European Journal of Taxonomy 448: 1–37
https://doi.org/10.5852/ejt.2018.448

ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2018 · Ramage T. *et al.*

Research article

urn:lsid:zoobank.org:pub:413AE92E-862A-4879-B72F-1C0DCF1F7240

Flower flies (Diptera, Syrphidae) of French Polynesia, with the description of two new species

Thibault RAMAGE [1], Sylvain CHARLAT [2] & Ximo MENGUAL [3,*]

[1] 9 Quartier de la Glacière, 29900 Concarneau, France.
[2] Laboratoire de Biométrie et Biologie Evolutive, Université de Lyon, CNRS (UMR 5558), Université Lyon 1, 69622 Villeurbanne, France.
[3] Zoologisches Forschungsmuseum Alexander Koenig, Leibniz Institut für Biodiversität der Tiere, Adenauerallee 160, D-53113 Bonn, Germany.

[*] Corresponding author: x.mengual@leibniz-zfmk.de
[1] Email: thibault.ramage@hotmail.fr
[2] Email: sylvain.charlat@univ-lyon1.fr

[1] urn:lsid:zoobank.org:author:8DE31F66-13BF-4516-A205-60F2EA39E3DD
[2] urn:lsid:zoobank.org:author:A9AE69C2-039D-47FD-9DD2-B34C4363CB71
[3] urn:lsid:zoobank.org:author:A509310D-B567-4830-B8A4-BCB139BB8768

Abstract. The flower flies (Diptera, Syrphidae) of French Polynesia are revised. A total of nine syrphid species were recorded from the five archipelagos of French Polynesia. Among them are two species new to science, *Allograpta jacqi* Mengual & Ramage sp. nov. and *Melanostoma polynesiotes* Mengual & Ramage sp. nov., and a new record for this country, *Syritta aenigmatopatria* Hardy, 1964. We provide DNA barcodes for all flower fly species of French Polynesia, making the syrphid fauna of this country the first one in the world to be entirely barcoded. New data on biology, flowers visited and some taxonomic notes are provided. An identification key for the species of Syrphidae in French Polynesia is given, as well as an identification key for the species of *Melanostoma* Schiner, 1860 in the Australasian and Oceanian Regions.

Keywords. Identification key, new species, new record, *Melanostoma*, *Allograpta*.

Ramage T., Charlat S. & Mengual X. 2018. Flower flies (Diptera, Syrphidae) of French Polynesia, with the description of two new species. *European Journal of Taxonomy* 448: 1–37. https://doi.org/10.5852/ejt.2018.448

Introduction

The terrestrial arthropods of French Polynesia form a peculiar fauna, with several missing orders among the Hexapoda, a phenomenon called taxonomic disharmony (Roderick & Gillespie 2016). The absence of major taxonomic groups is to some degree counterbalanced by a high endemism rate resulting from numerous local speciation events. Most of the Pacific Basin was colonized by species from New Guinea

and adjacent areas via over-water dispersal (Miller 1996; Ramage 2017). Munroe (1996) showed that there is a progressive decrease in the number of founding stocks and an increase in the proportion of radiating speciation with distance from the Papuan source areas, also known as the 'radiation zone' (MacArthur & Wilson 1967).

The pollinator entomofauna is unfortunately poorly known in French Polynesia. The only published records of flower / insect relationships concern a species of Megachilidae, *Megachile diligens* Smith, 1879 "taken on the blossoms of a trailing bean near the shore", most likely a species of *Vigna* Savi (Fabaceae) (Cheesman 1928), and the highly specialized pollination mutualism between the seed-feeding *Epicephala* Meyrick, 1880 moths (Lepidoptera, Gracillariidae) and species of *Phyllanthus* L. s. lat. (Phyllanthaceae) (Hembry *et al*. 2012, 2013a, 2013b). Studies on the pollinator entomofauna of French Polynesia are ongoing and the present work is a first contribution regarding pollinator insects.

Insects are represented in French Polynesia by 2497 species, with 67% of them being endemic, and there are 342 species of Diptera recorded for French Polynesia, of which 210 are endemic (70%) (Ramage 2017). World-wide, flower flies (Diptera: Syrphidae) are one of the most species-rich dipteran families with over 6000 valid species (Thompson 2013). Also known as hoverflies, syrphid adults feed on pollen and nectar and use flowers as mating sites. Their larvae, on the other hand, have unusually diverse natural histories and include mycophages of fungal fruiting bodies, phytophages of numerous plant families, pollen feeders, saprophages in media as diverse as dung, nests of social Hymenoptera, decaying wood and water bodies of numerous types, and predators of a range of other arthropods, mostly soft-bodied Hemiptera, caterpillars and immatures of ants and beetles (Rotheray & Gilbert 1999; Rojo *et al*. 2003; Weng & Rotheray 2008; Reemer & Rotheray 2009; Zuijen & Nishida 2011; Dumbardon-Martial 2016), but also on adult flies (Ureña & Hanson 2010).

The syrphid imagines are considered important pollinators in natural ecosystems as well as in agricultural areas (Speight & Lucas 1992; Pérez-Bañón *et al.* 2003; Ssymank & Kearns 2009; Inouye *et al*. 2015), and they have been used as bioindicators to assess the loss of biodiversity and the efficiency of restoration and conservation policies (Sommaggio 1999; Tscharntke *et al*. 2005; Ricarte *et al*. 2011; Sommaggio & Burgio 2014). Flower fly immatures play an important role as biological control agents of pests (Schmidt *et al*. 2004; Bergh & Short 2008; Pineda & Marcos-García 2008; Nelson *et al*. 2012; Amorós-Jiménez *et al*. 2014; Eckberg *et al*. 2015) and as decomposers of organic matter (Lardé 1989; Rotheray *et al*. 2009; Martínez-Falcón *et al*. 2012).

In French Polynesia, there are six recorded flower fly species belonging to five genera (Thompson & Vockeroth 1989), i.e., *Allograpta amphotera* (Bezzi, 1928), *A. nigripilosa* (Hull, 1944), *Ischiodon scutellaris* (Fabricius, 1805), *Ornidia obesa* (Fabricius, 1775), *Palpada vinetorum* (Fabricius, 1798) and *Syritta oceanica* Macquart, 1855. Among them, *A. nigripilosa* seems to be endemic, as it is known only from the Society Archipelago so far. Nishida (2008) listed *Simosyrphus grandicornis* (Macquart, 1842) from the Society Islands, but we have doubts about this record. Similar concerns pertain to records of *Allograpta exotica* (Wiedemann, 1830) by Fluke (1942) and of *A. amphotera* by Aubertin & Cheesman (1929) and Hull (1937). Recently, Ramage *et al*. (2017) conducted a biodiversity survey in the Society Islands based on DNA barcodes as part of the SymbioCode initiative in collaboration with the Moorea Biocode Project (http://biocode.berkeley.edu) (Check 2006). As a result, they provided DNA barcodes for six taxa belonging to Syrphidae: *I. scutellaris*, *O. obesa*, *P. vinetorum*, *Syritta* sp., *Allograpta* sp. and an unknown taxon.

The aims of the present study are: 1) to describe this unknown taxon reported by Ramage *et al*. (2017) as *Melanostoma polynesiotes* Mengual & Ramage sp. nov., 2) to describe another new species collected

during the latest expedition to Tahiti, *Allograpta jacqi* Mengual & Ramage sp. nov., 3) to report a new record for French Polynesia, i.e., *Syritta aenigmatopatria* Hardy, 1964, and to critically review the doubtful species records of Syrphidae, 4) to present the records of the flowers visited by syrphids in French Polynesia during the field expeditions and 5) to provide new DNA barcodes for all known flower flies of French Polynesia, making the syrphid fauna of this country the first one in the world to be entirely barcoded. An identification key for the species of Syrphidae in French Polynesia is provided, as well as an identification key for the species of *Melanostoma* Schiner, 1860 in the Australasian and Oceanian Regions.

Material and methods

Study area and sampling

Specimens collected in French Polynesia (Fig. 1) during the SymbioCode initiative (collector S. Charlat) were available for the present survey, as well as specimens collected by E. Claridge, A. Duplouy, F. Jacq, T. Laroche, T. Ramage and T. Sogado during field trips conducted in Bora Bora (2012), Fatu Hiva (2013), Hiva Oa (2013), Huahine (2007, 2012), Mangareva (2012), Moorea (2006, 2007), Morane (2012), Nuku Hiva (2013, 2014), Raiatea (2007, 2010, 2012, 2013, 2014, 2015), Rapa Iti (2017), Taha'a (2012), Tahiti (2006, 2007, 2012, 2013, 2014, 2015, 2017, 2018), Tahuata (2012) and Vahanga (2012). Additionally, specimens deposited in the Natural History Museum (London, UK) and in the Muséum national d'Histoire naturelle (Paris, France) were also studied.

Identification and format

Original descriptions and inspection of type material were used for syrphid identification, together with a few existing identification keys such as Lyneborg & Barkemeyer (2005) for the genus *Syritta* Lepeletier & Serville, 1828 and Carvalho Filho & Esposito (2009) for the genus *Ornidia* Lepeletier & Serville, 1828.

Differential diagnoses, synonymies, references and distributions are given for all species included in the study. New species are described following the terminology of Thompson (1999) and Mengual (2012). The abbreviations used for collections follow the standard of the *Systema Dipterorum* (Thompson 2013), and their equivalents are given below:

AMS = Australian Museum, Sydney, Australia
BMNH = The Natural History Museum, London, UK
BPBM = Bernice P. Bishop Museum, Honolulu, HI, USA
CTR = Thibault Ramage's personal collection
MNHN = Muséum national d'Histoire naturelle, Paris, France
NBCN = Naturalis Biodiversity Centre, Leiden, the Netherlands
NMW = Naturhistorisches Museum Wien, Vienna, Austria
OUMNH = University Museum of Natural History, Oxford, UK
SCL = Laboratoire de Biométrie et Biologie Evolutive, Université de Lyon, Villeurbanne, France
UZMC = Zoological Museum, University of Copenhagen, Copenhagen, Denmark
ZFMK = Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany

In the description of type labels, the contents of each label are enclosed within double quotation (" "), italics denote handwriting and the individual lines of data are separated by a double forward slash (//). The holding institution is indicated at the end of each record between parentheses.

All measurements are in millimetres and were taken using a reticule in a Leica M165 C microscope. Photographs were composed using the Zerene Stacker program ver. 1.04 (Richland, WA, USA), based

on images of pinned specimens taken with a Canon EOS 7D mounted on a P–51 Cam-Lift (Dun Inc., VA, USA) and with the help of Adobe Lightroom (ver. 5.6). 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.

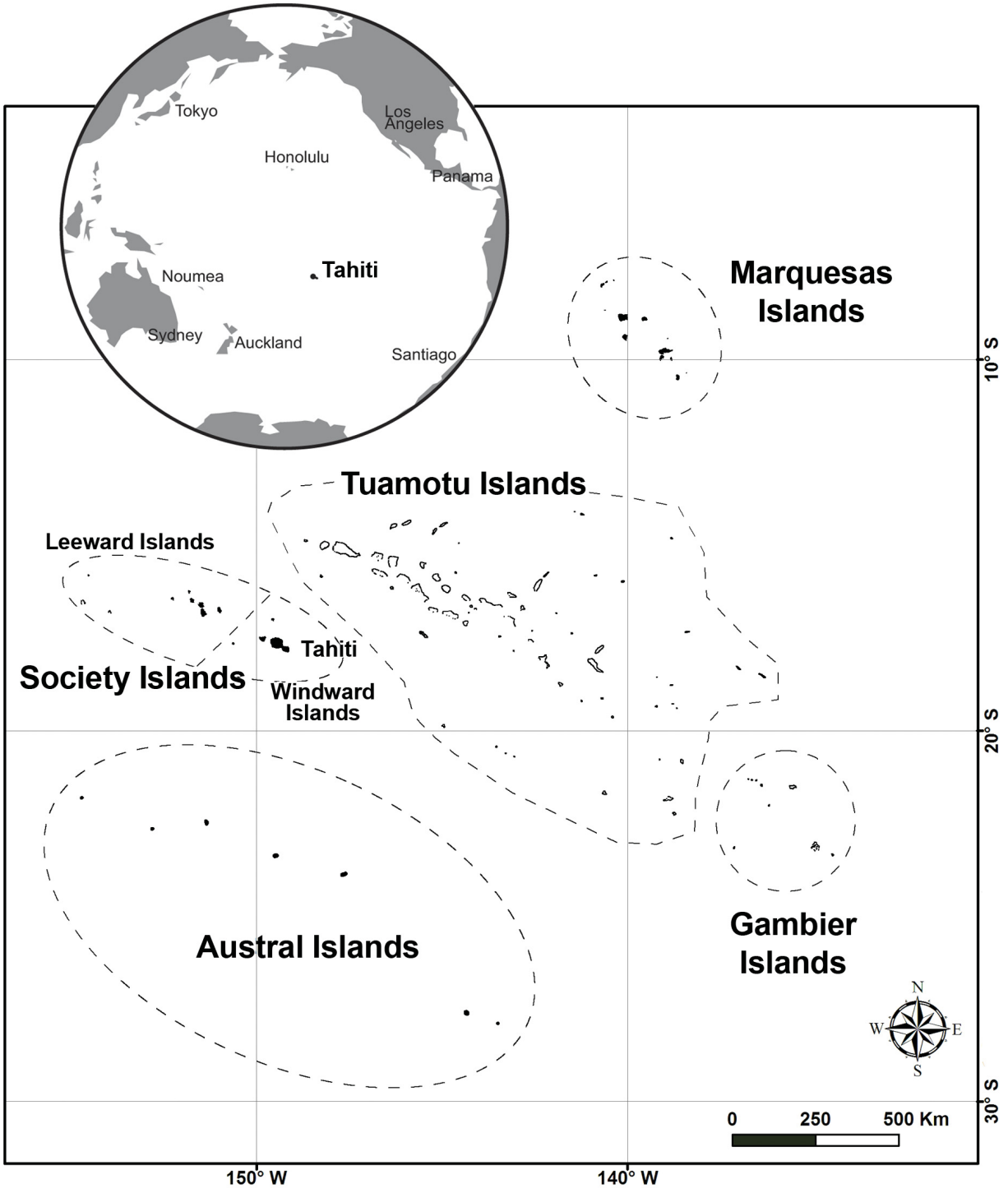

Fig. 1. Map of French Polynesia (from Fred Jacq; modified with globe from Rouzé *et al*. 2017). (https://doi.org/10.7717/peerj.2856/fig-1)

DNA-barcoding

Specimens with a DNA barcode are indicated in the text by a GenBank accession number and/or a BOLD Process ID. GenBank accession numbers starting with KX05 and BOLD IDs starting with SYC were generated using the protocols explained in Ramage *et al*. (2017) as part of the SymbioCode initiative (https://doi.org/10.5883/DS-SYMC). New DNA barcodes generated for this study as well as other marker sequences (GenBank accession numbers starting with MF44 or MH28) were produced using the DNA primers and PCR amplification protocols described in Mengual *et al*. (2008, 2012) at the ZFMK. Entire specimens or remnants of specimens were preserved and labelled as DNA voucher specimens for the purpose of morphological studies, except for one male of *Melanostoma polynesiotes* sp. nov., which was totally destroyed in the DNA extraction process and no body parts remain.

Results

A total of 228 specimens were studied for the present survey. Details are given in the Material examined section under each species. One species was recorded for the first time for French Polynesia, *Syritta aenigmatopatria* Hardy, 1964. In addition, two species new to science were found at high elevations on the island of Tahiti, *Allograpta jacqi* Mengual & Ramage sp. nov. and *Melanostoma polynesiotes* Mengual & Ramage sp. nov. Flower fly specimens have been observed foraging on flowers of endemic plants in French Polynesia, such as *Apetahia raiateensis* Baill., on flowers of invasive plants (e.g., *Lantana camara* L.), and on flowers of weeds, e.g., *Tridax procumbens* (L.) L. or *Hippobroma longiflora* (L.) G.Don. A total of 41 DNA barcodes were obtained for the following flower fly species present in French Polynesia: *A. jacqi* sp. nov. (1), *A. nigripilosa* (3), *I. scutellaris* (12), *M. polynesiotes* sp. nov. (4), *O. obesa* (9), *P. vinetorum* (7), *S. aenigmatopatria* (2) and *S. oceanica* (3). Barcodes for *A. amphotera* were retrieved from BOLD (http://www.boldsystems.org).

The flower fly species are listed below in alphabetic order. Two other species are also listed in order to clarify their status in French Polynesia, i.e., *Allograpta exotica* and *S. grandicornis*.

Animalia Linnaeus, 1758
Arthropoda Latreille, 1829
Insecta Linnaeus, 1758
Diptera Linnaeus, 1758
Syrphidae Latreille, 1802

Allograpta amphotera (Bezzi, 1928)
Figs 2A, 3A–B

Xanthogramma amphoterum Bezzi, 1928: 74 (holotype: ♂, BMNH; type locality: Cook Islands, Rarotonga).

Differential diagnosis

Species with yellow face with a medial black vitta, scutum black with a continuous lateral yellow vitta from postpronotum to scutellum, scutellum yellow with a median black macula, terga 2 and 5 with two lateral yellow maculae and terga 3 and 4 with a broad yellow fascia. It differs from *A. nigripilosa* only in the wing microtrichia, as stated in the key.

Material examined

Holotype

FIJI: ♂, "Holo- // type" [round, red margin], "*Rarotonga 9* // *1920*. // *H.W. Simmonds*" "*Xanthogramma* // *amphoterum* // *Type* ♂*g n.sp*." [red ink], "Fiji Is. // Pres.by // Imp.Bur.Ent. // Brit. Mus. // 1929–1." (BMNH).

Paratypes

FIJI: 1 ♂, Movua, Nov. 1920, H.K. Simmonds leg. (BMNH); 1 ♀, Lautoka, Aug. 1919, R. Veitch leg. (BMNH).

