TAXONOMIC STUDIES ON THE FAMILY TIPHIIDAE (HYMENOPTERA: VESPOIDEA) OF KERALA STATE

Thesis submitted to the University of Calicut in partial fulfilment of the requirements for the award of the degree of

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(Faculty of Science)

BY

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CERTIFICATE

This is to certify that this thesis entitled "**TAXONOMIC STUDIES ON THE FAMILY TIPHIIDAE (HYMENOPTERA: VESPOIDEA) OF KERALA STATE**" submitted to the University of Calicut for the award of the degree of Doctor of Philosophy in Zoology (Faculty of Science), is an authentic research work done by Ms. Hanima Raveendran K.P. in the Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, under my direct supervision and guidance. This work has not been previously formed the basis for any other degree, diploma or similar titles.

It is further certified that the candidate has passed the Ph.D. qualifying examination of the University of Calicut held in July, 2019.

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DECLARATION

I hereby declare that the work presented in the thesis entitled **TAXONOMIC STUDIES ON THE FAMILY TIPHIIDAE (HYMENOPTERA: VESPOIDEA) OF KERALA STATE** is based on the original work done by me under the guidance of **Dr. P. Girish Kumar**, Scientist-D, Zoological Survey of India, Western Ghat Regional Centre, 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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Hanima Raveendran K. P.

Dedicated to my Family

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ABSTRACT

Tiphiidae is a large, worldwide family of solitary wasps in 200 genera with more than 2,000 species placed in 7 subfamilies, namely, Anthoboscinae, Brachycistidinae, Diamminae, Methochinae, Myzininae, Thynninae and Tiphiinae. They are mostly external parasitoids of beetle larvae. The females in some subfamilies are wingless.

The present study focusses to taxonomically identify Tiphiidae species from Kerala. The present investigation brought into light 40 species from 4 genera, representing 3 subfamilies from the study area. Ten species new to science namely, *Methocha keralaensis* Hanima & Girsh Kumar, *Methocha krombeini* Hanima, Girish Kumar & Binoy, *Methocha paraceylonica* Hanima, Girish Kumar & Binoy, *Tiphia (Tiphia) bijui* Hanima & Girish Kumar, *Tiphia (T.) davidrajui* Hanima & Girish Kumar, *Tiphia (T.) kashmirensis* Hanima & Girish Kumar, *Tiphia (T.) kurumba* Hanima & Girish Kumar, *Tiphia (T.) novus* Hanima & Girish Kumar, *Tiphia (T.) rajeevani* Hanima & Girish Kumar, *Tiphia (T.) shajii* Hanima & Girish Kumar were described and published from Kerala. Two species namely, *Mesa keralaensis* **sp. nov.** and *Tiphia (T.) crassumpunctura* **sp. nov.** are described as new in the thesis. Also 9 species such as *Methocha taprobane* Krombein, *Methocha ubiquita* Krombein, *Tiphia (T.) consueta* Smith, *Tiphia (T.) flavipalpis* Allen, *Tiphia (T.) godavariae* Allen, *Tiphia (T.) lotharae* Allen, *Tiphia (T.) lyrata* Magretti, *Tiphia (T.) milleri* Allen, and *Tiphia (T.) nepa* Allen, were newly recorded from India. This study also provides dichotomous key of all the Indian tiphiids and also illustrating all the species found from the Kerala. The distribution to species of all genera are produced using Online QGIS. The present study led to the publication of one monograph, six international papers, two book chapters, and one online publication.

സംക്ഷിപ്തം

ലോകമെമ്പാടുമുള്ള 200 ജനുസ്സുകളിൽപെട്ട (Genus) ഒറ്റപ്പെട്ട ജീവിതം നയിക്കുന്ന കടന്നലുകളുടെ ഒരു വലിയ കുടുംബമാണ് ടിഫിഡെ (Tiphiidae). രണ്ടായിരത്തിലധികം സ്പീഷീസുകളെ (Species) 7 ഉപകുടുംബങ്ങളായ (Subfamilies) ആന്തോബോസിനെ (Anthoboscinae), ബ്രാക്കിസിസ്റ്റിഡിനെ (Brachycistidinae), ഡയാമ്മിനെ (Diamminae), മെതോചിനെ (Methochinae), മൈസിനിനെ (Myzininae), തൈന്നിനെ (Thynninae), ടിഫിനെ (Tiphiinae) എന്നിവയിൽ ഉൾപ്പെടുത്തിയിരിക്കുന്നു. ഇവയിൽ അധികവും വണ്ടുകളുടെ ലാർവകളുടെ ബാഹ്യ പരാദങ്ങളാണ്. ചില ഉപകുടുംബങ്ങളിലെ പെൺ ഇനങ്ങൾ ചിറകില്ലാത്തവയാണ്.

കേരളത്തിൽ നിന്നുമുള്ള ടിഫിഡെ സ്പീഷീസുകളെ വർഗ്ഗീകരണപരമായി തിരിച്ചറിയുന്നതിനാണ് ഇപ്പോഴത്തെ പഠനം ഊന്നൽ നൽകുന്നത്. കേരളത്തിൽ നിന്നുമുള്ള 3 ഉപകുടുംബങ്ങളെ പ്രതിനിധീകരിക്കുന്ന 4 ജനുസ്സുകളിൽ നിന്നുള്ള 40 സ്പീഷീസുകളെയാണ് ഇപ്പോഴത്തെ ഗവേഷണത്തിൽ കണ്ടെത്തിയത്. ഇവയിൽ പത്ത് പുതിയ ഇനങ്ങൾ ഉൾപ്പെടുന്നു. *മെതോച കേരളായെൻസിസ് (Methocha keralaensis)*, *മെതോച ക്രോംബീനി (Methocha krombeini)*, *മെതോച പാരാസെയിലോനിക്ക (Methocha paraceylonica)*, *ടിഫിയ (ടിഫിയ) ബിജുയി (Tiphia (Tiphia) bijui)*, *ടിഫിയ (ടി.) ഡേവിഡരാജൂയി (Tiphia (T.) davidrajui)*, *ടിഫിയ (ടി.) കുറുംബ (Tiphia (T.) kurumba)*, *ടിഫിയ (ടി.) കാശ്മീരെൻസിസ് (Tiphia (T.) kashmirensis)*, *ടിഫിയ (ടി.) നോവസ് (Tiphia (T.) novus)*, *ടിഫിയ (ടി.) രാജീവനി (Tiphia (T.) rajeevani)*, *ടിഫിയ (ടി.) ഷാജി (Tiphia (T.) shaji)* എന്നിവയാണ് കേരളത്തിൽ നിന്നും കണ്ടെത്തിയിട്ടുള്ള പുതിയ ഇനങ്ങൾ. കൂടാതെ കേരളത്തിൽ നിന്നും പുതിയതായി കണ്ടുപിടിച്ച *മീസ കേരളായെൻസിസ്* **സ്പീ. നോവ.** (*Mesa keralaensis* **sp. nov.**, *ടിഫിയ (ടി.) ക്രാസ്സുംപങ്ചുറ* **സ്പീ. നോവ.** *(Tiphia (T.) crassumpunctura* **sp. nov.**), എന്നിവയെ ഈ പ്രബന്ധത്തിൽ വിവരിച്ചിട്ടുണ്ട്. ഇതുകൂടാതെ *മെതോച ടാപ്രോബനെ (Methocha taprobane)*, *മെതോച യുബിക്വിറ്റ (Methocha ubiquita)*, *ടിഫിയ (ടി.) കൺസ്യൂട്ട (Tiphia (T.) conseuta)*, *ടിഫിയ (ടി.)*

ഫ്ലാവിപാൽപിസ് (Tiphia (T.) flavipalpis), ടിഫിയ (ടി.) ഗോദാവരിയെ (Tiphia (T.) godavariae), ടിഫിയ (ടി.) ലോതാറെ (Tiphia (T.) lotharae), ടിഫിയ (ടി.) ലൈറേറ്റ (Tiphia (T.) lyrata), ടിഫിയ (ടി.) മില്ലറി (Tiphia (T.) milleri), ടിഫിയ (ടി.) നേപ (Tiphia (T.) nepa) എന്നീ ഇനങ്ങളെ ഇന്ത്യയിൽ നിന്നും ആദ്യമായി റിപ്പോർട്ട് ചെയ്തു. ഈ പഠനത്തിൽ ഇന്ത്യയിൽ നിന്നുമുള്ള എല്ലാ ഇനങ്ങളുടെയും ഡൈകോട്ടമസ് കീ (Dichotomous key) നൽകിയിട്ടുണ്ട്. അതോടൊപ്പം കേരളത്തിൽ നിന്നുമുള്ള എല്ലായിനങ്ങളുടെയും ഫോട്ടോഗ്രാഫുകളും നൽകിയിട്ടുണ്ട്. ഒരു മോണോഗ്രാഫ്, ആറ് അന്തർദേശീയ പേപ്പറുകൾ, രണ്ട് പുസ്തക അധ്യായങ്ങൾ, ഒരു ഓൺലൈൻ പ്രസിദ്ധീകരണം എന്നിവ ഈ പഠനത്തിൽ നിന്നും ഇതിനകം പ്രസിദ്ധീകരിച്ചിട്ടുണ്ട്.

INTRODUCTION

1. INTRODUCTION

1.1. Taxonomy

At present more than a million different kinds of animals are known to science. This vast assemblage of animals often exhibits great similarity as well as diversity in their body organization and mode of life. To make a detailed study of all these animals individually is impossible rather than difficult. To solve this problem, biologists began to arrange these multitudes of organisms in to groups under different heads based on their similarities and differences. Such a grouping is called taxonomy. It is highly crucial to understand the living species around us, and rigorous and correct identification and classification are of vital importance (Kapoor, 1998). If we know the position of a particular animal in the taxonomy, we can easily predict the general characters of that particular one. So, taxonomy is the science of describing and classifying species that are necessary for the inventory of life on Earth (Narendran, 2006). About 1.7 million species have been named since Linnaeus and it is estimated that only around 5–10% of the world's biota has been described so far, and obviously, taxonomy plays significant role in this sense (Wilson, 2000; Disney, 2000). Without taxonomy, nobody would be sure of the identity of organisms they were interested in or whether they belonged to the same or different species as the organisms studied by others. Without taxonomy, there would be no meaningful genome projects and medical science, for example, would be seriously compromised and we could not begin to understand biodiversity and the related issue of conservation (Nature, 2002). However, although society has a growing need for credible taxonomic information in order to allow us to conserve, manage, understand and enjoy the natural world, support for taxonomy and collections is failing to keep pace and passing through a world crisis (Boero, 2001).

1.2. Hymenoptera

Hymenoptera is the third biggest order of insects, encompassing sawflies, wasps, bees, and ants. Taxonomists divide Hymenoptera in to two suborders: Symphyta and Apocrita. The first group, Symphyta, which have no waist is small and geologically old group which are commonly called as sawflies due to their saw like structure on the ovipositor. The suborder Apocrita which have a narrow waist and narrowed connection between abdominal segments 1 and 2. Apocrita include ants, bees and wasps. Apocrita have two subdivisions: Aculeata and Parasitica. The social wasps having predatory nature and stinging capacity are mainly included in Aculeata and Parasitica include parasitoid wasps (Aguiar *et al*., 2013).

1.3. Aculeata

The Aculeata are a monophyletic group comprised of ants, bees, social wasps, and a few other tiny groups. They are distinguished by the transformation of the ovipositor into a sting. Other hymenoptera use an ovipositor to lay their eggs, but in Aculeata, eggs are laid from the base of their sting, and the ovipositor is utilized to inject venom into prey and defend themselves. The superfamilies included in Aculeata are Chrysidoidea, Apoidea and Vespoidea (Brothers, 1975). As per the new classification, eight superfamilies are included in the Aculeata: Apoidea, Chrysidoidea, Formicoidea, Pompiloidea, Scolioidea, Thynnoidea Tiphioidea and Vespoidea (Pilgrim *et al*., 2008).

1.4. Vespoidea

Within ten taxonomic families, the superfamily Vespoidea is thought to consist of 27,389 species globally, exhibiting a range of morphological variations, behavioural patterns, and ecological functions (Vanoye-Eligio *et al*., 2020). Vespoidea includes highly social groups of Aculeata, paper-nesting wasps and ants. In addition, several groups of solitary predators and parasitoids also comprised under the superfamily. Bradynobaenidae, Formicidae, Mutillidae, Pompilidae, Rhopalosomatidae, Sapygidae, Scoliidae, Sierolomorphidae, Tiphiidae and Vespidae are the families included in the superfamily Vespoidea (Brothers, 1999, 2006; Brothers & Finnamore, 1993).

1.5. Tiphiidae

The family Tiphiidae was erected by Leach in 1815. Tiphiidae is a cosmopolitan and predominantly tropical family and comprises small group of parasitic, aculeate wasps with more than 2,000 described species and 200 genera worldwide (Allen, 1975; Krombein, 1982; Aguiar *et.al*, 2013; Hanima *et al*., 2019ab, 2021, 2022c). The family is divided into seven subfamilies namely, Anthoboscinae (6 genera), Methochinae (2 genera), Myzininae (12 genera), Tiphiinae (9 genera), Brachycistidinae (13 genera), Diamminae (1 genus) and Thynninae (50 genera). The first four subfamilies are occurring in the Indian subcontinent. The subfamily Brachycistidinae is reported from Nearctic Region only. The subfamily Thynninae is reported from Australasia and Neotropical Region and the subfamily Diamminae from Australia only (Brothers, 1999). Some subfamilies have been newly proposed by authors while others have raised to the family level (Argaman, 1994). The largest subfamily under the the family Tiphiidae is Tiphiinae (Arbouw, 1985). The seven subfamilies include 93 genera and among these, Indian genera are *Anthobosca* Guérin, *Cyanotiphia* Cameron, *Hylomesa* Krombein, *Mesa* Saussure, *Methocha* Latreille and *Tiphia* Fabricius (Kimsey, 1991). The majority of species coming under the family Tiphiidae occur in warmer regions like sandy

habitats (O'Neill, 2001). Members of this family ranges from small size to about 32 mm in length. Most of the species are black, in some species with variations of red, yellow, orange and brown, desert species and males of Myzininae are with yellow spots. The members of the family are distinguished by the following characters, male with unciform apical sternum VIII, both sexes with mesopleural lamella and winged forms with the posterior angle of the pronotum reaches the tegula or nearly so. Male and female tiphiid wasps are morphologically different and sexually dimorphic (Kimsey, 1991). The females are larger and more robust than the males. Females in some subfamilies are wing less (Brachycistidinae, Methochinae, Thynninae, Diamminae), all males are winged (Arnett, 2000).

Previously, the family Tiphiidae was placed in the superfamily Scolioidea and later Tiphioidae, currently the family is included under the superfamily Vespoidea. As per the new classification, eight superfamilies are included in the Aculeata and they are Apoidea, Chrysidoidea, Formicoidea, Pompiloidea, Scolioidea, Tiphioidea, Thynnoidea and Vespoidea (Pilgrim *et al*., 2008). Recently some subfamilies of Tiphiidae were classified as a separate lineage (Pilgrim *et al*., 2008). The subfamilies Anthoboscinae, Diamminae, Methochinae, Myzininae and Thynninae are included in the family Thynnidae as per this classification. The subfamilies included in the family Tiphiidae are Tiphiinae and Brachycistidinae. In the present study the classification of Brothers & Finnamore, 1993 is followed.

1.6. Biological importance

Family Tiphiidae includes solitary wasps. Larvae of tiphiid waps are parasitoids of Coleopteran beetles, especially Scarabaeidae, Tenebrionidae, Cicindelidae and less commonly Curculionidae. Members of the genus, *Diamma*, parasitizes mole crickets. Few studies have been conducted on their biology from world and no study have been reported till now from India. Members of the genus *Tiphia* are parasitoids of root-feeding white grubs (Clausen, 1940). *Tiphia* species are specific for its hosts and some species may attack several congeneric grub species (Jaynes & Gardner, 1924). The wasp stings its host and the host gets paralysed temporarily and the waps attach an egg on the grub at a species-specific location. During its first four instars, the larva of tiphiid wasps feeds the body fluids of grubs by piercing the integument. During the fifth instar, the larval *Tiphia* devours all but the sclerotized portions of the grub and then spins a silken cocoon in which it overwinters, emerging the following year the larval *Tiphia* goes through fifth instar, eating all of the grub except the sclerotized parts. It then spins a silken cocoon and emerge in the following year (Rogers & Potter, 2004). Adult tiphiid wasps feed on nectar and thus serve a minor role in pollination (Bogusch *et al.*, 2007).

1.7. Significance of the present study

The fauna of Tiphiidae from Kerala was poorly studied so far. Only two species of tiphiid wasps under one genus were reported from Kerala prior to this study (Krombein, 1982). After this study, a total of 40 species under 4 genera and 3 subfamilies have been reported from Kerala (Hanima *et al.*, 2019b, 2021, 2022a,b,c and the present thesis) including 2 new species. Tiphiidae are ecologically important organism since they have great role in the biological control of beetles. Nowadays biological control of pest species is getting great attention. Tiphiid wasps control many beetle larvae and mole crickets which affects crops and thereby maintain the ecological balance and can be considered beneficial as biological control agents (Given, 1954; Krombein, 1979; Ramoutar & Legrand, 2007).

1.8. Objectives of the study

- Collection and identification of wasps of family Tiphiidae from all districts of Kerala.
- Identifying and describing new taxa encountered and redescribing little known taxa.
- Preparation of dichotomous keys for subfamily, tribe, genera and species level identifications.
- Compilation of the data on the distribution of genera and species in the state.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. World Tiphiidae

The taxonomic study about the family Tiphiidae was very little and fragmentary. In **1775**, **Fabricius** erected the genus *Tiphia* and described the species *Tiphia femorata*, which marked the beginning of research into the family Tiphiidae. **Latreille** erected the genus *Methocha* in **1804** and **de Saussure** erected the genus *Mesa* in **1892**. During the period from 1855 to 1911 numerous new species of Tiphiinae were inadequately described by European specialists in Hymenoptera. **Smith (1855–1879)**, **Magretti (1892)**, **Cameron (1897–1904)**, **Bingham (1897, 1906)**, **Nurse (1903)** and **Turner (1908–1911)** described many species. **Allen & Jaynes (1930)** studied about the genus *Tiphia* and described 42 species from entire Asian region and also provided key to species. The genus *Tiphia* was placed in the family Scoliidae in this study. **Gahan (1930)** examined a number of types of Asiatic *Tiphia* in the British Museum and the observations were incorporated in the work of Allen & Jaynes (1930). **Parker (1935)** described three new species of *Tiphia* from Eastern Asia. **Krombein (1937)** reviewed the genotypes of *Myzinine* genera and provided a tentative key to the genera of the world. **Arnold (1939)** redescribed African *Tiphia* species from the types deposited in European museum with drawings of species. **Allen (1961)** studied about the genus *Tiphia* of America North of Mexico and described six new species and also provided key to species and notes on synonymy. **Krombein (1968)** erected the genus *Hylomesa* and provided the differences between the genera *Hylomesa* and *Mesa*. And also provided description of the novel species *H. bakeri* and key to the species and subspecies of *Hylomesa*. **Allen (1969)** redescribed the types of Tiphiinae from Asia, Africa and America in the British Museum and Hope Department of Entomology at Oxford University. New synonymy also has been indicated in this study. **Allen (1971)** published a monograph about the genus *Tiphia* from Western North America. In addition, **Allen (1972)** proposed and described a new genus, *Mallochia* and published a monograph on the subfamily Tiphiinae. This monograph included keys and descriptions based on type specimens of all known species of South American Tiphiinae with the exception of 8 species for which types were inaccessible. **Brothers (1975)** excluded the subfamily Myrmosinae from the family Tiphiidae and included in the family Mutillidae. In **1979**, **Krombein** presented a key to the genera and subgenera of Methochinae. Also included synonymy notes for the subgenera of *Methocha* Latreille, and described the new genus *Karlissa*. In the same year, **Krombein** published a catalogue of Hymenoptera in America North of Mexico in which family Tiphiidae is included in the superfamily Scolioidea and subfamily

Myrmosinae is included in family Tiphiidae. **Arbouw (1984)** catalogued the world species of subfamily Tiphiinae in *Hymenopterorum catalogus*, which contains literature references on the taxonomy and distribution of over 200 taxa. **Rasnitsyn (1986)** reviewed the fossil Tiphiidae from USSR and described one new species and also recognized two genera and six species. **Tsuneki (1986)** contributed more knowledge about the Tiphiidae from Taiwan and also described many new species. **Kimsey (1991)** examined the phylogenetic relationships between the Tiphiidae subfamilies by a thorough analysis of characters and also provided a phylogenetic tree. The tribe Diammini has been promoted to subfamily level, and each subfamily is briefly summarized and provided key to the other subfamilies. **Argaman & Özbek (1992)** discovered a new Laurasian relic from tertiary, a new subfamily, Silifkinae from turkey and *silifka fatima* as the type species. **Brown (1993)** described a new species of thynnid wasp namely *Lestricorhynnus campbelli* from New South Wales, Australia and also discussed interspecific miscoupling involving the species. **Bartalucci (2004)** splitted the subfamily Myzininae into four tribes: Austromyzinini, Myzinini, Mesini and Meriini; the last one is divided into two subtribes: Braunsomeriina and Meriina. Identification key for the Palaearctic genera of the subtribe Meriina with a special concern to the crepuscular and nocturnal forms is also proposed. He revised the taxon *Iswara* Westwood and *Komarowia* Radoszkowski. The genera *Cocovasna* Argaman, *Gonordula* Argaman and *Keyovaska* Argaman are synonymizied with *Myzinum* Latreille, *Nyuka* Argaman with *Mesa* Saussure and *Melaniswara* Gorbatovsky with *Komarowia* Radoszkowski. Besides these, he also proposed two new genera namely, *Tamerlanella* and *Lamprowara* and also described the new species, *Iswara physostomus, Iswara elongatus, Iswara arabicus, Komarowia meridiana, Komarowia concolor, Lamprowara leucothorax* and *Lamprowara gorbatovskyi*. The lectotypes *of Meria radialis* Saussure and *Pseudomeria tamerlanella* Saussure are designated, redescribed and their synonymy also proposed. He also designated lectotype and paralectotype of *Myzine nodosa* Guerin and the neotype of *Iswara fasciatus* Smith. The holotypes of *Iswara luteus* Westwood and *Iswara mongolicus* Guiglia, the lectotypes of *Myzine orientalis* Smith and *Myzine pallida* Smith and the paralectotype of *Milluta chobauti* Andre have been redescribed. The biology of *Tiphia pygidialis* in the field and laboratory were investigated and studied **Rogers & Potter (2004)**. They also examined adult flight period and also evaluated methods to monitor wasp activity and surveyed grub parasitism rates on golf courses. He also provided information on the seasonal biology and abundance of *T. vernalis* in Kentucky. **Bartalucci (2005)** described 6 new species and also synonymised *Anthobosca arabica* Turner with *A. suakinensis* Magretti and *Mesa seyrigi* Krombein with *M. nodosa* Guerin. He recorded the tiphiid wasps from

Comoro Islands for the first time and also proposed some arguments about biogeography of Malagasy tiphiid fauna. An extended key to the genera in the tribe Meriini, encompassing taxa from the afrotropical fauna, was proposed by Bartalucci (2007). Also described four new species, *Afromeria microtera*, *Afromeria poliorykta*, *Meriodes picea* and *Macromeria rhousiogastra* as well as three genera, *Afromeria*, *Allomeria*, *Meriodes*. **Bartalucci (2007)** proposed an extended key of the genera of the tribe Meriini, including taxa of the afrotropical fauna. In **2007**, **Han *et al.*,** newly reported *Tiphia sternocarinata* Allen & Jaynes from Korea and also provided a checklist of 21 valid species of Korean tiphiid wasps. **Bogusch (2007)** presented a checklist of Tiphiidae of the Czech Republic and Slovakia. **Han & Kim (2008)** described one new species, *Tiphia fuscopterum* based on two specimens collected from Korea and Japan. They also reported *T. antigenata* Allen and Jaynes for the first time from Korea. They synonymized *T. ogurai* Tsuneki with *T. antigenata*. In **2009**, **Achterberg & Harten** described and illustrated seven new species from UAE namely, *Iswara axiphilus, I. minutus, I. latifrons, I. stemmaticalis, Komarowia convexifrons, K. setosa* and *Lamprowara convexus*. **Kimsey (2009)** reviewed and redescribed 10 North American species of *Myzinum* and also provided key to species. Three genera, *Tokoparta*, *Fikoplesa* and *Ekepirka* described by Argaman are synonymized under *Myzinum*. *Myzinum spilonotum* (Cameron) is newly synonymized under *M. maculatum* (Fabricius), *M. beryli* (Brimley) under *M. obscurum* (Fabricius), and the two subspecies of *M. beryli* Krombein, *M. parksi* Krombein and *M. patei* Krombein are synonymized under *M. carolinianum* (Panzer). *M. fulviceps* (Cameron) is removed from synonymy under *M. quinquecinctus* (Fabricius) and is treated as a valid species. In the same year, **Kimsey** revised the Malagasy tiphiids in the genus *Anthobosca* with the description of 8 new species and also provided key to species, illustrations and distribution maps. In **2009**, Han & Kim, reviewed 20 South Korean tiphiid species and *Tiphia burrelli* is newly recorded and also provided a revised key to species with recognizable characters and digital images. **Yildirim & Bartalucci (2009)** studied about the tiphiid fauna of Turkey and recorded 18 species including 2 new species. In this study, 18 species of 8 genera belonged to 3 subfamilies of Tiphiidae were reported from Turkey. Argaman's subfamilies, Silifkinae and Tiphiinae have been named here as tribe Silifkina and Tiphiina within the subfamily Tiphiinae. **Bartalucci (2010)** reviewed the genus *Pseudotiphia* and furnished a generic key between *Tiphia* and *Pseudotiphia* and also described 5 new taxa, *Pseudotiphia thoracica, Pseudotiphia caspica, Pseudotiphia lampra*, *Pseudotiphia punica* and *Pseudotiphia gonodactyla*. **Kim & Han (2010)** gives first record of the subfamily Methochinae from Korea and discovered *Methocha articulata* (Latreille) with diagnostic characters and digital images of the species.

Kimsey (2011) studied about the tiphiid wasp fauna from Madagascar and described 8 new species, 7 new species belongs to the genus *Methocha* and one belongs to *Myzinella*. First and preliminary study on the fauna of Iranian Tiphiidae was carried out by **Samn *et al.* (2011)** which contains a few samplings from some regions of Iran. Five species of Tiphiidae including, *Icronatha caucasica* (Moscary), *Ludita villosa* (Fabricius), *Methocha* (*Methocha*) *articulata* (Latreille), *Tiphia* (*Tiphia*) *femorata* Fabricius and *Tiphia* (*Sierocolpa*) *minuta* van der Linden are reported from Iran. Synonymies and distributional data for the species are also provided. **Elcin *et al.* (2013)** described 2 new species, *Meria orotaura* and *Poecilotiphia melaena* from Turkey. **Kimsey & Wasbauer (2013)** reviewed brachycistidinae genus *Colocistis* Krombein and described two new species, *Colocistis chemsaki* and *C. oaxacana* from Baja California and Oaxaca, Mexico respectively. A key to the species and distribution maps are also provided. In **2015**, **Terayama & Mita** described 4 new species of tiphiid wasps, *Methocha okinawensis*, *M. uchinanensis*, *M. yaeyamensis* and *Hylomesa akitsushimana* from Japan. **Bartalucci (2016)** described new taxa of Myzinine waps within the genera, *Meria*, *Myzinella* and *Poecilotiphia* from Western Palaearctic and Northern Afrotropical regions and also added new records. **Okayasu (2016)** recorded the species, *Hylomesa akitsushimana* Terayama & Mita from Shikoku islands, Japan. **Justino *et al.* (2016)** studied about the species richness and diversity of Tiphiidae species from Atlantic forest region. **Carnimeo *et al.* (2017)** presents the first records of *Scotaena decora* (Smith) and *Scotaena polistoides* Turner from Brazil. In **2018**, **Okayasu** recorded the species *Hylomesa akitsushimana* Terayama & Mita for the first time from Korea. **Narita & Mita (2018)** described two new species, *Methocha cariniventris* and *M. granulosa* from Laos. Recently in **2020**, **Neveen & Brothers** provided an updated checklist of the Arabian species of Tiphiidae. **Han *et al.* (2021)** described and illustrated three new species of the subgenus *Jaynesia* namely *T. hohehotensis*, *T. displicata* and *T. rotunda* from China with a key to all known species. In **2021**, **Liao *et al.*** revised a total of 8 wasps of the tiphiid genus *Mesa* from China including two new species, *Mesa hongchibaensis* and *M. glaber*. They also recorded the species *M. dimidiata* (Guerin-Meneville) and *M. nursei* (Turner) for the first time from China. They also recorded male specimen of *M. formosensis* Tsuneki for the first time and also provided an updated key to the Oriental species of the genus. **Liao *et al.* (2022a)** described and illustrated one new species, namely *Methocha transcarinata* from Guangdong and Hainan, China. Additionally, *M. cariniventris* Narita & Mita and *M. kandyensis* Krombein are newly reported from China. A key to all the known species of the genus *Methocha* from China is also updated. **Liao *et al.*, (2022b)** revised the subfamily Myzininae from China and recorded 11 species belongs to 4 genera of myzininae namely, *Hylomesa*, *Komarowia*, *Meria*

and *Peocilotiphia*, among these four species are newly recorded ones. They also described and illustrated one new species, namely *Hylomesa punctata* from Tibet and Yunnan with key to species. **Saini *et al.*,** in **2022** studied about the genus *Cyanotiphia* and newly recorded the male species of *Cyanotiphia ruficauda* Cameron from North Sumatra, Indonesia. **Zheng *et al.* (2022)** described and illustrated one new genus *Burmatiphia* with the species, *Burmatiphia mandibulata* based on a new specimen from the lowermost Cenomanian Burmese amber as forming a distinct subfamily Burmatiphiinae. **Han *et al.*, (2023)** described and illustrated 21 species of the genus *Tiphia* Fabricius from China including three new species namely, *Tiphia* (*Tiphia*) *flavobrunnea*, *T.* (*T.*) *longistria*, *T.* (*T.*) *mediocarinata* and ten new records. They published a key to the Chinese species of the subgenus *Tiphia* based on collections and relevant references.

2.2. Indian Tiphiidae

Works on taxonomy of Tiphiidae owed much to the contributions by Allen and Krombein. The pioneer studies on the genus *Tiphia* from Indian Subcontinent was done by **Allen (1975)** and recorded 67 species with descriptions and also provided separate keys for males and females. In **1982**, **Krombein** published a monograph of the family Tiphiidae from Sri Lanka. 46 species in the subfamilies, Anthoboscinae, Methochinae, Myzininae and Tiphiinae were recorded in this monograph. Among these recorded species, 15 were occur in India. In **2010**, **Bartalucci** studied about Tiphiidae from south east Asia and described 15 new species from different south east Asian countries. **Hanima *et al.* (2019a)** carried out taxonomic studies on the genus *Tiphia* from Kashmir and described one new species, *Tiphia kashmirensis* and male of *T. khasiana* for the first time and also provided a modified key to species of *Tiphia* from the Indian subcontinent of Allen (1975). **Hanima *et al.* (2019b)** described one new species belongs to the genus *Methocha, M. keralaensis* from the Kozhikode district of Kerala. This was the first new species belongs to the genus *Methocha* from Kerala and also the first record of the subfamily Methochinae from Kerala. **Hanima & Girish Kumar (2020)** published a checklist of Tiphiidae from India as online which enlists 75 species. In **2020**, **Hanima *et al.*,** published a book chapter on the tiphiid wasps from the Western Ghats and compiled 24 species in 4 genera. In **2021**, **Hanima *et al.*,** studied about the genus *Methocha* from India and described three new species, *Methocha krombeini*, *M. paraceylonica*, and *M. shyamagatra* and also provided key to the species of *Methocha* from the Indian subcontinent. This is the first detailed study about the genus from India. Here the two new species described are from Kerala state. **Hanima *et al.* (2022a, b)** recorded two Sri Lankan species, *Methocha taprobane* Krombein and *Methocha ubiquita* Krombein from India for the first time. One of the significant

contributions to the study of Tiphiidae from India was given by **Hanima *et al.* (2022c)**. They published a monograph on the genus *Tiphia* from India and described and illustrated 10 new species. The male of *T. lyrata* Magretti was newly reported and described with descriptions and illustrations. 7 species of *Tiphia* wasps are recorded for the first time from India. They also modified the key to species of *Tiphia* from Indian subcontinent.

2.3. Previous work done on the taxonomy of Tiphiidae from Kerala

This family has never been thoroughly and in-depthly studied from Kerala. Only 2 species were recorded from Kerala prior to this study. In **1982**, **Krombein** described two new species, *Tiphia bouceki* and *T. knutsoni* from the Walayar forest of Kerala. In **2019b**, **Hanima *et al.*** described one new species *Methocha keralaensis* from the Kozhikode district of Kerala. In **2021**, **Hanima *et al.,*** described two new species, *Methocha krombeini* Hanima, Girish Kumar & Binoy and *M. paraceylonica* Hanima, Girish Kumar & Binoy from Kerala. *M. paraceylonica* is collected from the biodiversity rich Peppara Wildlife Sanctuary of Agasthyamalai Biosphere area. In **2022**, **Hanima *et al.,*** described 6 new species and also recorded 20 species of *Tiphia* for the first time from Kerala. This work was the first detailed study of the Family Tiphiidae from Kerala.

Review of literature indicated that scanty information is available on the Tiphiid wasps from India especially from the study area, Kerala. Hence, the present study was carved out which will form the baseline data on biodiversity for upcoming researchers and will also help in formation of biodiversity conservation strategies.

MATERIALS & METHODS

3. MATERIALS AND METHODS

3.1. Study area: Kerala

The specimens used in the present taxonomic study were collected from various locations of Kerala. Kerala is a state in India located on the Malabar Coast in the southwest. Kerala, with its 38,863 km2, is the twenty-third largest state in India by area. Nestled between the Arabian Sea and the Western Ghats, Kerala is a paradise renowned for its lush green surroundings. Kerala's verdant, lush terrain is home to a diverse array of flora and fauna.

The geography of Kerala includes highland deciduous, evergreen, and semi evergreen forests in various sections of the state. Furthermore, this state enjoys a humid tropical climate due to its distinct topography and height. Kerala's distinct characteristics make it a globally significant biodiversity hotspot. The Western Ghats contain the majority of biodiversity and are heavily protected. Some of the coastal areas of this state also occupy such biodiversity tracts. Kerala is also famous for shola forests and nearly 24% of the area of this state is covered by such forests. It can be seen mainly at the high elevated areas of the state. Above all, Kerala boasts various protected areas, including the well-known Nilgiri Biosphere Reserve. Up until the 18th century, thick forest covered three-quarters of Kerala's land area. Eastern Kerala's windward mountains support tropical moist and tropical dry forests, both of which are prevalent in the Western Ghats. Kerala's fauna is remarkable for its richness and high rates of endemism. It comprises 118 species of mammals, 500 species of birds, 189 species of freshwater fishes, 173 species of reptiles, and 151 species of amphibians (Nameer *et al.*, 2015). These are under threat by widespread habitat damage, such as soil erosion, landslides, salinization, and resource extraction. These enriched flora provide a platform for the faunal diversity including insects.

3.2. Collection localities

(Plate 1)

Collection of specimens is the first and foremost step for any taxonomic work. Different localities of Kerala state and adjacent ecosystems were surveyed for collecting tiphiid wasps.

Sl. No.	**District**	**Localities with coordinates**
1	Thiruvananthapuram	Neyyar Wildlife Sanctuary, Neyyar dam site (8°32'01"N & 77°08'56"E, 99 m), Neyyar Wildlife Sanctuary, Ananirathi (8°32'02"N & 77°08'59"E, 96 m), Neyyar Wildlife Sanctuary, Kaalippara, near temple side (8°31'35"N &

		77°08'32"E, 168 m), Neyyar Wildlife Sanctuary, Kothiram (8°39'45"N & 77°09'00"E, 125 m), Neyyar Wildlife Sanctuary, Kottur (10°31'34"N & 76°58'35"E, 303 m), Peppara Wildlife Sanctuary, Kanithadam (8°39'45"N & 77°09'00"E, 125 m), Peppara Wildlife Sanctuary, Pattankulichapara (8°37'22"N & 77°08'07"E, 135 m), Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), Peppara Wildlife Sanctuary, Peppara dam site (8°37'21"N & 77°08'12"E, 98 m), Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m).
2	Kollam	Monroe thuruth (8°59'49"N & 76°36'34"E, 2m), Shasthamkotta (9°02'27"N & 76°37'34"N, 4 m), Shasthamkotta, D.B. College Campus (9°02'027"N & 76°38'08"E, 19 m), Shasthamkotta, Vettolikadavu (9°02'45"N & 76°37'12"E, 21 m), Shendurney Wildlife Sanctuary, Kaatilappara (8°54'46.44"N & 77°6'53.496"E, 221 m), Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), Shendurney Wildlife Sanctuary, Thenmala, Ottakkal IB (8°57'34"N & 77°03'44"E, 77 m).
3	Pathanamthitta	Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m).
4	Alappuzha	Vettikode (9°10'23.79"N & 76°35'0.0672"E, 33 m).
5	Kottayam	Pala, Cherpunkal (9°41'05"N & 76°38'18"E, 22 m), Paika, Urulikunnam (9°38'37"N & 76°42'37"E, 52 m).
6	Idukki	Chinnar, Kootaram (10°18'22"N & 77°12'24"E, 596 m), Iravikulam National Park, Rajamalai (10°18'22"N & 77°12'24"E, 596 m), Kulamavu (9°47'31.2"N & 76°53'11.4"E, 724 m), Mathap, Mannavan Shola (10°11'20"N & 77°10'35"E, 2076 m), Mayiladumpara (9°53'07"N & 77°09'27"E, 1064 m), Pampadum shola National Park, Vattavada (10°08'01"N & 77°15'35"E, 1893

		m), Thekkadi, Kumarikulam (9°43'00"N & 76°57'51"E, 1003 m).
7	Ernakulam	Thattekkad Bird Sanctuary, Kolumba (10°06'15"N & 76°42'01"E, 41 m), Vytila (9°58'5.52"N & 76°19'5.52"E).
8	Thrissur	Elanad (10°30'38.52"N & 76°52'50.52"E, 68 m), Vallakkunnu (10°20'32"N & 76°15'53"E, 7 m).
9	Palakkad	Parambikulam Tiger reserve (10°26'56"N & 76°49'19"E, 586m), Silent Valley National Park (11°03'51"N & 76°32'16"E, 540m), Silent Valley National Park, Nilikkal (11°03'51"N & 76°32'16"E, 540m), Silent Valley National Park, Panthanthod (11°04'21"N & 76°25'25"E, 974 m).
10	Malappuram	Calicut University Campus (9°43'00"N & 76°57'51"E, 1003 m), Kerala Forest Research Institute Campus, Nilambur (11°18'0.36"N & 76°15'1.44"E, 48 m), Wandoor (11°11'36"N & 76°14'17"E, 33 m).
11	Kozhikode	Baby Memorial Hospital Campus (11°15'36"N & 75°47'33"E, 8 m), Chengottukaavu (11°25'20.64"N & 11°25'20.64"N, 17 m), Elathur (11°20'21"N & 75°44'26"N, 13 m), Edakkara (11°21'41.4"N & 76°35'24.72"E), Jaferkhan Colony (11°15'41.184"N & 75°47'13.2"E), Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), Kakkodi, Cherukulam (11°20'06"N & 75°46'20"E, 7 m), Kovoor (11°16'14.16"N & 75°49'52.32"E, 31 m), Malabar Wildlife Sanctuary, Kakkayam (11° 33' 27.3708" N & 75° 57' 28.08" E, 1185 m), Madappally (11°38'48"N & 75°34'13"E, 28 m), Paleri (11°37'22"N & 75°45'15"E, 27 m), Manipuram (11°24'45"N & 75°56'20"E, 61m), Moorad (11°33'54"N & 75°36'26"N, 9 m), 3.ii.2021, Nanminda (11°25'20.8416" N & 75° 49' 52.7448" E, 62 m), Peruvayal (11°15'47"N & 75°54'21"E, 24 m), Purameri (11°40'18"N & 75°37'46"E, 33 m), Sarovaram Biopark (11°16'6.96"N & 75°47'33.72"E, 6 m), Vilakottur (11°45'22"N & 75°39'06"E, 34 m).

12	Wayanad	Chandanathodu (11°50'47"N & 75°48'33"E, 810 m), Edavambam (11°42'21.4128"N & 76°20'12.0012"E, 848 m), Kalpatta, Madakkimala (8°46'32"N & 77°13'39"E, 1268 m), Karlad (11°38'56"N & 75°58'56"E, 752 m), Kuruva Island, Palkulam (11°49'02"N & 76°05'36"E, 714 m), Machikudi (11°40'24"N & 76°17'21"N, 913 m), Mangavayal (11°35'02"N & 76°05'35"E, 761 m), Meppadi, Mundakai forest (11°33'40"N & 76°08'44"E, 853 m), Moolankavu (11°40'24"N & 76°17'21"N, 913 m), Muthanga (11°40'17"N & 76°22'06"E, 848 m), Muthanga, Manchal (11°42'11.772"N & 76°22'1.38"E, 777 m), Ponkuzhi (11°41'15"N & 76°23'26"E, 837 m).
13	Kannur	Aralam Wildlife Sanctuary (11°58'04"N & 75°19'08"E, 7 m), Bekal Fort (11°33'27"N & 75°54'41"E, 543 m), Chavachi (11°55'20"N & 75°47'32"E, 77 m), Kannapuram Mangrooves (11° 58' 04" N & 75° 19' 08" E, 7 m), Keezhara (12°00'11"N & 75°19'44"E, 4 m), Manathana paddy field (11°54'51"N & 75°45'13"E, 92 m), Thekkumbad dweep (11°58'35.4"N & 75°17'27.24"E).
14	Kasaragod	Panathady (12°27'22"N & 75°18'25"E, 141 m), Ranipuram (12°25'19"N & 75°21'06"N, 925 m).

3.3. Collection equipments

- Yellow pans, sweep nets, malaise trap and containers for pitfall traps.
- Killing jars with ethyl acetate for killing the collected insects.
- Alcohol vials for storing the collected specimens.
- Detergents for yellow pan trap method.
- Strainer for transferring the yellow pan collection without missing any small specimens.
- Zip-lock covers for transferring the samples collected using the sweep nets.
- Brushes and forceps for dislodge the specimens stuck on the strainer and for transferring the specimens to vials or collection bottles.
- Water proof pen or pencil and field notebook for noting the locality details and for temporary labelling of the collections.

3.4. Collection methods

(Plate 2)

There are many types of equipments and techniques for the collection of tiphiid wasps.

3.4.1. Pan Trap/Moericke Trap

Pan trap is the best and effective method for the collection of tiphiid wasps. This method is based on the principle that day active, ground active wasps are attracted to the yellow colour. Yellow pans are shallow trays of 60–75 mm deep and about 30 cm circle painted with yellow colour. The yellow pans were filled with detergent solution as a surfactant to break the surface tension. The pans were placed on the ground early in the morning. Wasps land on the surface of the water and immediately sink and drown (Schauff, 1986). In the evening, the water is strained carefully through a fine sieve strainer without losing any specimen. Then the transferred specimens are washed with fresh water to remove the soap content and were transferred to the jars containing 70% alcohol. Tiphiid wasps are also collected using white/blue pan traps. The number of specimens collected through white or blue pans are less when compared to yellow coloured traps (Moreira *et al*., 2016).

3.4.2. Sweeping

Sweeping is also used for collecting tiphiid wasps. Mesh size of the net bag should be small, otherwise insects will escape through the net. These nets are generally made of lightweight materials that include a wooden or aluminium handle and a hoop constructed of stiff steel “music wire” or steel strap. The net is made from fine mesh material usually reinforced with cotton around the hoop (Murray & Beth, 2014). Butterfly nets are used to catch wasps by spotting at the site, while sweep nets are used to collect many small ones from the sweeping area by continuous movement of net through vegetations. After a wasp get trapped inside the butterfly net, keep the end part of the net upward. Trapped wasps move upward and remains there. The collected wasps are transferred to a killing jar containing ethyl acetate for killing and then to the vials containing alcohol. The small tiphiid wasps trapped in the triangle nets are collected using aspirator and then transferred to jar containing alcohol.

3.4.3. Pitfall Trap

Wingless female tiphiid wasps are usually moving on the ground and can easily collected using pitfall trap. This is the very effective and useful type of trap consists of a jar, can, or dish sunk in the ground (Epsky *et al*., 2008). The jar buried in the ground and partly filled with 70 percent ethanol, water mix, soap solution. The jar should be covered on the top side to exclude rain and small vertebrates. Wingless wasps crawl through the soil and get

trapped in the pitfalls. The collected specimens from pit falls should be washed thoroughly and transferred to 70% alcohol.

3.4.4. Malaise Trap

Tiphiids are collected rarely using malaise trap since, most of the tiphiid wasps are active in the ground floor. Wasps show positive phototaxis and negatively geotropic behaviours. Malaise traps works on this principle. Malaise traps were originally developed by the Swedish entomologist Rene Edmund Malaise (Malaise, 1937). It is a tent like device which catches insects as they fly into the sides of the trap, crawl upwards on the cloth to the roof, where they enter into the bottle with 70% alcohol. Malaise trap should be fixed in an area where sunlight reaches. After 1–7 days, the trapped wasps and other insects can be collected.

3.5. Processing

Processing the collected specimens include sorting, relaxing, mounting, labelling, registering and preserving the mounted and un-mounted materials.

3.5.1. Sorting

After collection, the specimens are sorted in to different groups like families, genera etc. Then appropriate specimens are taken and studied accordingly.

3.5.2. Relaxing

It is an important step before mounting especially those specimens which are collected long back and kept in paper packets. In such cases the specimens have to be relaxed by keeping them in relaxing chamber containing glacial acetic acid for 6–10 hours. Then the specimens become soft, moistened and suitable for mounting and spreading.

3.5.3. Mounting, Labelling and Registering

Equipments for mounting, labelling and registering of specimens

(Plate 3)

- Stereozoom binocular microscope: Sorting and mounting of specimen are carried out under Labomed stereozoom microscope (CZM 6) (Fig. C).
- Sorting trays: Collections are poured into sorting trays and respective specimens are sorted out (Fig. D).
- Blotting paper: Specimen taken from vials are placed on blotting paper to remove alcohol and moisture content prior to mounting. Wings and legs are spread to the maximum while placing on the blotting paper.
- Table lamp: The spreaded specimen is kept under light for drying and to remove the moisture content.

- Fine brush: Used to correctly place the specimens onto card points while mounting.
- Triangular or rectangular card points: Mounting paper is cut into small card points for mounting the specimens.
- Water-soluble translucent glue (Herkules glue): Used to fix the specimens to card points. Water soluble glue is used, otherwise improperly mounted specimens cannot be remounted.
- Entomological pins: Standard No. 00 and 0 entomological pins having size 39 mm × 0.30 mm and 39 mm × 0.35 mm respectively available from M/S *EntoSphinx*, Czech Republic, were used to pin the small specimens. Standard No. 1 & 2 entomological pins having size 39 mm × 0.40 mm and 39 mm × 0.45 mm were used to hold the specimen mounted on triangular card points and to spread the parts of specimens while pinning.
- Rotring pen of size 0.1 and Artline pen of size 0.1 and 0.05 for writing labels.
- Labelling paper: Used to write the locality details, species name, etc.

3.5.3.1 Mounting

Mounting is the most important procedure in the taxonomic study which requires extreme care. Specimens should properly mounted for the accurate morphological study of the specimens through microscope. Mainly there are two types of mounting, card mounting and pinning.

Card Mounting

For card mounting, the specimens were transferred from alcohol to blotting paper for drying and spreading. Then parts like antennae, wing and legs of specimens were properly spreaded using brushes. Then using an entomological pin, a very small drop of water soluble glue (Herkules glue) was placed on the tip of pinned triangular or rectangular mounting card (made with ivory paper) and the mesosoma of the specimen was glued to the card point. This mounting method is used for specimens with small size which will be damaged while pinning. Mounting should be done in such a way that, the morphological characters are visible while examining and studying the specimens.

Pinning

The relaxed and spreaded specimens were pinned through mesoscutum using Standard No. 00 or 0 sized entomological pins. Then antennae, wings and legs were spreaded using entomological pins and kept under table lamb for few hours for complete drying. According to the size of the specimen, different sized pins can be used for pinning the specimen.

3.5.3.2. Labelling and Registering

The mounted and pinned specimens are then properly labelled and kept in insect boxes for detailed systematic studies. There are 4 labels for each specimen. For new species, first label is that of Holotype or Paratype. Then it is followed by label with collection details, which is followed by determination label and then label with register number of specimen where the specimens are deposited. The collection labels gives essential information about collection such as; name of the country in capitals, name of the state, name of the district, name of the exact collection locality, date of collection, name of collector etc. Determination label contain the sex of species, name of species with year and determiner name. After the species is determined, it is registered in the Register of named collections. The named collections register provides following details: register number, broad classification, species name, state, district and exact collection locality, name of collector, date of collection, date of entry, number of examples of specimen collected, name of the person who determined the species, and remarks section which gives information about sex of the species, type category, etc.

The registered specimens were then kept inside insect box containing chemicals (mixture of phenol and camphor with 3:1 percentage) which prevent fungal growth and attacks by small insects. Insect collection boxes are periodically warmed under table lambs to avoid fungal growth. And also chemical (mixture of phenol and camphor) is added periodically.

3.6. Identification

Specimens were identified using keys and comparing with original descriptions of species. In some cases, the digital images of types obtained from various international depositories on request were also used in the identification process. Then the specimens which are not fit in the keys and shows differences from descriptions are kept as new species and are described. The species without proper description are redescribed. Family level and subfamily level identification are done using Hymenoptera of the World (Brothers & Finnamore, 1993). Genus and species level identifications are done using the literature of Allen (1969, 1975), Hanima *et al*. (2022c) and Krombein (1982). Allen (1975) and Krombein (1982) are used for the identification of species belong to the genus *Tiphia*. Krombein (1982) is used for the identification of species belongs to the genera *Mesa*, *Methocha* and *Hylomesa*.

3.7. Genitalia Dissection

In the case of very similar species, when species identification is difficult, the genital structure study is done.

Steps for dissection of genitalia

The first step is the relaxation of the specimen which is dried and pinned. Otherwise the specimen may be damaged by breakage. For relaxing, specimens were kept in relaxing chamber with glacial acetic acid for 8–10 hours. Then the specimens become soft for the removal of genitalia. Then the genital part was removed using pointed forceps and then immersed in 10% potassium hydroxide (KOH) for overnight to clear the structure. The genitalia then passes through a series of alcoholic solutions for dehydration. Then properly wash with water and kept in small vials. Genitalia are then photographed by immersing in pure glycerine on a cavity slide and then mounted on a card and pinned with the specimen. Photos were taken with Leica DFC500 & 450 digital camera attached to a Leica M205A stereomicroscope and then plates of photographs were improved for contrast and brightness using Adobe® Photoshop® CS5 software (Hanima *et al.*, 2022c).

3.8. Observation of specimens

The specimens were sorted and mounted under Labomed stereozoom microscope (CZM6). Specimens were studied and identified under the Leica M205C stereozoom microscopes and Labomed CZM6 microscopes.

3.9. Microphotography (digital imaging) and measurements

Digital imaging of different parts of the identified species were taken under high resolution stereozoom microscopes such as Leica MZ205 equipped with a Leica DFC500 and 450 digital cameras attached to the microscope that fed image data to a desktop computer. Images at varying depths were stacked into final image using Leica Auto montage Software V3.80.

Images of large specimens were taken using Canon EOS 6D camera. The final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® CS5 (Version 12.0 x64) software. Measurements of parts of the specimens were taken by using Leica MZ205 C microscope and software Leica LAS.

3.10. Distribution maps

Distribution maps of the species were generated using QGIS which is a free and open-source cross-platform desktop geographic information system application.

3.11. Preparation of checklist of tiphiid wasps

The entire collection of the present study and all the available literature were used to prepare the checklist of tiphiid wasps of India.

3.12. Terminology

(Plate 4)

Morphological terms followed in this study are of Allen (1975), Krombein (1982), Harris (1979) and Hanima *et al*. (2022c).

Head

Antenna: Sensory appendage present in the head. It is divided in to scape, pedicel and flagellar segments. Males are with 11 flagellar segments and females with 10 flagellar segments.

Clypeus : Medial sclerite of the head in between antennal toruli and labrum.

Frons : The area of the head between the ventral margin of the toruli and the anterior margin of the anterior ocellus.

Gena/Cheek : The area that is delimited by the intersection of the interorbital plane, the margin of the compound eye, the margin of the oral foramen, the occipital carina and the malar sulcus.

Ocellus : Simple eye which consists of one anterior ocellus and two posterior ocelli.

Torulus : The socket in which its antenna is attached.

Mesosoma

Areola: Carinated structure at the middle of the dorsal side of propodeum. Areola may be tricarinate or quinquecarinate.

Basitarsus: First tarsal segment.

Mesonotum: Dorsal part of mesothorax in between pronotum and metanotum.

Mesopleural lamella: *Mesopleuron* with fringed *lamella* overlapping base of midcoxa.

Mesopleuron: Lateral side of mesothorax.

Metanotum: Dorsal part of mesothorax in between mesonotum and propodeum. It is also known as post-scutellum.

Metapleuron: Lateral side of metathorax.

Notauli: The groove that extends sub-medially along the mesoscutum.

Parapsids: The line that extends sub-medially along the mesoscutum in between notauli and middle area of mesoscutum.

Pronotal carina: Transverse ridge on the dorsal side of pronotum.

Pronotum: Anterior, dorsal part of thorax which is undivided.

Propleuron: Lateral side of pronotum which is having groove, striations, etc.

Propodeum: Posterior part of thorax.

Scutellum: Posterior part of mesonotum.

Stigma: Dark pigmented spot on the front edge of the forewing.

Tegula: Sclerite covering the base of forewing.

Metasoma

Pygidium: Posterior part of metasoma.

Sternal denticle: Projection on the posterior, lateral sides of 6^{th} sternum.

Sternal hook: Last visible sternum of males form an apical upcurved hook.

Other terms used in the thesis

Aciculate: Sculpture resembles like needle scratches.

Apical width: Width measured at the posterior part of any structure.

Apterous: Wasps without wings.

Basal width: Width measured at the anterior part of any structure.

Bipunctate: Surface with two different types of punctures.

Emarginated: Notch or cut from the margin of body surface.

Groove: Impressed line.

Impunctate: Surface without punctures.

Infumate: Clouded with blackish colour on wings.

Infuscate: Darkened with a brownish tinge on wings.

Macropterous: Wasps with fully developed wings.

Puncture: A small hole from the surface. Punctures may deep or shallow and minute, medium or large in size.

Rugae: Wrinkled or folded irregularly linear sculpturing.

Setae: Hair

Setigerous punctures: Punctures having setae arising from it.

Shagreened: Untanned leather like sculpture.

Striation: sculpture with striped appearance.

3.13. Abbreviations for morphology

(Plate 4)

Fx: Flagellum, x being the flagellar number

Gs_x: Gastral sterna, x being the sternum number

Gt_x: Gastral terga, x being the tergum number

HW: Head width, the maximum width in between eyes

IOD: Inter ocular distance, the minimum distance between two eyes

LOD: Lateral ocellar distance, the distance between anterior ocellus and posterior ocellus

OOD: Ocello-ocular Distance

POD: Posterior ocellar distance

3.14. Abbreviations for museums and repositories

CERI: Canadian Entomological Research Institute, Canada.

MCNM: Museo Civico di Storia Naturale, Genova, Italy.

NHMUK: The Natural History Museum, London, England.

NMNH: National Museum of Natural History, Washington, D.C., USA (formerly USNM).

OUM: Oxford University Museum, Oxford, England.

RNHM: Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

ZSIK: Zoological Survey of India, Western Ghat Regional Centre, Kozhikode.

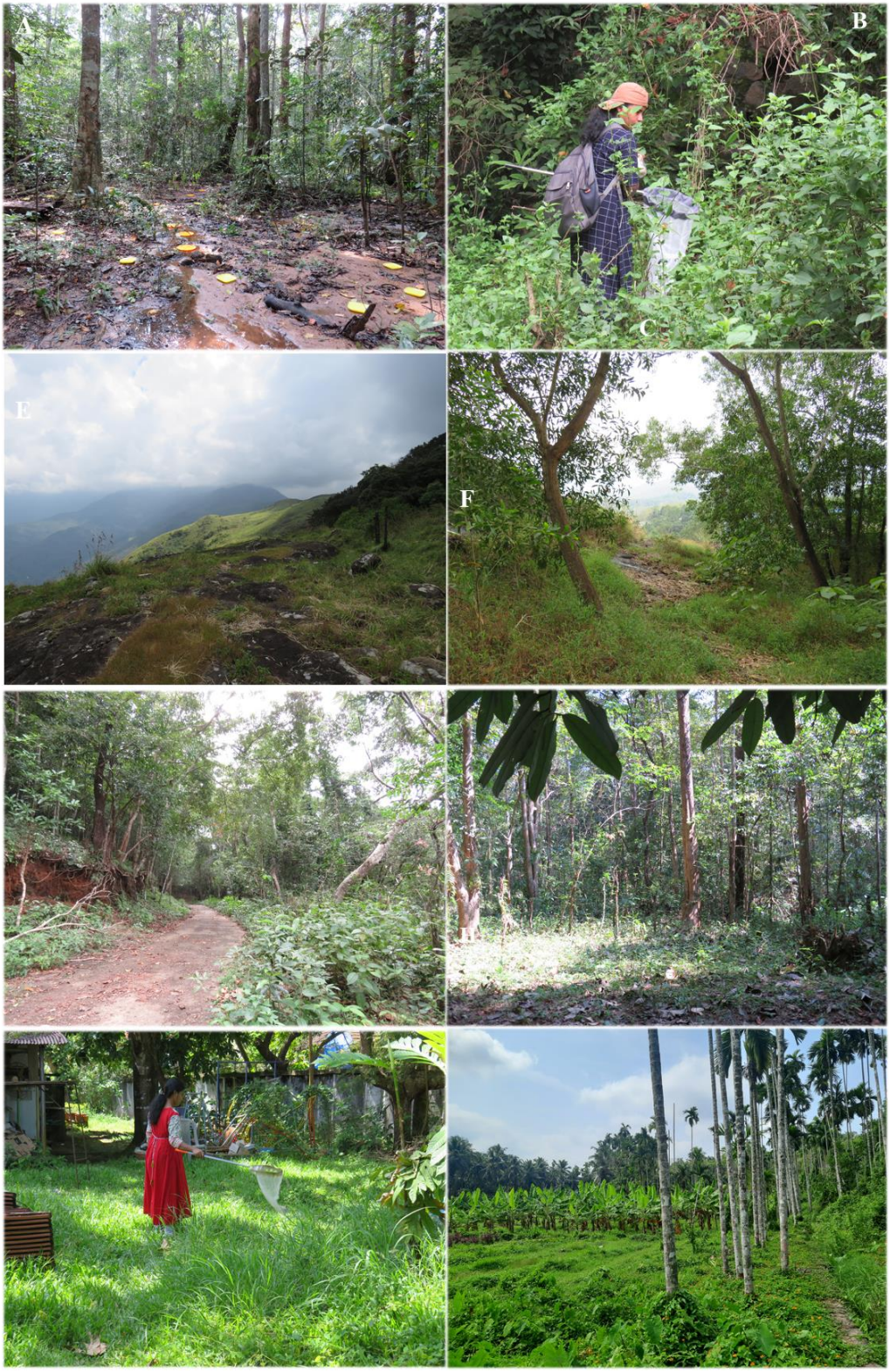

Plate 1. Collection localities.

Plate 2. Collection methods. A, B, C, D. Pan traps; E. Sweeping; F. Pitfall trap; G, H. Malaise trap.

Plate 3. Equipments for mounting, labelling, registering and genitalia dissection of specimens

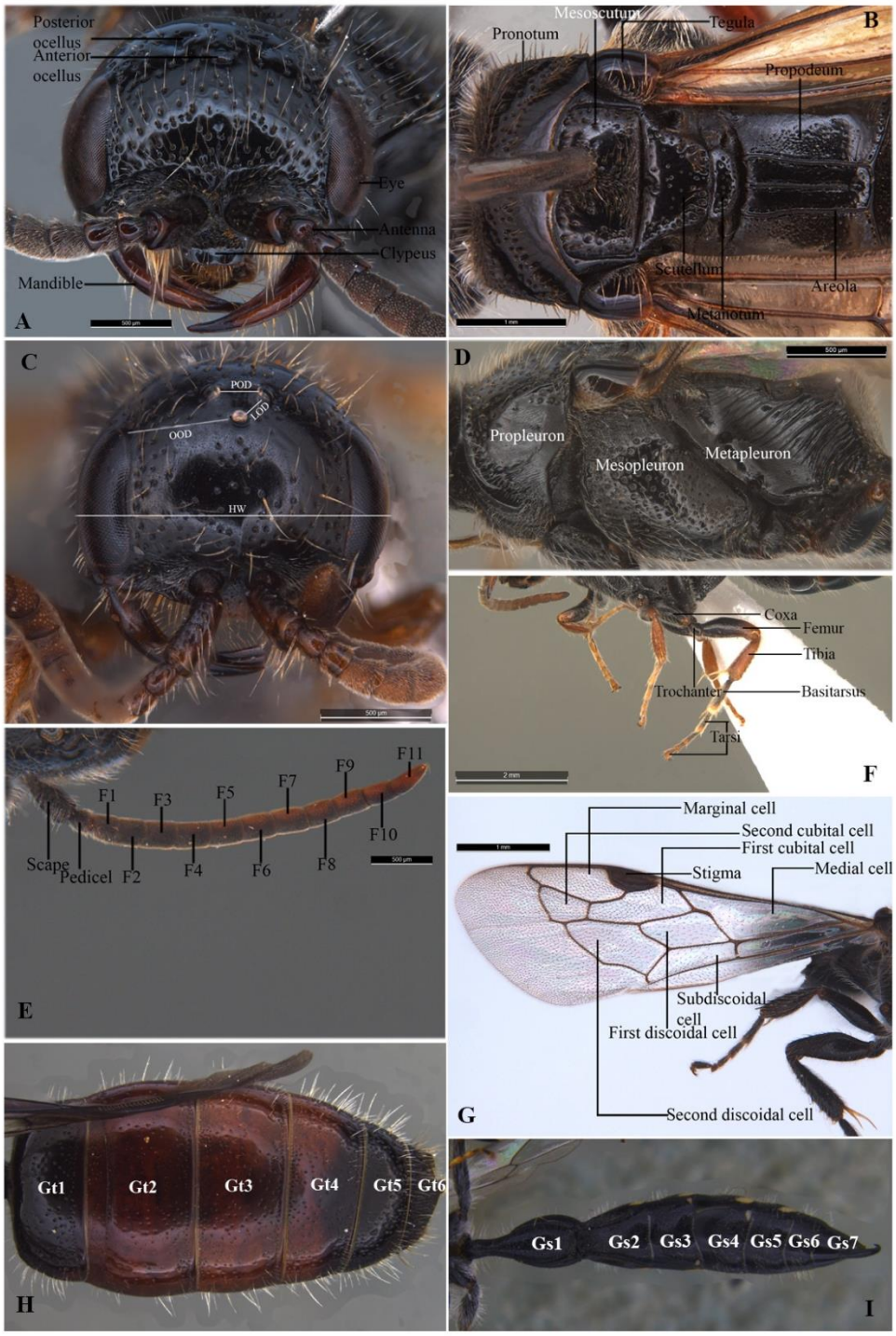

Plate 4. Morphological terms & Abbreviations.
A. *Tiphia* (*T.*) *exacta* Nurse: Head, frontal view; B. *Tiphia* (*T.*) *kashmirensis* Hanima & Girish Kumar: Mesosoma, dorsal view; C. *Tiphia* (*T.*) *capillata* Allen & Jaynes: Head, frontal view; D. *Tiphia* (*T.*) *cinchonae* Allen: Mesosoma, lateral view; E. *Tiphia* (*T.*) *hirsuta* Smith: Antenna; F. *Tiphia* (*T.*) *lyrata* Magretti: Leg; G. *Tiphia* (*T.*) *lotharae* Allen: Wing; H. *Mesa dimidiata* (Guerin): Metasoma, dorsal view; I. *Mesa claripennis* (Bingham): Metasoma, ventral view.

