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Ugyopini of New Caledonia (Hemiptera: Fulgoromorpha: Delphacidae: Asiracinae) with a description of *Notuchus linnavuorii* sp. nov.

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Abstract. The paper presents information about species of Ugyopini, Fennah, 1979 from New Caledonia. One new species from New Caledonia is described, *Notuchus linnavuorii* sp. nov., with notes on the morphological details of selected external structures. An identification key to all of the species of *Notuchus* Fennah, 1969 and a checklist of the species of this genus are also provided. The male terminalia of three species of the genus *Ugyops* Guérin-Ménéville, 1834 (*U. inermis* Distant, 1920, *U. nemestrinus* Fennah, 1969 and *U. taranis* Fennah, 1964) are described and illustrated for the first time.

Key words. Delphacidae, Ugyopini, *Notuchus*, *Ugyops*, new species, key to species, checklist, New Caledonia.

INTRODUCTION

The genus *Notuchus* Fennah, 1969 (type species *Notuchus risioides* Fennah, 1969) together with the genera *Canyra* Stål, 1862 (type species – in original combination: *Delphax placida* Stål, 1854), *Melanugyops* Fennah, 1956 (type species *Melanugyops erebea* Fennah, 1956), *Perimececera* Muir, 1913 (type species *Perimececera giffardi* Muir, 1913), *Ugyopana* Fennah, 1950 (type species *Ugyopana cassia* Fennah, 1950), *Ugyops* Guérin-Ménéville, 1834 (type species *Ugyops percheronii* Guérin-Ménéville, 1834), and *Serafinana*† Gębicki & Szwedo, 2000 (type species *Serafinana perperunae*† Gębicki & Szwedo, 2000) comprise the tribe Ugyopini within the Asiracinae subfamily (Gębicki & Szwedo 2000; Urban et al. 2010; Bourgoin 2020). The genus *Notuchus* comprises nine endemic species, which are found in Australia (Queensland) – *N. kurandae* Donaldson, 1979 (syn. *N. palmerstonensis* Donaldson), *N. oresbios* Donaldson, 1988 and *N. rotundifacies* Donaldson, 1979 (Donaldson 1979, 1983, 1988); on Lord Howe Island – *N. howensis* Donaldson, 1987 and *N. monticola* Fennah, 1973 (Donaldson 1987; Fennah 1973); in New Caledonia – *N. risioides* Fennah, 1969, and three cavernicolous species known only from New Caledonia: *N. kaori* Hoch

& Asche, 2006, *N. larvalis* Fennah, 1980 and *N. ninguae* Hoch & Asche, 2006 (Fennah 1980; Hoch et al. 2006). The representatives of this genus differ significantly from other Delphacidae in their general exterior and head morphology, which partly results from their hidden, epigeic life in the rainforest floor (Hoch et al. 2006).

N. linnavuorii Gębicki & Walczak sp. nov. represents the species group *monticola* as its only representative in New Caledonia. In its external structure, the species is most closely related to Australian *N. oresbios* Donaldson, 1988. The other species from New Caledonia are characterised by a distinctively different structure (especially the head). *N. risioides* Fennah, 1969, which represents the species group *risioides*, is distinguished by a shortened preocular part of the head, and *N. kaori* Hoch & Asche, 2006 and *N. ninguae* Hoch & Asche, 2006, representatives of species group *larvalis*, are characterised by advanced troglomorphism. The majority of known species of the genus *Notuchus* is characterised by a dorsoventrally flattened body (especially by a flattened head) with three clearly visible keels on its lateral margins and shortened, sclerotised, short and thick forewings (hindwings are rudimentary), which are morphological adaptations for living in leaf litter and in detritus (upper layer of detritus) (Hoch et al. 2006).

The largest genus within the tribe Ugyopini is *Ugyops* Guérin-Ménéville, which contains 101 species of which many are endemic (Asche 1985). It is probably a taxon of a Gondwanan origin comprising the species that currently inhabit two isolated areas: the Neotropical region (from the Antilles to central Brazil) and the Indo-Australian region (extending in the North to Central China and Japan, in the West to the Seychelles, in the East to some of the islands of Oceania including New Caledonia). There are two recognised subgenera within the genus *Ugyops*: *U. (Ugyops)* Guérin-Ménéville, 1834 and *U. (Paracona)* Fennah, 1965 of which the nominative subgenus contains most of the species, whereas the other comprises two species that are known only from New Zealand (Muir 1923; Fennah 1965).

Morphological descriptions of many species of the genus *Ugyops* Guérin-Ménéville are not very precise, especially descriptions of male genitalia are missing (Fennah 1969, 1973; Donaldson 1983). Therefore, it seems justified to supplement morphological descriptions using scanning electron microscopy (SEM) and complete information about male genitalia and male terminalia, which are now widely considered in recent descriptions of species of Ugyopini (Hoch et al. 2006).

MATERIAL AND METHODS

The studied material belongs to the collection of the Upper Silesian Museum in Bytom (USMB, Poland). It was collected in December 2006 and March–April 2008. To collect the specimens, a standard entomological sweep-net, ($\varnothing = 0.35$ m), a light trap (bulb “MIX”-type 250 W, E40) and pitfall traps were used.

The specimens were mainly identified based on the structure of the genital apparatus. The structures were extracted from the body and mounted using a 10% solution of KOH according to the procedure developed by Knight (1965). The material was identified on the basis of the following keys: Distant (1920), Fennah (1964, 1969), Donaldson (1979, 1988) and Hoch et al. (2006).

