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The Pteridophyte Flora of Khao Khiao, Khao Yai National Park, Thailand

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ABSTRACT.– A total of 113 species and six varieties from 59 genera within 25 families of pteridophytes were recorded from a single transect at the Khao Khiao area in the Khao Yai National Park, Thailand. Among these, three families, four genera and eight species were fern allies, the remaining majority being ferns. Three families of ferns, namely Polypodiaceae, Thelypteridaceae, Dryopteridaceae, were the most frequent families with 17, 13 and 12 species, respectively, although it is of note that most of these species were uncommon or rare. As regard to habit, terrestrials (65 species and two varieties) followed by epiphytes (39 species and two varieties) dominated with fewer lithophytes (21 species and two varieties). Ten and two species of ferns and fern allies, respectively, displayed more than one habit. With respect to habitat, the tropical rain forest section displayed the highest biodiversity (68 and six species of ferns and fern allies, respectively), followed by the hill evergreen forest (50 and two species of ferns and fern allies, respectively) with grassland and secondary forest considerably poorer (12 species two varieties of ferns). Sixteen species and 3 varieties of fern, and four species of fern allies grew in more than one forest type (habitat).

KEY WORDS: Pteridophyte, Ferns and Fern allies, Khao Khiao, Khao Yai National Park, Thailand

INTRODUCTION

Khao Yai National Park was the first national park to be created in Thailand, and recently was included in the list of UNESCO World Heritage sites due to its great diversity in flora and fauna (UNESCO World Heritage Centre, 2005). In general, the park is a mountainous area, with Khao Khiao as one of the high peaks. Though many areas are primary forests, the present grasslands along the road near the Head Quarters area are evidence of human disturbance in the past. The park is an interesting site for fern exploration (Boonkerd, 1996) yet, despite its extensive diversity of vegetation, it has a scarce history of botanical exploration. During the last five decades, most explorations of plant diversity in Khao Yai have been focused

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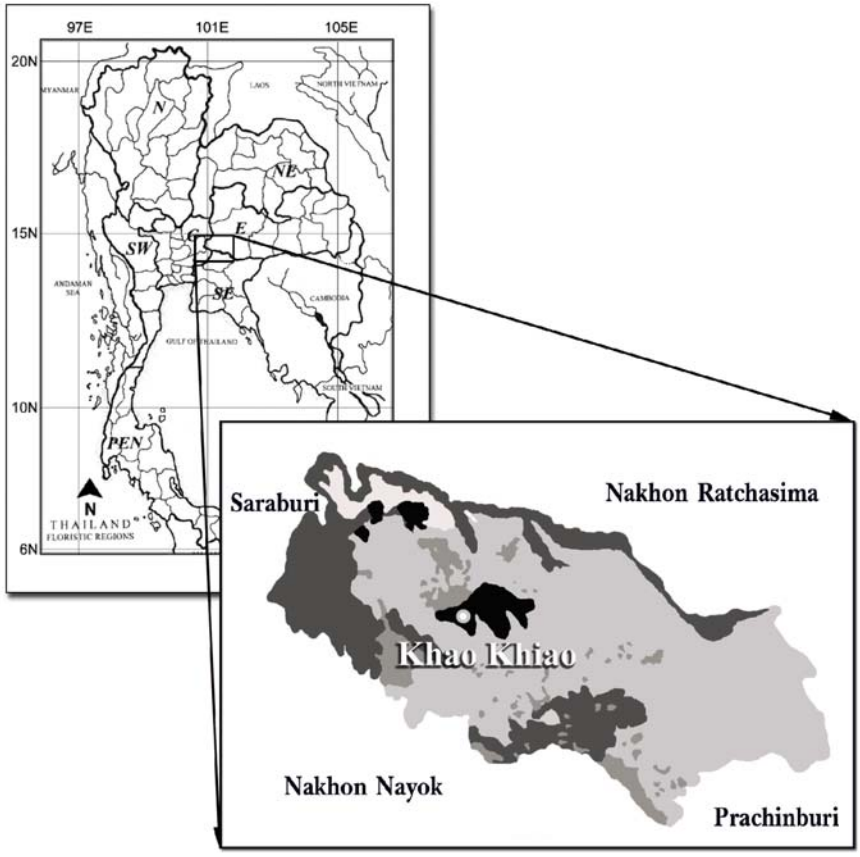

FIGURE 1. Locations of Khao Khiao area, Khao Yai National Park, Thailand.

mainly on flowering plants and usually excluded detailed studies of pteridophytes. The quantity of data relating to pteridophyte diversity in this area is rather small compared with the vast area of the park.

