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New records of predaceous midges from the Middle East, with the description of two new species (Diptera: Ceratopogonidae)

PATRYCJA DOMINIAK^{1,2}, ALICJA ALWIN¹ & WOJCIECH GILKA¹

¹Department of Invertebrate Zoology and Parasitology, University of Gdańsk, Wita Stwosza 59, 80-308 Gdańsk, Poland

²Corresponding author. E-mail: heliocopris@gmail.com

Abstract

Two new distinctive species of predaceous biting midges of the tribe Ceratopogonini are described and illustrated from the Middle East. *Brachypogon freidbergi* sp. nov., with a unique Y-shaped gonostylus, is recorded from Israel. We also provide the first records of *Brachypogon vitiosus* (Winnertz) and *B. aethiopicus* (Clastrier, Rioux & Descous) from this country, and a key to the adult males of the genus *Brachypogon* Kieffer from the Middle East. *Ceratopogon azari* sp. nov., described from Lebanon, shows a distinctive structure of the male genital apparatus, and is the southernmost species of that genus in the Western Palaearctic.

Key words: Diptera, Ceratopogonidae, biting midges, *Brachypogon*, *Ceratopogon*, new species, new records, Middle East

Introduction

The predaceous midges of the genus *Brachypogon* Kieffer, 1899 and *Ceratopogon* Meigen, 1803 belong to the tribe Ceratopogonini, which includes over 1200 extant species (Borkent 2013). The generic status of *Brachypogon* and *Ceratopogon* remained problematic for many years, until Grogan (1982) and Wirth & Grogan (1988) redefined these two taxa as well as *Isohelea* Kieffer, 1917, which is currently regarded as a subgenus of *Brachypogon*. Debenham (1991) proposed the new subgenus, *Sarissohelea*, for several Australasian and Indomalayan species with females having a long costa and the radius joining the costa at an oblique angle. Species of *Brachypogon* are distributed throughout the world except in Antarctica (Spinelli & Grogan 1998), and nearly 200 extant species are currently recognized (Borkent 2013). The genus *Ceratopogon* is well represented in Baltic amber (Szadziewski 1988), but only 42 extant species are currently recognized (Borkent 2013). It is now apparent that *Ceratopogon* is a relict genus of Holarctic distribution, with cold-adapted boreal species; the adults are active during late winter or spring, or, during summer in high mountainous regions (Remm 1974, Borkent & Grogan 1995) and peat bogs (Szadziewski 1988).

This article is part of a survey of biting midges of the Middle East (Dominiak *et al.* 2007, Szadziewski *et al.* 2011, Alwin & Szadziewski 2012, Dominiak & Alwin 2013). Our examination of material collected in Lebanon and Israel revealed two distinctive, hitherto unknown species of *Brachypogon* and *Ceratopogon*, and provides new data on geographical distribution of these genera.

Material and methods

All specimens examined were cleared in a solution of phenol-ethanol, then dissected and slide-mounted in a mixture of phenol-Canada balsam by the techniques described by Wirth & Marston (1968). Morphological terms in the descriptions and methods of measurements follow Szadziewski *et al.* (1994) and Borkent & Grogan (1995). The microphotographs were taken using the LAS Montage multifocus with a Leica DM6000. Holotypes, paratypes

and other specimens are deposited in the collection of the Department of Invertebrate Zoology & Parasitology, University of Gdańsk, Poland (UG), the Department of Zoology, Tel Aviv University, Israel (TAU) and the Faculty of Sciences, Lebanese University, Lebanon (LU).

Systematics

Genus *Brachypogon* Kieffer, 1899

Brachypogon (Brachypogon) vitiosus (Winnertz)

Ceratopogon vitiosus Winnertz, 1852: 49 (Germany).

Anakempia minima Kieffer, 1924: 402 (France).

Trishelea nigra Mayer, 1934: 291 (Poland).

Helea (Brachypogon) vitiosus: Goetghebuer 1934: 52 (Germany, Austria).

Helea (Brachypogon) vitiosa: Remm 1966: 65 (Lithuania).

Ceratopogon (Brachypogon) vitiosus: Remm 1967: 29 (Georgia); Remm 1971: 207 (Russia—Primorsky Krai); Remm 1974: 57 (syn. = *Anakempia minima*, = *Trishelea nigra*, Lithuania, Estonia, Georgia, Armenia, Kyrgyzstan, Tajikistan, Russia—Leningrad Oblast, Khabarovsk Krai, Primorsky Krai); Remm 1979: 46 (Estonia).

Brachypogon vitiosus: Havelka 1976: 72 (Germany); Glukhova 1979: 180 (Russia—Primorsky Krai); Havelka 1979: 59 (Spain); Szadziewski & Havelka 1984: 350 (neotype, Spain, France, Germany, Poland, Algeria, Afghanistan, Japan); Delécolle & Rieb 1990: 184 (France); Delécolle *et al.* 1991: 256 (France); Navai 1997: 184 (Afghanistan); Hagan *et al.* 2000: 470 (Norway); Brodskaya 2001: 186 (Russia—Pskov Oblast); Bernotienė 2002: 289 (Lithuania); Yu *et al.* 2005: 1406 (China); Dominiak 2009: 200 (Poland).

Brachypogon (Brachypogon) vitiosus: Wirth & Grogan 1988: 29 (catalogue); Borkent & Wirth 1997: 93 (catalogue); Borkent 2013: 115 (catalogue).

Material examined. ISRAEL, 'Enot Zuqim, 19.V.1998, 1 male, leg. O. Manheim (TAU).

