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Revision of the genus *Eugenys* Quate, 1996 (Diptera: Psychodidae), with the description of three new species

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Abstract. We review the diagnosis of the genus *Eugenys* Quate, 1996 (Diptera: Psychodidae) which occurs in the Neotropical Region. Initially known from Costa Rica, Nicaragua, and Panama, we describe one additional species from Costa Rica, *Eugenys singularis* sp. nov., and two species from Ecuador, namely, *Eugenys micra* sp. nov. and *E. upsilon* sp. nov., bringing the total known species to six. This study provides detailed descriptions of the new species based on male and female specimens, along with the first DNA barcodes for the genus and some of the newly described species. We also provide an identification key for identifying male specimens of the genus worldwide. Finally, we discuss the morphological characteristics of *Eugenys* and compare the genus with other taxa, tentatively suggesting a placement within the tribe Pericomaini.

Keywords. Psychodinae, taxonomy, moth flies, integrative taxonomy.

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Introduction

Eugenys Quate, 1996 is a Neotropical genus of Psychodidae Newman, 1834 (moth flies) with previously only three described species, namely, *Eugenys clavellata* Quate, 1996 from Costa Rica and Nicaragua, *Eugenys cymosa* Quate, 1999 from Panama, and *Eugenys panamensis* Quate, 1999 from Panama (Collantes & Martinez-Ortega 1999; Quate 1996, 1999). *Eugenys* was originally placed under the tribe Mormiini Enderlein, 1937, due to the wing venation with a pectinate radial sector and the basal position of radial and medial forks (Quate 1996, 1999). This tribal placement was followed by Wagner & Ibañez-Bernal (2009). On the other hand, modern studies using molecular characters suggested that this character system is insufficient to establish Mormiini in this sense as a monophyletic group (Espíndola *et al.* 2012;

Curler & Moulton 2012; Kvifte 2018). Recently, Kvifte (2018) placed *Eugenys* as an unplaced genus in his tentative tribal classification within Psychodidae.

In the present manuscript, we describe three new species of *Eugenys* based on male and female specimens. Moreover, we report the genus in Ecuador for the first time. In addition, the herein newly described species are compared with the previously known fauna of *Eugenys* and contextualized within Psychodinae through new interpretations of male genital homologies. Furthermore, we provide the first DNA barcodes (cytochrome c oxidase subunit 1 or COI) for the genus and for some of the species described herein. Finally, we provide an identification key for the males of the currently six described species of *Eugenys* worldwide

Material and methods

Terminology

We follow the general terminology proposed by Cumming & Wood (2017) except for epandrial appendages which are here called hypopods following Kvifte & Wagner (2017)

Collection and preparation of specimens

Specimens from Ecuador were collected using a Malaise trap, euthanized and preserved in 96° ethanol, and stored at -20°C. The preparation of permanent slides follows the procedure outlined by Jaume-Schinkel *et al.* (in press), the DNA extraction methodology is non-destructive allowing us the recovery of the entire specimen for slide mounting. Specimens coming from Costa Rica were collected using a Malaise trap and mounted on slides by L.W. Quate.

The remnants of DNA extracts are stored at ZFMK's Biobank facilities (https://bonn.leibniz-lib.de/en/biobank), accessible through the tissue codes ZFMK-TIS as listed in the Material examined section.

Institutional abbreviations

CAS = The California Academy of Sciences, San Francisco, California, USA
INABIO = Instituto Nacional de Biodiversidad, Quito, Ecuador
NHM = National History Museum, London, UK
USNM = Smithsonian Institution, National Museum of Natural History, Washington, USA
ZFMK = Museum Koenig, Leibniz-Institut zur Analyse des Biodiversitätswandels (LIB) (previously known as Zoologisches Forschungsmuseum Alexander Koenig), Bonn, Germany

Abbreviations for morphological terms

aed = aedeagus
eja = ejaculatory apodeme
ep = epandrium
gns = gonostyli
gnx = gonocoxite
hyp = hypandrium
par = paramere
par scl = parameral sclerite
par sh = parameral sheath

Genetics

Extraction and PCR were performed at ZFMK, and PCR products were shipped to Beijing Genomic Institute (BGI) (China, Hong Kong) for bidirectional sequencing. DNA sequences were assembled, aligned, and cleaned using Geneious ver. R7 (Biomatters, Auckland, New Zealand). The sequence length was set to 658 bp.

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Diptera Linnaeus, 1758
Suborder Psychodomorpha Hennig, 1968
Family Psychodidae Newman, 1834
Subfamily Psychodinae Newman, 1834

Genus ***Eugenys*** Quate, 1996

Eugenys Quate, 1996: 43.

Eugenys – Quate 1999: 432 (description of new species). — Kvifte 2018: 603 (tribal classification).

Type species

Eugenys clavellata Quate, 1996: 432 (by original designation).

Differential diagnosis

Eugenys is a very distinctive genus and it can be easily differentiated from other genera of Psychodinae by the following characters: eyes contiguous, eye bridge with three facet rows; antenna with 14 symmetric fusiform flagellomeres, except flagellomere 14 which is elongated and longer than the previous flagellomere, with a terminal apiculus; ascoids very long (the length of 3–4 flagellomeres), wavy-zigzag and rod-shaped (unknown in *E. cymosa*); mouthparts atrophied or very reduced; palpi short, not extending beyond flagellomere 3–4; thorax without allurement organs, with alveoli on the central part of anepisternum, posteriorly to anterior spiracle; broad wings, vein R_{2+3} very short, arising from R_4 (Rs pectinate), R_5 ending in wing apex or slightly after apex, CuA_2 ending beyond medial fork; male genitalia with asymmetrical aedeagal complex, hypopods with one tenaculum or multiple tenacula.

Remarks

Quate's (1996) original description of the genus was based only on the type species; however, when he later described two additional species in this genus (Quate 1999: *E. cymosa* and *E. panamensis*), not all the characters and structures were available for comparison, e.g., in type specimens of *E. panamensis* the antennae are incomplete; therefore, the last flagellomere is unknown. In type specimens of *E. cymosa* the ascoids are missing; consequently, there is no comparison of this character between the species. Furthermore, the last flagellomere in *E. clavellata* is considerably longer than the one present in *E. cymosa*. Lastly, the number of tenacula present on the hypopods varies from one in *E. clavellata* and *E. panamensis* to 14–16 in *E. cymosa* which makes *E. cymosa* hard to fit in the original diagnosis of the genus by Quate (1996) based solely on the number of tenacula and terminal flagellomeres. The updated diagnosis proposed above fits all of the previously described species, as well as the herein described species.

Biology

To date, nothing is known about the immature stages and the biology of the species of *Eugenys*. Adults have atrophied (or very reduced) mouthparts, and it is believed that adults do not feed (see Discussion).

Species included

Eugenys clavellata Quate, 1996, *E. cymosa* Quate, 1999, *E. micra* sp. nov., *E. panamensis* Quate, 1999, *E. singularis* sp. nov. and *E. upsilon* sp. nov. Species distribution is shown in Fig. 1.

Eugenys clavellata Quate, 1996

Figs 1, 2A, 3C

Eugenys clavellata Quate, 1996: 43. Type locality: Costa Rica, Heredia, Estacion Biologica la Selva. Additional reference: Collantes & Martinez-Ortega (1999).

Differential diagnosis

This species can be easily differentiated from all other species of *Eugenys* by the following characters: hypopods with singular apical tenaculum (10–14 in *E. singularis* sp. nov. and *E. cymosa*, one in *E. micra* sp. nov., *E. panamensis* and *E. upsilon* sp. nov.); antennal flagellomeres without patch of darkened sensilla (present in *E. upsilon* sp. nov. and *E. panamensis*, absent in remaining species); aedeagus long, more than half length of ejaculatory apodeme (aedeagus less than half length of ejaculatory apodeme in *E. micra*).

