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KEYS TO THE SOCIAL WASP SPECIES (HYMENOPTERA: VESPIDAE) KNOWN FROM PENINSULAR MALAYSIA

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ABSTRACT

Identification keys are provided for subfamilies, genera and all species of social wasps so far recorded in Peninsular Malaysia.

Key words: Hymenoptera, Vespidae, Social Wasps, Peninsular Malaysia

ABSTRAK

Kekunci pengecaman telah disediakan untuk subfamili, genera, dan kesemua spesies serangga tebuan sosial telah direkodkan bagi Semenanjung Malaysia

Kata kunci: Hymenoptera, Vespidae, Tebuan Sosial, Semenanjung Malaysia

INTRODUCTION

As one of the major parts of the Sundaland Biodiversity Hotspot, the peninsular part of Malaysia is expected to harbor biota as rich as that in Sumatra and Borneo. The area is adjacent to the Indo-Burma Biodiversity Hotspot bordered at the Isthmus of Kra in Thailand, thus its biota may also include animals and plants key to understanding the biogeography of the Malay Peninsula. Social wasps of the three subfamilies (Stenogastrinae, Polistinae and Vespinae) in the family Vespidae would not be exceptions. However, other than limited taxa, such as the hover wasp genus *Liostenogaster* (Turillazzi 1999), the social wasp fauna in Peninsular Malaysia has been rather poorly studied.

Not only because they are, in general, at the top positions in the food web in a terrestrial arthropods but also because they are often effective pollinators of various plants. The social wasps could be reasonably assigned as effective bio-indicators for environmental conditions and, as such they are vulnerable to their habitat condition changes. As in most of the other parts in South-East Asia, Peninsular Malaysia is under a rapid development with minimum environmental management, and thus organisms including social wasps inhabiting there are exposed to drastic habitat changes.

In the present paper, we present keys to social wasp species so far recorded from Peninsular Malaysia. We hope that it will stimulate further studies on this yet-poorly-studied fauna of social wasps. It is hope to be done in the TaBABI (Taxon Based Area Biodiversity Inventory) scheme, in which we will efficiently use and allocate our available human resources of taxonomic expertise on a given taxon not only to perform an area biodiversity inventory that can be the basis for a biodiversity study in broader scales, namely a planetary biodiversity inventory, but also to cooperatively promote education and training for young researchers.

The present paper also list the specimens of social wasps that have been identified and housed in the Center for Insect Systematics of the Universiti Kebangsaan Malaysia (abbreviated as “CIS”), together with brief taxonomic notes for some species.

KEYS, TAXONOMIC NOTES AND DISTRIBUTION RECORDS

A key to genera is first given. Then, under each genus, a key to species, and taxonomic notes if necessary, a list of identified specimens in the CIS and summary of distribution records (by island, or country and/or area when distribution records are on the continents) are given.

Key to subfamilies, tribes and genera of social wasps so far recorded from Peninsular Malaysia

The present key is based on the key by Carpenter and Nguyen (2003) with minor modifications.

1. Parategula (horizontal lobe projecting from posterolateral corner of mesoscutum) usually present; tibial spur usually simple and straight; tarsal claws usually bifid.....Eumeninae (solitary or subsocial, not dealt with here)
   Parategula absent; tibial spur long and curved; tarsal claws simple 2
2 Pronotal lobe separated from tegula by a distance several times its length; forewing not longitudinally plaited at rest.....4, Stenogastrinae
   Pronotal lobe separated from tegula by a distance equal to its length or less; forewing longitudinally plaited at rest 3
3 Hindcoxa without dorsal carina; hind-wing with jugal lobe; metasoma variable in shape, with first tergum petiolate to subsessile or funnel-shaped in dorsal view.....7, Polistinae
   Hindcoxa with dorsal carina on posterior surface; hindwing without jugal lobe; metasoma generally robust and more or less sessile, with first tergum having abrupt declivity, shaped broad trapezoid in dorsal view.....10, Vespinae
4. Occipital carina evanescing before reaching the hypostomal carina.....*Liostenogaster*
   Occipital carina reaching and fused with the hypostomal carina.....5

5. Second metasomal segment not basally petiolate in dorsal view.....*Eustenogaster*
   Second metasomal segment basally petiolate in dorsal view, extending nearly parallel sided for at least 1.5 times as long as its basal width.....6
6. Hindwing with posterior fringe of hairs greatly elongated, more so in males; vertex with median longitudinal groove; male with bidentate mandibles, antennae with flagellomeres flattened, pleural area sunken and densely pubescent, and foretibia with spatulate setae.....*Metischnogaster*
   Hindwings with posterior fringe of hairs very short; vertex without median longitudinal groove; male with tridentate mandibles, without flattened flagellomeres, sunken pleural area, and spatulate setae on foretibiae.....*Parischnogaster*
7. First metasomal segment usually subsessile, funnel-shaped in dorsal view, basally petiolate only in a few species; first sternum bluntly angled before widening posteriorly.....Polistini, *Polistes*
   First metasomal segment shaped variably, in dorsal view usually basally petiolate to long petiolate, but petiolate part nearly lacking in some *Ropalidia* species; first sternum never angled but smoothly continuous from base to posterior margin..... 8, Ropalidiini
8. Antenna with nine flagellomeres in female, ten in male; pronotum lacking dorsal carina; first metasomal segment in dorsal view nearly parallel sided throughout the length.....*Polybioides*
   Antenna with ten flagellomeres in female, 11 in male; pronotum with carina present, at least dorsally; first metasomal segment in dorsal view not entirely parallel sided.....9
9. Pronotum without pretegular carina; mesepisternum without scrobal sulcus. Tergum and sternum of second metasomal segment fused; suture between them often obliterated posteriorly.....*Ropalidia*
   Pronotum with pretegular carina; mesepisternum with scrobal sulcus. Tergum and sternum of second metasomal segment not fused.....*Parapolybia*

10. Ocelli enlarged, posterior ocelli closer to eye than to each other.....*Provespa*
    Ocelli not enlarged, posterior ocelli closer to each other than to eye.....*Vespa*

Subfamily Stenogastrinae

As the wasps of the subfamily Stenogastrinae or hover wasps are generally cryptic in their life compared with other social wasps (polistines and vespines), not only biological but also taxonomic study of the subfamily is yet behind that of the poilistine or vespine wasps.

The wasps of the subfamily are distributed in South Asia (India. Sri Lanka), South-East Asia and Papua region, and show a disjunct distribution pattern being absent from the Moluccas; of the seven genera in the subfamily, five (*Cochlischnogaster*, *Eustenogaster*, *Liostenogaster*, *Metischnogaster*, and *Parischnogaster*) occur in Asia and the other two (*Anischnogaster* and *Stenogaster*) are endemic to Papua region. All the Asian genera except *Cochlischnogaster* are distributed in Peninsular Malaysia; *Cochlischnogaster*, distributed in the Indochina north of Isthmus of Kra, is the sister-group of *Metischenogaster*. Wasps of *Metischnogaster* occur in the Malay Peninsula south of Isthmus of Kra, Sumatra Island, Borneo Island, eastern part of Java Island, and Palawan Island, and the distribution patterns of the two genera could be iterpreted as "the speciation separating *Chalogaster* [= *Cochlischnogaster*] and *Metschnogaster* occurred as a single vicatiance event around the Isthmus of Kra" (Carpenter and Starr 2000; for the generic synonymy, see Carpenter 2001).

Genus *Eustenogaster* van der Vecht, 1969

Key to *Eustenogaster* species so far recorded from Peninsular Malaysia

The present key does not include the male of *E. eximia*. Keys to all *Eustenogaster* species are available in Saito and Kojima (2007) and Saito (2009).

1. Female; antenna with ten flagellomeres; metasoma with six segments…….....2
   Male; antenna with 11 flagellomeres; metasoma with seven segments…….....9
2. Lateral sides of pronotum and dorsal part of mesepisternum dull, densely and sometimes rugosely punctate; puncture larger than interspace between punctures. Second metasomal tergum in lateral view distinctly convex dorsally.....3
   Lateral sides of pronotum and dorsal part of mesepisternum finely punctate; some interspaces between punctures larger than puncture. Second metasomal tergum in lateral view only slightly convex dorsally.....….....….....….....4
3. First tergum in dorsal view barely widened in some distance behind level of spiracles, then widened in posterior one-fifth of the tergum; second tergum weakly convex dorsally.
   Clypeus yellow except for broad apical band and lateral margins black; frons with large, yellow spot below each antennal socket; mesepisternum with two yellow spots; base of second tergum with paired yellow spots nearly coalescent.....*E. fraternal*
   First tergum in dorsal view gradually widened posteriorly from level of spiracles; second tergum strongly convex dorsally. Clypeus usually with yellow spot of variable size, rarely entirely black; propodeum with paired apical yellow spots; supraclypeal area and base of second tergum black…….....….*E. scitula*
4. Space between antennal sockets with rather sparse, shallow punctures; interspace between punctures larger than puncture. Scutum with sparse, shallow punctures; interspace between punctures usually larger than puncture.....*E. eximia*
   Space between antennal sockets densely, and sometimes rugosely, punctate; interspace between punctures smaller than puncture. Scutum densely covered with well-defined punctures; interspace between punctures mostly smaller than puncture.....5
5. Frons clearly demarcated from clypeus by suture Sixth metasomal tergum with sharp spine. Clypeus and

supraclypeal area yellow with median dark line. Eye emarginations black.……*E. latebricola*
Frons barely demarcated from clypeus…….....……6

6. Supraclypeal area just above clypeus with dense, well-defined punctures; interspace between punctures smaller than puncture…….....……..7
Supraclypeal area just above clypeus with sparse, shallow punctures; interspace between punctures larger than puncture…….....…….……..8

7. Extreme apex of clypeus sharply pointed. Gena black; pronotal neck with paired yellow spots; first metasomal tergum with paired posterolateral yellow spots……...…*E. hauxwellii*
Extreme apex of clypeus truncate. Gena yellow marked; pronotal neck and first tergum with yellow spots absent.…….....…*E. calyptodoma*

8. Median impunctate area in supraclypeal area much larger than anterior ocellus. Second metasomal tergum with distinct transverse impression separating somewhat swollen posterior two-fifths from anterior part. Eye emargination with yellow spot….....*E. gibbosa*
Median impunctate area in supraclypeal area smaller than anterior ocelli. Second metasomal tergum without transverse impression. Eye emargination filled with yellow…….....….*E. micans*

9. Mandible with three teeth, all more or less distinct and apically blunt.....10
Mandible single-toothed.....11

10. Second tergum in profile weakly convex dorsally. Supraclypeal area with paired yellow spots…..….*E. fraterna*
Second tergum in profile strongly convex dorsally. Supraclypeal area without yellow spots…….....*E. scitula*

11. Clypeus in lateral view flattened dorsally, smoothly passing into supraclypeal area. Digitus without median spine and apically with dense, long hairs…….....*E. hauxwellii*
Clypeus in lateral view weakly convex dorsally, separated from supraclypeal area by shallow depression or short suture. Digitus with median spine and apically with short hairs…12

12. Clypeus separated from supraclypeal area by short suture. Ventral margins of penis valve with prominent serrations extending apically toward apical swollen part of aedeagus.....*E. latebricola*
    Clypeus separated from supraclypeal area by shallow depression. Ventral margins of penis valve with serrations restricted to proximal part or minute if extending towards apical swollen part of aedeagus……..….13
13. Median impunctate area in supraclypeal area large, as large as or larger than. or only sometimes slightly smaller than anterior ocellus……..….....14
    Median impunctate area in supraclypeal area small, somewhat smaller than anterior ocellus. Pronotum dorsolaterally with deep furrows behind pronotal collar. Punctures on scutum fine and dense, with their interspaces smaller than their diameter. Gena ventrally with large, yellow spot….....…*E. calyptodoma*
14. Second metasomal tergum with transverse impression, separating somewhat swollen posterior two-fifths from anterior part. Supraclypeal area medially without hairs and impunctate. Eye emargination usually entirely black…….. *E. gibbosa*
    -Supraclypeal area finely punctate and covered with short hair. Eye emargination filled with yellow.....….*E. micans*

Eustenogaster calyptodoma **(Sakagami and Yoshikawa, 1968)**
Distribution. Malay Peninsula, Borneo (Sarawak), Sumatra.

