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RESEARCH PAPER

Updated checklist of hover flies (Diptera: Syrphidae) of the Azores archipelago with taxonomic notes and the description of a new species, *Eristalis azorensis* sp. nov.

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Abstract. We report the results of a field expedition to the Azores archipelago. A total of 13 species of hover flies were collected, including several species new to certain islands of the archipelago. The records of the expedition are supplemented with new island records found on iNaturalist and observation.org websites. A species new to science, *Eristalis* (*Eoseristalis*) *azorensis* sp. nov., was collected in our survey and is described here in full. DNA barcodes of this species were sequenced and compared to other European species of the genus. The new species was restricted to the mountainous region on the western side of São Miguel Island. Furthermore, we provide identification tools for the new species, as well as for Palaearctic species of *Xanthandrus* Verrall, 1901, including the endemic Macaronesian taxa. Our findings raise the total number of the Azorean hover fly fauna to 24 species.

Key words. Diptera, Syrphidae, *Eristalis*, *Xanthandrus*, hover flies, DNA barcoding, endemism, faunistics, identification key, new species, Azores archipelago

Zoobank: http://zoobank.org/urn:lsid:zoobank.org:pub:229E5F93-6C9F-4D76-B118-6B87EDEDC5D7

Introduction

The Azores are a remote archipelago of volcanic origin with nine islands situated in the Atlantic Ocean between 36°55′ and 39°43′ northern latitude, and between 24°46′ and 31°16′ western longitude. The closest point to the European mainland is roughly 1,400 km and the closest point to the Nearctic mainland is ca. 1,900 km. Altogether, the islands cover approximately 2,300 km^2, with the highest point being Mount Pico, a dormant stratovolcano on Pico Island, reaching 2,351 m. The Azores archipelago is part of the Macaronesia together with four other volcanic archipelagos, namely the Madeira archipelago, the Selvagens Islands, the Canary Islands, and the Cabo Verde archipelago. About 1,200 plant species occur in the Azores archipelago, of which approximately 6% are endemic to the Azores archipelago and approximately 70% consist of alien species (Schaefer 2021). The climate is temperate oceanic with a mean annual temperature of 17.5 °C and a mean annual precipitation between 1,000–1,600 mm at sea level (Schaefer 2021).

Syrphidae, commonly known as hover or flower flies, is a species rich family with over 900 European species and more than 6,200 described species worldwide (Marshall 2012, Evenhuis & Pape 2024). A total of 23 species of Syrphidae are known from the Azores archipelago with an important influence from the Palaearctic (Rojo et al. 1997, Smit 2010), and two of them are endemic to the islands: *Sphaerophoria nigra* Frey, 1945 and *Xanthandrus azorensis* Frey, 1945. *Xanthandrus azorensis* is morphologically very similar to *X. babyssa* (Walker, 1849), endemic to Madeira. Previous studies on hover flies from the Azores archipelago include Frey (1945), Gomes (1980, 1982), Rojo et al. (1997), Smit (2010), and Jentzsch (2014).

In the present work we report new records from our field expedition to the Azores archipelago. We present several species new to certain islands of the archipelago and revise the Syrphidae records found on iNaturalist and observation.org websites. Furthermore, we describe in full a species new to science collected in our survey, provide DNA barcodes and images for this new species, and include it in a published key to help in its identification.

In addition, an identification key to all European species of the genus *Xanthandrus* Verrall, 1901 is given to clarify the morphological differences amongst the sometimes very similar species.

Material and methods

Between September 8 and September 15, 2024, the first two authors surveyed the Azores archipelago, visiting the São Miguel (September 8–12), Graciosa (September 12–13) and Terceira (September 13–15) Islands. Specimens were collected using an entomological hand net. All our collected specimens are reported here.

Additionally, Syrphidae records from the Azores archipelago on the websites www.inaturalist.org and www.observation.org were checked on December 5, 2024 searching for new species records for each island. We considered a hover fly species to be new to an island if it was not documented in the most recent checklist by Smit (2010) or subsequently published in Jentzsch (2014). All species found on the mentioned websites to be new to a certain island are also reported here. A new record for a particular island is preceded by an asterisk. Almost all reported records from www.inaturalist.org and www.observation.org were photographically documented. In the few cases where photos were absent, the records are still reported here given the easy identification of the species occurring in the Azores archipelago.

Morphological terminology follows van Steenis et al. (2023). Body length was measured from the anterior oral margin to the posterior end of the abdomen, in lateral view. Wing length was measured from the wing tip to the basicosta.

Digital images. All photographs were taken with a Canon EOS 6D camera with a Mejiro Genossen FL0530 4.0/110 Float Lens (habitus photographs) or a Leitz-Wetzlar Photar 1:2/25 macro lens (other photographs). Before stacking in Helicon Focus 7.7.5 (Kharkiv, Ukraine), exposure and sharpening of the photos were adjusted in Adobe® Lightroom Classic (version 10.4).

Institutional abbreviations. The following acronyms are used to indicate entomological collections:

LHHN	Lenze Hofstee's private collection, Haren, the Netherlands;
MZHF	Finnish Museum of Natural History Luomus, Helsinki, Finland;
SBAN	Sander Bot's private collection, Anloo, the Netherlands;
ZFMK	Museum Koenig Bonn, Leibniz-Institut zur Analyse des Biodiversitätswandels, Bonn, Germany.

Molecular work. The nucleotide sequence of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene, also known as DNA barcode (Hebert et al. 2003a, b), was obtained from selected specimens. One or two legs of each sequenced specimen were used for DNA extraction. DNA primers, as well as extraction, amplification, purification, sequencing protocols and edition were carried out as described in Rozo-Lopez & Mengual (2015) and Müller et al. (2024). The remnants of the studied specimens were preserved and properly labelled as DNA voucher specimens.

All new sequences were submitted to GenBank via BOLD (www.boldsystems.org). GenBank accession numbers for each sequenced specimen are listed in the text.

To genetically characterize our new species, public nucleotide sequences (full-length barcodes with 658 bp and without contaminants) of European *Eristalis* species available in BOLD were downloaded (https://www.boldsystems.org; accessed on January 25, 2025). The public sequences and the newly obtained sequences were aligned without gaps or stop codons using Geneious Prime 2025.1.2 (Biomatters Ltd). Specimen information (locality, date, collector, identifier and unique identifier) is accessible via the GenBank Accession Numbers and in BOLD (https://www.boldsystems.org/) under the DS-AZOERIS dataset (http://dx.doi.org/10.5883/DS-AZOERIS).

A distance-based Neighbour-Joining (NJ) analysis was done using the Jukes-Cantor Model as implemented inGeneious Prime 2025.1.2. software. The DNA barcode of *Eristalinus taeniops* (Wiedemann, 1818) (GenBank n.: MT216279) was constrained as the root for the NJ tree (see Appendix 1). Bootstrap support values (BS) were estimated from 1000 replicates directly from Geneious Prime 2022.1.1. A table with similarity percentage as calculated in Geneious Prime 2025.1.2 is provided in the Supplementary file Table S1.

We also sequenced *Xanthandrus* specimens that we collected in the Azores archipelago. We followed the same steps as explained for *Eristalis*, except for the COI sequence of *Pelloloma nigrifacies* Vockeroth, 1973 (GenBank n.: MK751040) which was constrained as the root for the NJ tree (see Appendix 2). A table with similarity percentage for *Xanthandrus* as calculated in Geneious Prime 2025.1.2 is provided in the Supplementary file Table S2.

Results

Episyrphus balteatus (De Geer, 1776)

Material examined. *Graciosa: 1 ♂, Caldeira da Graciosa, 39.0251°N, 27.9726°W, 3 m a.s.l., 28.x.2022, not collected, observed by Carlos Picanço, https://www.inaturalist.org/observations/140262679; 1 ♀, Luz, 39.0167°N, 27.9929°W, 28 m a.s.l., 31.x.2022, not collected, observed by C. Picanço, https://www.inaturalist.org/observations/140657492; 1 ♂, Trás dos Pomares, 39.0402°N, 27.9952°W, 140 m a.s.l., 8.iv.2023, not collected, observed by C. Picanço, https://www.inaturalist.org/observations/153995611; 1 ♂, Terra do Conde, 39.0705°N, 28.0538°W, 48 m a.s.l., 4.vi.2023, not collected, observed by C. Picanço, https://www.inaturalist.org/observations/165490247; 1 ♂, Trás dos Pomares, 39.0404°N, 28.0053°W, 275 m a.s.l., 11.vi.2023, not collected, observed by C. Picanço, https://www.inaturalist.org/observations/222087065; 4 spec. (unknown sex), Caldeira da Graciosa, 39.0310°N, 27.9747°W, 245 m a.s.l., 6.viii.2023, not collected, observed by F. de Meijer and G. Keijl, https://observation.org/observation/284964408/; 1 ♂, Caldeira da Graciosa, 39.0254°N, 27.9717°W, 3 m a.s.l., 1.iv.2024, not collected, observed by C. Picanço, https://www.inaturalist.org/observations/204947004; 2 ♀♀, near Limeira, 39.0284°N, 28.0168°W, 79 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002625, SB.002626, SBAN; 1 ♀, Caldeira da Graciosa, 39.0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. L. Hofstee, LHHN; 1 ♂, Caldeira da Graciosa, 39.0258°N, 27.9638°W, 300 m a.s.l., 13.ix.2024, leg. S. Bot, SB.002636, SBAN. **São Miguel:** 2 ♀♀, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002559, SB.002560, SBAN; 1 ♀, same data as for preceding, leg. L. Hofstee, LHHN; 1 ♂, Pilar, 37.8987°N, 25.7891°W, 185 m a.s.l., 10.ix.2024, leg. S. Bot, SB.002566, SBAN; 3 ♀♀, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002581–SB.002583, SBAN. **Terceira:** 1 ♀, Reserva Florestal Natural Parcial do Biscoito da Ferraria, 38.7547°N, 27.2027°W, 584 m a.s.l. 14.ix.2024, leg. S. Bot, SB.002649, SBAN; 1 ♀, same data as for preceding, leg. L. Hofstee, LHHN.

Distribution. Throughout Europe, large part of Africa, from the Urals to the Pacific coast, Japan, China and Taiwan (Speight 2024).

Eristalinus (*Lathyrophthalmus*) *aeneus* (Scopoli, 1763)

Material examined. *Terceira: 2 unknown sex, Praia da Vitória, 38.7339°N, 27.0589°W, 6 m a.s.l., 4.viii.2023, not collected, observed by F. de Meijer and G. Keijl, https://observation.org/observation/284964792/.

Distribution. Cosmopolitan; Africa, south to Kenya and Tanzania; from Europe into Russia and China to the Pacific and south into the Oriental Region; in North America from Minnesota and Ontario south to California and Texas; Hawaii, Australia (Speight 2024).