Other material

FRENCH POLYNESIA: 1 ♂, Austral Islands, Rurutu, Mar. 1925, St. George Expedition (BMNH).

COOK ISLANDS: 1 ♂, Rarotonga, Avatiu Valley, 28 Mar. 1999, C. Wilkinson leg. (BMNH); 1 ♀, Rarotonga, Avarua, 0–200 m a.s.l., Nov.–Dec. 1979, N.L.H. Krauss leg. (BMNH).

Geographical distribution

Cook Islands, Fiji, French Polynesia (Marquesas Islands(?), Society Islands(?) and Austral Islands), Samoa.

Status in French Polynesia

Present.

Flowers visited

No records (ferns?, see Aubertin & Cheesman 1929).

Genetics

There are five DNA barcodes for Fiji specimens of this taxon with the following BOLD Process ID numbers: CNCDB1923-11, CNCDB1924-11, CNCDB1925-11, CNCDB1926-11 and CNCDB1927-11 (all by J.H. Skevington). The Barcode Index Number (BIN) for them is BOLD:AAZ6685 (https://doi.org/10.5883/BOLD:AAZ6685).

References

Aubertin & Cheesman 1929: 172 (records); Hull 1937: 83 (catalogue); Vockeroth 1969: 129 (list); Thompson & Vockeroth 1989: 441 (catalogue); Mengual *et al.* 2009: 15 (list).

Remarks

Aubertin & Cheesman (1929) recorded this species for the first time from French Polynesia (Tahiti, Raiatea and Bora-Bora) and mentioned that it was abundant on fern-covered slopes. Hull (1937) listed this species from Fiji, the Marquesas Islands and Tahiti, while Vockeroth (1969) mentioned it from Samoa. We were not able to collect specimens during any field expeditions, even though it might be abundant. The only studied specimen from French Polynesia that has the same wing microtrichia pattern as the holotype of *A. amphotera* is a male from Rurutu in the BMNH.

This species and *A. nigripilosa* are extremely similar, and after the study of the type material by XM, it is still not clear whether they are the same taxon or two different species, one located in the western and southern parts of the south Pacific Ocean (*A. amphotera*) and the other (*A. nigripilosa*) restricted to the central part. In the BMNH, there is a male (Cook Islands: Rarotonga, Avatiu Valley, 28 Mar. 1999, C. Wilkinson leg.) with the cell bm bare on the basal ⅓. This male does not match the type of *A. amphotera*, indicating a potential intraspecific variability or some damage during preservation of this specimen. This specimen might also be a male of *A. nigripilosa* that reached the Cook Islands, broadening the distribution range of this species. At this point, we should consider the records from French Polynesia by Aubertin & Cheesman (1929) as doubtful, since they were reported prior to the description of *A. nigripilosa* by Hull (1944). More specimens are needed to understand the variability of these Oceanic species of *Allograpta*, but the analysis of the available DNA barcodes, including the specimens of *Allograpta* from Fiji mentioned above, resolved Fijian and Polynesian specimens in the same cluster, with a bootstrap support value of 100 in the Neighbour-Joining analysis. Moreover,

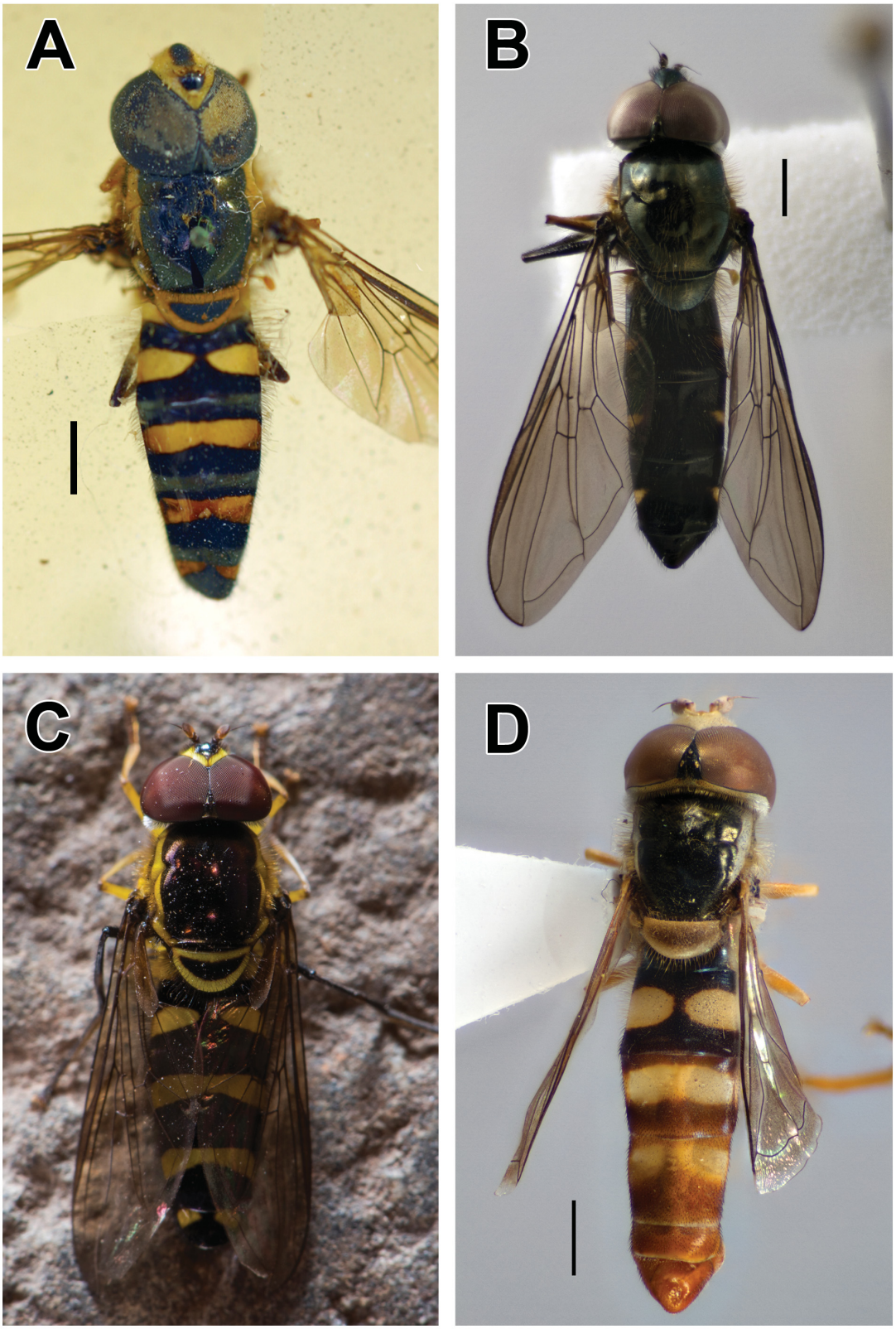

Fig. 2. A. *Allograpta amphotera* (Bezzi, 1928), holotype, ♂, dorsal view. **B**. *Allograpta jacqui* Mengual & Ramage sp. nov., holotype, ♂ (ZFMK-DIP-00019707), dorsal view. **C**. *Allograpta nigripilosa* (Hull, 1944), ♂, dorsal view (photograph by F. Jacq). **D**. *Ischiodon scutellaris* (Fabricius, 1805), ♂ (ZFMK-DIP-00019713), dorsal view. Scale bars = 1 mm.

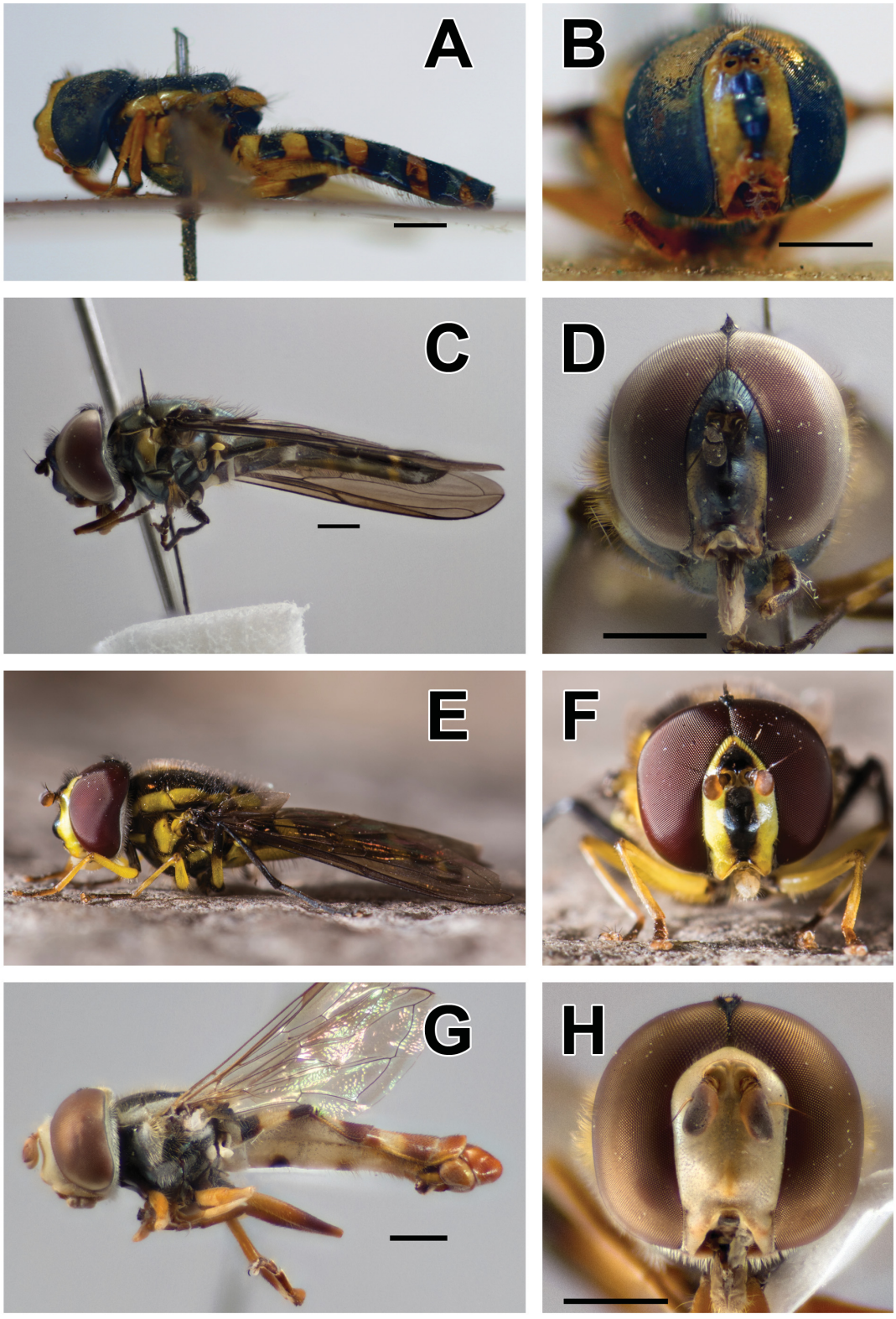

Fig. 3. A–B. *Allograpta amphotera* (Bezzi, 1928), holotype, ♂. A. Lateral view. B. Frontal view. **C–D**. *Allograpta jacqui* Mengual & Ramage sp. nov., holotype, ♂, (ZFMK-DIP-00026906). C. Lateral view. D. Frontal view. **E–F**. *A. nigripilosa* (Hull, 1944), ♂ (photographs by F. Jacq). E. Lateral view. F. Frontal view. **G–H**. *Ischiodon scutellaris* (Fabricius, 1805), ♂ (ZFMK-DIP-00019713). G. Lateral view. H. Frontal view. Scale bars = 1 mm.

BOLD groups all of these specimens in the same Barcode Index Number (BIN), BOLD:AAZ6685 (https://doi.org/10.5883/BOLD:AAZ6685). Although resolved in the same clade, the barcodes of Fijian and Polynesian specimens form two different clusters. In further studies we will try to collect more individuals of *Allograpta* to test the molecular variability of these two species; at the current stage, the synonymy of *A. amphotera* and *A. nigripilosa* seems plausible.

Allograpta exotica (Wiedemann, 1830)

Syrphus exoticus Wiedemann, 1830: 136 (lectotype: ♂, NMW; type locality: Brazil).
Syrphus quadrigemina Thomson, 1869: 500.
Allograpta fracta Osten Sacken, 1877: 331.
Allograpta interrupta Enderlein, 1938: 216.
Allograpta flavibuca Enderlein, 1938: 216.
Allograpta duplofasciata Enderlein, 1938: 217.
Allograpta bilineata Enderlein, 1938: 220.
Allograpta tucumana Enderlein, 1938: 220.
Allograpta skottsbergi Enderlein, 1938: 663.

Differential diagnosis

This species differs from the two other species of *Allograpta* in this paper by having the scutellum entirely yellow and terga 4 and 5 with two longitudinal yellow vittae connected (or not) basomedially with the lateral oblique maculae.

Material examined

Holotype

BRAZIL: ♂, "*Sc. exotica m.* // *Brasilia*. // *Mus. r. Berol*.", "*exotica* // Coll. Wiedem.", "LECTOTYPE // *Syrphus* // *exotica Wied* // Desig.Thompson 1977" [yellow], "*Allograpta* // *exotica* // Det.: X. Mengual 2014" (NMW).

Geographical distribution

The Americas, from USA south to Argentina, and Hawaii (introduced).

Status in French Polynesia

Doutbful.

References

Fluke 1942: 19 (cit.).

Remarks

This is a widespread species on the American continents, introduced in Hawaii, and not present in French Polynesia. We have included this taxon in our species list because Fluke (1942) mentioned records from the Crocker Expedition in Rikitea (French Polynesia, Gambier Islands, Mangareva Island). Charles Templeton Crocker (1884–1948) made several expeditions from 1931 to 1938 (SNAC 2016), but visited French Polynesia only once. Between September 15th 1934 and April 16th 1935, the American Museum of Natural History funded a scientific expedition to the South Pacific, including Eastern Polynesia, the so-called Templeton Crocker Pacific Expedition, with the following ports: Marquesas, Tuamotus, Australs, Mangareva, Pitcairn, Easter, Valparaiso, Chinchas and the Galapagos Islands. Van Duzee (1937) gave details on this expedition. Unlike other expeditions (Curran 1934, 1936), we could not find any report of Diptera collected during the 1934–1935 journey. The interesting part for the present

dilemma is that the expedition visited only one island of the Gambier Islands, Mangareva (Rikitea is a small town on Mangareva), to get some fuel before they left towards Pitcairn Island (Chapin 1935). On the return journey, the expedition visited Easter, Juan Fernandez and the Galapagos Islands, and *A. exotica* has been reported from Easter Island (Thompson 2015) and from Juan Fernandez (Fluke 1955). We strongly believe that *A. exotica* does not occur in French Polynesia and if a specimen with such a label exists, it is very likely due to mislabelling. Another option is a misidentification of *A. nigripilosa* by Fluke, although this seems unlikely based on his taxonomic expertise. Consequently, *A. exotica* is not included in the identification key.

Allograpta jacqi Mengual & Ramage sp. nov.
urn:lsid:zoobank.org:act:C4A54CF7-0C6F-4630-9B6E-E5A191322151
Figs 2B, 3C–D, 6C–E, 8D–F

Differential diagnosis

Species with face medially black, yellow laterally, scutum and scutellum black, and abdomen black with lateral small yellow maculae on terga 1–5. Easy to distinguish from other species of *Allograpta* by the general dark coloration.

Etymology

The specific epithet refers to the family name of the first collector of the species, Fred Jacq, a great naturalist and photographer. The species epithet is to be treated as a noun in the genitive case.

Material examined

Holotype

FRENCH POLYNESIA: ♂, Tahiti Island, Mont Marau, 1400 m a.s.l., 17°36′44.02″ S, 149°31′51.10″ W, genitalia in microvial, "FRENCH POLYNESIA: // Society Islands, Tahiti, // Mont Marau, 1400 m., // 27.VIII.2017. // Leg. T. Ramage & F. Jacq // PF1494", "DNA voucher specimen // ZFMK Lab code // JH13 // Bonn, Germany", "ZFMK-DIP // 00026906" [barcode], "HOLOTYPE // *Allograpta* // *jacqi* // *Det. X. Mengual 2017*" [red] (ZFMK).

Description

Male

Length (N = 1). Body 10.5 mm; wing 9.0 mm.

Head (Figs 3D, 6C, E). Face with a distinct tubercle, shiny, yellow with a medial broad black vitta, which does not reach oral margin, and two small black maculae on eye margin, yellow pilose with some black pile laterally and dorsally; gena black; lunule black; frons shiny black, with two small yellow maculae on eye margin at level of antennal insertion, black pilose; vertical triangle black, black pilose; antenna dark, black pilose; arista bare; eye bare, holoptic; occiput dark, covered with thick silver pollinosity on ventral ⅔, silver-white pilose on ventral ⅔ and black pilose on dorsal ⅓.

Thorax (Figs 2B, 3C, 6C–D). Scutum shiny, black with small yellow markings on posterior notopleuron and posterior postpronotum, with relatively long yellow pile with some abundant black pile; scutellum shiny black with long yellow and black pile, subscutellar fringe with long dark pile. Pleuron black, except posterior anepisternum yellow on posterior ½ and katatergum with a yellow macula, mostly shiny with some pale pollinosity anteriorly, yellow pilose; metaepisternum bare; metasternum with long yellow pile; calypter pale basally, darker apically, with dark pile; plumula long, yellow; halter yellow; posterior spiracular fringes yellow.

Wing. Infuscated, brownish, microtrichose, except cell c bare on basal ¼, cell r1 bare before bifurcation, cells r and bm bare on basal ½, cell cup bare on basal ⅓–½. Alula bare on basal ½.

Legs. Coxae and metatrochanters dark; pro- and mesofemora yellow with a dorsal dark area; pro- and mesotibiae yellow with a medial dark annulus; pro- and mesotarsi black; metaleg black; black pilose with some yellow pile on metacoxa.

