Pteridophyte Flora of Thong Pha Phum National Park, Kanchanaburi Province

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Abstract: A total of 26 families, 69 genera, and 171 species were recorded from Thong Pha Phum National Park, Kanchanaburi Province. Among these, 23 families, 65 genera, and 155 species were ferns, while 3 families, 4 genera and 16 species were fern allies. Among the fern allies, Selaginellaceae had the highest number of species, i.e. 12. Three families of ferns, namely Polypodiaceae, Thelypteridaceae, and Dryopteridaceae were among the common families. Polypodiaceae included 37 species, while Thelypteridaceae and Dryopteridaceae included 25 and 16 species, respectively. It was found that 5 species and 1 variety are new records for Thailand, i.e. *Adiantum philippense* L. var. *subjunonicum* H. Christ, *Arachniodes coniifolia* (Moore) Ching, *Belvisia spicata* (L.f.) Mirbel ex Copel., *Loxogramme centicola* M.G. Price, *Polystichum pseudotsus-simense* Ching and *Polystichum scariosum* (Roxb.) C. Morton. It is important to note that three new records, namely *Arachniodes coniifolia*, *Polysticum pseudotsus-simense*, and *Polysticum scariosum* are found only once and in rather small numbers. These species may be extirpated from the country soon if their present habitats continue to be disturbed.

Key words: Thong Pha Phum National Park, Kanchanaburi Province, ferns and fern allies

Introduction

Thong Pha Phum National Park is located in Kanchanaburi Province, which is a mountainous area in the South-western Thai floristic region. Due to past human activity of mining and logging, resulting in massive deforestation throughout Thong Pha Phum District, it seems likely that this area is not suitable for botanical exploration. So there have been few plant explorations. However, there were some pteridophyte collections in other protected areas of Kanchanaburi Province which recorded 127 species. These species comprised about 20% of the previous records in the Flora of Thailand (Tagawa and Iwatsuki, 1979, 1985, 1988, 1989). It therefore seems likely that this mountainous province is rich in pteridophyte diversity despite a lack of previous information from Thong Pha Phum District. Botanical enumeration of ferns and fern allies at Thong Pha Phum District is scarce and it is necessary to augment biodiversity knowledge, especially pteridophyte diversity of South-western Thailand. The purpose of this present work was to conduct a botanical inventory of ferns and fern allies at Thong Pha Phum National Park, Kanchanaburi Province. The data of pteridophytes obtained from this study may be useful in biodiversity conservation in the near future.

Tagawa and Iwatsuki (1979, 1985, 1988, 1989), Japanese botanists from Kyoto University, studied the existing herbarium specimens of pteridophytes from Thailand and their collection from their own field trips. They enumerated 34 families, 121 genera and 630 species. Their contributions to Thai pteridophytes were published in the Flora of Thailand, Vol. III, Parts 1-4. Next, Boonkerd and Pollawatn (2000) compiled data from various sources as well as from their own field trips to produce a checklist of ferns and fern allies in Thailand. A total of 671 species, 4 subspecies, and 28 varieties belonging to 139 genera and 35 families were enumerated. This checklist included 27 new records for Thailand.

Study site

Thong Pha Phum District covers an area of about 3,655 square kilometers. It is located in Tanao Sri mountain range. It is bounded on the north by Sangkhla Buri District of Kanchanaburi Province, Umphang District of Tak Province, and Ban Rai District of Uthaithanee Province, on the south by Sai Yok District, on the east by Si Sawat District. The park is also a natural border between Thailand and Myanmar in the west. Fig. 1 shows the location of this study site. It is demarcated approximately by the geographical coordinates of 14° 15′ to 15° 00′ north latitude and 98° 15′ to 99° 00′ east longitude (Royal Institute,

2002). Recently, Thong Pha Phum National Park was established covering some parts of the Thong Pha Phum District and covers an area of 1,120 km^2 (Royal Forest Department, n.d.).

In the last six decade, the biodiversity in this area was disturbed by forestry concessions to grant dam construction, a natural gas pipeline and mining. More than 20 mines were allowed to work after issuing mining concessions resulting in massive deforestation throughout the district (N.S. Consultant, 1989). Nowadays, Thong Pha Phum District has more than 20 mines left, covering an area of more than 60 km^2 (Tuleewan, 2000).

The climate of the area is tropical, with high average annual rainfall. Three seasons are observed, i.e. the summer season from February-April, the rainy season from May-October, and the winter season from November-January (Meteorological Department, 2003). The Thong Pha Phum Climatic Station in Kanchanaburi Province is the nearest station.

