Review of the bryofloristic connections of New Guinea Island

S. Piippo & T. Koponen

Abstract

S. Piippo[1] & T. Koponen[2] ([1]Botanical Museum, P.O. Box 47, FIN-00014 University of Helsinki, Finland; [2]Mailantie 109, FIN-08800 Kirkniemi, Finland) 2003. Review of the bryofloristic connections of New Guinea Island. Telopea *10 (1): 467–476*. The bryoflora of New Guinea has connections to Indonesia and Malaysia, and less stongly to Australia and New Zealand. This pattern is more evident in hepatics than in mosses, in which a pantropical element is more prominent. Vertical distribution also has clear connection with ranges, e.g. endemism is high at 1500–3000 m, disjunct boreal, temperate, and bipolar taxa occur at the highest altitudes, and pantropical or widely distributed taxa at the lowest altitudes. A preliminary attempt is made to compare the limits of vegetation zones in New Guinea and in Hunan Province of China, based on the vertical distribution of bryophyte species.

Material and Methods

Our studies on Western Melanesian bryoflora began in 1981 when D. H. Norris and T. Koponen made several field excursions in New Guinea in order to collect bryophytes. The original idea was to publish a list of the collections from the Huon Peninsula area but the target gradually changed toward a complete flora of Western Melanesia. We included Papua New Guinea, West Irian of Indonesia, and the Solomon Islands in our revisions and some of those revisions grew into world monographs of the genera studied. In total, Koponen and Norris collected c. 17 500 specimens in Madang, Morobe, and West and East Sepik Provinces of New Guinea (Fig. 1). Koponen and Norris are responsible for the study of the mosses and S. Piippo for the hepatics. Additionally we have had many collaborators (see the acknowledgments). The revisions are being published in Annales Botanici Fennici (Vols. 20–36) and Acta Botanica Fennica (Vols. 125–165) in three series: 'Bryophyte flora of the Huon Peninsula, Papua New Guinea' (67 parts published), 'Bryophytes from Frieda River, East and West Sepik Provinces, Papua New Guinea' (4 parts published), and 'Annotated catalogue of Western Melanesian bryophytes' (1 part published, 1 ms.). Additionally, with our colleagues we have published many papers dealing with the bryogeography, ecology, rarity and frequency of taxa, and human influence based on the collections or research (Koponen 2000).

Chinese bryoflora has been studied again (after V. F. Brotherus', 1849–1929, studies) in Helsinki beginning 1970, based on Finnish herbarium collections and new material (a total of 32 000 specimens) collected during Finnish-Chinese bryological expeditions. In addition to taxonomic research we have published checklists and floras of different provinces of China, such as Jiangxi (Fang et al. 1998), Guangdong (Li & Piippo 1994), Hainan (Lin et al. 1992), Hubei (Peng et al. 2000), Sichuan and Yunnan (Piippo et al. 1997, 1998), and checklist of the hepatics of the whole of China (Piippo 1990).

