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Epiphytic orchids and host trees diversity at Gunung Manyutan Forest Reserve, Wilis Mountain, Ponorogo, East Java

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ABSTRACT

Yulia ND, Budiharta S (2011) Epiphytic orchids and host trees diversity at Gunung Manyutan Forest Reserve, Wilis Mountain, Ponorogo, East Java. Biodiversitas 12: 22-27. Natural forests in Wilis Mountain have been destroyed by forest fires, landslides and illegal logging. As a consequence, biological diversity in this area is threatened by local extinctions, particularly of orchid species. This study was aimed to explore, document and analyze the diversity of epiphytic orchids at Gunung Manyutan Forest Reserve, a natural forest area in Wilis Mountain. Purposive sampling on 1 hectare (50 x 200 m^2) contiguous plot was used. This plot was divided into eight subplots (25 x 50 m^2). All data on orchid species were recorded including its number, host trees and zone of the host tree where the orchid attached. The results showed that there were 29 epiphytic orchid species recorded. *Flickingeria angulata* was the most abundant species (Relative Abundance of orchids/ %Fo = 38.74), continued by *Appendicula* sp. (%Fo = 10.91) and *Eria hyacinthoides* (%Fo = 6.57). The three most important host trees were *Pinus merkusii, Schima wallichii* and *Engelhardia spicata*. Zone 3 (bottom part of the branches) was revealed as the most favorable part at the host tree (281 individuals), while Zone 1 (bottom part of the main stem) was the least preferable one.

Key words: diversity, epiphytic orchid, *Flickingeria angulata*, host tree, Wilis Mountain.

INTRODUCTION

The orchid arguably gets more attention than any other kind of plant because of its unique shape and variety of colors of its flowers. According to Puspitaningtyas (2005), even though orchids are not heavily used for basic human needs they are commonly cultivated as ornamental plants, thus awareness arises about their extinction due to the accelerating rate of destruction as their natural forest habitats. Epiphytic vascular plants, including epiphytic orchids, are major components in tropical wet forests in terms of diversity and biomass (Gravendeel et al. 2004; Cardelus and Mack 2010).

One of orchids' natural habitats in Java which has not been explored so far is Gunung Manyutan Forest Reserve in Wilis Mountain. Previous study revealed that the diversity of medicinal plants in Wilis Mountain was very high, totaling 61 species in the eastern part of Wilis slope at Purut, Parang Village, District of Kediri (Tyas et al. 1999). However, there is no accurate information on orchid diversity of the area. Nowadays, the natural forest in Wilis Mountain is destroyed by various causes including forest fires, landslides and illegal logging. Inevitably, these processes have threatened biological diversity of the area, and particularly orchid species, which are further threatened by illegal harvesting (Perhutani's forest rangers, pers. comm.). This local decline in orchid diversity and abundance in Wilis is being repeated in many protected areas throughout Java (Puspitaningtyas 2005, 2007). Therefore, data and information gathering on the occurrence of orchids in their natural habitats is urgently required in order to develop potential conservation strategies. This effort is important considering the fact that in Java, large expanses of natural forest have been converted into human settlements, agricultural lands and plantations, which can lead to local population extinction of orchids. The impacts of such land conversion will be exaggerated if extinction occurs before species can be described and documented. Comber (1990) mentioned that there are 731 orchid species recorded in Java; with 390 among them are recorded in East Java.

This study aims at documenting and analyzing the diversity and abundance of epiphytic orchids at Gunung Manyutan Forest Reserve. This was achieved by conducting a fieldwork in order to record all data on orchid in the area. Orchids diversity and abundances were calculated in order to reveal the most important orchid species. Local forest rangers reported that the studied area is rich in epiphytic orchids species particularly from the genus *Vanda* (Perhutani's forest rangers, pers. comm.). This was used as baseline information in conducting this research.

MATERIALS AND METHODS

Study site

This study was conducted from 26 April to 3 May 2010 at Gunung Manyutan Forest Reserve, Wilis Mountain

(7º46.751' S; 111º39.637' E) (Figure 1). This area is administratively located at Pupus Village, Sub-district of Ngebel, District of Ponorogo, East Java and managed by *Kesatuan Pemangkuan Hutan* (Sub-forest District) Wilis Barat under Perum Perhutani (State Owned Forest Company).

