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Analysis of epiphytic orchid diversity and its host tree at three gradient of altitudes in Mount Lawu, Java

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ABSTRACT

Yulia ND, Budiharta S, Yulistyarini T (2011) Analysis of epiphytic orchid diversity and its host tree at three gradient of altitudes in Mount Lawu, Java. Biodiversitas 12: 225-228. The aim of this study was to observe epiphytic orchid diversity and their host trees at three different altitudes (1796, 1922 and 2041 m asl.) at southern part of Mount Lawu, District of Magetan, East Java. Line transect of 10 x 100 m was set up and then divided into ten plots (as replicates) of 10 x 10 m. At each plot, species name and number of individual of epiphytic orchids, and species name, number of individual and diameter at breast height (dbh) of host trees were recorded. The result showed that there were 19 species of epiphytic orchid recorded at the study sites. There were significantly different among gradient altitude in number of epiphytic orchid species (F = 3.7; df = (2, 27); P < 0.05). The highest number of species of epiphytic orchid was recorded at the altitude of 1922 m asl. (6.6 species/100 m^2) while the highest number of individual was recorded at the altitude of 1796 m asl. (1337.7 individuals/100 m^2). The study site at altitude of 1922 m asl. was recognized as the denser and richer in species of host trees (2.3 species/100 m^2 and 3.5 individuals/100 m^2 respectively). However, the highest basal area of host tree was recorded at the altitude of 2041 m asl. (4558 cm^2/100 m^2).

Key words: orchid diversity, host trees, gradient of altitudes, southern part, Mount Lawu.

INTRODUCTION

Epiphytic plant is one component of forest vegetation that still requires much research to maximize its potential uses (Setyawan 2000). Epiphytic plant needs other type of plants either tree or herb as its host (Dressler 1990; Hietz 1997). Despite by micro climate, the diversity of epiphytic plant is also influenced by typical condition of its host tree species such as canopy type, bark characteristic, and bio-chemistry processes (Setyawan 2000). In tropical forest, epiphytic plant is an important element since it contributes up to 25% of all vascular plant species in the tropics and represents 10% of plant diversity worldwide (Hietz 1997; Nieder 2001; Gravendeel 2004). According to Annaselvam and Parthasarathy (2001), epiphytic plants in Varagalair tropical evergreen forest include are Orchidaceae (54%), Piperaceae and Araceae (each 8%).

Kindlmann and Vergara (2009) highlight the importance of research in orchid especially in the topics of species diversity, such as species-area and species-abundance relationships. Two important factors for predicting orchid diversity and endemism in large and montane islands in West Indies are area and elevation (Ackerman et al. 2007). Van Steenis (1972) mentioned that generally, orchids grow well in mountain areas with altitude ranging from 500 to1500 m asl, and their variation decreases in out site of this range (below 500 m asl. or above 2000 m asl). According to Setyawan (2001) forest vegetation in Mount Lawu is relatively stable since there is no volcanic activity for long period and the low level of disturbances either caused by human or nature (such as forest fire, storm and landslide). The aim of this study is to observe the diversity of epiphytic orchids and their host trees at three gradient of altitudes (1796, 1922 and 2041 m asl.) in southern part of Mount Lawu, District of Magetan, East Java, Indonesia.

MATERIALS AND METHODS

Study sites

Mount Lawu is located along the border of East Java and Central Java with 5.719,4 ha in extent and the highest peak is 3.265 m asl. It is divided into two zones which are production zone and buffer zone (Perum Perhutani 2010). This study was conducted between 1 and 8 October 2010 at forest areas in Mount Lawu, Sub-district of Plaosan, District of Magetan (S 07º39'28.7"-07º39'42.1" and E 111º 11'39.6"-111º 13'02.5"). Purposive sampling was used by determining three study sites representing different altitude, were Mojosemi (1796 m asl; S 07°39'42.1" and E111°13' 02.5"), Tirtogumarang (1922 m asl; S 07°40'03.5" and E 111º11'30.2") and Cemorosewu (2041 m asl; S 07°39'28.7" and E 111°11'39.6") (Figure 1). These three sites are reserve forests managed by *Kesatuan Pemangkuan Hutan* or Forest Management District (KPH/FMD) Southern Lawu under Perum Perhutani (State Owned Forest Company). The climate at these sites is relatively cool and dry with temperature 19-26ºC and humidity 70-80%.

