View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Hochschulschriftenserver - Universität Frankfurt am Main

Tropical Bryology 2: 149-160, 1990

Bryophyte flora of Western Melanesia

Timo Koponen
Department of Botany, University of Helsinki, Unioninkatu 44, SF-00170, Helsinki, Finland

Abstract. A project dealing with the hepatic and moss floras of New Guinea and the Solomon Islands has proceeded more than halfway. The revision of the flora is based on the study of ca 17000 specimens collected in 1981. Two new genera and ca 50 new species have been described in 33 published papers and seven manuscripts. Many families, genera and species not previously recorded for the area have been added to the flora. More than 300 names have been reduced to synonyms. The percentage of endemic species of liverworts (40 %) is higher than that of mosses (18 %). Most of the endemic species occur at elevations above 1700 m. The geological history of New Guinea suggests that these high altitude endemics may be relatively young, i.e. less than 10 million years old. The moss flora is more closely related to the floras of Indonesia and the Philippines and continental Asia than to that of Australia. This can be explained by plate tectonics. The altitudinal distribution of hepatic and moss floras partly coincides with the zonation of vegetation proposed earlier. Human influence on bryophyte floras is devastating but a part of the flora may survive in gardens and plantations.

Introduction

In 1981 D. H. Norris of Humboldt State University, Arcata and I made several field trips in New Guinea in order to collect bryophytes (Koponen & Norris 1983a). The original idea was to publish a list of our collections but the target gradually changed to the preparation of a complete flora of Western Melanesia (West Irian, Papua New Guinea and the Solomon Islands). Up to now 30 papers with a total of 780 pages have been published in the series entitled “Bryophyte flora of the Huon Peninsula, Papua New Guinea” and 7 manuscripts (241 printed pages) have been accepted for publication (Appendix 1).

Material and methods

Our base in Papua New Guinea was the herbarium of the Forest Division in Lae. The specimens were collected during many separate excursions, each lasting 1 to 2 weeks (Koponen & Norris 1983a, fig. 4). The field work was organized so that we covered different areas during each excursion. Most of the time we were collecting things unknown to us, so we tried to collect all different-looking plants in any one locality. When the type of vegetation changed, or when we reached another vegetation zone, we began collecting anew and once again tried to cover all of the flora. By this means we hoped to discover the frequency of the taxa and their altitudinal ranges. Most of our collections came from high elevations, higher than 1700 m altitude. The project

Table 1. Moss families treated up till now in the Huon Peninsula series. Numbers of species according to the checklist (Koponen et al. 1984) and after revision (1989).

family	1984	1989	new species
Andreaeaceae	2	1	
Fissidentaceae	23	25	
Archidiaceae	1	1	
Ditrichaceae	6	6	
Seligeriaceae	1	1	
Dicranaceae	77	55	5
Dicnemonaceae	5	2	
Leucobryaceae	47	23	
Calymperaceae	80	54	
Pottiaceae	36	37	
Grimmiaceae	5	4	
Bryaceae	39	35	4
Leptostomataceae	4	2	
Mniaceae	5	6	1
Phyllodrepaniaceae	1	1	
Sorapillaceae	1	1	
Mitteniaceae	1	1	
Rhizogoniaceae	17	9	
Racopilaceae	9	7	
Hedwigiaceae	2	2	
Trachypodaceae	5	4	
Pterobryaceae	29	32	
Meteoriaceae	21	16	
Phyllogoniaceae	2	3	
Neckeraceae	28	19	1
Fabroniaceae	4	2	
Leskeaceae	1	2	
Thuidiaceae	15	14	1
Rhytidiaceae	-	1	
Hylocomiaceae	2	2	1
Buxbaumiaceae	1	3	
Diphysciaceae	2	2	
Polytrichaceae	19	21	
Dawsoniaceae	6	-	
Total	497	392	14

benefited greatly when Mr Heinar Streimann (Canberra) sent us his large collections from Papua New Guinea. These specimens are mostly from lower elevations than our material and have proved an essential addition. Some other smaller recent collections have also been used.

The first phase in writing the flora was the preparation of checklists based on the literature. The checklist of hepatics (Grolle & Piippo 1984) also gives many new records for the area. The checklist of mosses has not been published yet. These lists are used as the basis for distribution records in Western Melanesia and also as the starting point for generic and family revisions. We have tried to check the identity of all names recorded from West Irian, Papua New Guinea or the Solomon Islands. In many cases the type specimens have been studied. Voucher specimens of floristic records have been studied when we did not find the taxon in question. The nomenclature has been checked from the original literature.