Remarks. *Brachypogon vitiosus* is a widely distributed Palaearctic species reported from Spain, France, Norway, Germany, Austria, Poland, Lithuania, Estonia, Russia, Georgia, Armenia, Afghanistan, Tajikistan, Kyrgyzstan, China, Japan and Algeria. This species occurs in primarily cooler regions (Szadziewski & Havelka 1984), and currently we provide the first record from the Middle East. This is the fifth species of the subgenus *Brachypogon* reported from this region. The other four species are: *B. afifi* Boorman & Harten, 2002 (Yemen), *B. arabicus* Szadziewski, Gwizdalska-Kentzer & Gilka, 2011 (United Arab Emirates), *B. obesus* Szadziewski, Gwizdalska-Kentzer & Gilka, 2011 (United Arab Emirates) and *B. yarimii* Boorman & Harten, 2002 (Oman, Yemen). We consider that some literature data on *B. vitiosus* should be treated as doubtful. This species was mentioned by Remm (1974, 1988) from the British Isles, and by Glukhova (1979) and Remm (1988) from Kazakhstan and East Siberia, but without any supporting locality information. *Brachypogon vitiosus* was also included in the checklist of the biting midges of Slovakia (Országh & Chalupský 1987), but we have not been able to locate any faunistic records from that country.

Brachypogon (Isohelea) aethiopicus (Clastrier, Rioux & Descous)

Ceratopogon (Brachypogon) aethiopicum Clastrier, Rioux & Descous, 1961: 87 (Chad); Clastrier & Wirth 1961: 223 (Ethiopia).

Isohelea aethiopica: de Meillon & Downes 1986: 156 (South Africa).

Brachypogon (Isohelea) aethiopicum: Wirth & Grogan 1988: 30 (catalogue); Grogan & de Meillon 1993: 406 (Zimbabwe).

Brachypogon (Isohelea) aethiopica: Borkent & Wirth 1997: 93 (catalogue); Boorman & van Harten 2002: 452 (Yemen).

Brachypogon (Isohelea) aethiopicus: Borkent 2013: 115 (catalogue).

Material examined. ISRAEL, Herzliyya, beach, 27.VIII.2007, 5 males, leg. A. Freidberg (TAU).

Distribution. *Brachypogon aethiopicus* was previously known only from the Afrotropical region in Chad, Zimbabwe, South Africa, Ethiopia and Yemen. We provide the first record from Israel.

Remarks. The examined specimens have male genitalia consistent with the original description of the species

and the figures provided by Clastrier *et al.* (1961). However, their wings have a clearly visible vein M_2 (but broadly interrupted in basal portion), and the membrane appears to be completely devoid of macrotrichia.

***Brachypogon (Isohelea) freidbergi* sp. nov.**

(Figures 1, 2)

Type material. Holotype: adult male. ISRAEL, 'Enot Samar, 22.IV.1998, leg. A. Freidberg (TAU).

Diagnosis. The male of *Brachypogon freidbergi* is distinct in having elongate slender apicolateral processes of tergite 9, and a deeply forked Y-shaped gonostylus that resembles obtuse crayfish claws. Females are unknown.