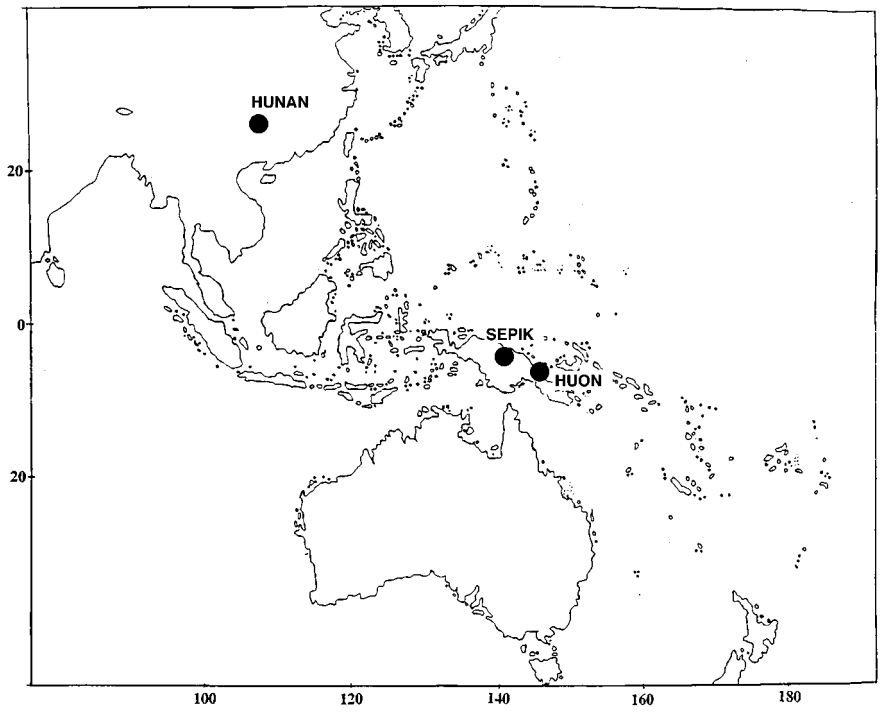

Fig. 1. The research localities in Western Melanesia (Sepik and Huon) and China (Hunan).

Results

1. Present state of study: Major taxonomic results from Western Melanesia are: Families studied 88, genera studied 296, species studied and published 1058, taxa new for science in total 87 (5 genera and 76 species), new combinations 65, new synonyms 446, first records for Western Melanesia of genera 44 and species 225. During these 20 years, 72 taxonomic revisions have been published (see Koponen et al. 1992, Koponen 2000, Gradstein et al. 2002). Today Anthocerotophyta and all the other families of Hepaticae except Aneuraceae and the genus *Bazzania* S. Gray of the Lepidoziaceae have been published, Lejeuneaceae are under revision. Most of the remaining families of Musci such as Hookeriaceae, Hypnaceae, Hypopterygiaceae, and Sematophyllaceae are under revision.

In 1997, our latest project in Hunan province, China, began (Fig. 1). The major objective is to compile bryophyte flora of the Hunan province and, in addition, to focus on ecology and phytogeography. A checklist of Hunanese bryophytes was published by Rao et al. (1997) and other records and revisions so far published are Koponen et al. (2000) and Potemkin (2000).

2. Bryofloristic connections of New Guinea: Hyvönen (1989) reviewed the bryofloristic connections of Western Melanesia. His review was based on 309 moss species and they showed that floristic affinities were to Asia, Oceania, and Australia, but to some extent also to South America and Africa. Enroth (1991) carried out a similar study on hepatics and showed that hepatics had much less affinity to Australia than mosses. Piippo (1992) and Piippo and Koponen (1997) studied the affinities of the bryophyte floras using Kroeber's similarity index. They compared 2900 species and 250 genera of hepatics in Western Melanesia, Australia, New Zealand, Borneo, Philippines, Taiwan, mainland China, Japan, Korea, and Bhutan; and 4 755 species and 550 genera of mosses in Western Melanesia, Australia, New Zealand, Philippines, Borneo, Lesser Sunda Islands, Peninsular Malaysia, Society Islands, Ceylon, Indochina, Taiwan, Korea, and Bhutan (Fig. 2). The plate tectonics behind the affinities were also discussed (see also Tan 1984, 1996, 1998, Tan & Engel 1990, Tan et al. 1988). Even though New Guinea belongs to the Australian plate, and the island is located much closer to Australia than to continental Asia, Western Melanesian hepatic flora is more closely related to the Laurasian flora than to the floras of Australia or New Zealand. This pattern is more clearly visible in species than in genera. Western Melanesian species shared with Indomalaysia and Asia are pantropical, Laurasian Asian widespread, or old Gondwanic elements speciated in Western Melanesia. China, Japan, Taiwan, Korea, and Bhutan are dominated by a Sino-Japanese temperate and warm-temperate element that is rather widespread also at high elevations in New Guinea. The affinities of Western Melanesian mosses to those of Indomalaysia are not as striking as those of the hepatics, even though the same pattern can be detected. The moss genera *Hypnodendron* (Touw 1971), *Dawsonia* (Zanten 1973), and *Desmotheca* (Vitt 1990) are examples of Gondwanic distribution types. Whitmore (1981) shows the same patterns in vascular plant distributions, such as Dipterocarpaceae and climbing palms (Laurasian), and Winteraceae (Gondwanic).

