CHAPTER 6

DISCUSSION AND CONCLUSION

Taxonomy of flowering plants in Pha Taem National Park, Ubon Ratchathani Province, had been carried out from May 2001 to August 2002. Three hundred and twenty seven specimens were collected. They were determined and categorized into 107 species, 67 genera and 28 families. Among these, 74 species are dicotyledons and 33 species are monocotytedons. Leguminosae is the largest dicotyledonous family while Orchidaceae is the largest monocotyledonous one, consisting of 11 and 28 species, respectively. In generic level, *Utricularia* (Lentibulariaceae) and *Habenaria* (Orchidaceae) are the two largest genera comprising respectively of 5 and 8 species.

According to their habits, those taxa found in this present investigation can be divided into 11 tree, 18 shrubs, 14 climbers and 64 herbaceous plants.

6.1 Plant diversity in two different habitats.

The Pha Taem National Park is composed of two types of habitats, i.e. the dry dipterocarp forest and the open rock platform. These two areas are quite different in their species composition. There are only 10 species that can be found occupied in both habitats (Table 1).

In dry dipterocarp forest, the dominant tree species are *Dipterocarpus obtusifolius* Teijsm. ex Miq., *D. tuberculatus* Roxb., and *Shorea siamensis* Miq. Other minor tree species such as *Hopea thorelii* Pierre, *Dillenia ovat*a Wall. ex Hook f. & Thomson, *Callerya atropurpurea* (Wall.) Schot are found scattered among the forest. It is noticeably that these tree species are rather short compared to their normal height in descriptions in other literatures. The highest tree is only about 10 meters. This may cause by the shallow depth of soil which is sandy and contains small humus.

Under the tree canopy, the forest is covered by shrubs of the family Sterculiaceae such as *Helicteres hirsutus* Lour. and *Helicteres angustifolia* L., and of the family Leeaceae such as *Leea indica* (Burm.f.) Merr. and *Leea thorelii* Gagnep. Herbaceous plants also found on the ground floors. They are cyclic seasonal change. The most abundant species are terrestrial orchids, *Habenaria lucida* Wall. ex Lindl. and *Spathoglottis affinis* de Vriese; and *Sophora exigua* Craib of the Leguminosae and *Kaempferia filifolia* K. Larsen of the Zingiberaceae. One species of aquatic herb, viz. *Barclaya longifolia* Wall. (Nymphaeaceae) is also found in the stream near Soi Sawan Waterfall, during the rainy season. However, in dry season when most trees

shed their leaves, almost all of these herbaceous ground covers disappear, except *Sophora exigua* Craib which seems to be able to tolerate the hot dry climate.

Climbers that are commonly found are *Entada reticulata* Gagnep. *Argyreia* cf. *laotica* Gagnep., *Argyreia osyrensis* (Roth) Choisy as well and *Hoya kerrii* Craib and *Bauhinia bassacensis* Pierre ex Gagnep. The epiphytes that commonly occupied tree trunks and branches are mostly orchids like *Bulbophyllum blepharites* Rchb.f., *Dendrobium draconis* Rchb.f., and *D. indivisum* (Blume) Miq. Almost all of the orchids found in Pha Taem National Park occur in the dry dipterocarp forest, especially those of epiphytic orchids have never been found in the rock platform area.

Two parasitic plants are found in the dry dipterocarp forest. *Aeginetia indica* L. (Orobanchaceae) is the very common root parasite found in the rainy season, in deep shade area near a small stream. *Tolypanthus lageniferous* (Wight) Tiegh., on the other hand, is very rare. It is also found during the rainy season as a parasite on *Memecylon* sp.

Contrary to the dry dipterocarp forest, the open rock platform is not occupied by the Dipterocarpaceae. They are *Terminalia pedicellata* Nanakorn (Combretaceae) as well as *Peltophorum dasyrhachis* (Miq.) Kurz which play the role as dominant tree species in this platform and has never been found in the dipterocarp forest.

Various kinds of shrubs of different families are abundantly found on the rock platform, i.e. *Droogmansia godefroyana* (Kuntze) Schindl. (Leguminosae), *Holarrhena curtisii* King & Gamble (Apocynaceae), *Helicteres lanata* (Teijsm. & Binn.) Kurz (Sterculiaceae), *Dillenia hookeri* Pierre (Dilleniaceae), *Melastoma pellegrinianum* (H.Boissieu) K.Meyer (Melastomataceae).

