Preliminary Results from the 52-hectare Long Term Ecological Research Plot at the Lambir National Parks, Sarawak, Malaysia

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INTRODUCTION

The 52-hectare Long Term Ecological Research (LTER) plot in Lambir plot is a joint research study involving the participation of three countries the United Sates (represented by the Harvard Institute of International Development), Japan (represented by a number of universities) and Malaysia (represented by the Forest Department of Sarawak).

The plot is located in a primary mixed dipterocarp forest (MDF). It is about 30 km from Miri Town and about 2 km from the Lambir National Park Headquarters along the Miri-Bintulu trunk road. The road is sited inside the Lambir National Park which has an area of 6,950 ha. The highest point in the park is 400 m above sea level. It is located at longtitude 114°E and latitude 4°N (see Figure 1).

PROJECT ACTIVITIES

Activities carried out in connection with the research plot can be divided into four classes: demarcation, assessment, data management and field checking. All these activities were carried out by the staff and labourers of the Forest Department

Demarcation of the plot took one year. It commenced in October 1990 and was completed in October 1991. The enumeration of trees and field check lasted two years. The enumeration started in September 1991 while a 100% field check started a year later. All field work was completed in September 1993.

Data entry started in October 1992 and was completed in December 1993.

PLOT SURVEY

The 52 ha plot measured 1,040 m by 500 m. Please see Figure 2 for plot orientation and layout. The demarcation was done using tacheometer and theodolite. All distances were slope corrected. The plot is divided into 52 strips, each of which is a hectare in area (Figure 2). Each of these strips, 20 m in width and 500 m in length, is further divided into 25 squares of 20 m. Each of these squares was further divided into 16 sub-quadrats 5 m in dimension. These sub-quadrats form the basic units of enumeration.

The LTER plot in Lambir was to have been 50 ha in area in conformation with other plots of same size in Panama, Pasoh and other areas. However a mistake was made in the demarcation of the initial two hectares. Rather than discard the area demarcated, it was decided to retain these two hectares as part of the plot.

All the corners of the squares were assigned 'X' and 'Y' co-ordinates as grid reference. These corners were further identified on the ground by plastic orange-coloured pegs with the co-ordinates labelled.

Care was exercised to avoid damaging plant materials on the ground in the process of the plot demarcation and assessment.

FIELD ASSESSMENT

Assessment of trees was carried out by a combination of assessment crew and tree identification crew. Usually, there were five (5) members in the combined crews, with the following division of work:-

	Work	No. of individual
(a)	tree identification	one (staff member)
(b)	recording	one (staff member)
(c)	tree diameter measurement	one (staff member)
(d)	marking of tree position, painting POM, tagging trees and layout of sub-quadrat	two (labourers)

In each 20 m square, there are 16 sub-quadrats. Assessment must be done strictly in sequence from sub-quadrat 1-1 to sub-quadrat 4-4 (Figure 3). The tree numbers in a square must be in running order starting from tree number 1 until the last tree of the last sub-quadrat. The first tree in the next square again starts with the number 1.

As mentioned earlier, the 5 m by 5 m sub-quadrats form the basic unit of assessment. A new field card is used for each subquadrat (Figure 4). The recorder is first required to fill the particulars of the line number, square number and the sub-quadrat number. Each row of the field card contains a complete set of information for a tree. Each tree is assigned a tree number. The stem identity class (SIC), vernacular name of the tree, diameter, point of measurement (POM) and buttress height (BH) were assessed and recorded. Information on crown illumination (CI), crown form (CF) and location of tree were not collected. The width of each numerical field is indicated on the field card.

Trees were systematically scouted from the lower left-hand corner of each sub-quadrat. Each tree is given a SIC. The procedure for SIC coding is given on the back of the field card (Figure 5). For each tree, a botanical identification is attempted. If this is not possible, the vernacular name is given. All trees equal to or greater than 1.0 cm in diameter at breast height (dbh) were assessed. Diameters were measured to one

tenth of a centimeter (cm) at a height of 1.3 m above ground for non-buttressed trees and at least 30 cm above buttress for a buttressed tree. Forking and presence of climbers at POM were noted.

Palms were excluded from the assessment.

DATA MANAGEMENT

All field cards were replicated. Copies were distributed to the US and the Japanese scientists. The Silviculture Research Office, Sibu keeps the original copy for purposes of checking. The field data were then entered into a computer at the Silviculture Research Office, Sibu where they can be easily retrieved and utilised. The computer data were replicated for storage in the US, Japan and the Forest Research Office in Kuching.

Species identification and coding

Species identification and species coding presents a major problem in data management.

In the field, trees were identified to species level wherever possible. In many cases, this was not feasible. In such cases, the closest genus was assigned based on the botanical characteristics of the tree. Leaf specimens of such cases were also collected for herbarium confirmation. These specimens were kept at the LTER field laboratory at Lambir.

It is not an easy task to develop a species list which could keep track of all the species encountered in the Lambir plot. The main difficulty is species diversity. The absence of a competent botanist with tropical rainforest background in the field is another hindrance. For these reasons trees identified to the generic level in the field have yet to be identified to the species level.

A species list with six-letter codes was developed after numerous revisions. The six-letter codes endeavour to decipher the botanical name of each species and abbreviate it into a systematic codes. This systematic and uniform coding is essential for data management. These codes were used in computer files to determine the botanical name of each tree. The list is constantly being updated as new species are encountered. The code is entered for each tree in the field card. (Figure 4).

Data entry

Data were entered using dBase III on two desk top computers. There are altogether 52 dBase datafiles one for each hectare strip. The computer filename bears the reference LTERXX, LTER being the acronym for the project and XX being the strip number.

The format for data entry is given in Figure 6.

A printout is generated to check for errors which could have been made in the field or during data entry. Editing of errors is done immediately if they are due to data entry and a copy of the cleaned data produced. Occasionally, rechecking in the field is necessary when gross errors are detected.

