The Tree Communities of the Central Catchment Nature Reserve, Singapore

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Abstract

A sample survey was conducted to study the tree communities of the Central Catchment Nature Reserve. The forests were stratified into types using vertical aerial photographs. Some 62 sampling units, each about 0.2 ha in size, were laid down in 3 forest types, consisting mainly of secondary forests, of different degrees of maturity, and relatively undisturbed patches of primary forests. The sampling percent was 0.8

The trees were measured for girths down to 30 cm and identified down to species. In all 7,462 trees were sampled and these were found to belong to 499 species, 46 of which could not be identified. The sample netted in some 20 species of dipterocarps with 154 individuals. A surprising discovery is the presence of 3 *Shorea curtisii* in a patch of primary Lowland Dipterocarp Forest, *sensu* Symington (1941) north of MacRitchie Reservoir. The species is not known to be associated with this forest type in Peninsular Malaysia and Singapore. Another distributional record is the discovery of 2 trees of *Shorea ochrophloia* in another patch of primary forest, though not within the sample. This belongs to the Heavy Hardwood (Balau) Group of the genus *Shorea* and so far none of its members has been recorded in Singapore.

Based on the trends of the species-area curves, the sample appears to have netted in most of the secondary forest species but the primary stands are likely to yield many more species if an inventory of a higher intensity of sampling is carried out.

Stand tables are given to show the distribution of the species in each forest type. Fifty-two species were found to be common to all the three forest types, there being no dipterocarps amongst them, as expected.

The stands from the relatively undisturbed patches of primary forests were compared with those at Bukit Timah. In terms of species complexity some stands of forests of the two places compare well with one another, but in terms of stand densities, and absolute number of species per unit area, the stands of the Catchment Reserve appear to be better than those of the Bukit Timah forests.

The secondary forests of the Reserve are supposed to have been developed on degraded soil. The present edaphic conditions are good.

Introduction

The Central Catchment Nature Reserve (hereafter referred to as the Catchment Reserve or simply the Reserve), estimated in this study to be about 1,660 ha in extent, occupies a central position on Singapore Island (see Fig.1). The vegetation is mostly of a secondary nature but patches of primary forest are scattered

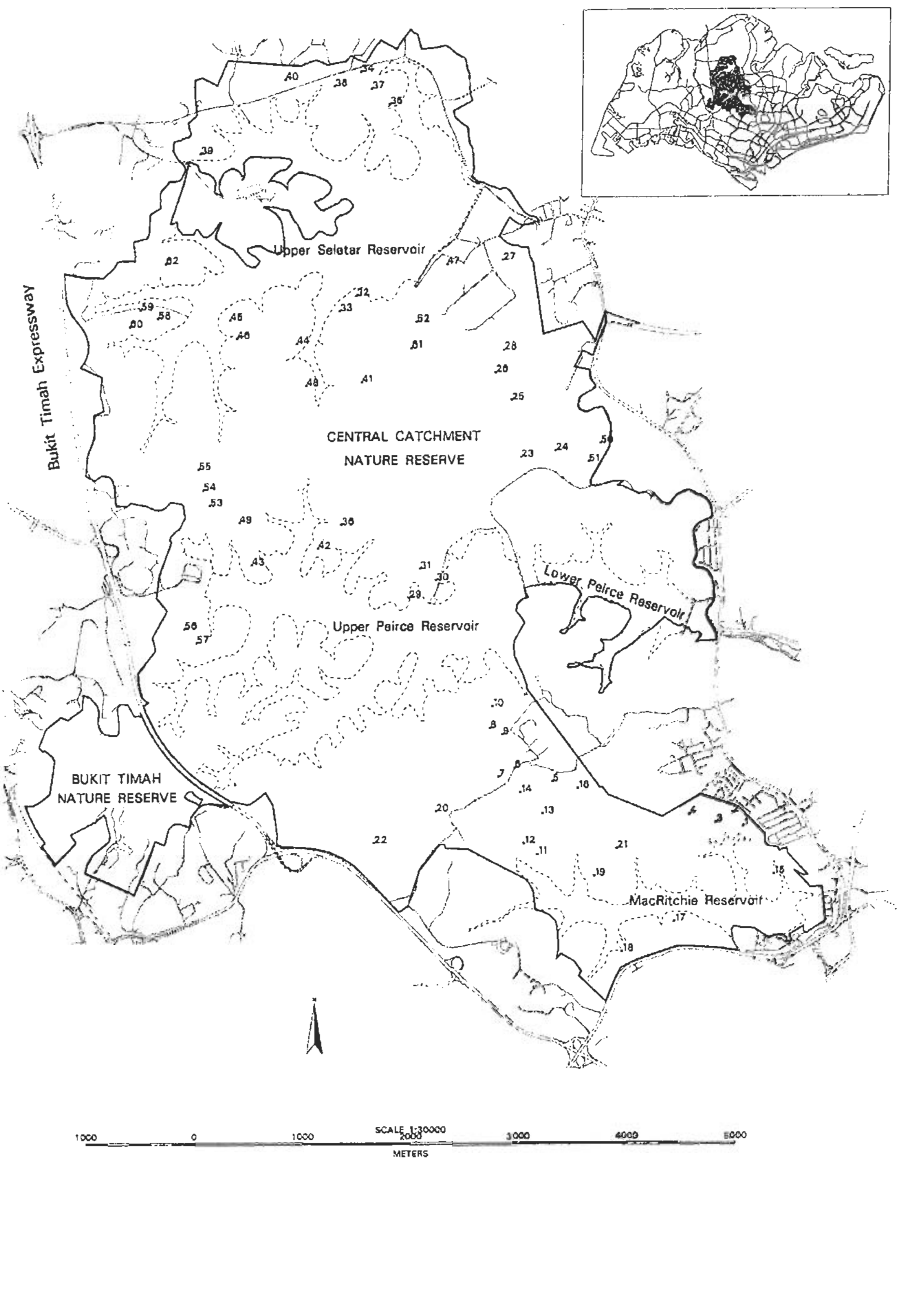

Fig. 1. Distribution of sampling units (clusters) in the Central Catchment Nature Reserve. Insert shows the position of the Nature Reserves within Singapore.

within the mosaic of secondary forests, undergoing different stages of succession.

Many qualitative observations concerning the plant communities within the Reserve have been made in the past. Gilliland (1958) was probably the first ecologist to have made some quantitative study over a small area of the forests. Recently Corlett (1991) while studying the succession in the secondary forests sampled selected areas of the more matured forests. So far as is known no quantitative sampling has ever been done to study the tree populations of the patches of primary forests, which are known to be dipterocarp bearing.

The National Parks Board (NParks), now administering all nature reserves in Singapore, has in the past few years commissioned various scientists and specialists to make studies on both the physical features & biological components of the Reserve. We were asked to study in particular the tree communities. The study covers an area of about 1,530 ha, with an overall sampling intensity of 0.8 %, but with much higher proportions of the sampling units located in older forest types and none in the open areas with early stages of ecological succession (see Table 1). Three of our sampling units are located in the Nee Soon Swamp Forest, estimated to be about 96 ha in extent. Sampling began in early 1992 and a detailed technical report was submitted to NParks in early 1993 (Wong, 1993).

The sampling points are permanently marked at site for future follow-up studies. Fig.1 shows the approximate positions of the sampling points.

Method of Study

1. Stratification of the Study Area into Forest Types

The forests were stratified using black and white vertical aerial photographs of scale 1:20,000 and taken in 1990. Four strata, based on the structures of the forests, could be recognised and were delineated. The phototypes, designated as Forest Types 1 - 4 (FT 1, FT 2, FT 3 & FT 4) were then traced out and a vegetation map produced. The general characteristics of these forest types, based on both photo appearance & ground checks, are briefly described below and the estimated area of each type is given in Table 1.

FT 1. Vegetation of early succession with few scattered trees or groups of trees, the ground being covered with thick Resam ferns

(*Dicranopteris spp.*), or tall shrubs, tall grasses and/or sedges. Tangles of woody climbers are common. The climber *Smilax bracteata* var. *barbata* could be rampant locally, smothering tree crowns.

FT 2. Vegetation with many small trees, 8 to 15 m tall. There is general closure of the canopy, but gaps with Resam and climber tangles are still quite common, although in the areas with a canopy cover, the climbers and ferns may be on their way out. The tree crowns are small; distinct tree crowns may not be discernible in the aerial photos. *Smilax* may still be rampant in places, with tangles of their stems carpeting the forest floor. The tree population has a high proportion of *Adinandra dumosa* and *Rhodamnia cinerea. Myrica esculenta* may also be locally abundant. Advanced growth of sizable trees may be scattered amongst the smaller trees.

FT 3. Vegetation with larger trees and higher density. Canopy is generally continuous. In the aerial photos, distinct tree crowns are discernible, as the larger trees have larger crowns. The canopy may range from 10 to 20m high. Advanced growth or relics of larger trees may be present. *Rhodamnia cinerea* still assumes a high proportion, although that for *Adinandra dumosa* may be reduced (see Appendix 2). The ground may still have some Resam ferns, but if present they exist in a sparse condition. Climbers may still be present. However, no tangles may be on the ground, except in open gaps.

Composition of the trees assumes a more complex nature with many more species to the unit area. High forest trees like species of *Calophyllum* & many species of *Eugenia* may be in the admixtures. *Garcinia* species are also common.

FT 4. Vegetation with a continuous canopy and much taller trees. The profile is typically multi-storey. Some areas may have structures and girth class distribution resembling those of primary forests. Relics left behind by previous fellings would have attained large to enormous sizes. Isolated crowns of emergents are clearly visible in the aerial photos. To this type also belong some patches of near-primary jungles, with the family Dipterocarpaceae showing some degree of structural and family dominance.

Included in this type is also the Nee Soon Swamp Forest.

2. Estimation of Areas of the Reserve and Forest Types

A dot-grid was used to make the estimate and the results are presented in Table 1.

Table 1. Area of Catchment Reserve, with Breakdown into Forest Types (FT) and Sampling Percentage Therein

FT	1	2	3	4	Total
Area (Ha)	124.3	144.4	979.4	283.5	1531.6*
No. of sampling units	0	5	35	22	62
Equivalent Hectares	0	1.0	7.0	4.4	12.4
Percentage Sampling	0	0.7	0.7	1.5	0.8

*Note: Including an area of 130 ha not studied in this survey, the total area of the Reserve appears to be in the region of 1,660 ha. No sampling was done in FT 1, hence the 0's.

3. Sampling Method

The sampling units were located subjectively in the different FT's. As the present study is both an ecological and botanical study, our bias was to locate more of the sampling units in the more matured forests and the near-primary forests (FT's 3 & 4). This is the reason why we did not sample FT 1, and located only 5 clusters in FT 2, which was found in essence to be an earlier stage of FT 3. We also tended to put the sampling units where the trees were.

