



Taxonomic Studies on vespid wasps (Vespidae: Vespoidea: Hymenoptera: Insecta) of Rajasthan, India with Six New Records from the State

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ABSTRACT

Vespidae is a cosmopolitan family of order Hymenoptera (Insecta) popularly called as wasps, members of which are predominantly found in tropical regions of the World, with more than 5000 species worldwide. The present studies recorded 26 species belonging to 15 genera, 3 subfamilies of Vespidae from Rajasthan. Out of which, the 6 species of Vespidae are new records from Rajasthan state.

Key words: Vespidae, Hymenoptera, New Records, Rajasthan, India.

INTRODUCTION

Vespidae is a cosmopolitan family of order Hymenoptera (Insecta) popularly called as wasps. Adults are usually black or brown but are often extensively marked with yellow or white. In social wasps, the larva is progressively fed by adult females on masticated insects or rarely predominantly on glandular secretions. In solitary species, the larva is usually predatory on the caterpillars of other insects, in a cell constructed and provisioned by the adult female, rarely supplied with a mixture of pollen and nectar. The vespid wasps play an important role in the ecosystem, and thus they can be considered as good bio-indicators for environmental conditions and habitat perturbation. Because of their predaceous habits, they have the potentiality to be effective biological control agents against pests. Adults are minute to large (6-28 mm) in size. Most species are solitary but many are social. Solitary wasps nesting either in soil, in pre-existing cavities (such as abandoned mud nest of other hymenopterans or beetle tunnels in wood) or in free mud nests which they build themselves. Social wasps often make spectacular paper nests and defend their colony vigorously by stinging.

Bingham (1897) and Das & Gupta (1989) made valuable contributions on the taxonomy of Vespidae from India and its adjacent countries. The knowledge on vespid fauna of Rajasthan is very scanty and fragmentary. Fourteen genera and 20 species are recorded from Rajasthan till date in scattered literatures (Nurse, 1903; van der Vecht, 1941; Chhotani & Ray, 1975; Giordani Soika, 1982; Gusenleitner, 2006; Kojima et al., 2007; Girish Kumar, 2010, 2011, 2012 a & b; Girish Kumar & Lambert Kishore, 2012; Girish Kumar & Carpenter, 2013; Girish Kumar et al., 2013). An attempt has been made here to provide a consolidated account on the fauna of the family Vespidae from the state of Rajasthan. In this paper, 15 genera and 26 species are reported of which 1 genus and 6 species are new records for Rajasthan.

MATERIALS AND METHODS

The systematic account on the vespid fauna of Rajasthan is given below based on the collections from different localities of the state as well as on the data from the published literatures. Most of the materials studied here are added to the “National Zoological Collections” of the Hymenoptera Section of the Zoological Survey of India, Kolkata (NZC) and some are added to the Desert Regional Centre of Zoological Survey of India, Jodhpur (DRCZSI).

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The following abbreviations used in the text for the Museums: BMNH— British Museum of Natural History, London, U.K.; DRCZSI— Desert Regional Centre of Zoological Survey of India, Jodhpur, Rajasthan, India; MHN— Muséum d'Histoire Naturelle, Genève, Switzerland; MNHN— Muséum national d'Histoire naturelle, Paris, France; NHRM— Naturhistoriska Rijkmuseet, Stockholm, Sweden; NZC— Zoological survey of India, Kolkata, India; OUM— Oxford University Museum, Oxford, U.K.; RMNH— Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands; SMNS— Staatliches Museum für Naturkunde, Stuttgart, Germany; 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; S1-S7 = Abdominal sterna 1 to 7; T1-T7 = Abdominal terga 1 to 7.

RESULTS AND DISCUSSION

The present studies recorded 26 species belonging to 15 genera, 3 subfamilies of Vespidae from Rajasthan. Out of which, the 6 species of Vespidae are new records from Rajasthan state.

Checklist of species is as given below:

Class INSECTA

Order HYMENOPTERA

Super Family VESPOIDEA

Family VESPIDAE

Subfamily POLISTINAE

Tribe **Polistini**

Genus *Polistes* Latreille, 1802

Subgenus *Polistes (Gyrostoma)* Kirby, 1828

1. *Polistes (Gyrostoma) olivaceus* (De Geer, 1773)

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

Subgenus *Polistes (Polistella)* Ashmead, 1904

3. *Polistes (Polistella) stigma tamula* (Fabricius, 1798)

Tribe **Ropalidiini**

Genus *Ropalidia* Guérin-Méneville, 1831

4. *Ropalidia brevita* Das & Gupta, 1989

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

6. *Ropalidia marginata* (Lepeletier, 1836)

7. *Ropalidia spatulata* van der Vecht, 1962

8. *Ropalidia variegata* (Smith, 1852)

Subfamily VESPINAE

Genus *Vespa* Linnaeus, 1758

9. *Vespa orientalis* Linnaeus, 1771

Subfamily EUMENINAE

Genus *Allorhynchium* van der Vecht, 1963

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

Genus *Antepipona* de Saussure, 1855

11. *Antepipona ceylonica* (de Saussure, 1867)

12. *Antepipona sibilans* (Cameron, 1903)

Genus *Anterhynchium* de Saussure, 1863

13. *Anterhynchium (Anterhynchium) abdominale* (Illiger, 1802)

13a. *Anterhynchium (Anterhynchium) abdominale abdominale* (Illiger, 1802)

13b. *Anterhynchium (Anterhynchium) abdominale bengalense* (de Saussure, 1855)

Genus *Antodynerus* de Saussure, 1855

14. *Antodynerus limbatus* (de Saussure, 1852)

Genus *Chlorodynerus* Blüthgen, 1951

15. *Chlorodynerus deesanus* (Cameron, 1907)

Genus *Delta* de Saussure, 1855

16. *Delta conoideum* (Gmelin, 1790)

17. *Delta dimidiatipenne* de Saussure, 1852

18. *Delta esuriens* (Fabricius, 1787)

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

Genus *Knemodynerus* Blüthgen, 1940

20. *Knemodynerus multimaculatus* Gusenleitner, 2006

Genus *Oreumenoides* Giordani Soika, 1961

21. *Oreumenoides edwardsii* (de Saussure, 1852)

Genus *Rhynchium* Spinola, 1806

22. *Rhynchium carnaticum* (Fabricius, 1798)

23. *Rhynchium oculatum leviscutis* (Cameron, 1908)

Genus *Stenodyneriellus* Giordani Soika, 1962

24. *Stenodyneriellus praeclusus* (Nurse, 1903)

Genus *Tropidodynerus* Blüthgen, 1939

25. *Tropidodynerus (Tropidopipona) hostis* (Nurse, 1903)

Genus *Xenorhynchium* van der Vecht, 1963

26. *Xenorhynchium nitidulum* (Fabricius, 1798)

Systematic Account

1. *Polistes (Gyrostoma) olivaceus* (De Geer, 1773)

1773. *Vespa olivacea* De Geer, 582. Type: Sex not mentioned, America (NHRM).

2006. *Polistes (Gyrostoma) olivaceus*; Gusenleitner, 679.