Sampling

We used purposive sampling at site with the richest orchid's diversity based on information from forest rangers. At this site, which was located in the forest interior, we established a 50 x 200 m^2 (1 ha) plot. Within this plot we created eight subplots (25 x 50 m^2) contiguously (Muñoz et al. 2003). All epiphytic orchid species attached to trees within the subplots were recorded. Various data were also collected including the species name of host tree and the zone on the tree where the orchid attached. Epiphyte position on the host tree was divided into five zones based on Dressler (1990), which are: (i) Zone 1: the bottom part (1/3) of the main stem; (ii) Zone 2: the upper part (2/3) of the main stem; (iii) Zone 3: the bottom part of the branches; (iv) Zone 4: the middle part of the branches; and (v) Zone 5: the outer part of the branches. Environmental data were also recorded including temperature, humidity and elevation.

Data analysis

All data were recorded in a spreadsheet, and the following parameters were calculated: Nt is the number of trees in the plot hosting a particular orchid species; No is the number of individuals of a particular orchid species within the plot. Based on these two parameters, Relative Frequency of host tree (%Ft) and Relative Abundance of orchid (%Fo) were computed as below:

$$\%Ft = \frac{Nt}{Total\ \ number\ of\ \ all\ host\ trees} \times 100$$

$$\%Fo = \frac{No}{Total\ number\ of\ \ all\ orchids} \times 100$$

Orchids were identified to species level if possible, and the genus level otherwise using the books by Comber (1990, 2001) as references.

