

Redescription of *Carbula indica* (Westwood, 1837) (Hemiptera, Heteroptera, Pentatomidae) from West Bengal, India with a key to the Indian species of the genus *Carbula* Stål, 1865

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ABSTRACT: *Carbula indica* (Westwood, 1837) (Hemiptera, Heteroptera, Pentatomidae) re-described with illustrations based on the material collected from the Himalayan hills of Darjeeling, West Bengal, India. New characters are included, along with both male and female genitalia and morphometric measurements to facilitate easy species determination. A key to the Indian species of *Carbula* Stål, 1865 is also presented. © 2023 Association for Advancement of Entomology

KEYWORDS: Taxonomy, morphometrics, genitalia, species determination, key

INTRODUCTION

The genus *Carbula* Stål, 1865, is distributed in the Oriental and Afrotropical regions, represented by 76 species worldwide, of which ten species are known from India (Ravneet Kaur *et al.*, 2013). *Carbula* can be recognized by the following characters: body dorsally ovate and ventrally convex; head rounded or somewhat truncated at apex; mandibular plates equal in length and pronotum with anterior lateral angles obtuse; genital capsule quadrangular and paramere with bilobed crown. Westwood (1837) placed *Carbula indica* under the genus *Pentatoma*, Distant (1902) later transferred it to the genus *Carbula* Stål. Both described the species based on external coloration and a few morphological features, which are insufficient to identify the species correctly. This

species was reported from West Bengal (Darjeeling), Sikkim and Nepal by Distant (1902); later reported from China (Rider *et al.*, 2002). During a collection of Himalayan Pentatomidae, four specimens (2 males, 2 females) of *C. indica* from Darjeeling were found and this opportunity is taken to re-describe and illustrate the species, including male and female genitalia and measurements to facilitate easy species identification. A key to the Indian species of *Carbula* Stål, 1865 is also provided.

MATERIALS AND METHODS

The material for the present study includes dry-pinned specimens housed at the Hemiptera Section of the Zoological Survey of India, Kolkata, West Bengal. The male genitalia was dissected following

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the method given by Ahmad (1986). After boiling the whole abdomen in hot water for about 10–15 minutes, the female genitalia was dissected with potassium hydroxide (KOH - 10%). The internal contents were cleared after thoroughly washing it in distilled water 2–3 times. With the help of fine forceps, the terminalia and spermatheca were detached from the abdominal ventrites. The measurements are given in millimeter and presented as median, with minimum and maximum values given in bracket. The following dimensions were measured: Body length (from apex of mandibular plates to apex of membrane, dorsal view), head length (from apex of mandibular plates to anterior margin of pronotum, dorsal view), head width (width of head including compound eyes, dorsal view), interocular width (between inner margins of compound eyes, dorsal view), length of each antennal segment, length of each segment of rostrum, pronotum length (medially, from anterior to posterior margin of pronotum, dorsal view), pronotum width (maximum width between humeri in dorsal view), scutellum length (medially from base to apex) and scutellum width (maximum width at base between basal angles of scutellum). Morphological terminology used for male and female genitalia broadly follows Salini (2019). The photographs were taken under a Leica M205A stereomicroscope using a Leica DMC-4500 camera. The photographs were processed in LAS V4.12 software for morphometry. Photographs were edited using Adobe Photoshop CS (Version 8.0).

Abbreviations used: Vlf: Valvifers, Lt: Laterotergite, P: Paramere, PA: Processes of aedeagus, CP: Conjunctival Processes, PT: Phallosome.

RESULTS AND DISCUSSION

Carbula indica (Westwood, 1837) [Figs. 1-16]

Pentatoma indica Westwood, 1837: 42.

C. fusca Distant, 1887: 346.

C. indica: Distant, 1902: 171.

Type locality: INDIA: West Bengal: Darjeeling: Kurseong

Material examined: 2 male, 2 female, Lepchajagat, Darjeeling, West Bengal, 4.vi.1975, Coll. J. K. Jonathan.

Redescription:

Coloration: Dark brownish yellow (Figs. 1, 12); anterior lateral margins of pronotum yellowish-brown; first three segments of antennae yellowish-brown, segment- IV slightly darker brown and apical two-third portion of last segment blackish. Abdomen pale brown with a broad central black fascia, spiracles and small marginal spots, black; rostrum blackish-brown with apex black; legs yellowish-brown with black punctation; genital capsule, pale brown and blackly punctate.