Several annual herbs are usually and commonly found on open rock during the rainy season (Table 2), such as *Osbeckia cochinchinensis* Cogn. (Melastomataceae), *Xyris pauciflora* Willd. (Xyridaceae), *Kaempferia filifolia* K. Larsen and *K. larsenii* Sirirugsa (Zingiberaceae). Among those herbs, many of them are carnivorous plants of the family Droseraceae and Lentibulariaceae, that grow abundantly in the rainy season, i.e. *Drosera burmannii* Vahl., *D. indica* L., *D. peltata* Sm.ex Willd., *Utricularia bifida* L., *U. caerulea* L., *U. delphinoides* Thorel ex Pellegr., *U. hirta* Klein ex Link, and *U. minutissima* Vahl. One species of pitcher plants, *Nepenthes thorelii* M.H.Lecomte is also found but rather uncommon in this area. The occurrence of these carnivorous plants may indicate or support that there is small amount of or lack of the nitrogen in the soil on the rock platform.

Only 6 species of orchids are found in this habitat. It is rather surprising that they are all terrestrial. No epiphytic orchid grows on tree trunk or branches of those 3 dominant tree species mentioned above.

Table 2 Flowering periods.

Taxon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Barleria strigosa Willd.								✲	✲	✲	✲	
Psilotrichum ferrugineum (Roxb.) Moq.							✲	✲				
Aganonerion polymorphum Pierre ex Spire							✲	✲	✲			
Alyxia reinwardtii Blume				✲	✲	✲	✲					
Holarrhena curtisii King & Gamble				✲	✲	✲	✲	✲				
Holarrhena pubescens Wall. ex G.Don		✲	✲	✲								
Ceropegia hirsuta Wight & Arn.						✲	✲	✲				
Ceropegia sp.							✲	✲				
Dischidia imbricata (Blume) Steud.		✲	✲	✲								
Hoya kerrii Craib				✲	✲	✲						
Hoya pachyclada Kerr				✲	✲	✲						
Impatiens violaeflora Hook.f.					✲	✲	✲					
Terminalia pedicellata Nanakorn		✲	✲	✲								
Argyreia lanceolata Choisy						✲	✲	✲	✲	✲	✲	
Argyreia cf. *laotica* Gagnep.								✲	✲			
Argyreia osyrensis (Roth) Choisy	✲									✲	✲	✲
Ipomoea pileata Roxb.										✲	✲	✲
Merremia hederacea (Burm.f) Hallier f.										✲	✲	
Merremia verruculosa S.Y.Liu								✲	✲			
Dillenia hookeri Pierre				✲	✲	✲						
Dillenia ovata Wall. ex Hook.f.& Thomson	✲	✲	✲									
Dipterocarpus obtusifolius Teijsm. ex Miq.	✲	✲									✲	✲
Dipterocarpus tuberculatus Roxb.	✲											✲
Hopea thorelii Pierre		✲	✲	✲								
Shorea siamensis Miq.										✲	✲	
Drosera burmannii Vahl							✲	✲	✲	✲	✲	
Drosera indica L.							✲	✲	✲	✲	✲	
Drosera peltata Sm. ex Willd.							✲	✲				
Bauhinia bassacensis Pierre ex Gagnep.	✲									✲	✲	✲
Bauhinia penicilliloba Pierre ex Gagnep.					✲	✲	✲					
Chamaecrista mimosoides (L.) Green										✲	✲	
Chamaecrista pumila (Lam.) K.Larsen										✲	✲	
Dialium cochinchinenese Pierre				✲	✲	✲						
Peltophorum dasyrachis (Miq.) Kurz		✲	✲	✲								
Sindora siamensis Teijsm. ex Miq.		✲	✲	✲								
Entada reticulata Gagnep.						✲	✲					
Callerya atropurpurea (Wall.) Schot		✲	✲	✲								
Droogmansia godefroyana (Kuntze) Schindl.							✲	✲	✲			
Sophora exigua Craib				✲	✲	✲						
Anisochilus harmandii Doan										✲	✲	✲
Pogostemon myosuroides (Roth) El Gazzar & L.Watson	✲											✲
Leea indica (Burm.f.) Merr.							✲	✲	✲			
Leea . rubra Blume ex Spreng.					✲	✲	✲	✲				
Leea thorelii Gagnep.							✲	✲	✲			
Utricularia bifida L.							✲	✲	✲	✲	✲	✲
Utricularia caerulea L.								✲	✲	✲	✲	✲
Utricularia delphinioides Thorel ex Pellegr.									✲	✲	✲	✲
Utricularia hirta Klein ex Link										✲	✲	✲
Utricularia minutissima Vahl							✲	✲	✲	✲	✲	✲
Tolypanthus lageniferus (Wight) Tiegh.							✲	✲				
Melastoma pellegrinianum (H.Boissieu) K.Meyer			✲	✲	✲	✲	✲					

Table 2 Flowering periods (cont.).

