Final Report
to
The Biodiversity Research and Training Program
(BRT)

Project

Biodiversity Monitoring Plots for Study of Forest Regeneration

แปลงสำรวจความหลากหลายทางชีวภาพ
เพื่อศึกษาการฟื้นตัวของป่า

(BRT R_345002)

Prof. Warren Y. Brockelman, Research Associate, BIOTEC
Ecology Laboratory, BIOTEC Central Research Unit

Final Report to the Biodiversity Research and Training Program
January 2005

Project Title: Biodiversity Monitoring Plots for Study of Forest Regeneration
แปลงสำรวจความหลากหลายทางชีวภาพ เพื่อศึกษาการฟื้นตัวของป่า (BRT R_345002)

Principal Investigator:

Name	Dr. Warren Y. Brockelman
Position	Research Associate, BIOTEC
Institution	BIOTEC/NSTDA, and
	Faculty of Graduate Studies, Mahidol University
Address	Center for Conservation Biology
	ISTRD, Mahidol University
	Salaya, Phuttamonthon 4 Road
	Nakhon Pathom 73170
Telephone	0-24419003-7 ext 1406 or 0-25646700 ext 3203
Facsimile	0-24411013 or 0-25646707
E-mail	wybrock@cscoms.com

Organization Head:

Name	Dr. Ruud Valyasevi
Position	Deputy Director
Institution	BIOTEC/NSTDA
Address	Biotec Central Research Unit
	113 Science Park
	Paholyothin Road, Klong1
	Klongluang, Pathumthani 12120
Telephone	0-25646700
Facsimile	0-25646707

Project Duration: 2 years 3 months (September 1, 2002 – December 31, 2004)

Investigator Team:

1. Name Anuttara Nathalang
   Position Research Assistant
   Institution BIOTEC/NSTDA
   Address Biotec Central Research Unit
   113 Science Park
   Paholyothin Road, Klong1
   Klongluang, Pathumthani 12120
   E-mail anut@biotec.or.th

2. Name Dr. George Gale
   Position Lecturer, Researcher
   Institution King Mongkut's University of Technology Thonburi
   Address School of Bioresources and Technology

83 Moo 8 Thakham, Bangkhumtien
Bangkok 10150
Telephone 0-24709751
Facsimile 0-24523455
E-mail igeogali@kmutt.ac.th

Collaborating Investigators

1. Name Dr. Chawalit Niyomdham
Address Director, Forest Botany Division
Department of National Parks, Wildlife and Plant Conservation
Paholyothin Road, Chatuchak, Bangkok 10900

2. Name Mr. Samrit Vilaipornrattana
Address Director, Phra Phuttachai National Park, Saraburi
Department of National Parks, Wildlife and Plant Conservation
Paholyothin Road, Chatuchak, Bangkok 10900

3. Name Ms. Siriporn Thongaree
Address Bala-Hala Wildlife Research Station,
Natural Resource Conservation Office,
Department of National Parks, Wildlife and Plant Conservation
Paholyothin Road, Chatuchak, Bangkok 10900

4. Name Dr. Edward L. Webb
Address School of Environment, Resource and Development
Asian Institute of Technology
P.O. Box 4 Klongluang
Pathum Thani 12120

Acknowledgements:

This project would not be possible without collaboration from the Department of National Parks, Wildlife, and Plant Conservation. We would like to thank Dr. Chavalit Niyomdham, Director of the Forest Herbarium, Mr. Suwat Kaewsrisuk, Chief of Hala-Bala Wildlife Sanctuary, Miss Siriporn Thongaree, Chief of Wildlife Research Center of Hala-Bala Wildlife Sanctuary, Mr. Samrit Vilaipornrattana, Chief of Phra Phuttachai National Park, and Mr. Prawat Wohandee, Chief of Khao Yai National Park for their assistance and support in our field works. Special thanks to all research assistants; Amnart Boonkongchart, Saiwaroon Boonkongchart, Yuree Siriwas, Wisanu Chongko, Samart Chomchin, Narumon Tantana, Marut Promchua, Somchai Nimnuan, Sirinan Wongwigkarn, Sukanda Jotikapukkana, Wirong Chantorn, Chanpen Wongsriphuek, Yingluck Rattanapongsai, Pachanee Panrangsri and Dum Semapakdee for their assistance to help fulfill this project requirements. We would also like to take this opportunity to thank Mr. J.F. Maxwell for plant idention and On-uma Petrmitr and Sumonta Korkaew for their herbarium assistance and contributions. Finally, this work has been supported by TRF/BIOTEC special program for Biodiversity Research and Training grant BRT R_345002.

Abstract:

Many disturbed forests in Thailand are now regenerating. This provides good opportunity for the project to set up permanent plots in several areas for long term monitoring of biodiversity. In the first phase of the project, 3 sites were selected: Hala-Bala Wildlife Sanctuary, Phra Phuttachai National Park, and 1-ha secondary forest at Mo Singto, Khao Yai National Park. The Bala and Phra Phuttachai plots are 4 hectares in area. However, the methodology of plot establishment is the same as large plots in the world and the 30-ha Mo Singto forest dynamics plot. So far the plot establishment at Bala is almost completed. It is in the tree census process. For the Phra Phuttachai plot is in process of plot survey only and we have some problems of survey markers missing and inadequate manpower. For the 1-ha secondary forest at Mo Singto, it is a part of thesis which will be completed and available in March 2005. Although establishment of the plots are not completed, we already started collecting plant specimens for learning all species. This will be very important and useful for plant identification on the plots. Besides, all data of tree census and herbarium are basically stored in MS Access at the Ecology Laboratory, BIOTEC. Last but not least, this project needs to be continued in phase-II to complete the inventory of plants and start preliminary survey of wild life and other specific topics. This will increase knowledge of biodiversity and promote biodiversity conservation and management.

Content:

List of Tables:

List of Figures:

Introduction:

During the past few decades, most of the forests in Thailand were disturbed or logged for a variety of reasons beyond our comprehension. In retrospect, many species of wildlife and plants have been lost in these forests. Presently, these forest areas are regenerating again and are governed as well as under the protection of the Department of National Parks, Wildlife, and Plant Conservation. This provides good opportunity for us to set up permanent plots for long term monitoring of biodiversity in these secondary forests. As our research team has experience from setting up the 30 ha Mo Singto Forest Dynamics Plot, Khao Yai National Park with the same methodology of plot establishment of large plots (50-ha) in the world, we started establishing at least two 4-ha plots at Hala-Bala Wildlife Sanctuary and Phra Phuttachai (Sam Lan) National Park which began regeneration about 30 years ago. Also each site represents a different forest and climate type. These are suitable for study of species composition, forest succession and the need for forest management. Besides, this project will be supported with available taxonomic expertise in plant identification as well as computer programs for storage and analysis of data.

Project Objectives:

1. Establish at least two 4-ha forest dynamics plots for the inventory of biodiversity and study of forest regeneration including monitoring of weather.

2. Study forest tree and liana growth and succession on the Mo Singto forest dynamics plot in Khao Yai Park and on the 4-ha plots.

3. Evaluate the extent to which mammals and birds utilize secondary forest.

4. Evaluate the role of vertebrate seed dispersers in secondary forest regeneration.

Methods and Techniques:

1. Site Selection

   The criteria of the site selection include topography, easy accessibility, security, forest condition and structure (disturbed or logged area), etc. Subsequently field survey follows with the measurements of the 4-ha plot area. With the aid of compass and measuring tapes, the square shape 200 x 200 metres plot and its centre point will be determined. This centre point is the starting point of plot survey. These measurements are very important because we will know the plot area whether they covers all the above-mentioned criteria for establishing a plot. After making decision of the site location, the research proposal needs to be approved by the Department of National Parks Wildlife and Plant Conservation, the land management authority.

2. Plot Establishment

   2.1 *Plot survey*: the methodology of 4-ha plot survey is the same standard as the large forest dynamics plots (Manokaran et al,1990, Condit, 1998), eg.

Barro Colorado Island in the Panama Canal Zone, or the Mo Singto Plot at Khao Yai National Park. The plot was survey into 20-m square quadrats, beginning near the center of the plot and working outwards. A digital theodolite was used for making sighting and reading horizontal and vertical angles. The ground distance was calculated from the vertical angle and the horizontal angle is for the aiming direction. After that, the surveyed point was marked with the permanent plastic stake displaying row and column numbers of quadrat.

2.2 *Plant census*: this started after the completion of plot survey. All woody stems with 1 cm dbh (diameter at breast height = 1.3 m from the base) were measured, tagged, and mapped. The methodology of census also followed the large forest dynamics plots around the world and the first tree census of Mo Singto Plot. A 20-m square quadrat is divided into 5x5 m subquadrats. This is useful to map the tree location with x and y coordinates.