The sampling unit each consists of a cluster of 4 circles. Each circle is given a radius of 12.6 m; its area is therefore 449 square metres. The 4 circles together therefore have an area of 1,996 square metres or very near to 0.2 ha. For some clusters, the 4 circles were laid systematically in the directions of the cardinal points about, and equidistant from, a centre. This is done when the forest was uniform. When such a systematic layout would hit gaps, the 4 circles were sited subjectively where the trees were. Half the number of the clusters were sited in this way.

In view of the subjective siting of the clusters and also of some of the circles of the cluster, it has therefore to be noted that the results as presented here may be on the optimistic side for each forest type and all interpretations of the results or extra-polation of the data would have to be viewed in this light.

4. **Enumeration And Plant Identification**

Within each circle of a cluster, all trees with girths equal to or larger than 30 cm were measured for girths at 1.3 m from the ground (referred to as girth breast height or gbh). A tree with buttresses higher than 1.3 m from the ground was measured above the buttresses or if these were too high, then the girth of the tree had to be estimated. For a tree with multiple stems, or with coppice shoots, if the bifurcation or splitting occurred at below 1.3 m, then each stem was measured and booked as though it was a separate tree, if its girth met the minimum requirement. Such cases are very common for species like *Rhodamnia cinerea*, *Adinandra dumosa* and *Gynotroches axillaris*. *Timonius wallichianus* and even *Eugenia grandis* also occasionally exhibit such a phenomenon, which is likely to have been induced by fire during early stages of succession. Vestiges of fire damage of very recent occurrences could be seen in areas of FT 1.

After measuring the girth, the tree was notched or lightly blazed with a knife, so as to avoid double accounting. The tree was then identified as far as possible down to species. As most of the trees are sterile at any one period of the year, identification in most cases are based on leaf and bark characteristics, including exudates from within the bark. If the tree could not be identified fully in the field then collection of leaf specimens had to be made for further identification in the herbarium.

The book was closed for every circle.

For the collection of leaf specimens, in most cases it was fairly easy to pick the right leaves on the forest floor. However, in some cases when the tree crown was smothered with heavy climbers, this could prove a difficult task. Indeed in some cases we just failed to know which could be the right leaves. For these, one would just have to give up and record such a tree as "unknown". In the list of trees presented in Appendix 2, the class at the end of the list labelled "ZU" shows such trees. There were in all 19 such individuals, each assumed to be a species. In other cases, although we had good specimens from the field, all matching work in the herbarium nevertheless failed. There were 37 such individuals and we have placed them under 27 species. The numerals prefixed with a "Z" at the end of the plant list in Appendix 2 show these unidentifiable plants.

There are thus in all some 46 species of trees, with 56 individuals, which could not be identified. This is a small percentage (0.73) considering that there are 7,462 trees in the sample of 62 clusters.

Results and Discussions

1. **Floristic Composition**

(a) General

The sample of 62 clusters netted in a total of 7,462 individual trees. A breakdown showing the number of clusters in each forest type and the number of species and individuals sampled therein is summarised in Table 2. FT 4, with 22 clusters, included three clusters located in the Nee Soon Swamp Forest. As stated earlier, 46 species with 56 individuals could not be identified. Of the 7,406 individuals which were identified, they have been found to belong to 453 species and these in turn fall under 63 families.

The list has included a couple of new records for dipterocarps. A few more of the non-dipterocarp species may also turn out to be new records for Singapore and checking is continuing at the Herbarium to confirm this.

The species are listed in Appendix 2 with indications of the number of individuals occurring in each forest type. Table 2 gives a summary of some of the stand attributes.

FT 2 and FT 3 consist of stands with an abundance of secondary forest species. The ubiquitous species is *Rhodamnia cinerea.* It occurs in all the forest types and in 50 of the total sample of 62 clusters. Even in the 15 relatively undisturbed primary forest stands of FT 4, some 60 individuals are found in 6 of them. It is, however, not present in the 3 clusters located within the Nee Soon Swamp Forest.

One reason why a secondary forest species like *Rhodamnia cinerea* appears to be so overwhelmingly present is our treatment of coppiced stems as "individuals" in our enumeration under certain conditions stated earlier. If we had considered only rooted frequency, then its overall numbers would be substantially less. We have, however, not compiled the data in that manner.

Table 2. Species And Individuals In Different Forest Types (FT)
(Species include the 46 unidentifiable species with 56 individuals)

FT	2	3	4	Overall
No. of Clusters	5	35	22	62
No. of Individuals	823	4386	2253	7462
Total No. of Species	65	287	417	499*
No.of identified species	64	271	386	453*
Families of the identified species	31	50	58	63*

*Note : The totals for species & families do not agree with the sum of the individual values because of overlap in species distribution in the different forest types.

The other dominant secondary species are *Adinandra dumosa*, *Timonius wallichianus* and *Macaranga conifera*. All these secondary species, appear to diminish in proportion in the population as the secondary forest gets older. Reference to Appendix 2 will show that *Adinandra* forms 11.5% of the population in FT 2 and it drops to 7.1% in FT 3. In FT 4 the percentage is only 1.3. *Rhodamnia* drops from 31.3%, through 27.9% to 7.3%. The drop for *Macaranga conifera* is dramatic from 17.1%, through 1.0% to 0.22%. *Timonius wallichianus* drops from 4.3% to 2.7% and persists with the latter proportion in FT 4. A species like *Gynotroches axillaris*, which is of frequent occurrence in old secondary forests and primary forests, on the other hand shows about 1.0% in FT 2, 2.4% in FT 3 and 2.0% in FT 4.

One species which is not actually a secondary forest species but nevertheless registers strongly in FT 3 is *Garcinia parvifolia*. Its presence in FT 2 is only 4 individuals out of a population of 823, or less than half a percent, but its proportion goes up to nearly 5%, or 10 times more, in FT

3, showing that originally fruits of this species from perhaps the primary forests had come in to seed up the young secondary forests and as the resultant stands and individuals mature they in turn produce seeds to enable the species to proliferate further. Seedlings of *Garcinia parvifolia* are found in large numbers on the forest floor. The fruits of *Garcinia* are eaten by bats and rodents and these must have been responsible for spreading the species. Reference to Appendix 2 will show similar pattern of succession from FT 2 to FT 3 for some of the *Calophyllum* species, *Gynotroches axillaris*, *Elaeocarpus mastersii,* and *Litsea elliptica.* Whether the same agents are responsible for their spread & proliferation is uncertain.

We present in Table 3 a list of the species common to all the three forest types. There are 52 of them. The list also shows their relative abundance in each of the forest types. Noticeably, but not surprisingly, there are no dipterocarps in the list. However, quite a number of these are high forest species and they are making their presence felt in FT 2 and FT 3, which are essentially secondary forests. Looking at the totals of the list, we note that the total number of individuals of these 52 species amounts to 4,814, or 64.5% of the total individuals in the sample population. The total of 52 is only about 11.6% of the species total of 499.

(b) The Dipterocarps

The dipterocarps are perhaps the most important tree family in the primary lowland forests in Malaysia and Singapore. Twenty-five clusters, 18 in FT 4 and 7 in FT 3, have species of dipterocarps. Taking the whole girth range of => 30cm, there are 154 individuals in the 25 clusters. These belong to 20 species of this family, and the most widespread, though not the most abundant, species is *Vatica ridleyana*, with 15 individuals occurring in 11 of the 25 clusters. The distribution of the other species is shown in the list in Table 4. *Vatica ridleyana* has individuals which are relatively small trees compared with other dipterocarps. If we take the greater girths of the sample, say => 61 cm, we have a population of 114 individuals, then the list is topped by *Shorea pauciflora* with 13 individuals distributed over 10 clusters. Specimens of *S. pauciflora* are huge, the largest encountered has a girth of 386 cm. In contrast the largest tree of *V. ridleyana* has a girth of only 140 cm.

Concerning the dipterocarps, one very interesting and indeed surprising find is the presence of Seraya (*Shorea curtisii*) in Cluster 13 of the Catchment Reserve. The forest type in which this cluster occurs is essentially Lowland Dipterocarp Forest (LDF), *sensu* Symington (1941) and in Peninsular Malaysia this species is not known to grow in LDF.

Table 3. Species Common to All Forest Types

	Species	No. of Individuals			TOTAL
		FT 2	FT 3	FT 4	
1	*Adinandra dumosa*	95	312	29	436
2	*Alstonia angustifolia*	19	39	6	64
3	*Alstonia angustiloba*	1	3	2	6
4	*Antidesma cuspidatum*	1	2	10	13
5	*Aquilaria malaccensis*	2	18	12	32
6	*Archidendron clypearia*	34	16	3	53
7	*Arthrophyllum diversifolium*	1	3	2	6
8	*Artocarpus rigidus*	1	6	5	12
9	*Artocarpus scortechinii*	2	32	19	53
10	*Beilschmiedia madang*	2	9	15	26
11	*Buchanania sessilifolia*	1	1	2	4
12	*Calophyllum pulcherrimum*	1	151	7	159
13	*Calophyllum tetrapterum*	1	23	35	59
14	*Campnosperma auriculatum*	22	93	19	134
15	*Campnosperma squamatum*	1	38	7	46
16	*Castanopsis wallichii*	1	2	1	4
17	*Cratoxylum arborescens*	1	8	2	11
18	*Decaspermum fruticosum*	7	1	1	9
19	*Dysoxylum cauliflorum*	1	9	22	32
20	*Elaeocarpus ferrugineus*	2	37	4	43
21	*Elaeocarpus mastersii*	18	46	4	68
22	*Elaeocarpus petiolatus*	1	17	2	20
23	*Endospermum diadenum*	4	7	5	16
24	*Eugenia glauca*	1	33	3	37
25	*Eugenia grandis*	2	65	3	70
26	*Eugenia longiflora*	37	29	4	70

	Species	No. of Individuals			TOTAL
		FT 2	FT 3	FT 4	
27	*Eugenia microcalyx*	22	16	22	60
28	*Euodia glabra*	13	1	4	18
29	*Fagraea fragrans*	1	9	7	17
30	*Ficus lamponga*	1	1	1	3
31	*Garcinia parvifolia*	4	213	40	257
32	*Gironniera nervosa*	11	60	47	118
33	*Gynotroches axillaris*	8	107	46	161
34	*Horsfieldia polyspherula*	1	12	18	31
35	*Ixonanthes reticulata*	9	38	11	58
36	*Knema intermedia*	5	6	5	16
37	*Lithocarpus ewyckii*	1	7	11	19
38	*Litsea elliptica*	1	67	33	101
39	*Litsea firma*	3	59	10	72
40	*Litsea grandis*	5	18	3	26
41	*Macaranga conifera*	141	45	5	191
42	*Macaranga triloba*	8	11	4	23
43	*Porterandia anisophylla*	4	29	14	47
44	*Prunus polystachya*	1	29	42	72
45	*Pternandra echinata*	2	47	15	64
46	*Rhodamnia cinerea*	258	1217	165	1640
47	*Scorodocarpus borneensis*	2	1	6	9
48	*Streblus elongatus*	6	14	15	35
49	*Styrax benzoin*	1	1	1	3
50	*Timonius wallichianus*	27	188	61	276
51	*Vitex pinnata*	1	6	1	8
52	*Xanthophyllum ellipticum*	1	2	3	6
	Total	796	3204	814	4814

Table 4. Dipterocarps in 25 Clusters, 18 in FT 4 and 7 in FT 3.
(All species => 30 cm girth)
(15 clusters in FT 4 are relatively undisturbed Primary Forests)
(INDI = No.of individuals, CSP = No. of clusters in which the species occur.)

