffn.		X	X	2015/ 2011
<i>Marchantia debilis</i> Goebel			A	2011
<i>Marchantia pappeana</i> Lehm. subsp. <i>pappeana</i>	<i>Marchantia planiloba</i> Steph. 1886		A	1886
<i>Marchesinia excavata</i> (Mitt.) Schiffn.	<i>Homalolejeunea henriquesii</i> Steph. 1888		A	1886
<i>Marchesinia principensis</i> Frank Müll. et Shevock		A		2018
<i>Mastigophora diclados</i> (Brid. ex F. Weber) Nees		X	X	2015/ 1886
<i>Megaceros flagellaris</i> (Mitt.) Steph.			X	2012
<i>Metalejeunea cucullata</i> (Reinw. et al.) Grolle		X		2015
<i>Metzgeria furcata</i> (L.) Dumort.	<i>Metzgeria thomeensis</i> Steph. 1891	X	X	2004/ 1891
<i>Metzgeria leptoneura</i> Spruce	<i>Metzgeria recurva</i> Steph. 1886	X	X	2004/ 1886
<i>Metzgeria lindbergii</i> Schuffn.		X		2015
<i>Microlejeunea africana</i> Steph.	<i>Microlejeunea africana</i> Steph. 1888	A	A	1888/ 1891
<i>Microlejeunea ankasica</i> E.W. Jones		A	A	2015
<i>Microlejeunea kamerunensis</i> Steph.	<i>Microlejeunea cochlarifolia</i> Steph 1888 (probably synonymy)	A	A	1990/ 1888
<i>Neurolejeunea breutelii</i> (Gottsche) A.Evans var. <i>africana</i> Pócs		E		2015
<i>Notoscyphus lutescens</i> (Lehm. et Lindenb.) Mitt.			X	2015
<i>Odontolejeunea lunulata</i> (F.Weber) Schiffn.	<i>Odontolejeunea thomeensis</i> Steph. 1912		X	2004/ 1912
<i>Pallavicinia lyellii</i> (Hook.) Carruth.	<i>Pallavicinia pilifera</i> Steph. 1891		X	1891
<i>Phaeoceros carolinianus</i> (Michx.) Prosk.			X	2011
<i>Plagiochila barteri</i> Mitt.	<i>Plagiochila triangularis</i> Steph. 1886; <i>P. quintasii</i> Steph. 1904	A	A	1962/ 1886
<i>Plagiochila barteri</i> var. <i>valida</i> (Steph.) Vanden Berghen		A	A	1981/ 1981
<i>Plagiochila brunneola</i> Steph.	<i>Plagiochila brunneola</i> Steph. 1904		A	1904
<i>Plagiochila divergens</i> var. <i>capensis</i> (Steph.) E.W. Jones			X	1962
<i>Plagiochila flabellata</i> Steph.	<i>Plagiochila flabellata</i> Steph. 1886; <i>P. molleri</i> Steph. 1886	A	A	2011/ 1886
<i>Plagiochila fusifera</i> Taylor	<i>Plagiochila amplifolia</i> Steph. 1901		X	1901

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Plagiochila gibbiflora</i> Steph.	<i>Plagiochila gibbiflora</i> Steph. 1904		E	1904
<i>Plagiochila heterostipa</i> Steph.		A		2015
<i>Plagiochila integerrima</i> Steph.	<i>Plagiochila integerrima</i> Steph. 1886	X	X	2011/ 1886
<i>Plagiochila loloensis</i> Steph.	<i>Plagiochila rotundifolia</i> Steph. 1904	A	A	2011/ 1904
<i>Plagiochila moenkemeyeri</i> Steph.		A	A	2011/ 1960
<i>Plagiochila neckeroidea</i> Mitt.		A	A	2011/ 1904
<i>Plagiochila pectinata</i> Willd. ex Lindenb.		A	A	2011/ 1960
<i>Plagiochila pinniflora</i> Steph.			A	2011
<i>Plagiochila praemorsa</i> Steph.	<i>Plagiochila cacuminis</i> Steph. 1918	X	X	1888/ 1918
<i>Plagiochila sarmentosa</i> (Lehm. et Lindenb.) Lindenb.	Requires confirmation			