3. Plant Collection and Identification

Plant collection started as early as the site selection because we need to know all species and identify all stems on plot. Reproductive materials of every species need to be collected for reference. However, vegetative materials are also important for learning how to do rapid identification in the field. The field identification has to be done during census too. If any tree cannot be identified, vegetative materials need to be collected to compare with the referencing specimens in the herbarium. Also it is given arbitrary names such as unknown #1, polyalthia#4, etc until a plant taxonomist can identify it.

All specimens of reproductive materials must be treated by either heating them in an oven at approximately 80°C for 2-3 days or deep-freezing them at –30°C for 3 days. This treatment is sufficient to eliminate all insect pests. Then the specimens must be mounted, labeled, and stored in the BIOTEC herbarium where is climate-controlled. Besides, duplicates of these specimens will be distributed to other herbaria, such as BKF, CMU herbarium, etc. A specimen label is produced by the program which is developed on MS Access.

4. Database and GIS

All census data are in the program files which Mr. Supakit Wanasith developed on MS Access. However, these files will be separated by plot names. In the field, a researcher collects and input data into a Palm which Mr. Aekasit Pacharawongsakda, a programmer of BIOTEC, has designed the interfacing software, Plot Database. After the data is in MS Access, it is easy to be converted to a dbf file for GIS to produce maps. Not only the census data has to be in the database, but the herbarium database is also developed for specimen labels.

Results:

1. Site Selection

In 2002, 3 study areas were visited, Hala-Bala Wildlife Sanctuary, Phra Phuttachai (Sam Lan) National Park, and Mo Singto/ Khao Yai National Park. The sites of these 3 plots have already been selected, including the research permission from the Department of National Park.

2. Plot Establishment

2.1 *Plot survey*: The first 4-ha plot survey was completed at Hala-Bala Wildlife Sanctuary in April 2003. The plot was surveyed into 20x20 m quadrats with a total size of 100 quadrats (100x100 m = 1 hectare), by using digital theodolite equipment. Figure 1 shows all quadrats of the 4- ha plot.

At the Phra Phuttachai National Park (Sam Lan), the 4-ha plot is still in the process of survey. We could have completed earlier if not for the missing nails that were used to mark the points of quadrat corners. We suspected poachers might have removed them since the plot location is not far from the trail and stream. Nonetheless, we have to re-survey again but at this moment, we do not have manpower from AIT, who collaborated with us on this project.

2.2 *Tree census*: this process includes measuring, tagging and mapping plants on plots. At the Bala plot, the plant census of 70 quadrats has been done and another 30 quadrats are only in tagging process. These 30 quadrats are planned to be completed in May 2005. The update total stems are 13,091. Figure 2 shows trees on the 4-ha Bala plot. However, liana is not included. Since tagging and mapping lianas is more complicated and takes more time, we plan to do its census after completion of tree census. Upon completion of all woody stems mapping, we need to re-check the tree on the map and field to determine whether it is on the correct location. Figure 3 is a tree map with tree id. This map and detail of every tree on a quadrat will be printed out from MS Access to be used for the re-checking on the field. Table 1 is a report of detail of every tree on a quadrat.

3. Plant Collection and Identification

Identification of plants on the Bala plot has not started yet because plants at Bala are different from Mo Singto plot. We can identify family and genus, but not the species. Therefore, we have to wait until that species have flowers and fruits. After tree mapping, we will concentrate more on identification. However, we have been collecting many specimens for learning all species. Table 2 shows a list of plant species at Bala Wildlife Sanctuary. So far 253 specimens from the Bala plot are in the BIOTEC herbarium. They were identified into 60 families, 134 genera, and 187 species.

At Phra Phuttachai National Park, we started to collect many specimens although the plot establishment is not completed yet. Table 3 shows a list of plant species at Phra Phuttachai National Park. There are 108 specimens in the herbarium. They were identified into 39 families, 91 genus, 102 species, and 1 unknown species. This identification of specimens will help us to work faster during field identification.

4. 1-ha Plot of Secondary Forest in Khao Yai National Park

This plot is at the north of Mo Singto original plot (figure 4). It is a part of thesis of M.Sc. student, Miss Supreeda Tangprasertsri, on the title "Secondary Succession of Tropical Seasonal Evergreen Forest: Species Composition and Dispersal at Mo Singto, Khao Yai National Park, Thailand". Her thesis will be completed and available in March 2005. The methodology of plot establishment is the same as the 4-ha plots and the Mo Singto long term ecological research plot. The census of all plants with dbh $\geq$1 cm was completed. Total number of plants is 9,383 stems of 74 species. Table 4 is a list of species on 1-ha secondary forest plot.

5. Database an GIS

Collecting data in the field, Mr. Aekasit Pacharawongsakda, a programmer of BIOTEC, has designed an interfacing software, Plot Database, on a handheld or palmtop device. This device is a very useful and handy field tool where all data input into it, can be downloaded as shown as an example in Figure 5 and 6. Figure 7 and 8 show data-inputting pages. When a researcher input details of individual tree, including x and y coordinates, a tree location can be displayed on the map immediately. This helps the accuracy of tree mapping in the field. Besides, the palmtop helps to calculate x and y coordinates of a subquadrat to be x and y coordinates of the plot. The complied data from the palmtop can be transferred to a notebook/desktop computer and directly into the database in MS Access.

All tree data from the plot will be kept in the database based on the Microsoft Access platform. Figure 6 and 7 is an example of the Bala plot database on MS Access. From this database, especially with the plot x and y coordinates, maps are produced by ArcView/GIS as shown in figure 2 and 3. GIS will help in spatial analysis; species distribution, quadrat maps, relation between contour and species, topographic illustration, etc.

Discussion:

This project was a follow-up of an earlier BRT project on the improvement of methodology for the establishment of permanent forest biodiversity plots. The methodology is now reasonably well established, and this project seeks to use it to establish at least 2 more plots using located in parks, in collaboration with local institutes or conservation units. The objectives of these particular plots are to provide inventories of the species of plants growing in intensively mapped areas, and study the regeneration of forest in these places. All 3 areas reported here are in various stages of regrowth after logging (Phra Phuttachai and Bala) or secondary succession

from a burned field (Mo Singto). These areas are representative of large areas of Thailand that have been logged or degraded in the past. The results should therefore be typical of what is occurring in large areas of Thai forests. The plots will also provide opportunities to study plant-animal relations and the redevelopment of the animal community as well as the vegetation.

Progress in two of the plots has been slower than expected, mostly due to problems in finding the manpower to complete the job of survey and inventory. The most serious trouble has been with the Phra Phuttachai plot because students with time to do concentrated work have not yet been available. The survey has to be restarted so that it can be completed without any pauses or work stopages. Personnel were not able to carry out the survey on weekends because interrupting the work caused errors and inconsistencies in sighting and tape measurements. Vandalism by local villagers or other visitors also seems to be a problem. The Bala plot has been surveyed and mapping is nearly complete. This plot will be difficult to complete because of the large number of species in this lowland tropical rainforest. Not all species are yet known but collecting will continue. The 1-ha secondary forest plot at Mo Singto is now complete, and identification of species was easy because of the large Mo Singto plot adjacent.

An additional plot was proposed to be located on the Sai Yok campus of Mahidol University, but the area is not easily accessible because the university has not completed the roads up the hill to the area selected for the plot. Nevertheless, botanical collecting has been initiated there with support form Mahidol University.

These plots are long-term projects and extensions of the project will be required to complete all of them, especially the plot at Phra Phuttachai National Park. This plot is particularly interesting because it lies on an ecotone between deciduous and dry evergreen forest.

Problems occurring during the project:

1. Manpower: there are 3 small permanent plots on this project, but the manpower is inadequate for working on all plots. Although we tried to collaborate with the Asian Institute of Technology (AIT), so far we have not been able to obtain efficient time for the students. Theoretically, the 4-ha plot survey takes about 2 weeks to complete. However, most students can only spend some days to work on the survey during the weekend but survey work needs to be carried out continuously for a week at a stretch according to our project schedule. Besides, the survey markers have become lost and we have to start all over again.

2. Time frame: not only manpower is inadequate, but also the time frame of work is very tight. Particularly in the process of tree census, it took longer time than expected. For example, all woody stems have to be measured, tagged, and mapped as this includes trees, treelets, shrubs, lianas. Therefore, in the phase-I we have to postpone the liana census. The liana census is more complicated than tree census because liana has genets rooting stem in the ground and ramets climbing up host trees. So the methods of census will be different and more time consuming.