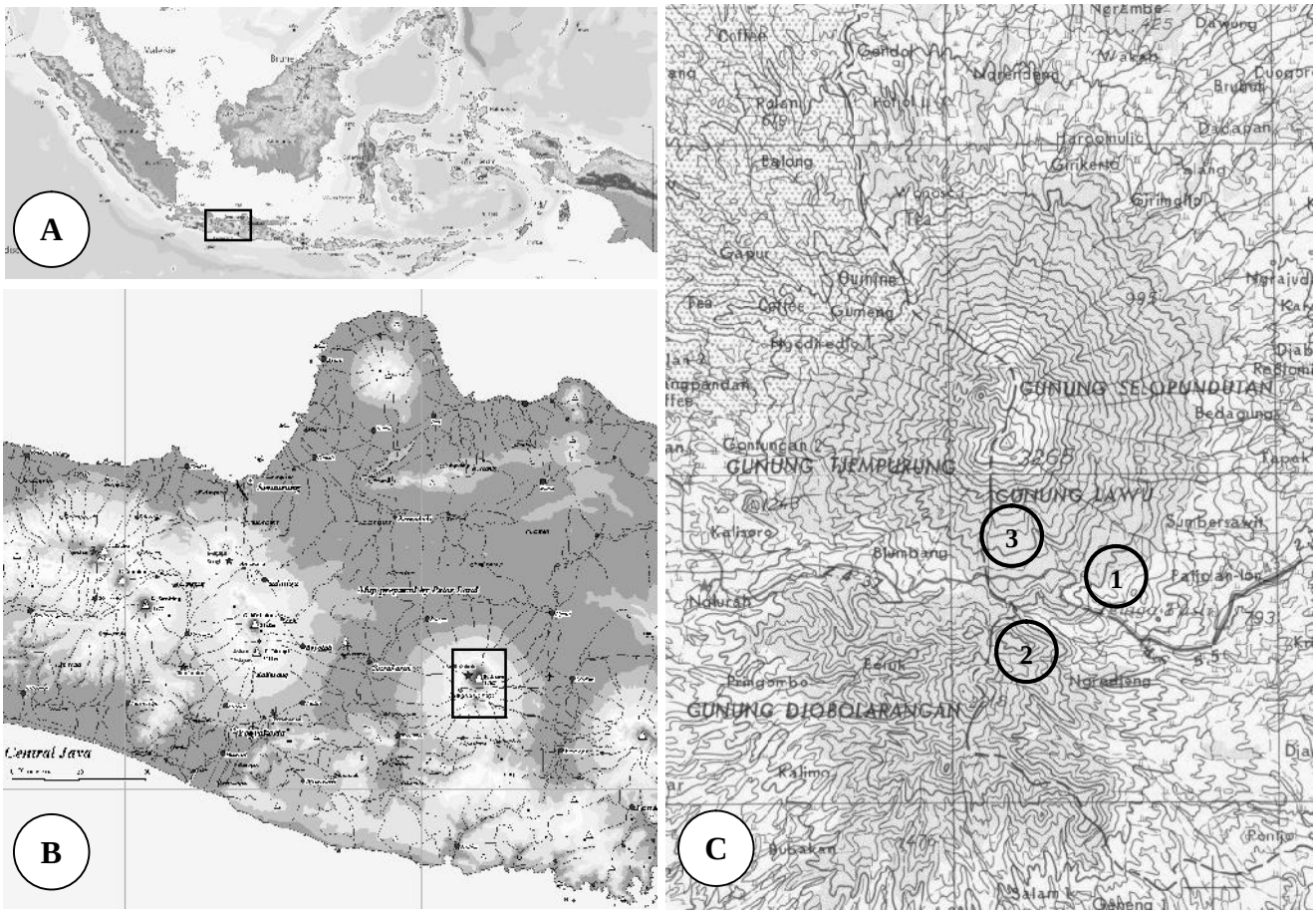

Figure 1. Location of study site at Mount Lawu, Sub-district of Plaosan, District of Magetan (B) and detailed map of three sites (C): 1. Mojosemi (1796 m asl), 2. Tirtogumarang (1922 m asl), 3. Cemorosewu (2041 m asl).

Vegetation types at the study areas are natural sub-montane forest, mixed secondary forest and agricultural lands. Some dominant tree species are *Casuarina junghuhniana* (cemara gunung), *Pinus merkusii* (tusam), *Altingia excelsa* (rasamala), *Lithocarpus sundaicus* (pasang), *Acer laurinum* and *Acmena* sp.

Data collection and analysis

Line transect of 10x100 m^2 were made at three study sites (Mojosemi, Tirtogumarang and Cemorosewu) and then divided into ten plots (and treated as replicates) of 10x10 m^2 (Annaselvam and Parthasarathy 2001; Focho et al. 2010). At each plot, species name and number of individual of epiphytic orchids, and species name, number of individual and diameter at breast height (dbh) of host trees were recorded. All living collections were then collected at Purwodadi Botanic Garden for identification.

All data recorded were calculated for average number of orchid species and individuals, and average number of host tree species, individual and basal area. These parameters were then analyzed using one-way Analysis of Variance (ANOVA) to test the difference among three gradients of altitudes. The ANOVA test was performed using PopTools version 3.0.6 (Hood 2008) and alpha was set at 0.05.

RESULTS AND DISCUSSION

Epiphytic orchid

