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Structure and Composition of Tree Species in Sub-Montane Forests of Mount Endut, Banten

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Abstract. Study of forest structure and tree species composition in the sub-montane forest of Mount Endut, Banten was carried out by using a plot method. Four plots of 10 m × 1 000 m (totaling 4 ha) ranging from 1 000 m to 1 297 m above sea level (top of Mount Endut) at North, South, East and West sides of Mount Endut were established. The objective of the study was to assess composition, structure, and plant diversity of this highest point in Mount Endut which is a part of Gunung Halimun Salak National Park. Data of trees having diameter breast height ≥ 10 cm was recorded for species, diameter, and height. Soil samples were taken for macro-nutrient content relating to ecological preferences of dominant plant species. Result shows that the studied forest on north slope plot consisted of 46 species belonging to 33 genera and 23 families, south (58 species, 35 genera, and 23 families), east (46 species, 34 genera, and 23 families), and west (40 species, 30 genera, and 20 families). Trees which had highest Important Values occupied the sub-montane forest of Mount Endut were *Castanopsis acuminata, Schima wallichii, Quercus lineata, Eurya acuminata, Platea excelsa*, and *Syzygium clavimyrthus*. Among the important families which occupied the sub-montane forest of Mount Endut were Fagaceae, Theaceae, Clusiaceae, Myrtaceae, and Clusiaceae.

Keywords: Banten, forest structure, Mount Endut, sub-montane forest, tree species composition.

INTRODUCTION

Mount Halimun Salak National Park (from now on abbreviated as GHSNP) was established based on Minister of Forestry Decree No. 175/Kpts-II/2003 with an area of ± 113 357 ha. The area of GHSNP is an extension of Gunung Halimun National Park (± 40 000 ha) with a protected forest area of Salak Mountain (Bogor, West Java) and Mount Endut (Lebak, Banten).

As the part of a national park, Mount Endut area is to be managed with an appropriate and sound planning. In managing the area, it needs a deep knowledge of the condition of vegetation ecology of the area. So far, the potency of flora and fauna especially the flora has not been explored widely; the floristic data of Mount Endut is very limited compared to that of Mount Salak [1]. Among recent floristic studies within GHSNP were carried out by Polosakan and Alhamd [2], Mirmanto [3], and Sambas *et al*. [4, 5].

Changing the status of Mount Endut from protection forest to become part of a national park (GHSNP) as well as lack of floristic data bringing the importance of research on vegetation for management purposes. The objective of the research was to assess composition, structure, abundance, and diversity of the tree species of Mount Endut. In addition, a soil sample was carried out to know the relation of soil nutrients to plant species.

STUDY AREA

The research was carried out at Cisoka and Gunung Bongkok Resorts, Lebak Section, Gunung Halimun Salak National Park. Administratively, the area is located at Lebak Gedong District (Lebaksangka and Lebakgedong villages), Sajira District (Pasirhaur and Girilaya villages), Sobang District (Sindanglaya and Citujah villages), and

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Muncang District (Cikarang village), Lebak Regency, Banten Province. Geographically, the area is located at 06°36'–06°39' South latitude and 106°20'–106º23' East longitude. Fig. 1 shows the Mount Endut area.