Material examined

Paratypes

COSTA RICA – **Heredia** • 1 ♂; Puerto viejo de Sarapaqui, Estacion Biologica LaSelva; alt. 50–100 m.; 1 Jul. 1993; Malaise trap; USNMENT00857092; USNM • 1 ♂; same collection data as for preceding; USNMENT00857112; USNM • 1 ♂; same collection data as for preceding; CAS • 1 ♂; same collection

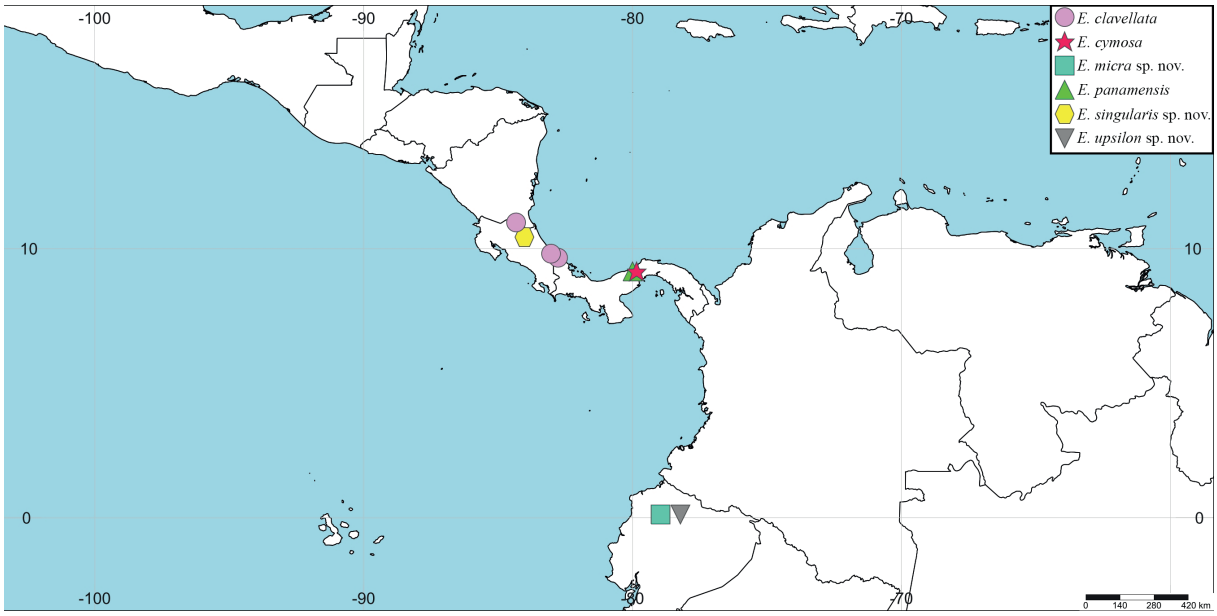

Fig. 1. Distribution map of the species of *Eugenys* Quate, 1996.

data as for preceding; INBIO-CRI0Q1-470625; NHM • 1 ♂; same collection data as for preceding; INBIO-CRI0Q1-470323; NHM.

Distribution

Costa Rica, Nicaragua (Quate 1996; Collantes & Martinez-Ortega 1999).

Genetics

No specimens were available for DNA sequencing.

Eugenys cymosa Quate, 1999
Figs 1, 2B, 3A

Eugenys cymosa Quate, 1999: 432. Type locality: Panama, Canal Zone, Barro Colorado Island.

Differential diagnosis

This species can be easily differentiated from all other species of *Eugenys* by the following characters: hypopods with 10–14 apical tenacula (12–14 present in *E. singularis* sp. nov., one apical tenaculum in remaining species).

Material examined

Paratypes

PANAMA – **Canal Zone** • 1 ♀; Barro Colorado Island; 9.1500° N -79.8500° W; 11–18 Aug. 1993; J Pickering leg.; BMNH(E)2001-8; NHM • 1 ♀; same collection data as for preceding; 1–8 Nov. 1993; NHM • 1 ♂; same collection data as for preceding; 23–4 Aug. 1993; NHM • 1 ♂; same collection data as for preceding; 4–11 Aug. 1993; NHM.

Distribution

Panama (Only known from the type locality, Quate, 1999).

Genetics

No specimens were available for DNA sequencing.

Eugenys micra sp. nov.
urn:lsid:zoobank.org:act:DDCD52D2-BE5D-4E0F-B3DC-BABEF28BEFDB
Figs 1, 3E, 4, 5A

Differential diagnosis

This species can be easily differentiated from all other species of *Eugenys* by the following characters: hypopods with singular apical tenaculum (10–14 present in *E. singularis* sp. nov. and *E. cymosa*, one in the remaining species); antennal flagellomeres without patch of darkened sensilla (present in *E. upsilon* sp. nov. and *E. panamensis*, absent in remaining species); aedeagus less than half length of ejaculatory apodeme (aedeagus long, more than half length of ejaculatory apodeme in *E. clavellata*).

Etymology

The speciphic epithet '*micra*' is derived from the Greek '*mīkrós*' (feminine '*mikrí'*), referring to the small size of the aedeagus of the species.

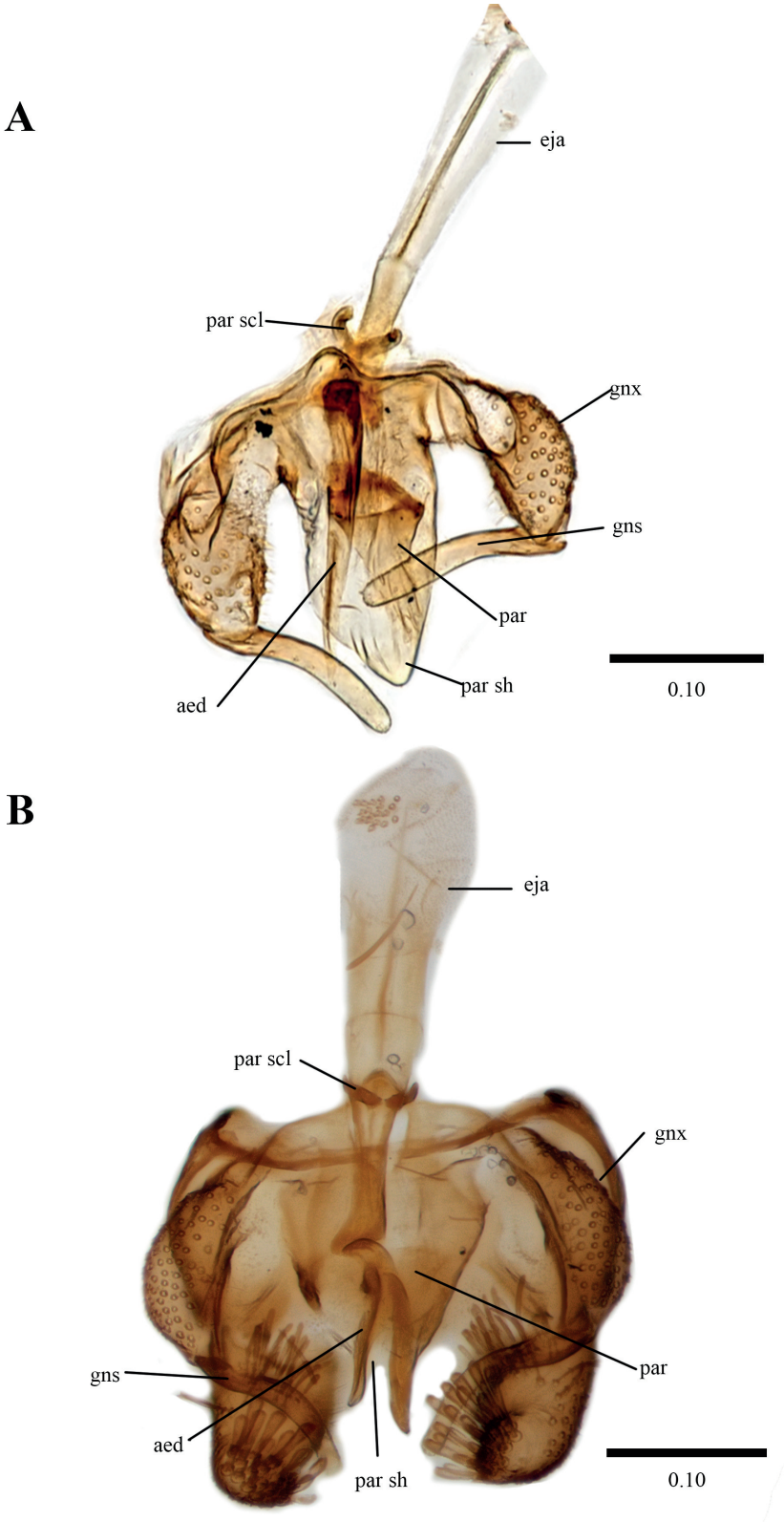

Fig. 2. A. *Eugenys clavellata* Quate, 1996, ♂, paratype (USNMENT00857092), genitalia (ventral view). **B**. *Eugenys cymosa* Quate, 1999, ♂, paratype (BMNH(E)2001-8), genitalia (ventral view). Photos A by David Pecor, Smithsonian Institute Museum, B by Santiago Jaume-Schinkel. Scales in millimeters (mm). Abbreviations: see Material and methods.

