

*Survey of the species diversity and  
geographical distribution of vascular plants  
in Doi Luang National Park, Chiang Rai*



BRT 139029

## **Report to Biodiversity Research and Training Program (BRT)**

**Project Title:** Servey of the species diversity and geographical distribution of vascular plants in Doi Luang National Park, Chiang Rai (BRT 139029)

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**August 1999**

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## Survey of the species diversity and geographical distribution of vascular plants in Doi Luang National Park, Chiang Rai

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### ABSTRACT/EXECUTIVE SUMMARY

The rationale of this project is that management of forest biodiversity should be based on knowledge of what plant species are present and their geographical distribution. Vascular plants, in particular trees, form the basis of all forest ecosystems and are therefore appropriate indicators of the overall biodiversity value of those habitats.

A 4-stage process was developed to survey the diversity and geographical distribution of vascular plants in Doi Luang National Park, Chiang Rai.

1/ Determine which plant species are present through opportunistic collection of all species of vascular plants encountered throughout the park. A total of 1155 species of vascular plants were enumerated, including two new records for Thailand (*Tetrastigma apiculatum* Gagnep., *Polygonatum kingianum* Coll. & Hemsl.).

2/ Develop materials to aid identification of tree species by non-taxonomists. Accurate field identification of tree species is critical to any ecological survey, but is severely hampered by a lack of appropriate identification materials. Photographs, line drawings, watercolor paintings and brief descriptions were compiled for over 400 species in order to assist this process.

3/ Determine which habitats have the highest value, in terms of total tree species present, and the proportion of rare species. Fifty-seven permanent ecological plots were established, covering an area of 29.28 hectares (183 rai). Lowland mesic evergreen forest was the most important habitat in the park both in terms of tree species richness (217 spp., 73.8 % of total spp.) and species rarity value (56.2% of all rare species).

4/ Determine the geographical distribution and fragmentation of forest habitats, using a combination of ground mapping and remote sensing analysis. A Geographical Information System (GIS) was developed using 1:50,000 topographic maps, aerial photographs and Landsat5 TM digital satellite data. This GIS was used to generate maps of forest type and condition which were cross-checked against ground maps in 6 core areas of 12 km<sup>2</sup> each. A total of 1112.6 km<sup>2</sup> (92.4% of the total area of the park) was included in the final analysis. 75.2 % of the surveyed area supports forest cover, but only 33.8 % of this forested area is in good condition. Lowland mesic evergreen forest, the richest habitat, occupies a total of 53.4 km<sup>2</sup> (4.6%). The most important areas for tree diversity are concentrated in the SE corner of the park. Elsewhere, remnant species-rich forest patches are generally too small or too fragmented to maintain viable populations without significant management input.

The most valuable lesson of the project is that a combination of techniques from several disciplines is required to gain a realistic perspective of the biodiversity status of a complex forested landscape. None of the techniques used in isolation could have achieved this result.

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# สำรวจความหลากหลายของชนิดพรรณไม้มีท่อและการกระจายของพรรณไม้

## ทางภูมิศาสตร์ ณ อุทยานแห่งชาติดอยหลวง จ. เชียงราย

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### บทคัดย่อ/สรุปสำหรับผู้บริหาร

หลักการและเหตุผลของโครงการนี้สืบเนื่องจากการในการจัดการดูแลเกี่ยวกับป่าและความหลากหลายของสิ่งมีชีวิตต่าง ๆ ควรจะอยู่บนพื้นฐานของความรู้ที่ว่ามีพรรณพืชชนิดไหนบ้างที่มีอยู่และมีการกระจายอย่างไร พรรณไม้มีท่อโดยเฉพาะอย่างยิ่งไม้ยืนต้นนับเป็นพื้นฐานของระบบนิเวศของป่าไม้ทั้งหมด ดังนั้นจึงเป็นธรรมชาติที่เหมาะสมในการปกป้องความหลากหลายทางชีวภาพในถิ่นที่อยู่ดังกล่าว

การสำรวจความหลากหลายและการกระจายทางภูมิศาสตร์ของพรรณไม้มีท่อในอุทยานแห่งชาติดอยหลวงมีการพัฒนาขั้นตอนต่าง ๆ 4 ขั้นตอน ดังนี้

1. ตรวจสอบว่ามีพรรณไม้ชนิดใดบ้าง โดยการเดินเก็บตัวอย่างพรรณไม้มีท่อที่พบในบริเวณอุทยาน ได้จัดทำรายชื่อพรรณไม้มีท่อจำนวน 1,155 ชนิด ซึ่งรวมถึงพืชที่มีการพบเป็นครั้งแรกในประเทศไทย ด้วย 2 ชนิดคือ *Tetratigma apiculatum* Gagnep. และ *Polygonatum kingianum* Coll. & Hemse.
2. การพัฒนาวัสดุที่ใช้ช่วยในการบ่งบอกชนิดของไม้ยืนต้นเพื่อให้บุคคลที่ไม่ใช่นักอนุกรมวิธานใช้ได้ การบ่งบอกชื่อที่ถูกต้องของพรรณไม้เป็นองค์ประกอบที่สำคัญยิ่งของการสำรวจทางนิเวศวิทยา งานนี้มักมีอุปสรรคที่ขาดหนังสือคู่มือที่จะใช้ ดังนั้นจึงมีการรวบรวมข้อมูลเพื่อจัดทำเป็นหนังสือดังกล่าว โดยทำการบันทึก เช่น การถ่ายภาพ วาดรูปลายเส้น วาดรูปสีน้ำ และเขียนบันทึกลักษณะอย่างย่อ ๆ ของพรรณไม้ยืนต้นมากกว่า 400 ชนิด
3. การตรวจสอบว่าในถิ่นที่อยู่แบบใด มีความหลากหลายของพรรณไม้ยืนต้นสูงที่สุด โดยพิจารณาจากอัตราส่วนระหว่างจำนวนทั้งหมดของชนิดพรรณไม้ต่อชนิดพรรณไม้ที่หายาก โดยใช้วิธีวางแปลงสำรวจถาวรจำนวน 57 แปลงรวมเนื้อที่ 183 ไร่ พบว่าป่าที่มีความสำคัญที่สุดในอุทยานนี้คือ ป่าดิบชื้นระดับต่ำ (lowland mesic evergreen) ทั้งในแง่ของความหลากหลายของชนิดพรรณไม้ยืนต้น (217 ชนิด, 73.8% ของชนิดทั้งหมด) และในแง่ของค่าของชนิดที่หายาก (56.2% ของชนิดที่หายาก)
4. การตรวจสอบการกระจายทางภูมิศาสตร์และพื้นที่ที่ย่อมป่า ดำเนินการโดยการทำแผนที่ภาคพื้นดินร่วมกับการวิเคราะห์ภาพถ่ายจากดาวเทียม ทั้งนี้มีการพัฒนาข้อมูลสารสนเทศภูมิศาสตร์ (GIS) โดยการใช้แผนที่ของสภาพพื้นที่ 1:50,000 ร่วมกับภาพถ่ายทางอากาศ และ ข้อมูลระบบตัวเลขจากดาวเทียม Landstat5 TM ข้อมูลสารสนเทศภูมิศาสตร์นี้นำมาใช้ในการสร้างแผนที่ของชนิดป่าและสภาพป่าในปัจจุบัน มีการตรวจสอบความถูกต้องของแผนที่ดังกล่าวโดยเปรียบเทียบกับแผนที่ภาคพื้นดินในบริเวณ 6 ตำแหน่ง ๆ ละ 12 กม<sup>2</sup> จากการวิเคราะห์ขั้นสุดท้ายภายในเนื้อที่ทั้งหมด 1112.6 ตารางกิโลเมตร (ร้อยละ 92.4 ของพื้นที่อุทยาน) ในจำนวนนี้ร้อยละ 75.2 ของพื้นที่สำรวจเป็นพื้นที่ป่า แต่มีเพียงร้อยละ 33.8 อยู่ในสภาพสมบูรณ์ ป่าดิบชื้นระดับต่ำเป็นป่าที่มีความหลากหลายของชนิดสูงที่สุด มีพื้นที่รวม 53.4 กม<sup>2</sup> (4.6%) บริเวณที่สำคัญที่สุดที่มีความหลากหลายของไม้ยืนต้นอยู่มุมด้านทิศตะวันออกเฉียงใต้ของอุทยาน ส่วนบริเวณอื่น ๆ ที่มีความอุดมสมบูรณ์ของชนิดพรรณไม้มักจะเป็นหย่อมเล็ก ๆ หรือกระจุกกระจายมากเกินไปจนไม่สามารถจะดำรงประชากรที่แข็งแรงให้รอดอยู่ได้ ถ้าไม่มีมาตรการจัดการที่เข้มงวด

ข้อสรุปที่สำคัญของโครงการนี้คือ การใช้วิธีการต่าง ๆ จากสหสาขาวิชามารวมกัน เป็นสิ่งจำเป็นในการที่จะเห็นภาพสภาวะที่แท้จริงของความหลากหลายทางชีวภาพในระบบนิเวศอันซับซ้อนของพื้นที่ป่า การใช้วิธีการใดอย่างหนึ่งเพียงวิธีเดียวไม่สามารถที่จะให้ผลดังกล่าวได้

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## **1. INTRODUCTION**

### **1.1/ Rationale**

The underlying rationale of the project is that the protection and management of biodiversity cannot be effective without a basic knowledge of what species are present and where they are distributed.

The recent increase in the number of protected areas in Thailand has created an urgent need to develop survey techniques that enable rapid assessment of the current biodiversity status of potentially important sites. Whilst remote sensing analysis is an excellent tool at the national level, it cannot yet be used to accurately predict forest condition in areas with complex topography and ecology, such as in northern Thailand. On the other hand, current ecological survey techniques, which rely on fixed plots are too time-consuming and cover too small an area to be the sole basis for resource management decisions. In addition, the lack of field taxonomists is a serious handicap for detailed forest surveys.

The solution is to combine the advantages of both techniques through a multidisciplinary approach which relies on the detail which can be obtained through ecological surveys as the basis for remote sensing interpretation covering a much wider area. Only through such an approach is it possible to develop techniques for the rapid assessment of protected areas at a scale and detail appropriate to their management.

Doi Luang National Park, Chiang Rai province was chosen as a study area to develop these techniques for 2 reasons: 1/ no prior vascular plant survey has been conducted in the area 2/ the park is large enough to contain representative areas of all major forest types found in northern Thailand, including both relatively pristine and degraded areas.

### **1.2/ The Study area**

Doi Luang National Park, situated between 99°29'E, 19°02'N and 99°51'E, 19°43'N, with an official area of 1,170 km<sup>2</sup> constitutes the second largest national park in northern Thailand. Since being declared as a national park in 1990 no detailed botanical survey has been conducted. The highest point in the park is Doi Luang Peak (1710 m), but 86% of the park lies below 1000 m, with only a small proportion (3.9%) over 1200 m. (see fig. 17). The climate is strongly seasonal with a mean annual rainfall of 1270 mm, of which 87.9% falling during the monsoon period between May and September. The minimum daily temperature varies from 11.9° in January to 22.4° in June whilst the maximum varies from 28.8° in December to 38.7° in April.<sup>1</sup>

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<sup>1</sup> rainfall averaged over the 34 year period 1961-1995, temperature averaged for 1989-1997, both for the meteorological station in Phan district at altitude of 394 m - probably rather drier & hotter than the average for the park as a whole.

### **1.3/ The project**

The project was the result of a close collaboration between the Departments of Biology and Geography, Chiang Mai University. The work was divided into 5 components of which the first 4 components were undertaken by the Biology department, while the fifth was the responsibility of the Geography Department.

Component 1 opportunistic collection of all vascular plants, with particular emphasis on tree species.

Component 2 development of materials (photos, drawings, keys etc) to help people with no formal botanical training to identify common tree species in the field.

Component 3 ecological survey employing traditional permanent plot techniques, which was used to identify the most valuable habitats and to assess the potential for using indicator species or vegetative parameters to predict habitat value.

Component 4 ground mapping and rapid vegetation survey of selected core areas, which provided a basis to assess the accuracy of remote sensing interpretation. Aerial photographs from 1995 were used to increase the spatial accuracy of the ground maps.

Component 5 The development of a GIS for the park using a novel technique which used the results of the ecological and ground mapping surveys to predict vegetation type and condition using 2 digital Landsat TM images from January and March 1998 in combination with a digital terrain model.

These project components will be discussed separately, before drawing the results together in our final discussion.

## **2. BOTANICAL INVENTORY**

### **2.1/ Objectives**

i/ to conduct a botanical inventory of Doi Luang National Park

ii/ to build up the CMU Biology Department Herbarium.

### **2.2/ Methodology**

Opportunistic sampling of all vascular plant species was conducted throughout the national park at all seasons of the year. At least one field trip of approximately one week duration was undertaken during every month for the first 20 months of the project. All specimens collected form part of the permanent reference collection at CMU herbarium.

### **2.3/ Results**

Opportunistic collection throughout the 2 year period of the project has resulted in the enumeration of 1144 vascular plant species, including 374 trees, 112 treelets, 44

shrubs, 69 woody lianas, 95 vines and 450 herbs. Specimens of either fruiting or flowering material for the majority of these species has been deposited in the CMU herbarium for future reference and verification. 2 species were recorded for the first time in Thailand, vis a vis *Tetrastigma apiculatum* Gagnep., *Polygonatum kingianum* Coll. & Hemsl.

(see appendix 1 for complete list)

### 3. IDENTIFICATION MATERIALS

#### **3.1/ Objectives**

i/ to develop visual materials to facilitate field identification of common tree species by people with no formal botanical training.

ii/ to develop a computerized key to aid the identification of sterile material.

iii/ to establish a photographic collection of common tree species to augment the specimen collections of CMU herbarium

#### **3.2/ Methods**

##### 3.2.1/ Photographic materials

All photographs were taken by project staff using Nikon F3 and Nikon FM2 cameras. The majority of photos used the Nikkor 55 mm micro lens, with the addition of Nikon Bellows for close ups (to a maximum of 4X life size). 24 mm and 70-300 mm zoom lenses were used for crown shots and flowers/fruits in situ. The film stock used was Fuji Provia 100 and Fuji Velvia 50. For each species, we aimed to have photos of crown, bark, flowers and fruit, including shots of clusters on the trees to illustrate growth form, as well as close ups to illustrate structure. Wherever possible, a voucher specimen was collected of each individual tree photographed, to ensure accurate verification of the identification. A total of 924 specimens were collected for this purpose, and are currently deposited in the reserve collection of CMU Herbarium.

##### 3.2.2 Drawings

In conjunction with the photographs, field sketches were made of many of the same specimens. In CMU, these sketches were drawn up into finalized watercolor paintings and augmented by detailed anatomical line drawings where necessary. The artist collected almost all of the specimens personally, and so was able to draw on her personal experience, as well as on the field sketches, dry specimens, alcohol collection and photographs to ensure a realistic representation.

##### 3.2.3 Descriptions

In conjunction with the graphic materials, a descriptive database has been established which is being used to develop both computerized and printed identification keys. The descriptions cover all aspects of plant morphology visible in the field and are derived

from 3 main sources - herbarium specimens, descriptions in the field of fresh material and literature sources. Information is entered in 11 separate categories, as follows:

crown	bark	leaf type
leaf shape	leaf veining	leaf texture/color
petiole/stem	inflorescence	perianth
flower structure	fruit	other

This information is then used to compile descriptions for each species which take into account the full range for each character based on all records examined. The options are entered as code, which greatly speeds up data entry and minimizes the risk of typing errors. This coded data is then converted into full English text by a customized program, which facilitates the use of the results without the need to refer to the codes. (see appendix 4 for example)

### **3.3/ Results**

#### **3.3.1/ photographs/drawings**

Photographs have been completed for 420 native tree/treelet species from 82 families, representing 86.4 % of the total known tree/treelet flora of the park. All processed slides have been labelled with details of specimen number, film/exposure number, scale (if appropriate) and species. They are stored in filing cabinets ordered by scientific family and are available for public use.

In addition, detailed line drawings and watercolour paintings of leaf, flower and fruit have been completed for some 150 species. In the future, we expect that these materials will form the starting point for a computerized image library of trees of northern Thailand.

#### **3.3.2/ Descriptive database**

The database currently holds 2152 records from 473 species. The software has already been developed for producing digital keys which are currently being tested prior to release.

#### **3.3.3/ Field Guide**

The materials and descriptions collected are currently being used to compile a fieldguide to the forest trees of northern Thailand which is expected to cover around 240 species and should be completed by December 1999.

## **4. ECOLOGICAL SURVEY**

### **4.1 Objectives**

4.1.1/ to identify the most valuable habitats in terms of tree species diversity and to use this information in conjunction with the satellite interpretation to produce maps of potential species diversity throughout the park.

4.1.2/ to identify tree species with a restricted local or regional range which might be of particular importance for conservation.

4.1.3/ to assess the potential for using indicator tree species or vegetative parameters to predict overall habitat biodiversity value.

4.1.4/ to establish permanent plots for long-term ecological monitoring.

4.1.5/ to correlate canopy cover and texture with satellite image data.

## 4.2/ Methods

Fifty-seven permanent plots, covering a total area of 29.28 hectares (183 rai) were established including 3 large plots of 500 X 80 m and 56 smaller plots of 80 X 40 m. The survey covered 4 aspects of the forest ecology.

1/ Trees. All individual tree stems within the plots with dbh > 9.5 cm were tagged, measured (dbh/height/crown width), mapped and identified if possible.

2/ Bamboo. All clumps with any culms > 3 cm were measured, identified and mapped as per trees ( basal area estimated as number of stems X area of an average stem)

3/ Shrubs. A subsample was conducted of all woody shrubs and saplings with dbh  $\geq$  1 cm within a 5.05 m radius of the centre of each 20 X 20 m square, (representing 20% of the total area in the plot). Dbh, height were measured but not mapped. The species was recorded only if readily recognisable.

4/ Dead wood. All pieces of both standing and fallen dead wood with in the whole plot with diameter >9.5 cm and length >30 cm were measured, but not mapped or identified, except for unmistakable timber (mainly teak).

The data from these plots was processed using software developed by project staff in collaboration with Biotec staff. This software can produce plot maps and canopy profiles as well as calculate canopy cover, texture, volume and other relevant parameters (see appendix 2 for examples).

## 4.3/ Forest classification

We have in general followed the forest classification system currently used by the Royal Forestry Department (SMITNAND 1977, SANTISUK 1988), but with the important difference that what are normally referred to as Dry Evergreen forests are here termed Mesic Evergreen, because of their reliance on ground water whereas Xeric Evergreen is reserved for locations which quickly dry out, such as steep south facing slopes with sandy soils. Common examples of xeric evergreen species include *Pinus spp.*, *Vaccinium spp.* and *Tristaniopsis burmanica*. These two evergreen forest types appear very different on the ground but are frequently confused in satellite interpretations.

The lowland vegetation in Doi Luang National Park, as in other areas in northern Thailand, consists of a complex mosaic of both deciduous and evergreen elements, the exact proportion in any one site determined by altitude, moisture availability and

disturbance. Above 1200 m evergreen forests predominate, with open grassland in disturbed areas.

In the ground surveys, a particular sample of forest was classified according to the percentage of exposed canopy which falls into seven categories-mesic evergreen, xeric evergreen, deciduous, bamboo, Fagaceae, dry dipterocarp, pine. Samples with 70% or more of one type are classed as predominantly that type, all other forests are regarded as mixed forests. For example, although mesic forests characteristically contain a deciduous emergent element, at least 70% of the exposed canopy is evergreen and they are therefore classed as mesic evergreen. The term "Deciduous + Evergreen" indicates that a majority (>50%) of trees are deciduous but there is also a significant(>20%) evergreen element.

#### 4.4/ Summary of Results

Only 4 of the initial 5 objectives proved to be feasible. Direct correlation of canopy cover and texture with satellite image data could not be achieved due to spatial distortion of the satellite image (see section 7)

In order to facilitate comparison of the data the 3 large plots are treated in this summary as consisting of 36 sites of 80 X 40 m each, which are combined with the 56 smaller plots to give a total of 92 sampling units, of which 88 are included in these results, covering a total of 28.16 hectares and including 9864 woody tree stems >9.5 cm dbh. The remaining 4 plots contain inconsistencies in the data which will have to be rechecked on the ground before inclusion in the final analysis.

##### 4.4.1 Species richness

A total of 293 tree/treelet species were recorded on the plots, representing 78.6% of the total known tree flora of the area. The remaining 21.4% of species are assumed to be either very rare species or species which closely resemble other species in the vegetative state and were therefore missed in the transect survey. (see appendix 2 for complete list)

The most important habitat from the point of view of tree species diversity was mesic evergreen forest, which is found in narrow strips along streams and in moist areas such as concavities or north-facing slopes below 1200 m. (see table1). Evergreen/Bamboo, which is a degraded form of mesic evergreen also supported a large number of species, but significantly less than the more pristine mesic evergreen. Deciduous+evergreen forests were also species-rich, which is probably explained by the transitional nature of these areas. Dry dipterocarp forests had the fewest number of species, only about 1/3 of those present in mesic evergreen forest. Xeric evergreen forests were also relatively species-poor.

However, at the level of the individual sampling unit, the total number of species for mesic evergreen, mesic evergreen/bamboo, evergreen+deciduous and deciduous/bamboo were very similar. The reason for this is that the sample size (0.32 ha) is not sufficient to estimate the total number of species in any of these forest types ( see section 4.4.3 ). A better estimate of the true value of each site can be reached by investigating the following variables.

#### 4.4.2 Species value

i/ *The total species rarity value.* The total number of species is only a partial estimate of the total biodiversity value of a site since the relative rarity of the species present is also significant. In order to take this into account, each species is given a local rarity value inversely proportional to the number of sampling units it occurs in (species rank / total species). Thus most abundant species scores  $1/293 = 0.003$  whereas the rarest species scores  $1/1 = 1$ . The total value for all species in a unit can then be calculated, which increases with the total number of species but also is higher for sites with more rare species. This value is a slightly better reflection of the overall pattern than the total number of species, but was still fairly similar between the four forest types discussed.

ii/ *The total number of locally rare species.* Another approach is to assume that the value of a site is a function only of the rarer species and to ignore all other species. In this survey, species were defined as locally rare if they occur in <5% of all transect sites. The overall balance of species in Doi Luang was typical of most tropical forest areas, with relatively few abundant species and many rare species. Only 53 species (18.1%) were found in more than 20% of all units, whereas 88 species were found in <5% of sites ( see figure 4). This result was even more pronounced with regards to the total number of stems per species-the majority of species were represented by only a few trees (141 species (48%) with <20 stems, out of a total of 9860 stems. (see figure 3)

Mesic evergreen forest supported the greatest number of locally rare species, more than twice as many as any other forest type. Evergreen/bamboo, which supported a high number of species, had relatively few rare species, indicating that a considerable proportion of the species richness in those sites in made up of secondary growth species which are of little diversity value. Dry dipterocarp and xeric evergreen forests were again the poorest forest types.

iii/ *The total number of regionally rare species.* This approach is similar to the previous one, but recognises that a species may be locally common but rare at the regional level. In terms of national biodiversity, these species may be the most significant. Regionally rare species were defined as those species found only in Doi Luang National Park, but not in any of the other 5 protected areas in the northern region for which we have comparable data, ie. Doi Suthep, Doi Chiang Dao, Doi Khunthan, Jae Sawn and Mae Soi. (CMU HERBARIUM DATABASE, 1999)

Mesic evergreen forests supported more than half the total number of regionally rare species, whereas evergreen/bamboo areas supported none at all, clearly indicating that the rarest species are the ones than are most noticeably affected by disturbance. Although hill evergreen forests supported fewer species than deciduous+evergreen forests, they contained a larger number of regionally rare species, which is often the case with more isolated mountain communities. This later result is similar to the situation in other mountains in northern Thailand, for example Doi Suthep and Doi Chiang Dao, but neither of these areas support such important lowland mesic evergreen forests.

**TABLE 1: Diversity value of forests types (tree/treelets only)**

Forest Type	total species	Average species per site	Average value per site	total locally rare	total regionally rare
Mesic evergreen	248	48.27	36.18	50	22
Evergreen/ Bamboo	199	48.34	35.3	18	0
Deciduous + Evergreen	202	42.48	32.51	24	6
Deciduous/Bamboo	128	42.98	31.27	15	2
Dry dipterocarp	87	25.8	19.06	6	0
Hill evergreen	163	36	25.67	22	10
Xeric evergreen (+- pine)	111	25.18	17.83	8	0
Degraded areas (bamboo, fallow fields etc)	90	-	-	3	2
Total <sup>2</sup>	299			88	42

In conclusion, mesic evergreen forest was the most important forest type for tree species diversity, Not only did this forest type support the highest number of species, but also the largest number of locally rare species as well as over half the total number of regionally rare species. However, at the level of the individual small transect site, these overall trends are often obscure.

#### 4.4.3 Survey area

An important question which must always be addressed with transect sites is whether the survey was large enough to ensure comprehensive coverage of the species present. The species/area graph for the whole transect survey indicates that further survey would probably result in only a very small increase in the number of species. Ninety percent of all species were included in the first 12 hectares (52.2% survey) and 50 % of species were found in the first 3.5 hectares ( 12.4% survey) - see figure 6) .

Therefore, at least 12 hectares of transect site are required to provide a reliable estimate of total species richness. A larger survey yields slightly more species but must be balanced against the considerable expenditure involved. In particular, a larger survey enables comparison between different habitat types (see figure 7). Initially, the richest forest type appeared to be evergreen/bamboo. However, the maximum number of species was reached after about 3 hectares, after which very few new species were encountered. Mesic evergreen forests has less species initially, but a larger area coverage continued to reveal more species, eventually outstripping all other forest types.

<sup>2</sup> the ecological survey did not include open areas



Although dry dipterocarp forests were the most species-poor, they contained a surprisingly high proportion of uncommon species. Even of sampling 2 hectares, the number of species continued to increase significantly. At least 3 hectares is needed for each forest type to gain a good estimate of total species richness, although this is not sufficient in very species-rich forests, such as mesic-evergreen. Dry dipterocarp forests are under-represented in the current survey. The total number of species is undoubtedly higher than the current estimate, but it is still very likely to be the poorest forest type.

#### 4.4.4 Structural indicators of tree species diversity.

An inventory of all tree species present in a plot is not only extremely time-consuming but also requires a high degree of expertise. If other parameters could be used as an estimate of tree species value, this could be very valuable for survey work. We looked at a large number of possible parameters, of which the following have been analysed:

##### *i/ Basal area*

##### *ii/ Top height (height of tallest tree in the plot)*

Mature forest areas are often thought to support a higher diversity than immature forests. Basal area and top height are commonly used to estimate the maturity of a tree stand, and therefore might be expected to show a good correlation with species richness. However, in the current survey, these two parameters appeared to be almost unrelated to tree species richness. Species-poor sites (<25 species) did in general have a low basal area or top height, but richer sites showed almost no correlation.

This result can be explained in several ways. Firstly, both basal area and top height are highly biased towards very large trees. Forty-one units contained individual trees with dbh >100 cm, often constituting almost half the total basal area of the site. Such giant trees tend to suppress the growth of other trees in the immediate area, thus lowering the tree species richness of the site (however, it should be remembered that the emergent crowns of such trees may support very large diversity of epiphytes, insects, birds etc which probably outweigh the associated loss of tree species). Secondly, mature forests with dense canopy cover may not contain sufficient gaps to enable non-shade tolerant species to become established. In this respect, semi-open sites contain a higher species richness, but often a lower diversity value.

##### *ii/ Crown area*

(Sum of the maximum area of each tree, regardless of whether it is exposed to the sky or not. Forests with many layers will have a crown area larger than ground area of the plot).

Crown area showed a slightly better correlation with species richness, although still not a strong one. (figure 10) Sixty-three percent of all sites had crown area greater than the total ground area, while 12.5% had crown area more than double ground area, which indicates a significant degree of layering. This layering produces a variety of microhabitats which is likely to support a wider variety of species, both of trees and of other groups of organism.

*iv/ Total bamboo stems*

Many forests in the area contain a significant proportion of bamboo. Nineteen units (21.6%) had bamboo culms constituting at least 10% of total basal area. It was expected that bamboo would have a negative effect on tree richness, partly through direct competition, but also because many bamboo species are well-known indicators of disturbance, particularly after logging in teak forests.

Although some relationship was detected between total tree basal area and bamboo basal area, there was almost no relationship between tree species richness and bamboo basal area (see figures 11 and 12 ). Competition from bamboo may have the greatest negative effect on commoner tree species, many of which are pioneer species intolerant of shade, whereas the rarer species tend to be more shade tolerant and are less effected by the proportion of bamboo. Further investigation is required to fully understand this complex relationship.

*v/ Total shrubs (1-9.5 cm dbh)*

The best correlation so far investigated was between tree species richness and abundance of shrub layer (figure 13). However, the correlation is not strong and is obscured by the disturbance history of any one site. In general, if the degree of disturbance to a site has remained relatively constant over a long period, the relationship is fairly clear, with an abundance of shrubs indicating a high richness of trees. However, if a site was more disturbed in the past than currently, the number of shrubs is likely to be disproportionately higher than the trees species, whereas a site which was less disturbed in the past but has recently become disturbed will support fewer shrubs than expected. It may be possible to quantify the disturbance history of a site by the relative values of these 2 parameters, but this hypothesis will need to be tested in an area with a well-known disturbance history, which is not available in Doi Luang.

*vi/ Total volume of dead wood*

No significant relationship could be detected between tree species richness and volume of dead wood (see figures 14). As with basal area, the volume of dead wood in a particular unit is highly biased towards units with a single large tree fall, which may constitute 90% or more of the total volume of dead wood in the unit. Possibly, this bias would be less if larger units were covered, but this would be too time consuming for a rapid forest survey. The other problem encountered in the dead wood survey was that much of the area has been at least partially logged, with the result that there is a disproportionately large volume of dead logs, both those left over by the logging as well as other trees which subsequently died due to windblow or changes in microhabitat. Both these factors tend to obscure any possible underlying relationship between tree species richness and dead wood volume, but the possibility that dead wood might be related to diversity of other life forms still needs to be investigated.

*Conclusion* None of the parameters analysed showed a strong correlation with tree species richness. Crown area showed a weak correlation with tree species richness and is probably also correlated with diversity in other groups of organism. However, it is very time-consuming to measure and is therefore not suitable for rapid survey techniques. Abundance of shrub layer also showed partial correlation with tree species richness and has the advantage that it is much easier to measure. Basal area, top height, abundance of bamboo and volume of dead wood were not significantly correlated with

tree species richness over the dataset as a whole. These results should be regarded as preliminary. We can expect that a better correlation will be found if the dataset is subdivided, for example by forest type. However, it is unlikely that any single factor is strongly correlated with tree species richness, although it is possible that several factors taken in combination may provide a reasonable estimate.

Doi Luang National Park: Site 56  
 Mature mesic evergreen forest at 550m elevation

Figure 1 : profile

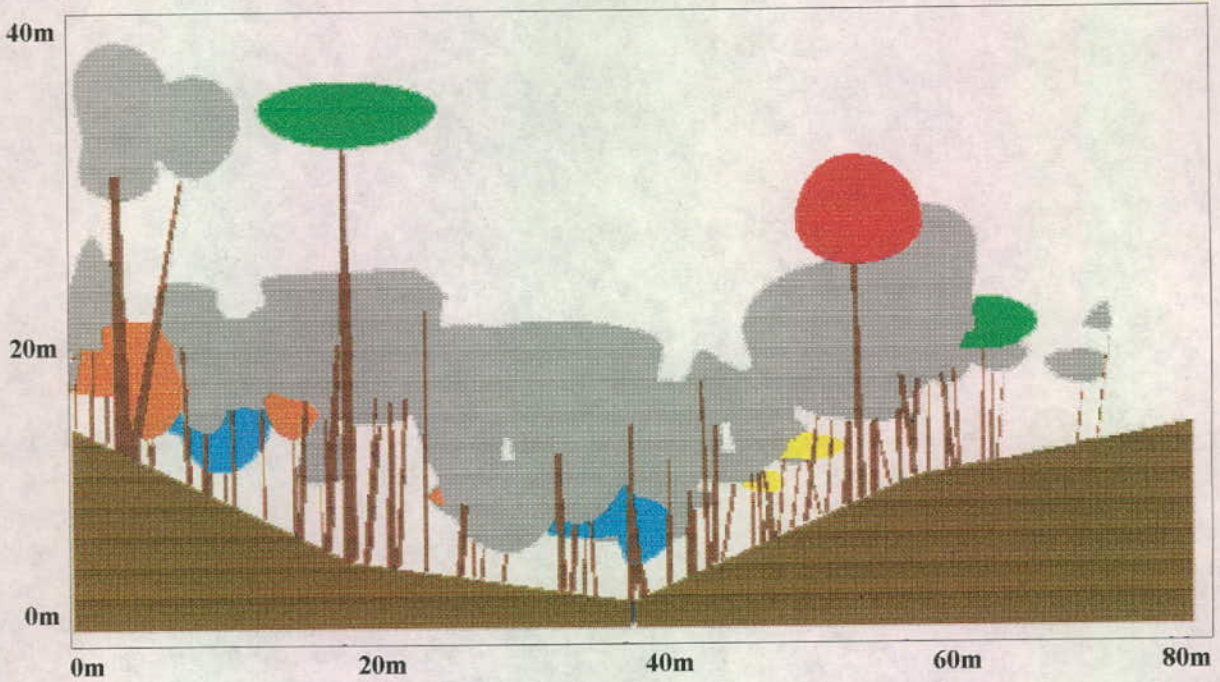
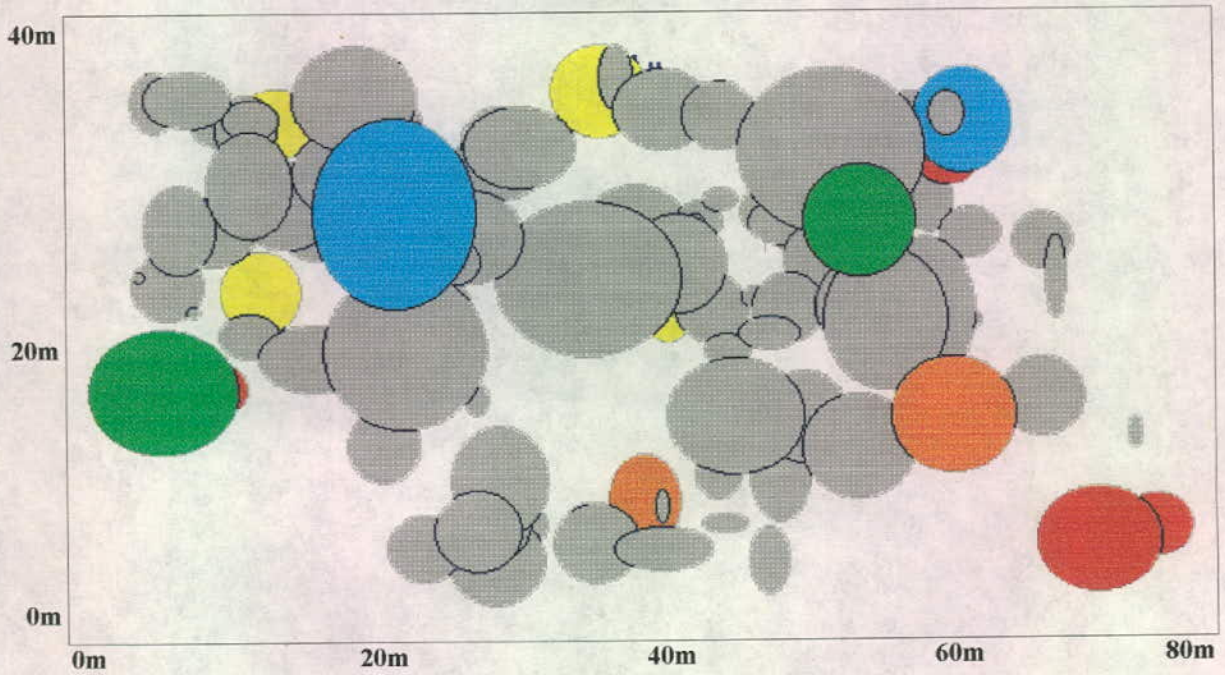


Figure 2 : plan view



Species	
	<span style="display: inline-block; width: 20px; height: 10px; background-color: blue; border: 1px solid black;"></span> <i>Artocarpus lakoocha</i>
	<span style="display: inline-block; width: 20px; height: 10px; background-color: yellow; border: 1px solid black;"></span> <i>Baccaurea ramiflora</i>
	<span style="display: inline-block; width: 20px; height: 10px; background-color: orange; border: 1px solid black;"></span> <i>Iringia malayana</i>
	<span style="display: inline-block; width: 20px; height: 10px; background-color: red; border: 1px solid black;"></span> <i>Sandoricum koetjape</i>
	<span style="display: inline-block; width: 20px; height: 10px; background-color: green; border: 1px solid black;"></span> <i>Tetrameles nudiflora</i>

Figure 3. Relative Species Rarity (per stems)

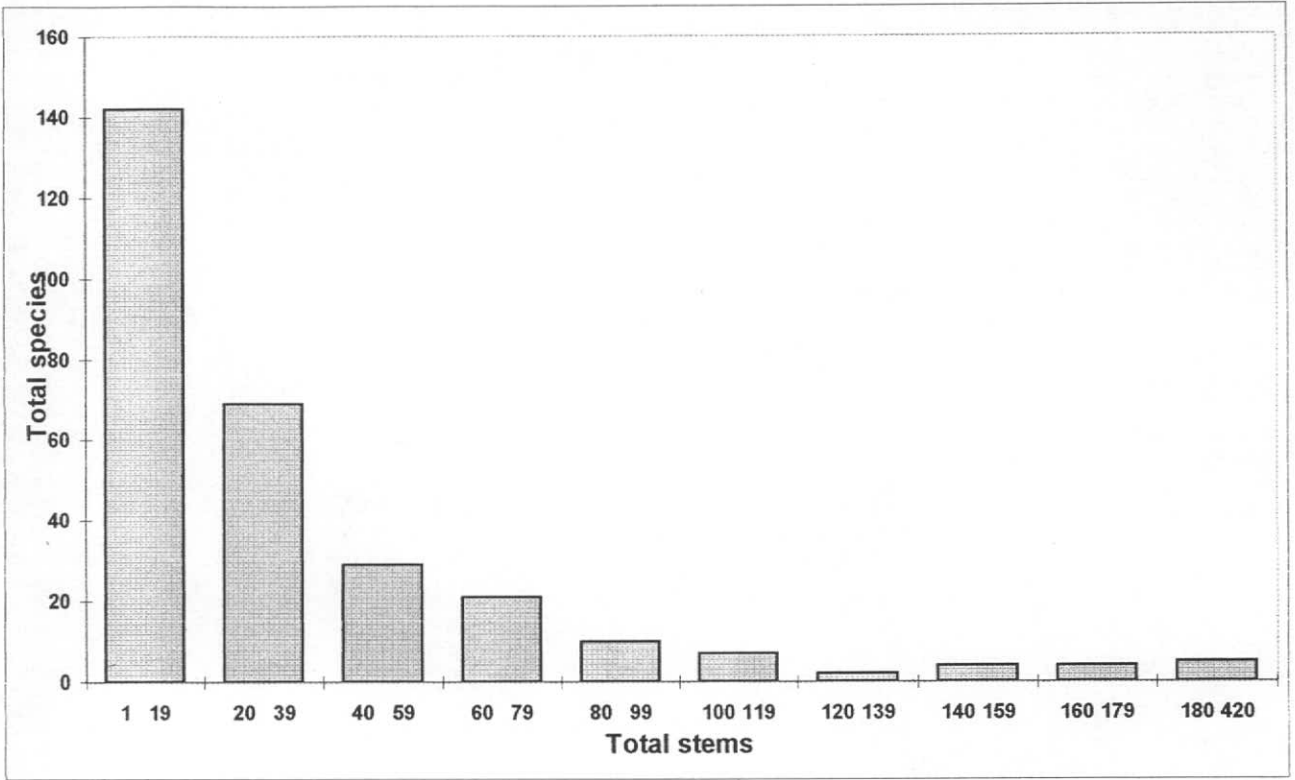


Figure 4. Relative Species Rarity (per transect sites)

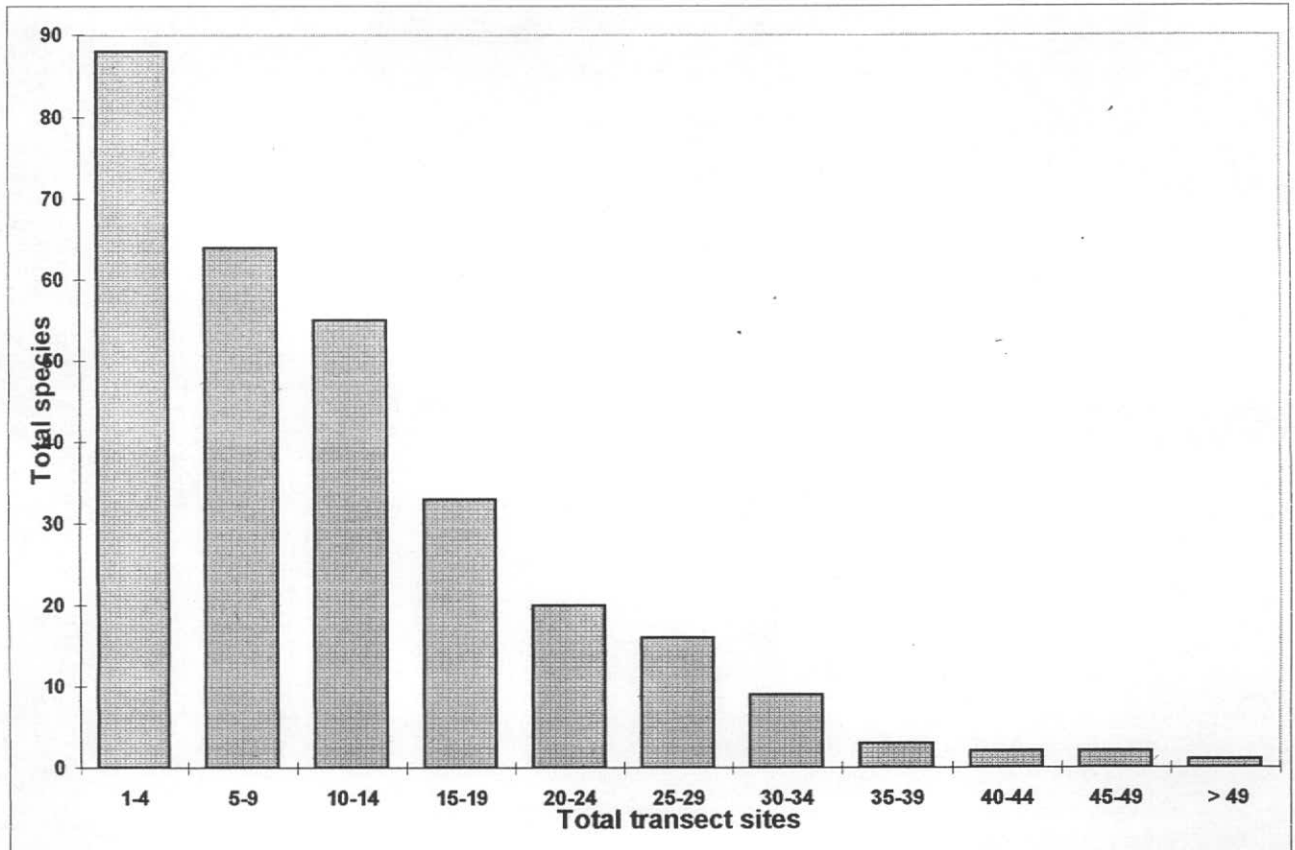


Figure 5. Species rarity (per rapid survey site)