Diagnosis: Female: Clypeus densely finely punctate, with a few larger scattered punctures interposed; frons, vertex and temple with fine scattered punctures; malar space with moderately larger and close punctures; occipital carina incomplete; pronotum sparsely finely punctate; mesoscutum almost impunctate; scutellum, metanotum and metapleuron impunctate; mesopleuron behind epicnemial carina and above sterno-pleural suture with scattered fine punctures; propodeum with distinct striations without distinct lateral edge;

gaster almost impunctate; S1 transversely striated. **Colour:** Body yellow with variable black markings and few reddish markings; some are dark form with extensive black markings while others are pale forms with less extensive black markings. Black markings as follows: basal and apical margin of clypeus narrowly; mandibular teeth; a short line on raised part of interantennal space; a mark above each antennal socket; a band on vertex (sometimes narrow line); occiput; a line on scape and flagellum above (often only scape apically above); in front of pronotal carina; a mark on pronotum ventrally towards propleuron (often absent); mesoscutum (except a longer median and two shorter lateral yellow lines, sometimes an incomplete median line); almost all thoracic sutures (sometimes faint); a line along median groove of propodeum (sometimes two marks on sides); T1 narrowly at base (sometimes absent); T2-T5 and S2-S5 with bisinuate marks; a line below coxae (sometimes absent); a line on hind tibiae above (sometimes faint). Reddish markings as follows: pronotum partly dorsally; two curved lines on propodeum on sides; T2 at base; legs partly.

Size (H+M+T1+T2): 13-20 mm.

Male: Similar to female except clypeus not touching eye; temple wider; proximal tooth of mandible short; S7 with bluntly projecting tubercle on each side; apophyses long, narrow and flattened at apex like a spatula, shiny and devoid of pubescence. **Size** (H+M+T1+T2): 16-17 mm.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Odisha, Rajasthan, Sikkim, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Afghanistan, Amirantes, Australia, Bangladesh, Cambodia, Chagos Archipelago, Chile (introduced), China, Egypt, Fiji, Indonesia, Iran, Japan (?), Laos, Madagascar, Malaysia, Marianas, Marquesas, Mauritius, Myanmar, Nepal, New Caledonia, New Zealand, Oman, Pakistan, Philippines, Reunion, Samoa, Seychelles, Singapore, Society Is., Sri Lanka, Tanzania, Thailand, Tongas, Tuamotu Archipelago, U.S.A., Vietnam.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Das & Gupta (1989). Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

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

(Images 1 & 17)

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

2010. *Polistes (Gyrostoma) wattii*; Girish Kumar, 43.

Diagnosis: Female: Clypeus with scattered larger punctures; supraclypeal area, interantennal space, inner orbit including ocular sinus, frons, vertex, temple, pronotum, mesoscutum, scutellum and metanotum mat; malar space with scattered punctures; occipital carina complete; mesepisternum behind epicnemial carina mat with scattered fine punctures; dorsal and ventral metapleuron impunctate; striations on propodeum weak, not distinct near the lower margin of side; metasoma smooth covered with short pubescence.

Colour: Body almost uniform yellow; in some specimens brown mixed with yellow especially on metasoma; in some specimens a black spot on scape at apex above, a black mark around each ocellus narrowly, hind tibia above usually black, a narrow transverse reddish brown line on T1 after middle, T2-T5 & S2-S5 with bisinuate reddish brown line; in some specimens two brown curved lines on propodeum.

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

Male: Similar to female except clypeus not touching the eye; proximal tooth shorter and broader than other teeth; temple wider; apophyses of subgenital plate long and narrow, not flattened at apex, densely pubescent. **Size** (H+M+T1+T2): 10-11 mm.

Material examined: India: Rajasthan, Nagaur dist., Sambhar Lakeside, 1♂, 10.xi.1956, Coll. Unknown, NZC Regd. No. 2217/H3; Bhilwara dist., Gudha, 4♀, 2-5.iii.1958, Coll. T.G. Vazirani, NZC Regd. Nos. 2827/H3, 2830/H3, 2831/H3 & 2833/H3; Jaipur dist., Korsina, 2♀, 18.iv.1958, Coll. T.G. Vazirani, NZC Regd. Nos. 2835/H3 & 2841/H3; Nagaur dist., Sambhar Lakeside, 1♀, 11.xi.1958, Coll. A.K. Mukherjee, NZC Regd. No. 2834/H3; Jodhpur dist., Mandore garden, 1♀, 7.ix.1963, Coll. Unknown, NZC Regd. No. 3603/H3; Jodhpur dist., AFRI Campus, 2♀, 8.vii.2014, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 15002/H3 & 15003/H3.

Distribution: India: Bihar, 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.

Remarks: Chhotani & Ray (1975) previously

reported this species from Gudha, Korsina, Kuchamon Road, Mohangarh and Sambhar Lake of Rajasthan as *Polistes hebraeus*. Subsequently, Girish Kumar (2010) also previously reported this species from Gudha, Korsina, Sambhar Lakeside and Mandore Garden of Rajasthan.

3. *Polistes (Polistella) stigma tamula* (Fabricius, 1798)

(Image 2)

1798. *Vespa tamula* Fabricius, 263. Type: ♀, “in India Orientali, Dom Daldorff” (ZMUK).

1983. *Polistes (Polistella) stigma tamula*; Das & Gupta, 414.

Diagnosis: Female: Median groove of propodeum shallow; forewing with subapical fuscous cloud; T1 about as long as wide; S1 without distinct margin at base.

Colour: Body predominantly reddish with some black markings and the following yellow markings: clypeus; mandible; a broad line along inner orbit up to lower half of ocular sinus; a line on temple bordering eye margin; malar space; basal and apical margin of pronotum narrowly; a line on scutellum at base; a line on metanotum at base; a mark on subtegular area; an elongated mark on mesepisternum at top and another in the middle of apico-lateral margin in front of metapleuron; raised ventral margin of mesepisternum and ventral metapleuron; a mark on dorsal metapleuron; two lines on mesosternum; two broad curved marks on propodeum; propodeal valvula; fore coxa in front; marks on middle coxa in front; two lines on hind coxa below; T1 except broad reddish mark at base; apical broad band on T3 and S3; fourth gastral segment almost entirely; S1 and a narrow band on T2 apically.

Size (H+M+T1+T2): 10.5 mm.

Material examined: India: Rajasthan, Alwar dist., Siliserh, 1♀, 10.x.1973, Coll. Y.P. Sinha & Party, DRCZSI Regd. No. 1449/3.

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

4. *Ropalidia brevita* Das & Gupta, 1989

(Image 3)

1989. *Ropalidia (Anthreneida) brevita* Das & Gupta, 121. Holotype: ♂, Delhi: University ridge (NZC). Type examined.

Diagnosis: Female: Propodeum with paired longitudinal basal carina, with weak transverse striations and scattered shallow punctures between

basal carinae; striations lateral to carinae weak; propodeal orifice very narrow; T1 proportionally wider with its maximum width in dorsal view nearly half as wide as that of T2.

Colour: Body red with the following yellow portions: scape below; a 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; a faint mark on sides of mesosternum; fore and middle coxae in front; a line on lateral side of hind coxa; tarsal segments of all legs (highly variable); a narrow apical band on T1; a 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): 11-13 mm.

