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Diversity of tree communities in Mount Patuha region, West Java

DECKY INDRAWAN JUNAEDI♥, ZAENAL MUTAQIEN♥♥
Bureau for Plant Conservation, Cibodas Botanic Gardens, Indonesian Institutes of Sciences (LIPI), Sindanglaya, Cianjur 43253, West Java, Indonesia,
Tel./Fax.: +62-263-51223, email: ♥decky.indrawan.junaedi@lipi.go.id; ♥♥zaenal.mutaqien@lipi.go.id

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ABSTRACT

Junaedi DI, Mutaqien Z (2010) Diversity of tree communities in Mount Patuha region, West Java. Biodiversitas 11: 75-81. Tree vegetation analysis was conducted in three locations of Mount Patuha region, i.e. Cimanggu Recreational Park, Mount Masigit Protected Forest, and Patengan Natural Reserve. Similarity of tree communities in those three areas was analyzed. Quadrant method was used to collect vegetation data. Morisita Similarity index was applied to measure the similarity of tree communities within three areas. The three areas were dominated by *Castanopsis javanica* A. DC., *Lithocarpus pallidus* (Blume) Rehder and *Schima wallichii* Choisy. The similarity tree communities were concluded from relatively high value of Similarity Index between three areas. Cimanggu RP, Mount Masigit and Patengan NR had high diversity of tree species. The existence of the forest in those three areas was needed to be sustained. The tree communities data was useful for further considerations of conservation area management around Mount Patuha.

Key words: Mount Patuha, tree communities, plant ecology, remnant forest.

INTRODUCTION

Forest vegetation has important roles to climate, soil formations, prevention of erosion and landslides, and establishment of ecological niche for variety of living forms. Forests vegetation also holds an important role in managing the water systems including ground water system (van Steenis 1972). Forest communities stability will be assured by the diversity of the forest communities it selves, especially on the producer level such as plants (McNaughton 1977).

According to Whitmore (1984) and Whitten et al. (1996), vegetation zoning system in Southeast Asia shows the distribution of plants based on the elevation of the forests. It consists of lower zone which occurred on 0-1200 m asl., lower montane forest zone on 1200-1800 m asl., montane forest zone between 1800-3000 m asl. and sub-alpine forest zone on more than 3000 m asl.

Mountain forests are a good laboratory for research on ecophysiology of the reciprocal relationships between the plants and their environments (Whitmore 1986). Smith (1989) mentioned that mountain rain forests vegetation is mostly dwarf, because of the limitation on their growth by combination of a low temperature, fluctuative rainfall and the lack of soil nutrition. Thus, the mountain forests play an important role in maintaining their resources. Furthermore, this forests formation are habitat for a large numbers of endemic species, and possibly many aspects of this forests still lack of scientific understanding (Aldrich et al. 1997).

Most of endemic plant species in Java can only be found in the mountain forests, although some of them may be found in lowland forests. The diversity of plant species in the western part of Java was higher than the middle and eastern Java (Whitten and Whitten 1996). Morrison (2001) stated that the conservation status of tropical mountain rainforests of West Java has reached threatened conditions. At this time, from totally 25 conservation areas of West Java covering 3,410 km^2 are mostly consist of mountainous forest.

Mount Patuha is one of the mount in Java with highest diversity of plant species (van Steenis 1972). Mt. Patuha was divided in several local areas management. It were Cimanggu conservation area (CA) and production forest of Perhutani in Mt. Patuha, non production forest area of Perhutani around Ranca Upas consist of several small mountain including Mt. Masigit. It was located north side of Mt. Patuha. Last, Patengan NR forest located west side of Mt. Patuha.

The aims of this research are to determine the actual condition of the three research site which assumed represent forest area around Mt. Patuha, especially the tree species diversities, abundances and similarities of the tree communities: Taman Wisata Alam Cimanggu (Cimanggu Recreational Park, RP), Hutan Lindung Gunung Masigit (Mount Masigit Protected Forest, PF), and Cagar Alam Patengan (Patengan Natural Reserve, NR).

