



Taxonomic studies on Vespid Wasps (Hymenoptera: Vespoidea: Vespidae) of Dumna Nature Park, Jabalpur, Madhya Pradesh

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Abstract

The diversity of wasps of the family Vespidae from Dumna Nature Park, Jabalpur, Madhya Pradesh is studied. It consists of 20 species with an additional subspecies belonging to 11 genera under 3 subfamilies. Out of these, 13 species and an additional subspecies are newly recorded here from Madhya Pradesh. The parasitic association of strepsipteran insects are also reported for the first time in the genus *Delta*.

Keywords: Dumna Nature Park, Ethology, Hymenoptera, Madhya Pradesh, New Record, Vespidae, Vespoidea

Introduction

Dumna Nature Park (DNP) is located about 10 km from Jabalpur city in Madhya Pradesh. DNP has an area of 1058 ha. Geographically Jabalpur is situated between coordinates 23° 10', 79° 57', at 460 m above the sea level. DNP is a forest owned by Jabalpur Municipal Corporation, and is managed by Department of Forest, Government of Madhya Pradesh. The dense forest has also a water reservoir, Khandari Lake. Besides a range of herbivores and carnivores in DNP, it also has an aquatic ecosystem that serves as a valuable habitat for migratory birds. Apart from being a bio-diversity zone, an eco tourist spot, DNP also attracts numerous educational institutions for student's expedition. Since its establishment, no efforts have been made to study the insect diversity in the Park. This paper focuses on the vespid wasps (Hymenoptera: Vespidae) diversity in the Park.

Material and Methods

The present study for collecting wasps was conducted during the year 2014-2015, by using Sweep net and Light trap. The insects collected were transferred to killing bottle and immediately brought to the Zoological laboratory of Government Science College, Jabalpur for setting them on the insect setter. The specimens were initially segregated, counted and digitally photographed before preserving them for identification. All the specimens were later transferred to ZSI Calicut for the identification.

The following abbreviations used in the text for the Museums: BMNH — Natural History Museum (or British Museum of Natural History), London, UK; LS — Linnaean Society, London, UK; MCZ — Museum of Comparative Zoology, Harvard University, Cambridge, USA; MP — Museum national d'Histoire naturelle, Paris, France; MRSN — Museo Regionale di Scienze Naturali,

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Torino, Italy; MSNG — Museo Civico di Storia Naturale di Genova Giacomo Doria, Genova, Italy; NMNH — National Museum for Natural History, Post bus 9 517, 2300 RA, Leiden, The Netherlands; NZC — Zoological survey of India, Kolkata, India; OLM — Oberosterreichischen Landes museum, Linz, Austria; ZMB — Zoologisches Museum der Humboldt Universität, Berlin, Germany; ZMUC — Zoologisk Museum, Københavns Universitet, Denmark; ZMUK — Zoological Museum, University of Kiel, Germany.

Abbreviations used for the terms: H = Head; M = Mesosoma; OOL = Ocellular length; POL = Posterior ocellar length; S = Abdominal sterna; T = Abdominal terga.

Results

In this paper, we are reporting 20 species with an additional one subspecies belonging to 11 genera and 3 subfamilies of which 13 species with an additional one subspecies are the first report from Madhya Pradesh. The parasitic association of strepsipteran insects is reported here for the first time in the potter wasp genus *Delta*.

Systematic List

Order HYMENOPTERA
Superfamily VESPOIDEA
Family VESPIDAE
Subfamily POLISTINAE
Tribe **Polistini**

Genus *Polistes* Latreille, 1802

Subgenus *Polistes (Gyrostoma)* Kirby, 1828

1. *Polistes (Gyrostoma) wattii* Cameron, 1900

Subgenus *Polistes (Polistella)* Ashmead, 1904

2. *Polistes (Polistella) stigma tamulus* (Fabricius, 1798)

3. *Polistes (Polistella) strigosus strigosus* Bequaert, 1940

Tribe **Ropalidiini**

Genus *Ropalidia* Guerin-Meneville, 1831

4. *Ropalidia brevita* Das & Gupta, 1989

5. *Ropalidia marginata* (Lepeletier, 1836)

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

Subfamily VESPINAE

Genus *Vespa* Linnaeus, 1758

7. *Vespa auraria* Smith, 1852

8. *Vespa orientalis* Linnaeus, 1771

9. *Vespa tropica haematodes* Bequaert, 1936

Subfamily EUMENINAE

Genus *Allorhynchium* van der Vecht, 1963

10. *Allorhynchium metallicum* (de Saussure, 1852)

Genus *Antepipona* de Saussure, 1855

11. *Antepipona ovalis* (de Saussure, 1853)

Genus *Anterhynchium* de Saussure, 1863

12. *Anterhynchium abdominale* (Illiger, 1802)