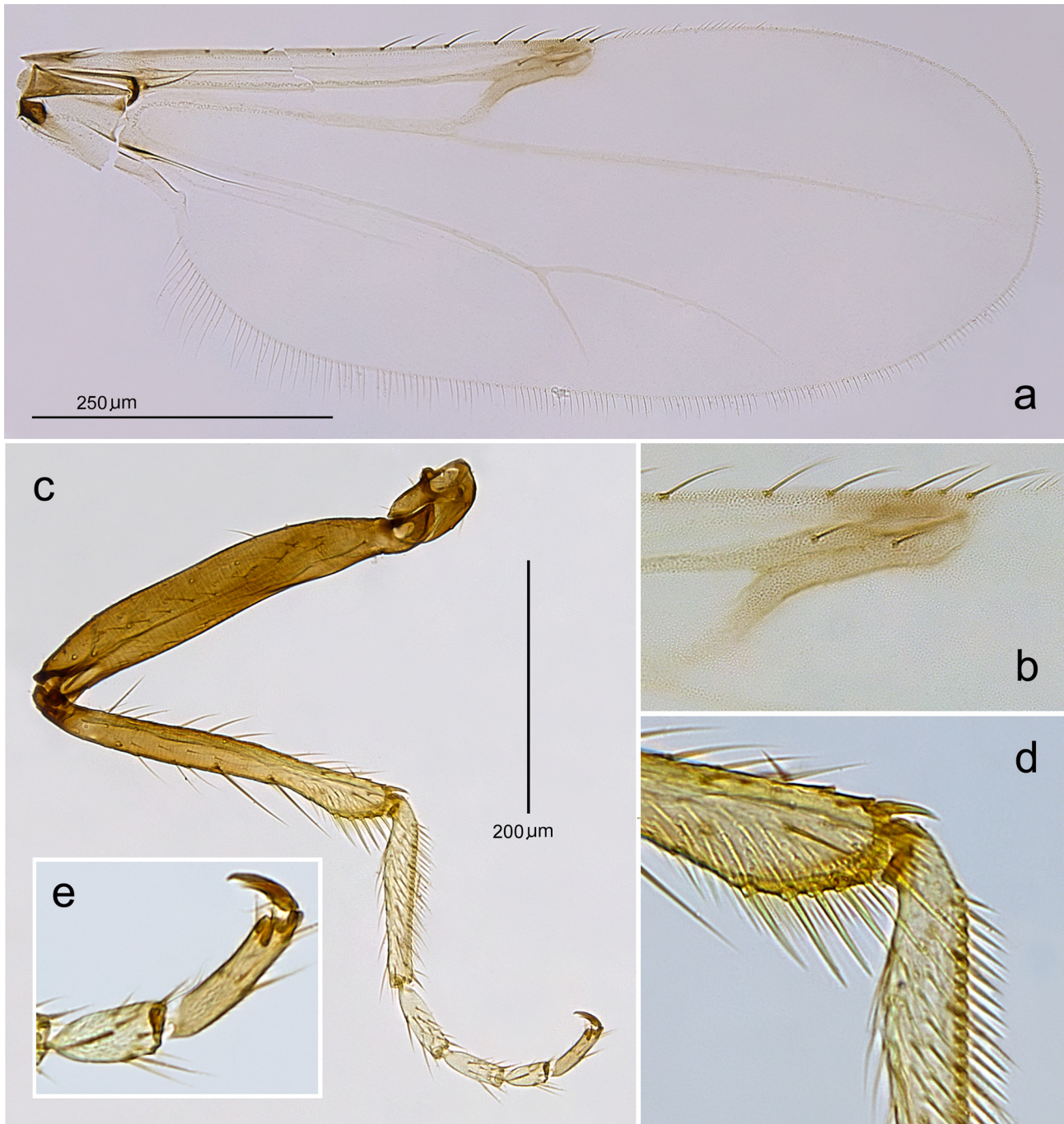
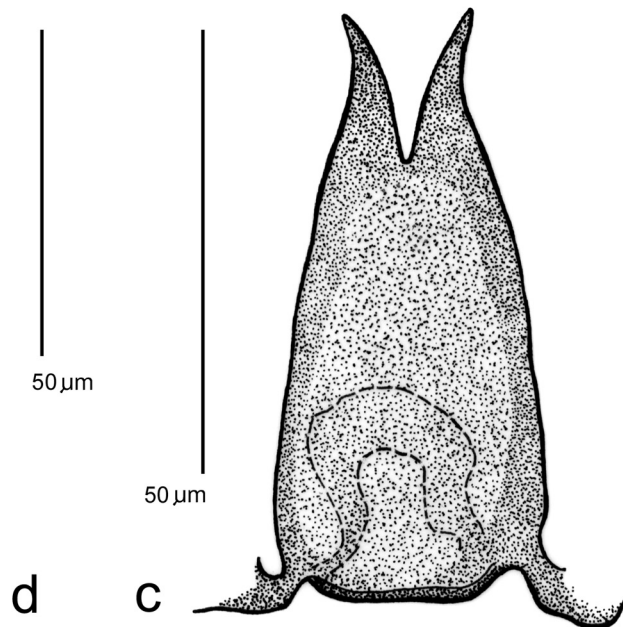
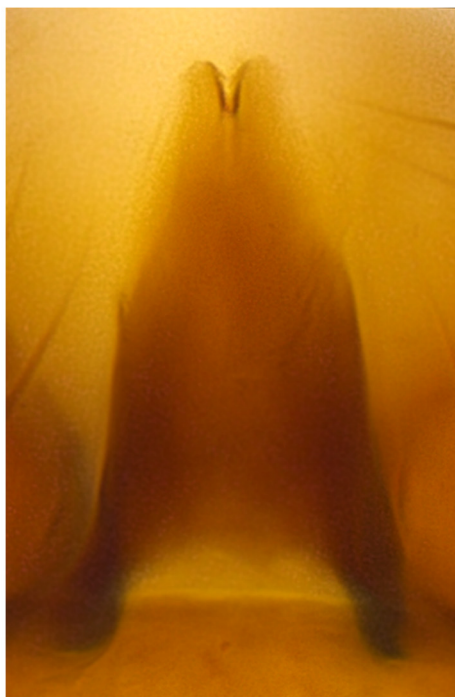
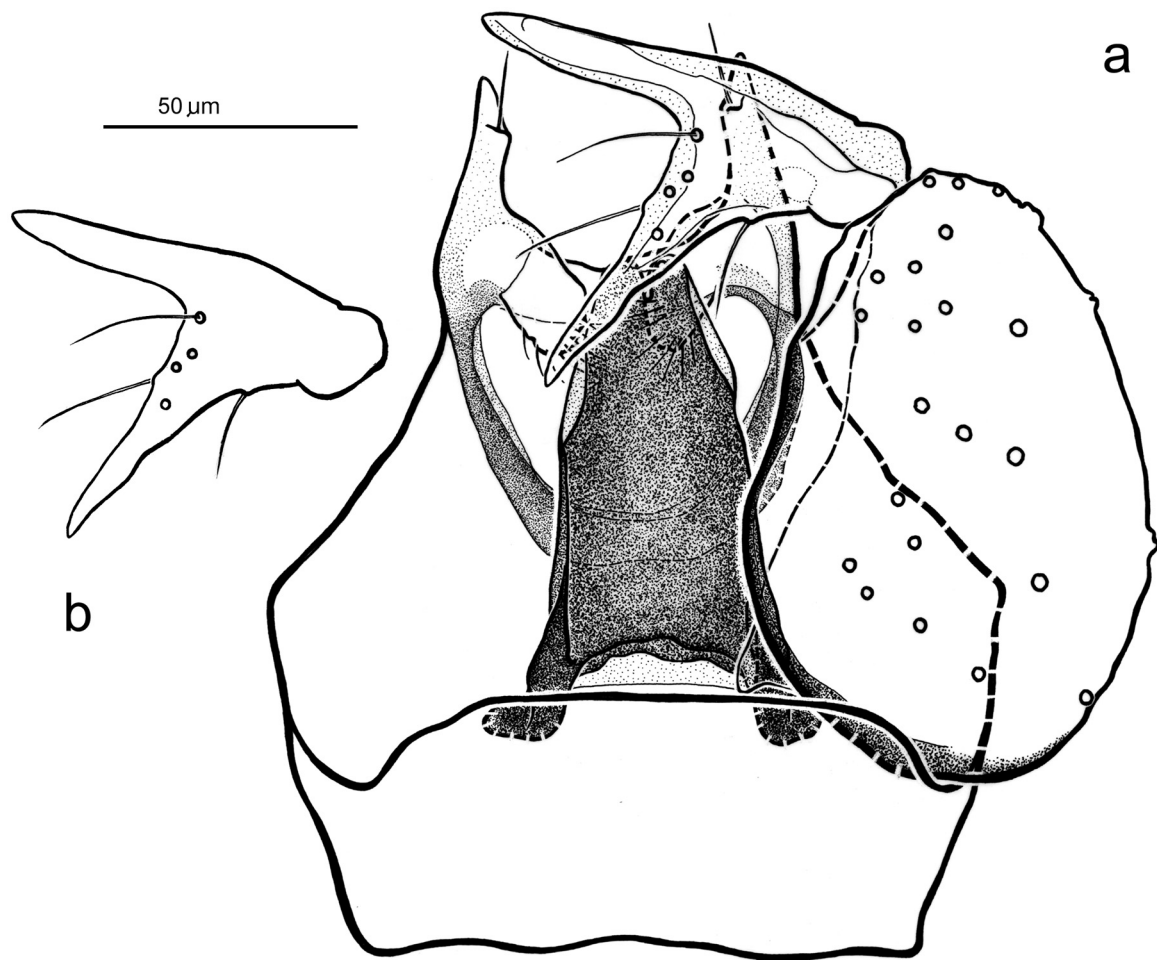