3. Plant identification: flora of three permanent plots is different. To identify species on plots, we need to collect more specimens from every plot, particularly reproductive materials.

4. Situation in the south of Thailand: there is still continuing violence in the south of Thailand. It does not seem to abate but on the contrary, the situation is getting worse. Last year, we have to postpone a few trips to Bala Wildlife Sanctuary because of terrorist incidents and reports. However, we do hope the situation will be better after the new election.

5. Promoting for more interest: we should get more interest from other laboratories at BIOTEC to study plants, organism and other products since the long term research plots in forests have the purpose of inventory of biodiversity, facilitating natural product research, and promoting ecological research on population and communities.

Solution:

We need to work continuously according to plan and progress work on one plot at a time

- At the Bala plot, we have to spend the entire 2 months to complete census and perhaps one more month for plant identification or naming of trees on the plot and it needs to be conducted before the rainy season.
- At the Phra Phuttachai plot, the plot survey needs to start all over again. This will take a further 2 weeks to complete. Then subsequently another 2 months for tree census and finally, one more month for plant identification.

Personnel and Administration:

In the first year report, one field research assistant, Mr. Samart Chomchin, resigned at the end of January, 2003.

At the end of February, 2003, Miss Narumon Tantana, research assistant at Hala-Bala Wildlife Sanctuary, resigned.

In June, 2003 Mr. Marut Promchua (M.Sc) commenced work with Biotec as a research assistant. He was stationed at the Hala-Bala Wildlife Sanctuary and has also resigned at the end of April 2004. There is still no replacement for him yet.

2 field research assistants (B.Sc), Mr. Wisanu Chongko and Miss Yuree Siriwas, have joined us since 1st February 2004. They have already signed a one-year contract with us. Their contracts will be renewed from the budget of Phase-II project.

References:

Brockelman, W. Y. 1998. Long term ecological research plot for the study of animal diets in Khao Yai National Park, Pages 307-310 *in* P. Poonswad (ed.) The *Asian Hornbills: Ecology and Conservation. Thai Studies in Biodiversity*, No. 2.

Brockelman, W. Y. and P. Charoenchai. 1999. Khao Yai forest dynamics plot established in gibbon study site. *Inside CTFS*, Summer 1999, p. 9 Center for Tropical Forest Science, Smithsonian Tropical Research Institute, Washington, D.C.

Condit, R. 1995. Research in large, long-term tropical forest plots. *Trend Ecol. Evol.* 10: 18-22.

Condit, R. 1998. *Tropical Forest Census Plots: Methods and Results from Barro Colorado Island, Panama and a Comparison with Other Plots.* Springer-Verlag, Berlin Heidelberg.

Dallmeier, F., editor. 1992. Long-term monitoring of biological diversity in tropical forest areas: methods for establishment and inventory of permanent plots. *MAB Digest* 11, UNESCO, Paris.

Heywood, I., S. Cornelius, and S. Carver. 2002. *An Introduction to Geographical Information Systems.* Pearson Education Limited. England.

Hubbell, S. P. 1979. Tree dispersion, abundance, and diversity in a tropical dry forest. *Science* 203: 1299-1309.

Hubbell, S. P. 1980. Seed predation and coexistance of trees species in tropical forests. *Oikos* 35: 214-229.

Hubbell, S. P., R. Condit and R. B. Foster. 1991. Presence and absence of density-dependence in a neotropical tree community. *Proc. Roy. Soc.* London B 330: 269-281.

Johnston, C. A. 1998. *Geographic Information Systems in Ecology.* Blackwell Science. UK.

Lee, H. S., P. S. Ashton, and K. ogino, editors. 1995. *Reports of a New Program for Promotion of Basic Sciences Studies of Global Environment Change with Special Reference to Asia and Pacific Region*, Vol. II-3: Long Term Ecological Research of Tropical Rain Forest in Sarawak. Ehime University, Matsuyama.

Losos, E. C. and E. G. Leigh, Jr., editors. 2004. *Tropical Forest Diversity and Dynamism: Finding from a Large-Scale Plot Network.* The University of Chicago Press. Chicago.

Manokaran, N., J. V. LaFrankie, K. M. Kochummen, E. S. Quah, J. E. Klahn, P. S. Ashton, and S. P. Hubbell. 1990. Methodology for the Fifty Hectare Research Plot at Pasoh Forest Reserve. Forest Research Institute Malaysia, *Research Pamphlet* No. 104, Kepong, Malaysia.

Maxwell, J. F. 1977. Vascular Flora of Sam Lan Forest Park, Muang District, Saraburi Province, Thailand. *Thai Forest Bulletin* 10: 47-110.

Okuda, T., N. Manokaran, Y. Matsumoto, K. Niiyama, S. C. Thomas, and P. S. Ashton, editors. 2003. *Pasoh: Ecology of a Lowland Rain Forest in Southeast Asia.* Springer-Verlag. Tokyo.

Table 1: A report of trees on a quadrat "04-00" showing details of each tree.

tree census

quadrat	*tree id*	*x*	*y*	*DBH1*	*DBH2*	*DBH3*	*stem status 1*	*stem status 2*	*stem status 3*
04-00									
	040001	81.53	1.37	6.9	5.9	0	Standing	Normal	Healthy
	040002	81.47	1.20	3.9	0	0	Standing	Normal	Healthy
	040003	81.35	1.61	3.8	0	0	Standing	Normal	Healthy
	040004	82.53	1.77	7.0	0	0	Standing	Normal	Healthy
	040006	80.54	8.27	2.0	0	0	Standing	Normal	Healthy
	040007	82.81	6.81	2.6	0	0	Standing	Normal	Healthy
	040008	83.13	6.76	2.4	0	0	Standing	Normal	Healthy
	040009	84.00	6.08	1.2	0	0	Standing	Normal	Healthy
	040010	84.50	6.06	1.6	1.0	0	Standing	Normal	Healthy
	040011	84.15	8.16	4.0	2.1	0	Standing	Normal	Healthy
	040012	84.22	8.26	1.1	0	0	Standing	Normal	Broken_below
	040013	82.74	6.37	1.3	0	0	Standing	Normal	Healthy
	040014	82.45	9.15	15.3	0	0	Standing	Normal	Healthy
	040015	82.21	9.21	2.0	0	0	Standing	Normal	Healthy
	040016	81.96	9.75	2.9	0	0	Standing	Normal	Healthy
	040017	80.45	8.60	1.1	0	0	Standing	Normal	Healthy

Table 2: A list of plants at Bala Wildlife Sanctuary.

Family	Botanical Name
ACANTHACEAE	*Gymnostachyum* sp.
ANACARDIACEAE	*Buchanania sessifolia* Bl.
ANNONACEAE	*Anaxagorea javanica* Bl. var. *javanica*
ANNONACEAE	*Artabotrys* sp.
ANNONACEAE	*Cyathostemma longipes* Craib
ANNONACEAE	*Desmose dasymachalus* (Bl.) Saff.
ANNONACEAE	*Desmose* sp.
ANNONACEAE	*Enicosanthum membranifolium* Sincl.
ANNONACEAE	*Enicosanthum* aff. *macranthum* (King) Sincl.
ANNONACEAE	*Friesodielsia* aff. *latifolia* (Hk. f. & Th.) Steen.
ANNONACEAE	*Meiogyne virgata* (Bl.) Miq.
ANNONACEAE	*Monocarpia eneura* Miq.
ANNONACEAE	*Orophea hirsuta* King
ANNONACEAE	*Polyalthia asteriella* Ridl.
ANNONACEAE	*Polyalthia cauliflora* Hk. f & Th. var. *desmantha* (Hk. f. & Th.) Sincl.
ANNONACEAE	*Polyalthia hookeriana* King
ANNONACEAE	*Polyalthia lateriflora* (Bl.) Miq.
ANNONACEAE	*Polyalthia sclerophylla* Hk. f. & Th.
ANNONACEAE	*Polyalthia* sp.
ANNONACEAE	*Pseuduvaria* sp.
APOCYNACEAE	*Tabernaemontana peduncularis* Wall.
ARALIACEAE	*Schefflera oxyphylla* (Miq.) R. Vig.
ASCLEPIADACEAE	*Cynanchum ovalifolium* Wight
BEGONIACEAE	*Begonia isopteroidea* King
BIGNONIACEAE	*Pajanelia longifolia* (Willd.) K. Sch.
BIGNONIACEAE	*Radermachera glandulosa* (Bl.) Miq.
BURSERACEAE	*Sanatria laevigata* Bl.
CELASTRACEAE	*Bhesa robusta* (Roxb.) Hou
CELASTRACEAE	*Euonymus cochinchinensis* Pierre
CELASTRACEAE	*Euonymus indica* Hey. *ex* Wall.
CELASTRACEAE	*Microtropis* aff. *discolor* (Wall.) Wall. *ex* Arn.
CELASTRACEAE	*Microtropis valida* Ridl.
CELASTRACEAE	*Salacia chinensis* L.
CELASTRACEAE	*Salacia macrophylla* Bl.
COMBRETACEAE	*Combretum latifolium* Bl.
COMMELINACEAE	*Sphatholirion ornatum* Ridl.
CONNARACEAE	*Agelaea trinervis* (Llanos) Merr.
CONVOLVULACEAE	*Argyreia sphaerocephala* (Prain) Hoogl.
CRYPTERONIACEAE	*Crypteronia paniculata* Bl. var. *paniculata*
DENNSTAEDTIACEAE	*Microlepia ridleyi* Copel.
EBENACEAE	*Diospyros toposia* Ham. var. *toposioides* (King & Gamb.) Pheng.
EBENACEAE	*Diospyros wallichii* King & Gamb. *ex* King
ELAEOCARPACEAE	*Elaeocarpus floribundus* Bl. var. *floribundus*
ELAEOCARPACEAE	*Elaeocarpus stipularis* Bl. var. *stipularis*
ELAEOCARPACEAE	*Elaeocarpus* sp.
EUPHORBIACEAE	*Antidesma tomentosum* Bl. var. *tomentosum*
EUPHORBIACEAE	*Baccaurea ramiflora* Lour.
EUPHORBIACEAE	*Bridelia insulana* Hance
EUPHORBIACEAE	*Croton argyratus* Bl. var. *argyratus*
EUPHORBIACEAE	*Erismanthus obliquus* Wall. *ex* M.-A.
EUPHORBIACEAE	*Galearia fulva* (Tul.) Miq.
EUPHORBIACEAE	*Glochidion rubrum* Bl.
EUPHORBIACEAE	*Glochidion wallichianum* M.-A.

