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First records of Pipunculidae
(Diptera) from French Guiana, with
the description of a new species

Dayse W. A. MARQUES,
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COUVERTURE / *COVER*:

Flight intercept trap and SLAM trap (background) in operation in lowland tropical rainforest in French Guiana (photo Julien Tourout). In médaillon, *Cephalops amapaensis* Rafael, 1991.

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First records of Pipunculidae (Diptera) from French Guiana, with the description of a new species

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ABSTRACT

The dipteran family Pipunculidae Walker, 1834 is recorded from French Guiana for the first time. It is represented by five genera, with four identified species (including a new species), and 13 females identified to genus level (including *Amazunculus* Rafael, 1986). *Cephalops amapaensis* Rafael, 1991, *Cephalosphaera aurata* Souza & Ale-Rocha, 2009, and *Eudorylas fortis* Rafael, 1995 are recorded for the first time from French Guiana, and *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp. is described and illustrated.

RÉSUMÉ

Première signalisation de Pipunculidae (Diptera) en Guyane, avec la description d'une nouvelle espèce.
La famille des diptères Pipunculidae Walker, 1834 est signalée pour la première fois en Guyane. Elle est représentée par cinq genres contenant quatre espèces identifiées (dont une nouvelle espèce), et 13 femelles identifiées au niveau de genre (dont *Amazunculus* Rafael, 1986). *Cephalops amapaensis* Rafael, 1991, *Cephalosphaera aurata* Souza & Ale-Rocha, 2009 et *Eudorylas fortis* Rafael, 1995 sont rapportées pour la première fois de Guyane, et *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp. est décrite et illustrée.

KEY WORDS

Big-headed flies,
French Guiana,
Neotropics,
new records,
new species.

MOTS CLÉS

Pipunculides,
Guyane,
région néotropicale,
signalisations nouvelles,
espèce nouvelle.

INTRODUCTION

The big-headed flies (Diptera, Pipunculidae Walker, 1834) have a worldwide distribution. The family is currently composed of slightly more than 1400 valid species, distributed over 21 genera and four subfamilies, Pipunculinae Walker, 1834, Chalarinae Aczél, 1939, Protonephrocerinae Aczél, 1948 and Nephrocerinae Aczél, 1939 (Kehlmaier *et al.* 2014). The Latin American and Caribbean fauna encompasses about 279 species (Rodríguez & Rafael 2012), but a large number of species await to be described.

In 2015 the “Our Planet Reviewed” or “La Planète revisitée” Guyane 2014-2015 expedition, also known as the “Mitaraka 2015 survey”, was conducted in French Guiana (Pollet *et al.* 2014; Pascal *et al.* 2015; Touroult *et al.* 2018) as the 5th edition of a large scale biodiversity survey undertaken by the Muséum national d’Histoire naturelle in Paris and the NGO Pro-Natura international (both in France). Basic arthropod taxonomy and species discovery were at the heart of the survey, although forest ecology and biodiversity distribution modelling were also project topics. The expedition was conducted in the Mitaraka Mountains, a largely unknown and uninhabited area in the southwesternmost corner of French Guiana, directly bordering Surinam and Brazil (Pollet *et al.* 2014; Krolow *et al.* 2017). It is part of the Tumuc Humac mountain chain, extending east in Amapá region (Brazil) and west in southern Surinam. The area consists primarily of tropical lowland rain forest with scattered inselbergs, i.e., isolated hills that stand above the forest plains. Diptera samples collected during this survey contained Pipunculidae, which is the first record of this family from French Guiana. In this paper, we present the results of this survey, with each species discussed and illustrated, and provide the description of a new species of *Clistoabdominalis* Skevington, 2001 (Skevington & Yeates 2001).

MATERIAL AND METHODS

Between 22 February and 27 March 2015, two consecutive equal-sized teams (of about 30 researchers) explored the Mitaraka area, including more than ten invertebrate experts. A third smaller team returned to the site from 12 to 20 August 2015. Marc Pollet was coordinator of the collected Diptera, and was also the only Diptera worker actively involved in this survey. Invertebrate sampling was carried out near the base camp, on the drop zone (an area near the base camp that had been clear-cut entirely to allow helicopters to land) and, in particular, along 4 trails of about 3.5 km that started from the base camp in four different directions (see Krolow *et al.* 2017). During the first period (22 February-11 March 2015) over 21 different collecting methods were applied, with a total of 401 traps operational within a perimeter of 1 km². This array consisted primarily of pan traps (n = 280), Charax butterfly traps (n = 50), square Malaise traps (SLAM)

(n = 32), Flight Intercept Traps (FIT, n = 13) and Butterfly banana traps (n = 12), but also a light trap (see Krolow *et al.* 2017). In the subsequent periods, pan traps were no longer operational. A total of 223 invertebrate samples (often pooled yields of different traps of the same type) were examined, including 94 sweep net samples (Pollet *et al.* 2018).

The identification of the pipunculid species was conducted by DWAM and JAR using taxonomical reviews and identification keys (Rafael 1991, 1992, 1995; Souza & Ale-Rocha 2009), original descriptions, and direct comparison with types from the Invertebrates Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil. All collected material was stored in 70% alcohol during the expedition, being dry mounted on pins about 12 months later in the laboratory. All specimens collected during the Mitaraka 2015 survey will be deposited in the Muséum national d’Histoire naturelle, Paris, France (MNHN).