The specimen from the genus *Notuchus* was quite dirty (this species lives on the surface of the ground and in its top layers). Using an ultrasonic cleaner did not give positive results. For this reason, we used the cleaning method of Schneeberg et al. (2017). For the SEM, the specimen was treated with 5% KOH for 14 h at room temperature (22°C). After the treatment, the KOH was removed with distilled water. Next, the specimen was dehydrated in an ascending ethanol/water series (70, 80, 96 and 100% ethanol and 100% acetone; in 70–96% ethanol for 15 min in each concentration, in 100% ethanol and 100% acetone for one hour each with four reagent changes) and then dried. The specimens of *Ugyops* were also cleaned in an ultrasonic washer, which gave much better results than

for the specimen of *Notuchus*. A method of Kanturski et al. (2015) was adapted and used to dehydrate and dry the specimens. The material was dehydrated in a graded ethanol/water series of 75%, 80%, 90%, 95% and 100% for 10 min in each concentration with three 100% ethanol changes. The dehydrated samples were then dried in hexamethyldisilazane (HMDS).

Color photographs of the specimens were obtained using a Leica M205C stereo microscope, a Leica DFC495 camera and the Leica application suite ver. 4.9.0. The photographs of the genital structures were obtained using a Nikon Eclipse E-600 biological microscope with a Nikon DS-Fi2 digital camera and NIS Elements ver. 4.10.

The SEM examinations were conducted in the Laboratory of Scanning Microscopy of the Jan Długosz University, Częstochowa, Poland using a Tescan VEGA 3 SBU scanning electron microscope equipped with an X-ray EDS spectrometer (OXFORD X-ACT PENTAFET Precision) in the low-vacuum mode and at the Institute of Biology, Biotechnology and Environmental Protection of the Faculty of Sciences of the University of Silesia in Katowice, Poland using a Phenom XL field emission scanning electron microscope in the low-vacuum mode. The samples for SEM analyses were mounted on aluminium stubs using double-sided adhesive carbon tape. In contrast to the methods that are usually used in morphological studies, the specimens were not sputter-coated with a film of electrically conductive material. However, the specimens were covered with anti-static spray. Using such methods and equipment enable relatively good quality photos to be obtained without destroying the specimens, which should be returned to the museum in a good condition (Gorczyca et al. 2019).

Using scanning microscopy made it possible to obtain high-quality images, including the overall morphology of the specimens, the legs in detail and the distribution and types of the sensilla on the antennae. The classification and description of the sensilla are based on Altner & Prillinger (1980), Stacconi & Romani (2011) and Zhu et al. (2019). The morphological terminology of the head is adopted from Holzinger et al. (2003).

Despite the fact that the described specimen of *Notuchus linnavuorii* sp. nov. was a single female, it was distinguished by a set of morphological features (especially concerning the head and mesonotum). The morphological features of this species make it possible to distinguish it from other similar species of the genus *Notuchus* Fennah, 1956, especially from *Notuchus oresbios* Donaldson, 1988, which is a morphologically similar species.

All of the known species of the genus *Notuchus* live hidden in the forest litter and under mosses (except for a few cavernicolous species), which is the reason that often only a few specimens are collected. A large number of specimens is rarely obtained without using specific collection methods.

Abbreviations

Quoting the labels of specimens: (/) is used to divide the data on the different rows on a label, (;) is used to divide the data from different labels and ([]) is used for the authors' comments.

RESULTS

Notuchus linnavuorii Gębicki & Walczak sp. nov.
(Figs 1–4)

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Delphacidae Leach, 1815

Ugyopini Fennah, 1979

Notuchus Fennah 1969

Notuchus linnavuorii Gębicki & Walczak sp. nov.

Etymology. The name of this new species is dedicated to Professor Linnavuori, a Fulgoromorphan and Heteropteran specialist.

Material examined

Holotype. 1 ♀ // *Notuchus linnavuorii* sp. nov. // Gębicki & Walczak det. 2015 [red label]; New Caledonia (N) // 21°00.318' S, 165°14.605' E // Tchamba (Wão Uni), 20.03.2008 // from refuge to 500 m // leg. R. Dobosz; 5915/26293 // coll. Upper Silesian Museum // (USMB) Bytom, Poland.

Description

Body. Oval (Fig. 1A, D), dorso-ventrally flattened (Fig. 1C).

Head. Broad, delta-shaped, vertex acutely rounded. Coronal keel relatively high, reaching $\frac{2}{3}$ of the vertex where it bifurcates. Vertex flat with a distinct concavity in the apical area (Fig. 2A). Frons with two pairs of flattened lateral keels that surround its weakly concave surface. The area between the keels is regularly arcuate and slightly concave, its maximal width at the level of antennae is almost three times narrower than the widest part of middle frons. Frons arcuately tapering towards the vertex, at its base almost straight with broad ventral margin. Additional pair of short keels stretching from dorsal margin of the eye to the apex of the head, which together with anterolateral keels form characteristic longitudinal concavity above the eye. Postclypeus broad with arcuate margins and with light-colored median keel. Anteclypeus triangular, distinctly shorter than postclypeus with a distinct median keel. Mouthpart long, reaching the base of hind legs (Fig. 2B). Rostrum very long, its tip exceeds the line between hind coxae considerably (Figs 1B, 2D). Compound eye slightly oval, its posterior margin with antenna hollow. Eye length (in lateral view) approximately equal to the length of the part of head anterior

to eyes. Ocelli absent. Scapus of antennae with slightly convex lateral margin, pedicellus apically expanding with numerous placoidal sensilla, which concentrate to form basal and apical groups (Fig. 3A–B). Apical part of pedicellus is covered with numerous minute spines, which are distinctly separated from wide scale-like structures that cover its basal part (Fig. 3D). A few rather long spines and more numerous short fine ciliate structures are evenly distributed among sensilla placoidea (Fig. 3C–D).

