The bryophytes collected int he la Réserve Spéciale de Manongarivo, Madagascar

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Chapter 3. The bryophytes collected in the Réserve Spéciale de Manongarivo, Madagascar

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ABSTRACT

PÓCS, T. & †P. GEISSLER (2002). The bryophytes collected in the Réserve Spéciale de Manongarivo, Madagascar. *Boissiera* 59: 41-76.

The rich bryophyte collections of Patricia Geissler from the Réserve Spéciale de Manongarivo (Antsiranana Province, Northwestern Madagascar) were enumerated and identified mainly by T. Pócs, and partly by A. Sass-Gyarmati (*Lejeuneaceae*, Subfam. *Ptychanthoideae*), by G. Kis (*Leucomiaceae* and *Pilotrichaceae*), and by S. Orbán (*Calymperaceae*). Nineteen taxa proved to be new to Madagascar and 4 new for the whole of Africa : *Cololejeunea peraffinis* var. *serrulata, Denotarisia linguifolia, Kymatocalyx rhizomatica* and *Bryum neelgheriense* var. *wichurae*. Seven taxa are new to science, with *Amphicephalozia geisslerae* Váňa & Pócs, *Bazzania decrescens* var. *ambahatrae* Pócs, *Diplasiolejeunea cobrensis* subsp. *antsirananae* Pócs, *Drepanolejeunea geisslerae* Pócs, *Lejeunea alata* Gottsche var. *patriciae* Pócs, *Lopholejeunea leioptera* Gyarmati and *Plagiochila fracta* Pócs. New synonymy is as follows: *Lejeunea camerunensis* (Steph.) E. W. Jones is conspecific with *Lejeunea tuberculosa* Steph. and *Schistochila pauciserrata* Kiaer & Pearson with *Schistochila alata* (Lehm.) Schiffn. The distribution patterns of the 167 identified species were analyzed. Thirty taxa (18%) proved to be endemic or sub-endemic to Madagascar, 50 (31%) to tropical Africa, 22 (13%) are disjunct between Madagascar and the surrounding islands and certain continental African areas (with the greatest affinity between East Africa and Madagascar), 24 (14%) Paleotropical (Afro-Asian), 11 (7%) Afro-American disjunct, and 16 (10%) Pantropical. From the smaller of the groups the 5 Asian taxa have greater significance, as they reach their western distributional limits in Madagascar and neighboring islands. On this basis the bryoflora of the Manongarivo Massif can be characterized as basically African, with a relatively high rate of endemism and with a closer affinity with Asia than is known for mainland Africa.

VERSION ABRÉGÉE EN FRANÇAIS

PÓCS, T. & †P. GEISSLER (2002). Les bryophytes récoltés dans la Réserve Spéciale de Manongarivo, Madagascar. *Boissiera* 59: 41-76.

En-dehors de quelques données éparses, la flore bryologique du massif de Manongarivo (Province d'Antsiranana, Nord-Ouest de Madagascar) est restée jusqu'alors pratiquement inconnue. Des échantillons ont été récoltés dans les parties inférieures du massif, jusqu'à une altitude de 700 m, en 1998 par T. Pócs & A. Szabó (non-publié), mais c'est avant tout la mission d'inventaire biologique de février-mars 1999, auquel a participé Patricia Geissler, qui a permis la récolte de près de 800 échantillons de bryophytes qui représentent un matériau relativement complet pour l'étude de la flore bryologique de cette région. En raison de son tragique décès, les hépatiques et une partie des mousses de cette collection ont été étudiées par Tamás Pócs, avec l'aide de plusieurs collaborateurs spécialistes de certains

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groupes: A. Sass-Gyarmati (*Lejeuneaceae*, Subfam. *Ptychanthoideae*), G. Kis (*Leucomiaceae* et *Pilotrichaceae*) et S. Orbán (*Calymperaceae*). Quelque 160 mousses restent encore indéterminées.

Les échantillons examinés dans cet article ont révélé 19 taxons nouveaux pour Madagascar dont 7 pour l'ensemble de la région malgache au sens large (y-compris les Seychelles, les Comores, et les Mascareignes), ainsi que 4 pour l'ensemble de la zone africaine: *Cololejeunea peraffinis* var. *serrulata, Denotarisia linguifolia* et *Kymatocalyx rhizomatica* et *Bryum neelgheriense* var. *wichurae* Sept taxons sont nouveaux pour la science: *Amphicephalozia geisslerae* Váňa & Pócs, *Bazzania decrescens* var. *ambahatrae* Pócs, *Diplasiolejeunea cobrensis* subsp. *antsirananae* Pócs, *Drepanolejeunea geisslerae* Pócs, *Lejeunea alata* Gottsche var. *patriciae* Pócs, *Lopholejeunea leioptera* Gyarmati et *Plagiochila fracta* Pócs. Ils sont décrits dans des articles séparés (SASS-GYARMATI, 2001; PÓCS, 2001; PÓCS, in prep.; PÓCS & VÁŇA, 2001). Nouvelles synonymies: *Lejeunea camerunensis* (Steph.) E. W. Jones est conspécifique de *Lejeunea tuberculosa* Steph. et *Schistochila pauciserrata* Kiaer & Pearson est conspécifique de *Schistochila alata* (Lehm.) Schiffn. Les 640 échantillons d'herbier ont été déposés principalement à G, avec des duplicata à TAN et EGR.

L'énumération répartit les 640 échantillons déterminés en 170 taxons dont 167 ont été identifiés au moins au niveau spécifique. Des synonymes sont donnés dans les cas où le taxon a été cité sous un autre nom dans des travaux récents. Le nom du taxon est suivi de sa distribution géographique sous forme abrégée. Les échantillons sont cités dans l'ordre de la numérotation de Patricia Geissler (PG). Sauf mention spéciale, c'est elle qui est l'auteur des récoltes. On donne ensuite l'amplitude altitudinale ainsi que le substrat sur lequel l'espèce a été récoltée. A la ligne, on trouvera pour finir le type de distribution du taxon, qui a servi à établir le spectre chorologique de la région. Lorsqu'une carte de distribution du taxon a été publiée, sa référence est citée entre parenthèses. L'arrangement des espèces suit l'ordre alphabétique des familles avec en premier lieu les hépatiques, puis les mousses.

La distribution des 167 taxons identifiés a été analysée et donne un tableau complet des affinités bryologiques de la Réserve Spéciale de Manongarivo.

Onze taxons (6,6%) sont strictement endémiques de Madagascar et 19 (11,4%) sont endémiques de la région malgache (c'est à dire y compris les Comores, les Seychelles et les Mascareignes). Ces taux sont relativement élevés si l'on tient compte de la facilité avec laquelle les bryophytes se dispersent par voie aérienne (ZANTEN, 1976; ZANTEN & PÓCS, 1981). Le taux d'endémiques ou de sub-endémiques (au total 18%) est comparable ou supérieur à celui de montagnes isolées comme le mont Kilimandjaro (2.3 + 5.3%) les monts Uluguru (1.4 + 2.2%, PÓCS, 1999), ou celui de grandes îles comme Cuba (12 + 13%, PÓCS, 1988), ou l'archipel des Galápagos (11%, GRADSTEIN & WEBER, 1982). Il peut être expliqué par la séparation ancienne de Madagascar, sa grande surface, et la diversité de ses habitats, à l'image du massif de Manongarivo.

Les espèces à aire disjointe entre Madagascar et une région d'Afrique (occidentale, orientale, centrale ou méridionale) représentent 13,2% des espèces. Ces disjonctions s'expliquent par plusieurs facteurs comprenant la séparation des continents, les extinctions et la dispersion à longue distance. La sous-catégorie la plus importante est de loin les espèces communes à Madagascar et à l'Afrique orientale, avec 14 espèces (8,4%) ce qui reflète probablement le fait que c'est de cette partie du continent africain que Madagascar s'est détaché.

Les espèces communes avec l'ensemble du continent africain représentent, avec 30,5%, la plus grosse partie de la flore bryologique du massif de Manongarivo. Elle a été partagée en deux sous-groupes: les espèces de basse et moyenne altitude (33 taxons, 19,8%) et les espèces limitées aux hautes zones de montagne (18 taxons, 10,7%). Les premières sont distribuées de manière continue dans toute l'Afrique tropicale et les îles de l'Océan Indien tandis que les secondes ont une aire fragmentée dans les montagnes de la région afro-montagnarde et des îles. Cette proportion élevée démontre clairement le rattachement de Madagascar en général et du massif de Manongarivo en particulier à l'empire floristique africain.

Parmi le groupe des espèces à aire disjointe entre deux continents, le sous-groupe paléotropical afro-asiatique (ou afro-océanien) est le plus important avec 29 taxons (17,4%). Ce sous-groupe est moins fréquent en Afrique orientale (12%, PÓCS, 1988). Sur l'ensemble du continent africain il n'atteint que 8,1% (PÓCS, 1992; TAN & PÓCS, 2000). Le sous-groupe

asiatique, dont les espèces n'atteignent en général pas le continent africain mais sont présents dans la région malgache, est représenté par 5 taxons (3%): *Cololejeunea peraffinis* var. *serrulata, Denotarisia linguifolia, Gottschea neesii, Iwatsukia jishibae* et *Bryum neelgheriense* var. *wichurae. Iwatsukia jishibae* a néanmoins été recensé une fois sur les Monts Mulanje, au Malawi (WIGGINTON & GROLLE, 1996). Le sous-groupe afro-américain contient 11 taxons (6,6%), tous des hépatiques. Leur distribution est analysée en détail par GRADSTEIN & al. (1984).

Sur cette base, la flore bryologique de la Réserve Spéciale de Manongarivo, avec ses 167 espèces identifiées et ses quelque 100 taxons non-identifiés, apparaît relativement riche et diversifiée en comparaison d'autres régions de montagne de taille semblable, comme par exemple les monts Usambara en Tanzanie, bien explorés et à la flore mieux connue qui compte 464 taxons (PÓCS, 1999). Les chiffres du Manongarivo indiquent que cette région est encore insuffisamment explorée et que des récoltes supplémentaires amèneraient vraisemblablement de nombreuses nouveautés. L'ancienneté de l'isolation de Madagascar a eu pour conséquence une relativement grande proportion d'endémiques. De plus, sa position passée et présente ont permis sa colonisation par un nombre plus important de taxons asiatiques que l'Afrique continentale. Les affinités de la flore bryologique malgache avec celle des autres îles de l'ouest de l'Océan Indien est intéressante: le lien le plus fort est avec les Comores, tandis que les Seychelles et les Mascareignes semblent plus proches entre elles que de Madagascar (PÓCS, 1997).

