

Bryophytes of Île Amsterdam in the South Indian Ocean: 1. Liverworts

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Abstract – The liverworts of Île Amsterdam are surveyed. On the basis of historical collections and specimens collected on the island in 2006 and 2007 some 29 species and one variety belonging to 18 families have been recorded. This means that in comparison with the last survey of the island's hepatics, in 2002, the number of taxa has been nearly doubled. Of these, eight taxa are recorded for the first time from the island, namely *Kurzia capillaris* (Sw.) Grolle subsp. *stephanii* (Renauld ex Steph.) Pócs, *Adelanthus lindenbergianus* (Lehm.) Mitt., *Syzygiella colorata* (Lehm.) K.Feldberg, Váňa, Hentschel et J.Heinrichs, *S. sonderi* (Gottsche) K.Feldberg, Váňa, Hentschel et J.Heinrichs, *Cephaloziella varians* (Gottsche) Steph., *Anastrophyllum auritum* (Lehm.) Steph., *Andrewsianthus marionensis* (S.W.Arnell) Grolle and *Heterogemma patagonica* (Herzog et Grolle) L.Söderstr. et Váňa, whilst *Aneura subcanaliculata* R.M.Schust. is excluded from the island's hepatic flora. Two taxa, *Kurzia capillaris* subsp. *stephanii* and *Gymnomitrium subintegrum* (S.W.Arnell) Váňa, are illustrated, and maps of global distribution are presented for *Plagiochila minutula* (Hook.f. et Taylor) Gottsche, Lindenb. et Nees, *Andrewsianthus marionensis*, *Heterogemma patagonica*, *Mnioloma fuscum* and *Gymnomitrium subintegrum*. The liverwort flora is distinctly south-temperate to tropical and these two main distribution patterns consist of 12 and eight species, respectively. The subantarctic element is represented by only three species, two species are endemic or near-endemic and five bipolar. Two names, *Riccardia insularis* Schiffn. and *R. novo-amstelodamensis* Schiffn., are lectotypified.

Bryogeography / Bryophyta / distribution / Hepaticae / Holantarctica / nomenclature / Southern Ocean / southern cool temperate zone / taxonomy

Résumé – Cette étude porte sur les hépatiques de l'Île Amsterdam. L'analyse de collections historiques et d'échantillons collectés sur cette île en 2006 et 2007 a révélé la présence de 29 espèces et une variété, appartenant à 18 familles. Ce nombre de taxons est presque le double de celui indiqué dans la dernière étude publiée en 2002. Huit taxa sont cités pour la première fois de cette île, à savoir *Kurzia capillaris* (Sw.) Grolle subsp. *stephanii* (Renauld ex Steph.) Pócs, *Adelanthus lindenbergianus* (Lehm.) Mitt., *Syzygiella colorata* (Lehm.) K.Feldberg, Váňa, Hentschel et J.Heinrichs, *S. sonderi* (Gottsche) K.Feldberg, Váňa, Hentschel et J.Heinrichs, *Cephaloziella varians* (Gottsche) Steph., *Anastrophyllum auritum* (Lehm.) Steph., *Andrewsianthus marionensis* (S.W.Arnell) Grolle et *Heterogemma*

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patagonica (Herzog *et* Grolle) L.Söderstr. *et* Váňa. En parallèle *Aneura subcanaliculata* R.M.Schust. est éliminée de la flore des hépatiques de l'Île Amsterdam. Des illustrations sont présentées pour deux taxons, *Kurzia capillaris* subsp. *stephanii* *et* *Gymnomitrium subintegrum* (S.W.Arnell) Váňa, ainsi que des cartes de distribution mondiale pour *Plagiochila minutula* (Hook.f. *et* Taylor) Gottsche, Lindenb. *et* Nees, *Andrewsianthus marionensis*, *Heterogemma patagonica*, *Mnioloma fuscum* *et* *Gymnomitrium subintegrum*. La flore des hépatiques de l'Île Amsterdam est nettement tempérée australe à tropicale avec respectivement 12 *et* huit espèces pour ces deux modes principaux de distribution. Cinq espèces sont bipolaires alors que trois seulement sont subantarctiques *et* deux sont endémiques ou quasi endémique. Un lectotype est indiqué pour *Riccardia insularis* Schiffn. *et* pour *R. novo-amstelodamensis* Schiffn.

Biogéographie / Bryophyta / distribution / Hepaticae / Holantarctique / océan austral / zone tempérée australe / taxonomie

INTRODUCTION

Several islands and archipelagos situated in the South Indian Ocean are among the most remote and isolated specks of land on the globe. For that reason they were very seldom visited by naturalists and consequently until now the diversity of their terrestrial flora and biota of fungi was imperfectly known. This is especially so because professional botanists and taxonomists have had very few chances to carry out field studies in this region.

These islands are situated at different latitudes and the differences in climatic conditions dictate their biogeographical status. The southern group of islands, including the Prince Edward Islands, Îles Crozet, Îles Kerguelen and Heard Island, are situated south of, or slightly to the north of, the Polar Frontal Zone (former Antarctic Convergence) and are classified as subantarctic islands. They all have a cool oceanic climate, annual mean temperature above 0°C and a total annual precipitation ranging from 800 (Îles Kerguelen) to 2575 mm (Marion Island). A characteristic feature of these islands is the lack of any arborescent plants and the vegetation is restricted to a type of tundra.

The northern two islands in this region, Île Amsterdam and Île Saint-Paul, lie to the north of the Subtropical Convergence at latitudes 37°50'S and 38°43'S, respectively, in the south-warm-temperate zone. They have a mild, humid oceanic climate with mean annual temperature of 14°C and a total annual precipitation of over 1100 mm. On Île Amsterdam the small indigenous tree *Phyllica arborea* Thouars was formerly widespread, but its stands were dramatically reduced due to repeated fires and impact of cattle which was introduced in 1871, but eradicated in 1988 and 2010. In contrast the smaller Île Saint-Paul lacks any arborescent vegetation.

STUDY AREA

Île Amsterdam is an oceanic island situated midway between the African continent and Australia in the South Indian Ocean at latitude 37°50'S and longitude 77°31'E. It is one of the most isolated and remote islands in the world,

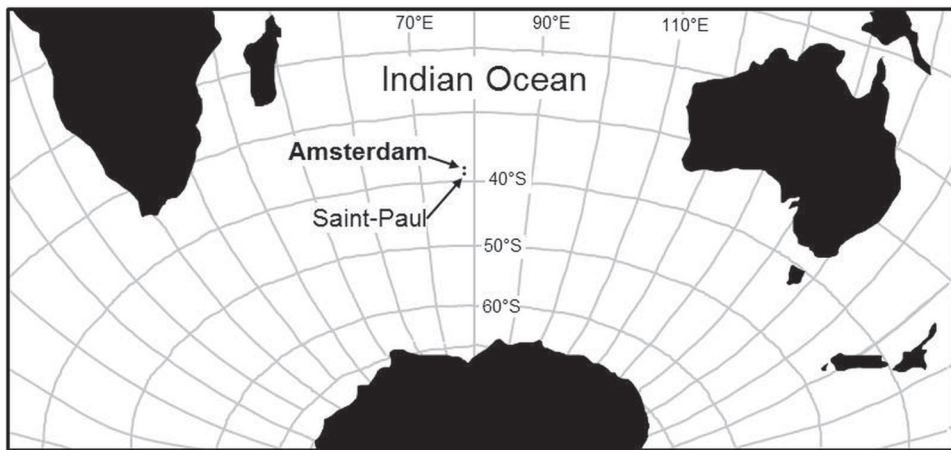


Fig. 1. Location of Île Amsterdam in the Southern Hemisphere.

being situated 3200 km west from Australia, 3200 km east from Madagascar and 3200 km north from the Antarctic continent (Fig. 1). The closest island neighbours are Île Saint-Paul, located 80 km to the south, and the subantarctic Îles Kerguelen archipelago which lies about 1475 km to the south-west. Administratively, Île Amsterdam belongs to the French Southern and Antarctic Lands (Terres australes et antarctiques françaises – TAAF), along with Île Saint-Paul, Îles Kerguelen and Îles Crozet.

The island was discovered in 1522 by Juan Sebastian del Cano, a travelling companion of Ferdinand Magellan during the first world circumnavigation, but he did not name it. In 1633 it was rediscovered by the Dutch Governor Anthonie van Diemen en route to Java, who named it Nieuw Amsterdam (Dutch for New Amsterdam) after his ship; it was known by this name until recently. The first recorded landing on the island was in 1696 by Dutch navigator Willem de Vlaming, but it was not until 1792 that Admiral Joseph-Antoine Bruni d'Entrecasteaux and Huon de Kermadec carried out the first exploration of Île Amsterdam, performing detailed surveys on the eastern coast. During the 18th and 19th centuries the island was of great importance to early transoceanic voyagers as a landmark, and to American and English sealers hunting subantarctic fur seals (*Arctocephalus tropicalis*) which were extremely abundant at that time. By the end of the 19th century the massacre of an estimated 50,000 seals had left this species virtually extinct. In 1843 Île Amsterdam was formally taken in possession by France and the French Government made concessions to the Polish captain Adam P. Mierosławski to exploit the island and the neighbouring Île Saint-Paul. In 1949-1950 France established a permanent meteorological station on the island which, with time, was changed into the scientific base Martin-de-Viviès (formerly called La Roche Godon).

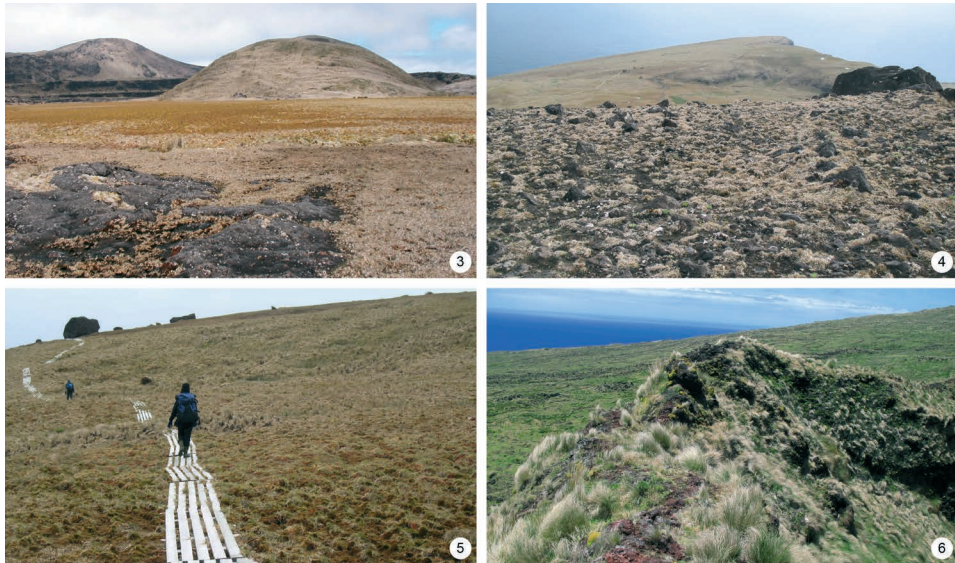
Île Amsterdam is a relatively young volcanic island, being a remnant of an extinct shield volcano. Palaeomagnetic data suggest that the main part of the island arose during the period 400-200 kyr BP (Giret, 1987; Doucet *et al.*, 2003). The island is approximately oval in shape with maximum dimensions of 9.2 × 7.4 km and area of 55 sq. km (Fig. 2). It has steep coastal cliffs, especially on the western side, and rises to a central crater reaching its highest point at



Fig. 2. Map of Île Amsterdam. Abbreviations: bdt = Barre des Toubibs, gm = Grande Marche, lb = Lac Bleu, rc = Ravin Coleridge.

881 m on Mont de la Dives, which is a remnant of the crater wall (Figs 3-6). The climate is temperate oceanic and mild with a mean annual sea-level air temperature of 14.0°C (11.2°C in August, 17.4°C in February), mean annual rainfall of 1115 mm, persistent westerly winds, and high humidity (Lebouvier & Frenot, 2007).

The extreme isolation of Île Amsterdam led to a high level of endemism amongst the native flora and fauna prior to human contact, but its indigenous terrestrial ecosystem was drastically disturbed by sealers and transoceanic voyagers who caused irreversible damage to the native flora and fauna, either directly by fires and culling, or indirectly by introduced animals, especially mammals (Micol & Jouventin, 1995) and plants (Jolinon, 1987). A characteristic



Figs 3-6. Île Amsterdam. – **3.** View of the central part of the island – Museu de Tanche in the foreground, Mont de la Dives in the background. **4.** View from the summit of Mont de la Dives towards Le Pignon. **5.** Peatland with duckboards between Mont de la Dives and Le Pignon. **6.** Rim of Cratère Vénus Inférieur.

feature of the island's vegetation is its distinct altitudinal zonation, as early reported by Vélain (1877) and Schenck (1905). Tréhen *et al.* (1990) gave a description of the main vegetation units, taking into account the impact of introduced cattle.