Mapping of tree position

All trees in the plot were given co-ordinates using a digitizer. The co-ordinates are later incorporated in the data file. The co-ordinates appear as 'X' and 'Y' in the data file.

The positions of all trees are mapped using a Roland Plotter. Figure 7 gives an output of the tree map with the diameter classes of trees differentiated by different symbols.

These programs were written by a member of the Japanese team.

Data analyses

Before data analysis was carried out, the data files were screened again using dBase III. This process enables any errors not detected earlier to be detected. Later, the edited file is converted into Statistical Package fro Social Scientists (SPSS) system file. The datafiles are then edited. This is subject to further screening for illogical data that had not been detected earlier.

Besides editing, the SPSS analysis would count the number of species and list the values of the SIC and dbh classes for further verification.

RESULTS AND DISCUSSIONS

Density and basal area

Preliminary results of the Lambir plot are shown in Tables 1, 2 and 3. Table 1 gives a summary of results of each 1 ha strip in the 52 hectares plot. Table 2 shows the number of species, genera and family. Table 3 gives the results of number of trees and basal area by diameter class. A total of approximately 358,900 trees above 1.00 cm dbh were assessed. The mean density is 6,902 trees/ha contributing to 43.3 m^2/ha (13.1%). The remaining 9.3% (633 trees/ha) above 10.0 cm contribute to a mean basal area of 37.5 m^2/ha.

As expected, there are more trees in the lower dbh class than that in the larger dbh class. Trees above 50 cm though representing only 0.6% of the tree population per ha contribute significantly to the total basal area 17.3 m^2/ha or 39.7% of the total basal area of 43.2m^2.

Species diversity

Seventy-two families, 278 genera and approximately 1,080 species have been recorded in the plot (Table 4).

The family with the largest number of species is Dipterocarpaceae. It has 11 genera with 143 species made up of 94 species identified and another 49 species classified by distinct botanical characteristics. The family Euphorbiaceae has the most genera, 28 being recorded. It has 118 species recorded with 117 identified and only 1 specie to be sorted out. Annonaceae is the third species rich family. It has 70 species, 57 of which have been identified and 20 yet to be sorted out.

Ten families are monospecific, these being Acanthaceae, Ampelidaceae, Compositae, Cornaceae, Crypteroniaceae, Erythroxylaceae, Juglandaceae, Linaceae, Saxifragaceae and Trigoniaceae.

Comparison between Pasoh plot and Lambir plot

In terms of species and genera diversity, Lambir plot was much richer of flora than Pasoh plot (Manokaran, 1992) in Peninsula Malaysia. The plots in Lambir and the one in Pasoh cannot be strictly compared because of the difference in size. Nevertheless interesting differences emerge to indicate the greater diversity of Lambir. These are tabulated in Tables 5 and 6. The Pasoh plot recorded a total of 78 families, compared to 72 for Lambir. There are 294 genera in Pasoh plot, but 278 genera in Lambir. Pasoh has 820 species while 1,083 are recorded in Lambir. Pasoh has a total of 335,240 trees but Lambir 358,905 trees. The tree density per hectare of Pasoh is 6,769 while for Lambir it is 6,903. The basal area per hectare is 43.2 for Lambir and 30.5 for Pasoh.

It must be noted that the figures for Lambir are not absolute at this stage because of problems in tree identification. Nonetheless the comparison is still valid.

CONCLUSION

The establishment and first enumeration of the LTER plot at Lambir has been completed successfully through the effort and dedication of the staff member and labourers of Silviculture Research office, Sibu. The Sibu office has also shouldered the responsibility of data management. This clearly demonstrates the ability of the Forest Department of Sarawak to handle research plots of such a scale. The plot will be continually monitored and maintained by the Department.

Preliminary results of the Lambir plot have shown that the forest is very rich in diversity and very dense in stocking. It is possible that Lambir has a greater number of larger diameter trees than Pasoh in Peninsula Malaysia. Approximately 1,080 species were recorded in 278 genera and 72 families. The forest had a stocking of 6,903 per ha of stems 1.0 cm dbh and above contributing to 43.2 m^2/ha in basal area. Forty-one trees in the diameter class 50cm and above are still standing.

Efforts will be continued to sort out trees currently identified only to generic level, in order that the absolute number of species in the plot is known. The data will be further analysed using larger and more advanced computers. Utilisation of the various species found in Lambir will be identified.

Further assessments of the LTER plot is certainly on the Department's agenda. Future enumeration will consider an assessment of the presence of non-timber species. A few sub-plots could be established to monitor plants less than 1.0 cm in dbh. Heights of trees will be measured or estimated to enable the volumes of the forest stand to be assessed.

REFERENCES

Anon. 1989. *Annual Report of Forest Department Sarawak, 1989*. Forest Department Kuching Sarawak, Malaysia.

Manokaran, N., James V. Lafrankie, K.M. Kochummen, E.S. Quah, J.E. Klahn, P.S. Ashton & S.P. Hubbel 1992. *Stand Table and Distribution of Species in the Fifty Hectares Research Plot at Pasoh Forest Reserve*. Published by FRIM, Malaysia.

Discussion for Chai *et al.*'s paper

Ashton I like to congratulate Ernest on his paper. I have no idea that so much work has been done on the data from the plot. It is exciting to see the comparison with the Pasoh plot though it is not absolute at this stage because there is still some problems with tree identification. I only like to make one suggestion which bears some relevance to why these very large plots are being recommended. Although these large plots require a tremendous amount of work, they can also give early results of the dynamics of the forest particularly in a climate like Sarawak's where there is constant rainfall distribution. We are familiar with using smaller plots which are measured over very long periods of 5 or 10 years. Precise data measurement is not quite so important because one has the advantage of getting the average over a long period of time. When you have a big plot with many trees, you can have more accurate information on growth over a shorter period of time because the sample for each population is vary large. But then it is very important to have precise day to day record of when the measurements were made. You have this information but it needs to be built into the database.