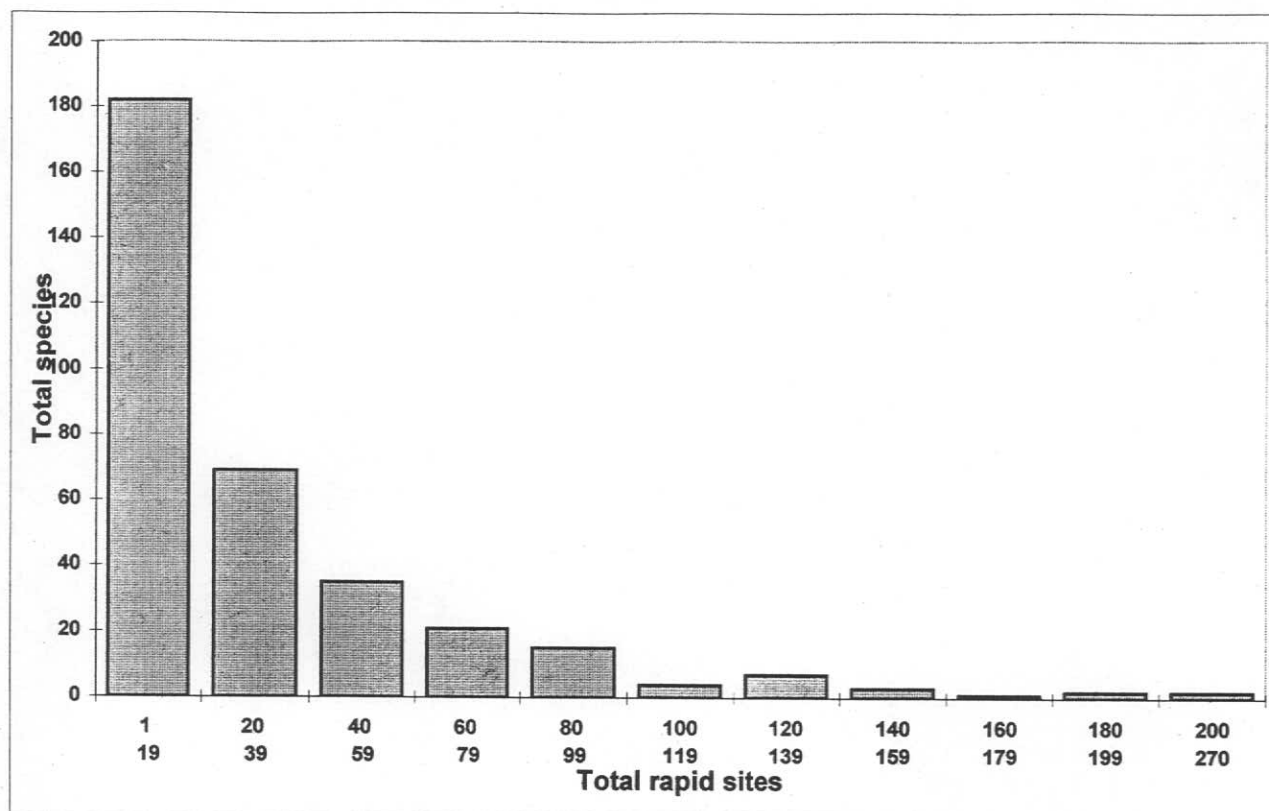


Figure 6. Tree species encountered per area surveyed

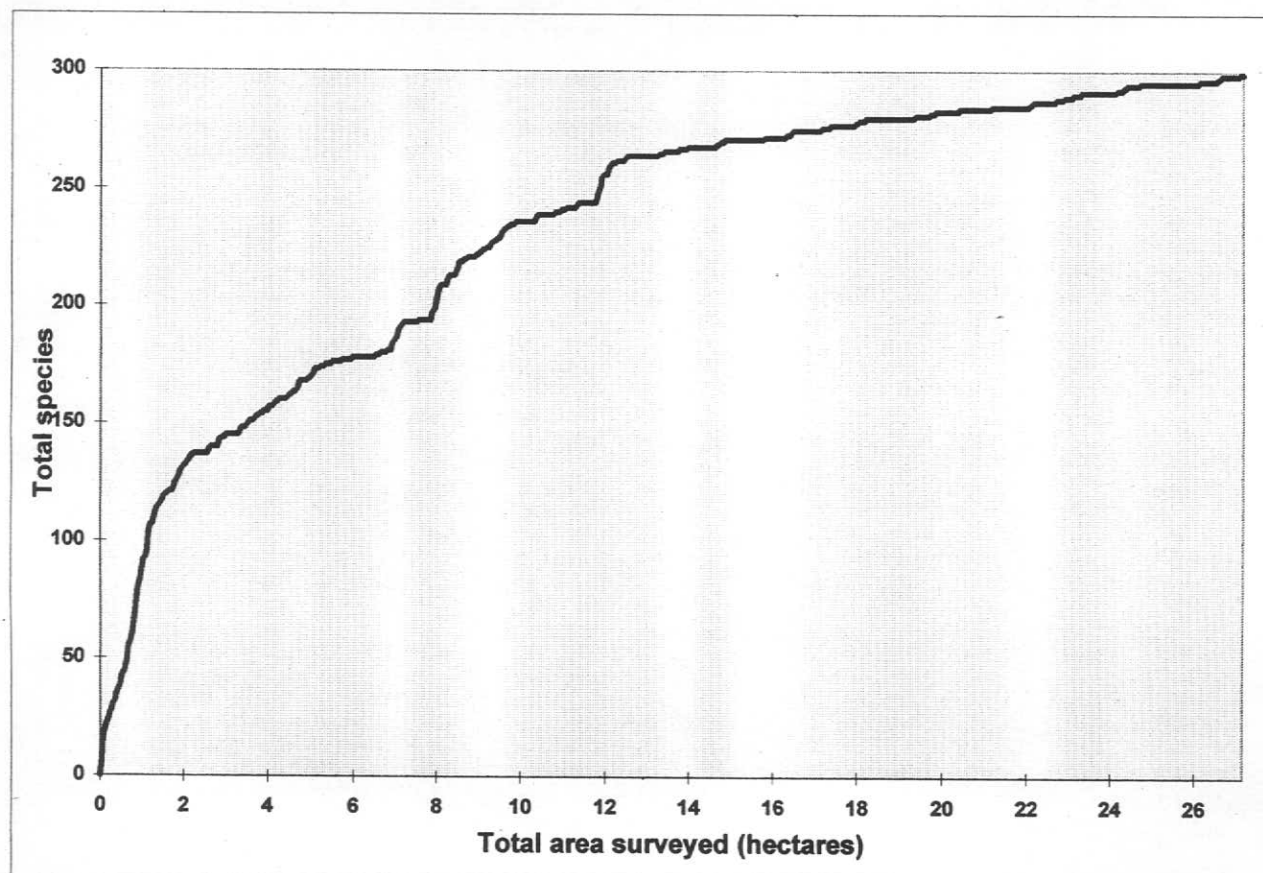


Figure 7. Tree species encountered per area surveyed (by forest type)

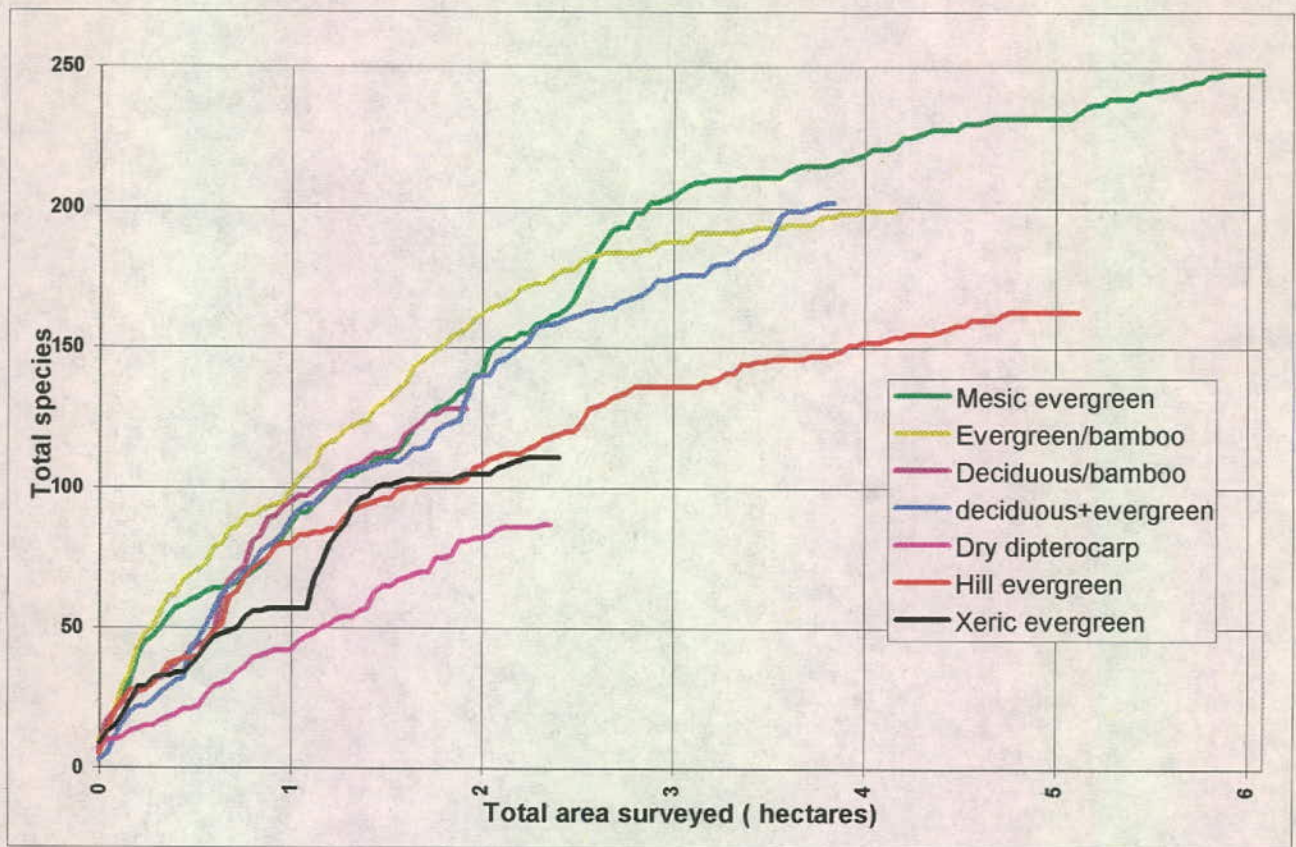


Figure 8. Total tree species v. basal area

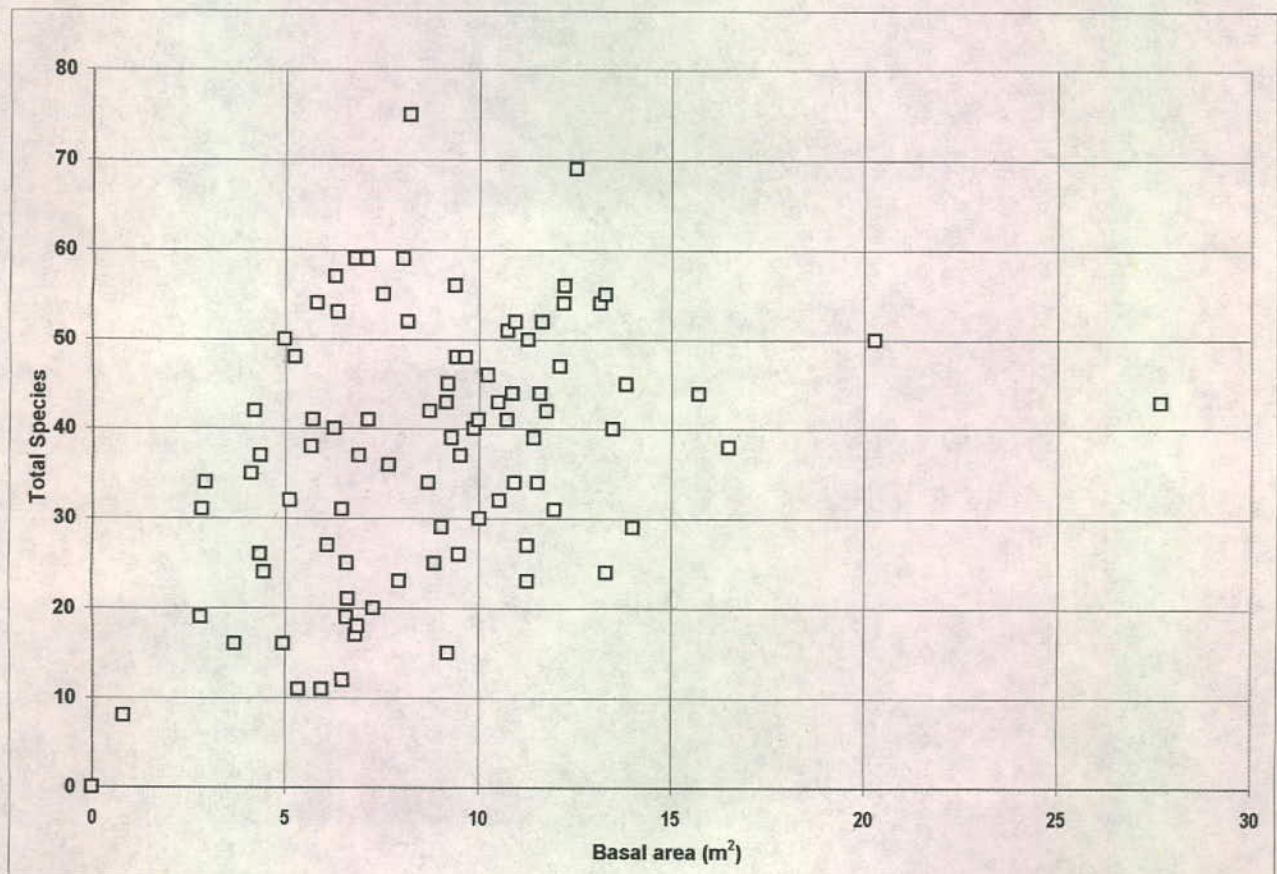


Figure 9. Total tree species v. top height

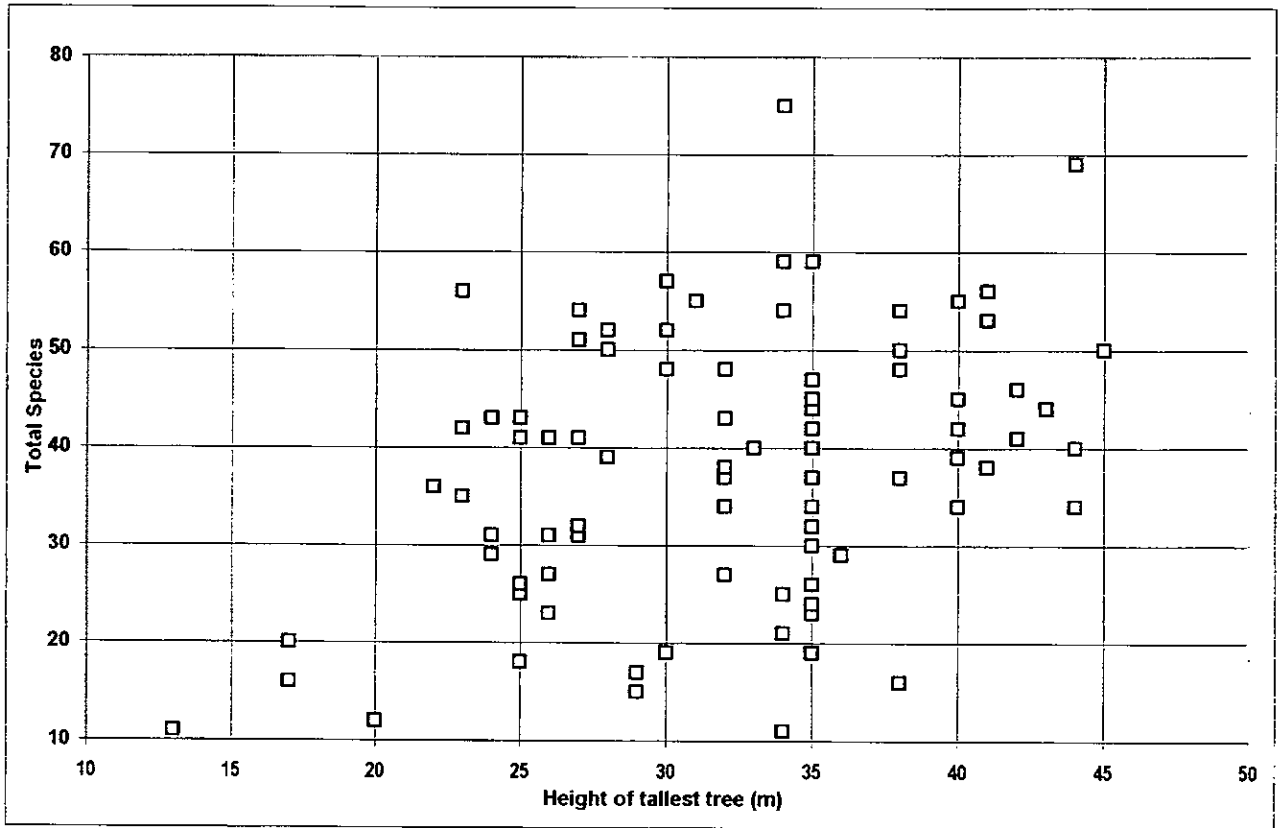


Figure 10. Total tree species v. crown area

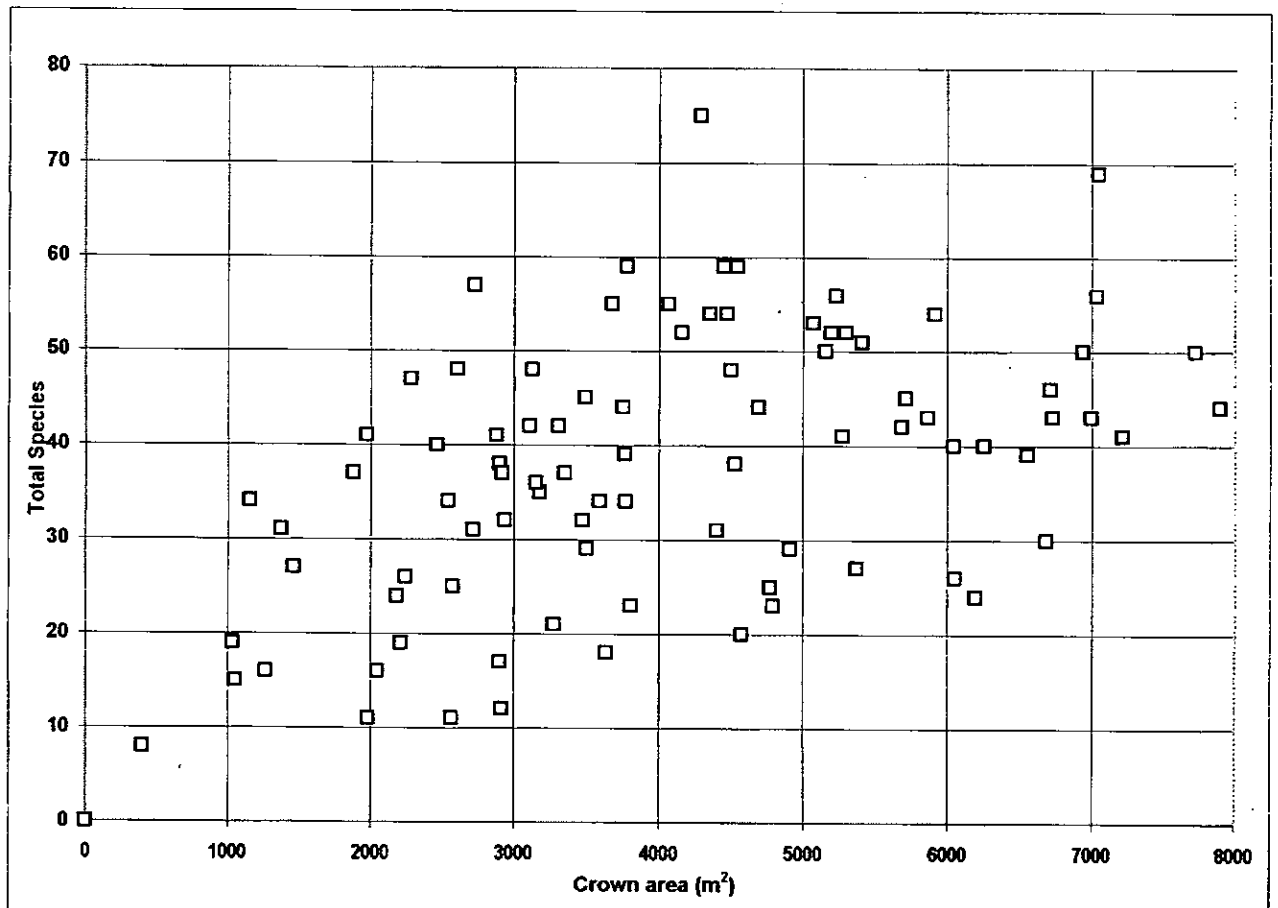




Figure 11. Total tree species v. bamboo stems

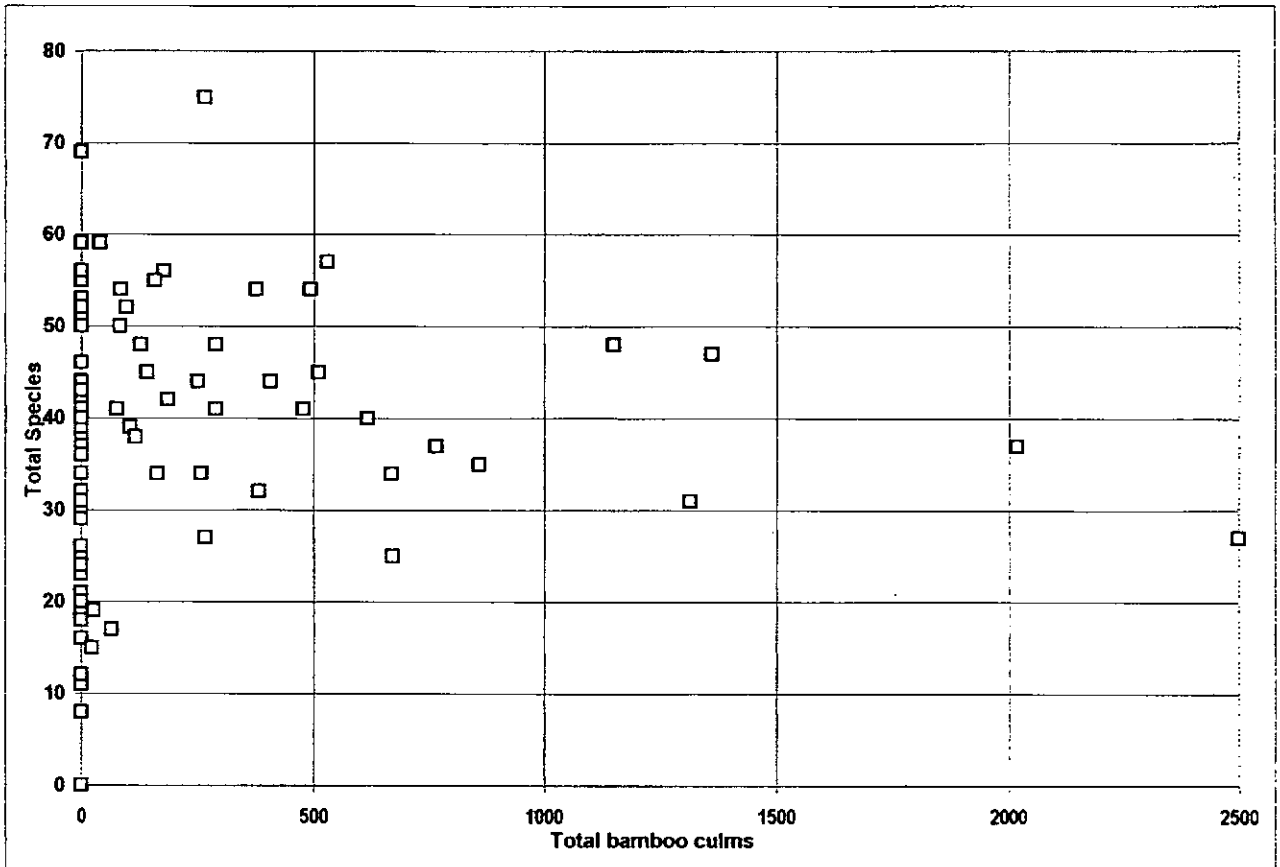


Figure 12. Total tree stems v. bamboo stems

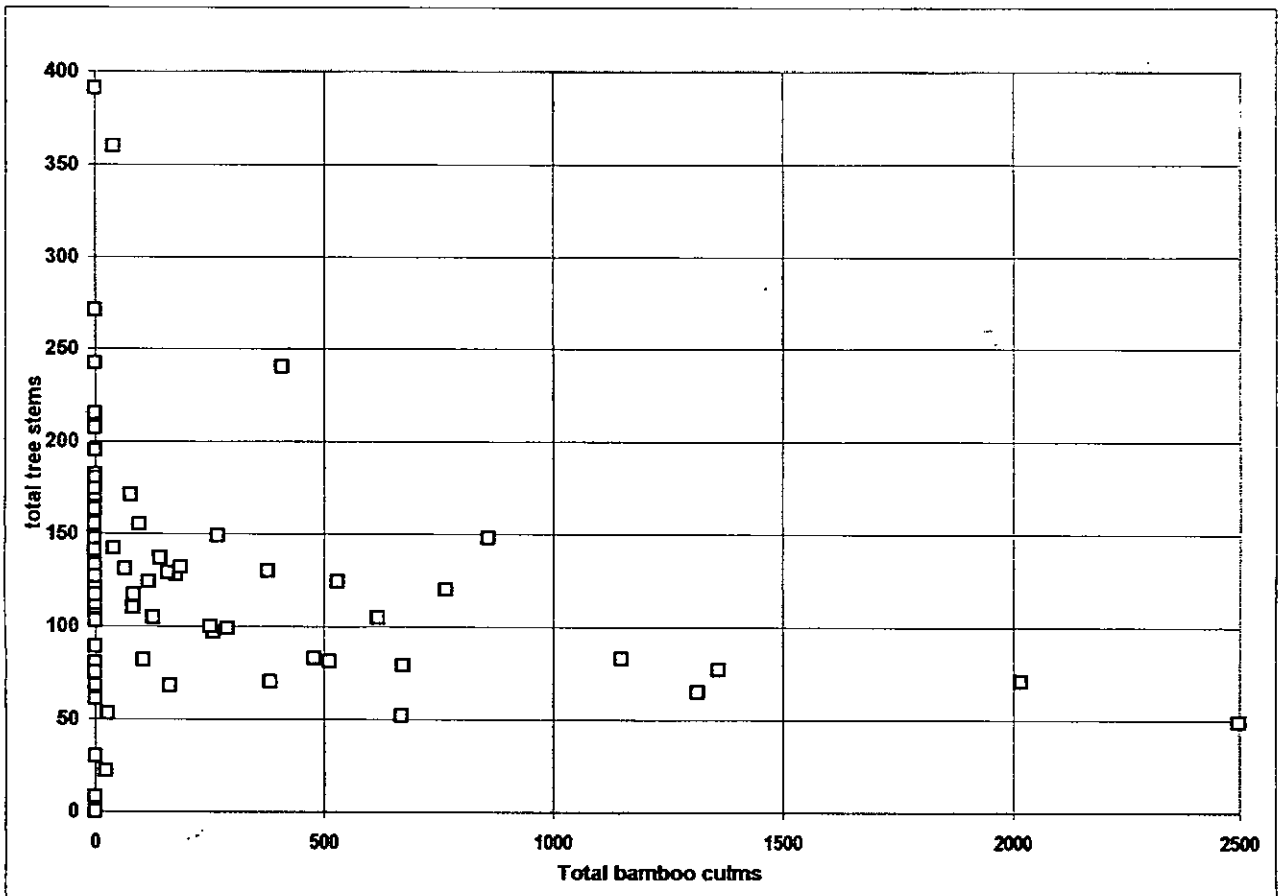


Figure 13. Total tree species v. shrub stems

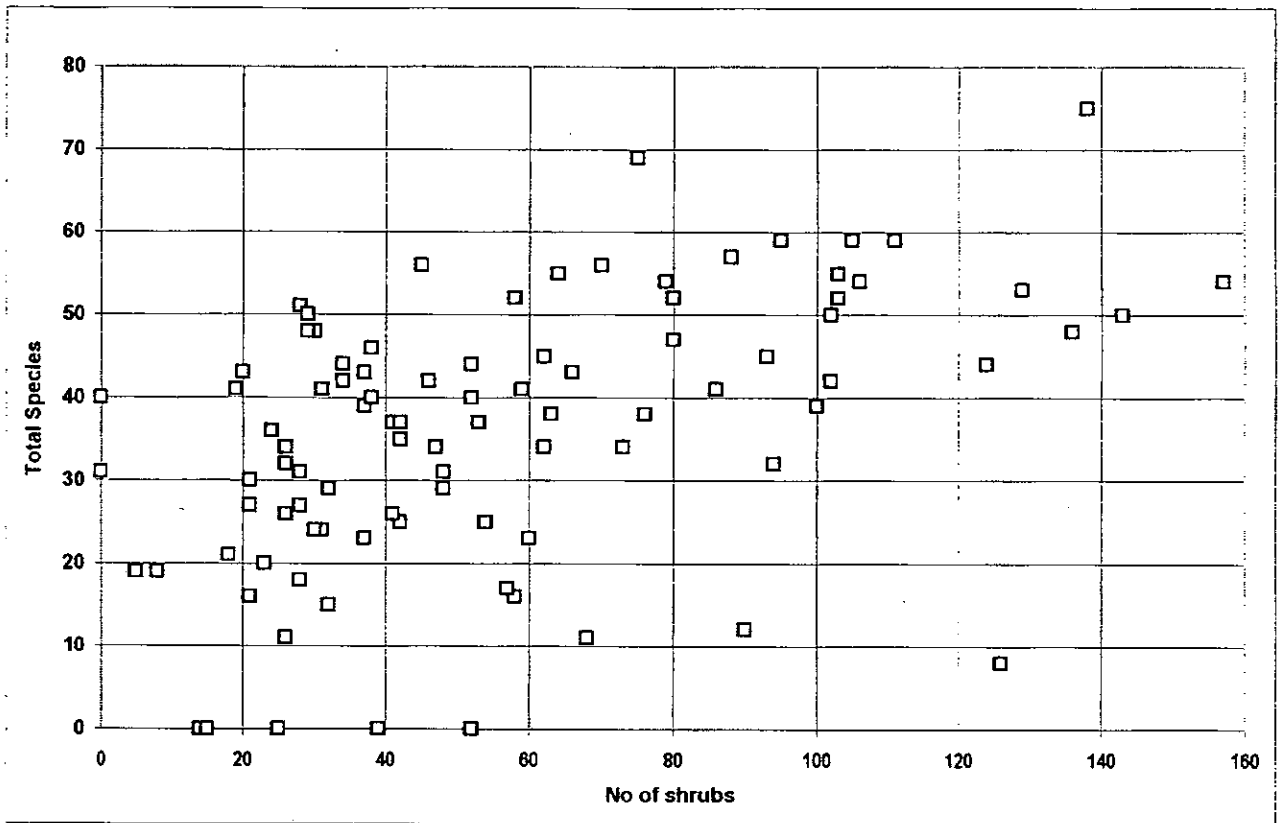
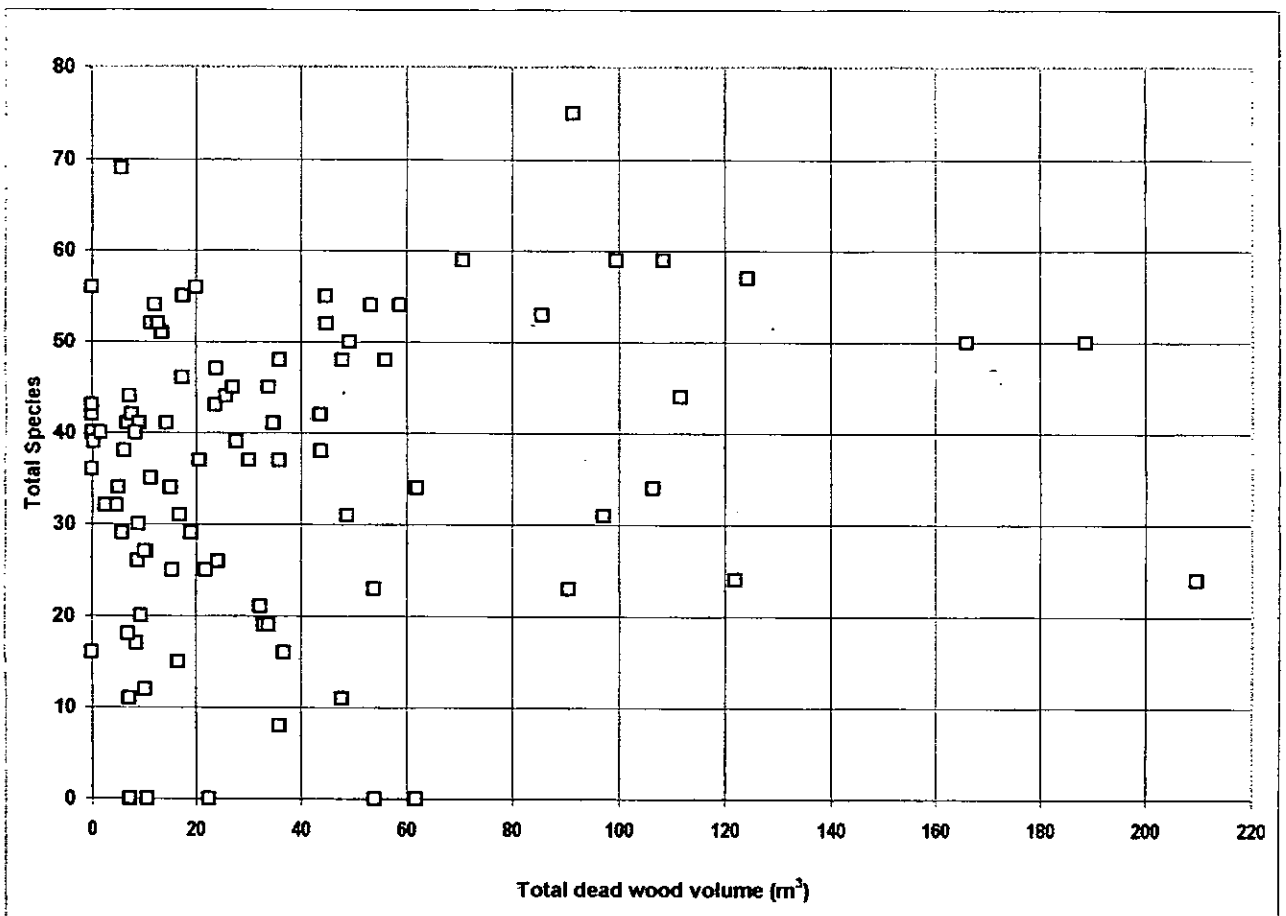


Figure 14. Total tree species v. dead wood volume



## 4.5/ Soil survey

### 4.5.1 pH & organic matter

The mean pH of the soils of the different vegetation types, as identified by the project varied within a range typical of other sites in northern Thailand *i.e.* 5.4-6.4. This is comparable to soils of similar forest types on Doi Suthep.

Although soil beneath hill evergreen forest had the highest organic matter content (6.2%), this value was lower than for similar forest on Doi Suthep (7.3%). Soil beneath deciduous dipterocarp forest had low organic matter content, compared with evergreen forest, as is typically experienced at other locations in northern Thailand. However the value of 3.5% was higher than that recorded for Doi Suthep (2.23%). It is notable that lowest organic matter content was found in deforested areas, indicating that any further tree cutting would lead to significant reduction in the soil quality of the national park.

Organic matter content had a strong linear relationship with percentage moisture at field capacity ( $R^2 = 0.9503$ ). Therefore, hill evergreen forest also had the highest field capacity and deforested areas the lowest. This indicates that deforested areas are more likely to contribute towards flooding and droughts than forest areas, due to low water storage capacity of the soil and rapid runoff. The so-called "mesic" evergreen forest had the lowest field capacity. Since it was more xeric than the so-called xeric evergreen forest and dry dipterocarp forest, a name revision is in order. In addition to the very low organic matter content, the very high percentage of sand in "mesic" evergreen forest soil may have contributed towards its low field capacity. In general, the field capacity of soils on Doi Luang was much higher than on Doi Suthep for similar forest types. Values for evergreen, mixed and deciduous dipterocarp forests on Doi Suthep were 35, 23 and 21 respectively, compared with 45, 27 and 28 respectively on Doi Luang. Since field capacity is one of the first soil properties to deteriorate as a result of disturbance, it could be argued that forests and soil on Doi Luang are in a better condition than on Doi Suthep.

### 4.5.2 Soil nutrients

Nitrogen levels were acceptable and typical of other areas.

Levels of phosphorus were within the range typical of tropical forests. In deciduous forest types, levels of phosphorus were lower than in other areas of northern Thailand and may be limiting.

Levels of potassium were generally lower than is typical for these forest types.

### 4.5.3 Variation in soil properties with elevation

In general both organic matter and percentage moisture at field capacity increased with increasing elevation. This is typically observed on mountains in northern Thailand.

No consistent trends in pH or nutrient concentrations were observed.

A reduction in clay content and an increase in sand content with increasing elevation were evident.

#### 4.5.4 Conclusions

The results of the soil survey illustrate two significant points. Firstly, soil quality, as measured in terms of percentage organic matter, is not related to tree species richness or to forest condition over the dataset as a whole. In particular, mesic evergreen forest, which supports the highest species richness, had one of the poorest soils. This result is typical of tropical rainforest soils, but is not normally found in northern Thailand, possibly because the majority of survey work in the area has been conducted in highland areas.

Secondly, soil field capacity (which is closely related to % organic matter) cannot always be used as a reliable estimate of the amount of moisture available to plants. In a situation where the only moisture input was rainfall, field capacity would probably be closely related to moisture availability since it determines the speed at which the soil dries out. However, the mesic forests in Doi Luang almost certainly rely on ground water rather than rainwater directly, as can be seen by their geographical distribution (see map 8). Soil field capacity is therefore not a significant factor in determining whether a site supports mesic or xeric evergreen forest, although in deciduous or hill evergreen forests, where the plants have less access to ground water, it may become a significant factor.

**Table 2. Mean soil parameters for each forest type at Doi Luang National Park**

Forest Type	n	pH		% Organic Matter		% Moisture at field capacity		% Nitrogen		Phosphorus (ppm)		% Sand		% Silt		% Clay			
		Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd		
Hill evergreen	12	5.4	0.5	6.2	2.3	45.2	8.5	0.3	0.1	13.5	18.2	125.0	56.6	50.7	16.1	26.9	9.1	22.6	10.1
Mesic evergreen	17	6.2	1.0	3.5	2.4	25.9	10.6	0.2	0.1	11.4	22.5	129.0	83.4	56.5	12.7	21.6	7.5	21.8	7.6
Mesic evergreen/bamboo	14	5.7	0.5	4.4	2.9	33.5	13.1	0.3	0.3	5.0	4.1	139.0	104.9	45.7	10.9	27.4	5.5	27.0	6.7
Xeric evergreen ( $\pm$ pine)	6	5.7	0.8	3.9	3.8	29.2	14.5	0.2	0.1	4.5	4.3	108.4	60.5	47.5	10.2	25.9	7.5	25.3	12.8
Deciduous/evergreen	13	6.3	0.8	4.2	2.9	27.1	10.8	0.2	0.1	4.2	2.5	136.5	111.4	56.7	13.3	21.0	5.9	22.3	8.9
Deciduous bamboo	5	6.0	0.3	3.5	0.8	27.0	5.0	0.2	0.0	6.9	11.2	138.1	49.4	37.7	6.0	30.6	5.7	31.6	3.5
Dry dipterocarp forest	5	5.8	0.5	3.6	2.2	28.5	6.9	0.2	0.1	2.5	1.7	109.3	95.4	42.4	7.8	24.7	2.8	32.9	5.4
Deforested areas	4	6.4	0.4	2.8	0.8	19.9	3.0	0.1	0.0	7.9	8.2	147.4	46.0	48.0	9.6	19.1	7.6	28.9	6.8

**Table 3. Variation in mean soil parameters with elevation at Doi Luang National Park**

Elevation range (m above sea level)	n	pH		% Moisture at field capacity		% Organic Matter		% Nitrogen		Phosphorus (ppm)		% Sand		% Silt		% Clay			
		Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd		
500-749	40	6.4	0.8	24.2	12.9	3.0	1.5	0.4	1.6	31.6	157.8	148.7	160.3	49.4	13.1	26.2	13.5	29.1	13.2
750-999	7	5.9	0.9	26.9	5.7	3.3	1.6	0.2	0.1	2.6	1.2	102.3	52.8	39.2	15.7	30.2	10.3	28.5	13.2
1,000-1,249	25	5.4	0.6	43.1	11.6	6.4	3.3	0.3	0.1	10.3	13.6	144.5	95.4	54.3	13.4	24.3	7.2	21.7	8.8
1,250-1,499	3	5.5	0.4	43.6	6.6	5.8	1.0	0.3	0.0	9.0	7.0	126.2	19.2	66.3	19.0	16.6	6.7	17.1	12.5

## 5. GROUND MAPPING

### 5.1/ Objectives

1/ to test that the conclusions drawn by the transect survey were in fact applicable to a wider area, in particular that the range of habitats included was representative of the area as a whole.

2/ to provide baseline data for ground truthing the analysis of the satellite image data.

### 5.2/ Methods

A non-random plotless method was used, designed to cope with a mountainous landscape where the vegetation changes rapidly over a short distance and the boundaries between vegetation units are relatively well-defined. In such areas, a strict grid or totally random allocation of survey sites is not only extremely difficult to carry out, but is also liable to neglect distinctive but very narrow habitats, such as along streams or ridges. In addition, because the sample sites were subsequently used as training areas for the satellite interpretation, it was necessary to actively select homogenous areas with similar vegetation for at least 50 m in at least 2 directions from the sampling point. The representiveness of the survey was achieved by trying to sample every single vegetation unit within 6 defined study areas of 3 X 4 km<sup>2</sup> each. The geographical position of the approximate centre of each unit was recorded using a Trimble Gro Explorer 2 GPS (differentially corrected with base station data from Chiang Mai where possible), and the following parameters noted for the area visible from that point:

- 1 - physical parameters (slope, aspect, topography, altitude, bedrock)
- 2 - vegetation structure (estimates of % cover, mean canopy and emergent height, extent of layering, broad composition of each layer-by dividing trees into seven categories - mesic evergreen, xeric evergreen, deciduous, bamboo, Fagaceae, dry dipterocarp, pine)
- 3 - specific signs of disturbance (logging, fire damage, domestic animals *etc.*)
- 4 - tree species, relative abundance of 140 target tree taxa, plus notes of any other species which were confidently identified by the surveyor.

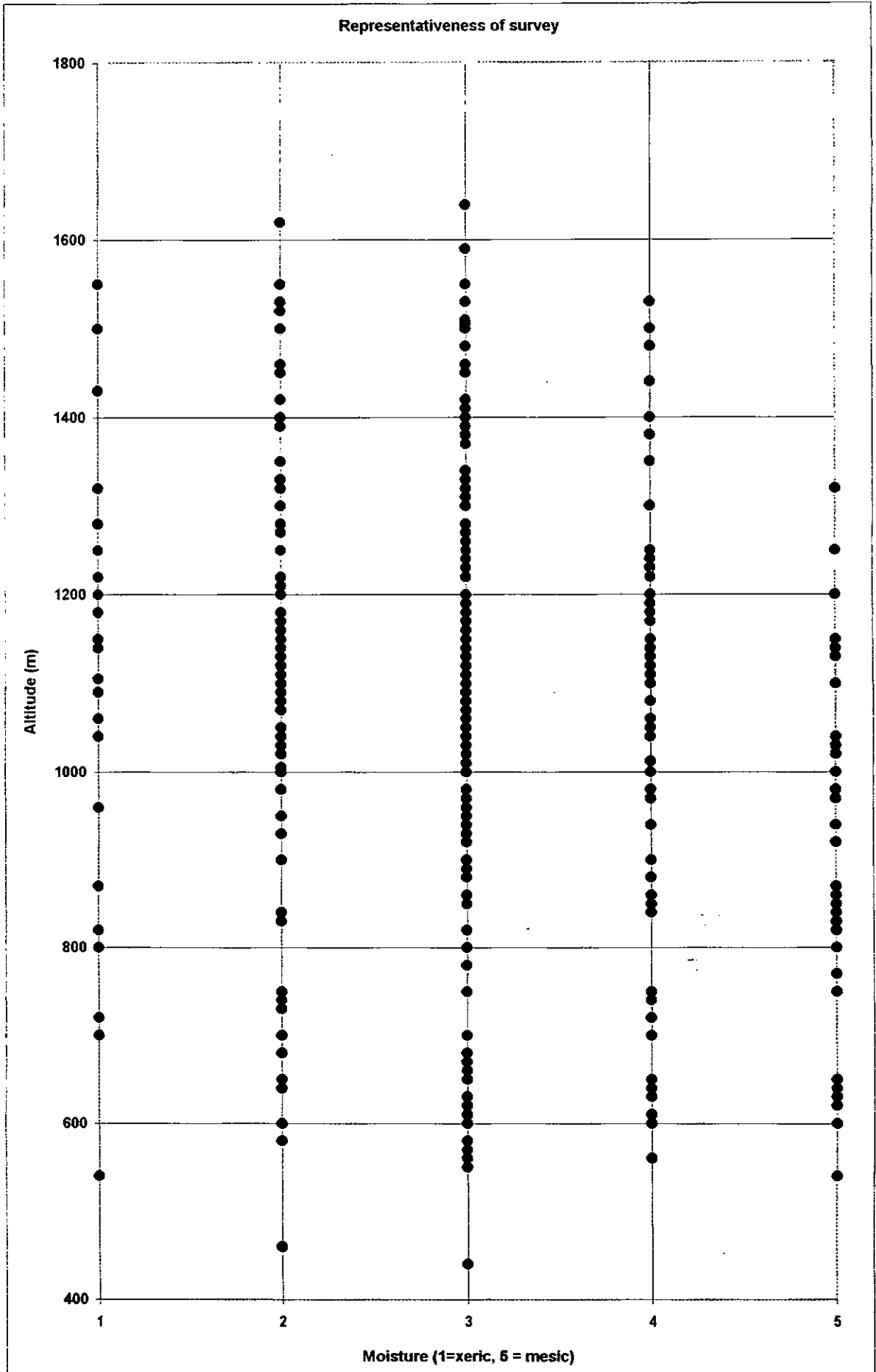
The boundaries of all mapping units were estimated on the ground and subsequently refined where possible using aerial photographs from 1995.

### 5.3/ Results

Six core areas of 12 km<sup>2</sup> (3 X 4) each were established in widely dispersed parts of the park (6.2% of the total area-see map 1). Five hundred and twenty-four separate units were surveyed from the ground, covering a total area of approximately 2000 hectares - around 28 % of the total land area in the 6 core areas (see maps 2-7). The full range of altitude and moisture were covered (see figure 15 )

A total of 345 species were recorded. As in the transect survey, the majority of species are rare; 182 (52.7%) species found in <5% of all units (see figure 5). The results will be analysed in a similar manner to the transect sites. However, the main purpose of the rapid survey was to provide ground data for the satellite image interpretation, as discussed in the next section.

Figure 15. Representativeness of survey  
RAPID GROUND SURVEY





## **6. SATELLITE IMAGE INTERPRETATION**

### **6.1/ Objectives**

i/ to investigate the potential for using satellite data to identify vegetation types and forest condition, using Doi Luang National Park as a training area.

ii/ to construct a GIS of the park, which could be used to produce maps of vegetation type, condition and potential species diversity.

### **6.2/ Methods**

Digital Landsat5 TM satellite image data from both January and March 1998 formed the basis of the remote sensing survey, which covered 96.3% of the total area of the park. Preliminary unsupervised and supervised classification of the image using various band combinations and transformations was unsuccessful due to the complexity of the vegetation mozaic and the topography.

In order to improve the classification, a Digital Terrain Model (DTM), based on 20m contours of 1:50,000 RTSD topographic map, was constructed and used to produce maps of potential moisture availability from a combination of aspect, slope, bedrock and distance to ridge/watercourses.

Around 100 of the sampling units covered by the ground survey were selected on the basis of positional accuracy, image clarity and low variability between pixels within each unit. The averaged digital data from all well-defined pixels within each unit was processed to construct a digital signature for the unit. These 100 signatures were compared with each other and combined into composite signatures where no significant difference between them could be identified. Fourteen well-defined signatures were identified, which formed the basis for the final classification of the satellite data from which a draft vegetation map was constructed.

Visual comparison of this draft map with the ground map showed that vegetation type and condition in the study areas could not be accurately predicted using the image data alone. However, the ground data revealed that many areas with the same satellite signature could be subdivided by reference to the DTM since every forest type has definite limits in terms of altitude, bedrock and moisture availability. This allowed us to identify a total of 33 vegetation categories, consisting of 11 main types in varying stages of degradation. This system was used to produce draft vegetation type/condition maps, which were visually compared with the ground maps of the 6 sample areas and inconsistencies reduced through an iterative process until a satisfactory correlation was obtained.

