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Updating and expanding the key to European *Megaselia* (Diptera, Phoridae): from Disney's Britain to a continental fauna, with 393 additions and four new species

Valerio CARUSO [1,*], Ronald Henry DISNEY [2], Daniel WHITMORE [3], Esben BØGGILD [4], Bernd GRUNDMANN [5] & Emily HARTOP [6,*]

[1,3] Staatliches Museum für Naturkunde Stuttgart, Rosenstein Gewann 1, 70191 Stuttgart, Germany.
[2] Department of Zoology, University of Cambridge, Downing St., Cambridge, CB2 3EJ, UK.
[4] Fayesgade 10, DK-9500, Hobro, Denmark.
[5] Diekstraße 6, D-33824 Werther, Germany.
[6] Department of Natural History, NTNU University Museum, Norwegian University of Science and Technology, Trondheim, NO-7012, Norway.

[*] Corresponding authors: valerio.caruso90@gmail.com; emily.hartop@ntnu.no
[2] Email: rhld2@cam.ac.uk
[3] Email: daniel.whitmore@smns-bw.de
[4] Email: esbenboggild@gmail.com
[5] Email: bernd.grundmann@hotmail.com

Abstract. We present a comprehensive list of additions to Disney's 1989 key 'Scuttle Flies. Diptera: Phoridae. Genus *Megaselia*', which has become the de facto fundamental reference for the identification of European species of *Megaselia*. The present update extends Disney's key to cover all Palearctic species, with 393 additions and an indication of where they fit in the key. The couplets in Disney (1989) where these species key are indicated. We also report the discovery of two specimens of *M. romphaea* (Schmitz, 1947) and provide an updated description of this species, as the original account is outdated and difficult to consult. In addition, we describe four new species of *Megaselia* from Germany – *M. bruna* Caruso, Bøggild & Grundmann sp. nov., *M. curta* Caruso, Bøggild & Grundmann sp. nov., *M. robertoi* Caruso sp. nov., and *M. splendida* Caruso, Bøggild & Grundmann sp. nov. – using the streamlined method of description developed specifically for the genus.

Keywords. Barcoding, integrative taxonomy, morphology, species description.

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Introduction

Phoridae Newman, 1835 are a hyperdiverse family of Diptera Linnaeus, 1758 with more than 4500 species across ~280 genera worldwide (Brown 2022b). However, over 90% of their global diversity remains undescribed, with some estimates reaching the hundreds of thousands of species (Srivathsan *et al.* 2019). The family includes parasitoids, parasites, scavengers, predators, fungivores, and herbivores, and plays key roles in decomposition, nutrient cycling, and pollination (Disney 1994; Marshall 2012). Many species are parasitoids, targeting diverse arthropods – including insects, arachnids, myriapods – and even mollusks (Disney 1994; Marshall 2012). Germany is one of the better studied regions, with 400 recorded species (Schmitz 1981; Pape *et al.* 2015; Morinière *et al.* 2019; Schumann *et al.* 1999). Over the past two centuries, numerous studies have led to the current knowledge of this fly family. Nevertheless, despite sustained research efforts, the family remains remarkably poorly understood, with its true species diversity largely unknown (Srivathsan *et al.* 2019; Hartop *et al.* 2020; Li *et al.* 2025). In recent years, the identification process for hyperdiverse groups has been pushed forward by technological innovations in the field of molecular sequencing (Meier *et al.* 2016; Srivathsan 2019, 2021, 2024; Yeo *et al.* 2020) and integrative taxonomy (Hartop *et al.* 2022). The genus *Megaselia* Rondani, 1856 is nested within the subfamily Metopininae Peterson, 1887, one of the two main branches of the family (Hartop *et al.* 2020; Li *et al.* 2025); this genus alone contains 1700 described species (Brown 2022a), 247 of which are recorded for Germany (Schumann *et al.* 1999; German Barcode of Life Consortium 2020) and has a projected global diversity nearing 50 000 species (Disney 1989, 1994; Srivathsan *et al.* 2019; Hartop *et al.* 2020). A recent phylogenetic analysis based on the most comprehensive molecular dataset for *Megaselia* to date (Hartop *et al.* 2020) confirmed that the genus, as traditionally defined, is not fully monophyletic, although most species form a well-supported 'core clade' that represents the bulk of the diversity of the genus. However, deeper relationships among these remain unresolved, underscoring persistent challenges in reconstructing its phylogeny.

During investigations of the diversity of *Megaselia*, researchers are invariably confronted with the overwhelming number of species and the challenges of species identification, which relies primarily on morphological characters of the male genitalia. An additional difficulty lies in the vast and scattered taxonomic literature, much of which is dated, not in English (e.g., Schmitz 1947, 1951, 1981), and often difficult to access. A solution that facilitates access to species descriptions and improves the usability of this literature could prove to be a crucial tool for taxonomic research and species identification.

We here release a comprehensive list of additions to Disney's (1989) British key to the genus *Megaselia*, published as 'Scuttle Flies. Diptera: Phoridae. Genus *Megaselia*', which originally included 221 species. We here add 393 species, expanding the key to encompass all currently described Palearctic species, along with two upcoming additions, one in press (Disney in press) and one currently under description. Palearctic species of the Arabian fauna are also included, for which a separate key is already available in Disney (2006a, 2009a). We also describe four species new to science, found in Germany following a LIT (large-scale integrative taxonomy) (Hartop *et al.* 2022) analysis of over 9000 specimens of *Megaselia*.

This work is part of 'An integrative framework for dark taxa biodiversity assessment at scale: a case study using *Megaselia* (Diptera, Phoridae)' by Caruso *et al.* (2024), and part of the large census project on hidden biodiversity of the so-called 'dark taxa', as part of the German Barcode of Life III (GBOL III) initiative (Hausmann *et al.* 2020).

Material and methods

Additions to the British key of *Megaselia* (Supp. file 1)

Additions to Disney's (1989) key were compiled through a comprehensive review of all available material on the listed species, including examination of primary types, original descriptions, redescriptions, and

existing keys. For years, many of these additions existed only as a filecard system in author HD's lab. They were later digitised by author EH and expanded by author VC for the phorid research community, and are now published here for the first time to make them broadly accessible. Column A states the number of the couplet where each species keys out (sometimes species have multiple listings if they key out in more than one place). Column B gives the species epithet, column C the country from which the species was described, and columns D–F give details of the original description (author, date, and citation).

The identification key to *Megaselia* of the British Isles is used as the foundation because it remains the most comprehensive and up-to-date resource for many European species of the genus, and is particularly valuable for its wealth of reference images. Although not originally designed to cover the full Palearctic fauna, its widespread use has established it as a reliable and widely accepted tool, especially for identifying major working species groups. When consulting Disney's key, users can now refer to the additions reported here after arriving at a couplet, allowing them to explore original descriptions of morphologically similar species and navigate more confidently through the expanding European diversity of *Megaselia*. When species already included in Disney's (1989) key appear in the updated list with different couplet numbers, it is important to clarify how these revisions should be interpreted. For all affected species, we provide notes in Supp. file 1 (column G) indicating their former couplet in Disney's (1989) key and explicitly stating when the earlier placement is no longer valid (rekey) or when the species is additionally keyed to other couplets. For these species, the diagnostic characters underlying the new placement are also reported in the notes in Supp. file 1.