To start to address this deficiency, this study reports on pteridophyte diversity at the Khao Khiao area within the Khao Yai National Park. It is expected that this and subsequent up-to-date and increasingly comprehensive data of pteridophyte diversity will be collected and can be further used for conservation and management of this ferny site.

MATERIALS AND METHODS

Study site

Khao Yai National Park was established in 1962 as the first national park of Thailand, and covers an approximate area of 2,165.55 km^2 lying between latitudes N 14° 05´ and 14° 15´ and longitudes E 101° 05´ and 101° 50´ (Royal Forest Department, n.d.). The park occupies parts of Saraburi, Nakhon Ratchasima and Prachin Buri Provinces in the east, Nakhon Ratcha-sima Province in the north, and Nakhon Nayok Province in the south (Fig. 1).

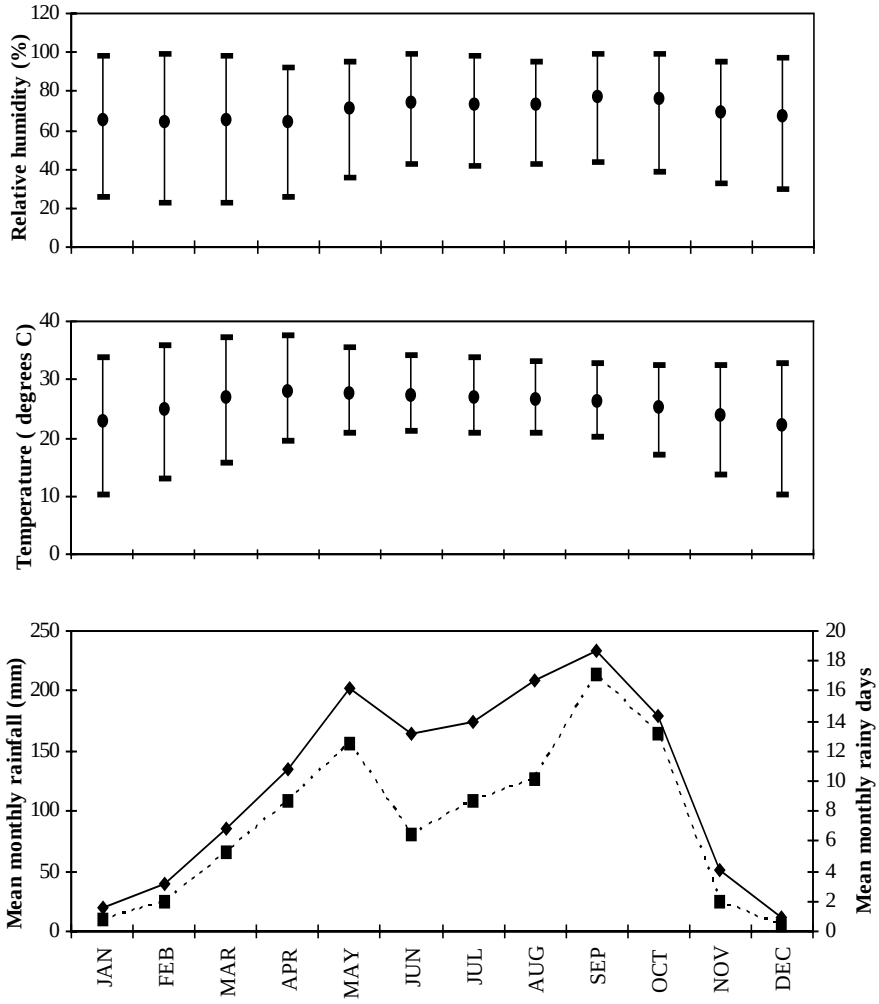

FIGURE 2. Climatological data during the period, 1974-2004, from Pak Chong Agromet Station (Data from the Department of Meteorology, Bangkok, Thailand). (Dark line: rainy days, Dot line: rainfall)

The national park is a mountainous area, part of the Phanom Dongrak Range with altitudes ranging from 250-1,351 m asl. Its highest peaks are Khao Rom (1,351 m), Khao Laem (1,326 m) and Khao Khiao (1,292 m). The vegetation of the park was classified into five principal types, viz. (i) dry evergreen forest, (ii) dry mixed deciduous forest, (iii) tropical rain forest, (iv) hill evergreen forest, and (v) grassland and secondary forest (Smitinand, 1968).