The morphological terminology is based on Cumming & Wood (2017). The specimen length was measured in lateral view from the frons (excluding antenna) to the apex of the abdomen.

The apex of the abdomen was removed and macerated in hot (150°C) 85% lactic acid for about 30 minutes, and subsequently examined on excavated slides with glycerin. After study and illustration, the dissected abdomen and terminalia were placed in microvials with glycerin. The right wing of the specimens was mounted between microslides with Canada balsam. Microslides and microvials were attached to their respective pinned specimens.

Photographs were taken through a Leica DFC500 digital camera fitted on a Leica MZ205 stereomicroscope connected to a computer with the Leica Application Suite software, which includes an Auto-Montage module (Syncroscopy software) (<http://www.syncroscopy.com/syncroscopy/>) that combines multiple layers of photographs into a single fully focused image.

ABBREVIATIONS

Species records are given as full labels, including specific codes of sampling sites and collecting methods. The site code format is: “MIT” – [trail code] – [habitat type] + number (in case more sites of the same habitat were investigated along the same trail), with trail code between A to E, or DZ (drop zone).

Habitat type

SL slope;
RBF river bed forest.

Collecting methods

LT light trap;
MT (6m)6 m long Malaise trap;
SLAM square Malaise trap;
WPT white pan trap.

RESULTS

The family Pipunculidae is recorded from French Guiana for the first time and as such, all species are first records as well. Four species, (including *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp.), are distributed across four genera, two tribes, and one subfamily. Additionally, 13 female specimens could not be associated to males and were identified to the genus level only, with one female of *Amazunculus* Rafael, 1986, five females of *Cephalops* Fallén, 1810, two females of *Cephalosphaera* Enderlein, 1936 and five females of *Eudorylas* Aczél, 1940.

Subfamily PIPUNCULINAE Walker, 1834

Tribe CEPHALOPSINI Macquart, 1834

Genus *Cephalops* Fallén, 1810

Cephalops amapaensis Rafael, 1991
(Fig. 1)

Cephalops amapaensis Rafael, 1991: 359, figs 1-8, 114. — De Meyer 1996: 27. — Rodriguez & Rafael 2012: 15. — Marques & Rafael 2017.

Pipunculus (*Pipunculus*) *villifemoralis* Hardy, 1965: 22, fig. 5a, b.

MATERIAL EXAMINED. — **Guyane**. 1 ♂, Mitaraka, nr MIT-A-RBF1, river, 1-7.III.2015, MT (6 m), leg. Julien Touroult & Eddy Poirier, sample code: MITARAKA/186, MNHN.

GEOGRAPHICAL RECORDS. — French Guiana (first record), Brazil: Amapá, Pará.

REMARKS

This species was described and illustrated by Rafael (1991). Figure 1A-L included here should enable a better identification of this species which can be easily recognized by the combination of the following characters: antenna entirely yellow, postpedicel with acute apex (Fig. 1A, B); legs predominantly yellow with mid and hind coxae light brown (Fig. 1A); wing slightly brown infusate, with anal lobe narrow basally (Fig. 1C); tergite 1 with brown pruinosity on basal half and gray pruinosity on distal half, tergites 2-3 with brown pruinosity but shiny brown to black posterolaterally, and tergites 4-5 with basal ¼-½ brown pruinose and shiny brown to black otherwise (Fig. 1D); syntergosternite 8 about ¾ as long as tergite 5, with large circular apical membranous area (Fig. 1E, F); surstylus subsymmetrical (Fig. 1E; see Fig. 1G, H for lateral view); gonopods symmetrical (Fig. 1I); phallic guide tapering at apex, with a small area slightly desclerotized at apex (Fig. 1J); phallus trifid, with ducts directed downwards and backwards (Fig. 1J-K); ejaculatory apodeme, see Fig. 1L.

Cephalops sp.

OTHER MATERIAL EXAMINED. — **Guyane**. 5 ♀, Mitaraka, MIT-E, partially opened areas on savane roche 2, 02°13'59.8"N, 54°27'46.5"W, 471 m, 13-20.VIII.2015, MT (6 m), leg. P. Henri Dalens, sample code: MITARAKA/230, MNHN.

REMARKS

Three additional putative species of *Cephalops* were found in the material. They are represented by five female specimens listed above, that do not fit the color pattern of the male of *Cephalops amapaensis*. We prefer to leave the specimens unidentified.

Genus *Cephalosphaera* Enderlein, 1936

Cephalosphaera aurata Souza & Ale-Rocha, 2009
(Fig. 2)

Cephalosphaera aurata Souza & Ale-Rocha, 2009: 993, fig. 4A-D. — Rodriguez & Rafael 2012: 16. — Marques & Rafael 2017).

MATERIAL EXAMINED. — **Guyane**. 1 ♂, Mitaraka, MIT-E, partially opened areas on savane roche 2, 02°13'59.8"N, 54°27'46.5"W, 471 m a.s.l., 13-20.VIII.2015, MT (6 m), leg. P. Henri Dalens, sample code: MITARAKA/230, MNHN.