Pronotum. Clearly differentiated medial part with three distinct keels and two lateral parts in the form of flat plates. Lateral keels arcuate and indistinctly connected to the posterior margin of pronotum. The structure of lateral plates forms a cleavage in which basal margins of wings are located (Fig. 2A).

Mesonotum. In the middle line about 1.5 times larger than pronotum with three distinct high keels. Its anterior margin joins pronotum at $\frac{1}{3}$ of the length of its lateral plates. Median keel bears the mark of the scutellum connection (Fig. 2A).

Tegmina. Coriaceous, strongly shortened and distally truncated. In medial and claval parts, strongly convex; in costal part, flattened and slightly upturned. Both tegmina and wings adhere to each other along the medial margin, narrowly bordered and apically arcuately rounded. In basal part, two protrusions formed at the veins R and M+Cu. Longitudinal veins indistinct with undulating course and with numerous transverse veins, supposedly vena spuria. Tegulae absent (Figs 1D, 2A).

Legs. Prothoracic and mesothoracic legs without spines along tibia but with a row of high chaetae. Their tarsal segments I and II are small, the third is the longest and is apically enlarged (Fig. 2C–D). Metathoracic legs with three strong spines on the ventral margin of tibia, the convex dorsal margin fits into the shallow elongated indentation of the femur.

Pattern arrangement of metatibial spines. 2+3, with the first one being the longest. Post-tibial calcar in cross section almost round and apically acuminate. The apex of the basal and medial segment of the tarsus with spines arranged in a way typical of the Ugyopini and Eodelphacini tribes (Figs 1B, 2E).

Abdomen. With three distinct longitudinal tergal keels with spikes (Fig. 1D). Ventral plates of pygofer convex, truncated at the apex. Ovipositor longer than pygofer, does not extend over the anal tube (Fig. 4A). Broad plates of the anal tube are joined together on the ventral side (Fig. 4B).

Ovipositor. Second pair of gonopophyses slightly arched downwards near apex (Fig. 4C), their dorsal edges covered with numerous homogenous denticles (Fig. 4D). Third pair of gonopophyses with strong sclerotised thickening at the basal part and over its entire length (Fig. 4E).

Measurements. Total body length 4.68 mm; maximal body width 2.56 mm; head length (in its coronal part) 0.52 mm; head width (at its base) 0.69 mm; head