Climatological data during the period 1973-2003 shows that the average annual relative humidity was about 79%, while the average maximum relative humidity was 93% and the average minimum relative humidity was 56%. The average annual temperature was 26.8°C. The average maximum temperature was 33.4 °C in April and the average minimum temperature was 20.4 °C in December. The average annual rainfall was 1,775 mm. The highest average monthly rainfall of approximately 349 mm, was observed in August. The lowest average monthly rainfall of about 8.4 mm occurred in December, which is usually the driest month (Meteorological Department, 2003).

The vegetation of Thong Pha Phum National Park, is comprised mainly of moist mixed deciduous forest, and hill evergreen forest (Royal Forest Department, n.d.).

Methodology

Field collections of ferns and fern allies were conducted monthly from January 2002 to December 2003 at Thong Pha Phum National Park. Three duplicates of specimens were collected and photographs were taken of each species. Specimens were gathered along existing forest trails, extending about 5 m from both sides. Some specific moist areas were selected for repeat visits, such as Sattamitr Waterfall, Pha Suk pass and nearby sites. Field

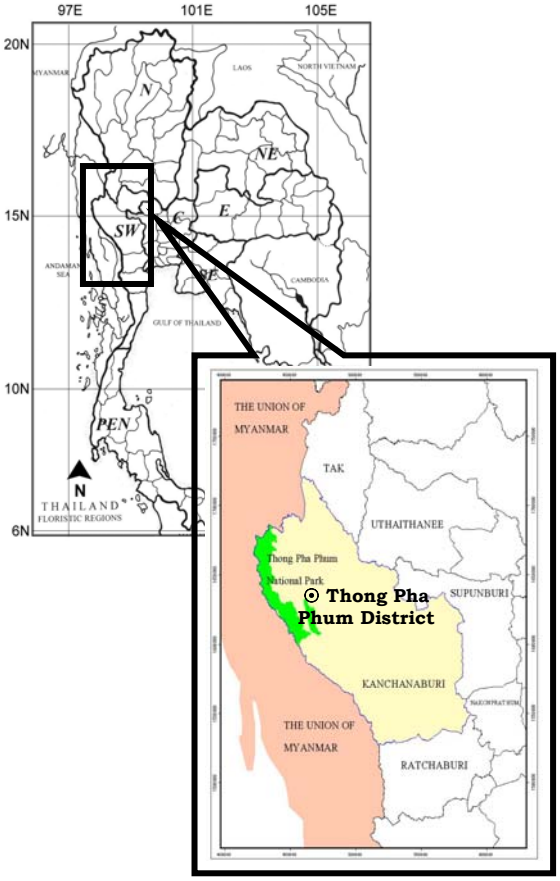

Figure 1. Locations of Thong Pha Phum District and Thong Pha Phum National Park.

notes viz. ecological data, habit, habitat and some diagnostic characters of each species were recorded.

Laboratory study was conducted at the Plants of Thailand Research Unit, Department of Botany, Faculty of Science, Chulalongkorn University. Dry herbarium specimens were prepared as described in Boonkerd et al. (1987) and deposited at BCU. Internal and external morphological characters of each specimen were studied. Pteridophyte specimens were identified using keys and descriptions from taxonomic literatures, such as Floras, manuals, monographs, as well as research papers, etc. Botanical names of each specimen were verified by comparison with voucher herbarium specimens deposited at BCU, BKF, BM, L and K. Authors of scientific names and abbreviations used in this paper are in accordance with the standard procedure for quoting authors of plant names (Brummitt and Powell, 1992). The classification system of pteridophytes in this paper follows that of Boonkerd and Pollawatn (2000).

Results and Discussion

A taxonomic survey of ferns and fern allies at Thong Pha Phum National Park was conducted from January 2002 to December 2003. In all, 515 specimens were collected. A total of 26 families, 69 genera, and 171 species were recorded. Among these, 3 families, 4 genera and 16 species were fern allies (Fig. 2), while 23 families, 65 genera and 155 species were ferns (Fig. 3). Among fern allies Selaginellaceae had the highest number of species, i.e. 12. Three families of ferns, namely Polypodiaceae, Thelypteridaceae, and Dryopteridaceae were among the common families. Polypodiaceae included 37 species, while Thelypteridaceae and Dryopteridaceae included 25 and 16 species, respectively. (Appendix 1).

1. Habitat and Diversity of Ferns and Fern Allies

Specimen collections were mainly focused in abandoned mines, existing forest in abandoned mine sites, hill evergreen forest near Thong Pha Phum National Park Headquarters, Pha Suk pass and nearby sites. The altitudes of these areas ranged from 200 to 1,050 m. The study area is rather a disturbed forest when compared with other protected areas in Kanchanaburi Province. In hill evergreen forest, tree trunks and branches are usually covered with bryophytes and epiphytic pteridophytes. This forest type has rather deep, humus-rich and highly humid soils. Pteridophytes include common families of ferns, such as Polypodiaceae, Thelypteridaceae, Dryopteridaceae and Aspleniaceae. It was found that ferns and fern allies thrive in various habitats, such as terrestrial, on rock (lithophytes), on tree-branches or tree-trunks (epiphytes) and in water (hydrophytes). Moreover, some species occur in more than one habitat.

