J. Insect Biodivers. Syst. 11 (4), 1027–1038 *https://jibs.modares.ac.ir*

OPEN ACCESS

Tarbiat Modares University Press | Research Article | https://doi.org/10.48311/jibs.11.4.1027 | **ISSN**: 2423-8112
Entomological Society of Iran | Taxonomy | *https://zoobank.org/urn:lsid:zoobank.org:3A9CD52A-70EE-4497-8D78-610D5C629F6C*

A brief review of the genus *Stegana* Meigen, 1830 (Diptera: Drosophilidae) from India, with description of a new species and an updated identification key

Pradeep Chandra Sati
Fly Lab. Department of Zoology, Faculty of Science, University of Allahabad (A Central University, Prayagraj- 211002, UP, India. ✉ *drpcsati@alluniv.ac.in* *https://orcid.org/0000-0001-6809-8575*

Mukul Kandpal
Cytogenetics Laboratory, Department of Zoology, Kumaun University, Nainital, Uttarakhand, India. ✉ *mukul83.ntl@gmail.com* *https://orcid.org/0009-0003-6122-6548*

Rajendra Singh Fartyal
Fruit Fly Lab, Department of Zoology, HNB Garhwal University (A Central University), Srinagar- Garhwal, Chauras Campus–249161, Uttarakhand, India. ✉ *fartyalrs@gmail.com* *https://orcid.org/0000-0002-8844-6263*

Kumari Asha
Fruit Fly Lab, Department of Zoology, HNB Garhwal University (A Central University), Srinagar- Garhwal, Chauras Campus–249161, Uttarakhand, India. ✉ *ashabhardwajrmp@gmail.com* *https://orcid.org/0000-0001-8277-2773*

Sonali Khali
Fruit Fly Lab, Department of Zoology, HNB Garhwal University (A Central University), Srinagar- Garhwal, Chauras Campus–249161, Uttarakhand, India. ✉ *sonalikhali14@gmail.com* *https://orcid.org/0000-0001-6860-7560*

Sushmika Pradhan
Department of Zoology, Ananda Chandra College, Jalpaiguri- 735101, West Bengal, India. ✉ *sushmika.pradhan@gmail.com* *https://orcid.org/0009-0007-4933-7383*

Durga Rawat
Fruit Fly Lab, Department of Zoology, HNB Garhwal University (A Central University), Srinagar- Garhwal, Chauras Campus–249161, Uttarakhand, India. ✉ *durgarawat705@gmail.com* *https://orcid.org/0009-0007-7672-5584*

ABSTRACT. This study presents a brief review of the genus *Stegana* Meigen (Diptera: Drosophilidae: Steganinae) from India, emphasizing its diversity and ecological significance within the Dipteran fauna. Through detailed morphological examination, we describe here a new species, *Stegana* (*Oxyphortica*) *minuta* Kandpal, Sati & Fartyal **sp. nov.**, from Ayarpatta, Nainital, Uttarakhand. The new species is described, and diagnostic characters are illustrated, along with a key to all six species of *Stegana* known from India. The discovery of a new species further enriches knowledge of the region's insect fauna. Based on a synthesis of existing records, India is estimated to harbor approximately 363 drosophilid species across 27 genera. This remarkable diversity reinforces the Indian subcontinent's status as a crucial center for drosophilid biodiversity.

Keywords: Dichotomous key, fruit flies, new species, *Oxyphortica*, Uttarakhand

Received: *May 25, 2025*

Accepted: *September 05, 2025*

Published *September 26, 2025*

Subject Editor: *Babak Gharali*

Citation: Sati, P.C., Kandpal, M., Fartyal, R.S., Asha, K., Khali, S., Pradhan, S. & Rawat, D. (2025) A brief review of the genus *Stegana* Meigen, 1830 (Diptera: Drosophilidae) from India, with description of a new species and an updated identification key. *Journal of Insect Biodiversity and Systematics*, 11 (4), 1027–1038.

INTRODUCTION

According to Gupta (2005), over 290 drosophilid species were documented across India, with the monograph providing comprehensive coverage of taxonomy, ecology, and distribution while highlighting biodiversity hotspots such as the Himalayas, Northeast India, and the Western Ghats. A checklist by Sati

Corresponding author: Rajendra Singh Fartyal, ✉ *fartyalrs@gmail.com*

et al. (2013) reported 94 species from Uttarakhand; this checklist, organized into two subfamilies and 16 genera, included several new regional records, and emphasized Uttarakhand's significant role in India's drosophilid diversity, serving as a key reference for further ecological and taxonomic studies. Subsequent research (Sarswat et al., 2016b; Fartyal et al., 2017, 2023; Toda et al., 2020; Khan et al., 2022; Bächli, 2025; Rawat et al., 2025), along with unpublished data from our laboratory, has expanded India's known drosophilid fauna to approximately 363 species across 27 genera. Together, these works provide a strong foundation for ongoing research in drosophilid taxonomy, ecology, and conservation in India.

The established evolutionary taxonomy based on morphological features of the Drosophilidae Rondani family has been questioned by recent molecular research worldwide (Yassin, 2013). Steganinae Hendel (30 genera) and Drosophilinae Rondani (43 genera) are the two subfamilies of the Drosophilidae family. Okada (1989) divided the family Drosophilidae into two subfamilies- Drosophilinae Rondani and Steganinae Hendel, based on 14 morphological characters. Of the seven tribes proposed, Steganini and Leucophengini belong to the subfamily Steganinae, while the remaining five tribes, Microdrosophilini, Hypselothyrini, Colocasiomyini, Dettopsomyini, and Drosophilini are classified under the subfamily Drosophilinae. After a year, Grimaldi (1990) revised this classification, establishing the present Drosophilidae family-group classification based on a cladistic assessment of 217 morphological traits (Yassin, 2013), in which Drosophilinae is extensive, with approximately 3,431 species, while Steganinae has about 1,190 species worldwide. There are 29 genera in the Steganinae, of which the genus *Stegana* is the largest with 334 species. Other noticeable large genera are *Leucophenga* Mik, 1886 (269 spp.), *Amiota* Loew, 1862 (191 spp.), and *Phortica* Schiner, 1862 (157 spp.), while the genera *Pseudocacoxenus* Duda, 1925, *Electrophortica* Hennig, 1965, *Paraphortica* Duda, 1934, *Soederbomia* Hendel, 1938, *Trachyleucophenga* Hendel, 1917, *Mayagueza* Wheeler, 1960, and *Erima* Kertesz, 1899 are represented by only one species each. The genus *Pyrgometopa* Kertész, 1901 is considered incertae sedis (Pirani & Grimaldi, 2019)

During this study, a new species of the genus *Stegana* Meigen is described and illustrated from Uttarakhand. This finding represents the subgenus *Oxyphortica* from India for the first time.

