Rediscovered after half a century – a new record of *Dasyhelea erici* Havelka, 1978 in Europe (Diptera, Ceratopogonidae)

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Adults of both sexes of *Dasyhelea erici* Havelka, 1978 (Diptera, Ceratopogonidae) are redescribed and illustrated. The species is rediscovered in Europe 52 years after its first record in Austria in 1972. The species is reported from Norway for the first time, DNA barcoded for the first time, and the adult female is described and illustrated for the first time. Unclear taxonomic position of the species is briefly discussed.

Key words: Diptera, Ceratopogonidae, *Dasyhelea erici*, biting midges, Norway, Scandinavia, redescription, DNA barcoding, COI.

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Introduction

The biting midge family Ceratopogonidae comprises minute, widely distributed nematoceran flies known from the subantarctic islands, through the tropics up to the far north (Borkent & Grogan 1995, Borkent & Dominiak 2020). Members of the family occur in various habitats and the world fauna consists of 112 extant genera with nearly 6300 species (Borkent *et al*. 2022). In Norway, 166 biting midge species have been reported so far (Dominiak & Stur 2022, Dominiak & Salmela 2023, Dominiak & Szadziewski 2023). Adult males of all Ceratopogonidae feed exclusively on sugar and water from nectar and honey dew. Females, on the contrary, show a broad range of feeding habits being nectarophagous, pollinivorous, predatory, and ectoparasitic (Szadziewski *et al*. 1997, Borkent & Dominiak 2020). Bloodsucking biting midges can act as vectors of a wide array of viruses, bacteria and nematodes, among others for the very well known bluetongue virus or protozoans causing avian malaria (Linley 1985, Borkent & Spinelli 2007).

A discovery of a new locality for a species previously only known from distant geographic areas, often raises the question if a change in climate causes these species migrations. However, for most biting midge species, especially the ones outside the parasite-vector spectrum, too little is yet known about their taxonomy, biology, population dynamics and geographical

distribution to be able to soundly discuss any kind of migration patterns. There is no doubt that only filling gaps in this basic knowledge about species will bring us closer to answer bigger questions about climate and environment changes and their impact on the species biodiversity and distribution of Ceratopogonidae. However, in the times of declining number of experienced taxonomists (Hochkirch *et al*. 2022), it is the lack of specialists which slows down the progress of gathering and processing this kind of data for various insect taxa, including ceratopogonids. With such a high number of species within the family (Borkent *et al*., submitted), and only a handful taxonomists working on the topic, it is not possible to address all problems connected to research on biting midges. Therefore, it is striking that a species previously only known from its type locality, and only from a single specimen, is suddenly being collected and recognized at three other distant and environmentally diverse localities in the last couple of years. There is no doubt that cases like this will significantly increase with a multiplied effort to not only collect but also to process the collected specimens.

Thanks to a synergy of two faunistic NBIC projects (Artsprosjektet 2021, 2022) and one DNA barcoding project (Global Malaise Trap Program), by sharing samples and results, ten specimens of *Dasyhelea erici* Havelka, 1978 are now being recorded from Norway. The species was originally described from Lunz am See in Austria, based on a single male specimen collected in 1972, and has not been reported since. *Dasyhelea erici* belongs to a species-rich genus with around 630 valid extant species described worldwide (Borkent & Dominiak 2020, Borkent *et al*. 2022), of which 24 are known to occur in Norway (Dominiak & Stur 2022, Dominiak & Salmela 2023, this publication).

Material and methods

The males and females of *Dasyhelea erici* were collected using a sweep net and Malaise trap, cleared in 10% KOH or phenol-ethanol mixture, dissected, and subsequently slide mounted in a mixture of Canada balsam and orange oil. The sexes were associated by DNA barcodes belonging to the same Barcode Index Number (BIN) in BOLD (BOLD:ACP8029). All the examined specimens are housed at the Arctic University Museum of Norway (Tromsø) but two males (BIOUG15674-D06, TSZD-PD-300379) deposited at the NTNU University Museum (Trondheim). Morphological terms and method of taking measurements are described in Szadziewski (1986), Dominiak (2012) and Díaz *et al.* (2018). Photographs were taken using a Zeiss Axioscope 7 microscope with an Axiocam 208 color camera, and Affinity Photo and Affinity Designer software were used for stacking and editing of photos, preparing final line drawings and composing of plates.