Chai Yes, we certainly will be doing this later on.

Ogino Do you have any comments on the species identification at this stage, Peter (Ashton)?

LaFrankie This will be covered in my presentation later.

TABLE 1: SUMMARY OF RESULTS PER HECTARE STRIP

LINE No.	No. Of Species	No. OF TREES BY DIAMETER CLASS & PERCENTAGE						TOTAL No. OF TREES	BASAL AREA BY DIAMETER CLASS & PERCENTAGE						TOTAL BASAL AREA	MAX. DIAM.
		< 10.0 cm		≥ 10.0 cm		≥50.0 cm			< 10.0 cm		≥ 10.0 cm		≥50.0 cm			
		No.	%	No.	%	No.	%		m2	%	m2	%	m2	%	m2	cm
01	340	6,300	92.8	490	7.2	28	0.4	6,790	5.24	15.6	28 3	84.4	12.5	37.3	33.5	154.0
02	390	6,111	92.3	506	7.6	43	0 6	6,618	5.16	13.7	32.5	86.3	18.1	48.2	37.6	121.3
03	368	6,279	92.5	509	7.5	30	0.4	6,788	5.76	16.6	29.0	83.4	13.8	39.7	34.7	152.0
04	401	6,315	92.2	533	7.8	24	0.4	6,848	5.50	16.6	27.6	83.4	11.3	34.0	33.1	156.8
05	382	5,657	90.8	574	9.2	31	0.5	6,231	5.17	13.7	32.5	86.3	15.3	40.6	37.7	151.4
06	450	5,882	90.5	615	9.5	26	0.4	6,497	5.59	14.6	32.6	85.4	11.4	29.9	38 2	194.2
07	412	6,314	91.6	577	8.4	16	0.2	6,891	5.75	18.3	25.7	81.7	9.2	29.2	31.4	132.0
08	424	5,905	91.4	559	8.6	27	0.4	6,464	5.28	15.7	28.5	84.3	12.1	35.8	33 8	120.0
09	449	5,844	90.7	601	9.3	34	0.5	6,445	5.59	15.2	31.1	84.8	13.4	36.5	36.7	125.5
10	375	5,873	90.8	596	9.2	34	0.5	6,469	5.56	13.6	35.5	86.4	18.4	44.9	41 0	151.2
11	393	6,033	90.9	603	9.1	23	0.3	6,636	5.47	16.5	27.6	83.5	10.5	31.6	33.1	131.1
12	366	6,168	90.4	652	9.6	26	0.4	6,820	5.85	15.8	31.1	84.2	10.9	29.4	37.0	112.5
13	351	6,390	90.7	655	9.3	28	0.4	7,045	6.11	15.9	32.3	84.1	13.0	33.7	38.4	116 7
14	345	6,181	90.2	674	9.8	55	0.8	6,855	6.06	11.6	46.2	88.4	24.6	47.1	52.2	143 7
15	355	6,289	90.1	690	9.9	42	0.6	6,979	5.84	13.5	37.3	86.5	16.3	37.7	43.1	134.9
16	338	6,682	89.7	765	10.3	50	0.7	7,447	5.82	11.3	45.9	88.7	23.4	45.1	51.7	129.3
17	270	6,465	90.3	694	9.7	44	0.6	7,159	6.17	12.5	43.1	87.5	21.2	43.1	49.3	142.8
18	349	6,231	90.9	624	9.1	44	0.6	6,855	6.23	14.5	36.8	85.5	19.4	45.0	43.0	144.0
19	369	6,309	90.5	662	9.5	41	0.6	6,971	5.86	12.3	41.7	87.7	21.7	45.6	47.5	184.5
20	343	6,162	91.2	593	8.8	39	0.6	6,755	5.54	14.0	33.9	86.0	16.0	40.5	39 5	119.0
21	309	5,307	90.3	568	9.7	51	0.9	5,875	4.75	11.0	38 3	89.0	21.1	49.1	43 0	106.6
22	244	5,645	90.8	571	9.2	46	0.7	6,216	5.12	11.9	38.0	88.1	19.9	46.2	43 1	108.5
23	315	6,068	91.8	542	8.2	51	0.8	6,610	5.39	11.8	40.3	88.2	23.1	50.6	45.7	144.4
24	300	6,158	92.0	537	8.0	36	0.5	6,695	5.49	12.8	37.2	87.2	18.0	42.1	42.7	138.7
25	241	6,541	92.2	553	7.8	39	0.5	7,094	5.70	14.8	32.9	85.2	14.7	38.0	38.6	122.6
26	298	7,103	92.2	597	7.8	41	0.5	7,700	6.17	14.2	37.3	85.8	17.9	41.1	43.4	122.7
27	249	6,589	90.6	683	9.4	66	0.9	7,272	5.97	11.0	48.4	89.0	26.6	48.8	54.4	128.8
28	297	6,315	89.7	725	10.3	55	0.8	7,040	5.69	11.0	45.9	89.0	20.4	39.5	51.6	129.7
29	329	6,039	88.7	768	11.3	50	0.7	6,807	5.53	10.4	47.5	89.6	21.0	39.6	53.0	138.8
30	270	6,348	90.8	640	9.2	42	0 6	6,988	6.17	14.4	36.5	85.6	15.8	37.1	42 7	107 7
31	301	6,257	91.3	594	8.7	32	0.5	6,851	5.89	14.9	33.6	85.1	13.2	33.4	39.5	141.5
32	315	5,782	89.5	679	10.5	45	0.7	6,461	6.03	13.4	38.9	86.6	17.0	37.9	44.9	123.7
33	308	6,404	90.6	665	9.4	36	0.5	7,069	5.80	14.0	35.7	86.0	15.0	36.3	41.5	114.3
34	311	6,376	90.4	677	9.6	48	0.7	7,053	5.63	11.7	42.5	88.3	20.4	42.4	48 1	115.6
35	285	6,248	90.0	698	10.0	39	0.6	6,946	5.45	12.1	39.4	87.9	16.2	36.1	44.9	123.4
36	264	6,223	89.9	696	10.1	50	0.7	6,919	5.20	9.9	47.1	90.1	22.5	43.1	52 3	125.0
37	267	6,410	90.4	679	9.6	45	0.6	7,089	5.89	13.0	39.4	87.0	16.5	36.4	45 3	116.0
38	271	7,153	91.6	655	8.4	49	0.6	7,808	5.95	13.0	39.7	87.0	18.5	40.5	45.6	113.0
39	317	7,040	91.5	650	8.5	46	0.6	7,690	5.98	13.0	40.0	87.0	18.7	40.7	45.9	131.0
40	305	7,317	92.0	638	8.0	47	0.6	7,955	6.14	13.0	41.0	87.0	18.3	38.7	47.2	124.0
41	243	7,373	91.9	647	8.1	38	0.5	8,020	5.83	13.2	38.5	86.8	16.5	37.1	44.3	118.1
42	267	6,287	90.3	672	9.7	40	0.6	6,959	5.72	12.5	39.9	87.5	17.5	38.3	45.6	125.7
43	304	6,540	90.5	685	9.5	40	0.6	7,225	5.66	12.6	39.2	87.4	16.0	35.7	44.9	103.0
44	332	6,223	90.8	634	9.2	35	0.5	6,857	5.42	13.6	34.3	86.4	12.8	32.3	39.8	119.5
45	251	6,081	90.5	638	9.5	50	0.7	6,719	5.17	11.7	38.9	88.3	18.1	41.2	44.0	114.6
46	251	6,236	91.0	618	9.0	40	0.6	6,854	5.60	13.9	34.7	86.1	13.5	33.6	40.3	99.4
47	220	6,570	90.5	686	9.5	42	0.6	7,256	5.65	12.4	39.8	87.6	14.9	32.7	45.5	104.2
48	263	6,018	90.3	647	9.7	50	0.8	6,665	5.39	12.3	38.4	87.7	19.3	44.0	43.8	118.1
49	270	5,829	89.5	686	10.5	37	0.6	6,515	5.41	12.0	39.8	88.0	15.2	33.6	45.2	125.0
50	270	6,004	90.1	658	9.9	51	0.8	6,662	5.42	11.4	42.2	88.6	20.8	43.6	47.6	120.0
51	266	6,419	90.6	663	9.4	47	0.7	7,082	5.65	12.3	40.4	87.7	17.4	37.7	46 0	109.3
52	321	5,685	89.0	705	11.0	60	0.9	6,390	5.27	10.3	45.7	89.7	22.0	43.1	51.0	119.0
TOTAL		325,978	90.8	32,926	9.2	2,129	0.6	358,905	293.7	13.3	1950.5	86.7	890.8	39.3	2244.2	
PER HECTARE		6,268.81		633.19		40.94		6,902.02	5.65		37.5		17.1		43.2	

