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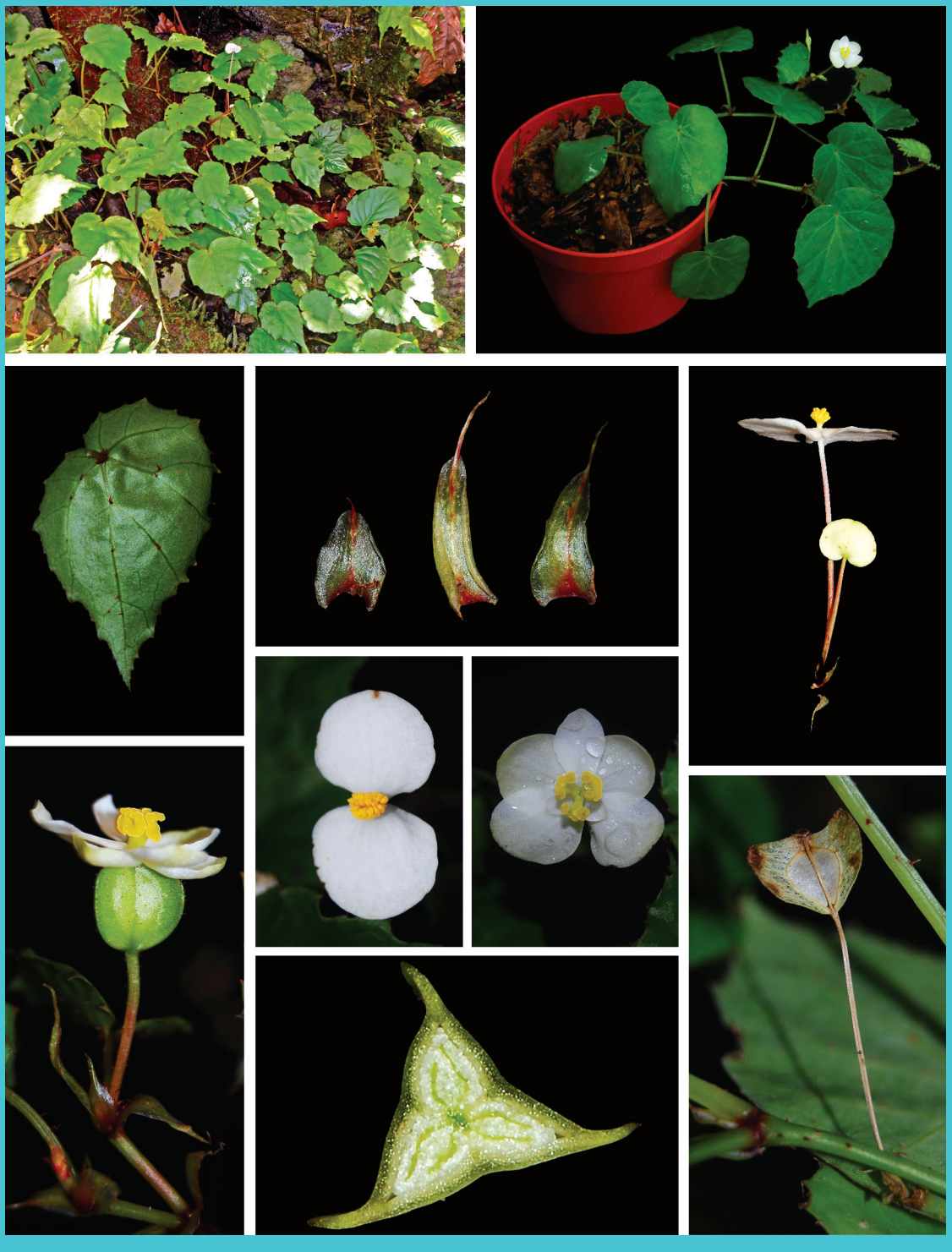

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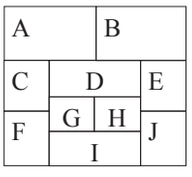

Cover images: *Begonia manuselaensis* Ardaka & Ardi. A. Plant habit in situ; B. Plant habit ex situ; C. Lamina abaxial surface with the small red scales on the veins; D. Stipules. E. Male inflorescence; F. Solitary female inflorescence; G. Male flower; H. Female flowers; I. Ovary cross section; J. Fruit. Source of materials: Wisnu Ardi, WI 104 (BO, KRB, SING). Photo credits: (B-J) by Wisnu Ardi; A: I.G. Tirta

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TREE SPECIES DIVERSITY IN THE LOWLAND FOREST OF THE CORE ZONE OF THE BUKIT DUABELAS NATIONAL PARK, JAMBI, INDONESIA

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ABSTRACT
RAHMAH, KARTAWINATA, K., NISYAWATI, WARDHANA, W. & NURDIN, E. 2016. Tree species diversity in the lowland forest of the core zone of the Bukit Duabelas National Park, Jambi, Indonesia. *Reinwardtia* 15(1): 11 − 26. — An analysis of the composition and structure of a one-hectare plot of forest on a lowland hill slope in the eastern core zone of the Bukit Duabelas National Park, Jambi, was conducted in October and November 2012. The objective of the study was to obtain a descriptive account of the structure and tree species composition of a lowland forest in the eastern core zone of the park. The plot was divided into 100 subplots of (10 m × 10 m) each and the seedling subplots (5 m × 5 m) were nested in the sapling subplots. A total of 414 trees were recorded with DBH (Diameter at Breast Height) ≥10 cm, representing 113 species and 38 families, with the total BA (Basal Area) of 25.71 m^2 and *Shannon−Wiener* diversity index of 4.29. *Prunus arborea* with IV (Importance Value) of 19.19 is the dominant species and the other prevalent species were, *Dracontomelon dao* (IV = 11.46) and *Hydnocarpus* sp. (IV = 11.38). A total of 44 species (38.9%) had each density of 1 tree/ha, which may be considered locally rare. *Ficus fistulosa* had the highest density (24 trees/ha) and *Prunus arborea* had the highest BA (3.28 m^2 = 12.8% of the total). Only 10 species had F (frequency) of 8-18%, of which *Hydnocarpus* sp. had the highest (18%); the remaining species had F<8%, which may be considered locally rare. Moraceae (IV= 34.05) was the dominant family. The two richest families were Moraceae (11) and Clusiaceae (9). A total of 61 species were registered in the Sumatra checklist and one of them was endemic (*Baccaurea dulcis*). A total of 13 species are listed in the IUCN Red List. The forest is a developing community after disturbance in the past with poor regeneration. Species with complete representation of trees, saplings and seedlings will probably remain in the forest in the future.

Key words: Jambi, lowland forest, regeneration, species richness, structure.

ABSTRAK
RAHMAH, KARTAWINATA, K., NISYAWATI, WARDHANA, W. & NURDIN, E. 2016. Keanekaragaman jenis pohon di hutan dataran rendah area inti Taman Nasional Bukit Duabelas, Jambi, Indonesia. *Reinwardtia* 15(1): 11 − 26. — Penelitian dilakukan di zona inti bagian timur Taman Nasional Bukit Duabelas, Jambi, pada bulan Oktober dan November 2012. Tujuan penelitian ini adalah untuk memperoleh data deskriptif mengenai struktur dan komposisi jenis pohon hutan pamah di zona inti bagian timur taman nasional. Penelitian dilakukan pada plot satu ha di lereng sebuah bukit. Plot dibagi menjadi 100 subplot berukuran (10 m × 10 m) dan pada setiap subplot semai yang berukuran (5 m × 5 m) dalam setiap subplot belta. Tercatat 414 pohon berdiameter setinggi dada (DSD)≥10 cm, yang mewakili 113 jenis dari 38 suku, dengan AD (area dasar) total 25,71 m^2 dan indeks keanekaragaman Shannon−Wiener (H') 4,29. *Prunus arborea* adalah jenis terpenting (Nilai Kepentingan, NK= 19,19) yang diikuti oleh *Dracontomelon dao* (11,46), dan *Hydnocarpus* sp. (11,38). Berdasarkan NK dan frekuensi, jenis yang paling menonjol adalah *Prunus arborea* dan *Dracontomelon dao*. Sebanyak 44 jenis (38,9%) mempunyai kerapatan 1 pohon/ha, yang secara lokal dapat dianggap langka. Kerapatan tertinggi (24 individu/ha) dicapai oleh *Ficus fistulosa* dan frekuensi tertinggi (F=8%) oleh *Hydnocarpus* sp., sedangkan AD tertinggi (2,38 m^2 atau 9,04%) oleh *Prunus arborea*. Moraceae (NK=34,05%) merupakan suku yang dominan. Moraceae dan Clusiaceae mempunyai kekayaan jenis tertinggi. Hanya 10 jenis mempunyai frekuensi 8-18%, dan yang lain F<8%, yang secara lokal dianggap langka. *Baccaurea dulcis* tercatat sebagai jenis endemik Sumatra. Sebanyak 13 jenis termasuk kategori IUCN Red List. Hutan ini adalah sebuah komunitas yang sedang berkembang setelah terjadi gangguan pada masa lalu dengan regenerasi yang kurang baik. Jenis yang mempunyai representasi pohon, belta dan semai lengkap diperkirakan akan tetap tumbuh dalam hutan ini di masa depan.

Kata kunci: Hutan pamah, Jambi, kekayaan jenis, regenerasi, struktur.

INTRODUCTION

The remaining lowland tropical forest of Sumatra is an important center of plant species diversity as well as the center of distribution for many families and genera within the Malesian archipelago (Kartawinata, 2013; Whitmore, 1986), yet large areas of the forests have not been investigated. The most widespread forest ecosystem in Sumatra is the dipterocarp forest, characterized by tall canopy dominated by an association of dipterocarp species. During the last four decades the dipterocarp forests have experienced extensive logging and conversion into oil palm plantations and industrial timber estates (Kartawinata, 2005; Kartawinata *et al*., 2008). To date the lowland hill and montane forests of the interior constitute the remaining relatively intact undisturbed primary forests and much of them are located in national parks and other conservation areas and protected forests.

A better knowledge of basic ecological information, including floristic composition and structure of the forest is necessary for development of sustainable forest management and conservation. To date, there are relatively few detailed descriptions and quantitative assessments of forest floristic and structure to represent and illustrate the huge area of the Malesian rain forests (Kartawinata, 2005; Whitmore & Sidiyasa, 1986).