Abdomen (Figs 2B, 6D). Parallel-sided, unmargined. Entirely black, except tergum 1 yellow laterally and terga 2–5 black with small triangular yellow maculae close to lateral margin, shiny except terga 2–4 with a large black pollinose area medially, mostly black pilose except tergum 1 yellow pilose laterally, and terga 2 and 3 yellow pilose anterolaterally; sterna black, yellow and black pilose.

Male genitalia. Small, as in Fig. 8D–F.

Female

Unknown.

Geographical distribution

Species only known from Tahiti (French Polynesia).

Status in French Polynesia

Endemic.

Flowers visited

No records.

Genetics

The GenBank accession numbers for this species are: 28S gene (MH282901), protein-coding COI gene (MH282896).

Remarks

This is a singular species due to its body coloration, without the common yellow fasciae of other species of the genus *Allograpta* and the with scutellum entirely shiny black. The Australian species of this genus were reviewed by Mengual & Thompson (2015), but a broader systematic revision is needed for the Australasian and Oceanian Regions (see Mengual *et al*. 2009).

Allograpta nigripilosa (Hull, 1944)
Figs 2C, 3E–F

Xanthogramma nigripilosa Hull, 1944: 52 (holotype: ♂, BMNH; type locality: Tahiti, French Polynesia).

Differential diagnosis

Extremely similar to *A. amphotera*, but it has a different microtrichia pattern on the wings, as stated in the key.

Material examined

Holotype

FRENCH POLYNESIA: ♂, "*HOLOTYPE* // *XANTHOGRAMMA* // *nigropilosa* // *Hull*" [red], "Holo- // type" [round, red margin], "Society Is. // Tahiti. // *5.5.25* // L.E.Cheesman. // B.M.1925–464." (BMNH).

Paratypes

FRENCH POLYNESIA: 2 ♂♂, Society Islands, Raiatea, 29 May 1925, L.E. Cheesman leg. (BMNH); 1 ♂, Tahiti, 5 May 1925, L.E. Cheesman leg. (BMNH).

Other material

FRENCH POLYNESIA: **Society Islands**: 7 ♂♂, Raiatea, 29 May 1925, L.E. Cheesman leg. (BMNH); 1 ♀, Raiatea, Opoa, Aratao, 2015, F. Jacq leg. (ZFMK: ZFMK-DIP-00019705); 1 ♀, Moorea, Opunohu, Trois Cocotiers Trail, 17°33′00″ S, 149°50′15″ W, 420 m a.s.l., 2 Dec. 2006, Malaise trap, S. Charlat leg. (ZFMK: symbiocode_03846, ZFMK-DIP-00046221); 1 ♂, Taha'a, Paripari, 16°35′20.29″ S, 151°31′47.16″ W, 30 m a.s.l., 29 Sep. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019704); 1 ♂, Raiatea, 5 May 1925, L.E. Cheesman leg. (BMNH); 1 ♀, Tahiti, 16 May 1925, LE. Cheesman leg. (BMNH); 1 ♂, Tahiti, 9 Jul. 1925, L.E. Cheesman leg. (BMNH); 1 ♀, Tahiti, Mount Marau, 17°36′08″ S, 149°33′42″ W, 970 m a.s.l., 31 Mar. 2007, Malaise trap, E. Claridge leg. (SCL: symbiocode_04422); 2 ♂♂, Tahiti, Mont Marau, 1400 m a.s.l., 27 Aug. 2017, T. Ramage and F. Jacq leg. (ZFMK: ZFMK-DIP-00026904, ZFMK DIP-00026905); 1 ♀, Tahiti, Papenoo Valley, Te Faaiti Natural Park, 17°35′34.96″ S, 149°26′32.37″ W, 296 m a.s.l., Malaise trap, 11 Jun. 2018, F. Jacq leg. (CTR).

Geographical distribution

French Polynesia (Society Islands).

Status in French Polynesia

Endemic.

Flowers visited

No records.

Genetics

The GenBank accession numbers for this species are: 28S gene (MF446468, specimen ZFMK-DIP-00019705), 18S gene (MF446423, specimen ZFMK-DIP-00019705), protein-coding COI gene (MF446518, specimen ZFMK-DIP-00019705; MF446520, specimen ZFMK-DIP-00019704). The BOLD Process ID for the DNA barcodes (5′–COI) for this species is SYC4342-14 (= GenBank accession number KX051597, specimen symbiocode_04422). The Barcode Index Number (BIN) for these specimens is BOLD:AAZ6685 (https://doi.org/10.5883/BOLD:AAZ6685).

References

Hull 1944: 52 (description); Vockeroth 1969: 130 (list); Thompson 1989: 16 (cit.); Thompson & Vockeroth 1989: 441 (catalogue); Mengual *et al.* 2009: 15 (list).

Remarks

See Remarks under *A. amphotera*.

Ischiodon scutellaris (Fabricius, 1805)
Figs 2D, 3G–H, 6A

Scaeva scutellaris Fabricius, 1805: 252 (holotype: ♂, UZMC; type locality: India, Tamil Nadu, Tranquebar).
Syrphus coromandelensis Macquart, 1842: 149.
Sphaerophoria annulipes Macquart, 1855: 116.
Syrphus splendens Doleschall, 1856: 410.
Syrphus nodalis Thomson, 1869: 497.
Syrphus erythropygus Bigot, 1884: 87.

Syrphus ruficauda Bigot, 1884: 96.
Melithreptus novaeguineae Kertész, 1899: 178.
Ischiodon trochanterica Sack, 1913: 6.
Melithreptus ogasawarensis Matsumura, 1916: 23.
Ischiodon boninensis Matsumura, 1919: 128.
Epistrophe platychiroides Frey, 1946: 164.
Ischiodon penicillatus Hardy, 1952: 363 (nomen nudum).
Epistrophe magnicornis Shiraki, 1963: 141.
Sphaerophoria macquarti Van der Goot, 1964: 220.

Differential diagnosis

Species with basoflagellomere elongate and subacute apically, face yellow, metasternum bare and abdominal terga 2–5 distinctly marginated (Figs 2D, 3G–H). It differs from *S. grandicornis* by having a dorsal yellow macula on the katepisternum and the male metatrochanter with a ventral spine-like process or calcar.

Material examined

FRENCH POLYNESIA: **Austral Islands**: 1 ♀, Rapa Iti, motu Karapoo rahi, 4 Apr. 2017, F. Jacq leg. (ZFMK: ZFMK-DIP-00019531). – **Gambier Islands**: 2 ♀♀, 3 ♂♂, 2 puparia, Mangareva, Rikitéa, 6 Apr. 1966, P. Cochereau leg. (MNHN); 1 ♀, Mangareva, 16 Apr. 1966, Malaise trap, P. Cochereau leg. (MNHN). – **Marquesas Islands**: 5 ♀♀, Fatu Hiva, ‘Omoa, 6–26. Aug. 2013, Malaise trap, F. Jacq leg. (3 ♀♀: CTR; 2 ♀♀: ZFMK: ZFMK-DIP-00019714, ZFMK-DIP-00019715); 1 ♀, 1 ♂, Hiva Oa, 5 Mar. 2013, F. Jacq leg. (1 ♀: CTR; 1 ♂: ZFMK: ZFMK-DIP-00019721); 2 ♀♀, Nuku Hiva, Vallée française, Apr. 2013, Malaise trap, F. Jacq leg. (CTR); 1 ♀, Nuku Hiva, Anaho, 13 Aug. 2014, F. Jacq leg. (CTR); 13 ♀♀, 2 ♂♂, Tahuata, 5 Sep. 2012, Malaise trap, F. Jacq leg. (9 ♀♀, 1 ♂: CTR; 4 ♀♀, 1 ♂: ZFMK: ZFMK-DIP-00019708 to ZFMK-DIP-00019712). – **Society Islands**: 13 ♀♀, 3 ♂♂, Bora Bora, Vairupe, 13 Nov. 2012, Malaise trap, F. Jacq leg. (11 ♀♀, 1 ♂: CTR; 2 ♀♀, 2 ♂♂: ZFMK: ZFMK-DIP-00019719, ZFMK-DIP-00019720, ZFMK-DIP-0001971922, ZFMK-DIP-00019723); 1 ♂, Huahine, motu Maeva, 16°41′51.5″ S, 150°58′50.8″ W, 1 Jul. 2007, S. Charlat leg. (SCL: symbiocode_07570); 1 ♀, Huahine, Pohue Rahi, 16°46′51.2″ S, 150°58′34.7″ W, 470 m a.s.l., 4 Jul. 2007, S. Charlat leg. (SCL: symbiocode_08019); 1 ♂, same collection data as preceding (SCL: symbiocode_08018); 1 ♂, Huahine, Pohue Rahi, 16°46′54.44″ S, 150°58′10.07″ W, 265 m a.s.l., 23 Sep. 2012, T. Ramage leg. (CTR); 2 ♂♂, Huahine, Pointe Tiva, 16°49′17.31″ S, 150°59′4.42″ W, 5 m a.s.l., 22 Sep. 2012, T. Ramage leg. (CTR); 1 ♀, Moorea, motu Tiahura, 17°29′15″ S, 149°54′43″ W, Malaise trap, Oct. 2006, S. Charlat leg. (SCL: symbiocode_01632); 2 ♀♀, same collection data as preceding but Nov. 2006 (SCL); 1 ♀, Moorea, Opunohu, Trois Cocotiers Trail, 17°33′00″ S, 149°50′15″ W, 420 m a.s.l., 2 Dec. 2006, Malaise trap, S. Charlat leg. (SCL: symbiocode_03845); 4 ♂♂, Moorea, 17°31′40″ S, 149°50′06″ W, 300 m a.s.l., 6 Jun. 2007, S. Charlat leg. (SCL: symbiocode_02597); 1 ♂, Raiatea, Faaroa Bay, 16°49′00.5″ S, 151°23′58.5″ W, 300 m a.s.l., 26 Jun. 2007, S. Charlat leg. (SCL: symbiocode_05172); 1 larva, Raiatea, marae Taputapuatea, 16°50′08″ S, 151°21′31″ W, 27 Jun. 2007, S. Charlat leg. (SCL: symbiocode_05606); 1 ♂, Raiatea, Te Mehani Rahi, 16°45′36.1″ S, 151°29′19.4″ W, 29 Jun. 2007, S. Charlat leg. (SCL: symbiocode_04987); 3 ♀♀, Raiatea, Avera Rahi, 16°47′42.17″ S, 151°24′48.82″ W, 10 m a.s.l., Malaise trap, 28 Sep. 2012, T. Ramage leg. (CTR); 1 ♀, Raiatea, Opoa, Aratao, 11 Jul. 2013, F. Jacq leg. (CTR); 1 ♂, Raiatea, Te Mehani ‘ute ‘ute, on *Apetahia*, 2014, F. Jacq and T. Laroche leg. (CTR); 1 ♀, 1 ♂, Raiatea, Opoa, 18 May 2015, Malaise trap, F. Jacq leg. (ZFMK: ZFMK-DIP-00019716, ZFMK-DIP-00019717); 1 ♂, Taha’a, Mount Ohiri Trail, 16°36′19.81″ S, 151°31′46.48″ W, 130 m a.s.l., 30 Sep. 2012, T. Ramage leg. (CTR); 1♂, Tahiti, 1854, Deyrolle leg. (MNHN); 1 ♂, Tahiti, Fautaua Valley, 333 m a.s.l., 23 Aug. 1928, A.M. Adamson leg. (NBCN); 1 ♀, Tahiti, Mount Marau, 17°36′08″ S, 149°33′42″ W, 970 m a.s.l., 4 Apr. 2006, Malaise trap, E. Claridge leg. (SCL: symbiocode_04455); 1 ♂, Tahiti, Arue, 17°32′8.26″ S, 149°31′6.74″ W, 200 m a.s.l., 16 Sep. 2012,

T. Ramage leg. (CTR); 1 ♂, Tahiti, Vallée de la Punaruu, 17°37′43.38″ S, 149°33′47.73″ W, 170 m a.s.l., 3 Oct. 2012, T. Ramage leg. (CTR); 1 ♂, Tahiti, Plateau Te Tamanu, 17°38′0.40″ S, 149°33′12.57″ W, 560 m a.s.l., 6 Oct. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019729); 1 ♀, Tahiti, Punaauia, 11 Oct. 2012, Malaise trap, T. Ramage leg. (CTR); 2 ♀♀, Tahiti, Mahina, 16 Nov. 2012, Malaise trap, F. Jacq leg. (CTR); 2 ♀♀, Tahiti, Papeete, Sainte-Amélie, 2014, F. Jacq leg. (CTR); 1 ♀, Tahiti, Papeete, Sainte-Amélie, Mar. 2015, Malaise trap, F. Jacq leg. (CTR); 1 ♀, Tahiti, Mont Marau, 1400 m a.s.l., 27 Aug. 2017, T. Ramage and F. Jacq leg. (ZFMK: ZFMK-DIP-00026903). – **Tuamotu Islands**: 1 ♀, Hao, 15 May 1966, Malaise trap, P. Cochereau leg. (MNHN); 2 ♂♂, Moruroa, Eider, 8 May 1966, on flowers of *Messerschmidia argentea*, P. Cochereau leg. (MNHN); 1 ♂, Morane, Motu est, 1 Jun. 2012, F. Jacq leg. (ZFMK: ZFMK-DIP-00019713); 2 ♀♀, Morane, Motu ouest, 3 Jun. 2012, F. Jacq leg. (1 ♀: CTR; 1 ♀: ZFMK: ZFMK-DIP-00019718).

Geographical distribution

Widespread species in the Oriental and Australasian Regions (Japan west to India and south to Australia, Papua New Guinea, New Caledonia, Micronesia, Samoa and other Pacific islands, including French Polynesia).

Status in French Polynesia

Present; recorded from Marquesas Islands, Gambier Islands, Tuamotu Islands, Austral Islands and Society Islands.

Flowers visited

Ischiodon scutellaris has been seen visiting two plant species, *Hippobroma longiflora* (L.) G.Don and *Apetahia raiateensis* Baill. (Campanulaceae). *Apetahlia raiateensis* is a shrub endemic to the three trachytic plateaus of Raiatea and it is listed as Critically Endangered by the IUCN (UICN France, MNHN & DIREN Polynésie française 2015). In terms of conservation, the identification of the pollinators of this species may be useful (F. Jacq, pers. comm.). A couple of males at the MNHN were collected on flowers of *Messerschmidia argentea* (L. f.) I.M.Johnst. (= *Tournefortia argentea* L. f. = *Heliotropium foertherianum* Diane & Hilger, 2003). Due to the overall similarity between females of *I. scutellaris* and *A. nigripilosa* in the field, some records of visited flowers cannot be confidently assigned to one of these species and they are not included.

Biology

Cochereau (1966, 1974) observed the food web of *I. scutellaris* (as *Xanthogramma* sp.) in Mangareva, Gambier Islands. Larvae of *I. scutellaris* attacked several aphids (Hemiptera: Aphididae) on different plants: *Rhopalosiphum maidis* (Fitch, 1856) and *Sitobion avenae* (Fabricius, 1775) on several species of Poaceae; *Brevicoryne brassicae* (Linnaeus, 1758) on *Brassica oleracea* L., (Brassicaceae); and *Aphis gossypii* Glover, 1877 on several plants belonging to Araceae, Asteraceae, Malvaceae and Myrtaceae. He also observed that the pupae of *I. scutellaris* were parasitized by a braconid wasp (Hymenoptera: Braconidae).

Genetics

The GenBank accession numbers for this species are: 28S gene (MF446488, specimen ZFMK-DIP-00019720), 18S gene (MF446444, specimen ZFMK-DIP-00019720), protein-coding COI gene (MF446540, specimen ZFMK-DIP-00019720; MF446516, specimen ZFMK-DIP-00019721). The BOLD Process IDs for the DNA barcodes (5′–COI) for this species are: SYC1600-14 (= KX053515, specimen symbiocode_01632), SYC2519-14 (= KX053518, specimen symbiocode_02597), SYC3765-14 (= KX053516, specimen symbiocode_03845), SYC4375-14 (= KX053520, specimen symbiocode_04455), SYC4907-14 (= KX053519, specimen symbiocode_04987), SYC5089-14 (= KX053521, specimen

symbiocode_05172), SYC5521-14 (= KX053513, specimen symbiocode_05606), SYC7453-14 (=KX053514, specimen symbiocode_07570), SYC7894-14 (=KX053517, specimen symbiocode_08018) and SYC7895-14 (= KX053522, specimen symbiocode_08019). The Barcode Index Number (BIN) for these specimens is BOLD:AAE5566 (https://doi.org/10.5883/BOLD:AAE5566).

References

Macquart 1855: 116 (description, Marquesas Islands); Thomson 1869: 497 (description, Tahiti); Aubertin & Cheesman 1929: 172 (records); Hull 1937: 83 (catalogue); Thompson 1989: 16 (cit.); Thompson & Vockeroth 1989: 444 (catalogue).

Remarks

Old records of this species are not easy to verify, as some authors used *S. grandicornis* and *I. scutellaris* as synonyms for a long time.

Melanostoma polynesiotes Mengual & Ramage sp. nov.
urn:lsid:zoobank.org:act:C80A600A-2ACE-4BBC-8B3F-D87A6878EA34
Figs 4A, C–D, 6F–G, 9D–F

Differential diagnosis

Species with face entirely black (Fig. 4C), scutum and scutellum black (Fig. 4A), and metasternum greatly reduced, with deep posterior incision on each side (typical metasternum for this genus). Easy to distinguish from other species in French Polynesia by its overall black coloration.

Etymology

The specific epithet *polynesiotes* refers to the country where this species occurs, French Polynesia, and it means 'belonging to, pertaining to' in Greek. The specific epithet is to be treated as a noun in apposition.

