

## TWO NEW SPECIES OF *MONOPELOPIA* FITTKAU, 1962 FROM FORESTS IN INDIA ALONG WITH A KEY TO ADULT MALES OF ORIENTAL AND PALEARCTIC SPECIES (DIPTERA: CHIRONOMIDAE)

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### Abstract

Two new species of *Monopelopia* Fittkau, 1962 are described and illustrated from the Oriental region based on adult males and immature stages. *Monopelopia (Monopelopia) recta* sp. n. and *Monopelopia (Monopelopia) obscurata* sp. n. are described from India and a DNA barcode of *M. recta* is compared with congeneric sequences in NCBI GenBank. Additionally, a key to the adult males of genus *Monopelopia* reported from the Oriental and Palearctic regions is given.

### Introduction

The genus *Monopelopia*, belonging to the tribe Pentaneurini, was erected by Fittkau (1962). The genus is divided into two subgenera *Cantopelopia* Roback, 1971 and *Monopelopia* s.str. (Cranston and Epler 2013; Silva and Ekrem 2016). According to the world catalogue of Chironomidae (Ashe and O'Connor 2009), this genus includes 11 species. Later, six new species from the Neotropical region were described by Oliveira et al. (2010) and Dantas and Hamada (2017) and two from the Oriental region (Paul et al. 2014; Duan et al. 2021). So far, a total of 19 species (15 belonging to *Monopelopia* s.str. and 4 species within *Cantopelopia*) have been described, of which four are from the Oriental region.

The present study includes description of two new species of the genus *Monopelopia* from India. A key to the adult male *Monopelopia* reported from the Oriental and Palearctic regions is also given.

### Materials and methods

Adult midge specimens were caught using open light trap and preserved in 70% ethanol. To facilitate association, larvae and pupae were reared individually in glass vials containing water and a small amount of habitat substrate (Epler 1995). Emerged specimens and immature skins were preserved in 70% ethanol. Specimens were slide mounted in Canada Balsam following the technique of Wirth

and Marston (1968). The general terminology follows Sæther (1980). All specimens examined are now retained in the collection of insects in the Entomology Division, Department of Zoology, The University of Burdwan, West Bengal, India and will be deposited in the National Zoological Collections (NZCI), Kolkata.

Thorax and one set of legs from one of the collected specimens were processed for DNA extraction using Qiagen DNeasy Blood and tissue kit. The extracted DNA was amplified using cytochrome c oxidase subunit I (COX I) universal primers LCO 1490 and HCO 2198 (Folmer et al. 1994) following the protocol of Lin et al. 2018. The amplified products were visualised by 1% agarose gel electrophoresis. The amplified products were outsourced for bidirectional Sanger's sequencing. The obtained sequence, trace files and other details were uploaded to the NCBI GenBank. MEGA X (Kumar et al. 2018), was used to calculate pairwise 2-Parameter (K2P) distances among the fifteen most similar sequences obtained through a BLAST search on NCBI GenBank. The K2P substitution model, 1000 bootstrap replicates, and pairwise deletion option for missing data were used to build the neighbor-joining tree in MEGA X.

Selected abbreviations are: BV – Beinverhältnisse (combined length of femur, tibia and tarsomere 1/ combined length of tarsomeres 2 to 5), SV – Schenkel-Schiene-Verhältnis (length of femur and tibia/ length of tarsomere 1), OR – Oriental region, PA – Palaearctic region, NE – Nearctic region.

### Results

#### *Monopelopia (Monopelopia) recta* sp. n.

<https://zoobank.org/3E037AAF-2981-42A3-A04C-959B52B4752C>

**Type Material.** Holotype male, labelled '*Monopelopia recta* sp. n. Mondal, Mukherjee and Hazra., India, West Bengal, Matha (23.11, 86.06),

03.VII.2019, Coll. D. Mondal'. Paratypes 3 males, same data as holotype. GenBank accession number: MW168820.

**Diagnosis.** AR 1.78–1.81 (1.81); squamal setae 15–17 (17); wing with macrotrichia on the distal portion; abdominal tergites I–V with broad anterior bands, T VI–VIII brown; 4–5 stout setae on second palpomere; fore, mid, and hind tibial spurs each with 3 lateral teeth, hind tibial comb with 8 setae; anal point short and conical; gonocoxite bearing with 3 strong dorsomedial setae in a uniform row; T IX with 2 dorsolateral setae on each side.

**Etymology.** The name '*recta*' is of Latin origin meaning 'straight' referring to inner side of gonocoxite bearing 3 strong basal setae in a straight row.

### Description

Male imago (n = 4). Total length 1.92–1.99 (1.98) mm.