Cliffs are dominated by tussock grasses, *Poa novarae* Reichardt and *Spartina arundinacea* (Thouars) Carmich. The lowland, between the shore line and 270 m a.s.l. has been intensively grazed by cattle. The eroded soil is thin. Introduced plant species are dominant (*Holcus lanatus* L., *Leontodon taraxacoides* (Vill.) Mérat, *Juncus effusus* L.) and the recovery of native vegetation after cattle eradication is very slow (Lebouvier *et al.*, 2002). Between 150 m and 270 m a.s.l. are the remnants of the former belt of *Phyllica arborea*, and trees have been replanted since 1988 as part of a rehabilitation plan. At higher elevations, 270 m to 500 m a.s.l., a fern brush occurs, dominated by *Gleichenia polypodioides* (L.) Sm., *Elaphoglossum succisaefolium* (Thouars) T.Moore, and *Blechnum penna-marina* (Poir.) Kuhn. The soil is deeper (> 1 m) with a high organic matter and moisture content. Bryophytes are abundant. Above 500 m a.s.l. on the peaty slopes, the soil has a high organic and water content. This wet zone was poorly frequented by cattle. Bryophytes and native grasses (*Poa fuegiana* (Hook.f.) Hack., *Trisetum insulare* Hemsl.) are dominant, but *Uncinia brevicaulis* (Mack.) Thouars and *U. compacta* R.Br. are also present. Peat bog occurs on the Plateau des Tourbières above 600 m a.s.l. and on the very wet plateau limited by the fault of the central caldera. Mosses (including *Sphagnum* L.) and liverworts are dominant, mixed with the endemic grass *Agrostis delislei* Hemsl., as well as *Scirpus aucklandicus* (Hook.f.) Boeckeler, and *Lycopodium trichiatum* Bory (Figs 7-10).



Figs 7-10. Biotopes on Îles Amsterdam from which bryophytes were collected. **7.** *Phylica arborea* wood in the NE part of the island (site 06-GB) with *Gleichenia polypodioides*, *Blechnum penna-marina*, *Scirpus nodosus*, *S. aucklandicus* and the alien grass *Holcus lanatus*. **8.** Peaty soil on the inner side of the Cratère Inférieur (site A002) with hummocks of *Hypodontium pomiforme* and the alien *Leontodon taraxacoides* and *Holcus lanatus*. **9.** La Grande Marche (site A110) with *Poa fuegiana*, *Agrostis delislei*, *Lycopodium trichiatum*, *Racomitrium lanuginosum*, *Riccardia insularis* and *Anastrophylopsis involutifolia*. **10.** Small gully SE of Le Pignon (site A081) with *Poa fuegiana*, *Scirpus nodosus* and *Clasmatocolea humilis*.

BRYOLOGICAL EXPLORATION

Because of its remoteness and isolation, Île Amsterdam was seldom visited by botanists and consequently its flora, especially the cryptogamic one, is still poorly known and underworked. The first observation of a bryophyte on the island should be credited to George L. Staunton (1797), the British diplomat who had been appointed secretary to Lord Macartney's mission to China in 1792-1794 on the ships *Lion* and *Hindustan*. The expedition made a short stop on Île Amsterdam in February 1793 and Staunton (1797) in his description of the island and its wildlife mentioned a marchantia growing "in great luxuriance" in some places. This term was rather used as a vernacular name, though he apparently observed stands of *Marchantia berteroana* Lehm. *et* Lindenb. which is a common hepatic on the islands in the Southern Ocean in bird nesting places.

The first collection of bryophytes on Île Amsterdam was made during the short visit of the Austro-Hungarian expedition of 1857-1859 on the frigate *Novara* under the command of Baron B. von Wüllerstorff-Urbair and Friedrich Pöck during the voyage of circumnavigation. The expedition visited Île Amsterdam on 6 December 1857 but because of the bad stormy weather, the landing was difficult. Consequently, only a small collection of plants was made including *Marchantia* sp. and *Campylopus flexuosus* Brid. (Reichardt, 1871: p. 9)

The next visit on the island yielded a much richer collection of bryophytes. It was made in 1875 by Georges de l'Isle, a naturalist to the French

Transit-of-Venus Expedition (1874-1875), on the ship *Dives*. As was with the *Novara* expedition, it operated mainly on Île Saint-Paul but de l'Isle was also able to visit Île Amsterdam briefly, where he made a collection of bryophytes. Bescherelle (1875) published a list of the mosses from the island, reporting 15 species, nine of which were new to science.

Georges de l'Isle also collected a few specimens of liverworts on Île Amsterdam. One of them was described by Stephani (1904) as *Plagiochila bescherelleana* Steph. and another was named *P. paulina* by C.M. Gottsche; this herbarium name was validated by Dugas (1929). At present these species are considered conspecific with *P. heterodonta* (Hook.f. et Taylor) Gottsche, Lindenb. et Nees (Grolle, 2002). The third liverwort collected by de l'Isle, *Symphyogyna podophylla* (Thunb.) Mont. et Nees, was recently reported by Grolle (2002).

The next two records of liverworts from Île Amsterdam were made by E. Vanhöffen during the German South Polar Expedition (1901-1903) and subsequently studied by Schiffner (1906) who described them as new species of *Riccardia*, *R. insularis* Schiffn. and *R. novo-amstelodamensis* Schiffn. After World War II some incidental collections of bryophytes were made on Île Amsterdam by S. J. Duplessis in 1956, E. Aubert de la Rüe in 1960, A. Lourteig and P. Cour in 1963, P. Noël in 1970 and J.-C. Jolinon in 1985. They were preserved in PC and recently studied by Grolle (2002) who reported ten species and one variety of liverworts and Tixier (1980) who recorded 20 species of mosses on the basis of these miscellaneous collections. Grolle (2002) recorded a total of 15 species and one variety of liverwort for Île Amsterdam. Seven further liverwort species were added recently (see below).

The present paper is the first survey of the liverwort flora of Île Amsterdam based on all available collections of these plants. It provides eight new additions to the island's hepaticoflora which represent remarkable range extensions for the taxa concerned.

MATERIAL AND METHODS

In 2006 and 2007 the third author made a representative collection of bryophytes on Île Amsterdam along a transect from Pointe d'Entrecasteaux on the south-western coast of the island to the summit part of Mont de la Dives and in Cratères Vénus. Included were most of the liverwort species previously recorded from the island, but a good number of them also proved to be new to the island's hepatic flora. Seven of these, *Anastrophylopsis involutifolia* (Mont. ex Gottsche, Lindenb. et Nees) Vána et L.Söderstr., *Aneura subcanaliculata* R.M.Schust., *Cephalozia bicuspidata* (L.) Dumort., *Colura calyptrifolia* (Hook.) Dumort., *Gymnomitrium subintegrum* (S.W.Arnell) Vána, *Kurzia setiformis* (De Not.) Grolle, and *Lophocolea werthii* (J.J.Engel et R.M.Schust.) Vána et L.Söderstr., have already been published in separate accounts (Vána et al. in Blockeel et al., 2009b; Vána et al., 2009; Vána et al. in Ellis et al., 2012b; Cykowska et al. in Ellis et al., 2012c). The voucher collections are housed in KRAM.

Apart from the above core collection, we had a chance to study about two dozen hepatic specimens collected in 1997 on Île Amsterdam by two American zoologists, H. Heatwole and M. Preker, which are deposited in DUKE, with a set of duplicates in KRAM. In addition, we checked many historical specimens of liverworts deposited in JE and PC and some type collections of species described from the study island.

For each taxon all specimens collected during the field work in 2006 and 2007 are listed. The specimens are numbered within each collecting site, for which coordinates are listed below. The global distribution of each taxon is reviewed and for five species distribution maps are presented. Some taxonomic remarks are also included and two species new to Île Amsterdam are fully illustrated. Species marked with an exclamation mark are new additions to the island's hepatic flora.

GEOGRAPHIC COORDINATES FOR LOCALITIES

06-Dives – 37°51'9.691''S, 77°32'50.399''E
06-Vénus – 37°48'49.306''S, 77°33'36.068''E
06-GB – 37°49'29.237''S, 77°35'0.409''E
06-013 – 37°51'16.456''S, 77°32'27.319''E
06-016 – 37°49'54.278''S, 77°33'55.89''E
A002 – 37°48'49.306''S, 77°33'36.068''E
A006 – 37°48'55.556''S, 77°33'33.494''E
A012 – 37°50'55.75''S, 77°32'54.97''E
A038 – 37°50'21.120''S, 77°33'34.862''E
A 040 – 37°50'24.779''S, 77°33'30.715''E
A041 – 37°50'27.290''S, 77°33'28.652''E
A042 – 37°50'27.316''S, 77°33'26.392''E
A043 – 37°50'27.146''S, 77°33'26.629''E
A046 – 37°50'23.870''S, 77°33'28.606''E
A052 – 37°50'23.248''S, 77°33'35.323''E
A076 – 37°51'45.986''S, 77°31'57.137''E
A077 – 37°51'36.821''S, 77°31'53.976''E
A081 – 37°51'39.575''S, 77°32'17.891''E
A082 – 37°51'13.921''S, 77°32'39.707''E
A086 – 37°51'16.848''S, 77°32'25.228''E
A089 – 37°51'7.646''S, 77°32'33.068''E
A093 – 37°51'1.159''S, 77°32'14.104''E
A096 – 37°51'13.514''S, 77°31'57.299''E
A098 – 37°51'07.304''S, 77°32'20.839''E
A103 – 37°50'35.797''S, 77°33'17.543''E
A110 – 37°50'4.761''S, 77°33'9.781''E
A111 – 37°50'44.311''S, 77°33'1.361''E
A115 – 37°51'1.422''S, 77°33'17.903''E
A116 – 37°50'59.208''S, 77°33'14.71''E

LIST OF TAXA

Family **MARCHANTIACEAE** Lindl.

Marchantia berteriana Lehm. *et* Lindenb.

ÎLE AMSTERDAM. *NE part*: (1) above base Martin-de-Viviès, on ground in rocky pasture with weeds on slope and on grazed boulder plain, 23 Jan 1997, *Heatwole & Preker 119, 137a & 146* (DUKE, KRAM); (2) same locality, on wet earthen wall of small cylindrical sink hole

about 40 cm in diameter on rocky pasture with weeds, 23 Jan 1997, *Heatwole & Preker 120* (DUKE, KRAM); (3) on ground in *Phyllica arborea* wood, 24 Jan 1997, *Heatwole & Preker 150a* (DUKE, KRAM).

Marchantia berterooana is a south-pantemperate species, occurring on all Southern Ocean islands, including New Zealand, and extending to the maritime Antarctic as far south as lat. 67°36'S, in southern part of South America, South Africa and Australia, and penetrating into the tropics in northern South America and Costa Rica in Central America, St Helena and Ascension Islands in the Atlantic Ocean and New Caledonia, New Guinea and Java in the Malesian region (for global distribution map see Bednarek-Ochyra *et al.*, 2000: p. 195). The species was first reported from Île Amsterdam by Bischler-Causse (1993: p. 60) and subsequently by Grolle (2002: p. 67). However, it is very likely that this species was first observed on the island in 1793 by Staunton (1797: p. 213) who wrote the following: "... In some places large beds of mosses, known by the name of marchantia and lycopodium, were growing in great luxuriance; ...". An unnamed species of *Marchantia* L., which apparently refers to *M. berterooana*, was reported from Île Amsterdam by Reichardt (1871: p. 9) during the visit of the Austro-Hungarian expedition on the frigate *Novara* which circumnavigated the globe in 1857-1859.

Family DUMORTIERACEAE D.G.Long

Dumortiera hirsuta (Sw.) Nees

ÎLE AMSTERDAM. **SW part:** (1) cliff between Pointe d'Entrecasteaux and les Grandes Ravines, alt. 80 m, 37°51'33.5"S, 77°31'55.5"E, steep cliff below le Pignon, the first stream from the south, 6 Dec 2007, *Van de Vijver B07-103*; (2) same locality, alt. 132 m, 6 Dec 2007, *Van de Vijver B07-103*.

Hitherto, this species was recorded only once on Île Amsterdam at two localities (Grolle, 2002: p. 63). Although *Dumortiera hirsuta* is often described as a cosmopolitan species, it is absent from many parts of the globe. Therefore it would be better classified as a pantropical and subtropical species, penetrating into the warm temperate zones of both hemispheres as correctly described in the treatments of several authors (e.g., Schuster, 1992; Bischler, 1998, including the global distribution map on p. 66; Gradstein & Costa, 2003; Bischler-Causse *et al.*, 2005). It is distributed in areas affected by oceanic and hyperoceanic climates because it is chiefly associated with shaded and continuously damp and wet sites. In the Western Hemisphere it extends in the Americas from northern Argentina and Paraguay to the Appalachians of Pennsylvania in eastern North America at lat. ca 40°N (Schuster, 1992) and then it is scattered in Macaronesia, northern Iberian Peninsula and Ireland and Britain where it extends to lat. ca 52°N in Scotland (Birks, 1991a). In Africa it is widely distributed, though scattered from the Gulf of Guinea to Réunion in the Mascarenes in the East Indian Ocean (Wigginton, 2009), and in Asia it extends from the Himalayan region to the Philippines and New Guinea, then recurring in the Fiji as well as in the Hawaiian and Society Islands in the Pacific Ocean (Miller *et al.*, 1983). The species is almost absent from Australasia having been only collected once in the Northland region on the North Island in New Zealand at lat. ca 35°09'S (Schuster, 1985) and in eastern Queensland in Australia (Downing, 1994). Thus, the localities of *D. hirsuta* on Île Amsterdam, which are situated at lat. ca 37°51'S, represent the southernmost occurrence of the species.

Family **PALLAVICINIACEAE** Mig.***Jensenia difformis*** (Nees) Grolle

Syn.: *Jensenia piscicolor* (Hook.f. *et* Taylor) Grolle

ÎLE AMSTERDAM. **Central part:** (1) on the southern slope of Mont de la Dives, alt. 780 m, 22 Dec 2006, *Lebouvier 06-Dives/1*. **SW part:** (2) between Mont de la Dives and Le Pignon, alt. 745 m, on a rock face, mixed with *Kurzia setiformis* and *Campylopus introflexus* (Hedw.) Brid., 10 Dec 2007, *Lebouvier A089a*.