Information on vegetation and physiography of Sumatra has been summarized by Laumonier (1997). Current knowledge of the ecology, floristic, structure and species richness of the lowland dipterocarp forests is mainly based on scattered studies carried out in different parts of Sumatra, mainly in national parks and other protected areas, such as the Batang Gadis National Park (Kartawinata *et al.,* 2004), Rimbo Panti Nature Reserve (Yusuf *et al*., 2005), Gunung Leuser National Park (Abdulhadi, 1991; Samsoedin & Heriyanto, 2010), Berbak National Park (Silvius *et al*., 1984), Bukit Tigapuluh National Park (Polosakan, 2001), Hutan Danau Bangko (Polosakan, 2011), Kerinci Seblat National Park (Gillison *et al.,* 1996), Tesso Nilo National Park (Gillison, 2001), Harapan Tropical Rainforest (Mansur *et al*., 2010) and Imbo Mengkadai customary forest (Elviqar, 2013; Hermawan, 2013). Such detailed studies in the Bukit Duabelas National Park (BDNP) in Jambi are still meager. To date such studies have been undertaken by Anas (2013) and Sehati (2013), who investigated species composition and structure of the forest in one-hectare plots in the middle and west sections of the core zone, respectively. The dominants species in the middle zone were *Dacryodes rostrata, Shorea leprosula* and *Hydnocarpus* sp. While in the west section were *Archidendron bubalinum*, *Dacryodes* sp. and *Antidesma neurocarpum*. The two sites have low species richness of 89 and 91, respectively.

The objective of the present study is to obtain a basic descriptive account of the structure and floristic composition of a lowland forest in the eastern core zone of the BDNP that may be useful for park management, including long-term investigation of forest dynamics and floristic changes. In this paper, analysis of the species inventory data collected in the plots will be limited to the description of the forest in terms of the main structural parameters, species richness, pattern of relative abundance and family composition.

MATERIALS AND METHODS

Study site

BDNP with a total area of 60,500 ha was established through the Ministry of Forestry and Plantation Decree No. 258/Kpts-II/2000 dated 23 August 2000, comprising primary and secondary forests, which were originally permanent production forests, limited production forest and forests designated for other uses (Sriyanto *et al*., 2003; Wiriadinata & Setyowati, 2000), which is within the lowland dipterocarp forest of Sumatra (Whitmore, 1986). It was designed to conserve lowland forest biological diversity and to function as one of the water catchment areas for the Province of Jambi (Wiriadinata & Setyowati, 2000). BDNP was also designed to provide a natural living environment for the indigenous Suku Anak Dalam (SAD) community that has been inhabiting the natural forests in Jambi for centuries (Setyowati, 2003).

BDNP contains rare plant species, such as *Eusideroxylon zwageri*, *Fagraea fragrans, Calamus manan*, *Daemonorops draco* and *Dyera costulata* (Kementerian Kehutanan dan Balai TNBD, 2011). Species diversity within BDNP and its surroundings has declined due to commercial timber logging (Wiriadinata & Setyowati, 2000) and harvesting of trees with high economic values by local communities (Kementerian Kehutanan dan Balai TNBD, 2011).

Fig. 1 shows the map of BDNP. BDNP is situated at 102°31’37” – 102°48’27” East and 1°44’35”– 2°03’15” South, with topography varying from flat to undulating to hilly, with an altitude of 50 - 438 m (Kementrian Kehutanan dan Balai TNBD, 2011). Climatically, it is located in the wet region belonging to the rainfall type A (Schmidt & Ferguson, 1951), with the mean annual rainfall of 3,669 mm. The mean monthly rainfall is greater than 100 mm, with the highest in December (366 mm) and the lowest in July (125 mm) (Boerlage, 1949), indicating that the area is everwet throughout the year with very mild dry period in June and July (Fig. 1). The soil of the area belongs to the Red Yellow Podsolic soils

(Kementerian Kehutanan dan Balai TNBD, 2011).

Methods

Field sampling was carried out from October to November 2012 in the lowland forest located in the eastern section of the core zone of BDNP, using the quadrat method (Cox, 1967; Mueller-Dombois & Ellenberg, 1974). A plot of one hectare (100 m × 100 m) was established subjectively in the most accessible area of the core zone on a slope in the forest near the Singkarak Kecil River. The plot was further divided into 100 tree-subplots of 10 m × 10 m each (Kartawinata *et al.,* 2004). Within each subplot all trees with DBH (Diameter at Breast Height) ≥ 10 cm were identified, their diameters and heights were measured and their positions were recorded. Woody lianas with DBH ≥ 10 cm were treated as trees. The plot was made into a permanent sample plot by numbering each tree and big woody liana within the plot with a numbered aluminum tag nailed onto the tree trunk 10 cm above the place where the diameter was measured. Saplings (small trees with DBH 5-10 cm) were recorded in a 5 m × 5 m sapling-subplot nested in each tree-subplot and seedlings (woody plants with height < 50 cm) were recorded in a seedling-subplot of 1 m × 1 m nested in each sapling-subplot.

Definition and calculation of density, frequency and dominance followed Cox (1967) and Mueller-Dombois & Ellenberg (1974). Density refers to the number of individuals per unit area, and counting was done within subplots. The number of individuals per species was later calculated for the total area of the plot, which is one hectare. The density for each species was expressed in terms of the number of individuals per hectare. The density in the plot is the sum of the individuals of all species. The Relative Density (RD) for each species was calculated using the following formula:

$$RD = \frac{\text{number of individulas of a species}}{\text{total number of individuals}} \times 100\%$$

Frequency relates to the number of times a species occurs in a given number of subplots in the plot and is expressed as percentage of the total number of subplots. No counting of individuals was carried out just recording the species presence. The Relative Frequency (RF) for each species was calculated using the following formula:

$$RF = \frac{\text{frequency of a species}}{\text{sum frequency of all species}} \times 100\%$$

Dominance for trees is usually defined as stem cover, which is the same as basal area. The basal area (BA) is obtained with the formula:

$$ba = (\tfrac{1}{2}d)2x\pi$$

where d stands for diameter. The Relative Dominance (RDo) was obtained with the following formula:

$$RDo = \frac{\text{dominance of a species}}{\text{dominance of all species}} \times 100\%$$

The sum of density, frequency and dominance can be used to indicate the importance of a species in the plot and this can be done only if they are expressed in terms of relative values. The Importance Value is then calculated with the formula:

$$IV = RD + RF + RDo$$

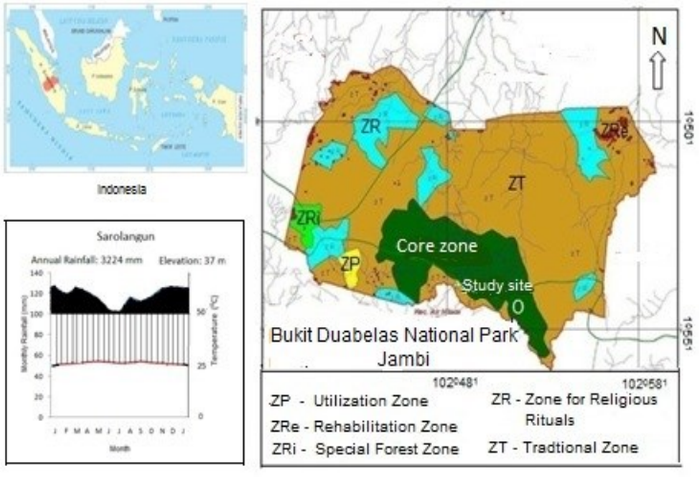

Fig. 1. The map showing the geographic location and the climate of the BDNP

and the IV of a species reaches a maximum of 300 in the plot consisting of only one tree species.

In each tree-subplot percentage of canopy gaps and the projected tree crown coverage were estimated, topograpy and air humidity were measured and soil type was noted. In the field, species of Dipterocarpaceae were identified using the *Tree Identification Guide for Dipterocarpaceae of Sumatra* (Newman *et al*., 1999). Herbarium specimens for each species within the plot were collected and identified at the Herbarium Bogoriense, Research Center for Biology–LIPI at Cibinong. The identity and nomenclature of each tree species followed the *Tree flora of Indonesia: checklist for Sumatra* (Whitmore & Tantra, 1986) and *Flora Malesiana* (Steenis *et al.,* 1948-2013).

The species-area curve was constructed based on species data from 100 subplots nested within the plot. It is not intended to establish the minimal -area of sampling the forest in the study area. The minimal sample area is usually applied to show that the species are as fully represented as possible when the objective is to obtain data using a single "minimal area" plot of the community (Mueller-Dombois & Ellenberg, 1974). This approach is normally difficult to apply in species-rich and complex tropical forests (Ashton, 1965; Mueller-Dombois & Ellenberg, 1974), such as those of Sumatra and Kalimantan (Kartawinata, 2005), where there is no indication of leveling-off of the curve at the area of 5 hectare.

A dendrogram of Jaccard similarity of species among plots in the study area was constructed by using computer software *Multivariate Statistical Package* (MVSP) Version 3.12 (Kovach, 2001).

RESULTS

Species composition

In the one hectare plot we recorded 414 trees, representing 113 species and 38 families (see Appendix). Fig. 2 shows that each of 44 species (38.94%) had only a density of one tree/ha, 17 species (15.04%), had a density of two trees/ha, 16 species (14.16%) had a density of three trees/ha, 32 species (28.32%) had a density of 4-12 trees/ha, and four species (3.54%) had a density of 13-24 trees/ha.

Table 1 shows 10 species having high IV, where *Prunus arborea, Dracontomelon dao*, *Hydnocarpus* sp. and *Ficus fistulosa* were the four most important species, with IV > 10. *Prunus arborea* with IV = 19.20 is definitely the dominant species.

Species density, dominance and distribution within plot vary. Ten species with highest density were also species with highest frequency, but they were in different orders (Table 2). *Ficus fistulosa* had the highest density (24 trees/ha). Species with the highest frequency was *Hydnocarpus* sp. (F=18%). In the plot there were only a few species having F>8% and most of the species had F = <8%, of which 44 species each had F = 1% .

In the present study the species-area curve tends to increase steadily and at one-hectare area there is no sign of levelling-off (Fig. 3). It indicates that the forest in the study plot has a relatively high species diversity, as shown also by the species richness index of 113 species/ha. It is further confirmed by the Shannon-Wiener Index (McCune & Grace, 2002) of 4.29.

