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Life on an island: the phylogenetic placement of *Loveridgeana* and Afrotropical *Sphaerophoria* (Diptera: Syrphidae) inferred from molecular characters

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Running title: Phylogenetics of *Loveridgeana* and *Sphaerophoria*

Abstract

Phylogenetic relationships of the *Sphaerophoria* lineage (*Sphaerophoria* Le Peletier & Audinet-Serville and related genera) were inferred based on molecular characters, with the specific aim to infer the phylogenetic placement of the Afrotropical *Sphaerophoria* species and *Loveridgeana beattiei* van Doesburg & van Doesburg. Three molecular markers were used, i.e., the mitochondrial protein-coding gene cytochrome c oxidase subunit I (COI) and the nuclear 28S and 18S ribosomal RNA genes. The *Sphaerophoria* lineage genera *Exallandra* Vockeroth and *Loveridgeana* were resolved within the genus *Sphaerophoria*, and the Indomalayan *Eosphaerophoria* Frey was placed sister to *Citrogramma* Vockeroth, both related to a large species radiation from the New World. *Fazia* Shannon and *Allograpta* Osten Sacken were recovered as non-monophyletic. Our results recovered two different *Fazia* clades with dissimilar natural history resulted from our analyses, and *Allograpta* species were resolved into two clades, one with Nearctic and Neotropical species and a second clade with species from Oceanian, Indomalayan and Afrotropical Regions. *Exallandra* is considered a subgenus of *Sphaerophoria*, *S. (Exallandra)* **stat. rev.**, and *Sphaerophoria cinctifacies* (Speiser) **n. comb.** a member of this subgenus together with *S. loewii* Zetterstedt. A new *Sphaerophoria* subgenus is designated *S. (Loveridgeana)* **stat. rev.** to include *S. beattiei* **n. comb.** and the South African species, i.e., *S. quadrituberculata* Bezzi, *S. retrocurva* Hull, and *S. aff. retrocurva*. Based on their phylogenetic distinctiveness, functional traits, and ecological relevance we do recommend further ecological study and protection efforts for this Afrotropical group of pollinators.

Keywords: Afrotropical, 28S, 18S, rRNA, COI, conservation, flower flies, hover flies, systematics

Introduction

Members of the family Syrphidae (Diptera), commonly known as hover or flower flies, are well-known flower visitors and important pollinators in crops and natural ecosystems (Inouye, Larson, Ssymank, & Kevan, 2015; Larson, Kevan, & Inouye, 2001; Ssymank & Kearns, 2009). Their coloration – syrphids are very often Batesian mimics with striking yellow and black patterns – often causes them to be confused with bees or wasps (Hymenoptera) (Rotheray & Gilbert, 2011). Among the most abundant and ubiquitous genera in the Holarctic Region, but also present in the Afrotropical, Oriental and Australasian Regions, is the genus *Sphaerophoria* Le Peletier & Audinet-Serville, 1828. It comprises 61 valid species worldwide; 41 species are present in the Palearctic Region and 14 species occur in the Nearctic Region (Thompson, 2019).

Based on larval and adult morphology and molecular characters (Mengual, 2015; Mengual et al., 2009; Mengual et al., 2008a; Mengual, Ståhls, & Rojo, 2008b; Mengual, Ståhls, & Rojo, 2012; Mengual, Ståhls, & Rojo, 2015; Mengual, Ståhls, Láska, Mazánek, & Rojo, 2018; Rotheray & Gilbert, 1999; Thompson, 2008; Vockeroth, 1969; Young et al., 2016), *Sphaerophoria* has been related with several genera of the subfamily Syrphinae, namely *Allograpta* Osten-Sacken, 1875, *Antillus* Vockeroth, 1969, *Claraplumula* Shannon, 1927, *Eosphaerophoria* Frey, 1946, *Exallandra* Vockeroth, 1969, *Fazia* Shannon, 1927, *Rhinoprosopa* Hull, 1942, and *Tiquicia*

Thompson, 2012. Mengual and Ghorpadé (2010), based on Thompson (2008), also listed the genera *Anu* Thompson, 2008, *Citrogramma* Vockeroth, 1969, *Giluwea* Vockeroth, 1969, and *Rhinobaccha* de Meijere, 1908 as related to *Sphaerophoria*. These taxa are members of the *Allograpta-Sphaerophoria* clade of Mengual and Ghorpadé (2010), or the so-called *Sphaerophoria* lineage, redefined in the present work.

Sphaerophoria species are small, yellow and black flower flies with a parallel-sided abdomen and large, globose male genitalia. Adults can be distinguished from morphologically highly similar genera by the subscutellar fringe (absent or nearly so in *Sphaerophoria*), the wing venation (in *Sphaerophoria* the meeting point of vein R₂₊₃ with the wing margin is situated more basally than the meeting point of vein R₄₊₅ with the marginal vein) and the structure of the male genitalia (large and globose in *Sphaerophoria*, with postgonite not fused with the hypandrium and surstylus usually divided into two lobes, the posterodorsal one bearing an inner lobe) (Láska, 2009; Láska, Mazánek, Bičík, & Hanáková, 2007; Mengual & Ghorpadé, 2010; Vockeroth, 1969). While imagoes are found in low vegetation or visiting flowers to feed on pollen and nectar, their larvae are predators feeding mostly on aphids (Hemiptera: Aphididae), but also on jumping plant lice (Hemiptera: Psyllidae), caterpillars (Lepidoptera larvae), thrips (Insecta: Thysanoptera), and mites (Arachnida: Acari) (Rojo, Gilbert, Marcos-García, Nieto, & Mier, 2003).

The taxonomy of this genus is not easy as most females cannot be easily identified using external adult morphology (Verlinden, 1995; but see Bartsch, 2009), female genitalia is not helpful to distinguish species within the same genus (Miranda & Moran,

2017), there is a high degree of variability in adult coloration and many synonyms (Barkalov, 2011; Knutson, 1973), only characteristics of the male genitalia are useful for determination, and DNA barcodes (Hebert, Cywinska, Ball, & Dewaard, 2003; Hebert, Ratnasingham, & de Waard, 2003) overlap for most species (Adachi-Hagimori, Barry, & Ihno, 2018; Mengual et al., 2020; unpub. data). Nevertheless, taxonomic revisions for *Sphaerophoria* species have been published for the Nearctic (Knutson, 1973), Palaearctic (Andersson, 1970; Bańkowska, 1964; Barkalov, 2011, 2012; Claußen & Mutin, 2007; Goeldlin de Tiefenau, 1974, 1989, 1991; He & Li, 1992; Skufjin, 1980), Oriental (Joseph, 1967, 1968, 1970) and Afrotropical Regions (Vockeroth, 1973), and there are notes on Holarctic species (Vockeroth, 1971), among other publications. Frey (1945) created a new subgenus *Nesosyrphus* Frey, 1945, for a dark species endemic from the Azores, *Sphaerophoria nigra* Frey, 1945; but Vockeroth (1969) and later Knutson (1973) did not recognize it as a valid subgenus. Despite the difficult taxonomy, several authors suggested species groups within *Sphaerophoria* in order to group similar taxa (e.g., Goeldlin de Tiefenau, 1989; Vockeroth, 1971). Bańkowska (1964) divided this genus into two groups based on biogeography, i.e. eastern and western Palaearctic species, but it was Knutson (1973) who first divided the *Sphaerophoria* species into four groups based on characters of the male genitalia: *contigua* group, *scripta* group, *loewii* group, and *novaeangliae* group. These species groups were later modified and expanded by Skufjin (1980), Goeldlin de Tiefenau (1991), He and Li (1992), and Claußen and Mutin (2007). More recently, based only on the male genitalia structure, Barkalov (2012) recognized three subgenera within *Sphaerophoria*: i.e., *Knutsonia* Barkalov, 2012, *Prosphaerophoria* Barkalov, 2012, and *Sphaerophoria sensu stricto*. Moreover, Barkalov (2012) classified the species of the nominal subgenus into five

different species groups: *scripta* group, *abbreviata* group, *macrogaster* group, *rueppellii* group, and *chonjini* group; but he left five species out of these groups in ‘uncertain position’.

Two Afrotropical flower fly species placed under *Sphaerophoria*, namely *S. quadrituberculata* Bezzi, 1915 and *S. retrocurva* Hull, 1944, have been topics of discussion among taxonomists to determine to which genus they belong. Vockeroth (1973) needed to emend his identification key to World syrphid genera (Vockeroth, 1969) to accommodate these two remarkably distinct species, and Barkalov (2012) did not include them in any *Sphaerophoria* subgenera or list them as ‘uncertain position’. Bezzi (1915) said that *S. quadrituberculata* was aberrant and distinguishable from any other species of *Sphaerophoria* due to an abdomen without yellow markings and males having four very prominent tubercles on the abdominal tergites. About his new species, Hull (1944) said that *S. retrocurva* was unrelated to any known Afrotropical species and its abdomen was black with small obscure spots. Unfortunately, no fresh specimens of these species were available for DNA analysis until now.

The genus *Loveridgeana* van Doesburg & van Doesburg, 1976 was described from Saint Helena Island in the South Atlantic Ocean (van Doesburg and van Doesburg, 1976). Nothing is known about the biology of *Loveridgeana beattiei* van Doesburg & van Doesburg, 1976, the single species of this genus, except that it was the pollinator of several plants on Saint Helena, including the recently extinct Saint Helena olive tree, *Nesiota elliptica* (Roxb.) Hook.f. This monotypic syrphid genus is very similar to *Sphaerophoria* and to *Eosphaerophoria*, but it has some morphological differences

from them that make it difficult to assess their relationships (van Doesburg and van Doesburg, 1976). Since its original description, some authors considered *Loveridgeana* a valid genus (Barkalov, 2012; Dirickx, 1998; Smith & Vockeroth, 1980), but others placed it as a subgenus of *Sphaerophoria* (Evenhuis & Pape, 2019; Mengual, Ruiz, Rojo, Ståhls, & Thompson, 2009; Mengual, Ståhls, & Rojo, 2008a; Thompson, 2008; Thompson & Skevington, 2014; Whittington, 2004) or simply as a species of *Sphaerophoria* (Gray et al., 2019; Paaanen & Cronk, 2020). Until now, no specimens of *L. beattiei* were available for DNA analysis, but the phylogenetic inference based on morphological characters by Mengual et al. (2009) resolved it as sister to *Sphaerophoria novaeangliae* Johnson, 1916 with low support.

In the present study, our aim was to infer the phylogenetic relationships of these three relevant Afrotropical species (*L. beattiei*, *S. quadrituberculata*, and *S. retrocurva*) with other *Sphaerophoria* species using molecular characters, i.e., the mitochondrial gene cytochrome *c* oxidase subunit I (COI), a fragment of the nuclear 18S rRNA, and the region D2–D3 of the nuclear 28S rRNA genes. We performed two analyses with different taxon sampling in order to infer 1) the phylogenetic placement of *L. beattiei*, *S. quadrituberculata*, and *S. retrocurva* among Syrphini; and 2) the evolutionary lineages within the genus *Sphaerophoria*.

Materials and methods

Taxon sampling

We tried to cover as much taxonomic diversity as possible for the tribe Syrphini (Diptera: Syrphidae). In our first analysis, the taxon sampling from Mengual (2015) was used as starting point to infer the phylogenetic placement of *L. beattiei*, *S. quadrituberculata*, and *S. retrocurva* among Syrphini. In a second analysis, some taxa from Mengual et al. (2008b) and newly sequenced species were analysed together to understand the evolutionary lineages of *Sphaerophoria* and to see if they support the current subgenera proposed by Barkalov (2012). Table 1 lists the species included in the analysis, the collection data and the GenBank accession numbers.

For the first analysis, a total of 112 taxa were included (see Table 1). *Merodon equestris* (Fabricius, 1794) (Syrphidae: Eristalinae) was constrained as outgroup. For the first time, we obtained DNA sequences for *L. beattiei*, *Sphaerophoria novaeangliae*, *S. retrocurva*, *S. quadrituberculata*, and for the genus *Eosphaerophoria* Frey, 1946. In the second analysis we included 88 taxa, with 31 species newly sequenced for this study (see Table 1). In this second analysis, *Pipiza quadrimaculata* (Panzer, 1804) (Syrphidae: Pipizinae) was constrained as outgroup and an effort was made to include as many representatives of the *Sphaerophoria* lineage (genus *Sphaerophoria* and related genera) as possible.

Laboratory protocols

One to three legs, the entire abdomen or the entire specimen, either dry pinned or ethanol preserved, were used for DNA extraction. Extractions were carried out using the DNeasy Blood & Tissue Kit (QIAgen®) following standard protocols. Entire specimens

or remnants of specimens were preserved and labelled as DNA voucher specimens for the purpose of morphological studies and deposited at the Zoological Museum of the Finnish Museum of Natural History (MZH), the Canadian National Collection of Insects, Arachnids and Nematodes (CNC), and the Zoological Museum Alexander Koenig (ZFMK), as listed in Table 1.

