

CHAPTER III

VEGETATION OF DOI PHU KHA NATIONAL PARK

METHODOLOGY

Relevant literature and information concerning vegetation of Thailand, including those of Credner (1935), Ogawa et al. (1961), Royal Forest Department (1962), Williams (1965), Neal (1967), Smitinand et al. (1978), Santisuk (1988), Smitinand (1989), Nanakorn (1996, 1997, Undated), Maxwell (2001) and Pooma & Barford (2001) have been gathered and studied. Description of the classification of vegetation of northern Thailand by Smitinand et al. (1978), Santisuk (1988), Maxwell (2001) and Pooma & Barford (2001) are reviewed and compared as shown in Chapter II.

Vegetation of Doi Phu Kha National Park is described by empirical classification based on floristic composition, elevation and other closely related environmental factors such as edaphic, geological information, topography, climate, moisture, human activities, etc. Ground surveys are made throughout the park during the regular botanical expeditions. Systems derived from Smitinand et al. (1978) and Santisuk (1988) have been used as general references and modified where appropriate. Srisanga (2003) is a preliminary study on the vegetation of Doi Phu Kha National Park.

RESULTS

Vegetation of Doi Phu Kha National Park can be classified into two main forest types: four evergreen categories and two deciduous categories. Secondary forest due to effect from human activities is described. Dominant floristic components in each forest type are mentioned.

Evergreen Forest

1. Dry Evergreen Forest
2. Pine Forest
3. Lower Montane Forest
4. Lower Montane Scrub

Deciduous Forest

5. Deciduous Dipterocarp Forest
6. Tropical Mixed Deciduous Forest

Evergreen Forest

Evergreen tree species are the main tree component of this forest, which do not shed their leaves. The canopy is more or less closed except in the lower montane scrub, where trees are noticeably scarce, with low shrubs and herbaceous plants being dominate. The forest ranges from the lowlands at elevation ca. 600 m up to 1,980 m a.s.l.

1. Dry Evergreen Forest

The dry evergreen forest is also known as seasonal rain forest (Santisuk, 1988; Pooma & Barford, 2001) or semi-evergreen forest (Smitinand, 1989). This forest is more dry and wilted in appearance, thus the name “dry evergreen forest” is retained here (Smitinand et al., 1978). Dry evergreen forest is dominated by various kinds of evergreen trees scattered mixed with deciduous trees in the canopy. There are three-storied in profile. Shrubs and climbers are frequently found. Ground floras are mainly characterized by herbaceous plants. Grasses are not the main species in ground layer. The characteristic high soil moisture is of great significance. The forest occurs in humid foothills, slopes, valleys or along streams (Figs. 11-12). It represents evergreen forest in the lowland area, between ca. 600-1,100 m a.s.l., and at intermediate elevations between moist deciduous forest and lower montane forest. The dry evergreen forest is found scattered throughout the park and is one of the forests subjected to shifting cultivation by highland Thais and hill tribe minorities.

The upper story consists of *Aphanamixis polystachya* (Wall.) R. Parker, *Elaeocarpus varunua* Buch.-Ham. ex Mast., *Erythrina subumbrans* (Hassk.) Merr., *Ficus* spp., *Garuga pinnata* Roxb., *Hopea odorata* Roxb., *Lagerstroemia* sp., *Michelia baillonii* (Pierre) Finet & Gagnep., *Nyssa javanica* (Bl.) Wang., *Semecarpus* sp. and *Syzygium cumini* (L.) Skeels.

The middle story consists of *Apodytes dimidiata* E. Meyer ex Arn., *Archidendron clypearia* (Jack) I.C. Nielsen, *Averrhoa carambola* L., *Castanopsis armata* (Roxb.) Spach, *Chionanthus mala-elengi* (Dennst.) P.S. Green subsp. *terniflorus* (Wall. ex G. Don) P.S. Green, *Diospyros glandulosa* Lace, *Flacourtia rukam* Zoll. & Mor., *Litsea* sp., *Olea salicifolia* Wall. ex G. Don and *Stereospermum colais* (Buch.-Ham. ex Dillw.) Mabberley.

The lower story consists of *Alangium chinense* Rehd., *Baccaurea ramiflora* Lour., *Diospyros martabanica* C.B. Clarke, *Helicia nilagirica* Bedd., *Litsea cubeba* (Lour.) Pers., *Mallotus philippensis* Mull. Arg., *Markhamia stipulata* Seem., *Memecylon edule* Roxb. var. *ovatum* (Sm.) C.B. Clarke, *Olea rosea* Craib, *Picrasma javanica* Bl., *Pittosporopsis kerrii* Craib, *Symplocos racemosa* Roxb., *Syzygium megacarpum* (Craib) Rathakr. & N. C. Nair and *Trigonostemon thyrsoides* Stapf.

Bamboos, although sparsely found, include *Bambusa* spp. and *Gigantochloa albociliata* (Munro) Munro.

