STUDIES ON THE TAXONOMY OF MICROGASTRINAE (BRACONIDAE: HYMENOPTERA) OF KERALA STATE

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DOCTOR OF PHILOSOPHY IN ZOOLOGY

By

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CERTIFICATE

This is to certify that this thesis entitled "***Studies on the taxonomy of Microgastrinae (Braconidae: Hymenoptera) of Kerala state***" is an authentic record of the work done by **Mrs. Veena. T.,** for the Ph.D. course program of the University of Calicut from 2010-2016 under my guidance and supervision for the partial fulfillment of the requirements of the degree of Doctor of Philosophy in Zoology under the faculty of Science of the University of Calicut. No part of this thesis has been presented before for the award of any other degree

Place: **Dr. Lambert Kishore**

DECLARATION

I hereby declare that this thesis entitled "***Studies on the taxonomy of Microgastrinae (Braconidae: Hymenoptera) of Kerala state***" is an authentic record of the work carried out by me under the supervision of **Dr. Lambert Kishore,** Associate Professor, PG & Research Department of Zoology, Malabar Christian College, Kozhikode and no part of this thesis has previously formed the basis for the award of any degree or diploma as stipulated in the statutes of the University of Calicut.

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INTRODUCTION

The hymenopteran family, Braconidae includes entomophagous species, that are parasitoids of various crop pests. Hence, it is of great interest to the entomologists. Foerster (1862) erected Subfamily Microgastrinae, parasitoids of lepidopteran caterpillars, which includes many speciose genera. They are host - specific and extensively used in biological control efforts, and figure prominently in trophic webs. But due to extraordinary diversity, associated with the presence of many cryptic species, initiates a significant taxonomic hindrance.

Mason (1981) estimated that, the worldwide Microgastrinae contains about 5,000 to 10,000 species with more than 2,300 species described so far (Yu *et al*., 2012). Recently, Rodriguez *et al*. (2013) estimated that the species richness of microgastrines are 8 - 10 times more than the presently described ~2,000 species. Microgastrinae is a hyperdiverse Subfamily of parasitoid wasps, commonly encountered as pupae or pre - pupae encased in silky white cocoons, on or nearby dead or dying bodies of their host caterpillars. More than 100 species in this group are used and investigated worldwide in the biological control of lepidopteran pests, and the total is yet to rise (Wharton *et al*., 1997).

The classification of Microgastrinae became very complex over the last three decades (Whitfield, 1997). The generic and tribal classifications are facing many issues due to its worldwide allocation as well as character reduction (Shaw & Huddleston, 1991). Microgastrinae contain five tribes, 62 extant genera and 2645 extant species to the date (Fernández-Triana & Ward, 2016). There are extinct species in three genera viz., *Dacnusites* Cockerell, *Eocardiochiles* Brues, *Palaeomicrogaster* Belokobylskij (Fernández - Triana & Ward, 2016). The extinct species are of the Eocene and Oligocene period

(37-44 million years ago). Many specimens from the Miocene (20–30 MYA) are known from Dominican and Chiapas ambers, but most appear to be undescribed specimens of present genera (Murphy *et al*., 2008). Belokobylskij (2014) revised the taxonomic status of all previously known taxa of fossil Microgastrinae, and described one new genus and two new species. The origin of Microgastrinae has been estimated at ~54 MYA by Murphy *et al*. (2008).

The major genera of Apantelini are *Alphomelon* Mason, *Apanteles* Foerster, *Dasylagon* Muesebeck, *Dolichogenidea* Viereck, *Exoryza* Mason, *Exulonyx* Mason, *Illidops* Mason, *Miropotes* Nixon, *Papanteles* Mason, *Pholetesor* Mason, *Pelicope* Mason, *Promicrogaster* Brues & Richardson, *Sendaphne* Nixon and *Teremys* Mason. The most speciose genera among them are *Apanteles*, *Illidops* and *Dolichogenidea*. *Apanteles* is the genus, which contains 882 species described to the date (Fernández-Triana & Ward, 2016). Microgastrini contains *Beyarslania* Kocak & Kemal, *Choeras* Mason, *Clarkinella* Mason, *Hygroplitis* Thomson, *Hypomicrogaster* Ashmead, *Iconella* Mason, *Microgaster* Latreille, *Neoclarkinella* Rema & Narendran, *Paroplitis* Mason, *Prasmodon* Nixon, *Pseudapanteles* Ashmead, *Rhygoplitis* Mason, *Sathon* Mason and *Xanthomicrogaster* Cameron. The speciose genera of this Tribe are *Microgaster*, *Choeras*, and *Pseudapanteles*. Forniciini Tribe has *Fornicia* Brullé as a speciose genus. Cotesiini contains the following genera *Buluka* de Saeger, *Cotesia* Cameron, *Deuterixys* Mason, *Diolcogaster* Ashmead, *Distatrix* Mason, *Exix* Mason, *Glyptapanteles* Ashmead, *Larissimus* Nixon, *Nyereria* Mason, *Parapanteles* Ashmead, *Promicroplitis* Ashmead, *Protapanteles* Ashmead, *Rasivalva* Mason, *Venanus* Mason, *Venanides* Mason, and *Wilkinsonellus* Mason. The speciose genera in it are *Diolcogaster*, *Cotesia*, *Glyptapanteles*, *Protapanteles* and *Parapanteles*. Microplitini Tribe contains four genera namely *Alloplitis* Nixon, *Microplitis*

Foerster, *Philoplitis* Nixon and *Snellenius* Westwood. The speciose genera in this Tribe are *Microplitis* and *Snellenius*.

The Microgastrinae fauna of India contains 231 species in 21 genera (Gupta & Fernández-Triana, 2014): *Apanteles* Foerster, *Buluka* de Saeger, *Choeras* Mason, *Cotesia* Cameron, *Distatrix* Mason, *Dolichogenidea* Viereck, *Diolcogaster* Ashmead, *Exoryza* Mason, *Fornicia* Brullé, *Glyptapanteles* Ashmead, *Hypomicrogaster* Ashmead, *Microgaster* Latreille, *Microplitis* Foerster, *Neoclarkinella* Rema & Narendran, *Parapanteles* Ashmead, *Parenion* Nixon, *Philoplitis* Nixon, *Pholetesor* Mason, *Protapanteles* Ashmead, *Promicrogaster* Brues & Richardson, *Protomicroplitis* Ashmead, *Snellenius* Westwood and *Wilkinsonellus* Mason.

Microgastrine Morphology

Microgastrines are small dark colored wasps with 16 antennal flagellomeres with reduced distal wing venation. Most of the flagellomeres are with two rows of placodes (Nixon, 1965; Mason, 1981; Achterberg, 1984). Prepectal carina is absent except in *Fornicia* and *Snellenius.* Maxillary palps contain four segments and apical margin of clypeus is concave. Second cubital cell is never longer than pterostigma.

Apanteles is the most speciose genus distinguished by the absence of fore wing vein r-m (Foerster, 1862). Most of the species were formerly placed in the genus *Apanteles* (Marshall, 1885; Muesebeck, 1920). But Nixon (1965) classified Microgastrinae in to two Tribes namely Microgastrini and Cardiochilini with few isolated genera and placed Subfamilies in an ordered manner. Cardiochilini is with the presence of vein r-m and antenna with 24 flagellomeres. Microgastrini is with the lack of vein r-m and 16 antennal flagellomeres. Later, Mason (1981) reclassified Microgastrinae with five tribes and 51 genera. Cardiochilinae is placed as separate Subfamily.

Apantelini, Microgastrini, Forniicini, Cotesiini and Microplitini are the five tribes.

Mason (1981) described the polyphyletic nature of *Apanteles*. Shenefelt (1972) listed 1118 valid species, but many of them have been transferred to various genera because of its polyphyletic nature. Although *Apanteles* show polyphylectic nature, it can be easily identified by the following characters; propodeum is never with a medial carina and marked with an areola, vannal lobe margin is strongly concave to straight and lacking setae at mid length, and posterior edge of scutellar disc is smooth. Braconids are rarely phytophagus.

Phylogenetic Analysis of Microgastrinae

The phylogenetic link within Microgastrinae genera were investigated with DNA sequence data taken from mitochondrial large sub unit, cytochrome oxidase genes, nuclear large sub unit, besides their morphological characters (Whitfield *et al*., 2002). Microgastrinae forms monophylectic group with Miracinae, Cardiochilinae and Khoikhoiinae (Mason, 1983; Quick & Achterberg, 1990; Wharton *et al*., 1992; Whitfield & Mason, 1994; Maetô, 1996). DNA sequences reveal the co-evolution of Microgastrines and Polydnavirus (Whitfield, 1997).

Due to the presents of cryptic species among Microgastrine wasps (Kankare *et al*., 2005; Smith *et al*., 2008) DNA barcoding act as a supplementary material for identification. Due to their tiny size (~2–5 mm), complex character combinations, high morphological convergence and character reduction, identification of microgastrine specimens are very strenuous in the field. Extreme time consumption in the laboratory occurs, and usually requires one expert taxonomist for each genus (Shaw & Huddleston, 1991). Despite such difficulties, this group has received

substantial phylogenetic consideration in present years (Mardulyn & Whitfield, 1999; Banks & Whitfield, 2006; Murphy *et al*., 2008).

Biology and Behaviour

The species are solitary or gregarious endoparasitoids of the larvae of Lepidoptera. They normally oviposit on young host larvae and generally emerge from the mature larvae. There is a tendency for species which attack large caterpillars (Macrolepidoptera) to generate in large broods (gregarious species), and, those attack small ones in mostly concealed habitats to develop one per host (solitary species), but there are some exceptions.

Microgastrine endoparasitoids are seen in pupae enclosed in silky white cocoons, near the dying bodies of host caterpillars. Most of the microgastrine host belongs to Dytrisia group of Lepidoptera. Due to the koinobiontic nature, they have intense host relation for a long term (Askew & Shaw, 1986) and are highly host specific. The evolution of host specificity within parasitic arthropods has long been the focus of a vast amount of research regarding the dynamics and stability of complex ecosystems (Anderson & May, 1978; Secord & Kareiva, 1996; Novotny & Basset, 2005). The nature of specialization pattern is not well understood and most discussions of this topic tend to focus on the trade-offs between the efficiency gained in resource use by specialists versus the benefits of using several resources as food by generalists (Bernays & Graham, 1988; Strand & Obrycki, 1996; Bernays, 2001; Henry *et al*., 2008). While a generalist is considered to stabilize food webs and perhaps is itself more stable at the level of population, a specialist is thought to increase compartmentalization within a food web, decreasing connectivity and possibly stable within a community (Novotny & Basset, 2005). The ratio between number of host and microgastrines reveal that, numbers of parasitoids are more compared with host species (Fernández-Triana, 2010). The species richness of

Microgastrinae depends on the species richness of Lepidoptera (Rodriguez *et al*., 2013). Microgastrines attack taxonomic and biological spectrum of entire Lepidoptera.

Egg-larval parasitism is common in Microgastrinae than larval parasitism. In most cases only one species attacks one host, but in some cases two or more than two may attack the same host. Some microgastrines have long ovipositors to reach the host, which are concealed in other substrates. Most of the species oviposit in to early or middle instar stages, but some of them in host embryos.

In the case of gregarious condition, the exchange of eggs takes place through in one insertion, but repeated insertions noted in some species (de Saeger, 1937). In some gregarious *Apanteles* species, the brood size is related to the size of the host (Le Masurier, 1987). The structure of cocoons may vary; some have simple white cocoons, and some others spin the cocoons in their exposed site forming large elaborate cocoons. In most cases, there will be no change in the parasitic nature from solitary to gregarious, but in some cases, the parasitoid shows solitary nature at first then show gregarious nature (Wilbert, 1960).

Mainly, three larval instars are seen in microgastrines (Lewis, 1970; Puttler & Thewke, 1970). The first instar larvae are mandibulate and caudate, and then develop an anal vesicle (Musebeck, 1918). Second instar larvae are with reduced mandibles. Final instar is with serrate mandibles, for making deep scrapes in host integument.

As outlined above, cocoon structure is extremely varied within the group, but in all cases a precisely circular cap is incised by the emerging adult. The loss of the final ectophagous phase, retained only by the more primitive groups of microgastrines, has left the more advanced groups with a

non-feeding final larval instar, which has presumably been able to specialize in cocoon construction. However, in a few *Microplitis* (Lewis, 1970; Arthur & Mason, 1986; Puttler & Thewke, 1970) and in at least one group of wholly endoparasitic *Apanteles* (Muesebeck, 1918) the final instar does appear to feed internally for a time (Shaw & Huddleston, 1991).

Distribution

Microgastrines are distributed from tropic to arctic climates. Some genera have restricted distribution. *Apanteles, Choeras, Cotesia*, *Diolcogaster* and *Microplitis* are cosmopolitan in distribution whereas *Fornicia* and *Wilkinsonellus* are distributed in pantropical area. *Exoryza* and *Illidops* are distributed in Holarctic and Oriental region. *Neoclarkinella* is restricted to Oriental region only.

Biological Control

Microgastrines are sensitive to environmental disturbances. This makes them good indicators of diversity. Due to the enormous diversity, microgastrines contribute greatly to biological control programmes. The presence of polydnavirus is essential for biological control mechanism. The virus weakens host immune system, which makes it easier pathway for the parasitoids to invade the host. Without the virus, immature wasp cannot survive inside the host, because the blood cells of the caterpillar kill the wasp's egg. The survival of the wasp is due to the suppression of immune system caused by the virus. So the symbiotic association between the wasp and the virus is the key factor in biological control of microgastrine wasp. DNA barcoding helps to improve biological control programmes with accurate identification of parasitiods and their relationships (Smith *et al*., 2012). Microgastrine species disrupt the biology of host caterpillars, so they

are also used for studying insect immunology, endocrinology and physiology (Beckage & Gelman, 2004).

Almost all the species coming under microgastrine genera are involved in biological control programmes. Many species of *Apanteles*, *Cotesia*, *Choeras*, *Dolichogenidia*, *Glyptapanteles*, *Microgaster* and *Microplitis* act as parasitoids in many crops. *Cotesia congregata* (Say) parasitize Tobacco horn worm. *Apanteles taragamae* Viereck is used as a biocontrol agent for cowpea pest, *Maruca vitrata* (Fabricius) (Dannon *et al*., 2010). *Glyptapanteles flavicoxis* (Marsh) and *Glyptapanteles militaris* (Walsh) are used to control gypsy moth.

Relevance of The Study

Members of Braconidae, Microgastrinae in particular, are primary parasitoids of other insects, which include several major pests of agricultural crops. Present investigations on the taxonomy of Microgastrinae in Kerala are not enough to bring out its actual diversity in this study area. Moreover, they play a vital role in the ecosystem by keeping the excessive increase of many insect pests under check.

Objectives of Study

1. To find selected genera of the Microgastrinae present in Kerala
2. To provide workable keys to identify them.
3. To give detailed illustrations as well as descriptions of new species and new genera.
4. To provide redescriptions of very little known Taxa
5. To give a check list, as well as assess the faunal diversity in the selected genera of Braconidae in India.

REVIEW OF LITERATURE

Background knowledge

Latreille (1805) described the genus *Microgaster* with a new species namely *Ichneumon deprimator* Fabricius. Untill 1862, all the species were described under the genus *Microgaster*. Foerster (1862) named *Microgaster* to Microgastrinae by observing, easily differentiated characters. He divided Microgastrinae in to three genera, namely *Microgaster, Microplitis* and *Apanteles*. In the same publication Foerster put the designation of *Microgaster* as *Microgaster* Latreille. Muesebeck (1921; 1922) synonymized many genera under *Apanteles*, *Microgaster* and *Microplitis*. Wilkinson (1927; 1928; 1930) revised the genera *Microgaster, Apanteles* and *Microplitis* from Ethiopian and Indo-Australian region respectively. Due to the enormous number of *Apanteles,* Wilkinson (1932) devised a system of letter-designated groups within *Apanteles.*

Nixon (1965) laid the foundation for microgastrine taxonomy through his reclassification. In his reclassification Nixon treated Microgastrinae as Microgasterinae. Mason (1981) reclassified microgastrine Subfamily into five tribes and 51 genera, 26 of which are previously placed in *Apanteles.* At present Microgastrinae contain five tribes, 62 extant genera with 2645 extant species (Fernández-Triana & Ward 2016).

Microgastrinae: World scenario

The genus *Fornicia* was erected by Brullé in 1846. Foerster (1862) erected the following microgastrine genera viz., *Apanteles*, *Microgaster* and *Microplitis*. Reinhard (1880) divided the most speciose microgastrine genera, *Apanteles* into three groups. Westwood (1882) erected the genus *Snellenius* with the type species *S. vollenhovii.* In addition to the species group

mentioned in Reinhard (1880), Marshall (1885) added one more group to the genus *Apanteles*. Cameron (1891) erected another speciose genus *Cotesia*. Ashmead erected the genus *Diolcogaster* in 1900 with *Microgaster brevicaudus* as the type species and in the same publication he reassigned the type species of *Diolcogaster* as *Microgaster melligaster* and explained the consistency of this genus. Ashmead (1900) erected the genus *Parapanteles* with the type species namely *P. aletiae*. Cameron (1911) erected another genus to the microgastrine Subfamily namely *Xanthomicrogaster* with *X. fortipes* as the type species. In addition to this he reported one more species namely *Xanthomicrogaster ruficollis*. Muesebeck (1922) synonymized *Cotesia* and *Parapanteles* in to *Apanteles*. The earliest works on *Cotesia* were done by Wilkinson (1928a; 1928b). Wilkinson (1932) revised the Ethiopian species of *Apanteles*.

Brues (1933) reported a fossil species from Berlin named as *Snellenius succinalis.* de Saeger (1944) described nine species in *Apanteles* from Congo and Rwanda. In 1949, Granger reported four species of *Apanteles* from Madagascar. Bhatnagar (1950) described many species to the genus *Apanteles*. Rao (1961) divided *Apanteles* in to two subgenera namey *Areolatus* and *Carinatus*.

Nixon (1965) provided a comprehensive work on world Microgastrinae by revising many genera along with the revision of the Tribe Microgastrini. Nixon (1965) divided *Apanteles* genus into 44 subgroups and mentioned on the polyphyletic nature of *Apanteles*. In the same publication he treated *Snellenius* as an extreme development and sister group of *Microplitis* and erected the genera *Philoplitis* and *Miropotes*.

Shenefelt (1968) described four species of *Snellenius* from Neotropical area, *S. atratus, S. bicolor, S. peruensis* and *S. tricolor* and he revised the genus *Microgaster*. Nixon (1970) revised North Western European species of

Microplitis. Nixon (1972) revised laevigatus group of *Apanteles.* Nixon (1973) revised North Western European species of circumscriptus, fraternus, formosus, metacarpalis, octonarius, vitripennis, pallipes, parasitellae, and triangulator groups of *Apanteles*. Nixon (1974) revised North-Western European species of *Apanteles glomeratus* group. Papp (1979) erected the genus *Glabromicroplitis* with *G. mahunkai* as the type species.

Mason (1981) revised the world Microgastrinae along with notes on the polyphyletic nature of *Apanteles.* In addition to this, Mason (1981) erected the genera *Choeras*, *Deuterixys*, *Distatrix*, *Exoryza*, *Nyereria*, *Venanus* and *Wilkinsonellus*. Mason (1981) considered *Apanteles* as a separate genus without any subgenera and transferred the genus *Buluka* in to the Subfamily Microgastrinae based on the characters of wing venation and flagellomeres. In the same publication he added many *Apanteles* species to the genus *Cotesia* and laid good foundation of the genus. Most of the species described by Muesebeck were transferred to *Cotesia* after the resurrection of the genus. Earlier the species of *Pholetesor* was treated under the genus *Microgaster* Latreille. Mason (1981) treated *Pholetesor* as a separate genus and in the same publication he brought more clarity to the generic status of *Snellenius.* He redescribed the genus *Miropotes* and confirmed the position of the species *Miropotes petiolaris* in the same publication.

Achterberg (1982) found similarity between *Ichneumon deprimator* Fabricius with *Microplitis sordipes* Nees. His findings generate the possibility of transferring *Microgaster* Latreille in to *Microplitis* Foerster. Papp (1983a) gave a survey of *Apanteles* Foerster of the following groups namely carbonarius, circumscriptus, fraternus, liparidis, pallipes, parasitellae, octonarius thomsoni and vitripennis. Papp (1983b) gave a detailed description of microgastrine fauna from Hungary. Shepard *et al*. (1983) studied the biology and host range of *Microplitis demolitor*. Whitfield (1985) described

three species of *Deuterixys* from Nearctic region namely *D. quercicola, D. pacifica* and *D. bennetti* and also provided a key to the Nearctic species. Papp (1986) gave the first survey of *Glabromicroplitis* of Holartic region. He transferred three species of *Microplitis* and one species of *Microgaster* to *Glabromicroplitis*. Papp (1986) took a survey of European species of glomeratus I group of *Apanteles* species and in (1987) he again took survey of European species of *Apanteles* and considered two groups namely glomeratus II and cultellatus.

Austin (1989) revised the genus *Buluka* with five species. Austin (1990) revised the Australian genus *Miropotes* with notes on phylogenetic importance and reported the two first records of species outside continental Australia, till then it was endemic to Australia. Austin & Dangerfield (1992) erected the genus *Austrocotesia* with three species namely *A. delicata*, *A. exigua* and *A. paradoxa* and described many species from the genera *Buluka*, *Deuterixys*, and *Wilkinsonellus*. Austin & Dangerfield (1993) synonymized *Glabromicroplitis* with *Microplitis* along with the description of 20 species from Australasian region. In addition to this, they commented on the host parasitoid relationship and biology of *Microplitis*.

Whitfield (1995) erected the genus *Xanthapanteles* from South America with *X. cameronae* as the type species and reviewed Nearctic species of some major genera of Microgatrinae. Berry (1997) commented on the nomenclature of *Apanteles* species from New Zealand.

Schumacher *et al*. (2000) reported *Cotesia geometricae* parasiting on autumn gum moth, *Mnesampela privata* (Guenée) from Australia. Achterberg (2002a) treated *Choeras* as the subgenus of *Apanteles* Foerster. Achterberg (2002b) reported first record of Trichoptera as host of Braconidae from Netherlands. A species from the genus *Xanthomicrogaster* Cameron namely *X. maculatus* was described by Penteado-Dias *et al*. from Brazil in 2002. In

this paper, he provided a key to the existing species which contain only three namely, *X. fortipes* Cameron, *X. pelides* Nixon, and *X. seres* Nixon. Whitfield & Oltra (2004) described four species of *Deuterixys* from Neotropical area. Valerio *et al*. (2004) reviewed the genus *Exoryza* with a species *E. monocavus* from Central America along with a key provided for all the three described species. Valerio *et al*. (2005) reported two species of *Austrocotesia* from South America. Achterberg (2006) described two species of *Cotesia* from Green Land. Whitfield (2006) revised the Nearctic species of the genus *Pholetesor*. Muirhead *et al*. (2008) studied the systematics and biology of *Cotesia nonagriae* and transformed its status in to *Cotesia flavipus*.

Grinter *et al*. (2009) described six species of *Distatrix* from Neotropical area. Fernández-Triana & Goulet (2009) revised the genus *Philoplitis* with three species and studied the extend distribution of this genus from Oriental to Afrotropical region. Fernández-Triana *et al*. (2009) studied the diversity of Microgastrinae in apple orchards of Canada. Valerio *et al*. (2009) reviewed world *Parapanteles* with the description of 14 Neotropical species. In this paper, they also give the description of final instar larvae of *Parapanteles* and provided relevant information on the biological part, 18 species in 11 Lepidopteran families are found to be attacked by *Parapnteles* species.

Fernández-Triana (2010) described a species namely *Distatrix carolinae* from Canada and Alaska. Fernández-Triana *et al*. (2011) erected a genus *Kiwigaster* from New Zealand showing sexual dimorphism in antennal segments. Whitfield *et al*. (2011) reviewed the world genus *Venanus* with three species. Whitfield *et al*. (2012) established a genus *Mariapanteles* from Neotropical and conducted molecular analysis. Pérez-Rodríguez *et al*. (2013) analyzed alpha, beta and gamma level biodiversity of Microgastrinae in the forest state of Artikutza in Spain. Rousse & Gupta (2013) erected a genus

Dodogaster with *D. grangeri* as the type species. In the same publication they reported a species of *Wilkinsonellus* from Reunion Island. Arias- Penna *et al*. (2014) described three species of *Wilkinsonellus* named as *W. alexsmithi*, *W. kogui* and *W. panamaensis* from Central and South America with the first host record for the genus, *Microthyris prolongalis* (Crambidae) for *W. alexsmithi*. Fernández-Triana *et al*. (2014) described one *Miropotes* species from Thailand and three from Australia. Fernández-Triana *et al.* (2014) reviewed *Apanteles* species from North-Western Costa Rica. Fernández-Triana & Boudreault (2016) erected a genus *Keylimepie* from North America showing the first report of brachyptery in microgastrine.

Microgastrinae: Oriental Perspective

In 1863, Motschoulsky described *Microgaster nigricornis* from Sri Lanka. Ashmead (1896) reported the existence of *Apanteles* species from Sri Lanka namely *Apanteles pratapae*. In 1904, Ashmead reported Hymenoptera of Philippine Islands with the description of *Protapanteles manilae* from Philippines. Ashmead (1905) described *Apanteles opacus* from Vietnam. Cameron (1908) described again a new species of *Apanteles* from Sri Lanka. Viereck (1911) erected Subgenus *Dolichogenidea* under *Apanteles* with *Apanteles* (*Dolichogenidea*) *banksi* as the type species. In 1928, Wilkinson revised Indo-Australian species of the genus *Apanteles*. The parasitic nature of *Microplitis mediator* on *Achaea janatha* (Linnaeus) was well studied by Cheriyan & Basheer (1947). Rao (1953) studied parasitic Hymenoptera from India with the description of a species from *Apanteles.* Rao (1961) made a key for the *Apanteles* species from Oriental region. Nixon (1965) in his reclassification reported a species of *Apanteles* from Vietnam, *Apanteles agamedes*. In the same publication he erected the genus *Alloplitis* with two species namely *A. guapo* and *A. typhon* from Philippines and Vietnam and described a species of *Philoplitis* named as *P. coniferens* which is the type

species of this genus from China. Nixon (1967) revised the *ultor* group of *Apanteles* from Indo-Australian region. Nixon revised the genus *Microgaster* and described many species in 1968.

Papp (1980) reported the genus *Fornicia* Brullé from the Oriental region including a key with two species namely *F. rixata* and *F. tergiversata*. Mason (1981) reported a species *Alloplitis completus* from Malaysia. Chalikwar & Nikam (1985) reported *Cotesia orientalis* and *Cotesia diurnii* as the parasitoids of *Exelastis atomosa* (Walsingham), a pest of pigeon pea, from India. Chou (1985) reported new distribution record for genus *Buluka* along with the description of a species namely, *B. orientalis* from Taiwan. You *et al*. (1987) reported many species of *Protapanteles* from China. In 1988, Sathe & Inamdar reported the existence of *Protapanteles* from India with a species *P. (Nyereria) rageshri*. Sumodan & Sevichan (1989) reported a species of *Apanteles* reared from Pyralid pest of Azolla, namely *Apanteles azollae* from Kerala. Austin (1989) reported a species of *Buluka* from Indian sub continent.

Sumodan & Narendran (1990) described a species from *Illidops* namely *I. keralensis*. In the same publication they reported many species of *Apanteles* from Kerala. Torreno (1990) studied the parasitization behaviour of *Microgaster manilae* against *Spodoptera litura* from Philippines. Sathe *et al.* (1991) studied the genera *Glytapanteles* and *Parenion* from India. In 1991 Valentine & Walker introduced *Cotesia glomerata* to New Zealand from England for the control of White butterfly (*Pieris rapae*). Austin & Dangerfield (1992) reported six species of *Diolcogaster* from Australasia. In the same publication they upgraded the Subgenus *Dolichogenidea* into a separate genus. Austin & Dangerfield published a paper on Australasian *Microplitis* with a review of their biology and host relationships in 1993 with the descriptions of 22 reports of Oriental *Microplitis*. In the same publication they redescribed the species, *Snellenius maculipennis* which was described

under *Microplitis* by Szépligeti in 1900 and reported three species of *Snellenius* from Oriental region. Sathe *et al.* (1994) studied the genus *Cotesia* with the description of two species from Maharashtra. Rema & Narendran (1996) described a genus *Neoclarkinella* with the type *N. nilamburensis* from Kerala. Achterberg & Narendran (1997) considered *Illidops* as a separate genus. Narendran (1998) described two species of *Choeras* namely *C. achterbergi* and *C. pappi* from India with a key for the Indian species of *Choeras.* Saeed *et al*. (1999) discussed the biology and host relationships of Australasian *Diolcogaster*.

Achterberg (2002b) considered *Illidops* as a synonym of *Apanteles*. In 2003 Narendran & Sheeba described a species From the genus *Diolcogaster* namely *D. malabarensis* from India. Song *et al.* (2003) studied the genus *Exoryza* with the description of a species. Luo *et al*. (2004) described genus, *Chaoa* from China with the type species *C. flavipes*, which is endemic to China. Rema & Sheeba (2004) described a species namely *Diolcogaster narendrani* and included a key for the Indian species of *Diolcogaster*. Ahmad *et al*. (2005) described a species to the genus *Neoclarkinella* namely *N. punctata* from India. Ahmed *et al.* (2005) published a paper treating *Illidops* as the Subgenus of *Apanteles* with the description of two species namely *Apanteles (Illidops) azamgarhensis* and *Apanteles (Illidops) lamprosomae.* Ahmad *et al*. (2005a) also reported a species of *Philoplitis* from India, *Philoplitis adustipalpus*. Ahmed *et al*. (2005b) discovered the genus *Wilkinsonellus* from India with a species namely *W. granulatus*. Li *et al*. (2006) studied the field release of *Microplitis mediator* for the control of *Helicoverpa armigera* in China. Long & Achterberg (2008) described three species of the Oriental restricted genus *Alloplitis* from Vietnam. In the same publication they described two species of *Protapanteles* namely *P. (Nyereria) yenthuyensis* and *P. (Nyereria) albicentrus* from Vietnam. Fernández-Triana & Goulet (2009) described *Philoplitis punctatus* from Thailand and

Philoplitis striatus from India and Sri Lanka. Shaw (2009) reported *Cotesia selenevora*, *Cotesia eunomiae* and *Cotesia adippevora* are the parasitoids of European Heliconiinae.

Akthar *et al*. (2010) reported a species of *Parapanteles* from India. Zeng & Chen (2011) reported two species from the genus *Deuterixys* from China namely *D. bifossalis* and *D. curticalcar* with a key to the Old World species of *Deuterixys.* Long *et al.* (2011) reviewed *Wilkinsonellus* of Vietnam with four species. Gupta (2013a) reported a species of *Buluka* from Indian subcontinent. Gupta (2013b) revised Indian *Microplitis* Foerster with a species namely *M. murkyi* and transferred *Snellenius macculipennis* to *Microliptis macculipennis*. Gupta *et al.* (2013) described four species of *Parapanteles* from India with the first report of strong host association between *Parapanteles* and lycaenid butterflies from India. Veena *et al.* (2014) described two species to the Oriental genus *Neoclarkinella*, *N. narendrani* and *N. janakikkadensis* along with a key for all described species.

Long (2015) recorded the genus *Buluka* from Vietnam describing one species. Ranjith *et al*. (2015) revised Oriental *Microplitis* with two species namely *M. pennatulae* and *M. narendrani*. Gupta & Fernández-Triana (2015) reported four species of *Diolcogaster* from India, namely *D. andamanensis*, *D. duocolor*, *D. longistria* and *D. solitarium* with a key for the Indian species of *Diolcogaster*. Ranjith *et al*. (2016) revised the genus *Buluka* with a species from South India.

MATERIALS AND METHODS

Study area

The entire Kerala state is considered as the study area (Fig. 1), as the excellent environmental flora contributes to the insect faunal habitat round the year. Kerala has most of its biodiversity concentrated and protected in the Western Ghats. 24% of Kerala is forested. The northern latitudes correspond to 8°18' and 12°48' whereas eastern longitudes correspond to 74°52' and 77°22'. Geographically, Kerala can be divided into three climatically well defined regions, namely, the eastern highlands, the central mid-lands, hill terrains, the western lowlands, as well as the coastal plains. Kerala experiences the humid equatorial tropic climatic condition. With around 120 to 140 days of rains around the year, Kerala has a wet tropical climate which determines the characteristic heavy rains, belonging to the southwest summer monsoon and northeast winter monsoon. Approximately 65% of the rainfall happens from June till August belonging to the Southwest monsoon, and the rest from September till December belonging to Northeast monsoon. Mean annual temperatures range from 25.0°C to 27.5°C in the coastal lowlands and 20.0°C to 22.5°C in the eastern highlands.

Methods of collection

1. Net sweeping

Sweeping with the help of the net contributed to the maximum collection of microgastrines within the shortest time period. There was a good collection of diversified species with this method. The triangular shaped frame of the net was connected to one end of the handle and the net was made of cotton cloth. The important rule for sweeping is such that the area should

be selected with maximum vegetation diversity. Sweeping was done according to the rules described by Noyes (1982).

2. Rearing

The prime advantage of rearing is proper understanding of the host, which is comparatively tough in other collection methods. The suspected hosts were shifted and transferred to emergence box.

3. Malaise trap

Malaise trap looks like a tent. The insects get trapped inside as they fly into the sides of the trap. Further the insect crawls upwards to the killing bottle containing 70% alcohol. The insects with in the killing bottle were sorted out and transferred in to the vials later.

4. Yellow pan trap

The principle behind this method is that yellow colour attracts insects. The tray is painted brilliant yellow inside, whereas neutral colors like black are painted outside. The tray is filled with detergent mixed water to reduce the surface tension. The collected insects were given a fresh water wash before getting transferred to alcohol.

Collecting equipments

The preliminary equipments for collection are aspirators, vials, forceps and brush.

Storage and Preservation

1. Unmounted material

The unmounted specimen should be stored in vials containing 70% alcohol and refrigerated. Periodical preservative change is mandatory in order to prevent specimen damage.

2. Card mounting

The present work has adopted the principles laid down by Noyes (1982). Rectangular as well as triangular cards were used for mounting specimens and the materials used are as follows.

a. Fine zero point brush

b. Entomological pins

c. Glue (water soluble)

d. Forceps

e. Mounting cards

Labeling

After mounting, labels were made permanent by Rotring ink. Data taken for labeling are as follows.

a. Scientific name

b. Name of locality where collected

c. Date of collection

d. Name of collector

e. Name of host (if available)

Storing of mounted specimens

Insect boxes primed with naphthalene balls were used to store mounted specimens, to prevent any fungal attack.

Observations and Measurements

All the collected specimens were identified, described and redescribed. The measurements of the examined specimens were taken with Leica DFC 295 camera attached with Leica S8 APO stereozoom trinocular microscope with 1–8x objectives. A series of images were taken by using Leica M 205A microscope with automated multiple image capture at preset focal levels using Leica DMC 2900 camera. Images of different focal levels were combined into a single image using Leica Automontage Software V4.7. All images were edited using Photoshop CS8 (Version 6.1) (Adobe Inc.) to remove the artifacts formed during the stack processing as well as to standardize the background colour.

Terminology

All the examined materials were deposited in Department of Zoology, University of Calicut, Kerala (DZUC). Terms for wing venation follow Eady 1974 and Achterberg (1979). Those for the morphology are as given in Achterberg (1988) and Austin & Dangerfield (1992; 1993) and Harris (1979) for integument sculpture. The term ‘median field’ (after Nixon, 1965) is used to describe the delimited medial area of T2.

All the descriptions and diagnosis presented in the study do not have the same pattern. It is only because of all the characters are not so important to define the generic boundaries within the Microgastrinae. In the character matrices of the discussed microgastrine genera there are some fields denoted

by “?” are the unknown character states in species that this work has not been able to study.

Statistical analysis

The alpha diversity of the species of the genera from Kerala has been studied. The alpha diversity was measured by calculating abundance and dominance of the species examined during the study. Abundance is measured using Shannon index and dominance is measured using Simpson index. These diversity indices are important tool for understanding rarity and commonness of species in a community and community structure.

Shannon-Wiener index

Shannon index is used to characterize species diversity among the community. It denotes both abundance and evenness of the species present. The typical value falls between 1.5–3.5 and rarely greater than 4. The value increases, in accordance with the increase of species richness, and evenness of the community. So Shannon index is directly proportional to abundance of species in the area.

Simpson index

Since evenness and dominance are both sides of the same coin, their measurements are complimentary. It is based on the probability by taking two individuals draw randomly from a large community which belong to the same species. The value (D) ranges from zero to one. Here diversity and Simpson index are inversely proportional, that means lower the value, higher the diversity. The value can also be stated by subtracting the value of D with 1. This makes more sense and represents dominance index. In this case greater the value greater the biodiversity. Here Simpson, Shannon and dominance

indices of seven genera are analyzed. The other genera are excluded from the analysis due to the negligible amount of collected specimens.

ABBREVIATIONS AND MEASUREMENTS

Abbreviations of taxonomic characters

OOL	:	Ocello-ocular line
POL	:	Post-ocellar line
T1–T7	:	Metasomal terga 1 to 7
Length	:	Length of head+ mesosoma+ metasoma

Abbreviations of museum

AEIC	=	American Entomological Institute, Gainesville.
BMNH	=	British Museum of Natural History, London.
BNHM	=	Bombay Natural History Museum, Mumbai.
CNC	=	Canadian National Collection, Ottawa.
DFRI	=	Department of Forest Research Institute, Dehradun.
DZUC	=	Department of Zoology, University of Calicut.
HAU	=	Hunan Agricultural University, Hunan.
HNHM	=	Hungarian Natural History Museum, Budapest.
IARI	=	Indian Agricultural Research Institute, Delhi.
IEBR	=	Institute of Ecology and Biological Resources, Tokyo.
RMNH	=	National Natuurhistorisch Museum, Leiden.

NBAII	=	National Bureau of Agriculturally Important Insects, Bengaluru.
NZSI	=	Zoological Survey of India, Kolkata, India.
USNM	=	National Museum of Natural History, Washington, D.C.
ZUH	=	Institute of Insect Sciences, Zhejiang University, Hangzhou.

GENERAL MORPHOLOGY OF MICROGASTRINAE

Microgastrines are small dark coloured wasps size ranging from 2–5 mm in length. Generally the body is black in colour, but some microgastrines have reddish brown or yellow coloured body. Compound eyes are grey or blackish brown in color. Flagellomres are brown or yellowish brown. In most cases, wings hyaline and wing veins including pterostigma are brown in colour. Maxillary palp and tibial spur are yellow or pale white in colour. Normally ocelli are reddish or yellowish brown. Ovipositor sheath is black and ovipositor is yellowish brown in colour.

Head: Head with flagellomeres are sixteen in numbers (Fig. 2A). Most of the flagellomeres have two rows of placodes. Scape, pedicel and flagellomere measurements are important for species identification (Fig. 2B). Toruli and occiput may be shiny or dull (Fig. 3A), smooth or sculptured. Occiput and face are with or without medial longitudinal carina (Fig. 2B). Apical margin of clypeus is concave. Maxillary palp is always four segmented.

Mesosoma: Most of the generic characters are present in mesosoma. It consists of pronotum, mesoscutum, scutellum, propodeum, propleuron and mesopleuron (Figs 3B & 4A). Presence or absence of prepectal carina is one of the main characters separating the genus *Microplitis* from *Snellenius*. Scutellar lunules may be wide or narrow with crenulations (Fig. 3B). Propodeum with or without areola, and some genera are with medial longitudinal carina without even a trace of areola (Fig. 4B). Sometimes numerous lateral carinae or transverse carinae are seen along with medial longitudinal carina (Fig. 4B). Generally mesoscutum and scutellum are with rugose or punctate sculpturing (Fig. 3B).

Wings: Veins measurements are one of the main characters for microgastrine identification. Comparison of the length and width of pterostigma, 1-R1, vein r, and 1CU-1 are the main veins using for measurements (Fig. 5A). Fore wings with or without areolet, and the size and shape of the areolet may vary (Fig. 5B). It may be large or slit like, triangular or quadrangular. Hind wings with vannal lobe margin concave, convex or straight with or without hairs.

Legs: Hind femur, tibial and basitarsal measurements, comparison of tibial spur with basitarsal length are the main characters taken for identification purposes. Length of hind coxa is another important character for Tribe as well as generic classification.

Metasoma: Metasoma with 1–7 tergites, without any sexual discrimination (Fig. 6B). The sculpturing pattern and comparison between length and width of first two tergites are the main character differences occurring among microgastrines. T1 may be parallel sided, narrowing posteriorly, or rectangular (Fig. 6A). Spiracles are situated on laterotergites. Hypopygium may be sclerotised or membranous. Ovipositor may be too short or long.

OBSERVATION & RESULTS

KEY TO THE GENERA OF MICROGASTRINAE OF KERALA

1. Ovipositor sheath usually (95%) longer than half the hind tibia (Fig. 7A); sheath uniformly setose through out 2

- Ovipositor sheath almost always (99%) short, rarely protruding much beyond the hypopygium (Fig. 19A); sheath never uniformly setose, only with few hairs concentrated sub apically..... 6

2. Propodeum with a percurrent medial longitudinal carina, rarely with diamond-shaped areola (Fig. 14D) 3

- Propodeum with distinct areola never with medial carina or confined to the horizontal part of the propodeum anterior to an areola (Fig. 7B) 4

3. T1 broad and widening posteriorly (Fig. 27D); T2 as long as or longer than T3 (Fig. 7E); fore wing with large areolet..... *Microgaster*

- T1 parallel sided or narrowed posteriorly (Fig. 16E); T2 shorter than T3; fore wing without areolet if present small one ..... *Choeras*

4. T1 and T2 large, rectangular, rugose, occupying entire dorsal surface (Fig. 24E); T1 wider than long without apicomedial trough; propodeum rugose (Fig. 24D) .....*Exoryza*

- T1 and T2 variable; T2 subtriangular; T1 longer than wide without apicomedial trough; propodeum not distinctly rugose 5

5. Inner margin of eyes converging posteriorly (Fig. 26B); T2–T7 weakly sclerotized apically (Fig. 26E); propodeum without distinct areola (Fig. 26D) ..... *Illidops*

- Inner margin of eyes parallel; T2–T7 sclerotized apically (Fig. 9D); propodeum with distinct areola (Fig. 12D) ..... *Apanteles*

6. TI–T3 heavily sclerotized and fused to form a carapace which occupies all or virtually all of dorsal surface of metasoma (Fig. 25A) 7

- TI–T3 not forming a carapace, or if rarely TI–T3 heavily sclerotized and appearing carapace-like then these tergites never occupying more than about 3/4 of dorsal surface of metasoma (Fig. 28A) 9

7. Head in lateral view relatively small compared with size of mesosoma (Fig. 25A); fore wing without areolet (Fig. 25F); cu-a of hind wing usually deeply sinuate..... *Fornicia*

- Head in lateral view of normal size compared with size of mesosoma (Fig. 14A); fore wing with areolet (Fig. 14F); cu-a of hind wing straight or curved 8

8. Metasomal tergites posterior to TI–T3 greatly reduced and hidden under carapace (Fig. 14F); fore wing areolet large (Fig. 14F); T1 with small, acute horns baso-laterally (Fig. 14E); T2 with at most an indistinct medial field; second metasomal suture deep ..... *Buluka*

- Metasomal tergites posterior to TI–T3 narrow but visible dorsally (Fig. 21E); fore wing areolet small and slit-like (Fig. 21F); T1 without small, acute horns baso-laterally; T2 with well defined elongate medial field (Fig. 21E); second metasomal suture shallow ..... *Diolcogaster* (in part)

9. Fore wing with areolet (Fig. 39F) 10

- Fore wing without areolet (Fig. 37F) 13

10. Hind coxa large and usually much longer than T1 (Fig. 22A); fore wing areolet slit like (Fig. 22F); first metasomal suture distinct; inner hind tibial spur long, more than half of basitarsus; T2 and T3 sculptured (Fig. 22E) .....*Diolcogaster* (in part)

- Hind coxa small, rarely longer than T1 (Fig. 39A); fore wing areolet triangular or quadrangular (Fig. 39F); first metasomal suture indistinct; inner hind tibial spur short less than half of basitarsus; T2 and T3 smooth (Fig. 39E) 11

11. Scutellum as long as mesoscutum and greatly prolonged posteriorly over Propodeum (Fig. 39C) ..... *Philoplitis*

- Scutellum shorter than mesoscutum, not prolonged posteriorly over propodeum (Fig. 39C) 12

12. Prepectal carina usually complete and always developed near anterior end of precoxal groove (Fig. 39E); scutellar disc heavily sculptured (Fig. 39C); mesoscutum heavily sculptured anteriorly; notauli usually very deep (Fig. 39C); propodeum usually comprising sharply angled two faces .....*Snellenius*

- Prepectal carina absent (Fig. 28D); scutellar disc not heavily sculptured (Fig. 28C); mesoscutum heavily sculptured anteriorly; notauli less well developed or virtually absent (Fig. 30C); propodeum evenly curved without sharply angled faces ..... *Microplitis*

13. T1 narrow, elongate 4x as long as wide (Fig. 41E) ..... *Wilkinsonellus*

- T1 much wide, less than 2.5xas long as wide..... 14

14. Propodeum rugose (Fig. 19B); T1 strongly rugose, parallel sided (Fig. 20D); T2 half as long as T3 ..... *Cotesia*

- Propodeum smooth; T1 weakly sculptured, narrowing apically; T2 variable 15

15. Propodeum smooth (Fig. 23D); T1 weakly narrowing posteriorly (Fig. 23E); T2 without antero-lateral elevated area (Fig. 23E); margin of hind wing vannal lobe straight or slightly concave, hairless; ovipositor sheath setose apically..... *Distatrix*

- Propodeum with a percurrent medial longitudinal carina and transverse carina sub apically (Fig. 38D); T1 strongly narrowing posteriorly with broad U-shaped depressed area at basally (Fig. 38E); T2 with antero-lateral elevated field (Fig. 38E); margin of hind wing vannal lobe convex and hairy; ovipositor sheath setose throughout ... *Neoclarkinella*

Genus *Apanteles* Foerster

Apanteles Foerster, 1862. *Verh. Natur.Ver. Preuss Rheinl. West*., 19: 270. Type species: *Microgaster obscurus* Nees, 1834.

Urogaster Ashmead, 1898. *Proc. Ent. Soc.Wash.*, 4:166. Type species: *Urogaster vulgaris* Ashmead, 1900. Synonymized by Muesebeck (1920).

Allapanteles Brethes, 1916. *An. Mus. Nac. Hist. Nat. B. Aires*., 27: 404. Type species: *Allapanteles cecidipiae* Brethes, 1916. Synonymised by Muesebeck (1920).

Xestapanteles Cameron, 1910. *Z. Naturw*., 81:447. Type species*: Xestapanteles latiannulatus* Cameron, 1910. Synonymized by Muesebeck (1920).

Diagnosis

Head punctate; toruli smooth, shiny or aciculate; face punctate with or without medial longitudinal carina; mesoscutum punctate with indistinct notauli; anterior margin of metanotum with lateral setiferous projections; propodeum coarsely punctate to smooth with complete or apical areola, without medial longitudinal carina; margin of hind wing vannal lobe concave or convex, sparsely setose; T1 longer than wide, parallel sided or narrowing posteriorly, usually bearing a longitudinal apical depression medially; T2 wider than long with or without diverging sulci; T3–T7 smooth; hypopygium large, pointed and bearing a series of longitudinal striae medially; ovipositor sheath long and setose throughout; ovipositor short or long gently decurved, gradually tapered; short hypopygium without folds usually correlated with short ovipositor.

Host : Microlepidoptera.

Distribution : Cosmopolitan.

Remarks: There are more than 882 species reported worldwide (Fernández-Triana & Ward 2016). In this study, 26 species found in Kerala are dealt.

KEY TO THE SPECIES OF *APANTELES* FOERSTER FROM KERALA

1. Propodeum without costulae (Fig. 12B) 2

- Propodeum with costulae (Fig. 11D) 10

2(1) Propodeum with apical areola; T1 punctate 3

- Propodeum with complete areola; T1 sculpturing variable..... 7

3(2) Propodeum dull; mesoscutum coarsely punctate (Fig. 12B); OOL as long as POL .....*A. singaporensis* Szépligeti

- Propodeum shiny (Fig. 10E); mesoscutum slightly punctate; OOL less than 1x POL..... 4

4(3) Areola apically 'U' shaped, rest punctate; length of T1 1.31x its apical width; scutellum punctate (Fig. 10F) .....*A. leptothecus* Cameron

- Areola not 'U' shaped apically, rest rugose-punctate; length of T1 1.50x its apical width; scutellum smooth 5

5(4) Eye length 3.30x as long as malar space; antenna as long as fore wing .....*A. javensis* Rohwer

- Eye length 4.80x as long as malar space; antenna 0.70–0.90x as long as fore wing 6

6(5) Length of ovipositor more than 2x as long as hind tibia; length of antenna 0.70x as long as body; length of hind tibia 3.80x its width; outer tibial spur 0.50x as long as basitarsus ....*A. araeceri* Wilkinson

- Length of ovipositor less than 2x as long as hind tibia; antenna as long as body; length of hind tibia 6.30x its width; outer tibial spur as long as basitarsus ..... *A. importunus* Wilkinson

7(2) Scutellar lunules wide; pterostigma 3x as long as wide; hind femur 3.60x as long as wide 8

- Scutellar lunules narrow; pterostigma less than 3x as long as wide; hind femur 1.30– 3x as long as wide 9

8(7) Ovipositor less than 2x as long as hind tibia; antenna 0.80x as long as fore wing; occiput smooth, shiny; length of mesosoma 1.40x its height; eye length 4x as long as malar space .... *A. tachardiae* Cameron

- Ovipositor more than 2x as long as hind tibia; antenna as long as fore wing; occiput punctate; length of mesosoma 1.20x its height; eye length 3.30x as long as malar space ....*A. tasmanica* Cameron

9(7) T1 aciculate; scutellum shiny, sparsely punctate (Fig. 8B); antenna 0.75x as long as body; length of hind femur 1.30x as long as hind tibia; outer tibial spur 0.61–0.70x as long as hind basitarsus; propodeal areola closed basally .....*A. calycinae* Wilkinson

- T1 rugose-punctate; scutellum dull, coarsely punctate (Fig. 8F); antenna 1.11x body; length of hind tibia 2.80x its width; outer tibial spur 0.40x as long as hind basitarsus; propodeal areola opened basally .....*A. grandiculus* Wilkinson

10(1) Propodeal areola acutely angled apically with numerous, strong lateral carinae ..... *A. opacus* (Ashmead)

- Propodeum without apically angled areola and lateral carina absent or weak 11

11(10) Antenna 1.10–1.40x shorter than body; toruli shiny, sparsely aciculate 12

- Antenna1.0–1.20x longer than or equal to body; toruli dull, coarsely aciculate 18

12(11) T1 rugose-striate; width of head 1.80–1.90x its length in dorsal view ..... *A. expulsus* Turner

- T1 sculpturing variable; width of head more than 1.90x its length in dorsal view 13

13(12) Frons punctate; eye length less than 4x as long as malar space 14

- Frons rugose or aciculate; eye length more than or equal to 4x as long as malar space 17

14(13) T1 punctate; propodeum with weak areola .....

.....*A. pongamiae* Sumodan & Narendran

- T1 rugose-punctate; propodeum with complete areola 15

15(14) Margin of hind wing vannal lobe slightly convex; notauli distinct (Fig. 9F); hind tibial spurs yellow .....*A. hyposidrae* Wilkinson

- Margin of hind wing vannal lobe concave; notauli indistinct; hind tibial spurs white 16

16(15) T2 smooth with diverging sulci; vein 1-R1 1.11x as long as pterostigma; head width 1.80x its length in dorsal view; face with medial longitudinal carina .....

.....*A. euproctisiphagus* Ahmad

- T2 rugose without diverging sulci; vein 1-R1 1.32x as long as pterostigma; head width 2x its length in dorsal view; face without medial longitudinal carina .... *A. azollae* Sumodan & Narendran

17(13) Ovipositor as long as hind tibia; propodeum with strong costulae; frons aciculate; antenna 0.80x as long as body; OOL 1.20x POL; T2 with diverging sulci; propodeal areola closed basally .... *A. taragamae* Viereck

- Ovipositor 2.40x as long as hind tibia; propodeum with weak costulae; frons rugose; antenna 1.10x as long as body; OOL 0.90x POL; T2 without diverging sulci; propodeal areola opened basally .... *A. bambusae* Wilkinson

18(11) Propodeum with laterally diverging carinae; T3–T7 rugose (Fig. 11F) ..... *A. parasae* Rohwer

- Propodeum without laterally diverging carinae; T3–T7 smooth 19

19(18) Occiput with a medial longitudinal carina; propodeum smooth .... *A. stantoni* (Ashmead)

- Occiput without medial longitudinal carina; propodeum with various sculptures 20

20(19) T1 with medial longitudinal carina; length of eye more than 6x as long as malar space ..... *A. hemitheae* Wilkinson

- T1 without medial longitudinal carina; length of eye less than 6x as long as malar space 21

21(20) Antenna as long as body length; length of T1 1.50x its apical width 22

- Antenna 0.70–1.10x as long as body; length of T1 1.90–3x as long as its apical width.....23

22(21) Length of mesosoma 1.50x its width; length of hind femur more than 3x its width; length of hind tibia less than 4x its width; scutellar lunules wide; face with medial longitudinal carina ....*A. machaeralis* Wilkinson

- Length of mesosoma 1.70x its width; length of hind femur less than 3x its width; length of hind tibia more than 4x its width; scutellar lunules narrow; face without medial longitudinal carina ....*A. hasorae* Wilkinson

23(21) Occiput punctate; T1 rugose-striate; scutellum rugose-striate ....*A. valvulae* Rao & Kurian

- Occiput smooth; T1 sculpuring variable; scutellum punctate 24

24(23) Face without medial longitudinal carina; occiput dull, slightly concave in dorsal view .....*A. ricini* Bhatnagar

- Face with medial longitudinal carina; occiput shiny, straight in dorsal view 25

25(24) Propodeum punctate; eye length less than 3.50x as long as malar space; width of head 2.50x its length in dorasl view; T2 punctate without diverging sulci .... *A. munnarensis* Sumodan & Narendran

- Propodeum rugose; eye length more than 3.50x as long as malar space; width of head 1.70x its width in dorasl view; T2 smooth with diverging sulci ..... *A. agilis* (Ashmead)

Character matrix for species of *APANTELES*

1. Head width & length: 0; equal to or more than 2x, 1; less than 2x
2. Toruli sculpturing: 0; aciculate 1; smooth, shiny 2; punctate
3. OOL: POL: 0; less than 1, 1; more than 1, 2; equal
4. Frons sculpturing: 0; punctate 1; aciculate 2; rugose 3; rugose-striate 4; rugose-punctate
5. Scutellar lunules: 0; narrow 1; wide
6. Propodeal costulae: 0; with costulae 1; without costulae
7. T1 sculpturing: 0; punctate 1; rugose-punctate 2; rugulose 3; rugose-striate 4; aciculate
8. Face: 0; with medial carina 1; without medial carina
9. Propodeal areola: 0; closed basally 1; opened basally
10. T2: 0; with diverging sulci 1; without diverging sulci
11. Notauli: 0; distinct 1; indistinct

Coding of the characters and their status for the species of *Apanteles*

Species/characters	1	2	3	4	5	6	7	8	9	10	11
Apanteles agilis	1	0	1	0	1	0	0	0	0	0	1
Apanteles araeceri	1	1	0	4	1	1	0	1	0	0	1
Apanteles azollae	0	0	0	0	1	0	1	1	0	1	1
Apanteles bambusae	?	0	0	2	1	0	3	1	1	0	1
Apanteles calycinae	1	2	0	0	0	1	4	1	0	0	1
Apanteles euproctisiphagus	1	0	0	?	?	?	2	0	?	0	?
Apanteles expulsus	1	0	0	0	1	0	4	1	0	0	1
Apanteles grandiculus	1	1	0	0	0	1	1	1	1	0	1
Apanteles hasorae	?	0	?	0	1	0	1	1	0	0	1
Apanteles hemitheae	1	0	?	0	1	0	3	0	0	1	1
Apanteles hyposidrae	?	0	?	0	1	0	0	1	0	1	0
Apanteles importunus	0	1	0	0	0	1	0	0	0	0	1
Apanteles javensis	0	1	0	3	0	1	0	0	0	0	1
Apanteles leptothecus	?	1	0	0	0	1	0	1	0	0	1
Apanteles machaeralis	?	0	?	0	0	0	1	0	0	0	1
Apanteles munnarensis	0	0	1	0	1	0	0	0	0	1	1
Apanteles opacus	0	1	1	0	1	0	0	0	0	0	0
Apanteles parasae	0	0	0	0	1	0	0	0	1	0	1
Apanteles pongamiae	0	0	0	0	0	0	0	0	0	1	1
Apanteles ricini	?	0	2	0	1	0	1	1	0	0	1
Apanteles singaporensis	?	1	2	0	0	1	0	0	0	0	1
Apanteles stantoni	0	0	1	0	1	0	1	1	1	0	1
Apanteles tachardiae	?	1	0	0	1	1	0	0	0	1	1
Apanteles taragamae	1	0	1	1	1	0	0	1	0	1	1
Apanteles tasmanica	?	1	0	0	1	1	0	1	0	1	1
Apanteles valvulae	1	0	2	0	1	0	3	1	0	1	1

Treatment of species

Apanteles agilis (Ashmead)

(Figs 7A & B)

Pseudapanteles agilis Ashmead, 1905. *Proc. U.S. Nat. Mus*., 28: 969. Female (USNM).
Apanteles agilis Wilkinson, 1928. *Bull. Ent. Res*., 19: 130; Nixon, 1967. *Bull. Br. Mus. Nat. Hist*. *(Ent.)*, 21(1): 22.
Apanteles hidaridis Rohwer, 1922. *Treubia*, 3: 54. Female (USNM) Synonymized by Wilkinson (1928).

Redescription

Female: Length 2.41 mm, antenna 2.41 mm, fore wing 2.30 mm, ovipositor 0.69 mm.

Head: Width of head 1.70x its length in dorsal view; length of face 0.60x its width; face punctate with a medial carina; clypeus punctate, setose; maxillary palp four segmented; eye length 3.60x malar space; vertex, temple, frons punctate, setose; occiput smooth, shiny, straight in dorsal view; toruli dull coarsely aciculate; OOL 1.04x POL; antenna as long as body; length of scape 1.30x its width; length of pedicel 0.80x its width; length of first flagellomere 2.60x its width; length of second flagellomere 2.80x its width.

Mesosoma: Length of mesosoma 1.42x its height, 2.51x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules wide crenulated; scutellum sparsely punctate; notauli indistinct; propleuron punctate, coarsely setose; mesopleuron punctate antero-ventrally, smooth postero-dorsally; metapleuron smooth; propodeum with strong areola, costulae, lateral carinae, rest coarsely rugose; length of pterostigma 2.38x its maximum width; vein 1-R1 1.50x as long as pterostigma; vein r 1.21x as long as width of pterostigma; margin of hind wing vannal lobe concave, sparsely setose; length of hind

femur 3.20x its width; length of hind tibia 6.72x its width; length of basitarsus 4.30x its width; outer hind tibial spur 0.42x as long as hind basitarsus.

Metasoma: T1 parallel sided, sparsely punctate, smooth at apex, 1.43x its width; length of T2 0.30x its apical width with diverging sulci; T3 1.21x longer than T2; T2–T7 smooth; ovipositor sheath setose; ovipositor as long as hind tibia.

Colour: Body black except ocelli, pterostigma, wing veins brown; wings hyaline; apex of fore femur, fore tibia, basal hind tibia, ovipositor yellow; base of fore femur reddish brown; tibial spur white.

Male: Unknown.

Host: *Hidari irava* Moore (Hesperiidae)

Distribution: India (Kerala), Indonesia, Manila, Philippines, Vietnam.

Material examined: 1F, India, Kerala, Kovalam, Narendran, 24.ii. 1989; 1F, India, Kerala, C.U.Campus, Rema, 3.vi. 1993; 1F, India, Kerala, Karimpuzha, Narendran, 12.xii.1990; 1F, India, Kerala, Anakkatty, Sumodan, 7.i.1989 (DZUC).

Discussion

The species *A. agilis* shows close resemblence with *A. munnarensis* in having aciculate nature of frons and wider scutellar lunules, but differs from *A. munnarensis* in having T2 with diverging sulci (T2 without diverging sulci in *A. munnarensis*). This species also shows similarity with *A. parasae* in having indistinct notauli and wider scutellum, but shows differences with *A. parasae* in the following features, like T1 parallel sided, sparsely punctate (T1 wider at apex, rugose-punctate in *A. parasae*) and ovipositor sheath as long as hind tibia (in *A. parasae* ovipositor sheath shorter than hind tibia).

Apanteles araeceri Wilkinson

(Figs 7C & D)

Apanteles araeceri Wilkinson, 1928. *Bull. Ent. Res*., 19: 118. Female (BMNH).
Apanteles araceri Wilkinson, Gupta, 1957. *Ind. J. Ent*., 19: 163; Nixon, 1965. *Bull. Br. Mus. Nat. Hist., Ent. Suppl*., 2:76.

Redescription

Female: Length 2.30 mm, antenna 1.51 mm, fore wing 2.20 mm, ovipositor 1.20 mm.

Head: Head 1.90x as wide as long in dorsal view; face punctate, setose, length of face 0.81x its width; clypeus sparsely punctate, setose; eye 4.81x as long as malar space; vertex transversly striate; temple rugose-punctate, coarsely setose; frons rugose-punctate, sparsely setose; occiput smooth; toruli smooth, shiny; OOL 0.80x POL; antenna 4.40x as long as head, 0.72x as long as body; length of scape 1.21x its width; length of pedicel 0.61x its width; length of first flagellomere 2.50x its width; length of second flagellomere 2.60x its width.

