

CHECKLIST OF BRYOPHYTES AT THE SUMMIT OF KHAO LUANG, HUAI YANG WATERFALL NATIONAL PARK, PRACHUAP KHIRI KHAN PROVINCE, THAILAND

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ABSTRACT

A taxonomic survey of bryophytes was conducted in an area with high diversity at the summit of Khao Luang, Huai Yang Waterfall National Park, Prachuap Khiri Khan Province, Thailand, from May 1999 to July 2002, at 1,000 to 1,250 m above mean sea level. A total of 575 specimens were collected. They were determined and classified into 93 species, 59 genera and 33 families, which included 1 species of hornwort, 49 species of mosses and 43 species of liverworts (4 species of thalloid liverworts and 39 species of leafy liverworts). The most common family was Lejeuneaceae, which included 12 species in 8 genera. Plagiochilaceae, Dicranaceae and Frullaniaceae were the next most common families, and included 7, 6 and 6 species, respectively. Of the 93 collected species, there were 50 epiphytes, 32 terrestrials and 11 species dwelling in both habitats. In addition, there were 12 new records for Thailand, viz. *Aerobryopsis subdivergens* (Broth.) Broth., *Drepanolejeunea dactylophora* (Nees *et al.*) Schiffn., *Fissidens bogoriensis* Fleisch., *Lejeunea discreta* Lindenb., *Plagiochila acanthophylla* Gottsche subsp. *japonica* (Sande Lac.) Inoue, *P. javanica* (Sw.) Dumort., *P. microdonta* Mitt., *P. yokogurensis* Steph., *Plagiochilion oppositus* (Reinw., Blume et Nees) S. Hatt., *Rhodrobryum ontariense* (Kindb.) Kindb., *Spruceanthus semirepandus* (Nees) Verd. and *Symphyogynopsis filicum* (Nadeaud) Grolle. Two genera, *Plagiochilion* S. Hatt. and *Symphyogynopsis* Grolle, are new records for Thailand and one species, *Radula caduca* Yamada, is endemic to Thailand. The collected dry specimens are deposited at the Professor Kasin Suvathabhandhu Herbarium, Department of Botany, Chulalongkorn University (BCU), Bangkok.

Key words: bryophyte, diversity, new records, endemic.

INTRODUCTION

Huai Yang Waterfall National Park is located at the narrowest point of the country, in Tubsakae and Bang Saphan Districts, Prachuap Khiri Khan Province. Geographically, this area is a transitional zone from the southwestern to the peninsular floristic region. The park is part of Tanao Sri Range and Khao Luang is one of the high peaks in this mountain range. Vegetation of Khao Luang includes dry evergreen forest at lower elevations and lower montane forest (hill evergreen forest) at higher elevations. Based on their finding of pteridophyte diversity, YUYEN & BOONKERD (2002) pointed out that this area is rich in all plant biodiversity, and may be the northernmost limit of plants from the Malesian element

