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Description of a new species of genus *Ceratina* Latreille, 1802 (Hymenoptera, Apoidea) from Eastern Himalayas, India with a new country record

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ABSTRACT. A new species of the genus *Ceratina* Latreille, 1802 is described from Tawang, Arunachal Pradesh, Eastern Himalaya, India. The new species is assigned to the subgenus *Ceratinidia* Cockerell & Porter, 1899 which was previously represented by seven species from mainland India. *Ceratina* (*Ceratinidia*) *bryanti* Cockerell, 1919 is also reported for the first time from India. Diagnostic features are elaborated and illustrated and distinguishing characters are discussed from closely allied species *Ceratina* (*Ceratinidia*) *bryanti*. Type localities mapped and augmented. An updated checklist of *Ceratina* species and their distribution in India is mapped and discussed.

Key words: Ceratinini, Eastern Himalaya, India, taxonomy, small carpenter bee, Checklist

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INTRODUCTION

Genus *Ceratina* Latreille, 1802, known as small carpenter bees, belongs to family Apidae from subfamily Xylocopinae which are represented by approximately 376 species globally with 23 subgenera (Michener, 2007; Terzo et al., 2007; Roig-Alsina, 2013; GBIF, 2022). Genus *Ceratina* is the sole representative of the tribe Ceratinini with validated tribal characteristics and is characterized by usually small, slender, shining and almost hairless bodies; body size ranges from 2.2 to 12.5 mm which vary from metallic green to black, with conspicuous yellow marking on the faces with exception of those from southern Asia and eastern hemisphere which have extensive yellow markings in other parts also; females of this genus are characterized by usually dark body with a unique longitudinal clypeal marking which is very uncommon in other bees (Michener, 2007). Being known as a cosmopolitan species, distribution of *Ceratina* is abundant

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globally except in Antarctica (not present) and Australia (where it is rare and limited in distribution) (Michener, 2007). *Ceratina* exhibits a diverse range of social behaviors like being solitary to subsocial, semisocial and colony organization eusocially and henceforth is considered as a key taxon to study the transitional changes in social structures (Rehan, 2020). Being wild bees, *Ceratina* are known to be effective pollinators suggested by several studies, though their true value on contribution on pollination of crops are not well studied (Olsen, 1996; Kobayashi-Kidokoro & Higashi, 2010). The genus *Ceratina* from Oriental region is extensively worked out by a number of contributions starting with the one of the most comprehensive studies done by van der Vecht (1952) and subsequently from Asia worked out by Yasumatsu (1969) from Japan, Hirashima (1971), Shiwohawa and Hirashima (1982), Shiwohawa (2002, 2006, 2008, 2010, 2015) from eastern Asia, southeast China, southeast Asia, Nepal, Philippines and Oriental region respectively; subsequent contributions include Warrit (2007, 2009) and Warrit et al. (2012) with revision of subgenus *Ceratinidia* Cockerell & Porter, 1899 describing one new species and commented on the taxonomic status and distribution of the present ten species from Thailand. Contributions to the taxonomy of *Ceratina* from India in XIX century includes Smith (1854), Bingham (1897); and more recently Gupta et al. (2013); Engel (2018); Prakash et al. (2020); Yogi & Khan (2021). The present study is an attempt to address the Wallacean and Eltonian shortfall extending information on taxa diversity, geographical distribution and important floral records benefitted from direct field observations and also effective for native stakeholders which is critical for formulating subsequent conservation policies (Sabino et al., 2011; Ghosh et al., 2019; de Oliveira et al., 2020). The present work is a contribution to description and illustration of the new species *Ceratina* (*Ceratinidia*) *tawangensis* sp. nov. and establishing the new record of *Ceratina* (*Ceratinidia*) *bryanti* Cockerell, 1919 from India by means of materials collected from Tawang district, Arunachal Pradesh, Eastern Himalayas, a biodiversity hotspot region. The study is a part of exploring hymenopteran diversity from the study region (Saini et al., 2018; Ghosh et al., 2020).

MATERIAL AND METHODS

Surveys were conducted in different parts of Tawang district, Arunachal Pradesh, India during April to June and again September to November in 2019. A total of 13 different sites were explored ranging from 1130 m a.s.l. to 4200 m a.s.l. in different locations of the district. Our study sites covered mostly *a.* Broad-leaved Forest (BLF) (<3000 m.); *b.* Conifer Broad-leaved Forest (CBF) (3000–4200 m a.s.l), *c.* Rhododendron Scrubland (RSL) (4000–4300 m a.s.l); *d.* Dwarf Rhododendron Meadows (DRM) (4200–4600 m a.s.l), and *e.* High-altitude Grassy Meadows (HGM) (4300–5250 m a.s.l). Human habitations are scattered in lower altitudes of the valley with temperate to subalpine areas (1100–3000 m a.s.l). Tawang has a warm and temperate climate with heavy rainfall in monsoon; hail and snow is common in early december to February (Mishra, 2004). Surveys for hymenopteran flower visitors were carried out using pan traps and variable transect walk in which bees and diversity of visited flowering plants were documented (Westphal et al., 2008; Nielsen et al., 2011). The flower visitors were then subsequently collected using hand nets, euthanized and preserved in 90% ethanol. Geocoordinates were recorded using a handheld GPS Navigator Garmin eTrex® -30 (Garmin Ltd, Switzerland). Floral resources were identified using relevant literature (Verma & Giri, 1996; Li, 2007; Pramanik et al., 2008; Chowdhery et al., 2009) and subsequently confirmed by taxonomists from the Botanical Survey of India. The specimens were then brought back to the laboratory and placed in a relaxing chamber. After a couple of days specimens were stretched, pinned and labeled according to their collection localities. Then they were examined under the LEICA® M205 stereo microscope and Leica® DFC 500 camera was used for taking images. Leica application suite V3.80 was used for measurements and image stacking. The images were post processed using Adobe Photoshop CS5 software. Data for the species diversity and distribution of different *Ceratina* species in India were collated from the literature, various field surveys and other web sources. The type localities as well as *Ceratina* species distribution in India is mapped (Figs 1 and 4) using QGIS v.2.4.0 (QGIS Development Team, 2018). All the type specimens are deposited in the National Zoological collections at Western Ghat Regional Centre, Zoological Survey of India, Kozhikode.