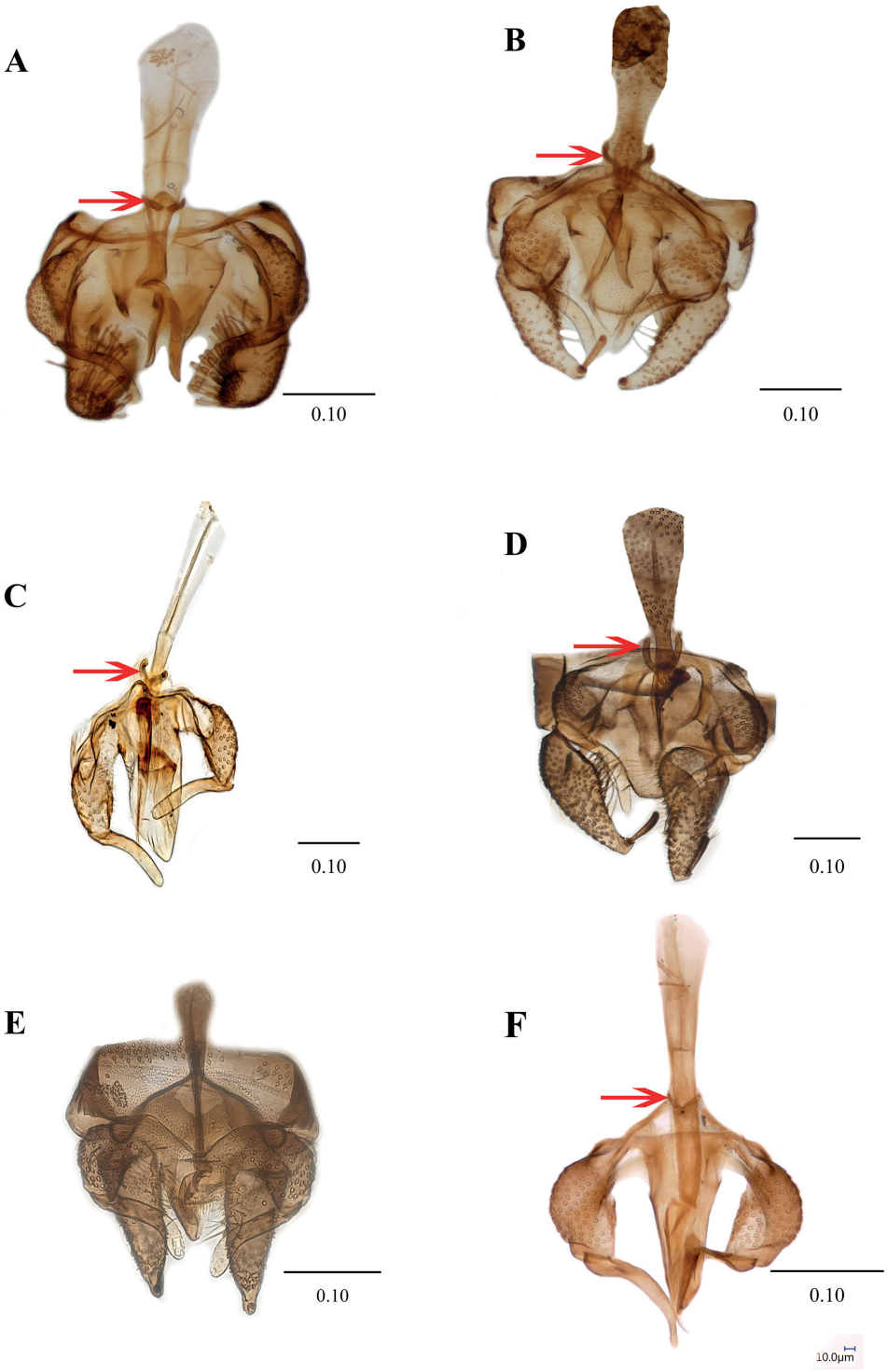

Fig. 3. Male genitalia, ventral view. **A**. *Eugenys cymosa* Quate, 1999, paratype (BMNH(E)2001-8). **B**. *Eugenys panamensis* Quate, 1999, paratype (BMNH(E)-2001-8). **C**. *Eugenys clavellata* Quate, 1996, paratype (USNMENT00857092). **D**. *Eugenys upsilon* sp. nov., holotype (ZFMK-DIP-00097918). **E**. *Eugenys micra* sp. nov., holotype (ZFMK-DIP-00097917). **F**. *Eugenis singularis* sp. nov., holotype (INBIO-CRI001470242). Red arrows point to the parameral sclerites. Photos: A–B, D–F by Santiago Jaume-Schinkel, C by David Pecor, Smithsonian Institute Museum. Scales in millimeters (mm).

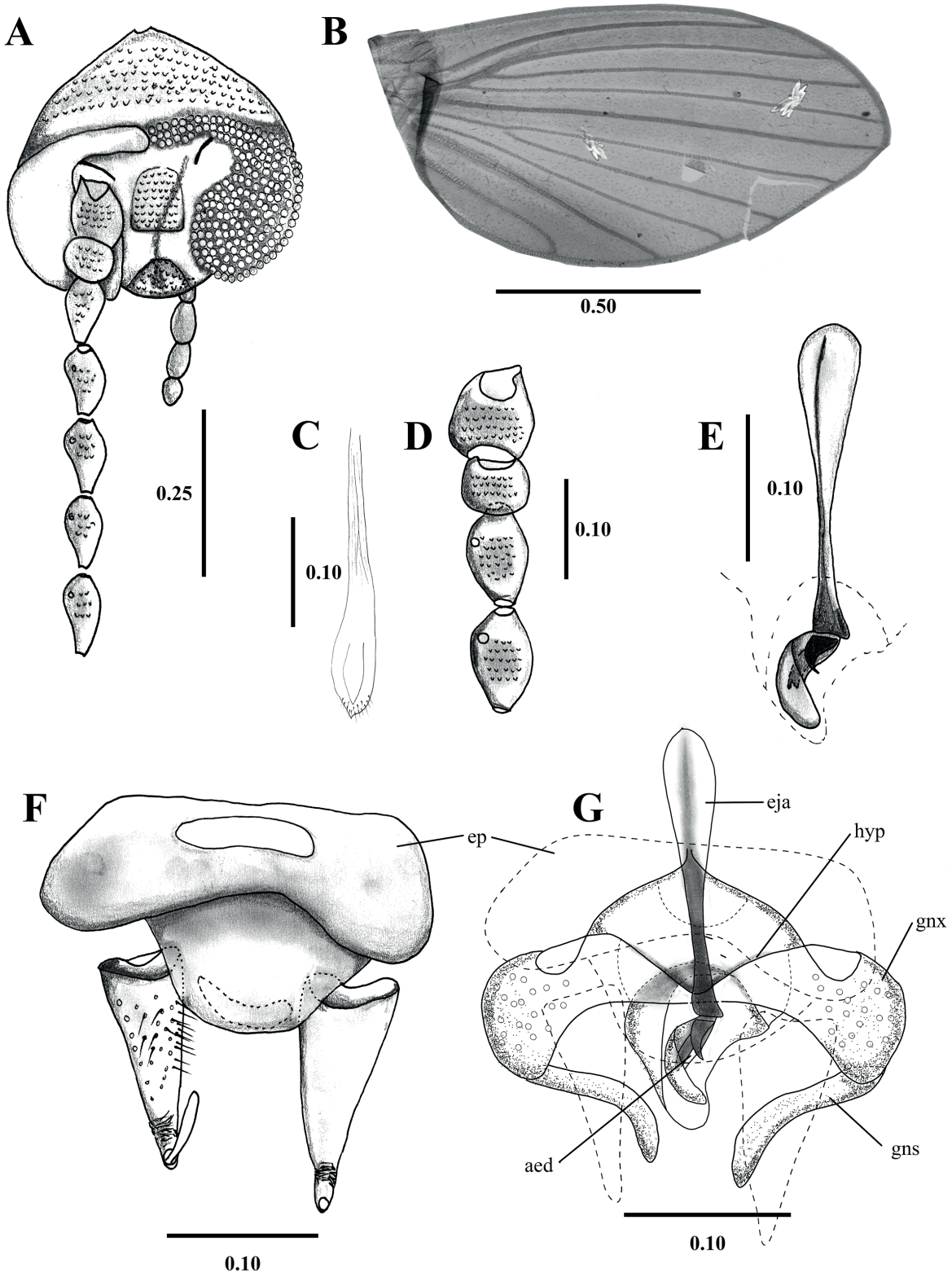

Fig. 4. *Eugenys micra* sp. nov., ♂, holotype (ZFMK-DIP-00097917). **A**. Head. **B**. Wing. **C**. Mouth parts. **D**. Scape, pedicel and first two flagellomeres. **E**. Aedeagus (ventral view). **F**. Epandrium and hypopods (ventral view). **G**. Aedeagus, gonocoxites, and gonostyli (ventral view). Scales in millimeters (mm). Abbreviations: see Material and methods.