MATERIAL AND METHODS

Methods

Quadrant method (Point Center Quadrant Method) (Cottam and Curtis 1956) was used to conducting vegetation analysis. Sampling taken at three locations: Cimanggu RP, Mt. Masigit and Patengan NR. Sampling points were considered from the area that representing the condition of each location. Number of sampling points was determined based on the species area curve analysis

(Muller-Dumbois and Ellenberg 1974) to be made before the sampling was taken. Vegetation data collection only measured tree habits, which defined as plants with dbh > 10 cm (Roberts-Pichette and Gillespie 2001). Total relative dominance in one type of a community was stated by Important Value Index (IVI), which is the sum of Relative Dominance (RDo), Relative Density (RDe) and Relative Frequency (RF) (Muller-Dumbois and Ellenberg 1974). Furthermore, Simpson Dominance Index was used to determine the dominant species in the three communities analyzed. Vegetation community similarity was analyzed based on Morisita (1959) with the formula:

$$Im = \{2(\Sigma Xa.Xb)\} / \{[((\Sigma Xa/(\Sigma Xa)(\Sigma Xa-1)) + ((\Sigma Xb/(\Sigma Xb)(\Sigma Xb-1))] \Sigma Xa.\Sigma Xb\}$$

Xa: total basal area of species X in location a
Xb: total basal area of species X in location b

Other supplementary data, such as location coordinates and altitude, air temperature, air relative humidity (RH), soil acidity and soil RH were taken. Understorey plants species was observed also. Herbarium specimens was made for identification and ecological prove which identified in *Cianjur Herbarium Tjibodasensis* (CHTJ)

Locations

Brief information about three research locations was showed in Table 1. Data showed based on Anonymous (2004a,b) and Anonymous (2008).

Table 1. Size and altitude of research locations.

Research location	Size (hectares)	Altitude (m asl)
Cimanggu RP	154	1600- 2200
Mt. Masigit	43.595	1600- 2000
Patengan NR	121	1600

Research was conducted in June 2008. Sampling points was located in the west slopes of Mt. Patuha, Patengan NR, and the south slopes of Mt. Masigit (Figure 1).

RESULTS AND DISCUSSION

Species area curve

Based on the species curve area, it shows that a minimum amount of sampling needed is 20 points. Coefficients value of logarithmic regression is 0.9849 (√ 0.9701) (Figure 2). This was quite significant; as a result validity of the equation was accepted.

