



Original Article

Southern Thailand Bryophytes III: A preliminary study on non-epiphyllous taxa in lowland areas

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Received: 9 August 2015; Accepted: 8 December 2015

Abstract

Examination of a collection of non-epiphyllous bryophytes from lowland areas of Phang Nga, Phuket and Surat Thani province yielded 38 liverwort and 29 moss species. *Microlejeunea filicuspis* (Steph.) Heinrichs. *et al.*, is new to Thailand and additional ten proved to be rarely recorded in this country, being hitherto known only from one other locality. Locality data and habitats are provided for each species and information on oil bodies is given for several species.

Keywords: bryophyte, lowland forest, rare species, Southern Thailand

1. Introduction

Southern Thailand lies between the latitudes of approximately 6° and 10°N, extending south through the Kra Isthmus to the Thailand-Malaysia border and forming a narrow peninsula flanked by the Gulf of Thailand in the east and the Andaman Sea in the west. Topographically, there are three main mountain ranges running through the length of the peninsula, the Phuket, the Nakhon Si Thammarat and the Sankalakhiri ranges (Smitinand, 1989). According to Whitmore (1998), southern Thailand is predominated mostly by tropical lowland forest and lower montane forest. The tropical lowland evergreen forest is dominated by members of the family Dipterocarpaceae, e.g. *Dipterocarpus kerrii* King, *Shorea curtisii* Dyer ex King and *S. roxburghii* G. Don. The species composition of lower montane forest varies locally, but it is usually dominated by *Dacrydium elatum* (Roxb.) Wall. ex Hook. (Podocarpaceae), *Lithocarpus* spp.,

Quercus spp. (Fagaceae); *Schima wallichii* (DC.) Korth. (Theaceae); *Rhododendron* spp. and *Vaccinium* spp. (Ericaceae).

The lowland tropical rain forest ecosystem has suffered from intensive pattern of destruction. Due to the heterogeneity in habitats, the warm and humid tropical lowland rain forest also harbors a rich diversity of bryophytes (Gradstein, 1992). Unfortunately, the lowland forest has been widely disturbed by human activities over the last 30-40 years, and much has been transformed to various agricultural usages such as rubber and oil palm plantations. Currently, the only undisturbed forests can be found in the mountainous regions where agriculture is not economically viable. It is estimated that approximately 25% of the land is under forest cover, including forest plantations (Maxwell, 2004).

In Thailand, the most of bryological studies had been focused on montane forest. In contrast, only few studies were conducted in lowland areas (Sukkharak and He, 2014; Hassama and Chantanaorrapint, 2015). The aim of the present study, therefore, was to investigate the bryophytes diversity in selected lowland areas in southern Thailand. This paper is the third in a series of southern Thailand bryophytes (Chantanaorrapint and Pócs, 2014; Pócs and Podani, 2015).

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2. Materials and Methods

The field work was carried out by the first author and his wife, Sarolta Pócs, in several vegetation types (Figures 1-2), in Phang Nga, Phuket and Surat Thani province, during January-February 2007. The collections of non-epiphyllous bryophytes were identified by the two authors. The classification system of the families and genera used in this account follows Goffinet *et al.* (2008) and Crandall-Stotler *et al.* (2008) for mosses and liverworts, respectively.

The records of species were consulted with the checklists of Lai *et al.* (2008) and He (1998-2015) and with subsequent papers (e.g. Chantanaorrapint *et al.*, 2004; Tan *et al.*, 2006; Chantanaorrapint, 2009, 2014, 2015; Frahm *et al.*, 2009; Orbán, 2009; Printarakul *et al.*, 2012, 2013, 2014; Promma and Chantanaorrapint, 2013, 2015; Chantanaorrapint and Pócs, 2014; Lee *et al.*, 2014; Sukkharak and He, 2014; Sukkharak *et al.*, 2014; Pócs and Podani, 2015; Hassama and Chantanaorrapint, 2015). The distribution of the species was investigated and geographical ranges for a few of them are mapped. Illustrations of certain species are also given. The voucher specimens are deposited in the herbarium of Eszterházy Károly College in Eger (EGR) with duplicates in the herbarium of Prince of Songkla University (PSU). The oil bodies of the liverwort species were studied in the field by a small Zeiss Jena Standard (1950) microscope. The species numbers in the list contain a locality number (see enumeration of localities below) and one letter distinguishing the different specimens within one locality.

