The Canadian Entomologist (2025), **157**, e49, 1–15
doi:10.4039/tce.2025.10032

Published on behalf of the Entomological Society of Canada

ARTICLE

Harnischia complex (Diptera, Chironomidae): systematic notes featuring a new species and two new records from India

Bindarika Mukherjee, Arka Mukherjee, Atanu Naskar, and Dhriti Banerjee

Zoological Survey of India, Prani Vigyan Bhawan, Kolkata, West Bengal, India
Corresponding author: Atanu Naskar; Email: atanudiptera@gmail.com

(Received 18 December 2024; accepted 26 August 2025)

Abstract

The *Harnischia* complex of the tribe Chironomini (Diptera: Chironomidae) comprises 20 genera. In the present study, we contribute to the taxonomic understanding of the genera *Beckidia* Sæther, *Cryptochironomus* Kieffer, and *Cryptotendipes* Beck and Beck of this complex in India. Our study employed an integrative taxonomic approach, incorporating morphological characteristics and molecular tools, to describe a new *Cryptotendipes* species. The genus *Cryptotendipes*, which comprises 26 species globally, is represented by five species in India, including the species that is newly described in the present study. In addition, we report new faunistic records for *Beckidia hirsti* (Freeman, 1957) and *Cryptochironomus tamaichimori* Sasa *in* Sasa and Kawai, 1987 for the first time from India.

Introduction

The *Harnischia* complex of tribe Chironomini (Diptera: Chironomidae) has been documented with 20 genera globally, among which 16 genera have been recorded from the Orient and 14 from India, including *Beckidia* Sæther, 1979; *Cladopelma* Kieffer, 1921; *Cryptochironomus* Kieffer, 1918; *Cryptotendipes* Beck and Beck, 1969; *Cyphomella* Sæther, 1977; *Demicryptochironomus* Lenz, 1941; *Harnischia* Kieffer, 1921; *Kloosia* Kruseman, 1933; *Microchironomus* Kieffer, 1918; *Olecryptotendipes* Zorina, 2007; *Parachironomus* Lenz, 1921; *Paracladopelma* Harnisch, 1923; *Robackia* Sæther, 1977; and *Saetheria* Jackson, 1977 (Mukherjee and Hazra 2023).

The genus *Cryptotendipes* comprises 24 species globally, of which eight have been recorded from the Oriental region, including four from India: *Cryptotendipes aculeatus* Pal and Hazra, 2018; *C. acutus* (Goetghebuer, 1936); *C. medialis* Mukherjee *et al.*, 2020; and *C. nodus* Yan *et al.*, 2005. In the present study, a new species, *Cryptotendipes tumidus* **sp. nov.**, is described, based on an integrated taxonomic approach, adding to the diversity of this genus in India.

To date, the genus *Beckidia* is represented by seven species, among which two species have been recorded from the Oriental region, including one species, *Beckidia inflata* Mukherjee and Hazra, 2023, from India (Mukherjee and Hazra 2023). In the present study, we report the first faunistic record of *Beckidia hirsti* (Freeman, 1957) from India, previously known to be found only in the Afrotropical region.

The genus *Crytochironomus* contains more than 140 valid species (Liu *et al.* 2024), with 20 species from the Oriental region, including 10 from India (Hazra *et al.* 2016). In the present

Subject editor: Joel Kits
ZooBank Registration number: urn:lsid:zoobank.org:pub:A11864AC-B4E5-422B-9226-7C9A9D8504E5

© The Author(s), 2025. Published by Cambridge University Press on behalf of Entomological Society of Canada.

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

study, *Cryptochironomus tamaichimori* Sasa *in* Sasa and Kawai, 1987 is reported for the first time from India; the species was previously reported from China and the Palaearctic regions.

Materials and methods

Study area

Specimens were collected from different regions of India, including different habitats, such as moist vegetation around lakes and dense forests with scattered aquatic bodies. Detailed data on the different collection sites are listed in Table 1 and shown in Fig. 1. (Fig. 1 map was made in ArcGIS Earth, version 2.2.1.4162; https://www.esri.com/en-us/arcgis/products/arcgis-earth/overview.)

Collection, preservation, and imagery

Specimens were collected using open white 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, 32 midge specimens were slide-mounted using phenol-balsam according to Wirth and Marston (1968), and a few 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.

Table 1. Collection sites of the present study

Location	Latitude, longitude	Specimen collection date
Nellore, Andhra Pradesh, India	14.3908° N, 80.0055° E	6 December 2020
Mumbai (suburban), Maharashtra, India	19.2289° N, 72.8691° E	28 May 2024
Kalimpong, West Bengal, India	27.0601° N, 88.4666° E	24 March 2024

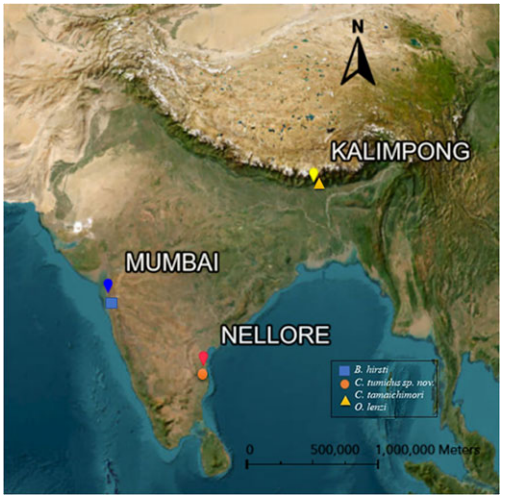


Figure 1. Distribution of the examined species of the *Harnischia* complex in India

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

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 molecular analyses, a small section of tissue was dissected from beneath 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 *c o*xidase 1 (*CO*1) gene was amplified using polymerase chain reaction with the primer pairs HCO2198: 5′-TAAACTTCAGGGTGACCAAAAAATCA-3′ and LCO1490: 5′-GGTCAACAAATCATAAAGA (Folmer *et al.* 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 Center 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 (leg conditions); 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 Center for Biotechnology Information.

