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

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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, \textit{Allograpta jacqi} Mengual \& Ramage sp. nov. and \textit{Melanostoma polynesiotes} Mengual \& Ramage sp. nov., and a new record for this country, \textit{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 \textit{Melanostoma} Schiner, 1860 in the Australasian and Oceanian Regions.

Keywords. Identification key, new species, new record, \textit{Melanostoma}, \textit{Allograpta}.


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-Garcia 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**


**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, Syriitta 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
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).


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.
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**


**Geographical distribution**

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

**Status in French Polynesia**

Doubtful.

**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**  

**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 ⅗.

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; calyptrae 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, unmarginated. 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
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, Aratato, 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, 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, Rikitā, 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-DIP-00019719, ZFMK-DIP-00019720, ZFMK-DIP-000197122, 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 ♀, Raitatae, 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, Raitatae, marae Taputapuatea, 16°50′08″ S, 151°21′31″ W, 27 Jun. 2007, S. Charlat leg. (SCL: symbiocode_05606); 1 ♀, Raitatae, Te Mehani Rahi, 16°45′36.1″ S, 151°29′19.4″ W, 29 Jun. 2007, S. Charlat leg. (SCL: symbiocode_04987); 3 ♀♂, Raitatae, 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 ♀, Raitatae, Opoa, Aratao, 11 Jul. 2013, F. Jacq leg. (CTR); 1 ♀, Raitatae, Te Mehani ‘ute ‘ute, on _Apetahia_, 2014, F. Jacq and T. Laroche leg. (CTR); 1 ♀, 1 ♂, Raitatae, Opoa, 18 May 2015, Malaise trap, F. Jacq leg. (ZFMK: ZFMK-DIP-00019716, ZFMK-DIP-00019717); 1 ♀, ‘Taha’a, Mount Ohiiri 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, Dewrolle 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,


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). Apetahia 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, 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. (CTR: CTR; 1 ♀: ZFMK: ZFMK-DIP-00019718).

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 avenuea (Fabricius, 1775) on several species of Poaceae; Brevicoryne brassicae (Linnaeus, 1758) on Brassica oleracea (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


Paratypes


Description

Male

LENGTH (N = 1). Body 9.4 mm; wing 7.0 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 ⅔ and dark pilose on dorsal ⅓.

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 ⅔ yellow; metatarsomeres dark.

ABDOMEN. Parallel-sided, unmarginied, 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 ⅔ between antennae and anterior ocellus; postalar callus black; sternum 2 dark on anterior ⅔ and pale on posterior ⅓.

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 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
Flower flies of French Polynesia

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 Rauvolchia 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

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.


*Eristalomyia croceipes* Bigot, 1880: 227.

*Eristalis soulougensis* 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°58′59.56″ W, 6 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.  
- **French Polynesia:** 1 ♂, Hiva Oa, 5 Mar. 2013, 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°58′59.56″ W, 6 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. (CTR).  
- **Tahiti:** 1 ♀, Hiva Oa, 5 Mar. 2013, F. Jacq leg. (CTR).  
- **Tahiti:** 1 ♂, Hiva Oa, 5 Mar. 2013, F. Jacq leg. (CTR).  
- **Tahiti:** 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, 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).  

**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.
Flowers visited


Three of these plants, i.e., *W. vescoi*, *E. fosbergii* 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](https://doi.org/10.5883/BOLD:AAY9710)).

References


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.


*Syrphus australiensis* Van der Goot, 1964: 220.

*Syrphus huttonii* 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*).
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

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 oceanica_ Macquart, 1855: 112 (misspelling).

Differential diagnosis
See above under _S. aenigmatopatria_.

Material examined

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

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 ........
   – 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 etenidium; entire body metallic green or purple (Fig. 4B) .........................
   – Arista bare (Fig. 4F); face carinate (Fig. 4F); metafemur greatly enlarged, with a etenidium 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) ................
   – 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) ........................................................................... 4
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 grandicorns* 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 ½ ........................................... *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 ½ ............ *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

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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) ..................

**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

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**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 Ōhara & 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 Ōhara & 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.

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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**