The localities of non-epiphyllous collections

No. 07001: Phuket Prov., Thalang Distr., E side of KHAO PHRA THAEO National Park, around BANGPAE Waterfall, at 50-100 m alt. 08°02'18.1"N, 99°23'26.1"E. Seasonal lowland rainforest on granitic ground, with Dipterocarpaceae (*Dipterocarpus* spp. and *Shorea* spp.) dominant in the upper and *Streblus ilicifolius* (S.Vidal) Corner (Moraceae) in the lower canopy and shrub layers. Date: 22. Jan. 2007.

No. 07002: Phuket Prov., Thalang Distr., Beyond the western gate of KHAO PHRA THAEO National Park, at 50-110 m alt. 08°01'39.5"N, 98°21'46.9"E. Seasonal lowland rainforest with tall Dipterocarpaceae (*Dipterocarpus*, *Shorea*) in the high canopy (emergent trees 40-45 m tall), *Arenga pinnata* Merr., *Calamus* sp. and the endemic *Kerriodoxa elegans* J. Dransf. (Palmae) in the lower levels. On granitic bedrock. Date: 22. Jan. 2007.

No. 07007: Surat Thani Prov., Phanom Distr., at the S edge of KHAO SOK National Park, at 98 km from Surat Thani town along the road half way between Phanom and Takuapa, at 80-120 m alt. 08°54'00.6"N, 98°37'13.2"E. Karstic lowland rainforest with very tall trees at the N foot of a huge limestone cliff, S of SOK River. Date: 25. Jan. 2007.

No. 07008: Phuket Prov.: Muang Phuket Distr., N of KATA village, 07°49'35.4"N, 98°19'26.0"E. Roadside along dry evergreen forest, E of the summit, at 120-140 m alt., on N slope, on granitic ground. Date: 27. Jan. 2007.

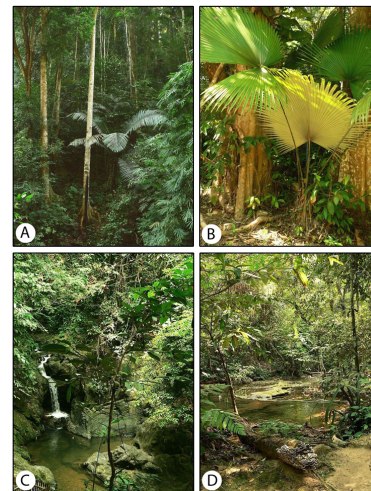


Figure 1. Collecting sites in primary habitats (A) locality 07009, Khao Phra Theo National Park, seasonal rainforest on granitic ground; (B) *Kerriodoxa elegans* Dransfield from the same habitat; (C) locality 07014, Nam Tok Raman lowland rainforest, (D) locality 07015, Sa Nang Manora Forest Park, karstic rainforest along cataracts with travertine deposits.

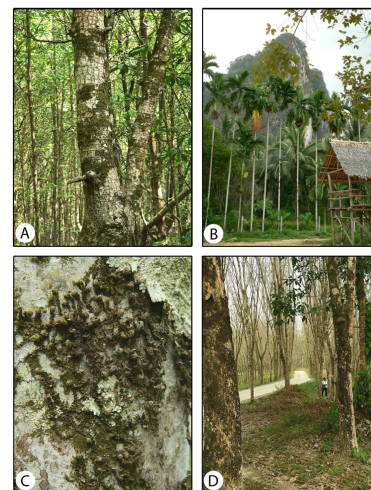


Figure 2. Collecting sites in mangrove and in secondary habitats (A) locality 07010, mangrove forest in Ao Phang Nga National Park; (B) locality 07006, village plantations S of Khao Sok National Park with betel palms; (C) *Caudalejeunea cristiloba* (Steph.) Gradst., with circinate gemmiferous branches, on betel palm bark; (D) locality 07009, rubber plantation in Phuket Island near Nai Thon beach.

No. 07009: Phuket Prov.: Thalang Distr., NAI YANG Bay, at 60 m alt. 08°03'45.3"N, 98°17'11.5"E. Old rubber plantation with remnants of lowland rainforest trees and undergrowth on granitic ground. Date: 28. Jan. 2007.