The result showed that the highest number of species of epiphytic orchid was recorded at Tirtogumarang (1922 m asl) with average 6.6 $\pm$ 3.57 species/plot, followed by Mojosemi (1796 m asl) and Cemorosewu (2041 m asl) with average 4.7$\pm$3.27 and 3$\pm$1.7 species/plot respectively (Figure 2A). The ANOVA test showed that there was significant difference among three gradient of altitudes in term of species number of epiphytic orchid (F = 3.7; df = (2, 27); P < 0.05). The result of this test suggested that elevation is an important factor that influences species richness of epiphytic orchid.

The composition of orchid species changes incessantly with increasing elevation. The result of this study is in accordance with Van Steenis (1972) that the variation of epiphytic orchid will decreased up to elevation above 2000 m asl. In addition, Jacquemyn et al. (2005) stated that elevation also influenced species evenness in negative relation (species evenness decreased significantly with increasing altitude). In sub-montane forest in Mount Lawu, the altitude of 2000's m asl. seems as a critical point in term of relation between species richness of epiphytic orchid and elevation as noted in this study. However,

another study stated that the tropical orchids largely distributed below 1600 m asl. and reach maximum richness on the altitudes between 400 and 800 m asl. (Jacquemyn et al. 2005). Another factor affecting orchid diversity is human disturbance. At low elevation with high level of human disturbances, the species richness of orchid is likely lower than species richness at higher altitude since most human activities are concentrated at low elevation (Tian et al. 2008).

The composition of orchid species is influenced by neighboring elevation belts that similarity index tends to be higher between sites with closer distant and more similar altitude. In this study, total species of epiphytic orchid at three gradients of altitudes was 19 species (Table 1).