Material examined

Holotype

FRENCH POLYNESIA: ♂, Tahiti Island, Tahiti Iti, Mount Te Atara Trail, 825 m a.s.l., 17°47′22.50″ S, 149°14′53.91″ W, genitalia in microvial, "FRENCH POLYNESIA: // Tahiti, Tahiti iti – sentier vers // le Mt Atara, 20.IX.2012, sweeping, // 17°47′22.50″ S, 149°14′53.91″ W // 825 m. Leg.: T. Ramage // PF_922", "DNA voucher specimen // ZFMK Lab code // D269 // Bonn, Germany", "ZFMK-DIP // 00019707" [barcode] "HOLOTYPE // *Melanostoma* // *polynesiotes* // *Det. X. Mengual 2016*" [red] (MNHN).

Paratypes

FRENCH POLYNESIA: **Society Islands**: 1 ♀, Tahiti, Mount Marau, 17°36′08″ S, 149°33′42″ W, 970 m a.s.l., 31 Mar. 2007, Malaise trap, E. Clardige leg. (ZFMK: symbiocode_04430, ZFMK-DIP-00046220); 1 ♂, Tahiti, Mount Marau, 17°36′32.2″ S, 149°32′26.8″W, 1340 m a.s.l., 11 Jun. 2007, S. Charlat leg. (SCL: symbiocode_02320, completely destroyed during DNA extraction); 1 ♂, Tahiti, Tahiti Iti, Mount Te Atara Trail, 17°47′26.55″ S, 149°14′48.62″ W, 815 m a.s.l., 20 Sep. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019706); 1 ♂, Tahiti, Mont Marau, 1400 m a.s.l., 27 Aug. 2017, T. Ramage and F. Jacq leg. (ZFMK: ZFMK-DIP-00026902); 1 ♀, Tahiti, Papenoo Valley, Te Faaiti Natural Park, 17°35′34.96″ S, 149°26′32.37″ W, 296 m a.s.l., Malaise trap, 13 Mar. 2018, F. Jacq leg. (ZFMK: ZFMK-DIP-00040465).

Description

Male

Length (N = 1). Body 9.4 mm; wing 7.0 mm.

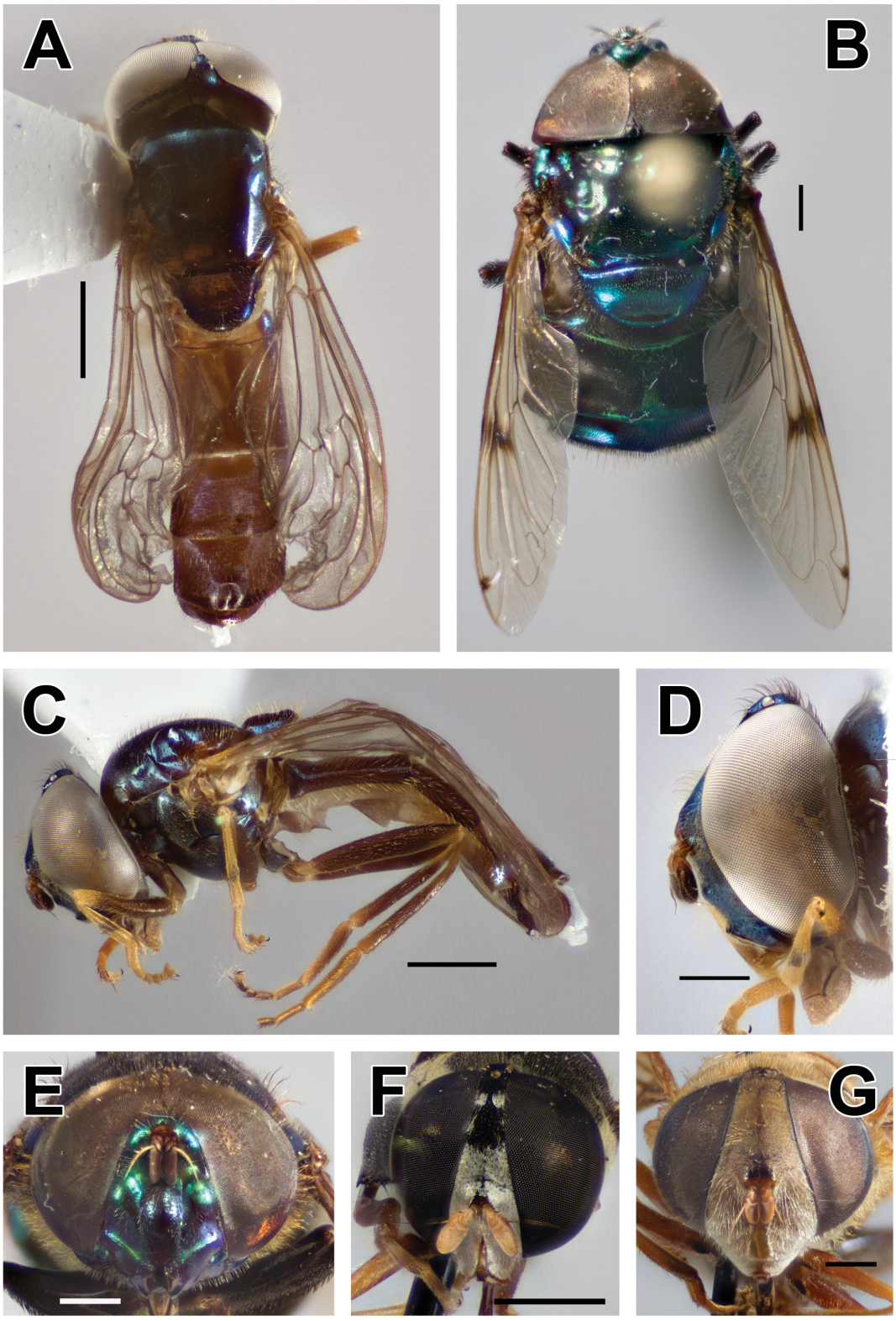

Fig. 4. A, C–D. *Melanostoma polynesiotes* Mengual & Ramage sp. nov., holotype, ♂ (ZFMK-DIP-00019707). A. Lateral view. C. Lateral view. D. Head, lateral view. **B, E**. *Ornidia obesa* (Fabricius, 1775), ♂ (ZFMK-DIP-00019747). B. Dorsal view. E. Frontal view. **F**. *Syritta aenigmatopatria* Hardy, 1964, ♀ (ZFMK-DIP-00019739), frontal view. **G**. *Palpada vinetorum* (Fabricius, 1798), ♀ (ZFMK-DIP-00019738), frontal view. Scale bars = 1 mm.

Head (Fig. 4D). Face almost straight, with a small facial tubercle that seems medially divided, black, yellow pilose, white-silver pollinose; gena black, shiny; lunule dark, a bit paler than frons; frons shiny black, slightly pale pollinose basolaterally, pale pilose; vertical triangle black, black pilose; scape and pedicel brown, paler than basoflagellomere, black pilose; basoflagellomere black; arista brown basally, darkening apically, pubescent with pile shorter than arista width; eye bare, holoptic; occiput black, pale pollinose, yellow pilose on ventral ¾ and dark pilose on dorsal ¼.

Thorax (Figs 4A, C, 6F). Scutum black, mostly shiny, pale pollinose anteriorly until notopleuron, with erected, relatively long yellow pile; postalar callus a bit lighter, tawny; scutellum black with erected yellow pile, subscutellar fringe with yellow pile. Pleuron black, mostly pale pollinose, yellow pilose; metasternum bare, reduced, with deep anterior incision on each side; calypter yellow; plumula yellow; halter yellow; posterior spiracular fringes yellow.

Wing. Hyaline, entirely microtrichose, except cell c basally bare.

Legs. Coxae dark; metatrochanters pale; femora black with basal and apical apices yellow; pro- and mesotibia yellow with a medial dark annulus; pro- and mesotarsomeres yellow; metatibia dark with basal ⅕ yellow; metatarsomeres dark.

Abdomen. Parallel-sided, unmargined, entirely black. Terga 2–5 black pilose medially and yellow pilose laterally; sterna dark.

Male genitalia. Enlarged (Fig. 4G); surstylus tapers to slender acute apex, curved towards dorsal part; superior lobes (postgonites) elongated, with rounded apex, with a spur-like process medially on the ventral margin and another spur-like process dorsally pointed anteriorly; hypandrium with two arms ending with two spur-like processes (one small and one larger); phallus one-segmented, distiphallus with two spur-like processes on each side, one pointed dorsally, the other pointed ventrally (Fig. 9D–F).

Female

Similar to male except for normal sexual dimorphism and as follows: frons shiny black, with pale pollinosity along eye margin on ventral ½ between antennae and anterior ocellus; postalar callus black; sternum 2 dark on anterior ½ and pale on posterior ½.

Geographical distribution

Species only known from Tahiti (French Polynesia).

Status in French Polynesia

Endemic.

Flowers visited

No records.

Genetics

The GenBank accession numbers for this species are: 28S gene (MF446466, specimen ZFMK-DIP-00019707), 18S gene (MF446421, specimen ZFMK-DIP-00019707), protein-coding COI gene (MF446515, specimen ZFMK-DIP-00019707; MF446522, specimen ZFMK-DIP-00019706). The BOLD Process IDs for the DNA barcodes (5′–COI) for this species are: SYC2242-14 (= KX054855, specimen symbiocode_02320), and SYC4350-14 (= KX054856, specimen symbiocode_04430). The Barcode Index Number (BIN) for these specimens is BOLD:ACN3906 (https://doi.org/10.5883/BOLD:ACN3906).

References

Ramage *et al*. 2017 (as Syrphidae, unknown; symbiocode_02320 and symbiocode_04430).

Remarks

A singular species due to its coloration, found at relatively high altitudes on Tahiti (Society Islands). A male paratype (symbiocode_02320) was completely destroyed during the DNA extraction and only its DNA template remains in the Laboratoire de Biométrie et Biologie Evolutive, Université de Lyon, France.

Species of the genus *Melanostoma* Schiner, 1860 occur in all biogeographic regions except the Neotropics. This new species differs from the other species of *Melanostoma* in the Australasian and Oceanian Regions, namely *M. univittatum* (Wiedemann, 1824), *M. apicale* Bigot, 1884, *M. fasciatum* (Macquart, 1850) and *M. fumivenosum* Doesburg, 1966, by the dark body coloration, very small facial tubercle and distinct male genitalia (Burt & Mengual 2018). Below we provide a key to the species of *Melanostoma* in the Australasian and Oceanian Regions.

Ornidia obesa (Fabricius, 1775)
Fig. 4B, E

Syrphus obesus Fabricius, 1775: 763 (lectotype: ♂, UZMC, designated by Thompson (1981: 195); type locality: St. Croix, Virgin Islands, as "America").
Volucella obesoides Giglio-Tos, 1892: 4.
Musca nero Curtiss, 1938: 157.

Musca obesa – Gmelin 1790: 2868 (subsequent combination).

Differential diagnosis

Among the flower flies present in French Polynesia, *O. obesa* is the only species with a metallic coloration, three facial tubercles and a plumose arista (Fig. 4B, E).

Material examined

FRENCH POLYNESIA: **Austral Islands**: 1 ♀, 3 ♂♂, Rapa Iti, Ahurei Village, inside house, 27°37′14.7″ S, 144°20′08.4″ W, 26 Mar. 2017, F. Jacq leg. (2 ♂♂: CTR; 1 ♀, 1 ♂: ZFMK: ZFMK-DIP-00027860, ZFMK-DIP-00027861). – **Gambier Islands**: 6 ♂♂, Mangareva, Rikitea, restaurant, 2 Apr. 1966, P. Cochereau leg. (MNHN); 1 ♀, 1 ♂, Mangareva, Rikitea, on flowers, 4 Apr. 1966, P. Cochereau leg. (MNHN); 1 ♂, Mangareva, Rikitea, hand net, 22 Apr. 1966, P. Cochereau leg. (MNHN). – **Marquesas Islands**: 1 ♂, Tahuata, Hanateio Valley, 180 m a.s.l., 25 Jul. 1930, Le Bronnec and H. Tauraa leg. (NBCN). – **Society Islands**: 1 ♀, 1 ♂, Bora Bora, Col Vaipapa, 4 Nov. 2012, F. Jacq leg. (1 ♀: CTR; 1 ♂: ZFMK: ZFMK DIP-00019747); 2 ♀♀, 2 ♂♂, Moorea, Jan. 1986, J. David leg. (MNHN); 1 ♀, Moorea, Feb. 1986, J. David leg. (MNHN); 1 ♀, Moorea, Gump Station, 17°29′25″ S, 149°49′35″ W, Aug. 2006, A. Duplouy leg. (SCL: symbiocode_01030); 1 ♀, Moorea, Maharepa, 17°28′59″ S, 149°48′37″ W, Nov. 2006, T. Sogado leg. (SCL: symbiocode_00899); 1 ♀, 1 ♂, Moorea, Gump Station, 17°29′25″ S, 149°49′35″ W, 17 Jan. 2007, A. Duplouy leg. (SCL); 1 ♂, Moorea, Opunohu, Trois Cocotiers Trail, 17°31′40″ S, 149°50′06″ W, 300 m a.s.l., 6 Jun. 2007, S. Charlat leg. (SCL: symbiocode_04748); 1 ♂, Moorea, 17°32′48.8″ S, 149°50′25.2″ W, 340 m a.s.l., 6 Jun. 2007, S. Charlat leg. (SCL); 1 ♀, Raiatea, Faaora Bay, 16°49′00.5″ S, 151°23′58.5″ W, 300 m a.s.l., 26 Jun. 2007, S. Charlat leg. (SCL: symbiocode_05168); 2 ♂♂, Raiatea, Te Mehani Rahi, 16°45′56″ S, 151°27′59.9″ W, 390 m a.s.l., 29 Jun. 2007, S. Charlat

leg. (SCL: symbiocode_05477, symbiocode_05478); 1 ♂, Raiatea, Te Mehani Rahi, 21 Mar. 2010, T. Ramage leg. (CTR); 1 ♂, Raiatea, Faaroa, 2015, F. Jacq leg. (CTR); 2 ♂♂, Tahiti (MNHN); 1 ♀, Tahiti, Faa'a, Jun. 1959, J. Rageau leg. (MNHN); 2 ♀♀, Tahiti, Punaauia, Jun. 1959, J. Rageau leg. (MNHN); 4 ♀♀, 1 ♂, Tahiti, municipal discharge of Papeete, 29 Apr. 1992, H. Labrousse leg. (MNHN); 2 ♂♂, Tahiti, Mount Mauru, 17°37′34.4″ S, 149°19′17.4″ W, 400 m a.s.l., 13 Jun. 2007, S. Charlat leg. (SCL: symbiocode_02694, symbiocode_02695); 1 ♀, Tahiti, 17°37′52.3″ S, 149°21′05.6″ W, 800 m a.s.l., 13 Jun. 2007, S. Charlat leg. (SCL: symbiocode_02945); 1 ♂, Tahiti, Vallée de la Fautaua, 17°34′58.76″ S, 149°31′51.35″ W, 205 m a.s.l., 19 Sep. 2012, T. Ramage leg. (CTR); 1 ♂, Tahiti, Tahiti Iti, Mount Te Atara Trail, 17°46′53.67″ S, 149°15′3.90″ W, 680 m a.s.l., 20 Sep. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019726); 2 ♀♀, 1 ♂, Tahiti, Arue, 17°32′8.26″ S, 149°31′6.74″ W, 200 m a.s.l., 16 Sep. 2012, T. Ramage leg. (1 ♀: CTR; 1 ♀, 1 ♂: ZFMK: ZFMK-DIP-00019727, ZFMK-DIP-00019728); 1 specimen, Tahiti, Papeete, Sainte-Amélie, Dec. 2014, F. Jacq leg. (CTR); 1 ♂, Tahiti, Mont Marau, 1400 m a.s.l., 27 Aug. 2017, T. Ramage and F. Jacq leg. (ZFMK: ZFMK-DIP-00026901).

Geographical distribution

Pantropical: from southern USA south to Argentina, including the West Indies, introduced in the Afrotropical (including Madagascar, Mauritius, Reunion and Seychelles), Oriental and Australasian Regions, and Oceania.

Status in French Polynesia

Introduced; recorded from Marquesas Islands, Gambier Islands, Austral Islands and Society Islands.

Flowers visited

Ornidia obesa has been observed visiting two plant species, belonging to two families: *Citharexylum spinosum* L. (Verbenaceae) and *Rauvolfia sachetiae* Fosberg (Apocynaceae), the latter being endemic to French Polynesia.

Genetics

The BOLD Process IDs for the DNA barcodes (5′–COI) for this species are: SYC881-14 (= KX054267, specimen symbiocode_00899), SYC1010-14 (= KX054269, specimen symbiocode_01030), SYC2616-14 (= KX054271, specimen symbiocode_02694), SYC2617-14 (= KX054270, specimen symbiocode_02695), SYC2866-14 (= KX054268, specimen symbiocode_02945), SYC4668-14 (= KX054274, specimen symbiocode_04748), SYC5085-14 (=KX054272, specimen symbiocode_05168), SYC5392-14 (= KX054266, specimen symbiocode_05477) and SYC5393-14 (= KX054273, specimen symbiocode_05478). The Barcode Index Number (BIN) for these specimens is BOLD:AAZ6930 (https://doi.org/10.5883/BOLD:AAZ6930).

References

Bezzi 1928: 77 (records); Curtiss 1938: 157 (description, Tahiti); Hull 1937: 83 (catalogue); Aubertin & Cheesman 1929: 173 (records); Thompson 1989: 16 (cit.); Thompson & Vockeroth 1989: 447 (catalogue).

Remarks

Thompson (2013) listed *Musca vespasianus* Curtiss, 1938 as a synonym of *O. obesa*. From the original publication, there is no doubt that the synonym of *O. obesa* is *Musca nero* and not *M. vespasianus*, which is smaller, has spotless wings and black and white legs. This is merely an error in Thompson (2013).