GEOGRAPHICAL RECORDS. — French Guiana (first record), Brazil: Amazonas.

REMARKS

This species was described and illustrated by Souza & Ale-Rocha (2009). It is close to *Cephalosphaera procera* Rafael & Menezes, 1999 described from Costa Rica. Figure 2A-K included here should enable a better identification of this species which can be easily recognized by the combination of the following characters: antenna with pedicel light brown, postpedicel yellow with somewhat obtuse apex (Fig. 2A, B); legs predominantly yellow, with coxae, apex of mid and hind femora, and hind tarsus brown (Fig. 2A); wing hyaline, section between dm cell and vein M₂ longer than vein dm-m (Fig. 2C); tergites 1-4 slightly yellow laterally in the specimen preserved in alcohol (yellow in original species description) with dark brown basal spot, base of tergite 5 dark brown to black, opaque, and apical ⅓ gray pruinose (Fig. 2D); syntergosternite 8 not as long as tergite 5, with large membranous area, not reaching epandrium (Fig. 2E, F); surstylus symmetrical (Fig. 2E; see Fig. 2G, H for lateral view); phallic guide short with group of stout spines at tip (Fig. 2I); phallus trifid, long and distally spiralized (Fig. 2J); ejaculatory apodeme as in Fig. 2K.

Cephalosphaera sp.

OTHER MATERIAL EXAMINED. — **Guyane**. 2 ♀, Mitaraka, MIT-DZ, tropical moist forest (plateau-slope-cleared), 02°14'01.8"N, 54°27'01.0"W, 306 m a.s.l., 1.III.2015, SLAM, leg. Julien Touroult & Eddy Poirier, sample code: MITARAKA/218, MNHN.

REMARKS

Two additional putative species of *Cephalosphaera* were found in the material at hand. They are represented by two female specimens listed above, that do not fit the color pattern of *Cephalosphaera aurata*. One of them resembles the pattern of *C. miriamae* Rafael, 1992. However, we have other undescribed species close to *C. miriamae*, so for the time being we prefer to leave this specimen unidentified.

