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Hornets (Hymenoptera: Vespinae) of Malaysia

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Abstract: The general biology and distribution of the seven species of hornets (*Vespa*) and three species of nocturnal hornets (*Provespa*) found in Malaysia are given. A key and plate should aid the rapid identification of all species occurring in Malaysia.

INTRODUCTION

The hornets (*Vespa* and *Provespa*) are a group of well known, conspicuous insects which are found predominantly in Eastern Asia. All hornets possess painful stings (only female hornets sting) which can be fatal to people especially to the young or old. Despite their bright warning colouration and large size, hornets still remain a little studied group. Malaysia has a rich hornet fauna with seven of the 23 species of *Vespa* and all three species of *Provespa.* Despite this, there is very little information readily available to either the amateur or professional entomologist about the hornets of tropical regions. Since the works of Bequaert (1936, 1939) and van der Vetch (1957) there has been little published on the Vespinae of the Malaysian region. It is the aim of this publication to present up-to-date information for each of the Malaysian species along with an easy guide to identify all the species. It is hoped this will tempt workers into this exciting area of research. It must be stressed that all material collected should be fully labelled with the date and collection locality; other information such as altitude and habitat type are always useful.

Malaysia is referred to as Peninsular Malaysia and East Malaysia (Sabah & Sarawak [Borneo]). Brunei and Kalimantan (Indonesia) are also covered under Borneo. Records from Singapore are also included due to its proximity to Malaysia.

The general classification of the family Vespidae is given in Fig. 1.

In Malaysia the following species of Vespinae have been recorded:

Provespa anomala	*V. bellicosa*
P. barthelemyi	*V. mocsaryana*
P. nocturna	*V. multimaculata*
Vespa affinis	*V. tropica*
V. analis	*V. velutina*

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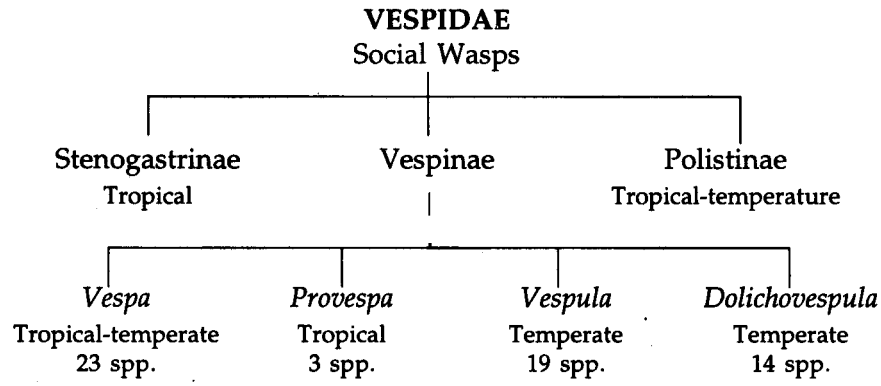

Figure 1. General classification of the family Vespidae.

These species can be grouped according to their abundance (Table 1) or altitudinal range (Table 2).

Table 1. Malaysian hornets grouped with respect to their abundance.

Common species	*V. affinis, V. tropica, V. velutina, P. anomala*
Occasional species	*V. analis, V. multimaculata, P. nocturna*
Rare species	*V. mocsaryana, V. bellicosa, P. barthelemyi*

Table 2. Malaysian hornets grouped with respect to their altitudinal range.

Lowland species	*V. affinis, V. tropica, Provespa spp. V. analis analis, V. mocsaryana, V. multimaculata* (Peninsular Malaysia).
Highland species	*V. analis nigrans, V. velutina, V. multimaculata* (Borneo)

GENERAL LIFE HISTORY

Although hornets have been well studied in temperate (Matsuura & Yamane, 1984; Martin, 1991) and sub-tropical (Kuo, 1984; Kuo & Yeh, 1985; Starr, 1992; Martin 1992a, b, 1995) regions, very little has yet to be done in the tropical regions of their range. Starr (1987) carried out some work on the hornets of the Philippines. In Malaysia Pagden (1952) wrote a short article on *V. affinis* and *V. tropica*. The life cycle of temperate and sub-tropical species is now well understood but much still remains to be learnt about the tropical species. Hornets feed their young on animal matter, e.g. insects and spiders, while the adults feed on the juices of the prey they feed their young supplemented by

nectar and tree sap. Many species of hornets can be found capturing honey bees as they return to their nest.