<i>Plagiochila strictifolia</i> Steph.		A	A	1962/ 1962
<i>Plagiochila terebrans</i> Nees et Mont. ex Lindenb.	<i>Plagiochila thomeensis</i> Steph. 1886	A	A	2011/ 1886
<i>Pleurozia gigantea</i> (F.Weber) Lindb.			X	1863
<i>Plicanthus hirtellus</i> (F.Weber) R.M. Schust.			X	1886
<i>Porella abyssinica</i> var. <i>hoehnelii</i> (Steph.) Pócs.			A	2011
<i>Porella subdentata</i> (Mitt.) E.W. Jones var. <i>subdentata</i>	<i>Madotheca thomeensis</i> Steph. 1910	A	A	1963/ 1910
<i>Porella subdentata</i> var. <i>camerunensis</i> E.W.Jones			A	2011
<i>Prionolejeunea grata</i> (Gottsche) Schiffn.		X	X	1960/ 1960
<i>Prionolejeunea principensis</i> Vanden Berghen		E		1960
<i>Radula ankefinensis</i> Gottsche ex Steph.		A	A	2011/ 2015
<i>Radula appressa</i> Mitt.	<i>Radula angustata</i> Steph. 1886; <i>R. molleri</i> Steph. 1910	A	A	1910/ 1886
<i>Radula boryana</i> (F.Weber) Mont.	<i>Radula tamariscina</i> Mitt. 1863; <i>R. bipinnata</i> Mitt. 1863	X	X	1996/ 1863
<i>Radula flaccida</i> Lindenb. et Gottsche		X	X	1939/ 1939

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Radula fulvifolia</i> (Hook.f. et Taylor) Gottsche et al.		X	X	2001/ 2011
<i>Radula stenocalyx</i> Mont.		X	X	2015/ 1910
<i>Riccardia amazonica</i> (Spruce) Schiffn. ex Gradst. et Hekking		X	X	2015/ 2011
<i>Riccardia erosa</i> (Steph.) E.W.Jones	<i>Aneura erosa</i> Steph. 1891	A	A	2011/ 1891
<i>Riccardia limbata</i> (Steph.) E.W. Jones	<i>Aneura reticulata</i> Steph. 1891	A	A	2011/ 1891
<i>Riccardia longispica</i> (Steph.) Pearson		A	A	2015/ 2011
<i>Riccia congoana</i> Steph.			X	2012
<i>Riccia discolor</i> Lehm. et Lindenb.		X		2015
<i>Riccia lanceolata</i> Steph.		A		2015
<i>Riccia moenkemeyeri</i> Steph.			A	2012
<i>Riccia stricta</i> (Lindenb.) Perold			X	2012
<i>Schiffneriolejeunea occulta</i> (Steph.) Gradst.		A	A	2015/ 2011
<i>Schiffneriolejeunea pappeana</i> (Nees) Gradst. var. <i>pappeana</i>	<i>Ptychocoleus quintasii</i> Steph. 1912		A	1912
<i>Schiffneriolejeunea polycarpa</i> (Nees) Gradst.	<i>Phragmicoma amplexens</i> Steph. 1886 = <i>P. molleri</i> Steph. 1886		X	1886
<i>Solenostoma borgenii</i> (Gottsche ex Pearson) Steph.			A	1974
<i>Solenostoma dusenii</i> (Steph.) Váňa, Hentschel et Heinrichs.		X	X	2019/ 1974
<i>Spruceanthus abbreviatus</i> (Mitt.) X. Q.Shi, R.L.Zhu et Gradst.		X		2015
<i>Spruceanthus floreus</i> (Mitt.) Sukkharak et Gradst.		A		1891
<i>Stictolejeunea balfourii</i> (Mitt.) E. W.Jones		X		2015
<i>Symphyogyna podophylla</i> (Thunb.) Mont. et Nees			X	2011
<i>Syzygiella manca</i> (Mont.) Steph.	<i>Jungermannia geminifolia</i> Mitt. 1863		X	1863
<i>Telaranea coactilis</i> (Spruce) J.J. Engel et G.L.Merr.			X	2011
<i>Telaranea nematodes</i> (Gottsche ex Austin) M.Howe	<i>Lepidozia quintasii</i> Steph. 1922		X	1922