No. 07010: Phang Nga Prov. and Distr., AO PHANG NGA National Park in the PHANG NGA Bay, at 0-2 m alt. 08°24'22.13"N, 98°30'27.71"E. Mature mangrove forest with *Avicennia officinalis* L., *Bruguiera parviflora* Wight & Arn.

ex Griff., *Nipa fruticans* (Wurmb) Thunb., *Rhizophora mucronata* Lam., *Sonneratia alba* Sm., *Xylocarpus granatum* J. Koenig and *X. moluccensis* (Lam.) M. Roem. No epiphylls but quite many bryophytes on the bark. Date: 28. Jan. 2007.

No. 07012: Phang Nga Prov. and Distr., SE valley of Mt. Khao Wang Ko, 3 km NW of Pak Ko village. Seasonal lowland rainforest on quartzitic substrate around Klong Tam Waterfall, at 100-120 m alt., 08°30'25.15"N, 98°27'00.40"E. Date: 29. Jan. 2007.

No. 07013. Phang Nga Prov. and Distr., 2 km WSW of Pak Kow village, on a hilltop at 108 m alt. 08°29'19.2"N, 98°27'31.8"E. Rubber plantation replacing seasonal lowland rainforest, with quite abundant bryophytes on the trunks of rubber trees. Date: 29. Jan. 2007.

No. 07014: Phang Nga Prov. and Distr., Nam Tok Raman Forest Park with waterfalls, 6 km W of Phang Nga town, at 20-50 m alt. 08°27'03.1"N, 98°26'55.3"E. Lowland rainforest with *Dillenia indica* L. in the high canopy in a rocky streamlet valley on quartzitic bedrock. Many epiphylls. Date: 31. Jan. 2007.

No. 07015: Phang Nga Prov. and Distr., Sa Nang Manora Forest Park 6 km NNE of Phang Nga town, at 70-110 m alt. 08°30'44.7"N, 98°32'18.9"E. Karstic primary rainforest with tall *Knema erratica* (Hook. f. & Thomson) J. Sinclair (Myristicaceae), *Sonneratia griffithii* Kurz (Sonneratiaceae) and *Terminalia bellerica* Roxb. (Combretaceae) trees along streamlet with cataracts on travertine deposits. Many epiphylls. Date: 31. Jan. 2007.

No. 07017: Phang Nga Prov. and Distr., Song Prak Waterfalls area on the E side of Khao Plai Bang To Mountains, near RONG KLUANG village, within Tonpariwat Wildlife Sanctuary, at 270-300 m alt. 08°36'46.6"N, 98°32'58.6"E. Seasonal lowland rainforest on siliciferous bedrock, without epiphylls. Date: 1 Feb. 2007.

3. Results

3.1 Bryophytes diversity

A total of 81 packets were collected and 67 species were identified, belonging to 54 genera, 21 families (Table 1). Among these 29 species are mosses and 38 species are liverworts (including two species of thalloid liverworts and 36 species of leafy liverworts). Most of them are epiphytes and some are either terrestrial plants or lithophytes. The richest families are Lejeuneaceae, represented by 30 species in 13 genera, followed by Calymperaceae included 12 species in five genera whilst Fissidentaceae and Neckeraceae are each composed of four and three species, respectively. All of these are among the 15 main families of the bryophytes in the tropical rainforest (Gradstein and Pócs, 1989).

3.2 Enumeration of the species new or rare in Thailand

Most collected bryophytes were found commonly or

abundantly throughout the country. Of these, ten are considered to be rare species, known only from one or two other localities and one hitherto unknown in Thailand.

Liverworts

Cheilolejeunea vittata (Steph. ex G. Hoffm.) R.M. Schust. & Kachroo

Two large oil bodies of the *Leucolejeunea*-type were observed in each cell of the species.

Specimen examined: On bark. *Pócs 07009/C* (EGR, PSU).

Distribution: A species widespread from Sri Lanka through Indonesia, Malaysia and the Philippines to Papua New Guinea and Australia (Mizutani, 1980; Zhu *et al.*, 2002). Only once published from Thailand (Lai *et al.*, 2008).

Cololejeunea paucimarginata Tixier

The species is characterized by the ligulate lobule and lobe margin containing only of a few hyaline cells.

Specimen examined: On rocks. *Pócs 07002/D* (EGR, PSU).