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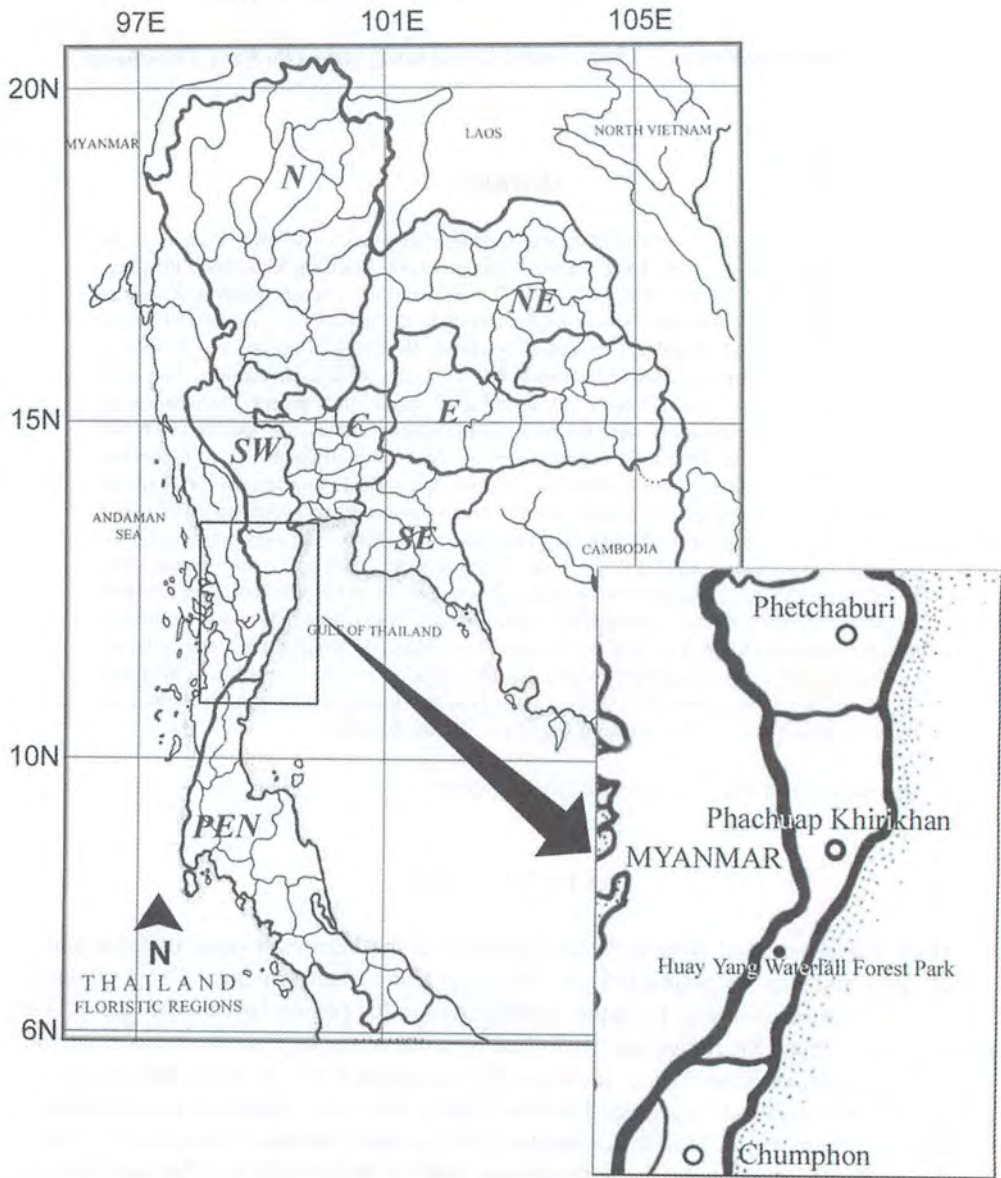


Figure 1. Maps showing the location of Huai Yang Waterfall National Park.

as well as the meeting point of plants from the Indo-Burmese, Indo-Chinese, and Malesian elements. So far the plant diversity of the southwestern floristic region has not been as frequently investigated as that of other parts of the country (HE, 1998). Some botanical expeditions have been made in Kanchanaburi Province, but they mainly focused on vascular plants. It is of interest to explore bryophyte diversity in this area, since knowledge of species diversity as well as geographical distribution of this plant group in this floristic region is rather scarce. This work aimed to conduct a botanical inventory of bryophytes at the summit of Khao Luang, Huai Yang Waterfall National Park, Prachuap Khiri Khan Province.

STUDY SITE

Huai Yang Waterfall National Park, established in 1971, is located in Tanao Sri Range. Khao Luang mountain is the natural border between Thailand and the Union of Myanmar. The park (11°37'–11°41' N; 99°24'–99°37' E) covers approximately 161 km² and occupies parts of 5 subdistricts: Huai Yang, Khao Lan, Sang Arun, Na Hu Kwang and Ang Thong of Tubsakae District, and subdistrict Chaikasame of Bang Saphan District, Prachuap Khiri Khan Province (Figure 1). It is bounded on the north by Hin Chaung Canal in Huai Yang subdistrict, Tubsakae District; on the south by Morasuap Canal in Chaikasame subdistrict; on the east by Tubsakae Reserve Forest, Tubsakae District and Bang Saphan District; and on the west by the Union of Myanmar (PLERDPLING, 2000).

The park ranges in elevation from 100 to 1,250 m at the summit of Khao Luang. Most of the park is mountainous, but plains occur in the valley. Generally, mountain slopes of the park have grades of 10–30%. (PLERDPLING, 2000).

Climatological data from 1972 to 2002 at Prachuap Khiri Khan Climatic Station indicate an average annual temperature of 27.1°C. The average maximum temperature is about 33°C during April and May, and the average minimum of 19.9°C occurred in January (Figure 2). The average annual relative humidity is 78%, while the average maximum relative humidity is 89% and the average minimum relative humidity is 63% (METEOROLOGICAL DEPARTMENT, 2003).

The average annual rainfall is 1,150 mm. The highest average monthly rainfall of approximately 230 mm was observed in October, whilst the lowest monthly rainfall of about 28 mm with only a few rainy days were observed in December, the driest month (Figure 2). The vegetation of Huai Yang Waterfall National Park consists of mixed deciduous forest, dry evergreen forest, tropical evergreen forest and hill evergreen forest (PLERDPLING, 2000).

