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Taxonomic Notes and New Records of Chironomini from India (Diptera: Chironomidae)

Bindarika MUKHERJEE[1a] Namrata RAY[1b] Atanu NASKAR[1c*]

Dhriti BANERJEE[1d]

[1]Zoological Survey of India, Prani Vigyan Bhawan, M Block, New Alipore, Kolkata 700053, West Bengal, INDIA

e-mails: [a]binda.lab.2019@gmail.com, [b]namrataray97@gmail.com, [d]diptera.zsi@gmail.com, [c]atanudiptera@gmail.com

ORCID IDs: [a]0000-0002-9792-7931, [b]0009-0003-3888-6687, [c]0000-0003-0097-318X, [d]0000-0002-2054-0165

*Corresponding author

ABSTRACT

The family Chironomidae (Diptera) is one of the most diverse groups of aquatic insects, yet its fauna remains poorly documented in India. This study reports four chironomid species newly recorded from India; *Benthalia carbonaria* (Meigen, 1804), *Robackia demeijerei* (Kruseman, 1933), *Stenochironomus watsoni* Freeman, 1961, and *Polypedilum* (*Tripodura*) *masudai* (Tokunaga, 1938), with supplementary morphological descriptions to support accurate identification and extend their known distributions. In addition, a redescription and neotype designation for *Chironomus* (*Chironomus*) *lobaticeps* Kieffer, 1911 are provided to resolve longstanding taxonomic ambiguity caused by damaged type material. Overall, this study enhances knowledge of the diversity, distribution, and taxonomy of Chironomini in India and underscores the need for continued faunistic and taxonomic investigations.

Keywords: Benthalia, *Chironomus*, Neotype, *Polypedilum*, *Robackia*, *Stenochironomus.*

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INTRODUCTION

The family Chironomidae (Diptera), commonly referred to as non-biting midges, represents one of the most diverse and ecologically significant groups of aquatic insects. With more than 6,300 species described worldwide (Li et al., 2022), chironomids play a crucial role in freshwater ecosystems, contributing to nutrient cycling, food web dynamics, and serving as important bioindicators of water quality (Karima, 2021). Despite their global diversity and ecological importance, the fauna of many zoogeographical realms, including parts of the Oriental region, remains incompletely documented.

In India, approximately 400 species of Chironomidae have been recorded to date, distributed among four recognized subfamilies. Among these, the subfamily Chironominae is the most speciose and taxonomically complex group, currently comprising over 200 species (Mukherjee, Ghosh, Naskar, & Banerjee, 2026), exhibit wide morphological and ecological variation, which has often led to taxonomic ambiguities and underreporting of species diversity in the region.

The present study makes a significant contribution to the growing knowledge of Indian Chironomidae by documenting four species newly recorded from India, accompanied by detailed supplementary descriptions to facilitate accurate identification. The species reported herein; *Benthalia carbonaria* (Meigen, 1804), *Robackia demeijerei* (Kruseman, 1933), *Stenochironomus watsoni* Freeman, 1961, and *Polypedilum* (*Tripodura*) *masudai* (Tokunaga, 1938) represent important additions to the known chironomid fauna of the region. These new records considerably extend the known geographical distribution of these taxa and underscore the inadequacy of current distributional data for Chironomidae in the Indian subcontinent, where many taxa remain under-sampled or poorly documented. In the present study, *Benthalia* Lipina, 1939 is treated as a valid genus. Although the generic concept of *Benthalia* has not yet been fully clarified, Martin (2025) reinstated it as a distinct genus based on the characteristic setal arrangement on tergite IX, which separates it from closely related genera such as *Einfeldia* Kieffer, 1922, *Chironomus* Meigen, 1803 and *Fleuria* Kieffer, 1924. Earlier, the genus *Einfeldia* was divided into four species groups (A-D) on the basis of larval and pupal morphology (Pinder & Reiss, 1983; 1986). Among these, species group B is now recognized as *Benthalia* Lipina, 1939 (Yamamoto et al., 2015); however, the diagnostic boundaries between these genera remain insufficiently defined.

In addition to reporting new distributional records, this study provides a comprehensive redescription and the formal designation of a neotype for *Chironomus* (*Chironomus*) *lobaticeps* Kieffer, 1911. The original type material of this species has long been in damaged condition, resulting in persistent taxonomic ambiguity and misidentifications in the literature. The designation of a neotype, supported by detailed morphological documentation, resolves this longstanding uncertainty and ensures nomenclatural stability in accordance with the principles of the International Code of Zoological Nomenclature. This action is particularly important for *Chironomus*, a genus known for its high species richness and morphological complexity.