Palpada vinetorum (Fabricius, 1798)
Figs 4G, 5A

Syrphus vinetorum Fabricius, 1798: 562 (as *vinctorum*, emended by Fabricius 1799: 48) (type: UZMC, only a name label remains (Zimsen 1964: 478); type locality: "America Insulis").
Musca surinamensis de Geer, 1776: 145.
Eristalis trifasciatus Say, 1829: 165.
Eristalis decora Perty, 1833: 185.
Eristalis uvarum Walker, 1849: 623.
Eristalomyia croceipes Bigot, 1880: 227.
Eristalis souloughensis Bigot, 1880: 228.
Doliosyrphus hirtipes Bigot, 1883: 121.
Eristalis trilimbatus Giglio-Tos, 1892: 5.

Differential diagnosis

Species with pilose postpronotum, vein R4+5 strongly sinuate (Fig. 5A), metafemur with basoventral patch of black setulae and scutum usually with two grey pollinose fasciae.

Material examined

FRENCH POLYNESIA: **Gambier Islands**: 1 ♂, Mangareva, Belvédère, 28 May 2012, F. Jacq leg. (CTR). – **Marquesas Islands**: 2 ♀♀, 1 ♂, Hiva Oa, 5 Mar. 2013, F. Jacq leg. (CTR). – **Society Islands**: 2 ♂♂, Huahine, Pohue Rahi, 16°46′54.3″ S, 150°58′12.4″ W, 200 m a.s.l., 4 Jul. 2007, S. Charlat leg. (SCL: symbiocode_09742, symbiocode_09743); 2 ♂♂, Huahine, Pointe Tiva, 16°49′15.11″ S, 150°59′0.61″ W, 2 m a.s.l., 21 Sep. 2012, T. Ramage leg. (CTR); 4 ♂♂, Huahine, 16°49′11.08″ S, 150°58′59.56″ W, 6 m a.s.l., 21 Sep. 2012, T. Ramage leg. (2 ♂♂: CTR; 2 ♂♂: ZFMK: ZFMK-DIP-00019734, ZFMK-DIP-00019735); 1 ♀, Huahine, 16°49′17.31″ S, 150°59′4.42″ W, 5 m a.s.l., 22 Sep. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019733); 1 ♀, 1 ♂, Raiatea, Te Mehani Rahi, 16°45′56.9″ S, 151°27′24.6″ W, 460 m a.s.l., 28 Jun. 2007, S. Charlat leg. (SCL); 1 ♂, same collection data as preceding (SCL: symbiocode_05523); 1 ♀, Raiatea, 16°45′36.1″ S, 151°29′19.4″ W, 29 Jun. 2007, S. Charlat leg. (SCL); 2 ♀♀, Raiatea, 16°45′56.0″ S, 151°27′59.9″ W, 390 m a.s.l., 29 Jun. 2007, S. Charlat leg. (SCL: symbiocode_05482, symbiocode_05488); 1 ♀, Raiatea, 27 Apr. 2012, F. Jacq and T. Laroche leg. (CTR); 1 ♂, Raiatea, Te Mehani 'ute 'ute, 16°46′51.12″ S, 151°27′39.39″ W, 645 m a.s.l., 25 Sep. 2012, T. Ramage, F. Jacq and T. Laroche leg. (CTR); 1 ♀, Raiatea, Faaroa, 2015, F. Jacq leg. (CTR); 1 ♀, Raiatea, Opoa, 18 May 2015, F. Jacq leg. (CTR); 1 ♀, Taha'a, Paripari, 16°35′20.29″ S, 151°31′47.16″ W, 30 m a.s.l., 29 Sep. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019732); 1 ♀, Tahiti, Mount Mauru, 17°37′33.3″ S, 149°19′58.6″ W, 525 m a.s.l., 13 Jun. 2007, S. Charlat leg. (SCL: symbiocode_02652); 2 ♂♂, Tahiti, 17°37′52.3″ S, 149°21′05.6″ W, 800 m a.s.l., 13 Jun. 2007, S. Charlat leg. (SCL: symbiocode_02946); 1 ♂, Tahiti, Mont Marau, 1400 m a.s.l., 27 Aug. 2017, T. Ramage and F. Jacq leg. (ZFMK-DIP-00026900); 1 ♂, Tahiti, Arue, 17°32′8.26″ S, 149°31′6.74″ W, 200 m a.s.l., 16 Sep. 2012, T. Ramage leg. (CTR); 1 ♂, Tahiti, Vallée de la Papenoo, Plateau de Anaorii, 17°39′47.85″ S, 149°25′18.24″ W, 675 m a.s.l., 2 Oct. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00046222); 1 ♀, Tahiti, Papeete, Sainte-Amélie, Nov. 2013, F. Jacq leg. (ZFMK: ZFMK-DIP-00019738).

Geographical distribution

From USA to Argentina, the West Indies and French Polynesia.

Status in French Polynesia

Introduced; recorded from Marquesas Islands, Gambier Islands and Society Islands.

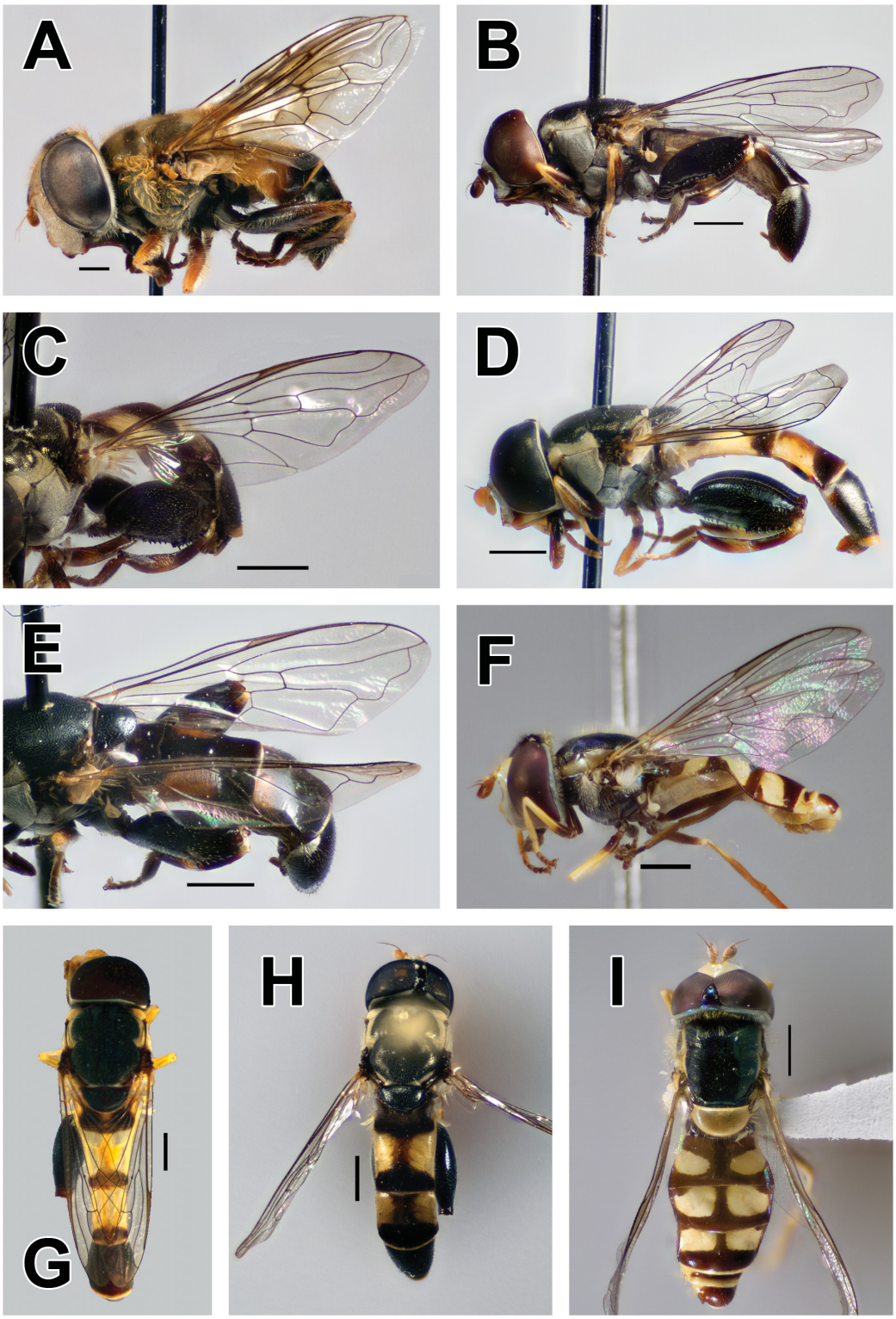

Fig. 5. A. *Palpada vinetorum* (Fabricius, 1798), ♀ (ZFMK-DIP-00019738), lateral view. **B, E**. *Syritta oceanica* (Macquart, 1855), ♀ (ZFMK-DIP-00019724). B. Lateral view. E. Detail of wing and abdomen. **C–D, H**. *Syritta aenigmatopatria* Hardy, 1964, ♀ (ZFMK-DIP-00019739). C. Wing and metaleg. D. Lateral view. H. Dorsal view. **F, I**. *Simosyrphus grandicornis* (Macquart, 1842), ♂ (ZFMK-DIP-00019736). F. Lateral view. I. Dorsal view. **G**. *Syritta aenigmatopatria* Hardy, 1964, ♂ (ZFMK-DIP-00019746), dorsal view. Scale bars = 1 mm.

Flowers visited

Palpada vinetorum has been seen visiting the flowers of 14 plant species in 12 families: *Emilia fosbergii* Nicolson, *Sphagneticola trilobata* (L.) Pruski, *Tridax procumbens* L. (Asteraceae), *Heliotropium foertherianum* Diane & Hilger (Boraginaceae), *Weinmannia vescoi* Drake (Cunoniaceae), *Euphorbia fosbergi* (J.Florence) Govaerts (Euphorbiaceae), *Hyptis capitata* Jacq. (Lamiaceae), *Geniostoma clavatum* J.W.Moore (Loganiaceae), *Pemphis acidula* J.R.Forst. & G.Forst. (Lythraceae), *Bougainvillea* sp. (Nyctaginaceae), *Ludwigia octovalvis* (Jacq.) P.H.Raven (Onagraceae), *Portulaca oleracea* L. cv. Wild Fire (Portulacaceae), *Gardenia taitensis* DC. (Rubiaceae) and *Lantana camara* L. (Verbenaceae). Three of these plants, i.e., *W. vescoi*, *E. fosbergi* and *G. clavatum*, are endemic to French Polynesia.

Genetics

The BOLD Process IDs for the DNA barcodes (5′–COI) for this species are: SYC2574-14 (= KX054301, specimen symbiocode_02652), SYC2867-14 (= KX054303, specimen symbiocode_02946), SYC5397-14 (= KX054299, specimen symbiocode_05482), SYC5403-14 (= KX054302, specimen symbiocode_05488), SYC5438-14 (= KX054298, specimen symbiocode_05523), SYC9601-14 (= KX054300, specimen symbiocode_09742) and SYC9602-14 (= KX054304, specimen symbiocode_09743). The Barcode Index Number (BIN) for these specimens is BOLD:AAY9710 (https://doi.org/10.5883/BOLD:AAY9710).

References

Thompson 1989: 16 (cit., records); Thompson & Vockeroth 1989: 451 (catalogue).

Remarks

Thompson (1989) reported this Neotropical species for the first time in the south Pacific Region and estimated a very recent introduction to this archipelago. The first records date back to 1984 and were from Moorea.

Simosyrphus grandicornis (Macquart, 1842)
Figs 5F, I, 6B

Syrphus grandicornis Macquart, 1842: 96 (holotype: ♂, MNHN; type locality: Australia, Sydney, Port Jackson).
Syrphus sydneyensis Macquart, 1846: 263.
Syrphus pusilla Macquart, 1847: 77.
Syrphus melanurus Bigot, 1884: 97.
Syrphus obesus Hutton, 1901: 41.
Syrphus vitiensis Bezzi, 1928: 71.
Ischiodon scutellaris Bryan, 1934: 412.
Metasyrphus fasciatus Shiraki, 1963: 186.
Syrphus australiensis Van der Goot, 1964: 220.
Syrphus huttoni Van der Goot, 1964: 220.

Differential diagnosis

Simosyrphus grandicornis has often been confused with species of *Ischiodon*, especially *I. scutellaris*, as they are sympatric and the males of both species have large genitalia. The morphological characteristics to distinguish *S. grandicornis* are the broadly rounded basoflagellomere (subacute apically in *I. scutellaris*), black katepisternum (Fig. 5F) (with a dorsal yellow marking in *I. scutellaris*; Fig. 3G), simple male metatrochanter (Fig. 6B) (with a spine-like process in *I. scutellaris*, Fig. 6A) and black metafemur, yellow on the apical fourth (mostly yellow, black only subapically in *I. scutellaris*).

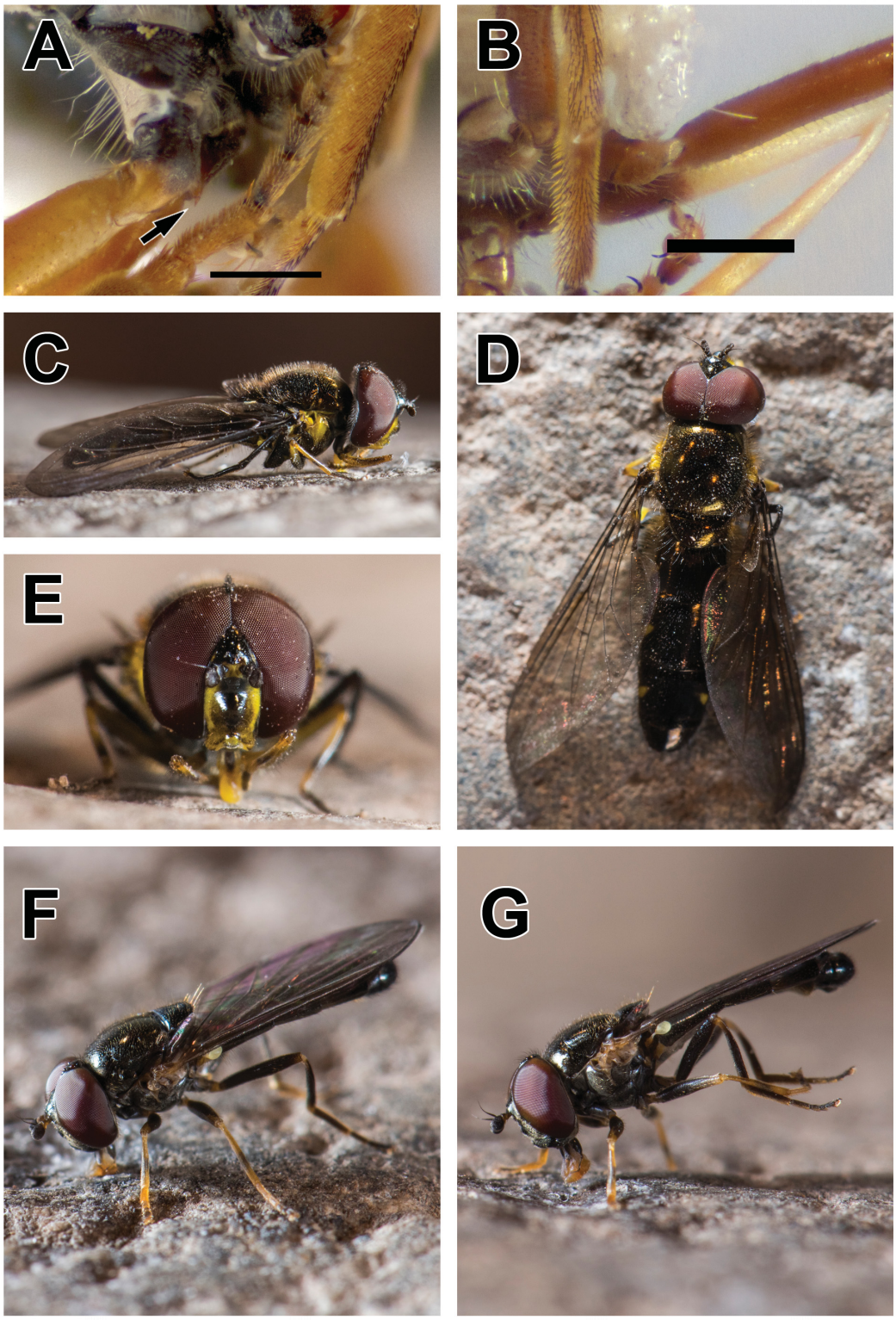

Fig. 6. A. *Ischiodon scutellaris* (Fabricius, 1805), ♂ (ZFMK-DIP-00019713), metacoxa and metatrochanter. Arrow indicates the ventral spine-like process. **B**. *Simosyrphus grandicornis* (Macquart, 1842), ♂ (ZFMK-DIP-00019736), metacoxa and metatrochanter. **C–E**. *Allograpta jacqui* Mengual & Ramage sp. nov., holotype ♂ (ZFMK-DIP-00026906). C. Lateral view. D. Dorsal view. E. Frontal view. **F–G**. *Melanostoma polynesiotes* Mengual & Ramage sp. nov., paratype, ♂ (ZFMK-DIP-00026902). F. Dorsolateral view. G. Lateral view. Scale bars = 0.5 mm.

Material examined

Not collected or studied from French Polynesia, but Nishida (2008) reported it from the Society Islands. We believe that Nishida's records might be a misidentification of *I. scutellaris*.

Geographical distribution

Very common Australasian species, found throughout Oceania (from New Caledonia and Fiji to Hawaii), New Zealand and Australia (all states). *Simosyrphus grandicornis* is absent from the island of New Guinea.

Status in French Polynesia

Unknown.

Flowers visited

No records.

References

Nishida 2008 (list).

Remarks

Among the material examined there were no individuals of this species from French Polynesia; thus, we believe that *S. grandicornis* is not present in the archipelago. Mengual (2015) stated that the dispersal of this species into many of the occupied Oceanic islands in its range was due to human activities, probably introduced by the early Polynesians who might have brought them in as larvae on fruits and plants they were transporting. Because it is plausible that *S. grandicornis* will reach the islands of French Polynesia in the near future, we have included this species in the identification key (indicated with an asterisk *).