DNA primers and PCR amplification protocols for mitochondrial COI, and nuclear 28S and 18S rRNA genes were the same as described in Mengual et al. (2008b, 2012) and Rozo-Lopez and Mengual (2015). The sequences were edited for base-calling errors and assembled using Geneious R7 (version 7.1.3, Biomatters Ltd.) and all new sequences were submitted to GenBank (see Table 1 for accession numbers).

Sequence alignment

The alignment of the protein-coding COI gene was done manually and it was not necessary to include gaps in this alignment. The COI alignment was then translated to amino acids to ensure there were no stop codons. The COI data matrix contained a total of 1,371 nucleotide characters. The alignment of 18S and 28S rRNA genes was done using the secondary structure of these genes, as explained by Kjer (1995) and implemented by Mengual (2015) and Mengual et al. (2012, 2015). As a result, the alignment of both rRNA genes differed from the first (642 bp for 28S; 608 bp for 18S) and the second (615 bp for 28S; 602 bp for 18S) analysis; numbers including gaps. This difference in the alignment of the rRNA genes is due to the different species included in

each dataset. A nexus file for each analysis with the final alignment is provided as online Supporting Information (Supplements 1 and 2).

Phylogenetic analyses

The combined dataset of the three genes was divided into five partitions: first codon position of COI, second codon position of COI, and third codon position of COI, 28S gene and 18S gene. We determined the best choice of model for each partition using jModelTest 2.1.1 (Darriba, Taboada, Doallo, & Posada, 2012) under the Akaike Information Criterion (AIC), as recommended by Posada and Buckley (2004). For the first analysis, the model chosen for position 1 of COI was GTR+I+G, for position 2 of COI was TIM1+I+G, and TIM3+G for position 3. The model TIM3+I+G was selected for 28S and the preferred model for 18S gene was TVM+I+G. For the second analysis the preferred models were: GTR+I+G for position 1 of COI, TPM3uf+I+G for position 2 of COI, TIM2+I+G for position 3, GTR+I+G for 28S, and TVM+I+G for 18S.

For the combined dataset, Maximum Likelihood (ML) analysis and Bayesian inference (BI) were performed to infer the phylogenetic relationships of the studied taxa. For the ML analysis, molecular data were analysed under the recommended models using Garli v.2.01 (Zwickl, 2006, 2011). Fifty independent runs were conducted using scorethreshforterm = 0.05 and significanttopochange = 0.0001 settings and the automated stopping criterion, terminating the search when the ln score remained constant for 50,000 consecutive generations. Bootstrap support values (BS) were estimated from 1,000 replicates using the same independent models in Garli.

Phylogenetic estimation using the Markov Chain Monte Carlo algorithm as implemented in MrBayes 3.2.6 (Huelsenbeck & Ronquist, 2001; Ronquist & Huelsenbeck, 2003) was performed using a parallelized version of the software (XSEDE in CIPRES Science Gateway). Data were divided into the above five partitions and a separate model for each partition was specified in the analysis where each partition has its own set of parameters. Priors were applied with default values. Six runs, with four chains each (one “cold” chain and three heated chains; temp = 0.2), were performed simultaneously for 30,000,000 generations which were sufficient to bring the convergence (average standard deviation) to a value < 0.005 (Ronquist, Huelsenbeck, & van der Mark, 2005), sampling trees every 2,500 generations. The program Tracer 1.5 (Rambaut & Drummond, 2007) was used to check convergence and acceptable mixing. The initial 3,000 trees (25%) were discarded as burn-in and Bayesian posterior probabilities (PP) were calculated using a 50% majority-rule consensus tree inferred from the data.

Analytical runs were performed on CIPRES Science Gateway (Miller, Pfeiffer, & Schwartz, 2010). All trees were drawn with the aid of FigTree v.1.3.1 (Rambaut, 2009).

Results

Nomenclatural acts

In order to facilitate the reading and explanation of the main results from our study and the visualization of these new combinations in the figures, we have compiled in this section the nomenclatural acts that we have taken based on our results.

Exallandra and *Loveridgeana* were resolved within the genus *Sphaerophoria* in both analyses (Figs 1, 2). Therefore, *Exallandra* is considered a subgenus of *Sphaerophoria*, *S. (Exallandra)* (Vockeroth, 1969) **stat. rev.**, and *Sphaerophoria cinctifacies* (Speiser, 1910) **n. comb.** a member of this subgenus together with *Sphaerophoria loewii* Zetterstedt, 1843. We also consider *Prosphaerophoria* Barkalov, 2012 a **junior synonym** of *Sphaerophoria (Exallandra)*. Furthermore, a new *Sphaerophoria* subgenus is designated *S. (Loveridgeana)* (van Doesburg & van Doesburg, 1976) **stat. rev.** to include *S. beattiei* (van Doesburg & van Doesburg, 1976) **n. comb.** and the South African species, i.e., *S. quadrituberculata*, *S. retrocurva*, and *S. aff. retrocurva*.

Phylogenetic analyses

The first analysis was designed to infer the phylogenetic placement of *Sphaerophoria beattiei*, *S. quadrituberculata* and *S. retrocurva* among Syrphini. The tree with the highest likelihood (−40,254.803945) was retained and is presented here (Figure 1). The topology of the majority-rule consensus tree resulting from the Bayesian inference compares favourably with the most likely tree and the PP are indicated on Figure 1. *Sphaerophoria (Loveridgeana) beattiei* was resolved as sister taxon of the two South African species, *S. quadrituberculata* and *S. retrocurva* (BS = 98; PP = 1), embedded within the *Sphaerophoria* clade. The second analysis (see below) also recovered the

same relationship of these three species within the *Sphaerophoria* clade. The other studied taxa were resolved in a similar way as in the analysis by Mengual (2015), with the novelty of the placement of *Eosphaerophoria*, with available molecular data for the first time. Both ML and BI resolved *Eosphaerophoria marginata* Frey, 1946 as sister to the genus *Citrogramma* (BS = 88; PP = 1). Together, they were resolved as sister group to large radiation in number of species from the New World (see Mengual et al., 2018).

The second analysis was planned to infer the evolutionary lineages within and around the genus *Sphaerophoria*, with emphasis to include the maximum possible number of species of the genera *Allograpta*, *Fazia* and *Sphaerophoria*. The Maximum Likelihood tree with the best likelihood score (−22,671.414) is presented in Figure 2. The topology of the majority-rule consensus tree resulting from Bayesian inference is the same for *Sphaerophoria* and related genera and the PP are shown on Figure 2. *Eosphaerophoria* and *Citrogramma* were resolved as a clade sister to *Ocyrtamus* and related genera, as in the first analysis but with lower support. *Allograpta* and *Fazia* were not recovered monophyletic and the *Sphaerophoria* lineage (BS = 96; PP = 1; indicated by a grey star in Figure 2) was resolved into four large clades. The genera *Antillus*, *Claraplumula*, *Fazia* (in part), *Rhinoprosopa*, and *Tiquicia* were recovered together (BS = 100; PP = 1) as sister to remaining taxa of the *Sphaerophoria* lineage. Then, all of the Neotropical species of *Allograpta* (BS = 96; PP = 1) were resolved together with some *Fazia* species (BS = 100; PP = 1) forming a different clade (BS = 79; PP = 1). The third clade is for all the studied species of *Sphaerophoria* including the subgenera *Exallandra* and *Loveridgeana* (BS = 78; PP = 1), which was resolved as sister group to a clade with the Oriental and African species of *Allograpta* (BS = 100; PP = 1). Within *Sphaerophoria*,

four clades representing the subgenera defined by Barkalov (2012) were recovered, i.e., *Prosphaerophoria* (now a junior synonym of *Exallandra*, see above) (BS = 82; PP = 0.99), *Knutsonia* (BS = 100; PP = 1) and *Sphaerophoria* (BS = 98; PP = 1), plus another clade for *S. (Loveridgeana) beattiei* and the South African *Sphaerophoria* species (BS = 95; PP = 1), where *S. beattiei* was resolved as the sister taxon of the South African *Sphaerophoria* species.

The female specimen D225, identified as *S. aff. retrocurva*, is morphologically very similar to the other studied females of *S. retrocurva*; as we mentioned before, females in this genus are difficult to identify as their overall morphology is very similar. The entire COI sequence of this D225 female differs ca. 3.6% from the COI sequence of the other *S. retrocurva* specimens (between 0.03614 and 0.03685 uncorrected pairwise distance). The 28S (574 nt length without gaps) and 18S (594 nt length without gaps) sequences of the female D225 were virtually the same (only one nucleotide change in each gene) as the 28S and 18S sequences of the three specimens of *S. retrocurva* (specimens D069, D071, and D176).

Discussion

Vockeroth (1969) described *Exallandra* based on the Afrotropical species *Syrphus cinctifacies* Speiser, 1910. He noted the external similarity with many species of the genus *Melangyna* Verrall, 1901 and the much smaller male genitalia in comparison with those of *Sphaerophoria* species. Vockeroth (1969) also recorded another difference; while in *Sphaerophoria* species the subscutellar fringe is absent, *Exallandra* has a well-

developed subscutellar fringe except on medial third. Previous molecular studies (Mengual, 2015; Mengual et al., 2008b, 2012) resolved *S. cinctifacies* as sister to *Sphaerophoria loewii* (first analysis BS = 81; PP = 0.96; second analysis BS = 82; PP = 0.99). Our results support previous works and resolved these two species together as sister to all the other studied *Sphaerophoria* species. Consequently, we consider these two species as members of the subgenus *Sphaerophoria* (*Exallandra*) **stat. rev.**

Vockeroth (1969) pointed out that the male genitalia of *S. loewii* (Figs 3–5) and *S. novaeangliae* (Figs 8–9) differ rather markedly from those of the other *Sphaerophoria* species studied by him. In the same line of argumentation, Knutson (1973) also recognized those differences placing *S. loewii* in its own species group and grouping *S. novaeangliae*, *S. viridaena* Brunetti, 1915 and *S. assamensis* Joseph, 1970 into the *novaeangliae* species group. Barkalov (2012) recognized these differences (see also Skufjin, 1980) and formally described the subgenus *Prosphaerophoria* for *S. loewii* and the subgenus *Knutsonia* for the *S. novaeangliae* and six more species. The diagnostic characters states of *Prosphaerophoria* (= *Exallandra*), following Barkalov (2012), are epandrium (tergite 9) is not confluent over the cerci (Fig. 3) [also valid for *S. cinctifacies* and the members of *Knutsonia*], the lateral yellow vitta of the scutum is short, ending before the scutellum [also valid for *S. cinctifacies*], face entirely yellow [not valid for *S. cinctifacies* as it has a median black vitta], surstylus without an inner lobe [also valid for *S. cinctifacies*; Figs 6–7], superior lobe is covered with distinct hairs along the dorsal side [also valid for *S. cinctifacies* (Fig. 6), but also present in other *Sphaerophoria* species], and its unusual hypandrium and postgonite [a difficult

character to interpret in our opinion, as there are other *Sphaerophoria* species with unusual male genitalia; e.g., Figs 23–30].

The other two subgenera of Barkalov (2012), i.e., *Knutsonia* and *Sphaerophoria sensu stricto*, were resolved as monophyletic groups for the studied species (BS = 100 and PP = 1 for *Knutsonia*, and BS = 98 and PP = 1 for *Sphaerophoria s. str.* in the second analysis). Diagnostic character states for *Knutsonia* species given by Barkalov (2012) are quite similar to the ones for *Exallandra*; i.e., a distinct membranous area between the cerci and the posterior margin of the epandrium (Fig. 9), the inner lobe of the surstylus is absent (Figs 9–16), face with a median black vitta, and lateral yellow scutal vitta short, among others. Members of the subgenus *Sphaerophoria* have epandrium completely sclerotized, so the cerci are surrounded by the epandrium (Figs 18, 19), surstylus with (Fig. 17) or without inner lobe (Figs 20, 21), lateral scutal vitta short or entire, among others (see Barkalov, 2012).