For the barcoding of cytochrome oxidase 1 (COI) gene, tissue samples containing up to three legs were sent to the Canadian Centre for DNA Barcoding, BIO (Ontario, Canada), where DNA was extracted and sequenced. The sequences and metadata are available in the Barcode of Life Data Systems (BOLD) (datasets "DS-CERTRO Ceratopogonidae Troms county", "DS-CERNOR Ceratopogonidae Nordland county", and Global Malaise Trap Program (Seymore et al. 2024)).

Results

Dasyhelea erici Havelka, 1978

Dasyhelea erici Havelka, 1978: 62 (male, Austria)

Diagnosis. The only *Dasyhelea* species in Europe with the following combination of characters. Male with tergite 9 lacking apicolateral processes; sternite 9 narrow, with posterior margin greatly elongated, connected with membranous part of aedeagus through well-visible bridge, and unevenly sclerotized in the middle; gonostylus single, markedly bent; paramere and gonocoxal apodemes fused, symmetrical, tapering towards rounded apex, with lumen. Female with elongated sternite 8, very long and slender subgenital plate, and distinct single spermatheca with a rim before its outlet and a weakly sclerotized duct.

Description. Male (N=3). Whole body dark except slightly paler tarsi. Proximal flagellomeres

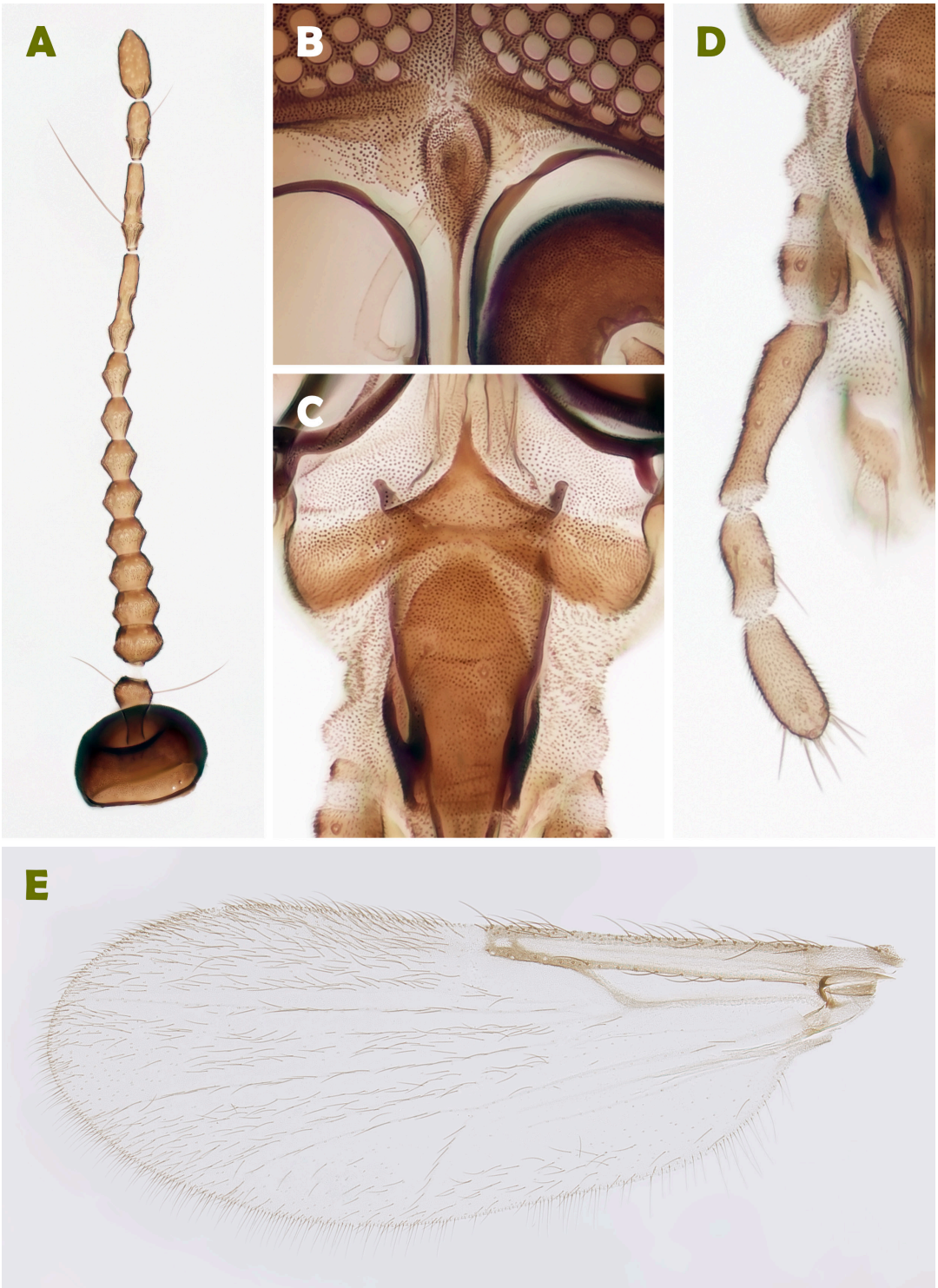

FIGURE 1. *Dasyhelea erici* Havelka, 1978, male. **A**. Antenna. **B**. Frons. **C**. Clypeus. **D**. Maxillary palp. **E**. Wing.

similar in size and shape, distal four longer, with last flagellomere without apical prolongation (Figure 1A); length of segments 10–13 (in µm): 60–71, 51–64, 37–46, 51–55; antennal ratio AR 0.7–0.9. Frontal sclerite elongated, rather narrow, leaf-shape (Figure 1B). Clypeus divided (Figure 1C), bearing 7–10 setae in total. Maxillary palp as in Figure 1D; palpomere 3 slender, widest