	SPECIES	INDI	CSP
1	*Vatica ridleyana*	15	11
2	*Shorea pauciflora*	13	10
3	*Shorea macroptera*	18	9
4	*Dipterocarpus sublamellatus*	16	7
5	*Shorea parvifolia*	7	6
6	*Anisoptera megistocarpa*	7	5
7	*Hopea griffithii*	11	4
8	*Hopea mengarawan*	10	4
9	*Shorea gibbosa*	6	4
10	*Shorea leprosula*	7	4
11	*Vatica maingayi*	5	4
12	*Dipterocarpus grandiflorus*	15	3
13	*Shorea bracteolata*	3	3
14	*Shorea ovalis*	5	3
15	*Dipterocarpus cornutus*	5	2
16	*Shorea gratissima*	4	2
17	*Shorea platycarpa*	2	2
18	*Dipterocarpus apterus*	1	1
19	*Shorea curtisii*	3	1
20	*Vatica ?ridleyana*	1	1
	Total	154	

(Same Stands but with species => 61 cm girth)

	SPECIES	INDI	CSP
1	*Shorea pauciflora*	13	10
2	*Shorea macroptera*	12	6
3	*Shorea parvifolia*	7	6
4	*Vatica ridleyana*	9	6
5	*Anisoptera megistocarpa*	4	4
6	*Dipterocarpus sublamellatus*	9	4
7	*Shorea gibbosa*	5	4
8	*Shorea leprosula*	7	4
9	*Hopea griffithii*	8	3
10	*Dipterocarpus grandiflorus*	14	2
11	*Hopea mengarawan*	4	2
12	*Shorea bracteolata*	2	2
13	*Shorea gratissima*	4	2
14	*Shorea ovalis*	4	2
15	*Vatica maingayi*	3	2
16	*Dipterocarpus apterus*	1	1
17	*Dipterocarpus cornutus*	4	1
18	*Shorea curtisii*	3	1
19	*Shorea platycarpa*	1	1
Total		114	

There, the species is found in the hill forests in the Main Range and other localities, generally beginning to occur at an elevation of about 300 m asl and rising up to 800 m asl, although in some Coastal Hill Forests, *sensu* Symington (1941) it begins to occur at much lower elevations.

In Singapore hitherto Seraya was known only from Bukit Timah. The forest at Bukit Timah is a Coastal Hill Forest according to Symington's classification.

Four Seraya trees were found, one of which was dead. The elevation of the site as shown in a topographic map is about 30 - 40 m asl. All four trees have attained a fair size. The three living ones have girths of 210, 216, and 267 cm. The trees are growing on a slight slope and regeneration appears to be quite numerous on the ground, with the taller ones having reached a height of about 3 to 4 m.

We also stumbled upon two *Shorea ochrophloia*, one near Cluster 21 and another near Cluster 55. This belongs to the Balau (Heavy Hardwood) Group of the genus *Shorea*. This is a new record for Singapore. Subsequent to this discovery, two more trees were found in a sample plot in Bukit Timah Nature Reserve. The plot has been used in a study undertaken by the Smithsonian Tropical Research Institute in collaboration with the National Institute of Education in Singapore. Hitherto, the heavy hardwood Shoreas have not been found in Singapore, although they are of common or sporadic occurrences in the Malaysian jungles, both in the lowland and in the hill forests. It is a matter for conjecture as to why we do not see more of the balaus in the Catchment Reserve. One reason could be that their timbers are naturally durable and were therefore continuously sought for constructional purposes during the early days of timber utilisation, when the technology for preservation had not been developed, taking not only big trees for conversion into sawn timbers but also pole sized timbers for rustic uses, perhaps also for use as firewood in the cooking of gambier, because dense timbers, such as they are, normally have higher calorific values. If the balaus were in the Catchment forests before, it is perhaps the continuous exploitation of small poles in addition to big sized timbers that had spelt their doom. They are very slow growing and conceivably poles were taken out even before they had reached reproductive age.

Another interesting find is *Dipterocarpus apterus*. Although not exactly a new record, only one specimen had been collected near MacRitchie Reservoir in 1957. We found the only specimen in our sample in Cluster 58, at the extreme west of Seletar Reservoir.

As pointed out earlier FT 3, essentially forests of a secondary nature, also has 7 stands with dipterocarps. This may give the impression that they are making a comeback in the secondary forests. This, however is not the case; it is more the outcome of our having used structure to delineate the forests into photo-types. In this process, highly disturbed forests with remnants of dipterocarps have been classified as FT 3.

2. **Degrees of Complexity of the Tree Flora**

We use the conventional *Mischungsquotient* (Richard, 1964), which is simply the ratio of the number of individuals per species of a population, to show the complexity. Under normal stand densities, the smaller the ratio, meaning few individuals to the species, the more complex is the specific composition of a forest. The ratio has been worked out for each cluster by forest type and the results are presented in Appendix 1. Looking at the mean values of the ratios for the forest types, as expected, one notes a gradation from a high to a low value as the forests mature from FT 2, through FT 3 to FT 4. The mean value for FT 2 is 7.3, that for FT 3, 3.9, and that for FT 4, 2.1. This shows higher complexity as the forests mature. In simple terms, for the stands of FT 2, for every species we encounter, there may be over 7 individuals in the forests, and the respective figures for FT 3 & FT 4 are about 4 and 2 individuals.

3. **The Species-Area Curve**

In our sample we have netted in 499 species of the trees with the minimum girth of 30 cm. To what extent have we exhausted the species list or are we likely to find more species of the same girth range? To give us some indications of this, we have plotted two species-area curves, one for FT 4 alone and the other for FT 2 & FT 3 combined. The reason for combining FT 2 & FT 3 is that these stands are located in secondary or highly disturbed, but not clear felled, regenerated forests, while FT 4 are in patches of primary forests, although 5 of these stands also have species lists suggesting they are matured secondary forests.

There are several ways of plotting a species-area curve (Greig-Smith, 1964). The method we have used here is perhaps the least efficient according to him. The area of a particular point in the graph is simply the cumulative total of areas of clusters added up to that point. Likewise the corresponding cumulative total for the species of the clusters is used. For the toting up we followed the numerical order in which the clusters were sampled in each forest type. FT 2 & FT 3 has a combined population of 5,209, and FT 4 2,253, individuals. The respective number of species are 293 and 417.

Table 5. Girth Class and Basal Area Distribution of trees in the Catchment Reserve (All trees with girths => 30 cm included. B.A.=basal area in m^2/ha.)

Girth (cm)		30-<60	60-<90	90-<120	120-<150	150-<180	180-<210	210-<240	>=240	Total
FT 2/3										
(1)	No. of sampled trees	3242	1277	411	145	66	36	14	18	5209
(2)	No.of trees/ha	405	160	51	18	8	5	2	2	
(3)	B.A. of (1)	48.0	52.9	34.3	20.5	13.7	10.6	5.6	11.3	196.9
(4)	B.A./ha	6.0	6.6	4.3	2.6	1.7	1.3	0.7	1.4	
FT 4										
(1)	No. of sampled trees	1178	493	215	127	91	57	36	56	2253
(2)	No.of trees/ha	268	112	49	29	21	13	8	13	
(3)	B.A. of (1)	17.5	21.0	18.1	17.7	19.1	17.0	13.9	35.6	159.9
(4)	B.A./ha	4.0	4.8	4.1	4.0	4.3	3.9	3.2	8.1	

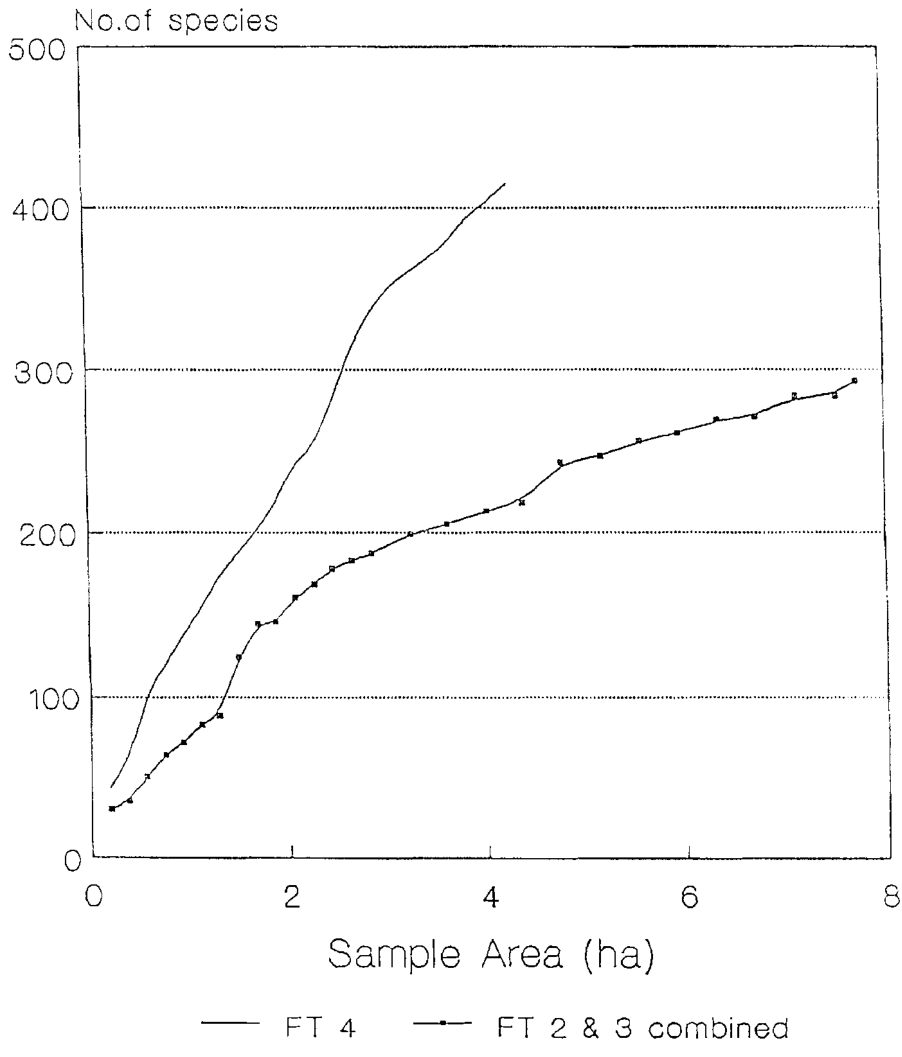

Fig. 2. Species / area curves
FT 2/3: S'dary foreests, 40 plots, 293 spp
FT 4: Mainly primary,, 22 plots, 417 spp

The two species-area curves are presented in Fig. 2. They show very characteristic trends. The curve for FT 2/3 shows not only a more gradual gradient, indicating more gradual species recruitment as the area increases, but also a definite gradual flattening out, indicating that our sample has perhaps netted in most of the species. Contrasting, the curve for FT 4 rises much more steeply and at the end still shows no flattening out, indicating that our sample of 22 clusters has in no way yet got most of the species. As a corollary, if we sample FT 4 more thoroughly, we are likely to net in many more species.