The hepatic flora has been studied mainly by Dr. Sinikka Piippo and the moss flora by D. H. Norris and myself. We have been fortunate in obtaining the collaboration of many colleagues. The plan has been to send our material and the checklist to specialists on the various families. Their role has been to identify the specimens and to write the descriptions and keys. Our part has been the general planning of the flora and the preparation of the lists of specimens, altitudinal distribution maps and other pertinent information.

A separate series of floristic papers has been published under the name "Bryophytes from Frieda River, East and West Sepik Provinces, Papua New Guinea" (Norris & Koponen 1985, Piippo 1986, Norris et al. 1988). Thirteen new species have been described in these papers.

Results

Taxonomy and floristics of Musci

The papers published so far are listed in Appendix 1 and an index given to the genera treated. In each paper there are keys to the genera and species and specific descriptions. Ecological details based on the labels of our collections are given, as well as distribution in Western Melanesia and world distribution. Family and generic descriptions are not provided but, in most cases, there is a discussion or review of generic and family concepts based on Brotherus' (1924, 1925) work.

Schultze-Motel's (1963) checklist of New Guinea mosses contains 826 specific names. Our checklist including the Solomon Islands, has 1026 names. One new genus, *Orthothuidium* Norris & T. Kop., and 14 new species have been described in the series (see the Appendix). Many records of species, genera and families new to the area have been added. However, many more names (ca 300 - this number includes synonyms in the Hepaticae), have been reduced to synonymy. The numbers of species in the families studied so far are given in Table 1. However, there are some 23 families still not studied or currently under revision. These include some large families such as the Orthotrichaceae (68 species), Hookeriaceae (89), Brachytheciaceae (19), Sematophyllaceae (146) and Hypnaceae (96). Accordingly, we do not yet know the total number of mosses in the flora of Western Melanesia. If the rate of new discoveries and synonymisation continues at the same pace the final number may be ca 830 moss species. The families and genera currently undergoing revision are the Amblystegiaceae (by R. Ochyra), Bartramiaceae, Meesiaceae and Spiridentaceae (by T. Koponen), *Ectropothecium* and related genera (by N.