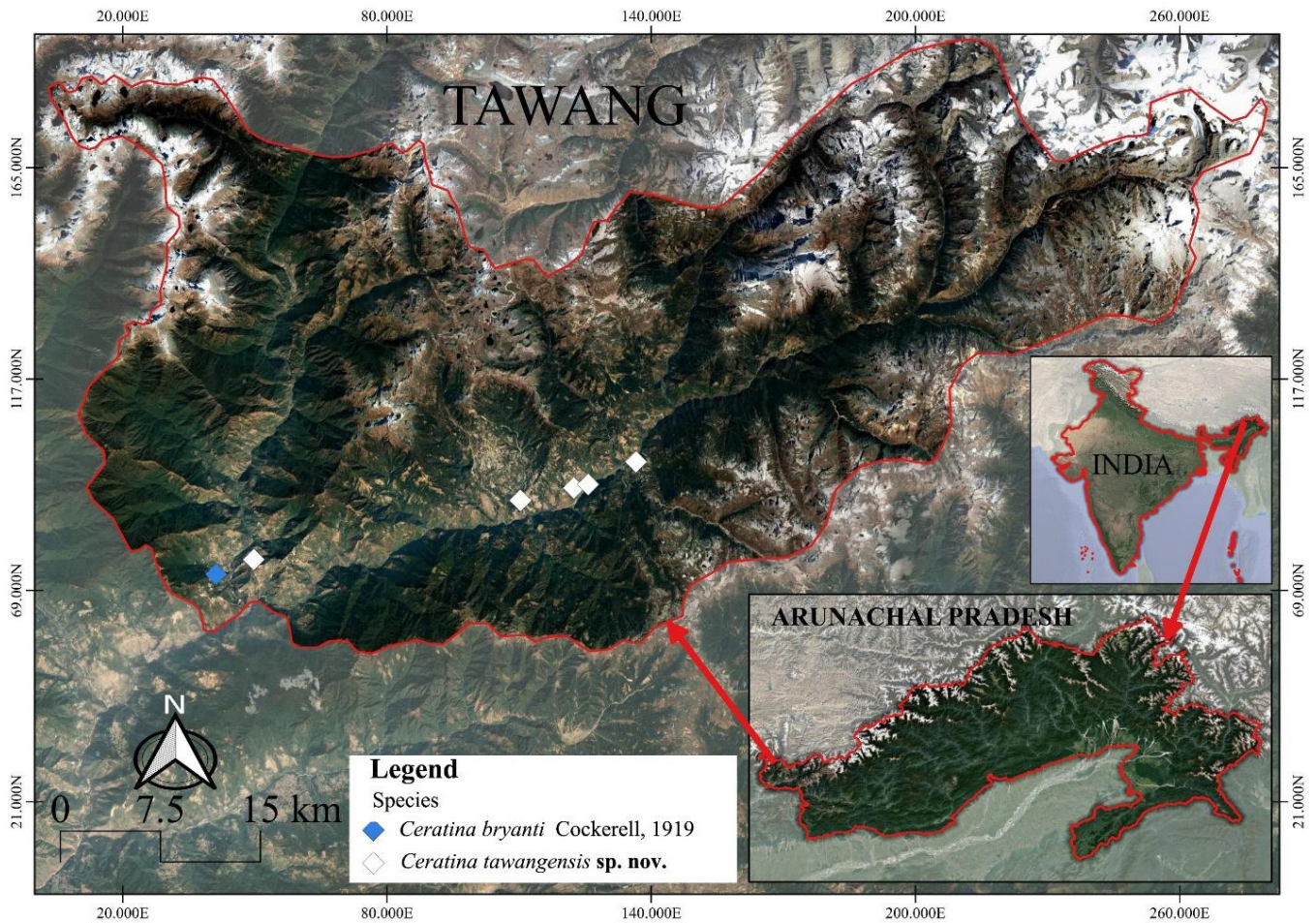


Figure 1. Collection localities of *Ceratina* (*Ceratinidia*) *bryanti* Cockerell, 1919 and *Ceratina* (*Ceratinidia*) *tawangensis* sp. nov., from Tawang district, Arunachal Pradesh, India.

Morphological information for comparisons were acquired from the taxonomic keys as well as original and comprehensive descriptions of other species of the subgenus *Ceratinidia* (Bingham, 1897; Cockerell, 1919; Hirashima, 1971; van der Vecht, 1952; Shiokawa, 2002, 2006, 2008; Warrit et al., 2012). Subsequently, images of identified *Ceratina* species in GBIF is also referred for morphological comparison and validation. The terminology in this work is followed by Michener (2007). Abbreviations used are as follows: T1, T2, T3 etc. denotes metasomal terga, HW denotes head width and ZSIK= Western Ghat Regional Centre, Zoological Survey of India, Kozhikode.

RESULTS

Class Hexapoda Blainville, 1816

Order Hymenoptera Linnaeus, 1758

Superfamily Apoidea Latreille, 1802

Family Apidae Latreille, 1802

Subfamily Xylocopinae Latreille, 1802

Tribe Ceratinini Latreille, 1802

Genus *Ceratina* Latreille, 1802

Subgenus *Ceratinidia* Cockerell & Porter, 1899

Type species: *Ceratina hieroglyphica* Smith, 1854, by original designation.

Diagnosis. Female of subgenus *Ceratinidia* is with the following yellow markings: on mandibles, labrum, clypeus (usually a reverse T-shaped mark, often reduced to transverse band), paraocular region, supraclypeal region, front (supra-antennal spots), antennae, pronotum with a transverse band, scutum with or without four longitudinal stripes, scutellum, mesopleura, postscutellum (rarely), tergum with apical transverse band (sometimes anteriorly incised, sometimes entirely black or with lateral spots), metasomal terga with sometimes apical transverse band broadened abruptly on lateral sides with interruption in T2 and T4 medially (often transverse band laterally narrowed, medially widened, anteriorly incised or broken in the middle), band pattern in T5 strongly widened medially, and laterally narrowed. Legs with yellow line and spots; frons, vertex, and mesepisternum with dense punctations (van der Vecht, 1952; Michener, 2007; Warrit et al., 2012).

Ceratina (Ceratinidia) tawangensis Ghosh, Jobiraj & Subramanian **sp. nov.** (Figs 2A–2H)

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Type material. (18♀) - **Holotype:** ♀, labeled as **India: Arunachal Pradesh**, Tawang district, Jang, Lhou (27°34'15.6"N, 91°56'2.4"E, altitude 2249 m), 25.V.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. No. ZSI/WGRC/IR/INV. 20687]. **Paratypes:** 2 ♀♀, labeled as **India: Arunachal Pradesh**, Tawang district, Jang, Lhou (27°34'15.6"N, 91°56'2.4"E, altitude 2249 m), 25.V.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. Nos. ZSI/WGRC/IR/INV. 20688, 20689]; 5 ♀♀, labeled as **India: Arunachal Pradesh**, Tawang district, Kharteng (27°31'51.6"N, 91°41'20.4"E, altitude 1677 m), 29.V.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. Nos. ZSI/WGRC/IR/INV. 20690, 20691, 20692, 20693, 20694]; 3 ♀♀, labeled as **India: Arunachal Pradesh**, Tawang district, near Jang forest rest house (27°35'13.2"N, 91°58'55.2"E, altitude 2133 m), 19.V.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. Nos. ZSI/WGRC/IR/INV. 20695, 20696, 20697]; 3 ♀♀, labeled as **India: Arunachal Pradesh**, Tawang district, Juksam (27°34'22.8"N, 91°56'42"E, altitude 2021 m), 25.V.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. Nos. ZSI/WGRC/IR/INV. 20698, 20699, 20700]; 4 ♀♀, labeled as **India: Arunachal Pradesh**, Tawang district, Kitpi (27°33'50.4"N, 91°53'34.8"E, altitude 2045 m), 17.V.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. No. ZSI/WGRC/IR/INV. 20701, 20702, 20703, 20704].