Table 2 : Summary of Results

LTER, LAMBIR

PLOT SIZE =	*52 HA*
TOTAL TREES ASSESSED =	*358,905*
NO. OF TREES/HA =	*6,903*
TOTAL BASAL AREA =	*2,244.2*
BASAL AREA M2/HA =	*43.2*
NO. OF FAMILIES =	*72*
NO. OF GENERA =	*278*
NO. OF SPECIES =	*1,083 (approx.)*

Table 3: No. of Trees and Basal Area by Diameter Class

	NO. OF TREES BY DIAMETER CLASS & PERCENTAGE						TOTAL NO. OF TREES
	<10.0 cm		≥10.0 - < 50.0 cm		≥50.0 cm		
	No.	%	No.	%	No.	%	
TOTAL	325,978	90.8	32,926	9.2	2,129	0.6	358,905
PER HECTARE	6,268.8		633.2		40.9		6,902

	BASAL AREA BY DIAMETER CLASS & PERCENTAGE						TOTAL BASAL AREA
	<10.0 cm		≥10.0 - < 50.0 cm		≥50.0 cm		
	m2	%	m2	%	m2	%	m2
TOTAL	293.7	13.1	1,950.5	86.9	890.8	39.7	2,244.2
PER HECTARE	5.65		37.5		17.1		43.2

Table 4: Number Of Species, Genera & Families Encountered

	FAMILY	GENERA	SPECIES
1	Acanthaceae	1	1
2	Alangiaceae	1	2
3	Ampelidaceae	1	1
4	Anacardiaceae	13	33
5	Annonaceae	12	57
6	Apocynaceae	5	7
7	Aquifoliaceae	1	2
8	Araliaceae	1	2
9	Araucariaceae	1	2
10	Bombacaceae	2	9
11	Burseraceae	5	18
12	Celasteraceae	4	8
13	Clusiaceae	5	20
14	Combretaceae	1	2
15	Compositae	1	1
16	Connaraceae	2	2
17	Convolvulaceae	1	1
18	Cornaceae	1	1
19	Crypteroniaceae	1	1
20	Dilleniaceae	1	5
21	Dipterocarpaceae	11	94
22	Ebenaceae	1	24
23	Elaeocarpaceae	1	5
24	Erythroxylaceae	1	1
25	Euphorbiaceae	28	117
26	Fagaceae	2	5
27	Flacourtiaceae	9	20
28	Gnetaceae	1	2
29	Hypericaceae	1	2
30	Icacinaceae	6	12
31	Ixonanthaceae	2	2
32	Juglandaceae	1	1
33	Lauraceae	11	23
34	Lecythidaceae	1	6
35	Leguminosae	13	36
36	Linaceae	1	1
37	Loganiaceae	2	5
38	Magnoliaceae	2	5
39	Melastomataceae	5	12
40	Meliaceae	6	10
41	Meliaceae	2	25