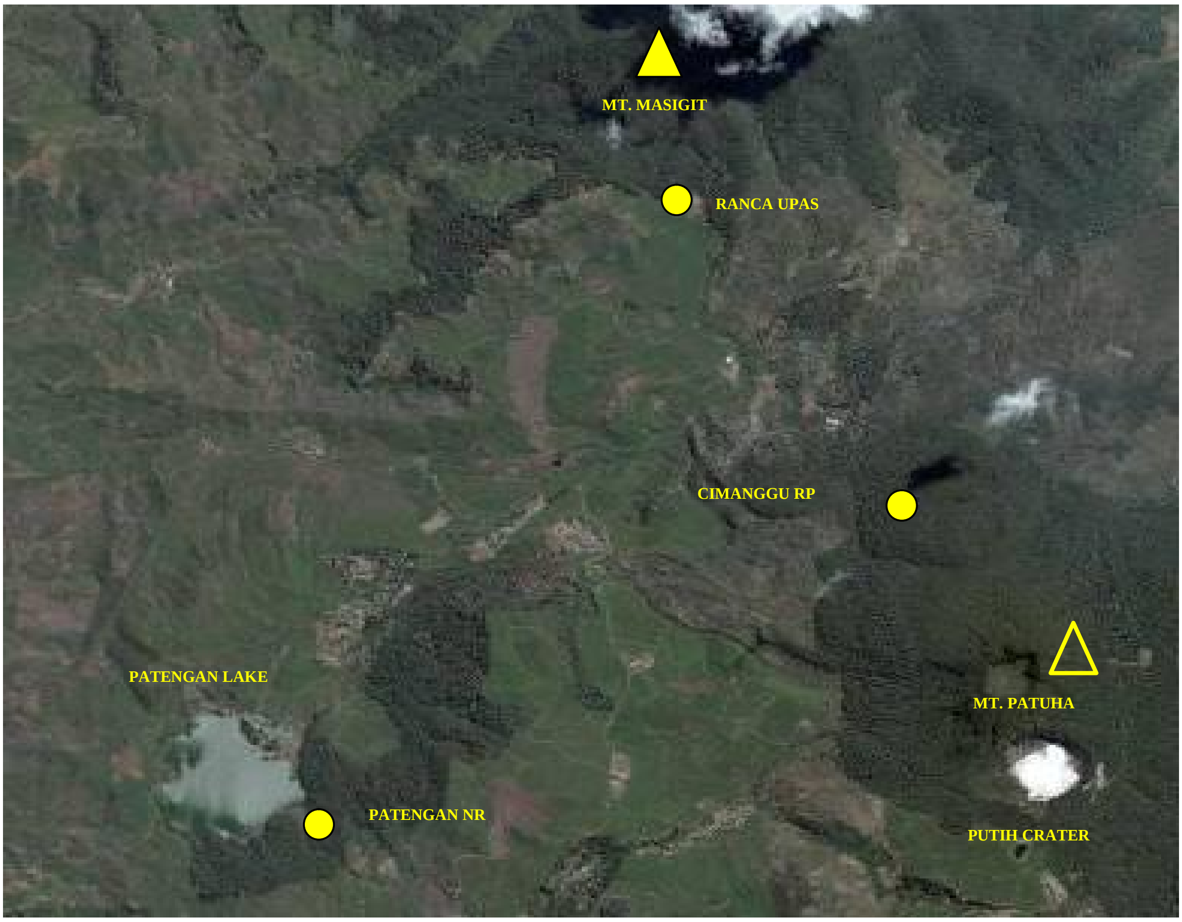

Figure 1. Map of research locations: Cimanggu RP, Mt. Masigit, and Patengan NR (www.google-earth.com).

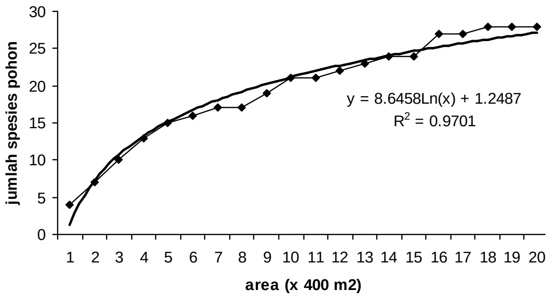

Figure 2. Species area curve with the number of sampling point 20 x 400 m^2 at research location. Analysis was taken in Mt. Masigit with the assumption of the tree communities condition with the least threat intensity than two other locations, i.e. Cimanggu RP and Patengan NR.

Vegetation analysis

Based on vegetation analysis, there were 49 tree species obtained from three research locations. There were 26 tree species in Cimanggu RP, 31 tree species in Mt. Masigit and 20 tree species in Patengan NR. Furthermore, list of tree species that found in three locations along with the observed value of IVI is summarized in Table 2. Understorey plants observed from three locations consist of 51 species, 43 genus and 36 families (Table 3). From the total number of species, 11 of them was seedling of tree species. Most of the understorey plants were member of Asteraceae, Euphorbiaceae, Rubiaceae and Urticaceae.

Table 2. Tree species found in three research locations: Cimanggu RP, Mt. Masigit and Patengan NR with its Important Value Index (IVI). IVI values with bold type indicate that the value is one of the three largest values in the mentioned locations.