Khao Khiao is in the central part of Khao Yai National Park, at elevations ranging from 600-1,292 m above mean sea level and covering an approximate area of 60 km^2. This mountain is the origin of various waterfalls and streams, i.e. Heo Narok Waterfall, Sarika Waterfall, Nakhon Nayok River (Tourism Authority of

Thailand, 2000). It consists of three principal vegetation types, viz. (i) tropical rain forest, (ii) hill evergreen forest, and (iii) grassland and/or secondary forest, and thus contains examples of the two likely most important habitats for Pteridophyte abundance and biodiversity.

Khao Yai National Park has three main climatic seasons. The summer season is observed during March-April; it is dry and often windy. The rainy season occurs during May-October and the cold season usually starts in November and finishes in February.

The nearest Meteorological station to the study site is Pak Chong Agromet Station, it has data of temperature, humidity and rainfall from 1974-2004. The average annual relative humidity is 70.2% (Fig. 2), with an average maximum and minimum relative humidity of 98.9% in October and 22.9% in February, respectively. The average temperature is about 25.8 °C with an average maximum and minimum temperature of 37.5 °C in April and 10.2 °C in December, respectively. The average annual rainfall is 1,090 mm, with the highest and lowest average monthly rainfalls of 214 mm in September and 5.6 mm in December, respectively, (Meteorological Department, 2004).

Field collections

Field collections of ferns and fern allies were conducted from December 2003 to March 2005 at Khao Khiao, Khao Yai National Park by granting permission from the Royal Forest Department. They were gathered along 12 km of the road number 3182 (Khao Khiao-Pha Trom Jai), extending about 50-100 m from both sides. Three duplicates of complete specimens were collected and photographs were taken.

Dried herbarium specimens were prepared as described in Boonkerd et al. (1987). Morphological characters of ferns and fern allies specimens were studied, then identifications were made using keys and descriptions from the Flora of Thailand, Vol. 3, Part 1-4 (Tagawa and Iwatsuki, 1979, 1985, 1988, 1989) and other taxonomic literature, such as Floras, Manuals, Monographs, research papers, etc., of neighbouring countries.

The collected specimens were confirmed for correct species/variety identity by comparison with the appropriate voucher herbarium specimens that were deposited at BCU, BKF, K, L and P (Herbarium abbreviations according to Holmgrens and Holmgrens, 2007). Authors of scientific names and abbreviations used in this paper follow the conventions covering the author of plant names given in Brummitt and Powell (1992). Classification of ferns and fern allies were according to Boonkerd and Pollawatn (2000). The voucher specimens are deposited at the Professor Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University (BCU) and the Forest Herbarium (BKF), National Park, Wildlife and Plant Conservation Department.

RESULTS

Two hundred and nineteen specimens of ferns and fern allies were collected between December 2003 and May 2005, and determined into 113 species and six varieties, 59 genera, within 25 families. The enumeration of species, together with habit, habitat and abundance of each species are summarised in the Appendix.

Fern biodiversity by far dominated (105 species with two varieties of one species, from 55 genera and 22 families) compared to the relatively scarce fern allies (eight species, four genera and three families). Three fern families were common, in terms of the number of different species rather than abundance, with 17 species from 10 genera for Polypodiaceae, 13 species in 6 genera for Thelypteridaceae, and 12 species in 7 genera for Dryopteridaceae. However, most of the species (11/17, 10/13 and 10/12 for Polypodiaceae, Thelypteridaceae and Dryopteridaceae, respectively) were uncommon or rare, illustrating clear differences between speciousness and abundance in these cases. With regard to habits, there were 61 and four species of terrestrials, 35 and four species of epiphytes and 21 and no species of lithophytes for ferns and fern allies, respectively. However, ten and two species of ferns and fern allies, respectively, could be found in more than one habit and in the above analysis were allocated to their predominant habit. With respect to habitat, when defined purely in terms of species richness, as expected the highest biodiversity was found in the tropical rain forest section (68 and six species of ferns and fern allies, respectively), followed by the hill evergreen forest section (50 species and two species of ferns and fern allies, respectively). Grassland and secondary forest were poor in biodiversity at the species level with 12 species and no species of ferns and fern allies, respectively). Sixteen and four species of ferns and fern allies, respectively, were found in more than one vegetation type (habitat) and have been recorded in the above summary in their predominant habitat.

