



Identification and description of Indian parasitic bee genus *Sphecodes* Latreille 1804, (Halictidae: Hymenoptera)

M. Balaji Rajkumar^{1*} and Debjani Dey²

^{1&2}Division of Entomology, Indian Agricultural Research Institute, New Delhi-110012, INDIA

¹Current address: Central Institute for Subtropical Horticulture, Lucknow- 226101-(Uttar Pradesh), INDIA

*Corresponding author. E-mail: balaento.ento@gmail.com

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Abstract: The present study provides an updated knowledge on taxonomy of three important species of *Sphecodes* Latreille, 1804 which were collected from different parts of India. Three species viz., *Sphecodes iridipennis* Smith 1879, *S. gibbus* Smith 1853, *S. crassicornis* Smith 1879 are redescribed with illustrations, genitalic features and measurements of their morphological features. An annotated checklist of species *Sphecodes* from India also provided.

Keywords: Cuckoo bee, Halictidae, Hymenoptera *Sphecodes*, Parasitic bee

INTRODUCTION

The genus *Sphecodes* belongs to the family halictidae which are commonly known as 'sweat bees' and distributed widely all over the world. The habitats of halictids are so diverse and they are potential pollinators of more than hundred crops including cereals, fruits, vegetables and medicinal herbs. It is one of the largest bee groups consisting of 3600 described species worldwide. Unlike honey bees, halictid bees lead a solitary or quasi-social life and live in nest or burrows built in the soil or wood. The halictid bees differs from other bee groups by following set of characters viz., basal vein strongly arched in forewing, single subantennal suture, first flagellar segment shorter than scape, lacinia represented by small, hairy lobe on anterior surface of labiomaxillary tube above rest of maxilla and stigma well developed. In total, 211 species were reported so far from India of which 22 species are under genus *Sphecodes*. The genus *Sphecodes* are the only parasitic group among the subfamily Halictinae. It has been reported as cleptoparasitic on *Halictus*, *Lasioglossum* etc., belonging to its own family and also on other bee families, Andrenidae, Colletidae, Melittidae (Michener, 2007).

The species of genus *Sphecodes* are usually with red metasoma, wider head, broad clypeus sparsely covered with hairs and the body length ranging from 4.5 to 15 mm (Michener, 2007). Body slender and appendages without substantial modifications. The sculpture of scutum and propodeum are the unique features amongst the species. Obviously males possess more significant features than female in differentiating

species. Hagens (1882) illustrated the male genitalia of *Sphecodes* for the first time and few other workers contributed remarkably on world species viz., Bluthgen, 1927, Tsuneki, 1983 and Warncke, 1992. The latter author has done regional work on west palaeartic species of genus *Sphecodes* Latr and provided taxonomic notes and key for identification of 39 species.

The earliest known record of genus *Sphecodes* from India was in "Catalogue of Insects in the Hymenopterous collections of the British Museum" by Smith (1853). He described two new species viz., *fumipennis* and *apicatus*. Later *apicatus* was synonymised to *gibbus* by Warncke, 1992. Again during 1879 he described another four new species from India viz., *S. crassicornis*, *S. albifrons*, *S. iridipennis* and *S. montanus*, all of which are still valid. Bingham (1898) described a new species *S. indicus* which are collected from Shimla and he also described a new species *Halictus cameronii*, during 1897 later it was transferred to *S. decorus*. Nurse (1903) described six new species from India viz., *S. sutor*, *S. hanuman*, *S. abuenisis*, *S. tantalus* *S. perplexus* and *S. desertus*. Three of them are still valid species while other species were later synonymised viz., *S. sutor* with *S. gibbus*, *S. hanuman* with *S. monilicornis*, *S. desertus* with *S. olivieri* by subsequent authors. Bluthgen (1927) did a comprehensive work on Indomalayan bees and described eleven species of *Sphecodes* including five new species from India and all of which are still valid. He also provided illustrations and key to new species. Cockerell (1911) recorded female of *S. cameronii* (Bingham) and described its body color. All the above

earlier work provided us the basis for study of Indian *Sphecodes*. However, the descriptions were sketchy on various morphological features, measurements and illustrations of male genitalia. In particular, there were no detailed descriptions of Indian species *S. crassicornis*, *S. gibbus* and *S. irridipennis*. Keeping this in view, the present study was undertaken to suffice the gap in existing knowledge.

MATERIALS AND METHODS

The bee specimens from the National Pusa Collection (NPC), Indian Agricultural Research Institute, New Delhi, India as well as collected from different locations of India viz., Madhya Pradesh, New Delhi and Tamil Nadu were studied. The collected specimens were sorted and grouped together with the keys of Bluthgen 1927 and Warncke, 1992. The bees are usually loaded with pollens or spills of nectar on the body, which obscures the morphological characters. So the specimens were washed with tap water followed by mixture of warm water with a drop of liquid soap in 100ml, then again washed with tap water and blotted on tissue paper. The specimens were then dehydrated using 95% alcohol and sponged down with paper towel until the moisture was removed. Before studying male genitalia, the dry specimens were relaxed in moist chamber containing moist filter papers and phenol. After that the apical segments (from S5) of abdomen were removed carefully and boiled in 10% potassium hydroxide for 1-2 minutes and then repeatedly washed with distilled water. Finally it was neutralized with glacial acetic acid and dehydrated with 70 % alcohol.

After study it was stored in a small vial contains glycerol for future use. The illustrations and photographs of processed specimens were made using Camera Lucida (Leica 10308700, Leica DFC 425 C), Leica LZ 205 FA. The images were processed further using adobe photoshop.

The standard terminology of Michener (2007) was used for the description of pilosity, sculptures and genitalia etc. the term ‘pilosity’ used in the description referred to type and arrangement of hairs and ‘sculptures’ referred to punctures, depressions and patterns on the cuticle. The morphometric details of morphological features viz., body length, head length and width, length of scutum, scutellum, propodeum, wings etc., are given in millimeter or as ratio. The antennal flagellum referred to as F1, F2, F3 etc., following the pedicel. The term apical bands or transverse fascia are used for abdominal tergal bands. The metasomal terga and sterna referred as T and S respectively and their numbers given in alphabets viz., T1, S1 etc. The term basal propodeum or propodeal triangle is used for mid dorsum of propodeum. The term outer and inner gonostylus was used if the gonostylus broad or could not viewed from dorsal or ventral. The geographical distribution compiled were based on literature available and many new distribution records within the country are also being reported based on the data labels of specimens actually examined and collections made during the course of study from different places of India. The new records on the distributions of species are asterisked (*) in the checklist. The checklist includes annotations of each reference.

RESULTS

Annotated checklist of genus *Sphecodes* Latreille, 1804 from India (Modified after Ascher and Pickering, 2014)

Subfamily: Halictinae

Genus *Sphecodes* Latreille, 1804

- Sphecodes* Latreille, 1804: 182
- Dichroa* Illiger, 1806: 46
- Sabulicola* Verhoeff, 1890: 328
- Drepanium* Robertson, 1903: 103
- Proteraner* Robertson, 1903: 103
- Sphecodium* Robertson, 1903: 104
- Machaeris* Robertson, 1903: 104
- Dialonia* Robertson, 1903: 104
- Sphecodes* (*Callosphecodes*) Friese, 1909: 182.