Diagnosis. Body andreniform, integument black; size > 9.3 mm. Distinct yellow longitudinal marking in the clypeus, medially with a subtriangular apical bar and without any transverse band basally (Fig. 2A); paraocular region without any vertical marking; pronotum without yellow transverse line and absence of yellow marking on scutum and scutellum (Figs 2B, 2C); distinct yellow spot below tegula as well as in protibia extending almost 1/2 of the tibial length and inner side apex of profemur (Figs 2B, 2E). The new species is similar to *Ceratina bryanti* Cockerell owing to a similar structural similarity of punctation and micro sculpture types in head (Fig. 2A), mesosoma and metasoma and distribution of hairs (labrum, mesopleuron, legs and T4-T6) (Fig. 2F) as well as hyaline wings (Fig. 2H) and finely coriaceous-reticulated propodeal triangle (Fig. 2B); but differs by an overall reduced maculation and the following characters: bigger body size (> 9 mm vs. <7 mm), lesser distance between the antennal sockets (Fig. 2A); finely reticulated gena and genal marking glabrous (vs. simple and punctated upper part of genal mark in *C. bryanti*) (Fig. 2B); absence of punctures on the propodeum (vs. finely and densely punctate in *C. bryanti* in lateral view) (Fig. 2C); absence of punctures on tibial marking and size of the marking extending 1/2 of the tibial length (vs. punctures present and marking extended 2/3 of the tibial length in *C. bryanti*) (Figs 2B, 2E); lateral longitudinal marking in paraocular area absent; clypeal marking longitudinal, extended almost to the full of clypeal length without any basal transverse extension (vs. inverted T-shaped clypeal impression in *C. bryanti*) (Fig. 2A); genal marking extended basally covering 1/3 of the eye length narrowed upwardly (vs. marking covering 2/3 of eye length and narrowed downwards in *C. bryanti*) (Fig. 2B). Yellow transverse band in pronotum absent (vs. usually unbroken transverse band in *C. bryanti*); scutum without any longitudinal lines (vs. four prominent longitudinal lines in *C. bryanti*); scutellum without any marking (vs. prominent large yellow marking almost covering the anterior region in *C. bryanti*). Transverse band on abdominal terga narrower and less prominent than *C. bryanti*.

Description — Female. *Measurements* (mm): Total body length: 9.87; forewing length: 7.49; head width: 3.21; head length: 2.65; eye length: 1.73; eye width: 0.75; ocellular distance: 0.68; diameter of median ocellus: 0.21; clypeus length: 1.04; clypeus width: 1.6; labrum length: 0.41; labrum width: 0.91; scape length: 0.83; scape width: 0.12; F1: 0.16; F2: 0.1; F3: 0.13; F4: 0.16; F5: 0.17; F6: 0.19; F7: 0.17; F8: 0.17; F9: 0.16; F10: 0.15; metatibia length: 1.93; metatibia width: 0.3; T2 width: 2.6; T4 width: 3.47; interantennal distance: 0.52; upper interocular distance: 2.01; median interocular distance: 2.06; lower interocular distance: 1.88; interocellar distance: 0.31; intertegular distance: 2.6.

Colouration & Pubescence. Integument black except for following parts: yellow maculation on head region, clypeus, mouthparts, uninterrupted pronotal lobe, outer part of fore tibia and basal area of T1, T2, T3 and T4 (Figs 2A, 2B, 2E). Clypeus with distinct longitudinal yellow marking, 1.5 × longer than broad reaching almost upper region of epistomal suture; subtriangular marking on supraclypeus; pair of vague yellow parallel spot in lower paraocular region near tentorial pit (Fig. 2A). Frontal area with yellow transverse spot medially. Gena with distinct elongated yellow marking extending 1/3 of eye length, slightly narrowed upward extending almost one third of length of eye. Antenna black except flagellar segments ventrally blackish brown. Tegula translucent, reddish golden; distinct yellow spot present below tegula. Protibia dark brown with distinct yellow mark extending downwards covering almost 2/3 of tibial length. Last tarsal segments honey brown. Ventral side of the front and middle leg with a small yellow marking at its very distal part. Metasomal tergal transverse yellow bands uninterrupted except T3, band of T2 and T3 broader than others laterally, T5 without any transverse band. 1st sternum honey gold. Wing veins dark brown. Pubescence on labrum light golden yellow, erected; supraclypeal area sparsely pubescent, lighter than that of clypeus; pubescence between antennal sockets much longer and lighter. Pubescence on other areas of head white, sparse and erect. Pubescence on scutum very sparse and golden yellow; scutellum and metanotum more densely haired. Pubescence on mesopleuron around tegulae longer and denser than that of scutellum. Apical region of scutellum and at base of tegula with densely packed stub like golden brown pubescence. Propodeal pubescence golden yellow and finely branched. Sides of mesosoma (especially on mesepisternum) and legs especially metatibia and femur with relatively dense, plumose and longer whitish silvery pubescence. Pubescence on metasoma simple, gradually longer and denser towards apex; denser on apical border of T2 and T4. Longer, erected and silvery white pubescence gradually increased from S4 to S6.

Head. HW 1.2× height in frontal view (Fig. 2A). Clypeus 1.5× as wide as long. Antennal socket in depression (Fig. 2A). Supraclypeal area at same level with clypeus and median paraocular region; head sutures deep and distinct. Labrum wider than long, closely and deeply punctured, especially at middle. Clypeus and paraocular area coarsely punctured. Gena shiny, impunctate. Vertex sparsely punctured. Scape finely punctured, twice as long as wide. Pedicel glabrous; flagellar segments with minute uniform hairs. Genal area minutely reticulate, yellow marking impunctate.

Mesosoma. Scutum glabrous, impunctate at middle but sparsely punctured anteriorly, medially (anteromedian line with one row of punctures) and laterally along parapsidal furrow. Mid region of mesosoma shiny and impunctate. Scutellum and anterior part of metanotum sparsely punctate. Propodeal triangle coriaceous-reticulate and impunctate. Mesepisternum more or less uniformly densely punctate (Fig. 2C).

Legs. Metatibia 6.4× as long as wide with prominent spine present at mid region (broadest part) with subsequent serrations (Fig. 2G). Tibial spur prominent.

