

THE DISTRIBUTION OF *MACARANGA*, GENUS (FAMILY EUPHORBIACEAE) IN PENANG ISLAND, PENINSULAR MALAYSIA

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Abstrak: Sejumlah lapan spesies *Macaranga* telah dikenal pasti dalam kajian yang dilakukan dari bulan Mac sehingga Disember 2005. Spesies yang paling biasa direkod adalah *Macaranga tanarius*, ditemui di semua habitat terganggu kecuali di dalam hutan primer. Tidak seperti *M. tanarius*, spesies kedua tersebar luas, iaitu *M. javanica* juga dapat ditemui di semua jenis habitat, kecuali di kawasan yang berpenduduk padat. Taburan enam spesies lain tidak menunjukkan pola yang jelas. Pembukaan hutan adalah faktor utama yang dijangkakan merangsang pertumbuhan populasi *M. tanarius* dan *M. javanica*, maka tidak hairanlah ia tersebar dengan luas dan berjaya di kebanyakan kawasan kajian berbanding spesies lain.

Kata kunci: *Macaranga tanarius*, *M. javanica*, Taburan, Kawasan Terganggu

Abstract: A total of eight species of *Macaranga* are identified in this study, which were carried out from March to December 2005 in Penang Island. The most common species recorded is *Macaranga tanarius* which is found in almost every disturbed habitats, except for primary forested area. Unlike *M. tanarius*, *M. javanica* (the second most common species) are also well distributed except in highly populated human inhabitation areas. The other six species are scattered without any clear distributing pattern. Land clearings by human activities are likely the main cause that triggers the spread of *M. tanarius* and *M. javanica* populations, thus the species are widely distributed and thrive well in these study areas.

Keywords: *Macaranga tanarius*, *M. javanica*, Distribution, Disturbed Area

INTRODUCTION

Macaranga (mahang) is a genus which is widely distributed in Malaysia. The populations are generally found in village-thickets, wastelands, at the edge of forest reserves or in swampy forests (Corner 1988). In Malaysia alone, there are 27 species of *Macaranga* (Whitmore 1967) from the total of 280 species worldwide. Not many study conducted on the genus except a few intensive studies conducted in Sabah and Sarawak by Jumaat (1981), Davies *et al.* (1998) and Slik *et al.* (2003). In Peninsular Malaysia, especially Penang Island, there is no specific publication on *Macaranga*. However, there are a few brief reports

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regarding the *Macaranga* genus in Penang, one of them being reported by Turner (1989) on the presence of *Macaranga lowii*.

Generally, *Macaranga* genus is fast growing, soft-wooded, evergreen trees reaching a height of 20 m. Some of the *Macaranga* species are associated with ants for producing nutrients and nesting spaces in exchange for herbivore protections (Feldhaar et al. 2000). A few species are used as indicator species for the degree of disturbances to a forested area (Slik et al. 2003), while other species are used as framework tree species (Elliott et al. 2003) as these genus is among the first to colonize a newly opened area. It is interesting to note that the distribution of each different population of *Macaranga* species differs from one to another, based on the condition of their habitats.

The main objective of this study was to evaluate the distribution pattern of *Macaranga* species in Penang Island as some of the species is invasive and caused a serious problem to agriculture and plantation sector, because most of the species will compete for light and space. This study was also useful to detect the main and rare species of *Macaranga* in Penang and if suitable, the identified species can be considered as indicator species for a disturbed area. In addition, this paper also served as preliminary list of the *Macaranga* species on the island of Penang which can be considered as one of the most highly developed islands in Malaysia.

MATERIALS AND METHODS

Sixteen study sites which represent available land (Table 1) uses in Penang are selected (Fig. 1). By surveying all available land uses, all species of *Macaranga* will be recorded. The sites location were mapped using Garmin GPS model 0.75 and later transferred onto a digital land used map. The surveys were carried out from January to December, 2005. A line transect measuring 1000 m each, were set up using the main road as the reference line. All *Macaranga* species above one meter high, found along the transect line were recorded and identified *in situ*. Unknown specimens were taken to the herbarium of the School of Biological Sciences, Universiti Sains Malaysia for further identification. Humidity and mean temperature readings were taken using the Whirling Hygrometer. Light readings were recorded using the Light Meter ISO-Tech ILM 350. Soil samples were also collected, dried, grinded and finally analyzed for soil texture based on FAO soil classification chart (FAO 1977). All data collected were analyzed using Multivariate Statistical Package Version 3.13 (MVSP) (2002).