Taxon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Osbeckia cochinchinensis Cogn.									✲	✲	✲	✲
Osbeckia thorelii Guillaumin							✲	✲	✲			
Sonerila erecta Jack									✲	✲	✲	
Baeckea cf. *frutescens* L.	✲	✲	✲	✲	✲	✲	✲	✲	✲	✲	✲	✲
Nepenthes thorelii M.H.Lecomte						✲	✲	✲				
Barclaya longifolia Wall.						✲	✲	✲				
Gomphia serrata (Gaertn.) Kanis		✲	✲	✲								
Aeginetia indica L.							✲	✲	✲	✲		
Salomonia thailandica H. Koyama						✲	✲	✲				
Buchnera cruciata Buch.-Ham. ex D.Don									✲	✲	✲	✲
Centranthera cochinchinensis (Lour.) Merr.								✲	✲			
Centranthera siamensis T.Yamaz.							✲	✲	✲	✲	✲	
Centranthera tranquebarica (Spreng.) Merr.							✲	✲	✲	✲	✲	
Lindernia aculeata (Bonati) T.Yamaz.								✲	✲			
Lindernia ciliata (Colsm.) Pennell							✲	✲	✲			
Lindernia crustacea (L.) F.Muell.							✲	✲	✲			
Pseudostriga cambodiana Bonati								✲	✲			
Sopubia fastigiata Bonati							✲	✲	✲			
Torenia fournieri Linden ex E.Fourn.							✲	✲	✲			
Helicteres angustifolia L.					✲	✲	✲	✲	✲	✲		
Helicteres hirsuta Lour.					✲	✲	✲	✲				
Helicteres lanata (Teijsm. & Binn.) Kurz					✲	✲	✲	✲				
Helicteres sp.								✲	✲	✲		
Hypoxis aurea Lour.					✲	✲	✲	✲				
Aerides falcata Lindl.					✲	✲						
Brachycorythis acuta (Rchb.f.) Summerh.						✲	✲	✲				
Bulbophyllum blepharistes Rchb.f.										✲	✲	
Bulbophyllum reclusum Seidenf.										✲	✲	
Cleisomeria pilosulum (Gagnep.) Seidenf. & Garay					✲	✲	✲					
Cleisostoma fuerstenbergianum Kraenzl.								✲	✲			
Coelogyne trinervis Lindl.										✲	✲	
Dendrobium delacourii Guill.				✲	✲	✲	✲					
Dendrobium draconis Rchb.f.					✲	✲	✲					
Dendrobium indivisum (Blume) Miq.					✲	✲	✲					
Dendrobium leonis (Lindl.) Rchb.f.					✲	✲	✲	✲	✲	✲	✲	
Doritis pulcherrima Lindl.							✲	✲	✲			
Eria lasiopetala (Willd.) Omerod									✲	✲	✲	
Eulophia graminea Lindl.	✲										✲	✲
Eulophia siamensis Rolfe ex Downie							✲	✲				
Habenaria dentata (Sw.) Schltr.								✲	✲			
Habenaria godefroyi Rchb.f.							✲	✲				
Habenaria humistrata Rolfe ex Downie						✲	✲					
Habenaria lucida Wall. ex Lindl.							✲	✲				
Habenaria cf. *mandersii* Collet & Hemsl.								✲	✲			
Habenaria rhodocheila Hance						✲	✲	✲				
Habenaria rostrata Wall. ex Lindl							✲	✲				
Habenaria viridiflora (Rottler ex Sw.) R.Br.								✲	✲			
Lusia trichorhiza (Hook.) Blume					✲	✲						
Pecteilis susannae (L.) Raf.								✲	✲			
Peristylus constrictus (Lindl.) Lindl.						✲	✲					
Spathoglottis affinis de Vriese										✲	✲	
Spathoglottis eburnea Gagnep.								✲	✲			
Xyris pauciflora Willd.							✲	✲	✲	✲	✲	✲
Gagnepainia thoreliana (Baill.) K.Schum.					✲	✲						
Kaempferia filifolia K.Larsen						✲	✲					
Kaempferia larsenii Sirirugsa						✲	✲					

6.2 New recorded, endemic and uncommon species in the Pha Taem National Park

According to this present study, 4 plants are reported here as new recorded taxa to Thailand viz. *Ceropegia hirsuta* Wight & Arn. (Asclepiadaceae), *Merremia verrucolosa* S.Y.Liu. (Convolvulaceae), *Habenaria* cf. *mandersii* Collet & Hemsl. (Orchidaceae) and *Tolypanthus lageniferus* (Wight) Tiegh. (Loranthaceae) All of them are also uncommonly found.