The *Provespa*

All members of this group are nocturnal and are attracted to artificial lights and so are commonly encountered by most people in their homes; despite this they are still poorly understood. Their distribution is restricted to the Oriental region. The queens and workers differ in size and the males have a different body shape. They initiate their nest by swarming (queen plus about 50 workers in *P. anomala*) (Matsuura & Yamane, 1984). They forage at night (Maschwitz & Hanel, 1988) and build aerial nests in the forests. The nests are built from fibrous plant material and the resulting uniform greyish brown colour makes them difficult to locate. The colony cycle is estimated to last 7-10 months (*P. anomala*).

The *Vespa*

Nests in temperate regions are always founded by a single queen after the over-wintering period. However, in the tropics nests can be founded by single or multiple queens depending on the species, and nests can continue to develop with multiple queens. *V. affinis* is now well know to favour the multiple queen method of founding nests (Matsuura, 1983; Spradbery, 1986; Martin, 1996), and *V. tropica* nests have been found with multiple queens (Matsuura, 1991), while *V. analis* has only one mother queen per nest. There are no data for the other species. There are tentative observations of possible swarming in tropical *V. affinis* (Matsuura & Yamane, 1984) but this needs to be confirmed. The queen or queens build a small embryo nest in which they will rear the first batch of workers (females). During this period the queens can fight for the posssession of nests. This is called usurpation and has been observed in single temperate and sub-tropical species (Martin, 1992b; Matsuura & Yamane, 1984) but the role of usurpation in tropical regions is still unknown. Nests are built from wood removed from dead trees, shrubs, posts, etc. These nests are small and consist of 30-40 cells. It takes 30-40 days for the first batch of workers to emerge in temperate and sub-tropical regions. After this the queen's or queens' duties gradually become confined to egg laying as the workers take over the duties of foraging and nest building, except in *V. tropica* in which the queen continues to forage along with the workers. As the number of workers increases the nest undergoes a rapid period of expansion before the queen/s switch to laying eggs which become new queens and males. As the sexuals start to emerge they leave the nest, after a period during which they build up their fat body, and mate, usually up in the tree canopy. The mother queen/s live for about one year. After mating the males die. The workers probably die of old age in the tropics and not starvation due to the onset of winter as in temperate regions. The fertilised queens may undergo a period of dormancy (over-wintering, in temperate and sub-tropical areas) before initiating a new nest, or may initiate a nest soon afterwards; this needs

to be investigated. Nests are annual and can be initiated at any time of the year in tropical regions. In the aerial nesting species that build in exposed places the nests have a distinctive conical roof which develops as the nest grows. This is undoubtedly to protect the brood against the heavy tropical rains and strong direct sunlight. The nest usual starts with a single downward pointing entrance which soon moves to the side where it normally remains. In the large nests more than one entrance is common.

The queens and workers can be easily distinguished by size in all the Malaysian species except *V. analis* and *V. tropica*. Unlike in temperate and sub-tropical regions, there is no seasonal periodicity in Malaysia and nests can be found at any time of the year in various stages of development.

Key to the Malaysian species of hornets *Vespa* and *Provespa*

The identification of all Malaysian species (excluding *Provespa*) can be done reliably on colour patterns. However, structural features provide important confirmation. The shape of the anterior margin of the clypeus is an important identification feature in the hornets. The clypeus is the large plate found on the head below the antenna and between the eyes (see Plate 1).

