



Taxonomic studies of the genus *Conura* Spinola (Chalcididae: Chalcidinae) from Oriental region with the first report of two New World species

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ABSTRACT. The chalcidine wasp genus *Conura* Spinola, 1837 (Hymenoptera: Chalcididae) is reviewed from the Oriental region. A New World species of *xanthostigma* group (*C. abdominalis* (Walker, 1861)) and an unnamed species represented by male specimens belonging to *maculata* group are reported for the first time from the Oriental region, India (Kerala). Diagnosis of species occurring in the Oriental region and a key to species are provided.

Key words: Chalcidinae, Nearctic, new record, India, species group, key

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INTRODUCTION

Conura is one of the most diverse genera of the subfamily Chalcidinae represented by 304 species worldwide (Noyes, 2019; Tavares et al., 2019; Brotto & Tavares, 2021). Though the genus is the second largest genus after *Brachymeria* Westwood (represented by 312 species) of family Chalcididae, and most speciose group in the Neotropics (261 species) (Brotto & Tavares, 2021). *Conura* is poorly-represented in the Oriental region with only one recorded species viz. *C. xanthostigma* (Dalman) along with some possible doubtful reports. Delvare (1992) reclassified the Chalcidini (Chalcidinae sensu Cruaud et al., 2020) and proposed classifying the species of *Conura* into three subgenera and 63 species groups. *Spilochalcis* Thomson is the largest subgenus (including 47 species groups), followed by *Conura* (ten species groups) and *Ceratomiscra* Ashmead (six species groups) (Delvare, 1992). The genus is very heterogeneous morphologically, and members are recognized mainly by the absence of diagnostic features of related genera (Brotto & Tavares, 2021). Delvare (1992) and Bouček (1992) provided keys to identify the genus and also diagnosed it. Members of the genus *Conura* are easily recognised by the distinctly petiolate metasoma, elongate, vertically placed propodeal spiracle, mid tibia with a distinct

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apical spur. They are generally reported attacking lepidopteran pupae but at times some species attack hymenopterans, coleopterans, and dipterans, or become hyperparasitoids on Braconidae and Ichneumonidae (Burks, 1940; Delvare, 1992; Mariau, 2001). Here we review the status of the genus from the Oriental region with reports of two New World species from Kerala, India along with a revised key to the species occurring in the Oriental region.

MATERIAL AND METHODS

The specimens studied here were collected from Elathur (11°20'37"N 75°43'6.74"E, 23m) and Atholi (11°23'35.9"N 75°45'11.2"E, 17m) both in the Kozhikode district of Kerala and using yellow pan traps. The wasp specimens were dried, pinned, examined under a Leica® M205 stereo zoom microscope and imaged with an attached Leica® DFC 2900 digital camera. Measurements were obtained using Leica® LAS software (Leica Application Suite V3.80) and images taken at varying focal depths were stacked using LAS. Final illustrations were improved for contrast and brightness using Adobe® Photoshop® CS5 (Version 12.0 x64) software. The specimens are deposited in the collections of Systematic Entomology Laboratory, Malabar Christian College, Kozhikode and will be deposited in the "National Zoological collections" of Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK).

Morphological terms and abbreviations used is mainly that of Delvare (1992) unless noted otherwise. The general abbreviations of the terms are as follows: **fu_x** – funiculars, with *x* being the funicle number; **Gt_x** – Gastral tergites, with *x* being the tergite number; **MV** – Marginal vein; **OD** – Median ocellar diameter; **OOL** – Oculo-ocellar distance; **POL** – Post-ocellar distance; **PMV** – postmarginal vein; **SMV** – submarginal vein; **STV** – Stigmal vein. **Museum abbreviation:** **ANSP** – The Academy of Natural Sciences of Drexel University, formerly the Academy of Natural Sciences of Philadelphia, U.S.A.; **BMNH** – Natural History Museum, London, England, UK; **ZMUC** – Natural History Museum of Denmark formerly Zoologiske Museum, Copenhagen, Denmark; **ZSIC** – Zoological Survey of India, Kolkata, India.

RESULTS

Taxonomic Hierarchy

Class Insecta Linnaeus, 1758

Order Hymenoptera Linnaeus, 1758

Superfamily Chalcidoidea Latreille, 1817

Family Chalcididae Latreille, 1817

Subfamily Chalcidinae Latreille, 1817

Genus Conura Spinola, 1837

Conura Spinola, 1837:1–2. Type species by monotypy *Conura flavicans* Spinola, 1837.

See Delvare (1992:192, 193) for a complete list of synonymies.

Diagnosis. Head with pre- and postorbital carina absent; petiolate metasoma; mesotibia with an apical spur; claws normal, edentate; vertically placed propodeal spiracle; hypopygium and ovipositor sheath not produced apically.

Host. Coleoptera; Lepidoptera; Diptera; Hymenoptera (Vejar-Cota et al., 2005; Bulgarella et al., 2017; Noyes, 2019).