While this study presents the findings from only a single transect in one region of this large park, and covers only three of the five principal habitat types, it is nevertheless expected to be a useful foundation for continued pteridological research in this botanically important region and provides a minimal, albeit likely underestimated, biodiversity estimate as a basis for future updating and comparison with other sites.

DISCUSSION AND CONCLUSION

Diversity of ferns and fern allies in relation to habit

Ferns and fern allies in the Khao Khiao area of Khao Yai National Park were largely found on either the forest floor (terrestrial), on tree trunks or branches (epiphyte) and on rocks (lithophyte), but ten and two species of ferns and fern allies, respectively, could be found in more than one habit. The distribution with respect to habit is discussed for each principal habitat below.

Terrestrial plants

Sixty one and four species of ferns and fern allies, respectively, were terrestrial plants (Appendix), and this included exposed areas, shady areas, stream banks and hill slopes. In terms of abundance, common fern species are members of Gleicheniaceae (three species), Thelypteridaceae (three species), Dryopteridaceae (three species), Schizaeaceae (two species) and Dennstaedtiaceae (two species). For fern allies, abundant species were members of Selaginellaceae (three species) and Lycopodiaceae (one species). Most species were found in shady areas which were shaded by tree or shrub canopy, such as

Dryopteris subtriangularis. The exposed areas are found along margins of the forests, along stream banks, or disturbed areas resulting from log cutting or road construction. Examples of terrestrial exposed plants included *Lycopodiella cernua* and *Dicranopteris linearis* var. *linearis*. These pteridophytes usually occur on hill slopes; they more or less protect soil erosion by using their penetrating roots. Along stream banks where sunlight can penetrate to the forest floors, some large ferns, e.g. *Angiopteris evecta* and *Pleconemia irregularis* were observed. On shady mountain slopes, high air humidity is frequent during the rainy season. It is usually cloudy and foggy in the morning up to midday. Some terrestrials such as *Selaginella siamensis*, *Asplenium normale* and *Diacalpe aspidioides* can be found in the hill evergreen forest section where such conditions occur. They usually occupy humus rich grounds or rocks. Indeed, *Asplenium normale* and *Diacalpe aspidioides* are common in hill evergreen forests or lower montane forests in Thailand and tend to be indicators of this vegetation type (Boonkerd, 1996).

Epiphytes

Thirty one and three species of ferns and fern allies, respectively, were strict epiphytes whilst an additional four and one species, respectively were principally epiphytes but also found in a lithophytic habit (Appendix). These species grew on tree-trunks, on mossy tree-trunks or on branches of trees. In terms of abundance, common fern species are members of the families Polypodiaceae (five species), Hymenophyllaceae and Aspleniaceae (two species each), and Davalliaceae and Oleandraceae (one species each). In the hill evergreen forest, tree-trunks and branches are usually covered with mosses and leafy liverworts. Common epiphytic pteridophyte species included the ferns *Lepisorus scolopendrium*, *Hymenophyllum polyanthos* and *Humata repens*. In some spots where sun light can penetrate to tree-trunks, a large epiphytic fern *Aglaomorpha coronans* could be observed. In contrast, some small ferns, members of the Grammitidaceae, i.e. *Grammitis dorsipila* and *Prosaptia khasyana*, are restricted to the hill evergreen forest, but in rather small numbers.

In some moist and shady places, such as near waterfalls or streamlets in the tropical rain forest, there are small or medium-sized epiphytes on shrubs or small trees, e.g. *Crepidomanes latemarginale*, *C. minutum*, *Antrophyum callifolium* and *Loxogramme involuta*. These ferns avoid total desiccation of the whole plant during the dry season by shrivelling of fronds, thus reducing transpiration. After the first rains at the beginning of the rainy season their fronds fully expand again.

Lithophytes

Twenty one species of fern, but no fern allies, were found as principal or strict lithophytes, although two fern allied species were found in lithophytic habitat they were from predominantly epiphytic and terrestrial habitats (Appendix). At Khao Khiao, lithophytes usually occupy bare or humus-rich rocks in shady areas. In the hill evergreen forest, ferns and fern allies usually occur in rock crevices or mossy cliffs. They usually have long-creeping rhizomes for extension over rock surfaces or in rock crevices. Examples include *Humata repens*, *Leucostegia immersa*, *Oleandra musifolia*. Among these three species,

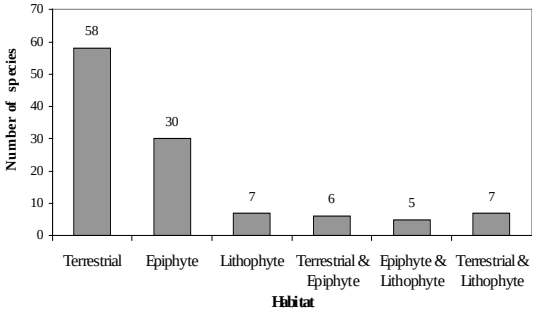

FIGURE 3. Diversity of ferns and fern allies in each habit.