Distribution: Previously known only from Java (Tixier, 1985) and from Fiji Islands (Pócs *et al.*, 2011; Pócs, 2012). Probably more widespread but overlooked. In Thailand known only from Nakhon Si Thammarat Province (Chantanaorrapint and Pócs, 2014).

Cololejeunea stylosa Steph.

Oil bodies observed in the species are of the *Calypogeia* type in the number 2-5 per cell. A species is easily recognizable by the combination of its filiform stylus, hyaline margined lobe with smooth cuticle and saccate lobule with acute second tooth.

Specimen examined: On bark. *Pócs 07009/B* (EGR, PSU).

Distribution: A Southeast Asiatic species known from Malaysia, Vietnam, Japan: Liukiu Islands, Philippines: Luzon (Mizutani, 1965). In Thailand, it was reported only once from eastern: Khao Yai National Park by Zhu and Lai (2003).

Colura brevistyla Herzog

Specimen examined: On trunk of betel palm. *Pócs 07006/Q* (EGR, PSU).

Distribution: Previously only one locality was known from Thailand in Phang Nga Province, near Chung Chang cave (Chantanaorrapint and Pócs, 2014). Known also from Sri Lanka, Philippines, Mariana, and Fiji Islands (Pócs *et al.*, 2011).

Lejeunea papilionacea Prantl.

Specimen examined: On bamboo stem. *Pócs 07014/V* (EGR, PSU).

Distribution: A widespread palaetropical species distributed from West Africa to Papua New Guinea (Zhu and Grolle, 2001; Dey and Singh, 2012). In Thailand known only from Trang Province (Hassama and Chantanaorrapint, 2015).

Table 1. Alphabetical list of bryophytes from the lowland areas of Phang Nga, Phuket and Surat Thani province.

Taxa	Locality and Collector No.
Marchantiophyta (liverworts)	
Calypogeiaceae	
1. <i>Calypogeia arguta</i> Nees & Mont.	07014/F
Dumortieraceae	
2. <i>Dumortiera hirsuta</i> (Sw.) Nees	07015/E
Frullaniaceae	
3. <i>Frullania nodulosa</i> (Reinw. <i>et al.</i>) Nees	07013/A
Geocalycaceae	
4. <i>Notoscyphus lutescens</i> (Lehm. & Lindenb.) Mitt.	07017/L
Lejeuneaceae	
5. <i>Acrolejeunea fertilis</i> (Reinw. <i>et al.</i>) Schiffn.	07004/A, 07006/P, 07009/A, 07013/K
6. <i>Caudalejeunea cristiloba</i> (Steph.) Gradst.	07006/O
7. <i>Caudalejeunea recurvistipula</i> (Gottsche) Schiffn.	07006/F
8. <i>Cheilolejeunea ceylanica</i> (Gottsche) R.M. Schust. & Kachroo	07017/M
9. <i>Cheilolejeunea ryukyuensis</i> Mizut.	07001/C
10. <i>Cheilolejeunea serpentina</i> (Mitt.) Mizut.	07006/G, 07010/E, 07013/D,E
11. <i>Cheilolejeunea vittata</i> (Steph. ex G. Hoffm.) R.M. Schust. & Kachroo	07009/C
12. <i>Cololejeunea paucimarginata</i> Tixier	07002/D
13. <i>Cololejeunea stylosa</i> Steph.	07009/B
14. <i>Colura brevistyla</i> Herzog	07006/Q
15. <i>Colura imperfecta</i> Steph.	07019/A
16. <i>Lejeunea anisophylla</i> Mont.	077003/B, 07014/T, 07019/B
17. <i>Lejeunea cf. dipterota</i> (Eifrig) G.E. Lee, sterile	07015/H
18. <i>Lejeunea micholitzii</i> Mizut.	07015/G
19. <i>Lejeunea cocoes</i> Mitt.	07015/D
20. <i>Lejeunea flava</i> (Sw.) Nees	07012/D
21. <i>Lejeunea papilionacea</i> Prantl.	07014/V
22. <i>Lejeunea parva</i> (S.Hatt.) Mizut.	07010/D
23. <i>Lejeunea sordida</i> (Nees) Nees	07014/Q, S, 07015/J
24. <i>Lepidolejeunea bidentula</i> (Steph.) R.M. Schust.	07014/M, O, U
25. <i>Leptolejeunea elliptica</i> (Lehm. & Lindenb.) Schiffn.	07006/C
26. <i>Leptolejeunea subrotundifolia</i> Herzog	07015/K
27. <i>Lopholejeunea eulopha</i> (Taylor) Schiffn.	07001/G
28. <i>Lopholejeunea horticola</i> Schiffn.	07002/C
29. <i>Lopholejeunea nigricans</i> (Lindenb.) Schiffn.	07007/C
30. <i>Lopholejeunea subfusca</i> (Nees) Schiffn.	07002/A, 07010/L
31. <i>Mastigolejeunea repleta</i> (Taylor) Schiffn.	07002/B
32. <i>Mastigolejeunea virens</i> (Aongstr.) Steph.	07017/P
33. <i>Microlejeunea filicuspis</i> (Steph.) Heinrichs <i>et al.</i>	07006/A
34. <i>Myriocoleopsis minutissima</i> (Sm.) R.L. Zhu <i>et al.</i>	07007/E, 07010/A
Lepidoziaceae	
35. <i>Bazzania callida</i> (Sande Lac.) N. Kitag.	07012/A
Pallaviciniaceae	
36. <i>Pallavicinia lyellii</i> (Hook.) Carruth.	07014/Y, Z
Plagiochilaceae	
37. <i>Plagiochila bantamensis</i> (Reinw. <i>et al.</i>) Mont.	07014/Y, Z
Radulaceae	
38. <i>Radula javanica</i> Gottsche	07015/H
Bryophyta (mosses)	
Bryaceae	
39. <i>Bryum coronatum</i> Schwägr.	07008/A

