A study of the genus *Sphex* Linnaeus (Hymenoptera: Sphecidae) from India

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**ABSTRACT.** The genus *Sphex* Linnaeus (Hymenoptera: Sphecidae) is studied from India and key to Indian species is provided. The state-wise distributions of four species of *Sphex* are augmented here. A new synonymy is proposed: *Sphex zubaidiyacus* Augul, 2013 = *S. obscurus* (Fabricius, 1804).

**Key words:** Digger wasps, *Sphex*, India, new records, taxonomy, key

**Introduction**

Digger wasps of the genus *Sphex* Linnaeus, 1758 are moderate to large wasps of the family Sphecidae (Insecta: Hymenoptera) and subfamily Sphecinae (Bohart & Menke, 1976). They show a variable distribution along various zoogeographical lines with most species reported from the Afrotropics followed by Australia (pers. comm. Thorleif H. Dörfel). However, this speciose group is scarcely reported from India with only nine recorded species till date. They are *Sphex argentatus* Fabricius, 1787; *S. deplanatus* Kohl, 1895; *S. diabolicus* F. Smith, 1858; *S. neoumbrosus* Jha & Farooqi, 1996; *S. obscurus* (Fabricius, 1804); *S. praedator* Smith, 1858; *S. pruinosus* Germar, 1817; *S. sericeus* (Fabricius, 1793); and *S. subtruncatus* Dahlbom, 1843. Female wasps of the genus are powerful predators, in which many species hunt on Orthoptera of the families Tettigoniidae, a few on Gryllacrididae and some on Gryllidae as provision for their larvae (Bohart & Menke, 1976; Evans et al., 1982; Kazenas, 2001; Roche, 2007; Dörfel & Ohl, 2015).

The genus *Sphex* was established by Linnaeus in 1758 based on the type species *S. flavipennis* Fabricius, 1793. Generic revisions were published by Menke & Pulawski (2000), Schmid-Egger (2014, 2019) and Dörfel & Ohl (2015). Taxonomic study of Indian *Sphex* remains scarce and limited. Here we aim to provide a study on the taxonomy and distribution of the *Sphex* species from India. Key characters of the species present in India were studied from relevant literatures (Smith, 1858a, 1858b; Cameron, 1889; Kohl, 1895; Bingham, 1897; Hensen, 1991; Jha & Farooqi, 1996; Dörfel & Ohl, 2015) and working key was prepared for the identification of Indian species which is provided below. *Sphex*
zubaidiyacus Augul, 2013 described from the Palaearctic region (Iraq, Baghdad) is newly synonymised here with S. obscurus Fabricius. S. fumicatus Christ, 1791 and S. ichneumoneus (Linnaeus, 1758) reported from India and reports of some Indian species from the African region by previous workers are omitted here due to the need of validation.

**Material and methods**

Specimens from the National Collections of Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK) along with fresh specimens collected from various localities in India were examined for the present study. The specimens mounted on entomological pins were studied under LEICA M205 stereoscopic binocular microscope and images were captured using attached LEICADFC 500 camera. Habitus images of the species were captured with digital camera (Canon Power Shot SX540bHS). Measurements were obtained using Leica LAS (Leica Application Suite V3.80) Microsystems by Leica (Heerburg, Switzerland). Images at varying focal planes were stacked using Leica Automontage Software V3.80 and the final illustrations were processed for contrast and brightness using Adobe® Photoshop® CS5 (Version 6.1) software. After curation, freshly collected specimens are added to the ‘National Zoological Collections’ of ZSIK. The morphological terminology used in this paper mostly follows Bohart & Menke (1976).

**Museum abbreviations:** NHMW: Naturhistorisches Museum, Wien, Austria; NHRCM: Natural History Research Center and Museum, University of Baghdad, Iraq; OXUM: Hope Department of Entomology, Oxford, Great Britain; ZMUC: Zoological Museum, University of Copenhagen, Copenhagen, Denmark; ZSIK: Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, India.