Sequence analysis. The BLASTn tool was used to compare the *CO*1 sequence of the new species of *Cryptotendipes tumidus* with the GenBank sequences available for the nucleotide algorithm. In the molecular analysis of *Cryptotendipes*, the sequences of nine species were extracted from the NCBI database, and *Cryptochironomus rostratus* Kieffer, 1921 was employed as an outgroup based on Cranston *et al.* (2012); even though Mukherjee and Hazra (2023) reported *C. disparilis* as a junior synonym of *C. acutus*, it is still considered as *C. disparilis* in the present study because of the documentation in the NCBI database. In MEGA 11 genetics analysis software (https://www.megasoftware.net/), every sequence of the taxa under study was aligned and trimmed (Tamura *et al.* 2021), and JModelTest (https://github.com/ddarriba/jmodeltest2) was used to select the substitution model of the chosen sequence. The GTR+I+G model (general time reversal model with invariant sites and a gamma distribution for rates across the sites) was selected for performing tree analysis with JModelTest software (Darriba *et al.* 2012). To construct the neighbour-joining tree, the number of bootstrap replications was 1000, and both (transition and transversion) substitutions were included, with a site coverage of 95%. Genetic divergence between taxonomic groups was estimated using MEGA 11 and Kimura's two-parameter model (Kimura 1980; Tamura *et al.* 2021). The maximum-likelihood tree of *Cryptotendipes* was constructed using the CIPRES portal (https://www.phylo.org/; Miller *et al.* 2011) using IQ-TREE software (https://iqtree.github.io/) with default parameters, and the neighbour-joining tree was constructed using MEGA 11. The tree was visualised using FigTree, version 2.10.1 (https://tree.bio.ed.ac.uk/software/figtree/). Furthermore, only the interspecific genetic distance between the available *CO*1 sequences of *Cryptotendipes* species was estimated in MEGA 11 – and not the intraspecific distance – because only single nucleotide sequences of each species were available in the global database. The GenBank accession numbers for all species in this study are listed in Supplementary material, Table S1. Because sequences for other species were lacking in the NCBI database, species delimitations were performed using Puillandre *et al.*'s (2021) assemble species by

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

automatic partitioning method (ASAP) and Zhang *et al.*'s (2013) multi-rate Poisson tree process (mPTP; Supplementary material, Figs. S1, S2, and S3).

Genetic divergence between taxonomic groups was estimated in MEGA-X using Kimura's two-parameter model (Kimura 1980; Tamura *et al.* 2021).

Results

Taxonomy (morphological)

Order Diptera Linnaeus, 1758
Suborder Nematocera Dumeril, 1805
Infraorder Culicomorpha Hennig, 1948
Family Chironomidae Newman, 1834
Subfamily Chironominae Newman, 1834
Tribe Chironomini Newman, 1834

Genus *Cryptotendipes* Beck and Beck, 1969. Diagnosis. This small to medium-sized genus differs from other genera in the *Harnischia* complex in that it has an inner expansion on the basal half of the gonostylus and no apical tooth on the gonostylus.

***Cryptotendipes tumidus* sp. nov.** ZooBank Nomenclature Act: urn:lsid:zoobank.org:act:726EB2EB-0027-442B-B43D-E2F35BB41A98

GenBank accession number: PQ663818

Type material. HOLOTYPE: India; ♂ (on slide); collected from Andhra Pradesh, Nellore district; 14.3908° N, 80.0055° E; 6.xii.2020; 26 m; R. Kumar leg. PARATYPE: India; 4 ♂ (on slide), collected from Andhra Pradesh, Nellore district; 14.3908° N, 80.0055° E; 6.xii.2020; 26 m; R. Kumar leg.

Diagnosis. Adult males are distinguished from other species of the genus *Cryptotendipes* by the absence of acrostichals, the presence of a prominent D-shaped protrusion on the basal part of the gonostylus, a median ridge on tergite IX, and a ridge on the anal point.

Etymology. The name "*tumidus*," a Latin word, refers to a swollen expansion of the gonostylus.

Description. MALE (n = 5): total length 3.95–4.03, 3.98 mm, wing length 2.35–2.5, 2.43 mm, costal length 2.25–2.3, 2.28 mm, antennal length 0.9–0.94, 0.92 mm. Colouration: thoracic vittae present as yellowish–brown laterally, legs light brown, and abdomen yellow to light brown. Head: head width 5.25–5.30, 5.28 mm; temporal setae 3 (IV 0, OV 2, Po 1); clypeal setae 7–8; frontal tubercles are also observed; eyes bare, with dorsomedial extension of 200–210, 205 µm. Ultimate flagellomere 650–670, 660 µm long; AR 2.4–2.6, 2.5. Length of palpomeres (I–IV; in µm): 20–22.5; 37.5; 87.5–88; 115–116.5, last one not countable; CA 0.56–0.58, 0.57. Thorax: acrostichals 0, dorsocentrals 7, prealars 3, supraalars 1–2, and scutellars 4. Wing (Fig. 2A): VR 1.10–1.12, 1.11. Brachiolum with two setae. Squama with six fringed setae. FCu distinctly distal to RM. Anal lobe well developed. Legs: fore tibia with 2–3 setae; mid legs with two narrowly separated combs, each with one spur, 22.5-µm-long and 15-µm-long spurs, with 22 and 9 lateral teeth, respectively; hind legs with two narrowly separated combs, each with one spur, 25-µm-long and 20-µm-long spurs, with 32 and 9 lateral teeth, respectively; lengths (µm) and proportions of legs are shown in Table 2. Hypopygium (Fig. 2B–D): anal tergite bands Y-shaped; tergite IX with a median ridge and 5–6 apicomedian anal tergite setae. Anal point 75–77.5, 76.25 µm long, parallel-sided and rounded at the apex, having a median ridge. Transverse sternapodeme 42.5–43, 42.75 µm long; longitudinal sternapodeme 150–155, 152.5 µm long. Superior volsella (Fig. 2E) 35–37.5, 36.25 µm long, digitiform and slightly expanded at the apex, with two apical setae. Gonocoxite 160–162.5, 161.25 µm long. Gonostylus 135–137.5, 136.25 µm long, having a distinct basal protrusion with a strong inner margin, five setae distally with pointed apex. HR 1.18–1.19. 1.185; HV 2.46–2.48, 2.47.