Species	Family	Important Value Index (IVI)		
		Cimanggu RP	Mt. Masigit	Patengan NR
Acer laurinum Hassk. ex Miq.	Aceraceae	3.14	5.7	-
Rauvolfia javanica Koord. & Valeton	Apocynaceae	11.4	-	-
Macropanax dispermum Kuntze	Araliaceae	-	10.22	12.06
Vernonia arborea Buch. Ham	Asteraceae	6.38	2.09	18.58
Viburnum sambucinum Reinw. ex Blume	Caprifoliaceae	-	1.83	-
Elaeocarpus oxypyren Koord. & Valeton	Elaeocarpaceae	8.49	-	-
Elaeocarpus sp.	Elaeocarpaceae	-	2.29	10.03
Elaeocarpus stipularis Blume	Elaeocarpaceae	9.99	-	-
Sloanea sigun (Blume) K.Schum.	Elaeocarpaceae	-	2.09	26.99
Claoxylon indicum (Reinw. ex Blume) Hassk.	Euphorbiaceae	2.98	-	-
Glochidion cyrtostylum Miq.	Euphorbiaceae	9.7	1.93	-
Homalanthus populneus Pax	Euphorbiaceae	5.55	-	2.98
Castanopsis javanica A. DC.	Fagaceae	43.06	46.58	32.33
Castanopsis tungurrut A. DC.	Fagaceae	2.78	-	-
Lithocarpus pallidus (Blume) Rehder	Fagaceae	31.18	33.98	20.46
Lithocarpus sp.	Fagaceae	-	-	13.08
Altingia excelsa Noronha	Hamamelidaceae	25.93	4.24	-
Engelhardia spicata Blume	Juglandaceae	44.53	32.59	-
Cinnamomum rhynchophyllum Miq.	Lauraceae	2.87	-	-
Cryptocarya lanceolata Merr.	Lauraceae	-	2.53	-
Litsea tomentosa Blume	Lauraceae	-	1.84	-
Neolitsea cassiaefolia (Blume) Merr.	Lauraceae	2.85	-	14.73
Neolitsea javanica (Blume) Backer	Lauraceae	3.87	3.89	-
Magnolia blumei Prantl.	Magnoliaceae	10.45	-	5.81
Astronia spectabilis Blume	Melastomataceae	-	-	3.8
Ficus cuspidata Reinw. ex Blume	Moraceae	-	-	3.39
Ficus fistulosa Reinw. ex Blume	Moraceae	2.77	-	3.03
Ficus ribes Reinw. ex Blume	Moraceae	-	1.84	-
Myrsine hasseltii Blume ex Scheff	Myrsinaceae	-	2.1	-
Decaspermum fruticosum J.R.Frost & G.Frost	Myrtaceae	-	8.64	-
Syzygium antisepticum (Blume) Merr.& L.M.Perry	Myrtaceae	-	33.79	-
Syzygium rostratum DC.	Myrtaceae	12.09	-	3.15
Syzygium sp.	Myrtaceae	-	4.18	-
Podocarpus neriifolius D.Don.	Podocarpaceae	-	2.03	-
Polyosma integrifolia Blume	Polyosmaceae	-	3.72	-
Polyosma sp.	Polyosmaceae	4.3	-	-
Helicia robusta (Roxb.) R.Br.ex Wall.	Proteaceae	2.97	1.81	-
Prunus arborea (Blume) Kalkman	Rosaceae	6.69	11.61	11.31
Cinchona pubescens Vahl.	Rubiaceae	-	-	56.94
Wendlandia densiflora DC.	Rubiaceae	2.84	6.25	-
Acronychia pedunculata Miq.	Rutaceae	2.9	9.53	-
Casearia sp.	Salicaceae	2.91	4.32	-
Turpinia Montana (Blume) Kurz	Staphyleaceae	-	3.47	3.77
Turpinia sphaerocarpa Hassk.	Staphyleaceae	-	-	6.09
Sterculia sp.	Sterculiaceae	-	-	10.67
Symplocos costata Choisy ex Zoll.	Symplocaceae	-	2.85	-
Eurya acuminata DC.	Theaceae	2.83	-	-
Gordonia excelsa Blume	Theaceae	-	7.66	-
Schima wallichii Choisy	Theaceae	44.55	34.13	41.11

Table 3. Understorey plants observed from three research locations: Cimanggu RP, Mt. Masigit and Patengan NR. Presence and absent of the species was limited to the subplots analyzed.