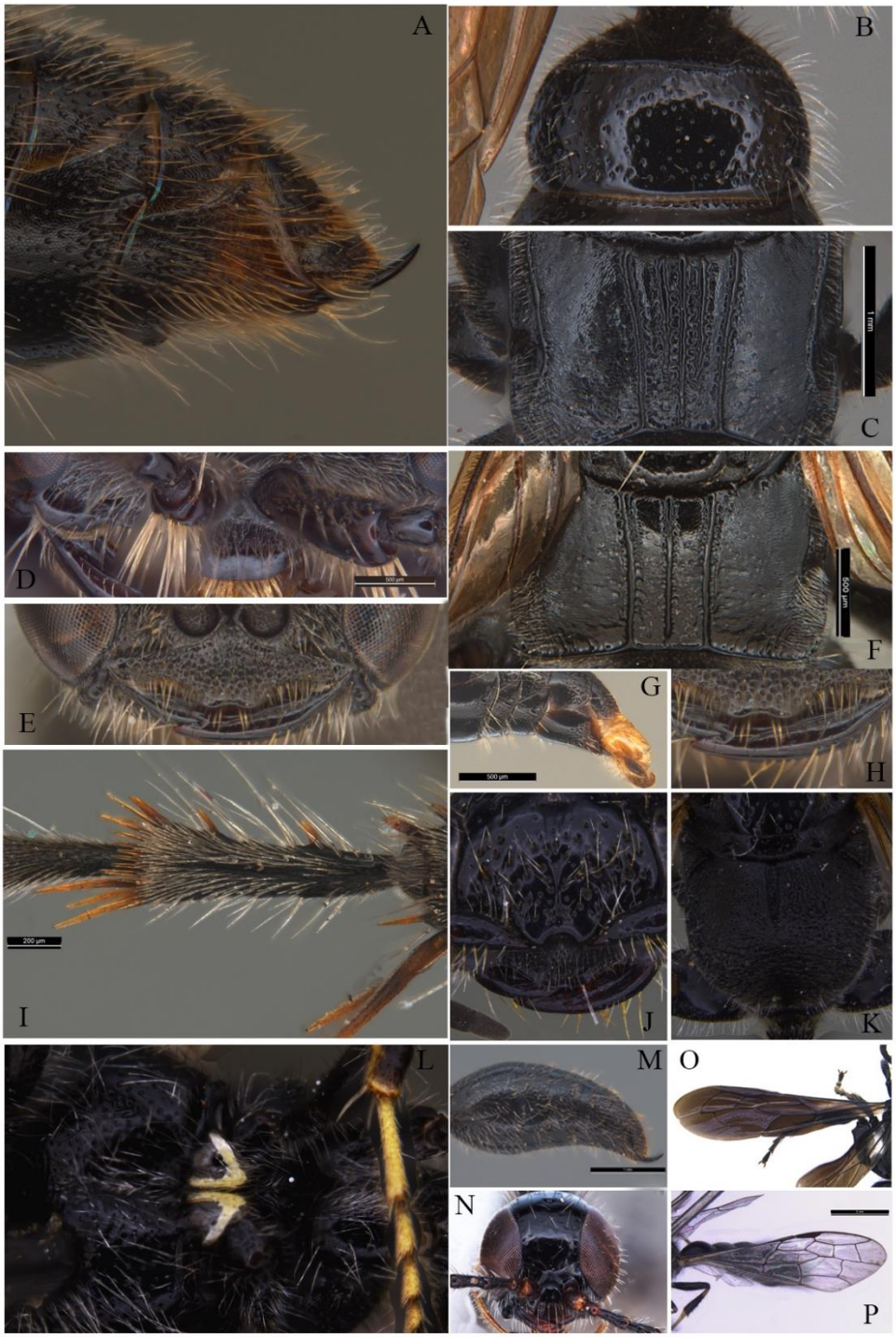

Plate 5. Morphological characters.
A. Gs6 showing tuft of setae; B. Gt1 showing anterior transverse carina; C. Quinquecarinate areola; D. Rounded clypeus; E. Emarginate clypeus; F. Tricarinate areola; G. Gs5 showing denticle; H. Mandible showing preapical denticle; I. Basitarsal groove of hind tibia; J. Frontal lobe; K. Propodeum showing crenuate groove; L. Mesopleural lamella; M. Sternal hook; N. Setose eye; O. Infumate wing; P. Hyaline wing.

Plate 6. Observation of specimens.

RESULTS

4. RESULTS

FAMILY TIPHIIDAE

The family Tiphiidae is a group of solitary, fossorial aculeate wasps under the superfamily Vespoidea. They are known by the common name, tiphiid wasps or flower wasps. All species are solitary. Seven subfamilies are currently recognized in the family Tiphiidae, namely, Anthoboscinae, Myzininae, Methochinae, Tiphiinae, Brachycistidinae, Thynninae and Diamminae with about 2,000 species in 200 genera worldwide (Allen, 1975; Krombein, 1982; Brothers & Finnamore, 1993; Aguiar *et al*., 2013; Hanima *et al*., 2019ab, 2021, 2022c, 2024). During the present study, nearly 700 specimens belonging to the family Tiphiidae were collected from various localities of Kerala. 40 species belonging to 4 genera in 3 subfamilies were identified and included in the thesis including 12 new species. All the new taxa have been described in detail and diagnostic characters and illustrations are given. A dichotomous key to Indian subfamilies, genera (Southern India) and species under each genus and an updated checklist of Tiphiidae of India are provided here.

4.1. General Morphology

Adult tiphiid wasps are predominantly black, sometimes marked with yellow, orange, red or variations of yellow, orange or red and varying from 3–30 mm in size. Females in some subfamilies are wingless (Brachycistidinae, Diamminae, Methochinae and Thynninae) whereas males are usually slender with long antennae. Tiphiidae are diagnosed having an upcurved hook of metasomal Gs_8 (hypopygium) of the male, mesopleural lamellae and the females with posterior angle of the pronotum reaches the tegula or nearly so (Kimsey, 1991).

Dorsal rim of torulus can be simple or tuberculate, or it can be an elevated as transverse ridge or as swelling of the frons. Inner margins of eyes are convex or more or less straight, rarely emarginated. In most cases, the postero-dorsal margin of the pronotum is weakly concave, but in some cases, the postero-lateral apex is truncate anterior to the tegula, and the postero-lateral apex is usually rounded. Hind wing with distinct claval and jugal lobes. Mesotibia and metatibia of females usually with stout and heavy spines. Metasoma are typically sessile but may be petiolate. Metasomal Gs1 and Gs2 are typically separated by a deep constriction, however occasionally without any constriction. Hypopygium can be simple or have 2-5 spines and is normally completely displayed, but it can also be somewhat covered. Females have open marginal cells. Antennal segments are 12 in females and 13 in males. Members of the family shows sexual dimorphism. Males are macropterous, females are usually macropterous or apterous, sometimes brachypterous. Mesosoma of brachypterous and apterous

forms different from that in macropterous form. The larvae of tiphiid waps are usually ectoparasitoids of Coleopteran larvae (Brothers & Finnamore, 1993).

Distribution. Cosmopolitan.

4.2. Systematic position

CLASS: INSECTA

ORDER: HYMENOPTERA

SUPERFAMILY: VESPOIDEA

FAMILY: TIPHIIDAE LEACH, 1815

Subfamily: Methochinae Rohwer, 1916

- *Methocha* Latreille, 1804

Subfamily: Myzininae Borner, 1919

Tribe: Mesini Argaman, 1994

- *Hylomesa* Krombein, 1968
- *Mesa* Saussure, 1892

Tribe: Meriini Costa, 1858

Subtribe: Meriina

- *Iswara* Westwood, 1851
- *Komarowia* Radoszkowski, 1886
- *Myzinella* Guiglia, 1959

Subfamily: Tiphiinae Leach, 1815

- *Tiphia* Fabricius, 1775

Key to the subfamilies of Tiphiidae from India (modified from Kimsey, 1991).

1. Wingless (some females); frons with projections or lobes overhanging antennal socket; fore wing of female with marginal cell closed on costal margin. …… 2

— Winged (all males and some females); frons without projections or lobes overhanging antennal socket; fore wing of female with marginal cell open on costal margin. ……. **Tiphiinae**

2. Mid and hindtibiae with 1 spur, hindtibial spur with spinose inner margin; eye of male without emargination, eye with setae; females wingless. ……...…….…. **Methochinae**

— Mid and hindtibiae with 2 spurs, one hindtibial spur often with basal notch; eye of male with emargination, eye without setae; females winged (except *Braunsomeria*) ...…. **Myzininae**

Key to genera of Tiphiidae from Southern India.

1. Torulus entirely exposed from above ……...……. ***Tiphia***

— Torulus partly or entirely concealed from above ……. 2

2. Eyes covered with setae; prothorax, mesothorax and metathorax-propodeum form 3 distinct, similar and almost equal regions separated by marked constrictions …….. ***Methocha***

— Eyes without setae; prothorax, mesothorax and metathorax-propodeum neither similar nor almost equal, with some regions not separated by marked constrictions ……. 3

3. Head red; anterior part of pronotum and Gt_1 with transverse ridge; anterior surface of mesopleuron concave ……. ***Hylomesa***

— Head black; anterior part of pronotum and Gt_1 without transverse ridge; anterior surface of mesopleuron flat ……...…. ***Mesa***

4.2.1. Subfamily: Methochinae Rohwer, 1916

I. Genus *Methocha* Latreille, 1804

Methocha Latreille, 1804: 179. Type species: *Mutilla articulata* Latreille (by monotypy).

Diagnosis. Eyes with setae (Figs. 3, 11, 16); males are macropterous (Fig. 15) and females apterous ((Figs. 1, 8). Apical part of metatibia of female with one S-shaped and dorsally finely comb-like spur (Fig. 22). Fore wing of males with two sub-marginal cells enclosed by tubular veins, vein Rs between true first and second sub-marginal cells reduced or absent, at least antero-apically (Fig. 15). Male: body long and slender (Fig. 15); tegula short, its end not reaching transcutellar suture (Fig. 18); metasoma with long upwardly hooked sting (Fig. 21); metasomal Gs_6 shorter than Gs_5, and not reaching the apex of pygidium (Fig. 21); Gs_7 partly exposed (Fig. 21). Female: prothorax, mesothorax and metathorax-propodeum forming distinct, similar, and almost equal regions separated by marked constrictions (Figs. 2, 10, 24 & 32); metathorax-propodeum almost globose (Fig. 32); legs elongated (Figs. 15, 29).

Distribution. Worldwide except Australia (Kimsey, 1991).

Remarks. The Indian fauna of *Methocha* comprises females of *M. bicolor* Cameron, *M. litoralis* Krombein, *M. keralaensis* Hanima & Girish Kumar and *M. krombeini* Hanima, Girish Kumar & Binoy and males of *M. litoralis* Krombein, *M. smithii* Magretti, *M. violaceipennis* Cameron and *M. paraceylonica* Hanima, Girish Kumar & Binoy. The female of species *M. keralaensis* Hanima & Girish Kumar and *M. krombeini* Hanima, Girish Kumar & Binoy and male species *M. paraceylonica* Hanima, Girish Kumar & Binoy are the newly described species during this study.

Key to the species of *Methocha* from India (Adopted from Hanima *et al.*, 2021).

1. Females: Wingless (Fig. 1); antenna 12 segmented (Fig. 13), not arising from beneath frontal tubercle (Fig. 12); tibial spur formula 111. ……..…. 2

— Males: Winged (Fig. 15); antenna 13 segmented (Fig. 15), arising from beneath frontal tubercle (Fig. 16); tibial spur formula 122. ……..……. 6

2. Ocelli arranged in acute triangle (Fig. 3). ……. 3

— Ocelli arranged in obtuse triangle [Hanima *et al*. (2022b): Fig. 2G]. ……..…. 5

3. Apico-medial margin of clypeal lobe rounded (Fig. 5). ……..……..……. ……..… ***M. keralaensis* Hanima & Girish Kumar**

— Apico-medial margin of clypeal lobe slightly emarginated (Fig. 12). ……. 4

4. IOD at posterior ocellus 1.2 × least IOD (Fig. 12); scutellum distinctly convex or bulging (Fig. 8). ……..…. ***M. krombeini* Hanima, Girish Kumar & Binoy**

— IOD at posterior ocellus 1.7 × least IOD (Fig. 25); scutellum concave (Fig. 22). ….……...…. ……...…. ***M. taprobane* Krombein**

5. Frons broader, with scatterly distributed punctures [Krombein (1982): Fig. 22], head 1.6–1.7 × as wide as narrowest part of frons, more strongly protuberant above antennae [Krombein (1982): Fig. 21], most puncture interspaces more than 3 × average puncture diameter; pronotal disc evenly convex, without a median groove; mesosternal tubercles anterior to mid coxae strong, acute, separated by a U-shaped emargination, area anterior to tubercles with shallow median fovea. ……. ***M. litoralis* Krombein**

— Frons narrower, with adjacently distributed punctures (Fig. 30), head 1.7–2.1× as wide as narrowest part of frons, puncture interspaces generally subequal to puncture diameters (Fig. 30); pronotal disc with median longitudinal groove (Fig. 35); mesosternal processes anterior to mid coxae varying from low obtuse teeth separated by a broad, shallow emargination to evanescent transverse ridges. ……..... ***M. ubiquita* Krombein**

6. Mesopleuron with a median ovate, impressed, densely setose fossa [Hanima *et al*. (2021): Fig. 45]; malar space usually well developed, more or less quadrate; hypostomal carina with a strong tooth anteriorly behind mandible; parapsides and notauli present, the latter short [Hanima *et al*. (2021): Fig. 44]; genitalia [Krombein (1982): Figs. 33–35] with ventral margin of paramere deeply emarginate medially. ……...……. **7**

— Mesopleuron without an impressed fossa (Fig. 19); malar space short, linear; hypostomal carina low, not toothed; parapsides present, notauli absent (Fig. 18); genitalia [Krombein (1982): Figs. 37, 38] with ventral margin of paramere rounded and convex medially. ……..…. **9**

7. Clypeal margin deeply emarginate medially [Hanima *et al*. (2021): Fig. 42]; mandible broad; malar space as wide as basal flagellomeres; punctation of mesosoma sparse and delicate [Hanima *et al*. (2021): Fig. 44]; tibiae and tarsi dark. ……..…. **8**

— Clypeal margin truncate or narrowly rounded in middle; mandible slender; malar space narrower, shorter than basal flagellar width; punctation of mesosoma denser and frequently coarser; base of mid and hindtibiae and all tarsi, except apical segment, pale. ……...…. ……..……...… ***M. ubiquita*** **Krombein**

8. Mesopleuron above median fossa with coarser punctures [Hanima *et al*. (2021): Fig. 45]; OOD 1.7 × POD [Hanima *et al*. (2021): Fig. 43]; mandible completely black; apices of metasomal terga without row of dense punctures. ……..……. ……. ***M. shyamagatra*** **Hanima, Girish Kumar & Sureshan**

— Mesopleuron above median fossa with sparser punctures; OOD 1.3 × POD; mandible, except base and tip, light red; apices of metasomal terga with a row of dense punctures. …… ***M. litoralis*** **Krombein**

9. Legs mostly light red, femora rarely light brown; OOD 1.5 × POD; punctures on mesopleural disc separated by more than one puncture diameter; hind margin of pronotal disc narrowly brown; length of fore wing 5.2 mm. ……..…..……. ***M. taprobane*** **Krombein**

— Legs dark brown, tarsi and tibia sometimes lighter brown (Fig. 15); OOD 2.1 × POD; punctures on mesopleural disc mostly separated by more than 3 × average puncture (Fig. 19); hind margin of pronotal disc narrowly yellow (Fig. 19); length of fore wing 4.8 mm. ……. ***M. paraceylonica*** **Hanima, Girish Kumar & Binoy**

Note. Males unknown for *M. keralaensis* and *M. krombeini*; females unknown for *M. shyamagatra* and *M. paraceylonica*. *M. bicolor*, *M. smithii* and *M. violaceipennis* are not included in the key due to insufficient description.

1. *Methocha keralaensis* Hanima & Girish Kumar, 2019

(Figs. 1–7)

Methocha keralaensis Hanima & Girish Kumar in Hanima *et al*., 2019b: 63–67. Holotype ♀, India, Kerala, Kozhikode district, Kakkattil (ZSIK).

Material examined. Kerala, Kozhikode district, Kakkattil (11°40'39.0144"N & 75°41'57.8832"E, 63 m), holotype ♀, 26.xi.2028, Coll. K. Anju, ZSIK Regd. No. ZSI/WGRC/IR/INV.12007.

Diagnosis. Female. Scape, pedicel, F1, F2, F3 and F4 brown (Fig. 2); ocelli arranged in acute triangle (Fig. 3); lower frons, immediately above antennal torulus, weakly coriaceous (Fig. 5); apical margin of clypeal lobe rounded (Fig. 5); mandible with small subapical teeth (Fig. 5);

prothorax, mesothorax and metathorax-propodeum forming three distinct and almost equal regions (Fig. 6); mesosoma black, smooth, polished with scattered punctures (Fig. 6); propodeum smooth with setigerous punctures and with few transverse striations towards posterior margin (Fig. 6); vestiture on thoracic dorsum dull white mixed with dark brown (Fig. 6); metasoma smooth with scattered setigerous punctures (Fig. 7); basal metasomal segments black (Fig. 7).

Size. 5 mm.

Male. Unknown.

Distribution. India: Kerala (Hanima *et al*., 2019b).

Remarks. Hanima *et al.,* 2019b described it for the first time from India (Kerala).

2. *Methocha krombeini* Hanima, Girish Kumar & Binoy, 2021

(Figs. 8–14)

Methocha krombeini Hanima, Girish Kumar & Binoy in Hanima *et al*., 2021: 262–265. Holotype ♀, India, Kerala, Kozhikode district, Elathur (ZSIK).

Material examined. INDIA: Kerala, Kozhikode district, Elathur (11°20’01”N & 75°46’17”E, 18 m), holotype ♀, 25.xi.2020, Coll. C. Binoy, ZSIK Regd. No. ZSI/WGRC/IR/INV.15311.

Diagnosis. Female. Frons with sparse setigerous punctures (Fig. 12); HW 2.3 × least IOD (Fig. 12); POD 1.2 × LOD, 0.79 × OOD (Fig. 11); lower frons, immediately above the antennal torulus, smooth without punctures (Fig. 12); apico-medial margin of clypeal lobes weakly emarginated (Fig. 12); mandibles with small subapical tooth (Fig. 12); scutellum distinctly convex (Fig. 8); posterior half of the mesopleuron smooth (Fig. 10); mesosternum without mesopleural lamella.

Size. 4.89 mm.

Male. Unknown.

Distribution. India: Kerala (Hanima *et al*., 2021).

Remarks. Hanima *et al.,* 2021 described this species for the first time from India.

3. *Methocha paraceylonica* Hanima, Girish Kumar & Binoy, 2021

(Figs. 15–21)

Methocha paraceylonica Hanima, Girish Kumar & Binoy in Hanima *et al*., 2021: 265–268. Holotype ♂, India, Kerala, Thiruvananthapuram district, Peppara (ZSIK).

Material examined. INDIA: Kerala, Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary (8°37’24”N & 78°08’09”E, 119 m), holotype ♂, 19.i.2019, Coll. P. Girish Kumar, ZSIK Regd. No. ZSI/WGRC/IR/INV.15312.

Diagnosis. Male. Apico-medial margin of clypeal lobe without deep emargination (Fig. 17); clypeal disc with scattered setigerous punctures (Fig. 17); pronotal disc without anterior ridge, with few transverse wrinkles (Fig. 18); lateral side of pronotum with scattered punctures, without ridge (Fig. 19); propodeum without distinct areola, with irregular rugose reticulations (Fig. 18); mesopleuron without a median, ovate, impressed, densely setose fossa (Fig. 19); tegula yellowish brown (Fig. 18); wings hyaline (Fig. 15); tergal segments with scattered setigerous minute punctures (Fig. 20).

Size. 8.4 mm.

Female. Unknown.

Distribution. India: Kerala, Karnataka (Hanima *et al*., 2021).

Remarks. Hanima *et al.,* 2021 described this species for the first time from India.

4. *Methocha taprobane* Krombein, 1982

(Figs. 22–28)

Methocha (*Dryinopsis*) *taprobane* Krombein, 1982: 87. Holotype ♂, Sri Lanka: North Western Province, Puttalam district, Pannika Villu, Wilpattu National Park (NMNH).

Material examined. Kerala, Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Peppara dam site (8°37'19.3008" N,
77°8'14.1432" E, 98 m), 1 ♀, 4.xii 2021, Coll. P. Girish Kumar & Party, ZSIK Regd. No. ZSI/WGRC/I.R.-INV.19646.

Diagnosis. Female. Vestiture silvery to cinereous (Fig. 22); flagellar segments black except apex of scape and pedicel brown (Fig. 26); legs black with tarsal joints light brown (Fig. 22); metasomal segments apically light brown (Fig. 27); head 2.2–2.4 times as wide as least interocular distance (Fig. 25); postocellar line 1.3 times lateral ocellar line and 0.7 times ocellocular distance; mesosoma smooth and shiny (Fig. 24).

Size. 4.8 mm.

Male. Unknown in the present study.

Distribution. India: Kerala. *Elsewhere*: Sri Lanka (Krombein, 1982; Hanima *et al*., 2022a).

Remarks. Hanima *et al.* (2022a) reported this species from India for the first time.

5. *Methocha ubiquita* Krombein, 1982

(Figs. 29–37)

Methocha (*Methocha*) *ubiquita* Krombein, 1982: 92. Holotype ♂, Sri Lanka, Eastern Province, Trincomalee District, Trincomalee (NMNH).

Material examined. Kerala: Kozhikode district, Kakkodi, Cherukulam (11°20′06″ N, 75°46′20″ E, 7m), 1 ♀, 21.viii.2021, Coll. T.K. Viswanath, ZSIK Regd. No. ZSI/WGRC/I.R.–INV.18313.

Diagnosis. Female. HW 1.9 × minimum distance of IOD (Fig. 30); lower frons protuberant above antennae and with a shallow groove medially (Fig. 30); clypeus without lateral lobe, medially with convex swelling (Fig. 31); inner surface of mandible with one sub-apical tooth (Fig. 31); pronotal disc with a median longitudinal groove (Fig. 35); scutum and scutellum bulged dorsally and separated by a constriction (Fig. 32); mesosoma with pronotum and propodeum orange red, scutum, scutellum, metanotum and pronotal collar reddish brown (Fig. 32); posterior half of mesopleuron with coarse, oblique rugulae (Fig. 33).

Size. 7.6 mm.

Male. Unknown in the present study.

Distribution. India: Kerala. *Elsewhere*: Sri Lanka (Krombein, 1982; Hanima *et al*., 2022b).

Remarks. Hanima *et al.* (2022b) reported this species from India for the first time.

4.2.2. Subfamily Myzininae Borner, 1919

Tribe Mesini Argaman, 1994

I. Genus *Hylomesa* Krombein, 1968

Hylomesa Krombein, 1968: 3–7. Type-species: *Myzine tricolor* Smith, 1858 by original designation of Krombein, 1968: 3.

Diagnosis. Female. Head porrect, more or less quadrate in dorsal view; inner margin of eyes shallowly and broadly emarginate; mandible stout, slightly curved, with a small subapical tooth on inner margin; antennae arising from beneath frontal lobes; ocelli small, three in number; clypeus broad and narrow with median keel weak to strongly produced, the apical margin with small rounded lobe on each side, the median lobe broadly rounded and usually with a pair of small teeth; mesopleuron convex; metapleuron flat, reduced; dorsal side of propodeum with a narrow, elongate, median cuneate impression, lateral surface with close, weak, oblique ridges; metasoma relatively broad, flattened, 6-segmented; disc of Gt_1 ridged anteriorly; pygidial area shagreened or polished at apex, not closely longitudinally striated (Krombein, 1968).

Male. Head not square (Fig. 39); ocelli three in number (Fig. 39); clypeus with weak median keel (Fig. 40); maxillary palpus 6-segmented, labial palpus 4-segmented; pronotal disc about as long as broad, the sides slightly converging anteriorly, a strong ridge between disc and abruptly declivous anterior portion of pronotum (Fig. 41); scutum shorter than pronotal disc, notauli and parapsidal furrows well-developed on posterior three-fourths (Fig. 41); scutellum as long as scutum; mesopleuron not so strongly bulging as in female, without an anterior ridge

and not produced anteriorly in middle (Fig. 42); propodeum with ridge between dorsal and posterior surfaces (Fig. 41); metasoma slender, 7-segmented; disc of Gt_1 ridged anteriorly (Figs. 45, 46); last dorsal segment convex, without differentiated pygidial area, its apex not notched for reception of the recurved hypopygial aculeus as in *Mesa* (Fig. 46); wings reaching nearly to apex of metasoma; anterior margin of marginal cell confluent anteriorly with costal margin of wing, narrowly rounded apically; three submarginal cells, the second and third each receiving a recurrent nervure; cubitus in hind wing arising before transverse median nervure; basal flagellar segments of antenna usually red, and wings hyaline basally and infumated apically (Krombein, 1968).

Notes. The genus *Hylomesa* contains 10 species and one subspecies worldwide. Among these eight species and one subspecies are distributed in the Oriental Region of which 4 species are reported from India.

Distribution. Gabon; India; Indonesia: Borneo, Java, Sumbawa; Malaysia; Myanmar; Philippines; Sri Lanka; Uganda (Krombien, 1968).

Key to the species of *Hylomesa* from India (modified from Krombein, 1968 & 1982).

(The females are unknown in *H. crassepunctata* and *H. dimidiaticornis*)

1. Females; metasoma with six visible segments; antenna apparently only 11- segmented because of the nearly entirely recessed pedicel. ……..…. 2

— Males; metasoma with seven visible segments (Fig. 46); antenna apparently only 12-segmented because of the recessed pedicel (Fig. 43). ……..…. 3

2. Inferior margin of hind femur sharply right-angled near apex; upper half of front of female with widely separated punctures, vertex with very few scattered punctures behind ocelli. ……..…. ***H. anomala*** **Krombein**

— Inferior margin of hind femur obtusely angulate in middle; front of female mostly contiguously to subcontiguously punctate, vertex with subcontiguous punctures immediately behind ocelli, mostly impunctate posteriorly. ……...…. ***H. longiceps*** **(Turner)**

3. Intermediate flagellar segments with length and width subequal; ocellocular and ocelloccipital distances subequal; pronotal disc anteriorly with one weak, transverse ridge; head and pronotum red; South India. ……....…. ***H. crassepunctata*** **(Turner)**

— Intermediate flagellar segments with length 1.2–1.5 times the width (Fig. 43); ocellocular distance 0.6-0.7 times the ocelloccipital distance; pronotal disc anteriorly either with a single strong ridge or with three weak ridges (Fig. 41); head usually red (Fig. 39); pronotum always black (Fig. 41). …….. 4

4. Gs_5– Gs_6 each with the posterior area clothed with dense, short, velvety vestiture; pronotal disc anteriorly with three weak transverse ridges. …… ***H. dimidiaticornis*** **(Bingham)**

— None of sterna with velvety vestiture (Fig. 47); pronotal disc anteriorly with a single strong transverse ridge (Fig. 41). …… 5

5. Gs_2– Gs_4 with scattered suberect discal setae, fifth and sixth with patch of dense setae posteriorly (Fig. 47). ……..…. ***H. longiceps*** **(Turner)**

— Gs_2– Gs_5 of male with scattered suberect discal setae, Gs_6 with a patch of dense suberect longer hair on posterior two-thirds. ……..……. ***H. anomala*** **Krombein**

1. *Hylomesa longiceps* (Turner, 1918)

(Figs. 38–47)

Plesia tricolor (Smith); Magretti, 1892: 258, 259 [in part, misidentified ♂ from Burma]; Turner, 1908a: 408 [misidentified ♀ from Assam].

Myzine tricolor (Smith); Bingham, 1897: 66 [misidentified ♀ from Assam].

Elis (Mesa) tricolor (Smith); Turner, 1912: 720 [in part, misidentified ♀ from Assam and W India].

Elis (Mesa) tricolor longiceps Turner, 1918: 87 [♀, Dibrughur, Assam; type in NHMUK], Rohwer, 1921: 90 [♀, ♂; Philippines].

Mesa tricolor longiceps (Turner); Guiglia, 1965: 315 [♀, Ceylon]; Baltazar, 1966: 207 [Philippines].

Hylomesa longiceps (Turner), Krombein, 1968: 12–15, fig. 1, pi. 1: fig. 1 [♀, ♂; Ceylon, India, Assam, Burma, Malaysia, Philippines].

Hylomesa longiceps (Turner), Krombein, 1982: 81.

Material examined. Kerala: Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 1 ♂, 27.v.2018, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25707.

Diagnosis. Head red except apex of mandible, hypostomal carina and ocellar area black (Figs. 38, 39); scape, pedicel, F1, F2, F3 and F4 red (Fig. 43); mandible with preapical denticle (Fig. 40); dorsal side of pronotum anteriorly with 3–4 transverse ridges (Fig. 41); mesoscutum with rugose reticulations (Fig. 41); dorsal side of propodeum irregularly rugulose, narrow median channel with transverse rugae (Fig. 41); tegula short (Fig. 41); fore wing and hind wing hyaline basally and dark infumated apically (Fig. 44); lateral side of pronotum towards head with coarse punctures, towards mesopleuron with transverse rugulae (Fig. 42); mesopleuron with coarse, contiguous rugose reticulations (Fig. 42); metapleuron with transverse rugulae (Fig. 42); lateral surface of propodeum with irregular rugose punctures (Fig. 42); tergites with

scattered minute punctures (Fig. 46); Gt_1 with anterior transverse carina (Fig. 45); Gs_5 and Gs_6 with patch of dense setae posteriorly (Fig. 47).

Size. 14 mm.

Female. Unknown in the present study.

Distribution. India: Assam, Kerala (**new record**). *Elsewhere*: Myanmar; Malaysia; Philippines; Sri Lanka (Hanima & Girish Kumar, 2020).

Remarks. This species is recorded for the first time from Kerala during the present study.

II. Genus *Mesa* Saussure, 1892

Mesa Saussure, 1892: 244–245. Type species: *Plesia abdominalis* Guérin-Méneville (1838), by subsequent designation of Bartalucci in Elçin *et al.,* 2013: 1662.

Plesia (*Mesa*): Turner, 1908a: 502–511.

Elis (*Mesa*): Turner, 1911: 617–618.

Nyuka Argaman, 1994: 90. Type species: *Plesia picticollis* Morawitz (1890), by original designation and monotypy. Synonym of *Mesa* by Bartalucci (2004).

Diagnosis. Torulus partly or entirely concealed from above with transverse carina or laminate tubercle formed by elaboration of frons (Fig. 58); eye bare, without any setae (Fig. 57); pronotal disc and the disc of the Gt_1 anteriorly without transverse ridges (Figs. 51, 55, 57, 64); wings with three submarginal cells, the second and third each receiving a recurrent nervure (Fig. 63); metatibia with posterior (inner) apical spur more or less straight (Fig. 65).

Distribution. Ethiopian, Oriental, and southern Palaearctic Regions.

Key to the Indian species of the genus *Mesa* Saussure (Modified from Liao *et al.*, 2021).

(Males of *M. apimacula*, *M. bengalensis*, *M. fuscipennis*, *M. opacifrons*, *M. rothneyi* and female of *M. nursei* are not included in the key)

1. Males (Slender body with color mainly black with yellow or straw color (Fig. 57)). ……. 2

— Females (Robust body with black color (Fig. 48)). ……..……. 7

2. Fore wing brownish infumated apically (Fig. 98). ……...…. 3

— Fore wing hyaline (Figs. 63, 82). ……. 4

3. Anterior side of pronotum with distinct transverse carina; vertex moderately to sparsely punctate; apex of metasomal segments without pale yellow narrow bands (metasoma completely black). …….. ***M. dimidiata* (Guerin)**

— Anterior side of pronotum without distinct transverse carina (Fig. 96); vertex densely punctate (Fig. 94); apex of Gt_2– Gt_5 with pale yellow narrow bands (Fig. 101). …….……. ……***M. petiolata* (Smith)**

4. Dorsal surface of propodeum transversely rugose, lateral sides largely with oblique wrinkles; anterior side of pronotum with transverse wrinkles; Gt_2– Gt_4 apically with very narrow ivory lateral spots and Gt_5– Gt_6 apically with transverse ivory bands. ……. ***M. nursei*** **(Turner)**

— Dorsal surface and lateral sides of propodeum largely with rugose reticulations (Figs. 60, 61, 79, 80); anterior side of pronotum without transverse wrinkles (Figs. 60, 79); Gt_1– Gt_5 apically with transverse ivory bands (Figs. 64, 83). ……. 5

5. Antennal flagellum beneath black (Fig. 81). ……. 6

— Antennal flagellum (terminal segments) beneath red. …….. ***M. claripennis*** **(Bingham)**

6. Frons and dorsal side of propodeum with separated punctures; dorsal side of metasoma with dense, erect vestitures. …….. ***M. flavipennis*** **Krombein**

— Frons with coarse contiguous punctures (Fig. 77) and dorsal side of propodeum with reticulations (Fig. 79); dorsal side of metasoma with sparse, erect vestitures (Fig. 83). ……..... ***M. keralaensis*** **Hanima & Girish Kumar sp. nov.**

7. Fore wing strongly yellowish (Fig. 54). ……...…. 8

— Fore wing not yellowish (infumated) (Figs. 73, 85). ……..……. 10

8. Metasomal segments completely black (Fig. 55); pygidium without distinct longitudinal striations (Fig. 55). ……. ***M. claripennis*** **Bingham**

— Metasomal segments not completely black, sometimes some segments completely red or with red apical bands; pygidium with distinct longitudinal striations. ……. 9

9. Narrow apical bands of Gt_1– Gt_5 dark red; frons without well-developed groove; pronotal disc with narrow median impunctate strip; antennal flagellum black. ……...…….. ……..…….. ***M. flavipennis*** **Krombein**

— Gt_4– Gt_6 completely red; frons with well-developed groove; pronotal disc without narrow median impunctate strip; antennal flagellum yellowish red. …… ……..... ***M. coimbatorea*** **Hanima & Girish Kumar sp. nov.**

10. Gt_6 longitudinally striate (Fig. 72). ……...…. 11

— Gt_6 punctate, not striate. ……..…. 13

11. Posterior area of hind ocelli with deep and contiguous punctures or shallow depression; Gt_2, Gt_3 and base of Gt_4 red (Fig. 74). ……. ***M. dimidiata*** **(Guerin)**

— Posterior area of hind ocelli without deep and contiguous punctures; metasomal tergites black (Fig. 91). ……...…. 12

12. Posterior side of propodeum distinctly truncated, abrupt and steep; outer margin of hindtibia with black spines; mandible fusco-ferruginous. ……...…. ***M. fuscipennis*** **(Smith)**

— Posterior side of propodeum indistinctly truncated, gradually sloping (Fig. 89); outer margin of hindtibia with yellowish-orange spines (Fig. 85); mandible black (Fig. 87). ……..……. ……...…… ***M. petiolata*** **(Smith)**

13. Vertex with sparse punctures; ocellar area without punctures. …….……. 14

— Vertex with dense punctures; ocellar area with punctures. ……. 15

14. Lateral side of pronotum closely and finely punctate. ……. ***M. opacifrons*** **(Turner)**

— Lateral side of pronotum anteriorly punctate and ventrally closely and finely striate. ……. ……...……. ***M. bengalensis*** **(Cameron)**

15. Fore wing pale infuscate and without purple luster; scutellum sparsely punctate. …….……. ……...….. ***M. apimacula*** **(Cameron)**

—Fore wing strongly infuscate and with purple luster; scutellum densely punctate. .....……. ……...……... ***M. rothneyi*** **(Cameron)**

1. *Mesa claripennis* (Bingham, 1897)

(Figs. 48–65)

Myzine claripennis Bingham, 1897: 68 [♀, Burma, Tenasserim; type in NHMUK]; Nurse, 1902: 82 [♀, differentiated from *M. hortata* Nurse in key].

Myzine hortata Nurse, 1902: 81, fig. 6 [♀; Deesa; location of type unknown but probably unlabelled as type in NHMUK].

Plesia (*Mesa*) *hortata* (Nurse); Turner, 1908a: 512 [♀; Deesa and Pusa, Bengal].

Elis (*Mesa*) *claripennis* (Bingham); Turner, 1912: 718 [♀, ♂; Burma, Ceylon, Bengal, Deesa; synonymises this and *M. hortata* Nurse and describes ♂].

Materials examined. Kerala: Kollam district, Sasthamkotta, Padinjarekkara (9°8'7.6992"N & 76°33'34.8696"E, 33 m), 2 ♀, 21.xii.2016, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.21139–21140; Kollam district, Sasthamkotta, Punnakad (10°54'50.2056"N & 76°9'7.4088"E, 87 m), 1 ♀, 23.xii.2016, Coll. M. Jafer Palot & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.21141; Kollam district, Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), 4 ♀, 9.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25486–25489; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 1 ♀, 17.iii.2019, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.21142; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 1 ♂, 8.v.2019, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25593; Wayanad district, Thalimala tea estate (11°31'29.532"N & 76°4'13.1052"E, 1360 m), 1 ♀, 16.viii.2022, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No.

ZSI/WGRC/IR/INV.21777; Kannur district, Aralam Wildlife Sanctuary, (11°58'04"N & 75°19'08"E, 7 m), 29 ♂, 11♀, 22.iii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.21778–21782 & 21965 & 25503–25512, 25533–25556; Kannur district, 17 ♂, Aralam Wildlife Sanctuary, (11°58'04"N & 75°19'08"E, 7 m), 16.iii.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25560–25576; Palakkad district, Silent Valley National Park, Thathengalam (11°2'21.5736"N & 76°27'6.9768"E, 113 m), 7 ♂, 14.xii.2017, Coll. Prashanth, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25579–25585; Kozhikode district, Haritha Nagar Colony (11°16'23.718"N & 75°48'24.6528"E, 26 m), 2 ♂, 14.v.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25586–25587; Idukki district, Chinnar, Kootaram (10°18'22"N & 77°12'24"E, 596 m), 2 ♂, 28.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25588–25589; Kozhikode district, Nanminda (11°25'15"N & 75°49'53"E, 46 m), 2 ♂, 16.x.2017, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV. 25518 & 25590–25591; Kozhikode district, Janakikkadu (11°37'31.4328"N & 75°47'36.9888"E, 44 m), 1 ♂, 1.iii.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25592; Kozhikode district, Elathur (11°20’01”N & 75°46’17”E, 18 m), 1 ♂, 21.ii.2021, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25557; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam damsite (11°33'27"N & 75°54'41"E, 543 m), 3 ♀, 17.iii.2022, Coll. V.D. Hegde & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25513–25515; Kozhikode district, Ooleri (11°32'28"N & 75°50'40"E, 30 m), 2 ♀, 24.iii.2019, Coll. Sandra Lishikumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25516–25517; Kozhikode district, Regional Science Centre and Planetarium (11°15'46.5732"N & 75°47'9.24"E, 23 m), 3 ♀, 31.v.2023, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25523–25525; Idukki district, Iravikulam National Park, Rajamalai (10°18'22"N & 77°12'24"E, 596 m), 1 ♂, 4.i.2018, Coll. A.P. Kamila, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25594; Thiruvananthapuram district, Neyyar Wildlife Sanctuary, Kaalipara (8°31'35"N & 77°08'32"E, 168 m), 5 ♀, 2.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25490–25494; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 4 ♀, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25495–25498; Thiruvananthapuram district, Neyyar Wildlife Sanctuary, Ananirathi (8°32'02"N & 77°08'59"E, 96 m), 2 ♀, 16.i.2019, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25499–25500; Thiruvananthapuram district, Neyyar Wildlife Sanctuary, Kothiram (8°39'45"N & 77°09'00"E, 125 m), 1 ♀, 17.i.2019, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25501; Ernakulam district, Thattekkad Bird Sanctuary,

Ootampara (10°7'27.3324"N & 76°41'11.58"E, 79 m), 1 ♀, 19.vi.2016, Coll. P. M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25502; Malappuram district, Nilambur (11°18'0.36"N & 76°15'1.44"E, 48 m), 4 ♀, 18.iv.2022, Coll. T. K. Soumya, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25519–25522; Wayanad district, Wayanad Wildlife Sanctuary, Manchal (11°42'11.772"N & 76°22'1.38"E, 777 m), 7 ♂, 21.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25526–25532.

Diagnosis. Female (Figs. 48–56). Head entirely black except middle part of mandible reddish (Fig. 49); mandible without subapical tooth (Fig. 50); frons with separated punctures, lower frons with longitudinal groove above antennal tubercles (Fig. 49); clypeal lobe with apex rounded (Fig. 50); dorsal side of pronotum without narrow smooth space medially, with uniformly spaced punctures (Fig. 51); mesoscutum and metanotum with scattered medium sized punctures (Fig. 51); dorsal side of propodeum with a narrow median groove on basal half, groove wider anteriorly than posteriorly (Fig. 51); lateral side of pronotum with coarse punctures anteriorly, obliquely rugulose posteriorly (Fig. 52); apical part of tegula reddish (Fig. 51); fore wing yellowish brown, hind wing clear (Fig. 54).

Size. 7.5–11 mm.

Diagnosis. Male (Figs. 57–65). Head entirely black except apical part of antennal tubercle, clypeus, more than half of mandible yellowish (Fig. 58); mandible with subapical tooth (Fig. 59); anterior side of pronotum without ridges (Fig. 60); dorsal side of pronotum, mesoscutum and metanotum with medium sized punctures (Fig. 60); dorsal side of propodeum rugoso-reticulate (Fig. 60); propleuron and mesopleuron with punctures (Fig. 61); lateral sides of propodeum largely with rugose reticulations (Fig. 61); metapleuron smooth with oblique ridges (Fig. 61); Gt_2– Gt_5 apically with transverse ivory bands (Fig. 64); fore wing hyaline (Fig. 63).

Size. 6.5–12 mm.

Distribution. India: Bihar, Gujarat, Kerala (**new record**). *Elsewhere*: Myanmar; Sri Lanka; Thailand (Krombein, 1982; Hanima & Girish Kumar, 2022).

Remarks. This species is recorded for the first time from Kerala during the present study.

2. *Mesa dimidiata* (Guerin, 1837)

(Figs. 66–75)

Myzine dimidiata Guerin, 1837: 584, 585 [♂; Bombay; type in Museum National d'Histoire Naturelle (Paris)]; Bingham, 1897: 68, 69; Dalla Torre, 1897: 123; Maxwell-Lefroy, 1909: 193 [records mating of *M. dimidiata* Guerin and *M. madraspatana* Smith].

Methocha [sic] *orientalis* Smith, 1855: 66 [♂; Northern India; type in NHMUK]; Dalla Torre, 1897: 3.

Myzine madraspatana Smith, 1855: 72 [♀; Madras; type in NHMUK]; Bingham, 1897: 65, 66; Dalla Torre, 1897: 124.

Myzine violaceipennis Cameron, 1897: 21, 23 [♂; Poona, Bombay; type in OUM].

Plesia (*Mesa*) *madraspatana* (Smith); Turner, 1908a: 507, 508 [synonymizes this and *M. violaceipennis* Cameron.

Plesia (*Mesa*) *dimidiata* (Guerin); Turner, 1908a: 508 [synonymizes this and *M. orientalis*].

Elis (*Mesa*) *dimidiata* (Guerin); Turner, 1912: 715 [synonymizes under this *M. orientalis* Smith, *M. madraspatana* Smith and *M. violaceipennis* Cameron; all of India except north-west].

Materials examined. Kerala: Thiruvananthapuram district, Kerala University (8°30'11.52"N & 76°56'50.28"E, 34 m), 1 ♀, 27.ix.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.20925; Ernakulam district, Thattekkad Bird Sanctuary (10°6'13.7772"N & 76°42'0.7884"E, 62 m), 1 ♀, 20.ix.2016, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.21136.

Diagnosis. Female. Head entirely black with coarse irregularly distributed punctures (Fig. 67); longitudinal groove medially between antennal tubercles (Fig. 68); mandible without subapical tooth (Fig. 68); clypeal lobe with median projection (Fig. 68); dorsal side of pronotum without carina anteriorly, surface with coarse, elongated punctures mixed with small punctures (Fig. 69); mesoscutum and metanotum with coarse punctures, mesoscutum with notauli and parapsids (Fig. 69); dorsal side of propodeum with complete, median channel tapered towards apex (Fig. 69); lateral side of pronotum with coarse punctures anteriorly and upper part, obliquely rugulose posteriorly (Fig. 70); mesopleuron with coarse punctures, lateral side of propodeum with oblique rugulae (Fig. 70); wing infumated (Fig. 73); Gt_2, Gt_3 and Gt_4 (except apical part) red (Fig. 74).

Size. 16–19 mm.

Male. Unknown in the present study.

Distribution. India: Karnataka, Kerala (**new record**), Maharashtra, Tamil Nadu, Uttarakhand (Krombein, 1982; Hanima & Girish Kumar, 2022).

Remarks. This species is recorded for the first time from Kerala during the present study.

3. *Mesa keralaensis* Hanima & Girish Kumar sp. nov.

(Figs. 76–84)

Type material. Holotype, 1♂, INDIA: Kerala, Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 29.ix.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25309; Paratypes, Thiruvananthapuram district, Kerala

University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 1 ♂, 27.ix.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25310; Thiruvananthapuram district, Agasthyamalai BR, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 2 ♂, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25311–25312; Kozhikode district, Ooleri (11°32'28"N & 75°50'40"E, 30 m), 1 ♂, 24.iii.2019, Coll. Sandra Lishikumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25313; Kozhikode district, Nanminda (11°25'15"N & 75°49'53"E, 46 m), 8 ♂, 16.x.2017, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV. 25314–25321; Kozhikode district, Jaferkhan Colony (11°15'41.184"N & 75°47'13.2"E), 3 ♂, 13.vii.2018, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25322–25324; Kozhikode district, Jaferkhan Colony (11°15'41.184"N & 75°47'13.2"E), 4 ♂, 14.v.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25325–25328; Kozhikode district, Jaferkhan Colony (11°15'41.184"N & 75°47'13.2"E), 1 ♂, 16.v.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV. 25329; Kozhikode district,, Haritha Nagar Colony (11° 16' 23.718" N & 75° 48' 24.6528" E, 26 m), 6 ♂, 22.ii.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV. 25330–25335; Kozhikode district, Sarovaram Biopark (11°16' 6.96"N & 75°47' 33.72"E, 6 m), 3 ♂, 26.x.2018, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Nos. ZSI/WGRC/IR/INV. 25336–25338; Kollam district, Sasthamkotta, Padinjarekkara (9° 8' 7.6992"N & 76° 33' 34.8696"E, 33 m), 3 ♂, 21.xii.2016, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV. 25339–25341; Idukki district, Kuttikanam, Teyla tea estate (9°34'39.8748"N & 76°58'15.9744"E), 5 ♂, 31.i.2023, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25342–25346; Idukki district, Kuttikanam, Teyla tea estate (9°34'39.8748"N & 76°58'15.9744"E),1051 m), 1 ♂, 30.i.2023, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25347; Kozhikode district, Edakkara (11°21' 41.4"N & 76°35'24.72"E), 1 ♂, 17.v.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV. 25348; Wayanad district, Kuruva Island (11°49'02"N & 76°05'36"E, 714 m), 1 ♂, 24.iii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV. 25349; Idukki district, Kulamavu (9°47'31.2"N & 76°53'11.4"E, 724 m), 1 ♂, 26.xi.2019, Coll. Mercy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV. 25350; Kollam district, Sasthamkotta (9°2'1.158"N & 76°37'29.1432"E, 43 m), 2 ♂, 22.viii.2016, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25351–25352; Palakkad district, Silent Valley National Park (11°03'51"N & 76°32'16"E, 540m), 1 ♂, 12.iii.2021, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25353; Idukki district, Kuttikanam, Satgbrook estate (9°35'58.686"N & 76°57'52.8264"E, 1069 m), 1 ♂, 24.i.2023, Coll. P. Girish Kumar & Party,

(ZSIK) Regd. No. ZSI/WGRC/IR/INV. 24354; Kannur district, Aralam Wildlife Sanctuary (11°58'04"N & 75°19'08"E, 7 m), 2 ♂, 16.iii.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25355–25356; Aralam Wildlife Sanctuary (11°58'04"N & 75°19'08"E, 7 m), 2 ♂, 22.iii.2021, Coll. K.A. Subramanian, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25357–25358; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 4 ♂, 17.iii.2019, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25359–25362; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 1 ♂, 3.iii.2019, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25363; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 1 ♂, 5.iii.2019, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25364; Thekkumbad dweep (11°58'35.4"N & 75°17'27.24"E), 2 ♂, 19.v.2019, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25365–25366; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27"N & 75°54'41"E, 543 m), 2 ♂, 11.iii.2019, Coll. S. Anagha, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.25367–25368; Kannur district, Koothuparamba (11°49'57.6372"N & 75°33'55.224"E, 70 m), 1 ♂, 30.ix.2020, Coll. Sr. Jeenu Lisb, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25369; Malappuram district, Nedumkayam (11°15'22.8456"N & 76°22'29.3808"E, 391 m), 1 ♂, 29.ii.2020, Tessy & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25370.

Diagnosis. Frons with deep punctures (Fig. 77); median lobe of clypeus emarginated apically (Fig. 78); dorsal side of propodeum with irregular rugose reticulations (Fig. 79); dorsal side of metasoma with sparse, erect vestiture (Fig. 83); wings hyaline (Fig. 82).

Description.

Colour. Wings hyaline, veins dark (Fig. 82); vestiture glittering white (Figs. 77, 78, 79, 80); apex of antennal tubercle pale yellow or straw coloured (Fig. 77); clypeus straw coloured, basally with two black spots, apex brown translucent (Fig. 78); apex and rim of mandible dark brown, other parts yellow (Fig. 78); apex of metasomal segments Gt_1–Gt_6 with yellow bands (Fig. 83); pronotum posteriorly with yellow coloured band (Fig. 79); tegula translucent yellowish brown (Fig. 79); forecoxa yellowish; apex of mesopleural lamella yellow; mid coxa with yellow spots (in some specimens without spots); tarsal segments yellowish except last segment brown (Fig. 84); apical small portion of fore and mid femora yellow; basal small portion of hindtibia yellow and half of fore and midtibia yellowish (Fig. 76).

Head. Upper front and vertex with deep punctures (Fig. 77); lower front (below anterior ocellus) with rugose reticulations and inside with deep punctures (Fig. 77); in front of anterior ocellus and behind posterior ocellus with a small, smooth area without punctures (Fig. 77);

clypeus basally with two large spots, median lobe of clypeus emarginated apically, surface with contiguous punctures (Fig. 78); mandible with subapical tooth (Fig. 78).

Mesosoma. Pronotal disc without anterior ridge, small adjacently placed punctures anteriorly and large sparsely placed punctures posteriorly, dense setae anteriorly and sparse ones posteriorly (Fig. 79); lateral side of pronotum anteriorly with large, deep punctures, posteriorly with ridges in between punctures (Fig. 80); scutum and scutellum with moderate sized punctures; post scutellum with close, contiguous punctures (Fig. 79); in between notauli and middle part of scutum with a longitudinal keel like structure formed by short, transverse rugae (Fig. 79); mesopleural disc with coarse, deep subcontiguous punctures except posteriorly with small and sparse punctures (Fig. 80); dorsal and lateral side of propodeum with irregular rugose-reticulations (Figs. 79, 80).

Metasoma. Petiole of Gt_1 almost half as long as the nodose section of Gt_1 (Fig. 83); terga with small punctures, rarely with large ones (Fig. 83); Gt_7 with 2 lateral ridges and a middle area higher than lateral ridges, in between middle area and ridges with deep coalesced punctures which forms pits (Fig. 83); dorsal side of metasoma with short and sparse setae (Fig. 83).

Male. Unknown.

Size. 8–12 mm.

Distribution. India: Kerala.

Etymology. The species is named after the state from where the holotype is collected.

4. *Mesa petiolata* (Smith, 1855)

(Figs. 85–102)

Myzine petiolata Smith, 1855: 72 [♂; India; two syntypes in OUM]; Bingham, 1897: 70 [Barrackpore, Bengal]; Dalla Torre, 1897: 125.

Myzine ceylonica Cameron, 1900: 18, 19 [♀; Trincomalee, Ceylon: type in NHMUK)].

Plesia (*Mesa*) *petiolata* (Smith); Turner, 1908a: 512 [synonymises this and *M. ceylonica* based on pair taken in copula at Pusa, Bengal].

Plesia petiolata (Smith); Turner, 1911: 152 [♀, ♂; Colombo, Ceylon].

Elis (*Mesa*) *petiolata* (Smith); Turner, 1912: 717, 718 [♀, ♂; Bengal, Bombay, Ceylon].

Materials examined. Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 2 ♀, 27.ix.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.21138, 23517; Wayanad district, Valad (11°47'39.1272"N & 75°54'21.3372"E, 763 m), 4 ♀, 16.xi.2022, 19.xi.2022, 22.xi.2022, 25.xi.2022, Coll. M. Vishnuja, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.22785–22788; Kozhikode district: Sarovaram Biopark, (11°16' 6.96"N & 75°47' 33.72"E, 6 m), 1 ♂, 25.x.2019, Coll. K.P. Hanima

Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25595; Palakkad district, Parambikulam TR, Sungam range, Thunakadavu dam site (10°25'48.5724"N & 76°47'1.14"E, 582 m), 1 ♀, 19.viii.2023, Coll. V.D. Hegde & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.24877.

Diagnosis. Female (Figs. 85–92).

Head entirely black (Fig. 86); front with separated punctures, lower half of front with weak median groove (Fig. 86); mandible without subapical tooth (Fig. 87), clypeal lobe with apex subtruncate (Fig. 87); dorsal side of pronotum without narrow strip medially, parapsids and notauli present (Fig. 89); lateral side of pronotum with punctures (Fig. 90); dorsal side of propodeum medially with a groove with small transverse ridges, other regions with punctures (Fig. 89); lateral sides of propodeum with oblique ridges or rugulae (Fig. 90); fore wing darkly infumated (Fig. 85).

Size. 9–10 mm.

Diagnosis. Male (Figs. 93–102).

Head entirely black except apical part of antennal tubercle, clypeus and more than half of base of mandible yellowish (Fig. 94); mandible with subapical tooth (Fig. 95); anterior side of pronotum without distinct transverse carina (Fig. 96); vertex densely punctate (Fig. 94); dorsal side of pronotum, mesoscutum and metanotum with medium sized punctures (Fig. 96); dorsal side of propodeum with small rugose reticulations (Fig. 96); propleuron and mesopleuron with punctures matted with thick, long setae (Fig. 100); metapleuron smooth with weak, oblique ridges and scattered punctures (Fig. 100); lateral sides of propodeum largely with small rugose reticulations matted with thick, long setae (Fig. 100); apical part of mesopleural lamella yellowish (Fig. 99); apex of Gt_2– Gt_5 with pale yellow narrow bands (Fig. 101); fore wing infumated apically, hyaline basally, hind wing completely hyaline (Fig. 98).

Size. 10–12 mm.

Distribution. India: Bihar, Kerala, Maharashtra, Pondicherry, Tamil Nadu, West Bengal. *Elsewhere*: Sri Lanka; Thailand (Krombein, 1982; Hanima & Girish Kumar, 2020).

4.2.3. Subfamily Tiphiinae Leach, 1815

I. Genus *Tiphia* Fabricius, 1775

Tiphia Fabricius, 1775: 353; Bingham, 1897: 56–57; Allen & Jaynes, 1930: 4–13. Type species: *Tiphia femorata* Fabricius, original designation.

Serpapinta Argaman in Argaman & Özbek, 1992: 9. Type species: *Tiphia scabrosa* Gerstacker, 1858, by original designation. Synonymized by Bartalucci (2011: 342).

Sasmarila Argaman in Argaman & Özbek, 1992: 11. Type species: *Tiphia cinchonae* Allen, 1975, by original designation. Synonymized by Bartalucci (2011: 342).

Diagnosis. Inner orbit of eye without emargination (Fig. 104); eyes without setae (Fig. 104); median extension of clypeus truncate (Fig. 105), rounded (Fig. 138) or faintly or deeply emarginated (Fig. 187); pronotum dorso-anteriorly with (Fig. 124) or without transverse carina (Fig. 139); lateral side of pronotum with (Fig. 265) or without transdiscal groove (Fig. 293); tegula elongate (Fig. 132) or circular (Fig. 139), concealing humeral and median plates and ending at or posterior to level of transscutal articulation; propodeum with carinate dorsal enclosure or areola (Fig. 139); fore wing with two cubital cells (Fig. 142); Gt_1 anteriorly with (Fig. 208) or without transverse ridge (Fig. 200). Female: mesoscutum usually with lateral notauli and a separate crescent-shaped antero-medial groove (Fig. 253); metanotum with or without (Fig. 253) a median impression or callosity; fore wing with open marginal cell (Fig. 256); hind basitarsus with (Fig. 320) or without a longitudinal groove; apical half of pygidium smooth, polished, shagreened (Fig. 241) or with longitudinal ridges (Fig. 331). Male: Gs_6 much longer than Gs_5 exceeding far beyond the apex of pygidium, Gs_7 hidden under Gs_6 (Fig. 120); apical extension of marginal cell of fore wing closed (Fig. 118) and either equal (Fig. 118), longer (Fig. 263) or shorter than second cubital cell (Fig. 347), and Gs_5 with or without lateral denticle (Hanima *et al*., 2022c).

Distribution. Worldwide (Hanima *et al*., 2022c).

Key to the subgenera of *Tiphia* (Adopted from Han *et al.*, 2021).

1. T1 anteriorly with transverse carina (Figs. 7, 10 in Tsuneki, 1986a). ……..... ……..….. ***Punctotiphia*** **Tsuneki**

— T1 without transverse carina. ……...…… 2

2. Lateral propodeal face puncto-reticulate. ……...…….. ***Sierocolpa*** **Nagy**

— Lateral propodeal face with oblique wrinkles. ……..…..…….. 3

3. T1 with subposterior margin extending and more or less covering subapical puncture groove in lateral view (Figs. 9, 18, 27 in Han *et al*., 2021). ……..... ***Jaynesia*** **Allen**

— T1 without subposterior margin, or not extending and covering subapical puncture groove in lateral view. ……...……. ***Tiphia*** **Fabricius**

Key to the Indian species of *Tiphia* Fabricius (Modified from Hanima *et al.*, 2022c).