Wings. Hyaline, translucent, finely and uniformly haired except in radial cell (Fig. 2H). Hind wings hyaline, translucent, and finely haired. Hamuli five in numbers.

Metasoma. Gradulus prominent and glabrous. T1 with minute, sparse punctures, almost glabrous; T2 more punctured than that of T1; T3 and T4 with distinct punctation; T5 and T6 strongly punctured than that of T3 & T4 (Fig. 2D).

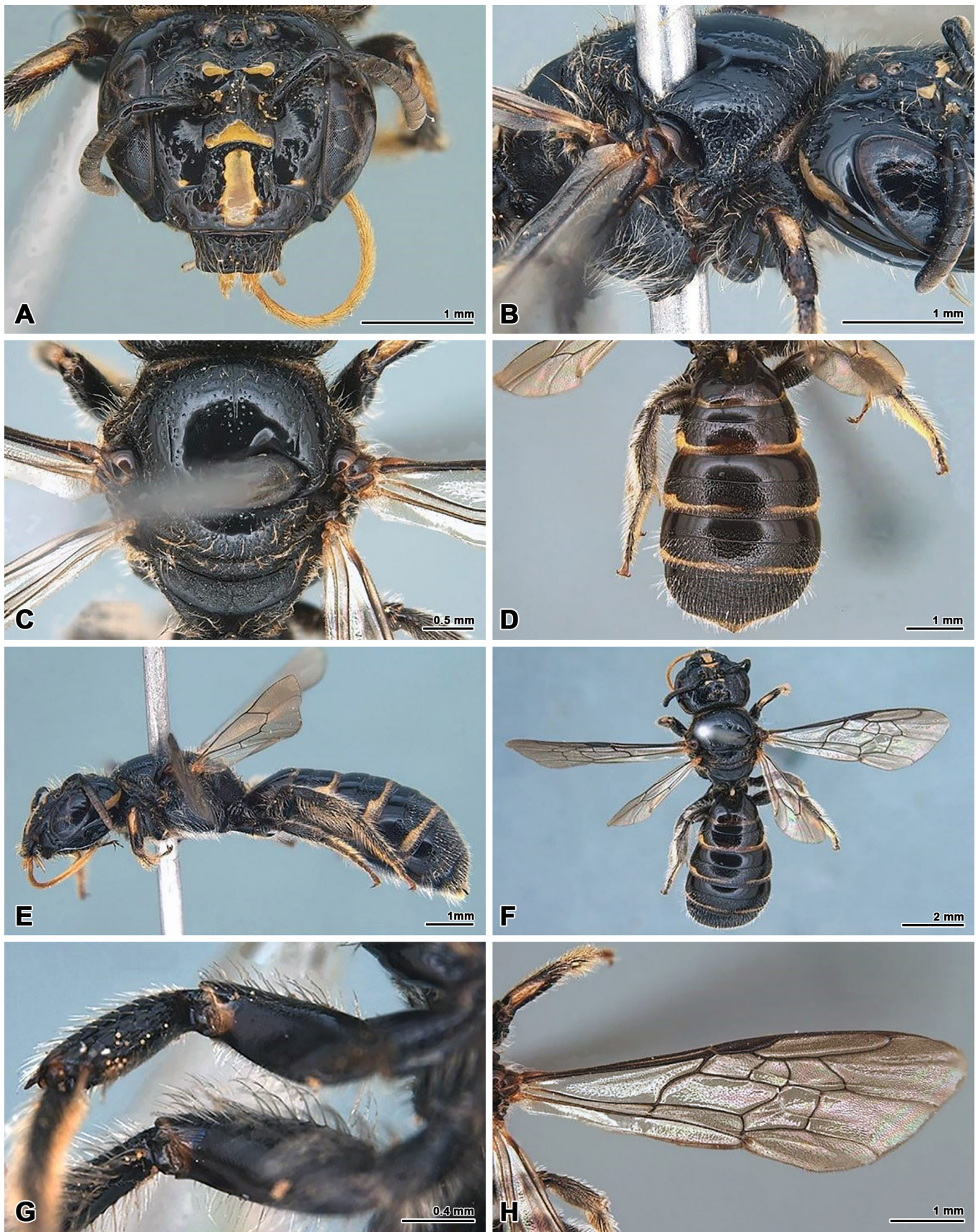


Figure 2. *Ceratina tawangensis* sp. nov., Holotype ♀. **A.** Head in frontal view; **B.** Mesosoma in lateral view; **C.** Mesosoma in dorsal view; **D.** Metasoma in dorsal view; **E.** Body in lateral view; **F.** Body in dorsal view; **G.** Fore and middle legs showing vestiture and yellow marking at the ventral distal top; **H.** Forewing.

Male. Unknown.

Distribution. India: Arunachal Pradesh (Fig. 1). The species has only been found in the lower valley in Tawang district in conifer broadleaved (*Abies densa* Griff., *Juniperus indica* Bertol., *Larix* sp., *Tsuga* sp., etc.) and broadleaved forest (*Acer* sp., *Rhododendron* sp., *Quercus* sp. etc.) as well as with agro-pastoral ecosystem between 1677 and 2249 m of elevation. Low-altitude forested areas are mainly de facto owned by village councils and are cleared for grazing purposes (Mishra et al., 2004). The surveyed sites are predominantly of cultivated land (forest clearings) and adjacent semi-natural habitats where rice is the principal crop and others include buckwheat, barley, maize, etc. Most of the individuals were observed and collected from non-crop flowering plants with the exception of coriander which is thoroughly used in the local livelihood.

Variations. Some of the paratypes show variations in following characters: yellow spot on lower part of paraocular region near tentorial pit absent; clypeal longitudinal mark bifurcated apically and pattern of broken transverse band observed in different tergum.

Floral association. *Fragaria vesca* L. (Rosaceae), *Isodon japonicus* (Burm.f.) H.Hara (Lamiaceae), *Raphanus* sp. (Brassicaceae), *Coriandrum sativum* L. (Apiaceae), *Fagopyrum esculentum* Moench. (Polygonaceae), *Galinsoga parviflora* Cav. (Asteraceae), *Aster* sp. (Asteraceae), *Desmodium* sp. (Fabaceae).

Etymology. The species is named after the Tawang region where all the type specimens were collected.

Ceratina (Ceratinidia) bryanti Cockerell, 1919 (Figs 3A–3H)

Material examined. 2 ♀♀, labeled as India: Arunachal Pradesh, Tawang district, Jang, Sanghar (27°31'19.2"N, 91°39'36"E, 1416 m a.s.l.), 01.xi.2019, Coll. D. Ghosh, Hand net. [ZSIK Regd. Nos. ZSI/WGRC/IR/INV. 18618, 18619]

Measurements (mm). Total body length: 6.92; forewing length: 5.7; head width: 2.6; head length: 2.04; eye length: 1.53; eye width: 0.49; ocellocular distance: 0.47; diameter of median ocellus: 0.19; clypeus length: 0.83; clypeus width: 1.21; labrum length: 0.39; labrum width: 0.7; scape length: 0.63; scape width: 0.12; metatibia length: 1.46; metatibia width: 0.38; T2 width: 2.4; T4 width: 2.88; interantennal distance: 0.432; upper interocular distance: 1.534; median interocular distance: 1.49; lower interocular distance: 1.43; interocellar distance: 0.34; intertegular distance: 2.05.

