DIVERSITY OF PLANT COMMUNITIES IN SECONDARY SUCCESSION OF IMPERATA GRASSLANDS IN SAMBOJA LESTARI, EAST KALIMANTAN, INDONESIA

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ABSTRACT

Regeneration of Imperata grassland areas is becoming increasingly important, both to create new secondary forest and to recover the original biodiversity. The diversity of plant communities in secondary succession of Imperata grasslands was studied using 45 subplots of 9 linear transects (10 m x 100 m). Data was collected and all stems over 10 cm dbh were identified, the Importance Values Index (IVI) for all trees were calculated, saplings and seedlings were counted and analysed, and soil samples were taken and analysed. Results showed that after more than 10 years of regeneration, 65 families were encountered consisting of 164 species, which were dominated by *Vernonia arborea* Buch.-Ham, *Vitex pinnata* L., *Macaranga gigantea* (Reichb.f. & Zoll.) Muell.Arg., *Symplocos crassipes* C.B. Clarke, *Artocarpus odoratissimus* Miq., and *Bridelia glauca* Blume. The effects of regeneration, from Imperata grassland to secondary forest, on soil were the strongest in the A-horizon where an increase in carbon, N content, and pH were observed. Our result shows that Imperata grasslands appear to be permanent because of frequent fires and human interferences and so far few efforts have been made to promote sustainable rehabilitation. If protected from fire and other disturbances, such as shifting cultivation, Imperata grassland will grow and develop into secondary forest.

Keywords: Imperata grasslands, Importance Values Index, regeneration, secondary succession

ABSTRAK

Regenerasi alami pada lahan alang-alang menjadi semakin penting, baik untuk menciptakan hutan sekunder baru dan memulihkan keanekaragaman hayatinya. Kami mempelajari keanekaragaman komunitas tumbuhan dalam suksesi sekunder di lahan alang-alang menggunakan 45 subplot dari 9 transek linier (10 mx 100 m). Data yang dikumpulkan dan diidentifikasi dari semua jenis yang ditemukan dengan ukuran diameter setinggi dada lebih dari 10 cm, kemudian dihitung dan dianalisis Indek Nilai Penting (INP) baik untuk tingkat pohon, sapling dan anakan, dan sampel tanah yang diambil kemudian dianalisis. Hasil penelitian menunjukkan bahwa selama proses regenerasi setelah lebih dari 10 tahun, 65 famili ditemukan dimana terdiri dari 164 jenis, yang didominasi oleh *Vernonia arborea* Buch.-Ham, *Vitex pinnata* L., *Macaranga gigantea* (Reichb.f. & Zoll.) Muell.Arg ., *Symplocos crassipes* CB Clarke, *Artocarpus odoratissimus* Miq., dan *Bridelia glauca* Blume. Pengaruh regenerasi dari lahan alang-alang menjadi hutan sekunder terhadap kondisi tanah terkuat di horizon-A, dimana terjadi peningakatan Karbon, Nitrogen dan pH. Hasil penelitian ini menunjukkan bahwa lahan alang-alang tampak permanen karena mengalami kebakaran yang berulang dan campur tangan manusia dan sejauh ini masih sedikit upaya yang telah dilakukan untuk melakukan merehabilitasi yang berkelanjutan. Jika dilindungi dari kebakaran dan gangguan lain seperti peladang berpindah, lahan alang-alang akan tumbuh dan berkembang menjadi hutan sekunder.

Kata kunci: Lahan alang-alang, Indek Nilai Penting, regenerasi, suksesi

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I. INTRODUCTION

East Kalimantan is one of the important tropical forest habitats in the world. Nowadays, large areas of primary forest in East Kalimantan have been changed into secondary forests, like oil palm plantations, timber estate plantations, slash-and-burn agricultures, coal mining as well as Imperata grasslands. In East Kalimantan alone, the rate of deforestation from 2003 to 2006 was around 248,500 ha per year (Ministry of Forestry, 2008).

MacKinnon et al. (1996) mentioned that Imperata grasslands were caused by logging, forest clearing for shifting cultivation, agriculture and grazing, and also by fire. The latter is a result of frequent human interference. When Imperata grasslands are abandoned and not burned regularly, they will undergo a series of vegetation changes, a process called secondary succession. Leps (1987) argued that this early stage of succession influences the later stages of vegetation development, which in turn determine the character of the secondary forest and the recovery of the original biodiversity.