1. Females (antenna with 12 segments (Fig. 108); metasoma with 6 segments (Fig. 110); marginal cell of fore wing open (Fig. 109)). ……..... 2

— Males (antenna with 13 segments (Fig. 126); metasoma with 7 segments (Fig. 128); marginal cell of fore wing closed (Fig. 127)). ……..... 53

2. Apex of metasomal Gt_1 with deep, tightly infolded incision. ……...……. ……... ***Tiphia*** **(*Jaynesia*)** ***assamensis*** **Allen & Jaynes**

— Apex of metasomal Gt_1 without deep, tightly infolded incision (Fig. 110). ……..…. 3

3. Gt_1 with anterior transverse carina (Fig. 208). …..……. ***Tiphia* (*Punctotiphia*)** ……. 4

— Gt_1 without anterior transverse carina (Fig. 110). ……..……. ***Tiphia* (*Tiphia*)** ……..…. 5

4. Hind basitarsus without longitudinal groove on inner face. ……..……...……. ……..…… ***Tiphia* (*Punctotiphia*) *coimbatorea* Allen**

— Hind basitarsus with longitudinal groove on inner face. ……..……...……. ……..…… ***Tiphia* (*Punctotiphia*) *exacta* Nurse**

5. Hind basitarsus without longitudinal groove on inner face. ……..……. 6

— Hind basitarsus with longitudinal groove on inner face (Fig. 172). ……..……. 27

6. Dorsal side of propodeum with conspicuous longitudinal carina about mid-way between areola and lateral margin (See fig. 32 of Allen, 1975). ……. ……. ***Tiphia* (*Tiphia*) *shillonga* Allen**

— Dorsal side of propodeum without longitudinal carina between areola and lateral margin (Fig. 106). ……..……...…. 7

7. Tegula more than 1.5 × as long as middle width (Fig. 351). ……..…...…. 8

— Tegula at most only slightly longer than middle width (Fig. 106). ……..……..…. 10

8. Larger species (11 mm) with black, brown to reddish-brown legs (usually coxae black) (Fig. 349). ……..……...…. 9

— Smaller species (6–8 mm) with bright-red legs (sometimes coxae black). ……...……..…. …… ***Tiphia* (*Tiphia*) *tegulita* Allen**

9. Body with medium sized punctures (Figs. 351, 355); dorsal side of propodeum with quinquicarinate areola (Fig. 351). ……. ***Tiphia* (*Tiphia*) *quinquecarinata* Cameron**

— Body with large, deep punctures (Figs. 17, 184); dorsal side of propodeum with tricarinate areola (Figs. 177). ……..…. ***Tiphia* (*Tiphia*) *crassumpunctura* sp. nov.**

10. Lateral side of propodeum without any parallel rugulae on upper part; smaller species (4.5–6.0 mm). ……..……. ***Tiphia* (*Tiphia*) *s-tertia* Allen**

— Lateral side of propodeum with parallel rugulae on upper part (Fig. 107); usually larger species (longer than 7 mm). ……..……..…. 11

11. Femora of middle and hind legs entirely bright red to orange (Fig. 333). ……..…...…. 12

— Femur of hind leg black or dull brown at least on outer face (Fig. 144). ……..…. 15

12. Tibiae of middle and hind legs entirely bright red to orange (Fig. 333). ……..…. 13

— Tibiae of middle and hind legs black (see fig. 375 of Hanima *et al*., 2022c). …… 14

13. Apical part of pygidium wrinkled and shagreened; hind tibia less strongly inflated (length 2.5 × width of tibia). ……...…. ***Tiphia* (*Tiphia*) *kurczewskii* Krombein**

— Apical part of pygidium smooth and glossy; hind tibia strongly inflated (Figs. 333, 337) (length 2.1 × width of tibia). ……..…. ***Tiphia* (*Tiphia*) *palmi* Krombein**

14. Marginal cell of fore wing nearly closed, with spur directed upward and inward toward costal margin; notaulices and anteromedian escarpment strongly connected; lower disc of punctate part of pygidium rough and almost rugose. ……..…….…. ……..…. ***Tiphia* (*Tiphia*) *scutensis* Allen**

— Marginal cell of fore wing distinctly open, without spur or with one outwardly directed spur (see fig. 382 of Hanima *et al*., 2022c); notaulices and anteromedian escarpment not connected (see fig. 379 of Hanima *et al*., 2022c); lower disc of punctate part of pygidium smooth, polished. ……..…. ***Tiphia* (*Tiphia*) *nathani* Allen**

15. Tibiae of middle and hind legs brownish yellow to dull red (Figs. 144, 356). …….……. 16

— Tibiae of middle and hind legs black (Figs. 251, 268). ……..……. 18

16. Submarginal carina of dorsal side of propodeum absent (Figs. 147, 359); lateral side of pronotum with weak or vestigial transdiscal groove (Figs. 148, 360). ……..…. 17

— Submarginal carina of dorsal side of propodeum present (see fig. 490 of Hanima *et al*., 2022c); lateral side of pronotum with well-developed transdiscal groove (see fig. 491 of Hanima *et al*., 2022c). …...…… ***Tiphia* (*Tiphia*) *sahyadriensis* Hanima & Girish Kumar**

17. Upper front mostly impunctate (Fig. 145); lateral side of propodeum weakly rugulate (Fig. 148); marginal cell and second cubital cell of fore wing with outwardly directed straight spur (Fig. 149). ……...…. ***Tiphia* (*Tiphia*) *capillata* Allen & Jaynes**

— Upper front almost uniformly punctate (Fig. 357); lateral side of propodeum strongly rugulate (Fig. 360); marginal cell and second cubital cell of fore wing without spur (Fig. 361). ……..…. ***Tiphia* (*Tiphia*) *rajeevani* Hanima & Girish Kumar**

18. Areola of dorsal side of propodeum with five high, thin, parallel carinae, of which intermediate two shorter (Fig. 270). ……..……..……. ***Tiphia* (*Tiphia*) *lyrata* Magretti**

— Areola of dorsal side of propodeum with only three longitudinal carinae (Fig. 253). ….... 19

19. Gs_2 with anterior transverse carina; size 17 mm. ……..…..……. ……..….. ***Tiphia* (*Tiphia*) *rothneyi* Cameron**

— Gs_2 without anterior transverse carina; size 12 mm or less. …….……..…. 20

20. Dorsal side of pronotum with anterior transverse carina not complete, interrupted at middle (Fig. 253). ……..…. 21

— Dorsal side of pronotum with anterior transverse carina complete (Fig. 299). …….…..…. 23

21. Mesoscutum with anteromedian escarpment and notaulices strongly connected (see fig. 5 of Allen & Jaynes, 1930). ……..……. ***Tiphia* (*Tiphia*) *katmanduae* Allen**

— Mesoscutum with its anteromedian escarpment and notaulices not connected (Fig. 253). ……...…. 22

22. Impunctate part of pygidium conspicuously and broadly shagreened; lateral side of pronotum without transdiscal groove. ……..…. ***Tiphia* (*Tiphia*) *tuberculata* Cameron**

— Impunctate part of pygidium not shagreened (Fig. 257); lateral side of pronotum with distinct transdiscal groove (Fig. 254). ……...……. ***Tiphia* (*Tiphia*) *lawrencei* Allen**

23. Lateral side of pronotum with either very weak or without transdiscal groove (Fig. 300). ……...……. 24

— Lateral side of pronotum with distinct transdiscal groove (Fig. 107). ……..…..……. 25

24. Lateral side of pronotum without transdiscal groove (Fig. 300); fore wing slightly infumated (Fig. 302). ……..…… ***Tiphia* (*Tiphia*) *nilgirensis* Allen**

— Lateral side of pronotum with a very weak transdiscal groove; fore wing strongly yellowish. ……..……... ***Tiphia* (*Tiphia*) *hirsuta* Smith**

25. Dorsal side of propodeum without submarginal carina (see fig. 544 of Hanima *et al*., 2022c); fore wing yellowish (see fig. 547 of Hanima *et al*., 2022c); hind tibia inflated (2.2 × as long as broad); larger species (13–16 mm). ……..……..…….. ……..…. ***Tiphia* (*Tiphia*) *venkataramani* Hanima & Girish Kumar**

— Dorsal side of propodeum with submarginal carina (Figs. 106, 154); fore wing hyaline or brownish infumated (Figs. 109, 156); hind tibia usually not inflated (2.4–3.0 × as long as broad); small to medium-sized species (5.5–10 mm). ……. 26

26. Wings yellowish hyaline (Fig. 156); carina of propodeal areola margined by obscure crenulations (Fig. 153); smaller species (5.5–6.0 mm). ……..……. ……***Tiphia* (*Tiphia*) *cinchonae* Allen**

— Wings brown infumated (Fig. 109); carina of propodeal areola margined by distinct crenulations (Fig. 106); medium-sized species (7–10 mm). …….……... ……...… ***Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar**

27. Tegula at least 1.5 × as long as middle width (see fig. 533 of Hanima *et al*., 2022). …… 28

— Tegula at most only slightly longer than middle width (Fig. 228). ……...……. 31

28. Pronotum with vestigial anterior transverse carina present on humeral third (see fig. 533 of Hanima *et al*., 2022c); mid leg castaneous except coxa (see figs. 529, 532 Hanima *et al*., 2022c). ……...…. ***Tiphia* (*Tiphia*) *tegelonga* Allen**

— Pronotum without anterior transverse carina; mid leg black except sometimes tarsi castaneous. ……. 29

29. Legs and antennae entirely black; upper front with interspaces between punctures, on average, as wide as or wider than ocellus diameter. ……. ***Tiphia* (*Tiphia*) *oswini* Turner**

— Legs not entirely black, sometimes fore tibia beneath red or fore and mid tarsi castaneous; antennal flagellum on lower side partly or completed castaneous; upper front with no interspaces between punctures, on average, as wide as ocellus diameter. ……. 30

30. Fore tibia beneath red; basal four flagellar segments beneath red. ……..……..……. ……..…… ***Tiphia* (*Tiphia*) *knutsoni* Krombein**

— Fore tibia beneath black; all flagellar segments beneath red. ……..…..……..……. ……... ***Tiphia* (*Tiphia*) *bouceki* Krombein**

31. Hind femur completely bright red (Figs. 226, 235). ……..……. 32

— Hind femur not completely bright red, although in some species middle and hind legs are reddish at least on inner surface (Figs. 165, 324). ……..……. 38

32. Mid femur black. ……..……... ***Tiphia* (*Tiphia*) *robusta* Cameron**

— Mid femur red (Fig. 226). ……..……. 33

33. Upper front without impunctate interspaces between punctures, on average, as wide as ocellus diameter. ……. 34

— Upper front with impunctate interspaces between punctures, on average, wider than ocellus diameter (Fig. 227). ……...…. 35

34. Subtegular patch of microsetae wider than tegula. ……...…. ***Tiphia* (*Tiphia*) *davarae* Allen**

— Subtegular patch of microsetae narrower than tegula. ……. ……***Tiphia* (*Tiphia*) *magrettii* Cameron**

35. Lateral side of pronotum with distinct transdiscal groove across its disc (Figs. 229, 238). ……...…. 36

— Lateral side of pronotum without transdiscal groove across its disc, or if present, very weakly developed (see figs. 310, 480 of Hanima *et al*., 2022c). ……..……..……. 37

36. Mid and hind femora bright red (Fig. 235); mid and hind tibiae black (Fig. 235); areola of dorsal side of propodeum without punctures (Fig. 237); apical half of pygidium polished and obscurely wrinkled (Fig. 241). ……..…. ***Tiphia* (*Tiphia*) *khasiana* Cameron**

— Mid and hind femora and tibia bright red (Fig. 226); areola of dorsal side of propodeum with punctures (Fig. 228); apical half of pygidium shagreened and apical margin wrinkled (Fig. 232). ……...…. ***Tiphia* (*Tiphia*) *kashmirensis* Hanima & Girish Kumar**

37. Hind basitarsus with very deep, narrow groove (see fig. 482 of Hanima *et al*., 2022c); fore wing slightly brownish infumated (see fig. 483 of Hanima *et al*., 2022c); metasoma broadly shagreened. ……..……. ***Tiphia* (*Tiphia*) *rufofemorata* Smith**

— Hind basitarsus with short, shallow groove, easily overlooked; fore wing yellowish hyaline (see fig. 312 of Hanima *et al*., 2022c); metasoma polished, not shagreened. ……..…..…. ***Tiphia* (*Tiphia*) *levipunctata* Allen & Jaynes**

38. Lateral side of pronotum without or weakly developed transdiscal groove across its disc (see fig. 138 of Hanima *et al*., 2022c). ……...……. 39

— Lateral side of pronotum with well-developed transdiscal groove or escarpment across its disc (Fig. 128). ……..……..……. 43

39. Dorsal side of pronotum with complete anterior transverse carina present as series of short scallops (see fig. 137 of Hanima *et al*., 2022c); hind basitarsus with short, shallow groove (see fig. 140 of Hanima *et al*., 2022c). ……...…. ***Tiphia* (*Tiphia*) *curvinerva* Cameron**

— Dorsal side of pronotum with anterior transverse carina at most restricted to short distance at humeral angle (see fig. 424 of Hanima *et al*., 2022c). ……..……..……. 40

40. Gt_1 with patch of dense micropunctures on anterior slope; preapical band of punctures of Gt_1 without escarpment on anterior border. ……...……. ***Tiphia* (*Tiphia*) *tibetana* Turner**

— Gt_1 without dense patch of micropunctures on anterior slope; preapical band of punctures of Gt_1 with or without faint, crooked escarpment on its anterior border. ……..... 41

41. Propodeal areola short, not more than 2 × as long as its apical width; preapical band of punctures of Gt_1 with faint escarpment on anterior border. ……..……..…….. ……. ***Tiphia* (*Tiphia*) *pullivora* Allen & Jaynes**

— Propodeal areola elongate, more than 2.5 × as long as its apical width (see fig. 389 of Hanima *et al*., 2022c); preapical band of punctures of Gt_1 without trace of escarpment on anterior border (see fig. 393 of Hanima *et al*., 2022c). …….…….……. 42

42. Rugulae of lateral sides of propodeum coarse and widely separated; fore wing darkly infumated; mid tibia elongate and not inflated. ……..…..…. ***Tiphia* (*Tiphia*) *millealta* Allen**

— Rugulae of lateral sides of propodeum shallow and closely spaced (see fig. 390 of Hanima *et al*., 2022c); fore wing yellowish infumated (see fig. 392 of Hanima *et al*., 2022c); mid tibia inflated on upper and outer surface. …….……..…. ***Tiphia* (*Tiphia*) *nepa* Allen**

43. Pygidium strongly rugose at apex (Fig. 331). ……..……..…. 44

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— Posterior side of propodeum without median carina (Fig. 316); metanotum laterally with coarse punctures, medially smooth (Fig. 316). …… ……. ***Tiphia* (*Tiphia*) *novus* Hanima & Girish Kumar**

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— Lateral side of pronotum with deep and narrow groove across its disc (see fig. 128 of Hanima *et al*., 2022c); metanotum with coarse punctures (see fig. 127); marginal cell of fore wing without outwardly directed straight spur (see fig. 130). ……...…… ……. ***Tiphia* (*Tiphia*) *consueta* Smith**

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49. Upper part of front with impunctate interspaces between punctures, on average, as wide as ocellus diameter (Fig. 166). ……..…. ***Tiphia* (*Tiphia*) *clauseni* Allen & Jaynes**

— Upper part of front without impunctate interspaces between punctures, on average, as wide as ocellus diameter. ……. 50

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— Vertex without obscure row of minute punctures on median line. …….…….……..…. 52

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52. Hind tibia with its sensorium abruptly sunk below surrounding surface. …… ……..……. ***Tiphia* (*Tiphia*) *s-sexta* Allen**

— Hind tibia with sensorium flush with surrounding surface. ……..……...…. ……..... ***Tiphia* (*Tiphia*) *s-prima* Allen**

53. Gs_5 with lateral denticle (see fig. 71 of Hanima *et al*., 2022c). …….……...……. 54

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— Fore and mid legs except coxae castaneous to bright red (see figs. 519, 522 of Hanima *et al*., 2022c); mandible without preapical denticle. ……..…. 60

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59. Legs black except fore tibia beneath red; mandible without preapical denticle. ……. ……..……. ***Tiphia* (*Tiphia*) *knutsoni* Krombein**

— Legs black except fore and mid tibiae and tarsi red (Fig. 129); mandible with small preapical denticle (Fig. 131). ……..…..……. ***Tiphia* (*Tiphia*) *bouceki* Krombein**

60. Tegula with fringes transparent; denticle of Gs_5 with massive and broadly overhanging polished plaque; antennal flagellum wholly black. ……. ……. ……. ***Tiphia* (*Tiphia*) *tegulita* Allen**

— Tegula with fringes obscurely translucent (see fig. 523 of Hanima *et al*., 2022c); denticle of Gs_5 not associated with polished plaque (see fig. 528 of Hanima *et al*., 2022c); antennal

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— Marginal cell of fore wing equal to or longer than second cubital cell in apical extension (Fig. 190). ……..……. 65

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66. HW 2.1 × least distance between eyes. …….. 67

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— Propodeal areola rectangular-shaped (Fig. 188); dorsal side of propodeum outside areola striate and reticulate (Fig. 188); tegula dark brown (Fig. 188); tibia and tarsi of hind leg black, tarsi apically yellowish orange (Fig. 186). …… …….. ***Tiphia* (*Tiphia*) *davidrajui* Hanima & Girish Kumar**

68. Dorsal side of propodeum outside areola only shallowly sculptured (Fig. 264). ……. ***Tiphia* (*Tiphia*) *lotharae* Allen**

— Dorsal side of propodeum outside areola broadly or completely strongly irregularly reticulate. ……..…. 69

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— Lower front without median carina. ……..……. ***Tiphia* (*Tiphia*) *simlaensis* Cameron**

70. Head and dorsal side of pronotum broadly shagreened (Fig. 277); HW 2.1 to 2.2 × least distance between eyes (Fig. 277). ……..…. 71

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71. Dorsal side of propodeum outside areola smooth; length of areola not more than 1.5 × as long as its apical width; Gs_6 with only sparse setae at apex; lateral sides of pronotum without transdiscal groove. ……..…. ***Tiphia* (*Tiphia*) *pullivora* Allen & Jaynes**

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— Gena and clypeus without unusually long, conspicuous setae (Fig. 194). ……..……. 74

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……...… ***Tiphia* (*Tiphia*) *decrescens* Walker**

— HW 2.2 × least distance between eyes; marginal cell of fore wing greatly longer than second cubital cell in apical extension; all tibiae and tarsi black except inner faces of fore and mid tibiae and tarsi shading to yellowish orange; larger species (6.5–7.8 mm). ……..……. ***Tiphia* (*Tiphia*) *nepalensis* Allen**

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— Fore wing with marginal cell slightly less than second cubital cell in apical extension; fore wing conspicuously infumate; apical part of areola rounded. …….. ……..…..…. ***Tiphia* (*Tiphia*) *orificia* Allen**

78. Dorsal side of propodeum entirely and very deeply transverse rugose (Fig. 365). ……...……. 79

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— Lateral side of propodeum with widely spaced rugulae (see fig. 258 of Hanima *et al*., 2022c); frontal punctures with interspaces as wide as or wider than ocellus; metanotum sparsely punctate in median area; antennal flagellum black. ……..……..……. 82

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— Lower half of lateral side of propodeum aciculate; legs black except mid and hind trochanters and femora and tibiae of all legs red (see figs. 253, 256 of Hanima *et al*., 2022c). …….…….……. ***Tiphia* (*Tiphia*) *khasiana* Cameron**

83. Gena narrower than antennal fossa. ……..……. 84

— Gena as wide as or wider than antennal fossa. ……..……. 86

84. Clypeal extension bidentate on front not wider than antennal fossa. ……...
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— Clypeal extension bidentate on front exceeding width of antennal fossa. ……..……..…. 85

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— Marginal cell only slightly longer than second cubital cell in apical extension. ……...
……..…. ***Tiphia* (*Tiphia*) *dampara* Allen**

86. Femora and tibiae of fore and mid legs yellowish orange (Fig. 121). ……..……. 87

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— Marginal cell long and greatly longer than second cubital cell in apical extension (Fig. 249); metanotal disc with small sparse punctures (Fig. 246); carina of dorsal side of pronotum without ridges (Fig. 246); carina of areola of dorsal side of propodeum with crenulations (Fig. 246). ……..…. ***Tiphia* (*Tiphia*) *kurumba* Hanima & Girish Kumar**

88. Dorsal side of pronotum without sharply defined transverse carina. ……. 89

— Dorsal side of pronotum with sharply defined transverse carina (Fig. 292). ……..…. 90

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— Marginal cell slightly longer than second cubital cell in apical extension; Gt_1 not unusually elongate, 1.3 × as long as wide. ……...……. ***Tiphia* (*Tiphia*) *fletcheri* Allen**

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— Fore wing hyaline (see fig. 226 of Hanima *et al*., 2022c); basal half of tegula dark brown, apical half yellowish orange (see fig. 223 of Hanima *et al*., 2022c); marginal cell of fore wing greatly longer than second cubital cell in apical extension (see fig. 226 of Hanima *et*

al., 2022c); leg with inner surface of fore and mid tibia brownish orange and tarsi yellowish orange (see fig. 219 of Hanima *et al*., 2022c). ……..…….....…. ……... ***Tiphia* (*Tiphia*) *hyalina* Hanima & Girish Kumar**

92. Hind tibia sharply carinate at entire length of inner face; median extension of clypeus deeply emarginated, clypeal disk coarsely and contiguously punctate (Fig. 114); apex of second cubital cell without outwardly directed spur (Fig. 118). ……. 93

— Hind tibia not carinate on inner face; median extension of clypeus slightly emarginated, clypeal disk imbricately punctate (Fig. 159); apex of second cubital cell with outwardly directed spur (Fig. 163). ……..…. ***Tiphia* (*Tiphia*) *cinchonae* Allen**

93. Dorsal side of propodeum outside areola with punctures (see fig. 197 of Hanima *et al*., 2022c). ……..……...…. ***Tiphia* (*Tiphia*) *godavariae* Allen**

— Dorsal side of propodeum outside areola with reticulations (Fig. 115). ……... ……...……. ***Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar**

94. Apical extension of marginal cell distinctly less than that of second cubital cell (see fig. 45 of Hanima *et al*., 2022c); (Dorsal side of propodeum coarsely and deeply rugose (see fig. 42 of Hanima *et al*., 2022c). ……...…..…. ***Tiphia* (*Tiphia*) *canaliculata* Cameron**

— Apical extension of marginal cell longer than that of second cubital cell. ……. 95

95. Gt_1 conspicuously elongated, 1.7 × as long as wide; preapical band of punctures of Gt_1 not differentiated from dorsal punctures; (upper front without interspaces between punctures, on average, as wide as ocellus diameter). ……..…. ***Tiphia* (*Tiphia*) *murreea* Allen**

— Gt_1 not conspicuously elongated; preapical band of punctures of Gt_1 present, differentiated from dorsal punctures. ……...…. 96

96. Upper front with impunctate interspaces between punctures, on average, as wide as ocellus diameter. ……. ***Tiphia* (*Tiphia*) *clavinerva* Cameron**

— Upper front without impunctate interspaces between punctures, on average, as wide as ocellus diameter. ……. ***Tiphia* (*Tiphia*) *dutti* Allen**

1. *Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar, 2022

(Figs. 103–120)

Tiphia (*Tiphia*) *bijui* Hanima & Girish Kumar in Hanima *et al.*, 2022c: 10. Holotype ♀, India, Kerala, Kozhikode district, Sarovaram Biopark (ZSIK).

Material examined. Kerala: Kozhikode district, Sarovaram Biopark (11°16'6.96"N & 75°47'33.72"E, 6 m), 9 ♀, 25.x.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18387–18395; Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m),

3 ♀, 24.v.2019, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18400–18402; Vilakottur (11°45'22"N & 75°39'06"E, 34m), 4 ♀, 3.vi.2021, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18412–18415; Idukki district, Chinnar, Kootaram (10°18'22"N & 77°12'24"E, 596 m), 2 ♀, 28.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18410–18411; Kulamavu (9°47'31.2"N & 76°53'11.4"E, 724 m), 1 ♀, 24.vi.2019, Coll. Tessy Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18428; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 1 ♀, 3.iii.2019, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18419; Kannur district, Keezhara (12°00'11"N & 75°19'44"E, 4 m), 1 ♀, 2.iii.2016, Coll. K.M. Rajesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18424; Kottayam district, Pala, Cherpunkal (9°41'05"N & 76°38'18"E, 22 m), 1 ♀, 26.xii.2019, Coll. Tessy Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18429; Kottayam district, Pala, Paika, Urulikunnam (9°38'37"N & 76°42'37"E, 52 m), 1 ♀, 20.i.2021, Coll. Tessy Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18430; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 3 ♀, 24.v.2019, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18400–18402; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 1 ♀, 4.i.2022, Coll. V.D. Hegde & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.20034; Kozhikode district, Vilakottur (11°45'22"N & 75°39'06"E, 34m), 4 ♀, 3.vi.2021, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18412–18415; Kozhikode district, Nanminda (11°25'15"N & 75°49'53"E, 46 m), 1 ♀, 16.x.2017, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18416; Kozhikode district, East Hill (11°17'22"N & 75°46'25"E, 16 m), 1 ♀, 25.iii.2015, Coll. P.M. Sureshan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18417; Kozhikode district, Kakkavayal (11°38'48"N & 76°08'26"E, 778 m), 1 ♀, 19.xi.2018, Coll. A. P. Ranjith, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18418; Kozhikode district, Kovoor (11°16'14.16"N & 75°49'52.32"E, 31 m), 1 ♀, 19.xii.2018, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18422; Kozhikode district, Chengottukaavu (11°25'20.64"N & 11°25'20.64"N, 17 m), 1 ♀, 30.iv.2019, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18423; Kozhikode district, Edakkara (11°21' 41.4"N & 76°35'24.72"E), 1 ♀, 17.v.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19327; Kozhikode district, Madappally (11°38'48"N & 75°34'13"E, 28 m), 1 ♀, 7.ii.2020, Coll. S. Anagha, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18425; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27"N & 75°54'41"E, 543 m), 2 ♀, 11.iii.2019, Coll. S. Anagha, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18403 & 18404; Kozhikode district, Malabar Wildlife Sanctuary,

Kakkayam dam site (11°33'27"N & 75°54'41"E, 543 m), 1 ♀, 10.i.2021, Coll. Tessy Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18431; Kozhikode district, Purameri (11°40'18"N & 75°37'46"E, 33 m), 1 ♀, 22.iv.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18432; Kozhikode district, Purameri (11°40'18"N & 75°37'46"E, 33 m), 4 ♀, 24.x.2020, 25.x.2020, 15.xii.2020, 04.iv.2021, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18433–18436; Malappuram district, Kerala Forest Research Iinsitute Campus, Nilambur (11°18'0.36"N & 76°15'1.44"E, 48 m), 1 ♀, 29.ii.2020, Coll. Tessy Rajan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18427; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 2 ♀, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19370 & 19371; Thiruvananthapuram district, Kerala University (8°30'11.52"N & 76°56'50.28"E, 34 m), 4 ♀, 28.ix.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18396–18399; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kothiram (8°39'45"N & 77°09'00"E, 125 m), 2 ♀, 17.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18405 & 18406; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kaalippara, near temple side (8°31'35"N & 77°08'32"E, 168 m), 1 ♀, 17.i.2019, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.20433; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Pattankulichapara (8°37'22"N & 77°08'07"E, 135 m), 1 ♀, 20.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18407; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 1 ♀, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18408; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Kanithadam (8°39'45"N & 77°09'00"E, 125 m), 1 ♀, 19.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18409; Wayanad district, Mangavayal (11°35'02"N & 76°05'35"E, 761 m), 1 ♀, 19.x.2016, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18420; Wayanad district, Muthanga (11°40'17"N & 76°22'06"E, 848 m), 1 ♀, 28.ii.2021, Coll. K.A. Subramanian & Party (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18426; Wayanad district, Machikudi (11°40'24"N & 76°17'21"N, 913 m), 1 ♀, 18.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19151; Wayanad district, Banasura hills (11°41'37.0104"N & 75°54'29.2248"E, 2054 m), 1♂, 22.x.2023, Coll. S. Amal, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.25397.

Diagnosis. Female (Figs. 103–111). Head with medium sized punctures concentrated adjacently in lower frontal area and sparsely on upper frontal area (Fig. 104); clypeus with its median extension nearly straight or very slightly emarginated, basal part of median extension of clypeus imbricate, half of apical part of median extension of clypeus with coarse and dense punctures, extreme apex smooth (Fig. 105); dorsal side of pronotum anteriorly with complete carina (Fig. 106); lateral side of pronotum with distinct transdiscal groove (Fig. 107); mesoscutum with its notauli not connected to anteromedian escarpment (Fig. 106); metanotum with small, sparsely placed punctures (Fig. 106); propodeal areola tricarinate, carina of propodeal areola margined by crenulations (Fig. 106); Gs_2 without anterior transverse carina; hind basitarsus without groove; fore wings brown infumated (Fig. 109); tergites with setigerous punctures, distribution of punctures less in Gt_1 compared to other remaining segments (Fig. 110).

Size. 6.5–11.2 mm.

Description of male.

Diagnosis. Male (Figs. 112–120). Clypeal extension bidentate with disc coarsely punctate basally, smooth apically (Fig. 114); mandible without preapical denticle (Fig. 114); dorsal side of pronotum with anterior transverse carina (Fig. 115); lateral side of pronotum without transdiscal groove (Fig. 116); fore wing hyaline with marginal cell equal to second cubital cell in apical extension (Fig. 118); Gt_1 without anterior transverse carina; Gs_5 with lateral denticle.

***Colour*.** Body black except margins of tegula orange brown (Fig. 116).

***Head*.** Head with coarse punctures adjacently placed on lower frons and scattered on upper frons (Fig. 113); HW 1.5 × least distance between eyes; POD 2.15 × LOD and 0.4 × OOD at posterior ocellus; median extension of clypeus emarginated (Fig. 114); mandible without preapical denticle (Fig. 114); length of scape: pedicel: Fu_1: Fu_2: Fu_3: Fu_4: Fu_5: Fu_6: Fu_7: Fu_8: Fu_9: Fu_{10}: Fu_{11} = 0.347: 0.170: 0.174: 0.222: 0.184: 0.237: 0.228: 0.226: 0.222: 0.193: 0.222: 0.303: 0.601 (Fig. 117).

***Mesosoma*.** Dorsal side of pronotum anteriorly with carina (Fig. 115); pronotum and mesoscutum with moderate sized punctures, metanotum with small punctures (Fig. 115); lateral side of pronotum without transdiscal groove, disc with aciculations, lower part with ridges (Fig. 116); tegula with length 1.3 × its middle width (Fig. 115); areola of propodeum tricarinate with length 1.9 × apical width and 1.4 × basal width, median carina of areola extending to apex (Fig. 115); mesopleuron with medium sized punctures (Fig. 115); lateral side of propodeum on upper part with moderately spaced rugulae (Fig. 116); fore wing with

marginal cell equal to second cubital cell in apical extension (Fig. 118); wings hyaline (Fig. 118). Length of mesosoma: 2.53 mm.

***Metasoma*.** Gt_1 without anterior transverse carina (Fig. 119); tergites with small punctures (Fig. 119); metasoma 1.6 × mesosoma; Gs_5 with lateral denticle; Gs_6 with sparse setae (Fig. 120). Length of metasoma: 3.94 mm.

Size. 7.72 mm.

Distribution. India: Goa, Karnataka, Kerala, Tamil Nadu, Uttarakhand, West Bengal (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 described the species based on females for the first time from India (Kerala).

2. *Tiphia* (*Tiphia*) *birganjae* Allen, 1975

(Figs. 121–128)

Tiphia (*Tiphia*) *birganjae* Allen, 1975: 47–49. Holotype ♂, Lothar near Birganj, Nepal (CERI).

Material examined. Kerala: Kannur district, Manathana paddy field (11°54'51"N & 75°45'13"E, 92 m), 1 ♂, 13.i.2018, Coll. T. Biju, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.13247.

Diagnosis. Front shagreened with setigerous punctures (Fig. 122); mandible without preapical denticle (Fig. 123); clypeus with median extension emarginated, with coarse punctures (Fig. 123); dorsal pronotal carina with longitudinal ridges (Fig. 124); lateral side of pronotum with transdiscal groove (Fig. 125); mesopleuron with large coarse punctures mixed with small ones (Fig. 125); areola of propodeum keystone shaped, areolar carina without crenulations (Fig. 124); metanotum with large, coarse punctures (Fig. 124); antennae beneath yellowish orange (Fig. 126); legs (except coxa) yellowish orange (Fig. 121); marginal cell of fore wing short, only slightly longer than second cubital cell in apical extension (Fig. 127); Gs_5 with lateral denticle (Fig. 128).

Genitalia. Paramere spatula-shaped and covered with long hairs; digitus apically with beak like projection; cuspis not clearly visible; aedeagus folded completely (Fig. 371).

Size. 4.9–6.2 mm.

Female. Unknown.

Variations. The specimens examined here differ in HW and least distance between eyes compared to the description of Allen (1975). HW 1.86 × least distance between eyes in the specimens examined, while HW 2.2 × least distance between eyes according to Allen.

Distribution. India: Kerala, Tamil Nadu, Uttarakhand. *Elsewhere*: Nepal (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported it for the first time from Kerala.

3. *Tiphia* (*Tiphia*) *bouceki* Krombein, 1982

(Figs. 129–135)

Tiphia (*Tiphia*) *bouceki* Krombein, 1982: 31. Holotype ♂, North Central Province, Sri Lanka (USNM).

Material examined. Kerala: Idukki district, Kuttikanam, Teyla tea estate (9°34'39.8748"N & 76°58'15.9744"E), 3 ♂, 30.i.2023, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.23182–23184.

Diagnosis. Frons with medium sized punctures (Fig. 130); mandible with small preapical denticle (Fig. 131); clypeus with median extension emarginated (Fig. 131); dorsal side of pronotum with anterior carina (Fig. 132); lateral side of pronotum with groove towards apex (Fig. 133); mesopleuron smooth with scattered medium sized punctures (Fig. 133); areolar carina without crenulations (Fig. 132); metanotum with large, coarse, separated punctures (Fig. 132); tegula elongate (Fig. 132); legs with tibiae orange brown (Fig. 129); marginal cell of fore wing longer than second cubital cell in apical extension (Fig. 134).

Size. 4.9–6.2 mm.

Female. Unknown in the present study.

Distribution. India: Kerala. *Elsewhere*: Sri Lanka (Krombein, 1982).

4. *Tiphia* (*Tiphia*) *brevistigma* Allen & Jaynes, 1930

(Figs. 136–143)

Tiphia brevistigma Allen & Jaynes, 1930: 65. Holotype ♀, Shillong, India (USNM).

Tiphia (*Tiphia*) *brevistigma*; Allen, 1975: 88–89.

Material examined. Kerala: Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Kanithadam (8°39'45"N & 77°09'00"E, 125 m), 1 ♀, 19.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16906; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Pattankulichapara (8°37'22"N & 77°08'07"E, 135 m), 3 ♀, 20.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16907, 19685 & 19686.

Diagnosis. Median extension of clypeus rounded (Fig. 138); mandible without preapical denticle, apex rounded (Fig. 138); dorsal side of pronotum without transverse carina (Fig. 139); metanotum coarsely arranged with medium sized punctures (Fig. 139); dorsal side of propodeum with areola subrectangular, area outside areola imbricate (Fig. 139); mesopleuron with large punctures in median area (Fig. 140); wings darkly infumated at more than half of basal area, apex almost hyaline (Fig. 142); hind basitarsus with short groove on inner face.

Variations. The specimens examined here differ in posterior side of propodeum compared to the description of Allen (1975). Posterior side of propodeum with median carina in the specimens examined, while posterior side of propodeum without median carina according to Allen.

Size. 9.5–11.3 mm.

Male. Unknown.

Distribution. India: Kerala, Meghalaya (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported it for the first time from Kerala.

5. *Tiphia* (*Tiphia*) *capillata* Allen & Jaynes, 1930

(Figs. 144–150)

Tiphia capillata Allen & Jaynes, 1930: 47. Holotype ♀, Shillong, Meghalaya, India (USNM).

Tiphia (*Tiphia*) *capillata*; Allen, 1975: 22–24.

Material examined. Kerala: Wayanad district, Wayanad Wildlife Sanctuary, Muthanga (11°40'17"N & 76°22'06"E, 848 m), 1 ♀, 13.x.2011, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17758; Thiruvananthapuram district, Peppara Wildlife Sanctuary, Ponmudi, Seethatheertham (8°45'34"N & 77°07'01"E, 923 m), 1 ♀, 5.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19729.

Diagnosis. Female. Mandible without preapical denticle (Fig. 146); dorsal side of pronotum without transverse carina (Fig. 147); lateral side of pronotum without transdiscal groove (Fig. 148); clypeus, antennal segments, femora, tibiae and tarsi orange brown (Figs. 144, 146); tegula translucent orange (Fig. 147); dorsal side of propodeum without submarginal carina (Fig. 147); marginal cell of fore wing with two outwardly directed straight spur (Fig. 149); hind basitarsus without groove.

Variations. The specimens examined here differ in the following characters compared to the description of Allen (1975). Mandible without preapical denticle and dorsal side of pronotum without transverse carina in the specimens examined, while mandible with minute, acute preapical denticle and dorsal pronotum with complete transverse carina according to Allen (1975).

Male. Unknown in the present study.

Size. 5.2 mm.

Distribution. India: Meghalaya, Karnataka, Kerala (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported it for the first time from Kerala.

6. *Tiphia* (*Tiphia*) *cinchonae* Allen, 1975

(Figs. 151–164)

Tiphia (*Tiphia*) *cinchonae* Allen, 1975: 55–56. Holotype ♂, Anamalai Hills, Southern India (RNHM).

Material examined. Kerala: Idukki district, Mathap, Mannavan Shola (10°11'20"N & 77°10'35"E, 2076 m), 1 ♂, 24.v.2014, Coll. P.M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19639; Chinnar, Kootaram (10°18'22"N & 77°12'24"E, 596 m), 2 ♂, 28.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16928 & 16929; Kannur district, Bekal Fort (11°33'27"N & 75°54'41"E, 543 m), 1 ♂, 18.i.2019, Coll. C. Binoy (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17760; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 1 ♀, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19137; Kollam district, Monroe Island (8°59'49"N & 76°36'34"E, 2m), 1 ♂, 1.ix.2019, Coll. Aseeb & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16936; Kozhikode district, Kakkavayal (11°38'48"N & 76°08'26"E, 778 m), 3 ♂, 19.xi.2018, Coll. A.P. Ranjith, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.13920 & 13921, 18144; Kozhikode district, East Hill (11°17'22"N & 75°46'25"E, 16 m), 1 ♂, 10.vi.2015, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.13249; Kozhikode district, East Hill (11°17'22"N & 75°46'25"E, 16 m), 1 ♂, 26.x.2015, Coll. P.M. Sureshan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.13250; Kozhikode district, Ooleri (11°32'28"N & 75°50'40"E, 30 m), 1 ♂, 12.xii.2018, Coll. Sandra Lishikumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16935; Kozhikode district, Ooleri (11°32'28"N & 75°50'40"E, 30 m), 5 ♀, 12.xii.2018, Coll. Sandra Lishikumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19132–19136; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam dam site (11°33'27"N & 75°54'41"E, 543 m), 1 ♂, 10.i.2021, Coll. Tessy Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17759; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 4 ♂, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19357–19360; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39" E, 1268 m), 4 ♂, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16931–16934; Wayanad district, Chandanathodu (11°50'47"N & 75°48'33"E, 810 m), 1 ♂, 15.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18210; Wayanad district, Chandanathodu (11°50'47"N & 75°48'33"E, 810 m), 1 ♂, 18.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18211.

Female. (Figs. 151–157)**.** Dorsal side of pronotum with a complete transverse carina (Fig. 153); lateral side of pronotum with transdiscal groove (Fig. 154); dorsal side of propodeum with strong submarginal carina (Fig. 155); dorsal side of propodeum outside areola with micro reticulations (Fig. 153); carina of propodeal areola margined by obscure crenulations (Fig.

153); metanotum with minute punctures (Fig. 153); hind basitarsus without groove; fore wing hyaline, marginal cell of fore wing without terminal spur, second cubital cell with one straight spur (Fig. 156).

Size. 5.5–6 mm.

Diagnosis. Male (Figs. 158–164)**.** Dorsal pronotal carina sharply defined with buttressing ridges (Fig. 160); median extension of clypeus emarginated (Fig. 159); lateral side of pronotum with obscure transdiscal groove (Fig. 161); mesoscutum and metanotum with coarse, contiguous punctures (Fig. 160); upper part of lateral side of propodeum with strong widely spaced rugae (Fig. 161); marginal cell of fore wing greatly longer than second cubital cell in apical extension (Fig. 163); Gs_5 without orifice beneath edge of lateral denticle; Gs_6 with short sparse hairs (Fig. 158).

Genitalia. Paramere shaped like spatula and covered with short, thick setae; digitus almost rounded; cuspis with punctures and sickle shaped apically; aedeagus long and slender and folded (Fig. 372).

Size. 8.5–11.6 mm.

Variations. The specimens examined here differ in the following characters compared to the description of Allen (1975). Metanotum with coarse, contiguous punctures in male and fore wing hyaline in female specimens examined, while metanotum with minute punctures in male and fore wing moderately infumated in female according to Allen.

Distribution. India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu. *Elsewhere*: Thailand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

7. *Tiphia* (*Tiphia*) *clauseni* Allen & Jaynes, 1930

(Figs. 165–173)

Tiphia clauseni Allen & Jaynes, 1930: 89. Holotype, ♀, Chirrapunji, Assam [Chirrapunji presently in Meghalaya], India (USNM).

Tiphia (*Tiphia*) *clauseni*; Allen, 1975: 89–90.

Material examined. Kerala: Idukki district, 3 ♀, Chinnar (10°18'22"N & 77°12'24"E, 596 m), 28.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17295–17297; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam dam site (10°18'22"N & 77°12'24"E, 596 m), 1 ♀, 10.i.2021, Coll. Tessy Rajan, (ZSIK) No. ZSI/WGRC/IR/INV.17761; Wayanad district, Kuruva Island (11°49'02"N & 76°05'36"E, 714 m), 1 ♀, 24.iii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17941; Wayanad district, Muthanga, Manchal (11°42'11.772"N &

76°22'1.38"E, 777 m), 1 ♀, 21.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17942.

Diagnosis. Clypeus with basal part imbricate and below coarse punctate and apex smooth, median extension of clypeus rounded (Fig. 167); dorsal side of pronotum with faint transverse carina lacking on median one-third (Fig. 168); metanotum with medium sized coarse punctures (Fig. 168); dorsal side of propodeum with weak submarginal carina on lateral sides (Fig. 168); propodeal areola subrectangular and about 1.75–2.40 × as long as apical width (Fig. 168); pygidium apically smooth (Fig. 173); fore wing darkly infumate with apical portion faintly infumate (Fig. 171); hind basitarsus with groove (Fig. 172).

Variations. The specimens examined here differ in the following characters compared to the description of Allen (1975). Propodeal areola subrectangular and about 1.75–2.40 × as long as apical width, tegula black, metanotum with medium sized coarse punctures and fore wing darkly infumate at the basal portion in the specimens examined, while propodeal areola rectangular and about 3 × as long as apical width, tegula almost entirely dark reddish translucent, metanotum with very small punctures located mostly on posterior aspect and fore wing faintly infumate according to Allen.

Size. 8.4–12.3 mm.

Male. Unknown.

Distribution. India: Karnataka, Kerala, Meghalaya (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

8. *Tiphia* (*Tiphia*) *crassumpunctura* Hanima & Girish Kumar sp. nov.

(Figs. 174–185)

Type material. Holotype, 1 ♀, INDIA: Kerala, Palakkad district, Parambikulam Tiger Reserve, Sungam range, Kariyanchola (10°22'12.9432" N & 76° 42' 27.1008" E, 917 m), 19.viii. 2023, Coll. V.D. Hegde & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.26376.

Diagnosis. Female. Body with irregularly placed large, deep punctures (Fig. 174); clypeus smooth, with coarse punctures, apical margin rounded (Fig. 176); dorsal side of pronotum without carina (Fig. 177); lateral side of pronotum with curved groove (Fig. 178); metanotum more than half of upper part smooth, lower part with small punctures (Fig. 177); dorsal side of propodeum with submarginal carina (Fig. 177); Gt1 without anterior transverse carina (Fig. 184).

Description. Holotype, ♀.

Colour. Body black, following orange red markings: mandible orange brown centrally and brown laterally (Fig. 176); tegula black with posterior part orange translucent (Fig. 177); wings fusco-hyaline (Fig. 183).

Head. Head and vertex with deep punctures (Fig. 175); HW 1.5 × least distance between eyes (Fig. 175); POD 1.6 x LOD and 0.38 x OOD at anterior ocellus (Fig. 175); lower frons with groove between antennal toruli (Fig. 175); clypeus with deep coarse 6–8 punctures, other areas smooth, apical margin without emargination (Fig. 176); mandible without preapical denticle (Fig. 176); antenna with scape, pedicel and F1 smooth with sparse, large setae, other segments with thick, small setae; length of scape: pedicel: Fu_1: Fu_2: Fu_3: Fu_4: Fu_5: Fu_6: Fu_7: Fu_8: Fu_9: Fu_{10} = 0.640: 0.157: 0.233: 0.258: 0.341: 0.265: 0.293: 0.324: 0.328: 0.340: 0.351: 0.618 (Fig. 182).

Mesosoma. Dorsal side of pronotum anteriorly without carina, upper part with rugose, contiguous punctures and lower part smooth without punctures (Fig. 177); lateral side of pronotum with curved groove, besides with lineolations, towards head with irregular ridges (Fig. 178); length of tegulae 1.95 × as long as its middle width (Fig. 177); mesoscutum with its notauli not connected to anteromedian escarpment, punctures closely placed in the middle area and sparsely in other areas (Fig. 177); scutum with contiguous punctures, other areas with smooth spaces (Fig. 177); scutellum with irregularly distributed small and large punctures (Fig. 177); metanotum more than half of upper part smooth, lower part with small punctures (Fig. 177); dorsal side of propodeum with submarginal carina on lateral sides (Fig. 177); area besides areola with scattered punctures, surface with lineolations, areolar carina with crenulations, length of areola 1.8 × basal width and 3.3 × apical width (Fig. 177); mesopleuron with deep punctures; lateral side of propodeum with ridges (Fig. 178); second submarginal cell of fore wing with 2 spurs (Fig. 183); Length of mesososma: 3.76 mm.

Metasoma. Gt_1 without anterior transverse carina, anteriorly with small punctures, posteriorly with large, irregular shaped punctures (Fig. 184); Gt_2 with elongated, rugose punctures (Fig. 184), other segments with small, elongated punctures (Fig. 180); more than half of anterior part of pygidium with elongated rugose punctures, posterior part smooth (Fig. 185); Length of mesososma: 6.2 mm.

Size. 11.40 mm.

Male. Unknown.

Discussion. As per the key of Hanima *et al*. (2022c), this new species comes close to *T.* (*T.*) *quinquicarinata* Cameron in the following features: elongate tegula, dorsal side of propodeum without longitudinal carina between areola and lateral margin, hind basitarsus without groove,

Gt_1 without anterior transverse carina, but this new species differs from *T.* (*T.*) *quinquicarinata* in the following features: body with elongate, deep punctures (in *T.* (*T.*) *quinquicarinata*, body with medium sized punctures); dorsal side of propodeum with tricarinate areola (in *T.* (*T.*) *quinquicarinata*, dorsal side of propodeum with quinquecarinate areola); antennal flagellum black (in *T.* (*T.*) *quinquicarinata*, antennal flagellum reddish orange).

Distribution. India: Kerala.

Etymology. The specific name *crassumpunctura* means coarse punctures present on the body surfaces.

9. *Tiphia* (*Tiphia*) *davidrajui* Hanima & Girish Kumar, 2022

(Figs. 186–192)

Tiphia (*Tiphia*) *davidrajui* Hanima & Girish Kumar in Hanima *et al.*, 2022c: 33. Holotype ♂, India, Kerala, Kozhikode district, Sarovaram Biopark (ZSIK).

Material examined. Kerala: Kozhikode district, Sarovaram Biopark (11°16'6.96"N & 75°47'33.72"E, 6 m), 8 ♂, 25.x.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18089–18096; Kozhikode district, Sarovaram Biopark (11°16' 6.96"N & 75°47' 33.72"E, 6 m), 4 ♂, 26.x.2018, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18106 & 18894–18896; Kozhikode district, Balusseri (11°26'20"N & 75°49'13"E, 33 m), 1 ♂, 15.ii.2021, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18902; Kozhikode district, Ooleri (11°32'28"N & 75°50'40"E, 30 m), 1 ♂, 12.xii.2018, Coll. Sandra Lishikumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18903; Kozhikode district, Vilakottur (11°45'22"N & 75°39'06"E, 34m), 1 ♂, 21.x.2018, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18905; Kasargode district, Ranipuram (12° 25' 19" N & 75° 21' 06" N, 925 m), 1 ♂, 8.xi.2013, Coll. P.M. Rajan, (ZSIK) No. ZSI/WGRC/IR/INV.18904; Malappuram district, Calicut University Campus (9°43'00"N & 76°57'51"E, 1003 m), 1 ♂, 27.ii.2020, Coll. A.P. Ranjith, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18104; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 1 ♂, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19372; Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 1 ♂, 28.ix.2019, Coll. K.P. Hanima Raveendran & Party (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18105; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kothiram (8°39'45"N & 77°09'00"E, 125 m), 2 ♂, 17.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18897 & 18898; Thrissur district, Elanad (10°30'38.52"N & 76°52'50.52"E, 68 m), 4 ♂, 5.v.2019, Coll. N.V. Ayisha Mawadda, (ZSIK) Regd. Nos.

ZSI/WGRC/IR/INV.18097–18100; Wayanad district, Karlad (11°38'56"N & 75°58'56"E, 752 m), 3 ♂, 29.ii.2020, Coll. K. Anju, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18899–18901.

Diagnosis. Dorsal side of pronotum anteriorly with strong transverse carina (Fig. 188); lateral side of pronotum with transdiscal groove (Fig. 186); dorsal side of propodeum with rectangular shaped areola (Fig. 188); median extension of clypeus bidentate (Fig. 187); fore wing hyaline (Fig. 190); marginal cell of fore wing greatly longer than second cubital cell in lateral extension (Fig. 190); metanotum with sparsely arranged punctures (Fig. 188); Gt_1 without anterior transverse carina (Fig. 191); Gs_5 with lateral denticle.

Genitalia. Paramere shaped like spatula and covered with long and short setae; digitus slightly curved and pointed at apex; cuspis with punctures and apically curved; aedeagus with apical portion rounded and basally with a stalk and a conical projection (Fig. 373).

Size. 5.93–9.01 mm.

Female. Unknown.

Distribution. India: Kerala, Tamil Nadu, West Bengal (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 described this species for the first time from India.

10. *Tiphia* (*Tiphia*) *decrescens* Walker, 1859

(Figs. 193–201)

Tiphia decrescens Walker, 1859: 376 [♂, not ♀ as stated; Ceylon; Type in NHMUK]; Walker in Tennent, 1861: 454 [listed]; Motschulsky, 1863: 22[listed]; Bingham, 1896: 431 [listed]; Dalla Torre, 1897: 135 [listed]; Turner, 1908b: 125 [synonymises ♂ *T. nervosa* Nurse and suggests it may be ♂ of *T. policarinata* Magretti] [listed]; Hedicke, 1936: 8 [listed].

Tiphia conscia Nurse, 1902: 81 [♀; Deesa; syntype series in NHMUK]; Turner, 1908b: 124 [synonymised *T. conscia* under *T. policarinata* Magretti].

Tiphia (Tiphia) batorea Allen, 1975: 34–35. Holotype, ♂, Coimbatore, Tamil Nadu, South India (RNHM).

Tiphia decrescens; Krombein, 1982: 42–45.

Material examined. Kerala: Kollam district, Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), 2 ♂, 9.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19640 & 19641; Kollam district, Shasthamkotta, D.B. College (9°02'027"N & 76°38'08"E, 19 m), 9 ♂, 22.viii.2016, Coll. K.G. Emilyamma & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16532–16540; Kollam district, Shasthamkotta (9°02'27"N & 76°37'34"N, 4 m), 1 ♂, 22.viii.2016, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16541; Kollam district, Shasthamkotta, Vettolikadavu (9°02'45"N & 76°37'12"E, 21 m), 1 ♂, 26.ix.2017, Coll. P. Girish Kumar, (ZSIK) Regd. No.

ZSI/WGRC/IR/INV.16542; Kasargode district, Panathady (12°27'22"N & 75°18'25"E, 141 m), 1 ♂, 29.xi.2017, Coll. P.M. Rajan (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16544; Kozhikode district, Vilakottur (11°45'22"N & 75°39'06"E, 34m), 1 ♂, 3.vi.2021, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19146; Kozhikode district, Paleri (11°37'22"N & 75°45'15"E, 27 m), 1 ♂, 10.ix.2018, Coll. Shaju, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16543; Kozhikode district, Nanminda (11°25'15"N & 75°49'53"E, 46 m), 4 ♂, 16.x.2017, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16545–16548; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27"N & 75°54'41"E, 543 m), 3 ♂, 22.xi.2018, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16549–16551; Kozhikode district, Madappally (11°38'48"N & 75°34'13"E, 28 m), 1 ♂, 14.vii.2019, Coll. K. Anju, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16552; Malappuram district, Kerala Forest Research Institute Campus, Nilambur (11°18'0.36"N & 76°15'1.44"E, 48 m), 1 ♂, 29.ii.2020, Coll. Tessy Rajan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17934; Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 1 ♂, 28.ix.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16553; Thrissur district, Vallakkunnu (10°20'32"N & 76°15'53"E, 7 m), 1 ♂, 20.xii.2017, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17849; Wayanad district, Edavambam (11°42'21.4128"N & 76°20'12.0012"E, 848 m), 1 ♂, 20.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17932.

Diagnosis. Upper front with scattered punctures and lower front with contiguous punctures (Fig. 194); median extension of clypeus slightly emarginated (Fig. 195); clypeus with its basal part with small punctures and apical part with coarse large punctures, apical margin bordered with shagreened sculptures (Fig. 195); dorsal side of pronotum with strong anterior transverse carina (Fig. 196); lateral side of pronotum with one curved groove (Fig. 197); metanotum with minute punctures (Fig. 196); marginal cell of fore wing almost equalling second cubital cell in apical extension (Fig. 199); Gs_6 with conspicuous tuft of dense setae (Fig. 201).

Genitalia. Paramere spatula-shaped and rounded apically covered with long and short setae; digitus broad and apically sickle shaped; cuspis broad and sparse punctures; aedeagus short and fat (Fig. 374).

Size. 3.4–6.2 mm.

Female. Unknown in the present study.

Distribution. India: Gujarat, Karnataka, Kerala, Odisha, Tamil Nadu, Uttarakhand. *Elsewhere*: Sri Lanka, Thailand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

11. *Tiphia* (*Punctotiphia*) *exacta* Nurse, 1903

(Figs. 202–209)

Tiphia exacta Nurse, 1903: 400. Holotype ♀, Kashmir, India (NHMUK).

Tiphia (*Tiphia*) *exacta*; Allen, 1969: 402; Allen, 1975: 73–74.

Material examined. Kozhikode district, Manipuram (11°24'45"N & 75°56'20"E, 61m), 1 ♀, 16.v.2019, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17762.

Diagnosis. Female. Clypeus with median extension slightly emarginated (Fig. 203); clypeus with its basal part with punctures and apical part smooth and shiny (Fig. 203); dorsal side of pronotum with complete anterior transverse carina (Fig. 204); lateral side of pronotum with distinct transdiscal groove (Fig. 205); fore wing yellowish (Fig. 207); dorsal side of propodeum outside areola with reticulations and punctures (Fig. 204); carina of propodeal areola margined by crenulations (Fig. 204); metanotum with punctures concentrated on laterally, medially smooth (Fig. 204); Gt_1 with a transverse carina anteriorly (Fig. 208); inner surface of hind basitarsus with a long, deep groove.

Variations. The specimens examined here differ in dorsal pronotal carina compared to the description of Allen (1975). Dorsal side of pronotum with complete anterior transverse carina in the specimens examined, while dorsal side of pronotum with transverse carina present only at humeral angle according to Allen.

Size. 10.5 mm.

Male. Unknown.

Distribution. India: Jammu & Kashmir, Kerala (Hanima *et al*., 2022c).

Remarks. This subgenus is a new combination. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

12. *Tiphia* (*Tiphia*) *flavipalpis* Allen, 1975

(Figs. 210–217)

Tiphia (*Tiphia*) *flavipalpis* Allen, 1975: 38–39. Holotype ♂, Pulchauki, Katmandu, Nepal (CERI).

Material examined. Kozhikode district, Baby Memorial Hospital Campus (11°15'36"N & 75°47'33"E, 8 m), 1 ♂, 2.xii.2019, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16917; Kozhikode district, Sarovaram Biopark (11°16'6.96"N & 75°47'33.72"E, 6 m), 1 ♂, 25.x.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16918; Thiruvananthapuram district, 1 ♂, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 18.i.2019, Coll. P. Girish Kumar,

(ZSIK) Regd. No. ZSI/WGRC/IR/INV.17851; Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 3 ♂, 28.ix.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16914–16916; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kothiram (8°39'45"N & 77°09'00"E, 125 m), 2 ♂, 17.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16912 & 16913; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kottur (10°31'34"N & 76°58'35"E, 303 m), 1 ♂, 19.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17940; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Ananirathi (8°32'02"N & 77°08'59"E, 96 m), 1 ♂, 15.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16924; Wayanad district, Chandanathodu (11°50'47"N & 75°48'33"E, 810 m), 4 ♂, 15.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18202–18205; Wayanad district, Machikudi (11°40'24"N & 76°17'21"N, 913 m), 1 ♂, 18.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18206; Wayanad district, Edavambam (11°42'21.4128"N & 76°20'12.0012"E, 848 m), 1 ♂, 20.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18563.

Diagnosis. Male. Clypeus coarsely punctate with median extension emarginated (Fig. 211); mandible without preapical cusp (Fig. 211); lateral side of pronotum with groove (Fig. 215); metanotum with minute punctures (Fig. 214); dorsal side of propodeum with areola rectangular and 1.25 × its apical width (Fig. 214); denticle of Gs_5 with rounded orifice under elevated edge; fore wing slightly infumate (Fig. 212); fore wing with marginal cell greatly longer than second cubital cell in apical extension (Fig. 212).

Variations. The specimens examined here differ in the colour of palpi and measurements of areola compared to the description of Allen (1975). Palpi dark brown and areola 1.25 × its apical width in the specimens examined, while palpi not flavous and areola more than twice its apical width according to Allen.

Genitalia. Paramere with a stalk and rounded flat apex covered with setae; digitus basally rounded and pointed apically; cuspis slender and beak-like apically; aedeagus folded completely (Fig. 375).

Size. 8.9–11.4 mm.

Female. Unknown.

Distribution. India: Karnataka, Kerala, Tamil Nadu. *Elsewhere*: Nepal, Thailand (Hanima *et al.*, 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from India.

13. *Tiphia* (*Tiphia*) *hirsuta* Smith, 1855

(Figs. 218–225)

Tiphia hirsuta Smith, 1855: 83 [♂; northern India; type in NHMUK]; Cameron, 1892: 115; Bingham, 1897: 63, 64; Dalla Torre, 1897: 137; Hedicke, 1936: 13; Allen, 1969: 393, 394 [type redescription and synonymy of *T. tarsata* and *T. clypealis*]; Allen, 1975: 33, 34 [northern India, Nepal].

Tiphia tarsata Cameron, 1897: 44 [♂; Mussouri; type in OUM]; Hedicke, 1936: 24.

Tiphia clypealis Cameron, 1897: 47, 48 [♂ not ♀; Mussouri; type in OUM]; Turner, 1908b: 124 [incorrectly synonymizes *T. flavipennis* Bingham and *T. quinquecarinata* Cameron]; Allen and Jaynes, 1930: 97; Hedicke, 1936: 7.

Tiphia (*Tiphia*) *hirsuta*; Allen, 1969: 393; Allen, 1975: 33–34.

Tiphia hirsuta; Krombein, 1982: 46–49.

Material examined. Kollam district, Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), 1 ♂, 9.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19738.

Diagnosis. Male. Mandible without preapical denticle (Fig. 220); clypeus, gena and mesopleuron masked with coarse white and yellowish orange setae (Figs. 220, 222); lateral side of pronotum with distinct transdiscal groove (Fig. 222); fore wing with marginal cell of fore wing slightly longer than second cubital cell in apical extension (Fig. 224); Gs_5 with lateral denticle; Gs_6 with tuft of fine setae (Fig. 225); tegula (Fig. 221), posterior margin of pronotum (Fig. 221), underside of antennae (Fig. 223), clypeus (Fig. 220), tarsi of fore and mid legs and tibia of fore leg yellowish orange (Fig. 218).

Genitalia. Paramere with a stalk and rounded flat apex covered with setae; digitus rounded apically; cuspis slender and beak-like apically; aedeagus folded completely (Fig. 376).

Size. 7.9–10.2 mm.

Female. Unknown in the present study.

Distribution. India: Gujarat, Kerala, Uttarakhand, West Bengal. *Elsewhere*: Nepal (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

14. *Tiphia* (*Tiphia*) *kashmirensis* Hanima & Girish Kumar, 2019

(Figs. 226–234)

Tiphia kashmirensis Hanima & Girish Kumar in Hanima *et al.*, 2019a: 127–141. Holotype ♂, Shalimar Garden, Srinagar, Kashmir (ZSIK).

Material examined. Idukki district, Thekkadi, Kumarikulam (9°43'00"N & 76°57'51"E, 1003 m), 3 ♀, 6.ix.2018, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16630–16633; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 4 ♀, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18374–18377; Wayanad district, Kalpatta, Madakkimala (8°46'32"N & 77°13'39"E, 1268 m), 1 ♀, 6.i.2009, Coll. K. Rajmohana, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18566.

Diagnosis. Female. Apical margin of clypeal lobe rounded (Fig. 227); lateral side of pronotum with a distinct transdiscal groove (Fig. 229); fore wing yellowish hyaline (Fig. 231); middle and hind trochanters, femora and tibia entirely bright red (Figs. 226, 229); hind basitarsus with groove on inner face; Gt_1 without anterior transverse carina (Fig. 233); apical half of pygidium shagreened and apical margin wrinkled (Fig. 233).

Size. 8.6–12.2 mm.

Male. Unknown in the present study.

Distribution. India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu, Uttarakhand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

15. *Tiphia* (*Tiphia*) *khasiana* Cameron, 1902

(Figs. 235–243)

Tiphia khasiana Cameron, 1902a: 86. Lectotype ♀, Khasia Hills, Assam [presently Khasia hills in Meghalaya] (OUM); Allen & Jaynes, 1930: 101; Hanima *et al*., 2019a: 133 (description of male).

Tiphia (*Tiphia*) *khasiana*; Allen, 1969: 405; Allen, 1975: 78–79.

Material examined. Idukki district, Thekkadi, Kumarikulam (9°43'00"N & 76°57'51"E, 1003 m), 4 ♀, 6.ix.2018, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16630–16633; Kozhikode district, Peruvayal (11°15'47"N & 75°54'21"E, 24 m), 2 ♀, 28.xii.2018, Coll. K. Rajmohana, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16634–16635; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 5 ♀, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19361–19365; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 1 ♀, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16636; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Peppara dam site (8°37'21"N & 77°08'12"E, 98 m), 1 ♀, 4.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19691;

Wayanad district, Kalpatta, Madakkimala (8°46'32"N & 77°13'39" E, 1268 m), 1 ♀, 6.i.2009, Coll. K. Rajmohana, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17847; Kollam district, Shendurney Wildlife Sanctuary, Thenmala, Ottakkal IB (8°57'34"N & 77°03'44"E, 77 m), 1 ♀, 6.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19693; 1 ♀, Shendurney Wildlife Sanctuary, Kaatilappara (8°54'46.44"N & 77°6'53.496"E, 221 m), 8.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19690.