This species has long been known under the name *Jensenia piscicolor* but it proved to be conspecific with *J. difformis* (Schuette & Stotler, 2005). It is sometimes designated as an amphiatlantic south-temperate species (Engel, 1990; Schaumann *et al.*, 2004; Frey *et al.*, 2010; Váňa & Engel, 2013), but it is actually a south-pantemperate species. Although it has its main centre of occurrence in southern South America, including the Falkland Islands and subantarctic South Georgia (Hässel de Menéndez & Rubies, 2009), in the Tristan da Cunha group in the South Atlantic Ocean (Váňa & Engel, 2013) and in the Kerguelen biogeographical province in the subantarctic (Prince Edward Islands, Îles Crozet, Îles Kerguelen) (Grolle, 2002: p. 65), it is also known from Tasmania (McCarthy, 2003) and this record completes its pan-Holantarctic range. As is the case with many cool-adapted species, *J. difformis* penetrates into the Neotropics, extending to the northern Andes and Costa Rica along the American Cordillera and to SE Brazil which is a well known refugium of austral-antarctic cool-adapted bryophytes (Herzog, 1925; Sehnem, 1955; Gradstein & Costa, 2003). The species was reported from Île Amsterdam by Grolle (2002: p. 65 as *J. piscicolor*).

Symphyogyna podophylla (Thunb.) Mont. *et* Nees

ÎLE AMSTERDAM. (1) “Ins. Nova Amsterdam (Ind. Ocean) Expédition astronomique aux Îles Saint-Paul et Amsterdam, 1874-75, M. G. de l’Isle s.n. (JE, PC).

Symphyogyna podophylla is a Gondwanan species which has an Afro-American distribution (Gradstein, 2013). It is also reported from Australasia, but the plants from this region represent a separate species, *S. hymenophyllum* (Hook.) Mont. *et* Nees (Schaumann *et al.*, 2003). The species is bicentric in distribution. It is frequent in northern South America and SE Brazil and in Africa where it ranges from the Cape to Ethiopia in East Africa, with an isolated occurrence in Cameroon in West Africa (Wigginton, 2004, 2009). The second centre of its occurrence is in the south-temperate zone where it exhibits an amphiatlantic range. It occurs in the *Nothofagus* zone in southern South America and in the Falkland Islands and then it recurs in Tristan da Cunha (Váňa & Engel, 2013), in the Kerguelen biogeographical province (Prince Edward Islands, Îles Crozet, Îles Kerguelen) in the Subantarctic, and on Île Saint-Paul and Île Amsterdam in the south-cool-temperate zone in the South Indian Ocean (Grolle, 2002: p. 70). On the latter islands it was collected in 1874-75 by the French Transit-of-Venus Expedition and it has not been seen since.

Family **ANEURACEAE** H.Klinggr.***Riccardia insularis*** Schiffn.

Riccardia insularis Schiffn. in Drygalski, *Deutsche Südpolar-Exped. 1901-1903*, 8: 66, pl. 6, f. 1-7. 1906. Type citation: Insel St. Paul: an den Wurzeln eines jungen *Aspidium filix mas*. Am 26. April 1903, c. inflor. lgt. E. Vanhöffen. – Insel

St. Paul; an den Wurzeln einer jungen *Lomaria alpina*. Am 26. April 1903, c. fr. mat. lgt. E. Vanhöffen. – Insel Neu-Amsterdam; an den Wurzeln eines jungen *Aspidium* aus einer Lavahöhle. Am 27. April 1903, c. inflor. lgt. E. Vanhöffen. [Lectotype (*selected here*): “Herb. V. Schiffner *Riccardia insularis* Schffn. n. sp. c. fr. Ins. St. Paul: an den Wurzeln einer jungen *Lomaria alpina* 26. April 1903 lgt. E. Vanhöffen Deutsche Südpolar-Exp. 1901-1903” – FH-Schiffner-00284243! Syntypes: (1) “*Riccardia insularis* Schffn. c. fl. mal., fem et androg. n. sp. Ins. St. Paul; an den Wurzeln eines jungen *Aspidium filix mas.* 26. April 1903. lgt. E. Vanhöffen Deutsche Südpolar-Exp. 1901-1903” – FH-Schiffner-00284244!; (2) “Herb. V. Schiffner. *Riccardia insularis* Schffn. n. sp. Ins. Neu-Amsterdam: an den Wurzeln eines jungen *Aspidium* aus einer Lavahöhle. 27. April 1903. lgt. E. Vanhöffen Deutsche Südpolar-Exp. 1901-1903” – FH-Schiffner-00284242!].

ÎLE AMSTERDAM. **NE part:** (1) coastal plain between base Martin-de-Viviès and *Phyllica* wood, on floor and wall of sink-hole cave, 23 Jan 1997, *Heatwole & Preker 140a & 142* (DUKE, KRAM). **Central part:** (2) Ravin Coleridge on the south-eastern slope of the summit, on western slope of the ravine in its central part, alt. 767 m, intermingled with *Sphagnum* sp., *Racomitrium lanuginosum* (Hedw.) Brid., *Uncinia compacta*, *Blechnum penna-marina* and *Poa fuegiana*; 12 Dec 2007, *Lebouvier A115/5*; (3) La Grande Marche, north-east of Mont de la Dives, south-eastern foot of rocky outcrops, alt. 736 m, intermingled with *Racomitrium lanuginosum*, *Poa fuegiana* and *Blechnum penna-marina*, 12 Dec 2007, *Lebouvier A110*; (4) in the middle of the caldera ESE of the cone of Museau de Tanche, southern side of the peat bog, alt. 705 m, intermingled with *Sphagnum* sp. and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A041/1*; (5) same locality, alt. 712 m, intermingled with *Sphagnum* sp. and some *Agrostis delislei*, 29 Nov 2007, *Lebouvier A052/1*; (6) same locality, 718 m, intermingled with *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A040/3*; (7) same locality, alt. 720 m, intermingled with *Racomitrium lanuginosum*, *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A046/1*; (8) without closer locality data, on wet grassy field on crater rim, 23 Jan 1997, *Heatwole & Preker 134c* (DUKE, KRAM).

Riccardia insularis was described on the basis of three specimens from Île Saint-Paul and Île Amsterdam collected by the German South Polar Expedition of 1901-1903 (Schiffner, 1906) and here this name is lectotypified. Hitherto, the species has been considered to be a local endemic of these two islands in the South Indian Ocean. It was admittedly reported from the Juan Fernandez Islands off South America on the Pacific Ocean (Evans, 1930; Arnell, 1957) but these records are based upon misdeterminations and actually refer to *R. tenerrima* (Steph.) A. Evans (Hässel de Menéndez, 1972). Judging from the number of records, *R. insularis* is a frequent species in the study area. It was formerly reported from the islands by Grolle (2002: p. 70).

The true identity of *Riccardia insularis* needs further studies which might change its biogeographical status. This species does occur on the subantarctic Prince Edward Islands (unpublished data) and on the basis of the accurate description and excellent illustrations *R. diversiflora* A. Evans subsp. *paucigyna* R.M. Schust. (Schuster, 1989) is probably identical to *R. insularis*. Thus, *R. insularis* is likely to be conspecific with *R. diversiflora* which is a southern South American species, known from Tierra del Fuego and southern Patagonia (Hässel de Menéndez, 1972; Engel, 1978). It was also reported from Tristan da Cunha (Arnell, 1958; Wace & Dickson, 1965), but in this archipelago only the closely related *R. tenerrima* occurs (Vána & Engel, 2013).

6. *Riccardia novo-amstelodamensis* Schiffn.

Riccardia novo-amstelodamensis Schiffn. in Drygalski, *Deutsche Südpolar-Exped. 1901-1903*, 8: 65, pl. 6, f. 8-11 ≡ *Aneura novo-amstelodamensis* Schiffn.

in Drygalski, *Deutsche Südpolar-Exped. 1901-1903*, 8: 65, pl. 6, f. 8-11. 1906. Type citation: Insel Neu-Amsterdam: In einer Süßwasserhöhle. Am 27. April 1903 lgt. E. Vanhöffen. [Lectotype (*selected here*): “Deutsche Südpolar-Expedition 1901-1903. Riccardia Novo-Amstelodamensis Schffr. Orig. Ex! Insel Neu-Amsterdam: in einer Süßwasserhöhle. 27. Apr. 1903. lgt. E. Vanhöffen det. Schiffner” – FH-Schiffner-00284246! (specimen No. 1); isotypes: specimens Nos. 2, 3 & 4 glued to the separate sheets in the same cover – FH-Schiffner-00284246!].

This species was described from material collected by E. Vanhöffen on Île Amsterdam during the German South Polar Expedition of 1901-1903 under the command of E. von Drygalski (Schiffner, 1906). The original material in the Schiffner herbarium at FH was studied and because it consists of four sheets with attached specimens in the same cover, lectotypification was necessary. In addition, in the Schiffner herbarium there are two large specimens apparently from the type locality collected by E. Werth, another naturalist to the German South Polar Expedition of 1901-1903. Unfortunately, all available specimens, including the type are entirely sterile, so a taxonomic assessment of the species is impossible since characters associated with the sex condition are significant in the taxonomy of this genus. Until now, the taxonomic status of *R. novo-amsteodamensis* remains unresolved and the species must be considered to be a local endemic of the island. It is worth noting that Schiffner (1906) proposed an alternative name for this species, *Aneura novo-amstelodamensis*, which according to Art. 36.2 of the current Code (McNeill *et al.*, 2012) is validly published.

Family LEJEUNEACEAE Cavers

Colura calyptriifolia (Hook.) Dumort.

ÎLE AMSTERDAM. **SW part:** (1) between Le Pignon and Mont de la Dives, alt. 748 m; on shoot of *Polytrichastrum formosum*, 22 Dec 2006, *Lebouvier 06-013/2* (EGR, KRAM).

Colura calyptriifolia is a bipolar species which has a Eurasian distribution in the Northern Hemisphere and principally an amphiatlantic south-temperate range in the Southern Hemisphere. It is the only species of the Lejeuneaceae which extends to the Subantarctic where it is known from the Prince Edward Islands and Îles Crozet in the Kerguelen biogeographical province (Grolle, 2002). In the south-cool-temperate zone *C. calyptriifolia* is known only from Tristan da Cunha in the South Atlantic Ocean (Váňa & Engel, 2013) and from Île Amsterdam in the South Indian Ocean from where this record was already published by Cykowska *et al.* (in Ellis *et al.*, 2012c) with a detailed review of its geographical range. The nearest locality of the species in this region is on Réunion Island (Ah-Peng *et al.*, 2008).

Family PSEUDOLEPICOLEACEAE Fulford *et J.*Taylor

Temnoma quadripartitum (Hook.) Mitt.

ÎLE AMSTERDAM. **Central part:** (1) Plateau Central, alt. 650-700 m, *de la Rüe* (JE-H3249!).

This species was found only once on the island (Grolle, 2002: p. 71) and it has not been found since. The occurrence of *Temnoma quadripartitum* on Île Amsterdam completes its south-pantemperate highly disjunct range, contrary to the statement of Engel (1978, 1990), who considered it as an amphipacific temperate species which is frequent in southern South America (including the

Falkland Islands) and in New Zealand. In the Indian Ocean sector of the Southern Ocean *T. quadripartitum* is frequent in the Prince Edward Islands, Îles Crozet and Îles Kerguelen and its occurrence on these subantarctic islands established it as a pan-Holantarctic species. The species was also reported from Tristan da Cunha in the South Atlantic Ocean (Arnell, 1958) but it has been excluded from the bryoflora of this archipelago since the relevant voucher specimens are either of *Pseudolepicolea temnomoides* (R.M.Schust.) Váňa *et* J.J.Engel or *Kurzia setiformis* (De Not.) J.J.Engel *et* R.M.Schust. (Váňa & Engel, 2013).

Family **HERBERTACEAE** Fulford *et* Hatcher

Herbertus dicranus (Taylor) Trevis.

Syn.: *Herbertus capensis* (Steph.) Sim

ÎLE AMSTERDAM. **N part:** (1) on the northern-east slope of Cratère de L'Olympe, alt. 528 m, 22 Dec 2006, *Lebouvier 06-016/4*; (2) without closer locality data, grassy slope halfway up slope to crater rim from base Martin-de-Viviès, 23 Jan 1997, *Heatwole & Preker 135d* (DUKE, KRAM). **Central part:** (3) Mont de la Dives, summit, alt. 880 m, in patches of *Racomitrium lanuginosum*, associated with *Anastrophyllum auritum*, 28 Nov 2007, *Lebouvier A012/2, A012/3 & A012/7*; (4) on the southern slope of Mont de la Dives, alt. 798 m, 22 Dec 2006, *Lebouvier 06-Dives/2*; (5) Le Museau de Tanche, south-eastern foot of the cone of Museau de Tanche, alt. 710 m, intermingled with *Racomitrium lanuginosum*, *Sphagnum* sp., *Scirpus aucklandicus* and *Agrostis delislei*, 29 Nov 2007, *Lebouvier A042/1 & A046/1*; (6) Ravin Coleridge on the south-eastern slope of the summit, in the bottom of the ravine in its upper part, alt. 759 m, intermingled with *Sphagnum* sp., *Uncinia brevicaulis*, *Poa fuegiana* and *Leontodon taraxacoides*, 12 Dec 2007, *Lebouvier A116/1*. **SW part:** (7) Plateau des Tourbières, southeasternmost part of the plateau, in middle part of steep west-facing cliff over Le Grand Balcon, alt. 585 m, on outcrop with very thin soil, 10 Dec 2007, *Lebouvier A098*; (8) between Le Pignon and Mont de la Dives, alt. 748 m, on rock, mixed with *Syzygiella colorata*, *Adelanthus lindenbergianus*, *Clasmatocolea humilis* and *Lepidozia laevifolia*, 22 Dec 2006, *Lebouvier 06-013/2 & 06-013/3*.