3. Vertical distribution of bryophytes in New Guinea and in Hunan: Enroth (1990) studied the vertical distribution of hepatics and mosses on the Huon Peninsula, and Piippo (1994a, 1994b, see also Piippo et al. 1987) those of endemic hepatics and epiphyllous Lejeuneaceae. All groups (hepatics and mosses and endemics) are most common at altitudes of 1200–2700(–3000) m, in mid-mountain forests, mossy forests and to some extent in high mountain forests. Only the epiphyllous Lejeuneaceae occur at 500–2300 m; they occur in lowland rainforests, and are more widespread due to better means of dispersal, their monoicous state, and due to their Laurasian origin. Endemism is high especially among Western Melanesian hepatics, c. 38%, due e.g. to the isolation of mountain-tops, and they are most common in montane forests. Asian-Oceanian and pantropical taxa prevail in lowland forests (0–300m) and foothill forests (300–1200 m); endemics prevail in SE Asiatic and Asian–Australian mid-mountain forests (1200–c. 2200 m), and mossy forests (c. 2200–c. 2800 m). At higher altitudes Southern and Northern Hemisphere taxa become more common. Norris et al. (1999) listed the disjunct occurrence of 21 boreal to temperate northern hemisphere taxa and 17 bipolar taxa at high altitudes of New Guinea.

4. Comparison of New Guinea and Hunan Province of China: Our results allow a bryofloristic and altitudinal comparison of the Huon Peninsula of New Guinea and Hunan Province of China (Figs. 3–5). The line in the Hunan maps shows the upper limit of the middle meridional (evergreen forest) zone. Based on this fact, of the hepatics: *Acrobolbus ciliatus* (Mitt.) Schiffn. (Fig. 3) is temperate; *Jungermannia comata* Nees, subtropical-meridional (Fig. 3); the very common species *J. truncata* (Mitt.) Amakawa, subtropical-temperate (Fig. 3); *J. virgata* (Mitt.) Steph., subtropical-meridional (Fig. 4); and *Notoscyphus lutescens* (Lehm.) Mitt., subtropical-meridional-temperate (Fig. 4), (but this species has severe taxonomic problems). *Schistochila blumii* (Nees) Trevis. is subtropical-meridional (Fig. 4). Of the mosses: *Palamocladium leskeoides* (Hook.) Britt. is meridional-temperate (Fig. 5); *Rhodobryum giganteum,* meridional-temperate (Fig. 5); and *Racopilum cuspidigerum* (Schwaegr.) Ångstr., tropical-subtropical (Fig. 5). Huon lies at the equator and Hunan at c. 25–30°N. The dots at c. 25°N in Hunan represent Mangshan, the only locality in Hunan that has subtropical elements.

Discussion

The altitudinal mapping of bryophyte distributions is a useful tool in two ways. Firstly, if the altitudinal maps do not correspond, two different taxa may be present. For instance, if a widely distributed species in Hunan occurs only in temperate areas, but is constantly subtropical or tropical on the Huon Peninsula, we can start to suspect the species concept (e.g. *Palamacladium leskeoides*, Fig. 5). There may be two related taxa in question, which can be confirmed by morphological comparison. Secondly, altitudinal distributions may support the vegetation zonal systems created by other parameters such as temperatures and temperature sums. Examples have been published from the northern hemisphere (e.g. Hämet-Ahti et al. 1974).

