

**TAXONOMIC STUDIES OF THE SUBFAMILY OPHIONINAE
(HYMENOPTERA: ICHNEUMONIDAE) OF
NORTH KERALA**

Thesis Submitted to
the University of Calicut for the
Award of the Degree of
DOCTOR OF PHILOSOPHY IN ZOOLOGY
(Under the Faculty of Science)

Submitted by
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Under the Guidance and Supervision of

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DECLARATION

I hereby declare that the work presented in the thesis entitled “**TAXONOMIC STUDIES OF THE SUBFAMILY OPHIONINAE (HYMENOPTERA: ICHNEUMONIDAE) OF NORTH KERALA**” is based on the original work done by me under the guidance of Dr. Sudheer. K, Associate Professor, Research Guide, The Zamorin’s Guruvayurappan College, Kozhikode and has not been included in any other thesis submitted previously for the award of any degree. The contents of the thesis are undergone plagiarism check, using iThenticate software at C. H. M. K Library, University of Calicut, and the similarity index found within the permissible limit. I also declare that the thesis is free from AI generated contents.

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Soumya, T. K.

Dedicated to

*My little Princess "Alamkritha",
Beloved Teachers
&
Family*

ABSTRACT

Subfamily Ophioninae (Hymenoptera: Ichneumonidae) is a moderately large monophyletic group that primarily consists of solitary koinobiont endoparasitoids of Lepidoptera. It is one of the most diverse and major group of family Ichneumonidae and perform the important ecosystem service of biological control by parasitizing various important pests. They are distributed in almost all regions of the world from subarctic tundra to desert and tropical rain forest with greatest species diversity in tropical forest between 1200 and 1700 metres in altitude. Currently 32 genera and more than 1,100 species are described. Ophionine wasps are almost nocturnal or crepuscular and large populations are frequently attracted to light. Their common characteristics include a testaceous body, large ocelli, large eye and long antennae which are together known as the “Ophionoid facies” in Hymenoptera. Ophioninae members belonging to the genera *Dictyonotus* Kriechbaumer, *Heinrichiella* Hedwig, *Hellwigiella* Szepliget and *Hellwigia* Gravenhorst have characteristics such as a black body, small ocelli and short antenna that are suitable for a diurnal behaviour of life.

The present investigation is attempted to understand the taxonomy and diversity of Subfamily Ophioninae from North Kerala. The study uncovered a total of 39 species belonging to four genera recorded from Kasaragod, Kannur, Kozhikode, Wayanad and Malappuram districts. Out of these, 11 new species viz., *Enicospilus anokha* sp. nov., *Enicospilus benazeer* sp. nov., *Enicospilus ghatensis* sp. nov., *Enicospilus kannurensis* sp. nov., *Enicospilus kasargodensis* sp. nov., *Enicospilus malabaricus* sp. nov., *Enicospilus punctatus* sp. nov., *Enicospilus robustus* sp. nov., *Enicospilus rufus* sp. nov., *Enicospilus squamacutus* sp. nov., *Enicospilus wayanadensis* sp. nov. and *Dicamptus neosinuatus* sp. nov. were described as new to science. One species *Stauropogon narendrani* Soumya and Sudheer was described and published from the study area. Two species *Enicospilus bres* and *Enicospilus centralis* were recorded for first time from India, nine species are newly reported from the state of Kerala and 17 species are new reports

from study area. The present research work also includes the redescription of already known but poorly described species. The study also provides dichotomous key to the subfamilies, genera and species of Ophionine wasps. Distribution maps to species of all genera collected in subfamily Ophioninae made using QGIS online software, are provided. The study documents the host parasitic index of species dealt and also provided an updated checklist of the Indian Ophionine wasps.

സംഗ്രഹം

ഷഡ്‌പദങ്ങളിലെ ഓർഡർ ഹൈമേനോപ്റ്ററിലെ കുടുംബമായ ഇക് ന്യൂമോണിടെയിലെ മിതമായ വലിപ്പമുള്ള ഒരു മോണോഫെലറ്റിക് വിഭാഗമായ ഓഫിയോണിനെയാണ് ഉപകുടുംബം ലെപിഡോപ്റ്ററ വിഭാഗത്തിലുൾപ്പെടുന്ന കീടങ്ങളിൽ കാണുന്ന ഒറ്റപ്പെട്ട കോയ്നോബയോണ്ട് ആന്തരിക പരാദ കടന്നലുകളാണ്. ഇക് ന്യൂമോണിയേ കുടുംബത്തിലെ ഏറ്റവും വൈവിധ്യപൂർണ്ണവും പ്രധാനവുമായ ഉപകുടുംബമാണിത്, കൂടാതെ വിവിധ പ്രധാന കീടങ്ങളുടെ പരാദങ്ങളായി ജൈവനിയന്ത്രണത്തിലൂടെ ആവാസവ്യവസ്ഥയിൽ പ്രധാന സേവനം നിർവ്വഹിക്കുന്നു. 1200 നും 1700 നും ഇടയിൽ ഉയരമുള്ള ഉഷ്ണമേഖലാ വനങ്ങളിൽ ഏറ്റവും വലിയ സ്പീഷിസ് വൈവിധ്യമുള്ള ഇവ സബാർട്ടിക് ടുണ്ട്ര മുതൽ മരുഭൂമി, ഉഷ്ണമേഖലാ മഴക്കാടുകൾ വരെയുള്ള ലോകത്തിലെ മിക്കവാറും എല്ലാ പ്രദേശങ്ങളിലും കാണപ്പെടുന്നു. നിലവിൽ 32 ജീനുകളും 1,100-ലധികം ഇനങ്ങളും അറിയപ്പെടുന്ന ഒഫിയോണിൻ കടന്നലുകൾ മിക്കവാറും നിശാപ്രാണികൾ അല്ലെങ്കിൽ സന്ധ്യാപ്രാണികൾ ആണ് മാത്രമല്ല കൂട്ടത്തോടെ വെളിച്ചത്തിലേക്ക് ആകർഷിക്കപ്പെടുന്നവയാണ്. അവയുടെ പൊതുവായ സവിശേഷതകൾ തവിട്ടു കലർന്ന മഞ്ഞ നിറമുള്ള ശരീരം, വലിയ ഓസിലിയ്ക്ക്, വലിയ കണ്ണ്, നീളമുള്ള ആന്റിന എന്നിവ ഉൾപ്പെടുന്നു, ഈ സവിശേഷതകൾ ഹൈമനോപ്റ്ററയിൽ "ഒഫിയോണോയിഡ് ഫേഷ്യസ്" എന്നറിയപ്പെടുന്നു. *ഡികുയോനോട്സ് ക്രിച്ച്ബൗമെർ*, *ഹെയ്ൻറിച്ച്യില്ല* *ഹെഡ്വിഗ്*; മുതലായ ചില ജീനുകൾക്ക് ദിനചാരികൾക്ക് അനുയോജ്യമായ കറുത്ത നിറമുള്ള ശരീരം, ചെറിയ ഓസിലിയ്ക്ക്, ചെറിയ ആന്റിന പോലുള്ള സ്വഭാവസവിശേഷതകൾ കാണാം.

വടക്കൻ കേരളത്തിൽ നിന്നുള്ള ഒഫിയോണിന എന്ന ഉപകുടുംബത്തിന്റെ വർഗ്ഗീകരണവും വൈവിധ്യവും മനസ്സിലാക്കാനാണ് ഇപ്പോഴത്തെ ഗവേഷണം. കാസർകോട്, കണ്ണൂർ, കോഴിക്കോട്, വയനാട്, മലപ്പുറം ജില്ലകളിൽ നിന്ന് രേഖപ്പെടുത്തിയ നാല് ജനുസ്സുകളിൽ പെട്ട 39 ഇനങ്ങളെയാണ് പഠനത്തിൽ കണ്ടെത്തിയത്. ഇവയിൽ 11 സ്പീഷിസുകൾ, *എനിക്കസ്‌പിലസ് അനോഖ*, *എനിക്കസ്‌പിലസ് ബേനസിർ*, *എനിക്കസ്‌പിലസ് ഘട്ടൻസിസ്*, *എനിക്കസ്‌പിലസ് കണ്ണൂരേനസിസ്*, *എനിക്കസ്‌പിലസ് കാസർഗോഡൻസിസ്*, *എനിക്കസ്‌പിലസ് മലബാറിക്കസ്*, *എനിക്കസ്‌പിലസ് പക്റ്റാറ്റസ്*, *എനിക്കസ്‌പിലസ് റോബസ്റ്റ്സ്*, *എനിക്കസ്‌പിലസ് റൂഫസ്*, *എനിക്കസ്‌പിലസ് സ്കമാക്യൂട്ടസ്*, *എനിക്കസ്‌പിലസ് വൈനാഡെൻസിസ്*, *ഡൈകാന്വടസ് നിയോസിനയേറ്റ്സ്* എന്നിവ ശാസ്ത്രത്തിന് പുതിയ സംഭാവനകളാണ്. *സ്റ്റുറോപോക്ലോണസ് നരേന്ദ്രാനി* സൗമ്യ, സുധീർ എന്ന ഒരു സ്പീഷിസിനെ പഠന മേഖലയിൽ നിന്ന് വിവരിക്കുകയും പ്രസിദ്ധീകരിക്കുകയും ചെയ്തു. നിലവിലുള്ള ഗവേഷണ പ്രവർത്തനത്തിന്റെ ഫലമായി *എനിക്കോസ്പിലസ് ബ്രെസ്*, *എനിക്കോസ്പിലസ് കോൺസെൻട്രേലിസ്* എന്നീ രണ്ട് സ്പീഷിസുകൾ ഇന്ത്യയിൽ നിന്ന് ആദ്യമായി രേഖപ്പെടുത്തിയിട്ടുണ്ട്, കേരളത്തിൽ നിന്ന് ഒമ്പത് സ്പീഷിസുകൾ പുതുതായി റിപ്പോർട്ട് ചെയ്യപ്പെട്ടിട്ടുണ്ട്, പഠന മേഖലയിൽ നിന്നുള്ള 17 സ്പീഷിസുകൾ പുതിയ റിപ്പോർട്ടുകളാണ്. ഇതിനകം അറിയപ്പെടുന്നതും എന്നാൽ പൂർണ്ണമായ വിവരണം ഇല്ലാത്തതുമായ സ്പീഷിസുകളുടെ പുനർവിവരണവും ഉൾപ്പെടുന്നു. ഒഫിയോണിൻ കടന്നലുകളുടെ

ഉപകടുംബങ്ങൾ, ജീനസുകൾ, സ്പീഷീസുകൾ എന്നിവയിലേക്കുള്ള ഡൈകോട്ടമസ്സ് കീ (ദ്വിമൂല കീ) പഠനം നൽകുന്നു. QGIS ഓൺലൈൻ സോഫ്റ്റ്‌വെയർ ഉപയോഗിച്ച് ഒഫിയോണിനേ ഉപകടുംബത്തിൽ ശേഖരിച്ച എല്ലാ ജീനസുകളുടെയും സ്പീഷീസുകളുടെയും വിതരണഭൂപടങ്ങൾ നിർമ്മിച്ചിട്ടുണ്ട്. പഠനത്തിൽ ഉൾപ്പെട്ട സ്പീഷീസുകളുടെ ഹോസ്റ്റ്-പരാദ സൂചിക പഠനം രേഖപ്പെടുത്തുകയും ഇന്ത്യൻ ഒഫിയോണിൻ കടന്നുകളുടെ പുതുക്കിയ ചെക്ക്‌ലിസ്റ്റ് നൽകുകയും ചെയ്തു.

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CHAPTER 1

INTRODUCTION

INTRODUCTION

TAXONOMY

The term “taxonomy” comes from the Greek words “taxis”, which means “arrangement” and “nomos” which means “law”, deals with the classification and description of organisms, which are crucial to the inventory of life on Earth (Lincoln *et al.*, 1998; Wagele, 2005). The history of taxonomy can be traced back to Aristotle, a Greek philosopher who put out the first basis of classification (Godfray, 2002). The binomial scheme and the tenets of biological classification were first proposed by Carl Linnaeus, the father of modern taxonomy. Traditionally, the field of taxonomy has three types of studies viz., Alpha (analytical phase), Beta (synthetic phase) and Gamma (biological phase) taxonomy. The identification and description of species is done at the level of Alpha taxonomy. Beta taxonomy refers to the placement of species in a natural system of hierarchical categories. Gamma taxonomy refers to the analysis of intraspecific variability and the study of evolution (Kapoor, 1998; Disney, 2000).

A lot of important studies are typically built on taxonomy, which is regarded as a crucial basic science that provide the framework for many other sciences. Taxonomy is essential for all relevant studies on biodiversity, pest management, medicine, quarantine, fisheries, defence etc. An organism’s scientific name serves as a functional label that may be used to access any information about the organism (Narendran, 2000).

TAXONOMY AND IMPORTANCE OF ICHNEUMONIDS

One of the most diverse parasitic families among Hymenoptera is the Ichneumonidae. With the exception of the Curculionids, Ichneumonids includes more species than the entire group of vertebrates (Townes, 1969). According to Yu *et al.*, (2016), the family Ichneumonidae is extremely diverse, with an estimated 60,000 species, of which 25,285 have been identified. The members of the family can be identified by their wing venation, particularly by its merged C and R veins, the presence of 2m-cu vein and the antennae with more than 16 segments.

Ichneumonids feed on the larval stages of many insect orders including the Lepidoptera, Trichoptera, Diptera, Coleoptera and Neuroptera. Their choice of host is influenced by ecological and physiological factors (Townes, 1958). The use of Ichneumonids in biological control strategies against insect pests is widespread throughout the world.

CLASSIFICATION OF PARASITIC HYMENOPTERA

The order Hymenoptera comprising more than 153,000 described species (Aguilar *et al.*, 2013). They fall behind the Coleoptera and Lepidoptera in this ranking, but some Hymenopterists argue that if undescribed species were considered, the Hymenoptera would have the highest number of species than any other order (Grissell, 1999). Hymenoptera is divided into two divisions viz., Parasitica (also known as Terebrantia) and Aculeata (Narendran, 1998). Members of Parasitica are likely a paraphyletic assemblage and have an ovipositor that still performs the basic egg laying function and is suited for piercing. Aculeata members which include those Hymenoptera whose ovipositor has been changed for stinging instead of egg laying are clearly monophyletic. There are 13 Superfamilies in the division Parasitica. They are Orussoidea, Chalcidoidea, Chrysidoidea, Stephanoidea, Megalyroidea, Ceraphronoidea, Cynipoidea, Evanionoidea, Ichneumonoidea, Proctotrupoidea, Vespoidea, Platygastroidea and Trigonalyoidea. Among the Hymenoptera, the Ichneumonidae is the largest family, which includes many beneficial parasitic species.

ROLE OF WASPS AS BIOLOGICAL CONTROL AGENTS AND THE RELEVANCE OF TAXONOMY IN BIOCONTROL

A number of factors including pollution, overexploitation, invasion by alien species and habitat destruction have placed parasitic hymenoptera in threat of becoming extinct. These led to an increase in host population, a greater reliance on pesticides, and ultimately the extinction of plant species (Lasalle and Gauld, 1991).

The most effective biological control agents belong to the Superfamily Ichneumonoidea. The majority of these species are parasitoids, meaning that they

prey on the host eggs or larvae. Most of the pests are insects mainly belonging to orders Lepidoptera, Diptera, Coleoptera, Hemiptera, Hymenoptera and Arachnida. There are very few phytophagous; their larvae consume seeds, stems, and galls.

The majority of parasitic hymenoptera may be able to control their hosts at a lower population density. Their regulatory function provides a permanent benefit in keeping their host population below subeconomic level. They are well adapted and synchronised with their hosts (Huffaker and Gutierrez, 1990). There are 23 examples according to De Bach and Rosen (1991), where parasitic hymenoptera control their hosts. The majority of hymenopteran parasites are keystone species. The removal of keystone species will cause the ecosystem to have a cascading effect (La Salle, 1993). Compared to other natural enemies of insect pests, parasitic hymenoptera exhibit higher ecological stability. Because they can survive and interact at lower host population levels, parasitic hymenoptera have been successful. Biological control efforts have shown that Keystone parasitoids of parasitic hymenoptera are always present, although in low numbers established (La Salle, 1993).

According to Gupta (1987), biocontrol will not advance without a fundamental knowledge of taxonomy. Before starting an Integrated Pest Management (IPM) programme, it is crucial to accurately identify the target pests and natural enemies. These are the most important steps. Research expenses, time and energy are frequently wasted due to incorrect identification (Ramani, 2013). Farmers have been using chemical pesticide for a long time, even though they are aware of their severe side effects. As a result, pest resurgence and secondary pest outbreaks became frequent occurrences. To tackle this problem, natural enemies have been developed as a biocontrol agent for a number of insect pest species. Based on studies conducted by Clausen (1978) and Noyes (1985), the parasitic Hymenoptera is the most effective natural enemies employed in biological control programmes against insect pests.

From Srilanka, *Eriborus trochanteratus* Morley (Ichneumonidae: Campopleginae) was introduced to Southern India for the management of the

coconut pest *Opisina arenosella* Walker (Oecophoridae), also known as black-headed caterpillar (Narendran, 2001). According to Pillai and Nair (1983, 1987) and Ramkumar (2002), three other Ichneumonid species, namely *Xanthopimpla nana nana* Schulz, *Xanthopimpla punctata* (Fabricius) and an unidentified species of *Xanthopimpla* are also reported to be efficient pupal parasitoids of the *Opisina arenosella* in Kerala and Bangalore. Ophioninae are solitary endoparasitoid wasp that utilize the larvae of holometabolous insects, particularly those of Lepidoptera, Coleoptera and Hymenoptera. Among many of the host species include *Sesamia inferens*, *Spodoptera litura*, *Spodoptera mauritia*, and *Heliothis armigera* which are known pest of agricultural crops (Gauld and Mitchell, 1981).

SUBFAMILY OPHIONINAE

The Subfamily Ophioninae (Hymenoptera: Ichneumonidae) is a moderately large monophyletic group that primarily consists of solitary koinobiont endoparasitoids of Lepidoptera (Gauld, 1985; Quicke *et al.*, 2009; Bennet *et al.*, 2019; Klopstein *et al.*, 2019). They are distributed in almost all regions of the world from subarctic tundra to desert and tropical rain forest (Gauld and Mitchell, 1981). Currently 32 genera and more than 1,100 species are described (Yu. *et al.*, 2016; Shimizu and Lima, 2018; Show and Voogd, 2019). Ophionine wasps are almost nocturnal or crepuscular and large populations are frequently attracted to light (Gauld and Mitchell, 1981; Quicke, 2005). Their common characteristics include a testaceous body, large ocelli, large eye and long antennae which are together known as the “Ophionoid facies” in Hymenoptera (Gauld and Huddleston, 1976). Ophioninae members belonging to the genera *Dictyonotus* Kriechbaumer, *Heinrichiella* Hedwig, *Hellwigiella* Szepligeti and *Hellwigia* Gravenhorst have characteristics such as a black body, small ocelli and short antenna that are suitable for a diurnal behaviour of life. The Ophionine wasps have the greatest species diversity in tropical forest between 1200 and 1700 metres in altitude, and they can be found in various types of habitats including upper montane heathland, forest and even semidesert (Gauld, 1984).

BIOLOGY

On the basis of their life strategies, Ichneumonids can be divided into two groups: Koinobionts and Idiobionts (Ashew and Shaw, 1986; Godfray, 1994; Quicke, 1997). When an idiobiont parasitizes, the host does not grow. They live on pupae as endo- or ectoparasitoids. In koinobionts, after parasitization host are allowed to develop further. The majority of them are endoparasitoids (Quicke, 2015). Ophioninae wasps are generally solitary koinobiont endoparasitoid of Lepidoptera, Coleoptera and Hymenoptera. The biology of *Enicospilus sesamiae* was studied by Moutia and Courtois (1952). These authors noticed that *Enicospilus* species laid a single, pale-coloured, cylindrical, slightly curved egg in the lepidopterous larva. The parasitized host did not exhibit any signs of paralysis. The ichneumonid egg was observed to hatch in 2-3 days, and the larva spent a total of 25-35 days (depending on temperature) in the host undergoing three instars. It was noticed that the third instar larva emerged from the host around the time of the host's death. After that, it took the Ichneumonid larvae 24 to 36 hours to spin a cocoon. Together, the prepupal stage and pupal instar lasted 28-42 days.

Ophionines oviposit in a variety of host species and are not particularly host specific. When ovipositing, some species do so in very early instar larvae, while others do it in much bigger larvae (Price, 1975). Certain Ophionine species have a large poison sac, and associated glands are present in the end of the abdomen (Gauld and Mitchell, 1981). In Ophioninae, there are few records of hyperparasitism. Riek (1962) reported a species of *Taeniogonalos* (Hymenoptera: Ichneumonidae) parasitizing the larva of an *Enicospilus* species. Barron (1976) observed a species of *Euceros* (Hymenoptera: Ichneumonidae) parasitizing the larva of an unidentified Ophioninae.

SCOPE OF THE STUDY

Research on the taxonomy and species richness can add to our knowledge of the biodiversity and conservation of these beneficial insects while also providing information needed to carry out biocontrol programmes. Such crucial information on the Western Ghats ecosystem is especially relevant in light of the recent impacts on biodiversity losses.

Numerous species of Indian Ichneumonidae are still poorly understood, despite their significance to ecosystems. Since it would be extremely impossible to research every subfamily of the family Ichneumonidae in the allotted period, this study will focus solely on the taxonomy of the Subfamily Ophioninae. The taxonomic study on the Subfamily Ophioninae of North Kerala, especially Southern Western Ghats contributes to our understanding of the faunal abundance of the Western Ghats and is significant in the field of conservation biodiversity, ecology (host acceptance and location) and agriculture, including integrated pest management.

OBJECTIVES OF THE PRESENT STUDY

1. Survey, collection and identification of parasitoids of the Ophionine Ichneumonids associated with various ecosystem in the districts of North Kerala.
2. Providing description of new taxa and to re-describe already known but poorly described species and to prepare dichotomous keys for the identification of the subfamilies, tribes, genera and species dealt with in the study.
3. To prepare distribution maps of the species recorded from the study.
4. To prepare a checklist of genera and species of subfamily Ophioninae of India.
5. To collect host data and provide a host-parasite index of the genera and species treated in this work.

CHAPTER 2

REVIEW OF LITERATURE

A systematic description of family Ichneumonidae was originally provided by Linnaeus in 1758. In the Ichneumonidae, Gravenhorst (1829) identified 13 subfamilies with 61 genera. In 1840, Swainson and Shuckard described the first Ophioninae tribe Ophionini. Wesmeal (1845) separated the Ichneumonidae into five groups - Ichneumonas, Crypti, Pimplae, Banchi and Ophiones. Schmiedeknecht (1908) published 14 tribes including the Helwiginii, Ophionini, Nototrachini, Anomalonini, Campoplegini, Paniscini, Banchini, Mesochorini, Pristomerini, Cremastini, Porizonini, Plectiscini, Xiphosomini and Pharasalini. Many genera were proposed by Cameron, Morley, Viereck and Schmiedeknecht between 1895 and 1925. Townes *et al.*, (1961) published the Catalogue of Indo-Australian Ichneumonidae. Townes released his first part on Ichneumonidae genera in 1969. He provided a thorough description and key to all subfamilies, tribe, genera and subgenera.

International

Swainson and Shuckard (1840) described the first Ophioninae tribe Ophionini. Schmiedeknecht (1908) published 14 tribes in *Opuscula Ichneumonologica* the system of classification of the family was widely in use for a long time. The Nearctic Ichneumonidae was reclassified by Townes in 1945. Townes reduced the Ophioninae to five tribes: the Campoplegini, Cremastini, Tersilochini, Anomalini and Ophionini, and also reallocated a number of tribes to other subfamilies. The Ophioninae were divided into three generic groups by Cushman (1947): *Thyreodon*, *Ophion* and *Enicospilus* genus - groups. Chiu (1954) published key to the Ophioninae of Taiwan and also, produced a number of synonyms. The tribe Anomalini previously listed in the Ophioninae, was replaced into the separate subfamily Anomalinae by Short (1959). Townes *et al.*, (1961) published a catalogue on Indo-Papuan species of Ophioninae, in which he described 8 genera and 189 species. In 1971, Townes discussed the tribe Enicospilini.

The Ophioninae of Australia was updated by Gauld (1977) which described seven genera and fifty-four species, including two new genera viz., *Riekophion* and *Pamophion* and twenty-seven species that are new to science. Oosterbroek (1978)

identified 15 species in the Netherlands belonging to the genera *Eremotylus*, *Platophion*, and *Ophion*. In 1978, the African Parasitic Wasps of the Subfamily Ophioninae were published by Gauld and Mitchell. 11 genera and 190 species were identified and a total of 106 new species were described as well as data on distribution and host-parasites were provided. The British species of the genus *Ophion* were updated by Brock (1982), who described 14 species, two of which were new. Gauld and Carter (1983) studied the Ophioninae of the Galapagos Island. A historical biogeographical study of Australian Ophioninae was published by Gauld (1984). Gauld (1985) published a thorough morphology-based phylogeny of Ophioninae that included analysis utilising compatibility and parsimony. The subfamily was divided into five major evolutionary lineages based on the high degree of homoplasy in morphological characters: the genus group of *Ophion*, *Sicophion*, *Eremotylus*, *Thyreodon* and *Enicospilus*. Gauld (1988) published a survey of the Ophionine wasps of tropical Mesoamerica with description of 12 genera and a key was provided to this region. Tang (1993) studied the taxonomy of genus *Dicamptus* Szepliget from China, described 7 species, of which 3 are new to science viz., *D. gracilis*, *D. brevicornis* and *D. atratus*.

In Korea, Lee and Cha (2000) published a catalogue of Ichneumonidae. It includes the following subfamilies: Anomaloninae, Eucerotinae, Mesochorinae, Metopiinae, Ophioninae, Paxylommatinae, and Tryphoninae. Lee *et al.*, (2003) published an article on new reports of the genus *Enicospilus* from Korea, which included a revised key to all Korean species. The taxonomy and biogeography of the Ophionine wasps in Cuba were studied by Fernandez (2005). Lee and Kim (2007) described a new species *Stauropoctonus nigrithorax* and updated the genus *Stauropoctonus* Brauns from South Korea. Lee *et al.*, (2007) published new records of *Enicospilus* species, viz., *E. melanocarpus* and *E. pseudoconspersae* from Korea. Yusof and Ghani (2009) described a new species of genus *Enicospilus* Stephen from Malaysia viz., *Enicospilus fatimaha*. Kim *et al.*, (2009) revised the genus *Ophion* Fabricius from Korea. Rouse and Noort (2014) published Afrotropical Ophioninae with two new species viz., *Dicamptus maxipol* and *Enicospilus gauldetmitchellorum*.

Watanabe (2015) published a checklist of Ichneumonidae from Japan. Broad *et al.*, (2015) studied the hosts of *Ophion luteus* in Europe. The molecular phylogeny of the genus *Ophion* Fabricius was discussed by Schwarzfeld *et al.*, (2015). Shimizu and Watanabe (2015b) published a new record of the genus *Leptophion* Cameron from Japan and the Palaearctic region, with descriptions of two new species, viz., *L. parvus* and *L. septentrionis*.

Amiri *et al.*, (2016) studied the subfamily Ophioninae in southern Iran. Broad and Shaw (2016) revised the British and Irish Species of *Enicospilus* with a description of a new species, *Enicospilus myricae*. Shimizu *et al.*, (2016) reported three species of *Leptophion*, including the newly discovered species *Leptophion giganteus*, and updated the Taiwanese species of the genus *Leptophion* Cameron. The phenological and distributional patterns of these three species, viz., *L. giganteus* Shimizu and Watanabe, *L. maculipennis* (Cameron, 1905) and *L. radiatus* (Uchida, 1956) were also recorded. Shimizu and Maeto (2016) studied three species of the genus *Enicospilus* from Japan. Rouse *et al.*, (2016) used morphological characteristics and molecular markers to study the phylogeny of the subfamily Ophioninae. To create an updated phylogeny, Rouse employed a morphological dataset of 62 characteristics in addition to sequences in the D2 -D3 region of 28S ribosomal DNA and the COI region of mitochondrial DNA.

Shimizu (2017) published a new species of the genus *Enicospilus* ie., *E. kikuchii*. The taxonomy of the South Korean genus *Ophion* was presented for the first time in a study by Kim *et al.*, (2017), with new records from South Korea viz., *Ophion hokkaidonis* and *Ophion nokkonis*. Shimizu and Konishi (2018) prepared a preliminary checklist of the Laotian species of the genus *Enicospilus* with 11 new records from Laos. Shimizu and Lima (2018) revised the Japanese species of the genus *Stauropoctonous* Brauns with discussion of their phenology and collection methods. Johansson and Cederberg (2019) revised the genus *Ophion* Fabricius from Sweden with description of 18 new species. They are *O. angularis*, *O. arenarius*, *O. autumnalis*, *O. borealis*, *O. broadi*, *O. brocki*, *O. confuses*, *O. ellenae*, *O. inclinans*, *O. kallanderi*, *O. matti*, *O. norei*, *O. paraparvulus*, *O. paukkuneni*, *O. splendens*, *O.*

sylvestris, *O. tenuicornis*, and *O. vardali*. Shaw and Voogd (2019) investigated the biology and morphology of the Netherlandian species *Hellwigia obscura*. They were reared for the first time from larvae of *Horisme* sp. (Lepidoptera: Geometridae) feeding on *Clematis vitalba*.

Pham *et al.*, (2020) described a new species from genus *Dicamptus* Szepligeti, *D. curvus*. The genus *Leptophion* Cameron was first recorded from Vietnam by Pham *et al.*, in 2020. This included three new records of species, viz., *L. giganteus* Shimizu and Watanabe, *L. maculipennis* (Cameron, 1905) and *L. radiatus* (Uchida, 1956). Shimizu *et al.*, (2020) revised the status of Japanese species of the genus *Enicospilus* Stephens using an integrative approach (combined morphology and DNA barcoding). They recorded 47 species of *Enicospilus*, of which 8 are new to science, viz., *E. acutus*, *E. kunigamiensis*, *E. limnophilus*, *E. matsumurai*, *E. pseudopuncticulatus*, *E. sharkeyi*, *E. takakuwai*, and *E. unctus*. Shimizu (2020) studied the Nepalese fauna of *Enicospilus* and described six new species viz., *E. alleni*, *E. kakanicus*, *E. nepalensis*, *E. nikami*, *E. phulchokiensis*, and *E. tangi*. A Preliminary identification key and elevational pattern of Nepalese species of *Enicospilus* were also provided.

Johansson *et al.*, (2021) described 4 new species from the genus *Enicospilus*, viz., *E. amerii*, *E. apocalypticus*, *E. haladai*, and *E. peri*, and 12 new species from the genus *Ophion*, viz., *O. al*, *O. angustigena*, *O. breviflagellator*, *O. golestanicus*, *O. klimenkoi*, *O. persicus*, *O. schmidtii*, *O. sinuosus*, *O. sistanicus*, *O. transcarinatus*, *O. vasi*, and *O. xrafstra* from Iran. Ihsan *et al.*, (2022) studied the species of genus *Enicospilus* from Pakistan with two newly reported species, viz., *Enicospilus adustus* and *E. ramidulus*. Pham *et al.*, (2022) published an article on a new record of the genus *Dicamptus* Szepligeti from Vietnam, along with a checklist and key of *Dicamptus* species of Vietnam.

Ihsan *et al.*, (2023) reported the genus *Leptophion* with the species *L. maculipennis* for the first time from Pakistan. Pham *et al.*, (2023) revised the genus *Enicospilus* Stephen from Vietnam with a description of ten new species, viz., *E. aequiscleritalis*, *E. bulbipennis*, *E. centraliscleritiger*, *E. circuliscleritalis*, *E.*

gialaiensis, *E. hiepi*, *E. melanothoracicus*, *E. nigristernalis*, *E. trui*, and *E. tuani*. Shaw and Broad (2023) published the data for the reared specimen of Western Palaearctic *Ophion* Fabricius in the collection of the National Museum of Scotland, with 22 species, of which two species were redescribed, and recorded 5 species as new to Britain and Ireland. Crowley and Broad (2024) studied the genomic sequence of an Ichneumonid wasp, *Ophion ventricosus* Gravenhorst. Segarra *et al.*, (2024) present a biodiversity study on the Ophionine wasps of Puerto Rico, with description of a new species *Enicospilus almodovar*.

National

The first attempt on the Indian species of *Enicospilus* was carried out by Morley (1912a, 1913). Townes, Townes and Gupta (1961) published a catalogue and reclassification of the Indo-Australian Ichneumonidae. Rao and Nikam (1969) published on the Indian species of *Enicospilus* and described two new species, viz., *E. tribindus* and *E. tricorniatus*, from Aurangabad. Rao (1970) prepared a revised key to the Indian species of *Enicospilus*. Nikam (1972) published an article on studies on Indian Ichneumonidae with descriptions of new species. Nikam (1980) recorded and described 49 species of *Enicospilus*; of these 5 were new to science, viz., *E. gauldi*, *E. marathwadensis*, *E. gasteralis*, *E. fittoni* and *E. guptai*, 18 species were recorded for the first time in India and 13 species were reduced to synonyms. Gauld and Mitchell (1981) published the taxonomy, distribution and host preferences of Indo-papuan parasitic wasps of the subfamily Ophioninae. Keys were provided given to the 11 genera and 354 species, a total of 213 new species were formally described and 110 new specific synonyms were proposed. Nikam and Kanhekar (1984) studied two new species of genus *Dicamptus* Szepilgeti from India. They were *D. bicarinus* and *D. lambai* and also provided keys to Indian species. Manish and Chandrakasan (2017) published a new report of *Enicospilus shinkanus* from Andaman and Nicobar Island. Soumya *et al.*, (2023) published a new record of the genus *Stauropogon* Brauns from India and described a new species *S. narendrani* from Kerala. Key to the Oriental species of *Stauropogon* and affinities to the related species were also included.

CHAPTER 3

MATERIALS AND METHODS

STUDY AREA – NORTH KERALA

Kerala is a state in India located on the Malabar coast. Kerala state has a distinct physiographic setting due to the narrow strip positioned between the Arabian Sea on the west and the Western Ghats Mountain range on the eastern side. Geographically, there are three climatically different regions within the research area. It consists of the western lowland, which include the coastal plains, the middle midland which is adorned with rolling hills, and the eastern highland, which are enhanced by strong, cool mountainous terrain. Kerala's topography is composed of wet, hot coastal plains that gradually rises to the high hills and mountains of the western ghat. The Southwest and Northeast monsoons cause seasonal heavy rains, which contribute to Kerala's mostly humid tropical wet climate (Chacko and Renuka, 2002). The Edavappathy, or Southwest monsoon is characterised by torrential rains. The river fills up with water, and greenery covers the entire land area. The season's highest temperature frequently reaches 30°C, though occasionally it drops to about 20°C. By mid-August, this monsoon season was over, leaving beautiful weather with occasional rain. The monsoon season in Kerala returns in October, bringing with it severe rainfall, lightning and thunder, this period is referred to as the retreating monsoon, Thulavarsham or Northeast monsoon. The average highest temperature at this time is 35°C, while the lowest is about 28° C.

The Western Ghats in Kerala are home to a rich variety of species. UNESCO has added the Western Ghats Mountain range, with forests older than those situated in Himalayan range, to its list of world heritage sites. The Western Ghats have been recognised as one of the eight "hottest hotspots" of biological diversity in the world (Myers, 1998). Starting at the border between Gujarat – Maharashtra, the Ghats include the states of Goa, Karnataka, Tamil Nadu and Kerala. The Western Ghats are remarkable for their exceptionally high level of biodiversity and endemism (Ramachandra and Suja, 2008).

The North Kerala, located between northern latitudes 10.7502° N and 12.7848° N and east longitudes 74.8675° E and 76.7016° E. The study area consists of 5 north districts of Kerala- Kasaragod, Kannur, Wayanad, Kozhikode and Malappuram. North Kerala is a suitable place to conduct taxonomic research because of its great biodiversity, which is mainly due to its seasonal rainfall, tropical climate and inclusion of parts of the Western Ghats hot spot region.

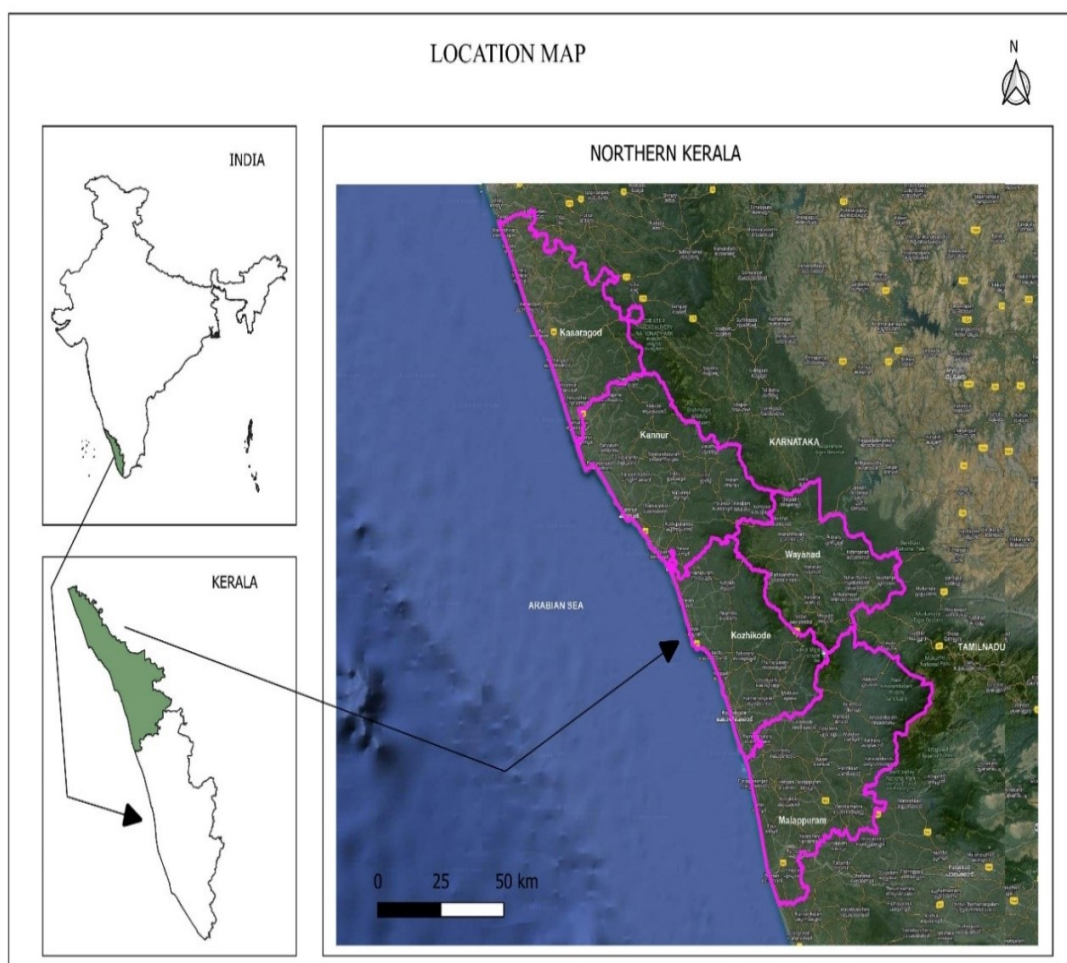


Figure 1: Map showing the study area of North Kerala.



Figure A-D : Collection Localities

Methods of Collection

Different methods were used for the collection of specimens, including Light traps, Malaise trap, Net sweeping, and Yellow pan traps.

a) Light Trap

Ophionine wasps are nocturnal, and they are frequently collected during night. The most common and widely used sampling method is light trapping. The most effective method for collecting sample of these insect is light trapping (Szenkiralyi, 2002). The study uses an electronic insect light trap with UV-A lighting technology (SAFS Timer Insect LED light trap, Model SAFS Itrap 01B). A tray on the trap holds the liquid solution. Soap water is used as solutions. It breaks the surface tension of the liquid to promote quick drowning. While the UV light from the trap could reach a distance of 500 m, each of them was positioned 500m apart (Patrick *et al.*, 1992). Throughout the year, a total of 5 light traps were placed for a duration of 12 hours in every sampling region. The trapped Ichneumonid wasp

were collected and washed using clear water. The specimens were preserved in 70% ethyl alcohol for further laboratory analysis.

b) Malaise Trap

Malaise traps were also used for collection in accordance with instructions of Townes (1972). Malaise traps are made of fine mesh netting that prevents flying insect from passing through, and the top part of the trap lead to a collecting chamber with a detachable bottle with a killing agent. The preservation or killing agent used in Malaise traps is 70% ethanol. The best areas are those with lots of flying activity, shades, and areas with abundant flowering plants. Two Malaise traps were run in different locations of the study area. The advantage of this Malaise trap is that it needs to be visited only once a week and can be serviced by a non-entomologist. This method was also found an effective collecting method for Ophionine wasps.

c) Net Sweeping

The present study adopts a modified version of sweep net model of Noyes (1982). It has a long aluminium handle (106-122 cm) and a triangular head (48×46×46cm). A triangular frame composed of fine cotton material has a net bag of 100 cm in length attached to it so that air can easily pass while also keeping tiny insects from escaping. Prior to conducting a net sweep, locations with high species diversity were chosen. Sweeping was done for 5 minutes, and then the net was twisted to allow the contents to fall down to the bottom. The net is positioned in the direction of the sun to attract insects to the brighter light at the closed end of the net bag. Large insects are collected and preserved in 70% alcohol. For collecting small insects an aspirator can be used. This method was effective to collect a lot of Ichneumonids; however, it yielded very few ophionine wasps.

d) Yellow pan trap

Yellow pan trap is another method of Ichneumonid wasp collection. The basis of this technique is the idea that yellow colour attracts a lot of insects. The trap is made up of a yellow colour, shallow tray with a depth of about 60 to 70 mm. Water was added to the trap, and a few drops of detergent were added to break the surface tension. Then the trap was placed on the ground. The tray was emptied once a day. The specimens were cleaned with fresh water before being transferred to

alcohol in order to avoid detergent contamination forming deposits on the specimens. Only very few species belonging to the subfamily Ophioninae got trapped using this method.



Figure A-B) Light trap, C-D) Malaise trap, E) Yellow pan trap, F) Sweeping net.

Storing and preservation

Specimens that were collected were preserved in 70% alcohol. The specimens were sorted out and identified. Then they were mounted on cards and placed inside the insect boxes. Naphthalene balls were positioned in the four corners of the insect box to ward off insect pests. To stop the fungus from growing additionally, 1,2-dichlorobenzene was added to the insect boxes. The specimens will be deposited in the NBRL Kozhikode which will be later transferred to WGRC Kozhikode.

Relaxing

It was best to mount the insects as soon as possible after they were killed. In case the specimens turned extremely rigid and dry, they were placed in a relaxing box or any other device of similar nature. A glass container was used to create a relaxing box. A thin sheet of synthetic sponge or another porous material was placed at the bottom of this container. Water was soaked into the sponge. To stop mould from growing on the specimen, which would otherwise happen in two or three days, a cotton swab soaked in roughly 10 to 15 ml of phenol was placed in one corner of the container. Next, they are spread out in a petridish with the insect specimens that need to relax.

Mounting

Mounting was done using the method adopted by Noyes (1982). The specimens were dried with a 40W table light. A rectangular card was used to mount the well-dried specimens, and one side of the thorax was glued to the card. This method has been selected since it enables the front, dorsal side and lateral aspects of the characteristics to be observed. Additionally, this method provides better protection than other methods for ichneumonid specimens including triangular card mounting, bristle mounting and pin gluing.

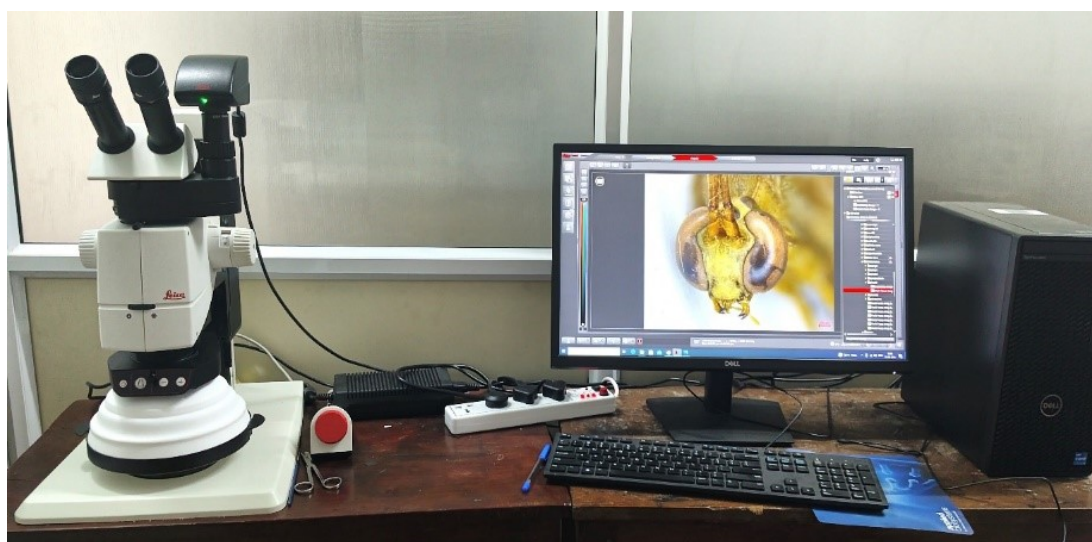
For card mounting, the following materials were used: Microscope, Rectangular cards, Blotting paper, Fine brush, Entomological pin, Water soluble glue and Table lamp

Labelling

Following the mounting process, labels with the names of the country, the state, the locality, the name of the individual who collected, the date of collection, the name of the host and register number of the specimens are affixed.

Observations

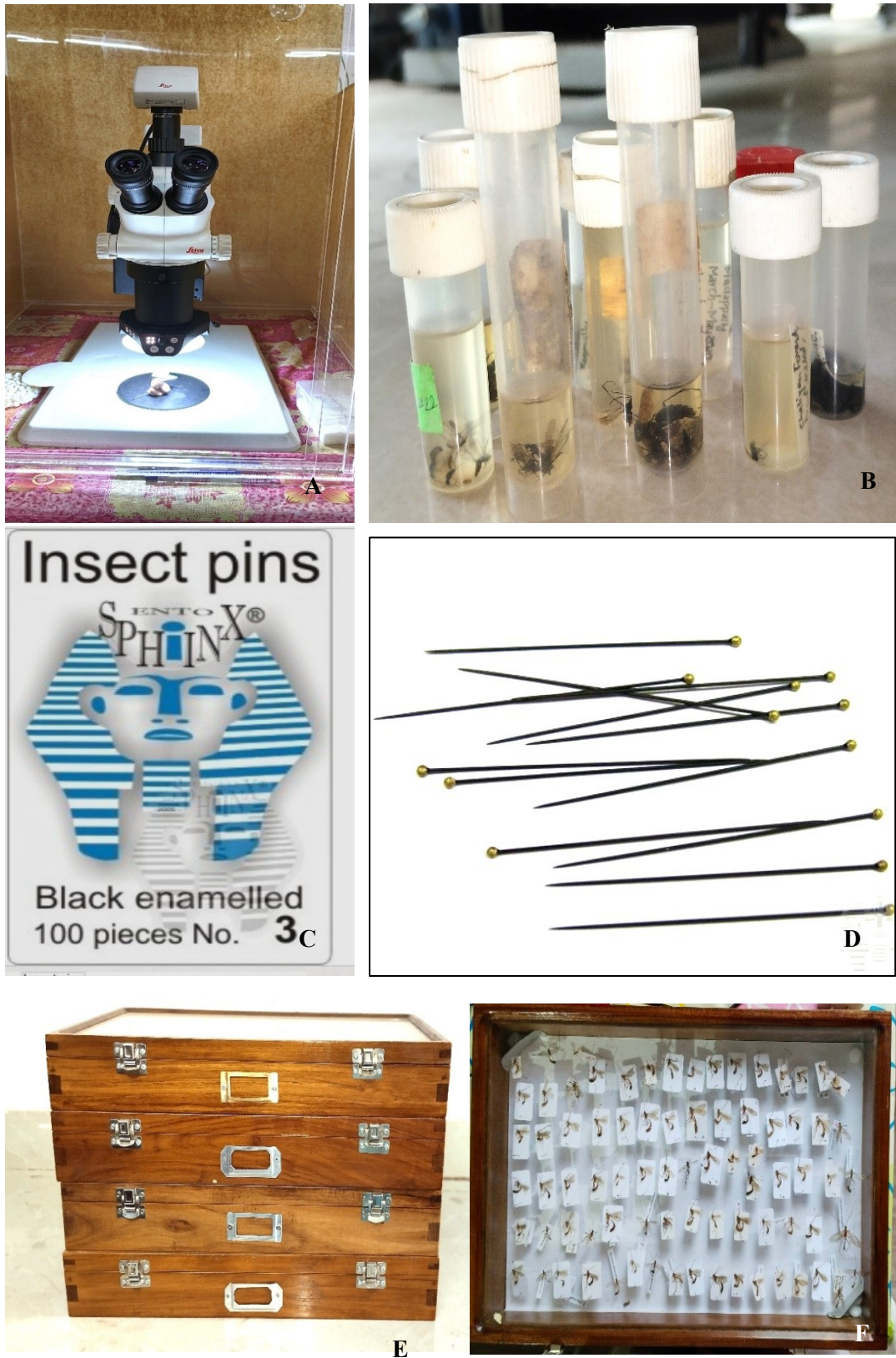
The morphological characteristics of mounted insect specimens were examined in details using a LEICA M205 stereozoom microscope. Photographs were taken using Leica MC 170 HD digital Camera.



LEICA MC170 HD digital Camera

Distribution Map

The name of each specimen, georeferenced location information and collection area were arranged in an excel sheet for the purpose of creating distribution maps. Maps were prepared with the help of species locations taken from the field itself using mobile GPS. Coordinate values of field sites imported into the GIS software platform. Open-source software like QGIS and Google Earth Pro were used for mapping.



A. LEICA M205 stereozoom microscope; **B.** Insect along with 70% Alcohol collected in bottles; **C & D.** Entomological Pin; **E & F.** Insect box

TAXONOMIC STATUS OF THE FAMILY ICHNEUMONIDAE

One of the hymenopteran families with greatest species richness, Ichneumonidae has 25,285 described species, 1601 genera, and 48 widely recognised subfamilies (Yu *et al.*, 2016). Townes (1969) estimated that there may be more than 60,000 species of Ichneumonids. Despite this, the group is still largely unexplored, even though the majority of these species are effective and often used biocontrol agents with enormous potential for managing biocontrol programmes (Gupta, 1987). The first scientist who described an Ichneumonid in a systematic manner was Linnaeus (1758). 13 subfamilies, comprising 61 genera of Ichneumonids, were identified by Gravenhorst (1829). Wesmael (1845) separated the Ichneumonids into five groups: Ichneumones, Crypti, Pimplae, Banchi and Ophiones. and then expanded the taxonomy of Ichneumones. The five subfamilies identified by Holmgren (1856) were Ichneumonides, Crypti, Ophionides, Tryphonides and Pimplariae. Several genera were proposed by Cameron, Morley, Viereck and Schmiedeknecht during 1895 and 1925. Townes (1969) published a detailed study on the Ichneumonidae genera. It included a detailed description and key to all subfamilies, tribes, genus and subgenera. Numerous catalogues have been published for the species of Ichneumonidae that have been described. These include the catalogue of Indo-Australian region by Townes, Townes & Gupta in 1961; the Eastern Palaearctic region by Townes, Momoi & Townes in 1965; the Neotropic region by Townes & Townes in 1966; the Ethiopian region by Townes & Townes in 1973; the Nearctic region by Carlson in 1979; World species by Yu & Horstmann in 1997. World Ichneumonoidea is available electronically in Taxapad (Yu *et al.*, 2016).

DIAGNOSIS OF THE FAMILY ICHNEUMONIDAE

Forewing with first discoidal and first submarginal cell are confluent; 2m-cu vein present; hind wing with enclosed sub basal cell; second metasomal tergite usually separated from third metasomal tergite; metasomal sternites usually weakly sclerotized; antennae with more than 13 flagellar segments.

KEY TO THE SUBFAMILIES OF FAMILY ICHNEUMONIDAE

1. Apex of scutellum with a long spine almost equal to the length to the scutellum; metasomal sternite 2-4 completely sclerotized.....**Agriotypinae**
 - Apex of scutellum without a long spine; metasomal tergite 2-4 partly to entirely of membranous **2**
2. Pronotum with raised bifurcate flange or bilobate process medio dorsally; forewing without second intercubital vein; flagellum usually flattened or widened medially; ovipositor sheath almost concealed.....**Eucerotinae**
 - Pronotum smooth mediodorsally or with a transverse groove, without bifurcate or bilobate process; forewing with or without second intercubital vein; flagellum not flattened and widened medially; ovipositor sheath usually visible. **3**
3. Clypeus separated from face by distinct groove; forewing with areolet various; posterior mesosternal carina complete; male genitalia with outer lobe very rarely produced into elongated process..... **4**
 - Clypeus not separated from face by distinct groove; forewing with areolet rhombic; posterior mesosternal carina not complete; male genitalia with outer lobe produced into elongate process..... **Mesochorinae**
4. Spiracle of first metasomal tergite behind midlength **5**
 - Spiracle of first metasomal tergite or in front of mid length **19**
5. Metasoma laterally compressed, its 3rd and 4th segment higher than wide..... **6**
 - Metasoma dorsoventrally depressed or cylindrical, its 3rd and 4th segment wider than high **12**
6. Forewing with 2rs-m vein joining M vein distad of 2m-cu vein by a distance greater than half its length; epomia absent; outer apical edge of front tibia without a spine or tooth **Ophioninae**
 - Forewing with 2rs-m vein joining M vein based of, opposite, or less than half its length distad of 2m-cu; epomia present and long (or sometimes reduced or absent); outer apical edge of front tibia with spine or tooth..... **7**
7. Propodeum without carinae, rarely with a basal transverse carina, propodeal sculpture usually coarse and reticulate; hind tarsus swollen, especially in males, areolet absent **Anomaloninae**
 - Propodeum with distinct carinae; propodeal sculpture not coarse and reticulate; hind tarsus usually not swollen; areolet present or absent..... **8**
8. Clypeus confluent with face; posterior mesosternal carina complete, or rarely interrupted in front of each mid coxa **9**

- Clypeus separated from the face by a distinct groove; posterior mesosternal carina absent or interrupted in front of each mid coxa **10**
- 9.** Mid and hind tibial spurs inserted in a common area with tarsus, apex of each tibia thus having a single membranous insertion area; clypeus usually confluent with face; face usually black.....**Campopleginae**
- Mid and hind tibial spurs inserted in a separate area from that of tarsus, apex of each tibia thus having two insertion area separated by a sclerotized bridge; clypeus separated from face by a groove; face usually more or less pale
..... **Cremastinae**
- 10.** Clypeus wide, with an apical fringe of long parallel setae; areolet absent....
..... **Tersilochinae**
- Clypeus not unusually wide, without an apical fringe of long parallel setae; areolet present..... **11**
- 11.** Labrum large and conspicuously exposed ventral to clypeal margin; abdomen joined to propodeum distinctly dorsal to hind coxal cavity; inner margin of eye not notched..... **Labeninae**
- Labrum small and mostly or entirely concealed by clypeus; abdomen joined to propodeum between or just above hind coxal cavity; inner margin of eye sharply notched.....**Brachycyrtinae** (*Brachycyrtus*)
- 12.** Hind tibia with one spur **Tryphoninae** (*Sphinctus*)
- Hind tibia with two spurs **13**
- 13.** Clypeus confluent with face; areolet petiolate..... **14**
- Clypeus separated from face by a groove, or if confluent then areolet petiolate **15**
- 14.** Posterior mesosternal carina complete **Campopleginae**
- Posterior mesosternal carina incomplete.....**Metopiinae**
- 15.** Ovipositor with dorsal subapical notch, ventral margin without apical teeth; first metasomal sternite not fused with its tergite **Banchinae**
- Ovipositor without dorsal subapical notch, ventral margin with apical teeth; first metasomal sternite fused with its tergite **16**
- 16.** Flagellum circular in cross section, slightly enlarged apically..... **17**
- Flagellum oval in cross section, not enlarged apically, setiform or fusiform **18**
- 17.** Labrum large and conspicuously exposed ventral to clypeal margin; abdomen joined to propodeum distinctly dorsal to hind coxal cavity; inner margin of eye not notched..... **Labeninae**

- Labrum small and mostly or entirely concealed by clypeus; abdomen joined to propodeum between or just above hind coxal cavity; inner margin of eye sharply notched..... **Brachycyrtinae** (*Brachycyrtus*)

- 18.** Sternaulus short or absent, if present less than half as long as mesopleurum; clypeus wide and flattened, its apical margin usually truncate and not impressed; ovipositor not extending beyond the apex of metasoma, ovipositor sheath rigid; 2rs-m vein present..... **Ichneumoninae**

- Sternaulus present and extending to at least half as long as mesopleurum; clypeus moderately to strongly convex, its apical margin usually convex and impressed; ovipositor extending beyond the apex of metasoma, ovipositor sheath flexible; 2rs-m vein present or absent..... **Cryptinae**

- 19.** Mid tibia with 1 apical spur **20**
- Mid tibia with 2 apical spur..... **21**

- 20.** Face with large concave or shield shaped flat region enclosed by a carina, dorsal side of face with projection between antennal toruli **Metopiinae** (*Metopius*)

- Face without large concave or shield shaped flat region, usually with smooth convex surface, dorsal side of face without projection between antennal toruli
..... **Tryphoninae**

- 21.** Clypeus and face not separated by a groove..... **22**
- Clypeus and face separated by a distinct groove **24**

- 22.** Eye hairy; tarsal claws of female with a large basal lobe; areolet absent.....
..... **Pimplinae** (*Schizopyga* and *Afrospinecta*)

- Eye usually bare; tarsal claw of female pectinate or simple; areolet present or absent... .. **23**

- 23.** Scape subcylindrical, 1.8 to 2.4 times as long as wide; dorsal side of face without projection between antennal toruli **Orthocentrinae**

- Scape ovoid, 1.2 to 1.7 times as long as wide; dorsal side of face with a triangular process between antennal toruli
..... **Metopiinae** (except *Periope*, *Ischrocnemis* and *Bremiella*)

- 24.** Upper tooth of mandible broad, more or less distinctly divided by a weak notch in its apical margin, mandible thus appearing three toothed; ovipositor not extending beyond the apex of metasoma..... **Diplazontinae**

- Upper tooth of mandible not divided by a weak notch in its apical margin, mandible thus appearing two toothed or one toothed; ovipositor varying length ...
..... **25**

25. Metasoma joined to propodeum distinctly dorsal to hind coxal cavity; epipleura of tergite 2 to tergite 4, 0.4 -0.6 times as wide as metasoma..... **Labeninae** (in part)
.....
- Metasoma joined to propodeum between or just above hind coxal cavities; epipleura of tergite 2 to tergite 4 often less than 0.4 times as wide as the metasoma **26**
26. Female subgenital plate large, elongate triangular, with a long apical point; fore and mid tarsal claws with a subapical appressed tooth..... **Acaenitinae**
- Female subgenital plate smaller, sometimes short triangular; fore and mid tarsal claws without a subapical appressed tooth **27**
27. Second to fifth metasomal tergite with sharp groove that bound a median triangular area; pronotum with epomia strong, its upper end projecting as a tooth **Lycorininae**
- Second to fifth metasomal tergite smooth or various impression, never with a median sharply bounded triangle; pronotum with epomia present or absent, rarely its upper end projecting as a tooth **28**
28. Apical margin of fore tibia produced apically in dorsal margin into a small tooth; ovipositor usually with dorsal subapical notch..... **Ctenopelmatinae**
- Apical margin of fore tibia rounded on dorsal margin; ovipositor with or without dorsal subapical notch..... **29**
29. First metasomal tergite with large glymma; tarsal claw more or less pectinate; clypeus not separated by distinct groove; areolet rhombic; posterior mesosternal carina not complete; female subgenital plate large, triangular **Mesochorinae**
- First metasomal tergite with or without glymma; tarsal claws pectinate or not; clypeus separated by distinct groove; areolet various; posterior mesosternal carina complete or incomplete; female subgenital plate various **30**
30. First metasomal tergite with a glymma; propodeum without transverse carina; first metasomal sternite more or less free from its tergite; tarsal claws often with a tooth or basal lobe **Pimplinae**
- First metasomal tergite without a glymma; propodeum with at least one transverse carina; first metasomal sternite fused with its tergite; tarsal claws simple **31**
31. Second intercubital vein present; mesopleuron without sternaulus; ovipositor not extending beyond metasomal apex **Ichneumoninae**
- Second intercubital vein present or absent; mesopleuron with sternaulus; ovipositor always extending beyond metasomal apex..... **32**

32. Mesopleuron with sternanulus indistinct, absent, or less than half as long as mesopleuron; propodeum with longitudinal and transverse carina; mandible with one or two teeth **Xoridinae**
- Mesopleuron with sternanulus distinct, more than half as long as mesopleuron; propodeum with one or two transverse carina; mandible with two teeth **Cryptinae**

DISCUSSION ON MORPHOLOGICAL CHARACTERS OF OPHIONINE WASPS

Ophionine wasps are characterised by a high degree of intraspecific variation and shows limited number of taxonomically significant character. These features make it difficult to define and key many species in an appropriate way. Due to the high level of intraspecific variation, it may be useful to discuss the relative taxonomic effectiveness of particular character.