**Results**

**Genus Sphex Linnaeus, 1758**

*Sphex* Linnaeus, 1758: 569. Type species: *Sphex flavipennis* Fabricius, 1793, designated by International Commission on Zoological Nomenclature, 1946: 571 (Opinion 180) which reversed its earlier designation as type of *Sphex sabulosus* Linnaeus, 1758 (1911: 76, Opinion 32). Pulawski (2021) gives a list of the synonymy, which is not repeated here.

**Diagnosis.** Length of basal veinlet of submarginal cell II equal to or (more often) shorter than anterior veinlet; inner orbits straight below but curving towards ocelli above; hind tibial spur closely, usually finely pectinate inside; length of petiole as measured along dorsum less than combined length of hind tarsomeres II–IV (Bohart & Menke, 1976).

*Sphex argentatus* Fabricius, 1787 (Figs 1–9, 38)

*Sphex argentatus* Fabricius, 1787: 274, sex not indicated (as argentata, incorrect original termination). Lectotype: ♂, southeastern India: Coromandel coast: no specific locality (ZMUC).

Pulawski (2021) gives a list of the synonymy, which is not repeated here.

**Diagnosis. Female** (Figs 1–6). Body entirely black; frons and clypeus with appressed silvery white pubescence and long erect setae of same colour, clypeus slightly convex, anterior margin medially with two indistinct lobes (Fig. 2); pronotal collar and scutum with moderately dense silvery white pubescence, scutum with slightly denser pubescence
laterally than medially; scutellum with shallow median impression near posterior margin; metanotum strongly bituberculate; propodeal enclosure transversely striate and covered with erect silvery white setae (Fig. 4); mesepisternum with silvery white setae (Fig. 5); metasoma finely pubescent (visible as aciculations under low magnification); fore wings hyaline with fuscous patch at apex, base darkened (Fig. 3).

**Male** (Figs 7–9). Resembles female in most aspects except, free clypeal margin truncate, slightly concave towards center with short median lobe (Fig. 8); antennae of male with placoids on fifth flagellomere.

**Male genitalia** (Fig. 38). Gonostyle pointed towards apex and covered with thick pubescence subapically; head of digitus in volsella with pyramid-shaped and clothed with moderately dense pubescence, apex of cuspis distinctly acuminate; penis valve long and slender with short head.


**Distribution.** India: Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Punjab, Sikkim, Tamil Nadu, Telangana (new record), Uttarakhand, Uttar Pradesh, West Bengal. **Elsewhere:** Australia; Cambodia; China (including Hong Kong); Dableeh Island; Indonesia; Israel; Japan; Kazakhstan; Korea; Kuwait; Laos; Malaysia; Myanmar; New Guinea; Pakistan; Philippines; Sri Lanka; Taiwan; Thailand; Vietnam (Jonathan & Kundu, 2003; Kundu et al., 2006; Barthélémy, 2014; Anagha & Girish Kumar, 2020; Gadallah, 2020; Pulawski, 2021).

**Sphex deplanatus** Kohl, 1895


**Diagnosis.** Male. Body black except metasoma red on side; head and thorax with silvery white pubescence; scutellum not convex, almost flattened; propodeal enclosure with five transverse wrinkles; fore wings infuscate violaceo-resplendentes.

**Note.** As no specimens were seen during the present study, the above diagnosis has been based on original description (Kohl, 1895). The description of the female of *S. deplanatus* by Kohl was based on misidentified specimens (pers. comm. Thorleif H. Dörfel) so the diagnosis of female has been excluded.
**Sphex diabolicus** F. Smith, 1858


Pulawski (2021) gives a list of the synonymy, which is not repeated here.  

**Diagnosis**. Body black; head pubescent; scutellum prominent with slight shallow longitudinal furrow; metanotum bituberculate; propodeal enclosure densely pubescent; fore wings strongly yellowish to yellowish brown.  

**Note**. As no specimens were seen during the present study, the above diagnosis has been based on published descriptions (Smith, 1858a; Bingham, 1897; Strand, 1913; Hensen, 1991).  

**Variability**. Vestiture on frons and propodeum of species is found to be variable from black to yellow (Smith, 1858a; Bingham, 1897; Strand, 1913).

