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Research article

urn:lsid:zoobank.org:pub:A8276C28-E296-497B-89A5-53D46212728E

A review of the genus *Stratiomys* Geoffroy (Diptera: Stratiomyidae) from India with description of a new species

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Abstract. A review of the genus *Stratiomys* from India is presented. The new species *Stratiomys brunettii* sp. nov. is described based on male and female specimens collected from the Kashmir Himalayas. The only other congener previously recorded in India, *Stratiomys approximata*, is redescribed. A key to the species is presented.

Keywords. Morphology, new species, nomenclature, soldierfly, taxonomy.

Yatoo S.F., Maqbool A. & Wachkoo A.A. 2023. A review of the genus *Stratiomys* Geoffroy (Diptera: Stratiomyidae) from India with description of a new species. *European Journal of Taxonomy* 910: 1–13.
<https://doi.org/10.5852/ejt.2023.910.2353>

Introduction

The flies belonging to the family Stratiomyidae Latreille, 1802 are commonly known as soldierflies. The global extant fauna of Stratiomyidae contains over 2800 species, distributed across 12 subfamilies and 378 genera (Woodley 2001, 2011; Hauser *et al.* 2022). The genus *Stratiomys* Geoffroy, 1762 is a medium-sized genus of soldierflies with above 90 species recorded worldwide (Woodley 2001, 2011; Nerudová *et al.* 2007). The members of the genus are mostly medium-sized flies with elongated antenna and a broad-flattened abdomen (Nerudová *et al.* 2007).

The majority of *Stratiomys* are found in the Holarctic Region and just a few species from the Neotropics and Oriental Region (Woodley 2001; Nerudová *et al.* 2007). There are just five species known from

the Oriental Region (Nerudová *et al.* 2007) with a single valid species currently known from India (Wachkoo *et al.* 2017).

Brunetti (1920) first identified the Indian specimens from Kashmir erroneously as *S. barca* (Walker, 1849); however, upon comparison with type material he later realized it was a new species and described it as *S. approximata* Brunetti, 1923. Brunetti also considered similar specimens collected from China to be the conspecific, although no direct comparison was made.

All the Oriental species have previously been presented by Brunetti (1920, 1923) and Nerudová *et al.* (2007). However, the species name *Stratiomys kashmirensis* attributed to specimens deposited in ZSI by Brunetti has never been published. The name *S. kashmirensis* was coined by Brunetti in 1921 for specimens from Sonamarg, Kashmir, but he did not formally publish it. *Stratiomys kashmirensis* is therefore an unavailable name according to the International Code of Zoological Nomenclature. Because a combination of characters readily distinguishes the species from other congeners, we herein describe it as a species new to science, *Stratiomys brunettii* sp. nov.

In this study, we revise the taxonomy of the genus *Stratiomys* in India, describe *S. brunettii* as a new species from the Kashmir Himalayan Region and present a redescription of *S. approximata* Brunetti, 1923. In addition, we provide an illustrated identification key to Indian species, as well as a map showing the known distribution ranges (Fig. 1).

Material and methods

Collection sites

This study is based on specimens collected in the Kashmir Valley, located in the north-western part of the Indian subcontinent between 33°22' and 34°50' N latitude and 73°55' and 75°33' E longitude