All the additions are listed and provided in the Supp. file 1, which is also available in the Zenodo repository: https://doi.org/10.5281/zenodo.16963238.

New species description

Samples were collected in Germany, mainly in the southern regions, with standardized Malaise traps, and more than 9000 specimens were sequenced for the barcode region of the *COI* mitochondrial gene (for full details see Caruso *et al.* 2024). Following the protocol presented by Hartop *et al.* (2022), 277 putative molecular species clusters were defined using the 'Objective Clustering' species delimitation algorithm (part of TaxonDNA in Meier *et al.* 2006). 3% minimum interspecific *p*-distance clusters were evaluated using a stability index and the intracluster maximum pairwise distance as predictors for incongruences between barcode clusters and morphology (Hartop *et al.* 2022). These putative species were morphologically examined using identification keys (Borgmeier 1964, 1966; Disney 1988, 1989, 1994, 1999, 2006b, 2009b, 2014; Disney & Aguiar 2008; Disney & Boggild 2021; Mostovski 2016; Schmitz 1927, 1936, 1981) and descriptions (see Supp. file 1), and six new species were identified. Two of them are treated separately, of which *M. heimingshofensis* Caruso, Grundmann & Bøggild, 2025 has already been published, and another species belonging to the *pulicaria* complex is in the process of being described and will be treated separately, in a revision of the complex. The remaining four are described here following the streamlined, table-based description method for *Megaselia* species developed by Hartop & Brown (2014a). Furthermore, the morphological terminology used by Hartop & Brown (2014a, 2015) is applied, replacing some of the terms present in Disney's keys (Disney 1983, 1989, 1994), as follows: "anepisternum" instead of "mesopleuron", "terminalia" instead of "hypopygium" and "hypoproct" instead of "proctiger".

The detailed methods and results of the study that led to these descriptions are reported in Caruso *et al.* (2024). The sequences of all barcoded specimens (Caruso *et al.* 2024) (including all the specimens described here) are openly available to consult in BOLD at https://doi.org/10.5883/DS-SPHD2401, and in GenBank under accession numbers OR924472 to OR933558. We note that although molecular diagnostic methods exist (reviewed by Brower & DeSalle 2024), the limited sampling and largely undescribed nature of this taxon make short-barcode diagnoses premature; full barcode sequences are provided for future, data-informed use.

Table 1. Species core information. Columns: 1 = Name of the species; 2 = "Habitus" refers to the photos and drawings of each specimen presented in this work; 3 = "Key" refers to the couplet into which the new species are inserted within Disney's (1989) key.

Name	Habitus	Key
M. bruna sp. nov.	Fig. 3; Table 2	59 and 120
M. curta sp. nov.	Fig. 4; Table 3	86
M. robertoi sp. nov.	Fig. 5; Table 4	203
M. splendida sp. nov.	Fig. 6; Table 5	199 and 232
M. romphaea (Schmitz, 1947)	Fig. 7; Table 6	1

The four new species are added to the key in 'Scuttle Flies. Diptera: Phoridae. Genus *Megaselia*' by Disney (1989), taking into consideration all the additions made in the years following the release of the key (Supp. file 1). The additions regarding the species described here are listed in Table 1.

Specimens were examined using a Leica M205C stereo microscope and photographed using a Sony α 7R II camera equipped with a Mitutoyo M Plan Apo 10× objective before slide mounting. Photograph stacking was done with Helicon Focus software (ver. 8.2.2; Helicon Soft Ltd. 2024). Drawings were made on paper based on photographs of slide-mounted terminalia taken with Keyence VHX-5000 photomicroscope and using a camera lucida (drawing tube). All images were edited with GIMP (ver. 2.10.38; The GIMP Development Team 2024). All body and wing measurements were taken with the Keyence measuring instrument after sectioning and before slide-mount preparation. In cases where a structure was broken into two pieces, both fragments were measured to obtain the total length.

Deposition of specimens

The specimens were preserved in 99.6% pure ethanol at -20°C from the moment of sorting to preparation. Holotypes were slide-mounted using Euparal, while paratypes are all preserved in 99.6% pure ethanol at -20°C. All type specimens are deposited in the Staatliches Museum für Naturkunde Stuttgart (SMNS) collection. Each specimen was assigned with an alphanumeric code (SMNS_DIP#) related to the SMNS collection, and another code (SMNS_#) related to the BOLD repository. These codes and the COI sequences of all the specimens are provided in Supp. file 2.

Repository acronyms

SMNS = Staatliches Museum für Naturkunde Stuttgart
ZFMK = Zoological Research Museum Alexander Koenig (Zoologisches Forschungsmuseum Alexander Koenig)

Standardised morphological characters (following Hartop & Brown 2014a, 2014b; Hartop *et al.* 2015)

- Supra-antennal (SA) setae ratio: the length of ventral SA (VSA) in percentage of the dorsal SA (DSA) length, where the same length is coded '1.00'.
- Positioning of ventral interfrontal (VIF) setae: coded as A, B, C or D, following the scheme in Fig. 1.
- Notopleural seta (NP): Number of notopleural setae and information about length and position. Also present in the wording 'NP cleft', where it indicates the presence or absence of a suture at the position of the first notopleural seta (in case of presence of NP cleft, therefore, only 2 NP setae are present).
- Halter color compared to the scutum (thorax): lighter, same, darker.
- Leg abbreviations: Tarsal segment (Ts), femur (F), tibia (T), antero-dorsal setae (AD), postero-dorsal setae (PD).
- Foretarsus (ts1) palisade: the numbers of foretarsal segments with setal palisades.
- Midtibial (t2) palisade: the portion of the tibia length with a setal palisade, starting from the basal part.

– Hind femoral (f3) basal setae terminology: B = basal, AV = antero-ventral.
– Costal index (CI): costal vein length in relation to the whole wing length.
– Costal ratios in decimals: as 'C1:C2:C3' with C3 at a value of 1. See Fig. 2.
– The ratio between the lengths of anal tube (AT) and the dorsal face of the epandrium (E). The length of the AT (cerci + hypoproct) is given relative to the dorsal face of the E as 'AT<E', 'AT=E', 'AT>E'.
– The ratio between the lengths of terminalia's setae is represented by the three operators' symbols '</=/>'. The bristles that we compare are respectively those present on the various parts of the terminalia: tergite 6 (T6), epandrium (E), cerci (C) and hypoproct (H).
– The specimen length is measured from edge of frons to tip of hypoproct.