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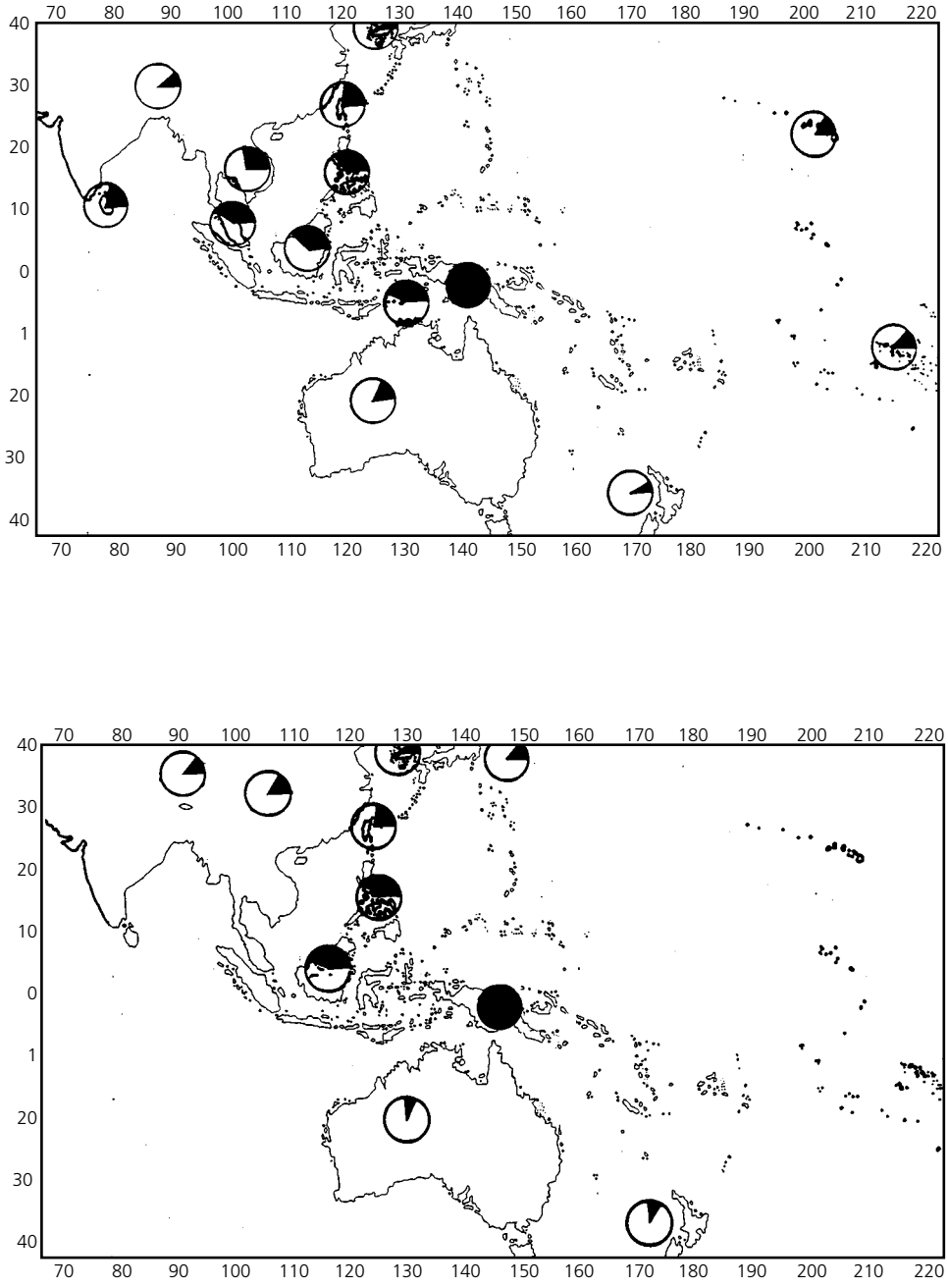

Fig. 2. Affinities of Western Melanesian moss species to other areas studied (above) and affinities of Western Melanesian hepatic species (below). First published in Piippo (1992) and Piippo & Koponen (1997).