A cluster analysis was performed using the MVSP software on the *Macaranga* genus data collected. A cluster analysis is a unique analysis of similarity/dissimilarity of certain places analysis with the main purpose is to determine or define the underlying structure in a data matrix. This type of analysis can indicate whether the plots share any similarities, ranging from the type of species and number of *Macaranga* species present. Jaccard's coefficient is used

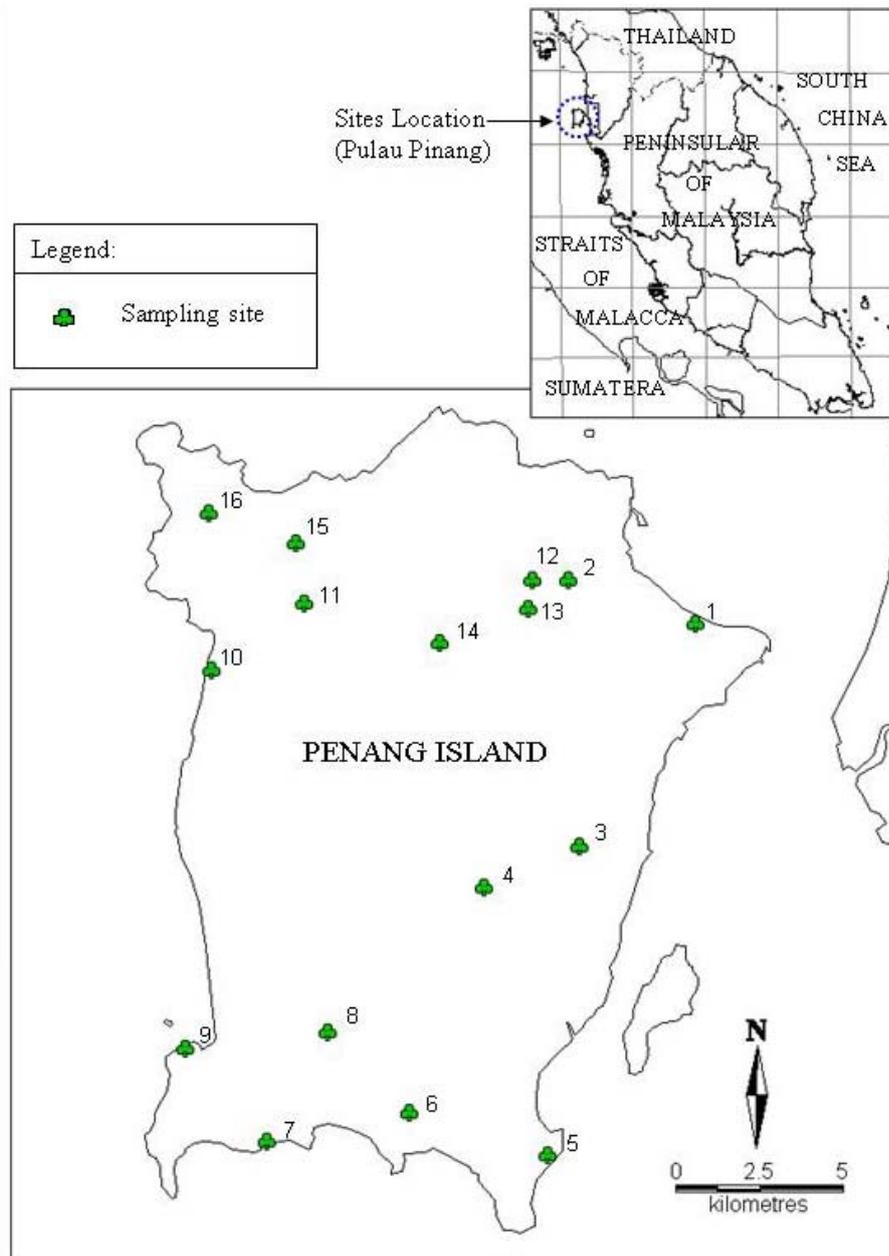


Figure 1: Map showing the location of sampling sites in Penang Island.

as a referral index for the analysis and using the UPGMA variant (Unweighted Pair Group Average, because the data is expected to have some cluster effects that are much smaller than others). Cluster analysis is a term used to describe a set of numerical techniques in which the main purpose is to divide the objects of study into discrete groups. The primary objective is to address the interrelationships (correlations) among a number of variables by defining a common underlying dimensions or factors (Hair *et al.* 1998). These groups are based on the characteristics of the objects and it is hoped that, the clusters will have some significant outline related to the research questions being asked. Two most useful features that can be achieved through this analysis are data summarization and data reduction on the *Macaranga* population. From the cluster generated we hope to identify how the *Macaranga* genus distributed in Penang and finally identified the preferred land type.

RESULTS AND DISCUSSION

Eight species of *Macaranga* are found in Penang Island (Table 1). From these eight species only two are inhabited by ants, namely the *M. triloba* and *M. hypoleuca*. The most dominant species is *M. tanarius* where its distributions concentrated in highly developed areas. This species distribution is more common in disturbed vegetation sites rather than natural forest as on site 3 to 11 (Table 1).