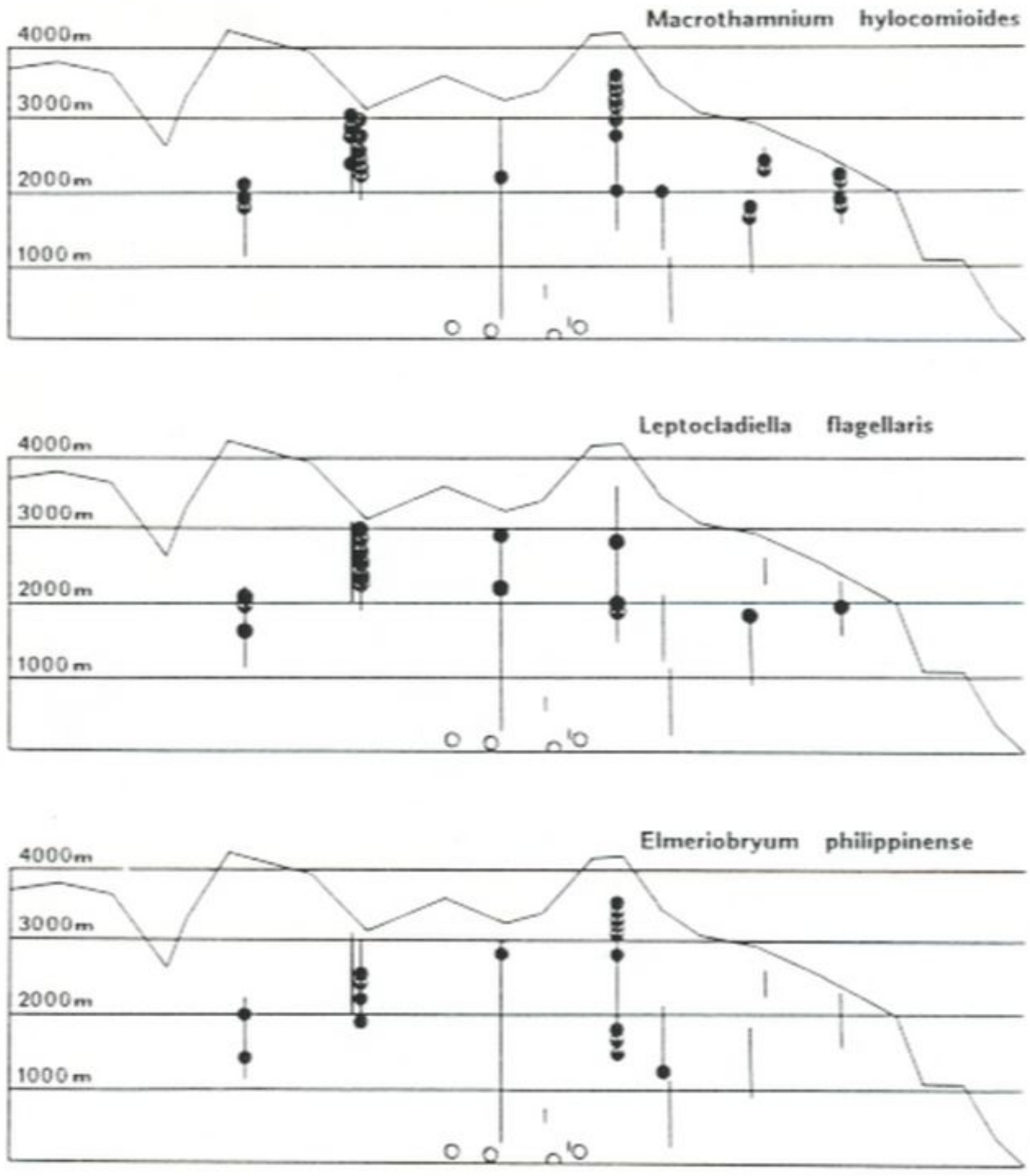
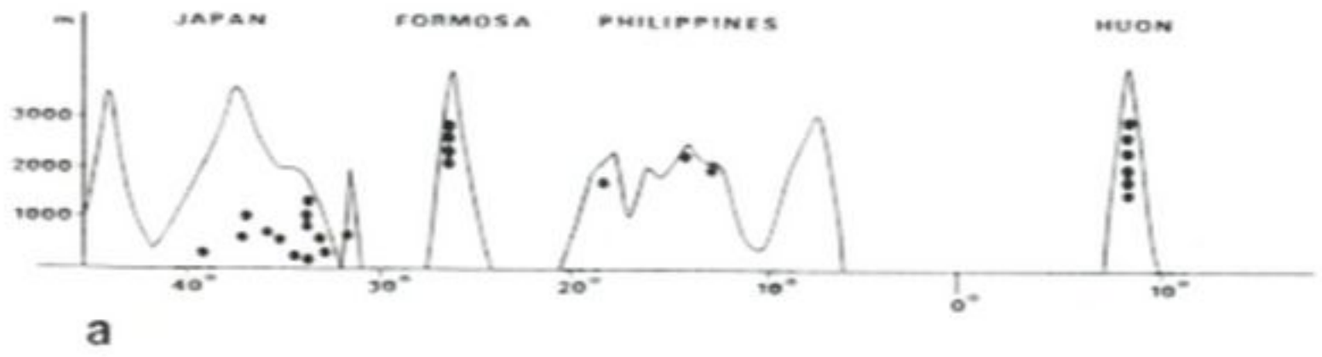


Fig. 1. The altitudinal distribution of *Macrothamnium hylocomioides* Fleisch., *Leptocladiella flagellaris* T. Kop. & Norris and *Elmeriobryum philippinense* Broth. on the Huon Peninsula (dots). From Koponen and Norris (1985).

Table 2. Hepatic families treated up till now in the Huon Peninsula series. Numbers of species according to the checklist (Grolle & Piippo 1984) and after revision (1989).

family	1984	1989	new species
Haplomitriaceae	1	1	
Lepicoleaeceae	3	3	1
Herbertaceae	8	5	
Pseudolepicoleaceae	3	3	
Trichocoleaceae	5	2	
Lepidoziaceae (p.p.)	43	43	1
Calypogeiaceae	3	3	
Adelanthaceae	1	1	
Cephaloziaceae	5	8	
Cephaloziellaceae	2	2	
Jackiellaceae	1	1	
Antheliaceae	1	1	
Jungermanniaceae	14	21	
Lophoziaceae	29	31	
Gymnomitriaceae	5	5	
Scapaniaceae	2	2	
Geocalycaceae	27	26	4
Plagiochilaceae	70	55	3
Arnelliaceae	1	1	
Acrobolbaceae	3	3	
Schistochilaceae	18	18	
Balantiopsaceae	2	2	
Pleuroziaceae	2	2	
Radulaceae	33	42	7
Porellaceae	4	4	
Frullaniaceae	77	84	4
Jubulaceae	2	2	
Treubiaceae	2	2	
Codoniaceae	-	2	
Allisoniaceae	1	1	
Makinoaceae	1	1	
Pallaviciniaceae	7	9	2
Metzgeriaceae	16	14	1
Targioniaceae	1	1	
Wiesnerellaceae	2	2	
Aytoniaceae	2	2	
Ricciaceae	1	1	
Total	398	406	23