Ceropegia hirsuta Wight & Arn. was previously reported only from India (Ansari, 1984). Its occurrence in Ubon Ratchathani might suggest its wide distribution from the Indian subcontinent to the Indo-china. However, this species together with another unidentified *Ceropegia*, are found scattered only one time in the dry dipterocarp forest in Pha Taem National Park.

Merremia verrucolosa S.Y.Liu was previously described only in Flora of China. It is found in Guanxi (Fang, R. C. and G. Staples, 1995). Due to the additional data from the present exploration, its distribution might be extended southward to Thai. Thus, it is supposed to be found in Laos and Cambodia as well.

Habenaria cf. *mandersii* Collet & Hemsl. is formerly reported its distribution in Myanmar and Laos (Seidenfaden, 1977, 1992). Thus, there should be a tendency to find this species in Thailand too. The Pha Taem's specimen has a little bit difference in the apex of the tongue from the description of Seidenfaden (1977, 1992) However, I still treat it here, with some hesitation, as a new recorded species.

Tolypanthus is treated here as a new recorded genus for Thailand. The former distribution of this genus is reported only from India and Sri Lanka (Hooker, 1886; Weins, 1987). The name *Tolypanthus lageniferus* (Wight) Tiegh. is, however, determined for the Pha Taem's specimens with some hesitation because there is only one publication which has short description.

From the literatures available, there are 6 endemic species to Thailand found in Pha Taem National Park. They are: *Centranthera siamensis* T.Yamaz., which was previously reported from Loei and Kanchanaburi (Yamazaki, 1990), *Eulophia siamensis* Rolfe ex Downie, that was formerly recorded from Chiang Mai, Mae Hong Son, Nakhon Ratchasima and Sri Sa Ket (Seidenfaden, 1983), *Habenaria humistrata* Rolfe ex Downie from Chiang Mai and Chaiyaphum, *Bulbophyllum reclusum* Seidenf. from Sakol Nakhon and two species of *Kaempferia*, *K. filifolia* K.Larsen reported from Nakhon Panom, Roi Et, and also Ubon Ratchathani, and *K. larsenii* Sirirugsa the endemic species for Ubon Ratchathani (Sirirugsa, 1992).

Since, this national park is very closed to Laos and Cambodia, so there is a high probability to find these 5 endemic species in these two neighboring countries and also *Ceropegia hirsuta* Wight & Arn., *Merremia verrucolosa* S.Y.Liu, *Tolypanthus lageniferus* (Wight) Tiegh. and *Luisia trichorrhiza* (Hook.) Blume, which have never been recorded from Laos and Cambodia either.

Apart from those new recorded species mentioned above, *Impatiens violaeflora* Hook.f. and *Sonerila erecta* Jack, are uncommonly found in small populations. The former species is found only on the cliff where high moisture is present and the latter species limitedly occupied only the bank of the small stream.

Even though many orchid species occur in this national park, but a number of species and populations are rather scarce. Some of them are found only once and never been found again or found in very small population, such as *Cleisomeria pilosulum* (Gagnep.) Seidenf. & Garay, *Habenaria dentata* (Sw.) Schltr., *Habenaria godefroyi* Rchb.f., *Habenaria humistrata* Rolfe ex Downie, *Habenaria viridiflora* (Rottler ex Sw.) R.Br., *Pecteilis susannae* (L.) Raf., and *Spathoglottis eburnea* Gagnep.

6.3 Probable New Species

According to the taxonomic data of *Helicteres* published in Flora of Thailand vol. 7 part 3, there are 7 species of *Helicteres* reported in Thailand (Phengklai, 2001). Specimens of unidentified *Helicteres* (T. Boonjaras, 110 and 262) collected from the dry dipterocarp forest between Soi Sawan Waterfall and Pha Jek cliff, are not resemble to any taxa described in Flora of Thailand. They are also not fit with any *Helicteres* species described in any available Floras of neighboring countries. Thus, it has high tendency to be a new species.

According to the floral characters (corolla, color, size, stigma, and indumentum on gynandrophore), it is rather similar to *H. lanata* (Teijsm. & Binn.) Kurz, but its cordate or orbicular leaves (Fig.76) are very much different from ovate-lanceolate leaves of *H. lanata* (Teijsm. & Binn.) Kurz (Fig. 75). Its leaves, however, are more similar to those of *H. isora* (L.), but its fruits are not twisted and other floral characters are different too. On the other hand, its fruit are more or less similar to those of *H. hirsuta* Lour., but the latter species has distinctly oblique leaves.