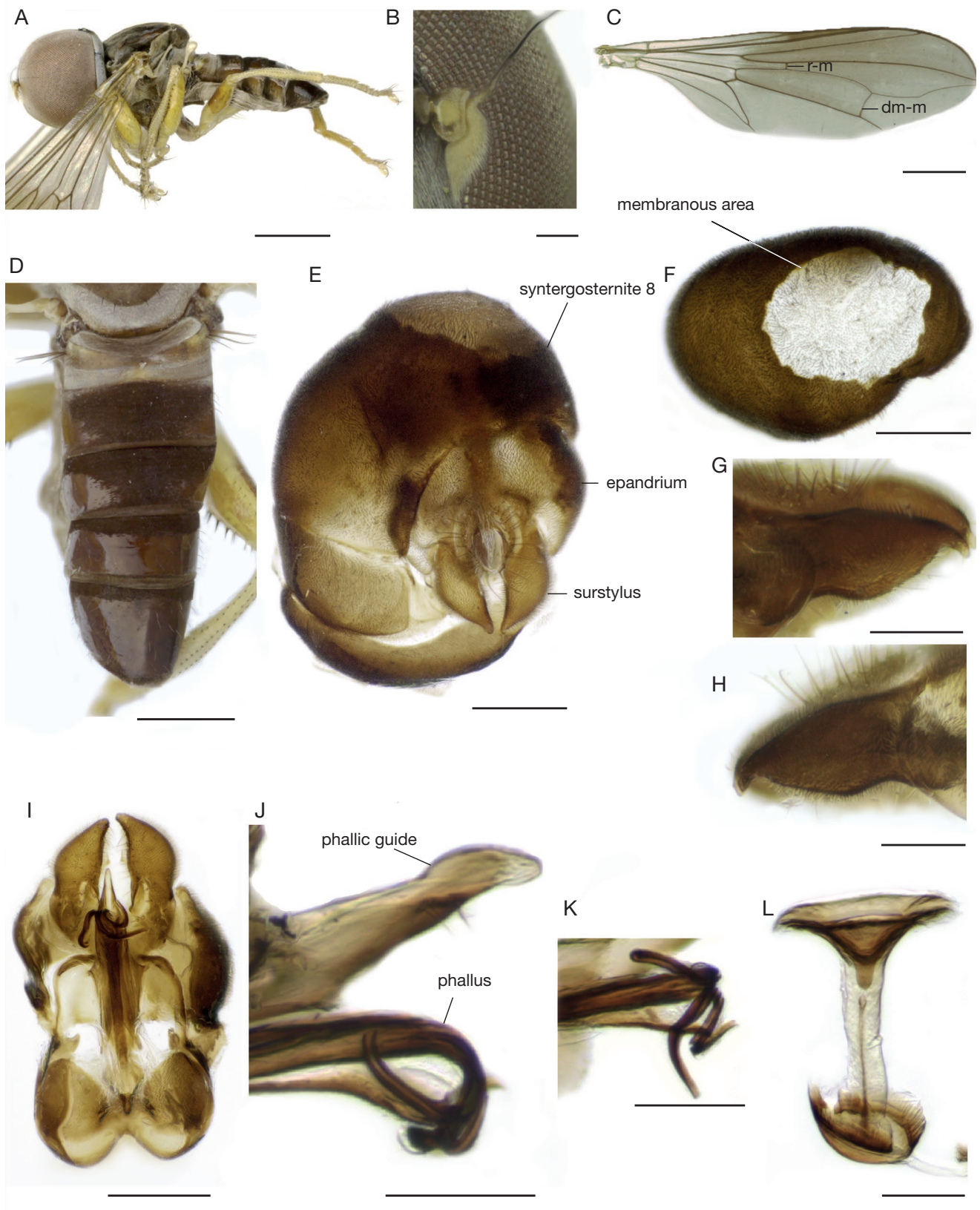


FIG. 1. — *Cephalops amapaensis* Rafael, 1991: **A**, habitus, lateral view; **B**, antenna; **C**, wing; **D**, abdomen, dorsal view (syntergosternite 8 removed); **E**, terminalia, dorsal view; **F**, syntergosternite 8, posterior view; **G**, left surstylus, lateral view; **H**, right surstylus, lateral view; **I**, epandrium, surstyli, hypandrium, gonopods, phallic guide and phallus, ventral view; **J**, phallic guide and phallus, lateral view; **K**, phallus, ventral view; **L**, ejaculatory apodeme. Abbreviations: **dm-m**, discal medial crossvein; **r-m**, radial-medial crossvein. Scale bars: A, C, 1 mm; B, G, H, J-L, 0.1 mm; E, F, I, 0.2 mm.