a

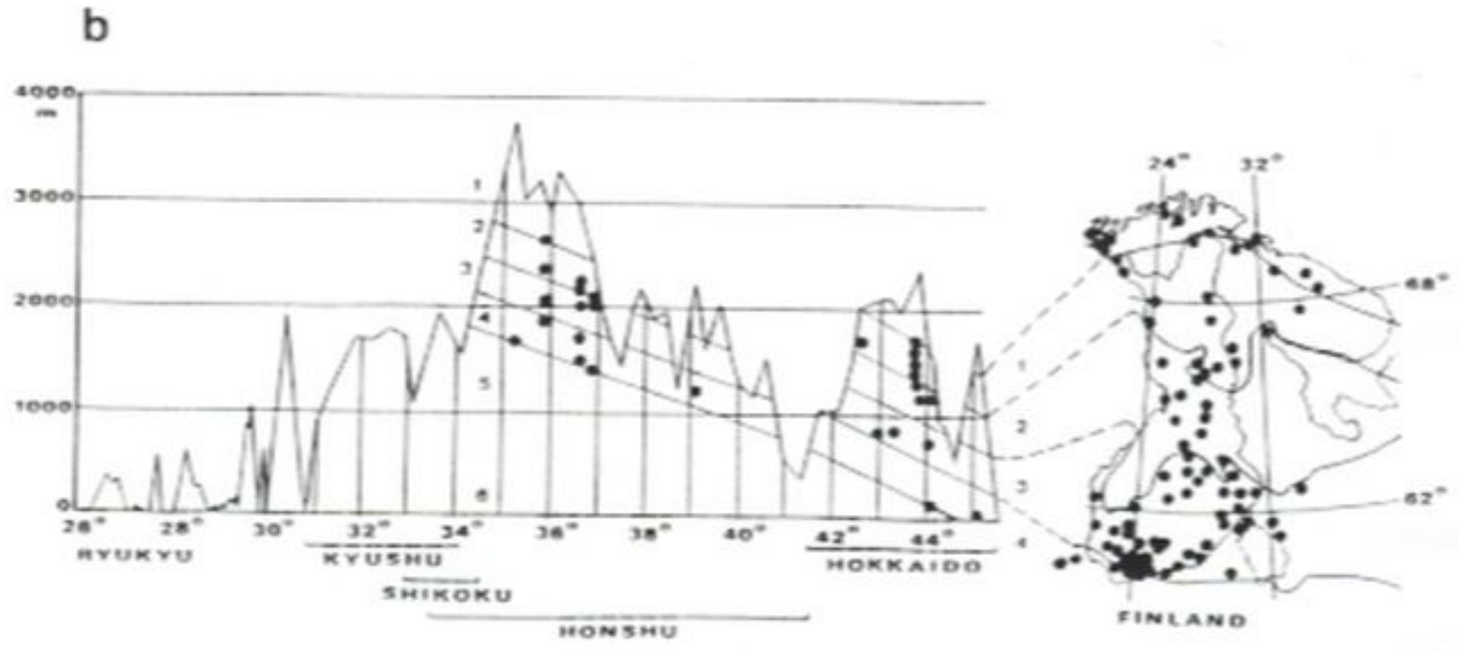


Fig. 2. a. Vertical distribution of *Rhodobryum giganteum* (Schwaegr.) Par. in Japan, Formosa, the Philippines and the Huon Peninsula, Papua New Guinea based on the present material and on specimens in the Botanical Museum, University of Helsinki (H). In Japan it is restricted to temperate and meridional zones which suggests that in New Guinea the lower limit of the meridional zone is at ca 2000 m. - **b.** Distribution of *Rhytidiadelphus subpinnatus* (Lindb.) T. Kop in Finland (from Koponen 1975) and its vertical distribution in Japan (from Koponen 1971). 1 = northern boreal subzone and (in Japan) upper oroboreal subzone. 2 = middle boreal subzone and middle oroboreal subzone. 3 = southern boreal subzone and lower oroboreal subzone. 4 = hemiboreal subzone and orohemiboreal subzone. 5 = temperate zone. 6 = meridional zone (zone borders not marked). The distribution in Finland and Japan coincide rather completely in this zone system. *R. subpinnatus* is not known from temperate areas in Europe (Karttunen & Koponen 1987).