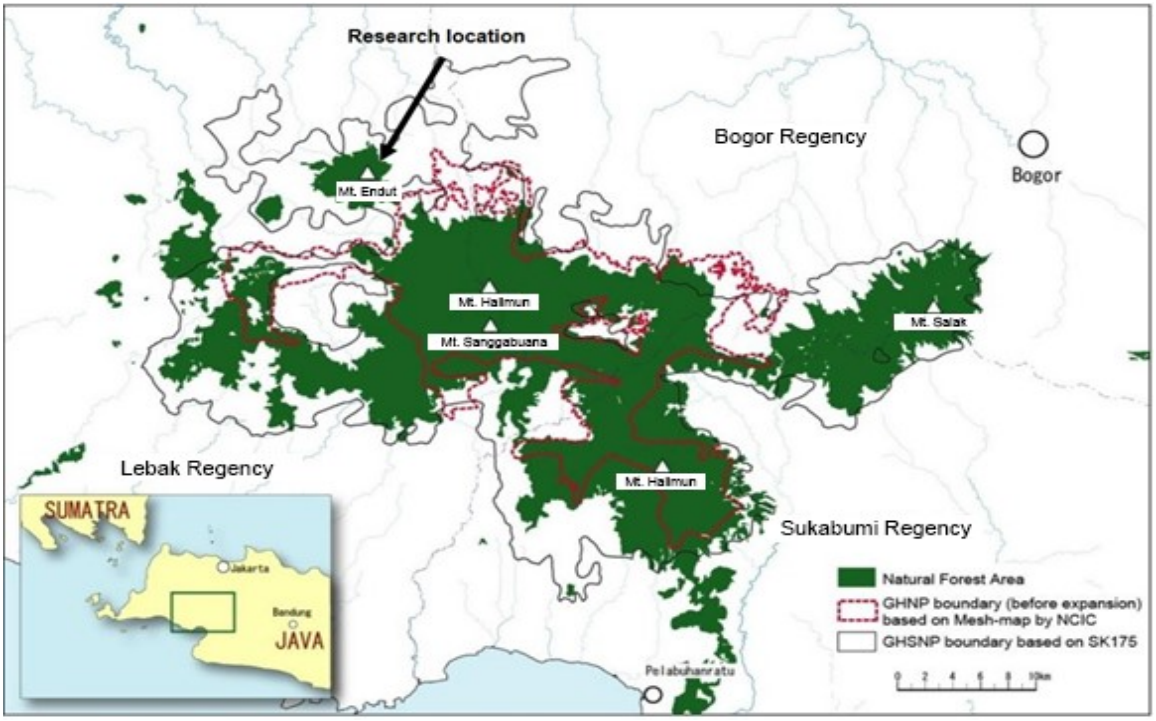

FIGURE 1. Mount Endut area within the Gunung Halimun Salak National Park

METHODS

The study was carried out by using a plot method by establishing four of 1 ha plots (totaling 4 ha) ranging from 1 000 m to 1 297 m above sea level (top of Mount Endut). A transect of 10 m × 1 000 m each was established on the North, South, West, and East of Mount Endut respectively to represent the sub-montane area of Mount Endut from elevation of 1 000 m above sea level to the peak of Mount Endut (1 297 m above sea level). The observation (data measurement) was done systematically on the 10 m × 10 m plot for the tree (diameter at breast height · dbh^{-1} of ≥ 10 cm). The study was conducted from Apr 2008 to Aug 2008.

Vegetation analysis was carried out to calculate Important Value Index according to the method described by Kusmana [6] and Cox [7]. Soil texture, total organic C, N, P, K and Al contents were analyzed at the Laboratory of Soil Sciences, Bogor Agricultural University (IPB). Identification of herbarium collections was made at Herbarium Bogoriense LIPI Cibinong, Bogor.

RESULTS

In four transects of 10 m × 1 000 m (4 ha), i.e. 100 plots of 10 m × 10 m, located on the four slopes (North, South, East, and West), there were recorded 94 tree species belonging to 65 genera and 34 families (with seven unidentified species). Table 1 shows a list of tree species in the sub-montane forests of Mount Endut. Table 2 presents ten dominant tree species in the four slopes of Mount Endut based on their important values. Pictures of two most dominant species, i.e*., Castanopsis acuminatissima* and *Schima wallichii* are presented in Fig. 2 and Fig. 3.

TABLE 1. List of tree species in the research area.