Eristalis (*Eoseristalis*) *arbustorum* (Linnaeus, 1758)

Material examined. *Graciosa: 1 ♂, near Limeira, 39.0284°N, 28.0168°W, 79 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002627, SBAN; 1 ♂, Caldeira da Graciosa, 39. 0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002632, SBAN; 1 ♂, same data as for preceding, leg. L. Hofstee, LHHN. São Miguel: 1 ♂, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002557, SBAN; 1 ♀, same data as for preceding, SB.002558; 1 ♂ 1 ♀, same data as for preceding, leg. L. Hofstee, LHHN; 1 ♂, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002591, SBAN.

Distribution. Throughout the Palaearctic Region, including North Africa; introduced in North America, now occurring throughout that continent (Skevington et al. 2019, Speight 2024).

Eristalis (*Eoseristalis*) *azorensis* sp. nov.
(Figs 1–4)

Type locality. Portugal, Azores archipelago, São Miguel, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l.

Type material. Holotype: ♂ (Figs 3A), labelled "PT Azores / São Miguel, 752m / gps37.8358, -25.7625 / 11.ix.2024 leg.L.Hofstee // Holotype ♂ / Eristalis azorensis / Bot, Hofstee & Mengual, 2025 // ZFMK DIP 00085050". Deposited in ZFMK; GenBank accession number: PV634338. Paratypes: **São Miguel:** 1 ♀, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002594, SBAN; 3 ♂♂, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002595, SB.002596=ZFMK-DIP-00085051 (GenBank n.: PV634337), SB.002597; SBAN; 3 ♀♀, same data as for preceding, SB.002598=ZFMK-DIP-00085052 (GenBank n.: PV634340), SB.002600, SB.002601, SBAN; 1 ♀, same data as for preceding, SB.002599=ZFMK-DIP-00085053 (GenBank n.: PV634339), ZFMK; 1 ♂; same data as for preceding; Leg. L. Hofstee, LHHN.

Description. ***Male.*** *Length* (n = 5). Body: 11.5–14.0 mm; wing: 9.5–11.5 mm.

Head. Face black; dorsal three quarters densely yellow pruinose, most dense along lateral margins; ventral quarter grey pruinose; ventrally and laterodorsally long yellow pilose, medially with shorter mixed black and yellow pile, ventral quarter bare (Fig 3A); with facial tubercle; below antennae narrower than eye. Parafacia narrow, yellow pruinose, long yellow pilose. Mala black and shiny, strongly contrasting with densely pruinose face. Frons black; slightly swollen; yellow pruinose, most so along lateral margins, less dense than on adjacent face, small area above lunule shiny; long black pilose, pile forward facing. Length of eye contiguity about 0.50–0.75 times the length of frons. Angle of approximation of eyes 90–100°. Vertical triangle black; grey pruinose; long black pilose. Occiput with dorsal and medial part black, grey pruinose and long black pilose. Lunule dark yellow. Scape black, sometimes outer side dark yellow; pedicel black; postpedicel dark brown to black, densely pruinose, very base sometimes orange, rounded, slightly longer than wide; arista black, plumose on basal half, bare on apical half. Eye entirely yellow to brown pilose.

Thorax black. Scutum blue-grey pruinose, medially with indistinct vaguely delimited brown-grey longitudinal stripes; with erect black pile, sometimes with a few white pili along lateral margin or in anterolateral corner. Scutellum grey pruinose; with erect black pile; scutellar fringe long black pilose. Pleura pruinose. Postpronotum mixed white and black pilose. Anterior part of proepimeron long white pilose. Anterior anepisternum bare. Posterior anepisternum long black pilose, except anteroventrally where long white pilose. Katepisternum with long black and white pile. Anterior anepimeron with long black pile. Posterior anepimeron, katepimeron and meron bare. Katatergum with dense short orange pile. Metasternum ventrally with long white pile, sometimes also with some long black pile. Plumule long orange pilose. Haltere pedicellum yellow with brown base, capitulum yellow and black. Calypter blackish; with short black pile; with blackish pile along posterior margin.

Wing bare except for microtrichose base of alula; hyaline except for black smudge of variable size in cell br anterior to vena spuria just before level of vein M_4 base. Veins black; vein R_{4+5} sinuate with dip into cell r_{4+5}; cell r_1 petiolate. Pterostigma about six times as long as broad, base black, remainder slightly hyaline, blackish, apex sometimes black again.

Legs. Coxae and trochanters black. Femora black (Fig. 1); black pilose; metafemur with black basolateral setose patch; metafemur not swollen. Tibiae black, sometimes basal half of mesotibia indistinctly paler, dark orange to black; black pilose except for anteriorly orange pilose protibia. Tarsi black; black pilose, except for ventrally where partly with golden pile. Claws with orange base and black apex.

Abdomen. All terga and sterna black (Fig. 1A). Tergum I pruinose, mixed black and white pilose; tergum II with shiny lateral margins, remainder black pruinose, except for two greyish pruinose roughly triangular macula, black pilose except in very anterolateral corner and along lateral margin where white pilose; tergum III with lightly blackish pruinose or shiny posterolateral corners, remainder blackish pruinose, except for two large greyish pruinose roughly rectangular anterolateral macula, black pilose except along anterior and lateral margins and in anterolateral corners where white pilose; tergum IV in anterior half greyish pruinose, in posterior half shiny or almost so, anterior half white pilose except for narrow black pilose medially, posterior half black pilose except for widely white pilose lateral margin. Sterna pruinose; sternum I anteriorly white pilose, posteriorly black pilose; sterna II–IV white pilose, medially intermixed with black pile; sternum VIII black pilose.

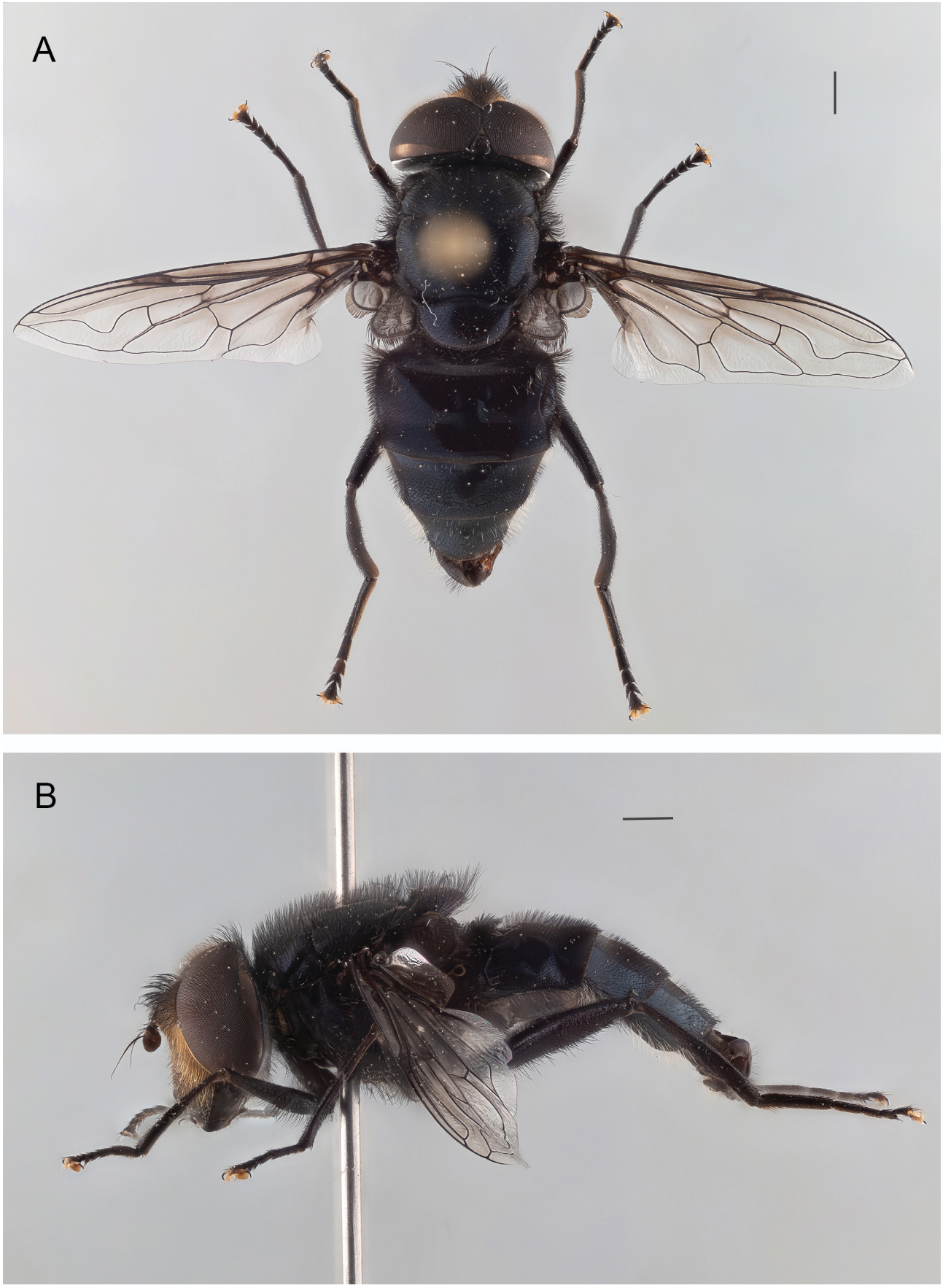


Fig. 1. *Eristalis azorensis* sp. nov., ♂ paratype (SB.002597; SBAN). A – habitus in dorsal view; B – habitus in lateral view. Scale bars = 1 mm.