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**Sphex neoumbrosus** Jha & Farooqi, 1996


**Diagnosis**. **Female**. Body black; clypeus broader than long with paired minute lobes, not delimited by submedian notches, lateral margin slightly wavy (see Fig. 1 of Jha & Farooqi (1996: 14)); dark brown long and short pubescence all over body except on flagellomeres, tibiae, tarsi and metasomal terga; scutellum with median longitudinal furrow; metanotum more or less bituberculate; propodeal enclosure transversely and finely striate; fore wings hyaline with bright yellow fulvescens, apex smoky.  

**Male**. Unknown.  

**Note**. As no specimens were seen during the present study, the above diagnosis has been based on original description (Jha & Farooqi, 1996).

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**Sphex obscurus** (Fabricius, 1804) (Figs 10–22, 39)


As *Sphex obscurus*: Dalla Torre, 1897: 419.  


**Justification of new Synonymy**. Analysis of key characters of fresh specimens of *Sphex obscurus* collected from Southern India, lectotype of species available from Zoological Museum Copenhagen (http://www.daim.snm.ku.dk/digitized-type-collection-details-simple?catno=zmuc00241276) and from related literature, the authors find it judicious to assign *S. zubaidiyacus* Augul described from Iraq (Augul, 2013) as a junior synonym of *S. obscurus*.  

**Diagnosis**. **Female** (Figs 10–15). Body black; frons and clypeus with distinct appressed silvery white pubescence and long erect setae of same colour; anterior clypeal margin medially with two lobes (Fig. 11); pronotal collar, scutum and scutellum with moderately dense silvery white pubescence, scutum with slightly denser pubescence laterally than medially; metanotum simple, not bituberculate, with pubescence similar as on scutellum;
propodeal enclosure with erect and appressed silvery white and golden yellow setae (Fig. 12); mesepisternum with silvery white setae (Fig. 13); metasoma finely pubescent (visible as aciculations under low magnification) (Fig. 15); fore wings subhyaline with orange tinge (Fig. 14).

**Male** (Figs 16–22). Resembles female in most aspects, vary in colour of pubescence, pubescence on head and thorax golden yellow (Figs 18 & 19); clypeus elongate, clearly swollen at middle (Fig. 18); antennae with placoids on the proximal third of flagellomere five and six (Fig. 18).

Male genitalia (Fig. 39). Gonostyle pointed towards apex covered with sparse pubescence; head of digitus in volsella pyramid-shaped (broader than in *Sphex argentatus*) and clothed with moderately dense pubescence, apex of cuspis distinctly acuminate; penis valve long and slender with short head.


**Distribution.** India: Kerala (new record), Uttarakhand, West Bengal. Elsewhere: Iraq; Sri Lanka; Thailand; Turkmenistan; United Arab Emirates (Pulawski, 2021).

*Sphex praedator* F. Smith, 1858

*Sphex praedator* F. Smith, 1858b: 14, ♂. Holotype or syntypes: ♂, Indonesia: Sulawesi: no specific locality (OXUM).

Pulawski (2021) gives a list of the synonymy, which is not repeated here.

**Diagnosis.** Body black with black pubescence; frons with silvery white pubescence and black setae; pronotal collar entire; scutellum naked and shining; metanotum simple; propodeal enclosure transversely finely rugulose; fore wings strongly yellowish to dark brown with violaceous effulgence.

**Note.** As no specimens were seen during the present study, the above diagnosis has been based on published descriptions (Smith, 1858b; Bingham, 1897).

*Sphex pruinosus* Germar, 1817

*Sphex pruinosus* Germar, 1817: 261, ♂ (as *pruinosa*, incorrect original termination). Holotype or syntypes: Dalmatia: Spalatro, now Croatia: Split (depository?).

Pulawski (2021) gives a list of the synonymy, which is not repeated here.

**Diagnosis.** Body black with metasoma partly or entirely red or ferruginous; head and thorax with silvery white pubescence; scutellum with median furrow; metanotum with indistinct tubercles; propodeal enclosure with broad transverse ridges; fore wings hyaline with smoky apex.