EUPHORBIACEAE	*Macaranga denticulata* (Bl.) M.-A.
EUPHORBIACEAE	*Mallotus macrostachyus* (Miq.) M.-A.
EUPHORBIACEAE	*Microdesmis caseariifolia* Pl.
EUPHORBIACEAE	*Phyllanthus* sp.
EUPHORBIACEAE	*Pimelodendron griffithianum* (M.-A.) Bth.
EUPHORBIACEAE	*Trewia nudiflora* L.
FAGACEAE	*Lithocarpus* sp.
FLACOURTIACEAE	*Hydnocarpus castanea* Hk. f. & Th.
FLACOURTIACEAE	*Hydnocarpus wrayi* King
FLACOURTIACEAE	*Ryparosa acuminata* Merr.
JUGLANDACEAE	*Engelhardia spicata* Lechen. *ex* Bl. var. *spicata*
GESNERIACEAE	*Aeschynanthus radicans* Jack
GESNERIACEAE	*Chirita caerulea* R. Br.
GESNERIACEAE	*Cyrtandra patula* Rild.
GRAMINEAE	*Pogonatherum paniceum* (Lmk.) Hack.
GRAMINEAE	*Scrotochloa* (*Leptaspis*) *urceolata* (Roxb.) Jud.
GUTTIFERAE	*Gracinia atroviridis* Griff. *ex* T. And.
LAURACEAE	*Alseodaphne* sp.
LAURACEAE	*Endiandra* sp.
LAURACEAE	*Litsea* aff. *umbellata* (Lour.) Merr.
LAURACEAE	*Litsea johorensis* Gamb.
LAURACEAE	*Litsea* sp.
LAURACEAE	*Phoebe tavoyana* (Meissn.) Hk. f.
LECYTHIDACEAE	*Barringtonia acutangula* (L.) Gaertn. ssp. *spicata*(Bl.) Pay.
LEEACEAE	*Leea indica* (Burm. f.) Merr
LEGUMINOSAE, Caesalpiniodeae	*Bauhinia bassacensis* Pierre *ex* Gagnep.
LEGUMINOSAE, Caesalpiniodeae	*Bauhinia integrifolia* Roxb. ssp. *integrifolia*
LEGUMINOSAE, Caesalpiniodeae	*Saraca declinata* (Jack) Miq.
LEGUMINOSAE, Caesalpiniodeae	*Saraca indica* L.
LEGUMINOSAE, Mimosoideae	*Archidendron bubalium* (Jack) Niels.
LEGUMINOSAE, Mimosoideae	*Parkia speciosa* Hassk.
LILIACEAE	*Tupistra grandis* Ridl.
LOGANIACEAE	*Fagraea ceilanica* Thunb.
MALVACEAE	*Hibiscus macrophyllus* Roxb. *ex* Horn.
MARATTIACEAE	*Blastus borneensis* Cogn.
MELASTOMATACEAE	*Clidemia hurta* (L.) D. Don
MELASTOMATACEAE	*Dissochaeta gracilis* (Jack) Bl.
MELASTOMATACEAE	*Dissochaeta monticola* Bl.
MELASTOMATACEAE	*Macrolenes nemorosa* (Jack) Bakh. f.
MELASTOMATACEAE	*Oxyspora exigua* (Jack) Maxw.
MELASTOMATACEAE	*Oxyspora stellulata* King
MELASTOMATACEAE	*Sonerila moluccana* Roxb.
MELIACEAE	*Aglaia barbatula* Koord. & Val.
MELIACEAE	*Chisocheton ceramicus* (Miq.) C. DC.
MELIACEAE	*Chisocheton macrophyllus* King ssp. *fulvescens* Mabb.
MELIACEAE	*Drysoxylum alliaceum* (Bl.) Bl.
MELIACEAE	*Drysoxylum cauliflorum* Hiern
MELIACEAE	*Dysoxylum densiflorum* (Bl.) Miq.
MELIACEAE	*Dysoxylum excelsum* Bl.
MELIACEAE	*Dysoxylum papolliosum* King
MORACEAE	*Ficus annulata* Bl.
MORACEAE	*Ficus fistulosa* Reinw. *ex* Bl. var. *fistulosa*

MORACEAE	*Ficus fulva* Reinw *ex* Bl.
MORACEAE	*Ficus grossularioides* Burm. f. var. *grossularioides*
MORACEAE	*Ficus hispida* L. f. var. *hispida*
MORACEAE	*Ficus lepicarpa* Bl.
MORACEAE	*Ficus nervosa* Hey. *ex* Roth. var. *nervosa*
MORACEAE	*Ficus ribes* Reinw. *ex* Bl.
MORACEAE	*Ficus* sp.
MORACEAE	*Ficus tinctoria* Forst. f. ssp. *gibbosa* (Bl.) Corn. var. *gibbosa*
MORACEAE	*Streblus taxoidea* (Hey. *ex* Roth) Kurz
MYRISTICACEAE	*Horsfieldia brachiata* (King) Warb.
MYRISTICACEAE	*Horsfieldia sparsa* Widl.
MYRISTICACEAE	*Knema laterica* Elm. ssp. *ridleyi* (Gand.) Wilde
MYRISTICACEAE	*Knema pseudolaurina* Wilde
MYRSINACEAE	*Ardisia furva* Ridl.
MYRSINACEAE	*Ardisia labisaefolia* King & Gamb.
MYRSINACEAE	*Ardisia porosa* Cl.
MYRSINACEAE	*Ardisia puberula* Flet.
MYRSINACEAE	*Embelia coriacea* Wall. *ex* A. DC.
MYRSINACEAE	*Maesa ramentacea* (Roxb.) A. DC.
MYRTACEAE	*Eugenia dyeriana* King
MYRTACEAE	*Eugenia maulleri* (Miq.) Miq.
MYRTACEAE	*Eugenia zeylanica* (L.) Wight
PALMAE	*Areca triandra* Roxb.
PALMAE	*Iguanura wallichiana* (Wall. *ex* Mart.) Becc. var. *wallichiana*
PIPERACEAE	*Piper retrofractum* Vahl
PIPERACEAE	*Piper stylosum* Miq.
POLYGALACEAE	*Xanthophyllum vitellinum* (Bl.) Dietr.
PROTEACEAE	*Helicia attenuata* (Jack) Bl.
PTERIDACEAE	*Pteris vittata* L.
RHAMNACEAE	*Gouania javanica* Miq.
RUBIACEAE	*Canthium dicoccum* (Gaertn.) Teijsm. & Binn. var. *impolitum* Craib
RUBIACEAE	*Canthium glabrum* Bl.
RUBIACEAE	*Fagerlindia fasciculata* (Roxb.) Tirv. var. *fasciculata*
RUBIACEAE	*Greenea corymbosa* (Jack) K. Sch.
RUBIACEAE	*Hedyotis capitellata* Wall. *ex* G. Don var. *capitellata*
RUBIACEAE	*Ixora grandifolia* Zoll. & Mor.
RUBIACEAE	*Ixora merguensis* Hk. f.
RUBIACEAE	*Ixora nigricans* R. Br. *ex* Wigh & Arn. var. *nigricans*
RUBIACEAE	*Ixora* sp.
RUBIACEAE	*Lasianthus formosensis* Matsum.
RUBIACEAE	*Lasianthus* sp.
RUBIACEAE	*Ophiorrhiza hispidula* Wall. *ex* G. Don. var. *hispidula*
RUBIACEAE	*Oxyceros longiflora* (Lmk.) Yama.
RUBIACEAE	*Paracoffea* sp.
RUBIACEAE	*Pavetta graciliflora* Wall. *ex* Ridl.
RUBIACEAE	*Porterandia anisophylla* (Jack *ex* Roxb.) Ridl.
RUBIACEAE	*Psychotria curviflora* Wall.
RUBIACEAE	*Psychotria montana* Bl.
RUBIACEAE	*Psychotria rhinocerotis* Reinw. *ex* Bl.
RUBIACEAE	*Rennellia spciosa* (Wall. *ex* Kurz) Hk. f.
RUBIACEAE	*Rennellia* sp.
RUBIACEAE	*Saprosma* sp.
RUBIACEAE	*Tarenna* sp.
RUBIACEAE	*Timonius* sp.
RUBIACEAE	*Uncaria elliptica* R. Br. *ex* G. Don
RUBIACEAE	*Uncaria macrophyllum* Wall.
RUTACEAE	*Melicope lunu-ankenda* (Gaerth.) T. Hart.
SAPINDACEAE	*Allophyllus cobbe* (L.) Raeusch.