4. Stand Density Attributes

Table 5 shows the stem densities and basal areas by girth classes. We are showing separately these attributes for FT 2 and FT 3 combined (40 clusters) and FT 4 by itself (22 clusters) for comparison. In both cases, the whole range of girth classes of =>30 cm is used.

It can be seen that the structure, in terms of girth class distribution, is typical of uneven-aged forests, with a high proportion of small stems, and as girth size increases, the number of trees drops rapidly. For the secondary forests one would expect the girth distribution to show a truncation after a certain point. The fact that FT 2/FT 3 have individuals dragging into the higher girth classes could be due to FT 3 having a few stands with relics or advanced growth.

In the FT 2/FT 3 forests, the strong presence of young poles in the 30 - 60 cm class shows that recruitment for the forest as a whole is good and this augers well for the Catchment Reserve.

As expected, FT 4 does show that the population has many individuals with very large girths, far outnumbering those of the younger stands in FT 2 & FT 3.

5. Vegetation dynamics

Although we did not sample FT 1, there is no doubt that within the Catchment Reserve this open type of vegetation would in time develop into the FT 2 type of forests, thence to FT 3, in the natural succession. The speed with which this process will take place would no doubt depend on edaphic, aerial and biotic factors. From FT 1 to FT 2, incidence of bush fire could play an important role. While it may destroy a stand of small trees, it may on the other hand burn up an existing climber or Resam thicket to enable the area to be seeded up by tree species. From FT 2 to FT 3, the presence of nearby seed sources would certainly speed up succession. The existing stands of FT 4 and the more matured stands of FT 3 will form such sources. Dispersal of such high-forest genera like *Garcinia*, *Calophyllum*, *Eugenia* and *Gynotoches* from these sources is definitely helped by birds, rodents and bats.

In general, at the moment, compositions of the FT 2 and FT 3 stands bear close similarities to Stage 3 & Stage 4 respectively of the succession described by Corlett (1991).

The influence of proximity of a seed source in succession is very much borne out by the observations of Sim et al (1992). They laid down 7 sample plots in secondary forests now dominated by *Adinandra dumosa*, perhaps much like FT 2 in our present study. All but one were isolated areas, the exception being in the Bukit Timah Nature Reserve. They have stated that succession in these plots has been arrested due inter alia to low pH, poor soil nutrients and the lack of a seed source to add new species to such communities. However, scrutiny of their plant lists reveals the presence of a substantial proportion of high forest tree species in their Bukit Timah plot. These species occur exclusively in that particular plot. The species are *Calophyllum pulcherrimum*, *Calophyllum* sp.1, *Calophyllum* sp.2, *Eugenia* sp.1, *Eugenia* sp.2, *Eurycoma longifolia*, *Gynotroches axillaris*, *Ochanostachys amentacea*, *Palaquium gutta*, *Psychotria* sp., and *Santiria apiculata*. It is clear evidence that succession has progressed beyond the *Adinandra/Rhodamnia* (equivalent to our FT 2) stage and the factor that is responsible is undoubtedly a nearby source of seeds of such high-forest species from within the Bukit Timah Nature Reserve.

6. **Forests Of Bukit Timah and Catchment Reserve Compared**

(a) **Floristic compositions**

As the Coastal Hill Forest, *sensu* Symington (1941), on Bukit Timah is the only other dipterocarp forest of a primary nature found in Singapore we would like to compare it with the stands of the primary forest of the Catchment Reserve which essentially is typical Lowland Dipterocarp Forest.

For this comparison we have taken the sampling units sited in the relatively undisturbed primary forest stands of the Catchment Reserve, but excluding the Nee Soon Swamp Forest, and those on Bukit Timah reported by Wong (1987). There are respectively 15 and 16 clusters. As the Bukit Timah sampling was for trees =>24 inches (61 cm) corresponding data of the Catchment Reserve were used.

Table 6. Comparison of Dipterocarps In Bukit Timah (BT) and the Central Catchment Reserve (CR)

(All trees with girth =>61 cm. The sample at BT has 16 clusters, at CR 15 clusters.)

	SPECIES	No.of individuals BT	CR
1	*Anisoptera costata*	1	0
2.	*Anisoptera megistocarpa*	0	4
3.	*Dipterocarpus apterus*	0	1
4.	*Dipterocarpus caudatus* ssp *penangianus*	29	0
5.	*Dipterocarpus cornutus*	0	4
6.	*Dipterocarpus grandiflorus*	0	14
7.	*Dipterocarpus sublamellatus*	3	7
8.	*Hopea griffithii*	0	8
9.	*Hopea mengarawan*	3	4
10.	*Shorea bracteolata*	1	1
11.	*Shorea curtisii*	41	3
12.	*Shorea gibbosa*	0	4
13.	*Shorea gratissima*	3	4
14.	*Shorea leprosula*	7	6
15.	*Shorea macroptera*	4	8
16.	*Shorea ovalis*	0	1
17.	*Shorea parvifolia*	0	4
18.	*Shorea pauciflora*	9	9
19.	*Vatica maingayi*	0	3
20	*Vatica ridleyana*	0	3
21.	*Vatica sp.A*	1	0
	Total	102	88

Table 6 shows that the Catchment Reserve has 18 species of dipterocarps and Bukit Timah 11 species, this despite the fact that the trees of Bukit Timah were sampled with 16 clusters while those of the Catchment Reserve with 15. However, this is to be expected as those clusters sited in the Catchment Reserve are spread over a much wider area, whereas those in Bukit Timah are located within a solid block of forests of 75 ha. In terms of individuals, the Bukit Timah stands appear to have more dipterocarps, there being 102 individuals compared to 88 in the Catchment Reserve sample. This superiority in numbers is due to the presence of large numbers of *Shorea curtisii* and *Dipterocarpus caudatus* ssp *penangianus* in the Bukit Timah stands.

(b) **Relative floristic complexity & stand densities of the two Areas**

We now compare the *Mischungsquotients* of the two areas. The comparison is presented in Table 7. It can be seen that the average stand of the Bukit Timah forest has a smaller quotient of 1.5, compared to 1.9 of the average stand in the Catchment Reserve. As stated earlier under normal stand densities, the smaller the quotient, the more complex is the stand. However, it has to be said that a low stocking, concomitant with the number of species being constant, could also give rise to small quotients. Looking at Table 7 and 8, the species per cluster of the two areas did not vary much (BT = 22.9 & CR = 24.5 species/cluster) but the stand densities of the Bukit Timah forests appear to be consistently much below those of the Catchment forests, showing that the reason for the lower quotients in Bukit Timah is exactly what has been just stated. So despite their smaller mean, the complexity of the forests in absolute terms appears to be not as good as that of the Catchment forests. To put it in another way, the Catchment forests have overall denser stocking and a higher number of species per unit area. The Catchment Reserve being more species rich is also borne out by the fact that for the 16 stands in the Bukit Timah forests there are 178 species of trees with girths => 61 cm. but the number in the Catchment Reserve is 215 species.

Our first reaction to the higher stocking density in the Catchment Reserve, when compared to stands at Bukit Timah, is that the stands in the Catchment Reserve may have smaller trees, because it is quite common to have young stands with a high density but with the numbers made up of small trees. To check on this point we present a comparison of the girth class distribution of the forests of the two places in Table 8. Looking at this comparison one is amazed by the fact that for the girth distributions of the two areas, class for class the number of trees per ha for the Catchment Reserve outnumbers that obtained for the Bukit Timah forests. And looking at the basal area per tree figures, class for class the size of the average tree of CR is remarkably similar to that of BT, showing that the higher stocking of the forests in the Catchment Reserve is achieved not through having a population of small trees.

Table 7. *Mischungsquotients* or Number of Individuals per Species

(Comparing the 15 less disturbed clusters of FT 4 with 16 clusters of primary forests of Bukit Timah. All trees are with gbh => 61 cm. The relevant stands of the Catchment Reserve contain 215 spp., the Bukit Timah stands only 178 spp.)

	Bukit Timah			Catchment Reserve		
	No.of Indiv.	No.of Species	*Mischungs-quotient*	No.of Indiv	No.of Species	*Mischungs-quotient*
	28	19	1.5	51	24	2.1
	42	28	1.5	31	23	1.4
	38	22	1.7	43	23	1.9
	42	27	1.6	27	17	1.6
	37	25	1.5	51	28	1.8
	39	27	1.4	55	26	2.1
	30	25	1.2	20	10	2.0
	32	20	1.6	50	23	2.2
	24	23	1.0	50	36	1.4
	24	20	1.2	52	26	2.0
	32	19	1.7	51	26	2.0
	39	24	1.6	59	22	2.7
	50	25	2.0	50	33	1.5
	27	21	1.3	35	13	2.7
	33	23	1.4	60	37	1.6
	23	19	1.2	-	-	-
Total	540	367		685	367*	
Mean	33.7	22.9	1.5	45.7	24.5	1.9

*Note: the two totals are exactly the same; this is entirely fortuitous.

Table 8. Distribution of Girths & Basal Areas (B.A.) in Stands of Bukit Timah and FT 4 of the Catchment Reserve (CR)

(All trees with girths =>61 cm. The same stands as used in Table 6 are used here for comparison)

Girth Classes (cm)	60-<90	90-<120	120-<150	150-<180	180-<210	210-<240	>=240	Total
CR No.of trees/ha	93	47	28	22	15	8	16	32.7
B.A. (m^2)	4.0	3.9	3.9	4.6	4.4	3.2	10.5	4.9
B.A./tree	0.04	0.08	0.14	0.21	0.29	0.40	0.66	
BT No.of trees/ha	70	43	18	13	10	7	8	24.1
B.A. (m^2)	3.1	3.6	2.6	2.9	3.0	2.8	5.5	3.3
B.A./tree	0.04	0.08	0.14	0.22	0.30	0.40	0.69	

At the upper extremes of the girth classes (=> 240 cm) there are actually 48 trees in the sample of the Catchment Reserve; 16 of these trees have girths exceeding 300 cm. The corresponding numbers for the Bukit Timah sample are 26 trees and 5 trees. However, the largest tree in the Bukit Timah sample (a *Shorea curtisii*) has a girth of 194 inches (or about 490 cm), whereas that in the Catchment Reserve (a *Dyera costulata*) is only 424 cm. The largest dipterocarp in the FT 4 in the sample is a *Shorea pauciflora* with a girth of 386 cm. (Note: the largest tree we came across in the Catchment Reserve, not in the sample, but not far from Cluster 13 northwest of MacRithchie Reservoir, is a *Dyera costulata* with a girth at breast height of 615 cm.)