We did not recover further subdivision of the subgenus *Sphaerophoria* as suggested by Knutson (1973) and Barkalov (2012) (Fig. 2). The five species groups within the nominal subgenus suggested by Barkalov (2012) are based on morphological characters of the male genitalia and the length of the lateral yellow mesonotal vitta, and our molecular data set did not have enough resolution power at this level, most likely. DNA barcoding is not useful to distinguish different *Sphaerophoria* species as there is no “barcoding gap” (Meyer & Paulay, 2005) between several taxa (see Adachi-Hagimori et al., 2018; Mengual et al., 2020; and results from the German barcode of Life, <https://www.bolgermany.de/>). In our study, although we used longer COI sequences

than the standardized DNA barcode, the uncorrected pairwise distances (p-dist) between some studied *Sphaerophoria* species was zero [e.g., between *S. assymetrica* Knutson, 1942 and *S. taeniata* (Meigen, 1822)] or very low [e.g., 0.02407 between *S. macrogaster* (Thomson, 1869) and *S. contigua* Macquart, 1847], while other species pairs showed higher values (see Excel file provided as online Supporting Information; Supplement 3). Low p-distance values or invariant barcodes (absence of a barcoding gap) have also been found in other flower fly genera such as *Allograpta* [e.g., between *A. calopus* (Loew, 1858) and *A. nasuta* (Macquart, 1842); Supplement 3], *Melanostoma* Schiner, 1860 (Haarto & Ståhls, 2014), *Merodon* Meigen, 1803 (Mengual, Ståhls, Vujić & Marcos-García, 2006; Ståhls et al., 2009), *Xanthogramma* Schiner, 1860 (Nedeljković et al., 2018), and in some Afrotropical species and genera (Jordaens et al., 2015). The nuclear 28S rRNA gene behaves similar to COI for *Sphaerophoria* and the nuclear 18S rRNA gene is too conservative to distinguish among closely-related species of *Sphaerophoria* (Supplement 3; both rRNA genes with gaps in the alignment). Although the COI gene is an informative molecular marker to differentiate among *Sphaerophoria* subgenera and most of their species, other even faster evolving molecular markers (see Haarto & Ståhls, 2014) are needed to distinguish all the species of the subgenus *S. (Sphaerophoria)*.

For the first time, molecular data for *S. (Loveridgeana) beattiei* and the South African species of *Sphaerophoria* were available to infer their phylogenetic placement. In both analyses, *S. beattiei* was resolved as the sister group of the South African *Sphaerophoria* species (BS = 98 and PP = 1 in the first analysis; BS = 95; PP = 1 in the second analysis). This is a very interesting clade comprising all the Afrotropical species

of *Sphaerophoria* (*S. beattiei*, *S. quadrituberculata*, *S. retrocurva* and *S. aff. retrocurva*), except *S. rueppellii* Wiedemann, 1830. A widespread species in the Palearctic Region (Peck, 1988), *Sphaerophoria rueppellii* has been recorded in the African continent only north of the Equator, i.e., Sudan, Eritrea, Ethiopia, Kenya (Mt. Elgon), and South Yemen (Vockeroth, 1973; Dirickx, 1998, Thompson, 2019), with the exception of Mt. Kilimanjaro in Tanzania (Classen et al., 2020).

Adults of the *Loveridgeana* subgenus do not look like typical *Sphaerophoria* species (Figs 31–36). South African taxa (*S. quadrituberculata*, *S. retrocurva* and *S. aff. retrocurva*) have the abdomen unusually long and slender, face entirely yellow, the lateral yellow scutal vitta ending at the suture, proepimeron, proepisternum and anepimeron without distinct yellow markings (Figs 33–36), surstylus without inner lobe, and the cercal notch of the male open (Figs 28, 30), i.e., membranous area between the cerci and the posterior margin of the epandrium (Vockeroth, 1973). The abdominal pattern is reduced, mostly dark with lateral yellow maculae on tergites 3 and 4 (Figs 33–36), and males of *S. quadrituberculata* have a pair of strong tubercles on each of tergites 3 and 4 (Figs 33–34). Adults of *S. beattiei* are a bit different: males are dichoptic, face entirely yellow, scutum with a lateral yellow vitta broad and entire (running from postpronotum to scutellum), pleuron mostly yellow, abdomen yellow with small black markings (Figs 31–32), surstylus without inner lobe, and male genitalia with a membranous area between the cerci and the posterior margin of the epandrium (Fig. 26). South African species do not look similar to the endemic taxon of Saint Helena, but all them have in common that they do not look like typical

Sphaerophoria species and occur in the southern Hemisphere of the Afrotropical Region.

Male genitalia of the genus *Sphaerophoria* are so unique among flower flies that when male genitalia were used for the first time in the systematics of Syrphidae, authors placed this genus in their own subfamily (Glumac, 1960) or tribe (Dušek & Láška, 1967) as a stand-alone taxon. Vockeroth (1969) also recognized that *Sphaerophoria* species (excluding *Loveridgeana* species) “undoubtedly form a natural group”.

Nevertheless, a number of genera have been related to *Sphaerophoria* in the more recent literature, mostly based on morphological characters but also on molecular analyses.

Mengual and Ghorpadé (2010) included in their identification key for *Eosphaerophoria* and related genera, the so-called *Allograpta-Sphaerophoria* clade, the following taxa:

Allograpta, *Anu*, *Citrogramma*, *Exallandra*, *Giluwea*, *Rhinobaccha*, and *Sphaerophoria*. Their concept of *Allograpta* also included the genera *Antillus*, *Claraplumula*, *Fazia*, *Rhinoprosopa*, and *Tiquicia* (Thompson, 2012).

Results from Mengual (2015) resolved *Citrogramma*, a genus found in the Palearctic, Indomalayan and Australasian biotic regions (see Mengual, 2012), as the sister group of a New World lineage. This American evolutionary lineage, the *Ocyptamus* lineage, comprises the genera *Eosalpingogaster* Hull, 1949, *Hermesomyia* Vockeroth, 1969, *Ocyptamus* Macquart, 1834, *Orphnabaccha* Hull, 1949, and *Toxomerus* Macquart, 1855 in our study, but also other taxa not included in the present analysis (see Mengual et al., 2012, 2018; Miranda, Marshall, & Skevington, 2014; Miranda, Skevington, Marshall, & Kelso, 2016; Miranda, 2017). In our two analyses, *Citrogramma* was resolved as sister

to *Eosphaerophoria*, placed together as sister to the representatives of the *Ocyptamus* lineage included in our study. For the first time, *Eosphaerophoria*, an Indomalayan and Australasian genus (see Mengual & Ghorpadé, 2010), was included in a molecular study and its phylogenetic placement inferred. Based on our results, *Citrogramma* and *Eosphaerophoria* are not members of the *Sphaerophoria* lineage as defined here.

Following the outcome of our second analysis, the *Sphaerophoria* lineage, equivalent to the *Allograpta-Sphaerophoria* clade of Mengual and Ghorpadé (2010), comprises the genera *Allograpta*, *Antillus*, *Claraplumula*, *Fazia*, *Rhinoprosopa*, *Sphaerophoria*, and *Tiquicia*. Three other morphologically related genera (i.e., *Anu*, *Giluwea*, and *Rhinobaccha*) lack molecular information and their phylogenetic placement could not be inferred. Mengual and Ghorpadé (2010) wrote that the phylogenetic relationships of *Rhinobaccha* with other genera are unclear and this remains valid. Thompson (2008) stated that: “*Anu* is related to *Sphaerophoria* in appearance and behaviour... and it probably forms a monophyletic group along with *Exallandra*, *Giluwea* and *Sphaerophoria* (including *Loveridgeana*) characterized by [a lateral] yellow mesonotal vitta, loss or reduced subscutellar fringe, loss or reduced lingula, bare or reduced metasternal pile.” Thompson (2008) also mentioned that: “*Anu* is probably the sister to *Giluwea* as their genitalia are most similar (both have asymmetric surstyli).”

The present study did not resolve *Fazia* and *Allograpta* as monophyletic genera. Some *Fazia* species (the *fascifrons* species group) were placed together with *Antillus*, *Claraplumula*, *Rhinoprosopa* and *Tiquicia* (BS = 100; PP = 1), while another group of *Fazia* species (the *micrura* species group) were resolved as sister to the American

species of *Allograpta* (BS = 79; PP = 1). These two *Fazia* groups were also recovered by previous molecular analyses (Mengual, 2015; Mengual et al., 2008b) and we provide here a name for these species groups for easy reference. The natural history of most *Fazia* and *Allograpta* species is unknown, but as pointed out by Nishida, Rotheray, & Thompson (2002) and Mengual et al. (2008b), evidence suggests the existence of a clade of leaf-miners in the *Sphaerophoria* lineage. It is very interesting to see that the only known three species with leaf-miner larvae [i.e., *Fazia centropogonis* (Nishida, 2002), *Fazia CR-5* Thompson, in litt. and *Tiquicia zumbadoi* (Thompson, 2000)] are resolved in the same clade. Larvae of *Fazia centropogonis* and *Fazia CR-5* are leaf miners of four species of *Centropogon* C. Presl. (Nishida et al., 2002), a genus of the bellflower family (Campanulaceae), and larvae of *Tiquicia zumbadoi* are leaf miners in early larval stages and stem borers in late stages on *Centropogon* plants (Zuijen & Nishida, 2011). The other *Fazia* species with known larval biology is *Fazia micrura* (Osten Sacken, 1877), whose larvae exclusively feed on pollen in *Castilleja* Mutis ex L.f. (Orobanchaceae) flowers (Weng & Rotheray, 2009). This species is resolved together with other *Fazia* species as the sister group of the New World *Allograpta*. Thus, present results support two different *Fazia* clades with dissimilar natural history, as far as we know.

Mengual et al. (2009) divided the old concept of *Allograpta* into subgenera that Thompson (2012) elevated to genus. Mengual et al. (2009) affirmed that the largest radiation of *Allograpta* is found in the Neotropics and that a small radiation also occurred in New Zealand. In order to document some morphological diversity within *Allograpta*, they divided the current *Allograpta* genus into species groups, i.e., *obliqua*

group, *alamacula* group and *ventralis* group. In our present study, only *Allograpta* species listed in the *obliqua* group were included and they were resolved into two different clades. Nearctic and Neotropical *Allograpta* species (the New World species group) were resolved as sister group of the *Fazia micrura* species group (BS = 79; PP = 1), while the *Allograpta* species from Oceanian, Indomalayan and Afrotropical Regions (the non-American species group) were recovered in a different clade as sister to *Sphaerophoria* (BS = 55; PP = 0.91). Mengual et al. (2008b) also recovered two clades of *Allograpta*, but without any biogeographic basis. Based on our results, further morphological and molecular studies are necessary to understand the evolutionary history of these two genera, *Allograpta* and *Fazia*, and the study of the members of the *alamacula* and *ventralis* species group might improve and change their inferred relationships.

Conservation of the *Loveridgeana* clade

Nature conservation efforts are made to preserve the biological diversity or biodiversity of our planet. Following Gaston and Spicer (2004), biodiversity is “variation of life at all levels of biological organization”, including genes, species and ecosystems.

Although most people think about species diversity and species richness when the term biodiversity appears, this term applies to several distinct kinds of diversity: taxonomic, ecological, genetic or molecular, phylogenetic and functional diversity.

Phylogenetic diversity. Phylogenetic diversity (Faith, 1992), also known as evolutionary diversity, has been neglected in conservation as no solid conceptual basis

for the added value has been proved (Winter, Devictor, & Schweiger, 2013; but see Rosauer & Mooers, 2013). Nevertheless, evolutionary diversity can be justified with four conservation approaches following Winter et al. (2013) and play different roles in conservation biology (Lean & Maclaurin, 2016): 1) the rarity aspect, related to phylogenetic distinctiveness (entities have a higher value when they are rare or unique); 2) the richness aspect as not always areas with high species richness imply areas with more phylogenetic diversity (Warwick & Clarke, 1995); 3) as a proxy for functional diversity, based on the assumption that “phylogenetically distinct species are likely to also have distinct functional traits” (Cadotte, Dinnage, & Tilman, 2012; Winter et al., 2003), but this argument can be misleading (Mazel et al., 2018; but see Owen, Gumbs, Gray, & Faith, 2018); and 4) as proxy for evolutionary potential, that is, the capacity of a species to evolve in response to environmental changes, although it “remains unclear whether the evolutionary potential depends on the phylogenetic position of a species” (Winter et al., 2013). The members of the new subgenus *Loveridgeana* are definitively morphologically and evolutionarily distinct; the reason we consider them as an independent unit (subgenus) in the evolution of *Sphaerophoria*, in other words, they are phylogenetically distinct. These species can be locally abundant, but limited in geographic distribution, so we consider them rare and unique, in terms of morphological traits. Moreover, these *Loveridgeana* species are spatially isolated from the other subgenera. All these characteristics make these taxa candidates for conservation efforts.

