Rec. zool. Surv. India: Vol. 118(4)/ 337-349, 2018
DOI: 10.26515/rzsi/v118/i4/2018/119059

ISSN (Online) : (Applied for)
ISSN (Print) : 0375-1511

Taxonomic studies on Wasps of Kottooli and Thalassery-Dharmadam Mangroves of Kerala (Insecta: Hymenoptera)

P. Girish Kumar[1]* and K. Rajmohana[2]

[1]Western Ghat Regional Centre, Zoological Survey of India, Kozhikode - 673006, Kerala, India; kpgiris@gmail.com
[2]Zoological Survey of India, M- Block, New Alipore, Kolkata – 700053, West Bengal, India; mohana.skumar@gmail.com

Abstract

A detailed systematic account of wasps of Kottooli and Thalassery-Dharmadam mangroves of Kerala are reported for the first time. Nineteen species of wasps (Vespidae - 16 species; Sphecidae - 3 species) were reported. The species *Antepipona brunnipes brunnipes* (Fabricius, 1804), *A. sibilans* (Cameron, 1903), *Antodynerus punctatipennis* (de Saussure, 1853), *Apodynerus troglodytes troglodytes* (de Saussure, 1855), *Indodynerus capitatus* Gusenleitner, 2008, *Paraleptomenes miniatus mephitis* (Cameron, 1901), *Phimenes flavopictum* (Blanchard, 1845), *Ammophila clavus* Fabricius, 1775 and *Sphex argentatus* Fabricius, 1787 are recorded for the first time from mangrove ecosystem. The species *A. brunnipes brunnipes* is recorded for the first time from India.

Keywords: Bees, Hymenoptera, Mangrove Ecosystem, Wasps

Introduction

Wasps plays significant role in our ecosystem. Most of the wasps are effective predators which help to control the population of many pest insects and spiders. Many of the wasps are parasitic in behaviour and act as effective bio-control agents. Wasps also play as minor pollinators (Naumann, 1991).

Mangrove ecosystem ecologically functions as a complex ecotone or interface zone between the land and sea water, providing diverse habitats with peculiar floral and faunal elements. Mangrove entomofauna remained a neglected field of study in different parts of the world, including India. Only very little information is available on Hymenoptera of mangrove ecosystems. In this paper, a detailed systematic account of wasps of Kottooli and Thalassery mangroves of Kerala are reported for the first time. Kottooli wetland (Figs. 20-22) is the largest eco-patch in the Kozhikode city limits with a rich mangrove habitat. It is situated on the bank of Canolly canal, which is a connecting link between Kallai River and Korappuzha River of Kozhikode district. The Anjarakkandy and Eranjoli Rivers around Thalassery-Dharmadam areas of Kannur district form considerable extend of wetland network system with mangroves.

Material and Methods

The present study is based on collection made from Kottooli and Thalassery-Dharmadam mangroves. The specimens were collected by using sweep net. Most of the vouchered specimens are deposited in the "National Zoological Collections" of the Western Ghats Regional Centre, Kozhikode (WGRC) and few of them in "National Zoological Collections" of the Zoological Survey of India, Kolkata (NZC).

Abbreviations for the Museums: BMNH- The Natural History Museum, London SW7 5BD, England; OLM- Oberösterreichischen Landes museum, Linz, Austria; OUM- Oxford University Museum, Oxford, UK; HMUG- Hunterian Museum, University of Glasgow, Scotland, UK; MCZ- Museum of Comparative Zoology, Harvard University, Cambridge, USA; MNHN- Museum National d'Histoire Naturelle, Paris, France; MP- Muséum National d'Histoire Naturelle, Paris, France; MRSN- Museo Regionale di Scienze Naturali di Torino, Italy; NMNH- National Museum for Natural History, Post bus 9 517, 2300 RA, Leiden, The Netherlands; NZC - Zoological Survey of India, Kolkata, India; UZMC- Universitetets

* *Author for correspondence*

Article Received on: 20.10.2017

Accepted on: 08.06.2018

Zoologiske Museum, Copenhagen, Denmark; ZMUK-Zoological Museum, University of Kiel, Germany.

Abbreviations for the Terms used in the text: H = Head; M = Mesosoma; S = abdominal sterna; T = abdominal terga.

Systematic List
Family VESPIDAE
Subfamily POLISTINAE
Tribe **Polistini**
Genus ***Polistes*** Latrielle, 1802

1. *Polistes (Polistella) stigma tamulus* (Fabricius, 1798)
Tribe **Ropalidiini**
Genus ***Ropalidia*** Guérin-Méneville, 1831

2. *Ropalidia brevita* Das & Gupta, 1989

3. *Ropalidia jacobsoni* (du Buysson, 1908)
Subfamily VESPINAE
Genus ***Vespa*** Linnaeus, 1758

4. *Vespa tropica haematodes* Bequaert, 1936
Subfamily EUMENINAE
Genus ***Allorhynchium*** van der Vecht, 1963

5. *Allorhynchium argentatum* (Fabricius, 1804)