Distribution. Mostly Neotropic and Nearctic (> 300 spp.); Afrotropical (~5 spp.); Oriental (3 spp.); Palaearctic (2 spp.) (Noyes, 2019; present report).

Remarks. Oriental fauna of *Conura* is represented by the only species *C. xanthostigma* (Dalman). Two New World species *C. abdominalis* (Walker, 1861) and *maculata* (*C. nigrifrons* (Cameron, 1884) are reported for the first time from Oriental region (Kerala, India). The species were assigned to *xanthostigma* group and *maculata* group using the keys to species group of *Conura* Spinola (Delvare, 1992).

Key to species of *Conura* Spinola from Oriental region

1. *Male*. Head and mesosoma with erect brown setae (Figs 15, 16); gaster distinctly longer than combined lengths of head and mesosoma (Fig. 13) [*maculata* species group]. *Conura* sp.
 – *Both sexes*. Head and mesosoma without such erect setae; gaster smaller than combined lengths of head and mesosoma. 2
2. Hind femur without an inner ventro-basal tooth; antennae attached distinctly above of ventral level of eye (Fig. 2); hind coxa smooth dorsally (Figs 8, 12). *C. abdominalis* (Walker)
 – Hind femur with an inner ventro-basal tooth; antennae attached distinctly above the ventral level of eye; hind coxa sparsely micropitted, densely pubescent dorsally. *C. xanthostigma* (Dalman)

XANTHOSTIGMA SPECIES GROUP

Till date, only members of the *xanthostigma* group of *Conura* were encountered from the Old World viz., *C. xanthostigma* (Dalman) [Palearctic and Oriental], *C. libanotica* (Schmiedeknecht) [Mediterranean basin only], *C. nigrorufa* (Walker), *C. andersoni* (Waterston), *C. congolensis* (Schmitz) [all from Afrotropical]. Till date only *C. xanthostigma* (Dalman) is reported from the Oriental region. The collected specimens were compared from literature and original descriptions of both Old and New World species.

Conura abdominalis (Walker, 1862) (Figs 1–12)

Smiera abdominalis Walker, 1862:177. Lectotype ♂, BMNH [misspelling for *Smicra* (Cresson, 1872):57].

Smicra ambigua Cresson, 1872:44. Lectotype ♂, ANSP Mexico [Synonymy by Kirby (1883):53].

Spilochalcis abdominalis (Walker, 1862) Schmiedeknecht, 1909:37 [combination by Burks (1977):384].

Conura (*Spilochalcis*) *abdominalis* (Walker, 1862) [combination by Delvare (1992):299].

Material Examined. 2♀♀, 1♂ – "India: Kerala, Kozhikode district, Elathur (11°20'37"N 75°43'6.74"E, 23m), 08.vii.2020, Coll. C. Bijoy".

Diagnosis. Metasoma shorter than combined lengths of head and mesosoma; antenna attached distinctly above the ventral level of eye; antennal scape not reaching the anterior ocellus; mesosoma densely punctured; mesoscutum with two yellow stripes along the outer margin of parapside; posterior margin of Gt₆ perpendicular. It can be separated from the other Indian *xanthostigma* group species *C. xanthostigma* (Dalman) in having the following set of features: head wider than mesosoma (in *C. xanthostigma*, head as wide as mesosoma); metasoma testaceous (in *C. xanthostigma*, metasoma completely black); apical margin of mesoscutellum truncated/straight (in *C. xanthostigma*, apical margin of mesoscutellum narrowly produced); hind femora testaceous yellow with reddish brown patch on medial disc and apically (in *C. xanthostigma*, hind femur black with yellow marking); hind femur without an inner basal tooth (in *C. xanthostigma*, hind femur with an inner basal tooth).

Redescription. ♀ (Figs 1–8). Length 3.38 mm; fore wing length 3.35 mm.

Colour. Testaceous with following parts different: head in frontal view brown with clypeus paler; scape pale yellow, pedicel brown, rest of antennomeres brown dorsally, markedly pale yellow ventrally, clava entirely yellow; vertex beyond anterior ocellus brown; pronotum with antero-medial declivity darker; mesoscutum except for parapsidal furrow and sides of parapsides black; axillae black; mesoscutellum with antero-medial inverted triangular area darker; dorsellum laterally brown; propodeum deep brown; mesopleuron and metapleuron dark brown with yellow patches below tegula; inner side of hind coxa reddish-brown; hind femur with medial patch on outer disc and apical patch reddish-brown; hind tibia with basal brown patch.

Pubescence. Moderately long yellowish-brown setae on head and mesosoma, metasomal terga Gt₁–Gt₅ bare, rest with short yellowish-brown setae; pubescence on propodeum moderately dense.