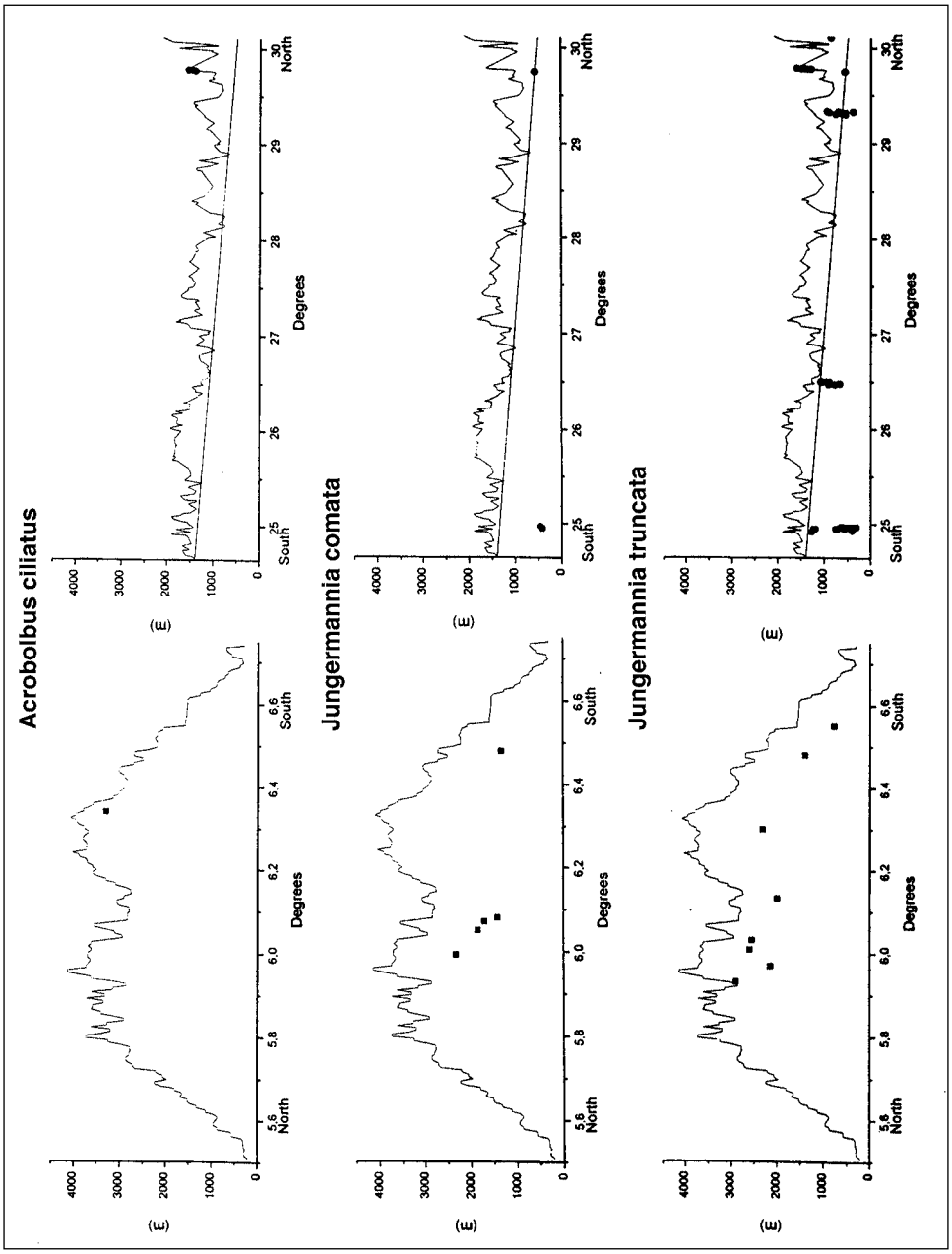

Fig. 3. Vertical distribution of *Acrobolbus ciliatus*, *Jungermannia comata*, and *J. truncata* on the Huon Peninsula and Hunan Province. The line in the Hunan map shows the upper limit of the middle meridional (evergreen forest) zone. The determinations of *Acrobolbus* and *Jungermannia*, are based on unpublished manuscripts by Koponen et al. and Váňa et al.