No.	Species	Family	North	South	East	West
1.	*Acer niveum* Blume.	Aceraceae	0	X	0	0
2.	*Actinodaphne* sp.	Lauraceae	0	0	0	X
3.	*Agathis dammara* (Lamb.) L.C. Rich.	Araucariaceae	0	0	X	0
4.	*Aidia racemosa* Triveng	Rubiaceae	0	X	X	0
5.	*Altingia excelsa* Noronha	Hammamelidaceae	X	0	X	0
6.	*Antidesma montanum* Blume	Euphorbiaceae	X	0	0	0
7.	*Archidendron clypearia*	Fabaceae	0	X	X	0
8.	*Ardisia elliptica* Bedd.	Myrsinaceae	X	X	X	0
9.	*Ardisia zollingeriana*	Myrsinaceae	X	X	0	0
10.	*Beilshmiedia maingayi* Hook.f.	Lauraceae	0	X	0	0
11.	*Beischmiedia madang* (Bl) Bl.	Lauraceae	0	X	0	0
12.	*Blumeodendron tokbrai* JJS	Euphorbiaceae	X	X	X	X
13.	*Calophyllum saigonense* Pierre	Clusiaceae	0	X	0	0
14.	*Castanopsis acuminatissima*	Fagaceae	X	X	X	X
15.	*Castanopsis argentea* (Bl.) DC.	Fagaceae	X	X	X	X
16.	*Castanopsis tungurrut* A. DC.	Fagaceae	0	X	0	0
17.	*Cinnamomum iners* Reiw ex Bl.	Lauraceae	X	0	0	0
18.	*Coffea canephora*	Rubiaceae	0	0	X	0
19.	*Croton laevifolius* Bl.	Euphorbiaceae	0	0	0	X
20.	*Cryptocarya densiflora* Blume	Lauraceae	0	0	X	0
21.	*Cyathea contaminans*	Cyatheaceae	X	0	0	X
22.	*Dysoxyllum exelsum* Bl.	Meliaceae	0	0	X	0
23.	*Elaeocarpus* sp.	Elaeocarpaceae	X	0	0	0
24.	*Engelhardia serrata* Blume.	Juglandaceae	X	0	X	X
25.	*Erythroxylum cuneatum* (Miq.) Kurz.	Erythroxylaceae	X	0	X	0
26.	*Eugenia overculata*	Myrtaceae	0	0	X	0
27.	*Eurya acuminata* DC.	Theaceae	0	0	X	X
28.	*Evodia latifolia* DC.	Rutaceae	X	0	X	X
29.	*Ficus fistulosa* Reinw	Moraceae	0	0	0	X
30.	*Ficus padana* Burm.f.	Moraceae	0	X	X	0
31.	*Garcinia lateriflora* Bl.	Clusiaceae	0	X	0	0
32.	*Garcinia parvifolia* (Miq.) Miq.	Clusiaceae	0	X	X	X
33.	*Garcinia rostrata* (Hassk.) Miq.	Clusiaceae	0	X	X	X
34.	*Gironniera cuspidata* (Bl.) Planch. ex Kurz.	Ulmaceaceae	X	X	0	0
35.	*Gironniera subaequalis* Planch.	Ulmaceae	0	0	X	0
36.	*Gomphandra javanica* Bl.	Icacynaceae	0	0	X	0
37.	*Gordonia exelsa* (Bl). Bl.	Theaceae	X	X	X	X
38.	*Gynotrodes axillaris* Bl.	Rhizophoraceae	X	0	0	X
39.	*Horsfieldia glabra* (Bl.) Warb.	Myristicaceae	0	0	X	X
40.	*Ilex plebiobrachiata* Loes	Icacynaceae	X	0	0	X
41.	*Knema cinerea* (Poir) Warb.	Myristicaceae	X	X	X	X
42.	*Knema laurina* (Bl) Warb.	Myristicaceae	0	X	X	0
43.	*Laportea stimulans* Miq.	Urticaceae	0	0	0	X
44.	*Lepisanthes tetraphylla* Radlk.	Sapindaceae	X	0	X	0
45.	*Lindera lucida* (Bl.) Boerl.	Lauraceae	0	0	X	0
46.	*Lithocarpus kunstleri* (King) A. Camus.	Fagaceae	X	X	0	0
47.	*Lithocarpus pseudomoluccanus* Rchd.	Fagaceae	X	X	0	0
48.	*Lithocarpus* sp.	Fagaceae	X	X	X	0
49.	*Litsea angulata* Bl.	Lauraceae	0	X	0	0
50.	*Litsea cubeba* (Lour.) Pers.	Lauraceae	X	X	0	0
51.	*Litsea garciae* Vidal	Lauraceae	0	X	0	0
52.	*Macaranga triloba* MA.	Euphorbiaceae	0	0	0	X