Functional diversity and natural history. There are multiple definitions of functional diversity (Cadotte, Carscadden, & Mirotchnick, 2011; Petchey & Gaston, 2006), although it usually refers to “the value and range of those species and organismal traits

that influence ecosystem functioning” (Tilman, 2001). The loss of evolutionarily distinct species can be interpreted as an irreversible loss of function for entire ecosystems (Bracken & Low, 2012) and consequently, nature conservation efforts should be taken to preserve the ecosystem service and functionality. As in the case of the evolutionary diversity, there are several measures or indices (Petchey & Gaston, 2006; Mouchet, Villéger, Mason, & Mouillot, 2010), but the key question is always which species traits to study. In Syrphidae several morphological and biological species traits have been surveyed in the literature (e.g., larval microhabitat, larval feeding mode, adult body size, wing length, adult diet, development duration, inundation tolerance, migratory status, number of generations, among others), but the larval feeding mode has been mostly used to divide the species into “functional groups” (de Groot & Vrezec, 2019; Debeljak, Tosser, Sarthou, Kuzmanovski, & Trajanov, 2019; Djellab, Mebarkia, Neffar, & Chenchouni, 2019; Gaytán, Ricarte, & González-Bornay, 2020; Larrieu, Cabanettes, & Sarthou, 2015; Naderloo & Rad, 2014; Schweiger et al., 2007).

All the known larvae of *Sphaerophoria* species are predators (Rojo et al., 2003).

Immature stages of *S. beattiei* are unknown, but larvae of *Sphaerophoria quadrituberculata* have been reported feeding on *Gigantothrips afer* Priesner, 1925 (Thysanoptera) in South Africa on the plant *Ficus craterostoma* Warb. ex Mildbr. & Burret (Moraceae) (Callan, 1955; Stuckenberg, 1954). The thrips *G. afer* has been reported from several countries in Africa (Democratic Republic of the Congo, Nigeria, South Africa, Sudan, and Uganda; World Thysanoptera website: <http://anic.ento.csiro.au/thrips/index.html>), which means that several potential predators or natural enemies may exist. Based on known natural history, *S. quadrituberculata*

may be a specialist predator of *G. afer* as the larval habit is quite unique and specialised: the larvae of *S. quadrituberculata* feed on thrips inside curled leaves or open galls. Callan (1955) noted that the leaf curling is caused by the feeding of another thrips species, *Gynaikothrips hirsutus* Karny, 1925, and that *G. afer* lives inside the curled leaves as inquiline. Callan (1955) also mentioned the voracity of the larvae of *S. quadrituberculata* feeding on the immature stages (larva, prepupa and pupa) of *G. afer*. This characteristic needs to be further studied, but *S. quadrituberculata* has the potential to become a good biological control agent for *G. afer*.

Schmutterer (1974) reported larvae of *S. retrocurva* feeding on jumping plant lice (?*Acizzia* sp.) from Kenya. To our knowledge this syrphid species is endemic to South Africa; we have studied material of *S. retrocurva* only from South Africa and Smith and Vockeroth (1980) listed only two *Sphaerophoria* species from Kenya, *S. cinctifacies* and *S. rueppellii*. Based on the current evidence and the fact that the material collected by Schmutterer is lost, we think that *S. retrocurva* does not occur in Kenya, and the larvae collected by Schmutterer (1974) belong to some other species.

Adults of *Sphaerophoria* species are ubiquitous flower visitors to feed on pollen and nectar (Gilbert, 1981), although no published data on visited flowers exist for *S. quadrituberculata* or *S. retrocurva*. However, van Doesburg and van Doesburg (1976) mentioned several plants in the studied material from the type series of *S. beattiei*, and some of those plants are endemic to Saint Helena Island. From the point of the functional diversity, some degree of protection for these flower fly species will preserve their ecosystem services as pollinators. We are too late to preserve some of these plant-

insect interactions, for instance the pollination by *S. beattiei* of the already extinct monotypic plant genus *Nesiota* Hook.f., the Saint Helena olive (Lambdon & Ellick, 2016; Russell, 2005). *Sphaerophoria beattiei* was the principal flower visitor of the extinct *Nesiota elliptica* (Roxb.) Hook.f. (Jackson, 1991), which also visits other endemics like *Nesohedyotis arborea* (Roxb.) Bremek. (Cronk, 1987; Percy & Cronk, 1997; Smith, 1996; van Doesburg & van Doesburg, 1976), another monotypic genus endemic to Saint Helena (Cronk & Ninnés, 2000). The importance of *S. beattiei* as pollinator on Saint Helena is remarkable as another two endemic plants, *Commidendrum robustum* (Roxb.) DC. (St Helena gumwood) and *Commidendrum rugosum* (Aiton) DC. (St Helena scrubwood), are also pollinated by this flower fly (Paajanen & Cronk, 2020).

The original vegetation cover of Saint Helena was mostly destroyed by 1750 (Cronk & Ninnés, 2000), and nowadays there is a relict vegetation, the so-called tree-fern thicket, in the high central ridge of the island, rich in endemics and pollinated exclusively by syrphid flies. Among the handful of flower flies recorded on Saint Helena, *S. beattiei* is especially attracted to the small white flowers of the tree-fern thicket and a considerable co-evolution between this generalist pollinator and the endemic trees has been suggested (Cronk & Ninnés, 2000; Percy & Cronk, 1997). Many endemic plants on Saint Helena have small white flowers in clusters, which *S. beattiei* visits regularly, “apparently as a convergent myophilous pollination syndrome” (Paajanen & Cronk, 2020). Percy & Cronk (1997) demonstrated that syrphid pollination is highly effective as a pollen vector up to ca. 30 m but that a sharp decline in pollination efficiency is indicated at distances greater than 50 m. Paajanen & Cronk (2020) said that “[w]hile the

myophilous pollination syndrome is highly effective at effecting pollination within populations and effecting gene transfer in continuous habitat, it is a relatively ineffective in fragmented anthropogenic landscapes”. Following this argument, “small isolated [*Commidendrum*] populations resulting from habitat destruction are now effectively cut off from gene flow unless supplemental conservation planting is carried out” (Paajanen & Cronk 2020).

Ongoing efforts to protect and preserve the invertebrate fauna and the endemic flora of Saint Helena should consider the ecosystem services of *S. beattiei* and its important role for the plant community (see Cairns-Wicks, Jervois, & Kin-demba, 2016; Gray et al., 2019; Smith, 1996). Thus, from the point of view of the functional diversity, members of the subgenus *Loveridgeana* deserve further study and protection as pollinators and as potential biocontrol agents of pests.

Legislative protection. Even though a coordinated group of specialists (<https://iucn-hsg.pmf.uns.ac.rs/about-hsg/> ; <https://www.iucn.org/commissions/ssc-groups/invertebrates/hoverfly>) is currently working on the European Red List of Hover flies (<https://www.iucn.org/regions/europe/our-work/european-red-list-threatened-species/european-red-list-hoverflies>) and many European countries have listed syrphid species in their national Red Lists, Serbia is the only country world-wide that has designated protected areas based on Syrphidae (Vujić et al., 2016) and has protected flower fly species by a national law (Miličić, Janković, Milić, Radenković, & Vujić, 2018a; Miličić et al., 2018b; Janković, Miličić, Ačanski, Popov, & Vujić, 2019), with additional species to be included in this list (Janković, Miličić, Radenković, & Vujić,

2017). Syrphidae, as pollinators, have been also used to designate area prioritization for conservation in islands (Picanço, Rigal, & Borges, 2017), and we believe it is crucial to include Syrphidae species in conservation efforts to preserve their ecosystem services. Besides *S. beattiei*, other flower fly species have been reported as pollinators of endangered plant species. This is the case for *Allograpta hortensis* Philippi, 1865, *Syrphus octomaculatus* Walker, 1836 and *Syrphus reedi* Shannon, 1927 as potential pollinators of the ‘Endangered’ Chilean tree *Gomortega keule* (Molina) Baill. (Lander, Harris, & Boshier, 2009), and also the flower fly *Aneriophora aureorufa* (Philippi, 1865), a native species of the Andean Patagonian and Valdivian Forests of Argentina and Chile that pollinates *Myrceugenia planipes* (Hook. & Arn.) O.Berg and *Eucryphia cordifolia* Cav., a tree classified as ‘Near Threatened’ in Argentina (González, 1998; López-García, Barahona-Segovia, Maza, Domínguez, & Mengual, 2019).

Based on our results, the species of the new subgenus *Sphaerophoria* (*Loveridgeana*) **stat. rev.** deserve further ecological study and protection efforts due to their phylogenetic distinctiveness, functional traits, and ecological relevance. We do recommend a detailed study of the plant-insect interactions of *S. beattiei* on Saint Helena to properly evaluate the key role of this flower fly in the pollination and survival of the endemic plants, and to survey comprehensively the natural history of the South African *Sphaerophoria* species (*S. quadrituberculata*, *S. retrocurva* and *S. aff. retrocurva*) to understand their potential and importance as endemic pollinator species and biological control agents of pests.

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Figure legends

Fig. 1. Best Maximum-Likelihood tree based on the combined dataset (COI, 28S, and 18S) with 112 taxa (first analysis) using Garli v.2.01 and the structural alignment for 28S and 18S. *Merodon equestris* (Syrphidae: Eristalinae) was constrained as outgroup. Bootstrap support values (above) and Bayesian posterior probabilities (below) are depicted at the nodes (only >50 or >0.5, respectively). BS = Bootstrap support values; PP = Bayesian posterior probabilities.

Fig. 2. Best Maximum-Likelihood tree based on the combined dataset (COI, 28S, and 18S) with 94 taxa (second analysis) using Garli v.2.01 and the structural alignment for 28S and 18S. *Pipiza quadrimaculata* (Syrphidae: Pipizinae) was constrained as outgroup. Bootstrap support values (above) and Bayesian posterior probabilities (below) are depicted at the nodes (only >50 or >0.5, respectively). BS = Bootstrap support values; PP = Bayesian posterior probabilities.

Figs 3–22. Male genitalia of *Sphaerophoria* species. Figs 3–5. *Sphaerophoria loewii* Zetterstedt, 1843 (from Barkalov, 2012): (3) tergite 9 with cerci, dorsal view; (4) sternite 9 with aedeagus, lateral view; (5) surstylus, lateral view. Scale bars 0.4 mm. Figs 6–7. *Sphaerophoria cinctifacies* (Speiser, 1910) (from Vockeroth, 1969): (6) lateral view; (7) sternite 9, superior lobes and aedeagal base, ventral view. Figs 8–9. *Sphaerophoria novaeangliae* Johnson, 1916 (from Vockeroth, 1969): (8) lateral view; (9) sternite 9, superior lobes and aedeagal base, ventral view. Figs 10–16. Surstylus of the subgenus *Knutsonia*, lateral view (from Claußen & Mutin, 2007): (10) *S. assamensis*

Joseph, 1970; (11) *S. novaeangliae*; (12) *S. shirchan* Violovitsh, 1957; (13) *S. reginae* Claußen & Mutin, 2007; (14) *S. tuvinica* Violovitsh, 1966; (15) *S. viridaenea* Brunetti, 1915; (16) *S. angulata* Claussen & Weipert, 2003. Figs 17–18. *Sphaerophoria scripta* (Linnaeus, 1758) (from Vockeroth, 1969): (17) lateral view; (18) sternite 9, superior lobes and aedeagal base, ventral view. Figs 19–22. *Sphaerophoria rueppellii* (Wiedemann, 1830) (from Barkalov, 2012): (19) tergite 9 with cerci, dorsal view; (20) surstyli, ventral view; (21) surstylus, lateral view; (22) sternite 9 with aedeagus, lateral view. Scale bars 0.4 mm.

Figs 23–30. Male genitalia of *Sphaerophoria* species. Figs 23–26. *Sphaerophoria beattiei* (van Doesburg & van Doesburg, 1976) (from van Doesburg & van Doesburg, 1976): (23) lateral view; (24) surstylus, lateral view; (25) right postgonite, lateral view; (26) tergite 9 with cerci and surstyli, dorsal view. Figs 27–28. *Sphaerophoria quadrituberculata* Bezzi, 1915 (from Vockeroth, 1973): (27) lateral view; (28) tergite 9 with cerci, dorsal view. Figs 29–30. *Sphaerophoria retrocurva* Hull, 1944 (from Vockeroth, 1973): (29) lateral view; (30) tergite 9 with cerci and surstyli, dorsal view.

Figs 31–36. Habitus and lateral view of the species of the subgenus *Loveridgeana*. Figs 31–32. *Sphaerophoria beattiei*, paratype male (ZFMK-DIP-00067296): (31) habitus, dorsal view; (32) lateral view. Figs 33–34. *Sphaerophoria quadrituberculata*, male (ZFMK-DIP-00067295): (33) habitus, dorsal view; (34) lateral view. Figs 35–36. *Sphaerophoria retrocurva*, male (ZFMK-DIP-00067294): (35) habitus, dorsal view; (36) lateral view. Scale bars 1 mm.

Supporting Information

Supplement 1. Nexus file with the alignment of the three genes (mitochondrial COI, and nuclear 28S and 18S rRNA genes) for the first analysis with 112 taxa.

Supplement 2. Nexus file with the alignment of the three genes (mitochondrial COI, and nuclear 28S and 18S rRNA genes) for the first analysis with 88 taxa.