Although the direction of the (early) secondary succession in Imperata grasslands is important, this aspect was hardly investigated in Indonesia. Most studies in Indonesia focused on tropical secondary forests (Brealey et al., 2004; Bischoff et al., 2005). Okimori and Matius (2000) described the secondary forest succeeding traditional slash-and-burn agriculture; in addition Kiyono and Hastaniah (2000) studied the role of slash-and-burn agriculture in transforming dipterocarp forest into Imperata grassland.

Some studies described the effect of fire on tree species composition of lowland dipterocarp forest (Ohtsuka, 1999; Matius et al., 2000; Hashimotio et al., 2000; Slik et al., 2002; Slik and Eichhorn, 2003; Hiratsuka et al., 2006). Recent study by Yassir et al. (2010) described the pathways of the secondary succession in Imperata grasslands in East Kalimantan on the same location where this study was made. However, Yassir et al., (2010) focused only on understorey species and vegetation that was less than 3.5 m, but vegetation that was higher than 3.5 m was not sampled.

The paper describes diversity of plant communities upon secondary succession from Imperata grasslands to young secondary forest with more than 10 years of regeneration time. The objectives of this study were (a) to examine how diversity of plant community develops after fire; and (b) to determine whether Imperata grasslands were a final and stable stage of land degradation.

II. MATERIAL AND METHOD

A. Study Area

The study was conducted at Samboja Lestari area (Figure 1), a 1,850 ha reforestation project managed by the Borneo Orangutan Survival Foundation (BOSF). The Köppen system classified the climate of the research area as Af (tropical rainforest). Average yearly precipitation is about 2,250 mm with a wet period from December to May. The driest month had an average precipitation of 132 mm, and the wettest month of 231 mm. The daily maximum temperature varied from 23 to 31^{o}C and the relative humidity was high, around 78 to 94%. The soils were formed on marine sediments of Tertiary age. Top soils were generally slightly coarser than the deeper layers. In the Food and Agriculture Organization (FAO) classification system (FAO, 2001) the soils of Samboja Lestari was classified as acrisols.

B. Data Collection

All field data were collected in the area of Samboja Lestari (secondary succession). In total there were 45 subplots out of 9 linear transects (10 m x 100 m). We collected and identified data of all living trees with a Diameter at Breast Height (DBH) more than 10 cm (trees) (10 m x 20 m); DBH 5 and <10 cm (saplings) (5 m x 5 m); DBH< 5 cm and a height < 1.3 m (seedlings including shrubs and herbs) (2 m x 2 m). All plant samples were identified to

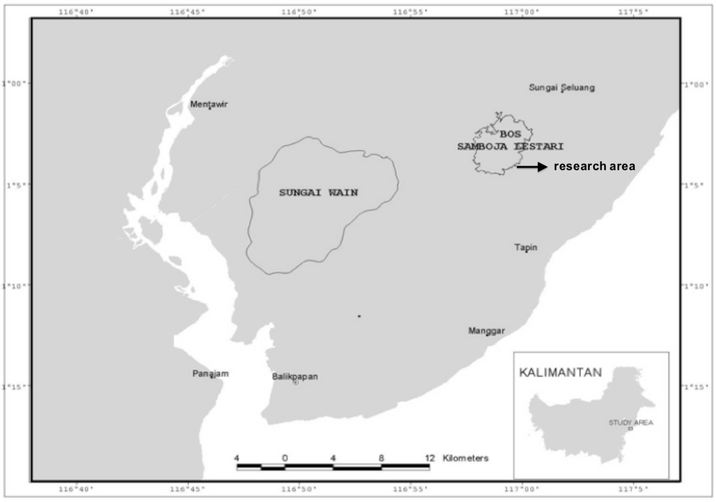

Figure 1. Location of BOS Samboja Lestari, East Kalimantan

the lowest possible taxonomic level. The soil sample of our previous study was collected in similar location and was used for this research (van der Kamp et al., 2009; Yassir et al., 2010). Soil samples were taken from the A-, AB- and B-horizon. As for chemical analyses, samples were taken from the full depth of each horizon. Samples were then taken to the laboratory in labelled plastic bags.