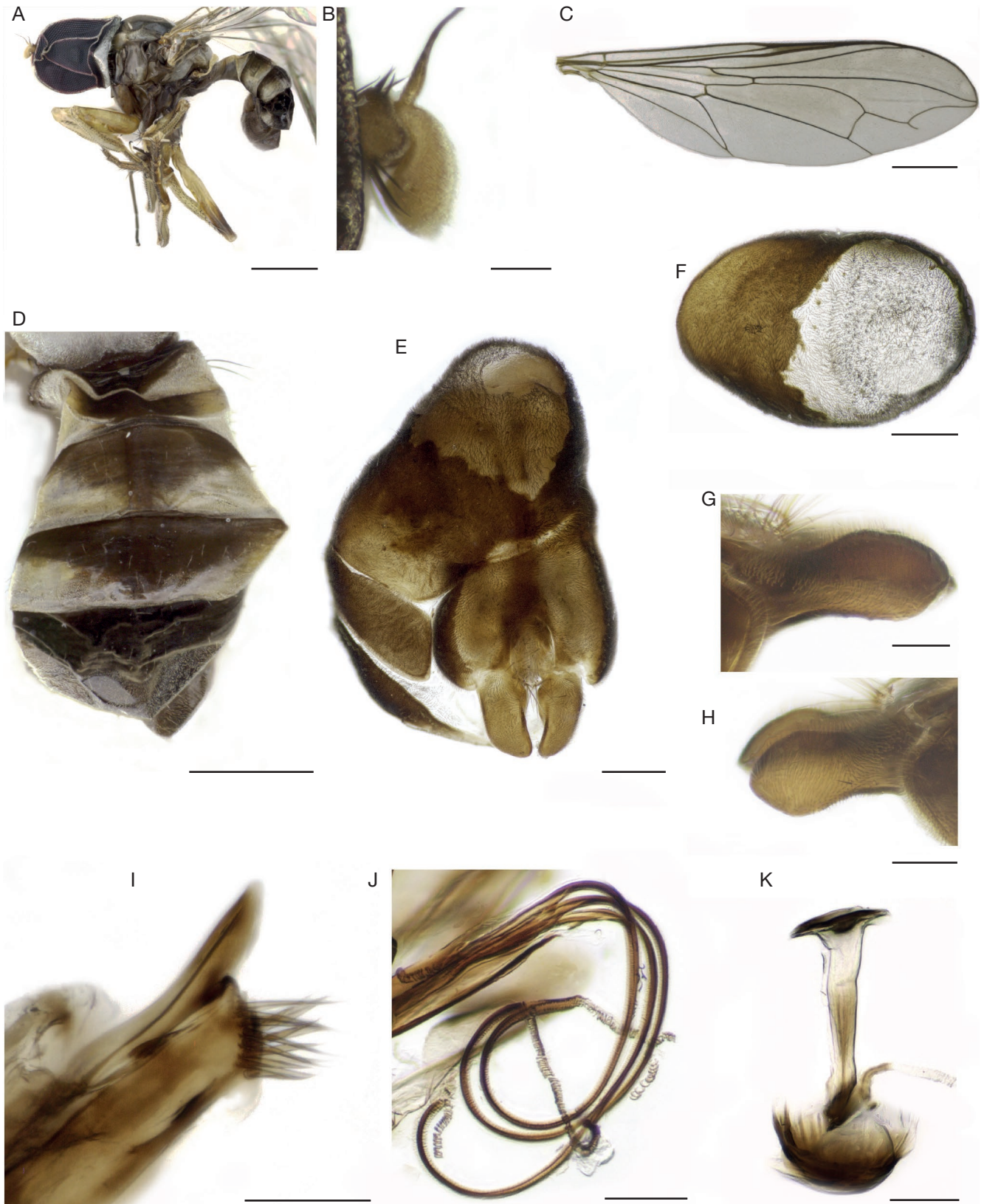


FIG. 2. — *Cephalosphaera aurata* Souza & Ale-Rocha, 2009: **A**, habitus, lateral view; **B**, antenna; **C**, wing; **D**, abdomen, dorsal view; **E**, terminalia, dorsal view; **F**, syntergosternite 8, posterior view; **G**, left surstylus, lateral view; **H**, right surstylus, lateral view; **I**, phallic guide, lateral view; **J**, phallus, lateral view; **K**, ejaculatory apodeme. Scale bars: A, C, 1 mm; B, G-K, 0.1 mm; D, 0.5 mm; E, F, 0.2 mm.

Tribe EUDORYLINI Rafael & De Meyer, 1992
Genus *Amazunculus* Rafael, 1986

Amazunculus sp.

MATERIAL EXAMINED. — **Guyane**. 1 ♀, Mitaraka, different sites nr base camp and along trails, tropical moist forest (different sites), 1-6.III.2015, SLAM, leg. Julien Touroult & Eddy Poirier, sample code: MITARAKA/195, MNHN.

REMARKS

Amazunculus specimens can only be morphologically identified to species level when male specimens are present in the samples. They are not common and few species are known, mainly from the Amazon Basin. The genus is recorded from French Guiana for the first time.

Genus *Clistoabdominalis* Skevington, 2001

Clistoabdominalis mitarakensis
Marques & Rafael, n. sp.
(Fig. 3)

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TYPE MATERIAL. — **Holotype**. Guyane, ♂, Mitaraka, MIT-DZ, drop zone, 02°14'01.8"N, 54°27'01.0"W, 306 m a.s.l., 24.II.2015-10.III.2015, LT, leg. Julien Touroult, sample code: MITARAKA/115, "Holotype ♂, *Clistoabdominalis mitarakensis* Marques & Rafael", MNHN.

HOLOTYPE CONDITION. — Right wing detached, mounted on microslide. Terminalia placed in a microvial with glycerin. Both attached to pinned holotype specimen.

ETYMOLOGY. — The specific name refers to the type locality, Mitaraka, French Guiana.

GEOGRAPHICAL RECORDS. — French Guiana (Mitaraka).

DIAGNOSIS. — Antenna dark brown to black, postpedicel acute. Legs predominantly dark brown to black. Wing brown infuscate. Tergite 1 entirely gray pruinosity; tergites 2-5 velvety black basally, gray brown pruinosity more distinct posterolaterally. Syntergosternite 8 with small membranous area. Surstyli symmetrical, curved inwards apically. Phallus trifid, short ramified. Ejaculatory apodeme very large, almost 2 times as long as hypandrium. Female unknown.

DESCRIPTION OF MALE HOLOTYPE

Body length
3.5 mm.

Head (Fig. 3A)

Eyes contiguous for a distance of sixteen facets. Frontal triangle and face brown pruinose. Postcranium dark, with dark brown pruinosity. Antenna (Fig. 3B) with scape black; pedicel dark brown to black, with four dorsal and two ventral bristles; postpedicel dark brown with acute apex.

Thorax

Postpronotal lobe brown. Scutum dark brown to black, with brown pruinosity. Notopleuron brown, with sixteen weak bris-

ties. Scutellum dark brown to black, with brown pruinosity and inconspicuous bristles. Mesopleuron and mediotergite dark brown to black, with brown pruinosity.

Wing (Fig. 3C)

Length 4.2 mm, almost 3 times as long as wide. Membrane slightly brown infuscate. Third costal section 1.2 times as long as fourth costal section. Vein r-m near middle of cell dm. Vein dm-m somewhat straight. Halter brown.

Legs (Fig. 3A)

Predominantly dark brown to black, with femuro-tibial and tibio-tarsal articulation somewhat yellow, setae black. Pulvilli yellow.

Abdomen (Fig. 3D)

Tergite 1 entirely gray pruinose with six small black lateral setae; tergites 2-5 velvety black basally with gray brown pruinosity posterolaterally; syntergosternite 8 (Figs 3D-F) almost ½ as long as tergite 5, with small membranous area (Fig. 3F).

Terminalia

Epandrium and surstyli brown (Fig. 3E). Surstylus (Fig. 3E) symmetrical, curved inwards apically; truncated in lateral view (Fig. 3G, H). Gonopods symmetrical (Fig. 3I). Phallic guide (Fig. 3I, J) simple, narrow. Phallus trifid, short ramified with ducts distinctly separated only in distal ⅓ and each duct with a small subapical projection (Fig. 3I, J). Ejaculatory apodeme very large, almost 2 times as long as hypandrium (Fig. 3I).