### 6.3/ Results

1112.6 km<sup>2</sup>, representing 92.4% of the calculated land area of the park<sup>1</sup> was classified into 9 major vegetation types, which were subdivided into 33 subtypes according to condition. 45 km<sup>2</sup> (3.7%) fell outside of the available image<sup>2</sup>, and a further 52.4 km<sup>2</sup> (3.9%) could not be classified, principally due to extreme shadow effects. 74.1 % of the surveyed area supports forest cover, but only 12.6% of this total is in very good condition, a further 21.2% is in fairly good condition whilst 37.6% is in poor or fairly poor condition<sup>3</sup> (see map 9)

Predominantly deciduous forests are almost twice as abundant as predominantly evergreen forests, occupying 68.1% of the total forest cover in the park (figure 16). However, the majority of areas are to some extent transitional, with deciduous+evergreen areas being the commonest single type. Of the 139.7 km<sup>2</sup> with sufficient moisture to support mesic evergreen forest in good condition, only 28.3 km<sup>2</sup> (20.2%) currently does so. The remainder is occupied by more degraded forest types, chiefly mesic evergreen/bamboo. These areas are concentrated in the SE corner of the park. Although good patches do occur in other areas, these are generally small and isolated from each other (see map 10)

**TABLE 4: Area of vegetation types**

Forest Type	Area (km <sup>2</sup> )	% total
Mesic evergreen	53.4	4.6
Evergreen/ Bamboo	108.7	9.3
Deciduous + Evergreen	292.7	25.0
Deciduous/Bamboo	118.4	10.1
Dry dipterocarp	149.2	12.8
Hill evergreen	63.7	5.5
Xeric evergreen (+- pine)	35.7	3.0
Degraded areas (bamboo, fallow fields etc)	187.7	15.9
Open areas (fields, grassland, roadsides)	115.3	9.9
Unclassified (reservoirs, deep shadow etc)	45.4	3.9
Total survey <sup>4</sup>	1168.8	100

<sup>1</sup> The calculated area of the park was 1210 km<sup>2</sup>, using GIS based on the official land title document of the park. This represents an explained discrepancy of 40 km<sup>2</sup> from the official figure of 1170 km<sup>2</sup>.

<sup>2</sup> Unquantified ground survey indicated that the area outside of the image is dominated by degraded & open areas.

<sup>3</sup> Condition is defined for the purposes of remote sensing analysis in terms of % canopy cover & texture relative to be best known examples of a particular vegetation type under particular conditions of altitude range/moisture/bedrock

<sup>4</sup> the Landsat image available covered 96.3 % of the total area of the park (1210 km<sup>2</sup>), as calculated by GIS based on the official land title document of the park. This represents an explained discrepancy of 40 km<sup>2</sup> from the official figure of 1170 km<sup>2</sup> percentages are of surveyed area only. The unsurveyed area consists largely of degraded & open areas.

Figure 16. Total area per forest type

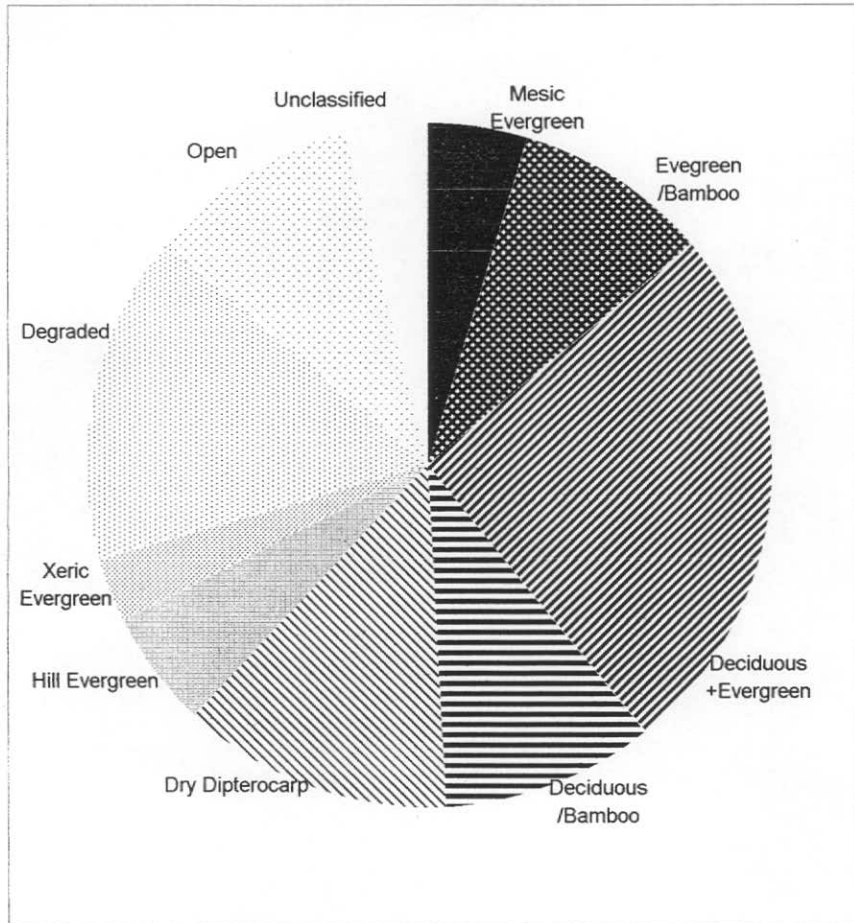
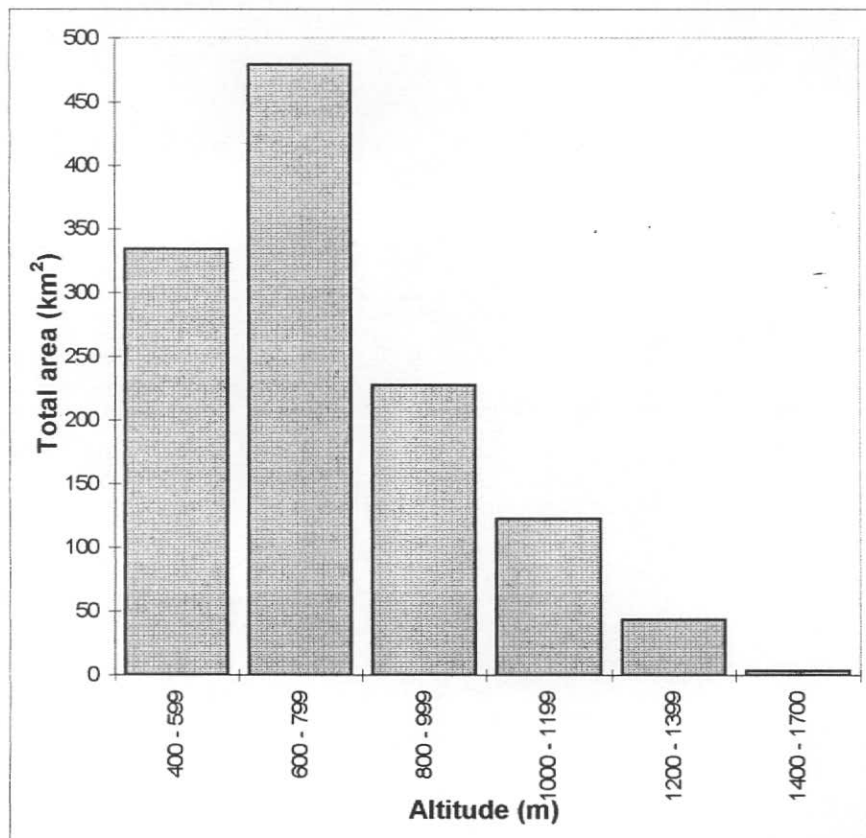


Figure 17. Total area per altitude



## **7. DISCUSSION and DIFFICULTIES ENCOUNTERED**

The underlying difficulty facing any biogeographical survey is the enormous difference in scale between the area which can actually be measured on the ground and the total area of the park. Inevitably, a great deal of extrapolation is involved which is practically unverifiable.

With a total of 57 transect sites covering 29,28 hectares, Doi Luang is probably as intensively surveyed as any protected area in Thailand with the sole exception of Huai Kha Khaeng. Even so, this represents a minute fraction (0.024%) of the total area of the park.

Our initial plan had been to use the transect sites directly as training areas for the satellite image analysis. This proved infeasible for two reasons:

1/ Spatial inaccuracy. Even if it had been possible to achieve a ground accuracy of <50 m with our GPS (true in <20% of cases, even after differential correction), the discrepancy between the satellite image and the topographic map was still too great to ensure that specific pixels on the satellite referred to particular 80 X 40 m transect plots.

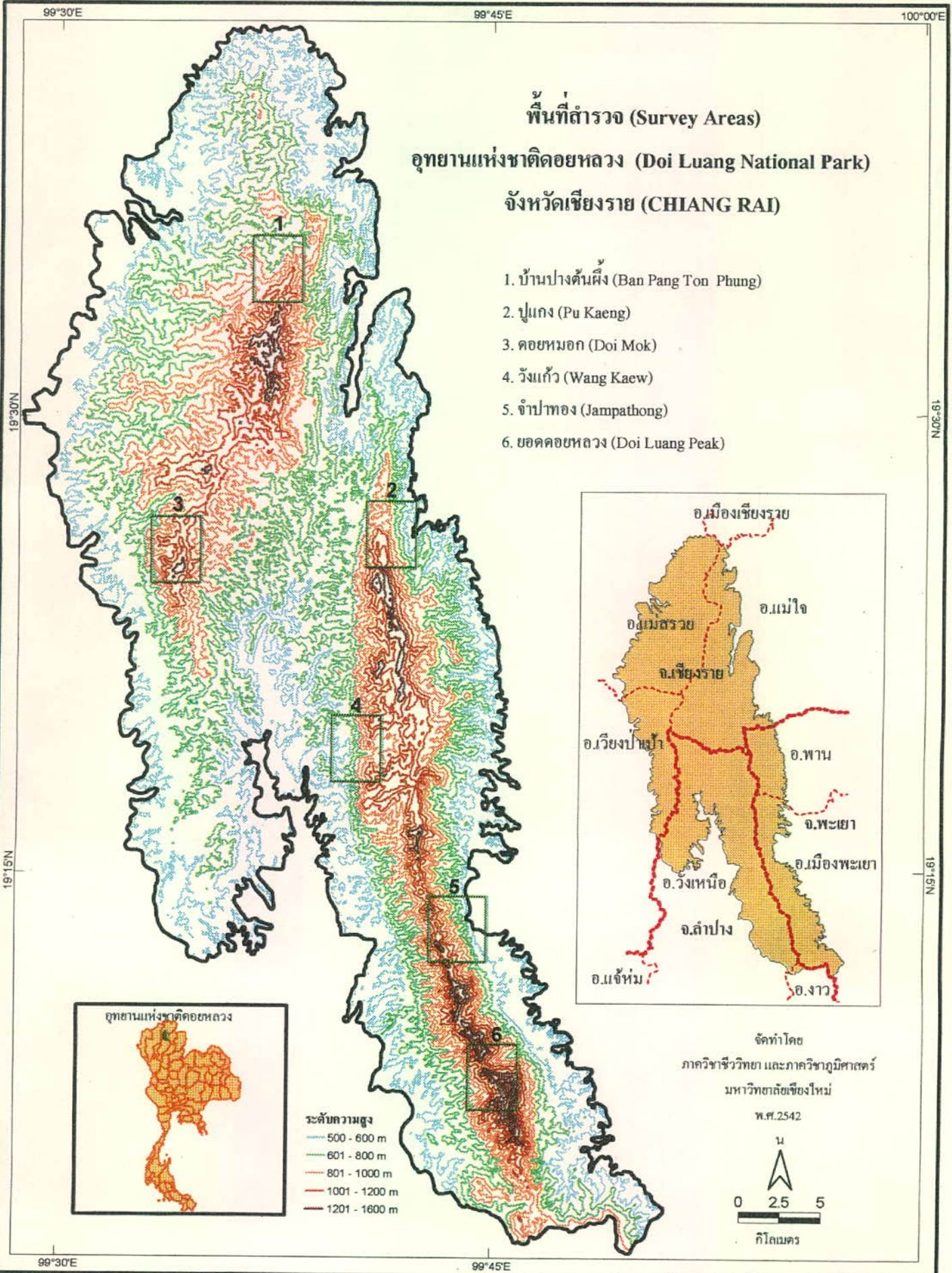
2/ Too few sites. Even with 57 sites it was still not possible to sample a statistically sufficient number of each vegetation types to cover the full range present in Doi Luang.

Ground mapping proved to be the single most important factor in improving the accuracy of vegetation mapping. Although the area covered was still relatively small (<2.5% total), the 524 units probably covered almost the full range of habitats in the park (see maps 11-22). This enabled us to determine the physical limits of each forest type in terms of altitude, moisture and bedrock, which was critical in separating areas with very similar satellite signatures, but importantly different ecologically.

A good example of this is evergreen forest areas, which can be difficult to distinguish based on the satellite alone. However, the ecological survey showed that mesic evergreen forests support the highest diversity in the park, whereas xeric evergreen forests are one of the most species-poor habitats. Moreover, the ground mapping revealed that in an undisturbed state mesic evergreen forest attains over 90% cover with high structural diversity, whereas 70% cover indicates moderately disturbed areas. On the contrary, even the most undisturbed dry evergreen sites never attain more than 70% cover. Therefore, a satellite signature indicating evergreen forest with about 70% cover can be classed as xeric evergreen forest in good condition if it is in a dry location, but as a moderately disturbed mesic evergreen forest if in a moist location. The same data provides information on both vegetation type and condition.

This example clearly illustrates the importance of integrating ecological survey, ground mapping and remote sensing interpretation to assess forest type and condition. Complex forest mosaics such as in Doi Luang cannot be interpreted without reference to the underlying topography and prior knowledge of the physical limits of each vegetation type.

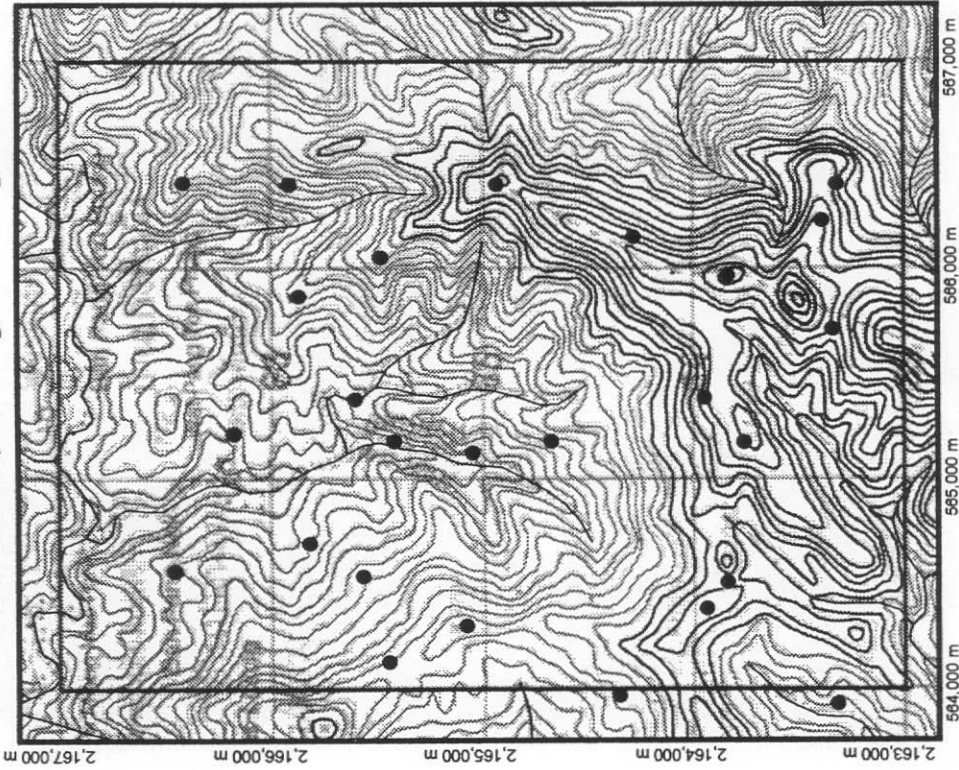
Map 1



แหล่งข้อมูล: แผนที่ภูมิประเทศ 1:50,000 (กรมแผนที่ทหาร) และแผนที่แบบภาพถ่ายทางอากาศที่ประกาศเขตอุทยานแห่งชาติ

Map 2

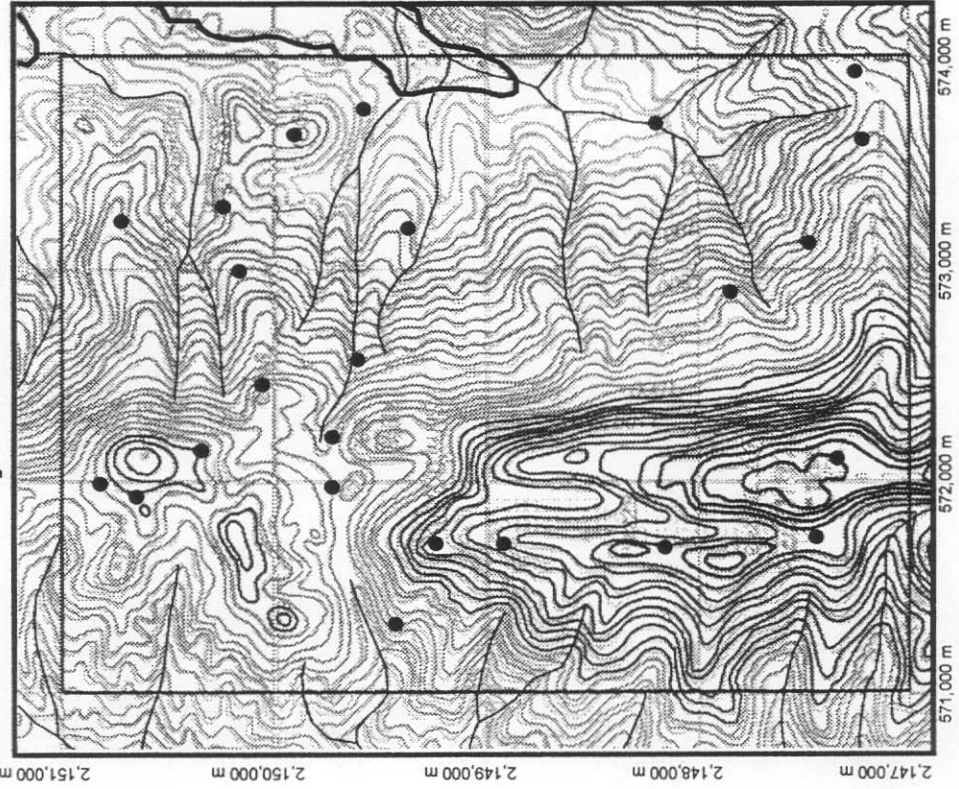
บ้านปางต้นผึ้ง (Ban Pang Ton Phung)



- จุดสำรวจ (Sampling Point)
- ขอบเขตพื้นที่สำรวจ (Sampling Boundary)
- ทางน้ำ (River)
- เขตอุทยานแห่งชาติ (National Park Boundary)

Map 3

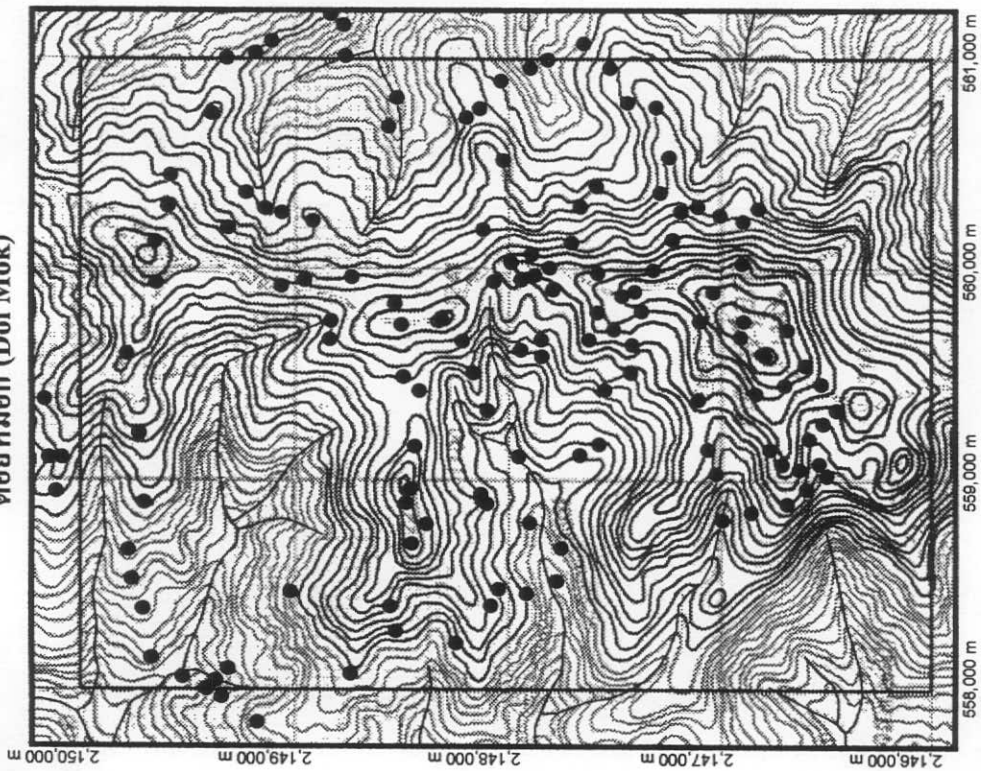
ป่าแก่ง (Pu Kaeng)



- ระดับความสูง (Elevation)
- ..... 400 - 600 m
  - ..... 601 - 800 m
  - ..... 801 - 1000 m
  - ..... 1001 - 1200 m
  - ..... 1201 - 1700 m

Map 4

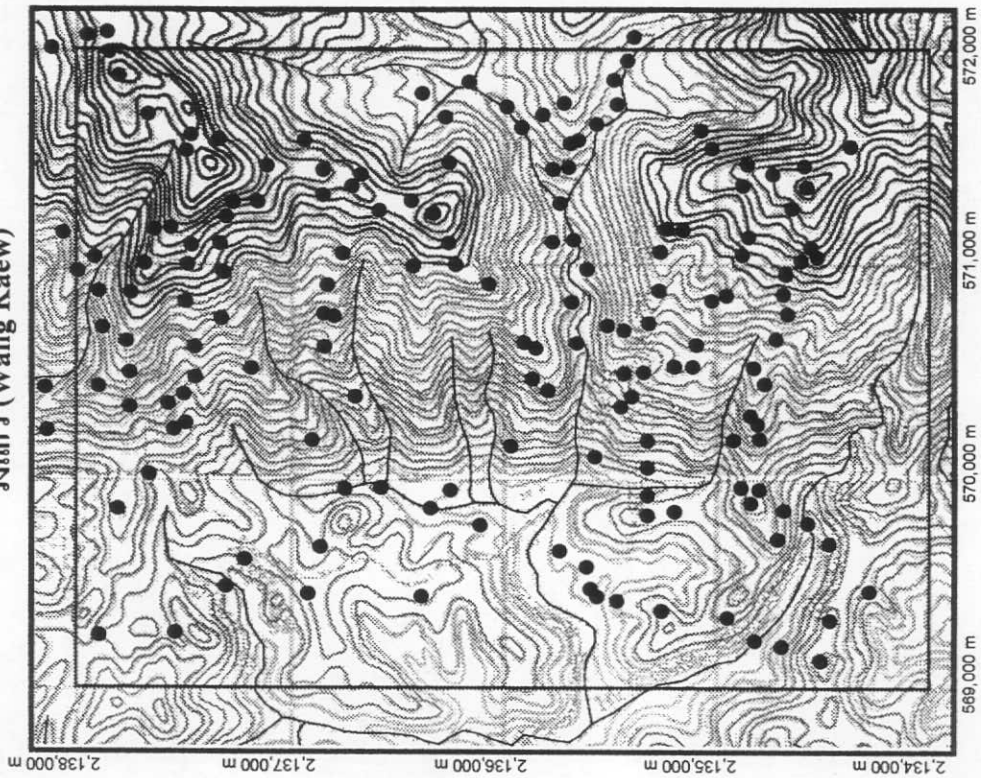
ดอยหมอก (Doi Mok)



- จุดสำรวจ (Sampling Point)
- ขอบเขตพื้นที่สำรวจ (Sampling Boundary)
- - - - - ทางน้ำ (River)
- เขตอุทยานแห่งชาติ (National Park Boundary)

Map 5

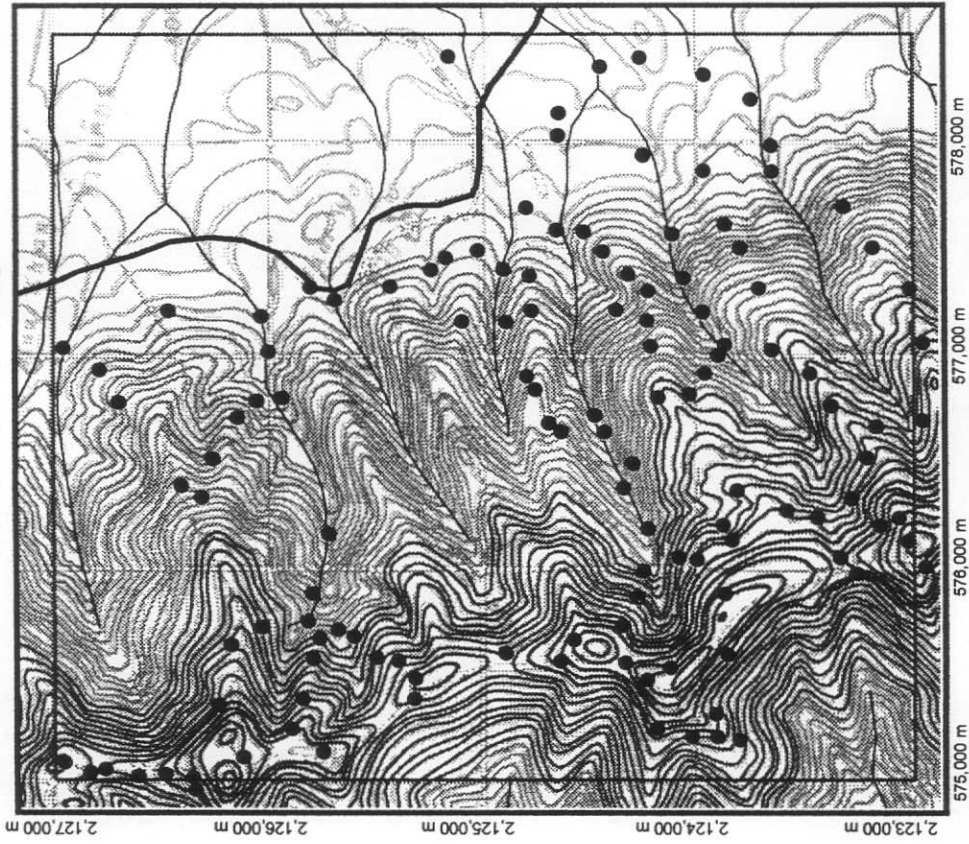
วังแก้ว (Wang Kaew)



- ระดับความสูง (Elevation)
- ..... 400 - 600 m
  - ..... 601 - 800 m
  - ..... 801 - 1000 m
  - ..... 1001 - 1200 m
  - ..... 1201 - 1700 m

Map 6

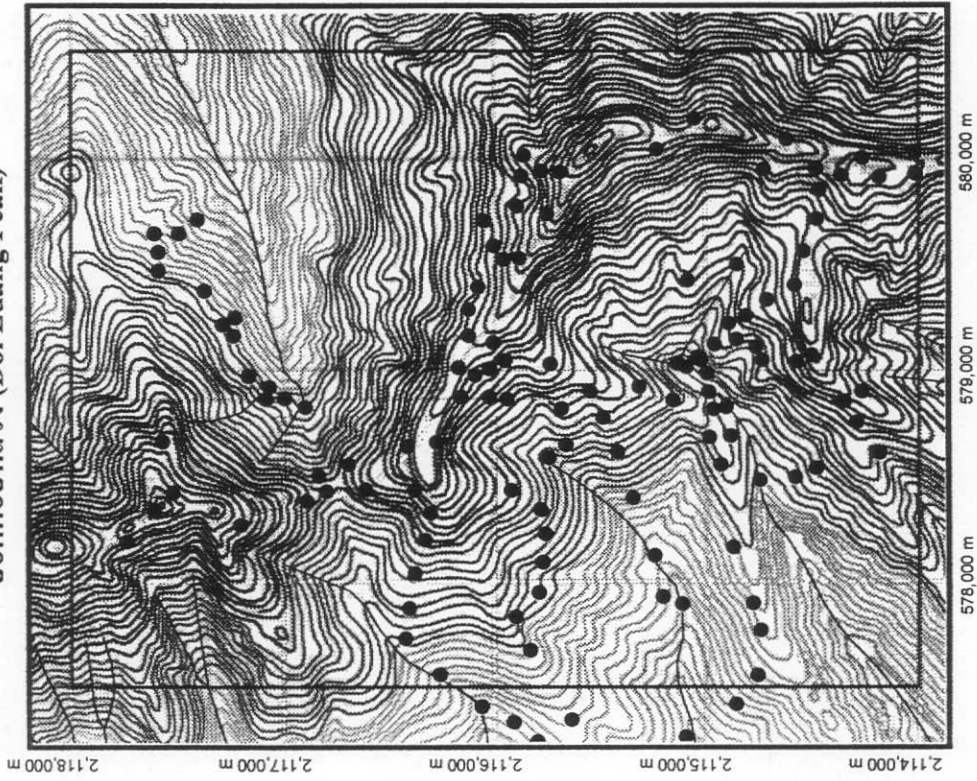
จำปาทอง (Jampathong)



- จุดสำรวจ (Sampling Point)
- ขอบเขตพื้นที่สำรวจ (Sampling Boundary)
- ทางการน้ำ (River)
- เขตอุทยานแห่งชาติ (National Park Boundary)

Map 7

ยอดดอยหลวง (Doi Luang Peak)



- ระดับความสูง (Elevation)
- ..... 400 - 600 m
- ..... 601 - 800 m
- ..... 801 - 1000 m
- ..... 1001 - 1200 m
- ..... 1201 - 1700 m



Map 8

99°30'E

99°45'E

100°00'E

19°30'N

19°15'N

19°30'N

19°15'N

ชนิดของพืชพรรณ  
 อุทยานแห่งชาติดอยหลวง จังหวัดเชียงราย  
 Vegetation Types  
 Doi Luang National Park  
 CHIANG RAI

สัญลักษณ์

- เขตอุทยานแห่งชาติ
- ป่าดิบชื้น
- ป่าดิบ/ป่าไผ่
- ป่าเบญจพรรณผสมป่าดิบ
- ป่าเบญจพรรณ/ป่าไผ่
- ป่าเต็งรัง
- ป่าดิบเขา
- ป่าดิบแล้ง
- ป่าเสื่อมโทรม (ดงไม้ ไร่ร้าง ฯลฯ)
- ที่โล่ง (ไร่ หญ้า ฯลฯ)
- ยังไม่สามารถบ่งบอก
- ไม่มีข้อมูล

จัดทำโดย

ภาควิชาชีววิทยา และภาควิชาภูมิศาสตร์

มหาวิทยาลัยเชียงใหม่

พ.ศ.2542

น



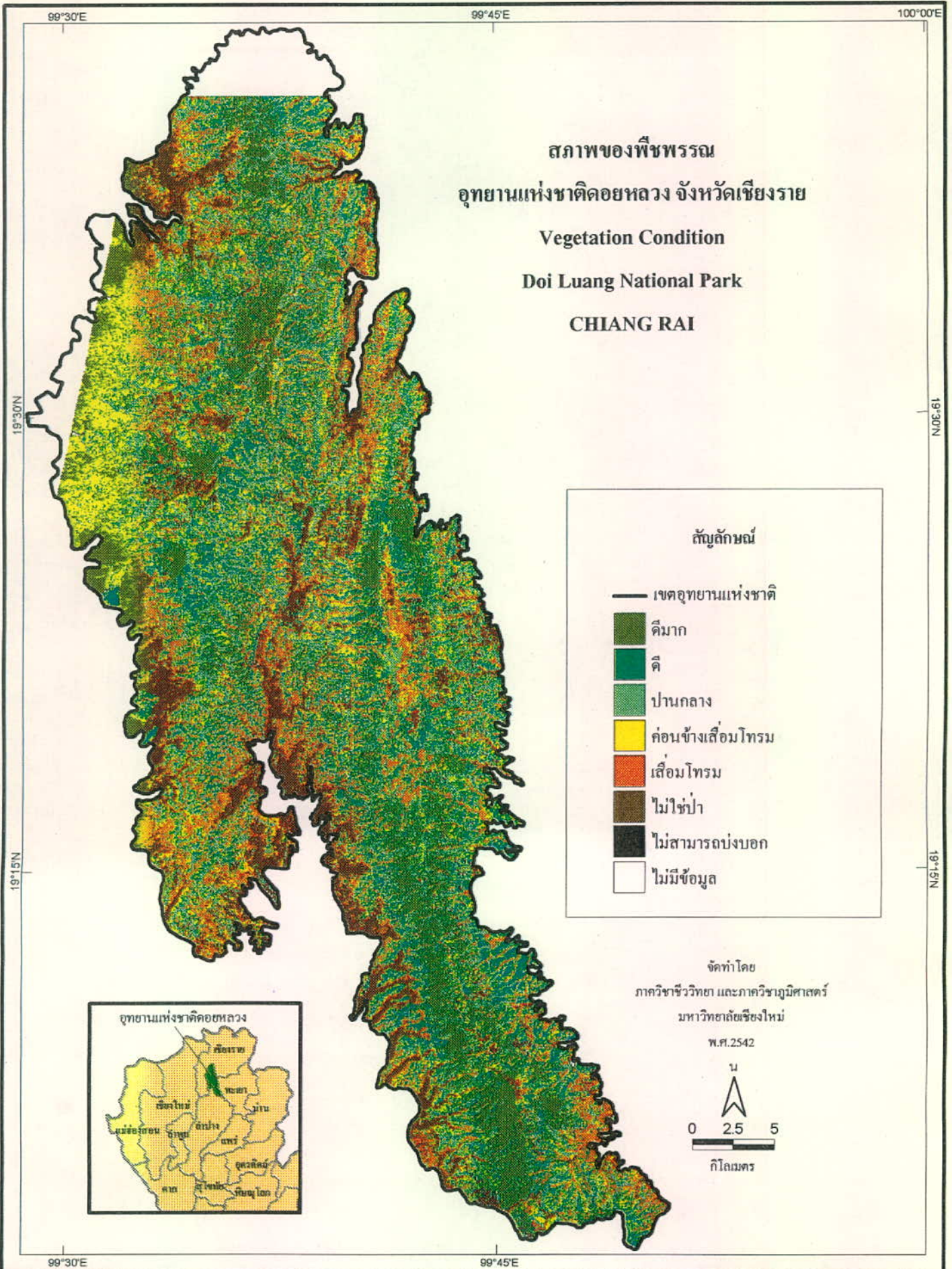
กิโลเมตร



99°30'E

99°45'E

Map 9



แหล่งข้อมูล: แผนที่ภูมิประเทศ 1:50,000 (กรมแผนที่ทหาร) ข้อมูลดาวเทียม LANDSAT TM (พ.ศ.2541) และการสำรวจเชิงนิเวศ

Map 10

99°30'E

99°45'E

100°00'E

# ป่าดิบชื้นและพื้นที่ที่มีศักยภาพเป็นป่าดิบชื้น

## อุทยานแห่งชาติดอยหลวง

### จังหวัดเชียงราย

#### Mesic Evergreen Forest and Potential Areas

#### Doi Luang National Park

#### CHIANG RAI

19°30'N

19°30'N

19°15'N

19°15'N

#### สัญลักษณ์

-  เขตอุทยานแห่งชาติ
-  ป่าดิบชื้นสภาพดี
-  ป่าดิบชื้นสภาพเสื่อมโทรม
-  พื้นที่ที่มีศักยภาพเป็นป่าดิบชื้น
-  พื้นที่อื่นๆ
-  ไม่มีข้อมูล

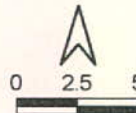
จัดทำโดย

ภาควิชาชีววิทยา และภาควิชาภูมิศาสตร์

มหาวิทยาลัยเชียงใหม่

พ.ศ.2542

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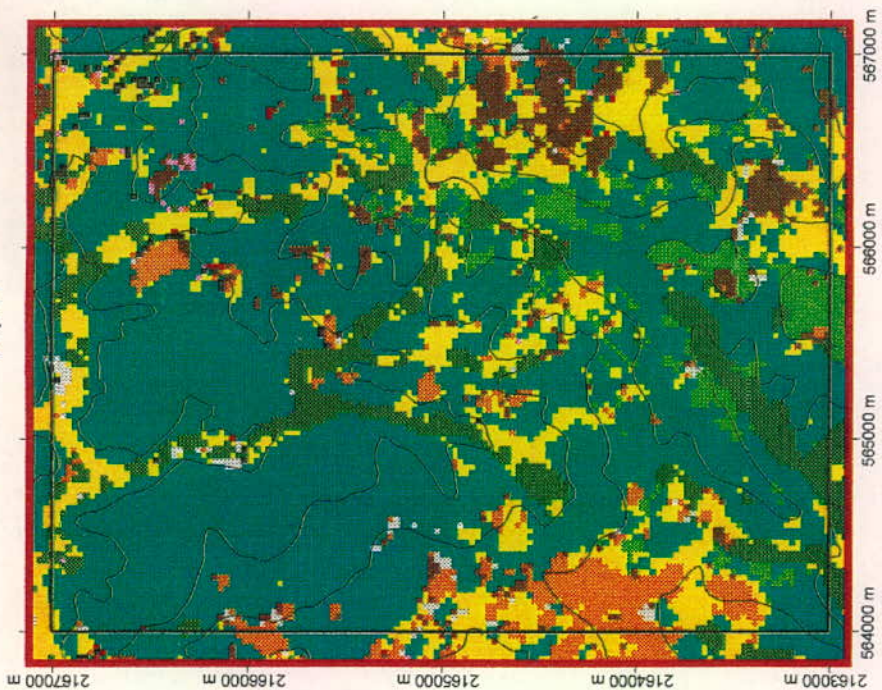


99°30'E

99°45'E

บ้านปางตันผึ้ง (Ban Pang Ton Phung)

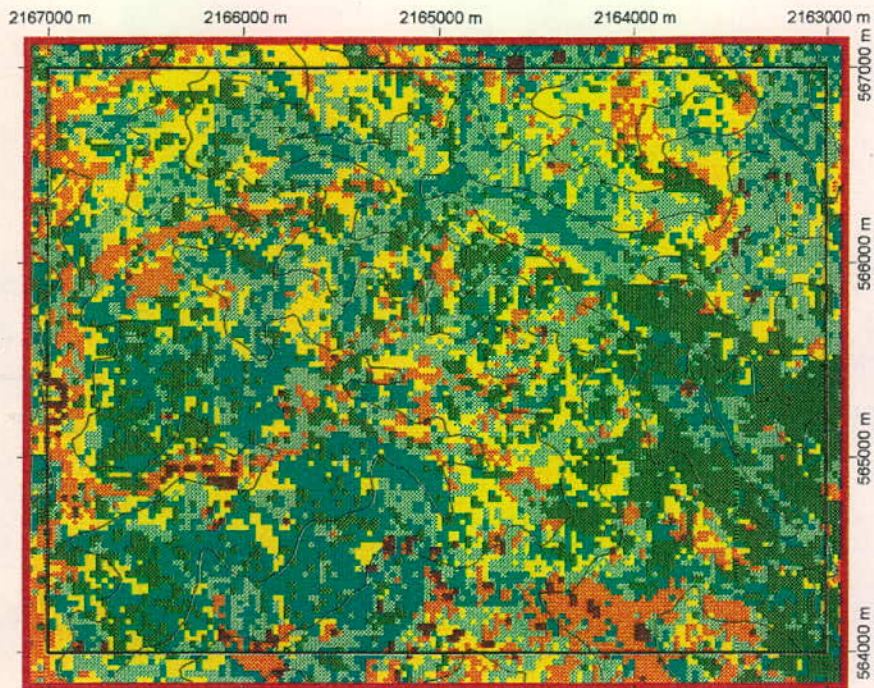
Map 11



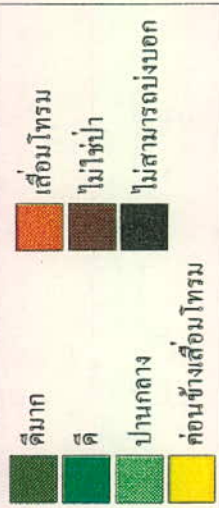
ชนิดที่พรรณน (Vegetation Types)



Map 12



สภาพที่พรรณน (Vegetation Condition)

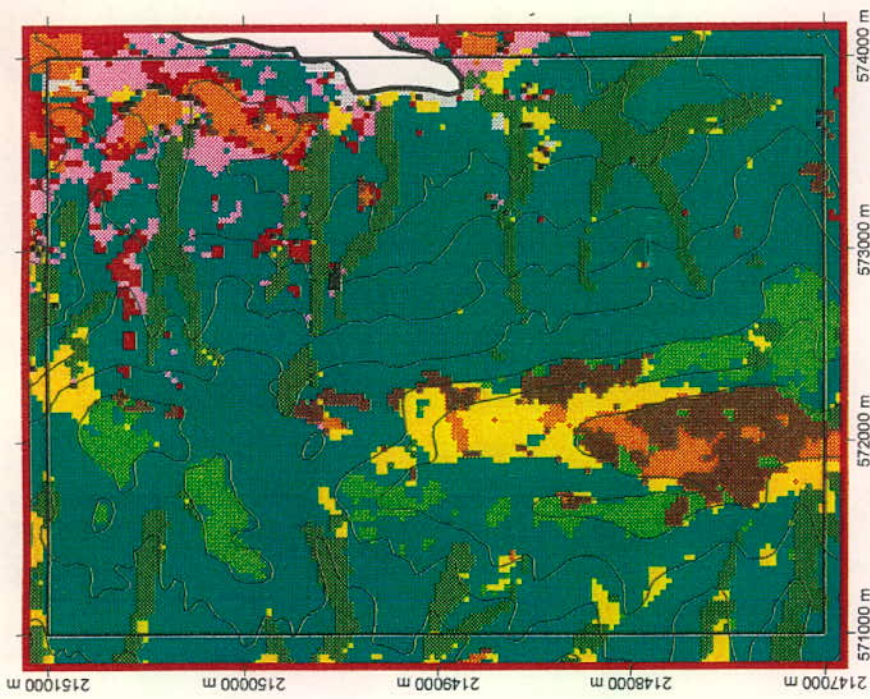


— เขตพื้นที่สำรวจ

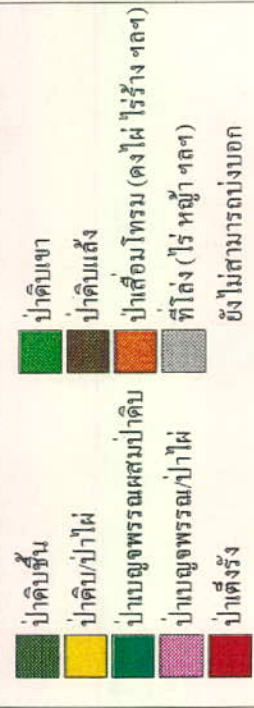
— เส้นชั้นความสูง 100 เมตร

ป่าแก่ง (Pu Kaeng)

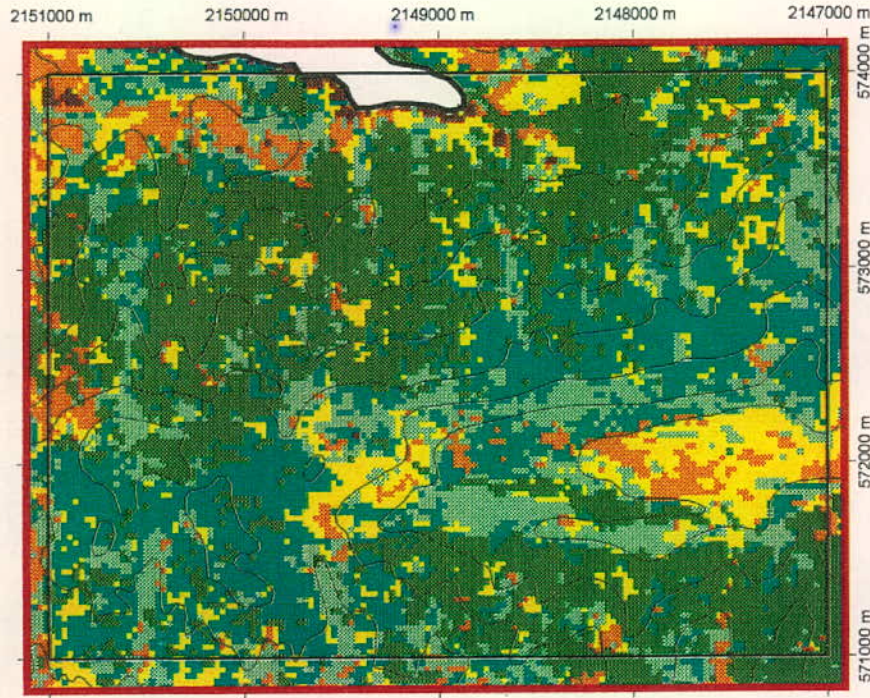
Map 13



ชนิดพืชพรรณ (Vegetation Types)



Map 14



สภาพพืชพรรณ (Vegetation Condition)

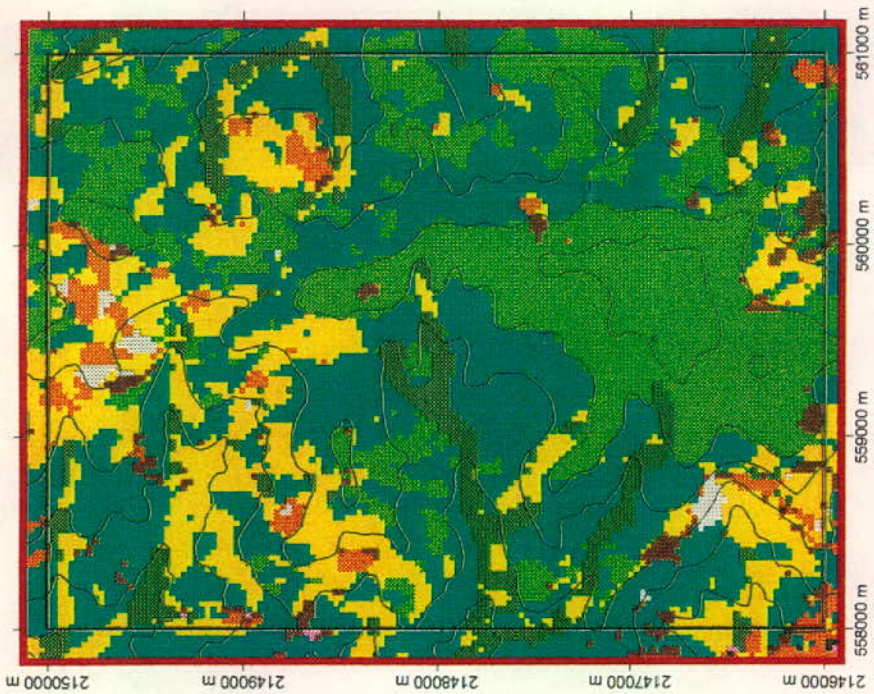


— เขตพื้นที่สำรวจ

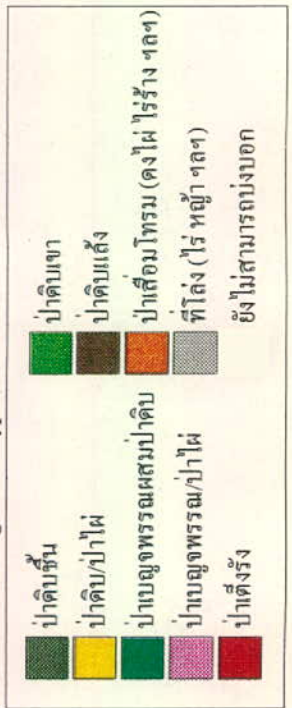
— เส้นชั้นความสูง 100 เมตร

คดยหมอก (Doi Mok)