C. Data Analysis

All field data were analysed in spreadsheets of Microsoft Excel. The Importance Values Index (IVI) of each tree species were calculated by summing up the relative density, relative dominance and relative frequency. Whereas, the importance values of each species for saplings and seedlings were calculated by summing up the relative density and relative frequency (Mueller-Dombois and Ellenberg, 1974). Methods of soil analysis were listed by van der Kamp et al., (2009) and Yassir et al., (2010). Bulk density of all horizons was measured at Samboja Lestari, using triplicate measurements with 100 cm^3 cylinders. Chemical properties were measured at the Soil Science Laboratory of Bogor Agricultural University (Bogor, Indonesia). Chemical measurements included total C determined by Walkley-Black (A-, AB- and B-horizon), available K determined by Bray I extraction and flame photometer (A- and B-horizon), total N determined by Kjeldahl/ titrimetric (macro; A-horizons only), available P determined by Bray I extraction (A- and B-horizon), pH determined in 1:1 (soil: water) suspension with a pH meter (A-horizon only).

III. RESULT AND DISCUSSION

A. Community Structure

Based on our 45 subplots with a total area of 0.9 ha in secondary forest, 65 families were encountered consisting of 164 species (Appendix 1). Based on the Important Value Index, the tree species were dominated by *Vernonia arborea*, *Vitex pinnata*, *Macaranga gigantea*, *Symplocos crassipes*, *Artocarpus odoratissimus*, and *Bridelia glauca* (Table 1). The important value index of species of saplings was dominated by *Fordia splendidissima*, *Symplocos crassipes*, *Macaranga trichocarpa*, *Malastoma malabathricum*, *Vitex pinnata* and *Macaranga beccariana*. While, the Important Value Index of species of seedlings including shrubs and herbs were dominated by *Nephrolepis bisserrata*, *Bridelia glauca*, *Fordia splendidissima*, *Scleria terrestris*, *Lygodium circinatum* and *Psychotria* sp.

Furthermore, Kiyono and Hastaniah (1997) reported in their study in East Kalimantan that one hectare of Imperata grassland contained

Table 1. List of dominance of 10 species based on the Important Value Index (IVI)

Stages	No.	Species	Family	IVI(%)
Trees	1.	*Vernonia arborea*	Asteraceae	62.5
	2.	*Vitex pinnata*	Verbenaceae	40.9
	3.	*Macaranga gigantea*	Euphorbiaceae	27.9
	4.	*Symplocos crassipes*	Symplocaceae	15.3
	5.	*Artocarpus odoratissimus*	Moraceae	11.8
	6.	*Bridelia glauca*	Euphorbiaceae	10.2
	7.	*Artocarpus tamaran*	Moraceae	7.9
	8.	*Melicope glabra*	Rutaceae	6.8
	9.	*Geunsia pentandra*	Verbenaceae	5.6
	10.	*Schima wallichii*	Theaceae	4.9
Saplings	1.	*Fordia splendidissima*	Leguminosae-Papilionoideae	29.0
	2.	*Symplocos crassipes*	Symplocaceae	12.0
	3.	*Macaranga trichocarpa*	Euphorbiaceae	11.3
	4.	*Melastoma malabathricum*	Melastomataceae	10.1
	5.	*Vitex pinnata*	Verbenaceae	10.1
	6.	*Macaranga beccariana*	Euphorbiaceae	8.8
	7.	*Bridelia glauca*	Euphorbiaceae	8.2
	8.	*Vernonia arborea*	Asteraceae	7.2
	9.	*Dillenia suffruticosa*	Dilleniaceae	7.0
	10.	*Macaranga gigantea*	Euphorbiaceae	6.9
Seedlings (including shrubs and herbs)	1.	*Nephrolepis biserrata*	Neprolepidaceae	18.1
	2.	*Bridelia glauca*	Euphorbiaceae	13.0
	3.	*Fordia splendidissima*	Leguminosae-Papilionoideae	11.3
	4.	*Scleria terrestris*	Cyperaceae	11.0
	5.	*Lygodium circinatum*	Schizaeaceae	7.6
	6.	*Psychotria* sp.	Rubiaceae	7.3
	7.	*Melastoma malabathricum*	Melastomataceae	6.1
	8.	*Curculigo racemosa*	Amaryllidaceae	5.6
	9.	*Macaranga beccariana*	Euphorbiaceae	5.5
	10.	*Clidemia hirta*	Melastomataceae	5.3