Mesosoma: Length of mesosoma 1.50x its height, 2.91x as long as head; mesoscutum coarsely punctate, sparsely setose; scutellar lunules wide, crenulated; scutellum smooth, shiny; notauli indistinct; propleuron punctate; mesopleuron punctate, setose antero- ventrally; propodeum with a well developed areola in the apical half and a medial longitudinal carina at basal half, rest rugose-punctate; length of fore wing 2.81x its maximum width; length of pterostigma 2.22x its maximum width; fore wing vein 1-R1 1.40x as long as pterostigma; vein r 0.80x as long as width of pterostigma; margin of hind wing vannal lobe concave, hairless; length of hind femur 3x its width; length of hind femur as long as hind tibia; length of hind tibia 3.80x its width; outer tibial spur 0.50x as long as basitarsus.

Metasoma: Length of T1 1.50x its apical width, punctate; T2 punctate, 0.20x as long as T1, with diverging sulci; T3 2.11x as long as T2; T3–T7 smooth; ovipositor 2.42x as long as hind tibia.

Colour: Body black except eyes grey; wing veins, ovipositor, fore tibia, fore tarsi yellow; mid tibia, mid tarsi, basal half of hind tibia yellowish brown; tibial spur white; hypopygium reddish brown.

Male: Unknown.

Host: *Araecerus fasciculatus* De Geer (Anthribidae)

Distribution: India (Kerala), Indonesia, Malaysia.

Material examined: 1F, India, Kerala, C.U.Campus, Rema, 5.xii.1993 (DZUC).

Discussion

This species shows differences from the Wilkinson's (1928) description in the following characters, transverse carina from the apex of medial longitudinal carina absent on propodeum, but in the description of Wilkinson (1928) propodeum with transverse carina present which reach in to the lateral carina of areola giving a closed appearance. This species shows close resemblance with *A. importunus* in having propodeum without costulae and notauli indistinct, but shows differences like wing veins yellowish brown (in *A. importunus* hyaline) and eyes grey (eyes blackish brown in *A. importunus*). Other differences are mentioned in the key.

Apanteles azollae Sumodan & Sevichan

Apanteles azollae Sumodan and Sevichan, 1989. *J. Ecobiol*., 1 (4): 319 Female (RMNH).

Diagnosis

Female: Length 3 mm, antenna 2.30 mm, fore wing 2.70 mm.

Head width 2x as long as its length in dorsal view; face punctate, setose without medial longitudinal carina; clypeus punctate, setose; ocelli shiny; eyes glabrous; eye length 3.51x malar space; vertex coarsely punctate, setose; frons punctate; occiput smooth, shiny; toruli shiny, aciculate; OOL 0.80x POL; maxillary palp with four segments; mesoscutum coarsely punctate; scutellar lunules broad, crenulated; scutellum sparsely punctate; propleuron punctate; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; propodeum rugose-punctate with strong areola without lateral carina; metapleuron punctate, setose, shiny, crenulated; fore wing 1.21x as long as antenna; fore wing vein 1-R1 1.30x as long as pterostigma; vein r slightly longer than width of pterostigma; margin of hind wing vannal lobe concave, sparsely setose; T1 rugose-punctate, 2.30x as long as its width at apex, parallel sided; T2 rugose, without diverging sulci; T3 1.70x as long as T2; T3–T7 smooth; ovipositor sheath longer than hind tibia.

Colour: Body black, except ocelli reddish brown; antennae, tegulae, pterostigma, wing veins dark brown; hind leg, ovipositor yellow; tibial spurs white; hind tarsi yellowish brown.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Remarks: This diagnosis is based on the original description Sumodan & Sevichan 1989.

Discussion

This species shows similarity with *A. euproctisiphagus* in the characters like OOL 0.80x POL and eye length 3.50x malar space, but it shows differences from *A. euproctisiphagus* in the characters mentioned in the key.

Apanteles bambusae Wilkinson

(Figs 7E & F)

Apanteles bambusae Wilkinson, 1928. *Bull. Ent. Res*., 19:129. Female (BMNH).
Apanteles bambusae Wilkinson, Beeson & Chatterjee, 1935. *Ind. For. Rec*., 1: 110.
Apanteles bambusae Wilkinson, Nixon, 1967. *Bull. Br. Mus. Nat. Hist. (Ent.)*, 21(1): 24.

Redescription

Female: Length 2.20 mm, antenna 2.10 mm, fore wing 1.80 mm, ovipositor 0.70 mm.

Head: Width of head 2x its length in dorsal view; face rugose-punctate, without medial longitudinal carina; length of face 0.91x its width; clypeus punctate, sparsely setose; eyes glabrous; eye length 4.30x malar space; vertex and temple punctate, setose; frons rugose; occiput smooth, shiny; toruli shiny, sparsely aciculate; OOL 0.90x POL; maxillary palp four segmented; antenna 1.20x as long as body, 6.80x as long as head; length of scape 1.30x its width; length of pedicel 1.10x its width; length of first flagellomere 2.80x its width; length of second flagellomere 3x its width.

Mesosoma: Length of mesosoma 1.51x its width, 2.71x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules wide, crenulated; scutellum shiny; notauli indistinct; propleuron, mesopleuron and metapleuron

coarsely punctate, setose; propodeum with well developed areola, open at base, without lateral carina; length of fore wing 3x its maximum width; length of pterostigma as long as its maximum width; fore wing vein 1-Rs as long as breadth of pterostigma; margin of hind wing vannal lobe slightly convex, sparsely setose; length of hind femur 2.90x its width; length of hind tibia 3.80x its width; outer tibial spur 0.51x as long as hind basitarsus; length of basitarsus 4.30x its width.

Metasoma: Metasoma 0.91x as long as mesosoma; length of T1 1.50x its width, parallel sided, rugose-striate; T2 rugose with diverging sulci; T3–T7 smooth; ovipositor 2.40x as long as hind tibia; ovipositor sheath setose.

Colour: Body, ocelli black; fore and mid leg, hind trochanter, ovipositor yellow; tibial spur white; pterostigma, wing veins, fore and mid coxae dark brown.

Male: Unknown.

Host: *Cosmopteryx bambusae* Meyrick (Cosmopterygidae)

Distribution: India (Bihar, Kerala).

Material examined: 1F, India, Kerala, Valayar, Sumodan, 27.ii.1989; 1F, India, Kerala, Kayamkulam, Sumodan, 21.ii.1989; 1F, India, Kerala, Pathiramanal, 14.iv.1990; 1F, India, Kerala ,Varkala, Sumodan, 26.ii.1989; 1F, India, Kerala, Neyyar dam, Sumodan, 29.ii.1989 (DZUC).

Discussion

This species has close resemblence with *A. taragamae* for the following characters, wider scutellar lunules and aciculate, shiny toruli, but it differs for the characters, ocelli black (ocelli yellow in *A. taragamae*), T2 with diverging sulci (T2 without diverging sulci in *A. taragamae*), and other characters

mentioned in the key. This species also shows similarity with *A. araeceri* in having smooth, shiny toruli and wider scutellar lunules, however it differs in having the characters, propodeal areola with costulae (propodeal areola without costulae in *A. araeceri*) and frons rugose (in *A. araeceri* frons rugose-striate).

Apanteles calycinae Wilkinson

(Figs 8A & B)

Apanteles calycinae Wilkinson, 1928. *Bull. Ent. Res*., 19:113. Female (BMNH).
Apanteles calycinae Wilkinson, Beeson & Chatterjee, 1935. *Ind. For. Rec*. 1: 110; Bhatnagar, 1950. *Ind. J. Ent.*, 10: 186; Nixon, 1965. *Bull. Br. Mus. Nat. Hist. (Ent.) Suppl*., 2: 175.

Redescription

Female: Length 2 mm, fore wing 1.90 mm, antenna 1.51 mm, ovipositor 0.80 mm.

Head: Width 1.61x its length in dorsal view; face punctate, setose without medial longitudinal carina; length of face 0.70x its width; clypeus coarsely punctate; eye 5.56x as long as malar space; vertex, frons punctate, setose; toruli sparsely punctate; occiput smooth, shiny; OOL 0.70x POL; antenna 0.81x as long as body; length of scape 0.91x its width; length of pedicel 0.60x its width; length of first flagellomere 2.92x its width; length of second flagellomere 2.80x its width.

Mesosoma: Length of mesosoma 1.51x its width, 2.70x as long as head; mesoscutum punctate; scutellar lunules narrow, crenulated; scutellum shiny, sparsely punctate; notauli indistinct; propleuron sparsely punctate; mesopleuron punctate anteriorly, smooth, shiny posteriorly; metapleuron polished; propodeum with areola, closed basally without lateral carina,

costulae; length of fore wing 2.61x its maximum width; length of pterostigma 2.60x its maximum width; fore wing vein r as long as 1Rs; margin of hind wing vannal lobe concave without hairs; length of femur 1.31x its width; length of hind tibia 5.80x its width; length of basitarsus 5x its width; tibial spur 0.60x as long as basitarsus.

Metasoma: Apical length of T1 1.91x its width, aciculate, narrowed at apex; T2 with diverging sulci; T3 1.80x as long as T2; T2–T7 smooth, shiny; ovipositor as long as hind tibia.

Colour: Body black except eyes grey, ocelli reddish brown; pterostigma, wing veins dark brown; fore and mid tarsi, hind femur, basal half of hind tibia ovipositor yellow; hind tarsi yellowish brown.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala), Vietnam.

Material examined: 2F, India, Kerala, C.U.Campus, Rema 23.iii.1995; 2F, India, Kerala, Mohana, 20.iii.1995; IF, India, Kerala, C.U.Campus, Veena, 11.ii.2011; 1F, India, Kerala, C.U.Campus, Rema, 5.v.1994; 1F, India, Kerala, Wayanad, Gopi, 23.iii.1995; 1F, India, Kerala, Kayamkulam, Narendran, 9.ii.1989; 1F, India, Kerala, Kazhakkoottam, T.C. Narendran, 25. ii. 1989 (DZUC).

Discussion

Apanteles calycinae is close to *A. grandiculus* having face without medial longitudinal carina and propodeum without costulae, but it shows differences which are mentioned in the key. This species also shows similarity to *A. hemitheae* in the following features like length of body and fore wing almost

equal and length of mesosoma 1.50x its width. The main differences are ovipositor as long as hind tibia (in *A. hemitheae* ovipositor 0.60x as long as hind tibia) and length of T1 more than 1.50x its width (length of T1 less than 1x its apical width in *A. hemitheae*).

Apanteles euproctisiphagus Ahmad

Apanteles euproctisiphagus Ahmad, 1945. *Ind. J. Ent*., 7:10. Female (IARI).
Apanteles euproctisiphagus Ahmad, Bhatnagar, 1950. *Ind. J. Ent*., 10: 168; Rao & Kurian, 1950. *Ind. J. Ent*., 12:183.

Diagnosis

Female: Length 2.60 mm, antenna 1.90 mm, fore wing 2.41 mm.

Width of head 1.80x its length in dorsal view; face punctate with a medial longitudinal carina; frons, vertex, temple, punctate; toruli shiny sparsely aciculate; eye length 3.50x malar space; OOL 0.80x POL; propleuron punctate, mesopleuron punctate antero-ventrally, smooth postero-dorsally; metapleuron smooth; propodeum areola without lateral carina; fore wing vein 1-R1 1.10x as long as pterostigma; T1 rugulose, length 2x its apical width; T2 with diverging sulci, 0.61x as long as T1; T3 1.50x as long as T2; T2–T7 smooth.

Colour: Black and shiny body except ocelli, T1, T2, T3, ovipositor reddish brown; pterostigma, wing veins brown; tibial spurs white; hind femur, basal part of hind tibia yellow.

Male: Unknown.

Host: *Euproctis lunata* Walker (Erebidae)

Distribution: India (Kerala).

Remarks: This diagnosis is based on the original description Ahmad 1946.

Discussion

This species shows close resemblence with *A. hyposidrae* in having aciculate nature of toruli and OOL 0.80x as long as POL, but differs in having T1 2x its apical width (in *A. hyposidrae* T1 1.20x its apical width) and face with a medial longitudinal carina (in *A. hyposidrae* longitudinal carina absent). This species also shows similarity with *A. agilis* in having eye length 3.50x as long as malar space, face with medial longitudinal carina. The differences with the same species are OOL 0.80x POL (in *A. agilis* OOL 1.40x POL), vein 1-R1 0.80x as long as pterostigma (in *A. agilis* 1.10x as long as pterostigma).

Apanteles expulsus Turner

(Figs 8C & D)

Apanteles expulsus Turner, 1919. *Trans. Ent. Soc. London*, 346. Female (BMNH).
Apanteles exulsus Turner, Wilkinson, 1928. *Bull. Ent. Res*., 19: 125; Weber, 1953. *Proc. Hawai. Ent. Soc*., 15(1): 128; Nixon, 1967. *Bull. Br. Mus.Nat. Hist (Ent.)*, 21(1): 27.

Redescription

Female: Length 2 mm, antenna 1.60 mm, fore wing 2 mm, ovipositor 0.12 mm.

Head: Width 1.70x its length in dorsal view; face sparsely punctate, setose without medial longitudinal carina; length of face 0.80x its width; clypeus sparsely punctate, setose; eyes glabrous; eye length 5x malar space; vertex coarsely punctate, setose; frons with a medial carina; occiput rugose; toruli shiny, sparsely aciculate; OOL 0.60x POL; maxillary palp four segmented; antenna 0.81x as long as body; length of scape 0.70x its width; length of pedicel 1.10x its width; length of first flagellomere 2.81x its width; length of second flagellomere 2.90x its width.

Mesosoma: Length of mesosoma 1.41x its height, 2.62x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules broad, crenulated; scutellum sparsely punctate, setose; notauli indistinct; propleuron punctate, shiny; mesopleuron, shiny, punctate, setose antero-ventrally, smooth postero-dorsally; propodeum with strong areola, weak lateral carina, basally punctate, shiny and smooth at apex; fore wing as long as body; length of fore wing 2.50x its maximum width; length of pterostigma 2.50x its maximum width; fore wing vein 1-R1 1.10x as long as pterostigma; width of pterostigma as long as vein r; margin of hind wing vannal lobe convex, setose; length of hind femur 3.50x its width; length of hind tibia 4.70x its width; outer hind tibial spur 0.40x as long as hind basitarsus; length of basitarsus 3.80x its width.

Metasoma: T1 rugose-striate, wider apically, median length equal to apical length, 1.10x its apical width; width of T2 3x its length, aciculate; T3 1.30x as long as T2; T3–T7 smooth; ovipositor 0.20x as long as hind tibia; ovipositor sheath short, setose.

Colour: Black except mandibles, basal flagellar segments, mid and hind trochanter yellowish brown; ocelli reddish brown; tibial spurs white; hind femur and tibia, fore and mid leg (except coxae) yellow.

Male: Length 1.90 mm. Characters same as that of female.

Host: *Anticarisa irrorata* Fabricius (Noctuidae)

Distribution: China, India (Kerala), Sri Lanka, Vietnam.

Material examined: 4F, India, Kerala, C.U.Campus, Rema, 20.vi.1995 (DZUC).

Discussion

This species shows similarity with *A. pongamiae* in many characters, but differs in the following characters like eye length 5x malar space (in *A. pongamiae* eye length 3.50x malar space) and face without medial longitudinal carina (in *A. pongamiae* face with medial longitudinal carina).

Apanteles grandiculus Wilkinson

(Figs 8E & F)

Apanteles grandiculus Wilkinson, 1929. *Bull. Ent. Res*., 20: 110. Female (BMNH).
Apanteles grandiculus Wilkinson, Nixon, 1965. *Bull. Br.Mus. Nat. Hist.(Ent.) Suppl*., 2: 166.

Redescription

Female: Length 2.70 mm, antenna 3 mm, fore wing 2.90 mm, ovipositor 0.40 mm.

Head: Width 1.90x its length in dorsal view; face punctate, setose without medial longitudinal carina; length of face 0.70x its width; clypeus punctate, setose; ocelli shiny; eyes glabrous; length of eye 5x malar space; vertex, frons coarsely punctate, setose; occiput smooth; toruli smooth, shiny; OOL 0.70x POL; antenna 1.10x as long as body; first flagellomere 2.75x its width; length of second flagellomere 4x its width; maxillary palp four segmented.

Mesosoma: Length of mesosoma 1.41x its width, 3x as long as head; mesoscutum, scutellum coarsely punctate, scutellar lunules narrow, crenulated; notauli indistinct; propleuron punctate, shiny; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron smooth; propodeum with areola opened basally, rest of propodeum rugose, lateral carina absent; fore wing 1.10x as long as body; length of pterostigma 2.50x its maximum width; fore wing vein 1-R1 1.60x as long as pterostigma;

width of pterostigma equal to vein r; margin of hind wing vannal lobe concave, setose; hind coxa punctate, dull, setose; length of femur 2.80x its width; length of hind tibia 5.80x its width; length of basitarsus 5x its width; tibial spur 0.40x as long as basitarsus.

Metasoma: T1 rugose-punctate, narrowed apically, 1.80x as long as its apical width; T2 with diverging sulci; T3 1.41x as long as T2; T2–T7 tergites smooth, shiny; ovipositor 0.50x as long as hind tibia; ovipositor sheath short, setose throughout.

Colour: Body black except ocelli, ovipositor yellow, pterostigma, wing veins reddish brown, hind trochanter dark brown.

Male: Unknown.

Host: Unknown.

Distribution: China, India (Kerala, Meghalaya), Vietnam.

Material examined: 1F, India, Kerala, Shertallai, Sumodan, 27.ii.1989; 1F, India, Kerala, Valayar, Sumodan, 27.ii.1989; 1F, INDIA, Kerala, Kayamkulam, Sumodan, 2.ii.1989 (DZUC).

Discussion

This species shows similarity with *A. tasmanica* in having characters like punctate frons, propodeum without costulae and face without medial carina. However it differs in having scutellar lunules narrow (wide in *A. tasmanica*), T1 rugose-punctate (in *A. tasmanica* T1 punctate) and T2 with diverging sulci (T2 without diverging sulci in *A. tasmanica*). The species also shows similarity to *A. calycinae* in having indistinct notauli and diverging sulci on T2. The main differences are mentioned in the key.

Apanteles hasorae Wilkinson

(Figs 9A & B)

Apanteles hasorae Wilkinson, 1928. *Bull. Ent. Res*., 19: 146. Female (BMNH).
Apanteles hasorae Wilkinson, Thompson, 1953. *Host. Par. Cat*., 2: 66.
Apanteles hasorae Wilkinson, Nixon, 1967. *Bull.Br. Mus. Eat. Hist., (Ent.)*, 21(1) :14.

Redescription

Female: Length 2 mm, antenna 2 mm, fore wing 2.10 mm, ovipositor 0.90 mm.

Head: Width of head 2x its length in dorsal view; face coarsely punctate, setose with out medial longitudinal carina; length of face 0.90x its width; clypeus sparsely punctate, setose; ocelli shiny; eyes glabrous; vertex, frons punctate, setose; occiput smooth; toruli dull, coarsely aciculate; antenna as long as body; length of scape 1.30x its width; length of pedicel 1.40x its width; length of first flagellomere 2.71x its width; length of second flagellomere 2.91x its width.

Mesosoma: Length of mesosoma 1.71x its width, 3x as long as head; mesoscutum coarsely punctate, setose, with a faint medial carina; scutellar lunules narrow, crenulated, scutellum coarsely punctate, setose; notauli indistinct; propleuron sparsely punctate, dull; mesopleuron punctate antero-ventraly, smooth and shiny postero-dorsally; propodeum with well developed areola and carina; transverse and medial carina absent; length of fore wing 2.50x its maximum width; length of pterostigma 3.10x its maximum width; length of vein r 1.30x width of pterostigma; vein 1-R1 1.51x as long as pterostigma; margin of hind wing vannal lobe concave, setose; length of hind femur 2.91x its width; length of hind tibia 6.60x its width; outer tibial spur 0.60x hind basitarsus; length of basitarsus 4.20x its width.

Metasoma: Apical length of T1 1.51x its width, narrowing posteriorly; T2 sparsely punctate, setose; T3–T7 smooth; length of ovipositor 1.50x hind tibia.

Colour: Body black except wing veins, pterostigma brown; tibial spur pale whitish yellow; ocelli, base of hind tibia brownish black; basal half of hind femur, hind tibia yellowish brown.

Male: Unknown.

Host: *Hasora mixta* Mabille (Hesperiidae)

Distribution: India (Kerala), Indonesia, Java.

Material examined: 1F, India, Kerala, Valanchery, Veena, 23.vi.2012 (DZUC).

Discussion

This species resembles with *A. machaeralis* for the characters, frons punctate and toruli aciculate and the main differences are mentined in the key. This species also has similarity with *A. bambusae* for the following characters, length of femur 2.90x its width, length of T1 1.51x its apical width and it differs from *A. bambusae* in having the following characters like length of ovipositor less than 1.50x hind tibia (in *A. bambusae* length of ovipositor less than 2.40x hind tibia), length of fore wing 2.50x its width (length of fore wing 3x its width in *A. bambusae*).

Apanteles hemitheae **Wilkinson**

(Figs 9C & D)

Apanteles hemitheae Wilkinson, 1928. *Bull. Ent. Res*., 19: 124. Female (BMNH).
Apanteles hemitheae Wilkinson, Thompson, 1953. *Host. Par. Cat*., 2:66; Mehra & Sah, 1966. *Ind. J. Ent*., 28: 349; Nixon, 1967. *Bull. Br. Mus. Eat. Hist. (Ent.)*., 21(1): 31.

Redescription

Female: Length 1.60 mm, antenna 1.70 mm, fore wing 1.60 mm, ovipositor 0.30 mm.

Head: Width 1.70x as its length in dorsal view; face punctate, shiny, coarsely setose with a faint medial longitudinal carina; length of face 0.90x its width; clypeus punctate; eye length 7x as long as malar space; vertex coarsely punctate, setose; occiput smooth; toruli coarsely aciculate, dull; OOL 1.05x POL; length of scape 0.80x its width; length of pedicel 0.90x its width; length of first flagellomere 2.30x its width; length of second flagellomere 2.61x its width.

Mesosoma: Length of mesosoma 1.60x its width, 3.40x as long as head; mesosutum shiny, punctate; scutellar lunules broad, crenulated, scutellum punctate, sparsely setose; notauli indistinct; mesopleuron coarsely punctate antero-ventrally, smooth postero-dorsally; metapleuron smooth; propodeum dull with strong areola and lateral carina; length of fore wing 2.30x its maximum width; length of pterostigma 2.30x its maximum width; fore wing vein 1-R1 as long as pteostigma; vein r longer than width of pterostigma; margin of hind wing vannal lobe convex, setose; outer tibial spur 0.40x hind basitarsus; length of basitarsus 5x its width.

Metasoma: Apical length of T1 0.70x its width, with a medial longitudinal carina; T1 and T2 rugose-striate; T3 1.40x as long as T2; T3–T7 shiny, smooth; ovipositor 0.60x as long as hind tibia.

Colour: Black, scape, pedicel, ovipositor yellow; ocelli reddish brown; wing veins, flagellum, apex of hind tibia, hind tarsi dark brown.

Male: Unknown.

Host: *Hemithea costipunctata* Moore (Geometridae)

Distribution: China, India (Kerala), Malaysia, Vietnam.

Material examined: 1F, India, Kerala, C.U.Campus, Rema, 17.ii.1993; 1F, India, Kerala, C.U. Campus, Rema, 25.v.1995; 1F, India, Kerala, Nilambur, T.C. Narendran, 1988 (DZUC).

Discussion

This species shows similarity with the species *A. stantoni* in having punctate frons and aciculate toruli and it differs from the same species with the characters, T1 with a medial longitudinal carina (medial longitudinal carina absent in *A. stantoni*) T2 without diverging sulci (diverging sulci present in *A. stantoni*). This species has character similarity with *A. bambusae* in having, length of body and antenna equal and length of mesosoma 1.60x its width. This species differs from *A. bambusae* for the following characters, ovipositor more than 0.50x as long as hind tibia (in *A. bambusae* ovipositor as long as hind tibia) and outer tibial spur less than 0.50x as long as basitarsus (in *A. bambusae* outer tibial spur more than 0.50x as long as hind basitarsus).

Apanteles hyposidrae **Wilkinson**

(Figs 9E & F)

Apanteles hyposidrae Wilkinson, 1928. *Bull. Ent. Res.*, 19: 125. Female (NBAII).
Apanteles hyposidrae Wilkinson, Thompson, 1957. *Host. Par. Cat*., 2:67; Nixon, 1967. *Bull. Br. Mus. Nat. Hist. (Ent.).*, 21(1): 29.

Redescription

Female: Length 2.20 mm, antenna 1.80 mm, fore wing 2.10 mm, ovipositor 0.20 mm.

Head: Width of head 1.90x its length in dorsal view; face coarsely punctate, setose; length of face 0.90x its width; clypeus punctate, sparsely setose; ocelli shiny; eyes glabrous; vertex, frons punctate, setose; occiput smooth, shiny; toruli slightly aciculate, shiny; antenna 0.80x as long as body; length of scape1.20x its width; length of pedicel 1.30x its width; length of first flagellomere 2.70x its width; length of second flagellomere 2.40x its width.

Mesosoma: Length of mesosoma 1.30x its width, 3x as long as head; mesoscutum coarsely punctate, setose with slight notauli; scutellum punctate, setose with crenulations; scutellar lunules wide; propleuron sparsely punctate; mesopleuron punctate antero-ventrally, smooth postero-dorsally; propodeum with complete areola, without lateral carina; metanotum shiny; length of fore wing 2.60x its maximum width; length of pterostigma 2.90x its maximum width; length of vein r 1.50x width of pterostigma; margin of hind wing vannal lobe convex, setose; length of hind femur 3.50x its width; length of hind tibia 4.30x its width; length of outer tibial spur 0.50x basitarsus; length of basitarsus 4x its width.

Metasoma: Length of T1 1.20x its apical width, rugose-punctate, narrowing posteriorly; T2 sparsely punctate; T3–T7 smooth; ovipositor 0.30x as long as hind tibia.

Colour: Black except ocelli, ovipositor yellowish brown; tibial spur pale whitish yellow; wing veins, pterostigma, half of hind femur, tibia brown.

Male: Unknown.

Host: Macrolepidoptera, Noctuidae.

Distribution: Australia, China, India (Kerala), Indonesia, Java, Vietnam.

Material examined: 1F, INDIA, Kerala, Nilambur, 4.i.10, No collector name (DZUC).

Discussion

This species have close resemblence with *A. pongamiae* in having the characters, T2 with diverging sulci and T1 punctate, it differs from the same species in the characters like, notauli distinct (in *A. pongamiae* notauli indistinct), face without medial longitudinal carina (in *A. pongamiae* face with medial longitudinal carina) and scutellar lunules wide (scutellar lunules narrow in *A. pongamiae*).

Apanteles importunus Wilkinson

(Figs 10A & B)

Apanteles importunus Wilkinson, 1928. *Bull. Ent. Res.*,19: 120. Female (BMNH).
Apanteles importunus Wilkinson, Thompson, 1953. *Host. Par. Cat*., 2:67; Nixon, 1967. *Bull. Br. Mus. Nat. Hist., Ent. Suppl*., 2:73.

Redescription

Female: Length 1.60 mm, antenna 1.70 mm, fore wing 1.80 mm, ovipositor 0.60 mm.

Head: Width 2x its length in dorsal view; face coarsely punctate, setose, with a medial carina; length of face 0.80x its width; clypeus punctate; length of eye

4.80x its malar space; vertex, frons, temple coarsely punctate, setose; occiput, toruli smooth; OOL 0.90x POL; antenna 1.10x as long as body; length of scape 1.30x its width; length of pedicel 1.21x its width; length of first flagellomere 1.80x its width; length of second flagellomere 1.71x its width.

Mesosoma: Length of mesosoma 1.40x its width, 3x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules narrow, crenulated, scutellum shiny, setose; notauli indistinct; propleuron smooth, shiny; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron punctate, setose; propodeum with well developed areola at apex, rest rugose without lateral carina; length of fore wing 3x its maximum width; length of pterostigma 2.40x its maximum width; fore wing vein 1-R1 longer than pterostigma; vein r and width of stigma equal; margin of hind wing vannal lobe concave sparsely setose ; length of femur 4.50x its width; length of hind tibia 6.30x its width; length of hind tibia 1.70x basitarsus; outer tibial spur as long as hind basitarsus.

Metasoma: T1 length 1.50x its apical width, smooth basally, punctate apically; width of T2 2x T1; T2–T7 smooth; ovipositor 1.20x as long as hind tibia.

Colour: Body black, except eyes blackish brown; wing veins colourless; fore tibia, fore tarsi, ovipositor yellow; hind tibia, ovipositor sheath yellowish brown; tibial spur white.

Male: Unknown.

Host: *Nephopteryx rhodobasalis* Hampson (Phycitidae)

Distribution: China, India (Kerala, Uthar Pradesh).

Material examined: 1F, India, Kerala, Ranni, Narendran, 24.xi. 1988; 2F, India, Kerala, C.U.Campus, Rema, 3.v.1993; 1F, India, Kerala,

Rema,10.ii.1993; 1F, India, Kerala, Ranni, Narendran, 24.xi.1988; 1F, India, Kerala, Kanchikkuzhi, Sumodan, 27.ii.1989; 1F, India, Kerala, Payyannur, Sumodan, 26.ii.1988; 1F, India, Kerala, Koodal, Narendran, 27.xi.1988 (DZUC).

Discussion

This species similar to *A. javensis* with the characters face with medial longitudinal carina and T2 with diverging sulci, but it from the same species in having the characters frons punctate (in *A. javensis* frons rugose-striate), OOL 0.90x POL (in *A. javensis* OOL 0.70x POL). The species is similar to *A. tachardiae* having indistinct notauli and propodeum with costulae, but differences are, ovipositor 1.10x as long as hind tibia (ovipositor 1.50x as ling as hind tibia in *A. tachardiae*), and hind tibia brown to black (in *A. tachardiae* basal half yellow, apical half darkened).

Apanteles javensis Rohwer

(Figs 10C & D)

Apanteles javensis Rohwer, 1918 (1919). *Proc.U.S. Nat. Mus.,* 54: 567. Female (USNM).
Apanteles javensis Rohwer Wilkinson, 1928. *Bull. Ent. Res.,* 19: 113; Subba Rao *et al.*, 1965. *Ind. J. Ent*., 27: 356; Gupta & Kalesh, 2012. *Zootaxa*, 3413:35.

Redescription

Female: Length 2.10 mm, antenna 1.90 mm, fore wing 1.90 mm, ovipositor 0.12 mm.

Head: Head width 2x its length in dorsal view; face punctate, setose with a faint medial carina; length of face 0.70x its width; eye length 3.30x its malar space; vertex, temple coarsely punctate, setose; frons rugose-striate; OOL 0.70x POL; antenna as long as fore wing; length of scape 1.30x its width;

length of pedicel 0.90x its width; length of first flagellomere 2.30x its width; length of second flagellomere 2.40x its width.

Mesosoma: Length of mesosoma 1.50x its height, 2.81x as long as head; mesoscutum coarsely punctate, densely setose; scutellar lunules narrow, crenulated, scutellum smooth, sparsely setose; propleuron smooth; metapleuron punctate, setose; pronotum smooth, shiny; metanotum crenulated; propodeum with an areola apically, lateral carina absent, rugose-punctate basally, shiny apically; length of fore wing 2.60x its maximum width; length of pterostigma 3x its maximum width; vein r 0.20x as long as width of pterostigma; 1-R1 as long as pterostigma; margin of hind wing vannal lobe concave, without hairs; length of hind femur 3.20x its width; length of hind tibia 5.60x its width; outer hind tibial spur 0.50x as long as hind basitarsus; length of basitarsus 4.60x its width.

Metasoma: T1 shiny, sparsely punctate, 1.50x as long as its apical width; T2 with diverging sulci, apex 3.40x as long as its basal width, 2.80x as wide as its median length; T2–T7 smooth; ovipositor 0.20x as long as hind basitarsus; ovipositor sheath setose.

Colour: Black in colour except antenna, vein 1-R1 dark brown; ocelli reddish brown; maxillary palp, wing veins, fore tibia, ovipositor yellow; tibial spur pale yellow.

Male: Unknown

Host: *Parnara conjuncta* Herrich-Schäffer (Papilionidae), *Pelopidas mathias* Fabricius (Hesperiidae), *Mycalesis perseus* Fabricius (Nymphalidae), *Polytremis pellucida* Murray (Hesperiidae).

Distribution: China, India (Kerala), Indonesia, Java, Japan, Sri Lanka, Thailand, Vietnam.

Material examined: 1F, India, Kerala, C.U.Campus, Rema, 10.iv.1993; 1F, India, Kerala, C.U.Campus, Rema, 26.iv.1995; 1F, India, Kerala, Neendakara, T.C.Narendran, 22.ii.1989; 1F, India, Kerala, Uppinangadi, T.C.Narendran, 17.xii.1990; 1F, India, Kerala, C.U.Campus Sumodan,1989 (DZUC).

Discussion

This redescription is similar to Wilkinson's description (1928) except that hind coxa smooth. This species shows similarity with the species *A. leptothecus* in having T1 punctate and propodeum with costulae, but differs from the same species in having frons rugose-striate (frons punctate in *A. leptothecus)* and face with medial longitudinal carina (medial longitudinal carina absent in *A. leptothecus*).

Apanteles leptothecus (Cameron)

(Figs 10E & F)

Pseudapanteles leptothecus Cameron, 1907. *J. Bom. Nat. Hist. Soc*., 17: 585 Female (BMNH).
Apanteles (pseudapanteles) leptothecus Ayyar, 1924. *Rep. Proc. Ent. Meet*., 5: 358.
Apanteles leptothecus (Cameron), Wilkinson, 1928. *Bull. Ent. Res.,* 19: 116.

Redescription

Female: Length 3 mm, antenna 2.20 mm, fore wing 2.80 mm, ovipositor 1.30 mm.

Head: Width of head 1.90x its length in dorsal view; face punctate, setose without medial longitudinal carina; length of face 0.80x its width; clypeus sparsely punctate; length of eye 3.30x malar space; vertex, frons punctate, shiny; occiput shiny without medial longitudinal carina; OOL 0.30x POL; antenna 0.73x as long as body; length of scape 0.90x its width; length of

pedicel 1.20x its width; length of first flagellomere 2.81x its width; length of second flagellomere 2.60x its width.

Mesosoma: Length of mesosoma 1.20x its width, 3.61x as long as head; mesoscutum coarsely punctate, setose; scutellum sparsely punctate, setose; propleuron sparsely punctate; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; propodeum with 'U' shaped areola at apex, without costulae, rest punctate; metapleuron punctate with hairs; fore wing 3x as long as its width; length of pterostigma 2.50x as long as its width; fore wing vein 1-R1 0.80x pterostigma, vein r 0.90x width of pterostigma; margin of hind wing vannal lobe convex without hairs; length of hind femur 3x its width; length of hind tibia 5.30x as long as its width; length of basitarsus 5x as long as its width; outer hind tibial spur 0.50x as long as basitarsus.

Metasoma: T1 punctate, striated at apex; length of T1 1.31x its apical width; T2 with diverging sulci; T2–T7 smooth; ovipositor 1.90x as long as hind tibia; ovipositor sheath longer than hind tarsi.

Colour: Body black except ocelli, apex of fore femur, fore tibia, fore tarsi, basitarsus yellow; wings hyaline, wing veins colour less; tibial spur pale yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala, Maharashtra)

Material examined: Female, India, Kerala, Peruvannamuzhi, Rema, 17. i. 1995; 1F, India, Kerala, Pathiramanal, 14. iv. 1990; 1F, India, Kerala, C.U.Campus, Rema, 19. v. 1994; 1F, India, Kerala, Anakkatty, Sumodan, 20.ii.1989; 1F, India, Kerala, Memana, T.C. Narendran, 26.ii.1989; 1F, India,

Kerala, Ernakulum, Padmasenan, 9.ii.1989; 1F, India, Kerala, Ranni, T.C. Narendran, 24. xi. 1988 (DZUC).

Discussion

This species shows similarity with *A. singaporensis* in having the characters propodeum with costulae and basally closed propodeal areola. *A. leptothecus* shows differeces from the same species in having OOL 0.30x POL (OOL as long as POL in *A. singaporensis*) and fore wing 3x as long as its width (in *A. singaporensis* fore wing 2.40x as long as its width).

Apanteles machaeralis Wilkinson

(Figs 11A & B)

Apanteles machaeralis Wilkinson, 1928. *Bull. Ent. Res.*, 19: 123. Female (NBAII).
Apanteles machaeralis Wilkinson, Bhatnagar, 1950. *Ind. J. Ent*., 10: 187; Nixon, 1965. *Bull. Br. Mus. Nat. Hist. (Ent.) Suppl*., 2:72.

Redescription

Female: Length 2.10 mm, antenna 2.10 mm, fore wing 1.80 mm, ovipositor 0.50 mm.

Head: Width of head 1.80x its length in dorsal view; face punctate, setose, with medial longitudinal carina; length of face 0.71x its width; clypeus punctate; ocelli shiny; vertex sparsely punctate, setose; frons dull, punctate; occiput dull, smooth; toruli dull, coarsely aciculate; maxillary palp four segmented; length of antenna as long as body; length of scape 1.51x itswidth; length of pedicel 1.30x its width; length of first flagellomere 2.61x its width; length of second antennal flagellomere 2.30x its width.

Mesosoma: Length of mesosoma 1.50x its width, 3.30x as long as head; mesoscutum punctate; scutellum punctate, setose, scutellar lunules wide; notautli indistinct; propleuron punctate, setose; mesopleuron punctate, antero-

ventrally, smooth postero-dorsally; metanotum shiny, smooth, crenulated; propodeum rugose with well developed areola and lateral carina; length of fore wing 2.91x its maximum width; length of pterostigma 3x its maximum width; vein r as long as width of pterostigma; hind wing vannal lobe convex, setose; length of hind femur 3.10x its width; length of hind tibia 3.81x its width; basitarsus 4.31x as long as its width; length of outer tibial spur 0.52x as long as basitarsus.

Metasoma: Metasoma 1.10x as long as mesosoma; length of T1 1.50x its width, narrowing posteriorly; T3–T7 smooth; ovipositor 0.70x as long as hind tibia.

Colour: Body black except wing veins, pterostigma brown; clypeus, ocelli, ovipositor yellowish brown; apical half of hind tibia, ovipositor sheath brownish black.

Male: Unknown.

Host: Unknown.

Distribution: China, India (Kerala), Myanmar, Vietnam.

Material examined: 1F, India, Kerala, Anakkatty, Narendran, 20.ii.1989 (DZUC).

Discussion

This species closely related to the species *A. hasorae* for the following characters, antenna as long as body, T1 1.50x its apical width and length of pterostigma 3x its width. It differs from the characters like length of mesosoma 1.50x its width (in *A. hasorae* length of mesosoma 1.71x its width), length of hind tibia 3.80x its width (in *A. hasorae* length of hind tibia 6.60x its width), frons dull (frons shiny in *A. hasorae*).

Apanteles munnarensis Sumodan & Narendran

Apanteles munnarensis Sumodan & Narendran 1990. *J. Ecobiol*., 2 (3). 241. Female (RMNH).

Diagnosis

Female: Length 2.40 mm, antenna 2.70 mm, fore wing 3 mm, ovipositor 0.90 mm.

Width of head 2.50x its length in dorsal view; face punctate with medial longitudinal carina; clypeus sparsely punctate; ocelli shiny; eye length 3.30x its malar space; vertex, frons punctate, setose; occiput shiny, straight in dorsal view; OOL 1.40x POL; toruli dull, coarsely aciculate; maxillary palp four segmented; mesoscutum coarsely punctate, setose; scutellar lunules wide, crenulated, scutellum shiny, sparsely punctate; propleuron punctate, sparsely setose; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; propodeum punctate with strong areola and lateral carina; fore wing vein 1-R1 1.40x as long as pterostigma, vein r longer than breadth of pterostigma, width of pterostigma equal to vein r; hind wing vannal lobe convex without hairs; hind coxa punctate, setose; outer hind tibial spur half of hind basitarsus, inner spur 0.30x of basitarsus; T1 parallel sided 2.40x as long as its width at apex, coarsely punctate; T2 punctate without diverging sulci; T3−T7 smooth, shiny; T3 1.70x as long as T2; ovipositor sheath as long as hind femur.

Colour: Body black except ocelli reddish brown, antenna, tegula, pterostigma, wing veins dark brown; fore and mid leg, basal half of hind femur and tibia, ovipositor yellow; tibial spur pale yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Remarks: This diagnosis is based on the original description Sumodan & Narendran 1990.

Discussion

This species shows similarity with *A. agilis* in many characters like frons punctate and wider scutellar lunules. But the species shows differences in the following characters, propodeum punctate (propodeum rugose in *A. agilis*) and T2 punctate (T2 smooth in *A. agilis*).

Apanteles opacus (Ashmead)

(Figs 11C & D)

Urogaster opacus Ashmead, 1905 (1906). *Proc. U.S. Nat. Mus*., 29:118. Female (USNM).
Apanteles opacus (Ashmead), Wilkinson, 1928. *Bull. Ent. Res*., 19: 128.

Redescription

Female: Length 2.10 mm, antenna 2.20 mm, fore wing 2.11 mm, ovipositor 0.50 mm.

Head: Width 2x its length in dorsal view; face coarsely punctate, setose with medial carina; length of face 0.70x its width; clypeus punctate, sparsely setose; eyes glabrous; vertex, temple punctate, setose; frons sparsely punctate; occiput smooth; OOL 1.50x POL; maxillary palp four segmented; antenna 1.10x as long as body; length of scape 0.80x its width; length of pedicel 1.21x its width.

Mesosoma: Length of mesosoma 1.30x its width, 2.50x as long as head; mesosutum coarsely punctate, setose; propleuron coarsely punctate, sparsely setose; scutellar lunules wide, crenulated; scutellum smooth, shiny; notauli

somewhat distinct; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron smooth anteriorly punctate, setose posteriorly; propodeum rugulose, areola at apex 'V' shaped, with numerous lateral carinae; length of fore wing 2.90x its maximum width; length of pterostigma 2.70x its maximum width; width of pterostigma equal to vein r; vein 1-R1 1.80x as long as pterostigma; margin of hind wing vannal lobe convex setose; length of hind tibia 6.30x its width; length of basitarsus 6.60x its width; outer tibial spur 0.41x as long as basitarsus.

Metasoma: Length of T1 1.60x its apical width; T1 punctate; T2 smooth, 0.30x as long as wide, with diverging sulci; length of hind femur 2.91x its width; ovipositor 0.70x as long as hind tibia.

Colour: Body black except ocelli, fore and mid legs, basal half of hind femur and hind tibia, tibial spur yellow; pterostigma, wing veins brown; hind tarsi yellowish brown.

Male: Unknown.

Host: Unknown.

Distribution: China, India (Kerala), Indonesia, Java, Japan, Malaysia, Philippines, Vietnam.

Material examined: 1F, India, Kerala, Ezhimala, 21.ix.1990; 1F, India, Kerala, Kasaragode, Sumodan, 27.ii.1988; 1F, India, Kerala, C.U.Campus, Rema, 2.v.1993; 1F, India, Kerala, Kumarakam, Sumodan, 29.xi.1988; 2F, India, Kerala, C.U.Campus, Veena, 7.iii.2012; 1F, India, Kerala, C.U.Campus, Rema, 1.xii.1993; 1F, India, Kerala, Kazhakoottam, Narendran, 25.ii.1989; 1F, India, Kerala, Nedunkayam, Aboobacker, 12.i.1995; 1F, India, Kerala, Valayar, Sumodan, 27.ii.1989 (DZUC).

Discussion

This species shows similarity with the species *A. expulsus* in punctate sculpturing of frons and T2 with diverging sulci. The main differences are occiput smooth (occiput rugose in *A. expulsus*) and frons lack medial carina (frons with medial carina in *A. expulsus*). This species shows similarity with *A. hemitheae* in having the following characters, length of body as long as fore wing and outer hind tibial spur 0.40x as long as basitarsus. This species differs from the species *A. hemitheae* for having apical length of T1 more than 1x its width (in *A. hemitheae* the apical length less than 1x its apical length) and length of fore wing more than 2.70x its width (length of fore wing less than 2.70x its width in *A. hemitheae*).

***Apanteles parasae* Rohwer**

(Figs 11E & F)

Urogaster philippinensis Ashmead, 1904. *J.N.Y. Ent. Soc*., 12:19 (not *Apanteles philippinensis* Ashm.1904) Female (USNM).
Apanteles parasae Rohwer, 1922. *Treubia*, 3:54.

Redescription

Female: Length 2.91 mm, antenna 3 mm, fore wing 3.10 mm, ovipositor 0.80 mm.

Head: Width 2x its length in dorsal view; face coarsely punctate, setose, a medial longitudinal carina below the antennal toruli; length of face 0.80x its width; clypeus sparsely punctate, setose; eye length 3.60x malar space; vertex, temple coarsely punctate, setose; frons punctate; occiput smooth; toruli dull, coarsely aciculate; OOL 0.80x POL; maxillary palp four segmented; length of scape 1.50x its width; length of pedicel 0.50x its width

in dorsal view; length of first flagellomere 2.80x its width; second flagellomere 2.80x as long as its width.

Mesosoma: Length of mesosoma 1.50x its height, 2.71x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules wide, crenulated; scutellum smooth, shiny sparsely setose; propleuron punctate, setose; mesopleuron coarsely punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron shiny anteriorly, punctate, setose posteriorly; propodeum with strong areola and laterally diverging carina, areola open at base, rest punctate; length of fore wing 1.10x its body; length of pterostigma 2.70x its maximum width; vein 1-R1 1.50x as long as pterostigma; vein r 1.10x as long as breadth of pterostigma; margin of hind wing vannal lobe concave, sparsely setose; length of hind femur 3x its width; length of hind tibia 5.20x its width; outer tibial spur 0.50x as long as basitarsus.

Metasoma: Metasoma 0.91x as long as mesosoma; T1 punctate 1.50x its apical width; T2 rugose, 0.20x its apical width; T2 with diverging sulci; T2–T7 rugose; ovipositor 0.80x as long as hind tibia.

Colour: Black except pterostigma, wing veins dark brown; fore leg except coxae, ovipositor yellowish brown; mid trochanter, tibia, tarsi, basal half of hind tibia yellow; tibial spur pale yellow.

Male: Unknown.

Host: *Parasa* sp. (Limacodidae)

Distribution: India (Kerala), Philippines (Manila).

Material examined: 1F, India, Kerala, C.U. Campus, Rema, 25.iii.1995; 2F, India, Kerala, C.U.Campus, Rema, 2.iii.1993; 1F, India, Kerala, Ranni, Narendran, 24.xi.1988; 1F, India, Kerala, Calicut, Mohana, 15.xi.1994; 1F, India, Kerala, Peechi, Narendran, 5.ii.1989; 1F, India, Kerala,

Peruvannamuzhi, Rema, 17.i.1995; 1F, India, Kerala, attingal, Sumodan, 23.ii.1989; 1F, India, Kerala, C.U.Campus, Rema, 17.v.1993; 1F, India, Kerala, Silent Valley, Sumodan, 20.xii. 1988 (DZUC).

Discussion

This species shows close resemblence with *A. stantoni* in having width of head 2x its length in dorsal and T1 1.50x its apical width. This species shows differences in having eye length 3.60x as long as malar space (eye length 7x as long as malar space in *A. stantoni*) OOL 0.80x POL (in *A. stantoni* OOL 1.10x POL) and occiput without medial longitudinal carina (In *A. stantoni* occiput with a medial longitudianl carina).

Apanteles pongamiae Sumodan & Narendran

Apanteles pongamiae Sumodan & Narendran, 1990. *J. Ecobiol*., 2(3): 246. Female (RMNH).

Diagnosis

Female: Length 1.90 mm, antenna 1.60 mm, fore wing 2.30 mm.

Head width 2x as its length in dorsal view; face coarsely punctate, setose with a medial longitudinal carina; clypeus sparsely punctate, setose; ocelli shiny; eye length 3.50x its malar space; vertex, frons punctate, setose; occiput smooth with a medial longitudinal carina; toruli shiny, aciculate; OOL 0.70x POL; mesoscutum coarsely punctate, setose; scutellar lunules narrow, crenulated; scutellum disc shiny, sparsely punctate; notauli indistinct; propleuron punctate, dull; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron smooth and shiny; propodeum rugose-punctate, with weak areola and lateral carinae; fore wing 1.20x as long as body; fore wing vein 1-R1 longer than pterostigma; vein r longer than breadth

of pterostigma and 1-Rs; hind wing vannal lobe convex and setose; T1 parallel sided, as long as its width at apex; T1 and T2 punctate, rest of tergites smooth; T3 a little longer than T2; T2 without diverging sulci; ovipositor sheath short, setose throughout.

Colour: Black except antenna, hind tarsi yellowish brown; ocelli, trochanter reddish brown; pterostigma, wing veins brown; hind femur, hind tibia, fore and mid legs except coxa, trochanter yellow.

Male: Unknown.

Host: Lepidopteran larva feeding on *Pongamia glabra.*

Distribution: India (Kerala).

Remarks: This diagnosis is based on the original description Sumodan & Narendran 1990.

Discussion

This species show similarity with *A. expulsus* in Rao's (1961) key, but differs in the following characters like, face with medial longitudinal carina (face without medial longitudinal carina in *A. expulsus*), T1 punctate (T1 rugose-striate in *A. expulsus*). This species also have resemblence with *A. hyposidrae* for propodeum without costula and punctate sculpturing of frons. The main differences are notauli indistinct (notauli distinct in *A. hyposidrae*) and scutellar lunules narrow (scutellar lunules wide in *A. hyposidrae*).

Apanteles ricini **Bhatnagar**

Apanteles ricini Bhatnagar, 1948. *Ind. J. Ent*., 10:175. (Repository not specified)

Diagnosis

Male: 2.21 mm in length.

Face punctate, setose without medial longitudinal carina; clypeus punctate; ocelli shiny; vertex coarsely punctate, setose; occiput dull slightly concave; toruli dull, coarsely aciculate; OOL as long as POL; antenna longer than body, inserted middle of the face; maxillary palp four segmented; mesoscutum with well separated punctures; scutellum dull, coarsely punctate; propleuron punctate; mesopleuron punctate antero-ventrally, smooth postero-dorsally; metapleuron shiny, crenulated; propodeum with well developed areola and lateral carina, rest rugose-punctate; fore wing vein 1-R1 longer than pterostigma, vein r longer than breadth of pterostigma; vein r 2x the length of vein 1-R1, 1-Rs equal to vein r; T1 parallel sided, 3x as long as its width, rugose-punctate; T2 punctate, setose with diverging sulci; T3 longer than T2; T3 – T7 smooth.

Female: Length 2.52 mm, ovipositor sheath as long as hind metatarsus.

Host: Erebidae family.

Distribution: India (Kerala).

Remarks: This diagnosis is based on the original description Bhatnagar 1948.

Discussion

This species shows close similarity with *A. valvulae* with the characters OOL as long as POL and aciculate sculpturing of toruli. The main differences are T2 with diverging sulci (T2 with out diverging sulci in *A. valvulae*) T1 3x its apical width (in *A. valvulae* T1 1.90x its apical width). This species also

shares some characters with *A. grandiculus* like smooth occiput and T2 with diverging sulci. The species shows differences in having OOL equal to POL (in *A. grandiculus* OOL 0.60x POL), antenna longer than body (antenna as long as body in *A. grandiculus*).

Apanteles singaporensis Szépligeti

(Figs 12A & B)

Apanteles singaporensis Szépligeti, 1905. *Ann. Atur, Nat. Hung.*, 3:49. Female (HNHM).
Apanteles singaporensis Szépligeti, Wilkinson, 1928. *Bull. Ent. Res*., 19:115.
Apanteles singaporensis Szépligeti, Bhatnagar 1950 (1948). *Ind. J. Ent*., 10:187.
Apanteles singaporensis Szépligeti, Subba Rao *et al.* 1965. *Ind. J. Ent*., 27: 356.

Redescription

Female: Length 1.90 mm, antenna, 1.80 mm, fore wing 1.91 mm, ovipositor 0.60 mm.

Head: Width of head 2.21x its length in dorsal view; face punctate, setose with medial longitudinal carina; length of face 0.90x its width; clypeus punctate; vertex, temple punctate, pubescent; occiput smooth; toruli smooth, shiny; OOL as long as POL; antenna as long as body; length of scape 1.20x its width; length of pedicel 0.90x its width; length of first flagellomere 2.40x its width; length of second flagellomere 2.23x its width.

Mesosoma: Length of mesosoma 1.31x its width, 2.92x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules narrow, crenulated, scutellum punctate, coarsely setose; propleuron punctate; metapleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron sparsely punctate; propodeum with areola at apex, lateral carina absent, basal part dull, punctate; length of fore wing 2.40x its maximum width; length of pterostigma 3.30x its maximum width; vein r 3x as long as 1Rs, equal to

width of pterostigma; margin of hind wing vannal lobe convex with sparse hairs; length of hind femur 2.80x its maximum width; length of hind tibia 4x its maximum width; length of basitarsus 4.50x its width; outer hind tibial spur 0.50x as long as basitarsus.

Metasoma: Length of metasoma as long as mesosoma; T1 punctate, 1.60x as long as its apical width; T2 2x as broad as apex of T1, with diverging sulci; T3 1.51x as long as T2; ovipositor 0.20x as long as hind tibia.

Colour: Body black except eyes grey; ovipositor, fore and hind tibia, pterostigma, wing veins yellowish brown; hind tibial spur white.

Male: Unknown.

Host: *Porthmologa paraclina* Meyrick (Oecophoridae)

Distribution: India (Bihar, Kerala), Singapore.

Material examined:1F, India, Kerala, Athirampuzha, Narendran, 1988; 1F, India, Kerala, C.U.Campus.Veena, 20.x.2011; 1F, India, Kerala, C. U. Campus, Rema, 23.xi.1995; 1F, India, Kerala, Anakkatty, Narendran, 7.i.1989; 1F, India, Kerala, Chalikkara, Rema,17.i.1995; 1F, India, Kerala, Sreekaryam, Sumodan, 25.ii.1989; 1F, India, Kerala, C.U.Campus, Rema, 12.i.1994; 1F, India, Kerala, Ranni, Narendran, 24.xi.1988; 1F, India, Kerala, Peechi, Sumodan, 1.ii. 1989; 1F, India, Kerala, Ranni, Narendran, 27. xi. 1988; 1F, India, Kerala, Nilambur, 1985 (DZUC).

Discussion

It shows small differences from Wilkinson's (1928) description in having ovipositor sheath as long as hind tibia (ovipositor a littile longer than hind tibia in Wilkinson's description. This difference is only variation of the same species. This species is similar to *A. leptothecus* in having propodeum without

lateral carina and T1 with punctate sculpturing. But differs from *A. leptothecus* in the characters like, OOL as long as POL (in *A. leptothecus* OOL 0.30x POL) and scutellum coarsely punctate (scutellum shiny, sparsely punctate).

Apanteles stantoni (Ashmead)

(Figs 12C & D)

Urogaster stantoni Ashmead, 1904. *J.N.Y. Ent. Soc*., 12:20. Female (BMNH).
Apanteles stantoni Ashmead, Wilkinson, 1928. *Bull. Ent. Res.*, 19:131.
Apanteles fistulae Wilkinson, 1928. *Bull. Ent. Res.*, 19: 134.

Redescription

Female: Length 1.90 mm, antenna 1.90 mm, fore wing 2 mm, ovipositor 0.90 mm.

Head: Width 2x its length in dorsal view; face sparsely punctate, pubescent; length of face 0.80x its width; clypeus punctate, pubescent; ocelli shiny; eye length 7x malar space; vertex, frons coarsely punctate, pubescent; occiput shiny with a medial longitudinal carina; toruli coarsely aciculate; OOL 1.10x POL; maxillary palp four segmented; antenna as long as body; length of scape 1.10x its width; length of pedicel 0.80x its width; length of first flagellomere 2.20x its width; length of second flagellomere 2.41x its width.

Mesosoma: Length of mesosoma 1.60x its width, 3x as long as head; mesoscutum coarsely punctuate; scutellar lunules wide, crenulated; scutellum smooth, shiny; notauli indistinct; propleuron smooth, shiny; mesopleuron punctate, pubescent antero-ventrally smooth postero-dorsally; metapleuron shiny, smooth; propodeum with strong areola, costulae, areola open basally, remaining part of propodeum slightly smooth; length of fore wing 2.50x its maximum width; length of pterostigma 2x its maximum width; fore wing vein

1-R1 1.40x as long as pterostigma; vein r 0.20x longer than width of pterostigma, as long as vein 1-R1; margin of hind wing vannal lobe concave, hairless.

Metasoma: Length of T1 1.50x its width, parallel sided, rugose-punctate; T2 with diverging sulci; T2-T7 smooth; T3 2.50x as long as T2; ovipositor sheath as long as hind tibia.

Colour: Body black except scape, pedicel yellowish brown; fore and mid legs, tibial spur, ovipositor yellow; tibial spur pale yellow; ocelli white; apex of hind tibia and tarsi dark brown.

Male: Unknown.

Host: *Parotis marginata* Hampson (Crambidae)

Distribution: India (Kerala, Uthar Pradesh, West Bengal, Bihar), Philippines (Manila).

Material examined: 1F, India, Kerala, Ranni, Narendran, 25.ii.1988; 1F, India, Kerala, C.U.Campus, Rema, 19.viii.1993; 1F, India, Kerala, Kadakkattupara, Narendran, 9.i.1988; 1F, India, Kerala, Mukkali, Sumodan, 10.xii.1987; 1F, India, Kerala, Erumeli, Sumodan, 25. ii. 1988 (DZUC).

Discussion

This species is similar to *A. parasae* with the characters, width of head 2x as its length in dorsal view and T1 1.50x its apical width, but differs with the same species in having eye length 3.60x malar space (in *A. parasae* eye length 7x as long as malar space) and length of pterostigma 2x as long as its width (length of pterostigma 2.70x as long as its width in *A. parasae*).

Apanteles tachardiae Cameron

(Figs 12E & F)

Apanteles tachardiae Cameron, 1913. *Ind. For. Rec*., 4:109. Female (BMNH).
Apanteles tachardiae Cameron, Wilkinson, 1928. *Bull. Ent. Res.,* 19:119.
Apanteles tachardiae Cameron, Nixon, 1967. *Bull. Br.Mus. Nat. Hist., Ent. Suppl*., 2:72.

Redescription

Female: Length 1.90 mm, antenna 1.90 mm, fore wing 2.21 mm, ovipositor 0.90 mm.

Head: Width of head 1.70x its length in dorsal view; face coarsely punctate, setose; length of face 0.60x its width; clypeus punctate; eye length 4x malar space; vertex, frons setose, coarsely punctate; occiput, toruli, smooth, shiny; OOL 0.80x POL; antenna as long as body length; length of scape 0.80x its width; length of pedicel 0.90x its width; length of first flagellomere 2.71x its width; length of second flagellomere 2.51x its width.

Mesosoma: Length of mesosoma 1.40x its height, 2.91x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules wide, crenulated; scutellar disc sparsely punctate, setose; propleuron sparsely punctate, setose; mesopleuron coarsely punctate, setose antero-ventrally, smooth postero-dorsally; propodeum with well developed areola, lateral carina absent, basal propodeum sparsely punctate; length of fore wing 3.20x its maximum width; length of pterostigma 3x its maximum width; fore wing vein 1-R1 1.10x as long as pterostigma; vein r 1.20x as long as width of pterostigma; margin of hind wing vannal lobe sparsely setose; length of hind femur 3.60x its width; length of hind tibia 4.50x its width; length of baitarsus 5.70x its width; outer tibial spur 0.50x as long as basitarsus.

Metasoma: Length of T1 1.50x its apical width, narrowed, punctate apically, smooth basally; T2 2x as wide as T1; T3 2x as long as T2; tergites smooth from T2 onwards; ovipositor 1.80x as long as hind tibia.

Colour: Body black except wings, pterostigma hyaline, apex of fore femur, tibia and tarsi yellowish brown; mid tarsi, basal hind tibia yellow; tibial spur white.

Male: Unknown.

Host: *Holocera pulverea* Meyrick (Blastobasidae)

Distribution: China, India (Bihar, Kerala, Uthar Pradesh, West Bengal).

Material examined: 1F, India, C.U.Campus, Rema, 15.i.1994; 1F, India, Kerala, C.U.Campus, Madhavikkutty, 4.xii.1992; 1F, India, Kerala, Memana, Narendran, 26.ii.1989; 1F, India, Kerala, Agali, Narendran, 7.i.1989; 1F, India, Kerala, C.U.Campus, Rema, 4.iii.1993; 1F, India, Kerala, Ranni, Narendran, 25.ii.1988; 1F, India, Kerala, Nilambur, Sumodan, 24.ii.1989; 1F, INDIA, Kerala, Trichur, Narendran, 1985; IF, India, Kerala, Silent Valley, Sumodan, 13. Xii. 1988 (DZUC).

Discussion

This species differs from Wilkinson's description (1928) in the following characters, fore wing vein r longer than width of pterostigma (vein r equal to the width of pterostigma in Wilkinson's description). This is a minor species variation. This species shows close resemblance with *A. tasmanica* in having absence of lateral carina on propodeum and antenna as long as body, it differs with the same species in having hyaline pterostigma (in *A. tasmanica* pterostigma brown) and all major differences are mentioned in the key.

Apanteles taragamae Viereck

(Figs 13A & B)

Apanteles taragamae Viereck, 1912. *Proc. U.S. Nat. Mus*., 42:140, Female (USNM).
Apanteles taragamae Viereck, Gupta, 1957. *Ind. J. Ent*., 19: 103.
Apanteles taragamae Viereck, Packard & Subba Rao, 1965. *Ind. J. Ent*., 26: 463.

Redescription

Female: Length 2 mm, fore wing 2.11 mm, antenna 1.50 mm, ovipositor 0.60 mm.

Head: Width 2.30x its length in dorsal view; face rugose- punctate, setose; length of face 0.90x its width; clypeus punctate; eye length 4x its malar space; vertex and temple coarsely punctate, setose; frons aciculate; occiput smooth; toruli smooth, shiny, aciculate; OOL 1.20x OOL; antenna 0.80x as long as body; length of scape 1.40x its width; length of pedicel 1.30x its width; length of first flagellomere 1.71x its width; length of second flagellomere 1.51x its width.