12a). *Anterhynchium abdominale abdominale* (Illiger, 1802)

12b). *Anterhynchium abdominale bengalense* (de Saussure, 1852)

Genus *Antodynerus* de Saussure, 1855

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

Genus *Delta* de Saussure, 1855

14. *Delta conoideum* (Gmelin, 1790)

15. *Delta dimidiatipenne* (de Saussure, 1852)

16. *Delta esuriens* (Fabricius, 1787)

17. *Delta pyriforme pyriforme* (Fabricius, 1775)

Genus *Indodynerus* Gusenleitner, 2008

18. *Indodynerus capitatus* Gusenleitner, 2008

Genus *Phimenes* Giordani Soika, 1992

19. *Phimenes flavopictum* (Blanchard, 1840)

Genus *Rhynchium* Spinola, 1806

20. *Rhynchium carnaticum* (Fabricius, 1798)

Systematic Account

1. *Polistes (Gyrostoma) wattii* Cameron, 1900

1900. *Polistes wattii* Cameron, 416. Type: Female, West Bengal (BMNH).

1996. *Polistes (Gyrostoma) wattii*; Carpenter, 9.

Diagnosis: Female: Occipital carina complete; dorsal and ventral metapleuron impunctate; striations on propodeum weak, not distinct near lower margin of side.

Colour description: Almost uniform yellow colour; hind tibia above usually black; narrow transverse reddish brown line on T1 after middle, T2 to T5 and S2 to S5 with bisinuate reddish brown line.

Size (H+M+T1+T2): 12.5-13.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 4♀, 10.iv.2014 & 18.ix.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Madhya Pradesh, Meghalaya, Odisha, Punjab,

Rajasthan, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Afghanistan, China, Iran, Iraq, Mauritius, Oman, Pakistan, Saudi Arabia, U.A.E.

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

Diagnosis: Female: 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.

Colour Description: Body predominantly reddish with some black markings and following yellow markings: clypeus, mandible, broad line along inner orbit up to lower half of ocular sinus, line on temple bordering eye margin, malar space, basal and apical margin of pronotum narrowly, line on scutellum at base, another on metanotum at base, mark on subtegular area, elongated mark on mesepisternum at top and another in middle of apical-lateral margin in front of metapleuron, raised ventral margin of mesepisternum and ventral metapleuron each, mark on dorsal metapleuron, two lines on mesosternum, two broad curved marks on propodeum, apical valvula entirely, fore coxa in front entirely, marks on mid coxa in front and two lines on hind coxa below, T1 except broad reddish mark at base, apical broad band on T3 and S3, fourth gastral segment almost entire

Size (H+M+T1+T2): 14.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 6♀, 18.ix.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Bihar, Chhattisgarh, Delhi, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh (new record), Maharashtra, Meghalaya, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Pakistan, Sri Lanka.

3. *Polistes (Polistella) strigosus strigosus* Bequaert, 1940
1940. *Polistes strigosus* Bequaert, 269-272. Holotype Female, China: Wong-Sa-Shui (MCZ).

1983. *Polistes (Polistella) strigosus strigosus*; Das & Gupta, 415.

Diagnosis: Female: Pronotum ribbed; head narrower than mesosoma; forewing without subapical fuscous cloud; median groove of propodeum deep, with strong transverse striations; S1 with distinct margin at base.

Colour Description: Body almost entirely and uniformly ferruginous, with ocellar region, flagellum above and some sutures of head and mesosoma black; T2 almost entirely yellow; wings yellowish, paler apically.

Size (H+M+T1+T2): 14.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 2♀, 29.iv.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Chhattisgarh, Madhya Pradesh (new record). *Elsewhere*: China, Taiwan.

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

Diagnosis: Female: 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 striation and scattered shallow punctures between basal carinae; striations lateral to carinae weak; propodeal orifice very narrow.

Colour Description: Body red with following yellow portions: antennal scape below, band on clypeus at apex, mandible (except at tip), inner orbit below ocular sinus (sometimes faint), pronotum anteriorly, two marks on metanotum (sometimes fused), two enlarged marks on apical half of propodeum, faint mark on sides of mesosternum, fore and middle coxae in front, line on lateral side of hind coxa, tarsal segments of all legs (highly variable), narrow apical band on T1 and broad apical band on T2. In some portions black patches are mixed with reddish body. The extents of yellow and black markings are variable.

Size (H+M+T1+T2): 12 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 4♀, 5.xi.2015, Coll. Altat Hussain Sheikh.

Distribution: India: Assam, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh (new record), Odisha, Rajasthan, Sikkim, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Pakistan.

5. *Ropalidia marginata* (Lepeletier, 1836)

1836. *Epipona marginata* Lepeletier, 541. Type, "Inde" (? MRSN).

2007. *Ropalidia marginata*; Kojima *et al.*, 380.