La comparaison du spectre chorologique des bryophytes de Manongarivo avec celui d'autres organismes comme les fougères (F. Rakotondrainibe, chap. 5) révèle des différences intéressantes: la proportion d'endémiques est bien plus grande chez les ptéridophytes (35% d'endémiques malgaches et 13% de subendémiques). La même comparaison effectuée à Cuba (TRYON, 1979; PÓCS, 1988) donne les mêmes résultats. Ainsi, bien que les deux groupes soient dispersés par des spores, il doit y avoir une différence dans leur dispersion susceptible d'expliquer cette observation. Il pourrait s'agir du fait que les spores des Ptéridophytes sont plus grosses et donc moins susceptibles d'être dispersées sur de longues distances par voie aérienne (ZANTEN & PÓCS, 1981) ou de la grande possibilité de dispersion des bryophytes par des propagules végétatives, ou de l'évolution plus rapide des ptéridophytes ou d'une combinaison de ces facteurs.

KEYWORDS: *Bryophyta* – *Hepaticae* – *Musci* – Africa – Madagascar – Manongarivo – Distribution – Diversity.

Introduction

The bryoflora of the Manongarivo Massif, apart from a few scattered data, was practically unknown. Previous records were from the Sambirano River valley and from coastal areas. Materials were collected from the lowermost part of the mountain, up to 700 m, in 1998 by T. Pócs & A. Szabó (unpublished). GEISSLER (1999) correctly pointed out that: "No bryophytes were hitherto recorded from these mountains covered by primary forest. The first results of an expedition in March 1999, collecting more than 500 specimens between 800 and 1600 m, revealed several taxa new to Madagascar". The 1998-99 biological inventory of the northern portion of the Manongarivo Massif, with the participation of Patricia Geissler, brought back the first comprehensive material, which revealed the high diversity of bryophytes in the area. The majority of the more than 800 bryophyte numbers were collected by P. Geissler herself. Due to her unexpected and very untimely death, the liverworts and a part of the mosses were identified and commented on by Tamás Pócs, who also sought the aid of several colleagues who are specialists of particular groups. Andrea Sass-Gyarmati identified the Ptychanthoid *Lejeuneaceae*, Gabriella Kis the members of *Hookeriales* (*Leucomiaceae* and *Pilotrichaceae* families), and Sándor Orbán dealt with the *Calymperaceae*. Still some 160 numbers of mosses remained unidentified.

From the material treated in this paper, 12 taxa are new to Madagascar, and 7 further to the whole Malagasy Region (including the islands of the Seychelles, Comoros, Réunion, Mauritius, and Rodriguez). Further, several taxa previously only known from mainland Africa were recorded on the slopes of the Manongarivo Massif (e.g., *Metzgeria limbato-setosa, Riccardia amazonica, R. erosa, Bryum caespiticium, Dicranum johnstonii, Thuidium intricatum,* and *T. tenuissimum.*

Cololejeunea peraffinis var. *serrulata, Denotarisia linguifolia*, *Kymatocalyx rhizomatica,* and *Bryum neelgheriense* var. *wichurae* are new for the whole of Africa, three of them being known only from Asia and *Kymatocalyx rhizomatica* from Asia and from tropical America. Finally 7 taxa proved to be new to science; these include *Amphicephalozia geisslerae* Váňa & Pócs, *Bazzania decrescens* var. *ambahatrae* Pócs, *Diplasiolejeunea cobrensis* subsp. *antsiranaнae* Pócs, *Drepanolejeunea geisslerae* Pócs, *Lejeunea alata* Gottsche var. *patriciae* Pócs, *Lopholejeunea leioptera* Gyarmati, and *Plagiochila fracta* Pócs. The new taxa are described in independent papers (SASS-GYARMATI, 2001; PÓCS, 2001; PÓCS, in prep.; PÓCS & VÁŇA, 2001). The 640 voucher specimens are kept mainly in G, duplicates are deposited in TAN and in EGR. *Lejeunea tuberculosa* Steph. is the new synonym of *L. camerunensis* (Steph.) E.W. Jones and of *Eulejeunea camerunensis* Steph.

The **enumeration** below contains data on the 640 identified specimens belonging to 170 taxa, of which 167 were identified to at least the species level. Synonyms are given only for cases for which if in recent times another name was used in the bryological literature concerning Africa. After the name of taxon the known geographical distribution is given in abbreviated form. The abbreviations of geographical regions are the following:

M Madagascar [when known, given in parentheses, which phytogeographic domains, according to HUMBERT (1955), as **S:** Sambirano, **E:** East, **C:** Center, and **W:** West]

RM Malagasy Region [in parentheses are given the island groups, as **S:** Seychelles, **C:** Comoro Islands, **Mas:** Mascarene Islands (if geographic details were available: **R:** Réunion, **M:** Mauritius, and **Ro:** Rodriguez)]

Aft Tropical Africa (widespread between the Sahara and southern Africa)

SAf Southern Africa (including Cape, Natal, Transvaal, Namibia, and Botswana)

EAf East Africa (from Ethiopia to Zimbabwe)

CAf Central Africa (including The Central African Republic, the former Zaire, Rwanda, and Burundi)

(mont) Distributed in the montane belt of any African region

WAf West Africa (from Guinea to Angola)

As Tropical and East Asia from India to Japan and New Guinea

Oc Australasia and Oceania

Amt Tropical America

Euas Temperate Eurasia

NAm Temperate North America

Ste Southern temperate

In the second row the specimens are enumerated according to the field collection numbers of Patricia Geissler (PG). If not otherwise stated, she was the collector. Thereafter the altitudinal range is given and finally the substrates on which the species were collected. The following abbreviations were used:

ct: corticolous, on bark

P: on palm trunk

ra: ramicolous, on twigs and on branches thinner than 4 cm

ph: epiphyllous, on living leaves

li: lignicolous, on dead or decaying wood

ru: rupicolous, on rocks or on stones

te: terricolous, on soil or on earthy ground

In the third line the distributional type is given, extracted from the above data. This pattern is used to establish the chorological spectrum of the area (see last section, Table 3-1 and Fig. 3-1). In the case when a distributional map of the species is published, the relevant reference is given in parentheses. The species follow alphabetic order according to the families within the *Hepaticae* and *Musci*.

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Enumeration

MARCHANTIOPHYTA / HEPATICAE

ADELANTHACEAE

Adelanthus Mitt.

***Adelanthus decipiens* (Hook.) Mitt.** **New to M; RM [M, R]; SAf, Aft (mont), Ste**

PG 19761/2, 19898 (leg. Gautier & Messmer); 1450-1869 m, ct.

An Afro-American southern temperate element penetrating into the tropical mountains and Atlantic Europe (GRADSTEIN & al., 1984, see map in GROLLE, 1969).

ANEURACEAE

Riccardia Gray

***Riccardia amazonica* (Spruce) Schiffn. ex Gradst. & Hekking** **New to RM; Aft, Amt**

PG 19706, 19777/1, 19795/3, 19811/2; 1200-1550 m, ct, P, ru, li.

Tropical Afro-American species (GRADSTEIN & HEKKING, 1979, see map in MEENKS & PÓCS, 1985).

***Riccardia erosa* (Steph.) E. W. Jones** **New to RM; Aft**

PG 18480, 18481/1; 700-800 m, li.

Tropical African species (see map in MEENKS & PÓCS, 1985).

***Riccardia longispica* (Steph.) Pearson** **M [E]; Aft (mont)**

PG 19708/5; 1300-1350 m, ct.

Tropical African montane species (see map in MEENKS & PÓCS, 1985).

BALANTIOPSIDACEAE

Isotachis Mitt.

***Isotachis aubertii* (Schwägr.) Mitt.** **M, RM [M, R, Rd], Aft, Amt (mont)**

PG 19708/2, 19709; 1300-1350 m, ct, ru.

Afro-American tropical montane species (see map in GRADSTEIN & al., 1984).

CALYPOGEIACEAE

Calypogeia Raddi

***Calypogeia annobonensis* Steph.** **New to M; RM [S], Aft**

PG 19476, 19555; 700-950 m, ru, te.

Tropical African lowland species.

Mnioloma Herzog

***Mnioloma* (subgen. *Caracoma*) *fuscum* (Lehm.) R. M. Schust.**
M, RM [R, S], Aft (mont), SAf, As, Oc

Calypogeia fusca (Lehm.) Steph., see SCHUSTER (1995).

PG 194544, 19455/2, 19460/3, 19554/1; ru, te, li.

Widespread Paleotropical species with scattered range in the mountainous areas (GROLLE, 1977a).

CEPHALOZIACEAE

Cephalozia (Dumort.) Dumort.

***Cephalozia fissa* Steph.** **M, Aft (mont), SAf**

PG 19645/3; 1200-1250 m, tb.

Widespread tropical African montane species (+ Australia? VÁŇA, 1988).

Iwatsukia N. Kitag.

***Iwatsukia jishibae* (Steph.) N. Kitag.**
M [E], RM [S, C, R, M), Aft (mont, only Malawi), As

PG 19724/1 (leg. Gautier & Messmer), 19901 & 19902 (leg. Gautier & Messmer); 1350-1869 m, ct.

Widespread in the Indian Ocean islands (PÓCS, 1995). Asian tropical montane species with its western most occurrence in the Mulanje Mountains of Malawi (WIGGINTON & GROLLE, 1996).

CEPHALOZIELLACEAE

Amphicephalozia R. M. Schust.

***Amphicephalozia geisslerae* Váňa & Pócs**

PG 19708/3, 19709/1; 1300-1350 m, ct, ru.

This new species is known only from Manongarivo Massif (see description in PÓCS & VÁŇA, 2001). This antipodal genus is new to Africa. The only known species (*A. amplexicaulis* R. M. Schust.) was described from Patagonia (SCHUSTER, 1971).

Cephaloziella (Spruce) Schiffn.

***Cephaloziella kiaeri* (Austin) Douin** **M, RM [S, R], Aft (mont), As, Oc**

PG 19687/2, 19704/2, 19705/2, 19739, 19794/2, 19798, 19836/1 (leg. Gautier & Messmer), 19837, 19894/1; 1200-1869 m; mostly ru and te, sometimes ct and li.

Widespread Paleotropical (montane) species (See map in PÓCS, 1992).

Kymatocalyx Herzog

***Kymatocalyx madagascariensis* (Steph.) Gradst. & Váňa** **M [E], RM [C, M, R]**

Stenorrhipis madagascariensis (Steph.) Grolle, see GRADSTEIN & VÁŇA, 1999

PG 19587/1; 700 m, ru.