This species was reported for the first time from Île Amsterdam by Grolle (2002: p. 64) as *Herbertus capensis* which was subsequently considered to be conspecific with *H. dicranus* (Hodgetts, 2008). It is widespread in East and Central Africa, from Ethiopia to Mpumalanga Province in South Africa with some stations in São Tome and Principe, Liberia and Cameroon in West Africa. Additionally, it is scattered in the Comoro Islands, Madagascar and Réunion Island in the East Indian Ocean, with this highly isolated station on Île Amsterdam in the South Indian Ocean. The global range of *H. dicranus* is difficult to delineate and, with some reservation, it is considered to be a palaeotropical species, having the main centre of its distribution in Asia (Juslén, 2006a). It is frequent from Sri Lanka and Nepal in the west to Japan and the Philippines in the east and Bali in the south, with a highly isolated station in the Hawaiian Islands. This typical palaeotropical range is markedly disturbed by the highly anomalous occurrence of the species in Northwest North America, where it ranges along the Pacific coast from south-eastern Alaska to Oregon (Juslén, 2006a). Thus, in this part of its range *H. dicranus* shows a typical circum-North-Pacific distribution pattern which is frequently observed in mosses and liverworts (e.g. Bednarek-Ochyra *et al.*, 2010). On the other hand, *H. dicranus* was reported from South America (Hodgetts, 2003) but subsequent molecular studies (Feldberg & Heinrichs, 2006) excluded this species from the bryoflora of this continent. Considering the frequent occurrence of cryptic speciation in *Herbertus*

(e.g. Feldberg *et al.*, 2004; Juslén, 2006b; Heinrichs *et al.*, 2010), further molecular and morphological studies, including Australasian species, are necessary to resolve the phytogeographical problems in the *H. dicranus* complex.

Family **LEPIDOZIACEAE** Limpr.

Bazzania decrescens (Lehm. *et* Lindenb.) Trevis.

ÎLE AMSTERDAM. ***N part:*** (1) without closer locality data, grassy slope halfway up slope to crater rim from base Martin-de-Viviès, 23 Jan 1997, *Heatwole & Preker 135a, 135b, & 135c* (DUKE, KRAM). ***Central part:*** (2) Mont de la Dives, summit, alt. 880 m, in patches of *Campylopus* sp. associated with *Cephaloziella varians*, 28 Nov 2007, *Lebouvier A012/8*; (3) Lac Bleu, SW of La Grande Marche, on saturated peat bog, northern edge of the lake, alt. 744 m, intermingled with *Sphagnum* sp., *Scirpus aucklandicus*, *Racomitrium lanuginosum* and *Agrostis delislei*, 11 Dec 2007, *Lebouvier A111/1*; (4) Ravin Coleridge on the south-eastern slope of the summit, at the bottom of the ravine in its upper part, alt. 759 m, intermingled with *Sphagnum* sp., *Uncinia brevicaulis*, *Poa fuegiana* and *Leontodon taraxacoides*, 12 Dec 2007, *Lebouvier A116/1*. ***SW part:*** (5) between Mont de la Dives and Le Pignon, alt. 749 m, intermingled with *Sphagnum* sp., *Agrostis delislei*, *Scirpus aucklandicus*, *Poa fuegiana* and *Uncinia compacta*, 10 Dec 2007, *Lebouvier A086/2 & A086/3*; (6) Plateau des Tourbières, southeasternmost part of the plateau halfway between le Grand Balcon and Mont de la Dives, alt. 648 m, on a small terrace, intermingled with *Sphagnum* sp., *Agrostis delislei*, *Poa fuegiana*, *Scirpus aucklandicus*, *Blechnum penna-marina* and *Uncinia compacta*, 10 Dec 2007, *Lebouvier A093/1*.

Bazzania decrescens was reported for the first time from Île Amsterdam by Grolle (2002: p. 61) on the basis of a single collection from Plateau Central. This is an African tropical species ranging from Sierra Leone in West Africa to the Mascarenes and Île Amsterdam in the Indian Ocean (Wigginton, 2009). The species exhibits great variability which was studied in detail by Jones (1975) who distinguished two subspecies within this species, namely subsp. *molleri* (Steph.) E.W.Jones which is chiefly distributed in West Africa, and the type subspecies which is widely distributed in eastern and southern Africa and on East African Indian Ocean islands. In addition, Pócs (1994) recognised a third subspecies, subsp. *pumila* (Mitt.) Pócs, which is distinguished by its much smaller habit, bilobate underleaf and caducous leaves from the two former subspecies. The plants from Île Amsterdam clearly refer to subsp. *decrescens*. According to Jones (1975), *B. decrescens* is likely to be conspecific with *B. adnexa* (Lehm. *et* Lindenb.) Trevis., a protean Australasian species (Meagher, 2013) which is also recorded from China (Zhou *et al.*, 2012). Until thorough biosystematic studies on the interrelationships between these species are available, the local name *B. decrescens* has to be used for the plants from Île Amsterdam and this obviously affects the phytogeographical status of the species.

Kurzia setiformis (De Not.) Grolle

ÎLE AMSTERDAM. ***N part:*** (1) Cratères Vénus, Cratère Inférieur south of Martin-de-Viviès, alt. 299 m, on spots of peaty soil on the inner side of the crater rim, sparsely concealed in tufts of *Fissidens plumosus* Hornsch., 27 Nov 2007, *Lebouvier A002/3*. ***Central part:*** (2) Le Musée de Tanche: (1) at the edge of peat bog in the north-eastern part of the caldera, alt. 716 m, intermingled with *Clasmatocolea humilis* in tuft of *Sphagnum strictum* Sull. subsp. *pappeanum* (Müll.Hal.) A.Eddy and *Dicranoloma subconfine* (Besch.) Paris, 29 Nov 2007, *Lebouvier A038/1c*; (3) same locality, NNE of the crater rim, in tuft of *Chorisodontium aciphyllum* (Hook.f. *et* Wilson) Broth., fairly abundant, 29 Nov 2007, *Lebouvier A040/1b*; (4) same locality, sparsely in tuft of *Dicranoloma subconfine* with a small admixture of *Chorisodontium aciphyllum* and *Anastrophylopsis involutifolia*, 29 Nov 2007, *Lebouvier*

A040/2c; (5) same locality, abundantly in a compact tuft of *Sphagnum strictum* subsp. *pappeanum* with a small admixture of *Riccardia insularis*, 29 Nov 2007, *Lebouvier A040/3a*; (6) same locality, east of the crater rim, sparsely in tuft of *Sphagnum strictum* subsp. *pappeanum* and *Clasmatocolea humilis*, with a small admixture of *Chorisodontium aciphyllum* and *Riccardia insularis*, 29 Nov 2007, *Lebouvier A041/1d*; (7) same locality, ENE of the crater rim, abundantly in tuft of *Sphagnum strictum* subsp. *pappeanum* in association with *Clasmatocolea humilis*, *Chorisodontium aciphyllum* and *Riccardia insularis*, 29 Nov 2007, *Lebouvier A052/2a*; (8) at the north-eastern foot of the cone of le Museau du Tanche, alt. 720 m, scattered amongst shoots of *Chorisodontium aciphyllum* and *Dicranoloma subconfine* in fairly dry habitat on the trunk, 29 Nov 2007, *Lebouvier A046/1e*. **SW part:** (9) Plateau des Tourbières, easternmost part of the plateau in middle part of steep cliff, alt. 585 m, on peaty soil in tuft of *Polytrichastrum formosum* (Hedw.) G.L.Sm. and *Herbertus dicranus*, 10 Dec 2007, *Lebouvier A098/a*; (10) between Mont de la Dives and Le Pignon, on a small cliff, alt. 745 m, in tuft of *Campylopus introflexus*, associated with *Jensenia difformis*, 10 Dec 2007, *Lebouvier A089/a*.

Kurzia setiformis is a highly disjunct south-pantemperate species (Váňa *et al.*, 2010b). It has optimum occurrence in southern South America where it extends along the western fringes of the continent from the Valdivian region to Tierra del Fuego and the Falkland Islands. Then, it recurs in Tristan da Cunha in the South Atlantic Ocean and on Île Amsterdam in the South Indian Ocean and reaches Tasmania (McCarthy, 2003). The species was reported for the first time from Île Amsterdam by Váňa *et al.* (2010b: p. 235).

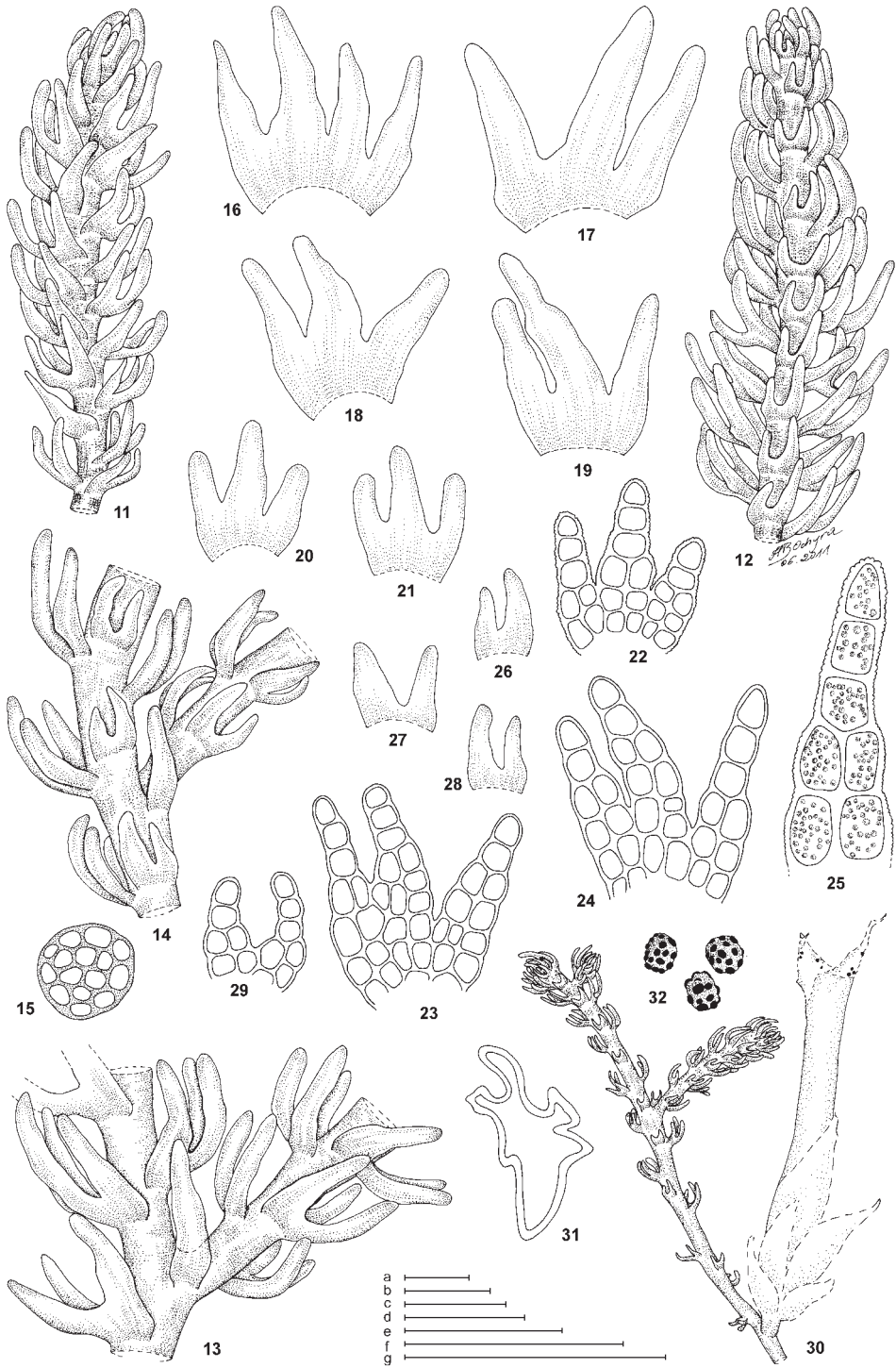
!K. capillaris (Sw.) Grolle subsp. **stephanii** (Renauld ex Steph.) Pócs

ÎLE AMSTERDAM. **NE part:** (1) on ground in *Phyllica* wood, 24 Jan 1997, *Heatwole & Preker 149* (DUKE, KRAM).

Kurzia capillaris is an Afro-American montane species (Gradstein *et al.*, 1984, including the global distribution map on p. 142; Gradstein, 2013) which is very variable morphologically and this prompted Pócs (1984, 2012) to recognise no fewer than three subspecies and one variety within this protean species. Three of these, namely the type subspecies, subsp. *paramicola* Pócs and var. *verrucosa* (Steph.) Pócs are known from the Neotropics, whereas the type subspecies with its var. *verrucosa* and subsp. *stephanii* are present in Africa. *Kurzia capillaris* subsp. *stephanii* (Figs 11-32) is a distinct taxon which differs from the type subspecies in the ratio of the uni- and biseriolate segments of the leaves. In the type subspecies the biseriolate basal part of leaves is longer than the upper uniseriate one, whereas in subsp. *stephanii* the situation is opposite and the distal uniseriate leaf segments are longer than the proximal biseriolate ones. In some regions of East Africa these two subspecies intergrade and occasionally some intermediate plants are found. *Kurzia capillaris* subsp. *stephanii* is an African endemic known from Malawi and Tanzania on mainland Africa and from Madagascar, Réunion and Mauritius in the East Indian Ocean. Herein, the range of this subspecies is extended to Île Amsterdam in the south-cool-temperate zone in the South Indian Ocean. It is worth noting that Pócs (1984) indicated, with a question mark, the occurrence of this taxon on Île Saint-Paul but it was not confirmed for this island (Grolle, 2002).