Type species: *Sphecodes gibba* Linnaeus 1785: 571 (monobasic).

S.N.	Species	Distribution
1	<i>abuensis</i> Nurse, 1903: 549 <i>Sphecodes abuensis</i> Nurse, 1903: 549	Rajasthan: Mount Abu,
2	<i>albifrons</i> Smith, 1879: 27 <i>Sphecodes albifrons</i> Smith, 1879: 27	Western India
3	<i>assamensis</i> Blüthgen, 1927 <i>Sphecodes assamensis</i> Blüthgen, 1927: 60	Assam

Contd.....

- 4 **chaprensis** Blüthgen, 1927
Sphecodes chaprensis Blüthgen, 1927: 96 Bihar: Chapra
West Bengal
- 5 **crassicornis** Smith, 1879
Sphecodes crassicornis Smith, 1879: 28 West Bengal: Kolkata
*Tamil Nadu: Coimbatore
- 6 **decorus** (Cameron, 1896)
Halictus decorus Cameron, 1896: 94
Halictus cameronii Bingham, 1897: 432 **Uttarakhand (Mussoorie)**
- 7 **dissimilandus** (Cameron 1896)
Halictus dissimilandus Cameron 1896: 95 Uttarakhand
- 8 **fumipennis** Smith, 1853
Sphecodes fumipennis Smith, 1853: 36 Sikkim (Rangit valley), Assam
- 9 **gibbus** (Linnaeus, 1785: 571)
Sphex gibba Linnaeus, 1785: 571
Apis glabra Fuebly, 1775: 51
Andrena ferrugena Olivier, 1789: 139
Apis gibbosa Christ, 1791: 177
Melitta sphecodes Kirby, 1802: 46
Melitta picea Kirby, 1802: 48
Andrena austriaca Fabricius, 1804: 325
Sphecodes apicatus Smith, 1853: 36; Warncke, 1992: 29
Sphecodes nippon Meyer, 1922: 171
Sphecodes castilianus Bluthgen, 1924: 473; Warncke, 1992: 29 Jammu & Kashmir: Srinagar
Himachal Pradesh: Simla; Uttarakhand: Mussoorie
- 10 **indicus** Bingham, 1898
Sphecodes indicus Bingham, 1898: 123
- 11 **invidus** (Cameron 1896)
Halictus invidus Cameron 1896:96 Uttarakhand
- 12 **iridipennis** Smith, 1879
Sphecodes iridipennis Smith, 1879: 27 *Bihar: Chapra
- 13 **lasimensis** Blüthgen, 1927
Sphecodes lasimensis Blüthgen, 1927: 40 Himachal Pradesh: Simla
- 14 **monilicornis** (Kirby 1802)
Melitta monilicornis Kirby, 1802:47
Sphecodes maculatus Lepeletier, 1841:545
Sphecodes subquadratus Smith, 1845:1014
Sphecodes gibbus var *ephippium* subvar *rufipes* Sichel, 1865:428
Sphecodes gibbus var *ephippium* subvar *dubious* Sichel, 1865:419
Sphecodes gibbus var *ephippium* subvar *incertus* Sichel, 1865:420
Sphecodes gibbus var *ephippium* subvar *nigrescens* Sichel, 1865: 427
Sphecodes gibbus var *ephippium* subvar *testaceipes* Sichel, 1865:428
Sphecodes ruficrus Dalla Torre, 1896: 10
Sphecodes hanuman Nurse, 1903:538;
Sphecodes monilicornis var *nigerrima* Blüthgen, 1927:41;
Sphecodes caucasicus Meyer, 1920:124
Sphecodes monilicornis quadratus Meyer, 1920: 129
Sphecodes monilicornis berberus Warncke, 1992:22 Jammu & Kashmir
- 15 **montanus** Smith, 1879
Sphecodes montanus Smith, 1879: 27 Uttarakhand: Mussoorie

Contd.....

- 16 **olivieri** Lepeletier, 1825:448
Sphecodes collaris Spinola, 1843: 137
Sphecodes hispanicus var *abyssinicus* Sichel, 1865:447
Sphecodes ruficornis Sichel, 1865:440
Sphecodes punctulatus Sichel, 1865:443
Sphecodes subpunctulatus Sichel, 1865:445
Sphecodes rufithorax Morawitz, 1876: 225
Sphecodes verticalis Hagens, 1882:219
Sphecodes desertus Nurse, 1903:540
Sphecodes chionospilus Cockerell, 1911: 217
Sphecodes chionospilus var *sanguinatus* Cockerell, 1911: 217
Sphecodes tenuis Meyer, 1919: 121
Sphecodes olivieri var *niveatus* Meyer, 1925: 4 Gujarat: Deesa
- 17 **perplexus** Nurse 1903
Sphecodes perplexus Nurse 1903: 540 Jammu and Kashmir
- 18 **shillongensis** Blüthgen, 1927
Sphecodes shillongensis Blüthgen, 1927: 95 Assam
 Meghalaya
- 19 **sikkimensis** Blüthgen, 1927
Sphecodes sikkimensis Blüthgen, 1927: 54 Sikkim
- 20 **simlaellus** Blüthgen, 1927
Sphecodes simlaellus Blüthgen, 1927: 46 Himachal Pradesh: Simla
- 21 **tantalus** Nurse, 1903
Sphecodes tantalus Nurse, 1903: 539 Jammu & Kashmir: Kashmir, Ladia,
- 22 **turneri** Cockerell, 1916
Sphecodes turneri Cockerell, 1916: 430 Assam

Redescription of species *Sphecodes crassicornis* Smith, 1879: 28

Male

Color: Head and thorax black; abdomen ferruginous; pale white pubescence; apical fascia of tergum hyaline; **Pilosity:** White silky pubescence on paracocular, pronotum, around pronotal lobe, post occiput, metanotum, frons, alveolar space and supraclypeus; fine silky pale white pubescence appressed on anterior surface of lower pronotum, forecoxa, and posterior surface of propodeum; Short fine silky sparse plumose on mesepimeron; long sparse hairs on metanotum; dorsolateral propodeum with long, slightly dense silky pubescence; scattered hairs on anterior surface of T1; T3 to T6 with same kind of scattered hairs except apex; short fine sparse hairs on S1 to S6 comparatively sparser than tergum. **Sculpture:** Small irregular, dense punctures on head; Punctures on vertex denser than in scutum with slightly elevated interspace (Plate.1c); supraclypeus elevated mid dorsally; frontal carina present; Punctures on clypeus slightly wider than supraclypeus and rest of the head; Small rounded uniformly dense punctures sparse on scutum (Fig.1a); same kind of punctures slightly wider on scutellum; Small wide punctures with smooth interspace on scutellum; metanotum with fine irregular dense punctures; dorso-lateral and basal propodeum with strong sculpturing irregular reticulation; posterior margin irregularly defined; small wider punctures on posterior surface

and strongly carinated at basolaterad; Tiny shallow punctures sparsely present on T1 (Fig. 1b, 1c); T2 with same punctures except marginal zone; shallow dense punctures on S2 to S5.

