

# Descriptions of *Brachypogon surma* sp. n. from Finland and *B. singularis* (Santos Abreu, 1918) from the Canary Islands (Diptera, Ceratopogonidae)

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Dominiak, P., Szadziewski, R. & Salmela, J. 2020. Descriptions of *Brachypogon surma* sp. n. from Finland and *B. singularis* (Santos Abreu, 1918) from the Canary Islands (Diptera, Ceratopogonidae). *Norwegian Journal of Entomology* 67, 235–245.

A new species *Brachypogon (Isohelea) surma* sp. n., with unique, leaf-like parameres, is described from Finnish Lapland based on males. Illustrations and COI sequences of this species are also provided. Females and males of *Brachypogon (I.) singularis* (Santos Abreu, 1918) from the Canary Islands are redescribed, a neotype is designated, and *Ceratolophus rufigastri* Santos Abreu, 1918 and *Ceratolophus obscurus* Santos Abreu, 1918 are proposed to be its new junior synonyms.

Key words: Biting midges, *Isohelea*, new species, neotype designation, new synonyms, DNA barcoding, Lapland, rich fens.

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## Introduction

Biting midges (Ceratopogonidae) of the genus *Brachypogon* Kieffer, 1899 have nearly global distribution and are present on every continent except Antarctica (Spinelli & Grogan 1998). The larvae of these tiny midges are good swimmers and inhabit various types of aquatic and semiaquatic habitats. They live in mud, wet sand and small pools on the margins of ponds, lakes or rivers. Some species are common inhabitants of marshes and peat bogs (Mayer 1940, Glukhova 1979, Delécolle & Grogan 1990, Szadziewski *et al.* 1994, Spinelli & Marino 2008). Females are predators on adult Chironomidae (Edwards 1923, Downes

1978), however they also, similarly to males, feed on nectar (Szadziewski & Krzywiński 1988, Szadziewski *et al.* 1994). Males were observed to fly in swarms (Edwards 1926, Chandler *et al.* 2008, P. Dominiak personal observation).

Globally the genus *Brachypogon* is represented by 201 extant species, and is currently divided into three subgenera: *Brachypogon sensu stricto* (112 species), *Isohelea* Kieffer, 1917 (82 species) and *Sarissohelea* Debenham, 1991 (5 species) (Borkent & Dominiak 2020). The latter is tropical and limited in distribution to Australasian and Indomalayan regions. In the Palaearctic region, ceratopogonids of the subgenus *Brachypogon s. str.* inhabit mainly southern borders of the region,

while the species-rich subgenus *Isohelea* is rather more common in northern latitudes and higher elevations.

In this paper we describe a new species from the Finnish Lapland, and designate a neotype and provide a redescription of another species of *Isohelea*, which was described by Santos Abreu (1918) from the Canary Islands.

## Materials and methods

**Morphology.** All materials examined were mounted on microscope slides following the methods described by Wirth & Marston (1968) and by Dominiak & Mathieu (2015). The photographs and measurements were taken using the LAS Montage multifocus with a Leica DM6000. The ink drawings were made with Olympus BX51 equipped with camera lucida. The materials examined are housed in the collection of the Department of Invertebrate Zoology & Parasitology, University of Gdańsk, Poland (CEIG) and in the Regional Museum of Lapland, Rovaniemi, Finland (LMM). Morphological terms used in the descriptions and method of taking measurements follow Szadziewski *et al.* (1994) and Spinelli & Grogan (1998).

**DNA barcoding.** Tissue samples (legs or 2–3 abdominal segments) were placed in 96% ethanol in a 96-well lysis microplate and dispatched to the Canadian Centre for DNA Barcoding, Biodiversity Institute of Ontario where DNA was extracted and sequenced using standard protocols and primers (deWaard *et al.* 2008). The new sequences are deposited in BOLD (<http://www.boldsystems.org/index.php>) and available through a public project FINBR – Finnish *Brachypogon* (*Isohelea*) barcodes. A 658 bp fragment of mitochondrial protein-encoding cytochrome c oxidase subunit I (COI) was successfully sequenced from a total of eight *Brachypogon* (*Isohelea*) specimens, including a paratype male (BOLD: JS-sl-2015-0149) of the new species described here.