Endemic to the Malagasy Region.

***Kymatocalyx rhizomatica* (Herzog) Gradst. & Váňa** **New to Africa; As, Amt**

Stenorrhipis rhizomatica Herzog, see GRADSTEIN & VÁŇA, 1999

PG 19724/3, 19725/1; 1350-1400 m, ct.

A species new to the whole of Africa, hitherto known to occur only in tropical Asia and America. GRADSTEIN & VÁŇA (1999) considered its distribution to be very unusual in hepatics and wrote: "An intensive search in potentially suitable habitats, especially in Africa, is needed to verify the actual distribution..." The new record therefore is very interesting and provides clear evidence that indeed this group is Pantropical in its distribution. Furthermore, on the basis of this record Madagascar becomes the only place on earth where three former *Stenorrhipis* species occur, as the Neotropical *Kymatocalyx dominicensis* outside the Americas is known only from northern Madagascar (PÓCS in GRADSTEIN & VÁŇA, 1999). The fourth species, *Kymatocalyx africanus* Váňa & Wigginton occurs only in continental East Africa.

FOSSOMBRONIACEAE

Fossombronia Raddi

***Fossombronia* sp.** **The genus is new to M**

Sterile, indeterminable, PG 19737; 1300-1350 m, te.

GEOCALYCACEAE

Conoscyphus Mitt.

***Conoscyphus trapezioides* (Sande Lac.) Schiffn.** **M [E], RM [S, R], As, Oc**

PG 19789/2, 19791, 19804/2, 19893 (leg. Gautier & Messmer); 1500-1869 m, ct, ru.

Paleotropical montane species (PÓCS, 1976).

Heteroscyphus Schiffn.

***Heteroscyphus splendens* (Lehm. et Lindenb.) Grolle**
M [E], RM [S, R, M], Aft (mont), As, Oc

Chiloscyphus mascarenensis S. Arn., *Chiloscyphus decurrens* Nees

PG 19450, 19461, 19468/2, 19521/1, 19734/2; 700-1400 m, mostly ct, rare te.

Widespread Paleotropical montane species, rare in continental Africa (see map in PÓCS, 1976).

Leptoscyphus Mitt.

***Leptoscyphus infuscatus* (Mitt.) E. W. Jones** **New to M; RM [R], Aft (mont).**

PG 19761/5; 1450-1500m, ct.

Tropical African montane species (see map in GROLLE, 1963).

Lophocolea (Dumort.) Dumort.

***Lophocolea bidentata* (L.) Dumort.** **M, RM [R, M], NAm, Euas**

PG 19586/5; 700 m, ru.

Temperate species widespread in the tropical mountains.

***Lophocolea concreta* Mont.** **M [E, C], RM, Aft, SAf**

PG 19396/1, 19405, 19542, 19487/2, 19639/2, 19848; 700-1250 m, ct, li.

Very widespread tropical African species.

***Lophocolea difformis* Nees** **New to M; RM [R, M], Aft, SAf**

PG 19405/2, 19601, 19640, 19842; 700-1250 m, ct, li.

Widespread tropical African species.

***Lophocolea lucida* (Spreng. ex Lehm.) Mont.** **M, RM, Aft, SAf**

PG 19452/2, 19759/2; 800-1500 m, ct, li.

Widespread tropical African species.

***Lophocolea martiana* Nees** **M, RM [M, R], Aft, SAf, Amt**

PG 19517; 19541/1; 700-900 m, li.

Widespread tropical Afro-American species (see map in GRADSTEIN & al., 1984).

***Lophocolea muricata* (Lehm.) Nees** **M, RM [C, R], Aft, As, Amt, As, Am, Eu**

PG 19508; 700-900 m, ru-te.

Pantropical and Southern temperate species.

HERBERTACEAE

Herbertus Gray

***Herbertus grossevittatus* (Steph.) S. Arn. ex Grolle** **M [E], RM [S, M]**

PG 19465, 19653/23, 19656/3, 19657, 19664, 19674, 19676, 19681/1, 19720/1, 19748, 19769, 19725/5, 19874, 19887/1, 19891 (leg. Gautier & Messmer), 19910 (leg. Gautier & Messmer); 1100-1868 m, ct with one exception (19769/3), where it occurs on soil.

Endemic to the mountains in the Malagasy Region (GROLLE, 1978). This species was identified by PATRICIA GEISSLER, who wrote, that it "was frequently found fertile, thus allowing for the first time analysis and illustration of the sporophyte nature of this genus" (GEISSLER, 1999).

JUBULACEAE

Frullania Raddi

***Frullania* sp. ster. cf. *apicalis* Mitt.** **M [Sb, W, E, C], RM [all], Aft (mont)**

PG 19724/2 p.p.; 1350-1400 m, ct.

Widespread tropical African montane species (see map 342 in VANDEN BERGHEN, 1976).

***Frullania angulata* Mitt.** **M [Sb, E], RM [C, R, M], Aft (mont)**

PG 19752, 19755/1, 19786; 1400-1550 m, ct.

Widespread tropical African montane species (see map 346 in VANDEN BERGHEN, 1976).

***Frullania apiculata* (Nees) Dumort.** **M [E], RM [C, R, M], Aft, As, Oc**

PG 19753; 1400-1450 m, ra.

Paleotropical species (see map 354 in VANDEN BERGHEN, 1976).

***Frullania diptera* (Lehm. et Lindb.) Gottsche** **M [C, E], RM [R, M], Aft, SAf**

PG 19577/3; 720 m, ct.

Tropical and South African lowland species (see map 369 in VANDEN BERGHEN, 1976).

***Frullania grossiclava* Steph.** **M [C, E], EAf**

PG 19509, 19675, 19682, 19801/3, 19803/1; 700-1550 m, ct, ru, li.

East Africa and Madagascar (see map 353 in VANDEN BERGHEN, 1976).

***Frullania imerinensis* Steph.** **M [C, E], RM [S], CAf**

PG 19468/1; 850-950 m, ct.

Central Africa, Seychelles, and Madagascar (PÓCS, 1995, see map 345 in VANDEN BERGHEN, 1976).

***Frullania lindenbergii* Lehm.** **M, RM [S, R, M], EAf, SAf**

PG 19563/2; 950-1050 m, ra.

East and South Africa and Malagasy Region (see map in VANDEN BERGHEN, 1976).

***Frullania loricata* Pearson** **M [Sb, E], CAf, EAf**

PG 19773/2, 19804/4, 19912/2 (leg. Gautier & Messmer); 1350-1650 m.

Widespread on Madagascar with sporadic occurrence in Uganda and Malawi (see map 352 in VANDEN BERGHEN, 1976).

***Frullania purpurea* Steph.** **M [E], RM [S, M], WAf**

PG 19549/1, 19563/1, 19699/2; 850-1300 m, ct, ra, ph.

Disjunct in West Africa and the Malagasy Region (see map 348 in VANDEN BERGHEN, 1976).

***Frullania schimperi* Nees** **M [E], WAf, EAf**

PG 19700/1; 1250-1300 m, ct.

East Africa and Madagascar with one disjunct locality in Cameroon (see map 343 in VANDEN BERGHEN, 1976).

***Frullania serrata* Gottsche** **M [Sb, C, E], RM [R], Aft, SAf, As, Oc**

PG 19651/2, 19653/22C, 19738/2,19764/2; **var. *pertenuis* (Nees) Gottsche:** 19680/1; 1200-1500 m, ct, te, li.

Paleotropical montane species widespread from West Africa to Oceania (see map 355 of African distribution in VANDEN BERGHEN, 1976).

***Frullania variegata* Steph.** **M [E], RM [R, M]. Aft, SAf**

PG 19540/1, 19740/1; 850-1350 m, ct, ra.

Very scattered both on the continent and in the Malagasy region (see map 358 in VANDEN BERGHEN, 1976).

JUNGERMANNIACEAE

Anastrophyllum (Spruce) Steph.

***Anastrophyllum piligerum* (Nees) Steph.** **M [E], RM [S, R, M], EAf, As, Oc, Amt**

PG 19653, 19656/2, 19723/1, 19725/2 & 6, 19727/1, 19744/1, 19746/1 p.p., 19758/1, 19774/1, 19883/3, 19989; 1100-1500 m, ct, li.

Pantropical, montane species (VÁŇA, 1982).

Chandonanthus Mitt.

***Chandonanthus hirtellus* (F. Weber) Mitt.**
M, RM [S, C, R, M], Aft (mont), SAf, As, Oc, NAm

PG 19656/1, 19665/1, 19670/2, 19728/2 19802, 19803/2, 19912/1 (leg. Gautier & Messmer), 19914/1 (leg. Gautier & Messmer); 1200-1650 m, ru, ct, li.

Paleotropical, montane species, with a disjunct occurrence in British Columbia (VÁŇA & PIIPPO, 1989).

Denotarisia Grolle

***Denotarisia linguifolia* (De Not.) Grolle** **New to the whole of Africa, As, Oc**

PG 19683, 19771/6, 19774/3, 19801/4; 1250-1550 m, ct, ru.

This Malesian-Oceanian species was known before only from Sri Lanka through the Malesian archipelago to Fiji, northwards to Thailand, and the Philippines, southwards (not occurring in Australia) to New Caledonia (see map in SCHUSTER, 1983). The nodulose

cell wall thickenings with star shaped intercellular channels and the dorsally overlapping leaf shoulders make this very interesting species unmistakable (see Fig. 1 in GROLLE, 1971).

Gottschelia Grolle

***Gottschelia schizopleura* (Spruce) Grolle** **M [Sb, E], RM [R, EAf, As, Oc**

PG 19708/1; 1300-1350 m, ct.

Paleotropical species, distributed from East Africa through Sri Lanka to Norfolk Island (see map in GROLLE, 1968).

Jamesoniella (Spruce) Nees

***Jamesoniella purpurascens* Steph.** **M [E], RM [R, M], EAf, SAf**

PG 19794/1; 1500-1550 m, li.

Distributed in the mountains of East Africa and in the Malagasy Region (GROLLE, 1968).

Notoscyphus Mitt.

***Notoscyphus lutescens* (Lehm. & Lindenb.) Mitt.**
M, RM [C, R, M], CAf, EAf, SAf, As, Oc

[*Notoscyphus belangerianus* (Lehm & Lindenb.) Mitt., fide GROLLE (1995)].

PG 19837/2; 1200 m, ru.

Paleotropical species (see map in UDAR & KUMAR, 1981).