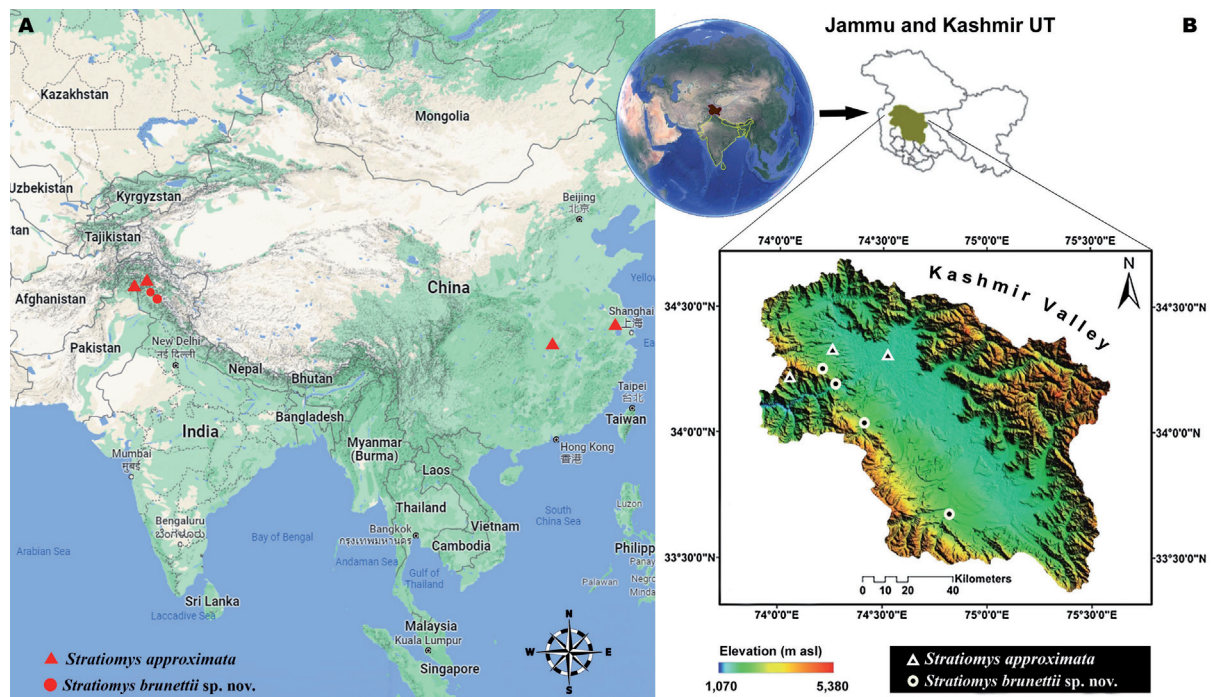


Fig. 1. A. Distribution map of the species of *Stratiomys* Geoffroy, 1762 from India. B. Map showing sampling sites for *Stratiomys* species in the Kashmir Valley.

(Maqbool *et al.* 2018; Wachkoo *et al.* 2019). The Kashmir Valley represents a transitional zone between Oriental and Palaearctic regions, sharing boundaries with the north-western tip of the Oriental and mid-south of the Palaearctic Region (Das 1966; Maqbool *et al.* 2022).

Morphological studies

The morphological study was conducted using a G2Mark stereo microscope (G2Mark, India). Adult specimens of *S. approximata* were identified using Nerudová *et al.* (2007) and compared with images of specimens of *S. barca* deposited at ZSI, which are identical with specimens (and possibly syntypes) of *S. approximata*. Direct comparisons were made with the images of specimens deposited at ZSI for *S. brunettii* sp. nov. Morphological terminology and abbreviations follow Cumming & Wood (2017) and Hauser *et al.* (2017), and for male terminalia Fachin & Hauser (2018).

Body length was measured as the outstretched length from the base of the antenna to the posterior end of the abdomen, in lateral view. Wing length was measured from the wing base to the wing apex.

Male terminalia preparation

For the extraction and preparation of male terminalia the procedure of Wachkoo *et al.* (2021) was followed with a little modification. Terminal abdominal segments were removed and placed in a 10% KOH solution overnight at room temperature to achieve proper transparency. The material was then treated with 100% glacial acetic acid for 10 minutes to neutralise the effect of KOH. Subsequently, the material was given a quick dip in 75% ethanol and transferred to a cavity glass slide having glycerol as a temporary mount. The synsternite was detached from the epandrium and genital capsule for better visual analysis. To attain an appropriate angle, water based sterile lubricant transparent gel (K-Y Jelly), was used. A small drop of the gel was placed on the centre of the glass slide cavity, with the material to be photographed placed over it and carefully manipulated with fine tipped forceps to achieve appropriate orientation. A drop of glycerol was added on top of the gel to smoothen the surface and reduce the amount of light reflection.

Images

Images of adult specimens were captured with a mirrorless digital camera (Nikon Z50). To achieve adequate exposure of specimens, a light box was used to produce diffused light (Wachkoo *et al.* 2021). Multiple images were focus stacked in the combine ZP programme to create one final image (Yatoo *et al.* 2022). Final plates were assembled with Adobe Photoshop® CS4. The above setup was also used for capturing terminalia (submersed in glycerol) microphotographs, with the addition of infinite microscope objectives (Maqbool *et al.* 2021).

Distributional maps

Global distributional map (Fig. 1A) was prepared using Google maps and Google Earth Pro ver. 7.3.6.9326. To prepare the map of Kashmir Valley showing the sampling sites (Fig. 1B), ArcMap module of the ArcGIS software package ver. 10.1 was used. Geographical coordinates of the sampling sites were imported to mapping software and the sampling site was plotted.