By integrating new faunistic records with a critical taxonomic revision and neotype designation, the present work substantially enhances the understanding of species

diversity, distribution, and taxonomy of Chironomini in India. The findings emphasize the importance of continued faunistic surveys, careful morphological reassessments, and taxonomic revisions to uncover the true extent of chironomid biodiversity.

MATERIALS AND METHODS

Study area

Specimens were collected from diverse regions across India, encompassing a range of habitat types, such as moist vegetation surrounding lakes (Jharkhand, India) and mixed vegetation with scattered aquatic bodies of Central Himalaya (West Bengal, India) and dense forest with slow-flowing streams in Eastern ghats (Andhra Pradesh, India). Detailed data on the different collection sites are listed in table 1 and shown in Fig. 1 (map was made in ArcMap V 10.8.).

Table 1. Data of collection sites.

Location	Latitude & Longitude	Collected species
Mumbai, India	19.2205°N, 72.9128°E	*Benthalia carbonaria* (Meigen, 1804)
West Bengal, India	27.0601°N, 88.4666°E	*Stenochironomus watsoni* Freeman, 1961; *Polypedilum* (*Tripodura*) *masudai* (Tokunaga, 1938)
Jharkhand, India	22.9117°N, 86.1503°E	*Robackia demeijerei* (Kruseman, 1933)
West Bengal, India	26.4185°N, 89.7201°E	*Chironomus lobaticeps* Kieffer, 1911
Andhra Pradesh, India	14.3908°N, 80.0055°E	*Chironomus lobaticeps* Kieffer, 1911

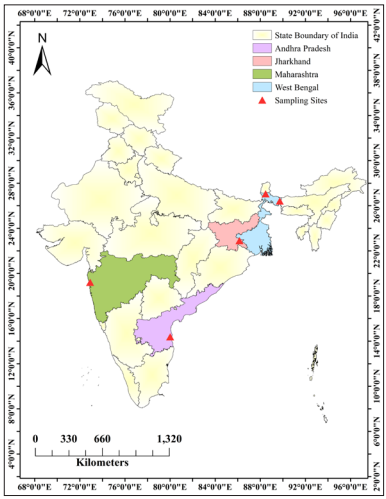

Figure 1. Location of collection sites of examined species in India.

Collection, preservation, and imagery

Specimens were collected using open light traps, and the chironomine midges were sorted out. The sorted samples were kept in 90% alcohol and stored at -20 °C for further studies. For morphological taxonomy, midge specimens were slide-mounted using phenol-balsam following Wirth & Marston (1968), and a few midges were processed

for DNA extraction. The mounted specimens were identified using a Leica DM1000 microscope (Leica Microsystems GmbH, Wetzlar, Germany), and photographs were captured using a Leica K3C camera mounted on the microscope. The general terminology follows Sæther (1980). The number of specimens measured is indicated by "n". All measurements are in micrometres (µm), excluding body, wing, costa, and antenna lengths, which are in millimetres (mm), with the ranges followed by the mean. All materials examined are retained in the National Zoological Collection of the Diptera Section, Zoological Survey of India, Kolkata, West Bengal, India.

Molecular methods

For DNA barcoding, a small section of tissue was dissected under the thorax of the specimen without damaging the major diagnostic structures and processed further using the QIAamp Blood and Tissue Kit (Qiagen, Hilden, Germany) to extract genomic DNA. The partial mitochondrial cytochrome oxidase 1 (COI) gene was amplified using polymerase chain reaction with the primer pairs HCO2198: 50-TAAACTTCAGGGTGAC-CAAAAAATCA-30 and LCO1490: 50-GGTCAACAAATCATAAAGA (Folmer, Black, Hoeh, Lutz, & Vrijenhoek, 1994). Polymerase chain reaction was performed according to the guidelines described by Ghosh et al. (2022). The amplified products were subjected to Sanger sequencing, and the obtained gene sequences were uploaded to GenBank and the National Centre for Biotechnology Information (NCBI) to obtain the accession numbers provided in the corresponding species descriptions.

The abbreviations used in the following text are as follows: IV, inner verticals; OV, outer verticals; Po, post orbitals; CA, head-antenna ratio; AR, antennal ratio; Acs, acrostichals; Dcs, dorsocentrals; Pa, prealars; Su, supraalars; Scts, scutellars; VR, veneral ratio; CR, costal ratio; RM, cross vein between radius and media; FCu, forked cubitus; Fe, femur; Ti, tibia; Ta, tarsomere; LR, leg ratio; BV, beinverhältnisse; SV, schenkel-schiene-verhältnis (thigh-splint ratio); An, anal vein; M, media vein; R, radius vein; HR, hypopygium ratio; HV, hypopygium value; BLASTn, Basic Local Alignment Search Tool for Nucleotides; NCBI, National Centre for Biotechnology Information; PA, Palearctic; NE, Nearctic; OR, Oriental; AU, Australasia.