Material examined

Holotype

ECUADOR – **Pichincha** • ♂; Pedro Vicente Maldonado, Parroquia Pedro Vicente Maldonato, Roadway to Pachijal; 0.11882° N, 78.95802° W; alt. 750 m; 1–9 Feb. 2022; I. Kilian leg.; ZFMK-DIP-00097917; INABIO.

Paratypes

COSTA RICA – **Limon** • 1 ♂; Hitoy-Cerere Biological Reserve; 9.80666° N, -83.02500° E; alt. 100–200 m; 17–26 Feb. 1999; L.W. Quate leg.; INBIO-CRI001472882; LACM • 1 ♂; same collection data as for preceding; INBIO-CRI001472884; INBIO • 1 ♂; same collection data as for preceding; INBIO-CRI001472896; INBIO.

Description

Male (holotype)

Measurements (in mm). Wing length 1.08, width 0.90; head length 0.17, width 0.45; antennal segments, scape 0.09, pedicel 0.06, flagellomeres 1–3: 0.10; palpal segments 1: 0.03, 2: 0.06, 3: 0.05, 4: 0.03.

Head. About 2 × as wide as long; eye bridge contiguous, eye bridge with three facet rows; no enlarged alveoli on postocular area (Fig. 4A); interocular suture appears absent. Antenna with scape about same width as its length, asymmetrical; pedicel spherical, about same width as its length; flagellomeres posterior to 4 lost in all examined specimens, 1–4 fusiform, flagellomeres without darkened patch of sensilla; ascoids absent in examined material; frontal alveoli patch quadrate; mouthparts reduced, not extending beyond margin of head. Palpal segments short and sclerotized, apical segment not corrugated; not extending more than half of flagellomere 2, palpal proportions 1.0:2.0:1.6:1.0.

Thorax. Without allurement organs; wing length about 2 × its width, hyaline, with alveoli on entire surface (Fig. 4B); Sc vein almost straight, ending at origin of R_5, fork of R_{2+3} slightly basal to M_{1+2}, R_{2+3} joining R_4, wing apex rounded, R_5 ending slightly below apex.

Terminalia (Fig. 4E–G). Hypandrium very narrow, plat-like, and V-shaped; gonocoxites about same length as gonostyli, longer than wide, gonocoxites joining in middle, and together giving origin to semi-sclerotized parameral sheath protruding beyond aedeagus, covering aedeagus only on dorsal surface (see Figs 3E, 4E, G); gonostyli narrow, outwardly curved; ejaculatory apodeme about 3 × as long as aedeagus, narrow but broadening towards anterior end, aedeagus curved, with claw-shaped and heavily sclerotized paramere; aedeagal sclerites apparently absent; epandrium about 4 × as wide as long, concave on posterior margin; hypopods elongate, longer than epandrium, curved and tapering towards apex, apex of hypopods with single tenaculum with crowned apex. Epiproct very wide, tongue-shaped with rounded margin, whole surface covered in small setulae.

Female

Unknown.

Distribution

Costa Rica and Ecuador.

Genetics

The holotype was successfully sequenced for COI, GenBank accession number OQ706370.

Eugenys panamensis Quate, 1999
Figs 1, 3B, 5B

Eugenys panamensis Quate, 1999: 430. Type locality: Panama, Canal Zone, Barro Colorado Island.

Diagnosis

This species can be easily differentiated from all other species of *Eugenys* by the following characters: hypopods with a singular apical tenaculum (10–14 present in *E. singularis* sp. nov. and *E. cymosa*, one in *E. micra* sp. nov., *E. panamensis* and *E. upsilon* sp. nov.); antennal flagellomeres with patch of darkened sensilla (present in *E. upsilon*, absent in remaining species); aedeagus straight, with distinguishable paramere (aedeagus curved, without distinguishable paramere in *E. upsilon*).

Material examined

Paratypes
PANAMA – **Canal Zone** • 1 ♂; Barro Colorado Island; 11–18 Aug. 1993; 9.1500° N, -79.8500° W; J. Pickering leg.; #1662; BMNH(E)-2001-8; NHM • 1 ♂ same collection data as for preceding; 4–11 Aug. 1993; #1709; NHM.

Genetics

No specimens were available for DNA sequencing.

Eugenys singularis sp. nov.
urn:lsid:zoobank.org:act:AA14FE8F-5A54-430F-9D08-56AC089FFB68
Figs 1, 3F, 6

Differential diagnosis

This species can be easily differentiated from all other species of *Eugenys* by the hypopods with a lateral digitiform projection (hypopods without lateral projection in remaining species).

Etymology

The species epithet is derived from the Latin '*singulāris*', referring to the unusual shape of the lateral projection of the hypopods.

Material examined

Holotype
COSTA RICA – **Heredia** • ♂; Puerto Viejo de Sarapaquí, Est. Biol. LaSelva; alt. 50–100 m; 1 Dec. 1993; Malaise trap M/00/009; INBIO-CRI001470242; LACM.

Paratypes
COSTA RICA • 1 ♂; same collection data as for holotype; INBIO-CRI001470896; LACM.

Description

Male
Measurements (in mm; n = 2). Wing length 1.8 (1.8–1.8), width 0.89 (0.89–0.90); head length 0.35 (0.32–0.38), width 0.40 (0.40–0.40); antennal segments, scape 0.09 (0.08–0.10), pedicel 0.05 (0.05–0.06), flagellomeres 1: 0.09 (0.09–0.10), 2–13: 0.08 (0.08–0.09), flagellomere 14: 0.09; palpomeres 1: 0.04 (0.04–0.05), 2: 0.06 (0.06–0.06), 3: 0.05 (0.05–0.05), 4: 0.04 (0.04–0.04).