Head. Head in frontal view 1.5× as long as wide; vertex faintly convex in frontal view; frons alutaceous with numerous setigerous pits (Fig. 2), impunctate area below interantennal projection; interantennal

projection prominent, forming short carina along scrobal basin; scrobe finely alutaceous; vertex with shallower punctures, interstice alutaceous; POL $1.6\times$ OOL; occipital carina indicated, emarginated (Fig. 3).

Mesosoma. Pronotal collar angulate antero-laterally, forming sharp angle on lateral corner with antero-median declivity, faintly punctate, interstices imbricate, posterior margin distinctly emarginate; mesoscutum with imbricate impunctate strip at anterior margin, rest clearly, coarsely punctate with alutaceous interstices; mesoscutellum and axillae with similar sculpturing; apical margin of mesoscutellum truncate, emarginate; dorsellum indicated, foveolate (Fig. 4); mesopleuron shiny, with an anterior longitudinal carina and several small radiating transverse rugae; metapleura distinctly punctate (Fig. 5); propodeum shiny with regular rugate areola (Fig. 6).

Legs. Hind coxa dorsally smooth, shiny, ventrally setose, $2.1\times$ as wide as long; hind femur $1.7\times$ as long as maximum width, without inner ventro-basal tooth, 16 teeth on ventral margin; tarsal claws normal, edentate (Fig. 8).

Wings. Fore wing subhyaline; SMV $2.23\times$ MV; PMV $1.4\times$ MV; STV $0.3\times$ MV (Fig. 7).

Metasoma. Petiole $1.4\times$ as long as wide, with lateral bordering carina (Fig. 9); Gt₁–Gt₅ smooth, dorsally bare, smooth, Gt₆ perpendicular, smooth, setose; ovipositor sheath not exerted.

Male. (Figs 9–12). Body size 3.67 mm; fore wing 3.27 mm. Similar to female except, POL $2.8\times$ OOL (Fig. 10); antenna stout with three rows of white multi-porous plate sensilla on surface; hind femur with medial red patch confluent with apical patch (Fig. 12); petiole $2.1\times$ as long as maximum width (Fig. 11).

Distribution. Oriental: India (Kerala) (new report). *Elsewhere:* Neotropical (Brazil; Costa Rica; Ecuador; Mexico) (Walker, 1862; Cresson, 1872; De Santis, 1979; Delvare, 1992).

Host. Unknown.

Conura xanthostigma (Dalman, 1820)

Chalcis xanthostigma Dalman, 1820:141, Sweden.

Smiera xanthostigma (Dalman) [combination by Walker (1834):25].

Spilochalcis xanthostigma (Dalman) [combination by Thomson (1876):16].

Spilochalcis simlaensis Cameron, 1902:438. Lectotype ♀, NHMUK, India: Uttar Pradesh.

Spilochalcis indica Mani, 1935:252. Holotype ♀, ZSIC, [synonymy by Narendran (1989):204].

Spilochalcis fletcheri Mani, 1936:340. [synonymy by Narendran (1989): 204].

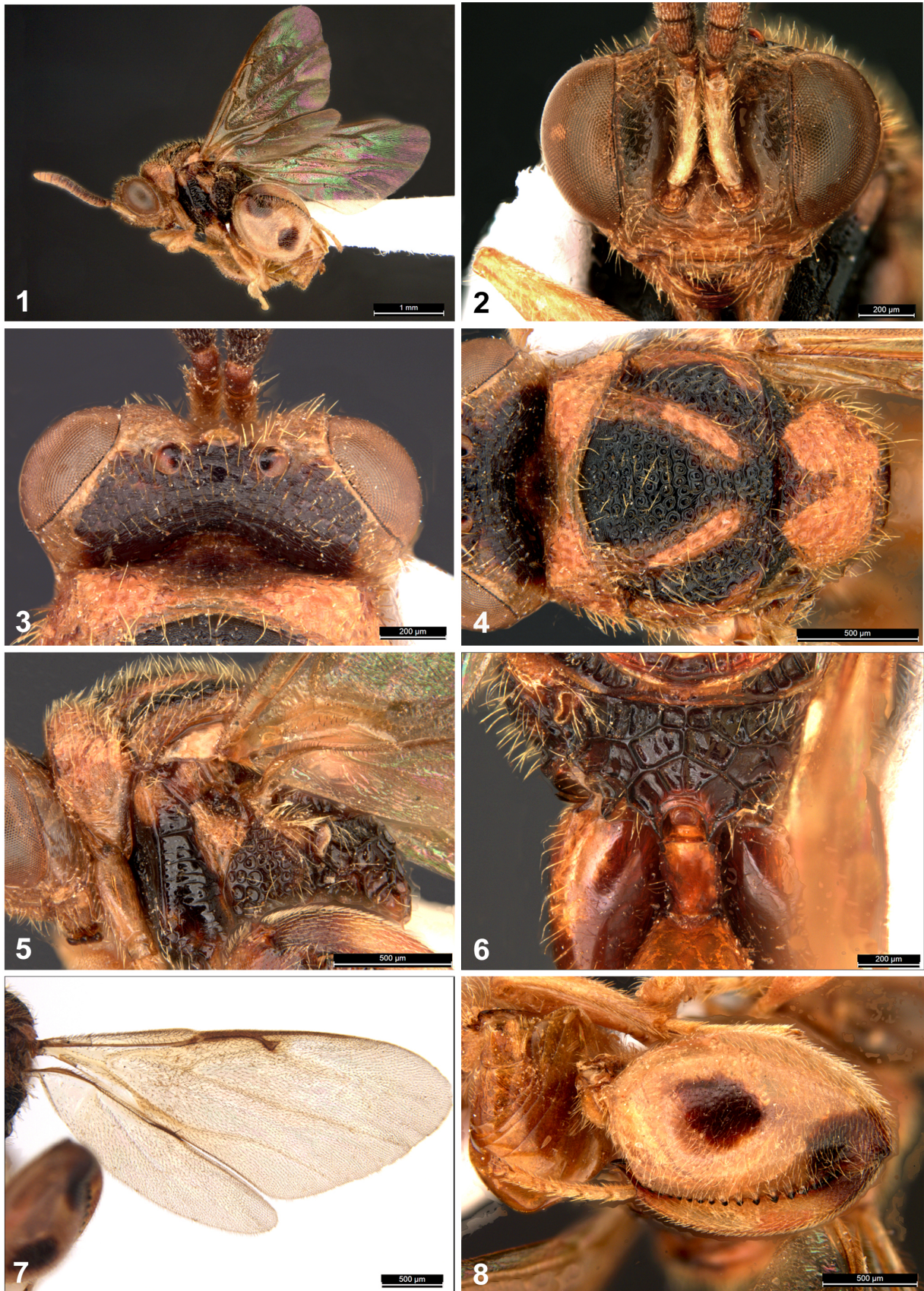
Conura (*Spilochalcis*) *xanthostigma* (Dalman) [combination by Delvare (1992):296].