From the above comparison of the less disturbed dipterocarp bearing stands of the two areas, one can conclude that such patches of forests in the Catchment Reserve are in some ways superior to the stands at Bukit Timah.

Conclusions

The relatively undisturbed stands of the primary forests of the Central Catchment Nature Reserve are indeed valuable natural assets because of their very diverse specific compositions and they therefore still contain a very large gene pool. The stands of secondary forests with very varied specific compositions also constitute a valuable scientific asset. They have redeveloped by themselves after the original forests were cleared and the land parcels used for long periods of cultivation until they were declared as protected catchment areas when cultivation was stopped. For the areas now with a tree cover, the regrowth period may vary from 50 to well over 130 years. The stands offer a good insight on plant succession under such conditions and could be used for scientific comparisons with vegetation developed in other parts of the Tropics.

The present study shows beyond doubt that some of the forest stands have floristic compositions and structural characteristics similar to those of primary forests in the Malaysian region. We do not know the exact history of these stands. Some of these could have been undisturbed; others could have been reserved for the supply of fuel wood for the gambier plantations and were therefore exploited to different degrees during the last Century. However, if they were so disturbed before, the vestiges of disturbance are now completely absent. Some of these areas surrounding the MacRitchie Reservoir must have been protected since the construction of this reservoir in 1867 (Anon., PUB publication, 1985). Over this long period of time, even if the stands had been disturbed, natural regeneration aided by the relics, including the dipterocarps, would have made such stands recover completely, ensuring also their biological diversity.

These primary stands are classified under Forest Type 4 (FT 4). Although according to the aerial phototyping and estimate of areas, this type amounts to some 280 ha, some of these have been found to be matured stands of secondary forests with big advanced growth or relics, including species of dipterocarps. The exact extent of the really primary patches is likely to be somewhat less than this.

Analysing the stand attributes of these primary stands, one is of the view that some stands are superior to those on Bukit Timah, traditionally regarded as the only place in Singapore with primary forests.

The species/area curve of the stands of FT 4 and that for the Bukit Timah forests show similar form with a sharp gradient without any flattening out, indicating that in both places more species are expected to be found, if a more intensive inventory is done.

The stands of secondary forests show the dynamics of succession in the Catchment Reserve and are developing well. The older of the truly secondary stands which have developed on land abandoned after prolonged cultivation (Corlett, 1991) though with superior stocking and with many high forest species now, yet do not have any species of dipterocarps. As dipterocarps have very inefficient seed dispersal, seeding under natural conditions may not happen and such stands might eventually mature into non-dipterocarp forests.

Corlett (1991) reckons that the secondary forests within the Catchment Reserve have developed from land severely degraded or exhausted by cultivation (gambier, pepper & pineapple being important crops). Degradation and exhaustion, however, were not defined. Agronomically we would regard severe sheet erosion, so much so that substantial layers of the solum are gone, and with severe gully formations, as severe degradation. We have during the 10 months of field work not found any evidence of severe gully formation and now that the forest cover is so good with a good litter on the forest floor and a good organic layer beneath, even if sheet erosion had occurred before, it would be difficult to discern now. We did, however, see some excavated spots, trenches here and there, and vestiges of roads and rides.

Looking at some of the trenches present (dug presumably during the War), the soil is deep and the profile is just as good as any one could see in a Rengam Series, an Ultisol of granitic origin, which is what the soil in the Reserve is, excepting of course the swamps and riparian fringes.

Acknowledgements

We are indebted to the National Parks Board and its Executive Director, Dr Tan Wee Kiat, for having given us the golden opportunity of conducting the survey for the Central Catchment Nature Reserve and for having given their permission for the data to be published in this article.

Dr Leong Chee Chiew, Mr Tay Eng Pin and Mr Robert Teo, all staff members of the Botanic Gardens did much of the spade work to have the survey initiated and also provided assistance during the field work for which we should like to express our grateful thanks.

We should also like to express our appreciation for the assistance provided by Dr Ian Turner and Dr Hugh Tan of the Botany Department, NUS, in checking the authenticities of many of the plants and plant names.

Last but not least, all of us involved in the survey wish to express our thanks to the PUB for having made available a boat and boatman for ferrying us to and from some of our sampling sites.

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Appendix 1. *Mischungsquotients* or No. of Individuals/Sp. for All Clusters of the Catchment Reserve (All trees => 30 cm gbh)

FT	Cluster	No. of Indiv	No. of Species	*Michungsquotient*
2	38	150	18	8.3
2	45	192	13	14.8
2	46	158	18	8.8
2	59	150	40	3.8
2	60	173	24	7.2
	Total	823	113	
	Mean	164.6	22.6	7.3
3	1	84	30	2.8
3	2	92	23	4
3	3	162	34	4.8
3	8	78	31	2.5
3	9	106	23	4.6
3	10	112	24	4.7
3	14	157	21	7.5
3	17	100	58	1.7
3	18	124	56	2.2
3	20	97	21	4.6
3	23	136	41	3.3
3	24	132	26	5.1
3	25	140	33	4.2
3	29	133	34	3.9
3	30	124	21	5.9
3	31	117	16	7.3
3	32	105	44	2.4
3	33	137	30	4.6
3	34	120	25	4.8
3	35	124	43	2.9
3	37	141	23	6.1
3	39	101	29	3.5
3	40	119	54	2.2
3	41	164	37	4.4
3	42	164	38	4.3
3	43	198	31	6.4
3	44	126	41	3.1
3	48	121	19	6.4

FT	Cluster	No. of Indiv	No. of Species	*Michungsquotient*
3	50	112	32	3.5
3	51	96	28	3.4
3	53	125	22	5.7
3	54	168	27	6.2
3	57	116	38	3.1
3	61	123	21	5.9
3	62	132	48	2.8
		Total	4386	1122
		Mean	125.3	32.1 3.9
4	4	90	44	2.0
4	5	92	25	3.7
4	6	63	50	1.3
4	7	71	39	1.8
4	11	70	43	2.0
4	13	105	56	1.9
4	15	95	42	2.3
4	16	81	44	1.8
4	19	85	42	2.0
4	21	94	29	4.6
4	26	108	53	2.0
4	27	107	71	1.5
4	28	121	61	2.0
4	36	128	61	2.1
4	47	132	36	3.7
4	49	110	50	2.2
4	52	144	56	2.6
4	55	106	72	1.5
4	56	104	39	2.7
4	58	126	71	1.8
	Total	2253	1090	
	Mean	102.4	49.5	2.1

Appendix 2. Distribution of Species In Forest Types (FT)

(All 62 Clusters, with 5 in Ft2, 35 in Ft3 and 22 in FT4)

(At end of list, Z=trees with collected leaf specimens but could not be identified in the herbarium, ZU=trees for which we failed to collect leaf specimens & could not be identified)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
1.	*Acronychia porteri* Hook. f.	0	9	11	20
2.	*Actinodaphne glomerata* (Bl.) Nees	0	1	0	1
3.	*Actinodaphne malaccensis* Hook. f.	0	3	2	5
4.	*Actinodaphne pruinosa* Nees	0	6	2	8
5.	*Adenanthera bicolor* Moon	0	10	14	24
6.	*Adinandra dumosa* Jack	95	312	29	436
7.	*Aglaia exstipulata* (Griff.) Theob.	0	0	1	1
8.	*Aglaia leucophylla* King	0	1	0	1
9.	*Aglaia maingayi* (Hiern) King	0	0	6	6
10.	*Aglaia malaccensis* (Ridl.) Pannell	0	0	6	6
11.	*Aglaia odoratissima* Bl.	0	0	2	2
12.	*Aglaia rubiginosa* (Hiern) Pannell	0	0	2	2
13.	*Aglaia* sp.	0	0	1	1
14.	*Aidia wallichiana* Tirv.	0	13	4	17
15.	*Alangium nobile* (Clarke) Harms	0	0	2	2
16.	*Albizia splendens* Miq.	0	1	2	3
17.	*Alphonsea maingayi* Hook. f. & Thoms.	0	0	5	5
18.	*Alseodaphne bancana* Miq.	0	0	6	6
19.	*Alseodaphne intermedia* kosterman	0	0	1	1
20.	*Alstonia angustifolia* Wall. ex A. DC.	19	39	6	64
21.	*Alstonia angustiloba* Miq.	1	3	2	6
22.	*Anisophyllea griffithii* Oliv.	0	0	1	1
23.	*Anisoptera megistocarpa* Sloot.	0	1	6	7
24.	*Antidesma coriaceum* Tul.	0	2	2	4
25.	*Antidesma cuspidatum* M.A.	1	2	10	13
26.	*Antidesma neurocarpum* Miq.	0	0	1	1
27.	*Antidesma salicinum* Ridl.	0	0	1	1
28.	*Aphanomyrtus skiophila* (Duthie) Valeton	0	1	0	1
29.	*Aporusa ?nervosa*	0	4	1	5
30.	*Aporusa ?penanqensis*	0	0	1	1
31.	*Aporusa benthamiana* Hook. f.	0	3	6	9
32.	*Aporusa bracteosa* P. & H.	0	0	3	3

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
33.	*Aporusa frutescens* Bl.	0	2	1	3
34.	*Aporusa miqueliana* M.A.	0	2	0	2
35.	*Aporusa nervosa* Hook. f.	0	1	2	3
36.	*Aporusa penangensis* (Ridl.) Airy Shaw	0	4	1	5
37.	*Aporusa symplocoides* (Hook. f.) Gage	0	6	2	8
38.	*Aquilaria malaccensis* Lamk.	2	18	12	32
39.	*Archidendron clypearia* (Jack) I. Niels	34	16	3	53
40.	*Archidendron ellipticum* (Bl.) Niels.	0	0	1	1
41.	*Archidendron globosum* (B1.) Niels.	0	2	1	3
42.	*Ardisia colorata* Roxb.	0	0	1	1
43.	*Arthrophyllum diversifolium* Bl.	1	3	2	6
44.	*Artocarpus ?kemando*	0	1	0	1
45.	*Artocarpus anisophyllus* Miq.	0	1	3	4
46.	*Artocarpus dadah* Miq.	0	8	4	12
47.	*Artocarpus fulvicortex* Jarrett	0	0	1	1
48.	*Artocarpus heterophyllus* Lamk.	0	2	0	2
49.	*Artocarpus integer* (Thunb.) Merr.	0	3	1	4
50.	*Artocarpus kemando* Miq.	0	1	8	9
51.	*Artocarpus lanceifolius* Roxb.	0	0	1	1
52.	*Artocarpus lowii* King	0	2	1	3
53.	*Artocarpus nitidus* Trec.	1	6	5	12
54.	*Artocarpus rigidus* B1.	2	32	19	53
55.	*Artocarpus scortechinii* King	0	1	0	1
56.	*Baccaurea ?sumatrana*	0	0	1	1
57.	*Baccaurea hookeri* Gage	0	0	2	2
58.	*Baccaurea kunstleri* King ex Gage	0	0	1	1
59.	*Baccaurea maingayi* Hook. f.	0	0	1	1
60.	*Baccaurea minor* Hook. f.	0	0	1	1
61.	*Baccaurea parviflora* (M.A.) M.A.	0	2	4	6
62.	*Baccaurea racemosa* (Reinw.) M.A.	0	1	2	3
63.	*Baccaurea reticulata* Hook. f.	0	0	1	1
64.	*Baccaurea sumatrana* M.A.	0	3	5	8
65.	*Beilschmiedia kunstleri* Gamble	0	0	1	1
66.	*Beilschmiedia madang* B1.	2	9	15	26
67.	*Bhesa paniculata* Arn.	0	12	13	25
68.	*Bhesa robusta* (Roxb.) Ding Hou	0	2	2	4
69.	*Blumeodendron ?tokbrai*	0	0	1	1
70.	*Blumeodendron tokbrai* (B1.) J.J. Smith	0	1	10	11
71.	*Bouea oppositifolia* (Roxb.) Meisn.	0	0	1	1
72.	*Brackenridgea hookeri* (Planch.) A. Gray	0	1	1	2
73.	*Buchanania arborescens* (B1.) B1.	0	0	I	1