Syzygiella Spruce

***Syzygiella concreta* (Gottsche) Spruce** **M [E], CAf, EAf, Amt**

PG 19724/2; 1350-1400 m, ct.

Disjunct tropical montane Afro-American element (see map in GRADSTEIN & al., 1984).

***Syzygiella geminifolia* (Mitt.) Steph.** **M [E], RM [R], WAf, EAf (mont)**

PG 19776; 1350-1400 m, ct.

Tropical African montane species (see map in GRADSTEIN & al., 1984).

LEJEUNEACEAE Subfam. LEJEUNEOIDEAE

Ceratolejeunea (Spruce) Schiffn.

***Ceratolejeunea belangeriana* (Gottsche) Steph.** **M, RM [C, R, M]**

PG 19539, 19584/4, 19626/1, 19667/3, 19771, 19832, 19850, 19854/2, 19856/2, 19857/1, 19861; 850-1200 m, ct, ph.

This species was considered to be an endemic to the Malagasy Region. The only known character distinguishing it from the *C. calabariensis – jungneri* complex, described from continental Africa, is the length of perichaetial leaves. The bracts and bracteole are described only half the length of the emergent perianth in *C. belangeriana,* while almost equaling the perianth in the continental species, which so becomes near to immersed (STEPHANI, 1913; BONNER, 1953; VANDEN BERGHEN, 1955). Studying many specimens in Madagascar and in the neighboring islands, this character seems to be very weak, as intermediates occur between the two extremes. The occurrence of *C. jungneri* Steph. in the Malagasy

Region has been previously noted (PÓCS, 1995). On the other hand, even in sympatry the difference between *C. calabariensis* Steph. and *C. jungneri*, based only on the length of the perianth horns, is inconsistent. VANDEN BERGHEN (1973) synonymized the two, demonstrating their high variability (l.c., Fig. 6). Although here we follow the catalogue of GROLLE (1995) distinguishing the three taxa, we are convinced that after further studies the whole complex will proved to be one variable species, in which case the name *C. belangeriana* has priority.

***Ceratolejeunea jungneri* Steph.** **M [E], RM [S, C], Aft**

PG 19505/2, 19524 p.p., 19857/2, 19858/11, 19859/2, 19860/2; 700-1200 m, ct, li, ph.

Tropical African species preferring lowland areas.

Cheilolejeunea (Spruce) Schiffn.

***Cheilolejeunea cordigera* (Steph.) Grolle** **M [E], RM [M]**

PG 19853/2, 19857/3, 19858/12, 19860/1, 19863; 1200 m, ph.

Endemic to the Malagasy Region, abundant as epiphyll in the collection area, usually fertile with characteristic, very flat, heart shaped perianth, well described by GROLLE (1977).

***Cheilolejeunea decursiva* (Sande Lac.) R. M. Schust.** **M [E], RM [C, R], Aft, As, Oc**

PG 1944655/3; 850-950 m, ct.

Paleotropical species (GROLLE, 1977, see map in BIZOT & PÓCS, 1982).

***Cheilolejeunea intertexta* (Lindenb.) Steph.** **M [E], RM [R], Aft, As, Oc**

PG 19546, 19563/3; 850-1050 m, ra.

Paleotropical species (see map in PÓCS, 1992).

***Cheilolejeunea krakakammae* (Lindenb.) R. M. Schust.**

PG 19501/3, 19725/2 p.p.; 700-1400 m, ct, li. **M, RM [C, R], CAf, EAf (mont), SAf**

Widespread tropical African montane species.

***Cheilolejeunea montagnei* (Gottsche) Schust.** **M, RM [C, R, M], Aft (mont)**

PG 19565/4, 19651, 19653/23B, 19700/2, 19720/3, 19722, 19771 p.p., 19761/4, 19784/2, 19788, 19801/2, 19857/5, 19900/1, 19914/2, 19917 (leg. Gautier & Messmer), 19919 p.p. (leg. Gautier & Messmer); 1200-1650 m, ct, ru, li.

Widespread tropical African montane species.

***Cheilolejeunea serpentina* (Mitt.) Mizut.** **M, RM [C, S, R, M], Aft, As, Oc**

PG 19423/5, 19625/4; 800-1250 m, ct, ph.

Paleotropical species, scattered from West Africa to the Caroline Islands.

***Cheilolejeunea surrepens* (Mitt.) E. W. Jones** **M, RM [all], Aft**

PG 19423/4, 19579/3, 19740/3, 19830/3, 19856/5; 720-1350 m. **var. *involuta* (Steph.) E. W. Jones:** PG 19909 (leg. Gautier & Messmer); 1550-165 m, ph.

Widespread tropical African species.

***Cheilolejeunea trifaria* (Reinw., Blume & Nees) Steph.** **M, RM [S, R, M], As, Oc, Amt**

PG 199725/2 p.p.; 1350-1400 m, ct.

Pantropical species.

***Cololejeunea* (Spruce) Schiffn.**

***Cololejeunea appressa* (A. Evans) Benedix** **M, RM [C,S, R], Aft, As, Oc, Amt**

PG 19575/3, 19830/2, 19864/3; 720-1200 m, ph, ra.

Pantropical species, rare in Africa.

***Cololejeunea auriculata* (E. W. Jones) R. M. Schust.** **M, RM [S], Aft**

PG 19565/2; 700-900 m, ph.

Tropical African lowland species.

***Cololejeunea distalopapillata* (E. W. Jones) R. M. Schust.** **M [C, E], RM [C], As**

PG 19549/5, 19708/8; 850-1350 m, ct, ph.

Tropical African species.

***Cololejeunea duvignaudii* E. W. Jones**

var. *papillata* Tixier **M, RM [R]**

PG 19565/1, 19858/1, 19873/2; 700-1200 m, ph.

The variety is endemic to the Malagasy Region, while the species is tropical African.

***Cololejeunea elegans* Steph.** **M, RM [C]**

PG 19590; 700 m, ph.

Tropical African species.

***Cololejeunea leloutrei* (E. W. Jones) R. M. Schust.** **M [Sb, C, E], RM [C, S, M**

PG 19624/1, 19830/1, 19851/13; 1200-1250 m, ph.

Tropical African species.

***Cololejeunea marginata* (Lehm. & Lindenb.) Schiffn.** **M, RM [C, S, R, M**

PG 19873/1; 1200 m, ph.

Endemic to the Malagasy Region. It was erroneously included in WIGGINTON & GROLLE (1996) from continental Africa, where all records belong to *C. leloutrei* in the sense of TIXIER, 1985.

***Cololejeunea obliqua* (Nees & Mont.) Schiffn.** **M, RM [S, C, R], As, Amt**

PG 19625/2, 19851/11, 19860/4; 1200-1250 m, ph.

Very widespread and variable Pantropical species.

***Cololejeunea obtusifolia* (E. W. Jones) Tixier** **M, As**

Cololejeunea pusilla Steph. var. *obtusifolia* E. W. Jones

PG 19624/2; 1200-1250 m, ph.

Very widespread tropical African species.

***Cololejeunea peraffinis* Schiffn.**

var. *serrulata* Benedix **New to Africa, As, Oc**

PG 19859/6, 19851/9, 19864/3; 1200 m, ph.

Widespread tropical Asian species with a single sporadic occurrence of var. *elegans* Bened. in West Africa, Guinea (JONES, 1968). Var. *serrulata* is new to the whole of Africa.

***Cololejeunea platyneura* (Spruce) A. Evans** **M, Aft, As, Amt**

Cololejeunea usambarica E.W. Jones

PG 19635, 19852/1, 19858/2; 1200-1250 m, ph, li.

Pantropical species (see map in ZHU & SO, 1998).

***Cololejeunea tanzaniae* Pócs** **M [E], RM [C, R, M], EAf**

PG 19625/1, 19851/1, 19858/6; 1200-1250 m, ph.

East African – Malagasy species (see map in PÓCS, 1980).

***Cololejeunea tonkinensis* Steph.** **M, RM[C], EAf, Aft, As**

Cololejeunea bolombensis (Steph.) Vanden Berghen

PG 19625/3; 1200-1250 m, ph.

Paleotropical species.

***Cololejeunea zenkeri* (Steph.) E. W. Jones** **New to M; RM [S], Aft**

PG 19582/3, 19859/7; 700-1200 m, ph.

Tropical African species.

***Colura* (Dumort.) Dumort.**

***Colura digitalis* (Mitt.) Steph.** **New to M; RM [C, S, R, M], Aft, Amt**

PG 19851/8, 19858/9, 16; 1200 m, ph.

Widespread tropical African species with a disjunct occurrence in Brazil (see map in PÓCS, 1991).

***Diplasiolejeunea* (Spruce) Schiffn.**

***Diplasiolejeunea cavifolia* Steph.** **M, RM [C, R, M], Aft, As, Amt**

Diplasiolejeunea brachyclada A. Evans

PG 19549/4, 19625/1; 850-1250 m, ph.

Pantropical species.

***Diplasiolejeunea cobrensis* Gotsche ex Steph.**

subsp. *antsirananae* Pócs

PG 19549/8; 880 m, ph (HOLOTYPE).

The variety is known only from Manongarivo (see description in PÓCS, 2001). The species is Pantropical.

***Diplasiolejeunea zakiae* Tixier** **M, EAf**

PG 19851/2; 1200 m, ph.

East African – Malagasy species.

Drepanolejeunea (Spruce) Schiffn.

***Drepanolejeunea cultrella* (Mitt.) Steph.** **New to RM; Aft**

PG 1626/2, 19851/4, 19858/7, 199859/5 p.p., 19860/8; 1200-1250 m, ph.

Widespread tropical African epiphyllous species.

***Drepanolejeunea geisslerae* Pócs**

PG 19423/1, 19463, 19559 (HOLOTYPE), 19839/2; 800-1200 m, on liana, palm and other tree bark and on decaying wood.

This recently described species is known only from Manongarivo Massif (PÓCS, 2001).

***Drepanolejeunea madagascariensis* (Steph.) Grolle** **M, RM [S, C, R, M], EAf**

PG 19858/3; 1200 m, ph.

East African – Malagasy species (see map in BIZOT & PÓCS, 1982).

***Drepanolejeunea pocsii* Grolle** **New to M; RM [C], EAf**

PG 19851/7;1200 m, ph.

East African – Malagasy species.

***Drepanolejeunea trematodes* (Nees) Bischl.** **M, RM [S, C, R, M], EAf**

PG 19625/3, 19708/7, 19860/5, 19858/8; 1200-1350 m.

East African – Malagasy species, with an uncertain disjunct occurrence in Mexico (GROLLE, 1976).