Non-dipterocarp species were prevalent in terms of the number of species, basal area and density (Table 3). In terms of the number of species the dominant families were Moraceae (11), Clusiaceae (9) and Lauraceae (7) (Table 4). Based on the importance value Moraceae was the most important family (IV=34.05), followed by Sapindaceae (20.25) and Rosaceae (19.19) (Table 4).

Structure

The total basal area for all species was 25.71 m^2, with the mean BA of 0.23 m^2. A total of 88 species (77.9%) had BA of < 0.3 m^2 (Fig. 4a). BA of the species of Moraceae was the highest (3.03 m^2 or 11.79% of the total). The BAs of other families were < 2 m^2.

Fig. 4b shows that trees with DBH < 30 cm had the highest number, *i.e.* 327 individuals (78.99%). Species of Moraceae dominated the diameter class ≥ 30 cm, *i.e*., 14 individuals (16.1%). Five individuals with DBH ≥ 100 cm were *Artocarpus odoratissimus. Cratoxylum arborescens, Litsea spathacea, Polyalthia kingii* and *Prunus arborea.*

Fig. 5 is the simulated profile diagram of the forest in the plot, prepared using the method of Kartawinata *et al*. (2004). It shows that the height of most trees (395 individuals or 95.4%) was < 20 m. It shows that the forest consisted of four strata: A (> 30 m), B (20-30 m), C (4-20 m), and D (1-4 m). Emergent trees with height > 30 m (Stratum A) consisted of *Cratoxylum arborescens, Hydnocarpus sumatrana* and *Prunus arborea.* In terms of number of trees Stratum B was dominated by *Dracontomelon dao* and *Dacryodes* spp., Stratum C by *Hydnocarpus* sp. and *Ficus fistulosa*, and Stratum D by *Madhuca* sp.

Regeneration

The total number of trees, saplings and seedlings species were 155, which can be divided into seven groups (Table 5).

Topography and habitat conditions in the study plots

The topography of the research plot varied from flat to undulating. Trees tended to grow more on flat subplots. In subplots with slopes of 16 - 45^o the average number was 4.1 trees/subplot, on

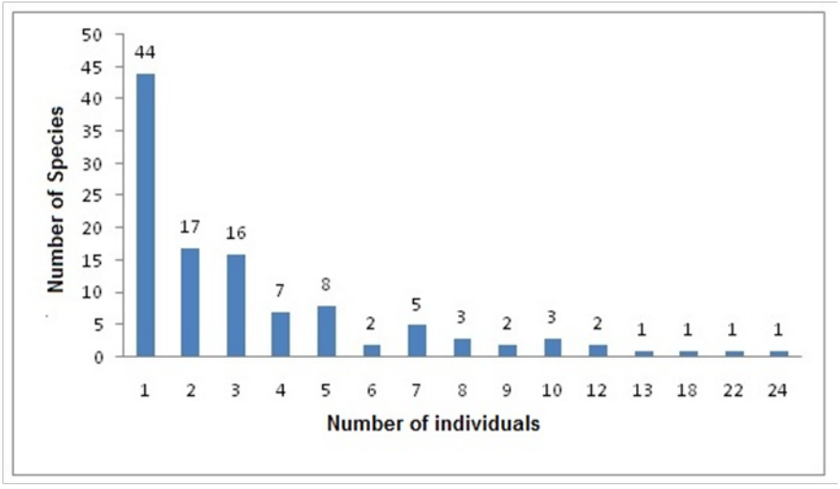

Fig. 2. Number of species and number of individuals of trees in a one-hectare plot of forest in the east section of the core zone at BDNP

Table 1. The Relative Density (RD), Relative Frequency (RF), Relative Dominance (RDo) and Importance Value (IV = RD +RF+ RDo) of the ten most important species based on IV.

No.	Species	RD (%)	RF (%)	RDo (%)	IV
1.	*Prunus arborea*	5.31	4.64	9.24	19,20
2.	*Dracontomelon dao*	2.17	2.46	6.83	11.46
3.	*Hydnocarpus* sp.	4.35	4.92	2.11	11.38
4.	*Ficus fistulosa*	5.80	2.73	2.29	10.83
5.	*Litsea spathacea*	1.69	1.64	5.17	8.50
6.	*Knema laurina*	3.14	3.01	1.11	7.25
7.	*Artocarpus odoratissimus*	1.21	1.37	4.59	7.16
8.	*Palaquium walsuraefolium*	2.90	2.19	2.05	7.13
9.	*Diospyros areolata*	2.90	2.73	0.99	6.62
10.	*Dacryodes* sp.	2.42	2.46	1.58	6.46

slopes of 8 - 16^{o} the average was 4.5 trees/subplot, and on slopes of 4 - 8^{o} the average was 5.4 trees/ subplot. A total of 73 subplots (73%) occurred on slopes of 16 - 45^{o}; 22 subplots on slopes of 8 - 16^{o} and 2 subplots on slopes of 4 - 8^{o}.

Humidity within the plot was high (77 – 90%), attributed to the dense stand and high mean percentage (76%) of canopy cover with a range of 50 - 100%. In general the soils of the BDNP belong to the red yellow podsolic group (Kementerian Kehutanan dan Balai TNBD, 2011). Although in the plot 18 subplots have sandy soils with large rocks above.

DISCUSSION

Species diversity and structure

The species richness [*i.e.*, number of species in a sampling unit (McCune & Grace, 2002)] and tree density in the forest of the eastern zone of the BDNP are smaller than those in several lowland forests in Sumatra and Kalimantan, but higher than those in the upper lowland forest of Java (Table 6). The situation is related to the status of the forests whether they are undisturbed lower lowland forests (Kartawinata *et al.,* 2004; Sheil *et al.,* 2010) or disturbed lower primary lowland forests (Anas, 2013; Elviqar, 2013; Hermawan, 2013; Sehati, 2013), disturbed upper primary lowland forests (Helmi *et al.,* 2009), or lowland secondary forests (Mansur *et al.*, 2010)

Tree density in the present study plot was the lowest compared to those in other forests in Jambi, but together with the Central BDNP the species richness was higher than those in HAIM 1, HAIM 2 and West BDNP (Table 6). Table 6 shows also that density and species richness in the Jambi

Table 2. Ten species with highest frequency (F), density (D) and basal area (BA), species with lowest density and frequency and species that is included in the IUCN Red List.

Species group	Species
a. Ten species with highest frequency (%)	*Hydnocarpus* sp. (18), *Prunus arborea* (17), *Knema laurina* (11), *Diospyros areolata* (10), *Ficus fistulosa* (10), *Dracontomelon dao* (9), *Paranephelium nitidum* (9), *Dacryodes* sp. (9), *Arenga pinnata* (9), *Palaquium walsuraefolium* (8)
b. Ten species with highest density (number of trees/ha)	*Ficus fistulosa* (24), *Prunus arborea* (22), *Hydnocarpus* sp. (18), *Knema laurina* (13), *Palaquium walsuraefolium* (12), *Diospyros areolata* (12), *Paranephelium nitidum* (10), *Dacryodes* sp. (10), *Arenga pinnata* (10), *Dracontomelon dao* (9).
c. Ten species with highest basal area (m^2)	*Prunus arborea* (2.38), *Dracontomelon dao* (1.75), *Litsea spathacea* (1.33), *Artocarpus odoratissimus* (1.18), *Polyalthia kingii* (1.12), *Cratoxylum arborescens* (0.93), *Gonocaryum gracile* (0.73), *Pterospermum javanicum* (0.66), *Ficus fistulosa* (0.59), *Hydnocarpus* sp. (0.54).
d. Forty four species with lowest density (1 tree/ha) and lowest frequency (1%)	*Alangium javanicum, Aphanamixis polystachya, Artocarpus nitida, Artocarpus glaucus, Baccaurea dulcis, Baccaurea* sp., *Bhesa paniculata, Bouea oppositifolia, Calophyllum molle, Calophyllum tetrapterum, Calophyllum* sp., *Claoxylon longifolium, Cratoxylum arborescens, C. cochinchinense, Diospyros lanceifolia, Dialium indum, Dimocarpus longan, Dracontomelon* sp., *Durio* sp., *Elaeocarpus glaber, Fagraea elliptica, Ficus elastica, Fissistigma latifolium, Garcinia celebica, Garcinia* sp., *Gluta renghas, Knema globularia, Knema mandaharan, Litsea elliptica, Mallotus floribundus, Madhuca sericea, Neo-uvaria acuminatissima, Neo-uvaria* sp., *Nephelium* sp., *Ochanostachys amentacea, Palaquium ridleyi, Pertusadina eurhyncha, Polyalthia kingii, Porterandia anisophylla, Scaphium macropodum, Shorea leprosula, Styrax benzoin, Tetranthera angulata, Uncaria gambir.*
e. Species included in the IUCN Red List	Endangered: *Shorea leprosula*; Low Risk: *Aglaia odoratissima, Alangium javanicum, Aphanamixis polystachia, Bhesa paniculata, Cratoxylum arborescens, Dacryodes rostrata, Dimocarpus longan, Diospyros areolata, Knema latifolia, Litsea spathacea, Prunus arborea, Scaphium macropodum.*

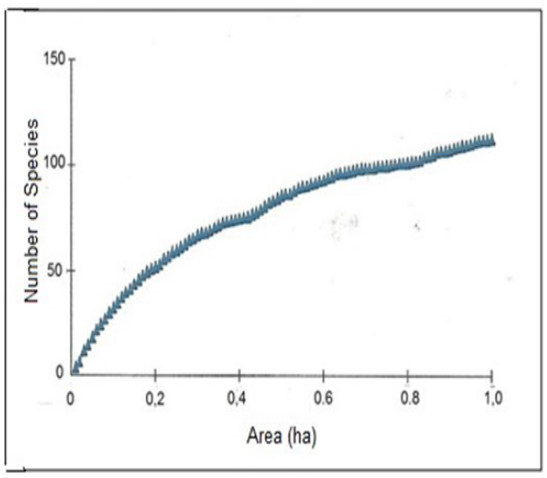

Fig. 3. A species-area curve in a one-hectare plot of forest at BDNP, Jambi.

Table 3. The floristic and structural characteristics of the forest at the East BDNP.

Vegetation Parameter	Diptero-carpaceae	Non-Dipterocarpa-ceae	Total
Number of species	2 (1.77%)	111 (98.23%)	113
Density (trees/ha)	3 (0.72%)	411 (99.28%)	414
Basal Area (m^2)	0.55 (2.13%)	25.16 (97.87%)	25.71
Importance values	3.68 (1.23%)	296.32 (98.77%)	300

Table 4. Summary of family characteristics at tree level.