Dominant shrubs include such species as *Alangium barbatum* (R. Br.) Baill., *Allophylus cobbe* (L.) Raeusch., *Ardisia crenata* Sims, *Chassalia curviflora* (Wall.) Thwaites, *Clausena excavata* Burm.f., *Duperrea pavettaefolia* (Kurz) Pitard, *Ixora*

butterwickii Hole, *Maesa ramentacea* (Roxb.) A. DC., *Mycetia chasalioides* (Craib) Craib, *Mycetia glandulosa* Craib, *Sambucus javanica* Reinw. ex Bl., *Trevesia palmata* Vis. and *Urobotrya latisquama* (Gagnep.) Hiepko.

Climbers and straggling shrubs are abundant and represented by *Adenia heterophylla* (Bl.) Koord., *Amalocalyx microlobus* Pierre ex Spire, *Bauhinia nervosa* (Wall. ex Benth.) Baker, *Bauhinia ornata* Kurz var. *subumbellata* (Pierre ex Gagnep.) K. & S.S. Larsen, *Caesalpinia hymenocarpa* (Prain) Hattink, *Embelia sessiliflora* Kurz, *Gelsemium elegans* (Gardn. & Champ.) Benth., *Hodgsonia heteroclita* (Roxb.) Hook.f. & Thomson, *Iodes cirrhosa* Turcz., *Linostoma decandrum* (Roxb.) Wall. ex Meisn., *Parameria laevigata* (Juss.) Moldenke, *Poikilospermum suaveolens* Merr., *Strychnos nitida* G. Don, *Thunbergia coccinea* Wall. ex D. Don, *Thunbergia laurifolia* Lindl., *Toddalia asiatica* (L.) Lamk. and *Uncaria macrophylla* Wall.

Ground floras consist of *Aglaonema* sp., *Amomum* sp., *Geophila herbacea* Ktze, *Globba* sp., *Gomphostemma parviflorum* Wall. ex Benth., *Hedyotis coronaria* (Kurz) Craib, *Hedyotis elegans* Wall. ex Kurz, *Lindenbergia philippensis* (Cham.) Benth., *Lobelia zeylanica* L., *Mouretia larsenii* Tange, *Ophiorrhiza* spp., *Phrynium imbricatum* Roxb., *Selaginella* spp., *Torenia flava* Hamilt. ex Benth. and *Torenia violacea* (Azaola ex Blanco) Pennell.

Terrestrial orchids are found such as *Arundina graminifolia* (D. Don) Hochr., *Calanthe ceciliae* Rehb.f., *Habenaria rhodocheila* Hance, *Liparis wrayii* Hook.f. and *Phaius* sp.

Epiphytic plants are orchids of the genera *Bulbophyllum*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Eria* and *Panisea*; and others such as *Aeschynanthus lineatus* Craib, *Pyrrosia flocculosa* (D. Don) Ching and *Vittaria elongata* Sw.

2. Pine Forest

The pine forest occurs in Doi Phu Huat, located in the southern part of the park, in Mae Charim district, at the altitudes ranging from 700-1,000 m a.s.l. This name "pine forest" is adopted here because the dominant species is solely represented by the two-needle pine species (*Pinus merkusii* Jungh. & de Vriese) (Fig. 15). The deciduous species are not very distinct thus it is appropriate to keep as the member of evergreen forest. The canopy is three-storied in profile. Grasses are the main component of the ground layer. Soils are gravelly, lateritic and sandy.

The upper story is only composed of *Pinus merkusii* Jungh. & de Vriese. It can be labeled as an emergent species.

The middle story consists of saplings of *Pinus merkusii* Jungh. & de Vriese and others such as *Anneslea fragrans* Wall., *Castanopsis* spp., *Engelhardia spicata* Lechen. ex Bl., *Irvingia malayana* Oliv. ex A.W. Benn., *Lithocarpus* spp., *Schima wallichii* (DC.) Korth., *Styrax benzoides* Craib and *Tristaniopsis burmanica* (Griff.) P.G. Wilson & J.T. Waterh. var. *rufescens* (Hance) J. Parn. & Nic Lughadha.

The lower story consists of small tree and shrub species such as *Aporosa villosa* (Wall. ex Lindl.) Baill., *Dalbergia cultrata* Graham ex Benth., *Craibiodendron stellatum* (Pierre) W. W. Sm., *Cycas pectinata* Griff., *Helicia nilagirica* Bedd., *Lyonia ovalifolia* (Wall.) Druce, *Phoenix acaulis* Roxb., *Phyllanthus emblica* L., *Vaccinium sprengelii* (D. Don) Sleum. and *Wendlandia tinctoria* (Roxb.) DC.