RESULTS

Taxonomy

Benthalia carbonaria (Meigen, 1804) (Figs. 2a-c)

GenBank accession number. PX924258

Supplementary description

Distribution. PA (Austria, China, Finland, France, Great Britain, Germany, Japan, Netherlands, Romania, South Korea, Sweden); OR (China (Guangdong, Hubei, Sichuan, Yunnan, Zhejiang), Japan (Ryukyu Archipelago), Taiwan, Thailand, India).

Material examined. India, Maharashtra, Mumbai [19.2205° N, 72.9128° E], 28.05.2024, 11 ♂, B. Mukherjee.

Diagnostic characters. The adult male is distinguished from other species of the genus *Benthalia* by the presence of rectangular shaped basal lobe of superior volsella.

Male (n=11)

Total length 2.8-3.2, 3 mm. Wing length 2.25-3, 2.62 mm. Costal length 2.15-2.2, 2.18 mm. Antennal length 1.3-1.6, 1.45 mm.

Colouration. Thorax yellowish brown, leg colour light brown, abdomen dark brown.

Head. Head width 750-770, 760 µm. Temporal setae 18-19 (IV 2, OV 5-6, Po 11). Clypeal setae 8-10. Frontal tubercles long, cylindrical, 65-70, 67.5 µm long. Eyes bare with dorsomedial extension of 190-200, 195 µm. Ultimate flagellomere 825-910, 867.5 µm long; AR 1.73-1.76, 1.74. Length of palpomeres (I-V) (µm): 30: 40-50, 45: 50-60, 55: 130-140, 135: 210-220, 215.

Thorax. Acrostichals 2-4, dorsocentrals 14, scutellars 8-9, prealar 4.

Wing (Fig. 2a). VR 1.05-1.10, 1.075. Brachiolium with 2 setae. Squama with 12-14 fringed setae. FCu distinctly distal to RM. Anal lobe moderately developed.

Legs. Fore tibia with 2 setae. Mid legs with 2 tibial spurs; 30 µm and 28 µm long, comb with 22-25 teeth. Hind leg with 2 tibial spurs; 30 µm and 28 µm long, comb with 28-30 teeth. Lengths (µm) and proportions of legs shown in table 2.

Table 2. Lengths (µm) and proportions of legs of *B. carbonaria* (Meigen, 1804).

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	BV	SV
P1	850–870, 860	650–670, 660	–	–	–	–	–	–	–	–
P2	900–910, 905	800–820, 810	450–470, 460	240	180–200, 190	100–110, 105	40–60, 50	0.56–0.57, 0.565	3.61–3.84, 3.725	3.68–3.78, 3.73
P3	920	1000–1010, 1005	–	–	–	–	–	–	–	–

Hypopygium (Figs. 2c-d). Anal tergite band V shaped. Anal point slender, parallel sided; 47.5-50, 48.75 µm long. Tergite IX with 5-6 longitudinal setae. Superior volsella with rectangular shaped, setose and microtrichiose strong basal lobe, 65 µm long with bare hook like apical process, 25 µm long. Inferior volsella setose, parallel-sided with expanded apex, 140-150, 145 µm long. Gonocoxite 190-210, 200 µm long. Gonostylus 200-220, 210 µm long, without preapical constriction. HR 0.94-0.95, 0.945; HV 1.47-1.52, 1.49.

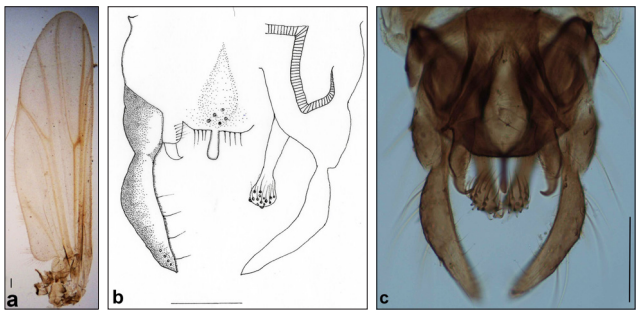

Figure 2. Adult male *Benthalia carbonaria* (Meigen, 1804). a) Wing, b) Hypopygium, c) Hypopygium, scale 0.01 mm.

Remarks. The specimen has large strong frontal tubercle and longitudinally arranged setae on tergite IX, characteristic of the genus *Benthalia* Lipina, 1939, while the shape of setigerous lobe of superipor volsella and absence of antepronotals and acrostichals can corroborate the specimen with *B. carbobnaria* (Meigen, 1804), which was redescribed by Martin, 2025. The difference between Indian and Japanese species are compared in table 3.