Characteristics	Family
Eight families with number of species ≥5	Moraceae (11), Clusiaceae (9), Lauraceae (7), Malvaceae (7), Euphorbiaceae (6), Sapindaceae (6), Phyllanthaceae (5), Annonaceae (5).
Ten families with highest density (trees/ha)	Moraceae (52), Sapindaceae (30), Lauraceae (27), Clusiaceae (25), Euphorbiaceae (23), Flacourtiaceae (23), Rosaceae (22), Burseraceae (21), Malvaceae (18), Myristicaceae (18).
Ten families with the highest basal area (m^2)	Moraceae (3.07), Rosaceae (2.38), Annonaceae (1.88), Lauraceae (1.87), Anacardiaceae (1.86), Malvaceae (1.59), Sapindaceae (1.38), Clusiaceae (1.09), Flacourtiaceae (0.97), Hyperacaceae (0.93).
Ten families with the highest Importance Value	Moraceae (34.0), Sapindaceae (20.25), Rosaceae (19.19), Lauraceae (16.92), Annonaceae (15.98), Flacourtiaceae (15.58), Malvaceae (15.2), Euphorbiaceae (14.73), Burseraceae (13.93), Anacardiaceae (13.46).

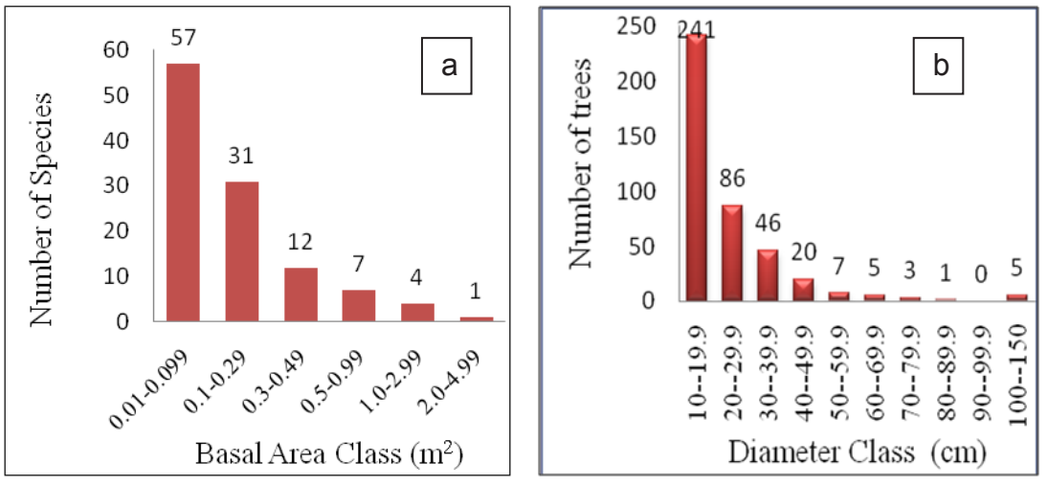

Fig. 4a. Number of species according to the BA classes and b. the number of trees according to the diameter classes.

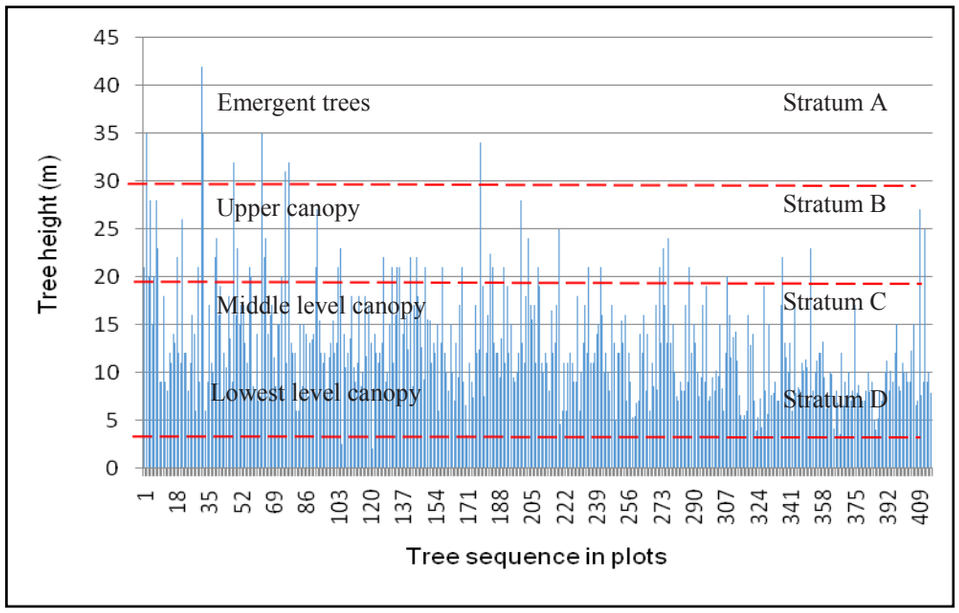

Fig. 5. Tree stratification profile based on the tree height and sequential tree positions from tree no. 1 in 1st subplot up to the tree no. 414 in 100th subplot in BDNP eastern core zone.

Table 5. Regeneration status of tree species in the study plots.

Regeneration Status	Species
1. Species (33) with complete representation of trees, saplings and seedlings	
1.1. Species (23) with poor seedling populations (1-3 seedlings/ha)	*Artocarpus nitidus, Artocarpus odoratissimus, Baccaurea javanica, Cleistanthus macropyllus, Dacryodes rostrata, Dacryodes rugosa, Diospyros areolata, Diospyros curanii, Dysoxyllum excelsum, Ficus fistulosa, Hydnocarpus* sp.*, Laportea stimulans, Litsea noronhae, Mallotus floribundus, Mallotus rufidulus, Memecylon excelsum, Memecylon edule, Neonauclea calycina, Paranephelium nitidum, Polyalthia sumatrana, Pterospermum* sp.*, Syzygium cymosa* and *Trigonostemon* sp.
1.2.Species (8) with relatively good seedling populations (5-16 seedlings/ha)	*Parashorea* sp.*, Palaquium walsurifolium, Litsea confusa, Prunus arborea, Antidesma erythrocarpum, Shorea leprosula, Polyalthia cauliflora,* and *Neouvaria acuminatissima.*
1.3.Rare species (2) with 1 seedling/ha	*Ficus elastica* and *Bouea oppositifolia*
2. Species (45) represented by trees only	*Aphanamixis polystachya, Arenga pinnata, Artocarpus glaucus, Baccaurea* sp.*, Bhesa* sp.*, Calophyllum molle, Calophyllum tetrapterum, Claoxylon longifolium, Cnestis palala, Cratoxylum arborescens, Cratoxylum cochinchinense, Dillenia cf. pentagyna, Dimocarpus longan, Diospyros lanceifolia, Durio* sp.*, Elaeocarpus glaber, Ficus padana, Ficus* sp. 1*, Ficus* sp. 2*, Garcinia* sp.*, Gironniera hirta, Gluta renghas, Knema globularia, Knema latifolia, Leptonychia caudata, Litsea elliptica, Madhuca sericea, Melochia umbelata, Mussaenda frondosa, Nephelium* sp.*, Ochanostachys amentacea, Oncosperma horridum, Palaquium ridleyi, Paratocarpus bracteatus, Pertusadina eurhyncha, Phoebe grandis, Polyalthia kingii, Porterandia anisophylla, Pterospermum javanicum, Rauvolfia sumatrana, Sterculia rubiginosa, Styrax benzoin, Tetranthera angulata, Tetrastigma lanceolarium* and *Uncaria gambir.*
3. Species (26) represented by trees and saplings	*Alangium javanicum, Artocarpus elasticus, Baccaurea dulcis, Blumeodendron tokbrai, Callophylum* sp.*, Dacryodes* sp.*, Dialium indum, Dialium platysepalum, Dracontomelon dao, Dracontomelon* sp.*, Durio oxleyanus, Fagraea elliptica, Fissistigma latifolium, Garcinia atroviridis, Hydnocarpus sumatrana, Knema laurina, Laportea* sp.*, Litsea spathacea, Macaranga hypoleuca, Madhuca* sp.*, Nephelium uncinatum, Ochanostachys amentacea, Pometia* sp.*, Scaphium macropodum* and *Strombosia javanica.*
4. Species (7) represented by saplings and seedlings	*Archidendron* sp.*, Gomphandra capitulata, Macaranga hulletii, Polyalthia lateriflora, Rinorea anguifera, Tetracera akara* and *Tetramerista glabra.*
5. Species (5) represented by trees and seedlings	*Artocarpus anisophyllus, Diospyros cauliflora, Garcinia celebica, Knema mandaharan* and *Microcos opaca.*
6. Species (20) represented by saplings only	*Alstonia* sp.*, Antidesma tetrandum, Aquilaria malaccensis, Atuna* sp.*, Cananga odorata, Garcinia parvifolia, Gironniera hirta, Gynotroches axillaris, Mangifera odorata, Nephelium lappaceum, Omalanthus populneus, Pentaspadon motley, Phoebe grandis, Porterandia* sp.*, Pternandra azurea* and *Tristaniopsis whiteana.*
7. Species (19) represented by seedlings only (1-22 seedlings/ha)	*Aglaia leucophylla, Agalmyla beccarii, Agelaea macrophylla, Agelaea trinervis, Antidesma cuspidatum, Aromadendron* sp.*, Artocarpus integer, Baccaurea macrophylla, Carallia brachiata, Ficus* sp.*, Leptonychia caudata, Leuconotis eugeniifolia, Pouteria malaccensis, Rinorea lanceolata, Spatholobus* sp.*, Timonius* sp.*, Urophyllum arboreum, Urophyllum* sp. and *Xanthophyllum incertum*.

forests were lower than those in the undisturbed primary forests in North Sumatra and in East Kalimantan. It should be noted that the forest in Harapan Rainforest was a secondary forest (Mansur *et al*., 2010). Low tree density in BDNP was possibly attributed to the physiography of the site, which ranges from undulating, hilly to steep slopes.