Mesosoma: Length of mesosoma 1.50x its height, 3.31x as long as head; mesoscutum coarsely punctate, setose anteriorly, striate posteriorly; scutellar lunules wide, crenulated; scutellum shiny, smooth; propleuron punctate; mesopleuron punctate, setose antero-ventrally; notauli indistinct; metapleuron punctate, setose posteriorly; propodeum rugose-punctate with strong areola and weak lateral carina; length of fore wing 2.60x its width; length of pterostigma 2.60x its width; fore wing vein 1-R1 1.30x as long as pterostigma; length of vein r 1.30x width of pterostigma; margin of hind wing vannal lobe convex, hairless; length of hind femur 3.30x its width; hind tibial length 6x its width.

Metasoma: Metasoma 1.30x as long as mesosoma; T1 1.50x as long as its width, parallel sided slightly narrowed at apex, punctate basally, striate

apically; T2 0.31x as long as T1 without diverging sulci; T3 2x as long as T2; T2–T7 smooth; ovipositor as long as hind tibia.

Colour: Body black except ocelli, distal half of fore femur, tibia, tarsi yellow; basal half of fore femur reddish brown; tibial spur white; basal half of hind tibia, tarsi, ovipositor yellowish brown.

Male: Unknown.

Host: *Taragama dorsalis* Walker (Lasiocampidae), *Plusia agramma* Guen (Noctuidae), *Homona coffearia* Nietner (Tortricidae) *Opisina arenosella* Walker (Oecophoridae), *Anadevida peponis* Fabricius (Noctuidae)

Distribution: China, India (Bihar, Karnataka, Kerala), Java, Japan, Korea, Sri Lanka, Thailand.

Material examined: 1F, India, Kerala, Malampuzha, Narendran, 10.xii.1989; 2F, India, Kerala,Valanchery, Veena, 15.vi.2011; 1F, India, Kerala, C.U.Campus,Veena, 5. vii.2012; 1F, India, Kerala, C.U.Campus, Rema, 10.ii.1993; 1F, India, Kerala, Kovalam, Narendran, 24.ii.1989; 1F, India, Kerala, pathanamthitta, Narendran, 1.xii.1989; 1F, India, Kerala, Aralam Farm, Narendran, 31.x. 1988; 1F, India, Kerala, Manjeswaram, Narendran, 27. ii. 1988 (DZUC).

Discussion

This species shows similarity with the species *A. azollae* having indistinct notauli and vein 1-R1 1.30x as long as pterostigma, but it differs with the characters like OOL 0.8x POL (OOL 1.20x POL in *A. azollae*), T1 1.50x its apical width (T1 2.30x its apical width in *A. azollae*) and eye length 4x as long as malar space (eye length 3.50x its malar space). This species shares many characters with *A. bambusae*, but shows many differences which are mentioned in the key.

Apanteles tasmanica Cameron

(Figs 13C & D)

Apanteles tasmanica Cameron, 1912. *Proc. Linn. Soc. N.S. Wales.,* 39:196. Female (BMNH).
Apanteles tasmanica Cameron Wilkinson, 1928. *Bull. Ent. Res.,* 19:120.

Redescription

Female: Length 1.60 mm, antenna 1.60 mm, fore wing 1.60 mm, ovipositor 1.02 mm

Head: Width 2.20x its length in dorsal view; face coarsely punctate, setose; length of face 0.70x its width; clypeus sparsely punctate; eyes glabrous; length of eye 3.30x malar space; vertex, temple, frons coarsely punctate, setose; occiput punctate; OOL 0.90x POL; maxillary palp four segmented; antenna as long as body; length of scape 1.21x its width; length of pedicel 0.90x its width; length of first flagellomere 2.50x its width; length of second flagellomere 2.30x its width.

Mesosoma: Length of mesosoma 1.20x its width, 2.71x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules narrow, crenulated; scutellum sparsely punctate; notauli indistinct; propleuron smooth; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron punctate, setose; propodeum with well developed areola without lateral carina; length of fore wing 2.30x its maximum width; length of pterostigma 3.10x its maximum width; fore wing vein 1-R1 1.20x as long as pterostigma; vein r 0.20x shorter than breadth of pterostigma; length of hind femur 3.60x its width; length of hind tibia 6.20x its width; length of basitarsus 6x its width; outer tibial spur 0.40x as long as basitarsus.

Metasoma: Length of T1 1.60x its width, parallel sided, coarsely punctate; T2 width 5x its length; T3 1.41x as long as T2; T3–T7 smooth, shiny; ovipositor 2x as long as hind tibia.

Colour: Body almost black except ocelli, ovipositor reddish brown; fore leg yellowish brown; pterostigma, wing veins brown.

Male: Unknown.

Host: Unknown.

Distribution: China, India (Kerala), Indonesia, Java, Japan, Korea, Sri Lanka, Thailand.

Material examined: 1F, India, Kerala, Peravoor, 25.ii.1988; 1F, India, Kerala, SilentValley, Narendran, 9.xii.1987; 1F, India, Kerala, Idukki, Narendran, 1.xii.1988 (DZUC).

Discussion

This species shows similarity with *A. calycinae* for the following characters, propodeum with out lateral carina and frons punctate, but differs with the characters T1 1.60x its width (T1 1.90x its width in *A. calycinae*), eye length 3.30x its malar space (in *A. calycinae* eye length 6x malar space) and T1 punctate (T1 aciculate in *A. calycinae*).

Apanteles valvulae Rao & Kurian

(Figs 13E & F)

Apanteles valvulae Rao & Kurian, 1950. *Ind. J. Ent*., 12: 7. Female (BMNH).
Apanteles valvulae Rao & Kurian, Rao & Chalikwar, 1970. *Marathwada Univ. J. Sci*., 9: 109.

Redescription

Female: Length 2.30 mm, antenna 2.40 mm, fore wing 2.81 mm, ovipositor 1.02 mm.

Head: Width of head 2.30x its length in dorsal view; face punctate, setose; length of face 0.90x its width; clypeus sparsely punctate; eyes glabrous; eye length 3x its malar space; vertex, frons, temple coarsely punctate, setose; occiput sparsely punctate; toruli aciculate; OOL as long as POL; antenna 0.60x as long as fore wing, inserted middle of face; maxillary palp four segmented; length of scape 0.70x its width; length of pedicel 0.90x its width; length of first flagellomere 2.50x its width; length of second flagellomere 2.41x its width.

Mesosoma: Length of mesosoma 1.50x its width, 3.32x as long as head; mesoscutum and scutellum rugose-striate; scutellar lunules wide, crenulated; notauli indistinct; propleuron smooth; mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron punctate, setose; propodeum with strong areola, rest rugose; length of fore wing 2.60x its maximum width; length of pterostigma 2.60x its maximum width; length of vein 1-R1 1.30x as long as pterostigma; vein r and breadth of pterostigma equal; margin of hind wing vannal lobe convex and setose; length of hind femur 3.50x its width; length of hind tibia 4.70x its width; outer tibial spur 0.50x as long as basitarsus.

Metasoma: T1 rugose-striate apically, punctate basally; length of T1 1.90x its apical width; T2 2x as wide as its length and 2x apical width of T1; T3 1.81x as long as T2; ovipositor 1.30x as long as hind tibia.

Colour: Body black except eyes grey; ocelli, pterostigma, fore and mid trochanter ovipositor reddish brown; vein r, r-m, hypopygium yellowish brown; fore and mid leg, tibial spur yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala, Uthar Pradesh).

Material examined: 1F India, Kerala, Malampuzha, Narendran, 11.xii.1987; 1F, India, Kerala, C.U.Campus, Veena, 21.i.2011; 1F, India, Kerala, C.U.Campus, Rema, 4.iii.1994; 1F, India, Kerala, C.U.Campus, Rema, 8.vi.1993; 1F, India, Kerala, Kazhakkoottam, Sumodan, 25.ii. 1989 (DZUC)

Discussion

Apanteles valvulae having close similarity with *A. ricini* with the characters OOL as long as POL and toruli aciculate, but it differs for the following characters T1 1.90x its apical width (in *A. ricini* T1 3x its apical width) and occiput not concave (occiput slightly concave in *A. ricini*). This species also shares characters with *A. hyposidrae*. They are the following: length of mesosoma less than or equal to 1.50x its width and outer tibial spur 0.50x basitarsus.This species differs from *A. hyposidrae* for the following features, ovipositor more than 0.80x hind tibia (in *A. hyposidrae* length of ovipositor less than 0.80x hind tibia) and length of T1 2x its apical width (length of T1 less than or equal to 1.50x its apical width in *A. hyposidrae*).

Genus *Buluka* de Saeger

Buluka de Saeger, 1948. *Explore. Parc. Natn. Albert Miss. C.F. de Witte*., 53:64.
Type species: *Buluka straeleni* de Saeger (Monobasic & Original designation) Synonimised by Nixon, 1965. *Bull. Br. Mus. Nat. Hist., Ent. Suppl*., 2: 265.

Diagnosis

Body coarsely sculptured except head; head setose, oval in anterior view; eyes strongly diverging behind antennal sockets (Fig. 14B); malar space with distinct groove; frons, vertex smooth, faintly striate; mesoscutum reticulate-rugose to rugose-punctate (Fig. 14C); notauli absent; scutellum coarsely sculptured than mesoscutum; propdeum with percurrent medial longitudinal carina, puncate-recticulate or recticulate-rugose in medial area (Fig. 14D); propleuron with small postero-apical lobe overlapping pronotum ventro-laterally; metanotum closely appressed to scutellum, phragma of scutellum never exposed; hind coxa large, extending past to the posterior margin of T2; fore wing with areolet large, quandrangular or triangular in shape; hind wing vannal lobe convex, setose; T1–T3 occupying entire dorsal surface of metasoma, more distal tergites lightly sclerotised and withdrawn beneath carapace (T2+T3) (Fig. 14E); T1 rugose or recticulo-rugose with a distinct medial longitudinal groove either complete or incomplete with a small medial triangular field apically; T2 basally or completely longitudinally striate, rarely with a smooth medial longitudinal band (Fig. 14 E); T3 smooth and largely punctate postero-medially, rest completely longitudinally striate; hypopygium short, evenly sclerotised; ovipositor short, curved curved; ovipositor sheath setose only at apical part.

Host: *Imma thyriditis* Meyrick (Lepidoptera: Immidae) and indeterminate Lepidopteran larva.

Distribution: Afrotropical, Australian and Oriental region.

Remarks: This rarely collected genus represents only eleven species in the world. In this study diagnosis of species from Kerala and key to the Indian species of *Buluka* included.

KEY TO THE SPECIES OF *BULUKA* DE SAEGER FROM INDIA

1. Temples and vertex striate at least laterally ..... *B. horni* Gupta

- Temples and vertex smooth 2

2(1) T1 and T2 black or with yellow markings; dorso-medial lobe of pronotum smooth ..... *B. quickei* Ranjith

- T1 and T2 yellow, rest of metasoma black or reddish brown; dorso-medial lobe of pronotum at least in posterior half rugose 3

3(2) Larger species approximately 3.60 mm in length; T3 black or reddish brown; width of face more than 0.40x as wide as head .....

.....*B. townesi* Austin

- Smaller species 2.50–2.60 mm in length; T3 black; width of face less than 0.40x as wide as head .....*B. noyesi* Austin

Character marix for the species of *Buluka*

1. Body size: 0; more than 3.50 mm 1; less than 3.50 mm
2. Colouration of T1 & T2: 0; complete yellow 1; incomplete yellow
3. Vertex, frons sculpturing: 0; smooth 1; striate
4. Fore wing veins 2SR & r-m length: 0; equal length 1; unequal length
5. Head colour: 0; black 1; yellow

6. Fore wing infuscation: 0; complete vertical infuscation below pterostigma 1; incomplete vertical infuscation below pterostigma

7. Eye & temple length: 0; equal 1; unequal

Coding of the characters and the status for the species of *Buluka*

Species/characters	1	2	3	4	5	6	7
Buluka horni	1	0	1	1	0	1	?
Buluka quickei	0	1	0	1	0	0	0
Buluka noyesi	1	0	0	0	0	?	?
Buluka townesi	0	0	0	1	1	0	1

Treatment of species

***Buluka quickei* Ranjith**

Buluka quickei Ranjith, 2016. *Bio. Syst*., 27: 36

Diagnosis

Female: Length 3.90 mm, fore wing 3.80 mm

Head oval in shape 0.84x as long as wide medially, setose (Fig. 14B); head 0.50x as long as wide in dorsal view; face smooth, setose with mid longitudinal raised area, 0.90x as long as wide medially; eyes 0.58x as long as head; clypeus smooth, setose; height of clypeus: inter-tentorial distance: tentorio-ocular distance = 2.5:7.25:3.4; malar space with distinct groove, 1.52x basal width of mandible; frons smooth, glabrous depressed behind antennal sockets; vertex smooth, glabrous medially; lateral temple smooth, setose 0.74x as wide as eye; mesosoma 1.41x as long as high; mesoscutum rugose-punctate setose (Fig. 14C); notauli absent; scutellar lunules wide medially divided by eight

carinae; scutellum punctate, setose with a smooth depressed area apically; sides of scutellum with lateral horn; propodeum rugose with a medial longitudinal carina with lateral crenulations (Fig. 14D); pronotum crenulate posteriorly; mesopleuron punctate, setose, smooth and glabrous anteriorly; metapleuron smooth and glabrous antero-medially, rest rugose; fore wing 2.70x as long as wide; pterostigma 3.30x as long as wide; 1-R1 1.42x as long as pterostigma; length of vein r 1.25x as wide as pterostigma, as long as m-cu; vein 2CU1 1.41x as long as m-cu; hind wing vannal lobe convex, setose; hind coxa punctate, setose, transversely striate; hind femur 3.21x as long as wide; hind tibia 5.40x as long as wide; hind basitarsus 4.90x as long as wide; inner hind tibial spur 0.60x as long as hind basitarsus; T1 carinate apically, 0.60x as long as wide apically with lateral horns; T2 0.41x as long as wide apically with a small smooth triangular field basally (Fig. 14D), longitudinally striate basally rest rugose; T2 suture strongly depressed; T3 longitudinally striate basally, rugose laterally distinctly punctate apically; ovipositor sheath setose apically.

Colour: Body black except antenna, face, ocelli, maxillary and labial palip, mid tibia basally and apically, T1 basally and apically, T2 medio-posteriorly, sternites yellow; fore leg dark yellow; fore wing infuscated through out below pterostigma and around the vein 1-Cu; veins light brown.

Male: Unknown.

Host: Unknown.

Material examined: Holotype, female, India, Kerala, Pandimotta, Ranjith (DZUC).

Remarks: The diagnosis is based on the original description Ranjith *et al*. 2016

Discussion

Buluka quickei differs from all the described species by its larger size. It shows similarity with *B. townesi* in having the characters, malar space with distinct groove and scutellum with lateral horn. It differs from the same species in having the characters length of pterostigma 3.30x its width (in *B. townesi* length of pterostigma 4.50x its width) and scutellar lunules with eight carinae (in *B. townesi* scutellar lunules with nine carinae).

Genus *CHOERAS* Mason

Choeras Mason, 1981. *Mem. Ent. Soc. Canada*, 115: p.79.
Type species*: Apanteles (Pseudapanteles) consimilis* Viereck, 1911. *Proc. U. S. Natn. Mus*. 40:177; Viereck, 1917. *Bull. Conn. St. Geol. Nat. Hist. Surv*., 22: 197; Muesebeck, 1926. *Proc. U.S. Natn. Mus*., 69:5.
Apanteles consimilis Muesebeck, 1920. *Proc. U. S. Natn. Mus*., 58: 523.
Choeras Mason, Narendran, 1998. *J. Ent. Res.*, 22(1): 91.

Diagnosis

Head setose (Fig. 15B); face punctate with or without medial carina; mesoscutum, scutellum coarsely punctate (Fig. 16C); scutellar lunules wide; propodeum with strong medial carina, with never indication of an areola, sculpturing varying from recticulate-rugose to complete smooth (Fig. 16D); metanotum without projections; pronotum with upper and lower groove; fore wing vein r, 1r-m straight; 2r-m absent; areolet absent or if present variable in size (Figs 16F, 17F & 18F); vannal lobe convex, setose, but flat, hairless in *C. psarae*; T1 parallel sided, tapering apically, sides straight, never with a medial groove; T2 rectangular or sub triangular (Fig. 16E); T3 smooth longer than T2; hypopygium large, medially folded in several striae; ovipositor as long as hind tibia, setose completely.

Host: Microlepidoptera (Pyraloidea)

Distribution: Australia, Chile, India.

Remarks: This genus was transferred as the subgenus of *Apanteles* (Achterberg, 2002). But due to the presence of unique characters like the presence of strong medial carina, presence of areolet in most of the species and convex margin of hind wing vannal lobe, it merits a generic status. A total of three species are reported from India so far and three new species are described in this work.

KEY TO THE SPECIES OF *CHOERAS* MASON FROM INDIA

1. Larger species more than 4 mm in length; pleural sulcus smooth; margin of hind wing vannal lobe flat, hairless; length of T1 3x its apical width ..... *C. psarae* Wilkinson

- Smaller species never exeed 3 mm; pleural sulcus punctate; margin of hind wing vannal lobe convex, setose; length of T1 less than 2.50x its apical width.....2

2(1) Fore wing without areolet; length of pterostigma equal to vein 1-R1; vein r arising from the middle of pterostigma; face rugose ....*C. pappi* Narendran

- Fore wing with triangular areolet; pterostigma 0.70–1.40x as long as vein 1-R1; vein r arising beyond the middle of pterostigma; face punctate..... 3

3(2) Length of fore wing 2.90x its width; OOL as long as POL; width of head less than 2x its length in dorsal view 4

- Length of fore wing 2.65–3.51x its width; OOL 0.70–0.90x POL; width of head more than 2x its length in dorsal view 5

4(3) Head 1.78x as long as its width; frons punctate; T1 1.50x as long as its apical width; T2 smooth; antenna 1.06x as long as fore wing; length of pterostigma 2.90x its width; length of hind tibia 1.20x its width; length of basitarsus 4.70x its width .....*C. nirupama* sp. nov.

- Head 1.60x as long as its width; frons striated; T1 1.90–2.30x as long as its apical width; T2 rugulose; antenna as long as fore wing; length of pterostigma 2.50x its width; length of hind tibia 5.20x its width; length of basitarsus 3.90x its width ..... *C. achterbergi* Narendran

5(3) Hind tibia 5.20x as long as its width; eye 2.80x as long as malar space; fore wing vein r 1.28x as long as width of pterostigma; flagellar segments brown; length of fore wing 2.65x its maximum width; first flagellomere 1.40x as long as second flagellomere; length of mesosoma 1.50x is width; scutellar lunules wide ..... *C. novus* sp. nov.

- Hind tibia 6.87x as long as its width; eye 5.30x as long as malar space; fore wing vein r as long as 0.82x width of pterostigma; flagellar segments bicoloured; length of fore wing 3.51x its maximum width; first flagellomere as long as second flagellomere; length of mesosoma 1.32x its width; scutellar lunules narrow..... .....*C. bicolor* sp. nov.

Character matrix for the species of *Choeras*

1. Face sculpturing: 0; rugose 1; punctate
2. Vannal lobe: 0; convex, setose 1; flat, hairless
3. T2 sculpturing: 0; smooth 1; punctate 2; rugose 3; aciculate
4. OOL & POL length: 0; OOL as long as POL 1; OOL not equal to POL
5. Scutellar lunules: 0; narrow 1; wide
6. Body size: 0; more than 4 mm, 1; less than 4 mm
7. Fore wing areolet: 0; present 1; absent

Coding of the characters and status for the species of *Choeras*

Species/characters	1	2	3	4	5	6	7
Choeras achterbergi	1	0	2	0	1	1	0
Choeras bicolor sp. nov.	1	0	3	1	0	1	0
Choeras nirupama sp. nov.	1	0	0	0	1	1	0
Choeras novus sp. nov.	1	0	2	1	1	1	0
Choeras pappi	0	0	3	0	1	1	1
Choeras psarae	1	1	0	1	1	0	0

Treatment of species

***Choeras achterbergi* Narendran**

Choeras achterbergi Narendran, 1998. *J. Ent. Res.*, 22(1): 91. Female (NNM)

Redescription

Female: Length 2.61 mm, fore wing 2.70 mm, antenna 2.70 mm.

Head: Width 1.60x its length in dorsal view, coarsely punctate setose; length of head 0.81x its width in anterior view; face punctate setose with a distinct medial carina (Fig 15B); length of face 0.65 x its width; clypeus punctate; eye length 5x malar space; eyes setose with infuscations; frons transversly striated; lateral temples slightly visible in anterior view; occiput smooth, shiny; toruli shiny; OOL as long as POL; length of scape1.61x its width; first flagellomere 0.90x as long as second flagellomere; length of first flagellomere 2.52x its width; length of second flagellomere 2.70x its width; antenna as long as fore wing.

Mesosoma: Length of mesosoma 1.60x its height, 2.61x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules wide with crenulations (Fig. 15C); scutellum shiny sparsely punctate; propleuron with small punctures; pronotum with lateral crenulations; mesopleuron punctate with deep furrow; metanotum crenulated; propodeum with a medial longitudinal carina which at its base bifurcates in to two transverse carina running on either side, these transverse carina joining with longitudinal lateral carina, rest rugose (Fig. 15C); fore wing 2.90x its maximum width; length of pterostigma 2.51x its maximum width; pterostigma as long as 1-R1; vein r equal to width of pterostigma; vein r arising beyond the middle of pterostigma; Vein 1-R1 1.40x length of pterostigma; hind femur 2.89x its width; hind tibia 5.30x its width; outer hind tibial spur 0.40x basitarsus; length of basitarsus 3.92x its width.

Metasoma: T1 2.30x as long as its width at apex, parallel sided, smooth (Fig. 15D); T2 rugulose 2.70x wide as its basal width; T3–T7 shiny with sparsely punctate, setose; ovipositor setose at apex; hypopygium membranous.

Colour: Body black generally except T1 and T2, fore and mid femora, ovipositor, clypeus reddish brown; maxillary palp pale yellow; ocelli, antennae brown; scape and pedicel yellowish brown; wing veins brownish black.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: 4F, India, Kerala, CPCRI, Girish, 21.i.03 (DZUC).

Discussion

The species have similar characters with the species *C. pappi* like wider scutellar lunules and OOL as long as POL, but it differs from the species for the width of head 1.60x its length in dorsal view (in *C. pappi* head 2.10x its width in dorsal view) and fore wing vein 1-R1 1.40x as long as pterostigma (vein 1-R1 as long as pterostigma in *C. pappi*).

Choeras bicolor sp. nov.

Holotype: Female: Length 2.51 mm, fore wing 2.25 mm, ovipositor 0.26 mm.

Head: Width of head 2.20x its length in dorsal view, shiny with irregular punctures; length of head 0.91x its width in anterior view; length of face 0.70x its width; face coarsely punctate and sparsely setose with a well defined medial carina (Fig. 16B); length of clypeus 2.60x its width, sparsely punctate; tentorio-ocular length 0.096; eye length 5.30x its malar space; vertex, temple, frons punctate; occiput smooth, shiny; toruli smooth, shiny; length of OOL 0.94x POL; maxillary palp with four segments; scape length 1.34x its width; length of pedicel 0.67x its width; scape 1.80x as long as pedicel; first flagellomere as long as second flagellomere.

Mesosoma: Length of mesosoma 1.32x its width, 2.20x as long as head; mesoscutum coarsely punctate, setose (Fig. 16C); notauli indistinct (Fig. 16C); propleuron punctate with crenulations; mesopleuron punctate anteriorly, smooth, shiny posteriorly; scutellar lunules narrow with up to eight crenulations; scutellum punctate; propodeum with well defined medial carina diverges at basal region (Fig. 16D); middle of medial carina with transverse carina extending up to spiracles, meeting longuitudinal carina, rest shiny, rugulose; length of fore wing 3.51x its maximum width; pterostigmal length

2.74x its maximum width; length of vein r 0.82x width of pterostigma; vein 1-R1 1.40x as long as pterostigma; margin of hind wing vannal lobe convex, setose; length of hind femur 3.96x its width; length of hind tibia 6.87x its width; hind tibia 1.15x as long as hind femur; outer tibial spur 0.50x as long as hind basitarsus; inner tibial spur 0.39x as long as basitarsus.

Metasoma: T1 parallel sided, basal 1/3 smooth, rest aciculate (Fig. 16E); apical length of T1 1.28x its width; T2 sub rectangular, aciculate; length of T2 0.41x its width; T1 1.89x as long as T2; T3 sparsely rugulose, rest sparsely irregularly punctate, shiny; ovipositor 0.28x as long as hind tibia.

Colour: Body black except wing veins, fore and hind legs, ovipositor, clypeus yellowish brown; maxillary palp pale yellow; propodeum brownish black; T1, T2 and T3 brownish yellow; T4–T7 brownish black; flagellar segments bi coloured, basal and terminal flagellomeres brown, middle pale yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: Holotype: 1F, India, Kerala, Koottanadu, Santhosh, 16.iv.2007 (DZUC).

Etymology: The species epithet 'bicolor' refers to its antennal bicolouration.

Discussion

This species shows close resemblence with the *C. novus* sp. nov. in having punctate sculpturing of face and width of head more than 2x its length, however it differs from the same species in many characters which are mentioned in the key. This species also shares some characters with the species *C. nirupama* sp. nov. like length of face 0.70x its width, but it differs

from the species in having OOL 0.94x POL (OOL as long as POL in *C. nirupama* sp. nov.) and length of fore wing 3.51x its width (in *C. nirupama* sp. nov. length of fore wing 2.90x its width).

Choeras nirupama sp.nov.

Holotype: Female: Length 3 mm, antenna 3.41 mm, fore wing 3.17 mm, ovipositor 0.53 mm.

Head: Width of head 1.78x its length in dorsal view, punctate, setose; length of head 0.79x its width in anterior view; face punctate with medial protruberance (Fig. 17B); face 0.70x as long as width; width of face 0.50x width of head; clypeus smooth, shiny; toruli smooth; frons, vertex, temple punctuate, setose; OOL as long as POL; length of scape 1.52x its width; pedicel 0.75x its width; first flagellomere 0.90x as long as second flagellomere; length of first flagellomere 2.52x its width; second flagellomere 2.40x its width; terminal flagellomere acute with 2.61x its width.

Mesosoma: Length of mesosoma 1.40x its width, 2.59x as long as head; mesoscutum coarsely punctate, setose (Fig. 17C); scutellum coarsely punctate, scutellar lunules wide with eight carinae (Fig. 17C), sides crenulated; notauli indistinct; propleuron shiny, granulate; lateral side of pronotum smooth, shiny with anterior crenulations; mesopleuron shiny, slightly punctate; propodeum with well defined medial carina diverging at apex, small transverse carinae arising on either side of medial carina, rest rugose; length of fore wing 2.90x its width; pterostigma 2.90x its maximum width; length of vein 1-R1 1.40x as long as pterostigma; length of vein r 1.40x width of pterostigma; hind wing vannal lobe convex, setose; hind tibia 1.20x its width; outer tibial spur 0.60x as long as basitarsus; length of basitarsus 4.71x its width.

Metasoma: Length of metasoma as long as mesosoma; apical length of T1 1.50x its width; T1 parallel sided shiny, sparsely punctate, setose anteriorly (Fig 17D); T2 smooth, shiny, triangular with lateral elevation, setose apically; T3–T7 punctate, setose; ovipositor sheath setose at apex, 0.50x as long as hind tibia.

Colour: Body generally brownish yellow, except head, T3–T7, ovipositor sheath black; flagellomeres brown.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined. Holotype: 1F, India, Kerala, C.U.Campus, Botanical garden, Veena, 11.v. 2011 (DZUC).

Etymology: The species name is an arbitrary combination of letters.

Discussion

This species shows character similarities with the following species *C. achterbergi* and *C. pappi* for the character OOL as long as POL, but shows difference for the characters basitarsus 4.70x as long as its width (in *C. achterbergi* basitarsus 3.90x as long as its width), width of head 1.78x its length (width of head 1.60x its length in *C. achterbergi*) and the main differences from *C. pappi* are fore wing areolet present (areolet absent in *C. pappi*) and vein r arising beyond the middle of pterostigma (vein r arising from the middle of pterostigma in *C. pappi*).

Choeras novus sp. nov.

Holotype: Female: Length 2.12 mm, antenna 2.70 mm, fore wing 2.03 mm, ovipositor 0.20 mm.

Head: Width of head 2.10x its length in dorsal view; length of head 0.90x its width in anterior view; face punctate, setose with medial carina, length 0.84x its width (Fig. 18B); length of clypeus 2.81x its width, sparsely punctate, setose, shiny; eyes glabrous with infuscations; eye length 2.78x malar space; vertex, temple sparsely punctate, setose (Fig. 18C); occiput smooth (Fig. 18C); toruli shiny; OOL 0.70x POL; maxillary palp four segments; length of scape 1.18x its width; pedicel length 0.56x its width; scape 2.31x as long as pedicel; first flagellomere 1.40x as long as second flagellomere.

Mesosoma: Length of mesosoma 1.50x its height, 2.59x as long as head; mesosutum punctate, sparsely setose (Fig. 18D); scutellar lunules wide with nine carinae; scutellum coarsely punctate, sparsely setose (Fig. 18D); notauli indistinct; propleuron punctate; lateral side of pronotum granulate with deep crenulations; mesopleuron punctate anteriorly smooth, shiny posteriorly; propodeum with medial longitudinal carina, rest slightly rugose; length of fore wing 2.65x its maximum width; length of pterostigma 2.80x its maximum width; vein 1-R1 1.40x as long as pterostigma; length of vein r 1.28x width of pterostigma; margin of hind wing vannal lobe convex, setose; length of hind femur 3.40x its width; length of hind tibia 5x its width; outer hind tibial spur 0.50x as long as hind basitarsus; hind basitarsus 6.61x as long as wide.

Metasoma: Length of T1 1.40x its width; T1 parallel sided; laterotergites setose; T1, T2 sparsely rugose; T3–T7 smooth; ovipositor 0.40x as long as hind tibia.

Colour: Body black except maxillary palp, fore coxae, tibial spur pale yellow; T1, T2, fore and mid leg, basal hind femora and tibia yellowish brown; apex of hind femur and tibia, ovipositor, wing veins, flagellomeres brown.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: Holotype: 1F, India, Kerala, Kakkencherry, Veena, 23.iv.2012 (DZUC).

Etymology: The specific epithet 'novus' means new in Latin.

Discussion

This species shows similarity with the species *C. pappi* in having the characters width of head 2.10x its length in dorsal view and presence of convex, setose hind wing vannal lobe margin. But it differs from the same species in having presence of fore wing areolet (areolet absent in *C. pappi*), face punctate (face rugose in *C. pappi*) and vein r 1.28x width of pterostigma (vein r as long as pterostigma in *C. pappi*).

Choeras pappi Narendran

Choeras pappi Narendran, 1998. *J. Ent. Res.*, 22(1): 92.Female (NNM).

Diagnosis

Female: Length 2.20 mm, fore wing 1.90 mm, antenna 1.80 mm.

Head width 2.10x as its length in dorsal view, punctate, setose; OOL as long as POL; vertex smooth, shiny; frons rugose; face rugose with medial carina; maxillary palp four segmented; toruli smooth; occiput smooth, shiny; mesoscutum punctate, setose; scutellum punctate, scutellar lunules wide, crenulated; propodeum rugose with a medial longitudinal carina; mesopleuron punctate antero-ventrally, smooth posteriorly; metapleuron punctate; fore wing vein R1 equal to pterostigma; vein r arising from middle of pterostigma; width of pterostigma equal to vein r; areolet absent; T1 parallel sided, apical width equal to basal width; T1–T2 aciculately punctate, setose; T3–T7 smooth, shiny; ovipositor less than half of hind coxa.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Remarks: This diagnosis based on the original description Narendran 1998.

Discussion

Choeras pappi shows character similarity with *C. bicolor* sp. nov. in having aciculate nature of T1and convex hind wing vanal lobe margin, but it differs from the same in having scutellar lunules wide (in *C. bicolor* sp. nov. scutellar lunules narrow), OOL as long as POL (OOL 0.90x POL in *C. bicolor* sp. nov.) and fore wing with out areolet (in *C. bicolor* sp. nov. fore wing with areolet).

Choeras psarae (Wilkinson)

Microgaster psarae Wilkinson, 1927. *Bull. Ent. Res.*, 18: 174. Female (BMNH).
Choeras psarae (Wilkinson), Narendran, 1998. *J. Ent. Res*., 22(1): 94.

Diagnosis

Female: Length 4.70 mm, fore wing 4.40 mm, antenna 4.20 mm.

Width of head 1.90x its length in dorsal view, punctate, setose; vertex sparsely punctate; OOL 0.60x POL; face coarsely punctate, setose with distinct medial carina; antenna 0.90x as long as body; pronotum smooth, shiny; mesoscutum coarsely punctate, setose; scutellar lunules broad, crenulated; scutellum sparsely punctate; metanotum crenulated; mesopleuron punctate anteriorly, smooth, shiny posteriorly; propodeum setose with medial longitudinal carina; mesopleural sulcus smooth; metapleuron smooth, shiny; fore wing vein 1-R1 1.40x as long as pterostigma; vein r arising beyond the middle of pterostigma and longer than width of pterostigma; areolet triangular; hind coxa more than half length of mesosoma, basally smooth apically punctate, setose; outer hind tibial spur half of hind basitarsus; T1 3x as long as its apical width, narrowed at apex; T3 1.80x as long as T2; T2–T7 smooth; ovipositor sheath equal to hind coxa.

Colour: Body black except labrum, ocelli, pronotum, fore and mid legs, basal part of hind tibia, hind tibial spur yellow; tegulae, T1 pale yellow; wings hyaline; wing veins dark brown; ovipositor yellowish brown.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Remarks: This diagnosis is based on Narendran 1998.

Discussion

This species shows close resemblence with the species *C. novus* sp. nov. for the characters scutellar lunules wide and fore wing vein 1-R1 1.40x as long as pterostigma.The main differences from the same species are length of T1 3x its apical with (length of T1 1.40x its apical width) and length of body more than or equal to 4 mm (length of body less than 3 mm in *C. novus* sp. nov.).

Genus *Cotesia* Cameron

Cotesia Cameron, 1891. *Mem.Proc.Manch.Phil.Soc*.,4:185. Type: *Cotesia flavipes* Cameron, 1891. *Mem. Proc. Man. Lit. Phil. Soc* (4)4: 182-194.
Cryptapanteles Viereck, 1910. *Proc. Ent. Soc. Wash*, 11:209. Type (*C. rileyanus* Viereck, 1910) = *Apanteles congregates* Riley, 1881. *var. scitulus*.
Stenopleura Viereck, 1911. *Proc. U.S. Nat. Mus*., 40 (1812): 173-196. Type*: Apanteles sesamiae* Cameron, 1906. *Trans. Sou. Afr. Phil. Soc*., 16(4): 334-336.

Diagnosis

Propodeum lack areola with a medial longitudinal carina or incomplete transverse carina arises laterally (Fig. 19B); T1 parallel sided, posteriorly broadened; T2 large rectangular, or truncate pyramid in shape with basal width greater than its median length, apical width twice the median length (Fig. 20D); T1, T2 rugose-punctate; T3–T7 smooth, shiny; hypopygium short, inflexible; ovipositor short concealed under hypopygium; ovipositor sheath sparsely setose apically.

Host: Larvae of Macrolepidoptera.

Distribution: Cosmopolitan.

Remarks: Here three species except *C. philoeampus* and *C. ruficrus* are transferred from the genus *Apanteles* to *Cotesia* due to the characters like short ovipositor, T1 parallel sided, T1–T2 sculpturing and propodeum with medial longitudinal carina.

KEY TO THE SPECIES OF *COTESIA* CAMERON FROM KERALA

1. Propodeum with faint medial carina; ovipositor less than 0.30x as long as basitarsus; OOL more than 1x POL ..... *C. ruficrus* (Haliday)

- Propodeum with strong medial longitudinal carina; ovipositor more than or equal to 0.50x as long as basitarsus; OOL less than or equal to POL 2

2(1) Occiput with a medial longitudinal carina; OOL as long as POL; length of fore wing vein r 0.90x breadth of pterostigma.....3

- Occiput without a medial longitudinal carina; OOL not equal to POL; length of fore wing vein r less than 0.90x breadth of pterostigma.....4

3(2) Face with a medial longitudinal carina; eye length 2.30x as long as malar space; length of face 0.80x its width; length of mesosoma 1.40x its height; vein 1-R1 1.30x as long as pterostigma .....

.....*C. euthaliae* Bhatnagar comb. nov.

- Face without medial longitudinal carina; eye length 4.30x as long as malar space; length of face 0.61 its width; length of mesosoma 1.21x its height; vein 1-R1 1.10x as long as pterostigma .....

..... *C. philoeampus* (Cameron)

4(3) Length of pterostigma less than 2x its width; apical length of T1 1.20x its width; frons punctate; length of hind tibia 5x its width; T3 dark brown; eye length 3.29x as long as malar space .....

.....*C. pratapae* Ashmead comb. nov.

- Length of pterostigma more than 2.70x its width; apical length of T1 0.90x its width; frons aciculate; length of hind tibia 6.60x its width; T3 reddish brown; eye length 4.30x as long as malar space .....

.....*C. bifida* Sharma comb. nov.

Character matrix for the species of *Cotesia*

1. Face medial carina: 0; present 1; absent

2. Frons sculpturing: 0; punctate 1; aciculate

3. Occiput carina: 0; present 1; absent

4. OOL & POL length: 0; OOL as long as POL 1; OOL not equal to POL

5. Propodeal carina: 0; strong 1; faint

6. Pterostigmal length & width: 0; less than 2.5, 1; more than 2.5

7. Propodeal sculpturing: 0; punctate 1; rugose 2; aciculate

8. Length of tibial spur & basitarsus: 0; less than 0.5, 1; equal to 0.5

9. Eye length & malar space: 0; more than 0.4, 1; less than 0.4

10. Length of ovipositor & basitarsus: 0; more than 0.5, 1; less than 0.5

Coding of the characters and status for the species of *Cotesia*

Species/Characters	1	2	3	4	5	6	7	8	9	10
Cotesia bifida	0	1	1	1	0	1	0	0	0	0
Cotesia euthaliae	0	0	0	0	0	1	2	0	1	1
Cotesia philoeampus	1	0	0	0	0	1	1	0	0	0
Cotesia pratapae	1	0	1	1	0	0	0	1	1	1
Cotesia ruficrus	0	0	1	1	1	1	0	1	1	1

Treatment of species

***Cotesia bifida* (Sharma) comb. nov.**

(Figs 19A & B)

Apanteles bifida Sharma, 1973. *Orient. Ins.*, 7: 119. Female (DFRI).

Redescription

Female: Length 2.51 mm, antenna 2.90 mm, fore wing 2.90 mm, ovipositor 0.30 mm.

Head: Width of head 1.90x as long as length in dorsal view; length of head 0.91x its width in anterior view; face punctate with a medial longitudinal carina; length of face 0.70x its width; eye length 4.30x malar space; vertex, temple coarsely punctate, setose; frons aciculate; OOL 0.90x POL; occiput smooth; antenna as long as fore wing; length of scape 1.21x its width; length of pedicel 0.92x its width; length of first flagellomere 2.91x its width; length of second flagellomere 2.71x its width.

Mesosoma: Length of mesosoma 1.40x its height, 2.60x as long as head; mesoscutum coarsely punctate, setose; scutellar lunules wide, crenulated; scutellum shiny; propodeum punctate with medial longitudinal carina, transverse carina, irregular lateral carinae on either side of median carina; propleuron punctate; mesopleuron punctate antero-ventrally, smooth postero-dorsally; metapleuron punctate posteriorly; hind coxa shiny, punctate; length of pterostigma 2.70x its width; fore wing vein 1R1 1.20x as long as pterstigma; length of vein r 1.10x width of pterostigma; margin of hind wing vannal lobe convex, setose; length of hind femur 3x its width; length of hind tibia 6.60x its width; outer hind tibial spur 0.40x as long as hind basitarsus; length of basitarsus 4.70x its width.

Metasoma: Metasoma 0.81x as long as mesosoma; length of T1 0.90x its apical width; length of T2 0.80x its width, punctate; T3-T7 smooth; ovipositor sheath short; ovipositor 0.30x as long as hind tibia.

Colour: Body black except mandibles, ocelli, T3–T5 reddish brown; ovipositor sheath dark reddish brown; scape, pedicel, wing veins, apex of tibia, tarsi yellowish brown; hind femur and tibia, ovipositor yellow; tibial spur pale yellow.

Male: Unknown.

Host: *Tiracola plagiata* Walker (Noctuidae)

Distribution: India (Kerala, West Bengal).

Material examined: 1F, India, Kerala, Mukkali, Sumodan, 10.xii.1989 (DZUC).

Discussion

This species resembles with *C. pratapae* comb. nov. sharing the characters, antenna as long as fore wing and OOL 0.90x POL, but it differs in many characters which are mentioned in the key. This species also shows similarity to *C. euthaliae* comb. nov. for the characters face with medial longitudinal carina and length of pterostigma 2.70x its maximum width. The main differences with the same species are length of vein r 1.10x breadth of pterostigma (in *C.euthaliae* comb. nov. length of vein r 0.90x breadth of pterostigma), length of hind femur 3x its width (in *C. euthaliae* comb. nov. length of hind femur 3.50x its width).

Cotesia euthaliae (Bhatnagar) comb. nov.

(Figs 19C & D)

Apanteles euthaliae Bhatnagar, 1948. *Ind. J. Ent*., 10:167. Female (IARI).

Redescription

Female: Length 1.91 mm, antenna 2.32 mm, fore wing 2.10 mm; ovipositor 0.17 mm.

Head: Head width 1.80x its length in dorsal view; length of head 0.90x its width in anterior view; face aciculate, setose with a short medial carina anteriorly; length of face 0.80x its width; eye length 2.30x malar space; frons, vertex, temple punctate, setose; occiput smooth with a medial longitudinal carina; OOL as long as POL; antenna 1.21x as long as body; length of scape

1.61x its width; length of pedicel 0.60x its width; length of first flagellomere 3.3x its width; length of second flagellomere 3.82x its width.

Mesosoma: Length of mesosoma 1.40x its height, 2.32x as long as head; mesoscutum punctate, shiny, sparsely setose; scutellar lunules narrow, crenulated; scutellum sparsely punctate, setose; propodeum aciculate with medial longitudinal carina; propleuron smooth, shiny; mesopleuron punctate, setose antero-ventrally; length of pterostigma 2.70x its maximum width; fore wing vein 1-R1 1.30x as long as pterostigma; vein r 0.90x as long as width of pterostigma; margin of hind wing vannal lobe flat without hairs; length of hind femur 3.50x its width; length of hind tibia 6x its width; outer hind tibial spur 0.40x hind basitarsus, inner spur 0.30x hind basitarsus; length of basitarsus 5.40x its width.

Metasoma: T1 parallel sided, 2x its apical width, 1.60x as long as T2; T2 with diverging sulci, 0.50x as long as T1; length of T2 0.30x its width; T3 1.60x as long as T2; ovipositor 0.20x as long as hind tibia; ovipositor sheath short.

Colour: Black except ocelli, T1–T3 reddish brown; wing veins, apical hind tibia, hind tarsi yellowish brown; basal hind femur, hind tibia yellow; tibial spur white.

Male: Unknown.

Host: *Euthalia garuda* Moore (Nymphalidae)

Distribution: India (Bihar, Kerala).

Material examined: 2F, India, Kerala, Peechi, Sumodan, 8.ii. 1989; 1F, India, Kerala, Munnar, Sumodan, 20.xii.1989; 1F, India, Kerala, Kulamavu, 1.xii.1988 (DZUC).

Discussion

It shows close resemblence with *C. philoeampus* and *C. pratapae* comb. nov. in having the characters face with medial carina and frons punctate, but it differs from *C. philoeampus* in many characters which are mentioned in the key. The main differences from *C. pratapae* comb. nov. are T1 2x its apical width (T1 1.20x its apical width in *C. pratapae* comb. nov.) and length of vein r 0.90x width of pterostigma (in *C. pratapae* comb. nov. length of vein r 0.60x width of pterostigma).

Cotesia philoeampus (Cameron)

(Figs 19E & F)

Apanteles philoeampus Cameron, 1911. *Proc. Linn. Soc. N.S.Wales*., 34:342 Female (BMNH).
Apanteles philoeampus Cameron, Wilkinson, 1928. *Bull. Ent. Res*., 19: 96.
Apanteles philoeampus Cameron, Parrot, 1953. *Pacif. Sci*., 7(2): 201.

Redescription

Female: Length 2.30 mm, antenna 2.40 mm, fore wing 2.40 mm, ovipositor 0.19 mm.

Head: width 1.70x as its length in dorsal view; face coarsely punctate, setose, without a medial longitudinal carina; length of face 0.61x its width; eye length 4.30x malar space; frons punctate; vertex smooth, shiny; occiput shiny with medial longitudinal carina; OOL as long as POL; antenna as long as fore wing; length of scape 1.21x its width; length of pedicel 0.82x its width; length of first flgellomere 2.61x its width; length of second flagellomere 2.80x its width.

Mesosoma : Length of mesosoma 1.21x its height, 2.50x as long as head, coarsely punctate, setose; scutellar lunules broad, crenulated; mesopleuron

punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron shiny, smooth anteriorly, posteriorly; propodeum dull, rugose, with strong medial longitudinal carina and basal transverse carina; length of pterostigma 2.60x its maximum width; fore wing vein 1-R1 1.10x as long as pterostigma; vein r 0.90x as long as width of pterostigma; margin of hind wing vannal lobe convex, setose; hind femur punctate, setose; length of hind femur 3x its width; length of hind tibia 6.50x its width; length of basitarsus 5x its width; outer tibial spur 0.40x as long as hind basitarsus.

Metasoma: T1 smooth, parallel sided, 1.30x as long as its width at apex; length of T2 0.30x its width, with diverging sulci; T1, T2 sparsely rugose at sides; T3 2x as long as T2; ovipositor sheath setose at apex; ovipositor 1.10x as long as hind tiba.

Colour: Body black except mandibles, ocelli, T3–T5 reddish brown; scape, pedicel, wing veins, apical tibia, tarsi yellowish brown; basal hind femur and tibia, ovipositor yellow; tibial spur pale yellow.

Male: Unknown.

Host: Unknown.

Distribution: Australia, India (Kerala).

Material examined: 4F, India, Kerala, Malampuzha, Narendran, 21.vi.1998; 1F, India, Kerala, C.U.Campus, Rema, 21.iii.1993; 1F, India, Kerala, C.U.Campus, Rema, 11.xii.1993 (DZUC).

Discussion

This species resembles with *C. euthaliae* comb. nov. in having the characters like presence of medial longitudinal carina in occiput and punctate

sculpturing of frons, but it differs from the same species having the characters which are mentioned in the key.

Cotesia pratapae (Ashmead) comb. nov.

(Figs 20A & B)

Apanteles pratapae Ashmead, 1896. *Proc. Nat. Mus*., no. 1092, 18: 647. Female (BMNH).

Redescription

Female: Length 2.30 mm, antenna 2.60 mm, fore wing 2.60 mm, ovipositor 0.17 mm.

Head: Width of head 2x its length in dorsal view; face punctate, setose, without medial longitudinal carina; eye length 3.29x malar space; frons shiny, punctate; occiput smooth; OOL 0.90x POL; antenna as long as fore wing; length of scape 1.70x its width; length of pedicel 0.61x its width; first flagellomere 0.95x as long as second flagellomere.

Mesosoma: Length of mesosoma 1.30x its height, 2.61x as long as head; mesoscutum coarsely punctate; scutellar lunules wide crenulated; propleuron punctate, mesopleuron punctate, setose antero-ventrally, smooth postero-dorsally; metapleuron smooth anteriorly and punctate, setose posteriorly; propodeum punctate, dull with a medial longitudinal carina; length of pterostigma 2x its width; fore wing vein r 0.30x as long as pterostigma, 0.60x width of pterostigma; margin of hind wing vannal lobe convex, setose; hind coxa shiny punctate; length of hind femur 2.90x its width; length of hind tibia 5x its width; hind basitarsus 4.38x its width; outer tibial spur 0.50x hind basitarsus.

Metasoma: Metasoma 0.79x mesosoma; length of T1 1.20x its apical width; T2 0.60x as long as T1; T3 1.30x as long as T2; T3–T7 smooth; ovipositor 0.20x as long as hind tibia, setose apically.

Colour: Body black except ocelli, T1–T7 except T3 reddish brown; fore and mid legs, basal half of hind tibia, T3, ovipositor yellow; wing veins dark brown; tibial spur pale yellow.

Male: Unknown.

Host: *Pratapa deva* Moore (Lycaenidae)

Distribution: India (Kerala), Sri Lanka.

Material examined: 1F, India, Kerala, Anakkatty, Narendran, 7.i.1989; 1F, India, Kerala, Adimali, Sumodan, 3.xii.1988; 1F, India, Kerala, Silent Valley, Sumodan, 30.xii.1990 (DZUC).

Discussion

Cotesia pratapae comb. nov. shows similarity with *C. bifida* comb. nov. in many characters like strong propodeal medial carina and absence of medial longitudinal carina in occiput, but differs from the same species in the characters mentioned in the key. This species also shares common characters with *C. ruficrus* in having punctate sculpturing of frons and absence of medial longitudinal carina in occiput. The main differences from *C. ruficrus* are face with a medial longitudinal carina (in *C. ruficrus* face lack medial longitudinal carina), propodeum with strong medial longitudinal carina (propodeum with faint medial longitudinal carina in *C. ruficrus*)

Cotesia ruficrus (Haliday)

(Figs 20C & D)

Microgaster ruficrus Haliday, 1835. *Ent. Mag*., 2:253.
Apanteles antipoda Ashmead, 1900. *Proc. Linn. Soc. New South Wales*., 25: 355.
Apanteles manila Ashmead, 1904. *J. New York ent.* Soc., 12: 19 Synonimised by Gahan.
Apanteles sydneyensis Cameron, 1911. *Proc. Linn. Soc. New South Wales*., 36:342.
Protapanteles narangae Viereck, 1913. *Proc. U.S. Nat. Mus*., 44: 642 Synonimised by Gahan.
Apanteles antipoda Wilkinson, 1928. *Bull. Ent. Res.*,19: 95 Synonimised by Wilkinson.
Apanteles ruficrus Wilkinson, 1929. *Bull. Ent. Res.*, 20:108.

Redescription

Female: Length 2.13 mm, antenna 2.61 mm, fore wing 2.10 mm, ovipositor 0.12 mm.

Head: Head 1.90x as wide as its length in dorsal view; length of head 0.92x its width in anterior view; face punctate, setose with a medial carina; length of face 0.70x its width; eye length 3.30x malar space; frons, vertex punctate, setose; occiput smooth; OOL 1.30x POL; antenna 1.22x as long as body; length of scape 1.40x its width; length of pedicel 0.71x its width; length of first flagellomere 3.20x its width; length of second flagellomere 3.10x its width; first flagellomere as long as second flagellomere.

Mesosoma: Length of mesosoma 1.30x its height, 2.43x as long as head; mesoscutum, scutellum coarsely punctate, setose; scutellar lunules broad, crenulated; mesopleuron punctate antero-ventrally, smooth postero-dorsally; propodeum punctate, with faint medial carina; length of pterostigma 2.80x its width; fore wing vein 1-R1 1.20x as long as pterostigma; vein r 0.80x as long as width of pterostigma, 0.20x as long as vein 1Rs; margin of hind wing vannal lobe convex, without hairs; length of hind femur 3.41x its width; length of hind tibia 6.30x its width; outer hind tibial spur 0.50x as long as hind basitarsus; length of basitarsus 6x its width.

Metasoma: T1 1.40x as long as its apical width; T2 0.40x as long as T1 with widely diverging sulci; length of T2 0.30x its width; T3 1.50x as long as T2; T3–T7 smooth, shiny; ovipositor 0.20x as long as hind tibia; ovipositor sheath short.

Colour: Body black except pterostigma, wing veins, T4–T7 yellowish brown; T3, tibial spur yellow; fore and mid coxa reddish brown.

Male: Unknown.

Host: *Cirphis loreyi* Dup (Noctuidae), *Cirphis unipuncta* Haw (Noctuidae), *Heliothis armigera* Hubner (Noctuidae), *Hypsipyla robusta* Moore (Pyralidae), *Naranga diffusa* Walker (Noctuidae), *Perigea capensis* Guenee (Noctuidae), *Phytometra* sp., *Plusia orchalcea* Fabricius (Noctuidae), *Spodoptera mauritia* Biosd. (Noctuidae), *Sesamia calamistis* Hampson (Noctuidae), *Sesamia cretica* Led (Noctuidae).

Distribution: India (Andra Pradesh, Bihar, Kerala, Tamil Nadu, Uthar Pradesh), Philippines, Sri Lanka.

Material examined: 1F, India, Kerala, Kannavam forest, Narendran, 31.x.1988; 1F, India, Kerala, Ranni, Narendran, 24.xi.1988; 2F, India, ICRI, Saklaspur, Jasvir Singh, 5.vi.1989; 1F, India, Kerala, Vazhani, 7.ii.1989 (DZUC).

Remarks: This species transferred from the *Apanteles* to *Cotesia* by Mason, 1981.

Discussion

This species shows similarity with the species *C. euthaliae* and *C. bifida* comb. nov. in having many characters like face with medial longitudinal carina and pterostigmal length more than 2.50x its width, but it differs from

C. euthaliae comb. nov. in having OOL 1.30x POL (in *C. euthaliae* comb. nov. OOL as long as POL) eye length 3.30x malar space (in *C. euthaliae* comb. nov. eye length 2.30x as long as malar space). The main differences from *C. bifida* in having the characters antenna 1.22x as long as fore wing (antenna as long as fore wing in *C. bifida* comb. nov.) and length of T1 1.40x its apical width (T1 0.90x its apical width in *C. bifida* comb. nov.).

Genus *Diolcogaster* Ashmead

Diolcogaster Ashmead, 1900. *Proc. U.S. natn. Mus*., 23: 132.
Type species*: Microgaster brevicaudus* Provancher, 1886. *Add. Corr. Faune. Ent. Can. Hym*., 140
Diolcogaster melligaster Ashmead, 1900. *Proc. U. S. natn. Mus*., 23: 132.
Diolcogaster brevicauda Ashmead, 1900. *Insects New Jers*., 594.
Microgaster (Diolcogaster) brevicaudis Viereck, 1911. *Proc. ent. Soc. Wash*., 13: 96.
Zadiolcogaster Viereck, 1913. *Proc. U.S. nat. Mus*., 46 (2031):359–386. (Synonymised by Mason 1981). Type species: *Zadiolcogaster anomus* Viereck, 1913. *Proc. U.S. nat. Mus*., 46 (2031): 359–386.

Diagnosis

Head oval, shiny, punctate; face with a faint or prominent medial carina (Fig. 21B); mesoscutum smooth to punctate-reticulate (Fig. 22C); scutellum smooth or weakly punctate; notauli absent (Fig. 22C); pronotum without upper crenulated groove; metanotum without sharp projecting anterior lobes; propodeum smooth, rugose-punctate with complete medial longitudinal carina (Fig. 22D); fore wing areolet present, shape variable from triangular, quadrangular to slit like (Fig 22F); margin of hind wing vannal lobe convex, setose but sometimes straight and rarely concave, hairless; first and second marginal cell same width; hind coxa large, hind tibial spur unequal in length; T1 paralllel sided or broad posteriorly, narrowing posteriorly with a sharp medial longitudinal groove throughout its length (Figs 22D & E); T2 variable but mostly rectangular with a medial field (Fig. 22E); T3 smooth to rugose with or without medial field; hypopygium short, sclerotised medially, not more than half length of hind tibia; ovipositor short, straight to strongly decurved, hidden with in the hypopygium; ovipositor sheath short, setosity variable from entire length to few hairs crowded at apex.

Host: Macrolepidoptera, Noctuidae, Geometridae, Pyraloidea.

Distribution: Cosmopolitan.

Remarks: Untill the redefinition of *Diolcogaster* the already described species were treated under the genus *Microgaster* L. (Wilkinson 1929, 1932). Nixon (1965) transferred them to *Protomicroplitis* and later Mason (1981) placed some species of *Protomicroplitis* under *Diolcogaster*.

KEY TO THE SPECIES OF *DIOLCOGASTER* ASHMEAD FROM INDIA

1. T1, T2 and T3 forming carapace 2

- T1, T2 and T3 not forming carapace 6

2(1) Vannal lobe flat; OOL as long as POL..... ..... *D. narendrani* Rema & Sheeba

- Vannal lobe convex or concave; OOL 0.50–1.40x POL.....3

3(2) Length of scape more than 2x its width; vein 1-R1 0.90x as long as pterostigma .....*D. longistria* Gupta

- Length of scape less than 2x its width; vein 1-R1 more than 0.90x as long as pterostigma 4

4(3) Length of fore wing 2.70x its width; length of T1 1.10x its apical width .....*D. buddha* sp. nov.

- Length of fore wing 2.90x its width; length of T1 0.80–0.90x its apical width 5

5(4) Fore wing vein 1-R1 1.20x as long as pterostigma; propodeum punctate; outer hind tibial spur 0.30x as long as hind tibia; length of scape 0.50x its width; length of hind femur 3.90x its width ....*D. andamanensis* Gupta

- Fore wing vein 1-R1 1.52x as long as pterostigma; propodeum rugose-punctate; outer hind tibial spur 0.42x as long as hind tibia; length of scape 1.30x its width; length of hind femur 3.30x its width .... *D. ranjithi* sp. nov.

6(1) Head 0.75–0.90x as long as its width 7

- Head 1.80–2.40x as long as its width 10

7(6) Inner hind tibial spur 0.90x as long as hind basitarsus; head 0.90x as long as its width; T2 with two sub medial carinae 8

- Inner hind tibial spur 0.63x as long as hind basitarsus; head less than 0.90x as long as its width;T2 with posteriorly narrowing sub medial carina 9

8(7) Scutellum with 12 carinae; OOL 1.40x as long as POL; T1 0.70x as long as its width .....*D. tomentosae* Wilkinson

- Scutellum with eight carinae; OOL 1.20x as long as POL; T1 1.10x as long as its width ..... *D. solitarium* Gupta

9(7) Flagellomere 5–7 white; first flagellomere 4.20x as long as wide; scutellum coarsely punctate posteriorly; propodeum coarsely rugose; pterostigma 3.50x as long as wide ..... *D. duocolor* Gupta

- Flagellomere 5–7 brown; first flagellomere 2.55x as long as wide; scutellum smooth posteriorly; propodeum smooth; pterostigma 2.64x as long as wide.....*D. longiterebra* (Rao & Chalikwar)

10(6) Fore and mid coxae black ....*D. indicus* Rao & Chalikwar

- Fore and mid coxae yellow 11

11(10) Face punctate with weak medial longitudinal carina; vannal lobe convex; T1 1.10x as long as its width; frons with medial longitudinal carina .....*D. malabarensis* Rema & Sheeba

- Face rugose-striate with strong medial longitudinal carina; vannal lobe straight; T1 2.50x as long as its width; frons without medial longitudinal carina .....*D. punctatus* Rao & Chalikwar

Character matrix for the species of *Diolcogaster*

1. T1–T3 carapace: 0; with carapace 1; without carapace
2. OOL & POL length: 0; OOL not equal to POL 1; OOL equal to POL
3. Pronotum sculpturing: 0; smooth 1; rugose 2; punctate
4. Hind wing vannal lobe: 0; convex 1; concave 2; flat
5. Tibial spur & basitarsal length: 0; tibial spur less than or equal to 0.7x basitarus 1; tibial spur morethan 0.7x basitarsus
6. T1 length & width: 0; less than 1x apical width 1; between 1–2x apical width 2; more than or equal to 2x
7. Scutellar carinae: 0; less than or equal to10, 1; more than 10

Coding of the chartacters and status for the Indian species of *Diolcogaster*

Species/characters	1	2	3	4	5	6	7
Diolcogaster andamanensis	0	0	?	?	1	0	0
Diolcogaster buddha sp. nov.	0	0	2	0	0	1	1
Diolcogaster duocolour	1	0	2	0	0	0	0
Diolcogaster indicus	1	?	?	0	?	?	?
Diolcogaster longistria	0	0	?	1	1	0	?
Diolcogaster longiterebra	1	0	?	?	0	2	?
Diolcogaster malabarensis	1	0	?	0	0	1	?
Diolcogaster narendrani	0	1	?	2	0	1	?
Diolcogaster punctatus	1	?	?	2	1	2	?
Diolcogaster ranjithi sp. nov.	0	0	2	0	1	0	0
Diolcogaster solitarium	1	0	?	0	1	1	?
Diolcogaster tomentosae	1	0	?	0	1	0	1

Treatment of species

***Diolcogaster buddha* sp. nov.**

Holotype: Female: Length 2.70 mm, antenna 3.10 mm, fore wing 2.60 mm, ovipositor 0.07 mm.

Head: Width of head 1.87x its length in dorsal view; head 0.46x as long as wide; face punctate, setose with a medial carina (Fig. 21B); length of face

0.92x its width; eye length 5x its malar space; height of clypeus: inter-tentorial distance: tentorio-ocular distance 2:7:2; eyes setose with infuscations; frons smooth, shiny; temple punctate, setose dorsally and aciculate laterally; temple 0.41x as long as eye in lateral view; occiput smooth, shiny; toruli aciculate; OOL 0.50x POL; antenna 1.10x as long as body; scape length 1.41x its width; pedicel length 0.59x its width; length of first flagellomere 2.60x its width; length of second flagellomere 2x its width.