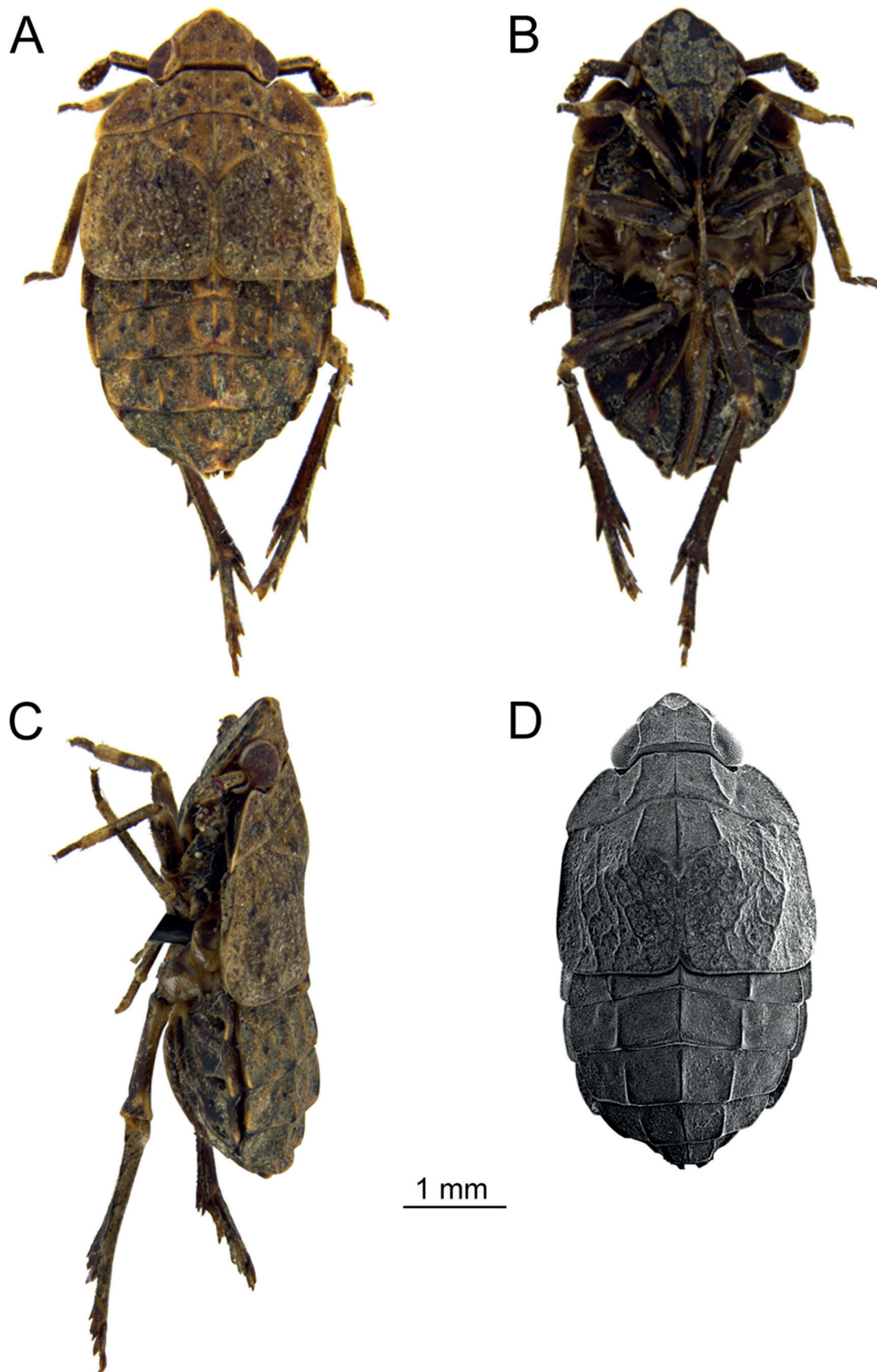


Fig. 1. *Notuchus linnavuorii* sp. nov., ♀. **A.** Dorsal view. **B.** Ventral view. **C.** Lateral view. **D.** Dorsal view, SEM.

width (including eyes) 1.35 mm; eye length (in dorsal view) 0.48 mm; pronotum length (along the median keel) 0.41 mm; pronotum length in its lateral part 0.56 mm; total pronotum length 2.21 mm; width of the median part of pronotum (between lateral keels) 0.63 mm; mesono-

tum length 0.78 mm; mesonotum width (at its anterior margin) 1.41 mm; tegmina length 1.47 mm; length of the ventral edge of tegmina 0.73 mm; tegmina width 1.34 mm; length of the visible part of abdomen 2.02 mm; maximal abdomen width 2.49 mm.

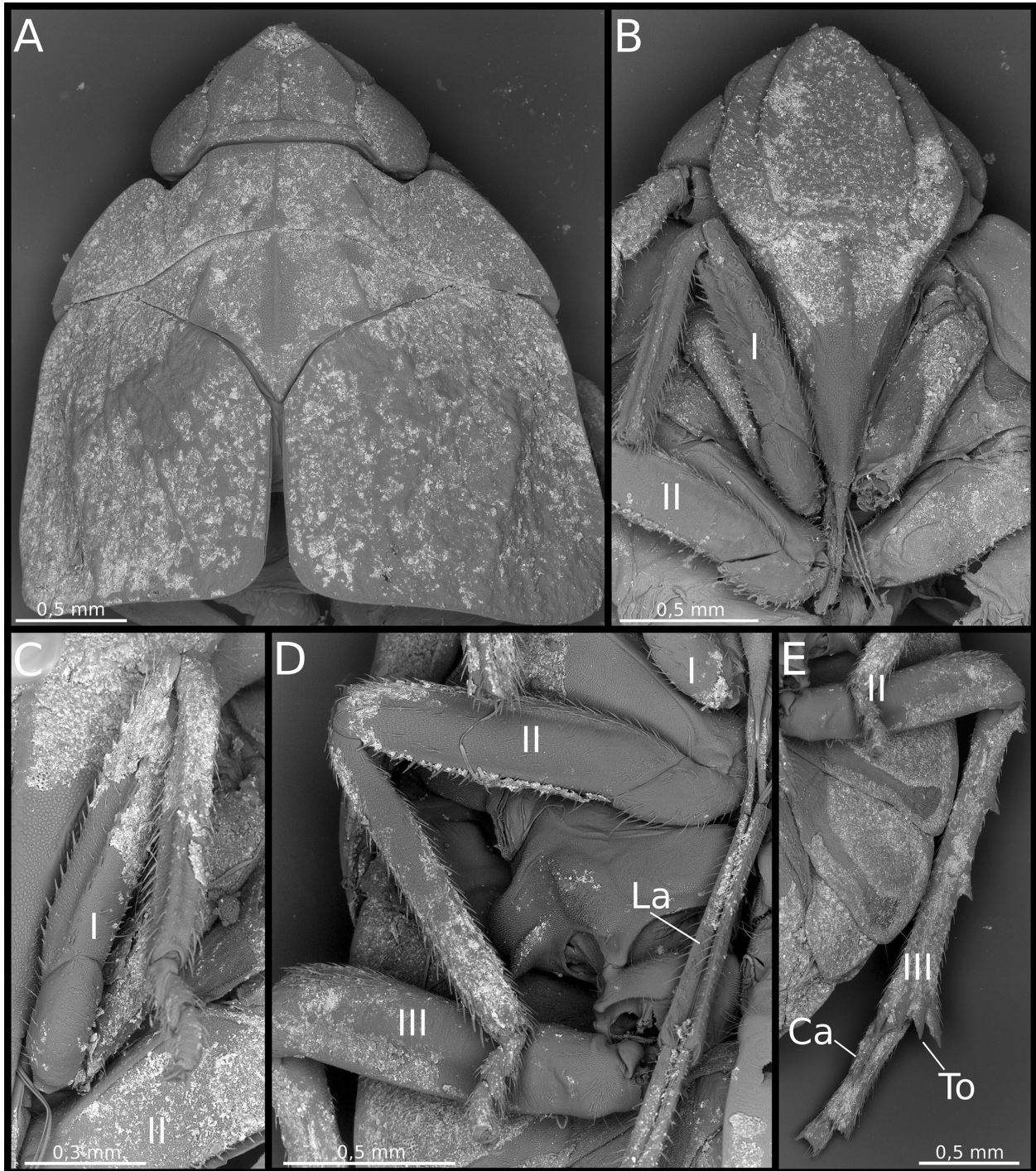


Fig. 2. *Notuchus linnavuorii* sp. nov., ♀. **A.** Head and thorax with brachypterous wings, dorsal view. **B.** Front of head. **C.** First pair of legs (I). **D.** Second pair of legs (II) and fragment of labium (La). **E.** Third pair of legs (III) with calcar (Ca) and teeth (To) in the distal part of the tibia.