***Drepanolejeunea vesiculosa* (Mitt.) Steph.** **M, RM [S, C, R, M], Aft, As, Oc**

Drepanolejeunea friesii Vanden Berghen, *D. physaefolia* (Gottsche) Steph.

PG 19549/3, 19698/2, 19692/2, 19887/3; 850-1300 m, ru, ct, ph.

Widespread Paleotropical montane species.

Haplolejeunea Grolle

***Haplolejeunea sticta* Grolle** **M, RM [R]**

PG 19423/3, 19448, 19452/3, 19452/3, 19463, 19838/1, 19839/1; 800-1200 m, ct, li.

Endemic species to the Malagasy Region. The genus is the only African representative of the former *Tuyamaelloideae* subfamily, with an other species in West Africa and South America (GROLLE, 1975).

Lejeunea Lib.

***Lejeunea alata* Gottsche**

Taxilejeunea mitracalyx Eifrig, *Lejeunea mitracalyx* (Eifrig) Mizut., *Hygrolejeunea alata* (Gottsche) Steph., *Lejeunea renauldii* Steph. (see full synonymy in GROLLE, 1977b).

var. *alata* **M, RM [S, C, R, M], As, Oc**

PG 19399/1; 700-800 m, li.

var. *patriciae* Pócs

PG 19852/2, 19855/1, 19856/1 (HOLOTYPE), 19857/2, 19858/15; 1200 m, ph.

The following specimens are sterile, but based on the size and colour of the plant, probably also belong to the above new variety: PG 19582/1, 19759/22, 19860/7; 1200 m, li, ph.

A highly variable and widespread (although locally rare) Paleotropical species. This variety is known only from Manongarivo (see description in PÓCS, 2001).

***Lejeunea caespitosa* Lindenb.** **New to M; RM [M]Aft, Amt, Oc**

PG 19399/2, 19406/2, 19857/3; 700-1200 m, ct, li.

Widespread tropical Afro-American species with a single known occurrence in Fiji (JONES, 1972; SCHUSTER, 1980).

***Lejeunea confusa* E. W. Jones** **New to M; RM [S, C], Aft**

PG 19854/1; 1200 m, ph.

Tropical African species.

***Lejeunea eckloniana* Lindenb.** **M, RM[R, M, Ro], Aft, SAf**

PG 19582/2, 19851/10; 700-1200 m, ph.

Tropical African species.

***Lejeunea flavovirens* Ångstr.** **M, RM [C, R, M], Aft**

PG 19550, 1972/4, 19784/1, 19921/1 (leg. Gautier & Messmer); 950-1650 m, ct, ra.

Tropical African species.

***Lejeunea tabularis* (Spreng.) Gottsche, Lindenb. & Nees** **M, RM [C], Aft, SAf**

PG 19627/1, 19756; 1200-1500 m, ct, ph.

Tropical African species.

***Lejeunea tuberculosa* Steph.**, Spec. Hepat. 5: 790 (1915) **M, RM [S, R, M], As**

Syn. nov.: *Lejeunea camerunensis* (Steph.) E. W. Jones, J. Bryol. 7: 33 (1972)

Eulejeunea camerunensis Steph., Spec. Hepat. 6: 417 (1923)

PG 19423/2; 800-900 m, ct.

Widespread Tropical African – Himalayan element (see map in PÓCS, 1992). After having seen rich material of the species, we can confirm the preliminary opinions (JONES, 1987; PÓCS, 1992) about the above synonymy.

***Lejeunea villaumei* (Steph.) Grolle** **M, RM [S, R], CAf, EAf, SAf**

Ciliolejeunea capensis S. Arnell, *Lejeunea arnelliana* Schuster

PG 19853/13, 19856/4; 1200 m, ph.

Another member of the "*Lejeunea eckloniana*" complex. Tropical African in distribution.

Leptolejeunea (Spruce) Schiffn.

***Leptolejeunea epiphylla* (Mitt.) Steph.** **M, RM [S, C, M], Aft, As, Oc**

Leptolejeunea quintasii Steph.

PG 19565/3, 19627/2; 700-1250 m, ph.

Widespread Paleotropical species.

Microlejeunea Steph.

***Microlejeunea fissistipula* Steph.** **M**

PG 19395, 19420/2, 19549/7, 19552/3, 19628/2, 19678; 700-1300 m, ct, ra, ph.

Malagasy endemic. This very rare species was previously known only from its type (GROLLE, 1995).

***Microlejeunea inflata* Steph.** **M, RM [C].**

PG 19540/2, 19628/1, 19851/3, 19865; 850-1250 m, ct, ph.

Endemic to the Malagasy Region, definitely different from the previous species, so we cannot confirm the assumption of JONES (1979), that the two are synonymous. See also the pertinent comments of GROLLE (1995).

Prionolejeunea (Spruce) Schiffn.

***Prionolejeunea grata* (Gottsche) Schiffn.** **M, RM [C, R, M], Aft**

PG 19541/2, 19857/7, 19631/119642/2, 19645/2, 19646/3, 19740/2; 850-1350 m, ct, li.

Widespread tropical African species.

Taxilejeunea (Spruce) Schiffn.

***Taxilejeunea conformis* (Nees & Mont.) Steph.** **M, RM [S, C, R, M], Aft, SAf**

PG 19398/21, 19542/1, 19841; 850-1200 m, ct, li.

Tropical African species.

***Taxilejeunea* sp. ster.**

PG 19759/2; 1450-1500 m.

Orbicular leaves with obtuse apex.

LEJEUNEACEAE Subfam. PTYCHANTHOIDEAE

By ANDREA SASS GYARMATI

Acanthocoleus R. M. Schust.

***Acanthocolus madagascariensis* (Steph.) Kruijt** **M, RM [C, R, M], Aft**

Dicranolejeunea madagascariensis Steph.

PG 19840; 1200 m, ct.

Tropical African – Malagasy species.

Acrolejeunea (Spruce) Schiffn.

***Acrolejeunea emergens* (Mitt.) Steph.** **M, RM [all islands], Aft, As (Sri Lanka)**

PG 19677; 1250-1300 m, ct.

Pantropical species (see map in GRADSTEIN, 1975).

Caudalejeunea (Steph.) Schiffn.

***Caudalejeunea* sp. ster.**

PG 19851/14; 1200 m, ph.

Lopholejeunea (Spruce) Schiffn.

***Lopholejeunea borbonica* Steph.** **M, RM [S, C, R, M]**

PG 19582/2, 19624/2; 700-1225 m, ra, ph.

Endemic to the Malagasy Region.

***Lopholejeunea eulopha* (Taylor) Schiffn.** **M, RM [S, C, R], CAf, As, Oc, Amt**

PG 19503, 19524 p.p., 19625/2; 700-1250 m.

Widespread Pantropical species.

***Lopholejeunea leioptera* Gyarmati**

PG 19576/3 (HOLOTYPE); 720 m, ra.

This recently described species is known only from Manongarivo Massif (see description in SASS-GYARMATI, 2001).

***Lopholejeunea grandicrista* Steph.** **M, RM [R]**

PG 19643, 19770/1 p.p., 19847/2; 1200-1350 m, ct.

Endemic to the Malagasy Region (VANDEN BERGHEN, 1984).

***Lopholejeunea subfusca* (Nees) Schiffn.** **M, RM [S, C, R, M], Aft, As, Oc, Amt**

PG 19389, 19394, 19424, 19523, 19536, 19576/21; 700-950 m, ct, ra, rarely li.

Widespread Pantropical species.

Marchesinia Gray

***Marchesinia excavata* (Mitt.) Schiffn.** **New to M; RM, Aft**

PG 19876; 1240 m, ct.

Tropical African species.

Odontolejeunea (Spruce) Schiffn.

***Odontolejeunea lunulata* (F. Weber) Schiffn.** **M, RM [C, M], Aft, Amt**

Odontolejeunea tortuosa (Lehm. & Lindenb.) Steph.

PG 19629/1, 19851/6, 19858/5; 1200-1250 m, ph.

Since TEEUWEN (1989) established that this species was conspecific with the *O. tortuosa,* described from Africa, it is known as a widespread tropical Afro-American species.

Schiffneriolejeunea Verd.

***Schiffneriolejeunea pappeana* (Nees) Gradst.**

var. *pappeana* **M, RM [R], Aft, SAf**

PG 19425, 19436, 19520, 19522, 19649, 19653/22, 19667/6, 19667/12, 19669, 19679, 19701, 19703, 19715, 19722, 19725/2 p.p., 19732, 19757, 19765/1, 19783, 19766/2; 700-1500, ct, rarely li.

Widespread tropical African species.

***Schiffneriolejeunea parviloba* (Steph.) Gradst.** **New to M; RM [R, M]**

PG 19570; 700-900 m, ra.

Endemic to the Malagasy Region.

***Schiffneriolejeunea polycarpa* (Nees) Gradst.** **M, Aft, SAf, Amt**

PG 19488/1, 19544; 700-950 m, ct.

Widespread tropical Afro-American species (see map in GRADSTEIN & al., 1984).

Thysananthus Lindenb.

***Thysananthus spathulistipus* (Reinw., Blume & Nees) Lindenb.**

M, RM [S, R, M), Aft, As, Oc

PG 19437/8, 19391/1, 19420, 19421, 19422, 19424/2, 19425/A, 19429, 19434, 19436 p.p., 19449, 19458/3, 19504, 19535/5, 19536/6, 19537 p.p., 19543, 19555, 19566/2, 19699, 19840/3, 19878, 19884/1, 19888/2; 700-1300 m, ct, li, rarely ru.

Widespread Paleotropical species.

LEPICOLEACEAE

Mastigophora Nees

***Mastigophora diclados* (Brid. ex F. Weber) Nees** **M, RM [S, C, R, S], Aft, As, Oc**

PG 19458, 19467, 19516, 19519, 19599, 19652, 19666/2, 19684/22, 19723/2, 19727/2 p.p., 19805, 19912/3 (leg. Gautier & Messmer), 19915 (leg. Gautier & Messmer), 19918 (leg. Gautier & Messmer), 19919 (leg. Gautier & Messmer) p.p.; 700-1650 m, ru, ct, li.

Widespread Paleotropical species, not too common in continental Africa.

LEPIDOZIACEAE

Arachniopsis Spruce

***Arachniopsis diacantha* (Mont.) M. Howe** **M, RM [S, C, R, M], Aft, Amt**

PG 19414, 19415, 19462, 19637 p.p., 19645/1, 19687/3, 19902 p.p. (leg. Gautier & Messmer); 700-1400 m, ru, te, ct, li.