MATERIAL AND METHODS

Specimens were collected using the net sweeping during the months of August and September from bushy plants in open forest areas in Himachal Pradesh and Uttarakhand, India. The external morphology of adult male flies was examined under a stereo-zoom microscope, and metric characters were measured with an ocular micrometre. To examine the detailed structures of the head, mouthparts, abdominal sternites, and male terminalia, respective organs were dissected, cleared by warming in 10% KOH solution around 100°C for 15 minutes, and observed in a droplet of glycerol on a cavity slide under a light microscope. The dissected parts were photographed using a DinoLite® Digital Eyepiece Camera. The morphological terminology and the definitions of measurements and indices mostly follow Okada (1980); McAlpine (1981); Zhang & Toda (1992); Hu & Toda (2001); Rice et al. (2019); Toda et al. (2020); and McQueen et al. (2022). The type materials are deposited in the following collections: Holotype and 5♂♂, 5♀♀ paratypes in the Department of Zoology, H.N.B. Garhwal University, Srinagar, Uttarakhand, India (DZHNBGU), and 1♂ paratypes in the Museum of Zoological Survey of India, Kolkata (ZSI).

RESULTS

Taxonomic hierarchy

Class Insecta Linnaeus, 1758

Order Diptera Linnaeus, 1758

Family Drosophilidae Rondani, 1856

Genus *Stegana* Meigen, 1830

Stegana Meigen, 1830:79; Wheeler, 1960:109; Okada, 1989:391. **Type species.** *Stegana nigra* Meigen, 1830.

Diagnosis. Head setae are generally thick and long, but the postocellar setae are thinner and, in some species, minute or absent. Mid tibia has a basal posterodorsal row of 3–5 erect setae or stout bristles,

followed distally by a row of shorter, less erect setae. Ac-index is greater than 4.0. wing not maculated and, in most species, conspicuously bent downward at rest, generally dark brown, particularly along the costa. Carina is undeveloped. Arista is usually plumose. The discal and second basal cells are separated (Okada, 1989; Toda & Peng, 1992; Vilela & Bächli, 2020).

I. Subgenus *Stegana* Meigen, 1830

Diagnosis. Face nearly unicolorous; frons and face form an obtuse angle in profile. Palpus large and entirely black. Scutellum nearly flat with marginal ridges. Mid tibia with four to six small setae on the dorsal surface at the base. Prescutellars well developed; postocellar seta present. Wings largely black and curved downward at rest. Abdominal tergites mostly dark brown to black. Postgena broad; frons and face form an obtuse angle. Postverticals present; posterior reclinate orbital seta closer to the inner vertical than to the proclinate orbital. Frontal triangle obscure. Surstylus anterodorsally fused with the epandrium (Okada, 1978; Zhang et al., 2014).

Stegana crescentica Gupta & Panigrahy, 1987

Stegana (*Stegana*) *crescentica* Gupta & Panigrahy, 1987:60.

Material. not examined.

Distribution. India.

II. Subgenus *Steganina* Wheeler, 1960

Steganina Wheeler, 1960:110; Okada, 1978:392. **Type species.** *Musca coleoptrata* Scopoli, 1763.

Diagnosis. Face with black and white bands; frons and face rectangular in profile. Palpus, mostly slender and yellow, sometimes black distally. The maximum diameter of the eye oblique to the body axis. Postgena broad; wings curved downward in resting posture. Scutellum nearly flat, with marginal ridges. Wings largely black or almost entirely dark fuscous; mid tibia with a few strong bristles proximally on the dorsal side. Surstylus anterodorsally separated from epandrium (Okada, 1978; Toda & Peng, 1992; Zhang et al., 2014).

Stegana nainitalensis Singh & Fartyal, 2002

Stegana (*Steganina*) *nainitalensis* Singh & Fartyal, 2002:16.

Material. not examined.

Distribution. India (Uttar Pradesh).

Stegana penihexata Gupta & Panigrahy, 1987

Steganina (*Steganina*) *penihexata* Gupta & Panigrahy, 1987:61.

Material. not examined.

Distribution. India.

Stegana shirozui Okada, 1971

Stegana (*Steganina*) *shirozui* Okada, 1971:84; Singh & Gupta, 1981:200.

Material. not examined.

Distribution. Taiwan, India (West Bengal).

Stegana subexcavata Vaidya & Godbole, 1976

Stegana (*Steganina*) *subexcavata* Vaidya & Godbole, 1976:88.; *Stegana subexcavata*: Vaidya & Godbole, 1977:55.

Material. not examined.

Distribution. India.

III. Subgenus *Oxyphortica* Duda, 1923

Diagnosis. Face nearly unicolorous; frons and face forming an obtuse angle in profile. *M* distally weakly curved forward. Maximum diameter of the eye perpendicular to the body axis; postgena narrow, linear. Wing not curved downward in resting posture and nearly entirely dark fuscous. Scutellum flat, with marginal ridges; mid tibia with a few strong bristles proximally on the dorsal side. Prescutellars well developed (Okada, 1978; Toda & Peng, 1992).

Stegana (*Oxyphortica*) *minuta* Kandpal, Sati & Fartyal sp. nov. (Figs 1–3)

Stegana minuta in Sarswat et al., 2016a:357, *nomen nudum* [India].

https://zoobank.org/urn:lsid:zoobank.org:act:6294ef45-4ef4-4fdb-901e-e582a80d6ece

Type materials. **Holotype** ♂ (DZHNBGU), India, Uttarakhand, Kumaon, Nainital, Ayarpatta; 29°22'49.4"N, 79°26'56.0"E; 2,200 m a.s.l.; 20–23 Aug. 2009; Mukul Kandpal leg.; **Paratypes** (DZHNBGU)**:** 5♂♂, 5♀♀, India, same collection data as for holotype; 5♂♂, 11♀♀; Himachal Pradesh, Shimla, Sungari-Bahli Forest; 31°04'59"N, 77°32'53"E; 2290 m a.s.l.; Aug.–Sept. 2016; Asha leg.; 2♂♂, 1♀, Uttarakhand, Garhwal, Rudraprayag, Sanband; 30°19'09"N, 78°56'47"E; 1,200 m a.s.l.; 18–20 Aug. 2020; Khali leg. A single male in ZSI on 30/05/2022.

Etymology. The Latin word "minuta" refers to the small aedeagus (phallus).

Diagnosis. Ocellar triangle black with a pair of tiny setae on the dorsal margin. Scutum and scutellum yellowish brown; pleura yellow with a broad dark longitudinal stripe below wing base. Acrostichal setulae arranged in about 10 irregular rows. Three katepisternal setae present, with the middle one small. Surstylus with 2 stouts, peg-like Prensisetae at the dorsal, lower corner (Fig. 2B). Aedeagus small plate, narrower than the basal portion of the apodeme, slightly concave on apical margin, without a few serrations on basolateral margins but not on ventral surface (Fig. 2C). Gonopods fused, generating a heavily serrated median plate that was roughly triangular in ventral view (Fig. 2C–D). Oviscapt with stout pegs somewhat irregular in shape on the mediocaudal portion of the dorsal surface (Fig. 3C).