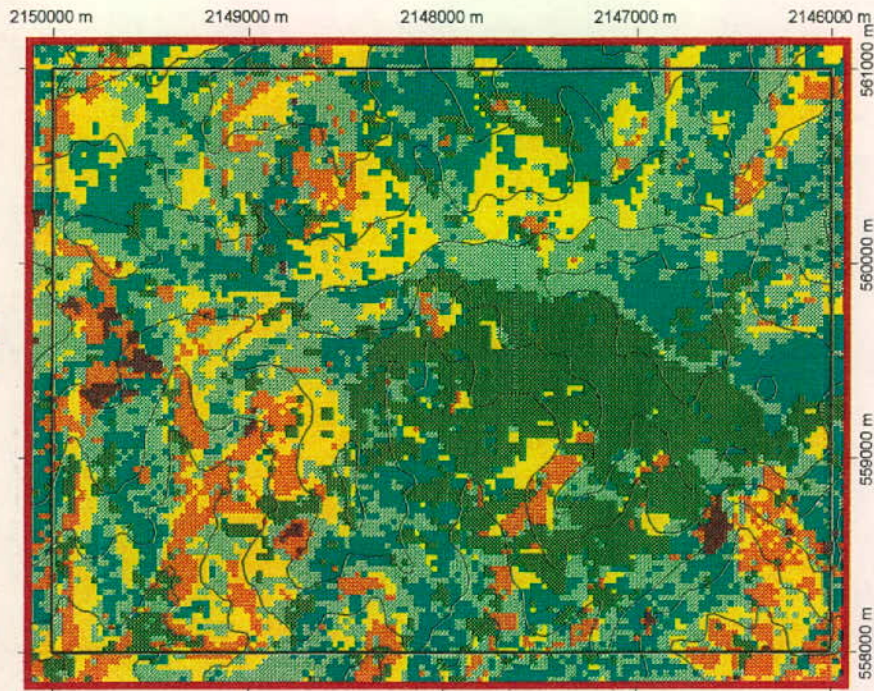
Map 15



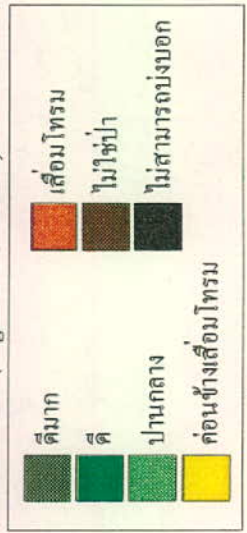
ชนิดพืชพรรณ (Vegetation Types)



Map 16



สภาพพืชพรรณ (Vegetation Condition)

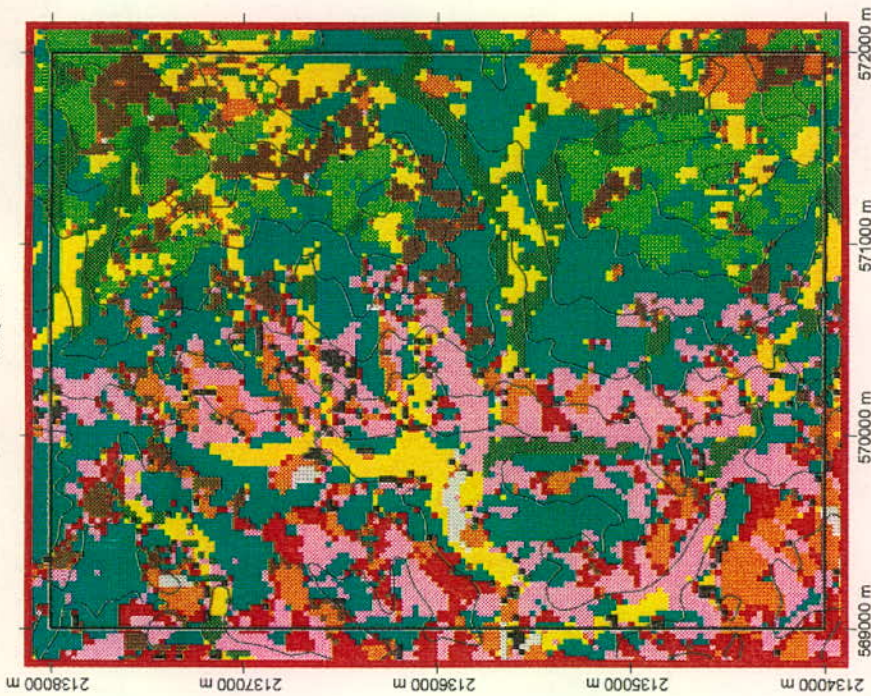


— เขตพื้นที่สำรวจ

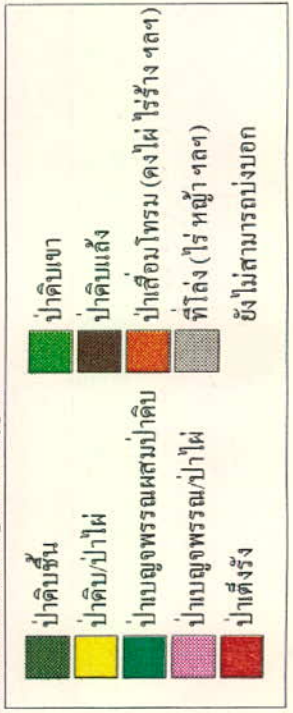
— เส้นชั้นความสูง 100 เมตร

วังแก้ว (Wang Kaew)

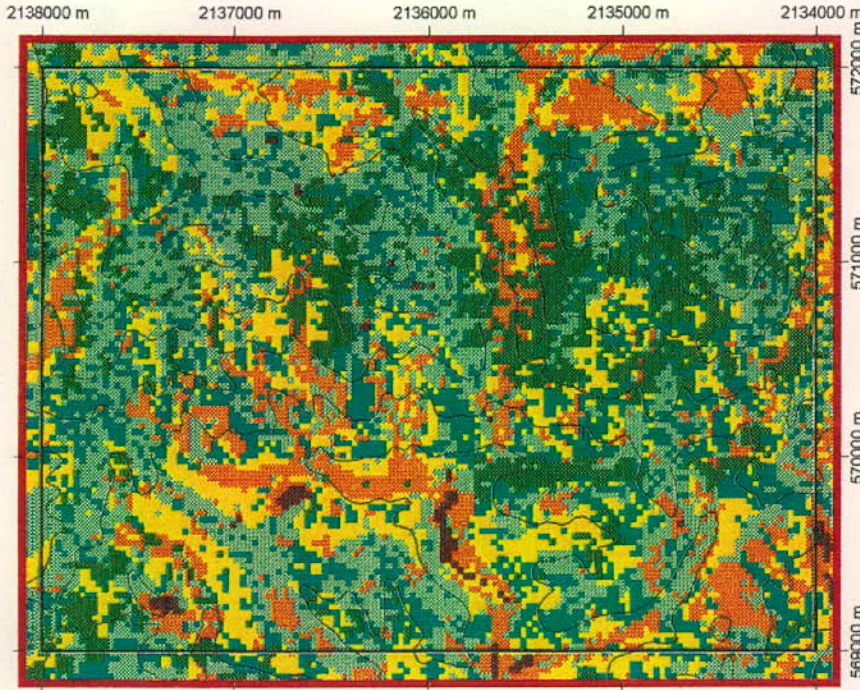
Map 17



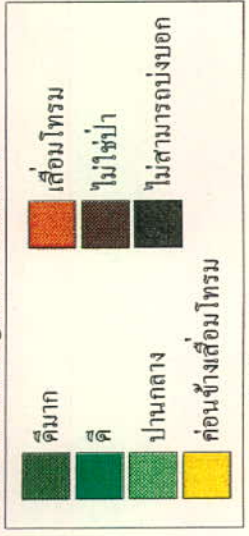
ชนิดพืชพรรณ (Vegetation Types)



Map 18



สภาพพืชพรรณ (Vegetation Condition)

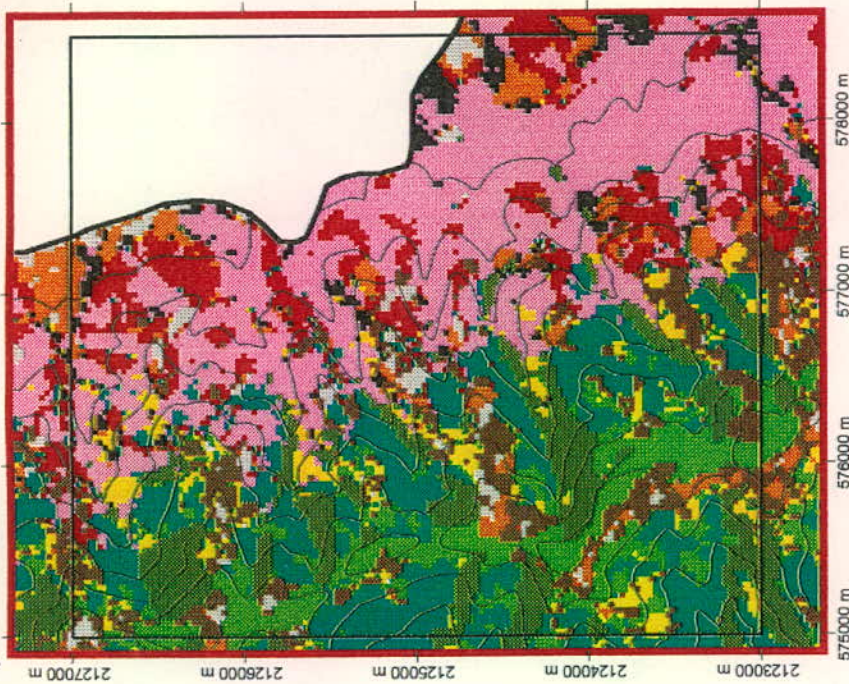


— เขตพื้นที่สำรวจ

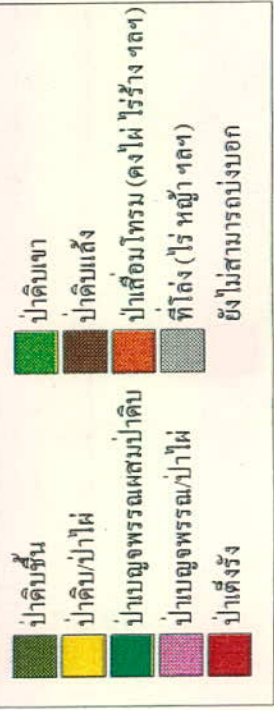
— เส้นชั้นความสูง 100 เมตร

จําปาทอง (Jampathong)

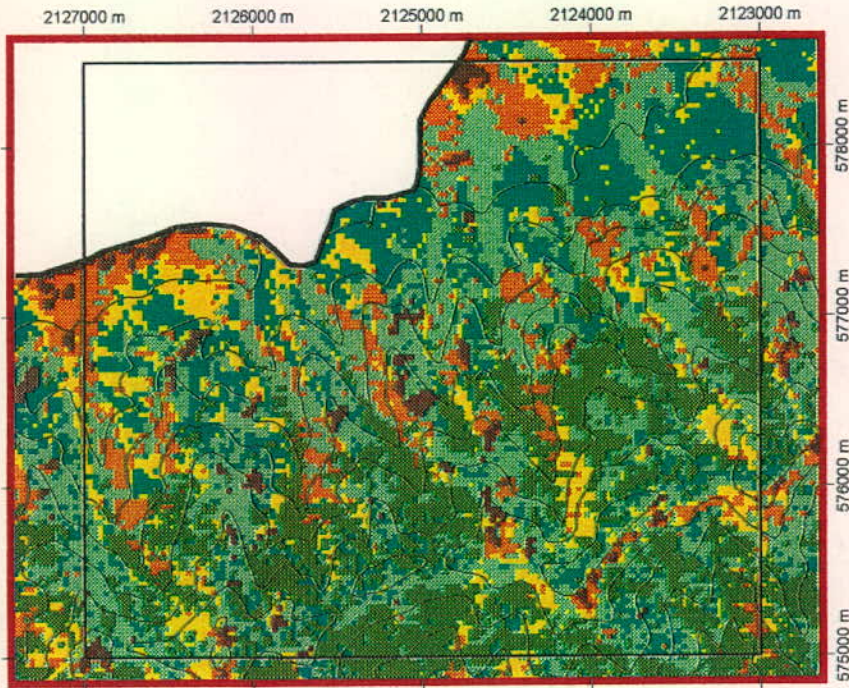
Map 19



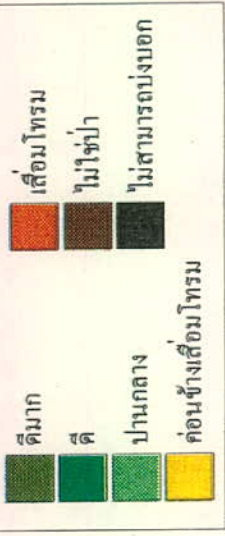
ชนิดพืชพรรณ (Vegetation Types)



Map 20



สภาพพืชพรรณ (Vegetation Condition)

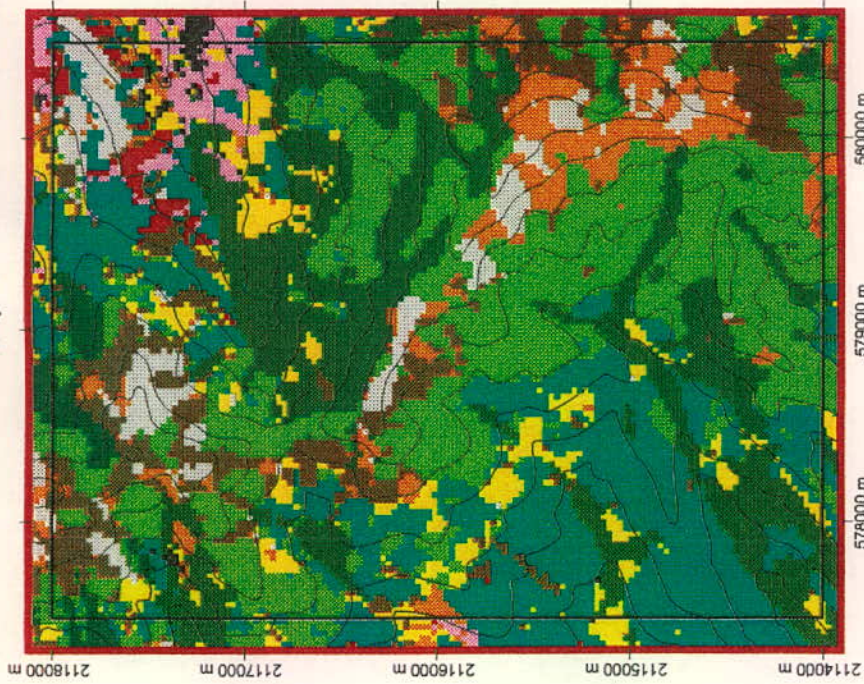


— เขตพื้นที่สำรวจ  
 — เส้นชั้นความสูง 100 เมตร

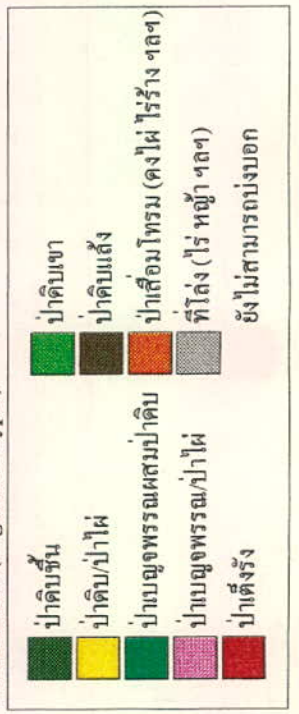


ยอดดอยหลวง (Doi Luang Peak)

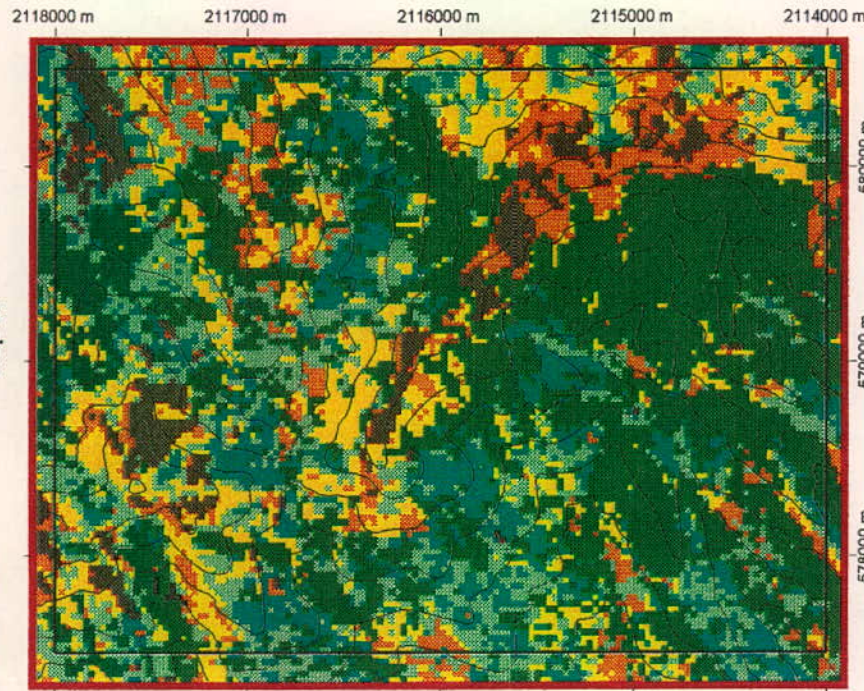
Map 21



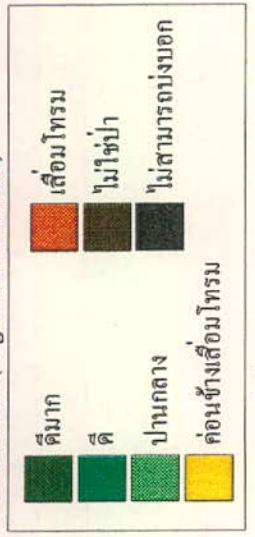
ชนิดพืชพรรณ (Vegetation Types)



Map 22



สภาพพืชพรรณ (Vegetation Condition)



— เขตพื้นที่สำรวจ

— เส้นชั้นความสูง 100 เมตร

## 8. CONCLUSIONS

- 1/ The most important habitat for tree diversity in Doi Luang National Park is lowland mesic evergreen forest. Most of this mesic forest is concentrated in the SW corner of the park-elsewhere it is fragmented to such an extent that it is unlikely to survive in the long term.
- 2/ Ecological survey plots are of little direct use as training areas for satellite image analysis, unless spatial accuracy both in terms of GPS and image overlay can be substantially improved. However, they are invaluable tools to identify the relative diversity value of different forest types.
- 3/ Satellite image interpretation can be greatly improved if the physical limits (altitude, moisture, bedrock) of the vegetation in the area are already known. Without this information, we would have been unable to accurately predict forest type or condition in Doi Luang National Park.
- 4/ We recommend that evergreen forests in northern Thailand be clearly divided into Mesic and Xeric types, since they have very few species in common and are of very different ecological importance. Although it is often difficult to divide these two types based on satellite image alone, it is easy to do so with reference to the underlying topography.
- 5/ None of the soil or vegetation structural parameters investigated showed a clear correlation with tree species richness, although crown area and shrub abundance may have some potential in certain circumstances.

## 9. THE WORK AHEAD

Although the initial objectives of the project, namely the production of species lists and vegetation maps for the park has been fulfilled, the data collected offers many more potentials which remain to be explored. Future work will focus on developing further 2 specific aspects of the project:

### 1/ Tree identification materials.

Accurate field identification plays such a critical role in any ecological project that we feel it would be useful to make the materials we developed more accessible to a wider audience. Further funding has been secured from IUCN/World Bank, Toyota Thailand Foundation and Kobfai Publishing Project for a Thai language edition of a Field Guide to the Native Trees of Northern Thailand, covering about 240 common or distinctive species. The Doi Luang materials will form the nucleus for this work, which we expect to complete by December 1999. The field guide will be aimed primarily at the non-technical audience and will be sold at cost price with no profit from sales going either to the authors or to the funding bodies. The critical support of BRT will of course be fully acknowledged.

## 2/ Ecological transect site analysis

The transect sites established offer a unique opportunity to study the forest ecology of the area. No other area in northern Thailand has been so thoroughly surveyed, either in terms of the total area covered, or in terms of the detailed structural information collected. In particular, we hope to investigate possible correlations between species richness and either forest structure (for example canopy cover, texture, abundance of shrub layer or dead wood) or the abundance of particular indicator species. If such correlations can be established for specific habitats, they can be incorporated into rapid survey techniques which do not necessitate the extremely time-consuming enumeration of all species present.

## 10. ACKNOWLEDGMENTS

This project is generously sponsored by The Biodiversity Research and Training Program (BIOTECH and Thailand Research Fund; BRT 139029). The Head, Mr. Permboon Judhatame; and staff of Doi Luang National Park and Mr. Petch Ploychareon and his staff of Nam Wang Watershed Station have played an essential role in the field for which we are very grateful. Dr. Chamlong Pengklai and Dr. Piya Chalermglin are thanked for helping with the identifications. Mr. Chen Nan from BIOTECH provided valuable advice on the transect site program. We would like to thank Rungtiwa Punyayod who was invaluable in the preparation of the manuscript and maintenance of the project accounts. We would like to thank the Computer Service Centre for operating the GPS base station as well as the Geography and Biology Departments, Chiang Mai University for institutional support.

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# **Appendix 1.**

## **List all species**

## VASCULAR PLANTS OF DOI LUANG NATIONAL PARK, CHIANG RAI

FAMILY	SPECIES	HABITAT	ALTITUDE-RANGE
Acanthaceae	1 <i>Andrographis laxiflora</i> (Bl.) Lindau	da in bb/df mxf	500-1300
	2 <i>Barleria cristata</i> L.	bb/df mxf egf eg/bb eg/pine	550-1700
	3 <i>Barleria strigosa</i> Willd.	bb/df mxf egf eg/bb	500-1200
	4 <i>Choresthes lanceolaria</i> (T. And.) B. Han.	streams in bb/df mxf	600-900
	5 <i>Clinacanthus nutans</i> (Burm. f.) Lindau	mxm da sg	550-650
	6 <i>Dicliptera roxburghiana</i> Nees	da sg in bb/df mxm	450-900
	7 <i>Dipteracanthus repens</i> (L.) Hassk.	da in bb/df mxm	450-950
	8 <i>Eranthemum tetragonum</i> Wall. ex Nees	da in bb/df mxm	600-900
	9 <i>Hypoestes malaccensis</i> Wight	streams in mxm egf	550-950
	10 <i>Justicia decumbens</i> Craib	wet areas in mxm da sg	575-750
	11 <i>Justicia procumbens</i> L.	bb/df mxm egf eg/pine eg/bb	300-1300
	12 <i>Justicia quadrifaria</i> (Nees) T. And.	mxm egf	600-1450
	13 <i>Lepidagathis incurva</i> Ham. ex D. Don	mxm da sg	475-1150
	14 <i>Mananthes pallida</i> (Im.) Brem.	bb/df eg/pine	300-1300
	15 <i>Nomaphila parishii</i> T. And.	mxm eg/bb da	700-900
	16 <i>Perilepta siamensis</i> (Cl.) Brem.	bb/df mxm open egf	500-1200
	17 <i>Peristrophe lanceolaria</i> (Roxb.) Nees	mxm egf	500-950
	18 <i>Phaulopsis dorsiflora</i> (Retz.) Sant.	da sg in bb/df mxm	450-900
	19 <i>Phlogacanthus curviflorus</i> (Wall.) Nees var. <i>curviflorus</i>	streams wet areas in egf	1050-1450
	20 <i>Phlogacanthus datii</i> R. Ben.	mxm da	500-750
	21 <i>Pseuderanthemum latifolium</i> (Vahl) B. Han.	streams in mxm egf	500-1150
	22 <i>Pseuderanthemum parishii</i> (T. And.) Lindau	bb/df mxm	550-900
	23 <i>Rungia parviflora</i> (Retz.) Nees var. <i>ciliata</i> Brem.	bb/df mxm egf eg/pine eg/bb mx/ bb	500-1400
	24 <i>Rungia parviflora</i> Nees var. <i>parviflora</i>	bb/df mxm da	450-1300
	25 <i>Sericocalyx quadrifarius</i> (Wall. ex Nees) Brem.	da mxm	500-800
	26 <i>Strobilanthes anfractuosa</i> Cl. ex Hoss.	mxm egf eg/bb	750-1450
	27 <i>Strobilanthes imbricatus</i> Nees	da in bb/df mxm egf	750-1600
	28 <i>Strobilanthes rubro-glandulosa</i> Craib	streams in bb/df mxm	500-850
	29 <i>Strobilanthes viscidus</i> Im.	streams in egf eg/bb	1000-1450
	30 <i>Thunbergia geoffrayi</i> R. Ben.	moista areas in da sg, mxm egf eg/bb	550-800
	31 <i>Thunbergia laurifolia</i> Lindl.	da sg in bb/df mxm	500-900
32 <i>Thunbergia similis</i> Craib	dof bb/df mxm eg/pine eg/bb	575-1500	
Agavaceae	33 <i>Dracaena angustifolia</i> Roxb.	streams in egf	900-1500
Aizoaceae	34 <i>Mollugo pentaphylla</i> L.	da sg	450-700
Alangiaceae	35 <i>Alangium barbatum</i> (R. Br.) Baill. var. <i>barbatum</i>	mxm egf	500-1000
	36 <i>Alangium chinense</i> (Lour.) Harms	streams in bb/df mxm	500-700
	37 <i>Alangium kurzii</i> Craib	mxm	600-950
Amaranthaceae	38 <i>Achyranthes aspera</i> L.	da sg in bb/df mxm	450-900
	39 <i>Achyranthes bidentata</i> Bl. var. <i>bidentata</i>	streams in mxm egf	800-1350
	40 <i>Aerva sanguinolenta</i> (L.) Bl.	bb/df mxm	450-900
Amaryllidaceae	41 <i>Cyathula prostrata</i> (L.) Bl. var. <i>prostrata</i>	mxm da	500-700
	42 <i>Curculigo capitulata</i> (Lour.) O.K.	mxm egf	550-1500
	43 <i>Curculigo latifolia</i> Dry. ex W.T. Ait. var. <i>latifolia</i>	bb/df	500-850
	44 <i>Hypoxis aurea</i> Lour.	dof bb/df eg/pine eg/bb	400-1700
Anacardiaceae	45 <i>Proiphys amboinensis</i> (L.) Herb.	bb/df	550-650
	46 <i>Buchanania arborescens</i> (Bl.) Bl.	mxm egf	700-1300
	47 <i>Buchanania glabra</i> Wall. ex Hk. f.	dof bb/df mxm	450-750
	48 <i>Buchanania lanzan</i> Spreng.	dof bb/df	450-900
	49 <i>Dracontomelon dao</i> (Blanco) Merr. & Rol.	mxm	500-700
	50 <i>Gluta obovata</i> Craib	dof bb/df egf eg/pine	700-1400
	51 <i>Gluta usitata</i> (Wall.) Hou	dof mxm	500-1050

FAMILY	SPECIES	HABITAT	ALTITUDE-RANGE
	52 <i>Lanea coromandelica</i> (Houtt.) Merr.	dof bb/df	500-850
	53 <i>Mangifera caloneura</i> Kurz	bb/df mxf	500-1050
	54 <i>Mangifera sylvatica</i> Roxb.	mxf	450-750
	55 <i>Rhus chinensis</i> Mill.	da sg in egf eg/bb	1000-1500
	56 <i>Rhus rhesoides</i> Craib	egf eg/bb	1050-1400
	57 <i>Semecarpus cochinchinensis</i> Engl.	bb/df mxf egf	350-1250
	58 <i>Spondias axillaris</i> Roxb.	egf eg/pine eg/bb	1000-1400
	59 <i>Spondias lakonensis</i> Pierre	streams in mxf	450-700
	60 <i>Spondias pinnata</i> (L. f.) Kurz	bb/df mxf open egf	500-1200
Annonaceae	61 <i>Alphonsea boniana</i> Fin. & Gagnep.	bb/df mxf	500-850
	62 <i>Alphonsea</i> zsp.	mxf egf	1000-1100
	63 <i>Anomianthus dulcis</i> (Dun.) Sincl.	da sg in bb/df mxf	500-650
	64 <i>Cananga latifolia</i> (Hk. f. & Th.) Fin. & Gagnep.	bb/df	450-650
	65 <i>Cyathocalyx martabanicus</i> Hk. f. & Th. var. <i>martabanicus</i>	mxf	550-650
	66 <i>Desmos praecox</i> Hk. f. & Th.	mxf egf	550-1200
	67 <i>Fissistigma oblongum</i> (Craib) Merr.	mxf	600-1000
	68 <i>Goniothalamus laoticus</i> (Fin. & Gagnep.) Ban	bb/df egf	500-1200
	69 <i>Milusa cuneata</i> Craib	mxf	600-1000
	70 <i>Milusa thorelli</i> Fin. & Gagnep.	streams in mxf egf	800-1100
	71 <i>Mitrephora vandaeiflora</i> Kurz	bb/df mxf	500
	72 <i>Orophea kerrii</i> Keb.	streams in mxf	600-850
	73 <i>Polyalthia evecta</i> (Pierre) Fin. & Gagnep.	mxf	550-850
	74 <i>Polyalthia littoralis</i> (Bl.) Boerl.	streams in bb/df	525-700
	75 <i>Polyalthia simiarum</i> (Ham. ex Hk. f. & Th.) Bth. ex Hk. f. & Th.	bb/df mxf	500-1050
	76 <i>Polyalthia</i> sp	mxf	600-800
	77 <i>Uvaria cordata</i> (Dun.) Alst.	bb/df mxf	500-850
Apocynaceae	78 <i>Aganosma marginata</i> (Roxb.) G. Don	dof	500-850
	79 <i>Alstonia rostrata</i> Fischer	mxf egf	850-1300
	80 <i>Alstonia scholaris</i> (L.) R. Br. var. <i>scholaris</i>	streams in bb/df mxf	450-1200
	81 <i>Amalocalyx microlobus</i> Pierre ex Spire	da in bb/df mxf egf	500-1200
	82 <i>Holarrhena pubescens</i> (Buch.-Ham.) Wall. ex G. Don	dof bb/df	500-950
	83 <i>Parameria laevigata</i> (Juss.) Mold.	mxf eg/bb	600-900
	84 <i>Rauvolfia cambodiana</i> Pierre ex Pit.	da in bb/df mxf	500-550
	85 <i>Rauvolfia serpentina</i> (L.) Bth. ex Kurz	bb/df	450-700
	86 <i>Rauvolfia verticillata</i> (Lour.) Baill.	mxf egf	550-1400
	87 <i>Tabernaemontana divaricata</i> (L.) Br. ex Roem. & Schult.	mxf	500-850
	88 <i>Wrightia arborea</i> (Dennst.) Mabb.	bb/df egf	450-1100
Aquifoliaceae	89 <i>Ilex umbellulata</i> (Wall.) Loesn.	bb/df egf eg/bb	600-1150
Araceae	90 <i>Aglaonema simplex</i> (Bl.) Bl.	bb/df mxf egf	450-1200
	91 <i>Alocasia alba</i> Schott	rocks in bb/df	500-850
	92 <i>Alocasia macrorrhizos</i> (L.) G. Don	bb/df mxf egf	500-1100
	93 <i>Alocasia navicularis</i> (C. Koch & Bou.) C. Koch & Bou.	mxf egf	650-1300
	94 <i>Amorphophallus krausei</i> Engl.	bb/df mxf	550-850
	95 <i>Amorphophallus paeoniifolius</i> (Denn.) Nichol.	da in mxf	550-650
	96 <i>Amorphophallus yunnanensis</i> Engl.	rocks in bb/df mxf egf	500-1350
	97 <i>Arisaema erubescens</i> (Wall.) Schott	egf eg/pine eg/bb	1325-1600
	98 <i>Arisaema praseri</i> Hk. f.	mxf egf eg/pine eg/bb	900-1500
	99 <i>Colocasia fallax</i> Schott	rocks in bb/df mxf	500-750
	100 <i>Epipremnum giganteum</i> (Roxb.) Schott	rocks cliffs bb/df mxf	500-900
	101 <i>Hapaline benthamiana</i> Schott	bb/df	550-650
	102 <i>Homalomena occulta</i> (Lour.) Schott	bb/df mxf egf	500-1100

FAMILY	SPECIES	HABITAT	ALTITUDE-RANGE
	103 <i>Pothos cathcartii</i> Schott	streams in bb/df mxf egf	450-1200
	104 <i>Remusatia vivipara</i> (Lodd.) Schott	mx f egf eg/pine eg/bb	800-1650
	105 <i>Rhaphidophora hookeri</i> Schott	bb/df	450-650
	106 <i>Rhaphidophora peepla</i> (Roxb.) Schott	streams in bb/df mxf egf	450-1500
	107 <i>Typhonium horsfieldii</i> (Miq.) Stecn.	rocks in bb/df	600-850
	108 <i>Typhonium trilobatum</i> (L.) Schott	da sg	400-1200
Araliaceae	109 <i>Aralia montana</i> Bl.	da sg in egf eg/pine	1000-1250
	110 <i>Macropanax dispermus</i> (Bl.) O.K.	egf	1100-1500
	111 <i>Macropanax undulatus</i> (Wall. ex G. Don) Seem.	streams in mxf egf	525-1450
	112 <i>Schefflera bengalensis</i> Gamb.	mx f egf	700-1400
	113 <i>Trevesia palmata</i> (DC.) Vis.	mx f egf	450-1200
Aristolochiaceae	114 <i>Aristolochia kerrii</i> Craib	bb/df mxf eg/bb	600-1250
	115 <i>Aristolochia tagala</i> Cham.	da sg in bb/df	450-650
Asclepiadaceae	116 <i>Crypoplepis elegans</i> Wall. ex G. Don var. <i>elegans</i>	bb/df mxf	600-700
	117 <i>Dischidia imbricata</i> (Bl.) Steud.	dof bb/df	500-900
	118 <i>Dischidia</i> zsp.	egf	900-1400
	119 <i>Heterostemma siamicum</i> Craib	bb/df mxf da	550-900
	120 <i>Hoya verticillata</i> (Vahl) G. Don var. <i>verticillata</i>	dof bb/df	450-850
	121 <i>Streptocaulon juvenas</i> (Lour.) Merr.	da sg in dof bb/df	450-900
	122 <i>Telosma pallida</i> (Roxb.) Craib	da sg in bb/df	525-700
	123 <i>Tylophora sootepensis</i> Craib	egf eg/pine	1050-1500
	124 <i>Tylophora tenuis</i> Bl.	egf eg/pine eg/bb	1100-1300
	125 <i>Zygostelma benthami</i> Baill.	bb/df	500-750
Aspleniaceae	126 <i>Asplenium apogamum</i> Mur. & Hat.	rocks streams in mxf egf	600-1200
	127 <i>Asplenium ensiforme</i> Wall. ex Hk. & Grev.	rocks in egf eg/pine	1200-1500
	128 <i>Asplenium interjectum</i> Christ	rocks cliffs bb/df	550-700
	129 <i>Asplenium obscurum</i> Bl.	streams in egf	900-1100
	130 <i>Asplenium yoshinagae</i> Mak.	egf eg/pine eg/bb	1000-1450
Athyriaceae	131 <i>Anisocampium cumingianum</i> Presl	bb/df mxf eg/bb	500-1200
	132 <i>Deparia petersenii</i> (O.K.) M. Kato	egf	1050-1500
	133 <i>Diplazium dilatatum</i> Bl.	streams in egf eg/bb	900-1100
	134 <i>Diplazium esculentum</i> (Retz.) Sw.	eg/pine	650-1100
	135 <i>Hypodematum crenatum</i> (Forssk.) Kuhn	rocks cliffs in bb/df	650-850
	136 <i>Kuniwatsukia cuspidata</i> (Bedd.) Pic.-Ser.	egf eg/pine eg/bb	900-1500
Balanophoraceae	137 <i>Balanophora fungosa</i> J.R. & G. Forst. ssp. <i>indica</i> ( Arn.) B. Han. var. <i>indica</i>	egf eg/bb	1000-1550
	138 <i>Balanophora latiseptala</i> (Tiegh.) Lec.	eg/pine eg/bb	1050-1200
Balsaminaceae	139 <i>Impatiens claviger</i> Hk. f.	streams in egf	900-1100
	140 <i>Impatiens violaeiflora</i> Hk. f.	rocks in bb/df mxf egf	600-1500
Begoniaceae	141 <i>Begonia integrifolia</i> Dalz.	mx f	500-750
	142 <i>Begonia yunnanensis</i> Lev.	streams in bb/df mxf	550-900
Berberidaceae	143 <i>Mahonia nepalensis</i> DC.	mx f egf eg/pine	850-1500
Betulaceae	144 <i>Betula alnoides</i> Ham. ex D. Don	egf eg/bb egf eg/pine	1000-1600
	145 <i>Carpinus londoniana</i> Wink.	egf eg/pine	850
Bignoniaceae	146 <i>Markhamia stipulata</i> (Wall.) Seem. ex K. Sch. var. <i>stipulata</i>	bb/df mxf da sg	550-1100
	147 <i>Millingtonia hortensis</i> L. f.	bb/df	550-800
	148 <i>Oroxylum indicum</i> (L.) Kurz	da sg in bb/df mxf	450-800
	149 <i>Radermachera glandulosa</i> (Bl.) Miq.	egf	1000-1250
	150 <i>Radermachera ignea</i> (Kurz) Steen.	bb/df (streams) mxf egf	500-1200
	151 <i>Stereospermum colais</i> (B.-H. ex Dillw.) Mabb.	bb/df mxf	500-850
	152 <i>Stereospermum fimbriatum</i> (Wall. ex G. Don) DC.	bb/df mxf	600-900
Blechnaceae	153 <i>Brainea insignis</i> (Hk.) J. Sm.	egf eg/pine	975-1600
	154 <i>Woodwardia cochinchinensis</i> Ching	eg/pine	1150-1400
Bombacaceae	155 <i>Bombax anceps</i> Pierre var. <i>anceps</i>	dof bb/df	400-800
	156 <i>Bombax ceiba</i> L.	da sg	400-550

FAMILY	SPECIES	HABITAT	ALTITUDE- RANGE	
Boraginaceae	157 <i>Ehretia acuminata</i> R. Br. var. <i>acuminata</i>	mx/df egf	700-1300	
	158 <i>Tournefortia intonsa</i> Kerr	bb/df mx/df egf	575-950	
Burmanniaceae	159 <i>Burmannia wallichii</i> (Miers) Hk. f.	bb/df	575-650	
Bursaceae	160 <i>Canarium strictum</i> Roxb.	bb/df open egf	450-1200	
	161 <i>Canarium subulatum</i> Guill.	bb/df mx/df	450-700	
	162 <i>Garuga pinnata</i> Roxb.	bb/df egf	350-1200	
	163 <i>Protium serratum</i> (Wall. ex Colebr.) Engl.	bb/df mx/df	450-850	
Buxaceae	164 <i>Sarcococca saligna</i> (D. Don) M.-A. var. <i>saligna</i>	bb/df mx/df	550-850	
Campanulaceae	165 <i>Codonopsis celebica</i> (Bl.) Thuan	eg/pine	1240	
	166 <i>Codonopsis javanica</i> (Bl.) Hk. f.	da in egf eg/pine	1150-1400	
	167 <i>Codonopsis parviflora</i> Wall. ex A. DC.	streams in bb/df mx/df	500	
	168 <i>Lobelia zeylanica</i> L.	bb/df egf	600-1200	
Capparaceae	169 <i>Capparis assamica</i> Hk. f. & Th.	egf	850-950	
	170 <i>Crateva magna</i> (Lour.) DC.	streams in bb/df	450-750	
	171 <i>Stixis suaveolens</i> (Roxb.) Pierre	egf	900-1050	
Caprifoliaceae	172 <i>Sambucus javanica</i> Reinw. ex Bl. ssp. <i>javanica</i>	da in bb/df mx/df egf	450-1100	
	173 <i>Viburnum inopinatum</i> Craib	mx/df egf eg/pine	950-1400	
Cariopteridaceae	174 <i>Cardiopteris quinqueloba</i> (Hassk.) Hassk.	da sg	500-950	
	175 <i>Drymaria diandra</i> Bl.	wet areas in bb/df	450-700	
Celastraceae	176 <i>Celastrus paniculatus</i> Willd.	dof bb/df	450-950	
	177 <i>Euonymus mitratus</i> Pierre	streams in egf	900-1000	
	178 <i>Euonymus petelotii</i> Merr.	mx/df	600-850	
	179 <i>Euonymus similis</i> Craib	streams in bb/df mx/df egf	500-1050	
	180 <i>Euonymus sootepensis</i> Craib	streams in egf	900-1100	
	181 <i>Glyptopetalum sclerocarpum</i> Kurz	mx/df egf	650-1100	
	182 <i>Maytenus</i> sp.	bb/df	650-800	
	183 <i>Reissantia indica</i> (Willd.) Halle	rocks in bb/df	500-600	
Chloranthaceae	184 <i>Siphonodon celastrineus</i> Griff.	bb/df mx/df	500-850	
	185 <i>Chloranthus erectus</i> (B.-H.) Verd.	streams in bb/df mx/df	500-900	
	186 <i>Chloranthus nervosus</i> Coll. & Hemsl.	da in egf eg/pine eg/bb	1100-1400	
Combretaceae	187 <i>Anogeissus acuminata</i> (Roxb. ex DC.) Guill. & Perr.	bb/df mx/df	500-850	
	188 <i>Calycopteris floribunda</i> (Roxb.) Lmk.	bb/df da sg	450-700	
	189 <i>Combretum griffithii</i> Heur. & M.-A.	bb/df mx/df	500-800	
	190 <i>Combretum latifolium</i> Bl.	mx/df da		
	191 <i>Combretum trifoliatum</i> Vent.	streams in da sg in bb/df	500-600	
	192 <i>Quisqualis indica</i> L. var. <i>indica</i>	bb/df mx/df	450-1050	
	193 <i>Terminalia alata</i> Hey. ex Roth	dof bb/df	450-850	
	194 <i>Terminalia bellirica</i> (Gaertn.) Roxb.	bb/df	450-700	
	195 <i>Terminalia mucronata</i> Craib & Hutch.	bb/df mx/df	450-900	
	Commelinaceae	196 <i>Aclisia secundiflora</i> (Bl.) Bakh. f.	streams in mx/df	550-750
		197 <i>Aneilema herbaceum</i> (Roxb.) Wall. ex Kunth	bb/df mx/df	600-800
198 <i>Aneilema ovatum</i> (Hassk.) Wall. ex Cl.		bb/df mx/df	550-700	
199 <i>Aneilema scaberrimum</i> (Bl.) Kunth		streams in mx/df egf	550-1400	
200 <i>Aneilema sinicum</i> Lindl.		dof do/pine eg/pine da sg mx/df	700-1400	
201 <i>Commelina diffusa</i> Burm. f.		streams wet areas in bb/df mx/df egf	550-1400	
202 <i>Commelina paludosa</i> Bl.		bb/df mx/df da	500-950	
203 <i>Cyanotis cristata</i> (L.) D. Don		rocks in bb/df egf eg/pine	500-1500	
204 <i>Forrestia glabratus</i> (Hassk.) Hassk.		streams in mx/df egf	500-1400	
205 <i>Forrestia mollissima</i> (Bl.) Kds. forma <i>marginata</i> (Bl.) Back.		streams in bb/df mx/df	550-900	
206 <i>Murdannia nudiflora</i> (L.) Bren.		mx/df da	500-700	
207 <i>Pollia hasskarlii</i> R. Rao	streams wet area in bb/df mx/df egf	500-850		
208 <i>Pollia thyrsoiflora</i> (Bl.) Steud.	streams in bb/df mx/df egf	500-1100		



FAMILY	SPECIES	HABITAT	ALTITUDE-RANGE
Compositae	209 <i>Anaphalis margaritacea</i> (L.) Bth. & Hk. f.	da sg	550-1800
	210 <i>Artemisia indica</i> Willd.	da sg in egf eg/pine	1100-1400
	211 <i>Bidens pilosa</i> L. var. <i>minor</i> (Bl.) Sherff	da	450-1600
	212 <i>Blumea lacera</i> (Burm. f.) DC.	da in bb/df mxf	
	213 <i>Blumea laciniata</i> (Roxb.) DC.	bb/df da	
	214 <i>Blumea lanceolaria</i> (Roxb.) Druce var. <i>spectabilis</i> (DC.) Rand.	mxf egf	800-1200
	215 <i>Blumea membranacea</i> DC. var. <i>membranacea</i>	da sg in bb/df mxf	500-900
	216 <i>Blumea napifolia</i> DC.	bb/df mxf da	300-800
	217 <i>Camchaya eberhardtii</i> (Gagnep.) Kit.	egf eg/pine eg/bb	1200-1600
	218 <i>Camchaya tenuiflora</i> Kerr	egf eg/pine eg/bb	1200-1400
	219 <i>Conyza leucantha</i> (D. Don) Lud. & Rav.	mxf egf ge/pine	800-1500
	220 <i>Conyza sumatrensis</i> (Retz.) Walk.	da	450-1200
	221 <i>Crassocephalum crepidioides</i> (Bth.) S. Moore	eg/bb	300-1700
	222 <i>Cyathocline purpurea</i> (Ham. ex D. Don) O.K.	streams in dof bb/df	500-650
	223 <i>Elephantopus scaber</i> L. var. <i>scaber</i>	da sg in bb/df mxf egf eg/pine eg/bb	500-1400
	224 <i>Eupatorium adenophorum</i> Spreng.	da sg in egf eg/pine	950-1700
	225 <i>Eupatorium odoratum</i> L.	da sg	400-1500
	226 <i>Gochnatia decora</i> (Kurz) Cabr.	da in egf eg/pine	1200-1600
	227 <i>Gynura pseudochina</i> (L.) DC.	dof do/pine eg/bb eg/pine	450-1650
	228 <i>Inula cappa</i> (Ham. ex D. Don) DC. forma <i>cappa</i>	dof bb/df egf mxf egf/pine eg/bb	500-1650
	229 <i>Inula indica</i> L.	dof bb/df egf eg/pine eg/bb	450-1400
	230 <i>Inula nervosa</i> Wall. ex DC.	eg/pine	1250-1500
	231 <i>Lactuca parishii</i> Craib ex Hoss.	bb/df	800-950
	232 <i>Piloselloides hirsuta</i> (Forsk.) C. Jeff.	egf eg/pine	1150-1400
	233 <i>Vernonia cinerea</i> (L.) Less. var. <i>cinerea</i>	da sg in bb/df mxf egf eg/pine	500-1500
	234 <i>Vernonia divergens</i> (DC.) Edgew.	mxf egf eg/pine	1100-1500
	235 <i>Vernonia parishii</i> Hk. f.	dof	500-850
	236 <i>Vernonia squarrosa</i> (D. Don) Less. var. <i>orientalis</i> Kit.	dof egf eg/pine eg/bb	600-1400
237 <i>Vernonia sutepensis</i> Kerr	dof bb/df eg/pine	700-1500	
238 <i>Wedelia thailandica</i> H. Koy.	bb/df mxf open egf	800-1300	
Connaraceae	239 <i>Connarus cochinchinensis</i> (Baill.) Pierre	streams in mxf	800-1100
	240 <i>Connarus semidecandrus</i> Jack	mxf egf	700-1150
	241 <i>Rourea minor</i> (Gaertn.) Leenh. ssp. <i>minor</i>	mxf egf	625-1400
Convolvulaceae	242 <i>Argyreia aggregata</i> Roxb. var. <i>aggregata</i>	da sg in mxf egf	900-1300
	243 <i>Argyreia capitiformis</i> (Poir.) Oost.	egf eg/pine eg/bb	1000-1700
	244 <i>Argyreia henryi</i> (Craib) Craib	egf eg/pine eg/bb	1000-1500
	245 <i>Argyreia obtecta</i> (Choisy) Cl.	bb/df mxf da sg da in: egf eg/bb	600-1400
	246 <i>Erycibe subspicata</i> Wall. ex G. Don	mxf egf	750-1200
Cucurbitaceae	247 <i>Merremia vitifolia</i> (Burm. f.) Hall. f.	da sg in bb/df mxf	450-700
	248 <i>Porana spectabilis</i> Kurz	bb/df mxf	500-750
	249 <i>Cucumis sativus</i> L.	eg/bb	1050-1340
	250 <i>Diplocyclos palmatus</i> (L.) C. Jeff.	da sg in bb/df mxf egf eg/pine	700-1150
	251 <i>Gynostemma pentaphyllum</i> (Thunb.) Mak.	da sg in bb/df mxf egf	450-1400
	252 <i>Momordica charantia</i> L.	da sg cult	400-1050
	253 <i>Mukia javanica</i> (Miq.) C. Jeff.	da sg in bb/df mxf egf eg/pine eg/bb	600-1000
	254 <i>Mukia maderaspatana</i> (L.) M.J. Roem.	da sg in bb/df mxf egf eg/pine eg/bb	600-1500
	255 <i>Neosalsmitra sarcophylla</i> (Wall.) Hutch.	rocks in bb/df	550-800
	256 <i>Solena heterophylla</i> Lour.	dof bb/df da in egf	500-1200
257 <i>Thladiantha hookeri</i> Cl.	bb/df da in mxf	450-850	