Head

A key characteristic of the ophionine species is the shape of the clypeus. Most species have a slightly impressed groove that divide it from the face, however in some *Enicospilus* species, it is flat and confluent with the face. The clypeus may appear convex, truncate or very rarely concave when viewed anteriorly (Gauld, 1977). The mandible provides a lot of taxonomic character and frequently a species characteristic. Adults mostly use its mandible for breaking its cocoon. Species that live in dry climate must bite through strong pupal cells, which requires a pick-like mandible with a long sturdy upper tooth (eg. *Enicospilus capensis*, *E. insularis*). The upper mandibular tooth is usually flattened dorsoventrally in species with thick silky cocoon whereas the lower tooth is typically sharply pointed (eg. *E. vestigator*). Very few species like *E. interruptus*, have a lower mandibular tooth that is significantly bigger than an upper tooth. Important characteristics of mandible also include tapering, the degree of torsion, the pilosity and the presence and absence of deep diagonal groove on the outer mandibular surface. Genus *Euryophion* and *Dictyonotus* have extremely large slightly tapering mandible. Several species including those in the genus *Leptophion* have thick bushes of long hair on the outer mandibular surface (Gauld and Mitchell, 1981). The shape of the mandible is a key

characteristic used to distinguish genus *Dicamptus* from *Enicospilus*. The mandible of members of the former genus are not tapered or twisted as they are in the later (Gauld, 1977).

Some *Enicospilus* species have highly variable gross head shapes, however these variations are of limited taxonomic use because many of these species have more intraspecific variation than interspecific variance. Many species, males typically, have more buccate genae and a longer malar space than their females. Other Ichneumonidae families show similar allomorphic variation, but there is still no adequate explanation for this phenomenon (Gauld, 1976). The position and size of the ocelli in relation to the eye are also very important. The ocelli of diurnal species, such as *Orientospilus individuus* are considerably smaller than those of their nocturnal relatives (Gauld and Mitchell, 1981)

Antennae are generally the same length in a majority of species, but it has been shown that the shape of each segment was found to be some importance. Species that live in dry open environments have shorter, stouter antennae than their forest dwelling relatives (Gauld and Mitchell, 1981). The presence and absence of occipital carina are important in generic classification. Species of *Stauropoctonus* lack occipital carina.

Mesosoma

Mesoscutum and propodeum profile shapes are highly distinct for species. The size, shape and convexity of scutellum are frequently used to identify a species. Considerable significance is attached to the propodeum and the spiracle position in relation to the lateral carina. Some authors (Cushman, 1947; Townes, 1971) have given the posterior transverse carina of the mesosternum generic significance, but some *Leptophion* species that are found to have this carina either present or absent.

Wing

In the genera *Dicamptus* and *Enicospilus* the discosubmarginal cell often bears an obvious fenestra behind R_{s+2r} and in the membrane of this fenestra having one or more detached sclerites. The proximal sclerite is generally triangular in many

species, however in certain individuals it can be deformed and seems comma shaped. Few species have proximal sclerite that are consistently comma shaped, hence it is necessary to distinguish these species from aberrant members of other species using other characteristics. The distal sclerite which arises from the thickening of the posterodistal margin of the fenestra, may be almost completely absent in some species while being heavily pigmented in other conspecific individuals. Although in some species the distal sclerite and the posterodistal corner of the proximal sclerite are often confluent, while in the median part of the fused sclerite is very faintly sclerotized giving the appearance of two distinct sclerites. The shape of the central sclerite varies greatly between the species, yet in others (like *Enicospilus antennatus*) it appears to be homogeneous (Gauld, 1977).

Many authors have tried to categorise *Enicospilus* into different genera during the past century based on the number of alar sclerite. *Allocamptus* for eg. has no sclerite; *Amesospilus* has no central sclerite and *Schizopilus* has two or more central sclerites. Interested observations about this subdivision are provided by Cushman (1947). Such characters are not significant phylogenetically and are primarily relevant for species identification. In the wings, there are many additional characteristics mainly in the relative length of veins, position of bullae and hairiness of discosubmarginal cell. In the genus *Leptophion*, shape of the distal hamuli and vein Rs in the hindwing are important (Gauld and Mitchell, 1981). Forewing with 1m-cu with or without ramellus are the key characters of genus identification. Species of the genera *Ophion* and *Sclerophion* have ramelli whereas most of the genera show no ramelli. Indexes for forewing, mainly SDI, CI and AI are important for the species level of *Enicospilus*.

Leg

Various species can be recognised by their hind tarsal claws. They frequently exhibit significant sexual dimorphism. The degree and kind of sexual dimorphism varies from species to species and is assumed to have phylogenetic importance (Gauld, 1977). The pectinae of the inner and outer hind tarsal claws vary slightly

between species and in a few forest – dwelling *Enicospilus* species, the claws are very highly asymmetrical (Gauld and Mitchell, 1981).

The tibial spurs offer several characters. The presence of a membranous flange behind the microtrichial comb is significant for generic classification (Gauld, 1977). A large number of spines on the outer tibial surface is an important characteristic of the genus *Dicamptus* and *Enicospilus* species. In *Stauropoctonous*, the distal margin of the trochantelli is converted into an acute tooth. Very long trochantelli are found in some species of *Enicospilus* that live at high altitudes (Gauld and Mitchell, 1981).

Metasoma

The metasoma offers a few unique characters. The species of the genera *Euryophion* and *Dictyonotus* often have stouter gaster than those of other genera (Gauld and Mitchell, 1981). The position and size of thyridium vary between *Enicospilus* species. In some species of *Enicospilus*, the shape of the gonosquama is of specific significance.

MORPHOLOGICAL TERMINOLOGY AND INDICES

The morphological terminology is based on Gauld and Mitchell (1981) and Gauld (1991). The present study utilises the indices proposed by Gauld and Mitchell (1981), Shimizu *et al.*, (2016) and Shimizu and Lima (2018).

MORHOLOGICAL TERMINOLOGY

HEAD

Antenna: A pair of segmented sensory appendages situated between the compound eyes, comprising three segments: the scape, pedicel and flagellum.

Clypeus: The region on the front of the head, below the face and above the mouth opening.

Face: A portion from the front face of the head, between the eyes, that extended from the antennal socket's lower margin to the groove that divided the face from the clypeus.

Frons: A portion of the heads front, between the eyes, that extending from the lower margin of the median ocelli to the lower margin of the antennal sockets.

Malar space: The distance between the lower margin of the compound eye and the mandibular socket.

Occipital carina: A subcircular carina on the hind aspect of the head between the vertex and hind margin of the compound eye and the foramen magnum.

Occiput: The upper region of the head's posterior side, extending from the vertex to the occipital carina

Ocellar triangle: The raised triangular area containing the three ocelli.

Pedicel: The second primary division of the antenna, which joins to the scape basally and the flagellum apically.

Scape: The first primary division of the antenna, which joins to the torulus basally and the pedicel apically.

MESOSOMA

Anterior transverse carina of the propodeum: the anterior one of the two transverse carina of the propodeum.

Bulla: A weak, translucent section of a wing vein, marking the area where a fold or flexion line of the wing crosses.

Carina: A ridge or raised line.

Coxa: The first portion of the leg, situated between the body and the trochanter.

Hamulus: The forewing and hindwing are joined by a tiny, bristle like hook on the front edge of the hindwing. There are two types of hamuli: proximal and Distal hamuli.

Lateral longitudinal carina of the propodeum: the lateral longitudinal carina of the propodeum lying between the median and pleural carina.

Mesonotum: Dorsal part of mesothorax.

Mesopleural suture: A vertical or oblique groove that extend from the middle coxal socket to the base of the front wing.

Mesopleuron: The ventral and lateral part of mesothorax.

Mesoscutum: The mesonotum excluding the scutellum.

Mesosoma: Thorax plus propodeum

Mesothorax: The second of the three primary divisions of the thorax.

Metathorax: The third of the three primary subdivisions of the thorax, bearing the hind legs and hind wings.

Notaulus: one of a pair of grooves on the mesoscutum, each beginning on the front margin to one side of the midline and extending backward. The notauli divide the mesoscutum into 3 parts: a median lobe between the two notauli and a lateral lobe on each side.

Pectinate: This word describes tarsal claws with a comb-like pattern of small teeth on the underside.

Pleural area: the region on the lateral side of the propodeum next to the metapleuron.

Pleural carina: Carina between the metapleuron and the propodeum.

Pronotum: The dorsal sclerite of the prothorax, occupying the dorso-lateral region.

Propodeum: The first metasomal tergum, which is typically connected to the remaining metasoma and immovably joined with the metanotum and each metapleurum of the thorax.

Prothorax: The first of the thorax's three main subdivisions, made up of the pronotum, propleuron and post sternum.

Scutellum: Behind the mesoscutum, an elevated, middle, subtriangular portion of the mesonotum.

Spiracle: A small, oval or round lateral aperture on a body part that allows air to enter the trachea.

Submetapleural carina: This is situated between the bases of the middle and hind coxae on the lower margin of the metapleurum's lower division.

Tarsus: The fifth leg segment, which is attached basally to the tibia and divided into tarsomeres. There are 3-5 tarsomeres on each tarsus.

Tibia: The fourth leg segment, between femur and tarsus.

Tibial spur: A spine like extension of cuticle found apically on tibiae.

Trochanter: The second leg segment, between the coxa and femur.

METASOMA

First metasomal tergite: When comparing the length and width of this sclerite, the length is calculated by measuring from the centre of the insertion area of the extensor tendon to the extreme apex on the midline. The first tergite's width is measured at its widest point, which is almost always in proximity to the apex. Three pairs of longitudinal carinae are usually present in first tergite: the median dorsal carinae are two on the upper side, in between the spiracles. The dorsolateral carina (one on each side) is at the level of the spiracle. Following the lower edges of the tergite is the ventrolateral carina.

Metasoma: The segments usually comprising the abdomen of insects; but in Ichneumonids the morphological first segment, is transferred to the thorax as the propodeum. Metasomal segments in Ichneumonids are numbered from front to rear, with the first apparent segment (morphologically the second segment) termed the first metasomal segment.

Ovipositor: In females, a slender, paired and interlocking saw-like or tubular structure used for laying eggs and for stinging.

Ovipositor sheath: the two outside covering part of the ovipositor. The length of the ovipositor sheath is the same as the length of the exerted part of the ovipositor.

Petiole: The part of the first abdominal segment in front of the spiracle

Thyridium: A scar-like area on each side of the second abdominal tergite, between its middle and base

INDICES

HEAD

Geno-Orbital Index (GOI) = maximum width of eye in profile / maximum width of gena in same line

FOREWING

Alar Index (AI) = length of 1m-cu between 2m-cu and bulla / length of 2rs-m

Cubital Index (CI) = length of CU between 1m-cu and 2cu-a / length of 2cu-a

Discoidal Index (DI) = maximum vertical distance between CU and 1m-cu / length of CU between 2Cu-a and 2m-cu

Intercubital Index (ICI) = length of 2rs-m / length of M between 2m-cu and 2rs-m

Second discoidal Index (SDI) = length of CU between 2cu-a and 2m-cu / length of CU between M& RS and 1m-cu.

Sinuosity Index (SI) = maximum length between 1m-cu and a straight line connecting the intersection of M, 2m-cu and 1m-cu and the intersection of 1m-cu and CU / distance between the intersection of M, 2m-cu and 1m-cu and intersection of 1m-cu and CU

Second Recurrent Index (SRI) = length of 2m-cu / length of CU between 2cu-a and 2m-cu

HIND WING

Nervellar Index (NI) = length of CU between M and cu-a / length of cu-a

METASOMA

Dorsal Metasomal Index (DMI) = length of dorsum of T2 / length of dorsum of T3

Petiolar Index (PI) = distance between the base of T1 and anterior margin of spiracle / distance between posterior margin of spiracle and apex of T1

Thyridium Index (THI) = distance between the anterior margin of T2 and anterior margin of thyridium / maximum diameter of thyridium

ABBREVIATIONS OF MORPHOLOGICAL TERM USED.

FWL = Forewing length

FWW = Forewing width

HWL = Hind wing length

HWW = Hind wing width

LT = Light Trap

MT = Malaise Trap

SN = Sweeping Net

YPT = Yellow Pan Trap

ABBREVIATIONS FOR DEPOSITARIES

- ANIC - Australian National Insect Collection, Canberra, Australia.
- BMNH - British Museum (Natural History), London, England.
- BPBM - Bernice P. Bishop Museum, Honolulu, U.S.A.
- DEI - Deutsches Entomologisches Institut, Munchenberg, Germany.
- EIHU - Entomological Institute, Hokkaido University, Sapporo, Japan.
- FZLU - Fachbereich Zoologie, Martin-Luther-Universitat, Halle, Germany.
- IRSNB - Institut Royal des Science Naturelles de Belgique, Bruxelles, Belgium.
- IZPAN - Instytut Zoologiczny Polska Akademia Nauk, Warszawa, Poland.
- MCZ - Museum of Comparative Zoology, Cambridge, USA.
- MNHU - Museum fur Naturkunde der Humboldt- Universitat, Berlin, E. Germany.
- MNHN - Museum National d'Historie Naturelle, Paris, France
- MUC - Marathwada University Collection, Aurangabad, India
- NBRL - Prof. T.C. Narendran Biodiversity Research Laboratory, Kozhikode, India.
- NM - Naturhistorisches Museum, Vienna, Australia.
- NR - Naturhistoriska Riksmuseum, Stockholm, Sweden.
- TARI - Taiwan Agricultural Research Institute, Taichung, Taiwan.
- TM - Termesztudományi Múzeum, Budapest, Hungary.
- UM - University Museum, Oxford, England.
- USNM - United States National Museum, Washington D. C, U.S.A.
- WGRC, ZSI - Western Ghats Regional Centre, Zoological Survey of India, Kozhikode, India.
- ZIUU - Zoological Institute, University of Uppsala, Sweden.
- ZMA - Zoological Museum, Amsterdam, The Netherlands.
- ZSI - Zoological Survey of India, Kolkata, India.

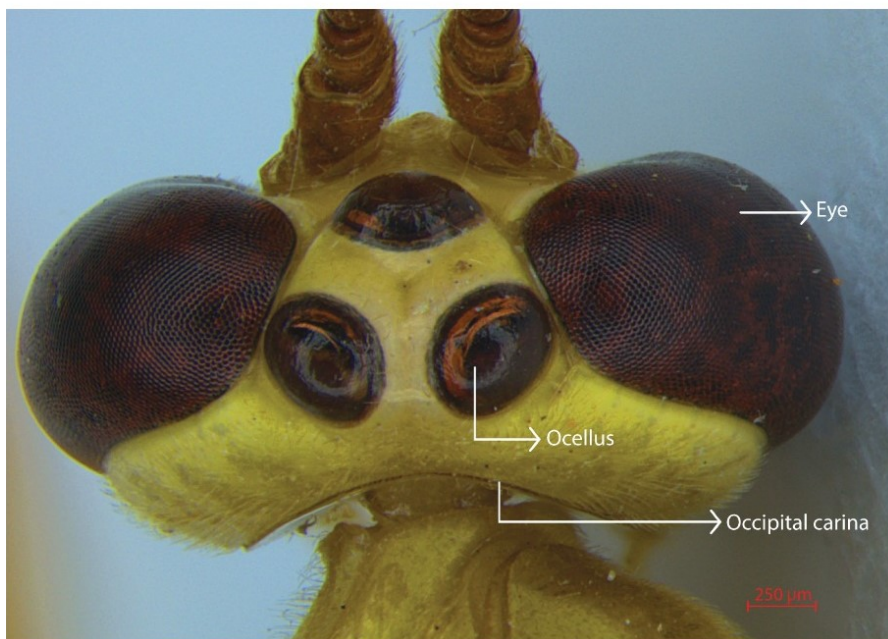
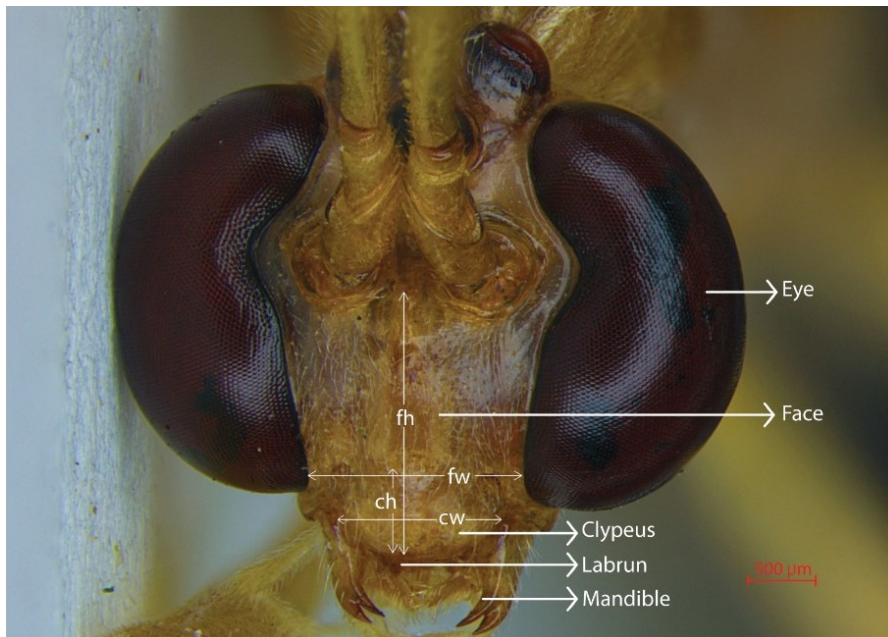


Figure 1 & 2. Morphological terms for Head frontal and dorsal view (fh= face height; fw= face width; ch= clypeus height; cw=clypeus width)

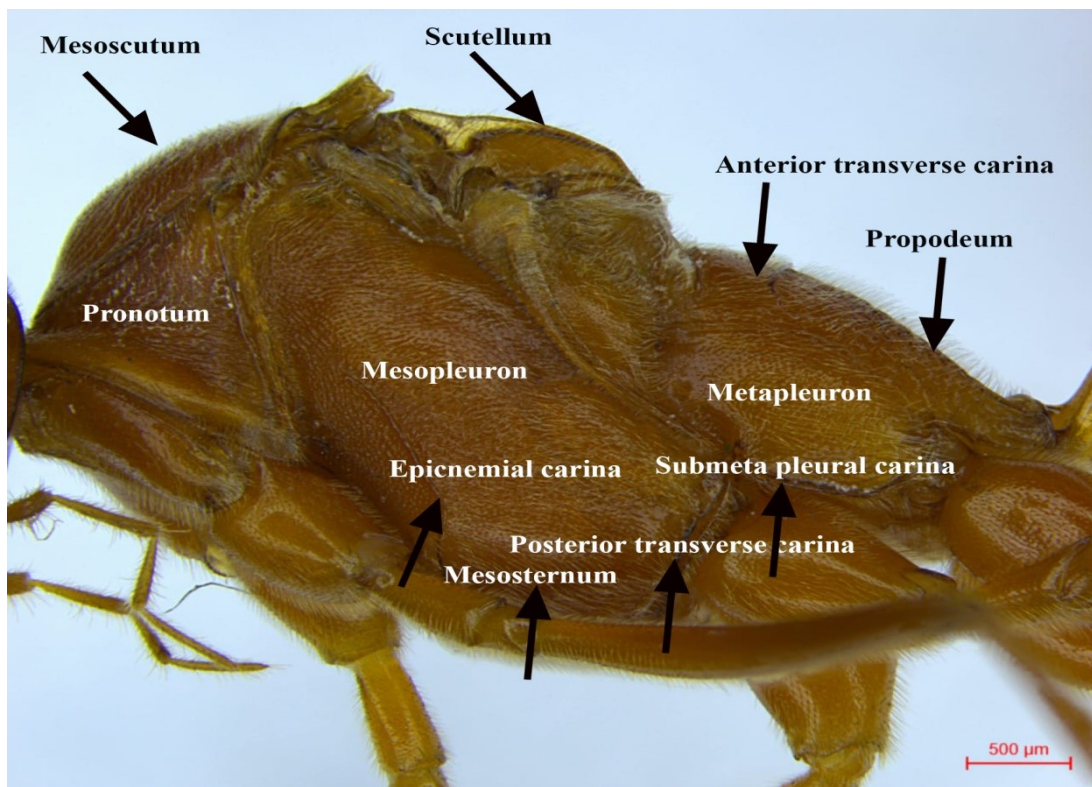


Figure 3. Morphological terms for mesosoma Lateral view

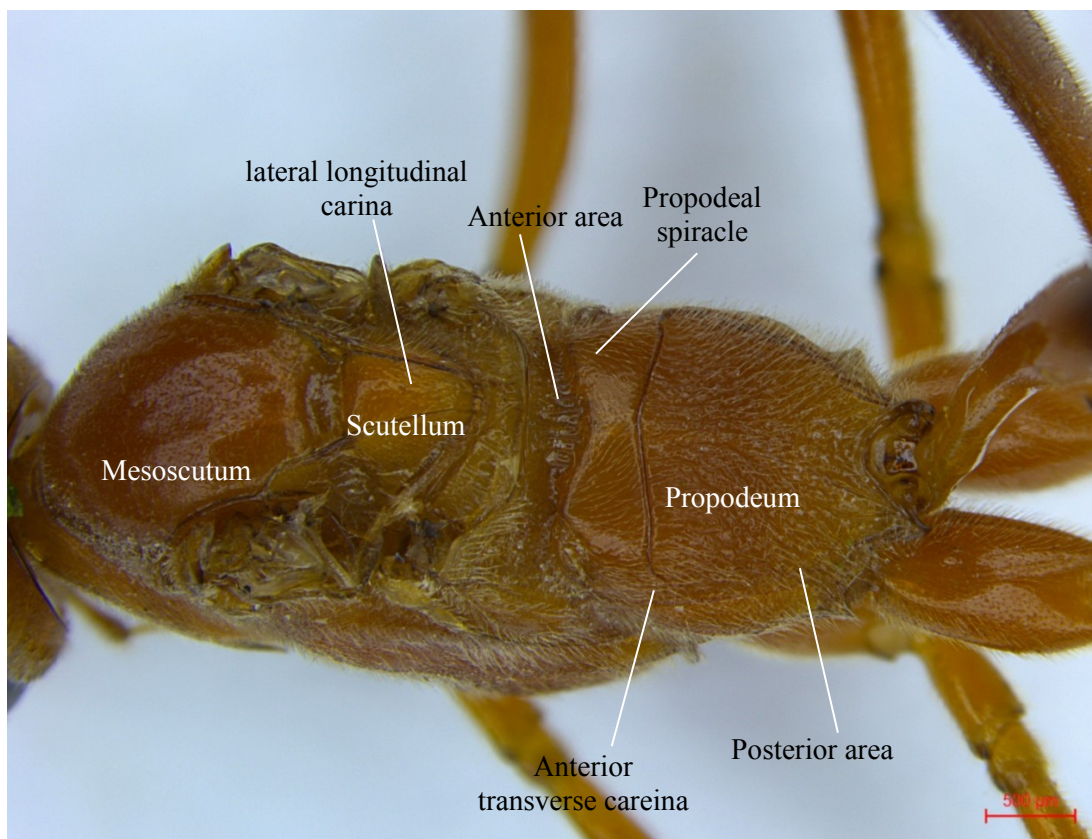


Figure 4. Morphological terms for mesosoma dorsal view

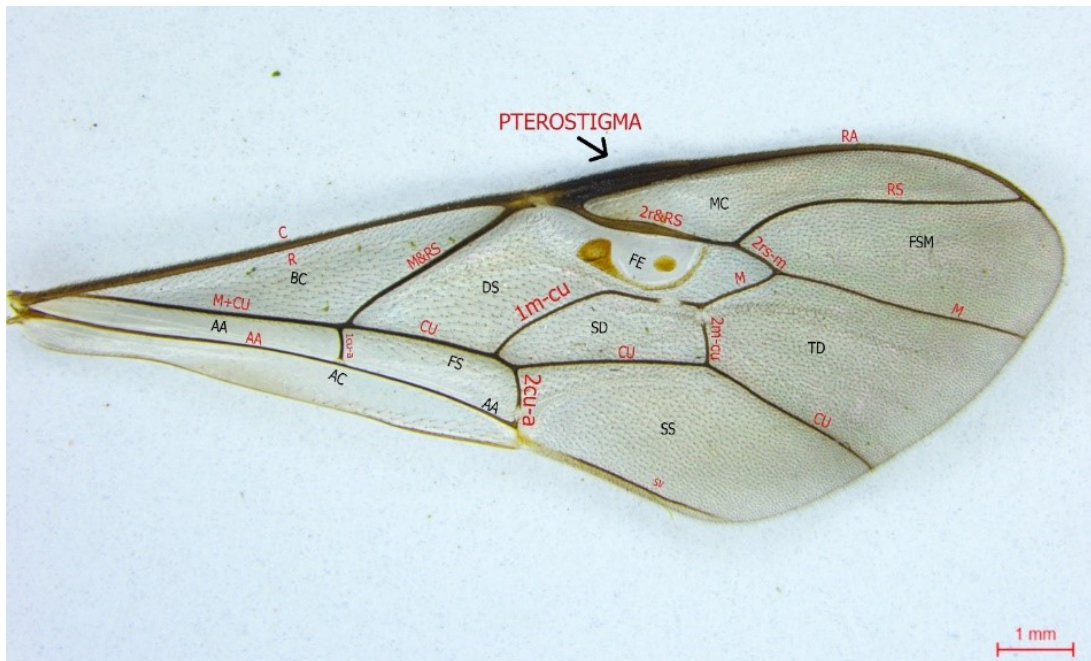


Figure 5. Morphological terms of forewing: AC = anal cell; BC = basal cell; DS = discosubmarginal cell; FE = fenestra; FS = first subdiscal cell; FSM = fourth submarginal cell; MC = marginal cell; SD = second discal cell; SB = subbasal cell; SS = second subdiscal cell; TD = third discal cell.

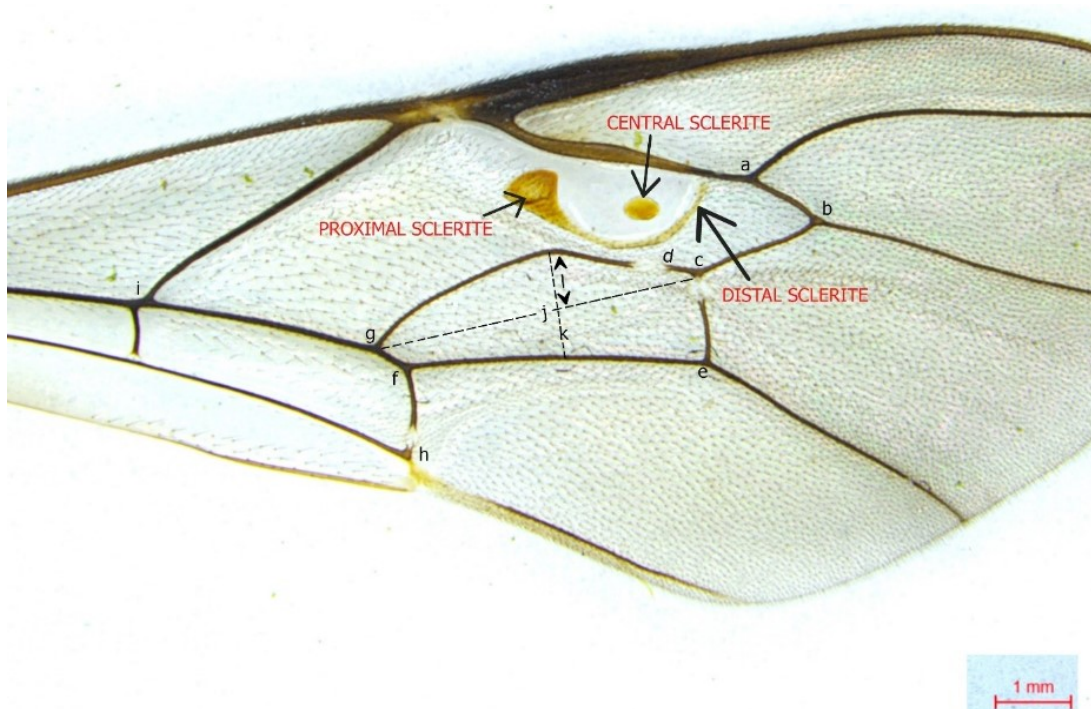


Figure 6. Morphological indices of forewing: $AI = cd/ab$; $CI = gf/fh$; $DI = k/fe$; $ICI = ab/bc$; $SDI = ef/gi$; $SI = l/j$; $SRI = ce/ef$

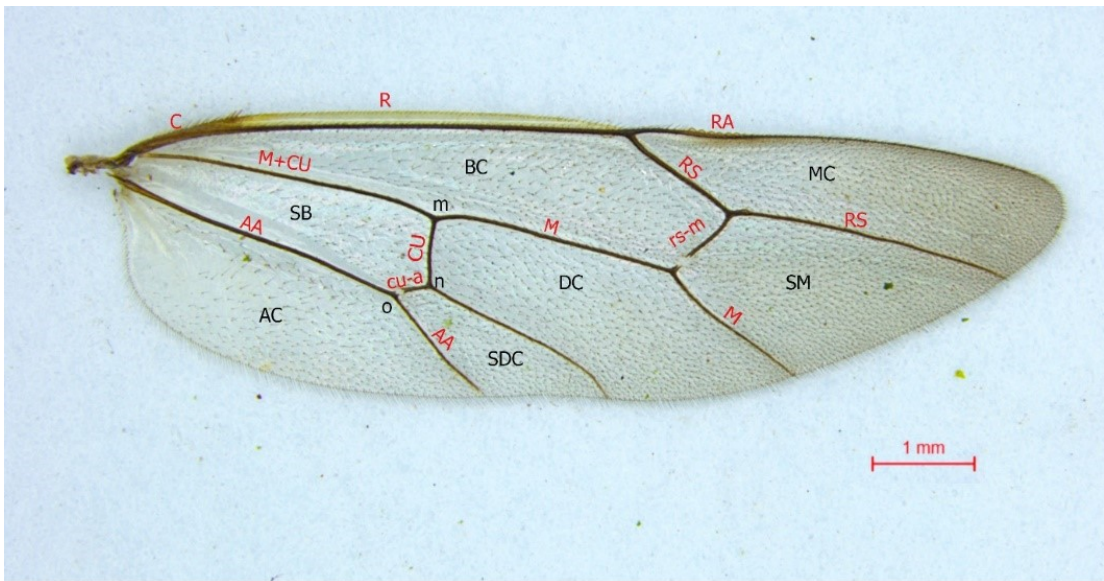


Figure 7. Morphological terms and indices of hind wing: AC = anal cell; BC = basal cell; DC = discal cell; MC = marginal cell; SB = subbasal cell; SDC = subdiscal cell; SM = submarginal cell; NI = mn/no

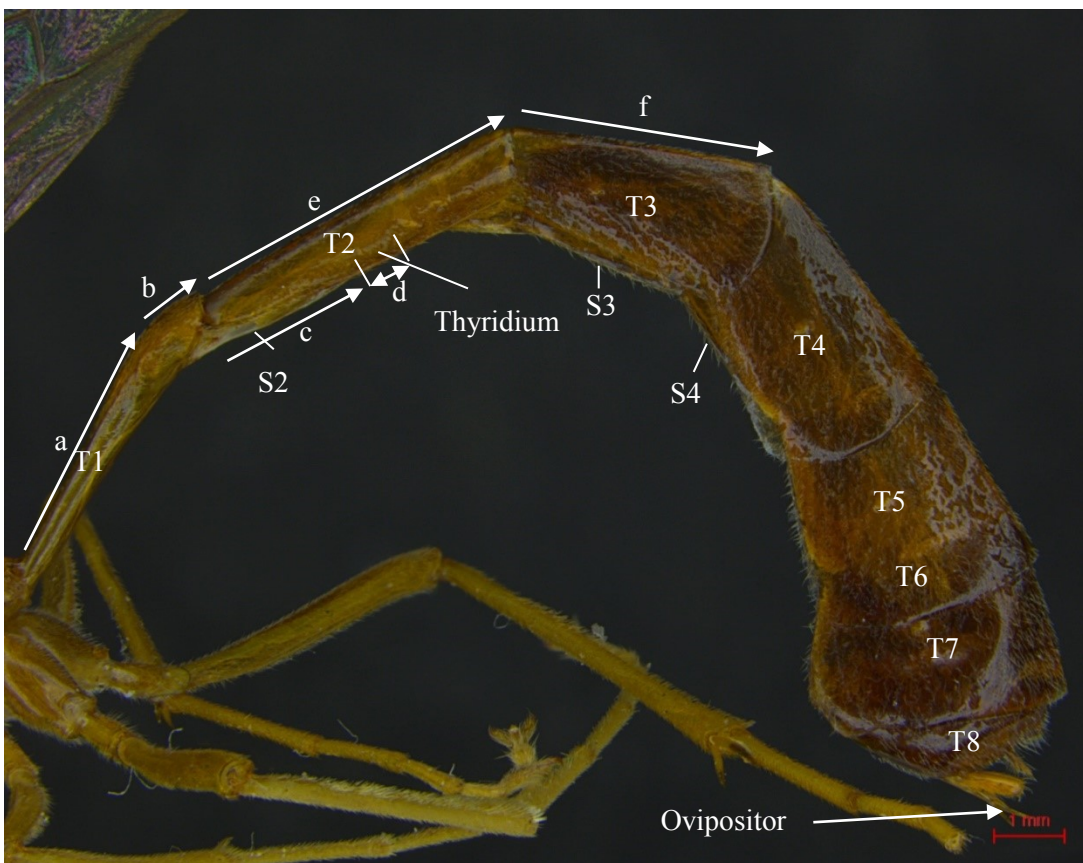


Figure 8. Morphological terms and measurement characters for metasoma (DMI = e / f , PI = a / b , THI = c / d)

CHAPTER 4

OBSERVATIONS, RESULTS AND DISCUSSION

SUBFAMILY OPHIONINAE SHUCKARD

Diagnosis: Ophionine wasps are characterised chiefly by a combination of characters such as spiracle of first metasomal tergite placed behind the mid length of tergite; metasoma strongly compressed; outer apical edge of front tibia without spine or tooth. Nocturnal Ophionine species are generally testaceous with large ocelli, large eye, long antennae and slender legs. A few diurnal species have characteristics such as black body, small ocelli, and short antenna.

Biology: Ophioninae wasps are generally solitary koinobiont endoparasitoids of Lepidoptera, Coleoptera and Hymenoptera (Gauld, 1985; Quicke *et al.*, 2009; Bennett *et al.*, 2019)

Distribution: Worldwide, 32 genera (Yu *et al.*, 2016; Shimizu and Lima, 2018; Show and Voogd, 2019).

KEY TO GENERA OF OPHIONINE WASPS OCCURRING IN ORIENTAL REGION

1. Posterior transverse carina of mesosternum centrally incomplete, slightly represented laterally..... 2
 - Posterior transverse carina of mesosternum complete, or very infrequently slightly demolished on mid-ventral line 7
2. Behind the macrotrichial comb on the foretibial spur with a membranous flange reaching almost to apex of the comb. 3
 - Behind the macrotrichial comb on the foretibial spur without a membranous flange, or with a flange extending at most 0.3x of its length..... 5
3. Forewing with vein R_s+2r proximally almost straight, often slender or little widened before joining pterostigma **OPHION** Fabricius
 - Forewing with vein R_s+2r proximally strongly curved, often abruptly thickened before joining pterostigma..... 4
4. Forewing with 1m-cu centrally angled and with a prominent ramellus; margin of clypeus convex..... **SCLEROPHION** Gauld
 - Forewing with 1m-cu sinuous and without a ramellus; margin of clypeus straight to concave **EREMOTYLUS** Foerster (in part)
5. Mandible very strongly narrowed, with longer upper tooth; pronotum mediodorsally with a transverse keel..... **ORIENTOSPILUS** Morley

- Mandible weakly narrowed, with equal tooth; pronotum without transverse keel..... 6
- 6. Antennae short and stout, not longer than forewing, with central segment quadrate; metasoma stout with tergite 2 less than 2.5x as long as posteriorly deep; distal hamuli in hindwing have similar size and shape.....
..... **EURYOPHION** Cameron
- Antennae slender, longer than forewing, with central segment elongate; metasoma slender with tergite 2 more than 3x as long as posteriorly deep; distal hamuli with penultimate longer than rest of hamuli.....
..... **LEPTOPHION** Cameron (in part)
- 7. Behind the macrotrichial comb on foretibial spur with a membranous flange reaching almost to apex of comb **EREMOTYLUS** Foerster (in part)
- Behind the macrotrichial comb on the foretibial spur without a membranous flange, or with a minute vestige of flange 8
- 8. Forewing with discosubmarginal cell without sclerite; outer distal margin of mid and hind trochantelli produced to form a tooth; occipital carina absent.....
..... **STAUROPOCTONUS** Brauns
- Forewing with alar sclerite present in discosubmarginal cell; outer distal margin of mid and hind trochantelli usually simple; occipital carina present 9
- 9. Posterior ocelli separated from eye by more than their own diameter; anterior corner of discosubmarginal cell uniformly hirsute; posterior margin of metanotum produced into large swelling opposite to propodeal spiracle.....
..... **DICTYONOTOUS** Kriechbaumer
- Posterior ocelli separated from eye by less than their own diameter; discosubmarginal cell with glabrous patch, rarely evenly hirsute; posterior margin of metanotum simple..... 10
- 10. Mandible not twisted; usually weakly tapered 11
- Mandible slightly to conspicuously twisted; weakly to strongly tapered.....
..... **ENICOSPILUS** Stephens
- 11. Forewing with clearly defined sclerite in discosubmarginal cell; hind wing with distal hamuli on R1 of similar size and shape **DICAMPTUS** Szepligeti
- Forewing without sclerite in discosubmarginal cell; hind wing with penultimate hamuli on R1 conspicuously longer than rest of hamuli
..... **LEPTOPHION** Cameron (in part)

Taxonomy

Class Hexapoda Blainville, 1816

Order Hymenoptera Linnaeus, 1758

Superfamily Ichneumonoidea Latreille, 1802

Family Ichneumonidae Latreille, 1802

Subfamily **Ophioninae** Shuckard, 1840

TRIBE **OPHIONINI** SHUCKARD, 1840

GENUS **LEPTOPHION** CAMERON, 1901

Leptophion Cameron, 1901: 227. Type species: *Leptophion longiventris* Cameron, by monotypy.

Spilophion Cameron, 1905: 124. Type species: *Spilophion maculipennis* Cameron, by monotypy, (Synonymized by Townes *et al.*, 1961: 265).

Coiloneura Szepligeti, 1905: 35. Type species: *Coiloneura melanostigma* Szepligeti, by subsequent designation, (Synonymized by Cushman, 1947: 462).

Diagnosis: Antennae long and slender; clypeus more or less convexly swollen in profile; mandible barely narrowed, not twisted, with an oblique groove on outer surface; posterior ocelli almost close to eye; occipital carina mediodorsally complete.

Pronotum unspecialized; notauli absent; scutellum usually with lateral longitudinal carina, weakly to moderately convex in profile; epicnemial carina present inclined towards anterior border of mesopleuron; posterior transverse carina of mesosternum usually complete; propodeum usually rounded, anterior with a transverse carina, anterior area striate, posterior area irregularly wrinkled, spiracular area usually smooth, posterior area with a transverse carina present at most only as lateral vestige; fore wing with discosubmarginal cell without fenestra, generally with a glabrous area in anterior corner; vein Rs+2r evenly sinuate sometime centrally angulate, generally broadened towards pterostigma; 1m-cu curved or sinuate; hind wing with usually 4-7 hamuli on R1, penultimate distal hamuli is longer than its fellows; SDI = 0.68-1.10; inner surface of fore tibial spur lacking membranous flange, distal margin of mid and hind trochantelli simple; hind tarsal claw with distal

pectina usually projecting beyond apical tooth; metasoma long and slender; thyridium ellipsoidal, widely separated from anterior margin of tergite; ovipositor short and straight.

Colour: Body colour usually reddish-brown.

Bionomics: Host Unknown. Adult wasps are usually collected in light trap (Gauld, 1985; Gauld and Mitchell, 1981; Shimizu *et al.*, 2016). *Leptophion maculipennis* is collected from Kozhikode district in forest habitat by using a sweep net.

Distribution: Australasian, Oceanic, Oriental and Palaearctic region (Gauld, 1977; Gauld and Mitchell, 1981; Shimizu and Watanabe, 2015a, and 2015 b; Shimizu *et al.*, 2016).

Remarks: Genus is represented by 33 described species worldwide, so far 14 species from Oriental species (Pham *et al.*, 2021). However, this species group is scarcely reported from India with only 3 recorded species till date *Leptophion maculipennis* (Cameron, 1905), *L. longiventris* Cameron, 1901, and *L. radiatus* (Uchida, 1956).

KEY TO THE ORIENTAL SPECIES OF *LEPTOPHION* CAMERON

1. Forewing with poorly developed sclerite; hind wing with 4 hamuli on R1
..... *L. pterospilus* Gauld and Mitchell
- Forewing without sclerite; hind wing with more than 4 hamuli on R1 2
2. Hind wing with R1 having hamuli of similar size and shape 3
- Hind wing with R1 having penultimate hamuli longer and more curved than the rest..... 4
3. Scutellum with lateral longitudinal carina reaching behind the middle; fore wing with 1m-cu strongly sinuous and with a trace of ramellus
..... *L. vechti* Gauld and Mitchell
- Scutellum with lateral longitudinal carina present only on anterior 0.2; fore wing with 1m-cu evenly curved and without ramellus..... *L. radiatus* (Uchida)
4. Marginal cell of forewing proximally not strongly infumate; fore wing with 1m-cu evenly arcuate *L. pubescens* Gauld and Mitchell

- Marginal cell of fore wing proximally strongly infumate; fore wing with 1m-cu sinuous 5
- 5. Small body and length of forewing less than 14 mm
..... *L. parvus* Shimizu and Watanabe
- Large body and length of forewing more than 14 mm 6
- 6. Mesopleuron polished with longitudinal wrinkles
..... *L. septentrionis* Shimizu and Watanabe
- Mesopleuron strongly polished without wrinkles 7
- 7. Marginal cell of hind wing with proximal end to level of distal hamuli, partially hirsute centrally *L. maculipennis* (Cameron)
- Marginal cell of hind wing with proximal end to level of distal hamuli, glabrous at very most with isolated hairs centrally 8
- 8. Hind wing with first abscissae of Rs with a swelling 9
- Hind wing with first abscissae of Rs without a swelling 10
- 9. Forewing with cu-a strongly oblique so that antero-proximal of first subdiscal cell is about 55° *L. townesi* Gauld and Mitchell
- Forewing with cu-a subvertical so that antero-proximal corner of first subdiscal cell is about 85° *L. alleni* Gauld and Mitchell
- 10. Forewing with a trace of ramellus on 1m-cu; anterior area of propodeum slightly shorter than spiracular area and with few striae *L. samari* Gauld and Mitchell
- Forewing without ramellus on 1m-cu; anterior area of propodeum slightly longer than spiracular area, with numerous striae 11
- 11. Flagellum black; pterostigma uniformly reddish orange
..... *L. samuelsoni* Gauld and Mitchell
- Flagellum orange, at most distally infusate; pterostigma black 12
- 12. Fore wing with 1m-cu strongly sinuous; cu-a proximal to base of Rs+M; forewing length 16-20 mm; ICI = 0.85-1.10 *L. quorus* Gauld and Mitchell
- Forewing with 1m-cu arcuate to moderately sinuous; cu-a usually opposite or distal to base of Rs+M; forewing length 14-15 mm; ICI = less than 0.85
..... *L. longiventris* Cameron

1. *Leptophion maculipennis* (Cameron, 1905)

(Plate - 29, Fig: 1 - 8; Map - 8)

Spilophion maculipennis Cameron, 1905: 125. (BMNH) Lectotype: ♀, Srilanka. (designated by Gauld, 1977: 34).

Stauropodoctonus orientalis Morley, 1912a: 18. (unnecessary replacement name for *maculipennis* Cameron).

Spilophion sigiriya Fernando, 1956: 666. (Fernando collection, whereabouts unknown) Holotype: ♀, Srilanka. (synonymized by Gauld and Mitchell, 1981: 77).

Description: Female. Body length = 22 mm; Antenna length = 25.80 mm; Ovipositor length = 1.60 mm.

Head: Antennae longer than body with 65 flagellomeres; length of first flagellar segment 2.20x as long as second, 20th flagellar segment 2.00x as long as broad; lower face punctate, scattered hairs, 0.75x as wide as long; clypeus usually moderately convex in profile, in anterior aspect clypeus 2.10x wider than length (Plate 29 Fig. 2); malar space 0.30x longer than basal width of mandible; mandible relatively long, barely tapered, outer surface with a proximal swelling and oblique groove; mandibular teeth unequal, upper tooth slightly longer than lower tooth (Plate 29 Fig. 2); posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete.

Mesosoma: Pronotum finely punctate; mesoscutum rounded in profile, finely punctate; scutellum usually with lateral longitudinal carina, weakly convex in profile (Plate 29 Fig. 5); epicnemial carina inclined towards anterior margin of mesopleuron (Plate 29 Fig. 4); mesopleuron strongly polished; metapleuron polished and finely punctate (Plate 29 Fig. 4); submetapleural carina present; propodeum in profile rounded, irregularly wrinkled, anteriorly with a strong transverse carina (Plate 29 Fig. 6).

FWL = 15.70 mm; FWW = 5.05 mm; HWL = 10.10 mm; HWW = 2.20 mm; discosubmarginal cell of forewing with a glabrous area below pterostigma (Plate 29 Fig. 7); alar sclerite absent; AI = 1.25; CI = 0.38; ICI = 0.75; SDI = 1.00; vein Rs+2r bowed; 1m-cu of fore wing sinuous without a ramellus; cu-a proximal to base of

Rs+M by 0.20x its own length (Plate 29 Fig. 7); first abscissae of Rs in hind wing strongly curved; 6 hamuli on R1, penultimate one longer than other hamuli; marginal cell with an area of short dense pubescence; proximal corner of marginal cell of hind wing about 95°; NI = 1.07.

Fore tibia with numerous fine spines on outer surface; hind coxa in profile 2.10x as long as deep; hind tarsal claw with distal pectina projecting beyond apical tooth.

Metasoma: Metasoma long and slender; ovipositor sheath broad; apex of ovipositor elongately acute.

Colour: Interocellar area yellow (Plate 29 Fig. 3); yellowish brown with following markings: Mesoscutum with three longitudinal vittae, both lateral vittae dark brown, middle vittae light brown (Plate 29 Fig. 5); mesopleuron, metapleuron, tergite 3 and posterior segment of metasoma black or blackish brown; pterostigma proximally brown, distally black; marginal cell of forewing proximally infumate (Plate 29 Fig. 7).

Male: Unknown.

Host: Unknown.

Biology: Unknown.

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chappanthottam (N11°67'29"-E75°76'73"), Coll. Soumya T. K, 12.x.2021, Reg. No. NBRL 354, LT.

Habitat: Clove plantation

Distribution: India: Kerala, Himachal Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh; Nepal; Srilanka; Burma; China; Malaysia; Taiwan and Thailand.

Remarks: This is the **first record** of this species from Kerala.

TRIBE ENICOSPHILINI TOWNES, 1971

GENUS *DICAMPTUS* SZEPLIGETI, 1905

Dicamptus Szepligeti, 1905b: 21. Type-species: *Dicamptus giganteus* Szepligeti, by monotypy.

Diagnosis: Medium to large-sized insects; antennae usually longer than forewing; clypeus flat to pyramidal in profile; mandible usually weakly tapered, not twisted; ocelli large; occipital carina complete; interocellar area black.

Scutellum usually with a strong lateral longitudinal carina, weakly to moderately convex in profile; epicnemial carina present generally not reaching towards anterior margin of mesopleuron; posterior transverse carina of mesosternum complete; propodeum usually rounded, anterior with a strong transverse carina, posterior area usually reticulate; fore wing with vein Rs+2r sinuate and usually broadened; discosubmarginal cell with distinct fenestra, often with proximal and sometimes distal sclerite; 1m-cu arcuate to sinuate; hind wing with usually 5-13 hamuli on R1; inner surface of fore tibial spur lacking membranous flange; outer distal margin of mid and hind trochantelli usually simple, without decurved tooth; claw usually weakly to moderately curved.

Metasoma long and slender; spiracle of tergite 1 far behind middle; thyridium oval to ellipsoidal, separated from anterior margin of tergite by more than its own length; ovipositor straight.

Colour: Body colour usually orange- brown; interocellar area black.

Distribution: Afrotropical, Australian, Oriental and Palearctic region (Yu *et al.*, 2016; Pham *et al.*, 2020).

Remarks: The genus *Dicamptus* Szepligeti comprises 33 valid species and is distributed in Afrotropical, Oriental, Palearctic and Australian region (Yu *et al.*, 2016). Around 10 species of *Dicamptus* are recognized from India (Yu *et al.*, 2016). In Kerala, only one species viz., *D. indicus* Nikam has been reported. One new species was discovered as a part of this study, viz., *D. neosinuatus*.

KEY TO THE ORIENTAL SPECIES OF *DICAMPTUS* SZEPLIGETI

1. Forewing with ICI and CI small, less than 0.55 2
 - Forewing with ICI and CI large, greater than 0.60 7
2. Forewing with proximal sclerite confluent with a narrow distal sclerite; ICI = 0.25-0.47; CI = 0.30-0.55 *D. fuscicornis* (Erichson)
 - Forewing with proximal sclerite not confluent with distal sclerite; ICI = 0.13-0.22; CI = 0.08-0.22 3
3. Forewing without distal sclerite 4
 - Forewing with distal sclerite 5
4. Lower face less than 0.79x as broad as long; antennae with 20th segment 2.10-2.20x as long as broad *D. indicus* Nikam
 - Lower face more than 0.80x as broad as long; antennae with 20th segment 1.50x as long as broad *D. brevicornis* Tang
5. Clypeus somewhat nose like; forewing with AI = 0.85.....
 - *D. bicarinus* Nikam and Kanhekar
 - Clypeus convex in profile; forewing with AI always greater than 1.10-1.50 6
6. Mandible with outer surface uniformly and finely pubescent; genae strongly constricted behind eye; GOI = 3.50; thorax virtually black and abdomen yellowish brown *D. atratus* Tang
 - Mandible with outer surface bears a conspicuous brush of hairs; genae slightly constricted behind eye; GOI = 2.00-2.50; thorax and abdomen yellowish-brown .
..... *D. ishikki* Uchida
7. Clypeus strongly convex; forewing with AI = 0.85; ICI = 0.65
 - *D. lambai* Nikam and Kanhekar
 - Clypeus flat to moderately convex; forewing with AI and ICI various 8
8. Forewing with Rs+2r concavely bowed, without a trace of sinuous; proximal sclerite carduate *D. carduatus* Gauld and Mitchell
 - Forewing with Rs+2r sinuous; proximal sclerite more or less triangular 9
9. Forewing with marginal cell adjacent to Rs+2r with a definite glabrous patch . 10
 - Forewing with marginal cell uniformly hirsute or rarely with hairs slightly sparser adjacent to Rs+2r, never with glabrous patches 12

- 10.** Hairs on discosubmarginal cell slightly broadened distal to centre; propodeum without posterior transverse carina; clypeus in profile strongly protuberant, virtually nasute, hind wing with NI = 1.10-1.70 11
- Hairs on discosubmarginal cell evenly tapered; propodeum with posterior transverse carina; clypeus flat in profile; hindwing with NI = 4.25
..... *D. neosinuatus* sp.nov.
- 11.** Metasoma strongly slender with tergite 2 in profile 3.50x as long as posteriorly deep; scutellum with two very strong median longitudinal ridges
..... *D. gracillus* Tang
- Metasoma less slender with tergite 2 in profile 2.50x as long as posteriorly deep; scutellum without conspicuous median longitudinal ridges
..... *D. nigropictus* (Matsumura)
- 12.** Mandible with a pronounced proximal concavity margined distally by an angular raised ridge; interocellar area black *D. reticulatus* (Cameron)
- Mandible flat or with a weak proximal concavity and never with such a concavity margined by a raised ridge; interocellar area various 13
- 13.** Mandible moderately tapered so that distal apex is about 0.50x as broad as base; metapleuron virtually entirely strongly reticulate *D. giganteus* Szepliget
- Mandible weakly tapered so that distal apex is at least 0.60x as broad as base; metapleuron at most with strong reticulations only on most posterior part, usually entirely puncto-coriaceous 14
- 14.** Propodeum with posterior transverse carina raised laterally
..... *D. zoracius* Gauld and Mitchell
- Propodeum without posterior transverse carina 15
- 15.** Forewing with 1m-cu curved at distal 0.7, not sinuous; SDI = 1.00-1.05; small species; forewing length 13-14 mm *D. flavoplagiatus* (Cushman)
- Forewing with 1m-cu sinuous; SDI more than 1.15; larger species; forewing length 15-20 mm 16
- 16.** Interocellar area yellowish-brown; head in dorsal view constricted behind eye; ♂ with sternite 6-8 bearing long stout erect pubescence *D. sinuatus* (Morley)
- Interocellar area black; head in dorsal aspect with genae somewhat inflated; ♂ with sternite 6-8 with fine short pubescence *D. cantoni* Gauld and Mitchell

1. *Dicamptus indicus* Nikam, 1972

Dicamptus indicus Nikam, 1972a: 661. (MUC) Holotype ♀, India.

Diagnosis: Antennae with 46-50 flagellomeres; 20th flagellar segment 2.10-2.20x as long as broad; mandible short, weakly narrowed, outer surface with strong proximal concavity; lower face finely and sparsely punctate, 0.60x as wide as long; forewing without distal sclerite; CI and ICI less than 0.55.

Host: Unknown

Material examined: Nil.

Distribution: India: Kerala, Maharashtra; Sri Lanka.

Discussion: This species is closely related to *D. brevicornis* Tang from which it differs in the characters given in the key. It is also very close to the species *D. isshikii* Uchida from which it differs in the presence of distal sclerite.

Remarks: The diagnosis is based on the original description of Nikam, 1972. The species was reported from Walayar Forest, Kerala by Gauld and Mitchell, 1981, but it is not represented in present collection.

2. *Dicamptus neosinuatus* sp. nov.

(Plate - 30, Fig: 1 - 8; Map - 9)

Description: Female. Body length = 27 mm; Antennae length = 28 mm; Ovipositor length = 2.59 mm.

Head: Antennae as long as body with 65 flagellomeres; length of first flagellar segment 2.10 x as long as second, 20th flagellar segment 2.10x as long as broad; lower face smooth, 0.80x as wide as long; clypeus flat in profile, in anterior aspect clypeus 1.60x wider than length (Plate 30 Fig. 2); malar space 0.10x longer than basal width of mandible; mandible relatively long, uniformly narrowed, not twisted, long hairs on outer surface, proximal concavity, without a groove on outer surface,

flat with scattered punctures; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.00.

Mesosoma: Mesoscutum slightly rounded in profile; scutellum weakly convex in profile, dorsally 1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron inadequately polished, upper part punctate to puncto-striate, lower part puncto-striate (Plate 30 Fig. 4); epicnemial carina not extending anterior margin of mesopleuron; metapleuron wrinkled; submetapleural carina evenly anteriorly widened; propodeum with anterior area striate, posterior area coarsely irregularly wrinkled tending to become subconcentrically wrinkled, anteriorly with a strong transverse carina, posterior with a transverse carina, margin of propodeal spiracle joined to lateral longitudinal carina (Plate 30 Fig. 5).

FWL = 18.25 mm; FWW = 5.60 mm; HWL = 12.45 mm; HWW = 3.08 mm; discosubmarginal cell with proximal sclerite triangular; distal sclerite linear (Plate 30 Fig. 6); AI = 1.25; CI = 0.95; DI = 0.40; ICI = 0.92; SDI = 0.95; SI = 0.14; SRI = 0.24; vein Rs+2r sinuous; 1m-cu sinuate; cu-a proximal to Rs+M by 0.20x its own length; Rs+M slightly curved; marginal cell with proximally glabrous; outer hind corner of second discal cell 120°; first abscissae of Rs in hind wing straight, second abscissae more or less straight; 12 hamuli on R1 (Plate 30 Fig. 7); NI = 4.25.

Legs slender; tibia with scattered spines on outer surface; tibial spur in foreleg 0.80x as long as tarsus 2; coxa in hind leg 1.70x longer than deep.

Metasoma: Metasoma long and slender; third tergite 1.80x as long as posteriorly deep; ovipositor apically elongately acute; DMI = 1.30; PI = 2.72; THI = 4.05.

Colour: Generally yellowish-brown; interocellar area infuscate (Plate 30 Fig. 3); mandibular teeth black; posterior part of mesoscutum black; dorsal part of tergite 3, tergite 5 and above are dark brown (Plate 30 Fig. 8); wings hyaline; pterostigma dark brown (Plate 30 Fig. 6).

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kozhikode, Chappanthottam (N11°67'29"-E75°76'73"), Coll. Soumya T.K, 11.i.2023, Reg. No. NBRL 355, LT.

Habitat: Clove plantation

Distribution: India: Kerala.

Etymology: The new species is named after *Dicamptus sinuatus* (Morley), due to its close resemblances.

Discussion: *D. neosinuatus* sp. nov. closely resembles *D. nigropictus* (Matsumura) in general appearance and morphology. However, it differs from *D. nigropictus* as follows: discosubmarginal cell between proximal sclerite and base of pterostigma glabrous (in *D. nigropictus* hirsute); hairs on the discosubmarginal cell evenly tapered (in *D. nigropictus* hairs slightly broadened central to distal); SDI = 0.95 and NI = 4.25. (in *D. nigropictus* SDI = 1.15-1.50 and NI = 1.10-1.50).