Table 1. Continued

Taxa	Locality and Collector No.
Calymperaceae	
40. <i>Calymperes afzelii</i> Sw.	07001/B, F
41. <i>Calymperes boulayi</i> Besch.	07010/B
42. <i>Calymperes erosum</i> Müll. Hal.	07017/E
43. <i>Calymperes motleyi</i> Mitt. ex Dozy & Molk.	07004/B
44. <i>Exostratum blumii</i> (Nees ex Hampe) L.T. Ellis	07015/F
45. <i>Leucophanes octoblepharoides</i> Brid.	07007/A
46. <i>Leucophanes angustifolium</i> Renauld & Cardot	07014/P
47. <i>Mitthyridium constrictum</i> (Sull.) H. Rob.	07014/J
48. <i>Mitthyridium fasciculatum</i> (Hook. & Grev.) H. Rob. var. <i>cardotii</i> (M. Fleisch.) A. Eddy	07006/N
49. <i>Mitthyridium jungquelianum</i> (Mitt.) H. Rob.	07017/G
50. <i>Mitthyridium repens</i> (Harv.) H. Rob.	07017/F
51. <i>Syrrhopodon croceus</i> Mitt.	07017/C, D
Diphysciaceae	
52. <i>Diphyscium mucronifolium</i> Mitt.	07014/G
Ditrichaceae	
53. <i>Garckea flexuosa</i> (Griff.) Marg. & Nork.	07008/D
Fissidentaceae	
54. <i>Fissidens ceylonensis</i> Dozy & Molk.	07008/C
55. <i>Fissidens guangdongensis</i> Z. Iwats. & Z.H. Li	07009/L
56. <i>Fissidens crispus</i> Mont. var. <i>crispus</i>	07012/B
57. <i>Fissidens javanicus</i> Dozy & Molk.	07014/E
Leucobryaceae	
58. <i>Leucobryum aduncum</i> Dozy & Molk.	07017/A
59. <i>Leucobryum sanctum</i> (Brid.) Hampe	07017/B
Meteoriaceae	
60. <i>Meteoriopsis squarrosa</i> (Hook.) M. Fleisch. ex Broth.	07007/B
Neckeraceae	
61. <i>Himantocladium plumula</i> (Nees) M. Fleisch.	07007/F
62. <i>Homaliiodendron exiguum</i> (Bosch & Sande Lac.) M. Fleisch.	07001/A
63. <i>Neckeropsis gracilenta</i> (Besch. & Sande Lac.) M. Fleisch.	07014/A
Phyllocladaceae	
64. <i>Mniomalina semilimbata</i> (Mitt.) Müll. Hal.	07015/L
Pilotrichaceae	
65. <i>Callicostella prabaktiana</i> (Müll. Hal.) Broth. & Sande Lac.	07014/N
Polytrichaceae	
66. <i>Pogonatum piliferum</i> (Dozy & Molk.) Touw	07014/W
Pylaisiadelphaceae	
67. <i>Isocradiella surcularis</i> (Dixon) B.C. Tan & Mohamed	07014/K

***Leptolejeunea subrotundifolia* Herzog**

Specimen examined: On the peeling bark of *Dillenia indica*. Pócs 07015/K (EGR, PSU).