Diagnosis. Clypeus smooth, with inverted 'T' shaped thick impression almost covering ½ of the clypeal length; paraocular region with linear marking curved inward basally; base of scape black (Fig. 3A); gena with yellow marking extending downward almost 2/3 of the eye length with sparse punctations apically (Fig. 3D); pronotum with unbroken yellow transverse band; four longitudinal median lines in scutum (Fig. 3C); yellow marking on pronotal lobe and scutellum; temple region flat behind the ocelli (Fig. 3B); protibia with yellow mark outwardly extending almost 2/3 of the length of tibia (Fig. 3D). Scutum densely punctate anteriorly and laterally, as well as behind ocelli row of punctures along anterodmedian line and parapsidal furrow (Figs 3A, 3B, 3C) (Warrit et al., 2012), Propodeal triangle finely coriaceous-reticulate (Fig. 3D).

Distribution. India (**new record**). Elsewhere: Nepal, southern Thailand, Malaysia and Indonesian islands like Bali, Java and Sumatra (Warrit et al., 2012; Ascher & Pickering, 2022)

Floral association. *Bidens pilosa* L. (Asteraceae), *Galinsoga parviflora* Cav. (Asteraceae) and *Fragaria vesca* L. (Rosaceae).

Variation. Shiokawa (2006) reported the species from Nepal from lower warm-temperate zone at altitudes of 1300–1400 m and van der Vecht (1952) reported darker morphs of the species were found in high altitudes of mountain regions than that of low altitude specimens. In our present study the species is found in a similar altitude band as in Nepal but both dark (Figs 3G–3H) and lighter (Figs 3A–3F) morphs were collected at same altitude from the study site.

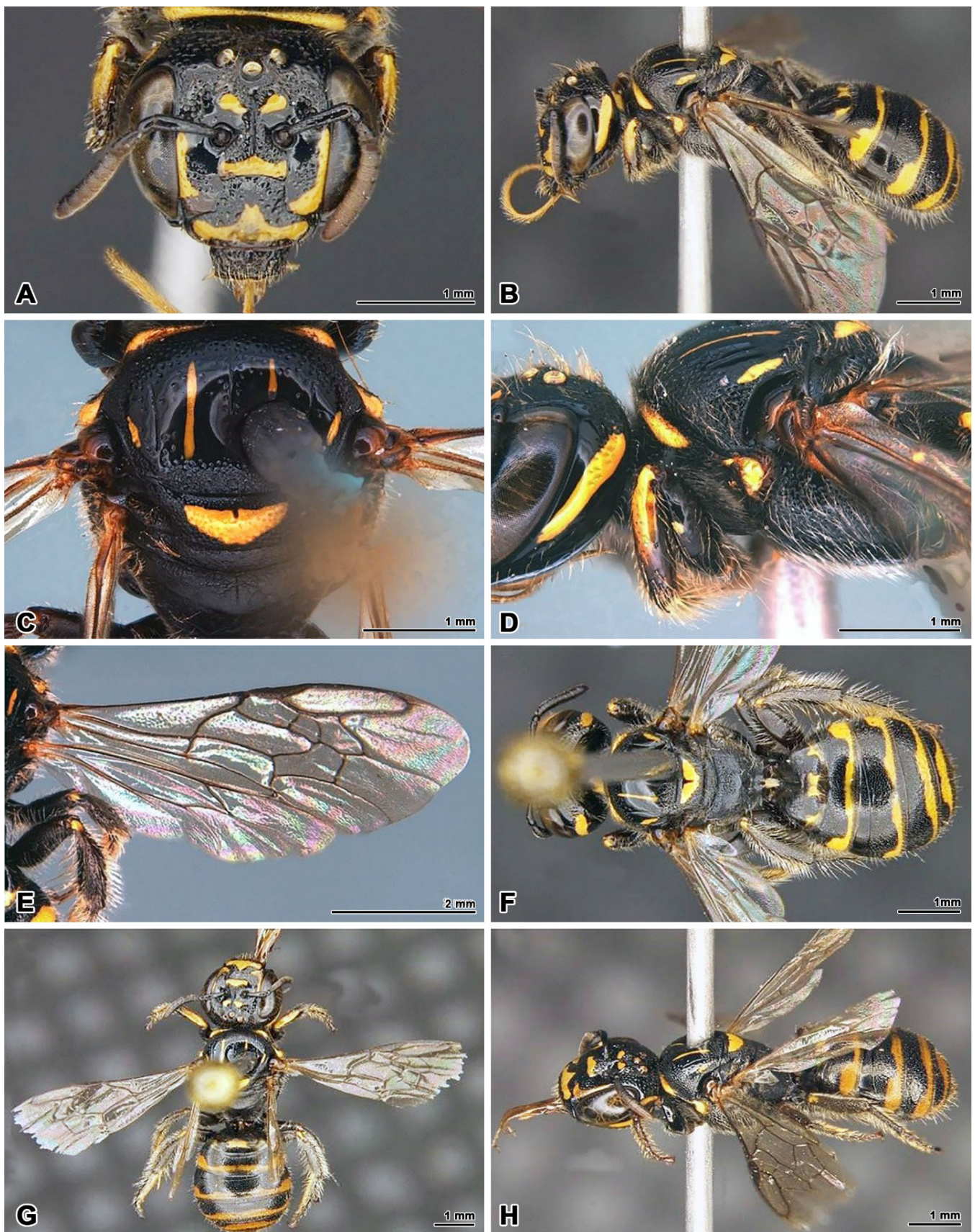


Figure 3. *Ceratina (Ceratinidia) bryanti* Cockerell, 1919, ♀. **A.** Head in frontal view; **B.** Body in lateral view; **C.** Mesosoma in dorsal view; **D.** Mesosoma in lateral view; **E.** Right wings; **F.** Body in dorsal view; **G–H.** Darker variant of *C. bryanti*. **G.** Body in dorsal view; **H.** Body in lateral view.