Table 4 .....Continued

42	Moraceae	5	26
43	Myristicaceae	4	21
44	Myrtaceae	4	24
45	Mysinaceae	2	2
46	Ochnaceae	3	4
47	Olacaceae	5	9
48	Oleaceae	3	4
49	Oxalidaceae	1	2
50	Polygalaceae	1	14
51	Proteaceae	1	5
52	Rhamnaceae	3	3
53	Rhizophoraceae	5	9
54	Rosaceae	3	4
55	Rubiaceae	22	37
56	Rutaceae	4	4
57	Sabiaceae	1	3
58	Sapindaceae	8	16
59	Sapotaceae	5	18
60	Saurauiaceae	1	2
61	Saxifragaceae	1	1
62	Simaroubaceae	3	4
63	Sterculiaceae	4	25
64	Symplocaceae	1	2
65	Theaceae	1	3
66	Thymelacaceae	3	7
67	Tiliaceae	8	36
68	Trigoniaceae	1	1
69	Ulmaceae	2	4
70	Urticaceae	2	2
71	Verbenaceae	3	14
72	Violaceae	1	3
73	Unconfirmed	-	191
	Total	278	1083

Table 5: ***Comparison Between Lambir and Pasoh***
(In Terms Of Family, Genus and Species)

	LAMBIR	*PASOH*	*DIFFERENCE*
SIZE OF PLOT (HA)	*52*	*50*	*+2*
FAMILIES	*72*	*78*	*-6*
GENERA	*278*	*294*	*-16*
SPECIES	*1,083*	*820*	*+263*

Table 6: ***Comparison Between Lambir and Pasoh***

		DIAMETER CLASS (CM)			
	SITE	*1 - 10*	*= 10*	*= 50*	*MEAN*
NUMBER OF TREES PER HECTARE	*LAMBIR*	*6,269*	*633*	*41*	*6,903*
		90.8%	*9.2%*	*0.6%*	*100%*
	PASOH	*6,239*	*530*	*N.A*	*6,769*
		92.1%	*7.8%*	*N.A*	*100%*
BASAL AREA M2 PER HECTARE	*LAMBIR*	*5.6*	*37.5*	*17.1*	*43.2*
		13.1%	*86.9%*	*39.7%*	*100%*
	PASOH	*5.3*	*25.2*	*N.A*	*30.5*
		17.4%	*82.6%*	*N.A*	*100%*
TOTAL NUMBER OF TREES MEASURED 1.0 CM DBH & ABOVE	*LAMBIR*	*358,905*			
	PASOH	*335,240*			
TOTAL BASAL AREA M2 1.0 CM DBH & ABOVE	*LAMBIR*	*2,244.2*			
	PASOH	*1,525.0*			

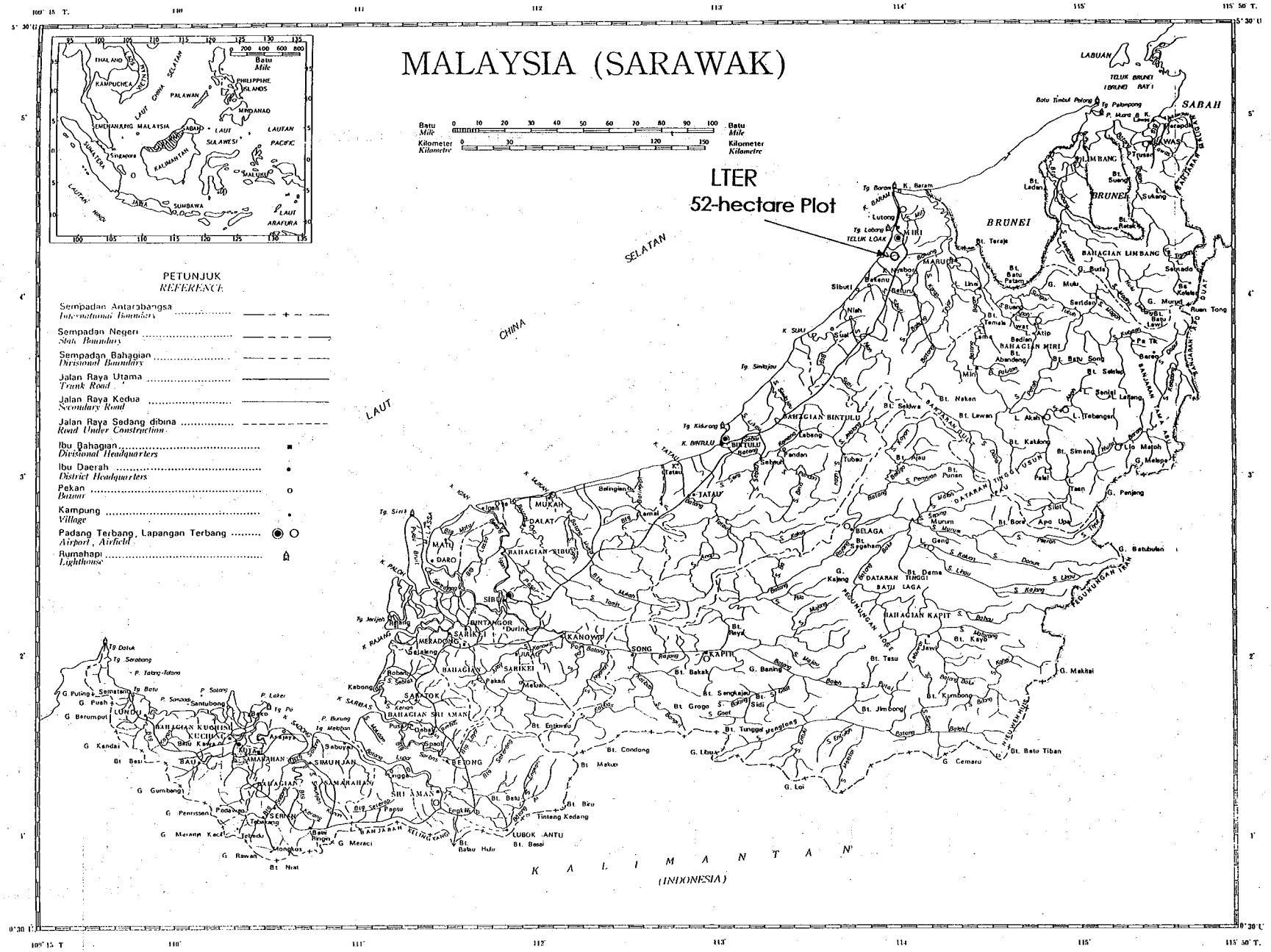


Figure 1. Location of 52-hectare Plot.