Uniform yellow-brown colour, nocturnal, very large ocelli with posterior ocelli closer to the eye than to each other (Plate 1a, b, c) .... *Provespa* 2
---- Normally brightly coloured, diurnal, ocelli closer to each other than to eye, stout body (Plate 1d-k) ..... *Vespa* 4

2. Anterior margin of clypeus deeply emarginated, worker 14-16 mm, male genitalia distinctive (Fig. 2a: Plate 1b) ..... *P. nocturna*
---- Anterior margin of clypeus nearly straight 3

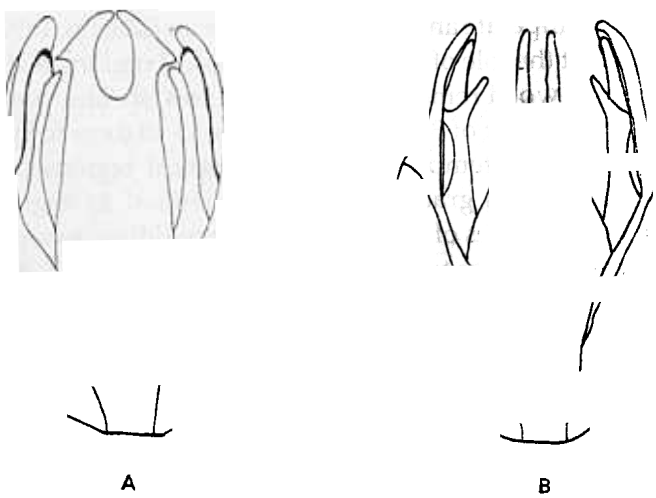

Figure 2. Male genitalia of *Provespa nocturna* and *P. anomala* (A); and *P. barthelemyi* (B).