**Colouration.** Head brown. Antenna pale brown, maxillary palp light brown. Thorax dark, vittae pale, antepnotum dark, wing membrane pale, cross vein dark brown, legs pale brown, T I–V of abdomen (Fig. 1D), with dark anterior bands, T VI–VIII brown. Hypopygium brown, megaseta dark.

**Head.** Eyes with dorsomedial extension 62–66 (62)  $\mu\text{m}$ . Antenna with strong preapical seta (Fig. 1A); number of flagellomeres 14, AR 1.78–1.81 (1.81). Temporal setae uniserial, 10–12, postorbitals 2–3. Clypeus with 17–19 (18) setae. Length of palpomeres I–V ( $\mu\text{m}$ ): 22–27 (23): 28–35 (30): 98–104 (102): 100–108 (104): 116–128 (119); second palpomere with 4–5 long pale setae. CA 0.66–0.70 (0.70). CP 1.29–1.34 (1.32).

**Thorax.** Scutal tubercle absent. Antepnotum with 3–4 (4) lateral setae; acrostichals 26–28 (26), irregularly biserial; humerals 8; dorsocentrals 15–18 (15) on each side, uniserial in middle and biserial distally; prealars 5–6; scutellars 9–10 (9).

**Wing** (Fig. 1B). Wing length from arculus 1.15–

1.18 (1.18) mm, width 0.39–0.42 (0.40) mm, L/W 2.89–2.98 (2.95). Total length/WL 1.67–1.72 (1.68). WL/ length of forefemur 2.12–2.19 (2.15). Wing membrane with macrotrichia on distal portion; squama with 15–17 (17) setae; brachiolum with 2 setae; vein lengths ( $\mu\text{m}$ ): C 1045–1055 (1050), Sc 568–577 (575), R<sub>1</sub> 445–453 (450), R<sub>2+3</sub> absent, R<sub>4+5</sub> 646–652 (650), M<sub>1+2</sub> 794–807 (800); anal lobe well developed, angular; CR 0.86–0.89 (0.89); VR 0.86–0.88 (0.88).

**Legs** (Fig. 1C). Fore tibial spur 43–48 (46)  $\mu\text{m}$  long bearing 3 lateral teeth; spurs of mid tibia 47–52 (52)  $\mu\text{m}$  long bearing 3 lateral teeth; spurs of hind tibia 58–65 (64)  $\mu\text{m}$  long, with 3 lateral teeth [not visible in Fig. 1C]. Hind tibial comb with 8 setae. Lengths and proportions of leg segments as in table 1.

**Abdomen.** T IX with 2 dorsolateral setae on each side (Fig. 1E). Abdominal banding pattern as in Fig. 1D.

**Hypopygium** (Fig. 1E). Anal point short and conical. Gonocoxite cylindrical, 138–145 (140)  $\mu\text{m}$  long, 67–70 (69)  $\mu\text{m}$  wide, 2.02  $\times$  as long as broad, 3-setal row. Gonostylus simple, slightly curved inwardly, 60–84 (72)  $\mu\text{m}$  long, basal width 26–28 (28)  $\mu\text{m}$ , Gs/Gc 0.67. Megaseta 9–11 (11)  $\mu\text{m}$  long. Phallapodeme 19–22 (21)  $\mu\text{m}$  long. HR 1.50–1.72 (1.69); HV 2.70–2.86 (2.83).

### Remarks

Some distinguishing male characters of *Monopelopia* (*Monopelopia*) *recta* sp. n. are compared with eight morphologically similar species in Table 2.

The submitted sequences have shown 8.6 % divergence with the closest sequences in GenBank of NCBI (Fig. 2).

**Distribution and bionomics.** *Monopelopia recta* is so far known only from India. Matha is a dense forested area with deciduous vegetation occupying the eastern fringes of the Chota Nagpur plateau. There are small streams within the forests and trees with tree holes containing water at the time of col-

Table 1. Lengths ( $\mu\text{m}$ ) and proportions of leg segments of *Monopelopia* (*M.*) *recta* sp. n. Mean values in parentheses.

	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>4</sub>	ta <sub>5</sub>	LR	BV	SV
P <sub>1</sub>	520–550 (550)	432–470 (450)	415–440 (425)	260–290 (280)	140–170 (152)	90–120 (102)	0.90–0.95 (0.94)	1.87–1.95 (1.93)	2.06–2.15 (2.13)
P <sub>2</sub>	650–688 (675)	456–480 (475)	500–536 (525)	280–310 (300)	152–186 (175)	115–137 (125)	1.02–1.13 (1.11)	1.92–2.02 (2.03)	3.79–3.88 (3.83)
P <sub>3</sub>	552–586 (575)	510–545 (525)	–	–	–	–	–	–	–