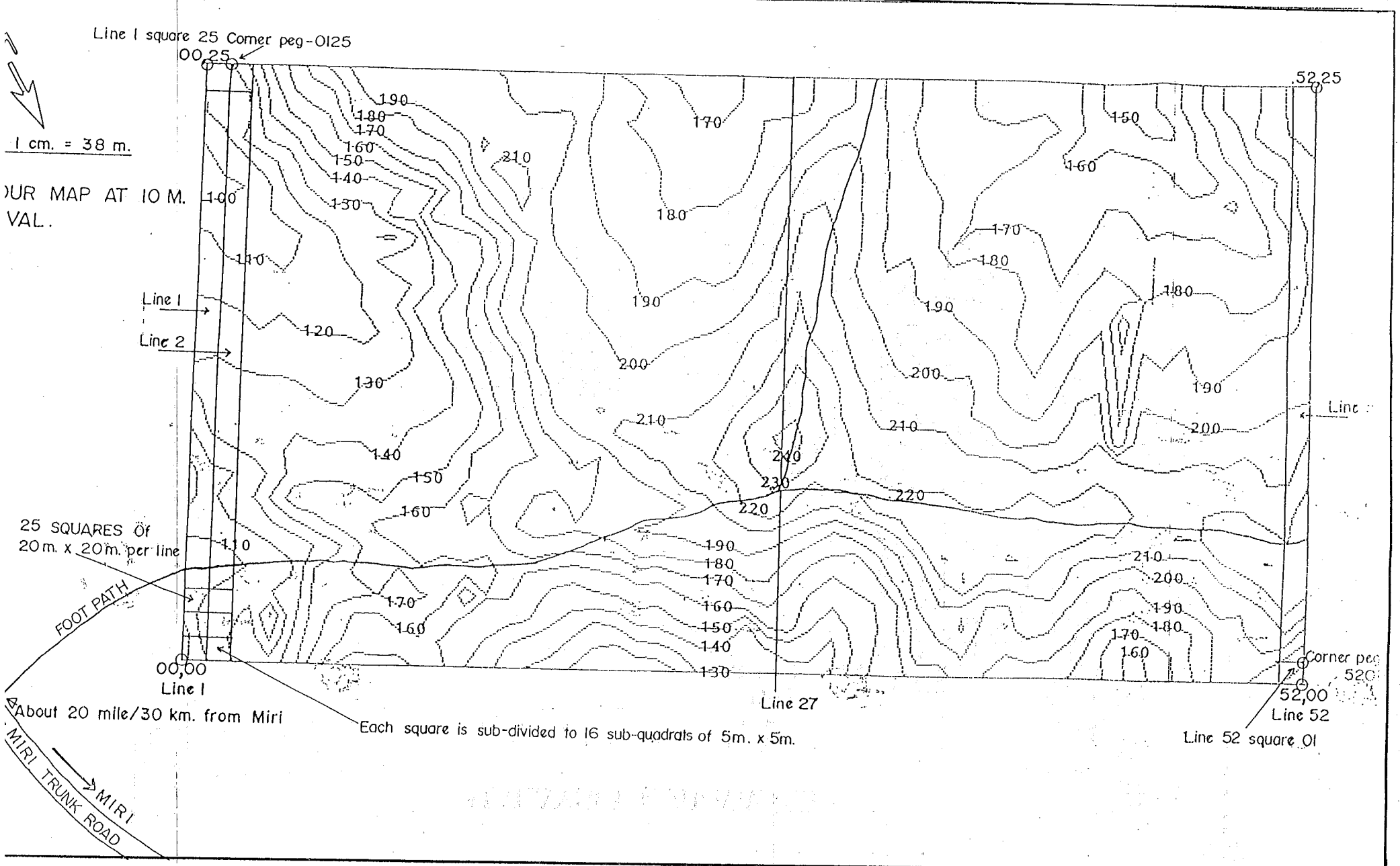
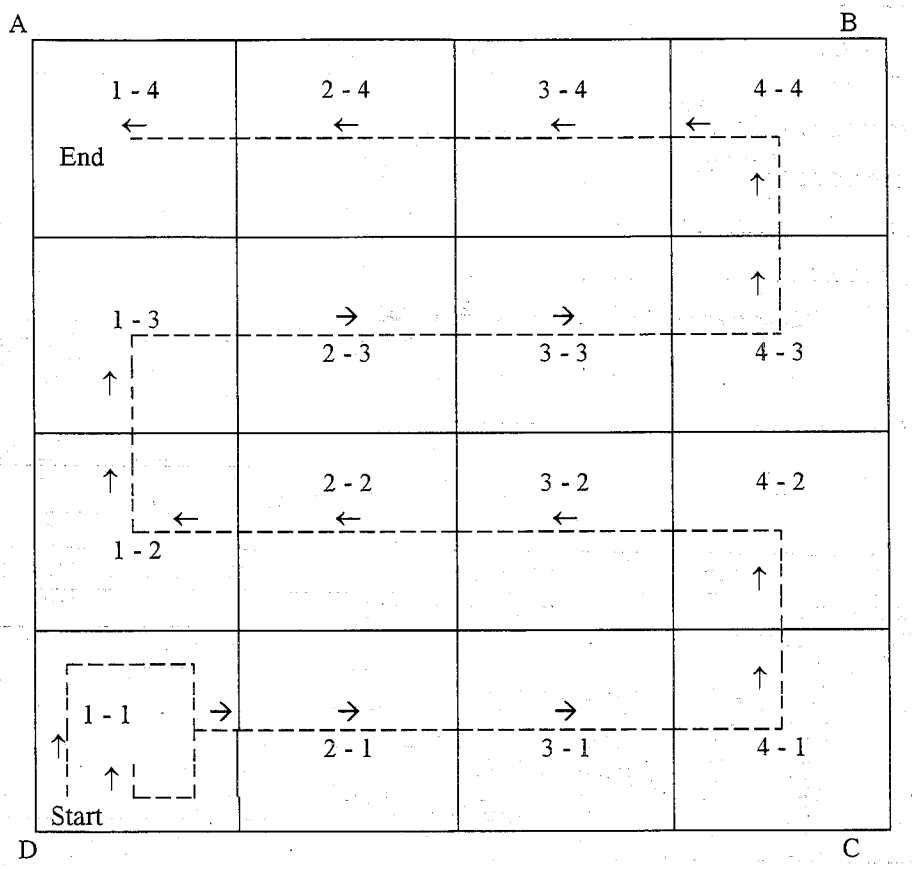