Khao Luang, one of the high peaks of Tanao Sri Range, ranges in elevation from 1,000 to 1,250 m and covers an area of approximately 3.5 km² or about 2% of the park area (PLERDPLING, 2000). Primary forest is found near the summit. The vegetation there is a lower montane forest, with rich humus soil and high humidity. This area is composed of 4 sub-habitats: 1) humus-rich rocks and grassland in open field; 2) streamlet-bank area; 3) shady valleys with trees more than 15 m tall; and 4) the summit with small trees 8–10 m tall with an open canopy. Heavy rains occurred between May 1999 and July 2002, the period of our specimen collection. This area has higher humidity than climatological data from the provincial capital indicate.

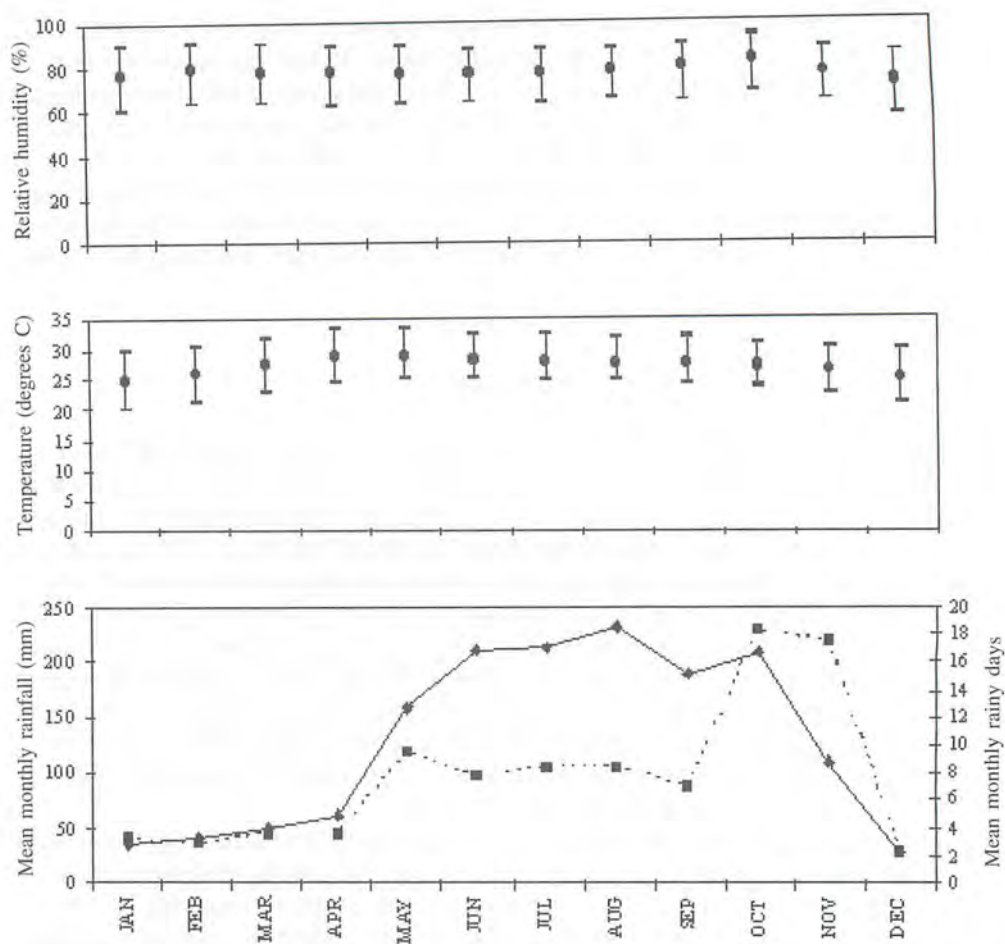


Figure 2. Climatological data during the period, 1973-2003, from Prachuap Khiri Khan Station (Department of Meteorology, 2003). ■-----■ Mean monthly rainfall; ◆-----◆ Mean monthly rainy days

MATERIALS AND METHODS

Clumps of gametophytes and sporophytes of mosses, liverworts and hornworts were collected using a plot-less method. Specimens were gathered along the existing forest trails, extending about 5 m on both sides. A monthly collection schedule was implemented for the field trips during May 1999 through July 2002. Ecological data and some diagnostic characters of each species were noted.

Dried herbarium specimens were prepared as described in BOONKERD *ET AL.* (1987) and deposited at the Professor Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University (BCU). Both internal and external morphological characters were studied. Bryophyte specimens were identified using both keys and descriptions from EDDY (1988, 1990, 1996); ENROTH (1996); HE (1999, 2001,

2002, 2003); HASEGAWA (1983); INOUE (1979); etc. Specimens were compared to voucher herbarium specimens deposited at BCU; BKF; Department of Biology, Faculty of Science, Ramkhamhaeng University (BRU); University of Malaya herbarium (KLU); and the Singapore Botanic Garden Herbarium (SING). Nomenclature and classification of taxa in this research are modified from SCHUSTER (1984).