Ground floras consist of *Blumea* sp., *Carex* sp., *Crotalaria* sp., *Desmodium oblongum* Wall. ex Benth., *Globba* sp., *Hedyotis* sp., *Hypoxis aurea* Lour., *Lobelia nicotianaefolia* Roth ex Roem. & Schult., *Osbeckia chinensis* L., *Scleria* sp. and *Vernonia* sp.

Grasses are *Arundinella setosa* Trin, *Capillipedium assimile* (Steud.) A. Camus, *Eulalia* sp., *Microstegium vagans* (Nees ex Steud.) A. Camus, *Panicum* sp., *Themeda arundinacea* (Roxb.) Ridl. and *Themeda triandra* Forssk.

Climbing plants are uncommon, but include *Dunbaria* sp., *Linostoma persimile* Craib, *Mucuna pruriens* (L.) DC., *Pueraria thomsonii* Benth. and *Shuteria involucrata* (Wall.) Wight & Arn.

Epiphytic plants are orchids of the genera *Bulbophyllum*, *Cleisostoma*, *Dendrobium* and *Eria* and others such as *Aeschynanthus* sp., *Dischidia* sp.

3. Lower Montane Forest

The lower montane forest is also known as hill evergreen forest (Credner, 1935; Royal Forest Department, 1962; Smitinand, 1989). This forest found throughout higher elevations of the park from 1,000 m upward. The forest is composed of tall and dense evergreen trees (Fig. 16). Species composition is very high and diverse. The canopy is rather closed and continuous with a three-storied profile. Light hardly reaches the ground layer. Humidity is high, as evidenced by the abundance of moss and epiphytic members. Shrub and climber species are frequently found. Ground flora consists of many varieties of herbaceous plants. Soils are moist and rich in organic matter. The lower montane forest is heavily subject to shifting cultivation and Litchi plantation by hill tribe minorities.

The upper story consists of *Acer laurinum* Hassk., *Acer calcaratum* Gagnep., *Acer wilsonii* Rehd., *Acrocarpus fraxinifolius* Wight ex Arn., *Bretschneidera sinensis* Hemsl., *Calophyllum polyanthum* Wall. ex Choisy, *Canarium strictum* Roxb., *Caryota gigas* Hahn ex Hodel, *Fraxinus floribunda* Wall. ex Roxb., *Lithocarpus* spp., *Michelia* sp., *Quercus* spp., *Schima wallichii* (DC.) Korth. and *Sloanea sigun* (Bl.) K. Schum.

The middle story consists of *Alphonsea tonkinensis* A. DC., *Camellia taliensis* (W.W. Sm.) Melchior, *Carallia brachiata* (Lour.) Merr., *Castanopsis* spp., *Cinnamomum* sp., *Drypetes dasycarpa* (Airy Shaw) Phuph. & Chayamarit, *Elaeocarpus braceanus* Watt ex C.B. Clarke, *Eriobotrya bengalensis* (Roxb.) Hook.f., *Euonymus* sp., *Gomphandra tetrandra* (Wall.) Sleum., *Helicia pyrrobotrya* Kurz, *Hovenia dulcis* Thunb., *Hydnocarpus kurzii* (King) Warb. subsp. *australis* Sleum., *Litsea* sp., *Mastixia euonymoides* Prain, *Morus macroura* Miq., *Prunus cerasoides* D. Don, *Sarcosperma arboreum* Hook.f., *Sloanea tomentosa* (Benth.) Rehd. & Wils., *Sycopsis griffithiana* Oliv., *Syzygium angkai* (Craib) P. Chantaranothai & J. Parn., *Tarennoidea wallichii* (Hook.f.) Tirveng. & Sastre and *Wightia speciosissima* (D. Don) Merr.

The lower story consists of *Callicarpa arborea* Roxb., *Capparis sabiifolia* Hook.f. & Thoms., *Chionanthus thorelii* (Gagnep.) P.S. Green, *Cyathea chinensis* Copel., *Drimycarpus racemosus* (Roxb.) Hook.f., *Engelhardia spicata* Lechen. ex Bl., *Fosbergia thailandica* Tirveng. & Sastre, *Goniothalamus cheliensis* Hu, *Gordonia*

axillaris (Roxb. ex Ker-Gawl.) Dietr., *Mallotus khasianus* Hook.f., *Musa itinerans* Cheesman, *Myrica esculenta* Buch.-Ham. ex D. Don, *Ostodes paniculata* Bl., *Pauldopia ghorta* (G. Don) Steenis, *Prunus wallichii* Steud., *Saurauia nepaulensis* DC., *Symplocos macrophylla* Wall. ex DC. subsp. *sulcata* (Kurz) Nootboom, *Turpinia pomifera* (Roxb.) DC., *Wallichia siamensis* Becc. and *Wendlandia paniculata* (Roxb.) DC.