The new species closely resembles *D. sinuatus* (Morley) but it differs from *D. sinuatus* as follows: fore wing with marginal cell adjacent to Rs+2r with a glabrous area (in *D. sinuatus* evenly hirsute); hind wing with 12 hamuli on R1 (in *D. sinuatus* hind wing with 9-10 hamuli); propodeum with posterior transverse carina strongly raised laterally (in *D. sinuatus* propodeum with posterior transverse carina not represented); SDI = 0.95 and NI = 4.25 (in *D. sinuatus* SDI = 1.15 and NI = 1.90-2.95); pterostigma dark brown (in *D. sinuatus* pterostigma yellowish-brown).

GENUS *ENICOSPILUS* STEPHENS, 1835

Enicospilus Stephens, 1835: 126. Type-species: *Ophion merdarius* Gravenhorst sensu Stephens (= *Ichneumon ramidulus* Linnaeus), by monotypy (Stephens, 1845).

Henicospilus Agassiz, 1846: 138 (Unjustified emendation).

Allocamptus Foerster, 1868: 150. Type-species: *Ophion undulatus* Gravenhorst, 1829, by subsequent designation (Thomson, 1888: 1189).

- Dispilus* Kriechbaumer, 1894: 309. Type-species: *Ophion (Dispilus) natalensis* Kriechbaumer, 1894, by monotypy.
- Pleuroneurophion* Ashmead, 1900: 86. Type-species: *Pleuroneurophion hawaiiensis* Ashmead, 1900, by original designation.
- Cymatoneura* Kriechbaumer, 1901a: 22. Type-species: *Ophion undulatus* Gravenhorst, 1829, by subsequent designation (Viereck, 1914: 126).
- Pterospilus* Kriechbaumer, 1901b: 156. Type-species: *Ophion (Enicospilus) dubius* Tosquinet, 1896, by subsequent designation (Viereck, 1914: 126).
- Trispilus* Kriechbaumer, 1901b: 156. Type-species: *Ophion (Enicospilus) trimaculatus* Tosquinet, 1896, by monotypy.
- Abanchogastra* Perkins, 1902: 141. Type-species: *Abanchogastra debilis* Perkins, 1902, by monotypy.
- Metophion* Szepligeti, 1905: 28. Type-species: *Metophion bicolor* Szepligeti, 1905, by subsequent designation (Viereck, 1914: 94)
- Ceratospilus* Szepligeti, 1905: 27. Type-species: *Ceratospilus biroii* Szepligeti, 1905, by monotypy.
- Atoponeura* Szepligeti, 1905: 34. Type-species: *Atoponeura concolor* Szepligeti, 1905 = (*Enicospilus atoponeurus* Cushman, 1947), by monotypy.
- Ophiomorpha* Szepligeti, 1905: 34. Type-species: *Ophiomorpha curvinervis* Cameron, 1886 = (*Enicospilus cameronii* Dalla Torre, 1901), by subsequent designation (Hooker, 1912).
- Eremotyloidos* Perkins, 1915: 530. Type species: *Eremotylus orbitalis* Ashmead, 1901, by monotypy.
- Amesospilus* Enderlein, 1914: 222. Type species: *Ophion unicallosus* Vollenhoven, 1878, by original designation.
- Schizospilus* Seyrig, 1935: 79. Type species: *Schizospilus divisus* Seyrig, 1935, by original designation.

Diagnosis: Medium to large-sized insects; antennae usually bear more than 50 flagellomeres and longer than forewing; clypeus flat to strongly convex, ventral margin impressed, blunt or acute; mandible usually long, weakly to strongly tapered, twisted, with or without a diagonal groove on outer surface; posterior ocelli almost close to or touching eye; occipital carina complete.

Mesosoma generally weakly to moderately shiny with setae; pronotum diagonally wrinkled or finely punctate; mesoscutum rounded in profile, punctate to smooth with setae; notauli absent; scutellum usually with lateral longitudinal carina, moderately convex in profile; epicnemial carina present straight to curved, inclined towards anterior border of mesopleuron; posterior transverse carina of mesosternum

usually complete; propodeum usually rounded, anteriorly with a strong transverse carina, anterior area striate, posterior area striate, wrinkled, rugose or reticulate, spiracular area usually smooth, posterior area without transverse carina; discosubmarginal cell with bare fenestra, often with one or more sclerites; vein Rs+2r sinuate and more or less widened, hirsute; 1m-cu evenly angulate, curved or sinuate; hind wing with usually 4- 12 hamuli on R1; inner surface of fore tibial spur lacking membranous flange, outer distal margin of mid and hind trochantelli usually simple without decurved tooth; claw usually simply pectinate, strongly to moderately curved; metasoma long and slender; spiracle of tergite 1 far behind middle; thyridium highly developed; ovipositor straight.

Colour: Body colour usually entirely testaceous; posterior segments of metasoma darker, sometimes dark brown to black or pale; wings usually hyaline or weakly infusate; fenestra with weakly to strongly pigmented sclerite.

Bionomics: *Enicospilus* species are generally known as koinobiont endoparasitoids that primarily infect late instar Lepidoptera larvae, while they can occasionally oviposit in early stages (Broad *et al.*, 2018). Numerous families of Lepidopterans, including Noctuidae, Saturniidae and Notodontidae are known to be hosts (Gauld and Mitchell, 1978, 1981; Gauld, 1988; Broad and Shaw, 2016). They are generally considered as nocturnal or crepuscular and they are often collected at light (Gauld and Mitchell, 1981; Gauld, 1988; Shimizu and Maeto, 2016; Shimizu, 2017). Certain *Enicospilus* species are parasitoids of economically significant Lepidopteran pests (Nagatomi *et al.*, 1972; Kusigemati, 1976). For example, *Enicospilus signativentris* (Tosquinet, 1903) is a parasitoid of poaceae pests which include the noctuid moths *Anadevidia peponis* Fabricius, *Autographa nigrisigna* Walker, and *Trichoplusia intermixta* (Warren). Similarly, *Enicospilus sakaguchii* (Matsumura & Uchida, 1926) is also considered a parasitoid of rice pests *Sesamia turpis* (Butler) and *Sesamia inferens* (Walker).

Distribution: Afrotropical, Australasian, Holarctic, Neotropical, Oceanic and Oriental regions (Yu *et al.*, 2016).

Remarks: There are 35 *Enicospilus* species reported from Kerala. Out of these 11 species are new to science, 2 species are newly reported from India, 8 species are newly recorded from Kerala, and 16 species are new records from study area. These specimens were collected in the Northern region of Kerala viz., Kozhikode, Kannur, Wayanad, Kasaragod and Malappuram. When compared to mid-land habitats, the majority of *Enicospilus* species were collected from the highland area. They were collected from a variety of habitat such as forest, grassland, vegetable garden, coco and clove plantations. Both light and Malaise trap are used to collect them.

KEY TO THE *ENICOSPILUS* SPECIES OF KERALA

1. Forewing fenestra without sclerite..... 2
 - Forewing fenestra with one or more distinct sclerite or in few species with rather poorly defined sclerite on periphery of sclerite 3
2. Forewing with SDI = 1.05; AI = 0.75-0.80; CI = 0.35-0.41.....
..... *E. bres* Gauld and Mitchell
 - Forewing with SDI = 1.20-1.25; AI = 1.15-1.20; CI = 0.65- 0.75
..... *E. erythrocerus* (Cameron)
3. Mid and hind trochantelli with outer distal margin produced into an acute decurved tooth *E. pinus* Gauld and Mitchell
 - Mid and hind trochantelli simple..... 4
4. Forewing with SDI = 1.07 or less 5
 - Forewing with SDI = 1.071 or more..... .9
5. Vein 1m-cu centrally strongly angulate; CI = 0.70 *E. wayanadenesis* sp. nov.
 - Vein 1m-cu centrally not angulate; CI less than 0.556
6. Interocellar area black..... 7
 - Interocellar area yellow 8
7. Forewing with AI = 0.45; proximal part of marginal cell glabrous; central sclerite linear, subparallel to distal sclerite; hind wing with distal abscissa of Rs sinuous *E. centralis* Cushman
 - Forewing with AI = 1.90-2.00; proximal part of marginal cell hirsute; central sclerite oval or ellipsoidal; Hind wing with distal abscissa of Rs straight
..... *E. xanthocephalus* Cameron

8. Forewing with AI = 0.90 or less; cu-a proximal to Rs+M by 0.10-0.20x its own length *E. insinator* Smith
- Forewing with AI = 0.91 or more; cu-a subopposite or distal to Rs+M by about 0.10x its own length..... *E. javanus* (Szepligeti)
9. Interocellar area black or dark – brown 10
- Interocellar area generally yellowish - brown to orange or in a few species infusate close to ocelli..... 11
10. Distal sclerite present; posterior segment of metasoma black or blackish brown; CI = 0.25-0.35 *E. dolosus* (Tosquinet)
- Distal sclerite absent; posterior segment of metasoma yellowish-brown; CI = 0.65 *E. kasargodensis* sp. nov.
11. Central sclerite present 19
- Central sclerite absent 12
12. Margin of the propodeal spiracle joined to lateral longitudinal carina..... *E. rufus* sp. nov.
- Margin of the propodeal spiracle not joined to lateral longitudinal carina..... 13
13. Forewing with CI = 0.45 or less 14
- Forewing with CI = 0.46 or more 16
14. Outer mandible surface with a diagonal groove extending upper proximal corner to between the base of teeth..... *E. kannurensis* sp. nov.
- Outer mandible surface without diagonal groove..... 15
15. Metapleuron irregularly wrinkled; gonosquama acute; hind wing with 5 hamuli on R1 *E. squamacutus* sp. nov.
- Metapleuron punctate; gonosquama evenly rounded; hind wing with 7-8 hamuli on R1 *E. biharensis* Townes, Townes and Gupta
16. Distal sclerite present..... 17
- Distal sclerite absent 18
17. Mesopleuron puncto-striate; forewing with discosubmarginal cell with proximal and distal sclerite linear *E. transverse* Chiu
- Mesopleuron punctate throughout; forewing with discosubmarginal cell with proximal sclerite absent; distal sclerite narrow with anterior side shorter than proximal side *E. lineolatus* (Roman)

18. Epicnemial carina straight, not extending to anterior margin of mesopleuron; margin of propodeal spiracle not joined to lateral longitudinal carina..... *E. ghatensis* sp. nov.
- Epicnemial carina curved to anterior margin of mesopleuron; margin of propodeal spiracle joined to lateral longitudinal carina.... *E. dasychirae* Cameron
19. Very large insect; forewing length 18mm or more; ICI and CI greater than 0.65; thyridium separated from anterior margin of tergite by 9x its own length..... *E. robustus* sp. nov.
- Various sized insect; forewing length less than 18mm; ICI and CI less than 0.65; thyridium separated from anterior margin of tergite by 5-7x its own length 20
20. Proximal and distal sclerite confluent..... 21
- Proximal sclerite not confluent with distal sclerite..... 27
21. Forewing with CI = 0.80..... *E. malabaricus* sp. nov.
- Forewing with CI = 0.30-0.40 22
22. Margin of the propodeal spiracle joined to lateral longitudinal carina by a ridge... 23
- Margin of the propodeal spiracle not joined to lateral longitudinal carina..... 24
23. Mandible flat without a diagonal groove on outer surface *E. anokha* sp. nov
- Mandible flat with a diagonal groove on outer surface *E. laqueatus* Enderlein
24. Clypeus flat; central sclerite various..... 25
- Clypeus strongly convex; central sclerite round to oval; strongly pigmented..... *E. melanocarpus* Cameron
25. Proximal sclerite linear *E. punctatus* sp. nov.
- Proximal sclerite triangular..... 26
26. Central sclerite linear, weakly pigmented *E. ashbyi* Ashmead
- Central sclerite large, circular to D shaped *E. vestigator* (Smith)
27. Clypeus very broad, 1.81-2.20x as broad as long; lower face 0.81-1.10x as broad as long..... *E. capensis* (Thunberg)
- Clypeus less broad, 1.60-1.80x as broad as long; lower face 0.60-0.80x as broad as long..... 28
28. Central sclerite fairly large, D- shaped, separated from proximal sclerite more than 2.00x its own length..... *E. laqueatus* Enderlein

- Central sclerite moderately large, weakly sclerotized, separated from proximal sclerite less than 2.00x its own length 29
- 29. Upper mandibular tooth more than 2.00x as long as the lower tooth.....
.....*E. aciculatus* (Taschenberg)
- Upper mandibular tooth less than 2.00x as long as the lower tooth 30
- 30. Propodeum with distinct posterior transverse carina arising from base of lateral carina, this carina centrally incomplete*E. signativentris* (Tosquinet)
- Propodeum without even a lateral vestige of posterior transverse carina 31
- 31. Metasoma with tergite 1-4 anteriorly pale yellow, posteriorly black; hind coxa slightly infuscate to black*E. abdominalis* (Szepligeti)
- Metasoma without alternate yellow and black banding on tergite 1-4; hind coxa reddish-brown to orange 32
- 32. Fore wing with AI = 0.65-1.20 33
- Forewing with AI = 0.30-0.64 *E. flavicaput* (Morley)
- 33. Margin of propodeal spiracle connected to lateral longitudinal carina by a raised flange 34
- Margin of propodeal spiracle not connected to lateral longitudinal carina
..... *E. verticinus* (Roman)
- 34. Hind wing with 8 hamuli; AI = 1.10; antennae with 55 flagellomeres
..... *E. benazeer* sp. nov.
- Hind wing with 6-7 hamuli; AI = 0.87-0.95; antennae with 62-65 flagellomeres ..
.....*E. nigriventris* Nikam

1. *Enicospilus abdominalis* (Szepligeti, 1906)

(Plate - 5, Fig: 1 - 8; Map - 1)

Henicospilus abdominalis Szepligeti, 1906: 138. (TM) Holotype: ♀, Srilanka.

Ophion semiopacus Matsumura, 1912: 114. (EICHU) Holotype: ♀, Taiwan. Synonymised by Gauld and Mitchell, 1981: 429).

Description: Female. Body length = 25-27 mm; Antennae length = 26-28 mm; Ovipositor length = 2.20-2.50 mm.

Head: Antennae as long as body with 64-66 flagellomeres; length of first flagellar segment 1.70-1.80x as long as second, 20th flagellar segment 2.50-2.60x as long as

broad; lower face closely punctate, 0.70-0.80x as wide as long; clypeus weakly convex in profile, in anterior aspect clypeus 1.80-1.90x wider than length (Plate 5 Fig. 2); labrum 0.20-0.25x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, strongly narrowed, twisted about 40°-50°, without a groove on outer surface, flat with fine pubescence; mandibular teeth unequal, upper tooth 1.30-1.40x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.00-3.20.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, dorsally 1.40-1.45x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron upper part punctate to punctato-striate, lower part coarsely striate; epicnemial carina inclined towards anterior border of mesopleuron (Plate 5 Fig. 4); metapleuron punctate with striate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area reticulate, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 5 Fig. 5).

FWL = 16-18 mm; FWW = 5.10-5.70 mm; HWL = 11.00-11.40 mm; HWW = 2.50-3.20 mm; discosubmarginal cell with proximal sclerite triangular; distal sclerite linear; central sclerite oval (Plate 5 Fig. 6); AI = 0.60-0.70; CI = 0.25-0.30; DI = 0.30-0.35; ICI = 0.70-0.78; SDI = 1.15-1.30; SI = 0.12-0.15; SRI = 0.30-0.32; vein Rs+2r more or less straight; 1m-cu slightly sinuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell generally hirsute except proximo-ventrally; first abscissae of Rs in hind wing straight, second abscissae slightly curved (Plate 5 Fig. 7); 7 hamuli on R1; NI = 2.50-3.00.

Legs slender; tibia subcylindrical with isolated spines on outer surface; longer tibial spur in mid leg 1.60-1.70x than shorter; coxa in hind leg 1.50-1.70x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, strongly curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 4.00-4.20x its length; THI = 4.00-4.20; DMI = 1.40-1.45; PI = 3.40-3.80.

Colour: Generally pale yellowish-brown; interocellar area brownish yellow (Plate 5 Fig. 3); mandibular teeth black; mesoscutum, anterior margin of pronotum, metapleuron ventrally, posterior region of propodeum, hind coxa, femur and posterior half of tergites 1-4 black or dark brown; anterior part of tergite 1-4 yellow; tergite 5 and above infusate (Plate 5 Fig. 8); wings hyaline; pterostigma yellow.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 21.ix.2021, Reg. No. NBRL 237, LT.

Other material examined: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40"-E75°89'52"), Coll. Sudheer. K, 27.iv.2000, Reg. No. NBRL 238, MT; 1♀, India: Kerala, Kannur, Kannavam (N11° 50'35"-E75° 39'48"), Coll. Soumya T. K, 13.ii.2021, Reg. No. NBRL 239, LT; 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 21.ix.2021, Reg. No. NBRL 240, MT.

Habitat: Rubber plantation, Botanical Garden, Semiever green forest.

Distribution: India: Karnataka, Kerala, Sikkim, Tamil Nadu; China: Fujian, Taiwan; Korea; Malaysia: Peninsular; Myanmar; Papua New Guinea; Philippines; Sri Lanka; Thailand.

Discussion: Among the *Enicospilus* species, the unique colour pattern of this species (ie., T1 to T4 each anteriorly yellow and posteriorly dark brown or black) is a significant identification character. *E. abdominalis* species closely resembles *E.*

nigropectus Cameron in general morphology. However, this species can be distinguished from *E. nigropectus* as follows: central sclerite present (in *E. nigropectus* central sclerite absent), interocellar area yellow (in *E. nigropectus* interocellar area black).

Remarks: This is the **first record** of this species from the study area.

2. *Enicospilus aciculatus* (Taschenberg, 1875)

Ophion aciculatus Taschenberg, 1875: 434. (FZLU) Lectotype: ♀, Java, designated by Townes, Townes & Gupta, 1961: 269.

Enicospilus malaitensis Brues, 1918: 117. (MCZ) Holotype: ♂, Solomon Is. (Synonymized by Gauld and Mitchell, 1981: 394).

Henicospilus okinawensis Matsumura & Uchida, 1926: 71. (EIHU) Lectotype: ♀, Ryukyu Is, designated by Townes, Townes & Gupta, 1961: 285. (Synonymized by Gauld and Mitchell, 1981: 394).

Henicospilus neddenveli Cheesman, 1936: 185. (BMNH) Holotype: ♂, New Hebrides. (Synonymized by Gauld and Mitchell, 1981: 394).

Enicospilus crucis Chiu, 1954: 70. (TARI) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 394).

Diagnosis: Mandible long, evenly narrowed, with a diagonal groove on outer surface running from upper proximal corner to base of the teeth; mandibular teeth unequal with upper tooth subcylindrical, 2.10-2.30x length of lower tooth; lower face 0.81-1.10x as wide as long; clypeus usually moderately convex in profile, in anterior aspect clypeus 1.80-2.20x wider than length; metapleuron diagonally striate; discosubmarginal cell with proximal sclerite not confluent with distal sclerite, central sclerite large, weakly sclerotized, indistinctly delineated; Rs+2r straight to weakly sinuous.

Host: Unknown

Material examined: Nil

Distribution: India: Kerala, Tamil Nadu; China: Fujian, Guangdong, Hainan Island, Sichuan, Taiwan, Xizang, Yunnan; Indonesia: Java, Sumatra; Japan: Okinawa;

Myanmar, Philippines: Luzon, Mindanao, Panay; Solomon Islands; Sri Lanka; Vanuatu; Vietnam.

Discussion: This species is closely related to *E. laqueatus* (Enderlein) and *E. yonezawanus* (Uchida) in general morphology. However, this species can be easily distinguished from other species of *Enicospilus* by the following characters: upper mandibular tooth more than 2.0x as long as lower, mandible with diagonal groove, fore wing with central sclerite weakly pigmented and positioned in anterodistal corner of fenestra.

Remarks: This species was originally described by Taschenberg from Java, Indonesia (1875). The species was reported from Kerala by Gauld and Mitchell, 1981. The above diagnosis is based on the redescription of Gauld and Mitchell, 1981, as the species is not represented in the present collection.

3. *Enicospilus aepulus* Gauld and Mitchell, 1981

Enicospilus aepulus Gauld and Mitchell, 1981: 295. (USNM) Holotype: ♀, Philippines.

Diagnosis: Clypeus usually more or less flat in profile, margin acute, in anterior aspect, clypeus 1.50x wider than length; metapleuron punctate; propodeum with anterior transverse carina complete, posterior area coarsely concentrically rugose; hind tarsal claw with few short pectinae; fore wing with AI = 0.94-1.40; pterostigma black; marginal cell uniformly hirsute.

Host: Unknown

Material examined: Nil

Distribution: India: Kerala; Philippines: Mindanao, Mindoro.

Discussion: This species is closely related to *E. corculus* (Tosquinet) in general morphology. However, this species can be distinguished from *E. corculus* as follows: hind tarsal claws with a few short pectinate (in *E. corculus* hind tarsal claws

closely pectinate), fore wing with AI = 1.30-1.40 (in *E. corculus* fore wing with AI = 0.94-1.10).

Remarks: The diagnosis is based on the original description of Gauld and Mitchell, 1981. The species was reported from Walayar Forest, Kerala by Gauld and Mitchell, 1981, but it is not represented in the present collection.

4. *Enicospilus anokha* sp. nov.

(Plate - 2, Fig: 1 - 9; Map - 10)

Description: Holotype: Female. Body length = 23.50 mm; Antennae length = 20.72 mm; Ovipositor length = 1.78 mm.

Head: Antennae as long as body with 55 flagellomeres; length of first flagellar segment 1.80 x as long as second, 20th flagellar segment 1.80x as long as broad; lower face closely punctate, 0.65x as wide as long; clypeus usually weakly convex in profile, in anterior aspect clypeus 1.60x wider than length (Plate 2 Fig. 2); labrum 0.30x as long as broad; malar space 0.40x longer than basal width of mandible; mandible relatively short, uniformly narrowed, twisted about 35°, without a groove on outer surface, almost flat with sparsely pubescence; mandibular teeth unequal, upper tooth 1.40x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.90.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum weakly convex in profile, dorsally 1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length (Plate 2 Fig. 4); mesopleuron inadequately polished, upper part puncto-striate, lower part striate (Plate 2 Fig. 5); epicnemial carina inclined towards anterior border of mesopleuron (Plate 2 Fig. 5); metapleuron closely punctate to puncto-striate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area with coarse subconcentric ridges centrally becoming irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge (Plate 2 Fig. 6), anteriorly with a strong transverse carina.

FWL = 12.98 mm; FWW = 4.35 mm; HWL = 10.45 mm; HWW = 2.45 mm; discosubmarginal cell with proximal sclerite subtriangular, confluent with distal sclerite; distal sclerite linear; central sclerite linear, positioned on antero-distal margin of fenestra (Plate 2 Fig. 7); AI = 0.88; CI = 0.20; DI = 0.22; ICI = 0.59; SDI = 1.40; SI = 0.08; SRI = 0.18; vein Rs+2r weakly sinuous to straight; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10x its own length; Rs+M slightly curved distally; marginal cell proximally hirsute; first subdiscal cell with scattered hairs on anterior (Plate 2 Fig. 7); first abscissae of Rs in hind wing slightly curved, second abscissae weakly curved (Plate 2 Fig. 8); 7 hamuli on R1; NI = 2.92.

Legs slender; tibia in foreleg slightly flattened, spines on outer surface; longer tibial spur in mid leg 2.30x than shorter; coxa in hind leg 1.60x longer than deep; trochantellus dorsally 0.10x as long as broad; claws symmetrical, pectinate, abruptly curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.40x its length; THI = 3.5; DMI = 1.47; PI = 3.85.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 2 Fig. 3); mandibular teeth black; mesoscutum dark reddish brown; posterior segments of metasoma yellowish dark brown (Plate 2 Fig. 9); wings hyaline; pterostigma yellowish-brown (Plate 2 Fig. 7).

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: **Holotype:** 1♀, India: Kerala, Kozhikode, Villiappally (N11°62'55''-E75°62'94''), 27.vi.2022, Coll. Soumya T.K, Reg. No. NBRL 219, LT.

Habitat: Sacred groves

Distribution: India: Kerala.

Etymology: Species epithet is based on its unique characteristics.

Discussion: The new species *E. anokha* sp. nov. resembles *E. ashbyi* (Uchida) in general morphology. However the new species can be distinguished from *E. ashbyi* as follows: distal sclerite present (in *E. ashbyi* distal sclerite absent), margin of propodeal spiracle joined to lateral longitudinal carina (in *E. ashbyi* margin of propodeal spiracle not joined to lateral longitudinal carina), Rs+M slightly curved distally (in *E. ashbyi* Rs+M straight), first sub discal cell with scattered hairs anteriorly (in *E. ashbhyi* first subdiscal cell with no hairs), and SDI = 1.40 (in *E. ashbyi* SDI = 1.25).

The new species *E. anokha* sp. nov. closely resembles *E. nigribasalis* (Uchida) but differs from *E. anokha* sp. nov. in having spiracular area smooth (in *E. nigribasalis* spiracular area punctate), margin of propodeal spiracle joined to lateral longitudinal carina (in *E. nigribasalis* margin of propodeal spiracle not joined to lateral longitudinal carina), and forewing length 12.48 mm (in *E. nigribasalis* forewing length 15-17 mm).

5. *Enicospilus ashbyi* Ashmead, 1904

(Plate - 6, Fig: 1 - 8; Map - 7)

Enicospilus ashbyi Ashmead, 1904: 17. (USNM) Holotype: ♂, Philippines.

Henicospilus tainanensis Uchida, 1928: 225. (EIHU) Lectotype: ♂, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 446).

Enicospilus concavus Chiu, 1954: 45. (TARI) Holotype: ♂, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 446).

Description: Female. Body length = 18-19 mm; Antennae length = 19-20 mm; Ovipositor length = 1.90 mm

Head: Antennae longer than body, with 48 flagellomeres; length of first flagellar segment 1.70-1.80x as long as second, 20th flagellar segment 1.80-1.90x as long as broad; lower face punctate, 0.70x as long as broad; clypeus flat in profile, in anterior aspect clypeus 1.30-1.40x wider than length (Plate 6 Fig. 2); labrum 0.20-0.30x as

long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, evenly narrowed, twisted about 40°, without a diagonal groove on outer surface extending from upper proximal corner to base of teeth, proximal concavity; mandibular teeth unequal, upper tooth subcylindrical 1.20-1.30x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.40.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, sparsely punctate, dorsally 1.50-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron upper part punctate and lower part puncto-striate (Plate 6 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron (Plate 6 Fig. 4); metapleuron puncto-striate; submetapleural carina anteriorly widened; propodeum with anterior area longitudinally striate, posterior area irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 6 Fig. 5).

FWL = 13-15 mm; FWW = 4.00-5 mm; HWL = 7.50-8.90 mm; HWW = 2.50-2.80 mm; discosubmarginal cell with proximal sclerite triangular; distal sclerite linear weakly pigmented; central sclerite linear, weakly pigmented (Plate 6 Fig. 6); AI = 0.70-0.80; CI = 0.35-0.40; DI = 0.25-0.30; ICI = 0.60-0.65; SDI = 1.15-1.20; SI = 0.10; SRI = 0.20-0.25; vein Rs+2r straight, weakly sinuous; 1m-cu evenly curved; cu-a proximal to Rs+M by 0.10x its own length; Rs+M straight; first subdiscal cell with anterior hirsute; first abscissae of Rs in hind wing straight; second abscissae evenly arcuate (Plate 6 Fig. 7); 7 hamuli on R1; NI = 2.50-2.60.

Legs slender; tibia subcylindrical with isolated spines on outer surface; longer tibial spur in mid leg 1.60x than shorter; coxa in hind leg 1.40-1.50x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, abruptly curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.80-4.00x its length; THI = 3.80-4.00; DMI = 1.35-1.40; PI = 2.80-3.00

Colour: Generally yellowish-brown; interocellar area yellow (Plate 6 Fig. 3); mandibular teeth black; pterostigma yellow; wings hyaline.

Male: Unknown

Host: *Polydesma ambricola* Boisduval (Lepidoptera: Noctuidae), (Gauld and Mitchell, 1981).

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 14.ii.2023, Reg. No. NBRL 241, LT.

Other material examined: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40"-E75°89'52"), Coll. Soumya T. K, 10.ii.2022, Reg. No. NBRL 242, LT.

Habitat: Cocoa plantation, Botanical Garden.

Distribution: India: Kerala, Orissa, Tamil Nadu; China: Hainan Island, Sichuan, Taiwan, Yunnan; Indonesia: Java; Malaysia: Peninsular; Papua New Guinea; Philippines: Luzon; Singapore; Vietnam.

Discussion: The *E. ashbyi* species closely similar to *E. pallidus* (Taschenberg) in having general morphology but differs from *E. ashbyi* in having central sclerite linear shaped parallel to Rs+2r (in *E. pallidus* central sclerite D shaped and formed from the distal margin of quadra).

Remarks: This is the **first record** of this species from Kerala.

6. *Enicospilus benazeer* sp. nov.

(Plate - 20, Fig: 1 - 8; Map - 11)

Description: Holotype: Female. Body length = 25 mm; Antennae length = 27 mm, Ovipositor length = 1.10 mm.

Head: Antennae as long as body with 55 flagellomeres; length of first flagellar segment 1.70x as long as second, 20th flagellar segment 2.40x as long as broad; lower face punctate, 1.20x as wide as long (Plate 20 Fig. 2); clypeus moderately convex in profile, in anterior aspect clypeus 1.70x wider than length; labrum 0.20x as long as broad (Plate 20 Fig. 2); malar space 0.25x longer than basal width of mandible; mandible relatively long, evenly narrowed, twisted about 70°, with a weak furrow on outer surface, finely pubescent (Plate 20 Fig. 2); mandibular teeth unequal, upper tooth subcylindrical, 1.40x the length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.20.

Mesosoma: Mesoscutum abruptly rounded in profile, notauli absent; scutellum weakly convex in profile, dorsally 1.40x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished; upper part punctate, lower part striate; epicnemial inclined towards anterior border of mesopleuron (Plate 20 Fig. 4); metapleuron reticulate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area striate, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 20 Fig. 5).

FWL = 19.50 mm; FWW = 6.50 mm; HWL = 12.45 mm; HWW = 3.50 mm; discosubmarginal cell with proximal sclerite triangular with an appendix; distal sclerite absent; central sclerite present (Plate 20 Fig. 6); AI = 1.10; CI = 0.35; DI = 0.32; ICI = 0.48; SDI = 1.32; SI = 0.12; SRI = 0.20; vein Rs+2r almost straight, hirsute; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10x its own length; Rs+M more or less straight; first subdiscal cell with antero-distally hirsute; first abscissae of Rs in hind wing more or less straight, second abscissae strongly bowed; 8 hamuli on R1 (Plate 20 Fig. 7); NI = 3.80.

Legs slender; tibia subcylindrical with isolated spines on outer surface; longer tibial spur in mid leg 1.60x than shorter; coxa in hind leg 1.60x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate slightly incurved, abruptly curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 8x its own length (Plate 20 Fig. 8); THI = 9; DMI = 1.10, PI = 2.85.

Colour: Generally yellowish-brown; interocellar area yellowish brown (Plate 20 Fig. 3); mandibular teeth black; mesoscutum posteriorly black; wings hyaline and infumate; pterostigma yellowish-brown.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 15.ii.2019, Reg. No. NBRL 320, MT.

Paratype: 2♂ & 2♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 15.ii.2019, Reg. No. NBRL 321, 322, 323 & 324, MT.

Habitat: Cocoa plantation

Distribution: India: Kerala.

Etymology: The species epithet is from Urdu meaning 'matchless' or 'unique' based on its unique features that distinguish it from other species.

Discussion: The new species *E. benazeer* sp. nov. resembles *E. nigriventris* Nikam in general morphology. However the new species can be distinguished from *E. nigriventris* as follows: antennae with 55 flagellomeres (in *E. nigriventris* antennae with 62-65 flagellomeres), hind wing with 8 hamuli (in *E. nigriventris* hind wing with 6-7 hamuli), forewing with AI = 1.10 (in *E. nigriventris* forewing with AI = 0.87-0.95); thyridium separated from anterior margin of tergite by 8x its own length (in *E. nigriventris* thyridium separated from anterior margin of tergite by 3.50-4.50x its own length).

7. *Enicospilus biharensis* Townes, Townes & Gupta, 1961

(Plate - 18, Fig: 1 - 8; Map - 6)

Henicospilus horsfieldi var *glabratus* Morley, 1913: 395. (BMNH) Holotype: ♀, India. (Junior secondary homonym of *Enicospilus glabratus*).

Enicospilus biharensis Townes, Townes & Gupta, 1961: 271. (replacement name for *glabratus* Morley).

Enicospilus (Bicorniata) bicornis Rao & Nikam, 1971: 177. (MUC) Holotype: ♀, India. (Synonymized by Nikam, 1980: 149).

Description: Female. Body length = 15-17 mm; Antennae length = 16-17 mm; Ovipositor length = 1.90-2.05 mm.

Head: Antennae as long as body with 52-55 flagellomeres; length of first flagellar segment 1.80-1.90x as long as second, 20th flagellar segment 1.80-2.10x as long as broad; lower face sparsely punctate, 0.70-0.80x as wide as long; clypeus almost flat in profile, in anterior aspect clypeus 1.60-1.90x wider than length (Plate 18 Fig. 2); labrum 0.20x as long as broad; malar space 0.20-0.30x longer than basal width of mandible; mandible relatively long, strongly narrowed, twisted about 30°-40°, without a groove on outer surface, flat with scattered pubescence; mandibular teeth unequal, upper tooth sub-cylindrical, 1.40-1.50x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.80- 3.25.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, dorsally 1.50-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished; upper part punctate, lower part punctate to puncto-striate; epicnemial carina inclined towards anterior border of mesopleuron (Plate 18 Fig. 4); metapleuron closely punctate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area reticulate, spiracular area punctate, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 18 Fig. 5).

FWL = 12-15 mm; FWW = 3.95-4.80 mm; HWL = 7.11-9.00 mm; HWW = 2.05-2.50 mm; discosubmarginal cell with proximal sclerite linear, weakly pigmented; distal sclerite linear; central sclerite absent (Plate 18 Fig. 6); AI = 0.50-0.60; CI = 0.35-0.38; DI = 0.30-0.35; ICI = 0.65-0.70; SDI = 1.28-1.35; SI = 0.10-0.15; SRI = 0.25-0.30; vein Rs+2r weakly sinuous to straight; 1m-cu evenly arcuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell with scattered hairs on anterior; first and second abscissae of Rs in hind wing more or less straight (Plate 18 Fig. 7); 7-8 hamuli on R1; NI = 3.80-4.50.

Legs slender; tibia subcylindrical with scattered spines on outer surface; longer tibial spur in mid leg 1.50-1.60x than shorter; coxa in hind leg 1.60-1.80x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium ellipsoidal, separated from anterior margin of tergite by 2.50-3.50x its length; THI = 2.50-3.50; DMI = 1.35-1.50; PI = 3.00-3.35.

Colour: Generally yellowish-brown; interocellar area dark brown (Plate 18 Fig. 3); mandibular teeth black; posterior segments of metasoma yellowish brown (Plate 18 Fig. 8); wings hyaline; pterostigma orange yellow.

Male: Similar as female

Host: *Laelia subrosea* Walker (Lepidoptera: Lymantriidae), (Gauld and Mitchell, 1981)

Biology: Unknown

Material examined: Plesiotype: 1♀ & India: Kerala, Wayanad, Korome (N11°74'38''-E75°88'10''), Coll. Soumya T. K, 08.xi.2019, Reg. No. NBRL 287, LT.

Other material examined: 2♀ & 1♂, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 09. viii.2021, Reg. No. NBRL 288, 289 & 290, SN; 1♀ India: Kerala, Wayanad, Makkiyad (N11°74'90''-E75°90'28''), Coll. Soumya T. K, 25.viii.2022, Reg. No. NBRL 291, LT.

Habitat: Vegetable Garden, Cocoa plantation, Grass land.

Distribution: India: Kerala, Andhra Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal; China: Fujian, Guangdong, Guangxi, Guizhou, Sichuan, Yunnan; Indonesia: Java, Sumatra; Japan, Malaysia: Peninsular; Myanmar; Nepal; Pakistan, Philippines: Luzon, Mindanao, Mindoro; Singapore; Sri Lanka; Thailand.

Discussion: This species very closely resembles *E. transversus* Chiu in general morphology. However, this species can be distinguished from *E. transversus* by smaller value of CI = 0.35-0.38 (in *E. transversus* CI = 0.55-0.60), and metapleuron closely punctate (in *E. transversus* metapleuron puncto-striate)

Remarks: This is the **first record** of this species from Kerala state

8. *Enicospilus bres* Gauld and Mitchell, 1981

(Plate - 16, Fig: 1 - 8; Map - 4)

Enicospilus bres Gauld and Mitchell, 1981: 157. (BPBM) Holotype: ♀, New Guinea.

Description: Female. Body length = 18-19 mm; Antennae length = 15.40-16.50 mm; Ovipositor length = 0.90 mm.

Head: Antennae as long as body thin with 58 flagellomeres, length of first flagellar segment 1.70-1.90x as long as second, 20th flagellar segment 1.40-1.60x as long as broad; lower face punctate, pubescent, 0.70-0.75x as wide as long (Plate 16 Fig. 2); clypeus weakly convex in profile, in anterior aspect clypeus 1.50-1.70x wider than length (Plate 16 Fig. 2); labrum 0.20x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, strongly narrowed, twisted about 30°, without a groove on outer surface; mandibular teeth unequal, upper tooth subcylindrical, 1.10x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.00-2.20.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate, notauli absent; scutellum moderately convex in profile, dorsally 1.40-1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length;

mesopleuron inadequately polished; upper part puncto-striate, lower part punctate (Plate 16 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron (Plate 16 Fig. 4); metapleuron closely punctate; submetapleural carina centre to anteriorly widened; propodeum with anterior area striate, posterior area irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina, anteriorly with a strong transverse carina.

FWL = 12-13 mm; FWW = 3.12-3.75 mm; HWL = 7.25-8.50 mm; HWW = 2.12-2.50 mm; discosubmarginal cell with no sclerite (Plate 16 Fig. 6); AI = 0.75-0.80; CI = 0.35-0.41; DI = 0.35-0.40; ICI = 0.75-0.80; SDI = 1.03-1.05; SI = 0.12-0.15; SRI = 0.29-0.35; vein Rs+2r almost straight; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10x its own length; Rs+M almost straight distally slightly curved; first subdiscal cell with anterior glabrous; first abscissae of Rs in hind wing almost straight, second abscissae almost straight (Plate 16 Fig. 7); 7 hamuli on R1; NI = 4.

Legs slender; tibia subcylindrical with scattered spines on outer surface; tibial spur in mid leg 2.00x longer than shorter; coxa in hind leg 1.80-1.90x longer than the deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.50-4.00x its own length; THI = 3.50-4.00; DMI = 1.60-1.80; PI = 2.20-2.40.

Colour: Generally yellowish-brown; interocellar area yellowish-brown (Plate 16 Fig. 3); mandibular teeth black; posterior segments of metasoma infusate (Plate 16 Fig. 8); wings hyaline; pterostigma yellowish-brown.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 09.viii.2021, Reg. No. NBRL 280, LT.

Other material examined: 1♀, India: Kerala, Wayanad, Niravilpuzha (N11°74'30"-E75°93'76"), Coll. Soumya T. K, 24.xii.2022, Reg. No. NBRL 281, LT.

Habitat: Cocoa plantation, Bitter gourd plantation.

Distribution: New Guinea; India: Kerala.

Discussion: This species closely resembles to *E. gressitti* Gauld and Mitchell in general morphology. However, this species can be distinguished from *E. gressitti* as follows: fore wing with AI = 0.72-0.89 (in *E. gressitti* fore wing with AI = 1.46), cu-a proximal to Rs+M by 0.10x its own length (in *E. gressitti* cu-a distal to Rs+M by 0.50x its own length).

Remarks: This is the **first record** of this species from India.

9. *Enicospilus capensis* (Thunberg, 1822)

Ichneumon capensis Thunberg, 1822: 262. (ZIUU) Holotype: ♀, South Africa.

Ophion lativertex Taschenberg, 1875: 435. (FZLU) Holotype: ♀, Java. (Synonymized by Gauld and Mitchell, 1981: 385).

Ophion antankarus Saussure, 1892: 15. (MNHN) Holotype: ♂, Madagascar. (Synonymized by Townes & Townes, 1973: 174)

Henicospilus montinus Enderlein, 1921: 21. (IZPAN) Holotype: ♀, Java. (Synonymized by Gauld and Mitchell, 1981:385).

Henicospilus praedator Enderlein, 1921: 28. (IZPAN) Holotype: ♀, Madagascar. (Synonymized by Townes & Townes, 1973: 175).

Enicospilus incarinatus Enderlein, 1921: 30. (IZPAN) Holotype: ♂, Madagascar. (Synonymized by Townes & Townes, 1973: 175).

Henicospilus euxoae Wilkinson, 1928: 261. (BMNH) Holotype: ♀, Zimbabwe. (Synonymized by Gauld and Mitchell, 1978: 143).

Enicospilus obnoxius Seyrig, 1935: 75. (MNHN) Lectotype: ♀, Kenya. Designated by Townes & Townes (1973: 18), (Synonymized by Gauld and Mitchell, 1978: 143).

Henicospilus yanagiharai Sonan, 1940: 371. (TARI) Holotype: ♂, Ryukyu Is. (Synonymized by Gauld and Mitchell, 1981: 385).

Enicospilus selvaraji Rao and Kurian, 1951: 68. (ZSI) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981: 385).

Enicospilus fossatus Chiu, 1954: 63. (TARI) Holotype: ♀, Malaysia. (Synonymized by Gauld and Mitchell, 1981: 385).

Enicospilus indica Rao and Grover, 1960: 280. (MUC) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981: 385).

Diagnosis: Mandible long, proximally narrowed, with a diagonal groove on outer surface running from upper proximal corner to base of teeth; clypeus moderately strongly convex in profile; scutellum moderately convex in profile; metapleuron coarsely or closely punctate; margin of propodeal spiracle not joined to lateral longitudinal carina; proximal sclerite not confluent with distal sclerite.

Host: *Agrotis segetum* Denis & Schiffermuller (Lepidoptera: Noctuidae); *Spodoptera mauritia* (Boisduval) (Lepidoptera: Noctuidae); *Spodoptera exempta* Walker (Lepidoptera: Noctuidae); *Heliothis armigera* (Lepidoptera: Noctuidae); *Cactoblastic cactorum* Berg (Lepidoptera: Pyralidae), (Gauld and Mitchell, 1981; Nikam and Gaikwad, 1989 and Nikam, 1900).

Material examined: Nil

Distribution: India: Bihar, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Uttar Pradesh; China: Guangdong, Guangxi, Hainan Island, Sichuan, Yunnan, Zhejiang; Congo; Ethiopia; Gabon; Indonesia: Java, Sulawesi, Sumatra; Japan: Okinawa; Kenya; Madagascar; Malaysia: Peninsular, Sarawak; Mauritius; Philippines: Luzon; Saudi Arabia; Senegal; Seychelles; South Africa; Sri Lanka; Tanzania; Uganda; Yemen; Zimbabwe.

Discussion: This species is easily distinguishable from other species of *Enicospilus* by its long mandible and lower face 1.2x as wide as long.

Remarks: This species was originally described by Thunberg (1822) from South Africa. The species was reported from Walayar Forest, Kerala by Gauld and

Mitchell, 1981. The above diagnosis is based on the redescription of Gauld and Mitchell, 1981, as the species is not represented in the present collection.

10. *Enicospilus centralis* Cushman, 1937
(Plate - 14, Fig: 1- 8; Map - 3)

Enicospilus centralis Cushman, 1937a: 305. (DEI) Holotype: ♀, Taiwan.

Description: Female. Body length = 17 mm; Antennae length = 17.5 mm; Ovipositor length = 1.70 mm.

Head: Antennae as long as body with 51 flagellomeres; length of first flagellar segment 1.60x as long as second, 20th flagellar segment 2.30x as long as broad; lower face polished with hairs, 0.65x as wide as long; clypeus moderately convex in profile, in anterior aspect clypeus 1.60x wider than length (Plate 14 Fig. 2); labrum 0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, twisted about 60°, sparsely hirsute, proximal concavity, without a diagonal groove on outer surface, mandibular teeth unequal, upper tooth 1.20x as long as lower; posterior ocelli almost close to eye, genae behind eye constricted. occipital carina complete, GOI = 3.20.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally three black longitudinal vittae, notauli absent; scutellum moderately convex in profile, dorsally 1.40x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron upper part puncto-striate, lower part coarsely punctato-striae (Plate 14 Fig. 4); epicnemial carina curved to anterior border of mesopleuron; metapleuron punctate and irregularly wrinkled; submetapleural carina anteriorly broadened; propodeum with anterior area striate, posterior area irregularly wrinkled (Plate 14 Fig. 5), spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with transverse carina.

FWL = 10.58 mm; FWW = 3.60 mm; HWL = 6.60 mm; HWW = 1.85 mm; discosubmarginal cell with proximal sclerite and central sclerite linear; distal sclerite linear, weakly sclerotized (Plate 14 Fig. 6); AI = 0.44; CI = 0.35; DI = 0.35; ICI = 0.28; SDI = 1.03; SI = 0.18; SRI = 0.29; vein Rs+2r weakly sinuous to more or less

straight, medially thickened; 1m-cu sinuous; marginal cell of fore wing proximally glabrous; cu-a proximal to Rs+M by 0.20x its own length; Rs+M more or less straight; first subdiscal cell scattered hairs; first abscissae of Rs in hind wing more or less straight; second abscissae of Rs sinuous (Plate 14 Fig. 7); 6 hamuli on R1; NI = 3.05.

Legs slender, tibia subcylindrical without spines on outer surface, longer tibial spur in mid leg 2.00x than shorter; coxa in hind leg 1.30x longer than deep; trochantellus dorsally 0.20x as long as broad; claws symmetrical.

Metasoma: Metasoma with long and slender; thyridium oval, separated from anterior margin of tergite by 4x its own length; THI = 4; DMI = 1.45; PI = 2.70.

Colour: Generally blackish-brown species; scutellum, interocellar area, mesoscutum, posterior part of pronotum, mesopleuron, metapleuron and anterior part of propodeum black; clypeus, orbit, mesoscutum margin and stripes yellow; leg, antennae, tergite 1-4 yellowish brown; tergite 5 and above dark brown (Plate 14 Fig. 8); pterostigma yellowish.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kasargod, Ranipuram (N12°25'16''-E75°21'00''), Coll. Soumya T. K, 22.v.2022, Reg. No. NBRL 275, LT.

Habitat: Shola forest

Distribution: India: Kerala; Brunei; China: Fujian, Taiwan, Zhejiang, Indonesia: Sulawesi; Japan; Myanmar; Papua New Guinea; Philippines: Mindoro.

Discussion: This species can be very easily distinguished from all other species of *Enicospilus* by the unique wing character of this species i.e., marginal cell of

forewing proximally glabrous, value of CI = 0.35 and ICI = 0.28, shape of proximal sclerite, central sclerite linear and parallel to distal margin of fenestra.

Remarks: This is the **first record** of this species from India.

11. *Enicospilus dasychirae* Cameron, 1905

Enicospilus (sic) dasychirae Cameron, 1905: 123. (BNMH) Holotype: ♀, Srilanka.

Enicospilus (sic) horsfieldi Cameron, 1905: 124. (BNMH) Holotype: ♀, Srilanka. (Synonymised by Townes *et al.*, 1961: 273).

Henicospilus borneensis Szepligeti, 1906: 138. (TM) Holotype: ♀, Borneo. (Synonymised by Townes *et al.*, 1961: 273)

Enicospilus nigrimarginalis Cushman, 1937: 311. (DEI) Holotype: ♂, Taiwan. (Synonymised by Townes *et al.*, 1961: 274)

Diagnosis: Mandible long, twisted about 25-35°, without a diagonal groove on outer surface; clypeus weakly convex in profile; scutellum moderately convex in profile; margin of propodeal spiracle joined to lateral longitudinal carina by a raised flange; epicnemial carina curved to anterior margin of mesopleuron; forewing with small drop shaped proximal sclerite present.

Host: *Dasychira horsfieldi* (Lepidoptera: Lymantriidae); *Dasychira mendosa* (Lepidoptera: Lymantriidae); *Psalis pennatula* (Lepidoptera: Lymantriidae); *Pseudodura dudgeoni* (Lepidoptera: Lymantriidae) (Gauld and Mitchell, 1981; Chiu *et al.*, 1984; Chen *et al.*, 2009)

Material examined: Nil

Distribution: India: Assam, Bihar, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, West Bengal; Brunei; China: Fujian, Guangdong, Guangxi, Guizhou, Hunan, Taiwan, Yunnan; Indonesia: Java, Kalimantan, Sumatra; Japan: Okinawa; Malaysia: Peninsular, Sabah, Sarawak; Papua New Guinea, Philippines: Mindanao; Sri Lanka.

Discussion: This species is easily distinguished from other *Enicospilus* species by the small drop shaped proximal sclerite of fore wing.

Remarks: This species was originally described by Cameron (1905) from Srilanka. The species was reported from Kerala (Gauld and Mitchell, 1981). The species is not represented in present collection. The above diagnosis is based on the redescription of Gauld and Mitchell, 1981.

12. *Enicospilus dolosus* (Tosquinet, 1896)

(Plate -1, Fig: 1 - 8; Map - 1)

Ophion (Enicospilus) dolosus Tosquinet, 1896: 389. (MNHU) Holotype: ♀, Egypt.

Enicospilus (Sic) spilonotus Cameron, 1905: 121. (BMNH) Holotype: ♀, Srilanka. (Synonymized by Gauld and Mitchell, 1981:285).

Enicospilus melanospilus Cameron, 1906: 48. (ZMA) Holotype: ♀, New guinea. (Synonymized by Gauld and Mitchell, 1981: 285).

Ophion (Henicospilus) samoanus Kohl, 1908: 315. (NM) Holotype: ♀, Samoa Is. (Synonymized by Gauld and Mitchell, 1981: 285).

Henicospilus atricornis Morley, 1912a: 46. (BMNH) Holotype: ♂, India. (synonymized by Gauld and Mitchell, 1981: 285).

Henicospilus apicifumatus Morley, 1915: 139. (BMNH) Holotype: ♀, Fiji. (Synonymized by Gauld and Mitchell, 1981: 285).

Amesopilus hammersteini Enderlein, 1921: 21. (IZPAN) Lectotype: ♀, Madagascar, designated by Townes & Townes, 1973:176. (Synonymized by Townes & Townes, 1973: 176).

Enicospilus latricarinatus Chiu, 1954: 19. (TARI) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 285).

Enicospilus dwibinduae Rao & Nikam, 1969: 12. (MUC) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981: 285).

Description: Female. Body length = 22-24 mm; Antennae length = 21-23 mm; Ovipositor length = 1.80-2.15 mm.

Head: Antennae as long as body with 50-55 flagellomeres, length of first flagellar segment 1.50-1.90x as long as second, 20th flagellar segment 1.80-2.30x as long as broad; lower face sparsely punctate, 0.60-0.70x as wide as long (Plate 1 Fig. 2); clypeus usually slightly to moderately convex in profile, in anterior aspect clypeus 1.60-1.80x wider than length (Plate 1 Fig. 2); labrum 0.15-0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, uniformly narrowed, twisted about 35-50°, without a groove on outer surface, flat with sparsely pubescence; mandibular teeth unequal, upper tooth sub-cylindrical, 1.50-1.60x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.00-3.20.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate, notauli absent; scutellum moderately convex in profile, dorsally 1.50-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron inadequately polished, upper part puncto-striate to striate, lower part striate; epicnemial carina inclined towards anterior border of mesopleuron (Plate 1 Fig. 4); metapleuron striate, submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area concentrically striate, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 1 Fig. 5).

FWL = 12-15 mm; FWW = 5-6 mm; HWL = 10-11 mm; HWW = 2.50-3 mm; discosubmarginal cell with proximal sclerite triangular, confluent with distal sclerite; distal sclerite linear; central sclerite absent (Plate 1 Fig. 6); AI = 1.01-1.20; CI = 0.28-0.35; DI = 0.28-0.32; ICI = 0.50-0.55; SDI = 1.25-1.35; SI = 0.12-0.15; SRI = 0.20-0.25; vein Rs+2r weakly sinuous to straight; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell with anterior 0.3 hairs; first abscissae of Rs in hind wing more or less straight, second abscissae slightly curved (Plate 1 Fig. 7); 6-7 hamuli on R1; NI = 2.00-2.50.

Legs slender; tibia subcylindrical with few spines on outer surface; longer tibial spur in mid leg 1.60-1.80x than shorter; coxa in hind leg 1.60-1.70x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate, abruptly curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.50-4.50x its length; THI = 3.50-4.50; DMI = 1.40-1.50; PI = 2.75-2.90; gonosquama evenly rounded.

Colour: Generally reddish-brown; interocellar area uniformly black (Plate 1 Fig. 3); posterior segments of metasoma black or blackish brown (Plate 1 Fig. 8); pterostigma reddish-brown, wings hyaline.

Male: Similar as female.

Host: *Anomis leona* Schaus (Lepitoptera: Noctuidae) (Gauld and Mitchell, 1981)

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chappanthottam (N11°67'29"-E75°76'73"), Coll. Soumya T. K, 22.vi.2022, Reg. No. NBRL 200, LT.

Other material examined: 2♀, India: Kerala, Kozhikode, Kakkayam (N11°54'98"-E75°92'96"), Coll. Soumya T. K, 18.viii.2019, Reg. No. NBRL 201 & 202, MT; 1♀, India: Kerala, Kozhikode, Vayalada (N11°51'75"-E75°85'87"), Coll. Soumya T. K, 25.ix.2019, Reg. No. NBRL 203, MT; 1♀ & 1♂, India: Kerala, Wayanad, Korome (N11°74'38"-E75°88'10"), Coll. Soumya T. K, 08.xi.2019, Reg. No. NBRL 204 & 205, SN; 2♀, India: Kerala, Wayanad, Manathavady (N11°48'24"-E76°0'34"), Coll. Soumya T. K, 17.xi.2019, Reg. No. NBRL 206 & 207, LT; 1♀, India: Kerala, Kozhikode, Villiappally (N11°62'55"-E75°62'94"), Coll. Soumya T. K, 20.i.2021, Reg. No. NBRL 208, LT; 1♀ & 1♂, India: Kerala, Kozhikode, Chappanthottam (N11°67'29"-E75°76'73"), Coll. Soumya T. K, 22.vi.2022, Reg. No. NBRL 209 & 210, LT; 1♀, India: Kerala, Kannur, Dharmadom (N11°77'75"-E75°47'03"), Coll. Soumya T. K, 17.viii.2022, Reg. No. NBRL 211, LT; 2♀, India: Kerala, Wayanad, Makkiyad (N11°74'90"-E75°90'28"), Coll. Soumya T. K, 25.viii.2022, Reg. No. NBRL 212 & 213, MT; 2♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58"-E75°79'35"), Coll. Soumya T. K, 23.ix.2022, Reg. No. NBRL 214 & 215, LT; 1♀, India: Kerala, Wayanad, Niravilpuzha (N11°74'30"-E75°93'76"), Coll. Soumya T. K, 24.xii.2022, Reg. No. NBRL 216, LT; 2♀ India: Kerala, Wayanad, Panamaram (N11°73'81"-E76°07'40"), Coll. Soumya T. K, 12.i.2023, Reg. No. NBRL 217 & 218, LT.

Habitat: Clove plantation, Forest, Vegetable Garden, Sacred groves, Coffee plantation, Grass land, Paddy field.

Distribution: India: Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh; Angola; Australia: Queensland; Bangladesh; Brunei; Central African Republic; China: Taiwan, Yunnan; Congo; Egypt; Ethiopian; Fiji; Gabon; Ghana; Guinea;

Indonesia: Irian Jaya, South Moluccas, Sulawesi, Sumatra; Ivory Coast; Kenya; Madagascar; Malaysia: Sabah; Mauritania; Mozambique; New Caledonia; Nigeria; Papua New Guinea; Philippines: Luzon, Negros, Palawan; Reunion; Senegal; Society Islands; Solomon Islands; South Africa; Sri Lanka; Tanzania; Uganda; Vanuatu; Vietnam; Western Samoa.

Discussion: *Enicospilus dolosus* is easily identified by its black interocellar area, concentrically striate propodeum, and striate meso and metapleuron. This species resembles the New Guinea species *E. zemiotes* Gauld and Mitchell but differs from *E. zemiotes* in having 20th flagellar segment less than 2.60x as long as broad (in *E. zemiotes* 20th flagellar segment more than 2.70x as long as broad), proximal sclerite triangular (in *E. zemiotes* proximal sclerite linear straightly broadened anteriorly).

Remarks: This is the **first record** of this species from the study area.

13. *Enicospilus erythrocerus* (Cameron, 1905)

(Plate - 8, Fig: 1-8; Map - 4)

Pleuroneurophion erythrocerus Cameron, 1905: 121. (BNMH) Holotype: ♀, Srilanka.

Allocamptus orientalis Uchida, 1928: 230. (SEHU) Lectotype: ♀, Okinawa, designated by Gauld and Mitchell, 1981: 175. (Synonymised by Townes *et al.*, 1961: 275) junior secondary homonym of *Enicospilus orientalis* (Morley, 1913).

Enicospilus hirayamai Uchida, 1955: 120. replacement name for *Enicospilus orientalis* (Uchida, 1928)

Description. Female. Body length = 20-22 mm; Antennae length = 21-22 mm, Ovipositor length = 2.30-2.61 mm.

Head: Antennae as long as body with 52-55 flagellomeres; length of first flagellar segment 1.70-1.80x as long as second, 20th flagellar segment 1.90-2.10x as long as broad; lower face punctate, 0.80-0.90x as wide as long; clypeus flat to convex in profile, in anterior aspect clypeus 1.70-1.80x wider than length (Plate 8 Fig. 2); labrum 0.15-0.20x as long as broad; malar space 0.40x longer than basal width of mandible; mandible short, evenly narrowed, twisted about 40°, proximal concavity,

without a groove on outer surface; mandibular teeth unequal, upper tooth flattened, 1.30-1.40x length of lower tooth (Plate 8 Fig. 2); posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.30-2.50.

Mesosoma: Mesoscutum slightly rounded in profile, smooth, notauli absent; scutellum moderately convex in profile, dorsally 1.50-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished, upper and lower part closely punctate (Plate 8 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron; metapleuron closely punctate; submetapleural carina anteriorly slightly widened; propodeum with anterior area striate, posterior area finely irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 8 Fig. 5).

FWL = 14-15 mm; FWW = 4.30-4.80 mm; HWL = 9.25-10.00 mm; HWW = 2.50-2.90 mm; discosubmarginal cell without sclerite (Plate 8 Fig. 6); AI = 1.15-1.20; CI = 0.65-0.75; DI = 0.38-0.45; ICI = 0.80-0.90; SDI = 1.20-1.25; SI = 0.12-0.15; SRI = 0.25-0.30; vein Rs+2r convex anteriorly; 1m-cu sinuous; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M slightly curved; first subdiscal cell with scattered hairs; first abscissae of Rs in hind wing straight, second abscissae weakly arcuate; 7 hamuli on R1; NI = 2.80-3.20.

Legs slender; tibia subcylindrical with few spines on outer surface; longer tibial spur in mid leg 1.30-1.40x longer than shorter; coxa in hind leg 1.70-1.75x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate, strongly curved.