Diagnosis. Female. Dorsal side of pronotum without anterior transverse carina (Fig. 237); lateral side of pronotum with long, narrow transdiscal groove (Fig. 238); areola of dorsal side of propodeum rectangular (Fig. 237); apical half of pygidium smooth (Fig. 241); femora of middle and hind legs bright red (Fig. 235); inner surface of hind basitarsus with a median groove.

Size. 6.1–11 mm.

Male. Unknown in the present study.

Distribution. India: Jammu & Kashmir, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttarakhand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

16. *Tiphia* (*Tiphia*) *kurumba* Hanima & Girish Kumar, 2022

(Figs. 244–250)

Tiphia (*Tiphia*) *kurumba* Hanima & Girish Kumar in Hanima *et al.*, 2022c: 55. Holotype ♂, Silent Valley National Park, Palakkad, Kerala (ZSIK).

Material examined. Palakkad district, Silent Valley National Park, Panthanthod (11°04'21"N & 76°25'25"E, 974 m), 2 ♂, 16.v.2016, Coll. Prashanth, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18084–18085; Wayanad district, Meppadi, Mundakai forest (11°33'40"N & 76°08'44"E, 853 m), 3 ♂, 16.xi.2018, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18912–18914.

Diagnosis. Antennae beneath yellowish orange (Fig. 244); median extension of clypeus emarginated (Fig. 245); carina of dorsal side of pronotum without ridges (Fig. 246); mandible without preapical denticle; metanotum with small sparse punctures (Fig. 246); carina of propodeal areola with crenulations, median carina of areola complete (Fig. 246); fore wing completely hyaline with large stigma (Fig. 251); marginal cell of fore wing long and greatly longer than second cubital cell in apical extension (Fig. 249); Gt_1 without anterior transverse carina (Fig. 250); Gs_5 with lateral denticle; Gs_6 with sparse setae (Fig. 250).

Genitalia. Paramere apically wider than base and covered with setae; digitus almost oval in shape; cuspis slender and sickle shaped and covered with setae; aedeagus folded **(**Fig. 377).

Size. 6.9–9.1 mm.

Female. Unknown.

Distribution. India: Kerala (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 described this species for the first time from India.

17. *Tiphia* (*Tiphia*) *lawrencei* Allen, 1975

(Figs. 251–258)

Tiphia (*Tiphia*) *lawrencei* Allen, 1975: 70–71. Holotype ♀, Nilgiri Hills, India (NMNH).

Material examined. Kozhikode district, Purameri (11°40'18"N & 75°37'46"E, 33 m), 1 ♀, 15.xii.2020, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17763; Kozhikode district, Sarovaram Biopark (11°16'6.96"N & 75°47'33.72"E, 6 m), 2 ♀, 25.x.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17764–17765; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 1 ♀, 24.v.2019, Coll. P. M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17766; Palakkad district, Silent Valley National Park (11°03'51"N & 76°32'16"E, 540m), 1 ♀, 12.iii.2021, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18201; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 1 ♀, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17853; Wayanad district, Edavambam (11°42'21.4128"N & 76°20'12.0012"E, 848 m), 1 ♀, 20.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17943.

Diagnosis. Mandible without preapical denticle (Fig. 252); apex of clypeal lobe rounded (Fig. 252); lateral side of pronotum with distinct transdiscal groove (Fig. 254); dorsal side of pronotum with transverse carina interrupted at middle (Fig. 253); metanotum with scattered minute punctures (Fig. 253); mesoscutum with anteromedian groove and notaulices not connected (Fig. 253); apical half of pygidium smooth (Fig. 257); hind basitarsus without groove.

Variations. The specimens examined here differ in the density of transdiscal groove of lateral side of pronotum compared to the description of Allen (1975). Lateral side of pronotum with distinct transdiscal groove in the specimens examined, while lateral side of pronotum with shallow obscure transdiscal groove according to Allen.

Size. 12–13 mm.

Male. Unknown.

Distribution. India: Daman, Kerala, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere*: Thailand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

18. *Tiphia* (*Tiphia*) *lotharae* Allen, 1975

(Figs. 259–267)

Tiphia (*Tiphia*) *lotharae* Allen, 1975: 24–25. Holotype ♂, Lothar near Birganj, Nepal (CERI).

Material examined. Idukki district, Thekkadi, Kumarikulam (9°43'00"N & 76°57'51"E, 1003 m), 8 ♂, 6.ix.2018, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18145–18152; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 1 ♂, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.16817; Wayanad district, Chandanathodu (11°50'47"N & 75°48'33"E, 810 m), 3 ♂,15.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18207–18209.

Diagnosis. Front shagreened (Fig. 260); mandible with small, distinct preapical denticle (Fig. 261); dorsal side of pronotum with strong and complete carina with obscure buttressing ridges (Fig. 264); lateral side of pronotum with curved groove (Fig. 265); mesopleuron shagreened and mixed with large and minute punctures (Fig. 265); metanotum with coarse punctures (Fig. 264); posterior side of propodeum without median carina; marginal cell of fore wing greatly longer than second cubital cell in apical extension (Fig. 263); Gt_1 without anterior transverse carina (Fig. 266); Gs_6 with sparse setae (Fig. 267).

Genitalia. Paramere with a stalk and rounded flat apex covered with setae; digitus pointed apically; cuspis slender and beak-like apically and wholly covered with setae; aedeagus folded completely (Figs. 378).

Size. 8.7–11.4 mm.

Female. Unknown.

Distribution. India: Karnataka, Kerala, Tamil Nadu. *Elsewhere*: Nepal (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported it for the first time from India.

19. *Tiphia* (*Tiphia*) *lyrata* Magretti, 1892

(Figs. 268–282)

Tiphia lyrata Magretti, 1892: 252. Type ♀, Burma [Myanmar], in MCNM; Bingham, 1897: 57; Allen & Jaynes, 1930: 46.

Tiphia (*Tiphia*) *lyrata*; Allen, 1975: 65–67.

Material examined. Kerala: Ernakulam district, Vytila (9°58'5.52"N & 76°19'5.52"E), 1 ♀, 20.iv.2019, Coll. S. Anagha, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.14901; Idukki district, Mayiladumpara (9°53'07"N & 77°09'27"E, 1064 m), 6 ♂, 26.x.2019, Coll. C. Binoy, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18074–18078 & 18907; Idukki district, Kulamavu (9°47'31.2"N & 76°53'11.4"E, 724 m), 2 ♀, 26.xi.2019, Coll. Mercy, (ZSIK) Regd. Nos.

ZSI/WGRC/IR/INV.15637–15638; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 1 ♀, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15639; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 1 ♀, 17.xii.2017, Coll. P.M. Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15641; Kasargode district, Panathady (12°27'22"N & 75°18'25"E,141 m), 2 ♀, 29.xi.2017, Coll. P.M. Rajan, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.15642 & 17311; Kollam district, Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), 8 ♀, 9.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19730–19737; Kollam district, Sasthamkotta (9°02'27"N & 76°37'34"N, 4 m), 2 ♀, 22.viii.2016, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.13639 & 14902; Kollam district, Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), 1 ♀, 9.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.20035; Kollam district, Shendurney Wildlife Sanctuary, Kulathupuzha (8°54'35"N & 77°03'37"E, 143 m), 23 ♂, 9.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.20036–20058; Kozhikode district, Vilakottur (11°45'22"N & 75°39'06"E, 34m), 1 ♀, 21.x.2018, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.20441; Kozhikode district, Elathur (11°20’01”N & 75°46’17”E, 18 m), 1 ♀, 15.ii.2020, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15640; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27" N & 75°54'41"E, 543 m), 8 ♀, 22.xi.2018, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.14900& 15626–15632; Kozhikode district, Nanminda (11°33'27"N & 75°54'41"E, 543 m), 1 ♀, 16.x.2017, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17310; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 2 ♀, 4.i.2022, Coll. V.D. Hegde & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.20031 & 20032; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 2 ♀, 24.v.2019, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.13923 & 13924; Malappuram district, Wandoor (11°11'36"N & 76°14'17"E, 33 m), 1 ♀, 27.iv.2019, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15643; Malappuram district, Kerala Forest Research Institute Campus, Nilambur (11°18'0.36"N & 76°15'1.44"E, 48 m), 2 ♀, 29.ii.2020, Coll. Tessy & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.15635 & 15636; Palakkad district, Silent Valley National Park (11°03'51"N & 76°32'16"E, 540m), 1 ♀, 12.iii.2021, Coll. K.P. Hanima Raveendran & Party (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18212; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 1 ♀, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19368; Thiruvananthapuram district,

Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Ananirathi (8°32'02"N & 77°08'59"E, 96 m), 1 ♀, 16.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19122; Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 2 ♀, 27.ix.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.15633 & 15634; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 1 ♀, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15644; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kaalippara, near temple side (8°31'35"N & 77°08'32"E, 168 m), 3 ♀, 3.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19687–19689; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Kaalipara, (8°31'35"N & 77°08'32"E, 168 m), 7 ♂, 3.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.20434–20440; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Peppara dam site (8°37'21"N & 77°08'12"E, 98 m), 1 ♀, 4.xii.2021, Coll. P. Girish Kumar & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19692.

Diagnosis. Female (Figs. 268–275). Mandible without preapical denticle (Fig. 269); lateral side of pronotum with distinct transdiscal groove (Fig. 271); mesoscutum with anteromedian escarpment and notaulices not connected (Fig. 270); metanotum with few scattered punctures (Fig. 270); dorsal side of propodeum with distinct submarginal carina between areola and lateral margin (Fig. 270); areola of propodeum with five carinae, 2nd and 4th not complete (Fig. 270); posterior side of propodeum without carina; marginal cell of fore wing without apical spur (Fig. 273); hind basitarsus without groove.

Diagnosis. Male (Figs. 276–282). Mandible with small preapical denticle; median extension of clypeus bidentate (Fig. 277); dorsal side of pronotum broadly shagreened with complete anterior transverse carina bordered by short ridges (Fig. 278); lateral side of pronotum with broad transdiscal groove (Fig. 279); fore wing yellowish hyaline (Fig. 280); marginal cell of fore wing only slightly longer than second cubital cell in apical extension (Fig. 280); metanotum with scattered small punctures (Fig. 278); dorsal side of propodeum outside areola shagreened (Fig. 278); Gt_1 without anterior transverse carina (Fig. 281); Gs_5 with appressed lateral denticle (Fig. 282); Gs_6 with tuft of setae (Fig. 282).

Genitalia. Paramere with a stalk and apical rounded part covered with setae; digitus with basal portion wider and apical part slender and with beak-like projection; cuspis slender; aedeagus stout (Fig. 379).

Size. 7.2–9.1 mm.

Variations. The specimens examined here differ in the following characters compared to the description of Allen (1975). Mesoscutum with anteromedian escarpment and notaulices connected and marginal cell of fore wing with apical spur directed inwardly toward coastal margin in the specimens examined, while mesoscutum with anteromedian escarpment and notaulices not connected and marginal cell of fore wing without apical spur according to Allen.

Size. 9.7–14.9 mm.

Distribution. India: Karnataka, Kerala, Tamil Nadu, Uttarakhand. *Elsewhere*: Myanmar (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from India and also described the male of the species.

20. *Tiphia* (*Tiphia*) *milleri* Allen, 1975

(Figs. 283–289)

Tiphia (*Tiphia*) *milleri* Allen, 1975: 37–38. Holotype, ♂. Pulchauki, Katmandu, Nepal (CERI).

Material examined. Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27"N & 75°54'41"E, 543 m), 2 ♂, 28.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV. 21619–21620.

Diagnosis. Male. Mandible without preapical denticle (Fig. 284); antenna beneath, palpi, tegula and fore and mid legs (except coxa) orange red (Figs. 283, 285); dorsal side of pronotum with complete transverse carina (Fig. 285); lateral side of pronotum without well-developed transdiscal groove (Fig. 286); marginal cell of fore wing greatly longer than second cubital cell in apical extension (Fig. 288); propodeum with rectangular shaped areola having lateral carinae bends medially (Fig. 285); Gs5 with distinct denticle.

Size. 5.3 mm.

Female. Unknown.

Distribution. India: Andaman & Nicobar Islands, Kerala (**new record**), West Bengal. *Elsewhere*: Nepal (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from India.

21. *Tiphia* (*Tiphia*) *nathani* Allen, 1975

(Figs. 290–296)

Tiphia (*Tiphia*) *nathani* Allen, 1975: 52–54. Holotype ♂. Kadamparai, Anamalai Hills, Tamil Nadu (RNHM).

Material examined. Idukki district, Chinnar (10°18'22"N & 77°12'24"E, 596 m), 2 ♂, 28.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16925 &

16926; Wayanad district, Kuruva Island, Palkulam (11°49'02"N & 76°05'36"E, 714 m), 1 ♂, 22.iii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18565.

Diagnosis. Male. Clypeus fully punctured with median extension bidentate (Fig. 291); dorsal pronotal carina buttressed with distinct ridges (Fig. 292); lateral side of pronotum with groove not complete across disc (Fig. 293); upper half of lateral side of propodeum with widely spaced rugulae (Fig. 293); metanotum coarsely punctate (Fig. 292); fore wing infumated with marginal cell moderately longer than second cubital cell in apical extension (Fig. 294); Gt_1 without transverse carina (Fig. 295); Gs_5 with lateral denticle; Gs_6 with sparse setae (Fig. 296).

Genitalia. Paramere spatula-shaped and covered with long hairs; cuspis not clearly visible; digitus basally with beak like projection; aedeagus folded completely (Fig. 380).

Size. 6.9–9.1 mm.

Female. Unknown in the present study.

Distribution. India: Andaman & Nicobar Islands, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttarakhand. *Elsewhere*: Thailand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

22. *Tiphia* (*Tiphia*) *nilgirensis* Allen, 1975

(Figs. 297–304)

Tiphia (*Tiphia*) *nilgirensis* Allen, 1975: 72–73, Holotype ♀, Nilgiri Hills and Coimbatore, South India (RNHM).

Tiphia nilgirensis; Krombein, 1982: 37–38.

Material examined. Kerala: Wayanad district, Karlad (11°38'56"N & 75°58'56"E, 752 m), 1 ♀, 29.ii.2020, Coll. K. Anju, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18188; Wayanad district, Muthanga, Manchal (11°42'11.772"N & 76°22'1.38"E, 777 m), 1 ♀, 21.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18189.

Diagnosis. Female. Clypeus with basal half punctured and apical half smooth and median extension rounded (Fig. 298); lateral side of pronotum without distinct transdiscal groove (Fig. 300); median carina of propodeal areola not complete (Fig. 299); dorsal side of propodeum without submarginal carina (Fig. 299); metanotum with coarse punctures except at small middle region (Fig. 299); fore wing slightly infumated, marginal cell of fore wing without a forwardly directed terminal spur (Fig. 302).

Size. 10.3–14.1 mm.

Male. Unknown in the present study.

Distribution. India: Karnataka, Kerala, Tamil Nadu. *Elsewhere*: Sri Lanka, Thailand (Hanima *et al*., 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

23. *Tiphia* (*Tiphia*) *nilgiria* Allen, 1975

(Figs. 305–313)

Tiphia (*Tiphia*) *nilgiria* Allen, 1975: 31–33. Holotype ♂, Nilgiri Hills, India (NMNH).

Material examined. Kerala: Ernakulam district, Thattekkad Bird Sanctuary, Kolumba (10°06'15"N & 76°42'01"E, 41 m), 2 ♂, 5.ii.2017, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17776 & 17777; Idukki district, Iravikulam National Park, Rajamalai (10°18'22"N & 77°12'24"E, 596 m), 1 ♂, 4.i. 2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17778; Idukki district, Kulamavu (9°47'31.2"N & 76°53'11.4"E, 724m), 8 ♂, 26.xi.2019, Coll. Mercy, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17071–17078; Kannur district, Kannapuram (11°58'04"N & 75°19'08"E, 7 m), 22 ♂, 11.viii.2018, 5.vi.2018, 3.iii.2019, 17.iii.2019, 5.v.2019, 19.v.2019, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17034–17042 & 17926–17928, 17043 & 17044, 17048–17050, 17775, 18257, 17045–17047; Kannur district, Kannapuram Mangrooves (11° 58' 04" N & 75° 19' 08" E, 7 m), 1 ♂, 6.v.2018, Coll. C. Charesh, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17769; Kannur district, Thekkumbad dweep (11°58'35.4"N & 75°17'27.24"E), 2 ♂, 19.v.2019, Coll. C. Charesh, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17095 & 17096; Kannur district, Chavachi (11°55'20"N & 75°47'32"E, 77 m), 4 ♂, 24.iii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18253–18256; Kannur district, Manathana paddy field (11°54'51"N & 75°45'13"E, 92 m), 5 ♂, 26.xi.2017, 28.xii.2017, 7.i.2018, 13.i.2018, Coll. T. Biju, **(**ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17770–17774; Kannur district, Aralam Wildlife Sanctuary (11°58'04"N & 75°19'08"E, 7 m), 1 ♂, 16.iii.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17845; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 8 ♂, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17087–17094; Kollam district, Monroe thuruth (8°59'49"N & 76°36'34"E, 2m), 1 ♂, 1.ix.2019, Coll. Aseeb & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17779; Kozhikode district, Edakkara (11°21'41.4"N & 76°35'24.72"E), 2 ♂, 17.v.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17079 & 17080; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27"N & 75°54'41"E, 543 m), 2 ♂, 8.xii.2015, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17081, 17843; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam (11°33'27"N & 75°54'41"E, 543 m), 20 ♂, 11.iii.2019, Coll. S. Anagha, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17051–17070; Kozhikode district, Nanminda (11°25'15"N & 75°49'53"E, 46 m), 1 ♂, 16.x.2017, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17084; Kozhikode district, Kovoor

(11°16'14.16"N & 75°49'52.32"E, 31 m), 1 ♂, 19.xii.2018, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17082; Kozhikode district, Peruvayal (11°15'45"N & 75°54'19"E, 16 m), 1 ♂, 29.xii.2018, Coll. K. Rajmohana, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17083; Kozhikode district, Jaferkhan Colony (11°15'41.184"N & 75°47'13.2"E), 1 ♂, 14.v.2019, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17787; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 26 ♂, 24.v.2019, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17003–17027 & 18259; Kozhikode district, Madappally (11°38'48"N & 75°34'13"E, 28 m), 11 ♂, 7.ii.2020, 10.ii.2020, 25.iii.2020, 11.iv.2021, Coll. S. Anagha, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17028–17033, 17790–17792, 17937 & 17938; Kozhikode district, Malabar Wildlife Sanctuary, Kakkayam dam site (11°20'10"N & 76°06'36"N, 672 m), 5 ♂, 10.i.2021, Coll. Tessy Rajan, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17780–17784; Kozhikode district, Sarovaram Biopark (11°16'6.96"N & 75°47'33.72"E, 6 m), 5 ♂, 26.x.2018, 25.x.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17802 & 17803, 17785 & 17786, 19336; Kozhikode district, Chengottukaavu (11°25'20.64"N & 11°25'20.64"N, 17 m), 2 ♂, 30.iv.2019, Coll. C. Binoy, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17788 & 17789; Kozhikode district, Paleri (11°37'22"N & 75°45'15"E, 27 m), 1 ♂, 8.iii.2020, Coll. Shaju, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18560; Kozhikode district, Kakkodi, Cherukulam (11°20'06"N & 75°46'20"E, 7 m), 3 ♂, 19.xii.2021, 27.ii.2022, Coll. T.K. Viswanath, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19637, 20403 & 20404; Kozhikode district, Moorad (11°33'54"N & 75°36'26"N, 9 m), 1 ♂, 3.ii.2021, Coll. S. Anagha, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19638; Malappuram district, Kerala Forest Research Institute Campus, Nilambur (11°18'0.36"N & 76°15'1.44"E, 48 m), 10 ♂, 29.ii.2020, Coll. Tessy Rajan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17793–17801, 18223; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 2 ♂, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19366 & 19367; Thiruvananthapuram district, Kerala University Campus (8°30'11.52"N & 76°56'50.28"E, 34 m), 2 ♂, 28.ix.2019, Coll. K.P. Hanima Raveendran & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17767 & 17768; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Ponmudi (8°46'32"N & 77°13'39"E, 1268 m), 10 ♂, 18.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.16992–17001; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar Wildlife Sanctuary, Ananirathi (8°32'02"N & 77°08'59"E, 96 m), 1 ♂, 15.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No.

ZSI/WGRC/IR/INV.17002; Wayanad district, Moolankavu (11°40'24"N & 76°17'21"N, 913 m), 2 ♂, 24.xii.2017, 7.i.2018, Coll. Sreeraman, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17085 & 17086; Wayanad district, Machikudi (11°40'24"N & 76°17'21"N, 913 m), 2 ♂, 18.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17935 & 17936; Wayanad district, Kuruva Island (11°49'02"N & 76°05'36"E, 714 m), 3 ♂, 20.iii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17929 & 17930, 18561; Wayanad district, Ponkuzhi (11°41'15"N & 76°23'26"E, 837 m), 1 ♂, 7.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17931; Wayanad district, Edavambam (11°42'21.4128"N & 76°20'12.0012"E, 848 m), 1 ♂, 20.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18252.

Diagnosis. Male. Mandible with strong preapical denticle (Fig. 307); dorsal side of pronotum with complete transverse carina without buttressing ridges (Fig. 308); lateral side of pronotum with transdiscal groove (Fig. 309); metanotal disc with sparse, small punctures (Fig. 308); dorsal side of propodeum with transverse rugulae besides areola (Fig. 308); fore wing with marginal cell equal to second cubital cell in apical extension (Fig. 311); Gt_1 without anterior transverse carina (Fig. 312).

Variations. The specimens examined here differ in the following characters compared to the description of Allen (1975). Dorsal side of pronotum with complete transverse carina with buttressing ridges and fore wing with marginal cell slightly longer than second cubital cell in apical extension in some specimens examined, while dorsal side of pronotum with complete transverse carina without buttressing ridges and fore wing with marginal cell equal to second cubital cell in apical extension according to Allen.

Genitalia. Paramere shaped like spatula and covered with long and short setae; digitus curved at apex; cuspis with deep punctures and setae and with a lobe like projection; aedeagus with apical portion folded and basally with a stalk and a conical projection (Fig. 381).

Size. 4.8–9.2 mm.

Female. Unknown.

Distribution. India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu (Hanima *et al.*, 2022c).

Remarks. Hanima *et al.*, 2022 reported this species for the first time from Kerala.

24. *Tiphia* (*Tiphia*) *novus* Hanima & Girish Kumar, 2022

(Figs. 314–323)

Tiphia (*Tiphia*) *novus* Hanima & Girish Kumar in Hanima *et al.*, 2022c: 81. Holotype ♀, Pampadum shola National Park, India (NMNH).

Material examined. Kerala, Idukki district, Pampadum shola National Park, Vattavada (10°08'01"N & 77°15'35"E, 1893 m), holotype ♀, 26.v.2014, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17854; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), paratype ♀, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19331.

Diagnosis. Female. Dorsal side of pronotum without strong, complete transverse carina anteriorly (Fig. 316); dorsal side of propodeum without submarginal carina (Fig. 316); clypeus basally with punctures and apically smooth, median extension rounded (Fig. 315); lateral side of pronotum with transdiscal groove (Fig. 317); scutum with anteromedian groove and notauli not connected (Fig. 316); metanotum laterally coarsely punctured and medially almost smooth without punctures (Fig. 321); pygidium strongly rugoso-striate apically, without punctures, basally punctate (Fig. 321); hind basitarsus with groove (Fig. 320).

Size. 8.8 mm.

Male. Unknown.

Distribution. India: Kerala (Hanima *et al.*, 2022c).

Remarks. Hanima *et al.,* 2022 described this species for the first time from India.

25. *Tiphia* (*Tiphia*) *ordinaria* Smith, 1873

(Figs. 324–332)

Tiphia ordinaria Smith, 1873: 184, ♂, Hyogo, Japan (NHM); Allen and Jaynes, 1930: 100; Allen, 1969: 358; Tsuneki, 1985: 4 (in key), 10 (in key), 30; Gorbamovskij, 1995: 200 (in key); Han *et al*., 2007: 309 (listed).

Tiphia bicarinata Cameron, 1902b: 11, ♀, Japan (MP); Allen and Jaynes, 1930: 15 (in key), 19 (in key), 66-70; Kim, 1970: 517 (in key), 519 (in key); Tsuneki, 1985: 30 (Synonymized with *Tiphia ordinaria* Smith).

Tiphia chosensis Allen, 1969: 359, ♀♂, Suwon, Korea (USNM); Tsuneki, 1985: 30 (Synonymized with *Tiphia ordinaria* Smith).

Material examined. Kerala: Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 1 ♀, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19331.

Diagnosis. Female. Dorsal side of pronotum anteriorly with weak ridge (Fig. 327); lateral side of pronotum with distinct groove (Fig. 328); areola of propodeum tricarinate, median carina not extending to apex (Fig. 327); dorsal side of propodeum without submarginal carina (Fig. 327); metanotum with coarse punctures laterally (Fig. 327); Tegula at most only slightly longer than middle width (Fig. 327); fore wing faintly infumated (Fig. 330); inner surface of hind basitarsus with groove (Fig. 332); pygidium strongly rugose at apex (Fig. 331).

Size. 11.2 mm.

Male. Unknown in the present study.

Distribution. India: Kerala (**new record**), Tamil Nadu. *Elsewhere*: Japan, Korea (Kim & Han, 2009).

Remarks. The species *T.* (*T.*) *chosensis* Allen is synonymised under *T.* (*T.*) *ordinaria* Smith by Han & Kim in 2009.

26. *Tiphia* (*Tiphia*) *palmi* Krombein, 1938

(Figs. 333–340)

Tiphia rufipes Smith, 1855: 83, Lectotype, ♀, Northern India (NHMUK); Magretti, 1892: 249 [♀; Burma [Myanmar]; misidentified?]; Bingham, 1897: 61, 62 [♀; brief description]; Turner, 1908b: 120 [♀; Ceylon; misidentified]; Allen & Jaynes, 1930: 100 [brief note]; Hedicke, 1936: 23 [listed].

Tiphia palmi Krombein, 1938: 187 [new name for *T. rufipes* Smith, not Latreille, 1797]; Krombein, 1982: 40–42.

Tiphia (*Tiphia*) *rufipes*; Allen, 1969: 396–398 [type redescription]; Allen, 1975: 63, 64 [description].

Material examined. Kerala: Ernakulam district, Thatekkad Bird Sanctuary (10°06'20"N & 76°42'08"E, 37 m), 2 ♀, 2.ix.2016, Coll. P. Girish Kumar, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.15266 & 15267; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 3 ♀, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.19354–19356.

Diagnosis. Female. Dorsal side of pronotum anteriorly with weak ridge (Fig. 336); lateral side of pronotum with evanescent transdiscal groove (Fig. 337); areola of propodeum tricarinate, median carina not extending to apex (Fig. 336); dorsal side of propodeum without submarginal carina (Fig. 336); metanotum with closely placed coarse punctures (Fig. 336); fore wing faintly infumated (Fig. 339); trochanters, femora and tibia of all legs orange red coloured (Fig. 333); mid and hind tibiae inflated (Fig. 333); inner surface of hind basitarsus without groove.

Variations. The specimens examined here differ in the length of median carina of areola compared to the description of Allen (1975). Median carina of areola not extending to apex in the specimens examined, while median carina of areola extending to apex or almost so according to Allen.

Size. 7.2–8.3 mm.

Male. Unknown in the present study.

Distribution. India: Himachal Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere*: Myanmar; Sri Lanka; Thailand (Hanima *et al.*, 2022c).

Remarks. Hanima *et al.*, 2022 reported this species for the first time from Kerala.

27. *Tiphia* (*Tiphia*) *pulchaukiae* Allen, 1975

(Figs. 341–348)

Tiphia (*Tiphia*) *pulchaukiae* Allen, 1975: 8–9. Holotype ♂. Pulchauki, Katmandu, Nepal (CERI).

Material examined. Kerala: Kozhikode district, Malabar Wildlife sanctuary, Kakkayam dam site (11°33'27"N & 75°54'41"E, 543 m), 1 ♂, 10.i.2021, Coll. Tessy Rajan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17106; Kozhikode district, Elathur (11°20’01”N & 75°46’17”E, 18 m), 1 ♂, 15.ii.2020, Coll. C. Binoy, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17099; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 1 ♂, 24.v.2019, Coll. P.M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17102; Kozhikode district, Kakkadampoyil (11°20'10"N & 76°06'36"N, 672 m), 1 ♂, 4.i.2022, Coll. V.D. Hegde & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.20033; Wayanad district, Moolankavu (11°40'24"N & 76°17'21"N, 913 m), 2 ♂, 7.i.2018, Coll. Sreeraman, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.17100 & 17101; Wayanad district, Edavambam (11°42'21.4128"N & 76°20'12.0012"E, 848 m), 2 ♂, 20.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18213 & 18214; Kasargode district, Ranipuram (12°25'19"N & 75°21'06"N, 925 m), 1 ♂, 22.i.2020, Coll. Swafvan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.17103.

Diagnosis. Male. Upper frons with scattered punctures, lower frons with adjacently spaced punctures (Fig. 342); mandible with preapical denticle (Fig. 343); median extension of clypeus emarginated (Fig. 343); dorsal side of pronotum with distinct transverse carina (Fig. 344); dorsal side of propodeum outside areola reticulate (Fig. 344); marginal cell of fore wing distinctly less than second cubital cell in apical extension (Fig. 347); metasoma without conspicuous rows of dark-orange bristles (Fig. 348); Gs_5 with lateral denticle; Gs_5 and Gs_6 without brush of dense setae (Fig. 348).

Variations. The specimens examined here differ in the shape of propodeal areola compared to the description of Allen (1975). Areola shape varies in the specimens examined, while areola rectangular shaped according to Allen.

Genitalia. Paramere spatula-shaped and covered with setae; cuspis not clearly visible; digitus and aedeagus folded completely (Fig. 382).

Size. 5.6–8 mm.

Female. Unknown.

Distribution. India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu, Uttarakhand. *Elsewhere*: Nepal (Hanima *et al.*, 2022c).

Remarks. Hanima *et al.*, 2022 reported this species for the first time from Kerala.

28. *Tiphia* (*Tiphia*) *quinquecarinata* Cameron, 1904

(Figs. 349–355)

Tiphia quinquecarinata Cameron, 1904: 288, Lectotype ♀, Khasia (OUM); Turner, 1908b: 124.

Tiphia (*Tiphia*) *quinquecarinata*; Allen, 1969: 398; Allen, 1975: 60–61.

Material examined. Kerala: Kozhikode district, Vilakottur (11°45'22"N & 75°39'06"E, 34m), 1 ♀, 25.viii.2018, Coll. K.P. Hanima Raveendran, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15613; Palakkad district, Parambikulam (10°26'56"N & 76°49'19"E, 586m), 1 ♀, 27.xi.2018, Coll. M. Jafer Palot & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15612; Palakkad district, Silent Valley National Park, Nillikal (11°03'51"N & 76°32'16"E, 540m), 1 ♀, 22.v.2016, Coll. Prashanth, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15614; Pathanamthitta district, Kochupampa, Goodrical range (9°15'53.12"N & 76°47'13.34"E, 1036 m), 1 ♀, 1.xi.2021, Coll. P.M. Sureshan & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19369; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Peppara Wildlife Sanctuary, Kanithadam (8°39'45"N & 77°09'00"E, 125 m), 1 ♀, 19.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15061; Thiruvananthapuram district, Agasthyamalai Biosphere Reserve, Neyyar dam site (8°32'01"N & 77°08'56"E, 99 m), 1 ♀, 16.i.2019, Coll. P. Girish Kumar, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.15060.

Diagnosis. Female. Dorsal pronotal carina complete (Fig. 351); tegula elongate with basal half dark brown and apical half yellow and translucent (Fig. 351); mesoscutum with anteromedian groove and notauli strongly connected (Fig. 351); metanotum with few, small punctures (Fig. 351); propodeal areola with five distinct carinae (Fig. 351); mesopleuron with scattered large coarse punctures anteriorly and minute punctures posteriorly (Fig. 352); antenna yellowish orange (Fig. 353); hind basitarsus without groove.

Variations. The specimens examined here differ in the density of dorsal pronotal carina, colour tegula, legs and antennal flagellum compared to the description of Allen (1975). Dorsal pronotal carina complete; tegula with basal half dark brown and apical half yellow and translucent; legs reddish brown to black; antennal flagellum yellowish orange in the specimens

examined, while dorsal pronotal carina not complete; tegula red; legs reddish brown; antennal flagellum dull red completely according to Allen.

Size. 6.3–8.1 mm.

Male. Unknown.

Distribution. India: Kerala, Meghalaya, Tamil Nadu, Uttarakhand (Hanima *et al.*, 2022c).

Remarks. Hanima *et al.,* 2022 reported this species for the first time from Kerala.

29. *Tiphia* (*Tiphia*) *rajeevani* Hanima & Girish Kumar, 2022

(Figs. 356–362)

Tiphia (*Tiphia*) *rajeevani* Hanima & Girish Kumar in Hanima *et al.*, 2022c: 89. Holotype ♀, Thekkadi, Idukki, Kerala, India (ZSIK).

Material examined. Kerala: Idukki district, Thekkadi, Kumarikulam (9°43'00"N & 76°57'51"E, 1003 m), 1 ♀, 6.ix.2018, Coll. P.C. Rajeevan, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.19123.

Diagnosis. Female. Upper frons almost uniformly punctate (Fig. 357); mandible without preapical denticle (Fig. 358); dorsal side of pronotum anteriorly with complete transverse carina (Fig. 359); lateral side of pronotum with weak groove (Fig. 360); tegula translucent orange (Fig. 359); dorsal side of propodeum without submarginal carina (Fig. 359); marginal cell of fore wing without spur (Fig. 361); second cubital vein of fore wing straight (Fig. 361); hind basitarsus without groove.

Size. 6.48 mm.

Male. Unknown.

Distribution. India: Karnataka, Kerala (Hanima *et al.*, 2022c, 2023).

Remarks. Hanima *et al.,* 2022 described this species for the first time from India.

30. *Tiphia* (*Tiphia*) *shajii* Hanima & Girish Kumar, 2022

(Figs. 363–370)

Tiphia (*Tiphia*) *shajii* Hanima & Girish Kumar in Hanima *et al.*, 2022c: 94. Holotype ♂, Manipuram, Kozhikode, Kerala, India (ZSIK).

Material examined. Kerala: Kozhikode district, Manipuram (11°24'45"N & 75°56'20"E, 61m), 3 ♂, 16.v.2019, Coll. C. Binoy, (ZSIK) Regd. Nos. ZSI/WGRC/IR/INV.18086–18088; Wayanad district, Muthanga, Machikudi (11°40'24"N & 76°17'21"N, 913 m), 1 ♂, 19.ii.2021, Coll. K.A. Subramanian & Party, (ZSIK) Regd. No. ZSI/WGRC/IR/INV.18911.

Diagnosis. Male. Clypeus with its median extension very slightly emarginated (Fig. 364); clypeal disc with minute punctures basally and remaining portion with coarse contiguous punctures, apically smooth (Fig. 364); mandible without preapical denticle (Fig. 364); dorsal

side of pronotum anteriorly with obscurely ridged carina (Fig. 365); lateral side of pronotum with distinct transdiscal groove, aciculations above the groove and ridges below the groove (Fig. 366); dorsal side of propodeum transversely rugose (Fig. 365); fore wing with marginal cell distinctly less than second cubital cell in apical extension (Fig. 367); Gt_1 without anterior transverse carina (Fig. 369); Gs_5 without orifice beneath edge of lateral denticle; Gs_6 with short, sparse setae (Fig. 370).

Genitalia. Paramere shaped like spatula and covered with long and short setae; digitus basally broad and curved at apex; cuspis with punctures and setae and with a beak like apical part; aedeagus with rounded apical portion (Fig. 383).

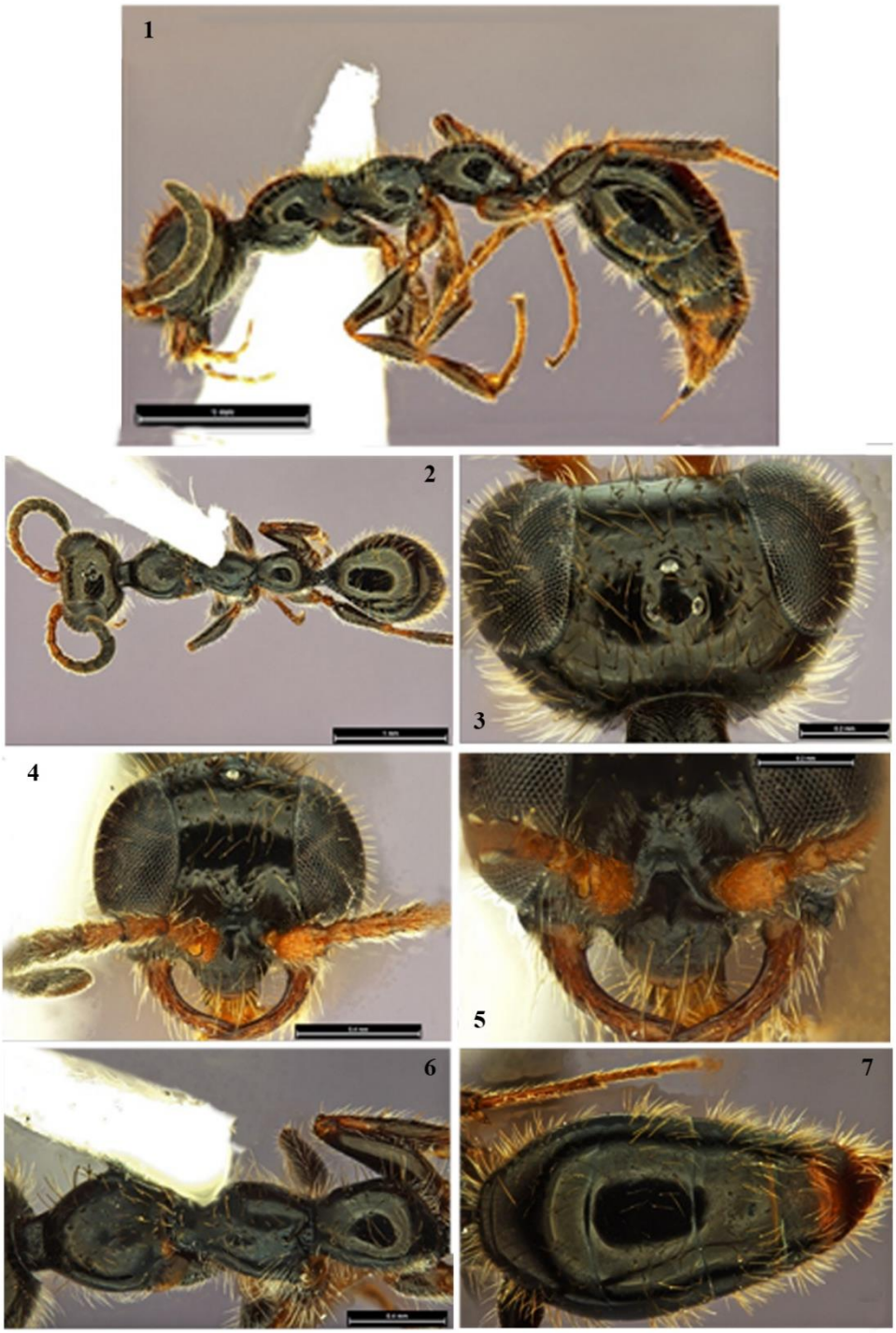
Size. 7.2–8.4 mm.

Female. Unknown.

Distribution. India: Kerala (Hanima *et al*., 2022c).

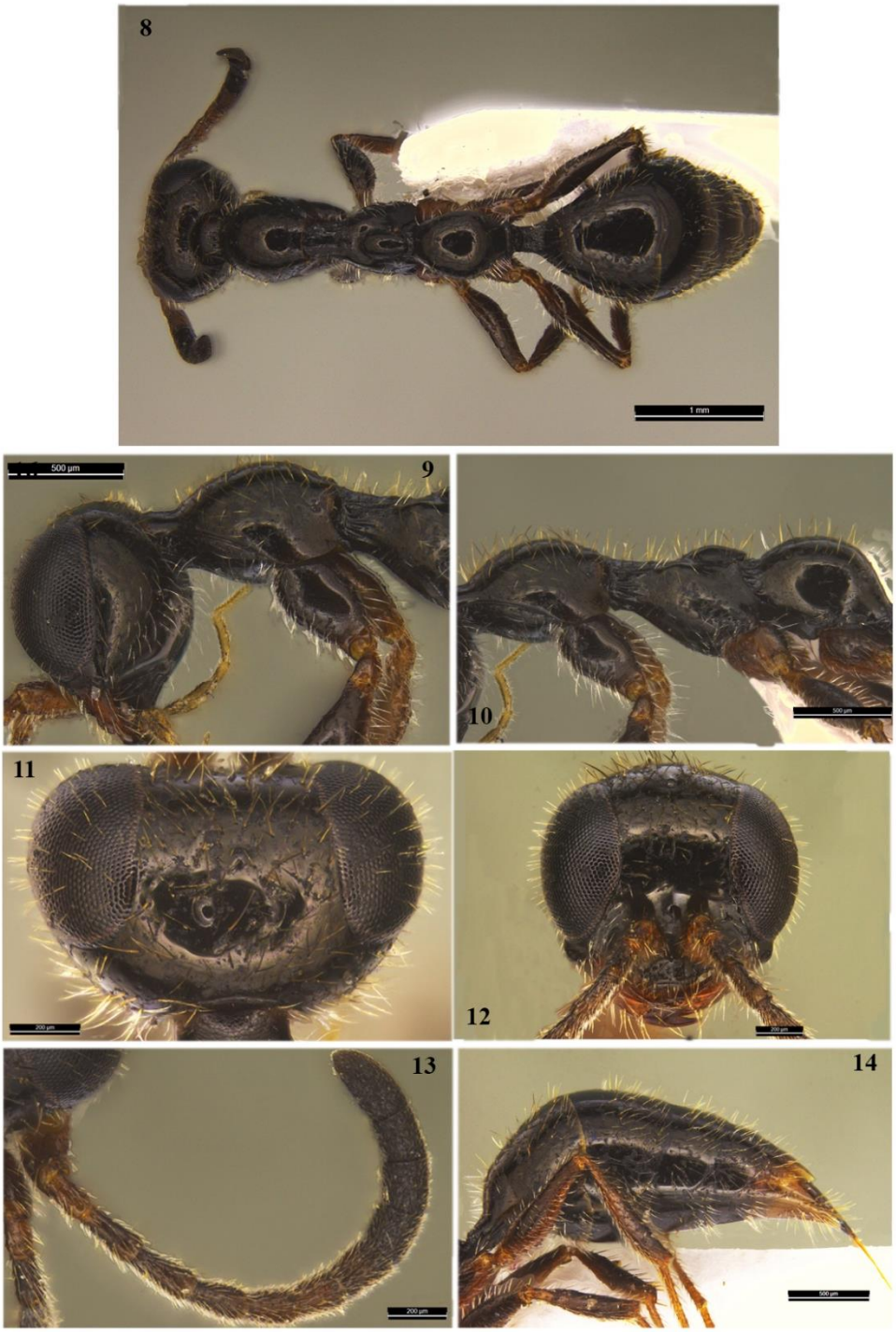
Remarks. Hanima *et al.,* 2022 described this species for the first time from India.

PLATE 7



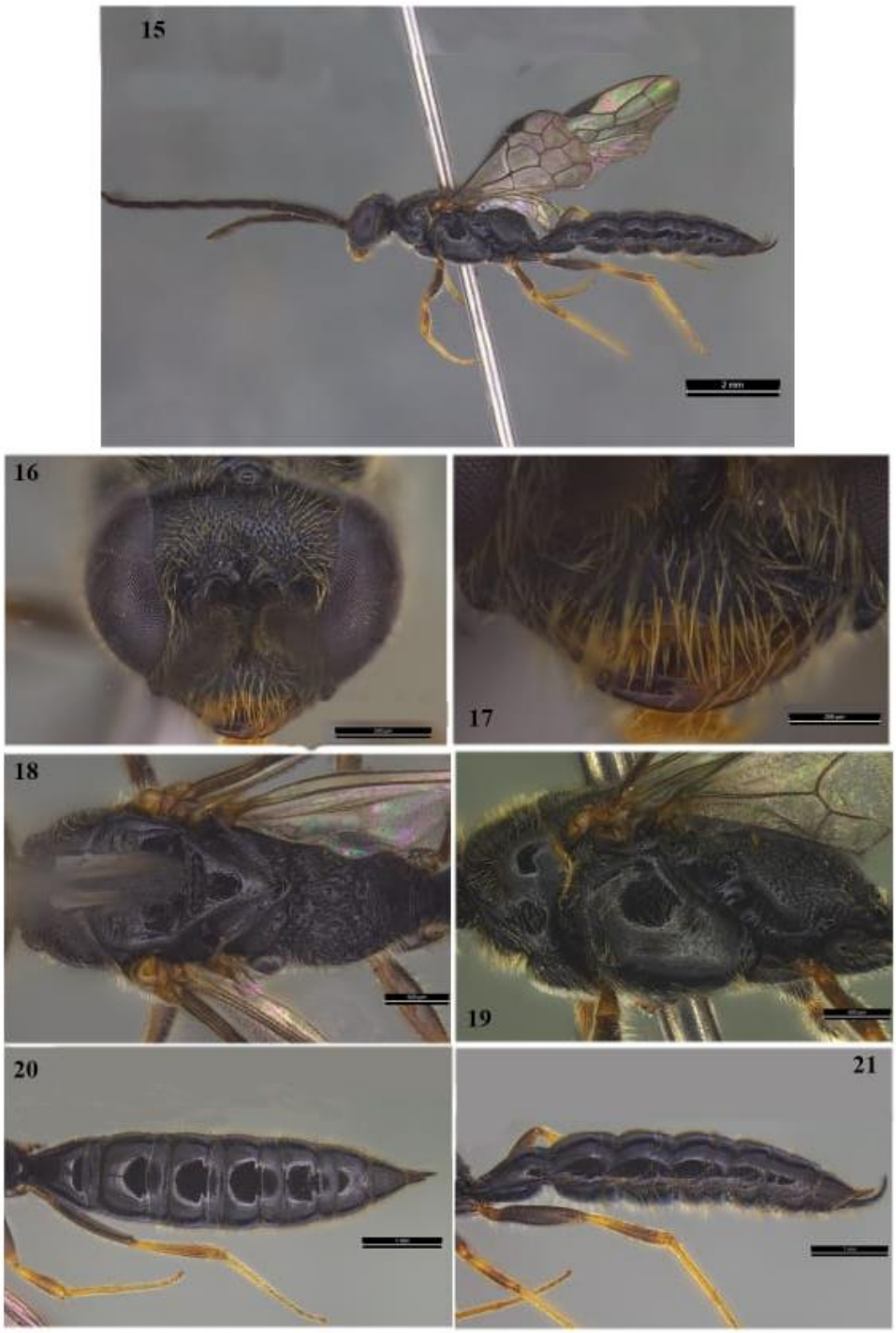
Methocha keralaensis **Hanima & Girish Kumar.**
Figures. 1-7. Female, 1. Habitus, lateral view; 2. Habitus, dorsal view; 3. Head, dorsal view; 4. Head, frontal view; 5. Clypeus dorsal view; 6. Mesosoma dorsal view; 7. Metasoma dorsal view.

PLATE 8



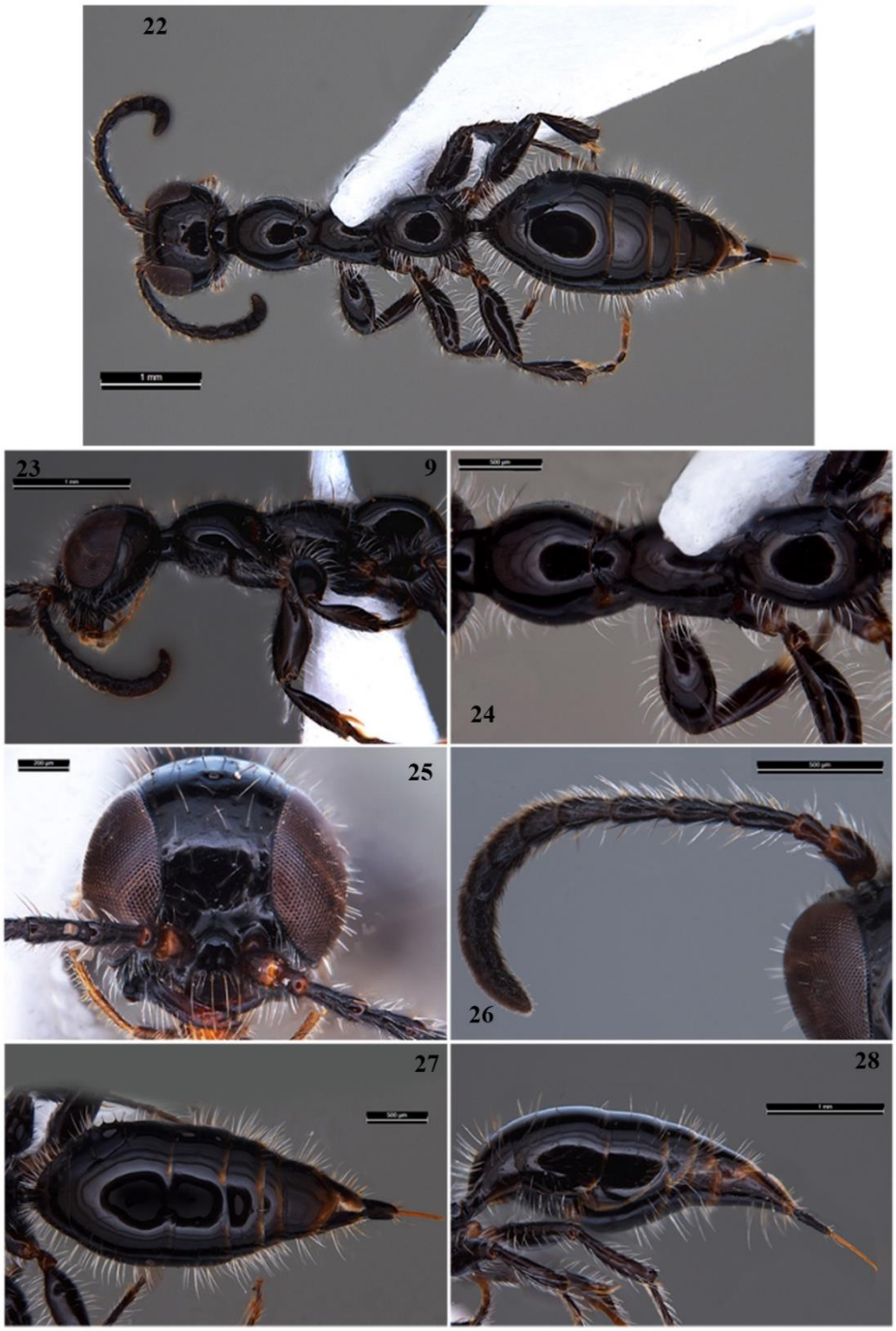
Methocha krombeini **Hanima, Binoy & Girish Kumar.**
Figures. 8-14. Female, 15. Habitus, lateral view; 16. Head, frontal view; 17. Clypeus dorsal view; 18. Mesosoma dorsal view; 19. Mesosoma lateral view; 20. Metasoma dorsal view; 21. Metasoma lateral view.

PLATE 9



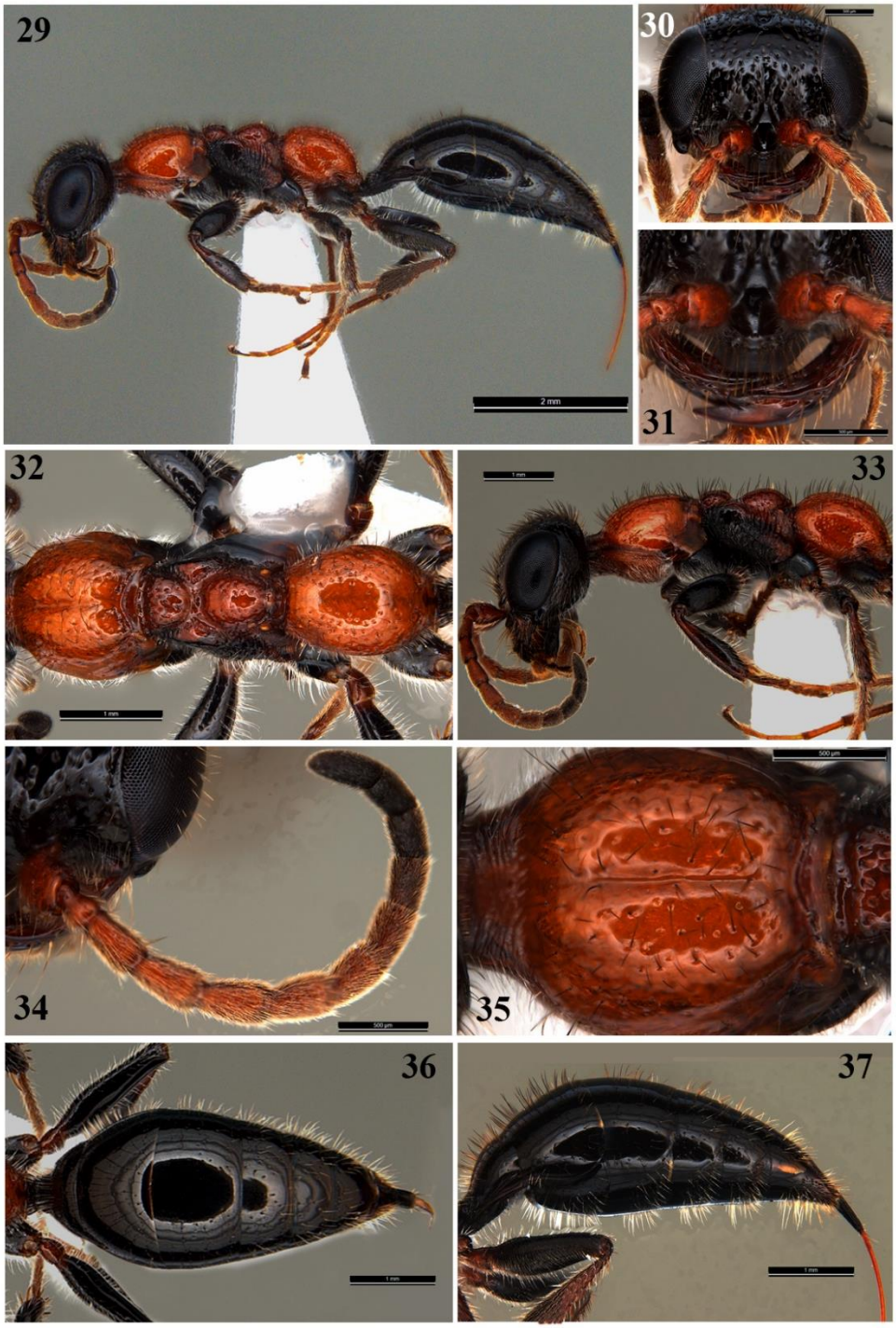
Methocha paraceylonica **Hanima, Girish Kumar & Binoy**
Figures. 15-21. Female, 15. Habitus, lateral view; 16. Head, frontal view; 17. Clypeus dorsal view; 18. Mesosoma dorsal view; 19. Mesosoma lateral view; 20. Metasoma dorsal view; 21. Metasoma lateral view.

PLATE 10



Methocha taprobane **Krombein.**
Figures. 22-28. Female, 22. Habitus, lateral view; 23. Head and mesosoma lateral view; 24. Mesosoma dorsal view; 25. Head, frontal view; 26. Antennae; 27. Metasoma dorsal view; 28. Metasoma lateral view.

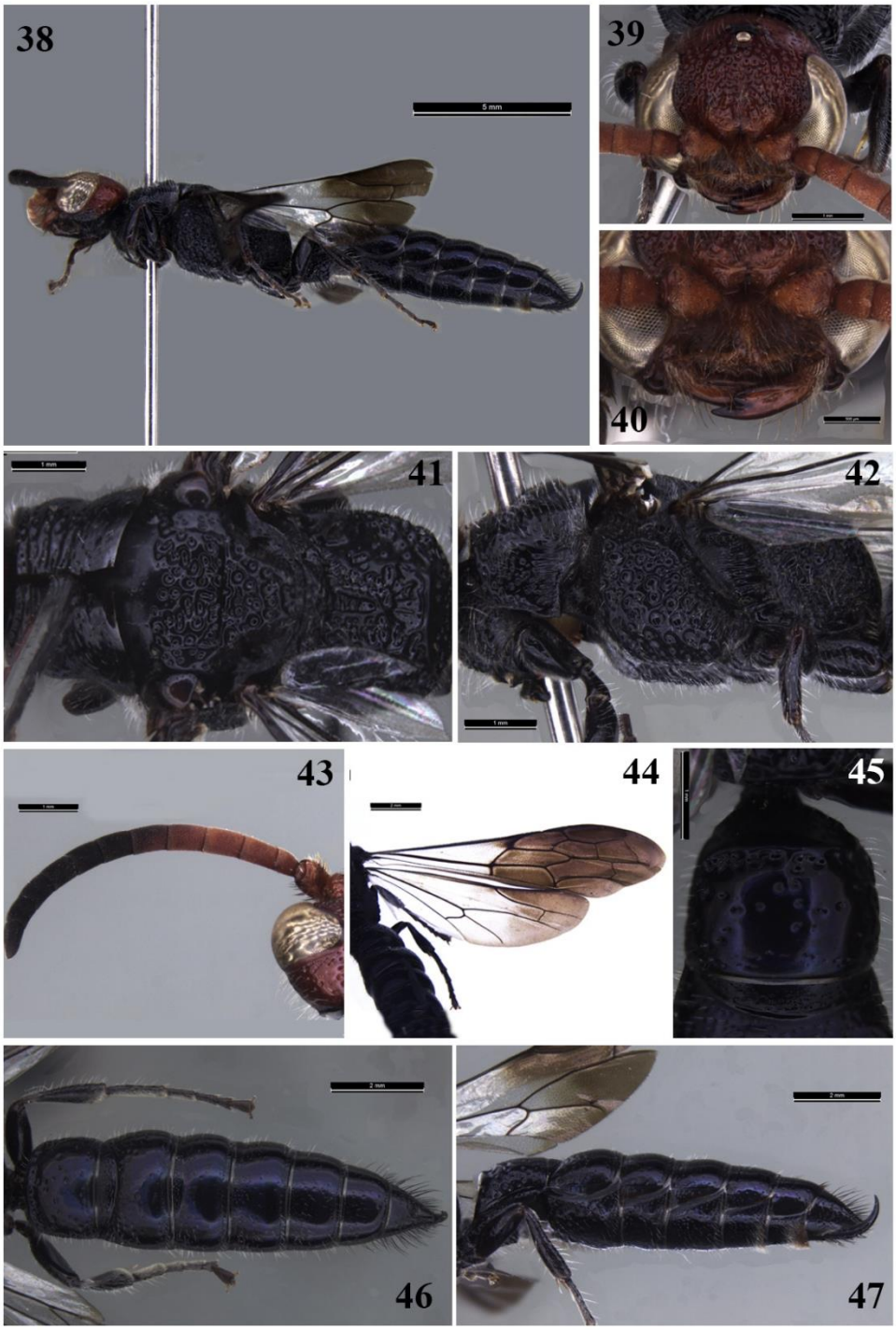
PLATE 11



Methocha ubiquita **Krombein.**

Figures. 29-37. Female, 29. Habitus, lateral view; 30. Head, frontal view; 31. Clypeus dorsal view; 32. Mesosoma dorsal view; 33. Head & mesosoma lateral view; 34. Antennae; 35. Pronotum dorsal view; 36. Metasoma dorsal view; 37. Metasoma lateral view.

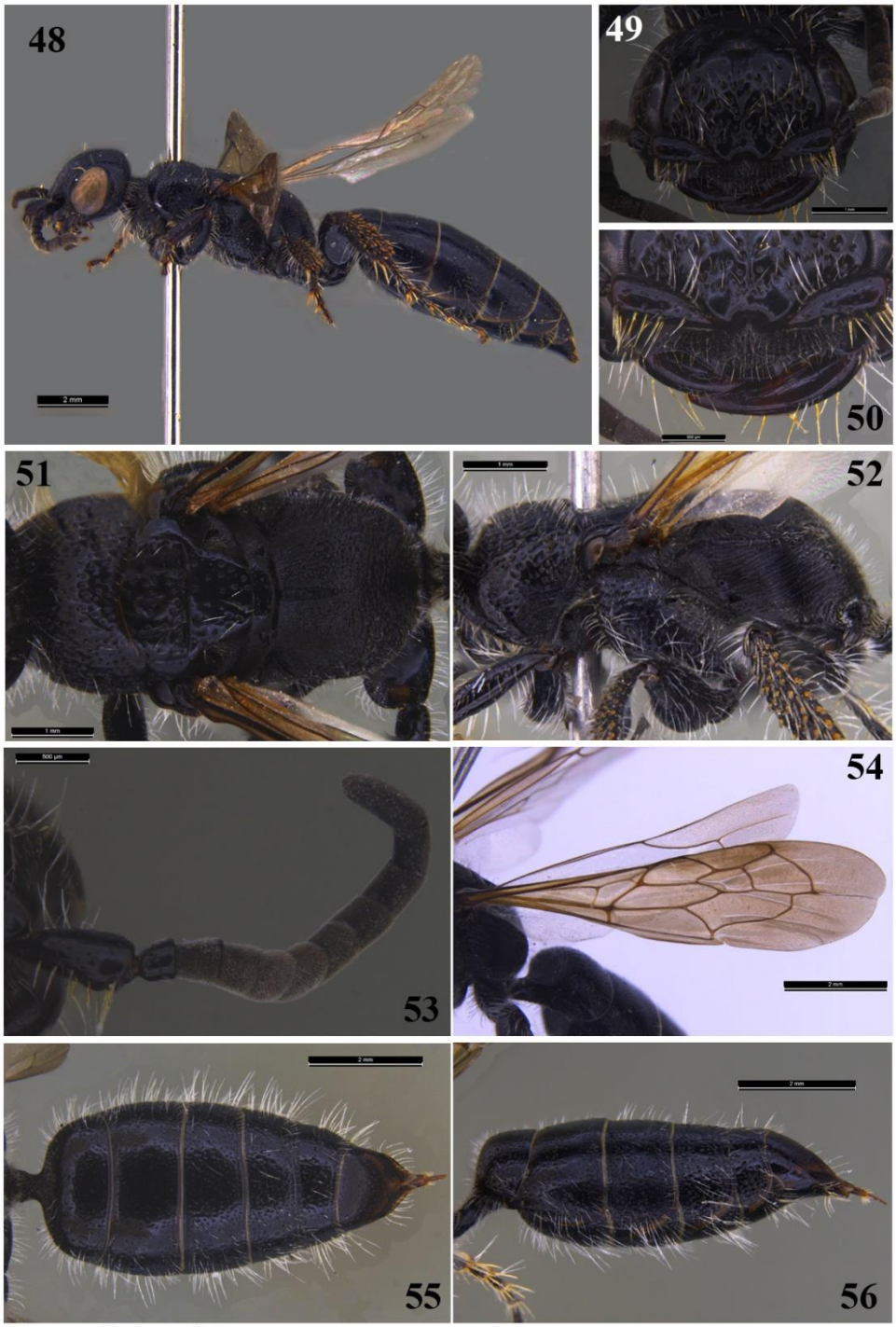
PLATE 12



Hylomesa longiceps **(Turner).**

Figures. 38-47. Male, 38. Habitus, lateral view; 39. Head, frontal view; 40. Clypeus dorsal view; 41. Mesosoma dorsal view; 42. Mesosoma lateral view; 43. Antennae; 44. Fore wing; 45. Gt1; 46. Metasoma dorsal view; 47. Metasoma lateral view.