Table 3. Morphological comparison between Japanese and Indian *B. carbonaria* (Meigen, 1804).

Characters	Japanese specimen	Indian specimen
AR	2.60–2.68, 2.64	1.73–1.76, 1.74
Wing length	2.40 mm	2.25–3, 2.62 mm
Squama	13–19	12–14
Frontal tubercle length	65–70, 67.5 µm	48 µm

Polypedilum (*Tripodura*) *masudai* (Tokunaga, 1938) (Figs. 3a-b)

Distribution. PA (Japan (Kyoto, Kagoshima, Tokushima, Shiga, Okayama, Nagano), Korea, Russian Far East, China (Henan); OR (China (Fujian, Hunan, Guangxi, Hainan, Guizhou), India).

Material examined. India, West Bengal, Kalimpong [27.0601° N, 88.4666° E], 24.03.2024, 2 ♂♂, B. Mukherjee.

Diagnostic characters. The species can be separated from the other members of the subgenus *Tripodura* by the presence of angulated posterior margin of tergite IX and the slender anal point without lateral projections at base.

Remarks. Zhang, Song, Qi, & Wang (2016) redescribed the species from China. After careful examination of the specimens, it fully corroborates with the *P. masudai,* based on the presence of all diagnostic characters along with wing with nine marking, pad-like superior volsella with 3 long setae and similar range of other morphometric values. The comparison of Indian and Chinese specimen is made in table 4.

Table 4. Morphological comparison between Chinese and Indian *P. masudai* (Tokunaga, 1938).

Characters	Chinese specimen	Indian specimen
AR	1.32–1.66, 1.44	1.56
Wing length	1.32–1.86, 1.54 mm	1.75 mm
Squama	5–13	8–9
HR	0.85–1.18, 0.98	0.74

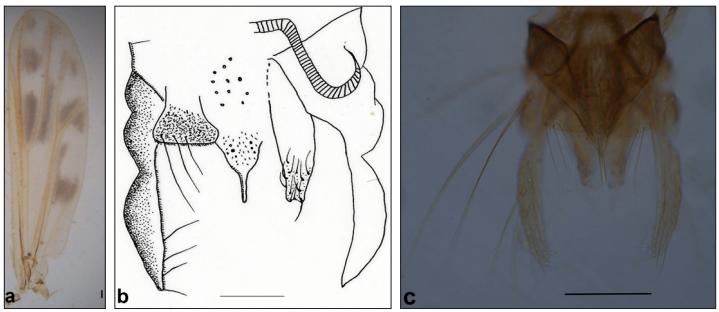

Figure 3. Adult male *Polypedilum* (*Tripodura*) *masudai* (Tokunaga, 1938). a) Wing, b) Hypopygium, c) Hypopygium, scale 0.01 mm.

***Robackia demeijerei* (Kruseman, 1933) (Figs. 4a-c)**

Supplementary description

Distribution. PA (Europe); NE (Florida, Michigan); OR (India).

Material examined. India, Jharkhand, Seraikela-Kharsawan [22.9117° N, 86.1503° E], 30.07.2025, 1 ♂, B. Mukherjee.

Diagnostic characters. The adult male is distinguished from other species of the genus *Robackia* by the presence of strong setae lateral to anal point.

Male (n=1)

Total length 2.75 mm. Wing length 1.25 mm. Costal length 1.22 mm. Antennal length 0.7 mm.

Colouration. Thorax yellowish brown, leg colour light brown, abdomen yellow to light brown.

Head. Head width 400 µm. Temporal setae 5 (IV 2, OV 3, Po not countable). Clypeal setae 10. Eyes bare with dorsomedial extension of 70 µm. Ultimate flagellomere 400 µm long; AR 1.3. Length of palpomeres (I-V) (µm): 25: 30: 70: 95: 125.

Thorax. Acrostichals 0, dorsocentrals 10, scutellars 4, others not countable.

Wing (Fig. 4a). VR 1.15. Brachiolium with 2 setae. Squama not countable. FCu distinctly distal to RM. Anal lobe moderately developed. CR 0.98.

Legs. Fore tibia with 2 setae. Mid legs with 2 tibial spurs; 17.5 µm and 12.5 µm long, comb with 22-25 teeth. Hind leg with 2 tibial spurs; 32.5 µm and 10 µm long, comb with 28-30 teeth. Lengths (µm) and proportions of legs shown in table 5.