Oleandra musifolia has drought avoidance behaviour. Plants of this species usually shed their fronds to prevent transpiration, hence only long creeping rhizomes with dense scales can be observed during the dry months. In the tropical rain forest, lithophytes usually occurred in high humidity areas such as along stream banks or on muddy rocks in streamlets. Examples include *Bolbitis virens* var. *virens*, *Bolbitis virens* var. *compacta*, *Bolbitis sinensis* var. *sinensis* and *Trichomanes motleyi*. *Microsorum pteropus*, usually found on muddy rocks near waterfalls or in streamlets, can withstand flood conditions for consideration periods and may be more accurately described as a rheophyte (Boonkerd, 1996). In some moist spots where sun-light can penetrate to the forest floor, along streamlet banks, *Adiantum philippense* was observed in clumps on moist or humus-rich rocks.

Some species of both ferns and fern allies were found in more than one habitat (Appendix; Fig. 3). It was found that *Asplenium normale*, *Bolbitis heteroclita*, *Phymatosorus nigrescens*, *Pityrogramma calomelanos*, *Trigonospora ciliata* and *Arachniodes cavalerii* can be terrestrials or lithophytes, whilst other species can be epiphytes or lithophytes, for example *Asplenium yoshinagae*, *Microsorum insigne* and *Oleandra musifolia*.

Diversity of ferns and fern allies and vegetation (habitat)

The vegetation of the Khao Khiao area in Khao Yai National Park includes tropical rain forest, hill evergreen forest, and grassland and/or secondary forest with shared and private fern and fern ally species between each different habitat (Fig. 4), and these are discussed in turn below.

Tropical rain forest

Tropical rain forest was found from 600 to 1,000 m asl elevation. This forest type usually has humid air and soil throughout the year. There are some streamlets in this area and many fern species were observed on the forest floor. With 68 and six species of ferns and fern allies, respectively, growing in the tropical rain forest section this habitat has the highest biodiversity in terms of number of species. Moreover, 52 species and two fern and fern ally species, respectively, were confined to this habitat. This high diversity is probably not only due to the fact that this habitat comprised the largest area among the three forest types but also to the favourable physical factors of this forest type. For example, moisture and temperature are rather stable and high during the day and night, sun light is shaded by the forest canopy making the light intensity and quality more suitable for most ferns and fern allies, and the close and dense canopy created by the growth of trees and shrubs generally prevents wind from penetrating into the forest interior, even at the margins. These physical environments promote growth of most ferns and fern allies and, especially, the terrestrials. The common (in terms of abundance) fern families included Thelypteridaceae (13 species, three common), Polypodiaceae

(nine species, three common) and Pteridaceae (four species, three common), and Dryopteridaceae and Lomariopsidaceae (six and four species, respectively, and one common species each), whilst fern allies were Lycopodiaceae (three species, two common) and Selaginellaceae (two common species). The characteristic species of this forest type included large ferns: *Angiopteris evecta*, *Cibotium barometz*, *Cyathea gigantea*, *Cyathea latebrosa* and *Pleocnemia irregularis*; medium-sized ferns: *Microlepia herbacea*, *Taenitis blechnoides*, *Blechnum orientale*, *Diplazium* spp., *Pteris biaurita* and *Pteris aspericaulis*. They usually grow near moist spots, e.g. stream banks. The common epiphytes comprised *Huperzia phlegmaria*, *Drynaria sparsisora* and *Microsorum punctatum*.

Hill evergreen forest

The hill evergreen forest is found from 1,000 m elevation to the summit of Khao Khiao (1,292 m) and was rich in the number of individuals, but with a lower species biodiversity of pteridophytes than the tropical rain forest section. The hill evergreen forest at Khao Khiao is mainly found on the mountain ridges and covers a much smaller area compared to the tropical rain forest section. Nevertheless, 50 and two species of ferns and fern allies, respectively, were collected and of these 31 fern and both fern ally species were restricted in distribution to the hill evergreen forest. Polypodiaceae (seven species, three common), Hymenophyllaceae (four species, three common) and Aspleniaceae (three common species) were among the fern families with high abundance, and only one fern ally species from Selaginellaceae. Most ferns and fern allies were epiphytes, e.g.