Key: FW= fruit weight, SS= seed shell , WS= wet seed, DS= dry seed

up to 107 plant species, including trees such as *Vernonia arborea*, *Cratoxylum formusum* and *Vitex pinnata*. Hashimotio et al. (2000) reported that after 10-12 years of fallow, the dominant species in regenerated lowland forest in Borneo were *Piper aduncum*, *Ficus* sp, *Geunsia pentandra*, *Vernonia arborea*, *Melastoma malabathricum*, *Macaranga* sp., and *Bridelia glauca*. Hiratsuka et al. (2006) reported that after the 1998 forest fires in East Kalimantan, the dominant pioneer species were *Homalantus populneus*, *Macaranga gigantea*, *Macaranga hypoleuca*, *Mallotus paniculatus*, *Melastoma malabathricum*, *Piper aduncum* and *Trema orientalis*. All these species are described by Kiyono and Hastaniah (1997), Hashimotio et al. (2000) and Hiratsuka et al. (2006) were also identified during our field research.

Compared to our previous study at the same location (Yassir et al., 2010), after three years of regeneration, *Imperata cylindrica* had the highest average coverage; it became less dominant from the fourth year onward. The average cover of *Pteridium aquilinum* is initially low but increases after 4 and 9 years of regeneration and also the average percentage of shrubs and young trees have increased significantly over time. In the secondary forest other tree species have taken over, and both *Imperata* and *Pteridium* have disappeared. Yassir et al., (2010) also reported that after three years of regeneration, *Melastoma malabathricum*, *Eupatorium inulaefolium*, and *Ficus* sp. were dominant species. There was a slight change in the 4-year old growth, where *Melastoma malabathricum*, *Eupatorium inulaefolium*, and *Ficus* sp. became the dominant species. After nine years of regeneration, *Melastoma malabathricum*, *Eupatorium inulaefolium* and *Vitex pinnata* were dominant species following the time of regeneration in Imperata grasslands.

In order to the family dominancy, Euphorbiaceae, Moraceae, Rubiaceae and Lauraceae were the dominant families (Figure 2). Based on our result, the dominant family of Euphorbiaceae is not surprising because Euphorbiaceae family is one of the major families in tropical rain forest in Borneo besides the Dipterocarpaceae family (MacKinnon et al., 1996).

Additionally, distribution pattern of diameter classes upon secondary succession in Imperata grassland showed that the number of species with diameter 10 cm-15 cm were dominant (51.2%), followed by diameter 15 cm-20 cm (28.1%) and diameter 20 cm-25 cm (13.0%)

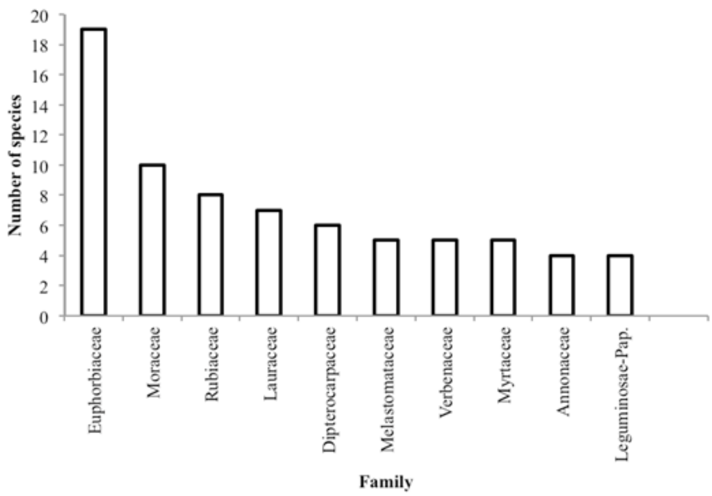

Figure 2. Total observed number of species based on the dominance of 10 families in Samboja Lestari (including seedlings stage)