REMARKS

Clistoabdominalis Skevington is easily distinguishable from the other genera of Eudorylini by the following features (Skevington 2001; Skevington & Yeates 2001): tergite 1 with lateral fan of setae absent or minute; syntergosternite 8 swollen, partially to entirely fused; membranous area of syntergosternite 8 usually absent and if present, very small; hypandrium deflected left at nearly 90° to phallic guide; phallus trifid, with ducts distinctly separated only in distal ⅓ and ejaculatory apodeme large, with a swollen basal rosette. *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp. does not fit all generic characters as the syntergosternite 8 is not swollen, but as it fits most of the *Clistoabdominalis* characters: (the size and shape of the hypandrium, phallus and ejaculatory apodeme), it is tentatively placed in *Clistoabdominalis*.

Genus *Eudorylas* Aczél, 1940

Eudorylas fortis Rafael, 1995
(Fig. 4)

Eudorylas fortis Rafael, 1995: 806, figs 55-60; 195. — De Meyer 1996: 56. — Rodriguez & Rafael 2012: 21. — Marques & Rafael 2017.

MATERIAL EXAMINED. — **Guyane**. 2 ♂ Mitaraka, MIT-E, partially opened areas on savane roche 2, 02°13'59.8"N, 54°27'46.5"W, 471 m a.s.l., 13-20.VIII.2015, MT (6 m), leg. P. Henri Dalens,

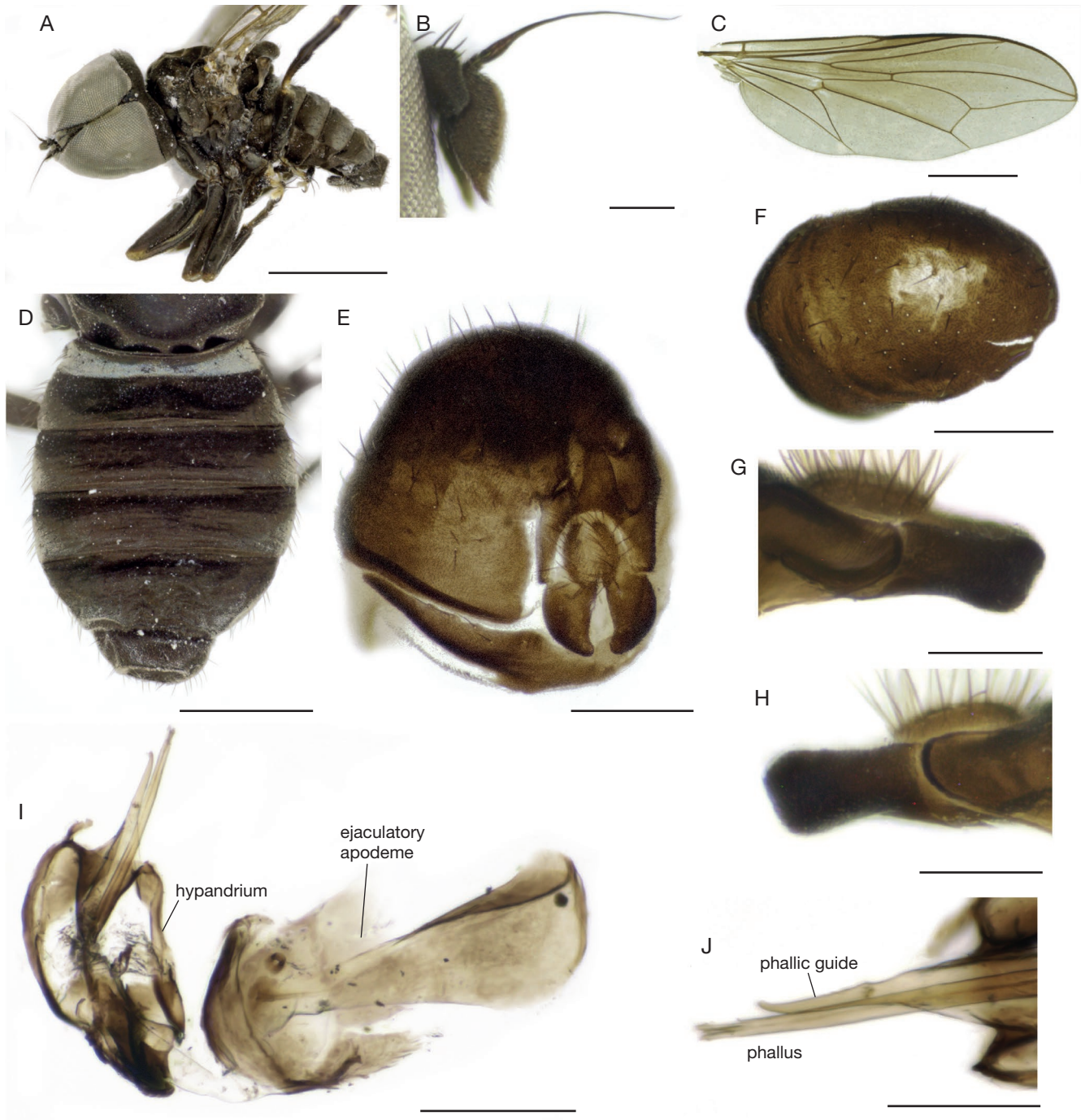


FIG. 3. — *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp.: **A**, habitus, lateral view; **B**, antenna; **C**, wing; **D**, abdomen, dorsal view; **E**, terminalia, dorsal view; **F**, syntergosternite 8, posterior view; **G**, left surstylus, lateral view; **H**, right surstylus, lateral view; **I**, hypandrium, gonopods, phallic guide, phallus and ejaculatory apodeme, ventral view; **J**, phallic guide and phallus, ventral view. Scale bars: A, C, 1 mm; B, G, H, J, 0.1 mm; D, 0.5 mm; E, F, I, 0.2 mm.