RESULTS AND DISCUSSION

Five hundred and seventy-five separate numbered samples, each potentially comprising one species, were collected during explorations at the summit of Khao Luang. They were determined and classified into 93 species, 59 genera and 33 families (Appendix). The collection included one species of hornwort, 49 species of mosses in 34 genera within 18 families, and 43 species in 24 genera within 14 families of liverworts. It was also found that 12 out of the 93 species are new records for Thailand.

Common Bryophytes

The bryophytes most commonly encountered in this study belong to five moss families, *i.e.* Dicranaceae, Fissidentaceae, Hookeriaceae, Hypopterygiaceae, and Meteoriaceae. These families are represented by 6, 5, 5, 5, and 5 species, respectively. Three families of liverworts, namely Lejeuneaceae (12 species), Plagiochilaceae (7 species), and Frullaniaceae (6 species) are also common. These findings agree with previous studies in Malaysia (MOHAMED & ROBINSON, 1991). They found that Hypopterygiaceae and Hookeriaceae are typically associated with lower montane forest (hill evergreen forest). SCHUSTER (1980) also noted that Lejeuneaceae and Plagiochilaceae are common families of liverworts in the tropical region.

Rare Species

Most collected bryophytes were found commonly or abundantly throughout the study area, except 4 species, namely, *Fissidens bogoriensis* Fleisch., *Frullania wallichiana* Mitt., *Megaceros flagellaris* (Mitt.) Steph. and *Symphyogynopsis filicum* (Nadeaud) Grolle. They were found only once, each in a small patch. Phytogeographically, these 4 species occur widely throughout Southeast Asia and tropical Asia (HATTORI, 1974; IWATSUKI & SUZUKI, 1982; HASEGAWA, 1983; GROLLE & PIIPPO, 1986). They were found at elevations from 800 to 2,200 m above mean sea level. It seems likely that physical factors such as moisture may play an important role in their presently restricted distribution.

Endemic Species

One species endemic to Thailand, *Radula caduca* Yamada, was also found in the study area. This epiphytic species, growing on tree-trunks, was previously collected from Khao Luang in Nakhon Si Thammarat Province, at 400–1,000 m above mean sea level (YAMADA, 1979). Hence, Huai Yang Waterfall National Park is the northern-most distribution of this endemic species.

New Records

From the literature and the results from this study, there are apparently 12 species which have not been previously recorded from Thailand.

- Aerobryopsis subdivergens* (Broth.) Broth., previously found in Japan and Formosa (NOGUCHI, 1976), occurs on branches of small trees and shrubs.
- Drepanolejeunea dactylophora* (Nees *et al.*) Schiffn., previously found in Australia, China, Indonesia, Japan, Malaysia, Philippines, and Vietnam (ZHU & SO, 2001), is an epiphyllous plant, occasionally growing on other bryophytes.
- Fissidens bogoriensis* Fleisch., recorded from China, Japan, Indonesia, and Philippines (IWATSUKI & SUZUKI, 1982), is found on soil in only one small group.
- Lejeunea discreta* Lindenb., occurring in India, Nepal, Ceylon, Sumatra, Java, Borneo, Molucca, New Guinea, New Caledonia, and Japan (ZHU & SO, 2001), is an epiphyte on tree trunks.
- Plagiochila acanthophylla* Gottsche subsp. *japonica* (Sande Lac.) Inoue, found in Indonesia, Sumatra, Andaman Islands, Celebes, Philippines and Tonkin (INOUE, 1964), is locally abundant on the bases of tree trunks.
- Plagiochila javanica* (Sw.) Dumort., reported once in Indonesia (INOUE, 1969), is also locally abundant on the bases of tree trunks.
- Plagiochila microdonta* Mitt., occurring in Malaysia and Ceylon (INOUE, 1979), is an epiphyte on tree branches.
- Plagiochila yokogurensis* Steph., reported once in Japan (SCHUSTER, 1957), is locally abundant on tree trunks.
- Plagiochilion oppositus* (Reinw., Blume *et* Nees) S. Hatt., found previously in China, Sumatra, Taiwan, Japan, India, Madagascar, East Africa, Bourbon and Hawaii (INOUE, 1964), is locally abundant on tree trunks.
- Rhodrobryum ontariense* (Kindb.) Kindb., previously recorded from China, Malaysia, India and Africa (MOHAMED, 1984), is locally abundant on humus-rich rocks.
- Spruceanthus semirepandus* (Nees) Verd., previously found in Japan, Formosa, China, India, Borneo, Indonesia and Philippines (ZHU & SO, 2001), is locally abundant on tree trunks and branches.
- Symphyogynopsis filicum* (Nadeaud) Grolle, occurring in Malaysia, Indonesia, Papua New Guinea, Tahiti and Fiji (GROLLE & PIIPPO, 1986), is terrestrial at the bases of tree trunks.