Species	Family	Cimanggu RP	Mt. Masigit	Patengan NR
Strobilanthes paniculata T. Anders.	Acanthaceae	+	+	+
Saurauia sp.*	Actinidiaceae	+	+	-
Curculigo sp.	Amaryllidaceae	+	+	+
Parameria sp.	Apocynaceae	+	+	-
Urophyllum sp.	Araceae	-	+	-
Calamus sp.	Arecaceae	+	+	+
Eupatorium riparium Regel	Asteraceae	+	+	+
E. inulaefolium H. B. K.	Asteraceae	+	+	+
Vernonia arborea Buch.-Ham*	Asteraceae	+	+	+
Impatiens platypetala Lindl.	Balsaminaceae	+	+	+
Begonia robusta Blume	Begoniaceae	+	+	-
Euonymus javanicus Blume*	Celastraceae	-	+	-
Perrottetia sp.*	Celastraceae	-	+	-
Cyathea junghuhniana Copel	Cyatheaceae	-	+	+
Cyperus sp.	Cyperaceae	-	+	-
Lindsaea sp.	Dennstaedtiaceae	-	+	-
Glochidion sp.*	Euphorbiaceae	+	+	-
Homalanthus populneus Pax*	Euphorbiaceae	+	+	+
Sauropus sp.	Euphorbiaceae	+	+	-
Dichroa sp.	Hydrangeaceae	+	+	+
Magnolia liliifera (L.) Baill.	Magnoliaceae	+	+	+
Melastoma malabathricum Linn.	Melastomataceae	+	+	+
Ficus cuspidata Reinw. ex Blume*	Moraceae	+	+	+
Ardisia javanica A. DC.	Myrsinaceae	-	+	-
Ardisia villosa Roxb.	Myrsinaceae	+	+	-
Passiflora edulis Sims	Passifloraceae	-	+	-
Polygala sp.	Polygalaceae	+	+	-
Polygonum chinense L.	Polygonaceae	+	+	-
Lysimachia biflora C.Y. Wu	Primulaceae	-	+	-
Pteris ensiformis Burm.	Pteridaceae	+	+	+
Rubus sp.	Rosaceae	+	+	+
Michelia sp.	Rubiaceae	+	+	-
Mussaenda sp.	Rubiaceae	+	+	+
Psychotria montana Blume	Rubiaceae	+	+	-
Toddalia asiatica (L.) Lam.	Rutaceae	-	+	-
Zanthoxylum sp.	Rutaceae	+	+	-
Symplocos sp.*	Symplocaceae	+	+	-
Smilax macrocarpa Blume	Smilacaceae	+	+	-
Solanum grossum C.V. Morton	Solanaceae	-	+	-
Turpinia sphaerocarpa Hassk*	Staphyleaceae	+	+	-
Eurya acuminata DC.*	Theaceae	+	+	-
Cyclosorus sp.	Thelypteridaceae	-	+	-
Elatostema sp.	Urticaceae	+	+	-
Pilea sp.	Urticaceae	+	+	+
Procris sp.	Urticaceae	-	+	-
Diplazium sp.	Woodsiaceae	+	+	+
Hedychium coronarium J.König	Zingiberaceae	+	+	-

Note: *Seedlings of tree species; +, presence in plot analyzed; - , absent in plot analyzed

Simpson dominance index shows that dominant trees in three research location consist of several species and there were no tree species with absolute dominance. This was taken from the value of dominance index which relatively small (Table 4) from all location. All indexes are smaller than 1. Simpson dominance index is reflecting the distribution dominance. Smaller value reflects more species number dominating the communities. Dominance index value of 1 indicates that communities were dominated by a single species (Heriyanto et al. 2006).

Schima wallichii is one of dominant tree species in the Cimanggu RP. Based on the RDe values, this species has the largest density in Cimanggu RP with 64 individual/ha. It means, *S. wallichii* has the largest population in the location. *Schima* is usually abundant in the forest up to high altitude of 2400 m asl. The small size and winged seeds makes it easy to spread by the wind (Sosef et al. 1995). Other dominant species in this location is *Engelhardia spicata*. Based on the IVI, this species has biggest size which reflected from the highest RDo with 22.01% (Table 5). Jacobs (1960) stated that *E. spicata* was grown with gregarious size in the tropical forests up to 2000 m asl. Other dominant trees in this location are *Castanopsis javanica*, *Lithocarpus pallidus* and *Altingia excelsa*.

Table 4. Simpson dominance index of tree species from three research locations: Cimanggu RP, Mt. Masigit and Patengan NR.

Research locations	Simpson dominance index
Cimanggu RP	0.09178
Mt. Masigit	0.08310
Patengan NR	0.09424

Tree species in Mt. Masigit is generally dominated by *Castanopsis javanica*. However, the species is only dominating the density in Mt. Masigit with 121 individual/ha. This tree usually occurs in the primary and old secondary forest and highland area (Lemmens et al. 1995). Furthermore, *Syzygium antisepticum* is the biggest tree in this location with highest RDo value with 19.78 %. However, *Lithocarpus pallidus* has the largest probability to found in G. Masigit with highest RF value (Table 5).