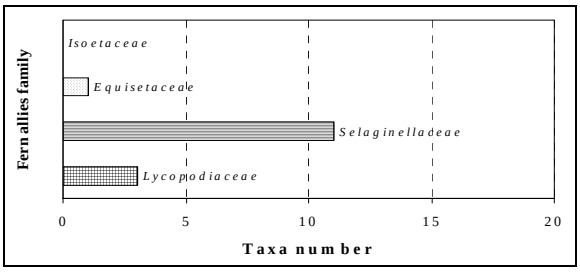

Figure 2. Number of species in each family of fern allies.

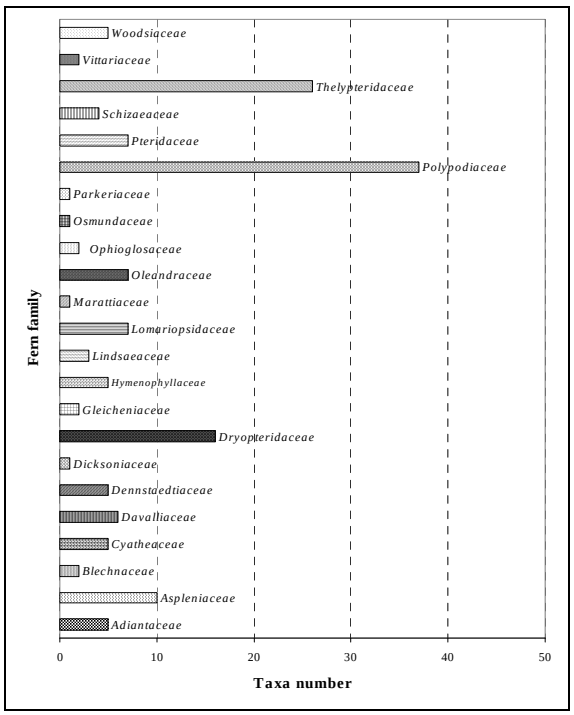

Figure 3. Number of species in each family of ferns.

A rather high pteridophyte diversity at Thong Pha Phum National Park is probably due to the high annual rainfall of about 5,000 mm in the mountainous area of Tavoy in Myanmar and the park area (Bender, 1983; Meteoroligical Department, 2003) which results in high air humidity within the park.

2. Terrestrial plants

It was found that 96 species of pteridophytes were terrestrial plants. Terrestrial habitat includes mountain slopes, shady areas, stream banks and open ground. Common families of ferns and fern allies, such as Selaginellaceae, Dennstaedtiaceae, Dryopteridaceae, Thelypteridaceae, Pteridaceae and Woodsiaceae were found. Most ferns were observed on mountain slopes. The common species included *Adiantum philippense, Cheilanthes tenuifolia, Lygodium polystachyum, Pteris biaurita, Tectaria polymorpha.* These ferns usually occupy humus-rich mountain slopes in shady places. While *Blechnum orientale, Pityrogramma calomelanos, Sphaenomeris chinensis*, can be found on rather dry slopes in semi-shaded areas. Along stream banks, where air humidity is rather high, large terrestrial ferns or tree ferns, such as *Angiopteris evecta, Cibotium barometz* and *Cyathea gigantea* typically grow, while *Cyclosorus interruptus, Pronephrium nudatum,* and *Diplazium esculentum* were found on wet ground, especially along stream banks where sunlight can penetrate to the forest floor. On exposed ground, for example in mine

areas, the two most common terrestrial sun-ferns were *Pteridium aquilinum* var. *wightianum* and *Dicranopteris linearis* var. *linearis*. They form dense long persistent thickets in open places and have become weedy species. Though these two species are sun-loving ferns, they do not normally occur together, because they have different soil preferences. It was found that *Pteridium aquilinum* prefers well-drained soil, whilst *Dicranopteris linearis* grows on clayey soil (Holttum, 1969).

3. Lithophytes

It was found that 23 species of ferns and fern allies were lithophytes. These species grew on bare rocks, humus-rich rocks, muddy rock, in rock crevices or cliffs. Lithophytes were confined to high humidity areas, such as along stream banks. They usually had long creeping rhizomes with numerous clinging roots adhering to the rock surface. Some lithophytes such as *Asplenium apogamum*, *Bolbitis* spp., *Leptochilus minor* and *Trigonospora ciliata* had become established in muddy rock crevices in partial shade. Some filmy ferns such as *Crepidomanes christii*, *Crepidomanes latealatum* and *Hymenophyllum exsertum* inhabit muddy rocks or moist cliffs by streams. On some exposed bare rocks or cliffs, some ferns, for example *Oleandra undulata*, adapt themselves through individual changes of habit coinciding with the changing environment, especially in the dry season. This fern can survive over the dry summer by shedding their fronds in order to reduce transpiration. Some lithophytes, for example, *Pyrrosia lingua*, *Oleandra undulata* have long slender creeping rhizomes; these species are usually found on bare rocks in full sunlight. They can protect the whole plant from water loss by having dense overlapping scales.