Tropical Afro-American species (see map in GRADSTEIN & al., 1984).

Bazzania Gray

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

var. *decrescens* **M, RM [C, R, M], Aft, SAf**

PG 19400/1, 19431/2, 19433, 19445/1, 19445/8, 19447/2, 19458/1, 19487/1, 19512/1, 19554/3, 19562/1, 19567, 19633, 19636/2, 19644/2, 19653, 19667/11, 19680/2, 19684/21, 19705/1, 19727/2, 19745/1, 19767/1, 19778, 19796 p.p., 19800/2, 19819, 19825, 19841/2, 19871/3, 19878/1, 19879/1, 19896/2 (leg. Gautier & Messmer), 19920 (leg. Gautier & Messmer); 700-1869 m, ru, te, ct, li.

Widespread tropical African species, more montane on the continent, down to sea level on the islands. Maybe belongs to the Australasian *Bazzania adnexa – involuta* complex (see comments of JONES, 1975; SCOTT, 1985; GROLLE, 1995).

var. *ambahatrae* Pócs

PG 19734/1, 19742 (HOLOTYPE); 1300-1400 m, ct.

The new variety is known only from the Manongarivo Massif (see description in PÓCS, in prep.).

***Bazzania nitida* (F. Weber) Grolle** **M, RM [S, C, R, M], Ste**

Bazzania convexa (Lindenb.) Trevis.

PG 193966/4, 19431/1, 19445/2,6, 19446/1, 19452/1, 19471, 19636/3, 19638 p.p.,19639/1, 19644/1, 19686/21, 19704/1, 19745/2, 19769/2, 19796, 19837, 19871, 19894/2 (leg. Gautier & Messmer), 19896 (leg. Gautier & Messmer); 700-1869 m, ru, te, ct, li.

Southern circum temperate species penetrating deep in the mountains of South America and Africa with uncertain synonymy in Australasia.

Kurzia G. Martens

***Kurzia capillaris* (Sw.) Grolle**

subsp. *capillaris* **M, RM [S], EAf, SAf, Amt, Ste**

PG 19727/3, 19899 (leg. Gautier & Messmer), 19902 (leg. Gautier & Messmer); 1350-1869 m, ct.

Afro-American species penetrating deep in the mountainous areas of tropics (see map in GRADSTEIN & al., 1984).

subsp. *stephanii* (Renauld ex Steph.) Pócs **M, RM [R, M], EAf**

PG 19687/1,1250-1300 m, ru.

Malagasy subspecies with isolated occurrences in East African mountains. PÓCS, after examining numerous specimens of *K. capillaris, K. tabularis*, and *K. stephanii* (including types), has established the synonymy of the first two taxa and has found several transitions towards the third, which has a partially overlapping distribution area. Therefore, *K. stephanii* was distinguished only at the subspecies level from *K. capillaris* (PÓCS, 1984, see map in GRADSTEIN & al., 1984). The related *K. nemoides* (Hook. f. & Taylor) Grolle from St. Helena differs notably by the special shape of its leaf lobes. Therefore the concern of SCHUSTER (2000: 250) about the taxonomy of the African species of these group is not justified, although the African taxa are still in need of identification keys and proper illustrations.

METZGERIACEAE

Metzgeria Raddi

***Metzgeria limbato-setosa* Steph.** **New to RM; EAf, SAf**

PG 19578/2; 720 m, ra.

East African montane species.

PLAGIOCHILACEAE

Plagiochila (Dumort.) Dumort.

***Plagiochila angusta* Lindenb.** **M, RM [R]**

Plagiochila chenagonii Steph.

PG 19430/2, 19471/2, 19485, 19491, 19554/2, 19564/1, 19568, 19570/2, 19578/3, 19588-9, 19607, 19612, 19760, 19815/1, 19820, 19824, 19839, 19841/3, 19849/1, 19886; 700-1500 m, mostly ct, ra, rarely li, ru.

Endemic to the Malagasy Region (VANDEN BERGHEN, 1981).

***Plagiochila barteri* Mitt.** **M, RM [C, R], Aft**

PG 19432, 19439, 19445/1, 19446/3, 19459 (very paraphyllose form), 19460, 19534/2,3, 19535/4, 19554/2, 19655/1, 19691/2, 19913 (leg. Gautier & Messmer); 800-1650 m, ru, ct, li.

Tropical African montane species. On smaller specimens paraphyllia are often present, either in the form of 1-3 celled spines or in the form of dentate cristae on the dorsal side of stem, parallel to its axis.

***Plagiochila fracta* Pócs**

PG 19691/1 (HOLOTYPE); 1250-1300 m, ru.

The new species is known only from Manongarivo Massif (see description in PÓCS, in prep.).

***Plagiochila incerta* Gottsche** **M, RM [R, M]**

PG 19388 p.p., 19426; 700-900 m, ct.

Endemic to the Malagasy Region (VANDEN BERGHEN, 1981).

***Plagiochila kiaeri* Gottsche** **M, Aft, SAf**

PG 19445/7, 19447/1, 19484, 19555 p.p., 19651/21, 19653/2C, 19655/2, 19667/4, 19685/2, 19721, 19730, 19746/1 p.p., 19755/2, 19761/1, 19789/1, 19800/1, 19833, 19844/2; 800-1550 m, ru, te, ct, ra, li.

Widespread tropical African species.

***Plagiochila paucidentata* Mont. & Gottsche** **M, RM [R, M]**

PG 19716; 1350-1450 m, ct.

Endemic to the Malagasy Region (VANDEN BERGHEN, 1981).

***Plagiochila pectinata* (Willd.ex F. Weber) Lindenb.** **M, RM [S, C, R, M], Aft**

PG 19745/3; 1400-1450 m, ct.

Tropical African montane species, more common on the islands than on the mainland.

***Plagiochila pseudo-attenuata* S. Arn.** **M, CAf, EAf, SAf**

Plagiochila subalpina Steph., non *P. subalpina* (Nees ex Lindenb.) Mont. & Nees in Nees

PG 19666/3 p.p.; 1200-1250 m, li.

Tropical African montane–alpine species known from most higher mountains in sub-Saharan Africa, between 1800-4200 m altitude, so the Madagascar locality, as well as others in Indian Ocean islands, is relatively low (JONES, 1962; VANDEN BERGHEN, 1981; WIGGINTON & GROLLE, 1996).

***Plagiochila terebrans* Nees & Mont. ex Lindenb.** **M, RM [C, R, M], Aft, SAf**

PG 19396/2, 19446/2, 19632; 700-1250, ct.

Tropical African montane species.

PLEUROZIACEAE

Pleurozia Dumort.

***Pleurozia gigantea* (F. Weber) Lindb.** **New to M; PM [S, R, M], Aft, Oc**

PG 19801/1, 19803/3, 19804/3, 19805/2; 1500-1550 m, ru.

Widespread Paleotropical montane species from St. Helena to Hawaii (see map in PÓCS, 1976).

RADULACEAE

Radula Dumort.

***Radula appressa* Mitt.** **M, RM [C, R, M], Aft**

PG 19392, 19479, 19848/2; 700-1200 m, ct.

Tropical African species. If it proves to be identical with the Asian *R. javanica* Gottsche, then Paleotropical.

***Radula boryana* (F. Weber) Nees** **M, RM [C, R, M], Aft, Amt**

PG 19574, 19609, 19702, 19749; 700-900 m, ru, ct.

Tropical montane Afro-American species (see map in GRADSTEIN & al., 1984).

***Radula comorensis* Steph.** **New to M; RM [C, R, M], CAf**

PG 19850/2; 1200 m, ct.

Central African – Malagasy species.

***Radula holstiana* Steph.** **M; RM [M, R], Aft, SAf**

PG 19505/3; 700-900 m, ct.

Tropical African species (see map in OCHYRA & PÓCS, 1982).

***Radula* aff. *macroloba* Steph.** **M, RM [R, M]**

Radula lespagnolii Steph.

PG 19586/3; 700 m, ru.

Endemic to the Malagasy Region.

***Radula stenocalyx* Mont.** **M, RM [C, R, M], Aft, SAf, Amt**

PG 19624/2, 19629/2, 19851/5, 19852/3, 19856/3, 19857/4, 19858/4, 19859/3, 19862; 1200-1250 m, ph.

Tropical montane Afro-American epiphyllous species (see map in GRADSTEIN & al., 1984).

SCHISTOCHILACEAE

Gottschea Nees ex Mont.

***Gottschea neesii* Mont.** **M, RM [C, R], As**

Paraschistochila neesii (Mont.) Lindb.

PG 19761/3; 1450-1500 m, ct.

Asian species reaching Africa only in the Indian Ocean islands.

Schistochila Dumort.

***Schistochila piligera* Steph.** **M [E]**

PG 19897 (leg. Gautier & Messmer); 1869 m, ct.

This is the third locality of this rare and interesting Madagascar endemic, representative of the subgenus *Austroschistochila* (SCHUSTER & ENGEL, 1977).

The other representative of this subgenus in Africa is *S. alata* (Lehm.) Schiffn., in Engl. & Prantl, Nat. Pflanzenfam. 1 (3): 111. 1893. This Afro-American species was first communicated under this name from Madagascar (Marojejy Massif) by PÓCS (1995). In the meantime the same author studied the holotype of *S. pauciserrata* Kiaer & Pearson, Christiana Vidensk. Selsk. Förh. 14: 9 (1892) from Leiden Herbarium: "coll. Borgen, ex Hb. Kiaer #102 in Hb. L 9802/1", and found it synonymous with the above species. The latter species was described from the Ankaratra Massif. Accordingly, at present two localities are known of *S. alata* from Madagascar and at least three other in South Africa from the Cape region (ARNELL, 1963; JONES, 1976; see map in GRADSTEIN & al., 1984).

TARGIONIACEAE

Cyathodium Kunze ex Lehm.

***Cyathodium africanum* Mitt.** **New to M; RM [Com], Aft**

PG 19890; 150-200 m, te.

Tropical African lownand species, probably identical with the Pantropical *C. cavernarum* Kunze (JONES, 1952; JOVET-AST, 1970; GROLLE, 1995).

BRYOPHYTA / MUSCI

BRYACEAE

Brachymenium Schwägr.

***Brachymenium nepalense* Hook.** **M, RM [M], Aft, SAf, As, Au**

PG 19906 & 19907 (leg. S. Goodman); 1550-1600 m, ct.

Widespread Paleotropical species.

Bryum Hedw.

***Bryum argenteum* Hedw.** **M, RM [C, R, M], all continents**

PG 19489/1; culture abandonnée, 700-800 m, tronc couché.