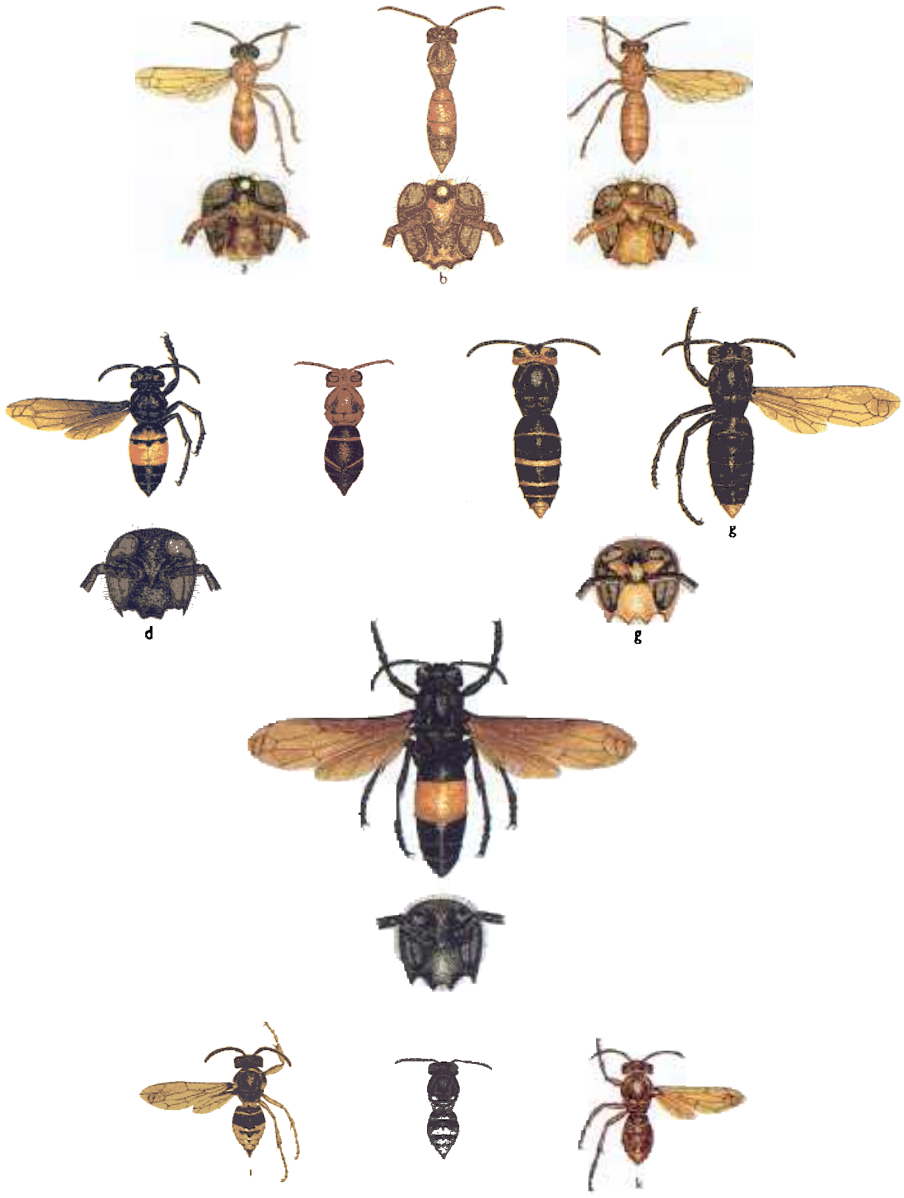

Plate 1. Hornets of Malaysia
a. *Provespa anomala* b. *P. nocturna* c. *P. barthelemyi* d. *Vespa affinis* e. *V. mocsaryana*
f. *V. analis nigrans* g. *V. analis analis* h. *V. tropica* i. *V. multimaculata multimaculata*
j. *V. bellicosa* k. *V. velutina*

3. Body slender, clypeus brownish, worker 11-13 mm, common, male genitalia distinctive (Fig. 2a; Plate 1a) ..... *P. anomala*
---- Body stout, clypeus pale yellow, worker 14-15 mm, rare, male genitalia distinctive (Fig. 2b; Plate 1c) ..... *P. barthelemyi*
4. Tip of gaster yellow, apical margin of clypeus with median tooth, large to medium size (Plate 1f, g) ..... *V. analis*
---- Tip of gaster black, or no median tooth 5
5. Thorax almost all brownish, gaster black with a narrow yellow apical band on the first and second segement (Plate 1e) ..... *V. mocsaryana**
---- Body usually black richly marked with yellow or orange 6
6. Gaster with a broad orange band (2nd and/or 1st segment), rest of body is black or reddish black, wings smoky brown 7
---- Gaster without broad orange band 8
7. Both first (in most cases) and second segments of gaster orange, medium sized species 20 mm worker, 20 mm male, 24-28 mm queen, lateral margin of clypeus produced as two rounded lobes (Plate 1d) ..... *V. affinis*
---- Only the second segment of gaster orange, largest Malaysian species, lateral margin of clypeus produced as two blunt triangular teeth (Plate 1h) ..... *V. tropica*
8. Gaster uniform gold colour, clypeus with no black strip down middle, body and throax extensively marked with yellow/orange (Plate 1k) ..... *V. velutina*
---- Gaster black with yellow bands, clypeus with black strip down middle 9
9. Mid and hind femora yellow beneath, first and second segments of gaster with narrow apical band (Plate 1i) ..... *V. multimaculata*
---- Mid and hind legs black or dark brown, apical band on the first and second segments of gaster broad (one third to one half on second segment) (Plate 1j) ..... *V. bellicosa*

Biology, distribution and habits

Provespa anomala (de Saussure, 1854)

Biology: Nocturnal, the most common species of this group. Adults rush out onto the nest surface if disturbed.

Nest: Built in trees and bushes, from heights of 10 cm to 10 m above the ground but usually close to the ground. Constructed from plant materials. Occasionally they nest in enclosed cavities. Mature nests contain 2000-2500 cells with 4-6

* Another species, *V. basalis*, superficially looks the same as *V. mocsaryana*; although it has never been reported from Malaysia it occurs in both Sumatra and Thailand. So the clypeus of all *V. mocsaryana* specimens should be checked. If the centre of clypeus has deep punctures making the surface rough it is *V. mocsaryana*, while if the centre of clypeus is smooth with only very small punctures it is *V. basalis*. Also *V. basalis* is a very hairy species and has no yellow bands on the abdomen.

combs, being 15-20 x 17-22 cm in size and are egg shaped. The single entrance is usually at the bottom.