The finding suggests that as a small island in the northern part of Peninsular Malaysia, the species count is rather high, compared to 27 species for the whole of Peninsular (Corner 1988). In contrast only 11 species were recorded in Borneo by Davies *et al.* (1998). All species found in Penang match the species recorded by Corner (1988). However, the species were quite different compared to the species from Borneo. In Penang, the highest individual count is *M. tanarius*, which were not recorded from Borneo (Davies *et al.* 1998). Species found in both Peninsular and Sabah and Sarawak are *M. gigantea*, *M. hosei* and *M. hypoleuca*. As comparison, in India Whitmore (1978) reported of 13 *Macaranga* species and only two (*M. tanarius* and *M. denticulate*) can be found in Penang. This finding suggests that the *Macaranga* does not show a similar distribution pattern. Further studies are needed to identify specific factors that contributed to their distribution. This finding also showed that even though the *Macaranga* populations are widely distributed, their species composition differ from place to place with some degree of similarity.

The species compositions based on sites are shown in Figure 2 where two clear clusters were established. Cluster No. 1 comprises of sites related to the natural forest, whereby Cluster No. 2 belongs to disturbed areas. The physical parameter taken showed no significant differences between the sites, concurring to the normal climate and physical condition of Peninsular Malaysia (Table 2). Any differences if detected were not contributed by this factor. From the study, the forest related study site (Fig. 1, Table 1) contained a higher number of *Macaranga* species but the total count showed otherwise. Disturbed area was

Table 1: *Macaranga* species found in Penang Island.

Site No.	Site description	<i>M. tanarius</i>	<i>M. javanica</i>	<i>M. lowii</i>	<i>M. denticulata</i>	<i>M. triloba</i>	<i>M. gigantea</i>	<i>M. hypoleuca</i>	<i>M. amissa</i>
1	George Town (Urban area)	14	0	0	0	0	0	0	0
2	Botanical Garden (Outside border)	1	2	0	0	0	9	0	0
3	Bukit Gambier (Universiti Sains Malaysia)	35	0	0	0	0	0	0	0
4	Relau Hill (Secondary forest, bushes)	15	17	0	0	0	2	0	0
5	Teluk Tempoyak (Secondary forest)	43	2	0	0	0	0	0	0
6	Bayan Lepas (Rural area)	19	3	0	0	0	0	0	0
7	Tanjung Asam (Bushes)	37	6	0	0	0	0	0	0
8	Balik Pulau (Secondary forest)	40	18	0	0	0	0	0	0
9	Pulau Betong (Secondary forest)	56	35	0	0	0	1	0	0
10	Pantai Aceh (Rural area)	39	14	0	0	0	1	0	0
11	Road Side (Pantai Aceh to Teluk Bahang)	27	11	0	0	12	2	1	0
12	Penang Hill 1 (Forest Reserve, BKFR)*	1	26	0	0	0	8	2	0
13	Penang Hill 2 (Forest Reserve, BKFR)*	0	18	0	0	23	14	3	0
14	Penang Hill 3 (Recreational area)	3	8	0	0	22	16	12	2
15	Teluk Bahang Forest Reserve (Jungle trail)	0	1	0	0	2	3	0	0
16	Pantai Aceh Forest Reserve (Jungle trail)	1	9	3	11	5	7	6	0
Total		331	170	3	11	64	63	24	2

Notes: All species found are not planted and considered as weed species with no commercial values.

* BKFR = Bukit Kerajaan Forest Reserve at road side

dominated mostly by *M. tanarius* which is one of the first pioneer woody species to grow in a newly disturbed areas. Evidently, this species could be used as indicator species for disturbed area because *M. tanarius* was not found in natural forest reserves but flourish well in developed or disturbed areas (Table 1). These findings concurred with Corner (1988). The variation in soil pH, soil type, humidity, light and temperature (Table 2) did not show a different species content.

The cluster analysis for the study sites evidently showed that all the sites were categorized into two clusters (Fig. 2). Cluster No. 1, with two sites (Site 1 = Georgetown and Site 3 = Bukit Gambier), was the group with the least count of species and both sites were situated in highly populated and residential areas. The two main groups have the coefficient of 0.30 which showed a low degree of similarity where only *M. tanarius* present at both sites. The individual counts for this species were relatively high, this is due to the high light intensities and durations received daily (Table 2). According to Turner (1989), *M. tanarius* needs high exposure of sunlight to survive.