Tree communities domination pattern in Patengan NR was similar to Cimanggu RP. Tree with largest IVI value does not have the largest value of RDo. The dominant tree species in TWA Patengan is *Cinchona pubescens*. This species has the highest value on the parameters of RF and RDe. Population density of *C. pubescens* in TWA Patengan is 222 individuals/ha. This is the highest density of tree population in all three research locations. Furthermore, the highest RDo in this location was gained by *Schima wallichii* (Table 5).

Generally, tree communities of research locations dominated by *Castanopsis javanica*, *Lithocarpus pallidus* and *Schima wallichii* with exception in Patengan NR. *Cinchona pubescens* dominating tree communities in Patengan NR. The history of quinine (kina) cultivation in this area since its first introduction of *Cinchona* by Junghuhn is the main factors that affecting dominance of *Cinchona pubescens* in Patengan NR. Kina specimen which planted in Indonesia was the result of the botany expedition to South America by Hasskarl in 1852. It was planted in 1854 in Java, including southern area of Bandung by Junghuhn (de Padua et al. 1999). This species was one of cultivation plants that have become invasive to natural forest ecosystems (Richardson 1998). *Cinchona pubescens* can dominate Patengan NR tree communities because of its invasiveness, especially in the highland forest ecosystem (Lowe et al. 2000; Buddenhagen et al. 2004; McDonald et al. 1988). Main factor of it invasiveness was small seed size with wings modification. Rejmanek (2000) stated that invasiveness of woody species in disturbed land were caused by small seed mass (< 50 mg), short juvenile period (< 10 years) and short interval between large seed crops (1-4 years).

Similarity analysis

Similarity analyses of tree communities in three locations show relatively high similarities (Table 6). Highest similarity occurs from Cimanggu RP and Mt. Masigit. In contrast, the lowest one occurs from Mt. Masigit and Patengan NR. *Castanopsis javanica*, *Lithocarpus pallidus*, *Prunus arborea*, *Schima wallichii* and *Vernonia arborea* occurs in all three locations. This five tree species represent three families: Fagaceae (*Castanopsis javanica* and *Lithocarpus pallidus*), Theaceae (*Schima wallichii*) and Rosaceae (*Prunus arborea*). Van Steenis (1972) stated that Fagaceae, Theaceae and Rosaceae were dominant families in sub-montana zone in Java at the elevation of 1000-2000 m asl. It was interesting to notice that three of those five species were dominant species in all three locations. It was *Castanopsis javanica*, *Lithocarpus pallidus* and *Schima wallichii* (Table 5). Dispersion and distribution pattern of the species may explain this phenomenon. This entire species has clumped distribution type (Arrijani et al. 2006).

Table 5. Five dominant tree species in three research location: Cimanggu RP, Mt. Masigit and Patengan NR based on Relative Dominance (RDo), Relative Frequency (RF) and Relative Density (RDe). Important Value Index (IVI) is the sum of RDo, RF, and RDe. The highest value in each parameters has shown with bold type.

Research locations	Species	Family	RDo	RF	RDe	IVI
Cimanggu RP	*Schima wallichii* Choisy*	Theaceae	15.46	14.08	15.00	44.54
	Engelhardia spicata Blume	Juglandaceae	22.01	11.27	11.25	44.53
	Castanopsis javanica A. DC.*	Fagaceae	16.64	12.68	13.75	43.07
	Lithocarpus pallidus (Blume) Rehder*	Fagaceae	12.73	8.45	10.00	31.18
	Altingia excelsa Noronha	Hamamelidaceae	12.80	5.63	7.50	25.93
Mt. Masigit	*Castanopsis javanica* A. DC.*	Fagaceae	18.82	11.93	15.80	45.93
	Schima wallichii Choisy*	Theaceae	11.45	11.01	11.70	34.16
	Lithocarpus pallidus (Blume) Rehder*	Fagaceae	6.89	13.76	13.30	33.95
	Syzygium antisepticum (Blume) Merrill & Perry	Myrtaceae	19.78	7.34	6.70	33.82
	Engelhardia spicata Blume	Juglandaceae	17.75	7.34	7.50	32.59
Patengan NR	*Cinchona pubescens* Vahl	Rubiaceae	8.09	19.35	29.49	56.93
	Schima wallichii Choisy*	Theaceae	32.43	4.84	3.85	41.12
	Castanopsis javanica A. DC.*	Fagaceae	10.78	11.29	10.26	32.33
	Sloanea sigun (Blume) K. Schum.	Elaeocarpaceae	6.72	11.29	8.97	26.98
	Lithocarpus. pallidus (Blume) Rehder*	Fagaceae	7.60	6.45	6.41	20.46

Note: * Species found in all locations generally dominating the tree communities

Table 6. Morisita similarity index of three research location: Cimanggu RP, Mt. Masigit and Patengan NR.