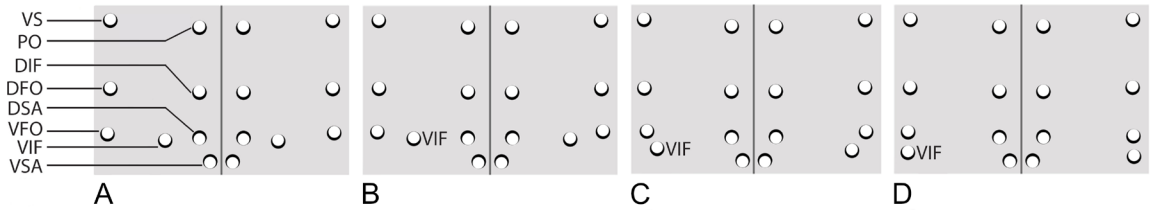

Fig. 1. Frontal setation pattern (from Hartop & Brown 2014a). VS = vertical seta; PO = postocellar seta; DIF = dorsal interfrontal seta; DFO = dorsal fronto-orbital seta; DSA = dorsal supra-antennal seta; VFO = ventral fronto-orbital seta; VIF = ventral interfrontal seta; VSA = ventral supra-antennal seta.

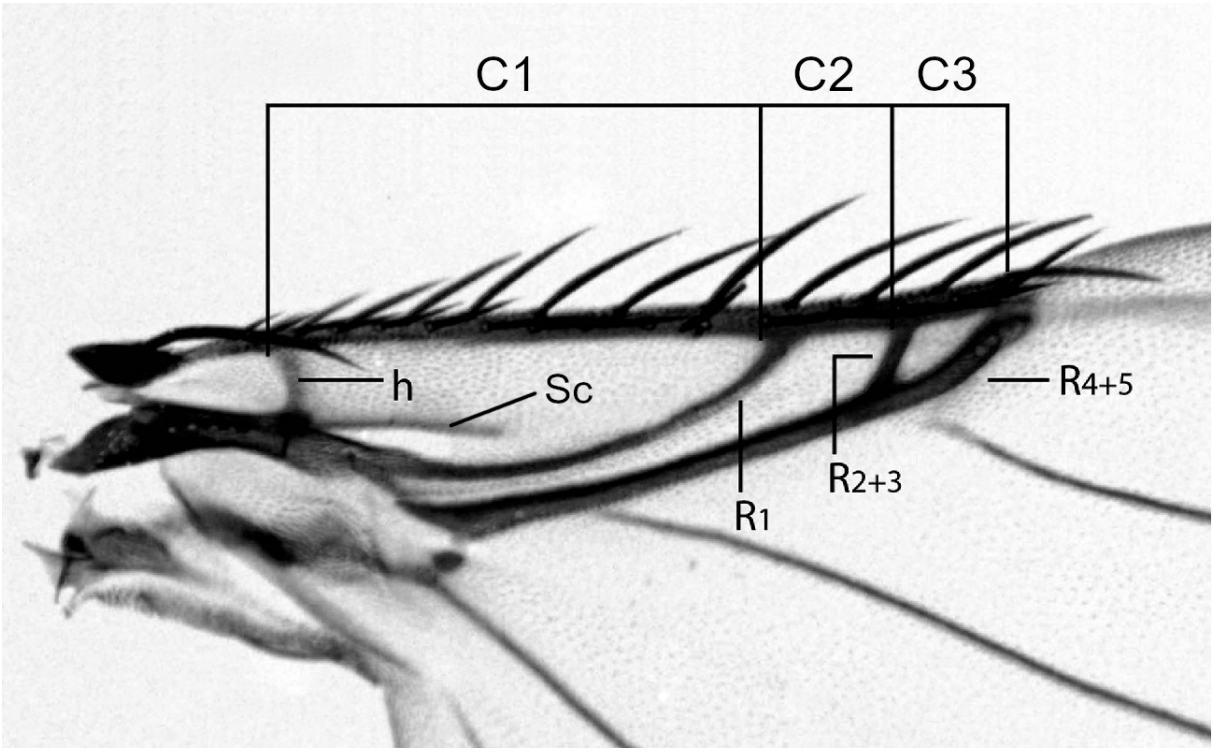

Fig. 2. Photograph of a *Megaselia* species right wing showing our measuring conventions. Here, proportions of C1:C2:C3 are 4.5:1.2:1. Abbreviations: h = humeral crossvein; R1 = radial vein 1; R2+3 = radial veins 2+3; R4+5 = radial veins 4+5; Sc = Subcosta (from Hartop & Brown 2014b after Schmitz 1951: textfig. 44).

Results

Additions

Through a systematic review of the Palearctic literature on *Megaselia*, we compiled 393 additions to Disney's (1989) key, effectively expanding its scope from the British fauna to the broader continental scale. The updated list (Supp. file 1) integrates all Palearctic species described to date and serves as an essential resource for navigating the growing diversity of the genus. Each entry is linked to each species' respective position in the key.

Descriptions of new species

Class Insecta Linnaeus, 1758
Order Diptera Linnaeus, 1758
Family Phoridae Newman, 1835
Subfamily Metopininae Peterson, 1887
Genus *Megaselia* Rondani, 1856

Megaselia bruna Caruso, Bøggild & Grundmann sp. nov.
urn:lsid:zoobank.org:act:674BC6E0-D427-478F-BAD9-70CEB06EC98C
Fig. 3; Table 2

Diagnosis

Uniform dark brown body. Frontal setae as long as the height of the frons. Anepisternum with 15 robust setae, each approximately equal in length to the setae of the ocular row. Haltere as dark as the body. Differs from *M. fuscipalpis* Lundbeck, 1919 in the costal ratio (costal section 1 clearly longer than section 2), and the shape and ratios of the epandrium: dorsal length of epandrium as long as anal tube (1.5 times in *M. fuscipalpis*) with a notch under the distal, pointed lobe. Differs from *M. vestita* (Wood, 1914) in the absence of a stronger seta on the left side of the epandrium. Epandrium with many robust hairs only. Left side of epandrium with a small pointed end below the anal tube, and a small notch on the distal inferior