In addition to the 12 new recorded species, two genera, viz. *Plagiochilion* S. Hatt. and *Symphyogynopsis* Grolle, are new records for Thailand.

Indicators of Lower Montane Forest (Hill Evergreen Forest)

Most bryophyte species in this study area commonly occur in lower montane forests (hill evergreen forests) at above 1,000 m elevation. Thus, bryophytes are indicators of this forest type, for example *Pleurozia gigantea* (F. Weber) Lindb. and *Rhodrobryum ontariense* (Kindb.) Kindb.



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Figures 3–7. 3, Humus-rich rocks and grassland sub-habitat. 4, A streamlet-bank sub-habitat. 5, The summit sub-habitat of Khao Luang. 6, *Campylopus ericoides*, an epipetric moss. 7, *Leptolejeunea epiphyllus*, an epiphyllous leafy liverwort.



Figures 8–14. Terrestrial mosses (8–10): 8, *Philonotis calomicra*. 9, *Pogonatum neesii*. 10, *Pyrrhobryum spiniforme*. Common species (11–12): 11, *Leucobryum javense* (moss). 12, *Heteroscyphus coalitus* (leafy liverwort). 13, *Frullania wallichiana*, a rare leafy liverwort. 14, *Rhodrobryum ortariense*, a new record moss for Thailand, growing on humus-rich rocks at 1,000 m altitude.

Table 1. Number of bryophyte group species in each habitat

Group of bryophytes	Habitat		
	Epiphyte	Terrestrial	Epiphyte and Terrestrial
Hornworts (1)	-	1	-
Mosses (49)	16	27	6
Liverworts (43)	34	4	5
Total (93)	50	32	11

Habitat and Diversity of Bryophytes

Bryophytes in the study area thrive in two main habitats, epiphytic and terrestrial. Among the 93 species recorded, the most common bryophytes were epiphytes (50 species). A summary of bryophyte diversity and their habitats is shown in Table 1.

Epiphytes are usually found on tree trunks and branches. They may be subdivided according to GRADSTEIN & POCS (1989) into corticolous (on the living bark of tree or shrub), ramicolous (on branches and twigs), epiphyllous (on leaf surfaces) and lignicolous (on rotten logs). Most epiphytic bryophytes in the study area were corticolous, except *Leptolejeunea epiphyllus* (Mitt.) Steph., *Drepanolejeunea dactylophora* (Nees et al.) Schiffn. and *Lejeunea wightii* Lindenb. The first one is epiphyllous, whilst the latter are epiphytic on other bryophytes.

Corticolous epiphytes may become lignicolous when the tree dies with age. Such species include *Bazzania appendiculata* (Mitt.) S. Hatt., *Bazzania tridens* (Reinw., Blume et Nees) Trev., *Leucobryum javense* (Brid.) Mitt., and *Octoblepharum albidum* Hedw.

Generally, the base of tree trunk is the richest in bryophytes diversity, since it is always shaded and cool with consistently high humidity. Further, some of the forest on the mountain peak may be called "cloud forest" because it is frequently enveloped in mist and cloud. This mist condenses on leaves, epiphytes and branches, and runs down over the bark and epiphytes to the bases of tree trunks, thus maintaining a relatively high level of water supply to bryophytes in this microhabitat.

Terrestrial bryophytes usually grow on the forest floor. They may be subdivided according to GRADSTEIN & PÓCS (1989) into terricolous species (growing on soil) and rupicolous species (growing on rocks and concrete). On the forest floor, where there is a layer of leaf litter, few bryophytes are observed. Along forest trails and on earthen banks, where some light penetrates to the ground, terricolous species may grow. *Leucobryum javense* (Brid.) Mitt. and *Pyrrhobryum spiniforme* (Hedw.) Mitt. are commonly seen in thick mats on the soil surface along shaded forest paths, but occasionally they grow on decaying logs and on tree trunks. Most Dicranaceae usually grow on open ground. Other terricolous species are found in shady areas.

Species Composition and Sub-habitats

It was observed that the species composition differs among the four sub-habitats (Appendix). The major differences are described below.

1. *Humus-rich rocks and grassland in open field* (HR). This sub-habitat has low humidity and full sun light; 12 species of bryophytes were found in this area (Appendix). Terrestrial mosses, including 10 species restricted to this area, viz. *Bryum coronatum* Schwägr., *Campylopodium medium* (Duby) Giese & J.-P. Frahm, *Campylopus ericoides* (Griff.) A. Jaeger, *Campylopus* sp., *Dicranella coarctata* (C. Müll.) Bosch & Sande Lac., *Hyophila involuta* (Hook.) A. Jaeger and *Microdus miquelianus* (Mont.) Besch. *Leucobryum javense* (Brid.) Mitt. and *Rhodrobryum ontariense* (Kindb.) Kindb. can also be found in the other sub-habitats. In this sub-habitat, *Campylopus ericoides* (Griff.) A. Jaeger is a dominant species, in contrast *Microdus miquelianus* (Mont.) Besch. was found only once, in just one small group.