Hypopygium (Figs. 4b-c). Anal tergite band V shaped. Anal point slender, parallel sided; 37.5 µm long. Two strong setae lateral to anal point, 30 µm long. Tergite IX with 2 lateral setae on each side of anal point. Transverse sternapodeme 25 µm long; longitudinal sternapodeme 87.5 µm long. Superior volsella elongate, falcate-like, apically curved inward with pointed apex, bearing 2 long setae; 30 µm long. Inferior volsella ovoid shaped pad like, with microtrichia; 30 µm long. Gonocoxite 90 µm long. Gonostylus 115 µm long, with widened apex. HR 0.78; HV 3.06.

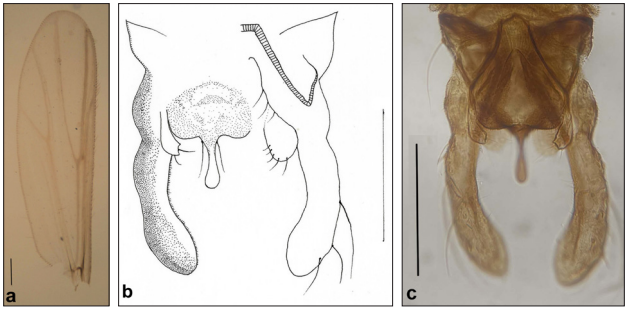

Figure 4. Adult male *Robackia demeijerei* (Kruseman, 1933). a) Wing, b) Hypopygium, c) Hypopygium, scale 0.01 mm.

Table 5. Lengths (μm) and proportions of legs of *R. demeijerei* (Kruseman, 1933).

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	BV	SV
P1	410	310	500	250	180	110	70	1.61	2	1.44
P2	430	400	180	100	70	50	40	0.45	3.88	4.61
P3	450	500	300	150	150	90	70	0.6	2.72	3.16

Remarks. Kruseman (1933) provided only a very brief description of this species, and a comprehensive supplementary description has long been needed. The present study addresses this gap by providing a detailed redescription based on Indian material, including comprehensive illustrations and complete morphometric data.

Stenochironomus watsoni Freeman, 1961 (Figs. 5a-c)

GenBank accession number. PX859792

Supplementary description

Distribution. AU (Australia); OR (India).

Material examined. India, West Bengal, Kalimpong [27.0601° N, 88.4666° E], 24.03.2024, 2 ♂♂, B. Mukherjee.

Diagnostic characters. The adult male is distinguished from other species of the genus *Stenochironomus* by the presence of slightly spatulated anal point at apex, banded abdomen and small digitiform superior volsella with four setae.

Male (n=2)

Total length 3.62-3.70, 3.66 mm. Wing length 2-2.2, 2.1 mm. Costal length 1.8-2, 1.9 mm. Antennal length 1.28-1.5, 1.39 mm.

Colouration. Thorax yellowish with brown stripes, leg colour light brown, abdomen yellowish with brown banded marking on the apices of segment.

Head. Head width 625-630, 627.5 μm. Temporal setae not countable. Clypeal setae 17-18. Eyes bare with dorsomedial extension of 175 μm. Ultimate flagellomere 810-850, 830 μm long; AR 1.3. Length of palpomeres (I-V) (μm): 75-77.5, 76.25: 100: 175: 200-203.5, 201.75: 300.

Thorax. Dorsocentrals 18, prealars 5, scutellars 12, and others not countable.

Wing (Fig. 5a). VR 1.07. Brachiolium with 2 setae. Squama with 11 fringed setae. FCu distinctly distal to RM. Anal lobe moderately developed.

Legs. Fore tibia with 2 setae. Mid legs with 2 tibial spurs; 50 μm and 40 μm long, comb with 38-46 teeth. Hind leg with 2 tibial spurs; 50 μm and 40 μm long, comb with 40-44 teeth. Lengths (μm) and proportions of legs shown in table 6.

Hypopygium (Figs. 5b-c). Anal tergite band V shaped. Anal point slender with wide apex; 290-300, 295 μm long. 4-5 setae lateral to anal point. Tergite IX with several median setae. Posterior margin of tergite IX with 7-8 setae. Transverse sternapodeme 30-35, 33.5 μm long. Longitudinal sternapodeme 140 μm long. Superior volsella short, digitiform with 4 setae. Inferior volsella slender, 300 μm long, with strong spine at apex and two setae pre-apically. Gonocoxite 170-180, 175 μm long. Gonostylus 200-210, 205 μm long, slightly expanded pre-apically with pointed apex. HR 0.85-0.87, 0.86; HV 2.05-2.13, 2.09.

Table 6. Lengths (µm) and proportions of legs of *S. watsoni* Freeman, 1961.