FIGURE 1. *Brachypogon freidbergi* sp. nov., holotype male: a. wing; b. radial cells of wing; c. hind leg; d. tibial comb, spur and palisade setae of hind leg; e. two distal tarsomeres of hind leg.



d

c

FIGURE 2. *Brachypogon freidbergi* sp. nov., holotype male: a. male genitalia in ventral view, b. gonostylus, c. parameres, d. aedeagus.

Description. Male. *Coloration.* Body dark, with distal halves of tibiae and tarsomeres 1–4 paler (Fig. 1c).

Head. Eyes pubescent, widely separated. Antenna with 13 flagellomeres, plume well-developed; total flagellum length 0.44 mm; flagellomere 1 with two whorls of long setae and two sensilla coeloconica; flagellomeres 2–11 fused, but with well defined anterior and posterior margins. Third palpal segment with small apical sensory pit; length 46 µm, PR 2.42. Fourth palpal segment bearing 2 long setae.

Thorax. Katepisternum with single seta; anepisternum bare. Transverse suture on scutum well-developed, 1 anterior and 5 posterior supraalar setae present. Scutellum with 4 large setae. Wing (Fig. 1a) membrane hyaline, lacking macrotrichia; two very small radial cells present (Fig. 1b), r_1 slit-like, r_2 narrow; wing veins slightly infuscated, darkest on well-defined stigma; vein M_2 absent; Cu_1 , Cu_2 obsolete on distal halves; wing length 0.75 mm; CR 0.50. Femora and tibiae of mid legs slender, those of fore and hind (Fig. 1c) legs slightly broader. Hind tibia with comb composed of 6 large setae, slender and moderately long apical spur, and basitarsus bearing single row of dense palisade setae (Fig. 1d). Tarsomere 4 (Fig. 1e) subcylindrical, bearing 1–2 long apical sinuous sensilla capitata; tarsomere 5 of all legs with small, equal-sized claws, lacking inner teeth, each with single long basal seta at base and with bifid apex; slender empodia present. Fore, mid and hind tarsal ratios: TR_I 1.7, TR_{II} 1.6, TR_{III} 2.1.

Genitalia (Fig. 2a). Tergite 9 tapering abruptly distally, with pair of slender elongate apicolateral processes, each bearing single subapical seta; ventrodistal portion with large, heavily sclerotized, semicircular proctiger. Sternite 9 moderately short, about 2.5 times broader than long, posterior margin nearly straight. Gonocoxite stout, broadest near base. Gonostylus (Fig. 2b) short, broad, deeply bifurcate, Y-shaped; both branches of similar length, pointed apically, inner branch bearing several long setae. Parameres (Fig. 2c) fused, slightly shorter than aedeagus; basal apodemes, lateral margins and apex well sclerotized, mid portion more lightly sclerotized; apex bifid, each half with pointed tip. Aedeagus stout, with low basal arch and bilobed apex, well sclerotized, especially in basal half (Fig. 2d).

Female and immatures. Unknown.

Derivation of the name. This species is named after Amnon Freidberg, who kindly loaned us the collection of biting midges from Israel.

Remarks. The unusual, deeply bifurcate, Y-shaped gonostylus and the long finger-like apicolateral processes in male genitalia of *Brachypogon freidbergi* are unique among all other extant species of the subgenus *Isohelea*. The latter character is found only in *B. prominulus* (Meunier, 1904), the species known from Eocene Baltic amber. The shape of the aedeagus and the sclerotized ventrodistal region of tergite 9 of this new species are similar to those of *B. hugoi* Spinelli & Grogan, 1994 from the Neotropics. Similar parameres, which are completely fused basally and divided in apical half, are known in *B. sociabilis* (Goetghebuer, 1920), the widely distributed European species.

Key to adult males of *Brachypogon* from the Middle East

1. Wing with one radial cell, or both radial cells obliterated (subgenus *Brachypogon*) ...2
- . Wing with two distinct radial cells (subgenus *Isohelea*)... 6
2. Gonostylus short, 1.5–1.8 length of gonocoxite 3
- . Gonostylus long, nearly as long as gonocoxite 4
3. Parameres well developed, readily visible *B. (B.) afifi* Boorman & Harten
- . Parameres indistinct, barely visible. *B. (B.) obesus* Szadziewski, Gwizdalska-Kentzer & Gilka
4. Apical portion of aedeagus slender *B. (B.) yarimii* Boorman & Harten
- . Apical portion of aedeagus broad 5
5. Parameres as long as aedeagus *B. (B.) vitiosus* (Winnertz)
- . Parameres distinctly shorter than aedeagus. *B. (B.) arabicus* Szadziewski, Gwizdalska-Kentzer & Gilka
6. Apex of gonostylus deeply bifurcate. *B. (I.) freidbergi* sp. nov.
- . Apex of gonostylus entire, not bifurcate or bifid. 7
7. Aedeagus triangular, with divided apex *B. (I.) aethiopicus* (Clastrier, Rioux & Descous)
- . Aedeagus tongue-like, with simple blunt apex *B. (I.) vanharteni* Szadziewski, Gwizdalska-Kentzer & Gilka

Genus *Ceratopogon* Meigen, 1803

Ceratopogon azari sp. nov.