Dominant shrubs include such species as *Alangium barbatum* (R. Br.) Baill., *Ardisia maculosa* Mez, *Capparis assamica* Hook.f. & Thoms., *Chloranthus erectus* (Buch.-Ham.) Verdc., *Dichroa febrifuga* Lour., *Ixora* sp., *Lasianthus* spp., *Leea indica* (Burm.f.) Merr., *Maesa perlarius* (Lour.) Merr., *Milusa cuneata* Craib, *Mycetia gracilis* Craib, *Osbeckia stellata* Buch.-Ham. ex Ker-Gawl., *Pavetta indica* L., *Persicaria chinense* (L.) H. Gross, *Phlogacanthus curviflorus* Nees, *Polygala arillata* Buch.-Ham. ex D. Don, *Psychotria* spp., *Rhynchochum obovatum* (Griff.) B.L. Burtt, *Sarcandra glabra* (Thunb.) Nakai subsp. *brachystachys* (Bl.) Verdc., *Schizomussaenda dehiscens* (Craib) Li, *Silvianthus tonkinensis* (Gagnep.) Ridsd., *Tabernaemontana corymbosa* Wall. and *Thunbergia colpifera* B. Hansen.

Climbers and straggling shrubs are abundant and represented by *Alyxia siamensis* Craib, *Aspidopterys glabriuscula* (Wall.) Juss., *Bauhinia gluca* (Wall. ex Benth.) Benth. subsp. *tenuiflora* (Watt ex C.B. Clarke) K. & S.S. Larsen, *Berchemia floribunda* Wall., *Caesalpinia cucullata* Roxb., *Calamus* spp., *Chonemorpha griffithii* Hook.f., *Clematis buchananiana* DC., *Deeringia amaranthoides* (Lamk.) Merr., *Dinetus racemosus* (Roxb.) Sweet, *Gardneria ovata* Wall., *Heterostemma* sp., *Jasminum attenuatum* Roxb. ex G. Don, *Melodinus cochinchinensis* (Lour.) Merr., *Mussaenda* sp., *Piper* spp., *Pothos chinensis* (Raf.) Merr., *Rhaphidophora peepla* (Roxb.) Schott, *Rubus leucanthus* Hance, *Stephania elegans* Hook.f. & Thoms. and *Zehneria bodinieri* (H. Lév.) W.J. de Wilde & Duyfjes.

Ground floras are composed of *Ajuga macrosperma* Wall., *Argostemma ebracteolatum* Geddes, *Balanophora fungosa* J.R. & G. Forst. subsp. *indica* (Arn.) B. Hansen, *Baliospermum siamense* Craib, *Begonia* spp., *Cardamine hirsuta* L., *Carlemannia tetragona* Hook.f., *Commelina diffusa* Burm.f., *Costus lacerus* Gagnep., *Costus speciosus* (Koen.) Sm., *Disporum cantoniense* (Lour.) Merr., *Globba clarkei* Baker, *Globba* sp., *Gomphostemma javanicum* (Bl.) Benth., *Hedychium* spp., *Hydrocotyle javanica* Thunb., *Hydrocotyle siamica* Craib, *Impatiens claviger* Hook.f., *Impatiens jurpia* Ham. ex Hook.f. & Thoms., *Impatiens violaeiflora* Hook.f., *Lobelia angulata* Forst., *Ophiorrhiza* sp., *Petrocosmea kerrii* Craib, *Phrynium pedunculiferum* D. Fang, *Plantago major* L., *Rhynchoglossum obliquum* Bl., *Strobilanthes* spp., *Viola pilosa* Bl. and *Zingiber* spp.

Terrestrial orchids are common, including such species as *Anoectochilus siamensis* Schltr., *Anthogonium gracile* Wall. ex Lindl., *Cheirostylis griffithii* Lindl., *Herpysma longicaulis* Lindl. and *Phaius flavus* (Bl.) Lindl.

Grasses include *Apluda mutica* L., *Capillipedium assimile* (Steud.) A. Camus, *Hyparrhenia rufa* (Nees) Stapf, and *Themeda triandra* Forssk.

Epiphytic plants are abundantly represented by orchids of the genera *Bulbophyllum*, *Coelogyne*, *Dendrobium*, *Eria*, *Pholidota* and *Thunia*; ferns of the genera *Asplenium*, *Davallodes*, *Lepisorus*, *Microsorium* and *Pyrrosia*; and others such as *Aeschynanthus* spp., *Agapetes lobbii* C.B. Clarke, *Cautleya gracilis* (Smith) Dandy, *Hoya* spp., *Medinilla rubicunda* (Jack) Bl. and *Neohymenopogon parasiticus* (Wall.) Bennet.

***Caryota gigas* Hahn ex Hodel (Arecaceae) Forest**

Caryota gigas Hahn ex Hodel (Giant mountain fishtail palm or Tao rang yak in Thai vernacular) is probably the largest species in the genus. The solitary stem is straight up to 40 m tall and 50-80 cm in diam. Leaves are in cluster and crowd at the top, spreading and drooping, rachis 4-6 m long (Fig. 152). Inflorescence is initiated at the top with 2-4 m long, pendulous bearing numerous flowers and when fruit sets, infrutescence is enlarged up to 5 m long. The plant is monocarpic, meaning after flowering and fruiting only once it dies.