Coloration. General body coloration almost uniformly greyish-brown. The base of abdomen, thorax and frons black. Along the anterolateral and interlateral keels of frons, alternate yellow and black spots present (6 each). Similar spots (three each) are present on the ventral side of lateral keels of pronotum. Vertex yellow. Lateral plates of pronotum with long black blurred spots. Tegmen brownish, its costal parts distinctly lighter. Longitudinal veins slightly darker than the rest of the wing. Legs dark.

Apical parts of pro and mesotibia yellowish, metatibia uniformly dark (Fig. 1A–C).

Distribution. Endemic for New Caledonia.

Remarks. *Notuchus linnavuorii* sp. nov. is differentiated from the other species in the same genus by a set of features: a well-developed compound eye, vertex in the lateral view extending anterior to eyes for about the

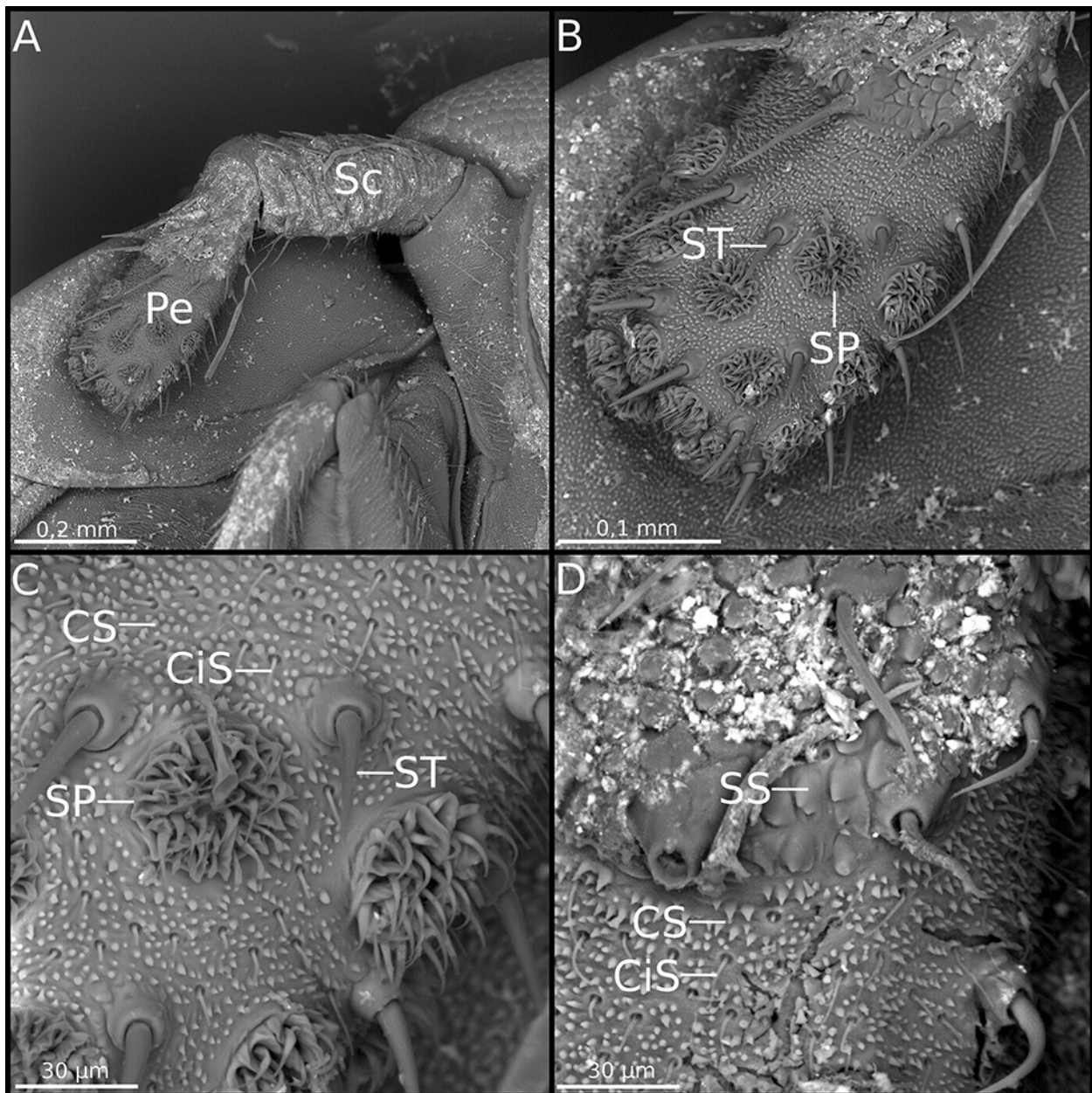


Fig. 3. *Notuchus linnavuorii* sp. nov., ♀ (SEM). **A.** Antenna: scapus (Sc) and pedicellus (Pe). **B.** Pedicellus with sensors structure: sensilla trichoidea (ST), sensilla placoidea (SP). **C.** Fragment of pedicellus: ciliate structure (CiS), conoidal structure (CS), sensilla placoidea (SP), sensilla trichoidea (ST). **D.** Fragment of pedicellus: ciliate structure (CiS), conoidal structure (CS), squamates structure (SS).

length of an eye, marginal carinae distinctly visible in the dorsal view, vertex with a ratio of total length in midline to length anterior to eyes > 1.8 ; vertex acutely rounded, mesonotum with median carina weakly curved. The last

feature and the vertex ratio differentiate *N. linnavuorii* sp. nov. from its closest Australian species *N. oresbios* Donaldson, 1988.