Distribution: Widespread throughout lowland Malayia.

Provespa nocturna (du Buysson, 1905)

Biology: Nocturnal, little studied.

Nest: Built in trees, bushes. Mature nests contain up to 5000 cells with 4-6 combs reaching 30 x 40 cm in size.

Distribution: Widespread throughout Malaysia.

Provespa barthelemyi van der Vecht, 1935
Biology: Nocturnal, not studied.

Nest: Unknown.

Distribution: Appears to reach its southern limit in northern Peninsular Malaysia.

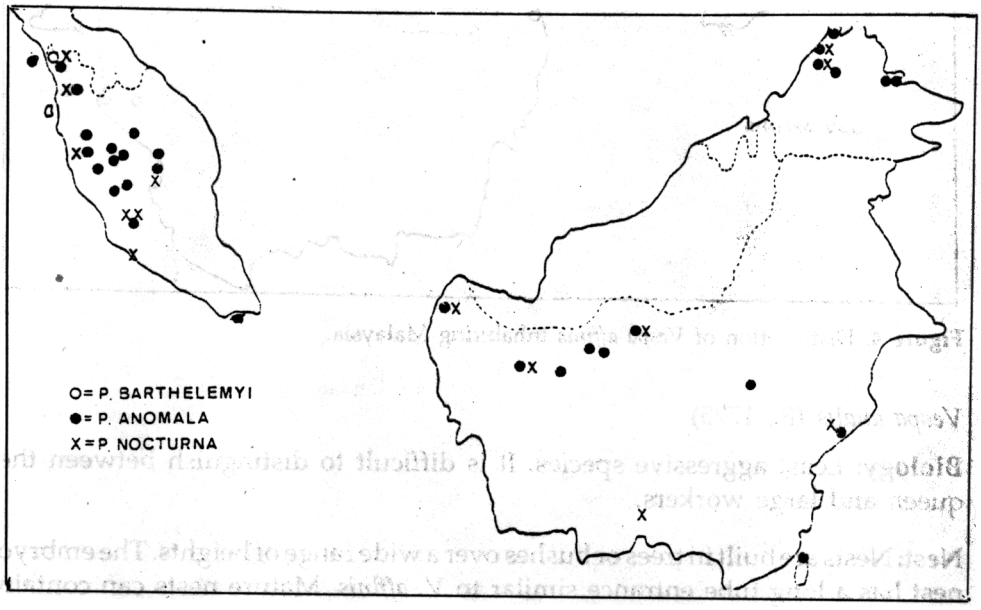

Figure 3. Distribution of the *Provespa* inhabiting Malaysia.

Vespa affinis (L., 1764) [Tiger wasp]

Biology: Commonest species in lowland Malaysia. Has become well adapted to live around human habitation, scavenging for food. It does occur in the forests but at much lower densities. Most nests contain multiple queens.

Nest: Built anywhere above the ground from low bushes to the tops of trees. Nests often built on the ends of exposed branches. The embryo nest is covered by a single-layer, inverted flask-shaped envelope. This is removed by the

workers after they emerge. The mature nest can reach very large sizes, containing over 14,000 cells and over 12 combs. Nests with diameters of over 40 cm are common.

Distribution: Predominatly a lowland species. However, individuals can be seen almost anywhere, especially if near human habitation e.g. at the Cameron Highlands at 1700 m (pers. obs.). Over its extensive range there are many colour forms. However, there is much variation with some specimens around Kota Kinabalu which are all black. Whether this is the accidental introduction of forms or not is unknown.