Figure 2: Plot Layout, 52-Hectare LTER, Lambir National Park.



: 20m. x 20m. Square
= 16 Sub - quadrats of 5m. x 5m.

Figure 3: Sequence of Assessment In a Square

LTER, 50 HA PLOT, BUKIT LAMBIR NATIONAL PARK

YEAR OF ENUMERATION 19 92

SQUARE # : 2808
(20m x 20m)

QUADRAT # :
(10m x 10m)

SUB – QUADRAT # : 2–1
(5m x 5m)

RECORDER : Yusof Lod.

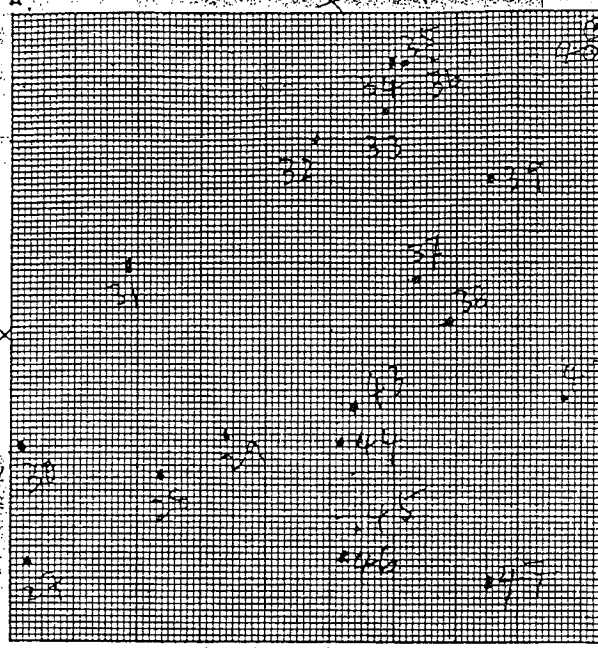
MEASURER : Basri

DATE : 1.9.1992

REMARKS :

* Measurement with Clinometer

SKETCH – MAP FOR A QUADRAT



SCALE 1:100

TREE #	SIC	SPECIES	DIAMETER	POM	BH	CI	CF	CO-ORDI
XXXX-XXX	XXX	(VERNACULAR NAME)	(CMS)	(M)	(M)			X
2808-027	211	Pitoh	0016	1.3				
028	211	Kayu malam	0013	1.3				
029	211	Segera.	0017	1.3				
* 030	271	Nyalin (MV)	0034	1.3				
031	211	Kembang Semangkok = 19	0011	1.3				
032	275	Upi	0019	1.3				
033	211	Ubah	0074	1.3				
034	211	Selukai Lada = 6.	0033	1.3				
035	215	Segera = 29.	0016	1.3				
036	211	Engkelili Hutan = 17	0013	1.3				
037	211	Kemantan	0048	1.3				
038	211	Engkelili Hutan = 17	0013	1.3				
039	261	Segera. = 29.	0016	1.3				
040	211	Seladah	0100	1.3				
041	211	Medang Pengait	0020	1.3				
042	211	Kandis	0025	1.3				
043	211	Seladah	0089	1.3				
044	211	Tongkat Ali	0047	1.3				
045	211	Segera = 3	0059	1.3				
046	215	Dipterocarpus Globosus.	0036	1.3				
047	211	Nyatoh entelit	0097	1.3				
END								

SIC = STEM IDENTITY CLASS. BH = BUTTRESS HEIGHT. CF = CROWN FORM

POM = POINT OF MEASUREMENT. CI = CROWN ILLUMINATION.

ORIGINAL

END / CONTINUE

Figure 4: Sample of Field Card

TREE	COMPLETE STEM	BROKEN STEM	BROKEN STUMP	CUT STUMP	BROKEN NEW GROWTH	BROKEN ASSESSMENT
Alive, standing	111	112	113	114	115	116
Alive, fallen	121	122	123	124	125	126
Dead, standing	131	132	133	134	XXX	XXX
Dead, fallen	141	142	143	144	XXX	XXX
2+ stems, standing	151	152	153	154	155	156
Dead at POM, coppice present	XXX	182	183	184	185	186
Missing tree — Alive 198				Missing tree — Dead 199		

SAPLINGS	COMPLETE STEM	BROKEN STEM	BROKEN STUMP	CUT STUMP	BROKEN NEW GROWTH	BROKEN ASSESSMENT
Alive, standing	211	212	213	214	215	216
Alive, fallen	221	222	223	224	225	226
Dead, standing	231	232	233	234	XXX	XXX
Dead, fallen	241	242	243	244	XXX	XXX
2+ stems, standing	251	252	253	254	255	256
Branch below POM	261	262	263	264	265	266
Coppies below POM	271	272	273	274	275	276
Dead at POM, coppice present	XXX	282	283	284	285	286
Missing sapling — 298				Dead before first SIC — 299		