Repositories

CUZM = Cluster University Zoological Museum, Srinagar, Jammu and Kashmir, India
GCSI = Government Degree College, Shopian, Jammu and Kashmir, India
ZSI = Zoological Survey of India, Kolkata, India

Results

Taxonomic account

Phylum Arthropoda Latreille, 1829
Class Insecta Linnaeus, 1758
Order Diptera Linnaeus, 1758
Family Stratiomyidae Latreille, 1802
Subfamily Stratiomyinae Latreille, 1802

Genus *Stratiomys* Geoffroy, 1762
Figs 2–5

Diagnosis

Among the Stratiomyini, the Asian species of the genus *Stratiomys* are characterized by having holoptic eyes in males, dichoptic ones in females; elongate scape, which is more than three times as long as the pedicel, and the cross section of the flagellomeres are round and not oval-shaped; scutellum is with two prominent straight or curved spines; vein R_{2+3} arises distinctly beyond the anterior cross vein r-m; vein R_4 is present; medial veins (M) originate from the discal cell and curve anteriorly toward apex, ending before the wing margin (Rozkošný 1973, 1982; Nagatomi 1977; Nerudová *et al.* 2007).

Stratiomys approximata Brunetti, 1923
Figs 2–3

Stratiomyia approximata Brunetti, 1923: 115.

Diagnosis

Stratiomys approximata is diagnosed by having eye distinctly hairy, scutellar spines straight or slightly incurved, wing slightly brownish towards middle region, yellow angled spots at edges of abdomen on tergite II, III and IV not joining at middle, mostly black tibiae; black femur, and mostly yellow tarsi with apical 2 segments blackish brown. The species is somewhat similar to *S. barca*, which can be separated by having yellow spots on tergites joining at middle forming a narrow continuous band, and femur brown and tarsi black.

Material examined

Syntypes

INDIA • 1 ♂; NW Himalayas, Kashmir; 1915; H.T. Pease leg.; ZSI 3646/H2 • 1 ♀; NW Himalayas, Kashmir, Jhelum Valley; alt. 5200 ft; 7 Sep. 1915; H.T. Pease leg.; ZSI 3647/H2. Images match our specimens, but we have not examined the actual specimens.

Additional material

INDIA – **Jammu and Kashmir** • 2 ♂♂, 3 ♀♀; Dist. Baramulla, Watlab; 34°21'38" N, 74°31'29" E; alt. 1607 m; 10 Aug. 2020; S.F. Yattoo leg.; CUZMS_Yatool00007 to S_Yatool00011 • 1 ♂; Dist. Kupwara, Handwara, Bata Pora Magam; 34°22'44.8" N, 74°13'43.5" E; alt. 1680 m; 5 Sep. 2021; A. Maqbool leg.; CUZMA_Maqbool00012.

Redescription

MEASUREMENTS. Male (Fig. 2): body length, 11.7–12.2 mm; wing length, 9.8–9.9 mm; female (Fig. 3): body length, 11.9–12.5 mm; wing length, 9.6–10.6 mm.



Fig. 2. *Stratiomys approximata* Brunetti 1923, ♂ (CUZM S_Yatoo100007). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head, frontal view. **E.** Head, lateral view. **F.** Head, dorsal view. **G.** Antenna. **H.** Thorax, lateral view. **I.** Thorax, dorsal view. **J.** Scutellum. **K.** Wing. **L.** Abdomen, dorsal view. **M.** Abdomen, lateral view. **N.** Epandrium, proctiger and cerci, dorsal view. **O.** Terminalia, dorsal view. **P.** Terminalia, ventral view. Abbreviations: cerc = cercus; epand = epandrium; goncx = gonocoxite; goncx apod = gonocoxal apodeme; gonst = gonostylus; lt lb = lateral lobe; md lb = medial lobe; ph = phallus; prct = proctiger; synst = synsternite. Scale bars: A–C = 1.0 mm; D–M = 0.5 mm; N–P = 0.1 mm.