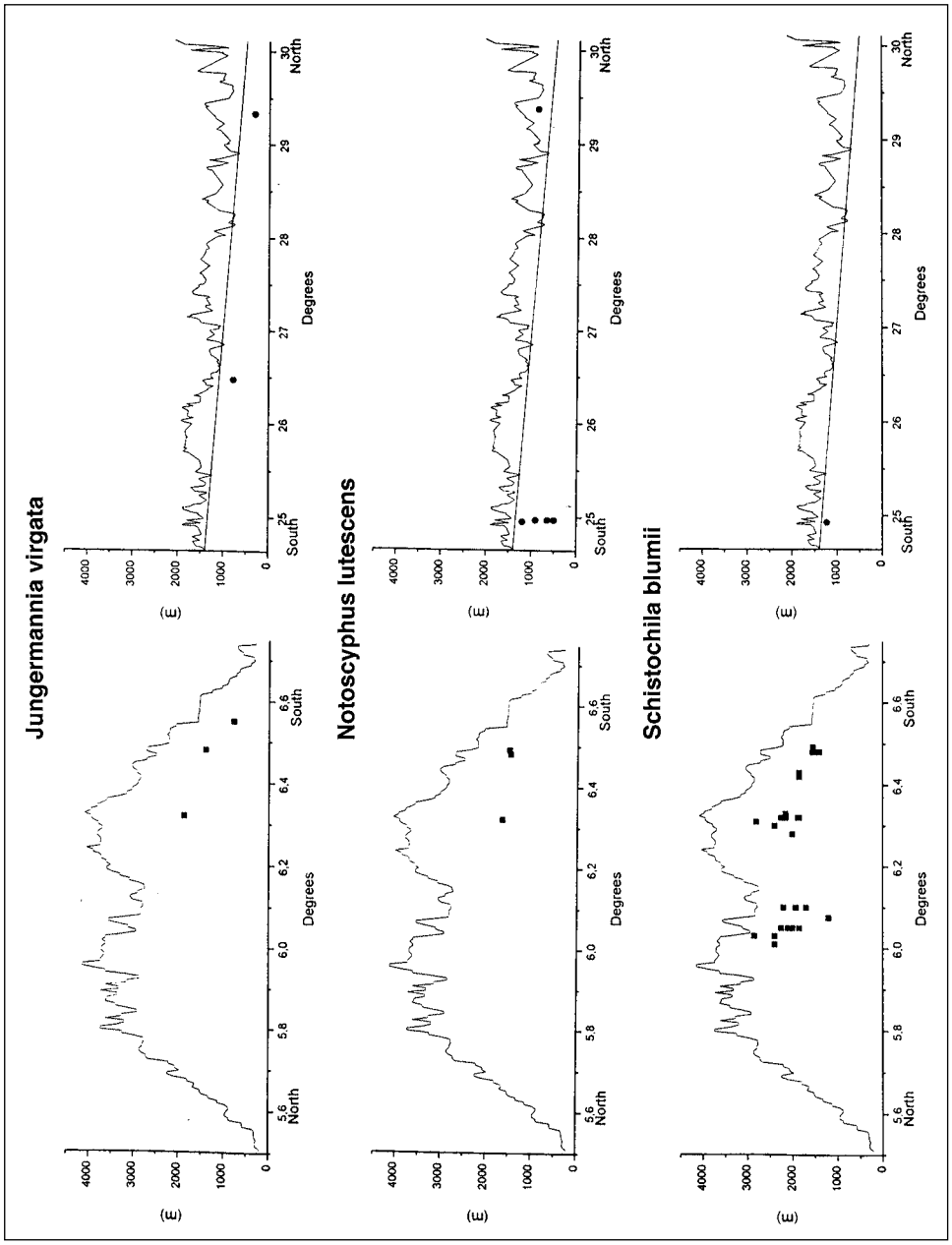

Fig. 4. Vertical distribution of *Jungermannia virgata, Notoscyphus lutescens*, and *Schistochila blumii* on the Huon Peninsula and Hunan Province. The line in the Hunan map shows the upper limit of the middle meridional (evergreen forest) zone. The determinations of *Jungermannia, Notoscyphus* and *Schistochila* are based on unpublished manuscripts by Váňa et al and Koponen et al.