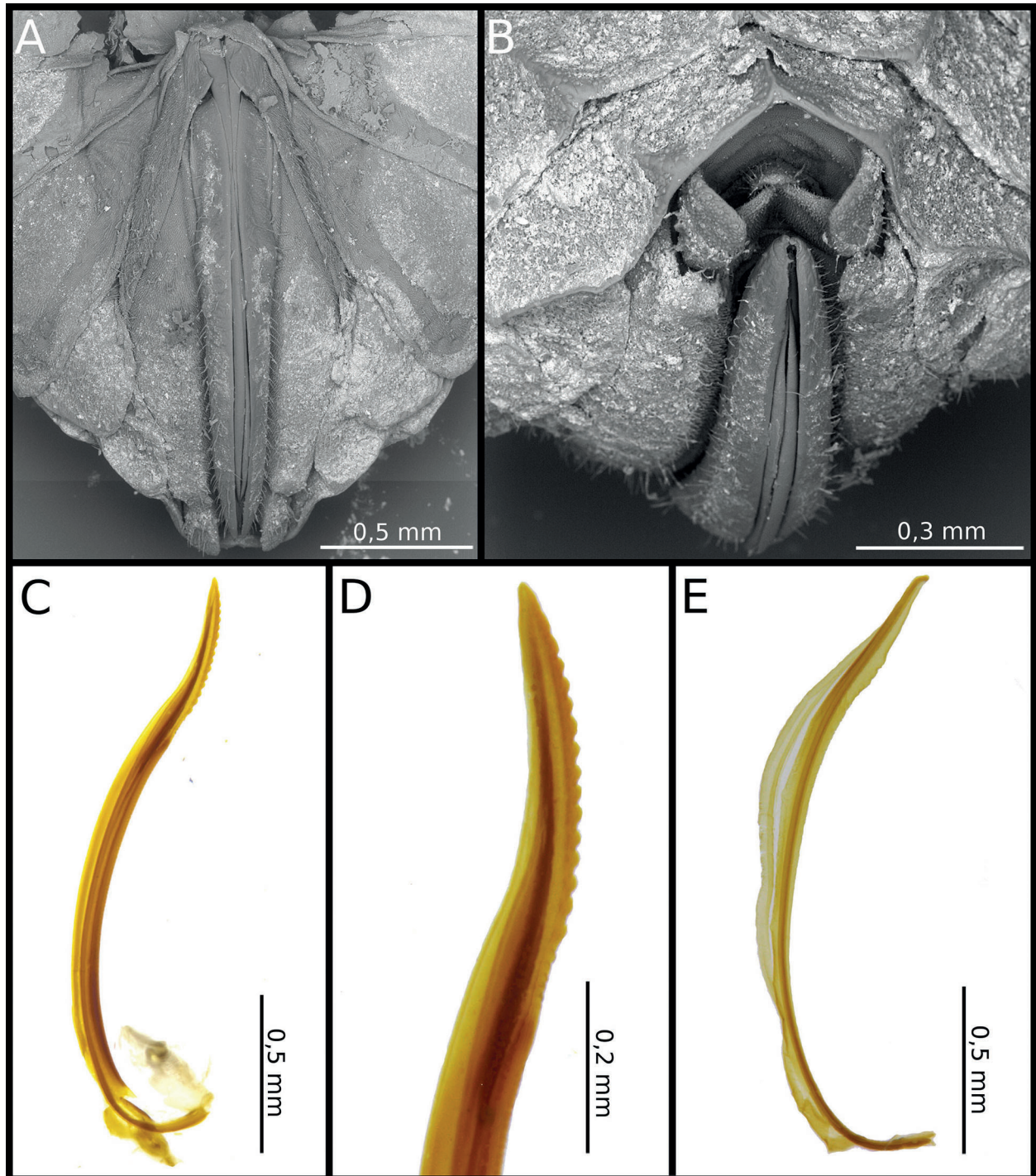


Fig. 4. *Notuchus linnavuorii* sp. nov., ♀. **A.** Abdomen from below. **B.** Abdomen from above. **C.** Left median gonapophysis. **D.** Distal part of left median gonapophysis. **E.** Ovipositor external valvae. **A–B.**: SEM.

Key to the males and females of the species of the genus *Notuchus* Fennah, 1969

The key is based on partial keys (Donaldson 1979, 1988; Hoch et al. 2006) and has been supplemented and modified.