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Table 1. Continued

No.	Species	Family	North	South	East	West
53.	*Mallotus paniculatus* M.A.	Euphorbiaceae	X	X	0	0
54.	*Mangifera* sp.	Anacardiaceae	0	0	X	0
55.	*Memexylon myrsinoides* Bl.	Melastomataceae	0	X	X	0
56.	*Muraya paniculata*	Rutaceae	X	0	0	0
57.	*Neesia altissima* (Blume) Blume	Malvaceae	X	X	0	0
58.	*Neolitsea cassia* (L.) Kosterm.	Lauraceae	0	0	0	X
59.	*Neonauclea* sp.	Rubiaceae	0	X	0	0
60.	*Nyssa javanica* (Bl.) Wang	Nyssaceae	X	X	X	X
61.	Omalanthus populneus	Euphorbiaceae	X	0	0	X
62.	Paratocarpus venenosus (Z &M) Becc.	Moraceae	0	X	0	X
63.	*Persea rimosa*	Lauraceae	0	0	0	X
64.	*Phoebe grandis* (Ness) Merr.	Lauraceae	X	0	0	X
65.	*Platea excelsa* Bl.	Icacinaceae	X	X	X	X
66.	*Polyalthia lateriflora* King	Annonaceae	0	X	0	0
67.	*Polyosma ilicifolia* Bl.	Saxifragaceae	0	0	X	0
68.	*Polyosma integrifolia*	Saxifragaceae	0	X	0	0
69.	*Pometia pinnata* Forst.	Sapindaceae	X	X	0	X
70.	*Prunus arborea* (Bl.) Kalkmam	Rosaceae	X	X	X	X
72.	*Quercus argentata* Korth.	Fagaceae	0	0	0	X
73.	*Quercus gemmeliflora* Bl	Fagaceae	X	X	X	X
74.	*Quercus lineata* Bl.	Fagaceae	X	X	X	X
75.	*Quercus oidocarpa* Korth.	Fagaceae	X	X	X	X
76.	*Rapanea haseltii (*Bl) Mez,	Myrsinaceae	0	X	X	X
77.	*Ryparosa* sp.	Achariaceae	X	X	0	0
78.	*Schima walichii* Choisy.	Theaceae	X	X	X	X
79.	*Stemonurus secondiflorus* Blume.	Icacynaceae	0	0	X	0
80.	*Stemonurus* sp.	Icacynaceae	0	X	0	0
81.	*Syzygium clavimyrtus* K. et V.	Myrtaceae	X	X	X	X
82.	*Syzygium cupprea*	Myrtaceae	0	X	0	0
83.	*Syzygium cymosa* Lamk.	Myrtaceae	X	X	X	0
84.	*Syzygium laxiflorum* (Bl.) DC.	Myrtaceae	X	X	X	X
85.	*Syzygium polyanthum*	Myrtaceae	0	X	0	X
86.	*Syzygium racemosum* (Bl.) DC.	Myrtaceae	X	0	0	0
87.	*Syzygium rostratum* (Bl.) DC.	Myrtaceae	0	0	X	0
88.	*Syzygium* sp.	Myrtaceae	X	X	X	X
89.	*Syzygium subglauca*	Myrtaceae	0	0	0	X
90.	*Syzygium zeylanicum* (L.) DC.	Myrtaceae	0	0	X	0
91.	*Urophyllum arboreum* (Reinw ex BL.) Koster.	Rubiaceae	X	0	0	0
92.	*Urophyllum corymbosum* Korth.	Rubiaceae	X	0	0	0
93.	*Urophyllum strigosum*	Rubiaceae	0	X	0	0
94.	*Weinmannia blumei*	Cunnoniaceae	0	X	0	0

Notes: X = presence 0 = absence

TABLE 2. Dominant tree species based on Important Value Index (IVI) on four slopes of Mount Endut.