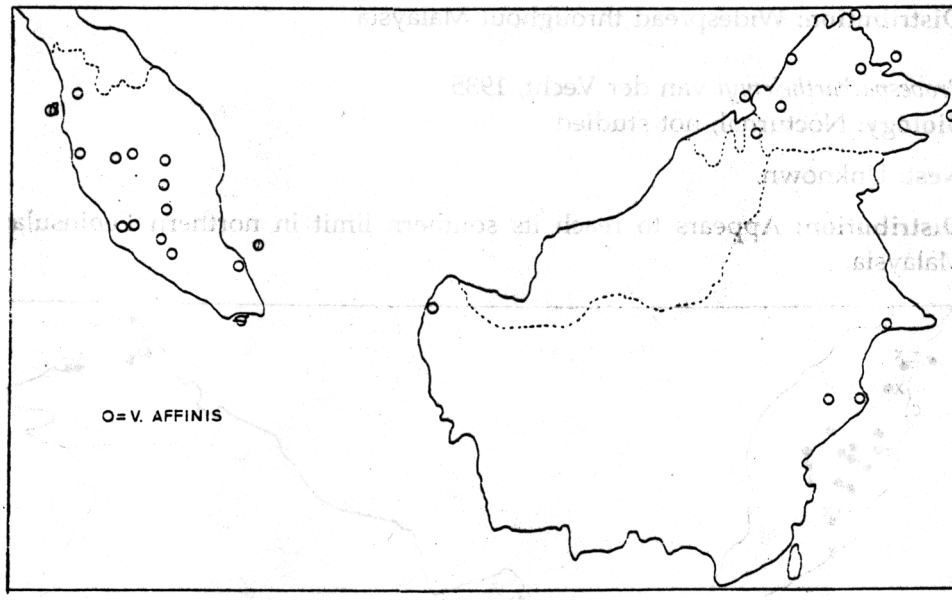

Figure 4. Distribution of *Vespa affinis* inhabiting Malaysia.

Vespa analis (F., 1775)

Biology: Least aggressive species. It is difficult to distinguish between the queen and large workers.

Nest: Nests are built in trees or bushes over a wide range of heights. The embryo nest has a long tube entrance similar to *V. affinis*. Mature nests can contain up to nine combs (80 cm high), e.g. eight combs with 3,050 cells.

Distribution: There are two clearly distinct colour forms which are geographically separated. The colour form *V. a. nigrans* is found only in the central mountain forest regions of Peninsular Malaysia (2000-5500 ft), while the *V. a. analis* colour form has recently appeared in Singapore where it is quite common in parks and gardens. This form was not listed in either Bequaert's (1939) or van der Vetch's (1957) work. Further reports of the distribution of the two colour forms will provide an interesting area of study.