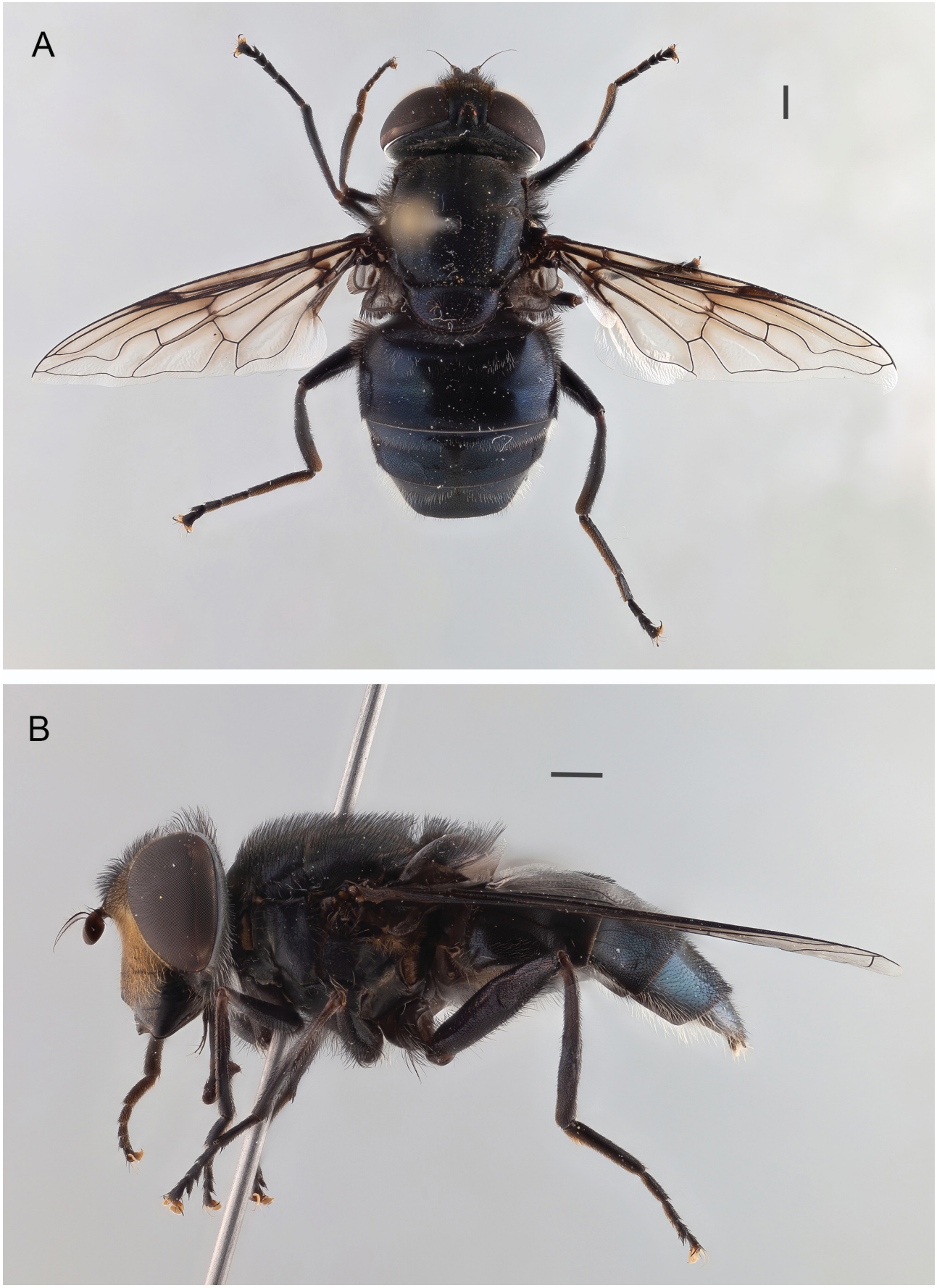


Fig. 2. *Eristalis azorensis* sp. nov. A – ♀ paratype (SB.002600; SBAN); habitus in dorsal view; B – ♀ paratype (SB.002598; SBAN); habitus in lateral view. Scale bars = 1 mm.

Genitalia. Cercus elongated, about two times longer than wide; with pointed apex. Surstylus extremely long and narrow, at least six times longer than wide, with rounded, slightly widening apex (Fig. 4A). Postgonite about 2.5 times longer than wide; with rounded apex; ventrally of apex with triangular extension (Fig. 4A). Apex of phallus (named as aedeagal lobes by Hippa et al. 2001) strongly curved (Fig. 4C).

Female. *Length* (n = 5). Body: 11.5–14.0 mm; wing: 9.0–11.5 mm.

Similar to the male, except for normal sexual dimorphism and the following characters. Frons grey pruinose, except for small area above lunule where shiny and in anterolateral corners where yellow pruinose; black pilose. Ocellar triangle grey pruinose, vertex posterior of ocellar triangle grey pruinose, vertex between eye and ocellar triangle bare and shiny. Lunule yellow. Tergum II laterally more extensively shiny and more extensively white pilose. Tergum III with wider white pile along anterior margin. Tergum IV in posterior half with rectangular shiny area extending from lateral margin to almost meeting in middle, only separated by narrow grey pruinosity. Tergum V grey pruinose except for shiny lateral macula occupying one third of tergum length; black and white pilose.

Differential diagnosis. The new species belongs to the subtribe Eristalina by having the wing vein R_{4+5} strongly sinuate, the wing cell r_1 petiolate, and metafemur with a basolateral setose patch (Thompson 2003). Within Eristalina, the following combination of characters places our new taxon in the genus *Eristalis* Latreille, 1804, subgenus *Eoseristalis* Kanervo, 1938: eye pilose, posterior anepimeron and katepimeron bare, postalar pile tuft absent, at least the apical third of wing bare, and metatibia not compressed nor carinate (Thompson 2003). The new species can be distinguished from all other European *Eristalis* species by the following combination of characters: arista plumose with pile longer than 3 times the basal dimeter of the arista, thorax and abdomen covered with short pile (less than half as long as the median length of the scutellum), pro- and mesotarsi black, pterostigma about six times as long as broad, and abdomen black without pale markings. Most *Eristalis* species are bee mimics and have partly yellow legs and yellow or orange markings on the abdomen. Other *Eristalis* species are bumblebee mimics and have long dense body piles of different colours. *Eristalis azorensis* sp. nov., however, is the only species of the genus known to us that does not mimic a hymenopteran species. Its body and legs entirely black, mimicking a bluebottle fly (see Figs 1, 2A, 2B and 3C).

On the Azores archipelago, the new species is easily distinguished from the other two *Eristalis* species known from the archipelago, namely *E. arbustorum* (Linnaeus, 1758) and *E. similis* (Fallén, 1817), by its body colouration (e.g., black abdomen instead of abdomen with pairs of orange or yellow maculae) and black legs (instead of partly yellow in the other two species). In the key to the Azorean Syrphidae by Rojo et al. (1997), *Eristalis azorensis* sp. nov. can be implemented as follows:

9a Eyes with spotted pattern. Postalar pile tuft present. ..... ***Eristalinus aeneus*** (Scopoli, 1763)

9b Eyes never with a spotted pattern. Postalar pile tuft absent. ..... 9’

9’a Abdominal terga black. Legs black or at most tibiae narrowly dark yellow ... ***Eristalis azorensis* sp. nov.**

9’b At least tergum II with yellow or orange maculae. Legs partly yellow, e.g., base of tibiae broadly yellow. 10

Etymology. The species name is derived from the locality where we collected the type series, the Azores archipelago, and the Latin suffix *-ensis* (*-ensis*, *-ense*) denoting place, locality, country, or belonging to, pertaining to (Brown 1956: 45, 303). Species epithet is to be treated as adjective.

Genetics. We were able to include DNA barcodes for all known European (and West-Palaearctic) *Eristalis* species, except for *E. tecta* Vujić, Radenković & Nielsen, 2004 in Vujić et al. (2004) (see Supplementary file Table S1). DNA barcodes of all included species clustered according to the morphological species concepts with high support (BS > 99%), except for the sequences of *E. alpina* (Panzer, 1798) that have a BS of 85.7%. DNA barcodes of *E. azorensis* sp. nov. are clustered together with high support (BS = 100%), and they form a highly-supported clade (BS = 100%) with the sequences of *E. similis* (also resolved in a different cluster with BS = 100%) (see Fig. 1).

Although it was not our aim to study the systematics of the West-Palaearctic species of the genus *Eristalis*, our NJ tree showed some interesting outcome regarding an accepted synonymy. The West-Palaearctic species of *Eristalis* were reviewed by Hippa et al. (2001), where *E. pseudorupium* Kanervo, 1938 was given a new status and considered a valid species. Years later, this species was synonymised with *E. obscura* Loew, 1866, a species described from Canada, by Hippa et al. (2009). In our NJ analysis the specimens from the Palaearctic Region (including Russian Siberia and Far East) identified as *E. pseudorupium* cluster together (BS = 99.1%), separated from the cluster of sequences of the specimens identified as *E. obscura* from the Nearctic Region (BS = 100%) (see Fig. 1). The synonymy between *E. pseudorupium* and *E. obscura* is beyond the scope of our work, but a taxonomic study with the help of DNA barcoding to dig into this matter may be warranted.

Habitat. The first specimen was collected resting on a leaf of *Hedychium gardnerianum* Sheppard ex Ker Gawl. along a forest edge consisting mainly of *Cryptomeria japonica* (Thunb. ex L.f.) D. Don at 569 m a.s.l. (Fig. 5A). The type locality is a more open terrain, along a parking lot with some flowering yellow Asteraceae at 762 m a.s.l. (Fig. 5B). The fact that the species was only recorded from 569 m a.s.l. upwards might indicate that the species occurs only at higher altitudes.

Distribution. Only known from three close-by localities on São Miguel Island in the Azores archipelago.

Remarks. The species was reported before by V. Jacinto, on August 15, 2015: https://www.inaturalist.org/observations/1890554. It was recorded only a few hundred

meters away from one of the type localities. However, the specimen was only photographed, so it could not be identified. Also, see the discussion about this observation here: https://www.diptera.info/forum/viewthread.php?forum_id=7&thread_id=68908&pid=290891#post_290891

Eristalis (*Eristalis*) *tenax* (Linnaeus, 1758)

Material examined. *Corvo: 1 ♂, Vila do Corvo, 39.6744°N, 31.1154°W, 50 m a.s.l., 9.x.2020, not collected, observed by Associação Vita Nativa, https://www.inaturalist.org/observations/62153163; 1 ♂, N of Vila do Corvo, 39.6784°N, -31.1165°W, 134 m a.s.l., 6.x.2024, not collected, observed by J. Renoult, https://www.inaturalist.org/observations/246236957; ***Graciosa:** 1 ♀, near Lagoa, 39.0617°N, 27.9827°W, 269 m a.s.l., 29.v.2023, not collected, observed by C. Picanço, https://www.inaturalist.org/observations/164388909; 1 ♀, near Limeira, 39.0284 N, 28.0168°W, 79 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002628, SBAN. **São Miguel:** 1 ♂, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002552, SBAN; 1 ♀, same data as for preceding, SB.002553; 1 ♂, same data as for preceding, leg. L. Hofstee, LHHN; 1 ♀, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002592, SBAN. **Terceira:** 1 ♀, Reserva Florestal Natural Parcial do Biscoito da Ferraria, 38.7547°N, 27.2027°W, 584 m a.s.l. 14.ix.2024, leg. S. Bot, SB.002648, SBAN.

Distribution. Cosmopolitan; known from all regions except the Antarctic (Speight 2024).

Eupeodes corollae (Fabricius, 1794)

Material examined. São Miguel: 1 ♂, Pilar, 37.9075°N, 25.784813°W, 128 m a.s.l., 10.ix.2024, leg. S. Bot, SB.002565, SBAN.

Distribution. Throughout Europe. Large parts of Africa; from the Urals to the Pacific coast; Japan; China; Taiwan (Speight 2024).

Meliscaeva auricollis (Meigen, 1822)

Material examined. Terceira: 1 ♂, near Agualva, 38.7667°N, 27.185305°W, 251 m a.s.l., 14.ix.2024, leg. S. Bot, SB.002549, SBAN.

Distribution. Throughout Europe, eastwards into the European parts of Russia; North Africa, Turkey and Israel; Caucasus (Speight 2024).