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
74.	*Buchanania sessifolia* Bl.	1	1	2	4
75.	*Calophyllum ?ferrugineum*	0	11	8	19
76.	*Calophyllum ?rufigemmatum*	0	1	0	1
77.	*Calophyllum dispar* P.F. Stevens	0	0	1	1
78.	*Calophyllum ferrugineum* Ridl.	0	107	11	118
79.	*Calophyllum lanigerum* Miq. v.*austrocoriaceum* (T.C. Whitmore) P.F. Steven	0	5	1	6
80.	*Calophyllum macrocarpum* Hook. f.	0	0	1	1
81.	*Calophyllum pulcherrimum* Wall. ex Choisy	1	151	7	159
82.	*Calophyllum rigidum* Miq.	0	2	0	2
83.	*Calophyllum rubiginosum* Hend. & Wyatt-Smith	0	13	1	14
84.	*Calophyllum rufigemmatum* Hend. & Wyatt-Smith	0	12	0	12
85.	*Calophyllum sundaicum* P.F. Stevens	0	2	0	2
86.	*Calophyllum tetrapterum* Miq.	1	23	35	59
87.	*Calophyllum teysmannii* Miq.	0	24	11	35
88.	*Calophyllum wallichianum* Planch. & Tr. v. *incrassatum* (Hend. & Wyatt-Smith) P.F. Stevens	0	20	5	25
89.	*Campnosperma auriculatum* (Bl.) Hook. f.	22	93	19	134
90.	*Campnosperma squamatum* Ridl.	1	38	7	46
91.	*Canarium ?grandifolium*	0	0	1	1
92.	*Canarium grandifolium* (Ridl.) Lam	0	0	1	1
93.	*Canarium littorale* Bl.	0	11	12	23
94.	*Canarium patentinervium* Miq.	0	0	9	9
95.	*Canarium pilosum* Benn.	0	1	1	2
96.	*Canthium glabrum* Bl.	0	1	0	1
97.	*Carallia brachiata* (Lour.) Merr.	0	9	13	22
98.	*Castanopsis megacarpa* Gamble	0	0	2	2
99.	*Castanopsis nephelioides* King ex Hook. f.	0	0	1	1
100.	*Castanopsis schefferiana* Hance	0	0	3	3
101.	*Castanopsis wallichii* King ex Hook. f.	1	2	1	4
102.	*Cheilosa malayana* (Hook.f.) Corner ex Airy Shaw	0	0	1	1
103.	*Chisocheton patens* Bl.	0	0	2	2
104.	*Chisocheton pentandrus* (Blanco) Merr.	0	0	3	3
105.	*Chisocheton sarawakanus* (C. DC.) Harms	0	3	0	3
106.	*Cinnamomum iners* Reinw. ex Bl.	0	8	4	12
107.	*Cleistanthus sumatranus* (Miq.) M.A.	0	0	2	2
108.	*Clerodendron laevifolium* Bl.	0	0	1	1
109.	*Cocos nucifera* L.	0	1	0	1
110.	*Cratoxylum ?maingayi*	0	0	2	2

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
111.	*Cratoxylum arborescens* (Vahl) Bl.	1	8	2	11
112.	*Cratoxylum cochinchinense* (Lour.) Bl.	0	1	0	1
113.	*Cratoxylum formosum* (Jack) Dyer	0	9	6	15
114.	*Cratoxylum maingayi* Dyer	0	7	0	7
115.	*Croton laevifolius* Bl.	0	0	1	1
116.	*Crypteronia griffithii* Clarke	0	0	2	2
117.	*Cryptocarya ferrea* Bl.	0	0	4	4
118.	*Cryptocarya impressa* Miq.	0	0	3	3
119.	*Cryptocarya rugulosa* Hook. f.	0	0	4	4
120.	*Ctenolophon ?parvifolius*	0	0	2	2
121.	*Ctenolophon parvifolius* Oliv.	0	0	4	4
122.	*Cyathocalyx ramuliflorus* (Maingay ex Hook. f. & Thoms.) Scheff.	0	31	22	53
123.	*Cyathocalyx ridleyi* (King) Sinclair	0	16	7	23
124.	*Dacryodes costata* (Benn.) Lam	0	2	3	5
125.	*Dacryodes laxa* (Benn.) Lam	0	0	1	1
126.	*Dacryodes rostrata* (Bl.) Lam	0	2	5	7
127.	*Dacryodes rugosa* (Bl.) Lam	0	1	5	6
128.	*Decaspermum fruticosum* J.R. & G. Forst.	7	1	1	9
129.	*Dehaasia incrassata* (Jack) Kostermans	1	2	0	3
130.	*Dialium ?maingayi* Baker	0	0	1	1
131.	*Dialium ?platysepalum*	0	0	1	1
132.	*Dialium indum* L. v. *bursa* (de Wit) Rojo	0	1	1	1
133.	*Dialium platysepalum* Baker	0	1	6	7
134.	*Dillenia grandifolia* Wall. ex Hook. f. & Thoms.	0	3	2	5
135.	*Diospyros ?ridleyi* Bakh.	1	0	0	1
136.	*Diospyros buxifolia* (Bl.) Hiern	0	0	3	3
137.	*Diospyros lanceifolia* Roxb.	0	3	4	7
138.	*Diospyros maingayi* (Hiern) Bakh.	0	0	4	4
139.	*Diospyros pilosanthera Blanco v. oblonga* (Wall. ex G. Don) Ng	0	0	2	2
140.	*Diospyros* sp. 1	0	1	0	1
141.	*Diospyros styraciformis* King & Gamble	0	2	7	9
142.	*Diplospora malaccensis* Hook. f.	0	1	3	4
143.	*Dipterocarpus apterus* Foxw.	0	0	1	1
144.	*Dipterocarpus cornutus* Dyer	0	0	5	5
145.	*Dipterocarpus grandiflorus* Blanco	0	0	15	15
146.	*Dipterocarpus sublamellatus* Foxw.	0	2	14	16
147.	*Drypetes pendula* Ridl.	0	1	0	1
148.	*Durio griffithii* (Mast.) Bakh.	0	0	5	5
149.	*Durio singaporensis* Ridl.	0	2	4	6
150.	*Dyera costulata* (Miq.) Hook. f.	0	14	33	47
151.	*Dysoxylum cauliflorum* Hiern	1	9	22	32

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
152.	*Dysoxylum densiflorum* (Bl.) Miq.	0	0	1	1
153.	*Dysoxylum excelsum* Bl.	0	0	1	1
154.	*Dysoxylum flavescens* Hiern	0	0	1	1
155.	*Elaeocarpus ferrugineus* (Jack) Steud.	2	37	4	43
156.	*Elaeocarpus floribundus* Bl.	0	1	0	1
157.	*Elaeocarpus masterii* king	18	46	4	43
158.	*Elaeocarpus nitidus* Jack v.*salicifolius* (King) Ng	0	14	11	25
159.	*Elaeocarpus palembanicus* (Miq.) Corner	0	1	0	1
160.	*Elaeocarpus petiolatus* (Jack) Wall.	1	17	2	20
161.	*Elaeocarpus rugosus* Roxb.	0	6	0	6
162.	*Elaeocarpus stipularis* Bl.	6	0	1	7
163.	*Endospermum diadenum* (Miq.) Airy Shaw	4	7	5	16
164.	*Enicosanthum* sp. 1	0	0	2	2
165.	*Eugenia ?microcalyx*	0	2	4	6
166.	*Eugenia ?nigricans*	0	3	0	3
167.	*Eugenia ?pseudosubtilis* King	0	2	0	2
168.	*Eugenia cerina* Hend.	0	6	1	7
169.	*Eugenia chlorantha* Duthie	0	4	1	5
170.	*Eugenia cumingiana* Vidal	0	6	3	9
171.	*Eugenia duthieana* King	0	1	3	4
172.	*Eugenia filiformis* Duthie v.*clabimyrtus* (Koord. & Valet.) Hend.	0	3	2	5
173.	*Eugenia glauca* King	1	33	3	37
174.	*Eugenia grandis* Wight	2	65	3	70
175.	*Eugenia longiflora* (Presl) F.-Vill.	37	29	4	70
176.	*Eugenia microcalyx* Duthie	22	16	22	60
177.	*Eugenia muelleri* Miq.	0	1	0	1
178.	*Eugenia nemestrina* Hend.	0	12	3	15
179.	*Eugenia ngadimaniana* Hend.	0	4	6	10
180.	*Eugenia nigricans* King	0	10	10	20
181.	*Eugenia oblongifolia* Duthie	0	4	1	5
182.	*Eugenia pachyphylla* kurz	0	2	1	3
183.	*Eugenia papillosa* Duthie	0	0	1	1
184.	*Eugenia pauper* Ridl.	0	16	1	17
185.	*Eugenia pendens* Duthie	0	0	2	2
186.	*Eugenia polyantha* Wight	0	3	2	5
187.	*Eugenia ridleyi* King	0	4	12	16
188.	*Eugenia spicata* Lamk.	0	1	0	1
189.	*Eugenia subdecussata* Duthie	0	5	2	7
190.	*Eugenia tumida* Duthie	0	0	3	3
191.	*Euodia glabra* (Bl.) Bl.	13	1	4	18
192.	*Eurya acuminata* DC.	0	1	5	6