Supplement 2. Excel file with the percentage identity of the three genes (mitochondrial COI, and nuclear 28S and 18S rRNA genes) for the members of the *Sphaerophoria* lineage.

Table 1. Taxon sampling used in the molecular analysis, including GenBank accession numbers. All GenBank accession numbers starting with MT denote new sequences used for the first time in the present study.

Taxon	Lab code	Label information	Accession no COI	Accession no 28S	Accession no 18S
ERISTALINAE					
<i>Graptomyza longirostris</i> Wiedemann, 1820	ZFMK_D007	REP. SINGAPORE: Dairy Farm N.P., 02.v.2012. Leg.: V. Gowda. Det.: X. Mengual.	KM270878	KM270847	KM270816
<i>Merodon equestris</i> (Fabricius, 1794)	MZH_Y690	FINLAND: N, Askola, 12.i.2007. Leg.: G. Ståhls. Det.: Ståhls.	EU431486	EU431455	EU431523
<i>Myolepta dubia</i> (Fabricius, 1805)	ZFMK_D012	GERMANY: Nordrhein-Westfalen, NP Eifel, FO: 7757, R 2532921, H 5613552. Odenbachtal-Felskuppen, 320 m., 24.vi–08.vii.2010, Malaise trap. Leg.: J. Esser. Det. A. Ssymank.	KM270877	KM270846	KM270815
PIPIZINAE					
<i>Neocnemodon larusi</i> (Vujić, 1999)	MZH_Y473	FINLAND: Ab, Karjalohja, Karkalinniemi, 66.81°N 24.8°E, 10.v.2006. Leg.: G. Ståhls. Det.: G. Ståhls.	EU431504	EU431472	EU431560
<i>Neocnemodon vitripennis</i> (Meigen, 1822)	MZH_Y211	FINLAND: N, Sibbo, Hindsby, 26.v.2004. Leg.: G. Ståhls. Det.: G. Ståhls.	EU431503	KM270845	EU431559
<i>Pipiza quadrimaculata</i> (Panzer, 1804)	ZFMK_XP218	FINLAND: Ka, Joutseno, Riikanmaa. KKJ-Y coord.: 3591:6777, 05.vii.2007. Leg.: M.P. van Zuijen & W. & J. van Steenis. Det.: G. Ståhls.	EU431506	EU431474	EU431562
<i>Pipizella viduata</i> (Linnaeus, 1758)	MZH_XP121	SWEDEN: Ha, Veinge motor-banan. RN 62718 13327, 17.viii.2006. Leg.: N. Ryrholm. Det.: G. Ståhls.	EU431507	EU431475	EU431563
SYRPHINAE					
<i>Allobaccha sapphirina</i> (Wiedemann, 1830)	MZH_S87	THAILAND: Chiang Mae, iv.2001. Leg.: D. Quicke & N. Laurenne. Det.: F.C. Thompson.	EF127349	EF127430	EU409230

<i>Allobaccha</i> sp.1	ZFMK_XM141	VIETNAM: PN Tam Dao, Malaise trap, 15–23.vi.2011. Leg.: S.W. Lingafelter. Det.: X. Mengual.	KM270848	KM270817	KM270764
<i>Allobaccha</i> sp.2	ZFMK_XM228	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Kiulu (bamboo forest), 570 m., 5°52'34"N 116°15'00"E, malaise, 18–24.x.2011. Leg.: S. Gaimari & M. Hauser. Det.: X. Mengual.	KM270849	KM270818	KM270765
<i>Allobaccha</i> sp.3	MZH_S150	TANZANIA: Amani Hills, 2001. Det.: G. Ståhls.	EF127347	EF127428	KM270766
<i>Allobaccha</i> sp.4	MZH_XP177	EAST TIMOR: Maliana, road verge in town. 8°58'51"S 125°13'08"E, 200 m., 11.xii.2005. Leg.: M.P. van Zuijen. Det.: X. Mengual.	EU409120	EU409175	EU409229
<i>Allograpta calopus</i> (Loew, 1858)	ZFMK_D178	SOUTH AFRICA: KwaZulu-Natal, Pitermaritzburg, Kwela Lodge, 29°29'36.5"S 30°21'40.3"E, 905m., 13.xii.2012. Leg. S. Rojo et al. Det.: X. Mengual.	MT449477	MT449512	MT449543
<i>Allograpta exotica</i> (Wiedemann, 1830)	ZFMK_XP193	VENEZUELA: Miranda State, San Antonio de los Altos, IVIC, Centro de Ecología. 1680–1690 m., 22.i.2007, 10° 24.069'N 066° 58.667'W. Leg.: G. Ståhls. Det.: X. Mengual.	EU241708	EU241756	EU241804
<i>Allograpta falcata</i> Fluke, 1942	ZFMK_XP61	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 15.ii.2006, 2175 m. Leg.: X. Mengual. Det.: X. Mengual.	EU241710	EU241758	EU241807
<i>Allograpta falcata</i> Fluke, 1942	ZFMK_XP63	COLOMBIA. Dpt. Caldas, Villamaría, Via La Esperanza, km 8, 2530 m., 19.ii.2006. Leg.: X. Mengual. Det.: X. Mengual.	EU241709	EU241757	EU241805
<i>Allograpta fuscotibialis</i> (Macquart, 1842)	ZFMK_D196	SOUTH AFRICA: KwaZulu Natal, Karkloof, near Benvie farm, 10.i.2015, 29°15'36.8"S 30°21'08"E, 1392 m. Leg.: M. Reemer & K.-D.B. Dijkstra. Det.: X. Mengual.	MT449478	MT449513	MT449544
<i>Allograpta fuscotibialis</i> (Macquart, 1842)	ZFMK_D198	SOUTH AFRICA: KwaZulu Natal, Royal Natal National Park, Fairy Glen, 13.i.2015, 28°40'52"S 28°56'28"E, 1560 m. Leg.: M. Reemer & K.-D.B. Dijkstra. Det.: X.	MT449479	MT449514	MT449545

		Mengual.			
<i>Allograpta jacqi</i> Mengual & Ramage, 2018	ZFMK_JH13	FRENCH POLYNESIA: Tahiti Island, Mont Marau, 1400 m., 17°36'44.02"S 149°31'51.10"W, 27.viii.2017. Leg.: T. Ramage & F. Jacq. Det.: X. Mengual.	MH282896	MH282901	—
<i>Allograpta kinabalensis</i> (Curran, 1931)	ZFMK_XM124	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Kipandi Butterfly Park, 720 m., 5°52'20"N 116°14'53"E, 15.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	MT449480	MT449515	MT449546
<i>Allograpta medanensis</i> (Meijere, 1914)	ZFMK_XM122	MALAYSIA, Sabah (Borneo), Penampang Distr., Crocker Range, Ulu Kalanggan, Dipterocarp tree, 5°51'23"N 116°18'29"E, 1350 m., 20.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	MT449481	MT449516	MT449547
<i>Allograpta nasuta</i> (Macquart, 1842)	ZFMK_D231	SOUTH AFRICA: Kwazulu-Natal, Howick, Mandela Capture Site, cafeteria, 1153 m., 29°27'49.4"S 30°10'20.9"E, 18.x.2015. Leg. X. Mengual. Det.: X. Mengual.	MT449482	MT449517	MT449548
<i>Allograpta neotropica</i> Curran, 1936	ZFMK_XP59	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 2175 m., 15.ii.2006. Leg.: X. Mengual. Det.: X. Mengual.	EU241733	EU241780	EU241831
<i>Allograpta neotropica</i> Curran, 1936	ZFMK_XP62	COLOMBIA: Dpt. Valle del Cauca, Cali, km18, Cerro San Antonio, 2175 m., radiotowers, 24.ii.2006, 03°29.377'N 76°33.495'W. Leg.: X. Mengual. Det.: X. Mengual.	EU241734	EU241781	EU241832
<i>Allograpta nigripilosa</i> (Hull, 1944)	ZFMK_D285	FRENCH POLYNESIA: Society Islands, Raiatea, Opoa, Aratao, 2015. Leg.: F. Jacq. Det.: X. Mengual.	MF446518	MF446468	MF446423
<i>Allograpta obliqua</i> (Say, 1823)	Jeff Skevington Specimen30066	CANADA: Ontario, Ottawa, Fletcher Wildlife Garden, 45°23'9.32"N 75°42'19.01"W, 18.vii.2013. Leg.: M.M. Locke & J.H. Skevington. JSM4951	MT257042 MT257043	MT256943	MT256934
<i>Allograpta obliqua</i> (Say, 1823)	ZFMK_XP64	COLOMBIA: Dpt. Valle del Cauca, Cali,	EU241711	EU241759	EU241808

		Corrg. Los Andes, Pichindé, El Faro, 1700 m., 15.ii.2006. Leg.: X. Mengual. Det.: X. Mengual.			
<i>Allograpta teligera</i> Fluke, 1942	ZFMK_XP149	COSTA RICA: PN Tapantí, Estación “La Esperanza”, 2600 m., 13.i.2005. Det. F.C. Thompson.	EU241712	EU241760	EU241809
<i>Antillus ascitus</i> Vockeroth, 1969	ZFMK_XP33	DOMINICAN REPUBLIC: Pedernales Prov., PN Sierra de Bahoruco, Las Abejas. 18°09.011'N 71°37.342'W, 1150 m., 18.vi.2005. Leg.: N.E. Woodley. Det.: F.C. Thompson.	EU241713	EU241761	EU241810
<i>Argentinomyia longicornis</i> (Walker, 1836)	ZFMK_XP95	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 2175 m., 15.ii.2006. Leg.: X. Mengual. Det.: X. Mengual.	KM270850	KM270819	KM270767
<i>Asarkina ericetorum</i> (Fabricius, 1781)	MZH_S222	KENYA: Kakamega forest, 5.xii.1995, 0°17.13'N 34°56.32'E. Leg.: Earthwatch Team 6. Det.: G. Ståhls.	EF127353	EF127434	EU241837
<i>Asarkina fulva</i> Hull, 1941	ZFMK_XP100	MADAGASCAR: Fianarantsoa Prov., Ranomafana N.P., Talatakely region, 22.xi.2004. Leg.: X. Mengual. Det.: X. Mengual.	EU241738	EU241785	EU24183
<i>Asarkina</i> sp.1	ZFMK_XM218	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Kipandi Butterfly Park, 720 m., 5°52'20"N 116°14'53"E, 14–24.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270851	KM270820	KM270768
<i>Asarkina</i> sp.2	ZFMK_XM126	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Kipandi Butterfly Park, 720 m., 05°52'20"N 116°14'53"E, 15.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270852	KM270821	KM270769
<i>Asarkina</i> sp.3	ZFMK_XP99	MADAGASCAR: Fianarantsoa Prov., Ranomafana N.P., Talatakely region, 27.xi.2004. Leg.: X. Mengual. Det.: X. Mengual.	EU241739	EU241786	EU241839

<i>Asiobaccha marissae</i> Mengual, 2016	ZFMK_XM127	INDONESIA: SE Sulawesi, North Kolaka, Mekongga Mt., nr Tinukari, 1000 m., 03°38'23.244" S 121°08'56.76" E, 30.ix.2010. Leg.: R.B. Kimsey. Det.: X. Mengual.	KM270854	KM270823	KM270771
<i>Asiobaccha notofasciata</i> Thompson & Mengual, 2016	Jeff Skevington Specimen20512	AUSTRALIA: Sanford Valley, Cedar Creek, 15.iv.2000. Leg.: M. Mathieson, J. & A. Skevington. Det.: X. Mengual, JSM218.	KM270853	KM270822	KM270770
<i>Asiobaccha virtuosa</i> (Curran, 1928)	ZFMK_XM224	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Gunung Alab, 1660 m., 5°48'47"N 116°20'16"E, 14.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270855	KM270824	KM270772
<i>Baccha elongata</i> (Fabricius, 1775)	MZH_Y242	FINLAND: Ta, Vesijako, vii.2004, malaise trap. Leg.: J. Jakovlev. Det.: G. Ståhls.	EF127326	EF127407	EU431540
<i>Baccha maculata</i> Walker, 1852	ZFMK_XM121	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Ulu Kalanggan, Dipterocarp tree, 5°51'23"N 116°18'29"E, 1350 m., 20.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270856	KM270825	KM270773
<i>Chrysotoxum cautum</i> (Harris, 1778)	MZH_XP166	GREECE: Lesvos Island, Agiasos, 08.v.2007. Leg.: G. Ståhls. Det.: G. Ståhls.	KM270857	KM270826	KM270774
<i>Chrysotoxum intermedium</i> (Meigen, 1822)	ZFMK_XP154	SPAIN: Alicante, Ibi, E.B. Torretes, 18.v.2007. Leg.: X. Mengual. Det.: X. Mengual.	EU431498	EU431466	EU431541
<i>Citrogramma currani</i> Ghorpadé, 2012	ZFMK_XM128	VIETNAM: Cao Bang Prov., Phia Oac Mt. road, 1422 m., 22°33.972'N 105°52.238'E, general daytime collecting, 24.v–5.vi.2011. Leg.: S. Lingafelter, E. Jendek, E. Vives, P. Hong Thai. Det.: X. Mengual.	KM270858	—	—
<i>Citrogramma fascipleurum</i> (Curran, 1931)	ZFMK_XM120	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Long Gong Kugan, 1630 m., 5°49'44"N 116°19'37"E, 22.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270859	KM270827	KM270775
<i>Claraplumula latifacies</i> Shannon, 1927	ZFMK_XM139	COLOMBIA: Antioquia, Belmira, Paramo Belmira, 3241 m., Jana arbusto, 06°38'43.9"S	KM270860	KM270828	KM270776