<i>Thysananthus auriculatus</i> (Wilson) Sukkharak et Gradst. var. <i>auriculatus</i>		X	X	2011/ 1949

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Thysananthus humilis</i> (Gottsche) Sukkharak et Gradst.		X	X	2014/ 1888
<i>Thysananthus nigrus</i> (Steph.) Sukkharak et Gradst.	<i>Mastigolejeunea nigra</i> Steph. 1891	A	X	2015/ 1891
<i>Thysananthus turgidus</i> (Steph.) Sukkharak et Gradst.	<i>Mastigolejeunea turgida</i> Steph.	A	X	1983/ 1917
DIVISION Bryophyta				
Mosses				
<i>Afrothamnium stipitatum</i> (Mitt.) Enroth			X	1982
<i>Anoetangium aestivum</i> (Hedw.) Mitt.			X	2016
<i>Anoetangium stracheyanum</i> Mitt.			X	2016
<i>Barbula</i> cf. <i>seramensis</i> H.Akiyama			X	2016
<i>Brachymenium leptophyllum</i> (Bruch & Schimp. ex Müll.Hal.) Bruch & Schimp. ex A.Jaeger			X	1972
<i>Brachymenium nepalense</i> Hook.			X	1972
<i>Brachymenium subuliferum</i> (Mitt.) A.Jaeger	<i>Bryum subuliferum</i> Mitt. 1863; <i>Bryum molleri</i> Müll.Hal. 1886		A	1863
<i>Brachymitrium moritzianum</i> (Müll. Hal.) A.K.Kop.	<i>Orthodon thomeanus</i> Broth. 1890; <i>Tayloria thomeana</i> Broth. 1903		X	1890
<i>Bryum apiculatum</i> Schwägr.	<i>Bryum areoblastum</i> Müll.Hal. 1886		X	1886
<i>Bryum argenteum</i> Hedw. var. <i>argenteum</i>	<i>Bryum squarripilum</i> Müll.Hal. 1886		X	1886
<i>Bryum coronatum</i> Schwägr.	<i>Bryum erythrostegeum</i> Müll.Hal. 1886		X	1886
<i>Bryum huillense</i> Welw. & Duby	<i>Bryum quintasii</i> Broth. 1890		X	1890
<i>Bryum thomeanum</i> P. de la Varde	<i>Bryum thomeanum</i> P.de la Varde 1959		E	1959
<i>Caduciella mariei</i> (Besch.) Enroth		X		2017
<i>Callicostella brevipes</i> (Broth.) Broth.			A	1952
<i>Callicostella chionophylla</i> (Müll. Hal.) Broth.	<i>Hookeria chionophylla</i> Müll.Hal. 1886		E	1886
<i>Callicostella fissidentella</i> (Besch.) Kindb.	<i>Hookeria thomeana</i> Broth. 1890	A	A	1890/ 1890
<i>Callicostella perpapillata</i> Broth. & P.de la Varde		X		1944
<i>Callicostella salaziae</i> (Besch.) Broth.	<i>Hookeria quintasi</i> Broth. 1890		A	1890
<i>Calymperes afzelii</i> Sw.	<i>Calymperes quintasi</i> Broth. 1890		X	1863
<i>Calymperes lonchophyllum</i> subsp. <i>saxatile</i> (Müll. Hal. ex Besch.) S.R. Edwards		A		1944

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Calymperes palisotii</i> Schwägr.		X		1987
<i>Calymperes pintasii</i> Müll.Hal. ex Besch.			A	1896
<i>Calymperes tenerum</i> Müll.Hal.	<i>Calymperes principis</i> Broth. 1890	X	X	1890/ 1959
<i>Calypothecium acutifolium</i> var. <i>breviusculum</i> (Müll.Hal. ex Dusén) Argent			A	2011
<i>Campylopus flexuosus</i> (Hedw.) Brid var. <i>flexuosus</i> .	<i>Campylopus quintasii</i> Broth. 1890		X	1890
<i>Campylopus savannarum</i> (Müll. Hal.) Mitt.	<i>Dicranum divaricatum</i> Mitt. 1863; <i>Campylopus erythrocaulon</i> Broth. 1890	X	X	1890/ 1863