Table 1. The composition of epiphytic orchid recorded at three gradients of altitudes in southern part of Mount Lawu (Mojosemi = 1796 m asl, Tirtogumarang = 1922 m asl. and Cemorosewu = 2041 m asl)

Species name	Altitude (m asl)		
	1796	1922	2041
Bulbophyllum angustifolium	+	+	+
Bulbophyllum mutabile	-	+	-
Bulbophyllum sp.1	+	-	-
Bulbophyllum flavidiflorum	-	+	+
Bulbophyllum ovalifolium	+	-	-
Bulbophyllum sp.2	-	+	-
Coelogyne miniata	+	+	+
Dendrochilum longifolium	-	+	-
Dendrochilum sp.1	+	-	-
Dendrochilum sp.2	+	-	+
Eria multiflora	+	+	+
Eria moluccana	-	+	+
Eria lamonganensis	-	-	+
Flickingeria luxurians	+	-	-
Liparis pallida	+	-	-
Pholidota globosa	-	+	+
Pholidota ventricosa	+	-	+
Luisia zollingeri	-	-	+
Tuberolabium odoratissimum	-	+	-

Note: + = found;-= not found; all habitus: epiphytic; Distribution status: widespread

Orchid species recorded on the study sites are typical orchid for elevation 500-2000 m asl. (Mahyar and Sadili 2003; Puspitaningtyas et al, 2003) and known as euryecious orchids (kind of orchid that is usually adaptable to various types of environment and has wide-ranging geographic distribution). There were three species orchid that recorded at three study sites, which are *Bulbophyllum angustifolium*, *Coelogyne miniata* and *Eria multiflora*.

The highest number of individual was noted at Mojosemi (1796 m asl) with average 1337.7±1626.20 individuals/plot, followed by Cemorosewu (2041 m asl) and Tirtogumarang (1922 m asl) with average 1278.1±1296.87 and 536.1±465.82 respectively (Figure 2B). The high value of standard deviation indicates that there is high variation of orchid abundances at the study sites. The one-way ANOVA test resulted that there is no significant difference on orchid abundance among three gradient of altitudes (F = 2.97; df = (2, 27); P-value >0.05). This means that altitude ranging from 1800's to 2000's is not a key factor on the abundance of epiphytic orchids in Mount Lawu.

The high abundances of epiphytic orchid at Mojosemi are due to environmental condition that favorable for specific orchid to grow. Orchid grow is mainly influenced the micro site condition such as light, temperature, wind speed and water availability (Parnata 2005). Beside those factors, the establishment of epiphytic orchid also depends on altitude, the existence of lower plants that ease orchid seeds to trap and aerial fallouts, providing suitable micro sites for growth (Focho et al. 2010).

Host tree

In this study, total species of host tree at three gradients of altitudes is 11 species (Table 2). The highest number of species of host tree was recorded at Tirtogumarang (1922 m asl) with average 2.3±1.5 species/plot, followed by Mojosemi (2041 m asl) and Cemorosewu (1796 m asl) with average 2.8±1.93 and 1.3±0.95 species/plot respectively (Figure 2C). The similar pattern also showed in the result of individual number of host tree that Tirtogumarang has the highest densities with average 2.8±1.93 individuals/plot, followed by Mojosemi with 3.5±2.8 individuals/plot and Cemorosewu with 1.3±0.95