Material examined: INDIA, Rajasthan, Alwar dist., Siliserh, 1♀, 10.x.1973, Coll. Y.P. Sinha & Party, DRCZSI Regd. No. 1449/3; Sirohi dist., Mount Abu, 8♀, 10-11.vii.2014, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 15004/H3–15011/H3.

Distribution: India: Assam, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. **Elsewhere:** Pakistan.

Remarks: Kojima *et al.* (2007) previously reported this species from Mount Abu of Rajasthan.

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

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

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 the sternum.

Colour: Body reddish brown with yellow and black markings. Yellow markings as follows: mandible except at tip and at base brown; clypeus except the characteristic black mark; a mark on inter antennal space; inner orbit up to ocular sinus broadly; ventral side of antenna; a narrow line along pronotal carina; basal and lateral margin of scutellum broadly; two large marks on metanotum; a small mark on upper part of mesopleuron; two broad marks on propodeum separated by broad black line along the median groove, inner side of tegula; fore and mid coxae in front; a line on hind coxa laterally; a line below fore femur; a small mark on middle femur laterally; a narrow line on all tibiae above; fore and mid basi-tarsi above; T2

with a large mark on each side at base and a broad apical band on T2 and S2, become narrow towards middle on S2. Black markings as follows: a mark on clypeus at base; supraclypeal area; a large circular spot above each antennal socket; a mark around each ocellus; occiput; basal area of anterior face of pronotum; margins of mesoscutum narrowly but apical margin towards scutellum broadly; a narrow vertical line on scutellum up to one-third from base; propleuron; dorsal metapleuron; ventral metapleuron apically towards mesopleuron broadly; mesosternum; a broad median line separating the two 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): 6-7 mm.

Male: Similar to female but differs in having clypeus (except its basal margin narrowly) black; supraclypeal area, a line on temple and mesosternum yellow. *Size* (H+M+T1+T2): 6-7 mm.

Distribution: India: Assam, Delhi, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere*: Bangka, Java, Lombok, Myanmar, Sulawesi, Sumatra.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Das & Gupta (1989). Van der Vecht (1941) previously reported this species from Mount Abu of Rajasthan.

6. *Ropalidia marginata* (Lepelletier, 1836)

1836. *Epipona marginata* Lepelletier, 541. Type: ? (Unknown).

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

Diagnosis: Female: Propodeum with paired, longitudinal, basal carinae; propodeal orifice very narrow; propodeum with weak transverse striations and scattered shallow punctures between basal carinae; striations lateral to carinae weak.

Colour: Body reddish brown with yellow markings. Yellow markings as follows: apical margin of clypeus; mandible; scape ventrally; a narrow line along anterior and posterior margin of pronotum; fore coxa ventrally; a mark on fore and mid tibia; a mark on scutellum; metanotum; tegula; a narrow band on T1 and T2 posteriorly.

Size (H+M+T1+T2): 12-13 mm.

Male: Similar to female except clypeus, supraclypeal area, interantennal space, inner orbit up to ocular sinus and lower part of frons entirely yellow. *Size* (H+M+T1+T2): 10-13 mm.

Distribution: India: Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu,

Uttarakhand, West Bengal. *Elsewhere*: Australia, Bali, Bangka, Borneo, Java, Kariman Djawa, Lombok, Malay Peninsula, Mariana Islands, Myanmar, New Britain, New Guinea, Palau Islands, Pakistan, Philippine Islands, Sri Lanka, Sulawesi, Sumatra, Sumba, Sumbawa, Talud Islands, Tukang Besi Islands, Vietnam, Volcano Islands.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Das & Gupta (1989). Kojima *et al.* (2007) previously reported this species from Mount Abu of Rajasthan.

7. *Ropalidia spatulata* van der Vecht, 1962

1962. *Ropalidia (Anthreneida) spatulata* van der Vecht, 9. Holotype: ♂, India: Kerala: Walayar Forest (RMNH).

2006. *Ropalidia spatulata*; Gusenleitner, 686.

Diagnosis: Female: Propodeum with paired longitudinal basal carina, weak transverse striations and scattered shallow punctures between basal carina; striations lateral to carina weak; propodeal orifice very narrow; maximum width of T1 in dorsal view approximately 0.4x as wide as that of T2.

Colour: Body reddish brown with black and yellow markings. Yellow markings as follows: interantennal space; inner eye margin; margins of clypeus; a mark on mandible basally; a narrow mark along pronotal carina; a pair of large marks on metanotum; a pair of marks on propodeum posteriorly; a narrow band at posterior edge of T1; a band on T2 posteriorly covering more than its one third. Black markings as follows: antennal socket; posterior margin of clypeus; around ocelli; margins of eye; middle of clypeus; anterior and posterior end of pronotum; posterior edge of mesoscutum; mid and hind tibia dorsally; a narrow portion just above the yellow band on T1; a broad region on T2 medially.

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

Male: Similar to female except last antennal article hooked, strongly curved, blunt apically; antennomeres with serrated margins; clypeus, inter antennal space, space between antenna and eye, mandibles and fore and mid coxae entirely yellow; aedeagus broadly spatulate apically. *Size* (H+M+T1+T2): 11-12 mm.

Distribution: India: Kerala, Rajasthan, Tamil Nadu. *Elsewhere*: Myanmar, Nepal.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Das & Gupta (1989). Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

8. *Ropalidia variegata* (Smith, 1852)

(Images 4 & 18)

1852. *Epipona variegata* Smith, 48. Type: ♀, Maharashtra: Poona (BMNH).

1918. *Ropalidia variegata*; Bequaert, 247.

Diagnosis: Female: Median line of median groove of propodeum indistinct; T1 in lateral view with dorsal margin more or less evenly convex, highest at level of posterior margin of sternum.

Colour: Body reddish brown with predominant yellow markings. Yellow markings as follows: mandible except for dark brown teeth; clypeus except reddish brown mark at base; supraclypeal area; inter antennal space; a broad line along inner orbit up to ocular sinus; a broad line on temple; ventral side of antenna; an interrupted line on vertex behind ocelli (sometimes faint); a spot in between median and lateral ocelli (sometimes faint); a line along pronotal carina; a line along posterior face of pronotum towards mesoscutum; basal margin of scutellum broadly; metanotum; a mark on mesopleuron; two broad irregular marks on propodeum separated by reddish brown or blackish brown line; inner side of tegula; fore and middle coxae in front; greater part of hind coxa; a line on fore and middle femur below; a small mark on hind femur on sides; a line on all tibiae above; two large spots at base of T2; a broad apical fascia on T2 and S2. Tarsi reddish brown with yellowish tinge. Wings transparent hyaline with stigma reddish brown and apical half of radial cell dark reddish brown.

Size (H+M+T1+T2): 6-7 mm.

Male: Similar to female except clypeus almost entirely yellow. **Size** (H+M+T1+T2): 6-7 mm.

Material examined: India: Rajasthan, Jodhpur dist., Mandore, 4♀ & 6♂, 19.xi.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 15012/H3–15021/H3. Jodhpur dist., Circuit House Campus, 3♀, 8.vii.2014, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 15022/H3–15024/H3. Sirohi dist., Mount Abu, 3♀, 10-11.vii.2014, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 15025/H3–15027/H3.