Lepidozia laevifolia (Hook.f. et Taylor) Gottsche, Lindenb. et Nees

ÎLE AMSTERDAM. **N part:** (1) Cratères Vénus: Cratère Inférieur south of Martin-de-Viviès, alt. 299 m, on the inner side of the crater rim, scarcely concealed in tuft of *Fissidens plumosus*, 21 Dec 2006, *Lebouvier 06-Vénus/7* and 27 Nov 2007, *Lebouvier A002/3*. **NE part:** (2) in a small hole full of water in *Phyllica arborea* wood, alt. 173 m, 21 Dec 2006, *Lebouvier 06-GB/1*; (3) on ground in *Phyllica arborea* wood, 24 Jan 1997, *Heatwole &*



Preker 148 (DUKE, KRAM). **Central part:** (4) Le Museau de Tanche, south-eastern foot of the cone of Museau de Tanche, alt. 721 m, 29 Nov 2007, *Lebouvier A043/1*; (5) Le Museau de Tanche, east of the cone of Museau de Tanche, alt. 720 m, intermingled with *Racomitrium lanuginosum*, *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A046/1*; (6) Ravin Coleridge on the south-eastern slope of the summit: on western slope of the ravine in its central part, alt. 767 m, intermingled with *Sphagnum* sp., *Racomitrium lanuginosum*, *Uncinia compacta*, *Blechnum penna-marina* and *Poa fuegiana* 12 Dec 2007, *Lebouvier A115/2*, *A115/4* & *A115/5*. **SW part:** (7) between Le Pignon and Mont de la Dives, alt. 748 m, on rock, mixed with *Syzygiella colorata*, *Herbertus dicranus*, *Clasmatocolea humilis* and *Adelanthus lindenbergianus*, 22 Dec 2006, *Lebouvier 06-013/2*.

Lepidozia laevifolia is a very widespread and locally common pan-Holantarctic species having primarily a south-pantemperate range. It is widespread in southern South America, extending from the Juan Fernández Islands to Tierra del Fuego, the Falkland Islands and subantarctic South Georgia (Engel, 1978, 1990) and in Australia, Tasmania and New Zealand where it extends as far south as the subantarctic Macquarie Island (McCarthy, 2003) and, then, recurring in Tristan da Cunha (Váňa & Engel, 2013) and on Île Amsterdam. It is also common on subantarctic islands in the Kerguelen biogeographical province, including the Prince Edward Islands, Îles Crozet and Îles Kerguelen (Grolle, 2002). The species was reported for the first time from Île Amsterdam by Grolle (2002: p. 65) on the basis of a single collection from Plateau Central, although it was already mentioned from this island by Pócs (1984: p. 109), but without citation of any specimens.

Family LOPHOCOLEACEAE Vanden Berghen

Clasmatocolea humilis (Hook.f. et Taylor) Grolle

ÎLE AMSTERDAM. **Central part:** (1) La Grande Marche, north-east of Mont de la Dives, south-eastern foot of rocky outcrops, alt. 736 m, intermingled with *Racomitrium lanuginosum*, *Poa fuegiana* and *Blechnum penna-marina*, 11 Dec 2007, *Lebouvier A110*; (2) eastern corner of the plateau between Barre des Toubibs and la Grande Marche, alt. 724 m, under cover of a big rock, 11 Dec 2007, *Lebouvier A103/2*; (3) Le Museau de Tanche, at the edge of peat bog in the north-eastern part of the caldera, alt. 716 m, intermingled with *Kurzia setiformis* in tuft of *Sphagnum strictum* subsp. *pappeanum* and *Dicranoloma subconfine*, 29 Nov 2007, *Lebouvier A038*; (4) Le Museau de Tanche, east of the cone of Museau de Tanche, alt. 712 m, intermingled with *Sphagnum* sp., some *Scirpus aucklandicus* and some *Agrostis delislei*, 29 Nov 2007, *Lebouvier A052/2*; (5) same locality, in the middle of the caldera ESE of the cone of Museau de Tanche, southern side of the peat bog, alt. 705 m, intermingled with *Sphagnum* sp. and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A041/1*; (6) without closer locality data, grassy field on crater rim, 23 Jan 1997, *Heatwole & Preker 134c & 134d* (DUKE, KRAM). **SW part:** (7) between Mont de la Dives and Le Pignon, alt. 749 m, intermingled with *Sphagnum* sp., *Agrostis delislei*, *Scirpus aucklandicus*, *Poa fuegiana* and *Uncinia compacta*, 10 Dec 2007, *Lebouvier A086/1*; (8) between Le Pignon

- ◀ Figs 11-32. *Kurzia capillaris* (Sw.) Grolle subsp. *stephanii* (Renauld ex Steph.) Pócs. – **11.** Sterile plant, dorsal view. **12.** Sterile plant, ventral view. **13.** Portion of shoot showing *Microlepidozia*-type branch, dorsal view. **14.** Same, ventral view. **15.** Transverse section of stem. **16-21.** Leaves. **22-24.** Areolation of leaves. **25.** Leaf lobe, showing papillosity. **26-28.** Underleaves. **29.** Underleaf areolation. **30.** Portion of perianth-bearing plant, ventral aspect. **31.** Outline of perianth transverse section. **32.** Spores. (All from *Heatwole & Preker 149*, KRAM). Scale bars: a – 100 µm (11-12); b – 100 µm (31); c – 100 µm (13-14); d – 100 µm (16-21, 26-28); e – 100 µm (15, 22-24, 29); f – 1 mm (30); g – 100 µm (25, 32).

and Mont de la Dives, alt. 748 m, on rock, mixed with *Syzygiella colorata*, *Herbertus dicranus*, *Lepidozia laevifolia* and *Adelanthus lindenbergianus*, 22 Dec 2006, *Lebouvier 06-013/2*; small gully south-east of Le Pignon in the upper part of Les Grandes Ravines, alt. 604 m, very wet, 10 Dec 2007, *Lebouvier A081/7*.

Clasmatocolea humilis was recorded for the first time on Île Amsterdam by Grolle (2002: p. 62) but the many additional records published herein indicate that this is a relatively frequent species in the island's bryoflora. Engel (1978, 1980, 1990) designated it as an amphipacific temperate species but actually its correct phytogeographical status is south-pantemperate since the occurrences on Tristan da Cunha and Gough Island (Váňa & Engel, 2013) and on Île Amsterdam nicely bridge the southern South American and Australasian centres of its distribution in the south-temperate zone. In addition, *C. humilis* extends to the Subantarctic in the Kerguelen biogeographical province where it occurs on the Prince Edward Islands, Îles Crozet and Îles Kerguelen (Grolle, 2002).

C. humilis* var. *suspecta (C.Massal.) J.J.Engel

ÎLE AMSTERDAM. **Central part:** (1) Plateau Central, alt. 650-700 m, *de la Rüe* (JE-H3250!).

Clasmatocolea humilis shows a considerable ecological amplitude growing in a wide range of habitats, from aquatic to dry and exposed and this is reflected in its considerable phenotypic plasticity. Engel (1980) recognised three varieties within this species including var. *suspecta* which differs from the type variety in its sparingly to regularly dentate leaves, in contrast to the entire leaves in var. *humilis*. This variety has an amphiatlantic distribution having the main centre of distribution in the *Nothofagus* zone in southern South America and extending to the Juan Fernández Islands and then recurring in Tristan da Cunha in the South Atlantic Ocean and on Îles Amsterdam in the South Indian Ocean, as well as on subantarctic Marion Island. This variety was reported first from the study area by Grolle (2002: p. 62).

Lophocolea werthii (J.J.Engel et R.M.Schust.) Váňa et L.Söderstr.

Syn.: *Lophocolea variabilis* Schiffn. in Drygalski, *Deutsche Südpolar-Exped. 1901-1903*, 8 (Bot.): 73. 1906 [Oct.] (Schiffner 1906), *hom. illeg.* (ICN Art 53.1); *non Lophocolea variabilis* Steph., *Bull. Herb. Boissier Sér. 2*, 6: 874 (*Sp. Hepat.* 3: 99). 1906 [Sept.] (Stephani 1906).

ÎLE AMSTERDAM. **NE part:** (1) on bark of pine tree at edge of *Phyllica* wood, 24 Jan 1997, *Heatwole & Preker 153* (DUKE, KRAM). **Central part:** (2) Le Museau de Tanche, east of the cone of Museau de Tanche, alt. 720 m, intermingled with *Racomitrium lanuginosum*, *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A046/1*. **SW part:** (3) cliff between Pointe d'Entrecasteaux and Les Grandes Ravines, steep cliff below le Pignon 300 m north-west of Les Grandes Ravines, the fourth stream from the south, alt. 29 m, along a small track through tufts of *Poa novarae*, 6 Dec 2007, *Lebouvier A076/5 & A077*.

Although *Lophocolea* (Dumort.) Dumort. was merged with *Chiloscyphus* Corda (Engel & Schuster, 1985), the traditional concept of the genus is accepted here, following the arguments of Grolle (1995) to maintain these genera as separate taxa and the recent concept of the genera of the family Lophocoleaceae based on molecular data (Söderström *et al.*, 2013a, b). *Lophocolea werthii* was described from two collections from Îles Kerguelen as *L. variabilis* (Schiffner, 1906) but because this name proved to be a younger homonym of *L. variabilis* Steph., *Chiloscyphus werthii* J.J.Engel et R.M.Schust. was proposed as its replacement (Engel & Schuster, 1985). It was subsequently rediscovered in this archipelago (Váňa & Gremmen, 2006). The species is closely

related, and possibly identical to the widespread *L. bidentata* (L.) Dumort., but the relationships between these species needs further studies. For a long time it was considered to be endemic to subantarctic Îles Kerguelen, but it was subsequently discovered on Île Saint-Paul and Île Amsterdam, two small, highly isolated islands in the South Indian Ocean (Vána *et al.* in Blockeel *et al.*, 2009b). The phytogeographical status of this species is a little uncertain because it occurs with equal frequency in such a small region. Because it is known to occur on two islands which lie some 75 km apart from each other and Îles Kerguelen are situated some 1400 km south of them, it may be considered as a south-cool-temperate species slightly penetrating into the Subantarctic.

Family **PLAGIOCHILACEAE** Müll.Frib. *et* Herzog

Plagiochila heterodonta (Hook.f. *et* Taylor) Gottsche, Lindenb. *et* Nees

ÎLE AMSTERDAM. **Central part:** (1) eastern corner of the plateau between Barre des Toubibs and la Grande Marche, alt. 724 m, under cover of a big rock, 11 Dec 2007, Lebouvier A103/1.

Plagiochila heterodonta is here considered as an amphiatlantic subantarctic species. It has maximum occurrence on the subantarctic islands in the Kerguelen biogeographical province where it is very common in the Prince Edward Islands, in Îles Crozet and Îles Kerguelen. The species is very rare and localised in the cool-temperate zone in southern South America where it occurs at high elevations in the Juan Fernández Islands and in the provinces of Osorno, Aysén and Chiloe in Chile and Neuquén, Chubut and Río Negro in Argentina (Hässel de Menéndez, 2006). The record of *P. heterodonta* from Tristan da Cunha (Arnell, 1958 as *P. remotidens* Steph.) is erroneous and the relevant voucher collections are of *P. wacei* Vána *et* J.J.Engel and *P. badia* Mitt. (Vána & Engel, 2013). Thus, the only area outside South America where *P. heterodonta* penetrates into the south-cool-temperate zone is Île Saint-Paul and Île Amsterdam in the South Indian Ocean where the species is very rare and occurs at high altitudes. The local populations from these islands were described as separate species, *P. bescherelleana* Steph. and *P. paulina* Gottsche *ex* Dugas, but these names were reduced to synonymy with *P. heterodonta* (Grolle, 2002).

Plagiochila minutula (Hook.f. *et* Taylor) Gottsche, Lindenb. *et* Nees

ÎLE AMSTERDAM. **Central part:** (1) Plateau Central, alt. 650-700 m, *de la Rüe* (JE-H3248! & JE-H3260/e!).

Plagiochila minutula is an amphiatlantic subantarctic species (Fig. 33) which has the main centre of its distribution in the Kerguelen biogeographical province where it is widespread in a wide range of habitats in the Prince Edward Islands, Îles Kerguelen and Îles Crozet but it is generally less frequent than *P. heterodonta* (Ochyra, personal observations). Additionally, it is known from subantarctic South Georgia in the American sector of Subantartica and from Isla Grande de Tierra del Fuego in Argentina in the south-cool-temperate zone (Hässel de Menéndez & Rubies, 2009). The species penetrates into the latter zone on Île Amsterdam where it is exceedingly rare in Central Plateau (Grolle, 2002: p. 69) but it has not been re-found during the recent survey of the island's bryoflora.



Fig. 33. Global distribution of *Plagiochila minutula* (Hook.f. & Taylor) Gottsche, Lindenb. & Nees. New record from Île Amsterdam marked with a star.

Family ADELANTHACEAE Grolle

!*Adelanthus lindenbergianus* (Lehm.) Mitt.