Head: Wider (across eyes) than long (1.911 : 1.503 mm) (Fig. 3); antennae five-segmented, segment IV longest, segment V longer than II, III, segment I smallest; rostrum long, four-segmented, passing metacoxae reaching up to II abdominal segment (Fig. 15) but sometimes up to anterior margin of III abdominal segment; segment II longest.

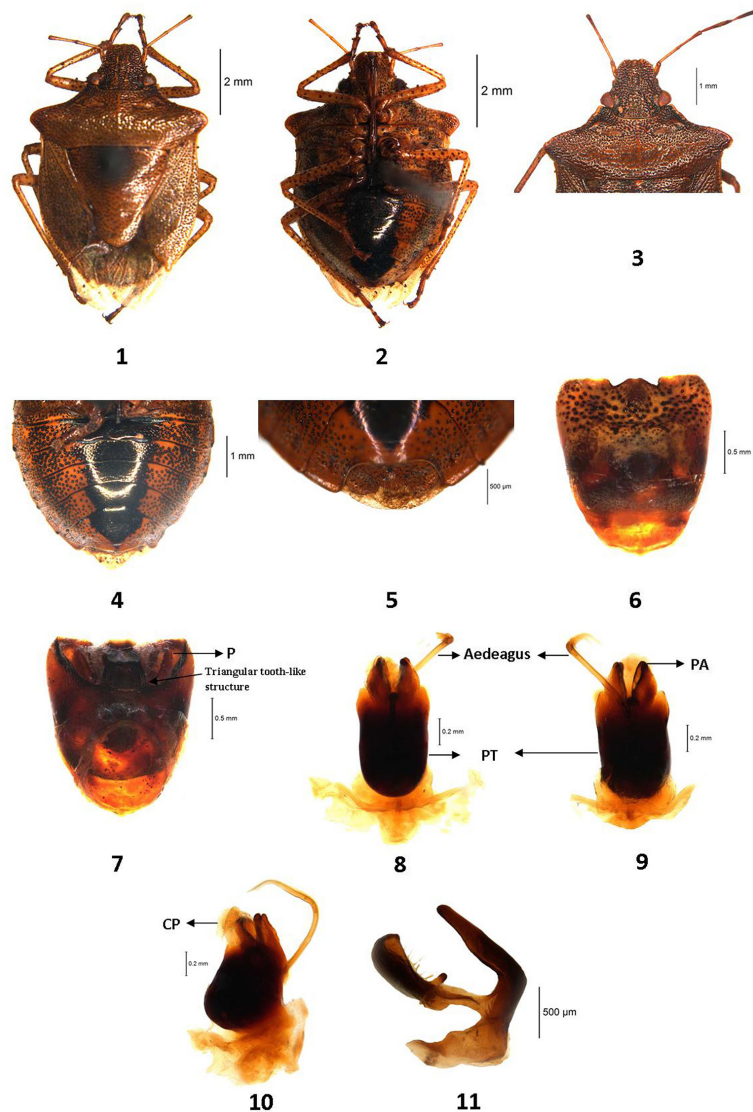
Thorax: Pronotum hexagonal, wider than longer, its width is 2.5 times than its length and about 2.5 times wider than head, anterolateral margins slightly serrated, lateral margins smooth, humeral angles rounded (Fig. 3).

Scutellum: Slightly longer than broad at base (3.747: 3.714mm) (Figs. 1, 10), apex rounded; hemelytral membrane passing tip of abdomen (Fig. 2).

Legs: With fine hairs and blackly punctate. Tibiae longer and slender than respective femora. Tarsi hairy, second tarsal segment shortest.

Abdomen: Abdomen broader than longer (6.396: 4.946) and with a broad central black fascia (Fig. 4).

Male genitalia: *Pygophore*. Longer than broad (2.136: 1.804mm), medially, in dorsal view (Fig. 7); postero-lateral lobes (= caudal lobes) tumescent (Figs. 5, 6), medial area slightly elevated (Fig. 5), subpentagonal in shape (Figs. 6, 7), Dorsal rim widely excavated with a narrow median notch