Eustenogaster eximia **(Bingham, 1890)**
Distribution. Sri Lanka, China (Yunnan), Thailand, Malay Peninsula.

Eustenogaster fraterna **(Bingham, 1897)**
Distribution. India (Assam, Sikkim), Myanmar, Malay Peninsula.

Eustenogaster gibbosa **Starr and van der Vecht, 2006**
Specimen in CIS. Pahang: 1 female, Hutan Kuala Lompat, 3.xi.1999, Ruslan & A. Nizar.

Distribution. Malay Peninsula including Singapore, Borneo, Sumatra, Mentawai Is., Kurakatau, Java, Bangka Is.

***Eustenogaster hauxwellii* (Bingham, 1894)**

Specimen in CIS. Negeri Sembilan: 1 females, Pasoh Forest Reserve, .ix.2002, Ng Y.-F. & Ruslan M.Y..

Distribution. India (Sikkim), Myanmar, Thailand, Malay Peninsula including Singapore, Java, Mindanao.

***Eustenogaster latebricola* Saito, 2007**

Distribution. Malay Peninsula, Borneo, Sumatra, Kurakatau, Java, Bangka Is.

***Eustenogaster micans* (de Saussure, 1852)**

Distribution. China (Yunnan), Myanmar, Thailand, Singapore, Borneo, Sumatra, Java.

***Eustenogaster scitula* (Bingham, 1897)**

Distribution. India (Assam, Meghalaya, Sikkim), China (Yunnan), Myanmar, Malay Peninsula.

Genus *Liostenogaster* van der Vecht, 1969

Key to *Liostenogaster* species so far recorded from the Peninsular Malaysia

The present key is for adult females based on the key in Turillazzi (1999) with some modifications, and it is not applicable to males.

1. Mandibles with two teeth, or with an extremely small third one 2
   Mandibles with three obvious teeth..... 3
2 Mesoscutum with four longitudinal stripes, two marginal and two paramedian. Angle of the anterior margins of the clypeus more than 70 degree. Petiole 4 times as long as wide when seen from above……..……*L. varipicta*
   Inferior part of the clypeus with an evident median carina starting from the apex, petiole more than 5 times as long as wide when seen from above……..... *L. filicis*

3 Propodeum and mesoscutum densely punctate.....4
Propodeum and mesoscutum smooth or only sparsely punctate 5

4. More delicate species. Club-shaped antennae with the maximum width of the funicule three times the minimum width.....*L. tutua*
More robust species. Antennae with the maximum width two times the minimum width .....*L. vechti*

5. Second tooth of the mandible pointed and with blunted edges 6
Second tooth of the mandible squared and with sharp edges 9

6. Eyes with long hairs..... *L. flavolineata*
Eyes without long hairs.....7

7 Last antennomere less than 1.5 times as long as wide..... *L. pardii*
Last antennomere more than 1.5 times as long as wide 8

8 Angle formed by the anterior margins of the clypeus around 90°..... *L. abstrusa*
Angle formed by the anterior margins of the clypeus less than 80°.....*L. campanulae*

9 Supraclypeal area and frons punctate..... *L. nitidipennis*
Supraclypeal area smooth..... *L. topographica*

Liostenogaster abstrusa Turillazzi, 1999

Distribution. Peninsular Malaysia.

Liostenogaster campanulae Turillazzi, 1999

Specimens in CIS. Negeri Sembilan: 4 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (10.vi.2002; 22.vi.2002; 22.ix.2002; 20.xi.2002); **Selangor:** 1 female, Hutan Simpan Sg. Lalang, xii.1999, Noor Farikhah Haneda; **Pahang:** 7♀, Hutan Kuala Lompat, Ruslan & A. Nizar (3.xi.1999, 17.xi.1999, 24.xi.1999, 12.i.2000, 26.i.2000, 1.iii.2000, 22.iii.2000)

Distribution. Peninsular Malaysia, Sumatra.

Liostenogaster filicis Turillazzi, 1999

Distribution. Malay Peninsula, Myanmar, Laos, Vietnam.

***Liostenogaster flavolineata* (Cameron, 1902)**

Distribution. Peninsular Malaysia, Singapore, Borneo (Sarawak), Sumatra.

***Liostenogaster nitidipennis* (de Saussure, 1853)**

Specimens in CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 12.iv.2002, Ng Y.-F. & Ruslan M.Y.; **Perak:** 1 female, Hutan Simpan Belum, Grik, 26-31.vi.2003; **Johor:** 3 females, Sagil, G. Ledang, 1-31.iii.2003, Chew Keng Ling (2 females, 900 m; 1 female, 1000 m)

Distributions. China (Yunnan), Myanmar, Thailand, Malay Peninsula including Singapore, Borneo, Java, Bali, Palawan, Luzon.

***Liostenogaster pardii* Turillazzi and Carfì, 1996**

Distributions. Peninsular Malaysia, Borneo (Sarawak).

***Liostenogaster topographica* Turillazzi, 1999**

In our 2006 paper on the distributional summary of the social wasps in the Sunda Islands (Kojima *et al*., 2006), a specimen of *L. topographica* from Sumatra was by a misidentification listed under *L. flaviplagiata* (Cameron, 1902). Corrections are as follows: Remove "Specimen examined. Sumatra; 1 female (IUNH), Ul Gadat, 7.xi.2001, J. Kojima" from the section under "*Liostenogaster flaviplagiata* (Cameron, 1902)" on page 4, and transfer it to the section under "*Liostenogaster topographica* Turillazzi, 1999" on page 5, but removing the last "s" of "Specimens", and then add "Sumatra" to the distribution of *L. topographica* so as to make "**Distribution.** Sumatra, Borneo; Malay Peninsula (Turillazzi, 1999) (Fig. 3)". Subsequently the distribution range of *L. topographica* in Fig. 3 should also be changed to include Sumatra.

Distribuition. Malay Peninsula, Sumatra, Borneo.

***Liostenogaster tutua* Turillazzi, 1999**

Distribution. Malay Peninsula.

***Liostenogaster varipicta* (Rohwer, 1919)**

Specimens in CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 23.x.2002, Ng Y.-F. & Ruslan M.Y.; **Pahang:** 4 females, Hutan Kuala Lompat, Ruslan & A. Nizar (2 females, 22.iii.2000; 24.xi.1999; 17.xi.1999).

Distribution. Malay Peninsula including Singapore, Sumatra, Borneo, Palawan, Visayas, Mindanao, Luzon.

***Liostenogaster vechti* Turillazzi, 1988**

Specimens in CIS. Negeri Sembilan: 2 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (15.iv.2002; 23.ix.2002).

Distribution. Malay Peninsula, Sumatra.

Genus *Metischnogaster* van der Vecht, 1977

In this genus only two species (*M. cillipennis* (Smith, 1857) and *M. drewseni* (de Saussure, 1857) have so far been known and their taxonomy was studied in detail by van der Vecht (1977). A species identification key is herewith provided based on that in van der Vecht (1977).

Key to *Metischnogaster* species

1. Female; antenna with ten flagellomeres; metasoma with six segments…….....2
   Male; antenna with 11 flagellomeres; metasoma with seven segments…….....3
2. Clypeus almost entirely yellow, with apical margin colored brown to dark brown. Propodeum weakly striate in anterior part of dorsal surface. Third and fourth metasomal terga with basal yellow band interrupted medially and dilated laterally .....*M. cilipennis*
   Clypeus yellow, with broad median band and apical margin colored dark brown. Propodeum obliquely striate in entire part of dorsal surface. Third and fourth metasomal terga each with paired widely separated yellow spots .....*M. drewseni*
3. Markings on scutellum, metanotum and propodeum ivory-white. Second metasomal tergum without yellow spot beneath spiracle ..... *M. cilipennis*

Markings on scutellum, metanotum and propodeum yellow. Second metasomal tergum with elongate yellow spot beneath spiracle..... *M. drewseni*

***Metischnogaster cillipennis* (Smith, 1857)**

Distribution. Malay Peninsula, Borneo, Sumatra.

***Metischnogaster drewseni* (de Saussure, 1857)**

Distribution. Malay Peninsula including Singapore, Borneo, Sumatra, Belitung, Java, Palawan.

Genus *Parischnogaster* von Schulthess, 1914

This genus may be the worst in the Stenogastrinae with respect to the species-level taxonomy. Currently ten species are recognized as valid, but there are undoubtedly not a few species awaiting to be described and the taxonomic status of species-group taxa now treated as synonyms may need to be revised. Dr. Christopher K. Starr is preparing a taxonomic revision of this genus, and the following key to species is based on his unpublished key to *Parischnogaster* species. *Parischonogaster jacobsoni* is not included in the key even though this species has been recorded from Peninsular Malaysia, simply because the identity of "*P. jacobsoni*" recorded from Peninsular Malaysia is yet uncertain.