1. Eyes reduced; length of vertex less than half width at base; surface dorsal and ventral part of the head of imaginal stage without distinct carinae. Tegmina vestigial. Endemics of New Caledonia: species group *larvalis* 2
- Eyes normal; vertex more than half width at base; head with distinct carinae. Tegmina short but converge on the dorsal surface 4
2. Tegmina foliated, veins visible
..... *N. larvalis* Fennah, 1980
- Tegmina narrowly lanceolate, veins reduced 3
3. Anterior margin and lateral portion of pronotum pale yellow; rostrum very long reaching anterior margin of genital segment in male and reaching posteriorly to mid-length of ovipositor in female; ventrocaudal margin of male genital segment bilobate; sclerite of flagellum membrane taeniform
..... *N. kaori* Hoch & Asche, 2006
- Thorax uniformly white; rostrum shorter not reaching anterior margin of genital segment in male and reaching proximal third of ovipositor in female; ventrocaudal margin of male genital segment medially shallowly incised; sclerite of flagellum membrane filiform
..... *N. ninguae* Hoch & Asche, 2006
4. Vertex with ratio of total length in midline to length anterior to eyes ≤ 1.8 : species group *monticola* 5
- Vertex with ratio of total length in midline to length anterior to eyes > 2 : species group *risioides* 8
5. Marginal carinae not visible in dorsal view; vertex very long, length anterior to eyes significantly more than width at base (Lord Howe Isl.)
..... *N. monticola* Fennah, 1973
- Marginal carinae distinctly visible in dorsal view; vertex shorter, length anterior to eyes at most equal to width at base 6
6. Vertex rounded, in lateral view extending anterior to eyes for about length of an eye (Lord Howe Isl.)
..... *N. howensis* Donaldson, 1987
- Vertex acutely rounded 7
7. Vertex in lateral view extending anterior to eyes for more than length of an eye; mesonotum with median carina strongly convex in lateral view (Donaldson 1988: Fig. 2) (Australia, Queensland)
..... *N. oresbios* Donaldson, 1988
- Vertex in lateral view extending anterior to eyes at most for length of an eye; mesonotum with median carina only slightly convex in lateral view (New Caledonia) *N. linnavuorii* sp. nov.

8. Frons with lateral margin angulate below level of eyes (New Caledonia) *N. risioides* Fennah, 1969
- Frons with lateral margins evenly curved below level of eyes (Australia, Queensland) 9
9. Frons generally convex, lateral areas not depressed below level of median area; length of median area in midline usually > 1.6 times greatest width
..... *N. rotundifacies* Donaldson, 1979
- Frons concave, lateral areas distinctly depressed below level of median area; length of median area in midline usually > 1.6 times greatest width
..... *N. kurandae* Donaldson, 1979

Checklist of species of the genus *Notuchus* Fennah, 1969

Species group *larvalis*

1. *Notuchus kaori* Hoch & Asche, 2006
2. *Notuchus larvalis* Fennah, 1980
3. *Notuchus ninguae* Hoch & Asche, 2006

Species group *monticola*

4. *Notuchus howensis* Donaldson, 1987
5. *Notuchus linnavuorii* sp. nov.
6. *Notuchus monticola* Fennah, 1973
7. *Notuchus oresbios* Donaldson, 1988

Species group *risioides*

8. *Notuchus kurandae* Donaldson, 1979
9. *Notuchus risioides* Fennah, 1969
10. *Notuchus rotundifacies* Donaldson, 1979

Information about the selected species of the genus *Ugyops* Guérin-Ménéville, 1834 from New Caledonia

Ugyops inermis Distant, 1920

(Figs 5A–B, 6A, 7A–B, 8A–B, 9A–B, 12A–B)

Ugyops inermis is an endemic species from New Caledonia (Distant 1920). Individuals of this species are about 5–7 mm long. The biology of the species remains unknown. Perhaps it is a nocturnal species. During the study in New Caledonia, both males and females came to the light sources (Fig. 5A–B). Our text and illustrations complete Distant's description (1920), which included a short and very inaccurate diagnosis of this taxon, without drawings.

Material examined

1 ♀ (Fig. 5A) // *Ugyops inermis* Distant // C. Gębicki det. 2015; New Caledonia (S) // 21°37.632' S, 165°45.830' E // Farino env., rainforest, at light // Les Grandes Fougères // 11.03.2008, 467 m // netting, beating // leg. R. Dobosz & T. Blaik; 5915/17537 // coll. Upper Silesian Museum // (USMB) Bytom, Poland. – 1 ♂ (Fig. 5B) // *Ugyops inermis* Distant // C. Gębicki det. 2015; New Caledonia (S)