Distribution: Hitherto known only from Krabi Province, Sa Marakot Reserve in Thailand and in Borneo: Kalimantan Barat (Chantanaorrapint and Pócs, 2014).

***Lopholejeunea horticola* Schiffn.**

Specimen examined: On bark. Pócs 07002/C (EGR, PSU)

Distribution: Only one locality is known from Thailand very near to the above: Phuket Island, near Thalang, Khao Kluay. A rare species known only from Indonesia's Java and Bali and from Thailand, see Figure 4 (Zhu and Gradstein, 2005).

***Microlejeunea filicuspis* (Steph.) Heinrichs, Schäf.-Verw., Pócs & S.Dong**

Oil bodies: 6-7 of the *Calypogeia*-type in the average lobe cells and one large, *Leucolejeunea*-type in the ocelli, see Figure 3D-E.

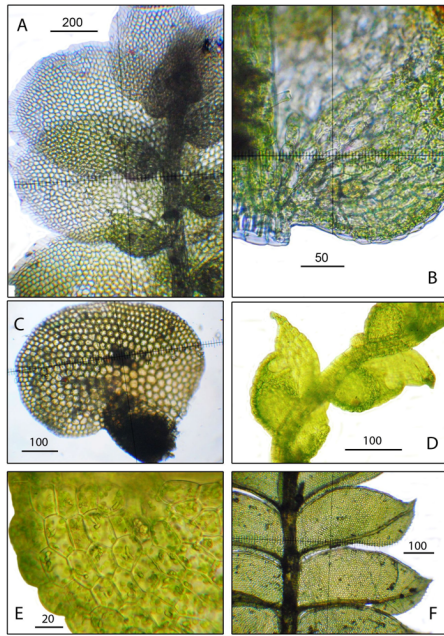


Figure 3. Some bryophytes from new localities (A) and (B) *Cololejeunea stylosa* Steph. from Pócs 07009/B, (A) habit, ventral view; (B) style and part of lobule, ventral view; (C) *Lopholejeunea horticola* Schiffn. from Pócs 07002/C, leaf, ventral view; (D) and (E) *Microlejeunea filicuspis* (Steph.) Heinrichs *et al.* from Pócs 07006/A, (D) habit, ventral view; (E) oil bodies in lobe cells; (F) *Mniomalia semilimbata* (Mitt.) Müll. Hal. from Pócs 07015/L, ventral view (scale bars indicated in μm).

Specimens examined: On trunk of planted betel palm Pócs 07006/A, also on bark of other trees, Pócs 07009/H.

Distribution: New to Thailand. Widespread in tropical Asia and in Australasia to New Zealand (Miller *et al.*, 1983; Piippo, 1990; Grolle and Reiner-Drehwald, 1999) and to Fiji (Pócs *et al.*, 2011), rare in the East African islands (Comoros, Madagascar, Seychelles) (Pócs and Váða, 2015), under the name of *Harpalejeunea filicuspis* (Steph.) Mizut. (See Figure 5).

***Myriocoleopsis minutissima* (Sm.) R.L.Zhu, Y.Yu & Pócs**

Specimen examined: On twigs. Pócs 07007/E (EGR, PSU).

Distribution: Pantropical, penetrating in the warm temperate, oceanic areas. In Thailand, it is known only from Phang Nga Province under the name of *Cololejeunea minutissima* (Sm.) Schiffn. (Thaithong, 1984).

Mosses

***Mitthyridium jungquelianum* (Mitt.) H. Rob.**

Specimen examined: On bark. Pócs 07017/G (EGR).

Distribution: Widely distributed in Malaysia and in the western Pacific, from Malaysia to the Philippines, Australia and New Guinea (Eddy, 1988). Known from Thailand only in Trang Province (Hassama and Chantanaorrapint, 2015).

***Mniomalia semilimbata* (Mitt.) Müll. Hal.**

Specimen examined: On the peeling bark of *Dillenia indica* L. Pócs 07015/L (EGR).