Description. — **Male** (holotype).

Head (Fig. 1A–E)**.** Vertex ridged to occiput, without postocellar setae. Supracervical setae are nearly straight, apically blunt, 15–17 per side. Occiput glossy, dark brown, with 2 sets of occipital setae: an upper set of approximately 6 arranged in an oblique row and a lower set of minute 4–5 per side; postocular setae 16–20 per side (Fig. 1B). In addition to ocellar setae, the ocellar triangle black with a pair of tiny setae on the dorsal margin. Gena is light brownish yellow. 1st flagellomere brownish yellow; arista with 6–7 dorsal and 4–5 ventral branches and a small, terminal fork. Face light brownish yellow; Carina is narrow, low, and short. Clypeus light brownish yellow and narrower than the palpus. Palpus with 8–9 long setae on the subapical to lateral margin (Fig. 1E). Cibarium oval in dorsal view, nearly flat in lateral view, not thickened on anterior margin; anterolateral corners somewhat knobbed but not projected; anterior sensilla 4, arranged in longitudinal row; medial sensilla minute, approximately 9–12 per side, arranged in submedially convergent, somewhat irregular rows; sensilla campaniformia 2 per side; posterior sensilla trichoid, gently curved forward, 12–15 per side, arranged in anteriorly divergent rows (Fig. 1A). Prementum pubescent basally and distally, with 1 pair of long and 2 pairs of short setae on the distal surface and 2 or 3 setae per side on the lateral margin (Fig. 1A). Lateral membrane of proboscis pubescent. Labellum with 5 pseudotracheae per side; the most posterior one is narrower than the others (Fig. 1B).

Thorax. Scutum, scutellum yellowish brown; pleura yellow, with a distinct, broad, dark brown, longitudinal stripe below the wing base. Postpronotal lobe whitish and yellow, with 1 prominent setula and 14–15 setulae. Subscutellum is not developed—acrostichal setulae in approximately 10 irregular rows. A pair of prescutellar setae present. Basal scutellar setae divergent; apical scutellar setae cruciate. Katepisternal setae 3; mid one small. Wings are dark brown anteriorly and brown posteriorly. Veins dark brown; crossveins clear; *bm-cu* crossvein present; R_{2+3} slightly curved to the costa at tip; M_1 distally gently curved forward, thus convergent to R_{4+5}. C_1 subequal C_2. Costal vein with 4–5 small warts between R_{2+3} and R_{4+5} on the underside. Halter white in the knob, greyish brown in the stalk.

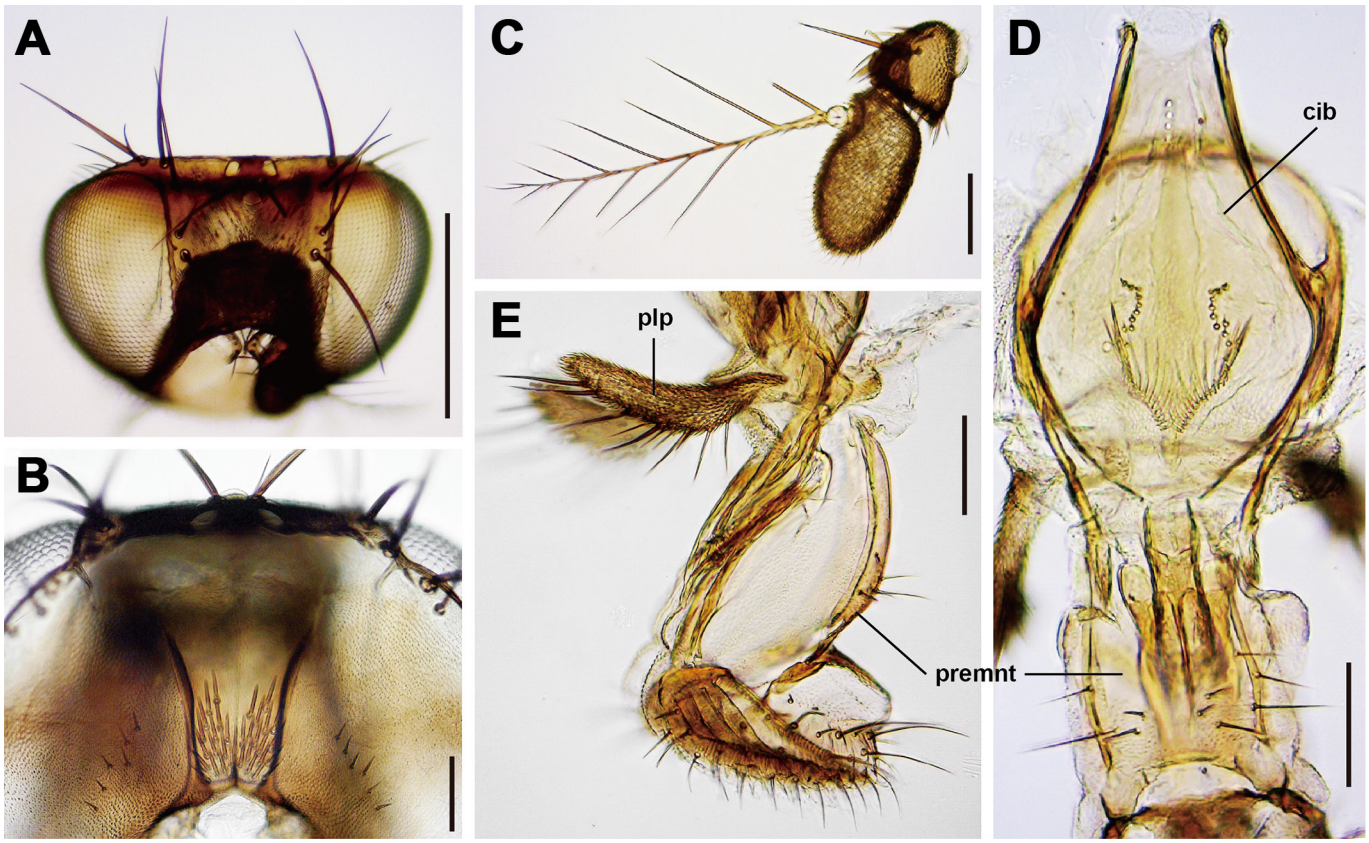

Figure 1. Head of *Stegana* (*Oxyphortica*) *minuta* **sp. nov.** ♂. **A.** Head (dorso-frontal view); **B.** Occiput (caudal view); **C.** Antenna; **D.** Mouth parts (dorsocaudal view); **E.** Proboscis (lateral view). Abbreviations: *cib*, cibarium; *plp*, palpus; *premnt*, prementum. Scale bars: 0.5 mm in A; 0.1 mm in B–E.