Metasoma: Metasoma long and slender (Plate 8 Fig. 8); thyridium oval, separated from anterior margin of tergite by 3.50-4.00x its length; THI = 3.50-4.00; DMI = 1.20-1.30; PI = 2.80-2.95.

Colours: Generally pale orange - brown; interocellar area yellow (Plate 8 Fig. 3); wings hyaline; pterostigma yellowish orange.

Male: Similar as female.

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Kakkayam (N11°54'98"-E75°92'96"), Coll. Soumya T. K, 18.iv.2022, Reg. No. NBRL 248, MT.

Other material examined: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40"-E75°89'52"), Coll. Sudheer. K, 27.iv.2000, Reg. No. NBRL 249, MT; 1♀, India: Kerala, Palakkad, Silent Valley (N11°06'94"-E76°42'80"), Coll. Prasanth, Rajesh & Manoj, 12.vii.2017, Reg. No. NBRL 250; 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40"-E75°89'52"), Coll. Renjith, 27.iv.2018, Reg. No. NBRL 251, MT; 2♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 28.ii.2019, Reg. No. NBRL 252 & 253, LT; 1♀ & 1♂, India: Kerala, Wayanad, Korome (N11°74'38"-E75°88'10"), Coll. Soumya T. K, 08.xi.2019, Reg. No. NBRL 254 & 255, LT; 1♀ India: Kerala, Wayanad, Makkiyad (N11°74'90"-E75°90'28"), Coll. Soumya T. K, 12.viii.2022, Reg. No. NBRL 256, LT; 1♀, India: Kerala, Wayanad, Manathavady (N11°48'24"-E76°0'34"), Coll. Soumya T. K, 17.xi.2022, Reg. No. NBRL 257, MT; 2♀ India: Kerala, Wayanad, Panamaram (N11°73'81"-E76°07'40"), Coll. Soumya T. K, 04.i.2023, Reg. No. NBRL 258 & 259, LT; 1♀, India: Kerala, Wayanad, Niravilpuzha (N11°74'30"-E75°93'76"), Coll. Soumya T. K, 09.xii.2023, Reg. No. NBRL 260, LT.

Habitat: Clove plantation, Forest, Coffee plantation, Grass land, Paddy field, Botanical Garden.

Distribution: India: Gujarat, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, West Bengal; Brunei; China: Fujian, Guangdong, Guangxi, Hainan Island, Taiwan, Zhejiang; Indonesia: Java, Sumatra; Japan; Malaysia: Peninsular, Sarawak; Myanmar; Philippines: Luzon, Mindanao, Mindoro; Singapore; Sri Lanka; Thailand.

Discussion: This species closely resembles *E. grandis* (Cameron, 1905) and *E. plicatus* (Brulle, 1846) in general morphology. However, this species can be

distinguishable by the short antennae, smaller size and uniformly punctate meso and metapleuron.

Remarks: This is the **first record** of this species from the study area.

14. *Enicospilus flavicaput* (Morley, 1912)
(Plate - 23, Fig: 1 - 8; Map - 7)

Enicospilus xanthocephalus Cameron, 1907a: 178. (BMNH) Holotype: ♀, Burma. (Junior primary homonym of *Enicospilus xanthocephalus* Cameron, 1905).

Henicospilus flavicaput Morley, 1912a: 45. (replacement name for *xanthocephalus* Cameron, 1907)

Henicospilus urospilus Enderlein, 1921: 27. (IZPAN) Holotype: ♀, Sumatra. (Synonymized by Townes, Townes & Gupta, 1961: 275).

Description: Female. Body length = 23 mm; Antennae length = 24 mm; Ovipositor length = 2.03 mm.

Head: Antennae as long as body with 68-72 flagellomeres, length of first flagellar segment 1.80-1.90x as long as second, 20th flagellar segment 2.10-2.30x as long as broad; lower face weakly punctate, 0.60-0.70x as wide as long; clypeus usually weakly convex in profile, in anterior aspect, clypeus 1.80x wider than length (Plate 23 Fig. 2); labrum 0.15-0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, uniformly narrowed, twisted about 25°-30°, without a groove on outer surface, flat with sparsely pubescence; mandibular teeth unequal, upper tooth subcylindrical, 1.50-1.60x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.00-3.20.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate; notauli absent; scutellum moderately convex in profile, dorsally 1.50-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending 0.8 or more of its length; mesopleuron inadequately polished, upper part finely striate, lower part striate; epicnemial carina inclined towards anterior border of mesopleuron (Plate 23 Fig. 4); metapleuron striate; submetapleural carina anteriorly widened; propodeum

with anterior area striate, posterior area coarsely reticulate, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 23 Fig. 5).

FWL = 15-17 mm; FWW = 5-6 mm; HWL = 10-11 mm; HWW = 2.50- 3 mm; discosubmarginal cell with proximal sclerite subtriangular with an appendix, distal sclerite absent; central sclerite arc shaped positioned on anterior side of Rs+2r (Plate 23 Fig. 6); AI = 0.35-0.40; CI = 0.21-0.28; DI = 0.25-0.30; ICI = 0.60-0.65; SDI = 1.18-1.30; SI = 0.07-0.10; SRI = 0.20-0.25; vein Rs+2r weakly sinuous to straight; 1m-cu sinuous; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell with scattered hairs antero-distally; first abscissae of Rs in hind wing straight; second abscissae of Rs more or less straight (Plate 23 Fig. 7); 6 hamuli on R1; NI = 2.00-2.50.

Legs slender; tibia subcylindrical with few spines on outer surface; longer tibial spur in mid leg 1.60-1.80x than shorter; coxa in hind leg 1.60-1.70x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.50-4.50x its length; THI = 3.50-4.50; DMI = 1.35-1.40; PI = 2.90-3.50.

Colour: Generally reddish-brown; interocellar area yellowish-brown (Plate 23 Fig. 3); mandibular teeth black; wings hyaline; pterostigma reddish-brown.

Male: Similar as female.

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Malappuram, Nilambur (N11°27'73''-E75°22'85''), Coll. Soumya T. K, 08.xi.2022, Reg. No. NBRL 331, LT.

Other material examined: 2♀ India: Kerala, Wayanad, Vythiri (N11°55'17''-E76°04'03''), Coll. Soumya T. K, 25.ix.2019, Reg. No. NBRL 332 & 333, LT; 1♂, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 18.vii.2021, Reg. No. NBRL 334, MT; 1♀, India: Kerala, Malappuram, Nilambur (N11°27'73''-E75°22'85''), Coll. Soumya T. K, 22.viii.2022, Reg. No. NBRL 335, LT; 2♀, India: Kerala, Kozhikode, Thamarassery (N11°27'27''-E76°05'03''), Coll. Soumya T. K, 27.viii.2022, Reg. No. NBRL 336 & 337, LT.

Habitat: Forest, Coffee plantation, Clove plantation, Grass land.

Distribution: India: Assam, Kerala, Maharashtra, Tamil Nadu; Brunei; China: Yunnan; Indonesia: Java, North Moluccas, Sumatra; Japan: Okinawa; Malaysia: Peninsular; Myanmar; Nepal; Philippines: Leyte, Luzon, Negros, Palawan; Sri Lanka; Vietnam.

Discussion: This species is closely related to *E. kanshirensis* (Uchida) in general morphology. However, this species can be distinguished from *E. kanshirensis* as follows: forewing with central sclerite slender (in *E. kanshirensis* forewing with central sclerite stout), forewing length 15mm or more (in *E. kanshirensis* forewing length less than 15mm).

Remarks: This is the **first record** of this species from Kerala state.

15. *Enicospilus ghatensis* sp. nov.

(Plate - 12, Fig: 1 - 8; Map - 3)

Description: Holotype: Female. Body length = 22 mm; Antennae length = 21.30 mm; Ovipositor length = 1.80 mm.

Head: Antennae as long as body with 55 flagellomeres; length of first flagellar segment 1.70x as long as second, 20th flagellar segment 1.80x as long as broad; lower face sparsely punctate, 0.80x as wide as long; clypeus usually moderately convex in profile, in anterior aspect clypeus 1.70x wider than length (Plate 12 Fig.

2); labrum 0.30x as long as broad; malar space 0.30 longer than basal width of mandible; mandible relatively long, narrowed, twisted about 30°, without a groove on outer surface, flat with sparsely pubescence; mandibular teeth almost equal; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.10.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, dorsally 1.20x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron inadequately polished, upper part punctate, lower part puncto-striate (Plate 12 Fig. 4); epicnemial carina not extending towards anterior border of mesopleuron (Plate 12 Fig. 4); metapleuron coriaceous; submetapleural carina evenly widened; propodeum with anterior area striate, posterior area coarsely wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge (Plate 12 Fig. 5), anteriorly with a strong transverse carina.

FWL = 16.50 mm; FWW = 5.80 mm; HWL = 10.30 mm; HWW = 2.80 mm; discosubmarginal cell with proximal sclerite oval; central sclerite and distal sclerite absent (Plate 12 Fig. 6); AI = 1.43; CI = 0.51; DI = 0.45; ICI = 0.52; SDI = 1.29; SI = 0.19; SRI = 0.25; vein Rs+2r more or less straight; 1m-cu sinuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell with anterior glabrous; first abscissae of Rs in hind wing straight, second abscissae weakly arcuate (Plate 12 Fig. 7); 7 hamuli on R1; NI = 3.10.

Legs slender; tibia subcylindrical with few spines on outer surface; tibial spur in mid leg 1.50x longer than shorter; coxa in hind leg 1.85x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 4.00x its length; THI = 4.50; DMI = 1.60; PI = 3.50.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 12 Fig. 3); mandibular teeth black; posterior segments of metasoma infuscate (Plate 12 Fig. 8); wings hyaline; pterostigma yellowish- orange.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 09.viii.2021, Reg. No. NBRL 270, LT.

Paratypes: 1♀, India: Kerala, Wayanad, Korome (N11°74'38"-E75°88'10"), Coll. Soumya T. K, 08.xi.2019, Reg. No. NBRL 271, LT; 1♀, India: Kerala, Kannur, Kottiyoor (N11°52'35"-E75°51'15"), Coll. Soumya T. K, 24.ii.2023, Reg. No. NBRL 272, LT.

Habitat: Clove plantation, Forest.

Distribution: India: Kerala

Etymology: Species epithet is after the Western Ghats which includes the collection locality of the type.

Discussion: The new species *Enicospilus ghatensis* sp. nov. resembles *E. dasychirae* Cameron in general morphology. However new species can be distinguished from *E. dasychirae* as follows: margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge (in *E. dasychirae* margin of propodeal spiracle joined to lateral longitudinal carina by a ridge); epicnemial carina straight, not extending anterior margin of mesopleuron (in *E. dasychirae* epicnemial carina curved to anterior margin of mesopleuron); first subdiscal cell with anterior glabrous (in *E. dasychirae* first subdiscal cell with scattered hairs).

16. *Enicospilus insinator* (Smith, 1860)

Ophion insinator Smith, 1860: 141. (UM) Holotype: ♀, Moluccas.

Enicospilus zyzus Chiu, 1954: 23. (TARI) Holotype: ♀, China. (Synonymized by Gauld and Mitchell, 1981: 353)

Diagnosis: Mandible long, without a diagonal groove on outer surface; clypeus weakly convex in profile; scutellum moderately convex in profile; margin of propodeal spiracle joined to lateral carina by a raised flange; forewing with anterodistal corner of fenestra antefurcal to Rs by more than 0.7x length of 2rs-m; CI less than 0.44; AI = 0.90 or less; cu-a proximal to Rs+M by 0.10-0.20x its own length.

Host: Unknown

Material examined: Nil

Discussion: This species closely related to *E. maai* Chiu in general morphology. However, this species can be distinguished from *E. maai* as follows: mesoscutum with longitudinal vittae or rarely entirely infusate (in *E. maai* mesoscutum with posterior part strongly infusate), anterodistal corner of fenestra antefurcal to Rs by more than 0.7x length of 2rs-m (in *E. maai* anterodistal corner of fenestra interstitial to Rs).

Distribution: India: Kerala, Uttar Pradesh; Bhutan; Brunei; China: Fujian, Guangdong, Hainan Island, Hunan; Indonesia: South Moluccas; Japan; Sri Lanka; Thailand.

Remarks: This species was originally described by Smith from Moluccas. The species was reported from Kerala (Gauld and Mitchell, 1981). The species is not represented in present collection. The diagnosis is based on the redescription of Gauld and Mitchell, 1981.

17. *Enicospilus javanus* (Szepligeti, 1910)

Henicospilus javanus Szepligeti, 1910: 93. (TM) Holotype: ♀, Java.

Enicospilus fulacorensis Brues, 1918: 117. (MCZ) Holotype: ♀, Solomon Is. (Synonymised by Gauld and Mitchell, 1981: 260).

Enicospilus gephyrus Chiu, 1954: 32. (TARI) Holotype: ♀, Japan. (Synonymised by Gauld and Mitchell, 1981: 260).

Enicospilus (Bicorniata) diurnus Nikam, 1975: 193. (MUC) Holotype: ♀, India. (Synonymised by Gauld and Mitchell, 1981: 260).

Diagnosis: Mandible long, evenly narrowed, without a diagonal groove on outer surface; metapleuron striate; propodeum with posterior area irregularly wrinkled to finely reticulate; forewing with proximal margin of fenestra widened, proximal sclerite irregularly triangular, AI more than 1, ICI generally less than 0.50; marginal cell infumate adjacent to Rs+2r; cu-a subopposite or distal to Rs+M; hind tarsal claws with distal pectina projecting beyond apical tooth of claw.

Host: Unknown

Material examined: Nil

Distribution: India: Bihar, Delhi, Haryana, Himachal Pradesh, Kerala, Maharashtra, Madhya Pradesh, Tamil Nadu; Australia: Queensland; Brunei; China: Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan; Indonesia: Irian Jaya, Java, South Moluccas; Japan; Malaysia; Myanmar; Nepal; Papua New Guinea; Singapore; Solomon Islands; Sri Lanka.

Discussion: This species is easily distinguishable from other species of *Enicospilus* by its fore wing fenestra widened proximally as well as shape of sclerites.

Remarks: This species was originally described by Szepligeti from Java in 1910. The species was reported from Kerala (Gauld and Mitchell, 1981). The above diagnosis is based on the redescription of Gauld and Mitchell, 1981, as the species is not represented in the present collection.

18. *Enicospilus kannurensis* sp. nov.

(Plate - 21, Fig: 1- 8; Map - 11)

Description: Holotype: Female. Body length = 22.25 mm; Antennae length = 25 mm; Ovipositor length = 1.50 mm.

Head: Antennae longer than body with 58 flagellomeres; length of first flagellar segment 1.70x as long as second, 20th flagellar segment 2.20x as long as broad;

lower face smooth, scattered hairs, 1.40x as long as broad; clypeus moderately convex in profile, in anterior aspect, clypeus 1.60x wider than length (Plate 21 Fig. 2); labrum 0.30x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, evenly narrowed, twisted about 60°, with a diagonal groove on outer surface extending from upper proximal corner to base of teeth, proximal concavity; mandibular teeth unequal, upper tooth 1.20x the length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.15.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, sparsely punctate, dorsally 1.30-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending 0.8 of its length (Plate 21 Fig. 5); mesopleuron upper part puncto-striate, lower part coarsely striate; epicnemial carina straight not inclined towards anterior border of mesopleuron (Plate 21 Fig. 4); metapleuron puncto-striate with few coarsely striate near lateral longitudinal carina; submetapleural carina weakly anteriorly widened; propodeum with anterior area longitudinally striate, posterior area with sub concentric wrinkles (Plate 21 Fig. 6), spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina.

FWL = 16 mm; FWW = 6 mm; HWL = 9.80 mm; HWW = 2.80 mm; discosubmarginal cell with proximal sclerite subtriangular having distinct appendix, confluent with distal sclerite; distal sclerite linear, weak, narrow; central sclerite absent (Plate 21 Fig. 7); AI = 0.85; CI = 0.49; DI = 0.20; ICI = 0.51; SDI = 1.21; SI = 0.10; SRI = 0.30; vein Rs+2r straight, weakly sinuous; 1m-cu evenly curved; cu-a proximal to Rs+M by 0.10x its own length (Plate 21 Fig. 7); Rs+M slightly curved distally; first subdiscal cell with scattered hairs antero- distally; first abscissae of Rs in hind wing straight; second abscissae weakly arcuate (Plate 21 Fig. 8); 7 hamuli on R1; NI = 2.50.

Legs slender; tibia subcylindrical with scattered spines on outer surface; longer tibial spur in mid leg 1.60x than shorter; coxa in hind leg 1.60x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 5.00x its length; THI = 5.00; DMI = 1.15; PI = 3.30.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 21 Fig. 3); mandibular teeth black; posterior segments of metasoma darkish brown; wings hyaline; pterostigma dark brown (Plate 21 Fig. 7).

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kannur, Kannavam (N11° 50'35''-E75° 39'48'') Coll. Soumya T. K, 13.ii.2022, Reg. No. NBRL 325, LT.

Habitat: Semievergreen Forest

Distribution: India: Kerala.

Etymology: Species epithet is after locality of collection Kannur district of Kerala.

Discussion: The new species *E. kannurensis* sp. nov. resembles *E. yonezawanus* (Uchida) in general morphology. However, the new species can be distinguished from *E. yonezawanus* as follows: mandible twisted about 60° (in *E. yonezawanus* mandible twisted about 10-15°), propodeum with posterior area with subconcentric wrinkles (in *E. yonezawanus* propodeum with posterior area finely reticulate), antennae with 58 flagellar segments (in *E. yonezawanus*, antennae with 65-70 flagellar segments); epicnemial carina straight (in *E. yonezawanus* epicnemial carina curved to anterior margin of mesopleuron).

19. *Enicospilus kasargodensis* sp. nov.

(Plate - 24, Fig: 1 - 8; Map - 10)

Description: Holotype: Female. body length = 27.50 mm; Antennae length = 27 mm; Ovipositor length = 2.05 mm.

Head: Antennae relatively long and thin with 59 flagellomeres, length of first flagellar segment 1.50x as long as second, 20th flagellar segment 1.90x as long as broad; lower face punctate, 0.70x as wide as long (Plate 24 Fig. 2); clypeus weakly convex in profile, in anterior aspect, clypeus 1.70x wider than length; labrum 0.30x as long as broad; malar space 0.25x longer than basal width of mandible; mandible relatively long, uniformly narrowed, twisted about 70°, with a groove on outer surface, flat with sparsely pubescence; mandibular teeth unequal, with upper tooth subcylindrical, 1.50x the length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.70.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate, notauli absent; scutellum moderately convex in profile, dorsally 1.20x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished, upper part punctate, lower part punctate to coarsely striate; epicnemial carina straight, not extending to anterior border of mesopleuron (Plate 24 Fig. 4); metapleuron irregularly wrinkled, submetapleural carina anteriorly strongly widened; propodeum with anterior area striate, posterior area coarsely and concentrically striate (Plate 24 Fig. 5), spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina.

FWL = 20 mm; FWW = 5 mm; HWL = 14.30 mm; HWW = 2.90 mm; discosubmarginal cell with proximal sclerite triangular, central sclerite and distal sclerite absent (Plate 24 Fig. 6); AI = 0.55; CI = 0.65; DI = 0.20; ICI = 0.55; SDI = 1.26; SI = 0.09; SRI = 0.10; vein Rs+2r weakly sinuous; 1m-cu sinuate; cu-a proximal to Rs+M by 0.10x its own length; Rs+M straight; first subdiscal cell with anterior most part with few hairs; first abscissae of Rs in hind wing straight, second abscissae arcuate (Plate 24 Fig. 7); 8 hamuli on R1; NI = 3.40.

Legs slender; tibia subcylindrical with few spines on outer surface; longer tibial spur in mid leg 1.60x than shorter; coxa in hind leg 1.80x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 4.30x its length; THI = 4.30; DMI = 1.45; PI = 2.90.

Colour: Generally yellowish-brown, interocellar area dark brown (Plate 24 Fig. 3), posterior segments of metasoma yellowish brown (Plate 24 Fig. 8); mandibular teeth black, wings hyaline (Plate 24 Fig. 6), pterostigma yellowish-brown.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kasargod, Ranipuram (N12°25'16''-E75°21'00''), Coll. Soumya T. K, 22.v.2022, Reg. No. NBRL 338, LT.

Paratype: 1♀, India: Kerala, Kasargod, Ranipuram (N12°25'16''-E75°21'00''), Coll. Soumya T. K, 22.v.2022, Reg. No. NBRL 339, LT.

Habitat: Shola Forest

Distribution: India: Kerala

Etymology: Species epithet is after locality of collection Kasaragod district of Kerala.

Discussion: The new species *Enicospilus kasargodensis* sp. nov. resembles *E. incubus* (Gauld and Mitchell) in general morphology. However the new species can be distinguished from *E. incubus* as follows: metasoma with tergite 3 and above yellowish brown (in *E. incubus* metasoma with tergite 3 and above black), wings hyaline (in *E. incubus* wings infumate), CI = 0.65 (in *E. incubus* CI = 0.25-0.40), clypeus in anterior aspects 1.70x wider than length (in *E. incubus*, clypeus in anterior aspects 1.20x wider than length).

20. *Enicospilus laqueatus* (Enderlein, 1921)

Henicospilus laqueatus Enderlein, 1921: 26. (IZPAN) Holotype: ♂, Taiwan.

Enicospilus leetoni Chiu, 1954: 38. (TARI) Holotype: ♀, Taiwan (Synonymized by Gauld and Mitchell, 1981: 396)

Diagnosis: Mandible long, weakly to moderately narrowed, with a diagonal groove bearing long brush of hair on outer surface; clypeus weakly convex in profile, in anterior aspect clypeus 1.50-1.70x wider than length; metapleuron punctate; proximal sclerite not confluent with distal sclerite; Rs+2r straight to weakly sinuous; fore wing with ICI and CI less than 0.65; claws symmetrical with very densely pectinate in ♂.

Host: Unknown

Material examined: Nil

Distribution: India: Bihar, Delhi, Himachal Pradesh, Kerala, Karnataka, Madhya Pradesh, Orissa, Tamil Nadu, West Bengal; China: Fujian, Guangxi, Guizhou, Taiwan, Yunnan; Nepal; Philippines: Luzon; Sri Lanka; Zambia.

Discussion: This species resembles to *E. aciculatus* (Taschenberg) and *E. yonezawanus* (Uchida) in general morphology. However, this species can be distinguished from those species in having central sclerite strongly pigmented (in *E. aciculatus* central sclerite weakly pigmented whereas in *E. yonezawanus* central sclerite absent).

Remarks: This species was originally described by Enderlein (1921) from Taiwan. The species was reported from Walayar Forest, Kerala by Gauld and Mitchell, 1981. The species is not represented in the present collection. The above diagnosis is based on the redescription of Gauld and Mitchell, 1981.

21. *Enicospilus lineolatus* (Roman, 1913)

(Plate - 25, Fig: 1 - 8; Map - 4)

Enicospilus striatus Cameron, 1899: 103. (UM) Holotype: ♀, India. (junior secondary homonym of *Enicospilus striatus* (Brulle) (Synonymized by Gauld and Mitchell, 1981: 304).

Henicospilus lineolatus Roman, 1913: 30. (NR) Holotype: ♂, Philippines.

Enicospilus uniformis Chiu, 1954: 25. (TARI) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 304).

Enicospilus flatus Chiu, 1954: 28. (TARI) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981:304).

Enicospilus gussakovskii Viktorov, 1957: 185. (Moscow) Holotype: ♀, USSR (Synonymized by Gauld and Mitchell, 1981: 304).

Enicospilus striolatus Townes, Townes & Gupta, 1961: 290. (Replacement name for *striatus* Cameron.) (Synonymized by Gauld and Mitchell, 1981: 304).

Enicospilus unicornis Rao & Nikam, 1969c: 343. (BMNH) Lectotype: ♂, India. (Synonymized by Gauld and Mitchell, 1981: 304)

Enicospilus unicornis Rao & Nikam, 1970: 103. (MUC) Holotype: ♀, India. junior primary homonym of *Enicospilus unicornis* Rao & Nikam, 1969a) Synonymized by Gauld and Mitchell, 1981: 304)

Description: Female. Body length = 26 mm; Antennae length = 26 mm; Ovipositor length = 2.90 mm.

Head: Antennae as long as body with 58 flagellomeres; length of first flagellar segment 2.00x as long as second; 20th flagellar segment 1.80x as long as broad; lower face punctate, 0.80x as wide as long; clypeus flat or weakly convex in profile, in anterior aspect clypeus 2.00x wider than length (Plate 25 Fig. 2); labrum 0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, twisted about 10-20°, sparsely hirsute, proximal concavity, with a diagonal groove on the outer surface; mandibular teeth unequal, upper tooth 1.50x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.50.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum weakly to moderately convex in profile, dorsally 1.40x longer than width anteriorly, lateral longitudinal carina of scutellum extending entire its length; mesopleuron

closely punctate throughout; epicnemial carina inclined towards anterior border of mesopleuron (Plate 25 Fig. 4); metapleuron punctate throughout; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area subconcentrically striate (Plate 25 Fig. 5), spiracular area punctate, margin of propodeal spiracle joined to lateral longitudinal carina, anterior with transverse carina.

FWL = 17 mm; FWW = 6 mm; HWL = 11 mm; HWW = 2.80 mm; discosubmarginal cell with proximal and central absent; distal sclerite present, broadened still distinctly delineated (Plate 25 Fig. 6); AI = 0.65; CI = 0.55; DI = 0.45; ICI = 0.85; SDI = 1.40; SI = 0.20; SRI = 0.24; vein Rs+2r weakly to moderately sinuous; 1m-cu sinuous; cu-a proximal to Rs+M by 0.20x its own length; Rs+M more or less straight; first subdiscal cell hairs on anterior; first abscissae of Rs in hind wing more or less straight; second abscissae of Rs more or less straight (Plate 25 Fig. 7); 7 hamuli on R1; NI = 4.20.

Legs slender; tibia flattened with scattered spines on outer surface; longer tibial spur in mid leg 2.10x than shorter; coxa in hind leg 1.70x longer than deep; trochantellus dorsally 0.20x as long as broad; claws symmetrical, curved.

Metasoma: Metasoma long and slender; thyridium oval to ellipsoidal; separated from anterior margin of tergite by 3.00x its length; THI = 3.00; DMI = 1.20; PI = 3.50.

Colour: Generally yellowish-brown; interocellar area reddish brown (Plate 25 Fig. 3); posterior segment of metasoma yellowish-brown (Plate 25 Fig. 8); pterostigma yellow; wings hyaline.

Male: Similar as female

Host: *Hyphantria cunea* (Lepidoptera: Erebidae), *Spilarctia subcarnea* (Lepidoptera: Erebidae), *Dendrolimus punctatus* (Lepidoptera: Lasiocampidae), *Psalis pennatula* (Lepidoptera: Lymantriidae), *Pseudodura dudgeon* (Lepidoptera: Lymantriidae), *Orgyia australis* (Lepidoptera: Lymantriidae), *Thiacidas postica*

(Lepidoptera: Noctuidae), *Loudonta dispar* (Lepidoptera: Notodontidae), (Sonan, 1927 and Gauld and Mitchell, 1981).

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 17.vii.2022, Reg. No. NBRL 343, MT.

Other material examined: 1♀, India: Kerala, Wayanad, Manathavady (N11°48'24"-E76°0'34"), Coll. Soumya T. K, 08.viii.2019, Reg. No. NBRL 344, MT; 2♀, India: Kerala, Kasargode, Balanthode (N12°45'92"-E75°32'08") Coll. Santhini K. P, 23.ix.2019, Reg. No. NBRL 345 & 346, LT; 1♀, India: Kerala, Kasargode, Rajapuram (N12°42'16"-E75°24'50"), Coll. Soumya T. K, 25.ix.2019, Reg. No. NBRL 347, LT; 1♀, India: Kerala, Malappuram, Calicut University campus (N11°13'40"-E75°89'52"), Coll. Ranjith, 22.ii.2020, Reg. No. NBRL 348, MT; 2♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58"-E75°79'35"), Coll. Soumya T. K, 23.i.2022, Reg. No. NBRL 349 & 350, LT; 1♀, India: Kerala, Malappuram, Vazhikkadavu (N11°23'19"-E76°20'47"), Coll. Soumya T. K, 28.ii.2023, Reg. No. NBRL 351, LT; 1♂, India: Kerala, Wayanad, Korome (N11°74'38"-E75°88'10"), Coll. Soumya T.K, 08.v.2023, Reg. No. NBRL 352, LT.

Habitat: Clove plantation, Forest, Rubber plantation, Botanical Garden, Grass land.

Distribution: India: Andhra Pradesh, Assam, Gujarat, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh; Australia: Capital Territory, New South Wales, Western Australia; Bhutan; Brunei; China: Anhui, Beijing, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hainan Island, Hebei, Hubei, Hunan, Jiangxi, Jilin, Shanxi, Shandong, Shanghai, Sichuan, Taiwan, Yunnan, Zhejiang; Indonesia: Irian Jaya, Java, Kalimantan, Sumatra; Japan: Okinawa; Korea; Malaysia: Peninsular, Sabah, Sarawak; Nepal; New Caledonia; Papua New Guinea; Philippines: Luzon, Mindanao; Singapore; Solomon Islands; Sri Lanka; Tajikistan.

Discussion: This species closely related to *E. transversus* Chiu in general morphology. However, this species can be distinguished from *E. transversus* as follows: mesopleuron punctate throughout (in *E. transversus* mesopleuron punctostriate), fore wing with proximal sclerite absent (in *E. transversus* fore wing with proximal sclerite present).

Remarks: This is the **first record** of this species from the study area.

22. *Enicospilus malabaricus* sp. nov.

(Plate - 3, Fig: 1 - 8; Map - 2)

Description: Holotype: Female. Body length = 20.45 mm; Antennae length = 18.15 mm; Ovipositor length = 1.95 mm.

Head: Antennae as long as body with 58 flagellomeres; length of first flagellar segment 1.60 x as long as second, 20th flagellar segment 2.30x as long as broad; lower face closely punctate, 1.30x as long as wide; clypeus usually strongly convex in profile, in anterior aspect clypeus 1.40x wider than length (Plate 3 Fig. 2); labrum 0.25x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, apically narrowed, twisted about 40°, with a diagonal groove on outer surface (Plate 3 Fig. 2); mandibular teeth unequal, upper tooth 1.60x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.90.

Mesosoma: Mesoscutum slightly rounded in profile, infusate throughout; notauli absent; scutellum moderately convex in profile, sparsely punctate, dorsally 1.30x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron upper part punctate, middle mesopleural groove shows striations (Plate 3 Fig. 4); epicnemial carina not inclined towards anterior border of mesopleuron (Plate 3 Fig. 4); metapleuron punctate; submetapleuron anteriorly widened; propodeum with anterior area longitudinally striate, posterior area irregularly wrinkled to reticulate, spiracular area smooth, margin of propodeal

spiracle joined to lateral longitudinal carina by a ridge (Plate 3 Fig. 5), anteriorly with a strong transverse carina (Plate 3 Fig. 5).

FWL = 12.50 mm; FWW = 3.95 mm; HWL = 8.00 mm; HWW = 2.8 mm; discosubmarginal cell with proximal sclerite subtriangular, having distinct appendix, confluent with distal sclerite; distal sclerite linear; central sclerite round to oval (Plate 3 Fig. 6); AI = 0.80; CI = 0.80; DI = 0.40; ICI = 0.60; SDI = 1.30; SI = 0.15; SRI = 0.25; vein Rs+2r medially slightly convex, basally thickened; 1m-cu evenly curved; cu-a proximal to Rs+M by 0.10x its own length; Rs+M almost straight; first subdiscal cell with scattered hairs antero- distally (Plate 3 Fig. 6); first abscissae of Rs in hind wing more or less straight; second abscissae straight (Plate 3 Fig. 7); 7 hamuli on R1; NI = 2.60.

Legs slender; tibia subcylindrical with scattered spines on outer surface; longer tibial spur in mid leg 1.30x than shorter; coxa in hind leg 1.80x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 6.00x its length; THI = 6.00; DMI = 1.32; PI = 3.50.

Colour: Generally yellowish-brown; interocellar area yellowish-brown (Plate 3 Fig. 3); mandibular teeth black; posterior segments of metasoma reddish dark brown to black (Plate 3 Fig. 8); wings hyaline; pterostigma yellowish-brown.

Male: Similar as female

Variations: In paratypes, antennae with 58-64 flagellomeres.

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 09.viii.2022, Reg. No. NBRL 220, MT.

Paratypes: 1♀, India: Kerala, Palakkad, Silent Valley (N11°06'94''-E76°42'80''), Coll. Prasanth, Rajesh & Manoj, 12.vii.2017, Reg. No. NBRL 221; 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40''-E75°89'52''), Coll. Soumya T. K, 15.i.2019, Reg. No. NBRL 222, MT; 2♀, India: Kerala, Kozhikode, Ulliyeri (N11°45'02''-E75°77'11''), Coll. Soumya T. K, 18.viii.2019, Reg. No. NBRL 223 & 224, LT; 1♀, India: Kerala, Wayanad, Korome (N11°74'38''-E75°88'10''), Coll. Soumya T. K, 08.xi.2019, Reg. No. NBRL 225, SN; 1♀, India: Kerala, Wayanad, Manathavady (N11°48'24''-E76°0'34''), Coll. Soumya T. K, 22.xi.2019, Reg. No. NBRL 226, LT; 1♀, India: Kerala, Wayanad, Panamaram (N11°44'20''-E76°04'23''), Coll. Soumya T. K, 24.xii.2019, Reg. No. NBRL 227, LT; 2♀, India: Kerala, Kasargod, Balanthode (N12°45'92''-E75°32'08''), Coll. Santhini K.P, 18.ix.2020, Reg. No. NBRL 228 & 229, LT; 1♀, India: Kerala, Kozhikode, Villiappally (N11°62'55''-E75°62'94''), Coll. Soumya T. K, 13.ii.2021, Reg. No. NBRL 230, SN; 1♂, India: Kerala, Kozhikode, Kodenchery (N11°43'23''-E76°00'73''), Coll. Soumya T. K, 06.ix.2021, Reg. No. NBRL 231, LT; 1♀, India: Kerala, Malappuram, Nilambur (N11°28'55''-E76°23'86''), Coll. Soumya T. K, 25.ii.2022, Reg. No. NBRL 232, LT; 2♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58''-E75°79'35''), Coll. Soumya T. K, 23.ix.2022, Reg. No. NBRL 233 & 234, LT.

Habitat: Clove plantation, Forest, Rubber plantation, Botanical Garden, Sacred grove, Grass land, Paddy field.

Distribution: India: Kerala.

Etymology: Species name refers to the Malabar region of Kerala, where the type specimens were collected.

Discussion: The new species *E. malabaricus* sp. nov. resembles *E. melanocarpus* Cameron in general morphology. However the new species can be distinguished from *E. melanocarpus* as follows: margin of propodeal spiracle joined to lateral longitudinal carina by a ridge (in *E. melanocarpus* margin of propodeal spiracle not joined to lateral longitudinal carina), epicnemial carina not inclined towards anterior border of mesopleuron (in *E. melanocarpus* epicnemial carina inclined towards

anterior border of mesopleuron), fore wing with CI = 0.80 (in *E. melanocarpus* fore wing with CI = 0.30-0.40), mesopleuron upper part punctate, middle mesopleural groove shows striations (in *E. melanocarpus* mesopleuron upper part punctate and lower part punctate to punctostriate).

23. *Enicospilus melanocarpus* Cameron, 1902

(Plate - 26, Fig: 1 - 8; Map - 11)

Enicospilus reticulatus Cameron, 1902: 52. (BMNH) Holotype: ♂, Maldive Is. (Synonymized by Gauld and Mitchell, 1981: 377) (Junior primary homonym of *Enicospilus reticulatus* Cameron, 1899).

Enicospilus (sic) *melanocarpus* Cameron, 1905: 122. (BMNH) Holotype: ♀, Srilanka.

Henicospilus nigrinervis Szepligeti, 1906: 142. (TM) Holotype: ♀, New guinea. (Synonymized by Gauld and Mitchell, 1981: 377) (Junior secondary homonym of *Enicospilus nigrinervis* Cameron, 1901).

Ophion (*Henicospilus*) *nocturnus* Kohl, 1908: 315. (NM) Holotype: ♀, Samoa. (Synonymized by Gauld and Mitchell, 1981: 377).

Henicospilus batavianus Szepligeti, 1910: 92. (TM) Holotype: ♀, Java. (Synonymized by Gauld and Mitchell, 1981: 377).

Henicospilus turneri Morley, 1912: 51. (BMNH) Lectotype: ♀, Australia, designated by Townes, Townes & Gupta, 1961: 291. (Synonymized by Gauld and Mitchell, 1981: 377).

Henicospilus atricornis var. *zeylanicus* Morley, 1913: 392. (BMNH) Holotype: ♀, Srilanka. (Synonymized by Gauld and Mitchell, 1981: 377).

Henicospilus uncivena Enderlein, 1921: 23. (IZPAN) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981: 377).

Henicospilus crassivena Enderlein, 1921: 24. (IZPAN) Holotype; ♀, Sumatra. (Synonymized by Townes, Townes & Gupta, 1961: 281).

Enicospilus nigrivenalis Cushman, 1937: 307. (DEI) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 377).

Enicospilus quintuplex Chiu, 1954: 61. (TARI) Holotype: ♀, China. (Synonymized by Gauld and Mitchell, 1981: 377)

Enicospilus (*Polycorniata*) *brunnis* Rao and Nikam, 1971: 105. (MUC) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981: 377)

Description: Female. Body length = 20-22 mm; Antennae length = 20-23 mm; Ovipositor length = 1.80-2.20 mm.

Head: Antennae as long as body with 55-60 flagellomeres; length of first flagellar segment 1.60-1.80x as long as second, 20th flagellar segment 1.90-2.20x as long as broad; lower face closely punctate, 1.30-1.40x as long as broad; clypeus strongly convex in profile, in anterior aspect clypeus 1.45-1.70x wider than length (Plate 26 Fig. 2); labrum 0.20-0.30x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, apically narrowed, twisted about 20°, with a diagonal groove on outer surface, sparsely pubescence (Plate 26 Fig. 2); mandibular teeth unequal, upper tooth 1.30-1.50x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.80-3.10.

Mesosoma: Mesoscutum slightly rounded in profile, infusate throughout; notauli absent; scutellum moderately convex in profile, sparsely punctate, dorsally 1.30-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending 0.9 of its length; mesopleuron upper part punctate, lower part punctate to punctostriate (Plate 26 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron; metapleuron punctate; submetapleural carina anteriorly widened; propodeum with anterior area longitudinally striate, posterior area irregularly wrinkled to reticulate, spiracular area rugulose, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 26 Fig. 5).

FWL = 11-13 mm; FWW = 3.60-4.10 mm; HWL = 8.00-10.00 mm; HWW = 2.8-3.10 mm; discosubmarginal cell with proximal sclerite subtriangular having distinct appendix, confluent with distal sclerite; distal sclerite linear; central sclerite round to oval (Plate 32 Fig. 6); AI = 0.80-0.90; CI = 0.45-0.50; DI = 0.30-0.40; ICI = 0.50-0.60; SDI = 1.10-1.25; SI = 0.12-0.15; SRI = 0.25-0.30; vein Rs+2r medially slightly convex, hirsute, basally thickened; 1m-cu evenly curved; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell with scattered hairs antero- distally; first abscissae of Rs in hind wing more or less straight; second abscissae straight (Plate 26 Fig. 7); 6-7 hamuli on R1; NI = 2.60.

Legs slender; tibia subcylindrical with scattered spines on outer surface; longer tibial spur in mid leg 1.30-1.40x than shorter; coxa in hind leg 1.80-1.90x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma with long and slender; thyridium oval, separated from anterior margin of tergite by 5.00- 6.00x its length; THI = 5.00-6.00; DMI = 1.32; PI = 3.5.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 26 Fig. 3); posterior segments of metasoma blackish (Plate 32 Fig. 8); mandibular teeth black; wings hyaline; pterostigma yellowish brown.

Male: Similar as female

Host: *Heliothis armigera* (Lepidoptera: Noctuidae); *Streblote siva* Lefebvre (Lepidoptera: Lasiocampidae); *Euproctis fraterna* Moore (Lepidoptera: Lymantriidae), (Gauld and Mitchell, 1981 and Nikam, 1990).

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Villiappally (N11°62'55''-E75°62'94''), Coll. Soumya T. K, 09.ix.2021, Reg. No. NBRL 340, LT.

Other material examined: 2♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58''-E75°79'35''), Coll. Soumya T. K, 24.ix.2022, Reg. No. NBRL 341 & 342, LT.

Habitat: Sacred groove, Forest.

Distribution: India: Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan, Tamil Nadu; Australia: New South Wales, Northern Territory, Queensland, Western Australia; Brunei; China: Beijing, Fujian, Guangdong, Guangxi, Guizhou, Hainan Island, Hebei, Hunan, Jiangxi, Shaanxi, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang; Fiji; Indonesia: Irian Jaya, Java, Kalimantan, North Moluccas, South Moluccas, Sulawesi, Sumatra; Japan:

Ogasawara, Okinawa; Korea; Malaysia: Peninsular, Sabah, Sarawak; Myanmar; Nepal; New Caledonia; Pakistan; Papua New Guinea; Philippines: Luzon, Mindanao, Negros, Palawan, Samar; Singapore; Society Islands; Solomon Islands; Sri Lanka; Vanuatu; Western Samoa.

Discussion: This species closely related to *E. sauteri* (Enderlein) in general morphology. However, this species can be distinguished from *E. sauteri* as follows: marginal cell of forewing uniformly hirsute (in *E. sauteri* marginal cell of forewing proximally glabrous), central sclerite oval shaped (in *E. sauteri* central sclerite linear shaped).

Remarks: This is the **first record** of this species from the study area.

24. *Enicospilus nigriventris* Nikam, 1975

(Plate -10, Fig: 1-8; Map - 6)

Enicospilus (sic) (Bicorniata) nigriventris Nikam, 1975: 195. (MUC) Holotype: ♂, India.

Description: Female. Body length = 25 mm; Antennae length = 27 mm, Ovipositor length = 1.10 mm.

Head: Antennae as long as body with 62 flagellomeres; length of first flagellar segment 1.70x as long as second, 20th flagellar segment 2.40x as long as broad; lower face punctate, 0.60x as wide as long; clypeus moderately convex in profile, in anterior aspect clypeus 1.70x wider than length (Plate 10 Fig. 2); labrum 0.20x as long as broad; malar space 0.25x longer than basal width of mandible; mandible relatively long, evenly narrowed, twisted about 70°, with a weak furrow on outer surface, finely pubescent; mandibular teeth unequal, upper tooth sub cylindrical, 1.40x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.10.

Mesosoma: Mesoscutum abruptly rounded in profile, notauli absent; scutellum weakly convex in profile, dorsally 1.40x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished,

upper part punctate, lower part puncto-striate (Plate 10 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron; metapleuron reticulate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area striate (Plate 10 Fig. 5), spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina.

FWL = 19 mm; FWW = 6 mm; HWL = 12 mm; HWW = 3.50 mm; discosubmarginal cell with proximal sclerite triangular with an appendix; distal sclerite absent; central sclerite present (Plate 10 Fig. 6); AI = 0.95; CI = 0.35; DI = 0.32; ICI = 0.48; SDI = 1.32; SI = 0.12; SRI = 0.20; vein Rs+2r almost straight; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10x its own length; Rs+M more or less straight; first subdiscal cell with antero-distally hirsute; first abscissae of Rs in hind wing more or less straight, second abscissae strongly curved (Plate 10 Fig. 7); 7 hamuli on R1; NI = 3.80.

Legs slender; tibia subcylindrical with isolated spines on outer surface; longer tibial spur in mid leg 1.60x than shorter; coxa in hind leg 1.60x longer than deep; trochantellus dorsally 0.20x as long as broad; claws symmetrical, pectinate slightly incurved.

Metasoma: Metasoma long and slender (Plate 10 Fig. 8); thyridium oval, separated from anterior margin of tergite by 4.50x its length; THI = 4.50; DMI = 1.10; PI = 2.85.

Colour: Generally yellowish-brown; interocellar area yellowish brown (Plate 10 Fig. 3); mandibular teeth black; mesoscutum posteriorly black; wings hyaline and infumate; pterostigma yellowish-brown.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"- E75°47'59"), Coll. Soumya T. K, 15.ii.2019, Reg. No. NBRL 264, LT.

Habitat: Cocoa plantation

Distribution: India: Maharashtra, Kerala, Tamil Nadu; Brunei; Philippines: Mindanao.

Discussion: The *E. nigriventris* species closely resembles *E. chion* Gauld and Mitchell in having general colour, sculpture and curvature of Rs in the hind wing. However, this species can be distinguished from *E. chion* as follows: mandible twisted 70° (in *E. chion* mandible twisted 45°), metapleuron reticulate (in *E. chion* metapleuron without reticulations).

Remarks: This is the **first record** of this species from the Kerala state.

25. *Enicospilus pinus* Gauld and Mitchell, 1981

Enicospilus pinus Gauld and Mitchell, 1981: 189 (BMNH) Holotype: ♀, India.

Diagnosis: Mandible long with a weak proximal concavity; clypeus almost flat in profile; anterior transverse carina of propodeum joined to lateral carina at 90°; mid and hind trochantelli with outer distal margin produced into an acute decurved tooth; central sclerite reniform; distal sclerite absent.

Host: Unknown

Material examined: Nil

Distribution: India: Kerala, Tamil Nadu.

Discussion: This species is easily distinguishable from other *Enicospilus* by its mid and hind trochantelli with outer distal margin produced into an acute decurved tooth.

Remarks: The diagnosis is based on the original description of Gauld and Mitchell, 1981. The species was reported from Walayar Forest, Kerala by Gauld and Mitchell, 1981. The species is not represented in the present collection.

26. *Enicospilus punctatus* sp. nov.

(Plate - 27, Fig: 1 - 9; Map - 11)

Description: Female. Body length = 20.40 mm; Antennae length = 17 mm; Ovipositor length

= 1.95 mm

Head: Antennae as long as body with 56 flagellomeres; length of first flagellar segment 1.50x as long as second, 20th flagellar segment 1.80x as long as broad; lower face punctate, 1.30x as long as broad; clypeus flat in profile, in anterior aspect clypeus 1.50x wider than length (Plate 27 Fig. 2); labrum 0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, apically narrowed, twisted about 40°, with a diagonal groove on outer surface; mandibular teeth unequal, upper tooth 1.20x length of lower tooth (Plate 27 Fig. 2); posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.80.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate, notauli absent; scutellum moderately convex in profile, dorsally 1.30x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron closely punctate (Plate 27 Fig. 4); epicnemial carina extending to anterior border of mesopleuron; metapleuron upper part punctate and irregularly wrinkled (Plate 27 Fig. 4); submetapleural carina uniformly widened; propodeum with anterior area striate, posterior area with discontinuous transverse wrinkles, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina (Plate 27 Fig. 5), anteriorly with a strong transverse carina.

FWL = 12 mm; FWW = 4.10 mm; HWL = 7.40 mm; HWW = 1.75 mm; discosubmarginal cell with proximal sclerite linear, confluent with distal sclerite; distal sclerite linear; central sclerite large, weakly sclerotized (Plate 27 Fig. 6); AI =

0.87; CI = 0.45; DI = 0.33; ICI = 0.60; SDI = 1.14; SI = 0.10; SRI = 0.25; vein Rs+2r straight; 1m-cu evenly curved; cu-a proximal to Rs+M by 0.10x its own length; Rs+M slightly curved distally; first subdiscal cell with hairs on antero-distally; first abscissae of Rs in hind wing straight; second abscissae slightly curved; 6 hamuli on R1 (Plate 27 Fig. 8); NI = 3.10.

Legs slender; tibia subcylindrical with scattered spines on outer surface; longer tibial spur in mid leg 1.60x than shorter; coxa in hind leg 2.00x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.20x its length (Plate 27 Fig. 9); THI = 3.20; DMI = 1.44; PI = 3.05.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 27 Fig. 3); metasoma uniformly yellowish brown; mandibular teeth reddish brown; wings hyaline; pterostigma yellowish brown.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kasaragod district, Bandadkha (N11°62'55''-E75°62'94''), 27.vi.2022, Coll. Soumya T. K, Reg. No. NBRL 353, LT.

Habitat: Forest

Distribution: India: Kerala.

Etymology: The specific epithet is based on the characteristics punctate mesopleuron of the species.

Discussion: The new species *E. punctatus* sp. nov. resembles *E. heinrichi* (Gauld and Mitchell) in general morphology. However the new species can be distinguished

from *E. heinrichi* as follows: margin of propodeal spiracle not joined to lateral longitudinal carina (in *E. heinrichi* margin of propodeal spiracle joined to lateral longitudinal carina); mesopleuron closely punctate (in *E. heinrichi* mesopleuron upper part finely punctate, lower part puncto-striate to striate); AI = 0.87 (in *E. heinrichi* AI = 0.25-0.40); metasoma uniformly yellowish brown (in *E. heinrichi*, metasoma with posterior segment black); wings hyaline (in *E. heinrichi* wings infumate)

27. *Enicospilus robustus* sp. nov.

(Plate - 13, Fig: 1-9; Map - 5)

Description: Holotype: Female. Body length = 33 mm; Ovipositor length = 1.50 mm.

Head: Antennae as long as body, with more than 60 flagellomeres; length of first flagellar segment 1.70x as long as second, 20th flagellar segment 1.80x as long as broad; lower face sparsely punctate, 0.60-0.70x as wide as long (Plate 13 Fig. 2); clypeus usually moderately convex in profile, in anterior aspect clypeus 2.10x wider than length (Plate 13 Fig. 2); labrum 0.15x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, uniformly narrowed, twisted about 40°, without a groove on the outer surface, flat with sparse pubescence; mandibular teeth almost equal; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.40.

Mesosoma: Mesoscutum slightly round in profile, dorsally infusate; notauli absent; scutellum moderately convex in profile, dorsally 1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length (Plate 13 Fig. 4); mesopleuron inadequately polished, upper part finely striate, lower part striate; epicnemial carina not extending towards anterior border of mesopleuron; metapleuron rugose; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area irregularly wrinkled (Plate 13 Fig. 6), spiracular

area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge (Plate 13 Fig. 5), anteriorly with a strong transverse carina.

FWL = 18 mm; FWW = 6 mm; HWL = 16.50 mm; HWW = 4.25 mm; discosubmarginal cell with proximal sclerite oval, distal sclerite linear, central sclerite absent (Plate 13 Fig. 7); AI = 1.67; CI = 0.72; DI = 0.39; ICI = 0.70; SDI = 1.19; SI = 0.12; SRI = 0.25; vein Rs+2r more or less straight; 1m-cu sinuous; cu-a proximal to Rs+M by 0.10x its own length; Rs+M slightly curved; first subdiscal cell with proximo-posterior glabrous; first abscissae of Rs in hind wing slightly curved; second abscissae weakly sinuous; 11 hamuli on R1; NI = 2.20.

Legs slender, tibia subcylindrical with few spines on outer surface; tibial spur in mid leg 1.40x longer than shorter; coxa in hind leg 1.50x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate, curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 9x its length (Plate 13 Fig. 8); THI = 9; DMI = 1.50; PI = 3.28.

Colour: Generally reddish-brown; interocellar area yellowish brown (Plate 13 Fig. 3); mandibular teeth black; posterior segments of metasoma dark brown (Plate 13 Fig. 9); wings hyaline; pterostigma dark brown; proximal part of marginal cell infumate (Plate 13 Fig. 7).

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 09.ii.2023, Reg. No. NBRL 273, LT.

Paratype: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40"-E75°89'52"), Coll. Sudheer. K, 22.iv.2000, Reg. No. NBRL 274, MT.

Habitat: Cocoa plantation, Botanical Garden.

Distribution: India: Kerala

Etymology: Species epithet is due to its hard, strong and large-sized body.

Discussion: The new species *E. robustus* sp. nov. resembles *E. nigronotatus* Cameron in general morphology. However new species can be distinguished from *E. nigronotatus* as follows: mesopleuron upper part striate (in *E. nigronotatus*, mesopleuron upper part finely punctate); epicnemial carina straight, not extending anterior margin of mesopleuron (in *E. nigronotatus*, epicnemial carina curved, extending to anterior margin of mesopleuron); clypeus 2.10x wider than length (in *E. nigronotatus*, clypeus 1.40x wider than length); thyridium separated from anterior margin of tergite by 9x its own length (in *E. nigronotatus*, thyridium separated from anterior margin of tergite by 5-6x its own length).

28. *Enicospilus rufus* sp. nov.

(Plate - 15, Fig: 1 - 9; Map - 5)

Description: Holotype: Male. Body length = 25 mm; Antennae length = 26.70 mm.

Head: Antennae as long as body with 60 flagellomeres, length of first flagellar segment 2.00x as long as second, 20th flagellar segment 2.10x as long as broad; lower face fine scattered punctures, 0.80x as wide as long; clypeus weakly convex in profile, in anterior aspect clypeus 1.80x wider than length (Plate 15 Fig. 2); labrum 0.25x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, evenly narrowed, twisted about 25°, without a groove on outer surface, flat with sparsely pubescence; mandibular teeth unequal, upper tooth subcylindrical, 1.30x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.40.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate; notauli absent; scutellum weakly convex in profile, dorsally 1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron upper and lower part punctato-striate (Plate 15 Fig. 4); epicnemial

carina not extending towards anterior border of mesopleuron; metapleuron punctato-striate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area concentrically striate, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge (Plate 15 Fig. 4), anteriorly with a strong transverse carina.

FWL = 21 mm; FWW = 7.02 mm; HWL = 13.20 mm; HWW = 3.53 mm; discosubmarginal cell with proximal sclerite linear, unpigmented (Plate 15 Fig. 6); AI = 1.10; CI = 0.63; DI = 0.34; ICI = 0.86; SDI = 1.24; SI = 0.15; SRI = 0.14; vein Rs+2r sinuous, hirsute; 1m-cu sinuate; cu-a proximal to Rs+M by 0.20x its own length; Rs+M almost straight, first subdiscal cell with anterior most part hirsute; first abscissae of Rs in hind wing straight, second abscissae slightly curved (Plate 15 Fig. 7); 8 hamuli on R1; NI = 5.80.

Legs slender; tibia cylindrical with few small spines on outer surface; tibial spur in mid leg 1.40x longer than shorter; coxa in hind leg 1.90x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate, abruptly curved.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 4.00x its own length; gonosquama acute apically (Plate 15 Fig. 9); THI = 4.07; DMI = 1.41; PI = 2.70.

Colour: Generally reddish-brown; interocellar area yellow (Plate 15 Fig. 3); mandibular teeth black; posterior segments of metasoma infusate (Plate 15 Fig. 8); wings hyaline; pterostigma dark brown.

Female: Similar as male

Host: Unknown

Biology: Unknown

Material examined: Holotype: 1♂, India: Kerala, Wayanad, Niravilpuzha (N11°74'30"-E75°93'76"), Coll. Soumya T. K, 02.ii.2023, Reg. No. NBRL 276, LT.

Paratypes: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40''-E75°89'52''), Coll. Sudheer. K, 27.iv.2000, Reg. No. NBRL 277, LT; 2♂, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 23.ii.2023, Reg. No. NBRL 278 & 279, MT.

Habitat: Clove plantation, Bitter gourd plantation, Botanical Garden.

Distribution: India: Kerala

Etymology: Species epithet is due to its reddish colour.

Discussion: The new species *E. acutus* sp. nov. resembles *E. plicatus* (Brulle) in general morphology. However, the new species can be distinguished from *E. plicatus* as follows: margin of the propodeal spiracle joined to lateral longitudinal carina (in *E. plicatus* margin of propodeal spiracle not joined to lateral longitudinal carina); gonosquama acute apically (in *E. plicatus* gonosquama rounded); second abscissae of Rs in hind wing slightly curved (in *E. plicatus* second abscissae of Rs in hind wing straight).

29. *Enicospilus signativentris* (Tosquinet, 1903)

(Plate - 19, Fig: 1 - 8; Map - 7)

Ophion (Enicospilus) signativentris Tosquinet, 1903: 37. (IRSNB) Lectotype: ♀, Java, designated by Townes, Townes & Gupta (1961: 289).

Henicospilus incompletus Szepliget, 1906: 143. (TM) Holotype: ♀, Sulawesi. (Synonymized by Gauld and Mitchell, 1981:411).

Henicospilus nigrosignatus Enderlein, 1921: 22. (IZPAN) Holotype: ♀, Java. (Synonymized by Townes, Townes & Gupta, 1961: 289).

Henicospilus tristrigatus Enderlein, 1921: 23. (IZPAN) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 411).

Henicospilus formosanus Enderlein, 1921: 25. (IZPAN) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 411).

Henicospilus emacescens Enderlein, 1921: 25. (IZPAN) Holotype: ♂, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 411).

Henicospilus taiwanus Uchida, 1928: 226. (EIHU) Syntype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 411).

Enicospilus frater Cushman, 1937a: 311. (DEI) Holotype: ♂, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 411).

Enicospilus pectiniclavae Rao and Nikam, 1969b: 14. (MUC) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981: 411).

Description: Female. Body length = 22-24 mm; Antennae length = 21-23 mm; Ovipositor length = 1.80-2.15 mm.

Head: Antennae as long as body with 54-56 flagellomeres; length of first flagellar segment 1.50-1.80x as long as second, 20th flagellar segment 2.50-3.00x as long as broad; lower face sparsely punctate, 0.60-0.70x as wide as long; clypeus usually weakly convex in profile, in anterior aspect clypeus 1.50-1.60x wider than length (Plate 19 Fig. 2); labrum 0.20-0.25x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, strongly and evenly narrowed, twisted about 10-20°, without a groove on outer surface, flat with sparsely pubescent; mandibular teeth unequal, upper tooth subcylindrical, 1.30-1.50x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.10-3.50.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, dorsally 1.50-1.60x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished; upper part finely punctate, lower part striate (Plate 19 Fig. 4); epicnemial carina curved towards anterior border of mesopleuron; metapleuron finely and closely punctate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area trans-striate, posterior transcarina present laterally (Plate 19 Fig. 5), spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina.

FWL = 14-15 mm; FWW = 4.20-5 mm; HWL = 9.10-9.70 mm; HWW = 2.50-3 mm; discosubmarginal cell with proximal sclerite triangular, confluent with distal sclerite; distal sclerite linear; central sclerite oval (Plate 19 Fig. 6); AI = 0.97-1.10; CI = 0.30-0.40; DI = 0.40-0.45; ICI = 0.32-0.40; SDI = 1.12-1.20; SI = 0.10-0.15; SRI = 0.25-0.30; vein Rs+2r weakly sinuous to straight; 1m-cu sinuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first

subdiscal cell with anterior hirsute; first abscissae of Rs in hind wing straight; second abscissae weakly bowed (Plate 19 Fig. 7); 6-7 hamuli on R1; NI = 2.50-3.00

Legs slender; tibia subcylindrical with scattered spines on outer surface; tibial spur in mid leg 1.60-1.80x longer than shorter; coxa in hind leg 1.70-1.80x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate, abruptly curved.

Metasoma: Metasoma long and slender (Plate 19 Fig. 8); thyridium oval, separated from anterior margin of tergite by 5-6x its own length; THI = 5.20-6.00; DMI = 1.30-1.40; PI = 2.75-2.90.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 19 Fig. 3); mandibular teeth black; wings hyaline; pterostigma yellowish-brown.

Male: Similar as female.