Distribution: India: Bihar, Chhattisgarh, Delhi, Gujarat, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Nepal, Pakistan, Malay Peninsula, Myanmar, Indonesia, China.

Remarks: Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

9. *Vespa orientalis* Linnaeus, 1771

(Image 5)

1771. *Vespa orientalis* Linnaeus, 540. Type: Worker, "Vespa ex. Oriente" (BMNH).

Diagnosis: Female: Clypeus rather flat and elongate, with scattered moderate sized punctures, apical margin emarginate with rounded lateral lobes. Hairs on head and mesosoma short, sparse, stiff and bristle-like; metasoma almost hairless dorsally.

Colour: 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. T3 with a median triangular blackish mark basally.

Size: Sterile female (H+M+T1+T2): 13 mm.

Material examined: India: Rajasthan, Thar Desert, Bikaner dist., Loonkaransar, 1♀, 15.xi.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14996/H3.

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

Remarks: Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

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

(Image 6)

1852. *Ryngchium metallicum* de Saussure, 114. Lectotype: ♀, Bengal (MNHN).

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

Diagnosis: Female: Apex of clypeus emarginate; frons, vertex and temple with close, strong and pit-like punctures; cephalic fovea present; anterior face of pronotum smooth without punctures; pronotal carina strong, complete; epicnemial carina distinct at lower half; propodeum vertical, concave posteriorly, median carina present which runs upwards in to a deep oval fovea at a short distance from the metanotum; forewing with outer vein of third submarginal cell anteriorly very close to apex of marginal cell; T1 and T2 with very small, sparse and very thin punctures except at lateral and apical portions strongly punctured; S2 with strong punctures.

Colour: Body entirely black except a 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): 12 mm.

Male: Colour similar to that of female except clypeus with two basal yellow spots; antenna with last article hooked apically and almost reaches the apex of tenth antennal segment in curved position; S7 with a distinctly uplifted basal area; basal lamina of volsella armed with a spine; apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female.

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

Material examined: India: Rajasthan, Sirohi dist., Mount Abu, 1♀ & 1♂, date of collection not known, Coll. Dudgeon, NZC Regd. Nos. 14089/H3 & 14090/H3.

Distribution: India: Assam, Delhi, Gujarat, Lakshadweep Islands, Madhya Pradesh, Maharashtra, Rajasthan (new record), Sikkim, Tamil Nadu, West Bengal. *Elsewhere:* Indonesia (Borneo, Moluccas), Maldives Islands, Malaysia (Sarawak), Myanmar, Pakistan, Sri Lanka, Taiwan.

11. *Antepipona ceylonica* (de Saussure, 1867)

(Image 7)

1867. *Odynerus ceylonicus* de Saussure, 12, in subgenus *Leionotus* division *Epsilon*. Type: Sex not mentioned, "Ceylon" (MHN).

1982. *Antepipona ceylonica*; Giordani Soika, 207, 215.

Diagnosis: Male: Clypeus slightly wider than long, rather strongly convex, emarginated at apex, with short sharp teeth, densely punctured; apical antennal article hook-like, which reaches the middle of the tenth article; pronotum with anterior carina well developed on lateral sides, does not reach dorsal side, it bends inwards before reaching dorsal side, dorsal side completely rounded.

Colour: Body black with yellow maculations. Yellow are: mandible except at tip; clypeus; supraclypeal area; inter antennal space; area in between antennal scrobe and inner eye margin extend up to inner orbit; a sub quadrate mark on frons; lower face of antenna; a linear mark on temple; two large spots on dorsal surface of pronotum; a large round spot on mesepisternum; tegula except a transverse brown band; parategula; two large spots on scutellum; two spots on metanotum; two wide longitudinal bands on propodeum; spots on all coxae; fore and mid femora except a dark line across the front face; all tibiae; all tarsi except apical tarsal segments brownish yellow; an apical band on T1, narrow at the sides; T2 with two large round spots at base and

an apical end slightly enlarged in middle and on sides; minute specks on lateral margins of T3; a thin band, sinuous, almost regular on T4 & T5; S2 with an apical band slightly enlarged in middle and on sides; S3 with narrow sinuous band at apical end; narrow specks on lateral margins of apex of S4. Wings sub hyaline, slightly browned along apical half of marginal cell.

Size (H+M+T1+T2): 6-7 mm.

Material examined: India: Rajasthan, Sirohi dist., Mount Abu, 3♂, 10-11.vii.2014, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 15028/H3–15030/H3.

Distribution: India: Karnataka, Kerala, Maharashtra, Odisha, Rajasthan (new record), Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh. *Elsewhere:* Myanmar, Sri Lanka.

12. *Antepipona sibilans* (Cameron, 1903)

(Image 8)

1903. *Odynerus sibilans* Cameron, 129. Type: ♂, "Barrackpore" (OUM).

1982. *Antepipona sibilans*; Giordani Soika, 206, 207, 225.

Diagnosis: Male: Clypeus wider than long, with apical emargination moderately deep, punctures about like that of front, but a little less weak. Apical antennal article hooked, and its apex reaching at least to the middle of tenth article.

Colour: Body black, with lower face of funicular segments ferruginous. Yellow are: mandible except at teeth; clypeus; scape except a black line on upper surface toward apex; across front, with exception of interantennal space and two black spots, which start from antennal toruli and directed obliquely upward; a large stain on temple; a broad band on dorsal surface of pronotum; almost all of upper mesepisternum; scutellum except posterior margin; metanotum except anterior margin; two large spots on propodeum, occupying entire dorsal faces; tegula except a brown spot medially; parategula; a mark on front face of all coxae; fore and mid femora; a stain on hind femur posteriorly; all tibiae; T1 with a large apical band together with two large lateral spots; T2 with two large lateral spots at base, and often combined with an apical end, which greatly enlarged in middle and on sides; T3 with a narrow band, but strongly enlarged at sides; a band almost regular on T4-T6; large apical band, strongly enlarged in middle on S2-S5, wider on S2 and narrower on next three. Wings very lightly browned, more heavily along apical half of marginal cell.

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

Material examined: India: Rajasthan, Sirohi dist., Mount Abu, 1♂, 10-11.vii.2014, Coll. Gaurav Sharma & Party, NZC Regd. No. 15031/H3.

Distribution: India: Chhattisgarh, Gujarat, Karnataka, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu, West Bengal. *Elsewhere:* Nepal; Pakistan.

Remarks: Giordani Soika (1982) previously reported this species from Mount Abu of Rajasthan.

13. *Anterhynchium (Anterhynchium) abdominale* (Illiger, 1802)

There are two distinct colour forms which have usually been regarded as different species by many old workers. Vecht (1963) treated these two colour forms as two subspecies of *A. abdominale* (Illiger) such as *A. (A.) abdominale abdominale* (Illiger) and *A. (A.) abdominale bengalense* (de Saussure). Both of them are very close to each other in their structure and sculpture. But the colour of metasoma of these two forms are distinctly different. The metasoma of *A. abdominale* is predominantly orange-red with some black markings but the metasoma of *A. bengalense* is entirely black. Actually these two forms are not geographically segregated. So, it requires further studies for the confirmation of species status of each colour form. For the time being we are following the concept of van der Vecht and considering them as two colour forms (subspecies) of the same species.