sample code: MITARAKA/230 MNHN); 1 ♀, Mitaraka, MIT-C-SL (MIT08), tropical moist forest (slope), 02°14'07.7"N, 54°26'41.5"W, 373 m a.s.l., 24.II-2.III.2015, WPT, leg. Marc Pollet, sample code: MITARAKA/120, MNHN.

GEOGRAPHICAL RECORDS. — French Guiana (first record), Brazil: Amazonas, Pará, Goiás.

REMARKS

This species was described and illustrated by Rafael (1995). Figure 4A-K included here should enable a better identification of this species which can be recognized by the combination of the following characters: antenna brown, postpedicel with subfiliform apex (Fig. 4A, B); legs predominantly black (Fig. 4A), all femora with ventral ctenidium; wing slightly

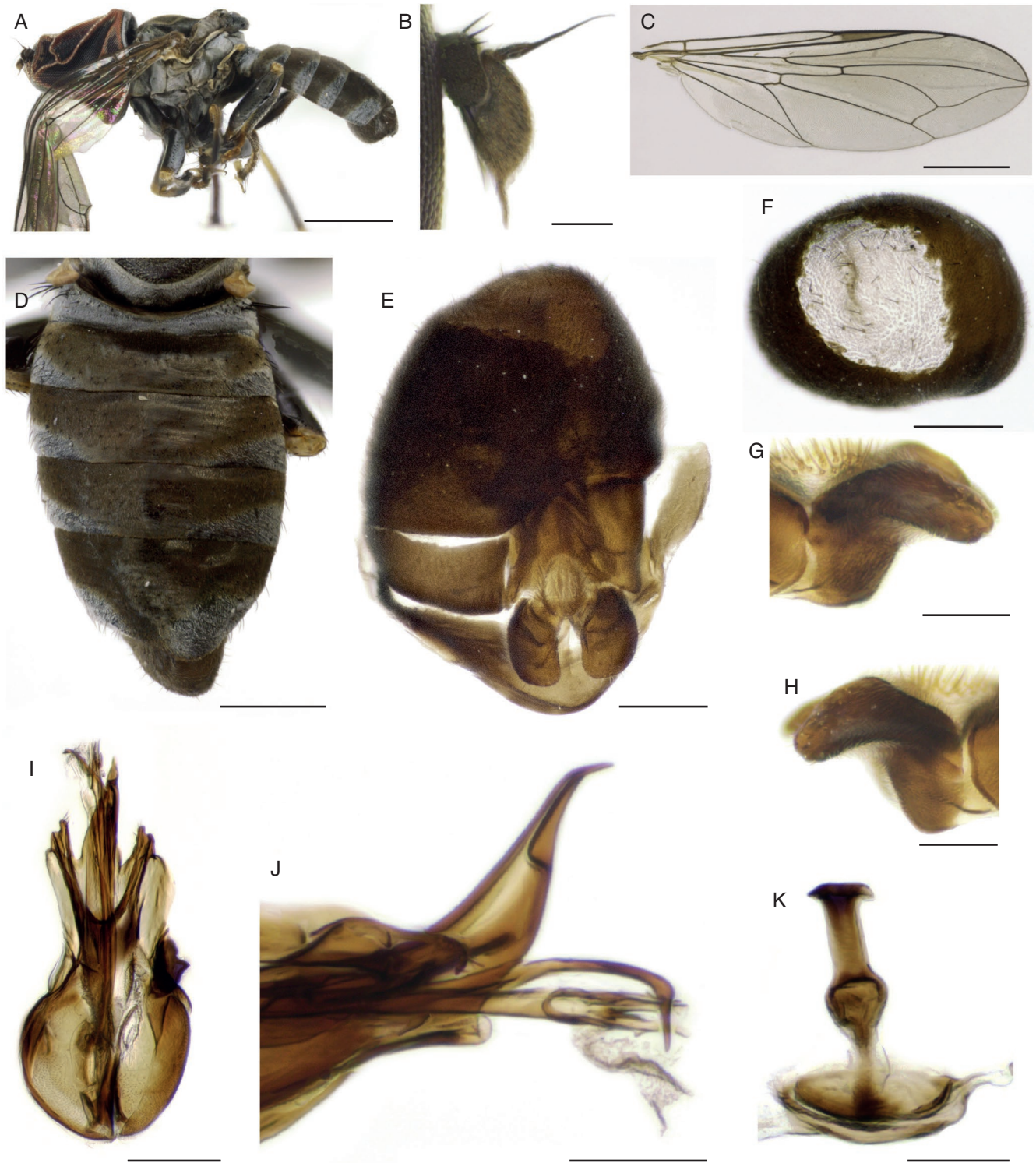


FIG. 4. — *Eudorylas fortis* Rafael, 1995: **A**, habitus, lateral view; **B**, zntenna; **C**, wing; **D**, abdomen, dorsal view; **E**, terminalia, dorsal view; **F**, syntergosternite 8, posterior view; **G**, left surstylus, lateral view; **H**, right surstylus, lateral view; **I**, hypandrium, gonopods, phallic guide and phallus, ventral view; **J**, phallic guide and phallus, lateral view; **K**, ejaculatory apodeme. Scale bars: A, C, 1 mm; B, G, H, J, K, 0.1 mm; D, 0.5 mm; E, F, I, 0.2 mm.