Very widespread cosmopolitan in open and dry habitats.

***Bryum caespiticium* Hedw.** **New to RM; Aft, all continents**

PG 19501/1; 700-900 m, li.

Cosmopolitan species.

***Bryum coronatum* Schwägr.** **M, RM [R, M], Au, all tropical continents**

PG 19489/5; culture abandonnée, 700-800 m, tronc couché.

Pantropical species (OCHI, 1985).

***Bryum huillense* Welw. & Duby** **M, RM [C, M], Aft, As, Amt**

PG 19466, 19489, 19494 (?), 19741; 700-1400 m, ct, te, li.

Pantropical species (OCHI, 1974, 1985).

***Bryum neelgheriense* Mont.**

var. *wichurae* (Broth.) Mohamed **New to Africa, As**

PG 19846; 800-900 m, ct.

Asian species widespread in tropical and eastern portions of the continent (HAJI MOHAMED, 1979), hitherto not known from Africa. Madagascar thus becomes its westernmost known limit.

Rhodobryum (Schimp.) Limpr.

***Rhodobryum commersonii* (Schwägr.) Brid.** **M, RM [C, R, M], EAf, SAf, As**

PG 19767; 1450-1500 m, te.

Paleotropical species known from East Africa to India (OCHI, 1985).

CALYMPERACEAE

By SÁNDOR ORBÁN

Calymperes Sw. ex F. Weber

***Calymperes afzelii* Sw.** **M, RM [C], Aft + all tropical continents**

PG 19498; 700-900 m, li.

Widespread Pantropical species (see map in REESE, 1987).

Leucophanes Brid.

***Leucophanes renauldii* Cardot** **M, RM[C, M]**

PG 19400, 19404, 19445/2, 19474, 19477, 19808/2, 19871/1; 700-1200 m, ct, ru, te.

Endemic to the Malagasy Region (see map in SALAZAR ALLEN, 1993).

Octoblepharum Hedw.

***Octoblepharum albidum* Hedw.** **M, RM [all islands], all tropical continents**

PG 19412, 19444, 19445/2, 19497, 19558; 700-950 m, ct, ru, li.

Very widespread Pantropical lowland species.

Syrrhopodon Schwaegr.

***Syrrhopodon africanus* (Mitt.) Par.**

subsp. *mandrakensis* (Tixier) W. D. Reese **M [E], CAf**

PG 19576/22, 19857/2, 19859/4, /6, 19864/4; 720-1200 m, ra, ph.

Central African – Madagascar subspecies of a widespread tropical African species.

***Syrrhopodon cuneifolius* Thér.** **M [E]**

PG 19596/1, 19670/2, 19688, 19708; 950-1350 m, ct, ru, li.

Malagasy endemic (see map in ORBÁN, 1985).

***Syrrhopodon gardneri* (Hook.) Schwägr.** **M, RM [C, R], Aft, all tropical continents**

PG 19472, 19665/2, /3, 19666/1, 19686/22; 700-1400 m, ru, ct, li.

Pantropical species (see African distribution map in ORBÁN, 1985).

***Syrrhopodon prolifer* Schwägr.**

var. *hispidocostatus* (Renauld & Cardot) Orbán & W. D. Reese **M, RM [S, R, M]**

PG 19535/3, 19835/2, 19847; 850-1200 m, ru, ct.

Malagasy Region endemic to a Pantropical species (see map in ORBÁN & REESE, 1990).

var. *seychellarum* Orbán **New to M; RM [S]**

PG 19464; 850-950 m, ct.

Malagasy Region endemic of a Pantropical species.

DICRANACEAE

Campylopus Brid.

***Campylopus robillardei* Besch.** **M, RM [S, R, M], EAf, SAf**

PG 19665/2; 1200-1250 m, li.

Southeast African – Malagasy species (see map in FRAHM, 1985).

Dicranum Hedw.

***Dicranum johnstonii* Mitt.** **New to RM; CAf, EAf**

PG 19904 (leg. Gautier & Messmer); 1869 m, ct.

Previously known only from the higher mountains of Central and East Africa (KIS, 1985).

FUNARIACEAE

Funaria Hedw.

***Funaria hygrometrica* Hedw.** **M, RM [R, M], all continents**

PG 19489/4; 700-800 m, culture abandonnée, sur un tronc couché.

Cosmopolitan, widespread in disturbed, burnt ground, including the tropics (especially its var. *calvescens* (Schwaegr.) Mont.

LEUCOBRYACEAE

Leucobryum Hampe

***Leucobryum comorense* Müll. Hal.** **M, RM [C, M]**

PG 19457; 850-950 m, li.

Endemic to the Malagasy Region (RENAULD & CARDOT, 1915; O'SHEA, 1998).

***Leucobryum parvulum* Cardot** **M**

PG 19557, 19647; 850-1250 m, ct, ru.

Seems to be a Malagasy endemic, but maybe only a poorly defined form of *L. mayottense* Cardot.

***Leucobryum perrotii* Renauld. & Cardot** **M, RM [M], EAf**

PG 19456, 19561, 19664, 19684-6, 19751/2, 19774/2, 19842/3, 19850; 850-1400 m, ct, li, ru, te.

East African – Malagasy species (RENAULD & CARDOT, 1915; BIZOT & PÓCS, 1979; KIS, 1985).

***Leucobryum sanctae-mariae* Cardot** **M [E]**

PG 19445/4; 800-900 m, ct.

Seems to be a Malagasy endemic, but maybe only a poorly defined form of *L. comorense* Müll. Hal. Since the classical works of CARDOT (1900-1902, 1904) and RENAULD & CARDOT (1915) there has been no comprehensive treatment of African *Leucobryum,* and the African representatives of the genus are in need of a modern revision.

Ochrobryum Mitt.

***Ochrobryum sakalavum* Cardot & Paris** **M [W]**

PG 19444, 19473/2, 19513, 19518, 19596/2, 19638 p.p., 19663/3, 19750, 19751/1, 19813, 19836/2, 19844/3, 19883, 19913 (leg. Gautier & Messmer); 700-1650 m, ct, li, ru, te.

The rediscovery of this isolated Madagascar endemic species has great significance, as it was previously known only from the type locality near Maintirano in central west Madagascar. The species seems to be widespread in the Réserve Spéciale de Manongarivo at a wide range of altitudes and on different substrates. Three of the specimens were fertile. The characters well match the descriptions and illustrations of CARDOT (1904), RENAULD & CARDOT (1915), and ALLEN (1992). In the generic revision of the latter author it was pointed out that *O. sakalavum* has an intermediate position between the two different groups of the other four *Ochrobryum* species. The richly developed calyptras show even greater variability in length than the protologue, showing a range of 2.5-3.5 mm.

LEUCOMIACEAE

By GABRIELLA KIS

Leucomium Mitt.

***Leucomium strumosum* (Hornsch.) Mitt.** **M, Aft, As, Amt**

PG 19810/2; 700-1200 m, 19489/3, 19636/1, 19636/4 (intermixed in *Callicostella papillata*); 1200-1250 m, li.

Pantropical species.

PILOTRICHACEAE

By GABRIELLA KIS

Callicostella (Müll. Hal.) Mitt.

***Callicostella papillata* (Mont.) Mitt.** **M, RM [C, Mas], As**

PG 19399/3, 19564/2, 19586/1, 19602, 19636/4, 19642/1, 19470; 700-1250 m, ct, ru, li.

Paleotropical species. A revision of the African *Callicostella* by G. KIS is currently being undertaken. From sub-Saharan Africa 27 species are recognized (O'SHEA, 1999), of which as MAGILL (1998) has also pointed out, many are closely related and vaguely delimited. Although DEMARET (1952) attempted to revise this group and synonymized part of the previously known taxa, however, many problems remained unresolved. The rich material collected since shows many transitions between the recognized species and suggests that in reality the number of taxa is considerably lower. The Paleotropic *C. papillata* was already studied in detail by TAN & ROBINSON (1990) and by LIN & TAN (1995) and proved to be highly variable, particularly with regards to the shape of leaf apex, the dentition of leaf margins, the position of the papillae of lamina cells and the abaxial teeth, and spines on the costa. This variability can be observed even within a single specimen. The study of type material recently carried out on African *Callicostella* confirms that *C. usambarica* (Broth.) Broth. and some related species are conspecific with *C. papillata*, but further investigations are needed to establish correct synonymies.

***Callicostella seychellensis* (Besch.) Renauld** **M, RM [S, M], WAf, CAf**

PG 19398/22, 19409; 700-800 m, ru, li, te.

Tropical African lowland species.

***Callicostella tristis* (Müll. Hal.) Broth.** **New to M; WAf, SAf**

PG 19481/2; 700-800 m, li.

Tropical African lowland species.

Cyclodictyon Mitt.

***Cyclodictyon vallis-gratiae* (Hampe) Broth.** **M, RM [S, C, R, M], Aft (mont), SAf**

PG 19489/2, 19533, 19806, 19808; 700-1200 m, ct, ru, li.

Tropical African montane species.

POLYTRICHACEAE

Pogonatum P. Beauv.

***Pogonatum belangeri* (Müll. Hal) A. Jaeger** **M, RM [R, M], Aft**

PG19711/2; 1300-1350 m, ru.

Tropical African – Malagasy species (see map in HYVÖNEN, 1989).

***Pogonatum capense* (Hampe) A. Jaeger** **M, SAf**

PG 19708/6; 1300-1350 m, ct.

South African – Malagasy species (see map in HYVÖNEN, 1989).

***Pogonatum convolutum* (Hedw.) P. Beauv.** **M, RM [R, M]**

PG 19711/1; 1300-1350 m, ru.

Endemic to the mountains of Malagasy Region (see map in HYVÖNEN, 1989).

SPLACHNACEAE

Tayloria Hook.

***Tayloria orthodonta* (P. Beauv.) Wijk & Marg.** **M, RM [R], Aft**

PG 19911; 1550-1650 m, ct.

Tropical African montane species (see map in KOPONEN & WEBER, 1972).

***Tayloria solitaria* (Cardot) T. J. Kop. & W. A. Weber** **M, Aft**

PG 19795/1, 19880;1240-1550 m, ct, li.

Tropical African montane species.

THUIDIACEAE

Thuidium Bruch & Schimp.

***Thuidium intricatum* A. Jaeger** **New to RM; WAf, CAf**

PG 19663; 1200-1250 m, li.

Tropical African species previously known only from West and Central Africa (see map in TOUW, 1976).

***Thuidium tenuissimum* Welw. & Duby** **New to RM; WAf**

PG 19531; 700-900 m, ru.