PLATE 13



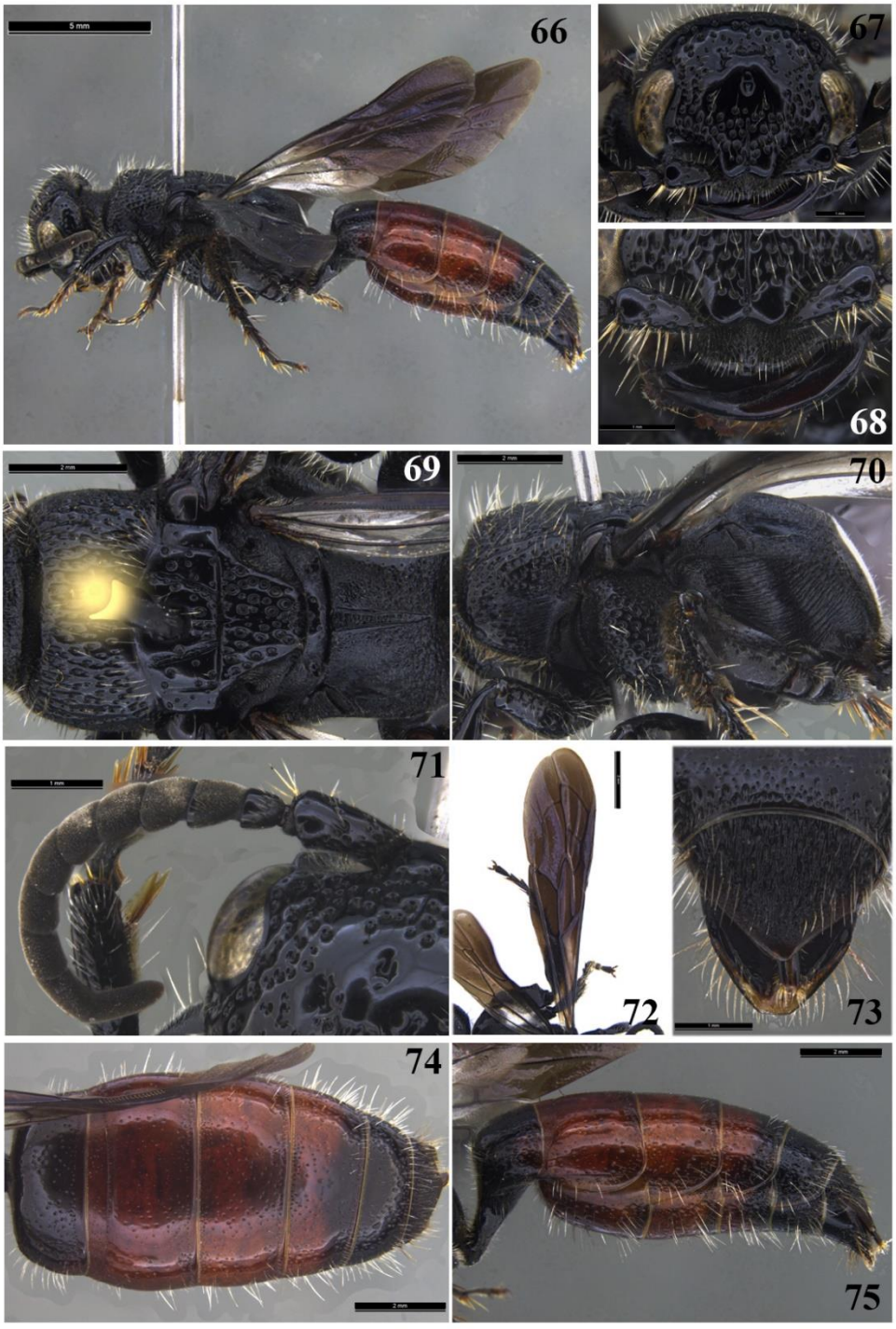
***Mesa claripennis* (Bingham).**

Figures. 48-56. Female, 48. Habitus, lateral view; 49. Head, frontal view; 50. Clypeus dorsal view; 51. Mesosoma dorsal view; 52. Mesosoma lateral view; 53. Antennae; 54. Fore wing; 55. Metasoma dorsal view; 56. Metasoma lateral view.

PLATE 14

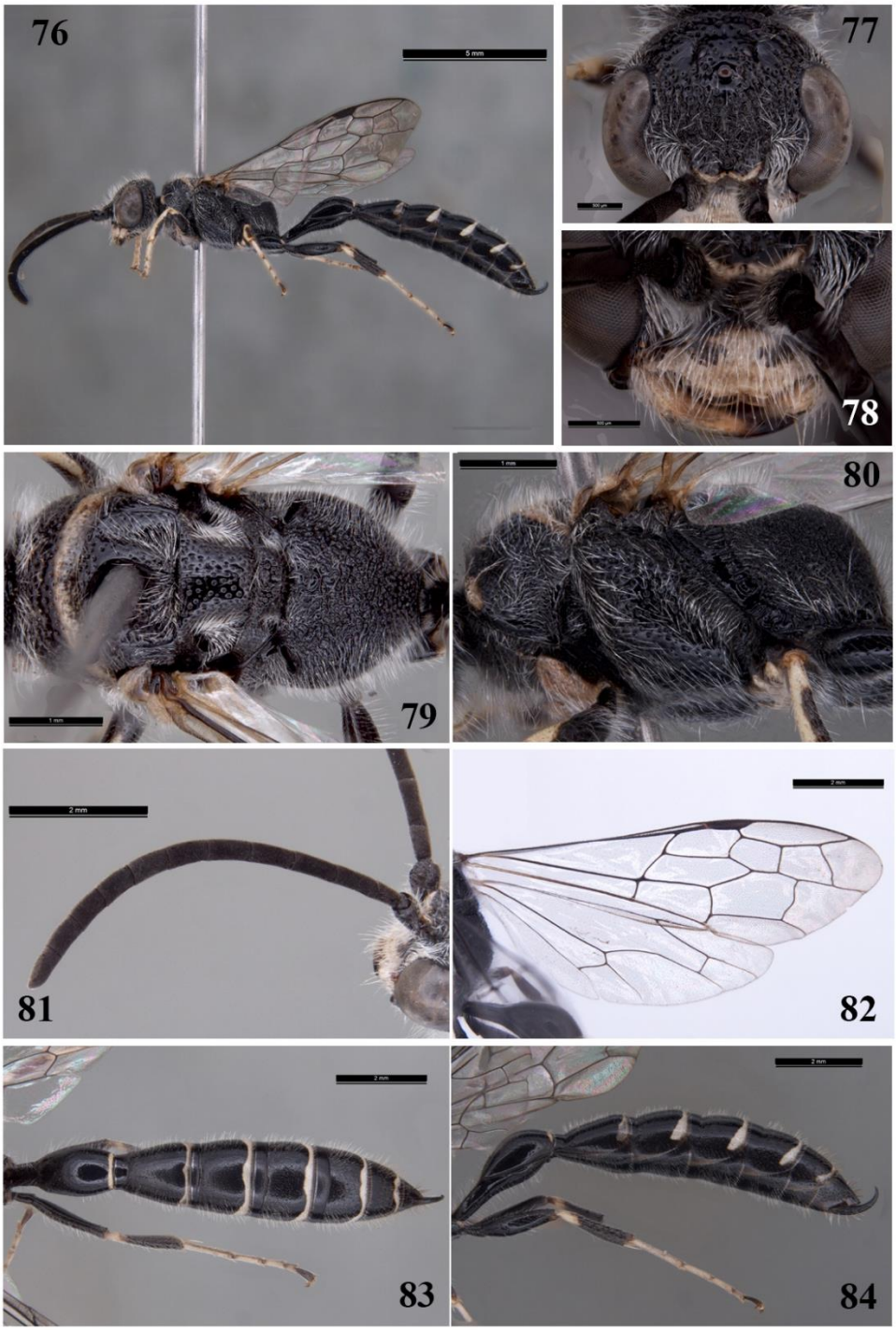
***Mesa claripennis* (Bingham).**
Figures. 57-65. Male, 57. Habitus, lateral view; 58. Head, frontal view; 59. Clypeus dorsal view; 60. Mesosoma dorsal view; 61. Mesosoma lateral view; 62. Antennae; 63. Fore wing; 64. Metasoma dorsal view; 65. Metasoma lateral view.

PLATE 15



Mesa dimidiata **(Guérin-Méneville).**
Figures. 66-75. Female, 66. Habitus, lateral view; 67. Head, frontal view; 68. Clypeus dorsal view; 69. Mesosoma dorsal view; 70. Mesosoma lateral view; 71. Antennae; 72. Fore wing; 73. Pygidium; 74. Metasoma dorsal view; 75. Metasoma lateral view.

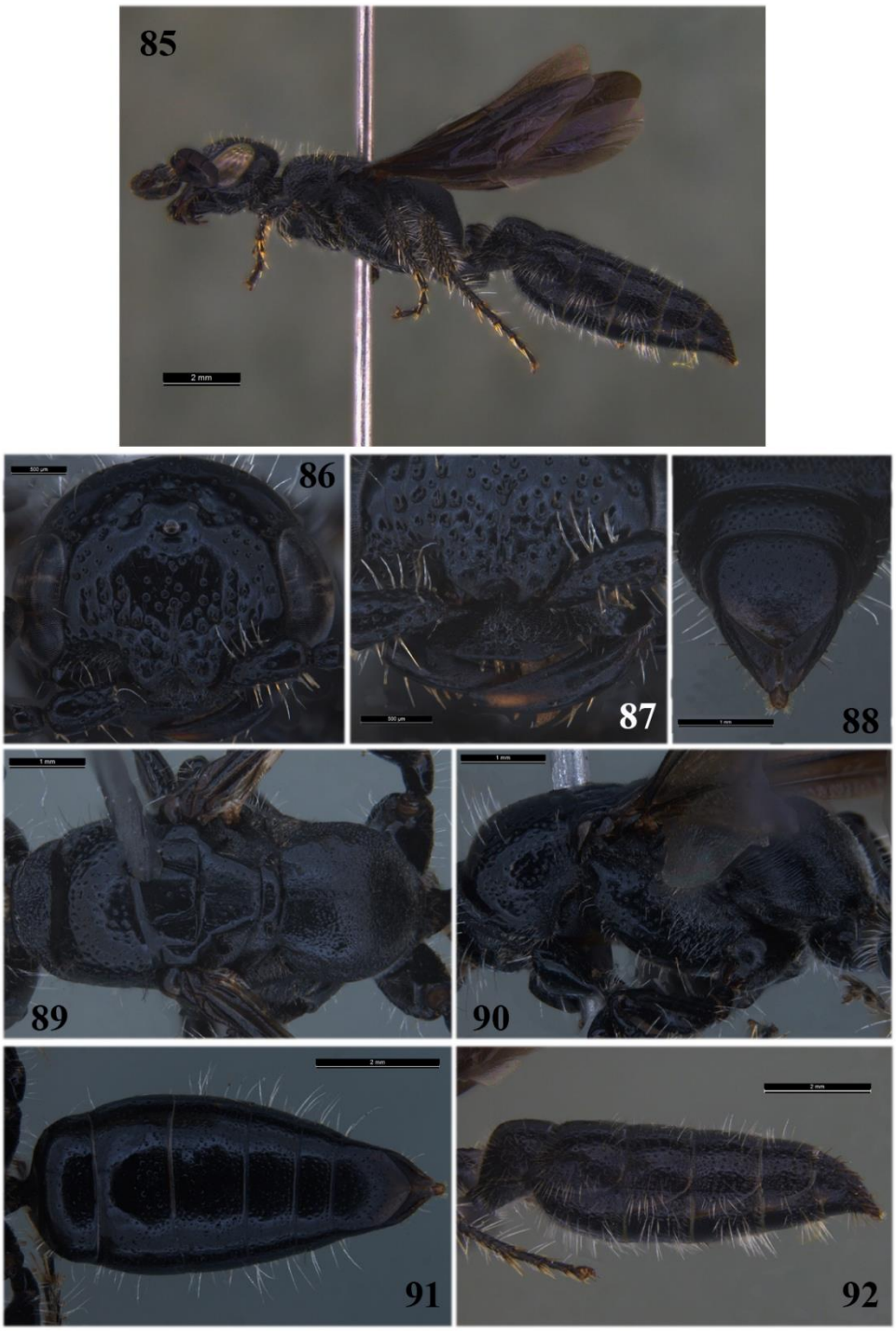
PLATE 16



Mesa keralaensis **Hanima & Girish Kumar sp.nov.**

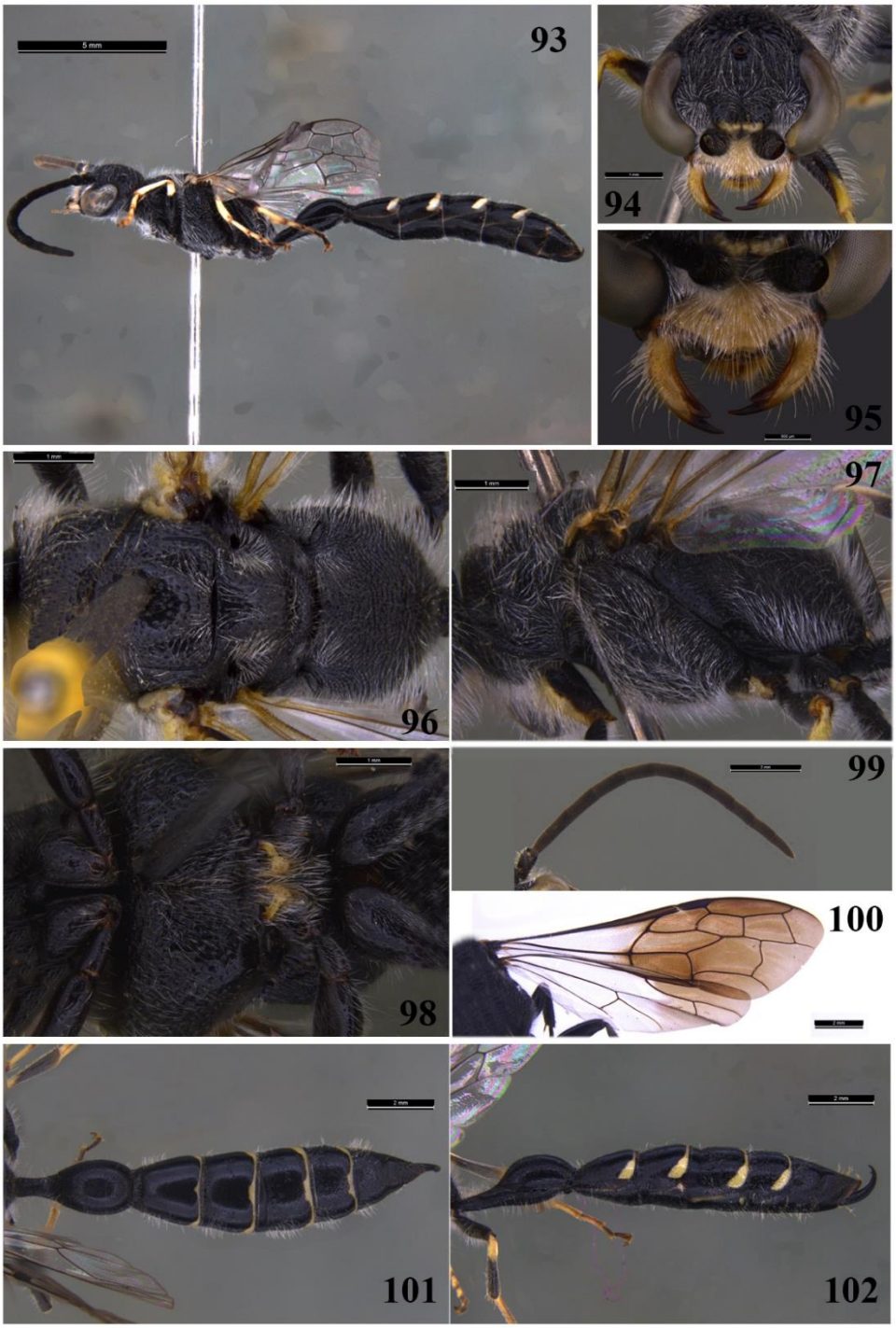
Figures. 76-84. Male, 76. Habitus, lateral view; 77. Head, frontal view; 78. Clypeus dorsal view; 79. Mesosoma dorsal view; 80. Mesosoma lateral view; 81. Antennae; 82. Fore wing; 83. Metasoma dorsal view; 84. Metasoma lateral view.

PLATE 17



***Mesa petiolata* (Smith).**
Figures. 85-92. Female, 85. Habitus, lateral view; 86. Head, frontal view; 87. Clypeus dorsal view; 88. Pygidium; 89. Mesosoma dorsal view; 90. Mesosoma lateral view; 91. Metasoma dorsal view; 92. Metasoma lateral view.

PLATE 18



Mesa petiolata **(Smith).**

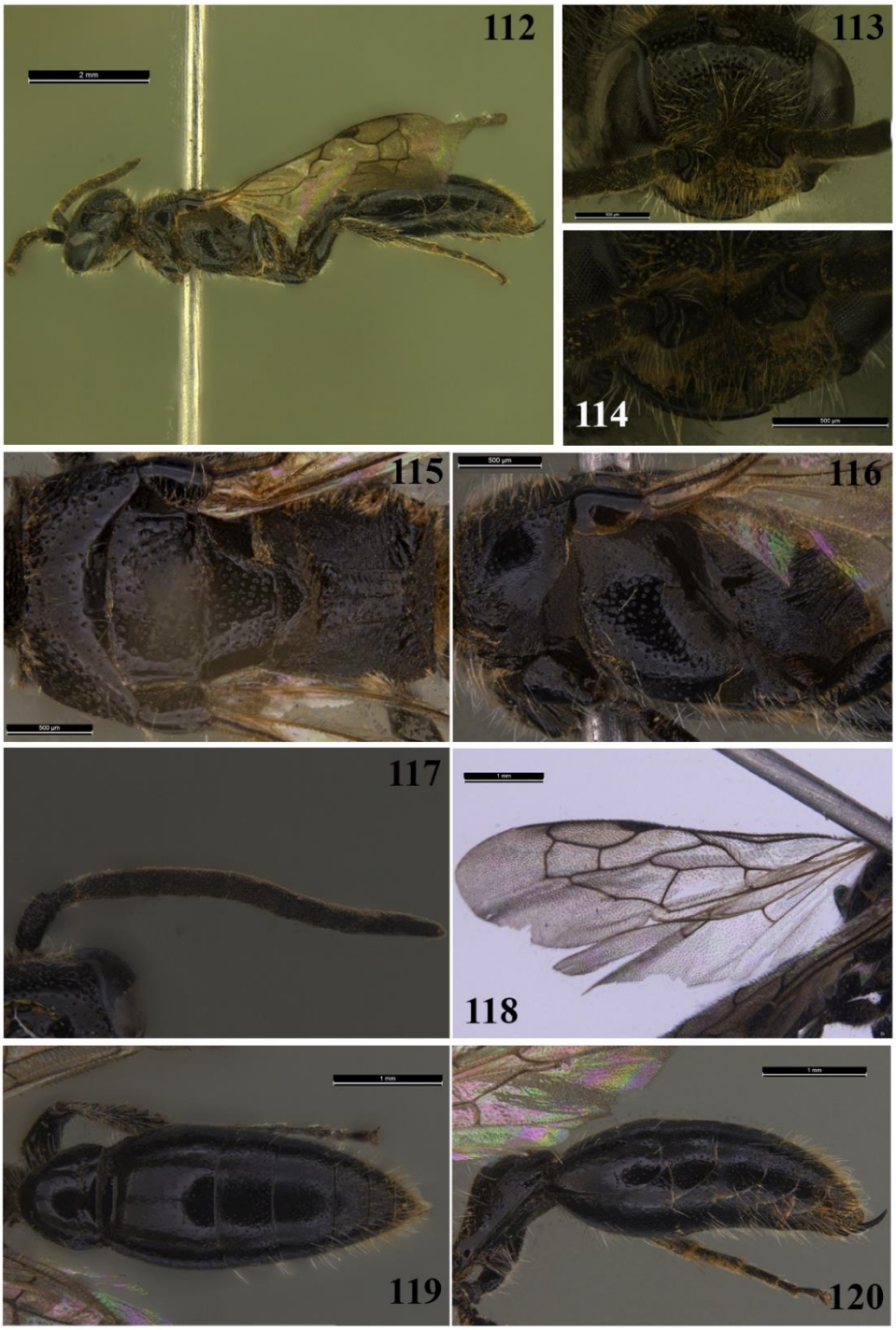
Figures. 93-102. Male, 93. Habitus, lateral view; 94. Head, frontal view; 95. Clypeus dorsal view; 96. Mesosoma dorsal view; 97. Mesosoma lateral view; 98. Mesosoma ventral view; 99. Antennae; 100. Fore wing; 101. Metasoma dorsal view; 102. Metasoma lateral view.

PLATE 19

***Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar**

Figures. 103-111. Female, 103. Habitus, lateral view; 104. Head, frontal view; 105. Clypeus dorsal view; 106. Mesosoma dorsal view; 107. Mesosoma lateral view; 108. Antennae; 109. Fore wing; 110. Metasoma dorsal view; 111. Metasoma lateral view.

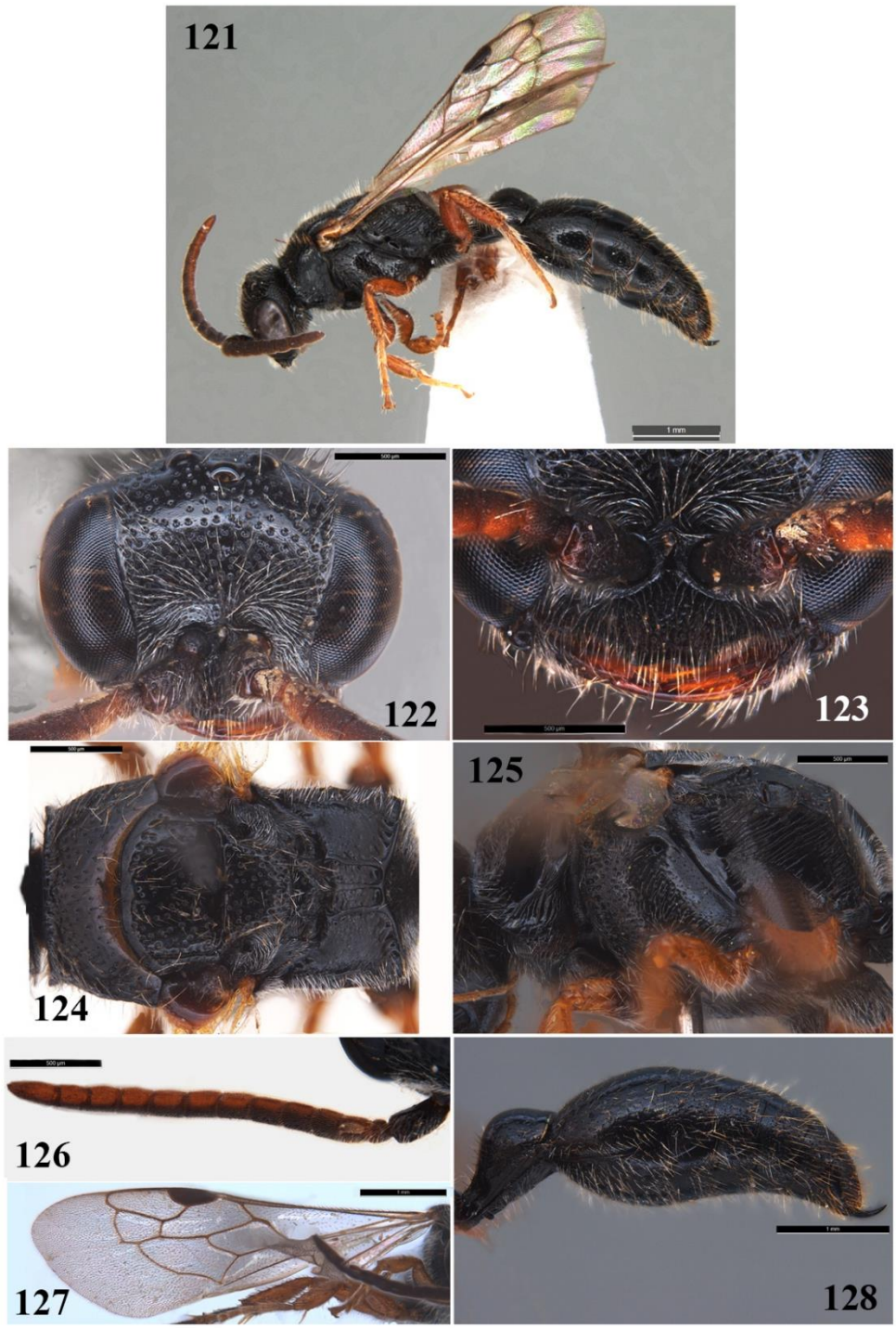
PLATE 20



***Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar**

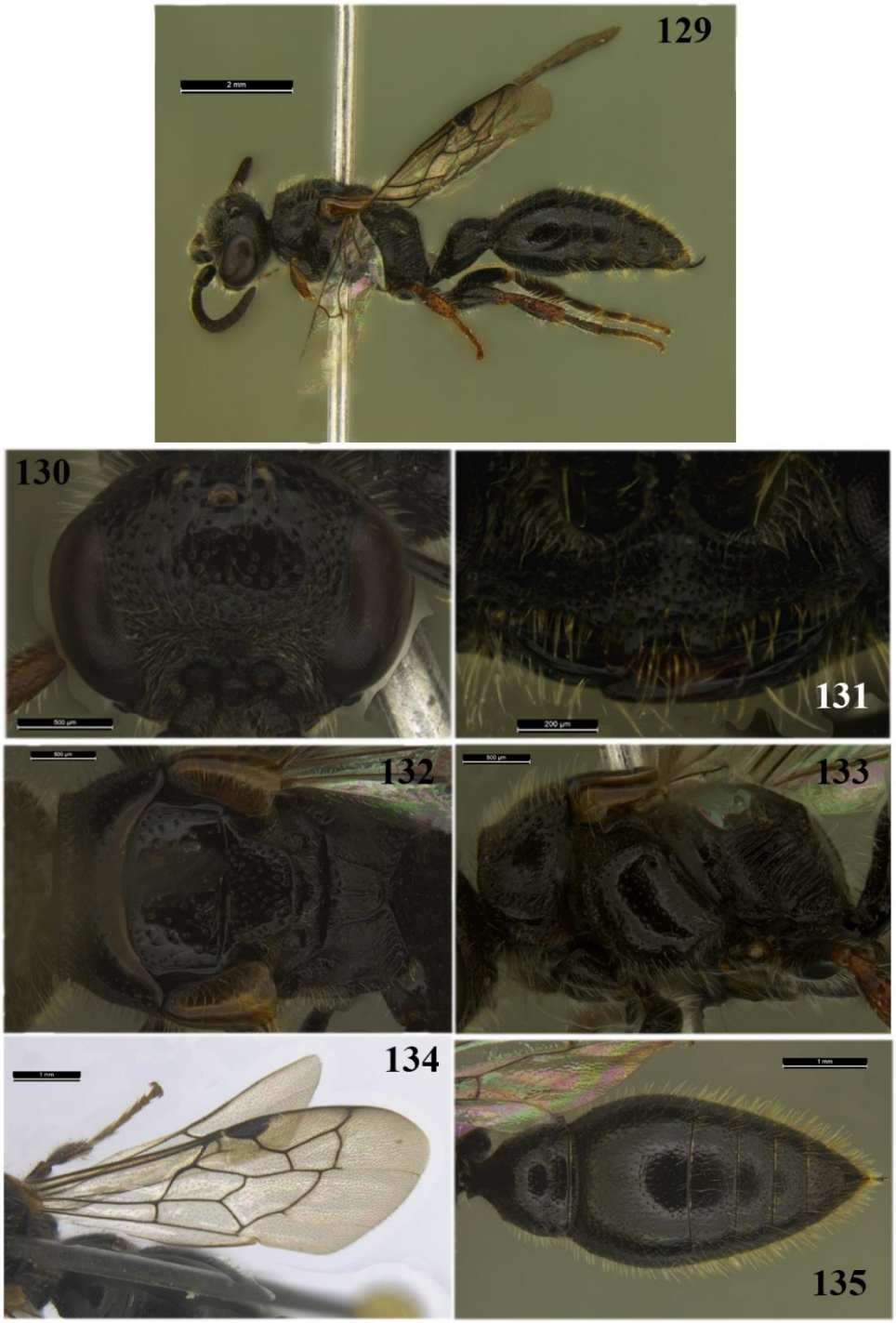
Figures. 112-120. Male, 112. Habitus, lateral view; 113. Head, frontal view; 114. Clypeus dorsal view; 115. Mesosoma dorsal view; 116. Mesosoma lateral view; 117. Antennae; 118. Fore wing; 119. Metasoma dorsal view; 120. Metasoma lateral view.

PLATE 21



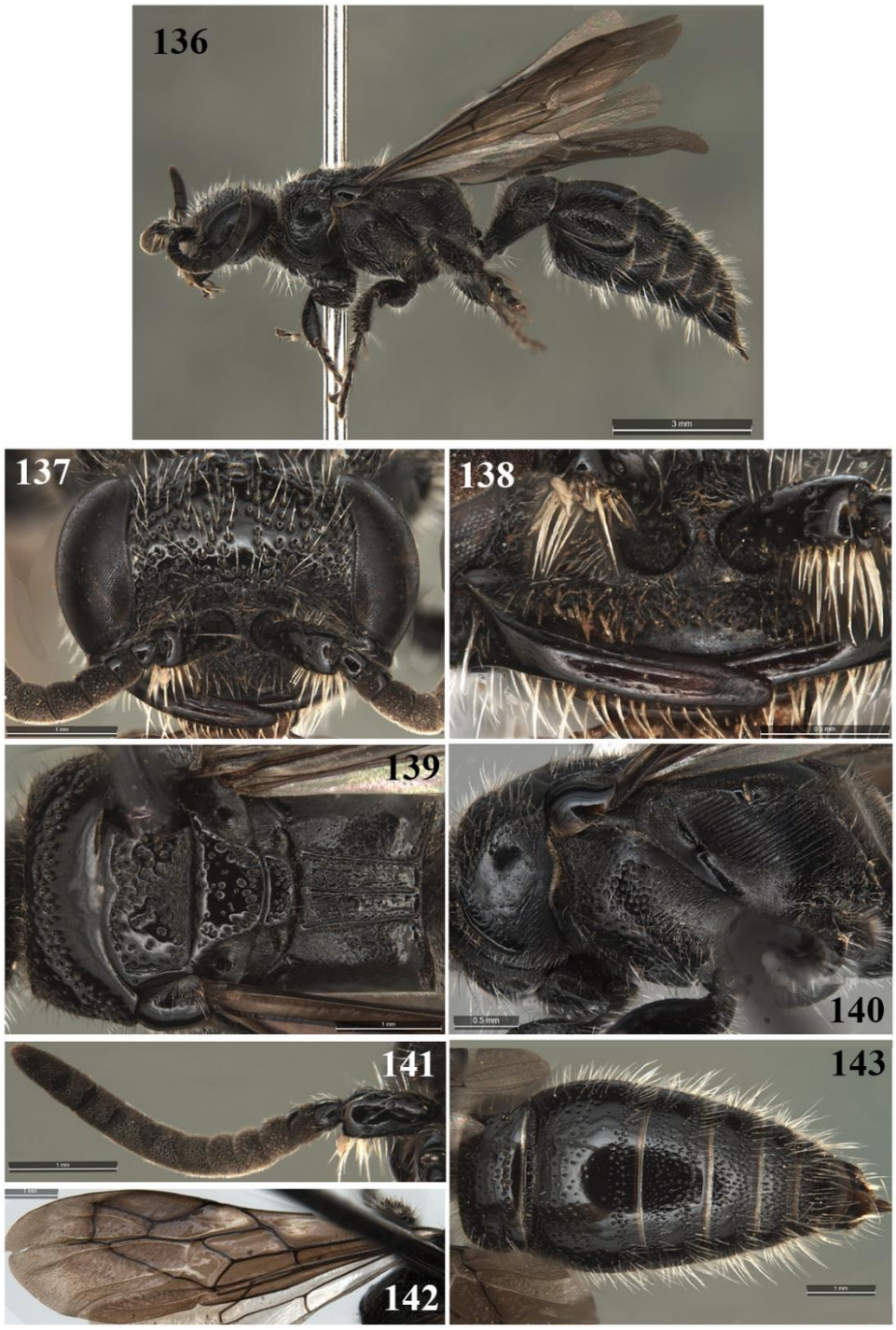
***Tiphia* (*Tiphia*) *birganjae* Allen.**
Figures. 121-128. Male, 121. Habitus, lateral view; 122. Head, frontal view; 123. Clypeus dorsal view; 124. Mesosoma dorsal view; 125. Mesosoma lateral view; 126. Antennae; 127. Fore wing; 128. Metasoma lateral view.

PLATE 22



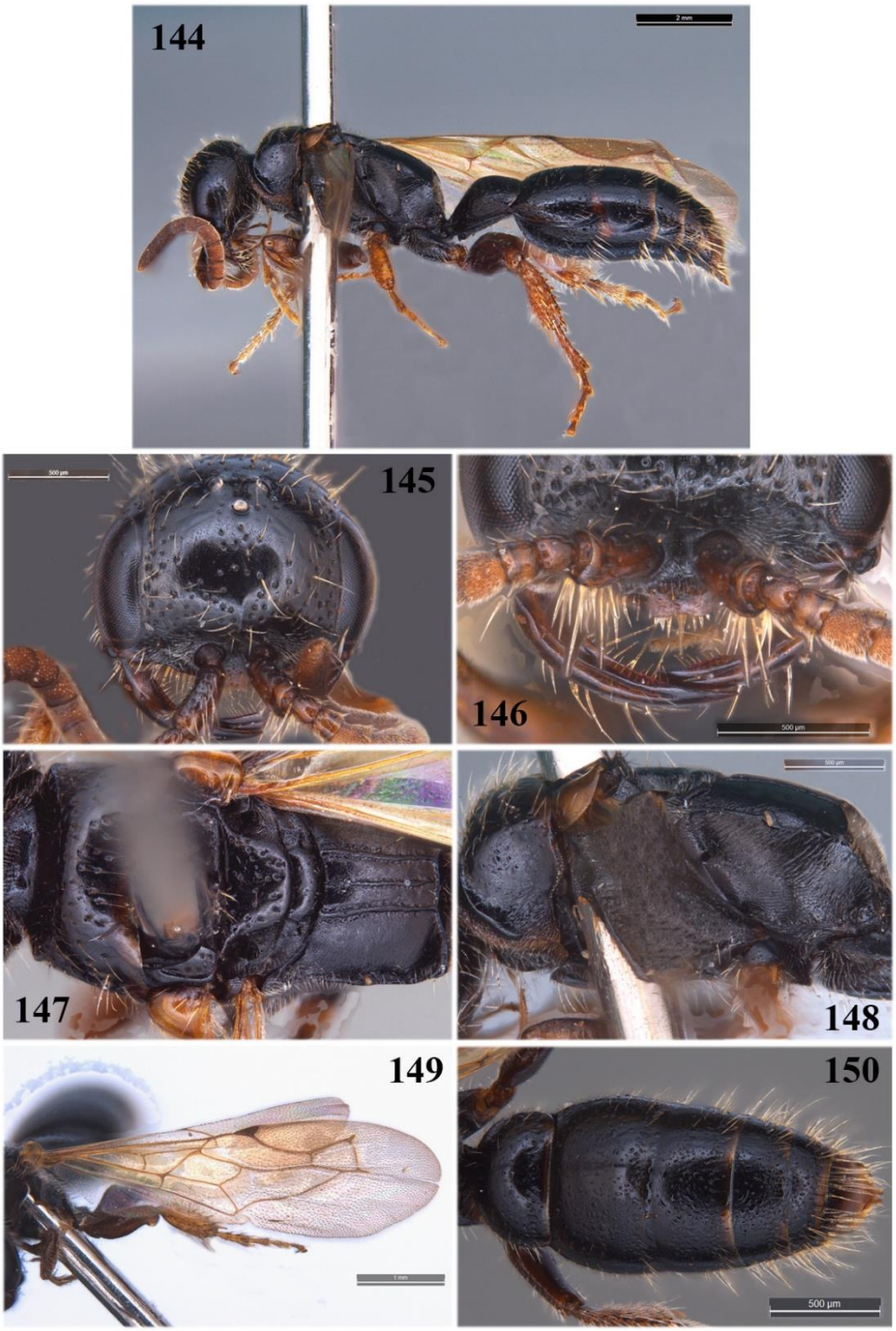
***Tiphia* (*Tiphia*) *bouceki* Krombein.**
Figures. 129-135. Male, 129. Habitus, lateral view; 130. Head, frontal view; 131. Clypeus dorsal view; 132. Mesosoma dorsal view; 133. Mesosoma lateral view; 134. Fore wing; 135. Metasoma dorsal view.

PLATE 23



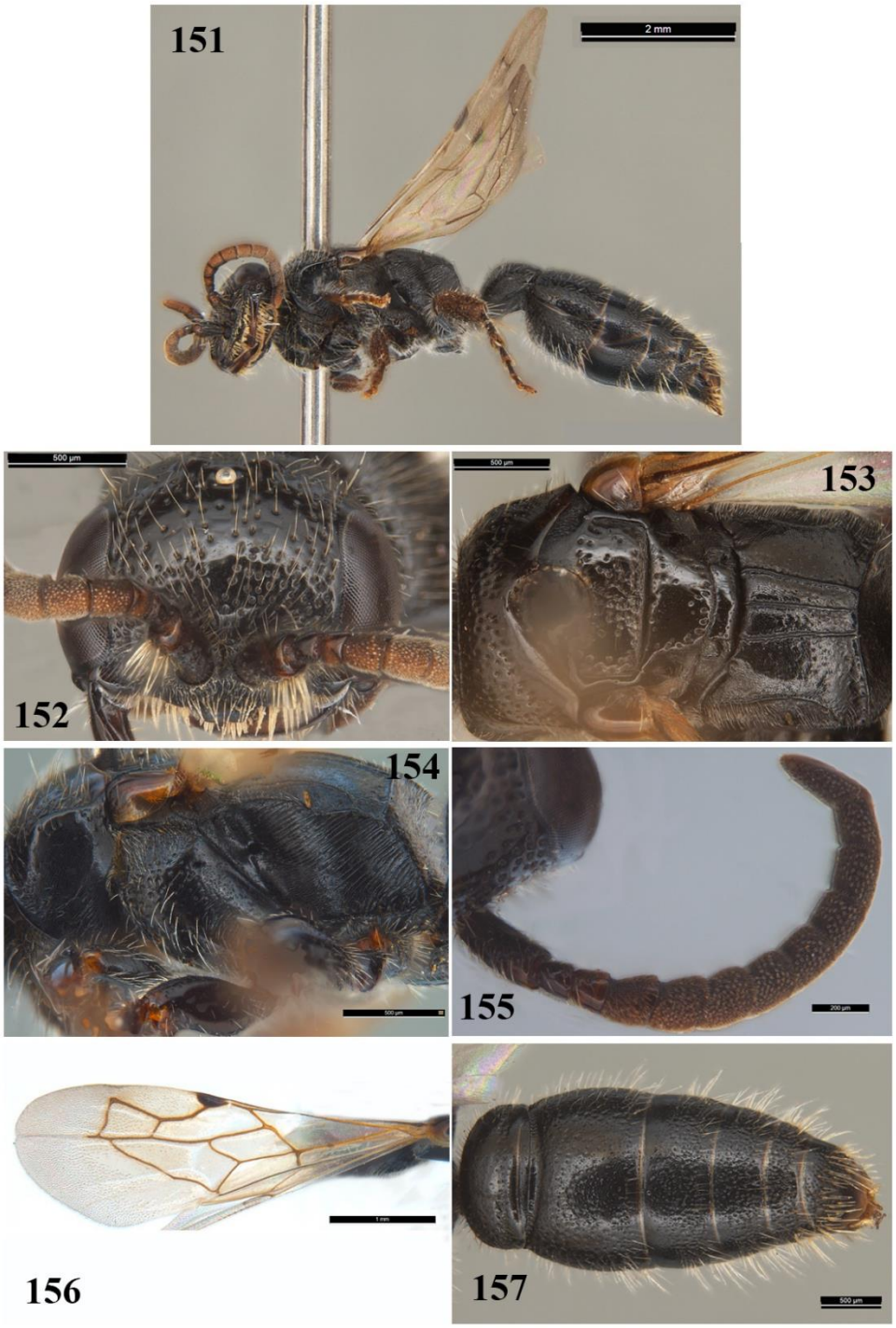
***Tiphia* (*Tiphia*) *brevistigma* Allen & Jaynes.**
Figures. 136-143. Female, 136. Habitus, lateral view; 137. Head, frontal view; 138. Clypeus dorsal view; 139. Mesosoma dorsal view; 140. Mesosoma lateral view; 141. Antennae; 142. Fore wing; 143. Metasoma dorsal view.

PLATE 24



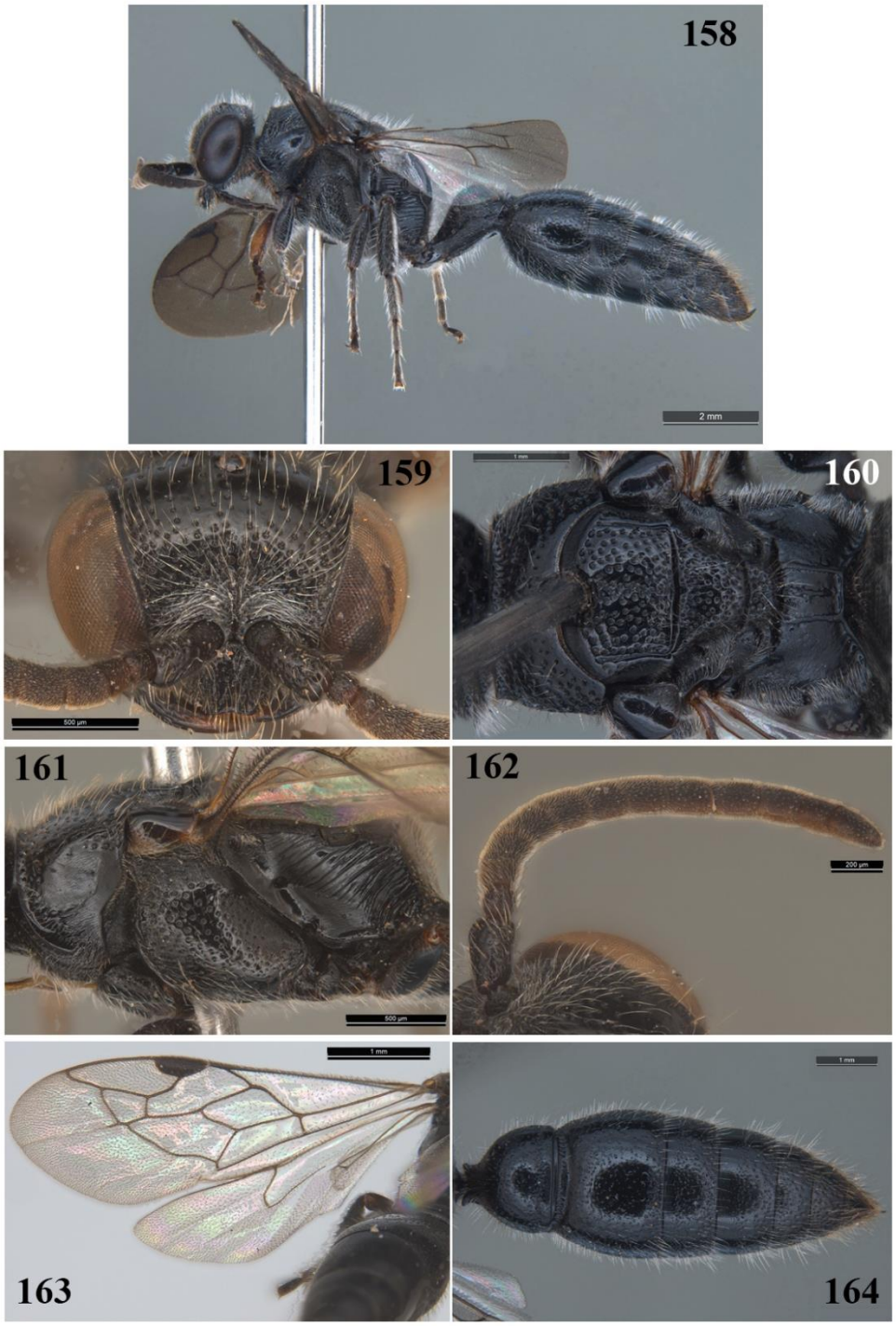
***Tiphia* (*Tiphia*) *capillata* Allen & Jaynes.**
Figures. 144-150. Female, 144. Habitus, lateral view; 145. Head, frontal view; 146. Clypeus dorsal view; 147. Mesosoma dorsal view; 148. Mesosoma lateral view; 149. Fore wing; 150. Metasoma dorsal view.

PLATE 25



***Tiphia* (*Tiphia*) *cinchonae* Allen.**
Figures. 151-157. Female, 151. Habitus, lateral view; 152. Head, frontal view; 153. Mesosoma dorsal view; 154. Mesosoma lateral view; 155. Antennae; 156. Fore wing; 157. Metasoma dorsal view.

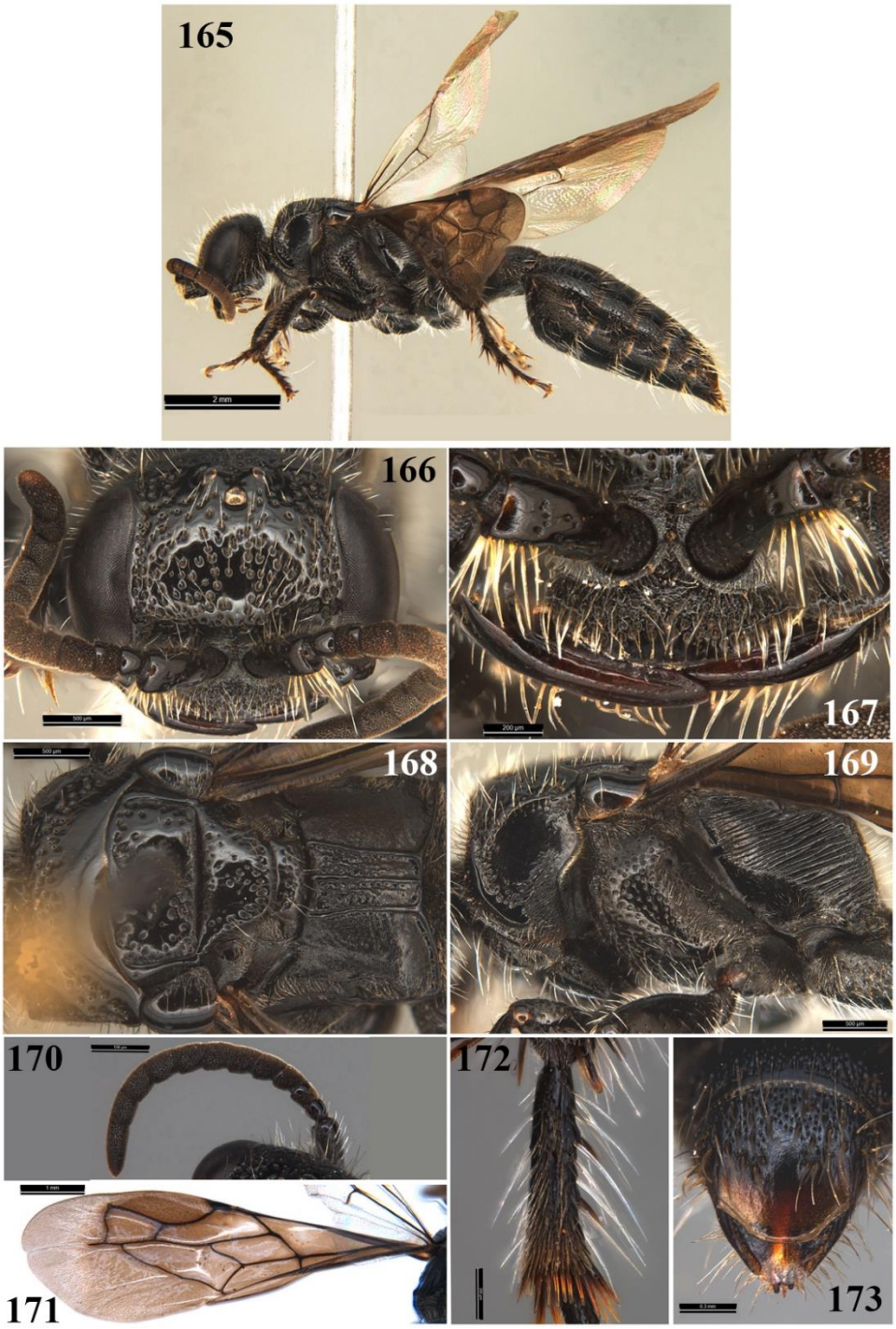
PLATE 26



***Tiphia* (*Tiphia*) *cinchonae* Allen.**

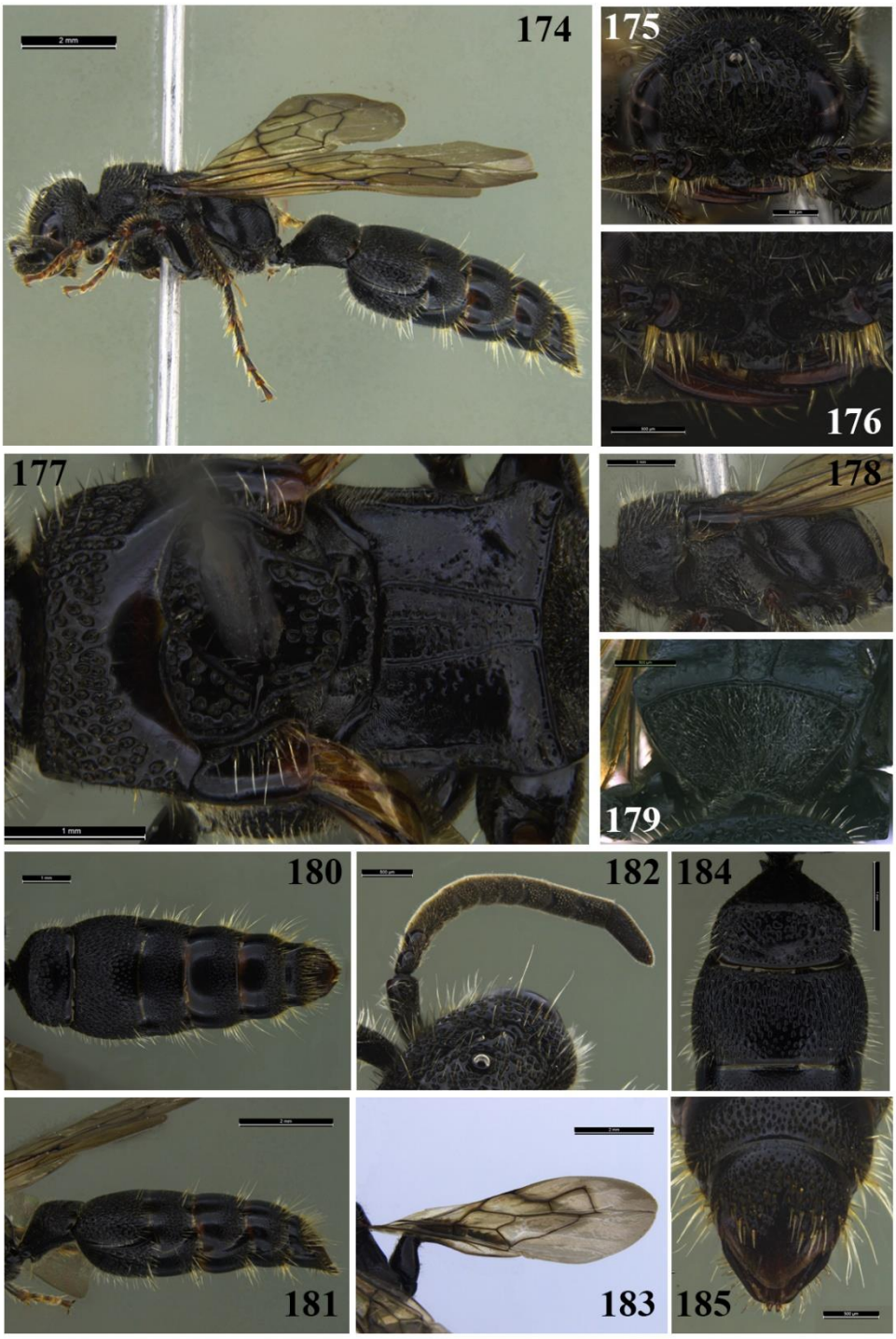
Figures. 158-164. Male, 158. Habitus, lateral view; 159. Head, frontal view; 160. Mesosoma dorsal view; 161. Mesosoma lateral view; 162. Antennae; 163. Fore wing; 164. Metasoma dorsal view.

PLATE 27



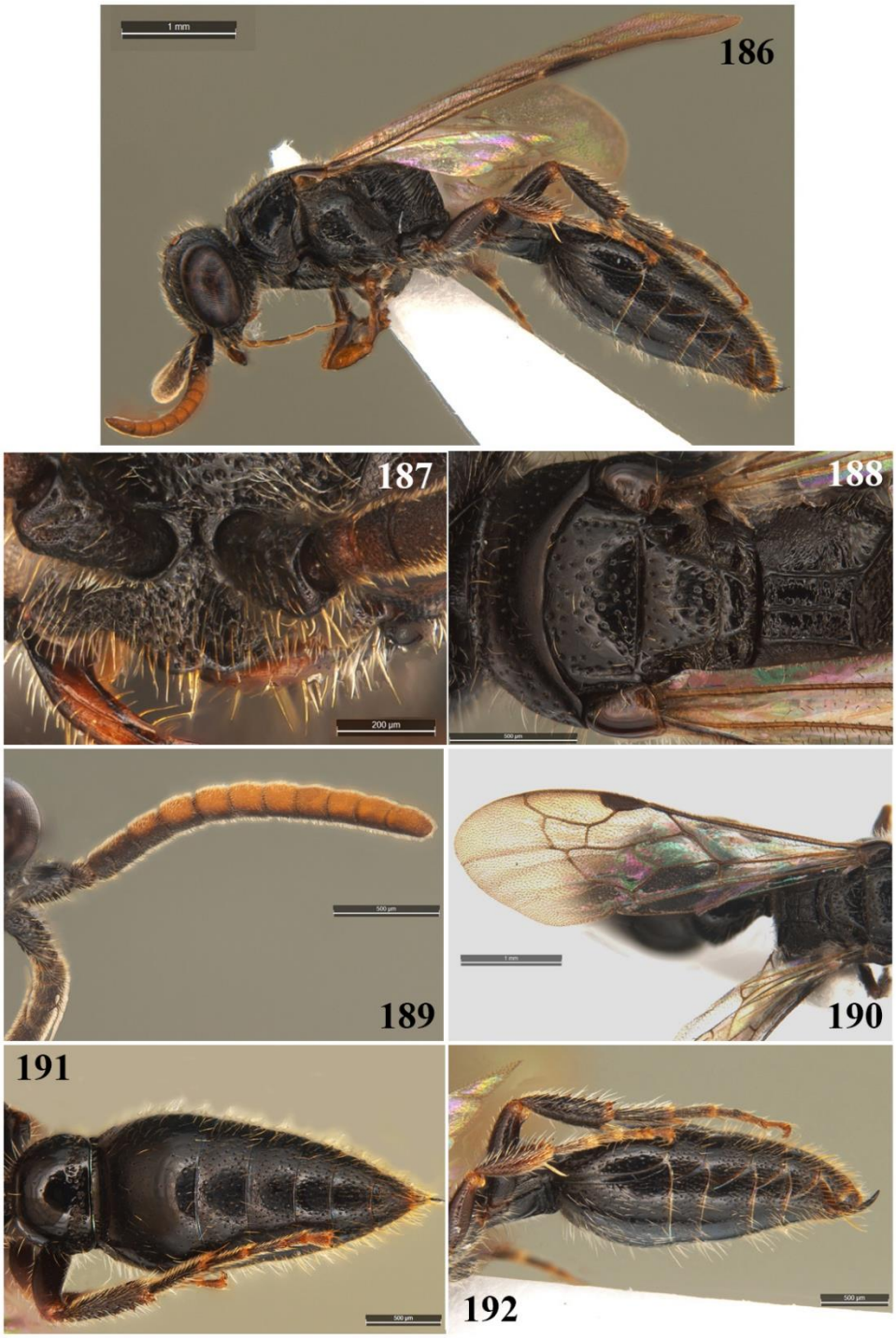
***Tiphia* (*Tiphia*) *clauseni* Allen & Jaynes.**
Figures. 165-173. Female, 165. Habitus, lateral view; 166. Head, frontal view; 167. Clypeus dorsal view; 168. Mesosoma dorsal view; 169. Mesosoma lateral view; 170. Antennae; 171. Fore wing; 172. Hind basitarsal groove; 173. Pygidium.

PLATE 28



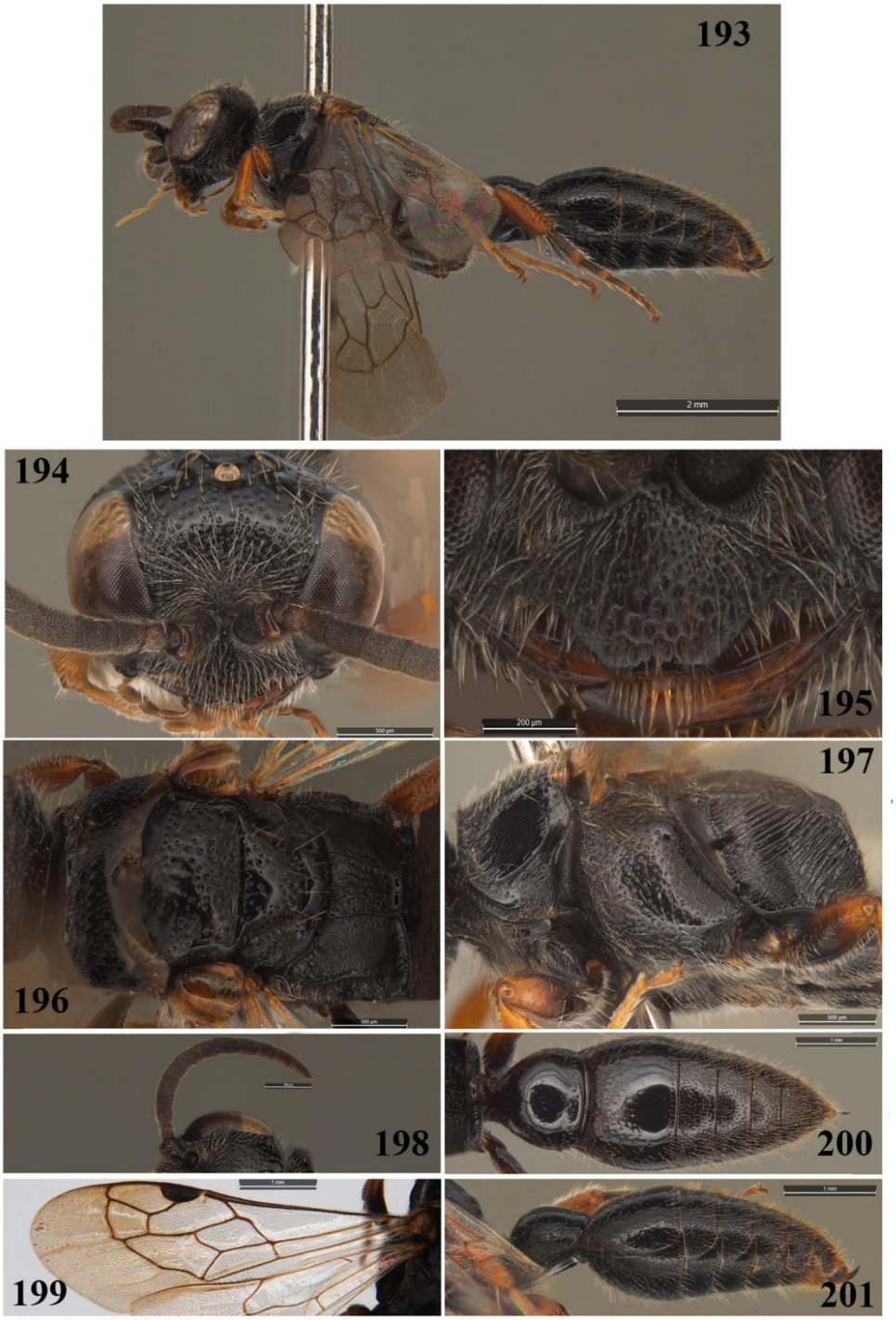
***Tiphia* (*Tiphia*) *crassumpunctura* Hanima & Girish Kumar, sp. nov.**
Figures. 174-185. Female, 174. Habitus, lateral view; 175. Head, frontal view; 176. Clypeus dorsal view; 177. Mesosoma dorsal view; 178. Mesosoma lateral view; 179. Propodeum posterior view; 180. Metasoma dorsal view; 181. Metasoma lateral view; 182. Antennae; 183. Fore wing; 184. Gt1, Gt2, dorsal view; 185. Pygidium.