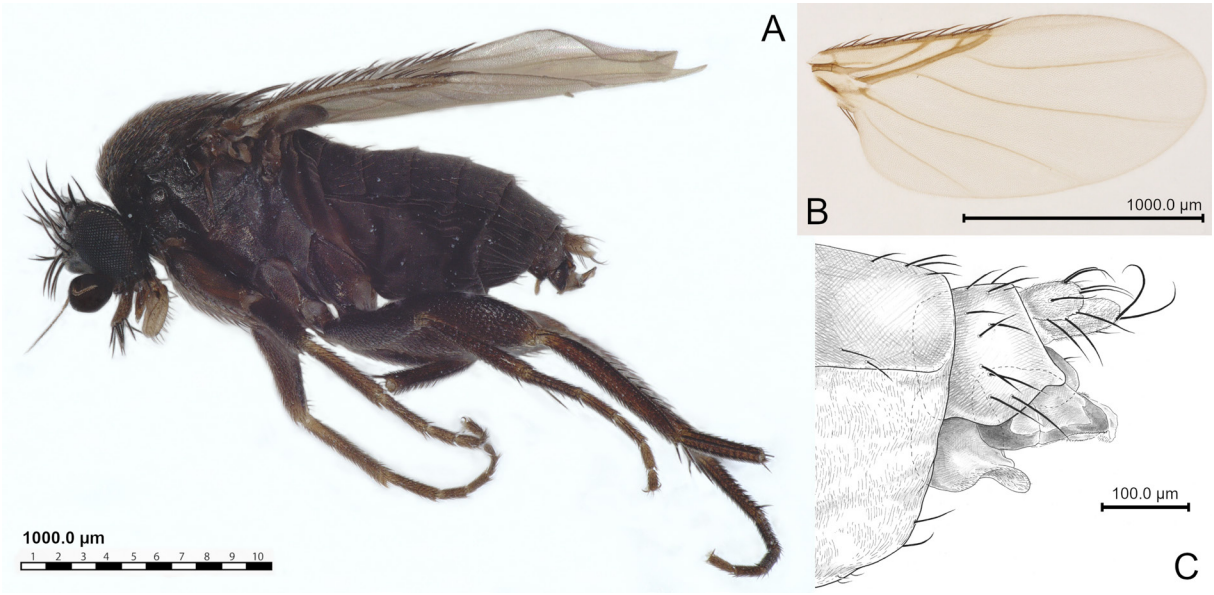

Fig. 3. *Megaselia bruna* Caruso, Bøggild & Grundmann sp. nov., holotype ♂ (SMNS_DIP_019269). **A**. Habitus. **B**. Wing. **C**. Terminalia. Specimen length 2.268 mm. Wing length 1.839 mm. Costal setae length 0.091 mm.

Table 2. *Megaselia bruna* Caruso, Bøggild & Grundmann sp. nov. Description (following Hartop & Brown 2014a).

Head	
SA ratio	1.0
VIF position	normal 'B'
Palpal setae length	long
Labellum spinosity	spinose sparse
Thorax	
Anepisternum	hairs (~15)
Relative halter color	same (slightly lighter)
Number NP setae	3
NP cleft	absent
Scutellar setae	2+2
Legs	
Ts1 palisade	1–5
T2 palisade	0.70
T3 comb bifurcate	absent
T3 setulae	PD only
F3 basal setae	B<AV
F3 basal setae differentiation	present (short and slightly hooked at the tip)
Wing	
Wing length	1.839 mm
Subcosta	incomplete
Hair at base of R	short
R2+3	present
Costal index	0.50/0.55
Costal ratios	4.2:1.3:1
Costal setae length	0.09 mm
Number alular setae	4+ (7/8)
Wing color	lightly infuscated
Genitalia	
AT length	E≥AT
E setation	hairs only
Relative posterior setation	T6=C<H>E

margin. Right side of epandrium extended downwards and with a lobe below the anal tube, forming a '>'-shaped notch (facing the back of the terminalia) and a large C-shaped concavity (facing the front of the terminalia). Relative posterior setation T6=C<H>E. Hypoproct hairs slightly longer than hairs on the cerci and longer than all other terminalia hairs. Left hypandrial lobe with hairs, right hypandrial lobe absent. Couplets in Disney (1989): 59 and 120 (see Additions to the British key of *Megaselia* (Supp. file 1)).

Etymology

Named after its dark brown body: '*bruna*' (adjective, feminine) means 'dark brown' in Latin.

Type material

Holotype

GERMANY • ♂; Nordrhein-Westfalen, Lkr. Düsseldorf, Nationalpark Eifel; 50.572° N, 6.416° E; 496 m a.s.l.; 18 May–1 Jun. 2009; J. Esser leg.; BOLD no: SMNS_1203416 (COI); SMNS, SMNS_DIP_019269.

Paratype

GERMANY • 1 ♂; Baden-Württemberg, Lkr. Rems-Murr, Backnang, Katharinenplaisir; 48.955° N, 9.440° E; 289 m a.s.l.; 4 Sep.2014; A. Rosenbauer leg.; BOLD no: SMNS_1198953 (COI); SMNS, SMNS_DIP_015196.

Description

Head. SA ratio 1.0. VIF position normal 'B'. Palpal setae long. Labellum spinose sparse.

Thorax. Anepisternum with ~15 hairs. Halter same color, slightly lighter. NP setae 3. NP cleft absent. Scutellar setae 2+2.

Legs. Ts1 palisade 1–5. T2 palisade 0.70. T3 comb bifurcate absent. T3 setulae PD only. F3 basal setae B<AV. F3 basal setae differentiated, short, hooked tip.

Wing. Length 1.839 mm. Subcosta incomplete. Base of R with short hair. R2+3 present. Costal index 0.50/0.55. Costal ratios 4.2:1.3:1. Costal setae 0.09 mm. Alular setae 4+ (7/8). Wing lightly infuscated.

Genitalia. AT length E≥AT. E setation hairs only. Posterior setation T6=C<H>E.

Megaselia curta Caruso, Bøggild & Grundmann sp. nov.
urn:lsid:zoobank.org:act:494EDA7C-0536-43DB-BAD5-2A2E6B388580
Fig. 4; Table 3

Diagnosis

Costa short (0.36 of wing length). Epandrium shape similar to that of *M. unicolor* (Schmitz, 1919), but with 3 feathered bristles. Hypoproct excavated in the ventral part, similar to that of *M. involuta* (Wood,