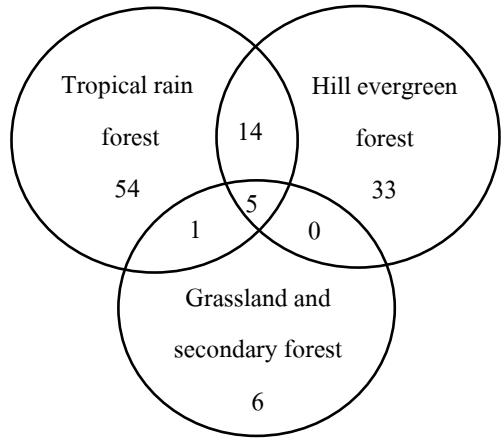

FIGURE 4. Diversity of ferns and fern allies in each vegetation (habitat) shown as the number of species.

Huperzia hamiltonii, *Lepisorus scolopendrium*, *Humata repens*, *Pyrrosia lingua* var. *heteractis*. Some species are well adapted to thrive in dry conditions during the dry season, for example, filmy ferns have lamina which contract for reducing transpiration areas. *Lepisorus scolopendrina* and *Goniophebium* spp. usually shed their fronds. On mossy tree branches or trunks can be seen a member of the Lomariopsidaceae, *Elaphoglossum malayense*. This species has somewhat succulent and light green sterile fronds, and acrostichoid fertile fronds. Its fronds do not shed and can be seen all year round. Among the terrestrial species *Asplenium normale* and *Diacalpe aspidoides* are common. They usually occur in moist and shady areas and can be indicators of this forest type (Boonkerd, 1996).

Grassland and secondary forest

Grassland and secondary forest habitats were also found along highway number 3182. This mixed vegetation type was previously part of the tropical rain forest but was disturbed during construction of the

road to the summit of Khao Khiao and now has an open area with rather low air and soil humidity, conditions which are not favourable for most ferns and fern allies. It is therefore not surprising that only 12 species of ferns were observed, although six of these species were confined to this habitat (Appendix). However, it was surprising to find three members of the Ophioglossaceae, i.e. *Helminthostachys zeylanica*, *Ophioglossum gramineum* and *O. petiolatum*, in grassland. These species are terrestrials of semi-exposed areas, and often occur near the margin of tropical rain forest. So these ferns may be the remnants of the tropical rain forest from the past. In the secondary forest the following species: *Pyrrosia piloselloides*, *Cheilanthes tenuifolia* and *Lygodium microphyllum* were observed. In addition, some species can be found in both grassland and secondary forest: *Pteridium aquilinum* var. *yarrabense*, *Lygodium salicifolium*.

Some species of ferns and fern allies can be found in more than one vegetation type (Fig. 4). Fourteen species such as *Huperzia squarrosa*, *Aglaomorpha coronans* and *Christella parasitica* can be found in both tropical rain forest and hill evergreen forest. *Lygodium salicifolium* can be found in tropical rain forest, grassland and secondary forest. It was found that three fern (*Dicranopteris linearis* var. *linearis*, *Lindsaea ensifolia* and *Pteridium aquilinum* subsp. *caudatum* var. *yarrabense*), and two fern ally (*Lycopodiella cernua* and *Selaginella siamensis*) species can be found in all forest types. However, these species are previously known to also have a wide distribution throughout Thailand (Tagawa and Iwatsuki, 1979).

Rare species

Some species of ferns and fern allies were found in only small numbers, for example *Bolbitis virens* var. *virens*, *Tectaria laotica* and *Microsorum insigne* were found in the tropical rain forest, and *Lindsaea heterophylla* and *Taenitis blechnoides* were found in the hill evergreen forest. The following species were found only once, i.e. *Bolbitis virens* var. *compacta*, *Diplazium esculentum*, *Dryopteris polita*, and *Dryopteris sparsa*.

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APPENDIX

List of the ferns and fern allies at Khao Khiao area in Khao Yai National Park. Habit: terrestrial herb = T, epiphytic herb = E, lithophytic herb = L; Habitat: tropical rain forest = 1, hill evergreen forest = 2, grassland and secondary forest = 3; Abundance: R = rare (1-2 plants were observed in the whole studied area), UC = uncommon (up to 10 plants were observed in the whole studied area), C = common (up to 30 plants were observed in the whole studied area), A = abundant (more than 30 plants were observed and can be found in 2 or more habitats), L = locally abundant (more than 30 plants were observed in one habitat).