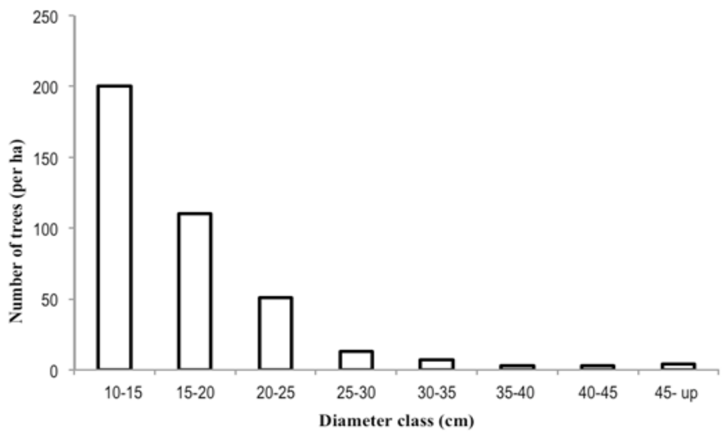

Figure 3. Distribution pattern of diameter classes in secondary succession of Samboja Lestari forest

Table 2. Soil properties and dominant species in sampled plots at Samboja Lestari

Regeneration Stage	Means							Dominant species
	Bd[a)] (g cm^{-3})	pH	C (g kg^{-1})	N (g kg-1)	C/N	P (mg kg^{-1})	K (cmol^{+} kg^{-1})	
3 years (n=47)								
A-horizon	1.18	5.29	14.52	1.43	10.53	4.04	0.16	*I. cylindrica*
AB-horizon	1.32		8.99					*E. inulaefolium*
B-horizon	1.38		3.75			3.16	0.11	
9 years (n=126)								
A-horizon	1.10	5.09	15.96	1.54	10.36	4.47	0.16	*M. malabathricum*
AB-horizon	1.34		9.10					*E. inulaefolium*
B-horizon	1.39		3.99			3.72	0.11	*V. arborea*
Secondary forest (±15 years; n=43)								
A-horizon	1.10	5.11	16.71	1.58	10.58	4.08	0.18	*V. arborea*
AB-horizon	1.32		8.93					*V. pinnata*
B-horizon	1.41		4.04			3.60	0.10	*S. crassipes*
								Macaranga sp.

*) Bd[a)] = bulk density

(Figure 3). The distribution pattern of diameter classes upon secondary succession in Imperata grassland was represented as reversed J shape. The shape of the reversed J is typical of self-regenerating communities or it describes that the process of regeneration is going well (Felfili, 1997).

B. Soil Properties in Different Phases of Regeneration

Based on our previous study (Yassir et al., 2010), soil properties in different phases of regeneration indicated that carbon, nitrogen content and pH in the A-horizon showed a small increase with the regeneration stage from Imperata grassland to young secondary forest (Table 2). When the vegetation was reduced to ashes through burning, as happened in the grassland plots, the pH increased due to the formation of carbonates (Binkley et al., 1989; Cruz and del Castillo, 2005; Farley et al., 2008). Bulk density generally increases with depth. Bulk density of the A-horizon was fairly high in most recently burned fields. It has decreased during the first phases of succession to secondary forest, possibly due to the appearance of the undergrowth. The carbon content of the A-horizon was the lowest in most recently burned plots. It was increased in the first phases of regeneration from Imperata grassland to secondary forest.

Table 2 also shows that there was no significant increase in P and K over time of secondary succession, which may indicate either a limited stock in the soil or leaching from the system. Leaching of P is unlikely, and therefore a limited supply is probably the best explanation. Yassir et al., (2010) also reported that soil properties had a strong influence on vegetation composition particularly pH, bulk density, sand and clay. Kooch et al., (2007) explained that soil texture and bulk density control the distribution of plant species by affecting moisture availability, ventilation and plant roots distribution. Schoenholtz et al., (2000) mentioned that the relation between bulk density, water and oxygen supply, and soil texture is the most fundamental soil physical property controlling water, nutrient, and oxygen exchange, retention and uptake. More detailed information related to Table 2 is described by van der Kamp et al. (2009) and Yassir et al. (2010).

IV. CONCLUSION

After more than 10 years of regeneration, 65 families were encountered consisting of 164 species, which were dominated by *Vernonia arborea*, *Vitex pinnata*, *Macaranga gigantea*, *Symplocos crassipes*, *Artocarpus odoratissimus*, and *Bridelia glauca*. Our result shows that Imperata grasslands seem to be permanent because of frequent fires and human interferences and so far few efforts have been made to encourage sustainable rehabilitation. If protected from fire and other disturbances such as shifting cultivation, Imperata grassland will develop into secondary forest. Therefore, the assumption that Imperata grasslands are a final stage of land degradation and are very difficult to recover for more valuable land uses is wrong and thus cannot be accepted. The introduction of native shrubs and trees will assist to speed up the process of succession from Imperata grasslands into secondary forest.