Diagnosis: Clypeus with weak punctures, from the 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, the interspaces everywhere much larger than the punctures; mandibles of male deeply emarginate on inner side near the middle.

13a. *Anterhynchium (Anterhynchium) abdominale abdominale* (Illiger, 1802)

1802. *Vespa abdominalis* Illiger, 192. Type: Sex not mentioned, "Bengalen" (? ZMB).

2006. *Anterhynchium abdominale abdominale*; Gusenleitner, 692.

Colour: Female: Head and mesosoma black; metasoma dull orange-red with variegated black markings as follows: the basal segment with a transverse black apical band (sometimes, black colour on T1 more pronounced or T1 completely black); T2 with or without a transverse black spot in the middle of its apical margin (sometimes, black colour more pronounced); 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.

Male: Colour pattern is almost same as that of female except clypeus almost entirely yellow with the lateral and apical margins black and scape in front yellow; clypeus more elongate and the apex between two teeth more deeply emarginated than female; antenna with last article hooked apically and almost reaches the apex of tenth antennal article in curved position; apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female. Size (H+M+T1+T2): 9-12 mm.

Distribution: India: Chhattisgarh, Kerala, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere:* Myanmar, Pakistan, Sri Lanka.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Girish Kumar (2013). Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

13b. *Anterhynchium (Anterhynchium) abdominale bengalense* (de Saussure, 1855)

1855. *Rhynchium bengalense* Saussure, 176. Type: Sex not mentioned, "Le Bengale" (MNHN).

2006. *Anterhynchium (Anterhynchium) abdominal bengalense*; Gusenleitner, 692.

Colour: Female: Body black (sometimes ventral side of antenna, apical tarsal segments and lateral sides of tergites reddish brown except last segment). Wings dark fuscous with violet reflections.

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

Male: Colour pattern is almost same as that of female except clypeus almost entirely yellow with the lateral and apical margins black and scape in front yellow. Size (H+M+T1+T2): 11-11.5 mm.

Distribution: India: Bihar, Delhi, Kerala, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Nepal.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Girish Kumar (2013). Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

14. *Antodynerus limbatus* (de Saussure, 1852)

1852. *Rhygchium limbatum* de Saussure, 117. Type: ♀, "L'Amerique?" (coll. de Romand).

1987. *Antodynerus limbatus*; Gusenleitner, 267.

Diagnosis: Female: Apex of clypeus truncate, apex of truncated portion distinctly incised, with moderately deep punctures on middle; frons, ocular sinus, vertex and temple strongly punctured; anterior face of pronotum smooth except at lateral side with few scattered punctures; pronotal carina strong and reaching the lateral margin of pronotum; epicnemial carina distinct; median area of propodeum strongly concave, with a broadly elongate fovea from which median carina runs to orifice; median area shiny with few punctures anteriorly and with few strong transverse striations posteriorly; postero-lateral margin almost entirely rounded with a strong transversely carinate projection, below that with strong transverse striations; metasomal segments with scattered punctures, punctures more prominent on S2.

Colour: Body brownish red with yellow and black marks; usually these colours inter mixed in many areas. Generally the yellow (sometimes brownish yellow) colour as follows: mandible except at lateral and apical margins brown; basal and lateral sides of clypeus (rarely entirely yellow); inner and outer eye margins; lower sides of temple and occiput; ventral side of scape; tegula; parategula; sometimes a spot on mesopleuron below tegula; apex of T1 to T5 and S2 to S5 (sometimes not prominent or absent). Black markings as follows: inner antennal space; antennal toruli; a vertical line from toruli towards lower frons; around ocellar area; occiput except at lower portion; anterior margins of anterior face of pronotum; mesoscutum except at broad median; margins of scutellum; propleuron; mesopleuron except at middle; metapleuron; propodeum except at two broad large reddish brown area on either side; basal area of tergites and sternites (sometimes not visible externally). Legs brown inter mixed with black and yellow, usually at base of coxa, trochanter and basal half of femora black, remaining portion brown to yellowish brown. Wings yellowish hyaline with a slight dark infumation at apex of radial cell.

Size (H+M+T1+T2): 10-12 mm.

Male: Colour pattern is almost same as that of female except clypeus entirely and a transverse band at lower frons yellow except a black longitudinal band from antennal toruli to lower frons in some specimens. Clypeus with the apex between two teeth more deeply emarginate; antenna with last article hook-like, almost reaches to the base of eleventh article in curved position; apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female. **Size** (H+M+T1+T2): 8-9 mm.

Distribution: India: Arunachal Pradesh, Assam,

Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Rajasthan, Sikkim, Tripura, Uttarakhand, West Bengal. *Elsewhere:* China (Tibet), Laos, Myanmar, Nepal, Pakistan, Thailand.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Girish Kumar & Carpenter (2013). Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

15. *Chlorodynerus deesanus* (Cameron, 1907)

1907. *Odynerus deesanus* Cameron, 1007. Type: ♀, Deesa (BMNH).

2006. *Chlorodynerus deesanus*; Gusenleitner, 691.

Diagnosis: Female: Clypeus wider than long, its apex broad, transverse, punctures not quite so strongly or so closely punctured as that of vertex; apex of metanotum broadly narrowed, sides broadly rounded, centre not much depressed, transversely striated; mesosoma closely punctured; metasoma distinctly but less strongly than mesosoma; T1 cup-shaped, short, clearly shorter than its maximum width; T2 longer than wide, its apex slightly, narrowly depressed; S2 with a distinct furrow basally.

Colour: Body pale yellow with following black marks: a line above on scape; a broad mark covering ocelli, broadly rounded behind, with two short curved lines on inner side of hind ocelli running obliquely beyond the apical, mark continue laterally as a broad line to each antenna; a mark at middle of occiput; a short oblique line on temple; a narrow line around base and sides of mesoscutum; a line at base of scutellum and another at base of metanotum; hind femora and tibia above; two large oblique oval marks on top of basal slop of T1; a broad line on base of T2 ; small obscure spots at middle of other tergites; a transverse line at base of S3. Antennal flagellum rufous. Wings hyaline.

Size: 12 mm.

Distribution: India: Gujarat, Rajasthan.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Cameron (1907). Gusenleitner (2006) previously reported this species from Jaisalmer of Rajasthan.

16. *Delta conoideum* (Gmelin, 1790)

(Image 9)

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

1987. *Delta conoideum*; Gusenleitner, 694.

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

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

Size: 23-26 mm.

Male: Aside from the usual sexual dimorphism of Vespidae structure similar to female in general appearance but smaller and slighter. **Size:** 16 mm.

Material examined: India: Rajasthan, Jodhpur dist., Takhat Sagar lakeside, 1♀, 4.ix.1964, Coll. V.C. Agrawal (DRCZSI No. I 1732).

Distribution: India: Arunachal Pradesh, Gujarat, Kerala, Odisha, Rajasthan (new record), Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere: Arabia, China, Malaysia, Myanmar, Pakistan, Sri Lanka, Thailand.

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

(Image 10)

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

2012a. *Delta dimidiatipenne* (de Saussure); Girish Kumar, 45.

Diagnosis: Female: Clypeus smooth, its anterior margin slightly concave at apex; frons closely and strongly punctured; vertex and temple with scattered minute punctures; petiole almost smooth with scattered punctures on apical half.