Diagnosis: Female: Head wider than mesosoma in front of tegulae; propodeum with paired, longitudinal basal carinae, with weak transverse striation and scattered shallow punctures between basal carinae; striation lateral to carinae weak; propodeal orifice very narrow; forewing with three cubital cells; epicnemium smooth.

Colour Description: Body reddish brown. Following parts with yellow markings: Mandible with large mark, apical margin of clypeus broadly, broad band along inner orbit up to ocular sinus, line on ventral side of scape, narrow line on basal margin of pronotum, two large marks on scutellum and metanotum, two marks on mesopleuron, two elongated marks on apical half of propodeum, fore coxa entirely in front, middle and hind coxa with lines (sometimes absent), T1 and T2 with apical narrow fascia. Wings yellowish hyaline, apical half of radial cell dark brown, stigma yellow.

Size (H+M+T1+T2): 11-12 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 5♀, 16.x.2015, Coll. Altat Hussain Sheikh.

Distribution: Andhra Pradesh, Chhattisgarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Australia, Bali, Bangka, Borneo, Java, Kariman Djawa, Lombok, Malay Peninsula, Mariana Islands, Myanmar, New Britain, New Guinea, Pakistan, Palau Islands, Philippines, Sri Lanka, Sulawesi, Sumatra, Sumba, Sumbawa, Talud Islands, Tukang Besi Islands, Vietnam, Volcano Islands.

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

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

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

Diagnosis: Female: 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 sternum.

Colour Description: Body reddish brown with yellow and black markings. Yellow markings as follows: mandible except at tip and at base brown, clypeus except characteristic black mark, mark on inter antennal space, inner orbit up to ocular sinus broadly, ventral side of antenna, narrow line along pronotal carina, basal and lateral margin of scutellum broadly, two large marks on metanotum, small mark on the upper part of mesopleuron just below subtegular area, two broad marks on propodeum separated by broad black line along median groove, inner side of tegula, fore and mid coxae in front, line on hind coxa laterally, line below fore femur, small mark on middle femur laterally, narrow line on all tibiae above, fore and mid basi-tarsi above, T2 with large mark on each side at base and broad apical band on T2 and S2, become narrow towards middle on S2. Black markings as follows: mark on clypeus at base, supraclypeal area, large circular spot above each antennal socket, mark around each ocellus, occiput, basal area of anterior face of pronotum, margins of mesoscutum narrowly but apical margin towards scutellum broadly, narrow vertical line on scutellum up to one-third from base, propleuron, dorsal metapleuron, ventral metapleuron apically towards mesopleuron broadly, mesosternum, broad median line separating the yellow marks and basal and apical margin of propodeum narrowly. Wings transparent hyaline with apical half of radial cell brown, stigma yellow.

Size (H+M+T1+T2): 6.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♀, 10.x.2015, Coll. Altat Hussain Sheikh.

Distribution: India: Assam, Chhattisgarh, Delhi, Karnataka, Kerala, Madhya Pradesh (new record), Maharashtra, Rajasthan, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere:* Bangka, Java, Lombok, Myanmar, Sulawesi, Sumatra.

7. *Vespa auraria* Smith, 1852

1852. *Vespa auraria* Smith, 46. Type: Female, "Northern India" (BMNH).

Diagnosis: Male: Clypeus moderately convex, its apical third depressed and punctate; temple less than 1.8x as wide as eye; posterior ocelli less than 3x farther from occiput than from eye; interocular distance shorter than ocellular distance.

Colour Description: Body black with following reddish brown markings: head, pronotal collar posteriorly, pronotum, tegula, scutellum, two lateral spots on metanotum and propleuron ventrally. Antenna reddish brown. Mandible concolorous with clypeus except at apex including teeth black. Mesoscutum black with U-shaped mark touching scutellum. Fore leg yellowish brown except inner basal corner of coxa, trochanter and basally in front of femur black. Mid and hind legs black except at apex of femur, apex of tibia and tarsi entirely yellowish brown to yellow. Bases of T1 and T2 brownish black, their margins and visible part of following segments yellowish brown. Base of S2 brownish black, their margins and visible part of following sternites yellowish brown. Wings brownish hyaline. Body covered with fine blackish erect hairs; metasoma with velvet appearance.

Size (H+M+T1+T2): 15 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♂, 15.xi.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Arunachal Pradesh, Assam, Chhattisgarh, Jammu & Kashmir, Jharkhand, Himachal Pradesh, Madhya Pradesh, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Afghanistan, China, Laos, Malaysia, Myanmar, Nepal, Pakistan, Thailand, Yemen.

8. *Vespa orientalis* Linnaeus, 1771

1771. *Vespa orientalis* Linnaeus, 540. Holotype female, "Oriente" (LS).