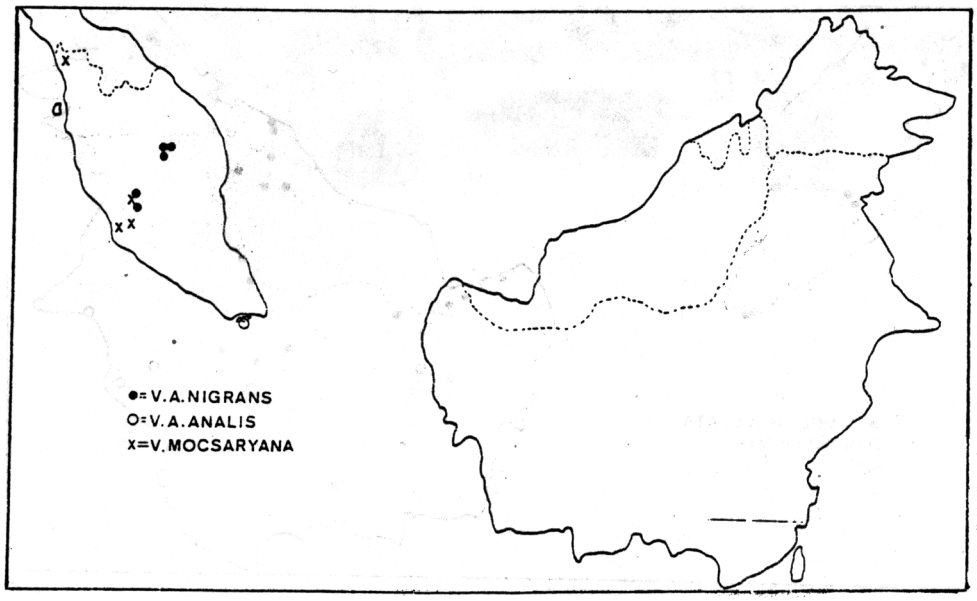

Figure 5. Distribution of *Vespa analis* and *V. mocsaryana* inhabiting Malaysia.

Vespa bellicosa de Saussure, 1854

Biology: Very closely related to *V. multimaculata*, but since it does not hybridise with it when they occur together they can be considered as sibling species (van der Vetch, 1957). However, very little is known about either species.

Nest: Unknown, probably subterranean.

Distribution: Borneo and Sumatra, primary forests.

Vespa multimaculata Perez, 1910

Biology: In flight and coloration, yellow and black, it resembles the wasps rather than the hornets. The only hornet (including *V. bellicosa*) with black markings on the clypeus, also the smallest species of hornet. They are very fast and agile. Their foraging pattern over the forest floor can resemble that of a blue bottle fly.

Nest: Local people report that on Mount Kinabalu, Sabah, this species nests in the ground especially under the roots of trees, and nests reach up to 20-30 cm in diameter.

Distribution: Again two colour forms may exist in Malaysia. In Peninsular Malaysia the *pendleburyi* form (yellow bands on abdomen all narrow) occurs in the lowland forests while the *multimaculata* form (Plate 1i) in Borneo appears to be restricted to the montane zone (4000 ft - 9000 ft) of Mount Kinabalu and the central highlands. Their distribution may be governed by the location of primary forests rather than altitude, but more records are needed.

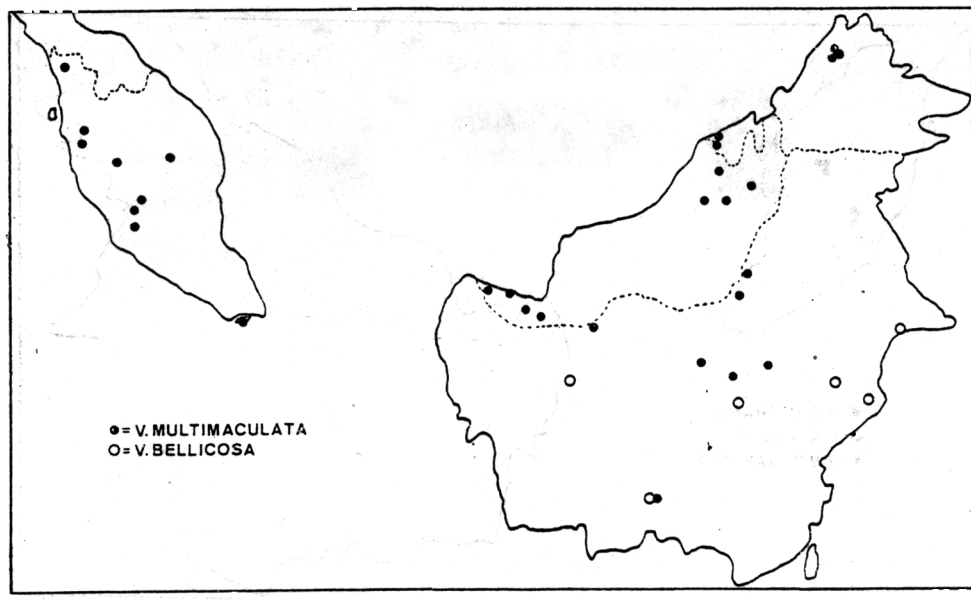

Figure 6. Distribution of *Vespa bellicosa* and *V. multimaculata* inhabiting Malaysia.

Vespa mocsaryana du Buysson, 1905

Biology: Unknown.