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	BV	SV
P1	1000–1100, 1050	800–900, 850	–	–	–	–	–	–	–	–
P2	1000–1020, 1010	800–850, 825	500–550, 525	300	250–275, 262.5	150	70–100, 85	0.62–0.64, 0.63	2.93–2.96, 2.95	3.49
P3	1100–1125, 1112	1000–1050, 1025	750	425	375	200	125	0.71–0.75, 0.73	2.53–2.6, 2.56	2.8–2.9, 2.85

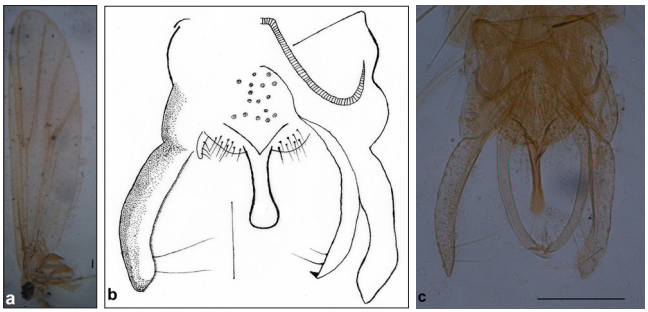

Figure 5. Adult male *Stenochironomus watsoni* Freeman, 1961. a) Wing, b) Hypopygium, c) Hypopygium, scale 0.01 mm.

Remarks. Freeman (1961) provided an initial but brief description of this species based on material from Australia. The species is somewhat similar with *S. longipalpis* (Kieffer, 1913) in having anal point with widened apex, but differs in the shape of superior volsella, variable number of setae on superior volsella along with the shape of gonostylus. The present study supplies a detailed redescription based on specimens collected from India, incorporating detailed illustrations, exhaustive morphometric analyses of all diagnostic structures, and molecular characterization using mitochondrial COI barcoding. In addition, a comparative assessment of key morphological characters between the Indian specimens and the original Australian material is presented in table 7, which aids in accurate species delimitation and confirms conspecificity across these geographically distinct populations.

Table 7. Morphological comparison between Indian and Australian *S. watsoni* Freeman, 1961.

Characters	Indian specimen	Australian specimen
AR	1.3	2
Wing length	2–2.2 mm	2–2.4 mm
Pre apical setae on inferior volsella	2	3
Setae on SV	4	4
Abdominal marking	Banded pattern on the apices of each segment	Banded pattern on the apices of each segment

Chironomus (*Chironomus*) *lobaticeps* Kieffer, 1911 (Figs. 6a-d)

GenBank accession number. PX859793

Material examined. Neotype, designated below; slide mounted (Fig. 6a), deposited at ZSI: ♂; India, West Bengal, Cooch Behar [26.4185° N, 89.7201° E], 30.04.2024, B. Mukherjee.

Additional material. Same data as neotype, 8 ♂; India, Andhra Pradesh, Nellore [14.3908° N, 80.0055° E], 20.04.2020, 7 ♂, R. Sharma.

Designation of neotype. A neotype fixation for *Chironomus* (*Chironomus*) *lobaticeps* Kieffer, 1911 is necessary to define objectively for both the genus and the species group as well. The type species designated with the following particulars (following ICZN 1999: Article 75.3).

1. The neotype is designated to permanently clarify the taxonomic status of the nominal taxon *Chironomus* (*Chironomus*) *lobaticeps* Kieffer, 1911.

2. The specimen designated is identified above (as in material examined).

3. Although Kieffer (1911) did not provide information regarding the type material in the original description of this species, all available paratypes were deposited in the National Zoological Collection (NZC), Zoological Survey of India (ZSI), Kolkata. During our examination of the type material, we found that all paratypes were completely damaged and destroyed, with no remaining specimen material available for study. Furthermore, no additional information regarding the holotype could be traced from the collections of ZSI or from the available literature. Therefore, the holotype of this species should be considered lost.

4. The specimen labelled only as *C. lobaticeps* Kieffer, 1911 (with no collection details provided on the label) was examined from the Diptera Section of ZSI. The dried and pinned specimen was slide-mounted and re-examined; however, most morphological structures were found to be damaged. Based on an extensive examination, the collected specimens were found to be fully consistent with *C. lobaticeps* Kieffer, 1911, particularly in the abdominal markings and hypopygial characteristics. Therefore, the specimen collected from Cooch Behar, West Bengal, India, is designated herein as the neotype, as it agrees morphologically with the original description by Kieffer (1911) and the historical specimen labelled as *C. lobaticeps* deposited in the Diptera Section of ZSI.

5. The neotype is the property of NZC, ZSI, a recognized scientific institution that houses and permanently preserves numerous name-bearing types.