Distribution: In Thailand known only from Trang Province (He, 1995-2015; Hassama and Chantanaorrapint, 2015). Outside Thailand distributed in Peninsular Malaysia (Mohamed *et al.*, 2009), Borneo, Taiwan, Vietnam, Indonesia, Philippines, Carolines, Australia, New Guinea, Bismarck, Solomon and Vanuatu Islands (Miller *et al.*, 1978; Norris and Koponen, 1987) and Fiji Islands, Vanuatu (Müller, 2012).

4. Discussion

Sukkharak and Chantanaorrapint (2014) discussed in very details the history of research in their thorough account on the bryophyte studies in Thailand. They refer to the two recent checklists with account on the bryoflora of Thailand.

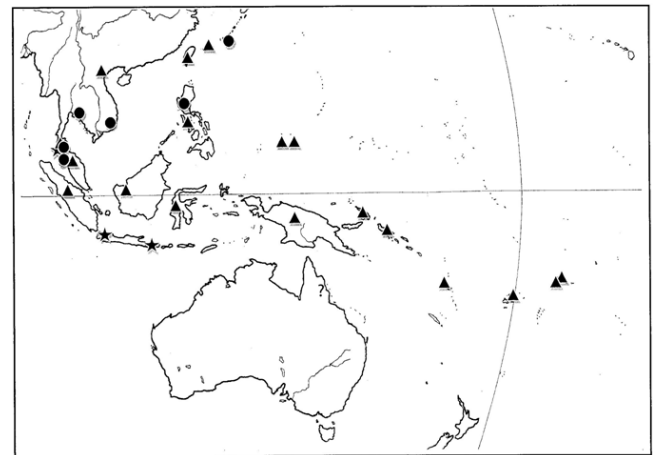


Figure 4. Distribution maps (★) *Lopholejeunea horticola* Schiffn. a Malesian endemic; (▲) *Mniomalia semilimbata* (Mitt.) Müll. Hal., and Indomalaysian species (occurrences in India and Sri Lanka not shown).

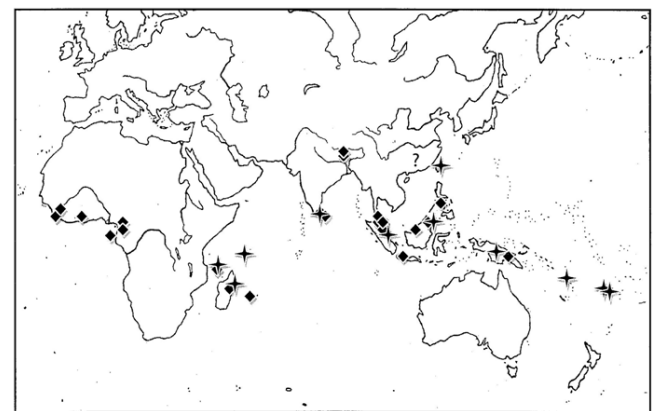


Figure 5. Distribution maps of palaeotropic elements (◆) *Lejeunea papilionacea* Prantl.; (★) *Microlejeunea filicuspis* (Steph.) Heinrichs *et al.*

Accordingly Lai *et al.* (2008) recorded 376 species of liverworts and 12 hornworts while He (1998) recorded 620 species and 31 infraspecific taxa of mosses. Since, by the publications mentioned in the introduction, these numbers raised to 418 liverwort and 15 hornwort species and 686 moss species respectively, taking also in account the new synonyms. The number of taxa hitherto known only from Thailand (prospective endemics) rose from 40 to 43, which is 3.85 %, compared the total number (1,120) of known Thai bryophytes. The rise of known species number (44 liverworts during 17 years and 110 mosses during 27 years) is meaningful, indicating that further intensive research in the bryologically less explored parts of the country may yield still a lot of novelties. As far as the bryophyte habitats are concerned, doubtless the primary rainforests are the richest, but one cannot neglect also the secondary habitats, as betel nut and coconut or oil palm, rubber and other tree crop plantations, where more light is at disposal, supposed that the air humidity is adequate at least for xeric bryoeiphytes.

Acknowledgements

T.P. is grateful to the Hungarian Academy of Sciences for contributing to his travel costs and to his wife, Sarolta (Saci) Pócs for her continuous help in collecting and preparing the specimens.

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