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
193.	*Eurycoma longifolia* Jack	0	0	2	2
194.	*Fagraea fragrans* Roxb.	1	9	7	17
195.	*Fahrenheitia pendula* (Hassk.) Airy Shaw	0	0	1	1
196.	*Ficus glandulifera* (Wall. ex Miq.) King	1	0	1	2
197.	*Ficus kerkhovenii* Val.	0	0	1	1
198.	*Ficus lamponga* Miq.	1	1	1	3
199.	*Galearia fulva* (Tul.) Miq.	0	1	0	1
200.	*Galearia maingayi* Hook. f.	0	1	1	2
201.	*Ganua kingiana* (Brace) Van Den Assem	0	0	5	5
202.	*Ganua motleyana* (De Vr.) Pierre ex Dubard	0	0	4	4
203.	*Garcinia atroviridis* Griff. & T. Anders.	0	0	2	2
204.	*Garcinia eugeniaefolia* Wall. ex T. Anders.	0	88	8	96
205.	*Garcinia forbesii* King	0	0	5	5
206.	*Garcinia griffithii* T. Anders.	0	6	1	7
207.	*Garcinia maingayi* Hook. f. v. *stylosa* King	0	1	0	1
208.	*Garcinia nervosa* Miq.	0	0	1	1
209.	*Garcinia parvifolia* (Miq.) Miq.	4	213	40	257
210.	*Garcinia scortechinii* King	0	0	3	3
211.	*Gardenia griffithii* Hook. f.	0	0	1	1
212.	*Gardenia tubifera* Wall.	0	0	3	3
213.	*Gironniera ?nervosa*	0	0	1	1
214.	*Gironniera nervosa* Planch.	11	60	47	118
215.	*Gironniera parvifolia* Planch.	0	1	20	21
216.	*Gironniera subaequalis* Planch.	0	2	8	10
217.	*Glochidion superbum* Baill.	1	1	0	2
218.	*Gluta wallichii* (Hook. f.) Ding Hou	0	5	19	24
219.	*Gnetum gnemon* L.	0	0	1	1
220.	*Gonystylus confusus* Airy Shaw	0	10	5	15
221.	*Gonystylus maingayi* Hook. f.	0	0	2	2
222.	*Gordonia ?singaporiana* Wall. ex Ridl.	0	1	0	1
223.	*Gordonia multinervis* King	1	11	0	12
224.	*Grewia blattaefolia* Corner	0	1	8	9
225.	*Guioa pleuropteris* (B1.) Radlk.	0	1	0	1
226.	*Guioa pubescens* (Z. & M.) Radlk.	0	18	2	20
227.	*Gymnacranthera bancana (Miq.)* Sinclair	0	0	1	1
228.	*Gymnacranthera farquhariana* (Hook. f. & Thoms.) Warb.	0	1	12	13
229.	*Gymnacranthera forbesii* (King) Warb.	0	6	0	6
230.	*Gynotroches axillaris* B1.	8	107	46	161
231.	*Helicia petiolaris* Benn.	0	2	1	3
232.	*Heritiera ?javanica* B1.	0	0	2	2
233.	*Heritiera elata* Ridl.	0	0	2	2
234.	*Heritiera borneensis* (Merr.) Kostermans	0	1	2	3

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
235.	*Heritiera simplicifolia* (Mast.) Kostermans	0	0	3	3
236.	*Hevea brasiliensis* (Willd. ex A. Juss.) M.A.	0	17	0	17
237.	*Hopea griffithii* Kurz	0	0	11	11
238.	*Hopea mangarawan* Miq.	0	0	10	10
239.	*Horsfieldia crassifolia* (Hook. f. & Thoms.) Warb.	0	0	2	2
240.	*Horsfieldia polyspherula* (Hook. f. emend. King) J. Sinclair	1	12	18	31
241.	*Horsfieldia sucosa* (King) Warb.	0	2	6	8
242.	*Horsfieldia superba* (Hook. f. & Thoms.) Warb.	0	0	1	1
243.	*Horsfieldia wallichii* (Hook. f. & Thoms.) Warb.	0	0	2	2
244.	*Hymenaea courbaril* L.	0	1	0	1
245.	*Ilex cymosa* B1	1	10	0	11
246.	*Ilex macrophylla* Hook.f.	0	1	0	1
247.	*Irvingia malayana* Oliv. & Benn.	0	0	1	1
248.	*Ixonanthes icosandra* Jack	0	30	35	65
249.	*Ixonanthes reticulata* Jack	9	38	11	58
250.	*Jackiopsis ornata* (Wall.) Ridsdale	0	0	1	1
251.	*Kibara coriace* (B1.) Tul.	0	0	1	1
252.	*Kibatalia maingayi* (Hook. f.) Woodson	0	1	3	4
253.	*Knema communis* Sinclair	0	2	6	8
254.	*Knema conferta* (King) Warb.	0	3	1	4
255.	*Knema curtisii* (King) Warb. v. *paludosa* J. Sinclair	0	3	2	5
256.	*Knema furfuracea* (Hook. f. & Thoms) Warb.	0	0	1	1
257.	*Knema hookeriana* (Wall. ex Hook. f. & Thoms.) Warb.	0	1	3	4
258.	*Knema intermedia* (B1.) Warb.	5	6	5	16
259.	*Knema latericia* Elm.	0	4	3	7
260.	*Knema laurina* (B1.) Warb.	0	1	6	7
261.	*Knema malayana* Warb.	0	2	8	10
262.	*Koompassia malaccensis* Maingay ex Benth.	0	4	12	16
263.	*Kopsia singapurensis* Ridl.	0	0	1	1
264.	*Lansium domesticum* Correa	0	0	1	1
265.	*Licania splendens* (Korth.) Pranc e	0	18	1	19
266.	*Lindera lucida* (B1.) Boerl.	6	4	0	10
267.	*Lithocarpus ?ewyckii*	0	0	1	1
268.	*Lithocarpus bennettii* (Miq.) Rehd.	0	0	2	2
269.	*Lithocarpus conocarpus* (Oudem.) Rehd.	0	1	1	2
270.	*Lithocarpus encleisacarpus* (Korth.) A. Camus	0	3	4	7
271.	*Lithocarpus ewyckii* (Korth.) Rehd.	1	7	11	19
272.	*Lithocarpus lucidus* (Roxb.) Rehd.	0	3	6	9
273.	*Lithocarpus sundaicus* (B1.) Boerl.	0	12	1	13

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
274.	*Litsea accedens* (B1.) Boerl.	0	3	2	5
275.	*Litsea castanea* Hook. f.	0	3	7	10
276.	*Litsea costalis* (B1.) Kostermans	0	0	2	2
277.	*Litsea elliptica* B1.	1	67	33	101
278.	*Litsea erectinervia* Kostermans	0	1	4	5
279.	*Litsea ferruginea* B1.	0	1	1	2
280.	*Litsea firma* Hook. f.	3	59	10	72
281.	*Litsea grandis* Hook. f.	5	18	3	26
282.	*Litsea maingayi* Hook. f.	0	0	2	2
283.	*Litsea ridleyi* Gamble	0	0	10	10
284.	*Litsea robusta* B1.	0	0	2	2
285.	*Lophopetalm multinervium* Ridl.	0	0	5	5
286.	*Lophopetalum wightianum* Arn.	0	1	3	4
287.	*Macaranga conifera* (Zoll.) M.A.	141	45	5	191
288.	*Macaranga gigantea* (Rchb. f. & Zoll.) M.A.	4	5	0	9
289.	*Macaranga hypoleuca* (Rchb. f. & Zoll.) M.A.	0	1	0	1
290.	*Macaranga lowii King* ex Hook. f.	0	0	8	8
291.	*Macaranga triloba* (Bl.) M.A.	8	11	4	23
292.	*Madhuca korthalsii* (Pierre) Lam	0	0	1	1
293.	*Madhuca malaccensis* (Clarke) Lam	0	1	0	1
294.	*Madhuca sericea* (Miq.) Lam	0	1	8	9
295.	*Magnolia candolii* (B1.) H. Keng	0	0	6	6
296.	*Magnolia elegans* (B1.) H. Keng	0	1	0	1
297.	*Mallotus penangensis* M.A.	0	1	9	10
298.	*Manqifera foetida* Lour.	0	0	1	1
299.	*Mangifera griffithii* Hook. f.	0	0	18	18
300.	*Mangifera indica* L.	0	1	0	1
301.	*Mangifera subsessilifolia* Kostermans	0	0	1	1
302.	*Maranthes corymbosa* B1.	0	1	0	1
303.	*Mastixia trichotoma* B1.	0	0	2	2
304.	*Melanochyla auriculata* Hook. f.	0	0	3	3
305.	*Melanochyla caesia* (B1.) Ding Hou	0	0	2	2
306.	*Meliosma lanceolata* B1. *v. lanceolata*	0	0	1	1
307.	*Meliosma simplicifolia* (Roxb.) Walp.	0	0	1	1
308.	*Memecylon edule* Roxb.	0	0	1	1
309.	*Memecylon floridum* Ridl.	0	2	0	2
310.	*Memecylon lilacinum* Z. & M.	0	0	1	1
311.	*Memcylon megacarpum* Furtado	0	1	5	6
312.	*Memecylon paniculatum* Jack	0	0	1	1
313.	*Mezzettia parviflora* Becc.	0	1	2	3
314.	*Microdesmis caseariifolia* Planch.	0	0	2	2
315.	*Monocarpia marginalis* (Scheff.) Sinclair	0	2	1	3
316.	*Mussaendopsis beccariana* Baill.	0	0	14	14

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
317.	*Myrica esculenta* Buch.-Ham.	0	6	2	8
318.	*Myristica ?guatteriifolia* A. DC.	0	0	1	1
319.	*Myristica ?lowiana*	0	0	1	1
320.	*Myristica ?maingayi*	0	0	2	2
321.	*Myristica cinnamomea* King	0	0	8	8
322.	*Myristica elliptica* Hook. f. & Thoms.	0	0	5	5
323.	*Myristica iners* Bl.	0	0	1	1
324.	*Myristica lowiana* King	0	0	2	2
325.	*Myristica maingayi* Hook. f.	0	2	2	4
326.	Myristicaceae 1	0	0	1	1
327.	Myristicaceae 2	0	1	0	1
328.	Myristicaceae 3	0	1	0	1
329.	*Nauclea officinalis* (Pierre ex Pitard) Merr. & Chun	0	1	0	1
330.	*Neesia synandra* Mast.	0	2	0	2
331.	*Neolitsea ?zeylanica*	0	1	0	1
332.	*Neolitsea zeylanica* Merr.	0	0	1	1
333.	*Neoscortechinia kingii* (Hook. f.) P. & H.	0	0	2	2
334.	*Nephelium cuspidatum* Bl. v. *eriopetalum* (Miq.) Leenh.	0	2	2	4
335.	*Norrisia maior* Soler.	0	0	1	1
336.	*Norrisia malaccensis* Gardn.	0	0	1	1
337.	*Nothaphoebe umbelliflora* (Bl.) Bl.	0	11	23	34
338.	*Ochanostachys amentacea* Mast.	0	3	3	6
339.	*Osmelia philippina* (Turcz.) Benth.	0	1	5	6
340.	*Palaquium ?rostratum*	0	0	1	1
341.	*Palaquium hexandrum* (Griff.) Baill.	0	0	7	7
342.	*Palaquium microphyllum* King & Gamble	0	5	1	6
343.	*Palaquium obovatum* (Griff.) Engl.	0	15	5	20
344.	*Palaquium rostratum* (Miq.) Burck	0	13	8	21
345.	*Palaquium* sp.1	0	0	13	13
346.	*Palaquium xanthochymum* (De Vr.) Pierre	0	1	9	10
347.	*Parartocarpus bracteatus* (King) Becc.	0	0	2	2
348.	*Parinari oblongifolia* Hook. f.	0	0	1	1
349.	*Parishia maingayi* Hook. f.	0	4	8	12
350.	*Parkia speciosa* Hassk.	0	4	4	8
351.	*Payena lucida* (G. Don) DC.	0	0	1	1
352.	*Payena obscura* Burck	0	4	1	5
353.	*Pellacalyx axillaris* Korth.	0	0	5	5
354.	*Pellacalyx saccardianus* Scort.	0	3	0	3
355.	*Pentace triptera* Mast.	0	0	5	5
356.	*Pertusadina eurhyncha* (Miq.) Ridsdale	0	1	21	22
357.	*Phoebe grandis* Merr.	0	0	1	1