SAPINDACEAE	*Nephelium hypoleucum* Kurz
SAPINDACEAE	*Paranephelium macrophyllum* King
SAURAUIACEAE	*Saurauia tristyla* DC.
SELAGINELLACEAE	*Selaginella wallichii* (Hk. & Grev.) Spring
SELAGINELLACEAE	*Selaginella wildenowii* (Desv.) Bak.
SONNERATIACEAE	*Duabanga grandiflora* (Roxb. *ex* DC.) Walp.
STEMONACEAE	*Stichoneurom caudatum* Ridl.
STERCULIACEAE	*Leptonychia caudata* (Wall. *ex* G. Don) Burr.
STERCULIACEAE	*Pterospermum lanceafolium* Roxb.
STERCULIACEAE	*Sterculia lanceolata* Cav. var. *coccinea* (Jack) Pheng.
THELYPTERIDACEAE	*Thelypteris (Trigorospora) ciliata* (Wall. *ex* Bth.) Ching
TILIACEAE	*Commersonia bartramia* (L.) Merr.
TILIACEAE	*Grewia acuminata* Juss.
TILIACEAE	*Microcos laurifolia* (Hk. *ex* Mast.) Burr.
TILIACEAE	*Trichospermum javanicum* Bl.
ULMACEAE	*Gironniera nervosa* Planch.
ULMACEAE	*Trema orientalis* (L.) Bl.
VERBENACEAE	*Callicarpa angustifolia* King & Gamb.
VERBENACEAE	*Clerodendrum lankawiense* King & Gamb.
VERBENACEAE	*Premna corymbosa* (Burm. f.) Rottl. & Willd. var. *corymbosa*
VITACEAE	*Cayratia* sp.
ZINGIBERACEAE	*Boesenbergia prainians* (Bak.) Schlter
ZINGIBERACEAE	*Globba variabilis* Ridl.
ZINGIBERACEAE	*Hedychium longicornutum* Griff. *ex* Bak.

Table 3: A list of plants at Phra Phuttachai National Park.

Family	Botanical Name
ACANTHACEAE	Dicliptera roxburghiana Nees
ACANTHACEAE	Dipteracanthus repens (L.) Hassk.
ACANTHACEAE	Justicia fragilis Wall. ex Cl.
ACANTHACEAE	Pseuderanthemum latifolium (Vahl) B. Han.
ACANTHACEAE	Rungia parviflora (Retz.) Nees var. parviflora
ACANTHACEAE	Sericocalyx schomburgkii (Craib) Brem.
AMARANTHACEAE	Achyranthes bidentata Bl. var. bidentata
APOCYNACEAE	Parameria laevigata (Juss.) Mold.
APOCYNACEAE	Vallaris solanacea (Roxb.) O.K.
ASCLEPIADACEAE	Ceropegia arnottiana Wight
ASCLEPIADACEAE	Gymnema latifolium Wall. ex Wight
ASCLEPIADACEAE	Streptocaulon juventas (Lour.) Merr.
ASCLEPIADACEAE	Toxocarpus villosus (Bl.) Decne.
BOMBACACEAE	Bombax ceiba L.
CAPPARACEAE	Capparis micracantha DC. ssp. micracantha
CARDIOPTERIDACEAE	Cardiopteris quinqueloba (Hassk.) Hassk.
COMBRETACEAE	Combretum latifolium Bl.
COMMELINACEAE	Cyanotis axillaris (L.) D. Don
COMMELINACEAE	Murdannia nudiflora (L.) Bren.
COMPOSITAE	Blumea membranacea DC. var. membranacea
CONVOVULACEAE	Merremia hederacea (Burm. f.) Hall. f.
CONVOVULACEAE	Merremia hirta (L.) Merr. var. hirta
CONVOVULACEAE	Merremia vitifolia (Burm. f) Hall. f.
CUCURBITACEAE	Neoalsomitra sarcophylla (Wall.) Hutch.
CYPERACEAE	Cyperus laxus Lmk. var. laxus
CYPERACEAE	Sclaria lithosperma (L.) Sw. var. lithosperma
DIOSCOREACEAE	Dioscorea paradoxa Pr. & Burk.
DIOSCOREACEAE	Dioscorea pentaphylla L.
DRYOPTERIDACEAE	Tectaria impressa (Fee) Holtt.
EUPHORBIACEAE	Alchornea rugosa (Lour.) M.-A. var. rugosa
EUPHORBIACEAE	Antidesma acidum Retz.
EUPHORBIACEAE	Bridelia stipularis (L.) Bl.
EUPHORBIACEAE	Bridelia tomentosa Bl.
EUPHORBIACEAE	Cladoygnos orientalis Zipp. ex Span.
EUPHORBIACEAE	Euphorbia antiquorum L.
EUPHORBIACEAE	Mallotus repandus (Willd.) M.-A.
EUPHORBIACEAE	Phyllanthus urinaria L.
EUPHORBIACEAE	Trewia nudiflora L.
GRAMINEAE	Apluda mutica L.
GRAMINEAE	Ardisia boisii A. Cam.
GRAMINEAE	Axonopus compressus (Sw.) P. Beauv.
GRAMINEAE	Centotheca lappacea (L.) Desv. var. lappacea
GRAMINEAE	Cyrtococcum accrescens (Trin.) Stapf
GRAMINEAE	Enteropogon dolichostachys (Lag.) Keng ex Laza.
GRAMINEAE	Oplismenus compositus (L.) P. Beauv.
GRAMINEAE	Setaria parviflora (Poir.) Kerg.
HYDROCHARITACEAE	Ottelia alismoides (L.) Pers.
LABIATAE	Hyptis suaveolens (L.) Poit.
LEGUMINOSAE, Papilionoideae	Alysicarpus vaginalis (L.) A. DC.
LEGUMINOSAE, Papilionoideae	Butea superba Roxb.
LEGUMINOSAE, Papilionoideae	Calopogonium mucunoides Desv.