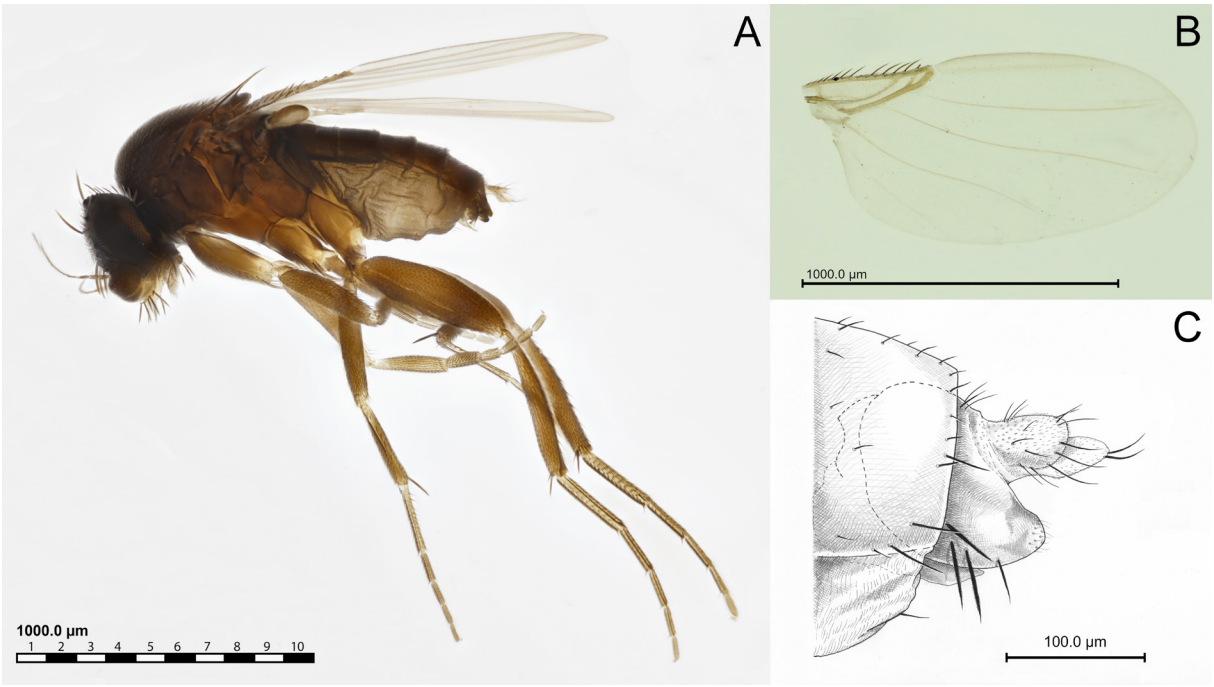

Fig. 4. *Megaselia curta* Caruso, Bøggild & Grundmann sp. nov., holotype ♂ (SMNS_DIP_014298). **A**. Habitus. **B**. Wing. **C**. Terminalia. Specimen length 1.480 mm. Wing length 1.289 mm. Costal setae length 0.042 mm.

Table 3. *Megaselia curta* Caruso, Bøggild & Grundmann sp. nov. Description (following Hartop & Brown 2014a).

Head	
SA ratio	0.7
VIF position	normal 'A'
Palpal setae length	long
Labellum spinosity	spinose
Thorax	
Anepisternum	hairs only (7 hairs)
Relative halter color	'same' (bicolor: dorsal part brownish/same, ventral part whitish)
Number NP setae	3
NP cleft	absent
Scutellar setae	2+2
Legs	
Ts1 palisade	1–4
T2 palisade	0.57
T3 comb bifurcate	absent
T3 setulae	PD only
F3 basal setae	B=AV
F3 basal setae differentiation	absent
Wing	
Wing length	1.289 mm
Subcosta	incomplete but well developed
Hair at base of R	minute/short
R2+3	present
Costal index	0.36
Costal ratios	7.50:1.25:1
Costal setae length	0.04 mm
Number alular setae	0
Wing color	lightly infuscated
Genitalia	
AT length	AT>E
E setation	hairs + 3 strong and feathered bristles
Relative posterior setation	T6=C=H<E

1910), but apical setae short and weak, up-curved and in a sub-apical position. Epandrium lobe edge with a 50° slope and with a short hair tuft at the tip. Couplet in Disney (1989): 86 (see Additions to the British key of *Megaselia* (Supp. file 1)).

Etymology

Named after the short and stocky body, and the relatively short costa. From the Italian term '*corta*' (feminine, adjective) which means 'short, brief', derived from the Latin term '*curtare*' ('to shorten' or 'to cut short').

Type material

Holotype

GERMANY • ♂; Baden-Württemberg, Lkr. Rems-Murr, Backnang; 48.955° N, 9.440° E; 294 m a.s.l.; 28 May–16 Jun. 2014; A. Rosenbauer leg.; BOLD no: SMNS_1198055; SMNS, SMNS_DIP_014298.

Paratypes

GERMANY • 1 ♂; Baden-Württemberg, Lkr. Rems-Murr, Backnang, Katharinenplaisir; 48.955° N, 9.440° E; 289 m a.s.l.; 28 May 2014; A. Rosenbauer leg.; BOLD no: SMNS_1197547; SMNS, SMNS_DIP_013790 • 2 ♂♂; Niedersachsen Lkr. Lüchow-Dannenberg, Pevestorf; 53.064° N, 11,474° E; 23 m a.s.l.; 6 Aug. 2013; L. Krogmann leg.; BOLD nos: SMNS_1196705, SMNS_1204298 (COI); SMNS, SMNS_DIP_012964, SMNS_DIP_020150 • 1 ♂; Baden-Württemberg Lkr. Tübingen, Hirschau; 48.504° N. 8.996° E; 367 m a.s.l.; 9 Oct. 2014; T. Kothe leg.; BOLD no: SMNS_1196861 (COI); SMNS, SMNS_DIP_013118.

Description

Head. SA ratio 0.7. VIF position normal 'A'. Palpal setae long. Labellum spinose.

Thorax. Anepisternum with hairs only (7 hairs). Halter same color (bicolor: dorsal part brownish/same, ventral part whitish). NP setae 3. NP cleft absent. Scutellar setae 2+2.

Legs. Ts1 palisade 1–4. T2 palisade 0.57. T3 comb bifurcate absent. T3 setulae PD only. F3 basal setae B=AV. F3 basal setae not differentiated.

Wing. Length 1.289 mm. Subcosta incomplete but well developed. Base of R with short hair. R2+3 present. Costal index 0.36. Costal ratios 7.50:1.25:1. Costal setae 0.04 mm. Alular setae absent. Wing lightly infuscated.

Genitalia. AT length AT>E. E setation hairs + 3 strong and feathered bristles. Posterior setation T6=C=H<E.

Megaselia robertoi Caruso sp. nov.

urn:lsid:zoobank.org:act:C55EB707-6D68-49B6-BB31-3779230865E8

Fig. 5; Table 4

Diagnosis

Palpal setae in apical position slightly (but certainly) longer than the maximum width of the palpus. Costal cilia as long as, or slightly longer than, R_{2+3}. Ventral surface of the hypandrial lobes covered with microscopic hairs. Differs from *M. cinereifrons* (Strobl, 1910) in having 2 NP setae (3 in *M. cinereifrons*) and an anal tube with a length-to-width ratio of ca 1.8:1 (Fig. 5C), compared to the more elongate and clavate form in *M. cinereifrons*, of 2.5:1 (Disney 1989: 125, fig. 438). Couplet in Disney (1989): 203 (see Additions to the British key of *Megaselia* (Supp. file 1)).

Etymology

Named after Roberto Caruso, father of VC, to whom this species is dedicated.

Type material

Holotype

GERMANY • ♂; Mecklenburg-Vorpommern, Lkr. Vorpommern-Rügen, Insel Rügen, Kniepow; 54.35° N, 13.35° E; 50 m a.s.l.; 27 Sep.–3 Oct. 2015; F. Koch leg.; BOLD no: SMNS_1203320 (COI); SMNS, SMNS_DIP_019173.

Paratypes

GERMANY • 1 ♂; Baden-Württemberg, Lkr. Biberach, Altheim; 48.140° N, 9.449° E; 64 m a.s.l.; 1 Sep. 2013; H. Schmalfuss leg.; BOLD no: SMNS_1202722 (COI); SMNS, SMNS_DIP_018597 • 2 ♂♂; Baden-Württemberg, Lkr. Rems-Murr, Backnang, Katharinenplaisir; 48.955° N, 9.440° E; 289 m

Table 4. *Megaselia robertoi* Caruso sp. nov. Description (following Hartop & Brown 2014a).