Myathropa florea (Linnaeus, 1758)

Material examined. *Faial: 1 ♀, Caldeira do Faial, 38.5921° N, 28.7229° W, 880 m a.s.l., 14.ix.2021, not collected, observed by P. Bruijsten, https://observation.org/observation/228453942/; 1 ♂, Jardim Botânico de Pedro Miguel, 38.5828°N, 28.6548°W, 397 m a.s.l., 22.v.2022, not collected, observed by G. Marques, https://www.inaturalist.org/observations/118215518; 1 ♀, Cabeço do Fogo, 38.5856°N, 28.7615°W, 947 m a.s.l., 14.ix.2024, not collected, observed by Sebi, https://observation.org/observation/328029795/. ***Graciosa:** 1 ♀, Caldeira da Graciosa, 39.0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002631, SBAN; 1 ♂, same data as for preceding, leg. L. Hofstee, LHHN. **São Miguel:** 1 ♂, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002554, SBAN; 2 ♀♀, same data as for preceding, SB.002555, SB.002556, SBAN; 1 ♂, Pilar, 37.8987°N, 25.7891°W, 185 m a.s.l., 10.ix.2024, leg. S. Bot, SB.002567, SBAN; 14 ♂♂, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002568–SB.002580, SB.003253, SBAN; 1 ♀, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002603, SBAN; 3 ♂♂, same data as for preceding, leg. L. Hofstee, LHHN. **Terceira:** 8 ♂♂, near Agualva, 27.1907°N, 38.7668°W, 304 m a.s.l., 14.ix.2024, leg. S. Bot, SB.002638–SB.002645, SBAN; 1 ♂, Reserva Florestal Natural Parcial do Biscoito da Ferraria, 38.7547°N, 27.2027°W, 570 m a.s.l. 14.ix.2024, leg. L. Hofstee, LHHN.

Distribution. North Africa; large parts of Europe, eastwards through the Palearctic to the Pacific coast (Speight 2024).

Sphaerophoria nigra Frey, 1945

Material examined. São Miguel: 1 ♂, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002624, SBAN; 12 ♀♀, same data as for preceding, SB.002613–SB.002623, SB.003256; 2 ♀♀, same data as for preceding, leg. L. Hofstee, LHHN.

Distribution. Endemic to the Azores archipelago, known from Flores, Faial, Pico, São Jorge, Terceira and São Miguel (Table 1).

Sphaerophoria scripta (Linnaeus, 1758)

Material examined. Graciosa: 1 ♂, Caldeira da Graciosa, 39.0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002635; 1 ♂, same data as for preceding, leg. L. Hofstee, LHHN. **São Miguel:** 2 ♂♂, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002561, SB.002562, SBAN; 1 ♀, same data as for preceding, SB.002563; 2 ♂♂, same data as for preceding, leg. L. Hofstee, LHHN; 2 ♀♀, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002593, SB.002612, SBAN.

Distribution. Southwest Greenland; eastwards through much of the Palaearctic to the Pacific coast of Asia; Kashmir and Nepal; North Africa (Speight 2024).

Syritta pipiens (Linnaeus, 1758)

Material examined. *Graciosa: 1 ♂, Caldeira da Graciosa, 39.0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002633; 1 ♀, Caldeira da Graciosa, 39.0258°N, 27.9638°W, 300 m a.s.l., 13.ix.2024, leg. L. Hofstee, LHHN. **São Miguel:** 1 ♂, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002564, SBAN; 1 ♂ 1 ♀, same data as for preceding, leg. L. Hofstee, LHHN; 2 ♂♂, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002584, SB.002585, SBAN; 1 ♂, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l., 11.ix.2024, leg. S. Bot, SB.003257, SBAN. **Terceira:** 2 ♂♂, near Agualva, 38.7668°W, 27.1907°N, 304 m a.s.l., 14.ix.2024, leg. S. Bot, SB.002646, SB.002647, SBAN; 1 ♂, Reserva Florestal Natural Parcial do Biscoito da Ferraria, 38.7547°N, 27.2027°W, 584 m a.s.l. 14.ix.2024, leg. L. Hofstee, LHHN.

Distribution. Known from most of the Palaearctic, including North Africa; most of North America, South America and the Oriental Region (Speight 2024).

Xanthandrus azorensis Frey, 1945

Material examined. São Miguel: 4 ♂♂, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002532–SB.002535, SBAN; 14 ♀♀, same data as for preceding, SB.002536–SB.002548, SB.003255=ZFMK-DIP-00085055 (GenBank n.: PV634342), SBAN; 1 ♀, same data as for preceding, leg. L. Hofstee, LHHN; 1 ♀, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002587, SBAN; 6 ♂♂, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002604–SB.002609, SBAN; 1 ♀, same data as for preceding, SB.002610; 1 ♂, same data as for preceding, leg. L. Hofstee, LHHN. ***Terceira:** 1 ♀, Terra Chã, 38.6816°N, 27.2649°W, 154 m a.s.l., ix.2022, not collected, observed by S. Lhoumeau, https://www.inaturalist.org/observations/135426392; 1 ♂, along EN 5-2A, 38.7239°N, 27.1746°W, 372 m a.s.l., 3.viii.2023, not collected, observed by G. Keijl, https://observation.org/observation/301834786/; 22 ♂♂, Reserva Florestal Natural Parcial do Biscoito da Ferraria, 38.7547°N, 27.2027°W, 584 m a.s.l. 14.ix.2024, leg. S. Bot, SB.002654– SB.002658, SB.002660–SB.002676, SBAN; 5 ♀♀, same data as for preceding, SB.002650–SB.002653, SB.002659; 6 ♂♂, same data as for preceding, leg. L. Hofstee, LHHN.

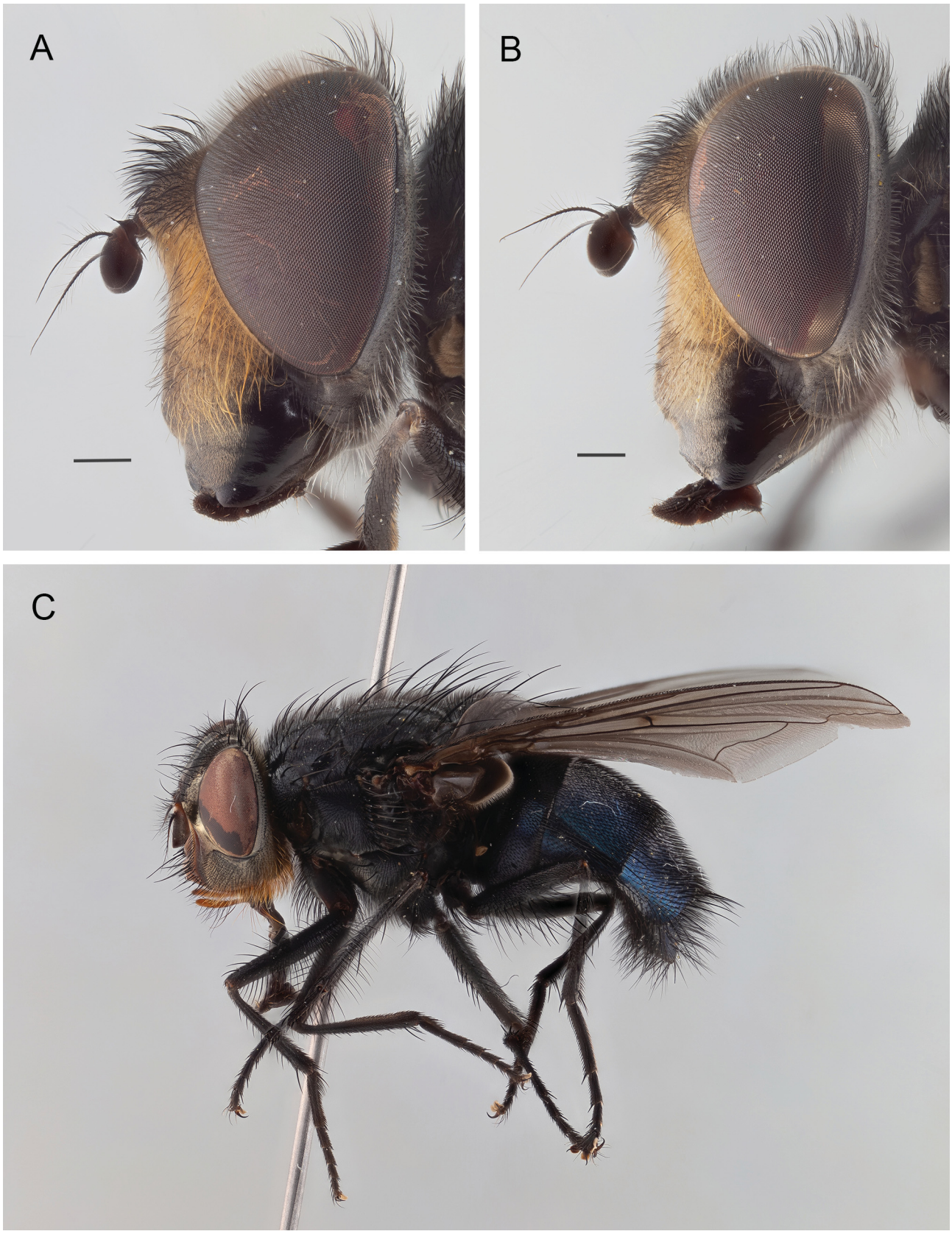


Fig. 3. A–B – *Eristalis azorensis* sp. nov. A – ♂ holotype (ZFMK-DIP-00085050; ZFMK); head in lateral view; scale bar = 0.5 mm; B – ♀ paratype (SB.002601; SBAN); head in lateral view, scale bar = 0.5 mm; C – *Calliphora vomitoria* (Linnaeus, 1758), ♀ (SB.002602; SBAN); habitus in lateral view; collected in the Azores archipelago; scale bar = 1 mm.