There is extremely restricted distribution occurring only over several square-kilometers on steep slopes of Doi Phu Kha area (in Pua district about 4 km east of park headquarters) at elevations between 1,400-1,600 m a.s.l. It occurs in groups of single stands and scattered with tree species associated with lower montane forest. This palm is also endemic to Thailand and moreover only found at Doi Phu Kha. The forest in the same mountainous range and elevation in Laos should be inspected for further distribution. It is a very rare and threatened species since its habitat is subject to destruction by hill tribe minorities. The cutting of the tree for consumption of the shoot to use as food for making soup by local people (Thai and hill tribe) is another hazard threatening its existence. Conservation of the original forest is strongly needed to protect the survival of this Palm species in its habitat. Seed germination and growth rate should be thoroughly studied for regenerative knowledge and accurate information.

4. Lower Montane Scrub

The lower montane scrub is found in Doi Phu Wae, the northern part of the park, in Chalerm Pra Kiat district, at altitudes ranging between 1,700-1,837 m a.s.l. The forest is characterized by dominant herbaceous plants and low shrubs with presenting of great number of temperate species: Indo-Burmese element (E Himalayan element) and Indo-Chinese element. It occurs along the exposed summits and ridges of rugged limestone massive hills. Trees are scarce, with only few species are found scattered (Figs. 17-19).

The prominent tree is represented by *Trachycarpus oreophilus* Gibbons & Spanner (palm species endemic to Thailand) (Fig. 153). The other trees are only found in small number and include *Castanopsis* sp., *Engelhardia spicata* Lechen. ex Bl., *Quercus* sp. and *Wightia speciosissima* (D. Don) Merr.

Shrubs are composed of *Euonymus* sp., *Glochidion* sp., *Mahonia siamensis* Takeda ex Craib, *Rhododendron* aff. *lyi* H. Lév. and *Zanthoxylum acanthopodium* DC.

Herbaceous plants are abundant and some thriving in the crevices of limestone rocks. The principal species are *Allium wallichii* Kunth, *Begonia* sp., *Bupleurum tenue* Buch.-Ham. ex D. Don, *Campanula cana* Wall., *Chlorophytum* sp., *Clarkella nana* (Edgw.) Hook.f., *Clematis subumbellata* Kurz, *Galium panduanum* Wall. ex Craib, *Habenaria dentata* (Sw.) Schltr., *Hedychium villosum* Wall., *Hydrocotyle sibthorpioides* Lamk., *Impatiens violaeflora* Hook.f., *Iris collettii* Hook.f., *Isodon*

coetsa (Buch.-Ham. ex D. Don) Kudo, *Isodon lophanthoides* (Buch.-Ham. ex D. Don) H. Hara, *Kalanchoe dixoniana* Hamet, *Peucedanum siamicum* Craib, *Polygala cardiocarpa* Kurz, *Rubia crassipes* Coll. & Hemsl., *Sedum susanae* Hamet, *Silene burmanica* Coll. & Hemsl., *Smilax* sp., *Strobilanthes* sp., *Swertia striata* Coll. & Hemsl., *Thalictrum foliolosum* DC., *Valeriana hardwickii* Wall., *Veratrum mengtzeanum* O. Loes. and *Viola pilosa* Bl.

The grasses are *Apluda mutica* L., *Arundinella setosa* Trin., *Capillipedium assimile* (Steud.) A. Camus, *Eulalia* sp., and *Hyparrhenia rufa* (Nees) Stapf.

The pteridophytes are *Botrychium lanuginosum* Wall. ex Hook. & Grev., *Cheilanthes rufa* D. Don, *Hypodematum crenatum* (Forssk.) Kuhn, *Lepisorus nudus* (Hook.) Ching, *Onychium contiguum* Hope and *Selaginella tamariscina* (Beauv.) Spring.

Deciduous Forest

The characteristic of the deciduous forest is represented by approximately 90 percent of deciduous tree species that lose their leaves in the dry season. The canopy is more open. The forest ranges in lowland at the elevation between 350-800 m.

5. Deciduous Dipterocarp Forest

The deciduous dipterocarp forest is scattered throughout the lower elevation of the park, between 350–700 m a.s.l (Figs. 20-21). The forest is characterized by dry habitat, dominant dipterocarp species with open canopy, two-storied, and covered by grasses in ground layer. Evergreen trees are scarcely represented. Soils are rather poor, acidic, gravelly, lateritic and sandy. Fire occurs nearly every year. Slope erosion and leaching are frequent problems.