4. Epiphytes

It was found that 57 species of ferns and fern allies were epiphytes. In general, these pteridophytes grow on tree trunks, on mossy tree-trunks or on branches of trees. They include common families of ferns, such as Polypodiaceae, Hymenophyllaceae, Aspleniaceae, and Davalliaceae. Examples of common epiphytes are *Huperzia hamiltonii*, *Hymenophyllum polyanthos*, *Aglaomorpha coronans*, *Asplenium yoshinagae*, *Humata repens*, *Oleandra musifolia*, *Araiostegia imbricata*, *Davallia trichomanoides*, *Leucostegia immersa*, and *Crypsinus rhynchophyllus*. In the dry season some epiphytes adapt to withstand the dry summer months by reducing the total transpirational frond surface by shriveling. Species such as *Asplenium perakense*, *Pyrrosia lingua*, and filmy ferns use this strategy to avoid death of the whole plant by desiccation.

5. Aquatic plants

It was found that at least 2 species of ferns and fern allies were restricted to aquatic habitat. Examples included *Equisetum debile* and *Ceratopteris thalictroides*. In addition, *Trigonospora ciliata*, *Microsorum pteropus* and *Leptochilus minor* usually grow on muddy rocks in streamlets or along stream banks. These ferns often experienced and can withstand floods for a considerable period of times, especially during the rainy season. So they tend to be rheophytes.

6. New records

It was found that 5 species and 1 variety are new records for Thailand, i.e. *Adiantum philippense* L. var. *subjunonicum* H. Christ, *Arachniodes coniifolia* (Moore) Ching, *Belvisia spicata* (L.f.) Mirbel ex Copel., *Loxogramme centicola* M.G. Price, *Polystichum pseudotsus-simense* Ching and *Polystichum scariosum* (Roxb.) C. Morton. It is important to note that three newly recorded species, namely *Arachniodes coniifolia*, *Polystichum pseudotsus-simense* and *Polystichum scariosum* were found only once and in rather small numbers. These species may be extirpated from the country soon if their present habitats continue to be disturbed.

7. Unidentified species

Among the 175 taxa, 9 species could not be determined to species due to the lack of fertile structures as well as keys. It seems likely that 3 out of the 9 unknown species are probably newly recorded taxa for Thailand or new to science, viz. 1 species of *Cyathea* and 2 species of *Pteris*, and are worth further investigating.

Cyathea sp.

Trunks about 1.6 m or more tall. *Stipes* green, 40-50 cm long, slightly spiny near base; densely covered with scales; scales dark brown, stiff; pneumathodes distinct, elongate, arranged in a single row; main rachis green, scaly throughout; lower pinnae reduced to 10 cm long, upper pinnae up to 70 cm or more long, 25 cm wide, acuminate at apex; pinnae-rachis scaly; larger pinnules about 2.5 cm apart, 25 in pairs, oblong-lanceolate, to 7 cm long, 1.7

cm wide, gradually narrowing towards acuminate apex, base truncate sessile, lobed nearly to costa; lobes oblique, slightly falcate, round at apex, slightly serrate at margin, to 1 cm long, 3 mm broad; costae scaly throughout; texture papyraceous, deep green, veins simple to forked. *Sori* dorsal on veinlets, close to costules; naked.

Ecology - In semi-shade, along stream in moist mixed deciduous forests at about 750 m altitude.

Pteris sp. I

This unknown species is similar to *Pteris scabripes*, but differs in having undulate margins instead of dentate margins.

Ecology - Terrestrial on damp soil, nearby spring, in mixed deciduous forest, about 650 m altitude.

Pteris sp. II

Rhizome short, erect, bearing a few fronds; scales narrow, concolorous brown, apex long acuminate, up to 3.5 cm long. *Stipe* up to 40 cm long, densely scaly on lower part, light brown. *Lamina* imparipinnate, elliptic to oblong, widest at middle; pinnae simple, lower ones slightly reduced, no auricles, middle pinnae oblong, sessile or subsessile, about 8.5 cm by 1.1 cm, base oblique to rounded or truncate, apex acuminate, margin serrate, terminal pinnae slightly longer, up to 12 cm long; rachis grooved on upper surface, covered with uniseriate multicellular hairs; veins all free or forked. *Sori* marginal, not continuous along margin of pinnae; indusia thin.

Ecology - Terrestrial in fresh water spring at about 250 m altitude.