Conura xanthostigma (Dalman) [earliest use of name by Vidal (2001):53].

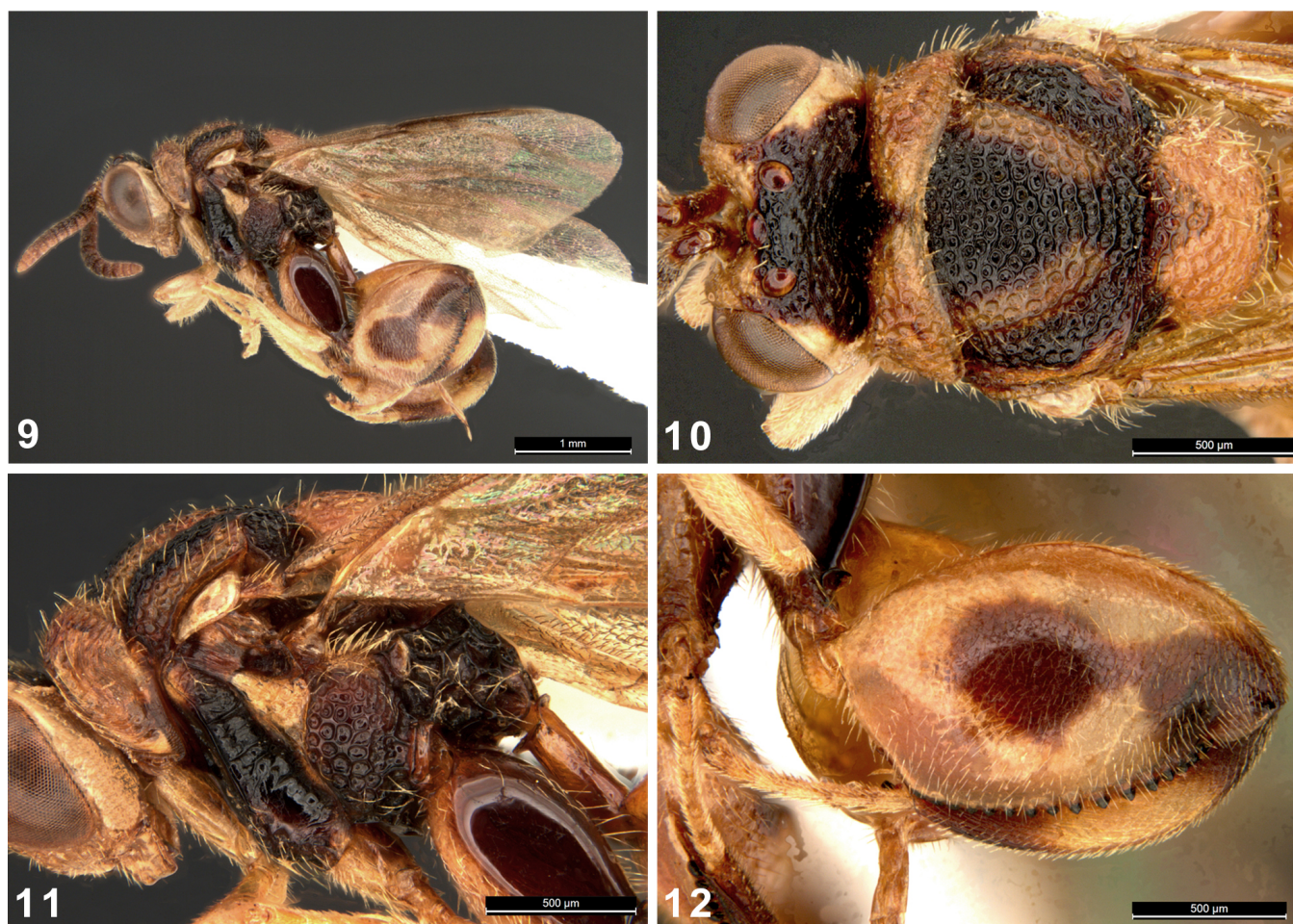
Type material. Lectotype ♀ –“India: Uttarakhand, Date ?, Coll. C.S. Nurse” [BMNH]. (not examined)