LEGUMINOSAE, Papilionoideae	Canavalia ensiformis (L.) A. DC.
LEGUMINOSAE, Papilionoideae	Christia obcordata (poir.) Bahk. f. var. obcordata
LEGUMINOSAE, Papilionoideae	Christia vespertilionis (L.f.) Bakh. f. var vespertilionis
LEGUMINOSAE, Papilionoideae	Dalbergia ovata Grah. ex Bth.
LEGUMINOSAE, Papilionoideae	Desmodium heterocarpon (L.) DC. ssp. angustifolium Oha.
LEGUMINOSAE, Papilionoideae	Desmodium heterocarpon (L.) DC. ssp. heterocarpon var. heterocarpon
LEGUMINOSAE, Papilionoideae	Mecopus nidulans Benn.
LEGUMINOSAE, Papilionoideae	Millettia xylocarpa Miq.
LEGUMINOSAE, Papilionoideae	Mucuna pruriens (L.) DC. var. pruriens
LEGUMINOSAE, Papilionoideae	Pueraria phaseoloides (Roxb.) Bth. var. phaseoloides
LEGUMINOSAE, Papilionoideae	Rhynchosia minima (L.) A. DC.
LEGUMINOSAE, Papilionoideae	Rhynchospora bracteata Bth. Bak.
LEGUMINOSAE, Papilionoideae	Stylosanthes hispida Rich.
MELASTOMATACEAE	Memecylon pauciflorum Bl.
MELASTOMATACEAE	Memecylon umbellatum Burm. f.
MELIACEAE	Walsura pinnata Hassk.
MORACEAE	Artocarpus lakoocha Roxb.
MORACEAE	Broussonetia kurzii (Hk. f.) Corn.
MORACEAE	Ficus rumphii Bl.
MORACEAE	Streblus asper Lour var. asper
MYRSINACEAE	Ardisia amherstiana A. DC. var. amherstiana
NYMPHAEACEAE	Hydrostemma longifolium (Wall.) Mabb.
OPILIACEAE	Urobotrya siamensis Hiep.
PARKERIACEAE	Hemonitis arifolia (Burm. f.) Moore
POLYGALACEAE	Polygala chinensis L.
POLYPODIACEAE	Drynaria bonii C. Chr.
PTERIDACEAE	Pteris venusta O.K.
RHAMNACEAE	Gouania javanica Miq.
RUBIACEAE	Borreria repens DC.
RUBIACEAE	Hedyotis gracilipes (Craib) Fuku. Var. gracilipes
RUBIACEAE	Ixora cibdela Craib var. cibdela
RUBIACEAE	Ixora javanica (Bl.) DC.
RUBIACEAE	Paederia linearis HK. f.
RUBIACEAE	Tarenna collinsae Craib
RUTACEAE	Glycosmis pentaphylla (Retz.) DC. var. pentaphylla
SAPINDACEAE	Arfeuillea arborescens Pierre
SAPINDACEAE	Lepisanthes rubiginosa (Roxb.) Leenh.
SELAGINELLACEAE	Selaginella delicatula (Desv.) Alst.
SELAGINELLACEAE	Selaginella repanda (Desv.) Spr.
STERCULIACEAE	Helicteres hissuta Lour.
TILIACEAE	Colona winitii (Craib) Craib
TILIACEAE	Corchorus aestuans L.
TILIACEAE	Corchorus capsularis L.
TILIACEAE	Grewia laevigata Vahl
TILIACEAE	Triumfetta rhomboidea Jacq.

VERBENACEAE	Congea tomentosa Roxb. var. nivea Munir
VERBENACEAE	Sphenodesme ferruginea (Griff.) Briq.
VITACEAE	Cayratia trifolia (L.) Dom. Var. trifolia
ZINGIBERACEAE	Curcuma sp.
ZINGIBERACEAE	Zingiber zerumber (L.) Sm.

Table 4: A list of species on 1- ha secondary forest plot, Mo Singto, Khao Yai National Park.

Family	Botanical Name
ANACARDIACEAE	*Buchanania arborescens*
ANACARDIACEAE	*Choerospondias axillaris*
ANACARDIACEAE	*Rhus rhetsoides*
ANNONACEAE	*Platymitra macrocarpa*
APOCYNACEAE	*Alstonia scholaris*
APOCYNACEAE	*Holarrhena pubescens*
APOCYNACEAE	*Wrightia arborea*
AQUIFOLIACEAE	*Ilex chevalieri*
CORNACEAE	*Mastixia pentandra*
CRYPTERONIACEAE	*Crypteronia paniculata*
DAPHNIPHYLLACEAE	*Daphniphyllum cambodianum*
DIPTEROCARPACEAE	*Dipterocarpus gracilis*
DIPTEROCARPACEAE	*Shorea roxburghii*
EBENACEAE	*Diospyros glandulosa*
ELAEOCAPACEAE	*Elaeocarpus robustus*
EUPHORBIACEAE	*Alchornea rugosa*
EUPHORBIACEAE	*Baccaurea ramiflora*
EUPHORBIACEAE	*Bridelia insulana*
EUPHORBIACEAE	*Fluggea virosa*
EUPHORBIACEAE	*Glochidion assamicum*
EUPHORBIACEAE	*Glochidion rubrum*
EUPHORBIACEAE	*Glochidion sphaerogynum*
EUPHORBIACEAE	*Macaranga denticulata*
EUPHORBIACEAE	*Mallotus paniculatus*
EUPHORBIACEAE	*Mallotus philippensis*
FAGACEAE	*Lithocarpus thomsonii*
GUTTIFERAE	*Cratoxylum cochinchinense*
GUTTIFERAE	*Garcinia benthamii*
HAMMELIDACEAE	*Altingia excelsa*
ICACINACEAE	*Apodytes dimidiata*
ICACINACEAE	*Gonocaryum lobbianum*
JUGLANDACEAE	*Engelhardia spicata*
LAURACEAE	*Cinnamomum ilicioides*
LAURACEAE	*Cinnamomum iners*
LAURACEAE	*Cinnamomum subavenium*
LAURACEAE	*Litsea umbellata*
LAURACEAE	*Machilus odoratissima*
LAURACEAE	*Phoebe lanceolata*
LEGUMINOSAE	*Dalbergia cochinchinensis*
LEGUMINOSAE	*Ormosia sumatrana*
MAGNOLIACEAE	*Michelia baillonii*
MALVACEAE	*Hibicus macrophyllus*
MELASTOMATACEAE	*Memecylon lilacinum*
MELIACEAE	*Chukrasia tabularis*
MELIACEAE	*Toona ciliata*
MORACEAE	*Ficus hispida*
MORACEAE	*Ficus nervosa*
MYRISTICACEAE	*Horsfieldia amygdalina*
MYRISTICACEAE	*Knema elegans*
MYRSINACEAE	*Ardisia sanguinolenta*
MYRTACEAE	*Cleistocalyx operculata*
MYRTACEAE	*Syzygium glande*

MYRTACEAE	*Syzygium siamensis*
MYRTACEAE	*Syzygium syzygioides*
OLEACEAE	*Fraxinus floribunda*
PROTEACEAE	*Helicia formosana*
RHIZOPHORACEAE	*Carallia brachiata*
ROSACEAE	*Prunus arborea*
RUBIACEAE	*Ixora cibdela*
RUBIACEAE	*Lasianthus kurzii*
RUTACEAE	*Clausena excavata*
RUTACEAE	*Melicope pteleifolia*
RUTACEAE	*Tetradium glabrifolium*
SANTALACEAE	*Scleropyrum wallichianum*
SAPINDACEAE	*Allophyllus cobbe*
SAPINDACEAE	*Lepisanthes tetraphylla*
STERCULIACEAE	*Pterospermum cinnamomeum*
SYMPLOCACEAE	*Symplocos cochinchinensis*
SYMPLOCACEAE	*Symplocos sumuntia*
THEACEAE	*Adinandra integerrima*
THEACEAE	*Eurya nitida*
THEACEAE	*Schima wallichii*
THYMELAEACEAE	*Aquilaria crassna*
ULMACEAE	*Trema orientalis*

Figure 1: All quadrat points of the 4-ha Bala plot.