General: Male much smaller, 6.25 ± 0.5 mm; Body long slender, cylindrical; **Head** small, 1.16x as broad as long; antenna long, dorsolaterally flattened and reaches the scutellum; antennal flagellum stout; first flagellomere next to ring segment is small and slightly extend outwards; surface not smooth; clypeus 2.03x as long as clypeoantennal distance; compound eye 0.62x as long as head; upper interocular distance 0.78x as long as lower interocular; Alveolar distance 0.42x as long as antennocellar distance; Inter ocellar distance 0.78x as long as ocello-ocular distance; Scape 3.36x as long as pedicel; Flagellum 7x as long as scape; F1 0.66x as long as pedicel and F2 2.4x as long as pedicel;

Thorax: longer, almost rectangular; femur 5.2x as long as trochanter; hind tibia 0.79x as long as femur; basitarsi 0.66x as long as hind tibia; forewing length $4.75x \pm 0.05$ mm; Hindwing length 3.65 ± 0.05 mm; Tegulae 2x as long as broad; forewing 2.96x as long as broad; Hindwing 2.88x as long as broad; forewing 1.31x as long as and 1.28x as broad as hindwing; stigma 3.13x as long as broad, 4.54x as long as prestigma; prestigma 1.35x as long as broad; marginal cell 2.06x as long as free marginal cell and 1.42x as long as marginal cell length beyond stigma; marginal cell

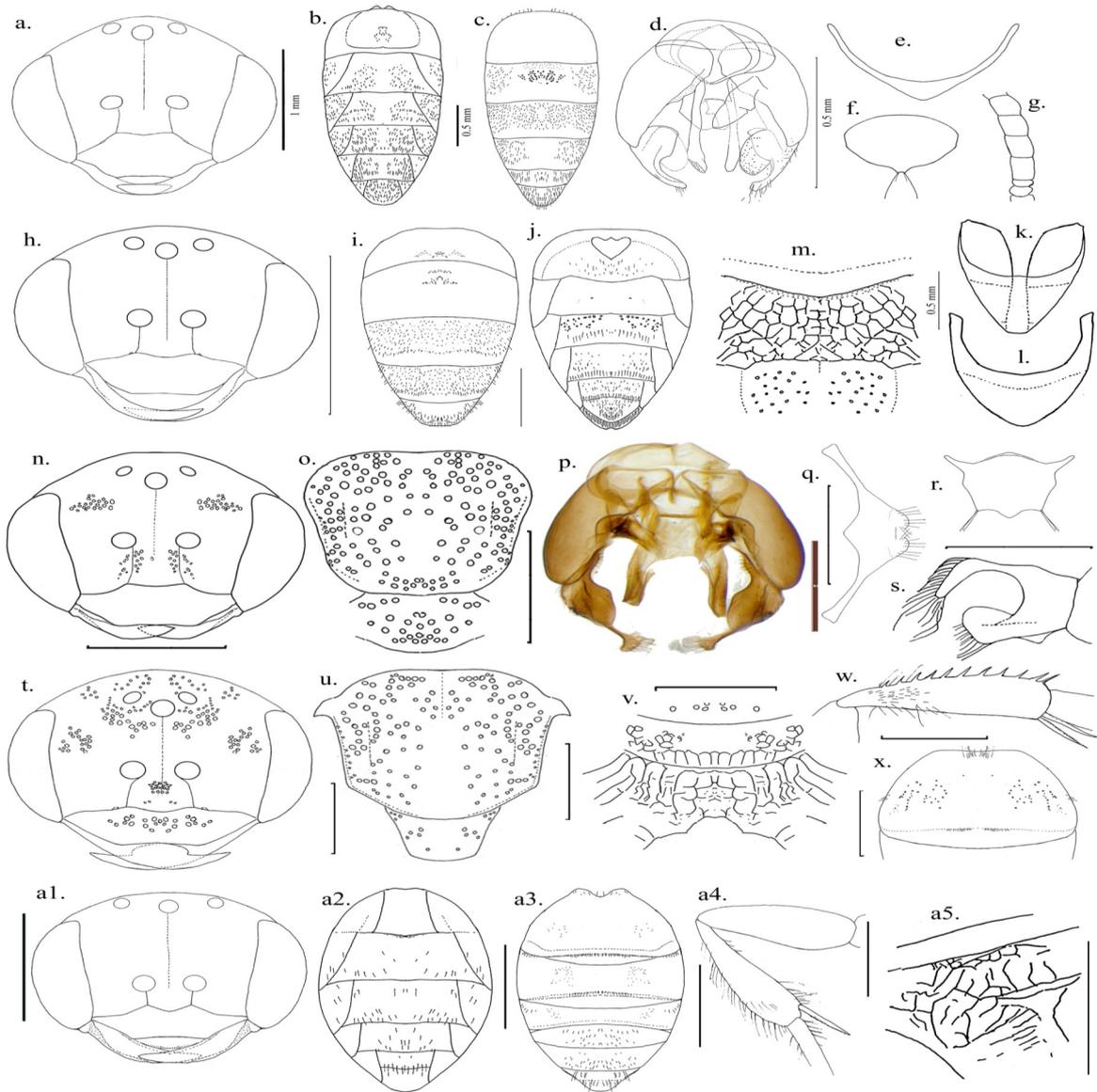


Fig. 1. (a to g) *S. crassicornis* ♂: a, head; b & c, abdomen ventral & dorsal view; d, genitalia dorsal & ventral view. e, S7; f S8; g, pedicel flagellomere (F1–F5); (h to m) ♀: h, head; i & j, abdomen ventra & dorsal view; k, propodium dorsal & posterior view. l, T6; m, T7; (n to s) *S. gibbus* ♂: n, head; o, scutum; p, genitalia q, S7; r, S8; s, lateral view of gonostylus. (t to x) ♀: t, head, anterior view; u, scutum & scutellum; v, propodeum posterior view; w, hind tibia; x, T1. (a1 to a5) *S. irridipennis* ♀: a1, head; a2 & a3, abdomen dorsal and ventral view; a4, hind femur & tibia; a5, latero posterior view of propodeum.