(Figures 3–6)

Type material. Holotype: adult male. LEBANON, Anti-Lebanon Mts., Maaraboun village near Baalbek (in the locality named Sheaibe), N 33°55.376 E 36°15.490, altitude 1781 m, stream and helocrene, 5.V.2012, net, leg. P. Dominiak (UG). Paratypes: same data as holotype, 2 males, 3 females (LU, UG).

Diagnosis. Males of *Ceratopogon azari* differ from all other species of the genus by the following combination of characters: apicolateral processes of tergite 9 elongate, each bearing two setae: 1 apical and 1 subapical; parameres fused on proximal 1/3, distal 2/3 divided, each half elongate, slender, apical portion long, harpoon-shaped. Aedeagus with seed-like medial prongs, lateral prongs lightly sclerotized with setose apices.

Description. Male. *Coloration.* Body dark brown, tarsomeres 1–3 of all legs paler (Fig. 3b–d).

Head. Eyes pubescent, widely separated. Antenna with 13 flagellomeres, total length 0.83–0.91 mm, AR 0.63–0.67 (n=2), plume well developed (Fig. 3a). Flagellomere 1 with two whorls of long setae and small sensilla coeloconica. Clypeus with two rows of setae in lateral position, each row with 2–4 setae. Third palpal segment slender, apical portion bearing a few small, shallow sensory pits; 62–81 µm long, PR 2.00–2.89 (n=3).

Thorax. Transverse suture on scutum well visible; 1 anterior and 6–8 posterior supraalar setae present. Scutellum with about 5 large and few small marginal setae arranged in single row. Wing transparent, 1.71–1.92 mm long, CR 0.59–0.61 (n=2). Two nearly equal-sized radial cells present; wing membrane completely devoid of macrotrichia, small sparse macrotrichia present only on subcosta. Femora and tibiae of all legs slender (Fig. 3b–d). Hind tibial comb with 8 large setae, spur absent (Fig. 3e). Basitarsus with a few ventral spine-like setae, tarsomeres 2–4 bearing only 2 apical spines (Fig. 3b–d) and fine sensilla capitata. Hind basitarsus with one row of palisade setae on proximal half (Fig. 3e) and single stout basal spine (not visible on Fig. 3d, e). Tarsomeres 4 cordiform, bearing 1–3 apical long, sinuous sensilla capitata (Fig. 3f). Tarsomeres 5 slender; claws small, equal-sized with single basal seta, bifid apices and slender empodia. Fore, mid and hind tarsal ratios: TR_I 1.8–2.0 (n=3), TR_{II} 2.0–2.1 (n=2), TR_{III} 1.7 (n=2).

Genitalia (Fig. 4a) about 2.5 times broader than segment 9. Tergite 9 tapering slightly distally from base, lateral margins parallel or nearly so, slightly constricted below U-shaped apex; apicolateral processes greatly elongate, moderately divergent distally, each bearing 2 long setae: 1 apical and 1 subapical (Fig. 4b); cerci elongate, cylindrical, setose. Sternite 9 moderately short, about 2.5 times longer than broad; anterior margin straight; posterior margin with broad, shallow excavation. Gonocoxite very long, about 2.5 times longer than broad, slightly curved; proximal half moderately slender with small mesobasal spur, distal half swollen. Gonostylus 0.25–0.28 mm long (n=3), greatly curved on proximal and distal 1/4 portion, mid portion nearly straight; apex slightly tapered, tip rounded with three small teeth. Parameres much longer than aedeagus; proximal 1/3 fused, distal 2/3 divided, each half elongate, slender, apical portion long, harpoon-shaped (Fig. 4b, c). Aedeagus slightly broader than long; basal arms, arch and margins of medial prongs heavily sclerotized; medial prongs seed-like in shape; lateral prongs elongate, stout, lightly sclerotized, apices truncate, setose (Fig. 4b, d).

Female. *Coloration.* As in male, including legs (Fig. 5b–d).

Head. Eyes pubescent, narrowly separate. Antennal flagellum (Fig. 5a) with 13 separate cylindrical flagellomeres, flagellomeres 2–8 slightly longer than broad, 9–13 distinctly longer than broad, 13 longest; flagellomere 1 with 3–5 sensilla coeloconica on distal half. Total flagellum length 0.56–0.62 mm, AR 0.88–0.99 (n=3). Clypeus with two rows of setae in lateral position, each row with 2–3 setae. Third palpal segment with a few shallow sensory pits usually only on distal half; length 63–65 µm, PR 2.03–2.13 (n=3). Mandible armed with 12 large coarse teeth decreasing in size towards base.

Thorax. Transverse suture on scutum well developed; 1 anterior and 7–8 posterior supraalar setae present. Scutellum with about 5 large and a few small marginal setae in single row. Wing transparent, 1.86–1.88 mm long, CR 0.64–0.65 (n=3). Two nearly equal-sized radial cells present, wing membrane devoid of macrotrichia. Fore femur moderately swollen, mid and hind femora more slender; fore tibia slightly swollen, mid and hind tibiae more slender (Fig. 5b–d). Hind tibial comb with 8–10 large setae, lacking apical spur. Palisade setae of hind basitarsus, shape of tarsomeres 4 and apical sensilla capitata similar to those found in male (Fig. 5d, e). Tarsomeres 5 slender, claws moderately large, nearly equal-sized on all legs, each talon with basal inner tooth (Fig. 5f). Fore, mid and hind tarsal ratios: TR_I 1.8 (n=3), TR_{II} 1.9–2.1 (n=3), TR_{III} 1.8–1.9 (n=3).