Colour: Head obscure dull red with following black markings: a broad band on vertex including upper half of frons, a 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; a black margin on scutellum anteriorly; propleuron usually black; mesopleuron usually with large black area except a dull red patch below tegula and another red mark at lower side near to mid coxa; metapleuron usually with large black area except a red patch on upper metapleuron; median groove of propodeum sometimes black; metasoma dull red except the following black markings: base of petiole, apical

half of T2 & S2, whole of the remaining tergites and sternites (sometimes apical tergites and sternites pale black). Wings ferruginous with apical half of forewing fuscous having a purple reflection.

Size (H+M+T1+T2): 20-23 mm.

Male: Aside from the usual sexual dimorphism of Vespidae structure similar to female in general appearance except the following differences in colour pattern: labrum yellow, clypeus yellow except one middle and two lateral black spots, supraclypeal area yellow, lower half of frons yellow except two black vertical black marks from antennal toruli to upper half of frons. Dorsal sides of apical antennal segments usually not as black as in female, dorsal side of last antennal article usually yellow with narrow black margin. Last antennal article hooked apically, hook long, curved and pointed, in curved position it almost reaches the apex of ninth article; S3-S6 with few large hairs apically; S7 with a deep median longitudinal groove; apical tip of aedeagus bulb-like; parameral spine elongate with moderately large hairs sub apically. Male comparatively smaller and slighter than female. Other characters almost same as in female. **Size (H+M+T1+T2):** 19-22 mm.

Material examined: India: Rajasthan: Jodhpur, 1♂ & 1♀, 23.xii.1956, Collector Unknown, NZSI Regd. No. 3838/H3; Jodhpur dist., Mandore, 1♀, 21.ix.1963, Collector Unknown, NZSI Regd. Nos. 2218/H3 & 2219/H3; Jodhpur dist., Mandore, 1♀, 9.ix.1964, Coll. V.C. Agrawal (DRCZSI No. A/956); Jodhpur, 1♂, 26.ii.1967, Coll. A.P. Kapur (DRCZSI No. 5811); Pali dist., Gadwada, 2♂, 20.xi.2013, Coll. Gaurav Sharma & Party, NZC Nos. 14997/H3 & 14998/H3.

Distribution: India: Arunachal Pradesh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Kerala, Maharashtra, Punjab, Rajasthan, Uttarakhand and 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 and Yemen.

Remarks: Tiwari *et al.*, (2004) previously reported this species from Girab of Rajasthan. Subsequently, Girish Kumar (2012a) also previously recorded this species from Mandore of Rajasthan.

18. *Delta esuriens* (Fabricius, 1787)

(Image 11)

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

2012b. *Delta esuriens*; Girish Kumar, 57.

Diagnosis: Female: Clypeus smooth; frons closely and strongly punctured; pronotum strongly and closely punctured except anterior face almost smooth; mesoscutum, scutellum and metanotum strongly and closely punctured; mesepisternum densely punctate; metapleuron almost smooth; propodeal dorsum strongly punctured except at dorso-lateral angle with scattered punctures; ventral area of propodeum strongly punctured except the inner concavity with scattered punctures; lateral areas of propodeum almost smooth; metasoma almost smooth.

Colour: Head yellow to brownish yellow with following black markings: a broad band on vertex including upper half of frons extending behind vertex to outer side of temple and to occiput, a black mark on anterior tentorial pit extending to subantennal suture to dorsal side of antennal scrobe and touches to the black band on frons; antennae light reddish; mandible yellow except at margins yellowish brown; pronotum almost entirely yellow except at anterior apex of anterior face of pronotum black; mesoscutum black except a large brown area posteriorly; scutellum light red; metanotum yellow, propleuron black; 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 baso-lateral apex near to lateral corner and at posterior end with yellow markings; legs light reddish with highly variable yellow markings; petiole light reddish except at base black, at sub apically a black band and then a yellow band; T2 basally light reddish, then a black band and remaining apical half yellow; S2 light red except at apex with a yellow band and two lateral yellow spots; all remaining visible part of gastral segments yellow, with their bases (when drawn out) black. Wings flavo-hyaline with a narrow sub apical 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 reaches the apex of 9th article; S3-S6 with few large hairs; S7 with a deep median longitudinal groove; genitalia with 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: Rajasthan: Jhunjhunu district, Gudha, 1♀, 11.iv.1958, Coll. T.G. Vazirani, NZSI Regd. No. 3123/H3; Jhunjhunu district, Gudha, 1♂, 27.v.1958, Coll. T.G. Vazirani, NZSI Regd. No. 3032/H3; Jodhpur district, Bishalpur, 1♂, 8.vi.1960, Coll. R.K. Bhatnagar, NZSI Regd. No. 3838/H3; Jodhpur district, Mandore, 1♀, 21.ix.1963, Collector Unknown,

NZSI Regd. No. 3604/H3; Sri Ganganagar dist., Manjuvas, 1♀, 16.xi.2013, Coll. Gaurav Sharma & Party, NZSI Regd. No. 15000/H3; Churu dist., Sujangarh, 1♀, 17.xi.2013, Coll. Gaurav Sharma & Party, NZSI Regd. No. 15001/H3. **Distribution:** India: Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal. **Elsewhere:** Arabia, Australia, Indonesia (Borneo, Java), Iran, Iraq, Laos, Mauritius, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Timor.

Remarks: Chhotani & Ray (1975) previously reported this species from Bishalpur and Gudha of Rajasthan. Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan. Girish Kumar (2012b) also previously recorded this species from Gudha, Bishalpur and Mandore of Rajasthan.

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

(Image 12)

1775. *Vespa pyriformis* Fabricius, 371. Syntype : Sex not mentioned, China (?).

2012. *Delta pyriforme pyriforme*; Girish Kumar & Lambert, 274.

Diagnosis: Male: Anterior margin of clypeus concave at apex; frons closely and strongly punctured; median groove of propodeum distinct, punctured and complete; pronotum with distinct pretegular carina; petiole almost smooth with scattered punctures on apical half; gaster almost smooth with minute scattered punctures; last antennal article hooked apically, hook long, curved and pointed, the terminal half distinctly swollen in profile and widened seen from above, in curved position it almost reaches the apex of ninth article; S3-S6 with few large hairs apically; S7 with a deep median longitudinal groove; apical tip of aedeagus bulb-like; parameral spine elongate with moderately large hairs sub apically; volsella with moderately large thick hairs.

Colour: Head yellow, a broad transverse black band between the eyes on vertex through ocellar area; occiput black; antenna reddish brown; pronotum entirely and mesoscutum anteriorly yellow, the later posteriorly black; tegula and parategula reddish brown; scutellum and metanotum reddish brown; propleuron black; mesopleuron, metapleuron, propodeum and legs reddish brown with highly variegated black markings; sutures between scutellum, metanotum and propodeum black; petiole and basal third of the second gastral segment reddish brown, the former



1. *Polistes (Gyrostoma) wattii* Cameron ♀



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



3. *Ropalidia brevita* Das & Gupta ♀



4. *Ropalidia variegata* (Smith) ♀



5. *Vespa orientalis* Linnaeus ♀



6. *Allorhynchium metallicum* (de Saussure) ♀

black at base, the middle of the later black, its posterior third and the visible part of remaining abdominal segments yellow; wings deep flavo-hyaline.