Diagnosis: Sterile female: Clypeus rather flat and elongate, as wide as long or little longer, with scattered moderate sized punctures, in females apical margin emarginate with rounded lateral lobes. Hairs on head and thorax short,

sparse, stiff and bristle-like; gaster almost hairless dorsally.

Colour Description: Body brown with clypeus, frons, scape ventrally, apical margin of T1 narrowly, T3 & T4 almost entirely, posterolateral corner of S2, S3 almost entirely and S4 partly yellow. T3 & T4 with blackish brown spot laterally. Yellow marks on T1 emarginate medially; T3 with median triangular blackish mark basally.

Size (H+M+T1+T2): 17- 22 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 2♀, 28.x.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Andhra Pradesh, Bihar, Delhi, Haryana, Jammu & Kashmir, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand, West Bengal. *Elsewhere:* Afghanistan, Albania, Algeria, Bahrain, Bulgaria, China, Cyprus, Egypt, Ethiopia, Greece, Iran, Iraq, Israel, Italy, Jordan, Lebanon, Libya, Madagascar, Malta, Nepal, Oman, Palestine, Pakistan, Romania, Russia, Saudi Arabia, Somalia, Syria, Tajikistan, Turkmenistan, Turkey, U.A.E., Uzbekistan, Yemen.

9. *Vespa tropica haematodes* Bequaert, 1936

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

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

Colour Description: Head and antenna reddish brown; pronotum dorsally and scutellum reddish brown; mesoscutum anteriorly with two short reddish brown lines; legs partly reddish brown; gaster blackish brown to black except T2 yellow with slight brown area basally and S2 yellow with large brown area basally.

Size (H+M+T1+T2): 20.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♀, 26.xi.2015, Coll. Altaf Hussain Sheikh.

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

10. *Allorhynchium metallicum* (de Saussure, 1852)

1852. *Ryngchium metallicum* de Saussure, 114. Lectotype: Female, Bengal (MP).

1963. *Allorhynchium metallicum*; van der Vecht, 60 (list).

Diagnosis: Female: 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.

Colour Description: Body entirely black except yellow line in between antennal toruli and inner eye margin; tarsal claws blackish brown; wings fusco-hyaline, broadly dark fuscous with purplish reflections along costal margin of forewing.

Size (H+M+T1+T2): 11 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♀ & 2♂, 21.ix.2015, Coll. Altat Hussain Sheikh.

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.

11. *Antepipona ovalis* (de Saussure, 1853)

1853. *Odynerus ovalis* de Saussure, 215. Type, "Les Indes Orientales; Pondichery" (MSNG).

1970. *Antepipona ovalis*; van der Vecht, 16, figures 1-2.

Diagnosis: Female: Clypeus very wide, weakly emarginated, with few small punctures; mesopleuron moderately punctate; metanotum with very small teeth, close to lateral metanotal margin; posterior side of propodeum without carinae; S2 not bulging at base.

Colour Description: Black, with apex of mandible, lower face of funicular segments and tarsal segments ferruginous. Yellow: base of mandible; clypeus; scape except black line on upper surface toward apex; quadrangular mark on lower half of front, base distinctly wider than apex; large stain on ocular sinus, which bulges out to lower frons, reaching up to clypeus; large stain on temple; broad band on dorsal surface of pronotum; broad mark on mesepisternum; scutellum except posterior margin; metanotum; two large spots on propodeum; tegula; parategula; front face of all coxae; fore and mid femora; hind femur posteriorly; all tibiae; T1 with large apical band, wider at middle, together with two large lateral spots; T2 with two large lateral spots at base, and it connecting to apical band, which greatly enlarged at middle and on sides; T3-T5 with comparatively narrow band, but strongly dilated at sides; round spot on T6; two broad spots at base of S2; large apical band, strongly enlarged at middle and sides on S2-S4. Wings slightly browned.

Size (H+M+T1+T2): 7 mm.

Male: Clypeus much wider than long, with large emargination at apex; last antennal article of medium size, slightly arched, rapidly narrowed from base to apex, which reaching to end of tenth article.

Size (H+M+T1+T2): 6 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 3♀ & 1♂, 3.xii.2015, Coll. Altat Hussain Sheikh.

Distribution: India: Chhattisgarh, Karnataka, Kerala, Madhya Pradesh (new record), Maharashtra, Odisha, Pondicherry, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere:* Afghanistan, China, Sri Lanka.

12. *Anterhynchium abdominale* (Illiger, 1802)

Diagnosis: Clypeus with weak punctures, from middle of clypeus to apex with few irregular longitudinal striations; narrow basal part of S1 smooth; gastral tergites only finely punctate at base; basal two thirds of T2 very finely and shallowly punctate, interspaces everywhere much larger than punctures; mandibles of male deeply emarginate on inner side near middle.

12a). *Anterhynchium abdominale abdominale* (Illiger, 1802)

1802. *Vespa abdominalis* Illiger, 192. Type: "Bengalen" (?ZMB).