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	258 <i>Trichosanthes ovigera</i> Bl.	da sg in bb/df mx f egf	450-1250
	259 <i>Trichosanthes tricusp data</i> Lour.	da sg	450-1250
	260 <i>Zehneria maysorensis</i> (Wight & Arn.) Arn.	da sg in bb/df eg/bb	550-1375
Cyatheaceae	261 <i>Cyathea podophylla</i> (Hk.) Copel.	streams wet areas in mx f egf eg/ bb	900-1100
Cycadaceae	262 <i>Cycas pectinata</i> B.H.	do/pine egf eg/pine	1075-1500
	263 <i>Carex baccans</i> Nees	mx f egf eg/pine	950-1600
	264 <i>Carex continua</i> Cl.	da sg in mx f egf eg/pine	800-1600
	265 <i>Cyperus cyperoides</i> (L.) O.K.	da in dof bb/df egf eg/pine	500-1500
	266 <i>Cyperus kyllingia</i> Endl.	da sg mx f egf eg/pine	450-1500
	267 <i>Cyperus laxus</i> Lmk. var. <i>laxus</i>	da sg bb/df mx f	550-700
	268 <i>Cyperus nutans</i> Vahl var. <i>nutans</i>	streams wet areas da in bb/df	500-600
	269 <i>Fimbristylis dichotoma</i> (L.) Vahl ssp. <i>dichotoma</i>	do/pine	1100-1250
	270 <i>Fimbristylis disticha</i> Boeck.	mx f da	450-750
	271 <i>Scleria levis</i> Retz.	dof mx f do/pine	600-1100
	272 <i>Scleria terrestris</i> (L.) Fass.	bb/df mx f	600-950
Datisceae	273 <i>Tetrameles nudiflora</i> R. Br. ex Benn.	bb/df	450-900
Davalliaceae	274 <i>Ariostegia imbricata</i> Ching	egf eg/pine eg/bb	1200-1500
	275 <i>Pachypleuria repens</i> (L. f.) M. Kato	egf eg/pine eg/bb	1200-1600
Dennstaedtiaceae	276 <i>Microlepia speluncae</i> (L.) Moore	da sg in mx f egf	600-1400
	277 <i>Pteridium aquilinum</i> (L.) Kuhn ssp. <i>aquilinum</i> var. <i>wightianum</i> (Ag.) Trv.	da	1100-1700
Dicksoniaceae	278 <i>Cibotium barometz</i> (L.) J. Sm.	da in egf eg/pine eg/bb	1000-1200
Dilleniaceae	279 <i>Dillenia indica</i> L.	streams in bb/df	550-700
	280 <i>Dillenia parviflora</i> Griff. var. <i>kerrii</i> (Craib) Hoogl.	dof	550-950
	281 <i>Dillenia pentagyna</i> Roxb.	dof bb/df mx f	500-800
Dioscoreaceae	282 <i>Dioscorea alata</i> L.	bb/df da sg in mx f egf	550-1300
	283 <i>Dioscorea arachidna</i> Prain & Burk. var. <i>arachidna</i>	bb/df da in mx f	525-750
	284 <i>Dioscorea bulbifera</i> L.	da sg in bb/df mx f egf eg/pine eg/bb	500-1450
	285 <i>Dioscorea decipiens</i> Hk. f.	bb/df	550-750
	286 <i>Dioscorea glabra</i> Roxb. var. <i>glabra</i>	da sg in bb/df mx f egf eg/pine eg/bb	500-1400
	287 <i>Dioscorea hispida</i> Denn. var. <i>hispida</i>	bb/df	450-700
	288 <i>Dioscorea hispida</i> Denn. var. <i>mollissima</i> (Bl.) Prain & Burk.	da in bb/df dof egf eg/pine	500-1300
	289 <i>Dioscorea pentaphylla</i> L. var. <i>communis</i> Prain & Burk.	eg/pine	500-1500
	290 <i>Dioscorea pentaphylla</i> L. var. <i>siamensis</i> Prain & Burk.	dof bb/df mx f egf	550-1550
	291 <i>Dioscorea prazeri</i> Prain & Burk.	bb/df egf eg/pine eg/bb	700-1500
	292 <i>Dioscorea rockii</i> Prain & Burk.	rocks in bb/df eg/pine	600-1650
Dipterocarpaceae	293 <i>Dipterocarpus costatus</i> Gaertn. f.	mx f egf	800-1050
	294 <i>Dipterocarpus obtusifolius</i> Teijsm. ex Miq. var. <i>obtusifolius</i>	dof do/pine eg/pine	500-1250
	295 <i>Dipterocarpus turbinatus</i> Gaertn. f.	mx f	800-950
	296 <i>Hopea odorata</i> Roxb. var. <i>odorata</i>	bb/df mx f	400-800
	297 <i>Shorea obtusa</i> Wall. ex Bl.	dof eg/pine	500-1600
	298 <i>Shorea siamensis</i> Miq. var. <i>siamensis</i>	dof do/pine	450-1150
Droseraceae	299 <i>Drosera peltata</i> J.E. Sm. ex Willd.	da in eg/pine	1200-1700
Dryopteridaceae	300 <i>Arachniodes henryi</i> (Christ) Ching	eg/bb	
	301 <i>Dryopteris cochleata</i> (D. Don) C. Chr.	dof bb/df mx f eg/pine eg/bb	550-1300
	302 <i>Dryopteris neoassamensis</i> Ching	do/pine egf	1050-1600
	303 <i>Dryopteris porosa</i> Ching	rocks in eg/pine	1350-1600
	304 <i>Pleocnemia irregularis</i> (Presl) Holtt.	streams in mx f egf	550-750

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	305 <i>Polystichum biaristatum</i> (Bl.) Moore	egf	1000-1500
	306 <i>Pteridrys cnemidaria</i> (Christ) C. Chr. & Ching	rocks streams in mx	600-900
	307 <i>Tectaria herpetocaulos</i> Holtt.	streams in bb/df mx egf	550-1200
	308 <i>Tectaria impressa</i> (Fee) Holtt.	mx	550-850
	309 <i>Tectaria manilensis</i> (Presl) Holtt.	rocks cliffs bb/df	450-850
Ebenaceae	310 <i>Diospyros coactanea</i> Flet.	bb/df	500
	311 <i>Diospyros dasyphylla</i> Kurz	mx	550-700
	312 <i>Diospyros ehretioides</i> Wall. ex G. Don	dof bb/df	450-900
	313 <i>Diospyros glandulosa</i> Lace	mx egf	550-1200
	314 <i>Diospyros martabanica</i> Cl.	egf eg/pine	1100-1400
	315 <i>Diospyros mollis</i> Griff.	bb/df mx	550-1000
	316 <i>Diospyros montana</i> Roxb.	bb/df mx	450-1600
	317 <i>Diospyros rhodocalyx</i> Kurz	egf eg/pine	1000-1300
	318 <i>Diospyros truncata</i> Zoll. & Mor.	mx	400-650
	319 <i>Diospyros undulata</i> Wall. ex G. Don var. cratericalyx (Craib) Bakh.	bb/df mx	500-850
Elaeagnaceae	320 <i>Elaeagnus conferta</i> Roxb.	mx	450-700
Elaeocarpaceae	321 <i>Elaeocarpus sphaericus</i> (Gaertn.) K. Sch.	mx	450-650
	322 <i>Elaeocarpus stipularis</i> Bl.	bb/df egf	500-1600
	323 <i>Elaeocarpus</i> zsp.	egf eg/pine	1100-1100
Equisetaceae	324 <i>Equisetum debile</i> Roxb. ex Vauch.	streams, wet areas in bb/df mx, eg/bb	500-1100
Ericaceae	325 <i>Agapetes hosseana</i> Diels	egf	1450-1650
	326 <i>Craibiodendron stellatum</i> (Pierre) W.W. Sm.	dof do/pine eg/pine	600-1500
	327 <i>Rhododendron ludwigianum</i> Hoss.	eg/pine	1300-1650
	328 <i>Rhododendron moluainense</i> Hk.	egf eg/pine	1300-1600
	329 <i>Vaccinium sprengelii</i> (D. Don) Sleum.	dof bb/df egf eg/pine	600-1700
Euphorbiaceae	330 <i>Acalypha kerrii</i> Craib	bb/df mx egf	450-1000
	331 <i>Alchornea rugosa</i> (Lour. M.A. var. <i>rugosa</i> )	streams in bb/df mx	450-600
	332 <i>Antidesma acidum</i> Retz.	dof bb/df egf eg/bb	450-1300
	333 <i>Antidesma bunius</i> (L.) Spreng.	mx egf	600-1450
	334 <i>Antidesma montanum</i> Bl.	bb/df mx egf	600-1100
	335 <i>Antidesma sootepense</i> Craib	bb/df mx egf	600-1100
	336 <i>Antidesma velutinosum</i> Bl.	egf eg/bb mx	1000-1400
	337 <i>Aporusa villosa</i> (Lindl.) Baill.	dof do/pine bb/df mx eg/pine	450-1500
	338 <i>Aporusa wallichii</i> Hk. f.	dof bb/df mx	450-900
	339 <i>Baccaurea ramiflora</i> Lour.	mx egf	600-1100
	340 <i>Bailospermum montanum</i> (Willd.) M.-A.	mx eg/bb da	450-700
	341 <i>Bailospermum siamense</i> Craib	streams in egf eg/bb	1000-1450
	342 <i>Balakara baccata</i> (Roxb.) Ess.	streams in bb/df, mx egf	450-1300
	343 <i>Bischofia javanica</i> Bl.	mx da eg/bb	500-1300
	344 <i>Breynia angustifolia</i> Hk. f.	mx da in eg/bb	450-1300
	345 <i>Breynia fruticosa</i> (L.) Hk. f.	bb/df	500-850
	346 <i>Bridelia glauca</i> Bl. var. <i>glauca</i>	mx egf	600-1500
	347 <i>Bridelia stipularis</i> (L.) Bl.	da sg in bb/df mx	550-900
	348 <i>Bridelia tomentosa</i> Bl.	da sg in egf eg/bb	1200-1250
	349 <i>Cleidion spiciflorum</i> (Burm. f.) Merr.	streams in bb/df mx egf	450-1100
	350 <i>Croton robustus</i> Kurz	da sg in mx egf eg/pine eg/bb	700-1200
	351 <i>Croton roxburghii</i> N. P. Balakr.	sg dof bb/df mx	450-700
	352 <i>Daphniphyllum latifolium</i> K. Rosenth.	mx	600-650
	353 <i>Drypetes roxburghii</i> (Wall.) Huru.	mx	500-700
	354 <i>Drypetes subsessilis</i> (Kurz) Pax & Hoffm.	mx	550-650
	355 <i>Falconeria insigne</i> Roy	bb/df mx	450-700
	356 <i>Glochidion assamicum</i> (M.-A.) Hk. f.	streams in bb/df mx	500-750
	357 <i>Glochidion eriocarpum</i> Champ.	dof da in egf do/pine	750-1300
	358 <i>Glochidion rubrum</i> Bl.	da sg in bb/df mx egf eg/bb	450-1200

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	359 <i>Glochidion sphaerogynum</i> (M.-A.) Kurz	da sg in do/pine egf eg/pine	700-1300
	360 <i>Homonoia riparia</i> Lour.	streams in dof bb/df	500-650
	361 <i>Macaranga denticulata</i> (Bl.) M.-A.	da sg in bb/df mx f egf	450-1300
	362 <i>Macaranga gigantea</i> (Rchb. f. & Zoll.) M.-A.	da sg in bb/df mx f	500-700
	363 <i>Mallotus barbatus</i> M.-A. var. <i>barbatus</i>	da sg in bb/df mx f egf	450-950
	364 <i>Mallotus paniculatus</i> (Lmk.) M.-A.	da sg in egf eg/bb	1000-1350
	365 <i>Mallotus peltatus</i> (Geisel.) M.-A.	streams in bb/df mx f	550-700
	366 <i>Mallotus philippensis</i> (Lmk.) M.-A.	da sg in bb/df mx f	450-1000
	367 <i>Megistostigma burmanicum</i> (Kurz) A.S.	bb/df mx f	500-700
	368 <i>Ostodes paniculata</i> Bl.	mx f egf	700-1300
	369 <i>Phyllanthus columnaris</i> M.-A.	sg in bb/df	450-750
	370 <i>Phyllanthus emblica</i> L.	bb/df mx f egf eg/pine eg/bb da sg	600-1700
	371 <i>Phyllanthus reticulatus</i> Poir.	streams wet areas in bb/df mx f	550-800
	372 <i>Phyllanthus roseus</i> (Craib & Hutch.) Beille	da sg in bb/df mx f egf	500-1200
	373 <i>Phyllanthus sootepensis</i> Craib	egf eg/pine eg/bb	1050-1500
	374 <i>Phyllanthus urinaria</i> L.	da sg in bb/df mx f	500-650
	375 <i>Sauropus bicolor</i> Craib var. <i>bicolor</i>	eg/pine	1400-1650
	376 <i>Securinega virosa</i> (Roxb. ex Willd.) Baill.	bb/df	575-700
	377 <i>Suregada multiflora</i> (A. Juss.) Baill. var. <i>multiflora</i>	bb/df mx f	550-850
	378 <i>Trewia nudiflora</i> L.	streams in bb/df mx f	500-900
	379 <i>Trigonostemon albiflorus</i> A.S.	rocks in mx f	500-600
	380 <i>Trigonostemon thyrsoides</i> Stapf	mx f	600-800
Fagaceae	381 <i>Castanopsis argyrophylla</i> King ex Hk. f.	dof bb/df egf eg/pine	525-1700
	382 <i>Castanopsis calathiformis</i> (Skan) Rehd. & Wils.	mx f egf eg/pine	700-1650
	383 <i>Castanopsis diversifolia</i> (Kurz) King ex Hk. f.	egf eg/pine	900-1600
	384 <i>Castanopsis indica</i> (Roxb.) A. DC.	mx/bb egf	600-1200
	385 <i>Castanopsis tribuloides</i> (Sm.) A. DC.	egf eg/pine eg/bb	700-1700
	386 <i>Lithocarpus elegans</i> (Bl.) Hatus. ex Soep.	mx f egf	600-1500
	387 <i>Lithocarpus fenestratus</i> (Roxb.) Rehd.	egf eg/pine eg/bb	1100-1650
	388 <i>Lithocarpus sootepensis</i> (Craib) A. Camus	bb/df mx f egf	500-1300
	389 <i>Quercus kerrii</i> Craib var. <i>kerrii</i>	dof	450-900
	390 <i>Quercus lenticellata</i> Bran.	egf eg/pine	1000-1500
	391 <i>Quercus semiserrata</i> Roxb.	egf eg/pine	1050-1600
	392 <i>Quercus vestita</i> Rehd. & Wils.	egf eg/pine	1650
Flacourtiaceae	393 <i>Casearia flexuosa</i> Craib	bb/df mx f	500-800
	394 <i>Casearia graveolens</i> Dalz.	dof bb/df	500-700
	395 <i>Casearia grewiifolia</i> Vent. var. <i>gelonioides</i> (Bl.) Sleum.	bb/df mx f eg/bb	600-1100
	396 <i>Casearia grewiifolia</i> Vent. var. <i>grewiifolia</i>	bb/df da sg	500-700
	397 <i>Flacourtia indica</i> (Burm. f.) Merr.	bb/df mx f	450-900
	398 <i>Xylosma brachystachys</i> Craib	mx f	600-1050
Gesneriaceae	399 <i>Aeschynanthus hosseusii</i> Pell.	mx f egf	500-1300
	400 <i>Aeschynanthus macranthus</i> (Merr.) Pell.	egf eg/pine eg/bb	1000-1500
	401 <i>Chirita anachoreta</i> Hance	mx f da	600-800
	402 <i>Chirita hamosa</i> Wall. ex R. Br.	streams wet areas in do/pine bb/ df	575-750
	403 <i>Didymocarpus aureoglandulosus</i> Cl.	egf eg/pine	1100-1400
	404 <i>Didymocarpus kerrii</i> Craib	rocks streams in dof bb/df egf eg/pine	575-1500
	405 <i>Epithema carnosa</i> (D. Don) Bth.	streams in mx f egf	600-1200
	406 <i>Paraboca kerrii</i> (Craib) Burt	rocks streams in dof bb/df mx f	500-900
	407 <i>Rhynchoglossum obliquum</i> Bl.	mx f mx/bb eg/bb	500-1100
	408 <i>Rhynchotechum obovatum</i> (Griff.) B.L. Burt	streams in egf	900-1450
	409 <i>Stauranthera grandiflora</i> Bth.	streams in mx f egf	600-1200

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Gnetaceae	410 Gnetum leptostachyum Bl.	bb/df mxf egf	500-1200
Gramineae	411 Alloteropsis cimicina (L.) Stapf	da sg in bb/df	575-700
	412 Apluda mutica L.	dof bb/df	450-950
	413 Arthraxon hispidus (Thunb.) Mak. var. hispidus	da sg in mxf egf eg/pine eg/bb	800-1300
	414 Arthraxon lancifolius (Trin.) Hochr.	rocks in egf eg/pine eg/bb	900-1550
	415 Arundinella bengalensis (Spr.) Druce	da sg in bb/df mxf egf eg/pine eg/bb	600-1250
	416 Arundinella setosa Trin. var. setosa	dof eg/pine	700-1700
	417 Bothriochloa bladhii (Retz.) S.T. Blake	da sg in mxf egf eg/pine eg/bb	800-1200
	418 Capillipedium assimile (Steud.) A. Camus	dof bb/df	450-850
	419 Capillipedium parviflorum (R. Br.) Stapf	dof eg/pine	800-1550
	420 Centotheca lappacea (L.) Desv. var. lappacea	da sg in bb/df mxf egf	550-1300
	421 Chrysopogon aciculatus (Retz.) Trin.	da	500-1100
	422 Cyrtococcum accrescens (Trin.) Stapf	da mxf	500-1200
	423 Cyrtococcum oxyphyllum (Steud.) Stapf	da in mxf egf	450-950
	424 Digitaria setigera Roth ex Roem. & Schult. var. setigera	da in mxf	550-800
	425 Digitaria siamensis Henr.	dof da in bb/df	575-700
	426 Eleusine indica (L.) Gaertn.	da	450-1300
	427 Eremochloa ciliaris (L.) Merr.	dof mxf da	450-900
	428 Eulalia siamensis Bor	dof do/pine bb/df eg/pine	600-1500
	429 Garnotia acutigluma (Steud.) Ohwi	eg/pine eg/bb	950-1650
	430 Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	dof bb/df eg/pine eg/bb	450-1100
	431 Imperata cylindrica (L.) P. Beauv. var. major (Nees) C.E. Hubb. ex Hubb. & Vaugh.	da	500-1700
	432 Lophatherum gracile Brongn. var. gracile	da in eg/bb	1100-1250
	433 Microstegium vagans (Nees ex Steud.) A. Camus	da sg	500-1700
	434 Mnesithea granularis (L.) Kon. & Sos.	da sg in dof bb/df eg/bb	525-1000
	435 Mnesithea striata (Nees ex Steud.) Kon. & Sos.	da sg in bb/df mxf egf eg/pine eg/bb	600-1250
	436 Ophiuros exaltatus (L. f.) O.K.	da sg	450-600
	437 Oplismenus compositus (L.) P. Beauv.	mxf egf da	500-1450
	438 Oryza meyeriana (Zoll. & Mor.) Baill. var. granulata (Watt) Duist.	bb/df	500-800
	439 Ottochloa nodosa (Kunth) Dandy	da in bb/df mxf	500-700
	440 Panicum notatum Retz.	bb/df mxf da	550-900
	441 Paspalum conjugatum Berg.	da in bb/df mxf egf	500-1300
	442 Paspalum scrobiculatum L.	da in dof bb/df	525-700
	443 Pennisetum pedicellatum Trin.	da	450-1700
	444 Pennisetum polystachyon (L.) Schult.	dof bb/df da	450-1550
	445 Phragmites vallisneria (Pluk. ex L.) Veldk.	da sg	550-650
	446 Pseudoechinolaena polystachya (H.B.K.) Stapf	da sg in bb/df mxf egf eg/pine eg/bb	500-1400
	447 Pseudopogonatherum contortum (Brongn.) A. Camus	dof bb/df	450-800
	448 Rhynchelytrum repens (Willd.) C.E. Hubb.	da sg	400-1200
	449 Saccharum arundinaceum Retz.	da sg	550-650
	450 Sacciolepis indica (L.) A. Chase	eg/pine mxf	500-1300
	451 Schizachyrium brevifolium (Sw.) Nees	dof bb/df da	450-800
	452 Setaria palmifolia (Koen.) Stapf var. palmifolia	da sg in bb/df mxf egf	550-1200
	453 Sorghum nitidum (Vahl) Pers.	dof bb/df da	450-700
	454 Sorghum verticilliflorum (Steud.) Stapf	dof bb/df eg/pine	550-1100
	455 Themeda triandra Forssk.	da sg in dof bb/df mxf egf eg/pine eg/bb	500-1700
	456 Thysanolaena latifolia (Roxb. ex Horn.) Honda	da sg	450-1700

FAMILY	SPECIES	HABITAT	ALTITUDE- RANGE
	457 <i>Urochloa panicoides</i> P. Beauv. var. <i>pubescens</i> (Kunth) Bor	da sg in dof bb/df	550-600
Gramineae ( Bambusoideae)	458 <i>Bambusa pallida</i> Munro	bb/df eg/bb	600-1400
	459 <i>Bambusa polymorpha</i> Munro	egf	1400-1650
	460 <i>Cephalostachyum pergracile</i> Munro	bb/df	600-850
	461 <i>Dendrocalamus longispathus</i> Kurz	eg/bb	1200-1400
	462 <i>Dendrocalamus membranaceus</i> Munro	bb/df	600-950
	463 <i>Dendrocalamus nudus</i> Pilg.	bb/df eg/bb	500-1200
	464 <i>Dinochloa maclellandii</i> (Munro) Kurz	egf eg/bb	1000-1300
	465 <i>Melocanna baccifera</i> (Roxb.) Kurz	bb/df	550-650
Guttiferae ( Hypericaceae)	466 <i>Calophyllum polyanthum</i> Wall. ex Pl. & Tr.	egf	1150-1400
	467 <i>Cratoxylum formosum</i> (Jack) Dyer ssp. <i>pruniflorum</i> (Kurz) Gog.	bb/df da sg in mx f egf	450-1500
	468 <i>Garcinia cowa</i> Roxb.	mx f egf eg/pine	700-1200
	469 <i>Garcinia hanburyi</i> Hk. f.	mx f	600-850
	470 <i>Garcinia merguensis</i> Wight	streams in mx f egf	600-900
	471 <i>Garcinia propinqua</i> Craib	mx f egf	950-1200
	472 <i>Garcinia speciosa</i> Wall.	mx f egf	500-950
	473 <i>Garcinia xanthochymus</i> Hk. f. ex T. And.	streams in mx f egf	500-1100
	474 <i>Garcinia</i> zsp.	streams in mx f	550-800
	475 <i>Mesua ferrea</i> L.	mx f egf	600-950
Hypericaceae	476 <i>Cratoxylum cochinchinense</i> (Lour.) Bl.	dof bb/df da	500-700
Icacinaceae	477 <i>Apodytes dimidiata</i> E. Mey. ex Arn.	mx f egf	600-1200
	478 <i>Gomphandra tetrandra</i> (Wall.) Sleum.	mx f egf	600-1200
	479 <i>Nothapodytes foetida</i> (Wight) Sleum.	mx f	600-700
	480 <i>Pittosporopsis kerrii</i> Craib	egf eg/pine	500-1200
Irvingiaceae	481 <i>Irvingia malayana</i> Oliv. ex Benn.	bb/df mx f	450-750
Juglandaceae	482 <i>Engelhardia serrata</i> Bl.	bb/df mx f	500-950
	483 <i>Engelhardia spicata</i> Lechen. ex Bl. var. <i>integra</i> (Kurz) Mann.	egf eg/pine	1100-1600
	484 <i>Engelhardia spicata</i> Lechen. ex Bl. var. <i>spicata</i>	egf eg/pine eg/bb	1000-1600
Labiatae	485 <i>Ajuga bracteosa</i> Wall. ex Bth.	da in mx f egf	900-1200
	486 <i>Anisomeles indica</i> (L.) O.K.	dof bb/df eg/pine	500-1300
	487 <i>Colquhounia elegans</i> Wall. var. <i>tenuiflora</i> Prain	da sg in egf eg/pine eg/bb	1000-1600
	488 <i>Gomphostemma lucidum</i> Wall. ex Bth.	mx f egf	550-1200
	489 <i>Gomphostemma strobilinum</i> Wall. ex Bth. var. <i>acaulis</i> (Kurz ex Hk. f.) Prain	bb/df mx f egf eg/pine eg/bb	300-1300
	490 <i>Gomphostemma wallichii</i> Prain	mx f eg/pine eg/bb	1000-1600
	491 <i>Leucas flaccida</i> R. Br.	mx f egf eg/pine	800-1600
	492 <i>Perilla frutescens</i> (L.) Britt.	streams in egf eg/bb	
	493 <i>Platostoma africanum</i> Beauv.	eg/bb	1350
	494 <i>Plectranthus lophanthoides</i> (B.-H. D. Don) Grier. & Long	egf eg/pine eg/bb	1050-1600
	495 <i>Pogostemon purpurascens</i> Dalz.	da in egf eg/pine eg/bb	1300-1500
	496 <i>Scutellaria glandulosa</i> Hk. f.	dof	450-850
Lauraceae	497 <i>Actinodaphne henryi</i> Gamb.	mx f egf	500-1200
	498 <i>Alseodaphne</i> zsp.	mx f egf	950-1100
	499 <i>Alseodaphne</i> zsp.	egf	1100-1100
	500 <i>Beilschmiedia</i> zsp.	mx f egf	525-1350
	501 <i>Beilschmiedia</i> zsp.	egf	1050-1200
	502 <i>Cinnamomum caudatum</i> Nees	egf	1100-1500
	503 <i>Cinnamomum iners</i> Reinw. ex Bl.	mx f egf	550-1250
	504 <i>Cinnamomum porrectum</i> (Roxb.) Kosterm.	mx f	575-800
	505 <i>Cinnamomum</i> zsp.	egf eg/pine	1100-1300

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	506 <i>Cryptocarya ferrea</i> Bl.	mx f egf	550-1300
	507 <i>Litsea cubeba</i> (Lour.) Pers.	da sg in egf eg/pine	875-1700
	508 <i>Litsea glutinosa</i> (Lour.) C.B. Rob. var. <i>glutinosa</i>	bb/df mx f da sg	450-650
	509 <i>Litsea monopetala</i> (Roxb.) Pers.	mx f egf	800-1500
	510 <i>Litsea salicifolia</i> Nees ex Roxb.	egf	950-1500
	511 <i>Litsea semecarpifolia</i> Wall. ex Nees	mx f egf	300-1300
	512 <i>Litsea</i> zsp.	egf e/pine	1000-1300
	513 <i>Phoebe cathia</i> (D. Don) Kosterm.	egf	1100-1400
	514 <i>Phoebe lanceolata</i> (Nees) Nees	mx f egf eg/bb	575-1300
	515 <i>Phoebe</i> zsp.	egf eg/pine	1000-1300
	516 <i>Potameia siamensis</i> Kosterm.	mx f egf	700-1200
Lecythidaceae	517 <i>Careya arborea</i> Roxb.	dof bb/df eg/bb	450-1100
Leeaceae	518 <i>Leea herbacea</i> Ham. ex Cl.	streams in egf	900-1100
	519 <i>Leea indica</i> (Burm. f.) Merr.	egf mx f da	500-1500
	520 <i>Leea macrophylla</i> Roxb. ex Horn.	rocks in bb/df	550-700
	521 <i>Leea rubra</i> Bl. ex Spreng.	rocks in: bb/df egf	600-1000
Leguminosae, Caesalpinioideae	522 <i>Acrocarpus fraxinifolius</i> Wight ex Arn.	bb/df mx f	500-900
	523 <i>Bauhinia hirsuta</i> Weinm.	rocks in bb/df	500-650
	524 <i>Bauhinia ornata</i> Kurz var. <i>kerrii</i> (Gagnep.) K. & S . S. Lar.	bb/df mx f egf da sg	500-1300
	525 <i>Bauhinia viridescens</i> Desv. var. <i>viridescens</i>	rocks in bb/df	500-900
	526 <i>Caesalpinia hymenocarpa</i> (Prain) Hatt.	da sg in bb/df mx f	450-700
	527 <i>Caesalpinia mimosoides</i> Lmk.	mx f da sg	450-600
	528 <i>Cassia fistula</i> L.	dof bb/df	450-900
	529 <i>Pterolobium macropterum</i> Kurz	da sg in bb/df	450-800
	530 <i>Senna hirsuta</i> (L.) Irwin & Barneby var. <i>hirsuta</i>	da sg	450-600
Leguminosae, Mimosoideae	531 <i>Acacia concinna</i> (Willd.) DC.	streams in bb/df mx f	500-750
	532 <i>Acacia pennata</i> (L.) Willd. ssp. <i>kerrii</i> Niels.	da sg in bb/df	500-850
	533 <i>Adenanthera microsperma</i> Teijm et Binn.	dof bb/df	450-650
	534 <i>Albizia chinensis</i> (Osbeck) Merr.	da sg in bb/df mx f eg/bb	450-1200
	535 <i>Albizia crassiramea</i> Lace	da in bb/df mx f	450-850
	536 <i>Albizia garrettii</i> Niels.	da in egf eg/pine	1200-1500
	537 <i>Albizia lebbeck</i> (L.) Bth.	bb/df mx f eg/bb da sg	400-750
	538 <i>Albizia lucidior</i> (Steud.) Niels.	da sg in mx f	525-850
	539 <i>Albizia odoratissima</i> (L. f.) Bth.	dof bb/df open egf	450-1400
	540 <i>Archidendron clypearia</i> (Jack) Niels. ssp. <i>clypearia</i> var. <i>clypearia</i>	mx f eg/bb sg in egf	800-1300
	541 <i>Archidendron lucidum</i> (Bth.) Niels.	mx f egf	600-1100
	542 <i>Entada rheedii</i> Spreng. ssp. <i>rheedii</i>	bb/df mx f	500-900
	543 <i>Mimosa diplotricha</i> C. Wright ex Sauv. var. <i>diplotricha</i>	mx f da	300-600
	544 <i>Parkia leiophylla</i> Kurz	mx f	450-950
	545 <i>Xylia xylocarpa</i> (Roxb.) Taub. var. <i>kerrii</i> (Craib & Hutch.) Niels.	bb/df mx f	500-900
	546 <i>Abrus pulchellus</i> Wall. ex Thw. ssp. <i>pulchellus</i>	da in mx f	500-700
Leguminosae, Papilionoideae	547 <i>Aeschynomene americana</i> L. var. <i>americana</i>	da sg	500-1100
	548 <i>Afgekia filipes</i> (Dunn) Gees.	bb/df mx f	800-950
	549 <i>Butea monosperma</i> (Lmk.) Taub.	da sg	400-500
	550 <i>Cajanus goensis</i> Dalz.	da in bb/df mx f egf	550-1300
	551 <i>Cajanus volubilis</i> (Blanco) Blanco	bb/df da sg	600-800
	552 <i>Callerya eurybotrya</i> (Duake) Schot	bb/df mx f	500-900
	553 <i>Cassia bakeriana</i> Craib	bb/df mx f	800-950
	554 <i>Cochlianthus gracilis</i> Bth.	da sg in egf eg/pine eg/bb	1000-1450

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	555 <i>Crotalaria acicularis</i> B.-H. ex Bth.	dof bb/df da	475-1000
	556 <i>Crotalaria alata</i> D. Don	dof eg/pine eg/pine	450-1500
	557 <i>Crotalaria albida</i> Hey. ex Roth	dof bb/df eg/pine	450-1500
	558 <i>Crotalaria bracteata</i> Roxb. ex DC.	da in bb/df mx f	500-900
	559 <i>Crotalaria dubia</i> Grah. ex Bth.	eg/bb	700-1400
	560 <i>Crotalaria ferruginea</i> Grah. ex Bth.	bb/df mx f egf eg/pine	500-1250
	561 <i>Crotalaria kurzii</i> Baker ex Kurz	bb/df mx f egf eg/pine	500-1450
	562 <i>Crotalaria montana</i> Hey. ex Roth var. <i>montana</i>	dof bb/df eg/bb	450-1050
	563 <i>Crotalaria sessiliflora</i> L.	dof bb/df	450
	564 <i>Cruddasia insignis</i> Prain	eg/pine	850-1500
	565 <i>Dalbergia cana</i> Grah. ex Bth. var. <i>cana</i>	bb/df mx f eg/bb	450-1150
	566 <i>Dalbergia cultrata</i> Grah. ex Bth. var. <i>cultrata</i>	dof bb/df open egf	450-1500
	567 <i>Dalbergia discolor</i> Bl. ex Miq.	dof bb/df mx f egf eg/pine	500-1200
	568 <i>Dalbergia lacei</i> Prain	dof bb/df egf	500-1150
	569 <i>Dalbergia lanceolaria</i> L. f. var. <i>errans</i> (Craib) Niyoo	da sg in bb/df mx f	500-750
	570 <i>Dalbergia nigrescens</i> Kurz var. <i>nigrescens</i>	dof	600-900
	571 <i>Dalbergia oliveri</i> Gamb. ex Prain	bb/df mx f	500-850
	572 <i>Dalbergia rimosa</i> Roxb. var. <i>rimosa</i>	bb/df mx f egf	500-1200
	573 <i>Dalbergia stipulacea</i> Roxb.	mx f eg/bb egf eg/pine	500-1500
	574 <i>Desmodium amethystinum</i> Dunn	egf eg/pine	1400-1650
	575 <i>Desmodium gangeticum</i> (L.) DC.	mx f da	500-800
	576 <i>Desmodium heterocarpon</i> (L.) DC. ssp. <i>angustifolium</i> Ohashi	bb/df mx f	550-900
	577 <i>Desmodium heterocarpon</i> (L.) DC. ssp. <i>heterocarpon</i> var. <i>heterocarpon</i>	bb/df mx f egf eg/pine	850-1450
	578 <i>Desmodium heterocarpon</i> (L.) DC. ssp. <i>heterocarpon</i> var. <i>strigosum</i> Mee.	bb/df mx f	550-900
	579 <i>Desmodium laxiflorum</i> DC. ssp. <i>laxiflorum</i>	bb/df mx f egf eg/pine da	500-1300
	580 <i>Desmodium longipes</i> Craib	bb/df mx f egf eg/pine	500-1250
	581 <i>Desmodium motorium</i> (Houtt.) Merr.	dof bb/df mx f egf	500-1300
	582 <i>Desmodium multiflorum</i> DC.	mx f egf eg/pine	1150-1600
	583 <i>Desmodium oblatum</i> Baker ex Kurz	bb/df mx f	300-1300
	584 <i>Desmodium oblongum</i> Wall. ex Bth.	mx f eg/pine eg/bb	600-1500
	585 <i>Desmodium pulchellum</i> (L.) Bth.	da sg in bb/df mx f	450-850
	586 <i>Desmodium strigillosum</i> Schindl.	egf eg/pine	1100-1400
	587 <i>Desmodium teres</i> Wall. ex Bth.	bb/df mx f da sg	550-800
	588 <i>Desmodium thorelii</i> Gagnep.	da in bb/df mx f	500-700
	589 <i>Desmodium triflorum</i> (L.) DC.	da mx f	500-800
	590 <i>Desmodium triquetrum</i> (L.) DC. ssp. <i>triquetrum</i>	da sg in mx/bb mx f eg/bb egf eg/pine	623-1300
	591 <i>Desmodium velutinum</i> (Willd.) DC. ssp. <i>velutinum</i> var. <i>velutinum</i>	da sg in bb/df mx f egf eg/pine	500-1250
	592 <i>Dunbaria podocarpa</i> Kurz	da sg in mx f egf eg/pine	300-1300
	593 <i>Eriosema chinense</i> Vog.	dof eg/pine	650-1550
	594 <i>Erythrina stricta</i> Roxb.	bb/df da in egf	400-1150
	595 <i>Erythrina subumbrans</i> (Hassk.) Merr.	bb/df mx f egf	450-1250
	596 <i>Flemingia lineata</i> (L.) Roxb. ex Ait f. var. <i>glutinosa</i> Prain	da mx f	550-800
	597 <i>Flemingia sootepensis</i> Craib	bb/df mx f egf eg/pine	500-1300
	598 <i>Flemingia strobilifera</i> (L.) R. Br. ex Ait. f. var. <i>strobilifera</i>	da sg in mx f	
	599 <i>Galactia tenuiflora</i> (Willd.) W. & A.	bb/df mx f	600-700
	600 <i>Indigofera caloneura</i> Kurz	egf eg/pine	1050-1400
	601 <i>Indigofera dosua</i> B.-H. ex D. Don	eg/pine	1500-1700
	602 <i>Lespedeza parviflora</i> Kurz	egf eg/pine	1200-1600
	603 <i>Millettia dorwardii</i> Coll. & Hemsl.	rocks cliffs bb/df	650-850



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	604 <i>Millettia extensa</i> (Bth.) Bth. ex Baker	dof	500-850
	605 <i>Millettia pachycarpa</i> Bth.	bb/df egf eg/pine	600-1500
	606 <i>Millettia pubinervis</i> Kurz	bb/df	500-750
	607 <i>Millettia</i> zsp.	streams in bb/df	500-800
	608 <i>Millettia</i> zsp.	egf	1150-1250
	609 <i>Mucuna bracteata</i> A. DC.	da in eg/pine	1400-1700
	610 <i>Mucuna interrupta</i> Gagnep.	bb/df mx f da	500-850
	611 <i>Mucuna macrocarpa</i> Wall.	egf eg/pine	1000-1450
	612 <i>Pterocarpus macrocarpus</i> Kurz	dof bb/df	450-900
	613 <i>Pueraria stricta</i> Kurz	mx f egf eg/pine eg/bb	500-1600
	614 <i>Pueraria wallichii</i> DC.	dof bb/df mx f egf eg/pine eg/bb	500-1500
	615 <i>Shuteria hirsuta</i> Baker	mx f egf eg/pine eg/bb	525-1400
	616 <i>Shuteria involucrata</i> (Wall.) Wight. & Arn. var. involucrata	mx/bb egf eg/pine eg/bb	750-1600
	617 <i>Spatholobus parviflorus</i> (Roxb.) O.K.	dof bb/df open egf	450-1100
	618 <i>Tephrosia kerrii</i> Drum. & Craib	egf eg/pine	1200-1550
	619 <i>Uraria campanulata</i> (Wall. ex Bth.) Gagnep.	dof bb/df	450-800
	620 <i>Uraria cordifolia</i> Wall.	mx f	600-800
	621 <i>Uraria crinita</i> (L.) Desv. ex DC.	bb/df	500-800
Liliaceae	622 <i>Vigna grahamiana</i> (W. & S) Verdc.	da in dof bb/df mx f egf eg/pine	700-1250
	623 <i>Asparagus filicinus</i> Ham. ex D. Don	mx f egf eg/pine	1100-1600
	624 <i>Chlorophytum intermedium</i> Craib	streams in egf	900-1300
	625 <i>Dianella ensifolia</i> (L.) DC.	mx f egf eg/pine	800-1650
	626 <i>Disporopsis longifolia</i> Craib	bb/df mx f	500-1200
	627 <i>Disporum calcaratum</i> Wall. ex D. Don	dof bb/df eg/bb	500-1000
	628 <i>Lilium primulinum</i> Bak. var. burmanicum (W. W. Sm.) Stearn	eg/pine	1350-1600
	629 <i>Ophiopogon malcolmsonii</i> Roy. ex Hk. f.	egf eg/pine	1250-1600
	630 <i>Ophiopogon reptans</i> Hk. f.	streams in egf	900-1450
	631 <i>Paris polyphylla</i> J.E. Smith	egf eg/pine eg/bb	1200-1600
	632 <i>Peliosanthes tetra</i> Andr. ssp. <i>humilis</i> (Andr.) Jess.	mx f egf	500-1300
	633 <i>Polygonatum kingianum</i> Coll. & Hemsl.	da in bb/df egf eg/bb	1100-1400
	634 <i>Tupistra albiflora</i> K. Lar.	mx f egf	575-1000
	635 <i>Reinwardtia indica</i> Dum.	bb/df mx f eg/pine	750-1400
Lindsaeaceae	636 <i>Lindsaea ensifolia</i> Sw. ssp. <i>ensifolia</i>	bb/df mx f egf	500-1150
Loganiaceae	637 <i>Buddleja asiatica</i> Lour.	da in do/pine eg/pine eg/bb	900-1500
	638 <i>Fagraea ceilanica</i> Thunb.	bb/df mx f	500-900
	639 <i>Strychnos nux-vomica</i> L.	dof bb/df	500-900
Lomariopsidaceae	640 <i>Bolbitis appendiculata</i> (Willd.) K. Iwats.	mx f	550-950
	641 <i>Bolbitis deltigera</i> (Bedd.) C. Chr.	rocks streams in bb/df mx f	600-800
	642 <i>Bolbitis virens</i> (Wall. ex Hk. & Grev.) Schott var. <i>virens</i>	rocks streams in mx f egf da	750-1000
	643 <i>Elaphoglossum marginatum</i> (Fee) Moore	eg/pine	1450-1650
Loranthaceae	644 <i>Dendrophthoe pentandra</i> (L.) Miq.	da sg mx f eg/bb cult	450-1300
	645 <i>Helixanthera parasitica</i> Lour.	mx f egf eg/pine	600-1600
	646 <i>Scurrula atropurpurea</i> (Bl.) Dans.	eg/bb	900-1200
	647 <i>Scurrula ferruginea</i> (Jack) Dans.	dof bb/df egf	450-1400
	648 <i>Viscum articulatum</i> Burm. f.	dof do/pine bb/df	450-1200
	649 <i>Viscum ovalifolium</i> Wall. ex DC.	egf eg/pine	850-1600
Lycopodiaceae	650 <i>Lycopodium squarrosum</i> Forst.	egf eg/pine eg/bb	1300-1600
Lythraceae	651 <i>Lagerstroemia cochinchinensis</i> Pierre var. <i>ovalifolia</i> Furt. & Mont.	bb/df	450-900
	652 <i>Lagerstroemia macrocarpa</i> Kurz var. <i>macrocarpa</i>	dof da sg in mx f	450-900
	653 <i>Lagerstroemia tomentosa</i> Presl	bb/df da sg in egf	350-1200
	654 <i>Lagerstroemia villosa</i> Wall. ex Kurz	bb/df da in egf	500-1150
Magnoliaceae	655 <i>Michelia baillonii</i> Pierre	mx f egf	700-1350