Size (H+M+T1+T2): 18.5 mm.

Material examined: India: Rajasthan: Sirohi dist., Mount Abu, 1♂, date of collection unknown, Coll. Dudgeon, NZSI Regd. No. 13195/H3.

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

Remarks: Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan. Girish Kumar & Lambert (2012) also previously recorded this species from Mount Abu of Rajasthan.

20. *Knemodynerus multimaculatus* Gusenleitner, 2006

2006. *Knemodynerus multimaculatus* Gusenleitner, 677, 691. Holotype: ♂, "India: Udaipur 50 km W, Rajasthan" (SMNS).

Diagnosis: Male: Clypeus broader than long, its apex deeply emarginate; front, vertex and temple uniformly finely punctured; punctures on pronotum, mesoscutum, scutellum, metanotum and mesopleuron significantly coarser than that of front; T1 and T2 much finer than mesoscutum.

Colour: Body black with the following white marks: mandible except teeth; labrum; clypeus; underside of scape; inner edge of eye to ocular sinus; a triangular mark on front; a wide mark on temple; a broad uninterrupted band on anterior face of pronotum; patches on upper portion of mesopleuron; tegula except translucent edges and large dark translucent median spot; a triangular spot on scutellum; metanotum almost entirely; large spots on both sides of propodeum; a laterally extended terminal band on T1; one in the middle and laterally extended terminal band on T2; small spots in the middle of T3 to T5; a narrow terminal band on S1; a sinuate twice wide terminal band on S2; a cross band in the middle of S3; coxae, distal ends of fore and mid femora, tibia and tarsi almost entirely. Reddish markings as follows: patches on T1; legs except white portions. Wings hyaline.

Size: 8 mm.

Distribution: India: Rajasthan.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Gusenleitner (2006). He originally described this species from Udaipur of Rajasthan.

21. *Oreumenoides edwardsii* (de Saussure, 1852) (Image 13)

1852. *Eumenes edwardsii* de Saussure, 60. Syntype: ♀, "Les Indes-Orientales, Bombay" (MNHN).

2011. *Oreumenoides edwardsii*; Girish Kumar, 16.

Diagnosis: Male: Apex of clypeus emarginate with two lateral triangular tooth-like projections; frons, anterior portion of interantennal space and vertex at middle near to ocellar triangle with moderately large punctures; anterior face of pronotum smooth; posterior and lateral portion of pronotum, mesoscutum, scutellum, mesopleuron with moderately strong punctures; metanotum shiny with scattered punctures; dorsal side of propodeum closely and densely punctate except at anterior margin towards metanotum smooth; metapleuron and lateral sides of propodeum smooth; pronotum with distinct pretegular carina; metasoma almost smooth, with minute punctures; last antennal article minute, not coiled apically; parameral spine with moderately large hairs.

Colour: Body ferruginous red with yellow and black markings. Yellow markings as follows: clypeus; interantennal space; inner margin of lower eye extends up to ocular sinus; a narrow line on outer margin of eye; a spot on ventral side of antennal attachment; a short line on middle of pronotum; a spot on tegula apically; parategula; lower half of metanotum; a small spot on postero-lateral corner of propodeum; propodeal valvula; a streak on outer side of tibiae and basitarsi; a mark on outer side of fore, mid and hind femora; a streak on each side just after middle of petiole; two subapical spots and two spots on postero-lateral corner on the same above; two lateral oval spots basally and a broad band apically on T2; two spots postero-laterally on T3 & T4; a narrow band on S2 apically; a broad band on S3 & S4 apically. Black markings as follows: frons except inner ocular sinus; vertex; temple except ocular margin of eye; occiput; mesoscutum except an M-shaped ferruginous brown marking; apical margin of scutellum; basal half of metanotum; axillary fossa; suture between metanotum and propodeum; median groove of propodeum; mesepimeron largely; ventral side of mesosoma; base and middle of petiole above; middle of T2; a broad longitudinal band from base up to middle of S2. Forewing almost hyaline with a distinct brown infumation on radial cell at distal half.



7. *Antepipona ceylonica* (de Saussure) ♂



8. *Antepipona sibilans* (Cameron) ♂



9. *Delta conoideum* (Gmelin) ♀



10. *Delta dimidiatipenne* de Saussure ♂



11. *Delta esuriens* (Fabricius) ♀



12. *Delta pyriforme pyriforme* (Fabricius) ♂

Size: 12.5 mm.

Material examined: India: Rajasthan: Sirohi dist., Mount Abu, 1♂, date of collection unknown, Coll. Dudgeon, NZC Regd. No. 12385/H3.

Distribution: India: Delhi, Bihar, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere: Myanmar, Nepal, Pakistan, Thailand.

Remarks: Girish Kumar (2011) previously recorded this species from Mount Abu of Rajasthan.

22. *Rhynchium carnaticum* (Fabricius, 1798)

(Image 14)

1798. *Vespa carnatica* Fabricius, 261. Syntype: Sex not mentioned, “Tranquebariae” (ZMUC).

2006. *Rhynchium carnaticum*; Gusenleitner, 2006: 692.

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 the punctures less than interspace.

Colour: Body brownish red with the following black marks: a spot on interantennal space; a vertical line on lower frons; around ocelli; occiput; a triangular mark on mesoscutum in front; a transverse line along its apex; lateral sides of propleuron; epicnemium; propodeum in the middle; basal area of T1; at base of T2; in between S1 & 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.

Material examined: India: Rajasthan, Jodhpur dist., Paota, 1♀, 5.viii.1961, Coll. J.S. Bhatti (DRCZSI).

Distribution: India: Andhra Pradesh, Assam, Bihar, Delhi, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, West Bengal.

Elsewhere: Indonesia, Pakistan, Sri Lanka.

Remarks: Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

23. *Rhynchium oculatum leviscutis* (Cameron, 1908)

(Image 15)

1908. *Odynerus leviscutis* Cameron, 306. Holotype: ♂, Bombay (BMNH).

1952. *Rhynchium oculatum leviscutis*; Giordani Soika, 49.

Diagnosis: Female: Clypeus with moderately deep punctures; extreme apex of clypeus not sharply truncated, almost rounded; frons closely, weakly and rugosely punctured; vertex weakly punctured except at shallow post ocellar fovea and area towards occipital carina almost smooth; anterior face of pronotum smooth without punctures; pronotal carina strong and reaching the lateral margin of pronotum; mesoscutum strongly, closely and rugosely punctate except at posterior portion smooth; scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially; epicnemial carina distinct; upper metapleuron smooth at lower portion and punctate at upper portion; propodeum vertical, concavo-truncate posteriorly; posterior concave area of propodeum with somewhat regular transverse striations; postero-lateral sides of propodeum with few strong stout spine-like structures; T1-T5 and S2-S5 with distinct, smooth punctures.

Colour: Body brown with the following yellow markings: a broad transverse marks on lower frons; inner margins of eye; tegula; T2 almost entirely except basal triangular brownish marks; lateral sides of S2. Wings yellowish hyaline; head and mesosoma dorsally with fine golden pubescence.