Taxon	Habit	Habitat & Abundance
Lycopodiaceae		
Huperzia hamiltonii (Spreng.) Trevis.	E	2, UC
Huperzia phlegmaria (L.) Rothm.	E	1, UC
Huperzia squarrosa (G. Forst.) Trevis.	E	1, 2, UC
Lycopodiella cernua (L.) Pic. Serm.	T	1, 2, 3, A
Selaginellaceae		
Selaginella biformis A. Braun ex Kuhn	T	1, UC
Selaginella roxburghii (Hook. & Grev.) Spring	T, L	2, UC
Selaginella siamensis Hieron.	T	1, 2, 3, A
Psilotaceae		
Psilotum nudum (L.) P. Beauv.	E, L	1, 2, UC
Marattiaceae		
Angiopteris evecta (G. Forst.) Hoffm.	T	1, C
Ophioglossaceae		
Helminthostachys zeylanica (L.) Hook.	T	3, UC
Ophioglossum gramineum Willd.	T	3, UC
Ophioglossum petiolatum Hook.	T	3, UC
Hymenophyllaceae		
Crepidomanes latealatum (Bosch) Copel.	L	1, UC
Crepidomanes latemarginale (Eaton) Copel.	E	1, UC
Crepidomanes maximum (Blume) K. Iwats.	L	2, R
Crepidomanes minutum (Blume) K. Iwats.	E	1, UC
Hymenophyllum barbatum (Bosch) Baker	E	1, UC
Hymenophyllum exsertum Wall. ex Hook.	E	2, C
Hymenophyllum polyanthos (Sw.) Sw.	E	2, C
Trichomanes motleyi Bosch	L	2, C
Gleicheniaceae		
Dicranopteris linearis (Burm.f.) Underw. var. *linearis*	T	1, 2, 3, A

Taxon	Habit	Habitat & Abundance
Dennstaedtiaceae		
Microlepia herbacea Ching & C. Chr. ex Tardieu & C. Chr.	T	1, C
Pteridium aquilinum (L.) Kuhn subsp. *caudatum* (L.) R. M. Tryon var. *yarrabense* Domin	T	1, 2, 3, A
Dicksoniaceae		
Cibotium barometz (L.) J. Sm.	T	1, C
Lindsaeaceae		
Lindsaea chienii Ching	T	2, UC
Lindsaea ensifolia Sw.	T	1, 2, 3, C
Lindsaea heterophylla Dryand.	T	1, R
Lindsaea lucida Blume	T	1, UC
Cyatheaceae		
Cyathea gigantea (Wall. ex Hook.) Holttum	T	1, 2, UC
Cyathea latebrosa (Wall. ex Hook.) Copel.	T	1, 2, UC
Adiantaceae		
Adiantum philippense L.	L	1, L
Cheilanthes pseudofarinosa (Ching & S. K. Wu) K. Iwats.	L	1, UC
Cheilanthes tenuifolia (Burm.f.) Sw.	T	3, C
Pityrogramma calomelanos (L.) Link	T, L	1, 2, UC
Taenitis blechnoides (Willd.) Sw.	T	2, R
Pteridaceae		
Pteris aspericaulis Wall. ex J. Agardh	T	1, C
Pteris biaurita L.	T	1, C
Pteris grevilleana Wall. ex J. Agardh	T	1, UC
Pteris vittata L.	T	1, C
Vittariaceae		
Antrophyum callifolium Blume	E	1, UC
Vittaria angustifolia Blume	E	1, 2, UC
Vittaria elongata Sw.	E	1, 2, UC
Vittaria flexuosa Fée	E	1, 2, UC
Aspleniaceae		
Asplenium apogamum N. Murak. & Hatan.	T	1, UC
Asplenium crinicaule Hance	E	2, UC
Asplenium nidus L.	E	1, UC
Asplenium normale D. Don	T, L	2, C
Asplenium yoshinagae Makino	E, L	2, C
Asplenium sp.	E	1, UC
Blechnaceae		
Blechum orientale L.	T	1, UC