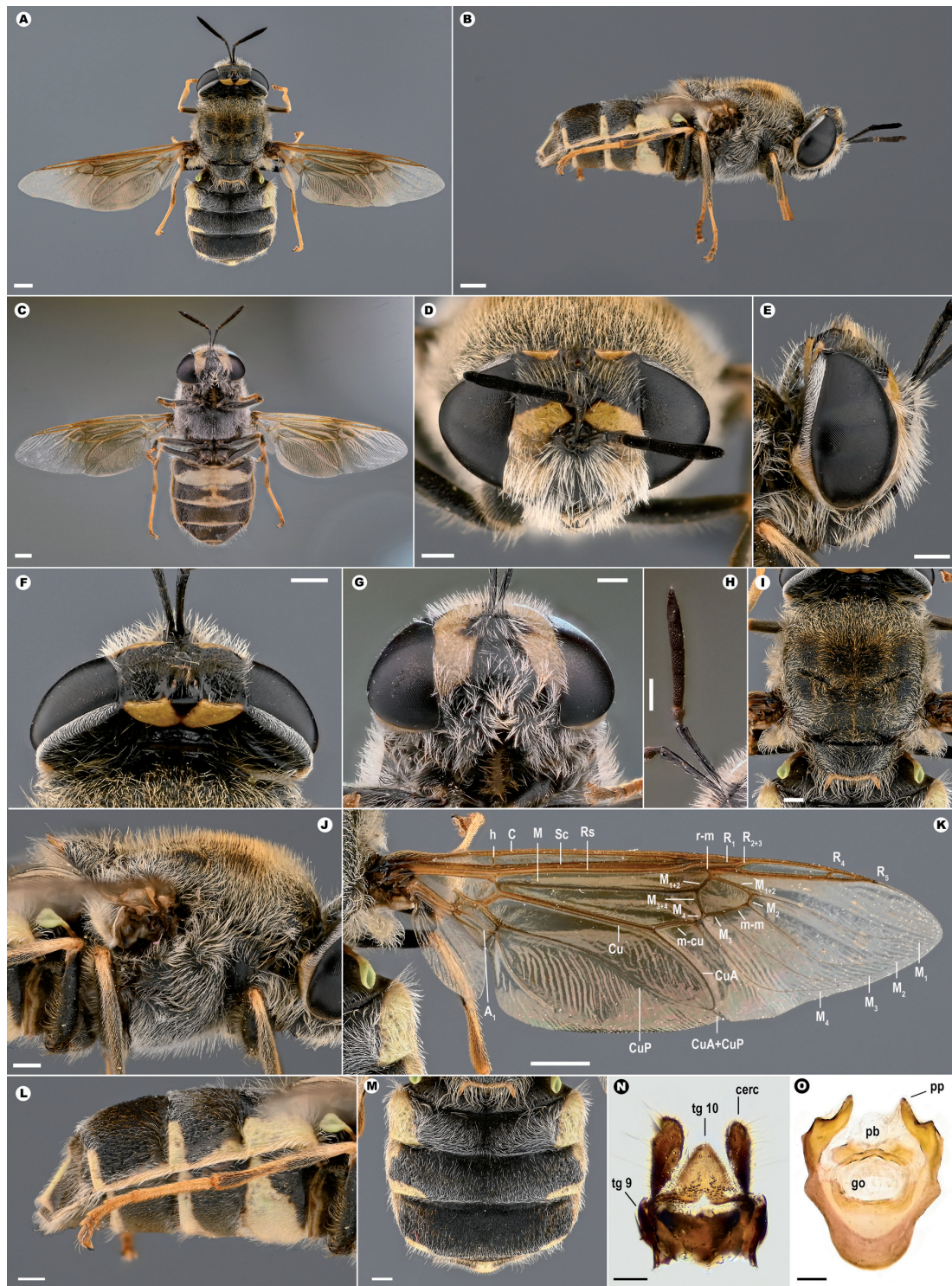


Fig. 3. *Stratiomys approximata* Brunetti 1923, ♀ (CUZM S_Yatoo100009). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head, frontal view. **E.** Head, lateral view. **F.** Head, dorsal view. **G.** Head, ventral view. **H.** Antenna. **I.** Thorax, dorsal view. **J.** Thorax, lateral view. **K.** Wing. **L.** Abdomen, lateral view. **M.** Abdomen, dorsal view. **N.** Terminalia, dorsal view. **O.** Genital fork, dorsal view. Abbreviations: cerc = cercus; go = genital opening; pb = posterior bridge; pp = posterolateral process; tg = tergite. Scale bars: A–C, K = 1.0 mm; D–J, L–M = 0.5 mm; N–O = 0.1 mm.

HEAD. Elliptical in anterior view, eyes distinctly hairy, antenna with 5 flagellomeres, black except for brownish pedicel and yellowish-brown base of 1st flagellomere, flagellum longer than scape and pedicel combined; area around antenna black (Fig. 2D–E); face black with two small yellow spots in male, near eye margin below base of antenna (Fig. 2C–E), much wider spots in female starting above antennal base and extending almost to lower margin of eye, leaving black pattern extending along frontal depression and continuing as broad medial stripe on face (Fig. 3D–G).