at its proximal ⅓, length 53–74 µm, palpal ratio PR 3.8–4.3, sensilla capitata present on inner surface, from base to about ½ of palpomere length. Scutellum with a single row of 5–6 strong setae. Transverse suture of scutum absent. Wing with small second radial cell, first radial cell reduced (Figure 1E), wing length 0.81–0.92 mm, costal ratio CR 0.43–0.45. Tarsal ratio of foreleg TR(1) 1.8–2.0, midleg TR(2) 2.2 (N=1), hind leg TR(3) 1.7–1.8. Hind tibial comb with 6 spines. Genitalia as in Figures 2A-F. Posterior margin of tergite 9 (Figure 2A) without apicolateral processes, with two wide and rounded apicolateral lobes, each with a group of 3–4 stronger setae. Cerci not visible. Sternite 9 (Figure 2B) very narrow, with posterior margin greatly elongated, mostly membranous except clearly visible and unevenly sclerotized middle portion, connected with membranous part of aedeagus through well-visible bridge (Figure 2F). Gonocoxite without modifications, as in Figure 2C. Gonostylus (Figure 2D) single, bent; in lateral view stouter at basal part and abruptly narrowing towards apex, with few strong setae located on protruded surfaces; in posterior view apex of gonostylus rounded, wide and flat. Paramere and gonocoxal apodemes as in Figure 2E, fused, symmetrical, complex, tapering posteriorly towards slightly rounded apex, with lumen. Aedeagus symmetrical, with very low basal arch and short, hook-like apicolateral projections (Figure 2F).

Female (N=3). Whole body dark except slightly paler tarsi. Proximal flagellomeres similar in size, subspherical, distal five flagellomeres slightly longer, subcylindrical; last flagellomere without apical prolongation; antennal ratio AR 0.7–0.8. Frontal sclerite elongated, rather narrow, leaf-shape. Clypeus divided, bearing 10–11 setae