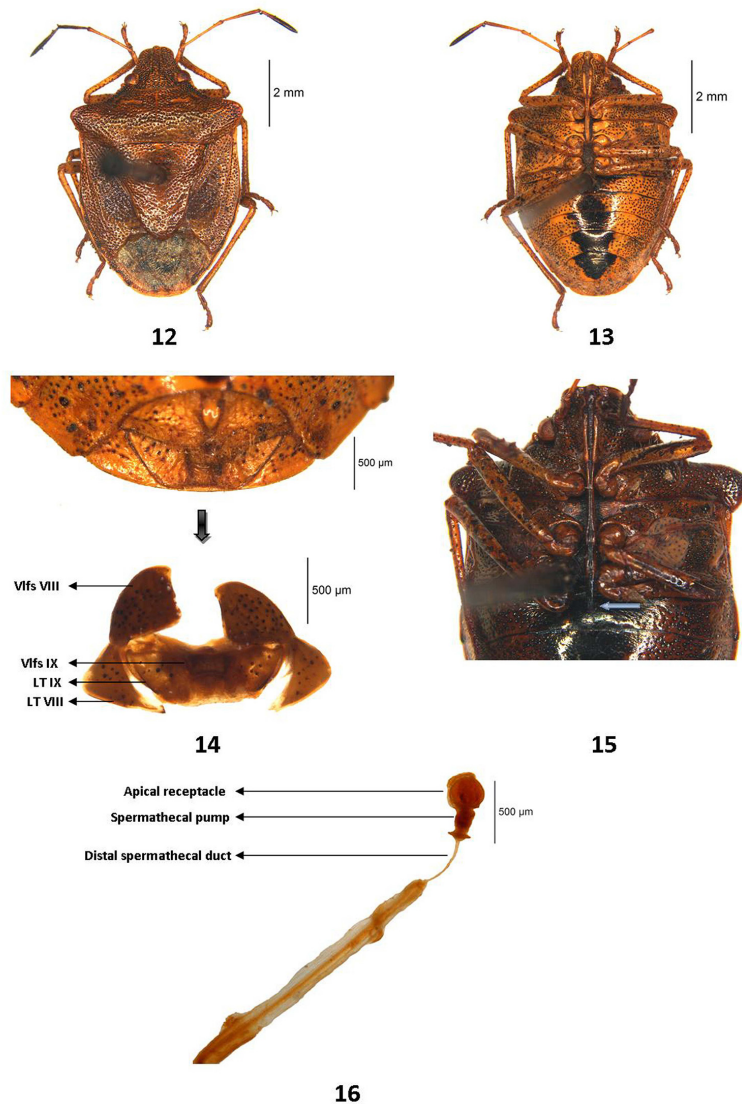


Figs. 1–11. *Carbula indica* (Westwood, 1837), male. 1, dorsal; 2, ventral; 3, head; 4, abdomen; 5, apex of abdomen (ventral); 6, pygophore (ventral); 7, pygophore (dorsal); 8, phallus (dorsal); 9, phallus (ventral); 10, phallus (lateral); 11, paramere. P–Paramere, PA–Processes of aedeagus (=Penial lobes). CP–Conjunctival Processes, PT–Phallosome.

which is associated with convex lobe-like outgrowth nearly resembling the 1+1 triangular tooth-like structure on the infoldings of dorsal rim (Fig. 7). There is a shallow roughly W-shaped notch at the medial portion of ventral rim (Fig. 6). *Phallus*. Phallosome of phallus (Figs. 8, 9) is barrel-shaped, slightly sclerotized without any process; one pair of slightly sclerotized processes of aedeagus (=Penial lobes), encircled by transparent, membranous conjunctival processes (Fig. 10); aedeagus long, tube-like and much longer than processes of aedeagus (=Penial lobes).

Paramere. Moderately sclerotized, crown bilobed (Fig. 11), upper lobe slender; lower lobe broader, spoon-shaped with a small projection at proximal end, slightly curved upwards facing towards upper lobe.

Female genitalia: Valvifers VIII sub-triangular with inner lateral margin curved (Fig. 14); valvifers VIII ventrally not meeting each other; valvifers IX fused to single quadrate plate with posterior margin concave, laterotergite VIII posteriorly encompassing laterotergite IX (Fig. 14);



Figs. 12–16. *Carbula indica* (Westwood, 1837), female. 12, dorsal; 13, ventral; 14, Terminalia; 15, rostrum; 16, Spermatheca. Vlfs–Valvifers, Lt–Laterotergite

spermatheca (Fig. 16) with proximal spermathecal duct longer than distal spermathecal duct, median dilation present but not balloon-like; intermediate part of spermatheca (=spermathecal pump) short, only single flange (proximal flange) visible; apical receptacle large or-bicular, with a finger-like process.