Host: *Trichoplusia* sp. (Lepidoptera: Noctuidae), (Gauld and Mitchell, 1981)

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 28.ii.2019, Reg. No. NBRL 292, LT.

Other material examined: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40''-E75°89'52''), Coll. Sudheer. K, 27.iv.2000, Reg. No. NBRL 293; 1♀, India: Kerala, Palakkad, Silent Valley (N11°06'94''-E76°42'80''), Coll. Prasanth, Rajesh & Manoj, 12.vii.2017, Reg. No. NBRL 294; 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40''-E75°89'52''), Coll. Soumya T. K, 15.i.2019, Reg. No. NBRL 295, LT; 3♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 28.ii.2019, Reg. No. NBRL 296, 297 & 298, SN; 2♀, India: Kerala, Kozhikode, Ulliyeri (N11°45'02''-E75°77'11''), Coll. Soumya T. K, 18.viii.2019, Reg. No. NBRL 299 & 300, LT; 1♀ & 1♂, India: Kerala, Wayanad, Korome (N11°74'38''-E75,°88'10''), Coll. Soumya T. K, 08.xi.2019, Reg. No. NBRL 301 & 302, LT; 1♀, India: Kerala, Kozhikode, Kodenchery (N11°43'23''-E76°00'73''), Coll. Soumya T. K, 06.ix.2021, Reg. No. NBRL 303, YPT ; 2♀, India: Kerala, Wayanad, Ambalavayal

(N11°61'97''-E76°21'03''), Coll. Soumya T. K, 17.xi.2021 Reg. No. NBRL 304 & 305, LT; 1♀, India: Kerala, Malappuram, Nilambur (N11°28'55''-E76°23'86''), Coll. Soumya T. K, 25.ii.2022, Reg. No. NBRL 306, LT; 1♀, India: Kerala, Kasargod, Bandadka (N12°50'10''-E75°26'83''), Coll. Soumya T. K, 23.v.2022, Reg. No. NBRL 307, LT; 2♀, India: Kerala, Kasargod, Kutikulam (N12°23'19''-E75°01'34''), Coll. Soumya T. K, 24.v.2022, Reg. No. NBRL 308 & 309, LT; 1♀ India: Kerala, Wayanad, Makkiyad (N11°74'90''-E75°90'28''), Coll. Soumya T. K, 12.viii.2022, Reg. No. NBRL 310, SN; 2♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58''-E75°79'35''), Coll. Soumya T. K, 23.ix.2022, Reg. No. NBRL 311 & 312, LT; 2♀ India: Kerala, Wayanad, Panamaram (N11°73'81''-E76°07'40''), Coll. Soumya T. K, 04.i.2023, Reg. No. NBRL 313 & 314, LT; 3♀ & 2♂, India: Kerala, Wayanad, Chundale (N11°34'26''-E76°03'28''), Coll. Soumya T. K, 09.xii.2023, Reg. No. NBRL 315, 316, 317, 318 & 319, LT.

Habitat: Botanical Garden, Cocoa plantation, Vegetable Garden, Sacred groves, Paddy field, Forest, Coffee plantation, Rubber plantation.

Distribution: India: Assam, Karnataka, Kerala, Rajasthan, Tamil Nadu; Bhutan; China: Fujian, Guizhou, Hainan Island, Taiwan; Indonesia: Java, South Moluccas, Sulawesi, Sumatra, Timor; Japan: Ogasawara, Okinawa; Malaysia: Peninsular, Sabah, Sarawak; Philippines: Luzon, Mindanao; Sri Lanka; Vietnam.

Discussion: This species closely resembles *E. abdominalis* (Szepliget) in general morphology. However, this species can be distinguished from *E. abdominalis* by strong posterior transverse carina of propodeum (in *E. abdominalis*, posterior transverse carina absent).

Remarks: This is the **first record** of this species from the study area.

30. *Enicospilus squamacutus* sp. nov.

(Plate - 22, Fig: 1-9; Map - 10)

Description: Holotype: Male. Body length = 19 mm; Antennae length = 20 mm.

Head: Antennae as long as body with 56 flagellomeres; length of first flagellar segment 1.70x as long as second, 20th flagellar segment 1.90x as long as broad; lower face closely punctate, medially convex, 1.50x as long as broad; clypeus moderately convex in profile, in anterior aspect clypeus 1.90x wider than length (Plate 22 Fig. 2); labrum 0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible long, evenly narrowed, twisted about 40°, without a groove on outer surface, flat with proximal concavity, scattered pubescence; mandibular teeth equal; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete (Plate 22 Fig. 3); GOI = 2.80.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, sparsely punctate, dorsally 1.30x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron upper part striate, lower part punctate; epicnemial carina inclined towards anterior border of mesopleuron (Plate 22 Fig. 5); metapleuron irregularly wrinkled (Plate 22 Fig. 5); submetapleural carina narrow, anteriorly widened; propodeum with anterior area striate, posterior area irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to pleural carina, anteriorly with a strong transverse carina (Plate 22 Fig. 6).

FWL = 10.22 mm; FWW = 3.50 mm; HWL = 6 mm; HWW = 1.70 mm; discosubmarginal cell with proximal sclerite very weakly pigmented; central sclerite absent; indistinct yellowish thickening on the periphery of the fenestra (Plate 22 Fig. 7); AI = 0.65; CI = 0.35; DI = 0.35; ICI = 0.85; SDI = 1.25; SI = 0.15; SRI = 0.20; vein Rs+2r proximally thick, straight; 1m-cu evenly curved; postero-distal angle of second discal cell less than 95°; cu-a proximal to Rs+M by 0.20x its own length; Rs+M straight; first sub discal cell with scattered hairs uniformly; first abscissae of Rs in hind wing straight, second abscissae more or less straight (Plate 22 Fig. 8); 5 hamuli on R1; NI = 3.05.

Legs slender; tibia subcylindrical with few isolated spines on outer surface; longer tibial spur in mid leg 1.40x than shorter; coxa in hind leg 1.60x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, small separated from anterior margin of tergite by 3.50x its length; THI = 3.50; DMI = 1.55; PI = 3.70; gonosquama acute terminally (Plate 22 Fig. 9).

Colour. Generally yellowish-brown; interocellar area yellowish brown (Plate 22 Fig. 3); mandibular teeth black; wings hyaline; pterostigma yellowish-brown (Plate 22 Fig. 7).

Female: Similar as male; ovipositor straight, apically elongately acute.

Host: Unknown

Biology: Unknown

Material examined: Holotype. 1♂, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 23.vii.2022, Reg. No. NBRL 326, LT.

Paratypes. 1♀, India: Kerala, Wayanad, Manathavady (N11°48'24"-E76°0'34"), Coll. Soumya T. K, 22.xi.2019, Reg. No. NBRL 327, LT. 2♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58"-E75°79'35"), Coll. Soumya T. K, 28.vii.2022, Reg. No. NBRL 328 & 329, LT; 1♂, India: Kerala, Wayanad, Niravilpuzha (N11°74'30"-E75°93'76"), Coll. Soumya T. K, 30.vii.2022, Reg. No. NBRL 330, LT.

Habitat: Clove plantation, Forest, Coffee plantation

Distribution: India: Kerala.

Etymology: The specific epithet is based on the distinctive acute gonosquama of the species.

Discussion: The new species *E. squamacutus* sp. nov. closely resembles *E. biharensis* (Uchida) but differs from *E. squamacutus* sp. nov. in having clypeus moderately convex (in *E. biharensis*, clypeus almost flat); metapleuron irregularly wrinkled (in *E. biharensis*, metapleuron coarsely and closely punctate); gonosquama

acute (in *E. biharensis*, gonosquama evenly rounded); hind wing with 5 hamuli on R1 (in *E. biharensis*, hind wing with 7-8 hamuli on R1).

31. *Enicospilus transversus* Chiu, 1954

(Plate - 17, Fig: 1 - 8; Map - 6)

Enicospilus transversus Chiu, 1954: 14. (TARI) Holotype: ♀, Taiwan.

Enicospilus (Unicorniata) perpendicularis Nikam, 1972: 196. (MUC) Holotype: ♀, India. (Synonymized by Gauld and Mitchell, 1981:298).

Description: Female. Body length = 21-23 mm; Antennae length = 20.50-22 mm; Ovipositor length = 2.15mm.

Head: Antennae as long as body with 56-58 flagellomeres; length of first flagellar segment 1.80-1.90x as long as second, 20th flagellar segment 1.90-2.00x as long as broad; lower face punctate, 0.80x as wide as long; clypeus usually moderately convex in profile, in anterior aspect clypeus 1.70-1.80x wider than length (Plate 17 Fig. 2); labrum 0.20x as long as broad; malar space 0.20-0.30x longer than basal width of mandible; mandible relatively long, uniformly narrowed, twisted about 20°, without a groove on outer surface, flat with weak proximal concavity, sparsely pubescence; mandibular teeth unequal, upper tooth subcylindrical, 1.30-1.40x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.90.

Mesosoma: Mesoscutum evenly rounded in profile, notauli absent; scutellum moderately convex in profile, dorsally 1.40-1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished, upper and lower part puncto-striate (Plate 17 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron (Plate 17 Fig. 4); metapleuron puncto-striate; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area concentrically striate, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina, anteriorly with a strong transverse carina (Plate 17 Fig. 5).

FWL = 14-16 mm; FWW = 4.85-5.25 mm; HWL = 10.65-11.45 mm; HWW = 3.25-3.50 mm; discosubmarginal cell with proximal sclerite and distal sclerite linear; central sclerite absent (Plate 17 Fig. 6); AI = 0.87-0.95; CI = 0.55-0.60; DI = 0.32-0.35, ICI = 0.45-0.60; SDI = 1.30-1.37; SI = 0.12- 0.15; SRI = 0.25-0.28; vein Rs+2r slightly sinuous to straight; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10x its own length; Rs+M almost straight; first subdiscal cell with scattered hairs; first abscissae of Rs in hind wing straight, second abscissae slightly curved (Plate 17 Fig. 7); 7 hamuli on R1; NI = 3.50.

Legs slender; tibia subcylindrical with few spines on outer surface; tibial spur in mid leg 1.30-1.40x longer than shorter; coxa in hind leg 1.90-2.00x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 3.50-4.40x its own length; THI = 3.40-4.40; DMI = 1.40-1.50; PI = 2.75-2.90.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 17 Fig. 3); mandibular teeth black; posterior segments of metasoma infusate (Plate 17 Fig. 8); wings hyaline; pterostigma yellowish brown.

Male: Similar as female.

Host: *Lymantria* (Lepidoptera: Lymantriidae) (Gauld and Mitchell, 1981)

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Vayalada (N11°51'75"-E75°85'87"), Coll. Soumya T. K, 25.ix.2019 Reg. No. NBRL 282, LT.

Other material examined: 1♀, India: Kerala, Wayanad, Manathavady (N11°48'24"-E76°0'34"), Coll. Soumya T. K, 17.xi.2019, Reg. No. NBRL 283, LT; 1♀, India: Kerala, Kozhikode, Janakikkad (N11°62'58"-E75°79'35"), Coll. Soumya T. K, 12.v.2021, Reg. No. NBRL 284, MT; 1♂, India: Kerala, Kannur, Kottiyoor (N11°52'35"-E75°51'15"), Coll. Soumya T. K, 24.ii.2023, Reg. No.

NBRL 285, LT; 1♀, India: Kerala, Wayanad, Niravilpuzha (N11°74'30"-E75°93'76"), Coll. Soumya T. K, 14.xii.2023, Reg. No. NBRL 286, LT.

Habitat: Semi evergreen forest, grass land, Coffee plantation.

Distribution: India: Kerala, Karnataka, Maharashtra; China: Fujian, Guangdong, Guangxi, Hubei, Hunan, Sichuan, Taiwan, Zhejiang; Indonesia: Java; Sri Lanka.

Discussion: This species closely resembles *E. hedilis* Gauld and Mitchell in general morphology. However, this species can be distinguished from *E. hedilis* as follows: fore wing with marginal cell proximally hirsute (in *E. hedilis* fore wing with marginal cell proximally glabrous), first subdiscal cell with scattered hairs (in *E. hedilis* first subdiscal cell without hairs), propodeum with posterior area concentrically striate (in *E. hedilis* propodeum with posterior area coarsely wrinkled).

Remarks: This is the **first record** of this species from Kerala State.

32. *Enicospilus verticinus* (Roman, 1913)

(Plate - 9, Fig: 1-8; Map - 4)

Enicospilus verticinus Roman, 1913: 28. (NR) Lectotype: ♀, Philippines, by present designation.

Enicospilus verticinus (Roman) Townes, Townes & Gupta, 1961: 293.

Description: Female. Body length = 26.00-27.20 mm; Antennae length = 23.75-24.50 mm, Ovipositor length = 2.00-2.19 mm.

Head: Antennae as long as body with 54-56 flagellomeres; length of first flagellar segment 1.70-1.80x as long as second, 20th flagellar segment 2.10-2.20x as long as broad; lower face finely punctate, 0.65x as wide as long; clypeus usually flat to weakly convex in profile, in anterior aspect clypeus 1.60-1.70x wider than length (Plate 9 Fig. 2); labrum 0.20x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, proximally strongly narrowed and distally weakly narrowed, twisted about 40°, without a groove on outer surface, flat

with finely pubescence; mandibular teeth unequal, upper tooth depressed, 1.20-1.30x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.00.

Mesosoma: Mesoscutum weakly rounded in profile, notauli absent; scutellum moderately convex in profile, punctate with striations posteriorly, dorsally 1.40-1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron weakly polished, upper part punctate and lower part puncto-striate (Plate 9 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron (Plate 9 Fig. 4); metapleuron punctate to punctato-striate; submetapleural carina anteriorly strongly widened; propodeum with anterior area striate, posterior area irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge (Plate 9 Fig. 5), anteriorly with a strong transverse carina.

FWL = 16-17 mm; FWW = 5.20-6.20 mm; HWL = 10-11 mm; HWW = 2.50- 3.10 mm; discosubmarginal cell with proximal sclerite triangular; distal sclerite absent; central sclerite C shaped (Plate 9 Fig. 6); AI = 0.75-0.85; CI = 0.31-0.35; DI = 0.28-0.30; ICI = 0.60-0.70; SDI = 1.15-1.25; SI = 0.15; SRI = 0.20-0.25; vein Rs+2r weakly sinuous to straight; 1m-cu weakly sinuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first sub discal cell with anterior scattered hairs; first abscissae of Rs in hind wing straight, second abscissae weakly curved (Plate 9 Fig. 7); 6-7 hamuli on R1; NI = 2.93.

Legs slender; tibia subcylindrical with scattered spines on outer surface; longer tibial spur in mid leg 1.20-1.30x longer than shorter; coxa in hind leg 1.60-1.70x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 4x its length; THI = 4; DMI = 1.40-1.50; PI = 2.75-2.90.

Colour: Generally reddish-brown; interocellar area yellow (Plate 9 Fig. 3); mandibular teeth black; posterior segments of metasoma infusate to black (Plate 9 Fig. 8); wings weakly infumate; pterostigma dark brown.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀ India: Kerala, Wayanad, Makkiyad (N11°74'90''-E75°90'28''), Coll. Soumya T. K, 23.viii.2021, Reg. No. NBRL 261, LT.

Other material examined: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 15.ii.2019, Reg. No. NBRL 262, LT; 1♀ India: Kerala, Wayanad, Makkiyad (N11°74'90''-E75°90'28''), Coll. Soumya T. K, 23.viii.2021, Reg. No. NBRL 263, LT.

Habitat: Clove plantation, Coffee plantation.

Distribution: India: Kerala, Tamil Nadu; Brunei; Indonesia: South Moluccas; Malaysia: Peninsular, Sarawak; Myanmar; Philippines: Bohol, Mindanao.

Discussion: This species very closely similiar to the New Guinea species *E. approximatus* Brues but differs from *E. approximatus* in having anterior corner of proximal sclerite rounded (in *E. approximatus* anterior corner of proximal sclerite acute), wings infumate (in *E. approximatus* wings subhyaline).

Remarks: This is the **first record** of this species from the Kerala state.

33. *Enicospilus vestigator* (Smith, 1858)

(Plate - 11, Fig: 1-8; Map - 2)

Ophion vestigator Smith, 1858: 122. (UM) Holotype: ♂, Malaysia.

Enicospilus (sic) unilineatus Cameron, 1905: 123. (BMNH) Holotype: ♂, Srilanka. (Synonymised by Gauld and Mitchell, 1981: 471)

Henicospilus xantusi Szepligeti, 1906: 138. (TM) Holotype: ♀, Borneo. (Synonymised by Gauld and Mitchell, 1981: 471)

Enicospilus receptor Chiu, 1954: 40. (TARI) Holotype: ♀, Taiwan. (Synonymised by Townes *et al.*, 1961: 293).

Enicospilus glabrifascies Chiu, 1954: 40. (TARI) Holotype: ♂, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 471).

Enicospilus (Polycornitata) carinatus Rao and Nikam, 1971: 103. (MUC) Holotype: ♀, India. (Synonymised by Gauld and Mitchell, 1981: 472).

Description: Female. Body length = 25.80-26.50 mm; Antennae length = 21-24 mm; Ovipositor length = 1.90-2.25 mm.

Head: Antennae as long as body with 56-60 flagellomeres; length of first flagellar segment 1.80-1.90x as long as second, 20th flagellar segment 2.10-2.20x as long as broad; lower face finely punctate, 0.70x as wide as long (Plate 11 Fig. 2); clypeus more or less flat in profile, in anterior aspect clypeus 1.70-1.80x wider than length (Plate 11 Fig. 2); labrum 0.20-0.30x as long as broad; malar space 0.20-0.30x longer than basal width of mandible; mandible relatively long, proximally narrowed, twisted about 60-70°, without a groove on outer surface, flat with isolated pubescence; mandibular teeth unequal, upper tooth depressed, 1.40-1.50x the length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.55-3.00.

Mesosoma: Mesoscutum slightly rounded in profile, dorsally infusate, notauli absent; scutellum moderately convex in profile, dorsally 1.40-1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron polished, upper part punctate, lower part puncto-striate (Plate 11 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron; metapleuron puncto-striate (Plate 11 Fig. 4); submetapleural carina anteriorly widened;

propodeum with anterior area striate, posterior area irregularly wrinkled (Plate 11 Fig. 5), spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina.

FWL = 15-16.50 mm; FWW = 5.00-5.95 mm; HWL = 10-11 mm; HWW = 3.00-3.45 mm; discosubmarginal cell with proximal sclerite triangular confluent with distal sclerite; distal sclerite linear; central sclerite circular to D shaped (Plate 11 Fig. 6); AI = 0.55-0.60; CI = 0.28-0.30; DI = 0.35; ICI = 0.62-0.65; SDI = 1.12-1.20; SI = 0.14-0.20; SRI = 0.23-0.28; vein Rs+2r weakly sinuous to straight; 1m-cu sinuate; cu-a proximal to Rs+M by 0.10-0.20x its own length; Rs+M almost straight; first subdiscal cell with anterior hairs; first and second abscissae of Rs in hind wing more or less straight (Plate 11 Fig. 7); 7 hamuli on R1; NI = 2.70.

Legs slender; tibia subcylindrical with isolated spines on outer surface; longer tibial spur in mid leg 1.40x than shorter; coxa in hind leg 1.80x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval, separated from anterior margin of tergite by 5-6x its length; THI = 5.10-6; DMI = 1.40-1.50; PI = 3.66.

Colour: Generally orange-brown; interocellar area yellow (Plate 11 Fig. 3); mandibular teeth black; posterior segments of metasoma yellowish brown (Plate 11 Fig. 8); wings hyaline; pterostigma reddish-brown to black.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31"-E75°47'59"), Coll. Soumya T. K, 09.viii.2021, Reg. No. NBRL 265, LT.

Other material examined: 1♀, India: Kerala, Kozhikode, Villiappally (N11°62'55"-E75°62'94"), Coll. Soumya T. K, 28.ii.2021, Reg. No. NBRL 266,

LT; 1♀, India: Kerala, Kannur, Kottiyoor (N11°52'35''-E75°51'15''), Coll. Soumya T. K, 24.ii.2023, Reg. No. NBRL 267, LT; 2♀, India: Kerala, Kannur, Thalassery (N11°74'91''-E75°48'90''), Coll. Soumya T. K, 23.xi.2023, Reg. No. NBRL 268 & 269, LT.

Habitat: Cocoa plantation, Sacred groves, Semiever green forest, Vegetable Garden.

Distribution: India: Andhra Pradesh, Karnataka, Kerala, Maharashtra, Sikkim, Tamil Nadu; Brunei; China: Hainan Island, Taiwan; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sarawak; Palau; Papua New Guinea; Sri Lanka; Vietnam.

Discussion: This species resembles *E. laqueatus* in having similiar sclerite. However, this species can be distinguished from *E. laqueatus* by outer mandibular surface without a diagonal groove (in *E. laqueatus* outer mandibular surface with a diagonal groove).

Remarks: This is the **first record** of this species from the study area.

34. *Enicospilus xanthocephalus* Cameron, 1905
(Plate - 7, Fig: 1 - 8; Map - 1)

Enicospilus (sic) *xanthocephalus* Cameron, 1905: 122. (BMNH) Holotype: ♀, Srilanka.

Enicospilus bullatus Chiu, 1954: 53. (TARI) Holotype: ♀, Taiwan. (Synonymized by Gauld and Mitchell, 1981: 210)

Enicospilus obliquus Chiu, 1954: 54. (TARI) Holotype: ♂, Taiwan. junior secondary homonym of *Enicospilus obliquus* (Morley, 1912) (Synonymized by Gauld and Mitchell, 1981: 210).

Enicospilus clinatus Townes, Townes and Gupta, 1961: 272. (replacement name for *Enicospilus obliquus* Chiu, 1954).

Enicospilus (sic) (*Bicornata*) (sic) *paraclinatus* Nikam, 1975: 198. (MUC) Holotype: ♂, India. (Synonymized by Nikam, 1980).

Enicospilus pexus Gauld, 1977: 57, 86. (ANIC) Holotype: ♀, Australia. (Synonymized by Gauld and Mitchell, 1981: 211).

Description: Female. Body length = 14-16 mm; Antennae length = 14.50-15.75 mm; Ovipositor length = 1.40-1.50 mm.

Head: Antennae as long as body with 45-48 flagellomeres; length of first flagellar segment 1.80-1.90x as long as second, 20th flagellar segment 2.10-2.25x as long as broad; lower face sparsely pubescent, 0.68-0.75x as wide as long; clypeus moderately convex in profile, in anterior aspect clypeus 1.60-1.70x wider than length (Plate 7 Fig. 2); labrum 0.15-0.20x as long as broad; malar space 0.20x longer than basal width of mandible; mandible relatively long, apically narrowed, twisted about 70°, without a groove on outer surface; mandibular teeth unequal, upper tooth subcylindrical, 1.20-1.30x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete (Plate 7 Fig. 3); GOI = 3.45-3.60.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum moderately convex in profile, dorsally 1.50-1.58x longer than width anteriorly, lateral longitudinal carina of scutellum extending its entire length; mesopleuron inadequately polished, upper part punctate, lower part striate (Plate 7 Fig. 4); epicnemial carina inclined towards anterior border of mesopleuron; metapleuron irregularly wrinkled; submetapleural carina anteriorly widened; propodeum with anterior area striate, posterior area irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle joined to lateral longitudinal carina by a ridge, anteriorly with a strong transverse carina (Plate 7 Fig. 5).

FWL = 8.50-9.50 mm; FWW = 3.50-3.80 mm; HWL = 5.25-6.00 mm; HWW = 1.86-1.90 mm; discosubmarginal cell with proximal sclerite circular to oval; central sclerite linear; distal sclerite absent (Plate 7 Fig. 6); AI = 1.90-2.00; CI = 0.25-0.35; DI = 0.25-0.35; ICI = 0.30-0.35; SDI = 0.95-0.98; SI = 0.12-0.15; SRI = 0.25-0.30; vein Rs+2r straight; 1m-cu sinuous, strongly convex; cu-a distal to Rs+M (Plate 7 Fig. 6); Rs+M almost straight; first subdiscal cell with anterior glabrous, but scattered hairs distally; first abscissae of Rs in hind wing straight, second abscissae straight (Plate 7 Fig. 7); 5 hamuli on R1; NI=2.90-3.20.

Legs slender; tibia subcylindrical with few spines on outer surface; longer tibial spur in mid leg 1.50-1.60x than shorter; coxa in hind leg 1.70-1.80x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical, pectinate, abruptly curved.

Metasoma: Metasoma long and slender (Plate 7 Fig. 8); thyridium oval, separated from anterior margin of tergite by 4.00-4.50x its length; THI = 4.20-4.50; DMI= 1.30-1.40; PI= 2.60-2.70.

Colour: Generally orange yellow; interocellar area black (Plate 7 Fig. 3); posterior segments of metasoma infusate; wings hyaline; pterostigma yellow.

Male: Similar as female.

Host: *Pericallia ricini* (Lepidoptera: Arctiidae), *Euproctis scintillans* and *E. fraterna* (Lepidoptera: Lymantriidae), (Gauld and Mitchell, 1981).

Biology: Unknown

Material examined: Plesiotype: 1♀, India: Kerala, Kozhikode, Chathangottunada (N11°41'31''-E75°47'59''), Coll. Soumya T. K, 20.ii.2022, Reg. No. NBRL 243, LT.

Other material examined: 1♀, India: Kerala, Malappuram, Calicut University Campus (N11°13'40''-E75°89'52''), Coll. Sudheer. K, 27.iv.2000, Reg. No. NBRL 244, MT; 1♀, India: Kerala, Kozhikode, Calicut (N11°25'88''-E75°78'04''), Coll. Sureshbabu, 21.v.2002, Reg. No. NBRL 245; 1♀, India: Kerala, Kozhikode, Calicut (N11°25'88''-E75°78'04''), Coll. Divakaran, 21.v.2002, Reg. No. NBRL 246; 1♂, India: Kerala, Wayanad, Korome (N11°74'38''-E75°88'10''), Coll. Soumya T. K, 08.v.2023, Reg. No. NBRL 247, LT.

Habitat: Cocoa plantation, Botanical Garden, Grass land.

Distribution: India: Himachal Pradesh, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, Delhi, Maharashtra, Andhra Pradesh, Bihar, Rajasthan; Australia: Queensland; Brunei; China: Guangxi, Guizhou, Taiwan; Indonesia: Sumatra; Papua

New Guinea; Philippines: Luzon, Mindanao, Mindoro, Panay, Samar; Sri Lanka; Thailand.

Discussion: The *E. xanthocephalus* species closely resembles *E. flavocephalus* (Kirby) in having general colour, small body size and body shape but differs from *E. flavocephalus* in having: interocellar area black (in *E. flavocephalus* interocellar area yellow), large value of AI more than 1.90 (in *E. flavocephalus* AI = 0.38-1.50).

Remarks: This is the **first record** of this species from the study area.

35. *Enicospilus wayanadensis* sp. nov.

(Plate - 4, Fig: 1- 8; Map - 10)

Description: Holotype: Female. Body length = 20 mm; Antennae length = 15 mm, Ovipositor length = 1.82 mm.

Head: Antennae moderately long with 46 flagellomeres; length of first flagellar segment 1.60x as long as second, 20th flagellar segment 1.60x as long as broad; lower face sparsely punctate, 0.54x as wide as long; clypeus weakly convex in profile, in anterior aspect clypeus 1.50x wider than length (Plate 4 Fig. 3); labrum 0.20x as long as broad; malar space 0.30x longer than basal width of mandible; mandible relatively long, twisted about 20°, with a diagonal groove on outer surface (Plate 4 Fig. 3); mandibular teeth unequal, upper tooth 1.60x length of lower tooth; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.00.

Mesosoma: Mesoscutum slightly rounded in profile, notauli absent; scutellum weakly convex in profile, dorsally 1.50x longer than width anteriorly, lateral longitudinal carina of scutellum extending 0.9 or more of its length; mesopleuron

coarsely punctate throughout; epicnemial carina not extending anterior border of mesopleuron (Plate 4 Fig. 4); metapleuron upper part finely wrinkled and coarsely punctate throughout (Plate 4 Fig. 5); submetapleural carina narrow, anteriorly

slightly widened; propodeum with anterior area smooth, posterior area coarsely irregularly wrinkled, spiracular area smooth, margin of propodeal spiracle not joined to lateral longitudinal carina by a ridge (Plate 4 Fig. 5), anteriorly with transverse carina.

FWL = 11 mm; FWW = 4.75 mm; HWL = 8.50 mm; HWW = 2.20 mm; discosubmarginal cell with proximal sclerite ovoid; distal sclerite absent; central sclerite elongately oval (Plate 4 Fig. 6); AI = 1.20; CI = 0.70; DI = 0.50; ICI = 0.55; SDI = 1.04; SI = 0.16; SRI = 0.30; vein Rs+2r straight; 1m-cu centrally strongly angulate, medially thickened; cu-a proximal to Rs+M by 0.10x its own length (Plate 4 Fig. 6); Rs+M almost straight; first subdiscal cell with few scattered hairs; first abscissae of Rs in hind wing more or less straight, second abscissae weakly curved (Plate 4 Fig. 7); 6 hamuli on R1; NI = 3.00.

Legs slender; tibia subcylindrical with isolated spines on outer surface; longer tibial spur in mid leg 1.80x than shorter; coxa in hind leg 1.60x longer than deep; trochantellus dorsally slightly as long as broad; claws symmetrical.

Metasoma: Metasoma long and slender; thyridium oval to ellipsoidal, separated from anterior margin of tergite by 3.20x its length; THI = 3.20; DMI = 1.30; PI = 2.70.

Colour: Generally yellowish-brown; interocellar area yellow (Plate 4 Fig. 2); face, frons, vertex yellow; posterior segments of metasoma dark brown (Plate 4 Fig. 8); wings hyaline.

Male: Unknown

Host: Unknown

Biology: Unknown

Material examined: Holotype. 1♀, India: Kerala, Wayanad, Thirunelly (N11°90'81''-E75°99'71''), 22.xi.2021, Coll. Soumya T. K, Reg. No. NBRL 235, LT.

Paratype. 1♀, India: Kerala, Wayanad, Thirunelly (N11°90'81''-E75°99'71''), 22.xi.2021, Coll. Soumya T. K, Reg. No. NBRL 236, LT.

Habitat: Shola Forest

Distribution: India: Kerala

Etymology: Species epithet is after locality of collection, Wayanad district of Kerala.

Discussion: The new species *E. wayanadensis* sp. nov. closely resembles *E. flavocephalus* (Kirby) in having large CI and centrally angulate 1m-cu but differs from *E. flavocephalus* in having cu-a proximal to Rs+M (in *E. flavocephalus* cu-a distal to Rs+M), outer mandibular surface with diagonal groove (in *E. flavocephalus* outer mandibular surface without diagonal groove), metapleuron upperpart finely wrinkled and punctate (in *E. flavocephalus* metapleuron finely wrinkled), epicnemial carina straight, not extending to anterior margin of mesopleuron (in *E. flavocephalus* epicnemial carina inclined to anterior margin of mesopleuron).

GENUS *STAUROPOCTONUS* BRAUNS, 1889

Stauropoctonus Brauns, 1889: 75. Type-species: *Ophion bombycivorus* Gravenhorst, by monotypy.

Stauropodoctonus Morley, 1913: 375. (Unjustified emendation).

Nipponophion Uchida, 1928: 201. Type-species: (*Nipponophion variegatus* Uchida) = *Stauropoctonus bombycivorus* Gravenhorst, by original designation.

Aulophion Cushman, 1947: 417. Type-species: *Aulophion bicarinatus* Cushman, by original designation.

Diagnosis: Antennae extremely long with 56-76 flagellar segment, usually twice as long as fore wing; clypeus weakly convex in profile; mandible strongly twisted, apically narrowed, with two subequal teeth, outer surface with a diagonal groove; occipital carina absent; posterior ocelli close to eye; maxillary palp 5 segmented; labial palp 4 segmented.

Pronotum finely punctate and polished with setae; mesoscutum elongated in profile, weakly to moderately polished and punctate with setae; notauli absent; scutellum usually with lateral longitudinal carina, weakly convex in profile; epicnemial carina present and its dorsal end not reaching anterior margin of mesopleuron; mesopleuron polished and punctate; mesopleural furrow well developed, extending from episternal scrobe to upper angulation of epicnemial carina; metapleuron polished and covered with setae; posterior transverse carina of mesosternum usually complete; propodeum usually rounded, anteriorly with a strong transverse carina, anterior area striate, posterior area with median longitudinal carina and lateral longitudinal carinae, spiracular area usually smooth, propodeal spiracle joined to lateral longitudinal carina of propodeum; discosubmarginal cell with a glabrous area in anterior corner, without fenestra; vein Rs+2r proximally moderately geniculate; 1m-cu weakly sinuate; hind wing with usually 3-13 hamuli on R1; inner surface of fore tibial spur lacking membranous flange; tibial spurs in mid leg having equal length; outer distal margin of hind trochantelli with an acute decurved tooth; claw usually simply pectinate, weakly curved; metasoma long and slender, entirely covered with setae; second laterotergite folded beneath tergite; ovipositor short and straight.

Colour: Body colour usually reddish brown.

Bionomics: They are generally considered as nocturnal and they are often collected at light (Townes, 1971; Gauld and Mitchell, 1981; Gauld, 1988; Yu *et al.*, 2012; Shimizu and Watanabe 2015a, b; Quicke 2015; Shimizu 2016; Shimizu *et al.*, 2016; Shimizu and Maeto, 2016; Shimizu, 2017). Certain *Stauropoctonus* species are parasitoids of lepidopteran species such as *Actias aliena* Butler (Saturniidae), *Stauropus fagi* Linnaeus (Notodontidae), and *Teia anartoides* Walker (Lymantriidae) (Gravenhorst, 1829; Uchida, 1928 & 1951; Schmiedeknecht, 1935; Peigler, 1994; Gerard *et al.*, 2011).

Distribution. Afrotropical, Australasian, Neotropical, Oriental and Palaearctic (Yu *et al.*, 2016).

Remarks: The genus is represented by 12 described species worldwide (Yu *et al.*, 2016). So far, 4 species are recorded from Oriental region, of which one species are from India. (Soumya *et al.*, 2023).

KEY TO THE ORIENTAL SPECIES OF STAUROPOCTONUS BRAUNS

(Soumya *et al.*, 2023)

1. Forewing vein cu-a reaching M+Cu distal of Rs+M; scutellar carina extending entire length of scutellum ***S. narendrani* Soumya and Sudheer**
 - Forewing vein cu-a reaching M+Cu proximal or opposite of Rs+M; scutellar carina not extending entire length of scutellum 2
2. Forewing with Rs+2r strongly curved at proximal 0.3 to join pterostigma; glabrous area in anterior corner of discosubmarginal cell large; 1m-cu evenly arcuate..... ***S. townesorum* Gauld and Mitchell**
 - Forewing with Rs+2r abruptly angled at proximal 0.1 to join pterostigma; glabrous area in anterior corner of discosubmarginal cell moderately small; 1m-cu sinuous 3
3. Forewing vein cu-a reaching M+Cu usually proximal of Rs+M by up to 0.2x its own length; cu-a subvertical; CI = 0.50-0.70; AI = 0.60 - 0.70.
.....***S. bombycivorus* (Gravenhorst)**
 - Forewing vein cu-a reaching M+ Cu opposite of Rs+M; cu- a oblique; CI = 0.85 - 1.10; AI = 0.80 - 0.90***S. torresi* Gauld**

1. *Stauropoctonus narendrani* Soumya and Sudheer, 2023

(Plate - 28, Fig: 1-10; Map - 08)

Stauropoctonus narendrani Soumya, Sudheer & Thejass, 2023. (NBRL) Holotype: ♀, India: Kerala

Diagnosis: Antennae very long and slender with 65 flagellar segments; mandible moderately long, twisted about 90⁰, outer surface with a diagonal groove, occipital carina absent; scutellum weakly convex with lateral longitudinal carinae extending entire length of scutellum; posterior area with transverse carina and sculptures; fore wing with vein 1m-cu sinuous; glabrous area in anterior corner of discosubmarginal cell extending 0.3x of length of Rs+ 2r; cu-a distal to base of Rs+M by 0.20x its own length; hind wing R1 with 13 hamuli of similar size and shape; fore tibial spur without trace of membranous flange behind microtrichial comb; distal margin of mid and hind trochantelli with acute curved tooth.

Colour: Generally yellowish to reddish brown species; interocellar area, apex of mandible and three longitudinal vitae of mesoscutum black; wings slightly infumate

except for glabrous area of discosubmarginal cell hyaline; pterostigma and fore wing vein Rs+2r light brown; fore, middle and hind leg yellowish to reddish brown; dorsal half of T3 and entire part of T5-8 and S5-8 are dark brown.

Male: Unknown.

Host: Unknown.

Material examined: Holotype: 1♀, India: Kerala, Kannur, Kannavam (11° 50'35''N 75° 39'48''E), Coll. Soumya T. K, 12.ix.2021, Reg. No. NBRL 198, LT.

Habitat: Forest

Distribution: India: Kerala

Discussion: The species *S. narendrani* closely resembles *S. bombycivorus* (Gravenhorst) but differs from *S. bombycivorus* as follows: forewing vein cu-a reaching M+Cu distal of Rs+M by up to 0.2x its own length (in *S. bombycivorus* forewing vein cu-a reaching M+Cu proximal of Rs+M by upto 0.2x its own length); lateral longitudinal carinae of scutellum extending entire length of scutellum (in *S. bombycivorus* lateral longitudinal carinae of scutellum extending to 0.2x length of scutellum); anterior corner of discosubmarginal cell with a glabrous area that extends to 0.3x length of Rs+ 2r (in *S. bombycivorus* glabrous area in cell extending 0.1x length of Rs+2r); NI = 1.07 mm, SRI = 0.28 mm, GOI = 3.7 mm (in *S. bombycivorus* NI = 0.7-0.9 mm, SRI = 0.4 mm, GOI = 2.5-3.0 mm).

This species closely resembles to the Japanese species *S. infuscus* (Uchida, 1928) in having epicnemial carina strong laterally; forewing vein cu-a reaching M+Cu distal to Rs+M by upto 0.2x its own length; forewing vein 1m-cu sinuate. However, *S. narendrani* differs from *S. infuscus* in having 13 hamuli on vein R1 (in *S. infuscus* 10-12 hamuli on vein R1); mandible twisted about 90° (in *S. infuscus* mandible twisted about 50-60°); DI = 0.4 mm (in *S. infuscus* DI = 0.6 mm).

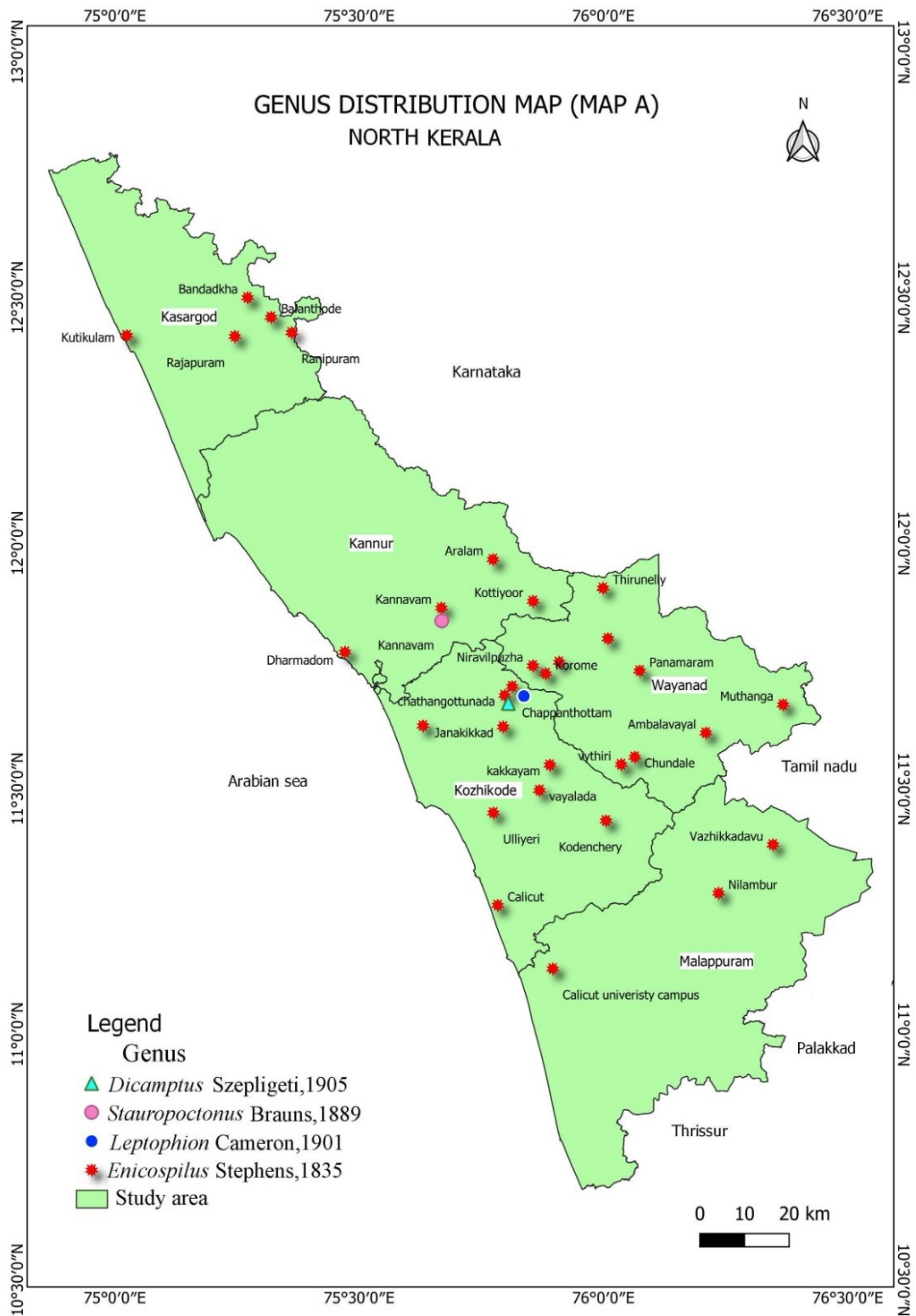
Remarks: Soumya *et al.*, (2023) described and published this species as the first record of this genus from India.

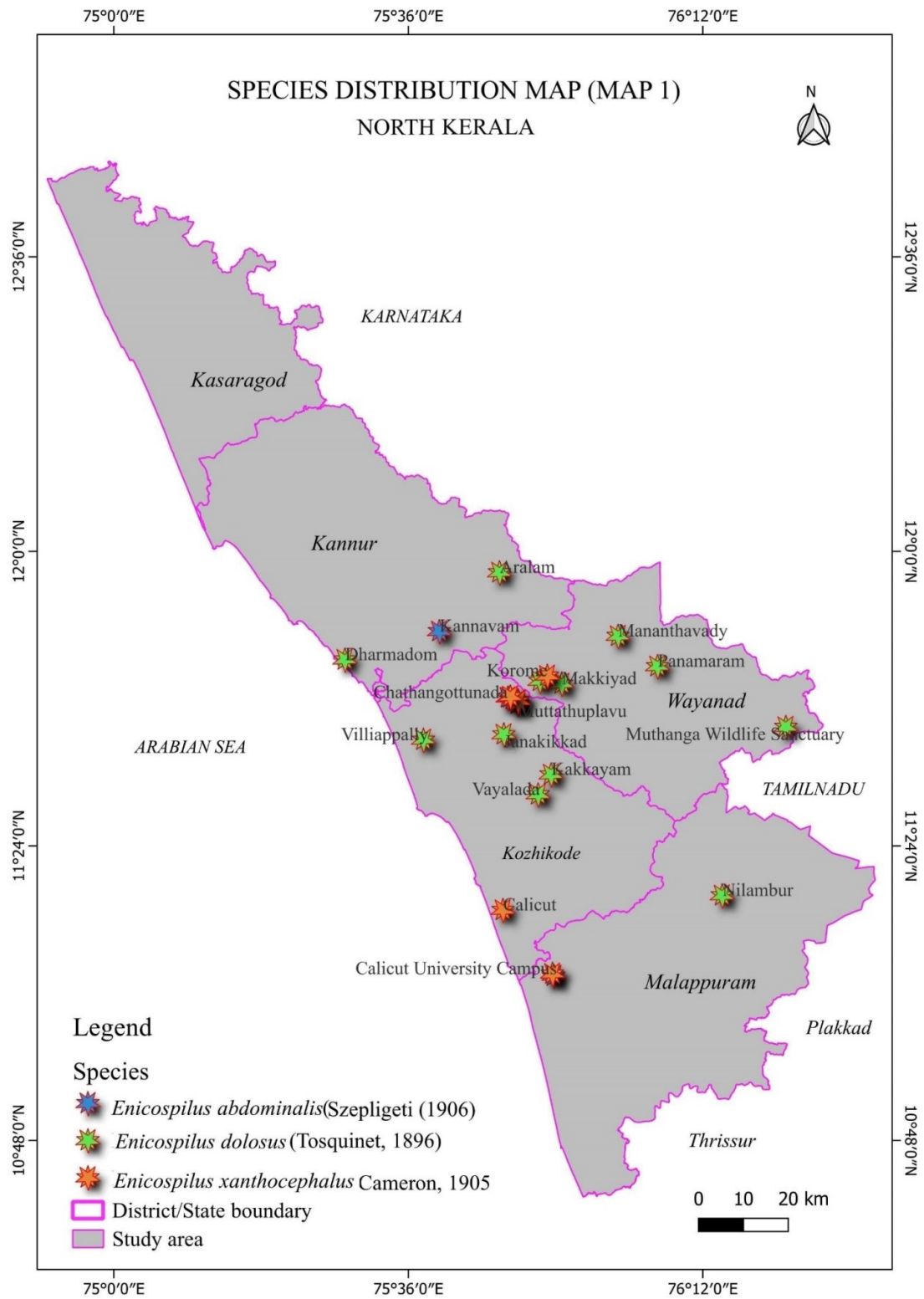
DISTRIBUTION MAPS

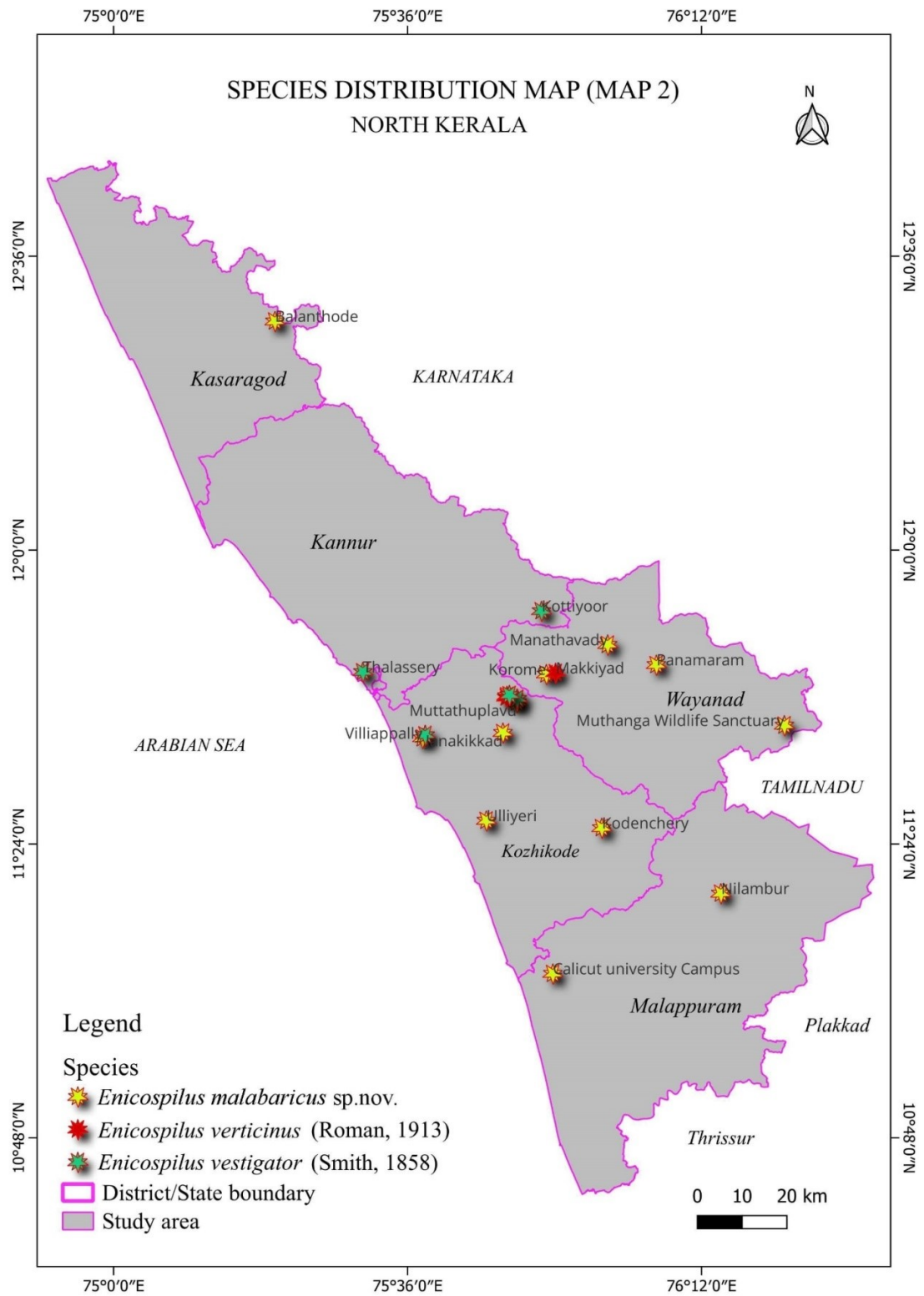
Maps were prepared with the help of species locations taken from the field itself using mobile GPS. Coordinate values of field sites imported into the GIS software platform. Open-source software like QGIS and Google Earth Pro were used for mapping them.

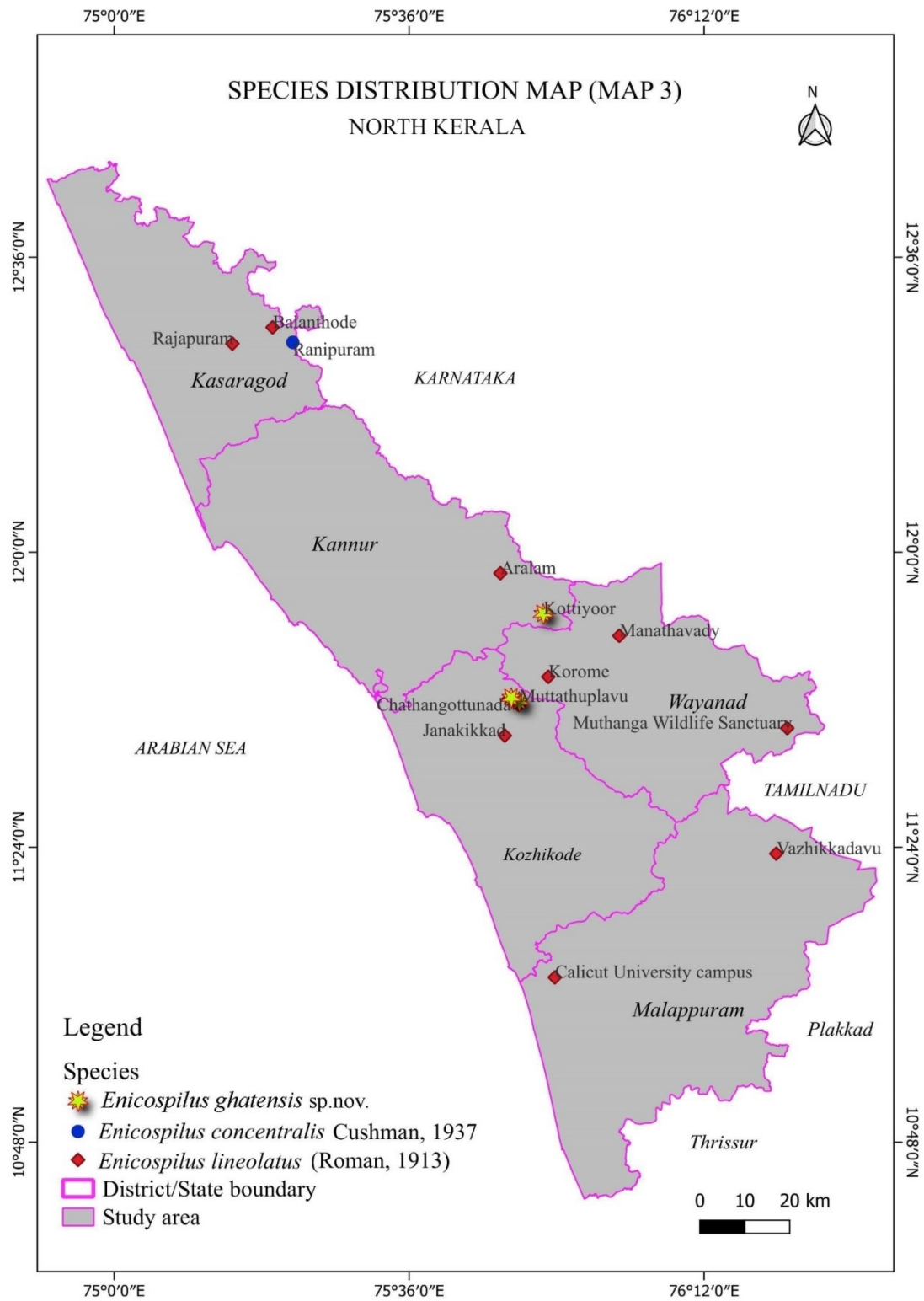
Table showing Location points of Ophionine wasps distributed in Northern Kerala

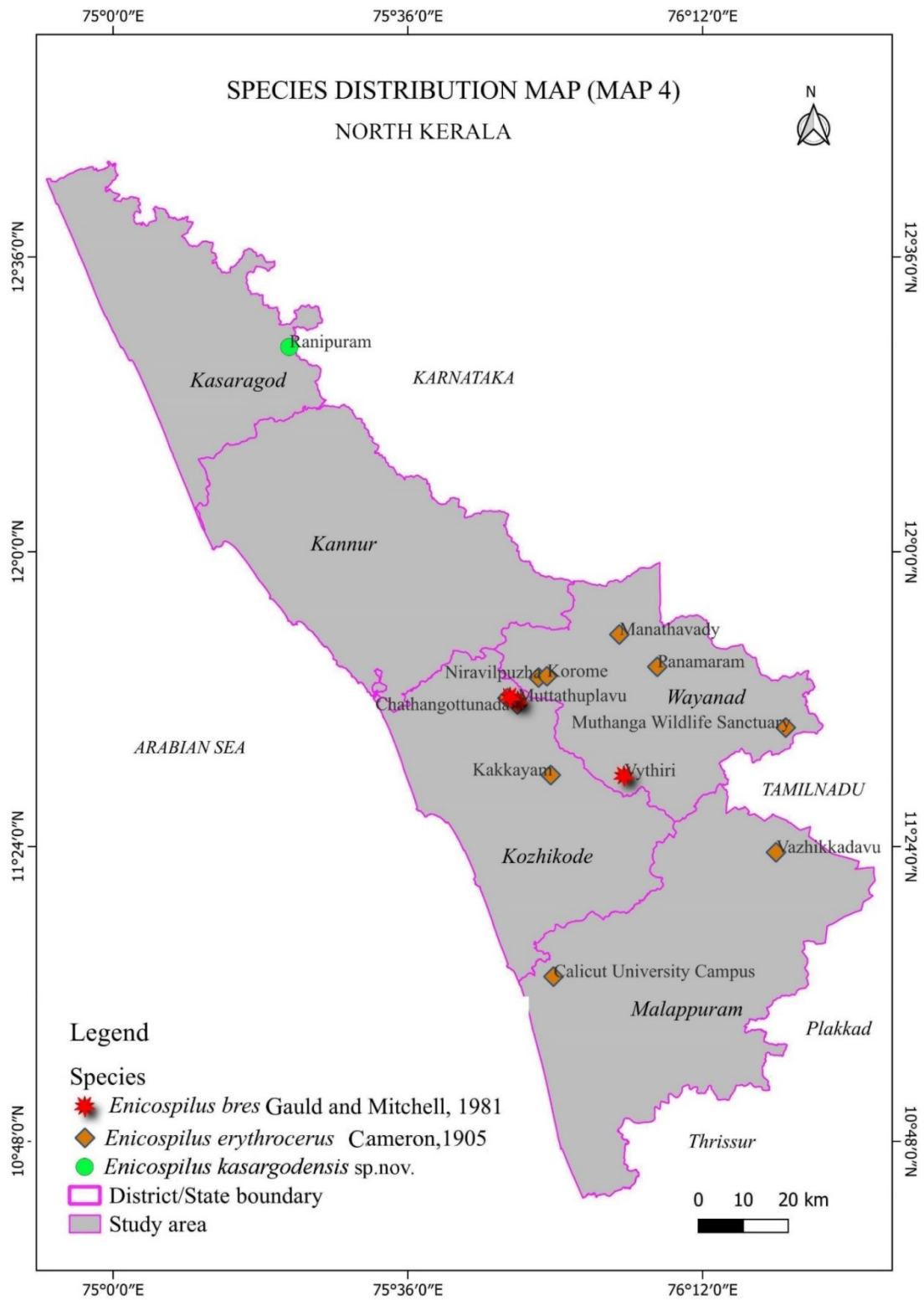
Sl. No.	District	Collection site	Geographical coordinates
1	Kasargod	Balanthode	N12°45'92''-E75°32'08''
2		Rajapuram	N12°42'16''-E75°24'50''
3		Ranipuram	N12°25'16''-E75°21'00''
4		Kutikulam	N12°23'19''-E75°01'34''
5		Bandadka	N12°50'10''-E75°26'83''
6	Kannur	Dharmadom	N11°77'75''-E75°47'03''
7		Kannavam	N11°50'35''-E75°39'48''
8		Aralam	N11°59'57''-E75°45'50''
9		Thalassery	N11°74'91''-E75°48'90''
10		Kottiyoor	N11°52'35''-E75°51'15''
11	Wayanad	Niravilpuzha	N11°74'30''-E75°93'76''
12		Manathavady	N11°48'24''-E76°0'34''
13		Makkiyad	N11°74'90''-E75°90'28''
14		Panamaram	N11°73'81''-E76°07'40''
15		Muthanga	N11°67'16''-E76°36'87''
16		Korome	N11°74'38''-E75°88'10''
17		Vythiri	N11°55'17''-E76°04'03''
18		Thirunelly	N11°90'81''-E75°99'71''
19		Chundale	N11°34'26''-E76°03'28''
20		Ambalavayal	N11°61'97''-E76°21'03''
21	Kozhikode	Muttathuplavu	N11°41'24''-E75°49'22''
22		Chappanthottam	N11°67'29''-E75°76'73''
23		Villiappally	N11°62'55''-E75°62'94''
24		Kakkayam	N11°54'98''-E75°92'96''
25		Vayalada	N11°51'75''-E75°85'87''
26		Janakikkad	N11°62'58''-E75°79'35''
27		Chathangottunada	N11°41'31''-E75°47'59''
28		Calicut	N11°25'88''-E75°78'04''
29		Ulliyeri	N11°45'02''-E75°77'11''
30		Kodenchery	N11°43'23''-E76°00'73''
31	Malappuram	Calicut University Campus	N11°13'40''-E75°89'52''
32		Nilambur	N11°28'55''-E76°23'86''
33		Vazhikkadavu	N11°23'19''-E76°20'47''