ÎLE AMSTERDAM. **Central part:** (1) Le Museu de Tanche, NNE of the cone of Museu de Tanche, alt. 718 m, intermingled with *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A040/2*. **SW part:** (2) between Le Pignon and Mont de la Dives, alt. 748 m, on rock, mixed with *Syzygiella colorata*, *Herbertus dicranus*, *Clasmatocolea humilis* and *Lepidozia laevifolia*, 22 Dec 2006, *Lebouvier 06-013/2*.

Adelanthus lindenbergianus is a bipolar species with the main part of its range in the Southern Hemisphere. Here, it exhibits a typical amphiatlantic south-temperate distribution, having its main centre of occurrence in the *Nothofagus* zone along the western fringes of southern South America from the Juan Fernández Islands and Valparaíso Province of Chile to Tierra del Fuego, the Falkland Islands and subantarctic South Georgia (Hässel de Menéndez & Rubies,

2009). Then, it recurs in Tristan da Cunha in the middle of the South Atlantic Ocean (Váňa & Engel, 2013) and extends to the Cape region and Lesotho in South Africa (Grolle, 1972; Hodgetts *et al.*, 1999) to the Mascarene Islands in the East Indian Ocean (Grolle, 1995) and Île Amsterdam from where it is recorded herein for the first time. As is the case with many austral cool-adapted bryophytes, *A. lindenbergianus* penetrates deeply into the tropics where it occurs at altimontane elevations in the American Cordillera, from Bolivia to Mexico (Grolle, 1969; Schuster, 1979) and in the East African mountains from Malawi to Kenya (Wigginton 2009). In the Northern Hemisphere, the species is locally frequent in open oligotrophic heather at high altitudes in north-western Ireland (Birks, 1991b).

!Syzygiella colorata (Lehm.) K.Feldberg, Váňa, Hentschel *et* J.Heinrichs

Syn.: *Jamesoniella colorata* (Lehm.) Schiffn.

ÎLE AMSTERDAM. **Central part:** (1) Mont de la Dives, summit, alt. 880 m, in patches of *Racomitrium lanuginosum*, associated with *Anastrophyllum auritum* and *Herbertus dicranus*, 28 Nov 2007, *Lebouvier A012/2, A012/3 & A012/6*; (2) Le Museau de Tanche, east of the cone of Museau de Tanche, alt. 720 m, intermingled with *Racomitrium lanuginosum*, *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A046/1*. **SW part:** (3) between Le Pignon and Mont de La Dives, alt. 748 m, on rock, mixed with *Adelanthus lindenbergianus*, *Herbertus dicranus*, *Clasmatocolea humilis* and *Lepidozia laevifolia*, 22 Dec 2006, *Lebouvier 06-013/2 & 06-013/3*.

Syzygiella colorata is a south-pantemperate species occurring in the southernmost parts of all Gondwanan continents (for distribution map see Engel, 1990: p. 101), including southern South America (with the Juan Fernández and Falkland Islands), southern Africa and south-eastern Australia, Tasmania and New Zealand (Grolle, 1971; Engel, 1978, 1990; Schuster, 1983). In addition, it is known from Tristan da Cunha in the South Atlantic Ocean and herein it is reported for the first time from Île Amsterdam in the South Indian Ocean. The species is also recorded from all subantarctic islands, except for Heard Island (Váňa & Gremmen, 2005), including South Georgia (Hässel de Menéndez & Rubies, 2009), the Prince Edward Islands, Îles Crozet and Îles Kerguelen and Macquarie Island (Seppelt, 1977).

!S. sonderi (Gottsche) K.Feldberg, Váňa, Hentschel *et* J.Heinrichs

Syn.: *Cryptochila grandiflora* (Lehm. *et* Gottsche) Grolle

ÎLE AMSTERDAM. **Central part:** (1) Mont de la Dives, summit, alt. 880 m, in patches of *Racomitrium lanuginosum*, associated with *Anastrophyllum auritum* and *Herbertus dicranus*, 28 Nov 2007, *Lebouvier A012/1, A012/5 & A012/7*; (2) on the southern slope of Mont de la Dives, alt. 780 m, 22 Dec 2006, *Lebouvier 06-Dives/3*.

Syzygiella sonderi is a south-pantemperate species which is known from the southernmost parts of all land masses in the Southern Hemisphere and all subantarctic islands (for distribution map see Engel, 1990: p. 100). It also extends to the northern maritime Antarctic where it grows on heated ground on volcanic islands in the South Sandwich Islands archipelago and on Deception Island in the South Shetland Islands archipelago (Bednarek-Ochyra *et al.*, 2000). In addition, the species deeply penetrates into the tropics where it occurs at high elevations in the central Andes of Bolivia and northern Andes of Peru, Ecuador and Colombia and in south-eastern Brazil in South America and in Panama, Costa Rica and Guatemala in Central America, northward to Mexico, on Réunion Island in the Mascarenes and in New Guinea and Borneo (Grolle, 1971; Menzel, 1988; Dauphin, 2005; Váňa & Engel, 2013). Herein, the range of *S. sonderi* is extended to Île Amsterdam.

Family **CEPHALOZIACEAE** Mig.

Cephalozia bicuspidata (L.) Dumort.

ÎLE AMSTERDAM. **N part.** (1) Cratères Vénus: 70 m south of Cratère Inférieur south of Martin-de-Viviès, alt. 308 m, on wet walls in a small hole, 27 Nov 2007, *Lebouvier A006/1*.

A bipolar species having a south-pantemperate distribution in the Holantarctic. It ranges from southern South America, through Tristan da Cunha, South Africa and Île Amsterdam to Tasmania. In the Subantarctic it has so far been recorded from South Georgia, Marion Island in the Prince Edwards Islands, as well as Île de la Possession in Îles Crozet and Îles Kerguelen (Váňa, 1988; Váňa *et al.* in Blockeel *et al.*, 2009b). The plants collected here are sterile but otherwise they fit other austral populations of this species very well morphologically.

Family **CEPHALOZIELLACEAE** Douin

!*Cephaloziella varians* (Gottsche) Steph.

ÎLE AMSTERDAM. **Central part.** (1) Mont de la Dives: summit, alt. 880 m, in tuft of *Campylopus* sp. associated with *Bazzania decrescens*, 28 Nov 2007, *Lebouvier A012/8*.

Cephaloziella varians is a bipolar species having wide continuous circumpolar ranges in both the Northern and Southern Hemispheres. In the Southern Hemisphere it is common in the maritime Antarctic and the isolated Bouvetøya in the Southern Ocean, and it is the only species of liverwort known from the Continental Antarctic where it reaches its southernmost station at 77°S in Victoria Land (Bednarek-Ochyra *et al.*, 2000). Outside the Antarctic *C. varians* occurs on most subantarctic islands, including South Georgia from whence it was described (Gottsche, 1890), the Prince Edward Islands (Váňa *et al.* in Blockeel *et al.*, 2010), Îles Crozet (Grolle, 2002), Îles Kerguelen (Váňa & Gremmen, 2006) and Heard Island (Váňa & Gremmen, 2005). In the south-temperate zone *C. varians* is very rare in Tierra del Fuego and in the Falkland Islands (Hässel de Menéndez & Rubies, 2009), in Tristan da Cunha (Váňa & Engel, 2013), New Zealand (Schuster, 1996), and here the species is recorded for the first time from Île Amsterdam.

Family **ANASTROPHYLLACEAE** L.Söderstr., Roo *et* Hedd.

!*Anastrophyllum auritum* (Lehm.) Steph.

ÎLE AMSTERDAM. **Central part.** (1) Mont de la Dives: summit, alt. 880 m, in patches of *Racomitrium lanuginosum*, associated with *Anastrophyloopsis involutifolia* and *Herbertus dicranus*, 28 Nov 2007, *Lebouvier A012/2*.

Anastrophyllum auritum is a pantropical oreophyte (Váňa, 1984; Zanten & Gradstein, 1988). It is widespread in the Neotropics, ranging from Mexico to Bolivia, in Africa where it extends from the Cape region to Ethiopia in East Africa and with isolated occurrence in Cameroon in West Africa, and very occasional in Borneo and New Guinea in Malesia. The species penetrates also into the south-cool-temperate zone and it is very rare in Tierra del Fuego (Hässel de Menéndez & Rubies, 2009), more frequent in Tristan da Cunha (Váňa & Engel, 2013) and here it is recorded for the first time from Île Amsterdam. In addition it is known from the subantarctic Prince Edward Islands and Îles Crozet (Grolle, 2002) and recently it was discovered on Heard Island (Váňa & Gremmen, 2005).

Anastrophylopsis involutifolia (Mont. ex Gottsche, Lindenb. et Nees) Váňa et L.Söderstr.

Syn.: *Anastrophyllum involutifolium* (Mont. ex Gottsche, Lindenb. et Nees) Steph.

ÎLE AMSTERDAM. **Central part:** (1) Mont de la Dives: summit, alt. 880 m, in patches of *Racomitrium lanuginosum*, associated with *Anastrophyllum auritum* and *Herbertus dicranus*, 28 Nov 2007, *Lebouvier A012/2d*; (2) Le Museau de Tanche, NNE side of the cone of Museau de Tanche, alt. 718 m, intermingled with *Sphagnum* sp., *Agrostis delislei* and *Scirpus aucklandicus*, 29 Nov 2007, *Lebouvier A040/2b*; (3) La Grande Marche, north-east of Mont de la Dives, south-eastern foot of rocky outcrops, alt. 736 m, intermingled with *Racomitrium lanuginosum*, *Poa fuegiana* and *Blechnum penna-marina*; 11 Dec 2007, *Lebouvier A110b*; (4) Lac Bleu, SW part of La Grande Marche, on saturated peat bog, northern edge of the lake, alt. 744 m, intermingled with *Sphagnum* sp., *Scirpus aucklandicus*, *Racomitrium lanuginosum* and *Agrostis delislei*, 11 Dec 2007, *Lebouvier A111/1b*; (5) Ravin Coleridge on the south-eastern slope of the summit: on western slope of the ravine in its central part, alt. 767 m, intermingled with *Sphagnum* sp., *Racomitrium lanuginosum*, *Uncinia compacta*, *Blechnum penna-marina* and *Poa fuegiana*, 12 Dec 2007, *Lebouvier A115/2c*, *A115/3b*, *A115/4b* & *A115/5d*; (6) without closer locality data, on wet grassy field on crater rim, 23 Jan 1997, *Heatwole & Preker 134c & 134d* (DUKE, KRAM). **SW part:** (7) between Mont de la Dives and Le Pignon, alt. 749 m, intermingled with *Sphagnum* sp., *Agrostis delislei*, *Scirpus aucklandicus*, *Poa fuegiana* and *Uncinia compacta*, 10 Dec 2007, *Lebouvier A086/2a & A086/3d*.

For a long time *Anastrophylopsis involutifolia* was known to occur in southern South America, from the Juan Fernández Islands to Tierra del Fuego (Hässel de Menéndez & Solari, 1985; Hässel de Menéndez & Rubies, 2009) and on subantarctic South Georgia (Hässel de Menéndez, 1977), as well as in Tristan da Cunha and Gough Island (Váňa & Engel, 2013). However, it was recently recorded from Île Amsterdam in the South Indian Ocean (Váňa *et al.*, 2010b) and this discovery established it as an amphiatlantic south-temperate species.

Family LOPHOZIACEAE Cavers

Andrewsianthus marionensis (S.W.Arnell) Grolle

ÎLE AMSTERDAM. **Central part:** (1) on the southern slope of Mont de la Dives, alt. 780 m, 22 Dec 2006, *Lebouvier 06-Dives/4*.