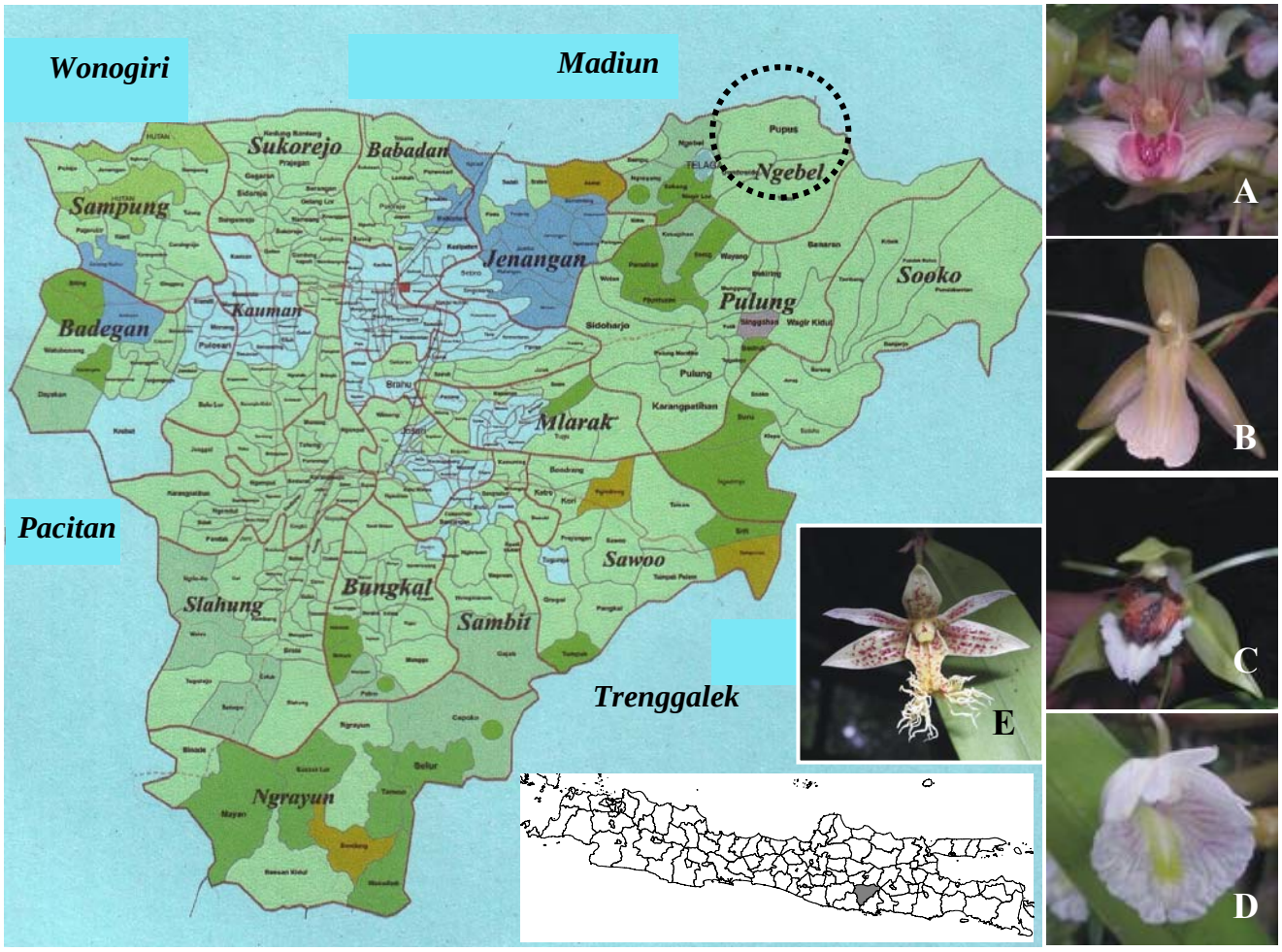

Figure 1. Location of study site at Gunung Manyutan Forest Reserve, in Wilis Mountain (dashed circle), and some of orchid species at this area: (A) *Eria flavescens*, (B) *Coelogyne longifolia*, (C) *Coelogyne speciosa*, (D) *Dendrobium linearifolium* and *Flickingeria angulata.*

RESULTS AND DISCUSSION

The results showed that of eight subplots of 25 x 50 m^2 at Gunung Manyutan Forest Reserve, there were 29 epiphytic orchid species belonging to 14 genera recorded. The most abundant species in the area were *Flickingeria angulata* (RA = 38.74%), *Appendicula* sp. (RA = 10.91%) and *Eria hyacinthoides* (RA = 6.57%) (Table 1). These three are very abundant in Java and found mostly at elevations between 500 and 1500 m asl.

Table 1. List of epiphytic orchid species at the study site and the value of parameters (Nt is the number of trees in the plot hosting a particular orchid species; No is the number of individuals of a particular orchid species within the plot; %Ft is Relative Frequency of host tree; %Fo is Relative Abundance of orchid)

Orchid species	Nt	No	%Ft	%Fo
Agrostophyllum majus	1	1	0.53	0.14
Agrostophyllum sp.	1	1	0.53	0.14
Appendicula sp.	20	78	10.53	10.91
Bulbophyllum sp.	9	30	4.74	4.20
Bulbophyllum sp.3	3	21	1.58	2.94
Bulbophyllum sp.4	3	16	1.58	2.24
Coelogyne longifolia	2	2	1.05	0.28
Coelogyne speciosa	1	2	0.53	0.28
Dendrobium linearifolium	1	1	0.53	0.14
Dendrobium sp.	3	10	1.58	1.40
Dendrochilum sp.	5	8	2.63	1.12
Eria flavescens	5	13	2.63	1.82
Eria hyacinthoides	9	47	4.74	6.57
Eria javanica	3	5	1.58	0.70
Eria moluccana	6	9	3.16	1.26
Eria monostachya	12	37	6.32	5.17
Eria oblitterata	1	1	0.53	0.14
Eria sp.	13	37	6.84	5.17
Flickingeria angulata	46	277	24.21	38.74
Flickingeria sp.	3	19	1.58	2.66
Liparis condylobulbon	5	9	2.63	1.26
Liparis sp.	2	7	1.05	0.98
Luisia zollingeri	4	7	2.11	0.98
Trichoglottis sp.	1	2	0.53	0.28
Thrixspermum sp.	10	21	5.26	2.94
Thrixspermum subulatum	3	13	1.58	1.82
Trichotosia angulata	1	1	0.53	0.14
Vanda limbata	1	1	0.53	0.14
Vanda tricolor	16	39	8.42	5.45
	190	715	100	100