Syritta aenigmatopatria Hardy, 1964
Figs 4F, 5C–D, G–H

Syritta aenigmatopatria Hardy, 1964: 409 (holotype: ♂, BPBM; type locality: USA, Hawaii, Oahu).

Differential diagnosis

Species with vein R4+5 straight, metafemur without basoventral patch of black setulae, arista bare, face carinate (Fig. 4F) and metafemur greatly enlarged with a ctenidium on the posteroventral half. It is similar to *S. oceanica*, but differs by having the spurious vein well sclerotized (Fig. 5C), as distinct as the neighboring R and M veins (spurious vein not sclerotized in *S. oceanica*, only formed by microtrichia; Fig. 5B, E), the ventral surface of the metatibia with an anteroventral carina forming a prominent lamina in males, less evident in females (metatibia without lamina in *S. oceanica*) and a distinct abdominal coloration, as stated in the key.

Material examined

FRENCH POLYNESIA: **Society Islands**: 1 ♂, Tahiti, Plateau Te Tamanu, 17°38′7.41″ S, 149°33′0.28″ W, 590 m a.s.l., 6 Oct. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019746); 1 ♂, Tahiti, 17°38′0.40″ S, 149°33′12.57″ W, 560 m a.s.l., 6 Oct. 2012, T. Ramage leg. (ZFMK: ZFMK-DIP-00019731); 1 ♀, Tahiti, Papeete, Sainte-Amélie, Dec. 2013, F. Jacq leg. (ZFMK: ZFMK-DIP-00019739).

Geographical distribution

Widely distributed in the Oriental and Oceanic Regions: Vietnam, Sumatra, Java, Philippines, Palau Islands, Samoa, Mariana Islands, Hawaii and French Polynesia.

Status in French Polynesia

New species record; known from the Society Islands.

Flowers visited

No records.

Genetics

The GenBank accession numbers for this species are: 28S gene (MF446467, specimen ZFMK-DIP-00019746; MF446470, specimen ZFMK-DIP-00019731), 18S gene (MF446422, specimen ZFMK-DIP-00019746; MF446425, specimen ZFMK-DIP-00019731), protein-coding COI gene (MF446517, specimen ZFMK-DIP-00019746; MF446521, specimen ZFMK-DIP-00019731).

Remarks

This is a new species record, since this taxon has not previously been recorded from French Polynesia.

Syritta oceanica Macquart, 1855
Fig. 5B, E

Syritta oceanica Macquart, 1855: 112 (155) (holotype: ♀, OUMNH; type locality: French Polynesia, Society Islands, Tahiti; original type locality as "De l'Oceanie, Otaïti et Nouvelle Zealande").
Syritta occanica Macquart, 1855: 112 (misspelling).

Differential diagnosis

See above under *S. aenigmatopatria*.

Material examined

FRENCH POLYNESIA: **Society Islands**: 1 ♂, Bora Bora, 12 Jun. 1925, L.E. Cheesman leg. (MNHN); 1 ♂, Huahine, Pohue Rahi, 16°46′51.2″ S, 150°58′34.7″ W, 470 m a.s.l., 4 Jul. 2007, S. Charlat leg. (SCL: symbiocode_08023); 7 ♂♂, Huahine, Pointe Tiva, 16°49′15.11″ S, 150°59′0.61″ W, 5 m a.s.l., 21 Sep. 2012, T. Ramage leg. (4 ♂♂: CTR; 3 ♂♂: ZFMK: ZFMK-DIP-0019725, ZFMK-DIP-0019730, ZFMK-DIP-0019741); 1 ♀, Huahine, 16°49′17.31″ S, 150°59′4.42″ W, 5 m a.s.l., 22 Sep. 2012, T. Ramage leg. (CTR); 1 ♂, Raiatea, Faaroa Bay, 16°49′00.5″ S, 151°23′58.5″ W, 300 m a.s.l., 26 Jun. 2007, S. Charlat leg. (SCL: symbiocode_05171); 1 ♀, Raiatea, Opoa, Aratao, 11 Jul. 2013, F. Jacq leg. (ZFMK: ZFMK-DIP-00019724); 1 ♂, Raiatea, Faaroa, 2015, F. Jacq leg. (CTR). – **Tuamotu Islands**: 1 ♀, Vahanga, old village, 5 Jun. 2012, F. Jacq leg. (ZFMK: ZFMK-DIP-00026780).

Geographical distribution

South-central and central parts of the Pacific: Austral Islands over the Cook Islands, Marquesas Islands and Society Islands to the Hawaiian Islands (Lyneborg & Barkemeyer 2005).

Status in French Polynesia

Present; recorded from the Marquesas Islands, Society Islands, Austral Islands and Tuamotu Islands.

Flowers visited

Syritta oceanica has been seen visiting the flowers of three plant species in three families: *Heliotropium foertherianum* Diane & Hilger (Boraginaceae), *Pemphis acidula* J.R.Forst. & G.Forst. (Lythraceae) and *Citharexylum spinosum* L. (Verbenaceae).

Biology

See Terry (1910), although for Hawaiian specimens.

Genetics

The GenBank accession numbers for this species are: 28S gene (MF446469, specimen ZFMK-DIP-0019730), 18S gene (MF446424, specimen ZFMK-DIP-0019730), protein-coding COI gene (MF446519, specimen ZFMK-DIP-0019730). The BOLD Process IDs for the DNA barcodes (5′–COI) for this species are: SYC5088-14 (= KX054853, specimen symbiocode_05171) and SYC7899-14 (= KX054854, specimen symbiocode_08023). The Barcode Index Number (BIN) for these specimens is BOLD:ACN4472 (https://doi.org/10.5883/BOLD:ACN4472).

References

Macquart 1855: 112 (description); Bezzi 1928: 82 (cit.); Aubertin & Cheesman 1929: 173 (records); Hull 1937: 84 (catalogue, note); Thompson 1989: 16 (cit.); Thompson & Vockeroth 1989: 457 (catalogue); Lyneborg & Barkemeyer 2005: 168 (redescription, diagnosis, male genitalia, bionomics).

Remarks

We report here the first record of this species from the Tuamotu Islands. Lyneborg & Barkemeyer (2005) clarified the status of this species and the allopatric *Syritta luteinervis* de Meijere, 1908, and they explained the error of the New Zealand record for *S. oceanica*.

Key to the species of Syrphidae in French Polynesia

1. Postpronotum bare, head posteriorly strongly concave and closely appressed to thorax so that postpronotum is partly or entirely hidden (Fig. 2B–C); male abdomen with five unmodified pregenital segments; tergum 5 visible in dorsal view (Fig. 2A–D) 5
– Postpronotum pilose, head posteriorly less strongly concave so that postpronotum is clearly exposed (Fig. 5A–B); male abdomen with four unmodified pregenital segments; tergum 5 usually not visible in dorsal view (Fig. 5D–E, G) 2

2. Vein R4+5 strongly sinuate (Fig. 5A); metafemur with basoventral patch of black setulae ....***Palpada vinetorum*** (Fabricius, 1798)
– Vein R4+5 straight or nearly so (Fig. 5C, E); metafemur without basoventral patch of black setulae 3

3. Arista plumose (Fig. 4E); face with medial and two lateral tubercles (Fig. 4E); metafemur not enlarged, without ctenidium; entire body metallic green or purple (Fig. 4B) ....***Ornidia obesa*** (Fabricius, 1775)
– Arista bare (Fig. 4F); face carinate (Fig. 4F); metafemur greatly enlarged, with a ctenidium on posteroventral half (Fig. 5B–E); body coloration mainly black with pale markings (Fig. 5B–E, G–H) 4

4. Spurious vein well sclerotized, as distinct as the neighboring R and M veins (Fig. 5C, G); ventral surface of metatibia modified, with anteroventral carina forming a prominent lamina in males, less evident in females. Male: terga 2 and 3 with a broad yellow fascia not divided medially (Fig. 5G). Female: tergum 4 with a distinct yellow fascia on posterior margin (Fig. 5D) ....***Syritta aenigmatopatria*** Hardy, 1964
– Spurious vein not sclerotized, appears as a shadow formed by microtrichia (Fig. 5B, E); metatibia without lamina; terga 2 and 3 with a medial black vitta forming two lateral yellow maculae (Fig. 5E) .....***Syritta oceanica*** Macquart, 1855

5. Face and scutellum entirely black in ground color (Fig. 4A, D); metasternum greatly reduced, with deep anterior incision on each side (as in Fig. 9C) .....***Melanostoma polynesiotes*** sp. nov.
– Face and/or scutellum partially pale in color, usually yellow in ground color (Figs 3F, H, 6E); metasternum entire, not reduced 6

6. Face partly black, usually yellow with a medial black vitta (Fig. 3B, D, F); metasternum with at least some pile; abdomen without margin (Figs 2A–B, 3A) 8
– Face entirely yellow (Fig. 3H); metasternum bare; abdomen distinctly marginated on terga 2–5 (Figs 2D, 3G, 5F) 7

7. Katepisternum without a dorsal yellow macula but densely pollinose (Fig. 5F); scutellum usually with black and pale pile; male metatrochanter without any process or projection (Fig. 6B) ....***Simosyrphus grandicornis*** Macquart, 1842 *****
– Katepisternum with a dorsal yellow macula (Fig. 3G); scutellum with pale pile only; male metatrochanter with a ventral spine-like process or calcar (Fig. 6A) ....***Ischiodon scutellaris*** (Fabricius, 1805)

8. Scutum and scutellum entirely black (Figs 2B, 6C); abdominal terga 3 and 4 black with two small yellow maculae each, close to the lateral margin (Figs 2B, 6D) .....***Allograpta jacqi*** sp. nov.
– Scutum black with lateral yellow vitta (Figs 2A, 3A) and scutellum yellow with black medial macula (Fig. 2A, C); abdominal terga 3 and 4 black with a yellow fascia each (Figs 2A, C, 3A) ...9

9. Wing entirely microtrichose except cell R bare anterior to spurious vein basally; costal cell bare basally, less than ⅕ .....***Allograpta amphotera*** (Bezzi, 1928)
– Wing partly bare basomedially, cell BM bare on basal ⅓–½ or more, cell R bare anterior to bifurcation; costal cell bare on basal ⅓ .....***Allograpta nigripilosa*** (Hull, 1944)

Key to Australasian and Oceanian species of Melanostoma

1. Face with a distinct tubercle (Fig. 7C, E); male genitalia small (Fig. 7A, C) 4
– Face with only a trace of a tubercle, almost straight (Figs 4D, 7D, 9A); male genitalia greatly enlarged, usually visible externally (Figs 6G, 7B, D, 9B) 2

2. Abdominal terga entirely black (Figs 4A, 6F–G); legs partly black in both male and female (Figs 4C, 6F–G). Male genitalia: surstylus curved towards dorsal part (Fig. 9D) (French Polynesia) .....***M. polynesiotes*** sp. nov.
– Abdominal terga with large orange or yellow abdominal markings; male abdomen almost entirely orange with apical margins narrowly black and genitalic segments black (Figs 7B, D, 9B); female abdomen with pairs of large, narrowly separated pale maculae (Figs 7F, 8A); legs all orange, rarely metatibia with an indistinct medial brown band (Fig. 7B, E). Male genitalia: surstylus curved towards ventral part (Fig. 9G, I) 3

3. Male surstylus club-shaped apically (Fig. 9I). Female: frons extensively pollinose, with two small shiny areas above lunule and ventrad to anterior ocellus; shiny areas do not reach eye margin (Fig. 8B) (India, Sri Lanka, Thailand, Taiwan, Philippines, Borneo, Java, Central Moluccas: Buru) .....***M. univittatum*** (Wiedemann, 1824)
– Male surstylus tapers to slender acute apex (Fig. 9G). Female: frons mainly shiny with two large lateral pollinose maculae; shiny areas reach eye margin (Fig. 8C) (New Guinea, Australia, New Caledonia, Solomons, Fiji, Tonga, Samoa) .....***M. apicale*** Bigot, 1884

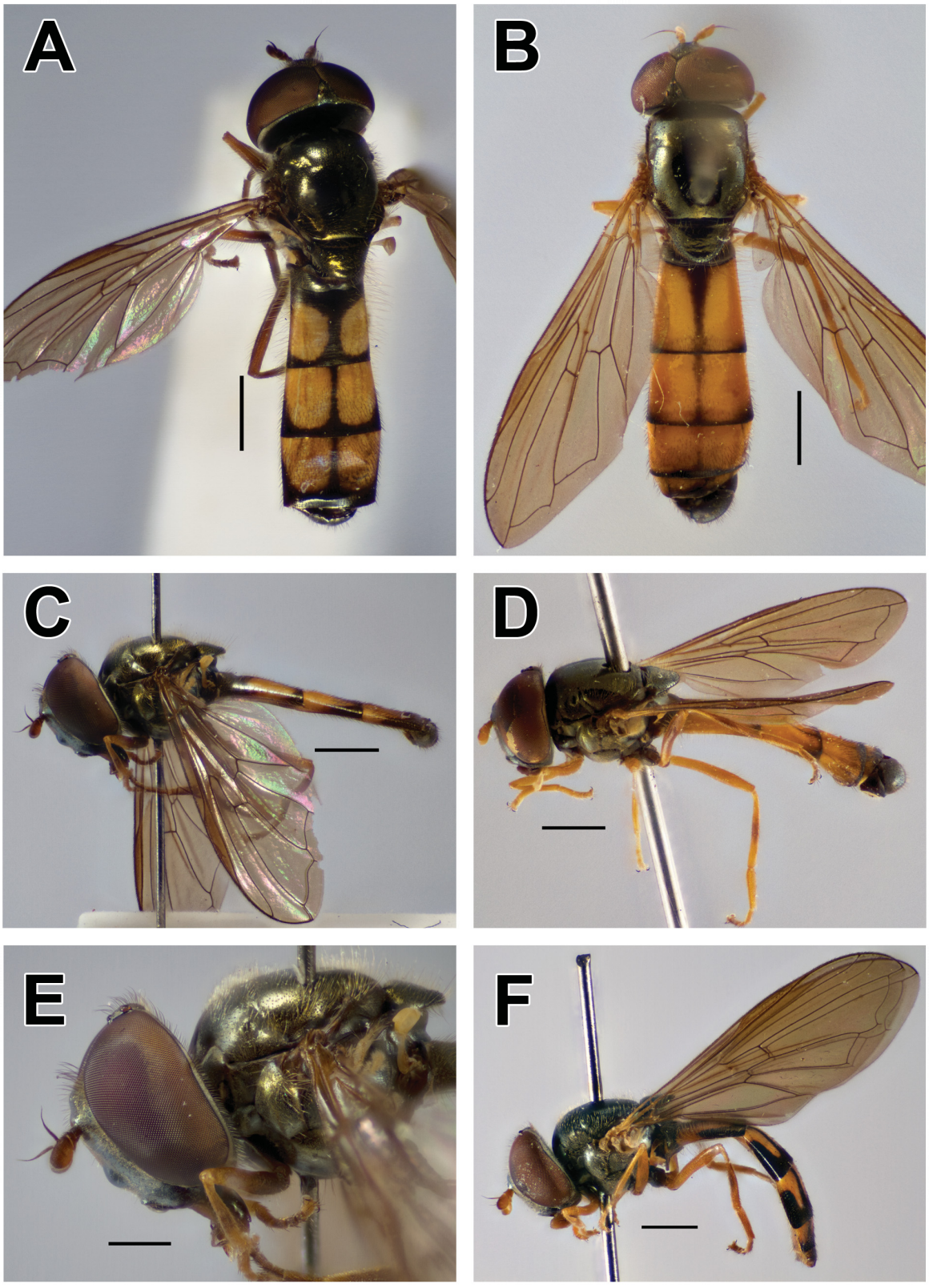

Fig. 7. A, C, E. *Melanostoma fasciatum* (Macquart, 1850), ♂ (AM_K407062). A. Dorsal view. C. Lateral view. E. Head and thorax, lateral view. **B, D**. *Melanostoma univittatum* (Wiedemann, 1824), ♂ (ZFMK-DIP-00019737). B. Dorsal view. D. Lateral view. **F**. *Melanostoma apicale* Bigot, 1884, ♀ (ZFMK-DIP-00019781), lateral view. Scale bars: A–D, F = 1 mm; E = 0.5 mm.