West African species, maybe identical with the Malagasy *T. byssoideum* Besch. (see map in TOUW, 1976).

TRACHYPODIACEAE

Trachypodopsis M. Fleisch.

***Trachypodopsis serrulata* (P. Beauv.) M. Fleisch.**
var. *serrulata* **M, RM [C, R], Aft, SAf, As**

19763/1, 19790, 19866; 1200-1550 m, ct, ra.

Paleotropical montane species (see map in ZANTEN, 1959).

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Phytogeographical evaluation

An analysis on the known distribution of the taxa enumerated above gives a comprehensive picture on the bryochorological affinities of the Réserve Spéciale de Manongarivo. Some conclusions can be drawn even about the evolution of its flora. The proportion of the different geo-elements of the area is shown in Table 3-1 and Figure 3-1

Endemic species

Under this term we include the Madagascar endemics in strict sense (11 taxa, 6.6% of the known Manongarivo bryoflora). These forms include:

Bazzania decrescens var. *ambahatrae*
Diplasiolejeunea cobrensis var. *antsirananae*
Drepanolejeunea geisslerae
Microlejeunea fissistipula
Lopholejeunea leioptera
Plagiochila fracta
Schistochila piligera
Leucobryum parvulum
Leucobryum sanctae-mariae
Ochrobryum sakalavum
Syrrhopodon cuneifolius

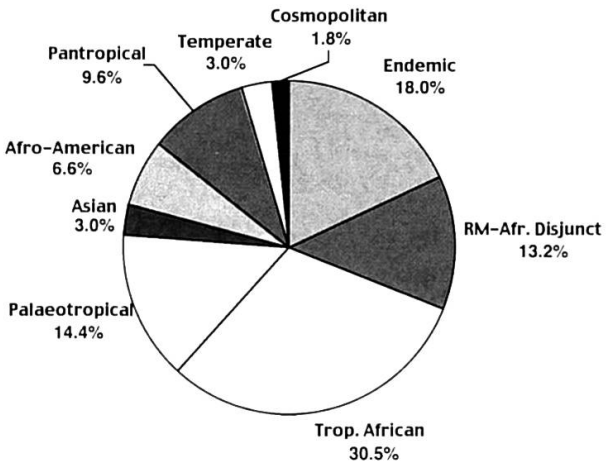

Fig. 3-1. – Chorological spectrum of the identified Manongarivo bryophytes. — *Spectre chorologique des bryophytes identifiés de Manongarivo.*

Table 3-1. – Distribution pattern of the identified bryophyte taxa of the Réserve Spéciale de Manongarivo. — *Types de distribution des taxons identifiés de bryophytes de la Réserve Spéciale de Manongarivo.*

Distribution type	*Distribution, as abbreviated in the list*	*Species number*	*%*	*Sub-total %*
Endemic to Madagascar	M	11	6.6	**18.0**
Endemic to Malagasy Region (sub-endemic)	RM	19	11.4	
Malagasy Region + West African disjunct	RM, WAf	3	1.8	**13.2**
Malagasy Region + East African disjunct	RM, EAf	14	8.4	
Malagasy Region + Central African disjunct	RM, CAf	3	1.8	
Malagasy Region + South African disjunct	RM, SAf	2	1.2	
Tropical African (mostly lowland)	Aft, M, RM, (SAf)	33	19.8	**30.5**
Tropical African (montane)	Aft, M, RM, (SAf)	18	10.7	
Paleotropical (African-Asian-Oc. disjunct)	Aft, M, RM, As, Oc	24	14.4	**24.0**
Asian (reaching Africa only in Malagasy Region)	M, RM, As, (Oc)	5	3.0	
Tropical Afro-American disjunct	M, RM, Aft, Amt	11	6.6	
Pantropical species		16	9.6	**9.6**
Boreal temperate species		1	0.6	**3.0**
Southern temperate species		4	2.4	
Cosmopolitan species		3	1.8	**1.8**
TOTAL		**167**	**100.0**	**100.0**

The sub-endemic species of the Malagasy Region are, which occur also on one or more other western Indian Ocean islands (Seychelles, Comoros, Réunion, Mauritius, and Rodriguez):

Ceratolejeunea belangeriana
Cheilolejeunea cordigera
Cololejeunea duvignaudii var. *papillata*
Cololejeunea elegans
Cololejeunea marginata
Haplolejeunea sticta
Herbertus grossevittatus
Lopholejeunea borbonica
Lopholejeunea grandicrista
Microlejeunea inflata
Plagiochila angusta
Plagiochila incerta
Plagiochila paucidentata
Schiffneriolejeunea parviloba
Leucobryum comorense
Leucophanes renauldii
Pogonatum convolutum
Syrrhopodon prolifer var. *hispidocostatus*
Syrrhopodon prolifer var. *seychellarum*

The first obvious fact is the relatively high rate of endemism among the bryophytes, in spite that they, similarly to other cryptogams, can be dispersed relatively easily by air (ZANTEN, 1976; ZANTEN & PÓCS, 1981). The rate of endemic and sub-endemic species on the Manongarivo Massif (6.6+11.4%, the two together 18.0%) is rather elevated as compared to other well-known areas. Higher and quite isolated mountains, like Mt. Kilimanjaro (2.3 + 5.3 %) and Uluguru Mts. (1.4 + 2.2%, PÓCS, 1999), or large islands, such as Cuba (12 + 13%, PÓCS, 1988),

or the Galápagos Islands (11 %, GRADSTEIN & WEBER, 1982), have similar or lower rates. This high rate of endemism obviously can be explained by the old age, large surface area, and by the considerable habitat diversity of Madagascar and of the Manongarivo Massif itself.

Malagasy – Tropical African disjuncts

Here we discuss four subgroups of different geographical elements, which are distributed in the Malagasy Region and in some regions of the continent, in Western, Central, Eastern or Southern Africa. This disjunction can be explained by several factors including plate dissection, by extinction or by long range dispersal. Probably the extinction caused by drastic climatic changes in the past explains part of the West African–Central African disjunctions. The Malagasy–East African and Malagasy–South African disjunctions can be explained better by the continental drift. By far the largest group among these different comparisons are the Malagasy–East African elements (14, 8.4%), perhaps indicating the zone where the Madagascar Plate was attached to the African continent. On the continental side the overwhelming portion of these elements (called Lemurian species) occur in the Precambrian crystalline Eastern Arc Mountains, from the southern Kenyan Taita Hills to the southeastern Tanzanian Udzungwe and Mufindi ranges. The significance of these "Lemurian" species in the flora evolution of the continent is discussed in detail by PÓCS (1975, 1999, 2000).

Tropical African species

This group forms the bulk (30.5%) of the bryoflora of the Réserve Spéciale de Manongarivo. We subdivided it into two subgroups, one with species occurring in the lowlands and a range of higher elevational zones (33, 19.8%) and the other with species restricted to the higher mountainous zones (18, 10.7%). The taxa of the first group are more or less continuously distributed all over tropical Africa including the Indian Ocean islands, while those of the second group are scattered over the mountains of the "Afromontane Region" and the islands. Their high proportion clearly shows that Madagascar, with Manongarivo, belongs to the African flora kingdom.

Bicontinental disjuncts

Among the three subgroups of bicontinental disjuncts the Paleotropical Afro-Asian-(Oceanian) element is the strongest in the area. Together with the Asian subgroup they account for 29 taxa or 17.4% of the flora. They are less frequent in East Africa (12%, PÓCS, 1988) and in the whole of the tropical African bryoflora their proportion is only 8.1% (PÓCS, 1992; TAN & PÓCS, 2000). Generally, the members of the Asian subgroup do not reach the African continent, but only the islands of the Malagasy Region. There are 5 such taxa (3%) in the Réserve Spéciale de Manongarivo (*Cololejeunea peraffinis* var. *serrulata, Denotarisia linguifolia, Gottschea neesii, Iwatsukia jishibae,* and *Bryum neelgheriense* var. *wichurae. I. jishibae* has been recorded once on the continent in the Mulanje Mts. of Malawi (WIGGINTON & GROLLE, 1996). In the whole Malagasy Region we know altogether 49 such species of which 13 reach only the Seychelles (PÓCS, 1992). The Afro-American subgroup counts 11 taxa (6.6%), all hepatics on the Manongarivo Massif. Their distribution is discussed in details by GRADSTEIN & al. (1984).

Temperate species

Mostly widely distributed southern temperate species, such as *Adelanthus decipiens*, which also occur in the higher elevational zones on tropical mountains. *Lophocolea muricata* is at the same time a near Pantropical element.

Cosmopolitan species

This group includes the most widespread and least interesting species. We wish to mention, that three of them (*Bryum argenteum, B. caespiticium*, and *Funaria hygrometrica*) occur only in disturbed habitat, such as regenerating sites of slash-and-burn agriculture.

Conclusions

The bryoflora of the Réserve Spéciale de Manongarivo with its 176 identified and approximately 100 unidentified taxa is relatively rich and highly diversified, compared to other mountainous areas of the same size. For example, the bryophyte flora of the much better known and well-explored Usambara Mountains of Tanzania, 464 species are known (PÓCS, 1999). The figure from the Manongarivo Massif indicates that the area is still only partly explored and many novelties can be expected from further collection work. The composition of the bryoflora reflects the geological history of the area. The geologically old separation of Madagascar has resulted in a relatively high number of endemics. Further, its former and present positions has allowed the island to be colonized by a much greater number of Asian species than continental Africa. The affinity of the Malagasy bryoflora relative to the other islands of the Malagasy Region is intriguing. The closest link seems to be to the Comoro Islands, while the Seychelles and Mascarenes, at least on the basis of exisiting data, seem to be more closely related to each other than to Madagascar (PÓCS, 1997).

If we compare the chorological spectrum of Manongarivo bryophytes with other selected groups, such as the pteridophytes of the same massif (RAKOTONDRAINIBE, chap. 5), we can see meaningful differences. The proportion of endemics among pteridophytes is much higher (35% for Madagascar and 13% in addition for the Malagasy Region sub-endemics). The same comparison for Cuba (TRYON, 1979; PÓCS, 1988) shows a similar pattern. Thus, although both groups are dispersed by spores, there must be a difference in various parameters of their diffusion to explain these observations. This might be explained by the fact that pteridophytes have larger spores, less suitable for long range air dispersal (ZANTEN & PÓCS, 1981), or the versatile dispersal ability of bryophytes by vegetative propagules, or the faster speed of evolution of the, in general, less conservative pteridophytes, or a combination of these factors.

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