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	656 <i>Michelia champaca</i> L. var <i>champaca</i>	mx f egf	600-1200
	657 <i>Michelia floribunda</i> Fin. & Gagnep.	mx f egf eg/pine	875-1600
	658 <i>Talauma hodgsonii</i> Hk. f. & Thoms.	streams in egf	650-1400
	659 <i>Aspidopterys tomentosa</i> (Bl.) Juss.	streams in mx f	550-1100
Malvaceae	660 <i>Abelmoschus moschatus</i> Medic. ssp. <i>moschatus</i> var. <i>moschatus</i>	da sg in bb/df mx f egf eg/pine eg/bb	550-1200
	661 <i>Hibiscus macrophyllus</i> Roxb. ex Horn.	da sg in mx f	400-800
	662 <i>Kydia calycina</i> Roxb.	da sg in egf eg/pine	900-1300
	663 <i>Sida mysorensis</i> Wight & Arn.	da in mx f	500-900
	664 <i>Sida rhombifolia</i> L. ssp. <i>rhombifolia</i>	da sg	400-1400
	665 <i>Thespesia lampas</i> (Cav.) Dalz. & Gibs. var. <i>lampas</i>	da in bb/df	450-850
	666 <i>Urena lobata</i> L. ssp. <i>lobata</i> var. <i>lobata</i>	da sg	500-1500
Marantaceae	667 <i>Donax cannaeformis</i> (G. Forst.) K. Sch.	streams in bb/df mx f	450-700
	668 <i>Phrynium capitatum</i> Willd.	streams wet areas in egf	400-1300
	669 <i>Stachyphrynium spicatum</i> (Roxb.) K. Sch.	bb/df mx f	450-650
	670 <i>Angiopteris evecta</i> (Forst.) Hoffm.	streams in bb/df mx f egf	550-1400
Melastomataceae	671 <i>Memecylon plebejum</i> Kurz	dof bb/df egf egf	450-1300
	672 <i>Osbeckia stellata</i> Ham. ex Ker-Gawl. var. <i>crinita</i> (Bth. ex Naud.) C. Han.	egf eg/pine eg/bb	1200-1600
	673 <i>Sonerila erecta</i> Jack	dof bb/df mx f egf eg/pine eg/bb	700-1200
Meliaceae	674 <i>Aglaja grandis</i> Korth. ex Miq.	streams in egf	1150-1250
	675 <i>Aglaja lawii</i> (Wight) Sald. & Rama.	mx f	550-800
	676 <i>Aphanamixis polystachya</i> (Wall.) R. Parker	bb/df mx f egf	450-1200
	677 <i>Chisocheton siamensis</i> Craib	mx f	550-850
	678 <i>Chukrasia tabularis</i> A. Juss.	bb/df mx f	450-600
	679 <i>Cispadessa baccifera</i> (Roth) Miq.	egf	1000-1300
	680 <i>Dysoxylum cochinchinense</i> Pierre	mx f egf	550-1050
	681 <i>Dysoxylum excelsum</i> Bl.	mx f egf	1000-1300
	682 <i>Melia toosendan</i> Sieb. & Zucc.	bb/df mx f egf	500-1200
	683 <i>Munronia humilis</i> (Blanco) Harms	bb/df mx f	500-700
	684 <i>Sandoricum koetjape</i> (Burm. f.) Merr.	mx f	450-700
	685 <i>Toona microcarpa</i> (C. DC.) Harms	mx f egf eg/pine	575-1400
Menispermaceae	686 <i>Cissampelos hispida</i> For.	dof bb/df da in egf	600-1200
	687 <i>Cissampelos pareira</i> L. var. <i>hirsuta</i> (B.-H. ex DC.) Forman	bb/df	450-700
	688 <i>Parabaena sagittata</i> Miers ex Hk. f. & Th.	bb/df mx f egf	500-1200
	689 <i>Stephania oblata</i> Craib	mostly open areas da in bb/df mx f egf eg/pine	450-1400
	690 <i>Stephania venosa</i> (Bl.) Spreng.	bb/df	450-750
	691 <i>Tinomiscium petiolare</i> Hk. f. & Thoms.	bb/df mx f	550-1200
	692 <i>Tinospora crispa</i> (L.) Hk. f. & Thoms.	bb/df	450-1000
Moraceae	693 <i>Artocarpus lakoocha</i> Roxb.	bb/df mx f egf da in egf	500-1200
	694 <i>Artocarpus lanceolata</i> Trec.	mx f egf eg/pine	700-1400
	695 <i>Broussonetia kurzii</i> (Hk. f.) Corn.	da sg in bb/df mx f	400-600
	696 <i>Broussonetia papyrifera</i> (L.) Vent.	da sg in bb/df mx f	500-900
	697 <i>Ficus annulata</i> Bl.	mx f	600-800
	698 <i>Ficus auriculata</i> Lour.	streams in bb/df mx f	450-850
	699 <i>Ficus callosa</i> Willd.	streams in bb/df mx f	550-1100
	700 <i>Ficus capillipes</i> Gagnep.	mx f	650-1100
	701 <i>Ficus curtipes</i> Corn.	mx f	450-900
	702 <i>Ficus cyrtophylla</i> Wall. ex Miq.	streams in mx f egf	950-1500
	703 <i>Ficus fistulosa</i> Reinw. ex Bl. var. <i>fistulosa</i>	mx f egf da sg	500-1400
	704 <i>Ficus glaberrima</i> Bl. var. <i>glaberrima</i>	streams in bb/df mx f	500-950
	705 <i>Ficus hederacea</i> Roxb.	bb/df mx f	550-1200
	706 <i>Ficus heterophylla</i> L. f. var. <i>heterophylla</i>	streams in mx f	500-700

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	707 <i>Ficus heteropleura</i> Bl. var. <i>heteropleura</i>	bb/df mxf egf	450-1200
	708 <i>Ficus hirta</i> Vahl var. <i>hirta</i>	da sg in bb/df mxf egf eg/pine	450-1550
	709 <i>Ficus hirta</i> Vahl var. <i>roxburghii</i> (Miq.) King	mxf egf	800-1300
	710 <i>Ficus hispida</i> L. f. var. <i>hispida</i>	da sg	450-1450
	711 <i>Ficus lacor</i> B.-H.	mxf	550-700
	712 <i>Ficus microcarpa</i> L. f. var. <i>microcarpa</i> forma <i>microcarpa</i>	bb/df mxf egf	500-1100
	713 <i>Ficus parietalis</i> Bl.	streams in egf	1000-1200
	714 <i>Ficus pisocarpa</i> Bl.	bb/df mxf	800-1450
	715 <i>Ficus racemosa</i> L. var. <i>racemosa</i>	streams in bb/df mxf	500-650
	716 <i>Ficus sagittata</i> Vahl var. <i>sagittata</i>	bb/df	600-700
	717 <i>Ficus sarmentosa</i> B.-H. ex J.E. var. <i>nipponica</i> (Fr. & Sav.) Corn.	bb/df mxf egf	550-1200
	718 <i>Ficus squamosa</i> Roxb.	streams in bb/df mxf egf	500-1450
	719 <i>Ficus subulata</i> Bl. var. <i>subulata</i>	mxf egf	600-1400
	720 <i>Ficus variegata</i> Bl. var. <i>variegata</i>	streams in bb/df mxf	500-850
	721 <i>Ficus virens</i> Ait. var. <i>sublanceolata</i> (Miq.) Corn.	rocks in bb/df mxf open egf	525-1250
	722 <i>Ficus</i> zsp.	rocks cliffs bb/df	650-800
	723 <i>Maclura fruticosa</i> (Roxb.) Corn.	mxf egf eg/pine eg/bb	850-1400
	724 <i>Morus macroura</i> Miq.	bb/df mxf egf	500-1200
	725 <i>Streblus asper</i> Lour. var. <i>asper</i>	bb/df mxf	450-850
	726 <i>Streblus ilicifolius</i> (Vidal) Corn.	rocks in bb/df mxf	500-800
Musaceae	727 <i>Musa acuminata</i> Colla ssp. <i>siamea</i> Simm.	streams wet areas in mxf egf	900-1500
	728 <i>Musa balbisiana</i> Colla	streams wet areas in dof bb/df mxf egf cult	400-1300
	729 <i>Musa glauca</i> Roxb.	bb/df	550-650
	730 <i>Musa itinerans</i> Cheesm.	streams wet areas in dof mxf egf da	700-1400
	731 <i>Musa nana</i> Lour.	rocks cliffs bb/df	650-800
	732 <i>Musa sikkimensis</i> Kurz	streams wet areas in dof mxf egf da sg	600-1450
Myricaceae	733 <i>Myrica esculenta</i> B. -H. ex D. Don	egf eg/pine	1200-1700
Myristicaceae	734 <i>Horsfieldia amygdalina</i> (Wall.) Warb. var. <i>amygdalina</i>	mxf	550-850
	735 <i>Horsfieldia thorelii</i> Lec.	mxf egf	550-1100
	736 <i>Knema conferta</i> (King) Warb.	mxf egf	500-1600
	737 <i>Knema laurina</i> (Bl.) Warb.	mxf egf	600-1200
Myrsinaceae	738 <i>Ardisia colorata</i> Roxb.	mxf	450-850
	739 <i>Ardisia crenata</i> Sims var. <i>crenata</i>	mxf egf eg/pine.	600-1600
	740 <i>Ardisia nervosa</i> Flet.	mxf	575-650
	741 <i>Ardisia quinquegona</i> Bl.	bb/df mxf	550-800
	742 <i>Ardisia villosa</i> Roxb.	mxf egf eg/pine eg/bb	850-1400
	743 <i>Ardisia virens</i> Kurz	egf	1100-1600
	744 <i>Embelia pulchella</i> Mez	egf	1300-1550
	745 <i>Embelia sessiliflora</i> Kurz	da sg in bb/df mxf egf eg/pine eg/bb	700-1600
	746 <i>Maesa montana</i> A. DC.	da in bb/df mxf	600-900
	747 <i>Maesa permollis</i> Kurz	mxf egf	700-1200
	748 <i>Maesa ramentacea</i> (Roxb.) A. DC.	da sg in bb/df mxf egf	500-1500
	749 <i>Rapanea yunnanensis</i> Mez	mxf egf eg/pine	600-1500
Myrtaceae	750 <i>Decaspermum parviflorum</i> (Lmk.) A. J. Scott ssp. <i>parviflorum</i>	egf eg/pine	1150-1600
	751 <i>Eugenia albiflora</i> Duth. ex Kurz	streams in bb/df mxf egf	550-1300
	752 <i>Eugenia cinerea</i> Kurz	mxf egf	600-900
	753 <i>Eugenia claviflora</i> Roxb.	egf eg/pine	1100-1500
	754 <i>Eugenia fruticosa</i> (DC.) Roxb.	bb/df mxf egf	800-1300

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	755 <i>Eugenia megacarpa</i> Craib	streams in bb/df mx/df egf	450-1050
	756 <i>Tristaniopsis burmanica</i> (Griff.) Wils. & Wat. var. <i>rufescens</i> (Hance) Parn. & Lug.	dof eg/pine	500-1500
Ochnaceae	757 <i>Ochna integerrima</i> (Lour.) Merr.	dof	500-850
Olacaceae	758 <i>Anacolosa ilicoides</i> Mast.	dof bb/df egf	725-1300
	759 <i>Schoepfia fragrans</i> Wall.	mx/df egf	950-1400
Oleaceae	760 <i>Chionanthus ramiflorus</i> Roxb.	bb/df mx/df egf	500-1150
	761 <i>Jasminum nervosum</i> Lour.	bb/df mx/df egf	600-1200
	762 <i>Olea rosea</i> Craib	egf eg/pine eg/bb	1000-1600
Oleandraceae	763 <i>Nephrolepis cordifolia</i> (L.) Presl	rocks cliffs bb/df egf eg/pine	650-1650
	764 <i>Oleandra undulata</i> (Willd.) Ching	dof mx/bb do/pine eg/pine	600-1550
Ophioglossaceae	765 <i>Helmintostachys zeylanica</i> (L.) Hk.	bb/df mx/df	700
Opiliaceae	766 <i>Urobotrya latisquama</i> (Gagnep.) Hiep.	mx/df	625-900
Orchidaceae	767 <i>Aerides falcata</i> Lindl.	dof bb/df	600-750
	768 <i>Anthogonium gracile</i> Wall. ex Lindl.	egf eg/pine eg/bb	1200-1600
	769 <i>Brachcorythis helferi</i> (Rchb. f.) Summ.	bb/df	550-850
	770 <i>Bulbophyllum affine</i> Lindl.	egf eg/bb	1100-1500
	771 <i>Bulbophyllum secundum</i> Hk. f.	eg/pine	1300-1600
	772 <i>Cleisostoma arietinum</i> (Rchb. f.) Gar.	dof bb/df	700-900
	773 <i>Cleisostoma filiforme</i> (Lindl.) Garay	dof bb/df	650-900
	774 <i>Coelogyne trinervis</i> Lindl.	dof bb/df mx/df	500-950
	775 <i>Cymbidium bicolor</i> Lindl.	dof bb/df mx/df	500-700
	776 <i>Cymbidium ensifolium</i> (L.) Sw.	dof	700-850
	777 <i>Dendrobium crepidatum</i> Lindl. & Paxt.	dof bb/df	650-900
	778 <i>Dendrobium draconis</i> Rchb. f.	dof	600-850
	779 <i>Dendrobium lindleyi</i> Steud.	dof	600-850
	780 <i>Dendrobium pulchellum</i> Roxb. ex Lindl.	dof bb/df	600-850
	781 <i>Didymoplexiella siamensis</i> (Rol. ex Dow.) Seid.	streams in mx/df	800-900
	782 <i>Epipogium roseum</i> (D. Don) Lindl.	streams in mx/df	825-1100
	783 <i>Eria bractescens</i> Lindl.	egf	1100-1300
	784 <i>Eria pannea</i> Lindl.	egf eg/bb eg/pine	1100-1500
	785 <i>Eria sutepensis</i> Rol. ex Dow.	egf	1300-1600
	786 <i>Eulophia nuda</i> Lindl.	da in dof bb/df egf open eg/pine	500-1600
	787 <i>Geodorum citrinum</i> Jacks.	dof bb/df	600-850
	788 <i>Habenaria dentata</i> (Sw.) Schltr.	egf eg/pine	1000-1200
	789 <i>Habenaria lucida</i> Wall. ex Lindl.	bb/df	575-700
	790 <i>Habenaria malintana</i> (Blanco) Merr.	bb/df mx/df egf eg/pine eg/bb	700-1200
	791 <i>Habenaria rhodocheila</i> Hance	rocks cliffs bb/df	575-700
	792 <i>Habenaria thailandica</i> Seid.	bb/df mx/df	450-700
	793 <i>Liparis jovispluvii</i> Par. & Rchb. f.	dof	575-850
	794 <i>Liparis paradoxa</i> (Lindl.) Rchb. f.	dof	575-950
	795 <i>Liparis sutepensis</i> Rol. ex Dow.	dof bb/df eg/bb	575-1000
	796 <i>Nervilia aragoana</i> Gaud.	bb/df mx/df	500-850
	797 <i>Nervilia calcicola</i> Kerr	dof bb/df	600-750
	798 <i>Nervilia crociformis</i> (Zoll. & Mor.) Seid.	dof bb/df eg/pine eg/bb	600-1500
	799 <i>Nervilia plicata</i> (Andr.) Schltr.	bb/df mx/df	550-700
	800 <i>Oberonia pachyrachis</i> Rchb. f. & Hk. f.	dof bb/df	650-900
	801 <i>Peristylis affinis</i> (D. Don) Seid.	bb/df	450-750
	802 <i>Pholidota articulata</i> Lindl.	egf eg/pine eg/bb	1200-1650
	803 <i>Pholidota convallariae</i> (Rchb. f.) Hk. f. var. <i>convallariae</i>	egf eg/pine eg/bb	1200-1650
	804 <i>Staurochilus dawsonianus</i> (Rchb. f.) Schltr.	dof bb/df	550-800
	805 <i>Trichostichia dasyphylla</i> (Par. & Rchb. f.) Krzl.	egf eg/pine eg/bb	1200-1650
Orobanchaceae	806 <i>Aeginetia indica</i> Roxb.	bb/df mx/df egf eg/bb	575-1600
	807 <i>Christonia siamensis</i> Craib	bb/df egf	550-950

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Oxalidaceae	808 <i>Biophytum sensitivum</i> (L.) DC.	mx f da	500-700
	809 <i>Oxalis corniculata</i> L.	da sg	450-1200
Palmae	810 <i>Areca laosensis</i> Becc.	egf	1100-1650
	811 <i>Arenga pinnata</i> (Wurmb) Merr.	mx f egf	500-950
	812 <i>Calamus harmandii</i> (Pierre ex Becc.) J. Drans.	streams in egf	1000-1100
	813 <i>Calamus kerrianus</i> Becc.	mx f	600-900
	814 <i>Calamus palustris</i> Griff. var. <i>cochinchinensis</i> Becc	da sg in egf eg/bb	1100-1200
	815 <i>Calamus pseudoscutellaris</i> Con.	streams in mx f egf	1000-1100
	816 <i>Calamus tenuis</i> Roxb.	streams in mx f	500-550
	817 <i>Caryota mitis</i> Lour.	egf	1000-1400
	818 <i>Livistona speciosa</i> Kurz	egf eg/pine	1100-1500
	819 <i>Wallichia carvotoides</i> Roxb.	streams in mx f egf	800-1450
Pandanaceae	820 <i>Pandanus ovatus</i> Warb.	egf	1000-1250
Parkeriaceae	821 <i>Adiantum capillus-veneris</i> L.	streams in bb/df mx f	575-775
	822 <i>Adiantum philippense</i> L.	dof eg/bb	550-1150
	823 <i>Adiantum zollingeri</i> Mett. ex Kuhn	dof bb/df	550-750
	824 <i>Cheilanthes pseudofarinosa</i> (Ching & S. K. Wu) K . Iw.	da sg in bb/df mx f egf eg/pine eg/bb	700-1500
	825 <i>Cheilanthes tenuifolia</i> (Burm. f.) Sw.	dof bb/df eg/pine eg/bb	575-1400
	826 <i>Hemionitis arifolia</i> (Burm. f.) Moore	da in bb/df mx f	500-850
	827 <i>Onychium contiguum</i> Hope	eg/pine	1300-1700
Passifloraceae	828 <i>Adenia heterophylla</i> (Bl.) Kds. ssp. <i>heterophylla</i> var. <i>heterophylla</i>	streams in bb/df mx f	550-750
	829 <i>Adenia pinnasecta</i> (Craib) Craib var. <i>pinnasecta</i>	bb/df	500-750
	830 <i>Passiflora foetida</i> L.	da sg cult	400-1000
Pinaceae	831 <i>Pinus kesiya</i> Roy. ex Gord.	do/pine eg/pine	925-1600
	832 <i>Pinus merkusii</i> Jungh. & De Vriese	do/pine	900-1100
Piperaceae	833 <i>Peperomia tetraphylla</i> (Forst. f.) Hk. & Arn.	egf eg/pine eg/bb	1100-1600
	834 <i>Piper cambodianum</i> C. DC.	mx f	600-700
	835 <i>Piper muricatum</i> Bl.	mx f egf	600-1100
	836 <i>Piper retrofractum</i> Vahl	bb/df mx f egf	450-1100
	837 <i>Piper sarmentosum</i> Roxb. ex Hunt.	da in mx f	450-700
	838 <i>Piper umbellatum</i> L. var. <i>glabrium</i> (Miq.) DC.	streams in mx f egf	550-950
Plumbaginaceae	839 <i>Plumbago indica</i> L.	da in bb/df mx f	550-700
Podocarpaceae	840 <i>Podocarpus neriifolius</i> D. Don	egf	1300-1500
Polygalaceae	841 <i>Polygala arillata</i> B. -H. ex G. Don	da in egf	1500-1650
	842 <i>Polygala chinensis</i> L.	bb/df eg/pine mx f	600-1700
	843 <i>Polygala persicariaefolia</i> DC.	da in egf eg/pine	1000-1600
	844 <i>Xanthophyllum flavescens</i> Roxb.	mx f	500-1400
	845 <i>Xanthophyllum virens</i> Roxb.	mx f	500-850
Polygonaceae	846 <i>Polygonum barbatum</i> L.	streams in dof bb/df	500-800
Polygonaceae	847 <i>Polygonum chinense</i> L.	da sg in mx f egf eg/pine eg/bb	600-1500
	848 <i>Polygonum odoratum</i> Lour.	streams in dof bb/df	500-800
Polypodiaceae	849 <i>Aglaomorpha coronans</i> (Wall. ex Mett.) Copel.	mx f egf	850-1600
	850 <i>Arthromeris lehmanni</i> (Mett.) Ching	egf eg/pine	1450-1650
	851 <i>Crypsinus oxylobus</i> (Wall. ex O.K.) Sledge	egf eg/pine eg/bb	1200-1500
	852 <i>Crypsinus rhynchophyllus</i> (Hk.) Copel.	egf eg/pine	1450-1650
	853 <i>Drynaria bonii</i> C. Chr.	bb/df mx f eg/bb	750-1000
	854 <i>Drynaria propinqua</i> (Wall. ex Mett.) J. Sm. ex Bedd.	egf eg/pine eg/bb	1250-1500
	855 <i>Drynaria rigidula</i> (Sw.) Bedd.	dof bb/df egf eg/pine	600-1200
	856 <i>Lepisorus nudus</i> (Hk.) Ching	egf eg/pine eg/bb	1100-1600
	857 <i>Leptochilus ellipticus</i> (Thunb.) Noot.	mx f egf	300-1300
	858 <i>Microsorium pteropus</i> (Bl.) Copel.	rocks streams in bb/df mx f	500-650
	859 <i>Microsorium punctatum</i> (L.) Copel.	rocks in bb/df mx f	500-700

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	860 <i>Platyterium wallichii</i> Hk.	bb/df	500-900
	861 <i>Polypodium amoenum</i> (J. Sm. ex Hk. & Grev.) Mett.	eg/pine	1450-1650
	862 <i>Polypodium subauriculatum</i> Bl.	mx f	550-850
	863 <i>Pyrosia adnascens</i> (Sw.) Ching	bb/df mx f	450-900
	864 <i>Pyrosia eberhardtii</i> (Christ) Ching	eg/pine	1500-1650
	865 <i>Pyrosia mollis</i> (O.K.) Ching	mx f da	500-800
	866 <i>Pyrosia stigmosa</i> (Sw.) Ching	bb/df	550-850
Primulaceae	867 <i>Lysimachia decurrens</i> Forst. f.	cult da sg in egf eg/pine	900-1000
	868 <i>Lysimachia peduncularis</i> Wall. ex Kurz	da sg in bb/df mx f egf eg/pine eg/bb	600-1200
Proteaceae	869 <i>Helicia formosana</i> Hemsl. var. <i>oblanceolata</i> Sleum	mx f egf	800
	870 <i>Helicia nilagirica</i> Bedd.	egf eg/pine	1000-1500
	871 <i>Heliciopsis terminalis</i> (Kurz) Sleum.	egf	1100-1500
Pteridaceae	872 <i>Pteris biaurita</i> L.	mx f egf	650
	873 <i>Pteris decrescens</i> Christ	bb/df eg/bb	500-1200
	874 <i>Pteris heteromorpha</i> Fee	bb/df mx/bb	500-900
	875 <i>Pteris venusta</i> Kunze	bb/df mx f	500-850
	876 <i>Pteris vittata</i> L.	streams in bb/df mx f egf	300-1300
Ranunculaceae	877 <i>Clematis smilacifolia</i> Wall. var. <i>angustifolia</i> Tamura	streams in bb/df	550-700
	878 <i>Clematis subumbellata</i> Kurz	da sg in bb/df mx f	550-1250
	879 <i>Thalictrum</i> zsp.	eg/pine	1400-1600
Rhamnaceae	880 <i>Berchemia floribunda</i> (Wall.) Wall. ex Brongn.	mx f da	450-650
	881 <i>Colubrina pubescens</i> Kurz	bb/df mx f	350-900
	882 <i>Ventilago denticulata</i> Willd.	bb/df mx f	500-750
	883 <i>Ziziphus oenoplia</i> (L.) Mill. var. <i>oenoplia</i>	rocks in bb/df da sg	600-850
	884 <i>Ziziphus rugosa</i> Lmk. var. <i>rugosa</i>	dof do/pine bb/df da sg	450-1050
Rhizophoraceae	885 <i>Carallia brachiata</i> (Lour.) Merr.	mx f egf	300-1300
Rosaceae	886 <i>Agrimonia nepalensis</i> D. Don var. <i>nepalensis</i>	egf eg/pine	1150-1200
	887 <i>Eriobotrya bengalensis</i> (Roxb.) Hk. f. forma <i>bengalensis</i>	egf eg/bb	1000-1450
	888 <i>Prunus arborea</i> (Bl.) Kalk. var. <i>montana</i> (Hk. f.) Kalk.	mx f egf	600-1400
	889 <i>Rubus alceifolius</i> Poir.	da sg in bb/df mx f	600-900
	890 <i>Rubus blepharoneurus</i> Card.	da sg in egf eg/bb	950-1400
Rubiaceae	891 <i>Aidia cochinchinensis</i> Lour.	mx f egf	700-800
	892 <i>Anthocephalus chinensis</i> (Lmk.) A. Rich. ex Walp	da sg in mx f	450-1050
	893 <i>Aphaenandra uniflora</i> (Wall. ex G. Don) Brem.	dof bb/df	450-900
	894 <i>Borreria laevis</i> (Lmk.) Griseb.	da sg mx f	450-700
	895 <i>Borreria repens</i> DC.	da sg in egf eg/pine eg/bb	1000-1400
	896 <i>Canthium parvifolium</i> Roxb.	bb/df mx f egf eg/pine	650-1700
	897 <i>Catunaregam spathulifolia</i> Tirv.	dof	550-900
	898 <i>Duperrea pavettifolia</i> (Kurz) Pit.	streams in bb/df mx f egf	450-950
	899 <i>Fegerlindia</i> zsp.	egf	1100-1350
	900 <i>Gardenia sootepensis</i> Hutch.	dof bb/df	450-900
	901 <i>Hedyotis auricularia</i> L.	dof bb/df eg/bb	575-1200
	902 <i>Hedyotis coronaria</i> (Kurz) Craib	bb/df mx f da	550-900
	903 <i>Hedyotis tenelliflora</i> Bl. var. <i>kerrii</i> (Craib) Fuku.	dof bb/df eg/pine	575-1400
	904 <i>Hedyotis vestita</i> R. Br. ex G. Don	da in eg/pine	1400-1600
	905 <i>Hymenopogon parasiticus</i> Wall.	rocks in eg/pine	1400-1600
	906 <i>Ixora cibdela</i> Craib var. <i>puberula</i> Craib	mx f egf	450-1200
	907 <i>Knoxia brachycarpa</i> R. Br. ex HK. f.	dof bb/df	500-800
	908 <i>Lasianthus kurzii</i> Hk. f.	mx f	575-1000

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	909 <i>Metadina trichotoma</i> (Zoll. & Mor.) Bakh. f.	streams in mxf egf	550-1300
	910 <i>Mitracarpus villosus</i> (Sw.) DC.	da sg	450-1600
	911 <i>Mitragyna rotundifolia</i> (Roxb.) O.K.	dof bb/df	400-800
	912 <i>Morinda angustifolia</i> Roxb. var. <i>scabridula</i> Craib	bb/df mxf	450-900
	913 <i>Morinda tomentosa</i> Hey. ex Roth	dof	450-750
	914 <i>Mussaenda kerrii</i> Craib	streams in mxf	550-900
	915 <i>Mussaenda parva</i> Wall. ex G. Don	mxf egf eg/pine da	850-1400
	916 <i>Mycetia chasaloides</i> (Craib) Craib	streams in mxf	500-850
	917 <i>Mycetia gracilis</i> Craib	streams in mxf egf	625-1400
	918 <i>Nauclea orientalis</i> (L.) L.	streams in mxf egf	750-1300
	919 <i>Ophiorrhiza hispidula</i> Wall. ex G. Don var. <i>hispidula</i>	mxf egf	600-1550
	920 <i>Paederia pallida</i> Craib	da sg in bb/df mxf egf eg/pine eg/bb mx/bb	500-1250
	921 <i>Paederia pilifera</i> Hk. f.	da sg in bb/df mxf	550-700
	922 <i>Pavetta tomentosa</i> Roxb. ex Sm. var. <i>tomentosa</i>	dof bb/df eg/pine	550-1600
	923 <i>Prismatomeris tetrandra</i> (Roxb.) K. Sch. ssp. <i>tetrandra</i>	egf eg/bb	1000-1400
	924 <i>Psychotria monticola</i> Kurz var. <i>monticola</i>	egf	900-1600
	925 <i>Psychotria ophioxylodes</i> Wall.	mxf egf	500-1200
	926 <i>Psychotria siamica</i> (Craib) Hutch.	mxf egf	625-1100
	927 <i>Psychotria winitii</i> Craib	mxf egf	600-1200
	928 <i>Rothmannia sootepensis</i> (Craib) Brem.	mxf egf	500-1100
	929 <i>Rubia siamensis</i> Craib	streams in egf	1200-1500
	930 <i>Spiradiclis caespitosa</i> Bl.	bb/df egf	600-1100
	931 <i>Tarenna vanprukii</i> Craib var. <i>vanprukii</i>	cliffs mxf eg/bb	300-1300
	932 <i>Tarennoidea wallichii</i> (Hk. f.) Tirv. & Sastre	mxf egf	550-1350
	933 <i>Vangueria (Meyna) pubescens</i> Kurz	dof bb/df	550-800
	934 <i>Wendlandia scabra</i> Kurz	da sg in egf	1000-1650
	935 <i>Wendlandia tinctoria</i> (Roxb.) DC. ssp. <i>floribunda</i> (Craib) Cowan	dof do/pine eg/pine	500-1650
	936 <i>Wendlandia tinctoria</i> (Roxb.) DC. ssp. <i>orientalis</i> Cowan	dof bb/df da in egf	550-1250
Rutaceae	937 <i>Acronychia pedunculata</i> (L.) Miq.	mxf egf	750-1400
	938 <i>Atalantia roxburghina</i> Hk. f.	mxf	600-800
	939 <i>Boenninghausenia albiflora</i> (Hk.) Roxb. ex Meissn	egf eg/pine	1200-1600
	940 <i>Clausena excavata</i> Burm. f. var. <i>excavata</i>	mxf egf da sg	600-1200
	941 <i>Euodia meliifolia</i> (Hance) Bth.	mxf egf	500-1150
	942 <i>Euodia triphylla</i> DC.	egf	1200-1600
	943 <i>Euodia viticina</i> Wall. ex Kurz	bb/df mxf egf	450-1300
	944 <i>Glycosmis puberula</i> Lindl. ex Oliv. var. <i>craibii</i> (Tana.) Stone	mxf egf	700-1200
	945 <i>Luvunga scandens</i> (Roxb.) Ham. ex Wight	streams in egf	800-1100
	946 <i>Micromelum falcatum</i> (Lour.) Tana.	da in mxf egf	550-1100
	947 <i>Micromelum minutum</i> (Forst. f.) Wight & Arn.	bb/df mxf	900-1250
	948 <i>Murraya paniculata</i> (L.) Jack	mxf egf	600-950
	949 <i>Paramigyna rectispinosa</i> Craib	mxf	600-800
	950 <i>Zanthoxylum nitidum</i> DC.	egf eg/bb eg/pine	1050-1500
	951 <i>Zanthoxylum rhetsa</i> (Roxb.) DC.	mxf egf	750-1250
Sabiaceae	952 <i>Meliosma pinnata</i> (Roxb.) Maxim. ssp. <i>arnottiana</i> (Wight) Beus. var. <i>arnottiana</i>	egf eg/pine	950-1500
	953 <i>Meliosma simplicifolia</i> (Roxb.) Walp. ssp. <i>fordii</i> (Hemsl. ex Forb. & Hemsl.) Beus.	streams in bb/df mxf	450-900
Salicaceae	954 <i>Salix tetrasperma</i> Roxb.	streams in bb/df mxf	500-850

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Santalaceae	955 <i>Scleropyrum wallichianum</i> (A. DC.) Arn. var. <i>siamensis</i> H. Lec.	mx f egf	475-1400
Sapindaceae	956 <i>Allophylus cobbe</i> (L.) Raeusch.	mx f egf	450-1100
	957 <i>Arytera littoralis</i> Bl.	streams in mx f egf	800-1100
Sapotaceae	958 <i>Dimocarpus longan</i> Lour. ssp. <i>longan</i> var. <i>longan</i>	bb/df mx f egf	500-1400
	959 <i>Harpullia arborea</i> (Blanco) Radlk.	bb/df mx f	500-850
	960 <i>Harpullia cupanioides</i> Roxb.	mx f egf	475-1000
	961 <i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	bb/df	450-950
	962 <i>Mischocarpus pentapetalus</i> (Roxb.) Radlk.	egf eg/pine	900-1500
	963 <i>Pometia pinnata</i> Forst. & Forst.	streams in bb/df mx f egf	550-950
	964 <i>Sapindus rarak</i> DC.	mx f egf	900-1450
	965 <i>Schleichera oleosa</i> (Lour.) Oken	bb/df	450-600
	966 <i>Palaquium garrettii</i> Flet.	egf	1050-1300
	967 <i>Payena lanceolata</i> Ridl. var. <i>annamensis</i> (Lec.) Van Bru.	mx f	600-800
Saurauiceae	968 <i>Planchonella punctata</i> Flet.	mx f	500-1200
	969 <i>Sarcosperma arboreum</i> Bth.	mx f egf eg/pine eg/bb	700-1400
	970 <i>Xantolis boniana</i> (Dub.) Royen	bb/df mx f egf	600-1200
	971 <i>Xantolis dongnaiense</i> (Pierre ex Dub.) Aubr.	bb/df mx f egf	650-1300
Schizaeaceae	972 <i>Saurauia roxburghii</i> Wall.	streams in bb/df mx f egf	450-1300
Scrophulariaceae	973 <i>Lygodium flexuosum</i> (L.) Sw.	bb/df mx f	500-1150
	974 <i>Lygodium giganteum</i> Tag. & K. Iw.	bb/df mx f	500-900
	975 <i>Lygodium polystachyum</i> Wall. ex Moore	mx f egf eg/bb da	600-1200
	976 <i>Lindenbergia indica</i> (L.) Vat.	bb/df mx f egf	500-1250
	977 <i>Lindenbergia philippensis</i> (Cham.) Bth.	wet areas in bb/df mx f da sg	500-900
	978 <i>Lindernia ciliata</i> (Colsm.) Penn.	da mx f	500-700
	979 <i>Lindernia crustacea</i> (L.) F. Muell. var. <i>crustacea</i>	da in mx f	500-800
	980 <i>Lindernia viscosa</i> (Horn.) Bold.	da sg in bb/df	550-650
	981 <i>Scoparia dulcis</i> L.	da	450-1300
	982 <i>Torenia violacea</i> (Aza. ex Blanco) Penn.	da sg in bb/df mx f	600-1400
Selaginellaceae	983 <i>Wightia speciosissima</i> (D. Don) Merr.	rocks in eg/pine	1400-1500
	984 <i>Selaginella helferi</i> Warb.	wet areas in bb/df mx f egf	500-1300
	985 <i>Selaginella minutifolia</i> Spr.	dof bb/df	600-850
	986 <i>Selaginella repanda</i> (Desv.) Spr.	rocks in bb/df mx f mx/bb	825
	987 <i>Selaginella roxburghii</i> (Hk. & Grev.) Spring var. <i>roxburghii</i>	dof bb/df	750-1400
Simaroubaceae	988 <i>Selaginella tenuifolia</i> Spring	mx f egf eg/bb	750-1200
	989 <i>Brucea mollis</i> Wall. ex Kurz	bb/df mx f egf	800-1200
Smilacaceae	990 <i>Picrasma javanica</i> Bl.	mx f egf	500-1300
	991 <i>Smilax ovalifolia</i> Roxb.	da sg in bb/df mx f egf	550-1200
Solanaceae	992 <i>Smilax perfoliata</i> Lour.	bb/df mx f egf	500-1500
	993 <i>Solanum barbisetum</i> Nees	egf eg/pine eg/bb	950-1400
	994 <i>Solanum macrodon</i> Wall. ex Nees	mx f egf	300-1300
Sonneratiaceae	995 <i>Solanum verbascifolium</i> L.	da sg in bb/df mx f	450-900
	996 <i>Duabanga grandiflora</i> (Roxb. ex DC.) Walp.	mx f egf	450-1200
Staphyleaceae	997 <i>Turpinia pomifera</i> (Roxb.) Wall. ex DC.	da in bb/df mx f eg/bb egf	600-1200
Stemonaceae	998 <i>Stemona burkillii</i> Prain	bb/df	450-650
Sterculiaceae	999 <i>Byttneria aspera</i> Colebr.	egf	900-1300
	1000 <i>Byttneria pilosa</i> Roxb.	ds sg bb/df	450-1075
	1001 <i>Eriolaena candollei</i> Wall.	dof bb/df	700-1200
	1002 <i>Firmiana colorata</i> (Roxb.) R. Br.	dof bb/df da in eg/pine	500-1250
	1003 <i>Firmiana kerrii</i> (Craib) Kosterm.	rocks cliffs in mx f egf	450-1325
	1004 <i>Helicteres elongata</i> Wall. ex Boj.	mx f da in egf	500-1300
	1005 <i>Melochia umbellata</i> (Houtt.) Stapf	bb/df mx f	600-950
	1006 <i>Pterocymbium laoticum</i> Tard.	bb/df mx f	525-850



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	1007 <i>Pterocymbium tinctorium</i> (Blanco) Merr.	bb/df	500-700
	1008 <i>Pterospermum grande</i> Craib	streams in mx/df egf	550-1000
	1009 <i>Pterospermum grandiflorum</i> Craib	bb/df mx/df egf	550-1150
	1010 <i>Pterospermum semisagittatum</i> Ham. ex Roxb.	bb/df mx/df	500-1000
	1011 <i>Sterculia balanghas</i> L.	bb/df mx/df egf eg/pine	550-1500
	1012 <i>Sterculia lanceolata</i> Cav. var. <i>lanceolata</i>	mx/df egf da	500-1200
	1013 <i>Sterculia pexa</i> Pierre	bb/df da sg	450-800
	1014 <i>Sterculia urena</i> Roxb. var. <i>thorelii</i> (Pierre) Pheng.	dof bb/df	500-800
	1015 <i>Sterculia villosa</i> Roxb.	dof bb/df eg/bb	500-1250
	1016 <i>Sterculia</i> zsp.	egf	1200
Styracaceae	1017 <i>Styrax benzoides</i> Craib	mx/df egf da sg	500-1400
Symplocaceae	1018 <i>Symplocos cochinchinensis</i> (Lour.) S. Moore ssp. <i>laurina</i> (Retz.) Noot.	mx/df egf	600-1200
	1019 <i>Symplocos macrophylla</i> Wall. ex DC. ssp. <i>sulcata</i> (Kurz) Noot. var. <i>sulcata</i>	egf eg/pine eg/bb	1200-1700
	1020 <i>Symplocos racemosa</i> Roxb.	dof bb/df mx/df egf	500-1050
	1021 <i>Symplocos sumunita</i> B.-H. ex D. Don	wet areas in mx/df	700-900
Taccaceae	1022 <i>Tacca chantrieri</i> Andre	bb/df mx/df egf	450-950
Theaceae	1023 <i>Anneslea fragrans</i> Wall.	egf eg/pine	900-1700
	1024 <i>Camellia connata</i> (Craib) Craib	mx/df egf	550-1000
	1025 <i>Camellia sinensis</i> (L.) O.K. var. <i>assamica</i> (Mast.) Kita.	mx/df egf	623-1300
	1026 <i>Camellia taliensis</i> (W.W. Sm.) Mel.	egf eg/pine	1200-1650
	1027 <i>Eurya acumminata</i> DC. var. <i>wallichiana</i> Dyer	da sg in egf	1100-1600
	1028 <i>Eurya nitida</i> Korth. var. <i>siamensis</i> (Craib) H. Keng	egf eg/pine	1300-1675
	1029 <i>Gordonia dalglieshiana</i> Craib	egf eg/pine	1200-1675
	1030 <i>Pyrenaria garrettiana</i> Craib	egf eg/pine	1200-1700
	1031 <i>Schima wallichii</i> (DC.) Korth.	bb/df mx/df egf	650-1500
	1032 <i>Sladenia celastrifolia</i> Kurz	egf	1050-1200
	1033 <i>Ternstroemia gymnanthera</i> (Wight & Arn.) Bedd.	egf eg/pine	1100-1700
Thelypteridaceae	1034 <i>Thelypteris articulata</i> (Houlst. & Moore) Tag. & K. Iw.	streams in bb/df mx/df	600-950
	1035 <i>Thelypteris crinipes</i> (HK.) K. Iw.	streams in bb/df mx/df egf eg/bb	650-1100
	1036 <i>Thelypteris nudata</i> (Roxb.) Mort.	streams in bb/df mx/df egf eg/bb	550-1200
	1037 <i>Thelypteris parasitica</i> (L.) Fosb.	bb/df mx/df egf	550-1450
	1038 <i>Thelypteris siamensis</i> Tag. & K. Iw.	streams in egf	1300-1500
	1039 <i>Thelypteris subelata</i> (Bak.) K. Iw.	bb/df mx/df	600-950
	1040 <i>Thelypteris terminans</i> (Hk.) Tag. & K. Iw.	da mx/df	500-1100
Thymelaeaceae	1041 <i>Aquilaria crassna</i> Pierre ex Lec.	mx/df egf	575-1000
	1042 <i>Linostoma persimile</i> Craib	dof do/pine	700-950
Tiliaceae	1043 <i>Berrya mollis</i> Wall. ex Kurz	dof bb/df	450-800
	1044 <i>Colona flagrocarpa</i> (Cl.) Craib	bb/df da in egf	450-1150
	1045 <i>Colona floribunda</i> (Kurz) Craib	da sg in bb/df mx/df egf	550-1300
	1046 <i>Colona winitii</i> Craib	bb/df	500-850
	1047 <i>Grewia abutilifolia</i> Vent. ex Juss.	dof eg/pine	450-1300
	1048 <i>Grewia eriocarpa</i> Juss.	dof bb/df	450-800
	1049 <i>Grewia hirsuta</i> Vahl	bb/df da in egf eg/bb	500-1400
	1050 <i>Microcos paniculata</i> L.	da sg in bb/df mx/df	450-1100
	1051 <i>Microcos tomentosa</i> Sm.	mx/df da	550-600
	1052 <i>Triumfetta pilosa</i> Roth	da sg in dof do/pine bb/df mx/df egf eg/pine eg/bb	550-1500
	1053 <i>Triumfetta rhomboidea</i> Jacq.	da in mx/df	500-700
Ulmaceae	1054 <i>Celtis tetrandra</i> Roxb.	streams in bb/df mx/df	500-700
	1055 <i>Celtis timorensis</i> Span.	streams wet areas in mx/df	550-800

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Umbelliferae	1056 <i>Trema orientalis</i> (L.) Bl.	da sg mxf	450-1250
	1057 <i>Ulmus lancaefolia</i> Roxb. ex Wall.	mxf	600-800
	1058 <i>Centella asiatica</i> (L.) Urb.	da sg in bb/df mxf	450-700
	1059 <i>Hydrocotyle javanica</i> Pont. ex Thunb.	mxf egf eg/pine eg/bb	700-1400
	1060 <i>Hydrocotyle siamica</i> Craib	egf eg/pine	1250-1650
Urticaceae	1061 <i>Hydrocotyle sibthorpioides</i> Lmk.	da in bb/df	600-650
	1062 <i>Boehmeria clidemioides</i> Miq. var. <i>clidemioides</i>	bb/df mxf egf	500-1100
	1063 <i>Boehmeria diffusa</i> Wedd.	da in mxf	500-700
	1064 <i>Boehmeria macrophylla</i> D. Don	streams in bb/df mxf	500-900
	1065 <i>Boehmeria malabarica</i> Wall. ex Wedd.	bb/df mxf	600-1100
	1066 <i>Boehmeria pilosiuscula</i> (Bl.) Hassk.	mxf	550-800
	1067 <i>Boehmeria platyphylla</i> D. Don	bb/df mxf	500-800
	1068 <i>Boehmeria zollingeriana</i> Wedd.	mxf egf	600-1100
	1069 <i>Debregeasia longifolia</i> (Burm. f.) Wedd.	mxf egf eg/pine da eg/bb	550-1300
	1070 <i>Dendrocnicide sinuata</i> (Bl.) Chew	streams in mxf egf	500-1000
	1071 <i>Elatostema clarkei</i> Hk. f.	rocks cliffs bb/df mxf	625-850
	1072 <i>Elatostema cyrtandraefolium</i> (Zoll. & Mor.) Miq.	rocks streams in bb/df	575-900
	1073 <i>Elatostema macintyreii</i> Dunn	streams in bb/df mxf egf	450-1300
	1074 <i>Elatostema monandrum</i> (B.-H. ex D. Don) Hara	bb/df mxf	500-850
	1075 <i>Girardinia hibiscifolia</i> Miq.	mxf eg/bb da	500-1400
	1076 <i>Laportea bulbifera</i> (Sieb. & Zucc.) Wedd.	streams in egf	1050-1450
	1077 <i>Laportea interrupta</i> (L.) Chew	streams wet areas in do/pine bb/df	575-700
		1078 <i>Maoutia puya</i> (Wall. ex Hk.) Wedd.	bb/df mxf egf
	1079 <i>Oreocnicide rubescens</i> Bl.	streams in bb/df mxf egf	550-1400
	1080 <i>Pellionia bulbifera</i> (Kurz) Hk. f. var. <i>bulbifera</i>	rocks streams in mxf	550-800
	1081 <i>Pellionia repens</i> (Lour.) Merr.	streams in bb/df mxf	550-850
	1082 <i>Pilea microphylla</i> (L.) Liebm.	rocks streams wet areas in do/pine bb/df	500-900
Verbenaceae	1083 <i>Pilea trinervia</i> Wight	bb/df mxf egf	550-1400
	1084 <i>Pouzolzia pentandra</i> (Roxb.) Benn.	dof do/pine eg/pine	800-1650
	1085 <i>Callicarpa arborea</i> Roxb. var. <i>arborea</i>	da sg in egf eg/pine eg/bb	900-1250
	1086 <i>Callicarpa rubella</i> Lindl.	egf eg/pine eg/bb	1100-1500
	1087 <i>Clerodendrum disparifolium</i> Bl.	mxf egf da	600-1200
	1088 <i>Clerodendrum fragrans</i> (Vent.) Willd.	da sg in mxf egf	550-1200
	1089 <i>Clerodendrum garrettianum</i> Craib	streams in mxf egf	550-900
	1090 <i>Clerodendrum glandulosum</i> Colebr. ex Lindl.	mxf da	500-700
	1091 <i>Clerodendrum paniculatum</i> L.	bb/df da sg	500-900
	1092 <i>Clerodendrum serratum</i> (L.) Moon var. <i>wallichii</i> Cl.	bb/df mxf da sg.	450-1300
	1093 <i>Congea tomentosa</i> Roxb. var. <i>tomentosa</i>	bb/df mxf	450-800
	1094 <i>Gmelina arborea</i> Roxb.	bb/df da in egf	350-1250
	1095 <i>Premna fulva</i> Craib	bb/df mxf egf	550-1000
	1096 <i>Premna latifolia</i> Roxb. var. <i>cuneata</i> Cl.	mxf	450-750
	1097 <i>Premna nana</i> Coll. & Hemsl.	dof do/pine	550-1300
1098 <i>Premna pyramidata</i> Wall. ex Schauer	bb/df mxf	500-700	
1099 <i>Premna villosa</i> Cl.	dof bb/df mxf	600-900	
	1100 <i>Tectona grandis</i> L. f.	bb/df	500-900
	1101 <i>Vitex canescens</i> Kurz	bb/df da in mxf	450-850
	1102 <i>Vitex limoniifolia</i> Wall. ex Kurz	egf eg/bb	900-1150
	1103 <i>Vitex peduncularis</i> Wall. ex Schauer	bb/df da in egf	450-1200
	1104 <i>Vitex quinata</i> (Lour.) Will.	mxf egf	550-1200
Violaceae	1105 <i>Scyphellandra pierreii</i> Boiss.	bb/df mxf	450-650
Vitaceae	1106 <i>Ampelocissus martinii</i> Planch.	bb/df mxf	500-850
	1107 <i>Ampelopsis</i> zsp.	bb/df	950-1100
	1108 <i>Cayratia</i> (vide <i>Cissus auriculata</i> (Roxb.) DC.)	streams in bb/df mxf	625-1100