5.21x as long as broad; scutum 0.85x as long as broad at the anterior and 1.02x as long as broad at the posterior; scutum 2.93x as long as scutellum; scutellum 1.6x as long as metanotum; scutellum 1.92x as broad as long; **Propodeum:** metanotum 0.62x as long as propodeum; posterior surface 0.53x as broad as the length of propodeum; basal propodeum reticulated strongly and longer than metanotum; posterior surface slightly depressed inward; posterior surface with sparse short plumose; punctures irregular, slightly deep and scattered; Basal area of propodeum longer than metanotum; **Tergum:** simple, seems to be glabrous; T2 with

transverse apparent depression near graduli;
Male genitalia: Oval, broad at middle, 1.12x as long as broad; laterally 0.56x as high as long; Gonobase 1.47x as broad as long; genital foramen broad equally as broad as long; Gonocoxite long, broad at base and 2.26x as long as broad; gonocoxite 0.32x as broad as the width of genitalia; penis valve slightly broader at apex and 10x as long as broad; gonostylus shorter; dorsal lobe of gonostylus 0.78x as broad as long where as ventral lobe 0.56x as broad as long; dorsal lobe parallel and elongated at apex with long hairs; the hairs 0.56x as long as dorsal lobe; ventral lobe broad oval;

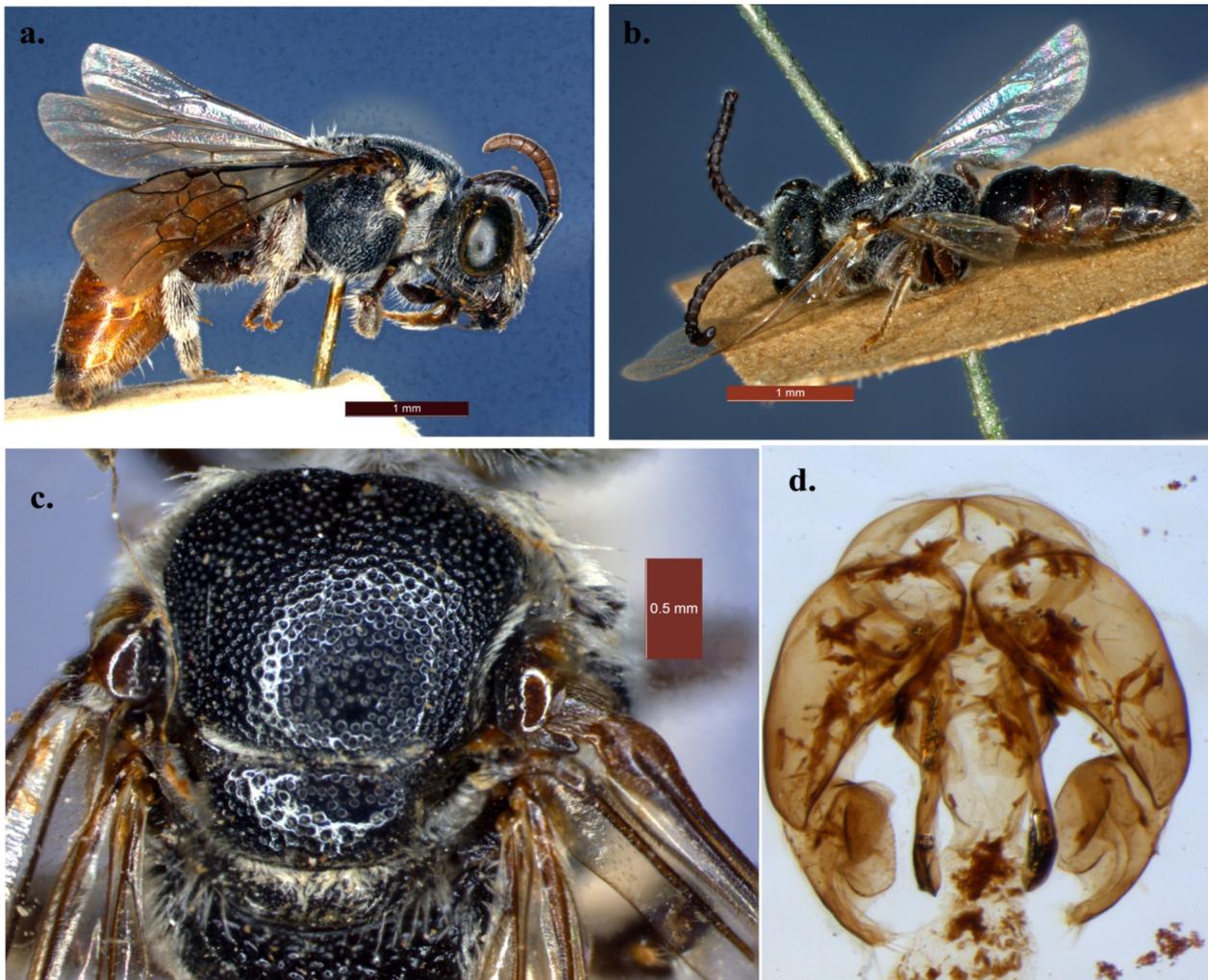


Plate 1. (a-d) *S. crassicornis* a&b lateral habit of female & male; c, dorsal view of thorax; d. dorsal and ventral view of male genitalia.

Volsella longer, 0.37x as broad as long (Fig.1d; Plate. 1d);

Measurements: Body length 6.25 ± 0.5 mm; forewing length $4.75x \pm 0.05$ mm; Hindwing length 3.65 ± 0.05 mm;

Female

Color: Body black; antenna, eyes and legs dark brown; abdomen ferruginous; apical fascia of tergum hyaline; **Pilosity:** Pale white dense plumose on frons, supraclypeus, paracocular alveolar area, pronotum, pronotal lobe and metanotum; fine plumose scattered on clypeus, hypostoma, occiput and vertex; Fine silky appressed pubescence on anterior surface of lower pronotum, forecoxa, mesepimeron, lateral and posterior surface of propodeum; pale white silky pubescence on along the lateral and posterior margin of propodeum; short fine silky plumose sparse on mesepimeron and post occiput; long sparse hairs on lateral metanotum; long silky dense pubescence on dorso-lateral propodeum; short white plumose scattered on

anterior surface of T1 and T2; short tiny sparse fine hairs on T2-T4; hairs comparatively longer on T5; fine slightly dense hairs on S1; short fine sparse hairs (sparser than tergum) on S2 to S4; long dense hairs at the apex of S5; **Sculpture:** Small irregular dense punctures on head; small and larger punctures sparsely present on scutum, the punctures wider on posterior scutum; small punctures scattered on scutellum with smooth interspace; punctures on vertex are denser and stronger than in scutum; supraclypeus strongly elevated; frontal line irregular; punctures on clypeus slightly wider than in supraclypeus and rest of the head; the scrobe of mesepimeron with areolated sculptures; small rounded dense punctures on scutum; punctures slightly dense near parapsidal lines fine irregular dense punctures on metanotum; strong irregular areolate on basal propodeum; posterior margin irregularly defined; small wider punctures on posterior surface; basolateral margin strongly carinated; tiny shallow sparse punctures on T1-T2 (Fig.1i, 1m); no punctures