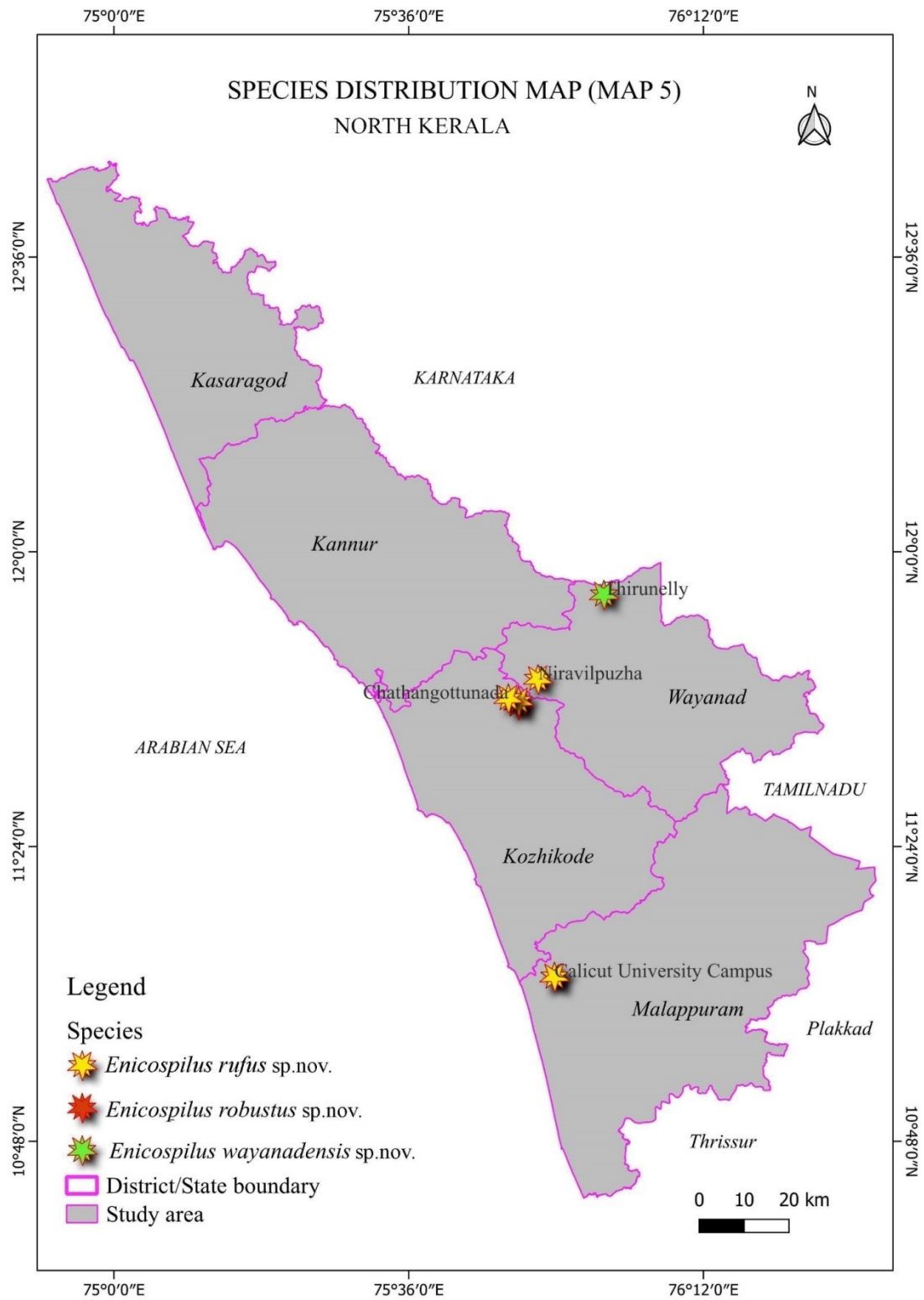


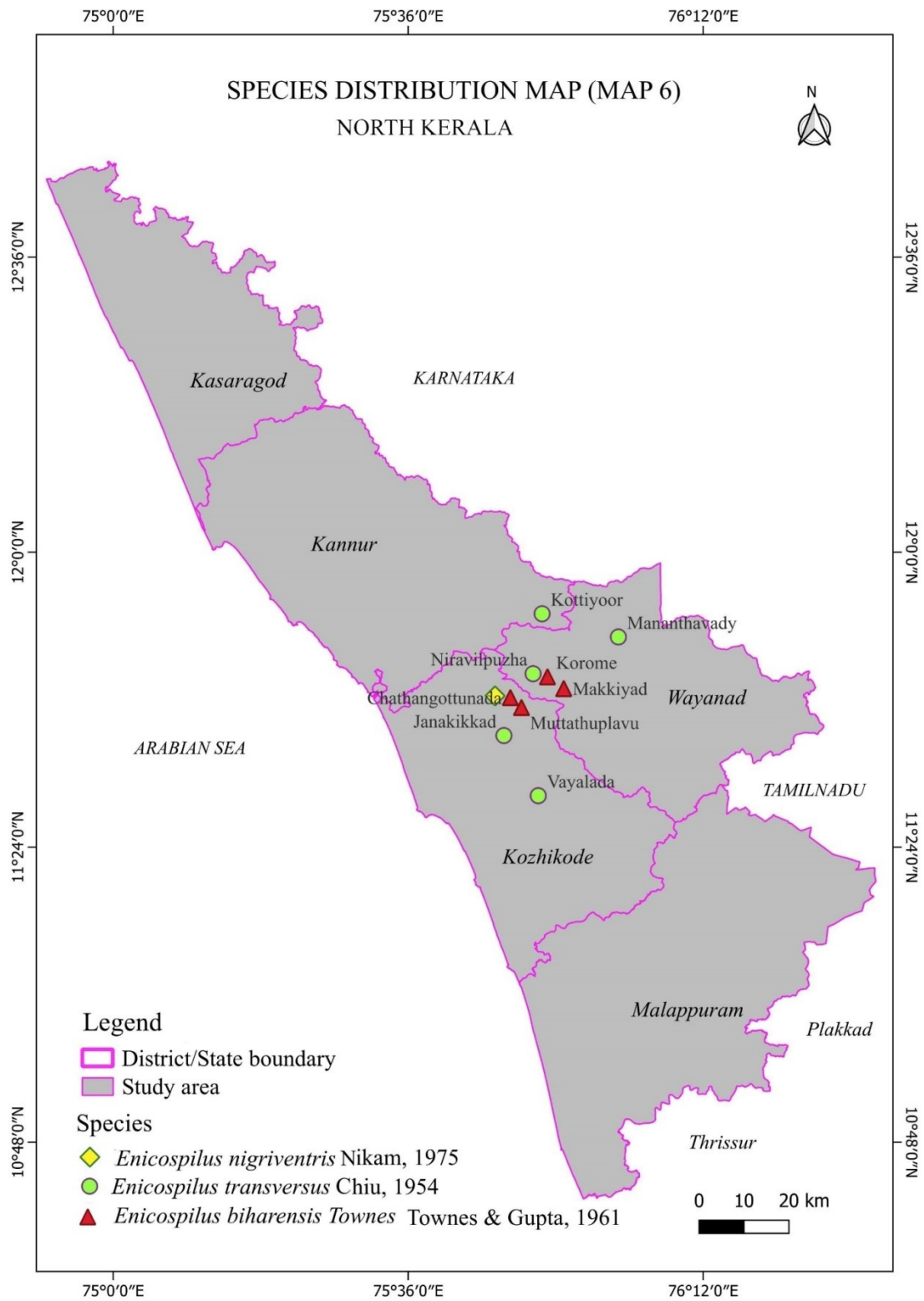


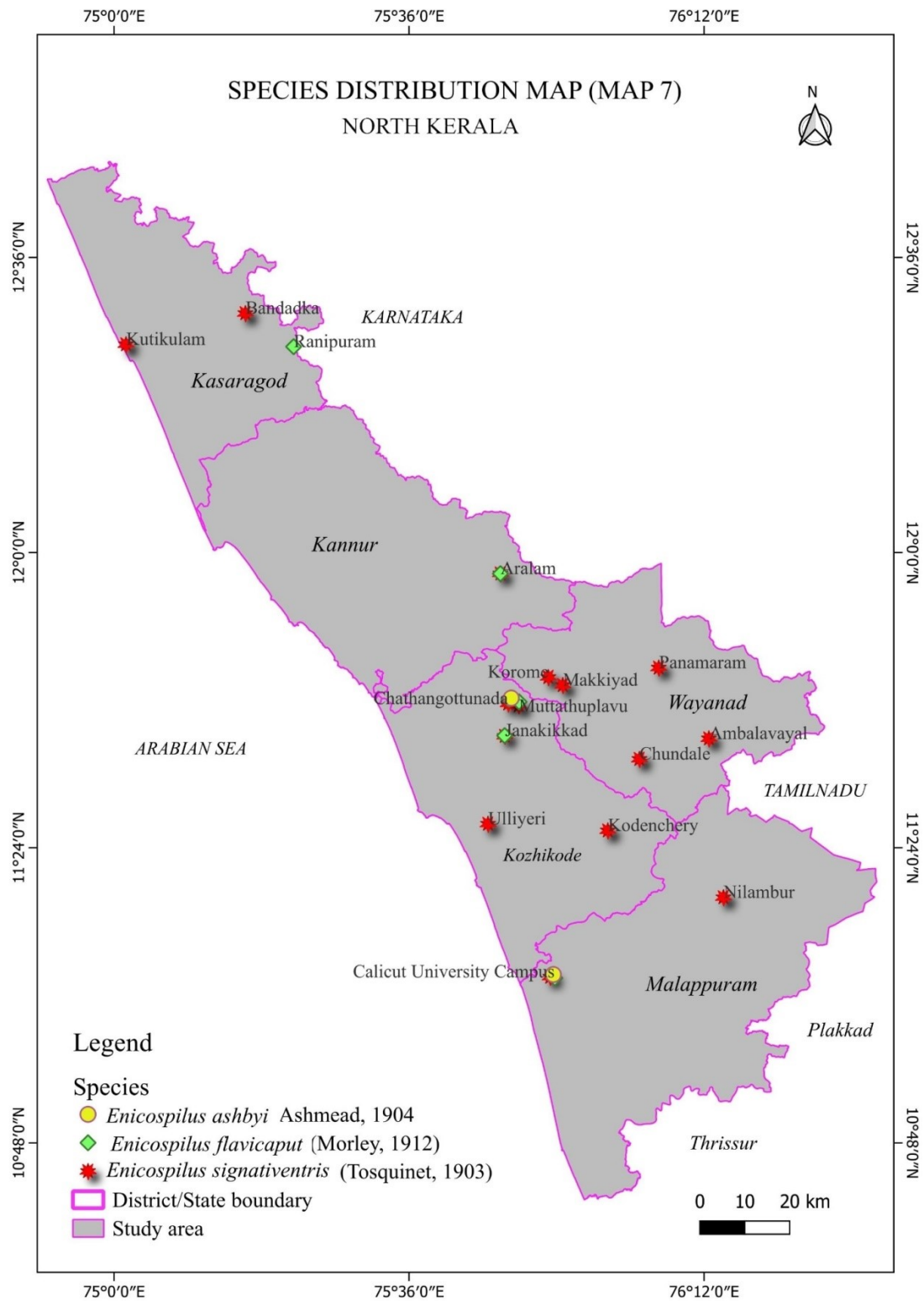


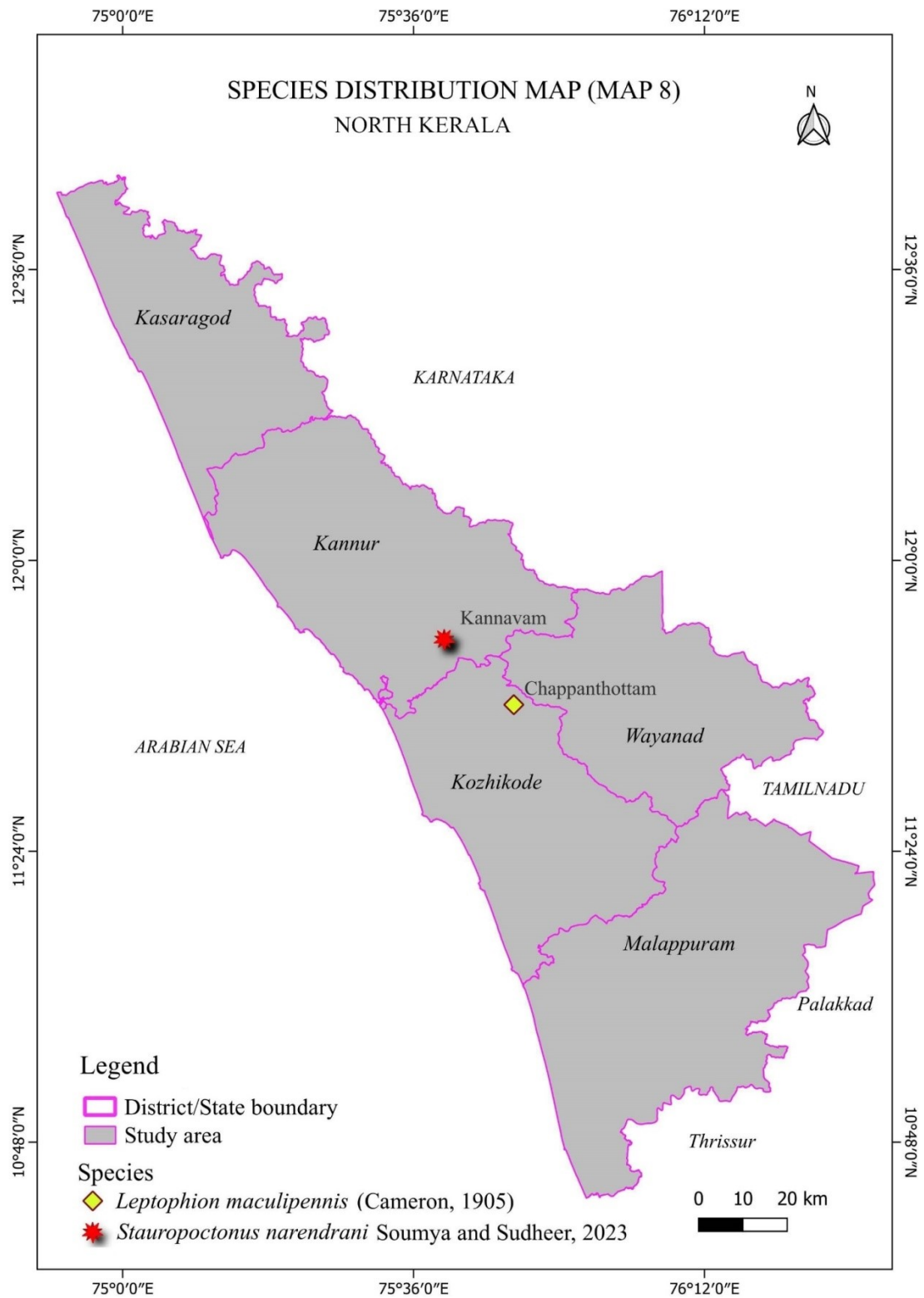


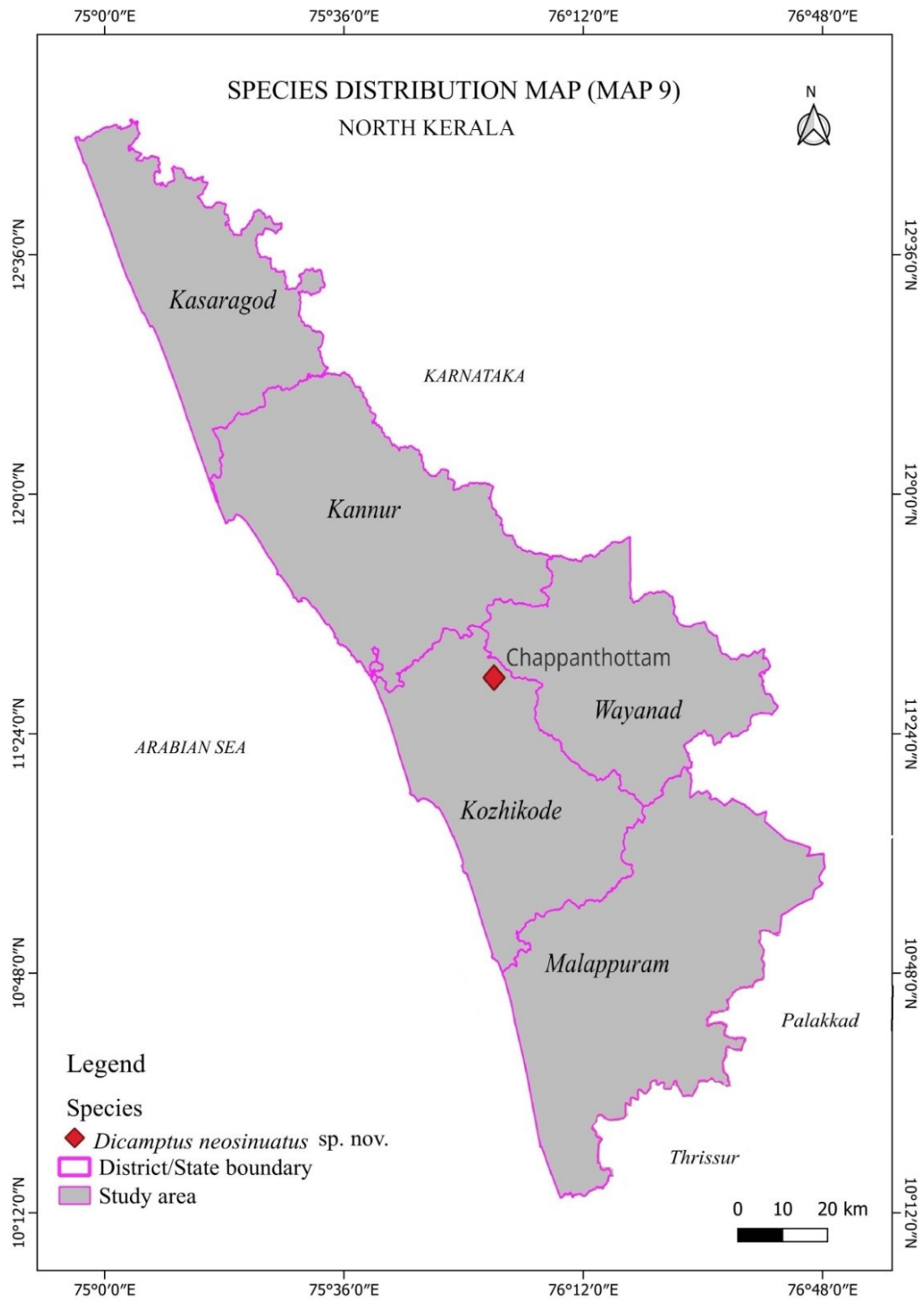


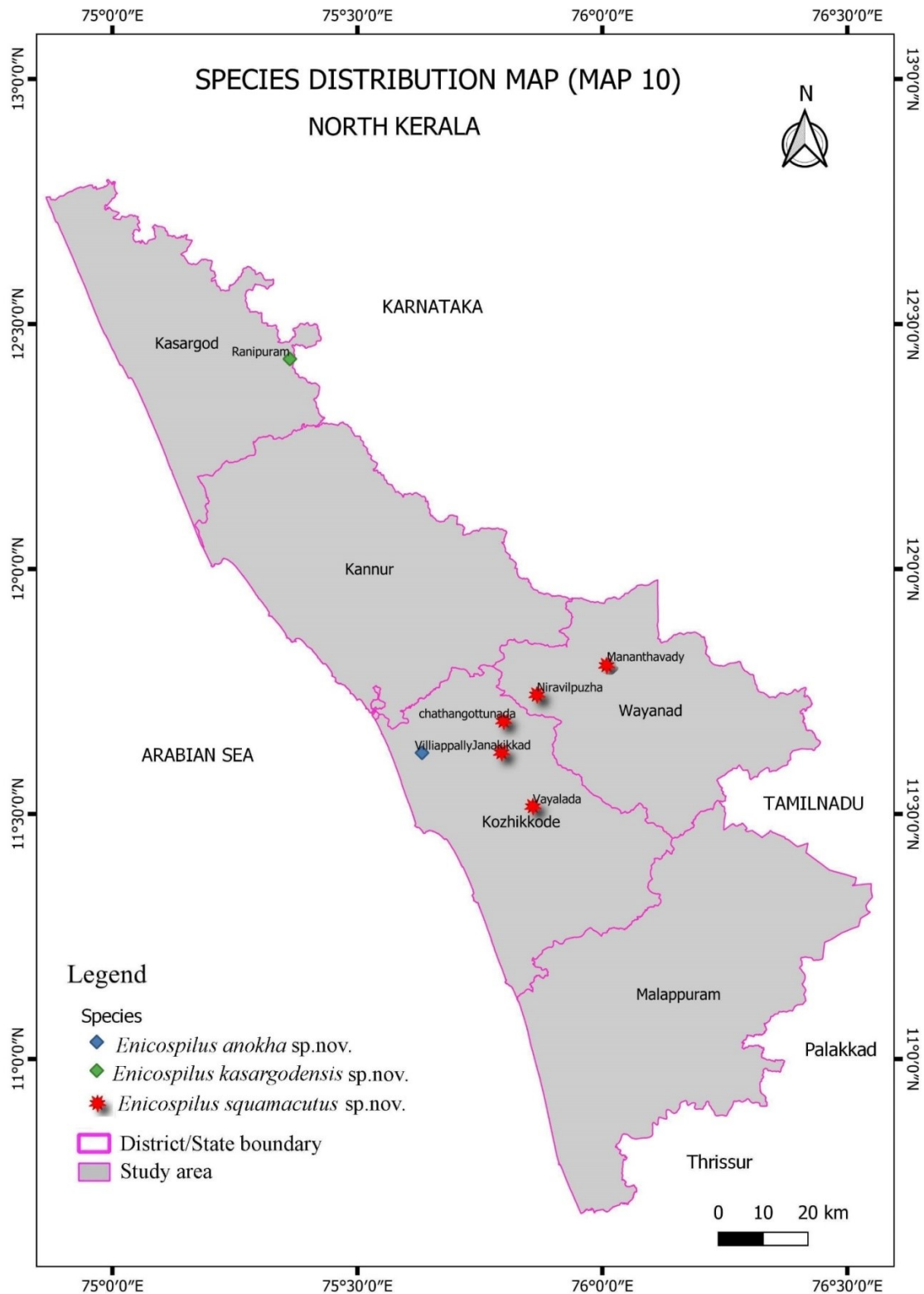


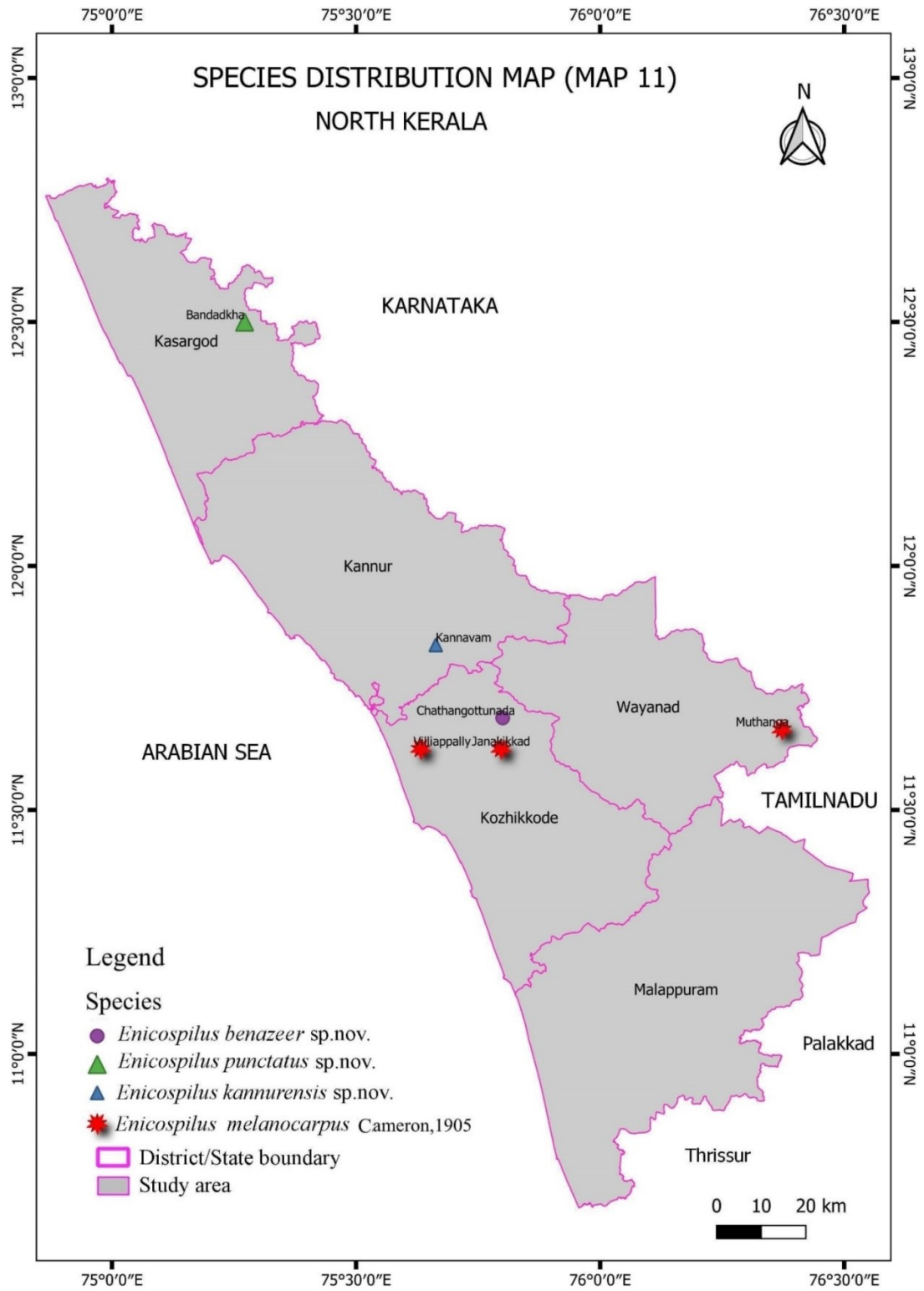












**CHECKLIST OF GENERA AND SPECIES OF
SUBFAMILY OPHIONINAE OF INDIA**

Even though extensive international work has been done to revise the taxonomy of Ophioninae, especially from regions such as South Korea, Vietnam, Japan, Pakistan, Great Britain, North America, South America etc. by entomologists such as Gauld (1984, 1985), Watanabe (2015), Pham *et al.*, (2020, 2023), Shimizu (2017), Ihsan *et al.*, (2023), Shaw and Broad (2023), have contributed significantly to describing and cataloguing Ophionine wasps globally. Currently, 32 genera and more than 1,100 species are described worldwide (Yu *et al.*, 2016). In India, taxonomic studies on the Subfamily Ophioninae are predominantly represented from the northern states, with comparatively limited studies from South India. Major contributions to Indian Ophioninae are that of Nikam (1972), Rao (1970), Townes *et al.*, (1961), and Gauld and Mitchell (1981). In India, 108 species under 7 genera have been described and from Kerala, only two genera with 17 species, i.e., 16 species of *Enicospilus* Stephens and 01 species of *Dicamptus* Szepliget were previously reported (Yu *et al.*, 2016).

The present study provides an updated checklist of 122 species under 8 genera viz., *Ophion* Fabricius, *Leptophion* Cameron, *Enicospilus* Stephens, *Sclerophion* Gauld, *Orientospilus* Morley, *Dicamptus* Szepliget, *Euryophion* Cameron, and *Stauropocetus* Brauns belonging to 2 tribes of Subfamily Ophioninae. Among those genera, *Enicospilus* is the most commonly occurring genus with 86 described species, including 11 species are new to science (*Enicospilus anokha* sp. nov, *E. malabaricus* sp. nov, *E. wayanadensis* sp. nov, *E. ghatensis* sp. nov, *E. robustus* sp. nov, *E. rufus* sp. nov, *E. benazeer* sp. nov, *E. kannurensis* sp. nov, *E. squamacutus* sp. nov, *E. kasargodensis* sp. nov, *E. punctatus* sp. nov.) and 02 species are newly recorded from India. Genus *Dicamptus* is represented by 11 species, of which one species is new to science *Dicamptus neosinuatus* sp. nov. The genus *Stauropocetus* Brauns, 1889 was reported first time from India with *S. narendrani* Soumya *et al.* from Kerala. The genus *Leptophion* Cameron, 1905 is reported for the first time from South India, with a single species *L. maculipennis* (Cameron, 1905) from Kerala.

TRIBE OPHIONINI SHUCKARD, 1840

GENUS *EURYOPHION* CAMERON, 1906

1. *Euryophion vexatious* Gauld and Mitchell, 1981

Distribution: India: Assam, West Bengal.

GENUS *LEPTOPHION* CAMERON, 1901

1. *Leptophion maculipennis* (Cameron, 1905)

Distribution: India: Kerala, Madhya Pradesh, Maharashtra, Uttar Pradesh; Australia: Queensland; Brunei; China: Fujian, Guangdong, Guizhou, Hainan Island, Hunan, Taiwan; Indonesia; Malaysia: Peninsular, Sarawak; Myanmar; Nepal; Sri Lanka; Taiwan; Thailand.

2. *Leptophion longiventris* Cameron, 1901

Distribution: India; Australia: Queensland; Indonesia; Papua New Guinea; Philippines, Solomon Island; Sri Lanka.

3. *Leptophion radiatus* (Uchida, 1956)

Distribution: India: Meghalaya, Sikkim, Uttar Pradesh; China: Taiwan; Malaysia: Peninsular; Nepal.

GENUS *OPHION* FABRICIUS, 1798

1. *Ophion albopictus* Smith, 1878

Distribution: India; China, China-Xinjiang.

2. *Ophion areolatus* Cameron, 1899

Distribution: India: Himachal Pradesh, Kashmir, Meghalaya, Uttar Pradesh; China: Xizang.

3. ***Ophion bicarinatus*** Cameron, 1905

Distribution: India: Arunachal Pradesh, Bihar, Tamil Nadu, Uttar Pradesh, West Bengal; China: Fujian, Hubei, Taiwan, Xizang; Malaysia: Peninsular; Myanmar; Nepal; Philippines: Luzon; Sri Lanka.

4. ***Ophion caudatus*** (Cushman, 1947)

Distribution: India: Sikkim, Uttar Pradesh; China: Sichuan; Nepal.

5. ***Ophion contentious*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh, Tamil Nadu, Uttar Pradesh; Myanmar.

6. ***Ophion dentatus*** Smith, 1878

Distribution: India: Kashmir; China: Sichuan; Pakistan.

7. ***Ophion facetious*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh, Kashmir, Sikkim, Uttar Pradesh; China: Hubei, Taiwan; Indonesia: Sumatra; Malaysia: Peninsular, Sabah; Nepal; Sri Lanka.

8. ***Ophion fuscomaculatus*** Cameron, 1899

Distribution: India: Himachal Pradesh, Sikkim, Uttar Pradesh, West Bengal; China: Taiwan; Japan; Korea; Nepal; Russia; Pakistan; Russia: Sakhalin Oblast.

9. ***Ophion guptai*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh.

10. ***Ophion hexus*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh, Kashmir.

11. *Ophion luteus* (Linneaus, 1758)

Distribution: India; Algeria; Argentina; Australia; Austria, Azerbaijan; Belarus; Belgium; Bulgaria; Canada: Quebec; Chile; China: Beijing, Guizhou, Hebei, Heilongjiang, Henan, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan, Zhejiang; Croatia; Czech Republic; Czechoslovakia; Estonia; Finland; France; Germany; Greece; Greenland; Hungary; Iceland; Iran; Ireland; Italy: Sardinia, Sicily; Japan: Okinawa; Korea; Latvia; Lebanon; Lithuania; Moldova; Mongolia; Morocco; Netherlands; Norway; Poland; Portugal; Romania; Russia: Altayskiy Kray, Astrakhans kaya Oblast, Bryansk Oblast, Chita Oblast, Dagestan kaya Respublika, Irkutsk Oblast, Kursk Oblast, Moscow Oblast, Omsk Oblast, Orel Oblast, Penza Oblast; Spain; Sweden; Switzerland; Syria; Turkey; U.S.A; Ukraine; United Kingdom, Uzbekistan.

12. *Ophion mastrus* Gauld, 1979

Distribution: India: Himachal Pradesh, Uttar Pradesh, West Bengal; China: Xizang, Yunnan; Myanmar; Nepal.

13. *Ophion nepus* Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh, Uttar Pradesh, West Bengal; Nepal.

14. *Ophion obscuratus* Fabricius, 1798

Distribution: India: Arunachal Pradesh, Himachal Pradesh, Uttar Pradesh; Argentina; Austria, Belarus; Belgium; Bulgaria; Canary Islands: Quebec; China: Fujian, Shanxi, Taiwan, Xizang; Cyprus; Czech Republic; Czechoslovakia; Egypt; Finland; France; Germany; Greece; Hungary; Iceland; Iran; Ireland; Israel; Italy; Japan; Korea; Latvia; Luxembourg; Moldova; Morocco; Myanmar; Nepal; Netherlands; Norway; Poland; Romania; Russia: Astrakhans kaya Oblast, Chelyabinsk Oblast, Sakhalin Oblast, Samar kaya Oblast, Saratov Oblast, Voronezh kaya Oblast; Spain; Sweden; Switzerland; Tajikistan; Turkey; Ukraine; United Kingdom.

15. ***Ophion ostentatious*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh.

16. ***Ophion turcomanicus*** Szepligeti, 1905

Distribution: India: Maharashtra; Afghanistan; Algeria; China: Qinghai, Xinjiang; Egypt; Georgia; Iran; Israel; Pakistan; Russia: Dagestan kaya, Respublika, Stavropolskiy Kray; Tajikistan; Turkmenistan; Uzbekistan.

17. ***Ophion virus*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh, Uttar Pradesh; China: Xizang.

GENUS ***ORIENTOSPILUS*** MORLEY, 1912

1. ***Orientospilus individuus*** Morley, 1912

Distribution: India: Maharashtra.

GENUS ***SCLEROPHION*** GAULD, 1979

1. ***Sclerophion longicornis*** (Uchida, 1928)

Distribution: India: Sikkim; Bhutan; China; Nepal.

2. ***Sclerophion uchidai*** Gauld and Mitchell, 1981

Distribution: India: Himachal Pradesh.

TRIBE ENICOSPILINI TOWNES, 1971

GENUS ***DICAMPTUS*** SZEPLIGETI, 1905

1. ***Dicamptus bicarinus*** Nikam and Kanhekar, 1984

Distribution: India: Maharashtra.

2. ***Dicamptus cantoni*** Gauld and Mitchell, 1981

Distribution: India: Meghalaya, Uttar Pradesh; China: Guangdong, Guangxi, Guizhou, Macau, Yunnan; Indonesia: Java; Thailand.

3. *Dicamptus flavoplagiatus* (Cushman, 1937)

Distribution: India: Uttar Pradesh.

4. *Dicamptus indicus* Nikam, 1972

Distribution: India: Kerala, Maharashtra; Sri Lanka.

5. *Dicamptus isshikki* Uchida, 1928

Distribution: India: Himachal Pradesh, Tamil Nadu; China: Guangxi, Shaanxi, Taiwan, Yunnan; Japan; Nepal; Philippines.

6. *Dicamptus lambai* Nikam and kanhekar, 1984

Distribution: India: Uttar Pradesh.

7. *Dicamptus neosinuatus* sp. nov.

Distribution: India: Uttar Pradesh.

8. *Dicamptus nigropictus* (Matsumura, 1912)

Distribution: India: Arunachal Pradesh; Brunei; China: Fujian, Gansu, Guangdong, Guangxi, Guizhou, Henan, Hunan, Jiangxi, Liaoning, Shaanxi, Shanghai, Shanxi, Sichuan, Taiwan, Yunnan; Japan; Korea; Laos; Malaysia: Sabah, Sarawak.

9. *Dicamptus reticulatus* (Cameron, 1899)

Distribution: India: Sikkim, Meghalaya; Bangladesh; China: Fujian, Gansu, Guangxi, Hubei, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang; Japan: Okinawa; Myanmar; Sri Lanka.

10. *Dicamptus sinuatus* (Morley, 1913)

Distribution: India: Andhra Pradesh, Karnataka, Tamil Nadu; Sri Lanka.

11. *Dicamptus zoracius* Gauld & Mitchell, 1981

Distribution: Southern India.

GENUS *ENICOSPILUS* STEPHENS, 1835

1. *Enicospilus abdominalis* (Szepliget, 1906)

Distribution: India: Karnataka, Kerala, Sikkim, Tamil Nadu; China: Fujian, Taiwan; Korea; Malaysia: Peninsular; Myanmar; Papua New Guinea; Philippines; Sri Lanka; Thailand.

2. *Enicospilus aciculatus* (Taschenberg, 1875)

Distribution: India: Kerala, Tamil Nadu; China: Fujian, Guangdong, Hainan Island, Sichuan, Taiwan, Xizang, Yunnan; Indonesia: Java, Sumatra; Japan: Okinawa; Myanmar, Philippines: Luzon, Mindanao, Panay; Solomon Islands; Sri Lanka; Vanuatu; Vietnam.

3. *Enicospilus aepulus* Gauld and Mitchell, 1981

Distribution: India: Kerala; Philippines: Mindanao, Mindoro.

4. *Enicospilus albiger* (Kriechbaumer, 1894)

Distribution: India: Bihar, Maharashtra, Tamil Nadu; Congo; Ivory Coast; Kenya; Madagascar; Mozambique; Nigeria; Senegal; South Africa; Sri Lanka; Tanzania; Zambia.

5. *Enicospilus anokha* sp. nov.

Distribution: India: Kerala.

6. *Enicospilus ashbyi* Ashmead, 1904

Distribution: India: Kerala, Orissa, Tamil Nadu; China: Hainan Island, Sichuan, Taiwan, Yunnan, Indonesia: Java; Malaysia: Peninsular; Papua New Guinea, Philippines: Luzon; Singapore; Vietnam.

7. *Enicospilus aurangabadensis* Rao, 1970

Distribution: India: Maharashtra.

8. *Enicospilus benazeer* sp. nov.

Distribution: India: Kerala.

9. *Enicospilus bharatensis* Nikam, 1980

Distribution: India: Assam, Bihar, Himachal Pradesh, Karnataka, Maharashtra, Meghalaya, Rajasthan, Uttar Pradesh; China: Fujian, Guangdong, Guangxi, Guizhou, Hainan Island, Sichuan, Yunnan, Indonesia: Irian Jaya; New Caledonia; Papua New Guinea; Philippines: Luzon; Sri Lanka; Vanuatu; Vietnam.

10. *Enicospilus biharensis* Townes, Townes and Gupta, 1961

Distribution: India: Andhra Pradesh, Kerala, Tamil Nadu, Uttar Pradesh, West Bengal; China: Fujian, Guangdong, Guangxi, Guizhou, Sichuan, Yunnan, Indonesia: Java, Sumatra; Japan, Malaysia: Peninsular; Myanmar; Nepal; Pakistan, Philippines: Luzon, Mindanao, Mindoro; Singapore; Sri Lanka; Thailand.

11. *Enicospilus biumbratus* (Morley, 1912)

Distribution: India: Tamil Nadu; Singapore.

12. *Enicospilus bres* Gauld and Mitchell, 1981

Distribution: India: Kerala, New Guinea.

13. *Enicospilus breviterebrus* Nikam, 1975

Distribution: India: Maharashtra, Tamil Nadu; Malaysia: Peninsular; Sri Lanka.

14. *Enicospilus capensis* (Thunberg, 1822)

Distribution: India: Bihar, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Uttar Pradesh; China: Guangdong, Guangxi, Hainan Island, Sichuan, Yunnan, Zhejiang; Congo; Ethiopia; Gabon; Indonesia: Java, Sulawesi, Sumatra; Japan: Okinawa; Kenya; Madagascar; Malaysia: Peninsular, Sarawak; Mauritius; Philippines: Luzon; Saudi Arabia;

Senegal; Seychelles; South Africa; Sri Lanka; Tanzania; Uganda; Yemen; Zimbabwe.

15. *Enicospilus cerialis* Gauld and Mitchell, 1981

Distribution: India: Sikkim.

16. *Enicospilus chion* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; Sri Lanka.

17. *Enicospilus centralis* Cushman, 1937

Distribution: India: Kerala, Sikkim; Brunei; China: Fujian, Taiwan, Zhejiang, Indonesia: Sulawesi; Japan; Myanmar; Papua New Guinea; Philippines: Mindoro.

18. *Enicospilus dasychirae* Cameron, 1905

Distribution: India: Assam, Bihar, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, West Bengal; Brunei; China: Fujian, Guangdong, Guangxi, Guizhou, Hunan, Taiwan, Yunnan; Indonesia: Java, Kalimantan, Sumatra; Japan: Okinawa; Malaysia: Peninsular, Sabah, Sarawak; Papua New Guinea, Philippines: Mindanao; Sri Lanka.

19. *Enicospilus dolosus* (Tosquinet, 1896)

Distribution: India: Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh; Angola; Australia: Queensland; Bangladesh, Brunei; Central African Republic; China: Taiwan, Yunnan; Congo; Egypt; Ethiopian; Fiji; Gabon; Ghana; Guinea; Indonesia: Irian Jaya, South Moluccas, Sulawesi, Sumatra; Ivory Coast; Kenya; Madagascar; Malaysia: Sabah; Mauritania; Mozambique; New Caledonia; Nigeria; Papua New Guinea; Philippines: Luzon, Negros, Palawan; Reunion; Senegal; Society Islands; Solomon Islands; South Africa; Sri Lanka; Tanzania; Uganda; Vanuatu; Vietnam; Western Samoa.

20. *Enicospilus eastopi* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; Brunei; Indonesia: North Moluccas; Malaysia: Sarawak; Philippines: Mindoro.

21. *Enicospilus enicospilus* Nikam, 1972

Distribution: India: Bihar, Maharashtra; China: Fujian, Guangxi, Guizhou, Hunan, Sichuan, Yunnan; Sri Lanka.

22. *Enicospilus erythrocerus* (Cameron, 1905)

Distribution: India: Gujarat, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, West Bengal; Brunei; China: Fujian, Guangdong, Guangxi, Hainan Island, Taiwan, Zhejiang; Indonesia: Java, Sumatra; Japan; Malaysia: Peninsular, Sarawak; Myanmar; Philippines: Luzon, Mindanao, Mindoro; Singapore; Sri Lanka; Thailand.

23. *Enicospilus fittoni* Nikam, 1980

Distribution: India: Meghalaya; Laos.

24. *Enicospilus flavicaput* (Morley, 1912)

Distribution: India: Assam, Kerala, Maharashtra, Tamil Nadu; Brunei; China: Yunnan; Indonesia: Java, North Moluccas, Sumatra; Japan: Okinawa; Malaysia: Peninsular; Myanmar; Nepal; Philippines: Leyte, Luzon, Negros, Palawan; Sri Lanka; Vietnam.

25. *Enicospilus flavocephalus* (Kirby, 1900)

Distribution: India: Himachal Pradesh; Australia: Christmas Island, Queensland; Brunei; China: Fujian, Guangdong, Guangxi, Guizhou, Hunan, Sichuan, Taiwan, Yunnan, Zhejiang; Indonesia: Irian Jaya, Java, South Moluccas; Japan: Okinawa; Malaysia: Peninsular; New Caledonia, Papua New Guinea, Philippines: Mindanao, Mindoro, Negros; Singapore; Solomon Islands; Sri Lanka.

26. *Enicospilus formosensis* (Uchida, 1928)

Distribution: India: Assam, Himachal Pradesh, Punjab; Brunei; China: Fujian, Guangdong, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, Zhejiang; Japan.

27. *Enicospilus fusiformis* Chiu, 1954

Distribution: India: Assam; Australia; China: Taiwan, Yunnan.

28. *Enicospilus gasteralis* Nikam, 1980

Distribution: India: West Bengal.

29. *Enicospilus gauldi* Nikam, 1980

Distribution: India: Himachal Pradesh, Uttar Pradesh; China: Fujian, Guizhou, Heilongjiang, Henan, Hunan, Jiangsu, Jiangxi, Jilin, Shaanxi, Shanghai, Yunnan, Zhejiang.

30. *Enicospilus ghatensis* sp. nov.

Distribution: India: Kerala.

31. *Enicospilus grammospilus* (Enderlein, 1921)

Distribution: India: Uttar Pradesh, West Bengal; Brunei; China: Guangxi, Taiwan, Yunnan; Indonesia: Sumatra; Malaysia: Sabah, Sarawak; Philippines: Luzon, Palawan; Vietnam.

32. *Enicospilus grandis* (Cameron, 1905)

Distribution: India: Karnataka, Tamil Nadu, Uttar Pradesh; China: Sichuan, Taiwan; Japan; Malaysia: Peninsular; Myanmar; Sri Lanka.

33. *Enicospilus guptai* Nikam, 1980

Distribution: India: Assam.

34. *Enicospilus hedilis* Gauld and Mitchell, 1981

Distribution: India: Meghalaya; China: Guangxi, Liaoning, Ningxia, Sichuan; Indonesia: Java; Sri Lanka.

35. *Enicospilus heinrichi* Gauld and Mitchell, 1981

Distribution: India: Sikkim; China: Guangxi, Sichuan, Yunnan; Laos; Myanmar.

36. *Enicospilus heliothidis* Viereck, 1913

Distribution: India: Karnataka, Maharashtra, Uttar Pradesh, Tamil Nadu; China: Jiangsu, Yunnan; Fiji; Indonesia: East Lesser Sundas, Irian Jaya, Java, Sumatra; Papua New Guinea; Sri Lanka; Vanuatu.

37. *Enicospilus insinator* (Smith, 1860)

Distribution: India: Kerala, Uttar Pradesh; Bhutan; Brunei; China: Fujian, Guangdong, Hainan Island, Hunan; Indonesia: South Moluccas; Japan; Sri Lanka; Thailand.

38. *Enicospilus javanus* (Szepliget, 1910)

Distribution: India: Bihar, Delhi, Haryana, Himachal Pradesh, Kerala, Maharashtra, Madhya Pradesh, Tamil Nadu; Australia: Queensland; Brunei; China: Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan; Indonesia: Irian Jaya, Java, South Moluccas; Japan; Malaysia; Myanmar; Nepal; Papua New Guinea; Singapore; Solomon Islands; Sri Lanka.

39. *Enicospilus kannurensis* sp. nov.

Distribution: India: Kerala.

40. *Enicospilus kanshirensis* (Uchida, 1928)

Distribution: India: Sikkim, Tamil Nadu; Brunei; China: Fujian, Guangxi, Hainan Island, Taiwan, Yunnan; Indonesia: Irian Jaya, Sumatra; Myanmar; Nepal; Philippines: Mindanao; Vietnam.

41. *Enicospilus kasargodensis* sp. nov.

Distribution: India: Kerala.

42. *Enicospilus laqueatus* (Enderlein, 1921)

Distribution: India: Bihar, Delhi, Himachal Pradesh, Kerala, Karnataka, Madhya Pradesh, Orissa, Tamil Nadu, West Bengal; China: Fujian, Guangxi, Guizhou, Taiwan, Yunnan; Nepal; Philippines: Luzon; Sri Lanka; Zambia.

43. *Enicospilus limax* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu.

44. *Enicospilus lineolatus* (Roman, 1913)

Distribution: India: Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh; Australia: Capital Territory, New South Wales, Western Australia; Bhutan; Brunei; China: Anhui, Beijing, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hainan Island, Hebei, Hubei, Hunan, Jiangxi, Jilin, Shanxi, Shandong, Shanghai, Sichuan, Taiwan, Yunnan, Zhejiang; Indonesia: Irian Jaya, Java, Kalimantan, Sumatra; Japan: Okinawa; Korea; Malaysia: Peninsular, Sabah, Sarawak; Nepal; New Caledonia; Papua New Guinea; Philippines: Luzon, Mindanao; Singapore; Solomon Islands; Sri Lanka; Tajikistan.

45. *Enicospilus maai* Chiu, 1954

Distribution: India: Assam; China: Guangxi, Hainan Island, Taiwan, Yunnan; Malaysia: Peninsular, Sarawak; Vietnam.

46. *Enicospilus malabaricus* sp.nov.

Distribution: India: Kerala.

47. *Enicospilus marathwadensis* Nikam, 1980

Distribution: India: Maharashtra; Myanmar.

48. *Enicospilus melanocarpus* Cameron, 1905

Distribution: India: Assam, Kerala; Australia: New South Wales, Northern Territory, Queensland, Western Australia; Brunei; China: Beijing, Fujian,

Guangdong, Guangxi, Guizhou, Hainan Island, Hebei, Hunan, Jiangxi, Shaanxi, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang; Fiji; Indonesia: Irian Jaya, Java, Kalimantan, North Moluccas, South Moluccas, Sulawesi, Sumatra; Japan: Ogasawara, Okinawa; Korea; Malaysia: Peninsular, Sabah, Sarawak; Myanmar; Nepal; New Caledonia; Pakistan; Papua New Guinea; Philippines: Luzon, Mindanao, Negros, Palawan, Samar; Singapore; Society Islands; Solomon Islands; Sri Lanka; Vanuatu; Western Samoa.

49. *Enicospilus merdarius* (Gravenhorst, 1829)

Distribution: India; Afghanistan; Algeria; Argentina; Azerbaijan; Belarus; Belgium; Brazil; Bulgaria; Canada; Canary Islands; Chile; China: Beijing, Gansu, Guangdong, Hebei, Heilongjiang, Liaoning, Nei Menggu, Ningxia, Shaanxi, Shanxi, Taiwan, Xinjiang; Colombia; Croatia; Cuba; Czechoslovakia; Egypt; Finland; France; Georgia; Germany; Guam; Honduras; Hungary; Iran; Italy; Japan: Okinawa; Kazakhstan; Latvia; Libya; Macedonia; Malaysia: Peninsular; Mexico; Moldova; Morocco; Myanmar; Netherlands; Nicaragua; Norway; Peru; Poland; Romania; Russia: Altayskiy Kray, Astrakhans kaya Oblast; Bryansk Oblast, Dagestan kaya Respublika, Irkutsk Oblast, Kursk Oblast, Moscow Oblast, Novgorod Oblast, Omsk Oblast, Perm Oblast, Rostov Oblast, Ryazan Oblast, Sakhalin Oblast, Samar kaya Oblast, Sankt Petersburg, Saratov Oblast, Stavropolskiy Kray, Tambov Oblast, Tula Oblast, Tverskaya Oblast, Voronezh kaya Oblast, Yaroslavl Oblast; Spain; Sri Lanka; Sweden; Switzerland; Tunisia; Turkey; Turkmenistan, U.S.A: Alabama, Maryland, New York, West Virginia, Wyoming; Ukraine; United Kingdom; Uruguay; Uzbekistan; Yugoslavia.

50. *Enicospilus mespilus* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; Sri Lanka.

51. *Enicospilus mirax* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; China: Guangxi.

52. *Enicospilus nathani* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; China: Yunnan; Myanmar.

53. *Enicospilus nigribasalis* (Uchida, 1928)

Distribution: India: Karnataka, Tamil Nadu; China: Guizhou, Taiwan; Japan; Philippines: Luzon; Sri Lanka.

54. *Enicospilus nigripectus* (Enderlein, 1921)

Distribution: India: Assam, Karnataka, Tamil Nadu, Uttar Pradesh.

55. *Enicospilus nigriventris* Nikam, 1975

Distribution: India: Kerala, Maharashtra, Tamil Nadu; Brunei; Philippines: Mindanao.

56. *Enicospilus nigropectus* Cameron, 1905

Distribution: India: Andhra Pradesh, Karnataka, Sikkim, Tamil Nadu; Brunei; China: Fujian, Guangxi, Hunan, Jiangsu, Liaoning, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang; Indonesia: Java, Kalimantan, North Moluccas, Sulawesi, Sumatra; Japan: Okinawa; Korea; Malaysia: Peninsular, Sabah, Sarawak; Myanmar; Papua New Guinea; Philippines: Leyte, Mindanao, Mindoro; Sri Lanka; Thailand.

57. *Enicospilus orientalis* (Morley, 1913)

Distribution: India: Madhya Pradesh, Maharashtra; Sri Lanka.

58. *Enicospilus pilmus* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; Pakistan.

59. *Enicospilus pinus* Gauld and Mitchell, 1981

Distribution: India: Kerala, Tamil Nadu.

60. *Enicospilus plicatus* (Brulle, 1846)

Distribution: India; Brunei; China: Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Taiwan, Xizang, Yunnan,

Zhejiang; Indonesia: Java, Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Papua New Guinea; Philippines: Mindanao, Samar; Singapore; Thailand; Vietnam.

61. *Enicospilus pseudantennatus* Gauld, 1977

Distribution: India: Andhra Pradesh, Karnataka, Tamil Nadu, Uttar Pradesh; Australia: Capital Territory, New South Wales, Western Australia; China: Fujian, Guangdong, Guangxi, Hainan Island, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan, Zhejiang; Indonesia: Irian Jaya, Java, South Moluccas, Sumatra; Myanmar; Nepal; Norfolk Island; Papua New Guinea; Philippines: Luzon, Mindanao; Sri Lanka; Vietnam.

62. *Enicospilus pseudoconspersae* (Sonan, 1927)

Distribution: India: Arunachal Pradesh, Himachal Pradesh, Sikkim; China: Anhui, Fujian, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang; Japan: Okinawa; Korea; Nepal; Philippines: Luzon.

63. *Enicospilus pudibundae* (Uchida, 1928)

Distribution: India: Sikkim; Brunei; China: Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Yunnan, Zhejiang; Japan; Korea; Laos, Sri Lanka, Vietnam.

64. *Enicospilus punctatus* sp.nov.

Distribution: India: Kerala.

65. *Enicospilus pungens* (Smith, 1874)

Distribution: India; China: Jiangsu; Japan: Okinawa; Korea; Singapore.

66. *Enicospilus rhetus* Gauld and Mitchell, 1981

Distribution: India: Punjab; Philippines: Palawan, Thailand.

67. *Enicospilus riukuensis* (Matsumura and Uchida, 1926)

Distribution: India: Arunachal Pradesh, Tamil Nadu; Brunei; China: Guizhou, Sichuan, Taiwan, Zhejiang; Japan: Okinawa; Madagascar; Malaysia: Peninsular; New Caledonia, Papua New Guinea.

68. *Enicospilus robustus* sp. nov.

Distribution: India: Kerala.

69. *Enicospilus rufus* sp. nov.

Distribution: India: Kerala.

70. *Enicospilus rogus* Gauld and Mitchell, 1981

Distribution: India: Tamil Nadu; Brunei; Vietnam.

71. *Enicospilus selmatos* Chiu, 1954

Distribution: India; Brunei; China: Hunan, Taiwan; Indonesia: Java, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Sri Lanka.

72. *Enicospilus shinkanus* (Uchida, 1928)

Distribution: India: Assam, Bihar, Delhi, Jammu Kashmir, Tamil Nadu, Uttar Pradesh, Maharashtra; Chagos Archipelago; China: Anhui, Fujian, Guangdong, Guangxi, Heilongjiang, Hubei, Jiangxi, Liaoning, Sichuan, Taiwan; Fiji; Japan: Okinawa; Korea; Malaysia: Sabah; New Caledonia; Palau; Papua New Guinea; Philippines: Luzon; Solomon Islands; Vanuatu; Vietnam, Western Samoa.

73. *Enicospilus signativentris* (Tosquinet, 1903)

Distribution: India: Assam, Karnataka, Kerala, Rajasthan, Tamil Nadu; Bhutan; China: Fujian, Guizhou, Hainan Island, Taiwan; Indonesia: Java, South Moluccas, Sulawesi, Sumatra, Timor; Japan: Ogasawara, Okinawa; Malaysia: Peninsular, Sabah, Sarawak; Philippines: Luzon, Mindanao; Sri Lanka; Vietnam.

74. *Enicospilus squamacutus* sp. nov.

Distribution: India: Kerala.

75. *Enicospilus stenophelps* Cushman, 1937

Distribution: India: Tamil Nadu; China: Fujian, Guangxi, Hunan, Sichuan, Taiwan, Yunnan, Zhejiang; Sri Lanka; Vietnam.

76. *Enicospilus stenopsis* (Kohl, 1905)

Distribution: India: Tamil Nadu, Rajasthan; China: Xinjiang; Iran; Kazakhstan; Spain; Tajikistan; Turkmenistan; Uzbekistan.

77. *Enicospilus transversus* Chiu, 1954

Distribution: India: Kerala, Karnataka, Maharashtra; China: Fujian, Guangdong, Guangxi, Hubei, Hunan, Sichuan, Taiwan, Zhejiang; Indonesia: Java; Sri Lanka.

78. *Enicospilus tribindus* Rao and Nikam, 1970

Distribution: India: Maharashtra, Tamil Nadu.

79. *Enicospilus tricorniatus* Rao and Nikam, 1970

Distribution: India: Maharashtra.

80. *Enicospilus tripartitus* (Chiu, 1954)

Distribution: India: Himachal Pradesh, Tamil Nadu; China: Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Zhejiang; Japan: Okinawa; Korea; Nepal.

81. *Enicospilus univittatus* (Brulle, 1846)

Distribution: India: Orissa, Tamil Nadu.

81. *Enicospilus verticinus* (Roman, 1913)

Distribution: India: Kerala, Tamil Nadu; Brunei; Indonesia: South Moluccas; Malaysia: Peninsular, Sarawak; Myanmar; Philippines: Bohol, Mindanao.

83. *Enicospilus vestigator* (Smith, 1858)

Distribution: India: Andhra Pradesh, Karnataka, Kerala, Maharashtra, Sikkim, Tamil Nadu; Brunei; China: Hainan Island, Taiwan; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sarawak; Palau; Papua New Guinea; Sri Lanka; Vietnam.

84. *Enicospilus xanthocephalus* Cameron, 1905

Distribution: India: Himachal Pradesh, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, Delhi, Maharashtra, Andhra Pradesh, Bihar, Rajasthan; Australia: Queensland; Brunei; China: Guangxi, Guizhou, Taiwan; Indonesia: Sumatra; Papua New Guinea; Philippines: Luzon, Mindanao, Mindoro, Panay, Samar; Sri Lanka; Thailand.

85. *Enicospilus wayanadensis* sp. nov.

Distribution: India: Kerala.

86. *Enicospilus yonezawanus* (Uchida, 1928)

Distribution: India: Himachal Pradesh, Karnataka, Sikkim; China: Fujian, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Sichuan, Taiwan, Yunnan; Indonesia: Irian Jaya, South Moluccas, Sumatra, Japan: Okinawa; Korea; Malaysia: Peninsular, Sabah; Myanmar; Papua New Guinea; Philippines: Luzon; Mindanao, Palawan.

GENUS *STAUROPOCTONUS* BRAUNS, 1889

1. *Stauropoctonus narendrani* Soumya and Sudheer, 2023

Distribution: India: Kerala.

HOST- PARASITE INDEX OF THE GENERA AND SPECIES TREATED IN THIS WORK

Ichneumonid wasps are extremely important in the natural control of plant pests. They use variety of insects and arachnids as their hosts and play an essential role in the ecosystems. Host data is available for many of Ichneumonid wasps which can be made useful in agricultural field, since majority of their host forms the major pest of important crops. Female Ichneumonid wasps target the larvae or pupae of their hosts and have been used successfully as biocontrol agents and there is a huge potential in managed biocontrol programs.