infusate, dm-m vein distinctly inclined (Fig. 4C); abdomen with gray pruinosity on tergite 1 and tergites 2-5 mainly brown pruinose and gray pruinose posterolaterally (Fig. 4D); surstyli somewhat symmetrical (Fig. 4E), in lateral view with distinct

median curvature (Fig. 4G, H); gonopods symmetrical, with stout setae apically (Fig. 4I); phallic guide tapering at apex (Fig. 4J); phallus trifid, with long lateral process (Fig. 4J), and ejaculatory apodeme as in Fig. 4K.

Eudorylas sp.

OTHER MATERIAL EXAMINED. — **Guyane.** 3 ♀, Mitaraka, MIT-E, partially opened areas on savane roche 2, 02°13'59.8"N, 54°27'46.5"W, 471 m, 13-20.VIII.2015, MT (6 m), leg. P. Henri Dalens, sample code: MITARAKA/230, MNHN; 1 ♀, Mitaraka, MIT-A-RBF2, 02°14'12.5"N, 54°27'08.1"W, 287 m, tropical wet forest (bas fond), 14-20.III.2015, SLAM, leg. Julien Touroult & Eddy Poirier, sample code: MITARAKA/199, MNHN; 1 ♀, Mitaraka, MIT-C-SL (MIT08), 02°14'07.7"N, 54°26'41.5"W, 373 m, tropical moist forest (slope), 24.II-2.III.2015, WPT, leg. Marc Pollet, sample code: MITARAKA/120, MNHN.

REMARKS

Five additional putative species of *Eudorylas* were found in the material at hand. They are represented by five female specimens listed above. No male specimens were collected that could be associated with these species.

DISCUSSION

This short list of big-headed flies of French Guiana certainly is a poor representation of the real species diversity in this part of South America. It is certain that the Mitaraka fauna is much richer in species and genera, but this is the first effort to fill this gap considering that pipunculids from this region are rare in collections and there are just a few specialists working on this family.

In this survey, most of the specimens of Pipunculidae were collected in the 6 m Malaise trap and the SLAM traps (16 specimens belonging to three species and 10 morphospecies). Only the new species, *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp. was collected with the light trap. *Eudorylas fortis* Rafael was collected with the Malaise trap and a white pan trap, and the latter method also collected another morphospecies of *Eudorylas*.

Targeted hand collecting (i.e. collecting pipunculids that are observed in contrast to random sweeping) is the best way to collect pipunculids. An experienced field worker can collect large numbers of them as they have a flight behaviour similar to Syrphidae. In contrast, they are rarely collected with random sweeping. Malaise traps are another effective method to collect pipunculids as has been illustrated here. In particular, small trap types are useful, as most of the pipunculids fly near the ground looking for their hosts in grass or shrubs. Also the color of the Malaise trap appears to have an effect on the yields as shown by field research in Manaus, Amazonas (Rafael, unpubl. data). A significant number of specimens was collected when using a model of suspendable Malaise trap described by Rafael & Gorayeb (1982) with a yellow interception panel. Other effective methods include suspended traps mounted in the canopy, and to a lesser extent, yellow pan traps. The diversity and abundance of pipunculids is greatest in forest openings, along forest edges and small creeks (Rafael & Skevington 2010). This corresponds with the findings of this survey: 8 of the 15 species were collected on a "savane roche", an

open, well-lit, rocky outcrop in the lowland rain forest with a mainly low vegetation, and three other specimens were obtained on the open drop zone. Although pipunculids are often seen hovering among shrubs looking for potential hosts, no specimen was collected by sweeping the vegetation in this survey (MP mainly focused on Dolichopodidae during his active collecting). On the other hand, the new species described here, *Clistoabdominalis mitarakensis* Marques & Rafael, n. sp., was collected with a light trap (retrieved from a white sheet). Although pipunculids are rarely collected with this method, the species found this way are often different from those collected in interception traps.

Female specimens are often more abundant in collections, presumably because they cover larger areas while actively looking for hosts and as such, are more easily detected or trapped. Thirteen female specimens belonging to 11 morphospecies could not be associated with males. Association of the sexes in pipunculids is often problematic because the different species are externally very similar in color and morphological attributes, and even if associations are made, females are often extremely difficult to separate from closely related species (Skevington *et al.* 2007). The secure identification of Pipunculidae species is based primarily on characters of the male terminalia. A few diagnostic characters are available in female specimens, e.g. the shape and size of the ovipositor. However, first the female specimen needs to be correctly associated to the male. Therefore, describing new species based on females is strongly discouraged and should be avoided (Rafael & Skevington 2010).

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