Diagnosis. Female. Black specimen with lemon yellow marking along inner eye margin, a band on frons, on interantennal projection and clypeus, anterior margins of pronotal collar, mesoscutum with parapsidal furrow and sides of parapsides, mesoscutellum with two lateral non-confluent patches, hind femur with variable yellow and black markings; head as wide as mesosoma, indistinctly pitted; scrobe microsculptured; POL $0.6\times$ OOL; stout interantennal projection; antennae thick, scape not reaching anterior ocellus, shorter than lengths of fu₄–fu₆ combined; mesosoma (except propodeum) dorsally densely pitted, interstices carinate, no microsculpture; pronotal collar without anterior carina, laterally formed teeth present; mesoscutellum with median longitudinal depression; MV 0.3 – $0.4\times$ SMV, PMV little longer than MV, STV $0.3\times$ MV; hind coxa with dense setigerous punctures dorsally; hind femur with dense minute setigerous punctures, inner basal tooth present, ventrally with 24–28 minute teeth; metasoma as long as or little shorter than mesosoma, strongly convex; Gt₁ more than $0.5\times$ length of gaster; epipygium not carinate at middle; ovipositor sheath slightly projecting beyond epipygium.

Male. Similar to female, hind coxa wholly black; hind femur with shorter yellow patch near apex on ventral side; antennae with fairly wider scape.



Figures 1–8. *Conura abdominalis* (Walker, 1861), female. 1. Habitus, lateral view; 2. Head, frontal view; 3. Head, dorsal view; 4. Mesosoma, dorsal view; 5. Mesosoma, lateral view; 6. Propodeum and petiole, dorsal view; 7. Fore and hind wings; 8. Hind leg.



Figures 9–12. *Conura abdominalis* (Walker, 1861), male. **9.** Habitus, lateral view; **10.** Head and mesosoma, dorsal view; **11.** Mesosoma, lateral view; **12.** Hind leg.

Note. No specimens of both sexes were obtained during the present study. So above mentioned diagnosis is based on the description of species (Burks, 1940; Habu, 1960; Delvare, 1992).

Distribution. India: Assam, Himachal Pradesh, Meghalaya, Uttar Pradesh. *Elsewhere:* Canada; China; Czech Republic; England, Finland; France; Germany; Italy; Netherlands; Russia; Slovakia; Sweden (Noyes, 2019).

Host. Hymenoptera; Lepidoptera (Noyes, 2019).

MACULATA SPECIES GROUP

The *maculata* species group of *Conura* can be easily identified by the following set of characters: interantennal projections only slightly convex; malar sulcus visible near the eye; antennal scape exceeding vertex, in male apex enlarged; head and mesosoma with distinct, erect pilosity. The species group is one of the largest in the genus comprising over 100 species (described and undescribed ones, Delvare (1992)) distributed mostly from Chile and Argentina all the way up to USA. The group till date is said to be confined to the New World, and the present report of two male specimens extend its distribution to the Old World. Males of some species of the *maculata* group (species from India superficially resembling *C. maculata* and *C. nigrifrons*) are very nearly identical in morphology and it is virtually impossible to differentiate them. Thus, the species though not specifically named is described here for making easeful future recognition.

Conura sp. (Figs 13–20)

Material Examined. 2♂♂ – "India: Kerala, Kozhikode district, Atholi (11°23'35.9"N 75°45'11.2"E, 17m), 29.xi.2020, Coll. C. Bijoy".