<i>Chionoloma bombayense</i> (Müll. Hal.) P. Sollman			X	2016
<i>Cyclodictyon filicuspis</i> P.de la Varde		X		1944
<i>Cyclodictyon laetevirens</i> (Hook. & Taylor) Mitt.			X	1944
<i>Deslooveria quintasii</i> (Broth.) Enroth	<i>Porotrichum quintasii</i> Broth. 1890		A	1890
<i>Deslooveria saotomensis</i> (Enroth & Shevock) Enroth	<i>Porotrichum saotomense</i> Enroth and Shevock (2011)		E	2011
<i>Dicranella falcularia</i> Müll.Hal. ex Dusén		A		1944
<i>Ectropothecium brevifalcatum</i> (Müll.Hal.) Kindb.	<i>Hypnum brevifalcatum</i> Müll.Hal. 1886		A	1888
<i>Ectropothecium diffusum</i> (Mitt.) A. Jaeger	<i>Stereodon diffusum</i> Mitt. 1863	A		1863
<i>Ectropothecium drepanophyllum</i> Broth.	<i>Ectropothecium drepanophyllum</i> Broth. 1890		E	1890
<i>Fissidens asplenioides</i> Hedw.			X	2013
<i>Fissidens borgenii</i> Hampe		A	X	2013/ 2013
<i>Fissidens crispulus</i> Brid. var. <i>crispulus</i>		X	X	2013/ 2013
<i>Fissidens crispulus</i> var. <i>robinsonii</i> (Broth.) Z. Iwats.& Z.-H. Li		X	X	2013/ 2013
<i>Fissidens crispus</i> Mont.			X	2013
<i>Fissidens darntyi</i> Schimp.			A	2013
<i>Fissidens enervis</i> Sim		A	A	2013/ 2013
<i>Fissidens flaccidus</i> Mitt.		X	X	2013/ 2013
<i>Fissidens glaucissimus</i> Welw. & Duby	<i>Fissidens subglaucissimus</i> Broth. 1890	A	A	1890/ 1890

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Fissidens intramarginatus</i> (Hampe) A.Jaeger			X	2013
<i>Fissidens metzgeria</i> (Müll.Hal.) Broth.			A	2013
<i>Fissidens microcarpus</i> Mitt.		A		2013
<i>Fissidens ovatus</i> Brid.			A	2013
<i>Fissidens pallidinervis</i> Mitt.			X	2013
<i>Fissidens palmatus</i> Hedw		X		2013
<i>Fissidens pellucidus</i> Hornsch.		X	X	2013/ 2013
<i>Fissidens porrectus</i> Mitt.		A	A	2013/ 2013
<i>Fissidens punctulatus</i> Sande Lac.			X	1890
<i>Fissidens ramulosus</i> Mitt.		A	A	2013/ 2013
<i>Fissidens sciophyllus</i> Mitt.	<i>Fissidens purpureocaulis</i> Müll. Hal. 1900	A	A	2013/ 2013
<i>Fissidens serratus</i> Müll.Hal. var. <i>serratus</i>		X		2013
<i>Fissidens submarginatus</i> Bruch			X	2013
<i>Fissidens usambaricus</i> Broth.			A	2013
<i>Fissidens zollingeri</i> Mont.		X		2013
<i>Floribundaria floribunda</i> (Dozy & Molk.) M.Fleisch.			X	2011
<i>Floribundaria vaginans</i> (Welw. & Duby) Broth.	<i>Papillaria patentissima</i> Müll.Hal. 1886		A	1886
<i>Funaria acicularis</i> Müll.Hal.	<i>Funaria acicularis</i> Müll.Hal. 1886		E	1886
<i>Funaria hygrometrica</i> Hedw. var. <i>hygrometrica</i>			X	1901
<i>Gymnostomiella erosula</i> (Müll.Hal. ex Dusén) Arts			A	2016
<i>Gymnostomiella vermicosa</i> (Hook.) M.Fleisch.			X	2016
<i>Hydrogonium consanguineum</i> (Thwaites & Mitt.) Hilp.		X	X	2016/ 2016
<i>Hydrogonium orientale</i> (F. Weber) Kucera		X		2016/ 1987?