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

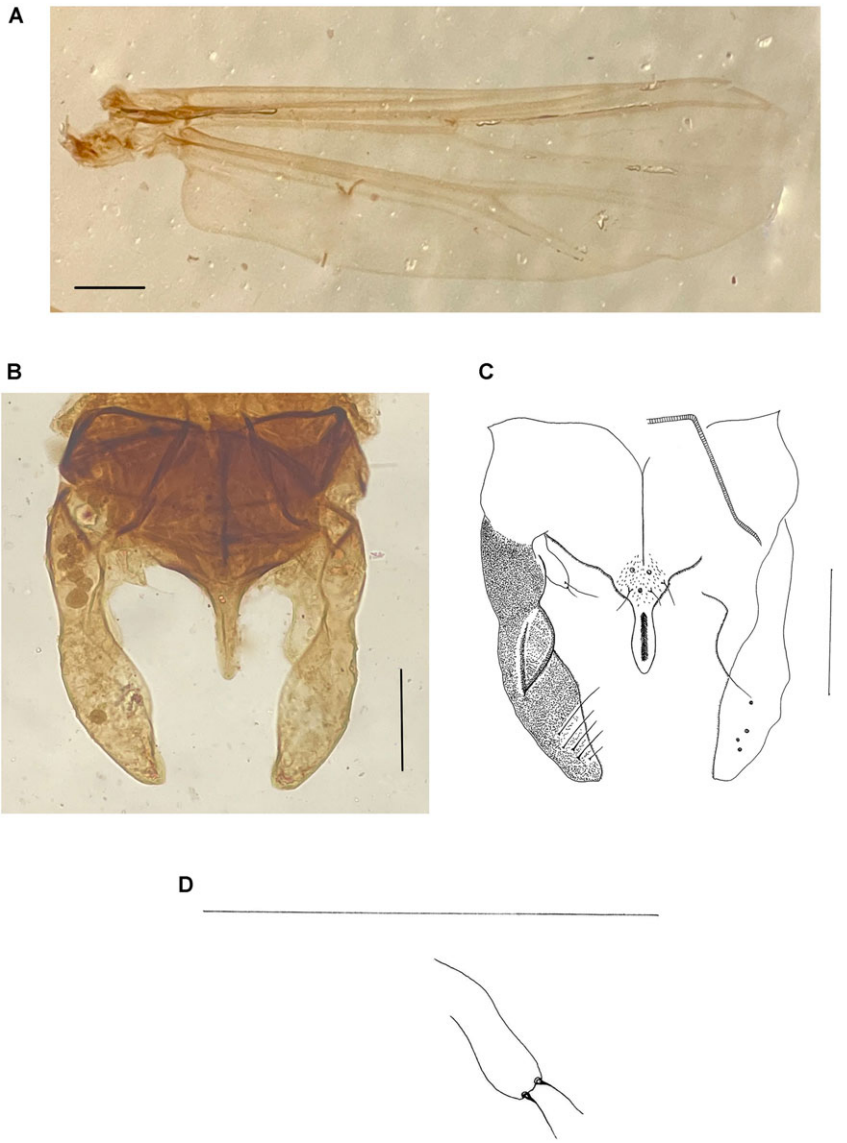


Figure 2. *Cryptotendipes tumidus* **sp. nov.** adult male: **A,** wing; **B,** hypopygium; **C,** hypopygium; and **D,** superior volsella. Scale bars: 100 μm

Table 2. Male leg lengths (μm) and proportions of legs in *Cryptotendipes tumidus* **sp. nov.** Fe, femur; Ti, tibia; Ta, tarsomere; LR, leg ratio; BV, beinverhältnisse; SV, schenkel–schiene–verhältnis (thigh–splint) ratio; BV, beinverhältnisse (leg conditions)

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR	SV	BV
P_1	750	500	925	550	400	275	150	1.85	1.35	1.58
P_2	775	725	350	200	175	100	100	0.48	4.28	3.22
P_3	850	875	550	350	300	175	125	0.63	3.14	2.39

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

Table 3. Comparison of some relevant characteristics of the Oriental species of *Cryptotendipes* Lenz, 1941. AR, antennal ratio; HR, hypopygium ratio; SV, schenkel–schiene–verhältnis (thigh–splint) ratio; Acs, acrostichals

Characters and taxa	*C. tumidus* **sp. nov.**	*C. aculeatus*	*C. acutus*	*C. daitogeheus*	*C. nodus*	*C. medialis*	*C. tobasecundus*	*C. tobatertius*	*C. bullum*
AR	2.5	2.35	1.99	1.89	1.74	2.42	1.81	1.58	1.98
HR	1.18	1.08	1.23	–	0.68	0.71	–	–	0.74
Anal tergite band	Y-shaped	V-shaped	V-shaped	V-shaped	V-shaped	V-shaped	–	–	V-shaped
SV length	36.25 µm	50 µm	25 µm	65 µm	25.3 µm	28.75 µm	–	47 µm	65 µm
Setae on SV	2	2	2–3	2	3	2–3	3	3	4
Ridge on the anal point	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Length of anal point	76.25	98 µm	75 µm	–	72 µm	70	–	–	75 µm
Gonostylus	Basal prominent expansion and six distal setae	Basal expansion abruptly narrowed at the apex	Little basal expansion with a gradually tapered apex	Slender and apically round	Slightly expanded basally with six long setae	Basal expansion with 6–8 inner setae	Long, slender, and concave inner margin, slightly expanded at the basal end	Conspicuously expanded at about basal 113, and strongly concave distally	Median bulb-like projection and inner margin medially concave
Acs	0	4	12–14	9	2	2–4	3–6	4	4

Distribution. India

Remarks. The new species was confirmed to belong to the genus *Cryptotendipes* by characteristics such as the presence of basal expansion of the gonostylus and the absence of apical teeth on the gonostylus. Among all valid species of this genus, the new species is morphologically closer to *C. acutus* (Goetghebuer, 1936). It has a similar type of superior volsella but differs in the shapes of the gonostylus, anal point, and anal tergite band, along with other morphometric variations. It also resembles *C. lyalichi* Zorina, 2006 with respect to the absence of acrostichals but entirely differs from that species in the shape of the hypopygium and other morphometric values. To increase the taxonomic comparative resolution, the new species was carefully compared with other Oriental species (Table 3) to establish its novelty within the genus *Cryptotendipes* of the *Harnischia* complex.

Sæther (1977), Yan *et al.* (2005), and Pal and Hazra (2018) had prepared a key for this genus previously, and Mukherjee *et al.* (2020) prepared a world pictorial key of the genus. The present study presents an updated key of the genus following the new discoveries and Mukherjee and Hazra's (2023) and He and Tang's (2025) proposed synonymic notes.