PLATE 29



***Tiphia* (*Tiphia*) *davidrajui* Hanima & Girish Kumar.**
Figures. 186-192. Male, 186. Habitus, lateral view; 187. Clypeus, dorsal view; 188. Mesosoma dorsal view; 189. Antennae; 190. Fore wing; 191. Metasoma dorsal view; 192. Metasoma lateral view.

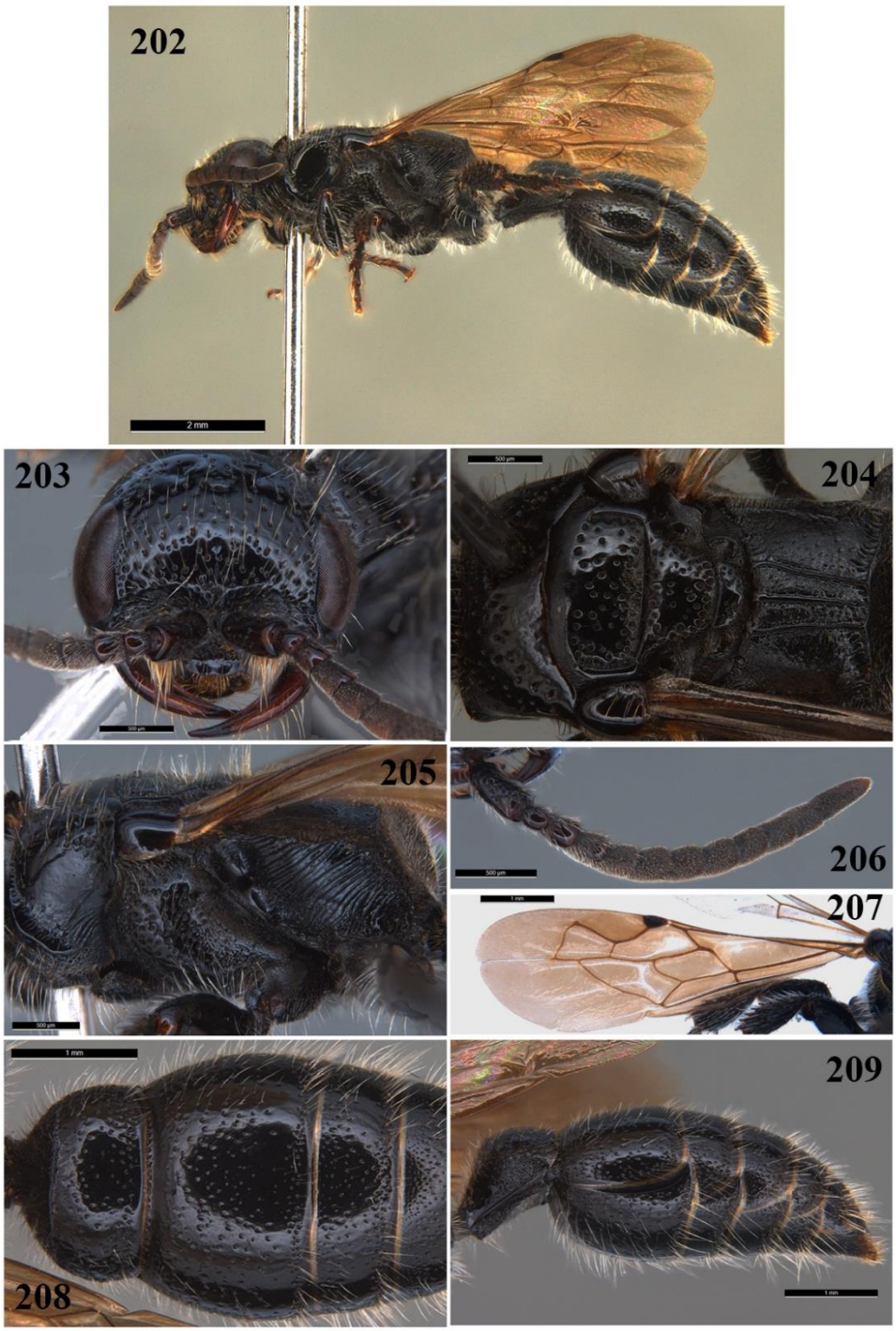
PLATE 30



***Tiphia* (*Tiphia*) *decrescens* Walker.**

Figures. 193-201. Male, 193. Habitus, lateral view; 194. Head, frontal view; 195. Clypeus dorsal view; 196. Mesosoma dorsal view; 197. Mesosoma lateral view; 198. Antennae; 199. Fore wing; 200. Metasoma dorsal view; 201. Metasoma lateral view.

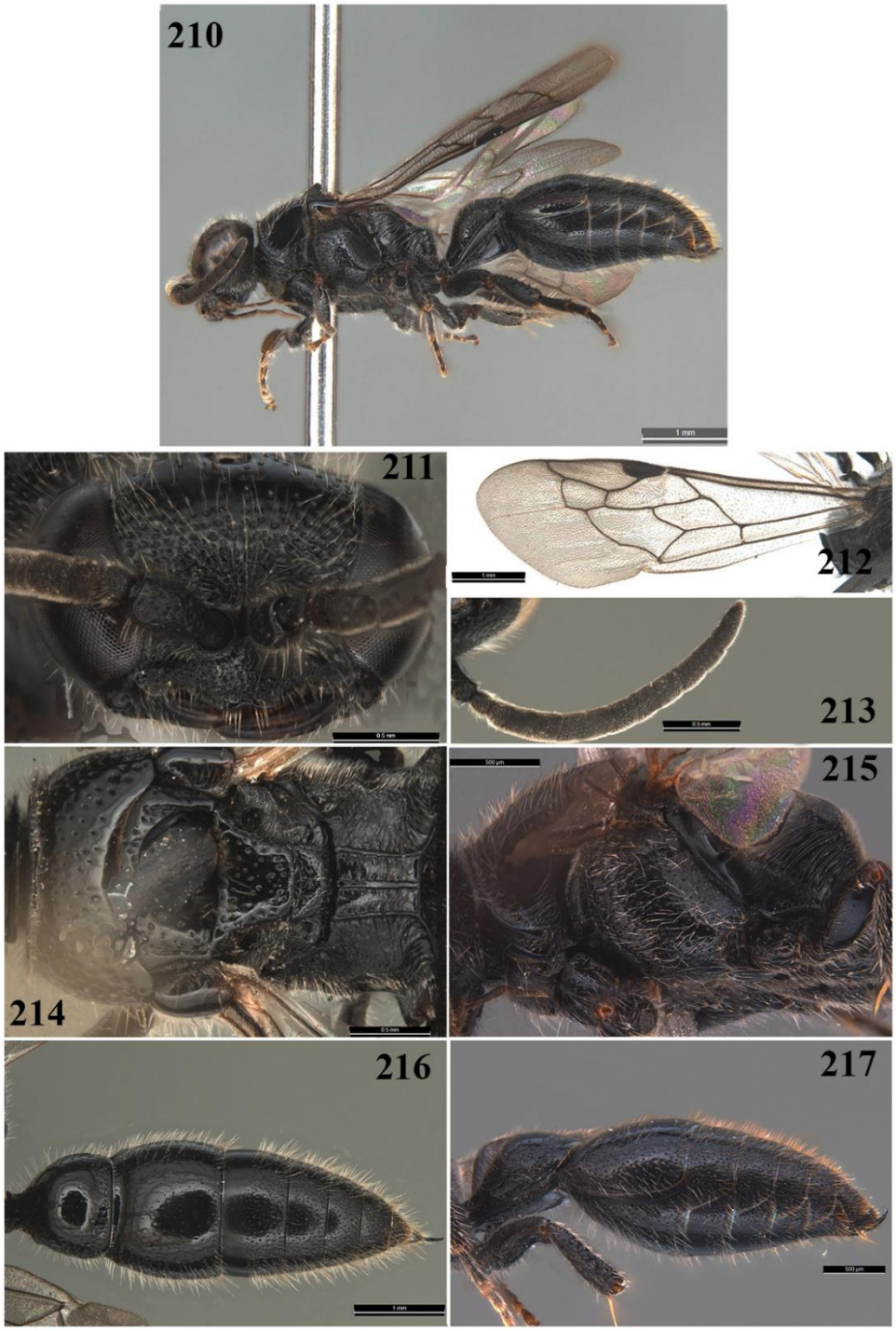
PLATE 31



***Tiphia* (*Tiphia*) *exacta* Nurse.**

Figures. 202-209. Female, 202. Habitus, lateral view; 203. Head, frontal view; 204. Mesosoma dorsal view; 205. Mesosoma lateral view; 206. Antennae; 207. Fore wing; 208. Metasoma (Gt1, Gt2, Gt3) dorsal view; 209. Metasoma lateral view.

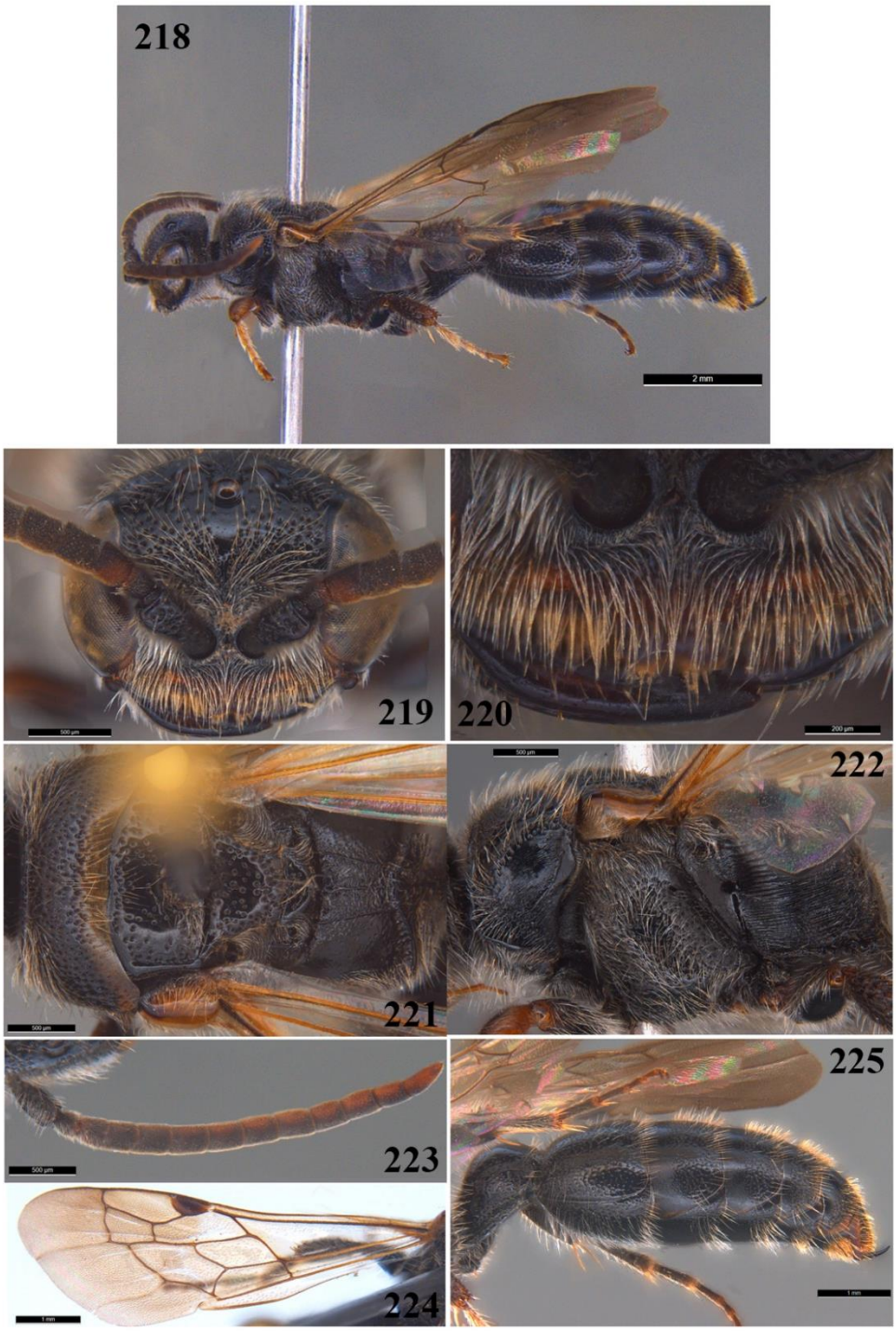
PLATE 32



***Tiphia* (*Tiphia*) *flavipalpis* Allen.**

Figures. 210-217. Male, 210. Habitus, lateral view; 211. Head, frontal view; 212. Fore wing; 213. Antennae; 214. Mesosoma dorsal view; 215. Mesosoma lateral view; 216. Metasoma dorsal view; 217. Metasoma lateral view.

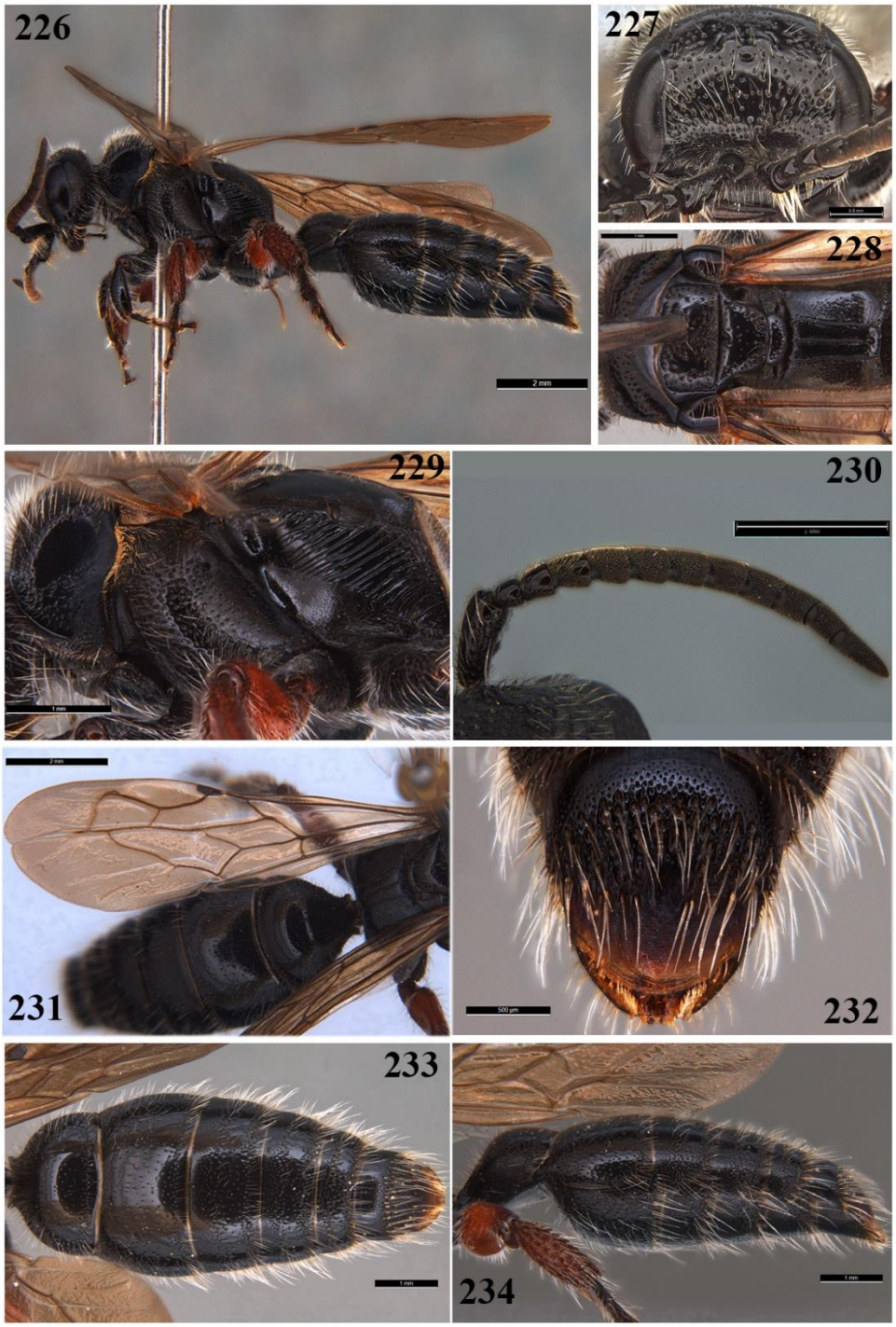
PLATE 33



***Tiphia* (*Tiphia*) *hirsuta* Smith.**

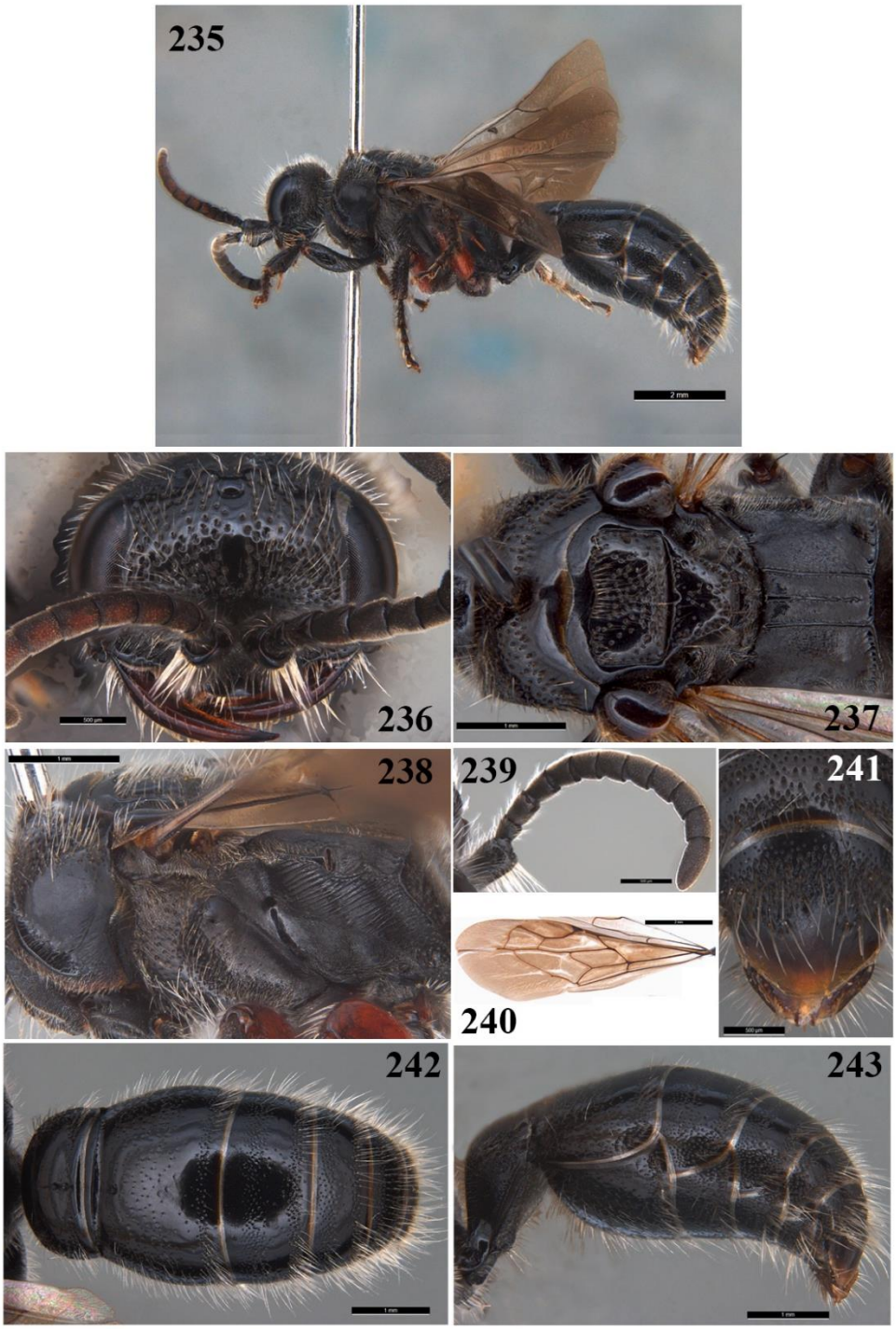
Figures. 218-225. Male, 218. Habitus, lateral view; 219. Head, frontal view; 220. Clypeus dorsal view; 221. Mesosoma dorsal view; 222. Mesosoma lateral view; 223. Antennae; 224. Fore wing; 225. Metasoma lateral view.

PLATE 34



***Tiphia* (*Tiphia*) *kashmirensis* Hanima & Girish Kumar.**
Figures. 226-234. Female, 226. Habitus, lateral view; 227. Head, frontal view; 228. Mesosoma dorsal view; 229. Mesosoma lateral view; 230. Antennae; 231. Fore wing; 232. Pygidium; 233. Metasoma dorsal view; 234. Metasoma lateral view.

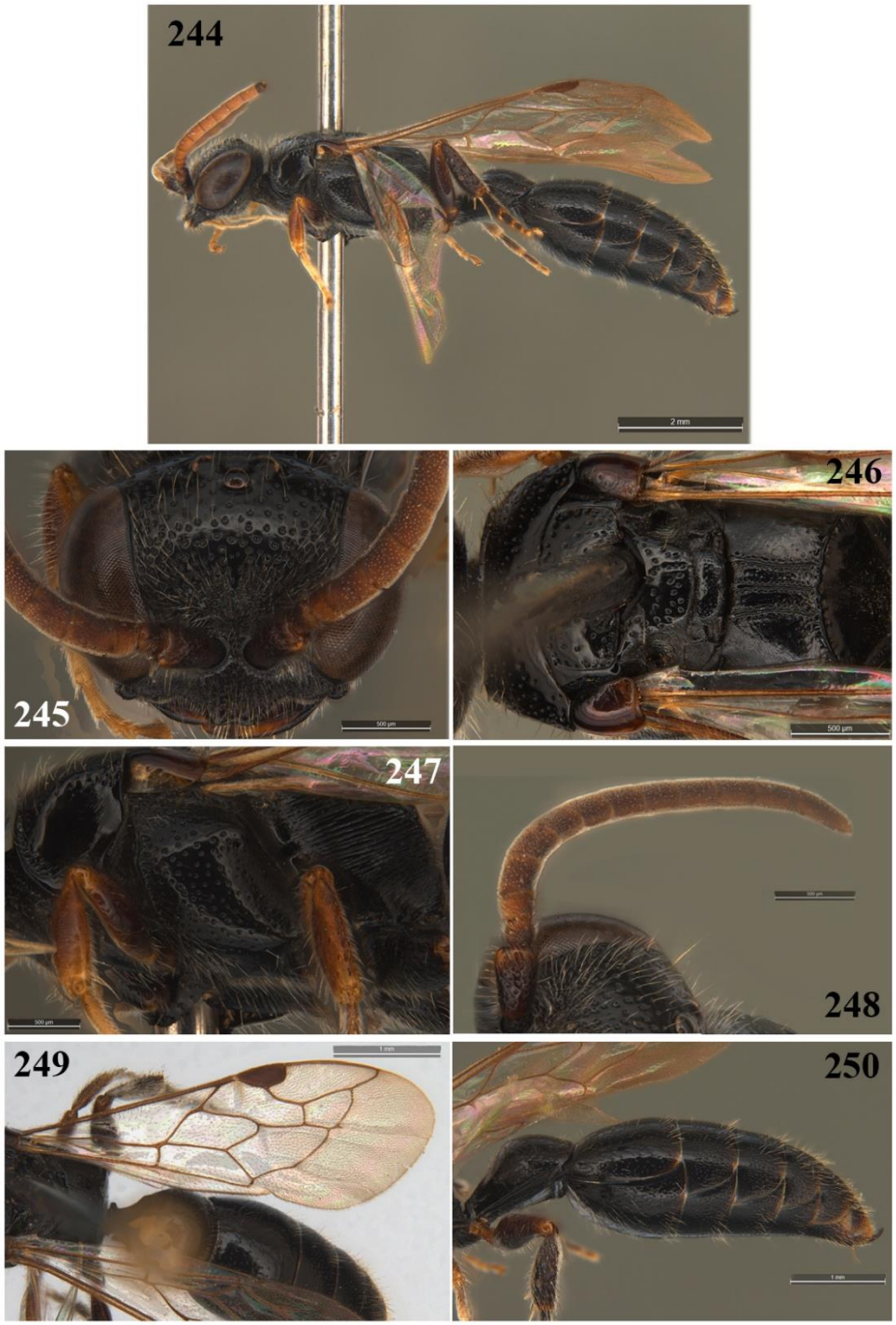
PLATE 35



***Tiphia* (*Tiphia*) *khasiana* Cameron.**

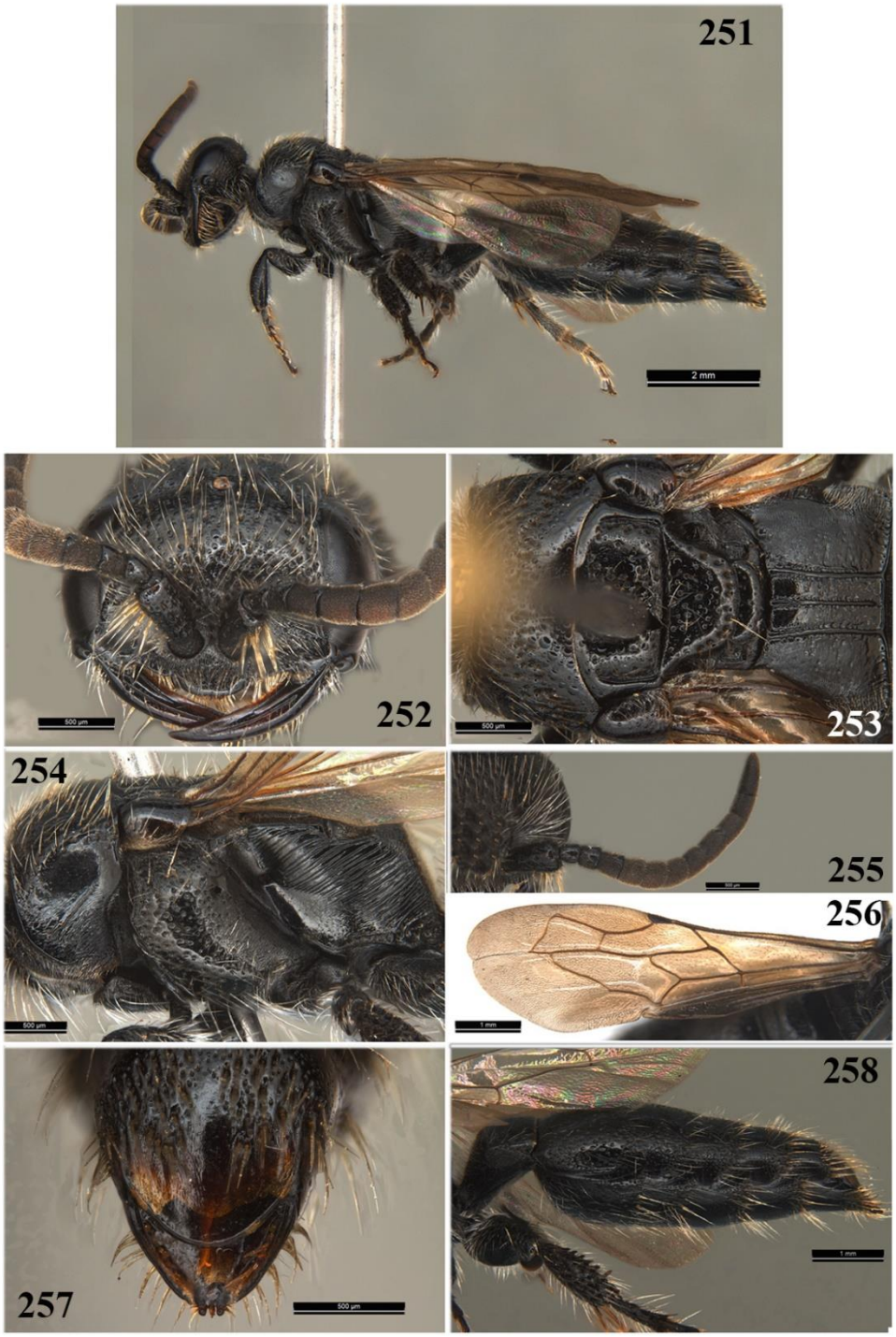
Figures. 235-243. Female, 235. Habitus, lateral view; 236. Head, frontal view; 237. Mesosoma dorsal view; 238. Mesosoma lateral view; 239. Antennae; 240. Fore wing; 241. Pygidium; 242. Metasoma dorsal view; 243. Metasoma lateral view.

PLATE 36



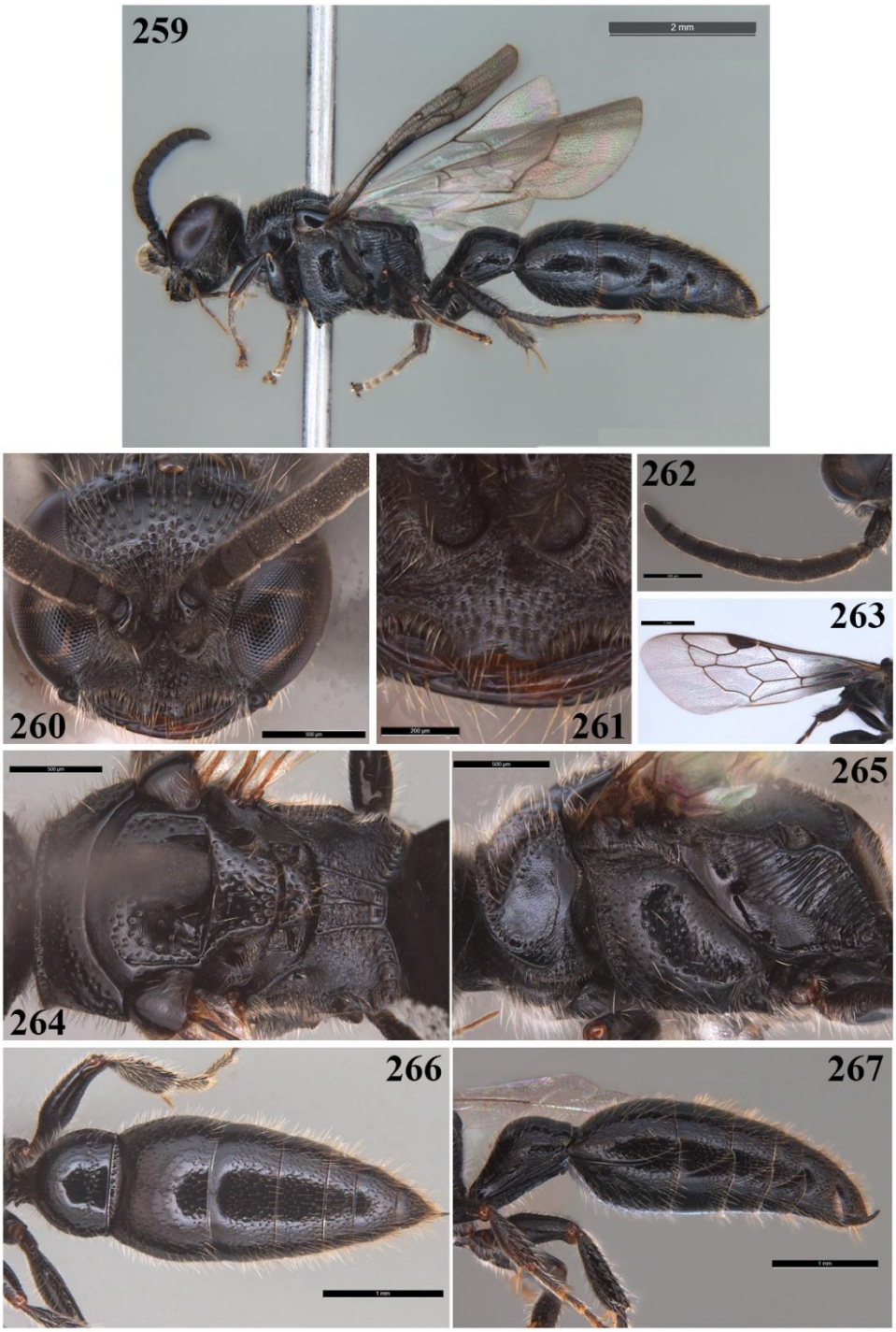
***Tiphia* (*Tiphia*) *kurumba* Hanima & Girish Kumar.**
Figures. 244-250. Male, 244. Habitus, lateral view; 245. Head, frontal view; 246. Mesosoma dorsal view; 247. Mesosoma lateral view; 248. Antennae; 249. Fore wing; 250. Metasoma lateral view.

PLATE 37



***Tiphia* (*Tiphia*) *lawrencei* Allen.**
Figures. 251-258. Female, 251. Habitus, lateral view; 252. Head, frontal view; 253. Mesosoma dorsal view; 254. Mesosoma lateral view; 255. Antennae; 256. Fore wing; 257. Pygidium; 258. Metasoma lateral view.

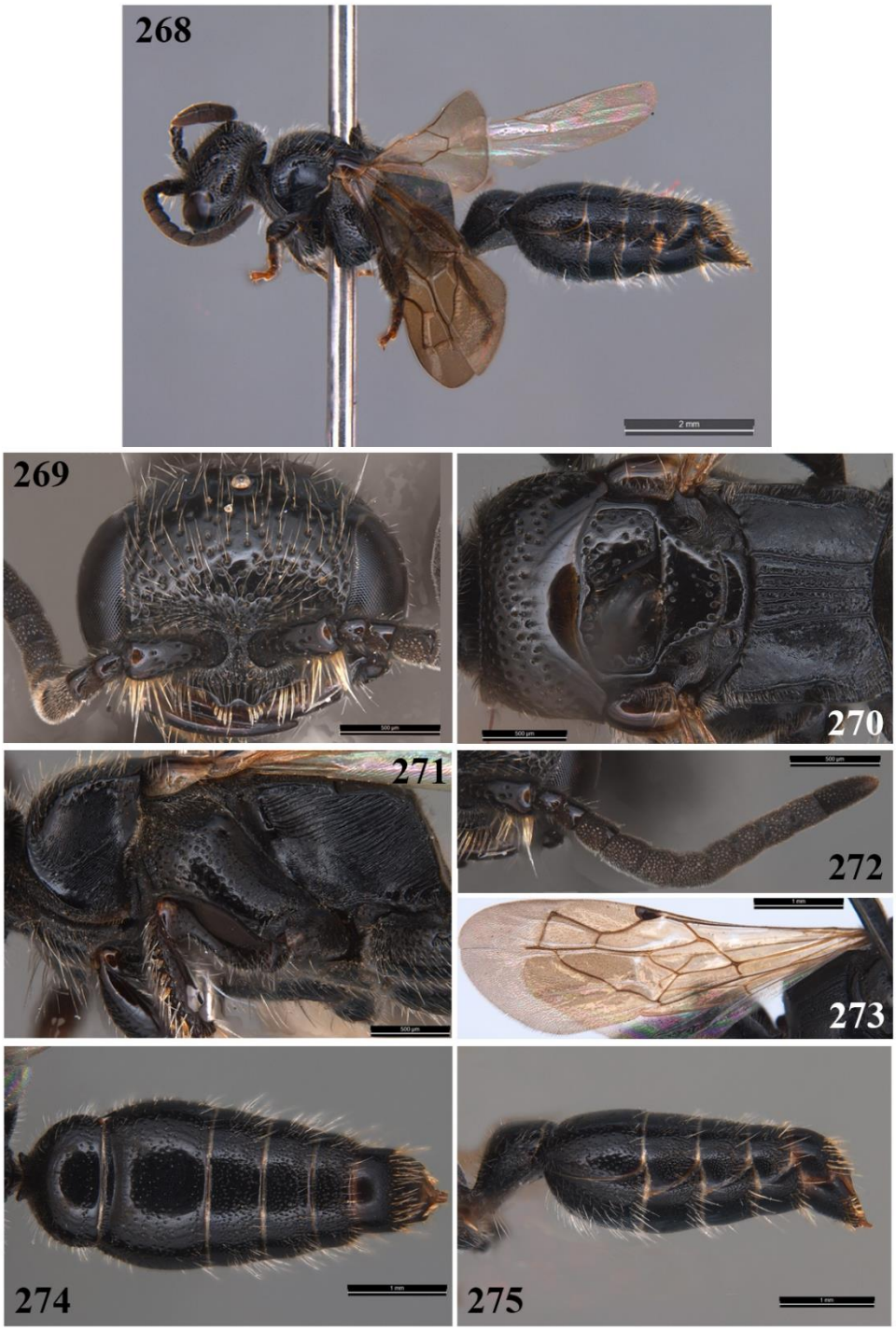
PLATE 38



***Tiphia* (*Tiphia*) *lotharae* Allen.**

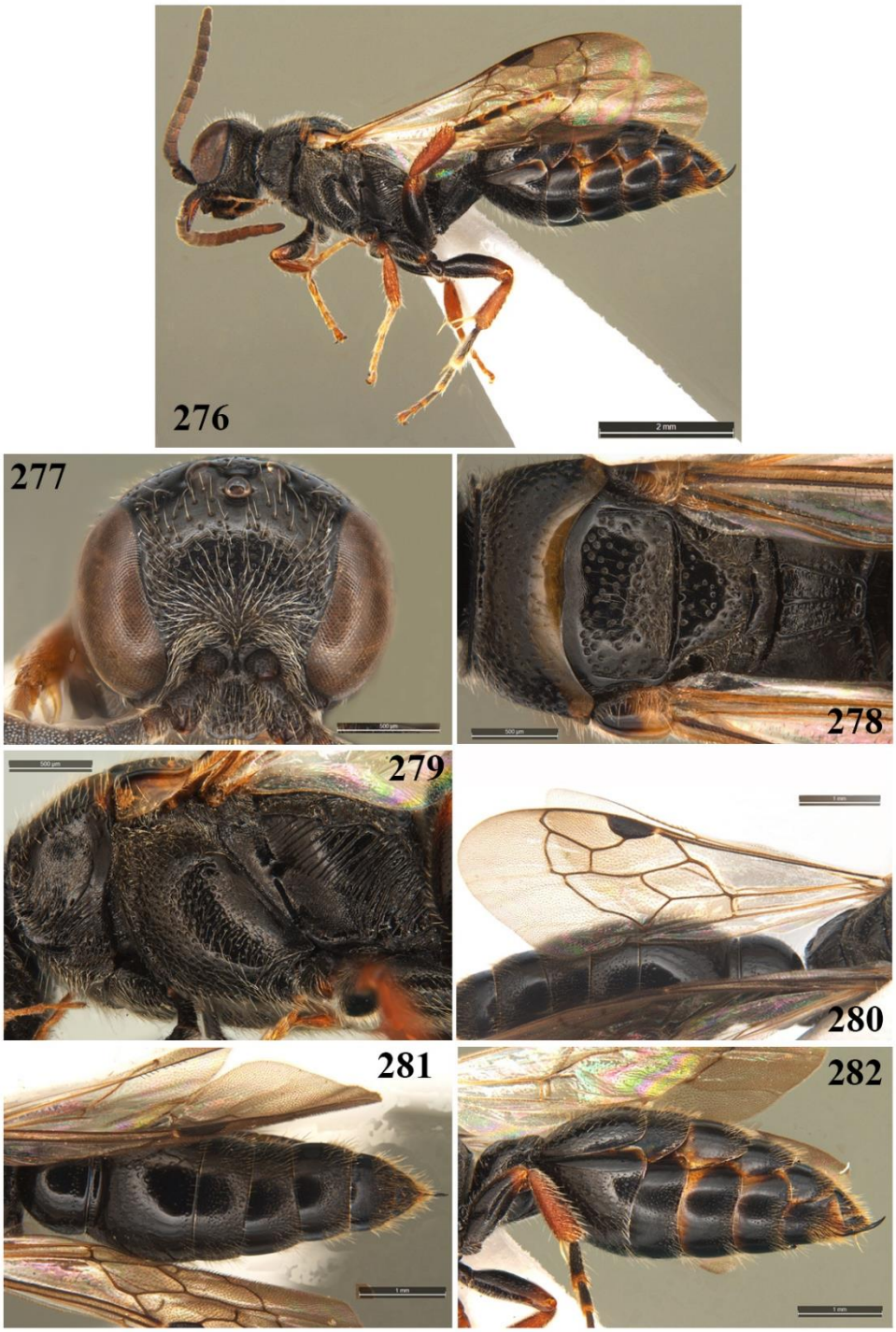
Figures. 259-267. Male, 259. Habitus, lateral view; 260. Head, frontal view; 261. Clypeus dorsal view; 262. Antennae; 263. Fore wing; 264. Mesosoma dorsal view; 265. Mesosoma lateral view; 266. Metasoma dorsal view; 267. Metasoma lateral view.

PLATE 39



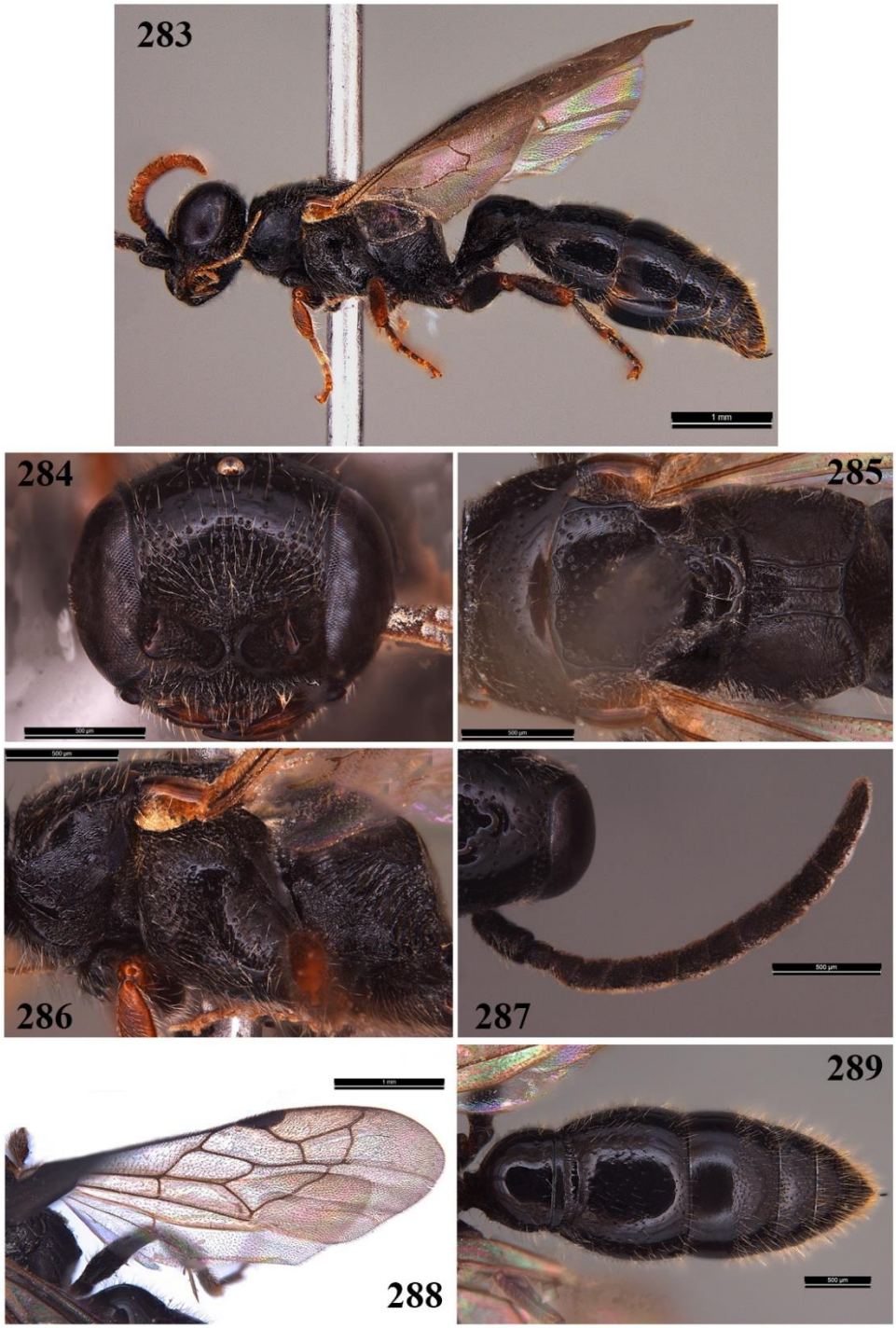
***Tiphia* (*Tiphia*) *lyrata* Magretti.**
Figures. 268-275. Female, 268. Habitus, lateral view; 269. Head, frontal view; 270. Mesosoma dorsal view; 271. Mesosoma lateral view; 272. Antennae; 273. Fore wing; 274. Metasoma dorsal view; 275. Metasoma lateral view.

PLATE 40



***Tiphia* (*Tiphia*) *lyrata* Magretti.**
Figures. 276-282. Male, 276. Habitus, lateral view; 277. Head, frontal view; 278. Mesosoma dorsal view; 279. Mesosoma lateral view; 280. Fore wing; 281. Metasoma dorsal view; 282. Metasoma lateral view.

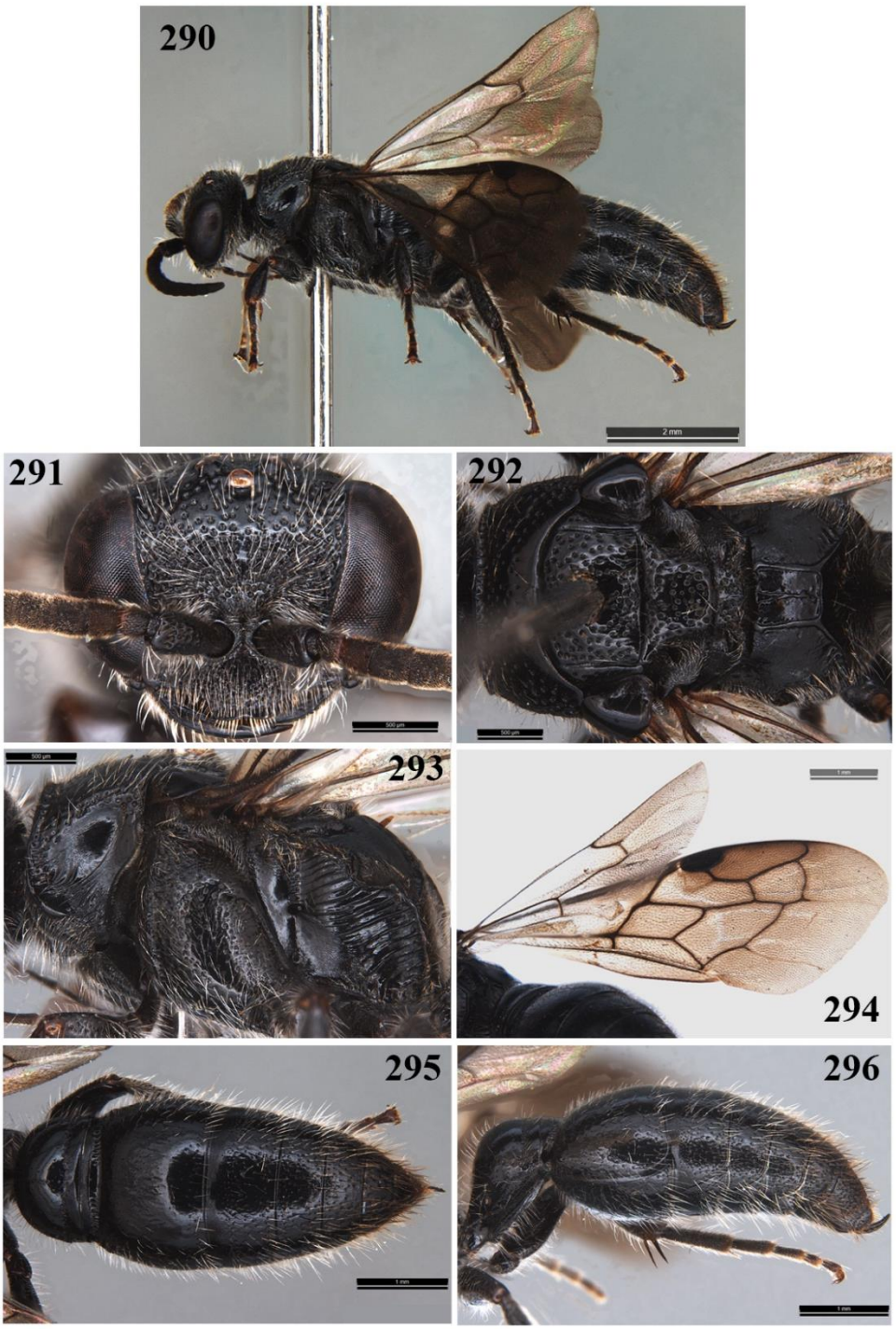
PLATE 41



***Tiphia* (*Tiphia*) *milleri* Allen.**

Figures. 283-289. Male, 283. Habitus, lateral view; 284. Head, frontal view; 285. Mesosoma dorsal view; 286. Mesosoma lateral view; 287. Antenna; 288. Fore wing; 289. Metasoma dorsal view.

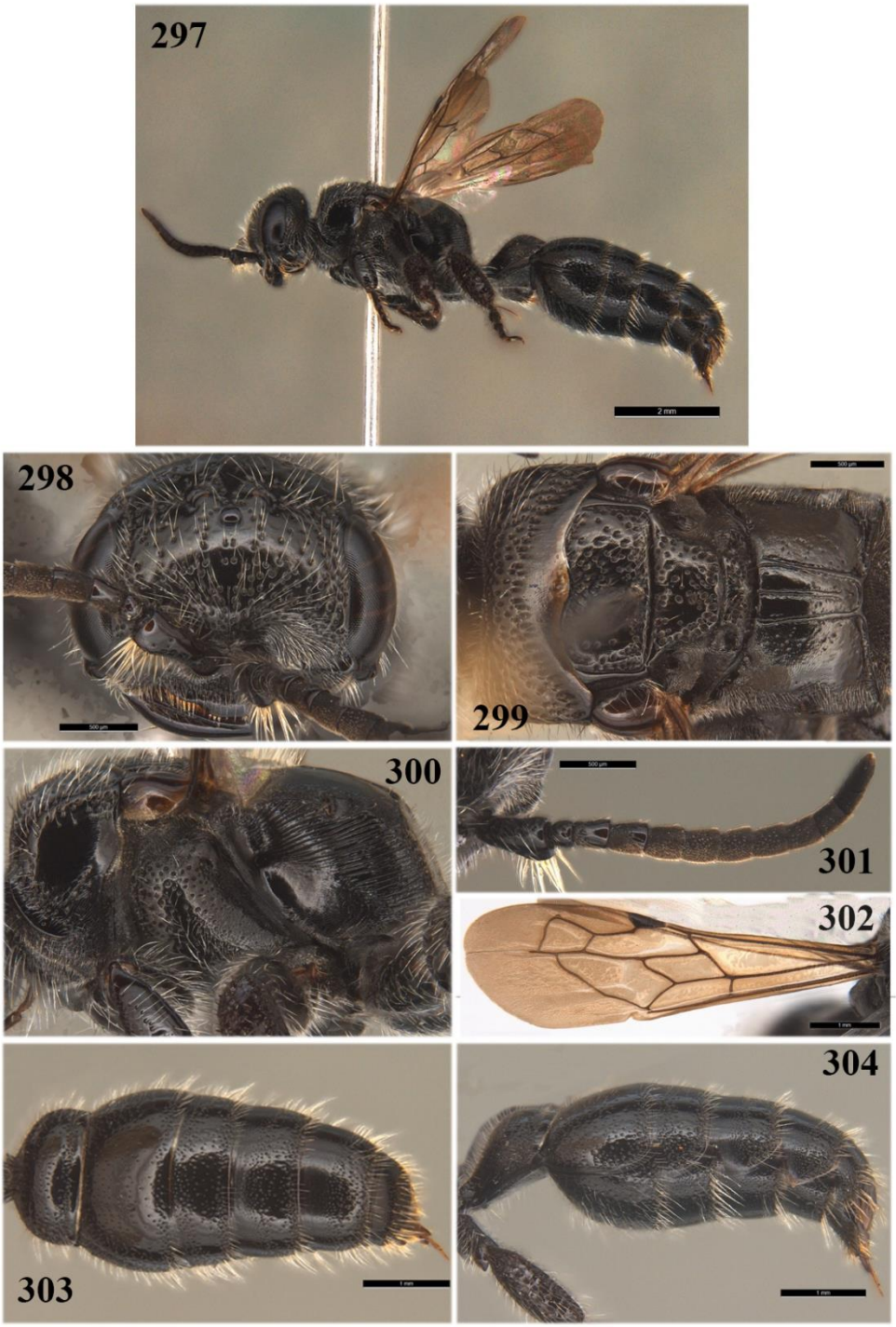
PLATE 42



***Tiphia* (*Tiphia*) *nathani* Allen.**

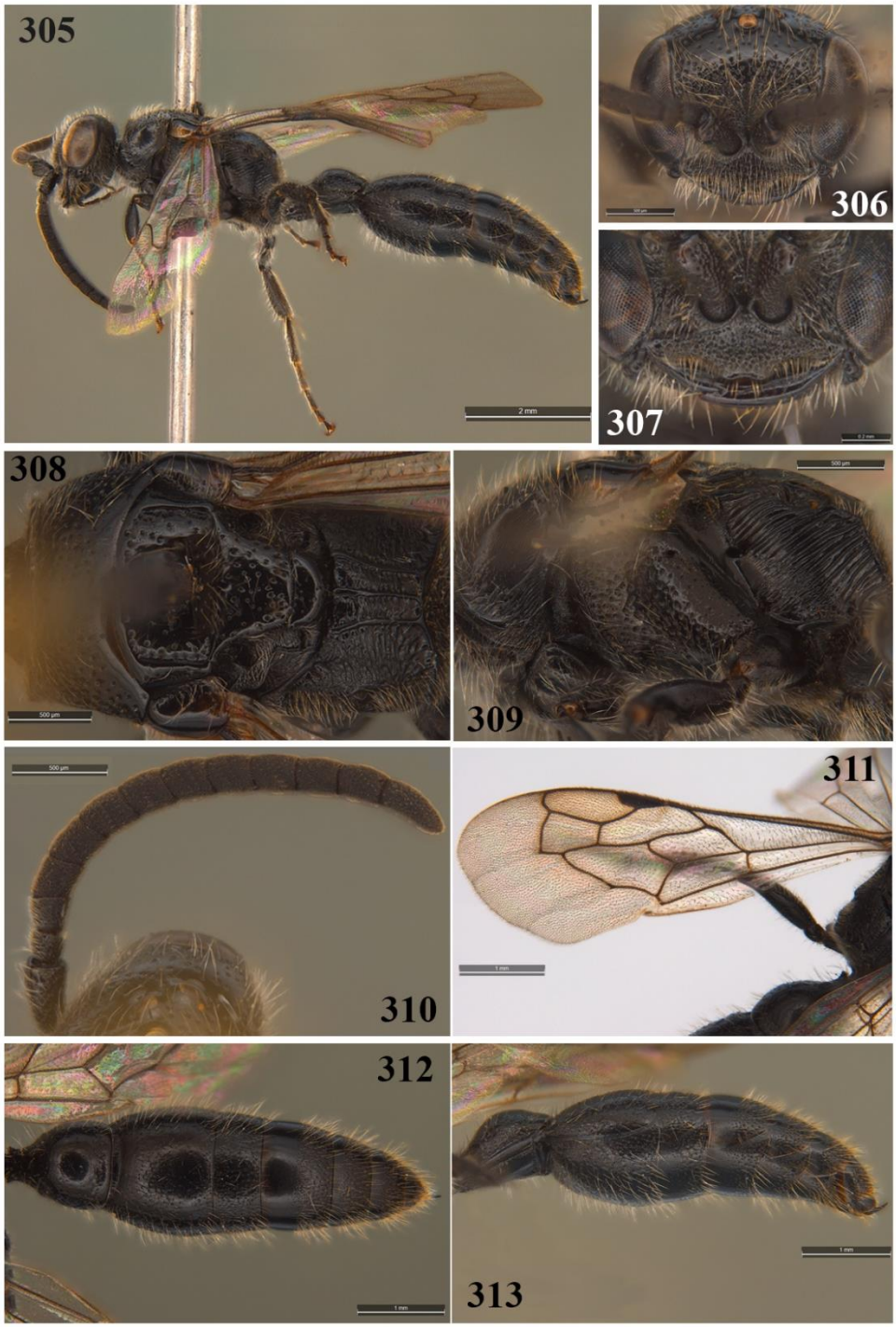
Figures. 290-296. Male, 290. Habitus, lateral view; 291. Head, frontal view; 292. Mesosoma dorsal view; 293. Mesosoma lateral view; 294. Fore wing; 295. Metasoma dorsal view; 296. Metasoma lateral view.

PLATE 43



***Tiphia* (*Tiphia*) *nilgirensis* Allen.**
Figures. 297-304. Female, 297. Habitus, lateral view; 298. Head frontal view; 299. Mesosoma dorsal view; 300. Mesosoma lateral view; 301. Antenna; 302. Forewing; 303. Metasoma dorsal view; 304. Metasoma lateral view.

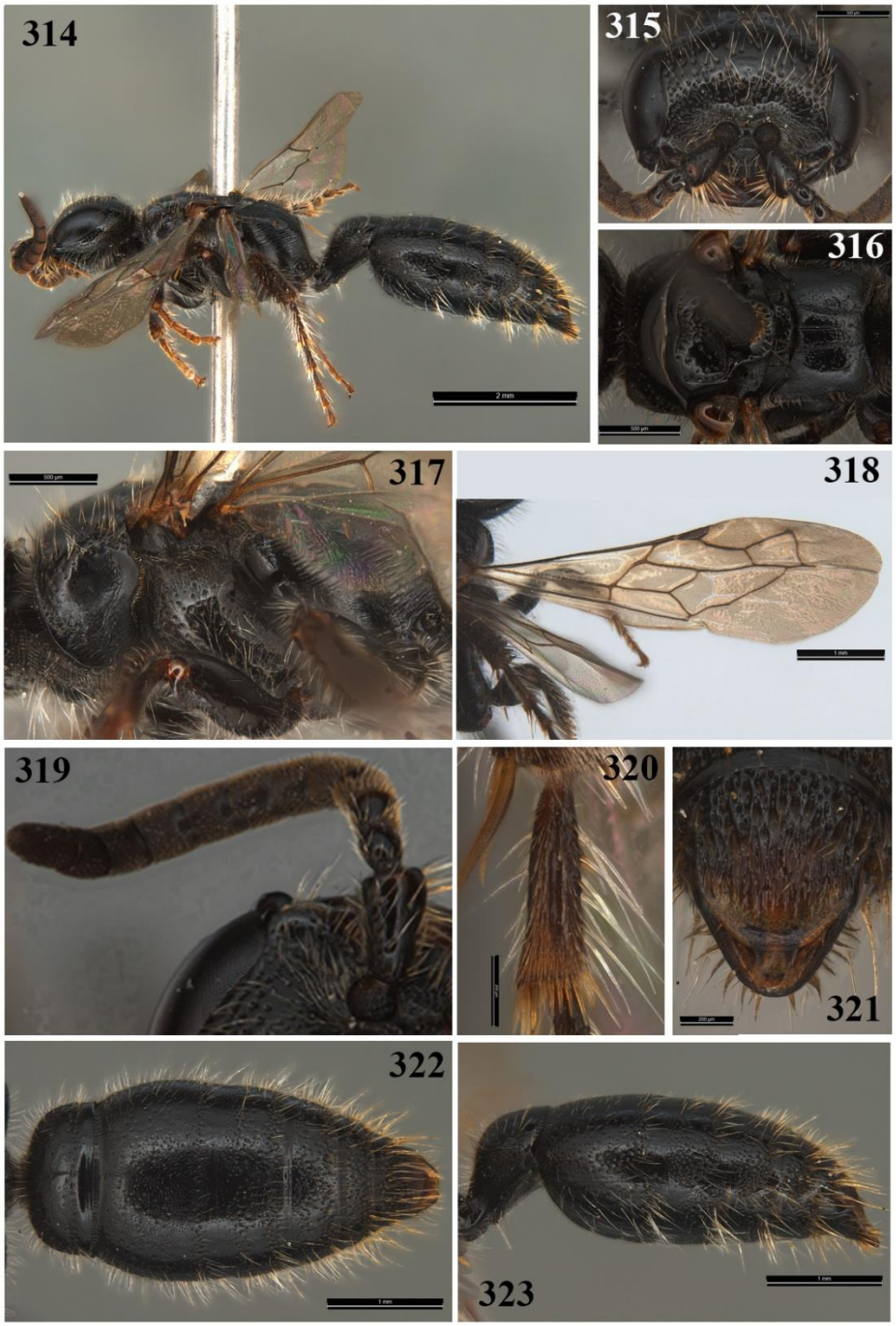
PLATE 44



***Tiphia* (*Tiphia*) *nilgiria* Allen.**

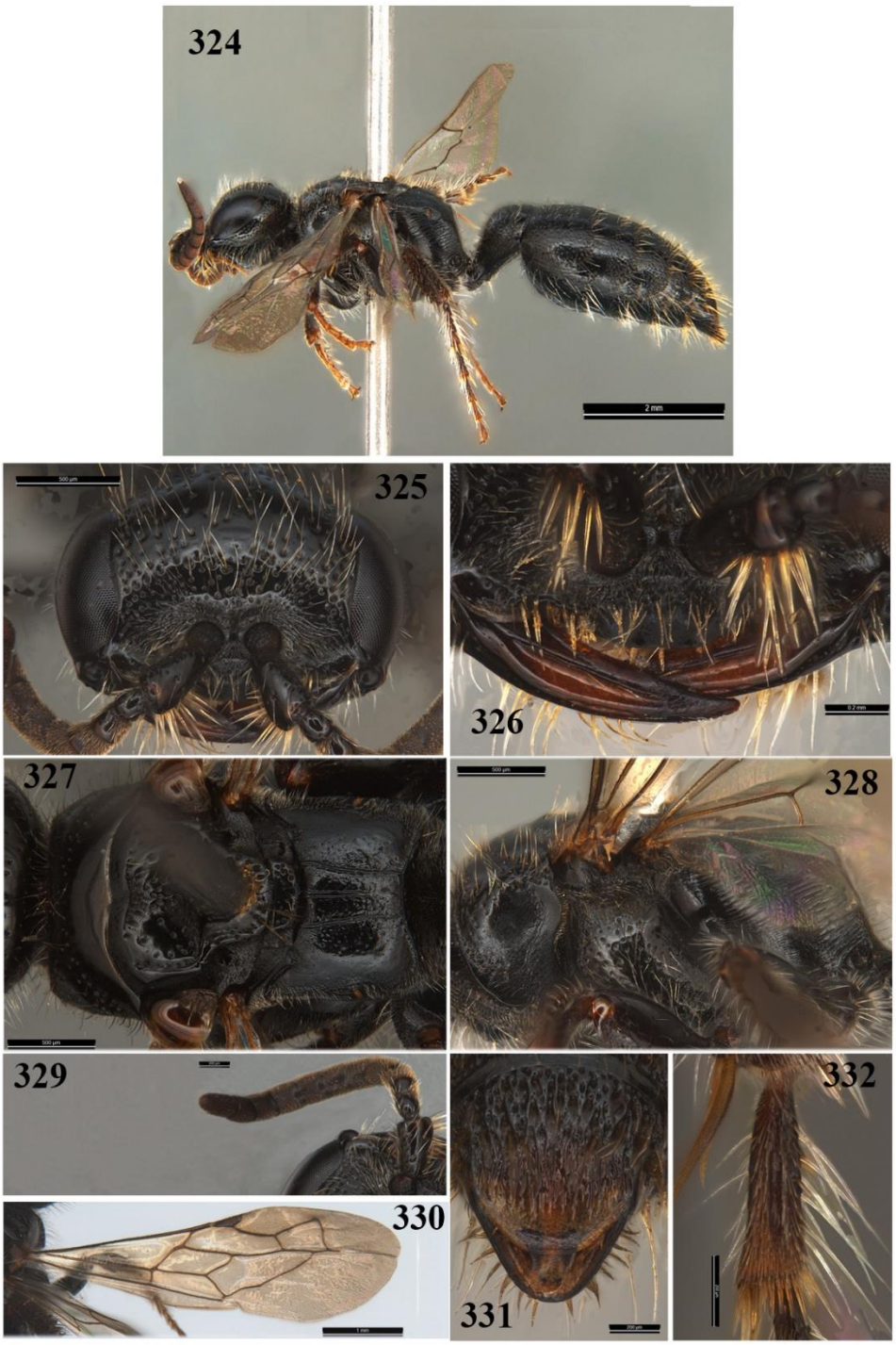
Figures. 305-313. Male, 305. Habitus, lateral view; 306. Head frontal view; 307. Clypeus, dorsal view; 308. mesosoMa dorsal view; 309. mesosoma lateral view; 310. Antenna; 311. Forewing; 312. Metasoma dorsal view; 313. Metasoma lateral view.