Nest: Unknown.

Distribution: Only six reports from Peninsular Malaysia, thought to occur in mountain forests but photographed on flowers at the University of Malaya, Kuala Lumpur.

Vespa tropica (L. 1758)

Biology: Largest Malaysian hornet and for many years was confused with *V. affinis*. Specialist feeder preying exclusively on the broods of social wasps (*Polistes, Parapolybia, Ropalidia* and *Stenogastrine*). It is very difficult to distinguish the mother queen/s from the larger workers.

Nest: Normally subterranean or in enclosed spaces, e.g. hollow trees, roofs of houses, although an aerial nest built onto the trunk of a tree over 30 m above the ground was found on Tioman Island (pers. obs.). The embryo nest has a bowl-shaped envelope, consisting of a single layer. Mature nests reach 5,000-6,000 cells (Matsuura, 1991) and the pupal caps are a brilliant white. Polygynous (multiple queen) colonies have been found in Sumatra and Malaysia (Matsuura, 1991).

Distribution: Widspread throughout lowland Malaysia.

Vespa velutina (Lepeletier, 1836) [Golden wasp]

Biology: A very aggressive and agile species. Attacks by large numbers of

hornets can occur with little provocation and attacks are often fatal due to the number and persistence of the attacking hornets. The relocation of colonies has been observed in this species in Taiwan (Matsuura, 1991) and in *V. auraria* in China (Dazhi & Yunzhen, 1989). This involves the movement of adults from the initial site of the embryo nest to a new nearby site which allows for nest expansion. This behaviour is common in *V. simillima* and *V. crabro.*

Nest: Large nests, built in the tops of trees or low down in bushes; underground nests have also been reported. The mature nest can reach or even exceed the size of *V. affinis* nests (11,912 cells in 11 combs, 75 cm high).

Distribution: Restricted to the highland mountain forests and hill stations in Peninsular Malaysia (3,500-6,600 ft) where it is quite common.

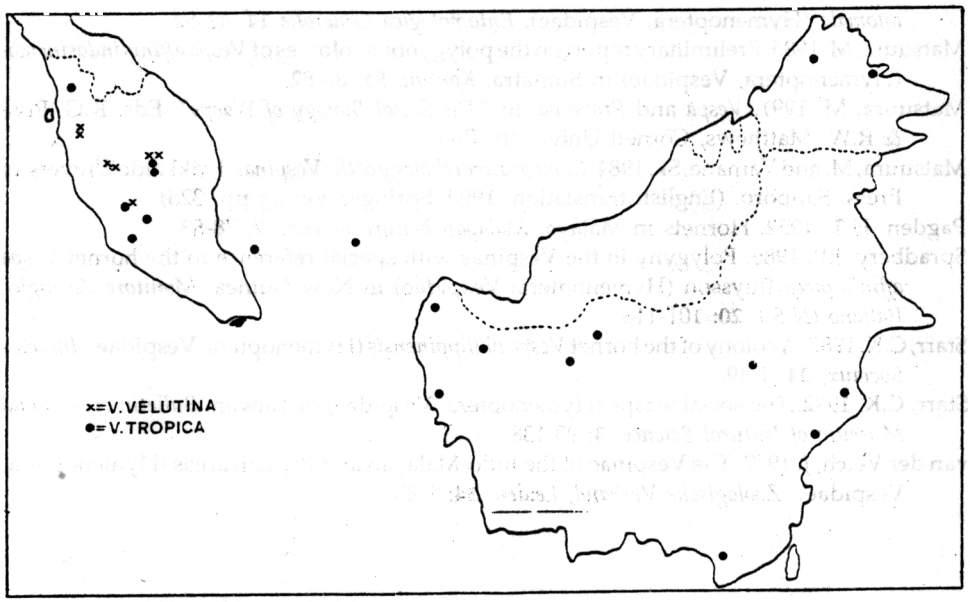

Figure 7. Distribution of *Vespa tropica* and *V. velutina* inhabiting Malaysia.

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