The dominance of *F. angulata* over other epiphytic orchids is also recorded at Penanggungan Mountain in East Java (Yulia and Yanti 2010). Lugrayasa et al. (2004) noted that *F. angulata* is at most abundant on the slope of mountains with altitude of ca. 500 m asl. and humidity 89-92%. All orchid species recorded at the study site (Table 1) are known as euryecious orchids (kind of orchid that is usually adaptable to various types of environment and has wide-ranging geographic distribution), and therefore not classified as endemics. Puspitaningtyas et al. (2003) mentioned that in general, orchid diversity is highest at altitudes 500 and 1500 m asl. and tends to decrease out of this range. The high level of *Eria* diversity is presumably related to relatively low temperature (28^o-30^o C during the day) and middle range humidity (60-80%). Most *Eria* species were recorded at altitudes between 500 and 2500 m asl (Mahyar and Sadili 2003).

Preliminary communication indicated that *Vanda tricolor* was abundant at Gunung Manyutan Forest Reserve (Perhutani's forest rangers, pers. comm.). However, we only find *V. tricolor* at four plots with a total of 39 individuals, much fewer than *F. angulata* (277 individuals). The low abundance of *V. tricolor* is presumably caused either by illegal exploitation by outsiders or gathering by local communities to be planted at their home gardens. The survival of epiphytic orchids depends on its host trees. In this study, 13 species of host trees were recorded, with 91 individuals (Table 2). The most important host trees were *Pinus merkusii* (24 individuals), *Schima wallichii* and *Engelhardia spicata* (19 individuals each).

Table 2. Environmental conditions at Gunung Manyutan Forest Reserve

Environmental data	Value
Air temperature (during day)	28^o-30^o C
Relative humidity	60-80%
Elevation	1300-1413 m asl

All host trees recorded are mountain specialist species and characterized by rough bark that made them favorable by orchids for root attachment. This fact is in line with Flores-Palacios and Ortiz-Pulido (2005) that epiphytic orchids are likely to attach to host trees with rough bark rather than smooth one. In addition, the typical peeling bark with cracked and soft texture apparently catches more water and nutrients than the smooth bark. Therefore, orchid seeds lodged in the crevices of bark more readily grow because of the available substrate necessary for the growth of seeds. However, the result of Bergstrom and Carter (2008) suggests that the structure of the bark is not the most important factor to the occurrence of epiphytic orchid since they found a host tree with smooth and relatively thin bark that preferred by a particular orchid. Also, due to the canopy structure of the host trees, which is not too dense, sunlight is allowed to penetrate to the part the tree where orchids grow. According to Seitske et al. (2001), epiphytic orchids in Indonesia are rarely found on trees with dense canopy since sunlight is hindered to go through.

Epiphytic orchids are not positioned randomly on all parts of the host. Dressler (1990) divides the part of host tree where the epiphytic orchid grows into five zones. The occurrence of orchids at each zone depends on its requirements for light and nutrients. Naturally, most orchids tend to grow at the particular part of the host tree that optimizes their resource acquisition. This study

showed that epiphytic orchids were found mostly at Zone 3 (281 individuals), followed by Zone 4 (201 individuals) (Figure 2). In contrast, Zone 1 and Zone 5 were disfavored by orchids, in that only 17 and 52 individuals were attached at these zones, respectively (Table 3).

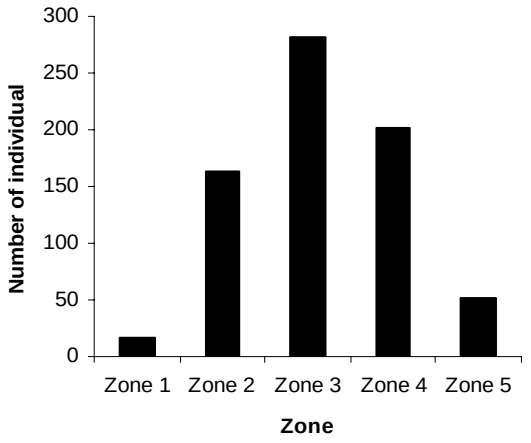

Figure 2. Number of epiphytic orchids at each zone of host tree (Zone 1: the bottom part (1/3) of the main stem; Zone 2: the upper part (2/3) of the main stem; Zone 3: the bottom part of the branches; Zone 4: the middle part of the branches; Zone 5: the outer part of the branches)