FAMILY	SPECIES	HABITAT	ALTITUDE-RANGE
	1109 <i>Cayratia tenuifolia</i> (Wight & Arn.) Gagnep. var. <i>tenuifolia</i>	bb/df mx f da	500-750
	1110 <i>Cayratia trifolia</i> (L.) Dom. var. <i>cinerea</i> (Lmk.) Gagnep.	rocks cliffs bb/df eg/pine	650-1500
	1111 <i>Cissus calcicola</i> Craib	rocks cliffs bb/df	600-900
	1112 <i>Cissus discolor</i> Bl. var. <i>discolor</i>	mx f egf	600-1550
	1113 <i>Cissus hastata</i> Miq.	bb/df mx f da	450-850
	1114 <i>Cissus repens</i> Lmk.	bb/df mx f	550-900
	1115 <i>Tetrastigma apiculatum</i> Gagnep.	streams in mx f	550-575
	1116 <i>Tetrastigma cruciatum</i> Craib & Gagnep.	streams in mx f egf	650-1300
	1117 <i>Tetrastigma garrettii</i> Gagnep.	bb/df mx f egf	500-1200
	1118 <i>Tetrastigma harmandii</i> Pl.	streams in mx f egf	600-900
	1119 <i>Tetrastigma laoticum</i> Gagnep.	streams wet areas in mx f egf	550-1200
	1120 <i>Tetrastigma quadrangulum</i> Gagnep. & Craib	mx f	600-900
	1121 <i>Tetrastigma serrulatum</i> (Roxb.) Planch.	streams wet areas in mx f egf	700-1400
	1122 <i>Tetrastigma siamense</i> Gagnep. & Craib	rocks cliffs bb/df	550-800
Vittariaceae	1123 <i>Antrophyum winitii</i> Tag. & K. Iw.	mx f	550-750
	1124 <i>Vittaria elongata</i> Sw.	egf eg/pine eg/bb	1000-1400
	1125 <i>Vittaria flexuosa</i> Fee	egf eg/pine	1400-1600
Xyridaceae	1126 <i>Xyris capensis</i> Thunb.	eg/pine	1550-1600
Zingiberaceae	1127 <i>Alpinia galanga</i> (L.) Willd.	do/pine eg/pine egf	1050-1300
	1128 <i>Alpinia malaccensis</i> (Burm. f.) Rosc.	da in mx f egf	300-1300
	1129 <i>Amomum siamense</i> Craib	da in egf eg/pine	1300-1500
	1130 <i>Amomum uliginosum</i> Koen.	mx f	500-700
	1131 <i>Amomum</i> zsp.	mx f	500-700
	1132 <i>Boesenbergia longipes</i> (King & Prain) Schltr.	bb/df mx f	450-900
	1133 <i>Caulokaempferia saxicola</i> K. Lar.	rocks streams in bb/df mx f	650-800
	1134 <i>Cautleya gracilis</i> (Sm.) Dandy	egf eg/pine	1450-1550
	1135 <i>Cornukaempferia aurantiflora</i> Mood & K. Lar.	egf eg/bb	1250-1300
	1136 <i>Costus globosus</i> Bl.	mx f	600-750
	1137 <i>Costus speciosus</i> (Koeh.) J.E. Sm.	bb/df mx f egf eg/bb	550-1400
	1138 <i>Curcuma ecomata</i> Craib	eg/pine eg/bb	975-1700
	1139 <i>Curcuma zedoaria</i> (Berg.) Rosc.	eg/pine eg/bb	1100-1350
	1140 <i>Curcuma</i> zsp.	bb/df mx f	500-850
	1141 <i>Etingera littoralis</i> (Kon.) Gise.	mx f egf	550-1200
	1142 <i>Gagnepainia godefroyi</i> (Baill.) K.Sch.	bb/df mx f	450-700
	1143 <i>Globba clarkei</i> Baker	streams in mx f egf	800-1100
	1144 <i>Globba garrettii</i> Kerr	rocks in bb/df	550-700
	1145 <i>Globba kerrii</i> Craib	bb/df	500-700
	1146 <i>Globba nuda</i> K. Lar.	dof do/pine eg/pine	450-1400
	1147 <i>Globba schomburgkii</i> Hk. f.	bb/df mx f egf	500-1300
	1148 <i>Globba thorelii</i> Gagnep.	streams in mx f	550-850
	1149 <i>Globba xantholeuca</i> Craib	bb/df	450-800
	1150 <i>Hedychium ellipticum</i> Ham. ex J. Sm.	egf eg/pine	1300-1600
	1151 <i>Hedychium gardnerianum</i> Rosc.	da sg in egf eg/pine eg/bb	1100-1500
	1152 <i>Kaempferia rotunda</i> L.	dof	450-800
	1153 <i>Zingiber bradleyanum</i> Craib	bb/df eg/bb eg/pine	500-1300
	1154 <i>Zingiber kerrii</i> Craib	bb/df eg/bb	550-1200
	1155 <i>Zingiber smilesianum</i> Craib	mx f da	500-700

## LIST OF ABBREVIATIONS (HABITAT)

dof	deciduous dipterocarp/oak
do/pine	pine dipterocarp forest
bb/df	bamboo + deciduous forest
mx	mixed deciduous + evergreen forest
egf	evergreen forest
eg/pine	evergreen forest with pine
eg/bb	evergreen forest with bamboo
da	disturbed areas, roadsides
sg	secondary growth
cult	cultivated areas

# **Appendix 2.**

## **Transect site data**

# DOI LUANG TRANSECT SITES

18/08/99

Forest types: 100 = mesic evergreen, 180 = evergreen/bamboo, 200 = deciduous/bamboo, 210 = deciduous+evergreen, 300 = dry dipterocarp, 400 = hill evergreen, 500 = xeric evergreen, 800 secondary growth

Site	Altitude	Forest	Trees			Bamboo		Shrubs	Dead wood volume (m3)	Tree Species		
			Stems	Basal Area (m2)	Crown Area (m2)	Stems	Basal Area (m2)			Total no	Mean Value	Total Value
1.01	670	200	75	6.4	2718.2	0	0.0	0	97.0	31	0.70	21.6
1.02	665	200	174	11.9	4401.1	0	0.0	48	48.7	31	0.79	24.4
1.03	650	180	113	4.9	5156.2	0	0.0	102	166.0	50	0.74	36.9
1.04	630	100	121	11.2	6940.1	0	0.0	143	188.6	50	0.74	37.1
1.05	610	100	127	15.7	7898.9	0	0.0	124	111.7	44	0.74	32.3
1.06	630	180	116	6.3	5072.7	0	0.0	129	85.5	53	0.73	38.4
1.07	650	180	68	6.8	2918.3	0	0.0	42	30.1	37	0.71	26.1
1.08	665	300	61	5.9	2565.6	0	0.0	26	47.7	11	0.68	7.4
1.09	680	300	80	4.9	2048.6	0	0.0	21	36.8	16	0.74	11.7
1.10	695	300	61	4.3	2244.3	0	0.0	26	24.1	26	0.67	17.4
1.11	710	100	110	6.6	3278.3	0	0.0	18	32.3	21	0.76	15.9
1.12	720	210	271	4.4	2181.8	0	0.0	31	121.9	24	0.70	16.7
1.13	730	210	30	2.8	1032.0	0	0.0	8	33.0	19	0.71	13.5
2.01	575	100	113	10.9	5295.9	0	0.0	103	44.8	52	0.78	40.4
2.02	580	100	117	12.2	5915.2	86	0.0	106	53.4	54	0.78	42.3
2.03	590	180	130	5.8	4474.6	378	0.1	157	12.2	54	0.75	40.4
2.04	595	210	99	9.6	3126.9	290	0.1	136	35.9	48	0.78	37.3
2.05	600	210	129	13.2	3683.4	159	0.0	103	44.7	55	0.76	41.6
2.06	600	200	124	6.2	2726.4	529	0.3	88	124.1	57	0.76	43.0
2.07	600	800	77	12.1	2283.7	1360	0.8	80	23.9	47	0.74	34.5
2.08	600	800	71	4.3	1878.8	2017	0.7	41	35.8	37	0.76	28.0
2.09	595	800	444	13.1	4354.4	494	0.1	79	58.8	54	0.73	39.1
2.10	585	180	601	8.2	4291.3	267	0.3	138	91.3	75	0.73	55.1
2.11	580	100	360	6.8	4546.2	40	0.0	111	108.3	59	0.74	43.8
2.12	590	210	147	5.6	2902.5	0	0.0	63	6.3	38	0.73	27.7
2.13	595	210	22	9.2	1052.4	24	0.0	32	16.6	15	0.72	10.7
3.01	1,150	400	162	10.0	6679.2	0	0.0	21	9.0	30	0.74	22.1
3.02	1,140	400	171	9.9	5274.5	78	1.1	31	9.2	41	0.75	30.7
3.03	1,105	100	70	10.5	2936.6	383	4.7	26	4.8	32	0.69	22.0
3.04	1,070	210	68	10.9	2545.8	164	2.5	47	106.4	34	0.67	22.7
3.05	1,090	180	100	11.5	3756.5	252	1.5	52	25.7	44	0.69	30.4
3.06	1,110	180	132	11.7	5680.9	187	1.2	34	43.6	42	0.74	31.1
3.07	1,125	180	240	10.8	4691.1	408	2.4	34	7.4	44	0.71	31.0
3.08	1,100	100	99	5.7	1975.0	290	1.9	59	34.7	41	0.78	32.0
3.09	1,095	180	52	2.9	1153.1	668	4.2	62	62.0	34	0.72	24.5
3.10	1,120	180	81	9.1	3500.3	512	2.5	62	33.8	45	0.77	34.6
3.11	1,145	400	105	9.4	4501.3	128	0.8	29	47.8	48	0.70	33.5
3.12	1,175	400	97	11.5	3596.1	259	0.6	26	15.2	34	0.71	24.0
3.13	1,185	500	53	6.5	2213.0	28	0.0	5	33.8	19	0.70	13.2
40.00	1,070	100	163	12.5	7049.3	0	0.0	75	5.7	69	0.77	53.4
41.00	1,120	210	110	20.2	7730.2	84	0.3	29	49.2	50	0.72	36.1
51.00	650	500	131	6.8	2902.6	66	0.1	57	8.5	17	0.62	10.5
52.00	600	210	83	7.1	2877.5	479	0.9	19	6.9	41	0.69	28.3
53.00	580	210	133	8.7	3110.8	0	0.0	102	7.7	42	0.71	29.9
54.00	690	400	117	14.0	4909.4	0	0.0	48	5.9	29	0.67	19.5
55.00	550	100	137	13.8	5711.7	143	0.0	93	27.0	45	0.72	32.3

Site	Altitude	Forest	Trees			Bamboo		Shrubs	Dead wood volume (m3)	Tree Species		
			Stems	Basal Area (m2)	Crown Area (m2)	Stems	Basal Area (m2)			Total no	Mean Value	Total Value
56.00	550	100	142	7.1	4451.3	42	0.0	95	70.7	59	0.74	43.7
57.00	600	180	49	6.0	1460.8	2498	4.8	21	10.5	27	0.73	19.7
58.00	880	400	182	5.3	1981.1	0	0.0	68	7.3	11	0.75	8.2
59.00	900	500	115	8.7	3772.7	0	0.0	73	5.2	34	0.72	24.6
60.00	500	100	155	8.1	5195.5	98	0.1	80	11.5	52	0.78	40.3
61.00	510	210	148	4.1	3183.7	858	0.6	42	11.3	35	0.72	25.3
62.00	1,100	400	89	5.1	3479.5	0	0.0	94	2.5	32	0.71	22.7
63.00	1,180	400	114	9.8	6253.0	0	0.0	52	1.6	40	0.69	27.4
64.00	790	500	154	6.4	2916.0	0	0.0	90	10.2	12	0.71	8.5
65.00	640	500	128	9.3	5229.5	178	0.1	70	20.0	56	0.66	37.0
66.00	700	800	65	2.8	1372.2	1313	1.1	28	16.8	31	0.74	22.9
67.00	600	200	120	9.5	3358.0	765	3.1	53	20.6	37	0.75	27.7
68.00	650	200	79	6.5	2574.5	671	2.7	42	21.8	25	0.77	19.2
69.00	870	500	242	9.4	6050.6	0	0.0	41	9.0	26	0.74	19.1
70.00	900	500	133	6.8	3640.5	0	0.0	28	7.0	18	0.78	14.0
71.00	780	180	83	5.2	2608.2	1149	3.3	30	55.9	48	0.75	35.7
72.00	730	180	105	6.2	2463.9	617	4.2	0	0.0	40	0.71	28.5
73.00	1,000	100	116	8.0	3781.6	0	0.0	105	99.5	59	0.72	42.7
74.00	1,200	210	215	11.6	4163.7	0	0.0	58	12.8	52	0.74	38.5
75.00	730	300	160	7.9	3811.3	0	0.0	60	90.5	23	0.71	16.3
76.00	780	100	103	13.4	6042.6	0	0.0	38	8.4	40	0.73	29.0
77.00	850	400	124	16.5	4526.0	117	0.4	76	43.7	38	0.75	28.4
78.00	830	100	82	11.4	3772.2	107	0.8	100	27.7	39	0.73	28.3
79.00	950	400	112	13.3	6196.2	0	0.0	30	209.5	24	0.71	17.0
80.00	1,240	400	207	4.2	3310.2	0	0.0	46	0.0	42	0.72	30.3
83.00	590	200	195	7.5	4068.1	0	0.0	64	17.5	55	0.79	43.3
84.00	1,550	100	75	11.2	4797.0	0	0.0	37	53.8	23	0.74	17.0
85.00	1,450	400	166	7.2	4577.8	0	0.0	23	9.6	20	0.66	13.2
86.00	1,050	400	180	9.2	6551.0	0	0.0	37	0.2	39	0.77	29.9
87.00	1,140	500	77	3.6	1263.9	0	0.0	58	0.0	16	0.80	12.7
88.00	630	300	103	8.8	4773.2	0	0.0	54	15.6	25	0.75	18.8
89.00	1,000	300	126	9.0	3506.2	0	0.0	32	19.0	29	0.75	21.6
90.00	1,080	100	171	10.7	5407.8	0	0.0	28	13.5	51	0.76	38.5
91.00	1,105	400	391	12.2	7035.4	0	0.0	45	0.0	56	0.64	36.0
92.00	1,054	300	139	7.6	3155.7	0	0.0	24	0.0	36	0.76	27.4
93.00	0	300	149	11.2	5369.5	268	1.7	28	10.2	27	0.75	20.3
94.00	1,150	100	155	27.6	6998.3	0	0.0	66	0.0	43	0.76	32.7
95.00	1,328	400	165	10.5	5863.7	0	0.0	37	23.7	43	0.76	32.5
96.00	1,120	400	166	10.7	7215.6	0	0.0	86	14.4	41	0.73	30.0
97.00	950	100	125	10.2	6710.2	0	0.0	38	17.4	46	0.71	32.5
98.00	1,210	210	141	9.1	6727.4	0	0.0	20	0.0	43	0.70	29.9

# **Appendix 3.**

## **List of species on transect sites**



DOI LUANG PROJECT: Species on transect sites & rapid survey

10/08/99

Species	Transect sites				Rapid survey		Species	Transect sites				Rapid survey	
	sites	rank	stems	Basal area cm <sup>2</sup>	sites	rank		sites	rank	stems	Basal area cm <sup>2</sup>	sites	rank
Acrocarpus fraxinifolius	6	187	12	14099	42	86	Betula alnoides	9	143	104	141128	82	32
Acronychia pedunculata	3	234	20	3343	8	248	Bidens pilosa	0	0	0	0	1	340
Actinodaphne henryi	41	5	101	32145	95	25	Bischofia javanica	19	58	39	43978	53	63
Afzelia xylocarpa	2	252	3	13447	3	293	Blechnum orientale	0	0	0	0	17	184
Aglaia grandis	0	0	0	0	1	341	Bombax anceps	21	48	29	8897	44	79
Aglaia lawii	10	139	36	23216	48	69	Bombax ceiba	0	0	0	0	3	298
Alangium kurzii	15	81	26	43653	9	235	Brassaiopsis speciosus	1	279	3	341	11	216
Alangium salvifolium	1	277	1	113	0	0	Bridelia pubescens	5	194	9	1035	0	0
Albizia chinensis	13	100	23	21027	67	44	Broussonetia papyrifera	0	0	0	0	4	284
Albizia crassiramea	19	60	52	30557	24	144	Buchanania arborescens	0	0	0	0	2	320
Albizia garrettii	10	138	14	4139	14	200	Buchanania lanzan	19	62	67	64458	105	19
Albizia odoratissima	11	127	15	6310	11	218	Calamus sp.	0	0	0	0	7	257
Alphonsea glabrifolia	19	63	45	72048	10	231	Callicarpa arborea	7	167	9	1693	25	139
Alphonsea sp.	3	237	3	1484	1	326	Calophyllum polyanthum	1	292	3	708	2	309
Alpinia malaccensis	0	0	0	0	18	177	Camellia connata	1	291	6	961	1	325
Alseodaphne sp.	1	273	1	201	1	322	Camellia sp.	1	290	1	79	8	249
Alstonia glaucescens	11	124	26	40980	26	135	Cananga latifolia	11	131	14	10091	6	263
Alstonia scholaris	8	156	12	7709	3	290	Canarium sp.	32	15	76	45176	87	28
Anacolosia ilicoides	51	1	258	67821	187	4	Careya arborea	3	227	3	801	1	323
Angiopteris evecta	0	0	0	0	13	208	Carpinus londoniana	6	175	6	11061	19	160
Anneslea fragrans	16	76	50	32417	107	18	Caryota mitis	1	266	1	908	8	243
Annonaceae	16	77	30	9704	7	256	Casearia graveolens	17	73	27	17407	18	176
Anogeissus acuminata	13	99	22	12592	24	143	Casearia grewiifolia	14	94	18	20071	23	148
Anthocephalus chinensis	4	215	5	2720	15	195	Cassia fistula	18	66	72	44126	10	227
Antidesma bunius	28	21	57	18253	64	50	Cassia sp	4	217	4	855	1	324
Antidesma sootepense	12	108	20	2648	19	164	Cassia timorensis	6	186	8	2702	2	306
Antidesma velutinsum	1	272	2	569	0	0	Castanopsis argyrophylla	13	95	151	82383	130	10
Aphanamixis polystachya	25	32	41	36882	35	106	Castanopsis calathiformis	20	50	103	57788	121	14
Aporosa dioica	10	135	28	27328	87	27	Castanopsis diversifolia	29	18	165	279190	197	3
Aquilaria crassna	8	154	24	28284	19	165	Castanopsis indica	4	208	4	2158	22	150
Aralia sp.	6	185	15	2867	32	112	Castanopsis sp.	0	0	0	0	67	47
Archidendron clypearia	3	228	10	1920	34	108	Castanopsis tribuloides	4	207	19	5987	35	103
Archidendron lucidum	9	150	24	14493	22	151	Catunaregam spathulifolia	0	0	0	0	1	339
Ardisia nervosa	4	213	4	1737	4	279	Celtis philippensis	2	244	2	663	6	258
Areca laosensis	0	0	0	0	23	149	Celtis tetrandra	19	55	28	27898	13	205
Artocarpus gomezianus	7	165	10	2414	12	209	Celtis timorensis	1	270	1	415	3	287
Artocarpus lakoocha	3	222	3	708	10	224	Cephalostachyum pergracile	0	0	0	0	12	215
Artocarpus lanceolata	12	106	21	23799	24	141	Chisocheton siamensis	1	284	1	79	3	294
Atalantia roxburghina	7	171	13	2260	8	247	Chukrasia tabularis	3	233	6	13126	36	102
Baccaurea ramiflora	27	23	74	15344	39	91	Chukrasia velutina	0	0	0	0	1	338
Bambusa pallida	0	0	0	0	71	39	Cinnamomum	8	155	24	16023	17	181
Bambusa tulda	0	0	0	0	27	134							
Bambusa vulgaris	0	0	0	0	16	194							
Bauhinia variegata	5	199	23	6054	32	113							
Beilschmiedia sp.	29	19	88	82774	117	17							
Benya mollis	15	85	43	16541	31	116							

Species	Transect sites				Rapid survey		Species	Transect sites				Rapid survey	
	sites	rank	stems	Basal area cm <sup>2</sup>	sites	rank		sites	rank	stems	Basal area cm <sup>2</sup>	sites	rank
caudatum							Duabanga grandiflora	8	157	14	89081	58	57
Cinnamomum iners	17	68	20	11066	33	109	Dysoxylum procerum	3	232	3	1911	9	236
Cispadessa baccifera	0	0	0	0	1	337	Dysoxylum sp.	8	160	17	8754	10	229
Cleidion spiciflorum	19	57	60	24180	24	142	Ehretia acuminata	0	0	0	0	2	318
Clerodendrum fragrans	0	0	0	0	4	283	Elaeocarpus stipularis	0	0	0	0	2	317
Cnestis palala	3	230	5	1101	0	0	Engelhardia serrata	21	41	43	21391	85	29
Colocasia gigantea	0	0	0	0	26	138	Engelhardia spicata	19	54	26	15398	71	38
Colona flagrocarpa	14	92	34	13766	41	88	Erythrina sp.	11	126	18	75740	69	41
Colona floribunda	17	70	34	7686	43	83	Etilingera littoralis	0	0	0	0	29	124
Colona sp.	1	288	1	227	0	0	Eugenia sp.	34	9	93	105817	130	11
Colona winitii	1	287	3	463	19	169	Euodia meliifolia	1	286	1	79	0	0
Connarus	3	229	5	2330	4	280	Euodia triphylla	0	0	0	0	6	266
cochinchinensis							Euodia viticina	0	0	0	0	1	334
Craibiodendron stellatum	12	113	57	17153	124	12	Eupatorium adenophorum	0	0	0	0	6	265
Cratoxylum formosum	26	30	62	29991	37	101	Eupatorium odoratum	0	0	0	0	13	207
Cratoxylum sp.	2	260	3	563	9	239	Eurya acumminata	11	129	22	3661	53	64
Croton oblongifolius	48	2	362	96117	98	22	Eurya nitida	5	204	15	9827	6	262
Cryptocarya ferrea	12	110	26	10908	28	127	Fagaceae sp2	14	87	43	51242	70	40
Cycas pectinata	2	240	9	9806	42	85	Fagraea ceilanica	3	225	4	1399	3	289
Dalbergia cana	2	251	3	708	10	226	Fernandoa adenophylla	9	146	46	29831	21	152
Dalbergia dongnaiensis	32	14	66	52992	84	30	Ficus annulata	4	210	5	26308	19	162
Dalbergia fusca	25	31	69	37398	28	129	Ficus benjamina	1	269	1	11310	5	267
Dalbergia oliveri	5	198	5	2706	6	259	Ficus callosa	15	78	22	18959	19	161
Dalbergia rimosa	21	46	78	35368	67	43	Ficus capillipes	7	164	10	5678	3	286
Dalbergia sp.	10	137	14	5833	3	292	Ficus fistulosa	20	51	46	14676	46	71
Debregeasia longifolia	1	267	1	201	9	232	Ficus hirta	2	243	3	252	9	233
Dendrocalamus membranaceus	0	0	0	0	97	23	Ficus hispida	6	177	8	1777	4	274
Dendrocalamus nudus	0	0	0	0	51	65	Ficus lacor	6	176	7	83858	18	171
Dendrocnide sinuata	3	220	4	565	4	273	Ficus microcarpa	1	268	1	9503	0	0
Dillenia indica	2	261	2	511	2	310	Ficus semicordata	12	105	21	4920	16	187
Dillenia parviflora	31	16	62	52288	61	55	Ficus sp.	5	192	6	65632	13	204
Dillenia pentagyna	25	33	66	71527	142	7	Ficus superba	2	242	3	1264	10	223
Dimocarpus longan	24	34	48	52901	67	45	Ficus virens	3	221	3	83711	10	222
Diospyros dasyphylla	0	0	0	0	1	336	Firmiana kerrii	0	0	0	0	1	333
Diospyros ehretioides	6	183	11	4242	9	234	Flacourtia indica	11	130	15	10054	12	213
Diospyros glandulosa	1	275	1	625	2	301	Garcinia cowa	15	86	28	12335	33	110
Diospyros martabanica	0	0	0	0	1	335	Garcinia sp.	0	0	0	0	14	203
Diospyros montana	2	248	2	211	0	0	Garcinia speciosa	8	163	20	4618	20	158
Diospyros rhodocalyx	9	147	23	9934	56	58	Garcinia	13	102	22	8671	15	198
Diospyros undulata	10	136	24	14998	28	128	xanthochymus						
Dipterocarpus alatus	0	0	0	0	2	319	Gardenia sootepensis	13	98	20	8469	43	82
Dipterocarpus costatus	6	190	29	115440	49	66	Garuga floribunda	16	74	22	9339	40	90
Dipterocarpus obtusifolius	14	93	97	92204	44	80	Gigantochloa apus	1	265	1	95	44	76
Dipterocarpus tuberculatus	8	161	21	14349	4	281	Glochidion sp.	12	107	42	12218	55	60
Dipterocarpus turbinatus	7	172	97	276997	29	123	Gluta obovata	38	7	70	43507	61	54
Dracontomelon dao	15	83	27	53183	42	87	Gluta usitata	19	61	124	70462	48	67
Drypetes roxburghii	5	193	12	15160	2	300	Gmelina arborea	13	97	15	6367	37	98
							Gochnatia decora	2	249	2	208	7	253
							Gomphandra tetrandra	21	47	36	12865	19	168
							Grewia eriocarpa	27	26	81	24728	37	100

Species	Transect sites				Rapid survey		Species	Transect sites				Rapid survey	
	sites	rank	stems	Basal area cm <sup>2</sup>	sites	rank		sites	rank	stems	Basal area cm <sup>2</sup>	sites	rank
Harpullia arborea	12	120	28	13541	26	137	Meliosma pinnata	23	36	32	21668	48	68
Helicia nilagirica	22	38	102	28826	118	16	Meliosma simplicifolia	8	159	18	13742	11	220
Hibiscus macrophyllus	0	0	0	0	5	272	Melochia umbellata	5	203	27	8394	3	295
Holarrhena pubescens	4	212	8	2192	4	278	Memecylon plebejum	4	216	4	1880	10	225
Hopea odorata	3	236	5	27858	19	170	Mesua ferrea	12	123	22	30486	38	94
Horsfieldia amygdalina	18	64	21	13112	16	189	Michelia champaca	11	132	20	33059	78	35
Hymenodictyon orixense	4	214	4	797	2	304	Microcos paniculata	14	91	37	22607	27	133
Ilex godajam	26	29	42	56334	44	78	Microcos tomentosa	3	235	5	759	9	238
Ilex umbellulata	2	255	3	1267	6	260	Micromelum hirsutum	1	285	1	12076	0	0
Imperata cylindrica	0	0	0	0	15	199	Millettia pubinervis	2	250	21	5746	5	269
Irvingia malayana	16	75	42	118239	38	93	Millettia sp.	1	282	2	6061	0	0
Knema conferta	1	274	1	314	18	172	Mimosa pigra	0	0	0	0	5	271
Knema laurina	26	28	71	67965	72	37	Mischocarpus pentapetalus	6	188	12	10773	16	192
Kydia calycina	12	121	15	8734	6	261	Mitragyna rotundifolia	12	116	20	6794	7	254
Lagerstroemia cochinchinensis	21	44	61	120503	26	136	Mitrephora maingayi	21	49	66	47764	38	95
Lagerstroemia macrocarpa	1	281	1	755	2	305	Morus macroura	13	96	21	23883	16	186
Lagerstroemia tomentosa	9	148	13	36499	18	174	Murraya paniculata	0	0	0	0	1	332
Lagerstroemia villosa	1	280	1	616	7	255	Musa sp.	0	0	0	0	78	36
Lagerstromia sp.	8	158	15	56206	3	291	Nauclea orientalis	1	276	4	897	2	303
Lannea coromandelica	2	254	3	476	16	191	Nothapodytes foetida	5	202	6	1388	8	246
Lauraceae	9	145	14	7135	28	126	Ochna integerrima	7	170	14	9916	18	175
Lithocarpus aggregatus	12	104	53	64857	99	20	Orophea kerrii	0	0	0	0	1	331
Lithocarpus elegans	32	13	155	96368	213	2	Oroxylum indicum	6	182	9	1164	4	277
Lithocarpus fenestratus	6	174	13	5518	17	178	Ostodes paniculata	10	134	24	6624	17	179
Lithocarpus garrettianus	2	241	2	334	34	107	Pandanus sp.	0	0	0	0	20	159
Lithocarpus thomsonii	8	153	20	15654	87	26	Paramichelia baillonii	33	12	80	89786	157	6
Litsea cubeba	0	0	0	0	2	316	Parkia leiophylla	7	168	10	17240	16	190
Litsea glutinosa	5	195	11	6326	12	211	Phoebe cathia	6	180	13	21923	20	155
Litsea salicifolia	12	109	32	61615	81	33	Phoebe sp.	9	144	16	9579	17	180
Livistona speciosa	0	0	0	0	43	84	Phoenix humilis	0	0	0	0	8	251
Lophopetalum wallichii	5	201	7	5869	24	146	Phragmites vallatoria	0	0	0	0	31	118
Macaranga denticulata	6	179	10	3054	44	77	Phrynium capitatum	0	0	0	0	48	70
Macaranga gigantea	14	89	38	14785	37	97	Phyllanthus columnaris	7	166	52	5658	1	321
Machilus parviflora	6	181	7	2450	35	104	Phyllanthus emblica	21	42	61	13795	96	24
Macropanax concinnus	6	184	23	8058	25	140	Picrasma javanica	10	140	15	7751	11	221
Maesa montana	0	0	0	0	2	315	Pinus kesiya	4	206	35	14101	45	73
Maesa sp.	3	226	3	1531	2	302	Pinus merkusii	2	239	47	9664	28	125
Mahonia nepalensis	0	0	0	0	2	314	Pittosporopsis kerrii	1	283	1	79	8	245
Mallotus barbatus	1	271	2	208	12	210	Podocarpus neriifolius	1	264	4	4691	16	185
Mallotus paniculatus	14	88	30	4298	27	132	Polyalthia viridis OR simiarum	29	20	94	84740	67	46
Mallotus peltatus	2	245	4	3635	16	188	Potameia siamensis	0	0	0	0	2	313
Mallotus philippensis	20	52	54	20493	27	131	Premna pyramidata	4	211	7	2128	4	276
Mangifera caloneura	12	119	36	66812	20	157	Protium serratum	39	6	149	164539	66	49
Mangifera sp.	2	253	2	1288	11	219	Prunus cerasoides	0	0	0	0	1	330
Mangifera sylvatica	4	218	6	5038	2	308	Pterocarpus macrocarpus	20	53	45	61534	37	99
Markhamia stipulata	14	90	22	5736	64	51	Pterocymbium laoticum	2	259	10	17865	17	183
Melia toosendan	7	169	16	5818	21	153	Pterospermum acerifolium	1	289	1	177	0	0



# **Appendix 4.**

## **Sample description form**

**I/ INF ARRANGE** Length  Pedicel  901 sessile  Other

100 Position 200 Direction 300 Arrangement 900 Timing 900 Other  
 101 terminal 201 upright 301 solitary 312 spikes 401 when deciduous 903 branch from base  
 102 pseudocul 202 lax 302 fascicles 307 racemes 402 with young lvs 904 fascicled  
 103 term+upr 203 pendulant 303 stumps 308 verticillate 403 with mature lvs 905 leafy bracts  
 104 axillary 304 umbel 309 panicle 404 with old leaves 906 pedicel/leaved  
 105 opposite 311 corymb 310 thyrse 907 no bracts 906 nocturnal  
 106 behind 305 head 306 dichasia 902 axile 907 slight fragrant  
 107 old stem 907 axmosa(not 306,311) 908 pedicel 908 very fragrant  
 108 trunk 904 calyx 909 foetid

**J/ FLOWERSIZE**  Calyx  Corolla  600 Color

100 Calyx 101 none 200 Corolla 201 none 400 Corolla lobe 600 Color  
 102 rotate 601 free 201 rotata 207 tubular 301 free 401 truncate 601 white  
 103 cup-shap 602 fuse at B 202 spiral 208 saucer 302 fuse at B 402 rounded 602 cream/PY  
 104 bell-shap 603 fuse+lobe 203 hood 209 urceolate 303 fuse+lobe 403 blunt tip 603 yellow/O  
 105 funnel 604 fuse+lobe 204 cup 210 papillo 304 fuse+lobe 404 sharp tip 604 pink  
 106 tubular 205 bell 211 bilabiate 405 notched 605 red  
 206 funnel 212 zygomorphic 406 divided 606 purple/blue  
 901 keeled 904 valvate 907 to left 607 green  
 902 cleft 905 imbricate 908 to right 608 brown  
 903 recurved 906 opposite 906 opposite 909 multi-color

**K/ STRUCTURE** Stamens  900 Other

100 Sex 200 Stamens 300 Style 900 Other  
 101 bisexual 201 free 301 one, sessile 901 with disc  
 102 bisexual + male 202 fuse at base 302 one, free 902 stamens exerted  
 103 bisexual + female 203 fuse in cluster 303 many sessile 903 stamens diff length  
 104 bisexual + M + F 204 fused in tube 304 many, free 904 stamens whorled  
 105 monoecious/same 205 fused to petal 305 many, fuse at 905 style exerted  
 106 dioecious(diff) 206 around style 306 many, fuse at 906 stigma lobed  
 207 staminal mass 307 column 408 club

**L/ FRUIT**  STALK  SEED

100 Fruit Type 200 Texture 300 Shape 400 Apex 500 Color 600 SEED 909 star pattern  
 101 achene 201 smooth 301 depresso 401 round 501 cream/grey 902 winged 905 black 903 hairy  
 102 nut 202 woody 302 globose 402 blunt 502 yellow/O 603 kidney 906 red 912 rupeose  
 103 winged 203 glaucous 303 ellipsoid 403 pointed 503 pink/red 913 curved 907 color / 910 ruminate  
 104 dry capsule 204 scatter hair 308 cylindrical 404 sunken 504 green 908 clear / 911 pleurogram  
 112 fleshy capsule 205 dense hair 304 flat(long) 405 nipple 505 brown  
 105 pod 206 spiny 305 ovoid 307 pear 606 purple/black  
 108 follicle 207 fibrous 306 obovoid 308 curve 607 blue 908 stigma  
 107 drupe 208 scaly/scurfy 701 loc, centr 900 SEED 909 star pattern  
 108 baccate 209 warty/bumpy 602 1 split 702 loc, side 902 winged 905 black 903 hairy  
 109 berry 210 pitted 603 2 split 703 septa 903 kidney 906 red 912 rupeose  
 110 pepo 211 glaucular 604 3 split 704 top 913 curved 907 color / 910 ruminate  
 111 aggregate 212 lentils 605 4/5 split 705 across 914 angled 908 clear / 911 pleurogram  
 606 >5 split

**M/ CROWN** height  Dbh

100 Season 200 Form 300 Shape 400 Trunk 500 Branching  
 101 evergreen 201 unbranched 208 scandent 301 flat-topped 401 cylindrical 601 mono, cont  
 102 flushing 202 2 whorled 209 epiphyte 302 umbrella 402 tapering 602 mono, rhy  
 103 semi-egg 203 2 horizontal 210 shrub 303 spherical 403 buttress 603 symp, app  
 104 deciduous 204 2 weeping 304 oval 404 spreading 604 symp, sub  
 205 2 strong ascend 305 cylindrical 405 knobby layered?  
 206 main stem 306 conical 406 crooked  
 207 no main stem 307 irregular 407 multiple

**N/ BARK** Thick  300 Inner bark  600 Middle ba 400 Late/asp

100 Outer Colour 200 Texture 301 translucent 501 white/crea 401 none  
 101 cream/ yellow 201 smooth 302 white 602 yellow 402 clear  
 102 pale grey 202 papery 801 O cork 902 dense L 603 orange 403 red/orange  
 103 orange/pale brown 203 scaly 902 ridges 304 rich yellow 804 red 404 brownish  
 104 rich red-brown 204 flaking 904 ridges 305 orange 905 brown 405 white  
 105 medium grey/brown 205 dipped/warty 905 wrinkles 306 pink 406 yellow  
 106 dark brown 206 scatter crack 906 vertical 307 red 407 >>dark  
 107 dark grey/black 207 fine crack 907 horizontal 308 brown  
 108 green 208 mod crack 908 spiral 309 striped R/W 901 O dense 904 fibrous  
 209 deep crack 909 network 902 O brittle 905 l>dark  
 210 thorn/vapine 906 exude resin 906 scented

L=usually, S=sometimes, R=rarely, ( )=slightly

E/LEAF VEIN number  to  angle  to

100 Pattern2 200 Vein Curve 300 Vein margin 400 Pattern3 500 Upper P S T  
 101 faint 201 straight 301 open 401 faint 501 raised 601 601 701  
 102 close para 202 curve near M 302 closed 402 parallel 502 flat 602 702  
 103 even para 203 continuous 303 forked 403 close ladder 503 sunken 603 703  
 104 uneven para 204 steep curve 304 looped 404 even ladder 504 rddged 604 604  
 105 irregular 205 abrupt curve 305 to teeth 405 uneven ladder 505 groove 605 605  
 106 multi-nerved 206 sinuous 306 to sinus 406 transverse 506 express 606 606  
 107 3 basal 207 sinuous 307 to vein 407 longitudinal 507 impress 607 607  
 108 palmate 208 sinuous 308 to vein 408 change 410 network 508 swollen base 608 608  
 109 asymmetric 209 asymmetric 309 asymmetric 409 perpen 411 fade 509 base recurvnt 609 609

F/100 COLOR 200 Blade 300 Texture 400 Position 500 Gland type 600 Gland posit  
 101 lamina tinge F 201 waxy 301 smooth 401 scatter V/P only 501 none 601 on blade  
 102 V/P tinged R 202 coriaceous 302 glaucous 402 dense V/P only 502 liny:lim 602 blade nr base  
 103 white/P grey B 203 charcoal 303 scurfy/mealy 403 scatter B (+VA) 503 flat 603 on vein  
 104 orange/brown B 204 membrane 304 minute hair 404 scatter A (+VB) 504 raised 604 vein axil  
 105 grey-green B 205 white hair 405 scatter both 505 sunken 605 axil nr base  
 106 yellow-green B 306 brown hair 406 dense B (+VA) 506 tufts 606 P apex  
 801 darkgreen A 802 buliate 307 silky 407 dense A (+VB) 507 domatia 607 P middle  
 903 white latex 905 yellow latex 308 long hair 408 dense B, scatter A 608 stalked 608 P base  
 905 dry black 906 dry green 309 rough hair 409 dense A, scatter B 608 nodes 811 margin  
 907 margin hyaline 908 odour 310 stellate hair 410 dense both 610 rachis 612 M nr base

G/PETIOLE&TWIG length  length  length  length  length  length  
 101 sessile 801 sessile  
 100 Petiole Shape 200 P Sectio 300 Stipule 401 liny < 3mm 501 hair-like 601 twig features  
 102 flat both ends 201 smooth 301 none 402 small(3-10) 502 narrow, point 602 shiny & smooth  
 103 swollen apex 202 1 ridge 303 beside-decid 403 medium(10- 503 blunt 603 spines/thorns  
 104 swollen base 203 2 ridge(m) 304 -persist 404 large(30- 504 blunt 604 intranetio ridge  
 105 swollen both 204 1 groove 305 inter-decidous 404 large>30m 505 oblong, point 605 looped ridges  
 205 2 groove 306 -persist 510 blunt 610 vertical ridges  
 802 pubinate 206 striate 307 encircling 504 broad, pointe 606 twist (planar/va)  
 803 knee 207 fluted 308 opposite 507 blunt 607 swollen nodes  
 804 flattened 208 decurrent 309 below 508 foliose 608 groove  
 805 base wrinkled 209 winged 310 above 509 curved 609 striate 610 hollow  
 806 base sheathing 209 winged 302 appressed 504 clasping 609 square 611 flatten  
 807 base followed

H/BLD 101 squat 102 ovoid 103 elongated 104 triangular VERNATION 201 appress 202 valvate 203 imbricate 204 opposite  
 COLOR 301 pale green 302 silver/white 303 yellow 304 red/pink 305 purple 306 brown  
 TEXTURE 401 smooth 402 silky 403 scatter hairs 404 dense hairs  
 OLD COLOR 501 yellow 502 red

U=usually, S=sometimes, R=rarely, ( )=slightly

Fam  Link  Rec no  Beat  Ck

VERSION 4.1 Source  No  By  Meth

Distinct

Note

C/LEAF TYPE C length  Leaflets  Leaflets

100 Leaf type 200 Leaf Arrange 300 Leaflet arrange 400 Proportion 500 Other  
 101 simple 201 alternate, spiral 301 alternate - odd 401 Bottom larges 501 tem stalk >1.5X  
 102 trifoliate 202 alternate, planar 302 alternate - even 402 Top largest 502 free ending  
 103 pinnate 203 opposite, spiral 303 opposite - odd 403 Middle largest 503 nodes swollen  
 104 bipinnate 204 opposite, planar 304 opposite - even 404 lte equal 504 rachis winged  
 105 digitate 205 decussate 305 low alt, up opp 505 low like stipule  
 106 trifoliate 206 whorl 306 low opp, up alt 506 terminal bud  
 207 cluster

D/LEAF SHAPE Length  to  width  to

100 Leaf shape 200 Leaf apex 300 Leaf base 400 Margin 500 Other  
 101 orbicular (<1.5) 201 caudate 301 attenuate 401 entire 501 U dentate  
 102 palmate 202 narrow acum 302 narrow cuneate 402 fine 502 Y dentate  
 103 broad ovate(1.5to2) 203 broad acum 303 broad cuneate 403 scatter 503 crenate  
 104 broad elliptic 204 abrupt acum 304 obtuse 404 regular 504 sharp teeth  
 105 broad obovate 205 mucronate 305 rounded 405 irregular 505 teeth in sinus  
 106 narrow ovate(2to3) 206 apiculate 306 truncate 407 apex only 506 ciliate  
 107 narrow elliptic 207 acute 307 cordate 408 double 507 ciliate  
 108 oblong 208 obtuse 901 sharp tip 308 oblique 508 undulate  
 109 narrow obovate 209 rounded 902 blunt tip 309 asymmetric 509 revolute  
 110 lanceolate 112 lateral 210 retuse 903 notch tip 310 petiate  
 111 linear(>1.5) 113 distink 211 multiple 904 3D tip 311 taper+blunt

100 Leaf shape 200 Leaf apex 300 Leaf base 400 Margin 500 Other  
 101 orbicular (<1.5) 201 caudate 301 attenuate 401 entire 501 U dentate  
 102 palmate 202 narrow acum 302 narrow cuneate 402 fine 502 Y dentate  
 103 broad ovate(1.5to2) 203 broad acum 303 broad cuneate 403 scatter 503 crenate  
 104 broad elliptic 204 abrupt acum 304 obtuse 404 regular 504 sharp teeth  
 105 broad obovate 205 mucronate 305 rounded 405 irregular 505 teeth in sinus  
 106 narrow ovate(2to3) 206 apiculate 306 truncate 407 apex only 506 ciliate  
 107 narrow elliptic 207 acute 307 cordate 408 double 507 ciliate  
 108 oblong 208 obtuse 901 sharp tip 308 oblique 508 undulate  
 109 narrow obovate 209 rounded 902 blunt tip 309 asymmetric 509 revolute  
 110 lanceolate 112 lateral 210 retuse 903 notch tip 310 petiate  
 111 linear(>1.5) 113 distink 211 multiple 904 3D tip 311 taper+blunt

U=usually, S=sometimes, R=rarely, ( )=slightly

# **Appendix 5.**

## **Sample line drawing and description**



**Family:**

COMMELINACEAE

**Botanical Name:** *Commelina diffusa* Burm. f.

**Description:** Diffuse, decumbent, succulent, evergreen annual, ground, herb, rooting at lower nodes. Roots light brown. Stems glabrous, light green to green. Leafy part erect. Leaves simple, alternate. Blades thin, narrowly oblong to lanceolate, tip acuminate, base acute to rounded, very finely denticulate; venation parallel, midvein prominent, sunken above; secondary veins 6; upper surface sparsely puberulous, lower side more densely so; dark green to green above, light green underneath; c. 2-6 x 0.8-2 cm. Petiole margins ciliate, light green; c. 1 mm long. Leaf sheaths tubular, margins truncate, sparsely scabrous outside, inside glabrous, light green; c. 1.4-2 cm long. Inflorescences axillary, solitary, axes densely puberulous, pale light green; 8-17 mm long. Bracts thin, conduplicate, broadly ovate, tip acuminate, base cordate, margins very finely denticulate; venation parallel, light green; 1.4-3.8 x 1.2-2 cm, secondary axes unequally bifid, one 2-6 mm long with 1 flower, the other 4-20 mm long, with 3 flowers and 4-5, light green. Flowers irregular, 3-merous, opening in the morning and closed by noon. Sepals 3, imbricate, carinate, glabrous; entire: upper sepal ovate, tip rounded and hooded, margins thin, 3-nerved; c. 4 x 2 mm; lateral sepals asymmetrically broadly ovate, tip rounded, translucent whitish to very pale light lilac or green; c. 4 x 2.5-3 mm. Petals 3, very thin, blue, less often white: 2 petals broadly oblong-reniform, tip rounded, base rounded and prominently clawed, entire-undulate, with dichotomous veins; c. 5 x 7 mm, claw 3 mm long. The other petal deflexed, broadly oblong-reniform, tip acute, entire, blade 3-3.5 x 4-4.5 mm; claw c. 1 mm long. Stamens 6, free, 3 fertile, 3 sterile. Anthers 2-locular, oppositipetalous, alternipetalous, basifixed, 3 sterile ones hastate, 5-lobed, tip rounded, yellow; c. 1 mm diameter; 2 fertile anthers, broadly ovate, tip and base rounded, blackish or orangish with blue; c. 0.7-1 mm long; 1 anther larger, narrowly sagittate or lanceolate, dull violet, connective and locules yellow; 1.5 mm long. All filaments slender, flattened, glabrous, blue; c. 4-6 mm long. Stigmas minutely capitate, light brown or light brownish. Style from the side of the top of the ovary, tip recurved, glabrous, pale light lilac or violet; 4-6 mm long. Ovary superior, oblong, 3-lobed, densely puberulous, dull light green; c. 2 x 1 mm, 3-locular with 1-2 axile ovules per locule. Capsules oblong, tip acute, base rounded, finely puberulous, whitish; c. 6-8 x 3-4 mm. Seeds up to 5 per capsule, ellipsoid, oblong alvolate, dark grey to blackish; c. 3-4 x 2-2.5 mm.