Key to *Parischnogaster* species so far recorded from Peninsular Malaysia

1. Female; antenna with ten flagellomeres; metasoma with six segments…….....2
   Male; antenna with 11 flagellomeres; metasoma with seven segments and pale flash bands on the terga…….....7
2. Basal petiolate part of second metasomal segment not long, only about as long as wide. Clypeus narrowly separated from eye. Posterior ocelli separated from each other by one ocellus diameter or less.....3
   Basal petiolate part of second metasomal segment long, much longer than wide. Clypeus more widely separated from eye. Posterior ocelli separated from each other by more than one ocellus diameter.....5

3. Striae of propodeum continuing strong from posterior face onto lateral sides.....*P. striatula*
   Striae of propodeum strong on posterior face, then fading more or less suddenly at the propodeal angles.....4
4. First antennal flagellomere in dorsal view more than twice as long as wide. Notaular stripes absent; scutellar spots small, separated by more than the diameter of one spot; yellow marks on third to fifth metasomal terga especially prominent.....*P. alternata*
   First antennal flagellomere less than twice as long as wide. Notaular stripes present, usually small; scutellar spots confluent or separated by a band narrower than the diameter of one spot.....*P. foveata*
5. Clypeus with a small central nodule or ridge. Clypeus often with small pale spot below the center; notaular stripes and mesoscutal spot distinct; distinct yellow spots on fourth metasomal sternum and usually fifth sternum...*P. unicuspata*
   Surface of clypeus smoothly rounded, without a central nodule or ridge. Clypeus without pale spot below the center.....6
6. Second to sixth metasomal sterna each with a pair of yellow spots, those on sixth sternum especially large, often coalescent and occupying most of the visible part of the sternum; third to fifth terga with spots, those on fourth tergum coalescent, forming a single band; yellow marks on pronotal collar forming a continuous band, or only narrowly interrupted dorsally.....*P. mellyi*
   Metasomal sterna entirely dark, or at most somewhat reddish. Notaular stripes absent, mesoscutum entirely dark; swollen posterior part of first metasomal tergum and spiracular area of second tergum without distinct yellow marks…….....*P. nigricans*
7. Petiolate basal part of second metasomal segment about as long as wide; tergal organ present on second metasomal segment. Mesosoma with distinct pleural organ. Clypeus narrowly separated from eye. Posterior ocelli separated from each other by one ocellus diameter or less.....8
   Petiolate basal part of second metasomal segment much

longer than broad; second metasomal segment plain, without a tergal organ. Clypeus more broadly separated from eye. Posterior ocelli separated by more than one ocellus diamete.....10

8. First antennal flagellomere distinctly less than twice as long as wide in dorsal view; third to fifth flagellomeres distinctly flattened below. Tergal organ very deep, narrow, with a round bottom.....*P. foveata*
   First antennal flagellomere about twice as long as wide in dorsal view; all flagellomeres evenly rounded below. Tergal organ either broad or relatively shallow.....9
9. Tergal organ deep, with a round bottom, bowed out at the sides, so that in dorsal view it occupies most of the main part of the tergum.....*P. alternata*
   Tergal organ much shallower, with a flat bottom, not especially broad.....*P. striatula*
10. Surface of clypeus with a sharp central protuberance. Mid-femur with a pronounced basal bulge below; anterior lobe of second tarsomere of mid-tarsus with terminal spines reduced.....*P. unicuspata*
    Surface of clypeus evenly rounded, unadorned. Mid-femur without a pronounced basal bulge below; anterior lobe of second tarsomere of mid-tarsus with terminal spines strong.....11
11. Apex of seventh metasomal sternum evenly rounded at sides. Antennal terminal flagellomere bulging somewhat below. Mesoscutal spot present.....*P. mellyi*
    Apex of seventh metasomal sternum angled at sides. Antennal terminal flagellomere less curved below. Mesoscutal spot absent.....*P. nigricans*

Parischnogaster alternata Sakagami, 1969

Distribution. Malay Peninsula including Singapore, Borneo.

Parischnogaster jacobsoni (du Buysson, 1913)

This species was originally described from central Java, Indonesia and has been recorded from Yunnan of China, Malay Peninsula, Borneo and Sumatra. Occurrences of this species or the taxonomic

status of so-called "*P. jacobsoni*" in the areas other than Java need confirmation.
Distribution. China (Yunnan), Malay Peninsula, Borneo, Sumatra, Java.

***Parischnogaster mellyi* (de Saussure, 1852)**
Distribution. India (Assam, Meghalaya, Sikkim), China (Yunnan), Myanmar, Vietnam, Thailand, Malay Peninsula including Singapore, Borneo, Sumatra, Java, Mindanao.

***Parischnogaster nigricans* (Cameron, 1902)**
Distribution. China (Yunnan), Malay Peninsula including Singapore, Borneo, Sumatra, Bangka, Krakatau, Java, Kangean, Luzon.

***Parischnogaster striatula* (du Buysson, 1905)**
Distribution. Thailand, Malay Peninsula, Borneo, Sumatra.

***Parischnogaster foveata* (du Buysson, 1907)**
This taxon was described from "Salawatti" of the western part of Papua (du Buysson, 1907) and often treated as a synonym of *P. striatula*. Judging from the fact that no *Parischnogaster* wasps, except for the type of *Ischnogaster foveatus* (= *P. foveata*), have been known from Papuan region, the type may have been erroneously labeled. The taxonomic status and the distribution range of this taxon should be clarified based on further intensive study.

***Parischnogaster unicuspata* Reyes, 1988**
Distribution. Malay Peninsula including Singapore, Borneo (Sarawak), Palawan.

Subfamily Polistinae
Tribe Polistini
Genus *Polistes* Latreille, 1802

The genus *Polistes* is cosmopolitan in the distribution, and with about 210 recognized species, is one of the largest genera in the subfamily Polistinae. In the genus, the following four

monophyletic subgenera are recognized: *Aphaniropterus* Meunier, 1888 includes about 90 species distributed in the New World; *Polistes* s. str., consisting 22 recognized species, is Palearctic and African in their distribution (except a few species accidentally introduced to North America, Australia and New Zealand); *Gyrostoma* Kirby, 1928, with 21 species currently recognized, is native to Middle-East, Asia (including the Far East), Australia and Pacific Islands; and *Polistella* Ashmead, 1904, occurring widely in the Old World (except Europe), includes nearly 80 species (Carpenter 1996a, b).

So far only two species in the subgenus *Gyrostoma* (*P. olivaceus* and *P. rothneyi*) and three species in the subgenus *Polistella* (*P. meadeanus*, *P. sagittarius* and *P. stigma*) have recorded from Peninsular Malaysia. Considering that wasps of the genus *Polistes* in Asia show much more divergence in subtropics and temperate regions than in tropics (Carpenter 1996a), this number of species in Peninsular Malaysia may not be much lower than the number of species really occurring there.

Key to *Polistes* species so far recorded from Peninsular Malaysia

Polistes flavobilineatus (Cameron, 1902) described as *Icaria flavobilineata* from Sarawak of Borneo was recorded also from Myanmar and Thailand (Dover 1931) and is expected to occur in the Peninsular Malaysia, but its identity is not yet certain and is not included in this key.

1 Clypeus not produced above anterior tentorial pits. Pronotal fovea present. Prestigma about as long as or longer than half length of pterostigma.....2, subgenus *Gyrostoma*
Clypeus dorsally produced well above anterior tentorial pits (Fig. 13). Pronotal fovea, epicnemial carina and dorsal groove all absent. Prestigma short, distinctly shorter than half length of pterostigma.….....3, subgenus *Polistella*

2. Propodeum with transverse striae strong and almost reaching the ventral margins of the lateral sides; anterolateral corners in posterodorsal view rather strongly angled. Occipital carina of female complete. Apex of male terminal antennal

flagellomere flattened and widened ……..*P. rothneyi*
Propodeum with transverse striae weak, obliterated in ventral parts of the lateral sides; anterolateral corners not produced laterally. Male terminal antennal flagellomere not flattened.....*P. olivaceus*

3. First metasomal segment elongate, with basal part more or less distinctly petiolate.....*P. meadeanus*
First metasomal segment subsessil, conical in shape in dorsal view.....4

4. Smaller species; forewing length about 10 mm or less. Gena proportionally narrow, in profile less than 0.7 times as wide as eye in female. Wings transparent, with dark spot in marginal cell. Body black, extensively marked with brown and yellow.....*P. stigma*
Larger species; forewing length nearly 20 mm. Gena wide, in profile about 0.9 times as wide as eye in female. Wings entirely strongly fuscous. Body ferruginous to dark brown, usually with dark orange-brown bands on second and/or first metasomal terga.....*P. sagittarius*

Subgenus *Gyrostoma* Kirby, 1828
***Polistes olivaceus* (DeGeer, 1773)**

Distribution. Madagascar, Réunion, Mauritius, Tanzania, Zanzibar, Amirantes, Seychelles, Chagos Archipelago, Egypt, Oman, Iran, Afghanistan, India, Sri Lanka, Nepal, Myanmar, southern China, Philippines, Vietnam, Laos, Cambodia, Thailand, Malay Peninsula including Singapore, Borneo, Sumatra, Borneo, Marianas, New Caledonia, Fiji, Tongas, Samoa, Society Is., Tahiti, Tuamotu Archipelago, Fakarava, Tahuata, Hiva Oa

***Polistes rothneyi* Cameron, 1900**

This species, represented by many local color forms including 17 that are formally given subspecific names, is widely distributed from Pakistan in the west to Java in the east, and to Japan in the north (van der Vecht 1968).

Distribution. Pakistan, India, Nepal, Myanmar, Vietnam, Malay Peninsula, Sumatra, Java, China, Korea, almost all islands of Japan.

Subgenus *Polistella* Ashmead, 1904

Polistes meadeanus (von Schulthess, 1913)

Distribution. Malay Peninsula, Borneo.

Polistes sagittarius de Saussure, 1853

Distribution. India, Nepal, southern China, Hong Kong, Myanmar, Thailand, Malay Peninsula including Singapore, Borneo, Sumatra, Borneo, Java, Bali, Lombok, Sulawesi, Flores, Sumbawa, Sumba, Sulawesi, Palawan.

Polistes stigma stigma (Fabricius, 1793)

Represented by many local color forms, this species widely occurs in the Oriental and Australian regions. Petersen (1987) made a rather extensive and intensive study on this species; however, his work seemed to bring another difficulty into the taxonomy of *P. stigma* or *P. stigma* species complex. That is, he has reduced the rank of two Papua-Australian species from species to subspecies and he established ten new subspecies each based on one or a few specimens. Here, however, according to his system, the distribution records are given for the nominotypical subspecies that is the only subspecies so far recorded from Peninsular Malaysia.

Distribution. Thailand, Malay Peninsula including Singapore, Borneo, Sumatra, Java, Bali, Lombok, Taiwan.

Tribe Ropalidiini

Genus *Parapolybia* de Saussure, 1854

In this genus, five species are currently recognized valid. They are two species endemic to the Middle-east, *P. escalerae* (Meade-Waldo, 1911) and *P. persica* (Meade-Waldo, 1911), *P. nodosa* van der Vecht, 1966 known to occur in continental Asia and Taiwan, and *P. indica* (de Saussure, 1854) and *P. varia* (Fabricius, 1787), both distributed widely in Asia (van der Vecht 1966). Only *P. varia* has been recorded from Peninsular Malaysia.

Parapolybia varia (Fabricius, 1787)

In this species, two subspecies, nominotypical subspecies and *furva* van der Vecht, 1966, are currently recognized. *Prapolybia varia furva* is known to occur in the northwestern part of New Guinea, and the below listed distribution records are of the nominotypical subspecies.

Distribution. India, Nepal, Myanmar, Thailand, Malay Peninsula, Borneo, Sulawesi, Sumbawa, Sumba, Philippine Is., Riouw-Archipelago (= Kepulauan Riau), China, Korea, Japan.

Genus *Polybioides* du Buysson, 1913

The wasps of this genus show a disjunct distribution pattern, with two [*P. melainus* (Meade-Waldo, 1911) and *P. tabidus* (Fabricius, 1781)], of the six species being Afro-tropical in distribution and the other four species distributed in Southeast Asia. Three of the four Southeast Asian species have been recorded in the Malay Peninsula; *P. augustus* van der Vecht, 1966 is endemic to Palawan Island in the Philippines (van der Vecht 1966).