No.	Species	Family	Important Value Index (IVI) (%)			
			North	South	East	West
1.	*Castanopsis acuminatissima* (Blume) A.DC.	Fagaceae	38.0	51.07	80.99	61.14
2.	*Castanopsis argentea* (BL.) DC.	Fagaceae	17.93	8.99	-	22.05
3.	*Evodia latifolia* DC.	Rutaceae	9.98	-	-	-
4.	*Gordonia exelsa* (Bl.) Bl.	Theaceae	7.28	-	9.72	-
5.	*Knema cinerea* (Poir) Warb.	Myristicaceae	9.71	-	-	-

Continued on next page

Table 2. Continued

No.	Species	Family	Important Value Index (IVI) (%)			
			North	South	East	West
6.	*Prunus arborea* (Bl) Kalkmam	Rosaceae	9.21	-	4.48	12.35
7.	*Quercus gemmeliflora* Bl.	Fagaceae	11.66	9.34	-	-
8.	*Quercus lineata* Bl.	Fagaceae	11.39	26.15	57.15	26.71
9.	*Schima walichii* Choisy.	Theaceae	16.65	22.79	59.87	28.94
10.	*Syzygium clavimyrtus* K. et V.	Myrtaceae	16.07	-	-	-
11.	*Platea excelsa* Bl.	Icacinaceae	-	12.62	-	13.77
12.	*Ardisia zollingeriana*	Myrsinaceae	-	7.96	-	-
13.	*Nyssa javanica* (Bl)Wang	Nyssaceae	-	7.67	-	-
14.	*Eurya acuminata* DC.	Theaceae	-	-	21.81	10.76
15.	*Quercus oidocarpa* Korth.	Fagaceae	-	-	-	8.57
16.	*Rapanea hasseltii* (Bl.) Mez.	Myrsinaceae	-	-	-	11.11
17.	*Syzygium laxiflorum*(Bl.) DC.	Myrtaceae	-	6.26	4.88	26.18
18.	*Syzygium zeylanicum* DC.	Myrtaceae	-	-	5.0	-
19.	*Polyosma ilicifolia* Bl.	Saxifragaceae	-	-	4.61	-
20.	*Syzygium cymosa* Lamk.	Myrtaceae	-	-	4.08	-

FIGURE 2. *Castanopsis acuminatissima* tree

FIGURE 3. *Schima wallichii* seedling

Based on the Important Value Index (IVI), the community types in the study area were *C. acuminatissima-C. argentea* (north slope), *C. acuminatissima-Q. lineata* (south slope), *C. acuminatissima-S. wallichii* (east slope), and *C. acuminatissima-S. wallichii* (West slope), respectively. Based on Table 2, five principal species had Important Values ≤ 5.0, i.e., *S. zeylanicum*, S. *laxiflorum*, *P. ilicifolia*, *P. arborea*, and *S. cymosa* in East plot due to highest Important Value of *C. acuminatissima* (IV = 80.99 %), Schima wallichii (IV = 59.87 %), and Quercus lineata (IV = 57.15 %). These three made IV = 196.91 % of total 300 %, and the rest 43 species only had total IV = 103.09 %.

Diameter class distribution of trees on the North, South, East, and West slopes of Mount Endut is presented in Table 3. Majority of the trees had diameter relatively small (dbh < 30 cm) especially on South, East, and West slopes. As for, Table 4 shows tree species distribution based on the frequency class in the study area. The species richness and heterogeneity of tree species were high as showed by the frequency class distribution which majority of trees had frequency ≤ 5 %.

TABLE 3. Number of trees based on diameter class on the four slopes of Mount Endut.

Diameter Class	Number of Individuals per ha			
	North	South	East	West
10 cm to 20 cm	49	148	193	74
20 cm to 30 cm	63	92	198	131
30 cm to 40 cm	71	59	97	70
40 cm to 50 cm	22	13	34	18
> 50 cm	15	20	14	4

TABLE 4. Tree species distribution based upon the frequency class on the four slopes of Mount Endut.