THORAX. Black with yellowish white dense and long pilosity (Fig. 2H–I); scutellum mostly black except for narrow yellow band along apical margin with two prominent spines (Fig. 2J); wing generally hyaline but slightly brownish towards middle region with brownish veins; veins M_1 , M_2 , M_3 and M_4 curved, ending before wing margin; vein r-m < M_2 (Figs 2K, 3K); legs mostly black with tarsus, base and apex of tibia yellow.

ABDOMEN. Black, broader than thorax with whitish yellow angled spots at edges of abdomen on tergite II, III and IV; spots on 2nd tergite wider (Fig. 2L–M); abdomen banded ventrally, sternites black with yellow margins, joined in middle forming a continuous yellow band from 2nd–4th sternite.

MALE TERMINALIA (Fig. 2N–P). Epandrium convex and semioval with emarginate anterior margin, transverse posteriorly, with short fine setae, denser towards lower and lateral margins and sparsely distributed towards centre; proctiger subtriangular with suboval cercus having posterior margin obliquely transverse, margins with large and small setae (Fig. 2N); in lateral view, cercus covering terminalia up to base of distal portion where aedeagal lobes are joined; synsternite triangular, with short and thick setae on middle portion and longer setae on lower middle and lateral margins; distal margin of synsternite arcuate medially, laterally produced into oval processes with round margin; gonostylus longer than wide, placed on distal third of synsternite, ending in short pointed edge; gonocoxal apodemes reaching up to anterior margin of genital capsule (Fig. 2O); phallus smooth, distinctly longer than genital capsule, tripartite distally, medial lobe distinctly shorter and wider than outwardly divergent lateral lobes (Fig. 2P); medial lobe arcuate terminally, lateral lobes pointed.

FEMALE TERMINALIA (Fig. 3N–O). Tergite 9 nearly rectangular, anterior margin sub-medially emarginate, creating nearly triangular process medially; tergite 10 strongly triangular, distal apex rounded; cerci ovate, narrow at base and wider towards apex (Fig. 3N); genital fork wide, anterior third more or less semicircular, narrower than posterior two-thirds; posterolateral process wider basally, narrower and strongly convergent towards apex; posterior bridge with shorter projections (Fig. 3O).

Distribution

China (Hankow, Shanghai), India (Kashmir), Pakistan (Jhelum Valley).

***Stratiomys brunettii* sp. nov.**

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Figs 4–5

Diagnosis

The new species appears distinct among its congeners in having upcurved scutellar spines nearly perpendicular to the body axis. The species is somewhat similar to the Oriental species *S. micropilosa* (Brunetti, 1920) but has upcurved scutellar spines nearly perpendicular to the body axis, all tibiae are nearly completely yellow, the postocular area is relatively expanded, and black sternites with wide yellow margins are joined laterally, as opposed to the scutellar spines not upright, all tibiae are nearly completely black, the postocular area is not expanded that much, the sternites are yellow-orange with lateral dark spots and no dark continuous bands in addition to the other characters stated below.

Etymology

This species is named in memory of Enrico Adelelmo Brunetti (1862–1927), for his valuable contributions to our knowledge of the systematics of the Indian Diptera.

Type material

Holotype

INDIA • ♂; Jammu and Kashmir, Dist. Kulgam, Kongwattan Meadow; 33°36'03" N, 74°46'50" E; alt. 2346 m; 28 Jul. 2020; A.A. Wachkoo leg.; GCSI A_Wachkoo00044.

Paratypes

INDIA – **Jammu and Kashmir** • 2 ♂♂, 1 ♀; Dist. Kulgam, Aharbal; 33°38'56" N, 74°46'55" E; alt. 2266 m; 18 Jun. 2021; A.A. Wachkoo leg.; GCSI A_Wachkool00045 to A_Wachkool00047 • 1 ♂; Dist. Baramulla, Gulmarg Nagbal; 34°03'09.5" N, 74°24'00" E; alt. 2697 m; 10 Aug. 2020; S.F. Yattoo leg.; CUZM S_Yatool00012 • 1 ♀; Dist. Baramulla, Ladi Angan; 34°13'47.02" N, 74°16'27.64" E; alt. 2274 m; 18 Aug. 2020; S.F. Yattoo leg.; CUZM S_Yatool00013 • 1 ♀; Dist. Baramulla, Rafiabad, Hamam Forest; 34°16'45" N, 74°11'35.03" E; alt. 2174 m; 15 Aug. 2021; A. Maqbool leg.; CUZM A_Maqbool00014.