Head	
SA ratio	0.80
VIF position	normal '~B' (B/C)
Palpal setae length	long
Labellum spinosity	sparse
Thorax	
Anepisternum	bare
Relative halter color	'same'
Number NP setae	2
NP cleft	absent
Scutellar setae	2+2
Legs	
Ts1 palisade	1–4
T2 palisade	7.78
T3 comb bifurcate	absent
T3 setulae	PD only
F3 basal setae	B≥AV
F3 basal setae differentiation	absent
Wing	
Wing length	2.126 mm
Subcosta	incomplete
Hair at base of R	long (2 setae)
R2+3	present
Costal index	0.42/45
Costal ratios	4.00:1.83:1
Costal setae length	0.1 mm
Number alular setae	3 to 5
Wing color	clear (hyaline)
Genitalia	
AT length	AT=E (7 setae each cercus)
E setation	hairs only
Relative posterior setation	T6>C=H=E

a.s.l.; 4 Sep. 2014; A. Rosenbauer leg.; BOLD nos: SMNS_1198850, SMNS_1198950 (COI); SMNS, SMNS_DIP_015093, SMNS_DIP_015193.

Description

Head. SA ratio 0.80. VIF position normal '~B' (B/C). Palpal setae long. Labellum spinose sparse.

Thorax. Anepisternum bare. Halter same color. NP setae 2. NP cleft absent. Scutellar setae 2+2.

Legs. Ts1 palisade 1–4. T2 palisade 7.78. T3 comb bifurcate absent. T3 setulae PD only. F3 basal setae B≥AV. F3 basal setae not differentiated.

Wing. Length 2.126 mm. Subcosta incomplete. Base of R with 2 long hairs. R2+3 present. Costal index 0.42/45. Costal ratios 4.00:1.83:1. Costal setae 0.1 mm. Alular setae 3 to 5. Wing clear, hyaline.

Genitalia. AT length AT=E, with 7 setae each cercus. E setation hairs only. Posterior setation T6>C=H=E.

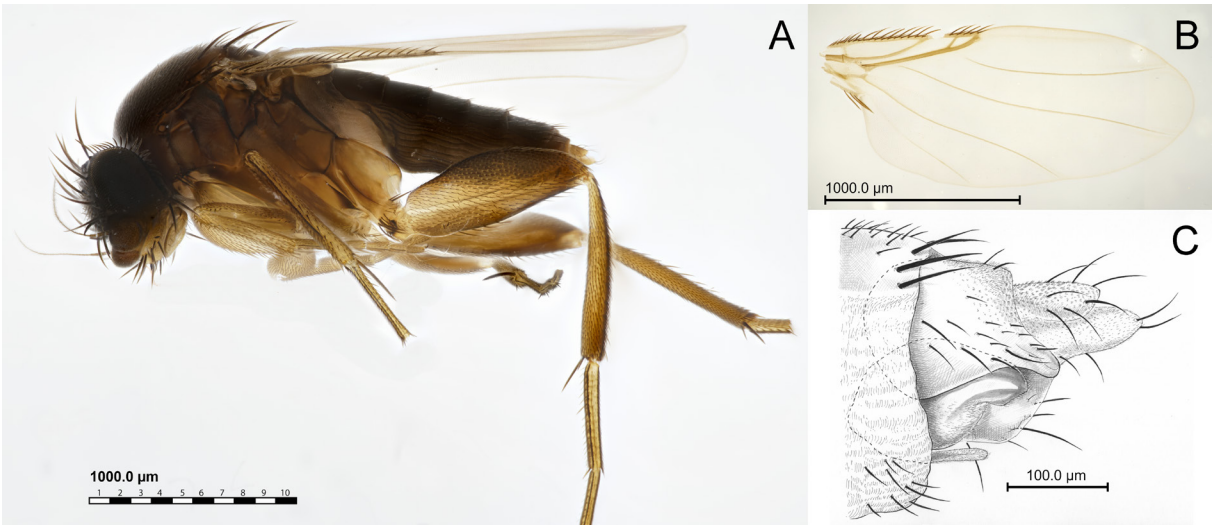

Fig. 5. *Megaselia robertoi* Caruso sp. nov., holotype ♂ (SMNS_DIP_019173). **A**. Habitus. **B**. Wing. **C**. Terminalia. Specimen length 2.524 mm. Wing length 2.126 mm. Costal setae length 0.102 mm.

Megaselia splendida Caruso, Bøggild & Grundmann sp. nov.
urn:lsid:zoobank.org:act:B44063F4-63DD-44D5-AE4C-29C5C1089AC0
Fig. 6, Table 5

Diagnosis

Head darker than the body, with yellow palps. Light-brown body with yellow fore-legs. Antero-lateral and antial bristles close together at almost the same level on the frons, as in *M. costalis* (von Roser, 1840), from which it differs in the costal index and in the ratio between the dorsal length of the epandrium and

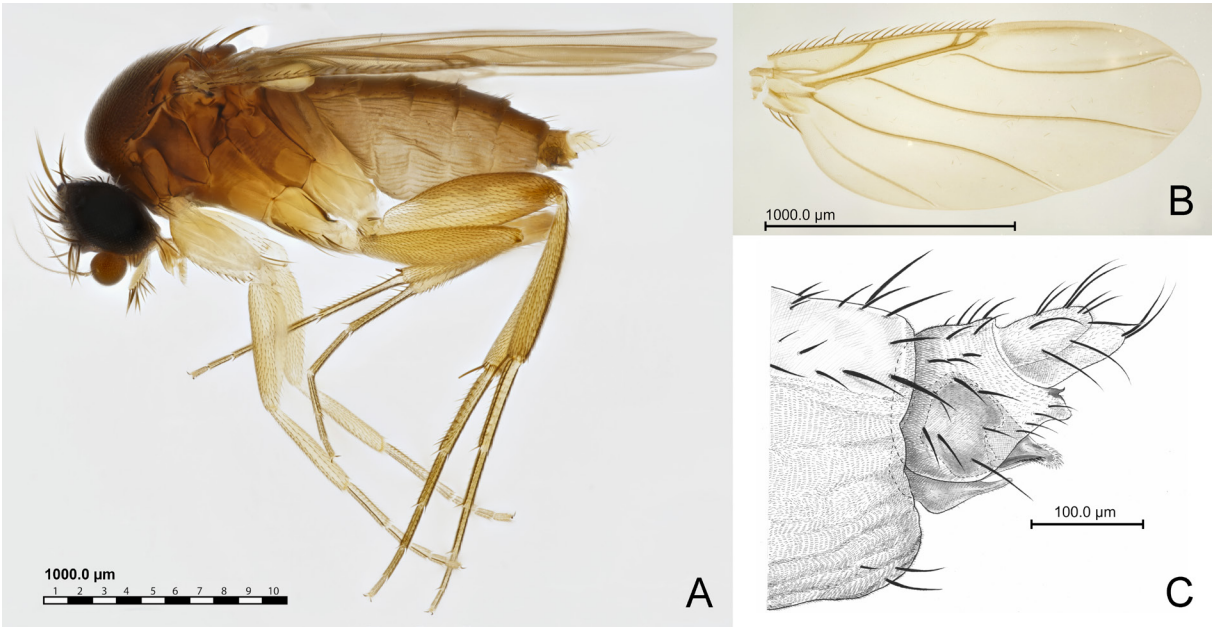

Fig. 6. *Megaselia splendida* Caruso, Bøggild & Grundmann sp. nov., holotype ♂ (SMNS_DIP_016074). **A**. Habitus. **B**. Wing. **C**. Terminalia. Specimen length 2.117 mm. Wing length 1.930 mm. Costal setae length 0.087 mm.