<i>Hymenostylium recurvirostrum</i> (Hedw.) Dixon var. <i>recurvirostrum</i>			X	2016
<i>Hyophila involuta</i> (Hook.) A.Jaeger		X	X	2016/ 2016
<i>Hypopterygium tamarisci</i> (Sw. ex Sw.) Brid. ex Müll.Hal.	<i>Hypopterygium brevifolium</i> Broth. 1890	X	X	1997/ 1863
<i>Isopterygium nanoglobum</i> (Müll. Hal.) Paris	<i>Hypnum nanoglobum</i> Müll.Hal. 1886		E	1886

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Lepidopilum lastii</i> Mitt.			A	1944
<i>Lepidopilum niveum</i> (Müll.Hal.) Kindb.	<i>Hookeria niveum</i> Müll.Hal. 1886		A	1886
<i>Leptodontium viticulosoides</i> (P. Beauv.) Wijk & Margad. var. <i>viticulosoides</i>			X	2016
<i>Leucobryum fouta-djalloni</i> Paris & Cardot			A	1959
<i>Leucobryum homalophyllum</i> Broth.	<i>Leucobryum homalophyllum</i> Broth. 1890		E	1890
<i>Leucobryum leucophanoides</i> Müll. Hal.	<i>Leucobryum leucophanoides</i> Müll. Hal. 1886		E	1886
<i>Leucoloma gracilescens</i> Broth.	<i>Leucoloma gracilescens</i> Broth. 1890		A	1890
<i>Leucoloma secundifolium</i> Mitt.	<i>Leucoloma secundifolium</i> Mitt. 1863		A	1863
<i>Leucomium strumosum</i> (Hornsch.) Mitt.			X	1944
<i>Leucophanes molleri</i> Müll.Hal.	<i>Leucophanes molleri</i> Müll.Hal. 1886		X	1886
<i>Leucophanes unguiculatum</i> Mitt.	<i>Leucophanes unguiculatum</i> Mitt. 1863	A		1863
<i>Lopidium struthiopteris</i> (Brid.) M. Fleisch.	<i>Hypopterygium subtrichocladum</i> Broth. 1890	X	X	1890/ 1997
<i>Macromitrium sulcatum</i> (Hook.) Brid. var. <i>sulcatum</i>	<i>Macromitrium undatifolium</i> Müll. Hal. 1886	X	X	1917/ 1886
<i>Mesonodon flavescens</i> (Hook.) W.R. Buck		X		2011
<i>Mittenothamnium leptoreptans</i> (Broth.) Cardot	<i>Microthamnium leptoreptans</i> Broth. 1890		E	1890
<i>Neckeromnion lepineanum</i> (Mont.) S.Olsson, Enroth, Huttunen & D. Quandt		X	X	2017/ 2017
<i>Neckeropsis disticha</i> (Hedw.) Kindb.		X	X	2011/ 1993
<i>Octoblepharum albidum</i> Hedw.		X	X	1944/ 1959
<i>Orthostichella rigida</i> (Müll. Hal.) B.H.Allen & Magill	<i>Pilotrichella leptoclada</i> Müll.Hal. 1886; <i>P. calomicra</i> Broth. 1890		X	1886
<i>Orthostichella versicolor</i> (Müll. Hal.) B.H. Allen & W.R. Buck	<i>Pilotrichella inflatifolia</i> Müll.Hal. 1886		X	1886
<i>Orthostichidium involutifolium</i> subsp. <i>thomeanum</i> (Broth.) Argent	<i>Hildebrandtiella thomeana</i> Broth. 1890; <i>Orthostichidium thomeanum</i> (Broth.) Broth. 1906	A	A	1996/ 1890
<i>Orthostichidium involutifolium</i> (Mitt.) Broth. subsp. <i>involutifolium</i> .			A	1959

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Philonotis nanothecia</i> (Müll.Hal.) Kindb.	<i>Bartramia nanothecia</i> Müll.Hal. 1886		A	1886
<i>Philonotis trichodonta</i> (Müll.Hal.) Kindb.	<i>Bartramia trichodonta</i> Müll.Hal. 1886		E	1886
<i>Pinnatella minuta</i> (Mitt.) Broth.	<i>Hypnum africanum</i> Welw. & Duby 1872	X	X	1917/ 1872
<i>Pinnatidendron piniforme</i> (Brid.) Enroth		X	X	2011/ 2011