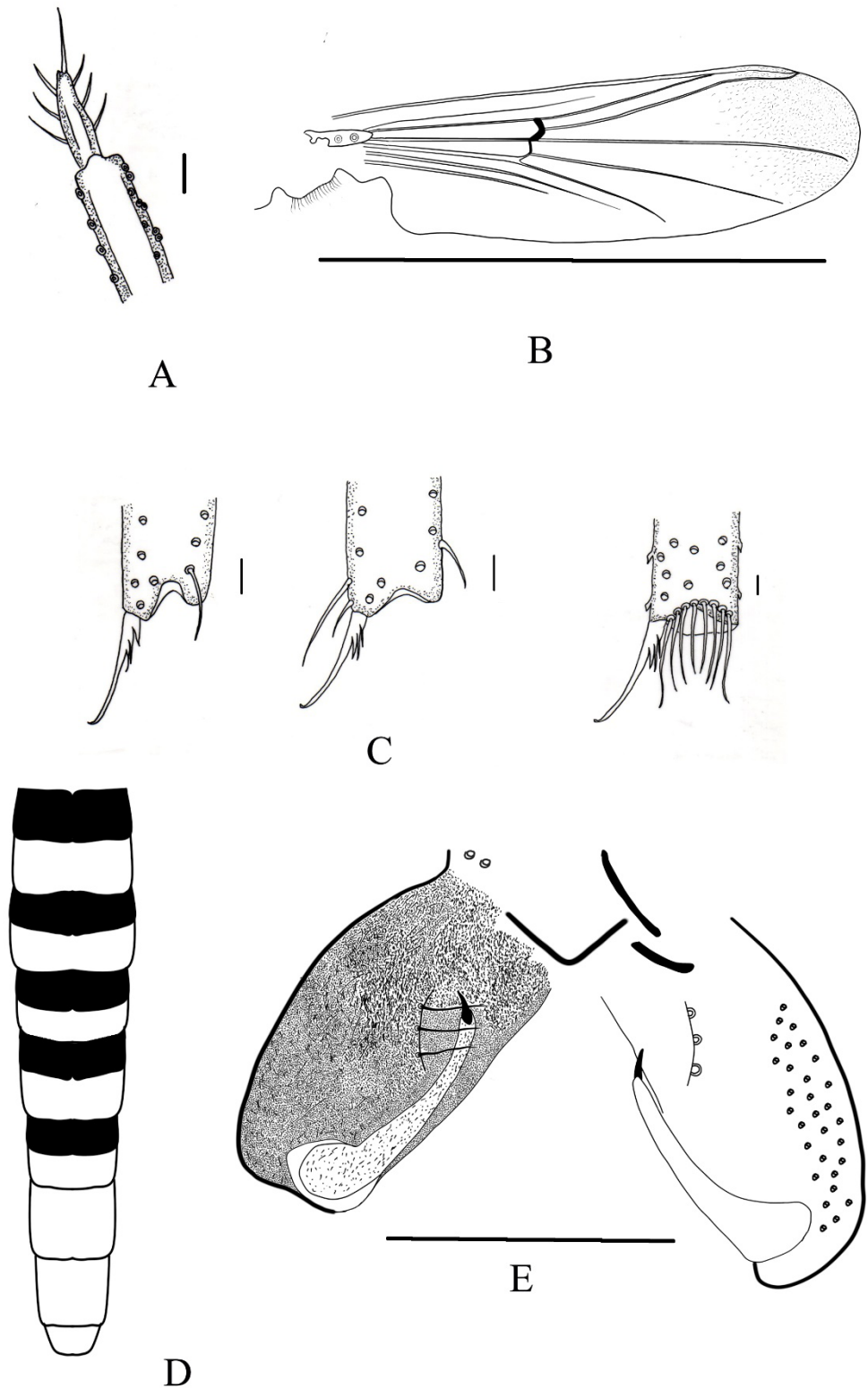


Figure 1. Male of *Monopelopia (Monopelopia) recta* sp. n. A, ultimate antennal flagellomere, scale: 30  $\mu$ m; B, wing, scale: 1 mm; C, tibial spurs, scale: 10  $\mu$ m; D, abdomen showing dark bands; E, hypopygium, scale: 100  $\mu$ m.