6. *Allorhynchium metallicum* (de Saussure, 1852)
Genus ***Antepipona*** de Saussure, 1855

7. *Antepipona brunnipes brunnipes* (Fabricius, 1804)

8. *Antepipona sibilans* (Cameron, 1903)
Genus ***Antodynerus*** de Saussure, 1855

9. *Antodynerus flavescens flavescens* (Fabricius, 1775)

10. *Antodynerus punctatipennis* (de Saussure, 1853)
Genus ***Apodynerus*** Giordani Soika, 1993

11. *Apodynerus troglodytes troglodytes* (de Saussure, 1855)
Genus ***Delta*** **de** Saussure, 1855

12. *Delta esuriens* (Fabricius, 1787)
Genus ***Indodynerus*** Gusenleitner, 2008

13. *Indodynerus capitatus* Gusenleitner, 2008
Genus ***Paraleptomenes*** Giordani Soika, 1970

14. *Paraleptomenes miniatus mephitis* (Cameron, 1901)
Genus ***Phimenes*** Giordani Soika, 1992

15. *Phimenes flavopictum* (Blanchard, 1845)
Genus ***Rhynchium*** Spinola, 1806

16. *Rhynchium brunneum brunneum* (Fabricius, 1793)
Family SPHECIDAE
Subfamily AMMOPHILILINAE
Genus ***Ammophila*** Kirby, 1798

17. *Ammophila clavus* Fabricius, 1775
Subfamily SCELIPHRINAE
Tribe **Sceliphrini**
Genus ***Sceliphron*** Klug, 1801

18. *Sceliphron madraspatanum madraspatanum* (Fabricius, 1781)
Subfamily SPHECINAE
Tribe **Sphecini**
Genus ***Sphex*** Linnaeus, 1758

19. *Sphex argentatus* Fabricius, 1787

Systematic Account

1. *Polistes (Polistella) stigma tamulus* (Fabricius, 1798) (Fig. 1)

1798. *Vespa tamula* Fabricius, 263. Type ♀, "in India Orientali, Dom Daldorff" (ZMUK).
1996. *Polistes (Polistella) stigma tamulus*; Carpenter: 16.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wetland, 2♀, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8932 & 8933; Kerala, Kannur district, Thalassery mangroves, 1♀ & 1♂, 21.v.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.6800 & 6801.

Diagnosis: S1 without distinct margin at base; T1 about as long as wide; median groove of propodeum shallow, with close fine transverse striations; forewing with subapical fuscous cloud.

Distribution: India: Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Pakistan; Sri Lanka; Vietnam (Sheikh *et al*., 2017).

2. *Ropalidia brevita* Das & Gupta, 1989
(Fig. 2)

1989. *Ropalidia (Anthreneida) brevita* Das & Gupta, 121. Holotype ♂, Delhi: University ridge (NZC).
2007. *Ropalidia brevita*; Kojima et al.: 380.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wetland, 5♀, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8934-8938; Kerala, Kannur district, Thalassery mangroves, Parappuram, 1♀ & 1♂, 16.v.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.6798 & 6799; Kerala, Thalassery mangroves, Parappuram, 1♀, 16.v.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.7256; Kerala, Thalassery mangroves, Kuyyali, 1♂, 15.viii.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.7257; Kerala, Thalassery mangroves, Koduvally, 1♀, 13.viii.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.7258; Kerala, Thalassery mangroves, Nadal, 1♀, 31.vii.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.7259; Kerala, Thalassery mangroves, Nadal, 1♂, 3.vii.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.7260.

Diagnosis: T1 proportionally wider with its maximum width in dorsal view nearly half as wide as that of T2; propodeum with paired, longitudinal basal carinae, with weak transverse striations and scattered shallow punctures between basal carinae; striations lateral to carinae weak; propodeal orifice narrow.

Distribution: India: Assam, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Pakistan (Sheikh *et. al*., 2017).

3. *Ropalidia jacobsoni* (du Buysson, 1908)
(Fig. 3)

1908. *Icaria jacobsoni* du Buysson, 123. Type ♀, Java: Djakarta (= Batavia) (NMNH).

2007. *Ropalidia jacobsoni*; Kojima et al., 386.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wetland, 2♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8939–8940.

Diagnosis: Median furrow of propodeum distinct; T1 in lateral view with dorsal margin more strongly convex in posterior half, highest slightly posterior to level of posterior margin of the sternum.

Distribution: India: Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bangka; Java; Lombok; Myanmar; Sulawesi; Sumatra (Sheikh *et al*., 2017).

4. *Vespa tropica haematodes* Bequaert, 1936
(Fig. 4)

1936. *Vespa tropica* var. *haematodes* Bequaert, 336, 338. Holotype ♀, India: "Kooloo" (MCZ).

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wet land, 2 sterile ♀, 9.ix.2015, Coll. K. Rajmohana, WGRC Regd. Nos. ZSI/WGRS/I.R-INV.4753–4754.

Diagnosis: Body rather large and thick, covered with strong and stiff hairs; clypeus coarsely punctate, apical margin hairy; apical margin of clypeus with broad emargination, its apico-lateral angle triangular; lower vertical area of pronotum with strong transverse ridges near pronotal pit.

Distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Odisha, Pondicherry, Sikkim, Tamil Nadu, Tripura, Uttarakhand, West Bengal. *Elsewhere*: Bhutan; China; Myanmar; Nepal; Pakistan; Sri Lanka; Vietnam (Sheikh *et. al*., 2017).

5. *Allorhynchium argentatum* (Fabricius, 1804)
(Fig. 8)

1804. *Vespa argentata* Fabricius, 260. Type ♂, "Sumatra" (UZMC).
1963. *Allorhynchium argentatum*; van der Vecht, 60 (list), fig. 5a.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wetland, 2♀ & 2♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8941–8944; Kerala, Kannur district, Thalassery mangroves, 1♀, 21.v.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.6805.

Diagnosis: Clypeal apex truncate and emarginate; frons, vertex and temple with close, strong and pit-like punctures, diameter of punctures greater than distance

between punctures; cephalic fovea small but deep with tuft of hairs; posterior face of pronotum, mesoscutum and scutellum with strong, close and pit-like rugose punctures; epicnemial carina distinct at lower half; propodeum vertical, concave posteriorly; forewing with prestigma 0.89x pterostigma; T1 and T2 with medium size, closely arranged and moderately dense punctures.

Distribution: India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Mizoram, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bhutan; Indonesia (Sumatra, Java, Bali, Borneo, Sulawesi); Laos; Malaysia; Myanmar; Nepal; Pakistan; Philippines; Singapore; Thailand (Girish Kumar & Sharma, 2015).

6. *Allorhynchium metallicum* (de Saussure, 1852)
(Fig. 6)

1852. *Rygchium metallicum* de Saussure, 114. Lectotype ♀, Bengal (MP).
1963. *Allorhynchium metallicum*; van der Vecht, 60 (list).

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, Kuyyali, 1♂, 11.vi.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.6971; Kerala, Thalassery mangroves, Koduvally, 1♂, 10.viii.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.7261.

Diagnosis: Median area of clypeus not strongly punctate, diameter of punctures almost equal or less than distance between punctures, interspaces not carinate; T1 and T2 with very small, sparse and very thin punctures except at lateral and apical portions strongly punctured; male antenna with last segment hooked apically and almost reaching apex of tenth antennal segment in curved position; male S7 with distinctly uplifted basal area.

Distribution: India: Andhra Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Lakshadweep Islands, Madhya Pradesh, Maharashtra, Manipur, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Indonesia: Borneo, Moluccas; Maldives Islands; Malaysia: Sarawak; Myanmar; Nepal; Pakistan; Sri Lanka; Taiwan (Sheikh *et. al.*, 2017).

7. *Antepipona brunnipes brunnipes* (Fabricius, 1804)
(Fig. 7)

1804. *Vespa brunnipes* Fabricius, 263, "Sumatra" (UZMC).
2004. *Antepipona brunnipes brunnipes*; Lambert, *in* Rajmohana *et al.*: 557 (key).

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wetland, 1♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. No. ZSI/WGRC/I.R-INV.8945.

Diagnosis: Apex of clypeus with less deep emargination, in shape of a part of circle; apical antennal article strongly curved, long, its apex reaching well beyond base of 11th segment, reaching almost half 10th article; posterior side of propodeum with two short horizontal carinae; S2 not strongly bulging basally; pronotum with regular carina, absent on dorsal side; anterior face of pronotum with two cross impressions at middle, surrounded by smooth area, its sides with large and thick punctures; metanotal teeth, triangular, separated by a distance which not much greater than that which separates them from lateral margins of metanotum.

Distribution: India (new record): Kerala. *Elsewhere*: Indonesia: Sumatra, Java, Bali (Giordani Soika, 1982).

8. *Antepipona sibilans* (Cameron, 1903)
(Fig. 8)

1903. *Odynerus sibilans* Cameron, 129, ♂, Barrackpore" (OUM).
1982. *Antepipona sibilans;* Giordani Soika, 206, 207 (key), 225, figs. 23–28 (syn.: *A. deflendiformis*; India).

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, Koduvally, 1♂, 23.vi.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.6972.

Diagnosis: Apical emargination of clypeus moderately deep; apical antennal article in male hooked, and its apex reaching middle of tenth article; metanotal teeth close to metanotal margin; distance between metanotal teeth twice as much distance between each tooth and lateral metanotal margin; head and mesosoma densely punctate; pronotum with horizontal series of punctures on middle third of anterior face, close to each other and separated by thin carina.

Distribution: India: Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu, Telangana, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Nepal; Pakistan (Girish Kumar et al, 2016).

9. *Antodynerus flavescens flavescens* (Fabricius, 1775)
(Fig. 9)

1775. *Vespa flavescens* Fabricius, 370. Lectotype ♂, "In India Orientali" (UZMC).
2013. *Antodynerus flavescens flavescens*; Girish Kumar & Carpenter, 269, figs. 1-8.

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, 1♀, 16.v.2016, Coll. Sruthi, ZSI/WGRC/I.R.-INV.6802.