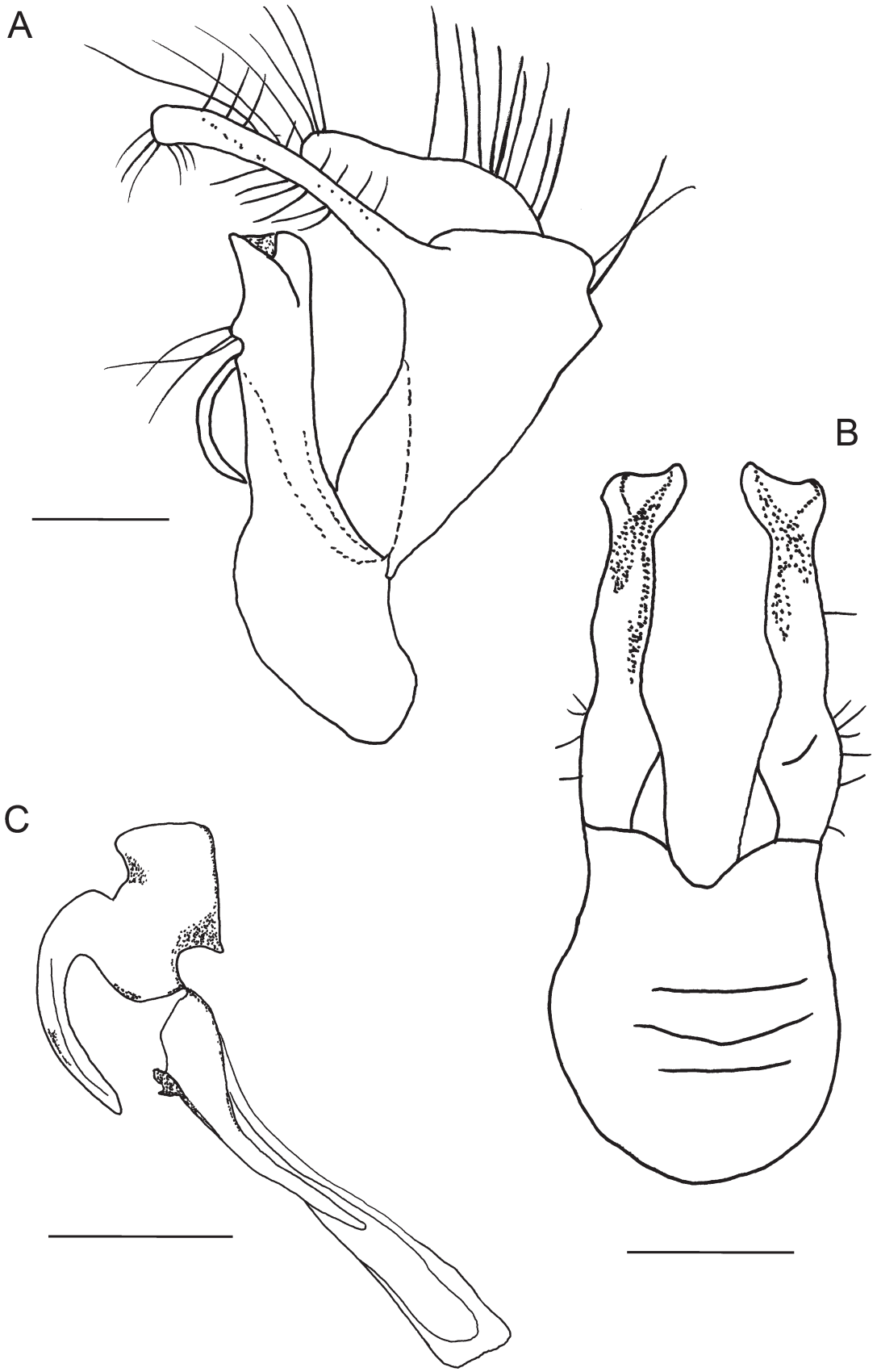


Fig. 4. *Eristalis azorensis* sp. nov. A – ♂ paratype (SB.002595; SBAN); genitalia in lateral view; B – ♂ paratype (ZFMK-DIP-00085051; SBAN); hypandrium and postgonite in ventral view; C – ♂ paratype (ZFMK-DIP-00085051; SBAN); phallus in lateral view. Scale bars = 0.25 mm.

Fig. 5. A – habitat of paratype; São Miguel, near Lagoa das Achades. B – habitat of holotype and paratypes; São Miguel, near Lagoa do Canário.

Genetics. We obtained a DNA barcode for *X. azorensis*, but we failed sequencing *X. comtus* (Harris, 1778) from the Azores archipelago. In our NJ analysis there is a group of *Xanthandrus* species very similar genetically (BS=99.1%), including *X. comtus*, *X. azorensis*, *X. babyssa* (Walker, 1849), *X. garhwalensis* (Kohli, Kapoor & Gupta, 1988) and other unidentified taxa from the Indomalayan Region. The COI sequence of *X. azorensis* is distinct from those of *X. comtus*, but the DNA barcode of *X. babyssa* is embedded among the sequences of *X. comtus* and both species cannot be separated molecularly (see Fig. 2).

Taxonomic remarks. In the Palaearctic Region there are three species of *Xanthandrus*, the widespread *X. comtus*, the endemic species of Madeira *X. babyssa*, and *X. azorensis*, which is endemic to the Azores archipelago. Currently, there is no key to separate these taxa (Speight 2024). We provide here an identification key to the Palaearctic species of *Xanthandrus*.

1 Eyes holoptic, the specimen is a male. 2
– Eyes dichoptic, the specimen is a female. 4
2 Cell bm almost entirely covered in microtrichia, only bare at the very base; wing dark brown infuscated. Abdominal tergum II black. Long pile on scutum entirely black (Fig. 6A) or with yellow base and black apex. ... 3
– Approximately basal half of cell bm bare; wing hyaline. Abdominal tergum II with a pair of orange markings of diverse size. Long pile on scutum yellow with black apex (Fig. 6B). Distribution in Europe: widespread, including the Azores archipelago, where it flies in sympatry with *X. azorensis*; not occurring on Madeira. ..... ***X. comtus*** (Harris, 1778)
3 Long pile on scutum sparse and black (Fig. 6A). Distribution: the Azores archipelago. ..... ***X. azorensis*** Frey, 1945
– Long pile on scutum dense, with a yellow base and black apex. Distribution: Madeira. ..... ***X. babyssa*** (Walker, 1849)
4 Approximately basal third to half of cell bm bare. Abdomen black or with small dark orange spots on the anterior half of tergum II. Long pile on scutum entirely black or with yellow base and black apex. 5
– Cell bm entirely or almost entirely bare. Abdominal terga II and III with large yellow to orange pairs of spots. Long pile on scutum yellow with black apex. Distribution in Europe: widespread, including the Azores, where it flies in sympatry with *X. azorensis*; not occurring on Madeira. ... ***X. comtus*** (Harris, 1778)
5 Long pile on scutum sparse and black. Abdomen black. Distribution: the Azores archipelago. ..... ***X. azorensis*** Frey, 1945
– Long pile on scutum dense and with yellow base and black apex. Abdomen either entirely black or with small dark orange markings on the anterior half of tergum II. Distribution: Madeira. ..... ***X. babyssa*** (Walker, 1849)

Distribution. Endemic to the Azores archipelago, known from Faial, Pico, São Jorge, Terceira and São Miguel (Table 1).

Xanthandrus comtus (Harris, 1778)

Material examined. ***Graciosa:** 2 ♀♀, Caldeira da Graciosa, 39.0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002629, SB.002630, SBAN; 1 ♀, Caldeira da Graciosa, 39.0258°N, 27.9638°W, 300 m a.s.l., 13.ix.2024, leg. S. Bot, SB.002637, SBAN. **São Miguel:** 1 ♂, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002588, SBAN; 2 ♀♀, same data as for preceding, SB.002589, SB.002590; 1 ♀, near Lagoa do Canário, 37.8358°N, 25.7625°W, 762 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002611; SBAN. **Terceira:** forest SW of Agualva, 38.7602, 27.1866, 380 m a.s.l., 14.ix.2024, leg. S. Bot, SB.002551, SBAN.

Distribution. Throughout Europe into Russia and the Caucasus and on to the Pacific coast; Japan; Taiwan (Speight 2024).

Xylota segnis (Linnaeus, 1758)

Material examined. ***Graciosa:** 1 ♀, Caldeira da Graciosa, 39.0278°N, 27.9742°W, 172 m a.s.l., 12.ix.2024, leg. S. Bot, SB.002634, SBAN. **São Miguel:** 6 ♀♀, along M1038, 37.7913°N, 25.1777°W, 758 m a.s.l., 9.ix.2024, leg. S. Bot, SB.002527– SB.002531, SB.003254, SBAN; 3 ♀♀, same data as for preceding, leg. L. Hofstee, LHHN; 1 ♀, near Lagoa das Achades, 37.8135°N, 25.7332°W, 569 m a.s.l., 11.ix.2024, leg. S. Bot, SB.002586, SBAN. **Terceira:** 1 ♀, forest SW of Agualva, 38.7603°N, 27.1866°W, 378 m a.s.l., 14.ix.2024, leg. S. Bot, SB.002550, SBAN.

Distribution. Throughout Europe; North Africa; the Caucasus; through Eurasia to the Pacific coast and Japan; eastern parts of North America, where possibly introduced (Skevington et al. 2019, Speight 2024).

Discussion

During the field expedition in 2024, a total of 13 species of hover flies were collected. In this work one species is recorded on Corvo for the first time (*Eristalis tenax*), one species is recorded on Faial for the first time (*Myathropa florea*), six species are recorded on Graciosa for the first time (*Episyrphus balteatus*, *Eristalis arbustorum*, *E. tenax*, *Myathropa florea*, *Syritta pipiens*, and *Xanthandrus comtus*), one species new to science is recorded on São Miguel (*Eristalis azorensis* sp. nov.), and two species are recorded on Terceira for the first time (*Eristalinus aeneus* and *Xanthandrus azorensis*) (Table 1). The discovery of *Eristalis azorensis* sp. nov. raises the total of hover fly species recorded in the Azores archipelago from 23 to 24 (Table 1). It is remarkable that amongst the 24 hover fly species recorded from the Azores archipelago, ten are seldomly or only once reported and lack recent records, namely *Baccha elongata* (Fabricius, 1775), *Chrysotoxum intermedium* Meigen, 1822, *Eumerus amoenus* Loew, 1848, *Eumerus strigatus* (Fallén, 1817), *Melanostoma mellinum* (Linnaeus, 1758), *Platycheirus albimanus* (Fabricius, 1781), *Pyrophaena rosarum* (Fabricius, 1787), *Sphaerophoria philanthus* (Meigen, 1822), *Sphaerophoria rueppellii* (Wiedemann, 1830), and *Syrphus ribesii* (Linnaeus, 1758). Consequently, we believe that their presence needs confirmation with new records. For a detailed overview of the records of these species, see Rojo et al. (1997).