## Results

### Genus *Brachypogon* Kieffer, 1899

Subgenus *Isohelea* Kieffer, 1917

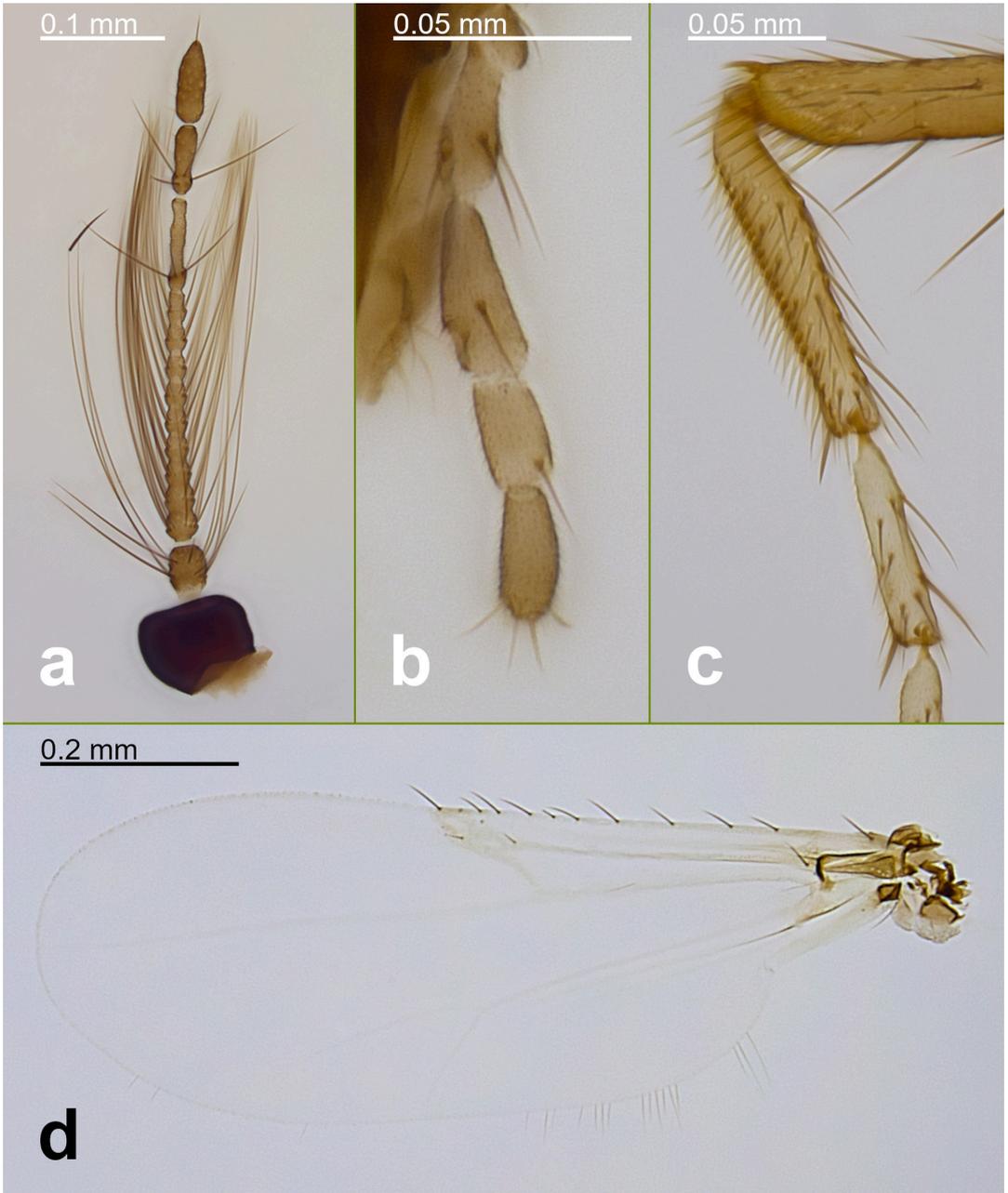
### *Brachypogon surma* Dominiak, Szadziewski & Salmela sp. n. (Figures 1–3)

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**Material examined.** *Holotype.* Adult male, Finland, Keminmaa, Kallinkankaan letot, Kallinkangas, rich flark fen, Malaise 1, N65.8161 E24.5050, 27.06.–28.07.2014, leg. J. Salmela, NVO.BRA-2020-1 (LMM). *Paratypes.* Same data as the holotype, 5 males - 4 males, NVO.BRA-2020-2 - NVO.BRA-2020-5 (LMM), 1 male (CEIG); Finland, Lkor, Pelkosenniemi Kätkäaapa S, rich spring fen, Malaise 2, N67.1014 E27.9045, 03.06–08.07.2015, JS-sl-2015-0149, BOLD:JS-sl-2015-0149, 1 male, leg. J. Salmela, NVO.BRA-2020-7 (LMM); Finland, Lkor, Pelkosenniemi, Kätkäaapa-Serrijoki, Kätkäaapa N, N67.1673 E27.8772, rich flark fen, 31.07.–29.09.2015, leg. J. Salmela, DIPT-JS-2016-0297, NVO.BRA-2020-8 and 2016-0298, NVO.BRA-2020-9, 2 males, (LMM); Finland, Lkor, Savukoski, Ainijärvi, rich fen, 67.7615 29.4389, 30.07.–28.09.2015, DIPT-JS-2016-0305, 1 male, leg. J. Salmela, NVO.BRA-2020-10 (LMM).

**Diagnosis.** Males of the new species are distinguished by having fused and broad leaf-like parameres and aedeagus with divergent apices. Females unknown.