Differences in topography appear to affect not only the number of species and density but also species combination forming the floristic composition of the forest. in line with Whitmore (1986), who stated that lowland forest variations from one place to another are related to terrain, topography and degree of natural disturbance. Fig. 5 shows low similarities of tree species composition, as indicated by low Jaccard's coefficients, between the forest in the present study (E. BDNP) and those at C. BDNP (Anas, 2013), HAIM 2 (Hermawan, 2013), HAIM 1 (Elviqar, 2013) and B. GADIS (Kartawinata *et al*., 2004). The topography at E. BDNP is undulating, while that in C. BDNP is hilly with steep slopes (Anas, 2013) and the topography at HAIM 1 (Elviqar, 2013) and HAIM 2 (Hermawan, 2013) is relatively flat. Big differences of species composition in the eastern core zone of the BDNP and those at HAIM 1 & 2 and B. Gadis NP were likely due to the differences in the degree and intensity of disturbances. Human disturbances at BDNP were lower than those at HAIM, but higher than those at B. Gadis NP, which is a relatively undisturbed primary forest (Kartawinata *et al.,* 2004).

The significance of the species-area relationship is fundamental to ecology (Plotkin *et al*., 2000) and can also be used to estimate species extinction due to habitat loss (May *et al*., 1995; Pimm & Raven, 2000) and to evaluate species diversity patterns in different forest types (Ashton, 1965). The curve is constructed to indicate species diversity in relation to increasing size of the area (Mueller-Dombois & Ellenberg, 1974) within the plot. In the present study the species-area curve tends to increase steadily and at one-hectare there was no sign of levelling-off (Fig. 3). It indicates that the forest had a relatively high species diversity, as shown also by the species richness index of 113 species/ha and the Shannon-Wiener Index of 4.29. Plot richness may be attributed to disturbance by allowing species dependent on disturbance to occur in very close association with late-successional species (Connell, 1978; Sheil & Burslem, 2003; Slik *et al*., 2008).

Trees with large diameters and the emergents in the A stratum were dominated by light demanding species, such as *Artocarpus odoratissimus* and *Cratoxylum arborescens*. We assume that they developed and grew well in the past during the time when canopy gaps were formed, due to natural disturbance and human activities. From the past history of BDNP, confirmed by the structure and floristic composition, the forest of the eastern core zone of BDNP is a disturbed forest due to the death of trees and tree extraction by the indigenous Suku Anak Dalam (SAD) community as well by commercial logging, which took place prior to the establishment of the BDNP in 2000. The existence of fallen decaying big trees on the forest floor and the tree stumps and other wood remains resulting from cutting by axes and knives usually operated by the indigenous SAD is a

Table 6. Comparison of number of species and density (trees/ha) in several one-hectare plots in Sumatra: Bukit Duabelas National Park (BDNP), Imbo Mengkadai customary forest (HAIM) in Jambi; Mount Leuser NP (National Park) and Batang Gadis NP in North Sumatra; Malinau in East Kalimantan; and Mount Gede-Pangrango National Park (MGPNP) in West Java.

No.	Locality	Area of Plot (ha)	Number of trees	Number of Species	Source
	Jambi				
1.	East BDNP	1	414	113	Present study
2.	Central BDNP	1	540	89	Anas (2013)
3.	West BDNP	1	463	91	Sehati (2013)
4.	HAIM 1	1	765	96	Elviqar (2013)
5.	HAIM 2	1	681	96	Hermawan (2013)
6.	Harapan Rainforest	1	550	96	Mansur *et al*. (2010)
	North Sumatra Mt				
7.	Leuser NP	1	687	184	Samsoedin & Heriyanto (2010)
8.	Batang Gadis NP	1	583	205	Kartawinata *et al*. (2004)
	East Kalimantan				
9.	Malinau	1	759	205	Sheil *et al*. (2010)
	West Java				
10	MGPNP	1	350	70	Helmi *et al*. (2009)

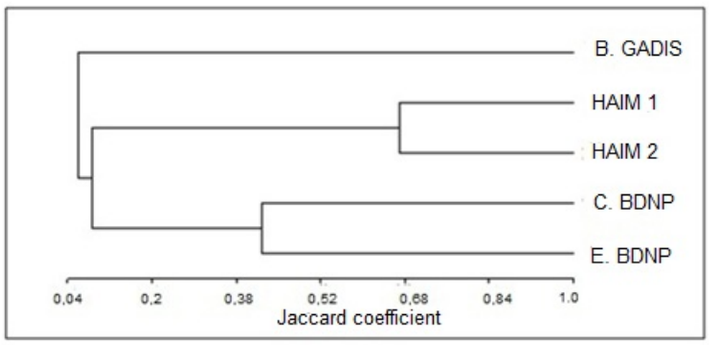

Fig. 6. Dendrogram of similarity of species among plots at Batang Gadis NP (B. GADIS), Hutan Adat Imbo Mengkadai (HAIM 1 and HAIM 2) and Bukit Duabelas NP (C. BDNP & E. BDNP).

strong proof.

In the BDNP forest 61 species (54%) are classified as primary forest species and are registered in the *Tree flora of Indonesia. Check list for Sumatra* and one of them, *Baccaurea dulcis,* is endemic to Sumatra (Whitmore & Tantra, 1986). The dominance of *Prunus arborea* does not reflect the typical forest of Sumatra, where dipterocarp species are generally dominant (Abdulhadi, 1991; Gillison, 2001; Gillison *et al.,* 1996; Kartawinata *et al*., 2004; Polosakan, 2011; Samsoedin & Heriyanto, 2010). In the present study dipterocarps were represented only by *Parashorea* sp. and *Shorea leprosula,* which were both at very low density and frequency. The insignificant presence and the disappearance of dipterocarp species are likely attributed to the commercial logging and were later followed by indiscriminate cutting of remaining commercial tree species, including dipterocarps, by illegal loggers. No records are available on dipterocarp populations in the forest at the eastern core zone prior to commercial logging activities, which took place before the establishment of the park in 2000 (Ministry of Forestry and Plantation, 2000). It is assumed that dipterocarps were dominant in BDNP just like in lowland dryland forests elsewhere in Sumatra (Abdulhadi, 1991; Gillison, 2001; Gillison *et al.,* 1996; Kartawinata *et al*., 2004; Polosakan, 2011; Samsoedin & Heriyanto, 2010; Whitmore & Tantra, 1986).

Prunus arborea grows in primary and secondary forest at 0-1800 m alt. (Kalkman, 1993), thus its presence with high importance value and density in the present study site could be in response to the previous disturbance and acted as pioneer and took advantage of the increased light and added to the original population in the primary forest prior to disturbance. In primary forest of Sumatra the population of *Prunus arborea* is very low (Kartawinata *et al*., 2004).

Other important species are *Ficus fistulosa* which is a forest species (Berg & Corner, 2005), *Dracontomelon dao,* a tall tree with diameter up to 150 cm and height up to 55 m, grows in secondary forest in high rainfall areas at 500-1000 m altitudes (Ding Hou, 1978) and *Knema laurina* which occurs in primary and degraded dipterocarp forests on a variety of soils at 1000 m alt. (Wilde, 2000). Other species that could be identified as secondary forest species (Corlett, 1991; Kartawinata, 1994; Keβler *et al*. 2000; Whitmore, 1986) were *Cratoxylum arborescens, C. cochinchinense, Dillenia pentagyna, Macaranga hypoleuca, Mallotus floribundus, Mallotus rufidulus, Melochia umbelata, Mussaenda frondosa, Neonauclea calycina,* and *Shorea leprosula. Shorea leprosula* is actually one of the major components of primary dipterocarp forests, but it often behaves more like a secondary forest species or even a pioneer species, invading canopy openings or open areas at forest edges. The presence and abundance of these species indicate past disturbances, including possibly minor landslides on unstable ridges. Disturbance may also explain the high density of smaller trees which also contribute to plot-level richness (Sheil *et al.,* 2010).

BDNP has undergone changes in tree species dominance from dipterocarps to non-dipterocarps as a result of various human activities, including commercial and illegal timber logging as well as tree harvesting by the SAD community. The forest in the study plot is a developing disturbed forest with relatively low richness of primary and secondary forest species. It is confirmed by the vertical and horizontal structure of the stand dominated by trees with diameters of less than 20 cm. The forest of the core zone of BDNP is a

community with heterogeneous species composition. The heterogeneity is reflected by the majority of the species having low frequency and density.

The decline of the populations of some species is attributed to harvesting by the SAD community to satisfy their various needs (Setyowati, 2003). *Shorea leprosula*, *Bouea oppositifolia,* and *Diospyros* sp. are used as building material, *Artocarpus anisophyllus, Oncosperma horridum, Garcinia atroviridis,* and *Dialium indum* as sources of food; *Ochanostachys amentacea* as a medicinal plant *Styrax benzoin* as materials for traditional rituals, and *Artocarpus elasticus* as clothing material. *Calamus manan, Daemonorops draco*, *Dyera costulata*, *Eusideroxylon zwageri* and *Fagraea fragrans,* which were reported as rare species (Kementerian Kehutanan dan Balai TNBD, 2011) were no longer present in the study plots. It is very likely that their absence is due to extraction or that they only growing elsewhere in the BDNP.

Regeneration

Hubbell & Foster (1986), defined a species as rare if, on the average, it has one or fewer stems per hectare. Following this definition, the 44 species (38.94% of the total) listed in the Table 2d can be definitely considered rare at least locally in the BDNP, which is not necessarily in line with IUCN criteria. They are extremely vulnerable to disappearance caused by even slight disturbances. This is aggravated by the fact that their regeneration was poor and only *Shorea leprosula* had slightly better regeneration (Table 5.1.2). Poor regeneration of dipterocarps is due to the absence of mature trees within and in the surrounding area of the plot as well as high exposure to light after heavy logging prevented seed germination and development of shade tolerance seedlings of dipterocarps.

Species that are represented only by trees with no representation of saplings and seedlings will usually sooner or later disappear from the forest (Richards, 1996). Some species, *e.g., Aphanamixis polystachya, Artocarpus glaucus, Calophyllum molle, Claoxylon longifolium, Cratoxylum arborescens, Cratoxylum cochinchinense, Dimocarpus longan, Elaeocarpus glaber, Gluta renghas* and *Madhuca sericea* were represented by trees with no saplings and seedlings, thus they will disappear sooner than the others. The 19 species of group 7 in Table 5, that were represented by seedlings only, particularly *Carallia brachiata*, could be considered as invaders that, in the long run, could probably slowly change if not take over the community, provided that the environmental conditions favor their growth. The regeneration processes in tropical forests, are complex (Richards, 1996) and are related to the presence of gaps (Whitmore, 1986). The seedlings are usually unevenly distributed and their abundance varies periodically. In a species-rich mixed rain forest the species composition of the seedling population may generally reflect fairly closely that of the tree storeys (Richards, 1996; Whitmore, 1986). Frequently, seedlings of certain tree species, usually large emergents, such as *Cratoxylum arborescens, Hydnocarpus sumatrana* and *Prunus arborea* in the present study, are absent or very rare so that it might be supposed that these species are disappearing from the community. In the canopy seed production is usually seasonal and different species of trees differ very much in the quantity and frequency of seed production. The abundance of tree seedlings in a given place depends on the availability of viable seeds which drop from the canopy, are carried from elsewhere in the 'seed rain' or are dormant in the soil (Richards, 1996; Riswan, 1982; Whitmore, 1986).