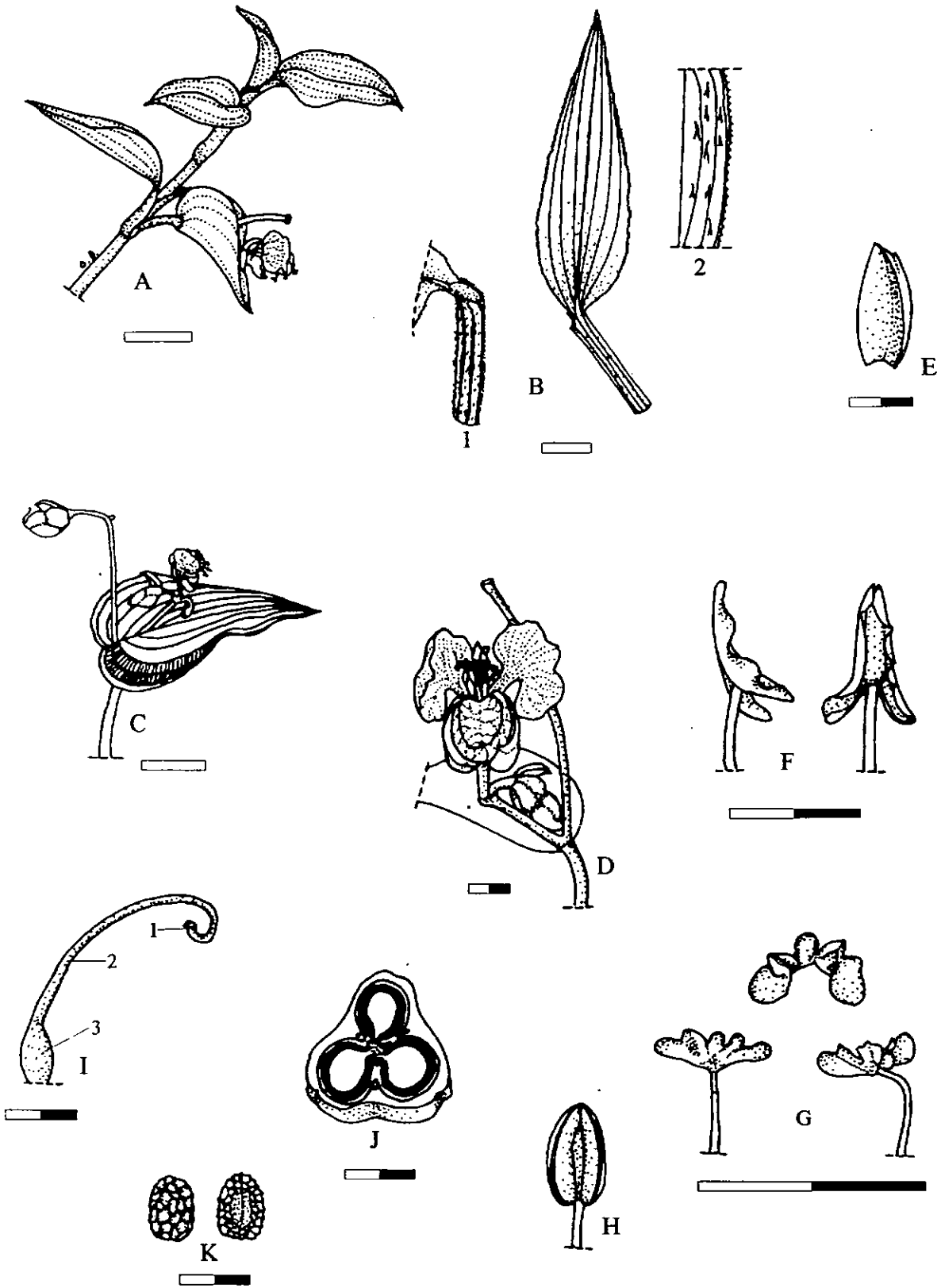
**Specimen:** O. Petrmitr #41, 10 August 1997

**Habitat:** open, very disturbed area, along a stream; mixed evergreen+deciduous seasonal, hardwood forest with grass; shale bedrock

**Abundance:** 3

**Phenology:** **Flowers:** January-November, **Fruits:** July-December, **Leaves:** January-December

**Elevation:** 360-950 m



**Sample 2. *Commelina diffusa* Burm. f. (Commelinaceae)**

A. upper part of stem; B. leaf: 1. details of leaf sheath; 2. details of epidermis; C. open bract showing inflorescence and capsule; D. flower and capsule; E. fat sepal; F. larger sterile stamens; G. smaller sterile stamens; H. fertile stamen; I. pistil: 1. stigma; 2. style; 3. ovary; J. ovary (x-section) showing placentation and ovules; K. seeds.

Scale bars: black and white, 1 mm units; white only, 1 cm units.

**Family:** EUPHORBIACEAE

**Botanical Name:** *Breynia angustifolia* Hk. f.

**Description:** Erect, branching, deciduous treelet up to c. 72 cm tall, basal diameter 6 mm. Epidermis of stems thin, smooth, brown to red-brown. Leaves simple, alternate. Blades thin, oblong, tip rounded and mucronulate, base rounded to slightly acute, entire; venation pinnate, midrib distinct, secondary nerves 5-6 fine ascending pairs, arching below the margins, glabrous on both surfaces; upper surface brownish and becoming green, lower surface dull light brown and becoming dull light green in mature blades; 10-38 x 6-19 mm. Petioles glabrous, light green; c. 1.5 mm long. Stipules minute, ovate, lanceolate, tip acuminate, dull light green, persistent; c. 1-2 x 0.5-1 mm. Flowers unisexual, axillary, solitary, regular, 6-merous, reflexed. Male flowers: pedicels glabrous, dull light green; c. 7 x 1 mm; calyx perianth campanulate, dull light green to cream or whitish, lobes inflexed; c. 4 x 3.5-4 mm. Stamens 3, erect, united in a column, dull light green; column c. 1.8 x 1 mm, each anther with 2, linear, oblong, orange locules c. 0.5 x 0.8 mm. Female flowers: pedicels dull light green; c. 4-6 mm long. Calyx rotate with 6, rounded, cuspidate lobes divided c. 1/3 way to the base, dull light with reddish or light green; c. 3.5-6 x 3.5-5 mm, accrescent in fruit. Stigmas 3, each bifid at the tip. Style 1, all dull light brown. Ovary superior, subglobose, dull light brown to green; c. 1 x 1.5 mm, 3-locular, each locule with one basal ovule. Capsules smooth, globose or subglobose, glabrous, green and maturing dark green; c. 10 x 7 mm. Seeds triangular, ellipsoid, smooth; c. 5 x 3.5 mm, hilum distinct.

**Specimen:** O. Petrmitr #19, 25 May 1997

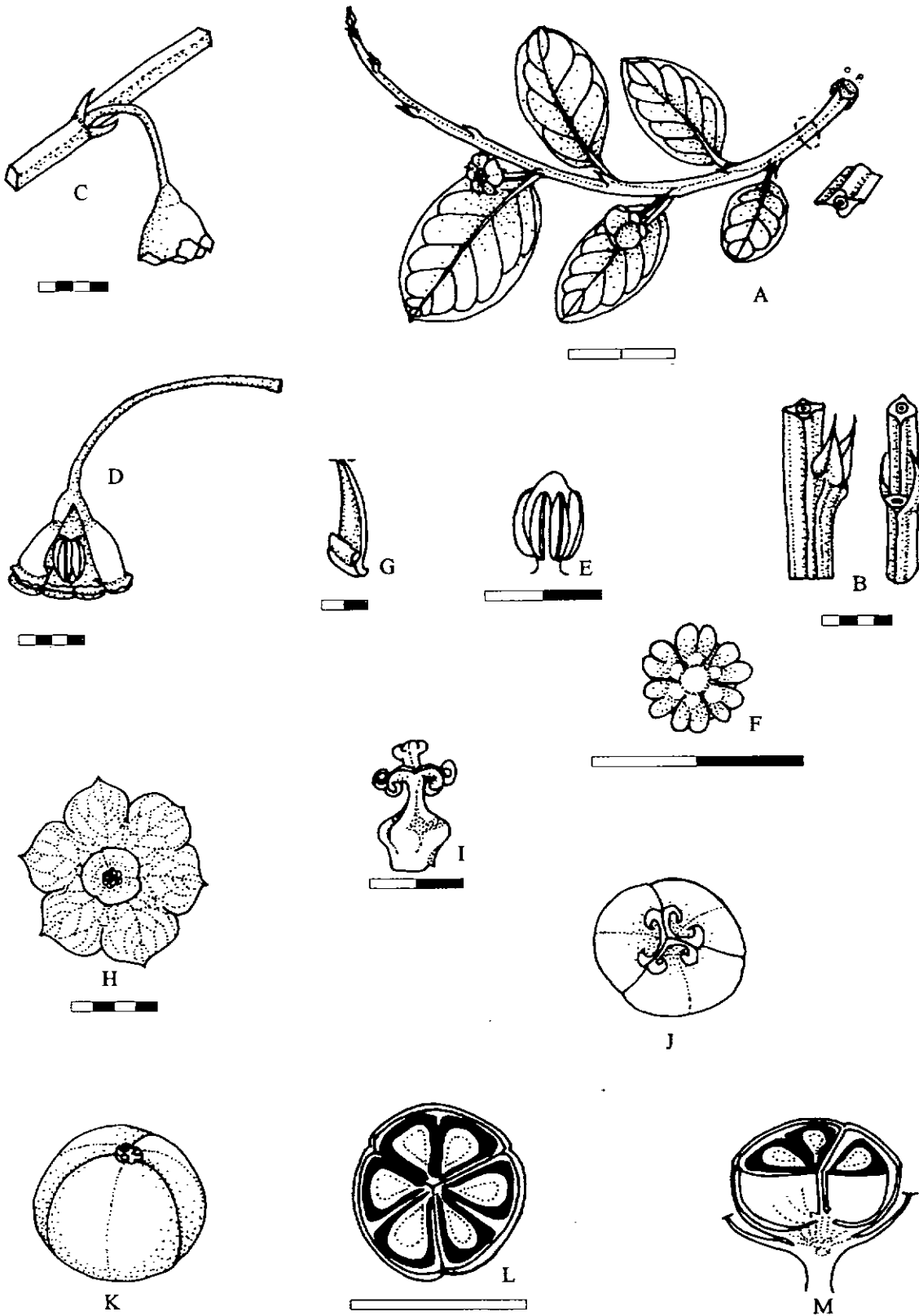
**Habitat:** shaded, partly disturbed area; mixed evergreen+deciduous, seasonal hardwood forest; shale bedrock

**Abundance:** 3

**Phenology:** **Flowers:** April-June, **Fruits:** July-August, **Leaves:** January-December

**Elevation:** 450-850 m

**Notes:** male and female flowers



**Sample 1. *Breynia angustifolia* Hk. f. (Euphorbiaceae)**

A. branchlet with flowers; B. stipular; C. male flower; D. opened male flower showing stamens; E. stamens; F. top view of stamen; G. details part of perianth; H. female flower; I. pistil; J. top of pistil; K. capsule; M. capsule (long section) showing placentation and seeds; L. capsule (x-section) showing locules and seeds.

Scale bars: black and white, 1 mm units; white only, 1 cm units.

**Family:** STEMONACEAE

**Botanical Name:** *Stemona burkillii* Prain

**Description:** Deciduous, perennial vine. Tubers in soil, several, digitate, thickened; light brown outside, whitish inside. Stems glabrous, green. Leaves simple, opposite. Blades thin, ovate, tip acuminate, base cordate; venation basal parallel, main nerves 12, arching, finer venation closely scalariform, glabrous on both surfaces; upper surfaces glossy greenish, light green below; margins crenate; c. 11-16.5 x 7-8.5 cm. Petioles dorsally sulcate, green; c. 6-8 cm long. Inflorescence axillary or from leafless nodes, cymose, to 6 cm long, axes green; peduncle c. 17-20 mm long, pedicels 10-12 mm long. Stipules none. Flowers few, bisexual, regular, 4-merous. Bracts thin, persistent, tip acute, light green, c. 8 mm long. Tepals lanceolate, imbricate, erect, tips acuminate, base truncate, glossy light green outside, dull light green with maroonish in the lower 1/3 inside. Stamens 4, free, oppositipetalous; locules 2 per anther, linear, tip acute, light green; c. 7.5 mm long; connective prominent, wider than the locules, erect, triangular tip, dull maroonish; c. 2.8 mm long. Filaments thickened, pale light green; c. 0.8-1 mm long. Stigma capitate. Style 1, cream, c. 1 mm long. Ovary superior, ovoid, glabrous, 1-locular, ovules numerous, placentation basal; c. 1.5 x 1 mm. Capsules ovoid, glabrous, light green; c. 2.3 x 1.9 cm, dry tepals persistent. Seeds elliptic, thin, oblong, aril covering one side of the seed, white, testa white; c. 10 mm long, funiculus with fleshy, white, fimbriate appendages 6 mm long.

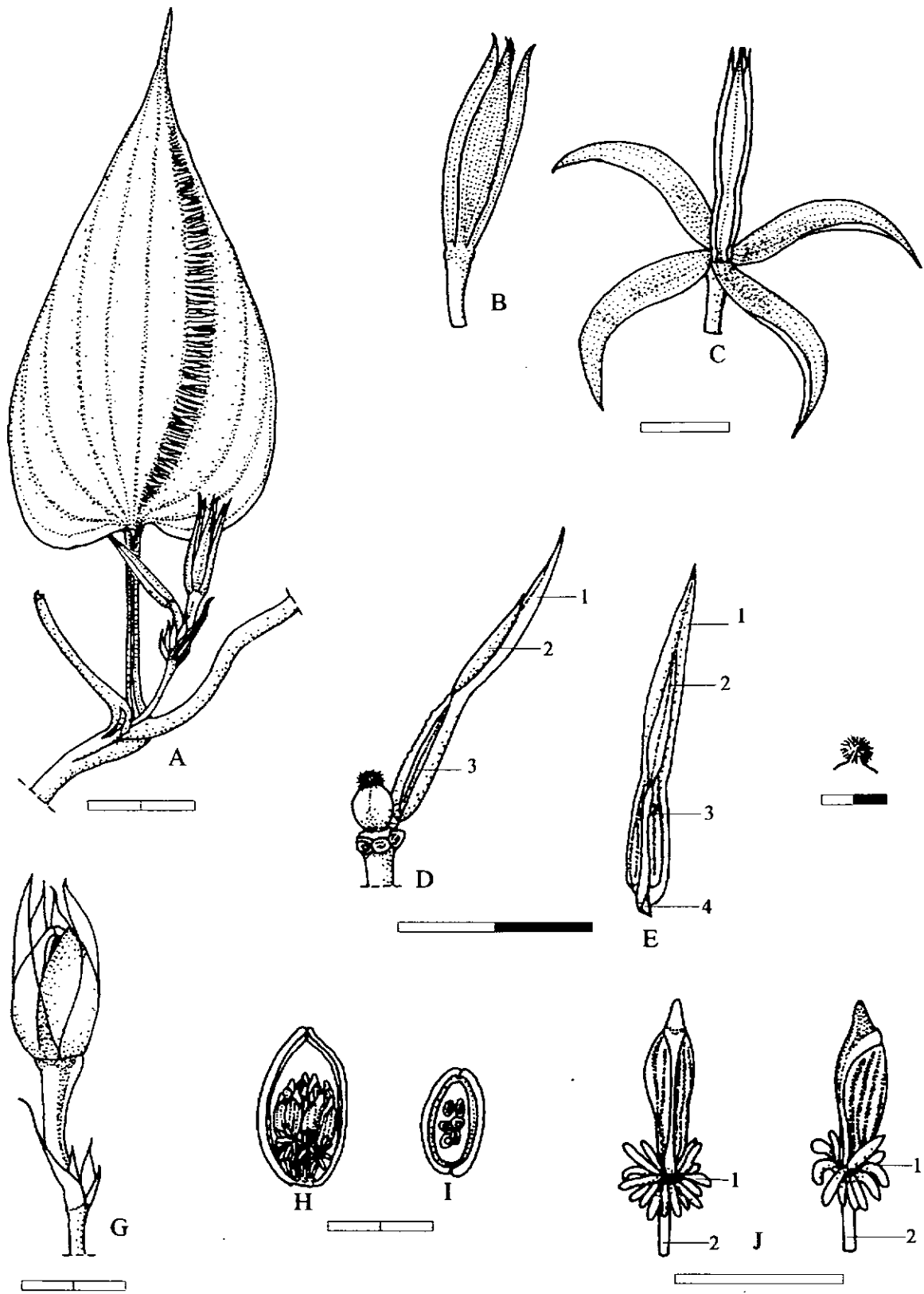
**Specimens:** O. Petritr #16 Flower, 26 May 1997; #83 Fruits, 25 July 1997

**Habitat:** # 16 partly shaded, fire-damaged, very disturbed, damaged area; mixed evergreen+ deciduous, seasonal, hardwood forest; shale bedrock  
# 83 open, fire-damaged; mixed evergreen+deciduous, seasonal, hardwood forest with bamboo; shale bedrock

**Abundance:** 3

**Phenology:** **Flowers:** April-May, **Fruits:** July-August, **Leaves:** May-December

**Elevation:** 450-650 m



**Sample 5. *Stemona burkillii* Prain (Stemonaceae)**

A. upper part of stem; B. flower; C. opened tepals and stamens; D, E. stamen with: 1. connective; 2. crest; 3. anther locule; 4. filaments; 5. pistil; F. stigma; G. capsule; H. opened capsule showing placentation and seeds; I. capsule (x-section); J. seeds with: 1. appendages; 2. finiculus

Scale bars: black and white, 1 mm units; white only, 1 cm units.

**Family:** ORCHIDACEAE

**Botanical Name:** *Habenaria thailandica* Seid.

**Description:** Erect, deciduous, perennial ground herb. Tuber in soil, succulent paired; tan outside, whitish inside; c. 3-5 x 1.5-2 cm. Stems glabrous, light green to pale light greenish. Leaves few, simple, spiral. Blades thin, oblong, tip acute, base rounded and decussate with the sheath, margins shallowly undulate; venation parallel, midrib distinct, secondary nerves 6, glabrous on both sides; upper surface green to dark green, lower surface light green to pale light green; c. 4.5-18 x 2-4 cm. Leaf sheaths dull light green. Inflorescence terminal, racemose; axes finely puberulous, light green. Bracts ovate-lanceolate, 1 per flower, tip acute, margins denticulate, 3-nerved, light green to green; c. 8-22 x 6.5 mm, persistent. Pedicels and ovary light green; c. 2-4 mm long. Flowers numerous, spiral, irregular. Sepals 3, light green to greenish, lateral 2 broadly ovate, tip filiform; c. 1 mm long, denticulate, the upper one, entire, hooded; c. 6-11 x 4-5.5 mm, 3-4 mm long, prominently, 3-nerved, glabrous, tip of sepal hooded acute-aristate. Petals 2, equal, sparsely puberulous, unequally bifid, linear; c. 6-8 x 0.8-1 mm; green outside, greenish with green tip, or white. Spur white with a greenish tip; c. 7-8 x 1-1.5 mm. Lip: epichile linear, white; 6-8 mm long; hypochil unequally bifid on each side lobes linear, lobes 2, similar to and slightly shorter than the epichile: pollinia, erect, light yellow; c. 3 mm long. Operculum caducous, not seen. Stigmas 2, white or white with greenish. Ovary inferior, linear, 1-locule, placentation parietal, ovules numerous, light green; c. 12 x 2.5 mm. Capsules fusiform, light green to green; c. 20 x 5 mm. Seeds numerous with a linear, membranous wing in each side; c. 1 x 0.5 mm.

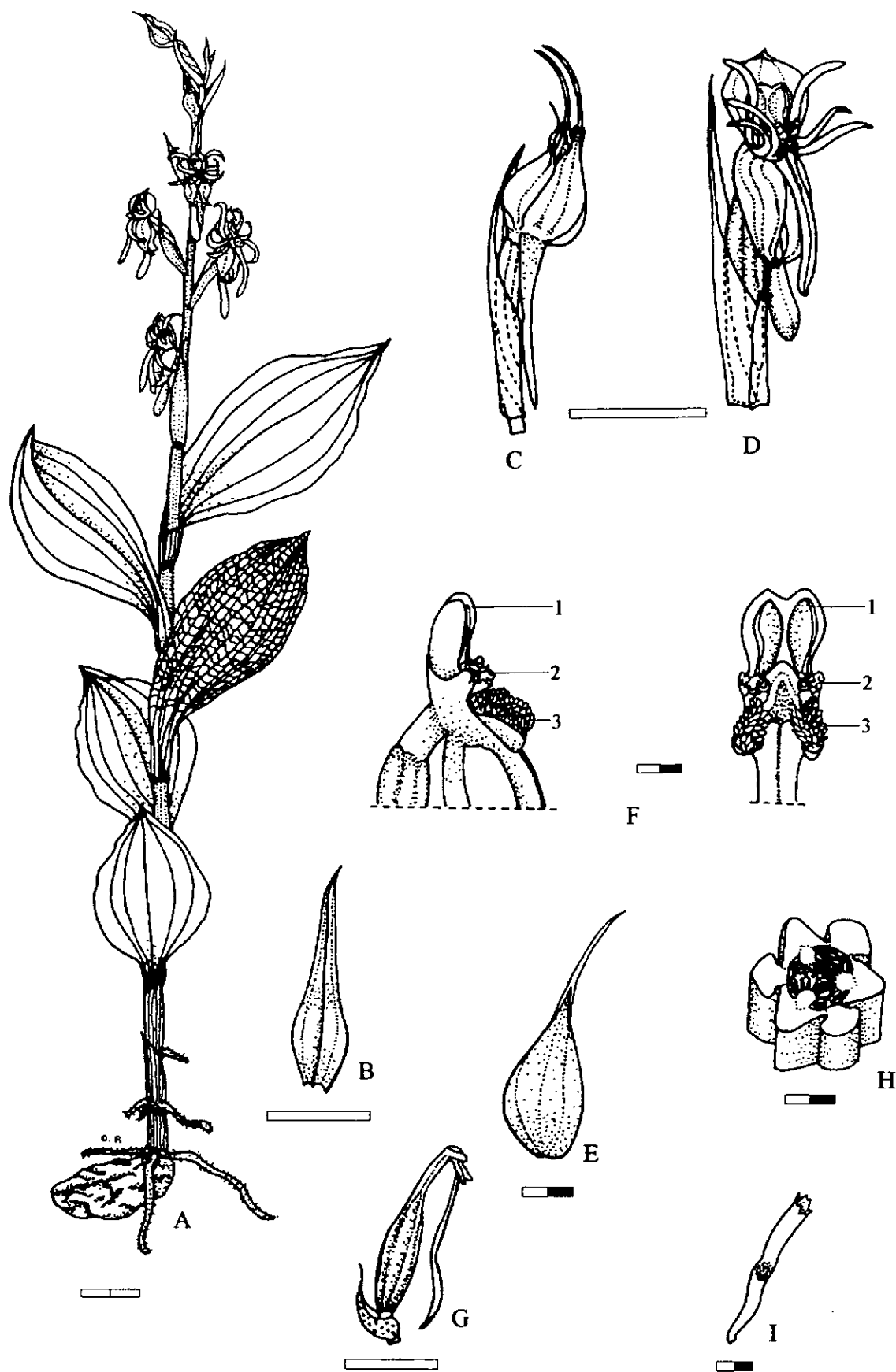
**Specimen:** O. Petrmitr #28 , 25 May 1997

**Habitat:** shaded, disturbed, slopes in, moist area; mixed primary evergreen + deciduous seasonal hardwood forest; shale bedrock

**Abundance:** 2

**Phenology:** **Flowers:** May-June, **Fruits:** October-December, **Leaves:** May-December

**Elevation:** 450-700 m



**Sample 4. *Habenaria thailandica* Seid. (Orchidaceae)**

A. habit; B. bract; C. immature flower; D. mature flower; E. larger lobe of petal; F. detail of column with: 1. anthers; 2. stylodes; 3. stigmas; G. capsule; H. capsule (x-section) with placentation and seeds; I. seed with membranous wing.

Scale bars: black and white, 1 mm units; white only, 1 cm units.



**Family:** ZINGIBERACEAE

**Botanical Name:** *Gagnepainia godefroyi* (Baill.) K. Sch.

**Description:** Erect, deciduous, perennial, ground herb, 16.5-25 cm tall. Roots fusiform to subglobose, tubers tan outside with many roots hairs, white to whitish and aromatic inside; c. 1.3-2.8 x 0.9-1.5 cm. Leafless when in flower, leaves not seen. Sheaths spiral, thin, tip mucronate-mucronulate, margins ciliate, striate parallel veined, outside densely softly puberulous, solitary, glabrous inside; lower sheaths white, upper sheaths light green; c. 0.5-1.5 cm long. Inflorescences from the rhizome. Peduncle spicate, solitary, axis densely softly puberulous, dull to pale light green; c. 13.5-32 cm long. Flowers in the upper ½ numerous, bisexual, zygomorphic, 3-merous, sessile. Calyx thin, tubular, densely softly puberulous outside, glabrous inside; tube c. 8 mm long; calyx lobes linear, tips acute, margins ciliate, upper 2/3 whitish, lower 1/3 pale light green; c. 8 x 3 mm. Corolla tube narrow, outside densely softly puberulous, inside glabrous, whitish to cream outside; c. 1.8 cm long; corolla lobes 3, imbricate in bud, ovate, tip broadly acute, margins sparsely ciliate, densely puberulous outside, glabrous inside, white; c. 10-7 x 4-5 mm; petaloid staminodes 2, unequally and broadly quadrangular-cuneate, tip rounded-truncate, entire with thickened upper margins, finely puberulous on both sides, white to cream with; c. 7-8 x 3.5-4 mm; lip complex; 3-lobed, side lobes petaloid, quadrate, tip truncate, finely puberulous; c. 3.5 x 3 mm; midlobe thickened, linear, apex narrow, horn-like, orange with white appendages, with 2 triangular appendages dorsally, glabrous, light orange upper margin. Fertile stamen 1. Anthers 2-locular, adnate, longitudinally dehiscent; locules orange or dark orange; c. 4 x 1 mm; crest slightly produced, rounded, entire; connective grooved, densely short puberulous inside, otherwise glabrous, whitish. Filament linear, anteriorly grooved, glabrous, with densely shortly puberulous on the middle, lower part sparsely so, white to whitish with base on each side inside with an olive-green dots; c. 10 x 1 mm. Stigma 1, clavate ciliate margins inside, white; c. 0.2 mm long, tip level with the top of the anther locules, glabrous. Style 1, passing between the anther locules, glabrous, white; c. 30 mm long. Ovary inferior, ovoid, 3-angled, densely softly puberulous, whitish; c. 2-4 x 1.5-2 mm, 1-locular or with 3 parietal placetation, 3-carpel, each with numerous ovules. Capsules ovoid, densely softly puberulous, immature light green; c. 13-18 x 5-10 mm. Fertile seeds 3-14 or more, subglobose to ovoid, glabrous, whitish; c. 3.5-4 x 2.5-3 mm; hilum membranous, distinct.

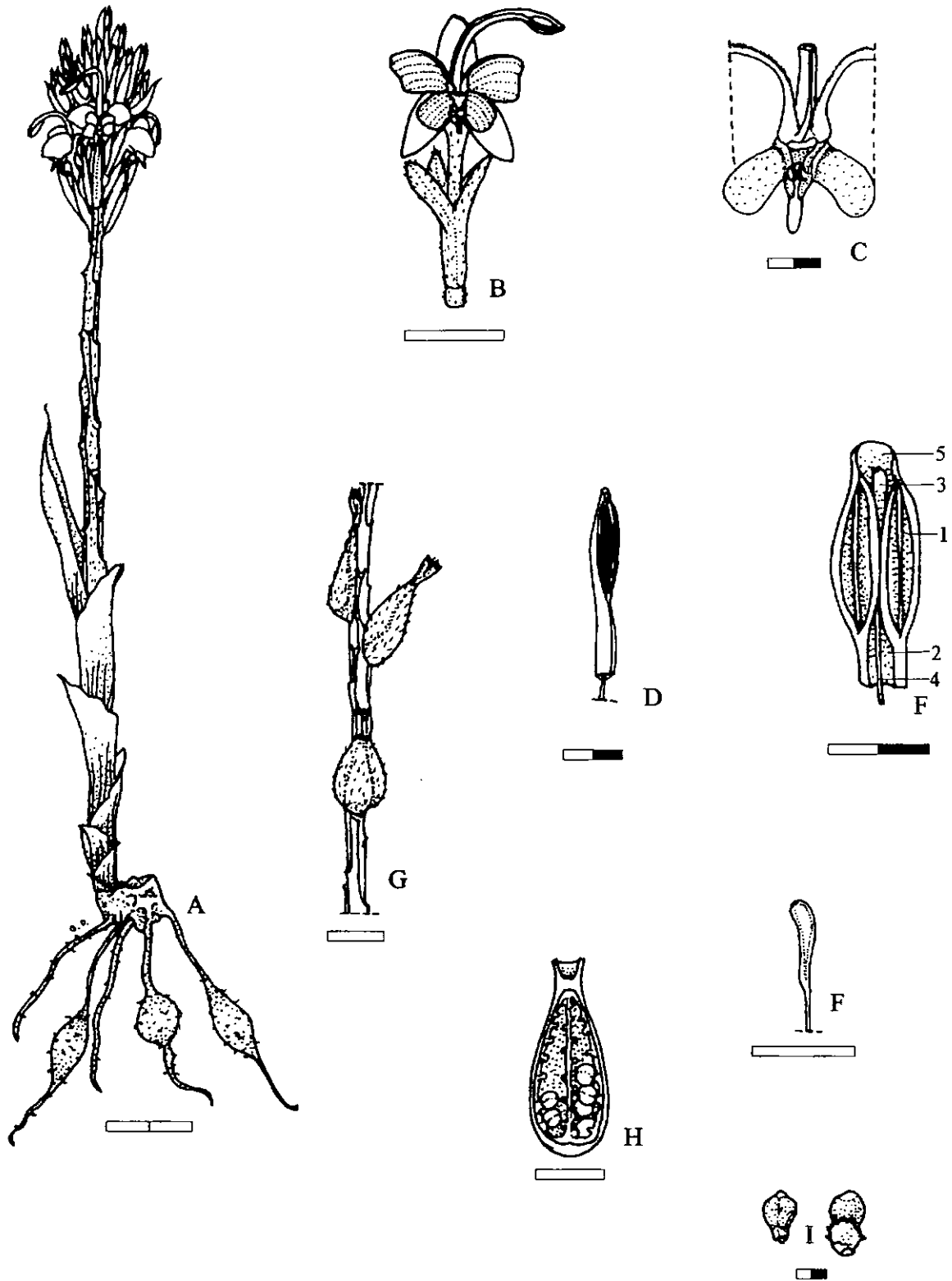
**Specimen:** O. Petrmitr #289, 23 April 1998

**Habitat:** shaded, very disturbed, a presently fire-damaged, burnt, degraded area along dry stream, in seasonal, mixed primary evergreen+deciduous hardwood forest; shale bedrock

**Abundance:** 3

**Phenology:** **Flowers:** April-May, **Fruits:** May-June, **Leaves:** May-November

**Elevation:** 450-700 m



**Sample 3. *Gagnepainia godefroyi* (Baill.) K. Sch. (Zingiberaceae)**

A. flowering habit; B. flower; C. lip part; D. stamen; E. details of: 1. anther locule; 2. filaments; 3. stigmas; 4. style; 5. crest; F. details of stigma; G. infructescence; H. capsule (long-section); showing placentation and seeds; I. seeds.

Scale bars: black and white, 1 mm units; white only, 1 cm units.

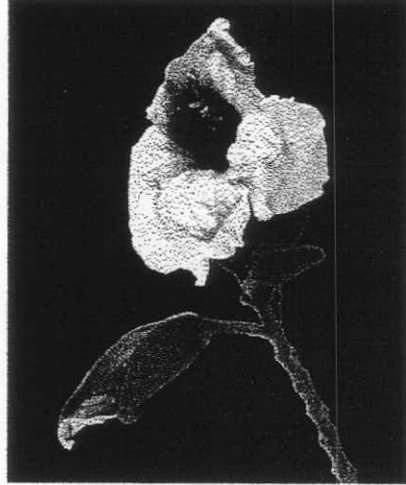
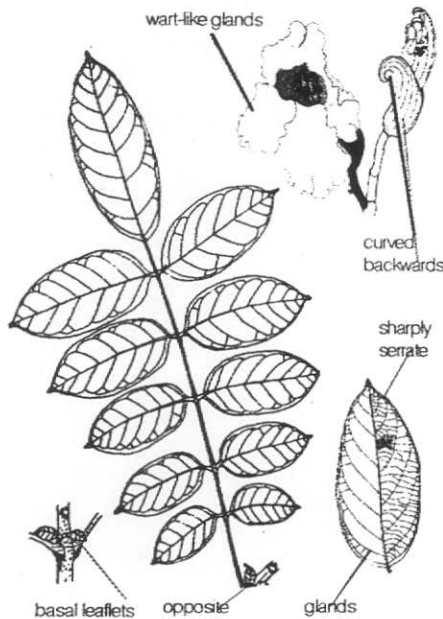
# **Appendix 6.**

## **Sample page of fieldguide**

## *Markhamia stipulata*

BIGNONIACEAE แคหางค่าง

Status	restricted range but locally common
Habitat	deciduous or deciduous/evergreen forest below 1250m.
Flower	January to March
Fruit	September to April
Uses	flower edible, used in kang somand as a dip for nam prik



Crown deciduous or semi-evergreen tree, usually not more than 15m.

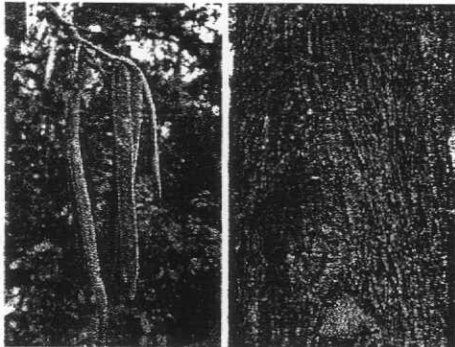
Bark creamy brown, slightly fissured, thin.

Leaf opposite, pinnate, 25-55cm long, 2-5 pairs of leaflets, usually also with staked terminal. Leaflet stalks 3-5 cm, elliptic or narrowly ovate, long-tipped, sharply serrate. Lower surface with indistinct pale brown hairs with sunken glands 2 mm near leaf base. 2 lowest leaflets much smaller than the others, 1.5-3cm, rounded, close to the base of the main stalk so appearing like stipules.

Flower terminal along single stem 14-33 cm long, petals pale cream or brownish-yellow, fused into open-mouthed funnel, 7-10 cm. Outer surface of petals with many large wart-like glands, 2-3mm. Calyx tubular 3.5-5.5 cm long, curved sharply backwards at the tip, without lobes, covered with dense brown hairs.

Fruit densely hairy pods 45-70cm long, straight or slightly curved towards tip, not ridged, splitting lengthways into 2 sections. Seeds rectangular, 3.5 cm, with thin semi-transparent wings on both sides.

**SIMILAR TREE** - *Fernadoa adenophylla* has leaves without teeth, flower calyx with 5 distinct lobes which are not curved backwards & much longer, spirally twisted fruit with 8-10 distinct ridges (see page)



# *Millingtonia hortensis*

BIGNONIACEAE

ปีป

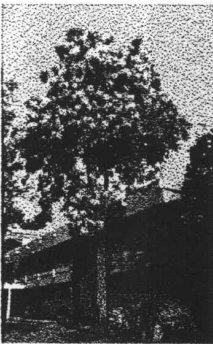
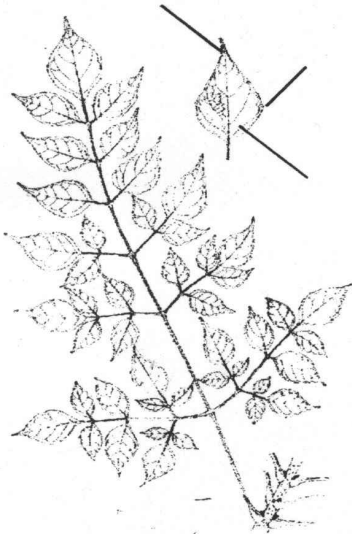
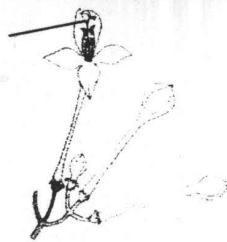
สถานะ พบได้ทั่วไปนิยมปลูกเป็นไม้ประดับ

เขตการกระจาย พบในป่าผลัดใบ/ไม้ หรือในที่โล่ง

ค่อนข้างแล้ง ระดับกว่า 900 เมตร

ดอก กันยายน-ตุลาคม (ไม้ที่ปลูกออกดอก เกือบตลอดปี)

ผล กุมภกัทณฑ์-มีนาคม



ต้น ไม้ต้นผลัดใบหรือไม้ผลัดใบสูงถึง 20 เมตร ลำต้นตรง เรือนยอดเป็นพุ่มแน่น กิ่งห้อยลู่ลง

เปลือก สีเทา มีรอยแตกเป็นร่องลึกไม่เป็นระเบียบหนา 10-15 มิลลิเมตรนุ่มคล้ายไม้คอร์ค เปลือกในสีน้ำตาลครีม

ใบ ใบประกอบ 2-3 ชั้นออกเป็นคู่ ๆ ตรงข้ามกัน ขนาด ยาว 20-60 เซนติเมตร ใบย่อยรูปไข่แกมหอก ขนาด

ยาว 2-3 เซนติเมตร เรียงเป็นแผ่นจากมากไปหาน้อย ที่ปลายใบ ปลายใบแหลม ขอบใบหยักมน ใบสีเขียว

ไม่มีขนหรือมีขนนุ่มที่ท้องของใบอ่อน มีต่อมปุ่มสีเขียว ประปรายใกล้กับโคนใบ ก้านใบย่อยขนาด 0.2-1 เซนติเมตร

ดอก เป็นช่อแผ่กว้างที่ปลายกิ่งขนาด 20-40 เซนติเมตร กลีบดอกเชื่อมติดกันเป็นหลอดสีขาว ปลายแยกเป็น 5 กลีบ

ขนาด 9-11 เซนติเมตร กลีบด้านบน 2 กลีบ เชื่อมติดกันตรงโคน กลีบรองดอกเป็นถ้วยเล็ก ปลายมี

กลีบมนเล็ก ๆ ขนาด 2-4 มิลลิเมตร

ผล ฝักแบนขนาด 30-40 เซนติเมตร เมื่อแก่จะแยกเป็น 2 ส่วน ข้างในมีเมล็ดจำนวนมากติดอยู่กับแกนกลาง

เมล็ดขนาด 1.5 เซนติเมตรมีปีกยาว 2 ปีก

ต้นไม้มากคล้ายกัน *Rasemachera ignea*

เปลือกเรียบกว่าและปลายใบทุก ๆ ขอบใบเรียบ ดอกสีส้ม

# สำรวจความหลากหลายของชนิดพรรณไม้มีท่อและการกระจายของพรรณไม้

## ทางภูมิศาสตร์ ณ อุทยานแห่งชาติดอยหลวง จ. เชียงราย

วิไลวรรณ อนุสารสุนทร<sup>1</sup>, พงษ์อินทร์ รักอริยะธรรม<sup>2</sup>, J. F. Maxwell<sup>1</sup>, Stephen Elliott<sup>1</sup>, รุ่งชล คุณารักษ์<sup>1</sup>,  
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### บทคัดย่อ/สรุปสำหรับผู้บริหาร

หลักการและเหตุผลของโครงการนี้สืบเนื่องจากการจัดการดูแลเกี่ยวกับป่าและความหลากหลายของสิ่งมีชีวิตต่าง ๆ ควรจะอยู่บนพื้นฐานของความรู้ที่ว่า มีพรรณพืชชนิดไหนบ้างที่มีอยู่และมีการกระจายอย่างไร พรรณไม้มีท่อโดยเฉพาะอย่างยิ่งไม้ยืนต้นนับเป็นพื้นฐานของระบบนิเวศของป่าไม้ทั้งหมด ดังนั้นจึงเป็นกรณีที่เหมาะสมในการบ่งชี้ความหลากหลายทางชีวภาพในถิ่นที่อยู่ดังกล่าว

การสำรวจความหลากหลายและการกระจายทางภูมิศาสตร์ของพรรณไม้มีท่อในอุทยานแห่งชาติดอยหลวงมี การพัฒนาขั้นตอนต่าง ๆ 4 ขั้นตอน ดังนี้

1. ตรวจสอบว่ามีพรรณไม้ชนิดใดบ้าง โดยการเดินเก็บตัวอย่างพรรณไม้มีท่อที่พบในบริเวณอุทยาน ได้จัดทำรายชื่อพรรณไม้มีท่อจำนวน 1,155 ชนิด ซึ่งรวมถึงพืชที่มีการพบเป็นครั้งแรกในประเทศไทย ด้วย 2 ชนิดคือ *Tetratigma apiculatum* Gagnep. และ *Polygonatum kingianum* Coll. & Hemse.
2. การพัฒนาวิธีที่ใช้ช่วยในการบ่งบอกชนิดของไม้ยืนต้นเพื่อให้บุคคลที่ไม่ใช่นักอนุกรมวิธาน ใช้ได้ การบ่งบอกชื่อที่ถูกต้องของพรรณไม้เป็นองค์ประกอบที่สำคัญยิ่งของการสำรวจทางนิเวศวิทยา แต่งานนี้มักมีอุปสรรคที่ขาดหนังสือคู่มือที่จะใช้ ดังนั้นจึงมีการรวบรวมข้อมูลเพื่อจัดทำเป็นหนังสือดังกล่าว โดยทำการบันทึก เช่น การถ่ายภาพ วาดรูปลายเส้น วาดรูปสีน้ำ และเขียนบันทึกลักษณะอย่างย่อ ๆ ของพรรณไม้ยืนต้นมากกว่า 400 ชนิด
3. การตรวจสอบว่าในถิ่นที่อยู่แบบใด มีความหลากหลายของพรรณไม้ยืนต้นสูงที่สุด โดยพิจารณาจากอัตราส่วนระหว่างจำนวนทั้งหมดของชนิดพรรณไม้ต่อชนิดพรรณไม้ที่หายาก โดยใช้วิธีวางแปลงสำรวจดาวจำนวน 57 แปลงรวมเนื้อที่ 183 ไร่ พบว่าป่าที่มีความสำคัญที่สุดในอุทยานนี้คือ ป่าดิบชื้นระดับต่ำ (lowland mesic evergreen) ทั้งในแง่ของความหลากหลายของชนิดพรรณไม้ยืนต้น (217 ชนิด, 73.8% ของชนิดทั้งหมด) และในแง่ของค่าของชนิดที่หายาก (56.2% ของชนิดที่หายาก)
4. การตรวจสอบการกระจายทางภูมิศาสตร์และพื้นที่ของป่า ดำเนินการโดยการทำแผนที่ภาคพื้นดินร่วมกับภาพถ่ายระยะไกลจากดาวเทียม ทั้งนี้มีการพัฒนาข้อมูลสารสนเทศภูมิศาสตร์ (GIS) โดยการใช้แผนที่ของสภาพพื้นที่ 1:50,000 ร่วมกับภาพถ่ายทางอากาศ และ ข้อมูลระบบตัวเลขจากดาวเทียม Landsat5 TM ข้อมูลสารสนเทศภูมิศาสตร์นี้นำมาใช้ในการสร้างแผนที่ของชนิดป่าและสภาพป่าในปัจจุบัน มีการตรวจสอบความถูกต้องของแผนที่ดังกล่าวโดยเปรียบเทียบกับแผนที่ภาคพื้นดินในบริเวณ 6 ตำแหน่ง ๆ ละ 12 กม<sup>2</sup> จากการวิเคราะห์ขั้นสุดท้ายภายในเนื้อที่ทั้งหมด 1112.6 ตารางกิโลเมตร (ร้อยละ 92.4 ของพื้นที่อุทยาน) ในจำนวนนี้ร้อยละ 75.2 ของพื้นที่สำรวจเป็นพื้นที่ป่า แต่มีเพียงร้อยละ 33.8 อยู่ในสภาพสมบูรณ์ ป่าดิบชื้นระดับต่ำเป็นป่าที่มีความหลากหลายของชนิดสูงที่สุด มีพื้นที่รวม 53.4 กม<sup>2</sup> (4.6%) บริเวณที่สำคัญที่สุดที่มีความหลากหลายของไม้ยืนต้นอยู่มุมด้านทิศตะวันออกเฉียงใต้ของอุทยาน ส่วนบริเวณอื่น ๆ ที่มีความอุดมสมบูรณ์ของชนิดพรรณไม้มีท่อจะเป็นหย่อมเล็ก ๆ หรือกระจัดกระจายมากเกินไปจนไม่สามารถจะดำรงประชากรที่แข็งแรงให้รอดอยู่ได้ ถ้าไม่มีมาตรการจัดการที่เข้มงวด

ข้อสรุปที่สำคัญของโครงการนี้คือ การใช้วิธีการต่าง ๆ จากสหสาขาวิชาารวมกัน เป็นสิ่งจำเป็นในการที่จะเห็นภาพสถานะที่แท้จริงของความหลากหลายทางชีวภาพในระบบนิเวศอันซับซ้อนของพื้นที่ป่า การใช้วิธีการอย่างใดอย่างหนึ่งเพียงวิธีเดียวไม่สามารถที่จะให้ผลดังกล่าวได้

## Survey of the species diversity and geographical distribution of vascular plants in Doi Luang National Park, Chiang Rai

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### ABSTRACT/EXECUTIVE SUMMARY

The rationale of this project is that management of forest biodiversity should be based on knowledge of what plant species are present and their geographical distribution. Vascular plants, in particular trees, form the basis of all forest ecosystems and are therefore appropriate indicators of the overall biodiversity value of those habitats.

A 4-stage process was developed to survey the diversity and geographical distribution of vascular plants in Doi Luang National Park, Chiang Rai.

1/ Determine which plant species are present through opportunistic collection of all species of vascular plants encountered throughout the park. A total of 1155 species of vascular plants were enumerated, including two new records for Thailand (*Tetrastigma apiculatum* Gagnep., *Polygonatum kingianum* Coll. & Hemsl.).

2/ Develop materials to aid identification of tree species by non-taxonomists. Accurate field identification of tree species is critical to any ecological survey, but is severely hampered by a lack of appropriate identification materials. Photographs, line drawings, watercolor paintings and brief descriptions were compiled for over 400 species in order to assist this process.

3/ Determine which habitats have the highest value, in terms of total tree species present, and the proportion of rare species. Fifty-seven permanent ecological plots were established, covering an area of 29.28 hectares (183 rai). Lowland mesic evergreen forest was the most important habitat in the park both in terms of tree species richness (217 spp., 73.8 % of total spp.) and species rarity value (56.2% of all rare species).

4/ Determine the geographical distribution and fragmentation of forest habitats, using a combination of ground mapping and remote sensing analysis. A Geographical Information System (GIS) was developed using 1:50,000 topographic maps, aerial photographs and Landsat5 TM digital satellite data. This GIS was used to generate maps of forest type and condition which were cross-checked against ground maps in 6 core areas of 12km<sup>2</sup> each. A total of 1112.6km<sup>2</sup> (92.4% of the total area of the park) was included in the final analysis. 75.2 % of the surveyed area supports forest cover, but only 33.8 % of this forested area is in good condition. Lowland mesic evergreen forest, the richest habitat, occupies a total of 53.4km<sup>2</sup> (4.6%). The most important areas for tree diversity are concentrated in the SE corner of the park. Elsewhere, remnant species-rich forest patches are generally too small or too fragmented to maintain viable populations without significant management input.

The most valuable lesson of the project is that a combination of techniques from several disciplines is required to gain a realistic perspective of the biodiversity status of a complex forested landscape. None of the techniques used in isolation could have achieved this result.

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