CROWN ILLUMINATION	
EMERGENT	1
FULL OVERHEAD LIGHT	2
SOME OVERHEAD LIGHT	3
MOSTLY SIDELIGHT	4
NO DIRECT LIGHT	5

CROWN FORM	
COMPLETE CIRCLE	1
IRREGULAR CIRCLE	2
HALF — CIRCLE	3
LESS THAN HALF — CIRCLE	4
ONLY A FEW BRANCHES	5
MAINLY COPPICE	6
ALIVE, BUT NO CROWN	7

Figure 5: Reverse of Field Card

A. FILE NAME = LTERXX (XX = Line No.)

FIELD	PARAMETER	NO. OF FIELDS	FIELD WIDTH	EXAMPLE
1	Year of assessment	XXXX	4	1992
2	Square Number	XX XX Line No. | Square No.	4	0102
3	Sub-Quardrat Number	X X Sub- quardrat square No. in X-axis | Sub-quardrat square No. in Y-axis	2	11/12
4	Tree Number	XXX Tree No.	3	001
5	Nature of forking	0 = No forking 1 = Forking A 2 = Forking B . 9 = more than 10 forking	1	1
6	Species Code	XXXXXX	6	BACCSA
7	Stem Identity Class	XXX	3	111/211
8	Diameter	XXXX Digit is 1/10	4	00260
9	Presence of climber	0 = Absent 1 = Climber Present	1	0
10	Point of Measurement (POM)	X X X 1/10 of a metre	3	013 = 1.3 M
11	Diameter	X X X 1/10 of a metre	3	103 = 10.3 M

Figure 6: Data Entry Format

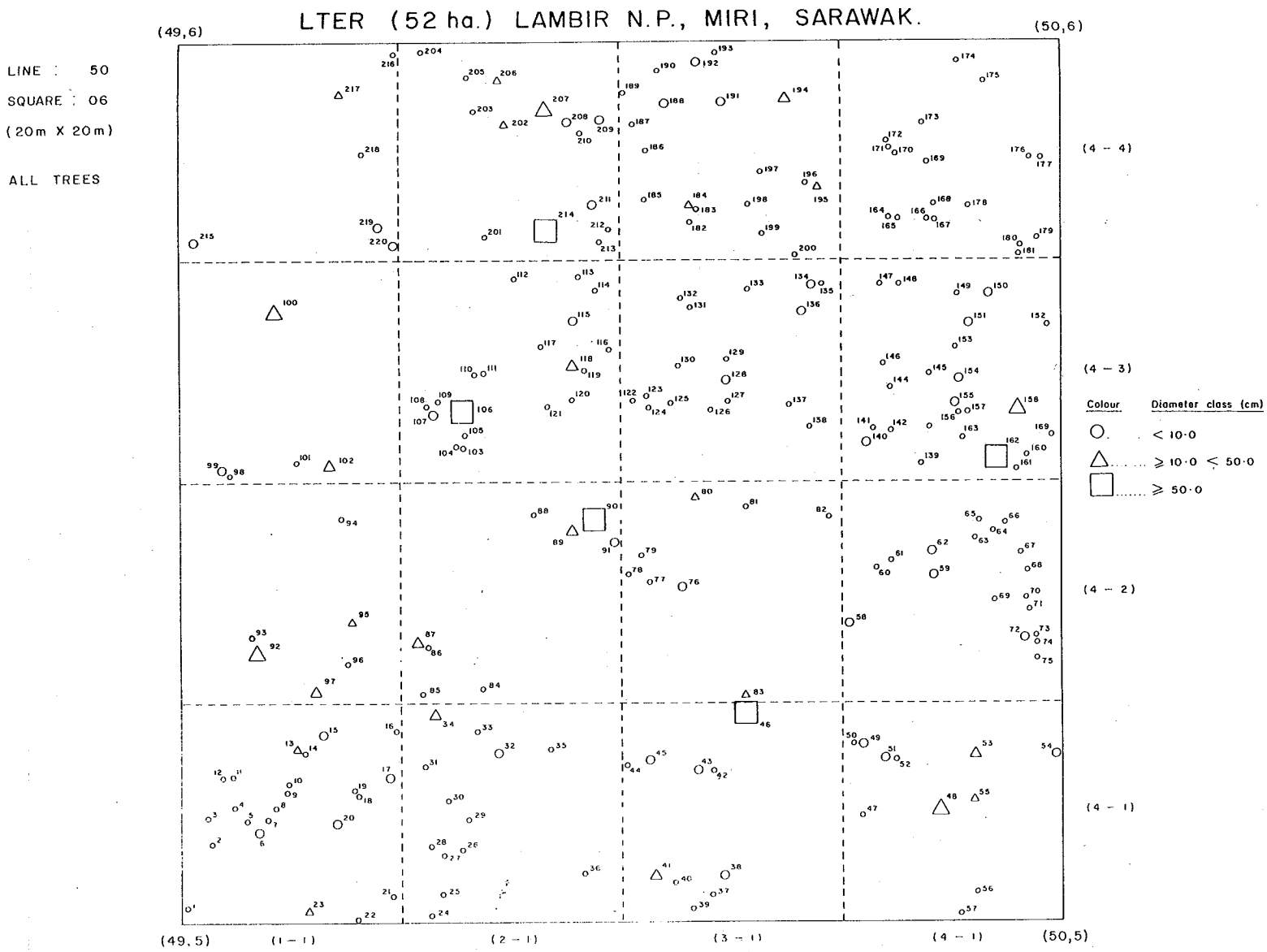


Figure 7. An example of output of the tree map of a 20 mx 20 m square.