Size (H+M+T1+T2): 10.5 mm.

Material examined: India: Rajasthan, Jodhpur dist., Patodi House, 1♀, 4.x.1966, Coll. N.K. Parida (DRCZSI No. I 2412); Bikaner dist., Loonkaransar, 1♀, 15.xi.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14999/H3.

Distribution: India: Delhi, Maharashtra, Rajasthan (new record).

24. *Stenodyneriellus praeclusus* (Nurse, 1903)

1903. *Odynerus praeclusus* Nurse, 532. Lectotype: ♀, “Mount Abu” (BMNH).

1994. *Stenodyneriellus praeclusus*; Giordani Soika, 55, 97.

Diagnosis: Clypeus of female much wider than long, almost truncate at apex; punctures on vertex behind ocelli with interspaces on average equal or ever smaller than diameter of punctures; metanotum declivous; dorsal face of propodeum not distinctly separated from posterior face; T1 much shorter than its width at apex, slightly narrower than T2; punctuation on T1 & T2 almost indistinct.

Colour: Black with antenna brown ferruginous. Ferruginous are: mandible and legs. Ivory white are: a band at base and two spots at apex of clypeus; a line on lower face of scape; a line above interantennal space towards anterior ocellus; ocular sinus; two lines behind ocelli; a line on temple; a



13. *Oreumenoides edwardsii* (de Saussure) ♂



14. *Rhynchium carnaticum* (Fabricius) ♀



15. *Rhynchium oculatum leviscutis* (Cameron) ♀



16. *Tropidodynerus (Tropidepipona) hostis* (Nurse) ♂



17. Nest of *Polistes (Gyrostoma) wattii* Cameron



18. Nest of *Ropalidia variegata* (Smith)

band on pronotum shortened towards sides; a small spot on mesepisternum; two lines at sides of scutellum; two bands on propodeum; anterior and posterior ends of tegula; parategula; outer side of coxa; a large spot at apex of fore femora; large part of outer side of fore and mid tibiae; a narrow line widely interrupted in middle of hind tibiae; outer side of all basitarsus; a band, closely notched in the middle, at apex of T1; a band of same width at apex of T2; a mark on apex of T4 and a much larger on T5; S2 except a large brownish black spot at base. Wings almost hyaline.

Distribution: India (Rajasthan).

Remarks: No material was available for our studies; hence the description is taken from Giordani Soika (1994). Nurse (1903) originally described this species from Mount Abu of Rajasthan.

25. *Tropidodynerus (Tropidepipona) hostis* (Nurse, 1903)

(Image 16)

1903. *Odynerus hostis* Nurse, 533, ♂, ♀, India: "Mt. Abu" (BMNH).

2013. *Tropidodynerus (Tropidepipona) hostis*; Girish Kumar *et al.*, 167.

Diagnosis: Male: Apical article of antenna coiled; frons sub opaque, with punctures approximately equal to those of the clypeus, but less dense; occipital carina strong only on sides and narrowed ventrally; anterior face of pronotum smooth with few small punctures on lateral sides; pronotal carina almost absent at middle, strong at its shoulders, below which stops abruptly; propodeum completely rounded at lateral and posterior sides, with dorsal side strongly convex, vertical median concave side almost smooth, deeply concave, with a weak median carina only at the base of propodeum, lateral sides almost smooth with few minute scattered punctures and faint minute transverse striations; tegula with posterior lobe short, rounded at apex without a partly straight edge posteriorly; apex of parategula reaches far beyond the apex of tegula; T2 without apical lamellae; punctures on T1 much bigger than those of dorsal surface of propodeum; punctures of T2 as that of T1 but at posterior and lateral sides larger and denser; S2 with distinct punctures, thicker than that of T2; apical tip of aedeagus rounded, parallel spines elongate without hairs.

Colour: Body black with ferruginous and yellow markings. Black and ferruginous colours intermixed in several places. Ferruginous markings as follows: inner and apical margin of mandible;

funicular segments; most of dorsal surface of propodeum; inner side of all coxae; base of all femora; lateral spot and base of S2. Yellow markings as follows: mandibles except at inner and apical margins brown; clypeus; supraclypeal area; a large mark on inter antennal space; wide band along inner orbits of eye extends up to ocular sinus; a line on temple; ventral face of scape; a broad band on dorsal surface of pronotum; two large round spots on scutellum; metanotum; tegula; parategula; a spot at upper part of mesepisternum; legs except inner side of all coxae and base of all femora; two large spots on either side connected to apical band on T1; two very large spots on either side connected to broad apical band on T2; apex of T3-T6 & S3-S6; a large area on S2. Wings slightly brownish.

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

Material examined: India: Rajasthan, Sirohi dist., Mount Abu, 1♂, date of collection unknown, Coll. Dudgeon, NZC Regd. No.13959/H3; Alwar dist., Siliserh, 1♂, 18.x.1973, Coll. Y.P. Sinha, NZC Regd. No. 13960/H3.

Distribution: India: Delhi, Jammu & Kashmir, Madhya Pradesh, Rajasthan.

Remarks: Nurse (1903) originally described this species from Mount Abu of Rajasthan. Subsequently, Girish Kumar *et al.* (2013) reported this species from Mount Abu and Siliserh of Rajasthan.

26. *Xenorhynchium nitidulum* (Fabricius, 1798)

1798. *Vespa nitidula* Fabricius, 262. Syntype: "India Orientalis" (ZMUK).

1963. *Xenorhynchium nitidulum*; van der Vecht, 111.

Diagnosis: Female: Apex of clypeus broadly emarginate and angularly incised; labrum triangularly pointed at apex; frons, vertex and temple with moderately large punctures; occipital carina absent behind vertex; metanotum strongly raised above the level of adjoining areas of propodeum, the flattened dorsal surface approximately rectangular and about as long as the vertically sloping posterior surface; propodeum with prominent lateral angles, the concave declivity rather sharply separated from dorsal and lateral areas; propodeal valvula sharply chitinized, thickened and not distinctly separated from lateral area of propodeum; metasoma almost smooth and shiny, with a few scattered shallow punctures, punctures more deeper and closer on lateral sides; sub apical transverse line of close punctures on T2 and T3, its apex smooth and shiny.

Colour: Black, lower part of ocular sinus brown, covered with fine silvery pile which somewhat dense on clypeus (except at middle), face in front, sides of mesosoma and on metasoma. Wings deep fuscous with a purple reflection broadly along costal margin of forewing, the rest fusco-hyaline.

Size: 13-16 mm.

Male: Black except base of clypeus and ventral side of scape whitish yellow, all flagellar segments brown ventrally, lower part of ocular sinus brown. Antennal hook long and curved, somewhat dilated and flattened in apical half, with rounded apex, in curved position it almost reaches the apex of ninth antennal article; S7 rather strongly excavated, the concave area finely, granulately punctate and bordered by an arcuate and blunt ridge; parameral spine elongate. Size: 13-15 mm.

Distribution: India: Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. **Elsewhere:** Pakistan.

Remarks: No material from Rajasthan was available for our studies; hence the description is taken from Girish Kumar & Lambert (2011). Gusenleitner (2006) previously reported this species from Udaipur of Rajasthan.

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