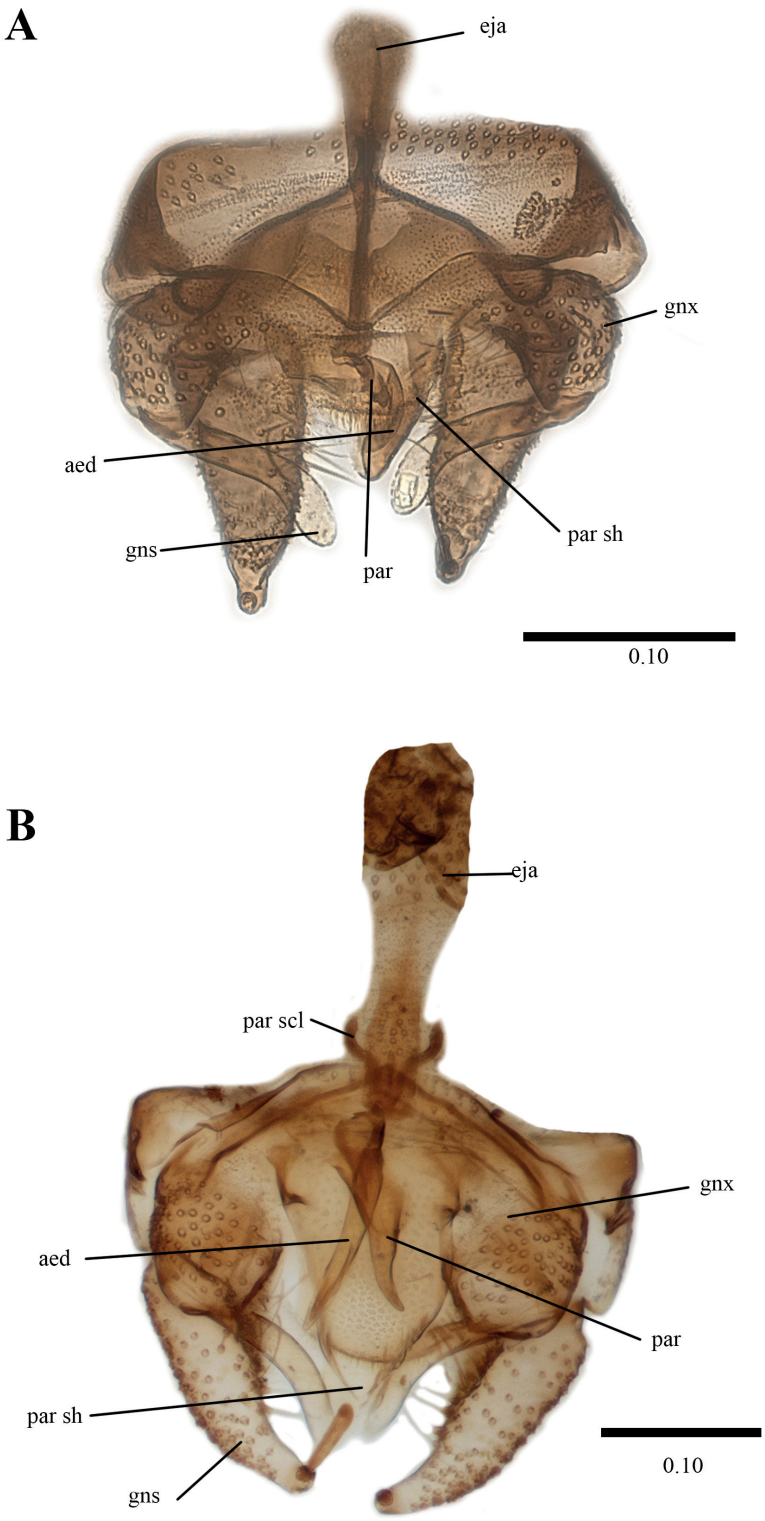

Fig. 5. Male genitalia, ventral view. **A**. *Eugenys micra* sp. nov., holotype (ZFMK-DIP-00097917). **B**. *Eugenys panamensis* Quate, 1999, paratype (BMNH(E)-2001-8). Scales in millimeters (mm). Abbreviations: see Material and methods.

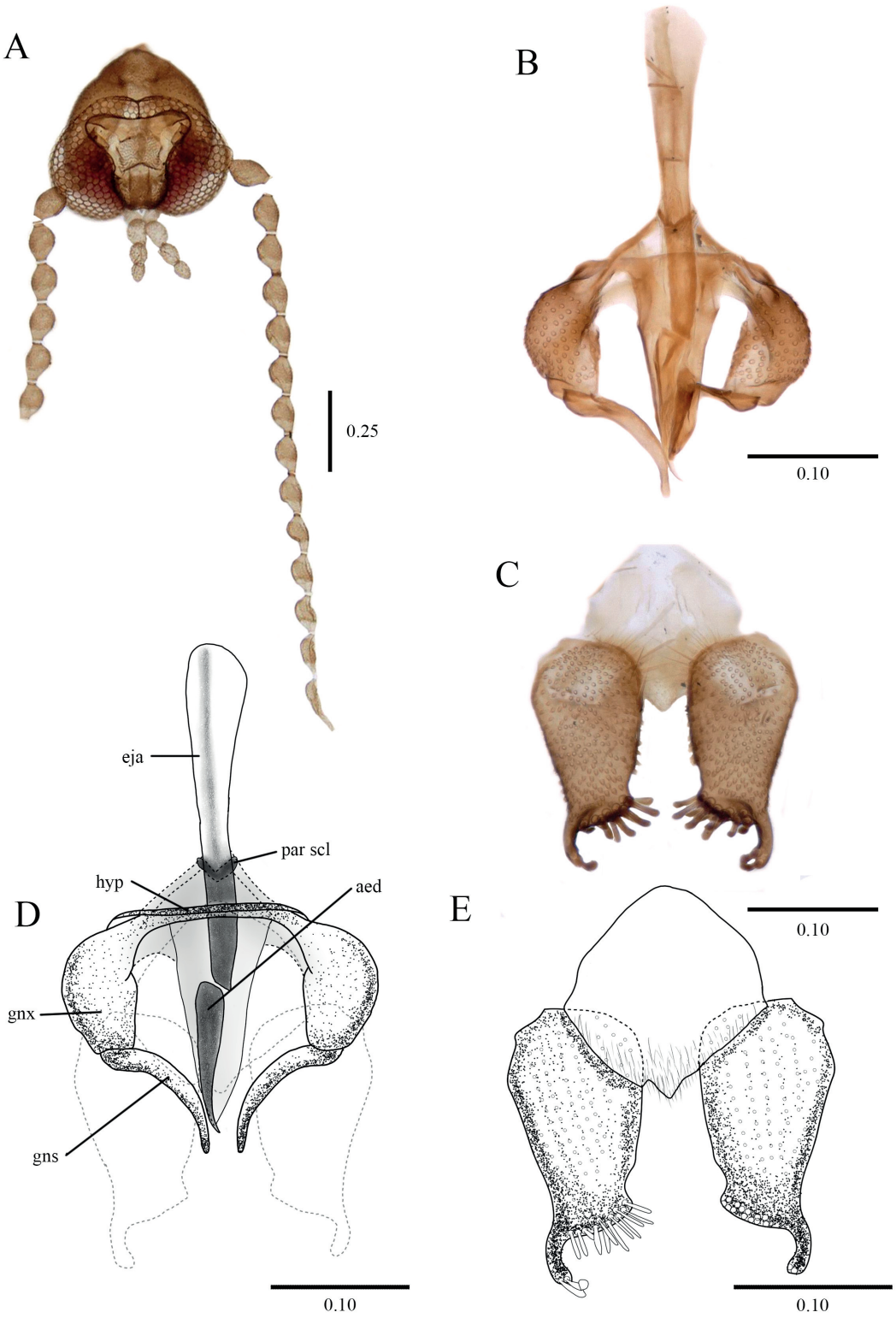

Fig. 6. *Eugenys singularis* sp. nov., ♂, holotype (INBIO-CRI001470242). **A**. Head. **B**. Aedeagus, gonocoxites and gonostyli (ventral view). **C**. Hypopods (ventral view). **D**. Aedeagus, gonocoxites and gonostyli (ventral view). **E**. Hypopods. Scales in millimeters (mm). Abbreviations: see Material and methods.

Head. Slightly wider than long; eye bridge contiguous, eye bridge with three facet rows; no enlarged alveoli on postocular area; interocular suture non-discernible in examined material (Fig. 6A). Antenna with scape cylindrical, about 2 × as long as pedicel; pedicel spherical; 14 flagellomeres, 1–13 fusiform, flagellomere 14 elongated, slightly longer than flagellomere 13, ending in digitiform apiculus, flagellomeres without patch of darkened sensilla; ascoids lanceolate, about 2 × as long as flagellomere carrying them; frontal alveoli patch square, lower margin with concavity in middle; mouthparts reduced, not extending beyond margin of head. Palpal segments short and sclerotized, apical segment not corrugated; not extending more than half of flagellomere 4, palpal proportions 1.0:1.4:1.1:1.0.

Thorax. Without allurement organs; wing length about 2 × its width, hyaline, with alveoli on entire surface; Sc vein almost straight, ending at about origin of R_5, fork of R_{2+3} basal to M_{1+2}, R_{2+3} joining R_4, wing apex rounded, R5 ending at wing apex.