The number of individuals in each species at tree, sapling and seedling stages is indicators of the ability of a forest to reproduce itself and to maintain its survival, stability and sustainability. A total of 33 species with complete representation of trees, saplings and seedlings (Table 5). Group 1 especially group 1.2. (*Parashorea* sp.*, Palaquium walsurifolium, Litsea confusa, Prunus arborea, Antidesma eurocarpum, Shorea leprosula, Polyalthia cauliflora,* and *Neo-uvaria acuminatissima*) will probably remain in the forest in the future.

CONCLUSION

The one-hectare plot should not be considered as a representative of the surrounding forests and does not even represent a minimal area, but it is sufficient to provide an illustration of the forest locally. Structurally and floristically the forest in the plot is a developing disturbed forest with heterogeneous species composition comprising primary and secondary forest species and heterogeneity is reflected by the majority of the species having low frequency and density. The species richness and tree density are smaller than those in several lowland forests in Sumatra. Non-dipterocarp species were prevalent in terms of the number of species, basal area and density. In terms of the number of species the dominant family was Moraceae. BDNP has undergone changes in tree species dominance from dipterocarps to non-dipterocarps as a result of various human activities. It is assumed that just like lowland dryland forests elsewhere in Sumatra, dipterocarps were dominant in BDNP.

Allowing the disturbed forest to develop naturally to promote natural succession gradually leading to formation of a forest similar to its original condition is one of many ways to manage and improve the park. The rate of natural succes-

sion is, however, slow, but could be enhanced and assisted by ecological restoration through planting tree species characteristics of undisturbed primary forest in the core zone and elsewhere in Jambi, particularly rare, endemic and species having multipurpose uses for the sustainable living of the SAD communities and species with high conservation values, such as those listed in the IUCN Red List.

Science-based conservation in and management of BDNP should be supported by further research on structure and composition of forests over a wider area in the park and Jambi to understand variation in composition related to habitat factors.

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REFERENCES

ABDULHADI, R. 1991. A Meliaceae forest in Ketambe, G. Leuser National Park, Sumatra, Indonesia. In: SOERIANEGARA, I., TJITROSOMO, S. S., UMALY, R. C. & UMBOH, I. (Eds.). Proceedings of the 4th Round-Table Conference on Dipterocarps, Bogor, Indonesia, 12-15 December 1989. *BIOTROP Special Publication* 41: 307−315. SEAMEO-BIOTROP, Bogor.

ANAS, A. 2013. Studi fitososiologi hutan pamah di zona inti bagian tengah Taman Nasional Bukit Duabelas, Jambi. Universitas Indonesia, Depok, [Thesis]. (In Indonesian).

ASHTON, P. S. 1965. Some problems arising in the sampling of mixed rain forest communities for floristic studies. In: Symposium on Ecological Research in Humid Tropics Vegetation (1963). 235-240. Government of Sarawak and UNESCO Science Cooperation Office for SE Asia, Tokyo Press Co. Ltd., Itabashi, Tokyo. 376 p.

BERG, C. C. & CORNER, E. J. H. 2005. Moraceae (*Ficus*). *Flora Malesiana* I. 17(2): 1−727.

BOERLAGE, H. P. 1949. *Regenval in Indonesië (Rainfalll in Indonesia),* Meteorologische en Geophysische Dienst, Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia, Verhandelingen No. 37: 134.

CONNELL, J. H. 1978. Diversity in tropical rain forests and coral reefs - high diversity of trees and corals is maintained only in a non-equilibrium state. *Science* 199: 1302–1310.

CORLETT, R. T. 1991. Plant succession on degraded land in Singapore. *Journal of Tropical Forest Science* 4(2): 151–161.

COX, W. G. 1967. *Laboratory manual of general ecology*. Wm. C. Brown Company Publisher, Dubuque.

DING HOU, 1978. Anacardiaceae, *Flora Malesiana* I, 8: 395−548.

ELVIQAR. 2013. Komunitas pohon di Hutan Adat Imbo Mengkadai, Desa Temenggung, Kabupaten Sarolangun, Provinsi Jambi. Universitas Indonesia, Depok. [Thesis]. (In Indonesian).

GILLISON, A. N. 2001. *Vegetation Survey and Habitat Assessment of the Tesso Nilo Forest Complex; Pekanbaru, Riau Province, Sumatra, Indonesia.* Report prepared for WWF-US. (October-November, 2001). Center for Biodiversity Management, Yungaburra, Australia.

GILLISON, A. N., LISWANTI, N. & ARIEF-RACHMAN, I. 1996. *Rapid Ecological Assessment, Kerinci Seblat National Park Buffer Zone, Central Sumatra*: Report for Plant Ecology. CIFOR Working Paper No. 14., Bogor, Indonesia.

HELMI, N, KARTAWINATA, K. & SAMSOEDIN, I. 2009. An undescribed lowland natural forest at Bodogol, the Gunung Gede Pangrango National Park, Cibodas Biosphere Reserve, West Java, Indonesia. *Reinwardtia* 13: 33−44.

HERMAWAN, A. 2013. Komposisi spesies pohon hutan pamah dan keanekaragaman *Artocarpus* serta pola sebarannya di Hutan Adat Imbo Mengkadai, Kabupaten, Sarolangun, Provinsi Jambi. Universitas Indonesia, Depok. [Thesis]. (In Indonesian).

HUBBELL, S. & FOSTER, R. 1986. Commonness and rarity in a neotropical forest: implications for tropical tree conservation. In: SOULE, M. (Ed.). *Conservation Biology*: *The Science of Scarcity and Diversity*. Sinauer Assoc. Inc., Sunderland, MA.

IUCN 2011. The IUCN Red List of Threatened Species. http://www.iucnredlist.org/apps/redlist. Accessed on 22 April 2013.

KALKMAN, C. 1993. Rosaceae. *Flora Malesiana* I, 11: 227 351.

KARTAWINATA, K. 1994. The use of secondary forest species in rehabilitation of degraded forest lands. *Journal of Tropical Forest Science* 7(1): 76–86.

KARTAWINATA, K. 2005. Six decades of natural vegetation studies in Indonesia. In: SOEMODIHARDJO, S. & SASTRAPRADJA, S. D. (Ed.), *Six Decades of Science and Scientists in Indonesia*, Naturindo, Bogor: 95−140.

KARTAWINATA, K. 2013. *Diversitas ekosistem alami Indonesia*. Yayasan Pustaka Obor Indonbesia & LIPI Press, Jakarta. (In Indonesian).

KARTAWINATA, K., SAMSOEDIN, I., HERIYANTO, M. & AFRIASTINI, J. J. 2004. A tree species inventory in a one-hectare plot at the Batang Gadis National Park, North Sumatra, Indonesia. *Reinwardtia* 12 (2): 145−157.

KARTAWINATA, K., PURWANINGSIH, PARTOMIHARDJO, T., YUSUF, R., ABDULHADI, R. & RISWAN, S. 2008. Floristics and structure of a lowland dipterocarp forest at Wanariset Samboja, East Kalimantan, Indonesia. *Reinwardtia* 12 (4): 301−323.

KEMENTERIAN KEHUTANAN DAN BALAI TNBD. 2011. *Buku informasi Taman Nasional Bukit Duabelas.* Kementerian Kehutanan dan Balai TNBD, Jambi.

KEβLER, P. J. A., PELSER, P. B., RIDSDALE, C. F. & SIDIYASA, K. 2000. Secondary forest trees of Kalimantan, Indonesia. MOFEC-Tropenbos-Kalimantan Project. Balikpapan.

KOVACH, W. 2001. Multivariate Statistical Package (MVSP) Version 3.12 Computer software, Kovach Computing Services, Anglesey, Wales, U.K.

LAUMONIER, Y. 1997. *The Vegetation and Physiography of Sumatra*. Kluwer Academic Publishers, Dordrecht, Netherlands.

MANSUR, M., TRIONO, T. & ISMAIL. 2010. Analisis vegetasi pohon di hutan hujan tropik Harapan, Jambi. *Berita Biologi* 10: 173−178.

McCUNE, B. & GRACE, J. B. 2002. *Analysis of Ecological Communities*, *MJM Software Design*, Gleneden Beach, Oregon.

MAY, R. J. LAWTON, J. & STORK, N. 1995. *Extinction rates.* In: LAWTON, J. & MAY, R. (Eds.), Oxford. University Press. Oxford. Pp: 1−24.

MINISTRY OF FORESTRY & PLANTATION. 2000. *Ministry of Forestry and Plantation Decree No. 258/ Kpts-II/2000 dated 23 August 2000.* Jakarta.

MUELLER-DOMBOIS, D. & ELLENBERG, H. 1974. *Aims and method of vegetation ecology*. John Wiley & Sons, New York.

NEWMAN, M. F., BURGESS, P. F. & WHITMORE, T. C. 1999. *Pedoman Identifikasi Pohon-pohon Dipterocarpaceae Sumatera*. PROSEA Indonesia, Bogor (In Indonesian).

PIMM, S. & RAVEN, P. 2000. Extinction by numbers. *Nature* 403: 843−845.

PLOTKIN, J. B., POTTS, M. D., LESLIEA, N., MANOKARAN, N., LAFRANKIE, J. & ASHTON. P. S. 2000. Species-area curves, spatial aggregation, and habitat specialization in tropical forests. *J. theor. Biol*. 207: 81−99.

POLOSAKAN, R. 2001. Komposisi jenis pohon di hutan kawasan Taman Nasional Bukit Tigapuluh, Propinsi Riau. Proyek inventarisasi dan karakterisasi sumberdaya hayati. *Laporan Teknik*. *Pusat Penelitian Biologi, LIPI*, 63−71 (In Indonesian).