Diagnosis: Median area of propodeum with shallow narrow fovea from which median carina runs to orifice, without distinct transverse striae; postero-lateral margin of propodeum rounded, without strong transversely carinate projection, below that with evanescent transverse striae; frons sparsely punctured, diameters of punctures less than distance between punctures; ocellar area almost smooth without punctures; vertex with moderately strong punctures except at middle and area towards occipital carina smooth.

Distribution: India: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Pondicherry, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bangladesh (Sheikh *et. al*., 2017).

10. *Antodynerus punctatipennis* (de Saussure, 1853)
(Fig. 10)

1853. *Odynerus punctatipennis* de Saussure, 210, ♀ (in subgenus *Leionotus*), "les Indes Orientales?" (MP).
1959. *Antodynerus punctatipennis*; van der Vecht, 239-241, figs. 2 (b, d, g, h, m) (India).

Material examined: INDIA: Kerala, Kozhikode district, Kottooli wetland, 3♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8946–8948.

Diagnosis: ♂. Frons, ocellar area and vertex with closely arranged strong punctures, diameter of punctures greater than distance between punctures; antenna with last article hook-like, reaching to base of eleventh segment in curved position; apical tip of aedeagus rounded, parallel spines elongate without hairs.

Distribution: India: Delhi, Karnataka, Kerala, Maharashtra, Sikkim, Uttarakhand, Uttar Pradesh (Girish Kumar & Carpenter, 2013).

11. *Apodynerus troglodytes troglodytes* (de Saussure, 1855)
(Fig. 11)

1855. *Odynerus troglodytes* de Saussure, 249, ♂ (in subgenus *Odynerus* division *Parodynerus*), "Le Sénégal" (MRSN).
1988. *Apodynerus troglodytes troglodytes*; Gusenleitner: 180.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli Wetland, 1♀ & 4♂, 28.vi.2008, Coll. K.C. Gopi & Party, NZC Regd. Nos. 13919/H3 to 13923/H3; Kerala, Kottooli wetland, 1♀ & 5♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8949–8954.

Diagnosis: Clypeal apex emarginate with dentiform angles; occipital carina strong, complete and narrowed ventrally; anterior face of pronotum smooth with group of transverse striations at middle and few punctures on lateral sides; pronotal carina strong, except at middle weak, and reaching lateral margin of pronotum; epicnemial carina distinct; T2 with thin apical lamellae; T1 with strong punctures, diameter of most of punctures more than distance between interspaces; T2 and S2 with distinct, moderately strong punctures, diameter of most of punctures almost equal to distance between interspaces.

Distribution: India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Karnataka, Kerala, West Bengal. *Elsewhere*: Bhutan; China (including Hong Kong); Borneo, Myanmar; Philippines, Thailand; Laos; Malaysia (including Sarawak, Sabah); Singapore; Indonesia: Sumatra, Java (including Kangean), Sulawesi, Moluccas; Vietnam (Girish Kumar *et. al*., 2013).

12. *Delta esuriens* (Fabricius, 1787)
(Fig. 12)

1787. *Vespa esuriens* Fabricius, 293. Syntype, Sex not mentioned, India (BMNH).
1992. *Delta esuriens*: Giordani Soika, 62.

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, Koduvally, 1♀, 27.vii.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.7262.

Diagnosis: Clypeus smooth, its anterior margin transversely truncate at apex; frons closely and strongly punctured; propodeal dorsum strongly punctured except at dorsolateral angle with scattered punctures; pronotum with distinct pretegular carina; forewing with prestigma 0.74x pterostigma; petiole and gaster almost smooth; T2 without lamellae separated by apical thickening.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bhutan; Iran; Iraq; Israel; Laos; Mauritius; Myanmar; New Caledonia; Oman; Pakistan; Qatar; Saudi Arabia; Sri Lanka; Thailand; United Arab Emirates; Vietnam (Sheikh *et. al*., 2017).

13. *Indodynerus capitatus* Gusenleitner, 2008
(Fig. 13)

2008. *Indodynerus capitatus* Gusenleitner, 1500, 1501. Holotype ♀, Karnataka: Sulyamedikeri (OLM).

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, 2♀, 16.v.2016, Coll. Sruthi, ZSI/WGRS/I.R.-INV.6803 & 6804.

Diagnosis: Clypeus with very fine sparse punctures; epicnemial carina absent.

Distribution: India: Chhattisgarh, Karnataka, Kerala, Madhya Pradesh. *Elsewhere*: Pakistan (Sheikh *et al*., 2017).

14. *Paraleptomenes miniatus mephitis* (Cameron, 1901)
(Fig. 14)

1901. *Odynerus mephitis* Cameron, 30, ♂, "Ceylon" (BMNH).
1994. *Paraleptomenes miniatus mephitis*; Giordani Soika, 123 (key), 127 (syn.: *O. rufobimaculatus*; India: Calcutta, Barrackpore, Coimbatore, Orissa; Sri Lanka: Kandy).