World key to the genus *Cryptotendipes* Beck and Beck (after Mukherjee *et al.* 2020)

1. Inner margin of gonostylus with basal or median projection 2
–. Inner margin of gonostylus without projection 24
2. Inner margin of gonostylus with median projection 3
–. Inner margin of gonostylus with basal projection 13
3. Anal point not longer than superior volsella 4
–. Anal point longer than superior volsella 6
4. Gonostylus with distinct concavity in apical half; Nearctic..... *C. tuberosus* (Sæther, 2010)
– Gonostylus without distinct concavity..... 5
5. Superior volsella columniform and straight; anal point rounded at the apex; Palaearctic ..... *C. nigronitens* (Edwards, 1929)
– Superior volsella digitiform and curved; anal point pointed at the apex; Palaearctic ..... *C. pflugfelderi* (Reiss, 1964)
6. Anal tergite with a high ridge or keel lies dorsally 7
– Anal tergite without ridge or keel 8
7. Acrostichals 1–7; dorsal ridge on proximal part of T IX; Holarctic ..... *C. casuarius* (Townes, 1945)
– Acrostichals absent; dorsal protrusion on distal part of T IX; Palaearctic ..... *C. lyalichi* (Zorina, 2006b)
8. Anal point with setae in basal half..... 9
–. Anal point entirely without setae 10
9. AR greater than 2.00; superior volsella with 2–3 apical setae and without lateral setae; Palaearctic ..... *C. usmaensis* (Pagast, 1931)
–. AR less than 2.00; superior volsella with one apical seta and two lateral setae; Orient ..... *C. tobatertius* (Kikuchi and Sasa, 1990)
10. Superior volsella with microtrichia only at base, inner margin of gonostylus sharply incised after proximal half; Holarctic..... *C. emorsus* (Townes, 1945)
–. Superior volsella with or without microtrichia, gonostylus without sharp concavity, smoothly curved 11
11. Superior volsella distinctly bilobed; Neotropics..... *C. daktylos* (Walley *in* Curran, 1934)
–. Superior volsella not bilobed 12
12. Superior volsella curved, swollen at the apex and truncated; anal point tapering to point; Nearctic ..... *C. pilicuspis* Sæther, 1977

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

–. Superior volsella straight, not swollen at the apex; anal point parallel-sided to point; Palaearctic ..... *C. parallelus* Yan *et al.*, 2005
13. Small digitiform lobe lies nearer to the middle of anal point 14
–. Anal point without lobe 18
14. Long setae of inner margin of gonostylus lie proximally; Orient ..... *C. medialis* Mukherjee *et al.*, 2020
–. Long setae of gonostylus present on entire inner margin 15
15. Tergite IX without dorsal or ventral lobes 16
–. Tergite IX with pair of dorsal and ventral lobes 17
16. Gonostylus with basal 1/3 moderately inflated; superior volsella apically triangular; Afrotropics, Orient, Palaearctic ..... *C. acutus* (Goetghebuer, 1936)
–. Gonostylus with basal 2/3 moderately inflated; superior volsella digitoform; Nearctic ..... *C. rutteri* (Epler, 2018)
17. Frontal tubercles absent; superior volsella pointed at the apex, without microtrichia; Orient ..... *C. tobasecundus* (Kikuchi and Sasa 1990)
–. Frontal tubercles present; superior volsella widened at the apex, covered by microtrichia; Palaearctic ..... *C. acalcar* (Reiss, 1990)
18. Tergite IX with distinct caudolateral shoulders; Holarctic ..... *C. darbyi* (Sublette, 1960)
–. Tergite IX without caudolateral shoulders 19
19. Superior volsella covered by microtrichia; gonostylus pointed at the apex; Nearctic ..... *C. ariel* (Sublette, 1960)
–. Superior volsella without microtrichia, gonostylus with variable ending 20
20. Anal point without lateral setae; Orient ..... *C. nodus* Yan *et al.*, 2005
–. Anal point with lateral setae 21
21. Tergite IX with no obvious band; superior volsella with four setae; Orient ..... *C. bullum* (Song and Wang, 2021)
–. Tergite IX with prominent bands; superior volsella with two apical setae 22
22. Anal tergite band Y-shaped; tergite IX with a median ridge; anal point with a ridge; Orient ..... *C. tumidus* **sp. nov**
–. Anal tergite band V-shaped; tergite IX without median ridge; anal point without ridge 23
23. Apex of anal point truncated; superior volsella with either two apical setae or two apical and one subapical seta; Orient ..... *C. daitogeheus* Sasa and Suzuki, 2001
–. Apex of anal point swollen; superior volsella with two apical setae; Orient ..... *C. aculeatus* Pal and Hazra, 2018
24. Gonostylus apically pointed; superior volsella with one apical and three subapical setae; Palaearctic ..... *C. holsatus* Lenz, 1959
–. Gonostylus apically rounded; superior volsella with two subapical and two apical setae; Holarctic ..... *C. pseudotener* (Goetghebuer, 1922)

Molecular identification

The aligned dataset contains 534 base pairs of the *CO*1 genes of nine species in the genus *Cryptitendipes*, family Chironomidae, where *Cryptochironomus* is used as an outgroup. We observed that the *CO*1 gene has 380 conserved sites, 59 variable singleton sites, 95 parsimony-informative sites, and 154 variable or polymorphic sites. In a search using BLASTn and NCBI, the similarity of our sequence matched 90.82% with the *Microchironomus* species of the family Chironomidae.

The results of both IQ-TREE software and MEGA 11 show nonmonophyly in the maximum-likelihood and neighbour-joining trees within the *Cryptotendipes* genus (Fig. 3). The interspecific