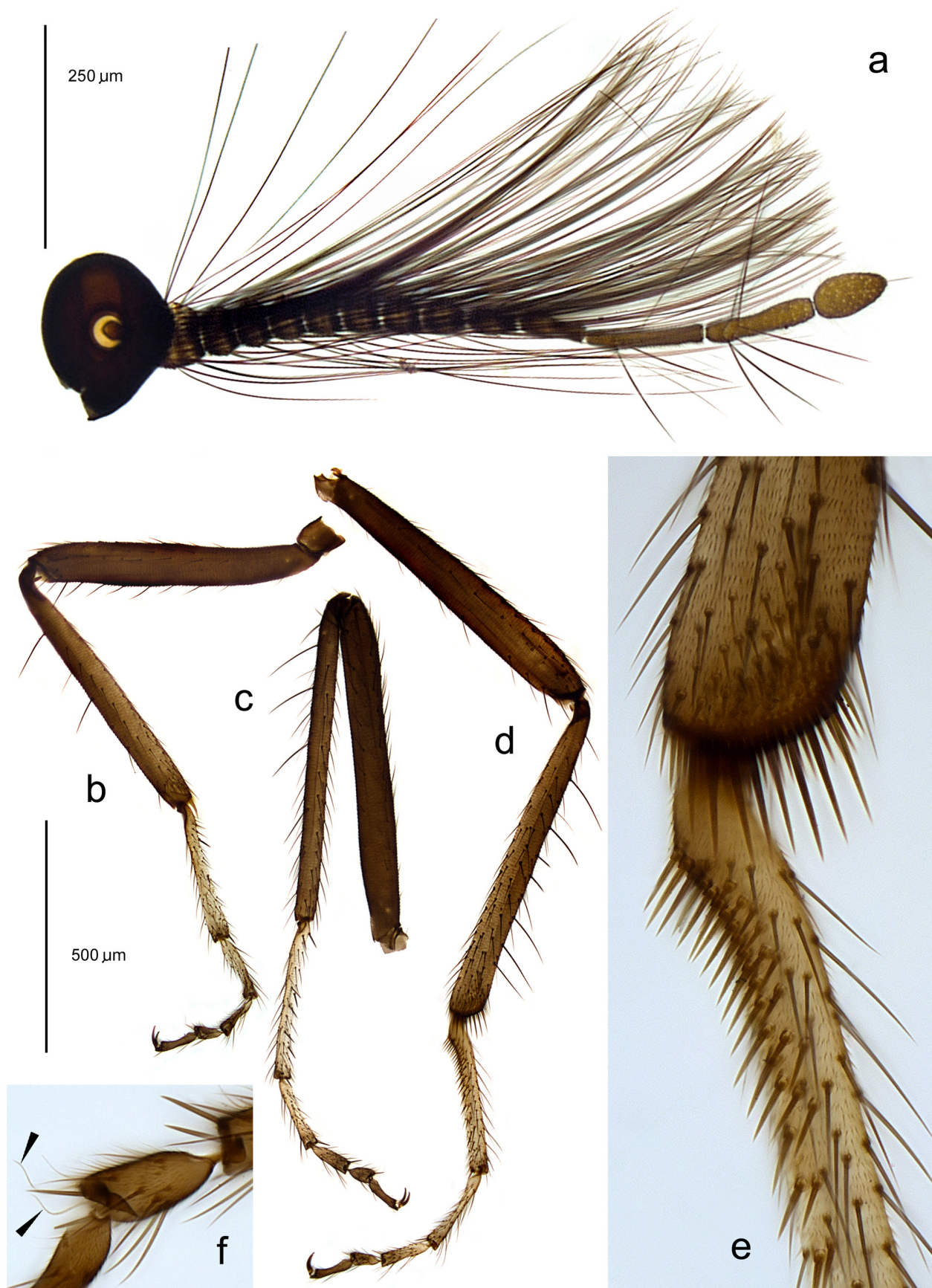


FIGURE 3. *Ceratopogon azari* sp. nov., male: a. antenna; b–d. legs of fore (b), mid (c) and hind pair (d); e. tibial comb and palisade setae of hind leg; f. tarsomere 4 of fore leg with sensilla capitata (indicated with arrows).