Additional material

INDIA • 1 ♂; NW Himalayas, Kashmir, Sonamarg; alt. 9000 ft; 17–23 Jun. 1921; stn 7 Kashmir Survey Collection; ZSI 9824/H2 • 1 ♀; same collection data as for preceding; ZSI 9826/H2. Images match our specimens, but we have not examined the actual specimens.

Description

Male (Fig. 4)

MEASUREMENTS. Body length, 12.35–13.26 mm; wing length, 9.85–11.33 mm.

HEAD. Black, dorsally hemispherical, elliptical in anterior view, suboval in lateral view, ocellar triangle black (Fig. 4E–F); eye bare, facets markedly smaller in lower third; antenna long, black, flagellum with 5 flagellomeres, flagellum longer than scape and pedicel combined, apical flagellomere dull, relative lengths of scape : pedicel : flagellum = 3 : 1 : 5 (Fig. 4G); face smooth with fine punctations, rugulose in lower middle portion (Fig. 4D); oral margin broadly black with black colouration continuing on gena below eye; face with long whitish yellow pilosity; lower frons above antenna shiny black, finely punctate with long whitish yellow pilosity; median line between eyes with tuft of small black setae longer and brownish behind ocellar tubercle; vertex with brownish yellow pilosity (Fig. 4E–F); face yellow with broad median stripe, narrowing toward oral margin and there merging into black oral margin (Fig. 4C–E); postocular rim narrow, yellow and swollen in lower third; back of head mainly black only with some yellow from postocular rim continuing to back of head; occiput pilose (Fig. 4F).

THORAX. Entirely black and coarse with yellowish white, woolly pilosity (Fig. 4H); pilosity longer and denser on sides (Fig. 4I); scutellum mostly yellow with yellowish or brownish yellow upcurved scutellar spines nearly perpendicular to body axis (Fig. 4J); wing hyaline, large veins brownish with slightly bronze tinge, smaller veins dark brown; veins R4 and R5 ending well before wing apex; veins M₂, M₃ and M₄ curved, ending far before wing margin; vein r-m < M₂ (Figs 4K, 5K); lower calypter haired, with usual fan-like process.

LEGS. Bicoloured (Fig. 4C); coxa, trochanter and femur black, apical portion of femur, tibia and tarsus yellow; tarsal claws black with basal half yellow; yellowish white pilosity on legs, finer on tibia and tarsi, and longer on femur and trochanter.



Fig. 4. *Stratiomys brunettii* sp. nov., paratype, ♂ (GCSI A_Wachkoo100045). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head, frontal view. **E.** Head, lateral view. **F.** Head, dorsal view. **G.** Antennae. **H.** Thorax, lateral view. **I.** Thorax, dorsal view. **J.** Scutellum. **K.** Wing. **L.** Abdomen, dorsal view. **M.** Abdomen, lateral view. **N.** Epandrium, proctiger and cerci, dorsal view. **O.** Terminalia, dorsal view. **P.** Terminalia, ventral view. Abbreviations: cerc = cercus; epand = epandrium; goncx = gonocoxite; goncx apod = gonocoxal apodeme; gonst = gonostylus; lt lb = lateral lobe; md lb = medial lobe; ph = phallus; prct = proctiger; synst = synstenite. Scale bars: A–C = 1.0 mm; D–M = 0.5 mm; N–P = 0.1 mm.