Frequency Class (%)	Total of Species (%)			
	North	South	East	West
1 to 5	80.44	84.48	78.26	71.43
6 to 10	10.87	8.62	10.87	11.90
11 to 20	6.52	1.72	2.17	7.14
> 20	2.17	5.18	8.70	9.53

Fagaceae was the plant family which had highest important values in all four slopes of Mount Endut, far above those of other families. Table 5 shows ten dominant plant families at Mount Endut based on the number of species, number of individuals, and basal area. Three families that having highest basal area are Fagaceae, Theaceae, and Myrtaceae, number of species (Lauraceae, Myrtaceae, and Fagaceae), and density (Fagaceae, Theaceae, and Myrtaceae).

TABLE 5. Species number, total individuals and basal area of the ten principal families at tree stage on the research site at Mount Endut.

No.	Family	Number of Species				Number of Individuals (individual per ha)				Basal Area ($cm^2 \cdot ha^{-1}$)			
		N	S	E	W	N	S	E	W	N	S	E	W
1.	Clusiaceae	0	4	0	0	0	8	0	0	0	2 679	0	0
2.	Euphorbiaceae	3	2	1	6	7	5	1	12	5 132	1 303	447	6 523
3.	Fagaceae	8	9	6	6	101	153	267	138	76 766	112 082	182	80 645
4.	Icacynaceae	2	2	3	2	8	12	3	15	5 981	9 015	1 155	10 343
5.	Lauraceae	3	5	2	3	3	5	3	5	2 810	3 101	2 044	1 012
6.	Myrsinaceae	2	3	2	1	4	18	5	11	6 061	9 245	3 699	6 914
7.	Myristicaceae	1	2	3	2	10	5	3	9	7 477	2 417	2 298	4 611
8.	Myrtaceae	5	6	7	5	24	14	37	36	18 868	7 753	20 87	20 986
9.	Rubiaceae	2	3	2	0	2	4	5	0	1 125	1 648	1 710	0
10.	Theaceae	2	2	3	3	23	41	184	37	28 912	26 056	94 38	34 181

Notes : N = North ; S = South ; E = East ; W = West.

Castanopsis acuminatissima and *Schima wallichii* were dominant plant species and widely distributed on the four slopes of Mount Endut, while Fagaceae was the plant family which dominated this region. Besides *C. acuminatissima,* three other species from this family were also included in the ten-species having highest important values on three of four slopes of Mount Endut, i.e., *C. argentea, Quercus gemmeliflora*, and *Q. lineata*. Soil properties in the study area on the North, South, East, and West slopes of Mount Endut is presented in Table 6.

TABLE 6. Soil properties of the sub-montane forest of Mount Endut.

Components	North	South	East	West
pH	4.60 to 5.40	4.60 to 4.70	4.60 to 4.70	4.50 to 4.60
C organic (%)	1.72 to 5.60	3.10 to 3.26	2.80 to 3.04	2.65 to 4.92
Al (me ·100 g^{-1})	0.46 to 4.28	4.78 to 6.94	5.60 to 6.12	3.16 to 7.20
H (me ·100 g^{-1})	0.20 to 0.29	0.32 to 0.40	0.34 to 0.42	0.31 to 0.46
N	0.18 to 0.48	0.32 to 0.34	0.29 to 0.32	0.28 to 0.50
C/N	9.56 to 11.67	9.59 to 9.69	9.50 to 9.66	9.46 to 9.84
P Bray-1 g · m^{-3})	4.0 to 8.3	5.8 to 6.4	7.8 to 9.2	4.0 to 8.2
Ca(me ·100 g^{-1})	1.62 to 4.26	1.50 to 2.40	1.68 to 1.80	1.40 to 1.72
Mg (me ·100 g^{-1})	0.50 to 1.30	0.48 to 0.74	0.54 to 0.62	0.38 to 0.59
K (me ·100 g^{-1})	0.08 to 0.14	0.06 to 0.09	0.07 to 0.08	0.05

Source: Raw soil data of research plots taken in 2008. Notes: me = milliequivalent is weight equals 1 mg of H^+.