		75°40'10"W, 8.i.2011. Leg.: A.L. Montoya. Det.: F.C. Thompson.			
<i>Dasysyrphus albostratus</i> (Fallén, 1817)	MZH_S565	THE NETHERLANDS: Leiden, Meijendel dune area, 5.ix.2005. Leg.: excursion participants. Det.: G. Ståhls.	EF127323	EF127402	EU431542
<i>Dasysyrphus lenensis</i> Bagatshanova, 1980	ZFMK_D006	GERMANY: Nordrhein-Westfalen, NP Eifel. TK: 5403, R 2521143, H 5596510. Döppeskaul 2009, Malaise-Falle, Bachtal, Nebenbach des Fuhrtsbachtals, FFH DE-5403-301, 18.v–01.vi.2009. Leg.: J. Esser. Det.: A. Ssymank.	KM270861	KM270829	KM270777
<i>Didea intermedia</i> Loew, 1854	MZH_S90	FINLAND. Det.: G. Ståhls.	EF127336	EF127418	EU431543
<i>Dideoides coquilletti</i> (van der Goot, 1964)	MZH_XP8	SOUTH KOREA: Gangweon-do, Weonju-si, Maeji-ri, Yonsei Univ. Campus, 4.x.1999. Leg.: C.H. Park. Det.: H.Y. Han & D.S. Choi.	EF127293	EF127373	KM270778
<i>Dideopsis aegrota</i> (Fabricius, 1805)	ZFMK_XM225	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Kipandi Butterfly Park, 720 m., 5°52'20"N 116°14'53"E, 15.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270862	KM270830	KM270779
<i>Dioprosopa clavata</i> (Fabricius, 1794)	ZFMK_XP116	MEXICO: Villa de Álvarez, Crta. Minatitlán, Colonia Burócratas, 23.viii.2006. Leg.: X. Mengual. Det.: X. Mengual.	KM270873	KM270841	KM270807
<i>Eosalpingogaster conopida</i> (Philippi, 1865)	ZFMK_Y214	CHILE: Region IV, Limari prov., Fundo Agua Amarilla, 7 km N Los Vilos, malaise in stable dunes, 58 m., 31°50.96'S, 71°29.60'W, 28.xii.2003–8.i.2004. Leg.: M.E. Irwin. Det.: F.C. Thompson.	EF127359	EF127440	EU241850
<i>Eosalpingogaster umbra</i> Mengual & Thompson, 2011	MZH_Y1035	VENEZUELA: Lara, P.N. Cerro Saroche, Sector Batatal, 700 m., 15–19.vii.2008, trampa amarilla. Leg.: E. Arcaya. Det.: X. Mengual.	HQ845759	HQ845762	HQ845767
<i>Eosphaerophoria marginata</i> Frey, 1946	ZFMK_D066	VIET NAM: Pia-Oac Mt. NR (Malaise Trap) 22°36'N 105°53'E, 04–06.viii.2010. Leg.: J. Constant & P. Limbourg I.G.31.668. Det.: X.	MT449483	MT449518	MT449549

		Mengual.			
<i>Epistrophe nitidicollis</i> (Meigen, 1822)	MZH_S61	FINLAND: Liesjärvi, 11.vi.2000. Leg.: G. Ståhls. Det.: G. Ståhls.	EF127325	EF127406	KM270780
<i>Epistrophella euchroma</i> (Kowarz, 1885)	MZH_S559	CZECH REPUBLIC: Bohemia, PLA distr., Chrudim Hermanuv mestec, park, 3.vi.2005. Leg.: L. Mazánek. Det.: L. Mazánek.	EF127315	EF501964	KM270781
<i>Episyrphus balteatus</i> (De Geer, 1776)	ZFMK_XP153	SPAIN: Alicante, P.N. Marjal Pego-Oliva, Muntanyeta Verda, 19.v.2007. Leg.: X. Mengual. Det.: X. Mengual.	EU241740	EU241788	EU241840
<i>Episyrphus divertens</i> (Walker, 1856)	ZFMK_XM123	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Kipandi Butterfly Park, 720 m., 05°52'20"N 116°14'53"E, 15.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270863	KM270831	KM270782
<i>Episyrphus nectarinus</i> (Wiedemann, 1830)	ZFMK_XM227	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Gunung Alab, 1660 m., 14.x.2011, 5°48'47"N 116°20'16"E. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270865	KM270833	KM270784
<i>Episyrphus obligatus</i> (Curran, 1931)	ZFMK_XM140	VIETNAM: Cao Bang Prov., Phia Oac, near Phja-Den, 22°32.4'N 105°52.0'E, 948 m., canopy Malaise trap, 26.v–6.vi.2011. Leg.: S. Lingafelter. Det.: X. Mengual.	KM270864	KM270832	KM270783
<i>Episyrphus stuckenbergi</i> (Doesburg, 1957)	ZFMK_XP52	MADAGASCAR: Fianarantsoa Prov., road from Valbio to Ranomafana city, 22.xi.2004. Leg.: X. Mengual. Det.: X. Mengual.	EF127319	EF127398	EU241841
<i>Episyrphus viridaureus</i> (Wiedemann, 1824)	ZFMK_XM119	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Long Gong Kugan, 1630 m., 5°49'44"N 116°19'37"E, 22.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270866	KM270834	KM270785
<i>Episyrphus viridaureus</i> (Wiedemann, 1824)	ZFMK_XM125	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Long Gong Kugan, 1630 m., 5°49'44"N 116°19'37"E, 22.x.2011. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270867	KM270835	KM270786

<i>Episyrphus viridaureus</i> (Wiedemann, 1824)	ZFMK_XP173	EAST TIMOR: Maliana, road verge in town, 08°58'51"S 125°13'08"E, 200 m., 11.xii.2005. Leg.: M.P. van Zuijen. Det.: X. Mengual.	EU241741	EU241789	EU241842
<i>Eriozona syrphoides</i> (Fallén, 1817)	MZH_Y184	RUSSIA: Gornyi Altai, Turotshakskii r-kordon obogo, 950 m, 30.vi.2003. Leg. Krolatscheva. Det.: G. Ståhls.	EF127358	EF127439	EU431544
<i>Eupeodes (Eupeodes) corollae</i> (Fabricius, 1794)	ZFMK_XP141	SPAIN: Alicante, Aspe, Partida Tolomó, 07.ii.2006. Leg.: P. Hurtado. Det.: X. Mengual.	EU431499	EU431467	EU431546
<i>Eupeodes (Eupeodes) volucris</i> Osten Sacken, 1877	ZFMK_XP43	USA: NE, Cass Co., Louisville Platte River Sp., 19.v.2005. Leg. W. van Steenis. Det. W. van Steenis.	KM270868	KM270836	KM270787
<i>Eupeodes (Macrosyrphus) confrater</i> (Wiedemann, 1830)	MZH_Y101	SOUTH KOREA: Gyeongsangbuk-do, Yeongju Sunheung-myeon, 8.vi.2002. Leg.: D.S. Choi. Det.: G. Ståhls.	EF127355	EF127436	KM270788
<i>Fagisyrphus cinctus</i> (Fallén, 1817)	MZH_S558	CZECH REPUBLIC: Bohemia, PLA Kokorinsko, Vojtechov, 14.v.2005. Leg.: L. Mazánek. Det.: L. Mazánek.	KM270869	KM270837	KM270789
<i>Fazia</i> aff. <i>centropogonis</i> [CR-5 Thompson, in litt.]	ZFMK_XP205	COSTA RICA: San José province, Cerro de la Muerte, La Cañón near Génesis II Cloudforest Reserve. 2385 m. 09°42'23"N 083°54'35.9"W. 24.iv.2007. Col.: K. Nishida. Det.: F.C. Thompson.	EU241719	EU241767	EU241817
<i>Fazia</i> aff. <i>forreri</i> [75-8 Thompson, in litt.]	ZFMK_XM220	COSTA RICA: San José Prov., San Gerardo de Dota, 2200–2600 m., 6.viii.2010. Leg.: G. Ståhls. Det.: X. Mengual.	MT449484	MT449519	MT449550
<i>Fazia</i> aff. <i>micrura</i> [CR-B Thompson, in litt.]	ZFMK_XP81	COSTA RICA: PN Tapantí. Estación “La Esperanza”, 13.i.2005, 2800 m. Det.: X. Mengual.	EU241716	EU241764	EU241813
<i>Fazia centropogonis</i> (Nishida, 2003)	ZFMK_XP151	COSTA RICA: INBio code: 3430. Det.: F.C. Thompson.	EU241715	EU241763	EU241812
<i>Fazia fasciata</i> (Curran, 1932)	MZH_S490	COSTA RICA: PN Tapanti, 1600 m., 12.i.2005. Det.: F.C. Thompson.	EF127366	EF127445	EU241806
<i>Fazia fascifrons</i> (Macquart, 1846)	MZH_XP60	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 15.ii.2006, 2200 m. Leg.:	EU241736	EU241783	EU241835

		X. Mengual. Det.: X. Mengual.			
<i>Fazia fascifrons</i> (Macquart, 1846)	ZFMK_XP69	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 15.ii.2006, 2200 m. Leg.: C. Gutiérrez. Det.: X. Mengual.	EU241737	EU241784	EU241836
<i>Fazia hians</i> (Enderlein, 1938)	ZFMK_XP56	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 15.ii.2006, 2200 m. Leg.: X. Mengual. Det.: X. Mengual.	EU241720	EU241768	EU241818
<i>Fazia hians</i> (Enderlein, 1938)	ZFMK_XP171	VENEZUELA: Aragua State, P.N. Henri Pittier, Portachuelo, 1152 m., 25.i.2007, 10°20.828'N 067°41.309'W. Leg.: X. Mengual. Det.: X. Mengual.	EU241721	EU241769	EU241819
<i>Fazia hians</i> (Enderlein, 1938)	ZFMK_XP172	VENEZUELA: Aragua State, P.N. Henri Pittier, Estación Biológica Rancho Grande, 1183 m., 25.i.2007, 10° 20.994'N 067° 41.059'W. Leg.: X. Mengual. Det.: X. Mengual.	MT449485	MT449520	MT449551
<i>Fazia imitator</i> (Curran, 1925)	ZFMK_XP57	COLOMBIA: Dpt. Caldas, Manizales, Correg. Las Palomas, Reserva Natural Río Blanco. 18.ii.2006, 2200–2500 m., 5°04'N 75°26.2'W. Leg.: X. Mengual. Det.: X. Mengual.	EU241717	EU241765	EU241814
<i>Fazia micrura</i> (Osten Sacken, 1877)	ZFMK_XP183	VENEZUELA: Aragua, P.N. Henri Pittier, Portachuelo, 1152 m., 26.i.2007, 10°20.828'N 067°41.309'W. Leg.: X. Mengual. Det.: X. Mengual.	EU241723	EU241771	EU241821
<i>Fazia nasigera</i> (Enderlein, 1938)	ZFMK_XP67	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 15.ii.2006, 2200 m. X. Mengual. Det.: X. Mengual.	EU241728	EU241775	EU241826
<i>Fazia roburoris</i> (Fluke, 1942)	ZFMK_XP181	VENEZUELA: Miranda State, San Antonio de los Altos, IVIC, 01.ii.2007, 10°24.069'N 066°58.667'W. Leg.: X. Mengual. Det.: X. Mengual.	EU241735	EU241782	EU241834
<i>Fazia rostrata</i> (Bigot, 1884)	ZFMK_XP66	COLOMBIA: Dpt. Valle del Cauca, Palmira, Correg. La Buitrera, Nirvana, 14.ii.2006, 1560–1600 m. Leg.: X. Mengual. Det.: X. Mengual.	EU241724	EU241772	EU241822