1963. *Anterhynchium abdominale*; van der Vecht, 75, figure 5e.

Colour Description: Female: Head and mesosoma black; metasoma dull orange-red with variegated black markings as follows: basal segment with transverse black apical band, T2 with or without transverse black spot in middle of its apical margin, remaining segments usually orange-red except last segment black, gastral sternites usually orange-red with varying degree of black colour except last segment entirely black. Brown colouration as follows: ventral side of antenna and tarsal segments (sometimes black). Wings dark fuscous with purple reflections.

Size (H+M+T1+T2): 12-14.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 6♀, 11.viii.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Chhattisgarh, Delhi, Jharkhand, Karnataka, Kerala, Madhya Pradesh (new record), Odisha, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal. *Elsewhere:* Myanmar, Pakistan, Sri Lanka, Vietnam.

12b). *Anterhynchium abdominale bengalense* (de Saussure, 1852)

1855. *Rhynchium bengalense* de Saussure, 176. Type: "Le Bengale" (MP).

1963. *Anterhynchium abdominale bengalense*; van der Vecht, 76.

Colour Description: Female: Body black. Wings dark fuscous with violet reflections.

Size (H+M+T1+T2): 13-14 mm.

Male: Body black (sometimes ventral side of antenna, apical tarsal segments and lateral sides of tergites reddish brown except last segment). Clypeus almost entirely yellow with lateral and apical margins black and scape in front yellow. Wings dark fuscous with violet reflections.

Size (H+M+T1+T2): 11-11.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 2♀ & 2♂, 11.viii.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Bihar, Chhattisgarh, Delhi, Kerala, Madhya Pradesh (new record), Punjab, Rajasthan, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Nepal.

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

1775. *Vespa flavescens* Fabricius, 370. Lectotype: Male, "In India Orientali" (ZMUC).

2013. *Antodynerus flavescens flavescens*; Girish Kumar & Carpenter, 269, figures. 1-8.

Diagnosis: Female: 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.

Colour Description: Body brownish red with yellow, white and black marks. Usually brownish red colour mixed with yellow and white marks in many areas. Generally yellow colour as follows: mandible except at lateral and apical margins brown, basal and lateral sides of clypeus (rarely entirely yellow), interantennal space (rarely brown or black), inner and outer eye margins, lower sides of temple and occiput, ventral side of scape, tegula except inner white margin (sometimes entirely yellow or yellowish brown), T2 except at base black, S2 almost entirely. Generally white (sometimes whitish yellow) markings as follows: throughout pronotal carina, inner side of tegula, sides of scutellum, posterior side of metanotum, spot on mesopleuron below tegula. Black markings as follows: inner side of ocellar area (sometimes absent), basal area of tergites which more prominent on T2 and T3, area in between S1 and S2. Legs pale brown inter mixed with yellow. Wings hyaline with pterostigma and apex of median cell yellow and dark infumation at apex of radial cell.

Size (H+M+T1+T2): 9-11 mm.

Male: Antenna with last article hook-like, almost reaching to base of eleventh antennal segment in curved position; apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female.

Colour Description: Colour pattern almost same as that of female except clypeus entirely and transverse band at lower frons yellow.

Size (H+M+T1+T2): 8.5-9.5 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 7♀ & 5♂, 19.ix.2015, Coll. Altat Hussain Sheikh.

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

14. *Delta conoideum* (Gmelin, 1790)

1787. *Vespa conica* Fabricius, 293. Syntype: Female. China (BMNH).

2006. *Delta conoideum*; Gusenleitner, 694.

Diagnosis: Female: Head above antenna and mesosoma closely and lightly punctured; clypeus pyriform, its apex truncate; metasoma smooth and shining with surface minutely aciculate.

Colour Description: Head yellow except mandibles and antenna reddish, broad transverse band across apex between tops of eyes black, black mark extends behind vertex to occiput; thorax dark red with black patches on mesoscutum, metapleuron and median area of propodeum, propleuron entirely black; legs pale reddish; gaster dark red with base of T2 and short transverse medially interrupted band on its middle above black; forewing basally flavohyaline and apically fusco-hyaline, with slight purplish reflection.

Size (H+M+T1+T2): 23-26 mm.

Male: Last antennal article hooked apically, hook

long, curved and pointed, in curved position it almost reaching apex of 9th antennal article; S7 with deep median longitudinal groove; Male comparatively smaller and slighter than female. Other characters almost same as that of female.

Size (H+M+T1+T2): 17 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 2♀ & 1♂, 9.ii.2015, Coll. Altat Hussain Sheikh.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Diu, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, West Bengal. *Elsewhere*: Arabia, China, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand.

15. *Delta dimidiatipenne* (de Saussure, 1852)

1852. *Eumenes dimidiatipennis* de Saussure, 51. Syntype: Female, Male, "Djidda (Arabie), les Indes Orientales, l'Egypte" (MP).