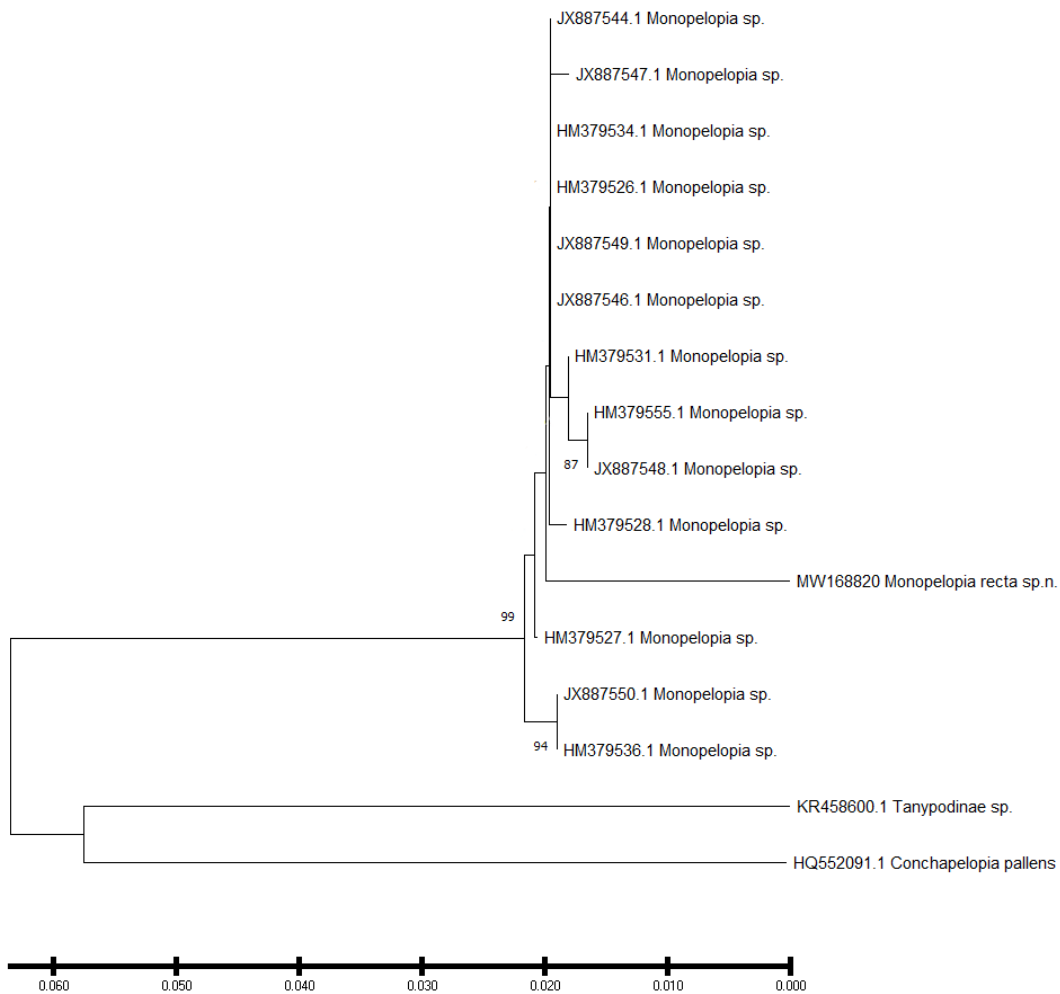


Figure 2. Neighbor-Joining tree based on the COX1 gene sequences of *Monopelopia recta* sp. n. and thirteen most similar sequences from NCBI GenBank. Scale: K2P genetic distance.

lection. The species was collected from light traps set from dusk to dawn using incandescent bulb.

***Monopelopia (Monopelopia) obscurata* sp. n.**

<https://zoobank.org/0A5C24CA-B5A8-489A-AC6A-B5C3F69C385D>

**Type Material.** Holotype male with larval and pupal exuviae (reared), labelled as ‘*Monopelopia obscurata* sp. n. Mondal, Mukherjee and Hazra, India, West Bengal, Suntaley khola (27.01, 88.78), 03.VII.2019, Coll. D. Mondal’.

**Diagnosis.** The new species can be separated from other members of the subgenus *Monopelopia* by having the following combination of characters: Male. AR 1.46; wing uniformly covered with dense macrotrichia; darkened r-m cross vein; hind tibial comb with 6 setae; T IX with 2 dorsolateral setae on each side. Pupa. Thoracic horn without acute apical projection, plastron plate occupying distal fifth of thoracic horn, L/W 6.1. Larva. Pecten hypopharyngis with 4 teeth, posterior parapod

with one darkened strongly curved claw with 5 inner teeth.

**Etymology.** The name ‘*obscurata*’ is of Latin origin meaning ‘darkened’ referring to darkened cross-vein, to be treated as adjective.

**Description**

Male imago (n = 1). Total length 1.62 mm. Wing length from arculus 1.16 mm, width 0.33 mm, L/W 3.5. Total length / WL 1.39. WL / Length of forefemur 2.44.

**Colouration.** Head brown. Antenna pale brown, maxillary palp light brown. Thorax brown, vittae dark, anteprepronotum dark, wings uniform pale except, dark brown cross vein, legs pale brown, abdomen entirely pale brown. Hypopygium brown.