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

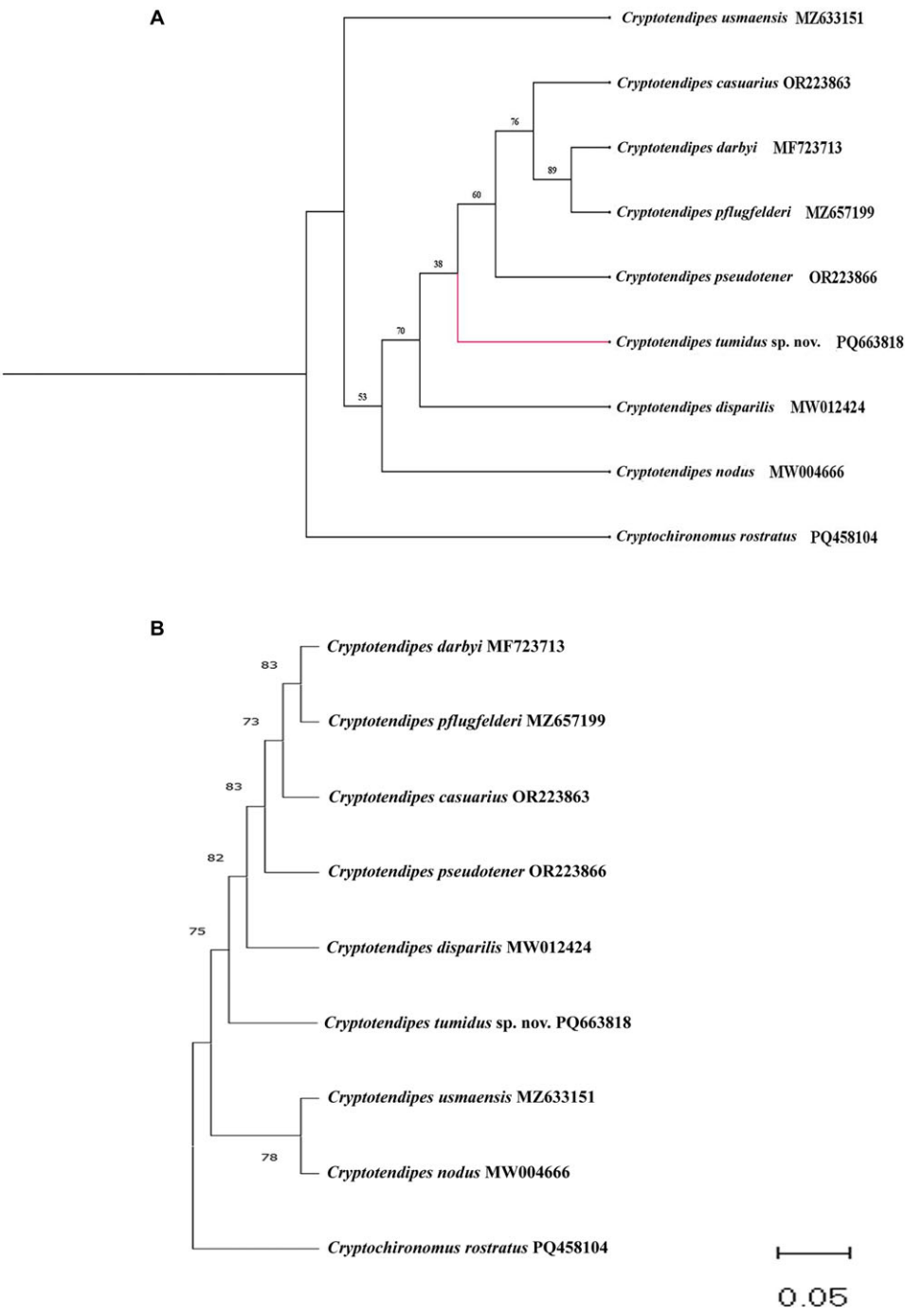


Figure 3. A, The maximum-likelihood tree, and **B,** the neighbour-joining tree of *Cryptotendipes* species, and one outgroup *Cryptochironomus rostratus* Kieffer, 1921 inferred from the *CO*1 nucleotide sequence data (534 bp)

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

Table 4. Kimura two-parameter average (per cent) interspecific distances obtained in MEGA 11 for the *Cryptotendipes* species

Taxa and interspecific distance	1.	2.	3.	4.	5.	6.	7.	8.
1. *C. usmaensis*								
2. *C. casuarius*	19%							
3. *C. darbyi*	18.87%	8.95%						
4. *C. disparilis*	18.61%	14.9%	13%					
5. *C. nodus*	14.10%	14.04%	14.27%	14.56%				
6. *C. pflugfelderi*	18.31%	9.83%	7.51%	13.81%	14.58%			
7. *C. pseudotener*	17.93%	9.58%	11.28%	13.03%	13.25%	12.07%		
8. *C. tumidus*	19.91%	15.11%	16.48%	13.83%	16.16%	14.28%	13.26%	

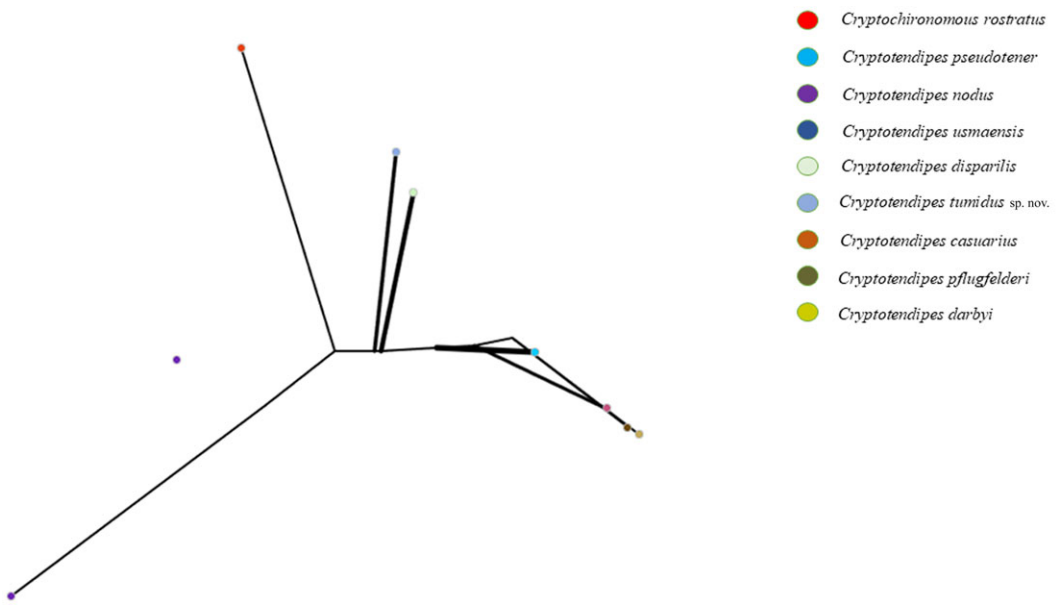


Figure 4. PhyloMap-PTP: PhyloMap visualisation of PTP species delimitation result

genetic distances between the species sequences available in the NCBI database were calculated. Among the interspecific genetic distances of *Cryptotendipes* species (Table 4), the highest genetic distance is between *C. usmaensis* and *C. tumidus* **sp. nov.** (19.91%), and the lowest is between *C. darbyi* and *C. pflugfelderi* (7.51%). The shortest distance between the new species and *C. pseudotener* is 13.26%. In this way, the molecular data also show the newness of this *Cryptotendipes* species and its closeness to *C. pseudotener*, whose Holarctic range and Palaearctic type locality both share important features with the Oriental realm. As only single nucleotide sequences were used for the analysis, the intraspecific genetic distances are not calculated.

Two species delimitation approaches were used to identify the new species: mPTP and ASAP (Supplementary material, Figs. S1, S2, and S3). The mPTP analysis shows nine individual molecular operational taxonomic units (*C. darbyi*, *C. pflugfelderi*, *C. casuarius*, *C. pseudotener*, *C. disparilis*, *C. usmaensis*, *C. nodus*, and *C. tumidus* **sp. nov.**), excluding the outgroup (Supplementary material, Fig. S3), and the ASAP shows the same result (Supplementary material,

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

Fig. S1). In the ASAP analysis, the best "partitioning" is observed in the fourth rank of the ASAP score among the seventh "best" partitions, based on Kimura's (1980) model.