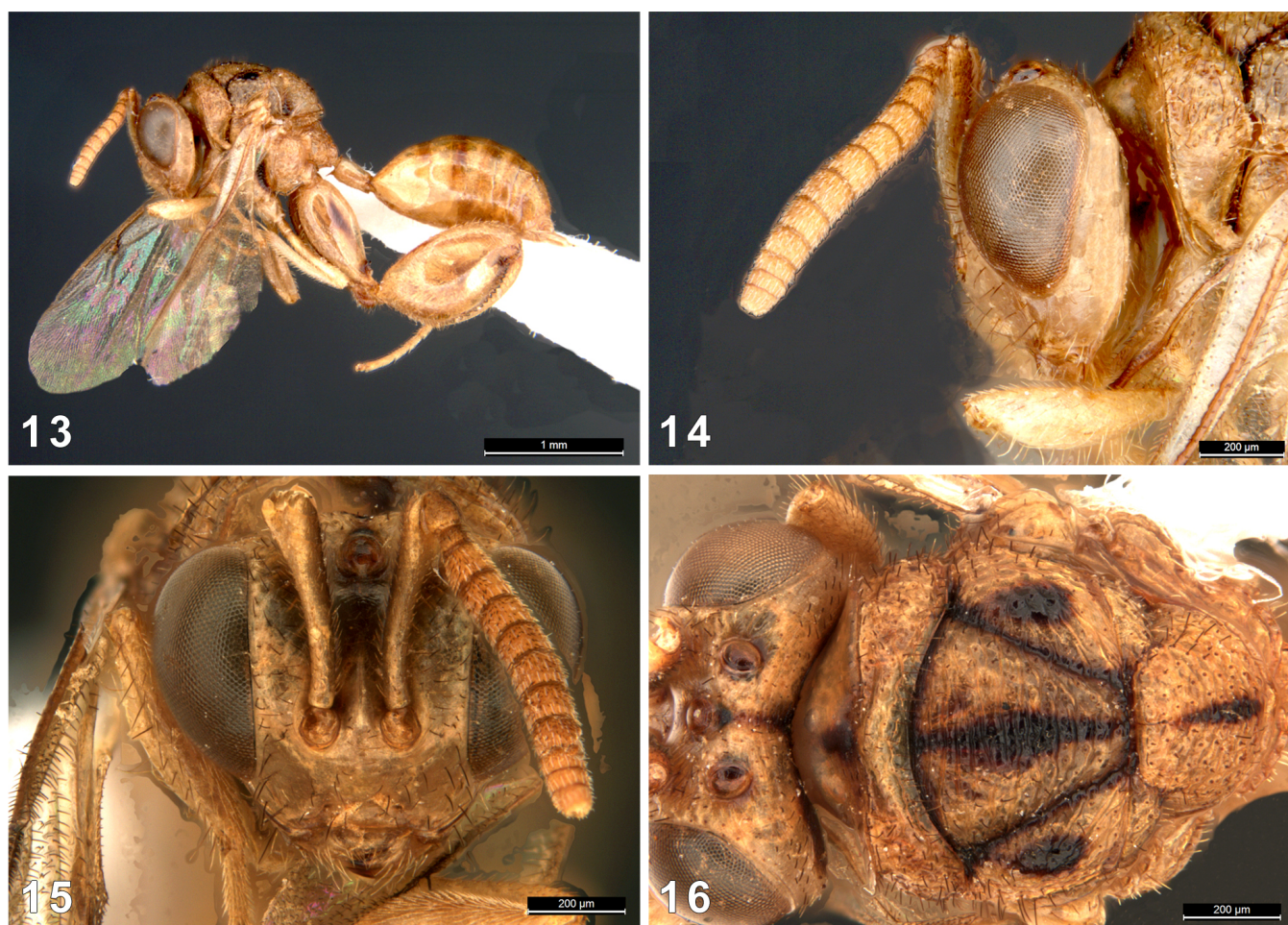
Diagnosis. Vertex with a distinct medio-longitudinal furrow from the anterior ocellus to the occiput along the ocellar triangle; scape reaching well beyond vertex and anterior ocellus; interantennal projection narrow, half as long as scrobe; head and mesosoma with scattered distinct thick brown setae; pronotum with distinct anterior bordering carina and raised antero-medial tubercle; metasoma distinctly longer than combined lengths of head and mesosoma.

Description. ♂ (Figs 13–20). Length 3.18 mm; fore wing length 2.28 mm.

Colour. Testaceous with following parts different: vertex with median longitudinal furrow brown; pronotal collar antero-medially beyond the anterior carina brown; mesoscutum with medial brown band; parapsidal furrow brown; lateral lobes of mesoscutum with antero-medial brown patch; mesoscutellar lamina with a longitudinal brown streak (not reaching apex); hind coxa with dorsal patch and ventral brown streak.

Pubescence. Moderately short, thick setae along on head, and mesosoma; metasomal terga Gt₁–Gt₅ bare, Gt₆ with short brown setae; legs with moderate setosity; pubescence on propodeum minimal.