Material examined: INDIA: Kerala, Kozhikode district, Kottooli Wetland, 1♀, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. No. ZSI/WGRC/I.R-INV.8955.

Diagnosis: Punctation on T1, T2 & S2 normal, not very coarse and thick; maximum width of T1 0.90-1.10x its median length; scutellum convex; metanotum oblique; clypeus long and pyriform, margined off by carina on each side and longitudinally rugoso-striate between carinae.

Distribution: India: Kerala, Maharashtra, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu, West Bengal. *Elsewhere*: Sri Lanka (Girish Kumar *et al*., 2014).

15. *Phimenes flavopictum* (Blanchard, 1845)
(Fig. 15)

1840. *Eumenes flavopictus* Blanchard, *in* Ch. d'Orbigny, vol. **2**, Ins., Hym., pl. 2, fig. 21, Type locality Unknown (?MNHN).
2013. *Phimenes flavopictum*; Girish Kumar, 120.

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, Koduvally, 1♀, 23.vi.2016, Coll. K. Sruthi, ZSI/WGRS/I.R.-INV.6973.

Diagnosis: Apex of clypeus widely truncate, anterior margin moderately emarginate, sparsely punctate; frons closely and strongly punctate; propodeal dorsum strongly punctate except at dorsolateral angle almost smooth; pronotum with distinct pretegular carina; fore wing with prestigma 1.31x pterostigma; petiole and gaster almost smooth; T2 without lamellae separated by apical thickening, slightly curved inwards medially at apex.

Distribution: India: Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttarakhand, West Bengal. *Elsewhere*: China; Hong Kong; Indonesia; Laos; Malaysia; Myanmar, Nepal; Singapore, Sri Lanka, Thailand; Vietnam (Sheikh *et al*., 2017).

16. *Rhynchium brunneum brunneum* (Fabricius, 1793)
(Fig. 16)

1793. *Vespa brunnea* Fabricius, 264. Syntype: sex not mentioned, "Tranquebariae, India (HMUG)".

1808. *Rhynchium brunneum*; Spinola, 189.

Material examined: INDIA: Kerala, Kannur district, Thalassery mangroves, Koduvally, 1♀, 14.vi.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.6974; INDIA: Kerala,

Kuyyali, 1♀, 22.vi.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.6975; INDIA: Kerala, Kuyyali, 1♂, 22.vii.2016, Coll. K. Sruthi, ZSI/WGRC/I.R.-INV.7263.

Diagnosis: Clypeus strongly convex, pyriform, apical third with broad medial vertical groove, extreme apex truncate, apex of truncated portion slightly incised, with moderately deep punctures, larger punctures on middle and smaller on sides; punctures on tergites large and dense; frons closely, strongly and rugosely punctured, diameters of punctures greater than distance between punctures; mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Odisha, Sikkim, Tamil Nadu, Tripura, Uttarakhand, West Bengal. *Elsewhere*: Afghanistan; Bangladesh; Bhutan; Cambodia; China; Guam, Indonesia; Iran; Iraq; Malaysia; Marquesas Island; Myanmar; Nepal; New Britain; Pakistan; Palau; Seychelles; Society Islands; Sri Lanka; Taiwan; Thailand; Vietnam (Girish Kumar & Sharma, 2015).

Family SPHECIDAE

17. *Ammophila clavus* Fabricius, 1775
(Fig. 17)

1775. *Sphex clavus* Fabricius, 348, sex not indicated (as *clauus*). Holotype or syntypes: ♀, Nova Hollandia, now Australia: no specific locality (BMNH).
1856. *Ammophila clavus*; Smith, 214.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli Wetland, 4♀ & 1♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8959–8963.

Diagnosis: Pronotal collar and scutum distinctly transversely ridged; gastral apex black with blue metallic shine; supra-antennal lamellate projection absent; scutellum and metanotum coarsely longitudinally ridged; episternal sulcus ending at level of scrobe; propodeal enclosure irregularly coarsely rugose along midline, laterally coarsely transversely rugose and glabrous; mesopleuron, metapleuron and propodeum laterally coarsely transversely punctato-rugose; mesothoracic venter anteriorly not prominent; claws without basal tooth.

Distribution: India: Assam, Delhi, Kerala, Maharashtra, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Australia; Indonesia; China; Japan; Laos; Nepal (Pulawski, 2018).

18. *Sceliphron madraspatanum madraspatanum* (Fabricius, 1781)
(Fig. 18)

1781. *Sphex madraspatanus* Fabricius, 445, sex not indicated (as *madraspatana*, incorrect original termination). Lectotype ♂, India: Malabar (BMNH), designated by van der Vecht, 1961: 43.
1892. *Sceliphron madraspatanum*; Mocsáry, 127.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli Wetland, 3♂, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. Nos. ZSI/WGRC/I.R-INV.8956–8958; Kerala, Kannur district, Thalassery mangroves, Kuyyali, 1♀, 11.vi.2016, Coll. K. Sruthi, ZSI/WGRS/I.R.-INV.6976; Kerala, Thalassery mangroves, Kuyyali, 1♂, 15.viii.2016, Coll. K. Sruthi, ZSI/WGRS/I.R.-INV.7264.