<i>Fazia</i> sp. [CR-4 Thompson, in litt.]	ZFMK_XP143	MEXICO, Veracruz, Coatepec, 28.ix.2006. Leg.: V. Vahtera. Det.: X. Mengual.	EU241726	EU241774	EU241824
<i>Fazia</i> sp. [CR-4 Thompson, in litt.]	ZFMK_XP150	COSTA RICA: INBio code: 3411. Det.: X. Mengual.	EU241725	EU241773	EU241823
<i>Fazia</i> sp. [CR-4 Thompson, in litt.]	ZFMK_XP224	MEXICO, Veracruz. Carretera Misanta, Volcán Acatlán. 05-11-2006. Leg.: V. Batear. Det.: X. Mengual.	MT449486	MT449521	MT449552
<i>Hermesomyia wulpiana</i> (Lynch Arribáizaga, 1891)	MZH_Y121	ARGENTINA: Jujuy prov., 36 km S Jujuy, Arroyo Las Lanzas; malaise trap in wooded, damp wash, 24°27.25'S 65°17.83'W, 1278 m., 27.x–14.xi.2003. Leg.: M.E. Irwin & F.D. Parker. Det.: F.C. Thompson.	EF127356	EF127437	EU241849
<i>Ischiodon scutellaris</i> (Fabricius, 1805)	MZH_S157	CHINA: Hong Kong, Park, 7.x.2001. Leg.: D. Iliff. Det.: G. Ståhls.	AY603768	EF127429	KM270790
<i>Lapposyrphus lapponicus</i> (Zetterstedt, 1838)	MZH_S65	CZECH REPUBLIC: 13.v.2000. Leg.: L. Mazánek. Det.: L. Mazánek.	DQ158897	DQ158897	KM270791
<i>Leucopodella delicatula</i> (Hull, 1943)	ZFMK_XP144	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 2200 m., 15.ii.2006. Leg.: C. Gutiérrez. Det.: X. Mengual.	KM270870	KM270838	KM270792
<i>Leucozona (Ischyrosyrphus) glaucia</i> (Linnaeus, 1758)	MZH_XP5	SPAIN: Pyrenees, Aran Valley, nr Arties, 1500 m., 1.viii.2003. Leg. G. Ståhls. Det.: G. Ståhls.	EF127292	EF127372	KM270793
<i>Leucozona (Leucozona) lucorum</i> (Linnaeus, 1758)	MZH_S139	ITALY: South Tirol, Val Venosta, vii.2001. Leg.: G. Ståhls. Det.: G. Ståhls.	EF127346	EF501965	EU431548
<i>Megasyrphus laxis</i> (Hull, 1925)	ZFMK_XP27	CANADA: AB, Jasper NP, Valley o/t Five Lakes, 52°48'N 117°98'E, 27.viii.2004. Leg. W. van Steenis. Det. W. van Steenis.	EF127302	EF127381	KM270794
<i>Melangyna (Austrosyrphus) collatus</i> (Walker, 1852)	ZFMK_XP124	AUSTRALIA: Victoria, Tarra Bulga NP, near Tarra Bulga Visitor Centre, AMG 55 462-5746, 26.i.2006. Leg.: W. van Steenis. Det.: W. van Steenis.	KM270871	KM270839	KM270795
<i>Melangyna (Melangyna) lasiophthalma</i> (Zetterstedt, 1843)	MZH_Y5	FINLAND: N, Mäntsälän Mustametsä, 10.v.2003. Leg.: G. Ståhls. Det.: G. Ståhls.	EF127361	EF501966	KM270796
<i>Melangyna (Melangyna) subfasciata</i> (Curran, 1925)	ZFMK_XP28	CANADA: Kluane, Whitehorse Airport, 60°45'N 135°05'E, 4.viii.2004. Leg.: W. van	EF127303	EF127382	KM270797

		Steenis. Det.: W. van Steenis.			
<i>Melanostoma annulipes</i> (Macquart, 1842)	MZH_XP53	MADAGASCAR: Fianarantsoa Prov., road from Valbio to Ranomafana, 25.xi.2004. Leg.: X. Mengual. Det.: X. Mengual.	EF127320	EF127399	KM270798
<i>Melanostoma scalare</i> (Fabricius, 1794)	MZH_Y441	FINLAND: Ok, Kuhmo, Lentuankoski, 15.viii.2006. Leg.: G. Ståhls. Det.: G. Ståhls.	EU431500	EU431468	EU431549
<i>Meligramma guttata</i> (Fallén, 1817)	MZH_Y478	FINLAND: Ab, Mietoinen, Perkkio, 6733:222, 21.vii.2004. Leg.: A. Haarto. Det.: G. Ståhls.	EF501960	EF501968	KM270800
<i>Meligramma triangulifera</i> (Zetterstedt, 1843)	MZH_S560	CZECH REPUBLIC: Jizerské Mountains, Rybí loucky-peat-bog, sq. 5158, 850 m, malaise trap with alcohol, 5–20.viii.2003. Leg.: Preisler. Det.: G. Ståhls.	EF127316	EF501967	KM270799
<i>Meliscaeva auricollis</i> (Meigen, 1822)	MZH_S123	GREECE: Lesbos island, iv.2001. Leg.: S. Rojo & C. Pérez. Det.: L. Mazánek.	EF127341	EF127423	EU241844
<i>Meliscaeva cinctella</i> (Zetterstedt, 1843)	MZH_S557	CZECH REPUBLIC: Bohemia, PLA Jezerske mountains, Korenov, 12.vi.2005. Leg.: L. Mazánek. Det.: L. Mazánek.	EU241743	EU241791	EU241845
<i>Meliscaeva</i> sp.	ZFMK_XM226	MALAYSIA: Sabah (Borneo), Penampang Distr., Crocker Range, Gunung Alab, 1660 m., 17.x.2011, 5°48'47"N 116°20'16"E, light. Leg.: M. Hauser & S. Gaimari. Det.: X. Mengual.	KM270872	KM270840	KM270801
<i>Ocyptamus funebris</i> Macquart, 1834	ZFMK_S487	COSTA RICA: San José, Heredia, INBioparque, 15–21.i.2005, malaise trap. Det.: F.C. Thompson.	EF127364	EF127443	EU409242
<i>Ocyptamus melanorrhinus</i> (Philippi, 1865)	MZH_Y215	CHILE: Region IV, Limari prov., Fundo Agua Amarilla, 7 km N Los Vilos, malaise in stable dunes, 28.xii.2003–8.i.2004, 58 m., 31°50.96'S 71°29.60'W. Leg.: M.E. Irwin. Det.: F.C. Thompson.	EF127360	EF127441	EU409248
<i>Orphnabaccha coerulea</i> (Williston, 1891)	ZFMK_XP89	COLOMBIA: Dpto. Cauca, Correg. El Tambo, 20 De Julio, 2900 m., 6–8.iii.2006. Leg.: C. Prieto. Det.: X. Mengual.	EU409138	EU409193	EU409254
<i>Orphnabaccha tiarella</i> (Hull, 1944)	ZFMK_XP176	VENEZUELA: Aragua, P.N. Henri Pittier,	EU241744	EU241792	EU241846

		Portachuelo, 1152 m., 26.i.2007. 10°20.828'N 067°41.309'W. Leg.: A. Martínez. Det.: X. Mengual.			
<i>Paragus (Pandasyopthalmus) haemorrhous</i> Meigen, 1822	MZH_S48	SPAIN: Alicante, 2000. Leg.: A. Vujić. Det.: A. Vujić.	AY174470	AY476866	EU409259
<i>Paragus (Paragus) bicolor</i> (Fabricius, 1794)	MZH_S108	GREECE: Lesbos island, iv.2001. Leg.: S. Rojo & C. Pérez. Det.: A. Vujić.	AY476857	AY476873	—
<i>Paragus (Paragus) pecchiolii</i> Rondani, 1857	MZH_S71	MONTENEGRO: Durmitor, 26.vi.2000. Leg.: A. Vujić. Det.: A. Vujić.	AY476844	AY476864	KM270803
<i>Paragus (Serratoparagus) crenulatus</i> Thomson, 1869	MZH_S62	MALAYSIA: Sabah, Danum Valley, viii.1999. Det.: A. Vujić.	AY476862	AY476880	KM270802
<i>Parasyrphus lineolus</i> (Zetterstedt, 1843)	MZH_S137	ITALY: South Tirol, Val Venosta, vii.2001. Leg.: G. Ståhls. Det.: L. Mazánek.	EF127342	EF127424	KM270804
<i>Platycheirus (Platycheirus) albimanus</i> (Fabricius, 1781)	MZH_E38	SWEDEN: 2000. Leg.: J. van Steenis. Det.: J. van Steenis	EF127351	EF127432	KM270805
<i>Platycheirus (Platycheirus) nielsenii</i> Vockeroth, 1990	MZH_E36	SWEDEN: 2000. Leg.: J. van Steenis. Det.: J. van Steenis	EF127352	EF127433	KM270806
<i>Rhinoprosopa aenea</i> (Hull, 1937)	ZFMK_XP145	DOMINICAN REPUBLIC: Independencia Prov., road from El Aguacate to Puerto Escondido, sitio de flores, 13.viii.2006. Leg.: D. Perez. Det.: X. Mengual.	EU241731	EU241778	EU241829
<i>Rhinoprosopa flavophylla</i> Hull, 1943	ZFMK_XM134	PERU: Cuzco, Est. Biol. Wayqecha, Trocha Oso near 2nd landslide, Malaise trap 6, WP 532, 13.1845°S 71.58459°W, 2806 m., 8–11.xii.2011. Leg.: Norrbom, Steck, Sutton & Nolzco. Det.: X. Mengual.	MT449487	MT449522	MT449553
<i>Rhinoprosopa lucifer</i> Hull, 1943	ZFMK_XP79	COSTA RICA: PN Tapantí, Site 2, 1500 m., 11.i.2005. G. Ståhls. Det.: X. Mengual.	EU241729	EU241776	EU241827
<i>Rhinoprosopa lucifer</i> Hull, 1943	ZFMK_XP147	COSTA RICA: Guanacaste Prov., Estac. Pitilla, 700m, 9 Km S. Santa Cecilia, i.1989, 85°25'40"W 10°59'26"N. Leg.: GNP Biodiversity Survey. Det.: X. Mengual.	EU241732	EU241779	EU241830
<i>Rhinoprosopa nasuta</i> (Bigot, 1884)	ZFMK_XP91	COLOMBIA: Dpt. Valle del Cauca. Palmira, Correg. La Buitrera, Nirvana, 14.ii.2006, 1440–1530 m. Leg.: X. Mengual. Det.: X.	EU241730	EU241777	EU241828

		Mengual.			
<i>Rohdendorfia alpina</i> Sack, 1938	MZH_G344	ITALY: Stelvio Pass. Leg.: G. Ståhls. Det.: G. Ståhls.	EF127338	EF127420	EU431552
<i>Salpingogaster cornuta</i> Hull, 1944	ZFMK_XP78	COLOMBIA: Dpt. Cauca, Correg. El Tambo, 20 De Julio. 2900 m., 6–8.iii.2006. Leg.: C. Prieto. Det.: X. Mengual.	EU241746	EU241794	EU241851
<i>Salpingogaster nigra</i> Schiner, 1868	ZFMK_XP77	COLOMBIA: Dpt. Meta, PNN Sumapaz, Cabaña Las Mirlas, 710 m., 3°48'N 73°52'W, 29.v–19.vi.2004. Leg.: H. Vargas. Det.: X. Mengual.	EU241748	EU241796	EU241853
<i>Salpingogaster pygophora</i> Schiner, 1868	ZFMK_XP169	VENEZUELA: Aragua State, P.N. Henri Pittier, Portachuelo, 1152 m., 10°20.828'N 067°41.309'W, 26.i.2007. Leg.: G. Ståhls. Det.: X. Mengual.	EU241749	EU241797	EU241854
<i>Scaeva (Scaeva) pyrastris</i> (Linnaeus, 1758)	ZFMK_D009	GERMANY: Nordrhein-Westfalen, Watchberg/Bonn, Oberbachem, Werthovener Weg., FO: 7891 D, TK: 530842, 138 m, 27.vii.2012. Leg. A. Ssymank. Det. A. Ssymank.	KM270874	KM270842	KM270809
<i>Scaeva (Semiscaeva) selenitica</i> (Meigen, 1822)	MZH_S69	CZECH REPUBLIC: Distr. Ostrava, Polanecký les, 3.iv.2000. Leg.: T. Kuras. Det.: L. Mazánek.	AY603764	EF127404	KM270808
<i>Simosyrphus grandicornis</i> (Macquart, 1842)	ZFMK_XP125	AUSTRALIA: Victoria, Mt. Buffalo NP, Dicksons Falls, AMG 55 481-5929, 1440 m., 29.i.2006. Leg.: W. van Steenis. Det.: W. van Steenis.	KM270875	KM270843	KM270810
<i>Spazigaster ambulans</i> (Fabricius, 1798)	MZH_S158	AUSTRIA: Imst. Leg.: J. van Steenis. Det.: J. van Steenis.	EF127350	EF127431	KM270811
<i>Sphaerophoria (Exallandra) cinctifacies</i> (Speiser, 1910)	ZFMK_XP148	KENYA: Aberdares Nat. Park, 31.xii–14.i.2006, malaise trap. Det.: F.C. Thompson.	EU241742	EU241790	EU241843
<i>Sphaerophoria (Exallandra) loewi</i> Zetterstedt, 1843	MZH_S273	SWEDEN: Upplands-Bro, 15.vi.2002. Leg.: H. Bartsch. Det.: G. Ståhls.	EF127318	EF127396	EU241856
<i>Sphaerophoria (Knutsonia) novaeangliae</i> Johnson, 1916	CNC1054980	CANADA: Quebec, Summit of Mount Rigaud, hilltopping, 45°27'59"N 74°19'35"W, 8.vi.2018. Leg.: J.H., A.W. & A.M.	MT257044 MT257045	MT256944	MT256935