Head. Head in frontal view 1.34× as wide as long; vertex faintly convex in frontal view, medially depressed; frons smooth with numerous setigerous pits; interantennal projection narrow, forming short



Figures 13–16. *Conura* sp., male. **13.** Habitus, lateral view; **14.** Head and antenna, lateral view; **15.** Head, frontal view; **16.** Head and mesosoma, dorsal view.

carina halfway along the scrobal basin; scrobe alutaceous, shallow; scape long, reaching beyond level of vertex, setose; three clavomeres (Fig. 14); vertex imbricate with moderate setigerous pits; strong longitudinal furrow from anterior ocellus towards occiput; POL $2.6\times$ OOL (Fig. 16); gena wide, shiny, faintly rugose; malar space long, $0.4\times$ length of eye in profile (Fig. 14); occipital carina faintly indicated, emarginated onto longitudinal furrow (Fig. 16).

Mesosoma. Pronotal collar with distinct anterior bordering carina and antero-medial raised tubercle, surface faintly rugose with numerous setigerous pits, posterior margin strongly emarginate (Fig. 16); mesoscutum with transverse rugae, numerous setigerous pits; mesoscutellum and axillae with similar circular rugae and setigerous pits; mesopleuron and metapleura rugose punctate (Fig. 17); apical margin of mesoscutellum pointed, emarginate; dorsellum indicated; propodeum shiny with regular rugate areola (Fig. 18).

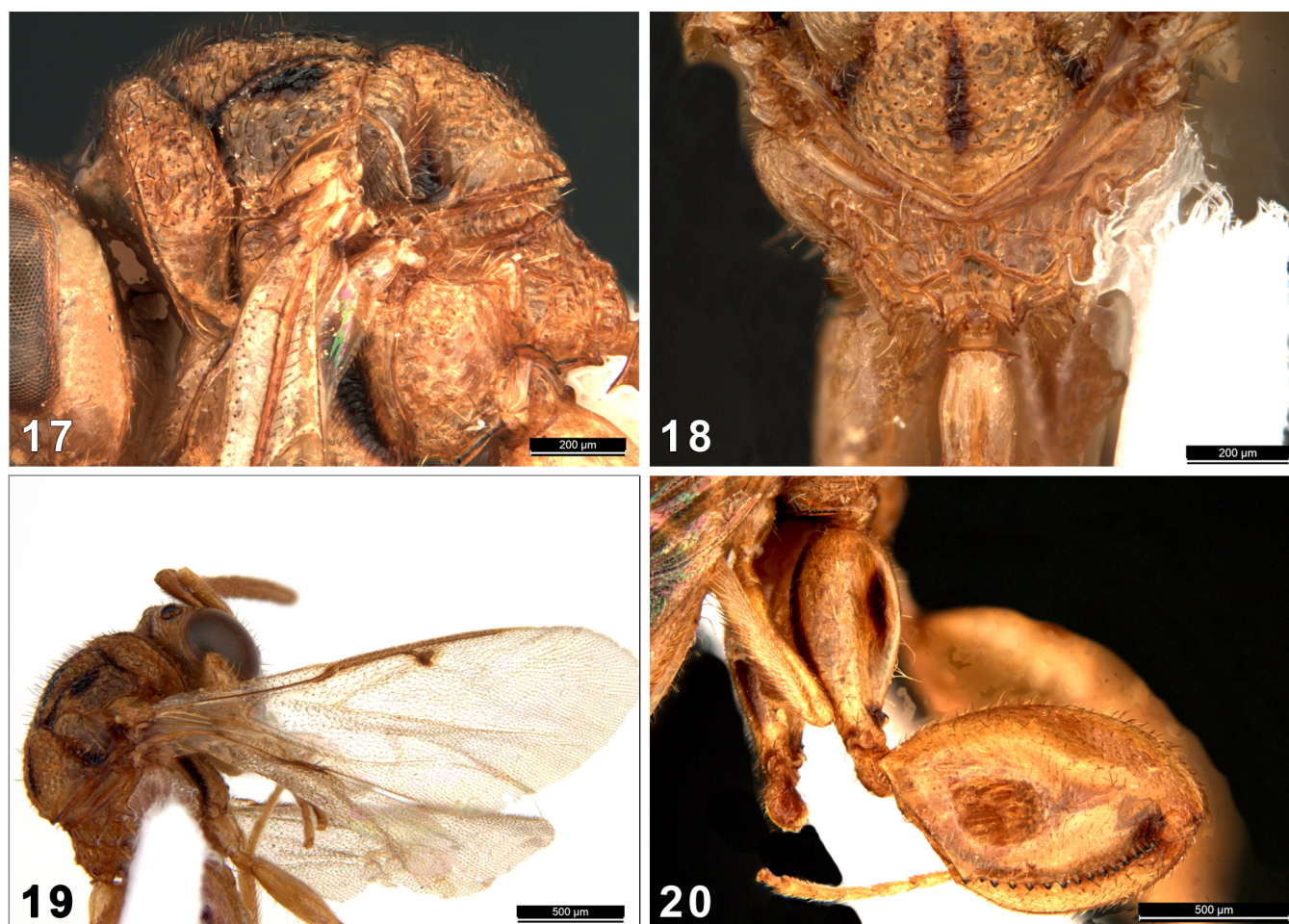
Legs. Hind coxa dorsally smooth, shiny, ventrally setose, $2.1\times$ as wide as long; hind femora $1.8\times$ as long as maximum width, without an inner basal tooth and 15 teeth on ventral margin, basal one larger; tarsal claws normal (Fig. 20).