Table 5. *Megaselia splendida* Caruso, Bøggild & Grundmann sp. nov. Description (following Hartop & Brown 2014a).

Head	
SA ratio	0.65
VIF position	VFO adjacent 'C'
Palpal setae length	long
Labellum spinosity	spinose sparse
Thorax	
Anepisternum	bare
Relative halter color	lighter
Number NP setae	3
NP cleft	absent
Scutellar setae	2+2
Legs	
Ts1 palisade	1–4
T2 palisade	0.70
T3 comb bifurcate	absent
T3 setulae	PD only
F3 basal setae	B>AV
F3 basal setae differentiation	present
Wing	
Wing length	1.930 mm
Subcosta	complete
Hair at base of R	short
R2+3	present
Costal index	0.55/0.58
Costal ratios	5:5.2–4.7:1
Costal setae length	0.09 mm
Number alular setae	3
Wing color	infuscated
Genitalia	
AT length	AT≤E
E setation	hairs only
Relative posterior setation	T6>C=H≥E

the anal-tube. Basal setae of the hind femora longer than the antero-ventral setae, tapering abruptly to a fine point only near the curved tip of the seta. Couplet in Disney (1989): 199 and 232 (see Additions to the British key of *Megaselia* (Supp. file 1)).

Etymology

Named after the Latin term '*splendidus*' (adjective), with the meaning of 'beautiful', 'magnificent'.

Type material

Holotype

GERMANY • ♂; Bayern, Lkr. Berchtesgaden, Königsee, Rinnkendlsteig; 47.551° N, 12.964° E; 695 m a.s.l.; 26 Jul.–9 Aug. 2017; D. Doczkal and J. Voith leg.; BOLD no: SMNS_1199918 (COI); SMNS, SMNS_DIP_016074.

Paratypes

GERMANY • 1 ♂; Baden-Württemberg, Lkr. Biberach, Altheim; 48.140° N, 9.450° E; 64 m a.s.l.; 1 Sep. 2013; H. Schmalfuss leg.; BOLD no: SMNS_1202538 (COI); SMNS, SMNS_DIP_018415 • 1 ♀; Baden-Württemberg, Lkr. Biberach, Altheim; 48.140° N, 9.450° E; 64 m a.s.l.; 2 Oct. 2013; H. Schmalfuss leg.; BOLD no: SMNS_1202896 (COI); SMNS, SMNS_DIP_018761.

Description

Head. SA ratio 0.65. VIF position VFO adjacent 'C'. Palpal setae long. Labellum spinose sparse.

Thorax. Anepisternum bare. Halter color lighter. NP setae 3. NP cleft absent. Scutellar setae 2+2.

Legs. Ts1 palisade 1–4. T2 palisade 0.70. T3 comb bifurcate absent. T3 setulae PD only. F3 basal setae B>AV. F3 basal setae differentiated.

Wing. Length 1.930 mm. Subcosta complete. Base of R with short hair. R2+3 present. Costal index 0.55/0.58. Costal ratios 5:5.2–4.7:1. Costal setae 0.09 mm. Alular setae 3. Wing infuscated.

Genitalia. AT length AT≤E. E setation hairs only. Posterior setation T6>C=H≥E.

Redescription

Megaselia romphaea (Schmitz, 1947)
Fig. 7; Table 6

Plastophora romphaea Schmitz, 1947: 114–116, fig. 1.

Diagnosis

Postpedicel enlarged, slightly oblong rather than globular, and flattened laterally. Arista short. Only 2 supra-antennal setae (anterior pair absent). Mid tibia with short AD and PD rows of spines, separated by a palisades row. F3 basal setae differentiation present (basal setae long and strong, not crowded, reaching mid length of F). Abdominal sternites 3–7 with hairs. Cerci enlarged and laterally compressed, covered by hairs only (~20 per cercus), hypoproct with 2 robust but short up-curved setae. Terminalia overall shape similar to that of *M. egena* Collin, 1912, a species known from the Seychelles, and *M. scalaris* (Loew, 1866), but with hypoproct apical setae shorter and non-feathered. Couplet in Disney (1989): 1 (see Additions to the British key of *Megaselia* (Supp. file 1)).

Type material

Holotype

AUSTRIA • ♂; Oberkärnten am Penzelberg; 1300–1400 m a.s.l.; 12 Jul. 1946; H. Schmitz leg.; ZFMK DIP 00012399.

Other material examined

GERMANY • 1 ♂; Bayern, Lkr. Berchtesgaden, Königsee, Rinnkendlsteig; 47.554° N, 12.965° E; 29 Jun.–13 Jul. 2017; D. Doczkal and J. Voith leg.; BOLD no: SMNS_1199712 (COI); SMNS, SMNS_DIP_015955 • 1 ♂; Bayern, Lkr. Berchtesgaden Königsee, Rinnkendlsteig; 47.554° N, 12.965° E; 694 m a.s.l.; 30 Jun. 2017; D. Doczkal leg.; BOLD no: SMNS_1199564 (COI); SMNS, SMNS_DIP_015807.

Redescription

Head. SA ratio 0.0 (only 2 SA). VIF position normal 'B'. Palpal setae long. Labellum with scattered spinosity.

Thorax. Anepisternum with 7 hairs + one long bristle. Halter color same (dark brown). NP setae 2. NP cleft absent. Scutellar setae 2+2.

Legs. Ts1 palisade 1–5. T2 palisade 0.8/0.85. T3 comb bifurcate absent. T3 setulae PD only. F3 basal setae B>AV. F3 basal setae differentiated.

Wing. Length 1.912 mm. Subcosta incomplete, almost absent. Base of R without hairs. R2+3 present. Costal index 0.50/0.55. Costal ratios 4.6:2.3:1. Alular setae 4+. Wing clear to lightly infuscated.

Genitalia. AT length AT>E. E setation hairs + bristles. Posterior setation T6>C<H>E.