In the IQ-TREE, the new species is the nearest neighbour to *Cryptodentipes pseudotener*. In the mPTP and ASAP analyses, all species separated perfectly, and the PhyloMap visualisation (Fig. 4) distinguished the new species. The bootstrap support of the maximum-likelihood and neighbour-joining trees was moderate due to the lack of NCBI sequences for *Cryptodentipes*, but the species delimitation analyses justified the molecular identification of *Cryptotendipes tumidus* **sp. nov**. as a new species.

New records from India

***Beckidia hirsti* (Freeman, 1957).** GenBank Accession No. PQ678659

Material examined. India – Maharashtra: 2 ♂ (on slide), Mumbai, 19.2289° N, 72.8691° E; 28.v.2024; 30 m; B. Mukherjee leg.

Diagnosis. The species *B. hirsti* is distinguished by the presence of two tibial spurs, a moderately narrow junction between gonostylus and gonocoxite, and a stout and evenly curved gonostylus.

Supplementary description. MALE (n = 2): total length 2.62 mm; wing length 1.55–1.65 mm; costal length 1.5–21.60 mm; antennal length 0.98 mm. Colouration: thorax with a light brown band, greenish–yellow abdomen. Head: width 4 mm; temporal setae 4 (IV 1, OV 2, Po 1); clypeal setae 14; frontal tubercles absent; eyes bare, with dorsomedial extension of 110–120 µm. Ultimate flagellomere 630 µm long; AR 1.7–1.8, 1.9. Length of palpomeres (I–IV; µm): 32.5; 75; 112.5; 160; last one not countable. CA 0.41. Thorax: acrostichals 0, dorsocentrals 4–5, prealars 3, supralars 1–2, and scutellars 2. Wings (Fig. 5A): VR 1.23; brachiolum with two setae; FCu distinctly distal to the RM. Anal lobe moderately developed. Legs: fore tibia with three setae and well-developed scale; mid legs with two narrowly separated comb, each with one spur, 25 µm and 17.5 µm long, with 12

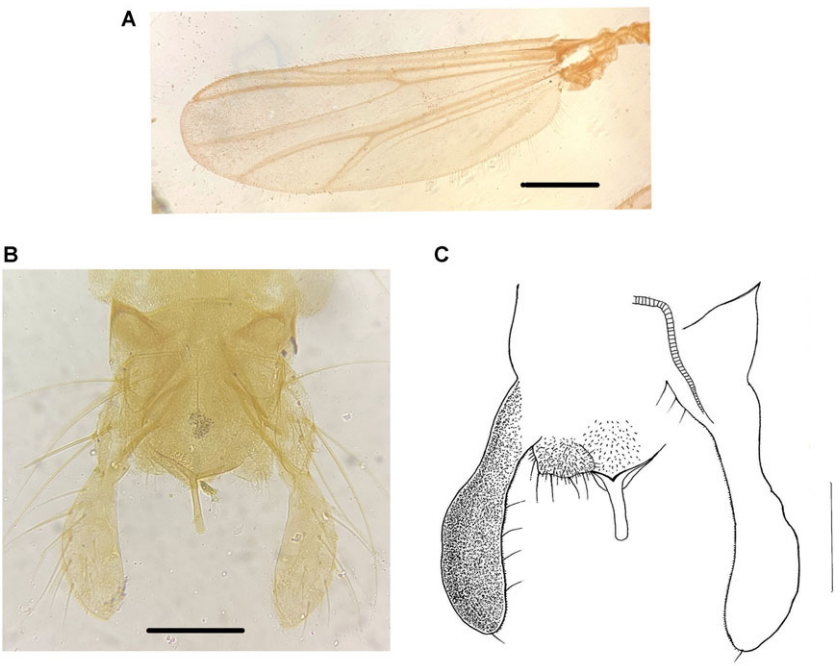


Figure 5. *Beckidia hirsti* adult male: **A,** wing; **B,** hypopygium (photograph); and **C,** hypopygium. Scale bars: 100 µm

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

Table 5. Male leg lengths (μm) and proportions of legs in *Beckidia hirsti.* Fe, femur; Ti, tibia; Ta, tarsomere; LR, leg ratio; SV, schenkel–schiene–verhältnis (thigh–splint) ratio; BV, beinverhältnisse (leg conditions)

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR	SV	BV
P_1	580	320	–	–	–	–	–	–	–	–
P_2	500	480	–	–	–	–	–	–	–	–
P_3	590	540	–	–	–	–	–	–	–	–

and 7 lateral teeth, respectively; hind legs with two narrowly separated combs, each with one spur, 27.5 μm and 12.5 μm long, with 18 and 8 lateral teeth, respectively; lengths (μm) and proportions of legs are shown in Table 5. Hypopygium (Fig. 5B, C): anal tergite band separated medially; anal point 40 μm long, parallel-sided and rounded at the apex. Laterosternite IX with 2–3 setae on each side of anal point. Transverse sternapodeme 20 μm long; longitudinal sternapodeme 75–80 μm long. Superior volsella roughly pediform, 25–30 μm long, 32.5 μm wide at the apex, broad apically with 5–7 setae. Gonocoxite 120–125 μm long. Gonostylus 125–130 μm long, evenly curved with a seta at the apex. HR 0.96; HV 2.19.

Remarks. Freeman (1957) illustrated this species under the genus *Chironomus* (*Cryptochironomus*) with only colouration, AR, and LR1, among all the morphological characters, and Sæther (1977) transferred this species within the genus *Beckidia* as a new combination. Following a comprehensive morphological assessment of the specimen, the species is considered to be *Beckidia hirsti*, based on the following combination of characters: AR 1.7–1.9, light brown marking on thorax, two tibial spurs, and evenly curved stout gonostylus. Upon examining the Indian specimen, AR 1.8 (AR 2 for the African specimen) and SV had seven setae (the illustration of the superior volsella provided in Freeman (1957, fig. 13a) shows five setae). In addition to this morphological study, the *CO*1 sequences of the species indicate proper taxonomic corroboration. This is the first faunistic record of this species from the Orient and India, suggesting a broader distribution of the species worldwide.

Distribution. Afrotropics (Sudan, Belgian Congo); Orient (India)

***Cryptochironomus tamaichimori* Sasa *in* Sasa and Kawai, 1987.** (Fig. 6A, B)

(n = 1)

Material examined. India – West Bengal: 1 ♂ (on slide), Kalimpong, 27.0601° N, 88.4666° E; 24.iii.2024; 798 m; T. Roy leg.