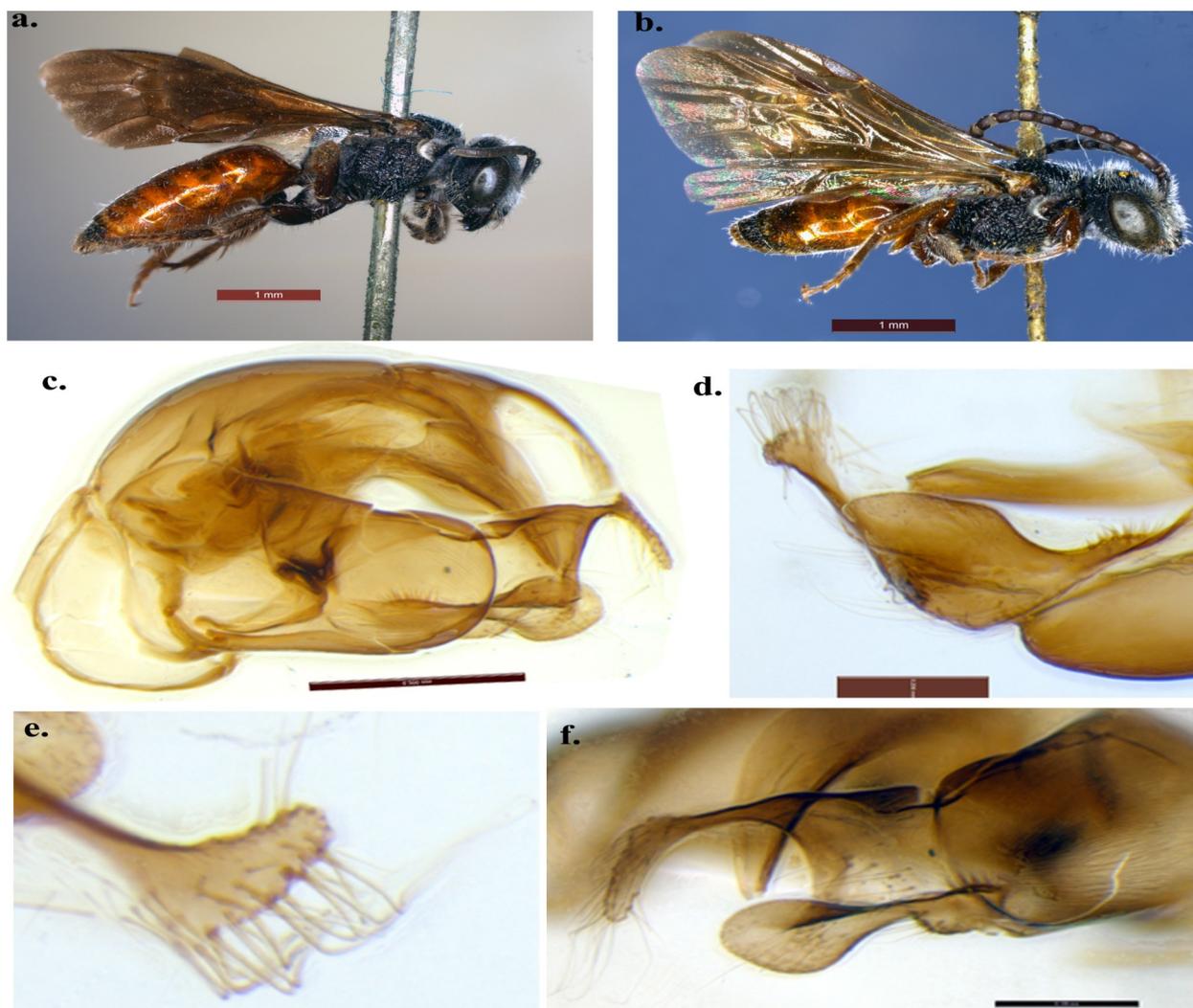


Plate 2. (a-f). *S. gibbus* a&b lateral habitat of female & male; c. genitalia lateral view; d, gonostylus dorsal view; e, apex of gonostylus; f, lateral view of gonostylus.

on marginal zone of T2; shallow sparse punctures on S2 to S5 (punctures larger than in tergum) (Fig. 1j);

General: **Head** 1.37x as broad as long; short alveolar distance; long scape; pedicel and F1 small; supra-clypeus strongly convex; clypeus 1.5x as long as clypeoantennal distance; compound eye 0.66x as long as head; upper interocular 1.15x as long as lower interocular distance; frontal carina strong near alveolar space; clypeus elevated transversely in the middle and lateral apex bent down; mandible long; alveolar distance 0.28x as long as antennocellar distance; interocular distance 0.61x as long as oculo ocular distance; scape 7.85x as long as pedicel; flagellum 2.14x as long as scape; F1 2.1x as long as pedicel; **Thorax:** basitarsi 0.65x as long as hind tibia; tegulae 1.91x as long as broad; forewing 2.91x as long as broad; Hindwing 3.50x as long as broad; forewing 1.29x as long as and 1.55x as broad as hindwing; stigma 3.46x as long as broad, 4.5x as long as prestigma; prestigma 1.66x as

long as broad; marginal cell 1.70x as long as free marginal cell and 1.15x as long as marginal cell length beyond stigma; marginal cell 3.71x as long as broad; scutum 0.84x as long as broad at the anterior and 1.09x as long as broad at the posterior; scutum 3.08x as long as scutellum; scutellum 1.53x as long as metanotum; **Propodeum:** basal propodeum longer than metanotum; metanotum 0.75x as long as propodeum; posterior surface slightly depressed; **Abdomen:** seems to be glabrous but with sparse tiny pale brown hairs; transverse depression near graduli on T2;

Measurements: Body length 9.15 mm; forewing length 7.0 mm; hindwing length 5.4 mm

Materials examined: Male, Coimbatore, Tamil Nadu, April, 1915, C.R. Dutt, P. Bluthgen det. H-6341; Female, H-6339, (syn: sodalist smith, abuense Nurse, des. Bluthgen) banhar, , behar, H. Inglis Coll., 16.5.19;