6.4 Diversity comparison to Pa Hin Ngam

There are very less studies in the floras of the northeastern or nearby regions in Thailand. And those studies seem to be fragmented and not so completed. So the comparison of the flora or the vegetation is rather difficult.

Even Pa Taem National Park and Pa Hin Ngam Forest Park, Chaiyaphum province, resemble to each other in the forest type. They composed of the dry dipterocarp forest intermingled with rock platform and also bearing windy, high rock cliff. However, the altitude of Pa Hin Ngam, is much higher than Pha Taem's (600-850 versus 250-300 m from sea level). The species composition of these two parks is quite different as evidence by only 26 common species are found in both places (Table 3). The dominant tree species in the dipterocarp forest of Pa Hin Ngam are quite different from Pha Taem (สมราน สุดดี, 2538). Except *Dipterocarpus obtusifolius* Teijsm & Miq., other dominant species, i.e. *Tristaniopsis burmannica* (Griff.) Peter G. Wilson & J. T. Waterhouse var. *rufescens* (Hance) J. Parn. & Nic Lughadha, *Albizia attopeuensis* (Pierre) I.C.Nielsen , *Syzygium helferi* (Duthie) P. Chantaranothai & J. Parn., *Castanopsis argyrophylla* King have never been found in Pa Taem. The great overlapping of species diversity found in these two park are mostly carnivorous plants of the family Droseraceae, Lentibulariaceae, and also herbaceous plants and shrubs of the family Scrophulariaceae, Lamiaceae, Sterculiaceae and Apocynaceae.

Table 3. Common species found in both Pha Taem and Pha Hin Ngam.

Family	Taxon
APOCYNACEAE	*Alyxia reinwardtii* Blume
	Holarrhena curtisii King & Gamble
	Holarrhena pubescens Wall. ex G.Don
ASCLEPIADACEAE	*Hoya kerrii* Craib
CONVOLVULACEAE	*Argyreia lanceolata* Choisy
	Merremia verruculosa S.Y.Liu
DIPTEROCARPACEAE	*Dipterocarpus obtusifolius* Teijsm. ex Miq.
DROSERACEAE	*Drosera burmanii* Vahl
	Drosera peltata Sm. ex Willd.
FABACEAE (LEGUMINOSAE)	*Droogmansia godefroyana* (Kuntze) Schindl.
LAMIACEAE (LABIATAE)	*Anisochilus harmandii* Doan
	Pogostemon myosuroides (Roth) El Gazzar & L.Watson
LEEACEAE	*Leea indica* (Burm.f.) Merr.

Table 3. Common species found in both Pha Taem and Pha Hin Ngam. (Cont.).

Family	Taxon
LENTIBULARIACEAE	*Utricularia bifida* L.
	Utricularia caerulea L.,
	Utricularia delphinioides Thorel ex Pellegr.
	Utricularia hirta Klein ex Link
MELASTOMATACEAE	*Osbeckia cochinchinensis* Cogn.
	Sonerila erecta Jack
OROBANCHACEAE	*Aeginetia indica* L.
SCROPHULARIACEAE	*Buchnera cruciata* Buch.-Ham. ex D.Don
	Centranthera cochinchinensis (Lour.) Merr.
	Centranthera siamensis T.Yamaz.
	Torenia fournieri Linden ex E.Fourn.
STERCULIACEAE	*Helicteres angustifolia* L.
	Helicteres hirsuta Lour.

6.5 Problems and suggestions

Open rock platform in the Pha Taem National Park is an interesting habitat. Even it seems to be arid area, though there are a number of particular species, which have never been found in other parts of the park, inhabitable here, especially those of carnivorous plant, as mentioned above. During my expedition, I have found that villagers always bring hundreds of cattle into the park and let these animals freely roam into the open rock platform. They then feed on small shrubs, climbers and herbaceous plants. Without any control, this activity may affect the depletion of plant diversity in this national park in the future.

Due to the limitation of study time, the diversity of flowering plants of Pha Taem National Park is somehow not yet complete in the present study. There are about 26 known species that are not included in this report together with more than 50 unidentified taxa.

Further exploration in this national park and also the areas along the Khong River are seriously needed to the completion of plant diversity along the east border of Thailand. Then, it will give more taxonomic data about species composition of the vegetation in this national park and also the distribution of Thai plants. Comparison with other areas in species richness or compositions will then give more accurate analysis.