<i>Plagiomnium rhynchophorum</i> (Hook.) T.J.Kop. var. <i>rhynchophorum</i> .			X	1944
<i>Pogonatum gracilifolium</i> Besch.	<i>Polytrichum rubentiviride</i> Müll. Hal. 1886; <i>P. molleri</i> Müll.Hal. 1886	A	A	1944/ 1886
<i>Pogonatum usambaricum</i> (Broth.) Paris			A	1989
<i>Pyrrhobryum spiniforme</i> (Hedw.) Mitt.			X	1886
<i>Racopilum orthocarpioides</i> Broth.	<i>Racopilum orthocarpioides</i> Broth. 1890		A	1890
<i>Racopilum thomeanum</i> Broth.	<i>Rhacopilum thomeanum</i> Broth. 1890		A	1890
<i>Radulina borbonica</i> (Bél.) W.R. Buck	<i>Trichosteleum subpyncocylindricum</i> Broth. 1890		X	1890
<i>Rhacopilopsis trinitensis</i> (Müll. Hal.) E.Britton ex Dixon	<i>Microthamnium subelegantulum</i> Broth. 1890		X	1890
<i>Rhizofabronia persoonii</i> (Schwägr.) M.Fleisch var. <i>persoonii</i> .			A	1863
<i>Rhynchostegium hopfferi</i> (Welw. & Duby) A.Gepp	<i>Hypnum hopfferi</i> Welw. & Duby 1872		E	1872
<i>Scabrellifolium elongatum</i> (Welw. & Duby) Enroth	<i>Hypnum molleri</i> Müll.Hal. 1886		A	1886
<i>Scabrellifolium substriatum</i> (Hampe) Enroth	<i>Porotrichum caudatum</i> Broth. 1890		X	1890
<i>Sematophyllum amblystegiocarpum</i> (Müll.Hal.) Broth.	<i>Hypnum amblystegiocarpum</i> Müll. Hal. 1886		E	1886
<i>Splachnobryum obtusum</i> (Brid.) Müll.Hal.			X	2016
<i>Symphiodon pygmaeus</i> (Broth.) S. He & Snider			X	2011
<i>Syrrhopodon gardneri</i> (Hook.) Schwägr.	<i>Syrrhopodon quintasii</i> Broth. 1890		X	1890
<i>Syrrhopodon lamprocarpus</i> Mitt.			A	1886
<i>Tayloria solitaria</i> (Hedw.) T.J.Kop. & W.Weber			A	1972

(continued)

Taxon species/subspecies/variety	Synonyms (basionyms) based in São Tomé and Príncipe collections	P	ST	Year of first ref. P/ST
<i>Thamnobryum corticola</i> (Kindb.) De Sloover			A	1902
<i>Thuidium involvens</i> subsp. <i>thomeanum</i> (Broth.) Touw	<i>Thuidium thomeanum</i> Broth. 1890		A	1890
<i>Trachypodopsis serrulata</i> (P. Beauv.) M.Fleisch. var. <i>serrulata</i>	<i>Trachypodopsis quintasiana</i> Broth. 1909		A	1909
<i>Trachypus bicolor</i> var. <i>viridulus</i> (Mitt.) Zanten	<i>Papillaria molleri</i> Müll.Hal. 1886		X	1886
<i>Trematodon divaricatus</i> Bruch	<i>Trematodon flexifolius</i> Müll.Hal. 1886??		A	1886
<i>Trematodon longicollis</i> Michx.	<i>Trematodon flexifolius</i> Müll.Hal. 1886		X	1886
<i>Trichosteleum dicranelloides</i> Broth.	<i>Trichosteleum dicranelloides</i> Broth. 1890		A	1890
<i>Vesicularia glaucula</i> (Broth.) Broth.	<i>Ectropothecium glauculum</i> Broth. 1890		A	1890
<i>Vesicularia scaturigina</i> (Brid.) Broth.			A	1863
<i>Vesicularia strephomischos</i> (Welw. & Duby) Broth.	<i>Hypnum strephomischos</i> Welw. & Duby 1872		A	1872
<i>Wijkia monodii</i> (P.de la Varde) H. Akiyama	<i>Gollania monodii</i> P.de la Varde 1959		E	1959
<i>Wijkia trichocoleoides</i> (Müll.Hal.) H.A.Crum	<i>Hypnum trichocoleoides</i> Müll.Hal. 1886		A	1886

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