**Head.** Eyes bare, dorsomedian extension 73.6 μm. Apical seta of antenna (Fig. 3B) 34.5 μm, AR 1.46. Temporal setae 9, uniserial. Clypeus with 28 setae. Length of palpomeres I-V (μm): 27.6: 34.5: 110.4: 115: 128.8. CA 0.66. CP 0.97.

Table 2. Comparison of male adult *Monopelopia (M.) recta* sp. n. and *Monopelopia (M.) obscurata* sp. n. with eight morphologically similar species.

	AR	LR <sub>1</sub>	Setae in Ti <sub>3</sub> comb	Wing membrane	Squamal setae	Dorsolateral setae on TIX	Median setal row on Gc	Megaseta (µm)	HR	Anal point
<i>M. (M.) iara</i>	1.13	0.97	9	Sparsely covered with macrotrichia	14	2 each side	Absent	11	1.31	Conical
<i>M. (M.) tenuicalcar</i>	1.16	0.80	6	Densely macrotrichiose	—	1 each side	Absent	12	1.52	Conical
<i>M. (M.) caraguata</i>	1.05	0.95	5	Macrotrichiose	13	4 each side	Absent	10	1.58	Long
<i>M. (M.) macunaima</i>	0.87	0.82	9	Few macrotrichiae over entire wing	12	3 each side	Absent	12	1.44	Broad based, conical
<i>M. (M.) edentata</i>	0.91	0.88	—	Few macrotrichiae over entire wing	12	4 each side	Absent	13	1.35	Broad based, conical
<i>M. (M.) mongpuense</i>	1.12	1.08	8	Macrotrichiose progressively denser toward the apex	18	3 each side	Absent	16	1.44	Short, straight
<i>M. (M.) adeliae</i>	1.17	0.75	7	Sparsely covered with macrotrichia	21	3 each side	Absent	14	1.35	Conical
<i>M. (M.) obscurata</i> sp. n.	1.46	1.04	6	Densely macrotrichiose	14	2 each side	Absent	13.8	2.0	Broad based, conical
<i>M. (M.) recta</i> sp. n.	1.81	0.94	8	Macrotrichiose distally	17	2 per side	Present	11	1.69	Short, conical

**Thorax.** Scutal tubercle and pit absent. Anteprototum with 2 lateral setae; acrostichals 32, irregularly biserial; dorsocentrals 19 each side, biserial anteriorly and uniserial posteriorly; prealars 5; scutellars 9.

**Wing** (Fig. 3A). Wing membrane with dense macrotrichia; squama with 14 setae; brachiolum with 2 setae; vein lengths ( $\mu\text{m}$ ): C 980, Sc 475,  $R_1$  375,  $R_{4+5}$  550,  $M_{1+2}$  700,  $R_{4+5}$  ending long before  $M_{1+2}$ ; anal lobe round, poorly developed; CR 0.84; VR 0.86.

**Legs.** Tibial spurs as in Fig. 3C. Ti I spur 39.1  $\mu\text{m}$  long; Ti II spur 41.4  $\mu\text{m}$  long; Ti III spur 52.9  $\mu\text{m}$  long; hind tibial comb with 6 setae. Length ( $\mu\text{m}$ ) and proportions of leg segments as in Table 3.

**Abdomen.** T IX with 2 dorsolateral setae on each side.

**Hypopygium** (Fig. 3D). Anal point conical in shape with broad base. Gonocoxite 135  $\mu\text{m}$  long, 51  $\mu\text{m}$  wide, L/W 2.64. Gonostylus simple, curved inwardly, 64.4  $\mu\text{m}$  long, basal width 18.4  $\mu\text{m}$ , Gs/Gc 0.75. Megaseta 13.8  $\mu\text{m}$  long. Phallapodeme 48.3  $\mu\text{m}$  long; HR 2; HV 2.53.

**Pupa** (n = 1)

**Colouration.** Exuviae pale yellow without apparent pattern.

**Total length.** 2.58 mm.

**Cephalothorax.** Frontal apotome triangular. Wing sheath 968  $\mu\text{m}$  long. Thoracic horn (Fig. 4A) tubular, 285  $\mu\text{m}$  long, 46.7  $\mu\text{m}$  broad without apical spine, surface with scattered broad-based spinules, ThR 6.1, plastron plate egg-shaped, 142  $\mu\text{m}$  long, 84  $\mu\text{m}$  wide occupying 0.38 length of horn; respiratory atrium tubular, about a third of the width of Th, walls thick with narrow duct-like lumen, basal lobe reduced.  $Dc_1$  112  $\mu\text{m}$  long,  $Dc_2$  111  $\mu\text{m}$  long and Sa 86  $\mu\text{m}$  long.