**Description.** **Male.** *Colouration.* Body uniformly dark, tarsomeres (except of hind basitarsus) slightly paler. *Head.* Antenna (Figure 1a) with flagellomeres 2–10 or 2–11 usually fused (in some specimens flagellomeres 3–11 only partially fused); flagellum length 0.45–0.51 mm, AR 0.83–0.92 (n=6). Palpus 5-segmented (Figure 1b); third palpal segment with small and shallow sensory pit located on distal half; length 0.031–0.040 mm, PR<sub>III</sub> 2.2–2.6 (n=6); fourth palpal segment bearing 1–2 setae. *Thorax.* Anepisternum bare, katapisternum with single seta; scutellum bearing 4 marginal setae. Legs slender; hind tibial comb composed of 8–9 large spines (Figure 1c); hind basitarsus with single row of palisade



**FIGURE 1.** *Brachypogon surma* Dominiak, Szadziewski & Salmela sp. n., male (a, b, d – holotype). **a.** Antenna, **b.** Maxillary palp, **c.** Tibial comb and tarsomeres 1, 2 of hind leg. **d.** Wing.

setae; hind tarsal ratio  $TR_{III}$  1.5–1.7 (n=7). Claws small, equal-sized, with bifid apices, each with single long seta at base, inner teeth absent. Wing membrane hyaline, without macrotrichia (Figure 1d); two short and similar in length radial cells

present, first one slit-like, second one - broader; wing veins pale; wing length 0.78–0.84 mm, CR 0.48–0.52 (n=6). *Genitalia* (Figures 2–3). Tergite 9 tapering towards broad blunt apex, bearing a pair of small cerci, each with single strong apical



**FIGURE 2.** *Brachypogon surma* Dominiak, Szadziewski & Salmela sp. n., holotype male, genitalia, ventral view. **a.** Outer layers, **b.** Inner layers.

seta (Figures 2b, 3a); apicolateral processes not developed; proctiger heavily sclerotized, frame-like, trapezoid-shaped (Figures 2b, 3a, b). Posterior margin of sternite 9 nearly straight (Figures 2a, 3a). Gonocoxite stout, 1.6 times longer than broad. Gonostylus (Figures 2b, 3a) 1.4 times shorter than gonocoxite, stout, evenly curved, with pointed apex. Aedeagus (Figures 2a, 3a, c) heavily sclerotized, nearly completely divided into two long lateral halves, with pointed, slightly divergent apices. Parameres (Figures 2a, 3a, d, e) very broad, leaf-like, fused in basal portion and deeply split distally.

**Female and immature stages.** Unknown.

**Etymology.** In the Finnish mythology, Surma is a name of a beast patrolling the borders of the underworld Tuonela. The name is a noun in apposition.

**DNA barcoding.** The paratype specimen belong to the BIN BOLD: ADD8364, shared by

no other members. The nearest specimens are very distant: 30 closest sequences available at the BOLD database have similarity values between 89.74 and 87.31, being assigned to unidentified species of *Brachypogon* and to *Brachypogon sociabilis* (Goetghebuer, 1920).

**Comments.** *Brachypogon surma* sp. n. has unique shape of male genitalia and can't be confused with any other Palaearctic species of *Isohelea*. It is close to *B. (I.) sevanicus* (Remm, 1974) from Armenia in having similar male genitalia with divergent apices of aedeagus; however, the latter species has greatly reduced rod-like parameres which in the new species are large, evenly rounded and fused into a rounded leaf-like structure with a deep incision.

It is the seventh species (among the valid names) of the subgenus in the Finnish fauna (Huldén & Huldén 2014, Salmela et al. 2015), and the second one described as new from Finland. The first species, *B. aquilonalis* (Clastrier), was described in 1961, together with *B. lapiae* (Clastrier) and *B. finniae* (Clastrier). However, the latter two names are currently treated as junior synonyms of *B. incompletus* (Kieffer, 1925) and *B. nitidulus* (Edwards, 1921), respectively.

The new species has hitherto been collected from pristine rich fens. Rich fens are mire habitats influenced by calcareous bedrock and characterised by brown mosses (e.g. *Scorpidium*, *Hamatocaulis*, *Meesia* spp.), not by regular peat mosses (*Sphagnum*). Such habitats are mostly converted to agricultural land or ditched in southern Finland and in SW Lapland. Rich fens are threatened habitats in Finland and harbour rich plant and invertebrate biota (Salmela & Suuronen 2014, Salmela et al. 2015, Hyvärinen et al. 2019).