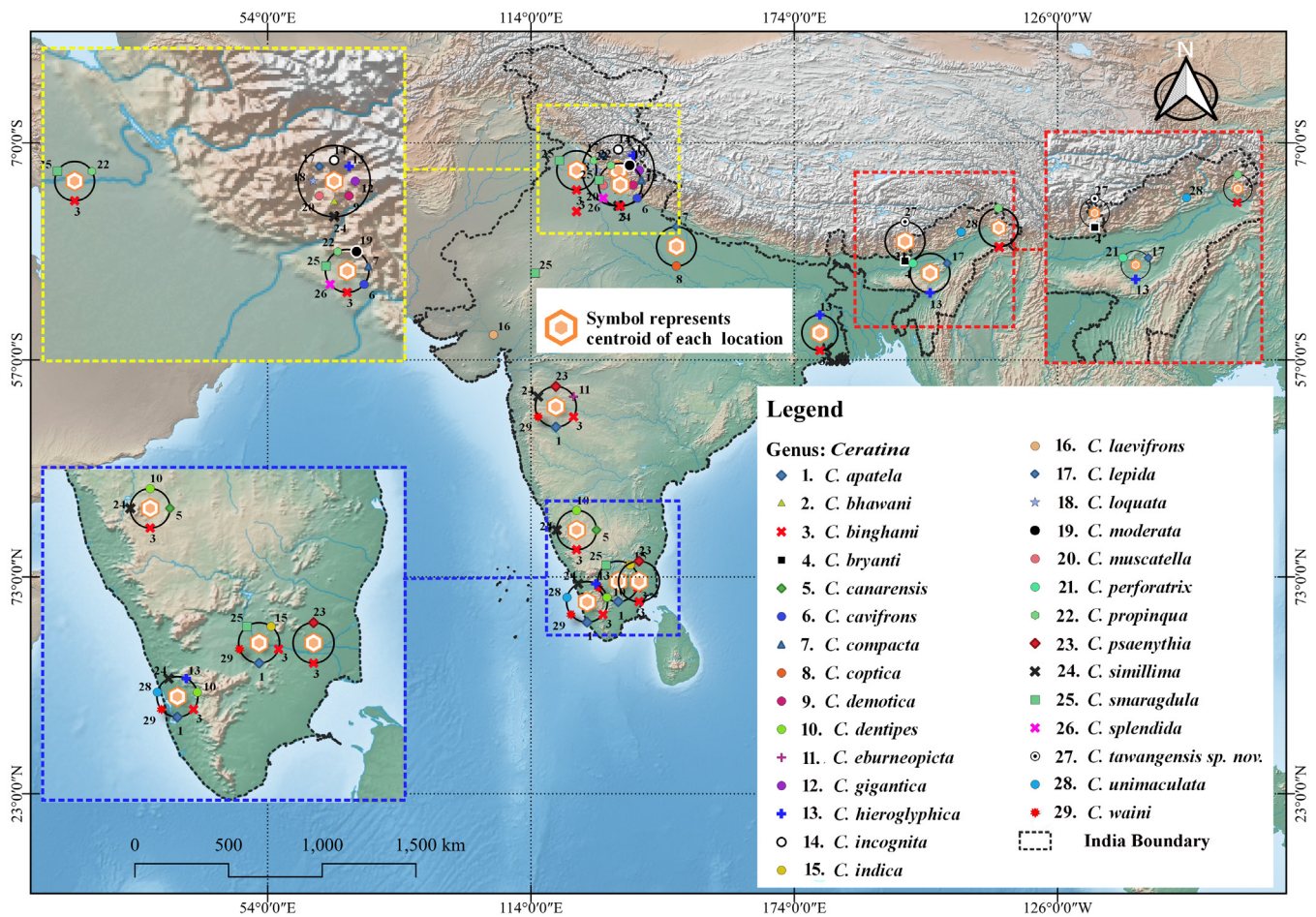


Figure 4. Distribution pattern of the genus *Ceratina* Latreille, 1802 in the Indian subcontinent (updated from Ascher & Pickering, 2022; GBIF, 2022).

DISCUSSION

The pattern of yellow maculation in genus *Ceratina* Cockerell is a very important character as many species are distinguished by the occurrence and pattern of that markings. Character matrices are distinguished in both males and females. The pattern of yellow maculation in females is very useful for distinguishing between species. The pattern of maculation in male varies which is not enough to differentiate between species. For species which lack the yellow maculations, the other characteristics like microsculpture and body size are useful (de Oliveira et al., 2020). The discussed new species is kept under *Ceratina bryanti*-species group. The present type specimens show characteristics of subgenus *Ceratinidia* but differ due to exclusion of the characters as follows: absence of yellow marking on paraocular region, transverse band below the vertical clypeal marking, scutum and scutellum. According to the characters shown by the type specimens, for the time being the species is kept under subgenus *Ceratinidia*. But further study is needed with more materials to determine its true subgeneric status. There is a strong possibility that it may form a new subgenus and further investigations through integrative taxonomic approach is needed to get a valid conclusion.

Genus *Ceratina* Latreille has a very high species diversity from the Indian subcontinent with 29 species reported till date (updated Ascher & Pickering, 2022; GBIF, 2022). Subgenus *Ceratinidia* Cockerell & Porter, 1899 shows the highest species diversity with 12 species followed by *Pithitis* Klug, 1807 with 07 species, *Neoceratina* Perkins, 1912 and *Catoceratina* Vecht, 1952 with 2 species each and *Lioceratina* Vecht, 1952, *Euceratina* Hirashima, Moure & Daly, 1971, each with a single species.

Table 1. Distribution of genus *Ceratina* in the Indian subcontinent (updated from Ascher & Pickering, 2022; GBIF, 2022).