Supplementary description

Distribution. OR (India).

Diagnostic characters. The adult male is distinguished from other species of the genus *Chironomus* by the presence of slightly rhomboid-shaped anal point at apex, slender superior volsella, and pre-apically widened gonostylus.

Male (n=16)

Total length 8.8-9.2, 9 mm. Wing length 4.95-5, 4.97 mm. Costal length 4.7-4.9, 4.8 mm. Antennal length 2-2.25, 2.12 mm.

Colouration. Thorax yellowish with brown stripes, leg colour light brown, abdomen yellowish with brown banded marking on the apices of segment.

Head. Head width 1180-1200, 1190 µm. Temporal setae 31-33 (IV 8, OV 20-21, Po 3-4). Clypeal setae 52-54. Frontal tubercles present, 50 µm long. Eyes bare with dorsomedial extension of 300-310, 305 µm. Ultimate flagellomere 1750-1850, 1800 µm long; AR 5.2-7, 6.1. Length of palpomeres (I-V) (µm): 35-40, 37.5: 80-90, 85: 300-310, 305: 200-205, 202.5: 240.

Thorax. Acrostichals 16-20, dorsocentrals 20, prealars 10, scutellars 46, and others not countable.

Wing (Fig. 6b). VR 0.96-1, 0.98. Brachiolium with 2 setae. Squama with 15 fringed setae. FCu slightly distal to RM. Anal lobe well developed.

Legs. Fore tibia with 2 setae. Mid legs with 2 tibial spurs; 50 µm and 40 µm long, comb with 38-46 teeth. Hind leg with 2 tibial spurs; 50 µm and 40 µm long, comb with 40-44 teeth. Lengths (µm) and proportions of legs shown in table 8.

Table 8. Lengths (µm) and proportions of legs of *C. lobaticeps* Kieffer, 1911.

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	BV	SV
P1	1750–1800, 1775	1750	2200–2250, 2225	1300	900–925, 912.5	920–925, 923	420–425, 423.5	–	–	–
P2	1750–1800, 1775	2000	1000–1100, 1050	750	575–580, 577.5	425	125–130, 127.5	0.62–0.64, 0.63	2.93–2.96, 2.95	3.49
P3	2350–2375, 2362.5	2245–2400, 2322,5	1750	1025	850–860, 855	525	150–160, 155	0.71–0.75, 0.73	2.53–2.60, 2.56	2.80–2.90, 2.85

Hypopygium (Figs. 6c-d). Anal tergite band V shaped. Anal point 200-230, 225 µm long, dark coloured rhomboid-shaped at apex; 290-300, 295. 10-12 setae present lateral to anal point. Tergite IX with 5-7 median setae. Transverse sternapodeme 130-150, 140 µm long. Longitudinal sternapodeme 540-550, 545 µm long. Superior volsella (Fig. 6d) long, slender with outward curving, 250-300, 275 µm long, with ovular prominent base, having 4 setae. Inferior volsella cylindrical shaped, 350-480, 415 µm long, with multiple setae at apex. Gonocoxite 550-650, 600 µm long. Gonostylus 220-350, 285 µm long, pre apically widened with pointed apex. HR 1.85-2.5, 2.18; HV 1.41-1.6, 1.51.

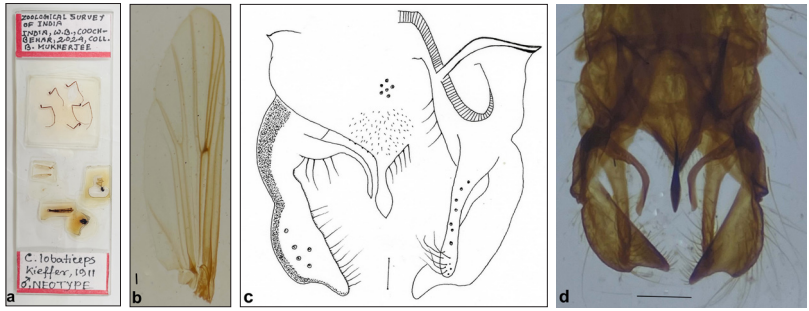

Figure 6. *Chironomus* (*Chironomus*) *lobaticeps* Kieffer, 1911, a) neotype, adult male slide mounted, b) Wing, c) Hypopygium, d) Hypopygium, scale 0.01 mm.

Remarks. *C. lobaticeps* was originally described by Kieffer (1911) based solely on the coloration of the entire body, making a supplementary description necessary. Therefore, the present study incorporates detailed morphological characters together with COI barcoding to facilitate accurate species identification.