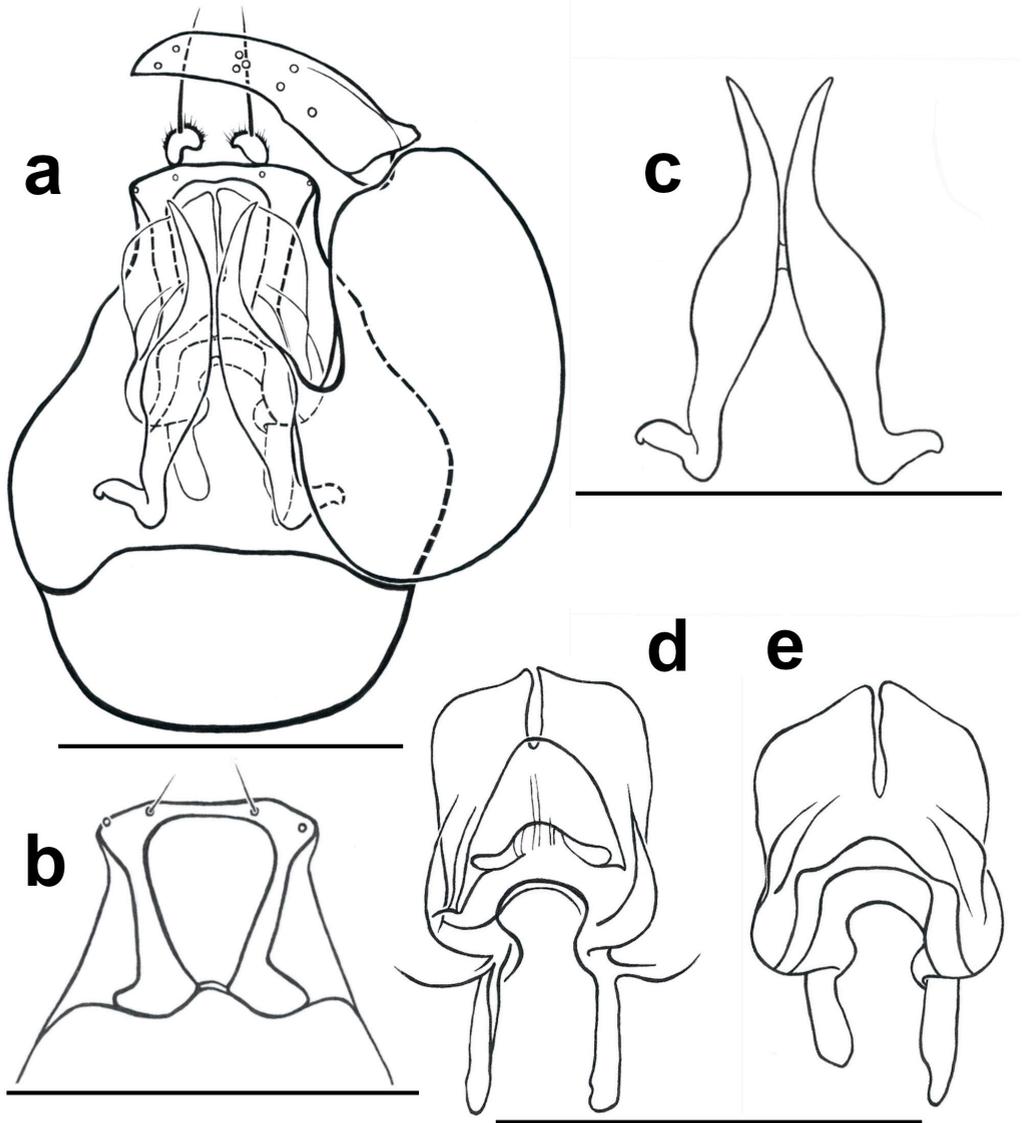
### ***Brachypogon singularis* (Santos Abreu)**

(Figures 4–7)

*Ceratolophus singularis* Santos Abreu, 1918: 317 (female, Canary Islands), Borkent & Dominiak 2020: 156 (*nomen dubium*).

*Brachypogon singularis*: Borkent 1997: 5 (combination, *nomen dubium*).

*Ceratolophus rufigastris* Santos Abreu, 1918: 321 (female, Canary Islands); Borkent & Dominiak 2020: 156 (*nomen dubium*). **Syn. n.**



**FIGURE 3.** *Brachypogon surma* Dominiak, Szadziewski & Salmela sp. n., male genitalia (a, c, e – holotype). **a.** Genitalia, ventral view, **b.** Tergite 9, **c.** Aedeagus, **d–e.** Parameres. Scale bar 0.1 mm.

*Brachypogon rufigastris*: Borkent 1997: 5 (combination, *nomen dubium*).