There are some environmental factors important for orchids to grow, such as light, temperature, wind speed and water availability (Parnata 2005). The distributional patterns of epiphytic orchids on the stems and branches of host trees are influenced by the needs of sunlight and humidity that make epiphytic orchids favor specific zones (Yulia and Yanti 2010). In addition, O'Malley (2009) stated that branch height and position on host tree highly correlate with substrate availability. In this study, Zone 3, which is located at the bottom part of the branches, is the most favorable zone for epiphytic orchids to grow. This is presumably in relation with the structure of Zone 3, which allows seeds to be trapped easily and then nourished with light, water and nutrients. In contrast, there were small numbers of orchids recorded at Zone 1. The rationale is that at this zone, light intensity is very low. Puspitaningtyas and Fatimah (1999) mentioned that orchids grew at Zone 3, Zone 4 and Zone 5 are those that favor plenty of sunlight. However, the individual state of the host tree also influences the occurrence of epiphytic orchids in terms of creating appropriate conditions such as light intensity, aeration and humidity (Zotz and Hietz 2001).

Table 3 suggests that epiphytic orchid at Gunung Manyutan Forest Reserve may attach to more than one host tree, implying either orchid or host tree listed in Table 4 above are generalist species. A study on specific associations between host trees and epiphytic orchids in Meru Betiri National Park (Puspitaningtyas 2007) also stated a similar conclusion with our study. A study on the relationship between epiphytic orchids and host trees in sub-tropical forest in Taiwan also showed that generalist orchid species tend to grow on various host tree with no specific association with a particular tree species (Martin et al. 2007). Also in Panamanian lowland forest, the relationship between host tree and epiphytic vascular plants is random without any host specificity (Laube and Zotz 2006). However, the occurrence of some particular epiphytic orchids is highly associated with the occurrence of particular host tree, showing strong preferences of an orchid to a host tree species such as *Epidendrum magnoliae* with *Quercus virginiana* (Bergstrom and Carter 2008), and *Dendrobium capra* with *Tectona grandis* (Yulia and Ruseani 2008).

Table 3. List of host tree species recorded and numbers of individuals at each plot

Species of host tree	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	Total number of individual
Lithocarpus sp.	2		3						5
Schima wallichii	3	13	1	2					19
Pinus merkusii		4	4	7	1	8			24
Engelhardia spicata		1			2	2	8	6	19
Callophyllum sp.	1								1
Lithocarpus teysmannii					4	1	1	1	7
Lithocarpus sundaicus					1		4	3	8
Proteacea							3		3
Nauclea sp.							1		1
Eudia sp.							1		1
Litsea sp.								1	1
Bridelia sp.								1	1
Tree stump							1		1
Sum	6	18	8	9	8	11	19	12	91

CONCLUSION

Epiphytic orchid diversity and abundance at Gunung Manyutan Forest Reserve in Wilis Mountain is relatively high. Within one hectare contiguous area, there were 29 epiphytic orchid species (totally 715 individuals) recorded. The most abundant orchid species were *Flickingeria angulata*, followed by *Appendicula* sp. and *Eria hyacinthoides*. In addition, there were 13 host tree species recorded, with three most important host species being *Pinus merkusii*, *Schima wallichii* and *Engelhardia spicata*. Zone 3 (bottom part of the branches) was noted as the most preferred zone on host trees to be attached by epiphytic orchid species, while Zone 1 (bottom part of the main stem) was the least preferred.