Distribution: Tamil Nadu: Coimbatore; West Bengal: Kolkata

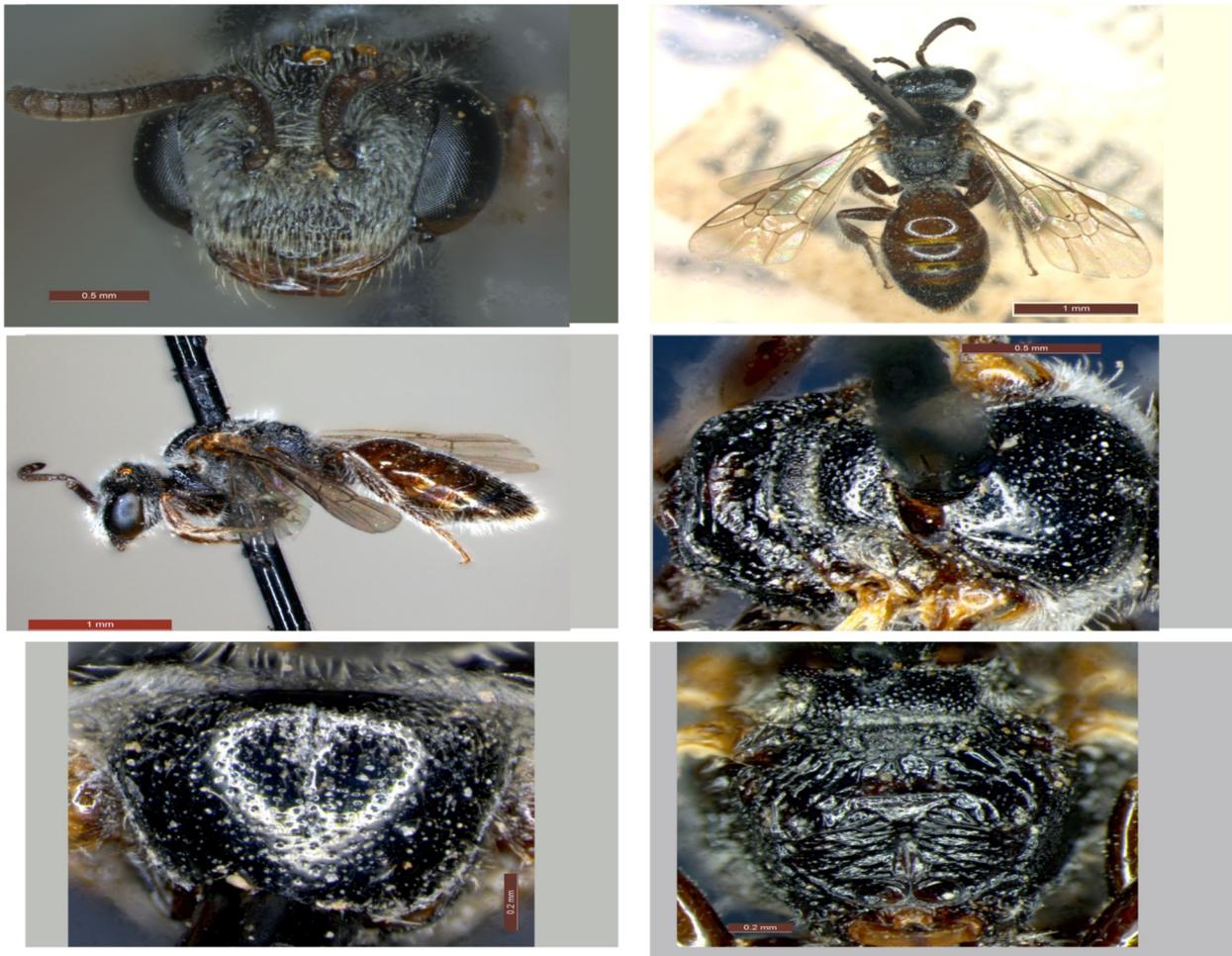


Plate 3. (a-f) *irridipennis* ♀: a, head anterior view; b & c, dorsal & lateral habitus; d, thorax dorsal view; e, scutum; f, Propodeum posterior view.

***Spehcodes gibbus* (Linnaeus 1785:571)**

Male

Color: Body ferruginous; head, scape and thorax black; legs, mandible, flagellum and compound eye dark brown; wings fuscous and hyaline apex; S1 brownish red; S2 ferruginous; **Pilosity:** Generally fine hairs scattered all over the body; tiny hairs sparse on flagellum and dense at base of each flagellomere; thick pubescence on paracocular area; sparse, short hairs on clypeus, scape, frons and vertex; tiny dense white hairs on pronotum and pronotal lobe; fine long amber hairs scattered on mesepisternum, sparse on femur, tibia and forebasitarsi; fine long hairs scattered on posterior hind coxa, trochanter, femur, mesepisternum, anteclypeal margin and mandible; long sparse hairs on outer hind tibia; anterior hind coxa, trochanter and femur glabrous; short plumose scattered on anterior surface of T1; short tiny hairs scattered at laterad and premarginal area of T1 to T3; **Sculpture:** small dense strong punctures on head; small punctures on supraclipeus and ocular margin; punctures scattered on clypeus, and vertex near mid ocelli; punctures denser on paracocular

area; scattered shallow punctures on occiput; transverse discontinuous carina on post occipital region; large rounded punctures sparsely on scutum and scutellum; interspace smooth; tiny punctures scattered on scape; irregular strong dense punctures on metanotum; basal propodeum strongly reticulated; posterior surface of propodeum with defined marginal carina; large strong punctures scattered on T1 mixed along with tiny and small punctures; marginal zone glossy; punctures on T1 comparatively stronger than female; marginal disc broad at the middle; premarginal line strong at laterad on T3 than T2, T1; tiny dot like punctures on T1 to T3 (Fig. 1n, 1o).

General structure: Head 1.15x as broad as long; clypeus 1.13 x as long as clypeoantennal distance; compound eye 0.62x as long as head; antenna dorsoventrally flattened and reaches beyond scutum; scape 3.3x as long as pedicel; pedicel 0.27x as long as F1; scape 0.03x as long as flagellum; F1 equally long as pedicel; upper interocular 1.2x as long as lower interocular distance; alveolar distance 0.74x as long as antennocellar distance; inter ocellar distance 1.41x as

long as ocello ocular distance; hind legs are slender; **Thorax:** scutum 0.88x as long as broad at the anterior and 1.05x as long as broad at the posterior; scutum 2.46x as long as scutellum; metanotum oblong; scutellum 1.6x as long as metanotum; Hindcoxa longer than other coxae; femur 4.6x as long as trochanter; hind tibia 1.29x as long as femur; basitarsi 0.50x as long as hind tibia; wings are fuscous and their apex hyaline; legs are slender compared to body; tegula small, oval and 1.5x as long as broad; forewing 2.71x as long as broad; forewing 1.25x as long as and 1.9x as broad as hindwing; stigma 2.43x as long as broad, 4.18x as long as prestigma; marginal cell 1.91x as long as free marginal cell and 2.87x as long as marginal cell length beyond stigma; marginal cell 4.1x as long as broad; posterior surface of propodeum depressed in the middle; metanotum 1.51x as long as propodeum; abdomen long cylindrical; **Sternum:** S2 transparent amber glossy; graduli strong and not straight depression below; S3 blackish transparent short scattered fine hairs; S4, S5 sparse short; S5 1.89x as long as broad; S6, 1.68x as broad as long and mid disc broad, with short, sparse hairs both sides of middle lateral; S7 transverse, wider and broad at the middle; 3.5x as long as broad; mid apical lobes with sparse fine erect hairs; S8 0.88x as broad as long with short lateral apodeme; mid apical lobe simple; lateral apex with small bunch of long fine hairs; disc is broad;

Measurements: Body length 8.0 ± 0.05 mm; forewing length 6.56 ± 0.03 mm; hindwing length 2.60 ± 0.03 mm;

Male genitalia: Oval, greatly convex and broader at middle; 0.98x as long as broad; laterally 0.61x as high as long; gonocoxite long oval and 0.20x as broad as the length of genitalia; gonobase 1.9x as broad as long; gonostylus laterally broader and concave; dorsal lobe 1.45x as long as broad and the apex 0.5x as broad as long; the dorsal lobe with deep semicircular cleft at preapex; apex narrow towards down with long bent hairs; ventral lobe 2.6x as long as broad and 3.6x as broad as dorsal lobe; the ventral lobe smaller than dorsal lobe, broader at apex with short, fine hairs and few strong hairs at their base; penis valve smaller, simple with apical and midlateral tooth; penis valve 7.4x as long as broad; hairs of dorsal lobe 0.93x as long as their apex (Fig. 1p, 1s; Plate. 2c-2f.);

Female

Females differ with males in size, antenna, abdomen, hind tibia, size of the punctures and mandible; Head: punctures same as present in male except the small punctures are slightly dense at the mid clypeus; antenna small, without tiny hair bands at the of base each flagellomere; punctures on the scutum and scutellum are smaller than in male and widely scattered; few smaller punctures scattered on scutellum; mandible longer than male; posterior margin of outer hind tibia with a row of tooth along the margin, angulated and

directed downward; hind tibia slightly broadened at apex; abdomen broader at the middle; T1 and T2 completely ferruginous; tiny small punctures scattered on T1-T2 and not as strong as in males (Fig. 1x); marginal zone transparent glossy, through this antecostal suture visible and row of fine tiny hairs visible; Metanotum almost rectangular with slightly angled posterior margin (Fig. 1t- 1v).