Remarks

Megaselia romphaea was originally described by Schmitz (1947) under the genus *Plastophora* Brues, 1905, a taxon that has since been synonymized with *Megaselia*. The original description (Schmitz 1947), based on a single male specimen, lacks illustrations suitable for reliable identification and is available only in German, which has likely contributed to the species being largely overlooked in subsequent studies. To our knowledge, no records of *M. romphaea* have been published since its original description, and no modern documentation of the species exists. The holotype of *M. romphaea* is housed at ZFMK. It is pinned and in relatively good condition; one leg and one wing have been removed and mounted on a slide, and the thorax is partly damaged by the pin. During GBOL sampling, two male specimens conforming to Schmitz's description were collected in the Königsee area (Supp. file 2), representing the first confirmed records of the species in over 75 years. Here, we provide a modern redescription of *M. romphaea* based on study of these newly collected specimens and the holotype.

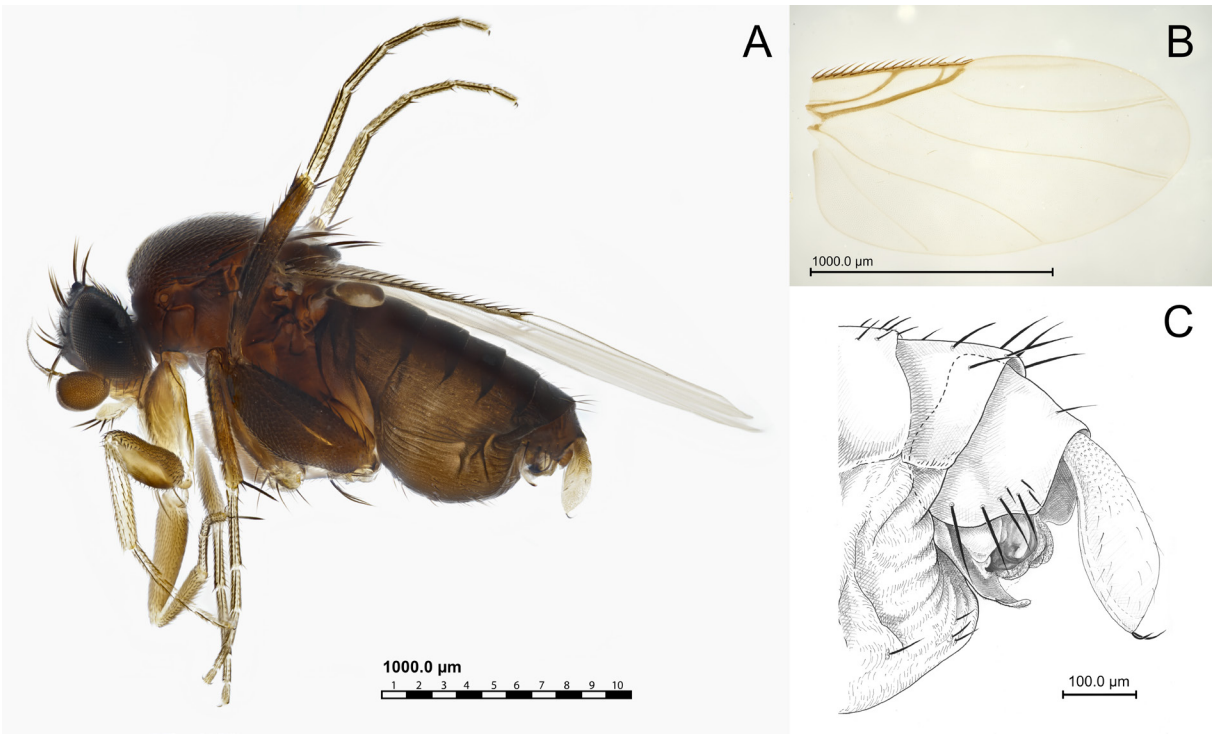

Fig. 7. *Megaselia romphaea* (Schmitz, 1947), ♂ (SMNS_DIP_015955). **A**. Habitus. **B**. Wing. **C**. Terminalia. Specimen length 2.425 mm. Wing length 1.912 mm. Costal setae length 0.082 mm.

Table 6. *Megaselia romphaea* (Schmitz, 1947) redescription (following Hartop & Brown 2014a).

Head	
SA ratio	0.0 (only 2 SA)
VIF position	normal 'B'
Palpal setae length	long
Labellum spinosity	scattered
Thorax	
Anepisternum	7 hairs + one long bristle
Relative halter color	same (dark brown)
Number NP setae	2
NP cleft	absent
Scutellar setae	2+2
Legs	
Ts1 palisade	1–5
T2 palisade	0.8/0.85
T3 comb bifurcate	absent
T3 setulae	PD only
F3 basal setae	B>AV
F3 basal setae differentiation	present
Wing	
Wing length	1.912 mm
Subcosta	incomplete (almost absent)
Hair at base of R	absent
R2+3	present
Costal index	0.50/0.55
Costal ratios	4.6:2.3:1
Number alular setae	4+
Wing color	clear to lightly infuscated
Genitalia	
AT length	AT>E
E setation	hairs + bristles
Relative posterior setation	T6>C<H>E

Discussion

The bibliography of descriptions and keys for species of *Megaselia* is fragmented and difficult to find, and many of the more complete and detailed keys are not in English. Currently, Disney's (1989) key remains one of the best available for European species, and when complemented by the additions provided here, becomes a much more comprehensive and user-friendly resource for identifying *Megaselia* species beyond the British Isles. By releasing all additions made to the key during 1990–2025, together with all Palearctic species not covered by the original key, this study provides a significant update to the identification resources available for Palearctic *Megaselia*, integrating 393 species and transforming the key into a modern, accessible tool for identifying species of this notoriously complex genus. The inclusion of additions facilitates a more accurate navigation of *Megaselia* diversity and enables direct linkage to the primary literature at the couplet level. This update thus converts a country-specific key into a Palearctic framework, providing much-needed guidance for researchers dealing with the fragmented and often inaccessible taxonomy of this genus.

This work also presents the description of four species of *Megaselia* new to science, captured in Germany during the GBOL project, sequenced for the COI gene and described during the 'GBOL III: Dark Taxa' through large-scale molecular screening of more than 9000 specimens using DNA barcoding.

In an attempt to shed light on the extreme diversity of this difficult group, the application of new methodologies that allow effective but rapid identification of species now seems essential (Srivathsan *et al.* 2019, 2021, 2024; Hartop *et al.* 2022; Caruso *et al.* 2024). This discovery of new species in Germany, whose fauna is one of the best known globally (Morinière *et al.* 2019; Caruso *et al.* 2024), underscores the need for continued efforts in exploring and documenting biodiversity, with even greater attention in countries with higher biodiversity. Unfortunately, describing species which are captured through passive trapping methods (e.g., Malaise traps) provides only limited ecological information and no ethological or life-history data, and field observation is now increasingly disappearing. At the same time, studies aimed at a few specimens take a long time and do not satisfy the growing and urgent need for biodiversity investigation, in a world that is facing an increasingly rapid loss of species.

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Supplementary files

Supp. **file 1**. Additions to the British key of *Megaselia*.
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Supp. **file 2**. Data of examined specimens.
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