Mesosoma: Length of mesosoma 1.21x its height; mesoscutum densely punctate, setose; scutellar lunules narrow with eight carinae (Fig. 21C); lateral side of pronotum coarsely setose, shiny with crenulations; mesopleuron punctate anteriorly, rugulose posteriorly; propodeum shiny, punctate with strong medial carina (Fig. 21D); fore wing length 2.70x its maximum width; length of pterostigma 2.51x its maximum width; vein 1- R1 1.50x as long as pterostigma; length of vein r 1.30x breadth of pterostigma; length of hind femur 3.49x its width; hind tibia 4.90x as long as its width; outer tibial spur 0.70x as long as basitarsus; basitarsus 4.93x as long as its width.

Metasoma: T1 1.10x as long as wide apically, with a crenulated medial groove (Fig. 21D); rest with a medial field; presence of carapace formation; T1–T7 punctate, setose (Fig. 21E); ovipositor setose apically; length of ovipositor 0.07x hind tibia.

Colour: Body black except antenna brownish yellow; maxillary palp, tibial spur pale white; basal hind femur, hind tibia yellowish brown; pterostigma brown; fore leg, basal hind femora, T1, T2 yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Holotype: 1F, India, Kerala, Janakikkadu, Veena, 3.iv.13 (DZUC)

Etymology: The species is named after Gauthama Buddha.

Discussion

This species shows resemblance with the species *D. longistria* in the absence of carapace. But it differs in having the characters length of scape 1.30x its width (in *D. longistria* length of scape 2.10x its width), vein 1-R1 1.50x as long as pterostigma (in *D. longistria* vein 1-R1 0.90x as long as pterostigma). It also shares characters with *D. solitarium* having T1 1.10x its apical width and length of fore wing 2.70x its width. The main characters which differs from the species are OOL 0.50x POL (in *D. solitarium* OOL 1.20x POL) and fore wing vein 1-R1 3.80x as long as pterostigma (fore wing vein 1-R1 1.10x as long as pterostigma in *D. solitarium*).

Diolcogaster malabarensis Narendran & Sheeba

Diolcogaster malabarensis Narendran & Sheeba, 2003. *J.Bio. Sci*.,11:1–3.
Diolcogaster malabarensis Narendran & Sheeba, Gupta & Fernández - Triana, 2015. *Syst. Parasitol.*, 90: 285–300.

Diagnosis

Female: Length 3.10 mm, antenna 3.80 mm, fore wing 3.60 mm.

Head 2.40x a wide as length in dorsal view, setose; face punctate with weak medial longitudinal carina; eye length 2.30x malar space; vertex, temple coarsely punctate with transverse striae; frons with medial longitudinal carina; POL 1.50x OOL; mesoscutum, scutellum punctate; scutellar lunules broad, crenulated; mesopleuron punctate, setose with transverse striations in middle; metapleuron coarsely punctate, setose postero-dorsally; propodeum, dull with medial longitudinal carina, rest punctate, setose; longer hind tibial spur 0.70x

of hind basitarsus, shorter spur half of metatarsus; fore wing vein 1-R1 1.10x pterostigma; width of stigma equal to vein r; areolet small, triangular; margin of hind wing vannal lobe convex sparsely setose; T1 punctate, 1.10x as long as its width at apex, wider than base, with a medial longitudinal groove; T2 with a medial field; T3 smooth, as long as T2; T3–T7 smooth; ovipositor sheath equal to short hind tibial spur.

Colour: Head, thorax, hind femur and hind tibia black; mandibles, labrum yellowish brown; fore and mid leg, ocelli, tegulae, T1–T3 yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Remarks: This diagnosis is based on the original description Narendran & Sheeba 2005.

Discussion

This species shares some characters with *D. punctatus* in having no carapace formation on tergites but differs from the same species in the characters mentioned in the key. This also shows similarity with *D. narendrani* in many characters, but differs from the same species in having frons with a medial longitudinal carina (frons without a medial longitudinal carina in *D. narendrani*) and POL 1.50x OOL (in *D. narendrani* OOL as long as POL).

Diolcogaster narendrani Rema & Sheeba

Diolcogaster narendrani Rema & Narendran, 2004. *Pers. Biosyst. Biod.*, 510.

Diolcogaster narendrani, Rema & Narendran, Gupta & Fernández, 2015. *Syst. Parasitol.*, 90: 285–300.

Diagnosis

Female: Length 3 mm, antenna 3.30 mm, fore wing 2.70 mm

Head 2.30x as wide as its length in dorsal view; face punctate, setose with strong medial longitudinal carina; eye 3x as long as malar space; vertex punctate; temple transversly striate, sparsely setose; occiput smooth; OOL as long as POL; mesoscutum, scutellum punctate, setose; scutellar lunules broad, crenulated; propodeum rugose with medial longitudinal carina and lateral carina on either side of it; mesopleuron with irregular striations medially, smooth posteriorly; metapleuron punctate; fore wing vein 1-R1 1.50x as long as pterostigma; width of pterostigma equal to vein r; margin of hind wing vannal lobe straight without hairs; hind coxa large more than half the length of abdomen; outer hind tibial spur 0.60x as long as hind basitarsus, inner tibial spur 0.30x as long as metatarsus; T1 1.20x as wide as its length; T1, T2 with medial groove, T1–T3 form carapace; T3 with a medial field, longitudinal carina on either side; ovipositor sheath short, setose apically.

Male: Characters same as that of female.

Host: Unknown.

Distribution: India (Kearla).

Remarks: This diagnosis is based on the original description Rema & Sheeba 2004.

Discussion

This species close to *D. malabarensis* Narendran & Sheeba in having, breadth of pterostigma equal to vein r and T2 with a medial groove. The species differs from the same species with, margin of hind wing vannal lobe flat without hairs (margin of vannal lobe convex, setose in *D. malabarensis*) and OOL as long as POL (POL 1.50x OOL in *D. malabarensis*).

***Diolcogaster ranjithi* sp. nov.**

Holotype: Female: Length 2.70 mm, antenna 3.30 mm, fore wing 3.10 mm.

Head: Width of head 1.40x its length in dorsal view; head 0.50x as long as wide; face punctate, setose with medial carina (Fig. 22B); length of face 0.90x its width; eye length 4.30x its malar space; intertentorial distance: tentorio-occular distance 3:4; vertex, temple punctate, setose; occiput smooth, shiny; toruli shiny, punctate; OOL 0.5x POL; length of scape 1.30x its width; pedicel length 0.60x its width; length of first flagellomere 2.20x its width; length of second flagellomere 2.30x its width.

Mesosoma: Length of mesosoma 0.90x metasoma; mesoscutum, scutellum punctate, setose; scutellar lunules narrow with 10 carinae (Fig. 22C); pronotum punctate with lateral crenulations; propodeum dull with strong medial carina, rest rugulose-punctate (Fig. 22D); fore wing length 2.90x its maximum width; length of pterostigma 2.60x its maximum width; vein 1-R1 1.52x as long as pterostigma; length of vein r 1.20x width of pterostigma; length of hind femur 3.30x its width; tibial length 4.60x its width; outer tibial spur 0.81x as long as basitarsus, 0.42x as long as hind tibia; length of basitarsus 4.1x its width.

Metasoma: Length of T1 0.90x its width; T1 punctate with medial groove (Figs 22D & E); basal part of T2 with up to eight crenulations; basal T3 with medial protruberence (Fig. 22E); T4–T7 shiny, punctate, setose.

Colour: Body black except antenna, pterostigma brownish black; wing veins brown; maxillary palp, tibial spur pale yellow; clypeus yellowish brown; fore leg, T1, T2, scape yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: Holotype: 1F, India, Kerala, Janakikkadu, Ranjith, 9.i.13.

Paratype: 1F, India, Kerala, Janakikkadu, Ranjith, 3.iv.13 (DZUC)

Etymology: The species is named after the name of the collector.

Discussion

This species has close resemblance with *D. andamanensis* in having OOL 0.50x POL, and scutellar lunules divided by 10 carinae. The species shows difference from the same species in the characters, width of head 0.40x in dorsal view (in *D. andamanensis* head width 0.80x its length in dorsal view) and fore wing vein 1-R1 1.52x as long as pterostigma (1-R1 1.20x as long as pterstigma).

Genus *Distatrix* Mason

Distatrix Mason, 1981. *Mem. Ent. Soc. Canada*, 115: p.93 Type species: *Apanteles papilionis* Viereck, 1912. *Proc. U. S. Natn. Mus*., 42: 145; Ayyar, 1920. *Rep. Proc. Ent. Meet. Pusa*., 3: 932; Wilkinson, 1930. *Bull. Ent. Res*., 21(2): 151; Thompson, 1956. *Host Par. Cat*., 2: 75; Nixon, 1965. *Bull. Br. Mus. Nat. hist., Ent. Suppl*., 2: 195.

Diagnosis

Antenna 2–2.4 mm in length; margin of hind wing vannal lobe straight or weakly concave, hairless; legs normal to slender, tibial spurs long, curved, inner spur of hind tibia more than half length of basitarsus; some female possess an excavation and enlarged hair medio-ventrally on distant tarsomere; propodeum smooth, without carina, weakly curved (Fig. 23D); side of pronotum smooth with ventral groove; T1 parallel sided, rounded or narrowed apically, 1.5–2x longer than wide, smooth (Fig 23E); T2 smooth, cheveron shaped with partial widely diverging anterior grooves, concave posterior margin, with an elongate, elevated medial area; hypopygium short, evenly sclerotised; ovipositor short, straight, gradually tapered; ovipositor sheath short, smooth, sparsely setose apically.

Host: Macrolepidoptera.

Distribution: Cosmopolitan.

Remarks: This genus is included in the key to Microgastrinae of Kerala, to exclude the chance of error, if in case it is obtained in the future, as it has shown its presence in the neighbouring states of Kerala ie, Karnataka and Tamil Nadu.

Distatrix papilionis (Viereck)

Apanteles papilionis Viereck, 1912. *Proc. U.S. Nat. Mus.*, 42:145, Female (USNM).

Redescription

Female: Length 2.70 mm, antenna 2.30 mm, fore wing 2.50 mm.

Head: Width of head 1.92x its length in dorsal view; face coarsely punctate (Fig. 23B); eye length 3.63x malar space; vertex weakly punctate setose; frons with medial carina; occiput smooth, shiny; toruli smooth; OOL 0.91x POL; length of scape 1.22x its width; pedicel length 0.91x its width; first flagellomere 0.93x as long as second flagellomere; length of first flagellomere 3.30x its width; length of second flagellomere 3.30x its width.

Mesosoma: Mesosoma strongly setose, 1.45x its width; scutellar lunules narrow (Fig. 23C); scutellum coarsely punctate, setose (Fig. 23C); mesopleuron punctate, setose antero-ventrally and smooth, shiny posteriorly; propodeum without areola and carina, weaky punctate (Fig. 23D); length of fore wing 2.70x its maximum width; pterostigma 2.50x as long as its maximum width; fore wing vein R1 equal to length of pterostigma, vein r equal to width of pterostigma; r and 1Rs sharply angled; margin of hind wing vannal lobe flat without hairs; length of hind femur 3.91x its width; length of hind tibia 4.19x its width; basitarsus 4.56x as long as its width; outer tibial spur 0.38x as long as hind tibia; outer tibial spur 0.60x as long as basitarsus.

Metasoma: Metasoma smooth, shiny, 1.04x as long as mesosoma; T1 parallel sided, narrowed at apex, 2x as long as its width at apex (Fig. 23E); T2 with diverging sulci, T2 and T3 sub equal.

Colour: Mandibles, pedicel, basal flagellomeres yellowish brown; vertex, thorax, ovipositor sheath black; fore and mid legs, hind coxae, basal 2/3 of hind tibia and tarsi yellow; wing veins light brown.

Male: Unknown.

Host: Papilionid butterflies, *Papilio polytes* Linnaeus (Papilionidae), *Papilio demodocus* Esper (Papilionidae), *Papilio demoleus* Linnaeus (Papilionidae), *Papilio sarpedon* Linnaeus (Papilionidae), *Papilio agamemnon* Linnaeus (Papilionidae).

Distribution: India (Karnataka, Maharashtra, Tamil Nadu), Java, East Africa.

Material examined: 2F, India, Maharastra, Pune, Charan 12.i.1995; 1F, India, Tamil Nadu, 1998; 1F, India, Karnataka, 1998 (No collector name) (DZUC).

Discussion

Morphological variations of the species from the redescription of Wilkinson (1928) are T3 yellow basally (T3 completely dark in Wilkinson's redescription), scape, pedicel and basal flagellomeres yellowish brown (in Wilkinson's redescription scape, pedicel and basal flagellomeres dark). But this is only minor species variation.

Genus *Exoryza* Mason

Type: *Apanteles schoenobii* Wilkinson, 1932. *Stylops*, 1:142.

Diagnosis

Vertex punctate coarsely and distinctly; face, clypeus sparsely punctate; anterior external angle of ocelli close to 90 degree; mesoscutum densely punctate (Fig. 24C); scutellar lunules arcuate (Fig. 24D); anterior margin of metanotum with crenulated grooves; pronotum with upper and lower grooves; propodeum rugose with a conspicuous areola open anteriorly; vein r slanting outwards; margin of hind wing vannal lobe convex, setose; T1, T2 rugose-aciculate, T1 short broadening apically (Fig. 24E); T2 rectangular; T3 as long as T2, weakly sculptured; ovipositor as long as hind tibia, decurved; hypopygium large with medial striae.

Host: Pyraloidea.

Distribution: Eastern Palearctic, Nearctic, Neotropical, Oriental.

Remarks

Only five species were reported in the world. Here redescription of one species included and this is the new report of the genus from India.

Exoryza schoenobii (Wilkinson)

Apanteles schoenobii Wilkinson, 1932. *Stylops*, 1:142.

Exoryza schoenobii (Wilkinson), Mason, 1981. *Mem. Entomol. Soc*. Canada, 115-40.

Exoryza schoenobii (Wilkinson), Valerio *et al.*, 2004. *Zootaxa*, 526:6.

Redescription

Female: Length 3.26 mm, antenna 3.50 mm, fore wing 3.24 mm, ovipositor 1.02 mm.

Head: Head coarsely puncate, length of head 1.32x its width; face setose with fine sculpturing (Fig. 24B); clypeus coarsely punctate, setose; width of clypeus 2.93x its height; OOL 1.80x POL; occiput smooth; vertex, gena punctate, setose; height of compound eye 2.70x its width; scape length as long as its width; length of pedicel 0.68x its width; length of first flagellomere 1.0x as long as second flagellomere; length of first flagellomere 3.67x its width; length of second flagellomere 3.41x its width; length of head 0.39x as long as mesosoma.

Mesosoma: Length of mesosoma 1.41x its width, 2.70x as long as head; mesoscutum punctate, setose (Fig. 24C); scutellum shiny with narrow scutellar lunules divided by 10 carinae; lateral lunules of scutellum arcuate; propleuron anteriorly foveate, posteriorly punctate; mesopleuron punctate; pronotum coarsely punctate, setose with upper and lower grooves; propodeum rugose with an areola open anteriorly (Fig 24D); length of fore wing 3.20x its maximum width; length of pterostigma 3.10x its maximum width; vein 1-R1 1.60x as long as pterostigma; vein r as long as width of pterostigma; 1CUa 0.60x as long as 1Cub; length of 1M 1.51x as long as m-cu; length of hind femur 3.21x its width; length of hind tibia 3.90x its width; length of hind tibia 1.40x as long as hind femur.

Metasoma: Length of T1 1x its width, rugose-punctate; T2 0.41x as long as its width, with aciculate sculpturing; medio longitudinal area of T1 depressed, not clearly defined (Fig. 24E); T3–T7 with shallow punctures, setose (Fig. 24E); hypopygium desclerotised medially; ovipositor long, setose, thin throughout its length.

Colour: Antenna, hind wing veins, T3–T6, ovipositor brownish yellow; wings hyaline, fore wing veins brown; ocelli, tibial spur whitish yellow; hypopygium, ocelli yellow; compound eyes silver.

Male: Unknown.

Host: Stem boring Pyraloidea larva on rice.

Material examined: 1F, India, Kerala, Valayamkulam, Narendran, 17.viii.1989 (DZUC).

Discussion

Exoryza schoenobii shows resemblance with *E. minnesota* in having hind tibia 1.40x as long as hind femur and length of T1 1x its width. It differs from the same species having scutellar lunules divided by 10 carinae (in *E. minnesota* scutellar lunules by seven carinae), 1CUa 0.60x as long as 1Cub (1CUa and 1Cub equal in length in *E. minnesota).* This species also shows similarity with *E. monocavus* having length of hind femur 3.21x its width and length of head 1.32x its width. It differs from *E. monocavus* in the absence of mediodistal pit on metapleuron (mediodistal pit distinct in *E. monocavus*) and length of fore wing 3.20x its maximum width (in *E. monocavus* length of fore wing 2.70x its maximum width).

Genus *Fornicia* Brullé

Fornicia Brullé, 1846. *Hist. Nat. Insectes. Hym*., 4:511. (Type species, by monotypy, *Fornicia clathra* Brullé). Papp, 1980b. *Fol. Ent. Hung*., 41(33) (2): 305; Mason, 1981. *Mem. Entomol. Soc. Canada*, 115:86; Austin, 1987. *Cab Internat*., 151.
Odontofornicia Enderlein, 1912. *Ent. Mitt. Berl*., 1: 260.
Type: *Odontofornicia arata* Enderlein, Cushman, 1929. *J. Sci*., 40: 233.
Monofornicia Fahringer, 1938. *Ark. Zool*., 30 A (12):6.
Type: *Fornicia africana* Wilkinson, 1930. *Bull. Ent. Res*., 21: 275.

Diagnosis

Head transverse, small (Fig. 25A); mesocutum, scutellum with complex varying sculpture, lateral lunules of scutellum moderate in size (Fig. 25C); scutellum projecting backwards and upwards as a short to long one or two lobed structure; mesopleuron with strong prepectal carina; pronotal groove broad and coarsely sculptured; propleuron laterally carinate and with posterior lobe that overlaps the posterior corner of the pronotum; propodeum with unusual type of carination, median part occupied by a Y-shaped carina with median stem and the arms of the "Y" enclosing a small area that open anteriorly, a pair of carinae running from arms of "Y" to the side of propodeum behind spiracle, a pair of well defined lateral longitudinal carina running from middle of carina to posterior margin of propodeum (Fig. 25D); metanotum with medial apical spine; margin of hind wing vannal lobe concave, hairless; T1–T3 completely fused in to carapace (Fig.25E); remaining tergites withdrawn under carapace; T1–T3 coarsely rugose with two transverse grooves indicating segmentation and a strong double medial carina, remaining tergites reduced to narrow with weakly sclerotised band (Fig. 25E); laterotergite 1 with vestigial spiracle, other spiracles normal.

Host: Limacodidae.

Distribution: Cosmopolitan.

Remarks: The complete prepectal carina and fused tergites 1–3 are the unique characters of the genus *Fornicia.* Only 35 species are reported in the world (Fernández-Triana & Ward 2016).

KEY TO THE SPECIES OF *FORNICIA* BRULLÉ FROM INDIA

1. Medial longitudinal ridge on metasoma reaching T3; medial ridge of T2 parallel sided anteriorly..... *F. neo ceylonica* sp.nov.

- Medial longitudinal ridge not reaching upto T3; medial ridge of T2 anteriorly widened, narrow posteriorly ....*F. ceylonica* Wilkinson

Fornicia neoceylonica sp. nov.

Holotype: Female: Length 5.05 mm, antenna 5.76 mm, fore wing 4.43 mm, ovipositor 1.03 mm.

Head: Width of head 2.21x its length in dorsal view; length of head 0.42x its width in dorsal view, 0.70x its width in anterior view; head punctate, setose; face densely punctate, setose with indistinct medial carina (Fig. 25B); length of face 0.60x its width; clypeus shiny, coarsely punctate; eyes setose with infuscations; eye length 2.81x malar space; vertex, gena coarsely punctate, setose; toruli smooth, shiny; OOL 0.89x as long as POL; length of scape 1.28x its width; length of pedicel 2.61x its width; length of first flagellomere 2.76x its width; length of second flagellomere 3.12x its width.

Mesosoma: Length of mesosoma 1.32x its width, 2.97x as long as head; mesoscutum punctate, setose (Fig. 25C); scutellar lunules narrow with six carinae (Fig. 25C); propleuron punctate; pronotum shiny, coarsely punctate,

pronotal groove broad; mesopleuron with strong prepectal carina continuous on sides and ventrally; mesoscutum shiny, coarsely punctate anteriorly, dull, densely punctate posteriorly; metanotum with upwardly directed spine; propodeum with developed areola, transverse carina extend to the spiracles, rest rugose (Fig. 25D); length of fore wing 2.95x its maximum width; length of pterostigma 2.80x its maximum width; vein r as long as width of pterostigma; vein 1-R1 1.11x length of pterostigma; margin of hind wing vannal lobe convex, setose; length of hind femur 3.80x its width; length of hind tibia 5.20x its width; outer tibial spur 0.28x as long as hind tibia; inner tibial spur 0.37x as long as basitarsus; length of basitarsus 4.21x its width.

Metasoma: Metasoma 1.60x as long as mesosoma; metasoma carapaced, rugose-recticulate (Fig. 25E); apical length of T1 0.60x its width; apical length of T1 1.51x T3; T1 and T2 with strong posteriorly diverging medial carina; T4–T7 tergites almost hidden under T3; hypopygium setose; ovipositor setose apically.

Colour: Body completely black except ocelli, clypeus, hind femur, wing veins, ovipositor brownish yellow; fore femur, basal hind tibia yellow; tibial spur pale yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: 1F, INDIA, Kerala, Idukki, Vadiperiyar, Babu, 2003 (DZUC)

Etymology: The name for this species is due to its close resemblance with *Fornicia ceylonica* Wilkinson.

Discussion

This species is closely related to *F. ceylonica* having metasoma 1.40x longer than wide and tongue shape protruberance of posterior scutellum. It differs from the same species in having median longitudinal ridge on metasoma reaching T3 (in *F. ceylonica* medial longitudinal ridge not reaching up to T3) and medial ridge of T2 parallel sided anteriorly (medial ridge anteriorly widened and narrow posteriorly in *F. ceylonica).*

Genus *Illidops* Mason

Illidops Mason, 1981. *Mem. Ent. Soc*. Canada, 115:56.
Type species: *Apanteles butalidis* Marshall, 1888. *Andre. Spec. Hym. Eur. Alg*., 4: 45.

Diagnosis

Antenna inserted about middle of the face (Fig. 26B); inner margins of eye converged below (Fig. 26B); ocelli form moderate triangle; scutellum shiny, sparsely punctate (Fig. 26C); propodeum dull, rugose-punctate never with areola or medial carina (Fig. 26D); metapleuron punctate or granulate; margin of hind wing vannal lobe convex or flat without hairs; T1 parallel sided, barrel shaped or apically narrowed (Fig. 26E); T2 rectangular or triangular, coarsely or weakly sculptured with diverging sulci (Fig. 26E); posterior tergites with medio-apical desclerotised area that give dry specimens the appearance of having terga pushed forward medially; ovipositor sheath long, setose; hypopygium large, medially striated.

Host: Psychidae and Scythridae.

Distribution: Neartic and Oriental.

Remarks: Achterberg (2002) considered *Illidops* as the synonym of *Apanteles*, but due to the presence of characters like desclerotisation of metasomal tergites 4–6, metasomal tergites appearing pushed forward and densely setose, short 1-R1 and slanding nature of fore wing vein r, it merits generic status. Only three species were reported so far from India and here a new species belonging to this genus dealt with.

KEY TO THE SPECIES OF *ILLIDOPS* MASON FROM KERALA

1. Occiput smooth; hind tibial spurs equal; fore wing vein R1 0.90x as long as pterostigma .....*I. malabaricus* sp. nov.

- Occiput punctate; hind tibial spurs not equal; fore wing vein R1 0.80x as long as pterostigma 2

2(1) Propleuron punctate anteriorly, smooth, shiny posteriorly; T1 1.90x as long as wide apically ..... *I. keralensis* (Sumodan & Narendran)

- Propleuron punctate entirely; T1 less than 1.80x as long as wide apically 3

3(2) T2 4.80x as wide as long medially; OOL as long as POL; vein r 0.70x as long as width of pterostigma; precoxal sulcus shallow, smooth; scutellum punctate anteriorly, smooth, shiny posteriorly.....

..... *I. azamgarhensis* Ahmad *et al.*

- T2 3.50x as wide as long medially; OOL 0.83x as long as POL; vein r 0.90x as long as width of pterostigma; precoxal sulcus deep, aciculate; scutellum punctate through out ..... *I. lamprosomae* Ahmad *et al.*

Character matrix for the species of *Illidops*

1. Occiput sculpturing: 0; punctate 1; smooth
2. Vannal lobe margin: 0; setose 1; hairless
3. OOL & POL length: 0; OOL as long as POL 1; OOL not equal to POL
4. Propodeum: 0; with medial longitudinal carina 1; without medial longitudinal carina 2; irregular carina
5. Vertex: 0; with medial longitudinal carina 1; without medial longitudinal carina
6. T1 length & width: 0; length less than or equal to1.50x width 1; length more than 1.50x width

7. Tibial spurs length: 0; equal 1; unequal

8. Vein R1 & pterostigma length: 0; vein R1 0.80x as long as pterostigma 1; vein R1 0.90x as long as pterostigma

Codes for the characters and status for the species of *Illidops*

Species/characters	1	2	3	4	5	6	7	8
Illidops azamgarhensis	?	0	0	2	1	0	1	0
Illodops keralensis	0	1	1	1	1	1	1	0
Illodops lamprosomae	?	0	1	0	1	1	1	0
Illidops malabaricus sp.nov.	1	1	0	1	0	1	0	1

Treatment of species

***Illidops keralensis* (Sumodan & Narendran)**

Apanteles keralensis Sumodan & Narendran, 1990. *J. Ecobiol*., 2(3):243, Female (RMNH).
Illidops keralensis (Sumodan & Narendran), Achterberg & Narendran, 1997. *Zool. Med. Leiden*, 71:177-179.
Illidops keralensis (Sumodan & Narendran), Ahmad *et al.*, 2005. *Orient. insects*., 39: 229-232.

Diagnosis

Female: Length 2.60 mm; antenna 2.30 mm; fore wing 2.60 mm; ovipositor 0.70 mm.

Length of head 1.90x its width in dorsal view; vertex coarsely punctate; OOL 1.30x POL; eyes setose with infuscations; length of eye 6.50x malar space; lateral temples visible in anterior view; length of face 0.70x its width; width of face 0.50x width of head; clypeus shiny, punctate; maxillary palp with four segments; toruli smooth, shiny; frons coarsely punctate, setose; antenna inserted about the middle of the face; length of scape 2.20x its width; occiput dull coarsely punctate; length of mesosoma 2.30x length of head; length of

mesosoma 0.78x length of metasoma; mesoscutum punctate, setose; propleuron strongly punctate anteriorly; mesopleuron densely punctate, setose antero-ventrally; metapleuron coarsely punctate; scutelleum strongly punctate, setose; propodeum dull, rugose-punctate without medial carina and complete areola; notauli indistinct; scutellar lunules wide, divided by six carinae; length of fore wing equal to length of the body; fore wing vein R1 0.80x as long as pterostigma; width of pterostigma longer than vein r; margin of hind wing vannal lobe convex without hairs; fore and hind coxa punctate and setose; hind tibia 1.20x as long as hind femur; length of hind femora 3.90x its width; length of hind tibia 6.21x its width; tibial spur subequal; inner tibial spur 0.40x as long as hind basitarsus; T1 parallel sided slightly narrowed at apex, punctate, 1.90x as long as its width at apex; T2 and T3 punctate, rest smooth, setose; ovipositor 1.60x as long as hind basitarsus.

Colour: Body generally black except clypeus, hind tibial spur yellow; maxillary palp white; tegulae, fore leg, mid and hind coxa yellowish brown; eyes yellowish black; ovipositor reddish brown.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Discussion

This species shows similarity with *I. malabaricus* sp. nov. in many characters like vein 1-R1 0.80x as long as pterostigma, but differs from the same species in having OOL 1.30x POL (in *I. malabaricus* sp.nov. OOL as long as POL) and eye length 6.50x malar space (in *I. malabaricus* sp.nov. eye length 5.50x malar space)

Illidops malabaricus sp. nov.

Holotype: Female: Length 2.87 mm, antenna 2.31 mm, fore wing 2.63 mm, ovipositor 0.71 mm

Head: Width 1.92x its length in dorsal view; length of head 0.52x as long as wide; length of face 0.80x its width with a faint medial carina; face, clypeus coarsely punctate, setose (Fig. 26B); eyes large converging anteriorly (Fig. 26B); eye length 5.51x malar space; vertex coarsely punctate, setose, with medial longitudinal groove; occiput smooth; toruli smooth, shiny; OOL 1.30x POL; antenna inserted at the middle of the eye; antenna 0.80x as long as body; length of pedicel 2.20x its width; length of first flagellomere 3.20x its width; length of second flagellomere 3.48x its width.

Mesosoma: Length of mesosoma 1.80x its heigh, 2.30x as long as head; mesoscutum coarsely punctate, setose (Fig. 26C); scutellar lunules narrow, with widely separated punctures (Fig. 26C); notauli indistinct; propleuron punctate, mesopleuron punctate, setose antero-ventrally, smooth posteriorly; propodeum dull, rugose-punctate, without medial carina and areola (Fig. 26D); metapleuron crenulated posteriorly; length of fore wing 2.87x its maximum width; length of pterostigma 2.20x its maximum width; vein 1-R1 0.80x pterostigma; vein r 0.50x as long as width of pterostigma; margin of hind wing vannal lobe convex without hairs; length of hind femur 3.86x its width; length of hind tibia 6.20x its width; outer hind tibial spur 0.44x as long as hind basitarsus; tibial spurs equal.

Metasoma: T1 parallel sided narrowed at apex, coarsely punctate (Fig. 26E); T1 2x as long as its width at apex; T2 with diverging sulci (Fig. 26E); T3 punctate, setose; T3 2x as long as T2; T3–T7 smooth, setose; ovipositor 0.70x as long as hind tibia; hypopygium large, striated.

Colour: Body black except mandibles, fore and mid legs yellowish brown; pterostigma, hind tibia and tarsi, T3–T7 dark brown; tibial spurs pale yellow.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: Holotype: Female, India, Peravoor, Narendran, 25.ii.1988.

Paratypes: 1F, India, Kerala, Peechi, Sumodan, 5.ii.1989; 1F, India, Kerala, C.U. Campus, Rema, 13.x.1993 (DZUC).

Discussion

This species shows similarity with the species *I. azamgarhensis* for the following characters like OOL as long as POL and fore wing vein R1 0.80x as long as pterostigma, but the differences are hairless vannal lobe margin and medial longitudinal carina in vertex (vannal lobe margin setose and vertex lack medial longitudianl carina in *I. azamgarhensis*). This species also shows resemblance with *I. keralaensis* in having hairless margin of hind wing vannal lobe and propodeum with out medial carina, but it shows differences in having medial longitudinal carina in vertex and smooth occiput (vertex lack medial longitudinal carina and occiput punctate in *I. keralensis*).

Genus *Microgaster* Latreille

Microgaster Latrielle, 1804. *Nouv. Dict. Hist. nat., 24*. 175.
Type species: *Ichneumon deprimator* (Fabricius) Latreille, 1805. *Hist. nat. Crust. Insectes.*, 13: 189.
Microgaster detractus Walker, 1860. *Ann. Mag. Nat. Hist*., (3), 5: 308; Wilkinson, 1927. *Bull. ent. Res*.,18:171.
Microgaster dorsalis Spinola, 1808. *Insect*. Liguriae, 2:151.

Diagnosis

Scutellum smooth to sparsely sculptured (Fig. 27C); notauli indistinct, indicated by broad depressed tracks (Fig. 27C); fore wing areolet large, subtriangular (Fig. 27F); vein r gently curved; hind wing vannal lobes slightly rounded, setose; propodeum coarsely rugose with a prominent medial carina, never with an areola; T1 short, broad, rugose, widening posteriorly (Fig. 27D); T2 rectangular, rugulose, as long as or longer than T3; T2 without any delimited area (Fig. 27E); hypopygium large with several medial folds or striae; ovipositor sheath setose throughout, 0.3–1.0x as long as hind tibia; ovipositor gradually tapered throughout its length.

Host: Microlepidoptera, Geometridae, Nymphalidae.

Distribution: Cosmopolitan.

Remarks: *Microgaster* is one of the specious genera of Microgastrinae. Here redescription of one *Microgaster* speies and key to the Indian species are included.

KEY TO THE SPECIES OF *MICROGASTER* LATRIELLE FROM INDIA

1. Propodeum without medial longitudinal carina; T1 smooth .....

.....*M. adisurae* Rao & Sharma

- Propodeum with medial longitudinal carina; T1 sculptured 2

2(1) T2 with a medial area; T1 with longitudinally excavated area .....

.....*M. indica* Wilkinson

- T2 with out medial area; T1 lack longitudinally excavated area 3

3(2) Metanotum aciculate; T2 without a basal curved furrow; propodeum with lateral carinae along with medial longitudinal carina .....

.....*M. kuchingensis* Wilkinson

- Metanotum smooth; T2 with a basal curved furrow; propodeum without lateral carinae along with medial longitudinal carina .....

.....*M. himalayensis* Cameron

Character matrix for the species of *Microgaster*

1. T1 sculpturing: 0; recticulate 1; smooth
2. Lateral carina on propodeum: 0; present 1; absent
3. Metanotum sculpturing: 0; smooth1; aciculate
4. T1 with excavated area: 0; present 1; absent
5. T2 with medial area: 0; present 1; absent
6. Propodeum with medial longitudinal carina: 0; present 1; absent

Coding of the characters and status for the species of *Microgaster*

Species/characters	1	2	3	4	5	6
Microgaster adisurae	1	1	?	?	?	1
Microgaster himalayensis	0	1	1	1	1	0
Microgaster indicus	2	1	?	0	0	1
Microgaster kuchingensis	0	0	0	1	1	0

Treatment of species

Microgaster kuchingensis Wilkinson

Microgaster kuchingensis Wilkinson, 1927. *Bull. Ent. Res*., 18: 176; 1929, *Trans. R. Ent. Soc*. Lond., 77:129.
Microplitis kuchingensis Wilkinson, Mathur, 1944. *Ind. J. Ent*., 5:121.
Microgaster kuchingensis Wilkinson, Thompson, 1953. *Host. Par. Cat*., 2:156.
Microgaster kuchingensis Wilkinson, Nixon, 1968. *Bull. Br. Mus. Nat. Hist. (Ent.)*., 22(2): 66.
Microgaster kuchingensis Wilkinson, Austin & Danger Field, 1992. *Invertebr. Taxon*., 39.

Redescription

Female: Length 4.21 mm, fore wing 3.90 mm, antenna 3.85 mm, ovipositor 1.04 mm.

Head: Width of head 2.18x its length in dorsal view; length of head 0.76x its width in anterior view; face punctate sparsely setose with medial carina (Fig. 27B); length of face 0.64x its width; width of clypeus 0.20x width of face; inner margins of eye slightly converging ventrally; inter tentorial distance 3.81x tentorio-occular distance; frons, vertex punctate, shiny; occiput smooth; toruli smooth, shiny; OOL 2.85x POL; scape 1.63x its width; length of pedicel 0.63x its width; length of first flagellomere 1.90x its width; length of second flagellomere 2x its width.

Mesosoma: Length of mesosoma 1.39x its width, 2.60x as long as head; mesoscutum smooth, shiny sparsely punctate, setose (Fig. 27C); notauli indistinct (Fig. 27C); scutellum with lateral carinae, lateral band of scutellum broad; mesopleuron smooth, shiny anteriorly, crenulate posteriorly; propodeum with distinct percurrent medial carina, rest coarsely rugose (Fig. 27D); several lateral carinae arising along with medial carina; length of fore wing 2.97x its maximum width; length of pterostigma 2.38x its maximum width; fore wing vein r slightly curved; vein r as long as breadth of pterostigma; vein 1-R1 1.71x as long as pterostigma; length of hind femur

3.78x its width; hind tibia 4.63x as long as its width; length of hind tibial spur 0.20x width of hind tibia; length of basitarsus 4.30x its width; hind tibial spur 1.40x width of basitarsus.

Metasoma: Metasoma 1.30x as long as mesosoma; apical length of T1 1.60x its width, coarsely reticulate-striate (Fig. 27D); T2 rectangular, densely rugose-punctate (Fig. 27E); T3–T7 sub equal in length, smooth, shiny (Fig. 27E); T1–T7 covered with long dark hairs; hypopygium evenly sclerotised; ovipositor sheath broad, curving ventrally; length of ovipositor 0.90x hind tibia.

Colour: Body black, except clypeus, maxillary palp, ocelli, fore and mid leg, hypopygium, ovipositor, tibial spur yellowish brown; scape, pedicel, wing veins brown.

Male: Unknown.

Host: *Coclebotys coclesalis* Walker (Crambidae), *Phlyctaenia flavofimbriata* Moore (Pyralidae).

Distribution: India (Kerala), Philippines, Taiwan.

Material examined: 2F India, Kerala, Koorachundu, Mercy, 22.v.2011.

Discussion

This species shows close resemblance with *M. himalayensis* for the recticulate nature of T1, but it shows difference for the characters, smooth metanotum (metanotum aciculate in *M. himalayensis*) and propodeum contain lateral carinae along with medial longitudinal carina (in *M. himalayensis* propodeum without lateral carinae).

Genus *Microplitis* Foerster

Microplitis Foerster, 1862. *Verh. Naturh. Ver. Peruss. Rheinl*., 19: 245.
Type species, by original designation, *Microgaster sordipes* Nees von Esenbeck-Marshall, 1872. *Cat. Br. Hym*., 106; Nixon, 1965. *Bull. Br. Mus. nat. Hist., Ent. Suppl*., 2:7; Nixon, 1970. *Bull. Br. Mus. Nat. hist. (Ent)*., 25; Mason, 1981. *Mem. Ent.Soc.Canada*, 115:132; Austin & Dangerfield, 1992. *Invertebr. Taxon.*, 6: 42; Chen & Song, 2004. *Fujian Science & Technology Publishing house.*, Fuzhou. 221.
Dapsilotoma Cameron, 1906. *J.Bombay. nat. Hist. Soc*., 17:101[Type species, *Dapsilotoma testaceipes* Cameron, by monotopy, 1906]. Synonymised by Viereck, 1914. *Bull. U.S.Natn. Mus*., 25.
Glabromicroplitis Papp, 1979. *Fol. Entomol. Hung.*, 176 [Type species, *Glabromicroplitis mahunkai* Papp, 1979].
Microplitis Foerster, Gupta, 2013. *Zootaxa*, 3620 (3): 429–452.
Microplitis Foerster, Ranjith *et al*., 2015. *Zootaxa*, 3963 (3): 375–376.

Diagnosis

Head rather thick from front to back, with dense sculpturing (Fig. 28B); clypeal margin concave to straight; labial palp three segmented, rarely with four segments; mesoscutum densely sculptured, with or without notauli (Figs 28C & 30C); prepectal carina absent; fore wing infuscated with an areolet (Fig. 32F); fore wing vein 1-R1 short, not reaching to SR1; 1CU-1 shorter than 2CU-1; r-m present; vannal lobe covex, setose; propodeum rugose with a medial longitudinal carina, never with an areola (Fig. 32D); T1 variable, widening to narrowing apically, sculptured, remaining tergites smooth (Fig. 32E); hind coxa small shorter than T1; hind tibial spurs unequal in length; mid tibial spurs shorter than mid basitarsus; hypopygium sclerotised, never membranous and expandable (Fig. 28E); ovipositor short (Fig. 28E).

Host: Macrolepidoptera (Noctuidae).

Distribution: Cosmopolitan.

Remarks: Twenty one species were reported from the Oriental region. Here, species of Kerala diagnosed with a key to the *Microplitis* species of Kerala. All the diagnosis was taken from Ranjith *et al*. 2015.

KEY TO THE SPECIES OF *MICROPLITIS* FOERSTER FROM KERALA

1. Scutellar lunules with five or more than five carinae (Fig. 30C); fore wing vein 1-M straight or arched; propodeum rugose 2

- Scutellar lunules with three carinae (Fig. 29C); fore wing vein 1-M slightly curved; propodeum reticulate- rugose .... *M. bicoloratus* Xu & He

2(1) Fore wing vein 1-M arched 3

- Fore wing vein 1-M straight 5

3(2) Head oval in anterior view; pterostigma less than 2.50x as long as wide; scutellum with seven carinae (Fig. 28C) .... *M. areyongensis* Austin & Dangerfield

- Head subcircular in anterior view; pterostigma more than 2.50x as long as wide; scutellum with five carinae (Fig. 34C) 4

4(3) T1 1.2x as long as wide; POL 1.10 OOL; hind femur more than 4x as long as its width; length of fore wing 3x its maximum width; antenna 1.10x as long as body; T1 parallel sided .... *M. spodopterae* Rao & Kurian

- T1 1.80x as long as wide; POL 0.90x OOL; hind femur less than 4x as long as its width; length of fore wing 2.80x its width; antenna 1.40x as long as body; T1 sub parallel sided .... *M. vitellipedis* Li, Tan & Song

5(2) Lateral temples visible in anterior view (Fig. 32B); T2 with distinct straight medial field 6

- Lateral temples hidden behind anterior view (Fig. 31B); T2 with indistinct or oval medial field 7

6(5) T1 morethan 2x its apical width; POL 1.50x OOL; length of pterostigma 2.30x its maximum width; scutellar lunules divided by seven carinae (Fig. 33C); antenna 1.20x as long as body; lateral temples slightly visible in anterior view .... *M. similis* Lyle

- T1 less than 2x its apical width; POL 1.90x OOL; length of pterostigma 2.60x its maximum width; scutellar lunules divided by six carinae (Fig. 32C); antenna as long as body; lateral temples visible in anterior view ....*M. pennatulae* Ranjith & Rajesh

7(5) Length of fore wing 3.20x its width; POL l.20x OOL; T1 2x as long as wide .....*M. zhaoi* Xu & He

- Length of fore wing 2.60–2.80x its width; POL 1.70–2x OOL; T1 1.60–1.70x as long as wide 8

8(7) Length of hind tibia 4x its width; scutellar lunules divided by nine carinae; mesoscutum with medial furrow; body black .... *M. narendrani* Ranjith & Nasser

- Length of hind tibia 6.90x its width; scutellar lunules divided by six carinae; mesoscutum with out medial furrow; body reddish brown ....*M. carnicollis* (Cameron)

Character matrix for the species of *Microplitis*

1. Body colour: 0; black 1; reddish brown

2. Scutellar lunules: 0; wide 1; narrow

3. Notauli: 0; faintly indicated 1; deeply impressed

4. Lateral temples in anterior view: 0; hidden 1; visible

5. T1 shape: 0; parallel sided 1; sub parallel sided or widening posteriorly 2; narrowing posteriorly

6. Sculpturing of face: 0; rugose or rugulose 1; punctate

7. Percurrent medial longitudinal carina of propodeum: 0; distinct 1; indistinct

8. Scutellar sculpturing: 0; rugose 1; rugulose 2; punctate

9. Longitudinal carina between antennal sockets: 0; present 1; absent

Coding of the character status for the species of *Microplitis*

Species/ Characters	1	2	3	4	5	6	7	8	9
Micriplitis areyongensis	0	0	1	0	1	0	0	1	1
Microplitis bicoloratus	0	1	1	0	0	0	0	0	1
Microplitis carinicollis	1	0	1	0	1	0	0	0	1
Microplitis narendrani	0	0	1	0	1	0	0	0	0
Microplitis pennatulae	0	1	1	1	1	0	0	2	0
Microplitis similis	0	1	1	1	0	0	0	1	0
Microplitis spodopterae	0	1	1	1	0	1	0	2	1
Microplitis vitellipedis	0	1	1	0	1	1	0	2	1
Microplitis zhaoi	0	0	1	1	0	1	0	0	0

Treatment of species

Microplitis areyongensis Austin & Dangerfield

Micropliotis areyongensis Austin & Dangerfield, 1993. *Invertebr. Taxon*., 7.1112 Female, (AEIC).
Microplitis areyongensis Austin & Dangerfield, Ranjith *et al.*, 2015. *Zootaxa*, 3963 (3):383.

Diagnosis

Female: Length 3.20 mm.

Head oval, lateral temples hidden behind eyes in anterior view; width of face 0.80x head; face rugose-punctate (Fig. 28B); vertex, temple, frons smooth with sparsely setose; POL 0.75x OOL; antenna as long as body; first flagellomere 2.70x as long as wide; mesoscutum wider than head (Fig. 28C); notauli impressed, rugose-crenulate (Fig. 28C); scutellum with seven carinae; scutellar lunules narrow, scutellum rugulose-punctate; propodeum with indistinct transverse carina; lateral pronotum with oblique crenulate furrow; mesopleuron punctate, setose in dorsal anterior part, smooth posteriorly; epicnemial furrow crenulated; mesosternum smooth sparsely setose; fore wing 2.60x as long as wide; pterostigma 2x as long as wide; 1-R1 short; 1-CU1 0.50x 1-CU2; first sub marginal cell elongate; hind wing with 2-SC+R short, but present; hind tibial spurs 0.30x hind basitarsus; T1 1.40x as long as wide; T2 0.70x as long as wide; hypopygium short sparsely setose (Fig. 28E).

Colour: Body black; legs red to brown; antenna dark brown.

Male: Unknown.

Host: Unknown.

Distribution: Australia, India (Kerala), Vietnam

Material examined: 2F, India, Kerala, Nilambur, 11.viii.1987, Sumodan (DZUC)

Discussion

This species shows resemblance with *M. spodoterae* for the characters, notauli deeply impressed and absence of longitudinal carina between antennal sockets. It differs from the same species having wider scutellar lunules (scutellar lunules narrow in *M. spodopterae*), lateral temples hidden in anterior view (in *M. spodopterae* lateral temples visible in anterior view) and T1 widening posteriorly (T1 parallel sided in *M. spodopterae*).

Microplitis bicoloratus Xu &He

Micropliotis bicoloratus Xu & He, 2003. *Acta. Zootax. Sin*., 28. 724:728. Female (ZUH).
Microplitis bicoloratus Xu & He, Ranjith *et al*., 2015. *Zootaxa*, 3963 (3):385.

Female: Length 2.70 mm.

Diagnosis

Width of head 2.20x its length in dorsal view; face 1.20x as wide as long rugose (Fig. 29B); frons rugose; vertex, temple punctate, setose; POL 0.70x OOL; antenna setose longer than body; scape 1.80x as long as wide; mesosoma 1.60x as long as wide; pronotum, mesoscutum rugose-punctate (Fig. 29C); notauli well developed (Fig. 29C); scutellar lunules with three carinae; scutellum rugose with crenulate margin (Fig. 29C); anterior mesopleuron smooth, posteriorly rugose; propodeum with medial longitudinal carina (Fig. 29D); fore wing 2.70x as long as wide; length of pterostigma 2.60x its maximum width; 1-R1 0.77x as long as pterostigma; vein r curved; 1-CU1 0.40x as long as 2-CU1; 1-M 1.80x as long as m-cu; hind femur 3.50x as long as wide; hind tibial spurs equal; T1 parallel sided, 2.60x as long as its maximum width (Fig. 29E); hypopygium long sclerotised, ovipositor sheath, long, setose 0.50x as long as hind tibia.

Colour: Body black, scape, fore and mid legs reddish yellow; mandibles yellowish brown; pterostigma blackish with a dark spot beneath pterstigma; tibial spurs yellowish white.

Male: Length 2.30–2.70, scape blackish.

Host: Unknown.

Distribution: China (Fujian, Zhejiang), India (Kearla).

Material examined: 1F India, Kerala, Agali, 12.xii.87, Narendran (DZUC).

Discussion

This species shares some characters with *M. areyongensis* having deeply impressed notauli and lateral temples hidden behind in anterior view. But the main differences from the same species are scutellar lunules narrow (scutellar lunules wide in *M. areyongensis*), scutellum rugose (scutellum rugulose in *M. areyongensis*) and length of T1 2.60x its apical width (in *M. areyongensis* T1 length 1.40x its apical width).

Microplitis carinicollis (Cameron)

Microgaster carinicollis Cameron, 1905. *Spol. Zeyla*., 3: 81
Microgaster carinicollis Cameron, Ayyar, 1924. *Proc. fifth Entomol. Meet*., 5: 359
Microgaster carinicollis Cameron, Wilkinson, 1927. *Bull. Entomol. Res.* 18: 173; 1929, *Trans. R. Ent. Soc. Lon*., 121.
Microgaster carinicollis Cameron, Thompson, 1953. *A. Cat. Parasi. Ins. Pest*., 2: 155.
Microplitis carinicollis (Cameron), Gupta & Fernández - Triana, 2014. *Zootaxa*, 3800(1):11.
Microplitis carinicollis (Cameron), Ranjith *et al*., 2015. *Zootaxa*, 3963 (3): 387.

Diagnosis

Female: Length 4.10 mm.

Head 1.20x its width, subcircular in anterior view; lateral temples hidden behind eyes (Fig. 30B); vertex, frons rugulose; occiput concave, sparsely sculptured; POL 1.70x OOL; antenna 1.10x as long as body; mesosoma 1.20x as long as width; mesoscutum rugulose, setose (Fig. 30C); notauli indicated by shallow depression with an indistinct longitudinal carina (Fig. 30C); scutellar lunules narrow divided by six carinae; scutellum rugose, setose (Fig. 30C); propodeum rugose with percurrent medial longitudinal carina, anterior transverse carina (Fig. 30D); lateral pronotum with indistinct crenulate groove; mesopleuron rugose, setose, smooth laterally; fore wing 2.60x as long as wide; pterostigma 2.80x as long as wide; 1-M straight; margin of hind wing vannal lobe convex, setose; hind femur 3x as long as wide; hind tibia 6.70x as long as wide; outer hind tibial spur 0.30x as long as basitarsus; T1 rugose, 0.60x as long as its apical width; T2–T7 smooth with lateral hairs (Fig. 30E); ovipositor 0.30x as long as hind basitarsus.

Colour: Body generally reddish; T2 yellowish brown, pterostigma, wing veins brown.

Male: Unknown.

Host: *Psalis pennatula* Fabricius (Erebidae).

Distribution: India (Kerala), SriLanka.

Material examined: 2F, India, Kerala, Kambalakkad, 8.xi.2012 Nasser; 1F, India, Kerala, Pattambi, 18.ii.2014, Rajesh (DZUC).

Discussion

This species shows silmilarity with the species *M. narendrani* and *M. pennatulae* for the following characters, body length more than 4 mm and T1 subparallel sided with a medial furrow. It differs from *M. narendrani* in having the characters, mesoscutum without medial furrow (in *M. narendrani*

mesoscutum with median furrow) and absence of longitudinal carina in between the antennal sockets (in *M. narendrani* longitudinal carina present in between the antennal sockets). It differs from *M. pennatulae* for the following characters like terminal flagellomere blunt (in *M. pennatulae* terminal flagellomere acute), hind femur 3x as long as wide (in *M. pennatulae* hind femur 3.30x as long as wide) and face 1.60x as wide as long (face 1.40x as wide as long in *M. pennatulae*).

Microplitis narendrani Ranjith & Nasser

Microplitis narendrani Ranjith & Nasser, 2015. *Zootaxa*, 3963 (3) 377.

Diagnosis

Female: Length 5.20 mm, antenna 5.90 mm, fore wing 3.90 mm, ovipositor 0.30 mm.

Head subcircular, width of head 2.40x its length in dorsal view; temples hidden behind the eyes (Fig. 31B); width of face 0.50x width of head; face rugose-punctate with medial carina (Fig. 31B); clypeus strongly punctate, setose; length of clypeus 0.40x its width; tentorial pit deep; length of maxillary palp 1.30x height of head in dorsal view; height of clypeus:inter-tentorial distance:tentorio-occular distance 7:17.5:3.5; length of eye 3.70x length of malar space; length of malar space 1.20x basal width of mandible; vertex, temple, frons punctate, setose; occiput smooth; POL 2x OOL; length of antenna 1.10x length of body; scape and pedicel 0.80, 0.30x as long as wide; mesoscutum punctate, setose, with medial furrow (Fig. 31C); notauli impressed, rugulose (Fig. 31C); scutellar groove, wide, crenulated with nine carinae; propodeum with well developed medial carina and transverse carina extending to spiracles, rest rugulose (Fig. 31D); mesopleuron punctate, setose anteriorly, smooth, shiny posteriorly; precoxal groove reaching epicnemial

furrow; fore wing 2.80x as long as wide; pterostigma 2.40x as long as wide; 1-R1 short; 1-M straight;1-CU1 0.20x as long as 2Cu1; first submarginal cell of hind wing short; length of hind femur 3x its width; length of hind tibia 4x its width; length of hind tibial spurs 0.50, 0.40x hind basitarsus; T1 1.70x as long as its width; T2 0.80x as long as T3; T2 sparsely setose apically (Fig. 31 E); T3–T5 smooth; ovipositor sheath rounded apically, setose.

Colour: Head mesosoma black; metasoma orange brown; hind tibial spur yellow; pterostigma yellow in proximal 1/3, rest black.

Male: Length 3.30 mm, rest of the characters same.

Host: *Psalis pennatula* Fabricius (Erebidae).

Distribution: India (Kerala)

Material examined: 2F, India, Kerala, Pattambi, Ranjith, 16.ii.2014; 1M, India, Kerala, Pattambi, 23.ii.2014 (DZUC).

Discussion

This species shows close similarity with the species *M. carinicolis* for the following characters, T1 sub parallel sided with medial longitudinal groove and large size, but shows difference from the following characters like mesoscutum with medial furrow (in *M. carinicolis* mesoscutum without medial furrow), scutellar lunules divided by nine carinae (scutellar lunules divided by six carinae in *M. carinicolis*).

Microplitis pennatulae Ranjith & Rajesh

Microplitis pennatulae Ranjith & Rajesh, 2015. *Zootaxa*, 3963 (3).379.

Female: Length 5 mm, antenna 5.40 mm, fore wing 4.10 mm, ovipositor 0.10 mm.

Head subcircular with lateral temples visible in anterior view (Fig. 32B); face 1.40x as wide as long; clypeus punctate, sparsely setose; length of clypeus 0.30x its width; length of eye 3.50x malar space; length of malar space 1.90x basal width of mandible; vertex sparsely punctate, setose; occiput smooth; antenna as long as body; POL 1.90x OOL; scape, pedicel 1.30, 0.30x as long as wide; mesosoma 1.30x as long as wide; notauli deep, rugulose with a faint medial longitudinal carina (Fig. 31C); scutellar lunules wide with seven carinae; scutellum rugulose (Fig. 32C); lateral lobes anterior scutellum extended to form triangular horn; propodeum with percurrent medial longitudinal carina, with well developed transverse carina extending to spiracles (Fig. 32D); mesopleuron rugose anteriorly, smooth posteriorly; epicnemial furrow crenulate reaching anterior margin of mesopleuron; mesosternum setose; fore wing 2.80x as long as wide; pterostigma 2.60x as long as wide; 1-M straight; 1-CU1 0.30x as long as 2-CU1; first submarginal cell elongate; T1 1.70x as long as wide; T2 0.60x as long as T3; T2,T3 sparsely setose (Fig. 32E); T4–T7 smooth; ovipositor sheath acute apically, setose; length of hind femur 3.30x its width; length of hind tibia 6.60x its width; length of hind tibial spurs 0.32, 0.27x hind basitarsus.

Colour: Body generally black; maxillary palp, hind tibial spur yellow; pterostigma yellow basally, rest black.

Male: Unknown.

Host*: Psalis pennatula* Fabricius (Erebidae).

Distribution: India (Kerala).

Material examined: 1F, India, Kerala, Pattambi, Ranjith 19.ii.2014; 2F with same collection data, except 20.ii.2014; 5F, India, Kerala, Pattambi, Ranjith, 22.x.2014.

Discussion

This species shows similarity with the species *M. similis* in having black body colour and narrow scutellar lunules, it differs from the same species in the characters mentioned in the key. This species also shares similar characters with *M. narendrani* having wider scutellar lunules and rugose sculpturing of propodeum with transverse carina. This species shows difference for the following characters, scutellar lunules 6–7 carinae (in *M. narendrani* scutellar lunules 8–9 carinae), pterostigma 2.60x as long as wide (in *M. narendrani* 2.40x as long as wide) and metasoma black (metasoma orange red in *M. narendrani*.)

Microplitis similis Lyle

Microlpitis similis Lyle, 1921. *Bull. Entomol. Res*., 12. 129; 1921:157. Female (BMNH).
Microlpitis similis Lyle, Ayyar, 1924. *Proc. fifth Entomol. Meet.,* 5: 359.
Microlpitis similis Lyle, Wilkinson, 1930. *Bull. Entomol. Res*., 21: 26.
Microlpitis similis Lyle, Beeson & Chatterjee, 1935. *Ind. For. Rec.*, 1. 132; Beeson, 1941. 372.
Microlpitis similis Lyle, Thompson, 1953. *A Cat. Parasi. Ins. Pest.*, 2: 163.
Microplitis similis Lyle, Ranjith *et al*., 2015, *Zootaxa*, 3963 (3). 404

Diagnosis

Female: Body length 1.80 mm.

Head 1.10x its width in anterior view; lateral temples visible in anterior view; width of head 0.50x width of head; face 1.70x as long as wide, rugulose (Fig. 33B); occiput concave, slightly rugose; frons rugulose, area between antennal

sockets without indistinct carina; POL 1.50x OOL; antenna 1.20x as long as body; terminal flagellomere acute 2.40x as long as wide; mesosoma 1.30x as long as wide; mesoscutum rugulose, setose (Fig. 33C); notauli indicated by shallow depression not separated by medial longitudinal carina (Fig. 33C); scutellar lunules divided by six carinae; scutellar disc flat, punctate, setose; lateral pronotum with crenulated groove; mesopleuron setose anteriorly, smooth posteriorly; propodeum with percurrent medial longitudinal carina and transverse carina, rest of propodeum rugose (Fig. 33D); fore wing 2.70x as long as wide; pterostigma 2.30x as long as wide; 1-M straight; margin of hind wing vannal lobe convex, setose; hind femur 3.50x as long as wide; hind tibia 6.70x as long as wide; outer hind tibial spurs 0.30x as long as hind basitarsus; T1 2.10x as long as wide, parallel sided (Fig. 33D); T2 with medial field (Fig. 33E); T2–T7 smooth; ovipositor 0.30x as long as hind basitarsus.

Colour: Body black except scape brownish black; maxillary palp yellow; pterostigma, legs, T1 brownish; metasoma reddish brown.

Male: Same as that of female except antenna 1.40x as long as body.

Host: *Agrotis ipsilon* Linnaeus (Noctuidae).

Distribution: India (Kerala), Indonesia, Vietnam.

Discussion

The species shows similarity with *M. pennatulae* in many characters and the differences are mentioned in the key. It also shares some common features with *M. vitelllipedis* in having deeply impressed notauli and narrow scutellar lunules. It differs from the same species in having the characters lateral temples visible in anterior view (in *M. vitellipedis* lateral temples hidden in

anterior view) and longitudinal carina between antennal socket present in *M. similis* (in *M. vitellipedis* carina absent).

Microplitis spodopterae Rao & Kurian

Microplitis spodopterae Rao & Kurian, 1950. *Ind.J. Ent.*, 12: 167–190. Female (NZSI)
Microplitis spodopterae Rao & Kurian, Gupta, 2013. *Zootaxa,* 3620(3):446.
Microplitis spodopterae Rao & Kurian, Ranjith *et al.*, 2015. *Zootaxa*, 3963(3):406.

Diagnosis

Female: Length 1.90 mm.

Head sub circular 1.10x as wide as long in anterior view; face punctate, 1.30x as wide as long (Fig. 34B); lateral temples slightly visible in anterior view; temples, vertex rugose; occiput concave, slightly rugose; frons rugose with raised area in anterior view; POL 1.10x OOL; mesosoma 1.10x as long as high; mesoscutum rugose (Fig. 34C); notauli impressed; scutellar lunules wide with six carinae; propodeum rugose with percurrent medial longitudinal carina and transverse carina (Fig. 34D); lateral pronotum crenulated; mesopleuron setose anteriorly, smooth posteriorly; fore wing 3x as long as wide; pterostigma 2.80x as long as wide; 1-M arched; margin of hind wing vannal lobe convex, setose; T1 1.20x as long as wide, parallel sided, rugose (Fig. 34E); T2–T7 smooth; T2 with a medial field; ovipositor 0.50x as long as hind basitarsus.

Colour: Body black except tegulae dark brown; fore and mid legs yellowish brown; hind femur either completely reddish brown or along with yellow brown patches in postero-lateral sides; tibia with median half white; tarsi dark reddish brown; wing veins brown; pterostigma dark brown.

Male: Same as that of female except scutellar lunules with four carinae, hind femur darker than female.

Host: Unknown.

Distribution: India (Bihar, Karnataka, Kerala)

Material examined: 1F, India, Kerala, Kundara, 24.i.2013, Ranjith (DZUC).

Discussion

This species is closely related with *M. vitellipedis* in many characters, but it shows differences from the same species and the characters mentioned in the key. This species also shows relation with *M. pennatulae* in having subcircular nature of head and visibility of lateral temples in anterior view. But the species differs from the same species in having POL 1.10x OOL (in *M. pennatulae* POL 1.90x OOL) and vein 1-M arched (1-M straight in *M. pennatulae*).

Microplitis vitellipedis Li, Tan & Song

Microplitis vitellipedis Li, Tan & Song, 2009. *Ent. Taxon.*, 31(3): 225-229. Female (HAU).
Microplitis vitellipedis Li, Tan & Song, Ranjith *et al.*, 2015. *Zootaxa*, 3963(3):409.

Diagnosis

Female: Length 2.20 mm.

Head 2x as wide as long in dorsal view; face 1.20x as wide as high, punctate; vertex, temple punctate; ocelli forming triangle; eye densely setose, inner margins parallel sided; POL 0.90x OOL; antenna 1.40x as long as body; mesosoma 1.40x as long as high; mesoscutum punctate (Fig. 35B); notauli deeply impressed; scutellum coarsely punctate (Fig. 35C); scutellar lunules divided by five carinae; propodeum reticulate-rugose with percurrent medial longitudinal carina (Fig. 35C); fore wing 2.80x as long as wide; pterostigma 2.80x as long as wide; fore wing areolet quandrangular (Fig. 35F); 1-M arched; 1-R1 1.60x as long as pterostigma; margin of hind wing vannal lobe

convex, setose; T1 sub parallel sided, 1.60–1.80x as long as its width; suture between T3 and T2 reduced without medial field; T3 1.30x as long as T2; T3–T7 smooth.