So far, *Andrewsianthus marionensis* has been considered a subantarctic species and near-endemic of the Kerguelen biogeographical province in the African sector of the Subantarctic, known from the Prince Edward Islands and Îles Crozet (Grolle, 2002: p. 61) and Îles Kerguelen (Váňa *et al.* in Blockeel *et al.*, 2009a) and only slightly penetrating into the south-cool-temperate zone in Tristan da Cunha (Váňa & Engel, 2013). However, the geographical range and the phytogeographical status of this species was significantly changed when two species, *A. australis* J.J.Engel from South America and *A. cuspidatus* R.M.Schust. (*A. squarrosus* (R.M.Schust.) R.M.Schust.) from Australasia were merged with *A. marionensis* (Váňa *et al.*, 2013). As a result, the range of the species was extended to southern South America including the Falkland Islands (Hässel de Menéndez & Rubies, 2009) and to south-western Australia, Tasmania and New Zealand (McCarthy, 2003; Engel & Glenny, 2008). In addition, the species was recently reported from subantarctic South Georgia (Váňa in Ellis *et al.*, 2014) and herein it is recorded for the first time from Île Amsterdam; this station nicely

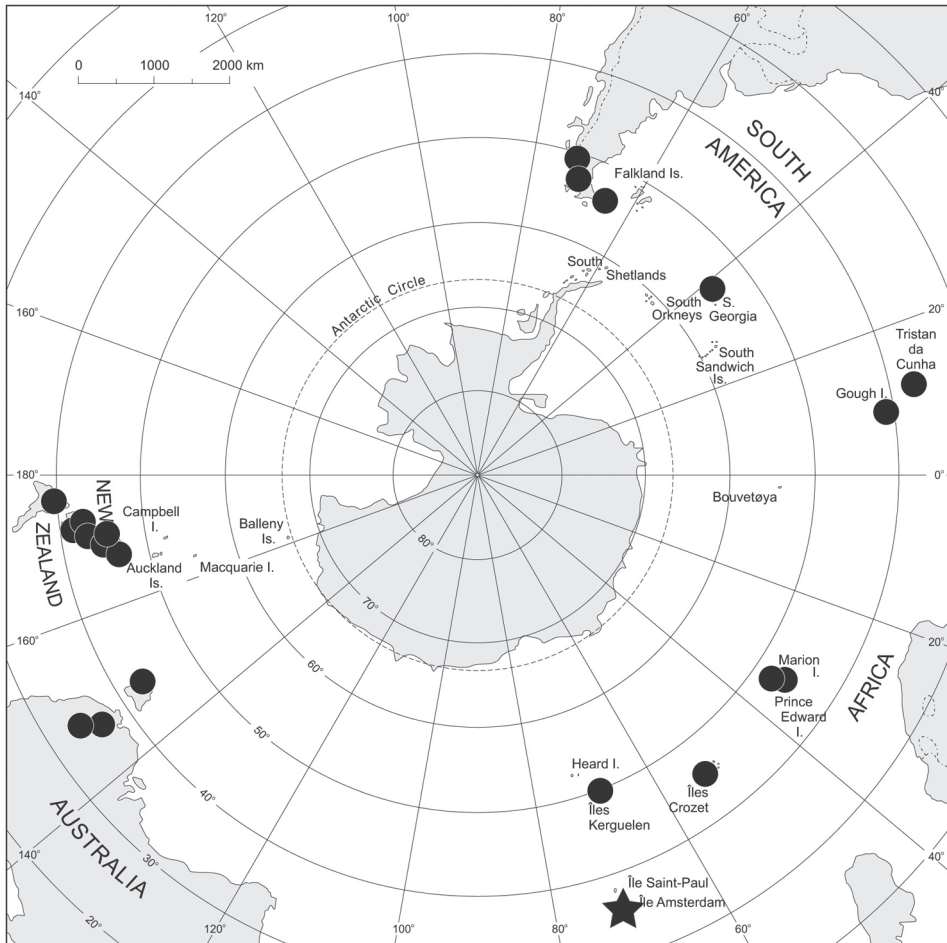


Fig. 34. Global distribution of *Andrewsianthus marionensis* (S.W.Arnell) Grolle. New record from Île Amsterdam marked with a star.

completes the range of the species in the south-temperate zone (Fig. 34). Accordingly, *A. marionensis* must be considered as a south-pantemperate species.

!Heterogemma patagonica (Herzog et Grolle) L.Söderstr. et Váňa

ÎLE AMSTERDAM. **SW part:** (1) between Mont de la Dives and Le Pignon, alt. 729 m, in a drainage depression, intermingled with *Sphagnum* sp., *Agrostis delislei*, *Blechnum penna-marina* and *Scirpus aucklandicus*, 10 Dec 2007, *Lebouvier A082*; (2) Plateau des Tourbières, south-easternmost part of the plateau 500 m north-west of Le Pignon, alt. 591 m, intermingled with *Sphagnum* sp., *Agrostis delislei*, *Blechnum penna-marina* and *Scirpus aucklandicus*, 10 Dec 2007, *Lebouvier A096/1*.

Until recently, *Heterogemma patagonica* was a rare South American endemic, scattered in the Chilean provinces of Valdivia, Osorno and Llanquihue (Hässel de Menéndez & Rubies, 2009) and on the Brunswick Peninsula in Magallanes Province (Engel, 1978). As with many austral cool-adapted species, it

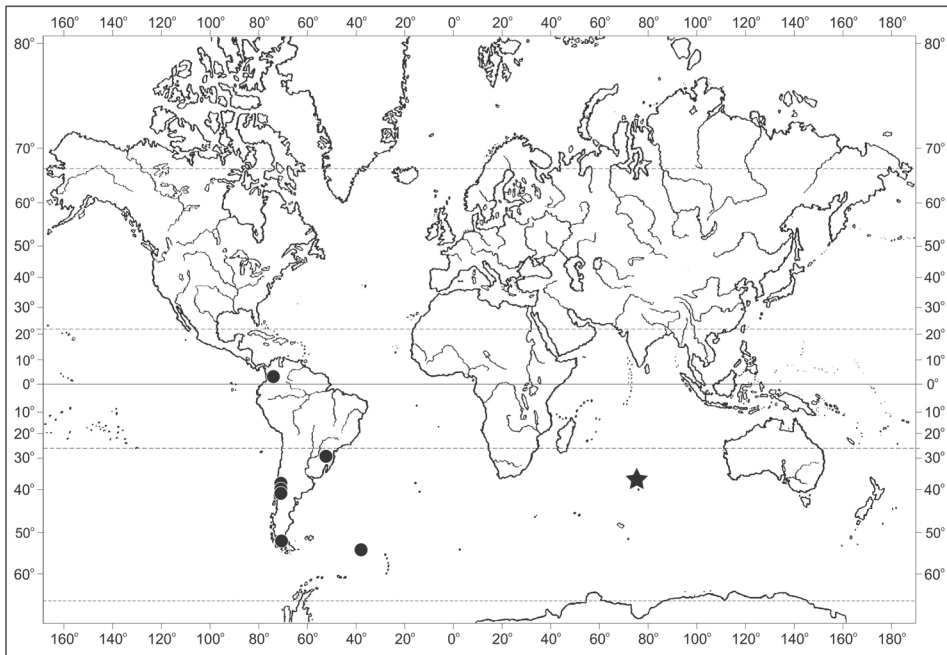


Fig. 35. Global distribution of *Heterogemma patagonica* (Herzog & Grolle) L.Söderstr. et Váňa. New record from Île Amsterdam marked with a star.

was discovered in the northern Andes of Colombia (Gradstein & Hekking, 1979) (this record, considered by R. Grolle as “cf.” and “vielleicht sogar artidentisch”, was confirmed by the senior author; cf. Váňa & Newsham in Ellis *et al.*, 2013) and in south-eastern Brazil (Schäfer-Verwimp, 1996). The geographical range has been markedly extended when it was discovered on subantarctic South Georgia (Váňa & Newsham in Ellis *et al.*, 2013) and herein it is reported for the first time from Île Amsterdam. Accordingly, *H. patagonica* must be considered as an amphiatlantic south-cool-temperate species (Fig. 35).

Family CALYPOGEIACEAE Arnell

Calypogeia fissa (L.) Raddi

ÎLE AMSTERDAM. *N part*: (1) Cratères Vénus, 70 m south of Cratère Inférieur south of Martin-de-Viviès, alt. 308 m, on wet walls in a small hole, 27 Nov 2007, *Lebouvier A006*. *NE part*: coastal plain between base Martin-de-Viviès and the *Phyllica* wood, on floor of a sink-hole cave, 23 Jan 1997, *Heatwole & Preker 140 & 140a* (DUKE, KRAM).

Calypogeia fissa is here interpreted as a bipolar species, although it can be also considered as an amphipacific-north-temperate suboceanic species, deeply penetrating into the African tropics. In the Holarctic it is represented by two vicariant subspecies, of which the type subspecies is widespread in Macaronesia, Europe and the Mediterranean, extending eastwards to central Russia, whereas subsp. *neogaea* R.M.Schust. is restricted to eastern North America (Damsholt, 2002). The species is widely distributed in tropical Africa,

including the islands in the Gulf of Guinea, Cameroon and Angola in the western part of the continent and East Africa where it ranges from Kenya to the Cape region. Additionally it is known from the Comoro Islands and Réunion Island in the East Indian Ocean (Bischler, 1970; Wigginton, 2009). The southernmost occurrence of the species is on Île Amsterdam where it was recorded for the first time by Grolle (2002, p. 62).

Mnioloma fuscum (Lehm.) R.M.Schust.

Île AMSTERDAM. **Central part:** (1) Plateau Central, alt. 650-700 m, *de la Riie* (JE-H3252!).

A palaeotropical species (Fig. 36), extending to subtropical and temperate zones in both hemispheres, including Macaronesia in the Northern Hemisphere (Bischler, 1970) and Tristan da Cunha (Váňa & Engel, 2013a) and Île Amsterdam (Grolle, 2002) in the Southern Hemisphere. It is widespread in tropical Africa, extending from St. Helena Island and Bioko in the Atlantic Ocean and Cameroon in West Africa to East Africa where it is frequent from Ethiopia to the Cape region and the Mascarene Islands in the East Indian Ocean (Bischler, 1970; Wigginton, 2009). In Asia it occurs in Sri Lanka, Thailand and Malesia including Borneo (Sarawak), Java, Sumatra and New Guinea (West Irian) and extending to the Solomon, Samoa and Hawaiian Islands in the Pacific Ocean (Grolle, 1977; Schuster, 1995). Recently, the species was recorded from the North Island and the South Island in New Zealand (Renner, 2003), but Engel (2006) described the New Zealand populations as a separate species, *M. novaezelandiae* J.J.Engel.

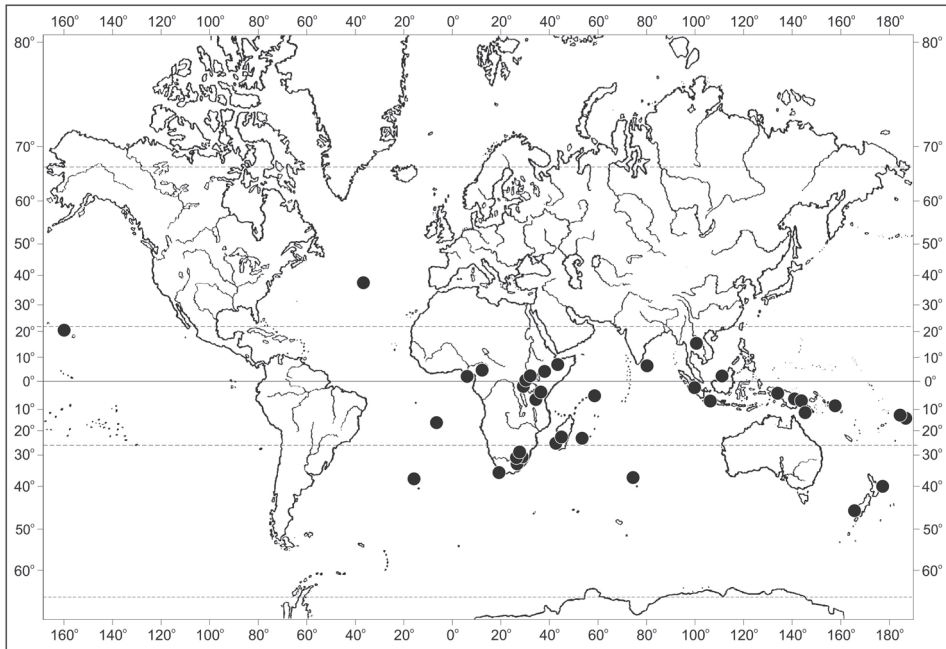


Fig. 36. Global distribution of *Mnioloma fuscum* (Lehm.) R.M.Schust.

Family **GYMNOMITRIACEAE** H.Klinggr.***Gymnomitrium subintegrum*** (S.W.Arnell) Váňa

ÎLE AMSTERDAM. **Central part:** (1) on the southern slope of Mont de La Dives, alt. 780 m, 22 Dec 2006, *Lebouvier 06-Dives/5*.

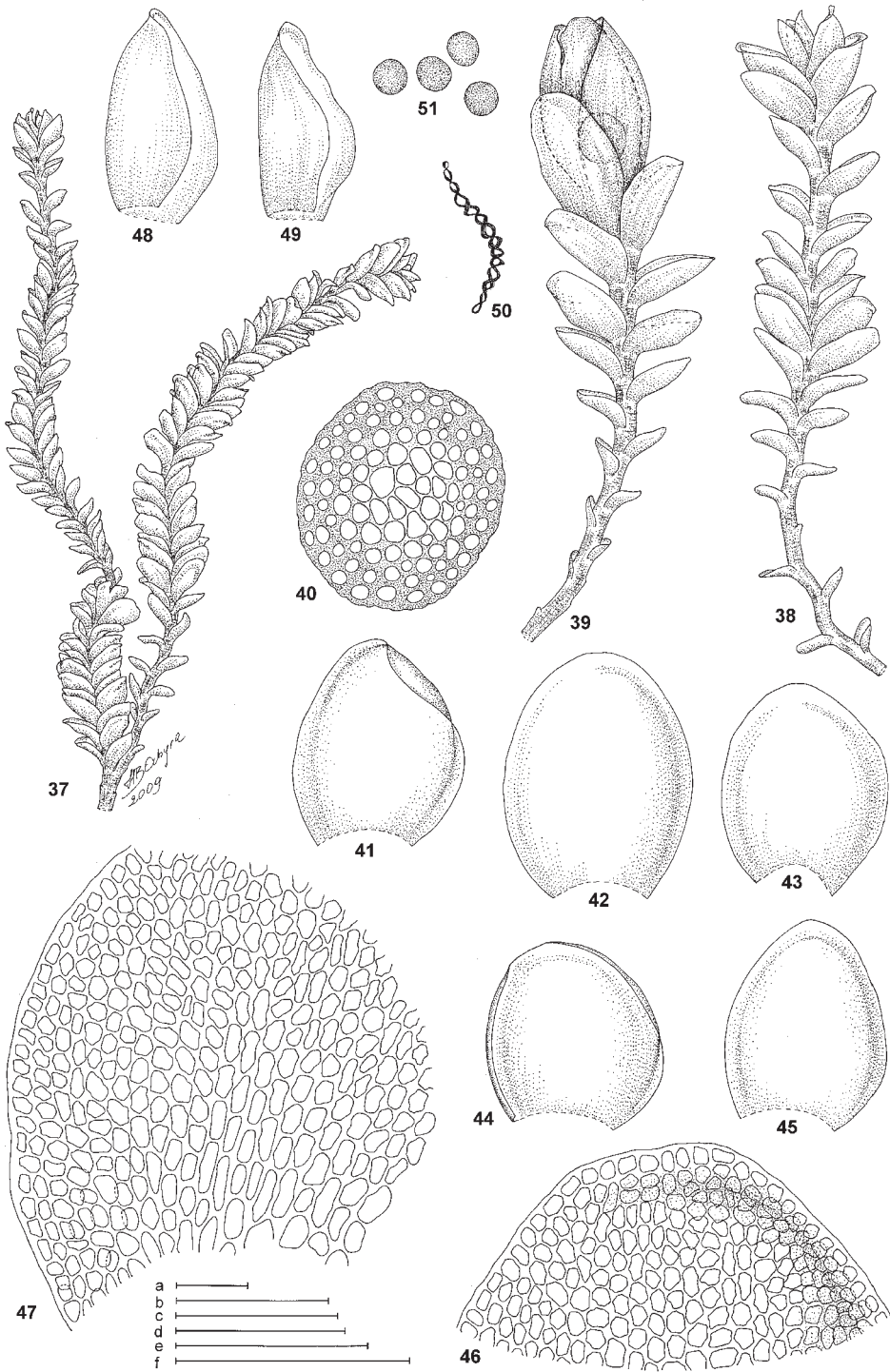
Gymnomitrium subintegrum (Figs 37-51) was originally positioned in *Marsupella* Dumort. but the lack of the perianth warrants its current placement in the genus *Gymnomitrium* Corda (Váňa *et al.*, 2010a). The species is a palaeotropical oreophyte (Fig. 52) which is widely scattered in Central and East Africa from Uganda to Malawi, extending to Réunion Island in the East Indian Ocean, whereas in Asia it is widely scattered in Malesia where it occurs in Borneo, Sumatra and New Guinea and penetrates to the north-temperate zone in Nepal in the Himalaya and to the south-cool-temperate zone on Île Amsterdam in the South Indian Ocean (Váňa *et al.* in Ellis *et al.*, 2012b). It is the southernmost occurrence of this species and the first discovery of the genus in the South Indian Ocean islands. The family Gymnomitriaceae is represented by four genera and four species in this region, including, beside *Gymnomitrium*, *Marsupella* (1) (Grolle, 2002), *Acrolophozia* R.M.Schust. (1) (Váňa *et al.* in Blockeel *et al.*, 2009b) and *Prasanthus* Lindb. (1) (Váňa *et al.*, 2010c).