	Cimanggu RP	Mt. Masigit	Patengan NR
Cimanggu RP		0,92719	0,83445
Mt. Masigit	0,92719		0,756116
Patengan NR	0,83445	0,756116	

Fragmentation of forest communities (forest remnants)

Based on the tree composition and similarity analysis, Patengan NR tree communities was different from the natural conditions even there was lack of former studies on plant communities in this location. This was concluded from two assumptions: (1) Patengan NR tree communities have been fragmented and formerly it was a unity with Cimanggu RP and Mt. Masigit. This assumption was supported by similarity value among three locations that have a range of values 0.5 <x <1, (2) Value of similarity index between Patengan NR with two other locations are relatively small. This value indicates a small difference between Patengan NR with two other locations (Table 6).

High value of similarity index between Cimanggu RP and Mt. Masigit (0.92) indicate that these two areas share the similar community, which is represented by dominant tree species composition. *Castanopsis javanica* and *Schima wallichii* are dominant trees in Cimanggu RP and Mt. Masigit. Simberloff (1998) stated plants species populations that locally abundant play an important role in their habitat. It population fluctuation can be used as indicators for other species in same communities.

Patengan NR has relatively low similarity index value compared either with Cimanggu RP or Mt. Masigit. The dominance of *C. pubescens* in Patengan NR which is known as an introduced species explains this low value. However, this value does not indicate a significant difference in the community with the other two locations.

Looking at accessibility and area perspective, Patengan NR was most accessible location compared to two other locations. Therefore, Patengan NR was very fragile to disturbance. This particular disturbance comes from human activity, this is happening because the site is adjacent to Telaga Patengan tourism area, a low slope land contour and accessibilities.

Ross et al. (2002) stated that there is a relationship between fragmented areas with tree species composition in tropical forests. Main factors which can affect composition of plant species in a fragmented area are the size itself and external interference. The Smaller size area of plant communities is more sensitive to the interference experienced. Patengan NR area is relatively small compared to Cimanggu RP and Mt. Masigit. The sensitivity of Patengan NR tree communities reflected from the composition of tree species that existed.

We face difficulties to explain the effects of fragmentation to the structure of tree communities of Patengan NR, because the limited time of observation and lack of previous data. Fragmentation effects to the structure of tree communities can be explained with the data covering the entire life cycle of tree species (Lienert and Fischer 2003). Generally, the age of a tree life cycle is more than ten years. The aspects that can be analyzed are the discrepancy of dominant tree species between Patengan NR as forest fragments with two other locations that considered as a forest ecosystem with has relatively natural conditions. An option to learn the composition of species in the fragmented forest is to compare them with the larger forest fragments (Vormisto et al. 2004). *Cinchona pubescens* dominance in Patengan forest shows the influence of fragmentation to the previous condition of community. Dos Santos et al. (2007) states that the composition of plant species in forest fragments is the result of the influence of various factors with different intensity and duration varies in times and area sizes. Habitat fragmentation effects on abundant plant species are still not many examined and need further research (Lienert 2004). Studies on the effects of fragmentation on abundant species in wetland in Switzerland showed that habitat fragmentation is not only threatening a small population of plants, but also threaten the population abundant species (Lienert and Fischer 2003).

CONCLUSIONS

The tree species composition in the area around Mount Patuha which consists of Cimanggu RP, Mt. Masigit, and Patengan NR are assumed as one community that can be seen from the dominant vegetation in all three areas, i.e. *Castanopsis javanica*, *Lithocarpus pallidus* and *Schima wallichii*. It also showed by relatively high value of Morisita similarity index between those three locations. Tree species composition in Patengan NR tree community shows that it was more sensitive to external interference than the two other locations. This tree communities data was useful for further considerations of conservation area management around Mt. Patuha.

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