Diagnosis. This species is diagnosed by the presence of a pad-like superior volsella with 2–3 setae, one long seta posteriorly, and short and stout gonostylus abruptly narrowed at the apex and apically pointed.

Remarks. Sasa and Ichimori (1983) described this species as *Cryptochironomus* sp. "hentona", whereas M. Sasa documented this specimen as *C. tamaichimori* in Japanese notes on *Cryptochironomus* (Sasa and Kawai 1987). The presence of the following combination of characters fully identifies the present specimen as *C. tamaichimori*: pad-like SV with 1–3 setae and with one long seta on posterior margin; long anal point, narrow and slender; short and stout gonostylus narrowed abruptly near apex and apically pointed; bands of ninth tergite united in the middle; frontal tubercles small; WL 2.37 mm; and AR 2.51. Other important taxonomic characters not covered in Sasa and Ichimori (1983) include: squama with six fringed setae; gonocoxite 162.5 μm long; gonostylus 150 μm long; SV 65 μm long and 22.5 μm wide; IV 25 μm long with two setae at the apex; anal point 75 μm long; tergite IX with eight median setae; laterosternite IX with three setae on each side of anal point; longitudinal sternapodeme 175 μm long; transverse sternapodeme 87.5 μm long; CR 0.97; VR 1.02; HR 1.18; LR1 1.44; LR2 0.75; and LR3 0.73. This species is recorded for the first time in India.

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

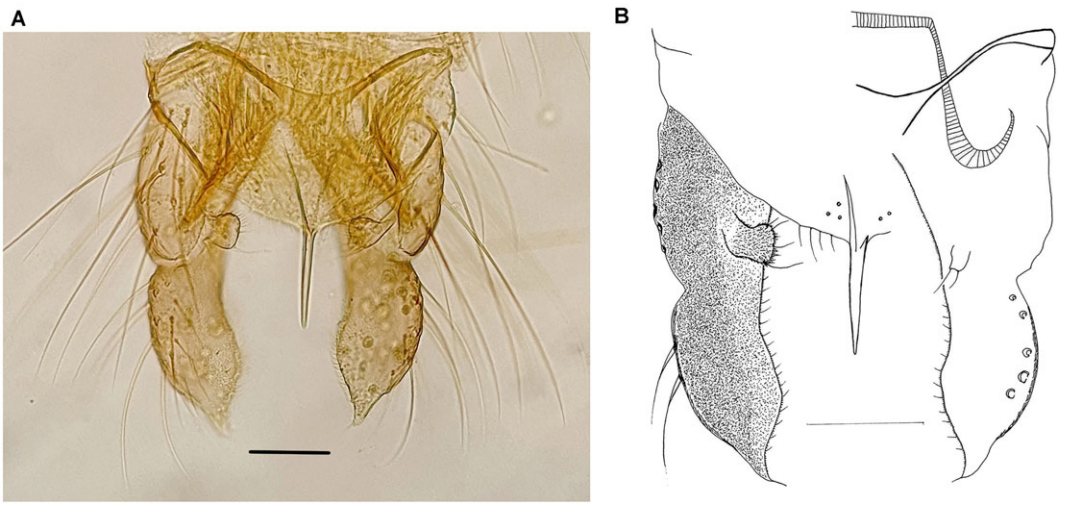


Figure 6. *Cryptochironomus tamaichimori* adult male: **A,** hypopygium (photograph); **B,** hypopygium. Scale bars: 100 µm

Distribution. Orient (China, India); Palaearctic (Japan, Russian Far East)

Discussion. The above-noted genera of the *Harnischia* complex have been recorded previously in the Oriental, Afrotropical, and Holarctic regions, whereas the present study describes their distribution in India. *Cryptotendipes tumidus* **sp. nov.** and *B. hirsti* are recorded from the Deccan plateau, the oldest plateau in India, the chironomid biodiversity of which is little known. The Afrotropical and Oriental distribution of *B. hirsti* offers critical insights into faunal migration routes through the northwestern gateway (*i.e.,* the corridor linking Afrotropical and Palaearctic faunas into India through the northwestern frontiers, especially the Western Himalaya) and the Western Syntaxial Bend of the western Himalayas, which traditionally are viewed as not conducive to faunal admixture (Mani 1974).

Cryptochironomus tamaichimori has been recorded in the Himalayan zone of West Bengal, a well-explored region in terms of chironomid diversity. Over the years, a variety of chironomid species have been documented in the northern and northeastern regions of India, representing both Holarctic and Oriental faunal elements. The present study's findings support the hypothesis of faunal exchange through the northeastern gateway (*i.e.*, the Indo–Burman ranges and northeastern hill corridors linking India with Southeast Asia and the Oriental region). The distribution of these species strongly suggests that India's chironomid fauna, much like many other animal groups, comprises a combination of species that originated from both Gondwanaland and the Holarctic region (Roback and Coffman 1989). This pattern reflects historical land connections and migrations that took place as the Indian subcontinent moved to its current position. However, despite the available distribution data, information on chironomid species diversity remains lacking in certain regions, particularly in Gondwana, southern, and western India. These regions remain largely unexplored, leaving gaps in our understanding of how chironomid species are distributed across these zoogeographic areas. Conducting more surveys and research in these regions is essential for building a complete picture of chironomid assemblages. In addition, morphological, geographical, and molecular taxonomic work in this group globally is incomplete. Given that the same or similar chironomid species from very different regions can have significant haplotype diversity in their conserved genes, such genetic information provides significant insights into and improved understanding of these species' populations. An improved understanding of this diversity and of India's faunal history and an application of an integrated taxonomical approach to the study of insect species could help to

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

broaden discussions of the biogeography, species movement, and evolutionary processes that shape biodiversity. In addition, morphological, geographical, and molecular taxonomic studies on this group remain incomplete worldwide. Since chironomid species from different regions often show high haplotype diversity even in conserved genes, genetic data can provide important insights into their populations. Combining this genetic information with India's faunal history and applying an integrated taxonomic approach would enhance our understanding of biogeography, species dispersal, and the evolutionary processes shaping biodiversity.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.4039/tce.2025.10032.

Acknowledgements. The authors thank the Director of the Zoological Survey of India, Kolkata, and Dr. Gurupada Mondal, Scientist-E, H.O.O., and the divisional in charge of the Zoological Survey of India. The authors are indebted to all other members of the Diptera section of the Zoological Survey of India, particularly Mr. Oishik Kar and Ms. Debjani Ghosh. The first author thanks the Zoological Survey of India, Govt. of India, for financial assistance in the form of a postdoctoral fellowship F.210-3/2022/Tech/2636.