Colour: Body black except antenna, wing veins, hind femur yellowish brown; maxillary palp, labial palp, tibial spur whitish yellow; tergites reddish yellow to reddish brown.

Male: Unknown.

Host: Unknown.

Distribution: China (Fujian), India (Kerala).

Material examined: 1F, India, Kerala, Mukkali, no collection date, Sheeba (DZUC).

Discussion

Microplitis vitellipedis closely related with *M. spodopterae* in having longitudinal carina in between antennal socket and punctate sculpturing of scutellum, but it differs from the same species in having lateral temples hidden in anterior view (in *M. spodopterae* lateral temples visible in anterior view) and T1 sub parallel sided (T1 strictly parallel sided in *M. spodopterae*).

Microplitis zhaoi Xu & He

Microplitis zhaoi Xu & He, 2000. *Entomol. Sin*., 7(2): 107-112. Female (ZUH).
Microplitis zhaoi Xu & He, Ranjith *et al.*, 2015. *Zootaxa*, 3963 (3):411.

Diagnosis

Female: Length 2.10–2.60 mm.

Width of head 1.10x its length, subcircular; width of face 0.50x width of head; lateral temples slightly visible behind eyes (Fig. 36B); lateral temples, vertex, occiput rugulose; POL 1.20x OOL; antenna 0.90x as long as body; terminal flagellomere acute 2.90x as long as wide; mesosoma 1.90x as long as wide; mesoscutum rugose, setose (Fig. 36C); notauli distinct (Fig. 36C); scutellar lunules wide with five carinae; propodeum with percurrent medial longitudinal carina; lateral pronotum with crenulated furrow; mesopleuron sparsely setose anteriorly, smooth postero-dorsally; fore wing 3.20x as long as wide; pterostigma 3x as long as wide; 1-M straight; margin of hind wing vannal lobe convex, setose; hind femur 4x as long as wide; hind tibia 7.50x as long as wide; outer hind tibial spur 0.30x as long as basitarsus; T1 2x as long as wide, rugose, parallel sided (Fig. 36D); T2 with indistinct medial field (Fig. 36E); T2–T7 smooth; ovipositor 0.40x as long as hind basitarsus.

Colour: Body black, antenna, legs reddish yellow; tibial spurs pale yellow.

Male: Similar to female except body length 2.30–2.70, antenna brownish black.

Host: Unknown.

Distribution: China, India (Kerala).

Material examined: 2F India, Kerala, Kallai, 24.vi.87, Sumodan; 1F, India, Kerala, C.U campus, 10.ii.93, Rema (DZUC).

Discussion

This species close to *M. narendrani* with the characters scutellar lunules wide and notauli deeply impressed, however it shows difference in having the characters T1 2x as long as wide (in *M. narendrani* T1 1.70x as long as wide) and lateral temples visible behind the eye (in *M. narendrani* lateral temples hidden behind the eyes).

Genus *Neoclarkinella* Rema & Narendran

Type: *Apanteles nilamburensis* Sumodan & Narendran, 1990. *J. Ecobiol.*, 239.
*Neoclarkinella nilam*burensis Rema & Narendran, 1994. *J. Bombay. Nat. His. Soc*., 93. 264–267.

Diagnosis

Head oval in shape with emargined eyes; face coarsely punctate with faint medial carina (Fig. 37B); clypeus, vertex punctate; propleuron rugose or punctate; scutellar lunules triangular, narrow or wide (Fig. 37C); notauli indistinct (Fig. 37C); pronotum with anterior crenulation; propodeum with a strong medial longitudinal carina and a weak transverse carina basally, rest rugulose (Fig. 37D); fore wing without areolet (Fig. 37F); margin of hind wing vannal lobe straight, convex and setose; T1 basally parallel sided with narrowing apex, with a broad "U" shaped depressed area at basal half (Fig. 37E); T2 triangular or sub triangular with or without lateral elevation (Figs 37E & 38E); hypopygium membranous; ovipositor sheath 0.60–1.20x as long as hind tibia.

Host: Unknown.

Distribution: Oriental, India (Kerala).

Remarks: This rarely collected genus resembles *Clarkinella* Mason 1981 in having medial and transverse propodeal carina. This genus was erected by Rema & Narendran (1996) and it represents only two species from India. In this study two more species and the key for Indian species of *Neoclarkinella* are included.

KEY TO THE SPECIES OF *NEOCLARKINELLA* REMA & NARENDRAN FROM INDIA

1. Length of T1 less than 2x its apical width; OOL 0.80x POL; T1 aciculate apically; margin of hind wing vannal lobe straight ....*N. nilamburensis* Rema and Narendran

- Length of T1 more than 2x its apical width; OOL 1.20x POL; T1 punctate or rugose apically; margin of hind wing vannal lobe convex 2

2. T1 rugose apically (Fig. 37E); scutellar lunules narrow (Fig. 37C); in lateral view medial temple 0.40x width of eye; face 0.50x as wide as head in anterior view; ovipositor sheath as long as hind tibia..... ..... *N. janakikkadensis* Veena

- T1 punctate apically (Fig. 38E); scutellar lunules wide (Fig. 38C); in lateral view median temple greater than 0.40x width of eye; face greater than 0.50x as wide as head in anterior view; ovipositor sheath 0.60x as long as hind tibia 3

3. Length of mesosoma 2x its height; T1 sub-triangular without lateral elevation; pterostigma 3.30x as long as wide; T1 3.80x as long as its apical width; vein r 1.20x as long as m-cu; 2SR 1.20x as long as r; R1 1.30x as long as pterostigma ....*N. punctata* Ahmad *et al*.

- Length of mesosoma 1.40x its height; T1 triangular with lateral elevation; length of pterostigma 2.60x its width; T1 2.60x as long as its apical width; vein r 1.60x as long as m-cu; 2 SR 0.90x as long as r; R1 1.50x as long as pterostigma .....*N. narendrani* Veena

Character matrix for the species of *Neoclarkinella*

1. Margin of hind wing vannal lobe: 0; straight, setose; 1; convex, setose
2. Apical T1 sculpturing: 0; punctate 1; rugose 2; aciculate
3. T2 shape: 0; triangular 1; subtriangular
4. Lateral elevation on T2: 0; present 1; absent
5. Clypeus puncturing: 0; punctate 1; indistinctly punctate
6. Scutellar lunules: 0; narrow 1; wide
7. OOL & POL: 0; OOL less than or equal to 0.80x POL 1; morethan 0.80x POL
8. Ovipositor sheath & hind tibia lengths: 0; ovipositor sheath 0.60x as long as hind tibia 1; 1.20x as long as hind tibia
9. Fore wing vein r & m-cu length: 0; vein r morethan 1.50x m-cu 1; r less than 1.50x m-cu
10. Length of R1 & pterostigma: 0; length of R1 1.30x pterostigma length 1; morethan 1.30x pterostigma length

Coding of the characters and the status for the species of *Neoclarkinella*

Species/Characters	1	2	3	4	5	6	7	8	9	10
Neoclarkinella janakikkadensis	1	1	1	1	1	0	1	1	1	1
Neoclarkinella narendrani	1	0	0	0	0	1	0	0	0	1
Neoclarkinella nilamburensis	0	2	1	1	0	1	0	?	?	?
Neoclarkinella punctata	1	0	1	1	1	1	0	0	1	0

Neoclarkinella janakikkadensis Veena

Neoclarkinella janakikkadensis Veena, 2014. *Zootaxa*, 3857 (3):425 Female (DZUC).

Diagnosis

Female: Length 2 mm, antenna 2.20 mm, fore wing 1.90 mm, ovipositor 0.70 mm.

Length of head 0.60x its width in anterior view; face punctate anteriorly, rugose posteriorly with medial carina, 0.50x as long as wide (Fig. 37B); clypeus coarsely punctate, length of clypeus 0.30x as long as its width; eyes 4.50x as long as malar space; lateral temples visible in anterior view; toruli, frons smooth, shiny; OOL 1.20x POL; antenna 1.10x as long as body; length of scape 1.30x its width; pedicel 0.40x as long as its width; length of mesosoma 1.40x its height; mesoscutum punctate, pubescent (Fig. 37C); scutellar lunules narrow with 10 carinae (Fig. 37C); sides of scutellum smooth, shiny; propleuron rugose; notauli indistinct; lateral pronotum granulate with weak crenulation; mesopleuron punctate anteriorly, smooth posteriorly; propodeum with a strong basal carina and a transverse basal carina, postero-lateral side smooth, rest rugulose (Fig. 37D); pterostigma 4.20x its width; vein1-R1 1.40x as long as pterostigma; length of vein r 1.10x width of pterostigma; hind wing vannal lobe convex, setose; T1 punctate, 2.90x as long as its apical width with basal semicircular field (Fig. 37E); laterotergites with long hairs anteriorly; T2 punctate without elevated triangular field (Fig. 37E); T2 0.60x as long as T3; length of hind femur 2.90x its width; length of hind tibia 5.70x as long as its width; outer hind tibial spur 0.30x as long as hind basitarsus; ovipositor sheath 1.20x as long as hind tibia.

Colour: Body black except maxillary palp pale white; hind femur brownish yellow; tibial spur, ovipositor yellow; T1 semicircular field yellowish brown; hind femur brownish yellow; laterotergites yellowish white.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: Holotype: Female, India, Kerala, Janakikkadu, 29.vi.2012, Veena (DZUC).

Remarks: The above diagnosis is from the original description Veena *et al.* 2014.

Discussion

This is closely related with *N. punctata* in having length of vein r 1.10x width of pterostigma, T2 sub triangular without lateral elevation, but differs in having T1 rugose apically (punctate in *N. punctata*), scutellar lunules narrow (wide in *N. punctata*) and OOL 1.20x POL (OOL 0.80x POL in *N. punctata*).

Neoclarkinella narendrani Veena

Neoclarkinella narendrani Veena, 2014. *Zootaxa*, 3857 (3): 427. Female (DZUC).

Diagnosis

Female: Length 2.60 mm, antenna 3.10 mm, ovipositor 0.50 mm.

Head oval in shape, length of head 1.80x its width in dorsal view; face punctate with medial carina, length of face 0.50x its width in anterior view (Fig. 38B); clypeus punctate, setose; eyes pilose, inner margins of eye slightly emarginated beyond antennal sockets in anterior view; eyes 5x as long as malar space; lateral temples hidden behind in anterior view; OOL 0.80x POL; frons punctate with medial protruberance; toruli smooth, shiny; occiput smooth; antenna 1.20x as long as body; length

of mesosoma 1.40x its width; mesoscutum punctate, pubescent (Fig. 38B); scutellar lunules wide with five carinae (Fig. 38B); upper and lower grooves of pronotum deep, crenulated; propleuron punctate, pubescent; notauli indistinct; percoxal groove with shallow depression; medio-posterior depression of scutellum smooth, shiny; propodeum with strong medial carina and a transverse carina at basal one third, rest rugulose; length of pterostigma 2.60x its width; vein 1-R1 1.50x as long as pterostigma; vein r 1.10x as long as width of pterostigma; hind wing vannal lobe convex; T1 2.60x as long as wide apically, with basal semicircular field (Fig. 38E); laterotergites setose anteriorly; T2 0.38x as long as T3; length of hind femur 3.60x as long as its width; hind tibia 6.10x as long as its width; outer hind tibial spur 0.30x as long as hind basitarsus; hind basitarsus 6.60x as long as wide; ovipositor sheath 0.60x as long as hind tibia; hypopygium membranous.

Colour: Body generally black except antenna, clypeus brown; maxillary palp pale yellow; wing veins, pterostigma, fore legs, hind femur, ovipositor yellowish brown; tibial spur yellow; T1 semicircular field, laterotergires, T3 yellowish white.

Male: Unknown.

Host: Unknown.

Distribution: India (Kerala).

Material examined: Holotype: Female, India, Kerala, Wayanad, Santhosh (DZUC).

Remarks: This diagnosis is based on the original description Veena *et al.* 2014.

Discussion

This shows similarity with *N. punctata* in having punctate T1, ovipositor sheath 0.60x as long as hind tibia, it has similarity with *N. janakikkadensis* in the following characters, length of vein r 1.10x width of pterostigma, margin of hind wing vannal lobe convex, it shows differences for the characters T1 triangular with lateral elevation (in *N. punctata* and *N. janakikkadensis* T1 sub triangular without lateral elevation) and length of pterostigma 2.60x its width (in *N. janakikkadensis* and *N. punctata* length of pterostigma more than 3x its width).

Neoclarkinella nilamburensis Rema & Narendran

Apanteles nilamburensis Sumodan & Narendran, 1990. *J.Eco. biology*, 2(3): 239-248. Female (RMNH)

Neoclarkinella nilamburensis Rema & Narendran, 1994. *J. Bombay.nat.his. soc*., 93, 264-267.

Neoclarkinella nilamburensis Rema & Narendran, 1994. Veena *et al.*, 2014. *Zootaxa*, 3857(3): 423-432.

Diagnosis

Female: Length 2.90 mm, antenna 3.70 mm, fore wing 3 mm, ovipositor 1.40 mm.

Width of head 2x as its length in dorsal view; face punctate, setose with medial longitudinal carina; vertex, clypeus punctate, pubescent; occiput smooth; OOL 0.75x POL; pronotum punctate, upper and lower grooves crenulated; mesoscutum coarsely punctate, pubescent; propodeum dull with a medial longitudinal carina and a transverse carina; width of pterostigma shorter than vein r; hind wing vannal lobe straight, sparsely setose; hind coxa shiny, punctate; T1 0.40x as long as its width, aciculate with 'U' shaped depressed area basally; T2 0.23x as long as T1, 0.60x T3; T2, T3 apically

punctate, rest smooth; T3 with transverse depression basally, remaining tergites smooth; ovipositor long; hypopygium membranous.

Male: Characters similar to female.

Host: Unknown.

Distribution: India (Kerala).

Remarks: The diagnosis is based on original description by Rema & Narendran 1996.

Discussion

Neoclarkinella nilamburensis shows close resemblemce with the species *N. janakikkadensis* for having the characters like absence of lateral elevation in T2 and sub triangular shape of T1, it differs from *N. janakikkadensis* for the characters T1 aciculate (T1 punctate in *N. janakikkadensis*), margin of hind wing vannal lobe convex (in *N. janakikkadensis* margin of hind wing vannal lobe straight) and scutellar lunules wide (scutellar lunules narrow in *N. janakikkadensis*).

Genus *Philoplitis* Nixon

Philoplitis Nixon, 1965. *Bull.Br. Mus. Nat. His., Ent. Suppl*., 2:267.
Type*: Philoplitis coniferens* Nixon, 1965. *Bull. Br. Mus. Nat. Hist., Ent. Suppl*., 2:267.

Diagnosis

Maxillary and labial palpi dark, apical segments pale white; head rugose-punctate except frons which is transversely striate (Fig. 39B); pronotum with a broad crenulated dorsal groove and narrow ventral one; propleuron with lobe above coxae extending up and back over lower corner of pronotum; mesoscutum with carinate lateral margin above tegula; notauli long and deep not meeting posteriorly (Fig. 39C); scutellum coarsely rugose and prolonged backward over propodeum, being as long as mesoscutum when measured from the anterior margin of the scutellar scrobe (Fig. 39C); metanotum withdrawn from scutellum, broadly exposing scutellar phragma, anterior margin bearing laterally long cylindrical apically setose process; propodeum rugose with complete medial longitudinal carina;T1 rectangular (Fig. 39D) and T2 with a pyramidal area (Fig. 39E).

Host: Unknown.

Distribution: Afrotropical, Oriental.

Remarks: Generic distribution restricted to Afrotropical and Oriental region. Only five species were reported from the world (Fernández-Triana & Ward, 2016). In this work, one species described which is new to Kerala and a key to Indian species of *Philoplitis* are included.

KEY TO THE SPECIES OF *PHILOPLITIS* NIXON FROM INDIA

1. Length of T1 less than 2x its apical width; head reddish orange .... *P. striatus* Fernández & Goulet

- Length of T1 more than 2x its apical width; head black 2

2(1) Antenna 0.80x as long as body; length of T1 2.10x its apical width; length of pterostigma 2.20x its maximum width; scutellum rugose ....*P. audistipalpus* Ahmed

- Antenna 1.30x as long as body; length of T1 2.30x its apical width; length of pterostigma 1.90x its maximum width; scutellum punctate .... *P. keralensis* sp. nov.

Character matrix for the species of *Philoplitis*

1. Sculpturing of scutellum: 0; punctate 1; rugose

2. T1 shape: 0; rectangular 1; parallel 2; narrowing posteriorly

3. Sculpturing of head: 0; rugose-punctate 1; rugose

4. Head & mesosoma colour: 0; reddish orange 1; black

5. T1 length & width: 0; less than 2x its width 1; more than or equal to 2x its width

6. T2 length & width. 0; less than 1x its width 1; more than 1x its width

Codes for the characters and status for the species of *Philoplitis*

Species/characters	1	2	3	4	5	6
Philoplitis audistipalpus	1	1	1	1	1	1
Philoplitis keralensis sp. nov.	0	0	0	1	1	0
Philoplitis striatus	?	?	0	0	0	0

Treatment of species

***Philoplitis keralensis* sp. nov.**

Holotype: Female: Length 3.66 mm, antenna 3.42 mm, fore wing 2.76 mm, ovipositor 0.13 mm.

Head: Width of head 1.78x its length in dorsal view; head length 0.93x its width in anterior view; face dull, rugose-punctate, setose (Fig. 39B); length of face 0.89x its width; eyes glabrous with infuscations (Fig. 39B); inter tentorial distance 2.10x tentorio-ocular distance; vertex, gena punctate, setose; frons striate; toruli smooth; OOL 0.60x POL; scape length 0.90x its width; length of pedicel 0.70x its width; length of first flagellomere 3.40x its width; length of second flagellomere 3.20x its width.

Mesosoma: Length of mesosoma 1.31x its width, 2.52x as long as head; mesoscutum punctate, setose with carinated lateral margin; notauli deeply impressed (Fig. 39C); scutellum coarsely punctate, enormously developed backward (Fig. 39C); pronotum crenulated laterally; propleuron punctate; propodeum rugose with complete medial carina; mesopleuron and metapleuron punctate; length of fore wing 2.70x its maximum width; length of pterostigma 1.96x its maximum width; length of vein r 0.50x pterostigmal width; fore wing vein 1-R1 0.80x as long as pterostigma; length of tibia 5x its width; length of basitarsus 3.41x its width; outer tibial spur 0.48x as long as basitarsus; basitarsus 0.49x as long as hind tibia.

Metasoma: T1 length 2.31x its apical width; T1 rectangular, somewhat parallel sided with rugose-punctate (Fig. 39D); T2 length 0.36x its width at apex with shallow convergent groove in the middle forming transverse striated triangle (Fig. 39E); T3–T7 smooth; ovipositor 0.03x as long as hind tibia.

Colour: Body black except ocelli light brown; eyes, apical T1 and T2, tibial spurs yellowish brown; wing veins brown; fore wing faintly infuscated apically; mediotergite 2 yellow, laterotergite 1–3 yellowish white.

Male: Same as female.

Host: Unknown.

Etymology: The species epithet is given after the name of Kerala, since which is the first report from Kerala.

Material examined: Holotype: Female: India, Kerala, Janakikkadu, 31.v.2013, Veena (DZUC).

Paratype: 1M, India, Kerala, Janakikkadu, 21.v.2013, Ranjith (DZUC).

Discussion

Philoplitis keralensis sp. nov. resembles with *P. audistipalpus* in having colour of head and mesosoma, and vein r 0.50x as long as breadth of pterostigma, but it differs from the same species in having punctate scutellum (scutellum rugose in *P.audistipalpus*) and T1 rectangular (T1 parallel sided in *P.audistipalpus*).

Genus *Snellenius* Westwood

Snellenius Westwood, 1882. *Tijdschr. Ent*., 25:19.
Type: *Snellenius vollenhoveni* Westwood, Dalla Torre, 1898. *Cat. Hym*., 4: 189. Ashmead, 1900. *Proc. U.S. Natn. Mus*., 23: 129.
Snellenius atratus Shenefelt, 1968. *Proc. Ent. Soc. Wash*., 70:342.
Microplitis radicalis Wilkinson, 1929. *Bull. Ent. Res.*, 21–24.
Snellenius radicalis Wilkinson, 1934. *Stylops*, 3:120; Nixon, 1965. *Bull.Br. Mus. Nat. Hist. Ent.Suppl*., 2:270; Shenefelt, 1968. *Proc.Ent. Soc. Wash.*, 70:340.
Snellenius tricolor Shenefelt, 1968. *Proc. Ent. Soc. Wash*., 70: 341.

Diagnosis

Antenna strongly compressed (Fig. 40A); vertex, frons punctate, setose; face with medial longitudinal carina (Fig. 40B); mesoscutum strong with strongly crenulated complete notauli (Fig. 40C); mesopleuron with a prepectal carina (Fig. 40E); pronotum with a single wide groove; apical margin of scutellum smooth, narrow without lunules, scutellum elevated and rugose, with carinate margins; anterior margin of metanotum with lateral lobes lying close to scutellum; T1 1.5–4x longer than wide, sub rectangular, T2 and T3 smooth weakly separated; short, stout abdomen; hypopygium short sclerotised; ovipositor sheath sparsely setose.

Host: Macrolepidoptera, Noctuidae.

Distribution: Australasian, Neotropical, Oriental.

Remarks: *Snellenius* is a comparatively less speciose genera. Only 17 species were reported in the world. Here a new species is described and this is the first report of the genus from Indian subcontinent.

Snellenius indicus sp. nov.

Holotype: Female: Length 3.77 mm, fore wing 3.11 mm, antenna 3.61 mm, ovipositor 0.03 mm.

Head: Width of head 1.75x its length in dorsal view, length 0.56x its width in dorsal view; length of head 0.96x its width anteriorly; face 0.87x as long as its width, rugose-punctate (Fig. 40B); face with prominent medial carina; length of clypeus 2.60x its width; inter-tentorio distance as long as tentorio-ocular distance; inner margins of eye slightly emarginated adjascent to antennal socket (Fig. 40B); vertex, frons punctate, setose; posterior vertex, temple rugose-punctate; occiput smooth, shiny; toruli smooth, shiny; OOL 1.02x POL; length of scape 1.49x its width; pedicel length 0.50x its width; scape 4.31x as long as pedicel; length of first flagellomere 3.52x as long as its width; length of second flagellomere 3.40x its width.

Mesosoma: Mesosoma 1.21x as long as its height, 2.68x as long as head; mesoscutum with well defined carinated notauli with a medial groove (Fig. 40C); scutellar lunules with five carinae (Fig. 40C); scutellum rugulose-punctate (Fig. 40C); mesopleuron punctate, sparsely setose with well developed prepectal carina (Fig. 40E); fore coxa finely punctate, setose; propodeum with medial carina, rest recticulate rugose; length of fore wing 2.90x its maximum width; length of pterostigma 2.74x its maximum width; 1-Cu variable in length; r-m present; vein r 1.21x as long as width of pterostigma; vein 1-R1 0.80x as long as pterostigma; vannal lobe convex, setose; hind femora 3.31x as long as its width; length of hind tibia 4.57x its width; length of basitarsus 4.71x its width; outer tibial spur 0.43x as long as basitarsus; length of outer tibial spur 0.18x as long as hind tibia.

Metasoma: Metasoma 1x as long as mesosoma; length of T1 0.40x mesosoma; ovipositor short, setose apically; length of ovipositor 0.03x as long as hind tibia.

Colour: Head, metasomal tergites, hind legs black; face, wing veins brownish black; mesosoma, ocelli, maxillary palp golden brown; tibial spur golden yellow.

Male: Unknown.

Host: Unknown.

Material examined: 1F, India, Kerala, Thrissur, No collector & collection date (DZUC).

Etymology: The species epithet is after the country name India, since it is the first report from Indian subcontinent.

Discussion

This species closely related with the species *S. nigellus* in having length of mesosoma 1.21x its height and sparsely crenulated deep notauli. It shows difference from *S. nigellus* in having pterostigma 2.74x as long as wide (in *S. nigellus* 2.60x as long as wide), scutellar lunules with five carinae (scutellar lunules with three in *S. nigellus*).

Genus *Wilkinsonellus* Mason

Type: *Apanteles iphitus* Nixon, 1965. *Bull. Br. Mus. Nat. His., Ent. Suppl*., 2: 198.

Diagnosis

Head coarsely rugose-punctate (Fig. 41B); ocelli in equilateral triangle; propleuron with a dorsal directed lobe that overlaps pronotum; mesoscutum

dull with aciculate or punctate sculptuting (Fig. 41C); propodeum rugose with a strong medial carina (Fig. 41D); scutellum strongly sculptured with a medio apical carina (Fig. 41C); scutellar lunules wide; fore wing wing vein 1A sinuate, touching posterior margin of fore wing; fore wing vein r-m absent; vannal lobe convex to straight, setose on the margin; T1 3–5x longer than wide, with a medial furrow, narrower in the middle (Fig. 41E); T2 smooth, shiny with a rectangular or triangular medial field in the middle (Fig. 41E); hind coxa large, coarsely rugose; hypopygium short without medial folding; ovipositor and ovipositor sheath short bearing minute hairs apically.

Host: Unknown.

Distribution: Afrotropical, Australasian, Neotropical, Oriental.

Remarks: This genus has a similarity to the genus *Distatrix* due to the reduced ovipositor hairs, but propodeum smooth and T1 without medial groove in *Distatrix*.

KEY TO THE SPECIES OF *WILKINSONELLUS* MASON FROM INDIA

1. T1 less than 4x its apical width; OOL as long as POL; vein r more than 1x as long as pterostigma ....*W. longicentrus* Long & Achterberg

- T1 more than 4x its apical width; OOL not equal to POL; vein r less than or equal to 1x as long as pterostigma 2

2(1) T2 trapezoidal without medial field; length of vein r 0.90x breadth of pterostigma; length of pterostigma 2.50x its width .... *W. wayanadensis* sp. nov.

- T2 not in trapezoidal with indistinct medial field; vein r as long as breadth of pterostigma; length of pterostigma 3.10x its width .... *W. granulatus* Ahmed *et al.*

Character matrix for the species of *Wilkinsonellus*

1. Face sculpturing: 0; punctate 1; rugulose-punctate 2; recticulate-rugose
2. Notauli: 0; distinct 1; faintly indicated
3. T2 shape: 0; trapezoidal 1; not trapezoidal
4. Scutellar sculpturing: 0; recticulate 1; punctate
5. OOL & POL length: 0; OOL as long as POL; 1; OOL not equal to POL
6. Vein r length & pterostigma width: 0; vein r less than 1x or equal to pterostigma 1; vein r more than 1x pterostigma
7. T1 length & width: 0; less than or equal to 4x apical width 1; more than 4x apical width

Codes for the characters and status for the species of *Wilkinsonellus*

Species/Characters	1	2	3	4	5	6	7
Wilkinsonellus granulatus	2	?	1	0	1	0	0
Wilkinsonellus longicentrus	0	0	1	1	1	1	0
Wilkinsonellus wayanadensis sp. nov.	1	0	0	1	1	0	1

Treatment of species

Wilkinsonellus longicentrus Long & Achterberg

Wilkinsonellus longicentrus Long & Achterberg, 2003. *Zool. Med. Leiden*, 77(10): 227. Female (IEBR).

Redescription

Female: Body length 3.94 mm, fore wing 3.46 mm, antenna 5.31 mm.

Head: Width of head 2x its length in dorsal view; face punctate, setose with a medial longitudinal carina, length of face 0.90x its width (Fig. 41B); malar space 0.20x as long as eye; inter-tentorial distance 6x as long as tentorio-ocular distance; ocelli triangle, medium sized; vertex, malar space rugulose-punctate; toruli, occiput smooth, shiny; OOL as long as POL; length of pedicel 0.39x its width; scape 2.20x as long as wide; length of first flagellomere 2.80x its width; length of second flagellomere 2.90x its width.

Mesosoma: Length of mesosoma 1.26x its width, 2.60x as long as head; mesoscutum punctate, setose (Fig. 41C); notauli distinct (Fig. 41C); scutellar lunules narrow with eight carinae; scutellum coarsely punctate, setose (Fig. 41C); propleuron sparsely punctate, shiny; metapleuron punctate antero-ventrally, somewhat smooth, shiny postero-dorsally; propodeum with medial carina, lateral carina arising on either side of medial carina, rest rugulose (Fig. 41D); length of fore wing 3.20x its maximum width; length of pterostigma 3.12x its maximum width; vein 1-R1 1.30x as long as pterostigma; vein r 1.30x as long as width of pterostigma; length of hind femur 3.63x its width; length of hind tibia 7.24x its width; outer tibial spur 0.38x as long as hind tibia; length of basitarsus 6.50x its width; basitarsus 0.50x as long as hind tibia.

Metasoma: Length of T1 3.01x its apical width, with a well defined medial groove; T2 with middle, basal shiny, smooth area, sparsely setose (Fig. 41E); ovipositor sheath short, protruding beyond apex of metasoma.

Colour: Body light brown except head, apex of hind tibia, hind femur, hind basitarsus, tarsal segments, wing veins brownish black; maxillary palpi pale yellow; ovipositor sheath reddish brown.

Male: Unknown.

Host: Unknown.

Material examined: 1F, India, Kerala, Janakikkadu, Ranjith, 2.iv.2015 (DZUC)

Discussion

This species is close to *W. wayanadensis* sp. nov. in having distinct notauli and recticulate sculpturing of scutellum, but it shows differences in having the characters like face punctate (face rugulose-punctate in *W. wayanadensis* sp. nov.), T2 not trapezoidal (T2 trapezoidal in *W. wayanadensis* sp.nov.), length of pterostigma 3.20x its maximum width (length of pterostigma 2.50x its width in *W. wayanadensis* sp. nov.) and OOL as long as POL (in *W. wayanadensis* sp. nov. OOL 0.90x POL).

***Wilkinsonellus wayanadensis* sp. nov.**

Holotype: Female: Length 3.37 mm, antenna 4.88 mm, fore wing 3.72 mm.

Head: Width of head 2.10x its length in dorsal view, length 2.11x its width; length of head 0.86x its width in anterior view; face punctate with medial carina, length of face 0.93x its width (Fig. 42B); eyes with slight emargination; inter-tentorial distance 4.80x tentorio-ocular distance; vertex,

gena coarsely punctate, setose; occiput smooth, shiny; OOL 0.88x POL; length of scape 1.31x its width; length of pedicel 0.36x its width.

Mesosoma: Length of mesosoma 1.21x its width, 2.60x as long as head; mesoscutum punctate, setose (Fig. 42C); scutellum, propleuron punctate; mesopleuron punctate anteriorly, smooth postero-dorsally; propodeum with medial carina, rest rugulose-punctate (Fig. 42D); length of fore wing 3.12x its maximum width; length of pterostigma 2.50x its maximum width; fore wing vein 1-R1 1.40x as long as pterostigma; length of vein r 0.91x as wide as pterostigma; length of hind femur 3.70x as its width; length of basitarsus 6x its width; outer tibial spur 0.40x as long as hind tibia; length of hind tibia 6.41x its width.

Metasoma: T1 rather short, medially constricted with a deep groove (Fig. 42E); T1 4.80x its apical width; T2 trapezoidal (Fig. 42E).

Colour: Body yellowish brown except middle anterior mesoscutum, apex of hind femur and hind tibia, wing veins dark brown; antenna light brown.

Male: Unknown.

Host: Unknown.

Material examined: Holotype: 1F, India, Kerala, Sultan Bathery, No collector & collection date (DZUC).

Etymology: The species epithet *wayanadensis* is after the collection locality, Wayanad.

Discussion

This species is close to *W. granulates* in many characters, but differs in many aspects which are mentioned in the key. This species shows similarity to *W. tobiasi* in having the colouration of lateral lobes of mesoscutum and

mesopleuron ventrally, but it differ in the following characters ocelli strongly protuberant (ocelli not strongly protuberant in *W. tobiasi*), inter-tentorial distance 4.80x tentorio-ocular distance (1.50x in *W. tobiasi*), diameter of lateral ocellus as long as POL (1.30x in *W. tobiasi*), scutellar lunules divided by seven carinae (scutellar lunules divided by five carinae in *W. tobiasi*), middle lobe of mesoscutum longitudinally striate posteriorly (in *W. tobiasi* middle lobe of mesoscutum entirely transversly rugose-punctate).

DIVERSITY OF THE SELECTED MICROGASTRINE GENERA

Statistical analysis

The following seven genera namely *Apanteles*, *Choeras*, *Cotesia*, *Diolcogaster*, *Microplitis*, *Neoclarkinella* and *Wilkinsonellus* were analyzed using diversity indices. The other genera were excluded from the analysis due to the negligible amount of collected specimens. Comparing with other genera the most abundant genus is *Apanteles* (2.72) with the dominance index 0.93. A total of 114 specimens were examined out of the 21 collected species of *Apanteles*, which made the genus more abundant. Apart from *Apanteles*, *Microplitis*, *Choeras* and *Cotesia* are the other three genera showing more species abundance with Shannon index 1.82, 1.15 and 1.14 respectively. Twenty one specimens of *Microplitis* out of eight species, 17 specimens of *Cotesia* from five species and 7 specimens of *Choeras* out of four species were examined in the work. The other three genera *Diolcogaster*, *Neoclarkinella* and *Wilkinsonellus* have the range of 0.63–0.69, showing less abundance. Three specimens were analysed from *Diolcogaster* out of two species, two specimens from *Neoclarkinella* and *Wilkinsonellus* out of two species.

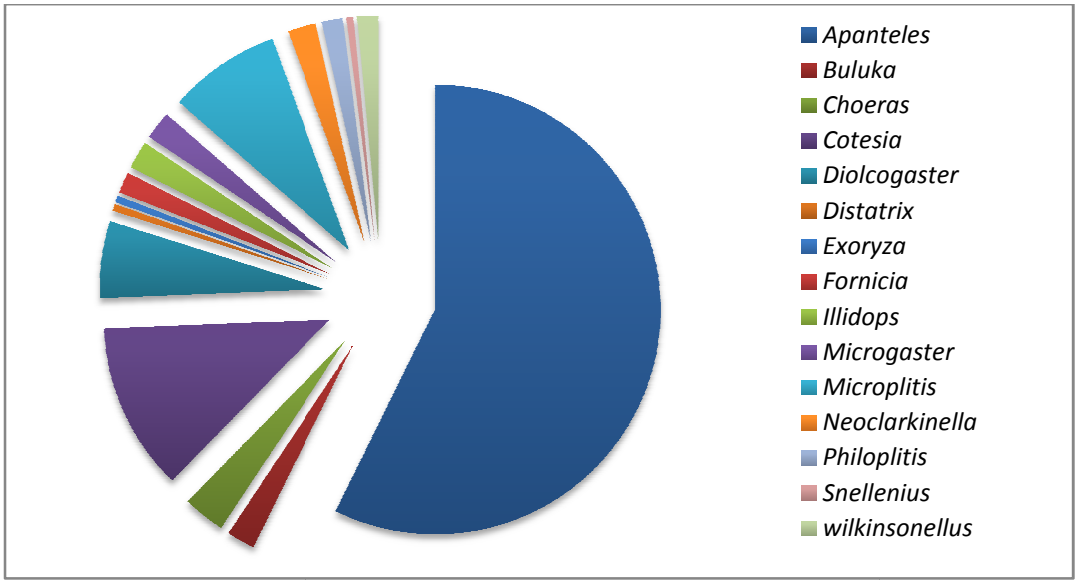
Diversity indices of the selected genera

Name of the genera	Simpson index(D)	Dominance index(1-D)	Shannon index
Apanteles	0.067	0.93	2.72
Choeras	0.285	0.71	1.15
Cotesia	0.22	0.77	1.14
Diolcogaster	0.33	0.66	0.63
Microplitis	0.16	0.83	1.82
Neoclarkinella	0	1	0.69
Wilkinsonellus	0	1	0.69

By comparing the seven genera *Apanteles*, *Neoclarkinella* and *Wilkinsonellus* are most dominant. The dominancy of other four genera are ranging from 0.16–0.28. The genera excluded from the analysis are *Buluka*, *Distatrix*, *Exoryza*, *Fornicia*, *Illidops*, *Microgaster*, *Snellenius* and *Philoplitis*, represented by only one species. Four specimens were examined from the genera *Distatrix* and *Illidops*, two specimens from *Microgaster* and *Philoplitis* and one from *Buluka*, *Exoryza*, *Fornicia* and *Snellenius*.

Pie diagram

The diversity of the selected genera in India is represented through a pie diagram.



Check list of Braconid species of India belonging to fifteen genera of the Subfamily Microgastrinae

Subfamily: Microgastrinae

		Distribution
I	**Genus *Apanteles* Foerster, 1862**	
1.	*Apanteles agilis* (Ashmead, 1905) - *Pseudoapanteles agilis* Ashmead, 1905 - *Apanteles hidaridis* Rohwer, 1922	India, (Kerala), Java, Indonesia, Philippines, Sumatra,Vietnam
2	*Apanteles ahmednagarensis* Kurhade & Nikam, 1997	India (Maharashtra).
3	*Apanteles aithos* Sharma, 1973	India
4	*Apanteles alternatus* Papp, 1973	India (Tamilnadu).
5	*Apanteles angaleti* Muesebeck, 1956	China, India, Indonesia, Sumatra, Pakistan, Vietnam.
6	*Apanteles araeceri* Wilkinson, 1928	India (Kerala), Indonesia, Java, Malaysia.
7	*Apanteles arginae* Bhatnagar, 1948	India.
8	*Apanteles argiope* Nixon, 1965	India, Indonesia, Philippines, Malaysia, Singapore.
9	*Apanteles ariadne* Nixon, 1965	China, India, Sri Lanka.
10	*Apanteles aristaeus* Nixon, 1965	China, India, Indonesia, Java, Taiwan.
11	*Apanteles aristolochiae* Wilkinson, 1928	India, Sri Lanka.
12	*Apanteles asavari* Sathe, 1989	India (Maharashtra).
13	*Apanteles aso* Nixon, 1967	China, India (Mussoorie).

14	*Apanteles attevae* Yousuf, Hassan & Singh, 2008	India (Madhya Pradesh).
15	*Apanteles azollae* Sumodan & Sevichan, 1989	India (Kerala).
16	*Apanteles badgley* Wilkinson, 1928	India.
17	*Apanteles bagicha* Narayanan & Subba Rao, 1961	India.
18	*Apanteles balteatae* Lal, 1942	India.
19	*Apanteles bambusae* Wilkinson, 1928	India (Bihar, Kerala).
20	*Apanteles baoris* Wilkinson, 1930,	China,India, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam.
21	*Apanteles bidentatus* Sharma, 1972	India.
22	*Apanteles bisulcatus* Cameron, 1909	China, India, Sri Lanka, Taiwan.
23	*Apanteles brachmiae* Bhatnahar, 1948	India.
24	*Apanteles brunnus* Rao & Chalikwar, 1976	India (Maharashtra).
25	*Apanteles cajani* Wilkinson, 1928	India.
26	*Apanteles calycinae* Wilkinson, 1928	India (Kerala), Vietnam.
27	*Apanteles camila* Nixon, 1965	India.
28	*Apanteles caniae* Wilkinson, 1928	China, India, Indonesia, Sri Lanka, Thailand.
29	*Apanteles cassiae* Chalikwar & Rao, 1982	India.
30	*Apanteles cerberus* Nixon, 1965	India.
31	*Apanteles chatterjeei* Sharma & Chatterjee, 1970	India (Tamil Nadu).
32	*Apanteles cleo* Nixon, 1967	India (Assam), Vietnam.
33	*Apanteles clita* Nixon, 1965	China, India, Vietnam.
34	*Apanteles crocidolomiae* Ahmad, 1945	India.

35	*Apanteles darjeelingensis* Sharma & Chatterjee, 1970	India (West Bengal).
36	*Apanteles deepica* Rao & Chalkiwar, 1971	India (Maharashtra).
37	*Apanteles delhiensis* Muesebeck & Subba Rao, 1958	India (New Delhi).
38	*Apanteles detrectans* Wilkinson, 1928	India.
39	*Apanteles diaphantus* Nixon, 1965	India.
40	*Apanteles diocles* Nixon, 1965	India, Indonesia, Philippines, Vietnam.
41	*Apanteles effrenus* Wilkinson, 1928	India.
42	*Apanteles endii* Sathe & Ingawale, 1995	India (Medshingi).
43	*Apanteles epijarbi* Rao, 1953	India.
44	*Apanteles euproctisiphagus* Ahmad, 1945	India (kerala)
45	*Apanteles exelastisae* Bhatnagar, 1948	India.
46	*Apanteles expulsus* Turner, 1919	India (Kerala), Sri-Lanka, Vietnam.
47	*Apanteles fabiae*, Wilkinson 1928	India.
48	*Apanteles fakhrulhajiae* Mahdihassan, 1925	India, Vietnam.
49	*Apanteles galleriae* Wilkinson, 1932	China, India, Pakistan,Turkey.
50	*Apanteles grandiculus* Wilkinson, 1929	China, India (Kerala, Meghalaya), Vietnam
51	*Apanteles hasorae* Wilkinson, 1928	India (Kerala), Indonesia, Java.
52	*Apanteles hemitheae* Wilkinson, 1928	China, India (Kerala), Malaysia, Vietnam.
53	*Apanteles hyposidrae* Wilkinson, 1928	India (Kerala, Maharashtra, Tamil- Nadu, Uthar Pradesh), Indonesia, Java, Malaysia, Vietnam.

54	*Apanteles hypsipylae* Wilkinson, 1928	India.
55	*Apanteles importunus* Wilkinson, 1928	China, India (Kerala, Uthar Pradesh).
56	*Apanteles indicus* Bhatnagar, 1948	India.
57	*Apanteles javensis Rohwer*, 1919	China,India (Kerala), Indonesia, Java, Sri Lanka, Taiwan, Thailand, Vietnam
58	*Apanteles Jhaverii Bhatnagar*, 1948	India.
59	*Apanteles jujubae Wilkinson*, 1929	India.
60	*Apanteles lebene Nixon*, 1967	India.
61	*Apanteles leptothecus* Cameron, 1907	India (Kerala, Maharashtra).
62	*Apanteles longitergiae* Rao & Kurian, 1950	India.
63	*Apanteles Lucidus* Sharma, 1972	India.
64	*Apanteles machaeralis* Wilkinson, 1928	China, India (Kerala), Myanmar, Vietnam
65	*Apanteles malacosomae* pandey, 2004	India (Himachal Pradesh).
66	*Apanteles malevolus* Wilkinson, 1929	India, Myanmar.
67	*Apanteles maro* Nixon, 1967	India.
68	*Apanteles mehdialii* Rao & Chalikwar, 1970	India (Maharashtra).
69	*Apanteles metagenes* Nixon, 1965	India.
70	*Apanteles mujtabai* Bhatnagar, 1948	India.
71	*Apanteles munnarensis* Sumodan & Narendean, 1990	India (Kerala).
72	*Apanteles Muzaffarensis* Lal, 1939	India.
73	*Apanteles mycetophilus* Wilkinson, 1931	India.
74	*Apanteles namkumensis* Gupta, 1957	India.
75	*Apanteles nigrescens* Cameron, 1906	India, Pakistan.
76	*Apanteles nydia* Nixon, 1967	India.
77	*Apanteles opacus* (Ashmead, 1905)	China, India

	- *Apanteles derogatae* Watanabe 1935 - *Urogaster opacus* Ashmead, 1965	(Kerala), Indonesia, Java, Malaysia, Philippines, Vietnam.
78	*Apanteles orientalis* Szepligeti, 1913	India, Tanzania.
79	*Apanteles oritias* Nixon, 1965	China, India.
80	*Apanteles pachkuriae* Bhatnagar, 1948	India.
81	*Apanteles paludicolae* Cameron, 1909 - *Apanteles platyptiliae* Cameron, 1909	India, Sri Lanka
82	*Apanteles parasae* Rohwer, 1922	China, India, Indonesia, Java, Malaysia, Philippines, Sri Lanka, Thailand.
83	*Apanteles parasundanus* Bhatnagar, 1948	India.
84	*Apanteles parbhanii* Rao, 1969	India (Maharashtra).
85	*Apanteles parijatki* Sathe & Rokade, 2005	India (Maharashtra).
86	*Apanteles phycodis* viereck, 1913	India.
87	*Apanteles platyptiliophagus* shenefelt, 1972 - *panteles platyptiliae* Rao & Kurian, 1950	India.
88	*Apanteles pongamiae* Sumodan & Narendran, 1990	India (Kerala).
89	*Apanteles priscus* Nixon, 1967	China, India, Malaysia, Sri Lanka,Vietnam
90	*Apanteles prodeniae* Viereck, 1912	China, India, (Karnataka), Thailand, Vietnam
91	*Apanteles puera* Wilkinson, 1928	India, Myanmar.
92	*Apanteles pusaensis* Lal, 1942	India.
93	*Apanteles rangii* Bhatnagar, 1948	India.
94	*Apanteles ricini* Bhatnagar, 1948	India (Kerala).
95	*Apanteles rugiceps* Wilkinson, 1934	India.
96	*Apanteles ruidus* Wilkinson, 1928	India.

97	*Apanteles salutifer* Wilkinson, 1931	China, India, Japan, Korea, Myanmar, Thailand, Vietnam
98	*Apanteles sathei* Sathe Rokade, 2005	India (Maharashtra)
99	*Apanteles sauros* Nixon, 1965	India.
100	*Apanteles shrii* Sathe & Ingawale, 1995	India (Maharashtra).
101	*Apanteles significans* (Walker, 1860) - *Microgaster significans*, Walker, 1860.	China, India (Delhi), Pakistan, Philippines, Singapore, Sri Lanka,Vietnam.
102	*Apanteles singaporensis* szepligeti, 1905	India (Bihar, Kerala), Singapore.
103	*Apanteles stantoni* (Ashmead, 1904) - *Urogaster stantoni* Ashmead, 1904 - *Apanteles fistulae* Wilkinson, 1928	China, India (Kerala, Uthar Pradesh), Philippines, Vietnam. Bengal, Bihar.
104	*Apanteles stennos* Nixon, 1965	India.
105	*Apanteles symithae* Bhatnagar, 1948	India.
106	*Apanteles tachardiae* Cameron, 1913	China, India (Bihar, Kerala, Uthar Pradesh, West - Bengal).
107	*Apanteles taragamae* Viereck, 1912 - *Apanteles homonae* Rohwer, 1922 - *Apanteles plusiae* Viereck, 1913	China, India (Karnataka, Kerala) Indonesia, Japan, Java,
108	*Apanteles tarvadi* Sathe & Rokad, 2005	India (Maharashtra).
109	*Apanteles tasmanica* Cameron, 1912	India (Kerala), Tasmania.
110	*Apanteles tineaephagus* Bhatnagar, 1948	India.

111	*Apanteles turri* Rao & Chalikwar, 1976	India (Maharashtra).
112	*Apanteles ujlai* Sathe & Rokade, 2005	India (Maharashtra).
113	*Apanteles valvulae* Rao & Kurian, 1951	India (Kerala, Uthar Pradesh).
114	*Apanteles yamini* Sathe & Rokade, 2005	India (Maharashtra) .
II	**Genus *Buluka* de Saeger, 1948**	
1	*Buluka horni* Gupta, 2013	India (Karnataka).
2	*Buluka noyesi* Austin, 1989	India.
3	*Buluka quickei* Ranjith, 2016	India (Kerala)
4	*Buluka townesi* Austin, 1989	India (Karnataka), Malaysia.
III	**Genus *Choeras* Mason, 1981**	
1	*Choeras achterbergi* Narendran, 1998	India (Kerala).
2	*Choeras bicolor* sp.nov.	India (Kerala).
3	*Choeras nirupama* sp.nov.	India (Kerala).
4	*Choeras novus* sp.nov.	India (kerala).
5	*Choeras pappi* Narendran, 1998	India (Kerala)
6	*Choeras psarae* Wilkinson, 1927	India (kerala), Korea, Malaysia, Sri Lanka, Thailand.
IV	**Genus *Cotesia* Cameron, 1891**	
1	*Cotesia bifida* (Sharma, 1973) - *Apanteles bifida* Sharma, 1972	India(Uthar Pradesh, West Bengal, Kerala)
2	*Cotesia bataviensis* (Rohwer, 1919) - *Apanteles bataviensis* Rohwer, 1919	India, Indonesia, Java, Vietnam.
3	*Cotesia bosei* (Bhatnagar, 1948) -*Apanteles bosei* Bhatnagar, 1948	China, India.
4	*Cotesia chilonis* (Munakata, 1910) - *Apanteles chilonis* Munakata, 1910.	China, India, Indonesia, Iran,

	- *Cotesia chilocida*, viereck, 1912.	Java, Japan, Korea, Myanmar
5	*Cotesia cirphicola* (Bhatnagar, 1948) - *Apanteles cirphicola* Bhatnagar, 1948	China, India, Vietnam.
6	*Cotesia diurnii* Rao & Nikam, 1984	India (Maharashrta).
7	*Cotesia euprocti* Sathe, 2005	India (Maharashtra).
8	*Cotesia euthaliae* (Bhatnagar, 1948) *-Apanteles euthaliae* Bhatnagar, 1948	India(Kerala)
9	*Cotesia flavipes* Cameron, 1891 *Cotesia flavata* (Ishida, 1915) *Cotesia simplicus* (Viereck, 1913)	Bangladesh, China, India Indonesia, Japan, Malaysia, Mynmar, Nepal, Pakistan, Philippines, Tanzania, Thailand
10	*Cotesia* gramini Sathe & Rokade, 2005	India (Maharashtra).
11	*Cotesia indica* Sathe & Rokade, 2005	India (Maharashtra).
12	*Cotesia jayanagarensis* (Bhatnagar, 1948) - *Apanteles jayanagarensis* Bhatnagar, 1948	China, India.
13	*Cotesia karviri* Sathe & Rokade, 2005	India (Maharashtra).
14	*Cotesia kazak* (Telenga, 1949) *Apanteles kazak* Telengana, 1949	India, Iran,Turkey, Uzbekistan
15	*Cotesia lepidopteri* Sathe & Rokade, 2005	India (Maharashtra).
16	*Cotesia meghrangini* Dawale, Bhosale & Sathe, 1993	India (Maharashtra).
17	*Cotesia nikami* Kurhade & Nikam, 1998	India.
18	*Cotesia orientalis* Halikwar & Nikam, 1984	India (Maharashtra).
19	*Cotesia parijati* Sathe, 2003	India (Maharashtra).

20	*Cotesia philoeampus* (Cameron ,1911) - *Apanteles philoeampus* Cameron, 1911	India(Kerala), New Southwales
21	*Cotesia pratapae* (Ashmead,1896) -*Apanteles pratapae* Ashmead, 1896	India (Kerala), Sri Lanka
22	*Cotesia ruficrus* (Haliday, 1834)	China, India (Kerala), Indonesia, Java, Malaysia, Nepal, Thailand, Turkey
23	*Cotesia shrii* Sathe Ingawale & Bhosale, 1994	India.
24	*Cotesia suvernii*, Sathe, Ingawale, & Bhosale, 1994	India, Vietnam, Yemen.
V	**Genus *Diolcogaster* Ashmead, 1900**	
1	*Diolcogaster andamanensis* Gupta, 2015	India.
2	*Diolcogaster buddha* sp.nov.	India (Kerala).
3	*Diolcogaster duocolor* Gupta, 2015	India.
4	*Diolcogaster indicus* Rao & Chalikwar, 1970	India.
5	*Diolcogaster longistriae* Gupta, 2015	India.
6	*Diolcogaster longiterebra* (Rao & Chalikwar, 1976) -*Protomicroplitis longiterebra* Rao & Chalikwar 1976	India
7	*Diolcogaster malabarensis* Rema & Sheeba, 2005	India (Kerala)
8	*Diolcogaster narendrani* Rema & Sheeba, 2004	India (Kerala).
9	*Diolcogaster punctatus* Rao & Chalikwar, 1976	India.
10	*Diolcogaster ranjithi* sp. nov.	India (Kerala).
11	*Diolcogaster solitarum* Gupta, 2015	India.
12	*Diolcogaster tomentosae* Wilkinson, 1930	India.
VI	**Genus *Distatrix* Mason, 1981**	
1	*Distatrix papilionis* (Viereck 1912) - *Apanteles papilionis* Viereck, 1912	China, India (Karnataka, Kerala, Maharashtra,

		Tamil Nadu), Indonesia, Java, Malaysia, Myanmar
VII	**Genus *Exoryza* Mason, 1981**	
	Exoryza schoenobii (Wilkinson, 1932) - *Apanteles schoenobii* Wilkinson, 1932	Bangladesh, China, India (Kerala), Malaysia, Philippines, Sri Lanka, Vietnam.
VIII	**Genus *Fornicia* Brullé, 1846**	
1	*Fornicia ceylonica* Wilkinson, 1928	China, India, Indonesia, Philippines, Sri Lanka, Thailand
2.	*Fornicia neoceylonica* sp.nov.	India (Kerala).
IX	**Genus *Illidops* Mason, 1981**	
1.	*Illidops azamgarhensis* Ahmad *et al.*, 2005	India (Uttar Pradesh).
2.	*Illidops keralensis* (Sumodan Narendran, 1990)	India (Kerala).
3	*Illidops lamprososmae* Ahmad *et al.*, 2005	India (Uttar Pradesh).
4	*Illidops malabaricus* sp. nov.	India (Kerala).
X	**Genus *Microgaster* Latreille, 1804**	
1.	*Microgaster adisurae* Rao & Sharma, 1960	India
2	*Microgaster himalayensis* Cameron, 1910	India
3	*Microgaster indica* Wilkinson, 1927	India, Indonesia, Java, Myanmar
4	*Microgaster kuchingensis* Wilkinson, 1927	India (Kerala), Malaysia, Philippines.
XI	**Genus *Microplitis* Foerster, 1862**	
1.	*Microplitis ajmerensis* Rao & Kurian, 1950	India (Rajasthan).
2	*Microplitis areyongensis* Austin & Dangerfield, 1993	India (Kerala), Vietnam.
3	*Microplitis bicoloratus*, Xu & He, 2003	China, India

		(Kerala).
4	*Microplitis carinicollis* (Cameron, 1905) - *Microgaster carinicollis*, Cameron, 1905	India (Kerala), Sri Lanka
5	*Microplitis demolitor* Wilkinon, 1930	India (Kerala), Pakistan
6	*Microplitis indicus* Marsh, 1978	India (Himachal Pradesh).
7	*Microplitis maculipennis* Szepligeti, 1900	India (Bihar, Tamil Nadu), Malaysia
8	*Microplitis manila* Ashmead, 1904	China, India, Korea, Malaysia
9	*Microplitis murkyi* Gupta, 2013	India (Karnataka).
10	*Microplitis narendrani* Ranjith & Nasser, 2015	India (Kerala).
11	*Microplitis pennatulae* Ranjith & Rajesh, 2015	India (Kerala).
12	*Microplitis prodeniae* Rao & Kurian, 1950	China, India, Vietnam
13	*Microplitis similis* Lyle, 1921	Bangladesh, India, (Bihar, Kerala), Indonesia, Vietnam
14	*Microplitis spodopterae*, Rao & Kurian, 1950	India (Bihar, Karnataka, Kerala).
15	*Microplitis vitellipepdis* Li, Tans & Song, 2009	China, India (Kerala).
16	*Microplitis zhaoi* Xu & He, 2000	China, India (Kerala). Philippines, Thailand, Vietnam.
XII	**Genus *Neoclarkinella* Rema & Narendran, 1996**	
1.	*Neoclarkinella janakikkadensis* Veena, 2014	India (Kerala).
2	*Neoclarkinella narendrani* Veena, 2014	India (Kerala).
3	*Neoclarkinella nilambirensis* Rema & Narendran, 1990	India (Kerala).
4	*Neoclarkinella punctata* Ahmad *et al.*, 2005	India (Uthar Pradesh).

XIII	**Genus *Philoplitis* Nixon, 1965**	
1	*Philoplitis adustipalpus* Ahmad, 2005	India (Uthar Pradesh).
2	*Philoplitis keralensis* sp. nov.	India (kerala)
3	*Philoplitis striatus* Fernández - Triana & Gouelt, 2009	India (Tamil Nadu).
XIV	**Genus *Snellenius* Westwood, 1882**	
1.	*Snellenius indicus* sp.nov.	India (Kerala).
XV	**Genus *Wilkinsonellus* Mason, 1981**	
1.	*Wilkinsonellus granulates* Ahmad *et al.*, 2005	India (Maharashtra).
2.	*Wilkinsonellus longicentrus* Long & Achterberg, 2003	India (Kerala), Vietnam.
3	*Wilkinsonellus wayanadensis* sp. nov.	India (Kerala).

DISCUSSION

The subfamily Microgastrinae ranges from 17,000 to 46,000+ species (Rodriguez *et al*., 2013), and it is one of the important subfamily, in terms of species richness and economic importance. In addition to the biological control, microgastrines also gathered attention in ecological studies of tropical host-specificity (Smith *et al*., 2008). The most striking character of Microgastrinae Subfamily is the presence of sixteen antennal flagellomeres except in *Kiwigaster* showing sexual dimorphism in flagellomeres (Fernández-Triana *et al*., 2011). Recently Fernández-Triana & Boudreault (2016) reported the first brachypterous state within the Subfamily by erecting an interesting genus, *Keylimepie* from southern Florida.

In this study, fifteen genera found in Kerala are considered. The genera are *Apanteles* Foerster, *Buluka* de Saeger, *Cotesia* Cameron, *Choeras* Mason, *Diolcogaster* Ashmead, *Distatrix* Mason, *Exoryza* Mason, *Fornicia* Brullé, *Illidops* Mason, *Microgaster* Latreille, *Microplitis* Foerster, *Neoclarkinella* Rema & Narendran, *Philoplitis* Nixon, *Snellenius* Westwood & *Wilkinsonellus* Mason. The genus *Distatrix*, not reported so far from Kerala, but from neighboring states of Tamil Nadu and Karnataka is included here, due to the strong possibilities for the same getting collected in the future.

New species and new distributional records

Ten new species were established in this study, three from *Choeras*, two from *Diolcogaste*r, one from *Fornicia*, *Illidops*, *Philoplitis*, *Snellenius* and *Wilkinsonellus*. The two genera *Exoryza* and *Snellenius* were the first record from India. From the above genera *Exoryza schoenobii* (Wilkinson) and *Snellenius keralensis* sp. nov. were the two species studied from Kerala. The following genera *Fornicia*, *Microgaster*, *Philoplitis* and *Wilkinsonellus*

were reported from Kerala for the first time. *Wilkinsonellus longicentrus* Long & Achterberg is recorded from India for the first time.

A dichotomous key to the genera of Microgastrinae of Kerala and a key (India or Kerala) to the species for the genera *Apanteles, Buluka*, *Choeras*, *Cotesia*, *Diolcogaster*, *Fornicia*, *Illidops*, *Microgaster*, *Microplitis*, *Philoplitis* and *Wilkinsonellus* are included. Character matrix and coding are prepared for all the genera mentioned above except *Fornicia* because only two species were reported in India and also due to the inadequate characters for the preparation of character matrix. The other genera are excluded from the preparation of key and character matrix because, it contains only one species and no other species were reported from India.

A check list for the fifteen selected braconid genera belonging to the Subfamily Microgastrinae was prepared and a statistical analysis of the diversity of the selected genera in India, and abundance as well as dominance of the species from the studied genera in Kerala, were also studied.

Distributional record of the genera

Due to the large size and worldwide distribution, classification of Microgastrinae became complex over the last three decades (Whitfield, 1997). They are cosmopolitan in distribution, and found in all terrestrial ecosystems. 'They are found from as north as 82°32´N in the Canadian Arctic (Alert, Ellesmere Island) to as south as 55°S in South America (Tierra del Fuego, Argentina and Chile) and 50° S in New Zealand (Sub-Antarctic Auckland Islands. This subfamily is also obtained from even 4000 meters of altitude (In the Andes and Himalayas)' (Fernández-Triana & Ward, 2016).

The most speciose genera, *Apanteles* and *Cotesia* are cosmopolitan in distribution. In this study, twenty six species of *Apanteles* from Kerala, along with the key to the species of Kerala is given. The species of *Cotesia* found in

Kerala are redescribed and a key for the species of Kerala is included. The genus *Buluka* is rarely collected and highly distinctive genus, originally collected from Afrotropical region (de Saeger, 1948). After this, the distribution range of this genus is extended to the Australasian and Oriental regions (Chou, 1985; Austin, 1989; Gupta, 2013; Long, 2015; Ranjith *et al.*, 2016). This rare genus contains only eleven species in the world (Fernández-Triana & Ward, 2016). The genus *Choeras* contains only 53 species with worldwide distribution, but they are common in south temperate zones of Australia and Chile. Later the species were reported from the Australasian and Oriental region (Narendran, 1998; Achterberg, 2002b). The present investigation includes three new species from Kerala and a key to the Indian species of *Choeras.*

There are 83 species reported from *Diolcogaster* (Fernández-Triana & Ward, 2016), out of which 11 species are from India. This genus is more diverse in Neotropical, Oriental and Afrotropical regions and the species are evenly distributed in Tropical and subtropical areas, occurring about latitude 55°N. The species of this genus can be collected from habitats ranging from temperate grass lands to tropical rain forests and sandy deserts. Two new species from Kerala and a key for the Indian species of *Diolcogaster* is included in this work. The genus *Distatrix* is distributed in Afrotropical, Nearctic, Neotropical, oceanic and Oriental. There is only one species *Distatrix papilionis* (Viereck) redescribed in this study which is collected from Pune, Karnataka and Tamil Nadu.

Exoryza is one of the infrequently collected and less speciose genera of the tribe Apantelini, which contain only five species, reported in the world (Fernández-Triana & Ward, 2016). The distribution of *Exoryza* is restricted to North temperate region with one Asian and one North American species. Later, distribution was expanded to Central America (Valerio *et al.*, 2004).