**Note.** As no specimens were seen during the present study, the above diagnosis has been based on published descriptions (Kohl, 1885; Cameron, 1889; Nurse, 1903; Roche, 2007).

**Variability.** Male show variation in colour of metasoma being entirely black or red or ferruginous or partly red or ferruginous (Kohl, 1885; Cameron, 1889; Nurse, 1903; Roche, 2007).
**Sphex sericeus** (Fabricius, 1793) (Figs 23–31, 40)

*Sphex aurulentus* Fabricius, 1793: 201, sex not indicated, junior primary homonym of *Sphex aurulentus* Fabricius, 1787 (now in *Liris*). Holotype or syntypes: India: Tranquebar (depository unknown).

As *Sphex sericeus*: Dahlbom, 1843: 26.

Pulawski (2021) gives a list of the synonymy, which is not repeated here.

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**Diagnosis. Female** (Figs 23–31). Body black with following parts orange: basal half of mandible, clypeus, scape, pedicel, base of flagellomere I, scutellum, metanotum, first and anterior two third of second metasomal segments, and legs excluding claw; frons and clypeus with appressed orange pubescence and long erect setae of same colour; clypeus swollen at middle with glabrous stripe, anterior margin notched in middle (Fig. 24); pronotal collar and scutum with moderately dense orange pubescence, scutum with slightly denser pubescence laterally than medially; scutellum with shallow median impression near posterior margin; metanotum strongly bituberculate; propodeal enclosure with three to four broad transverse ridges, appressed orange pubescence and sparse, erect setae of same colour (Fig. 26); mesepisternum with orange setae (Fig. 27); metasoma finely pubescent (visible as aciculations under low magnification) (Fig. 28); fore wings fuscous with slight blue iridescence (Fig. 25).

**Male** (Figs 29–31). Vary largely in colour with female, body black except metasoma; pubescence on head and thorax silvery white; metasoma mixed with red and black colours (Fig. 31); free clypeal margin concave towards center (Fig. 30); antennae of male with placoids on fifth to sixth flagellomere.

**Male genitalia** (Fig. 40). Gonostyle slightly pointed towards apex, digitus in volsella with short head, apex of cupisus acuminate; penis valve long and slender.

**Variability.** One female specimen from South Andaman examined here shows colour variation in metasoma being completely black; all the female specimens examined here have petiole black and wings fuscous with blue iridescence while petiole is red or orange and wings subhyaline with yellow tinge according to previous workers (Bingham, 1897; Dörfel & Ohl, 2015).

Distribution. India: Andaman & Nicobar Island (new record), Assam, Goa (new record), Karnataka, Kerala, Maharashtra, Meghalaya, Odisha, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. Elsewhere: Australia; Cambodia; Chagos Archipelago; China (including Hong Kong); Indonesia; Japan; Korea; Laos; Malaysia; Myanmar; New Guinea; Pakistan; Philippines; Sri Lanka; Taiwan; Thailand; Vietnam (Sudheendrakumar & Narendran, 1989; Jonathan & Kundu, 2003; Barthélémy, 2014; Anagha & Girish Kumar, 2020; Pulawski, 2021).

*Sphex subtruncatus* Dahlbom, 1843 (Figs 32–37)

*Sphex subtruncatus* Dahlbom, 1843: 25, ♀ (as *subtruncata*, incorrect original termination). Lectotype: ♀, "Africa": no specific locality but actually Oriental Region according to W. Schulz, 1912: 94 (Lund).

Pulawski (2021) gives a list of the synonymy, which is not repeated here.

Diagnosis. Female. Body black, femora and tibiae orange; frons and clypeus with appressed silvery white pubescence and long erect black setae; clypeus slightly convex, anterior clypeal margin medially emarginate (Fig. 33); pronotal collar and scutum with brown or black pubescence; scutellum and metanotum with median impression; metanotum simple, not bituberculate; propodeal enclosure transversely ruguloso-striate with median impression and erect black setae (Fig. 34); mesepisternum with black setae (Fig. 35); metasoma finely pubescent (visible as aciculations under low magnification)(Fig. 37); fore wings subhyaline with yellowish tinge and fuscous patch at apex (Fig. 36).