1961. *Delta dimidiatipenne*; Blüthgen, 279.

Diagnosis: Female: Clypeus smooth, its anterior margin concave at apex; frons and ocular sinus closely and strongly punctured; vertex and temple with minute punctures.

Colour Description: Head obscure dull red with following black markings: broad band on vertex including upper half of frons, vertical line to each antennal toruli, extending behind vertex to outer side of temple and to occiput; dorsal side of apical four segments of antenna. Mesosoma dull red with highly variable black patches as follows: mesoscutum usually entirely black except parategula; black margin on scutellum anteriorly; propleuron usually black; mesopleuron usually with large black area except dull red patch below tegula and another red mark at lower side near to mid coxa; metapleuron usually with large black area except red patch on upper metapleuron; median groove of propodeum sometimes black; metasoma dull red except following black markings: base of petiole, apical half of second tergite and sternite, whole of remaining tergites and sternites. Wings ferruginous with apical half

of forewing fuscous having purple reflection.

Size (H+M+T1+T2): 21 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♀, 23.iv.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Arunachal Pradesh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Kerala, Madhya Pradesh (new record), Maharashtra, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh. *Elsewhere*: Afghanistan, Africa, Algeria, Arabia, Canary Islands, Central Africa, Central Sahara, Chad, Djibouti, Egypt, Eritrea, Ethiopia, Iran, Madagascar, Mauritania, Nepal, Niger, Pakistan, Palestine, Somalia, South Africa, Sudan, Syria, Turkey, Uganda, Yemen.

16. *Delta esuriens* (Fabricius, 1787)

1787. *Vespa esuriens* Fabricius, 293. Syntype, Sex not mentioned, India (BMNH).

1992. *Delta esuriens*: Giordani Soika, 62.

Diagnosis: Female: Clypeus smooth, strongly convex, flattened in middle, 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 pretergular carina; fore wing with prestigma 0.74x pterostigma; petiole and gaster almost smooth; T2 without lamellae separated by apical thickening.

Colour Description: Head yellow to brownish yellow with following black markings: broad band on vertex including upper half of frons extending behind vertex to outer side of temple and to occiput, black mark on anterior tentorial pit extending to subantennal suture to dorsal side of antennal scrobe and touching to black band on frons and vertex; antennae light reddish; visible part of labrum concolorous with clypeus; mandible yellow except at margins yellowish brown; pronotum almost entirely yellow except at anterior apex of anterior face of pronotum black; mesoscutum black except large brown area posteriorly; scutellum light red; postscutellum yellow, propleuron black or blackish brown; mesopleuron yellow to brownish yellow except mesepimeron brown to blackish brown and mesosternum black; metapleuron light red to reddish brown; propodeum light red except

at basolateral apex near to lateral corner with yellow markings; legs light reddish with highly variable yellow markings; petiole light reddish except at base black, at subapically black band and then yellow band; second gastral tergite basally light reddish then black band and remaining apical half yellow; second gastral sternite light red except at apex with yellow band; all remaining visible part of gastral segments yellow, with their bases (when drawn out) black. Wings flavohyaline with narrow subapical dark infumation on forewing.

Size (H+M+T1+T2): 14-20 mm.

Male: Last antennal article hooked apically, hook long, curved and pointed, in curved position it almost reaching to apex of ninth antennal segment; S7 with deep median longitudinal groove; apical tip of aedeagus bulb-like; parameral spine elongate with moderately large hairs subapically. Other characters almost same as in female.

Size (H+M+T1+T2): 14-17 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 4♀ & 3♂, 16.x.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh (new record), Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Arabia, Australia, Indonesia (Borneo, Java), Iran, Iraq, Israel, Laos, Mauritius, Myanmar, New Caledonia, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Sri Lanka, Thailand, Timor, United Arab Emirates, Vietnam.

Ethology: In this study we observed parasitic association of strepsipteran insect for the first time. In one male specimen of *D. esuriens*, a strepsipteran parasite seen as projected out from one of the tergal segments of the host wasp (Figure 21).

17. *Delta pyriforme pyriforme* (Fabricius, 1775)

1775. *Vespa pyriformis* Fabricius, 371. Type: China (?).

1991. *Delta pyriforme pyriforme*; Krombein, 8.

Diagnosis: Female: Clypeus smooth, strongly convex, flattened in middle, its anterior margin concave at apex, frons closely and strongly punctured; upper part of propodeum strongly punctured except at dorsolateral angle smooth; fore wing with prestigma 1.1x pterostigma; gaster almost smooth with minute scattered punctures; T2 without lamellae separated by apical thickening.