General structure: head 1.31x as broad as long; clypeus 1.31x as long as clypeoantennal distance; compound eye 0.61x as long as head; upper interocular 0.97x as long as lower interocular distance; Alveolar distance 0.55x as long as antennocellar distance; inter ocellar distance 0.53x as long as ocello ocular distance; scape 2.61x as long as pedicel; flagellum 2.27x as long as scape; F1 0.44x as long as pedicel; **thorax:** femur 1.23x as long as trochanter; hind tibia 1.06x as long as femur; basitarsi 1.58x as long as hind tibia; tegulae 2x as long as broad; forewing 2.85x as long as broad; Hindwing 2.84x as long as broad; forewing 1.28x as long as and 1.31x as broad as hindwing; stigma 0.31x as long as broad, 3.41x as long as prestigma; prestigma 2.4x as long as broad; marginal cell 1.84x as long as free marginal cell and 1.27x as long as marginal cell length beyond stigma; marginal cell 0.24x as long as broad; scutum 0.75x as long as broad at the anterior and 0.95x as long as broad at the posterior; scutum 2.42x as long as scutellum; scutellum 1.61x as long as metanotum; **Propodeum:** scutellum 1.6x as broad as long; propodeum 1.6x as long as metanotum; posterior surface 2.52x as broad as the length of propodeum; scutellum 0.64x as long as broad;

Measurements: Body length 12.2 ± 0.03 mm; forewing length 9.9 ± 0.03 mm; hindwing length 3.47 ± 0.03 mm;

Materials examined: Male, H-6337, Kashmir, 5200ft, Srinagar, Jun-Aug, 1923, P Bluthgen, det, , Dutt Coll.; Male, H-6336, Kashmir, 5200ft, Srinagar, Jun-Aug, 1923, P Bluthgen, det, , Dutt Coll.; Female, H-6333, Kashmir, 5200ft, Srinagar, Jun-Aug, 1923, P Bluthgen, det, , Fletcher coll.; Male, H-6334, Kashmir, 5200ft, Srinagar, Jun-Aug, 1923, P Bluthgen, det, Dutt Coll.;

Distribution: India: Kashmir;

***Sphecodes iridipennis* Smith, 1879: 27**

Female (Fig 1. a1 to a5)

Color: Body black; metasoma ferruginous; dark brown antenna, sternum; **Pilosity:** sparse fine, white pubescence on paraocular, supraclypeus, pronotum, pronotal lobe, frons and very sparse on clypeus; fine, scattered plumose on vertex and occiput; pale white hairs, sparsely on anterior surface of pronotum; tiny scattered hairs on scutum; fine pale short hairs on anterior margin of metanotum; dorsal and lateral propodeum glabrous; long white silky sparse subdecumbent hairs on femur, tibia and basitarsi of all the legs; short tiny, fine hairs on mid premarginal line; T1 glossy,

smooth, and tiny hairs scattered on anterior surface; long scattered hairs on marginal zones of all the tegum; slightly long very fine scattered hairs on lateral apex of S1 to S3; same kind of hairs sparsely present on S4 to S6; **Sculpture:** fine dense shallow punctures on paracocular, vertex, clypeus, supraclypeus and occiput; frontal carina irregular strong and reaches upto interantennal area; shallow rounded punctures on scutum and scutellum and sparser than in head (Plate 3e); supraclypeus slightly elevated;-- irregular sculptures on metanotum; mid and forefemur glabrous; basal propodeum strongly reticulated and carinated strongly at posterior margin; interspace smooth and shiny; transverse carina towards the pit on posterior propodeum; small shallow punctures scattered on T1; small shallow sparse punctures on T2 to T5; few shallow sparse punctures on midlateral S1; the same kind of punctures laterally on S2 to S5; mesepimeron scrobe areolated (Fig. 1a1, 1a2);

General structure: Head: scape long; pedicel and F1 smaller; supraclypeus slightly elevated; frontal carina well defined; clypeus short and transversely elevated in the middle; mandible long, strong preapical tooth; scape longer; head 1.30x as broad as long; clypeus 1.2x as long as clypeoantennal distance; compound eye 0.73x as long as head; upper interocular 0.91x as long as lower interocular distance; alveolar distance 0.5x as long as antennocellar distance; inter ocellar distance 0.93x as long as ocellar distance; scape 5x as long as pedicel; flagellum 2.13x as long as scape; F1 0.75x as long as pedicel (Plate. 3a); **Thorax:** metanotum smaller than scutellum; hind femur slightly broader at base; hind tibia broader at apex; tibial spur long narrow towards apex and lower margin finely serrated near base; Femur 2x as long as trochanter; hind tibia 1.02x as long as femur; basitarsi 0.65x as long as hind tibia; Tegulae 1.4x as long as broad; forewing 3.26x as long as broad; Hindwing 3.37x as long as broad; forewing 1.30x as long as and 1.35x as broad as hindwing; Stigma 3x as long as broad marginal cell, 1.50x as long as free marginal cell and 1.22x as long as marginal cell length beyond stigma; marginal cell 3.5x as long as broad; scutum 0.82x as long as broad at the anterior and 1.20x as long as broad at the posterior; scutum 2.61x as long as scutellum; scutellum 1.63x as long as metanotum; scutellum 1.66x as broad as long (Plate. 3d); **Propodeum:** basal propodeum depressed in the middle (Plate. 3f); posterior surface slightly depressed; metanotum 0.68x as long as propodeum; posterior surface 3.18x as broad as the length of propodeum (Fig. 1a5); **Abdomen:** T1 anterior surface slightly flattened; T3 marginal zone slightly longer in the middle than T1;

Measurements: Body length 5.10± 0.30mm; forewing length 4.41± 0.03 mm; hindwing length 3.37± 0.03 mm;

Materials examined: Male/Female, H-6346, GR Dutt, Chapra, Bengal, Mackenzie;

Distribution: Bihar: Chapra.