Key to *Polybioides* species so far recorded from Peninsular Malaysia

1. Metasomal sterna entirely yellow. Mesepisternum yellow, sometimes with ill-defined brown spot on ventral side. First metasomal segment about 4.5 times as long as its maximum width. Mesoscutum without yellow spot.....*P. raphigastra*
   Metasomal sterna dark brown with yellow apical margin. Mesepisternum dark brown to nearly black, with large, well defined yelow mark.....2
2. First metasomal segment relatively less slender, about 4 times as long as its maximum width; tergum laterally with yellow line running from base to apex. Mesoscutum with yellow median spot near posterior margin.....*P. psecas*
   Fist metasomal segment more slender, about 4.5 to 5 times as long as its maximum width; lateral yellow lines on the tergum present only in posterior two-thirds. Mesoscutum without yellow spot.....*P. gracilis*

***Polybioides gracilis* van der Vecht, 1966**

Distribution. Myanmar, Malay Peninsula, Vietnam.

***Polybioides psecas* (du Buysson, 1913)**

Distribution. Thailand, Malay Peninsula, Borneo, Sumatra, Nias.

***Polybioides raphigastra* (de Saussure, 1854)**

Specimens in the CIS. Negeri Sembilan: 200 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (2 females, 15.iv.2002; 12.v.2002; 9 females, 10.vi.2002; 8 females, 21.vi.2002; 5 females, 13.vii.2002; 10 females, 21.vii.2002; 3 females, 17.viii.2002; 10 females, 19.viii.2002; 3 females, 15.ix.2002; 21 females, 23.ix.2002; 6 females, 24.x.2002; 11 females, 21.xi.2002; 7 females, 21.xii.2002; 3 females, 4.i.2003; 21.i.2003; 4 females, 12.v.2002; 12.v.2002; 8 females, 20.v.2002; 6 females, 9.vi.2002; 9 females, 22.vi.2002; 5 females, 7.vii.2002; 17 females, 20.vii.2002; 6 females, 17.viii.2002; 17.viii.2002; 4 females, 18.viii.2002; 6 females, 7.ix.2002; 7.ix.2002; 3 females, 10.xi.2002; 10.xi.2002; 10 females, 22.ix.2002; 2 females, 23.x.2002; 23.x.2002; 9 females, 24.x.2002; 3 females, 10.xii.2002; 31.i.2003; 2 females, 15.iii.2003); **Kelantan:** 23 females, Dabong G. Stong, 25-28.v.2003, CIS (Trial 3); **Kedah:** 6 females, Sik H.S. Ulu Muda, 23-29.iii.2003, CIS (Permatang); **Perak:** 8 females, Grik, H.S. Belum, 26-31.vii.2003, CIS (Trek 3); **Selangor:** 3 females, Hutan Simpan Sg. Lalang, xii.1999 (MT), Noor Farikhah Haneda; **Johor:** 1 female, Sagil, G. Ledang, 600 m, 1-28.ii.2003, Chew Keng Ling; **Borneo, Sabah:** 2 females, Lembah Danum, 27.iv.2003, CIS (NT).

Distribution. Malay Peninsula, Borneo, Sumatra, Nias, Natuna Is.

Genus *Ropalidia* Guérin-Méneville, 1831

Key to *Ropalidia* species so far recorded from Peninsular Malaysia

The present key is for females but is possibly applicable to males except for characters that usually exhibit sexual dimorphism, such as characters of the head. Figures for most of the major characters

used in this key are available in Nguyen *et al*. (2006a) and Kojima *et al*. (2007).

1. Propodeum with paired, longitudinal, basal carinae; propodeal orifice very narrow, slit-like, pointed above. Propodeal valvula large, broadly rounded. First metasomal tergum strongly swollen in posterior half both in lateral and anterodorsal views, but moderately narrowed near apex in dorsal view, dorsal face in profile depressed near apex; second segment obliquely cut off posteriorly, tergum longer than sternum.....2, *R. marginata* group
   Propodeum without such carinae; propodeal orifice broader, rounded above.....3
2. Propodeum with strong punctures between basal carinae; striations lateral to carinae strong. Second metasomal tergum usually completely black or mainly black with very narrow, yellow, apical band.....*R. magnanima*
   Propodeum with week striation between basal carinae; striations lateral to carinae weak. Second metasomal tergum reddish-brown, with wide, yellow, apical band.....*R. marginata*.
3. Basal angle of forewing second submarginal cell distinctly less than 90°.....4, *R. stigma* species group
   Basal angle of forewing second submarginal cell larger than 90°.....5
4. Preapical part of second metasomal tergum strongly swollen mediodorsally.....*R. artifex*
   Preapical part of second metasomal tergum not swollen dorsally Ventral metapleuron smooth, without punctures.....*R. stigma*
5. Ventral corner of pronotum obliqiely cut off. First metasomal tergum abruptly swollen dorsally near posterior margin of basal slit to receive metasomal suspensory ligament.....*R. rufoplagiata*
   Ventral corner of pronotum gradually narrowed ventrally. First metasomal tergum in lateral view gradually swollen posteriorly.....6

6. Propodeal valvula large, in lateral view covering most part of propodeal teeth forming orifice…….....…7
   Propodeal valvula small, in lateral view most part of propodeal teeth visible…….……9
7. Posterior margin of head in dorsal view broadly and shallowly emarginate medially. Pronotal carina barely sinuate backward at humeral angle. Propodeal valvula large, nearly circular. First metasomal segment long, with posterior widened part of the tergum in dorsal view more or less gradually swollen posteriorly, then narrowed again near apical margin.....*R. fasciata*
   Posterior margin of head in dorsal view barely emarginate medially. Pronotal carina strongly sinuate backward at humeral angle. Propodeal valvula rounded-trianlge. First metasomal segment short, with posterior widened part of the tergum in dorsal view gradually swollen toward apical margin, or parallel-sided or only slightly narrowed near posterior margin..... 8, *R. variegata* species group
8. Median furrow of propodeum usually indistinct. First metasomal tergum in lateral view with dorsal margin more or less evenly convex, highest at level of posterior margin of the sternum.....*R. variegata*
   Median furrow of propodeum usually distinct. First metasomal tergum in lateral view with dorsal margin more strongly convex in posterior half, highest slightly posterior to level of posterior margin of the sternum.....*R. jacobsoni*
9. Mandible twisted; all teeth in the same plain as clypeus and their entire parts visible in frontal view.....10, *R. malayana* species group
   Mandible not twisted.....11
10. Head in dorsal view with lateral sides behind eyes relatively strongly convex and converging posteriorly in posterior half; gena in lateral view about as wide as eye, Pronotum ferruginous to black; mesoscutum usually black.....*R. malayana*
    Head in dorsal view with lateral sides behind eyes weakly convex and converging posteriorly from the posterior margins

of eyes; gena in lateral view about 0.75 times as wide as eye. Pronotum and mesoscutum usually reddish-brown…….....……*R. erythrospila*

11. Border between punctured posterodorsal area and unpunctured anteroventral area of mesepisternum distinct, often marked by carina. Posterior margin of first metasomal sternum not deeply emerginata.....12
    Border between punctured posterodorsal area and unpunctured anteroventral area of mesepisternum indistinct; punctures often extending into anteroventral part, though very sparsely. Posterior margin of first sternum deeply emerginate medially.....17
12. Second metasomal segment in lateral view obliquely cut off posteriorly, with tergum shorter than sternum. Body black; most of first metasomal tergum red.....13
    Second metasomal segment in lateral view vertically cut off posteriorly, or if obliquely cut off, with tergum slightly longer than sternum.....14
13. First flagellomere of female antenna distinctly less than twice as long as its apical width. Apical margin of second metasomal segment slightly depressed..... *R. curvilineata*
    First flagellomere of female antenna distinctly more than 2.5 times as long as its apical width. Apical margin of second metasomal segment strongly depressed.....*R. sumatrae*
14. Marginal cell with well-defined dark cloud occupying the distal half to two-thids of the cell; proximal part hyaline. Small, body length (head + mesosoma + first two metasomal segments) 5 to 7.5 mm .....*R. cyathiformis*
    Marginal cell entirely dark brown or yellow.....15
15. Marginal cell entirely yellow. Propodeum with distinct striae, interposed with reticulate punctures laterally. Body black, except for first metasomal segment red..... *R. granulata*
    Marginal cell dark brown. Propodeum at most finely sculptured……16
16. Female gena in profile distincly narrower than eye. Propodeum evenly rounded, with narrow, shallow median furrow. Body dark reddish-brown, extensively marked with yellow.....*R. latebalteata*

Female gena in profile about as wide as eye. Propodeum median concavity. Body black, except for first metasomal segment red..... *R. modesta*

17. Body relatively large, length (head + mesosoma + first two metasomal segments) 9 to 10 mm. Occipital carina prominently widened in ventral part. Body surface shiny, nearly impunctate.....*R. decorata*
    Smaller, body length (head + mesosoma + first two metasomal segments) usually less than 8.5 mm. Occipital canina fine or only slightly widened in near mandibular base.....18
18. Frons and mesoscutum dull, with dense microscopic punctures, without corse large punctures. Small, body length (head + mesosoma + first two metasomal segments) less than 7.5 mm. Body extensively marked with yellow..... *R. opifex*
    Frons and mesoscutum dull, covered with dense microscopic punctures and corse, larger, falt-bottomed punctures.....19
19. Marginal cell uniformly and strongly infuscated, infuscation extending slightly beyond the limits of the cell.....*R. aristocratica*
    Marginal cell infuscated along anterior margin, posterior part distincly less dark.....20
20. Mesoscutum entirely black. Smaller, body length (head + mesosoma + first two metasomal segments) 6-7 mm. First metasomal segment short, about 1.5 times as long as its maximum width.....*R. timida*
    Mesoscutum with paired, longitudinal yellow stripes. Larger, body length (head + mesosoma + first two metasomal segments) usually more than 7 mm…….....21
21. Occipital carina in lateral view weakly bent anteriorly at level near mid-height of eye (less distinct in the male), then running down in nearly straight line. First metasomal segment rather short; in profile dorsal face of tergum rising from posterior end of reception of propodeal suspensory ligament, then weakly curved down towards posterior margin, but slightly concave near posterior margin. Yellow spot on

each lateral side of second metasomal tergum reduced.....*R. flavopicta*
Occipital carina in lateral view smoothly curved. First metasomal segment proportionally longer and more slender; in profile dorsal face of tergum slightly concave just after reception of propodeal suspensory ligament, then gradually rising. Yellow spot on each lateral side of second metasomal tergum large.....*R. ornaticeps*

***Ropalidia aristocratica* (de Saussure, 1853)**
Distribution. Thailand, Malay Peninsula, Sumatra.

***Ropalidia artifex* (de Saussure, 1853)**
Distribution. Myanmar, Malay Peninsula, Sumatra, Borneo, Java.

***Ropalidia curvilineata* (Cameron, 1908)**
Distribution. Malay Peninsula, Borneo, Sumatra.

***Ropalidia cyathiformis* (Fabricius, 1804)**
Specimens in CIS. Kuala Lumpur: 50 females, Bukit Namas Forest Reserve, N.G. Foo, Azura, Zabidi & Ruslan (13 females, viii. 2002; 11 females, ix. 2002; 26 females, x.2002).
Distribution. Nepal, India (Utter Pradesh, Arunachal Pradesh, Bihar, Assam, Madhya Pradesh, Maharashtra, Goa, Karnatakas, Kerala), Sri Lanka, Myanmar, Thailand, Malay Peninsula, Vietnam, Java, Bali, Lombok, Flores, Sumba, Sulawesi, Philippine Is.