Legs are entirely pale yellow. Fore femur with approximately 13–14 long setae in 2 rows on the lateral surface. Preapical dorsal setae present on all tibiae; apical ventral setae on fore- and mid-tibiae. Mid tibia basally with 2 long, strong setae on the dorsal surface. Fore tarsus with long hairs along antero-inner margin. Mid- and hind tarsi ventrally with 2 and 1 row(s) of minute cuneiform setulae, respectively. Fore- and hind-tarsomere is as long as tarsomeres II, III, and IV combined; midleg tarsomere I is as long as the rest of the tarsomeres combined.

Abdomen. Tergites I to IV laterally dark greyish brown, medially pale greyish yellow; V dark greyish brown, anteromedially with a pale greyish yellow patch; VI entirely dark greyish brown; setae on the posterior margin of each tergite longer than others. Sternites greyish yellow and darker in posterior ones; Sternite VI twice as wide as long, with 2 stout, long setae on the lateral margin.

Terminalia (Fig. 2A–D)**.** Epandrium broad, nearly entirely pubescent except for anterior to ventral margin, with 5–6 long setae per side near posterior margin and 14–16 setae on the lateral to ventral portion (Fig. 2A). Surstylus somewhat crescent, ventrally narrowing and curved inward, with many fine setae along the posterior margin and on the inner surface and apical portion (Fig. 2B). Tenth sternite narrow transverse, with a narrow plate connecting the surstyli. Cercus narrow, separated from the epandrium, with 25–30 setae (Fig. 2A). The membrane between the epandrium and cercus not pubescent (Fig. 2A). The hypandrium plate as broad as long and roundish on the anterior margin, posterolaterally with narrow arms apically articulated to gonopods (Fig. 2C–D). Paramereis small, club-shaped, apically with 1 sensillum, and fused to an aedeagal guide (Fig. 2C–D). Aedeagal apodeme fused to aedeagus, proximally dilated, distally rod-like (Fig. 2C–D).

Measurements. (holotype + 5♂♂ paratypes, in mm). *BL* = 2.52/2.48–2.96, *ThL* = 1.30/0.93–1.33, *WL* = 2.33/1.89–2.63, *WW* = 1.33/1.07–1.33.

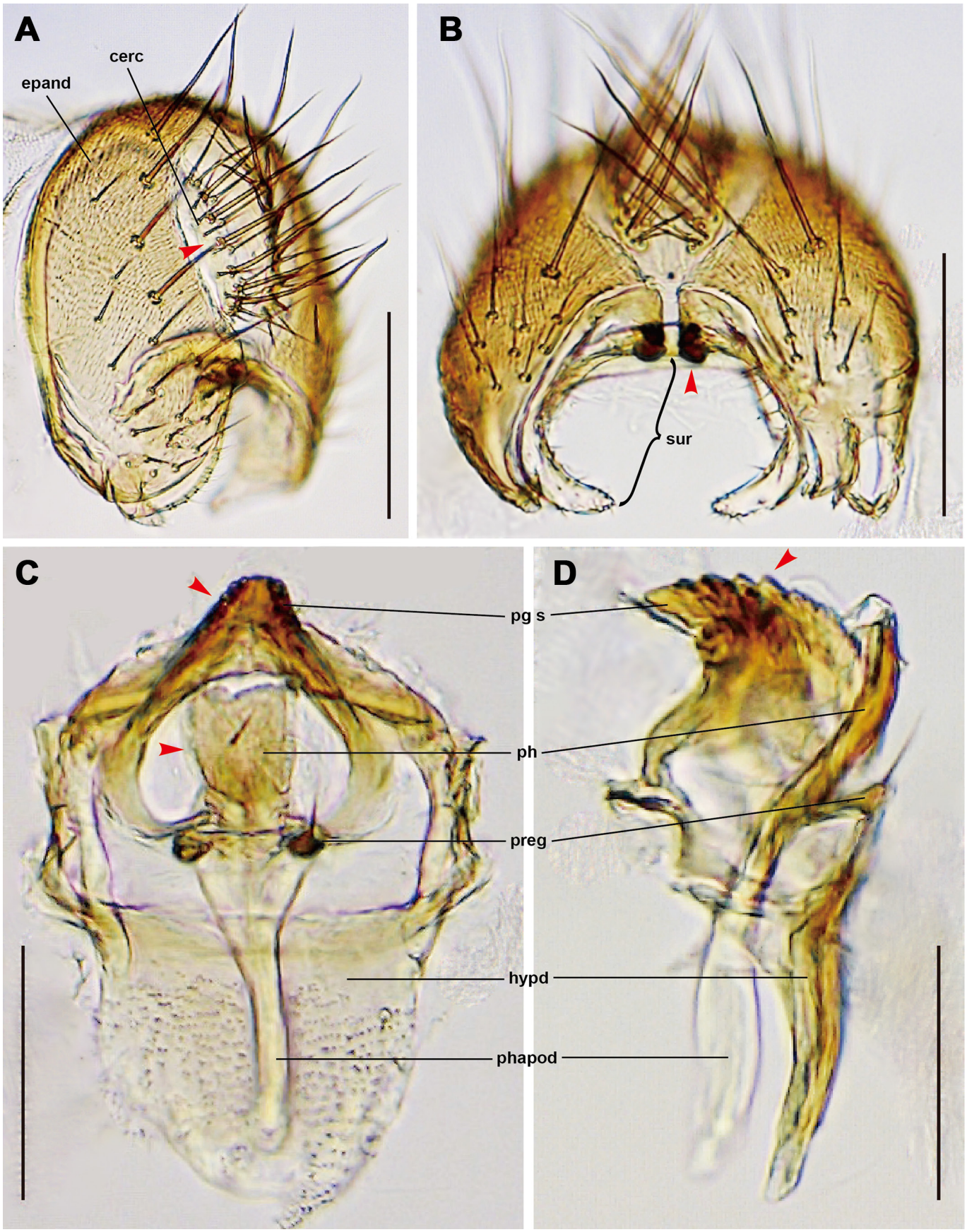

Figure 2. Male terminalia of *Stegana* (*Oxyphortica*) *minuta* **sp. nov. A.** Periphallic organs, caudo-lateral view; **B.** ditto, caudo-ventral view; **C.** Phallic organs, ventral view; **D.** ditto, lateral view. Abbreviations: *cerc*, cercus; *epand*, epandrium; *hypd*, hypandrium; *pgs*, postgonal sheath; *ph*, phallus (aedeagus); *phapod*, phallapodeme; *pregt*, pregonite; *sur*, surstylus. Scale bars: 0.1 mm.