Diagnosis: Pronotum, tegulae and metanotum with yellow markings; inner side of mandibles with more or less distinct tooth; hind coxae normal, rounded on outer side; terminal gastral sternite slightly convex, not keeled; lower half of inner eye margins distinctly converging towards clypeus.

Distribution: India: Assam, Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharashtra, Meghalaya, Pondicherry, Sikkim, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal. *Elsewhere*: Myanmar; Nepal; Sri Lanka; Maldives; Thailand; Laos; Vietnam; Cambodia; Malaysia; Indonesia (Pulawski, 2018).

19. *Sphex argentatus* Fabricius, 1787
(Fig. 19)

Sphex argentatus Fabricius, 1787: 274, sex not indicated (as *argentata*, incorrect original termination). Lectotype: ♀, India: Coromandel (= southeastern coast): no specific locality (UZMC), designated by van der Vecht 1961: 28.

Material examined: INDIA: Kerala, Kozhikode district, Kottooli Wetland, 1♀, 7.v.2016, Coll. P. Girish Kumar, ZSIK Regd. No. ZSI/WGRC/I.R-INV.8964.

Diagnosis: Tubercles on metanotum distinct; fore basitarsal rake with 10 long spines; free clypeal margin with two inconspicuous lobes medially, distance between them less than 1/8 length of flagellomere II; distance between hind ocelli 0.8× their shortest distance to compound eyes; scutellum flat, with shallow medial impression near posterior margin; length of petiole 1.4× length of flagellomere II; tomentum sparse on metasomal tergum I, absent on tergum II.

Distribution: India: Assam, Kerala, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere*: Widely distributed (Pulawski, 2018).

Acknowledgements

The authors are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata, for providing facilities and encouragements. PGK is also grateful to Dr. P.M. Sureshan, Officer-in-Charge, Western Ghats Regional Centre, Zoological Survey of India, Kozhikode, for providing facilities and encouragements and to Miss. Sruthi, Department of Zoology, Kannur University, Mananthavady Campus, for providing specimens collected from Thalassery Mangroves.

References

Bequaert, J. 1936. The common Oriental hornets, Vespa tropica and Vespa affinis and their color forms. *Treubia*, **15**: 329- 351.

Blanchard, E. 1840. Classe des Insectes. In: d'Orbigny, C., Dictionnaire universel d'Histoire naturelle. Atlas, Tome II, Zoologie. Abel, Pilon et Cie, Éditeurs, Paris, pp. 9-22.

Buysson, R. du. (1908). Deux Hyménoptè res nouveaux de Java. *Notes from the Leiden Museum*, **30**: 123-126.

Cameron, P. 1901. On the Hymenoptera collected during the "Skeat Expedition" to the Malay Peninsula, 1899-1900. *Proc. Zool. Soc. London*, **1901**(2): 16–44.

Cameron, P. 1903. Description of nineteen new species of Larridae, Odynerus and Apidae from Barrackpore. *Trans. Entomol. Soc. London*, **1903**: 117-132.

Carpenter, J.M. 1996. Distributional checklist of the species of the genus Polistes (Hymenoptera: Vespidae; Polistinae, Polistini). *Amer. Mus. Novitates*, **3188**: 1-39.

Das, B.P. and Gupta, V.K. 1989. The social wasps of India and the adjacent countries (Hymenoptera: Vespidae). *Orient. Ins. Monograph*, **11**: 1-292. https://doi.org/10.1080/00305316.1989.11835532

Fabricius, J.C.F. 1775. Systema Entomologiae, sistens Insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus. Kortii, Flensburgi et Lipsiae [= Flensburg and Leipzig]. [1-32], 1-832 pp.

Fabricius, J.C.F. 1781. Species Insectorum exhibentes eorum differentias specificas, synonyma auctorum, loca natalia, metamorphosin adiectis observationibus, descriptionibus, 1. Carol. Ernest. Bohnii, Hamburgi et Kilonii [= Hamburg and Kiel]. I-VIII, 1-517 pp.

Fabricius, J.C.F. 1787. Mantissa Insectorum sistens eorum species nuper detectas adiectis characteribus genericis, differentiis specificis, emendationibus, observationibus, Vol. 1. Christ. Gottl. Proft, Hafniae [= Copenhagen]. I–XX+ 1–348 pp.

Fabricius, J.C.F. 1793. Entomologia Systematica Emendate etacuta. Secundum, Classes, Ordines, Genera, Species, Adiectis Synonymis, Locis, Observationibus, Descriptionibus 2. Hafniae, viii+519pp.

Fabricius, J.C.F. 1798. Supplementum entomologiae systematicae. [2]+572 pp. Hafniae.

Fabricius, J.C.F. 1804. Systema Piezatorum Secundum, Ordines, Genera, Species, Adiectis Synonymis, Locis, Observationibus, Descriptionibus. Brunschweig, XIV+[15]-[440]+[1]-30pp.

Giordani Soika, A. 1982. Revisione delle specie orientali del genere Antepipona Sauss. *Boll. Mus. civ. Stor.nat. Venezia*, **32**: 205-257.