With the description of *Eristalis azorensis* sp. nov. the number of endemic hover flies of the Azores archipelago is three, the other two being *Sphaerophoria nigra* and *Xanthandrus azorensis*. It is interesting to see that all

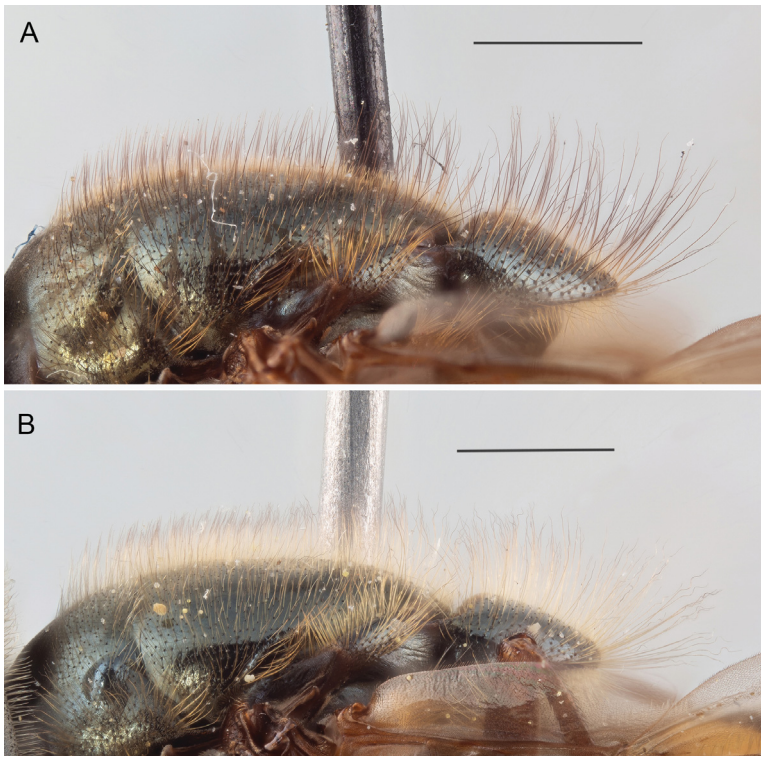


Fig. 6. Male scutum in lateral view. A – *Xanthandrus azorensis* Frey, 1945 (MZHF), collected in the Azores archipelago; B – *Xanthandrus comtus* (Harris, 1778) (SBAN), collected in Georgia. Scale bars = 1 mm.

three endemics have a blacker body compared to their mainland relatives: *Eristalis azorensis* sp. nov. is the only known *Eristalis* having a black body and black legs; *S. nigra* is the only known *Sphaerophoria* species having the abdomen entirely black; and in *X. azorensis*, the male has the abdominal tergum II black (with yellow spots in *X. comtus*) and the female has the abdomen entirely black (abdomen with pairs of spots on at least terga II and III in *X. comtus*). The same pattern can be seen in another archipelago of Macaronesia: three of the endemic hover flies of the Madeira archipelago, *Melanostoma wollastoni* Wakeham-Dawson et al. 2004, *Myathropa usta* (Wollaston, 1859) and *Xanthandrus babyssa* (Walker, 1849), also have blacker body compared to their mainland relatives. Thermoregulation could be the selective force for the colour pattern on these islands: the darker, volcanic soil or the dark and humid evergreen forests occurring on these islands could dictate a much darker pattern in the endemic species. This thermoregulation argument was also used by Hadrava et al. (2025) to explain the darker form of *Temnostoma* species in northern Europe. Another hypothesis for *Eristalis azorensis* sp. nov. to be the only *Eristalis* species not mimicking a bee or bumblebee might be related with the lack of larger bees in the Azores archipelago, which would act as models for mimetic flies. Although the honeybee *Apis mellifera* Linnaeus, 1758 and three species of bumblebees now occur on the Azores archipelago (Weissmann et al. 2017), these species are introduced and no native mimic models occur in the archipelago (Weissmann et al. 2017). Without a noxious model to maintain the colour pattern, the existing pattern might have decayed (F. Gilbert, pers. comm. 2024).

Eristalis azorensis sp. nov. looks quite similar to the sympatrically occurring blow fly *Calliphora vomitoria* (Linnaeus, 1758) (Diptera: Calliphoridae) (Fig 3C), sharing the yellowish face, black scutum with grey pruinosity, and abdomen with blue shine. This similarity was distinctive in the field, where *Eristalis azorensis* sp. nov. was easily overlooked amongst the higher number of *C. vomitoria* specimens. This similarity might also explain why *Eristalis azorensis* sp. nov. remain undiscovered even though it is such a large distinctive hover fly. There seems to be little benefit in mimicking a non-noxious blow fly, although blow flies might be even more agile than hover flies. It is also well possible that the similarity is a coincidence and no mimicry is involved. The latter might be especially true in this case since *Calliphora vomitoria* is an introduced species in the Azores archipelago (Smit 2010), making it an unlikely model.

Eristalis azorensis sp. nov. might well deserve the IUCN status of endangered or even critically endangered species. It is restricted to one island, and within it only known from a small area in the mountains on the west side of the island. As far as it is known, this might be one of the most restricted distributional ranges for a hover fly species in Europe. Habitat destruction, invasive plant species, tourism-related activities and climate change are all possible threats to the already small population of *Eristalis azorensis* sp. nov.

Acknowledgements

We are thankful to Mário Boieiro for arranging the collecting permit. Santos Rojo, Guido Keijl and Fons de Meijer are thanked for providing useful information during the preparation of the field work. We thank Francis Gilbert for the interesting discussion on mimicry. Our field work was possible with a permit from the Região Autónoma dos Açores, number CCIR-RAA/2024/13.

Table 1. Hover fly records (Diptera: Syrphidae) of the Azores archipelago specified by island. Island records marked with an asterisk are first records.

	Corvo	Flores	Faial	Pico	Graciosa	São Jorge	Terceira	São Miguel	Santa Maria
Baccha elongata (Fabricius, 1775)								x	
Chrysotoxum intermedium Meigen, 1822								x	
Episyrphus balteatus (De Geer, 1776)		x	x	x	x*	x	x	x	x
Eristalinus aeneus (Scopoli, 1763)		x					x*	x	x
Eristalis arbustorum (Linnaeus, 1758)		x		x		x*	x	x	x
Eristalis azorensis sp. nov.								x*	
Eristalis tenax (Linnaeus, 1758)	x*	x	x	x	x*	x	x	x	x
Eumerus amoenus Loew, 1848	x							x	x
Eumerus strigatus (Fallén, 1817)	x							x	
Eupeodes corollae (Fabricius, 1794)	x	x	x	x		x	x	x	x
Melanostoma mellinum (Linnaeus, 1758)								x	
Meliscaeva auricollis (Meigen, 1822)		x		x		x	x	x	
Myathropa florea (Linnaeus, 1758)		x	x*	x	x*	x	x	x	x
Platycheirus albimanus (Fabricius, 1781)		x						x	
Pyrophaena rosarum (Fabricius, 1787)							x		
Sphaerophoria nigra Frey, 1945		x	x	x		x	x	x	
Sphaerophoria philanthus (Meigen, 1822)							x		
Sphaerophoria rueppellii (Wiedemann, 1830)							x		
Sphaerophoria scripta (Linnaeus, 1758)	x	x	x	x	x	x	x	x	x
Syritta pipiens (Linnaeus, 1758)		x	x	x	x*	x	x	x	x
Syrphus ribesii (Linnaeus, 1758)								x	
Xanthandrus azorensis Frey, 1945			x	x		x	x*	x	
Xanthandrus comtus (Harris, 1780)					x*		x	x	x
Xylota segnis (Linnaeus, 1758)			x	x	x*		x	x	x

Supplementary files

Two supplementary files are available in the online version of the paper on the websote of the journal:

Table S1. Percentage identity table for *Eristalis* specimens as calculated in Geneious, representing the proportion of identical sites between two sequences.

Table S2. Percentage identity table for *Xanthandrus* specimens as calculated in Geneious, representing the proportion of identical sites between two sequences.

References

BROWN R.W. 1956: *Composition of scientific words*. Smithsonian Books, Washington, 885 pp.

EVENHUIS N. & PAPE T. 2023: *Syrphidae. Systema Dipterorum, version 4.4*. Available from http://www.diptera.org/Nomenclator (accessed 17 Dec. 2024).

FREY R. 1945: Tiergeographische Studien über die Dipterenfauna der Azoren. *Commentationes Biologicae* **8 (10)**: 1–114.

GOMES A. 1980: Sirfideos capturados pela 2.a Expediçao afidológica ao arquipélago dos Açores (Diptera, Syrphidae). *Boletim da Sociedade Portuguesa de Entomologia* **9**: 1–6.

GOMES A. 1982: Notícia sobre a sirfidofauna do arquipélago dos Açores (Diptera, Syrphidae). *Boletim da Sociedade Portuguesa de Entomologia* **7(A)**: 293–299.

HADRAVA J., KLEČKA J., MORAN K., KLEČKOVÁ I., KELSO S., ETZBAUER C., SKEVINGTON J. H. & MENGUAL X. 2025: The evolution of wasp mimicry and biogeography in the genus *Temnostoma* (Diptera: Syrphidae). *Molecular Phylogenetics and Evolution* **205 (108298)**: 1–28.

HEBERT P. D. N., CYWINSKA A., BALL S. L. & DEWAARD J. R. 2003a: Biological identifications through DNA barcodes. *Proceedings of the Royal Society of London B* **270**: 313–321.

HEBERT P. D. N., RATNASINGHAM S. & DEWAARD J. R. 2003b: Barcoding animal life: cytochrome c oxidase subunit 1 divergences among closely related species. *Proceedings of the Royal Society of London B* **270**: S96–S99.

JENTZSCH M. 2014: New data on hoverflies (Diptera: Syrphidae) from the Azorean island Pico (Portugal). *Arquipelago*, *Life and Marine Sciences* **31**: 4 pp (unpaginated).

MARSHALL S. A. 2012: *Flies: the natural history and diversity of Diptera*. Firefly Books, New York, 616 pp.

MÜLLER B., THORMANN J., VON DER MARK L., ASTRIN J. & RULIK B. 2024: Supplemental Lab-Protocol for Barcoding Primers: dEURYT-BRBM2, LCO1490-JJ, LCO1490-JJ2 & LCO1490-JJ3. protocols.io. https://doi:10.17504/protocols.io.6qpvr96kbvmk/v1

ROJO S., ISIDRO P. M., PEREZ-BAÑÓN C. & MARCOS-GARCÍA M. A. 1997: Revision of the hoverflies (Diptera: Syrphidae) from the Azores archipelago with notes on Macaronesian syrphid fauna. *Arquipélago*, *Life and Marine Sciences* **15A**: 65–82.

ROZO-LOPEZ P. & MENGUAL X. 2015: Mosquito species (Diptera, Culicidae) in three ecosystems from the Colombian Andes: identification through DNA barcoding and adult morphology. *ZooKeys* **513**: 39–64.

SCHAEFER H. 2021: *Flora of the Azores – A Field Guide*. Margraf Publishers GmbH, Weikersheim, 445 pp.

SKEVINGTON J. H., LOCKE M. M., YOUNG A. D., MORAN K., CRINS W. J. & MARSHALL S. A. 2019: *Field Guide to the Flower Flies of Northeastern North America*. Princeton University Press, New Jersey, 511 pp.

SMIT J. T. 2010: Diptera (Syrphidae). P. 240. In: BORGES P. A. V., COSTA A., CUNHA R., GABRIEL R., GONÇALVES V., MARTINS A. F., MELO I., PARENTE M., RAPOSEIRO P., RODRIGUES P., SANTOS R. S., SILVA L., VIEIRA P. & VIEIRA V. (eds): *A list of the terrestrial and marine biota from the Azores*. Princípia, Cascais, 433 pp.