Colour Description: Head yellow, broad transverse black band between eyes on the vertex through ocellar area; occiput mostly black; antenna reddish brown; pronotum entirely and mesoscutum anteriorly yellow, later posteriorly black or brown or reddish brown; tegula reddish brown; parategula reddish brown; scutellum and postscutellum usually reddish brown with highly variable black markings; propleuron black; mesopleuron, metapleuron, propodeum and legs reddish brown with highly variegated black markings; sutures between scutellum, postscutellum and propodeum black; petiole and basal third of second gastral segment reddish brown, former black at base and with subapical black band, the middle of later black, its posterior third and the visible part of the remaining abdominal segments yellow. Wings deep flavohyaline with narrow infumation on apical margin of forewing.

Size (H+M+T1+T2): 25-27 mm.

Male: Last antennal article hooked apically, hook long, curved and pointed, terminal half distinctly swollen in profile and widened seen from above, in curved position it almost reaching to apex of ninth antennal segment; S3-S6 with few large hairs apically; S7 with deep median longitudinal groove; apical tip of aedeagus bulb-like; parameral spine elongate with moderately large hairs subapically; volsella with moderately large thick hairs. Male comparatively smaller and slighter than female. Other characters almost same as that of female.

Size (H+M+T1+T2): 18-23 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 5♀ & 3♂, 10.xi.2015, Coll. Altat Hussain Sheikh.

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka,

Kerala, Madhya Pradesh (new record), Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Bhutan, Cambodia, China, Hawaii, Hong Kong, Indonesia, Malaysia, Moluccas, Myanmar, Nepal, New Guinea, Pakistan, Sri Lanka, Taiwan, Thailand, Vietnam.

18. *Indodynerus capitatus* Gusenleitner, 2008

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

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

Colour Description: Body black with following white parts: transverse band at base of clypeus, thick band at inner margin of eye starting from base of clypeus up to ocular sinus, spot at interantennal space, mark on upper portion of temple, transverse band at middle of pronotum; T1 with broad and T2 with narrow transverse band at apex; S2 with small spot on postero-lateral corner. Mandible, tarsal spines and claws blackish brown. Wings dark with violaceous reflections.

Size (H+M+T1+T2): 11 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 2♀, 25.x.2015, Coll. Altat Hussain Sheikh.

Distribution: India: Chhattisgarh, Karnataka, Kerala, Madhya Pradesh (new record). *Elsewhere:* Pakistan.

19. *Phimenes flavopictum* (Blanchard, 1840)

1840. *Eumenes flavopictus* Blanchard, in Ch. d'Orbigny, vol. 2, Ins., Hym., pl. 2, figure 21, Type locality Unknown (? MP).

2013. *Phimenes flavopictum*; Girish Kumar, 120.

Diagnosis: Female: Apex of clypeus widely truncate, anterior margin moderately emarginate, sparsely punctate; frons closely and strongly punctured; propodeal dorsum strongly punctured 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.

Colour Description: Black with following yellow markings: clypeus, inter antennal mark, line at inner orbits, narrow line at outer orbits; transverse band on pronotum; four spots on mesoscutum, small mark on lateral areas of scutellum, marks behind axillary fossa near base of hind wing, vertical band on mesepisternum, band on outer margin of tegulae, band on postscutellum, two large marks on posterior area of propodeum; marks on outer side of mid and hind coxae, line at inner side of fore femora, most of fore tibiae (leaving brown line on inner side), line on outer side of mid and hind tibiae; three pairs of spots on gastral petiole; pair of transverse spots at base of T2, forming interrupted band, narrowly interrupted bands at apex of T2-T5, pair of small spot at apex of T6 and widely interrupted bands at apex of S2-S5. Brown markings as follows: labrum brown; mandible blackish brown. Wings fusco-hyaline.

Size (H+M+T1+T2): 24-26 mm.

Male: Apical antennal article hooked apically, hook long, curved and pointed, in curved position it almost reaching to apex of ninth antennal segment; S3-S6 with dense hairs; S7 almost flat, rounded apically without dense hairs except at apical margin, apical margin with dense hairs; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle; parameral spine elongate with moderately large hairs. Other characters almost same as in female.

Size (H+M+T1+T2): 18 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♀ & 1♂, 14.x.2015, Coll. Altaf Hussain Sheikh.

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

20. *Rhynchium carnaticum* (Fabricius, 1798)

1798. *Vespa carnatica* Fabricius, 261. Syntype, sex not mentioned, Tranquebariae (ZMUC).

1852. *Rhynchium carnaticum*; de Saussure, 112.

Diagnosis: Female: Mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially; T2-T5 with very minute sparse and shiny punctures on $\frac{3}{4}$ area and S2-S4 with distinct punctures, diameter of most of punctures less than interspaces.