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Appendix I. List of all species recorded in young secondary forest in Samboja Lestari

No.	Family	Species
1	Acanthaceae	*Hygropila erecta* (Burm.f.) Hochr.
2	Amaryllidaceae	*Curculigo latifolia* (Dryand. ex W.T. Aiton)
3	Amaryllidaceae	*Curculigo racemosa* Ridl.
4	Anacardiaceae	*Dracontomelon dao* (Blanco) Merr. & Rolfe
5	Anacardiaceae	*Mangifera caesia* Jack
6	Anacardiaceae	*Mangipera indica* L,.
7	Anacardiaceae	*Mangipera pajang* Kosterm.
8	Annonaceae	*Artabotrys suaveolens* (Blume) Blume
9	Annonaceae	*Mitrephora korthalsiana* Miq.
10	Annonaceae	*Popowia pisocarpa* (Blume) Endl.
11	Annonaceae	*Uvaria elmeri* Merr.
12	Apocynaceae	*Tabernaemontana macrocarpa* Korth. ex Blume
13	Apocynaceae	*Willughbeia angustifolia* (Miq.) Markgr.
14	Aquifoliaceae	*Ilex cymosa* Blume
15	Arecaceae	*Calamus* sp.
16	Aristolochiaceae	*Aristolochia jackii* Steud.
17	Asteraceae	*Eupatorium inulaefolium* Kunth
18	Asteraceae	*Vernonia arborea* Buch.-Ham.
19	Bignoniaceae	*Dolicandrone* sp.
20	Blechnaceae	*Stenochlaena palustris* (Burm.) Bedd.
21	Celastraceae	*Lophopetalum javanicum* (Zoll.) Turez,.
22	Celastraceae	*Salacia macrophylla* Blume
23	Compositae	*Mikania scandens* Willd.
24	Connaraceae	*Roureopsis acutipetala* (Miq.) Leenh.
25	Cornaceae	*Alangium javanicum* Blume
26	Cucurbitaceae	*Trichosanthes sp.*
27	Cyperaceae	*Mapania longiflora* C.B. Clarke
28	Cyperaceae	*Scleria terrestris* (L,.) Fass.
29	Datiscaceae	*Octomeles sumatrana* Miq.
30	Dilleniaceae	*Dillenia suffruticosa* (Griff.) Martelli
31	Dilleniaceae	*Tetracera macrophylla* Wall. ex Hook.f. & Thoms.
32	Dipterocarpaceae	*Cotylelobium melanoxylum* (Hook.f.) Pierre
33	Dipterocarpaceae	*Hopea dryobalanoides* Miq.
34	Dipterocarpaceae	*Parashorea tomentela* (Symington) Meijer
35	Dipterocarpaceae	*Shorea johorensis* Foxw.
36	Dipterocarpaceae	*Shorea leprosula* Miq.
37	Dipterocarpaceae	*Shorea smithiana* Sym.
38	Ebenaceae	*Diospyros borneensis* Hiern
39	Ebenaceae	*Diospyros confertiflora* (Hiern) Bakh.
40	Ebenaceae	*Diospyros sumatrana* Miq.
41	Elaeocarpaceae	*Elaeocarpus glaber* Blume
42	Elaeocarpaceae	*Elaeocarpus stipularis* Blume
43	Euphorbiaceae	*Aporosa nitida* Merr.
44	Euphorbiaceae	*Baccaurea motleyana* (Muell.Arg.) Muell.Arg.
45	Euphorbiaceae	*Baccaurea sumatrana* (Miq.) Muell.Arg.
46	Euphorbiaceae	*Breynea racemosa* (Blume) Muell.Arg.
47	Euphorbiaceae	*Bridelia glauca* Blume
48	Euphorbiaceae	*Cleistanthus myrianthus* (Hassk). Kurz
49	Euphorbiaceae	*Galearia fulva* (Tul.) Miq.
50	Euphorbiaceae	*Glochidion arborescens* Blume
51	Euphorbiaceae	*Glochidion* sp.
52	Euphorbiaceae	*Homallanthus populneus* (Geiseler) Pax
53	Euphorbiaceae	*Macaranga beccariana* Merr.
54	Euphorbiaceae	*Macaranga gigantean* (Reichb.f. & Zoll.) Muell.Arg.
55	Euphorbiaceae	*Macaranga motleyana* (Muell.Arg.) Muell.Arg.
56	Euphorbiaceae	*Macaranga pruinosa* (Miq.) Muell.Arg.
57	Euphorbiaceae	*Macaranga tanarius* (L,.) Muell. Arg.
58	Euphorbiaceae	*Macaranga trichocarpa* (Reichb.f. & Zoll.) Muell.Arg.
59	Euphorbiaceae	*Mallotus paniculatus* (Lam.) Muell.Arg.
60	Euphorbiaceae	*Omphalea bracteata* (Blanco) Merr.
61	Euphorbiaceae	*Trigonostemon laevigatus* Muell.Arg.
62	Fagaceae	*Castanopsis* sp.
63	Gleicheniaceae	*Dicranopteris linearis* (Burm.f.) C.B. Clarke.
64	Graminae	*Imperata cylindrica* (L,.) Beauv.