2. *Streamlet-bank area* (S). This sub-habitat is rather high in both atmospheric and soil humidity. Light on the forest floor varies from partial shade to deep shade. Most species grow on rock along stream banks; 5 species of bryophytes are restricted to this specific habitat: *Distichophyllum nigricale* Mitt. ex Bosch. & Sande Lac., *Distichophyllum schmidtii* Broth., *Dumortiera nepalensis* (Taylor) Nees, *Fissidens javanicus* Dozy & Molk. and *Megaceros flagellaris* (Mitt.) Steph. However, two species, namely *Heteroscyphus argutus* (Reinw. et al.) Schiffn. and *H. coalitus* (Hook.) Schiffn. can be found in the other sub-habitat (Appendix). Each species mentioned above is usually found in small groups or colonies.

3. *Shady valleys and hill slopes*, have trees more than 15 m tall (VS). This sub-habitat has moderate humidity and shade. This is the main sub-habitat of the study site where 2 distinctive bryophyte groups were found. The first group was growing on humus-rich rocks, while the latter was growing on tree trunks, especially on the bases of tree trunks (Appendix). Among 32 terrestrial species, 24 are confined to this habitat. It was observed that *Fissidens bogoriensis* Fleisch. is rare in this area, while the genus *Plagiochila* is common.

4. *The summit*, with small trees ca. 8–10 m tall with open canopy (SM). This sub-habitat, which is frequently subject to atmospheric cloud and mist to the extent that it might be called “cloud forest”, is high in humidity and the richest in bryophyte diversity. Trees are covered throughout with bryophytes. Fifty-six species were collected from this sub-habitat, of which 43 were restricted to this habitat (Appendix). *Bazzania appendiculata* (Mitt.) S. Hatt. is a common species, whereas *Frullania wallichiana* Mitt. and *Pleurozia gigantea* (F. Weber) Lindb. were found only once in one small group.

Heteroscyphus argutus (Reinw. et al.) Schiffn., *H. coalitus* (Hook.) Schiffn. and *Leucobryum javense* (Brid.) Mitt. are common species, found in three sub-habitats. The first and the second species are flaccid bryophytes, usually growing in moist parts of habitats S, VS and SM. The last one is a robust bryophyte, found in dryer parts of habitats HR, VS and SM.

In addition, 13 species of bryophytes were found commonly from both the valley and the slope sub-habitat and the summit sub-habitat (Appendix). It was observed that these two areas have rather similar physical environment characteristics, such as humidity.

Phytogeography and Distribution

The bryophytes of Thailand can be divided into two phytogeographic regions, the Sino-Himalayan in the North and the Northeast, and the Malayan in the Southwest and the Peninsula (KITAGAWA, 1967; TOUW, 1968; NOGUCHI, 1973; INOUE, 1974; HE, 1998). Huai Yang Waterfall National Park is located on the southwestern floristic region of Thailand. It was found that more than 30 species are commonly distributed in Southeast Asia and tropical Asia, such as *Bazzania tridens* (Reinw., Blume et Nees) Trev., *Bryum coronatum* Schwägr., *Campylopodium medium* (Duby) Giese & J.-P. Frahm, *Campylopus ericoides* (Griff.) A. Jaeger, *Dicranella coarctata* (C. Müll.) Bosch & Sande Lac., *Frullania apiculata* (Reinw. et al.) Dumort., *F. berthoumieuvi* Steph., *Heteroscyphus argutus* (Reinw. et al.) Schiffn. and *H. coalitus* (Hook.) Schiffn. etc.

Hyophila involuta (Hook.) A. Jaeger and *Lopholejeunea subfusca* (Nees) Steph., are among those species widely distributed from the tropical to subtropical, and lowland forest to lower and upper montane forests.

Of the 93 recorded species, two species, namely *Plagiochila javanica* (Sw.) Dumort. and *Symphyogynopsis filicum* (Nadeaud) Grolle (INOUE, 1969; GROLLE & PIIPPO, 1986), are distributed in Malaysia, Indonesia, Papua New Guinea, Tahiti and Fiji (Malesian Element). Likewise, *Plagiochila microdonta* Mitt., occurring in Thailand, is also found in Malaysia and Ceylon (INOUE, 1979).

The summit of Huai Yang Waterfall National Park seems likely to be the meeting point of bryophytes from Sino-Himalayan and the Malesian floristic regions. Geographically, this area is a transitional belt between northern and peninsular Thailand as well as between the Sino-Himalayan and the Malesian floristic. Furthermore, it should be noted that the transitional composition of bryophytes of Huai Yang Waterfall National Park is also in accordance with those of pteridophytes (YUYEN & BOONKERD, 2002) and Orchidaceae (CHANTANAORRAPINT & THAITHONG, 2002).