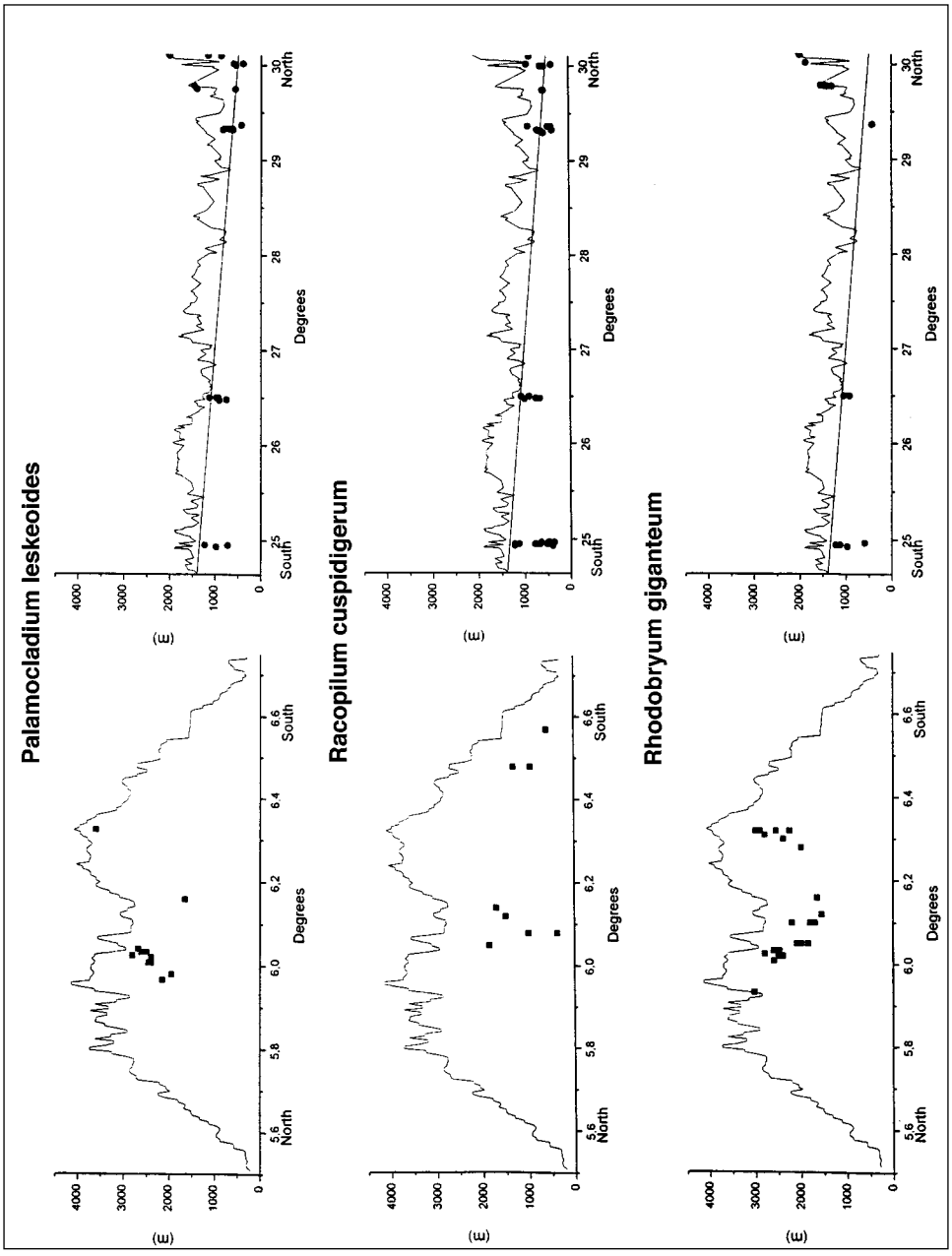

Fig. 5. Vertical distribution of *Palamocladium leskeoides, Racopilum cuspidigerum*, and *Rhodobryum giganteum* on the Huon Peninsula and Hunan Province The line in the Hunan map shows the upper limit of the middle meridional (evergreen forest) zone. The determinations of *Palamocladium, Racopilum* and *Rhodobryum* are based on unpublished manuscripts by Ignatov et al. and Koponen et al.

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