POLOSAKAN, R. 2011. Studi keanekaragaman jenis pohon di kawasan Hutan Danau Bangko, Jambi: analisis aspek ekologi dan pemanfaatannya. In: PURWANTO, Y., WALUYO, E. B. & WAHYUDI, A. (Eds.). *Valuasi hasil hutan bukan kayu* (*Kawasan Lindung PT. Wirakarya Sakti Jambi*), LIPI Press, Jakarta. 215−224 (In Indonesian).

RICHARDS, P. W. 1996. *The tropical rain forest: An ecological study*, 2nd edition. Cambridge University Press, Cambridge.

RISWAN, S. 1982. Ecological studies on primary, secondary and experimentally cleared mixed dipterocarp forest and kerangas forest in East Kalimantan, Indonesia. [Ph.D. Thesis], University of Aberdeen.

SAMSOEDIN, I. & HERIYANTO, N. M. 2010. Struktur dan komposisi hutan pamah bekas tebangan ilegal di kelompok hutan Sei Lepan, Sei Serdang, Taman Nasional Gunung Leuser, Sumatera Utara. *Jurnal Penelitian Hutan dan Konservasi Alam* 7: 299−314 (In Indonesian).

SCHMIDT, F. H. & FERGUSON, J. H. 1951. *Rainfall types based on wet and dry period rations for Indonesia with Western New Guinea*. Verhandelingen Djawatan Meteorologi dan Geofisika, Djakarta 42.

SEHATI. 2013. Komposisi dan struktur hutan pamah di zona inti bagian barat Taman Nasional Bukit Duabelas, Jambi. Universitas Indonesia, Depok. [Thesis] (In Indonesian).

SETYOWATI, F. M. 2003. Hubungan keterikatan masyarakat Kubu dengan sumberdaya tumbuh-tumbuhan di Cagar Biosfer Bukit Duabelas, Jambi. *Biodiversitas* 4: 47−54 (In Indonesian).

SHEIL, D. & BURSLEM, D. F. R. P. 2003. Disturbing hypotheses in tropical forests. *Trends in Ecology & Evolution* 18: 18–26.

SHEIL, D., KARTAWINATA, K., SAMSOEDIN, I., PRIYADI, H. & AFRIASTINI, J. J. 2010. The lowland forest tree community in Malinau, Kalimantan (Indonesian Borneo): results from a one-hectare plot. *Plant Ecology and Diversity* 3: 59−66.

SILVIUS. M. J., SIMMONS, H. W. & VERHEUGT, W. J. M. 1984. *Soils, vegetation, fauna and nature conservation in Berbak Game Reserve, Sumatra, Indonesia*. Research Institute for Nature Management, Arnhem, The Netherlands.

SLIK, J. W. F., BERNARD, C. S., BREMAN, F. C., VAN BEEK, M., SALIM, A. & SHEIL, D. 2008. Wood density as a conservation tool: quantification of disturbance and identification of conservation-priority areas in tropical forests. *Conservation Biology* 22: 1299–1308.

SRIYANTO, A., WELLESLEY, S., SUGANDA, D., WIDJANARTI, E. & SUDARYONO, D. 2003. *Guidebook of 41 National Parks in Indonesia*. Ministry of Forestry of Republic of Indonesia, UNESCO and CIFOR, Jakarta.

STEENIS, C. G. G. J, VAN, KALKMAN, C., KIRKUP, D. W., NOTEBOOM, H. P., WILDE, W. J. J. O. DE, SAW, L. G., STEVENS, P. F., COODE, M. J. E. & WELZEN, P. C. VAN (Eds.). 1948−2013. *Flora Malesiana* Series I, Volumes 4−21. Foundation Flora Malesiana, Leiden.

WHITMORE, T. C. 1986. *Tropical rain forests of the Far East,* 2nd Edition. ELBS/Oxford University Press, Oxford.

WHITMORE, T. C. & SIDIYASA, K. 1986. Composition and structure of a lowland rain forest at Toraut, northern Sulawesi. *Kew Bulletin* 41: 747−756.

WHITMORE, T. C. & TANTRA, I. G. M. 1986. *Tree flora of Indonesia. Check list for Sumatra*. Forest Research and Development Centre, Bogor.

WILDE, W. J. J. O. DE. 2000. Myristicaceae. *Flora Malesiana*, I, 14: 1−632.

WIRIADINATA, H. & SETYOWATI, F. M. 2000. Kajian pemanfaatan tumbuhan oleh Suku Anak Dalam di Cagar Biosfer Bukit Duabelas Jambi. In: PURWANTO, Y. & WALUJO, E. B. (Eds.). Prosiding Seminar Nasional Ethnobotani III. Pusat Penelitian dan Pengembangan Biologi−LIPI, Bogor: 274−283 (In Indonesian).

YUSUF, R., PURWANINGSIH & GUSMAN. 2005. Komposisi dan struktur vegetasi Hutan Alam Rimbo Panti, Sumatra Barat. *Biodiversitas* 6: 266−271.

Appendix. The density (D), relative density (RD), frequency (F), relative frequency (RF), dominance (Do), relative dominance (RDo), importance value (IV) and family importance value (FIV) in one-hectare forest block at the east section of the core zone of the Bukit Duabelas National Park (BDNP), Jambi

No.	Family and Species	D (Tree/ Ha)	RD (%)	F (%)	RF (%)	Do (m2)	RDo (%)	IV (%)	FIV (%)
	Anacardiaceae								13,46
1	*Bouea oppositifolia*	1	0.24	1	0.27	0.08	0.31	0.82	
2	*Dracontomelon* sp.	1	0.24	1	0.27	0.03	0.11	0.63	
3	*Dracontomelon dao*	9	2.17	9	2.45	1.75	6.83	11.45	
4	*Gluta renghas*	1	0.24	1	0.27	0.01	0.05	0.56	
	Annonaceae								12.43
5	*Fissistigma latifolium*	1	0.24	1	0.27	0.06	0.25	0.76	
6	*Neo-uvaria* sp.	1	0.24	1	0.27	0.32	1.25	1.77	
7	*Neo-uvaria acuminatissima*	1	0.24	1	0.27	0.04	0.14	0.65	
8	*Polyalthia cauliflora*	7	1.69	5	1.36	0.34	1.33	4.38	
9	*Polyalthia sumatrana*	5	1.21	5	1.36	0.25	0.98	3.55	
10	*Polyalthia kingii*	1	0.24	1	0.27	1.12	4.35	4.87	
	Apocynaceae								1.69
11	*Rauvolfia sumatrana*	2	0.48	2	0.54	0.17	0.66	1.69	
	Arecaceae								8.54
12	*Arenga pinnata*	10	2.42	9	2.45	0.35	1.38	6.25	
13	*Oncosperma horridum*	5	1.21	2	0.54	0.14	0.54	2.30	
	Bombacaceae								3.48
14	*Durio oxleyanus*	2	0.48	2	0.54	0.46	1.81	2.84	
15	*Durio* sp.	1	0.24	1	0.27	0.03	0.13	0.64	
	Burseraceae								13.93
16	*Dacryodes sp*	10	2.42	9	2.45	0.41	1.58	6.45	
17	*Dacryodes rugosa*	6	1.45	6	1.63	0.20	0.76	3.85	
18	*Dacryodes rostrata*	5	1.21	5	1.36	0.27	1.07	3.64	
	Cannabaceae								1.20
19	*Gironniera hirta*	2	0.48	2	0.54	0.04	0.17	1.19	
	Cardiopteridaceae								4.89
20	*Gonocaryum gracile*	4	0.97	4	1.09	0.73	2.83	4.88	
	Celastraceae								0.70
21	*Bhesa paniculata*	1	0.24	1	0.27	0.05	0.18	0.70	
	Clusiaceae								15.98
22	*Calophylum molle*	1	0.24	1	0.27	0.04	0.15	0.66	
23	*Calophyllum* sp.	1	0.24	1	0.27	0.14	0.54	1.06	
24	*Calophyllum tetrapterum*	1	0.24	1	0.27	0.02	0.08	0.59	
25	*Garcinia atroviridis*	2	0.48	2	0.54	0.04	0.14	1.17	
26	*Garcinia celebica*	1	0.24	1	0.27	0.02	0.06	0.57	
27	*Garcinia* sp.	1	0.24	1	0.27	0.02	0.08	0.59	
	Connaraceae								1.38
28	*Cnestis palala*	3	0.72	0.02	0.54	0.03	0.11	1.38	
	Cornaceae								0.56
29	*Alangium javanicum*	1	0.24	0.01	0.27	0.01	0.05	0.56	
	Dillenaceae								1.26
30	*Dillenia pentagyna*	2	0.48	0.02	0.54	0.06	0.23	1.26	
	Dipterocarpaceae								3.68
31	*Parashorea* sp.	2	0.48	0.02	0.54	0.53	2.05	3.08	
32	*Shorea leprosula*	1	0.24	0.01	0.27	0.02	0.09	0.61	
	Ebenaceae								10.34
33	*Diospyros areolata*	12	2.90	0.11	3.00	0.26	0.99	6.89	
34	*Diospyros curranii*	2	0.48	0.02	0.54	0.08	0.31	1.34	
35	*Diospyros cauliflora*	2	0.48	0.02	0.54	0.07	0.26	1.29	
36	*Diospyros lanceifolia*	1	0.24	0.01	0.27	0.08	0.31	0.82	
	Elaeocarpaceae								2.94
37	*Elaeocarpus glaber*	3	0.72	0.03	0.82	0.36	1.39	2.93	

Appendix. The density (D), relative density (RD), frequency (F), relative frequency (RF), dominance (Do), relative dominance (RDo), importance value (IV) and family importance value (FIV) in one-hectare forest block at the east section of the core zone of the Bukit Duabelas National Park (BDNP), Jambi (continued)