Indices (holotype + 5 ♂♂ paratypes). *FW/HW* = 0.50/0.43–0.57, *ch/o* = 0.17/0.17–0.25, *prorb* = 1.14/1.08–1.21, *rcorb* = 0.71/0.67–0.92, *orbito* = 2.00/2.00–2.22, *vb* = 0.67/0.48–0.67, *dcl* = 0.25/0.25–0.50, *dcp* = 0.17/0.16–0.29, *presctl* = 0.38/0.27–0.58, *sctl* = 1.50/1.38–1.57, *sctlp* = 2.00/1.00–1.67 *sterno* = 1.20/0.78–1.25, *C* = 2.63/2.48–2.86, *4c* = 0.80/0.78–0.81, *4v* = 1.30/1.30–1.68, *5x* = 1.80/1.38–1.80, *ac* = 8.00/7.00–10.67, M = 0.45/0.45–0.56, C_3F = 0.67/0.69–0.81.

Female. The head, thorax, and wing are the same as in males.

Legs. Foreleg tarsus without long hairs along antero-inner margin.

Terminalia (Fig. 3A–D). Tergite VIII small, dark brown except for the pale dorsal portion, pubescent only on the dorsocaudal portion, with 2 small setae per side on the subdorsal, posterior margin. Epiproct, hypoproct, and cerci nearly entirely pubescent and setigerous; cerci are basally fused to epiproct (Fig. 3A–B). Oviscapt sternite-like plate, proximally less chitinized but distally brown, with several longitudinal wrinkles laterally (Fig. 3C). Spermathecal dark brown and fusiform, with discoloured appendages apically and numerous, with minute barbs on the outer surface, but not a basal introvert (Fig. 3D).

Measurements (range in 5 ♀♀ paratypes, in mm). *BL* = 2.99–3.44, *ThL* = 1.15–1.26, *WL* = 2.33–2.96, *WW* = 1.18–1.41.

Indices (range in 5 ♀♀ paratypes). *FW/HW* = 0.42–0.57, *ch/o* = 0.13–0.25, *prorb* = 1.09–1.40, *rcorb* = 0.79–0.90, *orbito* = 1.90–2.22, *vb* = 0.40–0.63, *dcl* = 0.42–0.61, *dcp* = 0.33, *presctl* = 0.46–0.51, *sctl* = 1.01–1.33, *sctlp* = 1.10–1.38, *sterno* = 0.78–1.01, *C* = 2.56–2.94, *4c* = 0.77–0.86, *4v* = 1.64–1.71, *5x* = 1.13–1.43, *ac* = 5.67–7.20, *M* = 0.42–0.50, C_3F = 0.71–0.80.

Distribution. India (Uttarakhand, Himachal Pradesh).

Remarks. This species resembles *Stegana* (*Oxyphortica*) *enigma* Sidorenko, 1998, in having the horizontally flattened, plate-like aedeagus, the crescent surstylus, and the small, club-shaped paramere, but can be clearly distinguished from it by the diagnostic characters in *S. enigma*, cercus pubescent dorsally to medially, aedeagus wider than aedeagal apodeme and with many serrations on the ventral surface, and oviscapt with 3–4 irregular rows of tooth-shaped spinules caudally (see "fig. 4–9" in Sidorenko, 1998).

Key to Indian species of genus *Stegana* Meigen, 1830

During the preparation of the key, we followed the original published literature related to *Stegana* species reported from India (Okada, 1971; Vaidya & Godbole, 1976; Gupta & Panigrahy, 1987; Singh & Fartyal, 2002)

1	Legs entirely pale yellow; wings distinctly darker anteriorly and pale posteriorly; surstylus crescent-shaped with fine setae. ..... ***Stegana minuta* Kandpal, Sati & Fartyal sp. nov.**
—	Legs not entirely pale yellow; wing not sharply bicolored; surstylus not crescent-shaped. **2**
2	Abdominal tergites yellowish with narrow uninterrupted dark bands; surstylus hammer-shaped and pointed downward; aedeagus rounded and densely haired at tip. .... ***Stegana nainitalensis* Singh & Fartyal, 2002**
—	Abdomen dark or uniformly colored; surstylus of other shape; aedeagus different. **3**
3	Aedeagus subapically swollen; basal apodeme of aedeagus twice as long as aedeagus; surstylus narrow with fine setae. ..... ***Stegana crescentica* Gupta & Panigrahy, 1987**
—	Aedeagus not subapically swollen; basal apodeme shorter or fused; surstylus different. **4**
4	Aedeagus hexagonal; basal apodeme one-fourth the length of aedeagus; surstylus broad and rounded with two rows of setae along outer margins. ..... ***Stegana penihexata* Gupta & Panigrahy, 1987**
—	Aedeagus rod-shaped or slender. **5**
5	Aedeagus rod-shaped with an apical crown of hairs; surstylus with a minute serrated process on the outer surface and a row of *prensi* setae distomedially. ..... ***Stegana shirozui* Okada, 1971**
—	Aedeagus slender apically; surstylus short and pointed; scutum with a broad dark longitudinal band. .....***Stegana subexcavata* Vaidya & Godbole, 1976**