The soil in the sub-montane forest of Mount Endut was acid. The C/N ratios on the North, South, East, and West slopes were low to moderate. The cation exchange capacity (CEC) was moderate.

DISCUSSION

In the sub-montane forest of Mount Endut, which was primary forest, Sambas *et al*. [4] identified (1) forest alliances of *Castanopsis acuminatissima-Schima wallichii*/*Freycnetia javanica* which consisted of 155 species, 94 genera, and 48 families in total area of 17.2 ha, and (2) *Castanopsis argentea-Dendrocnide stimulans/Schismatoglottis calyptrata* (94 species; 64 genera; 34 families) in 4.4 ha. Species diversity in the research site (4 ha) (Table 1) is comparable to the latter forest alliance. In another part (Cidahu subdistrict) of the Gunung Halimun Salak National Park, Polosakan and Alhamd [2] recorded 71 tree species (dbh ≥ 4.8 cm) belonging to 49 genera and 31 families in 1 ha area at elevation of 1 267 m above sea level. According to indicative zonation, the peak area of Mount Endut is the core zone in the National Park because some areas are still primary forest. In another study area (Citorek) of this National Park, formerly Gunung Halimun National Park, in [8] recorded that Fagaceae and Theaceae were dominant in the basal area whereas Lauraceae and Euphorbiaceae in a number of species. While Hammamelidaceae, Myrtaceae, Clusiaceae, Saxifragaceae, and Ulmaceae were dominant in a number of individuals. In this study, Fagaceae and Theaceae were dominant families as having the highest number of species, individuals, and basal area (Table 5).

In general, the largest number of individual trees were in the small diameter class and decreased with the increase of the diameter class size. A common phenomenon that is also frequently found in tropical forests that always experience dynamics [9]. *Castanopsis acuminatissima* was the most dominant species because it had the largest frequency, density, and basal area values compared to other species. Partomihardjo (2001) in [10] recorded that *C. acuminatissima* was also found to have large basal areas in the forests of the Central Yapen Nature Reserve. Another dominant species was *Schima wallichii*. From several studies conducted in the forests of West Java, *S. wallichii* is the most commonly found species [1, 11]. Both species grow naturally, but their dominance does not lead to homogenous forest types. *S. wallichii* is an important component in some mountain wet tropical rainforests in a sub-mountain zone such as Mount Salak, West Java [12] and in Mount Kinabalu, Malaysia [13].

Plant communities exhibited through their structure and composition have a very close interconnection with their habitat, where ecological habitat terms refer to all the physical and chemical factors that make up the plant community. Disclosure of associations between species distribution with various variations of soil factor (edaphic) and topography is one of the most important keys to understanding the characteristics of tropical rainforests [14].

According to Kappelle [15], one of the characteristics of soil in sub-mountains and mountains is the acid soil properties. The acidity of the soil will increase with increasing elevation. This is consistent with the conditions in the study area, where the pH was relatively low with variations between 4.50 to 5.40 (at mountaintop). Veneklaas (1991) in Wiharto [1] states that comparing to wet tropical lowlands, in this area is covered by clouds and the air

humidity is much higher. Evapotranspiration reduces very sharply, and so with the temperature. This condition causes the process of decomposition of organic material is difficult so that organic materials found in the soil become difficult to decompose and cause a high acid influence.

The condition of element P in the research area based on the soil characteristics issued by the Soil Science Laboratory of IPB was very low, i.e., $< 15\ g \cdot m^{-3}$. The presence of P elements in the study area is feared to be an obstacle to the development and growth of forests in the future. As Jordan (1985) in Wiharto [1] points out, the very low availability of P elements is an obstacle to most tropical rainforest ecosystems. However, according to [16] that in an ecosystem with high deficit with soil P element, the soil P element will play a significant role in determining net primary productivity and weathering organic matter either directly or through interaction with N elements.