Giordani Soika, A. 1992. Di Alcuni Eumenidi Nuovi O Poco Noti (Hymenoptera Vespoidea). *Lavori- Soc. Ven. Sc. Nat.*, **17**: 41-68.

Giordani Soika, A. 1994. Ricerche sistematiche su alcuni generi di Eumenidi della Regione Orientale e della Papuasia. *Ann. Mus. civ. stor. nat. "Giacomo Doria"*, **90**: 1-348.

Girish Kumar, P. 2013. A taxonomic revision of Phimenes Giordani Soika (Hymenoptera: Vespidae: Eumeninae) of Indian subcontinent. *Rec. zool. Surv. India*, **113**(Part-3): 119-135.

Girish Kumar, P. and Carpenter J.M. 2013. A taxonomic review of the genus Antodynerus de Saussure, 1855 (Hymenoptera: Vespidae: Eumeninae) from the Indian subcontinent. *Zootaxa*, **3731**(2): 267-278. https://doi.org/10.11646/zootaxa.3731.2.7

Girish Kumar, P., Carpenter, J.M. and Gaurav Sharma, 2014. A review of the genus Paraleptomenes Giordani Soika, 1970 (Hymenoptera: Vespidae: Eumeninae: Odynerini) from the Indian subcontinent, with the description of a new species from the eastern Himalayas. *Zootaxa*, **3802**(1): 131-143.

Girish Kumar, P., Carpenter, J.M. and Sureshan, P.M. 2016. A taxonomic review of the genus Antepipona de Saussure, 1855 (Hymenoptera: Vespidae: Eumeninae) from India. *Zootaxa*, **4150**(5): 501-536. https://doi.org/10.11646/zootaxa.4150.5.1

Girish Kumar, P. and Gaurav Sharma, 2015. Taxonomic studies on vespid wasps (Hymenoptera: Vespoidea: Vespidae) of Chhattisgarh. *Journal of Threatened Taxa,* **7**(14): 8096-8127. https://doi.org/10.11609/jott.2426.7.14.8096-8127

Girish Kumar, P., Mohammed Shareef, K.P., Lambert Kishore and Carpenter J.M. 2013. A taxonomic study on the Oriental genus Apodynerus Giordani Soika (Hymenoptera: Vespidae: Eumeninae) from the Indian subcontinent. *Biosystematica,* **7**(1): 23-31.

Gusenleitner, J. 1988. Über Eumenidae aus Thailand, mit einer Bestimmungstabelle fürorientalischer Labus- Arten (Hymenoptera Vespoidea). *Linzer Biol. Beitr*, **20**(1): 173-198.

Gusenleitner, J. 2008. Bemerkenswerte Faltenwespen-Funde aus der orientalischen region Teil 4. Mit einem Anhang uber eine Art aus Neu-Kaledonien (Hymenoptera, Vespidae, Eumeninae). *Linzer biol. Beitr*, **40**(2): 1495-1503.

Kojima, J, Lambert, K, Nguyen, L.T.P. and Saito, F. 2007. Taxonomic notes on the paper wasps of the genus Ropalidia in the Indian subcontinent (Hymenoptera: Vespidae). *Entomol. Sci*, **10**: 373-393. https://doi.org/10.1111/j.1479-8298.2007.00237.x

Lambert, K. 2004. Two new species and a new subspecies of Antepipona Saussure (Hymenoptera: Vespidae) from India with a key to species. In: Rajmohana, K., Sudheer, K., Kumar, P.G. & Santhosh, S. (Eds.), Perspectives on Biosystematics and Biodiversity, Prof. T. C. Narendran Commemoration Volume. SERSA, Kerala, pp. 553–566.

Mocsáry, A. 1892. Hymenoptera in expeditione comitis Belae Szechenyi in China et Tibet a dom. G. Kreitner et L. Lóczy anno 1879 collecta. *Természetrajzi Füzetek*, **15**: 126-131.

Naumann, I.D. 1991. Hymenoptera (Wasps, bees, ants, sawflies). In: The Insects of Australia. A text book for students and research workers. 2nd Edition. Carlton Vic.: Melbourne University Press, CSIRO, pp. 916-1000.

Pulawski, W.J. 2018. Catalog of Sphecidae. Available on: http://research.calacademy. org/ent/catalog_sphecidae

Saussure, H. De. 1852-1858. Etudes sur la famille des vespides. Vols. 1-3. V. Masson & Cherbuliez, Paris & Geneva.

Sheikh, A.H., Girish Kumar, P., Bhandari, R. and Thomas, M. 2017. Taxonomic studies on vespid wasps (Hymenoptera: Vespoidea: Vespidae) of Dumna Nature Reserve Park, Jabalpur, Madhya Pradesh. *Records of Zoological Survey of India*, **117**(3): 198-213. DOI: https://doi.org/10.26515/rzsi/v117/i3/2017/119330

Smith, F. 1856. Catalogue of hymenopterous insects in the collection of the British Museum. Part IV. Sphegidae, Larridae and Crabronidae. Taylor and Francis, London. 207-497 pp.