**Abdomen** (Figs. 4b–c). Scar on tergite I 128  $\mu\text{m}$  long, elongate and without pigmentation. Tergites I–VIII without shagreen, 4 LS setae on tergite VII

located at 0.27, 0.47, 0.62 and 0.91 respectively from anterior margin; tergite VIII with 5 LS setae located 0.36, 0.50, 0.73, 0.87 and 0.98 respectively from anterior margin. Anal lobe 320  $\mu\text{m}$  long, 265  $\mu\text{m}$  wide; L/W 1.2, outer margin with 6 spinules, male genital sacs 351  $\mu\text{m}$  long, 187  $\mu\text{m}$  wide, not extending beyond apices of anal lobes, G/F 1.09, L/W 2.70.

**Fourth instar larva** (n = 1)

Total length 3.2 mm.

**Colouration.** Pale yellow.

**Head.** Cephalic index 0.49. Antenna (Fig. 5A). AR 3.54; length of antennal segments I–IV ( $\mu\text{m}$ ): 253, 59.8, 4.6, 6.9; ring organ situated 0.54 from base; blade 55  $\mu\text{m}$  long, accessory blade 51  $\mu\text{m}$  long. Mandible (Fig 5B.). 69  $\mu\text{m}$  long; apical tooth 23  $\mu\text{m}$  long, basal tooth 16.1  $\mu\text{m}$  long; A1/MD 3.67. Maxilla (Fig 5C.). Basal segment 32.2  $\mu\text{m}$  long; ring organ situated 0.46 from base. Mentum and M appendage (Fig. 5D). Two small dorsomental teeth reduced, 4  $\mu\text{m}$  long, on each side of base. Pseudoradula 69  $\mu\text{m}$  long with distally coarser granulation. Ligula (Fig. 5E). 54  $\mu\text{m}$  long, with 5 subequal teeth forming slightly concave margin; paraligula 34.5  $\mu\text{m}$  long, bifid. Pecten hypopharyngis with 4 teeth.

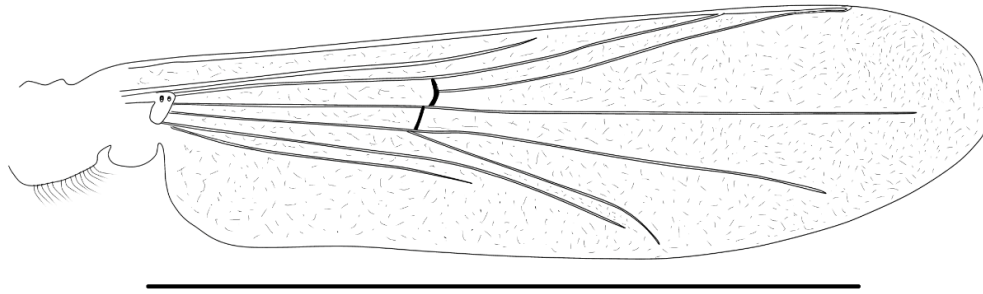
**Cephalic chaetotaxy** (Fig. 5F). Dorsal seta. S7 and S8 closely placed each other and along with S5 formed acute angle. Ventral seta. VP and SSm directly medial;  $S_{10}$  further anterolateral;  $S_9$  even further anteromedial.

**Body.** Anal tubules cylindrical, 94.3  $\mu\text{m}$  long, 25.3  $\mu\text{m}$  wide; supra-anal setae 264.5  $\mu\text{m}$  long. Procerus 88  $\mu\text{m}$  long and 33  $\mu\text{m}$  wide with 7 apical setae. Length of sub basal setae of posterior parapod 128  $\mu\text{m}$ . total number of setae 4; 2 long claws each with 4 and 2 inner teeth, short claw one with 2 inner teeth and another strongly curved claw with 4 inner teeth (Fig. 5G).

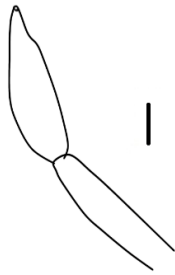
Table 3. Length ( $\mu\text{m}$ ) and proportions of leg segments of *Monopelopia* (*M.*) *obscurata* sp. n.

	Fe	Ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub>	LR	BV	SV
P <sub>1</sub>	475	382	400	232	158	98	76	1.04	2.22	3.69
P <sub>2</sub>	600	410	501	256	195	110	88	1.22	2.32	4.33
P <sub>3</sub>	512	450	—	—	—	—	—	—	—	—





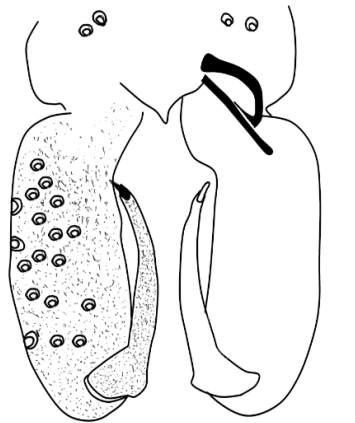
A



B



C



D

Figure 3. Male of *Monopelopia (Monopelopia) obscurata* sp. n. A, wing, scale: 1 mm; B, ultimate flagellomere, scale: 30  $\mu$ m; C, tibial spurs, scale: 10  $\mu$ m; D, hypopygium, scale: 100  $\mu$ m.