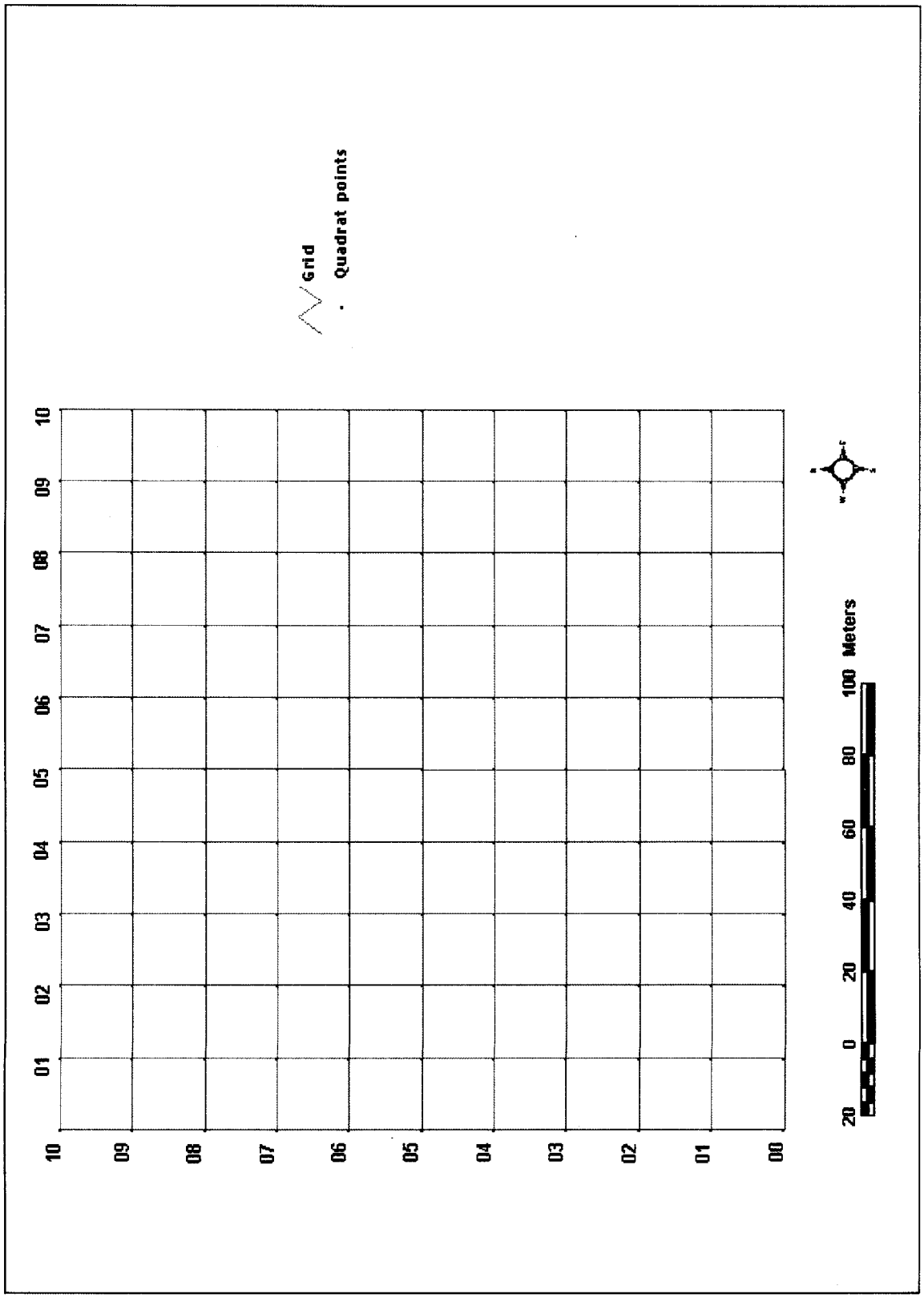

Figure 2: A map from ArcView program showing trees on the 4-ha Bala plot.

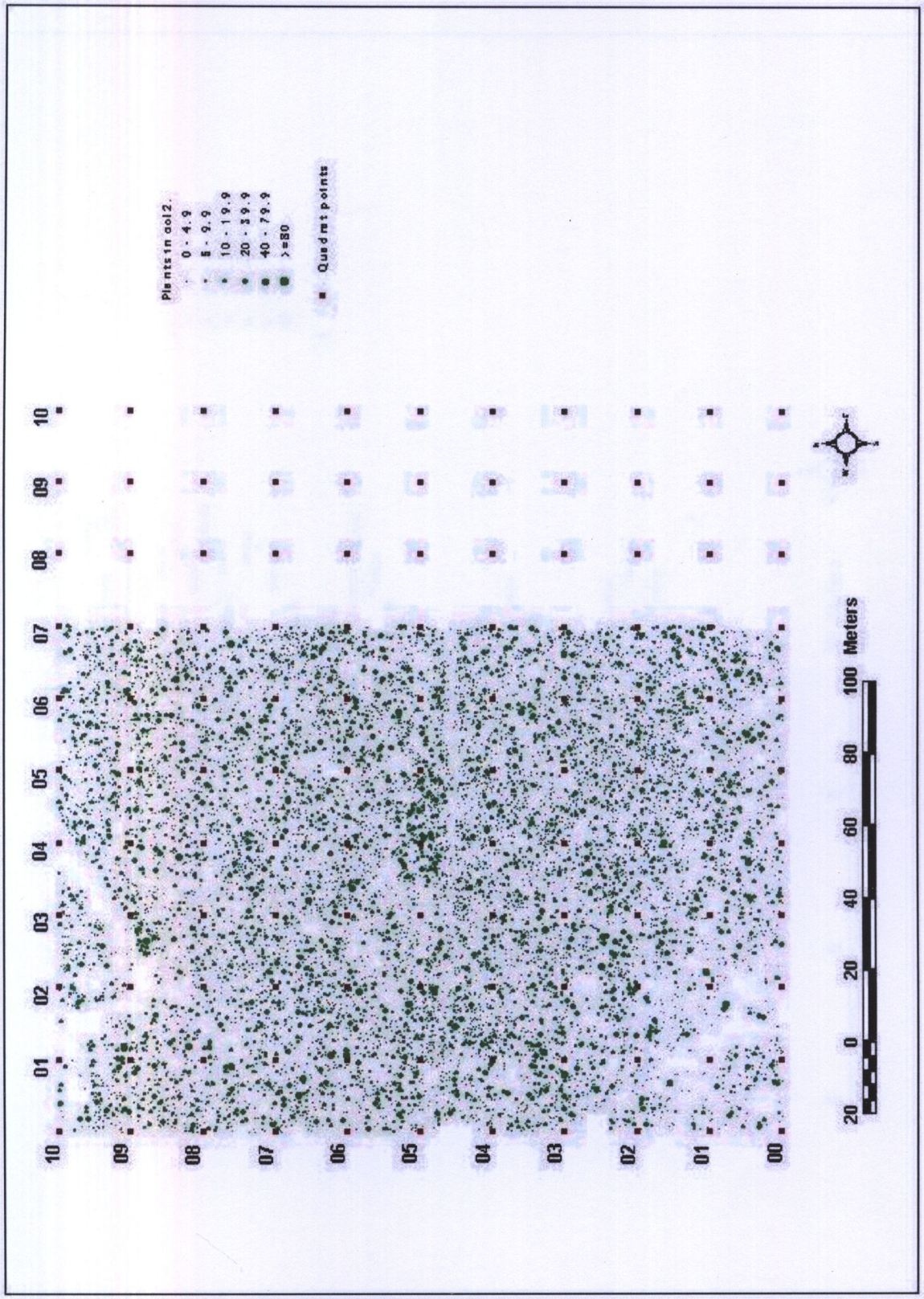

Figure 3: A map from ArcView program showing tree location and tree id in quadrat 06-00.