Terminalia. Hypandrium narrow, plate-like; gonocoxites cylindrical, about two-thirds length of gonostyli; gonocoxites joining in middle, and together giving origin to semi-sclerotized parameral sheath protruding beyond aedeagus, covering aedeagus only on sternal surface (see Fig. 6B, D); gonostyli digitiform, tapering towards apex, with rounded apex, outwardly curved; ejaculatory apodeme about 2 × as long as aedeagus, narrow but broadening towards basal margin; aedeagus digitiform and tapering towards the apex, apex pointed; parameral sclerites fused, forming single Y-shaped sclerotized segment, linked to aedeagal sheath and aedeagus; epandrium not discernible in examined material; hypopods cylindrical, with outer laterally curved projection (Fig. 6C, E), lateral projection carrying two apical tenacula, while margin prior to projection in apex of hypopods carries 12–14 tenacula, all tenacula with rounded apex; epiproct v-shaped, covered in small setulae.

Female

Unknown.

Distribution

Only known from the type locality in Costa Rica.

Genetics

No specimens were available for sequencing.

Eugenys upsilon sp. nov.

urn:lsid:zoobank.org:act:56AB3A46-1F40-471F-B126-5C667FA33B48

Figs 1, 3D, 7–8

Differential diagnosis

This species can be easily differentiated from all other species of *Eugenys* by the following characters: hypopods with singular apical tenaculum (10–14 present in *E. singularis* sp. nov. and *E. cymosa*, one apical tenaculum in *E. micra* sp. nov., *E. panamensis* and *E. upsilon* sp. nov.); antennal flagellomeres with patch of darkened sensilla (present in *E. panamensis*, absent in remaining species); aedeagus curved, without distinguishable paramere (aedeagus straight, with distinguishable paramere in *E. panamensis*).

Etymology

The species epithet is derived from the Greek letter 'ύψιλον' ('ýpsilon'), referring to the Y- to U-shaped parameral sclerite.

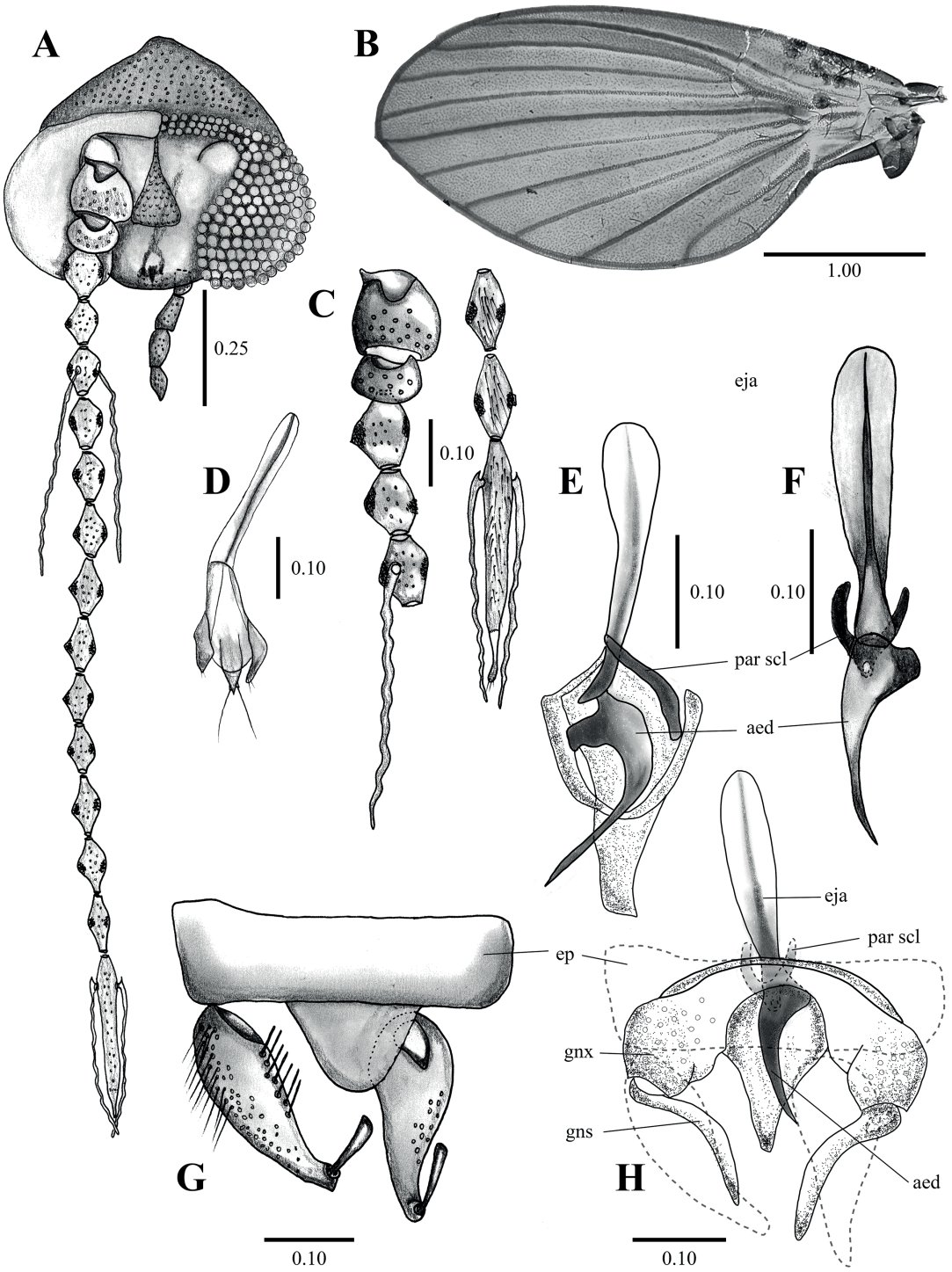

Fig. 7. *Eugenys upsilon* sp. nov. **A**. ♂, paratype **(**ZFMK-DIP-00097921), head. **B**. ♂, paratype **(**ZFMK-DIP-00097914), wing. **C**. ♂, paratype **(**ZFMK-DIP-00097921), mouth parts. **D**. ♂, paratype **(**ZFMK-DIP-00097921), first antennal segments. **E–H**. ♂, holotype (ZFMK-DIP-00097918). **E**. Aedeagus (lateral view). **F**. Aedeagus (ventral view). **G**. Epandrium and hypopods (ventral view). **H**. Aedeagus, gonocoxites, and gonostyli (ventral view). Scales in millimeters (mm). Abbreviations: see Material and methods.