Wings. Fore wing hyaline, SMV $2.47\times$ MV; PMV $1.24\times$ MV; STV $0.34\times$ MV (Fig. 19).

Metasoma. Petiole $1.73\times$ as long as wide, without any lateral bordering carina, smooth; Gt₁–Gt₅ smooth, bare; Gt₆ setose; epipygium exerted (Fig. 13).

Distribution. Oriental: India (Kerala).

Host. Unknown.



Figures 17–20. *Conura* sp., male. 17. Mesosoma, lateral view; 18. Propodeum and petiole, dorsal view; 19. Fore and hind wings; 20. Hind leg.

DISCUSSION

Members of the genus *Conura* Spinola are usually encountered in the Nearctics and Neotropics with only a few reported elsewhere. With more than 300 species described from the New World, the genus is represented by only eight species from Old World (Afrotropical, Palearctic, Oriental) (Noyes, 2019). The *xanthostigma* group comprises six described species recorded from New World and seven from Old World. The *maculata* group is represented by about 31 described species and, probably, more than one hundred waiting for description (Delvare, 1992). This present record forms the first report of the specimen of *maculata* group reported from the Old World. Since many species of *maculata* group are parasitoids of Lepidoptera larvae associated with cultivated plants (Delvare, 1992), it is quite likely that the male specimen collected from southern India belongs to a New World species accidentally introduced in India through imported plants or plant parts.

The only representative of the genus *Conura* confined to the Oriental region is *C. xanthostigma* (Dalman). Noyes (2019) erroneously reports a Nearctic species, *C. delumbis* (Cresson) from India. This might have occurred due to confusion over the acronym Del. given as the site of collection of the host material, *Lema* sp. on Jimsonweed (*Datura* sp.). This denotes Delaware in the USA rather than Delhi in India. Puttler (1966) confirms this distribution from Dover in Delaware rather than Delhi (India). An African species *C. nigrorufa* (Walker) is also said to be misrepresented from India (Narendran, 1989). The otherwise Nearctic species *C. side* (Walker) is cited only once since the establishment of the genus in Philippines, parasitizing *Diadegma insulare* (Cresson, 1865) (Hymenoptera: Ichneumonidae) (Thompson, 1955). Since the species is very extensively distributed in the Nearctic and Neotropical regions, its occurrence in the Oriental region is highly doubtful and is particularly strange. Thus the species is provisionally removed from the Oriental list until fresh specimens are available from the region.

The scant representation of the genus from the Oriental region may directly be associated with the absence of a wide repertoire of potential hosts for the species readily available in the Nearctics and Neotropics, and thorough sampling of the agricultural crops may yield more species of the group. The presence of two Nearctic species from the Oriental region (India, Kerala) can be hypothesized to represent a previously unnoticed accidental introduction of this insect species into India from the Nearctics and may have sustained on either their usual hosts (which may also have acclimatized to the Oriental conditions) or have adopted a broader host range in India and is utilizing alternative host species. A recent discovery of a Neotropical species of *Brachymeria*, *B. trinidadensis* (Narendran & Varghese) from Kerala (Binoy et al., 2022) substantiates this hypothesis.

AUTHOR'S CONTRIBUTION

The authors confirm contribution to the paper as follows: C.B. study conception and design, specimen collection and assembling, analysis and interpretation of results, draft manuscript preparation; C.B., M.N. & S.S. correction of manuscript after review process. All authors reviewed the results and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

Not applicable.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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مطالعه رده‌بندی جنس *Conura* Spinola (Chalcididae: Chalcidinae) از منطقه اورینتال به همراه گزارش دو گونه از منطقه دنیای جدید

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چکیده: جنس *Conura* Spinola, 1837 (Hymenoptera: Chalcididae) در منطقه اورینتال مورد بررسی قرار گرفت. یک گونه از منطقه دنیای جدید متعلق به گروه *xanthostigma* به نام *C. abdominalis* (Walker, 1861) و یک گونه ناشناخته بر اساس نمونه نر متعلق به گروه *maculata* برای اولین بار از منطقه اورینتال، هند (کرالا) گزارش شد. صفات افتراقی و کلید شناسایی برای گونه‌های منطقه اورینتال ارائه شد.

واژگان کلیدی: کالسیدها، نثارکتیک، گزارش جدید، هند، گروه‌گونه‌ای، کلید شناسایی