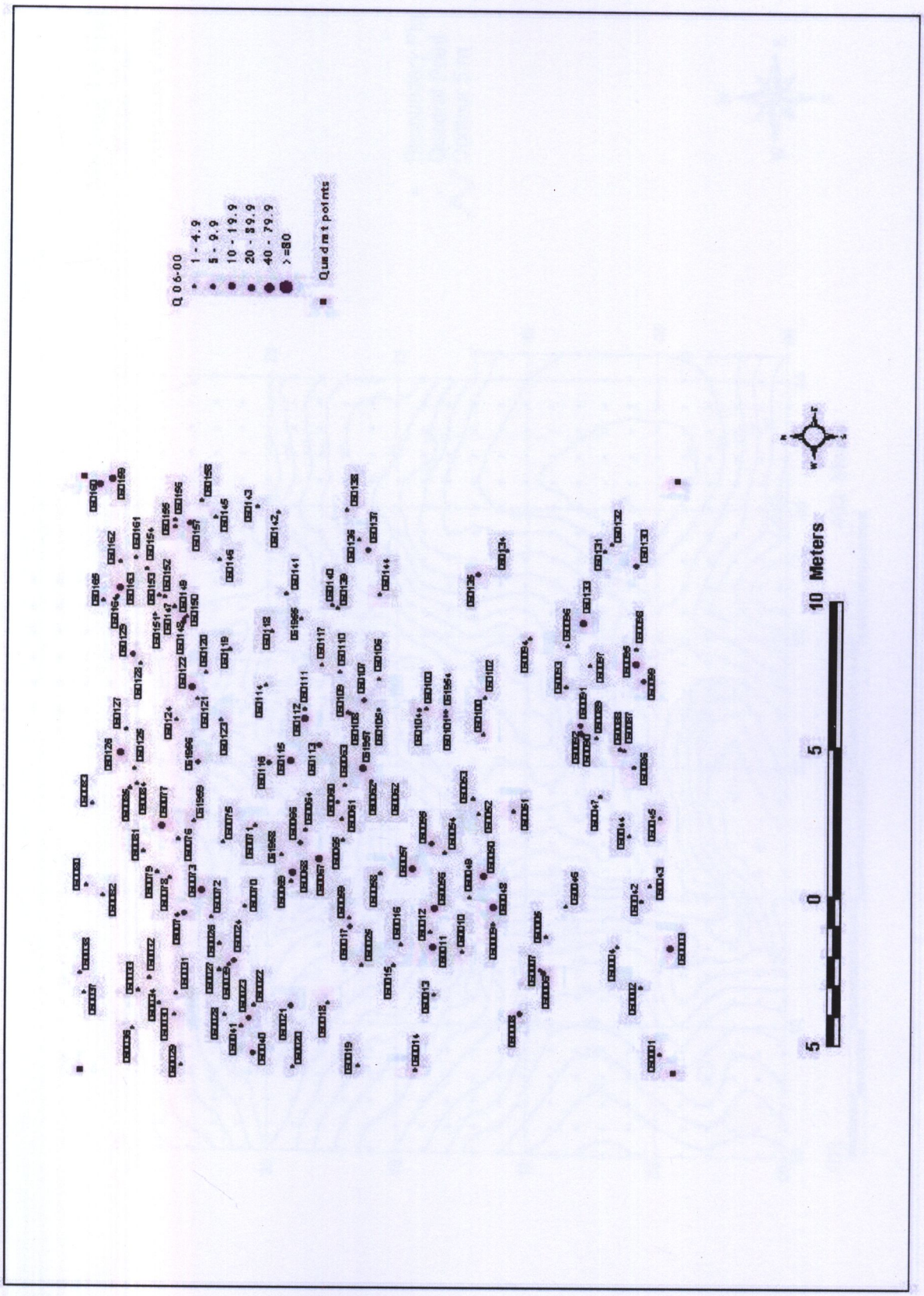

Figure 4: This map shows location of the 1-ha secondary forest plot at Mo Singto, Khao Yai National Park.

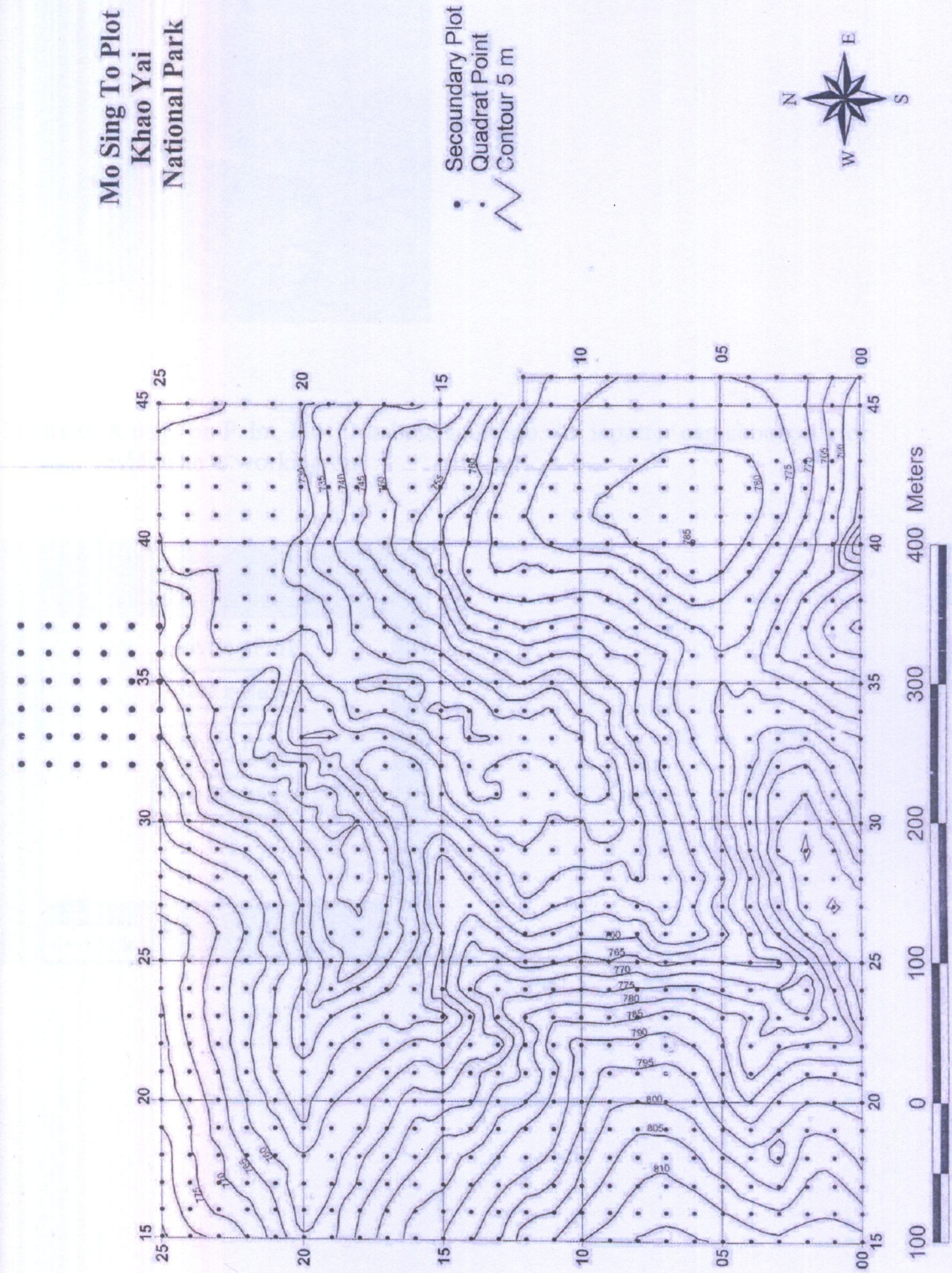

Figure 5: Picture of palmtop for inputting data.

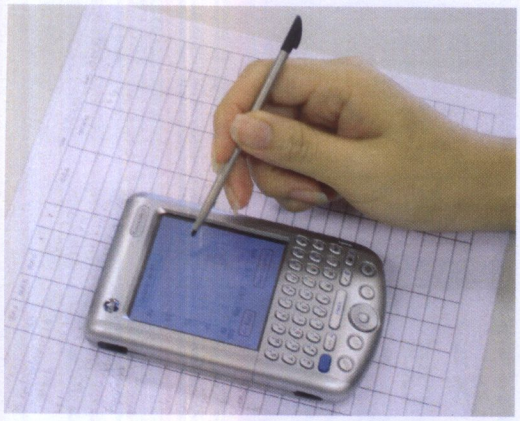

Figure 6: A page on Palm, Plot Database software. An inputter can choose a plot which he is working on.

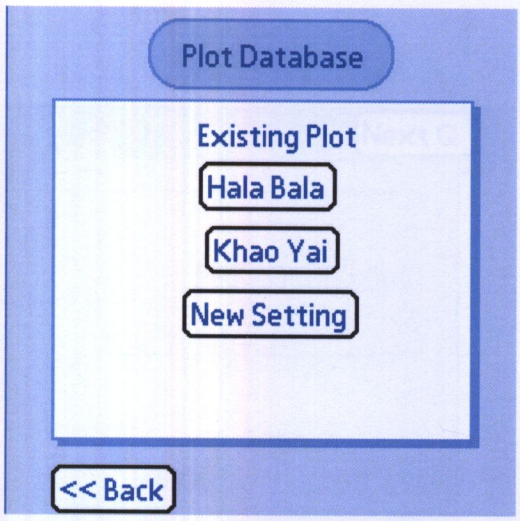

Figure 7: A page for data entry of an individual tree on Palm.

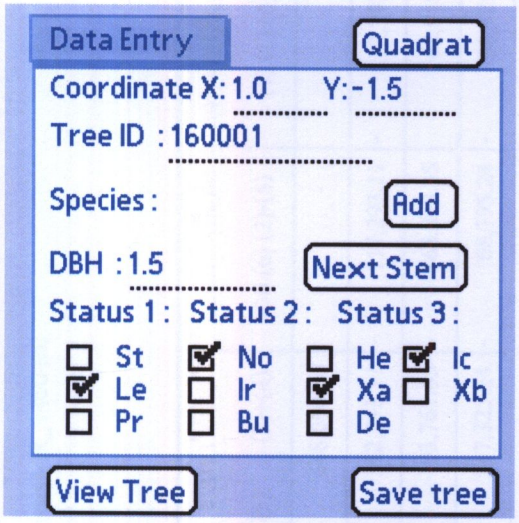

Figure 8: Displaying a map of tree location after inputting the x and y coordinates of tree.