Colour Description: Body brownish red with following black marks: spot on interantennal space, vertical line on lower frons, around ocelli, occiput, triangular mark on mesoscutum in front, transverse line along its apex, lateral sides of propleuron, epicnemium, propodeum in middle, basal area of T1, at base of T2, in between S1 and S2, base of S3. Legs brownish red with variegated black markings. Wings yellowish hyaline, deeper and darker towards base; apical margin of forewing slightly infumated.

Size (H+M+T1+T2): 14.5 mm.

Male: Head 1.05x as wide as long in front view; mandible with teeth not strong as in female; interocular distance 1.24x greater on vertex than at clypeus; clypeus more elongate and apex between two teeth slightly emarginate, width 0.90x length medially; POL 1.53x OOL; occipital carina come close to eye at lower side; apical antennal article hook-like, almost reaching to apex of tenth article in curved position; mid femur basally emarginate; stiff and stout hairs forms spine-like structures at apical margin of S7; apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female.

Colour Description: Colour pattern almost same as that of female except clypeus, transverse band at lower frons and scape ventrally yellow. Inner eye margin yellow and extending towards frons, ocellar area, vertex and temple.

Size (H+M+T1+T2): 10 mm.

Material examined: INDIA: Madhya Pradesh, Jabalpur district, Dumna Nature Park, 1♀ & 1♂, 15.iii.2015, Coll. Altaf Hussain Sheikh.

Distribution: India: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, West Bengal. **Elsewhere:** Indonesia, Pakistan, Sri Lanka.

Summary

The present paper deals with the taxonomic studies of the family Vespidae from Dumna Nature Park, Jabalpur, Madhya Pradesh. It consists of 20 species with an additional subspecies belonging to 11 genera and 3 subfamilies. Out of these, 13 species and an additional subspecies are newly recorded here from Madhya Pradesh. They are as follows: *Polistes (Polistella) stigma tamulus* (Fabricius, 1798), *Polistes (Polistella) strigosus strigosus* Bequaert, 1940, *Ropalidia brevita* Das & Gupta, 1989, *Ropalidia jacobsoni* (du Buysson, 1908), *Vespa tropica haematodes* Bequaert, 1936, *Antepipona ovalis* (de Saussure, 1853), *Anterhynchium abdominale abdominale* (Illiger, 1802), *Anterhynchium abdominale bengalense* (de Saussure,

1852), *Antodynerus flavescens flavescens* (Fabricius, 1775), *Delta dimidiatipenne* (de Saussure, 1852), *Delta esuriens* (Fabricius, 1787), *Delta pyriforme pyriforme* (Fabricius, 1775), *Indodynerus capitatus* Gusenleitner, 2008, and *Phimenes flavopictum* (Blanchard, 1840). The parasitic association of strepsipteran insects reported here for the first time in the potter wasp genus *Delta*.

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PLATE 1



1. *Polistes (Gyrostoma) wattii* Cameron ♀



2. *Polistes (Polistella) stigma tamulus* (Fabricius) ♀



3. *Polistes (Polistella) strigosus strigosus* Bequaert ♀



4. *Ropalidia brevita* Das & Gupta ♀



5. *Ropalidia marginata* (Lepelletier) ♀



6. *Ropalidia jacobsoni* (du Buysson) ♀

PLATE 2



7. *Vespa auraria* Smith ♀



8. *Vespa orientalis* Linnaeus ♀



9. *Vespa tropica haematodes* Bequaert ♀



10. *Allorhynchium metallicum* (de Saussure) ♀



11. *Antepipona ovalis* (de Saussure) ♀



12a. *Anterhynchium abdominale abdominale* (Illiger)
♀

PLATE 3



12b. *Anterhynchium abdominale bengalense* (de Saussure) ♀



13. *Antodynerus flavescens flavescens* (Fabricius) ♀



14. *Delta conoideum* (Gmelin) ♀



15. *Delta dimidiatipenne* (de Saussure) ♀



16. *Delta esuriens* (Fabricius) ♀



17. *Delta pyriforme pyriforme* (Fabricius) ♀

PLATE 4



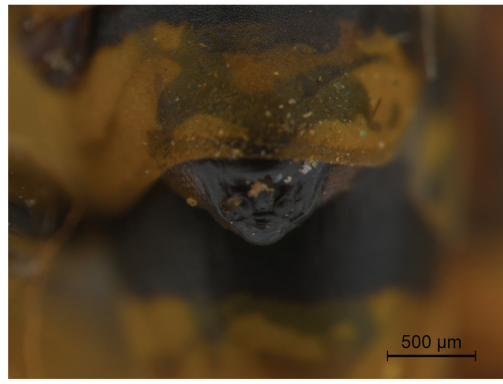
18. *Indodynerus capitatus* Gusenleitner ♀



19. *Phimenes flavopictum* (Blanchard) ♀



20. *Rhynchium carnaticum* (Fabricius, 1798) ♀



21. Strepsiptera on abdominal terga of *D. esuriens*