	Species	Distribution in India
1.	<i>Ceratina (Pithitis) apatela</i> Engel, 2018	Maharashtra, Tamil Nadu
2.	<i>Ceratina bhawani</i> Bingham, 1908#	Himachal Pradesh
3.	<i>Ceratina (Pithitis) binghami</i> Cockerell, 1908	Arunachal Pradesh, Haryana, Karnataka, Kerala, Maharashtra, Puducherry, Punjab, Tamil Nadu, Uttarakhand, West Bengal
4.	<i>Ceratina (Ceratinidia) bryanti</i> Cockerell, 1919*	Arunachal Pradesh
5.	<i>Ceratina (Lioceratina) canarensis</i> Cockerell, 1919	Karnataka
6.	<i>Ceratina (Ceratinidia) cavifrons</i> Shiokawa, 2006	Uttarakhand
7.	<i>Ceratina (Ceratinidia) compacta</i> Smith, 1879	Uttarakhand
8.	<i>Ceratina (Ceratinidia) coptica</i> Baker, 2002	Uttar Pradesh
9.	<i>Ceratina (Ceratinidia) demotica</i> Baker, 2002	Himachal Pradesh
10.	<i>Ceratina (Neoceratina) dentipes</i> Friese, 1914	Karnataka, Kerala
11.	<i>Ceratina (Ceratinidia) eburneopicta</i> Cockerell, 1911	Maharashtra
12.	<i>Ceratina (Ceratinidia) gigantica</i> Gupta, Mattu & Kumar, 2013	Himachal Pradesh
13.	<i>Ceratina (Ceratinidia) hieroglyphica</i> Smith, 1854	Assam, Himachal Pradesh, Kerala, West Bengal
14.	<i>Ceratina incognita</i> Bingham, 1898#	Himachal Pradesh
15.	<i>Ceratina (Pithitis) indica</i> (Hirashima, 1969)	Tamil Nadu
16.	<i>Ceratina (Euceratina) laevifrons</i> Morawitz, 1894	Gujarat
17.	<i>Ceratina (Ceratinidia) lepida</i> Smith, 1879	Assam, Himachal Pradesh, Uttar Pradesh
18.	<i>Ceratina loquata</i> Nurse, 1902#	Himachal Pradesh
19.	<i>Ceratina (Ceratinidia) moderata</i> Cameron, 1897	Uttarakhand
20.	<i>Ceratina muscatella</i> Nurse, 1902#	Himachal Pradesh
21.	<i>Ceratina (Catoceratina) perforatrix</i> Smith, 1879	Assam
22.	<i>Ceratina (Neoceratina) propinqua</i> Cameron, 1897	Arunachal Pradesh, Punjab, Uttarakhand
23.	<i>Ceratina (Pithitis) psauenythia</i> Engel, 2018	Maharashtra, Puducherry
24.	<i>Ceratina (Ceratinidia) simillima</i> Smith, 1854	Maharashtra, Himachal Pradesh, Karnataka, Kerala
25.	<i>Ceratina (Pithitis) smaragdula</i> (Fabricius, 1787)	Punjab, Rajasthan, Tamil Nadu, Uttarakhand
26.	<i>Ceratina (Catoceratina) splendida</i> Shiokawa, 2008	Uttarakhand
27.	<i>Ceratina (Ceratinidia) tawangensis</i> sp. nov. **	Arunachal Pradesh
28.	<i>Ceratina (Pithitis) unimaculata</i> Smith, 1879	Arunachal Pradesh, Kerala
29.	<i>Ceratina (Pithitis) waini</i> (Shiokawa & Sakagami, 1969)	Kerala, Maharashtra, Tamil Nadu

* New species from India | ** New record to India | # Uncertain subgeneric classification.

The remaining four species do not have designated subgenera so kept as in uncertain status (Table 1, Fig. 6). Himachal Pradesh shows the highest *Ceratina* species diversity in India with 9 species, followed by Kerala (7 species), Maharashtra and Uttarakhand (6 species each), Tamil Nadu and Arunachal Pradesh (5 species each), Karnataka (4 species), Assam (3 species), and Puducherry, Uttar Pradesh, West Bengal (2 species each) whereas Gujarat, Haryana and Rajasthan shows the least (1 species) (Table 1, Fig. 5). Among all the *Ceratina* species, *C. binghami* is the most widely distributed with occurrence in maximum 10 states, followed by *C. hieroglyphica*, *C. simillima* and *C. smaragdula* in 4 states each and *C. waini* in 3 states in India. Several studies have reflected the commonality and abundance of these species belonging to subgenus *Ceratinidia* and *Pithitis* (Baker, 1997) in different regions of the country in India and have contributed a fair share of information on their preferences for foraging plant resources as well as nesting substrates (Table 2). Genus *Ceratina* is well documented being polylectic, several crop and non-crop species were reported from India as their preferred foraging resources mostly belonging to the family Verbenaceae, Fabaceae, Solanaceae, Poaceae, Brassicaceae, Anacardiaceae etc.; while *Caesalpinia pulcherrima* (L.) Sw. (Fabaceae), *Anacardium occidentale* (L.) (Anacardiaceae), *Croton* spp.

(Euphorbiaceae) and *Rosa* spp. (Rosaceae) were found to be the most preferred nesting substrate for multiple *Ceratina* species in India. However, lack of studies has made the knowledge on bees very scanty from the country. Though the Indian *Ceratina* fauna is very diverse, most of them are poorly known from a taxonomic and ecological point of view. A collated effort for more in-depth surveys of the regions explored in the past as well as new regions to be explored (Indian biogeographic regions: Desert, Semi-arid, Deccan Peninsula, Gangetic plains, North-east and Himalayas) for improved documentation of provincial bee diversity, comprising publication efforts of checklists of bees. The majority of areas of the vast Indian subcontinent are underexplored for bees, and probably this should yield a substantial database of bees and their biology for future conservation perspectives.

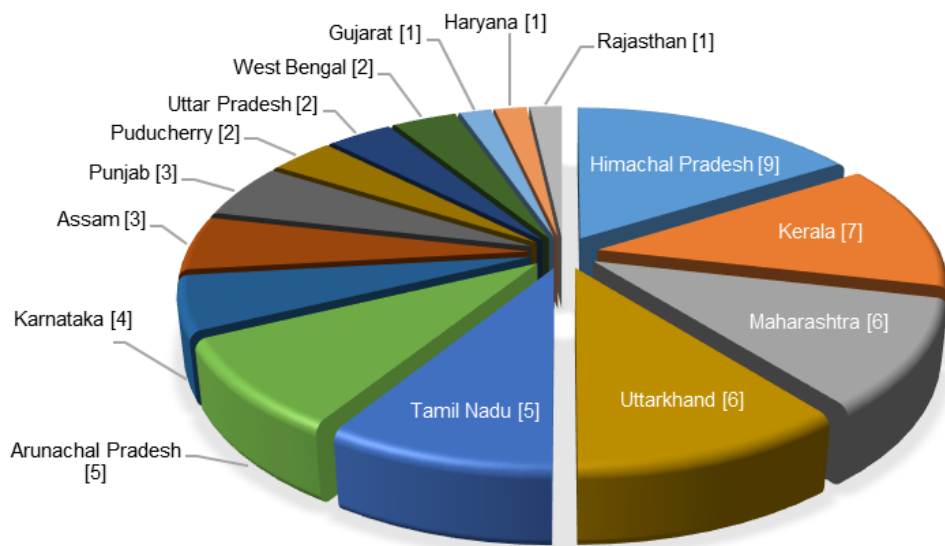


Figure 5. State wise distribution of different species of genus *Ceratina* Latreille in India.