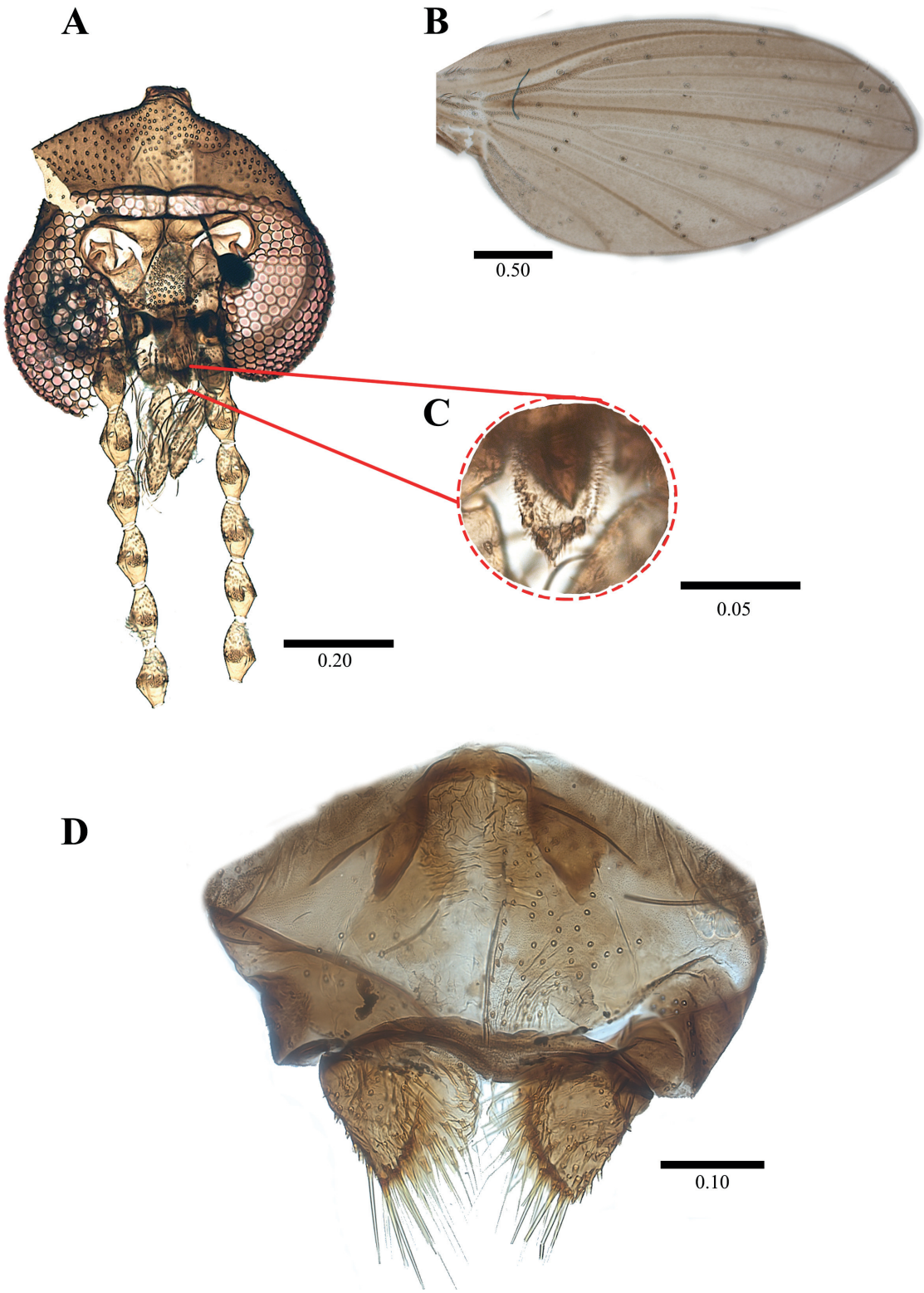

Fig. 8. *Eugenys upsilon* sp. nov., ♀, paratype (ZFMK-DIP-00097916). **A**. Head. **B**. Wing. **C**. Mouth parts. **D**. Genitalia (ventral view). Scales in millimeters (mm).

Material examined

Holotype

ECUADOR – **Pichincha** • ♂; Pedro Vicente Maldonado, Parroquia Pedro Vicente Maldonato, Roadway to Pachijal; 0.11882° N, 78.95802° W; alt. 750 m; 1–9 Feb. 2022; I. Kilian leg.; ZFMK-TIS-2637135; ZFMK-DIP-00097918; INABIO.

Paratypes

ECUADOR • 1 ♂; same collection data as for holotype; ZFMK-TIS-2637099; ZFMK-DIP-00097913; INABIO • 1 ♂; same collection data as for holotype; ZFMK-TIS-2637105; ZFMK-DIP-00097914; ZFMK • 1 ♂; same collection data as for holotype; ZFMK-TIS-2637111; ZFMK-DIP-00097915; ZFMK • 1 ♂; same collection data as for holotype; ZFMK-TIS-2637140; ZFMK-DIP-00097919; ZFMK • 1 ♂; same collection data as for holotype; ZFMK-TIS-2637141; ZFMK-DIP-00097920; ZFMK • 1 ♂; same collection data as for holotype; ZFMK-TIS-2637144; ZFMK-DIP-00097921; ZFMK • 1 ♀; same collection data as for holotype; ZFMK-TIS-2637123; ZFMK-DIP-00097916; ZFMK.

Description

Male

Measurements (in mm; n = 7). Wing length 3.04 (2.8–3.4), width 1.53 (1.3–1.63); head length 0.53 (0.56–0.50), width 0.63 (0.66–0.60); antennal segments, scape 0.13, pedicel 0.08, flagellomeres 1: 0.11, 2–12: 0.10, 13:0.11, 14: 0.36; palpal segments 1: 0.05, 2: 0.01, 3: 0.08, 4: 0.05.

Head (holotype). Wider than long; eye bridge contiguous, eye bridge with two facet rows on narrowest part and three facet rows on remaining part of bridge; no enlarged alveoli on postocular area; interocular suture appears absent (Fig. 7A). Antenna with scape wider than long, asymmetrical; pedicel spherical, about 2 × as wide as long; 14 flagellomeres, 1–13 fusiform, flagellomere 14 elongated, 3 × as long as previous flagellomere, ending in digitiform apiculus, flagellomeres with patch of darkened sensilla; ascoids very long, at least length of three flagellomeres, rod-like and with zigzag shape; frontal alveoli patch egg-shaped; mouthparts reduced, not extending beyond margin of head. Palpal segments short and sclerotized, apical segment not corrugated; not extending more than half of flagellomere 4, palpal proportions 1.0:2.0:1.6:1.0.

Thorax. Without allurement organs; wing length about 2 × its width, hyaline, with alveoli in whole surface (Fig. 7B); Sc vein almost straight, ending at origin of R_5, fork of R_{2+3} basal to M_{1+2}, R_{2+3} joining R_4, wing apex rounded, R5 ending slightly below apex.

Terminalia. Hypandrium narrow, plate-like, and rounded, Gonocoxites about half length of gonostyli, about as wide as long, gonocoxites joined in middle, and together giving origin to semi-sclerotized parameral sheath protruding beyond aedeagus, covering aedeagus only on sternal surface (Figs 3D, 7F, H); gonostyli narrow, outwardly curved; ejaculatory apodeme slightly longer than aedeagus, narrow but broadening towards basal margin, aedeagus curved in ventral view, and claw-shaped in lateral view, aedeagus with heavily sclerotized lump at base, which in lateral view extends towards dorsal surface (Fig. 7E); parameral sclerite forming single Y-shaped sclerotized structure, linked to aedeagal sheath and aedeagus; epandrium about 4 × as wide as long; hypopods elongate, longer than epandrium, tapering towards apex, apex of hypopods with single tenaculum with crowned apex. Epiproct tongue-shaped with rounded margin, covered in small setulae.

Female

Same as male except for palpi consisting of three segments; terminal flagellomeres absent in material examined; maximum number of flagellomeres present: 6. Mouthparts slightly more developed than in male, mouthparts with teeth-like sclerotized structures (Fig. 8C).

Distribution

Only known from the type locality in Ecuador.

Genetics

All specimens examined were successfully sequenced. All sequences are identical. Genebank's accession numbers are OQ706367, OQ706373, OQ706374, OQ706368, OQ706372, OQ706366, OQ706371, OQ706369.

Key to the males of Eugenys Quate, 1996

1. Hypopods with a lateral digitiform and curved projection (see Fig. 6C, E.) ....***E. singularis*** sp. nov.
– Hypopods without a lateral digitiform projection (as in Fig. 3A–E) 2

2. Hypopods with 14–16 apical tenacula (Figs 2B, 3E) .....***E. cymosa*** Quate, 1999
– Hypopods with a single apical tenaculum (Fig. 3B, D–E) 3

3. Antennal flagellomeres without a patch of darkened sensilla (Fig. 4A) 5
– Antennal flagellomeres with a patch of darkened sensilla (Fig. 8A) 4

4. Aedeagus curved, without distinguishable paramere apart from the parameral sclerite (Figs 3D, 7E–F, H) .....***E. upsilon*** sp. nov.
– Aedeagus straight, with distinguishable paramere in addition to the parameral sclerite(Figs 3B, 5B) ..... ***E. panamensis*** Quate, 1999

5. Aedeagus short, less than half the length of the ejaculatory apodeme; parameral sclerite not Y-shaped, appears absent (Figs 3E, 4E, G, 5A) .....***E. micra*** sp. nov.
– Aedeagus long, more than half the length of the ejaculatory apodeme; parameral sclerite Y-shaped and sclerotized (Figs 2A, 3C) ..... ***E. clavellata*** Quate, 1996

Discussion

With the present publication, we increase the number of species inside *Eugenys* to six. All of them are restricted to the Neotropical Region, and the currently recorded species have been recorded in four countries (Fig. 1), namely, Costa Rica with three species (*E. clavellata*, *E. micra* sp. nov., and *E. singularis* sp. nov.), Ecuador with two species (*E. micra* sp. nov. and *E. upsilon* sp. nov.), Nicaragua with one species (*E. clavellata*), and Panama with two species (*E. cymosa* and *E. panamensis*). The presence of this genus in other Neotropical countries is very likely, and the distributional gap might be due to the lack of systematic collections, but any further hypothesis might just be speculation.