Male. Not seen in the present study. Similar to female except smaller size; wings darker; clypeus longer, anterior margin slightly arched, almost truncate (Bingham, 1897).

Variability. Colour of wings and legs of species is found to be variable. Wings in certain specimens are dark fuscous with a brilliant purple effulgence, and have very little of the yellow tinge on the disc; femora and tibiae of the intermediate and posterior pair, or of the posterior pair only, may be wholly or partially red or orange (Bingham, 1897).


Distribution. India: Arunachal Pradesh, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Sikkim, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. Elsewhere: Bhutan; China (including Hong Kong); Indonesia; Japan; Korea; Laos; Myanmar; Nepal; Philippines; Singapore; Sri Lanka; Taiwan; Thailand; Vietnam (Barthélémy, 2014; Dollfuss, 2008; Kundu et al., 2006; Anagha & Girish Kumar, 2020; Pulawski, 2021).

Note. Girish Kumar et al. (2018) misidentified the species as *Sphex praedator* F. Smith, 1858.
Key to Indian species of *Sphex* (except *S. deplanatus* Kohl, 1895 due to unavailability of key characters)

1. Metanotum with medially raised tubercles (Figs 4 & 26). .......................................................2
   – Metanotum without medially raised tubercles (Figs 12, 19 & 34) (indistinct tubercles in *S. pruinosus* Germar, 1817). .................................................................5

2. Propodeal enclosure with broad transverse ridges (Fig. 26). ................................................. 
   .......................................................................................................................... *Sphex sericeus* (Fabricius, 1804)
   – Propodeal enclosure without broad transverse ridges (Fig. 4). ............................................3
3. Cellular wing area clearly hyaline without yellow tinge (Fig. 3). ...............................................

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\textit{Sphex argentatus} Fabricius, 1787

– Cellular wing area subhyaline with yellow tinge. .................................................................4

4. Pubescence on propodeal enclosure concealing sculpture. .......................................................

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\textit{Sphex diabolicus} F. Smith, 1858

– Pubescence on propodeal enclosure not concealing sculpture. ..............................................

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\textit{Sphex neoumbrosus} Jha & Farooqi, 1996

5. Propodeal enclosure with broad transverse ridges. ...... \textit{Sphex pruinosus} Germar, 1817

– Propodeal enclosure without broad transverse ridges. ........................................................6

6. Legs entirely or partly red or orange. ...............\textit{Sphex subtruncatus} Dahlbom 1843

– Legs entirely black. ...............................................................................................................7

7. Pubescence on propodeal enclosure silvery white or golden yellow (Figs 12 & 19). ...........

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\textit{Sphex obscurus} (Fabricius, 1793)

– Pubescence on propodeal enclosure light brown or black. ...................................................

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\textit{Sphex praedator} F. Smith, 1858


\textbf{Discussion}

Wasps of genus \textit{Sphex} are cosmopolitan in distribution with 132 species worldwide. Of these, \textit{Sphex neoumbrosus} Jha & Farooqi, 1996 is the last Indian species to be reported from the Indian subcontinent and of the Oriental region. The scarcity of studies most likely points to a shortage of accessible taxonomic resources (Forbes et al., 2018) and the present paper aims in providing one such comprehensive study to understand \textit{Sphex} fauna of India. Key and figures of species included may help in the easy identification of the group in future and it is expected that further integrated studies and collection methods may help in identifying more species from the area.
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Conflict of Interests
The authors declare that there is no conflict of interest regarding the publication of this paper.

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References


مطالعه جنس (Hymenoptera: Sphecidae) Sphex Linnaeus از هند

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چکیده: جنس هندی Sphex در هند مورد مطالعه قرار گرفت و کلید گونه‌ها ارائه شد. یک گونه جدید Sphex, S. obscurus (Fabricius, 1804) به عنوان مناسب کم‌سابقه نام Sphex zubaidiyacus Augul, 2013 افزوده شد.

واژگان کلیدی: ژنیورهای حفار، رده هند، و گزارش‌های جدید، رده کلید شناسایی