Note This unknown species is similar to *Pteris vittata*, but differs in having uniseriate multicellular hairs along the rachis and costa; base of pinnae oblique or rounded whereas *Pteris vittata* has cordate base. Sori in *Pteris vittata* usually continuous along margin, but this species has some broken marginal sori.

8. Comparisons with Pteridophytes from other areas

Table 1 shows the numbers of pteridophyte species in 5 protected areas of northern Thailand. It can be seen that species numbers are nearly the same for Doi Inthanon, Doi Suthep-Pui and Thong Pha Phum National Parks. However, the areas of the national parks should be considered. In this case Thong Pha Phum National Park is very much larger than the two important national parks of northern Thailand. It might be expected that if further botanical exploration could be carried out along the Thailand-Myanmar border, there might be some more species found. Anyhow, if we consider the fertility of the areas, it should be noted that Thong Pha Phum National Park has less fertile land since forest disturbance still exists in the area.

Conclusion

In summary, the results from this study indicate that Thong Pha Phum National Park is one of the areas in the country that is rich in pteridophyte diversity despite its previous forest disturbance as compared with the important protected areas of northern Thailand.

Six new records for Thailand and three potential new species were found which are the highest numbers in comparison with other pteridophyte explorations, such as Yuyen and Boonkerd, 2002; Boonkerd and Rachata, 2002; Rattanathirakul and Boonkerd, 2003. So, if there are further botanical explorations in this area, especially in bryophytes and flowering plant, it is expected that the total number of plants species in Thailand will be increased. New records and new species tend to be found in this national park.

Table 1. Pteridophyte diversity in 5 protected areas of northern Thailand and Thong Pha Phum National Park. WS= wildlife sanctuary, NP= national park

Protected area	Altitude (m)	Total area (km^2)	Families	Genera	Species
Doi Chiang Dao WS[1,2,3]	300-2,225	521	18	46	98
Doi Inthanon NP[4]	300-2,565	272	**24**	**67**	**171**
Doi Suthep-Pui NP[5,6]	350-1,685	261	**27**	**65**	**174**
Doi Luang NP[7]	400-1,710	1,170	21	48	87
Khun Korn Waterfall Forest Park[8]	625-1,635	18	24	66	154
Thong Pha Phum National Park	200-1,050	1,120	**26**	**69**	**171**

Notes: [1]Nanakorn (1998); [2]Maxwell (1992); [3]Maxwell (1998); [4]Koyama (1986); [5]Tagawa and Iwatsuki (1979, 1985, 1988, 1989); [6]Maxwell and Elliott (2001); [7]Anusarnsunthorn et al. (1999); [8]Boonkerd and Rachata (2002).

Acknowledgements

Our thanks to the staff of PTT (Petroleaum Thailand) and Thong Pha Phum National Park for their assistance and cooperation during specimen collection. Our sincere thanks go to the curator and staff of BKF, BM, L and K for their kind permission to study pteridophyte specimens. In addition, we would like to thank the Meteorological Department for providing climatological data of Thong Pha Phum Station.

This work was supported by The TRF/BIOTEC Special Program for Biodiversity Research and Training grant BRT R_144021.

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Appendix 1. The Pteridophytes of Thong Pha Phum National Park.
Habit: A = aquatic herb, E = epiphytic herb, L = lithophytic herb, T = terrestrial herb
Habitat: 1 = moist mixed deciduous forest, 2 = disturbed mixed deciduous forest, 3 = hill evergreen forest, 4 = disturbed hill evergreen forest
Abundance: A = abundant, C = common, L = locally abundant, R = rarely found, UC = uncommon