***Ropalidia decorata* (Smith, 1858)**
Distribution. Malay Peninsula, Borneo, Sumatra.

***Ropalidia erythrospila* (Cameron, 1908)**
Distribution. Malay Peninsula, Borneo, Sumatra.

***Ropalidia fasciata* (Fabricius, 1804)**
Distribution. Nepal, India (Uttar Pradesh, Sikkim, Arunachal Pradesh, Assam, Tripura, Maharashtra, Tamil Nadu), Sri Lanka,

Myanmar, Thailand, Malay Peninsula, Vietnum Sumatra, Nias, Bangka Is., Java, Karimon Djawa Is., Bali, Komodo, Flores, Timor, Borneo, South China, Palawan, Taiwan, Ryukyu Islands.

***Ropalidia flavopicta* (Smith, 1857)**

Specimen in CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 23.iv.2002, Ng Y.-F. & Ruslan M.Y.

Distribution. Hong Kong, Vietnam, Malay Peninsula, Borneo, Sumatra.

***Ropalidia granulata* van der Vecht, 1941**

Specimen in the CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 15.iii.2003, Ng Y.-F. & Ruslan M.Y.

Distribution. Malay Peninsula, Sumatra.

***Ropalidia jacobsoni* (du Buysson, 1908)**

Distribution. India (Delhi, Utter Pradesh, Rajasthhan, Maharashtra, Karnataka, Kerala, Tamil Nadu, Assam, Bangalore), Myanmar, Bangka, Sumatra, Java, Lombok, Sulawesi.

***Ropalidia latebalteata* (Cameron, 1902)**

Specimens in the CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 23.x.2002, Ng Y.-F. & Ruslan M.Y.; **Selangor**: 1 female, Air Hitam, UPM, 9.v.2000, Idris A.B. & Ruslan

Distribution. Malay Peninsula, Borneo, Sumatra.

***Ropalidia magnanima* van der Vecht, 1941**

Distribution. India (Kerala), Myanmar, Vetnam, Malay Peninsula.

***Ropalidia malayana* (Cameron, 1903)**

Specimen in the CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 21.xi.2002, Ng Y.-F. & Ruslan M.Y.

Distribution. Vietnam, Malay Peninsula, Sumatra, Sunda Shelf, Borneo.

***Ropalidia marginata* (Lepeletier, 1836)**

Distribution. Pakistan, India (Pinjab, Uttar, Pradesh, West Bengal, Rajasthan, Gujarat, Madhya Pradesh, Orissa, Maharashtra, Andhra

Pradesh, Kenataka, Kerala, Tamil Nadu), Sri Lanla, Myanmar, Vietnam, Malay Peninsula, Borneo, Bangka, Sumatra, Java, Kariman Djawa, Bali, Lombok, Sumbawa, Sumba, Sulawesi, Talud Islamds, Lesser Sunda Is., Sulawesi, Talud Is., Tukang Besi Is., Philippine Is., Mariana Is., Palau Is., Volcano Is., New Guinea, New Britain, Australia (Thursday Is, Queensland).

***Ropalidia modesta* (Smith, 1858)**

Distribution. Myanmar, Thailand, Malay Peninsula, Vietnam, Borneo, Sumatra, Java.

***Ropalidia opifex* van der Vecht, 1962**

Distribution. Malay Peninsula, Borneo, China (Yunnan).

***Ropalidia ornaticeps* (Cameron, 1900)**

Distribution. India (Assam, Tripura), Myanmar, Thailand, Cambodia, Malay Peninsula, Vietnam.

***Ropalidia rufoplagiata* (Cameron, 1905)**

Distribution. India (Uttar Pradesh, Karnataka, Kerala, Maharashtra), Andaman Is., Myanmar, Thailand, Vietnum, Malay Peninsula, Sumatra, Bangka, Java, Lombok, Sumbawa, Timor.

***Ropalidia stigma* (Smith, 1858)**

Specimens in the CIS. Negeri Sembilan: 27 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (21.i.2003; 2 females, 20.v.2002; 21.iv.2002; 9.vi.2002; 4 females, 22.vi.2002; 13.vii.2002; 1♀, 20.vii.2002; 3 females, 21.vii.2002; 18.viii.2002; 19.viii.2002; 2 females, 22.ix.2002; 23.ix.2002; 23.x.2002; 24.x.2002; 20.xi.2002; 21.xii.2002; 3.i.2003; 2 females, 4.i.2003; 15.iii.2003).

Distribution. Nepal, India(Utter, Pradesh, Sikkim, Bihar, West Bengal, Assam, Meghalaya, Manipur, Tripura, Madhya Pradesh, Orissa, Maharashtra, Goa, Kerala)), Sri Lanka, Myanmar, Thailand, China (Hainan), Malay Peninsula, Vietnam, Borneo, Sumatra, Java, Bali, Philippine Is.

***Ropalidia sumatrae* (Weber, 1801)**

Specimens in the CIS. Negeri Sembilan: 4 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (12.v.2002; 2 females, 10.vi.2002; 23.x.2002); **Pahang:** 1 female, Hutan Kuala Lompat, 3.xi.1999, Ruslan & A. Nizar.

Distribution. India (West Bengal), Myanmar, Thailand, Malay Peninsula (**new record**), Vietnam, China (Yunnan), Borneo, Bangka, Sumatra.

***Ropalidia timida* van der Vecht, 1962**

Distribution. Malay Peninsula, Borneo, Sumatra.

***Ropalidia variegata* (Smith, 1852)**

Distribution. Pakistan, India (Kashimir, Punjab, Delhi, Uttar Pradesh, Bihar, West Bengal, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala), Nepal, Myanmar, Malay Peninsula, China, Sulawesi.

Subfamily Vespinae

Genus *Provespa* Ashmead, 1903

Key to *Provespa* species

1. Female; antenna with ten flagellomeres; metasoma six segmented……..2
   Male; antenna with 11 flagellomeres; metasoma seven segmented.....4
2. Anterior margin of clypeus distinctly emarginate medially, with lateral angles of the emargination roundly prominent, somewhat raised. Metasoma elongate. Clypeus pale brown to brown.....*P. nocturna*
   Anterior margin of clypeus only slightly emarginate medially or nearly straight.....3
3. Body slender, with metasoma in dorsal view nearly 1.5 times as long as wide (including regulae); mesoscutum distinctly longer than wide. First metasomal segment slender, in dorsal view apical width about 1.7 times the length of the segment. Clypeus pale brown to brown.....*P. anomala*

Body stouter, with metasoma in dorsal view less than 1.3 times as long as wide (including tegulae); mesoscutum scarcely longer than wide. First metasomal segment stouter, in dorsal view apical width about twice the length of the segment. Clypeus pale yellow, darker along the margins..... *P. barthelemyi*

4. Anterior margin of clypeus shallowly but distinctly emarginate medially. Antenna without tyloides....*P. nocturna*
   Anterior margin of clypeus barely emarginate, nearly straight.....5
5. Antenna with linear raised ridges (tyloides)....*P. barthelemyi*
   Antenna without tyloides.....*P. anomala*

Provespa anomala (de Saussure, 1854)

Specimens in CIS. Negeri Sembilan: 8 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (12.iv.2002; 17.viii.2002; 2 females, 18.viii.2002; 15.ix.2002; 11.xi.2002; 21.i.2003); **Selangor:** 8 females, Hutan Simpan Sg. Lalang, ix.1999 (MT), Noor Farikhah Haneda. **Borneo, Sabah:** 1 female, Lembah Danum, 27.iv.2003, CIS (NT).

Distribution. India (Uttar Pradesh, Sikkim), Myanmar, Thailand, Malay Peninsula including Singapore, Sumatra, Bangka, Batu Is., Java, Borneo.

Provespa barthelemyi (du Buysson, 1905)

This species was recorded, in Peninsular Malaysia, from only northern part.

Distribution. India (Sikkim, Assam), Bhutan, China (Yunnan, Guangxi), Myanmar, Thailand, Malay Peninsula, Laos, Cambodia, Vietnam.

Provespa nocturna van der Vecht, 1935

Specimens in CIS. Selangor: 2 females, Hutan Simpan Sg. Lalang, ix.1999 (MT), Noor Farikhah Haneda.

Distribution. Vietnam, Malay Peninsula, Sumatra, Bangka, Borneo.

Genus *Vespa* Linnaeus, 1758

Key to *Vespa* species so far recorded from Peninsular Malaysia

Figures for most of the major characters used in this key are available in Nguyen *et al*. (2006b).

1. Female; antenna with ten flagellomeres; metasoma six segmented……...2
   Male; antenna with 11 flagellomeres; metasoma seven segmented…….....8
2. Anterior margin of clypeus with broad and rather deep median emargination, lateral edges of emargination forming broadly rounded lobes, with median bluntly triangular tooth.....…….….....*V. analis*
   Anterior margin of clypeus more or less emarginated, without median tooth…….....…….……3
3. Head enlarged and swollen behind eyes; in lateral view gena more than 1.8 times eye width. Pronotum with median impression. First metasomal tergum short, less than half as long as wide in dorsal view.....*V. mandarinia*
   Head not swollen behind eyes; gena less than 1.4 times eye width.....4
4. Pretegular carina incomplete, only extending to or only slightly beyond center of spiracular operculum. Center of the clypeus usually covered by small punctures, with inter-puncture distance more than puncture diameter …….....5
   Pretegular carina complete, crossing spiracular operculum. Center of the clypeus covered by coarse and large punctures, with distance between punctures less than puncture diameter.…….....….....…….....….....6
5. Clypeus with black markings.....*V. multimaculata*
   Clypeus without black markings.....*V. velutina*
6. Clypeus with bluntly triangular tooth on each side of the apical emargination.....…….....*V. tropica*
   Clypeus with short, broadly rounded lobe on each side of the apical emargination…….....….……...7
7. Mesoscutum, vertex and propodeum with distances between punctures greater than puncture diameter. Ventrolateral part

of pronotum rugose, with transverse striae. Vertex yellow-brown; second metasomal tergum black.....*V. mocsaryana*
Mesoscutum, vertex and propodeum with distances between punctures less than puncture diameter. Ventrolateral part of pronotum not rugose. Vertex black; second metasomal tergum orange-yellow.....*V. affinis*

8. Head strongly swollen behind eyes; in lateral view gena more than 1.3 times eye width.....*V. mandarinia*
Head not swollen behind eyes; in lateral view gena less than 1.2 times eye width.....9
9. Pretegular carina complete.....10
Pretegular carina incomplete.....13
10. Apical margin of sixth metasomal sternum shallowly emarginate. Second metasomal tergum entirely orange-yellow.....*V. tropica*
Apical margin of sixth metasomal sternum deeply emarginate.....11
11. Metapleura covered with rather dense punctures. Seventh metasomal tergum medially with short, sharp apical notch.....*V. affinis*
Metapleura nearly impunctate. Seventh metasomal tergum without apical notch.....12
12. Anterior margin of clypeus depressed. Incision of sixth metasomal sternum semi-elliptical, wider than deep..... *V. analis*
Anterior margin of clypeus hardly depressed. Incision of sixth metasomal sternum about as wide than deep.....*V. mocsaryana*
13. Clypeus finely punctate.....*V. velutina*
Clypeus rather coarsely punctate.....*V. multimaculata*

Vespa affinis (Linnaeus, 1764)

Distribution. India (Bihar, West Bengal, Maharashtra, Karnataka, Tamil Nad, Kerala, Sikkim, Assam), Sri Lanka, Myanmar, China (Hainan, Xianggang, Guangdon, Fujian, Guangxi, Hunan, Hubei, Shanghai), Taiwan, Ryukyu Is. south of Miyako I., Thailand, Laos, Vietnam, Malay Peninsula including Singapore, Borneo, Sumatra,

Nias, Bangka, Java, Sulawesi, Talaud Is., Buton, Salayar, Sunda Islands, Timor, Moluccas (Morotai, Ternate, Tidore, Halmahera, Bacan, Buru, Ambon, Saparua, Haruku, Seram), Kai, Misool, Salawati, Waigeo, Sorong, Yapen, New Guinea, New Britain, New Ireland, Palawan, Dumaran, Labuan, Mindanao, Samar, Luzon.