Nishimura), *Macrothamnium* and *Schlotheimia* (by D. H. Vitt), Sphagnaceae (by P. Isoviita), Splachnaceae and Splachnobryaceae (by A. Koponen), *Neolindbergia* (by H. Akiyama) and Hookeriaceae and Sematophyllaceae (by D. H. Norris).

Our additions to the Western Melanesian flora are so numerous that it is not possible to list them here. It is clear that the flora is far from being completely known (see Hyvönen 1989). For example, we collected 38 specimens of the large moss, *Macrothamnium hylocomioides* Fleisch. from the Huon Peninsula (Fig. 1). It was already known from 7 provinces in New Guinea, but only one earlier record existed from the Huon Peninsula. *Elmeriobryum philippinense* Broth. is another species often occurring in large quantities. There are only two previous records of it, under the name *Calliergon wilhelmense* Bartr. We were even able to recognise it in the field. An equally common and characteristic, but smaller, species proved to be undescribed and has been named *Leptocladiella flagellaris* T. Kop & Norris (Koponen & Norris 1985).

Taxonomy and floristics of Hepaticae

The treatment of liverwort taxa is similar to that of mosses. However, in most cases a detailed species description is given only for those species present on the Huon Peninsula. This procedure was selected in order to avoid repeating the text of some recent monographs (e.g. Hattori 1982, Inoue 1984). One new genus *Symphyogynopsis* Grolle, and 23 new species have been described in the series. Unlike the mosses new discoveries seem to be more numerous than reductions to synonymy. The checklist (Grolle & Piippo 1984) includes 709 species but will probably increase to ca 725 with the present rate of revision. Most of the hepatic families have been treated (Table 2). The untreated families are the Anthocerotaceae (10 species), Lepidoziaceae subfam. Bazzanioideae (ca 50), Aneuraceae (43), Marchantiaceae (10) and what may prove to be the most time-consuming, the Lejeuneaceae (34 genera and 193 species). The first five are currently under review by Drs S. Piippo, N. Kitagawa, T. Furuki and H. Bischler. The first manuscript on Lejeuneaceae by R. Grolle and S. Piippo has been sent to reviewers. Accordingly, work on the hepatic flora seems to be proceeding more quickly than that on mosses. A summarising paper giving a key to Western Melanesian Hepaticae and Anthocerotae is in press (Piippo 1990). A list of papers completed so far and an index to the genera contained in them are given in Appendix 1.

Phytogeography

Hyvönen (1989) has carried out an bryogeographical analysis based on 27 of the 57 Melanesian moss families and on 298 species and subspecific taxa. His most remarkable finding is that the New Guinea flora is more closely related to the floras of the Asian continent (43 % of the taxa in common), Indonesia (68 %), Malaysia (39 %) and the Philippines (52 %) than to those of Australia (42 %) or New Zealand (12 %). This agrees with the results obtained from other groups of plants and animals (Whitmore 1987) and can be explained by plate tectonics. The latest

discoveries from the study of plate tectonics suggest that Tibet, Burma, Malaya, Sumatra, Borneo and Western Sulawesi separated from Gondwanaland in the late Jurassic (160 Ma ago) and drifted away from what is now the Australian plate. It is proposed that they have been permanently above sea level (Audley-Charles 1987). The first mountain peaks of present New Guinea became dry land only in the Miocene, - ca 10 Ma ago. It seems evident that New Guinea acquired most of its moss flora from the North, and not from the South. However, there are some moss groups which show an ancient southern Gondwanalandic pattern, e.g. *Tayloria* (A. Koponen 1982), *Rhacocarpus* (Koponen & Norris 1986), *Leptostomum* (Hyvönen 1987) and *Hymenodon* (Koponen et al. 1986). The percentage of endemics in the New Guinea moss flora is 18 % (Hyvönen 1989) which is much less than that for Hepatics, - 40 % (Piippo 1988). Moreover, some of the hepatic genera show much higher endemism, even over 40 %, and the center of speciation for some genera seem to be in this area, e.g. that of *Schistochila* (Piippo 1984). One reason may be that these genera are in a very active phase of speciation which may be related to relatively recent geological epochs when the high mountains of New Guinea were raised due to the collision of the Australian and Pacific plates. At a very early stage of our research it was found that most of the endemic species occur at high elevations (Piippo et al. 1987). This finding was confirmed when more revised material became available (Enroth 1990). The endemic taxa seem to be descendants of the early sea level colonists, which had to contend with dramatically changing ecological conditions. If this can be shown to be true when our studies are complete then they must be comparatively young endemics, i.e. less than 10 Mio years old.