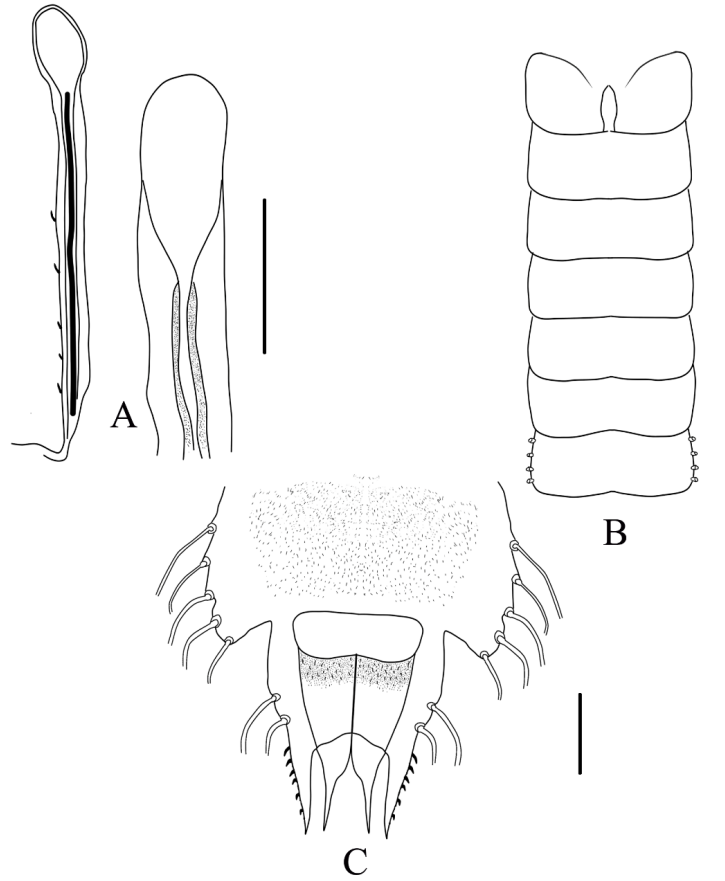


Figure 4. Pupal exuvia of *Monopelopia (Monopelopia) obscurata* sp. n. A, thoracic horn, scale: 100  $\mu$ m; B, abdominal TII-TVII, scale: 1 mm; C, tergite VIII and anal lobe, scale: 100  $\mu$ m.