No.	Family	Botanical Name	Habit	Habitat	Abundance
1.	Lycopodiaceae	*Huperzia hamiltonii* (Spreng.) Trevis.	E	4	C
2.		*Huperzia squarosa* (G. Forst.) Trevis.	E	2	UC
3.		*Lycopodiella cernua* (L.) Pic.-Serm.	T	2	A
4.	Selaginellaceae	*Selaginella biformis* A. Braun ex Kuhn	T	2	UC
5.		*Selaginella bisulcata* Spring	T	2	UC
6.		*Selaginella chrysorrhizos* Spring	T	2	UC
7.		*Selaginella delicatula* (Desv. ex Poir.) Alston	L	2	L
8.		*Selaginella helferi* Warb.	T	2	UC
9.		*Selaginella inaequalifolia* (Hook. & Grev.) Spring	T	2	L
10.		*Selaginella lindhardii* Hieron.	T	2	UC
11.		*Selaginella leptophylla* Baker	L	2	L
12.		*Selaginella monospora* Spring	T	2	R
13.		*Selaginella* ornata (Hook. & Grev.) Spring	T	2	UC
14.		*Selaginella willdenowii* (Desv.) Baker	T	2	L
15.		*Selaginella* sp. I	T	2	L
16.	Equisetaceae	*Equisetum debile* Roxb. ex Vauch.	A, T	2	L
17.	Adiantaceae	*Adiantum philippense* L.	T	2	C
18.		*Adiantum philippense* L. var. *subjunonicum* H. Christ	T	2	UC
19.		*Cheilanthes tenuifolia* (Burm. f.) Sw.	T	2	C
20.		*Pityrogramma calomelanos* (L.) Link.	T	2	A
21.		*Taenitis blechnoides* (Willd.) Sw.	T	2	UC
22.	Aspleniaceae	*Asplenium apogamum* N. Murakami et Hatanaka	T	3	UC
23.		*Asplenium confusum* Tardieu & Ching	E	1	R
24.		*Asplenium crinicaule* Hance	E	1	UC
25.		*Asplenium grevillei* Wall. ex Hook. & Grev.	L	1	L
26.		*Asplenium perakense* B. Mathew & H. Christ	E	4	UC
27.		*Asplenium phyllitidis* D. Don	L	1	UC
28.		*Asplenium nidus* L.	L	1	UC
29.		*Asplenium yoshinagae* Makino	E	4	UC
30.		*Asplenium* sp. I	L	1	R
31.		*Asplenium* sp. II	L	1	R
32.	Blechnaceae	*Blechnum orientale* L.	T	2, 4	A
33.		*Brainea insignis* (Hook.) J. Sm.	T	4	UC
34.	Cyatheaceae	*Cyathea borneensis* Copel.	T	2	R
35.		*Cyathea contaminans* (Wall. ex Hook.) Copel.	T	1	UC
36.		*Cyathea gigantea* (Wall. ex Hook.) Holttum	T	1	UC
37.		*Cyathea latebrosa* (C. Presl.) Copel.	T	1	UC
38.		*Cyathea* sp. I	T	1	UC
39.	Davalliaceae	*Araiostegia imbricata* Ching	E	3	UC
40.		*Davallia denticulata* (Burm. f.) Mett. ex Kuhn	E	1	UC
41.		*Davallia solida* (G. Forst.) Sw.	E	1	UC
42.		*Davallia trichomanoides* Blume var. *lorrainii* (Hance) Holttum	E	3	C
43.		*Humata repens* (L. f.) J. Small ex Diels	E, L	3	UC
44.		*Leucostegia immersa* C. Presl	E, L	3	UC
45.	Dennstaedtiaceae	*Histiopteris incisca* (Thunb.) J. Sm.	T	2	UC
46.		*Hypolepis punctata* (Thunb.) Mett. ex Kuhn	T	2	L
47.		*Microlepia hookeriana* (Wall. ex Hook.) C. Presl	T	2	R
48.		*Microlepia speluncae* (L.) T. Moore	T	1, 2	A
49.		*Pteridium aquilinum* (L.) Kuhn var. *wightianum* (J. Agardh) R.M. Tryon	T	2, 4	L
50.	Dicksoniaaceae	*Cibotium barometz* J. Sm.	T	2	UC
51.	Dryopteridaceae	*Arachniodes coniifolia* (Moore) Ching	T	4	R
52.		*Arachniodes henryi* (H. Christ) Ching	T	4	R
53.		*Dryopteris polita* Rosenst.	T	4	R
54.		*Heterogonium gurupahense* (C.Chr.) Holtt.	T	1	R
55.		*Heterogonium sagenioides* (Mett.) Holttum	T	1	R
56.		*Pleocnemia irregularis* (C. Presl) Holttum	T	1	UC

Appendix 1. (continued)