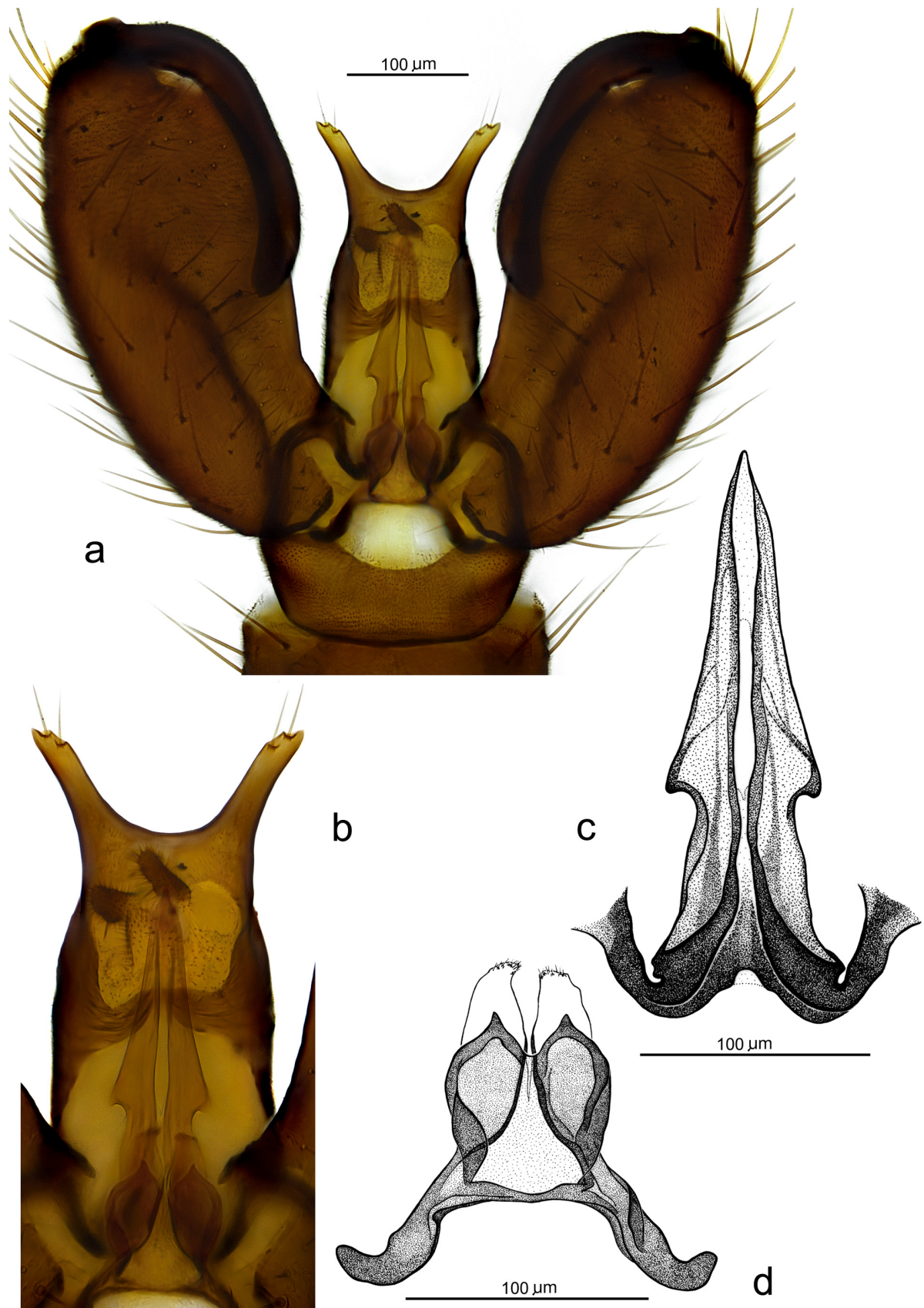


FIGURE 4. *Ceratopogon azari* sp. nov., male, holotype: a. male genitalia in ventral view; b. aedeagus (in part), parameres and apicolateral processes of tergite 9; c. parameres; d. aedeagus.

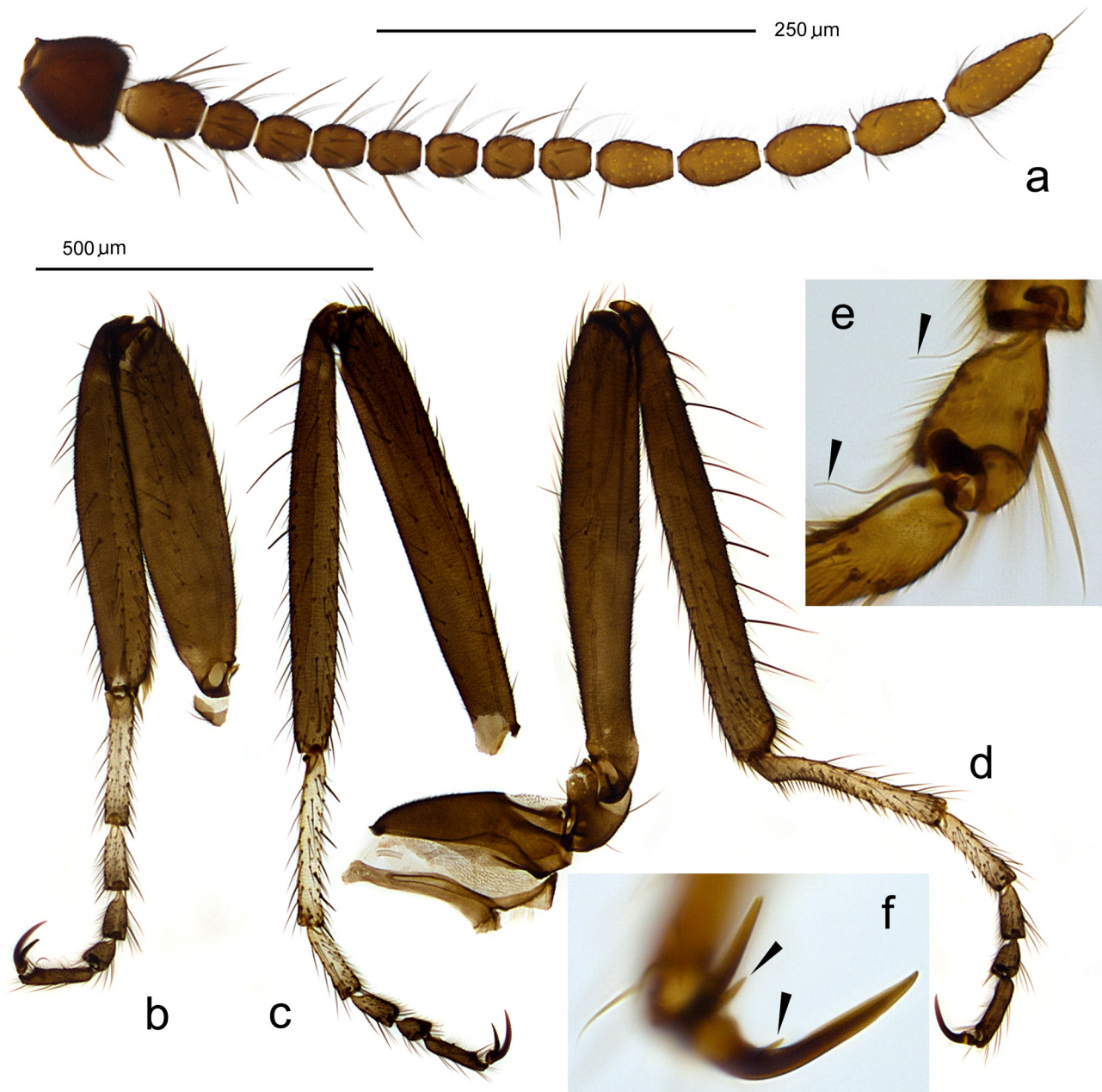


FIGURE 5. *Ceratopogon azari* sp. nov., female: a. antenna; b–d. legs of fore (b), mid (c) and hind pair (d); e. tarsomere 4 of hind leg (sensilla capitata indicated with arrows); f. claws of hind leg with inner teeth (indicated with arrows).