The major distribution areas of *Exoryza* are Eastern Palaearctic, Neartic, Neotropical and Oriental. The present investigation included one species of this genus, which is the new distribution record of *Exoryza* from Indian sub continent. One of the studied genera, *Fornicia* contains 35 species in the world (Fernández-Triana & Ward, 2016) which are distributed in Afro-tropical, Australasian, Eastern Palaearctic, Neotropical and Oriental region. This study concentrate on a new species and it is the new report from Kerala.

Illidops is mainly distributed in Holarctic region and well adapted to arid regions. Desert and Arid areas of south western part of U.S.A., Mediterranean area and Central Asia contain half of the *Illidops* species (Mason, 1981). The genus is also distributed to Canadian Arctic, Rocky Mountains and India. During this investigation one new species is obtained and a key to the Indian species is also included. *Microgaster* is another large genus distributed in Afrotropical, Australasian, Palaearctic, Nearctic, Neotropical, Oceanic, Europe and Oriental region (Yu *et al*., 2012). One species is redescribed which is the first report from Kerala and a key to the Indian species is also provided in the study.

Majority of the species of apomorphic genus *Microplitis* is obtained from Holarctic region (Shenefelt, 1973; Papp, 1984; Tobias *et al.*, 1986). Later the distribution extended to Afrotropical, Nearctic, Neotropical, Palaeartic, Oceanic and Oriental (Yu *et al*., 2012). Altogether one eighty species were reported worldwide (Fernández-Triana & Ward, 2016). In the present study species of Kerala were diagnosed and a key to the species of Kerala is included. *Neoclarkinella* is the only genus restricted to Oriental region. Only four species were recorded, from which three are from Kerala (Veena *et al*., 2014). Diagnosis and key to the Oriental species of *Neoclarkinella* is included. The number of species reported from the genus *Philoplitis* were a total of five in the world (Fernández-Triana & Ward, 2016).

The distribution of *Philoplitis* is found to be restricted in the Afrotropical and Oriental regions (Yu *et al*., 2012). The description regarding one new species of this genus along with the key to the Indian species is carried out.

Snellenius is another genus with restricted distribution, as it is distributed in Australasian, Neotropical and Oriental region (Yu *et al*., 2012). This genus distribution is expanded to Mesoamerica (Fernández-Triana *et al*., 2015) with only 17 species in the world (Fernández-Triana & Ward, 2016). The present study dealt with a new species, which is the first report from India. The distribution of the genus *Wilkinsonellus* is Pantropical (Whitfield, 1997). Later the distribution expanded to Afrotropical, Australasian and Oriental regions. (Austin & Dangerfield, 1992; Yu *et al*., 2012). Three species were reported from Neotropics (Arias-Penna *et al*., 2013). Apart from this first record, the genus was again reported from Fiji by Arias-Penna *et al*. (2014). This study reports the new distribution record of *Wilkinsonellus* from south India with one new species. One additional species of *Wilkinsonellus* is also recorded from India for the first time. A key to the Indian species is also included.

Character plasticity within Microgastrinae

Microgastrinae is one of the important groups of Braconidae regarding biological control hence many research programs had been carried out in understanding natural history, host relationships and agro-ecology (Walker *et al*., 1990). Due to the high level of morphological convergence and character loss, resolving of genera is the main problem in the past (Nixon 1965; Mason, 1981). Changes in generic characters lead to high degree of character variance among species. Using of morphological characters for phylogenetic analysis (Mason, 1981; Walker *et al*., 1990) discarded due to the wide conflicts between character systems among microgastrine genera (Mardulyn & Whitfield, 1999).

Carapace like metasoma is one of the main characters among the three genera of Microgastrinae, *Diolcogaster*, *Fornicia* and *Buluka*. But this character is inconsistent among *Diolcogaster* species. The species like *Diolcogaster andamanensis*, *Diolcogaster longistria*, *Diolcogaster narendrani*, *Diolcogaster buddha* sp. nov. and *Diolcogaster ranjithi* sp. nov. exhibit carapaciation whereas *Diolcogaster duocolor*, *Diolcogaster longiterebra*, *Diolcogaster malabarensis*, *Diolcogaster punctatus*, *Diolcogaster tomentosa* lack carapace nature. Smooth vertex and temples are the characters which resemble *Diolcogaster* Ashmead *sensu* Mason (*Protomicroplitis* Ashmead *sensu* Nixon) with *Buluka* (Nixon, 1965). But in *Buluka* some species have striated vertex and temples (Austin, 1989; Gupta, 2013a). Wing infuscation is the other non-static character in the genera *Diolcogaster* and *Buluka*. The shape and size of fore wing areolet are highly variable within the species among genera of Microgastrinae. One of the generic characters of *Choeras* is the presence of areolet in the fore wing, but the species *Choeras pappi* lack areolet (Narendran, 1998).

The major character variance appeared in the genus *Apanteles*, which is divided by Nixon (1965) into 44 groups due to its character complexity. The position of propodeal areola, presence of costula on propodeum, ovipositor length, medial carina in the occiput and medial longitudinal carina on face are some of the character variance are seen among *Apanteles* species. The presence of concave nature of hind wing vannal lobe is one of the generic character of *Apanteles*, but some of the *Apanteles* species exhibit convex or flat hind wing vannal lobe.

The genera *Microplitis* and *Snellenius* are the two morphologically distinct group of Microgastrinae (Nixon, 1965; Mason, 1981; Walker *et al*., 1990). These two genera are found to be confused due to its character resemblence (Austin & Dangerfield, 1993). One of the main characters in

both genera is the presence of percurrent medial longitudinal carina on propodeum, but in some species of *Microplitis* medial longitudinal carina is not distinct. The most striking character of both the genera is the presence of large fore wing areolet (Austin & Dangerfield, 1993) and *Microplitis* differs from the genus *Snellenius* with the absence of prepectal carina, more or less sculptured scutellum, and presence of two sharply angled corners in lateral view of propodeum.

Redescription

Thirty one species of microgastrine wasps were redescribed due to the inadequate descriptions of some important characters. Out of 26 species, twenty one species of *Apanteles* were redescribed with proper illustrations. The other redescriptions were *Choeras achterbergi* Narendran from *Choeras*, *Cotesia bifida* (Sharma) comb. nov., *Cotesia euthaliae* (Bhatnagar) comb. nov., *Cotesia philoeampus* (Cameron), *Cotesia pratapae* (Ashmead) comb. nov., *Cotesia ruficrus* (Haliday) from *Cotesia*, *Exoryza schoenobii* (Wilkinson) from *Exoryza*, *Microgaster kuchingensis* Wilkinson from *Microgaster*, *Distatrix papilionis* (Viereck) from *Distatrix* and *Wilkinsonellus longicentrus* Long & Achterberg from *Wilkinsonellus*. Five species of *Apanteles* (*A. azollae*, *A. euproctisiphagus*, *A. munnarensis*, *A. ricini*, *A. pongamiae*) two species of *Choeras* (*C. psarae*, *C. pappi*) and *Diolcogaster* (*D. malabarensis*, *D. narendrani*) and one species of *Illidpos* (*I. keralensis*) and *Neoclarkinella* (*Neoclarkinella nilamburensis*) were diagnosed based on the original description due to the lack of collected specimens. All other diagnosed species were provided with photographs.

Biology and host parasitoid relation

In order to attain a strong distinct successful biological control programme a solid host-parasitoid relationship is mandatory (Gupta &

Kalesh, 2012). Microgatrine wasps are koinobiont endoparasitoids of lepidopteran family with the exception of Hepialidae (Whitfield, 1997). *Choeras geilsi* Achterberg is the only larval parasitoid that attacks *Enoicyla pusilla* (Burmeister) from Trichoptera (Achterberg, 2002) and all other microgastrines are parasitoids of lepidoptera. The species may be solitary or gregarious and these species have a long term physiological interaction with their hosts (Koinobionts *sensu* Askew & Shaw, 1986). Those attack macrolepidoptera will develop in to gregarious and those attack small, concealed caterpillars will develop in to solitary form (Gupta, 2013b). Each microgastrine species is unique in spinning their cocoon, its structure and color pattern (Gupta & Fernández-Triana, 2014). Thus the nature of cocoon makes their identity.

Microplitis, *Cotesia*, and *Diolcogaster* are the advanced groups in biological control as they feed on haemolymph, body fats and attack exposed hosts (Austin & Dangerfield, 1993; Saeed *et al*., 1999; Shaw & Huddleston, 1991). *Diolcogaster*, one of the important genera of parasitoid complex of Microgastrinae (Shaw & Huddleston, 1991) attack early, middle instar of exposed larvae or oviposit in to host embryo and their biology show similarity with *Cotesia* (Johanson, 1951; Tadic, 1958; Wilbert, 1960). Unlike other genera of Cotesiini, *Diolcogaster facetosa* (Weed) has polydnavirus with individually enveloped nucleocapsids (Stoltz & Whitfield, 1992). Life span of *Microplitis* is up to fifteen days and this group has intense affiliation with the lepidopteran family, Noctuidae with few exceptions like Erebidae (Ranjith *et al*., 2015). Polydnavirus block cell immune response (Shaw & Huddleston, 1991) and the nature of cocoon formation depends up on the climatic condition. *Microplitis* exhibits both solitary and gregarious forms. In the case of solitary species the cocoon is formed along the side or beneath the dead or dying host (Austin & Dangerfield, 1993; Song & Chen, 2008). The virulent activity will be shown from August to September (Gupta *et al*., 2013).

Most of the species of *Apanteles* show solitary nature with few exceptions. Some species like *Apanteles taragamae* shows solitary and gregarious nature (Gupta & Fernández-Triana, 2014).The genus *Buluka* contains solitary parasitoids with white cocoon. Comparing with other microgastrine genera this cocoon is unique having oval shape with a faint black spot in the center and light black oval lining surrounding the black spot. The cocoons were found attached to the leaf surface with white fibers arising from the edges and parasites the family Noctuidae (Gupta & Fernández-Triana, 2014). The cocoons of *Distatrix* are similar to *Buluka* in colour and they are solitary or gregarious pedunculated type attached to host by asymmetrical silken stalk at opposite end from parasitoid location (Grinter *et al*., 2009; Gupta & Fernández-Triana, 2014).

Some exclusive host-parasitic relationships were seen among the Subfamily Microgastrinae. *Fornicia* parasitized only Limacodidae, Gracillaridae by *Dolichogenidea*, Bombycidae and Sphingidae by *Glyptapanteles* (Gupta & Fernández-Triana, 2014). Some groups like *Microplitis* have hyperparasitoids (Prabhakar & Prasad 2005; Ranjith *et al*., 2015).

SUMMARY

Microgastrinae is the second most speciose subfamily among Braconidae. About 2645 species were reported in the world. The fifteen genera of the subfamily in Kerala were selected for study. Sixty four species were included from these fifteen genera in Kerala. The entire thesis is divided in to six chapters contain introduction, review of literature, materials and methods, observations and results and discussion. In addition to these keys, illustrative photographs, character matrix, statistical analysis and checklist are also included in the current study.

The first chapter introduction deals with general awareness about Microgastrinae. A brief note on the microgastrine taxonomy is included. The importance of molecular analysis and phylogeny within the microgastrine taxonomy are mentioned. A brief account on the biology and behaviour of the microgastrine wasp, explaining life history strategy and interesting symbiotic association between polydnavirus and microgastrine wasp are included. The important aspects of microgastrine wasps are its involvement in biological control. Some of the successful biological control programmes carried out by microgastrine wasps are also included in the introductory section.

The second chapter, review of literature is divided in to three parts. First section reveals the back ground knowledge about the microgastrine taxonomy. Second section deals with the world scenario of the subfamily, and the third section deals with Oriental view. Oriental part clearly mentions the majority of the study done in India and Kerala.

The third chapter deals with the methodology adopted for collection, preservation and identification process. The specifications of the microscope, the terminology adopted for the descriptive taxonomy and abbreviations of

taxonomic measurements and museum are also included in this chapter. The fourth chapter deals with general morphology of the Subfamily Microgastrinae.

The fifth chapter deals with the key to the genera of Microgastrinae in Kerala and descriptions of new species, redescription and diagnosis of the already described species. Key to the species level for the genera except *Distatrix*, *Exoryza* and *Snellenius* were prepared. Thirty one redescriptions, 23 diagnosis and 10 new species were dealt in this study. In addition to this abundance and dominance of the genera were analysed statistically.

The sixth chapter discusses about the present study. It reflects the distributional pattern of the genera, biology and host parasitoid relation, character plasticity seen among Microgastrinae and above all, redescriptions, diagnosis, new species and new distributional records. At the end of the thesis a check list of selected braconid genera within the Subfamily Microgastrinae, and a list of references are also given.

REFERENCES

Achterberg, C. van. 1979. A revision of the subfamily Zelinae auct. (Hymenoptera, Braconidae). *Tijsdchrift voor Entomologie.* **122**: 241–479.

Achterberg, C. van. 1982. Notes on some type-species described by Fabricius of the subfamilies Braconinae, Rogadinae, Microgastrinae and Agathidinae (Hymenoptera: Braconidae). *Entomologische Berichten Amsterdam*. **42**: 133–139.

Achterberg, C. van. 1984. Essay on the phylogeny of Braconidae (Hymenoptera: Ichneumonoidea). *Entomologisk Tidskrift.* **105**: 41–58.

Achterberg, C. van. 1988. Revision of the subfamily Blacinae Foerster (Hymenoptera, Braconidae). *ZoologischeVerhandelingen Leiden*. **249**: 1–324.

Achterberg, C. van. 2002a. *Apanteles (Choeras) gielisi* spec. nov. (Hymenoptera: Braconidae: Microgastrinae) from the Netherlands and the first report of Trichoptera as host of Braconidae. *Zoologische Mededelingen Leiden*. **76**(5): 53–60.

Achterberg, C. van. 2002b. Western Palaearctic genera of the subfamily Microgastrinae: A re-appraisal of the generic and tribal division (Hymenoptera: Braconidae). In: Melika, George; Thuróczy, Csaba (eds.) *'Parasitic wasps: Evolution, systematics, biodiversity and biological control.' Agroinform*. Budapest. **480**: 19–35.

Achterberg, C. van. 2006. The Braconidae (Hymenoptera) of Greenland. *Zoologische Mededelingen Leiden*. 80-1(2): 13–62.

Achterberg, C. van., and Narendran, T.C. 1997. Notes on the types and type depositories of Braconidae (Insecta: Hymenoptera) described by T.C. Narendran and students. *Zoologische Mededelingen Leiden*. **71**(16):177–179.

Ahmad, Z., Haider, A. A. and Shuja-Uddin. 2005. Two new species of *Apanteles (Illidops)* Mason (Hymenoptera: Braconidae) from India. *Oriental Insects*. **39**: 229–232.

Ahmad, Z., Pandey, K., Haider, A.A. and Shuja-Uddin. 2005. Description of a new species of the genus *Neoclarkinell*a Rema & Narendran (Hymenoptera: Braconidae) from India. *Journal of the Bombay Natural History Society*. **102**(2): 208–209.

Ahmad, Z., Pandey, K., Kavita., Haider., A. A. and Shuja-Uddin. 2005a. A new *Philoplitis* species (Hymenoptera: Braconidae) from India. *Zoos' Print Journal*. **20**(1): 1736.

Ahmad, Z., Pandey, K., Kavita., Haider., A. A. and Shuja-Uddin. 2005b. Discovery of the genus *Wilkinsonellus* Mason (Hymenoptera: Braconidae) from India. *Zoos' Print Journal*. **20**(3): 1804.

Akhtar, Mir Samim., Ahmad, Z. and Ramamurthy, V.V. 2010. Description of two new species of Microgastrini (Hymenoptera: Braconidae) from India. *Zootaxa*. **2608**:57–62.

Anderson R. M. and R. M. May. 1978. Regulation and Stability of Host-Parasite Population Interactions: I. Regulatory Processes. *Journal of Animal Ecology*. **47:** 219–247.

Arias-Penna, D. C., Whitfield, J. B., Janzen, D. H. and Hallwachs, W. 2013. Three new species in the genus *Wilkinsonellus* (Braconidae,

Microgastrinae) from the Neotropics, and the first host record for the genus. *ZooKeys.* **302**:79–95.

Arias-Penna, D., Zhang, Y. and Whitfield, J. B. 2014. First record of the genus Wilkinsonellus (Hymenoptera, Braconidae, Microgastrinae) from Fiji with description of three new species. *ZooKeys* **397**: 25–47.

Arthur, A. P. and Mason, P. G. 1986. Life history and immature stages of the parasitoid *Microplitis mediator* (Hymenoptera: Braconidae), reared on the bertha armyworm *Mamestra configurata* (Lepidoptera: Noctuidae). *Canadian Entomologist*. **118**(5): 487–491.

Ashmead, W. H. 1896. On some reared parasitic Hymenopterous insects from Ceylon. *Proceedings of United States National Museum*. **18:**633–648.

Ashmead, W. H. 1900. Classification of the Ichneumon flies, or the superfamily. Ichneumonoidea, *Proceedings of United States National Museum*. **23**(1206): 1–220.

Ashmead, W. H. 1904. A list of Hymenoptera of the Philippine Islands with descriptions of new species. *Journal of the New York Entomological Society*. **12**:1–22.

Ashmead, W. H. 1905. Additions to the recorded hymenopterous fauna of the Philippine Islands, with descriptions of new species., *Proceedings of the United States National Museum*. **28**(1413): 957–971.

Askew, R. R. and Shaw, M. R. 1986. Parasitoid communities: their size, structure and development. *Insect Parasitoids* Academic Press, London. 225–264.

Austin, A. D. 1989. Revision of the genus *Buluka* de Saeger (Hymenoptera: Braconidae: Microgastrinae). *Systematic Entomology*. **14**(2):149–163.

Austin, A. D. 1990. Revision of the enigmatic Australasian genus *Miropotes* Nixon (Hymenoptera: Braconidae: Microgastrinae), with comments on the phylogenetic importance of the female ovipositor system. *Systematic Entomology*. **15**:43–68.

Austin, A. D. and Dangerfield, P. C. 1992. Synopsis of Australasian Microgastrinae (Hymenoptera: Braconidae), with a key to genera and description of new taxa. *Invertebrate Taxonomy*. **6**(1): 1–76.

Austin, A. D. and Dangerfield, P. C. 1993. Systematics of Australian and New Guinean *Microplitis* Foerster and *Snellenius* Westwood (Hymenoptera: Braconidae: Microgastrinae), with a review of their biology and host relationships. *Invertebrate Taxonomy*. **7**(5): 1097–1166.

Banks, J. C. and Whitfield, J. B. 2006. Dissecting the ancient rapid radiation of microgastrine wasp genera using additional nuclear genes. *Molecular Phylogenetics and Evolution*. **41**:690–703.

Beckage, N. E. and Gelman, D. B. 2004. Wasp parasitoid disruption of host development: implications for new biologically based strategies for insect control. *Annual Review of Entomology*. **49**: 299–330.

Belokobylskij, S. A. 2014. Family Braconidae Nees, 1812. In: Alexander V. Antropolieva and Alexandr P. Rasnitsyn (2014). The wasps, bees and ants (Insecta: Vespida=Hymenoptera) from the Insect Limestone (Late Eocene) of the Isle of Wight, UK . Earth and Environmental Science *Transactions of the Royal Society of Edinburgh*. **104**: 335-446.

Bernays, E. A. 2001. Neural limitations in phytophagous insects: Implications for diet breadth and evolution of host affiliation. *Annual Review of Entomology*. **46**: 703-727.

Bernays, E. A. and Graham, M. 1988. On the evolution of host specificity in phytophagous arthropods. *Ecology*. **69**:886–892.

Berry, J. A. 1997. The nomenclature of the microgastrine braconid genus *Apanteles* (s.l.) (Hymenoptera: Braconidae) in New Zealand. *New Zealand Entomologist*. **20**(0): 49–50.

Bhatnagar, S. P. 1950. Studies on *Apanteles* Forster (Vipionidae: parasitic Hymenoptera) from India. *Indian Journal of Entomology*. **10**(2): 133–203.

Brues, C. T. 1933. The parasitic Hymenoptera of the Baltic amber, part 1. *Bernstein Forschungen*. Heft **3**: 4–178.

Brullé, M. A. 1846. Tome Quatrième. Des Hyménoptères. Les Ichneumonides. In: Lepeletier de Saint-Fargeau A. *"Histoire Naturelles des Insectes."* Paris. **680**: 56–521.

Cameron, P. 1891. Hymenopterological notices. I. On some Hymenoptera parasitic in Indian injurious insects. *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*. **4** (4): 182–194.

Cameron, P. 1908, Description of a new species of *Apanteles* from Ceylon. *Spolia Zeylanica*. **5**: 17–18.

Cameron, P. 1911. On the Hymenoptera of the George town Museum, British, Guiana. Part II. *Timehri*. **1**: 306–330.

Chalikwar, M. R., Rao, S. N. and Nikam, P. K. 1985. Two new species of *Cotesia* from India (Hymenoptera: Braconidae)., *Oriental Insects*. **18** (1984): 17–23.

Cherian, M. C. and Basheer, M. 1947. The parasite complex on the castor semilooper, *Achaea janata* (Linn.). *Indian Journal of Entomology*. **9**: 139–141.

Chou, L. Y. 1985. A new species of *Buluka* (Hymenoptera: Braconidae) from Taiwan. *Chinese Journal of Entomology*. **5**: 85–88.

de Saeger, H. 1937. L' *Apanteles sagax* Wilk. Parasite de la pyrale du cotonnier. *Bulletin Agricole du congo* Belge **28**: 47–52.

de Saeger, H. 1944. Microgasterinae (Hymenoptera: Apocrita). *Exploration du Parc National Albert.* Mission G.F. de Witte. **47**:1–342.

de Saeger, H. 1948. Cardiochilinae et Sigalphinae (Hymenoptea: Apocrita) Fam. Braconidae. *Exploration du Parc National Albert.* Mission G.F. de Witte. **53**:1–272.

Eady, R .D. 1974. The present state of nomenclature of wing venation in the Braconidae (Hymenoptera); its originsand comparison with related groups. *Journal of Entomology, Series B (Taxonomy)*, **43**: 63–72

Dannon, E. A., M. Tamò., A. van Huis and M. Dicke. 2010. Functional response and life history parameters of *Apanteles taragamae*, a larval parasitoid of *Maruca vitrata.* BioControl. **55**(3)

Fernández-Triana., J. L. 2010. Eight new species and an annotated checklist of Microgastrinae (Hymenoptera, Braconidae) from Canada and Alaska. *ZooKeys*. **63**:1–53.

Fernández-Triana., J. L. and H. Goulet. 2009. Revision of the genus *Philoplitis* Nixon (Hymenoptera, Braconidae, Microgastrinae). *ZooKeys*. **20**: 285–298 (Special Issue).

Fernández-Triana, J. L., H. Goulet, N. J. Bostanian and C. Boudreault. 2009. Diversity of Microgastrinae (Hymenoptera: Braconidae) in apple orchards of southern Quebec, Canada. *Biocontrol Science and Technology*. 19(3):237–248.

Fernández-Triana, J. L., Ward, D. F. and Whitfield, J. B. 2011. *Kiwigaster* gen. nov. (Hymenoptera: Braconidae) from New Zealand: the first Microgastrinae with sexual dimorphism in number of antennal segments. *Zootaxa*. **2932**: 24–32.

Fernández-Triana., J. L., Achterberg. C. van and Whitfield, J. B. 2014. Australasian endemic no more: four new species of *Miropotes* Nixon (Hymenoptera, Braconidae, Microgastrinae), with the first record from the Oriental region. *Tijdschrift voor Entomologie*, **157**(1): 59 – 77.

Fernández-Triana, J. L., M. R. Shaw., S. Cardinal., P. G. Mason. 2014. Contributions to the study of the Holarctic fauna of Microgastrinae (Hymenoptera, Braconidae). I. Introduction and first results of transatlantic comparisons. *Journal of Hymenoptera Research*. **37**: 61–76.

Fernández-Triana, J. L., Whitefield, J. B., Rodriguez, J. J., Smith, M. A., Janzen, D. H., Hallwachs, W. D., Hajibabaei, M., Burns, J. M., Solis, M. A., Brown, J., Cardinal, S., Goulet, H. and Hebert, P. D. 2014. Review of *Apanteles sensu* stricto (Hymenoptera, Braconidae, Microgastrinae) from Area de Conservación Guanacaste, northwestern Costa Rica, with keys to all described species from Mesoamerica. From Area de Conservación Guanacaste, northwestern Costa Rica, with keys to all described species from Mesoamerica. *ZooKeys*. Feb **24**;(383):1–565.

Fernández-Triana, J. L., J. B. Whitfield, M. A. Smith., R. Kula., W. Hallwachs and D. H. Janzen. 2015. Revision of the genera *Microplitis* and *Snellenius* (Hymenoptera, Braconidae, Microgastrinae) from Area de Conservacion Guanacaste, Costa Rica, with key to all species previously described from Mesoamerica. 2015. *Deutsche Entomologische Zeitschrift*. **62**(2): 137–201

Fernández-Triana, J. L. & Ward, D. F. 2016. Microgastrine Wasps of the World.http://www.microgastrinae.myspecies.info/microgastrinae/microgastrinae accessed on 12 February 2016.

Fernández-Triana, J. L. and Boudreault, C. 2016. *Keylimepie peckorum* gen. n. and sp. n., (Hymenoptera, Braconidae) from southern Florida, U.S., the first known brachypterous member of the subfamily Microgastrinae. *ZooKeys*. **584**: 95–107.

Foerster, A. 1862. Synopsis der Familien und Gattungen der Braconiden. *Verhandlungen des Naturhistorischen Vereins der Preussischen Rheinlande und Westfalens*. **19**: 225–288.

Granger, C. 1949. Braconides de Madagascar. *Mémoires de l'Institut Scientifique de Madagascar*. (A) **2**: 1–428.

Grinter, C. C., J. B. Whitfield, Connahs, H., Dyer, L. A., Hallwachs, W. and D. H. Janzen. 2009. A key to New World *Distatrix* Mason (Hymenoptera: Braconidae), with descriptions of six new reared Neotropical species. *Journal of Insect Science*. **9**(29): 1–17.

Gupta, A. 2013a. Three new species of reared parasitic wasps (Hymenoptera: Braconidae: Microgastrinae) from India. *Zootaxa*. **3701** (3): 365–380.

Gupta, A. 2013b. Revision of the Indian *Microplitis* Foerster (Hymenoptera: Braconidae: Microgastrinae), with description of one new species. *Zootaxa*. **3620** (3): 429–452.

Gupta, A. & Kalesh, S. 2012. Reared parasitic wasps attacking hesperiids from Western Ghats (Kerala, India) with description of a new species of *Dolichogenidea* (Hymenoptera: Braconidae) as a larval parasitoid of *Thoressa evershedi* (Evans) (Lepidoptera: Hesperiidae). *Zootaxa*. **3413**: 29–43.

Gupta, A., B. Pereira and P. V. Churi. 2013. A new species of *Parapanteles* Ashmead (Hymenoptera: Braconidae) from India reared from *Abisara echeria* Stoll (Lepidoptera: Riodinidae) with key to the Indian *Parapanteles* species. *Zootaxa*. **3709** (4): 363–370.

Gupta, A. and Fernández-Triana., J. L. 2014. Diversity, host association, and cocoon variability of reared Indian Microgastrinae (Hymenoptera: Braconidae) *Zootaxa*. **3800** (1): 001–101.

Gupta, A. and Fernández-Triana, J. L. 2015. Four new species of the genus *Diolcogaster* Ashmead, 1900 (Hymenoptera: Braconidae: Microgastrinae) from South East Asia with a key to the Indian species. *Systematic Parasitology*. **90**: 285–300.

Harris, R. A. 1979. A glossary of surface sculpturing. *California Department of Food andAgriculture,Bureau of Entomology, Occasional Paper*. **28**: 1–31.

Henry, L. M., Roitberg, B. D. and Gillespie, D. R. 2008. Host-range evolution in *Aphidius* parasitoids: fidelity, virulence and fitness trade-offs on an ancestral host. *Evolution*. **62** (3): 689–699.

Johansson, A. S. 1951. Studies on the relation between *Apanteles glomeratus* (Hym. Brac.) and Pieris brassicae L. (Lep. Pieridae). *Norsk Entomologisk Tidsskrift*. **8**(4–5): 145–186.

Kankare, M., van Nouhuys, S., Gaggiotti, O. and Hanski, I. 2005. Metapopulation genetic structure of two coexisting parasitoids of the Glanville fritillary butterfly. *Oecologia*. **143**(1): 77–84.

Latreille, P. A. 1805. Histoire naturelle, genérale et particuliere, des Crustacés et des Insectes. *Tome treizième*. Paris. (1802-1804) 432 pp. (Ichneumonidae pp. 161–190).

Le Masurier, A. D. 1987. A comparative study of the relationship between host size and brood size in *Apanteles spp*. (Hymenoptera: Braconidae). *Ecological Entomology*. **12**(4):383–393.

Lewis, W. J. and Burton, R. L. 1970. Rearing *Microplitis croceipes* in the laboratory with *Heliothis zea* as hosts. *Journal of Economic Entomology*. **63**(2): 656–658.

Li J., Yan F., Coudron T. A., Pan W., Zhang X., Liu X. and Zhang Q. 2006: Field release of the parasitoid *Microplitis mediator* (Hymenoptera: Braconidae) for control of *Helicoverpa armigera* (Lepidoptera: Noctuidae) in cotton fields in northwestern China's Xinjiang province. *Environmental Entomology*. **35**: 694–69.

Long, K. D. 2015. New record of the genus *Buluka* de Saeger (Hymenoptera: Braconidae: Microgastrinae) with description of a new species from Vietnam. *Tap Chi Sinh Hoc*, **37**: 282–287.

Long, K. D. and Achterberg, C. van. 2008. Two genera and one species newly recorded with description of five species of the subfamily

Microgastrinae (Hymenoptera: Braconidae) from Vietnam., *Tap Chi Sinh Hoc* . **30**(3): 78–87.

Long, K. D. and Achterberg, C. van. 2011. Review of the genus *Wilkinsonellus* Mason, 1981. (Hymenoptera, Braconidae, Microgastrinae) from Vietnam, with a key to species and four new species. *Deutsche Entomologische Zeitschrift*. **58**(1): 123–133.

Luo, Qing-Huai, You, Lan-Shao and Xiao, Zhi-Shu. 2004. [A new genus of Microgastrinae from China (Hymenoptera, Braconidae).]. *Acta Zootaxonomica Sinica*. **29**(2): 339–341.

Maetô, K. 1996. Inter-generic variation in the external male genitalia of the subfamily Microgastrinae (Hymenoptera, Braconidae), with a reassessment of Mason's tribal system. *Journal of Hymenoptera Research.* **5**: 38–52.

Mardulyn, P. and Whitfield, J. B. 1999. Phylogenetic signal in the COI, 16S, and 28S genes for inferring relationships among genera of Microgastrinae (Hymenoptera; Braconidae): evidence of a high diversification rate in this group of parasitoids. *Molecular Phylogenetics and Evolution*. **12**(3): 282–294.

Marshall, T. A. 1885. Monograph of British Braconidae. Part I. *Transactions of the Entomological Society of London*. **1885**: 1–280.

Mason, W. R. M. 1981. The polyphyletic nature of *Apanteles* Foerster (Hymenoptera: Braconidae): A phylogeny and reclassification of Microgastrinae. *Memoirs of the Entomological Society of Canada*. **115**: 147 pp.

Mason, W. R. M. 1983. A new South African subfamily related to Cardiochilinae (Hymenoptera: Braconidae). *Contribution to American Entomological Institute* **20:** 49–62.

Motschoulsky, V. 1863. Essai d'un catalogue des insectes de l'ile Ceylan. *Bulletin de la Société Impériale des Naturalistes*. Moscou. **36**: 1–153.

Muesebeck, C. F. W. 1918. Two important introduced parasites of the brown-tail moth. *Journal of Agricultural Research*. **14**(5): 191–206.

Muesebeck, C. F. W. 1920. A revision of the North American Ichneumon-flies belonging to the genus *Apanteles*. *Proceedings of United States National Museum*. **58**: 483–576.

Muesebeck, C. F. W. 1921. A revision of the North American species of ichneumon-flies belonging to the genus *Apanteles*. *Proceedings of the United States National Museum*. **58**: 483–576.

Muesebeck, C. F. W. 1922. A revision of the North American ichneumon-flies, belonging to the subfamilies Neoneurinae and Microgasterinae. *Proceedings of the United States National Museum.* **61**: 1–76.

Muirhead, K., Austin, A. D. and Sallam, M. 2008. The systematics and biology of *Cotesia nonagriae* (Olliff) stat. rev. (Hymenoptera: Braconidae: Microgastrinae), a newly recognized member of the *Cotesia flavipes* species complex. *Zootaxa*.**1846**: 35–46.

Murphy, N., Banks, J. C., Whitfield, J. B. and Austin, A. D. 2008. Phylogeny of the parasitic microgastroid subfamilies (Hymenoptera: Braconidae) based on sequence data from seven genes, with an improved time estimate of the origin of the lineage. *Molecular Phylogenetics and Evolution.* **47**: 378–395.

Narendran, T. C. 1998. On Indian species of *Choeras* Mason (Hymenoptera: Braconidae). *Journal of Entomological Research*. **22**(1): 89–96.

Narendran, T. C. and Sheeba, M. 2003. A new *Diolcogaster* Ashmead (Hymenoptera: Braconidae : Microgastrinae) from Kerala, India. *Journal of Biological Science*. **11**: 1–3.

Nixon, G. E. J. 1965. A reclassification of the tribe Microgasterini (Hymenoptera: Braconidae). *Bulletin of the British Museum (Natural History), Entomology series.* Supplement **2**: 1–284.

Nixon, G. E. J. 1967. The Indo-Australian species of the ultor-group of *Apanteles* Förster (Hymenoptera: Braconidae). *Bulletin of the British Museum (Natural History), Entomology series*. **21**(1): 1-34.

Nixon, G. E. J. 1968. A revision of the genus Microgaster Latreille (Hymenoptera: Braconidae). *Bulletin of the British Museum (Natural History), Entomology series*. **22**: 33–72.

Nixon, G. E. J. 1970. A revision of the north western European species of *Microplitis* Förster (Hymenoptera: Braconidae). *Bulletin of the British Museum (Natural History), Entomology series*. **25**(1): 1–30.

Nixon, G. E. J. 1972. A revision of the north-westen European species of the laevigatus-group of *Apanteles* Förster (Hymenoptera, Braconidae). *Bulletin of Entomological Research*. **61**:701–743.

Nixon, G. E. J. 1973. A revision of the north-western European species of the vitripennis, pallipes, octonarius, triangulator, fraternus, formosus, parasitellas, metacarpalis and circumscriptus- groups of *Apanteles* Förster (Hymenoptera: Braconidae). *Bulletin of Entomological Research*. **63**: 169–228.

Nixon, G. E. J. 1974. A revision of the north-westen European species of the glomeratus-group of *Apanteles* Foerster (Hymenoptera, Braconidae). *Bulletin of Entomological Research*. **64**: 453–524.

Novotny, V. and Basset Y. 2005. Host specificity of insect herbivores in tropical forests. *Proceedings of Royal Society of Biological Sciences*. **272**(1568): 1083–90.

Noyes, J. S. 1982. Collecting and preserving Chalcid wasps (Hymenoptera: Calcidoidea). *Journal of Natural History*. **16**: 315–334.

Papp, J. 1979. Braconidae (Hymenoptera) from Tunisia, 1. *Folia Entomologica Hungarica*. **32**(2): 175–187.

Papp, J. 1980. On the genus *Fornicia* Brullé with two new Oriental species (Hymenoptera, Braconidae: Microgasterinae). *Folia Entomologica Hungarica*. **41**(33)(2): 305–311.

Papp, J. 1983a. A survey of the European species of *Apanteles* Först. (Hymenoptera, Braconidae: Microgastrinae), VII. The carbonarius-, circumscriptus-, fraternus-, pallipes-, parasitellae-, vitripennis-, liparidis-, octonarius- and thompsoni- group. *Annales Historico-Naturales Musei Nationalis Hungarici*. **75**: 247–283.

Papp, J. 1983b. Contributions to the braconid fauna of Hungary, IV. Microgastrinae. (Hymenoptera: Braconidae). *Folia Entomologica Hungarica*. **44**: 125–138.

Papp, J. 1984. Palaearctic species of *Microgaster* Latreille (=*Microplitis* Foerster) with description of seven new species (Hymenoptera, Braconidae, Microgastrinae). *Entomologische Abhandlungen und Berichte aus dem Staatlichen Museum fur Tierkunde*, Dresden, **47**: 95–140.

Papp, J. 1986. A survey of the European species of *Apanteles* Först. (Hymenoptera, Braconidae: Microgastrinae) IX. The glomeratus-group, 1. *Annales Historico-Naturales Musei Nationalis Hungarici.* **78**: 225–247.

Papp, J. 1986. First survey of the *Glabromicroplitis* Papp species of the Holarctic Region, with taxonomical remarks of three *Microgaster* Latreille species (Hymenoptera, Braconidae: Microgastrinae). *Annales Historico-Naturales Musei Nationalis Hungarici.* **78**: 249–253.

Papp, J. 1987. A survey of the European species of *Apanteles* Förster (Hymenoptera, Braconidae: Microgastrinae), X. The glomeratus-group 2 and the cultellatus-group. *Annales Historico-Naturales Musei Nationalis Hungarici*. **79**: 207–258.

Penteado-Dias, A. M., Shimabukuro, P. H. F. and Achterberg, C. van. 2002. A new species of the genus *Xanthomicrogaster* Cameron (Hymenoptera: Braconidae: Microgastrinae) from Brazil. *Zoologische Mededelingen Leiden*. **76**(3): 41–44.

Pérez-Rodríguez, J., Oltra-Moscardó, T., Peris-Felipo, F. J. and Jiménez-Peydró, R. 2013, Microgastrinae (Hymenoptera: Braconidae) in the Forest State of Artikutza (Navarra: Spain): Diversity and Community Structure. *Insects* 4(3):493-505.

Prabhakar, M. and Prasad, Y. G. 2005. Biology and seasonal dynamics of *Snellenius maculipennis* (Szepligeti) (Hymenoptera: Braconidae) a larval parasitoid of castor semilooper, *Achaea janata* (Linnaeuus) (Lepidoptera: Noctuidae). *Journal of Biological Control*. **19**(1): 29–34.

Puttler, B. and Thewke, S. E. 1970. Biology of *Microplitis feltiae* (Hymenoptera: Braconidae), a parasite of the black cutworm, *Agrotis ipsilon*. *Annals of the Entomological Society of America*. **63**(3): 645–648.

Quicke, D. L. J. and Achterberg, C. van. 1990. Phylogeny of the subfamilies of the family Braconidae (Hymenoptera: Ichneumonidae). *Zoologische Verhandelingen*. **258**: 1–95.

Ranjith, A. P., Rajesh, K. M. and Nasser, M. 2015. Taxonomic studies of Oriental *Microplitis* Foerster (Hymenoptera: Braconidae: Microgastrinae), with description of two new species from South India. *Zootaxa*. **3963** (3): 369–415.

Ranjith, A. P., Veena, T., P. D. Rajan and Nasser, M. 2016. Revision of *Buluka* de Saeger (Hymenoptera: Microgastrinae) with the Description of One New Species from South India. *Biosystematica.* **9** (2): 29–37.

Rao, S. N. 1953. Notes on some parasitic Hymenoptera from India with the description of a new species, *Apanteles epijarbi*., *Indian Journal of Entomology*. **15**(1): 23–28.

Rao, S. N. 1961. Key to the Oriental species of *Apanteles* Foerster (Hymenoptera). *Proceedings of the National Academy of Sciences India*. **31**: 32–46.

Reinhard, H. 1880. Beiträge zur Kenntniss einiger Braconiden-Gattungen. Fünftes Stück. XVI. Zur Gattung *Microgaster*, Latr. (*Microgaster*, *Microplitis*, *Apanteles*). *Deutsche Entomologische Zeitschrift*. **24**: 353–370.

Rema, C. G. and Narendran, T. C. 1996. A remarkable new genus of Braconidae (Hymenoptera) from India. *Journal of the Bombay Natural History Society,* **93**: 264–267.

Rema, C. G. and Sheeba, M. 2004. A new species of *Diolcogaster* Ashmead (Hymenoptera: Braconidae: Microgastrinae) from Kerala, India with a key to Indian species. In: Rajmohana, K.; Sudheer, K.; Girish Kumar, P.; Santhosh, S. (eds.) *'Perspectives on Biosystematics and Biodiversity.'* Harvest Media Services. Calicut, India. **666**: 509–513.

Rodriguez, J. J., Fernández-Triana., J. L., M. A. Smith., D. H. Janzen., W. Hallwachs., T. L. Erwin and Whitfield, J. B. 2013. Extrapolations from field studies and known faunas converge on dramatically increased estimates of global microgastrine parasitoid wasp species richness (Hymenoptera: Braconidae). *Insect Conservation and Diversity*. **6** (4): 530–536.

Rousse, P. and Gupta, A. 2013. Microgastrinae (Hymenoptera: Braconidae) of Reunion Island: a catalogue of the local species, including 18 new taxa and a key to species. *Zootaxa. **3616** (6): 501–547.*

Saeed, A., Austin, A. D. and Dangerfield, P. C. 1999. Systematics and host relationships of Australasian *Diolcogaster* (Hymenoptera: Braconidae: Microgastrinae). *Invertebrate Taxonomy*. **13**: 117–178.

Sathe, T. V. and Inamdar, S. A. 1988. A new species of the genus *Nyereria* Wilkinson (Hymenoptera: Braconidae) from India. *Journal of Advanced Zoology*. **9**(2): 128–131.

Sathe, T. V. and Inamdar, S. A. 1991. Two new species of the genus *Glytapanteles* Ashmead and *Parenion* Nixon (Hymenoptera: Braconidae) from India., *Hexapoda (Insecta Indica).* **3**(1-2) : 89–93.

Sathe, T. V., Ingawale, D. M. and Bhosale, Y. A. 1994. Two species of the genus *Cotesia* Cameron (Hymenoptera: Braconidae) from India. *Hexapoda (Insecta Indica*). **6**(2): 65–71.

Schumacher, R. K., Austin, A. D. and Floyd, R. B. 2000. Parasitoids of the autumn gum moth, *Mnesampela privata* (Guenee) (Lepidoptera: Geometridae) in south-eastern Australia, with description of two new larval parasitoids., *Transactions of the Royal Society of South Australia*. **124**(1): 1–15.

Secord, D. and Kareiva, P. 1996. Perils and Pitfalls in the host specificity paradigm. *Bioscience*. **46**: 448–453.

Shaw, M. R. 2009. *Cotesia* Cameron (Hymenoptera: Braconidae: Microgastrinae) parasitoids of Heliconiinae (Lepidoptera: Nymphalidae) in Europe, with description of three new species. *British Journal of Entomology and Natural History*. **22**: 133–146.

Shaw, M. R. and Huddleston, T. 1991. Classification and biology of Braconid wasps (Hymenoptera: Braconidae). *Handbooks for the Identification of British Insects*. **7**(11): 1–126.

Shenefelt, R. D. 1968. *Snellenius* in the Neotropical Region. *Proceedings of the Entomological Society of Washington*. **70**(4): 339–345.

Shenefelt, R. D. 1972. Braconidae 4. Microgasterinae: *Apanteles*. *Hymenopterorum Catalogus* (nova editio). Pars **7**: 429–668.

Shenefelt, R. D. 1973. Braconidae 5, Microgasterinae & Ichneutinae. Part 9. In: van der Vecht, J. & Shenefelt, R. D. (Eds.), *'Hymenopterorum Catalogus'*. Dr W. Junk, Gravenhage, pp. 669–812.

Shepard, M., Powell, J. E. and Jones, W. A. Jr. 1983. Biology of *Microplitis demolitor* (Hymenoptera: Braconidae), an imported parasitoid of *Heliothis* (Lepidoptera: Noctuidae) spp. and the soybean looper, *Pseudoplusia includens* (Lepidoptera: Noctuidae). *Environmental Entomology*. **12**(3): 641–645.

Smith, M. A., Rodriguez, J. J., Whitfield, J. B., Deans, A. R., Janzen, D. H., Hallwachs, W. and Herbert, P. D. N. 2008. Extreme diversity of tropical parasitoid wasps exposed by integration of natural history, DNA barcoding, morphology, and collections. *Proceedings of the National Academy of Sciences of the United States of America*. **105**(34): 12359–12364.

Smith, M. A., C. Bertrand, K. Crosby, E. S. Eveleigh, Fernández-Triana, J. L., B. L. Fisher, J. Gibbs, M. Hajibabaei, W. Hallwachs, K. Hind, J. Hrcek, Da-Wei Huang, M. Janda, D. H. Janzen, Y. Li, S. E. Miller, L. Packer, D. L. J. Quicke, S. Ratnasingham, J. J. Rodriguez, R. Rougerie, M. R. Shaw, C. Sheffield, J. K. Stahlhut, D. Steinke, J. B. Whitfield, M. Wood, X. Zhou (2012) *Wolbachia* and DNA barcoding Insects: patterns, potential, and problems. *Plos One*. 7:36514.

Song, D. and Chen, Jia-Hua. 2003. [A study on the genus *Exoryza* Mason from China with the description of one new species (Hymenoptera: Braconidae: Microgastrinae).] (in Chinese with English summary) *Shanghai Jiaotong Daxue Xuebao Nongye Kexue Ban*. 21(4) General serial**. 77**: 286–288.

Song, D. and You, Lan-shao. 2008. A new species of the genus *Microplitis* Foerster from China (Hymenoptera: Braconidae: Microgastrinae). *Journal of Hunan Agricultural University*. **34**(2): 226–228.

Stoltz, B. and Whitfield, J. B. 1992. Viruses and virus-like entities in the parasitic Hymenoptera. *Journal of Hymenoptera Research*. **1**(1): 125–139.

Strand, M. R. and Obrycki, J. J. 1996. Host specificity of insect parasitoids and predators. *Bioscience*, **46**: 422–429.

Sumodan, P. K. and Sevichan, P. J. 1989. A new species of *Apanteles* Foerster (Hymenoptera: Braconidae) reared from a pyralid pest of *Azolla*. *Journal of Ecobiology*. **1**(4): 319–322.

Sumodan, P. K. and Narendran, T. C. 1990. Five new species of *Apanteles* Foerster (Hymenoptera: Braconidae) from Kerala, India. *Journal of Ecobiology*. **2**(3): 239–248.

Szépligeti, G. 1900. Braconiden aus New-Guinea in der Sammlung des Ungarischen National Museums, *Természetrajzi Fiizetek.* **23**: 49-65.

Tadic, M. D. 1958. *Apanteles hyphantriae* Riley, an egg parasite of the fall webworm. *Proceedings of the 10th International Congress of Entomology*. Montreal. **1956**. 4: 859–861.

Tobias, V. I. & Kotenko, A. G. 1986. Family Braconidae, subfamily Microgastrinae. Pp.1-509 in Medvedev, G. (Ed.) *Key to the insects of European part of USSR*, **3**(4). Nauka, Leningrad. [In Russian.]

Torreno, H. S. 1990. Parasitization behaviour and efficiency of the braconid, *Microgaster manilae* (Ashmead), against the cutworm, *Spodoptera litura* (F.). *Tropical Pest Management*. **36**(2): 128–130.

Valentine, E. W. and Walker, A. K. 1991. Annotated catalogue of New Zealand Hymenoptera. *D.S.I.R. Plant Protection Report* No. 4.

Valerio, A. A., Deans, A. R. and Whitfield, J. B. 2004. Review of the microgastrine braconid wasp genus *Exoryza*, with description of a new species, *E. monocavus*, from Central America. *Zootaxa*. **526**: 1–11.

Valerio, A. A. and Whitfield, J. B. 2005. Two new species of the genus *Austrocotesia* Austin & Dangerfield (Hymenoptera: Braconidae) from the Andean region of South America. *Zootaxa*. **888**: 1–11.

Valerio, A. A., Whitfield, J. B. and Janzen, D. H. 2009. Review of world *Parapanteles* Ashmead (Hymenoptera: Braconidae: Microgastrinae), with description of fourteen new Neotropical species and the first description of the final instar larvae. *Zootaxa*. **2084**: 1–49.

Veena, T., Ranjith, A. P., Santhosh. S. and Kishore, L. 2014. Review of the Oriental genus *Neoclarkinella* Rema and Narendran 1996 (Hymenoptera: Braconidae, Microgastrinae) with the description of two new species from India. *Zootaxa* **3857** (3): 423–432.

Viereck, H. L. 1911. Descriptions of six new genera and thirty-one new species of Ichneumon flies. *Proceedings of the United States National Museum*. **40**:173–196.

Walker, A., Kitching I. and Austin, A. D. 1990. A reassessment of the phylogenetic relationships with in the Microgastrinae (Hymenoptera: Braconidae). *Cladistics* **6**: 291–306.

Westwood, J. O. 1882. Descriptions of new or imperfectly known species of Ichneumones Adsciti. *Tijdschrift voor Entomologie*. **25**: 17-48.

Wharton, R. A., Shaw, S. R., Sharkey, M. J., Wahl, D. B., Woolley, J. B., Whitfield, J. B., Marsh, P. M. and Johnson, W. 1992. Phylogeny of the subfamilies of the family Braconidae (Hymenoptera: Ichneumonoidea): A reassessment. *Cladistics*. **8** (3): 199–235.

Wharton, R. A., Marsh, P. M. and Sharkey, M. J. 1997. Manual of the new world genera of the family Braconidae (Hymenoptera). Special Publication 1. *International Society of Hymenopterists*, Washington, D.C. USA, pp. 439.

Whitfield, J. B. 1985. The Nearctic species of *Deuterixys* Mason (Hymenoptera: Braconidae). *Pan-Pacific Entomologist*. **61**(1):60–67.

Whitfield, J. B. 1995. *Xanthapanteles*, a new genus of Microgastrinae (Hymenoptera: Braconidae) from South America. *Proceedings of the Entomological Society of Washington*. **97**(4): 879–883.

Whitfield, J. B. 1997. Molecular and morphological data suggest a single origin of the polydnaviruses among braconid wasps. *The Science of Nature, Naturwissenschaften.* **84**(11): 502–507.

Whitfield, J. B. 1997. Subfamily Microgastrinae. *In*: Wharton, R. A, Marsh, P. M. and Sharkey, M. J. (Eds.), Manual of the New World Genera of the family Braconidae (Hymenoptera). *Special Publication of the International Society of Hymenopterists*, No. **1**: 333–364.

Whitfield, J. B. 2006. Revision of the Nearctic species of the genus *Pholetesor* Mason (Hymenoptera: Braconidae). *Zootaxa*. **1144**: 3–94.

Whitfield, J. B. and W. R. M. Mason. 1994. Mendesellinae, a new subfamily of braconid wasps (Hymenoptera, Braconidae) with a review of relationships within the microgastroid assemblage. *Systematic Entomology*. **19**: 61–76.

Whitfield, J. B., Mardulyn, P., Austin, A. D. and Dowton, M. 2002. Phylogenetic relationships among microgastrine braconid wasp genera based on data from the 16S, COI and 28S genes and morphology. *Systematic Entomology*. **27**(3):337–359.

Whitfield, J. B. and Oltra-Moscardo, M. T. 2004. The Neotropical species of *Deuterixys* Mason (Hymenoptera: Braconidae). *Journal of Hymenoptera Research*. **13**(1): 134–148.

Whitfield, J. B., Rasmussen, C. and Arias-Penna, D. C. 2011. Review of the new world genus *Venanus* (Hymenoptera: Braconidae: Microgastrinae), with a new key and descriptions of three new reared Neotropical species. *Annals of the Entomological Society of America*. **104** (6):1119–1127.

Whitefield, J. B., Fernández-Triana., J. L., Janzen, D. H., Hallwachs, W., Smith, M. A. and Cardinal S. 2012. *Mariapanteles* (Hymenoptera, Braconidae), a new genus of Neotropical microgastrine parasitoid wasp discovered through biodiversity inventory. *ZooKeys*. **208**: 61–80.

Wilbert, H. 1960. *Apanteles pieridis* (Bouché) (Hym., Braconidae), ein parasit von *Aporia crataegi* (L.) (Lep., Pieridae). *Entomophaga.* **5**(3):183–211.

Wilkinson, D. S. 1927. On the Indo-Malayan species of the genus *Microgaster* (Hymenoptera: Braconidae), *Bulletin of Entomological Research*. **18**: 171–178.

Wilkinson, D. S. 1928a. A revision of the Indo-Australian species of the genus *Apanteles* (Hym. Bracon.). Part I., *Bulletin of Entomological Research*. **19**:79–105.

Wilkinson, D. S. 1928b. A revision of the Indo-Australian species of the genus *Apanteles* (Hym. Bracon.). Part II., *Bulletin of Entomological Research*. **19**:109–146.

Wilkinson, D. S. 1930. A revision of the Indo-Australian species of the genus *Microplitis* (Hym. Bracon.). *Bulletin of Entomological Research*. **21**: 23–27.

Wilkinson, D. S. 1932. A revision of the Ethiopian species of the genus *Apanteles* (Hym. Bracon.). *Transactions of the Entomological Society of London*. **80**: 301–344.

Wilson, J. S., Forister M. L., Dyer, L. A., O'Connor, J. M., Buris, K., Feldman, C. R., Jaramillo, M. A., Miller, J. S., Rodríguez-Castañeda, G., Tepe, E. J., Whitfield, J. B. and Young, B. 2012. Host Conservatism, host shift and diversification across three trophic levels in two Neotropical forests. *Journal of Evolutionary Biology*. **25**: 532–546.

You, L. S., Xiong, S. L. and Zhou, Z. H. 1987. [On a new species of *Apanteles* Foerster from Yunnan Province (China) (Hymenoptera: Braconidae: Microgasterinae).]. *Acta Zootaxonomica Sinica*. **12**(4): 424–426.

Yu, D. S., Achterberg, C, van. and Horstmann, K. 2012. Taxapad 2012, Ichneumonoidea 2011. Ottawa, Ontario, Canada. Database on flash-drive. www.taxapad.com.

Zeng, J., He, Jun-Hua and Chen., X. X.. 2011. The genera *Deuterixys* Mason, 1981 and *Wilkinsonellus* Mason, 1981 (Hymenoptera, Braconidae, Microgastrinae) from China, with description of two new species. *ZooKeys*. **120:** 27–40.