Enroth (1990) also studied the altitudinal distribution of bryophytes in relation to vegetation zonation and found some correlations. Bryophytes are more conservative and wide-ranging than vascular plants and their distribution patterns can be used as an additional tool in the identification of corresponding bioclimatic areas. The application of this method to our Huon Peninsula material is shown in Fig. 2.

Human influence

Hyvönen et al. (1987) assessed the effect of human acitivity on the bryophyte flora of New Guinea and Norris (1990) surveyed the kinds of disturbance. Their conclusion is that at least some bryophytes can survive the disturbance caused by small and shifting agricultural plots in a thinly populated area. Some species can find suitable ecological niches in gardens and coffee plantations. Major changes, especially in moss forests, expose bryophytes to desiccation through greatly increased insolation and wind movement. When contiguous bryophyte colonies are destroyed and only separated tufts remain they simultaneously lose their ability to maintain hydration. Some plants with narrow geographical or ecological ranges will be seriously endangered by large scale agriculture, forestry, and mining, and by hydroelectric plants.

Acknowledgements

I wish to express my sincere thanks to Prof. D. H. Norris and Dr. S. Piippo and my students, Mr. J. Enroth and J. Hyvönen, whose participation in the project has been essential, as well as to Dr Pekka Isoviita for his help with nomenclatural problems and my student, Mr. K. Karttunen, for providing Latin descriptions. I also wish to thank the specialists in various bryophyte families as well as the reviewers of our papers. Their cooperation has made the publication of the Huon Peninsula series possible. Dr Alan

Harrington revised my manuscript linguistically, which is cordially recorded.

References

In the list of references are given only those papers, which are not listed in the Appendix 1.

Audley-Charles, M. G. 1987: Dispersal of Gondwanaland: relevance to evolution of the Angiosperms. - Oxford Monographs Biogeography 4: 5-25.

Brotherus, V. F. 1924, 1925: Musci (Laubmoose). II. Spezieller Teil. In: Engler, A. & Prantl, K., Die natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten insbesondere den Nutzpflanzen. 2 Aufl. 10(1): 129-131, 143-478, 11: i-vi, 1-542.

Enroth, J. 1990: Altitudinal zonation of bryophytes on the Huon Peninsula, Papua New Guinea. A floristic approach with bryogeographic considerations. - Tropical Bryology 2: 61-90.

Grolle, R. & Piippo, S. 1984: Annotated catalogue of Western Melanesian bryophytes. I. Hepaticae and Anthocerotae. - Acta Botanica Fennica 125: 1-86.

Hattori, S. 1982: A synopsis of New Guinean Frullania, Hepaticae. - Journal Hattori Botanical Laboratory 51: 203-271.

Hyvönen, J. 1987: A synopsis of genus Leptostomum (Leptostomataceae, Musci). - Annales Botanici Fennici 24: 63-72.

Hyvönen, J. 1989: On the bryogeography of Western Melanesia. - Journal Hattori Botanical Laboratory 66: 231-254.

Hyvönen, J., Koponen, T. & Norris, D. H. 1987: Human influence on the moss flora of tropical rainforest in Papua New Guinea. - Symposia Biologica Hungarica 35: 621-629.

Inoue, H. 1984: The genus Plagiochila (Dum.) Dum. in southeast Asia. - vi + 142 pp., 76 pls. Academia Scientific Book Inc., Tokyo.

Karttunen, K. & Koponen, T. 1987 ('1986'): The Eurasian distribution of Rhytidiadelphus subpinnatus. - Abstracta Botanica 9 (Suppl. 2): 55-62.

Koponen, A. 1982: The family Splachnaceae in Australasia and the Pacific. - Journal Hattori Botanical Laboratory 52: 87-91.

Koponen, T. 1971: The taxonomic status of Rhytidiadelphus yunnanensis. - Hikobia 6: 53-56.

Koponen, T. 1975: The distribution of Rhytidiadelphus and Hylocomium in Finland. - Annales Botanici Fennici 12: 59-62.

Norris, D. H. 1990: Bryophytes in perennially moist forests in Papua New Guinea: ecological orientation and predictions of disturbance effects. - Botanical Journal Linnean Society (in press).

Norris, D. H. & Koponen, T. 1985: Bryophytes from Frieda River, East and West Sepik Provinces, Papua New Guinea. I. Musci. - Annales Botanici Fennici 22: 367-396.

Norris, D. H., Reese, W. D. & Koponen, T. 1988: Bryophytes from Frieda River, East and West Sepik Provinces, Papua New Guinea. III. Syrrhopodon curticancellinatus, species nova. - Annales Botanici Fennici 25: 149-151.