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Appendix. Bryophyte diversity at the summit of Khao Luang, Huai Yang Waterfall National Park. Note: * = New records; E = Epiphyte, growing on shrubs or trees; T = Terrestrial, growing on soil or humus-rich rocks; HR = humus-rich rocks and grassland; S = streamlet-bank area; VS = shady valleys and slopes with trees more than 15 m high; SM = the summit with small trees ca. 8–10 m and open canopy.

Taxa	Habitat	Sub-habitats
Anthocerotopsida		
Dendroceraceae		
1. <i>Megaceros flagellaris</i> (Mitt.) Steph.	T	S
Bryopsida		
Bartramiaceae		
2. <i>Philonotis calomicra</i> Broth.	T	HR
Bryaceae		
3. <i>Bryum coronatum</i> Schwägr.	T	HR
4. <i>Bryum</i> sp.	T	SM
*5. <i>Rhodrobryum ontariense</i> (Kindb.) Kindb.	E, T	HR, SM
Calyperaceae		
6. <i>Calymperes lonchophyllum</i> Schwägr.	E	VS
7. <i>Calymperes palisotii</i> Schwägr.	T	VS
Dicranaceae		
8. <i>Campylopodium medium</i> (Duby) Giese & J.-P. Frahm	T	HR
9. <i>Campylopus ericoides</i> (Griff.) A. Jaeger	T	HR
10. <i>Campylopus</i> sp.	T	HR
11. <i>Dicranella coarctata</i> (C. Müll.) Bosch & Sande Lac.	T	HR
12. <i>Dicranodontium</i> sp.	E	VS, SM
13. <i>Microdus miquelianus</i> (Mont.) Besch.	T	HR
Fissidentaceae		
14. <i>Fissidens anomalus</i> Mont.	E	VS
*15. <i>Fissidens bogoriensis</i> Fleisch.	T	VS
16. <i>Fissidens hollianus</i> Dozy & Molk.	E	VS
17. <i>Fissidens javanicus</i> Dozy & Molk.	T	S
18. <i>Fissidens</i> sp.	T	HR
Hookeriaceae		
19. <i>Callicostella papillata</i> (Mont.) Mitt.	T	SM
20. <i>Chaetomitrium orthorrhynchum</i> (Dozy & Molk.) Bosch. & Sande Lac.	T	SM
21. <i>Distichophyllum nigricaulis</i> Mitt. ex Bosch. & Sande Lac.	T	S
22. <i>Distichophyllum schmidtii</i> Broth.	T	S
23. <i>Hookeriopsis utacamundiana</i> (Mont.) Broth.	T	SM
Hypopterygiaceae		
24. <i>Cyathophorum adianta</i> (Griff.) Mitt.	E, T	VS, SM
25. <i>Cyathophorum hookerianum</i> (Griff.) Mitt.	T	VS
26. <i>Hypopterygium tamarisci</i> (Sw.) Brid. ex Müll.Hal.	T	VS

Taxa	Habitat	Sub-habitats
27. <i>Lopidium struthiopteris</i> (Brid.) Fleisch	E, T	VS
28. <i>Lopidium trichocladon</i> (Bosch & Sande Lac.) Fleisch.	T	VS
Leucobryaceae		
29. <i>Leucobryum javense</i> (Brid.) Mitt.	E, T	HR, VS, SM
30. <i>Leucobryum bowringii</i> Mitt.	E, T	VS, SM
31. <i>Octoblepharum albidum</i> Hedw.	T	VS, SM
Meteoriaceae		
*32. <i>Aerobryopsis subdivergens</i> (Broth.) Broth.	E	SM
33. <i>Barbella flagellifera</i> (Card.) Nog.	E	SM
34. <i>Meteoriopsis squarrosa</i> (Hook.) Fleisch. ex Broth.	E	SM
35. <i>Meteorium</i> sp.	E	SM
36. <i>Papillaria chrysoclada</i> (C. Müll.) A. Jaeger	E	SM
Neckeriaceae		
37. <i>Homaliodendron exiguum</i> (Bosch & Sande Lac.) Fleisch.	E	VS
38. <i>Homaliodendron flabellatum</i> (Sm.) Fleisch.	E	SM
39. <i>Neckeriopsis fimbriata</i> (Harv.) Fleisch.	E	SM
40. <i>Neckeriopsis lepineana</i> (Mont.) Fleisch.	E	SM
Orthotrichaceae		
41. <i>Macromitrium</i> sp.	E	SM
Polytrichaceae		
42. <i>Pogonatum cirratum</i> (Sw.) Brid.	T	SM
43. <i>Pogonatum neesii</i> (C. Müll.) Dozy	T	SM
Pottiaceae		
44. <i>Hyophila involuta</i> (Hook.) A. Jaeger	T	HR
Racopilaceae		
45. <i>Racopilum cuspidigerum</i> (Schwägr.) Ångstr.	E	VS, SM
Rhizogoniaceae		
46. <i>Pyrrhobryum spiniforme</i> (Hedw.) Mitt.	E, T	VS, SM
Sematophyllaceae		
47. <i>Acroporium</i> sp.1	E	SM
48. <i>Acroporium</i> sp.2	T	SM
Thuidaceae		
49. <i>Thuidium</i> sp.	T	SM
Trachypodaceae		
50. <i>Trachypodopsis</i> sp.	T	HR
Hepaticopsida		
Anuraceae		
51. <i>Riccardia</i> sp.	T	SM
Frullaniaceae		
52. <i>Frullania apiculata</i> (Reinw. et al.) Dumort.	E	SM
53. <i>Frullania berthoumieui</i> Steph.	E	SM
54. <i>Frullania ericoides</i> (Nees) Mont.	E	SM
55. <i>Frullania gaudichoudii</i> Nees & Mont.	E	SM
56. <i>Frullania wallichiana</i> Mitt.	E	SM