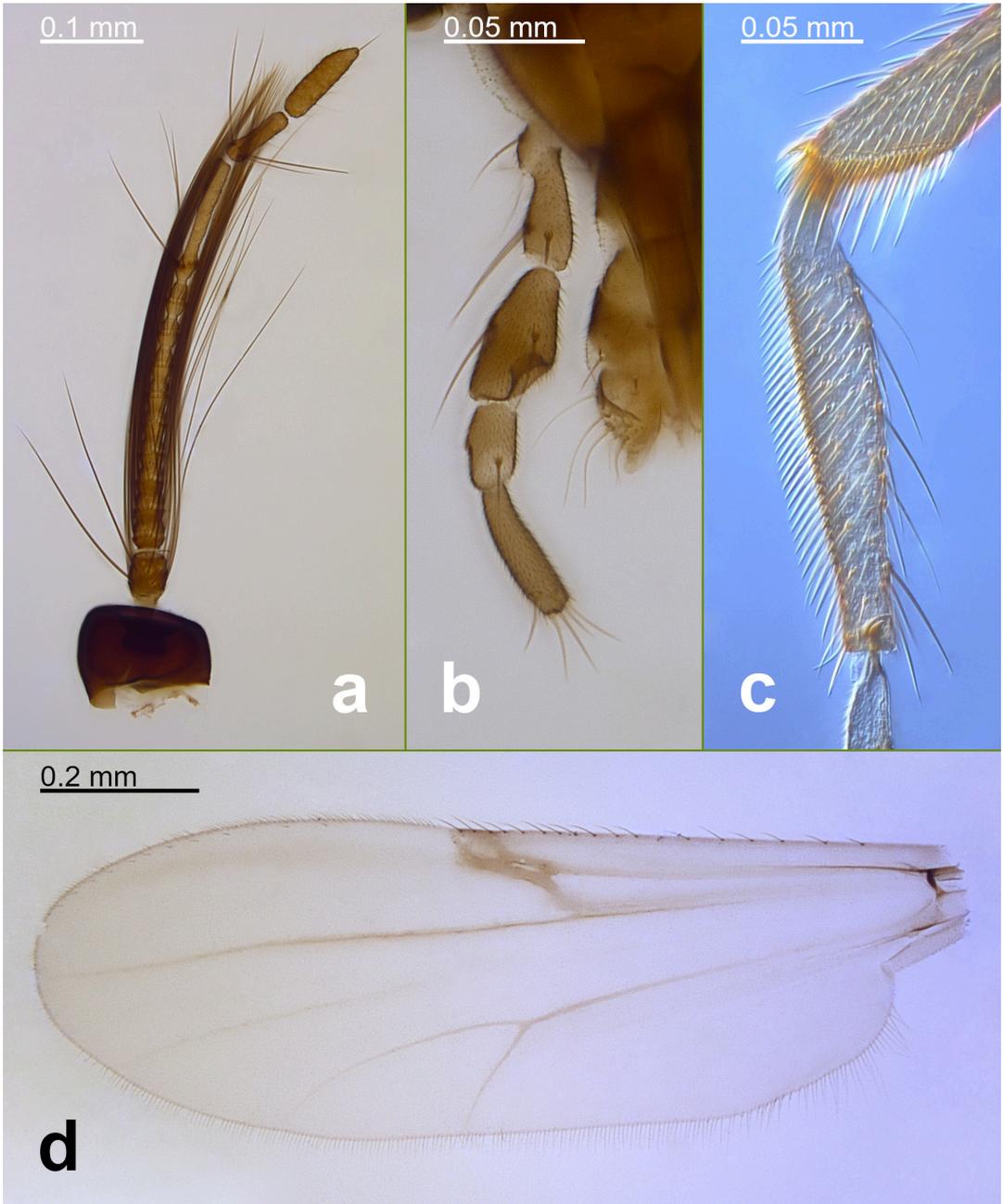
*Ceratolophus obscurus* Santos Abreu, 1918: 323 (as variety of *rufigastris*, female, Canary Islands); Borkent & Dominiak 2020: 156 (*nomen dubium*). **Syn. n.**

*Brachypogon obscurus*: Borkent 1997: 5 (combination, *nomen dubium*).

**Material examined.** *Neotype.* Adult male, present designation, Spain, labelled as follows: *B. (I.) singularis*, ESP. Gran Canaria, Bco.

Tirajana, 16 XI 1995, light trap, Baez, Nilsson & Malmqvist, (CEIG). *Other materials.* Same data as the neotype, 8 males, 2 females, (CEIG).

**Diagnosis.** Males of the species can be easily distinguished by having triangular aedeagus with subapical ring bearing strong ventral spine and two long dorsal plate-like projections, and U-like, strong and pointed parameres. Female similar to other species, with 2 unequal seminal capsules