Vespa analis Fabricius, 1775

Distribution. India (Kashmir, Uttar Pradesh, West Bengal, Tamil Nadu, Meghalaya, Sikkim, Assam), Nepal, China (Sichuan, Yunnan, Hainan, Guangxi, Fujian, Hubei, Zhejiang, Heilongjiang), Myanmar, Thailand, Laos, Malay Peninsula including Singapore, Borneo, Sumatra, Bangka, Sunda Is. (Sebesi, Sangijiang, Sebuku, Sertung, Madura, Lombok, Legundi, Rakata, Krakatau, Panaitan, Deli), Java, Bawean, Bali, Taiwan, Korea, Japan, including Ryukyu Is., Russia (Amur, Primor'ye).

Vespa mandarinia Smith, 1852

Distribution. Distribution: India (Himachal Pradesh, Uttar Pradesh, West Bengal, Sikkim, Assam, Meghalaya), Sri Lanka, Nepal, Bhutan, Myanmar, Thailand, Laos, Malay Peninsula, China (Sichuan, Yunnan, Xianggang, Jiangxi, Fujian, Hubei, Shanghai, Jiangsu), Taiwan, Russia (Primor'ye, Korea), Japan, including Yaku-shima I. and Tanega-shima I.

Vespa mocsaryana du Buysson, 1905

Specimens in CIS. Negeri Sembilan: 16 females, 5 males, Pasoh Forest Reserve, 21.i.2003, Ng Y.-F. & Ruslan M.Y. (1 female, 15.iv.2002; 1 female, 2 males, 10.vi.2002, 2 males, 21.vi.2002; 1 male, 12.iv.2002; 1 female, 13.vii.2002; 2 females, 18.viii.2002; 1 female, 7.ix.2002; 3 females, 22.ix.2002; 2 females, 23.x.2002; 3 females, 24.x.2002; 1 female, 21.xii.2002; 1 female, 3.i.2003); **Selangor:** 1 female, Hutan Simpan Sg. Lalang, ix.1999 (MT), Noor Farikhah Haneda; Johor: 2 females, 1 male, Sagil, G. Ledang, 600 m, 1-28.ii.2003, Chew Keng Ling.

Distribution. India (Meghalaya, Sikkim, Assam), China (Sichuan, Fujian, Anhui), Myanmar, Thailand, Laos, Vietnam, Malay Peninsula, Sumatra.

Vespa multimaculata Pérez, 1910

Specimens in CIS. Negeri Sembilan: 1 female, Pasoh Forest Reserve, 21.i.2003, Ng Y.-F. & Ruslan M.Y.; **Kedah:** 6 females (including 2 queens), Sik H.S. Ulu Muda, 23-29.iii.2003, CIS (Bki. Putih); **Selangor:** 1 female, Hutan Simpan Sg. Lalang, xii.1999 (MT), Noor Farikhah Haneda; **Perak:** 1 female, Grik, H.S. Belum, 26-31.vii.2003, CIS (Trek 1); **Johor:** 2 females Sagil, G. Ledang, 1-31.iii.2003, Chew Keng Ling (1 female, 900 m; 1 female, 1000 m).

Distribution. Thailand, Malay Peninsula including Singapore, Sumatra, Borneo.

Vespa tropica (Linnaeus, 1758)

Specimens in CIS. Negeri Sembilan: 6 females, Pasoh Forest Reserve, Ng Y.-F. & Ruslan M.Y. (9.vi.2002; 2 females, 22.vi.2002; 21.vii.2002; 19.viii.2002; 4.i.2003).

Distribution. Afghanistan, Pakistan, India (Himachal Pradesh, Bihar, West Bengal, Maharashtra, Karnataka, Tamil Nadu, Kerala, Sikkim, Assam, Meghalaya), Andaman Is., Nicobar Is., Sri Lanka, Nepal, Bhutan, China (Yunnan, Xianggang, Fujian), Myanmar, Thailand, Laos, Cambodia, Vietnam, Malay Peninsula, Borneo, Anambas Is., Sumatra, Nias, Batu, Enggano, Bangka, Belitung, Sunda Is. (Sangijiang, Sebesi, Sebuku, Legundi, Krakatau, Panaitan), Java, Bawean, Madura, Kangean Is., Bali, Lombok, Komodo, Sumbawa, Sumba, Flores, Wetar, Timor, Sulawesi, Salayar, Sula Is., Moluccas (Morotai, Halmahera, Ternate, Tidore, Bacan, Obi, Buru, Ambon, Haruku, Seram), Banda, Waigeo, Aru, New Guinea, New Britain, Philippine Islnds

Vespa velutina Lepeletier, 1836

Distribution. India (West Bengal, Sikkim, Assam), Bhutan, China (Sichuan, Jiangxi, Fujian, Hubei, Zhejiang, Xianggang), Taiwan, Myanmar, Thailand, Laos, Vietnam, Malays Peninsula, Sumatra, Java, Bali, Lombok, Sumbawa, Komodo, Sumba, Flores, Timor, Sulawesi.

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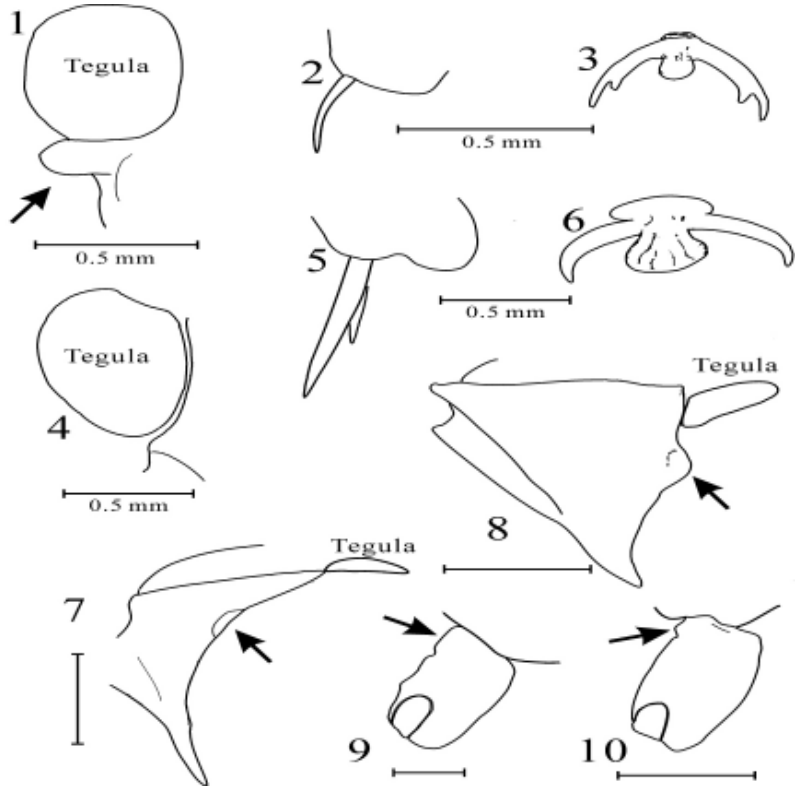
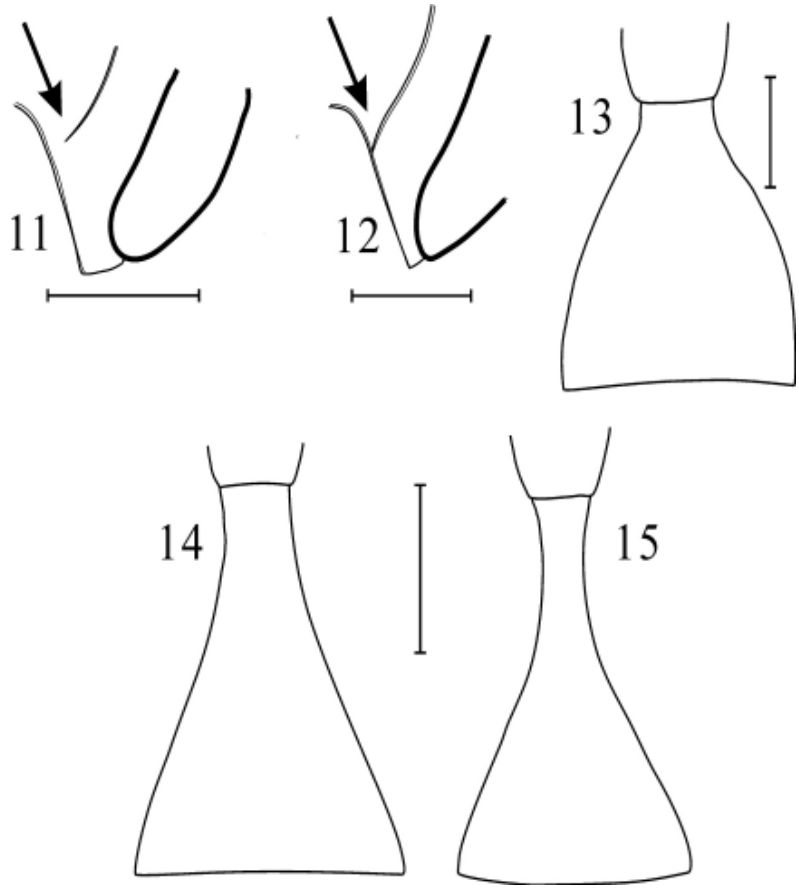
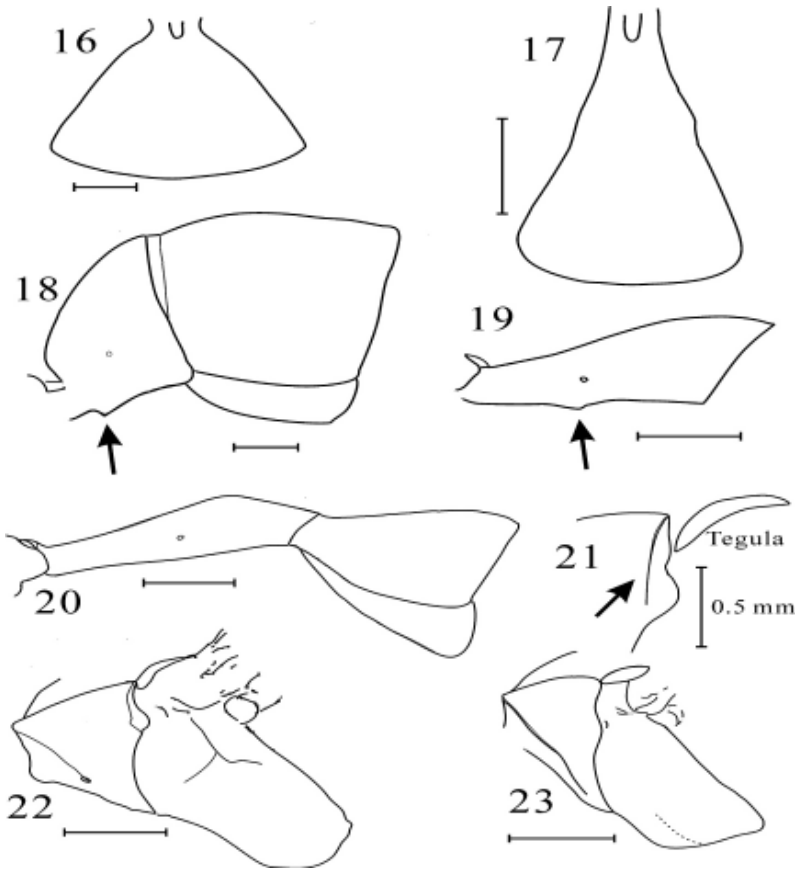