65	Graminae	*Saccharum sponthaneum* L,.
66	Guttiferae	*Calophyllum nodusum* Vasque
67	Guttiferae	*Calophyllum* sp.
68	Hypericaceae	*Cratoxylum formosum* (Jack) Dyer
69	Hypericaceae	*Cratoxylum sumatranum* (Jack) Blume
70	Hypolepidaceae	*Pteridium aquilinum* (L,.) Kuhn
71	Lauraceae	*Alseodaphne peduncularis* (Wall. ex Nees) Meissn.
72	Lauraceae	*Cryptocarya crassinervia* Miq.
73	Lauraceae	*Dehaasia peduncularis* Meisn.
74	Lauraceae	*Eusideroxylon zwageri* Teijsm. & Binn.
75	Lauraceae	*Litsea angulata* Blume
76	Lauraceae	*Litsea firma* (Blume) Hook.f.
77	Lauraceae	*Litsea* sp.
78	Lecythidaceae	*Barringtonia macrostachya* Jack
79	Leguminosae-Caes.	*Bauhinia excelsa* (Miq.) Prain
80	Leguminosae-Mim.	*Archidendron jiringa* (Jack) I.C. Nielsen
81	Leguminosae-Mim.	*Archidendron microcarpum* (Benth.) I.C. Nielsen
82	Leguminosae-Mim.	*Paraserianthes falcataria* (L,.) I.C. Nielsen
83	Leguminosae-Pap.	*Dalbergia abbrevialata* Craib
84	Leguminosae-Pap.	*Fordia splendidissima* (Blume ex Miq.) Buijsen
85	Leguminosae-Pap.	*Spatholobus ferrugineus* Benth.
86	Leguminosae-Pap.	*Spatholobus hirsutus* H. Wiriadinata & J.W.A. Ridder-Numan
87	Liliaceae	*Dracaena elliptica* Thunb.
88	Liliaceae	*Smilax odoratissima* Blume
89	Loganiaceae	*Fagraea racemosa* Jack ex Wall.
90	Lycopodiaceae	*Lycopodium cernuum* L,.
91	Magnoliaceae	*Magnolia tsiampacca* (L,.) Dandy
92	Malvaceae	*Sida* sp.
93	Malvaceae	*Urena lobata* L,.
94	Marantaceae	*Phrynium borneensis* Blume
95	Marantaceae	*Stachyphrynium borneensis* (K. Koch) K. Schum.
96	Melastomataceae	*Clidemia hirta* D. Don
97	Melastomataceae	*Melastoma malabathricum* L,.
98	Melastomataceae	*Pternandra azurea* (Blume) Burkill
99	Melastomataceae	*Pternandra* sp.
100	Melastomataceae	*Pternandra rostrata* (Cogn.) M.P. Nayar
101	Meliaceae	*Chisocheton ceramicus* (Miq.) C.DC.
102	Meliaceae	*Heynea trijuga* (Roxb.) ex Sims
103	Menispermaceae	*Pericamphyllus glaucus* (Lam.) Merr.
104	Moraceae	*Artocarpus anisophyllus* Miq.
105	Moraceae	*Artocarpus dadah* Miq.
106	Moraceae	*Artocarpus integer* (Thunb.) Merr.
107	Moraceae	*Artocarpus nitidus* Trec. subsp. borneense
108	Moraceae	*Artocarpus odoratissimus* Miq.
109	Moraceae	*Artocarpus tamaran* Becc.
110	Moraceae	*Ficus aurata* Miq.
111	Moraceae	*Ficus obscura* Blume
112	Moraceae	*Ficus* sp.
113	Moraceae	*Ficus variegata* Blume
114	Myristicaceae	*Knema latericia* Elmer
115	Myrsinaceae	*Embelia javanica* DC.
116	Myrsinaceae	*Maesa ramentacea* Wall.
117	Myrtaceae	*Eugenia caudatilimba* Merr.
118	Myrtaceae	*Rhodamnia cinerea* Jack
119	Myrtaceae	*Syzygium lineatum* (DC) Merr. & Perry
120	Myrtaceae	*Syzygium* sp.
121	Myrtaceae	*Syzygium tawahense* (Korth.) Merr. & Perry
122	Neprolepidaceae	*Nephrolepis biserrata* (Sw.) Schott.
123	Neprolepidaceae	*Nephrolepis* sp.
124	Pandanaceae	*Freycinetia* sp.
125	Passifloraceae	*Passiflora foetida* L,.
126	Piperaceae	*Piper aduncum* L,.
127	Polygalaceae	*Xanthophyllum affine* Korth. ex Miq.
128	Polygalaceae	*Xanthophyllum rufum* A.W. Benn.
129	Rhamnaceae	*Alpitonia excelsa* (Fenzl) Reiss ex Endl.
130	Rubiaceae	*Gardenia tubifera* Wall.
131	Rubiaceae	*Hedyotis congesta* Wall. ex G. Don
132	Rubiaceae	*Nauclea subdita* Merr.