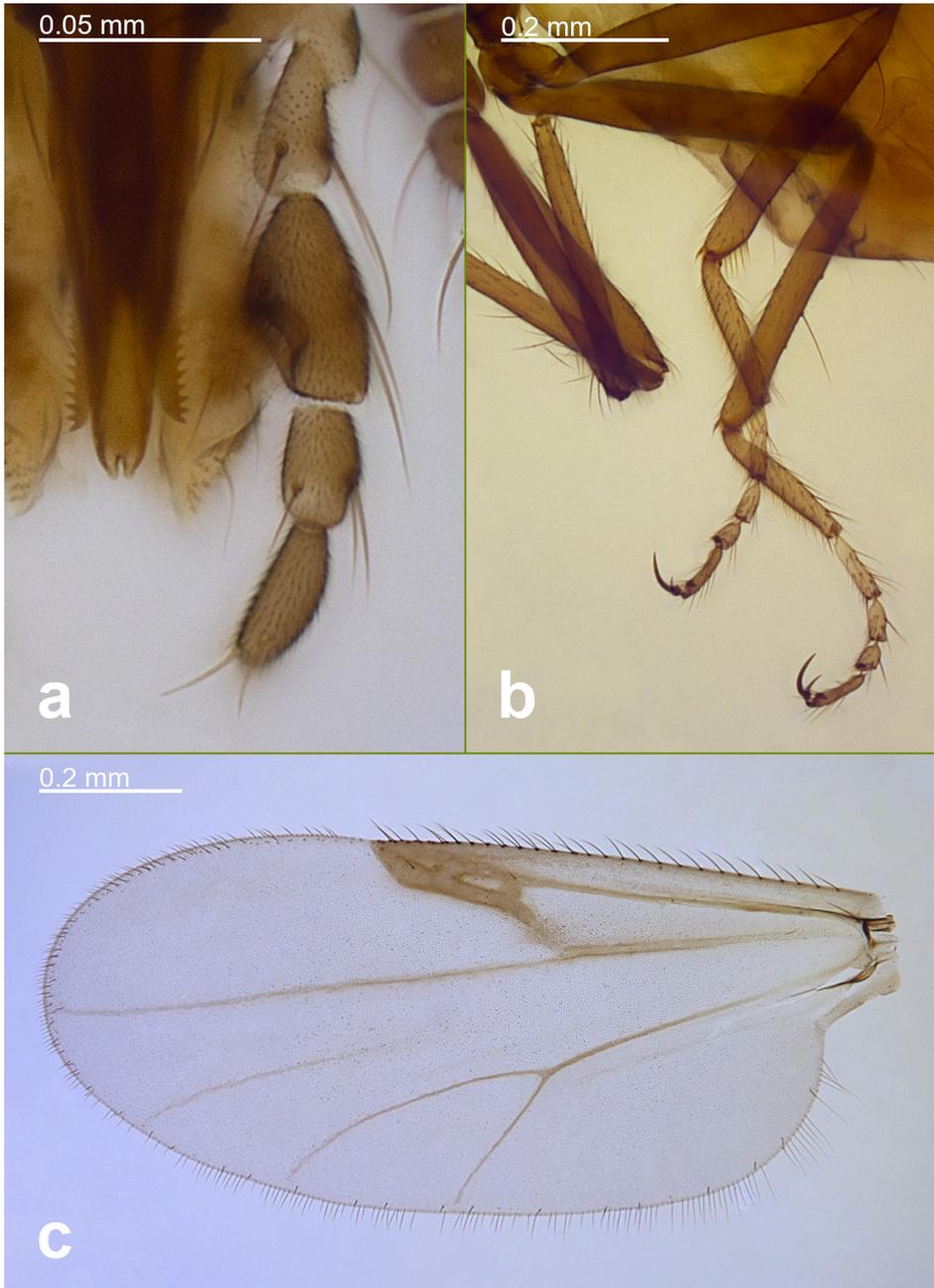


**FIGURE 4.** *Brachypogon singularis* (Santos Abreu, 1918), male (a, d – neotype). **a.** Antenna, **b.** Maxillary palp, **c.** Tibial comb and basitarsus of hind leg, **d.** Wing.

and two internal, rod-like sclerotizations under the abdominal sternite 9.

**Description. Male. Colouration.** Body dark. Tarsomeres 1–2, especially those of mid leg, slightly paler; hind basitarsus dark. **Head.** Antenna

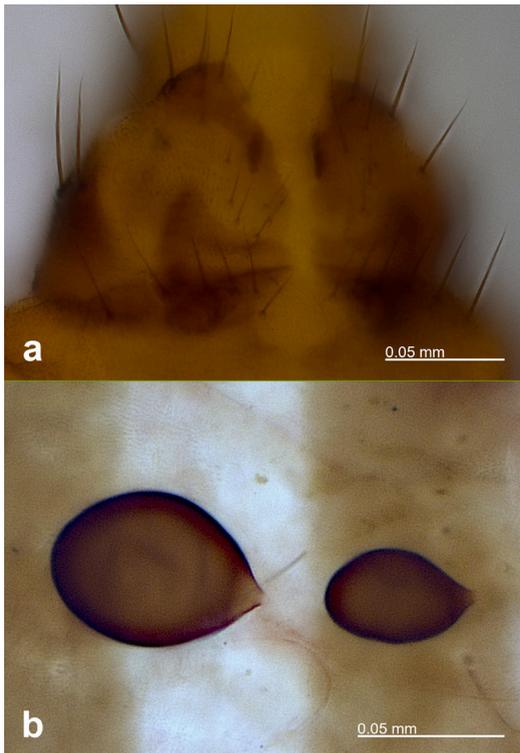
(Figure 4a) with flagellomeres 2–5 or 2–10 fused (n=9); total flagellum length 0.65–0.70 mm (n=6), AR 0.95–1.00 (n=5). Palpus (Figure 4b) with third palpal segment stout, with well-defined shallow sensory pit located on distal half; length 0.044–



**FIGURE 5.** *Brachypogon singularis* (Santos Abreu, 1918), female. **a.** Mouthparts, **b.** Hind legs, **c.** Wing.

0.052 mm,  $PR_{III}$  1.7–2.1 (n=7); fourth palpal segment with 2–3 setae. *Thorax.* Anepisternum bare, katepisternum with single seta; scutellum with 4 marginal setae. Legs slender; hind leg with tibial comb composed of 7–9 large spines (n=9),

and basitarsus with single row of palisade setae (Figure 4c); 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; hind tarsal ratio  $TR_{III}$  1.5–1.7 (n=8). Wing



**FIGURE 6.** *Brachypogon singularis* (Santos Abreu, 1918), female. **a.** Abdominal sternites 8 and 9, ventral view, **b.** Seminal capsules.