4. Abdominal terga with yellow maculae on terga 2–4, sometimes very large, but always with a medial continuous black vitta (Fig. 7A) (New Zealand) .....***M. fasciatum*** (Macquart, 1850)
– Abdominal terga entirely black, sometimes extensively dark pollinose (New Guinea) ....***M. fumivenosum*** Doesburg, 1966

Discussion

The study of the recently collected material and the specimens deposited in the MNHN and BMNH resulted in a new species record for French Polynesia, *Syritta aenigmatopatria*, and two species new to science, *Allograpta jacqi* sp. nov. and *Melanostoma polynesiotes* sp. nov. Due to the physical isolation of this archipelago from the neighboring mainlands, few syrphid species have reached its islands. The

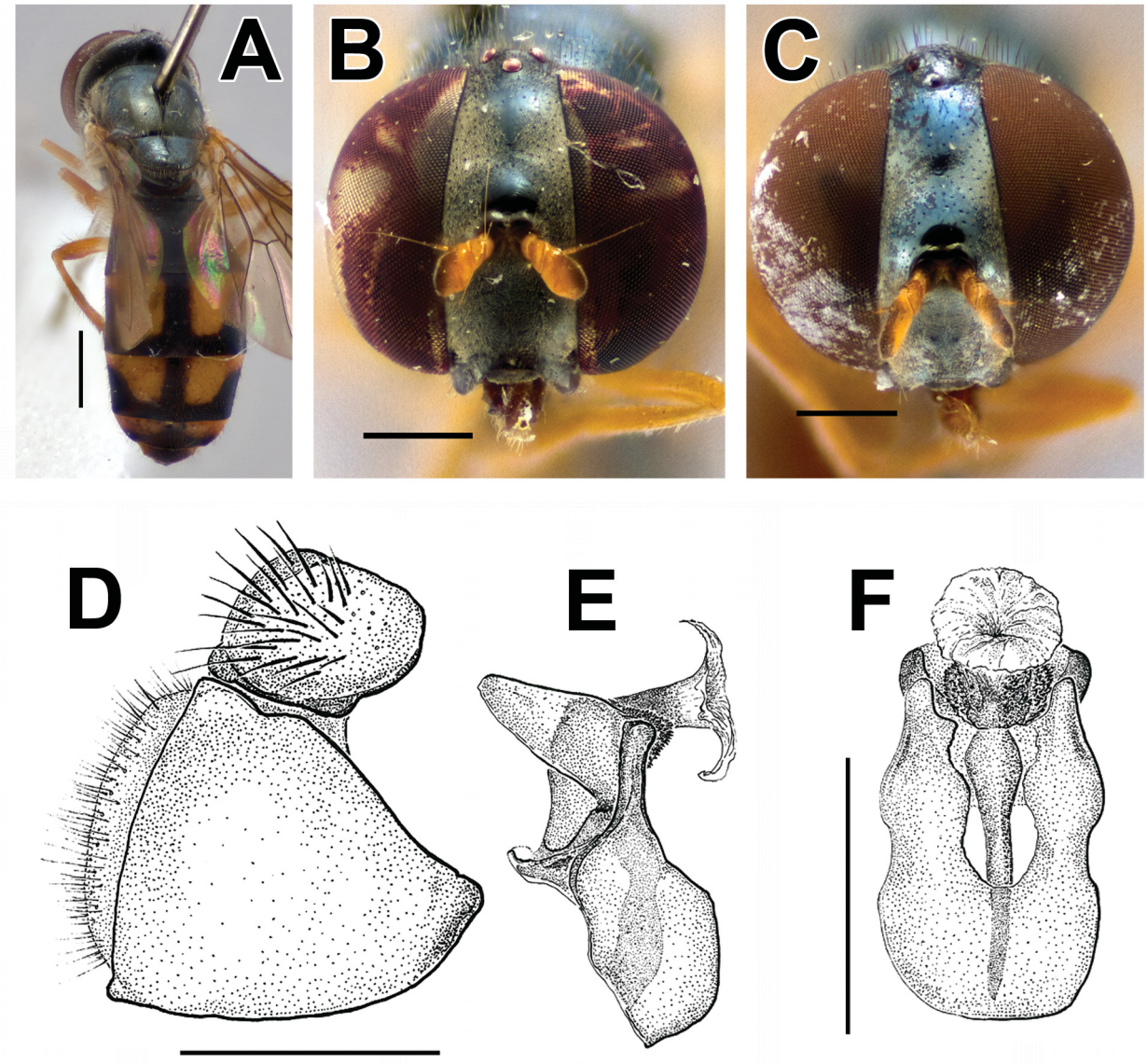

Fig. 8. A, C. *Melanostoma apicale* Bigot, 1884, ♀ (ZFMK-DIP-00019781). A. Posterior view. C. Head, frontal view. **B**. *Melanostoma univittatum* (Wiedemann, 1824), ♀ (ZFMK-DIP-00019740), head, frontal view. **D–F**. *Allograpta jacqui* Mengual & Ramage sp. nov., holotype, ♂ (ZFMK-DIP-00019707), genitalia. D. Epandrium with surstylus and cercus, lateral view. E. Hypandrium, lateral view. F. Hypandrium, ventral view. Scale bars: A–C = 1 mm; D–F = 0.5 mm.

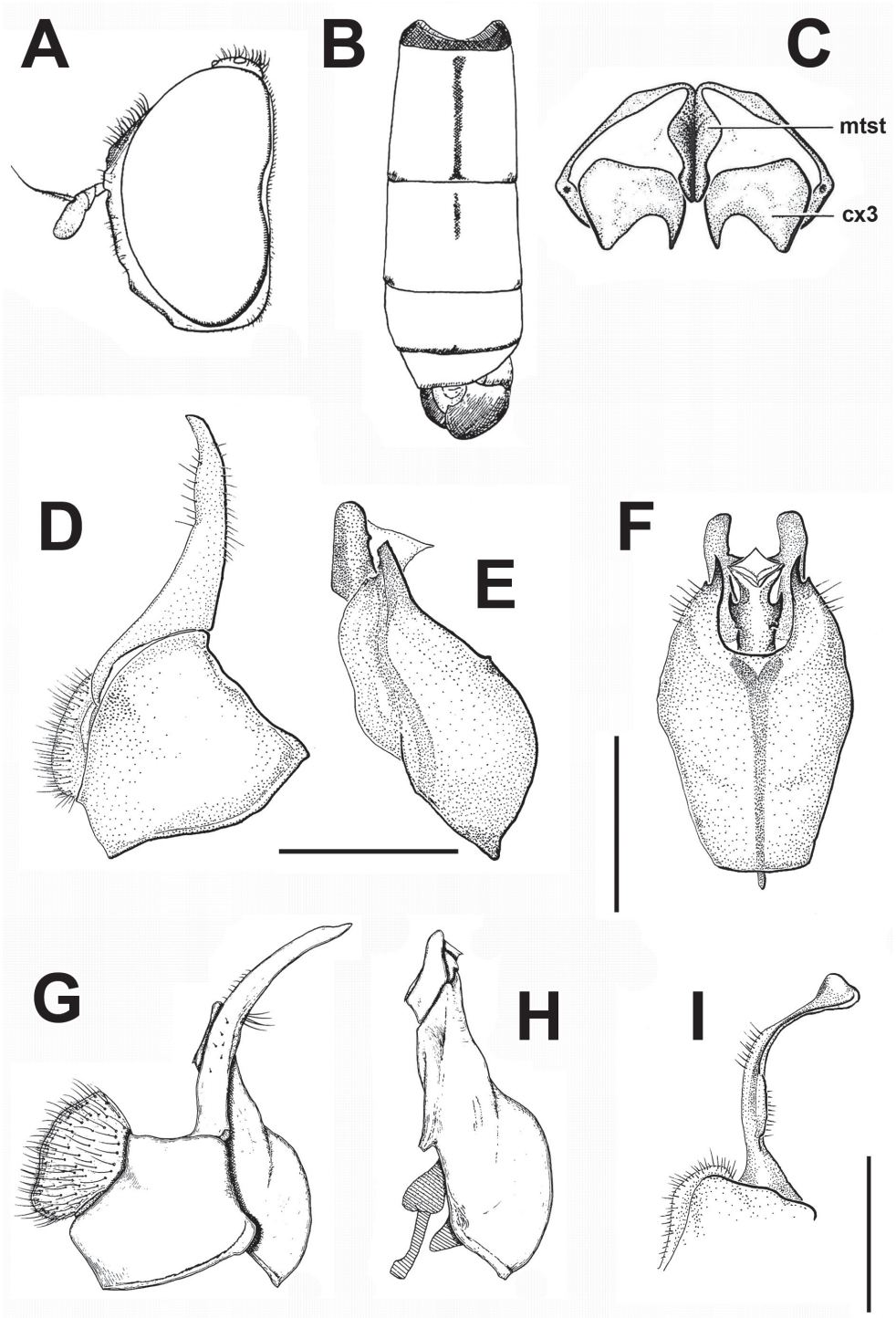

Fig. 9. A–B. *Melanostoma apicale* Bigot, 1884, ♂ (from Ôhara & Kusigemati 1985, as *M. univittatum* (Wiedemann, 1824)). A. Head, lateral view. B. Abdomen, dorsal view. **C.** *Melanostoma mellinum* (Linnaeus, 1758), ♂, metasternum, ventral view (from Vockeroth & Thompson 1987; mtst = metasternum, cx3 = metacoxa). **D–F**. *Melanostoma polynesiotes* Mengual & Ramage sp. nov., holotype, ♂ (ZFMK-DIP-00019707), genitalia. D. Epandrium with surstylus and cercus, lateral view. E. Hypandrium, lateral view. F. Hypandrium, ventral view. **G–H.** *M. apicale* Bigot, 1884, ♂, genitalia, lateral view (from Ôhara & Kusigemati 1985, as *M. univittatum* (Wiedemann, 1824)). G. Epandrium with surstylus and cercus. H. Hypandrium. **I**. *Melanostoma univittatum* (Wiedemann, 1824), ♂ (ZFMK-DIP-00019737), surstylus and part of epandrium and cercus, lateral view. Scale bars = 0.5 mm.

discovery of these new species in the mountainous areas of Tahiti prompts us to hypothesize that new endemics from French Polynesia are possible. With the newly obtained DNA barcodes, together with the barcodes obtained within the SymbioCode initiative, and with the taxonomy of *Allograpta amphotera* and *A. nigripilosa* to be corroborated, French Polynesia has become the first country in the world whose flower fly fauna is fully barcoded, a small but meritorious achievement. We hope that new material and new records will become available after this survey and that they help to resolve some taxonomic questions that remain open, such as the systematics of the genus *Melanostoma* in the Oceanian and Australasian Regions.

Acknowledgements

This study has been partly funded by the Société d'Histoire naturelle Alcide-d'Orbigny, the program Terres et Mers Ultramarines, the Société des Amis du Muséum, the Société entomologique de France (Grant Germaine Cousin) and the CNRS ATIP SymbioCode grant to SC. All these structures and programs are thanked for their trust; without them the ongoing studies on the entomofauna of French Polynesia would not exist. The collection of specimens in the Te Mehani 'ute 'ute plateau protected area was authorized by the management committee of the Te Mehani 'ute 'ute plateau protected area (N°521/2012, 8th of June, 2012). We also thank the Direction de l'Environnement de Polynésie Française to allow Fenua Environment, Fred Jacq and Thibault Ramage to collect specimens in the Te Faaiti National Park (agreement no. 4675).

This research received support from the SYNTHESYS Project (http://www.synthesys.info/), which is financed by the European Community Research Infrastructure Action under the FP7 "Capacities" Program; grant FR-TAF-5931 to XM.

We deeply thank Fred Jacq, Jean-François Butaud, Michel Charleux, Marie-Hélène Burle, François Sanz, Claire Etienne, Céline Robert, the Tetumu family, the Laroche family, the Masseron family, Romy Tavaearii, Terii Tetumu, Thierry Laroche, Jérôme Tarati, Jean-Yves Meyer, Jean-Claude Thibault, Ron Englund, Maruiti Terorotua, Noëlla Tutavae, the Association pour la protection de la vallée de Punaru'u, Caroline Blanvillain, Laurent Yan, Rainui Maraetefau and the SOP Manu for all their various contributions to the study of the arthropods of French Polynesia. We are indebted to Fred Jacq for letting us study the material he collected, for the map of Figure 1, and for the beautiful photographs of live specimens. We also thank Trevor Burt for the drawings of male genitalia of the new species (Figs 8D–F, 9D–F, I) and Jiří Hadrava for taking most of the photographs of pinned specimens that illustrate our work. We thank Claudia Etzbauer for her help in the molecular lab. Thanks to Nigel Wyatt (BMNH), Russell Cox (AMS), Peter Sehnal (NMW), Ben Brugge and Pasquale Ciliberti (NBCN) and Christophe Daugeron (MNHN) for letting us study the material in their care.

This paper was started by TR years ago with a preliminary key to identify the syrphids of French Polynesia. TR contributed with field work, specimens collected, observations of flowers visited and revision of the literature. TR and XM contributed with the identifications and examination of material. SC contributed with the laboratory protocols and most of the DNA barcodes. XM contributed with the diagnoses, new descriptions and identification keys, as well as with the figures. All authors collaborated on the final manuscript.

References

Amorós-Jiménez R., Pineda A., Fereres A. & Marcos-García M.A. 2014. Feeding preferences of the aphidophagous hoverfly *Sphaerophoria rueppellii* affect the performance of its offspring. *BioControl* 59: 427–435. https://doi.org/10.1007/s10526-014-9577-8

Aubertin D. & Cheesman L.E. 1929. Diptera of French Oceania. *Entomologist* 62: 172–176.

Bergh J.C. & Short B.D. 2008. Ecological and life-history notes on syrphid predators of woolly apple aphid in Virginia, with emphasis on *Heringia calcarata*. *BioControl* 53: 773–786. https://doi.org/10.1007/s10526-007-9114-0

Bezzi M. 1928. *Diptera Brachycera and Athericera of the Fiji Islands based on Material in the British Museum (Natural History)*. Trustees of the British Museum, London.

Bigot J.M.F. 1880. Diptères nouveaux ou peu connus. 14e partie, XXI: Syrphidi (mihi). – Genre *Eristalis* (Fabr.). *Annales de la Société entomologique de France*, série 5, 10: 213–230.

Bigot J.M.F. 1883. Diagnoses de genres et espèces inédits de Syrphidés (2e partie). *Bulletin des Séances de la Société entomologique de France* (6) 2: 120–122.

Bigot J.M.F. 1884. Diptères nouveaux ou peu connus. 24e partie (1), XXXII: Syrphidi (2e partie). Espèces nouvelles, No III (2). *Annales de la Société entomologique de France*, série 6, 4: 73–80, 81–116.

Bryan Jr. E.H. 1934. A review of the Hawaiian Diptera, with descriptions of new species. *Proceedings of the Hawaiian Entomological Society* 8: 399–468.

Burt T.O. & Mengual X. 2018. New records of *Melanostoma fumivenosum* (Diptera: Syrphidae) with the description of the male. *The Australian Entomologist* 45 (2): 209–216.

Carvalho Filho F. da S. & Esposito M.C. 2009. A review of the flower fly genus *Ornidia* Lepeletier & Serville (Diptera: Syrphidae) with the description of a new species from Brazil. *Zootaxa* 2014: 59–64. https://doi.org/10.5281/zenodo.185912

Chapin J.P. 1935. The Templeton Crocker Pacific Expedition. *The Scientific Monthly* 41 (3): 281–285.

Check E. 2006. Treasure island: pinning down a model ecosystem. *Nature* 439: 378–379. https://doi.org/10.1038/439378a

Cheesman L.E. 1928. A contribution towards the insect fauna of French Oceania. Part II. *Annals and Magazine of Natural History* 10 (1): 169–194. https://doi.org/10.1080/00222932808672762

Cochereau P. 1966. *Compte rendu d'une Mission d'Inventaire faunistique aux Îles Gambier et Tuamotu (Avril–Mai 1966)*. ORSTOM, Noumea, New Caledonia.

Cochereau P. 1974. Ébauche d'un inventaire faunistique de l'île de Mangareva (Archipel des Gambier). *Cahiers du Pacifique* 18 (2): 479–532.

Curran C.H. 1934. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. Diptera. *Proceedings of the California Academy of Sciences, 4th series* 21 (13): 147–172.

Curran C.H. 1936. The Templeton Crocker Expedition to western Polynesian and Melanesian islands, 1933. *Proceedings of the California Academy of Sciences, 4th series* 22 (1): 1–67.

Curtiss A. 1938. *A Short Zoology of Tahiti in the Society Islands*. Guide Printing, Brooklyn, NY, USA.

Doleschall C.L. 1856. Eerste bijdrage tot de kennis der dipterologische fauna van Nederlandsch Indië. *Natuurkundig Tijdschrift voor Nederlandsch Indië* 10: 403–414. https://biodiversitylibrary.org/page/13612961

Dumbardon-Martial E. 2016. Pollen feeding in the larva of *Toxomerus pulchellus* (Diptera, Syrphidae). *Bulletin de la Société entomologique de France* 121 (4): 413–420.

van Duzee E.P. 1937. The Hemiptera of the Templeton Crocker Expedition to Polynesia in 1934–1935. *Proceedings of the California Academy of Sciences, 4th series* 22 (4): 111–126.

Eckberg J.O., Peterson J.A., Borsh C.P., Kaser J.M., Johnson G.A., Luhman J.C., Wyse D.L. & Heimpel G.E. 2015. Field abundance and performance of hoverflies (Diptera: Syrphidae) on soybean aphid. *Annals of the Entomological Society of America* 108 (1): 26–34. https://doi.org/10.1093/aesa/sau009

Enderlein G. 1938. Beitrag zur Kenntnis der Syrphiden. *Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin* 1937: 192–237.

Fabricius J.C. 1775. *Systema Entomologiae, sistens Insectorum Classes, Ordines, Genera, Species, adiectis Synonymis, Locis, Descriptionibus, Observationibus*. Kortii, Flensbvrgi et Lipsiae [= Flensburg and Leipzig].

Fabricius J.C. 1798. *Entomologia Systematica emendata et aucta, secundum Classes, Ordines, Genera, Species adjectis Synonimis Locis Observationibus Descriptionibus*. Vol. II. Hafniae [= Copenhagen].

Fabricius J.C. 1799. *Index Alphabeticus in J. C. Fabricii Suppelementum Entomologiae Systematicae, Ordines, Genera et Species Continens*. C.G. Proft et Storch, Hafniae [= Copenhagen].

Fabricius J.C. 1805. *Systema Antliatorum: secundum Ordines, Genera, Species adiectis Synonymis, Locis, Observationibus, Descriptionibus*. Carolus Reichard, Brunsvigae [= Braunschweig, Germany].

Fluke C.L. 1942. Revision of the Neotropical Syrphini related to *Syrphus* (Diptera, Syrphidae). *American Museum Novitates* 1201: 1–24.

Fluke C.L. 1955. Los insectos de las Islas Juan Fernandez. 18. Syrphidae (Diptera). *Revista Chilena de Entomologia* 4: 39–43.

Frey R. 1946. Übersicht der Gattungen der Syrphiden-Unterfamilie Syrphinae (Syrphinae + Bacchinae). *Notulae Entomologicae* 25: 152–172.

de Geer C. 1776. *Mémoires pour servir à l'Histoire des Insectes.* Vol. 6. P. Hesselberg, Stockholm.