SPEIGHT M. C. D. 2024: Species accounts of European Syrphidae, 2024. *Syrph the Net, the database of European Syrphidae (Diptera)*. Vol. 115. Syrph the Net publications, Dublin, 381 pp.

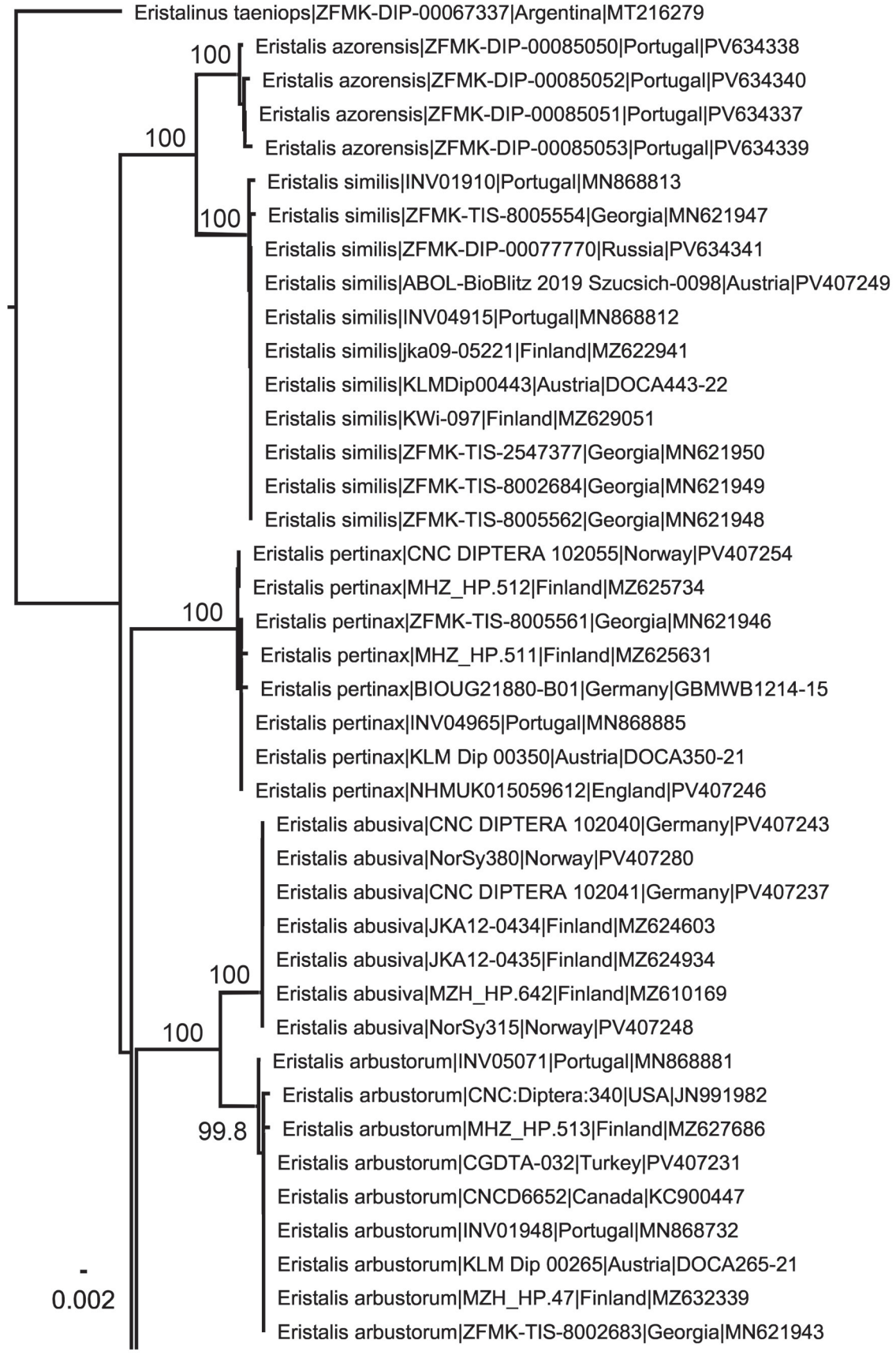
THOMPSON F. C. 2003: *Austalis*, a new genus of flower flies (Diptera: Syrphidae) with revisionary notes on related genera. *Zootaxa* **246**: 1–19.

VAN STEENIS J., MIRANDA GIL F. G., TOT T., MENGUAL X. & SKEVINGTON J. H. 2023: Glossary of morphological terminology of adult Syrphidae (Diptera): an update and extension. *Journaal van Syrphidae* **2 (4)**: 1–99.

VUJIĆ A., RADENKOVIĆ S., NIELSEN T. R. & SIMIĆ S. 2004: A new species of genus *Eristalis* Latreille, 1804 (Diptera: Syrphidae). *Entomologica Fennica* **15**: 119–123.

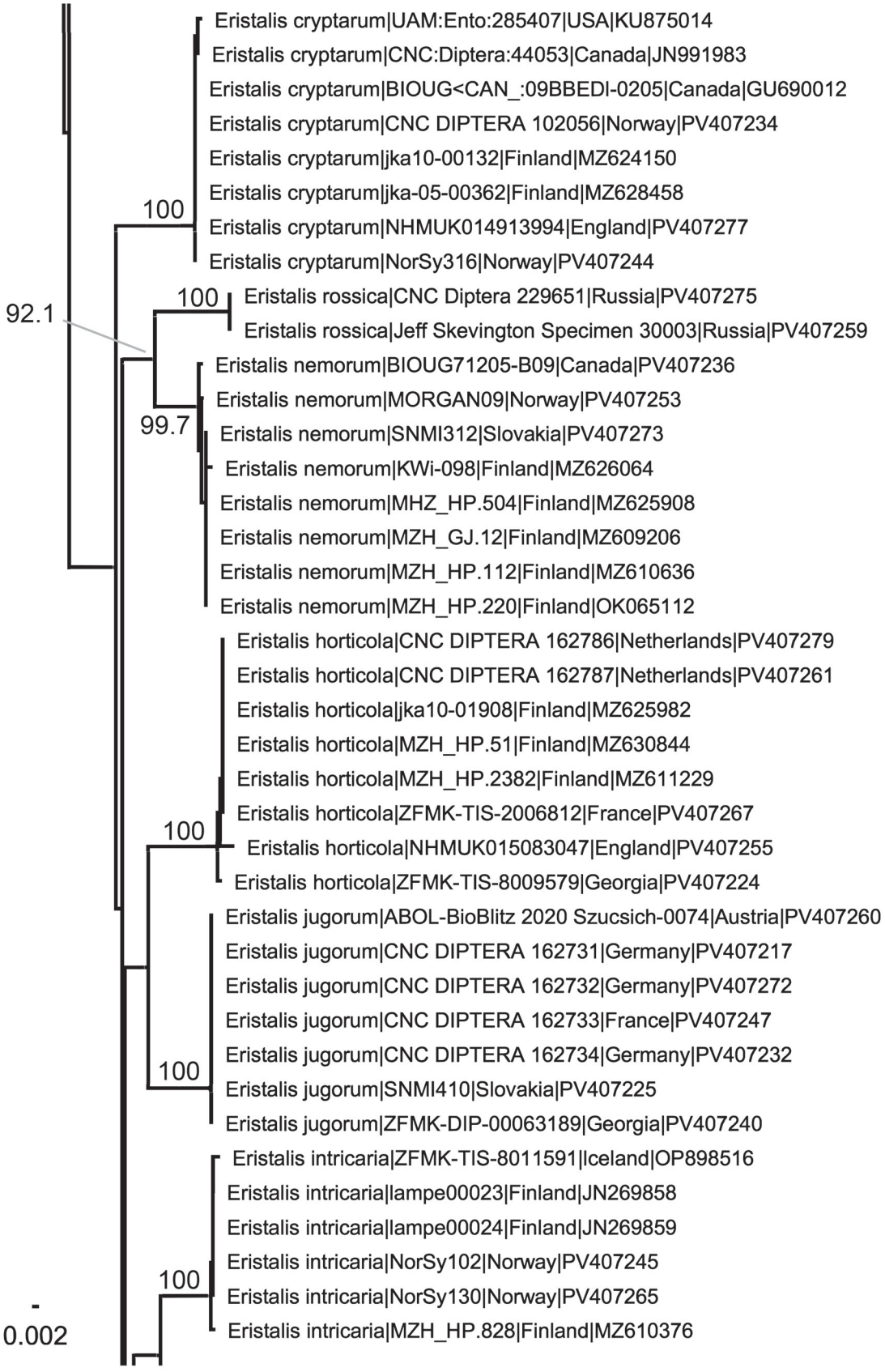
WEISSMANN J. A., PICANÇO A., BORGES P. A. V. & SCHAEFER H. 2017: Bees of the Azores: an annotated checklist (Apidae, Hymenoptera). *ZooKeys* **642**: 63–95.