The wasp from the *Enicospilus* genus of Ophioninae collected from the study area are known to parasitize lepidopteran hosts of different families. *Enicospilus* wasps and their host species are given in the table, based on the data collected from published literatures. As per the collected data, it is noted that the *Enicospilus* show the highest specificity towards their host as they parasitise only lepidopteran species. Among these Lepidopteran hosts some families are more specific to the attack of *Enicospilus* wasps. For example, the families Noctuidae and Erebidae are parasitised by many species of *Enicospilus* wasps. Lepidopteran species are the major pests of cotton, vegetables, coco and many other economically important crops. Unfortunately, parasitism of Ophionine species have not been studied in majority cases and further comprehensive research is needed in natural as well as biological control. Even though Ichneumonid parasitoids were reared from larval and pupal stages of various hosts collected from the fields, none of them were belonging to subfamily Ophionina

SL.NO	HOST	PARASITOIDS
1	<ul style="list-style-type: none"> ➤ <i>Anomis leona</i> Schaus (Lepidoptera: Noctuidae) ➤ <i>Anomis flava</i> (Fabricius) (Lepidoptera: Erebidae) ➤ <i>Haritalodes derogate</i> (Fabricius) (Lepidoptera: Crambidae) 	<i>Enicospilus dolosus</i> (Tosquinet, 1896)
2	<ul style="list-style-type: none"> ➤ <i>Helicoverpa armigera</i> (Hubner) (Lepidoptera: Noctuidae) ➤ <i>Streblote siva</i> (Lefebvre) (Lepidoptera: Lasiocampidae) ➤ <i>Euproctis fraterna</i> Moore (Lepidoptera: Erebidae) 	<i>Enicospilus melanocarpus</i> Cameron, 1902
3	<ul style="list-style-type: none"> ➤ <i>Polydesma umbricola</i> Boisduval (Lepidoptera: Erebidae) 	<i>Enicospilus ashbyi</i> Ashmead, 1904
4	<ul style="list-style-type: none"> ➤ <i>Olepa ricini</i> Fabricius (Lepidoptera: Erebidae) ➤ <i>Euproctis scintillans</i> Walker (Lepidoptera: Erebidae) ➤ <i>Euproctis fraterna</i> Moore (Lepidoptera: Erebidae) ➤ <i>Hypena laceratalis</i> Walker (Lepidoptera: Erebidae) ➤ <i>Crocidolomia pavonana</i> (Fabricius) (Lepidoptera: Crambidae) 	<i>Enicospilus xanthocephalus</i> Cameron, 1905
5	<ul style="list-style-type: none"> ➤ <i>Dasychira horsfieldi</i> Strand (Lepidoptera: Erebidae) ➤ <i>Dasychira mendosa</i> (Hubner) (Lepidoptera: Erebidae) ➤ <i>Psalis pennatula</i> Fabricius (Lepidoptera: Erebidae) ➤ <i>Pseudodura dudgeoni</i> Swinhoe (Lepidoptera: Erebidae) ➤ <i>Orgyia australis</i> Walker (Lepidoptera: Erebidae) 	<i>Enicospilus dashychirae</i> Cameron, 1905
6	<ul style="list-style-type: none"> ➤ <i>Lymantria</i> sp. (Lepidoptera: Erebidae) ➤ <i>Euproctis cryptosticta</i> Collenette (Lepidoptera: Erebidae) 	<i>Enicospilus transversus</i> Chiu, 1954

Observations, Results and Discussion

7	<ul style="list-style-type: none"> ➤ <i>Cretonotos transiens</i> (Walker) (Lepidoptera: Erebidae) ➤ <i>Laelia subrosea</i> (Walker) (Lepidoptera: Erebidae) ➤ <i>Agrotis ipsilon</i> (Hufnagel) (Lepidoptera: Noctuidae) 	<p><i>Enicospilus biharensis</i> Townes, Townes & Gupta, 1961</p>
8	<ul style="list-style-type: none"> ➤ <i>Anadevidia peponis</i> (Fabricius) (Lepidoptera: Noctuidae) ➤ <i>Autographa nigrisigna</i> (Walker) (Lepidoptera: Noctuidae) ➤ <i>Ericeia inangulata</i> (Guenee) (Lepidoptera: Erebidae) ➤ <i>Helicoverpa armigera</i> (Hubner) (Lepidoptera: Noctuidae) ➤ <i>Trichoplusia intermixta</i> (Warren) (Lepidoptera: Noctuidae) 	<p><i>Enicospilus signativentris</i> (Tosquinet, 1903)</p>
9	<ul style="list-style-type: none"> ➤ <i>Agrotis segetum</i> Denis & Schiffermuller (Lepidoptera: Noctuidae) ➤ <i>Spodoptera mauritia</i> (Boisduval) (Lepidoptera: Noctuidae) ➤ <i>Spodoptera exempta</i> Walker (Lepidoptera: Noctuidae) ➤ <i>Helicoverpa armigera</i> (Hubner) (Lepidoptera: Noctuidae) ➤ <i>Cactoblastic cactorum</i> Berg (Lepidoptera: Pyralidae). 	<p><i>Enicospilus capensis</i> (Thunberg, 1822)</p>

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PLATE 1

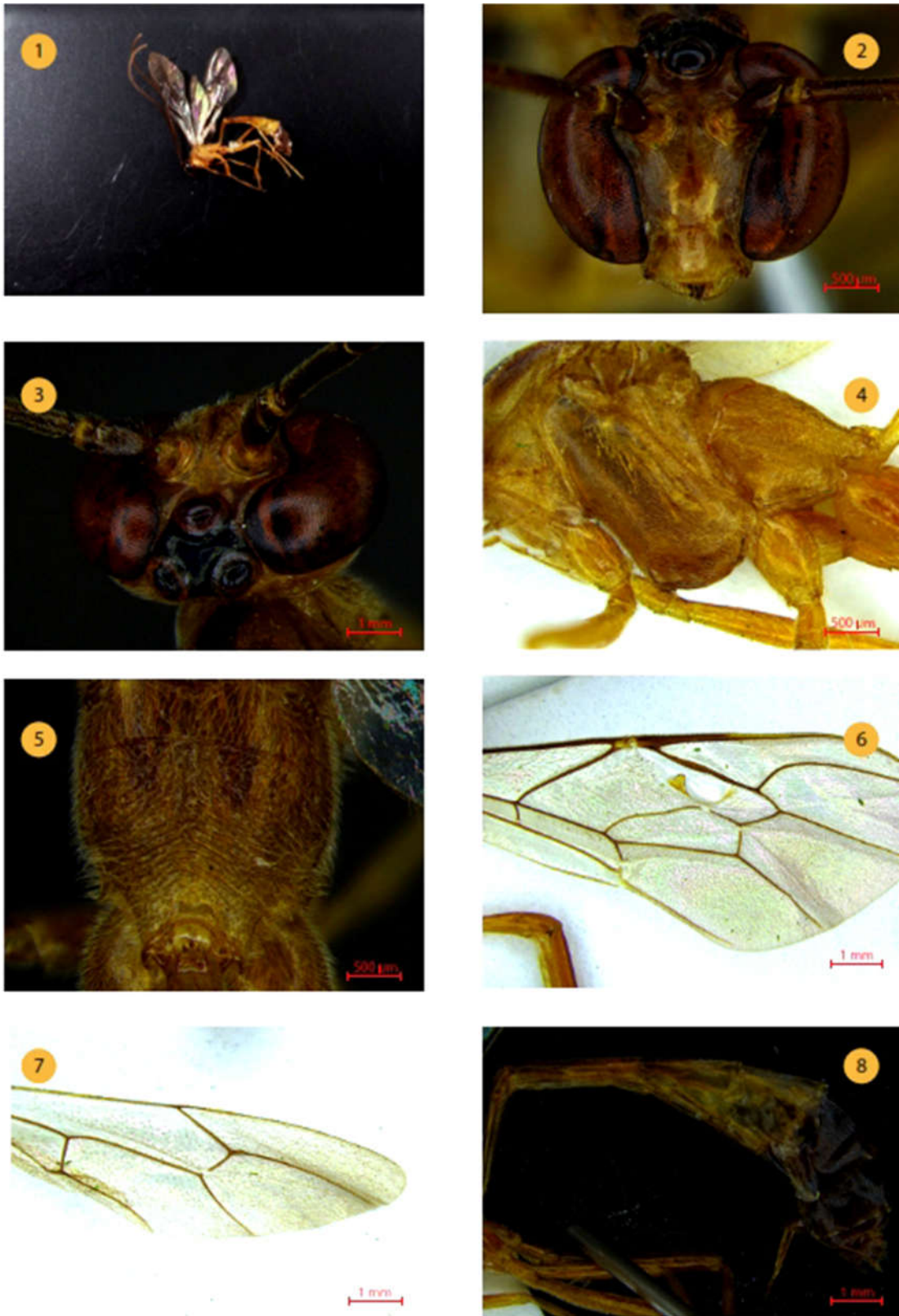


Fig: 1-8 *Enicospilus dolosus* (Tosquinet): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 2

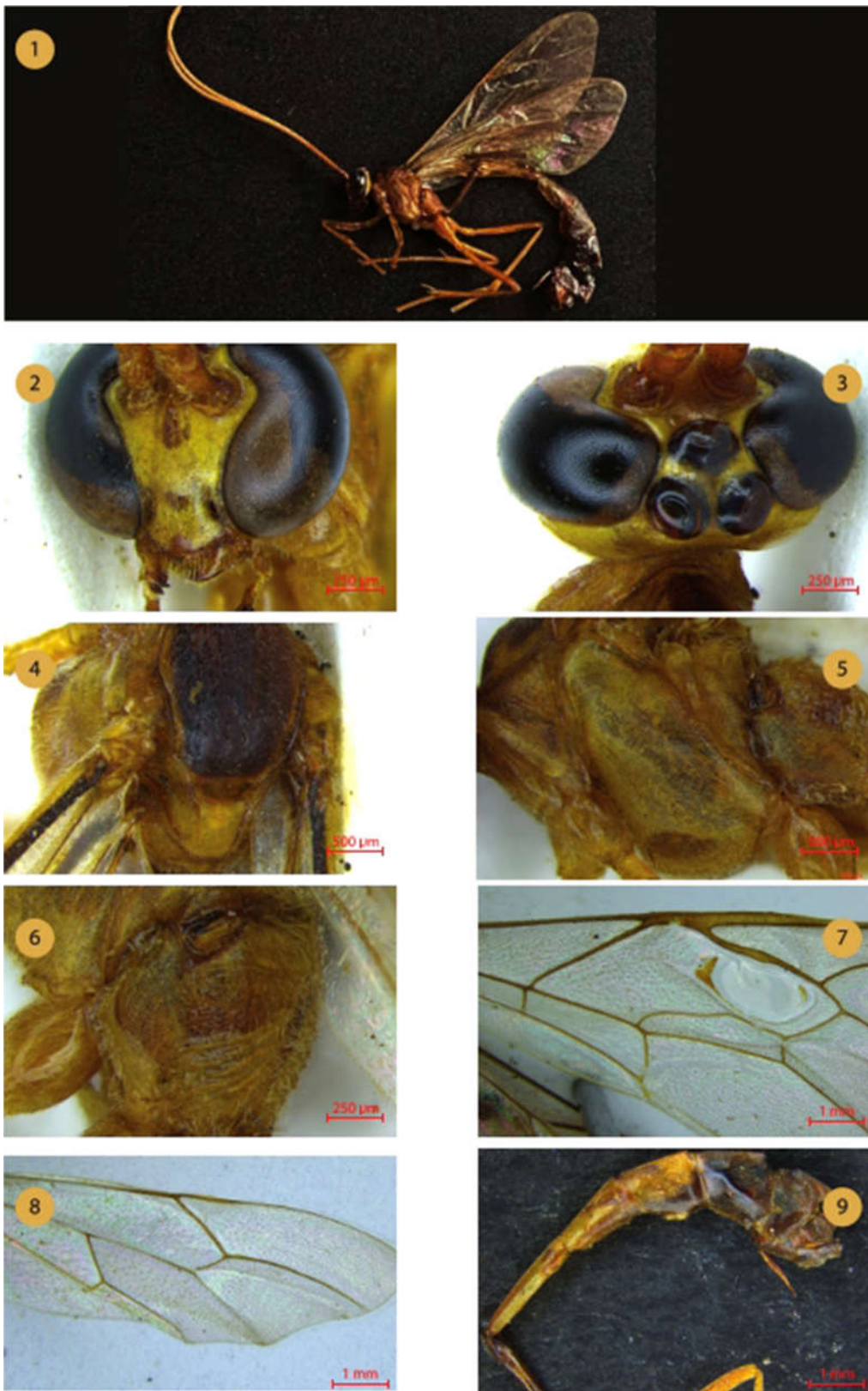


Fig: 1-9 *Enicospilus anokha* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Scutellum; 5. Mesosoma lateral view; 6. Propodeum dorsal view; 7. Forewing; 8. Hindwing; 9. Metasoma lateral view.

PLATE 3

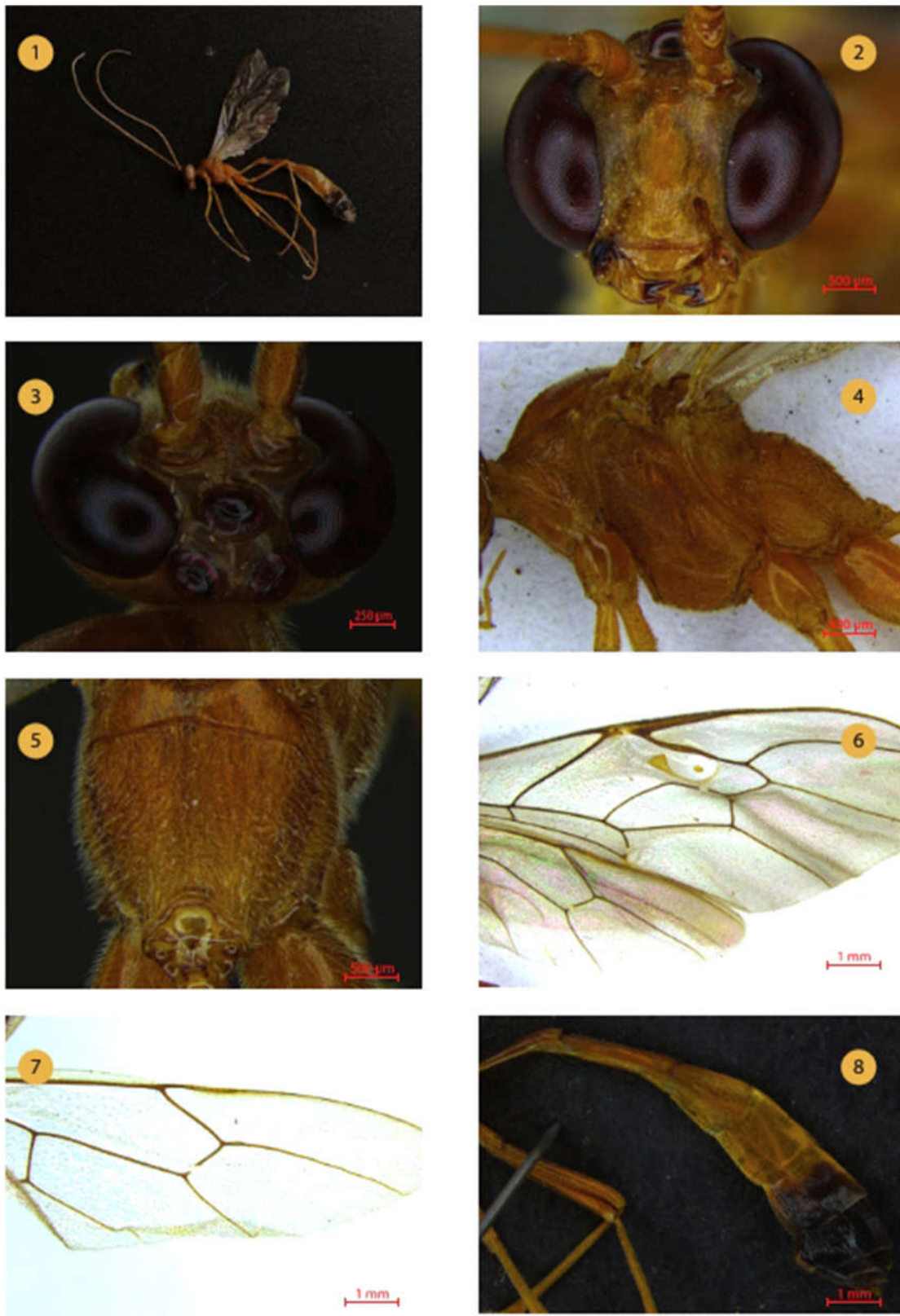


Fig: 1-8 *Enicospilus malabaricus* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 4

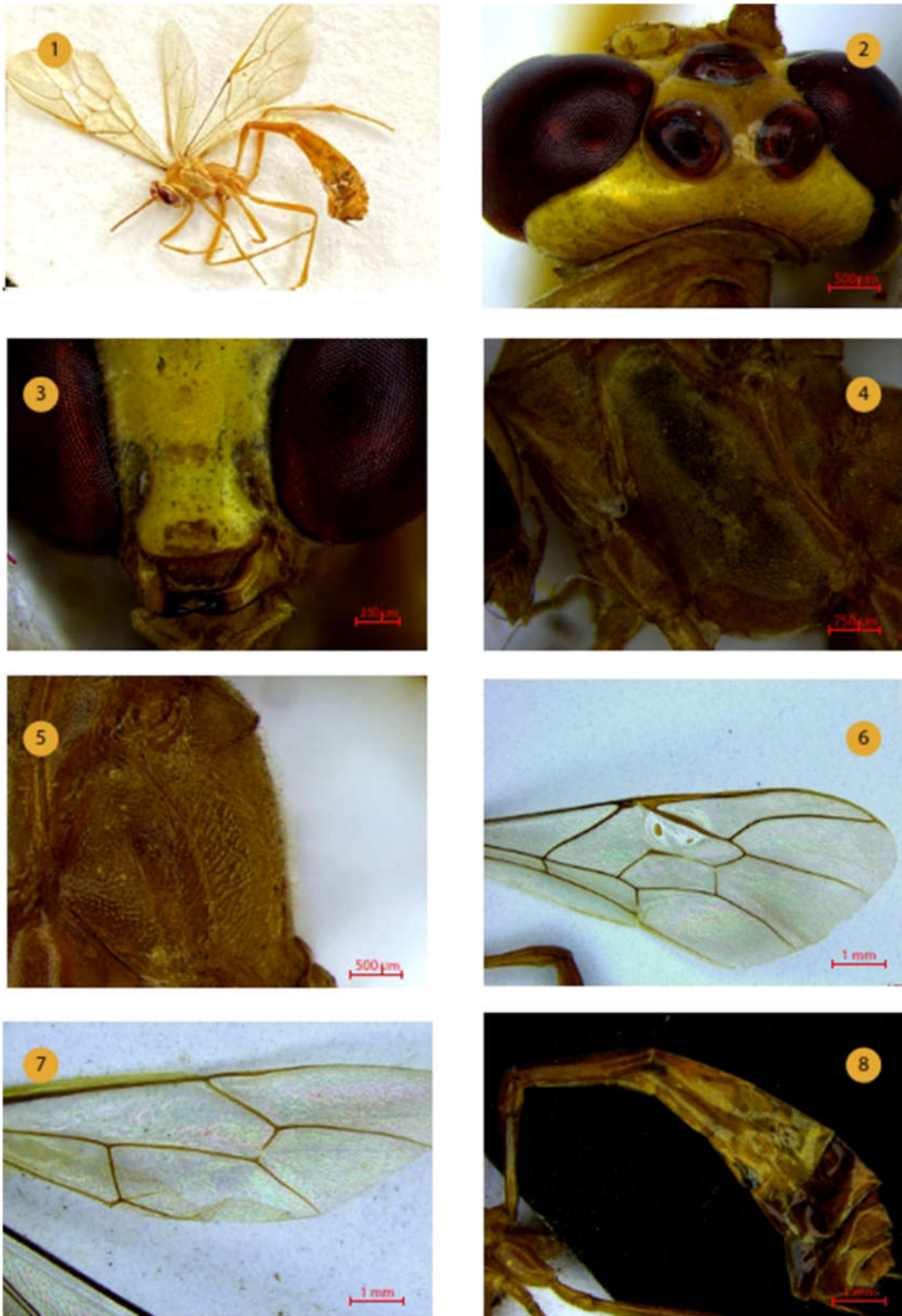


Fig: 1-8 *Enicospilus wayanadensis* sp. nov.: 1. Habitus lateral view; 2. Head dorsal view; 3. Head frontal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 5



Fig: 1-8 *Enicospilus abdominalis* (Szepligeti): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 6

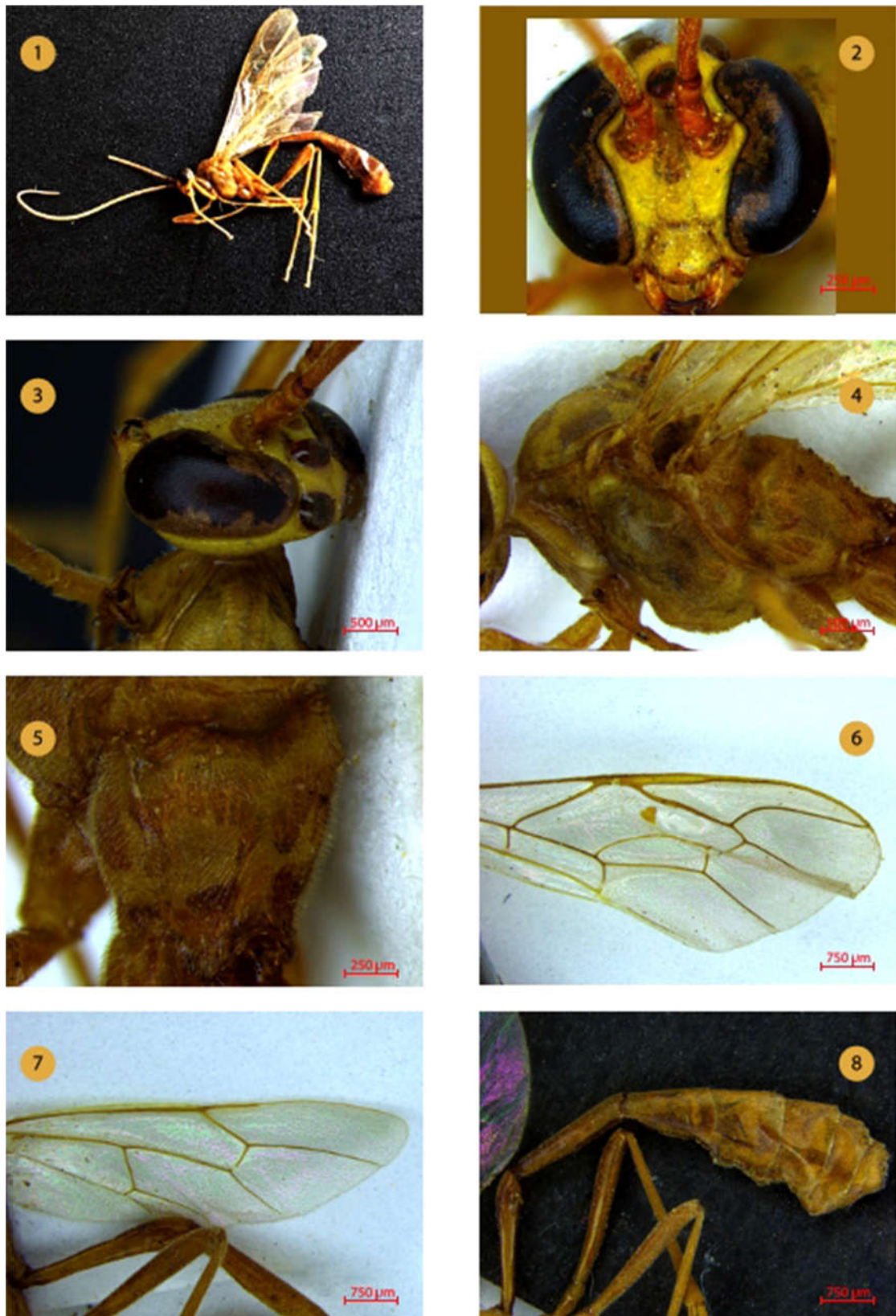


Fig: 1-8 *Enicospilus ashbyi* Ashmead: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 7

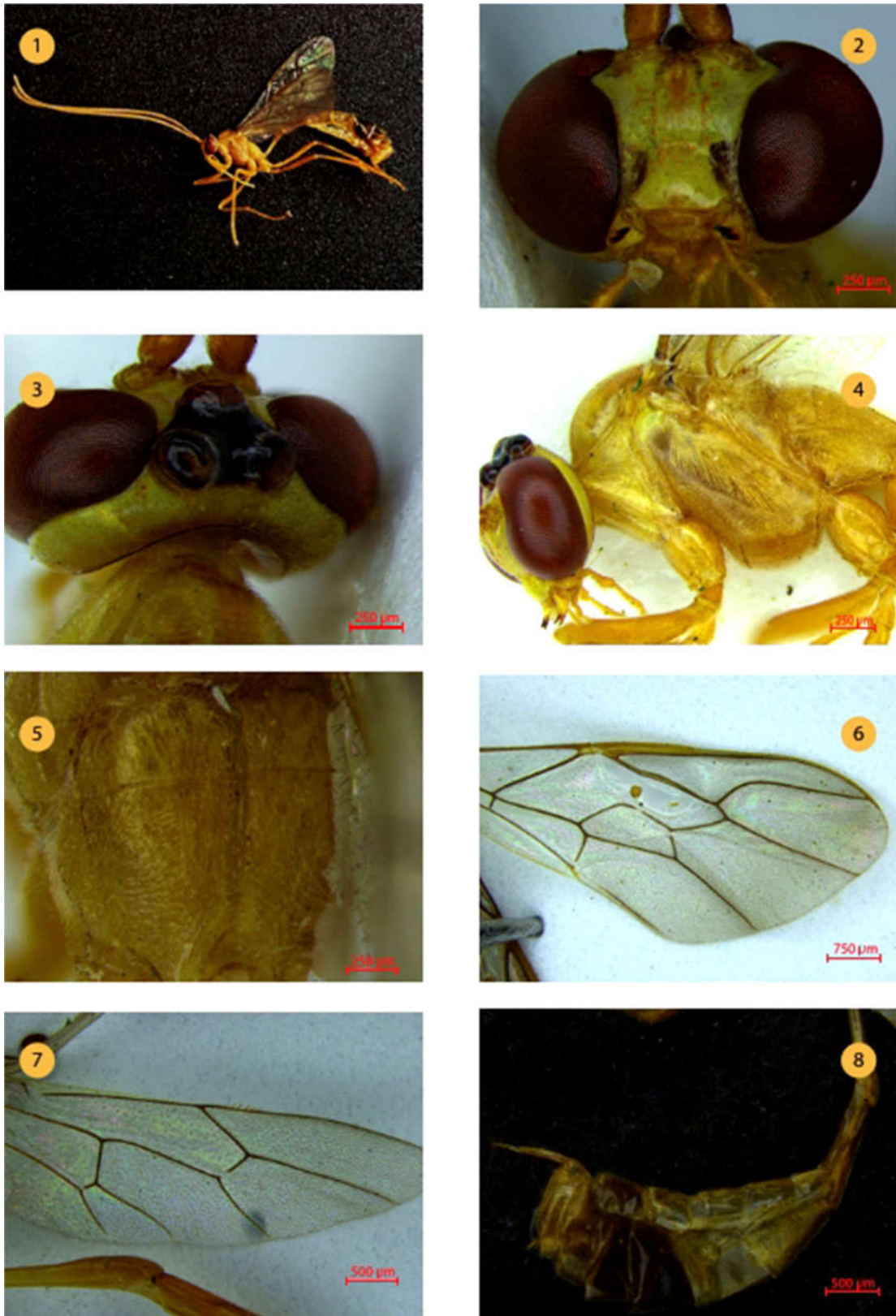


Fig: 1-8 *Enicospilus xanthocephalus* Cameron: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 8

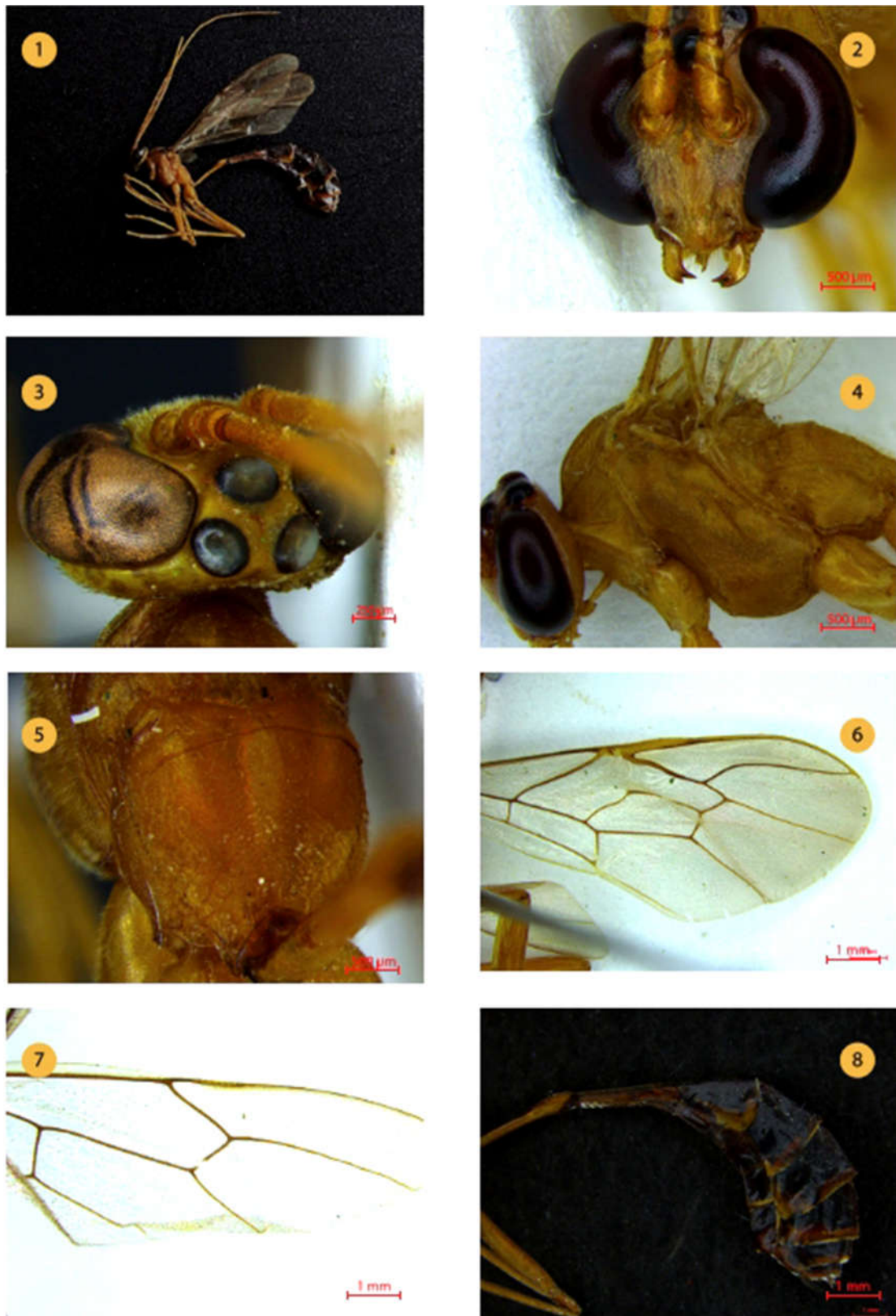


Fig: 1-8 *Enicospilus erythrocerus* (Cameron): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 9

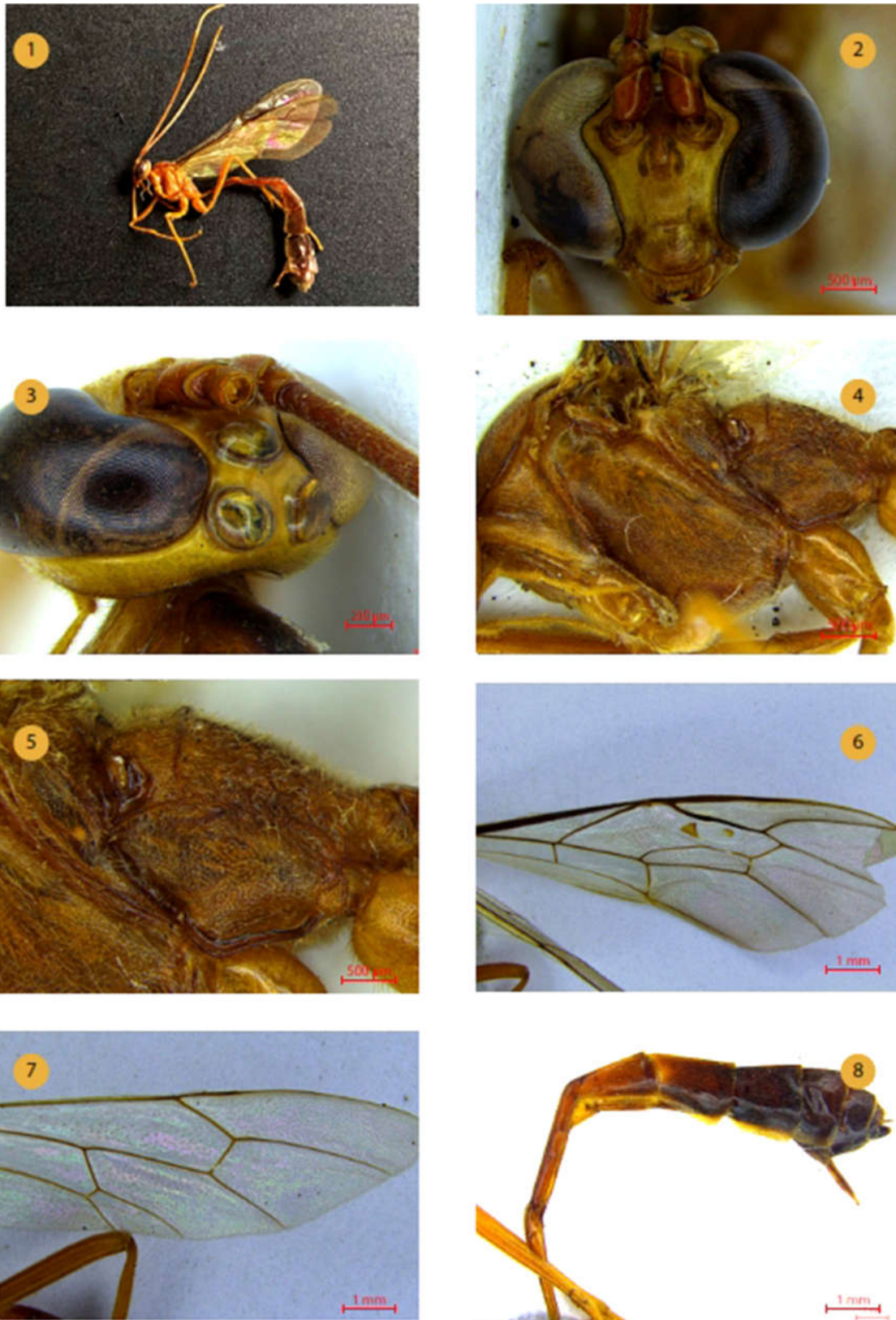


Fig: 1-8 *Enicospilus verticinus* (Smith): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 10

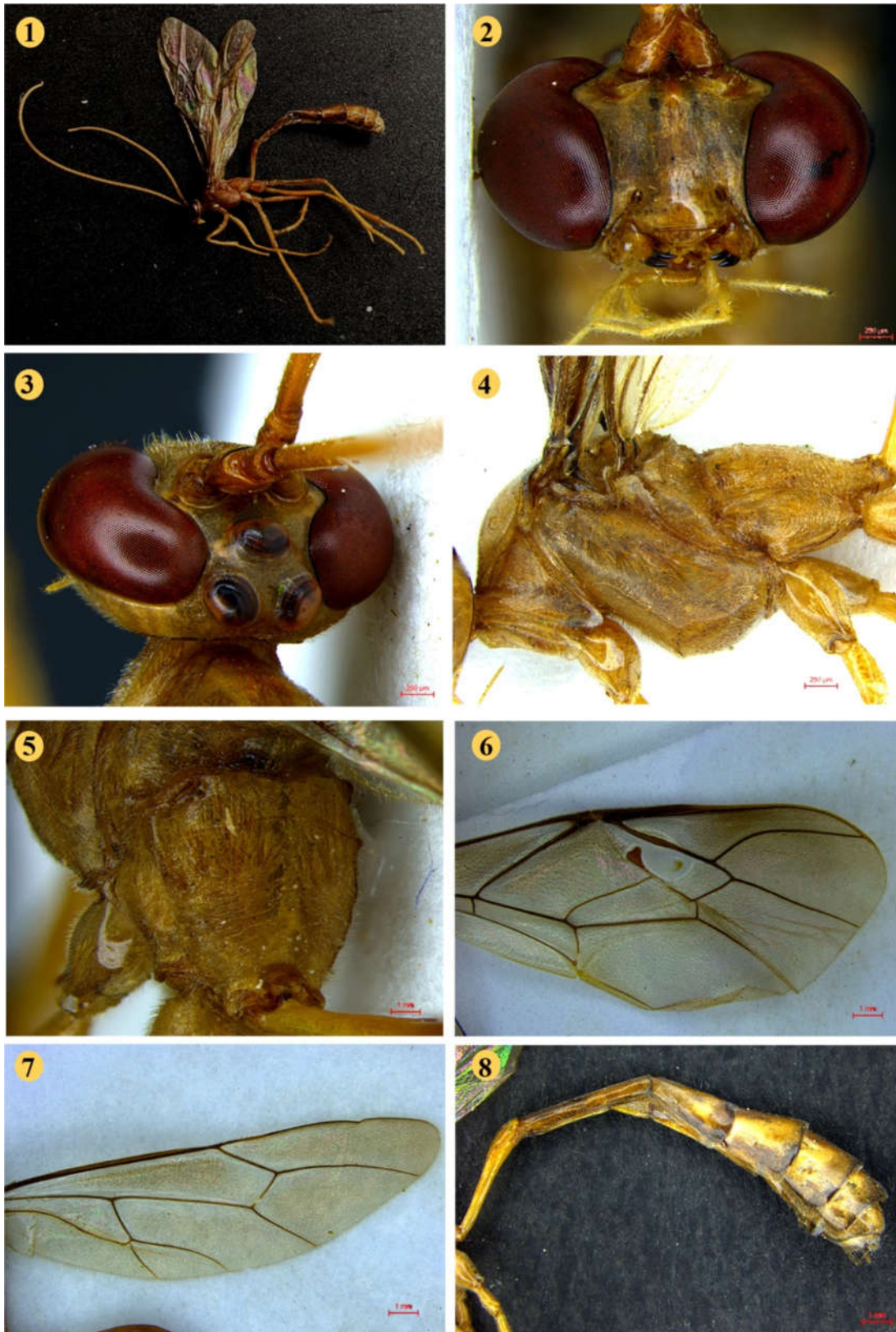


Fig: 1-8 *Enicospilus nigriventris* Nikam: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 11

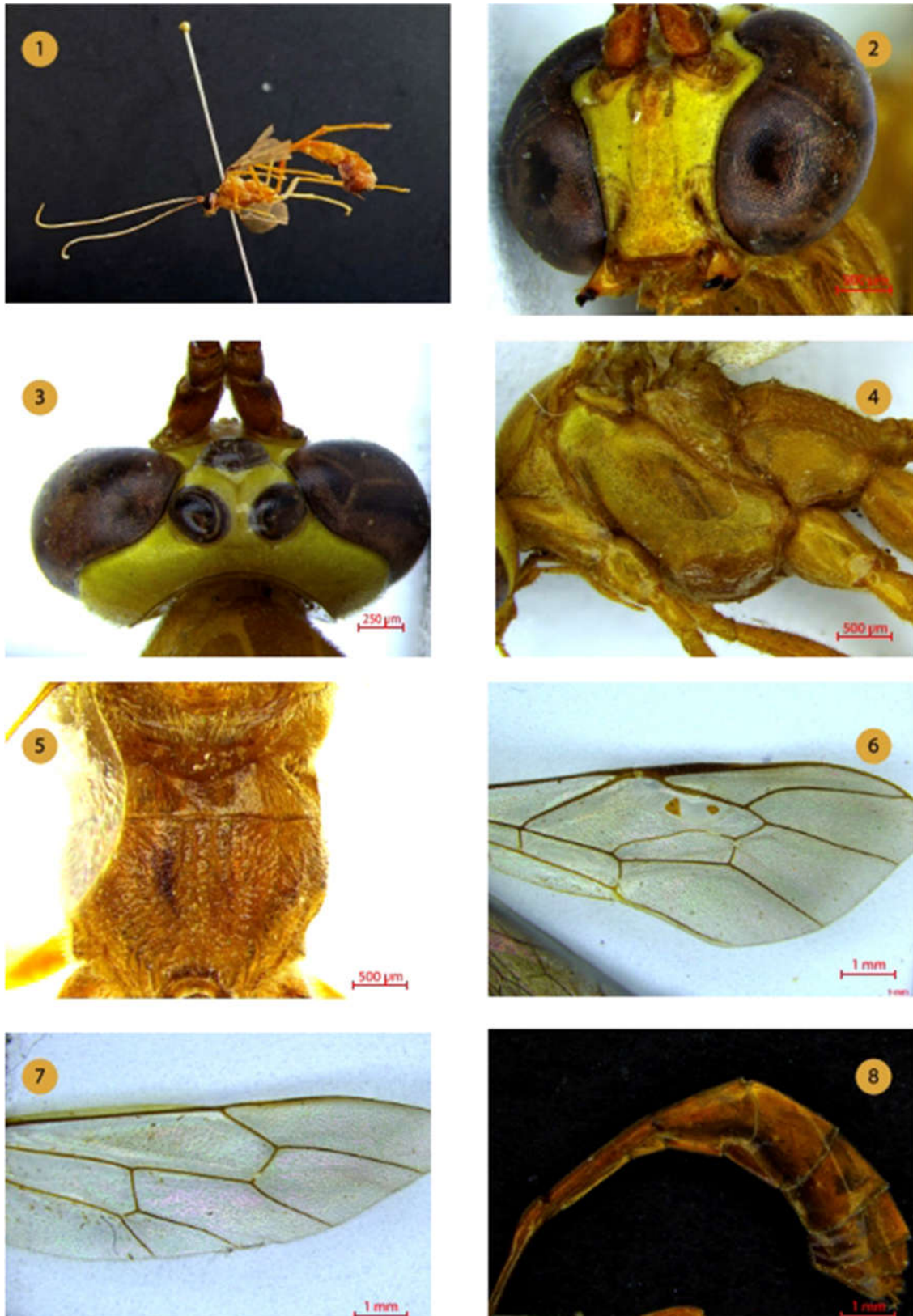


Fig: 1-8 *Enicospilus vestigator* (Smith): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 12

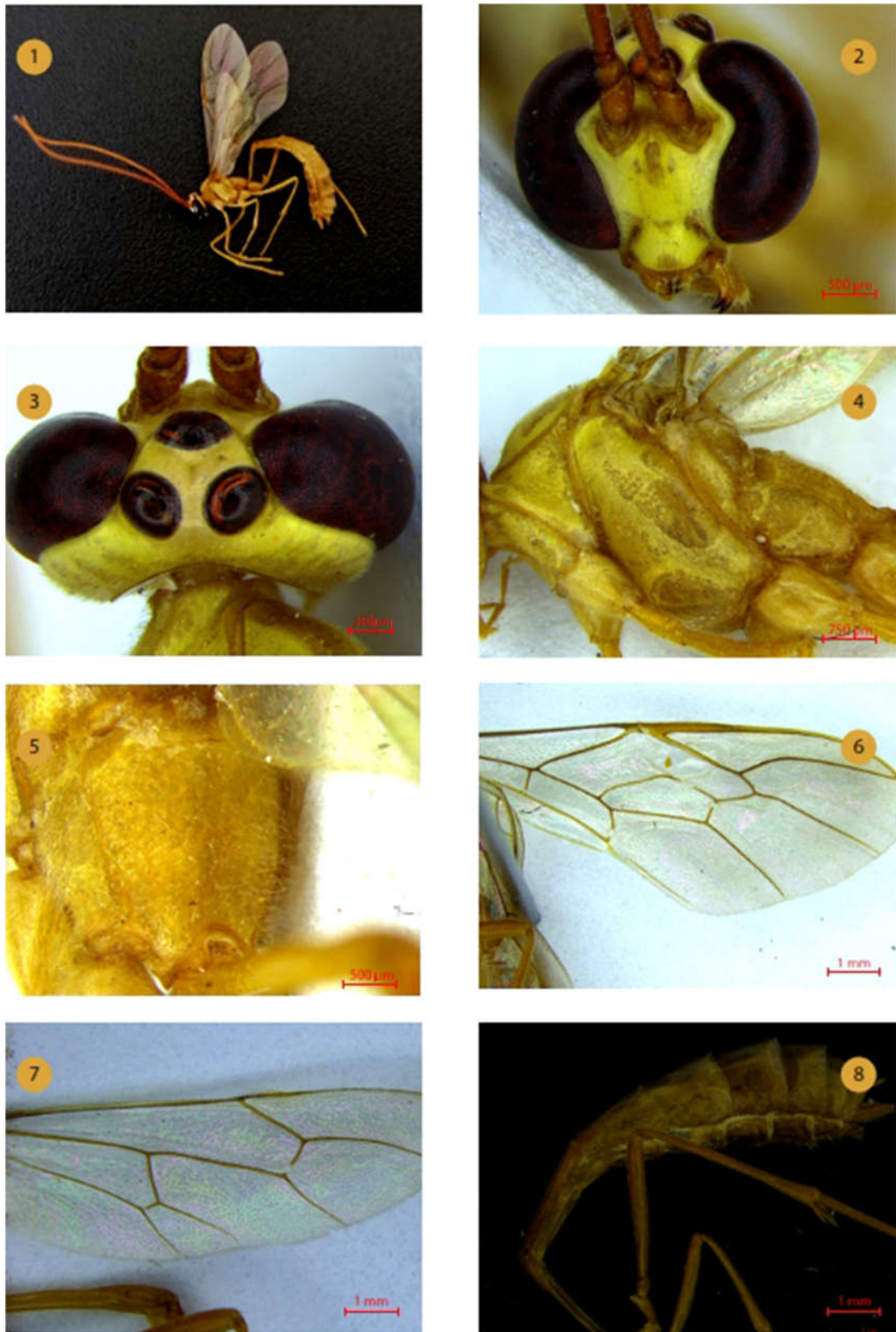


Fig: 1-8 *Enicospilus ghatensis* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 13

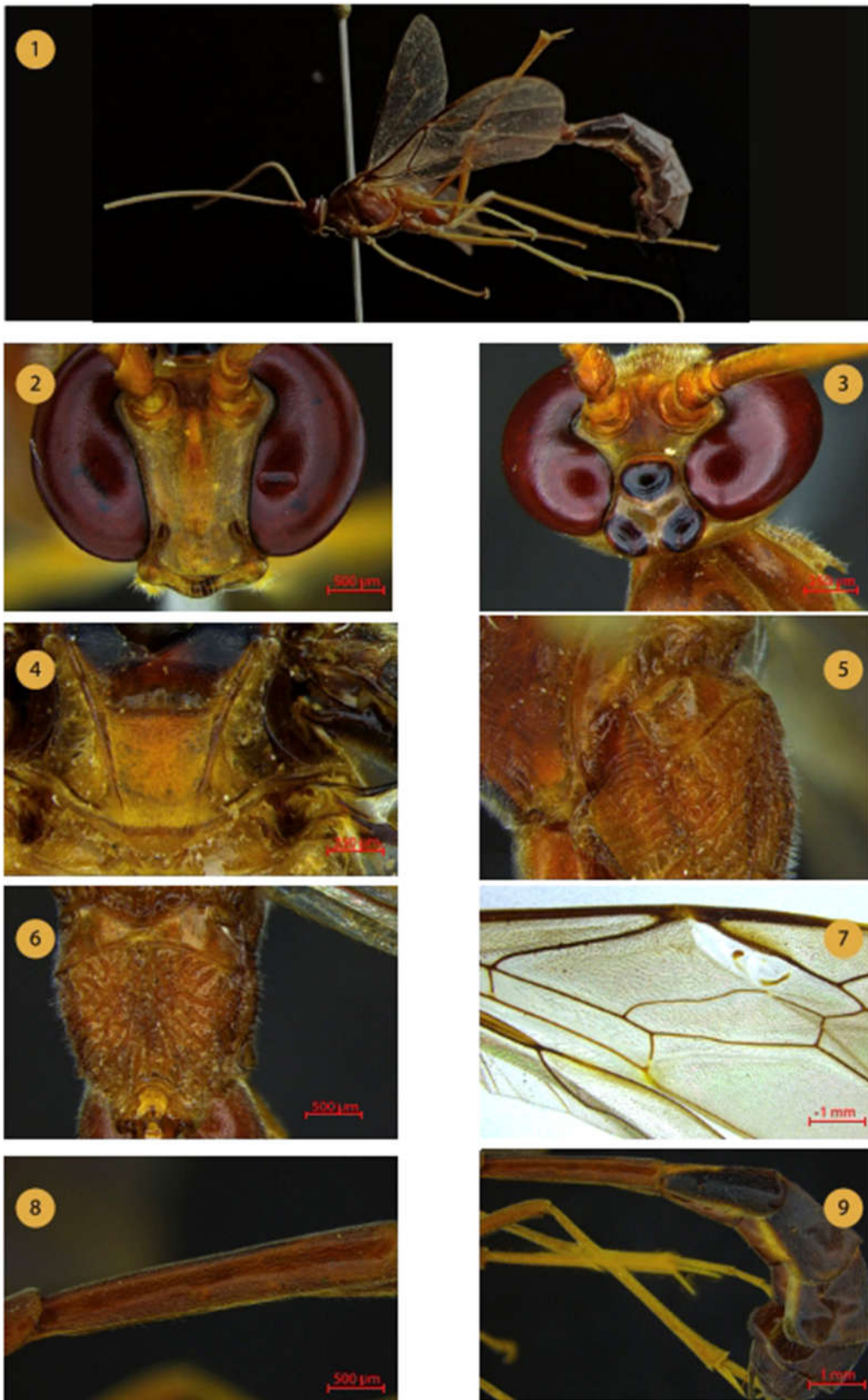


Fig: 1-9 *Enicospilus robustus* sp. nov: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Scutellum; 5. Mesosoma lateral view; 6. Propodeum dorsal view; 7. Forewing; 8. Thyridium; 9. Metasoma lateral view.

PLATE 14



Fig: 1-8 *Enicospilus centralis* Cushman: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 15

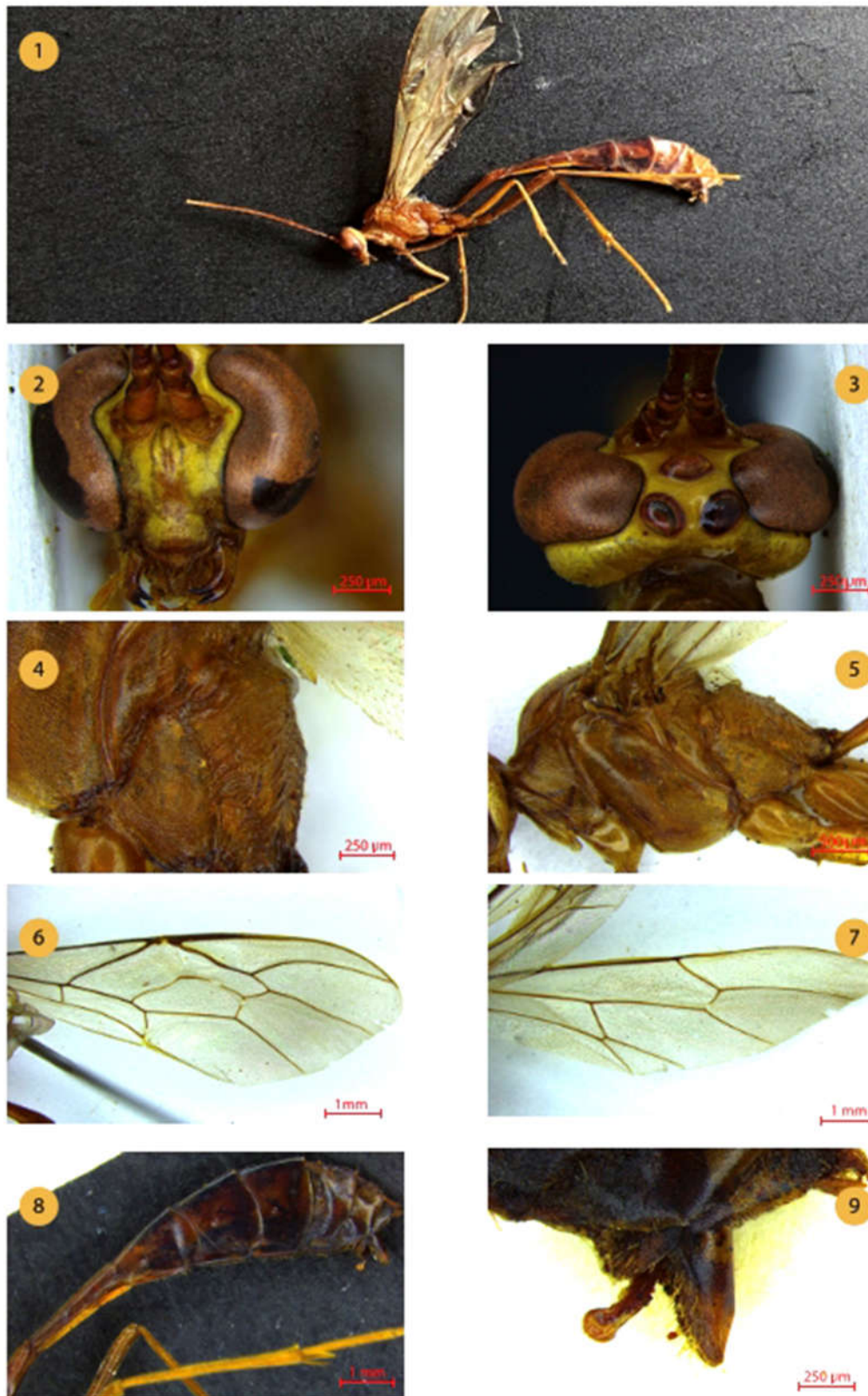


Fig: 1-9 *Enicospilus rufus* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Propodeal spiracle; 5. Mesosoma lateral view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view; 9. Gonosquama.