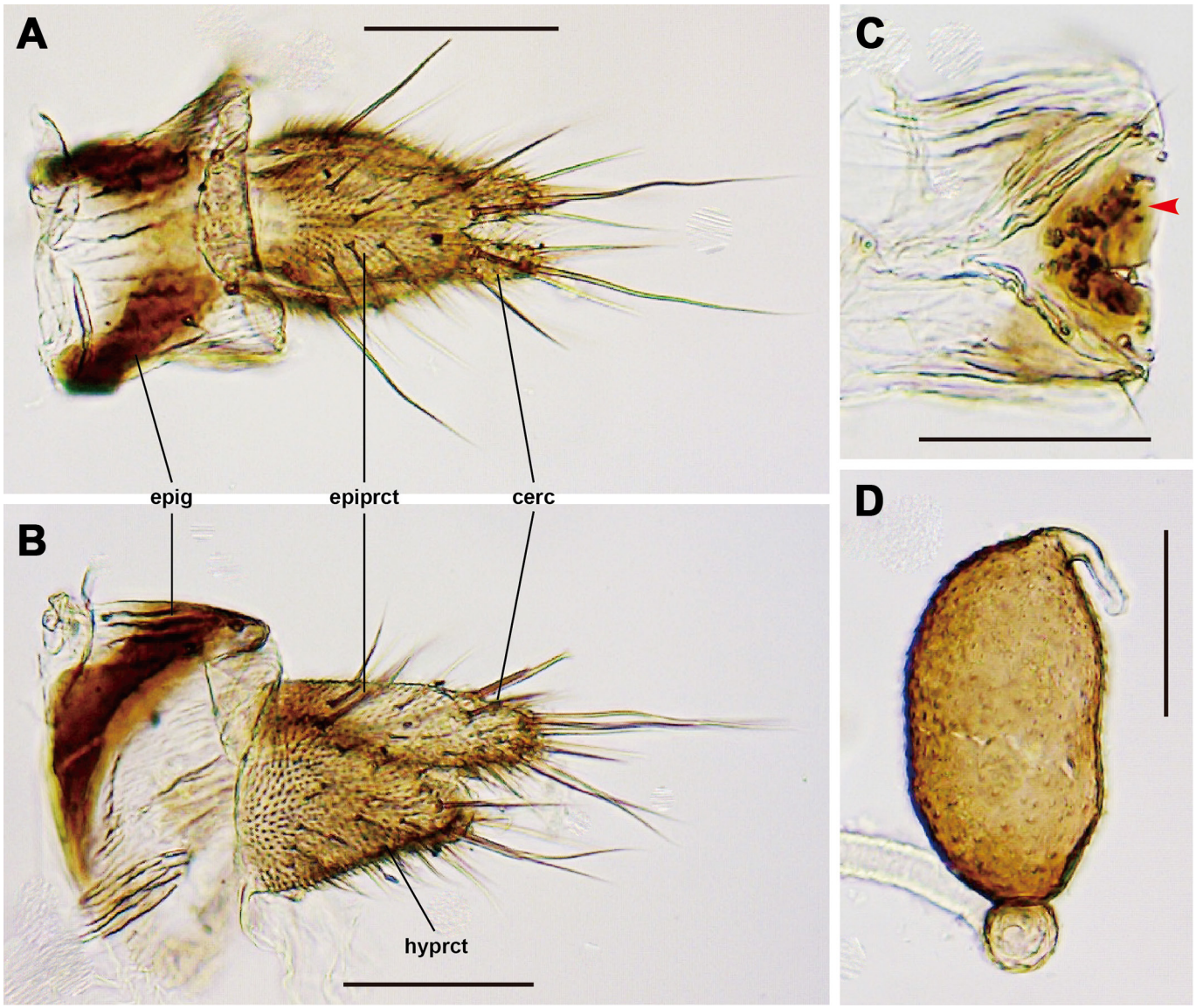

Figure 3. Female terminalia of *Stegana* (*Oxyphortica*) *minuta* **sp. nov. A.** Epigynium and analia, dorsal view; **B.** ditto, lateral view; **C.** Hypogynium, ventral view; **D.** Spermatheca, lateral view. Abbreviations: *cerc*, cercus; *epig*, epigynium; *epiprct*, epiproct; *hyprct*, hypoproct. Scale bars: 0.1 mm

DISCUSSION

The subgenus *Oxyphortica* Duda, 1923 of the genus *Stegana* Meigen is among the most diverse groups of Steganinae, with South China representing a major center of its diversity (Wang et al., 2017). The genus *Stegana* comprises about 334 species worldwide (Toda, 2025), divided into five subgenera, of which *Oxyphortica* includes 58 species, 57 of them recorded from the Oriental region (Wang et al., 2020, 2021, 2022; Toda, 2025). Species of *Oxyphortica* are mainly associated with moist, forested habitats, particularly montane and subtropical zones, where they are commonly found near streams, waterfalls, and decaying vegetation, feeding on tree sap, moss, and fungi. Although primarily Oriental in distribution, a few species extend into the southern Palaearctic (Japan) and northern Australian (New Guinea) regions (Brake & Bächli, 2008; Wang et al., 2017; Huang et al., 2018; Wang et al., 2021).

The total number of *Stegana* species in India is 6, including this species. At the time of publication of our previous study (Sarswat et al., 2016a), only a few specimens of *Stegana minuta* **sp. nov.** were available, making it impossible to provide a formal description, diagnostic characters, or designation of a type specimen in accordance with the ICZN. Consequently, the species name remained a "*nomen nudum*".

The molecular data for *Stegana minuta* **sp. nov.** were already deposited in the public domain (Sarswat et al., 2016a), consisting of mitochondrial DNA sequences for 16S rRNA, COI, and COII, with GenBank accession numbers KP730830–KP730831, KP731048–KP731050, and KP731264–KP731266, respectively.

Based on a synthesis of published literature (Sati et al., 2013; Toda et al., 2020; Bächli, 2025) and unpublished data from our laboratory, India is estimated to harbor approximately 363 drosophilid species across 27 genera. This remarkable diversity reinforces the Indian subcontinent's status as a crucial center for drosophilid biodiversity. The identification of a new species from a relatively localized survey underscores how underexplored many Indian habitats remain, suggesting that ongoing fieldwork will likely uncover additional undescribed taxa. The presence of *Oxyphortica* in India presents a promising avenue for evolutionary and ecological research.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: P.C. Sati: conceptualization, study design, data compilation, writing the manuscript, and proofreading; M. Kandpal: data collection, literature review and species description; R.S. Fartyal: conceptualization, species identification, data validation, preparation of the figures; drafting the manuscript, and overall supervision; K. Asha: data collection and Literature review; S. Khali: data collection and Literature review; S. Pradhan: literature survey and proofreading; D. Rawat: literature review and proofreading. The authors read and approved the final version of the manuscript.

FUNDING

This work is financially supported by a Seed money grant provided to Dr Pradeep Chandra Sati by the University of Allahabad and the University Grants Commission, New Delhi, India, as a Major Research Project to Dr R.S. Fartyal, Ref. No. UGC Project F. No. 37-198/2009 (SR).

AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the collection of the Department of Zoology, H.N.B. Garhwal University, Srinagar, Uttarakhand, India, and in the Museum of Zoological Survey of India, Kolkata (MZSIK), and are available from the curator upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

ACKNOWLEDGMENTS

We want to acknowledge Prof. B.K. Singh, one of the prominent figures in *Drosophila* taxonomy in India, whose guidance and expertise greatly contributed to the identification of *Stegana* (*Oxyphortica*) *minuta* Kandpal, Sati & Fartyal, as a new species. Under his supervision, Dr. Mukul Kandpal successfully identified this species. The authors wish to offer cordial thanks to Dr. Masanori J. Toda, Emeritus Professor, Hokkaido University Museum, Sapporo, Japan, for confirmation of the new species. We also deeply acknowledge the National Biodiversity Authority, Chennai, and the Zoological Survey of India, Kolkata. Additionally, the authors are thankful to the subject editor of the journal and the anonymous reviewers for their thorough review.

REFERENCES

Bächli, G. (2025) *Taxodros*: The database on taxonomy of Drosophilidae. Available from: https://www.taxodros.uzh.ch/ [Accessed June 25, 2025]

Brake, I. & Bächli, G. (2008) Drosophilidae (Diptera). In: Brake, I. & Bächli, G. (eds) *World Catalogue of Insects*. Apollo Books, Stenstrup, pp. 249–257.

Duda, O. (1923) Die orientalischen und australischen drosophiliden-arten (Dipteren) des ungarischen National-Museums zu Budapest. *Annales Historico-Naturales Musei Nationalis Hungarici*, 20, 24–59.