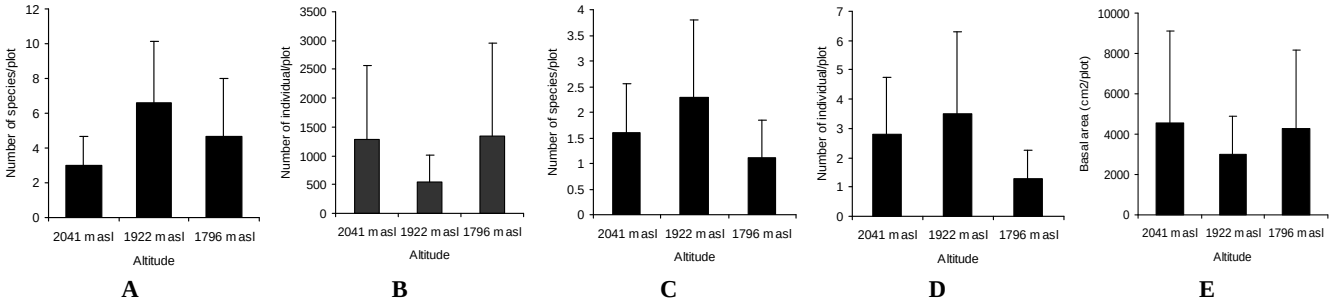

Figure 2. Average number of species of epiphytic orchid (A); Average number of individual of epiphytic orchid (B); Average number of species of host tree (C); Average number of individual of host tree (D); Average basal area of host tree (E). Three gradients of altitudes are Cemorosewu (2041 m asl), Tirtogumarang (1922 m asl) and Mojosemi (1796 m asl). Stacked bars indicate standard deviation.

individuals/plot (Figure 2D). These results suggest that either species richness or abundance of host trees in the study sites is relatively low. One-way ANOVA test resulted that gradient of altitudes ranging between 1800's and 2000's m asl. did not influence significantly either on species number of host tree (F= 2.94; df = (2, 27); *P*-value > 0.05) or its individual number (F= 3.04; df = (2, 27); *P*-value > 0.05)

Table 2. The composition of host tree recorded at three gradients of altitudes in southern part of Mount Lawu (Mojosemi = 1796 m asl, Tirtogumarang = 1922 m asl. and Cemorosewu = 2041 m asl)

Species name	Altitude (m asl)		
	1796	1922	2041
Acmena acuminatissimum	+	+	-
Acer laurinum	-	+	+
Astronia spectabilis	+	+	-
Canthium glabrum	-	+	-
Castanopsis javanica	+	+	-
Glochidion littorale	+	-	-
Lithocarpus sundaicus	+	+	+
Lupinus sp.	-	+	-
Macropanax concinnus	+	+	+
Schima wallichii	-	-	+
Tree stump	-	-	+

Note: + = found;-= not found

All three study sites are located in buffer zone of forest area in Mount Lawu. The most dominant host tree at three sites is pasang (*Lithocarpus sundaicus*). The high abundances of host trees at Tirtogumarang is probably due to the succession process at this site has not reach the climax level yet which is indicated by lowest basal area 2975.23±1931.43 cm^2/plot, compared to Cemorosewu 4558.01±4525.40 cm^2/plot and Mojosemi 4295.73± 3875.18 cm^2/plot (Figure 2E). The result of one-way ANOVA showed that basal area of host tree was not significantly different among three gradient of altitudes (*F* = 0.55; df = (2, 27); *P*-value > 0.05).

Local micro site factors, such as soil, as well as macro environmental factors, such as precipitation and elevation are the key variables that influence tree species distribution in the Albertine rift forests (Eilu et al. 2004).

CONCLUSION

In sum, our study suggests that elevation ranging between 1796 m asl. and 2041 m asl. is an influence factor on epiphytic orchid species richness but not on their abundance. The number of host tree species and their abundance are not influenced by the altitude on this range. Our result showed that there was 19 epiphytic orchid species at three gradients of altitudes in southern part of Mount Lawu. The number of species is significantly lower at higher altitude. The highest number of epiphytic orchid species (6.6 species/100 m^2) was recorded at site with altitude 1922 m asl, while the highest number of individual (1337.7 individual/100 m^2) was noted at site with altitude 1796 m asl. Altitude of 1922 m asl. was noted as the site with the highest number of species and individual of host trees (2.3 species/100 m^2 and 3.5 individuals/100 m^2 respectively). However, the highest basal area of host tree was recorded at the altitude of 2041 m asl. (4558 cm^2/100 m^2).

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