CONCLUSION

From the result of recorded trees on the four slopes of Mount Endut, Gunung Halimun Salak National Park, it can be concluded that North, South, East, and West slopes were occupied by *Castanopsis acuminatissima-Castanopsis argentea, Castanopsis acuminatissima-Quercus lineata, Castanopsis acuminatissima-Schima wallichii*, and *Castanopsis acuminatissima-Schima wallichii* communities, respectively. Plant species diversity in the Mount Endut region was relatively low especially on the West and North slopes. Tree density in the whole area of this region was also relatively small.

REFERENCES

1. M. Wiharto, "Klasifikasi vegetasi zona sub Pegunungan Gunung Salak, Bogor, Jawa Barat" [Sub-mountain zone vegetation classification at Mount Salak, Bogor, West Java], Dissertation, IPB, 2009. [Bahasa Indonesia].
2. R. Polosakan and L. Alhamd, Jurnal Teknologi Lingkungan Edisi Khusus "Hari Bumi," 53–59 (2012).
3. E. Mirmanto, *Buletin Kebun Raya* **17**(2), 91–100 (2014). [Bahasa Indonesia].
4. E. N. Sambas, C. Kusmana, L. B. Prasetyo, and T. Partomihardjo, Berita Biologi **10**(5), 597–604 (2011). [Bahasa Indonesia].
5. E. N. Sambas, C. Kusmana, L. B. Prasetyo, and T. Partomihardjo, Jurnal Biologi Indonesia **9**(2), 209–218 (2013).
6. C. Kusmana, *Metode Survey dan Interpretasi Data Vegetasi* [*Survey Method and Vegetation Data Interpretation*] (IPB Press, Bogor, 2017), pp. 33–47. [Bahasa Indonesia].
7. G. W Cox, *General Ecology Laboratory Manual 8th Ed* (McGraw-Hill, New York, 2002), pp. 61–71.
8. E. Mirmanto and H. Simbolon, 1998. "Vegetation Analysis of Citorek Forest, Gunung Halimun National Park" *in Research and Conservation of Biodiversity in Indonesia. Vol. IV. Gunung Halimun: The Last Submontane Tropical Forest in West Java*, edited by H. Simbolon, M. Yoneda and J. Sugardjito (Research and Development Center for Biology, Bogor, 1998), pp. 41–59.
9. B. Dendang and W. Handayani, *Struktur dan Komposisi Tegakan Hutan di Taman Nasional Gunung Gede Pangrango, Jawa Barat* [*Structure and Composition of Forest Stands in Mount Gede Pangrango National Park, West Java*], Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia **1**(4), 691–695 (2015). [Bahasa Indonesia].
10. E. N. Sambas, "Klasifikasi vegetasi Gunung Endut, Taman Nasional Gunung Halimun Salak" [Vegetation classification of Mount Endut, Gunung Halimun-Salak National Park, Banten], Dissertation, IPB, 2012. [Bahasa Indonesia].
11. D. Rinaldi, S. A. Harahap, D. M. Prawiradilaga, E. Sambas, H. Wiriadinata, Purwaningsih, *et al*., *Ekologi Koridor Halimun-Salak, Taman Nasional Gunung Halimun Salak* (GHSNP-MP-JICA, Bogor, 2008), pp. 11–14.
12. M. Wiharto and F. Mochtar, Journal of Developments in Sustainable Agriculture, **7**(1), 55–64 (2012).
13. K. Kimura, Global Environmental Research-English Edition, **7**(1), 113–122 (2003).
14. K. Miyamoto, E. Suzuki, T. Kohyama, T. Seino, E. Mirmanto, and H. Simbolon, J. Trop. Ecol. **19**(1), 43–54 (2003).
15. M. Kapelle, "Tropical Montane Forests", in *Encyclopedia of Forest Sciences Volume 4*, edited by J. Burley, J. Evans, J. A. Youngquist (Elsevier, Oxford, 2004), pp. 1782–1793.
16. K. Kitayama, N. Majalap-Lee, and S. Aiba, Oecologia **123**(3), 342–349 (2000).