Genitalia (Fig. 6a). Sternite 8 entire, moderately sclerotized, posterior margin with shallow excavation. Sternite 9 divided into two halves (Fig. 6c, d); anterior arm long, slender, sharply pointed; posterior arm stout, with heavily sclerotized spot on distal part. Three ovoid seminal capsules present (Fig. 6b), each with short neck; two larger, similar in size (60–72 µm long, n=3), one markedly smaller (43–48 µm, n=2).

Immatures. Unknown.

Derivation of the name. The species is named in honor of Dany Azar, for his great assistance with collecting materials throughout Lebanon.

Remarks. The structure of the aedeagus in *Ceratopogon azari* resembles the aedeagus of *C. grandiforceps* (Kieffer, 1913) and *C. niveipennis* Meigen, 1818 (figs. 7D–G and 7A–C respectively in Borkent & Grogan 1995). However, this new species can be readily distinguished from those two species by its long, cylindrical apicolateral processes of tergite 9, which bear only two setae, and the shape of the parameres that are fused on proximal 1/3. Unfortunately, unique diagnostic features could not be discovered for adult female of *C. azari*. Female of *C. azari* resembles females of several other Palaearctic species of *Ceratopogon*, but its fore femur is moderately swollen.

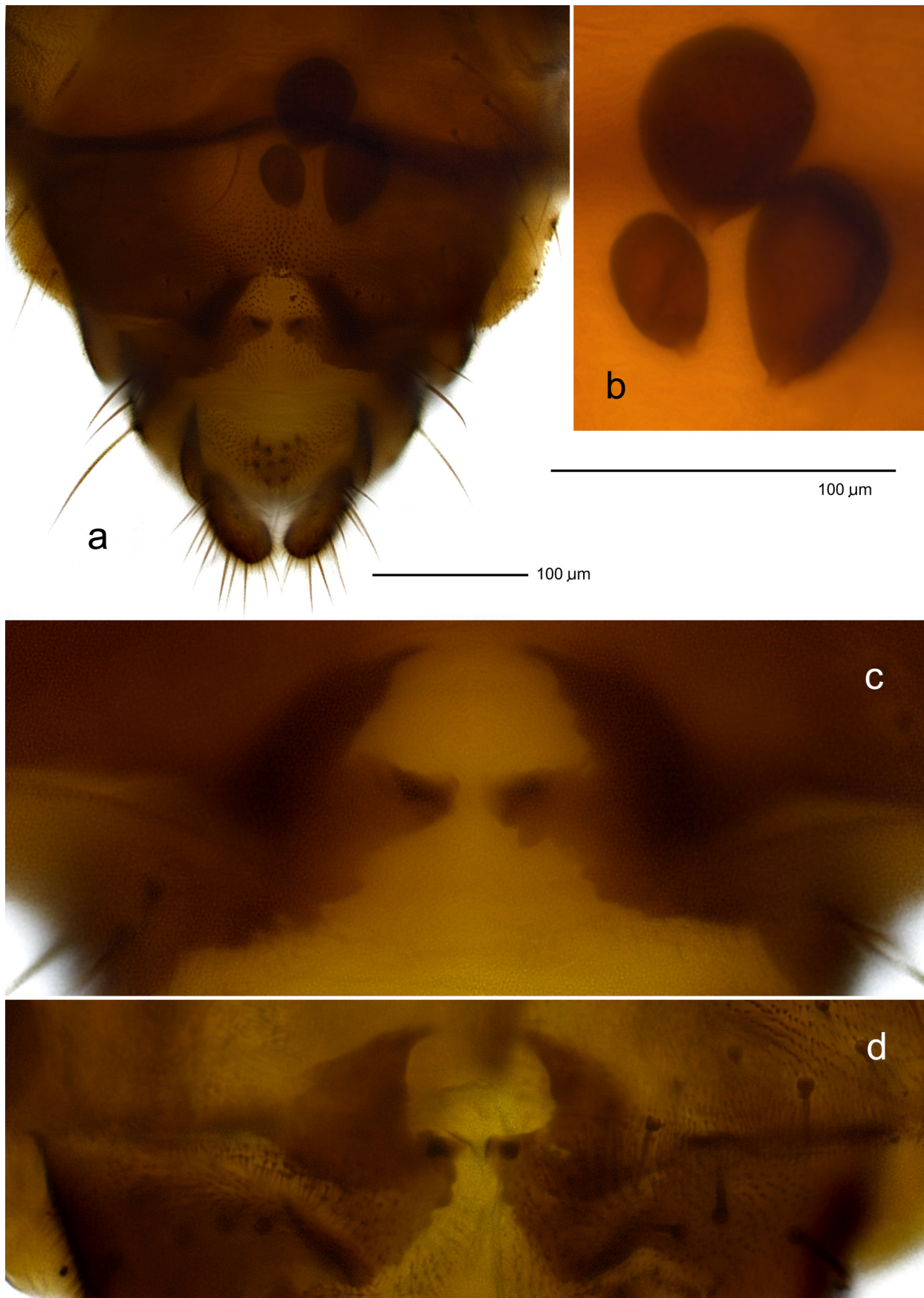


FIGURE 6. *Ceratopogon azari* sp. nov., female: a. distal abdominal segments in ventral view; b. seminal capsules; c, d. sternite 9, variation.

Both sexes of *C. azari* were co-associated as they were collected together from same site in the Anti-Lebanon Mountains, at a small stream and an adjacent helocrene spring. This is the first record of *Ceratopogon* from the Middle East and the southernmost site for this genus in the Western Palearctic (cf. Yu *et al.* 2005, Grogan & Wirth 1980).

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