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
358.	*Pimeleodendron griffithianum* (M.A.) Benth.	0	2	4	6
359.	*Pithecellobium jiringa* (Jack) Prain	0	2	0	2
360.	*Planchonella maingayi* (Clarke) van Royen	0	1	2	3
361.	*Ploiarium alternifolium* (Vahl) Melchior	2	4	0	6
362.	*Polyalthia ?hookeriana* King	0	1	0	1
363.	*Polyalthia glauca* (Hassk.) Muell.	0	0	11	11
364.	*Polyalthia jenkensii* (Hook. f. & Thoms.) Hook.f. & Thoms.	0	0	1	1
365.	*Polyalthia macropoda* King	0	0	2	2
366.	*Polyalthia rumphii* Merr.	0	1	2	3
367.	*Polyalthia sumatrana* (Miq.) Kurz	0	0	2	2
368.	*Pometia pinnata* Forst. f. *alnifolia*	0	0	14	14
369.	*Popowia fusca* King	0	3	5	8
370.	*Popowia pisocarpa* (B1.) Endl.	0	0	1	1
371.	*Porterandia anisophylla* (Jack ex Roxb.) Ridl.	4	29	14	47
372.	*Pouteria malaccensis* (Clarke) Baehni	0	9	15	24
373.	*Prunus arborea* (B1.) Kalkm.	0	1	1	2
374.	*Purnus polystachya* (Hook. f.) Kalkm.	1	29	42	72
375.	*Pseudoeugenia singaporensis* King	0	0	1	1
376.	*Psydrax sp.* 10 of Wong (1989)	0	26	5	31
377.	*Psydrax sp.* 11 of Wong (1989)	0	1	0	1
378.	*Pternandra coerulescens* Jack	0	3	4	7
379.	*Pternandra echinata* Jack	2	47	15	64
380.	*Pyrenaria acuminata* Planch. ex Choisy	0	0	2	2
381.	*Rhodamnia cinerea* Jack	258	1217	165	1640
382.	*Sandoricum beccarianum* Baill.	0	0	1	1
383.	*Sandoricum koetjape* (Burm. f.) Merr.	0	1	1	2
384.	*Santiria ?griffithii*	0	1	0	1
385.	*Santiria apiculata* Benn.	0	0	4	4
386.	*Santiria griffithii* (Hook. f.) Engl.	0	11	23	34
387.	*Santiria laevigata* B1.	0	8	19	27
388.	*Santiria rubiginosa* B1.	0	3	5	8
389.	*Santiria tomentosa* B1.	0	7	4	11
390.	Sapotaceae? 1	0	0	1	1
391.	*Sarcotheca griffithii* (Planch. ex Hook. f.) Hall. f.	0	0	3	3
392.	*Sarcotheca laxa* Knuth v. *sericea* (Ridl.) Veldk.	0	0	1	1
393.	*Scaphium macropodum* (Miq.) Beumee ex Heyne	1	0	5	6
394.	*Scleropyrum wallichianum* (Wight & Arn.) Arn.	0	1	0	1
395.	*Scorodocarpus borneensis* Becc.	2	1	6	9
396.	*Shorea bracteolata* Dyer	0	1	2	3

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
397.	*Shorea curtisii* Dyer ex King	0	0	3	3
398.	*Shorea gibbosa* Brandis	0	1	5	6
399.	*Shorea gratissima* Dyer	0	0	4	4
400.	*Shorea leprosula* Miq.	0	1	6	7
401.	*Shorea macroptera* Dyer	0	6	12	18
402.	*Shorea ovalis* Bl.	0	3	2	5
403.	*Shorea parvifolia* Dyer	0	3	4	7
404.	*Shorea pauciflora* King	0	4	9	13
405.	*Shorea platycarpa* Heim.	0	0	2	2
406.	*Sindora coriacea* Maingay ex Prain	0	2	2	4
407.	*Spathodea campanulata* P. Beauv.	0	3	0	3
408.	*Stemonurus scorpioides* Becc.	0	0	1	1
409.	*Sterculia ?shillinglawii* F.V. Muell.	0	1	0	1
410.	*Sterculia cordata* Bl.	0	0	1	1
411.	*Sterculia edelfetii* F.v. Muell.	0	0	1	1
412.	*Sterculia macrophylla* Vent.	0	0	2	2
413.	*Sterculia parviflora* Roxb.	0	2	1	3
414.	*Sterculia rubiginosa* Vent.	0	0	2	2
415.	*Streblus elongatus* (Miq.) Corner	6	14	15	35
416.	*Strombosia ceylanica* Gardn.	0	1	39	40
417.	*Strombosia javanica* Bl.	0	3	13	16
418.	*Styrax benzoin* Dryand.	1	1	1	3
419.	*Swintonia schwenkii* (T. & B.) T. & B.	0	0	1	1
420.	*Symplocos adenophylla* Wall. ex G. Don	0	1	0	1
421.	*Symplocos fasciculata* Zoll.	0	0	1	1
422.	*Symplocos rubiginosa* Wall. ex DC.	0	1	0	1
423.	*Tarenna costata* (Miq.) Merr.	1	0	0	1
424.	*Tarenna mollis* (Wall. ex Hook. f.) B.L. Robinson	0	0	1	1
425.	*Tarenna odorata* (Roxb.) B.L. Robinson	0	1	0	1
426.	*Teijsmanniodendron ?holophyllum* (Baker) Kostermans	0	0	1	1
427.	*Teijsmanniodendron coriaceum* (Clarke) Kostermans	0	0	6	6
428.	*Terminalia subspathulata* King	0	0	1	1
429.	*Ternstroemia penangiana* Choisy	0	0	1	1
430.	*Timonius wallichianus* (Korth.) Valeton	27	188	61	276
431.	*Triomma malaccensis* Hook. f.	0	0	3	3
432.	*Tristaniopsis merguensis* (Griff.) Wilson & Waterhouse	0	0	1	1
433.	*Turpinia sphaerocarpa* Hassk.	0	2	0	2
434.	*Vatica ?ridleyana*	0	0	1	1
435.	*Vatica maingayi* Dyer	0	0	5	5

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
436.	*Vatica ridleyana* Brandis	0	3	12	15
437.	*Vitex pinnata* L.	1	6	1	8
438.	*Xanthophyllum ?affine*	0	1	0	1
439.	*Xanthophyllum affine* Korth.	0	2	14	16
440.	*Xanthophyllum amoenum* Chodat	0	1	1	2
441.	*Xanthophyllum ellipticum* Korth.	1	2	3	6
442.	*Xanthophyllum eruhynchum* Miq.	0	3	2	5
443.	*Xanthophyllum griffithii* Hook. f. ex Benn	0	0	1	1
444.	*Xanthophyllum obscurum* Benn.	0	0	2	2
445.	*Xanthophyllum stipitatum* Benn.	0	0	3	3
446.	*Xanthophyllum vitellinum* (B1.) Dietr.	0	8	6	14
447.	*Xerospermum noronhianum* B1.	0	1	3	4
448.	*Xylopia caudata* Hook. f. & Thoms.	0	8	2	10
449.	*Xylopia ferruginea* (Hook. f. & Thoms.) Hook. f. & Thoms.	0	44	4	48
450.	*Xylopia ferruginea* v.oxyantha (Hook. f. & Thoms.) Sinclair	0	14	0	14
451.	*Xylopia fusca* Maingay ex Hook. f. & Thoms.	0	0	1	1
452.	*Xylopia magna* Maingay ex Hook. f. & Thoms.	0	0	1	1
453.	*Xylopia malayana* Hook. f. & Thoms.	0	8	10	18
454.	Z01	0	0	1	1
455.	Z02	0	2	0	2
456.	Z03	0	1	1	2
457.	Z04	0	1	0	1
458.	Z05	0	1	0	1
459.	Z06	0	0	2	2
460.	Z07	0	0	2	2
461.	Z08	0	1	0	1
462.	Z09	0	0	1	1
463.	Z10	0	0	1	1
464.	Z11	0	0	1	1
465.	Z12	0	0	2	2
466.	Z13	0	0	1	1
467.	Z14	0	0	1	1
468.	Z15	0	0	1	1
469.	Z16.	0	1	1	1
470.	Z17.	0	1	2	3
471.	Z18.	0	0	1	1
472.	Z19.	0	0	1	1
473.	Z20.	0	1	0	1
474.	Z21.	0	0	1	1
475.	Z22.	0	1	0	1
476.	Z23.	0	0	1	1

Appendix 2 (Continued)

	SPECIES	No. of Individuals			
		FT 2	FT 3	FT 4	Total
477.	Z24.	0	0	1	1
478.	Z25.	0	0	1	1
479.	Z26.	1	0	0	1
480.	Z27.	0	4	0	4
481.	ZU01.	0	0	1	1
482.	ZU02.	0	0	1	1
483.	ZU03.	0	0	1	1
484.	ZU04.	0	0	1	1
485.	ZU05.	0	0	1	1
486.	ZU06.	0	1	0	1
487.	ZU07.	0	1	0	1
488.	ZU08.	0	1	0	1
489.	ZU09.	0	0	1	1
490.	ZU10.	0	0	1	1
491.	ZU11.	0	0	1	1
492.	ZU12.	0	0	1	1
493.	ZU13.	0	1	0	1
494.	ZU14.	0	1	0	1
495.	ZU15.	0	0	1	1
496.	ZU16.	0	0	1	1
497.	ZU17.	0	0	1	1
498.	ZU18.	0	1	0	1
499.	ZU19.	0	1	0	1
TOTAL		823	4386	2253	7462