The upper story is mainly composed of several tree species in the Dipterocarpaceae family, i.e. *Dipterocarpus obtusifolius* Teijsm. ex Miq., *Dipterocarpus tuberculatus* Roxb., *Shorea obtusa* Wall. ex Bl. and *Shorea siamensis* Miq. Other deciduous trees are also characteristic of this forest such as *Cassia fistula* L., *Cratoxylum formosum* (Jack) Dyer subsp. *pruniflorum* (Kurz) Gogel., *Dalbergia cana* Graham ex Kurz, *Dalbergia cultrata* Graham ex Benth., *Gluta usitata* (Wall.) Ding Hou, *Pterocarpus macrocarpus* Kurz and *Terminalia alata* Heyne ex Roth. In higher elevations above 600 m, members of Oak (Fagaceae) such as *Castanopsis*, *Lithocarpus* and *Quercus* spp. are also commonly found.

The lower story is composed of shrub or small tree species such as *Aporosa villosa* (Wall. ex Lindl.) Baill., *Catunaregam spathulifolia* Tirveng., *Catunaregam spinosa* (Thunb.) Tirveng., *Ceriscoides turgida* (Roxb.) Tirveng., *Gardenia obtusifolia* Roxb. ex Kurz, *Gardenia sootepensis* Hutch., *Ochna integerrima* (Lour.) Merr. and *Phyllanthus emblica* L.

Ground florals are composed of low shrub and herb species such as *Barleria cristata* L., *Blumeopsis flava* (DC.) Gagnep., *Carex continua* C.B. Clarke, *Crotalaria* spp., *Desmodium* spp., *Globba* spp., *Habenaria* spp. *Hedyotis* spp., *Indigofera* spp.,

Phoenix acaulis Roxb., *Phylloodium pulchellum* (L.) Desv. and *Rungia parviflora* (Retz.) Nees.

Grasses in principal dominance are *Arundinella hispida* Hack., *Bothriochloa bladhii* (Retz.) S.T. Blake, *Eulalia siamensis* Bor, *Heteropogon contortus* (L.) Roem. & Schult., *Imperata cylindrica* (L.) Beauv., *Setaria pallide-fusca* (Schum.) Stapf & C.E. Hubb., *Sporobolus diander* (Retz.) Beauv. and *Themeda arundinacea* (Roxb.) Ridl.

Climbing plants are *Aganosma marginata* (Roxb.) G. Don, *Argyreia splendens* (Hornem.) Sweet, *Dunbaria bella* Prain and *Spatholobus parviflorus* (DC.) Kuntze.

Epiphytic plants include orchids of the genera *Bulbophyllum*, *Cleisostoma*, *Dendrobium*, *Eria* and *Rhynchostylis*; ferns such as *Drynaria bonii* Christ and *Platyterium* sp. and others such as *Dischidia major* (Vahl) Merr., *Dischidia nummularia* R. Br. and *Hoya kerrii* Craib.

6. Tropical Mixed Deciduous Forest

The tropical mixed deciduous forest is also scattered at lower elevation as the deciduous dipterocarp forest and can reach up to 800 m a.s.l (Fig. 22). The forest is characterized by the composition of variable deciduous species mixed together with no real dominant trees. Dipterocarp species are hardly distinct. Evergreen trees are represented in lower proportion. The canopy is three-storied. Grasses principally dominate the ground layer. Annual burning and surface erosion are frequently occurred.

The upper story consists of *Azelia xylocarpa* (Kurz) Craib, *Bombax anceps* Pierre, *Butea monosperma* (Lam.) Taub., *Canarium subulatum* Guill., *Dalbergia cultrata* Graham ex Benth., *Dalbergia oliveri* Gamble, *Dillenia parviflora* Griff., *Garunga pinnata* Roxb., *Gmelina arborea* Roxb., *Haldina cordifolia* (Roxb.) Ridsd., *Lagerstroemia calyculata* Kurz, *Melia azedarach* L., *Protium serratum* (Wall. ex Colebr.) Engl., *Pterocarpus macrocarpus* Kurz, *Spondias pinnata* (L.f.) Kurz, *Syzygium cumini* (L.) Skeels, *Tectona grandis* L.f., *Terminalia alata* Heyne ex Roth and *Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C. Nielsen.

The middle story consists of *Anogeissus acuminata* (Roxb. ex DC.) Guill. & Perr. var. *lanceolata* C.B. Clarke, *Careya sphaerica* Roxb., *Cassia fistula* L., *Cratoxylum formosum* (Jack) Dyer subsp. *pruniflorum* (Kurz) Gogel., *Gluta usitata* (Wall.) Ding Hou and *Schleichera oleosa* (Lour.) Oken.

The lower story consists of *Bauhinia variegata* L., *Bridelia retusa* (L.) A. Juss., *Dioecrescis erythroclada* (Kurz) Tirveng., *Gardenia sootepensis* Hutch., *Lagerstroemia macrocarpa* Wall., *Phyllanthus emblica* L. and *Strychnos nux-blanda* A.W. Hill.