No.	Family and Species	D (Tree/ Ha)	RD (%)	F (%)	RF (%)	Do (%)	RDo (%)	IV (%)	FIV (%)
	Euphorbiaceae								
38	*Blumeodendron tokbrai*	5	1.21	0.05	1.36	0.12	0.48	3.05	
39	*Claoxylon longifolium*	1	0.24	0.01	0.27	0.04	0.15	0.67	
40	*Macaranga hypoleuca*	4	0.97	0.04	1.09	0.14	0.54	2.59	
41	*Mallotus floribundus*	1	0.24	0.01	0.27	0.05	0.20	0.71	
42	*Mallotus rufidulus*	4	0.97	0.03	0.82	0.28	1.08	2.86	
43	*Trigonostemon* sp.	8	1.93	0.07	1.91	0.26	1.00	4.84	
	Fabaceae								4.53
44	*Dialium platysepalum*	3	0.72	0.02	0.54	0.47	1.82	3.09	
45	*Dialium indum*	1	0.24	0.01	0.27	0.24	0.93	1.44	
	Flacourtiaceae								15.58
46	*Hydnocarpus* sp.	18	4.35	0.18	4.90	0.54	2.11	11.37	
47	*Hydnocarpus sumatrana*	5	1.21	0.05	1.36	0.42	1.64	4.21	
	Hyperacaceae								4.65
48	*Cratoxylum arborescens*	1	0.24	0.01	0.27	0.92	3.58	4.09	
49	*Cratoxylum cochinchinense*	1	0.24	0.01	0.27	0.01	0.04	0.56	
	Lauraceae								20.34
50	*Litsea confusa*	2	0.48	0.02	0.54	0.04	0.16	1.19	
51	*Litsea elliptica*	1	0.24	0.01	0.27	0.01	0.05	0.57	
52	*Litsea noronhae*	9	2.17	0.07	1.91	0.20	0.79	4.87	
53	*Litsea spathacea*	7	1.69	0.06	1.63	1.33	5.17	8.50	
54	*Phoebe grandis*	2	0.48	0.02	0.54	0.05	0.20	1.23	
55	*Tetranthera angulata*	1	0.24	0.01	0.27	0.01	0.06	0.57	
	Loganiaceae								1.00
56	*Fagraea elliptica*	1	0.24	0.01	0.27	0.12	0.48	1.00	
	Malvaceae								15.20
57	*Melochia umbellata*	3	0.72	0.02	0.54	0.38	1.46	2.73	
58	*Pterospermum* sp.	2	0.48	0.02	0.54	0.15	0.58	1.61	
59	*Pterospermum javanicum*	3	0.72	0.03	0.82	0.66	2.56	4.10	
60	*Leptonychia caudata*	4	0.97	0.04	1.09	0.21	0.82	2.88	
61	*Scaphium macropodum*	1	0.24	0.01	0.27	0.02	0.08	0.59	
62	*Sterculia rubiginosa*	3	0.72	0.03	0.82	0.15	0.57	2.11	
63	*Microcos opaca*	2	0.48	0.02	0.54	0.04	0.15	1.18	
	Melastomataceae								3.23
64	*Memecylon excelsum*	3	0.72	0.03	0.82	0.10	0.40	1.94	
65	*Memecylon edule*	2	0.48	0.02	0.54	0.07	0.26	1.29	
	Meliaceae								7.45
66	*Aglaia odoratissima*	8	1.93	0.07	1.91	0.28	1.09	4.93	
67	*Aphanamixis polystachya*	1	0.24	0.01	0.27	0.03	0.11	0.63	
68	*Dysoxylum excelsum*	3	0.72	0.03	0.82	0.09	0.36	1.90	
	Moraceae								34.05
69	*Artocarpus anisophyllus*	3	0.72	0.03	0.82	0.19	0.75	2.29	
70	*Artocarpus nitidus*	1	0.24	0.01	0.27	0.06	0.25	0.76	
71	*Artocarpus elasticus*	4	0.97	0.04	1.09	0.43	1.68	3.74	
72	*Artocarpus odoratissimus*	5	1.21	0.05	1.36	1.18	4.59	7.16	
73	*Artocarpus glaucus*	1	0.24	0.01	0.27	0.20	0.79	1.31	
74	*Ficus elastica*	1	0.24	0.01	0.27	0.01	0.03	0.55	
75	*Ficus fistulosa*	24	5.80	0.1	2.72	0.59	2.30	10.82	
76	*Ficus* sp. 1	3	0.72	0.02	0.54	0.05	0.19	1.46	
77	*Ficus padana*	2	0.48	0.02	0.54	0.02	0.09	1.11	
78	*Ficus* sp. 2	5	1.21	0.04	1.09	0.28	1.09	3.39	
79	*Paratocarpus bracteatus*	3	0.72	0.02	0.54	0.05	0.19	1.46	
	Myristicaceae								11.36
80	*Knema latifolia*	3	0.72	0.03	0.82	0.28	1.08	2.63	
81	*Knema laurina*	13	3.14	0.11	3.00	0.28	1.11	7.24	

Appendix. The density (D), relative density (RD), frequency (F), relative frequency (RF), dominance (Do), relative dominance (RDo), importance value (IV) and family importance value (FIV) in one-hectare forest block at the east section of the core zone of the Bukit Duabelas National Park (BDNP), Jambi (continued)

No.	Family and Species	D (Tree/ Ha)	RD (%)	F (%)	RF (%)	Do (%)	RDO (%)	IV (%)	FIV (%)
82	*Knema globularia*	1	0.24	0.01	0.27	0.10	0.39	0.90	
83	*Knema mandaharan*	1	0.24	0.01	0.27	0.02	0.07	0.58	
	Myrtaceae								1.71
84	*Syzygium cymosum*	2	0.48	0.02	0.54	0.18	0.68	1.71	
	Olacaceae								6.53
85	*Strombosia javanica*	8	1.93	0.08	2.18	0.33	1.29	5.41	
86	*Ochanostachys amentacea*	1	0.24	0.01	0.27	0.02	0.07	0.58	
87	*Ochanostachys* sp.	1	0.24	0.01	0.27	0.01	0.03	0.55	
	Phyllanthaceae								8.35
88	*Cleistanthus macropyllus*	3	0.72	0.03	0.82	0.04	0.15	1.69	
89	*Baccaurea* sp.	1	0.24	0.01	0.27	0.03	0.11	0.63	
90	*Baccaurea dulcis*	1	0.24	0.01	0.27	0.01	0.05	0.57	
91	*Baccaurea javanica*	2	0.48	0.02	0.54	0.04	0.16	1.19	
92	*Antidesma neurocarpum*	7	1.69	0.07	1.91	0.17	0.68	4.27	
	Rosaceae								19.20
93	*Prunus arborea*	22	5.31	0.17	4.63	2.38	9.24	19.19	
	Rubiaceae								7.17
94	*Porterandia anisophylla*	1	0.24	0.01	0.27	0.02	0.08	0.59	
95	*Neonauclea calycina*	5	1.21	0.05	1.36	0.22	0.85	3.42	
96	*Mussaenda frondosa*	3	0.72	0.03	0.82	0.11	0.42	1.96	
97	*Pertusadina eurhyncha*	1	0.24	0.01	0.27	0.03	0.13	0.64	
98	*Uncaria gambir*	1	0.24	0.01	0.27	0.01	0.05	0.56	
	Sapindaceae								20.25
99	*Dimocarpus longan*	1	0.24	0.01	0.27	0.02	0.07	0.59	
100	*Nephelium* sp.	1	0.24	0.01	0.27	0.01	0.05	0.57	
101	*Nephelium uncinatum*	7	1.69	0.07	1.91	0.40	1.56	5.16	
102	*Paranephelium nitidum*	10	2.42	0.09	2.45	0.27	1.04	5.90	
103	*Pometia* sp.	7	1.69	0.06	1.63	0.52	2.02	5.35	
104	*Pometia pinnata*	4	0.97	0.04	1.09	0.16	0.63	2.68	
	Sapotaceae								4.16
105	*Madhuca* sp.	6	1.45	0.06	1.63	0.11	0.42	3.50	
106	*Madhuca sericea*	1	0.24	0.01	0.27	0.04	0.14	0.65	
107	*Palaquium ridleyi*	1	0.24	0.01	0.27	0.04	0.15	0.66	
108	*Palaquium walsurifolium*	12	2.90	0.08	2.18	0.53	2.05	7.12	
	Styracaceae								0.63
109	*Styrax benzoin*	1	0.24	0.01	0.27	0.03	0.11	0.63	
	Urticaceae								3.98
110	*Laportea stimulans*	4	0.97	0.04	1.09	0.05	0.20	2.25	
111	*Laportea* sp.	3	0.72	0.03	0.82	0.05	0.19	1.73	
	Violaceae								1.16
112	*Rinorea lanceolata*	2	0.48	0.02	0.54	0.03	0.13	1.16	
	Vitaceae								1.69
113	*Tetrastigma lanceolarium*	3	0.72	0.03	0.82	0.04	0.15	1.69	
	TOTAL	**414**	**100**	**3.67**	**100**	**25.71**	**100**	**300**	**300**

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ERRATUM

REINWARDTIA Vol. 14 (2), 2015

1. Please change the existing epithet name in p. 307, LINE 2 on ABSTRACT after *Zingiber: engganoense*

2. Please change the existing epithet name in p. 307, LINE 2 on ABSTRAK after *Zingiber: engganoense*

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4. Please change the existing epithet name in p. 307, COLUMN 2, LINE 9 on SPECIES DESCRIPTION after *Zingiber: engganoense*

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References. Bibliography, list of literature cited or references follow the Harvard system as the following examples.

Journal : KRAENZLIN, F. 1913. *Cyrtandraceae* novae Philippinenses I. *Philipp. J. Sci.* 8: 163–179.
MAYER, V., MOLLER, M., PERRET, M. & WEBER, A. 2003. Phylogenetic position and generic differentiation of *Epithemateae* (*Gesneriaceae*) inferred from plastid DNA sequence data. *American J. Bot.* 90: 321–329.

Proceedings :TEMU, S. T. 1995. Peranan tumbuhan dan ternak dalam upacara adat "Djoka Dju" pada suku Lio, Ende, Flores, Nusa Tenggara Timur. In: NASUTION, E. (Ed.). Prosiding Seminar dan Lokakarya Nasional Etnobotani II. LIPI & Perpustakaan Nasional: 263–268. (In Indonesian).
SIMBOLON, H. & MIRMANTO, E. 2000. Checklist of plant species in the peat swamp forests of Central Kalimantan, Indonesia. In: IWAKUMA, T. *et al*. (Eds.) Proceedings of the International Symposium on: Tropical Peatlands. Pp.179-190.

Book : RIDLEY, H. N. 1923. *Flora of the Malay Peninsula 2*. L. Reeve & Co. Ltd, London.

Part of Book : BENTHAM, G. 1876. *Gesneriaceae*. In: BENTHAM, G. & HOOKER, J. D. *Genera plantarum 2*. Lovell Reeve & Co., London. Pp. 990–1025.

Thesis : BAIRD, L. 2002. *A Grammar of Kéo: An Austronesian language of East Nusantara*. Australian National University, Canberra. [PhD. Thesis].

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