DISCUSSION

In the present study, the existing information on the three species viz., *S. crassicornis*, *S. gibbus*, *S. iridipennis* was supplemented with additional description, illustrations and morphometric ratios of important taxonomic features including male genitalia. Description of pilosity, sculpture and male genitalia focused in this study is the recent trend in bee taxonomy used by bee specialists. It is difficult to recognize species of genus *Sphecodes* as they are cleptoparasitic and obviously do not possess much specialized features. The male genitalia and sculpture of mesosoma are the well-built features for identification of species. Generally the females are much bigger and males are slender with longer antenna. All the three species generally varied in size and the type of punctures on mesosoma viz., small, dense punctures in *S. crassicornis*, large sparse punctures in *S. gibbus* and shallow punctures in *S. iridipennis*; the density of punctures slightly vary between the sex, for example, the punctures on scutum of male *S. gibbus* is denser than in female. Likewise it was observed in *S. crassicornis*. As far as the male genitalia is concerned, wide variation was observed on gonostylus. The dorsal lobe of gonostylus with deep semicircular cleft was observed in *S. gibbus* while it is parallel in case of *S. crassicornis*.

The redescription is necessary in the context of increasing attention on bee diversity and advent of new species. It needs in depth studies on the morphology to identify key feature which helps in differentiating relatively closer species. This study may be stepping stone for identification of all the Indian species under genus *Sphecodes* Latreille 1804.

Conclusion

The taxonomy of genus *Sphecodes* has been inadequately worked out in India during the past. The earlier descriptions lacked illustrations especially those of male genitalia and photographs. The present study bridges the gap in existing knowledge.. The check list also has been prepared and it will be useful in future taxonomic studies.

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REFERENCES

- Ascher, J. S. and J. Pickering (2014). Discover life bee species guide and world checklist (Hymenoptera : Apoidea: Anthophila), http://www.discoverlife.org/mp/20q?guide=Apoidea_species
- Bingham, C. T. (1897). *The Fauna of British India Including Ceylon and Burma, Hymenoptera*, Vol. I. Wasps and

- Bees. Xxix+577 p., 4 pls. London: Taylor and Francis. (Reprinted, 1975, New Delhi: Today and Tomorrow's)
- Bingham, C. T. (1898). On some new species of Indian Hymenoptera volume.12 part I. *Journal of the Bombay Natural History Society*, 12: 1-234
- Bluthgen, P. (1924). Zur Systematik der Bienengattung *Sphecodes* Latr. II. *Deutsche Entomologische Zeitschrift* issue, 6: 456-516
- Blüthgen, P. (1927). Beiträge zur Systematik der Bienengattung *Sphecodes* Latr. III. *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Tiere*, 53: 23-112
- Blüthgen, P. (1933). *Halictus* Latr., *Sphecodes* Latr., *Nomioides* Schenck, p. 52-63 In: A. Nadig, sen. & Jun. Contribution to the knowledge of the Hymenopteren fauna of Morocco and western Algeria. Part One: Apidae, Sphegidae, Vespidae. *Annual reports of the nature of Research Society*, 71: 37-107
- Cameron, P. 1896 (1897). Hymenoptera Orientalia, or Contributions to the knowledge of the Hymenoptera of the Oriental zoological region, Part V. *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 41(2): 1-144
- Cockerell, T. D. A. (1911). New and little known bees. *Transactions of the American entomological Society*, 37: 217-234.
- Cockerell, T. D. A. (1938). Bees of the genus *Sphecodes* from the Belgian Congo. *Revue de Zoologie et de Botanique africains*, 30: 327-329
- Dalla Torre, C. G. de. (1896). *Catalogus Hymenopterorum, Apidae (Anthophila)*. Leipzig: Engelmann.10 (viii): pp 643
- Friese, H. (1909). Die Bienen Afrikas nach dem Stande unserer heutigen Kenntnisse, In L. Schultz, *Zoologische und Anthropologische Ergebnisse einer Forschungsreise westlichen und zentralen südafrika ausgeführt in den Jahren 1903-1905*, Jena: Fischer. Band 2, Lieferung 1, X Insecta (ser.3) (Jenaische Denkschriften) Vol. 14: pp. 83-476
- Hagens, D. Von. (1882). Ueber die männlichen Genitalien der Bienen-Gattung *Sphecodes*. *Deutsche Entomologische Zeitschrift* 26: 209-228.
- Illiger, K. (1806). William Kirbys Familien der Bienenartigen Insekten mit Zusätzen, Nachweisungen und Bemerkungen. *Magazin für Insektenkunde* 5:28-175
- Kirby, W. (1802). *Monographia Apum Angliae*, Ipswich, U. K. Privately published Vol. 1&2: pp 388.
- Latereille, P. A. (1804). Tableau méthodique des insectes, In: *Nouveau Dictionnaire d'Histoire Naturelle*, Paris Déterville Vol. 24: pp.129-200
- Lepelletier de Saint-Fargeau, A. (1841). Natural history of insects, Hymenoptera. Vol.2, *Roret encyclopedic library*, Paris. 2: pp 680
- Linnaeus, C. (1758). *Systema Naturae*, The system of nature through the three kingdoms of nature, according to classes, Orders, genera, species, cum characters, differences, synonyms, locis. Holmiae: Salvii 1: 824 p
- Meyer, R. (1919). Apidae, Sphecodinae I. *Archiv für Naturgeschichte* 85 A 1:79- 242
- Meyer, R. (1925). Zur Bienengattung *Sphecodes*. *Archiv für Naturgeschichte* 90 A 12:1-12
- Michener, Charles. D. (2007). *The bees of the world*, second edition. The Johns Hopkins University Press, Baltimore, Maryland 21218-4363. pp 953
- Morawitz, F. (1876). Bienen (Mellifera). II. Andrenidae. In: FEDTSCHENKO, A. P. Reisen in Turkestan I. *Izv. Imp. Obshch. Ljubit. Estest. Antrop. Etnog.* Taf. 1-3. 21: 161-303
- Nurse, C. G. (1903). New species of Indian Aculeate Hymenoptera. *Annals and Magazine of Natural History*, 11: 393-403, 511-526, 528-549
- Robertson, C. (1903). Synopsis of Sphecodinae. *Entomological News*, 14: 103-107.
- Sichel, J. 1865. Révision monographique, critique et synonymique du genre mellifera *Sphecodes* Latr. *Annales de la Société Entomologique de France* (4) 5: 397-466
- Smith, F. (1845). Weibchen Männchen, England *Zoologist* 3: 1014
- Smith, F. (1853). *Catalogue of Insects in the Hymenopterous collections of the British Museum*, Part I. Andrenidae and Apidae. Printed by order of the trustees, British Museum, London 1: 197 p
- Smith, F. (1879). *Description of new species of Hymenoptera in the collection of the British Museum*. Printed by order of the trustees, British Museum, London. xxi: pp 240
- Tsuneki, K. (1983). A contribution to the knowledge of *Sphecodes* Latreille of Japan (Hymenoptera, Halictidae). *Special Publications of the Japan Hymenopterists Association*, 26: 1-71
- Verhoeff, C. (1890). Ein Beitrag zur deutschen Hymenopteren-Fauna. *Entomologische Nachrichten* 16: 321-335
- Warncke, K. (1992). Die westpaläarktischen Arten der Bienengattung *Sphecodes* Latr. *Bericht der Naturforschende Gesellschaft Augsburg*, 52: 9-64