Measurements:

Males (n = 2); median (minimum–maximum). Body length 7.050 (6.798–7.303); head: length 1.503

(1.496–1.510), width (across eyes) 1.911 (1.897–1.925), interocular width 1.183 (1.177–1.189); lengths of antennal segments: I—0.280 (0.271–0.289), II—0.756 (0.747–0.765), III—0.728 (0.721–0.735), IV—0.931 (0.926–0.936), V—0.839 (0.833–0.845); lengths of segments of rostrum: I—1.549 (1.536–1.562), II—1.680 (1.600–1.761), III—0.800 (0.800–0.801), IV—0.668 (0.626–0.711); pronotum: length 1.942 (1.938–1.946), width: 4.879 (4.861–4.897); scutellum: length 3.276 (2.805–3.747), width (at basal angles) 3.247 (2.781–3.714).

Females (n = 2); median (minimum–maximum). Body length 7.367(7.359–7.375); head: length 1.693 (1.665–1.721), width (across eyes) 2.034 (1.956–2.112), interocular width 1.230 (1.155–1.251); lengths of antennal segments: I—0.358 (0.352–0.364), II—0.755 (0.745–0.765), III—0.767 (0.765–0.769), IV—0.936 (0.929–0.943), V—0.898 (0.885–0.911); lengths of segments of rostrum: I—1.585 (1.566–1.604), II—1.734 (1.707–1.762), III—0.796 (0.792–0.801), IV—0.642 (0.628–0.656); pronotum: length 2.107 (1.992–2.222), width: 5.420 (5.284–5.556); scutellum: length 3.304 (2.861–3.748), width (at basal angles) 3.297 (2.849–3.746).

Distribution: India: West Bengal (Darjeeling, Kurseong) and Sikkim. *Elsewhere:* Nepal (Distant, 1902) and China (Rider *et al.*, 2002).

Key to species of *Carbula* Stål, 1865 from India

1. Humeral angles spinously produced.....2
 - Humeral angles obtusely angulate.....5
2. Upwardly and forwardly directed humeral angles.....3
 - Slightly backwardly directed humeral angles with subacute spines...***biguttata* (Fabricius, 1794)**
3. Scutellum densely punctate, upper lobe of parameres slightly angulate apically ***aliena* Distant, 1918**
 - Scutellum sparingly and coarsely punctate, upper lobe of parameres apically nearly broadly rounded.....4
4. Scutellum with a Y-shaped luteous marking at middle portion and punctate except each basal angle and the apex..... ***scutellata* Distant, 1887**
 - Scutellum brownish-ochraceous without Y-shaped luteous marking and uniformly punctate except two basal angle and apex ***aspavia* Distant, 1908**
5. Mandibular plates equal to clypeus.....6
 - Mandibular plates longer than clypeus

.....***rugulosa* Distant, 1902**

6. Median continuous black stripe on each of the abdominal segments; rostrum passing metacoxae reaching up to II abdominal segment but sometimes up to anterior margin of III abdominal segment, humeral angle less produced with apices rounded***indica* (Westwood, 1837)**

- Median black stripe only on two terminal abdominal segments; rostrum just passing metacoxae reaching up to II abdominal segment, humeral angle broadly produced with apices obtuse and slightly paler and levigate7

7. Scutellum brownish-ochraceous, uniformly punctate and without any luteous spots at each basal angle and apex ..***crassiventris* (Dallas, 1849)**

- Scutellum luteous, sparingly punctate with a large luteous spot at each basal angle and apex.....8

8. Antennae luteous.....***socia* (Walker, 1867)**

- Antenna with the first, second, and third joints ochraceous, fourth and fifth black with their bases ochraceous9

9. Antero-lateral margins of pronotum smooth, luteous levigate.....***producta* Distant, 1901**

- Antero-lateral margins of pronotum crenulated, luteous levigate***insocia* (Walker, 1868)**

The *C. indica* specimens were compared with the photographs of paratype of *C. indica* held by Natural History Museum, London, thus enabled us to redescribe the species in greater detail. *C. indica* is closely related to *C. crassiventris* on the basis of morphological data, during re-examination of the both species were found to have some minute morphological differences between these two species. Re-examination revealed that humeral angle of pronotum less protruded in *C. indica*; first three antennal segment of *C. indica* yellowish-brown, segment- IV slightly darker brown and apical two-third portion of last segment blackish, while in *C. crassiventris* whole segments of antennae reddish brown; in *C. indicia* adomen pale brown with a broad central black band, while in *C.*

crassiventris there was a more or less distinct central spot on each of the two terminal abdominal segments. It is important to note that this study will help to facilitate the taxonomic study of genus *Carbula* as the published information on this species is limited. Earlier work cited above only provided information on external coloration and a few morphological features, while this study has provided the details of morphology of this species, in the form of digital photographs of both male and female habitus and genitalia, for the first time.

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