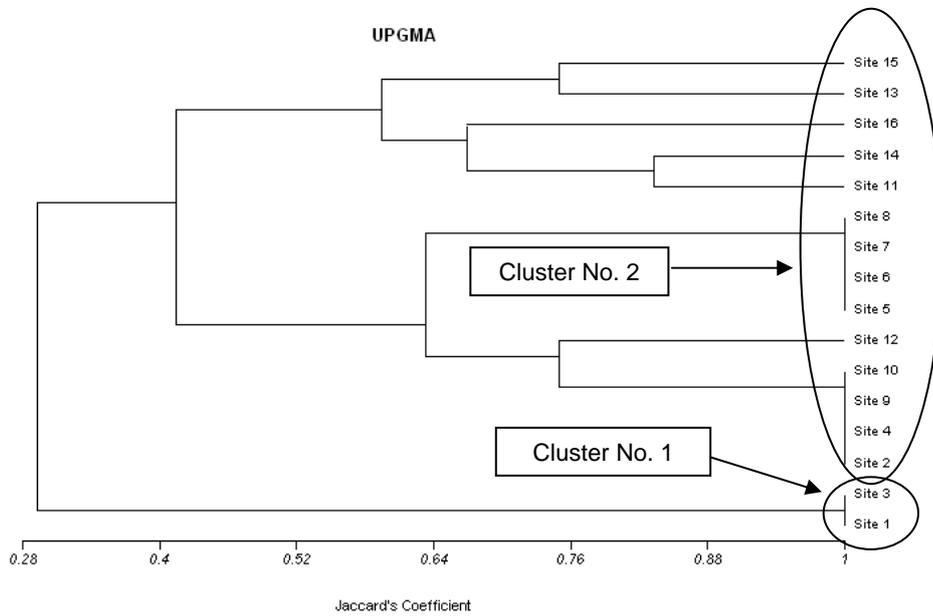


Figure 2: The dendrogram extracted from MVSP (version 3.13) showing the relation between the study sites.

Table 2: Physical parameters and species occurrences for the study sites in Penang Island.

	Study area (Site)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Species																
<i>M. tanarius</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
<i>M. javanica</i>	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>M. triloba</i>	-	-	-	-	-	-	-	-	-	-	+	-	+	+	+	-
<i>M. gigantea</i>	-	+	-	+	-	-	-	-	+	+	+	+	+	+	+	+
<i>M. hypoleuca</i>	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+
<i>M. amissa</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>M. denticulata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>M. lowii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Environmental Parameters																
Soil pH*	4.3	4.9	4.7	4.8	4.9	4.2	4.5	4.6	4.9	4.9	4.6	4.8	4.7	4.5	4.8	4.7
Soil type***	A	b	b	c	b	b	a	b	b	a	b	b	b	c	c	b
Vegetation type	Mix	Mix	Mix	Mix	Mix	Fruit Orchard	Coastal	Mix	Coastal	Coastal	Fruit Orchard	Forest	Forest	Forest	Forest	Forest
Altitude (meter)*	30	40	80	250	60	40	25	135	35	30	170	150	250	600	180	100
Light (Lux) (1000)**	44.7	51.2	56.7	65.1	58.4	36.9	55.8	49.5	63.8	38.8	37.4	18.5	16.3	21.3	15.8	17.4
Humidity*	68	81	76	80	78	72	75	72	76	82	78	82	84	88	84	82
Mean Temperature(°C)	30.2	28.5	29.2	28.6	28.1	28.5	29.0	28.6	29.1	28.5	28.2	28.0	27.4	27.0	28.1	28.5

Key: a = Silt-clay, b = Sandy Loam, c = Silt Loam, * = average, ** = at 1200 H, *** = Soil Classification Chart (FAO, 1977), + = Present, - = Absent

Group two, where the rest of the sites were included were divided into two subgroups with Jaccard's coefficient about 0.4. Sites 11, 13, 14, 15 and 16 were all basically forest (secondary or natural forest) with the most number of *Macaranga* species recorded. The rest of the sites in this group were located in areas near to either plantation or housing areas where the physical parameters showed some degree of differences (Table 2). In this group the soil and vegetation are undisturbed for at least 10 years, evidently from the overall size of plant growing in these areas. Because of these factors, species composition here is relatively similar. The most similar site in term of species composition is Site 11 (5 species) and Site 14 (6 species), with Jaccard's coefficient of more than 0.80. This is due to the site location in semi forested areas, where disturbance once occur before being colonize by pioneer *Macaranga* species as shown in Table 2.

CONCLUSION

The study suggests that the genus *Macaranga* prefer to grow in not forested areas or semi forested areas (secondary forest). The numbers of *Macaranga* species found in Penang are relatively high and the species distribution can be divided into the forest species or disturbed area species. Evidently, physical and chemical parameters do not affect the type of species found. The most dominant species which are well distributed in Penang Island are *M. tanarius* and *M. javanica* with the highest number and sites they are detected. Perhaps, these species can be used as indicator species of disturbed areas. On the other hand, the rarest species found is *M. amissa*.

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