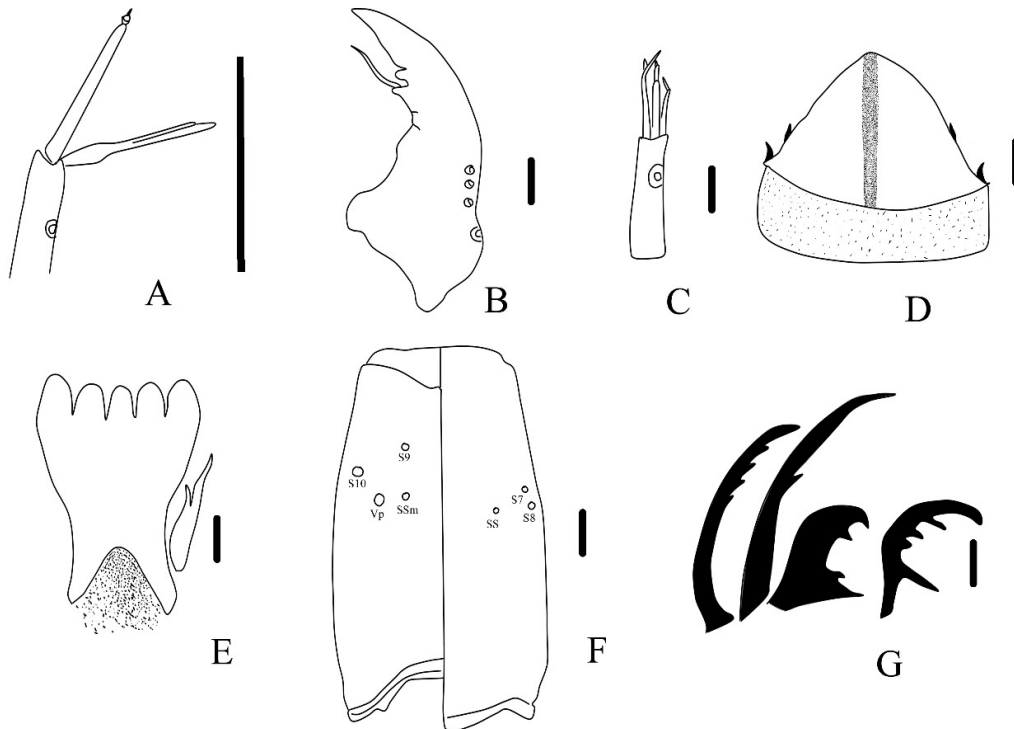


Figure 5. Larva of *Monopelopia obscurata* sp. n. A, antenna, distal end, scale: 100  $\mu$ m; B, mandible, scale: 10  $\mu$ m; C, maxillary palp, scale: 10  $\mu$ m; D, mentum and m appendage, scale: 10  $\mu$ m; E, ligula and paraligula, scale: 10  $\mu$ m; F, cephalic chaetotaxy; G, claws of posterior parapod, scale: 10  $\mu$ m.



Table 4. Comparison of *Monopelopia (M.) obscurata* sp. n. immature characters with four other species.

	Thoracic horn	ThR	Shagreen on pupal exuviae	Location of LS-VII	Loc. LSV-VIII	Male genital sac	Head-CI	AR	A1/MD	PP claws
<i>M. (M.) macunaima</i>	Large robust	11.2	TII with patches of 2-5 spinules	0.30: 0.38: 0.53: 0.84	0.25: 0.5: 0.62: 0.75: 0.87	Not extending	0.71	2.26	2.10	Smaller claws indistinct, larger claws serrated
<i>M. (M.) monguense</i>	Tubular without spine	4.02	Dense in TII	0.29: 0.42: 0.57: 0.84	0.27: 0.49: 0.69: 0.85: 0.96	Not extending	0.53	3.26	2.79	4, heavily sclerotised claw deeply curved with 4 teeth on inner margin
<i>M. (M.) adeltae</i>	Large and robust	5	Absent from TI-TVIII	0.30: 0.46: 0.61: 0.92	0.42: 0.57: 0.71: 0.78: 0.92	Not extending	0.70	2.73	2.08	4, heavily sclerotised claw deeply curved with 2 teeth on inner margin
<i>M. (M.) edentata</i>	Elongated slender with spine	5.8	Absent from TI-TVIII	0.23: 0.38: 0.76: 0.92	0.31: 0.43: 0.56: 0.72: 0.95	Extending beyond anal lobe	0.70	2.40	1.82	4, pale
<i>M. (M.) obscurata</i> sp. n.	Slender elongated without spine	6.1	Absent from TI-TVIII	0.27: 0.47: 0.62: 0.91	0.36: 0.50: 0.73: 0.87: 0.98	Reaching the tip of anal lobe	0.49	3.54	3.67	4 dark claws, one strongly curved with 3 inner teeth

## Remarks

A comparison among *M. mongpuense*, *M. recta*, *M. adeliae*, *M. macunaima*, *M. edentata* and *M. obscurata* sp. n. is given in Table 2 and Table 4.

**Distribution and bionomics.** *M. obscurata* is so far known only from India.

Suntaleykhola is a dense forested area with temperate climate, occupying the eastern fringes of the Himalayan foothills. The larva was collected from a marshy area at the bank of a small stream.

## Key to males of *Monopelopia* Fittkau from the Oriental and Palaeartic Regions

1. Mid and hind legs with single tibial spur (subgenus *Monopelopia* Fittkau) ..... 2
  - Mid and hind legs with two tibial spurs (OR: Oriental China) .....  
..... ***M. (Cantopelopia) zhengi* Lin, 2021**
- 2 (1). R<sub>2+3</sub> present ..... 3
  - R<sub>2+3</sub> absent or faintly indicated ..... 4
- 3 (2). Macrotrichia cover entire wing surface (OR: Indonesia) .....  
..... ***M. (M.) divergens* (Johannsen, 1932)**
  - Macrotrichia cover distal third wing surface only (OR: India) ..... ***M. (M.) mongpuense* Paul, Hazra and Mazumdar, 2014**
- 4 (2) AR < 1.2; r-m crossvein pale (PA: Europe; NE: Canada, U.S.A.) .....  
..... ***M. (M.) tenuicalcar* (Kieffer, 1918)**
  - AR > 1.2; r-m crossvein darkened ..... 5
- 5 (4) AR 1.5; wing surface entirely covered with macrotrichia; abdomen without dark bands (OR: India) ..... ***M. (M.) obscurata* sp. n.**
  - AR 1.8; wing surface with macrotrichia covering distal third; abdomen with dark bands (OR: India) ..... ***M. (M.) recta* sp. n.**

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