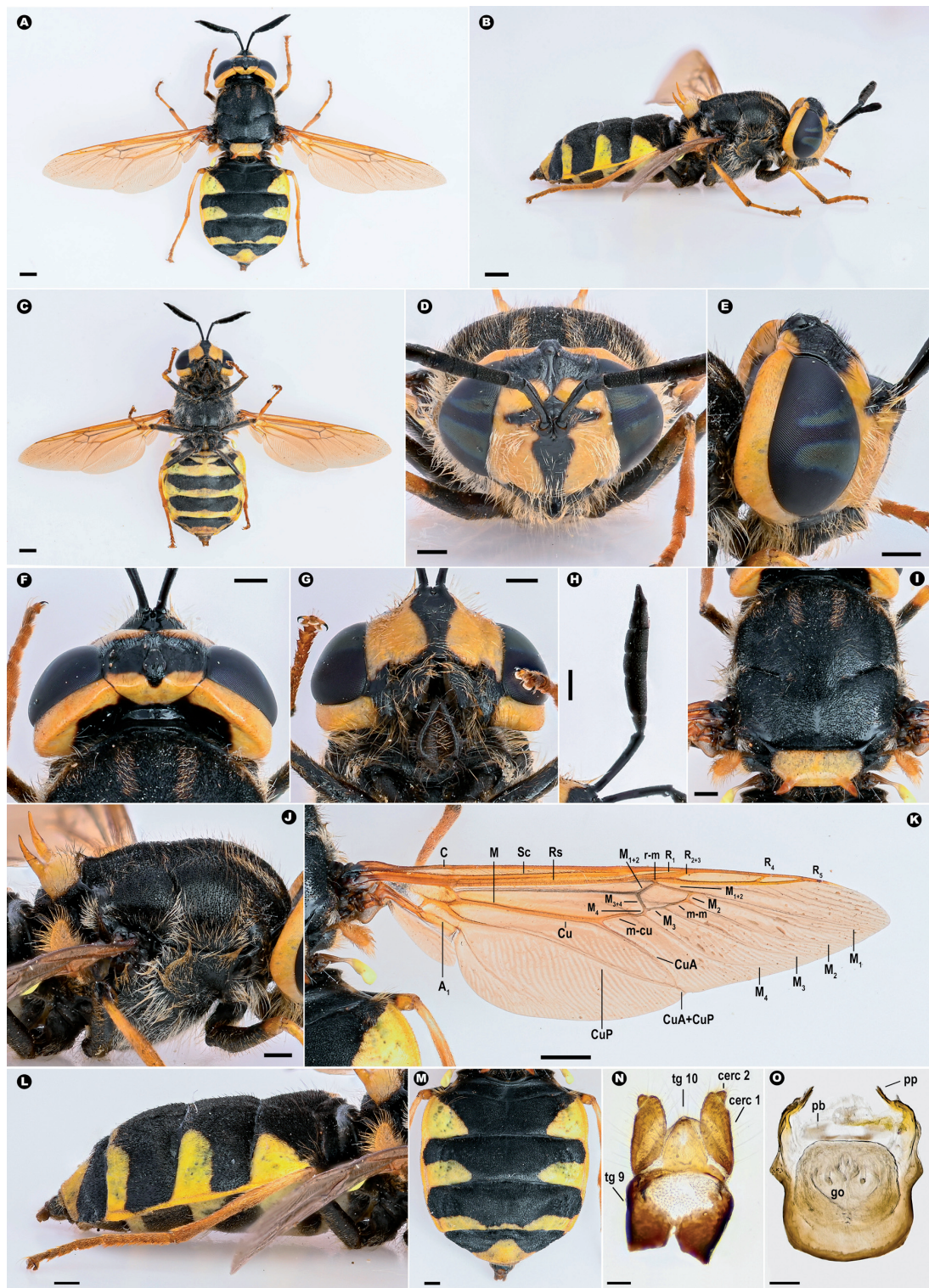


Fig. 5. *Stratiomys brunettii* sp. nov., paratype, ♀ (CUZM S_Yatoo100013). A. Habitus, dorsal view. B. Habitus, lateral view. C. Habitus, ventral view. D. Head, frontal view. E. Head, lateral view. F. Head, dorsal view. G. Head, ventral view. H. Antenna. I. Thorax, dorsal view. J. Thorax, lateral view. K. Wing. L. Abdomen, lateral view. M. Abdomen, dorsal view. N. Terminalia, dorsal view. O. Genital fork, dorsal view. Abbreviations: cerc = cercus; go = genital opening; pb = posterior bridge; pp = posterolateral process; tg = tergite. Scale bars: A–C, K = 1.0 mm; D–J, L–M = 0.5 mm; N–O = 0.1 mm.

ABDOMEN. Rounded, broader than thorax, predominantly black; angled pale yellow spots at edges of abdomen (Fig. 4L–M); wider spots on II and III tergite, narrow posterior-lateral spots on tergite IV, lateral margins of tergite II–IV yellow; narrow longitudinal medial stripe on tergite V not reaching anterior margin and partly extending along posterior margin; abdomen mostly black ventrally with yellow bands, black sternites with wide yellow margins joined laterally; longer brownish yellow pilosity on tergites, finer, whitish pilosity on sternites.