Fartyal, R.S., Sati, P.C., Pradhan, S., Kandpal, M.C., Toda, M.J., Chatterjee, R.N., Singh, B.K. & Bhardwaj, A. (2017) A review of the genus *Lordiphosa* Basden in India, with description of four new species from the Himalayan region (Diptera: Drosophilidae). *Zookeys*, 688, 49–79. https://doi.org/10.3897/zookeys.688.12590

Fartyal, R.S., Topal, P., Sati, P.C. & Kumar, K. (2023) Preliminary study of drosophilids (Diptera, Drosophilidae) and their host plant preference in the subtropical and temperate forest of Central Himalayas. In: Arya, M.K. (ed.) *Biodiversity, Environment and Ecosystem Services*. Discovery Publishing House, New Delhi, pp. 156–167.

Grimaldi, D.A. (1990) A phylogenetic, revised classification of genera in the Drosophilidae (Diptera). *Bulletin of the American Museum of Natural History*, 197, 1–139.

Gupta, J.P. (2005) A monograph on Indian Drosophilidae. *Journal of Scientific Research*, 51, 1–252.

Gupta, J.P. & Panigrahy, K.K. (1987) Some further additions to the list of Indian fauna of Drosophilidae. *Proceedings of Zoological Society*, Calcutta, 36, 57–66.

Hu, Y.G. & Toda M.J. (2001) Polyphyly of *Lordiphosa* and its relationships in Drosophilinae (Diptera: Drosophilidae). *Systematic Entomology*, 26, 15–31. https://doi.org/10.1046/j.1365-3113.2001.00135.x

Huang, J., Wang, N.N., Zhang, Y. & Chen, H.W. (2018) *Stegana* (*Oxyphortica*) *convergens* species group (Diptera: Drosophilidae) from the Oriental region, with morphological and molecular evidence. *Journal of Natural History*, 52 (23–24), 1473–1492. https://doi.org/10.1080/00222933.2018.1478010

Khan, M.Z., Bhardwaj, A., Khali, S., Sati, P.C., Toda, M.J. & Fartyal, R.S. (2022) Morphological comparison between a pair of wing-pigmented and non-pigmented sibling species of the genus *Hirtodrosophila* (Diptera: Drosophilidae), with description of a new species from Western Himalaya. *Journal of Insect Biodiversity*, 34 (2), 45–56. https://doi.org/10.12976/jib/2022.34.2.4

McAlpine, J.F. (1981) Morphology and terminology-Adults. In: McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (eds) *Manual of Nearctic Diptera*. Biosystematics Research Institute Ottawa, Ontario, pp. 9–63.

McQueen, E.W., Afkhami,, M., Atallah J., Belote, J.M., Gompel, N., Heifetz, Y., Kamimura, Y., Kornhauser, S.C., Masly, J.P., O'Grady, P., Peláez, J., Rebeiz, M., Rice, G., Ernesto, S.H., Nunes, M.D.S., Rampasso, A.S., Schnakenberg, S.L., Siegel, M.L., Takahashi, A., Tanaka, K.M., Turetzek, N., Zelinger, E., Virginie, C.O., Toda, M.J., Wolfner, M.F. & Yassin, A. (2022) A standardized nomenclature and atlas of the female terminalia of *Drosophila melanogaster*. *Fly*, 16 (1), 128–151. https://doi.org/10.1080/19336934.2022.2058309

Meigen, J.W. (1830) *Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten*. Sechster Theil. Schulz, Hamm. 401 p.

Okada, T. (1971) A revision and taxometric analysis of the genus *Stegana* Meigen of Japan and adjacent countries (Diptera, Drosophilidae). *Mushi*, 45, 81–99.

Okada, T. (1978) *Pseudostegana*, a new subgenus of the genus *Stegana* Meigen (Diptera, Drosophilidae). *Kontyu*, 46(3), 392–399.

Okada, T. (1980) A revision of the genus *Hypselothyrea* De Meijere and *Timbourella* Wheeler (Diptera, Drosophilidae). *Kontys*, 4S, 501–516.

Okada, T. (1989) A proposal of establishing tribes for the family Drosophilidae with key to tribes and genera (Diptera). *Zoological Science*, 6 (2), 391–399.

Pirani, G. & Grimaldi, D.A. (2019) Rediscovery, redescription, and reclassification of the rare and unusual fly *Pyrgometopa penicillata* Kertész (Diptera: Drosophilidae). *Zootaxa*, 4661 (3), 445–456. https://doi.org/10.11646/zootaxa.4661.3.2

Rawat, D., Pradhan, S., Sati, P.C., Khali, S. & Fartyal, R.S. (2025) A review of Drosophilids (Drosophilidae: Diptera) biodiversity in India: Insights from the Northern and Western-Southern regions. *Environment Conservation Journal*, 26 (2), 713–728. https://doi.org/10.36953/ECJ.31873039

Rice, G., David, J.R., Kamimura, Y., Masly, J.P., McGregor, A.P., Nagy, O., Noselli, S., Nunes, M.D.S., O'Grady, P., Ernesto, S.H., Siegel, M.L., Toda, M.J., Rebeiz, M., Virginie, C.O. & Yassin, A. (2019) A standardized nomenclature and atlas of the male terminalia of *Drosophila melanogaster*. *Fly*, 13, 51–64. https://doi.org/10.1080/19336934.2019.1653733

Sarswat, M., Dewan, S. & Fartyal, R.S. (2016a) Mitochondrial DNA sequence variation in Drosophilid species (Diptera: Drosophilidae) along an altitudinal gradient from the Central Himalayan region of India. *Journal of Genetics*, 95 (2), 357–367. https://doi.org/10.1007/s12041-016-0646-x

Sarswat, M., Sati, P.C., Dewan, S. & Fartyal, R.S. (2016b) Implying quantitative ecology of Drosophilid fauna as a tool for biodiversity assessment-A case study along an altitudinal transect in the Garhwal region of Central Himalaya. *Tropical Ecology*, 57 (4), 637–647.

Sati, P.C., Fartyal, R.S., Sarswat, M., Dewan, S., Kandpal, M. & Kumar, A. (2013) Check-list of drosophilid species so far described and recorded from Uttarakhand state, India. *Drosophila Information Service*, 96, 79–83.

Sidorenko, V.S. (1998) New Asian species and new records of the genus *Stegana* Meigen (Diptera: Drosophilidae). III. Descriptions, taxonomic remarks, and a key to the Asian species. *Annales de la Société Entomologique de France* (N.S.), 34, 285–300. https://doi.org/10.1080/21686351.1998.12277900

Singh, B.K. & Fartyal, R.S. (2002) Family Drosophilidae (Insecta: Diptera) in Kumaon Region, India, with the description of one new species and three new records. *Proceedings of Zoological Society*, Calcutta, 55 (1), 11–18.