PLATE 45



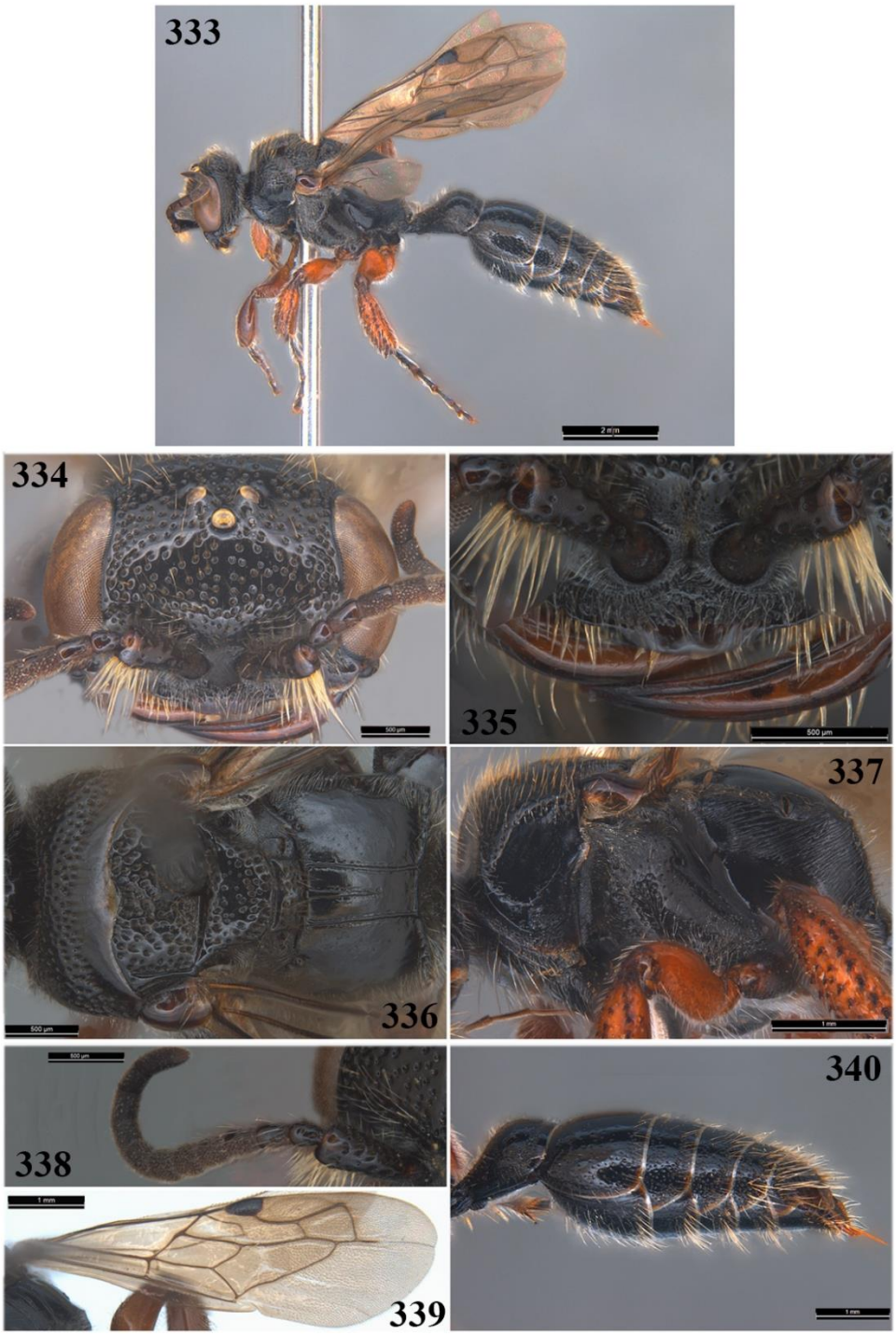
***Tiphia* (*Tiphia*) *novus* Hanima & Girish Kumar.**
Figures. 314-323. Female, 314. Habitus, lateral view; 315. Head frontal view; 316. Mesosoma dorsal view; 317. Mesosoma lateral view; 318. Forewing; 319. Antenna; 320. Hind basitarsal groove; 321. Pygidium; 322. Metasoma dorsal view; 323. Metasoma lateral view.

PLATE 46



***Tiphia* (*Tiphia*) *ordinaria* Smith.**
Figures. 324-332. Female, 324. Habitus, lateral view; 325. Head frontal view; 326. Clypeus, dorsal view; 327. mesosoma dorsal view; 328. mesosoma lateral view; 329. Antenna; 330. Forewing; 331. Pygidium; 332. Basitarsal groove.

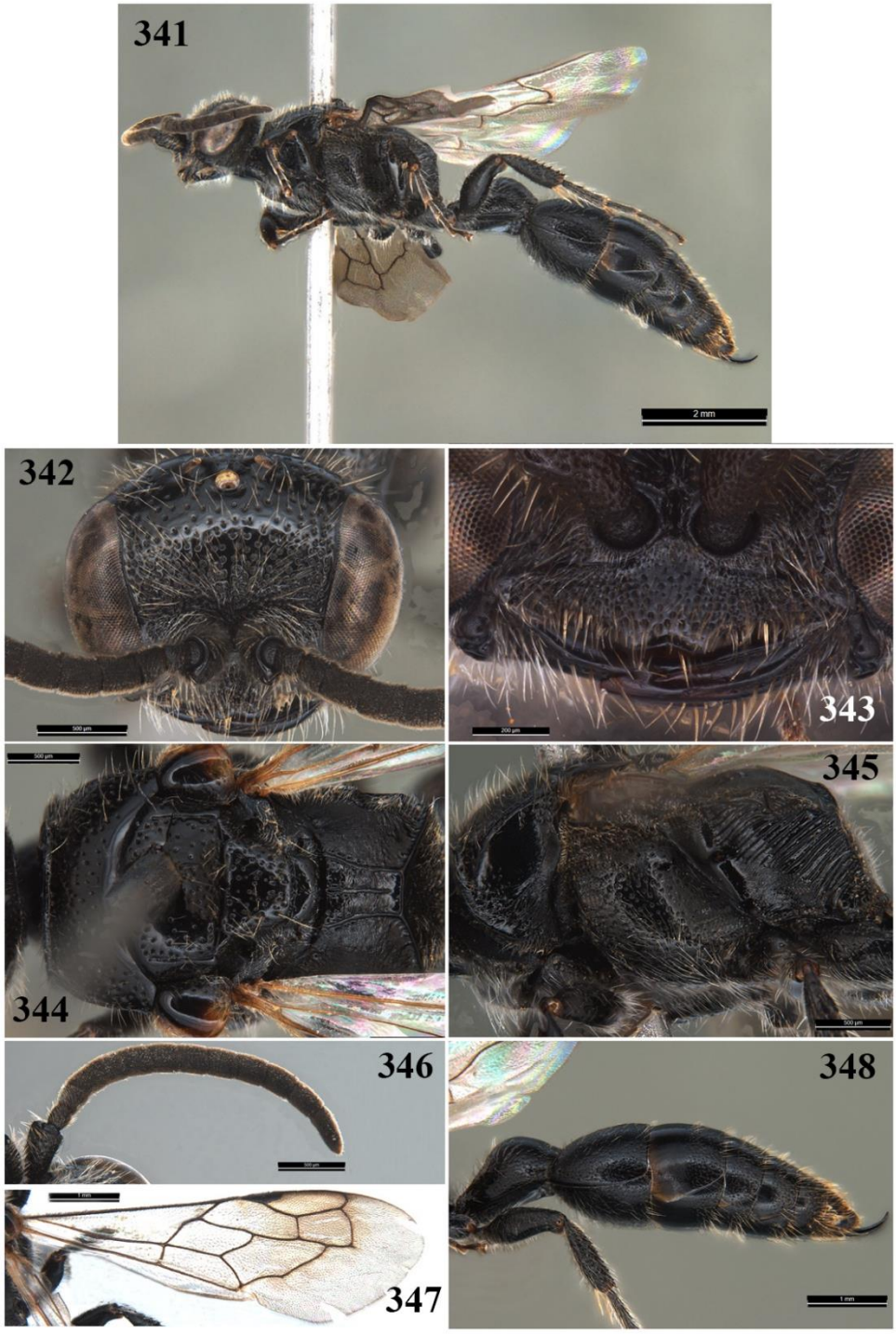
PLATE 47



***Tiphia* (*Tiphia*) *palmi* Krombein**

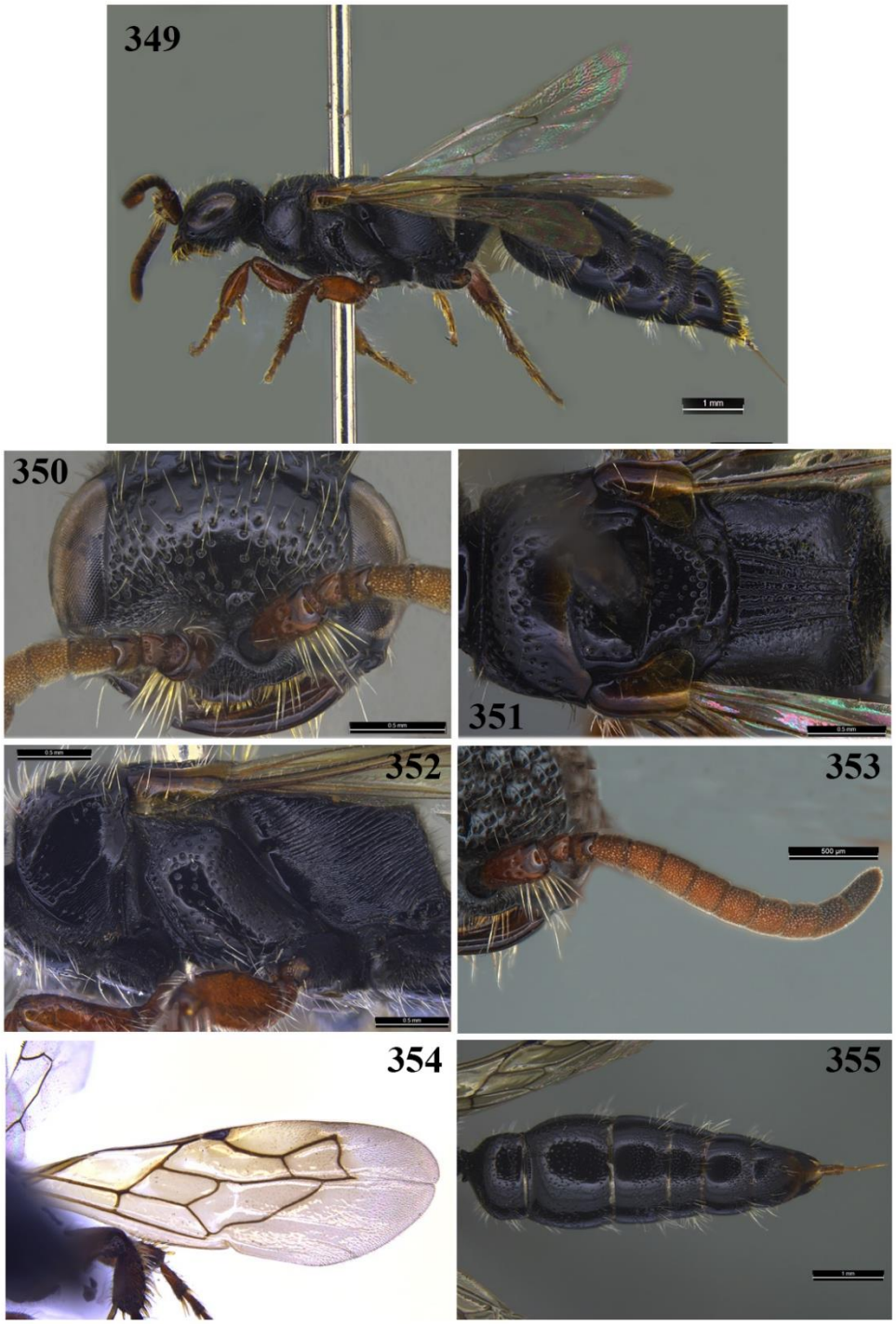
Figures. 333-340. Female, 333. Habitus, lateral view; 334. Head frontal view; 335. Clypeus, dorsal view; 336. Mesosoma dorsal view; 337. Mesosoma lateral view; 338. Antenna; 339. Forewing; 340. Metasoma lateral view.

PLATE 48



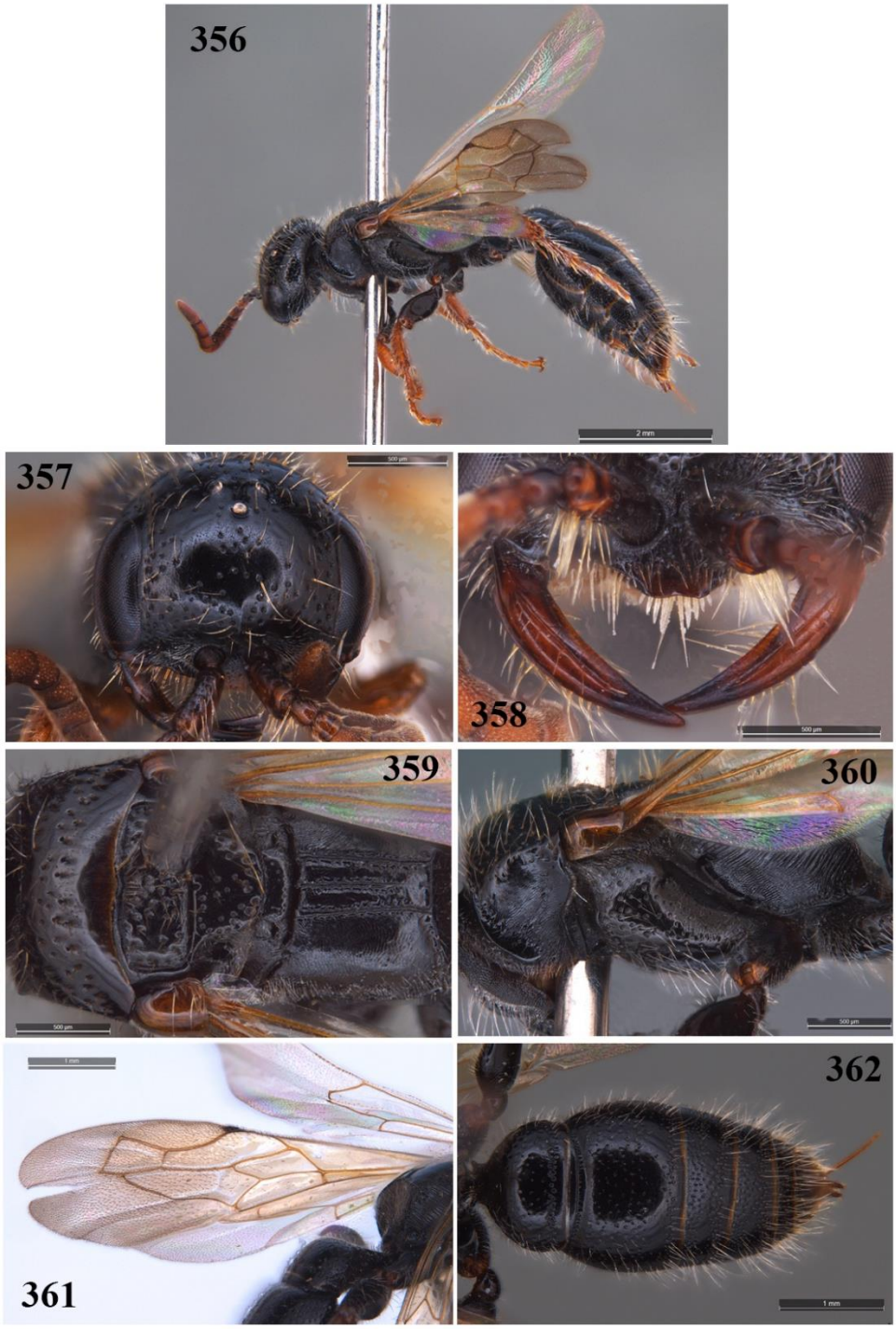
***Tiphia* (*Tiphia*) *pulchaukiae* Allen.**
Figures. 341-348. Male, 341. Habitus, lateral view; 342. Head frontal view; 343. Clypeus, dorsal view; 344. Mesosoma dorsal view; 345. Mesosoma lateral view; 346. Antenna; 347. Forewing; 348. Metasoma lateral view.

PLATE 49



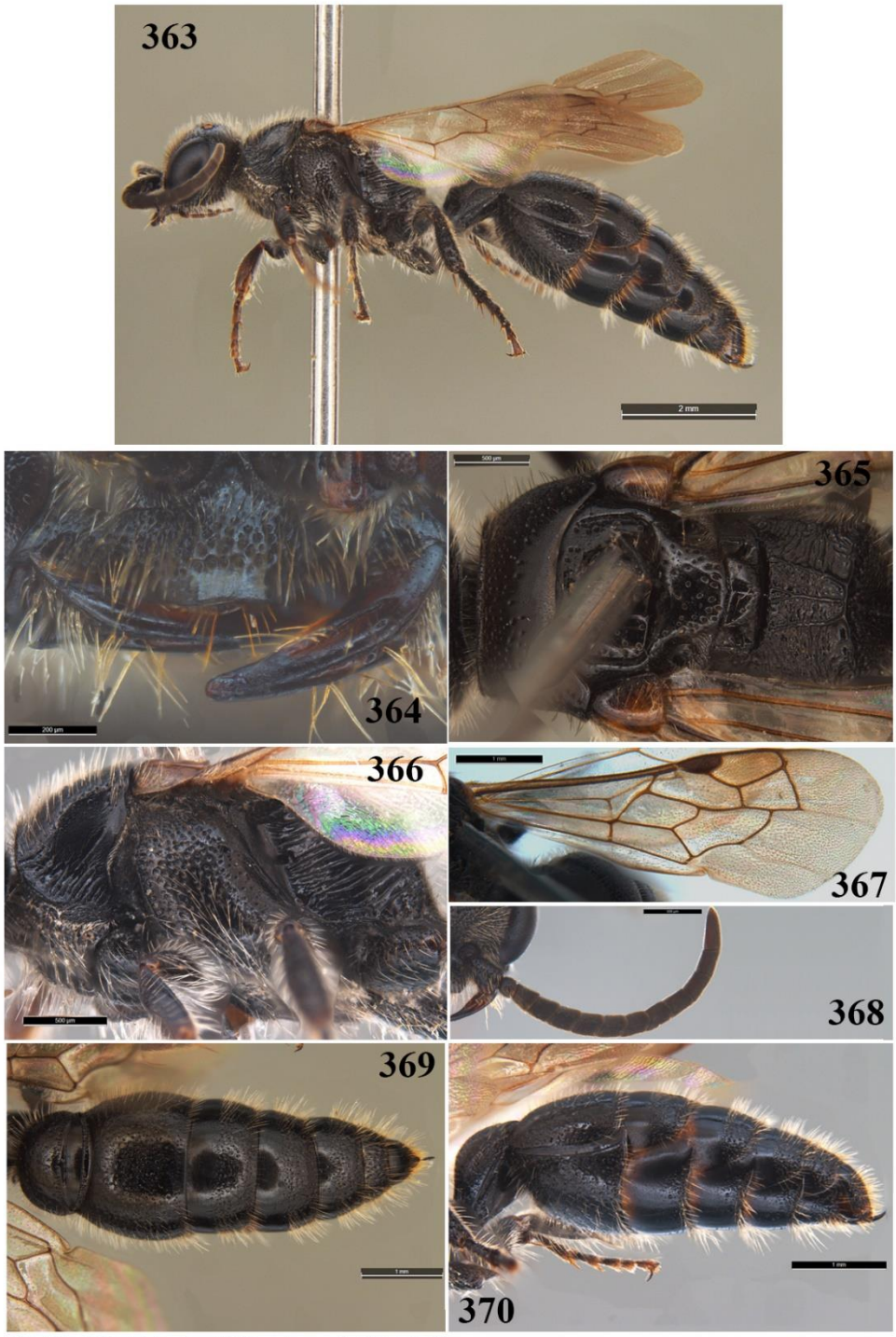
***Tiphia* (*Tiphia*) *quinquecarinata* Cameron.**
Figures. 349-355. Female, 349. Habitus, lateral view; 350. Head frontal view; 351. Mesosoma dorsal view; 352. Mesosoma lateral view; 353. Antenna; 354. Forewing; 355. Metasoma dorsal view.

PLATE 50



***Tiphia* (*Tiphia*) *rajeevani* Hanima & Girish Kumar.**
Figures. 356-362. Female, 356. Habitus, lateral view; 357. Head frontal view; 358 Clypeus, dorsal view; 359. Mesosoma dorsal view; 360. Mesosoma lateral view; 361. Forewing; 362. Metasoma dorsal view.

PLATE 51



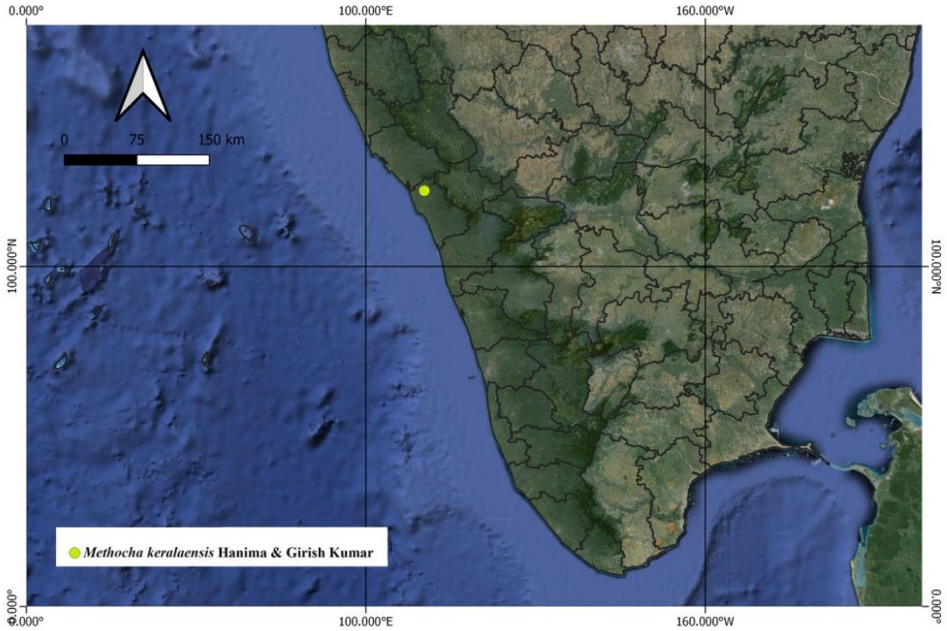
***Tiphia* (*Tiphia*) *shajii* Hnaima & Girish Kumar.**
Figures. 363-370. Male, 363. Habitus, lateral view; 364. Clypeus, dorsal view; 365. Mesosoma dorsal view; 366. Mesosoma lateral view; 367. Fore wing; 368. Antenna; 369. Metasoma dorsal view; 370. Metasoma lateral view.

PLATE 52

Genitalia of species. Figures. 371-383. 371. *Tiphia* (*T.*) *birganjae* Allen; 372. *Tiphia* (*T.*) *cinchonae* Allen; 373. *Tiphia* (*T.*) *davidrajui* Hanima & Girish Kumar; 374. *Tiphia* (*T.*) *decrescens* Walker; 375. *Tiphia* (*T.*) *flavipalpis* Allen; 376. *Tiphia* (*T.*) *hirsuta* Smith; 377. *Tiphia* (*T.*) *kurumba* Hanima & Girish Kumar; 378. *Tiphia* (*T.*) *lotharae* Allen; 379. *Tiphia* (*T.*) *lyrata* Magretti; 380. *Tiphia* (*T.*) *nathani* Allen; 381. *Tiphia* (*T.*) *nilgiria* Allen; 382. *Tiphia* (*T.*) *pulchaukiae* Allen; 383. *Tiphia* (*T.*) *shajii* Hanima & Girish Kumar

PLATE 53

Distribution map of *Methocha keralaensis* Hanima & Girish Kumar



Distribution map of *Methocha krombeini* Hanima, Girish Kumar & Binoy

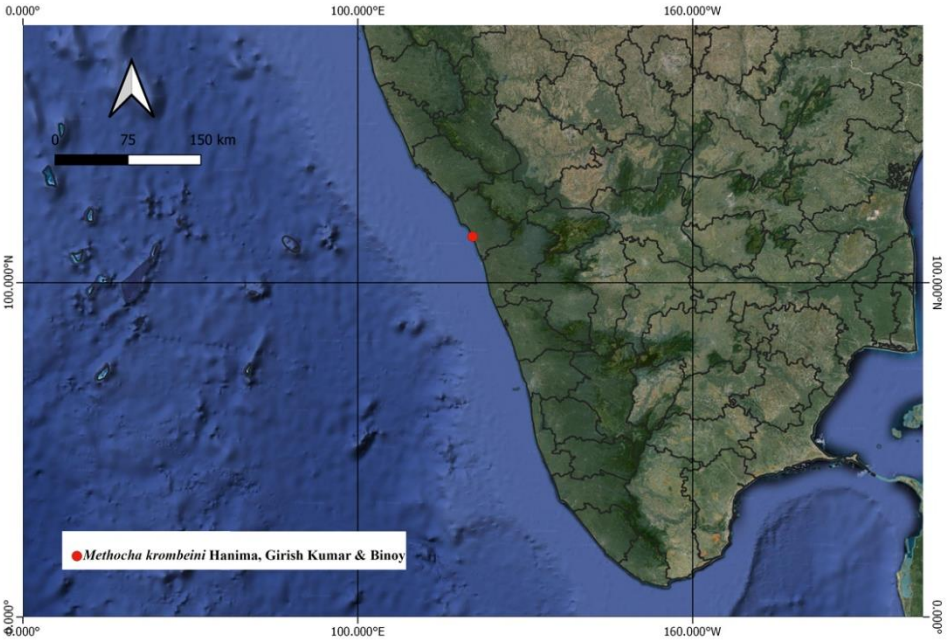
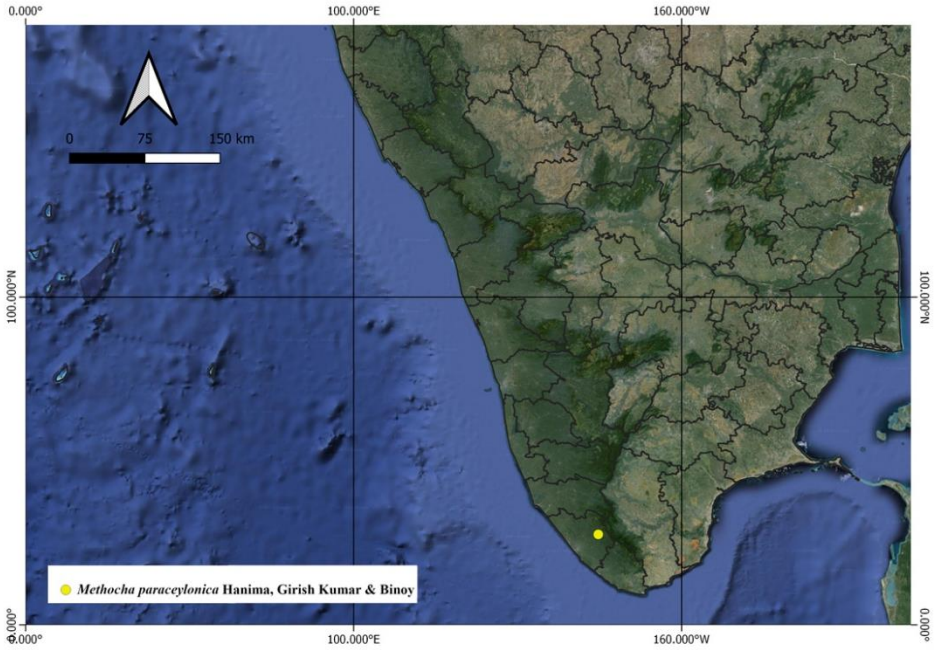


PLATE 54

Distribution map of *Methocha paraceylonica* Hanima, Girish Kumar & Binoy



Distribution map of *Methocha taprobane* Krombein

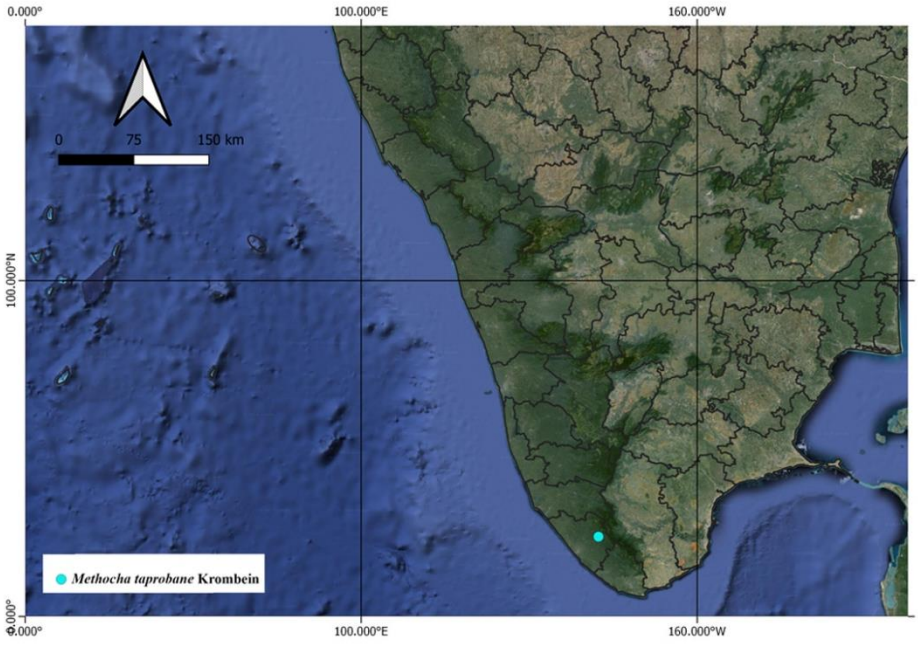
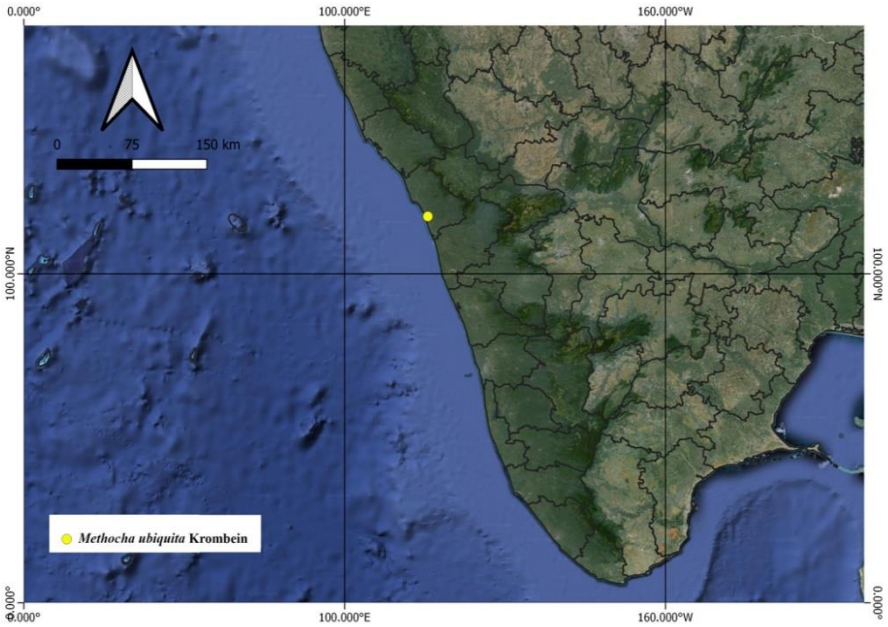


PLATE 55

Distribution map of *Methocha ubiquita* Krombein



Distribution map of *Hylomesa longiceps* (Turner)

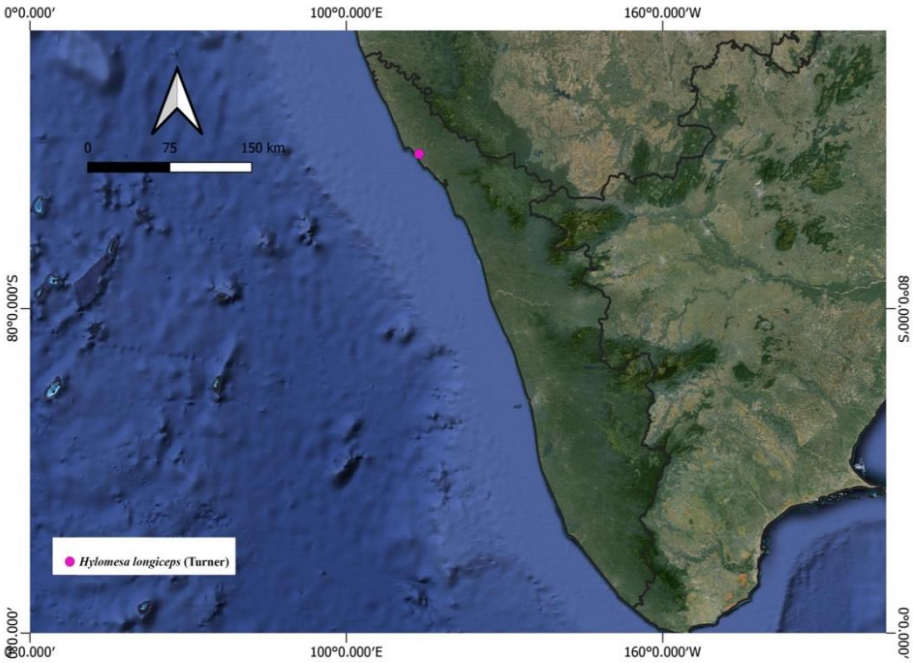
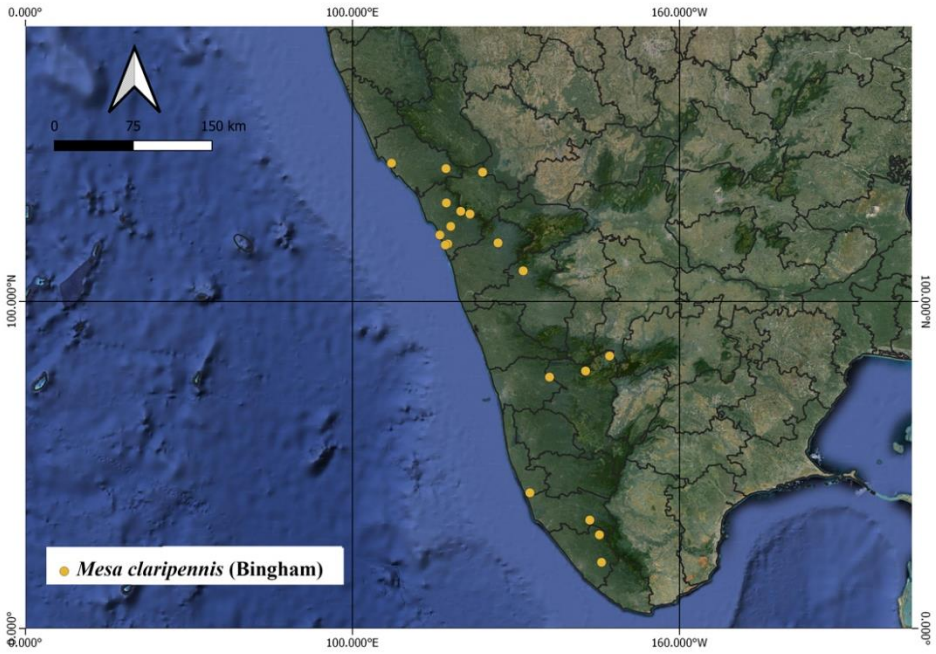


PLATE 56

Distribution map of *Mesa claripennis* (Bingham)



Distribution map of *Mesa dimidiata* (Guerin)

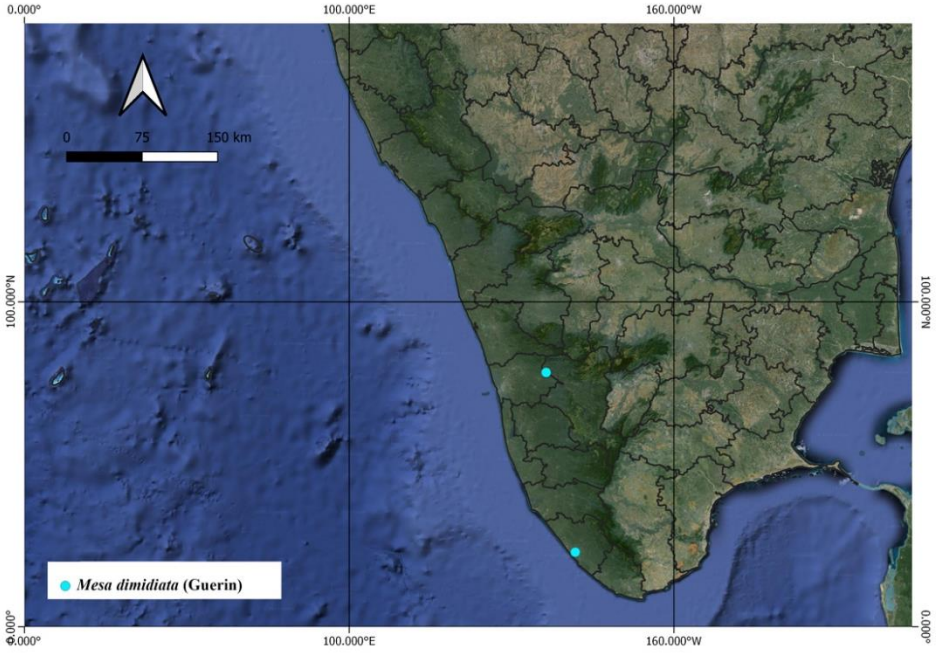
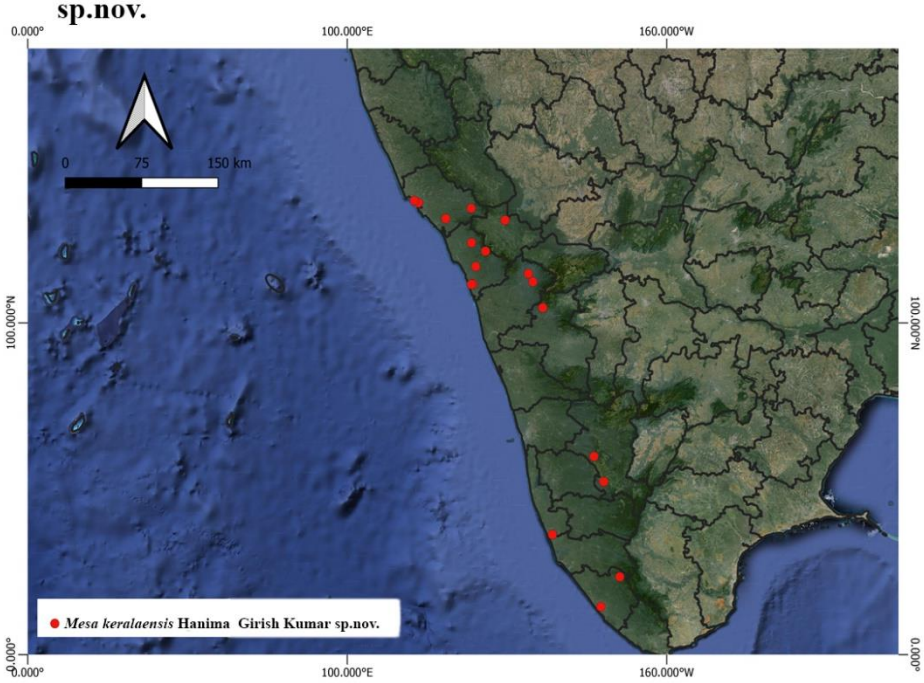


PLATE 57

Distribution map of *Mesa keralaensis* Hanima & Girish Kumar sp.nov.



Distribution map of *Mesa petiolata* (Smith)

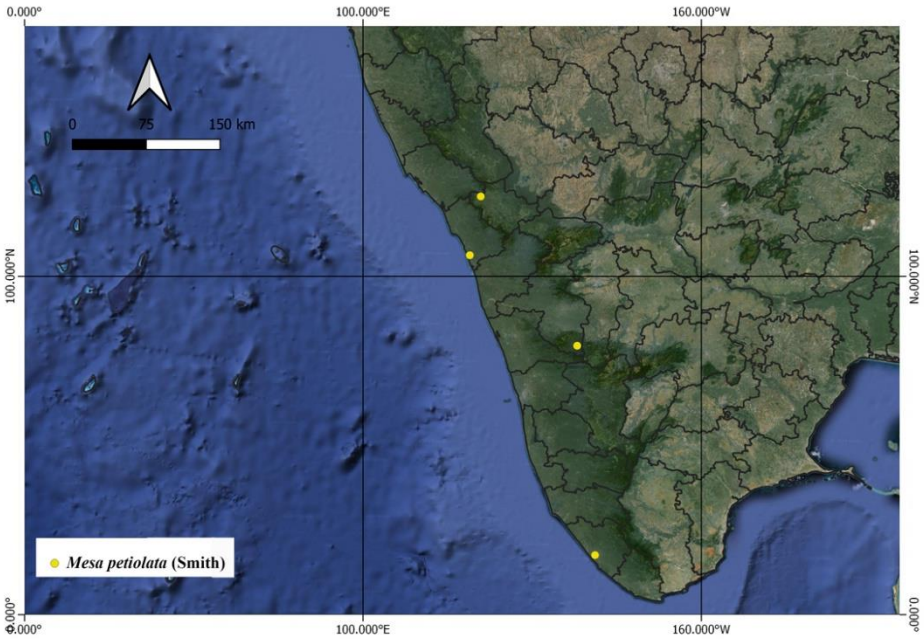
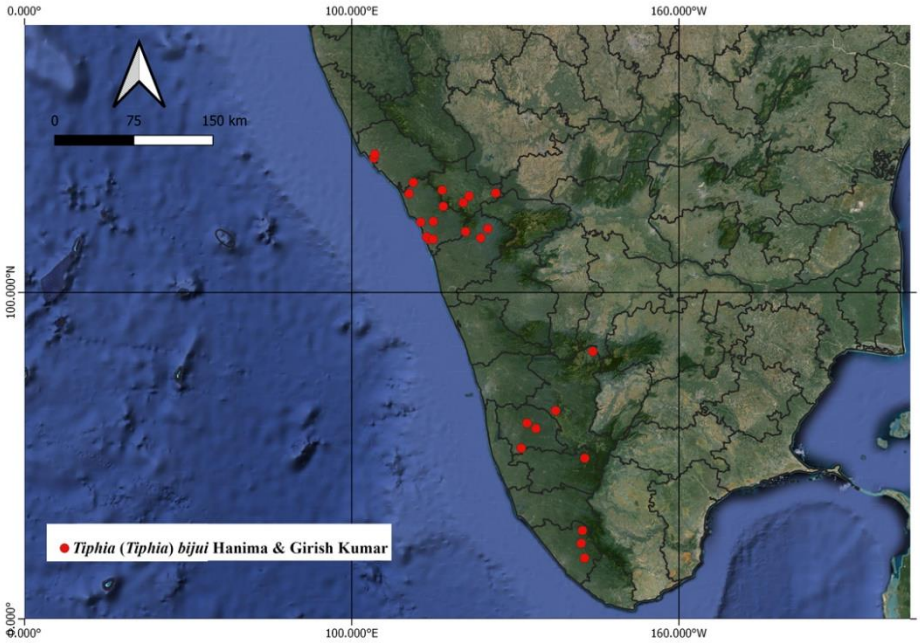


PLATE 58

Distribution map of *Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar



Distribution map of *Tiphia* (*Tiphia*) *birganjae* Allen

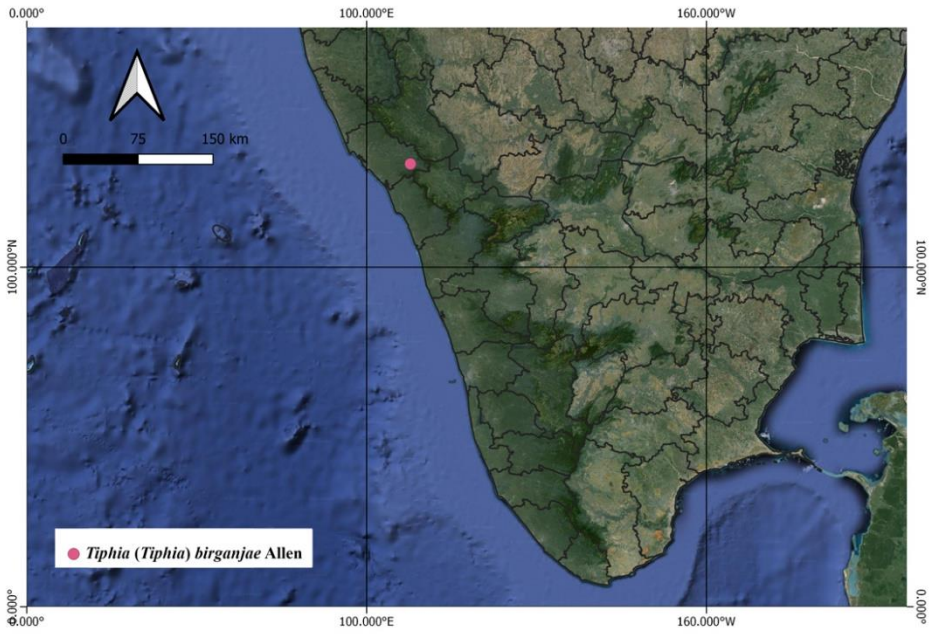
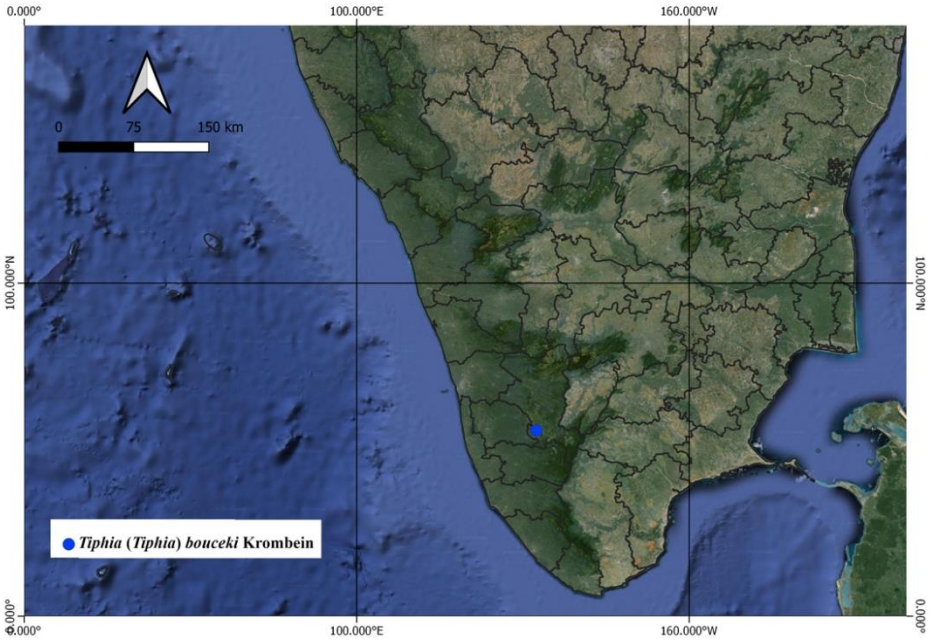


PLATE 59

Distribution map of *Tiphia* (*Tiphia*) *bouceki* Krombein



Distribution map of *Tiphia* (*Tiphia*) *brevistigma* Allen & Jaynes

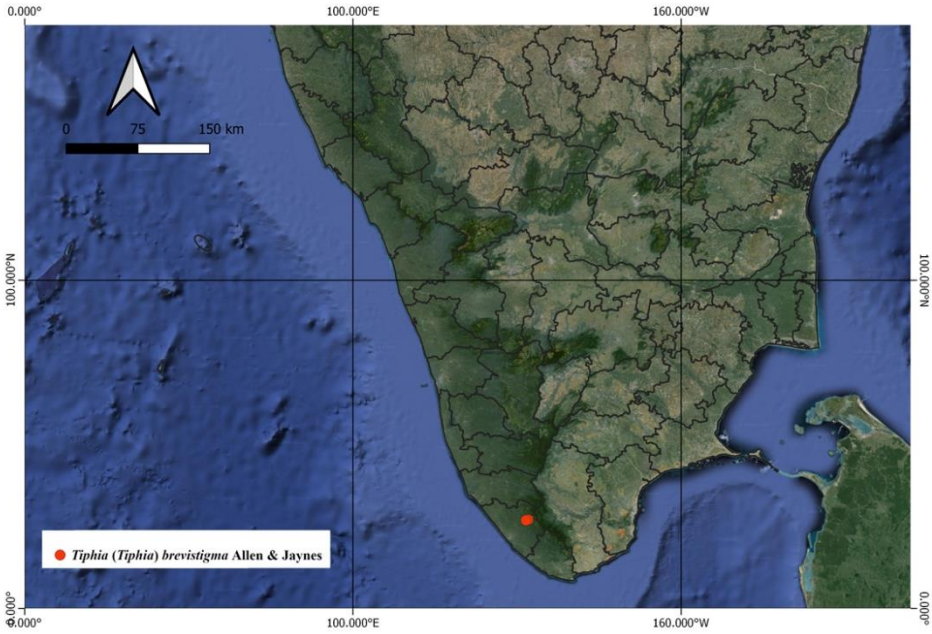
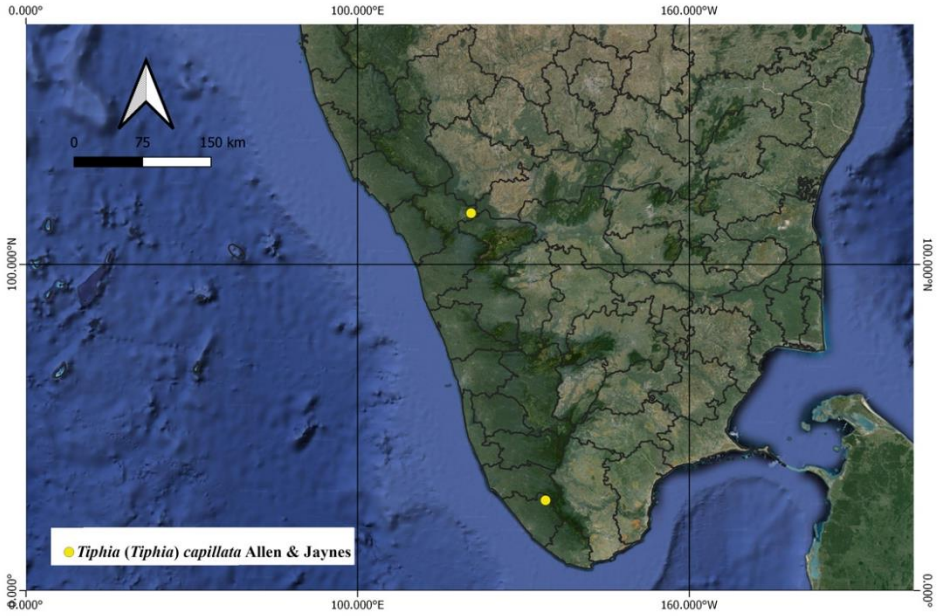


PLATE 60

Distribution map of *Tiphia* (*Tiphia*) *capillata* Allen & Jaynes



Distribution map of *Tiphia* (*Tiphia*) *cinchonae* Allen

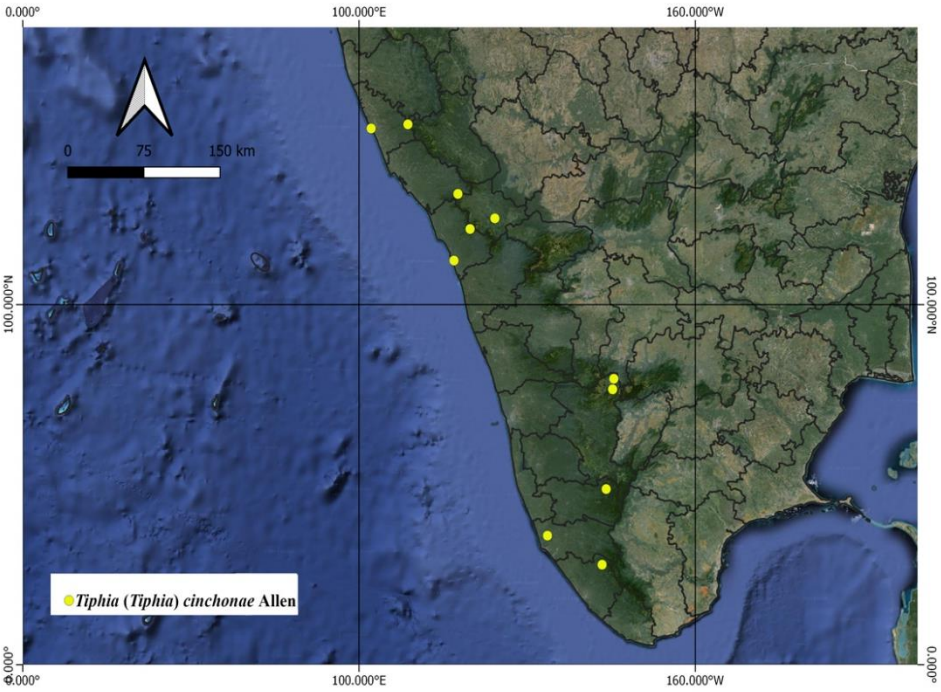
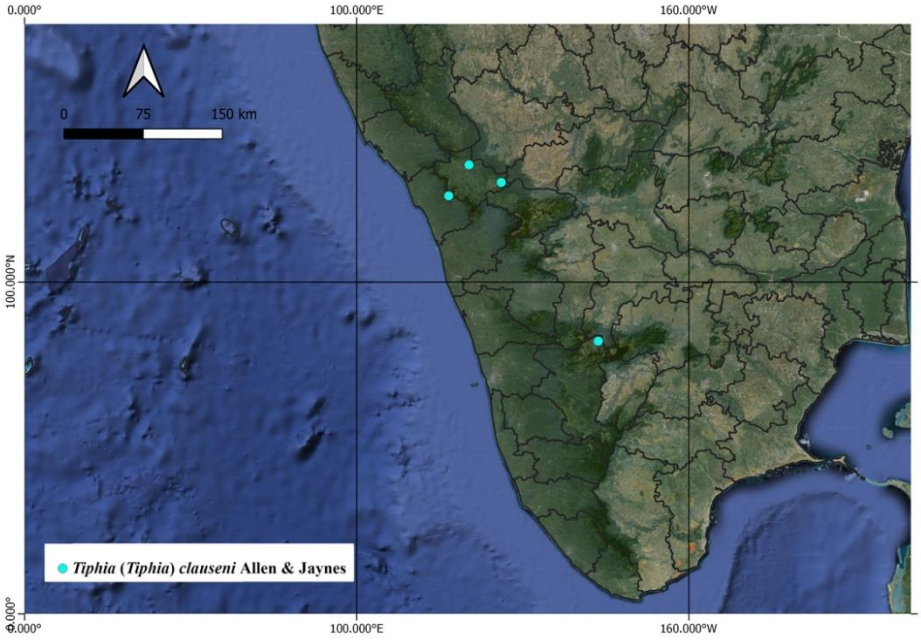


PLATE 61

Distribution map of *Tiphia* (*Tiphia*) *clauseni* Allen & Jaynes



Distribution map of *Tiphia* (*Tiphia*) *crassumpunctura* Hanima & Girish Kumar sp. nov.