Appendix 1 - part 1



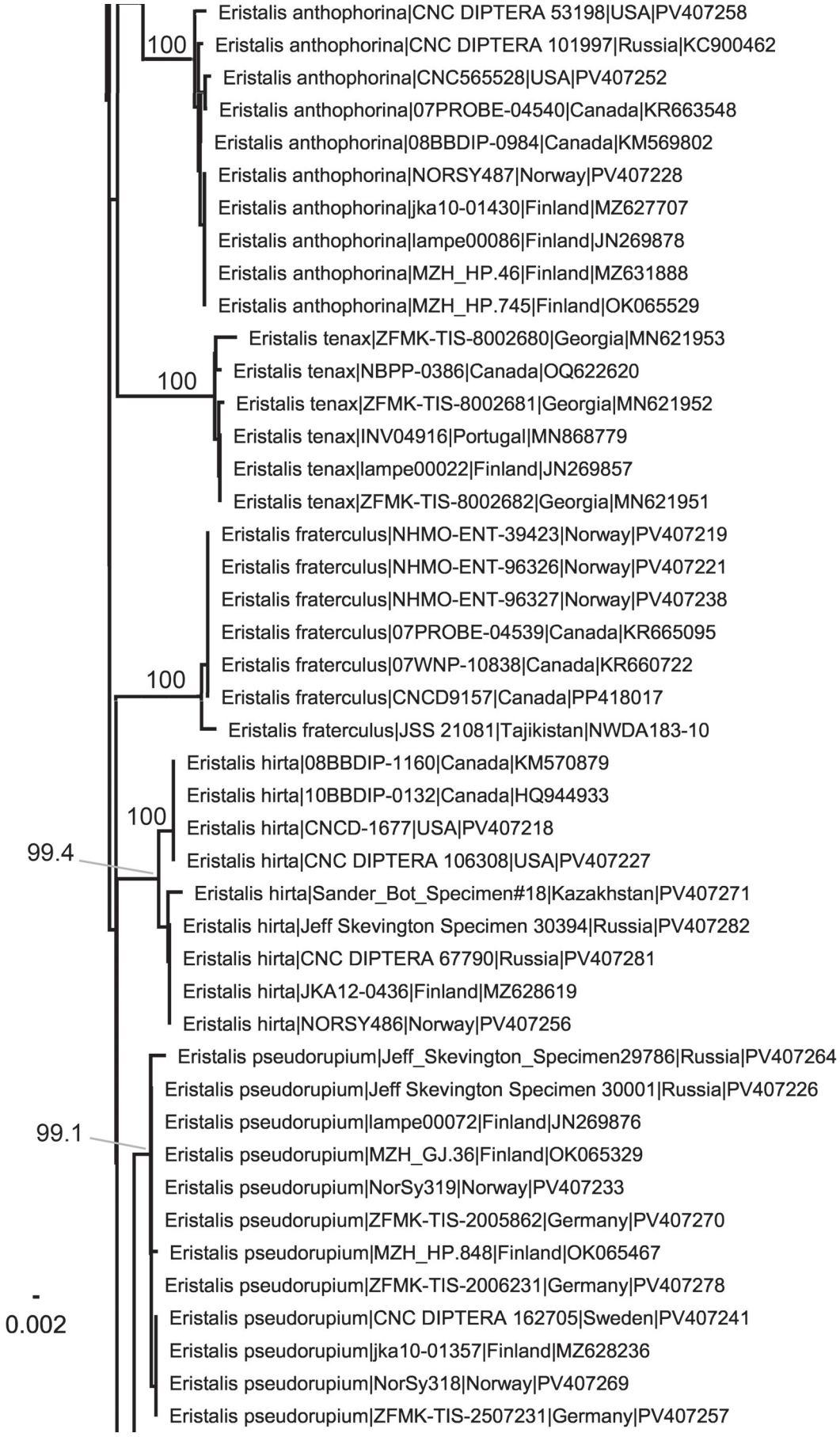
Appendix 1. Neighbour-joining tree using Jukes-Cantor model of the *Eristalis* specimens included in our study. Bootstrap support values (>90) are indicated at the nodes. The name for each specimen indicates: species name | Unique collection identifier and/or Process ID | Country of origin | GenBank accession number.

Appendix 1 - part 2



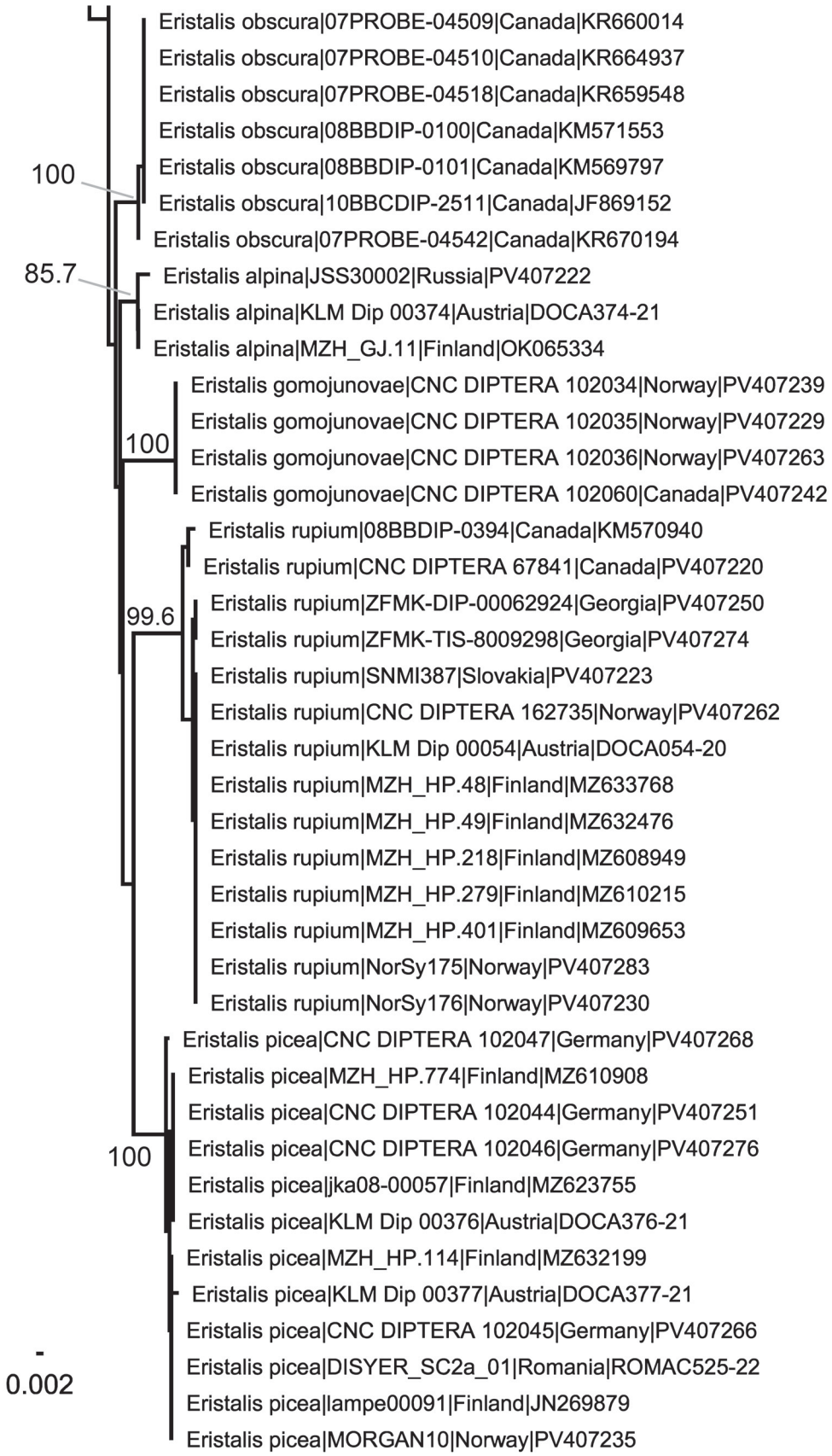
Appendix 1. Neighbour-joining tree using Jukes-Cantor model of the *Eristalis* specimens included in our study. Bootstrap support values (>90) are indicated at the nodes. The name for each specimen indicates: species name | Unique collection identifier and/or Process ID | Country of origin | GenBank accession number.

Appendix 1 - part 3



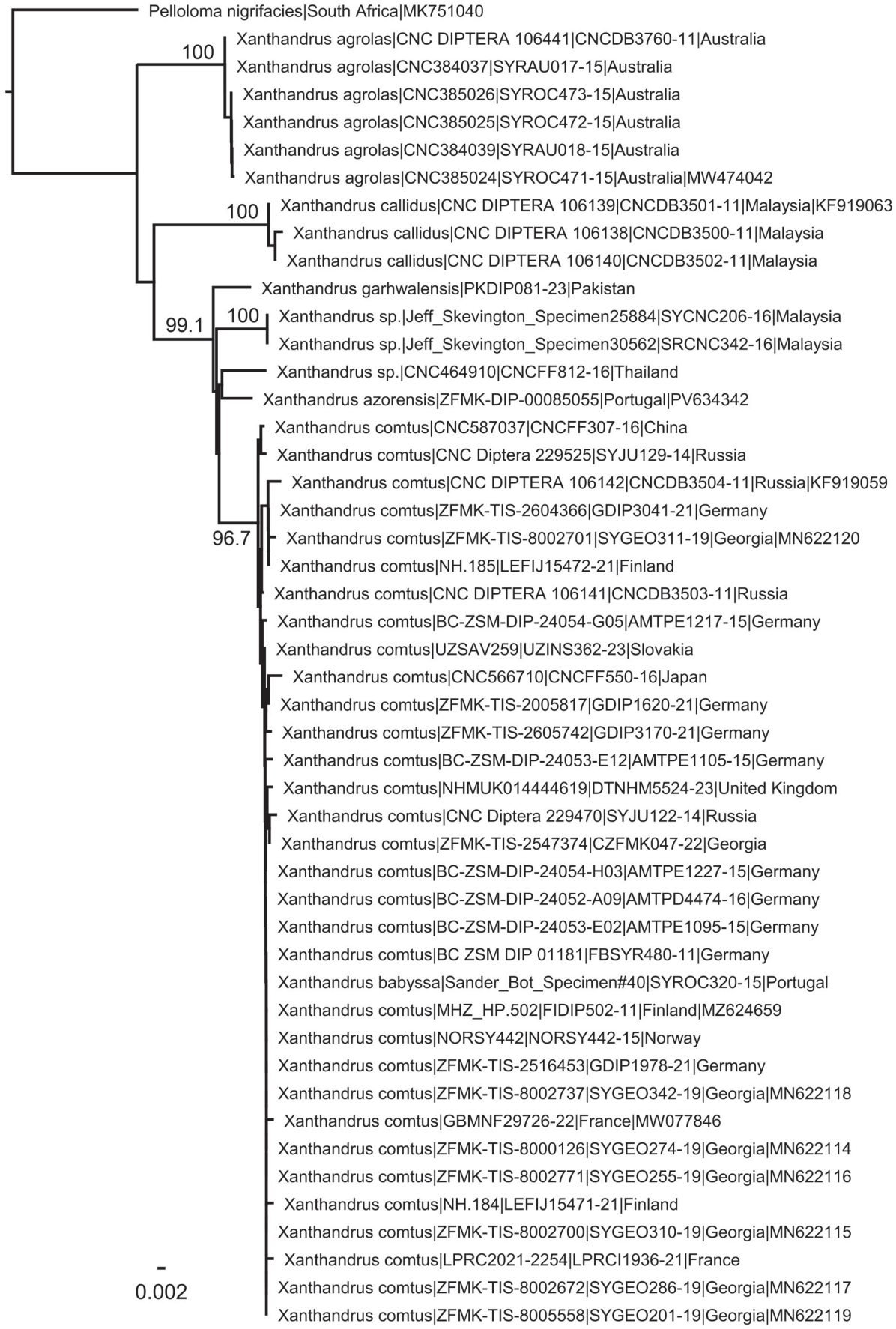
Appendix 1. Neighbour-joining tree using Jukes-Cantor model of the *Eristalis* specimens included in our study. Bootstrap support values (>90) are indicated at the nodes. The name for each specimen indicates: species name | Unique collection identifier and/or Process ID | Country of origin | GenBank accession number.

Appendix 1 - part 4



Appendix 1. Neighbour-joining tree using Jukes-Cantor model of the *Eristalis* specimens included in our study. Bootstrap support values (>90) are indicated at the nodes. The name for each specimen indicates: species name | Unique collection identifier and/or Process ID | Country of origin | GenBank accession number.

Appendix 2



Appendix 2. Neighbour-joining tree using Jukes-Cantor model of the *Xanthandrus* specimens included in our study. Bootstrap support values (>90) are indicated at the nodes. The name for each specimen indicates: species name | Unique collection identifier and/or Process ID | Country of origin | GenBank accession number.