PLATE 16

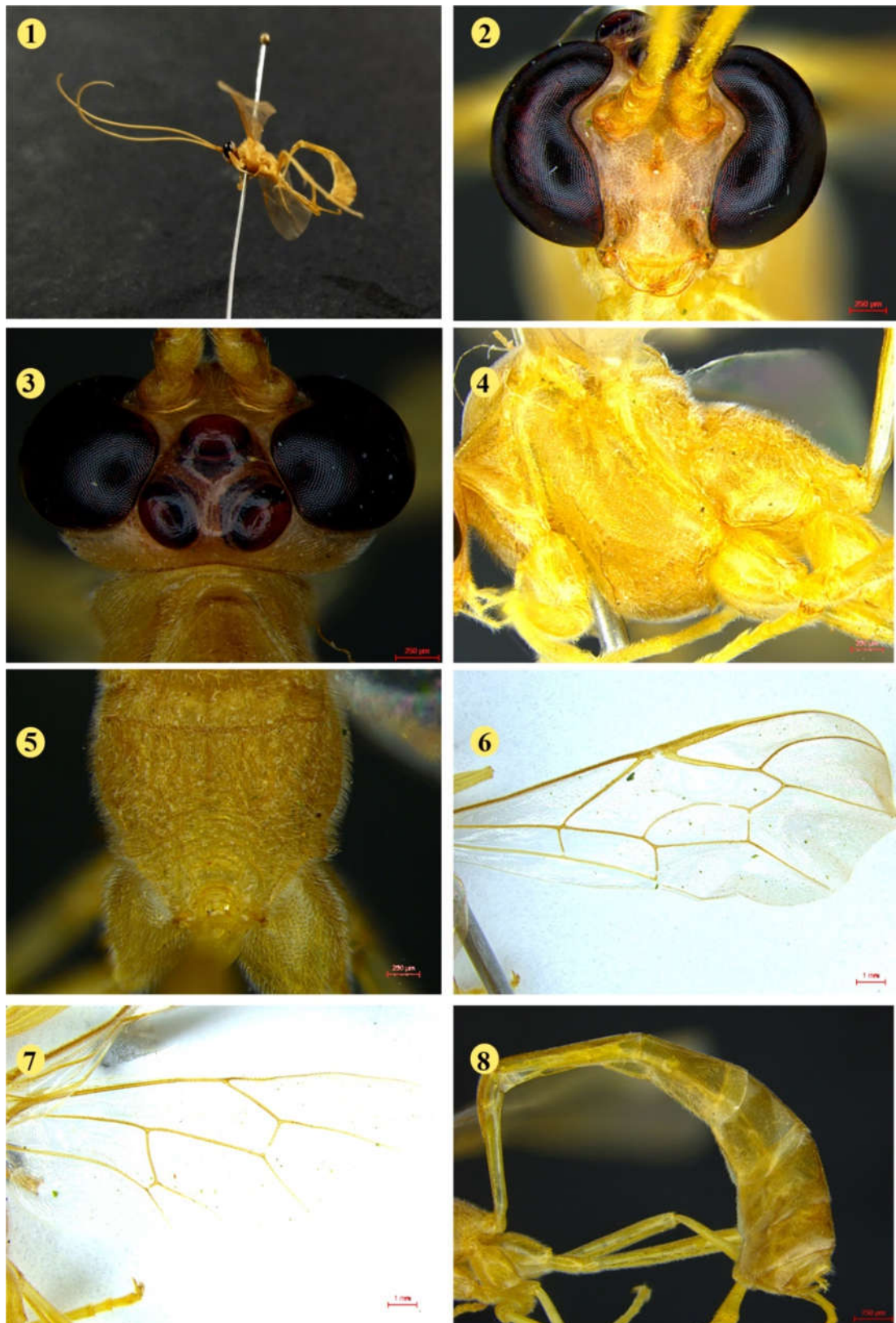


Fig: 1-8 *Enicospilus bres* Gauld and Mitchell: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 17

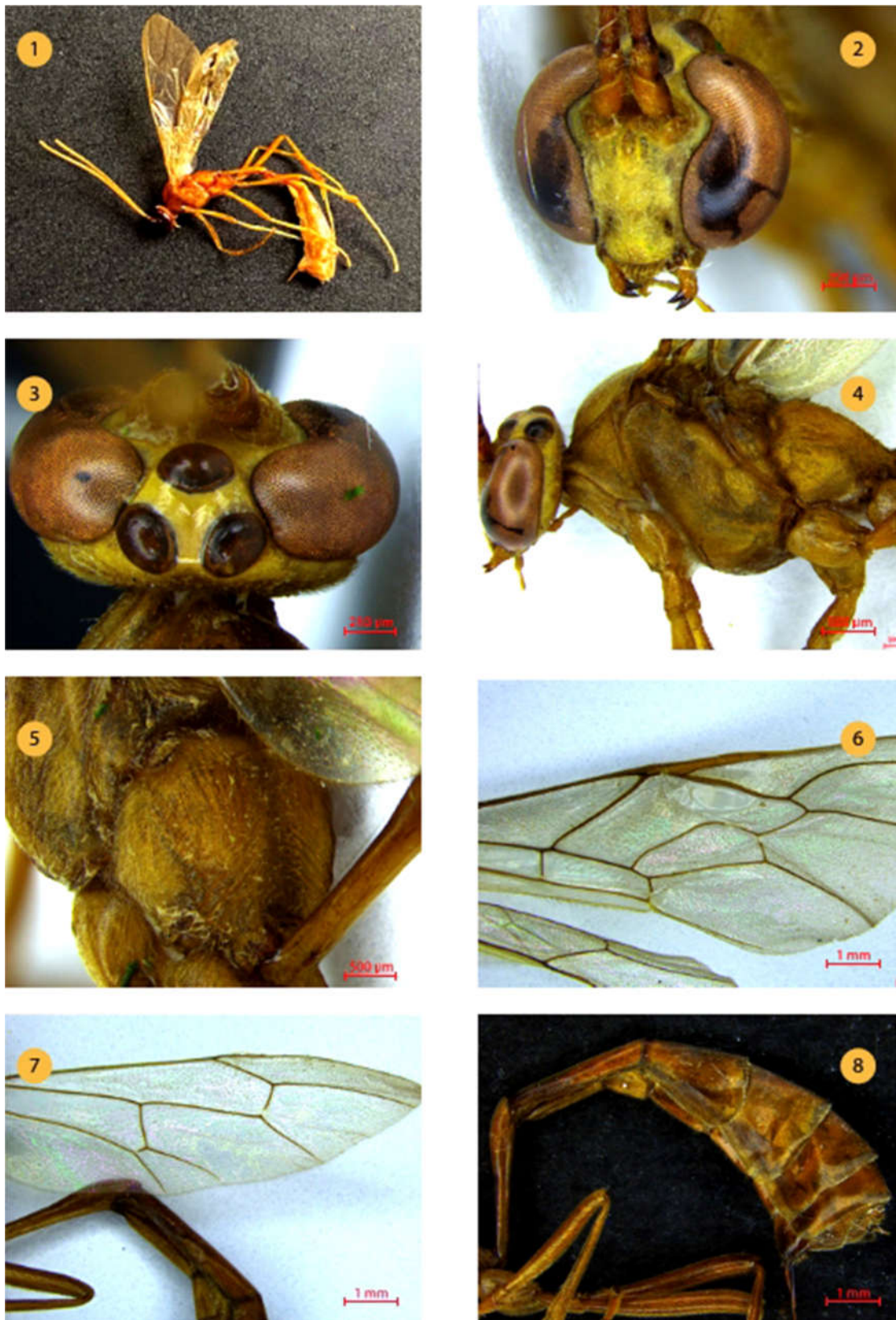


Fig: 1-8 *Enicospilus transversus* Chiu: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 18

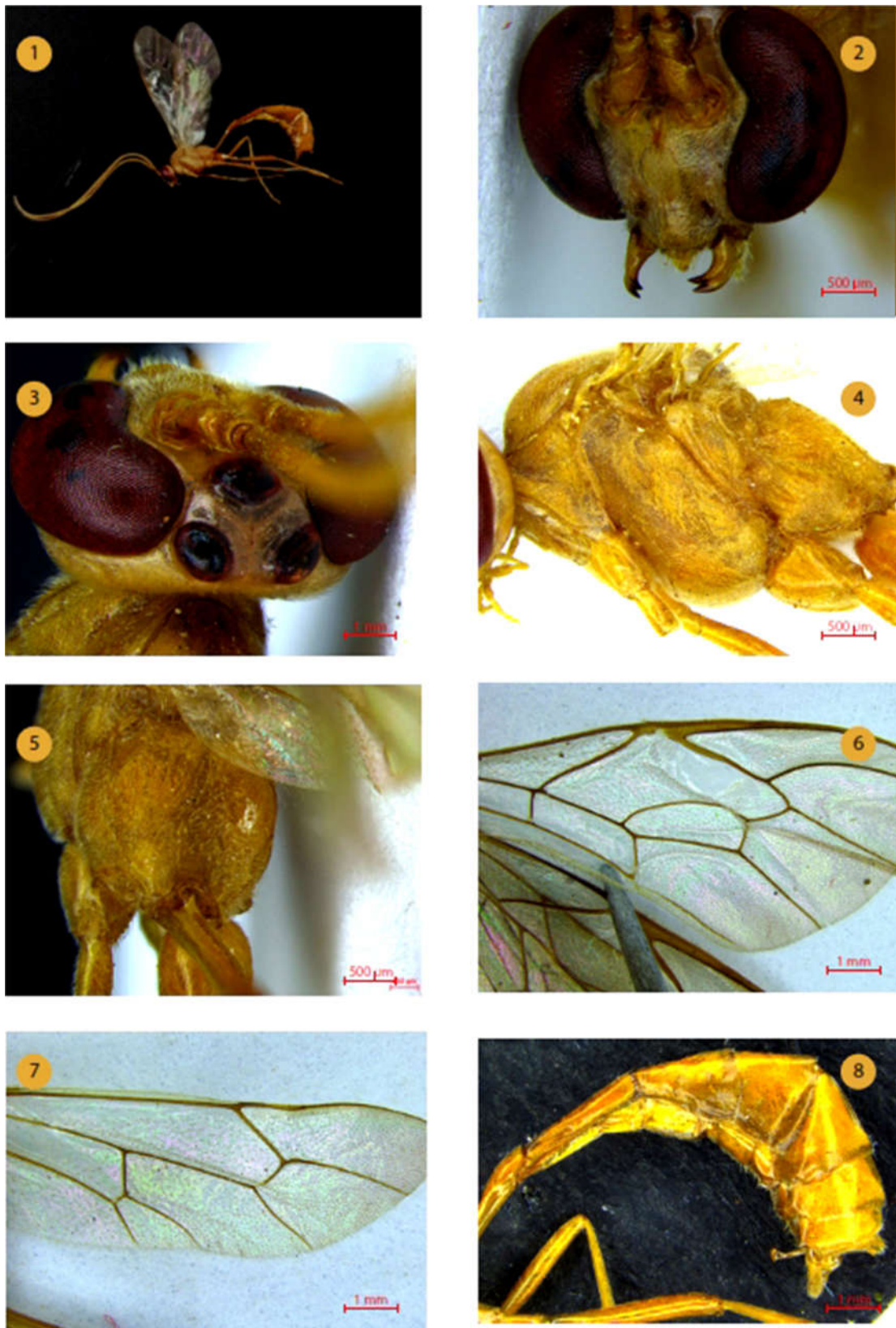


Fig: 1-8 *Enicospilus biharensis* Townes, Townes & Gupta: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 19



Fig: 1-8 *Enicospilus signativentris* Tosquinet: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 20

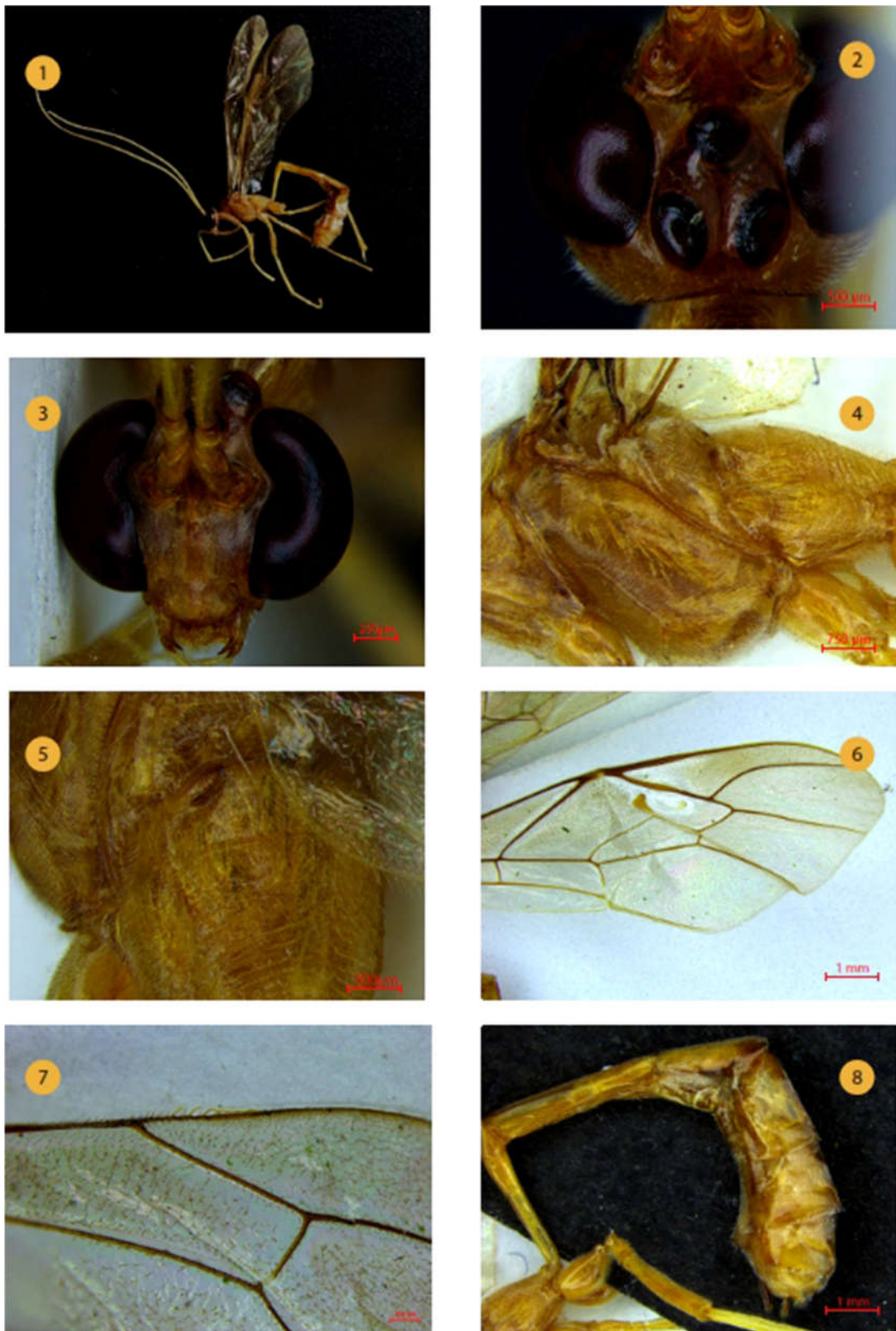


Fig: 1-8 *Enicospilus benazeer* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 21

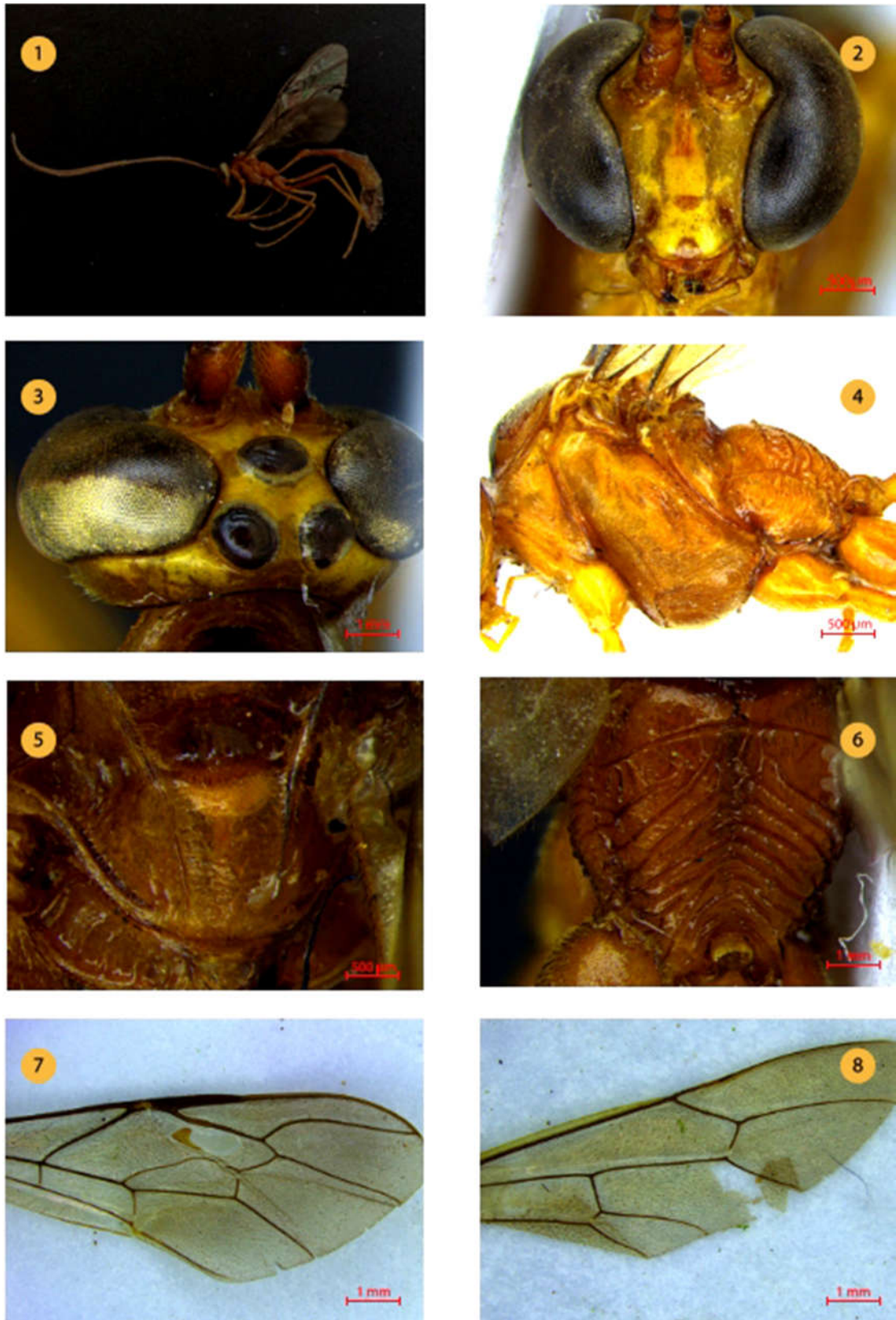


Fig: 1-8 *Enicospilus Kannurensis* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Scutellum; 6. Propodeum dorsal view; 7. Forewing; 8. Hindwing.

PLATE 22

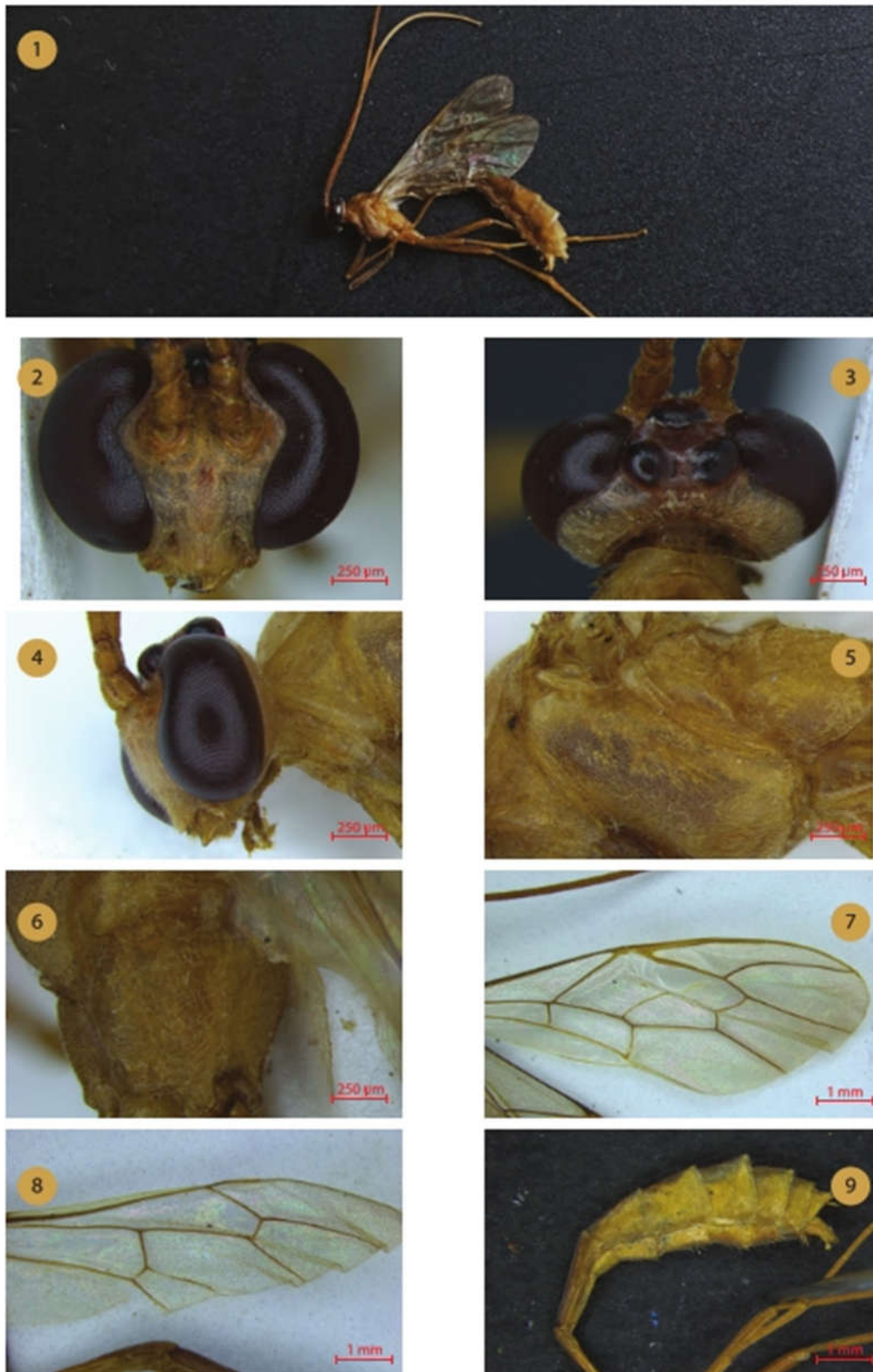


Fig: 1-9 *Enicospilus squamacutus* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Head lateral view; 5. Mesosoma lateral view; 6. Propodeum dorsal view; 7. Forewing; 8. Hindwing; 9. Metasoma lateral view.

PLATE 23

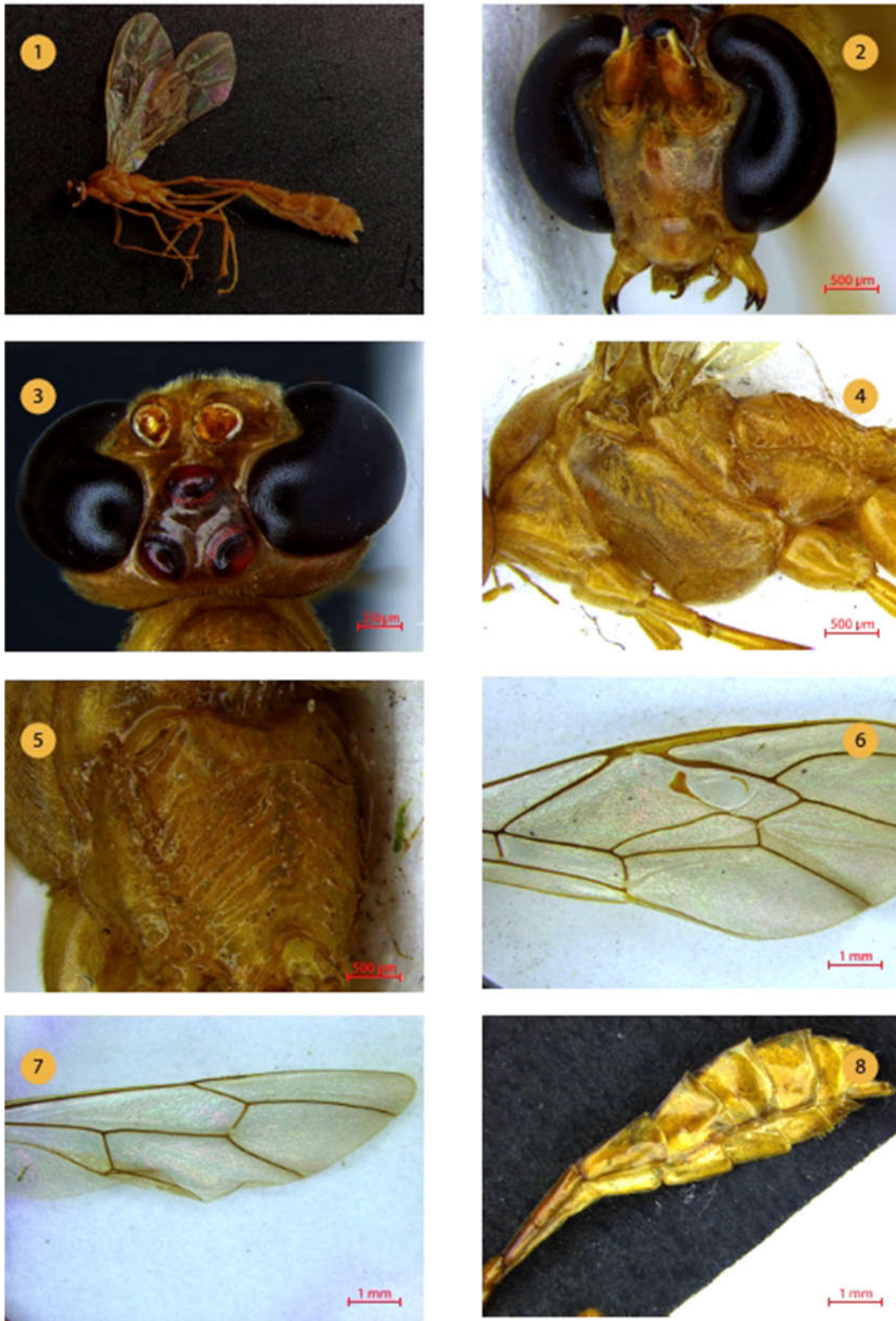


Fig: 1-8 *Enicospilus flavicaput* (Morley): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 24

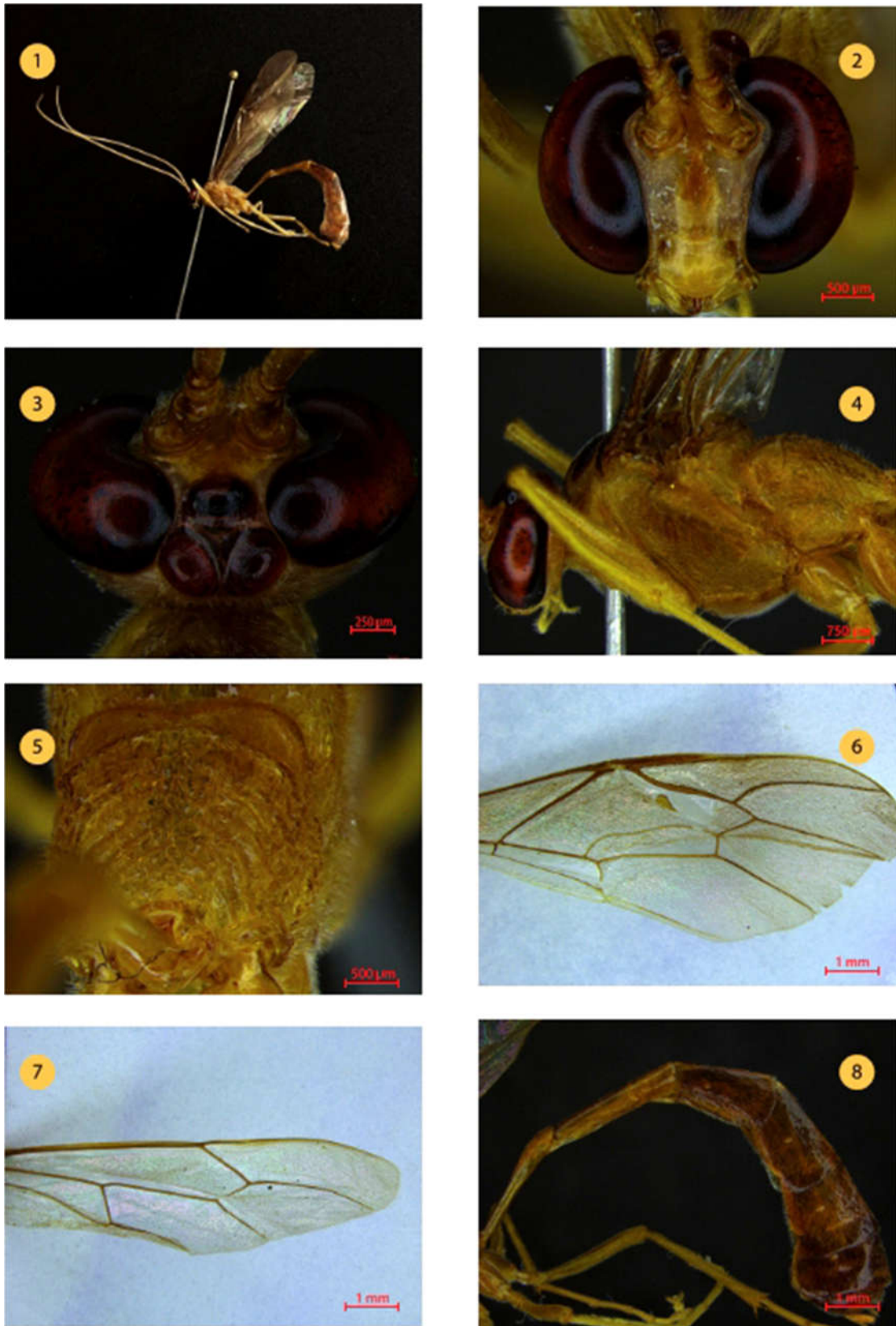


Fig: 1-8 *Enicospilus kasargodensis* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 25

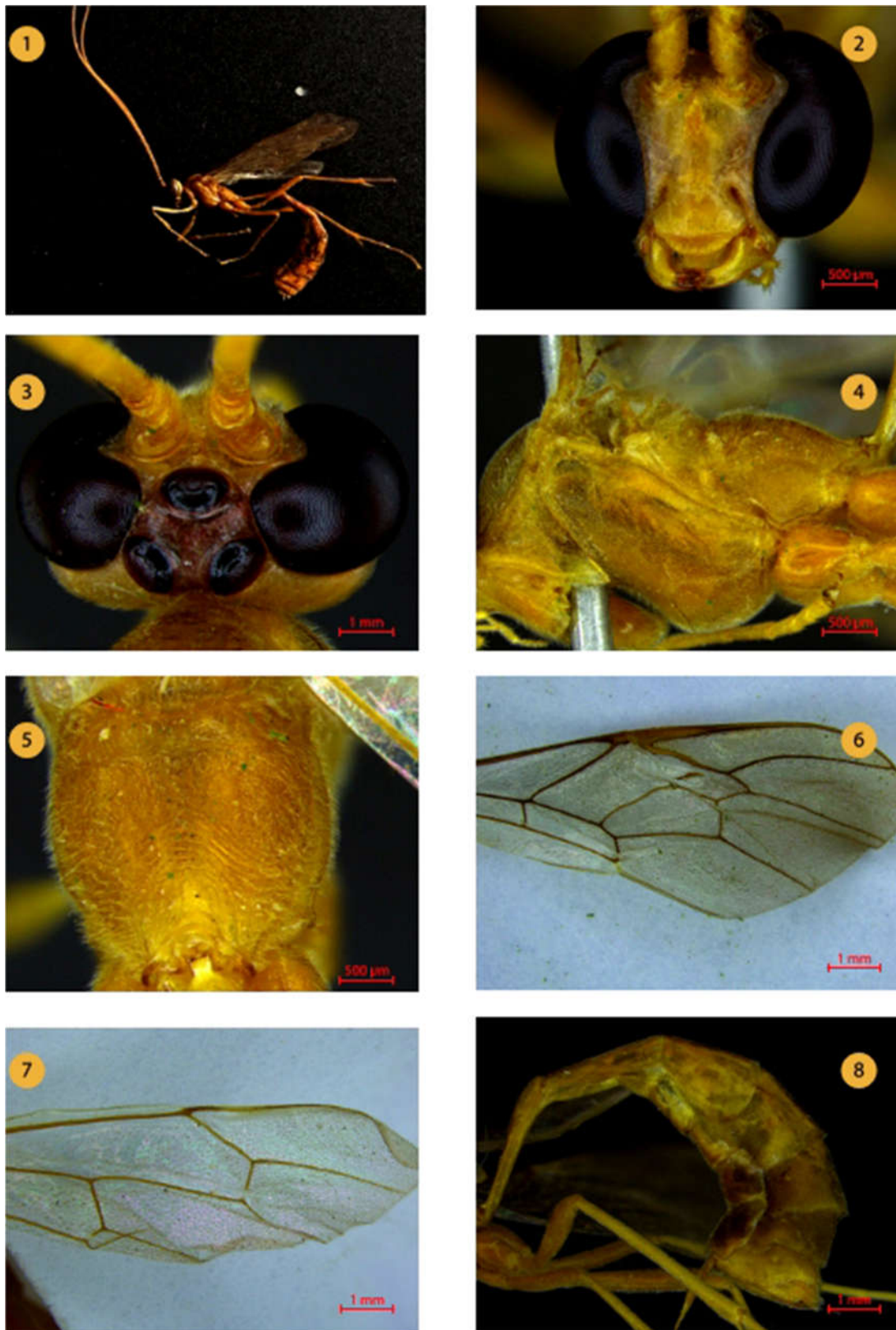


Fig: 1-8 *Enicospilus lineolatus* (Roman): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 26

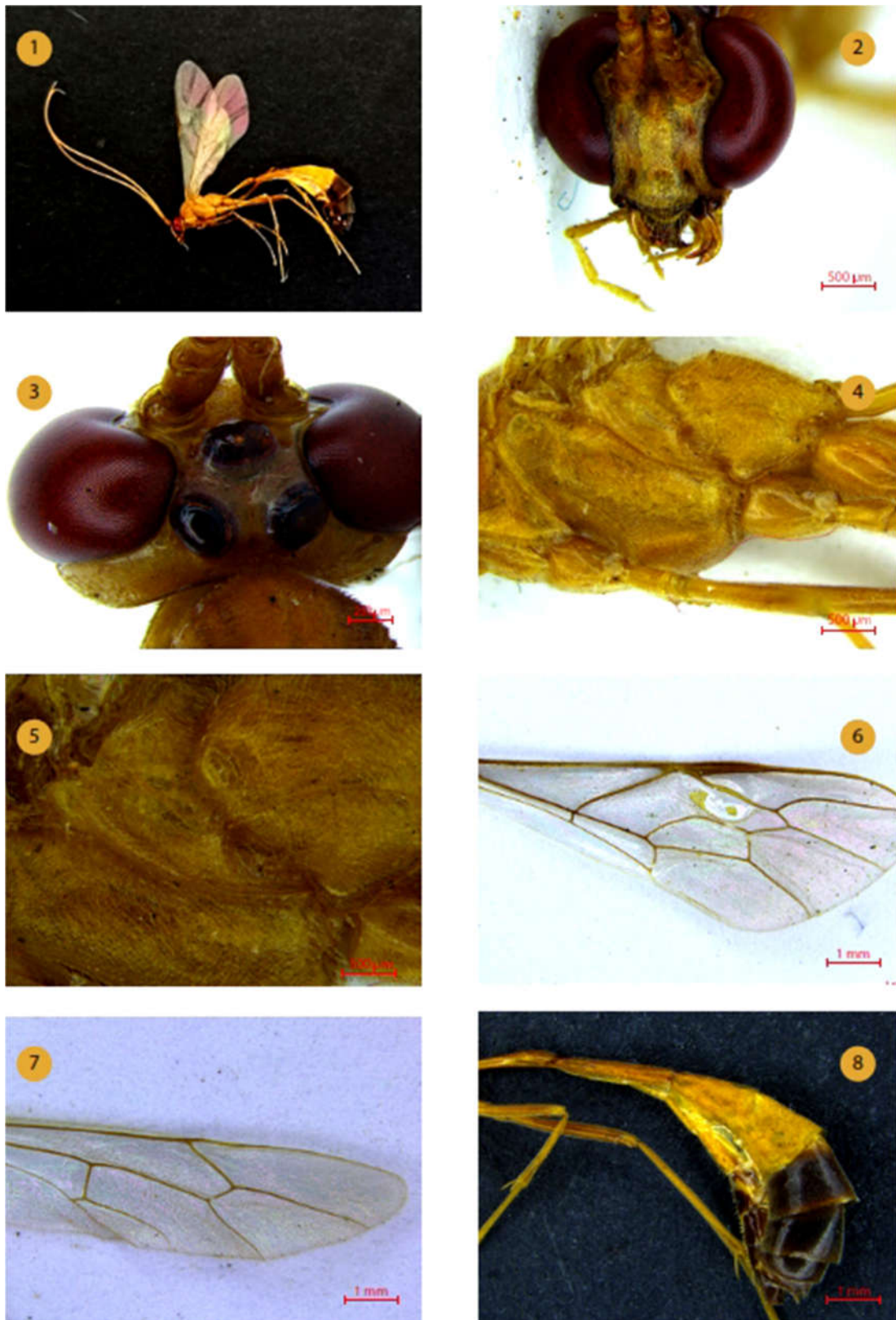


Fig: 1-8 *Enicospilus melanocarpus* (Cameron): 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hindwing; 8. Metasoma lateral view.

PLATE 27

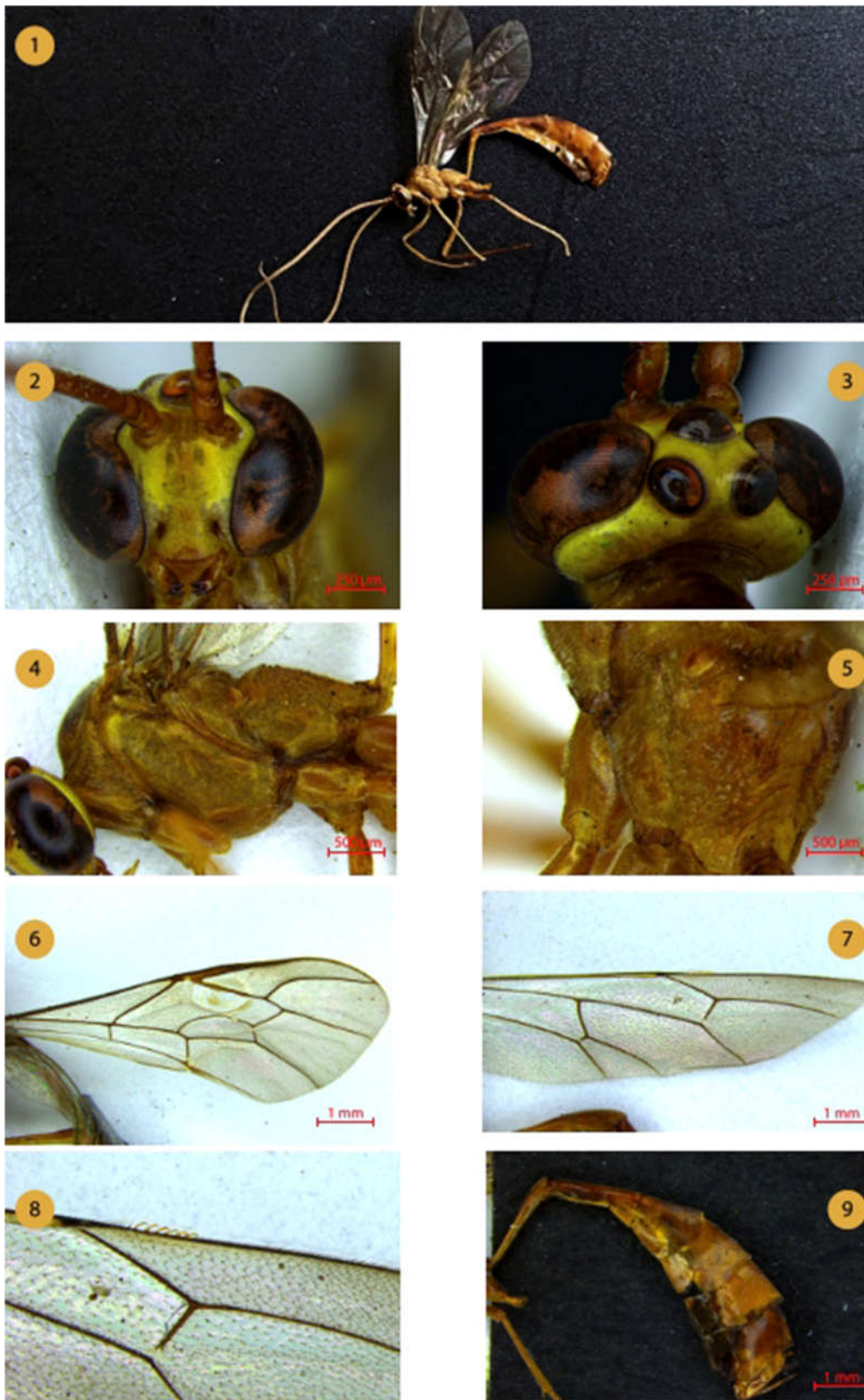


Fig: 1-9 *Enicospilus punctatus* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeal spiracle; 6. Forewing; 7. Hindwing; 8. Hamuli; 9. Metasoma lateral view.

PLATE 28

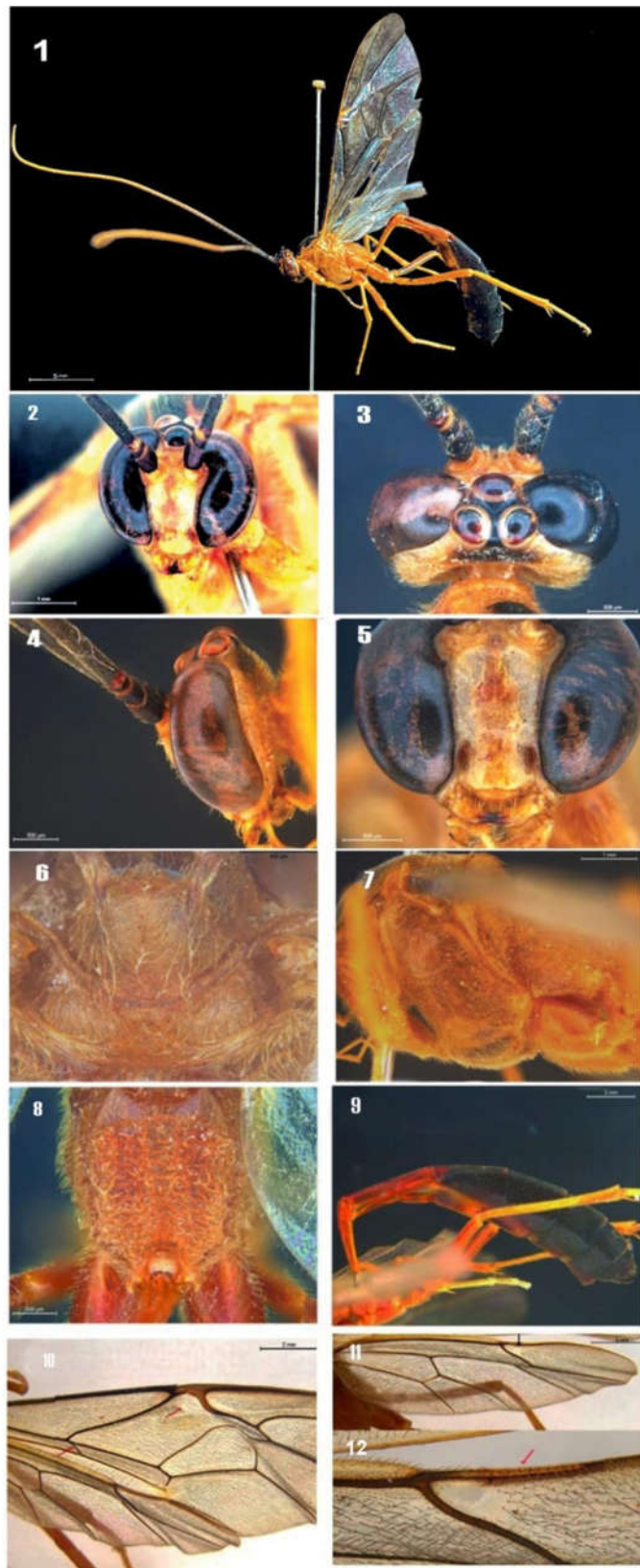


Fig: 1-11 *Stauropoctonus narendrani* Soumya & Sudheer: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Head lateral view; 5. Mandible; 6. Scutellum; 7. Mesosoma lateral view; 8. Propodeum dorsal view; 9. Metasoma lateral view; 10. Forewing; 11. Hindwing (Hamuli).

PLATE 29



Fig: 1-8 *Leptophion maculipennis* Cameron: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Mesoscutellum; 6. Propodeum dorsal view; 7. Forewing; 8. Metasoma lateral view.

PLATE 30

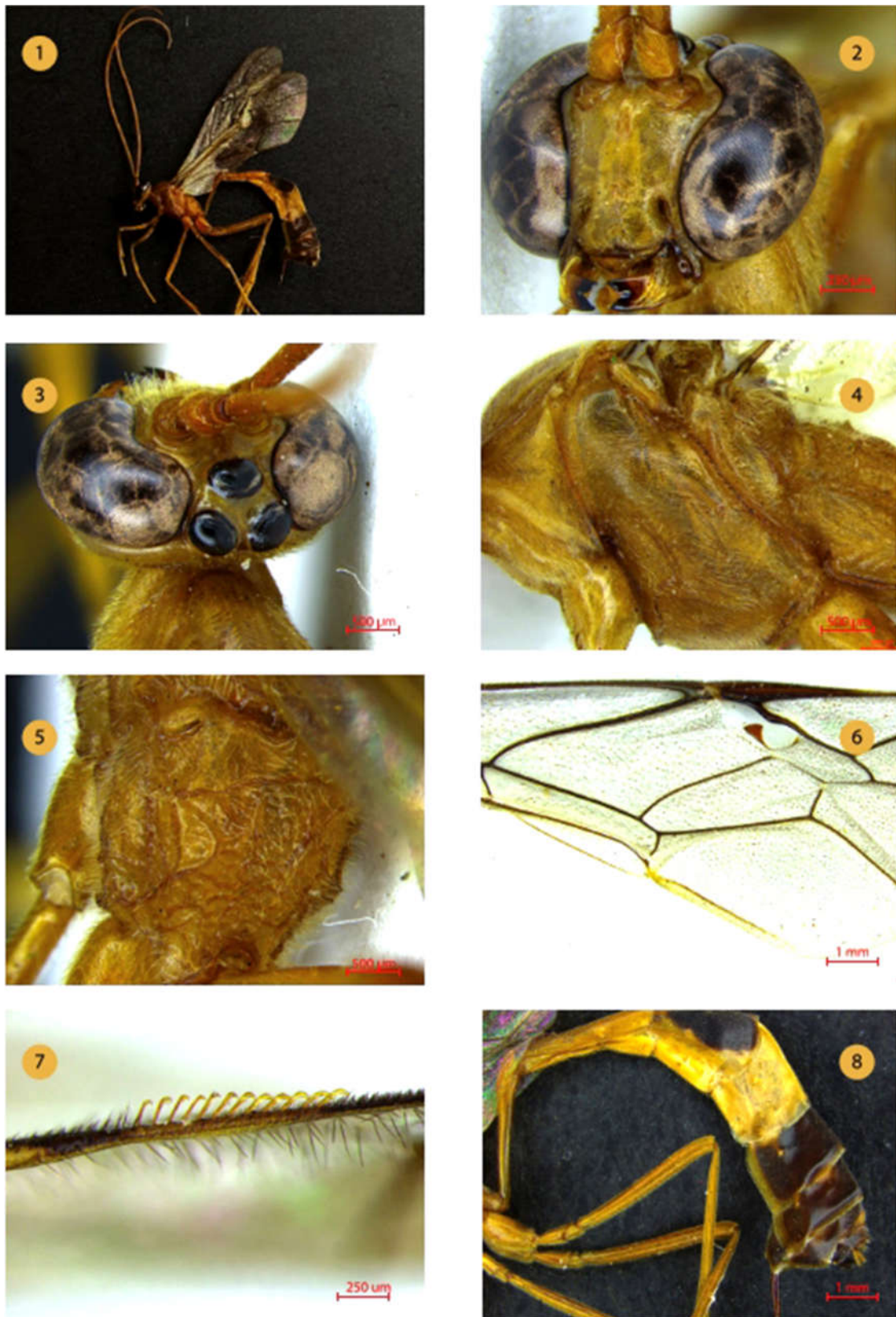


Fig: 1-8 *Dicamptus neosinuatus* sp. nov.: 1. Habitus lateral view; 2. Head frontal view; 3. Head dorsal view; 4. Mesosoma lateral view; 5. Propodeum dorsal view; 6. Forewing; 7. Hamuli; 8. Metasoma lateral view.

CHAPTER 5

SUMMARY

SUMMARY

North Kerala is an excellent place to conduct taxonomic research because of its great biodiversity, which is mainly due to its seasonal rainfall, tropical climate and inclusion of parts of the Western Ghats hotspot region. This is evident in the case of diversity of Ichneumonid wasps too. The present study deals with the taxonomic study of subfamily Ophioninae. Based on the available statistics, knowledge of Ophionine wasps in the Southern Western Ghats is far from completion. To address this gap in knowledge, a taxonomic study on the subfamily Ophioninae from the five districts of North Kerala, that forms part of the Southern Western Ghats was done extending for a period of five years. The findings are summarised below:

- A total of about 2100 hymenopteran specimens were collected from the study area, of which 60% were belonging to family Ichneumonidae and 30% of the Ichneumonids were found as members of subfamily Ophioninae.
- Within the study period (2019-2023), a total of 39 species belonging to four genera are documented from the North Kerala.
- Eleven new species from genus *Enicospilus* Stephens are described.
- One new species from genus *Dicamptus* Szepligetii is described.
- One new species from genus *Stauropoctonus* Brauns was described and published.
- Two Ophionine wasps are newly reported from India, nine species are newly reported from Kerala and Seventeen species are new reports from study area.
- Redescriptions are provided in case of already known but poorly described species.
- Keys to the subfamilies, genera of the Oriental region and keys to the species under each genus are also provided.
- Plates to all the examined species were prepared and provided at the end of the chapter.
- An updated checklist of the Indian Ophionine wasps is provided.

- Host parasitic index of the genera and species treated in this work are included.
- Distribution map of the genera and species were prepared using QGIS software.

To summarize the findings, a total of 12 new species and 17 new records under 4 genera of Ophionine wasps are documented from the study area as a part of this research work that extended for a period of five years (2019-2023). The table showing the statistics of new species and new records documented in this study are provided below:

Table showing new species and new records documented in this study

Sl. No	Genera	Number of species	Number of new species	New record from Study area	New record from Kerala	New record from India
1.	<i>Leptophion</i> Cameron	01	--	01	01	--
2.	<i>Dicamptus</i> Szepliget	02	01	--	--	--
3.	<i>Enicospilus</i> Stephens	35	11	16	08	02
4.	<i>Stauropoctonus</i> Brauns	01	--	--	--	--
	Total	39	12	17	09	02

The twelve new species discovered in this study are listed below, followed by a table showing the new records from the study area :

New species

- *Dicamptus neosinuatus* sp. nov.
- *Enicospilus anokha* sp. nov.
- *Enicospilus benazeer* sp. nov.
- *Enicospilus ghatensis* sp. nov.
- *Enicospilus kannurensis* sp. nov.

- *Enicospilus kasargodensis* sp. nov.
- *Enicospilus malabaricus* sp. nov.
- *Enicospilus punctatus* sp. nov.
- *Enicospilus robustus* sp. nov.
- *Enicospilus rufus* sp. nov.
- *Enicospilus squamacutus* sp. nov.
- *Enicospilus wayanadensis* sp. nov.

Table showing the new records from study area

NEW RECORDS			
SL.NO	NORTH KERALA	KERALA	INDIA
1	<i>Enicospilus abdominalis</i> (Szepliget, 1906)		
2	<i>Enicospilus ashbyi</i> Ashmead, 1904	✓	
3	<i>Enicospilus biharensis</i> Townes, Townes and Gupta, 1961	✓	
4	<i>Enicospilus bres</i> Gauld and Mitchell, 1981	✓	✓
5	<i>Enicospilus centralis</i> Cushman, 1937	✓	✓
6	<i>Enicospilus dolosus</i> (Tosquinet, 1896)		
7	<i>Enicospilus erythrocerus</i> (Cameron, 1905)		
8	<i>Enicospilus flavicaput</i> (Morley, 1912)	✓	
9	<i>Enicospilus lineolatus</i> (Roman, 1913)		
10	<i>Enicospilus melanocarpus</i> Cameron, 1902		

11	<i>Enicospilus nigriventris</i> Nikam, 1975	✓	
12	<i>Enicospilus signativentris</i> (Tosquinet, 1903)		
13	<i>Enicospilus transversus</i> Chiu, 1954	✓	
14	<i>Enicospilus vestigator</i> (Smith, 1858)		
15	<i>Enicospilus verticinus</i> (Roman, 1913)	✓	
16	<i>Enicospilus xanthocephalus</i> Cameron, 1905		
17	<i>Leptophion maculipennis</i> (Cameron, 1905)	✓	

The table below shows 30 species of Ophioninae wasps, belonging to the genera *Dicamptus*, *Enicospilus*, *Stauropoctonus*, *Leptophion*, collected from various parts of North Kerala, summarizing the collection method and habitat of collection. Collections were made in almost all months with peak observations in February, and August to November shows high species diversity and occurrence. Months from August to November (Post monsoon period) shows favourable humidity and vegetation growth in Kerala's forests and plantation. Many species were collected in February month (Start of pre-monsoon), linked to specific life cycle stages or availability of host species. Clove, Cocoa, Coffee plantation and forest habitats support wasps year-round, with spikes during the above peak month. Low activity was recorded during December-January and from March to June.

Different types of Collection techniques are used to sample Ophioninae wasps. Light trap was the most successful among the used methods. It was found effective for nearly all species across almost all habitats. It is effective for nocturnal species common in plantation, forests, sacred groves, grass land and paddy field. Malaise trap was used selectively, often combined with light traps. It was helpful for species in botanical gardens, semi-evergreen forests and coffee plantations. Collections from Sweeping Net and Yellow Pan trap are comparatively poor for

Ophionine wasps. Specimens belonging to the taxa were collected from grassland, paddy field, vegetable garden and sacred groves using these techniques.

Table showing month, place, collection method and Habitat of Ophionine wasps

Sl. No	Species Name	Month	Place	Collection method	Habitat
1.	<i>Dicamptus neosinuatus</i> sp. nov.	February	Chappanthottam	Light trap	Clove plantation
2.	<i>Enicospilus abdominalis</i> (Szepligeti, 1906)	March, February, September.	Chathangottunada, Calicut University Campus, Kannavam	Light trap, Malaise trap	Rubber plantation, Botanical garden, Semievergreen forest
3.	<i>Enicospilus anokha</i> sp. nov.	June	Villiappally	Light trap	Sacred groves
4.	<i>Enicospilus ashbyi</i> Ashmead, 1904	February	Chathangottunada, Calicut University Campus.	Light trap	Cocoa plantation, Botanical garden
5.	<i>Enicospilus benazeer</i> sp. nov	February	Chathangottunada	Malaise trap	Cocoa plantation
6.	<i>Enicospilus biharensis</i> Townes, Townes and Gupta, 1961	August, November	Korome, Chathangottunada, Makkiyad.	Light trap, Sweeping Net	Vegetable Garden, Cocoa plantation, Grass land.
7.	<i>Enicospilus bres</i> Gauld and Mitchell, 1981	August, December.	Chathangottunada, Niravilpuzha.	Light trap	Cocoa plantation, Bittergourd plantation.
8.	<i>Enicospilus centralis</i> Cushman, 1937	May	Ranipuram	Light trap	Shola forest

9.	<i>Enicospilus dolosus</i> (Tosquinet, 1896)	January, June, August, September November December.	Chappanthottam, Kakkayam, Vayalada, Korome, Manathavady, Villiappally, Dharmadom, Makkiyad, Janakikkad, Niravilpuzha, Panamaram.	Light trap, Malaise trap, Sweeping Net.	Clove plantation, Forest, Vegetable garden, Sacred groves, Coffee plantation, grassland, paddy field.
10.	<i>Enicospilus erythrocerus</i> (Cameron, 1905)	January, February, April, August, November.	Chathangottunada, Kakkayam, Korome, Makkiyad, Manathavady, Calicut University Campus, Niravilpuzha, Panamaram.	Light trap, Malaise trap	Clove plantation, Forest, Coffee plantation, Grassland, Paddy field, Botanical garden.
11.	<i>Enicospilus flavicaput</i> (Morley, 1912)	June, August, September.	Nilambur, Vythiri, Chathangottunada, Thamarassery.	Light trap, Malaise trap.	Forest, Coffee plantation, Clove plantation, Grass land.
12.	<i>Enicospilus ghatensis</i> sp. nov.	February, August, November.	Chathangottunada, Korome, Kottiyoor.	Light trap	Clove plantation, Forest, Vegetable garden.
13.	<i>Enicospilus kannurensis</i> sp. nov.	February	Kannavam	Light trap	Semievergreen forest
14.	<i>Enicospilus kasargodensis</i> sp. nov.	May	Ranipuram	Light trap	Shola forest
15.	<i>Enicospilus lineolatus</i> (Roman, 1913)	January, February, May, July, September.	Chathangottunada, Manathavady, Balanthode, Rajapuram, Calicut University Campus, Janakikkad, Vazhikkadavu, Korome.	Light trap, Malaise trap	Clove plantation, Forest, Rubber plantation, Botanical garden, Forest, Grass land

16.	<i>Enicospilus malabaricus</i> sp. nov.	January, February, July, August, September, October, November, December.	Chathangottunada, Manathavady, Balanthode, Calicut University Campus, Villiappally, Kodenchery, Nilambur, Korome, Panamaram, Janakikkad.	Light trap, Malaise trap, Sweeping net.	Clove plantation, Forest, Rubber plantation, Botanical garden, Sacred groves, Forest, Grass land, Paddy field
17.	<i>Enicospilus melanocarpus</i> Cameron, 1902	September	Villiappally, Janakikkad.	Light trap	Sacred groves, Forest
18.	<i>Enicospilus nigriventris</i> Nikam, 1975	February	Chathangottunada	Light Trap	Cocoa plantation
19.	<i>Enicospilus punctatus</i> sp. nov.	November	Bandadkha	Light Trap	Forest
20.	<i>Enicospilus robustus</i> sp. nov.	February, April.	Chathangottunada, Calicut University Campus.	Light Trap, Malaise Trap	Cocoa plantation, Botanical garden.
21.	<i>Enicospilus rufus</i> sp. nov.	February, April.	Niravilpuzha, Calicut university Campus, Chathangottunada.	Light Trap, Malaise Trap.	Clove plantation, Bitter gourd plantation, Botanical Garden
22.	<i>Enicospilus signativentris</i> (Tosquinet, 1903)	January, February, April, May, July, August, September, November, December.	Calicut university Campus, Chathangottunada, Ulliyeri, Korome, Kodenchery, Ambalavayal, Nilambur, Bandadka, Kutikulam, Makkiyad, Janakikkad, Panamaram, Chundale.	Light Trap, Sweeping Net, Yellow pan Trap	Botanical Garden, Cocoa plantation, Vegetable Garden, Sacred groves, Paddy field, Forest, Coffee plantation, Rubber plantation

23.	<i>Enicospilus squamacutus</i> sp.nov.	June, July, November	Chathangottunada, Manathavady, Janakikkad, Niravilpuzha.	Light Trap	Clove plantation, Forest, Coffee plantation
24.	<i>Enicospilus transversus</i> Chiu, 1954	February, May, September, November, December.	Vayalada, Manathavady, Janakikkad, Kottiyoor, Niravilpuzha.	Light Trap, Malaise Trap	Semi evergreen forest, Grass land, Coffee plantation
25.	<i>Enicospilus verticinus</i> (Roman, 1913)	February, July.	Makkiyad, Chathangottunda.	Light Trap	Clove plantation, Coffee plantation
26.	<i>Enicospilus vestigator</i> (Smith, 1858)	February, July, November.	Chathangottunda, Villiappally, Kottiyoor, Thalassery.	Light Trap	Cocoa plantation, Sacred groves, Semi-ever green forest, Vegetable Garden
27.	<i>Enicospilus xanthocephalus</i> Cameron, 1905	February, April, May.	Chathangottunada, Calicut University Campus, Kozhikode, Korome.	Light Trap, Malaise Trap	Cocoa plantation, Botanical garden, Grassland
28.	<i>Enicospilus wayanadensis</i> sp. nov.	November	Thirunelly	Light Trap	Shola Forest
29.	<i>Stauropoctonus narendrani</i> Soumya and Sudheer, 2023	September	Kannavam	Light trap	Forest
30.	<i>Leptophion maculipennis</i> (Cameron, 1905)	October	Chappanthottam	Light trap	Clove plantation

The checklist of genera and species of subfamily Ophioninae from India includes 17 species of *Ophion* Fabricius, 2 species of *Sclerophion* Gauld, 1 species of *Orientospilus* Morley and *Euryophion* Cameron each, 3 species of *Leptophion* Cameron under the tribe Ophionini and 12 species of *Dicamptus* Szepliget, 86

species of *Enicospilus* Stephens and 1 species of *Stauropoctonus* Brauns under the tribe Enicospilini. In total, the updated checklist includes 122 species under 8 genera.

Table showing the statistics of updated checklist of Indian Ophioninae

Sl. No	Genera	No of Species	Tribe
1	<i>Euryophion</i> Cameron	01	Ophionini
2	<i>Leptophion</i> Cameron	03	
3	<i>Ophion</i> Fabricius	17	
4	<i>Orientospilus</i> Morley	01	
5	<i>Sclerophion</i> Gauld	02	
6	<i>Dicamptus</i> Szepligeti	11	Enicospilini
7	<i>Enicospilus</i> Stephens	86	
8	<i>Stauropoctonus</i> Brauns	01	
	Total	122	

Host parasite index reveals that only data of 9 species are available so far among the 40 species recorded from the study area. An analysis shows that data of only 20% species of host parasitic wasps relation are known in a vast majority of taxonomic groups. Further investigation in this area is needed to reveal more data that may aid in biocontrol programs

Distribution maps were prepared with the help of species location taken from the field, using open-source software.

CHAPTER 6

RECOMMENDATIONS

RECOMMENDATIONS

Ophionine wasps, one of the largest and most diverse subfamily of family Ichneumonidae under the order Hymenoptera, play a crucial role in controlling insect populations in natural and agricultural ecosystems. Their biology makes them subjects of interest for entomological research and biological control strategies as their parasitic activities help control the number of potential pests and maintain ecological balance. Despite their valuable role in our ecosystem, only a small fraction of these wasp species have been identified and described, especially from Western Ghats, including Kerala. This small fraction likely represents less than a quarter of their true richness as reliable estimates are lacking, along with much of the most basic knowledge about their ecology, distribution, and evolution. Host data of many species and even many genera are not available or yet to be studied, which may improve our current practice of biological control strategies. Also, molecular studies of Ophionine wasps are very few from India that may lead to the misidentification of closely related species.

The present study provides baseline information on taxonomy, distribution, and host data of Ophionine wasps in North Kerala and reported 12 new species and 17 new records from the study area. In the present study, the study area is limited to North Kerala covering five districts. Extending similar studies to other parts of Kerala are recommended to explore the hidden diversity of Ophionine wasps. Further biosystematic, ecological, and molecular studies on these groups will give more insights into the biological potential of these ecologically important groups.

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