Little is known about the biology of this genus, there is no information regarding larval stages or development. The reduced and/or atrophied mouthparts suggest that the adults of the genus are likely not to feed. However, as observed in Fig. 8C, the female of *Eugenys upsilon* sp. nov. possesses slightly more developed mouthparts than her male counterpart, and we observed some teeth-like sclerotized structures around the mouthparts that might suggest the mouthparts are not completely atrophied and some feeding might occur; however, there is no strong evidence, and this is a conjecture based on the observed morphological structures.

To date, the females are only known for two species (*E. panamensis* and *E. upsilon* sp. nov.) and both females are morphologically similar. Quate (1999) stated that the female genitalia is unlike that of all other Psychodinae. Male and female association in Quate's work (1999) was based on co-occurrence while describing the species. Male and female association in this study was based on DNA barcodes

(male and female barcodes of *E. upsilon* are identical, differing by 15% with the barcodes of *E. micra* sp. nov.). For the two species found at the same locality in Ecuador, namely, *E. micra* and *E. upsilon*, males can be easily separated through genital characters. On the contrary, the female of *E. micra* remains unknown, making it difficult to compare morphological characters with other known females. In the future, DNA barcodes will be helpful in describing new species and dealing with sex associations.

Most species of Psychodinae with fusiform flagellomeres, asymmetric male genitalia, and hypopods with a single apical tenaculum belong to the tribe Maruinini Enderlein, 1937 as defined by Duckhouse (1987, 1990; see also Quate & Brown 2004 who treated these taxa as Setomimini Vaillant, 1982). Some of the apomorphic characters of *Eugenys* indeed also occur in some Maruinini such as the elongated ascoids (similar to those observed in *Setomima* Enderlein, 1937 (see Duckhouse 1978)). However, whereas the linkage between the parameral-aedeagal complex and the subepandrial sclerite in Maruinini is developed as a distinct "ball-and-socket" configuration as described by Duckhouse (1987), this linkage is developed as a U- to Y-shaped parameral-subepandrial sclerite resembling what Vaillant (1971) described as "furca" in his Telmatoscopini (Fig. 3, indicated with a red arrow).

Kvifte (2014) suggested that the linkage parameral-subepandrial sclerite is mostly paramerally derived and showed its presence across most lineages of his Paramormiini Enderlein, 1937 (part of Pericomaini s. lat. of Kvifte 2018) and not just the ones considered by Vaillant (1971) to possess the "furca". The "Paramormiini" taxa in which the Y- to V-shaped parameral-subepandrial sclerite is most conspicuous (as observed in *Eugenys,* see Fig. 7E), however, mostly have nodiform flagellomeres, vein Rs not pectinate, male genitalia symmetrical (parameres paired or reduced, except in *Lepiseodina* Enderlein, 1937 and *Moruseodina* Bravo & Cordeiro, 2014, which have a single unpaired paramere) and hypopods with multiple aseriate apical tenacula (as in *Eugenys cymosa* and *E. singularis* sp. nov.).

The narrow eyebridge of only three facet rows and the pectinate Rs are characters shared with *Mormia* s. lat., which prompted Quate (1996) to place *Eugenys* in Mormiini originally. However, *Mormia* s. lat. all have nodiform flagellomeres, male genitalia symmetrical, and hypopods with multiple aseriate apical tenacula. Moreover, the narrow eyebridge of three facet rows, the fusiform flagellomeres and the male genitalia with a single paramere are shared characters with species of *Tonnoiriella* Vaillant, 1971 (the paramere was considered a distiphallic sclerite by Wagner & Withers 2020). However, *Tonnoiriella* differs from *Eugenys* by much shorter ascoids and hypopods with multiple aseriate apical tenacula. Nevertheless, we deem it likely that both *Eugenys* and *Tonnoiriella* may warrant a placement within or basal to Pericomaini s. lat. sensu Kvifte (2018) based on morphological characters, in particular the Y-shaped linkage of the aedeagal-parameral complex with the subepandrial sclerite.

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References

Collantes F. & Martinez-Ortega E. 1999. Nuevas citas de especies conocidas de Psychodinae (Diptera: Psychodidae) en Nicaragua. *Revista Nicaraguense de Entomologia* 46: 17–27.

Cumming J.M. & Wood D.M. 2017. Adult morphology and terminology. *In*: Kirk-Springs A.H. & Sinclair B.J. (eds) *Manual of Afrotropical Diptera. Vol. 1. Introductory Chapters and Keys to Diptera Families. Suricata 4*: 89–133. South African National Biodiversity Institute, Pretoria.

Curler G.R. & Moulton K. 2012. Phylogeny of psychodids subfamilies (Diptera: Psychodidae) inferred from nuclear DNA sequences with a review of morphological evidence for relationships. *Systematic Entomology* 37: 603–616. https://doi.org/10.1111/j.1365-3113.2012.00634.x

Duckhouse D.A. 1978. Non-phlebotomine Psychodidae (Diptera, Nematocera) of southern Africa. II. *Neoarisemus* and the brunettoid and telmatoscopoid genera. *Annals of the Natal Museum* 23: 305–359.

Duckhouse D.A. 1987. A revision of Afrotropical *Setomima*, elucidation of their genealogical relationships and descriptions of other Afrotropical Psychodinae (Diptera: Psychodidae). *Annals of the Natal Museum* 28: 231–281.

Duckhouse D.A. 1990. The Australasian genera of pericomoid Psychodidae (Diptera) and the status of related Enderlein genera in the Neotropics. *Invertebrate Taxonomy* 3: 721–746. https://doi.org/10.1071/IT9890721

Espíndola A., Buerki S., Jacquier A., Ježek J. & Alvarez N. 2012. Phylogenetic relationships in the subfamily Psychodinae (Diptera, Psychodidae). *Zoologica Scripta* 41: 489–498. https://doi.org/10.1111/j.1463-6409.2012.00544.x

Jaume-Schinkel S., Müller B., Avila-Calero S., Kukowka S., Rduch V., Mengual X. In press. Preserving morphology while extracting DANN: a non-destructive field-to-museum protocol for slide mounted specimens. *Biodiversity Data Journal*.

Kvifte G.M. 2014. Nomenclature and taxonomy of *Telmatoscopus* Eaton and *Seoda* Enderlein; with a discussion of parameral evolution in Paramormiini and Pericomaini (Diptera: Psychodidae, Psychodinae). *Zootaxa* 3878 (4): 390–400. https://doi.org/10.11646/zootaxa.3878.4.5

Kvifte G.M. 2018. Molecular phylogeny of moth flies (Diptera, Psychodidae, Psychodinae) revisited, with a revised tribal classification. *Systematic Entomology* 43 (3): 596–605. https://doi.org/10.1111/syen.12288

Kvifte G.M. & Wagner R. 2017. Review of *Neurosystasis* Satchell, with two new species from Cuba and a discussion of cerci and surstyli in Psychodinae (Diptera: Psychodidae). *Zootaxa* 4306 (1): 81–90. https://doi.org/10.11646/zootaxa.4306.1.4

Quate L.W. 1996. Preliminary taxonomy of Costa Rican Psychodidae (Diptera), exclusive of Phlebotominae. *Revista de Biología Tropical* 44 (1): 1–81.

Quate L.W. 1999. Taxonomy of neotropical Psychodidae. (Diptera) 3. Psychodines of Barro Colorado Island and San Blas, Panamá. *Memoirs on Entomology International* 14: 409–441.

Quate L.W. & Brown B.V. 2004. Revision of Neotropical Setomimini (Diptera: Psychodidae: Psychodinae). *Natural History Museum of Los Angeles County Contributions in Science* 500: 1–117. https://doi.org/10.5962/p.210558

Vaillant F. 1971. Psychodidae – Psychodinae. *In*: Lindner E. (ed.) *Die Fliegen der Palearktischen Region. Lieferung 287*: 1–48. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

Wagner R. & Ibáñez-Bernal S. 2009. Psychodidae (sand flies and moth flies or owl flies). *In*: Brown B.V., Borkent A., Cumming J.M., Wood D.M., Woodley N.E. & Zumbado M.A. (eds) *Manual of Central American Diptera Vol. I*: 319–333. NRC Research Press, Ottawa.

Wagner R. & Withers P. 2020. The West-Palearctic species of the genus *Tonnoiriella* Vaillant, 1971 (Diptera: Psychodidae, Psychodinae). *Zootaxa* 4728 (2): 4728. https://doi.org/10.11646/zootaxa.4728.2.2

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