Bamboos are also found such as *Bambusa* spp., *Dendrocalamus strictus* (Roxb.) Nees and *Thyrsostachys siamensis* Gamble.

Ground floras consist of *Barleria cristata* L., *Crotalaria* spp., *Desmodium* spp., *Flemingia* sp., *Globba* spp., *Habenaria* spp., *Hedyotis* spp. and *Sonerila erecta* Jack.

Grasses in principal dominance are *Arundinella setosa* Trin., *Bothriochloa bladhii* (Retz.) S.T. Blake, *Capillipedium parviflorum* (R. Br.) Stapf, *Echinochloa* sp.,

Eragrostis spp., *Hackelochloa granularis* (L.) Kuntze, *Heteropogon triticeus* (R. Br.) Stapf ex Craib, *Imperata cylindrica* (L.) Beauv., *Panicum* spp., *Sporobolus fertilis* Clayton and *Themeda triandra* Forssk. Sedges of the genera *Cyperus*, *Carex*, *Scleria* and *Fimbristylis* are also recorded.

Climbing plants and straggling shrubs are represented by *Congea tomentosa* Roxb., *Dioscorea* spp., *Harrisonia perforata* (Blanco) Merr., *Hiptage benghalensis* (L.) Kurz, *Mucuna pruriens* (L.) DC., *Smilax* spp., *Spatholobus parviflorus* (DC.) Kuntze, *Stemona* sp., *Thunbergia grandiflora* Roxb. and *Lygodium flexuosum* (L.) Sw.

Epiphytic plants mainly consist of orchids of the genera *Bulbophyllum*, *Cleisostoma*, *Cymbidium*, *Dendrobium*, *Eria* and *Rhynchostylis*; ferns such as *Drynaria bonii* Christ, *Drynaria rigidula* (Sw.) Bedd. and *Platyserium* sp. and others such as *Aeschynanthus* spp., *Dischidia major* (Vahl) Merr., *Dischidia nummularia* R. Br. and *Hoya kerrii* Craib.

Secondary Forest

Secondary forest is mainly affected by cultivation. Other causes are from development such as road construction (Fig. 27) and urbanization and also from cattle and logging. It can be estimated that about 15% of the total area are completely destroyed by highland agriculture (Figs. 23-26). Dry evergreen forest and lower montane forest are heavily subject to cultivation by highland Thais and hill tribe minorities because both forest types show suitable factors for agriculture pattern such as high moisture, many tall and large trees, rich ground cover and less gravelly or sandy soils. In Doi Phu Kha, various stages of succession are presented.

The principal tree of secondary forest are *Betula alnoides* Buch.-Ham. ex G. Don, *Broussonetia papyrifera* (L.) Vent., *Callicarpa arborea* Roxb., *Duabanga grandiflora* (Roxb. ex DC.) Walp., *Engelhardia spicata* Lechen. ex Bl., *Eurya acuminata* DC. var. *wallichiana* Dyer, *Ficus semicordata* Buch.-Ham. ex Sm., *Litsea cubeba* (Lour.) Pers., *Macaranga denticulata* (Bl.) Muell. Arg., *Mallotus peltatus* (Geisel.) Muell. Arg. and *Trema tomentosa* (Roxb.) Hara

Shrubs are represented by *Croton* sp., *Buddleja asiatica* Lour., *Debregeasia velutina* Gaudich, *Ficus hirta* Vahl, *Glochidion* sp., *Rhus chinensis* Miller, *Triumfetta pilosa* Roth and *Vernonia volkamereiifolia* Wall. ex DC.

Ground floras are *Ageratina adenophora* (Spreng.) R.M. King & H. Rob., *Ageratum conyzoides* L., *Chromolaena odoratum* (L.) R.M. King & H. Rob., *Commelina diffusa* Burm.f., *Imperata cylindrica* (L.) P. Beauv., *Neyraudia reynaudiana* (Kunth) H. Keng ex Hitchc., *Pteridium aquilinum* (L.) Kuhn var. *wightianum* (J. Agardh) R.M. Tryon, *Saccharum spontaneum* L. and *Thysanolaena latifolia* (Roxb. ex Horn.) Honda.

Climbers are *Embelia sessiliflora* Kurz, *Mucuna pruriens* (L.) DC., *Passiflora foetida* L., *Pueraria thomsonii* Benth., and *Thunbergia laurifolia* Lindl.

The attempt to replant trees in Doi Phu Kha began several years ago. At the beginning, *Pinus kesiya* Royle ex Gord. was a principal tree for reforestation in lower montane forest. In lowland area, *Eucalyptus camaldulensis* Dehnh., native to Australia, had been introduced. Several projects initiated from both government and

private agencies for restoration and regeneration of disturbed areas have been actively done since the establishment of the park such as planting forest to commemorate the Golden Jubilee coronation of His Majesty the King project, planting forest to commemorate 72nd Birthday of Her Majesty the Queen project, reintroduction of orchids to the forest project, etc. Fortunately, native tree species have been involved such as *Acer calcaratum* Gagnep., *Bauhinia variegata* L., *Bretschneidera sinensis* Hemsl., *Calamus* spp., *Caryota gigas* Hahn ex Hodel, *Prunus cerasoides* D. Don, etc.