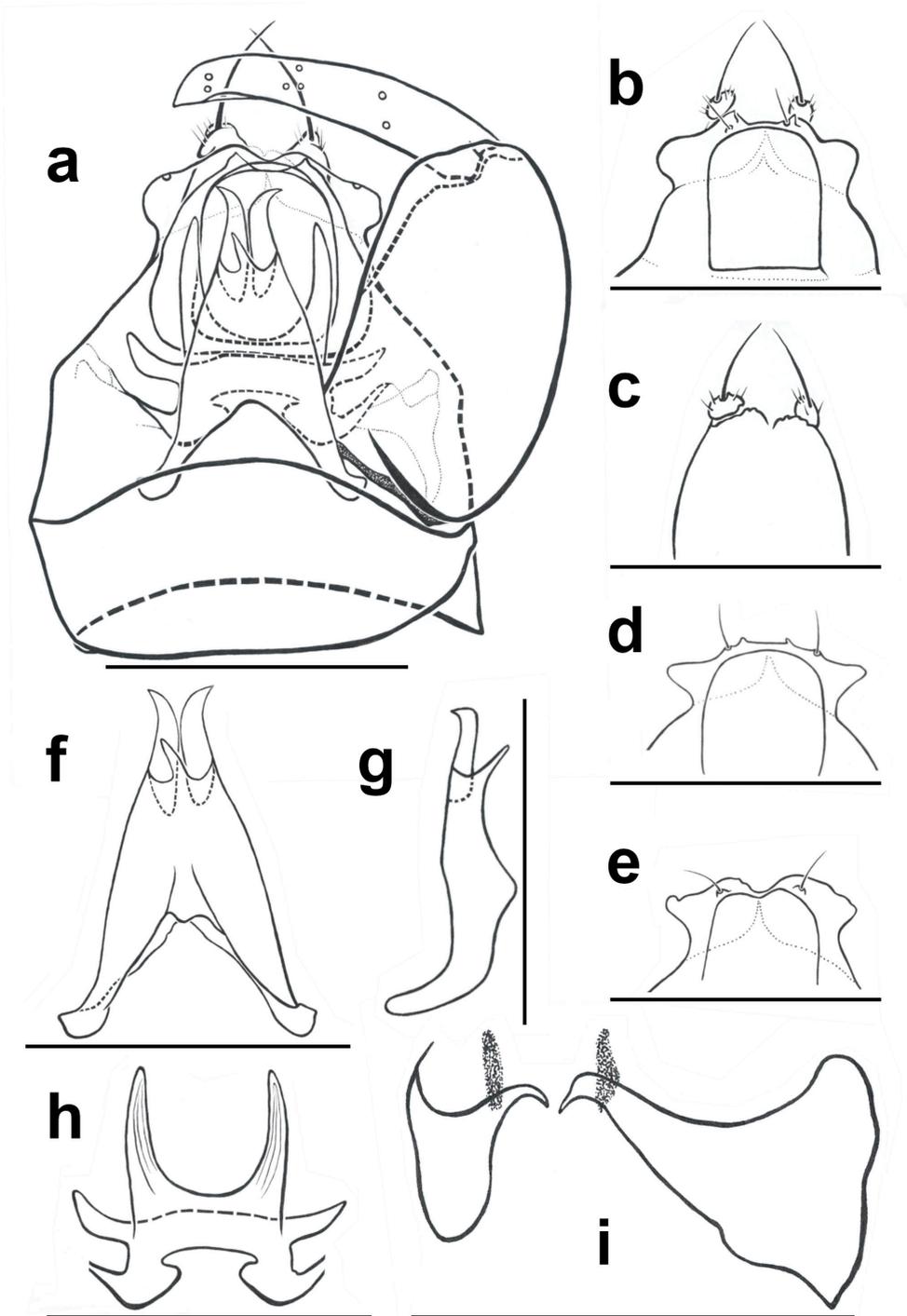
membrane slightly infuscated (Figure 4d), with some macrotrichia along apical margin; two short radial cells present, similar in length, first one slit-like, second broader; wing veins infuscated; wing length 1.10–1.20 mm, CR 0.53–0.54 (n=5). **Genitalia** (Figures 7a–h). Apicolateral processes of tergite 9 weakly developed (Figures 7a, b, d, e), each bearing single seta. Cerci small, each with single strong seta (Figures 7a–c). Proctiger heavily sclerotized, rectangular, frame-like (Figures 7a, b). Posterior margin of sternite 9 gently rounded (Figure 7a). Gonocoxite stout, 1.7 times longer than broad (Figure 7a). Gonostylus nearly as long as gonocoxite, straight, with slightly pointed apex (Figure 7a). Aedeagus triangular with high basal arch (Figures 7f, g); subapical ring armed with strong ventral spine curved ventrally and two dorsal long plate-like projections. Parameres (Figure 7h) with dorsobasal half relatively long, with well-established horn-like lateral processes;

ventroapical half with basal part fused and apical part bifid, composed of two horn-like apicolateral processes.