Giglio-Tos E. 1892. Diagnosi di nuove specie di Ditteri. VI. *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino* 7 (123): 1–7.

Gmelin J.F. 1790. *Caroli a Linné. Systema Naturae per Regna Tria Naturae: secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis. Editio decima tertia, aucta, reformata* [= Ed. 13], *Vol. 1: Regnum Animale, Pars 5*. G.E. Beer, Lipsiae [= Leipzig].

Hardy D.E. 1952. Notes and exhibitions. *Ischiodon penicillatus* (Hull). *Proceedings of the Hawaiian Entomological Society* 14: 363.

Hardy D.E. 1964. *Diptera: Brachycera, family Dolichopodidae. Cyclorrhapha, series Aschiza. Families Lonchopteridae, Phoridae, Pipunculidae, and Syrphidae*. Insects of Hawaii 11. University of Hawaii Press, Honolulu, HI, USA.

Hembry D.H., Okamoto T. & Gillespie R.G. 2012. Repeated colonization of remote islands by specialized mutualists. *Biology Letters* 8 (2): 258–261. https://doi.org/10.1098/rsbl.2011.0771

Hembry D.H., Okamoto T., McCormarck G. & Gillespie R.G. 2013a. Phytophagous insect community assembly through niche conservatism on oceanic islands. *Journal of Biogeography* 40 (2): 225–235. https://doi.org/10.1111/j.1365-2699.2012.02792.x

Hembry D.H., Kawakita A., Gurr N.E., Schmaedick M.A., Baldwin B.G. & Gillespie R.G. 2013b. Non-congruent colonizations and diversification in a coevolving pollination mutualism on oceanic islands. *Proceedings of the Royal Society B* 280 (1761): e20130361. https://doi.org/10.1098/rspb.2013.0361

Hull F.M. 1937. A check list of the Syrphidae of Oceania. *Occasional Papers of the Bernice P. Bishop Museum* 13 (10): 79–87.

Hull F.M. 1944. Some flies of the family Syrphidae in the British Museum (Natural History). *Annals and Magazine of Natural History* 11: 21–61. https://doi.org/10.1080/00222934408527401

Hutton F.W. 1901. Synopsis of the Diptera Brachyera of New Zealand. *Transactions and Proceedings of the Royal Society of New Zealand* 33: 1–95.

Inouye D., Larson B.M.H., Ssymank A. & Kevan P.G. 2015. Flies and flowers III: Ecology of foraging and pollination. *Journal of Pollination Ecology* 16 (16): 115–133.

Kertész K. 1899. Verzeichniss einiger, von L. Biró in Neu-Guinea und am malayischen Archipel gesammelten Dipteren. *Természetrajzi Füzetek* 22: 173–195.

Lardé G. 1989. Investigation on some factors affecting larval growth in a coffee-pulp bed. *Biological Wastes* 30: 11–19. https://doi.org/10.1016/0269-7483(89)90139-0

Lyneborg L. & Barkemeyer W. 2005. *The Genus* Syritta*: A World Revision of the Genus* Syritta *Le Peletier & Serville, 1828 (Diptera: Syrphidae)*. Entomonograph Volume 15. Apollo Books, Stenstrup, Denmark.

MacArthur R.H. & Wilson E.O. 1967. *The Theory of Island Biogeography*. Princeton University Press, Princeton, NJ, USA.

Macquart P.J.M. 1842. Diptères exotiques nouveaux ou peu connus. Tome deuxième, 2e partie. *Mémoires de la Société royale des Sciences, de l'Agriculture et des Arts de Lille* 1: 65–200.

Macquart P.J.M. 1846. Diptères exotiques nouveaux ou peu connus. Supplément [1]. *Mémoires de la Société royale des Sciences, de l'Agriculture et des Arts à Lille* 1844: 133–364.

Macquart P.J.M. 1847. Diptères exotiques nouveaux ou peu connus. Supplément [2]. *Mémoires de la Société royale des Sciences, de l'Agriculture et des Arts à Lille* 1846: 21–120.

Macquart P.J.M. 1855. Diptères exotiques nouveaux ou peu connus. 5e supplément. *Mémoires de la Société royale des Sciences, de l'Agriculture et des Arts de Lille* 2 (1): 25–156.

Martínez-Falcón A.P., Marcos-García M.A., Moreno C.E. & Rotheray G.E. 2012. A critical role for *Copestylum* larvae (Diptera, Syrphidae) in the decomposition of cactus forests. *Journal of Arid Environments* 78: 41–48. https://doi.org/10.1016/j.jaridenv.2011.10.010

Matsumura S. & Adachi J. 1916. Synopsis of the economic Syrphidae of Japan. Pl. [sic] [= Pt.] I. *The Entomological Magazine, Kyoto* 2: 1–36.

Matsumura S. & Adachi J. 1919. Synopsis of the economic Syrphidae of Japan. Pt. III. [sic] [= IV]. *The Entomological Magazine, Kyoto* 3: 128–144.

Mengual X. 2012. The flower fly genus *Citrogramma* Vockeroth (Diptera: Syrphidae): illustrated revision with descriptions of new species. *Zoological Journal of the Linnean Society* 164: 99–172. https://doi.org/10.1111/j.1096-3642.2011.00750.x

Mengual X. 2015. *Simosyrphus grandicornis* (common hover fly). Invasive Species Compendium. The Centre for Agriculture and Bioscience International (CABI).
Available from http://www.cabi.org/isc/datasheet/50061 [accessed 27 Apr. 2017].

Mengual X., Ståhls G. & Rojo S. 2008. Molecular phylogeny of *Allograpta* (Diptera, Syrphidae) reveals diversity of lineages and non-monophyly of phytophagous taxa. *Molecular Phylogenetics and Evolution* 49: 715–727. https://doi.org/10.1016/j.ympev.2008.09.011

Mengual X., Ruiz C., Rojo S., Ståhls G. & Thompson F.C. 2009. A conspectus of the flower fly genus *Allograpta* (Diptera: Syrphidae) with description of a new subgenus and species. *Zootaxa* 2214: 1–28. https://doi.org/10.5281/zenodo.189912

Mengual X., Ståhls G. & Rojo R. 2012. Is the mega-diverse genus *Ocyptamus* (Diptera, Syrphidae) monophyletic? Evidence from molecular characters including the secondary structure of 28S rRNA. *Molecular Phylogenetics and Evolution* 62: 191–205. https://doi.org/10.1016/j.ympev.2011.09.014

Mengual X. & Thompson F.C. 2015. Australian *Allograpta* Osten Sacken (Diptera, Syrphidae). *ZooKeys* 513: 65–78. https://doi.org/10.3897/zookeys.513.9671

Miller S.E. 1996. Biogeography of Pacific insects and other terrestrial invertebrates: A status report. *In*: Keast A. & Miller S.E. (eds) *The Origin and Evolution of Pacific Island Biotas, New Guinea to Eastern Polynesia: Patterns and Processes*: 463–475. Academic Publishers, Amsterdam.

Munroe E.G. 1996. Distributional patterns of Lepidoptera in the Pacific Islands. *In*: Keast A. & Miller S.E. (eds) *The Origin and Evolution of Pacific Island Biotas, New Guinea to Eastern Polynesia: Patterns and Processes*: 275–295. Academic Publishers, Amsterdam.

Nelson E.H., Hogg B.N., Mills N.J. & Daane K.M. 2012. Syrphid flies suppress lettuce aphids. *BioControl* 57: 819–826. https://doi.org/10.1007/s10526-012-9457-z

Nishida G.M. 2008. French Polynesia Diptera Checklist.
Available from essigdb.berkeley.edu/checklists/fpDiptera.doc [accessed 27 Apr. 2017].

Ôhara K. & Kusigemati K. 1985. Syrphidae of Solomon Islands and Fiji (Insecta, Diptera). *Kagoshima University Research Center South Pacific, Occasional Papers* 5: 81–86.
Available from http://hdl.handle.net/10232/15876 [accessed 8 Jun. 2018].

Osten Sacken C.R. 1877. Western Diptera: Descriptions of new genera and species of Diptera from the region west of the Mississippi and especially from California. *Bulletin of the United States Geological and Geographical Survey of the Territories* 3: 189–354.

Pérez-Bañón C., Juan A., Petanidou T., Marcos-García M.A. & Crespo M.B. 2003. The reproductive ecology of *Medicago citrina* (Font Quer) Greuter (Leguminosae): a bee-pollinated plant in Mediterranean islands where bees are absent. *Plant Systematics and Evolution* 241: 29–46.
https://doi.org/10.1007/s00606-003-0004-3

Perty J.A.M. 1833. *Delectus Animalium Articulatorum: quae in Itinere per Brasiliam, Annis MDCCXVII–MDCCCXX jussu et auspiciis Maximiliani Josephi I. Bavariae Regis Augustissimi peracto*: 125–224. F.S. Hubschmann, Monachii [= Munich] & Fleischer, Lipsiae [= Leipzig].

Pineda A. & Marcos-García M.A. 2008. Introducing barley as aphid reservoir in sweet-pepper greenhouses: effects on native and released hoverflies (Diptera, Syrphidae). *European Journal of Entomology* 105: 531–535. https://doi.org/10.14411/eje.2008.070

Ramage T. 2017. Checklist of the terrestrial and freshwater arthropods of French Polynesia (Chelicerata; Myriapoda; Crustacea; Hexapoda). *Zoosystema* 39 (2): 213–225. https://doi.org/10.5252/z2017n2a3

Ramage T., Martins-Simoes P., Mialdea G., Allemand R., Duplouy A., Rousse P., Davies N., Roderick G.K. & Charlat S. 2017. A DNA barcode-based survey of terrestrial arthropods in the Society Islands of French Polynesia: host diversity within the SymbioCode Project. *European Journal of Taxonomy* 272: 1–13. https://doi.org/10.5852/ejt.2017.272

Reemer M. & Rotheray G.E. 2009. Pollen feeding larvae in the presumed predatory syrphine genus *Toxomerus* Macquart (Diptera, Syrphidae). *Journal of Natural History* 43: 939–949.
https://doi.org/10.1080/00222930802610576

Ricarte A., Marcos-García M.A. & Moreno C.E. 2011. Assessing the effects of vegetation type on hoverfly (Diptera: Syrphidae) diversity in a Mediterranean landscape: implications for conservation. *Journal of Insect Conservation* 15: 865–877. https://doi.org/10.1007/s10841-011-9384-9

Roderick G.K. & Gillespie R.G. 2016. Arthropodes terrestres des îles Marquises: diversité et évolution. *In*: Galzin R., Duron S.-D. & Meyer J.-Y. (eds) *Biodiversité terrestre et marine des îles Marquises, Polynésie française*: 391–403. Société française d'Ichthyologie, Paris.

Rojo S., Gilbert F., Marcos-García M.A, Nieto J.M. & Mier M.P. 2003. *A World Review of Predatory Hoverflies (Diptera, Syrphidae: Syrphinae) and their Prey*. Centro Iberoamericano de la Biodiversidad (CIBIO), Alicante, Spain.

Rotheray G.E. & Gilbert F. 1999. Phylogeny of Palaearctic Syrphidae (Diptera): evidence from larval stages. *Zoological Journal of the Linnean Society* 127: 1–112. https://doi.org/10.1111/j.1096-3642.1999.tb01305.x

Rotheray G.E., Marcos-García M.A., Hancock G., Pérez-Bañón C. & Maier C.T. 2009. Neotropical *Copestylum* (Diptera, Syrphidae) breeding in Agavaceae and Cactaceae including seven new species. *Zoological Journal of the Linnean Society* 156 (4): 697–749. https://doi.org/10.1111/j.1096-3642.2008.00503.x

Rouzé H., Lecellier G.J., Saulnier D., Planes S., Gueguen Y., Wirshing H.H. & Berteaux-Lecellier V. 2017. An updated assessment of *Symbiodinium* spp. that associate with common scleractinian corals from Moorea (French Polynesia) reveals high diversity among background symbionts and a novel finding of clade B. *PeerJ* 5: e2856. https://doi.org/10.7717/peerj.2856

Sack P. 1913. H. Sauter's Formosa-Ausbeute. Syrphiden I. (Dipt.). *Entomologische Mitteilungen* 2: 1–10.

Say T. 1829. Descriptions of North American dipterous insects. *Journal of the Academy of Natural Sciences of Philadelphia* 6: 149–178.

Schmidt M.H., Thewes U., Thies C. & Tscharntke T. 2004. Aphid suppression by natural enemies in mulched cereals. *Entomologia Experimentalis et Applicata* 113: 87–93. https://doi.org/10.1111/j.0013-8703.2004.00205.x

Shiraki T. 1963. Diptera: Syrphidae. *Insects of Micronesia* 13: 129–187.

SNAC. 2016. SNAC (social networks and archival context). Crocker, Templeton, 1884–1948. Available from: http://socialarchive.iath.virginia.edu/ark:/99166/w6z60q6z [accessed 20 Apr. 2017].

Sommaggio D. 1999. Syrphidae: can they be used as environmental bioindicators. *Agriculture, Ecosystems and Environment* 74: 343–356. https://doi.org/10.1016/S0167-8809(99)00042-0

Sommaggio D. & Burgio G. 2014. The use of Syrphidae as functional bioindicator to compare vineyards with different managements. *Bulletin of Insectology* 67 (1): 147–156.

Speight M. & Lucas J. 1992. Liechtenstein Syrphidae (Diptera). *Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg* 19: 327–463.

Ssymank A. & Kearns C. 2009. Flies-pollinators on two wings. *In*: Ssymank A., Hamm A. & Vischer-Leopold M. (eds) *Caring for Pollinators – Safeguarding Agro-Biodiversity and Wild Plant Diversity*: 39–52. Bundesamt für Naturschutz, Bonn, Germany.

Terry F.W. 1910. Life-history of *Syritta oceanica* Macq. [Dipt.]. *Proceedings of the Hawaiian Entomological Society* 2 (3): 96–97.

Thompson F.C. 1981. Flower flies of the West Indies (Diptera: Syrphidae). *Memoirs of the Entomological Society of Washington* 9: 1–200.

Thompson F.C. 1989. *Palpada vinetorum* (Fabricius). *Proceedings of the Hawaiian Entomological Society* 29: 15–16.

Thompson F.C. 1999. A key to the genera of the flower flies of the Neotropical Region including the descriptions of genera and species and a glossary of taxonomic terms. *Contributions on Entomology, International* 3: 319–378.

Thompson F.C. 2013. Syrphidae. *Systema Dipterorum*, ver. 1.5. Available from http://www.diptera.org [accessed 8 Mar. 2017].

Thompson F.C. 2015. Flower flies of Eastern Island (Diptera: Syrphidae). *Entomologist's Monthly Magazine* 151: 130.

Thompson F.C. & Vockeroth J.R. 1989. 51. Family Syrphidae. *In*: Evenhuis N.L. (ed.) *Catalog of the Diptera of the Australasian and Oceanian Regions*: 437–458. Bishop Museum Special Publication 86. Bishop Museum Press, Honolulu and E.J. Brill, Leiden.

Thomson C.G. 1869. Diptera. Species nova descripsit. *In*: *Kongliga Svenska Fregatten Eugenies Resa omkring Jorden under Befäl af C.A. Virgin, åren 1851–1853*: 443–614. Vol. 2 (Zoologi), part 1 (Insecta). P. A. Norstedt & Söner, Stockholm.

Tscharntke T., Klein A.M., Kruess A., Steffan-Dewenter I. & Thies C. 2005. Landscape perspectives on agricultural intensification and biodiversity-ecosystem service management. *Ecology Letters* 8: 857–874. https://doi.org/10.1111/j.1461-0248.2005.00782.x

UICN France, MNHN & DIREN Polynésie française. 2015. La Liste rouge des espèces menacées en France – Chapitre Flore vasculaire endémique de Polynésie française. Available from http://uicn.fr/wp-content/uploads/2015/12/Liste_rouge_Flore_vasculaire_endemique_de_Polynesie_francaise.pdf [accessed 27 Apr. 2017].

Ureña O. & Hanson P. 2010. A fly larva (Syrphidae: *Ocyptamus*) that preys on adult flies. *Revista de Biologia Tropical* 58: 1157–1163. https://doi.org/10.15517/rbt.v58i4.5401

Van der Goot V.S. 1964. Fluke's catalogue of Neotropical Syrphidae (Insects, Diptera), a critical study with an appendix on new names in Syrphidae. *Beaufortia* 10: 212–221.

Vockeroth J.R. 1969. A revision of the genera of the Syrphini (Diptera: Syrphidae). *Memoirs of the Entomological Society of Canada* 62: 1–176.

Vockeroth J.R. & Thompson F.C. 1987. Family Syrphidae. *In*: McAlpine J.F. (ed.) *Manual of Nearctic Diptera* 2: 713–743. Agriculture Canada, Canadian Government Publishing Centre, Hull, Québec, Canada.

Walker F. 1849. *List of the Specimens of Dipterous Insects in the Collection of the British Museum, Part III*: 485–687. British Museum (Natural History), London.

Weng J.L. & Rotheray G.E. 2008. Another non-predaceous syrphine flower fly (Diptera: Syrphidae): pollen feeding in the larva of *Allograpta micrura*. *Studia Dipterologica* 15 (1): 245–258.

Wiedemann C.R.W. 1830. *Außereuropäische zweiflügelige Insekten. Zweiter Theil*. Schulz, Hamm, Germany. Available from https://biodiversitylibrary.org/page/27759634 [accessed 8 Jun. 2018].

Zimsen E. 1964. *The Type Material of J.C. Fabricius*. Munksgaard, Copenhagen.

Zuijen M.P. & Nishida K. 2011. Life history and immature stages of *Allograpta zumbadoi* Thompson, a phytophagous flower fly (Diptera: Syrphidae: Syrphinae). *Studia Dipterologica* 17: 37–51.

Manuscript received: 8 February 2018
Manuscript accepted: 16 May 2018
Published on: 4 July 2018
Topic editor: Gavin Broad
Desk editor: Danny Eibye-Jacobsen