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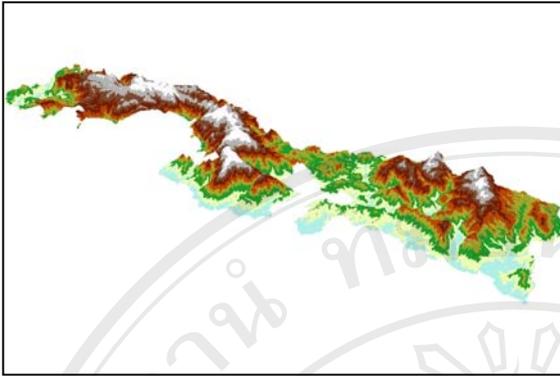


Figure 9. Three dimensions topography of Doi Phu Kha National Park



Figure 10. Entrance of Doi Phu Kha National Park Headquarters



Figure 11. Dry evergreen forest, along valleys



Figure 12. Dry evergreen forest, by streams



Figure 13. Thon Tong Waterfall

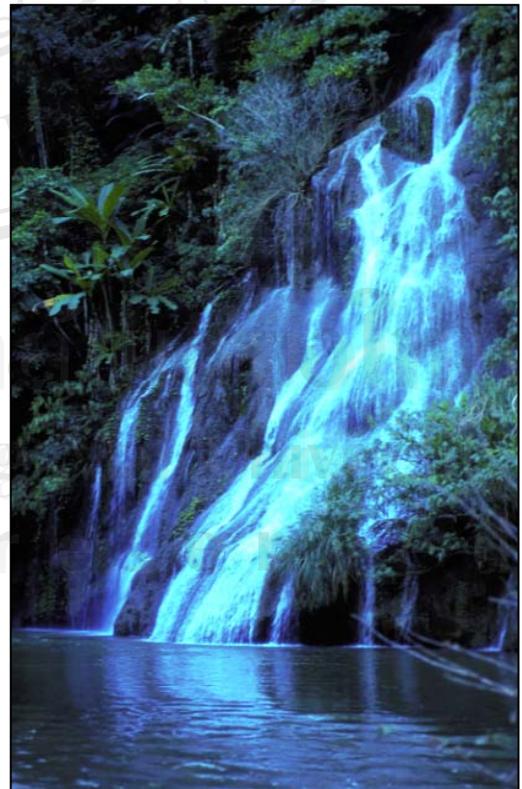


Figure 14. Wiang Peian Waterfall



Figure 15. Pine forest



Figure 16. Lower montane forest



Figure 17. Lower montane scrub

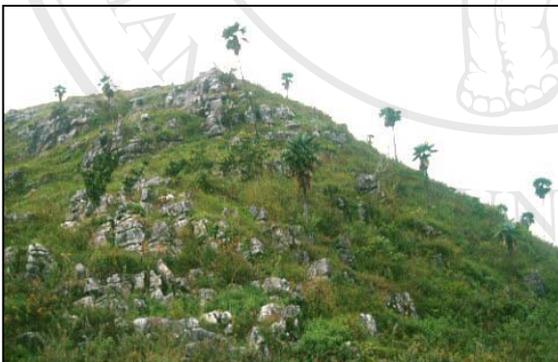


Figure 18. Lower montane scrub



Figure 19. Lower montane scrub



Figure 20. Deciduous dipterocarp forest



Figure 21. Deciduous dipterocarp forest



Figure 22. Tropical mixed deciduous forest



Figure 23. Disturb areas, ca. 800 m a.s.l.



Figure 24. Upland rice fields, ca. 1,300 m a.s.l.



Figure 25. Forest fallows, ca. 1,300 m a.s.l.

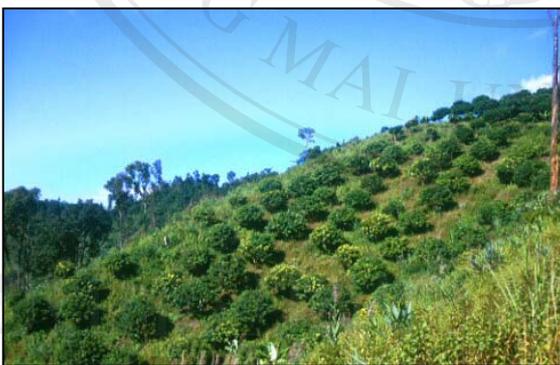


Figure 26. Litchi plantation, ca. 1,300 m a.s.l.



Figure 27. Road construction around the highest peak of the highway 1256, ca. 1,684 m a.s.l.

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