Taxon	Habit	Habitat & Abundance
Lomariopsidaceae		
Bolbitis appendiculata (Willd.) K. Iwats.	L	1, UC
Bolbitis heteroclita (C. Presl) Ching ex C. Chr.	T, E	1, L
Bolbitis sinensis (Baker) K. Iwats.	L	2, L
Bolbitis virens (Wall. ex Hook. & Grev.) Schott var. *virens*	L	1, R
Bolbitis virens (Wall. ex Hook. & Grev.) Schott var. *compacta* Hennipman	L	1, R
Elaphoglossum malayense Holttum	E	2, UC
Woodsiaceae		
Diplazium bantamense Blume	T	1, UC
Diplazium donianum (Mett.) Tardieu	T	1, UC
Diplazium esculentum (Retz.) Sw.	T	1, R
Diplazium simplicivenium Holttum	T	1, UC
Dryopteridaceae		
Arachniodes cavalerii (H. Christ) Ohwi	T, L	2, UC
Diacalpe aspidioides Blume	T	2, C
Dryopteris polita Rosenst.	T	2, R
Dryopteris sparsa (D. Don) Kuntze	T	2, R
Dryopteis subtriangularis (C. Hope) C. Chr.	T	1, 2, C
Heterogonium gurupahense (C. Chr.) Holttum	T	1, UC
Pleocnemia irregularis (C. Presl) Holttum	T	1, UC
Polystichum biaristatum (Blume) T. Moore	T	2, UC
Tectaria fauriei Tagawa	T	1, UC
Tectaria griffithii (Baker) C. Chr.	T	1, UC
Tectaria laotica Tardieu & C. Chr.	T	1, UC
Tectaria sp.	T	2, UC
Thelypteridaceae		
Amphineuron immersum (Blume) Holttum	T	1, R
Amphineuron terminans (J. Sm.) Holttum	T	1, UC
Christella appendiculata (C. Presl) Holttum	T	1, UC
Christella hispidula (Decne.) Holttum	T	1, UC
Christella papilio (C. Hope) Holttum	T	1, UC
Christella parasitica (L.) H. Lév.	T	1, 2, A
Christella subelata (Baker) Holttum	T	1, UC
Christella subpubescens (Blume) Holttum	T	1, UC
Macrothelypteris torresiana (Gaudich.) Ching	T	1, UC
Pneumatopteris truncata (Poir.) Holttum	T	1, UC
Pronephrium nudatum (Roxb.) Holttum	T	1, C
Pronephrium triphyllum (Sw.) Holttum	T	1, C
Trigonospora ciliata (Wall. ex Benth.) Holttum	T, L	1, UC
Davalliaceae		
Davallia sp.	T	2, UC
Davallia trichomanoides Blume var. *trichomanoides*	E	1, 2, UC
Humata repens (L.f.) Diels	E, L	2, L
Leucostegia immersa (Wall. ex Hook.) C. Presl	T, L	2, UC

Taxon	Habit	Habitat & Abundance
Oleandraceae		
Oleandra musifolia (Blume) C. Presl	E, L	2, L
Polypodiaceae		
Aglaomorpha coronans (Wall. ex Mett.) Copel.	E	1, 2, UC
Belvisia annamensis (C. Chr.) Tagawa	E	2, UC
Belvisia henryi (Hieron. ex C. Chr.) Tagawa	E	2, UC
Belvisia mucronata (Fée) Copel.	E	1, 2, UC
Crypsinus oxylobus (Wall. ex Kunze) Sledge	E	2, UC
Drynaria rigidula (Sw.) Bedd.	E	1, UC
Drynaria sparsisora (Desv.) T. Moore	E	1, C
Goniophlebium subauriculatum (Blume) C. Presl	E	2, C
Goniophlebium sp.	L	2, UC
Lepisorus scolopendrium (Buch.-Ham. ex D. Don) Tagawa	E	2, C
Loxogramme involuta (D. Don) C. Presl	E	1, UC
Microsorum insigne (Blume) Copel.	E, L	1, R
Microsorum pteropus (Blume) Copel.	L	1, C
Microsorum punctatum (L.) Copel.	E	1, C
Phymatosorus nigrescens (Blume) Pic. Serm.	E	1, UC
Pyrrosia lingua (Thunb.) Farw. var. *heteractis* (Mett. ex Kuhn) Hovenkamp	E	2, L
Pyrrosia piloselloides (L.) M. G. Price	E	3, UC
Grammitidaceae		
Grammitis dorsipila (H. Christ) C. Chr. & Tardieu	E	2, UC
Prosaptia khasyana (Hook.) C. Chr. & Tardieu	E	2, R