EXCLUDED SPECIES***Aneura subcanaliculata*** R.M.Schust.

This species was described from the subantarctic Prince Edward Islands (Schuster, 1989) and it was subsequently recorded on Île de la Possession in Îles Crozet (Grolle, 2002) and on Île Australia in Îles Kerguelen (Váňa & Gremmen, 2006). *Aneura subcanaliculata* was once reported from Îles Amsterdam (Cratère Inférieur of Cratères Vénus south of Martin-de-Viviès, alt. 299 m, 37°48'49.306"S, 77°33'36.068"E, on spots of soil on the inner side of the crater rim, 27 Nov 2007, *Lebouvier A002/2*, KRAM) (Váňa *et al.* in Blockeel *et al.*, 2009b). This record is based upon a misidentification and actually the voucher specimen consists of a mixture of two species of hornworts. They will be dealt with in a separate account.

DISCUSSION

The hepatic flora of Île Amsterdam is not very rich but this is a general feature of the flora of the far southern regions of the Earth in all groups of plants and fungi (Ochyra *et al.*, 2008). Grolle (2002) reported only 15 species and one variety of liverwort from this island. The present study, based mainly upon material collected during the 2006 and 2007 mission, nearly doubled this number since it yielded 14 additional taxa. This raises the total number of hepatics known from Île Amsterdam to 29 species and one variety. This number makes the diversity of the liverworts of this island higher than that of subantarctic Heard Island where only 18 species are known to occur (Váňa & Gremmen, 2005). This number makes it nearly as rich as the hepatic flora of Îles Kerguelen for which, until 2002, only 31 species were known (Grolle, 2002) and only recent discoveries have increased this number to 34 species and one subspecies (Váňa *et al.* in



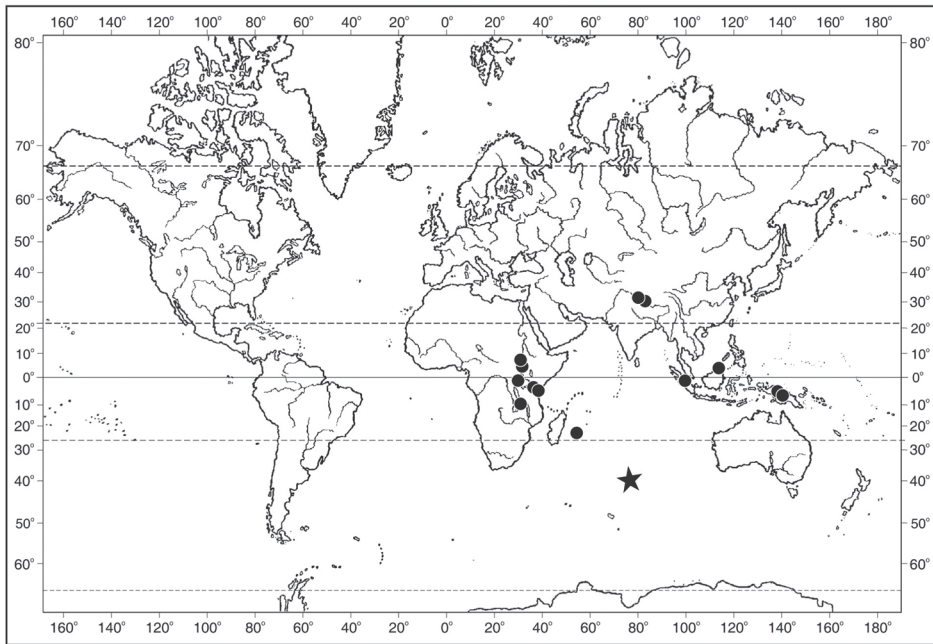


Fig. 52. Global distribution of *Gymnomitrium subintegrum* (S.W.Arnell) Váňa. New record from Île Amsterdam marked with a star.

Blockeel *et al.*, 2009a, b). It is almost certain that future collecting trips by professional bryologists will result in more additions to the hepaticoflora. Liverworts are mostly small and tiny plants, often concealed within moss tufts or turves and can be easily overlooked by inexperienced casual collectors.

Because Île Amsterdam is situated at the meeting point of two climatic zones, temperate and subtropical ones, its geographical position clearly influences the phytogeographical composition of the hepatic flora. In general, it consists of representatives of five floristic elements, but only two of these are dominant.

1. The south-temperate element consists of 12 species which have the main centre of their occurrence in the southern temperate zone. It comprises two distinct distribution patterns (sub-elements):

(a) south-pantemperate sub-element comprising species which are generally widespread and locally common and abundant throughout all or most temperate regions in the Southern Hemisphere. This sub-element consists of the following eight species: *Marchantia berteriana*, *Jensenia difformis*, *Temnoma quadripartitum*, *Kurzia setiformis*, *Lepidozia laevifolia*, *Clasmatocolea humilis*, *Syzygiella colorata* and *S. sonderi*;

- ◀ Figs 37-51. *Gymnomitrium subintegrum* (S.W.Arnell) Váňa. – **37.** Sterile plant, dorsal view. **38.** Portion of sterile branch, dorsal view. **39.** Female plant with enlarged bracts. **40.** Stem cross-section. **41-45.** Leaves. **46.** Distal leaf cells. **47.** Cells at leaf base. **48-49.** Female bracts. **50.** Elater. **51.** Spores. (All from *Lebouvier 06-Dives/5*). Scale bars: a – 1 mm (37); b – 1 mm (39) and 100 µm (40, 46-47); c – 1 mm (38); d – 0.5 mm (41-45); e – 1 mm (48-49); f – 100 µm (50-51).

(b) amphiatlantic south-temperate sub-element comprising species which are distributed mainly in the temperate regions of southern South America and South Africa including Tristan da Cunha and Gough Island in the South Atlantic Ocean. Three species and one variety of this sub-element occur on Île Amsterdam: *Jensenia difformis*, *Anastrophylopsis involutifolia*, *Heterogemma patagonica* (Fig. 35) and *Clasmatocolea* var. *suspecta*.

2. The tropical/subtropical element consists of seven species. This is a very diverse element and it is subdivided into no fewer than four different distribution patterns:

(a) pantropical sub-element which consists of species distributed throughout the tropics, including Neotropics and Palaeotropics. Two species are included here: *Dumortiera hirsuta* and *Anastrophyllum auritum*;

(b) palaeotropical sub-element which comprises species occurring in Africa and tropical Asia and Oceania. Two oreophytic species are included here: *Mnioloma fuscum* (Fig. 36) and *Gymnomitrium subintegrum* (Fig. 52);

(c) Afro-American sub-element which consists of species restricted in their distribution to tropical Africa and America. Only one species, *Symphyogyna podophylla*, is included here.

(d) African sub-element comprises taxa which are restricted in their distribution to Africa and conterminous islands, especially in the East Indian Ocean. Two taxa belong to this sub-element: *Bazzania decrescens* and *Kurzia capillaris* subsp. *stephanii*.

3. The subantarctic element is defined here as comprising species which have an optimum occurrence and abundance on subantarctic islands only occasionally penetrating into more northerly areas. Although Île Amsterdam and Îles Kerguelen are only 1475 km apart, the subantarctic archipelago has no special influence on the hepatic flora of Île Amsterdam and only three subantarctic species have been recorded at high elevation on the island. These are *Plagiochila heterodonta*, *P. minutula* (Fig. 33) and *Lophocolea werthii*.

4. Bipolar element consists of species which are distributed at highly disjunct stations in the Northern and Southern Hemispheres. This element is also very diverse and most often it consists of species which are widely distributed in the Northern Hemisphere and less frequent but otherwise widespread in the Southern Hemisphere. On Île Amsterdam this distribution pattern is represented by three species, namely *Cephalozia bicuspidata*, *Cephaloziella varians* and *Calyptogeia fissa*. Two other species, *Colura calyptrifolia* and *Adelanthus lindenbergianus*, have the major part of their ranges in the Southern Hemisphere and show an amphiatlantic south-temperate range and extend into the tropical mountains, whereas in the Northern Hemisphere they are exceedingly rare in restricted areas (especially the latter).

5. There are not many endemic species on the islands in the South Indian Ocean. There have been many species described in the past from various islands but they were subsequently discovered elsewhere or considered conspecific with taxa known from other areas. At present three species and one monotypic genus are endemic to the Prince Edward Island (Váňa *et al.*, 2009; Váňa, 2013), one to Heard Island (Váňa & Gremmen, 2005) and one to the Kerguelen biogeographical province (Bednarek-Ochyra *et al.* in Ellis *et al.*, 2012a).

Three species were described as new to science from Île Amsterdam but one of them, *Plagiochila bescherelleana* Steph. is identical to *P. hererodonta* (Grolle, 2002). Of the two species of *Riccardia*, *R. insularis* apparently also occurs in the Prince Edward Islands, so it can be considered as a near-endemic to Île Amsterdam, whilst the taxonomic status of *R. novo-amstelodamensis* is very

uncertain because the species is known only in the barren state and its identity cannot be established. This species certainly needs special search in the field to find fertile specimens.

The absence of distinct hepatic endemic species may be explained by the fact that the island is geologically very young. No endemism was found among lichens (Aptroot *et al.*, 2011) and testate amoebae (Heger *et al.*, 2009), but endemics are known in mosses (Bescherelle, 1875; Flatberg *et al.*, 2011), vascular plants (Ronsted *et al.*, 2002), diatoms (Van de Vijver *et al.*, 2008), birds (Jouventin & Roux, 1983), and insects (Tréhen *et al.*, 1990). This suggests that Île Amsterdam is enough old for speciation to have occurred in some groups of organisms.

Evaluation of the local distribution of liverworts within the island is difficult since most of available records were made in a single transect and more sampling is necessary from other parts of the island to obtain a realistic picture of the hepaticoflora. Nonetheless it is obvious that hepatics seem to be most common at higher elevations on the island's central plateau. No less than two third of species are restricted to, or have optimum occurrence at elevations above 700 m. This is apparently associated with the greater diversity of habitats as well as climatic conditions. In this zone occur most of the cool-adapted species including tropical oreophytes, south-temperate and subantarctic species. At these higher elevations climatic conditions are more severe than at sea level with an adiabatic air temperature decrease of around 1°C per 100 m increase in altitude (Schultze, 1971). For example, on the subantarctic Prince Edward Islands Zinderen Bakker (1978) estimates that at 250 m above sea level the temperature just above the soil surface falls below 0°C on about 50% of the nights, compared to about 30% at sea level. Additionally, strong winds contribute much to the severity of the climate in these regions. On Île Amsterdam meteorological records made in 1988 (Frenot & Valleix, 1990) showed that the temperature is lower by 7°C and the rainfall is higher (at least double) near Le Museau de Tanche (alt. 700 m) compared with the base Martin-de-Viviès (alt. 27 m). Hepatics are less frequent, both in terms of the number of species and abundance at low elevation and this is probably associated with the lower precipitation and nebulosity, the less diverse habitats and the strong disturbance of the natural ecosystem by human activity (Frenot *et al.*, 2001). Only a few hepatics were found almost exclusively in this zone, including *Marchantia berteriana* and *Cephalozia bicuspidata*, but for some old collections elevational data are missing.

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