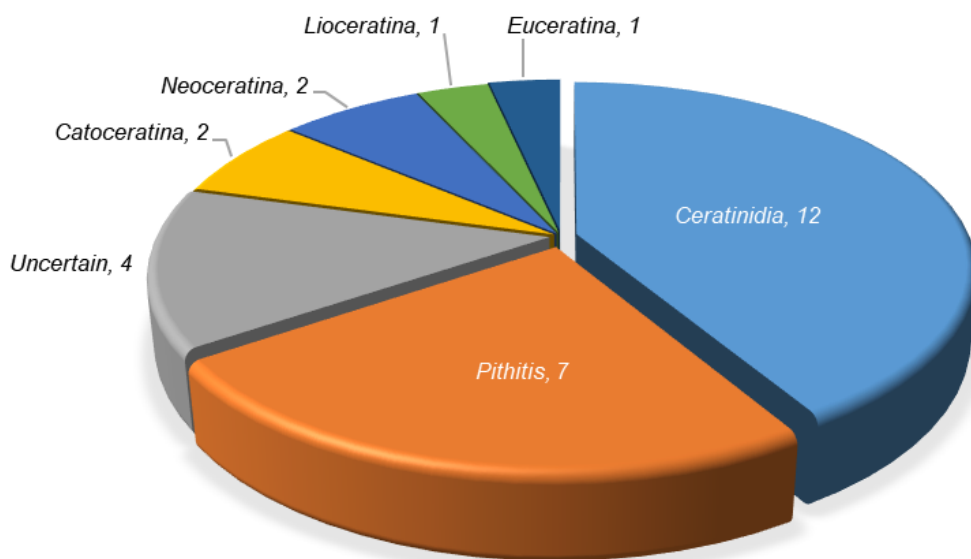


Figure 6. Species diversity in different subgenera of *Ceratina* L. in India.

Table 2. Association of genus *Ceratina* Latreille with different plant species as foraging resources and nesting substrate preferences in India.

Species	Foraging plants	Nesting material	Reference
<i>C. apatela</i> Engel, 2018	<i>Eriolaena</i> sp., <i>Leucas</i> sp. <i>Vitex</i> sp.	Unknown	Gupta (2022)
<i>C. binghami</i> Cockerell, 1908	<i>Anacardium occidentale</i> , <i>Cajanus cajan</i> (L.) Millsp., <i>Crotalaria juncea</i> L., <i>Medicago sativa</i> , <i>Psophocarpus tetragonolobus</i> (L.) D.C., <i>Solanum</i> spp., <i>Verbesina encelioides</i> (Cavanilles) Bentham & Hooker, <i>Zea mays</i> L.	<i>Adenantha pavonina</i> L., <i>Caesalpinia pulcherrima</i> (L.) Sw., <i>Codiaeum</i> sp., <i>Croton</i> spp., <i>Justicia adhatoda</i> L., <i>Peltophorum pterocarpum</i> (DC.) K.Heyne, <i>Rosa</i> spp. and <i>Tecoma</i> sp.	Sundararaju (2011); Udayakumar & Shivalingaswamy (2019); Gupta (2022)
<i>C. bryanti</i> Cockerell, 1919 *	<i>Idens pilosa</i> L., <i>Galinsoga parviflora</i> Cav., <i>Fragaria vesca</i> L.	Unknown	Present study
<i>C. compacta</i> Smith, 1879	<i>Brassica juncea</i> (L.) Czern. <i>Cajanus cajan</i> (L.) Millsp., <i>Helianthus annuus</i> L., <i>Luffa</i> sp.	<i>Caesalpinia pulcherrima</i> (L.) Sw., <i>Rosa</i> spp.	Yogi & Khan (2021)
<i>C. hieroglyphica</i> Smith, 1854	<i>Anacardium occidentale</i> (L.), <i>Elettaria cardanomum</i> (L.) Maton, <i>Verbesina encelioides</i> (Cavanilles) Bentham & Hooker	<i>Anacardium occidentale</i> (L.), <i>Caesalpinia pulcherrima</i> (L.) Sw.	Sinu & Shivanna (2007); Amala et al. (2018); Kaliaperumal (2019); Kachhawa & Charan (2021)
<i>C. propinqua</i> Cameron, 1897	<i>Luffa echinata</i> Roxb., <i>Merremia hederacea</i> (Burm. fil.) Hall. fil., <i>Tridax procumbens</i> L.	<i>Caesalpinia pulcherrima</i> (L.) Sw., <i>Saccharum bengalense</i> Retz.	Yogi & Khan (2021); Deeksha et al. (2022)
<i>C. simillima</i> Smith, 1854	<i>Convolvulus arvensis</i> L., <i>Luffa echinata</i> , <i>Solanum nigrum</i>	<i>Caesalpinia pulcherrima</i> (L.) Sw., <i>Rosa</i> spp.	Yogi & Khan (2021); Deeksha et al. (2022)
<i>C. smaragdula</i> (Fabricius, 1787)	<i>Anacardium occidentale</i> L., <i>Cajanus cajan</i> (L.) Millsp., <i>Cucumis sativus</i> L., <i>Guizotia abyssinica</i> (L.f.) Cass., several species of Compositae, Fabacea, and Lamiaceae	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Sundararaju (2011); Udayakumar & Shivalingaswamy (2019); Gupta (2022)
<i>C. tawangensis</i> sp. nov.	<i>Fragaria vesca</i> L., <i>Isodon japonicus</i> (Burm.f.) H.Hara, <i>Raphanus sativus</i> L., <i>Coriandrum sativum</i> L., <i>Fagopyrum esculentum</i> Moench., <i>Galinsoga parviflora</i> Cav., <i>Aster</i> sp., <i>Desmodium</i> sp.	Unknown	present study
<i>C. waini</i> (Shiokawa & Sakagami, 1969)	<i>Pogostemon</i> sp., <i>Randia</i> sp.	Unknown	Gupta (2022)

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: D. Ghosh: Field-work, conceptualization, data interpretation, writing original draft and review-editing; T. Jobiraj: Conceptualization, identification, review; P. Girish Kumar: Writing original draft and review-editing; K.A. Subramanian: Conceptualization, drafting, review-editing and final draft preparation. All authors read and approved the final version of the manuscript.

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توصیف یک گونه جدید از جنس *Ceratina* Latreille, 1802 (Hymenoptera, Apoidea) از هیمالایای شرقی، یک گزارش جدید گونه از هند

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چکیده: گونه جدیدی متعلق به جنس *Ceratina* Latreille, 1802 از منطقه تاوانگ واقع در آروناچال پرادش، هیمالایای شرقی هند توصیف شد. این گونه در زیر جنس *Ceratinidia* Cockerell & Porter, 1899 که قبلاً شامل هفت گونه گزارش شده از سرزمین اصلی هند بود، قرار گرفت. گونه دیگری به نام *Ceratina (Ceratinidia) bryanti* Cockerell, 1919 نیز برای اولین بار از هند گزارش شد. ویژگی‌های افتراقی گونه‌ها، تشریح و تصویربرداری شدند و خصوصیات قابل استفاده در تفکیک گونه جدید از گونه‌های نزدیک *Ceratina (Ceratinidia) bryanti* مورد بحث قرار گرفت. فهرست به‌رو گونه‌های جنس *Ceratina* و پراکنش آنها روی نقشه تهیه و بحث شد.

واژگان کلیدی: *Ceratinini*، هیمالایای شرقی، هند، تاکسونومی، زنبور نجار کوچک، فهرست گونه‌ها