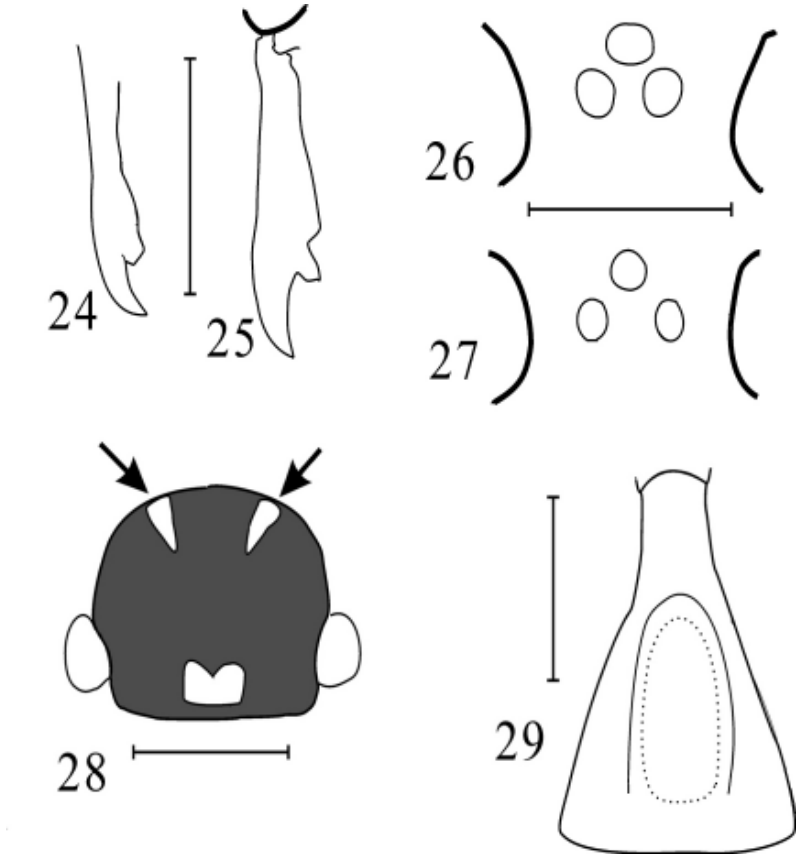
Figs. 1-10. Characters separating social wasp genera known from Peninsular Malaysia. 1, 4. Tegula and part of mesoscutum behind it. An arrow shows the parategula. 2, 5. Apical part of hind tibia, showing tibial spur(s). 3, 6. Tarsal claws of hind tarsus. 7, 8. Pronotum and tegula in lateral view. An arrow shows the pronotal lobe. 9, 10. Hind coax. An arrow shows forsal carina. 1-3. *Eumenes inconspicuous* (Eumeninae). 4-6, 8. *Polistes meadeanus*. 7. *Eustenogaster calyptodoma*. 9. *Vespa analis*. 10. *Provespa anomala*. Scale lines, 1 mm unless indicated.



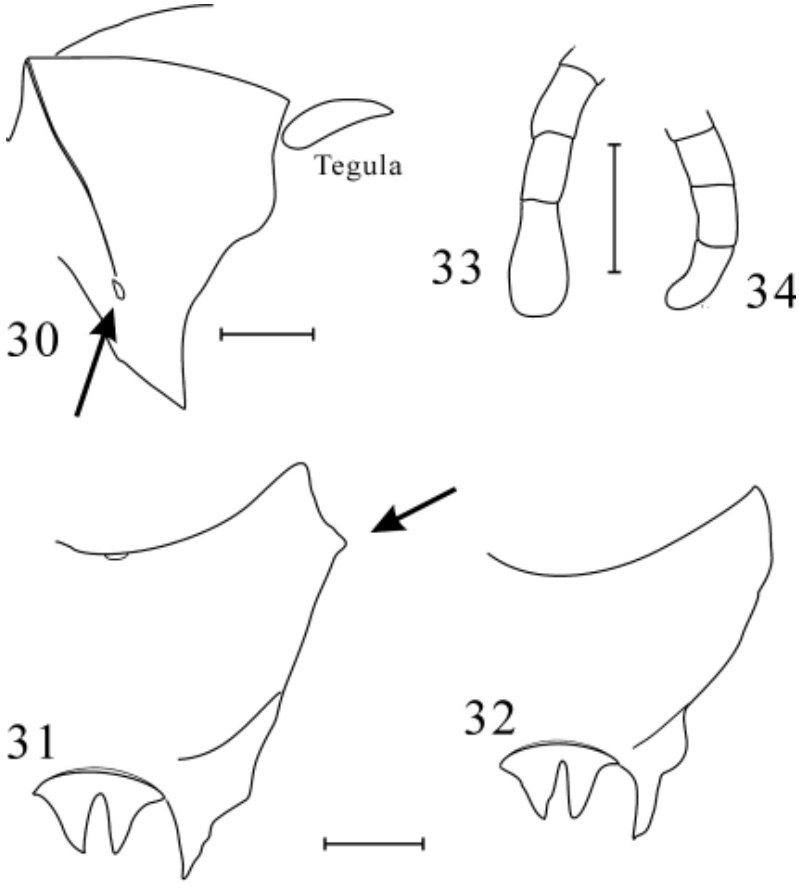
Figs. 11-15. Generic characters of Stenogastrinae. 11, 12. Occiput in posterior view. 13-15. Posterior part of first metasomal tergum and second metasomal tergum in dorsal view. 11. *Liostenogaster campanulae*. 12, 13. *Eustenogaster calyptodoma*. 14. *Parischnogaster alternate*. 15. *Parischnogaster mellyi*. Scale lines, 1 mm.



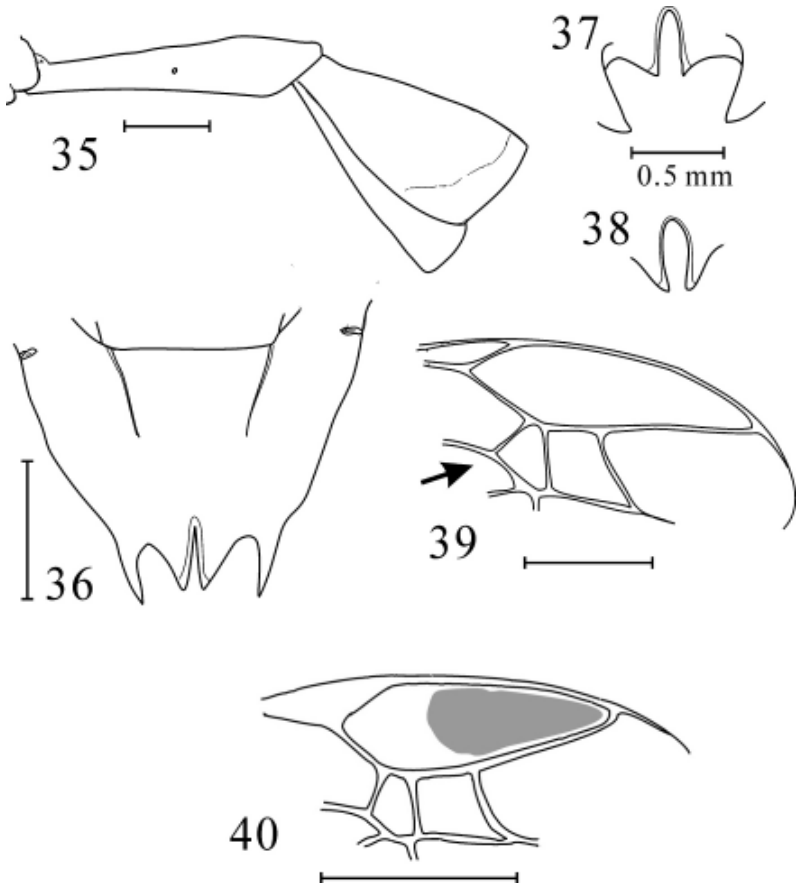
Figs. 16-23. Generic characters of Polistinae. 16, 17. First metasomal tergum in dorsal view. 18, 20. First and second metsomal segments in lateral view. An arrow shows the angulation of the sternum. 19. First metasomal segment in lateral view. An arrow shows the angulation of the sternum. 21. Posterior part of pronotum and tegula in lateral view. An arrow shows the pretegular carina. 22, 23. Pronotum and mesepisternum in lateral view. 16, 18. *Polistes Sagittarius*. 17, 18. *Polistes meadeanus*. 20-22. *Parapolybia varia*. 23. *Ropalidia stigma*. Scale lines, 1 mm unless indicated.