Competing interests. The authors declare that they have no competing interests.

References

Cranston, P.S., Dillon, M.E., Pinder, C.V., and Reiss, F. 1989. The adult males of Chironominae (Diptera: Chironomidae) of the Holarctic region: keys and diagnoses. *In* Chironomidae of the Holarctic Region: Keys and Diagnoses. Part 3. Adult males. *Edited by* T. Wiederholm. Entomologica Scandinavica Supplement, **34**: 353–532.

Cranston, P.S., Hardy, N.B., and Morse, G.E. 2012. A dated molecular phylogeny for the Chironomidae (Diptera). Systematic Entomology, **37**: 172–188. https://doi.org/10.1111/j.1365-3113.2011.00603.x.

Darriba, D., Taboada, G.L., Doallo, R., and Posada, D. 2012. JModelTest 2: more models, new heuristics and parallel computing. Nature Methods, **9**: 772–772.

Folmer, O., Black, M., Lutz, R., and Vrijenhoek, R. 1994. DNA primers for amplification of mitochondrial cytochrome *c* oxidase subunit 1 from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology, **3**: 294–299.

Freeman, P. 1957. A study of the Chironomidae (Diptera) of Africa, South of Sahara, II. The Bulletin of the British Museum (Natural History), **5**: 323–426. https://doi.org/10.5962/bhl.part.1515.

Ghosh, D., Kar, O., Pramanik, D., Mukherjee, A., Sarkar, S., Mukherjee, K., et al. 2022. Molecular identification and characterization of muscid flies (Diptera: Muscidae) of medico-veterinary importance from the Gangetic plains of eastern India. International Journal of Tropical Insect Science, **42**: 3759–3769. https://doi.org/10.1007/s42690-022-00900-9.

Hazra, N., Niitsuma, H., and Chaudhuri, P.K. 2016. Checklist of chironomid midges (Diptera: Chironomidae) of the Oriental region. Occasional Paper No. 376. Records of the Zoological Survey of India. Zoological Survey of India, Kolkata, West Bengal, India. 204 pp.

He, Y. and Tang, H. 2025. Synonymic notes on two Mongolian *Cryptotendipes* species (Diptera, Chironomidae). Zootaxa, **5590**: 294–300.

Kimura, M. 1980. A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. Journal of Molecular Evolution, **16**: 111–120.

Liu, W.B., Wang, C.Y., Tang, Y.N., Pei, W.X., and Yan, C.C. 2024. DNA barcodes and morphology reveal new species within the *Cryptochironomus* Kieffer from Oriental China (Diptera: Chironomidae). Zootaxa, **5493**: 165–174.

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press

Mani, M.S. 1974. Ecology and biogeography in India. Dr. W. Junk Publishers, The Hague, The Netherlands. 773 pp.

Miller, M.A., Pfieiffer, W., and Schwartz, T. 2011. The CIPRES science gateway: a community resource for phylogenetic analyses. *In* Proceedings of the 2011 TeraGrid Conference: Extreme Digital Discovery, July 18–21, 2011, Salt Lake City, Utah. Association for Computing Machinery, New York, New York, United States of America. Pp. 1–8.

Mukherjee, B. and Hazra, N. 2023. Taxonomic studies on *Harnischia* complex from India (Diptera: Chironomidae). Zootaxa, **5278**: 239–263.

Mukherjee, B., Mukherjee, T., and Hazra, N. 2020. A new species of the genus *Cryptotendipes* Beck and Beck, 1969 (Diptera: Chironomidae) from India, with a world key to the males and tentative phylogenetic relationship. Zootaxa, **4896**: 201–223.

Pal, G. and Hazra, N. 2018. Two new species of the genus *Cryptotendipes* Lenz (Diptera: Chironomidae) from India, with a worldwide key to the genus. Oriental Insects, **53**: 34–45. https://doi.org/10.1080/00305316.2018.1439785.

Puillandre, N., Brouillet, S., and Achaz, G. 2021. ASAP: assemble species by automatic partitioning. Molecular Ecology Resources, **21**: 609–620. https://doi.org/10.1111/1755-0998.13281.

Roback, S.S. and Coffman, W.P. 1989. Tanypodinae pupae from southern India (Diptera: Chironomidae). *Proceedings of the Academy of Natural Sciences of Philadelphia*, **141**: 85–113.

Sæther, O.A. 1977. Taxonomic studies on Chironomidae: *Nanocladius*, *Pseudochironomus*, and the *Harnischia* complex. Bulletin of the Fisheries Research Board of Canada, **196**: 1–143.

Sæther, O.A. 1980. Glossary of chironomid morphology terminology (Diptera: Chironomidae). Entomologica Scandinavica Supplement, **14**: 1–51.

Sasa, M. and Ichimori, K. 1983. Studies on chironomid midges of the Tama River. Part 7. Additional species collected in winter from the main stream. Research Report from the National Institute of Environmental Studies, Japan, **43**: 100–122.

Sasa, M. and Kawai, K. 1987. Studies on the chironomid midges of Lake Biwa (Diptera, Chironomidae). Lake Biwa Study Monograph, 3. Lake Biwa Research Institute, Ohtsu, Shiga Prefecture, Japan. 119 pp.

Tamura, K., Stecher, G., and Kumar, S. 2021. MEGA 11: molecular evolutionary genetics analysis, version 11. Molecular Biology and Evolution, **38**: 3022–3027.

Wirth, W.W. and Marston, N. 1968. A method for mounting small insects on microscope slides in Canada balsam. Annals of the Entomological Society of America, **61**: 783–784. https://doi.org/10.1093/aesa/61.3.783.

Yan, C., Tang, H., and Wang, X. 2005. A review of the genus *Cryptotendipes* Lenz (Diptera: Chironomidae) from China. Zootaxa, **1086**: 1–24.

Zhang, J., Kapli, P., Pavlidis, P., and Stamatakis, A. 2013. A general species delimitation method with applications to phylogenetic placements. Bioinformatics, **29**: 2869–2876. https://doi.org/10.1093/bioinformatics/btt499.

Cite this article: Mukherjee, B., Mukherjee, A., Naskar, A., and Banerjee, D. 2025. *Harnischia* complex (Diptera, Chironomidae): systematic notes featuring a new species and two new records from India. The Canadian Entomologist. https://doi.org/10.4039/tce.2025.10032.

https://doi.org/10.4039/tce.2025.10032 Published online by Cambridge University Press