No.	Family	Botanical Name	Habit	Habitat	Abundance
57.		*Polystichum scariosum* (Roxb.) C. Morton	T	4	R
58.		*Polystichum pseudotsus-simense* Ching	T	4	R
59.		*Pteridrys australis* Ching	T	1	L
60.		*Pteridrys syrmatica* (Willd.) C.Chr. & Ching	T	1	L
61.		*Tectaria angulata* (Willd.) C. Chr.	T	1	UC
62.		*Tectaria fuscipes* (Wall. ex Bedd.) C. Chr.	T	1	R
63.		*Tectaria impressa* (Fée) Holttum	T	1	A
64.		*Tectaria polymorpha* (Wall. ex Hook.) Copel.	T	1	C
65.		*Tectaria rockii* C. Chr.	T	1	R
66.		*Tectaria* sp. I	T	1	R
67.	Gleicheniaceae	*Dicranopteris splendida* (Hand.-Mazz.) Tagawa	T	4	L
68.		*Dicranopteris linearis* (Burm. f.) Undrew.	T	2, 4	A
69.	Hymenophyllaceae	*Crepidomanes birmanicum* (Bedd.) K. Iwats.	E	1	L
70.		*Crepidomanes christii* (Copel.) Copel.	E, L	1	UC
71.		*Crepidomanes latealatum* (Bosch) Copel.	E, L	1	UC
72.		*Hymenophyllum exsertum* Wall. ex Hook.	E, L	1	L
73.		*Hymenophyllum polyanthos* (Sw.) Sw.	E	3	L
74.	Lindsaeaceae	*Lindsaea ensifolia* Sw.	T	1	A
75.		*Sphaenomeris chinensis* (L.) Maxon var. *divaricata* (Christ) Kramer	T	1	UC
76.		*Sphaenomeris chinensis* (L.) Maxon var. *rheophila* Kramer	T	2	C
77.	Lomariopsidaceae	*Bolbitis appendiculata* (Willd.) K. Iwats. subsp. *appendiculata*	L	1	UC
78.		*Bolbitis appendiculata* (Wild.) K. Iwats. subsp. *vivipara* var. *vivipara* (Hamilt. ex Hook.) Hennipman	L	2, 3, 4	C
79.		*Bolbitis deltigera* (Bedd.) C. Chr.	L	1	UC
80.		*Bolbitis heteroclita* (C. Presl) Ching	L	1	C
81.		*Bolbitis sinensis* (Baker) K. Iwats. var. *costulata* (Hook.) Tagawa & K. Iwats.	L, T	4	UC
82.		*Bolbitis virens* (Wall. ex Hook. & Grev.) Schott var. *compacta*	L	3	UC
83.		*Elaphoglossum marginatum* (Fée) Moore	E	3	UC
84.	Marattiaceae	*Angiopteris evecta* (G. Forst.) Hoffm.	T	1, 2, 3	C
85.	Oleandraceae	*Nephrolepis biserrata* (Sw.) Schott	T	4	L
86.		*Nephrolepis cordifolia* (L.) C. Presl	T	4	R
87.		*Nephrolepis delicatula* (Decne.) Pic.-Serm.	T	4	R
88.		*Nephrolepis hirsutula* (G. Forst) C. Presl	T	4	L
89.		*Oleandra undulata* (Willd.) Ching	E	3	L
90.		*Oleandra musifolia* (Blume) C. Presl	E	3	C
91.		*Oleandra wallichii* (Hook.) C. Presl	E	3	L
92.	Ophioglossaceae	*Ophioglossum pendulum* L.	E	1	R
93.		*Ophioglossum petiolatum* Hook.	T	2, 4	UC
94.	Osmundaceae	*Osmunda vachellii* Hook.	T	2	R
95.	Parkeriaceae	*Ceratopteris thalictroides* (L.) Brongn.	A	2	UC
96.	Polypodiaceae	*Aglaomorpha coronans* (Wall. ex Mett.) Copel.	E	1, 2, 3, 4	A
97.		*Belvisia henryi* (Hieron. ex C. Chr.) Raymond	E	3, 4	UC
98.		*Belvisia mucronata* (Fée) Copel.	E	3, 4	UC
99.		*Belvisia spicata* (L.f.) Mirbel ex Copel.	E	3, 4	UC
100.		*Colysis hemionitidea* (C. Presl) C. Presl	L	2	UC
101.		*Colysis pedunculata* (Hook. & Grev.) Ching	E	1	UC
102.		*Crypsinus cruciformis* (Ching) Tagawa	E	3	UC
103.		*Crypsinus oxylobus* (Wall. ex Kunze) Sledge	E	3	L
104.		*Crypsinus rhynchophyllus* (Hook.) Copel.	E	3, 4	C
105.		*Drynaria quercifolia* (L.) J. Sm.	E	1	C
106.		*Drynaria rigidula* (Sw.) Bedd.	E	1	C
107.		*Drynaria sparsisora* (Desv.) T. Moore	E	1	UC
108.		*Goniophlebium subauriculatum* (Blume) C. Presl.	E	3, 4	UC
109.		*Lemmaphyllum carnosum* (J. Sm. ex Hook.) C. Presl.	E	4	UC
110.		*Lepisorus bicolor* (Takeda) Ching	E	4	R
111.		*Lepisorus nudus* (Hook.) Ching	E	4	UC
112.		*Lepisorus scolopendrium* (Buch.-Ham. ex D. Don) Mehra & Bir	E	4	UC
113.		*Leptochilus minor* Fée	L	1	L

Appendix 1. (continued)