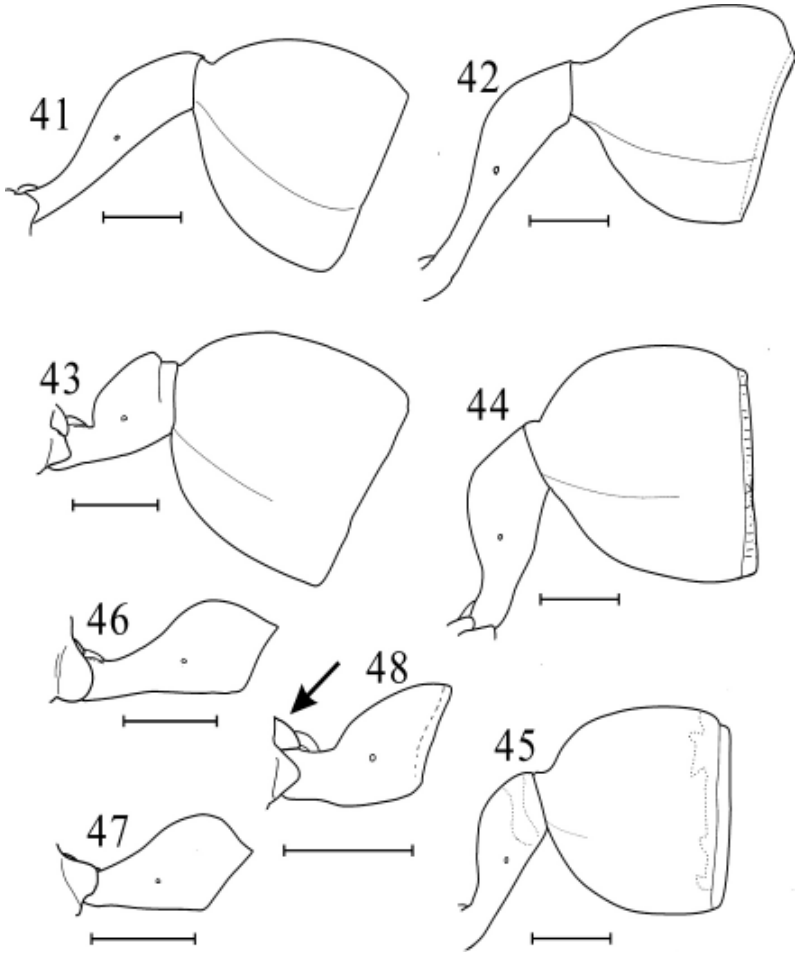
Figs. 24-29. Specific characters of Steogastrinae. 24, 25. Female mandible. 26, 27. Fenale ocelli and inner margins of eyes. 28. Female mesoscutum. Arrows indicate the notaular stripes. 29. Male second metasomal tergum in dorsal view. 24. *Liostenogaster filicis*. 25. *Liostenogaster nitidipennis*. 26. *Parischnogaster alternate*. 27, 28. *Parischnogaster mellyi*. 29. *Parischnogaster striatula*. Scale lines, 1 mm.



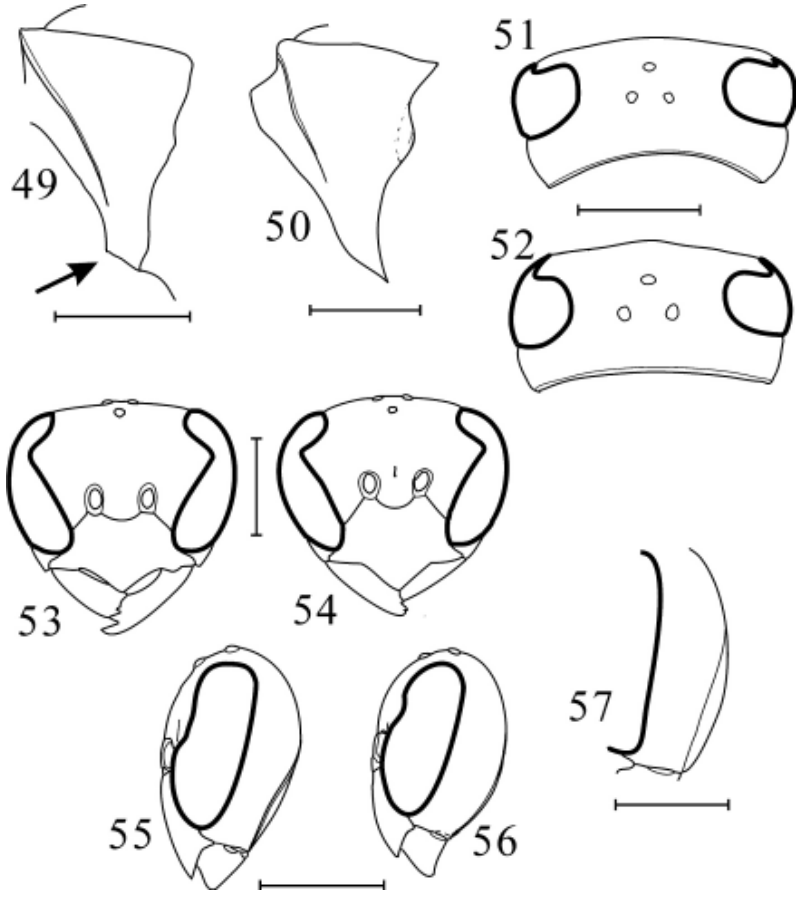
Figs. 30-34. Specific characters of *Polistes*. 30. Pronotum and tegula in lateral view. An arrow indicates the pronotal fovea. 31, 32. Propodum in posterodorsal view. 33, 34. Apical flagellomeres of male antenna. 30, 31, 33. *Polistes rothneyi*. 32, 34. *Polistes olivaceus*. Scale lines, 1 mm.



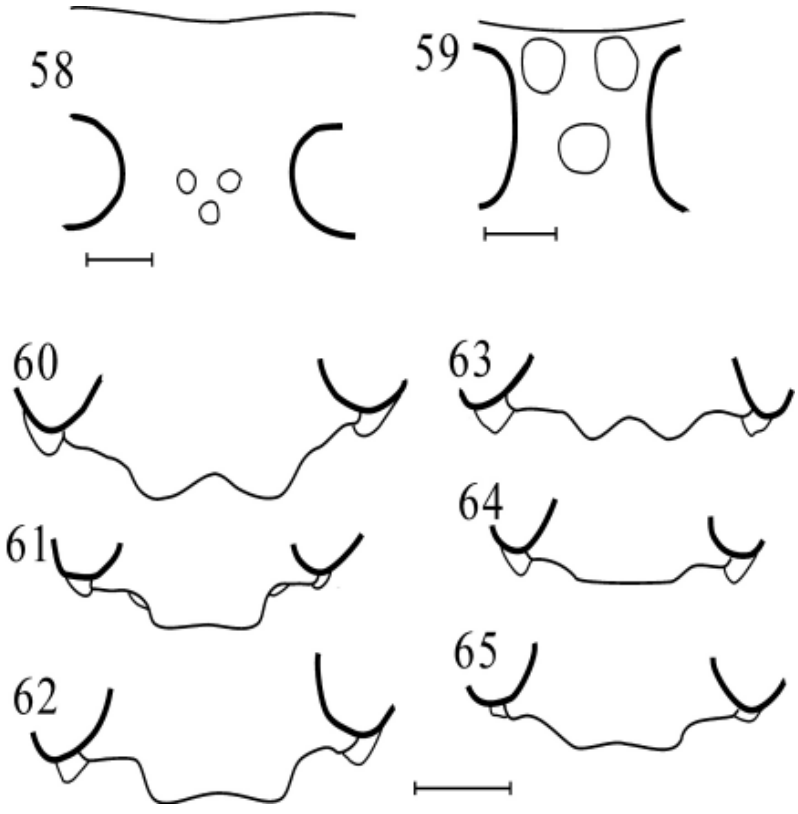
Figs. 35-40. Characters of Ropalidiini. 35. First and second metasomal segments in lateral view. 36. Propodeum in posterodorsal view. 37, 38. Propodeal orifice. 39, 40. Distal part of forewing. 35. *Polybioides raphigastra*. 36. *Ropalidia marginata*. 37, 39. *Ropalidia stigma*. 38. *Ropalidia flavopicta*. 40. *Ropalidia cyathiformis*. Scale lines, 1 mm.



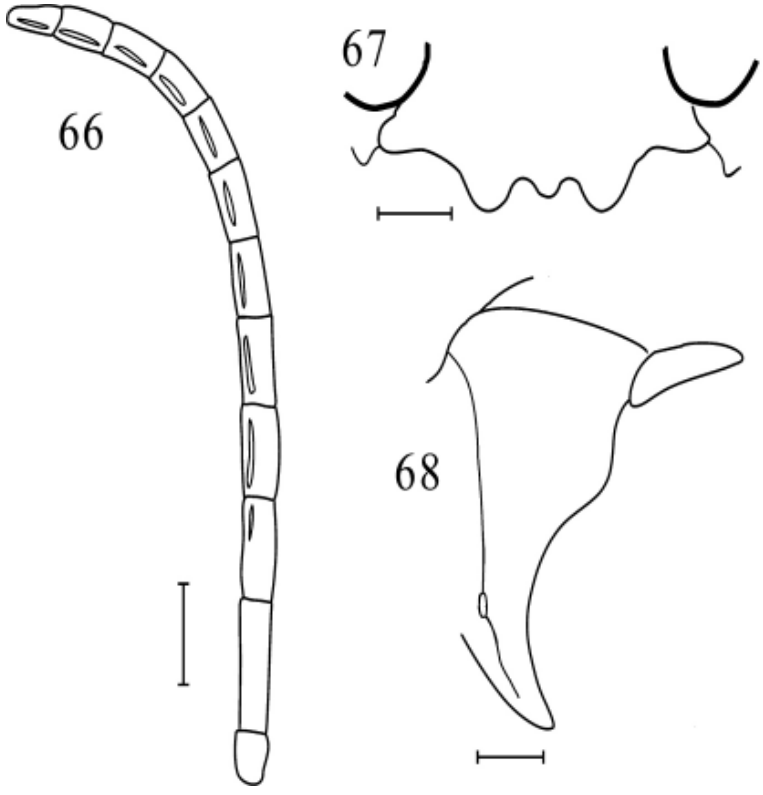
Figs. 41-48. Specific characters of *Ropalidia*. 41-45. First and second metasomal segment in lateral view. 46-48. Apical part of propodeum and first metasomal segment in lateral view. An arrow indicates the propodeal tooth. 41. *Ropalidia stigma*. 42. *Ropalidia artifex*. 43. *Ropalidia rufoplagiata*. 44. *Ropalidia sumatrae*. 45. *Ropalidia latebalteata*. 46. *Ropalidia fasciata*. 47. *Ropalidia variegate*. 48. *Ropalidia malayana*. Scale lines, 1 mm.



Figs. 49-57. Specific characters of *Ropalidia*. 49, 50. Pronotum in lateral view. An arrow shows the ventral corner obliquely cut off. 51, 52. Head in dorsal view. 53, 54. Head in frontal view. 55, 56. Head in lateral view. 57. Gena in lateral view, showing widened occipital carina. 49. *Ropalidia rufoplagiata*. 50. *Ropalidia sumatrae*. 51. *Ropalidia fasciata*. 52. *Ropalidia variegate*. 53. *Ropalidia malayana*. 54, 55. *Ropalidia flavopicta*. 56. *Ropalidia ornaticeps*. 57. *Ropalidia decorate*. Scale lines, 1 mm.



Figs. 58-65. Generic and specific characters of Vespinae. 58, 59. Vertex, showing ocelli, inner margins of eyes and posterior margin of head. 60-65. Clypeus (60-62. Female. 63-65. Male). 58. *Vespa analis*. 59, 61, 64. *Provespa anomala*. 60, 63. *Provespa nocturna*. 62, 65. *Provespa barthelemyi*. Scale lines, 1 mm.



Figs. 66-68. Characters of Vespinae. 66. Male antenna of *Provespa barthelemyi*. 67. Female clypeus of *Vespa analis*. 68. Pronotum and tegula of *Vespa analis* in lateral view.