Singh, O.P. & Gupta, J.P. (1981) Studies on the Indian fauna of Drosophilidae. *Proceedings: Animal Sciences*, 90, 195–202. https://doi.org/10.1007/BF03185994

Toda, M., Bänziger, H., Sati, P., Fartyal, R., Suwito, A. & Katoh, T. (2020) Taxonomy and evolution of asymmetric male genitalia in the subgenus *Ashima* Chen (Diptera: Drosophilidae: *Phortica* Schiffner), with descriptions of seven new species. *Zootaxa*, 4789 (1), 1–54. https://doi.org/10.11646/zootaxa.4789.1.1

Toda, M.J. (2025) *DrosWLD-Species*: Taxonomic information database for world species of Drosophilidae. Available from https://evolgen.biol.se.tmu.ac.jp/DrosWLD/modules/stdb/index.php [Accessed August 1, 2025].

Toda, M.J. & Peng, T.X. (1992) Some species of the subfamily Steganinae (Diptera: Drosophilidae) from Guangdong Province, southern China. *Annales de la Société entomologique de France*, 28 (2), 201–213.

Vaidya, V.G. & Godbole, N.N. (1976) Systematic study of Drosophilidae in Poona and Neighbouring areas IV. *Journal of the University of Poona, Science and Technology*, 48, 85–92.

Vaidya, V.G. & Godbole, N.N. (1977) A new species of genus *Stegana* (Drosophilidae) from India: *Stegana* (*Steganina*) *subexcavata* sp. nov. *Drosophila Information Service*, 52, 55–56.

Vilela, C.R. & Bächli, G. (2020) On the identities of Neotropical *Stegana* species (Diptera, Drosophilidae). I. Redescription of *Stegana magnifica* Hendel, 1913 and *Stegana fumipennis* (Enderlein, 1922). *Revista Brasileira de Entomologia*, 64 (3), e20200024. https://doi.org/10.1590/1806-9665-rbent-2020-0024

Wang, N., Zhang, Y., Cheng, Y. & Chen, H. (2017). Nine new species of the subgenus *Stegana* (*Oxyphortica*) from the Oriental region, with morphological and molecular evidence based on Chinese species (Diptera: Drosophilidae). *Journal of Natural History*, 51 (33–34), 1943–1970. https://doi.org/10.1080/00222933.2017.1360960

Wang, Y.L., Lu, J.M., Zhang, Y. & Chen, H.W. (2020) Molecular phylogeny, species delimitation and biogeographic history of the *Stegana* (*Steganina*) *shirozui* species group (Diptera: Drosophilidae) from East Asia. *Zoological Journal of the Linnean Society*, 192, 998–1016. https://doi.org/10.1093/zoolinnean/zlaa118

Wang, Y.L., Wang, N.N., Zhang, Y., Tsaur, S.C. & Chen, H.W. (2021) Cryptic diversity in the subgenus *Oxyphortica* (Diptera: Drosophilidae: *Stegana*). *PeerJ*, 9, e12347. https://doi.org/10.7717/peerj.12347

Wang, Y.L., Lu, J.M., Gao, J.J., Zhang, Y. & Chen, H.W. (2022) Molecular phylogeny and systematics of the subgenus *Oxyphortica* Duda from the Oriental region (Diptera: Drosophilidae: *Stegana*). *Systematic Entomology*, 47 (1), 52–64. https://doi.org/10.1111/syen.12515

Wheeler, M.R. (1960) A new subgenus and species of *Stegana* Meigen (Diptera: Drosophilidae). *Proceedings of the Entomological Society of Washington*, 62, 109–11.

Yassin, A. (2013) Phylogenetic classification of the Drosophilidae Rondani (Diptera): the Role of morphology in the postgenomic era. *Systematic Entomology*, 38, 349–364. https://doi.org/10.1111/j.1365-3113.2012.00665.x

Zhang, W.X. & Toda, M.J. (1992) A new species-subgroup of the *Drosophila immigrans* Species-group (Diptera, Drosophilidae), with description of two new species from China and revision of taxonomic terminology. *Japanese Journal of Entomology*, 60, 839–850.

Zhang, Y., Tsaur, S.C. & Chen, H.W. (2014) Survey of the genus *Stegana* Meigen (Diptera, Drosophilidae) from Taiwan, with DNA barcodes and descriptions of three new species. *Zoological Studies*, 53 (1), 2. https://doi.org/10.1186/1810-522X-53-2

مروری مختصر جنس *Stegana* Meigen, 1830 (Diptera: Drosophilidae) در هند، با توصیف یک گونه جدید و کلید شناسایی روزآمد

پردایپ چاندرا ساتی[۱]، موکول کاندپال[۲]، راجندرا سینگ فارتیال[۳*]، کوماری آشا[۳]، سونالی خالی[۳]، سوشمیکا پرادهان[۴]، دورگا راوات[۳]

۱ آزمایشگاه دوبالان، گروه جانورشناسی، دانشکده علوم، دانشگاه الله‌آباد، اوتار پرادش، هند
۲ آزمایشگاه سیتوژنتیک، گروه جانورشناسی، دانشگاه کومون، نایینیتال، اوتاراکند، هند
۳ آزمایشگاه مگس میوه، گروه جانورشناسی، دانشگاه گاروال، سریناگر-گاروال، پردیس چوراس، اوتاراکند، هند
۴ گروه جانورشناسی، کالج آنندا چاندرا، جالپایگوری، بنگال غربی، هند.

* پست الکترونیک نویسنده مسئول مکاتبه: *fartyalrs@gmail.com*

| **تاریخ دریافت:** ۰۴ خرداد ۱۴۰۴ | **تاریخ پذیرش:** ۱۴ شهریور ۱۴۰۴ | **تاریخ انتشار آنلاین** ۰۴ مهر ۱۴۰۴ |

چکیده: این تحقیق، مروری مختصر بر جنس *Stegana* Meigen (Diptera: Drosophilidae: Steganinae) را در هند رائه می‌دهد و به معرفی تنوع و اهمیت اکولوژیک آنها از بین دوبالان می‌پردازد. بر اساس بررسی‌های ریخت‌شناسی دقیق، یک گونهٔ جدید به نام *Stegana* (*Oxyphortica*) *minuta* Kandpal, Sati Fartyal **sp. nov.** از آیارپاتا، نایینیتال، اوتاراکند توصیف شد. گونهٔ جدید، توصیف شده و ویژگی‌های افتراقی آن به همراه کلید شناسایی شش گونه از جنس *Stegana* شناخته شده در کشور هند ارایه شد. کشف این گونهٔ جدید، دانش مربوط به حشرات منطقه را غنی‌تر می‌کند. با تلفیق اطلاعات موجود، تخمین زده می‌شود که حدود ۳۶۳ گونه متعلف به ۲۷ جنس از دوبالان خانواده Drosophilidae در هند انتشار دارند. این تنوع شگفت‌انگیز، وضعیت زیرقاره هند را به عنوان یک مرکز حیاتی برای تنوع زیستی این حشرات تقویت می‌کند.

واژگان کلیدی: کلیدشناسایی، مگس‌های میوه، گونهٔ جدید، زیرجنس *Oxyphortica*، اوتاراکند