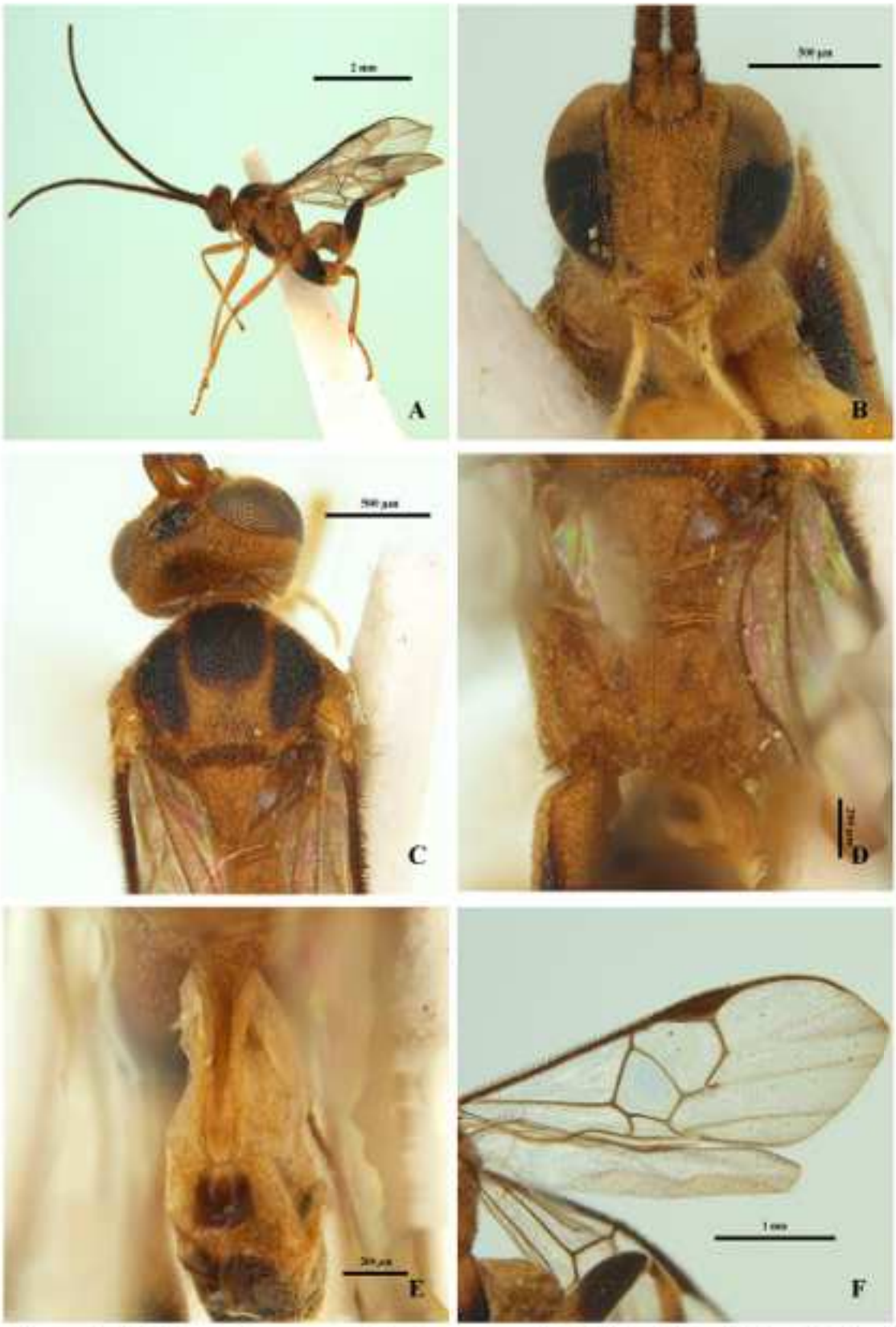


Figure 42. *Wilkinsonellus wayanadensis* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

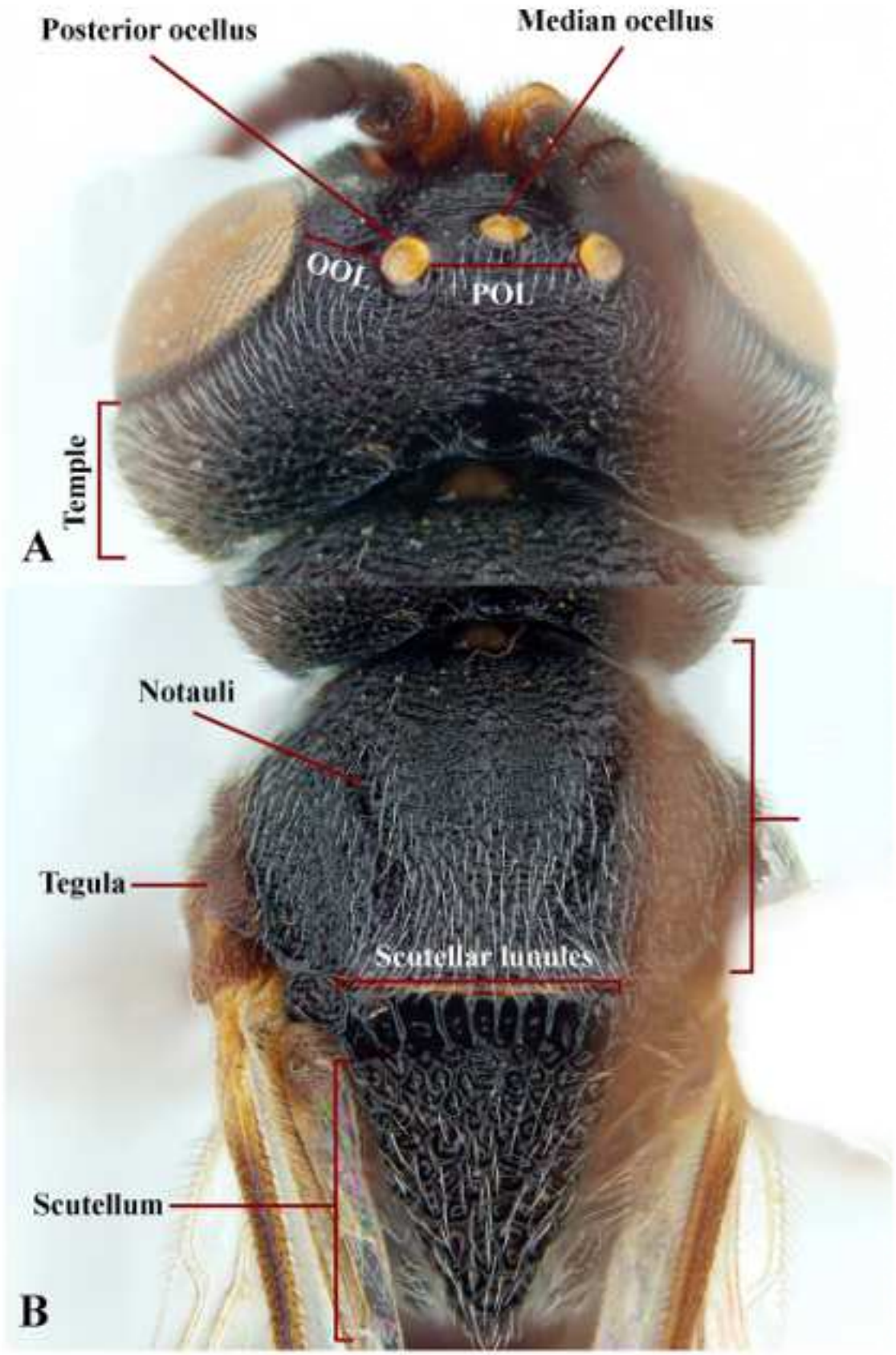


Figure 3. Morphology of microgastrine wasp A: Head, dorsal view; B Mesosoma, dorsal view

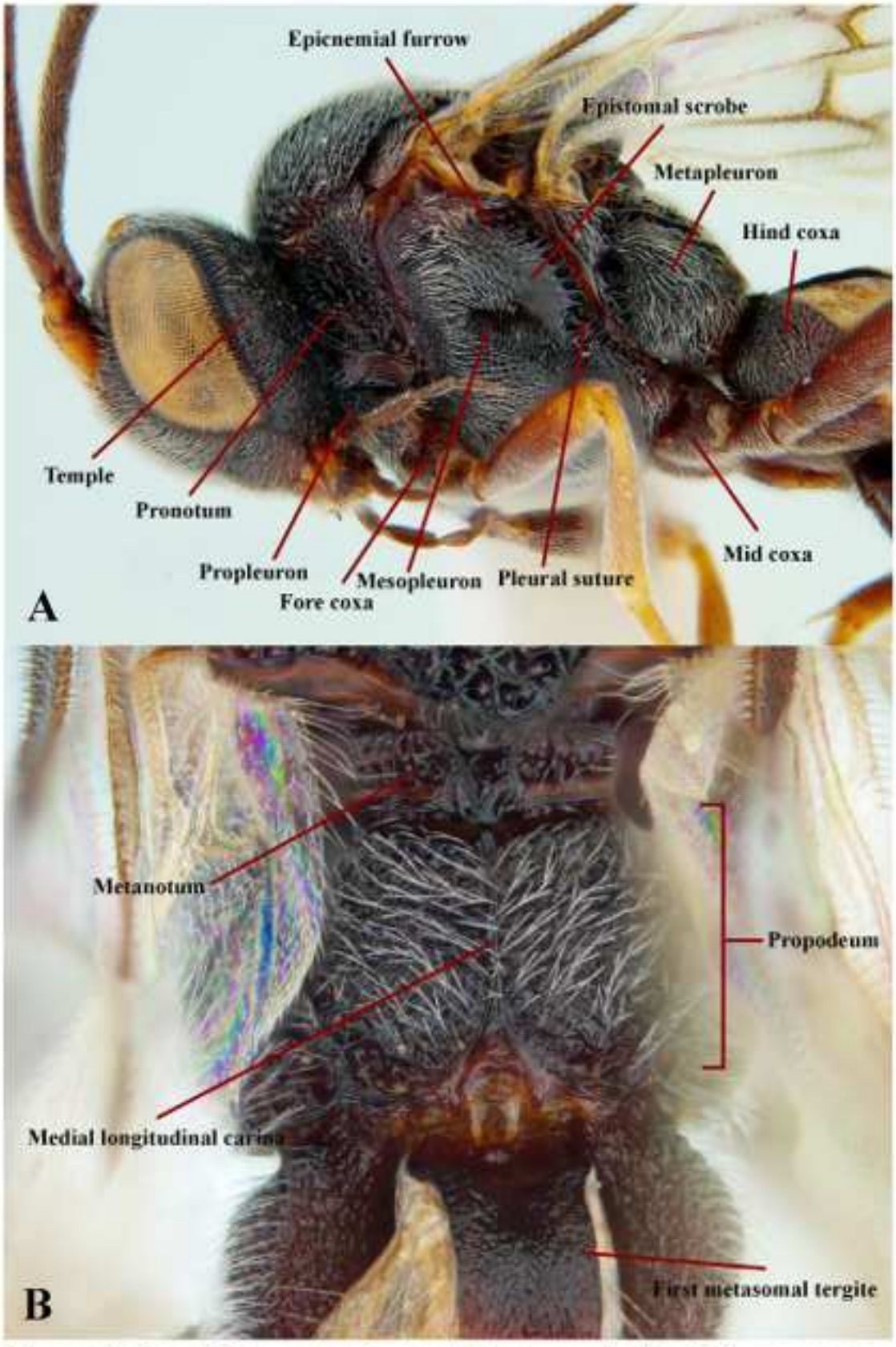


Figure 4. Morphology of microgastrine wasp A: Head & mesosoma, lateral view; B: Metanotum and propodeum, dorsal view

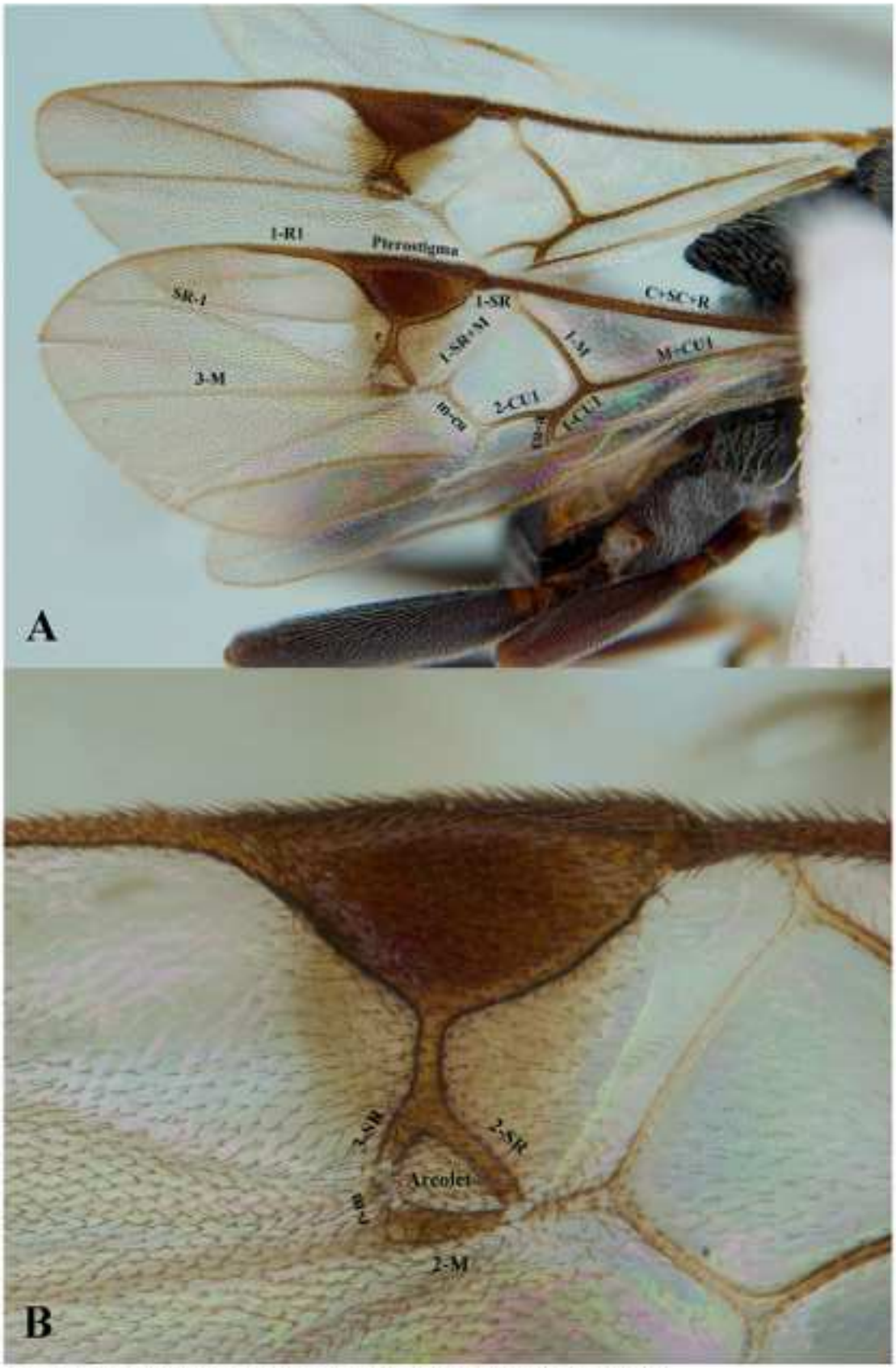


Figure 5. Morphology of microgastrine wasp A & B: Wings

Figure 6. Morphology of microgastrine wasp A: First metasomal tergite, dorsal view; T2-T6, dorsal view

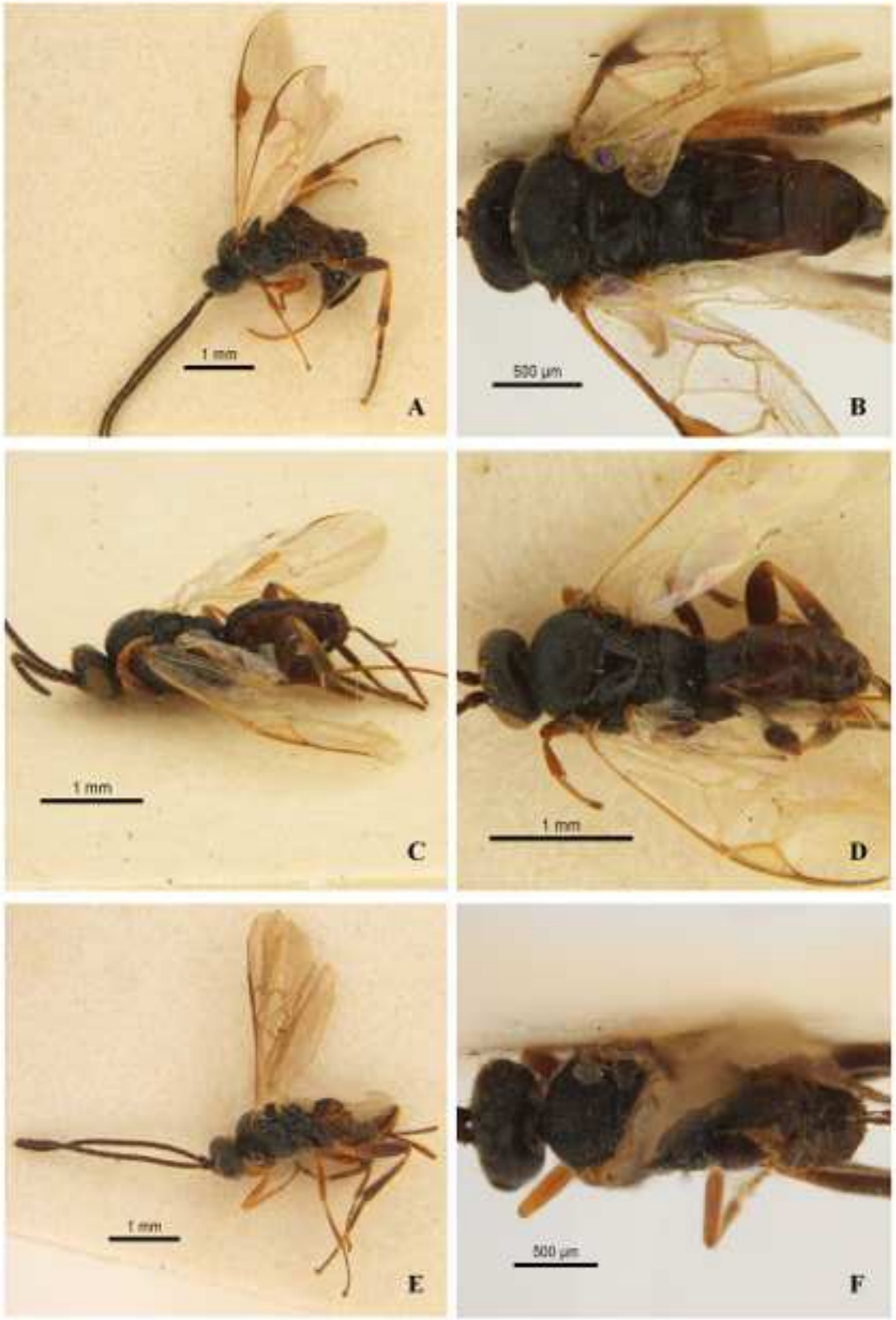


Figure 7. A) *Apanteles agilis* (Ashmead), habitus, lateral view; B) Dorsal view; C) *Apanteles araeceri* Wilkinson, habitus, lateral view; D) Dorsal view; E) *Apanteles bambusae* Wilkinson, habitus, lateral view; F) Dorsal view

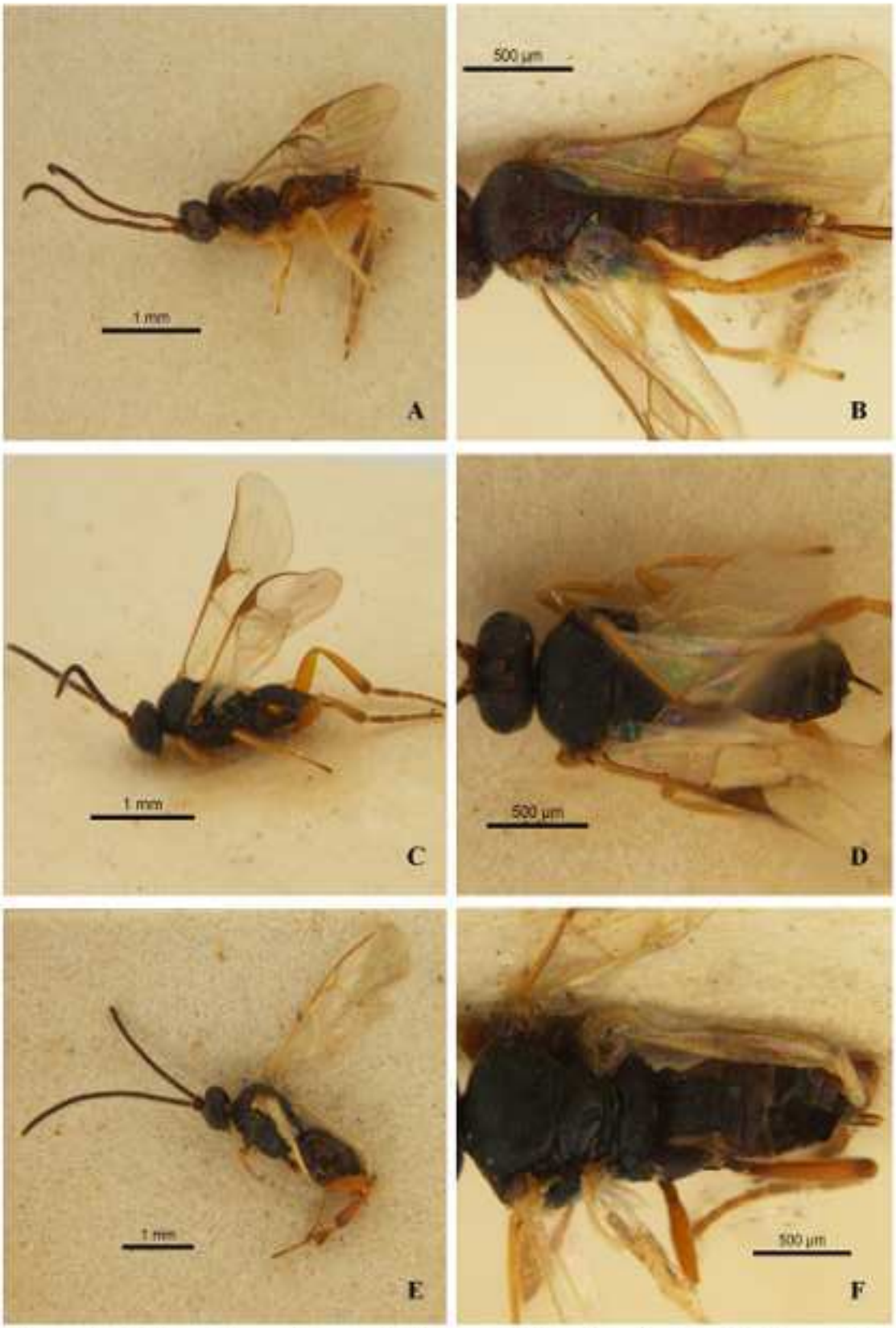


Figure 8. A) *Apanteles calycinae* Wilkinson, habitus, lateral view; B) Dorsal view; C) *Apanteles expulsus* Turner, habitus, lateral view; D) Dorsal view; E) *Apanteles grandiculus* Wilkinson, habitus, lateral view; F) Dorsal view

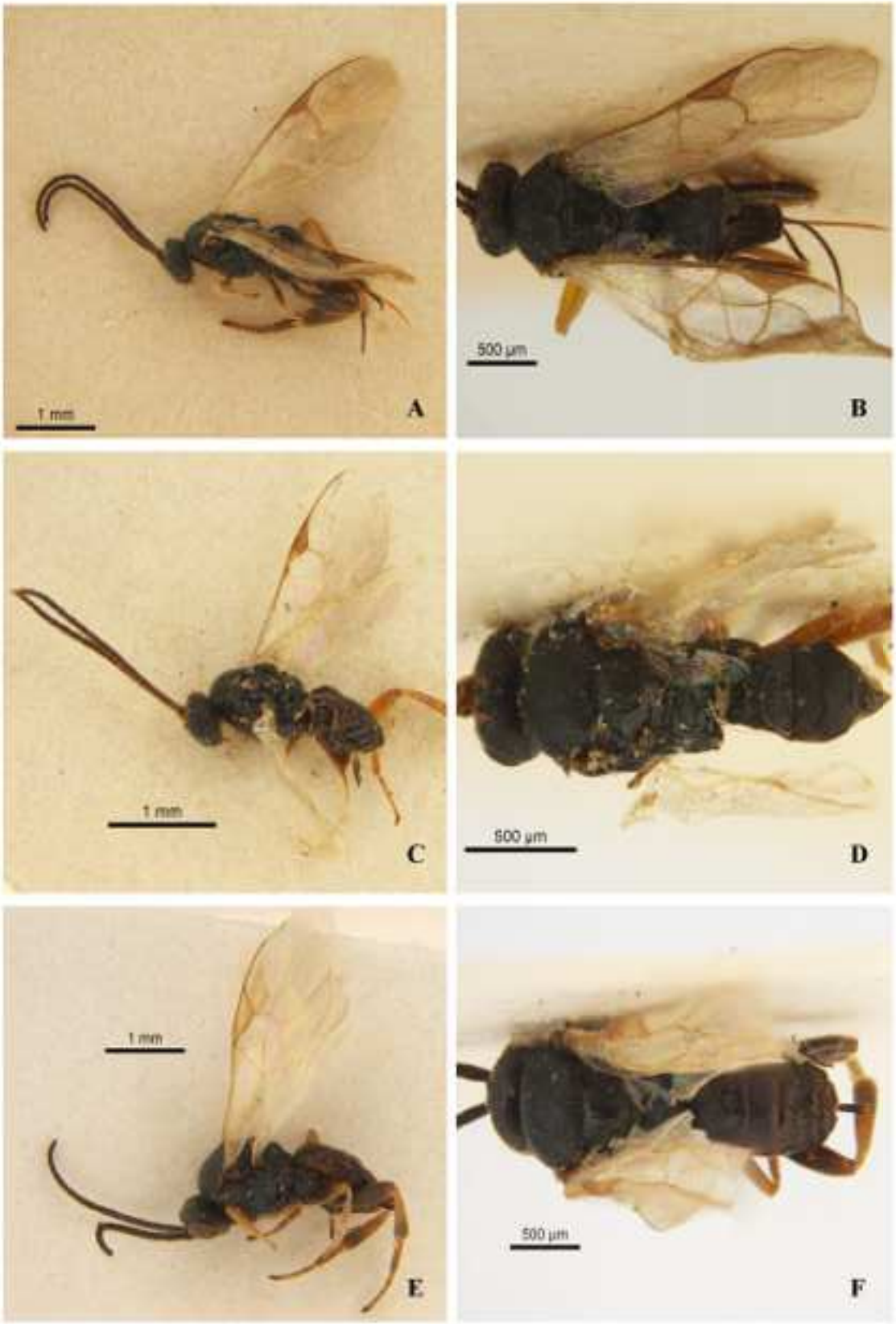


Figure 9. A) *Apanteles hasorae* Wilkinson, habitus, lateral view; B) Dorsal view; C) *Apanteles hemitheae* Wilkinson, habitus, lateral view; D) Dorsal view; E) *Apanteles hyposidrae* Wilkinson, habitus, lateral view; F) Dorsal view

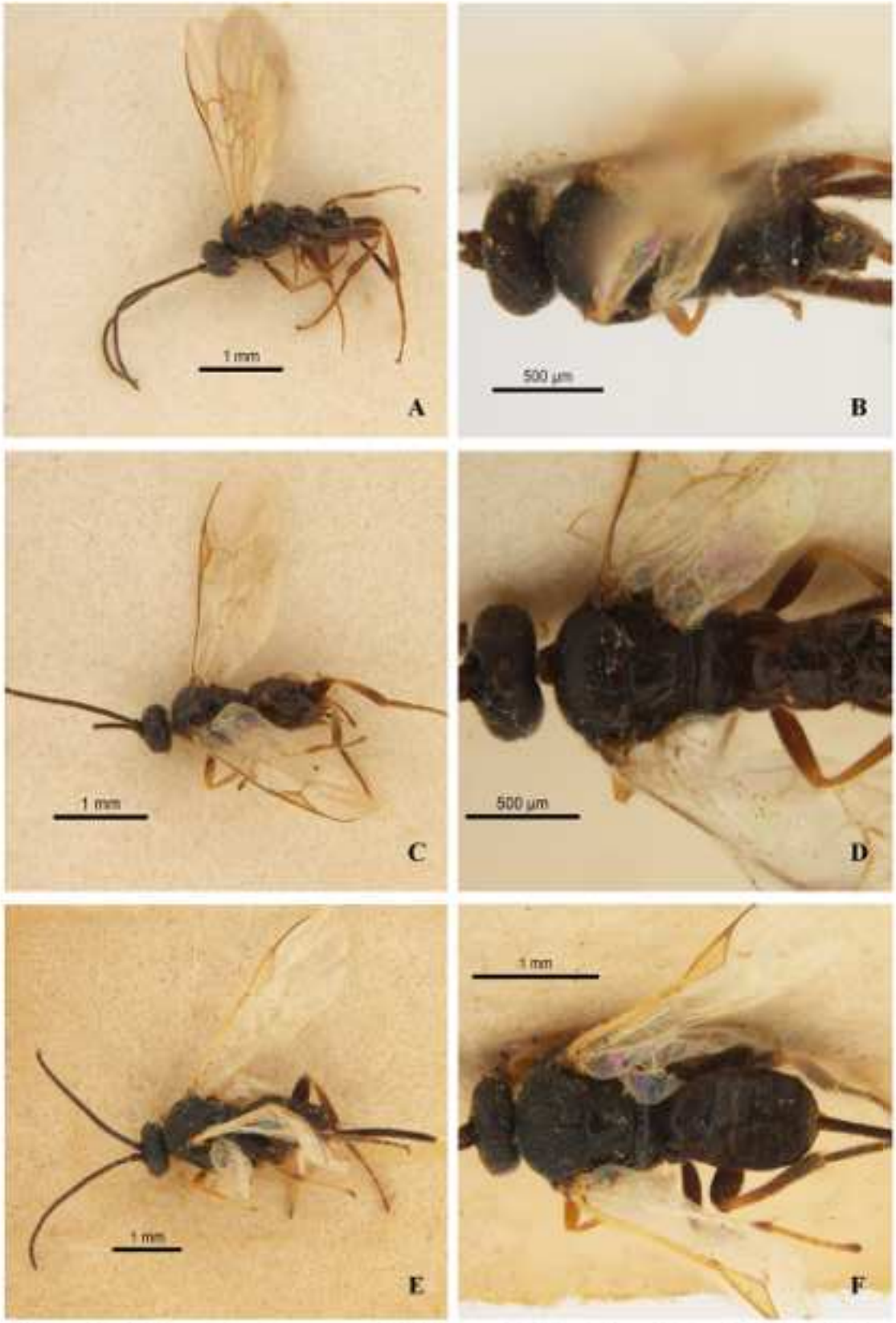


Figure 10. A) *Apanteles importunus* Wilkinson, habitus, lateral view; B) Dorsal view; C) *Apanteles javensis* Rohwer, habitus, lateral view; D) Dorsal view; E) *Apanteles leptothecus* (Cameron), habitus, lateral view; F) Dorsal view

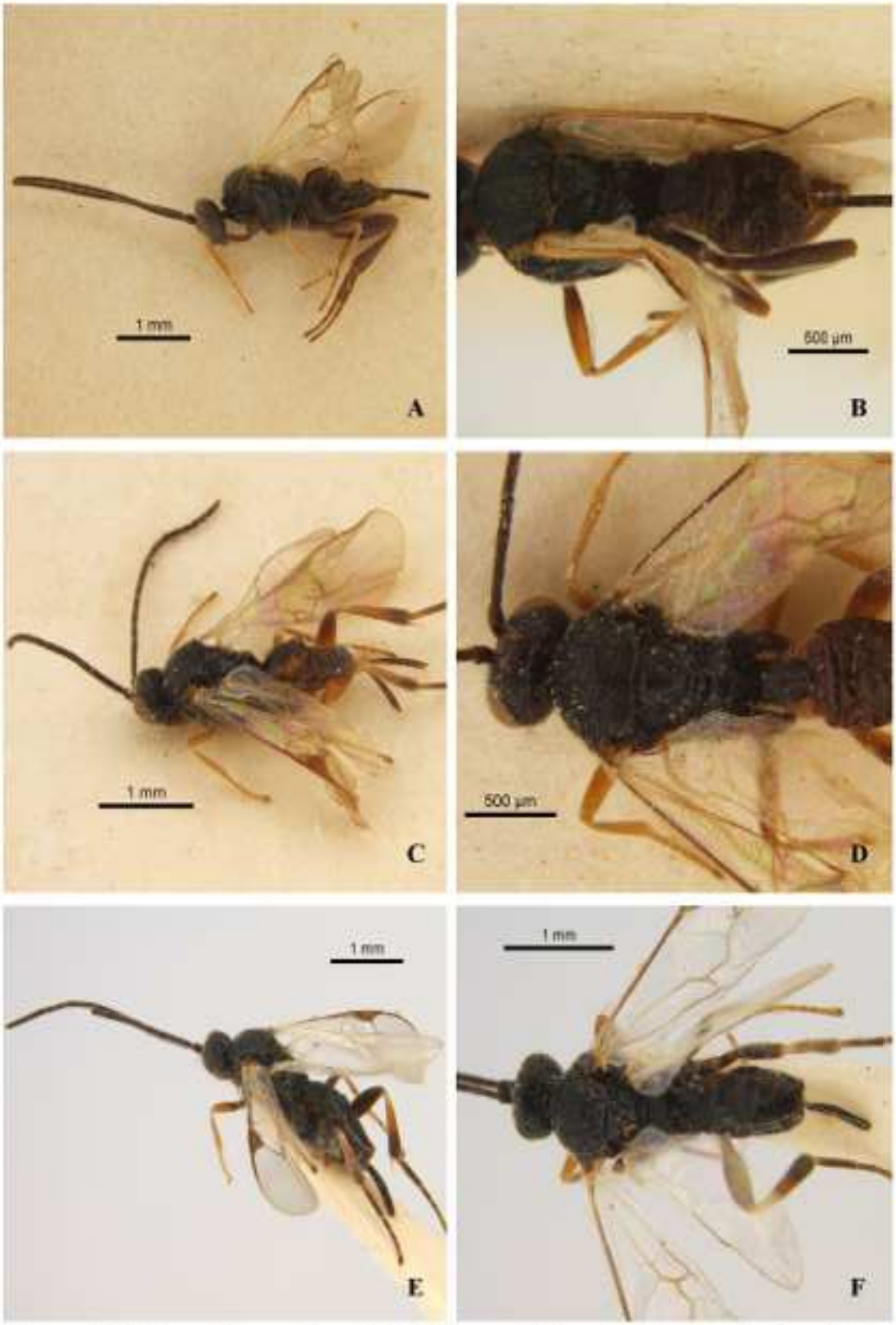


Figure 11. A) *Apanteles machaeralis* Wilkinson, habitus, lateral view; B) Dorsal view; C) *Apanteles opacus* (Ashmead), habitus, lateral view; D) Dorsal view; E) *Apanteles parasae* Rohwer, habitus, lateral view; F) Dorsal view

Figure 12. A) *Apanteles singaporensis* Széligeti, habitus, lateral view; B) Dorsal view; C) *Apanteles stantoni* (Ashmead), habitus, lateral view; D) Dorsal view; E) *Apanteles tachardiae* Cameron, habitus, lateral view; F) Dorsal view

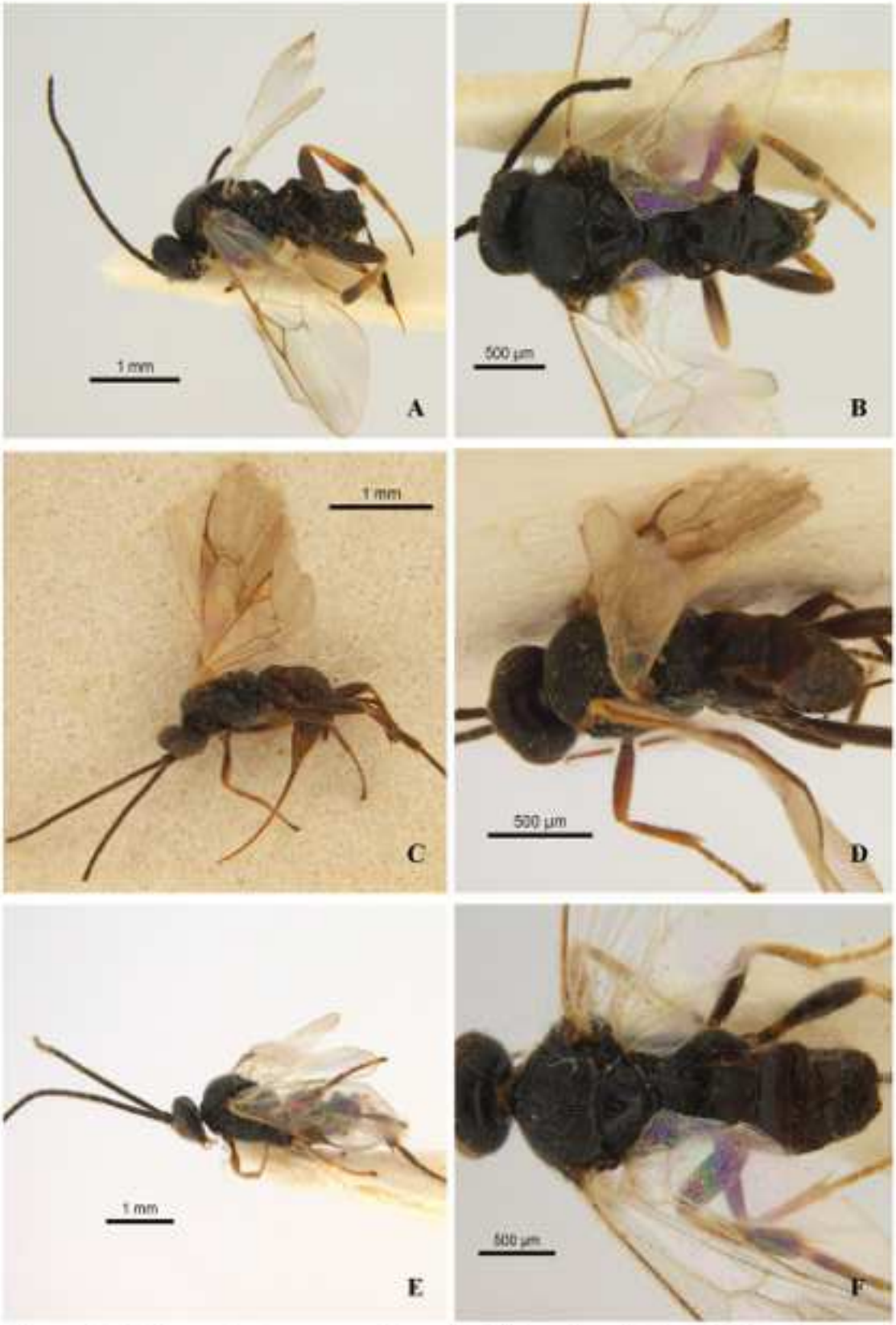


Figure 13. A) *Apanteles taragamae* Viereck, habitus, lateral view; B) Dorsal view; C) *Apanteles tasmanica* Cameron, habitus, lateral view; D) Dorsal view; E) *Apanteles valvulae* Rao & Kurian, habitus, lateral view; F) Dorsal view

Figure 14. *Buluka quickei* Ranjith, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

Figure 15. *Choeras achterbergi* Narendran, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Metasoma, dorsal view

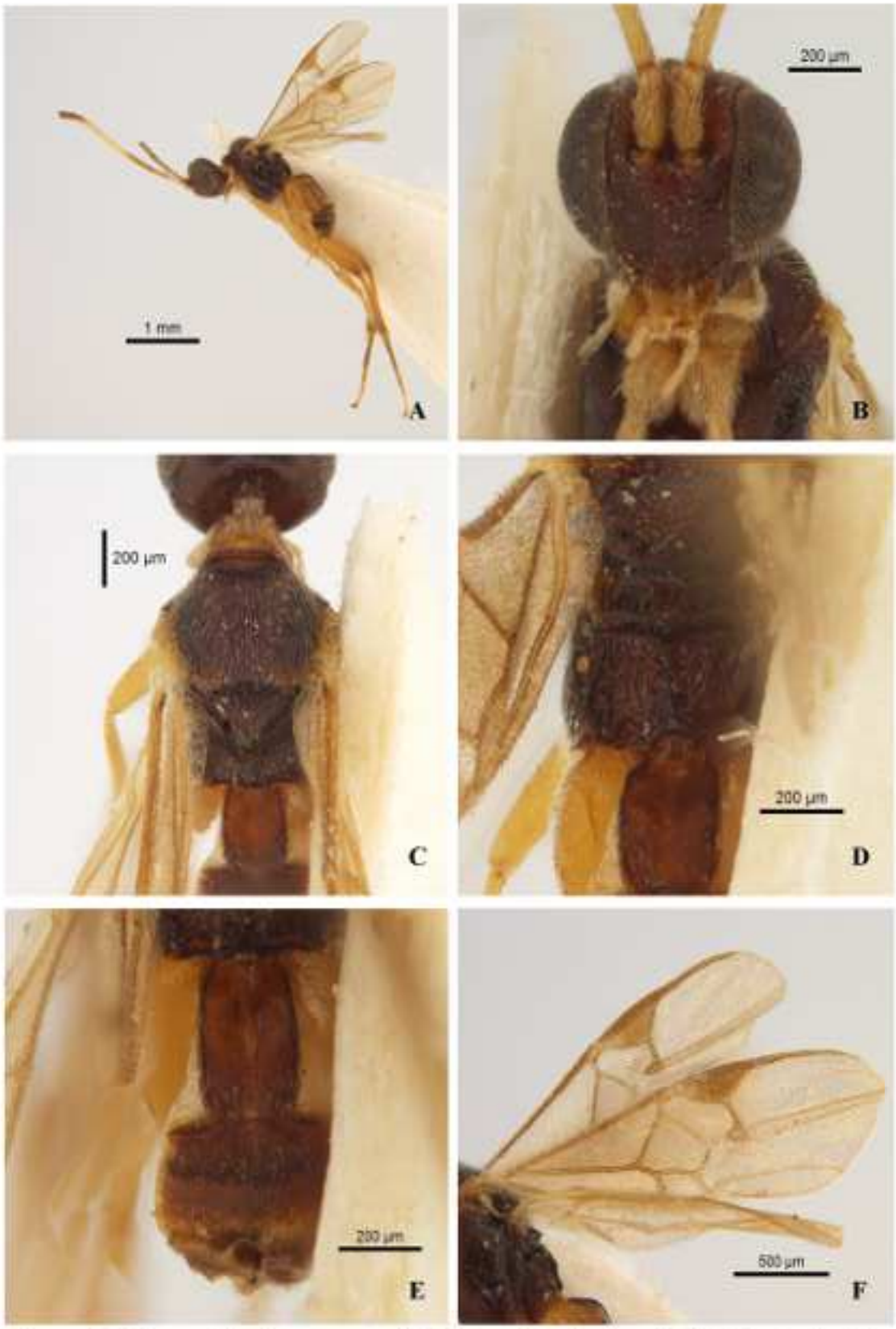


Figure 16. *Choeras bicolor* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

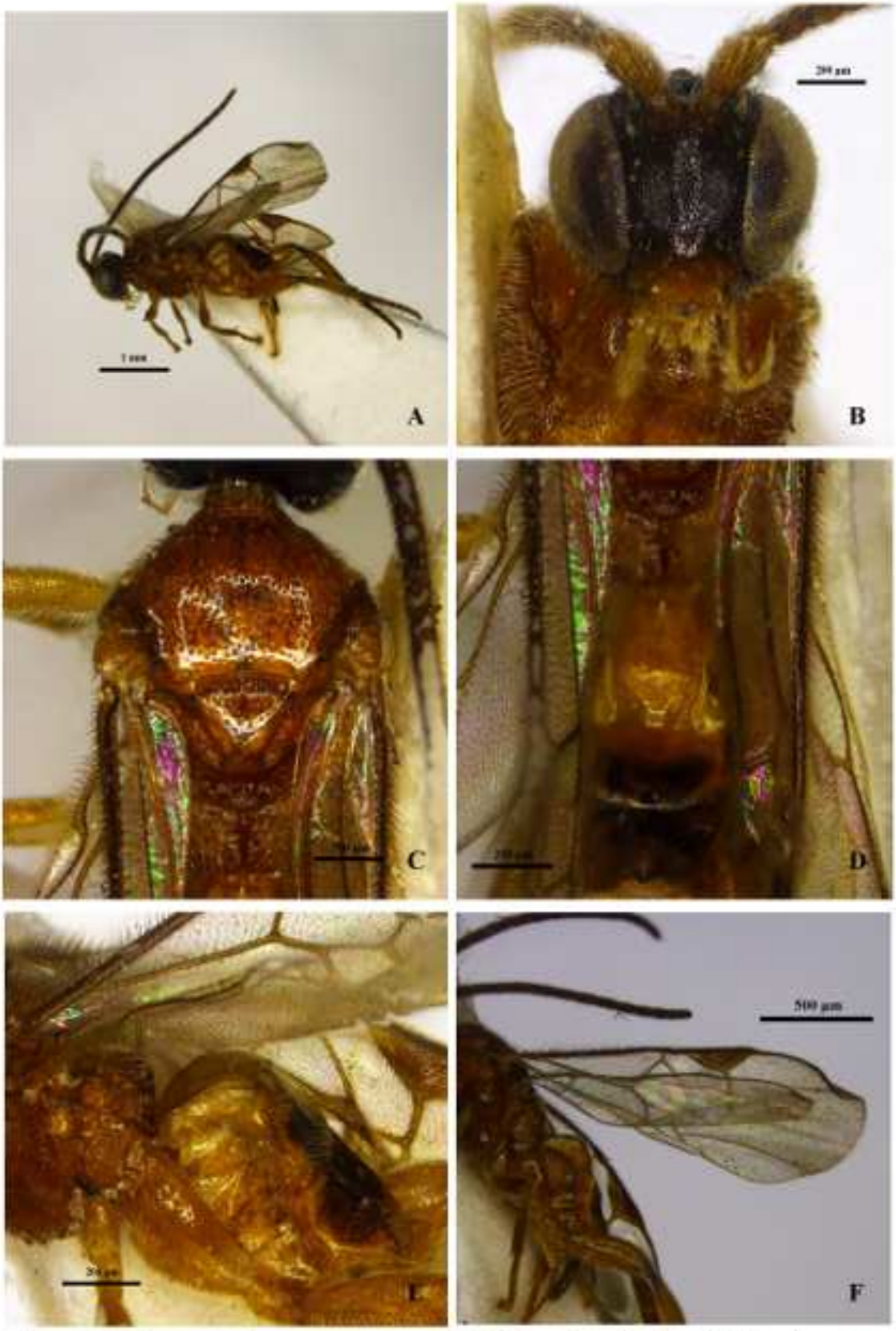


Figure 17. *Choeras nirupama* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, lateral view; F) Wings

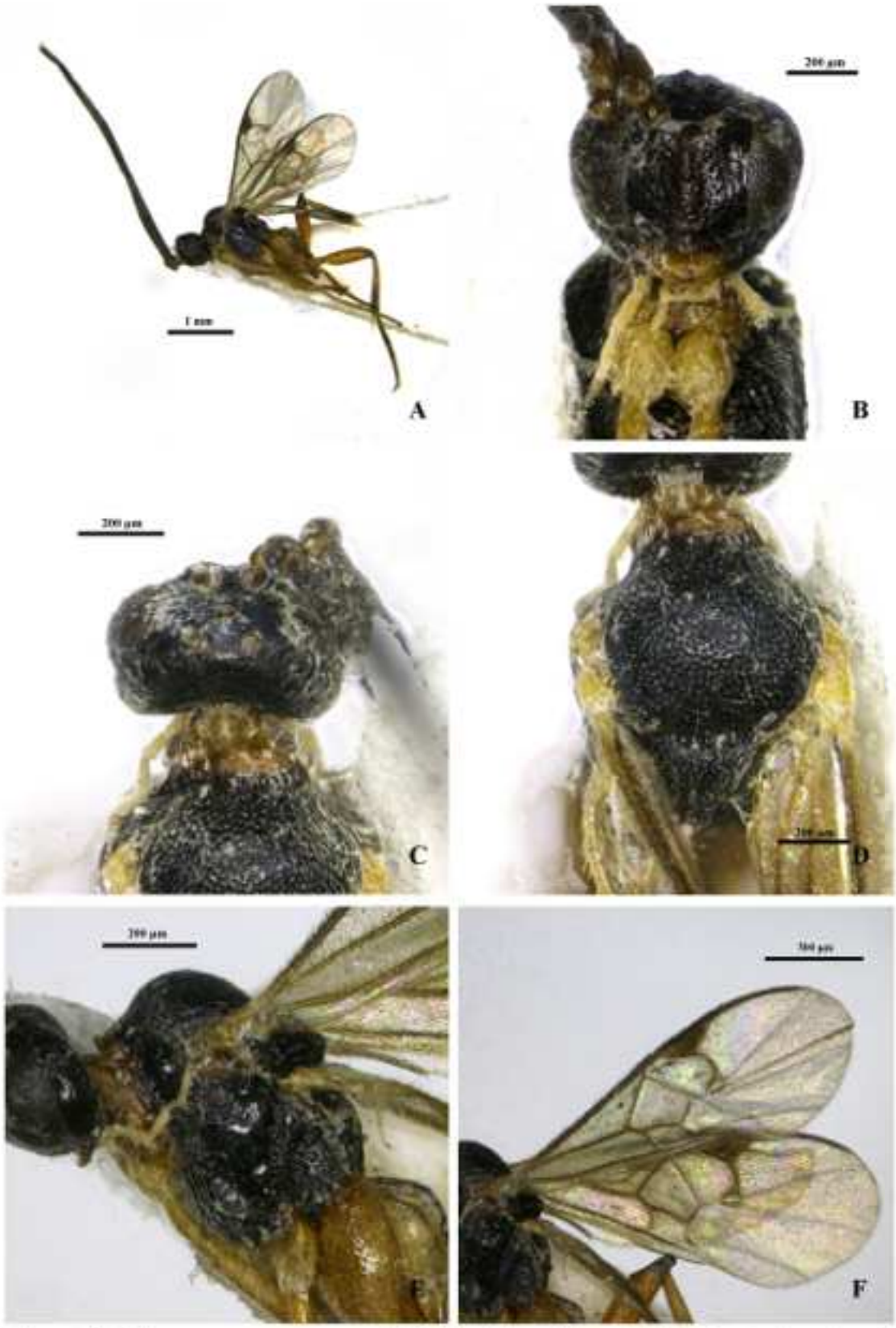


Figure 18. *Choeras novus* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Head, dorsal view; D) Mesosoma, dorsal view; E) Mesosoma, lateral view; F) Wings

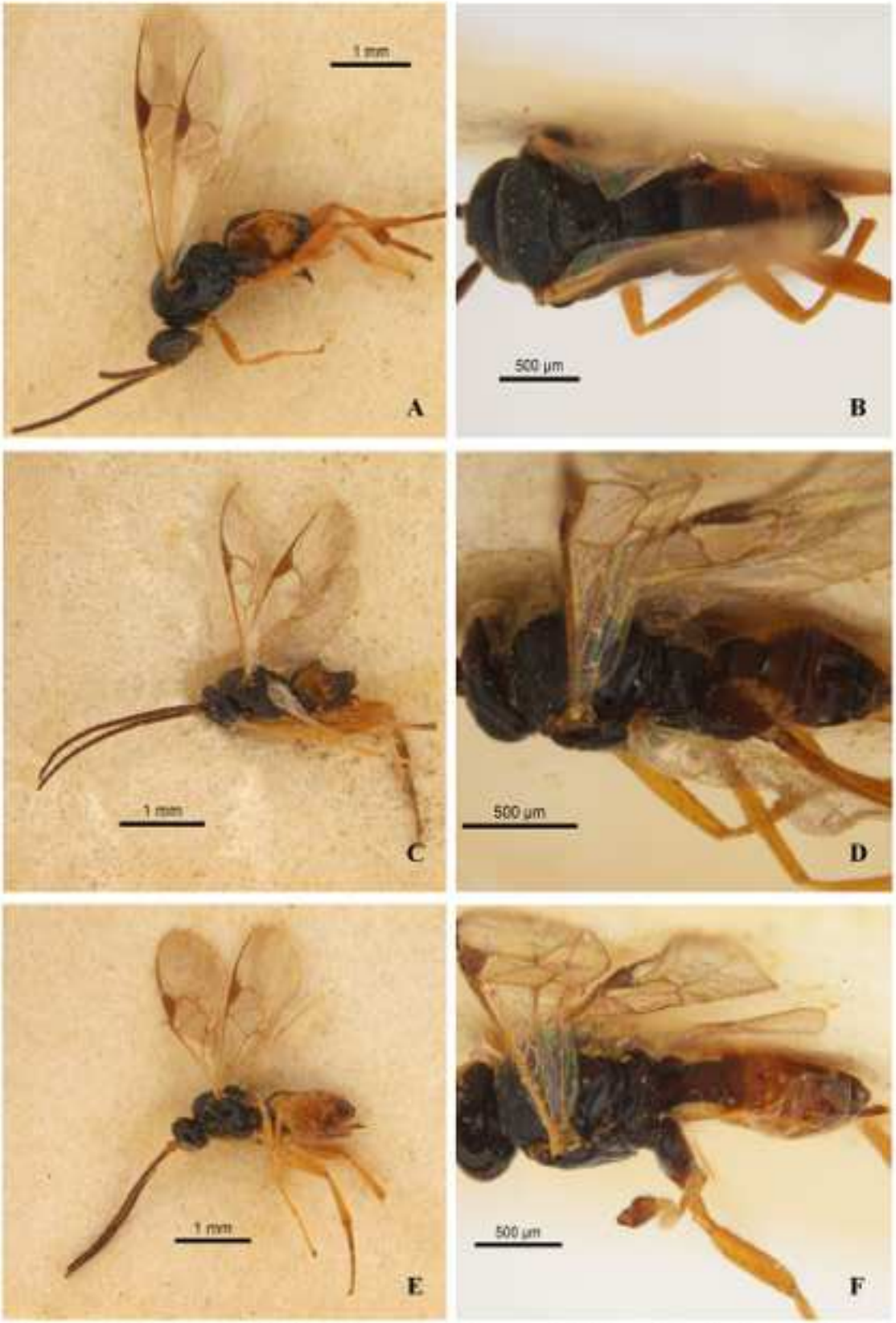


Figure 19. A) *Cotesia bifida* (Sharma) comb. nov., habitus, lateral view; B) Dorsal view; C) *Cotesia euthaliae* (Bhatnagar) comb. nov., habitus, lateral view; D) Dorsal view; E) *Cotesia philoeampus* (Cameron), habitus, lateral view; F) Dorsal view

Figure 20. A) *Cotesia pratapae* (Ashmead) comb. nov., habitus, lateral view; B) Dorsal view; C) *Cotesia ruficrus* (Haliday), habitus, lateral view; D) Dorsal view

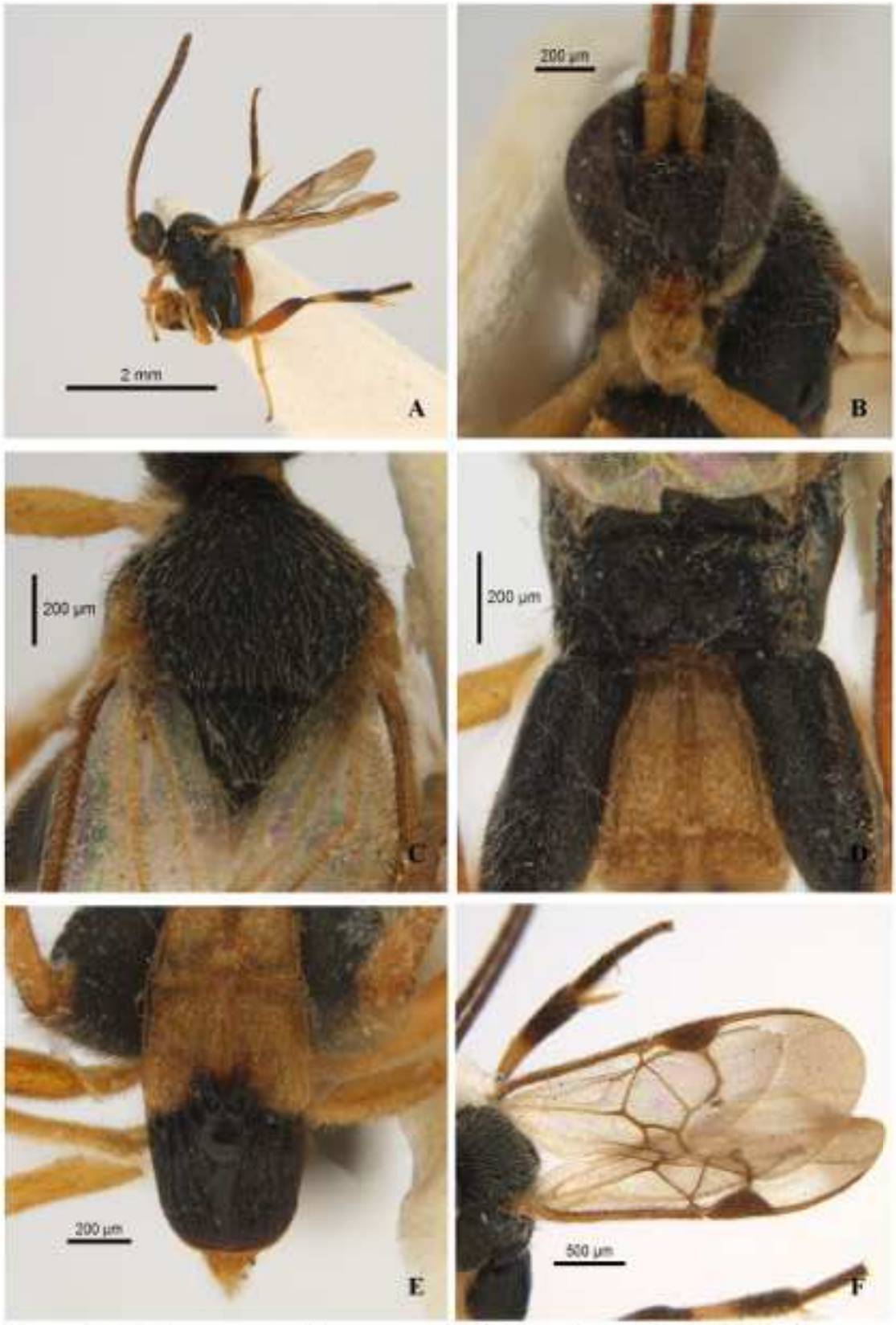


Figure 21. *Diolcogaster buddha* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

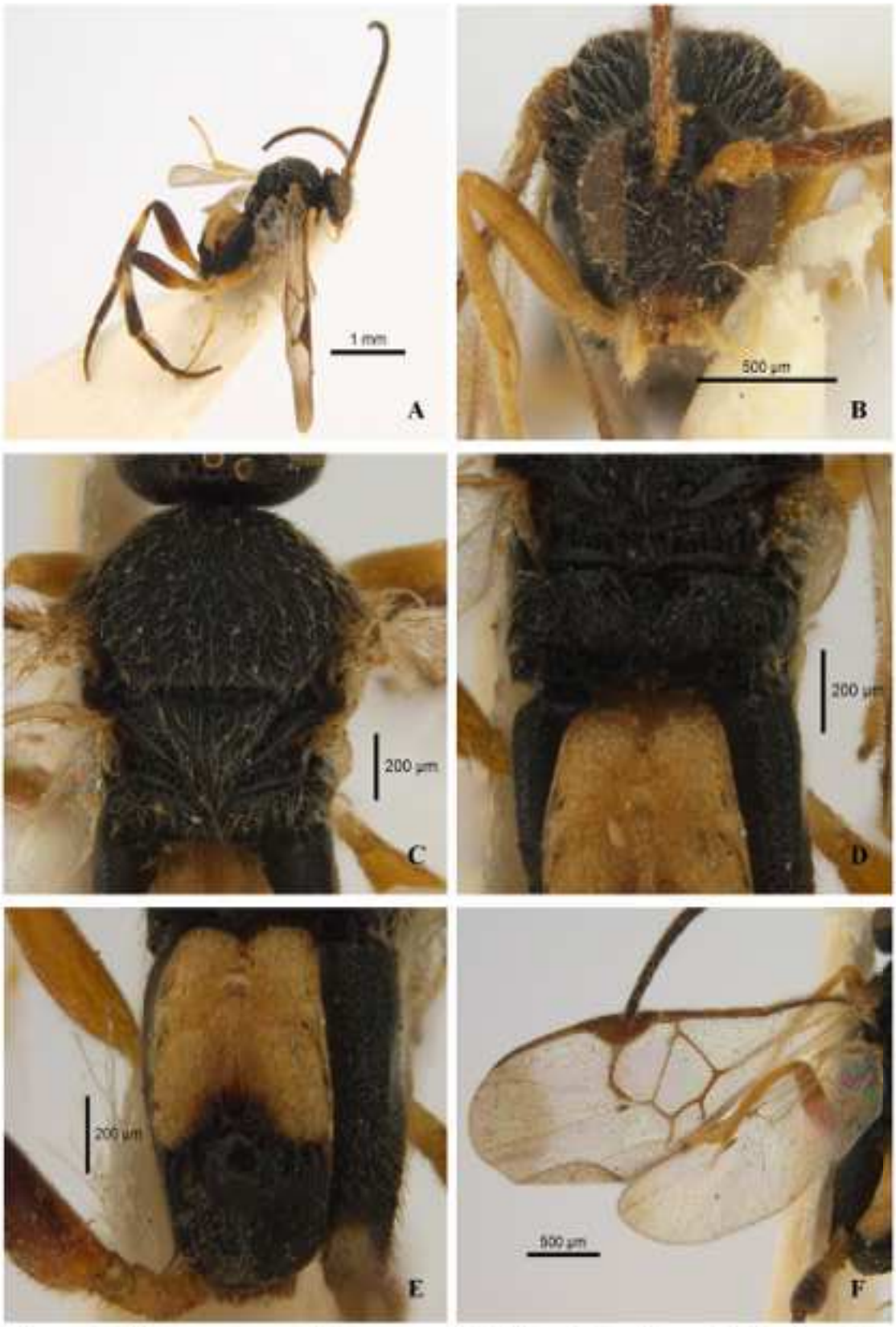


Figure 22. *Diolcogaster ranjithi* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

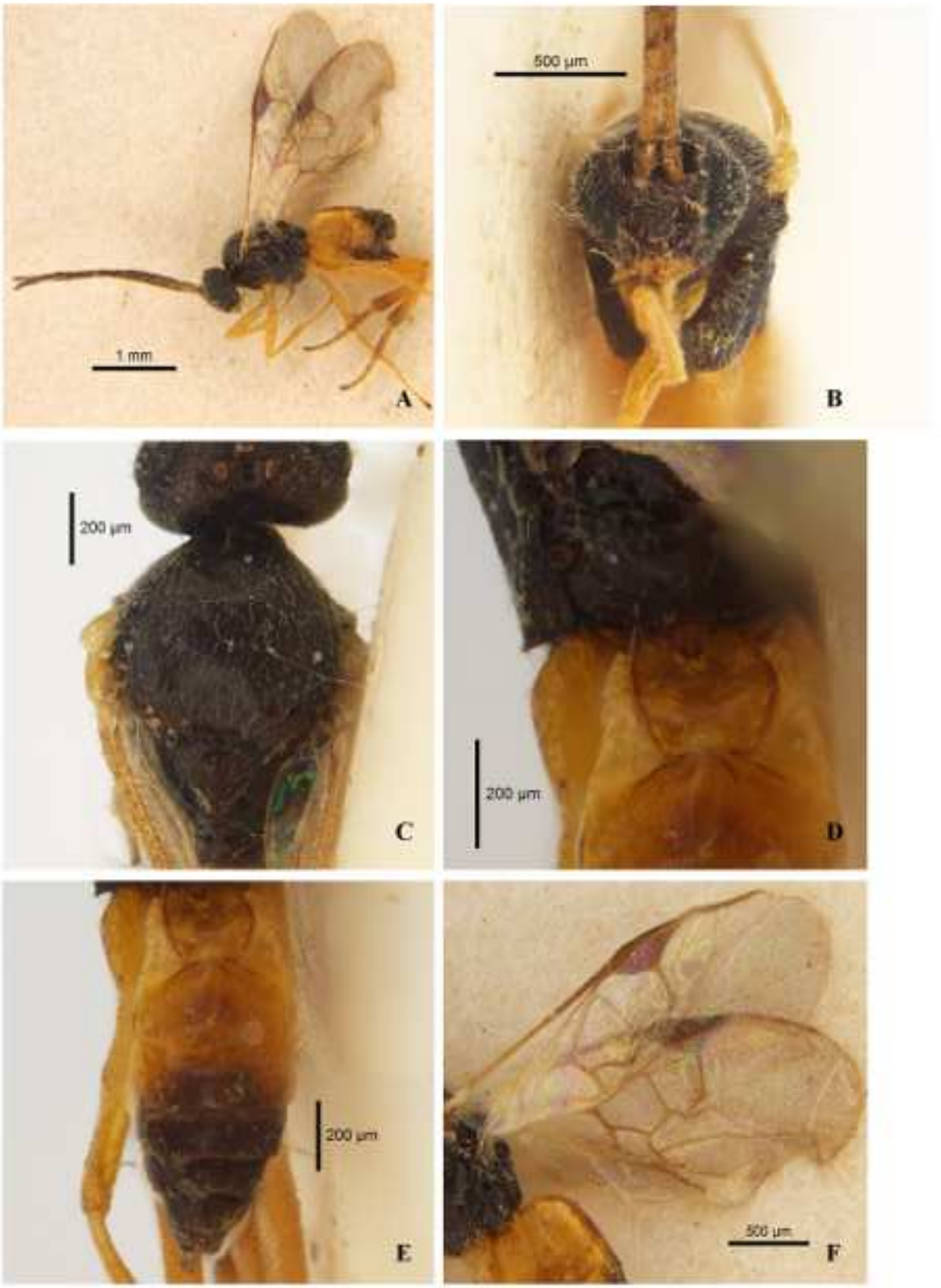


Figure 23. *Distatrix papilionis* (Viereck), A) Habitus, lateral view; B) Head, anterior view; C) Mesosoa, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

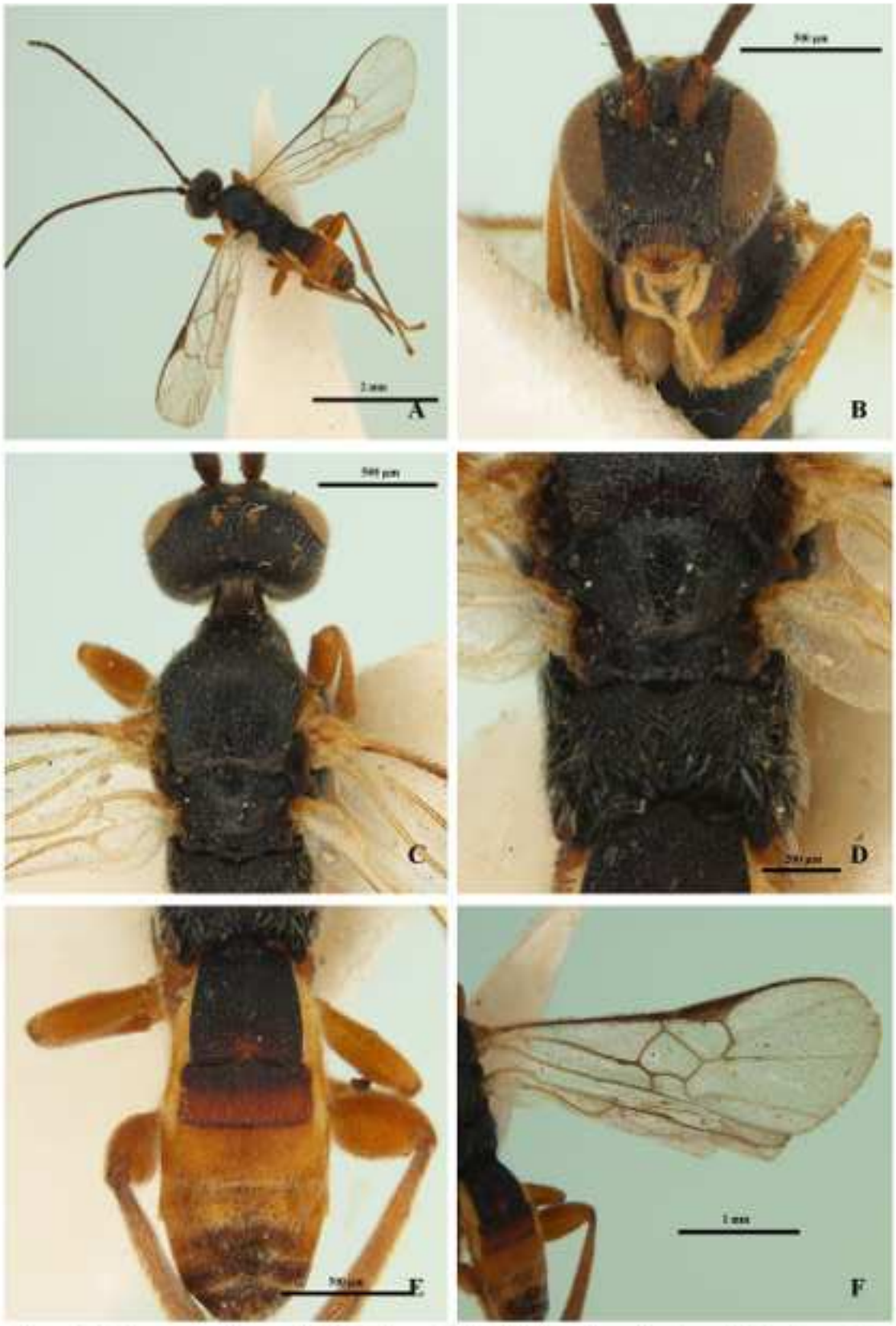


Figure 24. *Exoryza schoenobii* (Wilkinson), A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; Wings