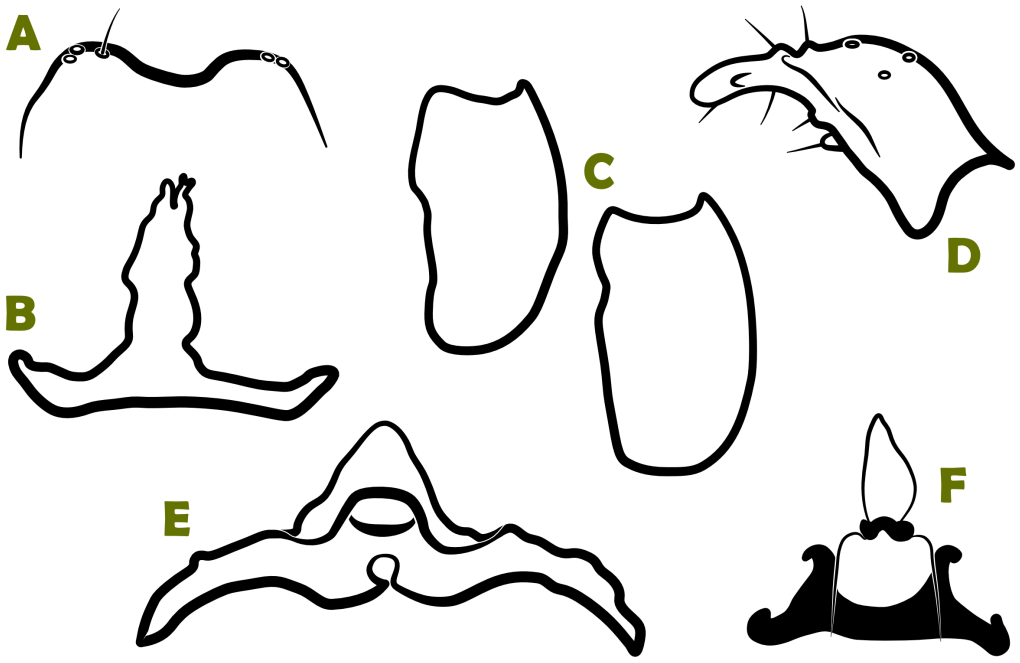

FIGURE 2. *Dasyhelea erici* Havelka, 1978, male. **A**. Distal part of tergite 9. **B**. Strongly sclerotized part of sternite 9. **C**. Gonocoxites. **D**. Gonostylus. **E**. Paramere and gonocoxal apodemes. **F**. Aedeagus and sternite 9 complex.

in total. Palpomere 3 slender, widest at its proximal ⅓ – ½, length 58–64 µm, palpal ratio PR 3.1–3.6; sensilla capitata present on inner surface, from base to about ½ of palpomere length. Scutellum with a single row of 6 strong setae. Transverse suture of scutum absent. Wing with second radial cell, first one reduced, wing length 0.87–0.89 mm, costal ratio CR 0.47–0.54. Tarsal ratio of foreleg TR(1) 1.8–1.9 (N=2), hind leg TR(3) 1.8–2.0; midleg not available for measurements. Hind tibial comb with 6 spines. Abdomen and genitalia as in Figure 3A. Sternites of segments 3–8 well-sclerotized (N=2); sclerotization medially disjunct on segments 3–5, nearly complete on segment 6 and complete on segments 7–8. Tergite 8 normal-sized, tergite 9 long. Sternite 8 elongated, with small median notch on distal margin. Subgenital plate with very long rami and greatly elongated slender notum (Figure 3B). Cerci small. Spermatheca single, ovoid, with a rim before its outlet (Figure 3C), dimension 41–46 µm x 32–35 µm; spermathecal duct weakly sclerotized.

Material examined. NORWAY, Nordland, Bodø municipality, Løding, 67.3102525N, 14.80164212E, 105 m a.s.l., peat bog, 25.VI.2023, net, leg. P. Dominiak, 4 males (TSZD-PD-300374, TSZD-PD-300376, TSZD-PD-300425, TSZD-PD-300426), 4 females (TSZD-PD-300372, TSZD-PD-300373, TSZD-PD-300423, TSZD-PD-300424). Troms, Senja municipality, Tennevatnet, nature reserve, 69.20712N, 17.59073E, 17 m a.s.l., calcareous lake, 09.VII.2023, net, E. Stur & T. Ekrem, 1 male (TSZD-PD-300379 (NTNU-VM-239135)). Trøndelag, Trondheim municipality, Trondheim, 63.40531N, 10.38222E, 75 m a.s.l., 01. - 08.VI.2014, Malaise trap, E. Stur & T. Ekrem, 1 male (BIOUG15674-D06 (NTNU-VM-181672)).

Distribution. So far, the species has been reported from Austria and in present studies from Norway. *Dasyhelea erici* mentioned as known from Germany in a checklist by Havelka & Aguilar (1999) is doubtful as the authors did not provide any metadata for the record. The biting midge