133	Rubiaceae	*Pertusadina eurhyncha* Ridsdale
134	Rubiaceae	*Pleiocarpidia polyneura* (Miq.) Bremek.
135	Rubiaceae	*Psychotria* sp.
136	Rubiaceae	*Timonius flavescens* (Jack) Baker
137	Rubiaceae	*Urophyllum arborescens* (Reinw. ex Blume) Korth.
138	Rutaceae	*Melicope glabra* (Blume) T.G. Hartley
139	Sapindaceae	*Guioa* sp.
140	Sapindaceae	*Lepisanthes amoena* (Hassk.) Leenh.
141	Sapindaceae	*Nephelium cuspidatum* (Blume) var. *eriopetalum* (Miq.) Leenh.
142	Sapotaceae	*Madhuca sericea* (Miq.) H.J. Lam
143	Sapotaceae	*Palaquium quercifolium* (de Vriese) Burck
144	Schizaeaceae	*Lygodium circinatum* (Burm.f.) S.w.
145	Schizaeaceae	*Lygodium microphyllum* (Cav.) R.Br.
146	Solanaceae	*Solanum jamaicence* Mill.
147	Sterculiaceae	*Heritiera elata* Ridl.
148	Sterculiaceae	*Sterculia rubiginosa* Vent
149	Symplocaceae	*Symplocos crassipes* C.B. Clarke
150	Theaceae	*Schima wallichii* (DC.) Korth.
151	Tiliaceae	*Pentace laxiflora* Merr.
152	Tiliaceae	*Pentace triptera* Mast.
153	Ulmaceae	*Trema tomentosa* (Roxb). Hara
154	Ulmaceae	*Gironniera nervosa* Planch.
155	Verbenaceae	*Clerodendrum adenophysum* Hallier f.
156	Verbenaceae	*Clerodendrum disparifolium* Blume
157	Verbenaceae	Clerodendrum sp.
158	Verbenaceae	*Geunsia pentandra* Merr.
159	Verbenaceae	*Vitex pinnata* L,.
160	Vitaceae	*Tetrastigma* sp.
161	Vitaceae	*Tetrastigma pedunculare* (Wall.) Planch.
162	Zingiberaceae	*Alpinia galanga* Willd.
163	Zingiberaceae	*Costus speciosus* (Koenig) Smith
164	Zingiberaceae	*Etlingera* sp.