Spinola, M. 1806-1808. Insectorum Liguriae. Species novae aut rariores 2. Genua (Y. Gravier): 262 pp.

Vecht J. van der. 1959. On some Fabrician types of Indo-Australian Vespidae (Hymenoptera). *Arch. Neerland. Zool*., **13**, Suppl. 1, 234-247, 4 figs. Leiden.

Vecht J. van der. 1961. Hymenoptera Sphecoidea Fabriciana. Zool. Verhandel., **48**: 1-85.

Vecht J. van der. 1963. Studies on Indo-Australian and East Asiatic Eumenidae (Hymenoptera: Vespoidea). *Zool. Verh. Leiden*, **60**: 1-116.

Plate 1

1. *Polistes (Polistella) stigma tamulus* (Fabricius), female.

2. *Ropalidia brevita* Das & Gupta, male.

3. *Ropalidia jacobsoni* (du Buysson), male.

4. *Vespa tropica haematodes* Bequaert, sterile female.

5. *Allorhynchium argentatum* (Fabricius), male.

6. *Allorhynchium metallicum* (de Saussure), male.

Plate 2

7. *Antepipona brunnipes brunnipes* (Fabricius), male.

8. *Antepipona sibilans* (Cameron), male.

9. *Antodynerus flavescens flavescens* (Fabricius), female.

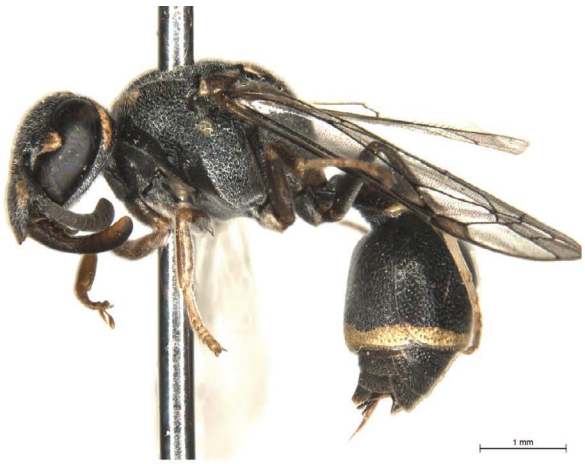
10. *Antodynerus punctatipennis* (de Saussure), male.

11. *Apodynerus troglodytes troglodytes* (de Saussure), female.

12. *Delta esuriens* (Fabricius), female.

Plate 3

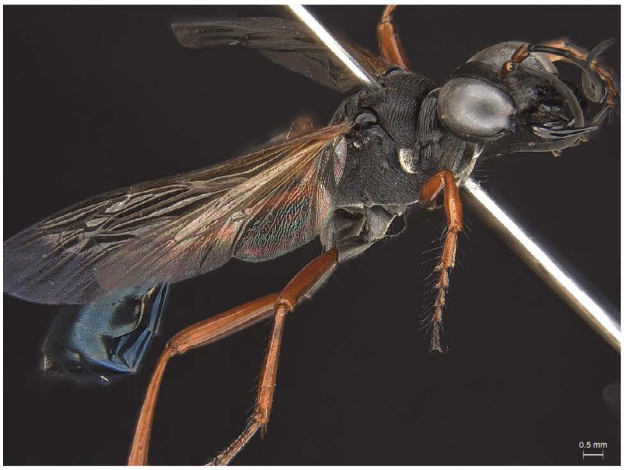
13. *Indodynerus capitatus* Gusenleitner, female.



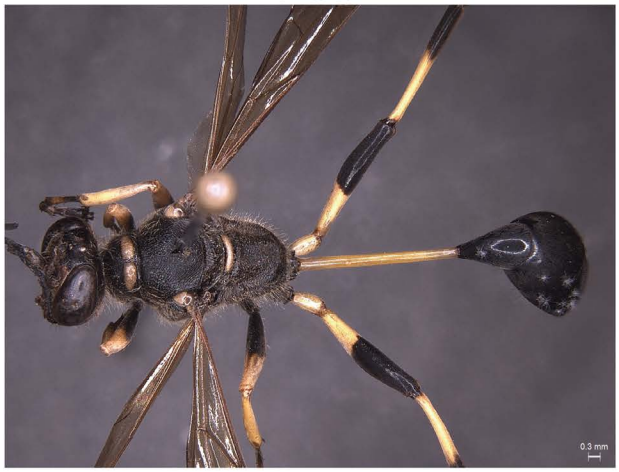
14. *Paraleptomenes miniatus mephitis* (Cameron), female.

15. *Phimenes flavopictum* (Blanchard), female.

16. *Rhynchium brunneum brunneum* (Fabricius), female.



17. *Ammophila clavus* Fabricius, female.



18. *Sceliphron madraspatanum madraspatanum* (Fabricius), female.

Plate 4

19. *Sphex argentatus* Fabricius, female.

20. Kottooli wetland, a collection locality.

21. Kottooli wetland, a collection locality.

22. Kottooli wetland, a collection locality.