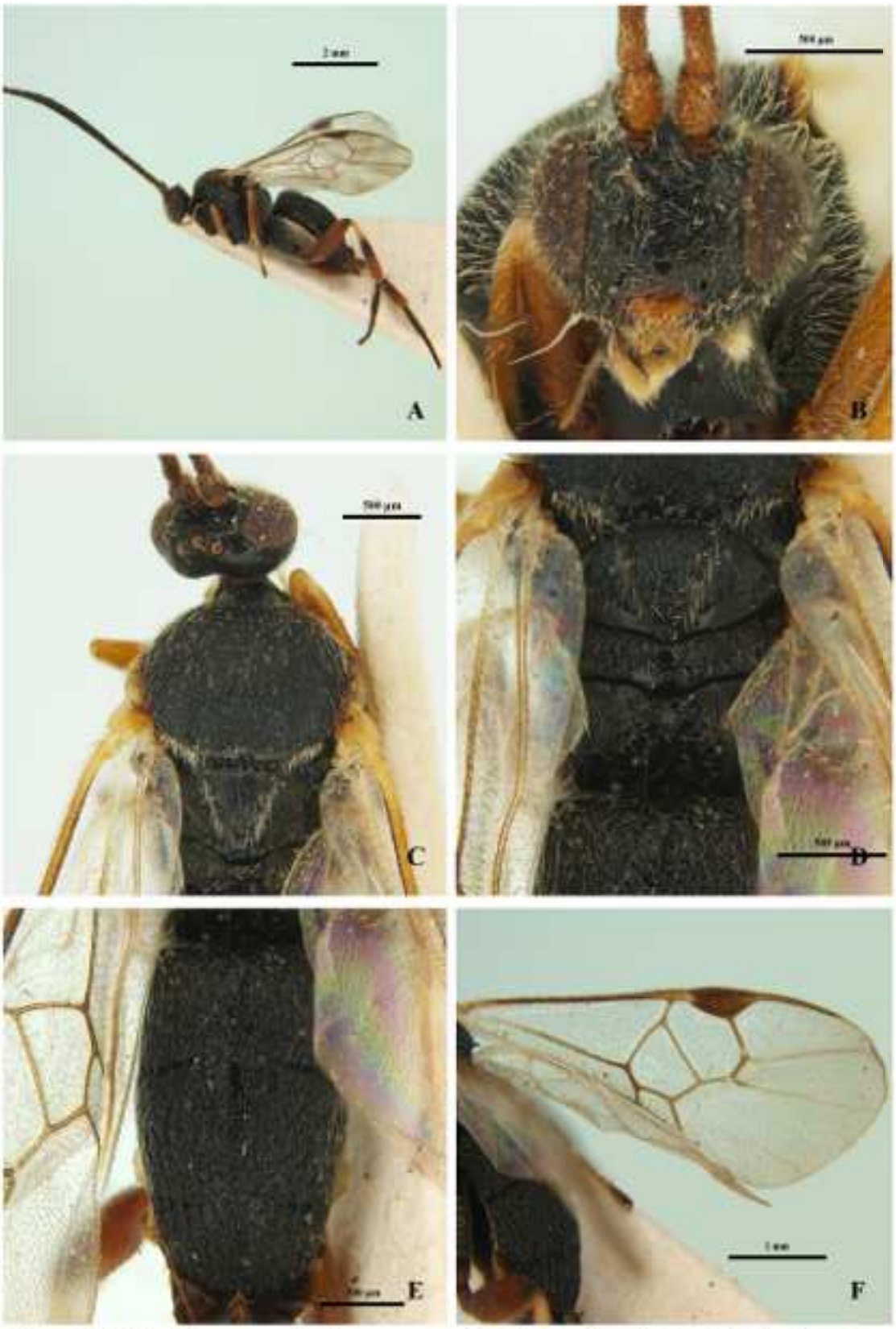


Figure 25. *Formicia neoceylonica* sp. nov., A) Habitus, dorsal view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F Wings

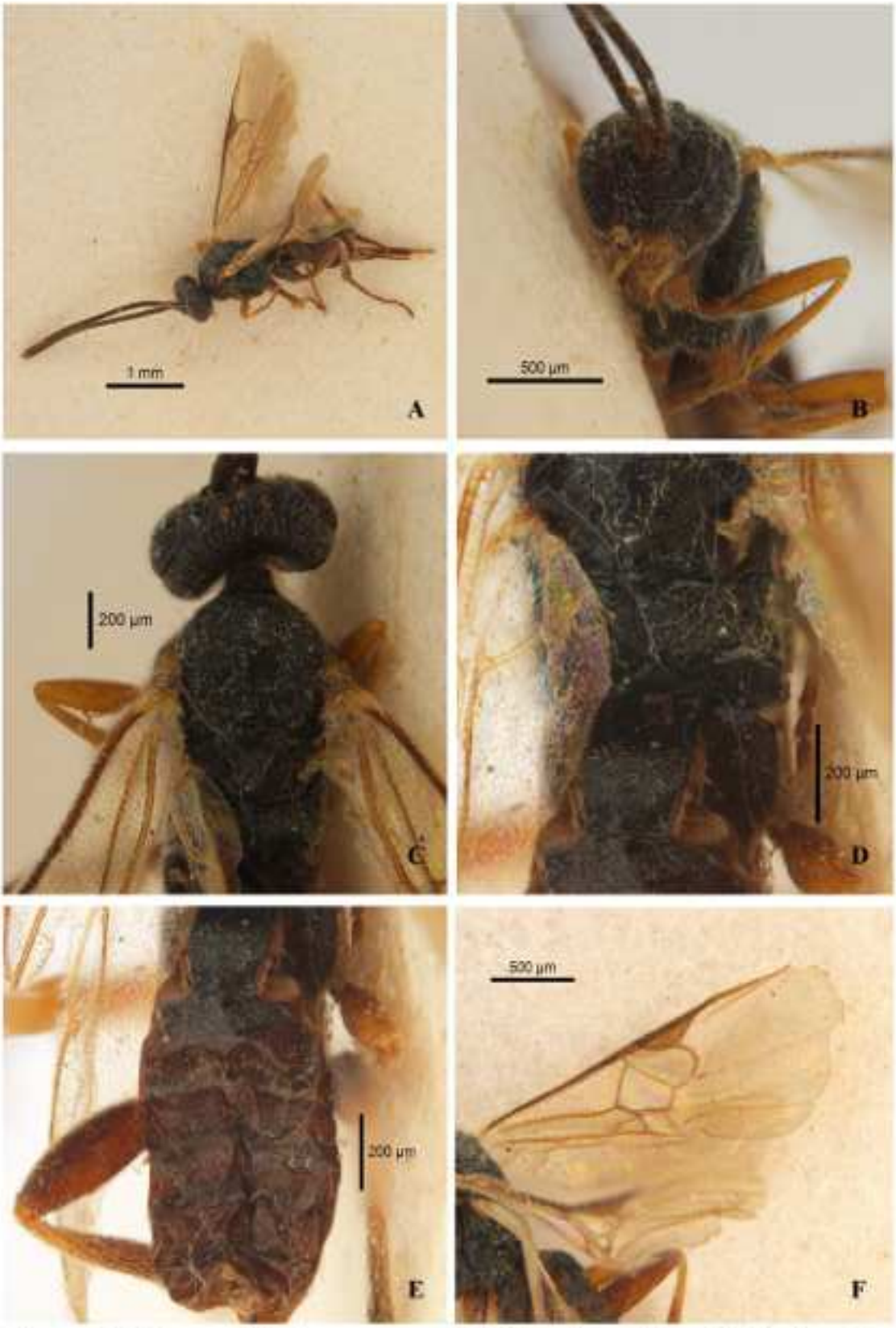


Figure 26. *Illidops malabaricus* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

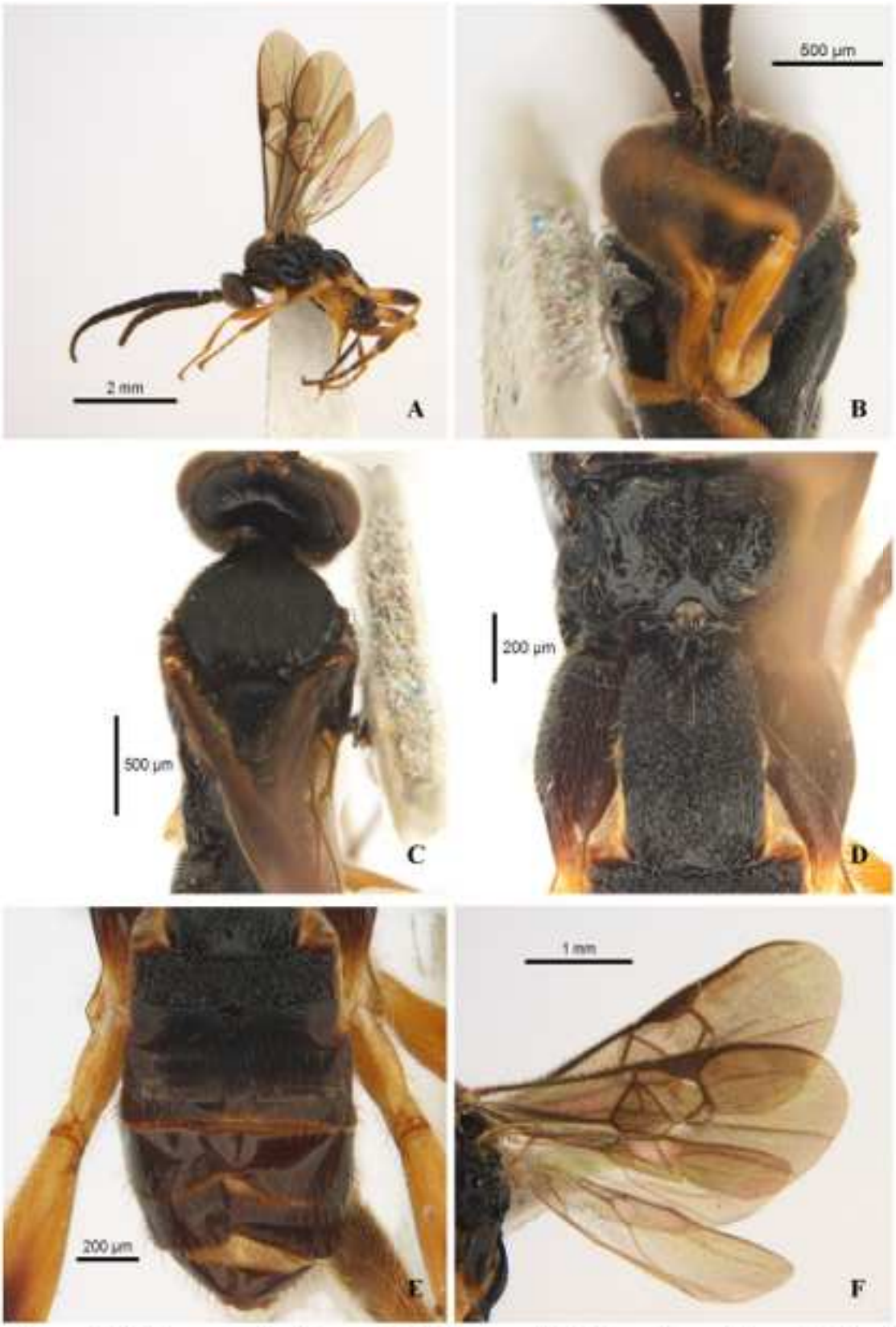


Figure 27. *Microgaster kuchingensis* Wilkinson, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

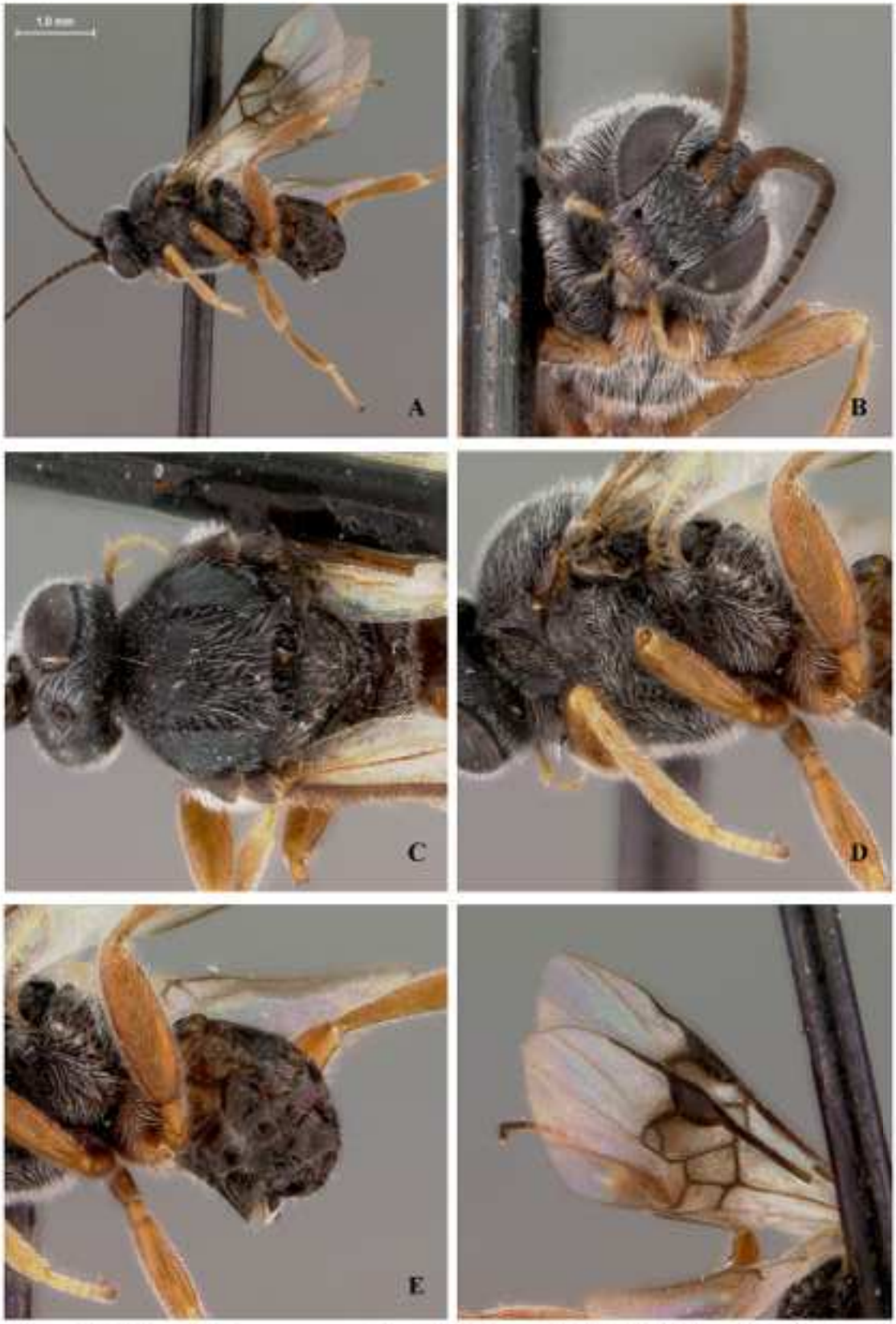


Figure 28. *Microplitis areyongensis* Austin & Dangerfield, A) Habitus, lateral view; B) Head, anterior view; C) Head & mesosoma, dorsal view; D) Mesosoma, lateral view; E) Metasoma, lateral view; F) Wings

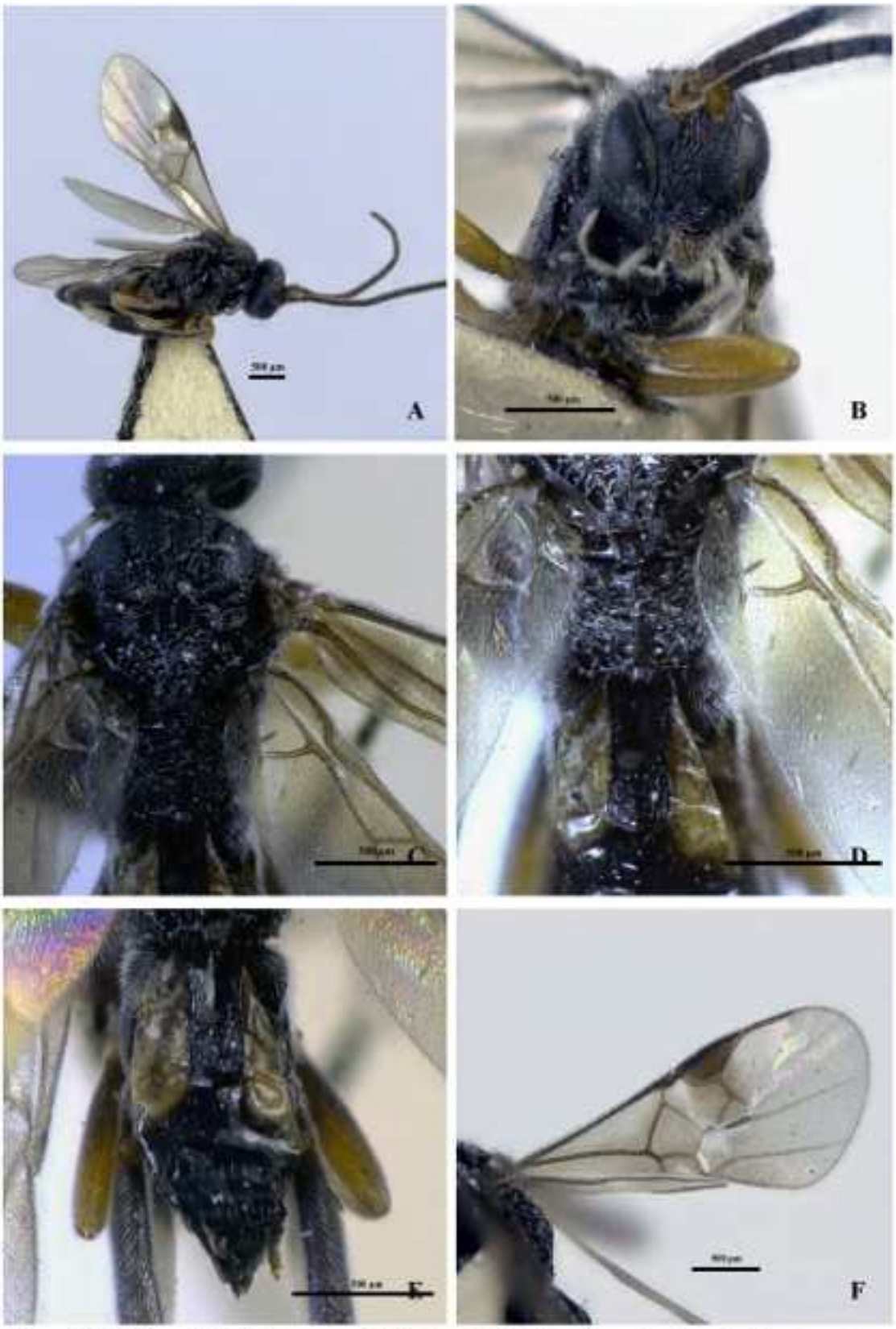


Figure 29. *Microplitis bicoloratus* Xu & He, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

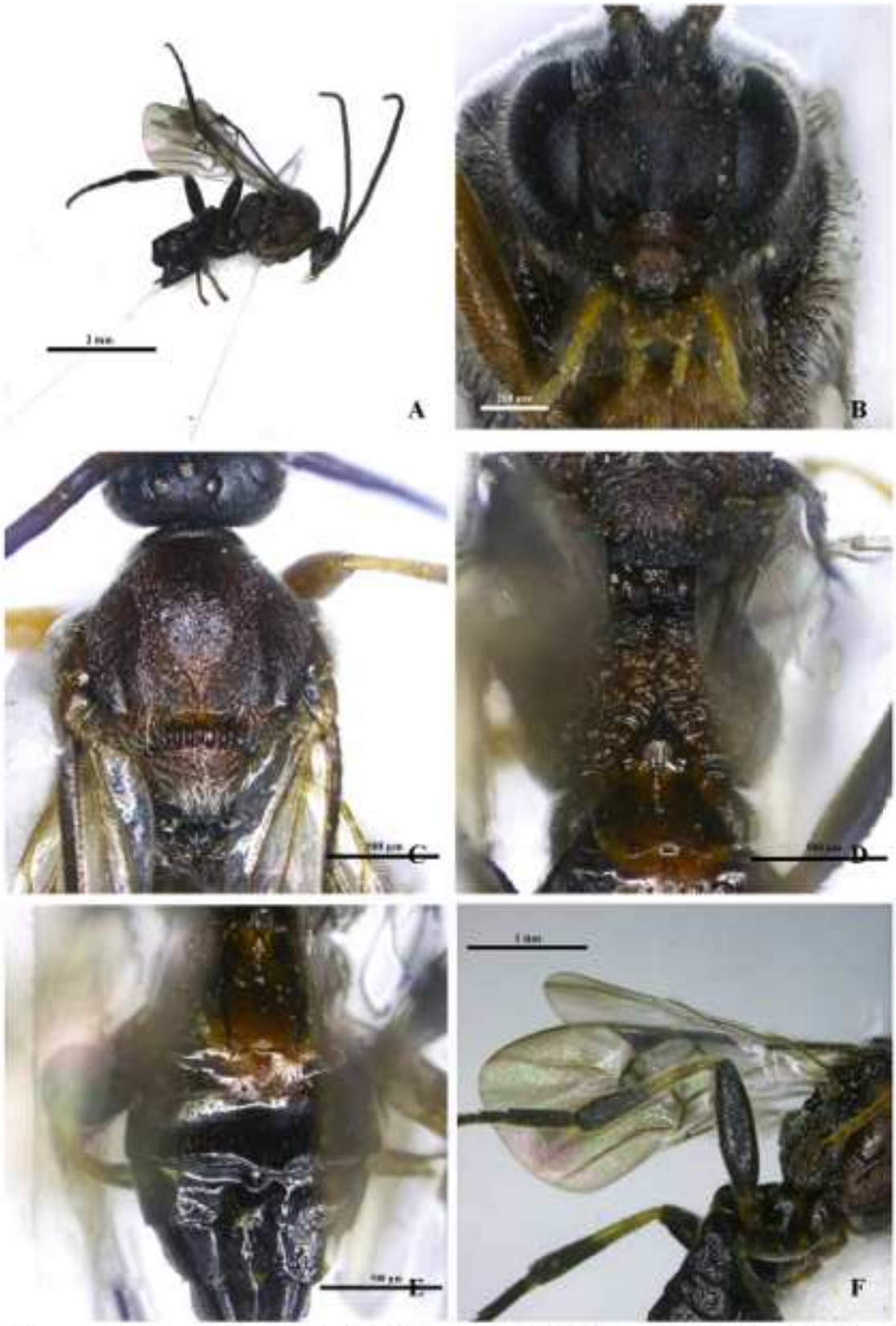


Figure 30. *Microplitis carinicollis* (Cameron), A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

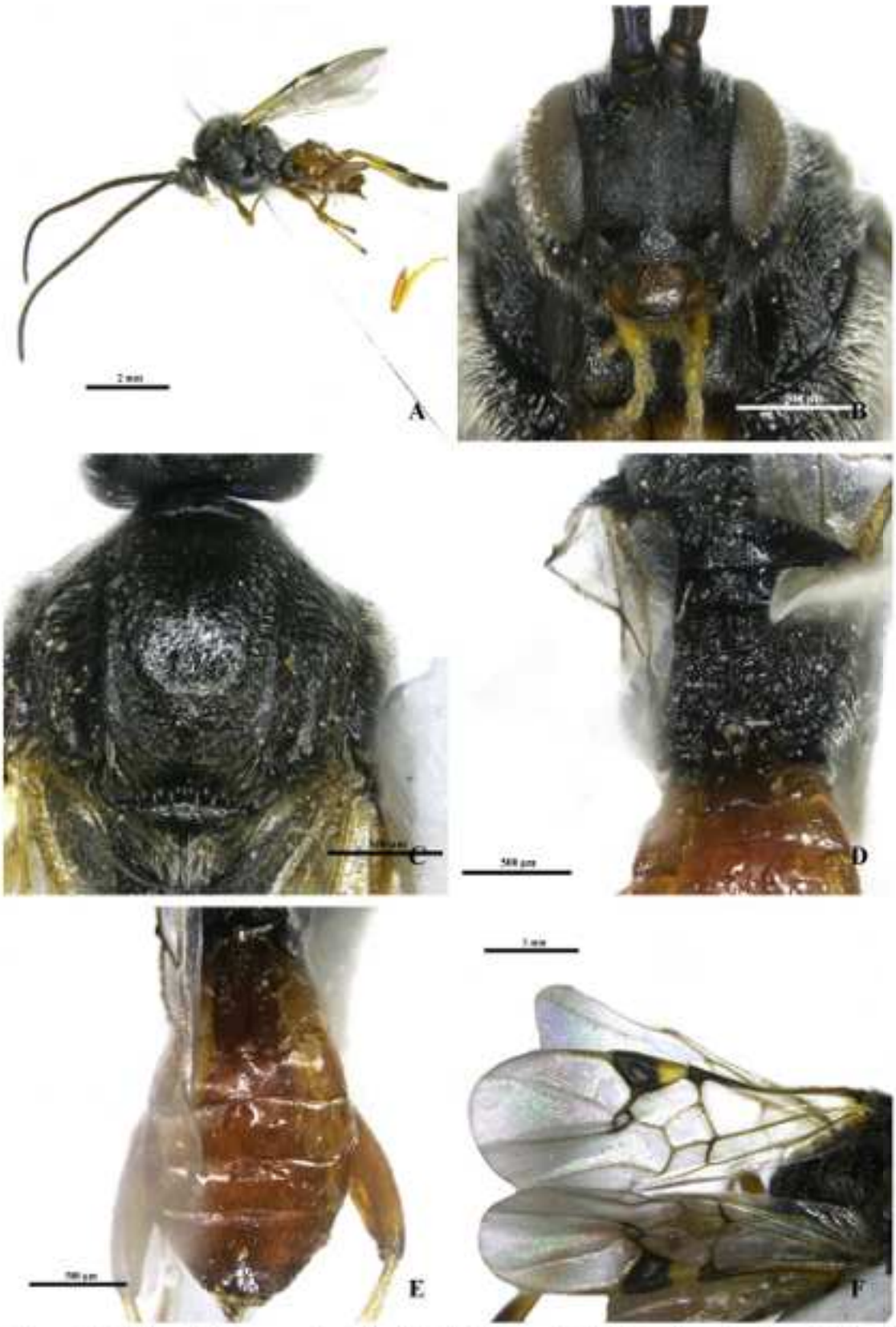


Figure 31. *Microplitis narendrani* Ranjith & Nasser, A) Habitus, lateral view; B) Head, anterior view; C) Mesoaoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

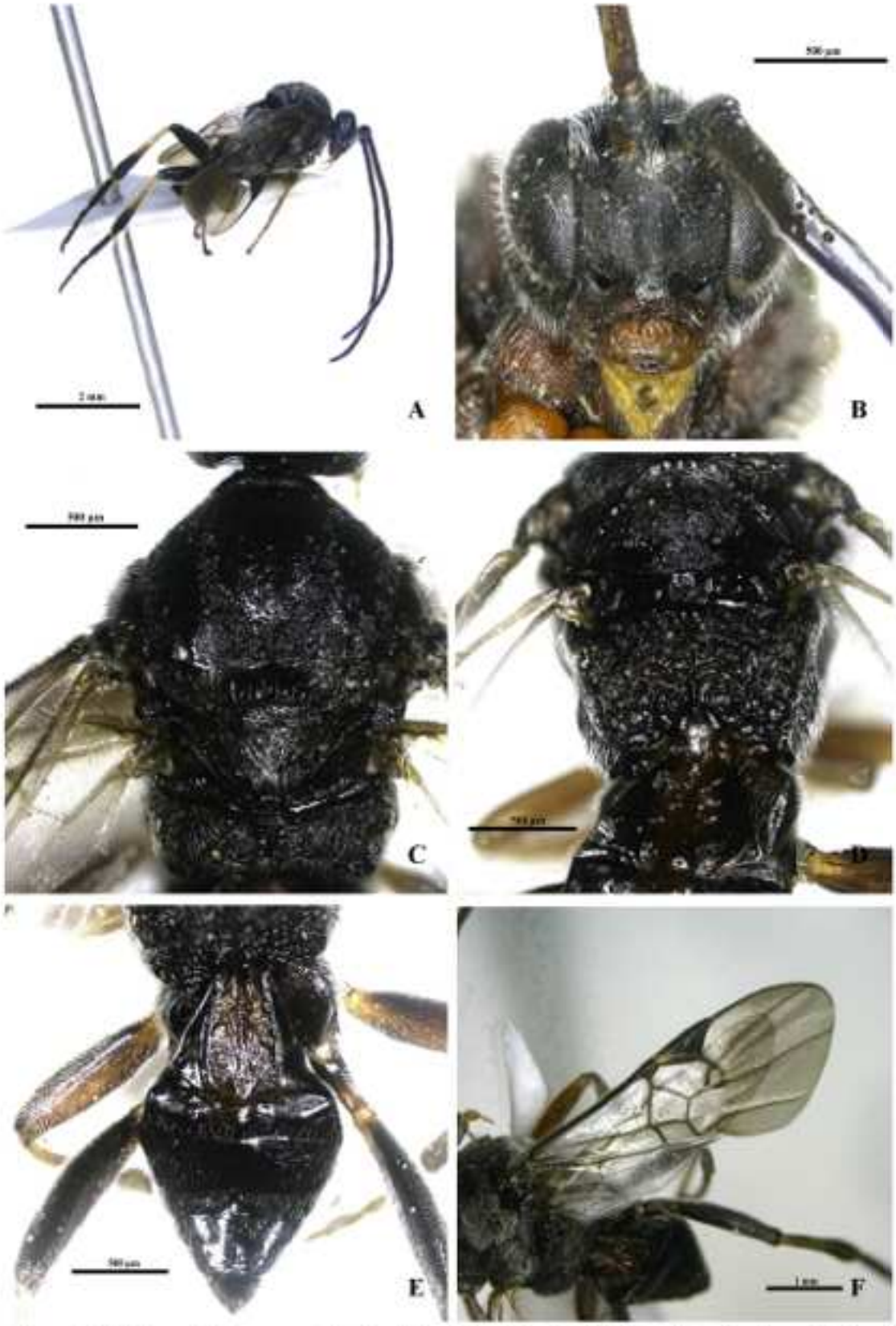


Figure 32. *Microplitis pernatulae* Ranjith & Rajesh, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

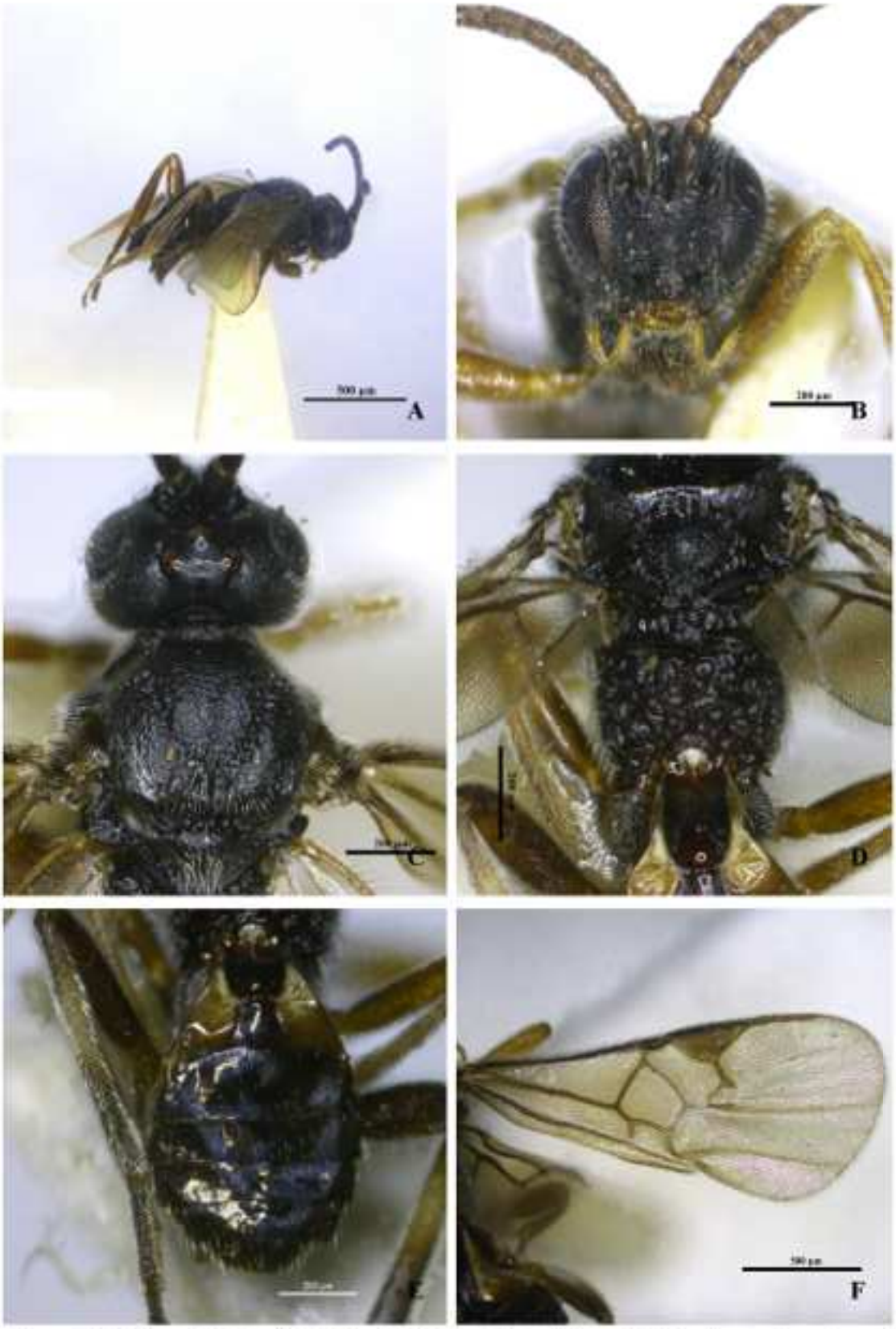


Figure 33. *Microplitis similis* Lyle, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum; E) Metasoma; F) Wings

Figure 34. *Microplitis spodopterae* Rao & Kurian, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

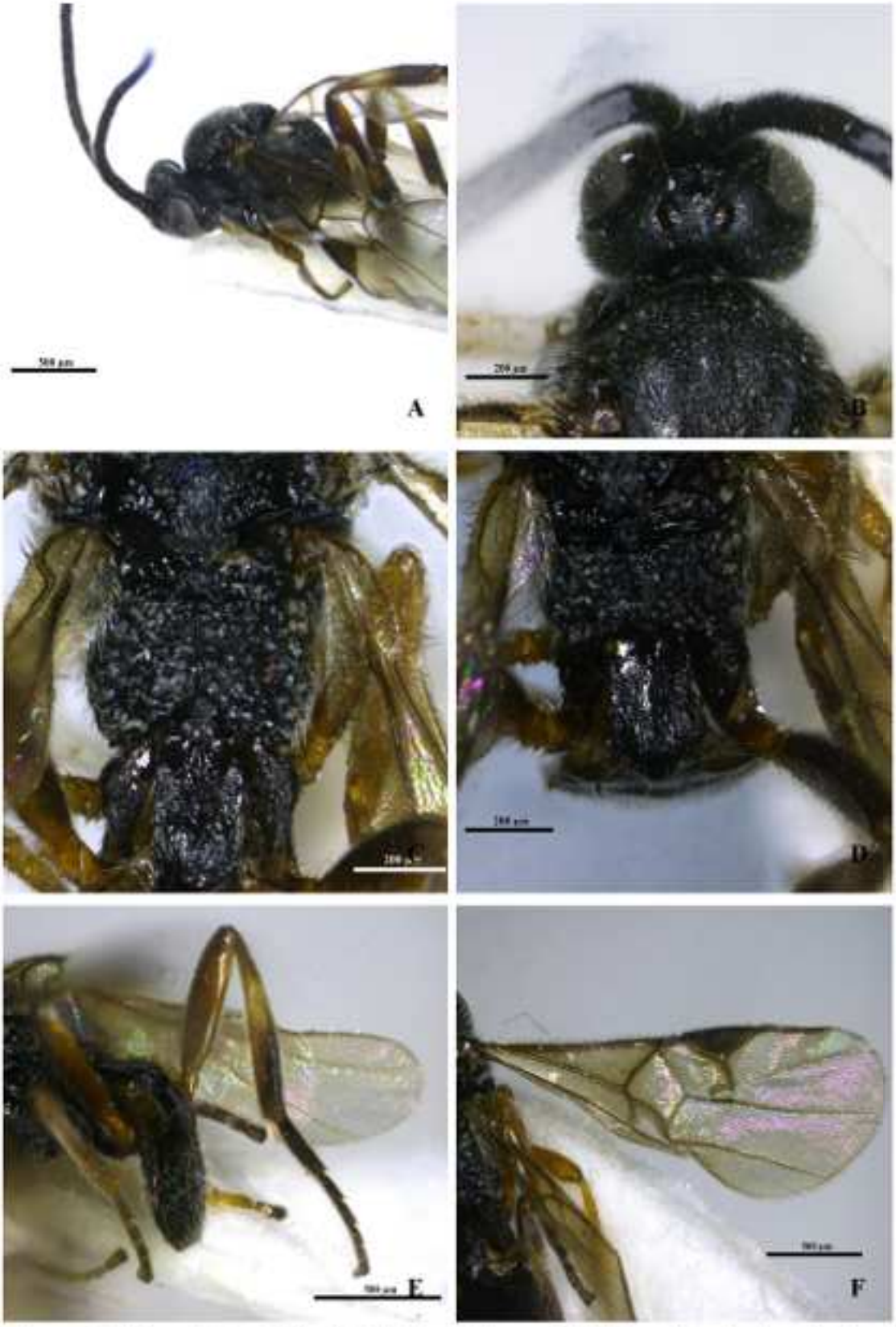


Figure 35. *Microplitis vitellipedis* Li, Tan & Song. A) Habitus, lateral view; B) Head, dorsal view; C) Propodeum, dorsal view; D) First metasomal tergite; E) Metasoma, lateral view; F) Wings

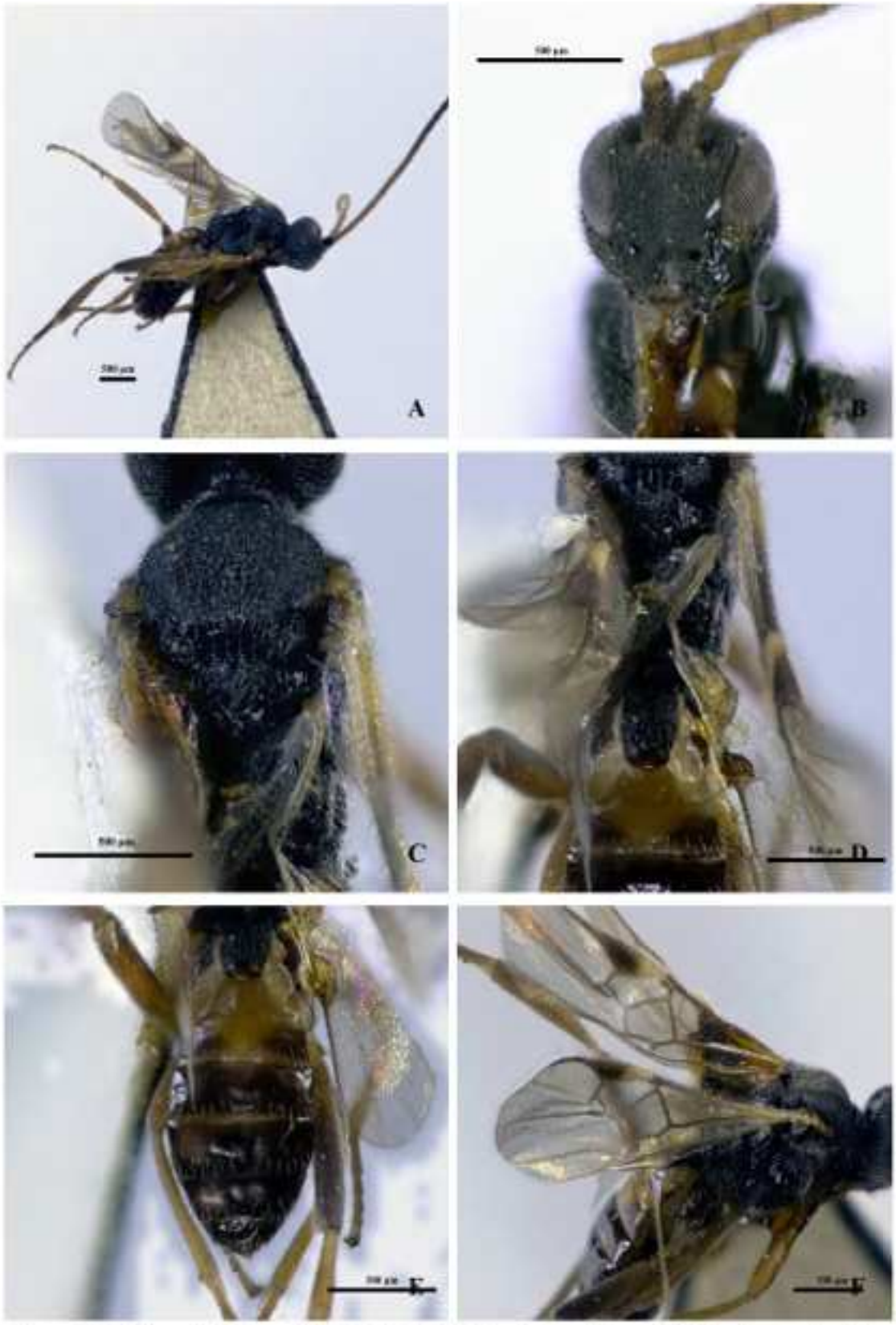


Figure 36. *Microplitis zhuoi* Xu & He, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

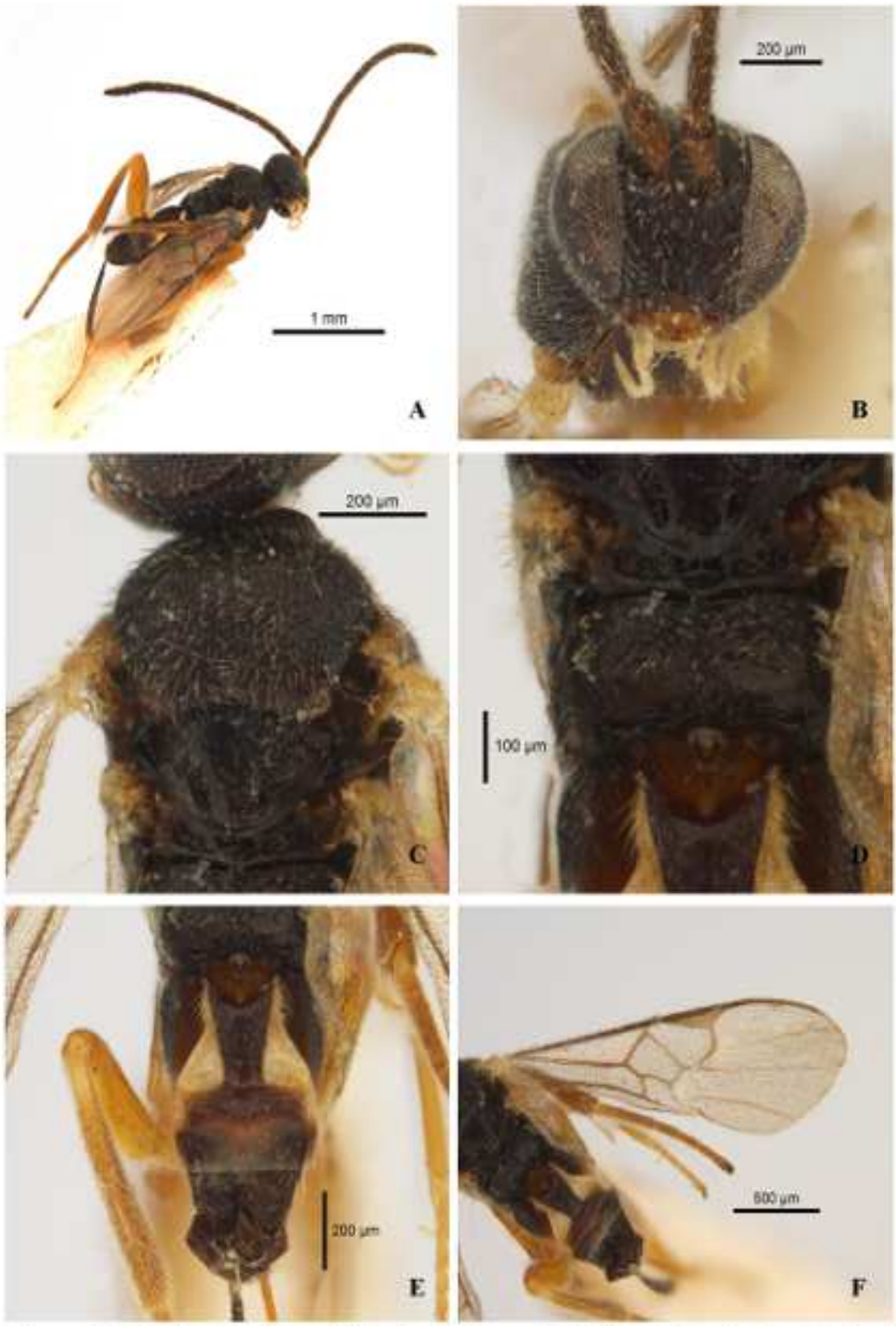


Figure 37. *Neoclarkinella janakikkadensis* Veena, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

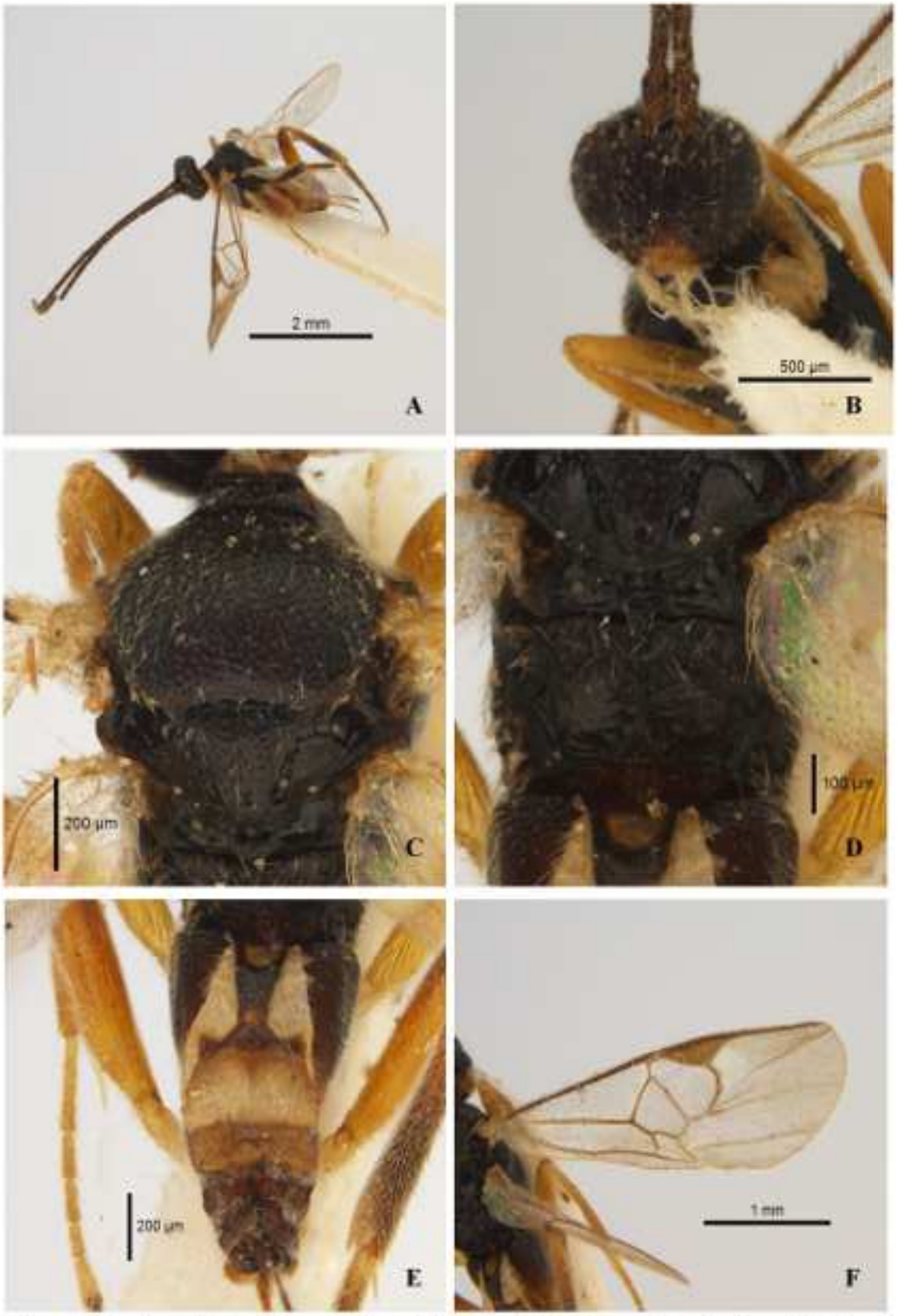


Figure 38. *Neoclarkinella narendrani* Veena, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings

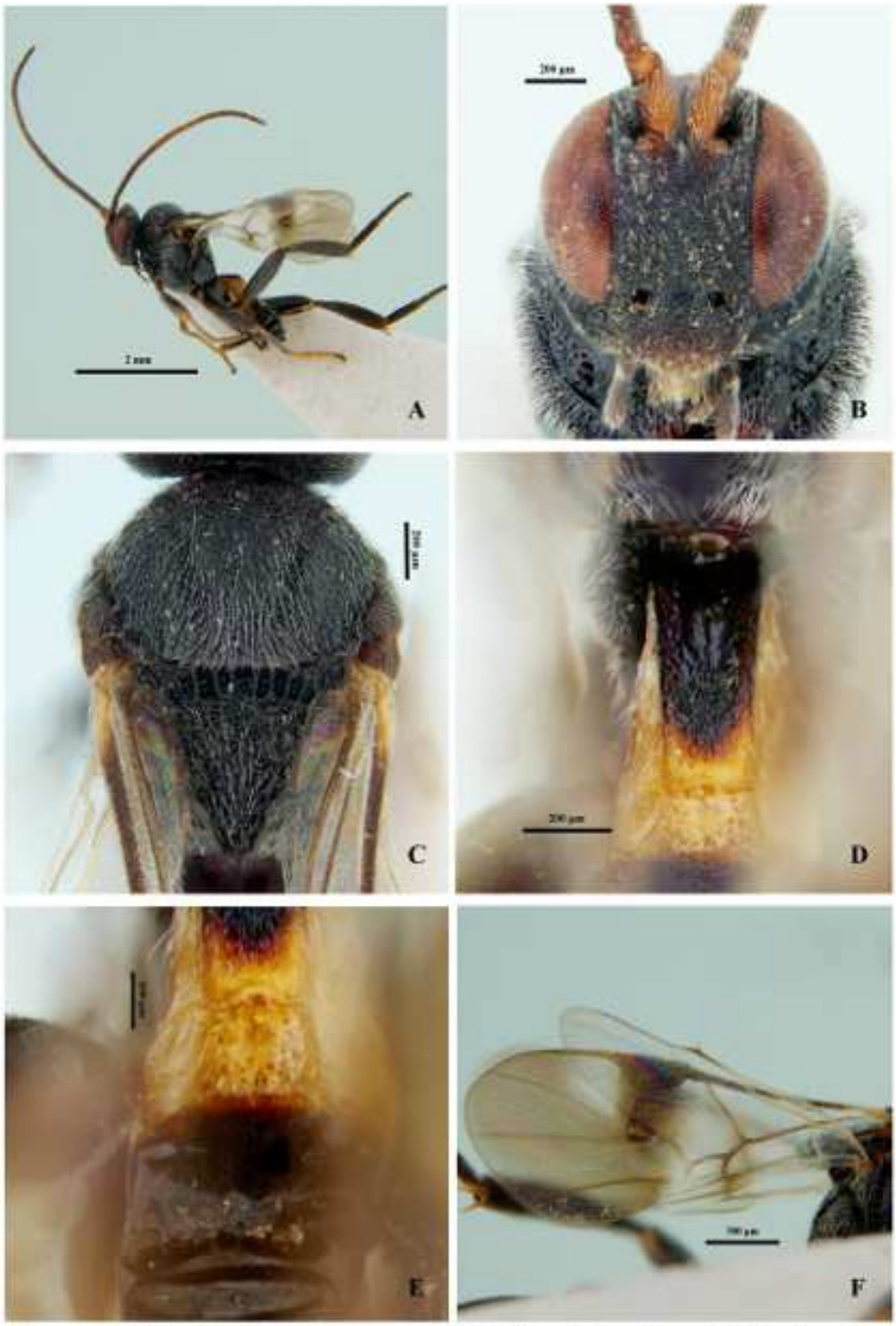


Figure 39. *Philoplitis keralensis* sp. nov., A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) First metasomal tergite, dorsal view; E) Metasomal tergite 2 & 3, dorsal view; F) Wings

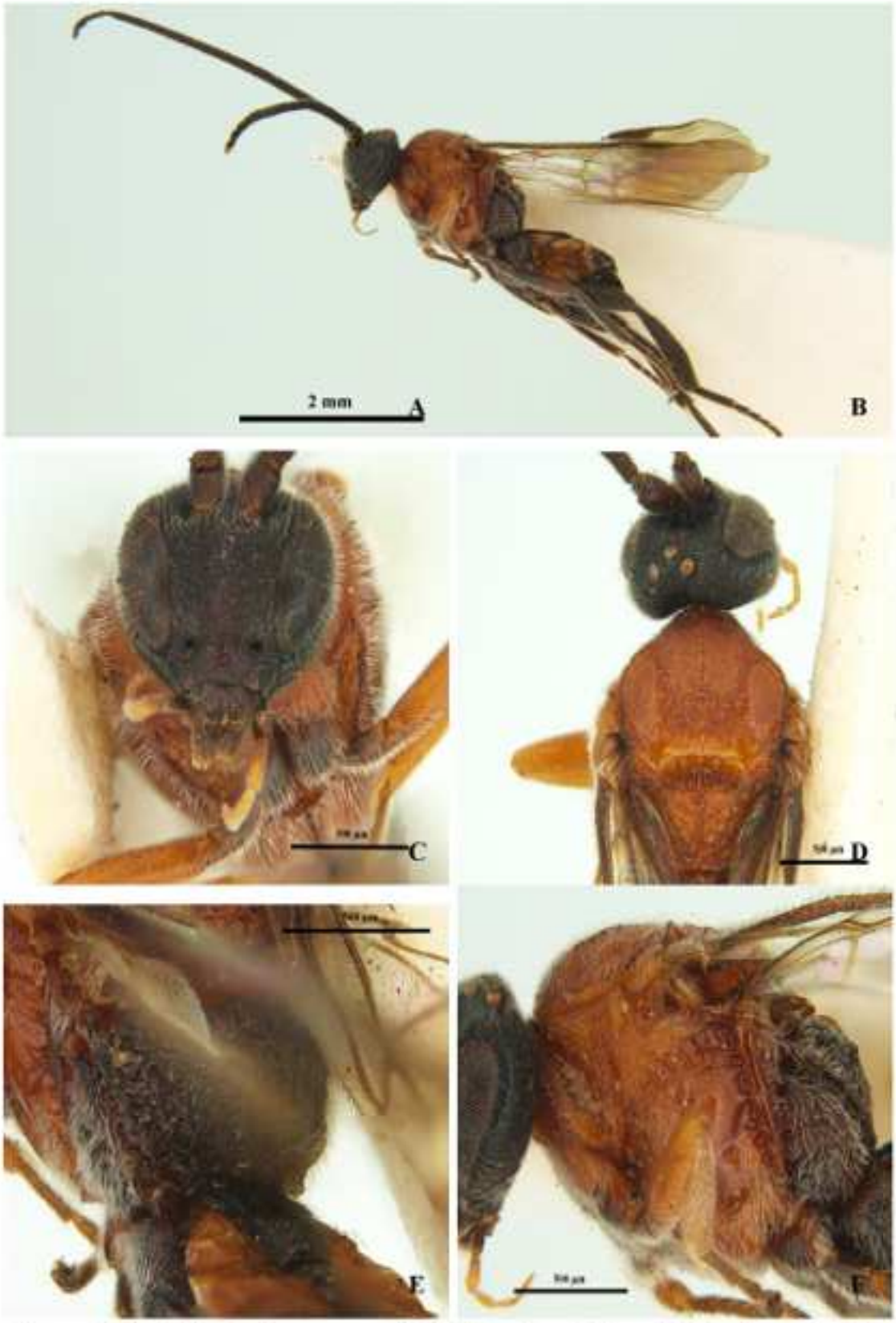


Figure 40. *Snellenius indicus* sp. nov. A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, lateral view; E) Mesosoma, Lateral view

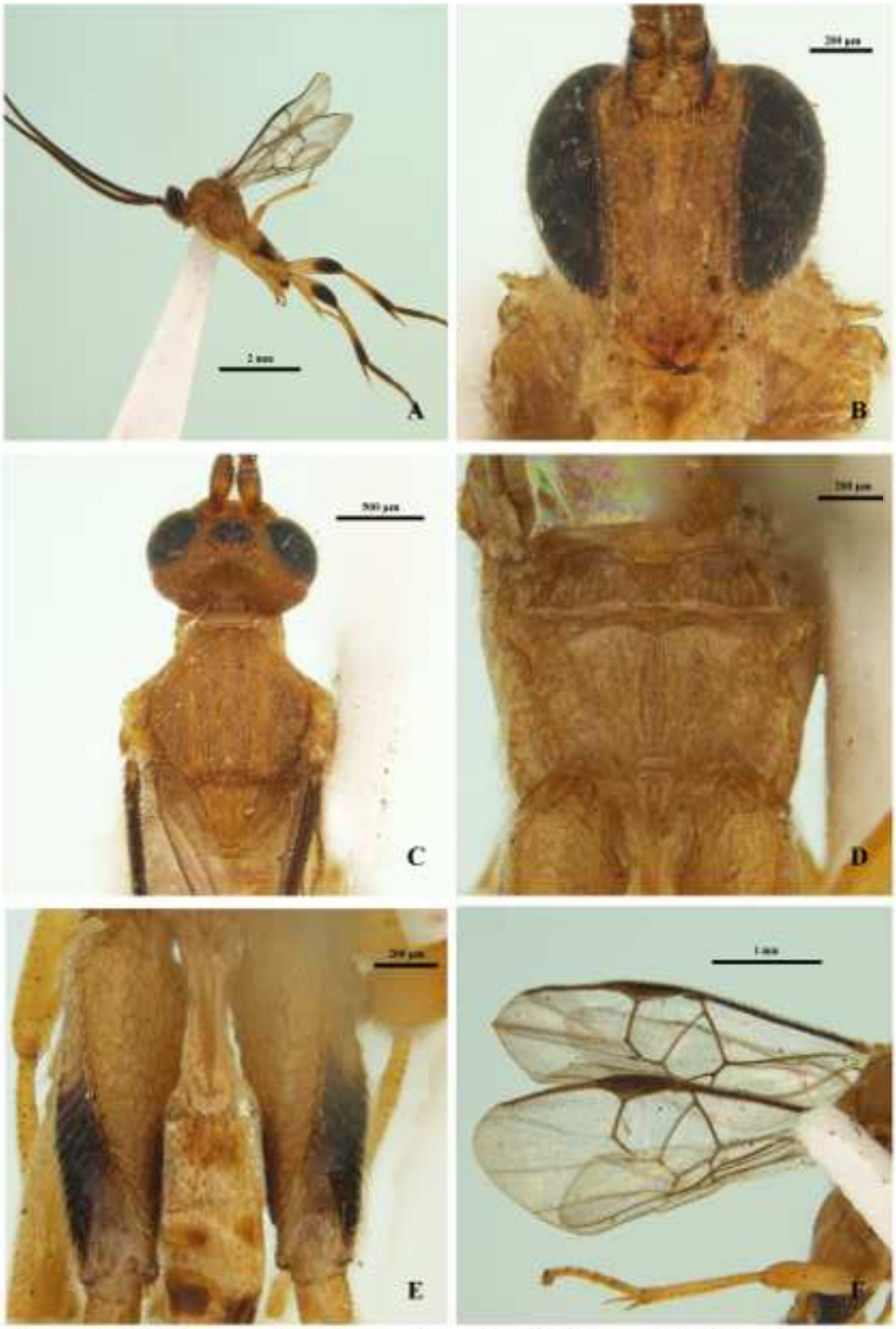


Figure 41. *Wilkinsonellus longicentrus* Long & Achterberg, A) Habitus, lateral view; B) Head, anterior view; C) Mesosoma, dorsal view; D) Propodeum, dorsal view; E) Metasoma, dorsal view; F) Wings