MALE TERMINALIA (Fig. 4N–P). Epandrium convex and semioval, posterior margin obtuse, arcuate anteriorly with short fine setae, denser towards lower and lateral margins and sparsely distributed towards centre (Fig. 4N); proctiger resembling low triangle with subquadrangular cercus having posterior margin obliquely transverse with slightly produced posteromedial lobe, margins with large and small setae; cercus totally covering terminalia in lateral view; synsternite subquadrate, with short and thick setae on middle portion and longer setae on lower middle and lateral margins; distal margin of synsternite medially obtuse, laterally produced into oval processes with round margin; gonostylus longer than wide, placed on distal third of synsternite, ending in two pointed edges, one smaller and short pointed edge and a longer gradually tapering pointed edge; gonocoxal apodemes reaching beyond anterior margin of genital capsule (Fig. 4O); phallus smooth, tripartite and slightly longer than genital capsule, lobes dilated in distal third, distinctly narrowing in apical one third; lateral lobes slightly incurved, medial lobe straight and shorter than lateral lobes (Fig. 4O–P).

Female (Fig. 5)

MEASUREMENTS. Body length, 12.60–13.7 mm; wing length, 10.85–11.9 mm.

Differs from male in the following aspects: body pilosity less dense than male (Fig. 5A–C); frons broad and black with two yellow spots extending towards middle but not joined (Fig. 5D); vertex wide and prominent, with areas densely covered with short black pilosity; area around base of antenna black, black pattern narrowly extending along frontal depression and continuing as broad medial stripe on face (Fig. 5D, G); oral margin broadly black with black colouration continuing on gena below eye (Fig. 5G); postocular rim contrasting yellow and continuing on posteroventral margin of eye; median occipital sclerite with large yellow spots (joined in most specimens); occiput yellow smooth with fine yellow pilosity (Fig. 5F); scutellar spines pale yellow with brownish apical region (Fig. 5I–J); pale yellow abdominal spots on tergite III (Fig. 5L–M) slightly narrower than in male, spots on tergite IV joined in the middle forming continuous band.

FEMALE TERMINALIA (Fig. 5N–O). Tergite 9 nearly square-shaped, emarginate base with deep notch medially; cercus 2 very small, appearing as bud on cercus 1 (Fig. 5N); tergite 10 triangular, distal apex rounded; genital fork nearly uniformly wide, with slightly arcuate anterior margin; posterior bridge without projections; posterolateral process wider basally, narrower and strongly convergent towards apex (Fig. 5O).

Distribution

India (Kashmir).

Key to the Indian species of *Stratiomys* Geoffroy, 1762

1. Eye distinctly hairy; scutellar spines straight or slightly incurved (Fig. 2J); wing slightly brownish towards middle region; tibiae mostly black; phallus distinctly longer than genital capsule, tripartite distally, medial lobe distinctly shorter and wider than outwardly divergent lateral lobes (Fig. 2N–P) *S. approximata* Brunetti, 1923
- Eye bare; scutellar spines upcurved nearly perpendicular to the body axis (Fig. 4J); wing hyaline; tibiae mostly yellow (Fig. 4C); phallus slightly longer than genital capsule, tripartite and lobes dilated in distal third, distinctly narrowing in apical one third; lateral lobes slightly incurved, medial lobe straight and shorter than lateral lobes (Fig. 4O–P) *S. brunettii* sp. nov.

Discussion

The identity of *S. kashmirensis* is clarified and the specimens of this unpublished name deposited at ZSI are described herein as a new species, *S. brunettii* sp. nov. *Stratiomys* is mainly Holarctic with more species in colder climates. The species of *Stratiomys* are not often found in the tropics or subtropics. The two presently recorded species in the India are distributed in the Kashmir Himalayas characterized with a mixture of Palaearctic and Indomalayan insect faunal elements (Das 1966; Shah *et al.* 2014; Zubair *et al.* 2021). Therefore, the distribution of *Stratiomys* in India is not surprising, and the known habitats of the Indian species accord well with previous accounts of species' ecology within the genus from temperate regions.

Acknowledgements

We thank the subject editor, Torbjørn Ekrem, and the two anonymous reviewers for their insightful comments. We are much indebted to Martin Hauser (Department of Food and Agriculture, California) and Diego Aguilar Fachin (Universidade de São Paulo, Brazil) for their discussions and comments on the identification of the Indian *Stratiomys*. We also thank Jessica Hunter (Imperial College London, United Kingdom) for the language editing. SFY is grateful to Mansoor Ahmad Ganaie (Forest Department, Jammu and Kashmir) for facilitating collection trips to the northern forest ranges of Kashmir.

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Manuscript received: 24 January 2023

Manuscript accepted: 31 July 2023

Published on: 30 November 2023

Topic editor: Tony Robillard

Section editor: Torbjørn Ekrem

Desk editor: Pepe Fernández

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Band/Volume: [0910](#)

Autor(en)/Author(s): Yatoo Suhaib Firdous, Maqbool Amir, Wachkoo Aljaz Ahmad

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