No.	Family	Botanical Name	Habit	Habitat	Abundance
114.		*Loxogramme centicola* M.G. Price	E	3	UC
115.		*Loxogramme cuspidata* (Zenker) M.G. Price	E	3	UC
116.		*Microsorum nigrescens* (Blume) Pic.-Serm.	E	1	UC
117.		*Microsorum punctatum* (L.) Copel.	E	1	UC
118.		*Microsorum pteropus* (Blume) Copel.	L	1	UC
119.		*Microsorum zippelii* (Blume) Ching	E	1	UC
120.		*Platycerium coronarium* (J.G. Koen. ex C. Muell) Desv.	E	2	R
121.		*Platycerium wallichii* Hook.	E	1, 2	UC
122.		*Pyrrosia adnascens* (Sw.) Ching	E	2	UC
123.		*Pyrrosia albicans* (Blume) Ching	E	2	UC
124.		*Pyrrosia costata* (Presl ex Bedd.) Tagawa & K. Iwats.	E	2	UC
125.		*Pyrrosia lingua* (Thunb.) Farw. var. *lingua*	E	3, 4	L
126.		*Pyrrosia lingua* var. *heteractis* (Mett. ex Khun) Hovenkamp	E	3, 4	C
127.		*Pyrrosia nuda* (Gies.) Ching	E	3, 4	UC
128.		*Pyrrosia nummulariifolia* (Swartz) Ching	E	3	UC
129.		*Pyrrosia piloselloides* (L.) M.G. Price	E	3	UC
130.		*Pyrrosia stigmosa* (Sw.) Ching	E	2, 4	UC
131.		*Pyrrosia varia* (Kaulf.) Farw.	E	1	UC
132.		*Pyrrosia* sp. I	E	4	R
133.	Pteridaceae	*Pteris biaurita* L.	T	1, 2, 3, 4	A
134.		*Pteris longipes* D. Don	T	3	R
135.		*Pteris mertensioides* Willd.	T	1	UC
136.		*Pteris venusta* Kunze	T	2	UC
137.		*Pteris vittata* L.	T	2	A
138.		*Pteris* sp. I	T	1	R
139.		*Pteris* sp. II	T	1	R
140.	Schizaeaceae	*Lygodium flexuosum* (L.) Sw.	T	2	A
141.		*Lygodium microphyllum* (Cav.) R. Br.	T	2, 4	UC
142.		*Lygodium polystachyum* Wall. ex T. Moore	T	1, 2	C
143.		*Lygodium salicifolium* C. Presl	T	1, 2	C
144.	Thelypteridaceae	*Amphineuron opulentum* (Kaulf.) Holttum	T	2	UC
145.		*Amphineuron immersum* (Blume) Holttum	T	2	UC
146.		*Amphineuron terminans* (J. Sm.) Holttum	T	2	UC
147.		*Christella appendiculata* (Presl) Holttum	T	2	UC
148.		*Christella arida* (D. Don) Holttum	T	2	UC
149.		*Christella dentata* (Forssk.) Brownsey & Jermy	T	2	UC
150.		*Christella papilio* (C. Hope) Holttum	T	2	UC
151.		*Christella parasitica* (L.) H. Lev.	T	2	UC
152.		*Christella siamensis* Tagawa & K. Iwats.	T	2	UC
153.		*Christella subelata* (Baker) Holttum	T	2	UC
154.		*Christella subpubescens* (Blume) Holttum	T	2	L
155.		*Cyclosorus hirtisorus* (C. Chr.) Ching	T	2	UC
156.		*Cyclosorus interruptus* (Willd.) H. Ito	T	2	L
157.		*Macrothelypteris ornata* (Wall. ex Bedd.) Ching	T	4	UC
158.		*Macrothelypteris torresiana* (Gaudich.) Ching	T	4	L
159.		*Metathelypteris dayi* (Bedd.) Holttum	T	4	R
160.		*Metathelypteris singalanensis* (Baker) Ching	T	4	UC
161.		*Pneumatopteris truncata* (Poir.) Holttum	T	2	UC
162.		*Pronephrium articulatum* (Houlston & T. Moore) Holttum	T	2	UC
163.		*Pronephrium lakhimpurense* (Rosenst.) Holttum	T	2	UC
164.		*Pronephrium nudatum* (Roxb.) Holttum	T	2	A
165.		*Sphaerostephanos hirtisorus* (C. Chr.) Holtt.	T	2	L
166.		*Sphaerostephanos polycarpus* (Blume) Copel.	T	2	L
167.		*Sphaerostephanos* sp. I	T	1	R
168.		*Trigonospora ciliata* (Wall. ex Benth.) Holttum	L	1	L
169.	Vittariaceae	*Antrophyum callifolium* Blume	L	1	UC
170.		*Vittaria taeniophylla* Copel.	E	1	R
171.	Woodsiaceae	*Anisocampium cumingianum* C. Presl	E	1	R
172.		*Diplazium esculentum* (Retz.) Sw.	T	1, 2	C
173.		*Diplazium donianum* (Mett.) Tardieu	T	3	UC
174.		*Diplazium simplicivenium* Holttum	T	2, 4	UC
175.		*Diplazium tomentosum* Blume	T	1, 3	R