Taxa	Habitat	Sub-habitats
57. <i>Frullania</i> sp.	E	SM
Geocalyaceae		
58. <i>Heteroscyphus argutus</i> (Reinw. et al.) Schiffn.	E, T	S, VS, SM
59. <i>Heteroscyphus coalitus</i> (Hook.) Schiffn.	T	S, VS, SM
60. <i>Heteroscyphus splendens</i> (Lehm. & Lindenb.) Grolle	E	SM
Herbertaceae		
61. <i>Herbertus dicrmus</i> (Taylor) Miller	E	SM
Jugermanniaceae		
62. <i>Anastrophyllum piligerum</i> (Nees) Spruce	E	SM
63. <i>Chandoanthus birmensis</i> Steph.	E	SM
64. <i>Notoscyphus paroicus</i> Schiffn.	T	SM
Lejeuneaceae		
*65. <i>Drepanolejeunea dactylophora</i> (Nees et al.) Schiffn.	E	SM
*66. <i>Lejeunea discreta</i> Lindenb.	E	SM
67. <i>Lejeunea sordida</i> (Nees) Nees	E	SM
68. <i>Lejeunea wightii</i> Lindenb.	E	SM
69. <i>Leptolejeunea epiphyllus</i> (Mitt.) Steph.	E	SM
70. <i>Lopholejeunea subfusca</i> (Nees) Steph.	E	VS
71. <i>Mastigolejeunea indica</i> Steph.	E	VS
72. <i>Mastigolejeunea repleta</i> (Taylor) A. Evans	E, T	VS
73. <i>Ptychanthus striatus</i> (Lehm. & Lindenb.) Nees	E	SM
74. <i>Spruceanthus polymorphus</i> (Sande Lac.) Verd.	E	VS
*75. <i>Spruceanthus semirepandus</i> (Nees) Verd.	E	SM
76. <i>Thysananthus planus</i> Sande Lac.	E	VS
Lepidoziaceae		
77. <i>Bazzania appendiculata</i> (Mitt.) S. Hatt.	E	VS
78. <i>Bazzania tridens</i> (Reinw., Blume et Nees) Trev.	E, T	VS, SM
79. <i>Bazzania uncigera</i> (Reinw., Blume et Nees) Trev.	E	SM
Marchantiaceae		
80. <i>Dumortiera nepalensis</i> (Taylor) Nees	T	S
Metzgeriaceae		
81. <i>Metzgeria</i> sp.	E, T	SM
Pallaviciniaceae		
*82. <i>Symphyogynopsis filicum</i> (Nadeaud) Grolle	E, T	VS, SM
Plagiochilaceae		
83. <i>Plagiochila acanthophylla</i> Gottsche subsp. <i>acanthophylla</i>	E	VS
*84. <i>Plagiochila acanthophylla</i> Gottsche subsp. <i>japonica</i> (Sande Lac.) Inoue	E	VS
*85. <i>Plagiochila javanica</i> (Sw.) Dumort.	E	VS, SM
*86. <i>Plagiochila microdonta</i> Mitt.	E	SM
*87. <i>Plagiochila yokogurensis</i> Steph.	E	VS
88. <i>Plagiochila</i> sp.	E	VS
*89. <i>Plagiochilion oppositus</i> (Reinw., Blume et Nees) S. Hatt.	E	SM

Taxa	Habitat	Sub-habitats
Pleuroziaceae		
90. <i>Pleurozia gigantea</i> (F. Weber) Lindb.	E	SM
Radulaceae		
91. <i>Radula caduca</i> Yamada	E	VS
92. <i>Radula perottetii</i> Gottsche ex Steph.	E	VS, SM
Schistochilaceae		
93. <i>Schistochila philippiensis</i> (Mont.) Jack et Steph.	E	SM