CONCLUSIONS AND DISCUSSION

The present study significantly enhances the knowledge of Indian Chironomini by documenting several new distributional records supported by detailed morphological illustrations and, where applicable, molecular evidence. These records not only increase the

known species richness of Chironomidae in India but also provide valuable insights into the biogeographical history and dispersal pathways of the group across the Indian subcontinent.

The genus *Benthalia* Lipina, 1939 is recorded from India for the first time, further substantiated by COI barcoding, representing the first molecular data for the genus from India. Earlier, *Benthalia carbonaria* (Meigen, 1804) was known from the Palearctic and Oriental region (Hazra, Niitsuma, & Chaudhuri, 2016). Its occurrence in Western Ghats of India suggests a wider Oriental penetration than previously recognized and highlights the role of the Western Ghats and adjoining peninsular regions as a major biogeographical gateway for insect dispersal and persistence (Mani, 1974).

Robackia demeijerei (Kruseman, 1933), previously known from the Holarctic region (https://www.gbif.org/citation-guidelines#nondata), is newly recorded from Deccan Peninsular region of India, representing a significant southward extension of its known range. Prior to this study, only a single species of *Robackia* was reported from India, and the present record increases the species representation of this genus in the country.

The discovery of *Stenochironomus watsoni* (Freeman, 1961) from Central Himalayan region of India, constitutes a noteworthy addition to the Indian fauna. This species was previously known only from Australasia (Freeman, 1961), and its presence in northeastern India represents a substantial range extension. With this addition, the genus *Stenochironomus*, earlier represented by two species from India, now shows increased species diversity. Moreover, the COI of this genus have been documented very first from India, enriching the molecular library, which would aid in further accurate identification. Northeastern India, particularly the Central Himalaya, is widely recognized as a major faunal gateway, linking the Indian subcontinent with Southeast Asia and the Indo-Chinese region (Mani, 1974; Proches & Ramdhani, 2012). The complex topography, high precipitation, and habitat heterogeneity of this region promote colonization and diversification of taxa with Oriental and Australasian affinities, and the occurrence of *S. watsoni* strongly supports this biogeographical role.

Similarly, *Polypedilum masudai*, previously described from Oriental China (Zhang et al., 2016), is reported for the first time from India. This record increases the number of Indian species of *Polypedilum* (*Tripodura*) from eleven to twelve. The genus *Polypedilum* is ecologically versatile and widely distributed, and its expanded presence in India further underscores the strong faunal continuity between India and the broader Oriental region (Cranston, Oliver, & Sæther, 1989).

Collectively, the new records of *Benthalia carbonaria*, *Stenochironomus watsoni*, *Robackia demeijerei*, and *Polypedilum masudai* reveal complex biogeographical patterns, shaped by historical landmass movements, climatic oscillations, and ecological connectivity. The complementary distribution of these taxa across north-eastern India, eastern-central India, and western peninsular India highlights the combined influence of the northeastern faunal gateway and the western biogeographical corridor in structuring Indian Chironomidae diversity (Mani, 1974; Morrone, 2015).

In addition to the distributional and biogeographical findings, the present study addresses important nomenclatural issues of the species *C. lobaticeps* Kieffer, 1911. The type material was found to be severely damaged, rendering key diagnostic characters indiscernible. To

ensure taxonomic stability, a neotype is designated herein, accompanied by a supplementary description, in accordance with the provisions of the International Code of Zoological Nomenclature (ICZN, 1999). Furthermore, the taxon *C. vallidus* var. *lobaticeps* is regarded as a nomen dubium, and the neotype designation of *C. lobaticeps* is expected to facilitate accurate identification and future taxonomic resolution within this species complex.

Comprehensively, the COI gene, a universal molecular marker widely used across animal taxa (Hebert et al., 2003), was employed in the present study for accurate species identification and to further support taxonomic validation. COI-based approaches provide valuable complementary evidence for species recognition, particularly in taxonomically challenging groups such as Chironomidae (Ekrem et al., 2007; Carew et al., 2011). The deposition of COI sequences with accession numbers linked to voucher specimens provides a permanent molecular reference for future taxonomic studies, enabling reliable identification, comparative analyses, and biodiversity assessments. Furthermore, the integration of morphological characters with molecular data enhances the reliability of species delimitation and contributes to the development of a comprehensive DNA barcode library for Indian Chironomidae.

Overall, this study expands the documented diversity of Chironomini in India and emphasizes the importance of integrating morphological, molecular, biogeographical, and nomenclatural approaches. The findings reinforce India's pivotal role as a biogeographical crossroads and highlight the need for continued systematic surveys across underexplored regions to fully elucidate the diversity and evolutionary history of Chironomidae.

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