Table 4. Recapitulation of orchid species at each zone of host tree

Species of orchid	Species of host tree	F host tree	Number of orchids at each zone					Total number
			1	2	3	4	5	
Flickingeria angulata	*Lithocarpus* sp.	5		13	19	27		59
	Schima wallichii	12		14	33	15		62
	Pinus merkusii	20		57	40	5		102
	Lithocarpus teysmannii	4		8	22	8		38
	Lithocarpus sundaicus	4		1	7	7		15
	Engelhardia spicata	1			1			1
Vanda tricolor	*Lithocarpus* sp.	1			2			2
	Engelhardia spicata	10	1	3	6	9	5	24
	Lithocarpus sundaicus	3	3	2		6	1	12
	Proteaceae	1						0
	Bridelia sp.	1		1				1
Eria mononstacya	*Lithocarpus* sp.	3			4			4
	Schima wallichii	2		5	3			8
	Pinus merkusii	2		1	3			4
	Lithocarpus teysmannii	2				6		6
	Engelhardia spicata	2		1	6	5		12
	Lithocarpus sundaicus	1				3		3
Eria moluccana	*Lithocarpus* sp.	1			1			1
	Lithocarpus teysmannii	1		1				1
	Schima wallichii	1			1			1
	Pinus merkusii	2			2			2
	Lithocarpus sundaicus	1			4			4
Eria sp.	*Lithocarpus* sp.	1			1			1
	Schima wallichii	1				4		4
	Lithocarpus teysmannii	3			1	7		8
	Nauclea sp.	1			2			2
	Lithocarpus sundaicus	3		1		4		5
	Engelhardia spicata	4	9	3	5			17
Eria javanica	*Lithocarpus* sp.	1				3		3
	Lithocarpus teysmannii	1				1		1
	Lithocarpus sundaicus	1				1		1
Thrixspermum sp.	*Lithocarpus* sp.	1		2				2
	Schima wallichii	6		6	6	3		15
	Engelhardia spicata	2			1	2		3
	Calophyllum sp.	1			1			1
Thrixspermum subulatum	*Calophyllum* sp.	1				2		2
	Schima wallichii	1		9				9
	Engelhardia spicata	1				2		2
Coelogyne speciosa	*Lithocarpus* sp.	1		2				2
Appendicula sp.	*Schima wallichii*	3			4	3		7
	Engelhardia spicata	11		1	27	11	13	52
	Lithocarpus teysmannii	1			1			1
	Lithocarpus sundaicus	2			6	7		13
	Eudia sp.	1			2			2
	Litsea sp.	1					1	1
	Bridelia sp.	1		2				2
Agrostophyllum majus	*Pinus merkusii*	1		1				1
Bulbophyllum sp.	*Lithocarpus teysmannii*	3		5	9	4		18
	Lithocarpus sundaicus	3			2	6		8
	Engelhardia spicata	2			1		1	2
	Eudia sp.	1			2			2
Dendrobium sp.	*Lithocarpus teysmannii*	1			1			1
	Lithocarpus sundaicus	2			5	3	1	9
Dendrochilum sp.	*Lithocarpus sundaicus*	3			2	3		5
	Pinus merkusii	2			3			3
Flickingeria sp.	*Lithocarpus teysmannii*	1		4				4
	Lithocarpus sundaicus	2				15		15
Luisia zollingeri	*Lithocarpus sundaicus*	1				1		1
	Engelhardia spicata	3		1		1	4	6
Vanda limbata	Tree stump	1		1				1
Bulbophyllum sp.4	Proteaceae	1				10		10
	Lithocarpus sundaicus	2		3	3			6
Eria flavescens	Proteaceae	1				1		1
	Lithocarpus sundaicus	1		2				2
	Engelhardia spicata	3		1	5		4	10
Eria hyacinthoides	*Lithocarpus sundaicus*	4		5	7	8	3	23
	Engelhardia spicata	4		3	4		15	22
	Lithocarpus teysmannii	1			2			2
Bulbophyllum sp.3	*Lithocarpus sundaicus*	2			10			10
	Engelhardia spicata	1			10		1	11
Eria oblitterata	*Lithocarpus sundaicus*	1				1		1
Liparis condylobulbon	*Lithocarpus sundaicus*	2		1	2			3
	Engelhardia spicata	2		1		1	1	3
	Lithocarpus teysmannii	1				3		3
Liparis sp.	*Lithocarpus sundaicus*	1	3	2				5
	Lithocarpus teysmannii	1				2		2
Agrostophyllum sp.	*Engelhardia spicata*	1			1			1
Coelogyne longifolia	*Lithocarpus sundaicus*	1			1			1
	Bridelia sp.	1		1				1
Trichoglottis sp.	*Engelhardia spicata*	1					2	2
Trichotosia annulata	*Engelhardia spicata*	1	1					1
Dendrobium linearifolium	*Engelhardia spicata*	1				1		1
Sum of individual			17	164	281	201	52	715

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