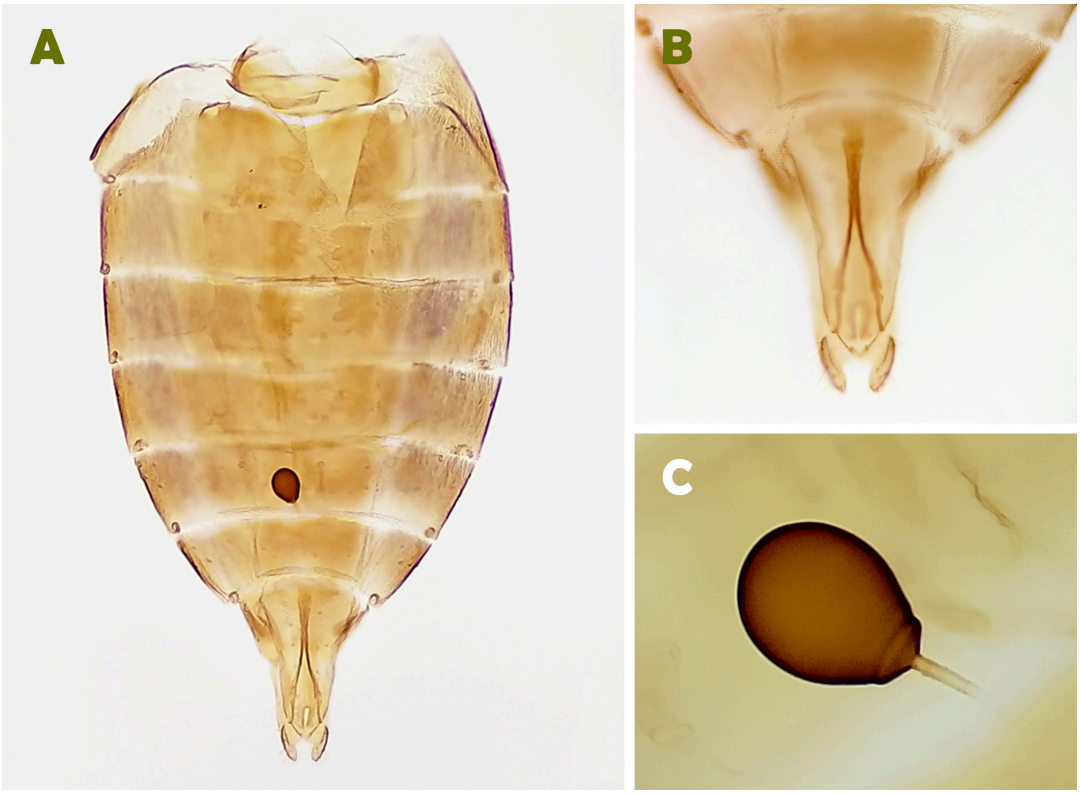

FIGURE 3. *Dasyhelea erici* Havelka, 1978, female. **A**. Abdomen, ventral view. **B**. Subgenital plate. **C**.Spermatheca.

species probably represents a boreomontane faunal element.

Discussion

Remm (1988) and Havelka & Aguilar (1999) included the species in the subgenus *Pseudoculicoides* Malloch, 1915 of *Dasyhelea.* The leaf-shaped frons, relatively long third palpal segment, male sternite 9 and aedeagus fused by well-sclerotized bridge, and symmetrical paramere-gonocoxal apodemes complex indicate that *D. erici* indeed belongs to this subgenus (see diagnosis of *Pseudoculicoides* in Dominiak 2012). The peculiar morphology of the male genitalia, without apicolateral processes on tergite 9 and complicated structure of the paramere and gonocoxal apodemes complex, allows to easily distinguish *D. erici* from other members of the subgenus. The elongated sternite 9 and markedly bent gonostylus are observed also in some species of the *fasciigera* group of *Pseudoculicoides*. All of them have, however, divided and complex gonostyli, usually well-defined apicolateral processes of tergite 9 and asymmetrical paramere-gonocoxal apodemes complex. *Dasyhelea erici* resembles also species from the *johannseni* group of the subgenus *Pseudoculicoides* in protruded distal margin of sternite 9, shape of paramere-gonocoxal apodemes complex and presence of a well-visible bridge connecting sternite 9 and the aedeagus. All known species from the latter group differ in having long, evenly arched gonostyli and slender, finger-like apicolateral processes of tergite 9. In the original description of the male genitalia of *D. erici* (Havelka 1978) both the shape of aedeagus and paramere are misinterpreted. The aedeagus has only two posterior projections, not four. The pair of pincer-like median projections of aedeagus shown on Figure 4 (Havelka 1978, p. 63) is a fragment of the greatly protruded, heavily sclerotized posterior margin of sternite 9. The apical part of paramere is not split but it is tapering towards a rounded apex. The female of *D. erici* is similar to *D. longicauda* Yu, in Yu *et al*. 2005, described from Chongqing, China. Females of both species have an elongated and narrow distal part of the abdomen but differ in body coloration and the shape of subgenital plate's notum. *Dasyhelea erici* has a dark pigmented body and slender notum, while *D. longicauda*, according to the original description, is light-colored and has a wider notum.

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