P**iippo, S. 1986:** Bryophytes from Frieda River, East and West Sepik Provinces, Papua New Guinea. II. Hepaticae (Haplomitriaceae - Frullaniaceae). - Annales Botanici Fennici 23: 1-10.

Piippo, S. 1988: Länsi-Melanesian sammalkasviohanke. (Summary: The bryophyte flora project of Western Melanesia). - Luonnon Tutkija 92: 150-152.

Piippo, S., Koponen, T. & Norris, D. H. 1987: Endemism of the bryophyte flora in New Guinea. - Symposia Biologica Hungarica 35: 361-372.

Schultze-Motel, W. 1963: Vorläufiges Verzeichnis der Laubmoose von Neuguinea. - Willdenowia 3: 399-549.

Whitmore, T. C. (ed.) 1987: Biogeographical evolution of the Malay Archipelago. - Oxford Monographs Biogeography 4: 1-147.

Appendix 1. Published papers and manuscript accepted for printing of the Huon Peninsula series. The order of papers in press (nos. 32-40) may not be final.

1. **Koponen, T. & Norris, D. H. 1983a:** Bryophyte flora of the Huon Peninsula, Papua New Guinea. I. - Study area and its bryological exploration. - Ann. Bot. Fennici 20: 15-29.
2. **Koponen, T. & Norris, D. H. 1983b:** Bryophyte flora of the Huon Peninsula, Papua New Guinea. II. Mniaceae (Musci). - Ann. Bot. Fennici 20: 31-40.
3. **Piippo, S. 1984**: Bryophyte flora of the Huon Peninsula, Papua New Guinea. III. Haplomitriaceae, Lepicoleaceae, Herbertaceae, Pseudolepicoleaceae, Trichocoleaceae, Schistochilaceae, Balantiopsaceae, Pleuroziaceae and Porellaceae (Hepaticae). - Ann. Bot. Fennici 21: 21-48.
4. **Koponen, T. & Norris, D. H. 1984:** Bryophyte flora of the Huon Peninsula, Papua New Guinea. IV. Anomobryum, Bryum and Rhodobryum (Bryaceae, Musci). - Ann. Bot. Fennici 21: 265-290.
5. **Grolle, R. & Piippo, S. 1984:** Bryophyte flora of the Huon Peninsula, Papua New Guinea. V. Lepidoziaceae subfam. Zoopsoideae and Cephaloziaceae subfam. Schiffnerioideae (Hepaticae). - Ann. Bot. Fennici 21: 299-307.

6. Piippo, S. 1984: Bryophyte flora of the Huon Peninsula, Papua New Guinea. VI. Lepidoziaceae subfam. Lepidozioideae, Calypogeiaceae, Adelanthaceae, Cephaloziaceae subfam. Cephalo zioideae and subfam. Odontoschismatoideae and Jubulaceae (Hepaticae). - Ann. Bot. Fennici 21: 309-335.

7. Norris, D. H. & Koponen, T. 1985: Bryophyte flora of the Huon Peninsula, Papua New Guinea. VII. Trachypodaceae, Thui diaceae and Meteoriaceae. - Acta Bot. Fennica 131: 1-51.

8. Koponen, T. & Norris, D. H. 1985: Bryophyte flora of the Huon Peninsula, Papua New Guinea. VIII. Hylocomiaceae and Rhytidiaceae. - Acta Bot. Fennica 131: 53-61.

9. Frahm, J.-P., Giese, M., Padberg, M., Koponen, T. & Norris, D. H. 1985: Bryophyte flora of the Huon Peninsula, Papua New Guinea. IX. Atractylocarpus, Bryohumbertia, Campylopodium and Campylopus (Dicranaceae, Musci). - Acta Bot. Fennica 131: 63- 88.

10. Piippo, S. 1985a: Bryophyte flora of the Huon Peninsula, Papua New Guinea. X. Jackiellaceae, Scapaniaceae, Arnelliaceae and Acrobolbaceae (Hepaticae). - Acta Bot. Fennica 131: 89-96.

11. Koponen, T. & Norris, D. H. 1985: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XI. Brachymenium, Epiptery gium, Leptobryum, Mielichoferia, Orthodontium and Pohlia (Bryaceae) and Leptostomataceae (Musci). - Acta Bot. Fennica 131: 97-127.

12. Piippo, S. 1985b: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XII. Geocalycaceae (Hepaticae). - Acta Bot. Fennica 131: 128-167.

13. Piippo, S. 1985c: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XIII. Arachniopsis and Kurzia (Lepidoziaceae subfam. Lepidozioideae, Hepaticae). - Acta Bot. Fennica 131: 168-179.