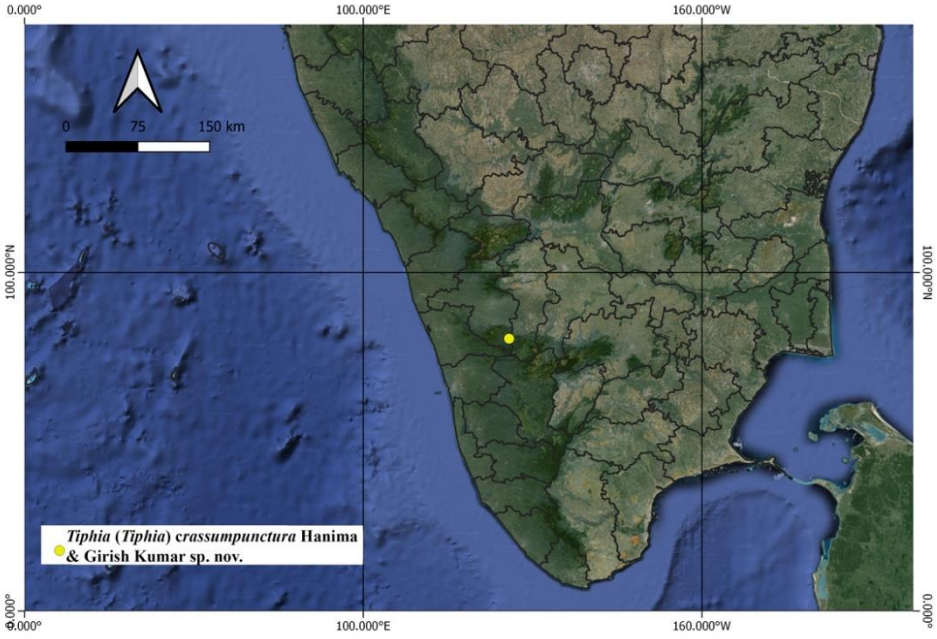
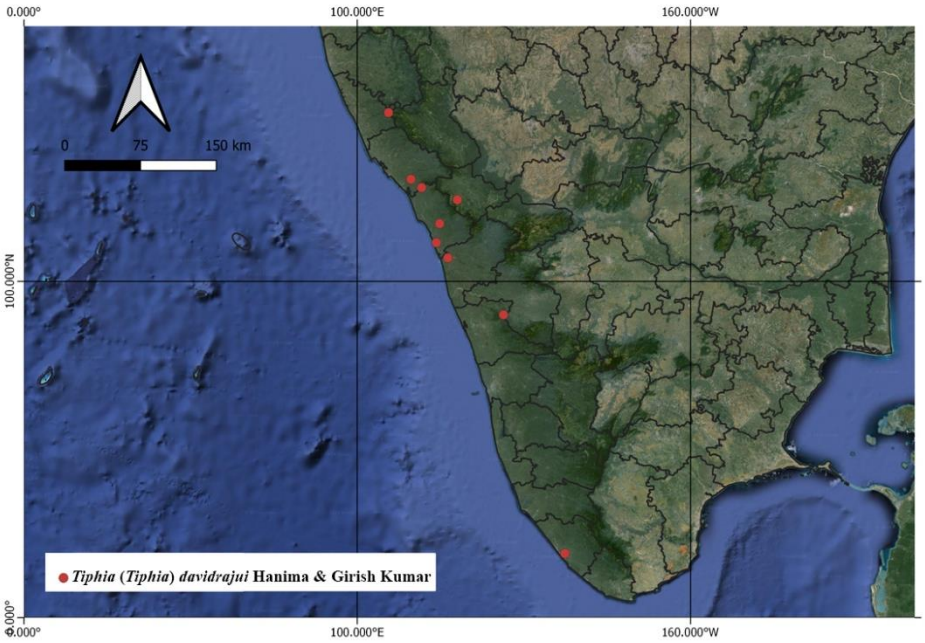


PLATE 62

Distribution map of *Tiphia* (*Tiphia*) *davidrajui* Hanima & Girish Kumar



Distribution map of *Tiphia* (*Tiphia*) *decrescens* Walker

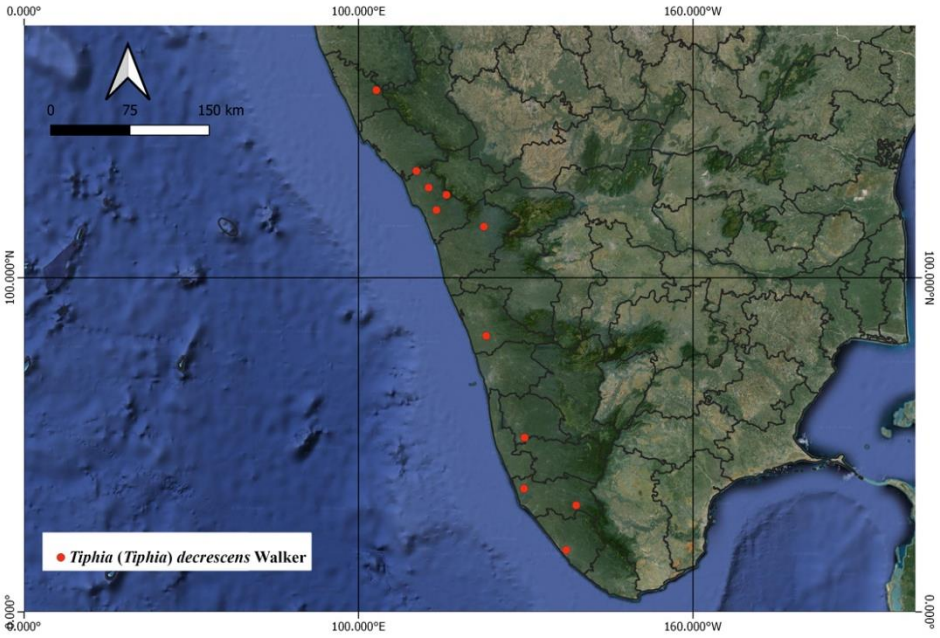
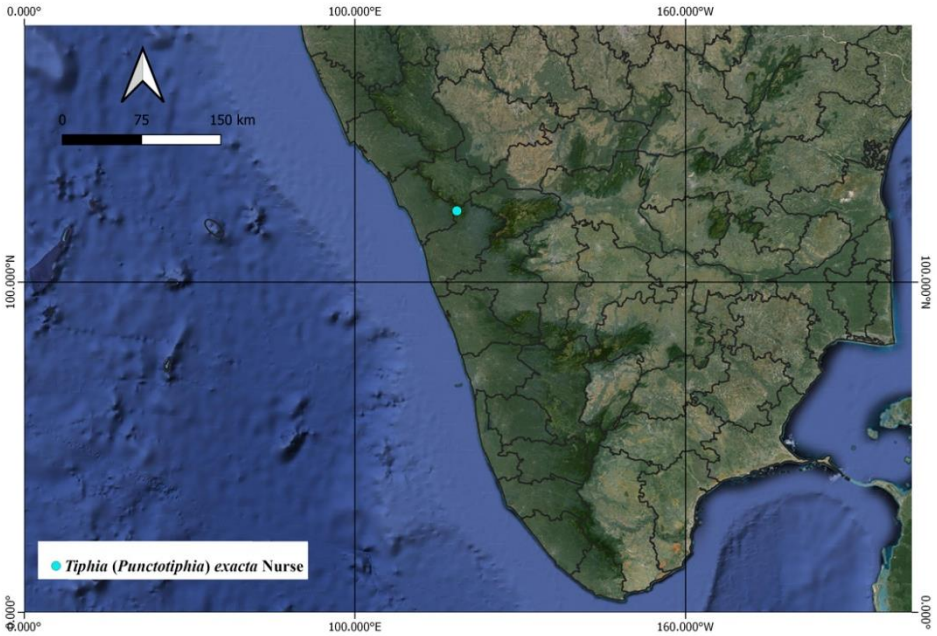


PLATE 63

Distribution map of *Tiphia* (*Punctotiphia*) *exacta* Nurse



Distribution map of *Tiphia* (*Tiphia*) *flavipalpis* Allen

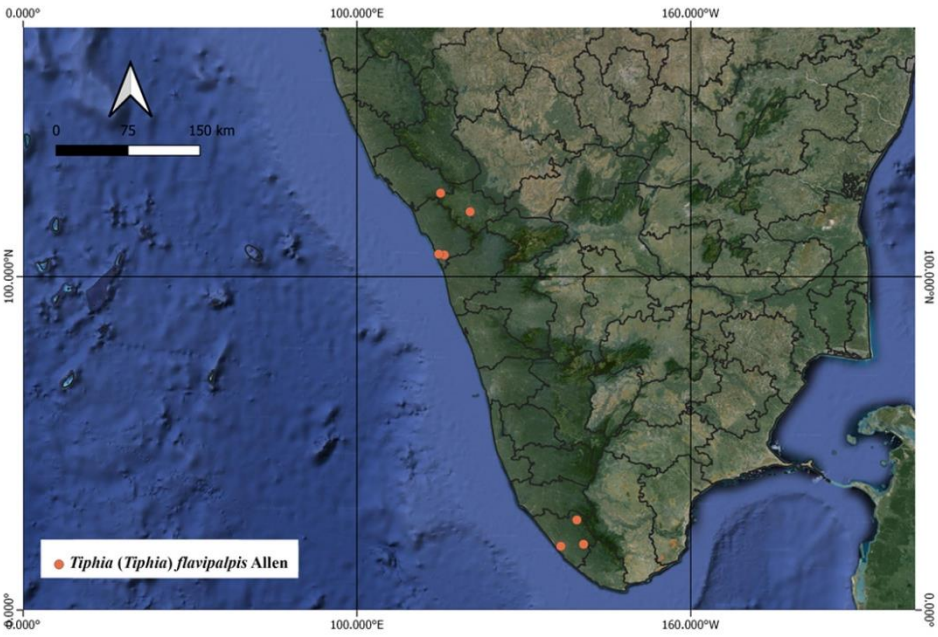
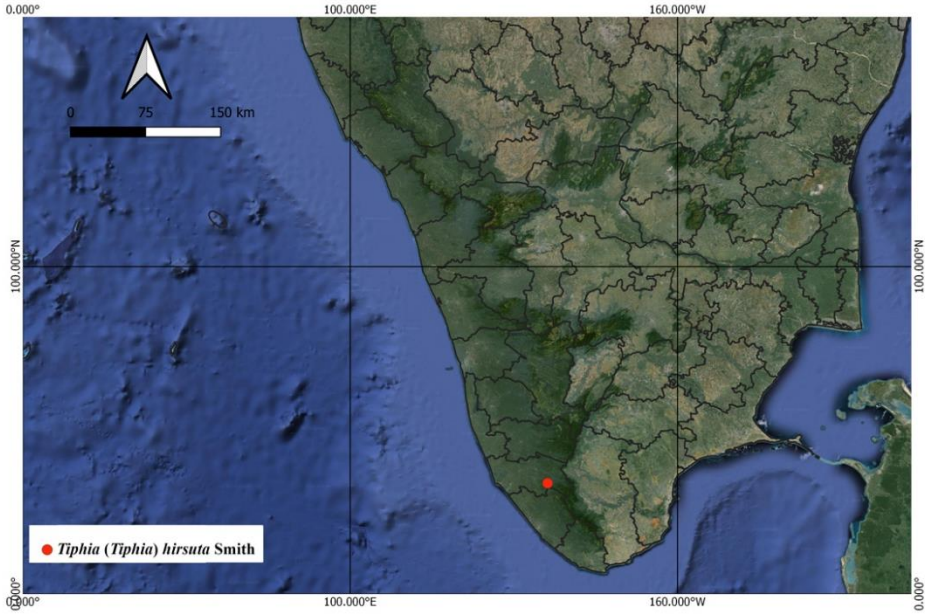


PLATE 64

Distribution map of *Tiphia* (*Tiphia*) *hirsuta* Smith



Distribution map of *Tiphia* (*Tiphia*) *kashmirensis* Hanima & Girish Kumar

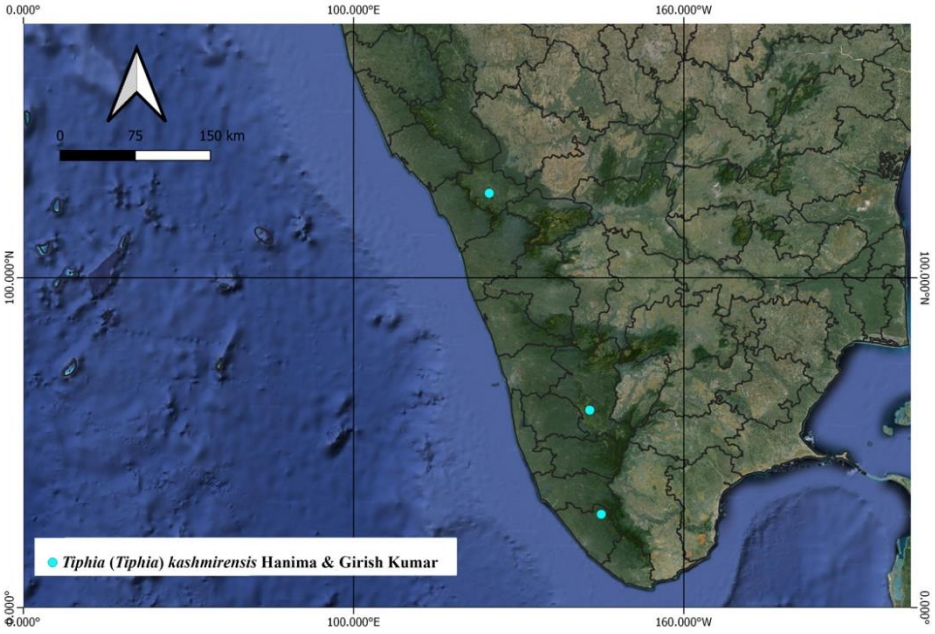
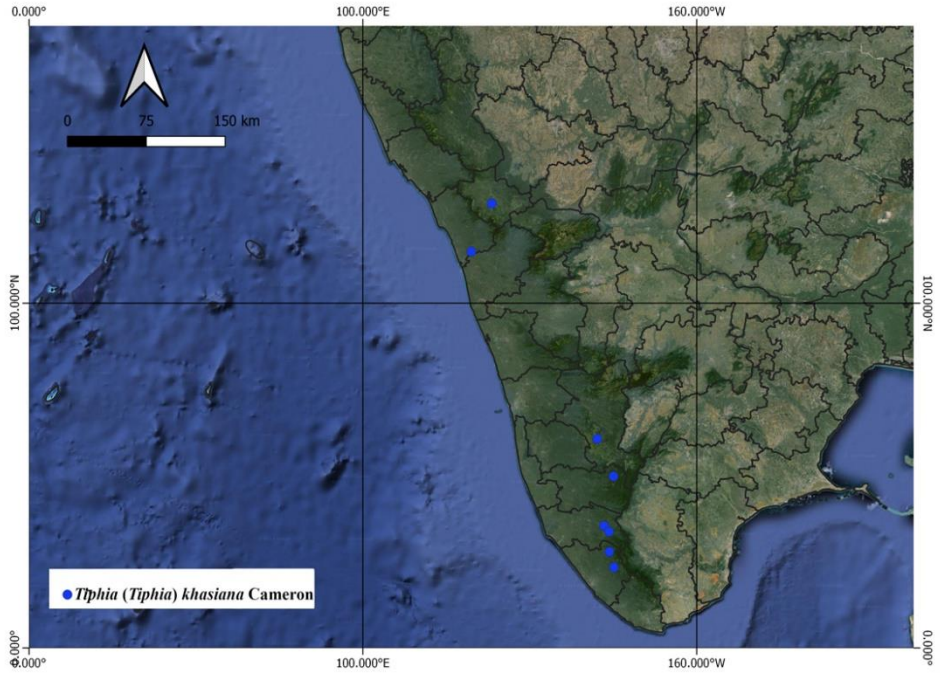


PLATE 65

Distribution map of *Tiphia* (*Tiphia*) *khasiana* Cameron



Distribution map of *Tiphia* (*Tiphia*) *kurumba* Hanima & Girish Kumar

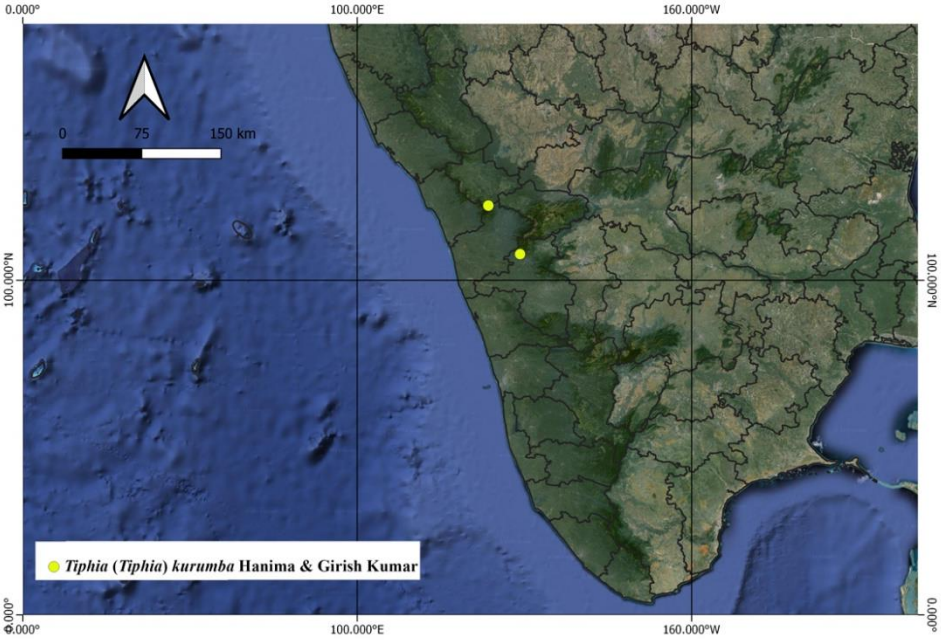
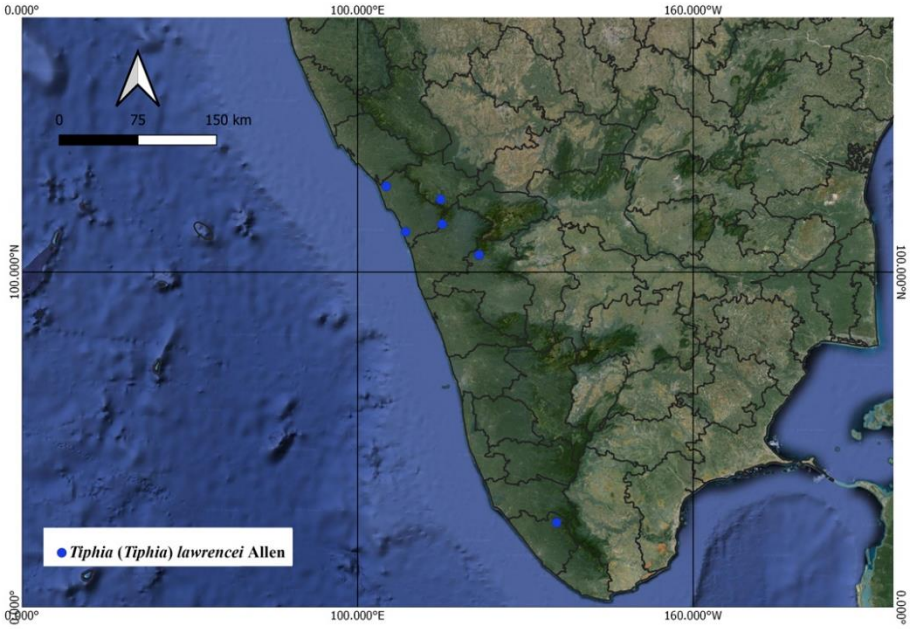


PLATE 66

Distribution map of *Tiphia* (*Tiphia*) *lawrencei* Allen



Distribution map of *Tiphia* (*Tiphia*) *lotharae* Allen

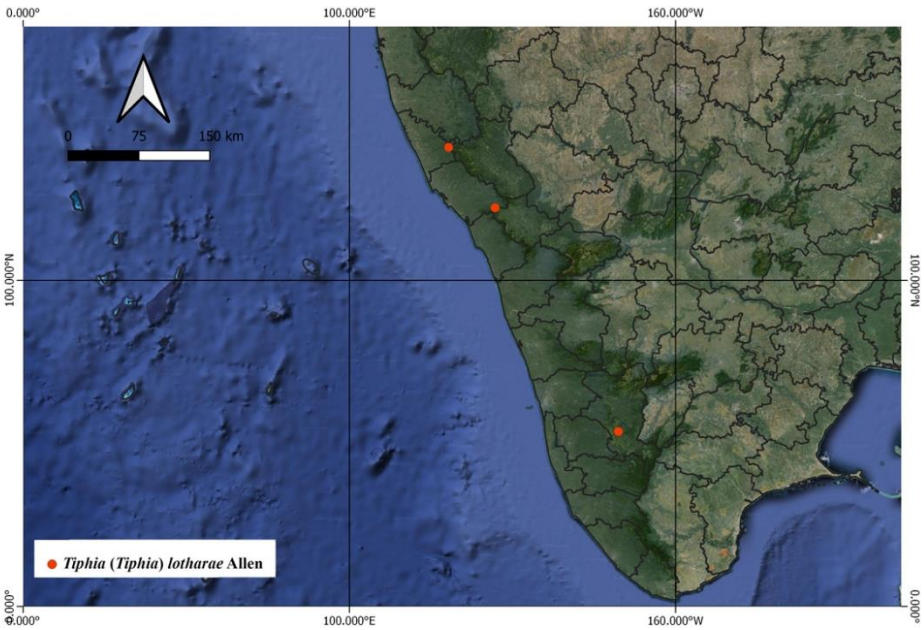
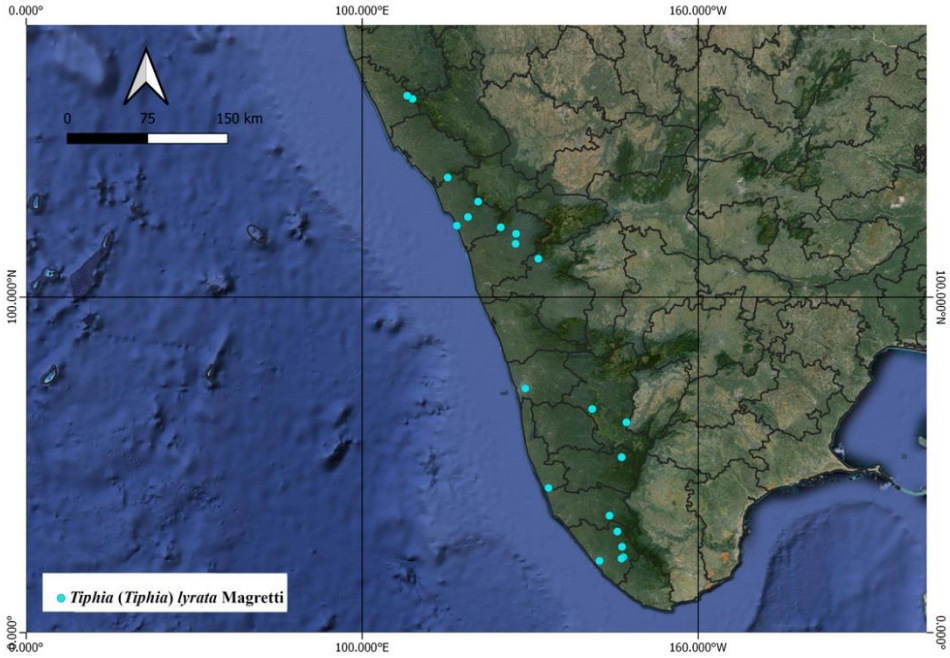


PLATE 67

Distribution map of *Tiphia* (*Tiphia*) *lyrata* Magretti



Distribution map of *Tiphia* (*Tiphia*) *milleri* Allen

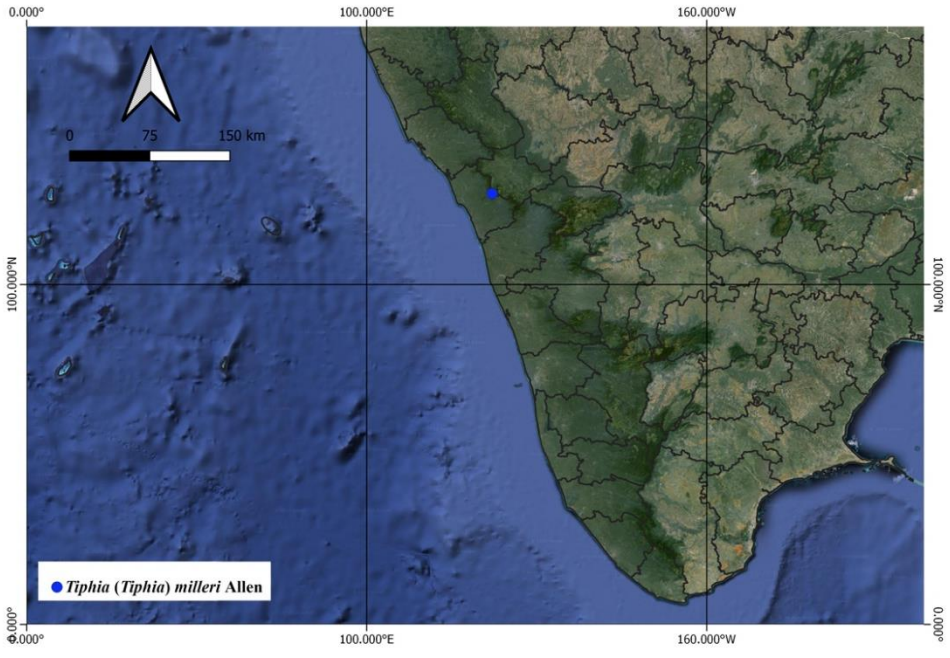
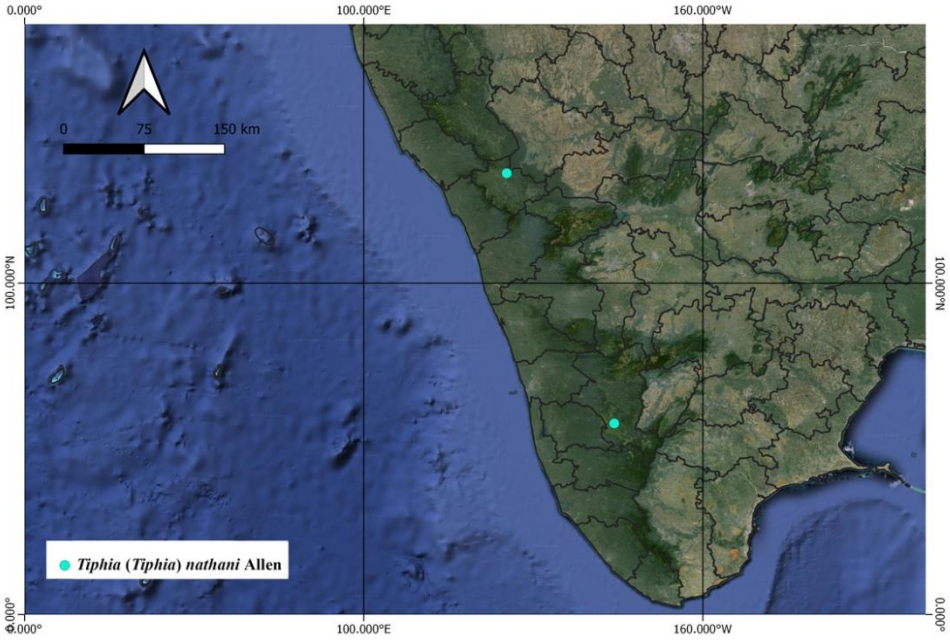


PLATE 68

Distribution map of *Tiphia* (*Tiphia*) *nathani* Allen



Distribution map of *Tiphia* (*Tiphia*) *nilgirensis* Allen

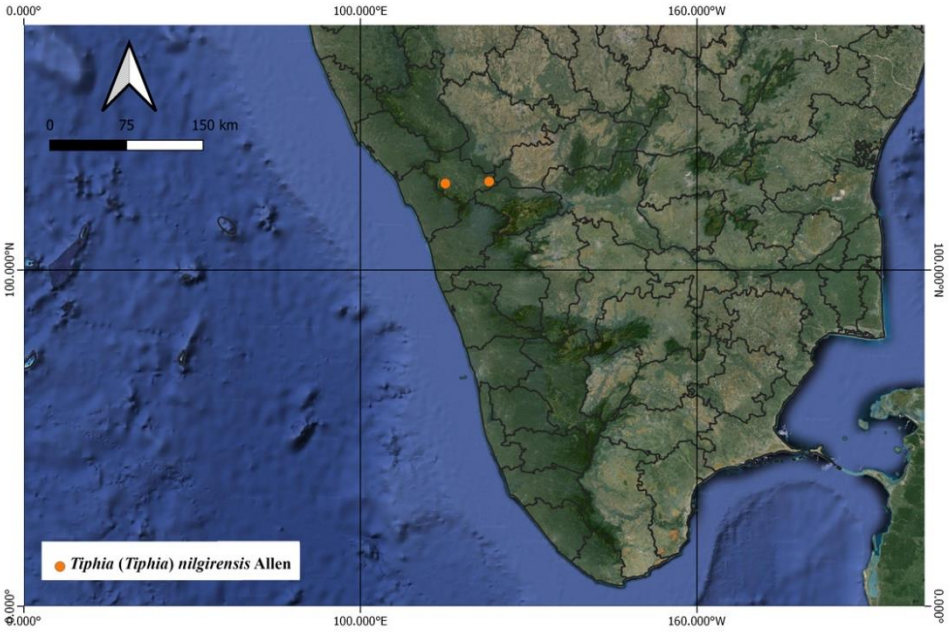
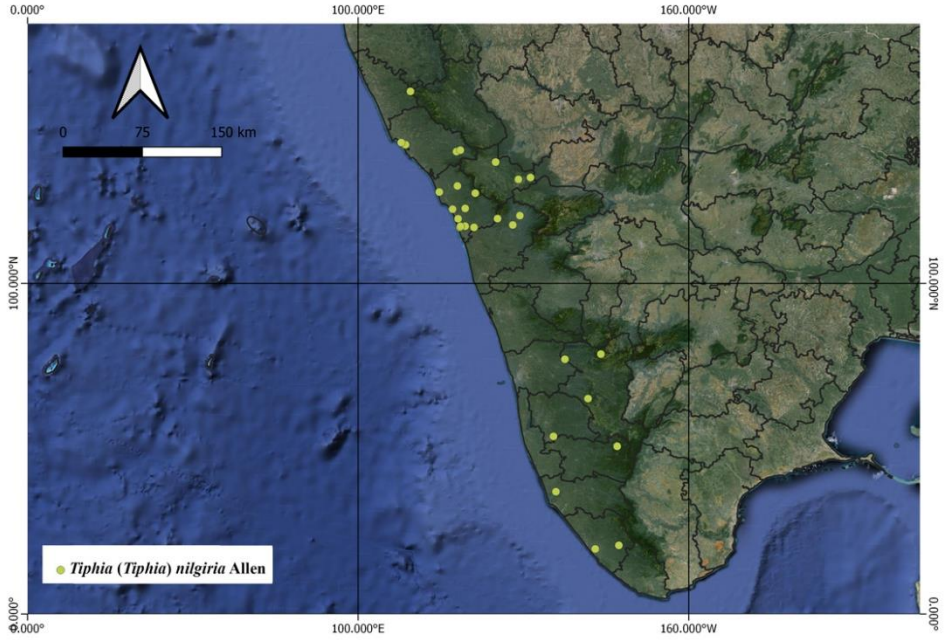


PLATE 69

Distribution map of *Tiphia* (*Tiphia*) *nilgiria* Allen



Distribution map of *Tiphia* (*Tiphia*) *novus* Hanima & Girish Kumar

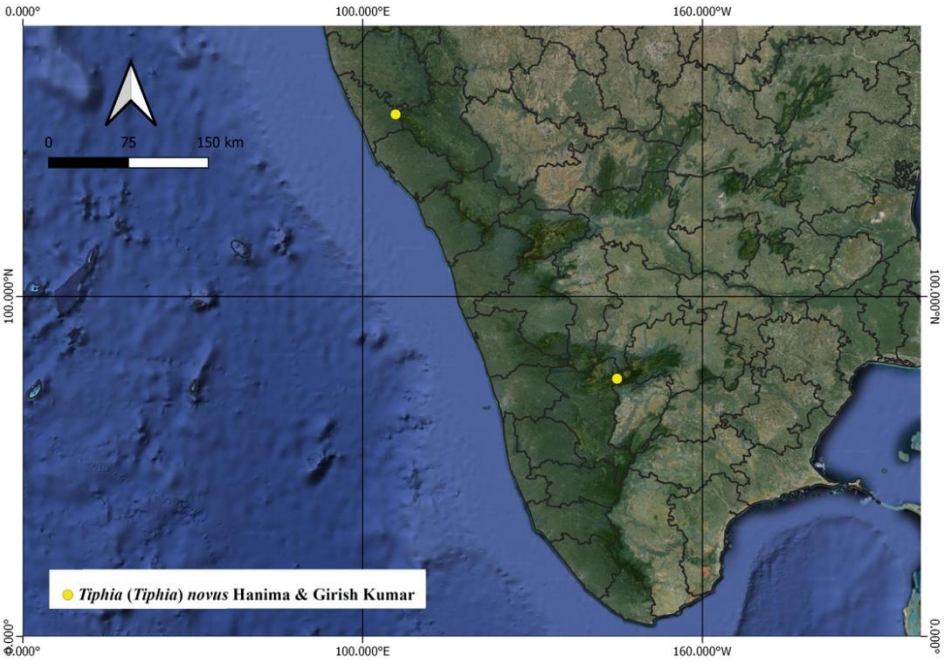
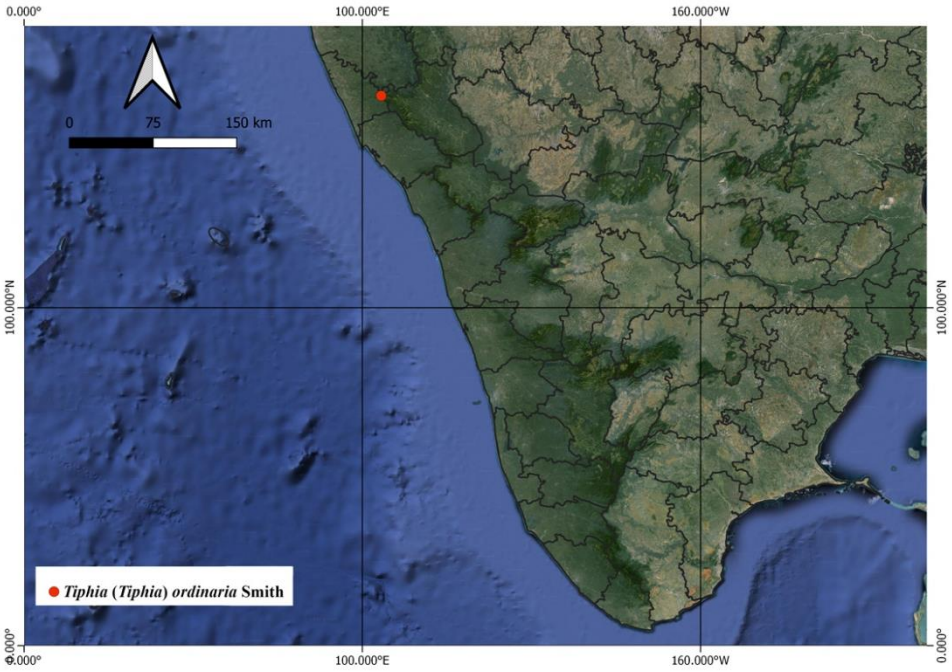


PLATE 70

Distribution map of *Tiphia (Tiphia) ordinaria* Smith



Distribution map of *Tiphia (Tiphia) palmi* Krombein

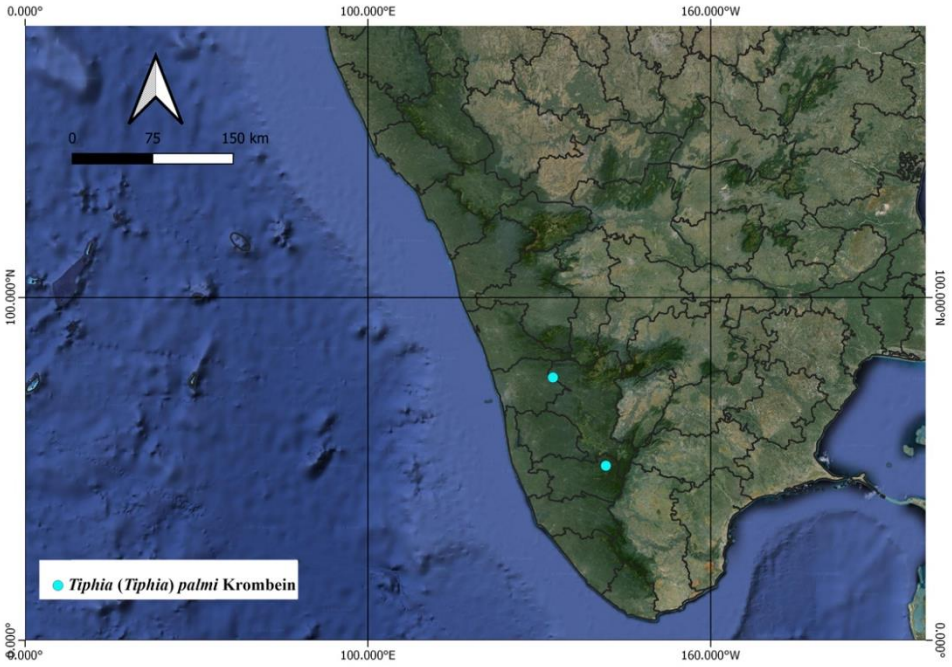
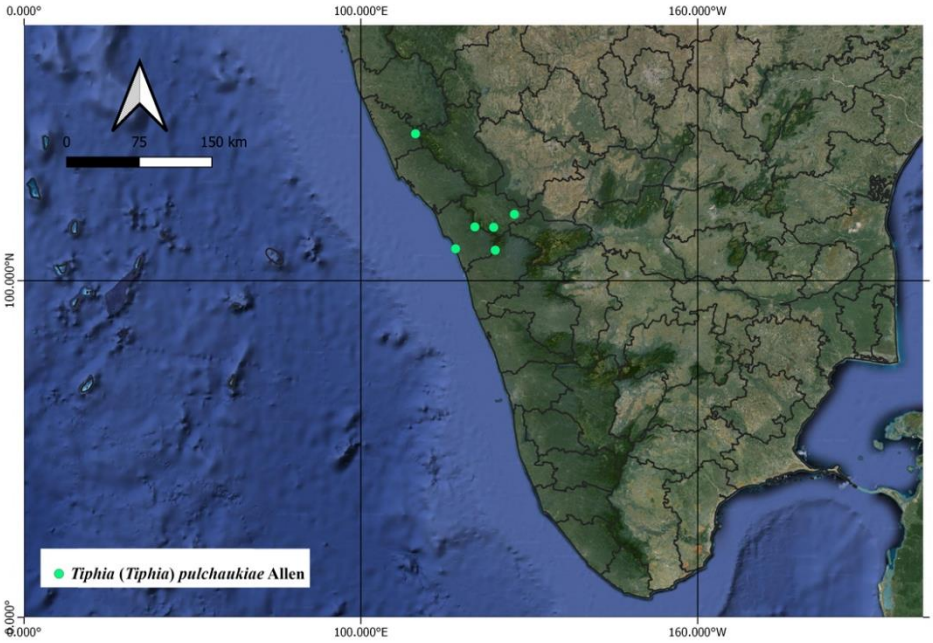


PLATE 71

Distribution map of *Tiphia (Tiphia) pulchaukiae* Allen



Distribution map of *Tiphia (Tiphia) quinquecarinata* Cameron

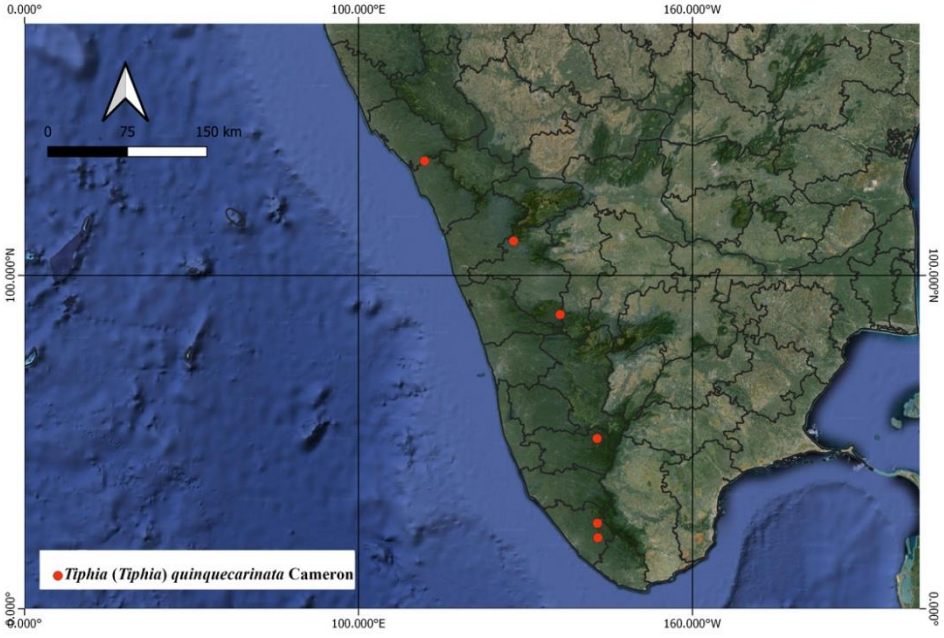
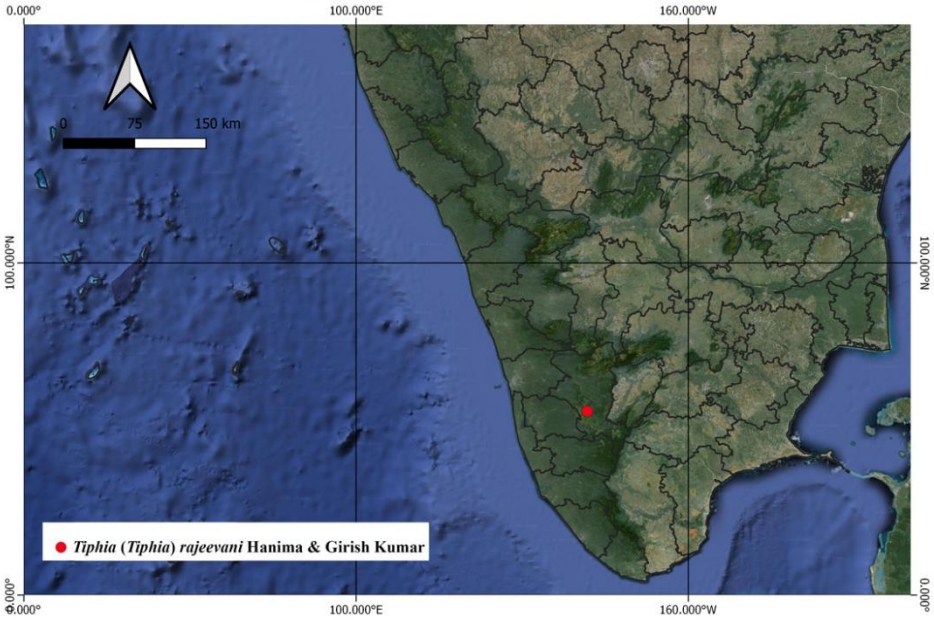
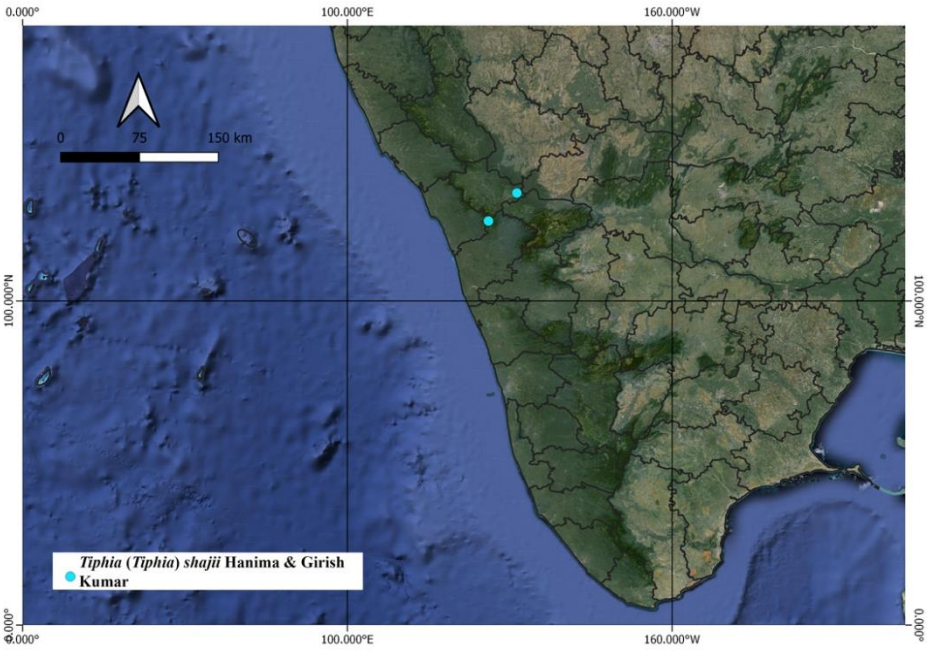


PLATE 72

Distribution map of *Tiphia* (*Tiphia*) *rajeevani* Hanima & Girish Kumar



Distribution map of *Tiphia* (*Tiphia*) *shajii* Hanima & Girish Kumar



CHECKLIST OF TIPHIIDAE OF INDIA

FAMILY TIPHIIDAE LEACH, 1815

SUBFAMILY METHOCHINAE ROHWER, 1916

GENUS *METHOCHA* LATREILLE, 1804

1. *Methocha bicolor* (Cameron, 1897) — India: West Bengal.
2. *Methocha keralaensis* Hanima & Girish Kumar, 2019 — India: Kerala.
3. *Methocha krombeini* Hanima, Girish Kumar & Binoy, 2021 — India: Kerala.
4. *Methocha litoralis* Krombein, 1982 — India: Pondicherry. *Elsewhere*: Sri Lanka.
5. *Methocha paraceylonica* Hanima, Girish Kumar & Binoy, 2021 — India: Karnataka, Kerala.
6. *Methocha shyamagatra* Hanima, Girish Kumar & Sureshan, 2021— India: Uttarakhand.
7. *Methocha smithii* (Magretti, 1892) — India: Northern India (exact collection locality unknown). *Elsewhere*: Myanmar.
8. *Methocha taprobane* Krombein, 1982— India: Kerala. *Elsewhere*: Sri Lanka.
9. *Methocha ubiquita* Krombein, 1982 — India: Kerala. *Elsewhere*: Sri Lanka.
10. *Methocha violaceipennis* (Cameron, 1899) — India: Meghalaya.

SUBFAMILY MYZININAE BORNER, 1919

TRIBE MESINI ARGAMAN, 1994

GENUS *HYLOMESA* KROMBEIN, 1968

11. *Hylomesa longiceps* (Turner, 1918) — India: Assam, Kerala (**new record**). *Elsewhere*: Myanmar; Malaysia, Philippines; Sri Lanka.
12. *Hylomesa dimidiaticornis* (Bingham, 1896) — India: Uttarakhand.
13. *Hylomesa crassepunctata* (Turner, 1914) — India: Tamil Nadu.

GENUS *MESA* SAUSSURE, 1892

14. *Mesa bengalensis* (Cameron, 1898) — India: Maharashtra, West Bengal.
15. *Mesa claripennis* (Bingham, 1897) — India: Bihar, Gujarat, Kerala (**new record**). *Elsewhere*: Myanmar; Sri Lanka; Thailand.
16. *Mesa dimidiata* (Guérin, 1837) — India: Karnataka, Kerala (**new record**), Maharashtra, Tamil Nadu, Uttarakhand.
17. *Mesa flavipennis* Krombein, 1982 — India: Pondicherry, Tamil Nadu. *Elsewhere*: Sri Lanka.
18. *Mesa fuscipennis* (Smith, 1855) — India (exact collection locality unknown).
19. *Mesa keralaensis* Hanima & Girish Kumar **sp. nov.** — India: Karnataka, Kerala.
20. *Mesa nursei* (Turner, 1908) — India: Himachal Pradesh.

21. *Mesa petiolata* (Smith, 1855) — India: Bihar, Kerala, Maharashtra, Pondichery, Tamil Nadu, West Bengal. *Elsewhere*: Sri Lanka; Thailand.
22. *Mesa rothney* (Cameron, 1902) — India: Meghalaya. *Elsewhere*: Thailand.

TRIBE MERIINI COSTA, 1858

SUBTRIBE MERIINA

GENUS *ISWARA* WESTWOOD, 1851

23. *Iswara luteus* Westwood, 1851 — India: East India (exact collection locality unknown).
24. *Iswara pallidus* (Smith 1879) — India (exact collection locality unknown).
25. *Iswara rajasthanicus* Chhotani & Ray, 1975 — India: Rajasthan.

GENUS *KOMAROWIA* RADOSZKOWSKI, 1886

26. *Komarowia fasciata* (Smith 1873) — India: Gujarat, Rajasthan. *Elsewhere*: Pakistan.

GENUS *MYZINELLA* GUIGLIA, 1959

27. *Myzinella clavicornis* (Turner, 1909) — India: Western India (exact collection locality unknown).

SUBFAMILY: TIPHIINAE LEACH, 1815

GENUS *TIPHIA* FABRICIUS, 1775

28. *Tiphia* (*Jaynesia*) *assamensis* Allen & Jaynes, 1930 — India: Meghalaya.
29. *Tiphia* (*Tiphia*) *andhraensis* Hanima & Girish Kumar, 2024 — India: Andhra Pradesh.
30. *Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar, 2022 — India: Goa, Karnataka, Kerala, Tamil Nadu, Uttarakhand, West Bengal.
31. *Tiphia (Tiphia) birganjae* Allen, 1975 — India: Kerala, Tamil Nadu, Uttarakhand. *Elsewhere*: Nepal.
32. *Tiphia (Tiphia) bouceki* Krombein, 1982 — India: Kerala. *Elsewhere*: Sri Lanka.
33. *Tiphia (Tiphia) brevistigma* Allen & Jaynes, 1930—India: Kerala, Meghalaya.
34. *Tiphia* (*Tiphia*) *canaliculata* Cameron, 1902 — India: Meghalaya, Uttarakhand.
35. *Tiphia* (*Tiphia*) *capillata* Allen & Jaynes, 1930 — India: Karnataka, Kerala, Meghalaya.
36. *Tiphia* (*Punctotiphia*) *chareshi* Hanima & Girish Kumar, 2022 — India: Tamil Nadu.
37. *Tiphia* (*Tiphia*) *cinchonae* Allen, 1975 — India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu. ***Elsewhere*:** Thailand.
38. *Tiphia* (*Tiphia*) *clauseni* Allen & Jaynes, 1930 — India: Karnataka, Kerala, Meghalaya.
39. *Tiphia* (*Tiphia*) *clavinerva* Cameron, 1904 — India: Meghalaya.
40. *Tiphia* (*Punctotiphia*) *coimbatorea* Allen, 1975 — India: (Tamil Nadu). ***Elsewhere*:** Sri Lanka.

41. *Tiphia* (*Tiphia*) *consueta* Smith, 1879 — India: Himachal Pradesh, Karnataka, Sikkim, Uttarakhand. ***Elsewhere*:** Sri Lanka.
42. *Tiphia* (*Tiphia*) *crassumpunctura* Hanima & Girish Kumar **sp. nov.** — India: Kerala
43. *Tiphia* (*Tiphia*) *curvinerva* Cameron, 1902 — India: Arunachal Pradesh; Meghalaya.
44. *Tiphia* (*Tiphia*) *dampara* Allen, 1975 — India: Tamil Nadu, Uttarakhand. ***Elsewhere*:** Thailand.
45. *Tiphia* (*Tiphia*) *davarae* Allen, 1975 — India: Uttarakhand. ***Elsewhere*:** Nepal.
46. *Tiphia* (*Tiphia*) *davidrajui* Hanima & Girish Kumar, 2022 — India: Kerala, Tamil Nadu, West Bengal.
47. *Tiphia* (*Tiphia*) *decrescens* Walker, 1859 — India: Gujarat, Karnataka, Kerala, Odisha, Tamil Nadu, Uttarakhand. ***Elsewhere*:** Sri Lanka; Thailand.
48. *Tiphia* (*Tiphia*) *dutti* Allen, 1975 — India: Meghalaya.
49. *Tiphia* (*Punctotiphia*) *exacta* Nurse, 1903 — India: Jammu & Kashmir, Kerala.
50. *Tiphia* (*Tiphia*) *flavipalpis* Allen, 1975 — India: Karnataka, Kerala, Tamil Nadu. ***Elsewhere*:** Nepal, Thailand.
51. *Tiphia* (*Tiphia*) *fletcheri* Allen, 1975 — India: Tamil Nadu.
52. *Tiphia* (*Tiphia*) *fuscinervis* Cameron, 1897 — India: Uttarakhand.
53. *Tiphia* (*Tiphia*) *godavariae* Allen, 1975 — India: Delhi, Tamil Nadu. ***Elsewhere*:** Nepal.
54. *Tiphia* (*Tiphia*) *hirsuta* Smith, 1855 — India: Gujarat, Kerala, Uttarakhand, West Bengal. ***Elsewhere*:** Nepal.
55. *Tiphia* (*Tiphia*) *hyalina* Hanima & Girish Kumar, 2022 — India: Karnataka, Tamil Nadu.
56. *Tiphia* (*Tiphia*) *implicata* Cameron, 1897 — India: Uttarakhand.
57. *Tiphia* (*Tiphia*) *incisa* Cameron, 1897 — India: Uttarakhand.
58. *Tiphia* (*Tiphia*) *kashmirensis* Hanima & Girish Kumar, 2019 — India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu, Uttarakhand.
59. *Tiphia* (*Tiphia*) *khasiana* Cameron, 1902 — India: Jammu & Kashmir, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttarakhand.
60. *Tiphia* (*Tiphia*) *knutsoni* Krombein, 1982 — India: Kerala. ***Elsewhere*:** Sri Lanka.
61. *Tiphia* (*Tiphia*) *kurczewskii* Krombein, 1982 — India: Tamil Nadu. ***Elsewhere*:** Sri Lanka.
62. *Tiphia* (*Tiphia*) *kurumba* Hanima & Girish Kumar, 2022 — India: Kerala.
63. *Tiphia* (*Tiphia*) *lawrencei* Allen, 1975 — India: Daman, Kerala, Tamil Nadu, Uttarakhand, West Bengal. ***Elsewhere*:** Thailand.
64. *Tiphia* (*Tiphia*) *levipunctata* Allen & Jaynes, 1930 — India: Arunachal Pradesh, Meghalaya. ***Elsewhere*:** Thailand.

65. *Tiphia* (*Tiphia*) *lotharae* Allen, 1975 — India: Karnataka, Kerala, Tamil Nadu. ***Elsewhere*:** Nepal.
66. *Tiphia* (*Tiphia*) *lyrata* Magretti, 1892 — India: Karnataka, Kerala, Tamil Nadu, Uttarakhand. ***Elsewhere*:** Myanmar.
67. *Tiphia* (*Tiphia*) *madrasa* Allen, 1975 — India: Tamil Nadu.
68. *Tiphia* (*Tiphia*) *magrettii* Cameron, 1897 — India: Uttarakhand.
69. *Tiphia* (*Tiphia*) *milleri* Allen, 1975 — India: Andaman & Nicobar Islands, Kerala (**new record**), West Bengal. ***Elsewhere*:** Nepal.
70. *Tiphia* (*Tiphia*) *murreea* Allen, 1975 — India: Uttarakhand. ***Elsewhere*:** Pakistan.
71. *Tiphia* (*Tiphia*) *nathani* Allen, 1975 — India: Andaman & Nicobar Islands, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttarakhand. ***Elsewhere*:** Thailand.
72. *Tiphia* (*Tiphia*) *nepa* Allen, 1975 — India: Arunachal Pradesh, Jammu & Kashmir, Uttarakhand. ***Elsewhere*:** Nepal.
73. *Tiphia* (*Tiphia*) *nilgirensis* Allen, 1975 — India: Karnataka, Kerala, Tamil Nadu. ***Elsewhere*:** Sri Lanka; Thailand.
74. *Tiphia* (*Tiphia*) *nilgiria* Allen, 1975 — India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu.
75. *Tiphia* (*Tiphia*) *novus* Hanima & Girish Kumar, 2022 — India: Kerala.
76. *Tiphia* (*Tiphia*) *ordinaria* Smith, 1873 — India: Kerala (**new record**), Tamil Nadu.
77. *Tiphia* (*Tiphia*) *orificia* Smith, 1873 — India: Meghalaya.
78. *Tiphia* (*Tiphia*) *palmi* Krombein, 1938 — India: Himachal Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttarakhand, West Bengal. ***Elsewhere*:** Myanmar; Sri Lanka; Thailand.
79. *Tiphia* (*Tiphia*) *pulchaukiae* Allen, 1975 — India: Jammu & Kashmir, Karnataka, Kerala, Tamil Nadu, Uttarakhand. ***Elsewhere*:** Nepal.
80. *Tiphia* (*Tiphia*) *pullivora* Allen and Jaynes, 1930 — India: Meghalaya.
81. *Tiphia* (*Tiphia*) *quinquecarinata* Cameron, 1904 — India: Kerala, Meghalaya, Tamil Nadu, Uttarakhand.
82. *Tiphia* (*Tiphia*) *rajeevani* Hanima & Girish Kumar, 2022 — India: Kerala.
83. *Tiphia* (*Tiphia*) *robusta* Cameron, 1904 — India: Meghalaya.
84. *Tiphia* (*Tiphia*) *rothneyi* Cameron, 1903 — India: Meghalaya.
85. *Tiphia* (*Tiphia*) *rufofemorata* Smith, 1855 — India: Uttarakhand.
86. *Tiphia* (*Tiphia*) *sahyadriensis* Hanima & Girish Kumar, 2022 — India: Tamil Nadu.
87. *Tiphia* (*Tiphia*) *scutensis* Allen, 1975 — India: Meghalaya.

88. *Tiphia* (*Tiphia*) *shajii* Hanima & Girish Kumar, 2022 — India: Kerala.
89. *Tiphia* (*Tiphia*) *shillonga* Allen, 1975 — India: Meghalaya, Uttarakhand. ***Elsewhere*:** Thailand.
90. *Tiphia* (*Tiphia*) *simlaensis* Cameron, 1904 — India: Himachal Pradesh, Meghalaya.
91. *Tiphia* (*Tiphia*) *s-prima* Allen, 1975 — India: Karnataka, Meghalaya.
92. *Tiphia* (*Tiphia*) *s-quarta* Allen, 1975 — India: Meghalaya.
93. *Tiphia* (*Tiphia*) *s-secunda* Allen, 1975 — India: Meghalaya.
94. *Tiphia* (*Tiphia*) *s-sexta* Allen, 1975 — India: Meghalaya.
95. *Tiphia* (*Tiphia*) *s-tertia* Allen, 1975 — India: Meghalaya. ***Elsewhere*:** Thailand.
96. *Tiphia* (*Tiphia*) *tegelonga* Allen, 1975 — India: Meghalaya, Tamil Nadu. ***Elsewhere*:** Thailand.
97. *Tiphia* (*Tiphia*) *tegulita* Allen, 1975 — India: Meghalaya, Tamil Nadu, Uttarakhand. ***Elsewhere*:** Nepal.
98. *Tiphia* (*Tiphia*) *tuberculata* Cameron, 1904 — India: Meghalaya.
99. *Tiphia* (*Tiphia*) *venkataramani* Hanima & Girish Kumar, 2022 — India: Tamil Nadu, Uttarakhand.

CONCLUSION

5. CONCLUSION

5.1. Summary

The present study deals with the alpha taxonomy of family Tiphiidae. As previously stated, knowledge of tiphiid fauna from the Kerala state is very poor (with only 2 species were previously known from the state (Krombein, year)). To address this large gap in knowledge, a taxonomic study of the family Tiphiidae from the Kerala state was done by me. My findings on the study of family Tiphiidae from Kerala are summarised below:

- A total of 40 species belonging to four genera in three subfamilies were recorded from the study area.
- Ten new species from Kerala during the study period.
- Two species were described as new to science in the present thesis with illustrations.
- Nine species were recorded for first time from India which are already published during the study period.
- Twenty four species were new state records from Kerala.
- Male species of *Tiphia* (*T.*) *bijui* Hanima & Girish Kumar and *Tiphia* (*T.*) *lyrata* Magretti were described for the first time with illustrations in the present thesis.
- A dichotomous key to Indian subfamilies, genera (Southern India) and species under each genus and an updated checklist of Tiphiidae of India were provided.
- Co-ordinates using accurate GPS were noted for the collection site of tiphiid specimens and distribution maps were prepared using QGIS online software.

5.2. New species (Described and published)

- *Methocha keralaensis* Hanima & Girish Kumar, 2019
- *Methocha krombeini* Hanima, Girish Kumar & Binoy, 2021
- *Methocha paraceylonica* Hanima, Girish Kumar & Binoy, 2021
- *Tiphia* (*Tiphia*) *bijui* Hanima & Girish Kumar, 2022
- *Tiphia* (*Tiphia*) *davidrajui* Hanima & Girish Kumar, 2022
- *Tiphia* (*Tiphia*) *kashmirensis* Hanima & Girish Kumar, 2019
- *Tiphia* (*Tiphia*) *kurumba* Hanima & Girish Kumar, 2022
- *Tiphia* (*Tiphia*) *novus* Hanima & Girish Kumar, 2022
- *Tiphia* (*Tiphia*) *rajeevani* Hanima & Girish Kumar, 2022
- *Tiphia* (*Tiphia*) *shajii* Hanima & Girish Kumar, 2022

5.3. New species (Described in the thesis)

- *Mesa keralaensis* **sp. nov.**
- *Tiphia* (*Tiphia*) *crassumpunctura* **sp. nov.**

5.4. New country records of India

- *Methocha taprobane* Krombein, 1982
- *Methocha ubiquita* Krombein, 1982
- *Tiphia* (*Tiphia*) *consueta* Smith, 1879
- *Tiphia* (*Tiphia*) *flavipalpis* Allen, 1975
- *Tiphia* (*Tiphia*) *godavariae* Allen, 1975
- *Tiphia* (*Tiphia*) *lotharae* Allen, 1975
- *Tiphia* (*Tiphia*) *lyrata* Magretti, 1892
- *Tiphia* (*Tiphia*) *milleri* Allen, 1975
- *Tiphia* (*Tiphia*) *nepa* Allen, 1975

5.5. New state records of Kerala

- *Hylomesa longiceps* (Turner, 1918)
- *Mesa claripennis* (Bingham, 1897)
- *Mesa dimidiata* (Guérin, 1837)
- *Tiphia* (*Tiphia*) *birganjae* Allen, 1975
- *Tiphia* (*Tiphia*) *brevistigma* Allen & Jaynes, 1930
- *Tiphia* (*Tiphia*) *capillata* Allen & Jaynes, 1930
- *Tiphia* (*Tiphia*) *cinchonae* Allen, 1975
- *Tiphia* (*Tiphia*) *clauseni* Allen & Jaynes, 1930
- *Tiphia* (*Tiphia*) *decrescens* Walker, 1859
- *Tiphia* (*Punctotiphia*) *exacta* Nurse, 1903
- *Tiphia* (*Tiphia*) *flavipalpis* Allen, 1975
- *Tiphia* (*Tiphia*) *hirsuta* Smith, 1855
- *Tiphia* (*Tiphia*) *khasiana* Cameron, 1902
- *Tiphia* (*Tiphia*) *lawrencei* Allen, 1975
- *Tiphia* (*Tiphia*) *lotharae* Allen, 1975
- *Tiphia (Tiphia) lyrata* Magretti, 1892
- *Tiphia* (*Tiphia*) *milleri* Allen, 1975
- *Tiphia* (*Tiphia*) *nathani* Allen, 1975

- *Tiphia* (*Tiphia*) *nilgirensis* Allen, 1975
- *Tiphia* (*Tiphia*) *nilgiria* Allen, 1975
- *Tiphia* (*Tiphia*) *ordinaria* Smith, 1873
- *Tiphia* (*Tiphia*) *palmi* Krombein, 1938
- *Tiphia* (*Tiphia*) *pulchaukiae* Allen, 1975
- *Tiphia (Tiphia) quinquecarinata* Cameron, 1904

5.6. Future Prospects

The present study will serve as a preliminary reference work for the tiphiid fauna of Kerala as it provide a baseline information of these waps and for further studies like biological and molecular aspects of members of this family in Kerala. Prior to this study, only 2 species were reported from Kerala (Krombein, 1982) which represent only a very minor fraction of the fauna of Kerala. The present thesis revealed the occurrence of several taxa of Tiphiidae from Kerala and now the number of species became 40 including 12 new species of which 10 are already published during the study period. Tiphiid wasps play an important role in controlling pests of agricultural crops. The main hosts of tiphiids includes beetles of the family Scarabaeidae, which are considered as serious pests of several plantation crops such as coconut, arecanuts and other crops like sugar cane, etc. In this context, comprehensive survey, collection and identification of tiphiid wasps of Kerala found relevant in agricultural pest control. The molecular and phylogenetic study of these wasps is an exciting area that has yet to be investigated.

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