		Skevington, A.D. Young, K.M. Moran, M. Morales, M. Reemer. JSM11325.			
<i>Sphaerophoria (Knutsonia) shirchan</i> Violovitsh, 1957	ZFMK_D153	RUSSIA: Khabarovsk Krai, Tumnin, Tumninsky Rodnik sanatorium, hilltop, 847 m, 49°40'04"N 139°58'42"E, 15.vi.2013. Leg.: X. Mengual. Det.: X. Mengual.	MT449488	MT449523	MT449554
<i>Sphaerophoria (Knutsonia) tuvinica</i> Violovitsh, 1966	ZFMK_D158	RUSSIA: Khabarovsk Krai, Tumnin, Tumnin river bank, 60 m., 49°38'49"N 140°04'58"E, 15.vi.2013. Leg.: X. Mengual. Det.: X. Mengual.	MT449489	MT449524	MT449555
<i>Sphaerophoria (Loveridgeana) aff. retrocurva</i>	ZFMK_D225	SOUTH AFRICA: Western Cape, Kogelberg Nature Reserve, small river, 185 m., 34°19'57.3"S 18°57'02.6"E, 25.x.2015. Leg. X. Mengual. Det.: X. Mengual.	MT449490	MT449525	MT449556
<i>Sphaerophoria (Loveridgeana) beattiei</i> (van Doesburg & van Doesburg, 1976)	ZFMK_D370	SAINT HELENA Diana's Peak, 818 m., 15°57'35"S 05°41'29"W, 20.ii.2018. Leg.: N. Stevens & S. Isaac. Det.: X. Mengual.	MT449491	MT449526	MT449557
<i>Sphaerophoria (Loveridgeana) quadrituberculata</i> Bezzi, 1915	ZFMK_D230	SOUTH AFRICA: Western Cape, Kogelberg Nature Reserve, small river, 185 m., 34°19'57.3"S 18°57'02.6"E, 25.x.2015. Leg. X. Mengual. Det.: X. Mengual.	MT449492	MT449527	MT449558
<i>Sphaerophoria (Loveridgeana) retrocurva</i> Hull, 1944	ZFMK_D069	SOUTH AFRICA: KwaZulu-Natal Prov., Cathedral Peak NP, 7.xii.2012. Leg.: G. Ståhls. Det.: X. Mengual.	MT449494	MT449529	MT449560
<i>Sphaerophoria (Loveridgeana) retrocurva</i> Hull, 1944	ZFMK_D071	SOUTH AFRICA: KwaZulu- Natal Prov., Royal Natal N.P., George Car Park, 1530 m., 28°42'48.5"S 28°56'06.0"E, 03.xii.2012. Leg.: A. Ssymank. Det.: A. Ssymank	MT449495	MT449530	MT449561
<i>Sphaerophoria (Loveridgeana) retrocurva</i> Hull, 1944	ZFMK_D176	SOUTH AFRICA: KwaZulu Natal, Royal Natal NP, Thendele, 28°42'28.6"S 28°56'03.3"E, 1621 m., Afromontane forest, 12–16.i.2015, malaise trap. Leg.: M. Reemer & K.-D.B. Dijkstra. Det.: X. Mengual.	MT449493	MT449528	MT449559
<i>Sphaerophoria (Sphaerophoria) asymmetrica</i> Knutson, 1972	ZFMK_D150	CANADA: ON, Ottawa, Fletcher Wildlife Garden, 45°23'09.3"N 075°42'19"W,	MT449497	MT449532	MT449563

		18.vii.2013. Leg.: X. Mengual. Det.: X. Mengual.			
<i>Sphaerophoria (Sphaerophoria) asymmetrica</i> Knutson, 1972	ZFMK_XP221	CANADA: QC, Montérégie, Huntingdon, 5 km WSW, Forêt de Muir, 50 m., 45°05'11"N 74°06'35"W, 14.viii.2007. Leg. W. van Steenis. Det.: W. van Steenis.	MT449496	MT449531	MT449562
<i>Sphaerophoria (Sphaerophoria) bengalensis</i> Macquart, 1842	ZFMK_D376	CYPRUS: Larnaca, Larnaca, near Hala Sultan Tekke, creek, 34°53'10.37"N 33°36'30.74"E, 5 m., 03.x.2017. Leg.: X. Mengual. Det.: X. Mengual.	MT449498	MT449533	MT449564
<i>Sphaerophoria (Sphaerophoria) contigua</i> Macquart, 1847	ZFMK_XP97	U.S.A.: MO, Barry Co., Cassville, 7 mi. S Rouring River SP, 12.iv.2004. Leg.: J. & W. van Steenis. Det. W. van Steenis.	EU241750	EU241798	EU241855
<i>Sphaerophoria (Sphaerophoria) indiana</i> Bigot, 1884	ZFMK_D142	RUSSIA: Novosibirsk, Sosnovka resort Hotel, 120–157 m., 54°47'25"N 083°06'19"E, 20.vi.2013. Leg.: X. Mengual. Det.: X. Mengual.	MT449499	MT449534	MT449565
<i>Sphaerophoria (Sphaerophoria) indiana</i> Bigot, 1884	ZFMK_D145	RUSSIA: Khabarovsk Krai, Khabarovsk, Sita river, 75 m., 48°06'09.5"N 135°30'02.2"E, 18.vi.2013. Leg.: X. Mengual. Det.: X. Mengual	MT449500	MT449535	MT449566
<i>Sphaerophoria (Sphaerophoria) interrupta</i> (Fabricius, 1805)	ZFMK_D197	GERMANY: Monschau, Höfen, NSG Perlenbach-Fuhrtsbachtal-Talsystem / Nationalpark Eifel, 50°30'N 6°16'E, 570 m., netting, 11.v.2015. Leg. X. Mengual. Det.: X. Mengual.	MT449501	MT449536	MT449567
<i>Sphaerophoria (Sphaerophoria) kaa</i> Violovitsh, 1960	ZFMK_D156	RUSSIA: Khabarovsk Krai, Tumnin, Tumnin river bank, 60 m., 49°38'49"N 140°04'58"E, 15.vi.2013. Leg.: X. Mengual. Det.: X. Mengual.	MT449502	MT449537	MT449568
<i>Sphaerophoria (Sphaerophoria) macrogaster</i> (Thomson, 1869)	ZFMK_D144	RUSSIA: Khabarovsk Krai, road from Komsomolsk-na-Amure to Khabarovsk, 49°21'01"N 136°32'45"E, 33 m., 17.vi.2013. Leg.: X. Mengual. Det.: X. Mengual	MT449503	MT449538	MT449569
<i>Sphaerophoria (Sphaerophoria)</i>	MZH Y1583	PORTUGAL: Azores, Terceira island,	MT449504	MT449539	MT449570

<i>nigra</i> Frey, 1945		28.viii.2011.Leg.: G. Ståhls. Det.: G. Ståhls.			
<i>Sphaerophoria (Sphaerophoria) philantha</i> (Meigen, 1822)	ZFMK_XP41	CANADA: AB, Jasper NP. Valley o/t Five Lakes, 52°48'N 117°98'E, 27.viii.2004. Leg. W. van Steenis. Det. W. van Steenis.	EU241751	—	EU241858
<i>Sphaerophoria (Sphaerophoria) rueppellii</i> (Wiedemann, 1830)	MZH_S12	SPAIN: Alicante, 1999. Leg.: S. Rojo. Det.: S. Rojo.	EF127328	EF127409	EU241859
<i>Sphaerophoria (Sphaerophoria) scripta</i> (Linnaeus, 1758)	ZFMK_D143	RUSSIA: Novosibirsk, Sosnovka resort Hotel, 120–157 m., 54°47'25"N 083°06'19"E, 20.vi.2013. Leg.: X. Mengual. Det.: X. Mengual	MT449505	MT449540	MT449571
<i>Sphaerophoria (Sphaerophoria) scripta</i> (Linnaeus, 1758)	ZFMK_XP142	SPAIN: Alicante, Aspe. Partida Tolomó, 07.ii.2006. Leg.: P. Hurtado. Det.: X. Mengual.	EU241752	EU241800	EU241860
<i>Sphaerophoria (Sphaerophoria) sulphuripes</i> (Thomson, 1869)	ZFMK_XP215	U.S.A.: CA, Marin Co., Point Reyes Ntl., Seashore, Fern canyon trail, 25 m., 37°55'45"N 122°44'30"W, 01.viii.2007. Leg. W. van Steenis. Det.: W. van Steenis.	MT449506	MT449541	MT449572
<i>Sphaerophoria (Sphaerophoria) taeniata</i> (Meigen, 1822)	ZFMK_D154	RUSSIA: Khabarovsk Krai, Tumnin, Tumninsky Rodnik sanatorium, hilltop, 847 m., 49°40'04"N 139°58'42"E, 14.vi.2013. Leg.: X. Mengual. Det.: X. Mengual	MT449507	MT449542	MT449573
<i>Syrphocheilosia claviventris</i> (Strobl, 1910)	MZH_G327	ITALY: South Tirol, Stelvio Pass, 28.vii.1999. Leg.: G. Ståhls. Det.: G. Ståhls.	EF127334	EF127415	KM270812
<i>Syrphus shorae</i> Fluke, 1950	ZFMK_XP158	VENEZUELA: Aragua State, P.N. Henri Pittier, Portachuelo, 1152 m., 10°20.828'N 067°41.309'W, 26.i.2007. Leg.: X. Mengual. Det.: X. Mengual.	EU409136	EU409191	EU409252
<i>Syrphus vitripennis</i> Meigen, 1822	MZH_S53	GREECE: Lesbos island, iv.2001. Leg.: S. Rojo & C. Perez. Det.: S. Rojo.	AY212797	AY261728	EU431554
<i>Tiquicia zumbadoi</i> (Thompson, 2003)	ZFMK_XP203	COSTA RICA: San José Prov., Parque Nacional Chirripó, Llano Bonito, refugio, 2550 m., near <i>Centropogonis ferrugineus</i> plants, 09°27'08"N 083°32'20"W, 20.iv.2005. Leg.: K. Nishida. Det.: F.C. Thompson.	EU241714	EU241762	EU241811
<i>Toxomerus apeiensis</i> (Harbach,	MZH_XP184	SURINAME: Distr. Brokopondo,	EU409144	EU409199	EU409261

1974)		Brownsberg National Park. Mazaroni Trail. 04°56'45"N 55°10'59"W, 04.iii.2006. Leg.: M. Reemer. Det.: M. Reemer.			
<i>Toxomerus politus</i> (Say, 1823)	ZFMK_XP82	COSTA RICA: PN Tapantí, 1600 m., 12.i.2005. Leg.: X. Mengual. Det.: F.C. Thompson.	EU241755	EU241803	EU241863
<i>Toxomerus watsoni</i> (Curran, 1930)	ZFMK_XP188	SURINAME: Distr. Para, Colareek (nr. Zanderij), 05°27'58"N 55°13'47"W, 23.iii.2006. Leg.: M. Reemer. Det.: M. Reemer.	EU409174	EU409228	EU409292
<i>Xanthandrus plaumanni</i> Fluke, 1937	ZFMK_XP98	COLOMBIA: Dpt. Valle del Cauca, Cali, Cerro San Antonio, 2200 m., 03°29.137'N 76°33.596'W, 24.ii.2006. Leg.: X. Mengual. Det.: X. Mengual.	KM270876	KM270844	KM270813
<i>Xanthogramma flavipes</i> (Loew, 1863)	ZFMK_XP31	U.S.A.: NE, Cass Co., Louisville, Platte River SP, 19.v.2005. Leg. W. van Steenis. Det. W. van Steenis.	EF127306	EF127385	KM270814
<i>Xanthogramma pedissequum</i> (Harris, 1776)	MZH_S120	GREECE: Lesbos island, iv.2001. Leg.: S. Rojo & C. Pérez. Det.: S. Rojo.	EF127339	EF127421	EU431557

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