14. Koponen, T., Touw, A. & Norris, D. H. 1986: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XIV. Rhizogoniaceae (Musci). - Acta Bot. Fennica 133: 1-24.

15. Hattori, S. & Piippo, S. 1986: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XV. Frullania (Frullaniaceae, Hepaticae). - Acta Bot. Fennica 133: 25-58.

16. Grolle, R. & Piippo, S. 1986: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XVI. Pallaviciniaceae (Hepaticae). - Acta Bot. Fennica 133: 59-79.

17. Koponen, T. & Norris, D. H. 1986: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XVII. Grimmiaceae, Hedwigia ceae and Racopilaceae (Musci). - Acta Bot. Fennica 133: 81- 106.

18. Hyvönen, J. 1986: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XVIII. Polytrichaceae and Buxbaumiaceae (Musci). - Acta Bot. Fennica 133: 107-150.

19. Reese, W. D., Koponen, T. J. & Norris, D. H. 1986: Bryophyte flora of the Huon Peninsula, Papua New Guinea. IXX. Calymperes, Syrrhopodon and Mitthyridium (Calymperaceae, Musci). - Acta Bot. Fennica 133: 151-202.

20. Norris, D. H. & Koponen, T. 1987: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XX. Fissidentaceae, Mitte niaceae, Phyllodrepaniaceae, Phyllogoniaceae and Sorapillaceae (Musci). - Ann. Bot. Fennici 24: 177-219.

21. Piippo, S. 1988a: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXI. Lepicolea norrisii (Lepicoleaceae, Hepaticae). - Ann. Bot. Fennici 25: 55-57.

22. Piippo, S. 1988b: Bryophyte flora of the Huon Peninsula. XXII. Targioniaceae, Wiesnerellaceae, Aytoniaceae and Ric ciaceae (Marchantiales, Hepaticae). - Ann. Bot. Fennici 25: 97-107.

23. Piippo, S. 1988c: Bryophyte flora of the Huon Peninsula. XXIII. Treubiaceae, Allisoniaceae and Makinoaceae (Metzge riales, Hepaticae). - Ann. Bot. Fennici 25: 159-164.

24. Norris, D. H. & Koponen, T. 1988: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXIV. Andreaeaceae, Archidiaceae, Ditrichaceae and Seligeriaceae (Musci). - Ann. Bot. Fennici 25: 165-177.

25. Frahm, J.-P., Norris, D. H. & Koponen, T. 1988: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXV. Campylopodiella (Dicranaceae, Musci). - Ann. Bot. Fennici 25: 259-260.

26. Hyvönen, J. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXV. Pterobryaceae (Musci). - Acta Bot. Fennica 137: 1-40.

27. Enroth, J. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXVII. Neckeraceae (Musci). - Acta Bot. Fennica 137: 41-80.

28. Norris, D. H. & Koponen, T. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXVIII. Pottiaceae (Musci). - Acta Bot. Fennica 137: 81-138.

29. Vana, J. & Piippo, S. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXIX. Jungermanniaceae and Gymnomitriaceae (Hepaticae). - Ann. Bot. Fennici 26: 107-125.

30. Piippo, S. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXX. Plagiochilaceae (Hepaticae). - Ann. Bot. Fennici 26: 183-236.

31. Vana, J. & Piippo, S. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXI. Cephaloziaceae subfam. Alobielloideae, Cephaloziellaceae, Antheliaceae and Lophozia ceae (Hepaticae). - Ann. Bot. Fennici 26: 263-290.

32. Yamada, K. & Piippo, S. 1989: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXII. Radula (Radulaceae, Hepaticae). - Ann. Bot. Fennici 26 (in press).

33. Norris, D. H. & Koponen, T. 1990: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXIII. Leskeaceae and Fabroniaceae (Musci) plus corrigenda and addenda to previous papers. - Ann. Bot. Fennici 27 (in press).

34. Piippo, S. 1990: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXIV. Key to the genera of Western Melanesian Hepaticae and Anthocerotae. - Ann. Bot. Fennici 27 (in press).

35. Norris, D. H. & Koponen, T. 1990: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXV. Dicranaceae and Dicnemonaceae (Musci). - Acta Bot. Fennica 139 (in press).

36. Enroth, J. 1990a: Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXVI. Leucobryaceae (Musci). - Acta Bot. Fennica 139 (in press).

37. Piippo, S. 1990: Bryophyte flora of the Huon Peninsula,

Index to genera in the Huon Peninsula series. Numbers refer to the serial numbers of separate papers listed above.