**Female. Colouration.** Body dark. Tarsomeres 1–2, especially those of mid leg, slightly paler; hind basitarsus dark. Abdomen slightly paler (in both specimens examined filled with eggs). **Head.** Antenna with 8 proximal flagellomeres ovoid to subcylindrical, and 5 distal flagellomeres cylindrical; length of flagellum 0.43–0.44 mm, AR 1.22–1.23 (n=2). Maxillary palp (Figure 5a) with third palpal segment stout, with large but shallow sensory pit located apically; length 0.046–0.049 mm, PR<sub>III</sub> 1.6–1.9 (n=2); fourth palpal segment bearing 2–3 setae. Mandible with 12 teeth, smaller in basal half, bigger towards apex (Figure 5a). **Thorax.** Anepisternum bare, katepisternum bearing single seta; scutellum with 4 setae. Femora and tibiae of all legs slender; hind tibial comb composed of 8–9 spines (Figure 5b); hind basitarsus armed with single row of palisade setae; all legs with tarsomere 4 subcylindrical and tarsomere 5 armed with slightly unequal large claws (Figure 5b), each with basal inner tooth; hind tarsal ratio TR<sub>III</sub> 1.9–2.0 (n=2). Wing membrane with single row of macrotrichia along whole distal and posterior margin (Figure 5c); two short and narrow radial cells present; wing veins infuscated; wing length 1.16 mm, CR 0.61 (n=1). **Genitalia** (Figures 6a, 7i). Sternite 8 divided lengthwise, separated from tergite 8, desclerotized medially, with broad triangular excavation on posterior margin. Medioventral halves of sternite 9 with slender, pointed arm; two internal, rod-like sclerotizations under sternite 9 present (Figures 6a, 7i). Sternite 10 with one pair of setae. Two ovoid, unequal, highly sclerotized seminal capsules present (Figure 6b), dimension (mean values) 0.054x0.033 mm and 0.075x0.054 mm (n=2).

**Immature stages.** Unknown.

**Comments.** The remains of the Santos Abreu's collection of biting midges from the Canaries were examined by Borkent (1997), who designated the lectotypes, proposed several new junior synonyms, and treated some other names as *nomina dubia*. Among the latter, there are three names originally placed in the genus



**FIGURE 7.** *Brachypogon singularis* (Santos Abreu, 1918), genitalia of male (a–h) (a, f, h – neotype), and female (i). **a.** Male genitalia, ventral view, **b–e.** Ventral view of cerci and tergite 9, **f.** Aedeagus, ventral view, **g.** Aedeagus, lateral view, **h.** Parameres, **i.** Female abdominal sternite 9. Scale bar 0.1 mm.

*Ceratolophus* Kieffer, 1899 but belonging to the subgenus *Isohelea* of *Brachypogon*, i.e. *singularis* (p. 317), *rufigastris* (p. 321) and *obscurus* (p. 323, as variety of *rufigastris*). The type materials of these are believed to be destroyed (Borkent 1997). In the new world catalogue of biting midges (Borkent & Dominiak 2020) all these names were still treated as *nomina dubia*. In order to clarify the taxonomic status of these names and to stabilize the nomenclature within the taxonomically complicated subgenus *Isohelea*, we selected a male specimen of *Brachypogon* collected in the Canary Islands and designated here a neotype for *Ceratolophus singularis* Santos Abreu, 1918. Among the materials examined there were specimens of both sexes, and the females perfectly fit to the description of this species given by Santos Abreu. Regarding the two remaining names, we propose here to treat them as conspecific, and moreover – as synonymous with *B. singularis* (new synonyms). Except of rather unimportant differences in colouration of the body, there are no other characters which allow to distinguish *B. rufigastris* and *B. obscurus*. According to the original description (Santos Abreu 1918) female of *B. rufigastris* is characterized in having hind basitarsus as long as the combined length of two next tarsomeres (three tarsomeres in *B. singularis*) and equal claws lacking inner teeth (slightly unequal with inner teeth in *B. singularis*). However, when the results of Borkent's (1997) study are taken into the consideration, it appears obvious, that the specific traits indicated by Santos Abreu as crucial for species delimitation are of much less taxonomic value. Borkent (loc. cit.) proved that many names authored by Santos Abreu are synonymous. It is essential to mention that biting midges of the genus *Brachypogon* are minute and especially females look very much alike, and thus their correct identification based on pinned specimens seems to be quite impossible or at least may cause difficulties.

*Brachypogon singularis* and *B. clavatus* (Clastrier, 1966) are two species of the subgenus *Isohelea* currently known from the Canaries.

Rudimentary internal sclerites under the abdominal sternite 9 in females of *B. singularis* are homologous to those present in females of the

subgenus *Wirthomyia* Vargas, 1973 of *Culicoides* Latreille, 1809.

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Received: 21 August 2020

Accepted: 1 December 2020