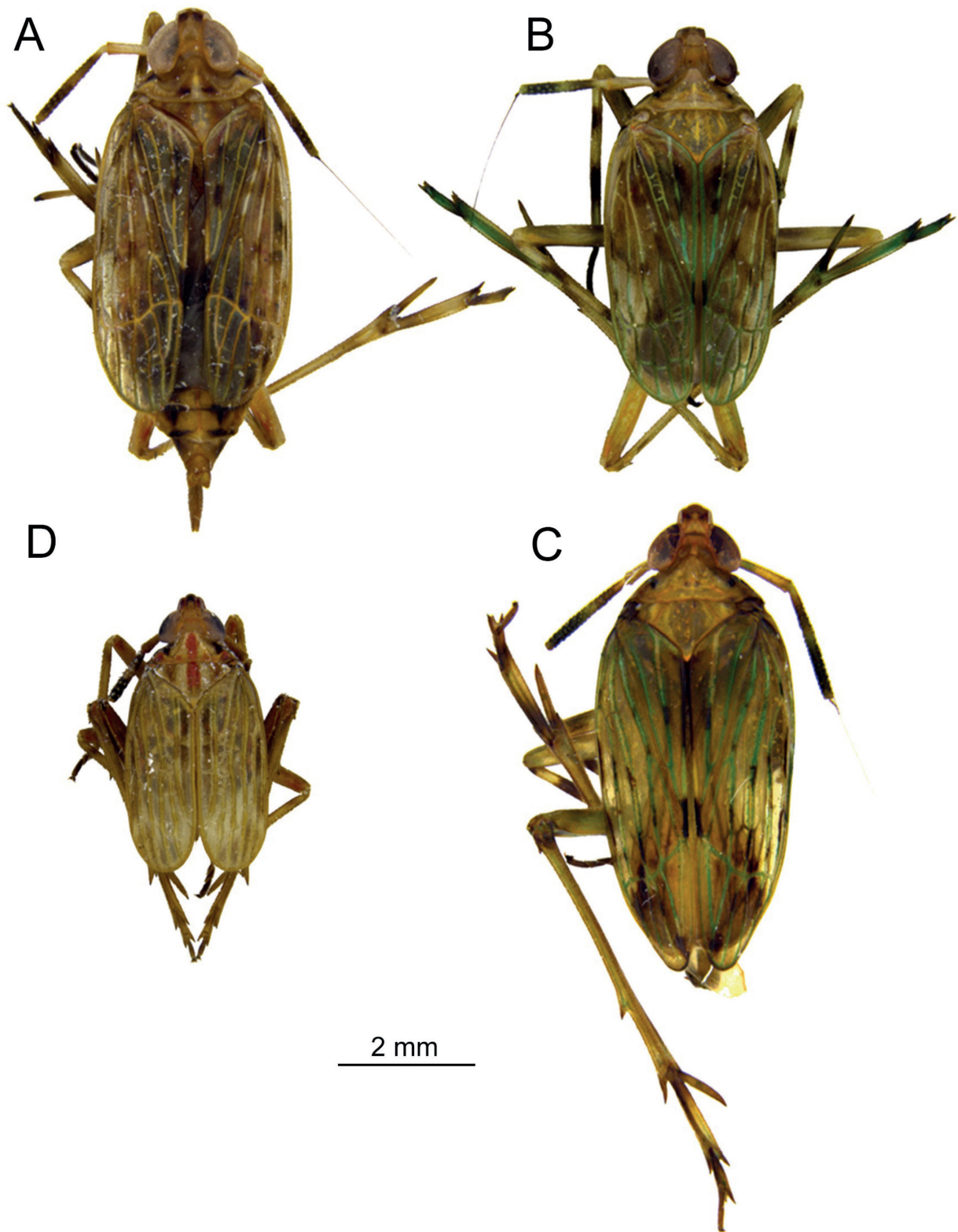


Fig. 5. A. *Ugyops inermis* Distant, 1920, ♀. B. *U. inermis* Distant, 1920, ♂. C. *Ugyops nemestrinus*, ♂. D. *Ugyops taranis* Fennah, 1964, ♂.

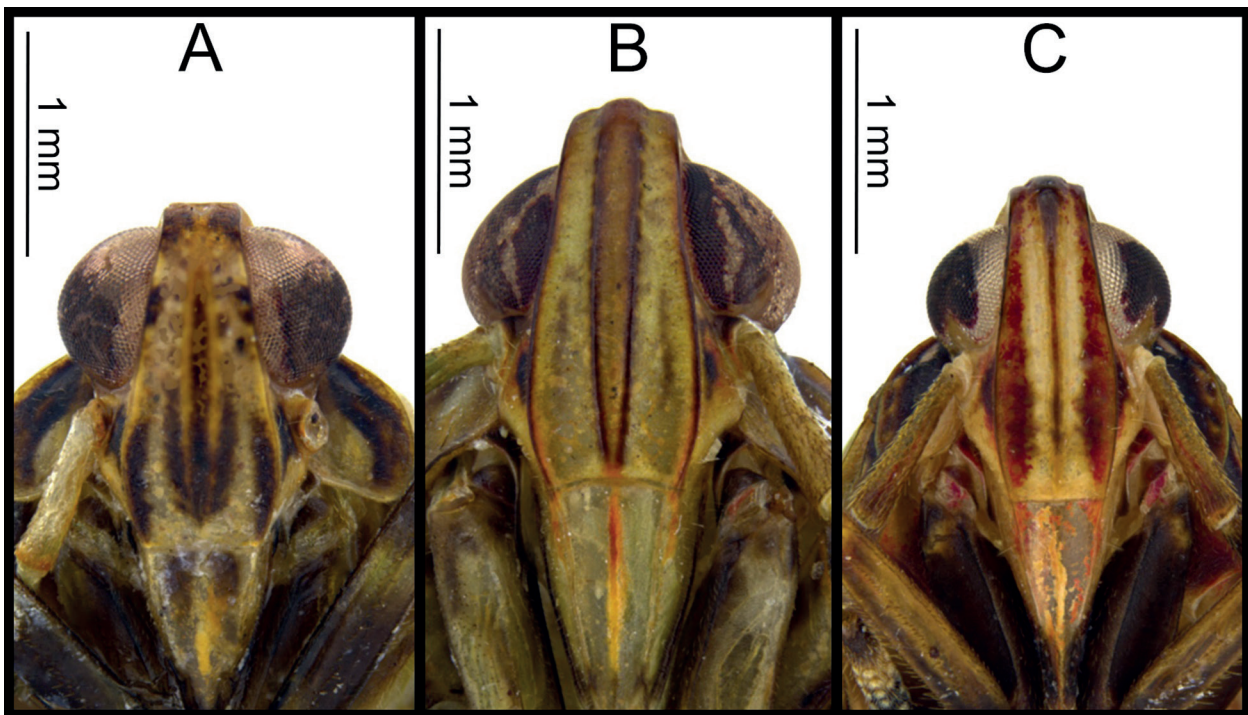


Fig. 6. Heads in frontal view. **A.** *Ugyops inermis* Distant, 1920, ♂. **B.** *Ugyops nemestrinus* Fennah, 1969, ♂. **C.** *Ugyops taranis* Fennah, 1964, ♂.

// 22°10.648' S, 166°30.430' E // Mt Koghi rainforest // 12.04.2008, 480 m // at light // leg. R. Dobosz & T. Blaik; 5915/18481 // coll. Upper Silesian Museum // (USMB) Bytom, Poland.

Description of the external features of *U. inermis*

Vertex separated from large occiput by horizontal groove (Fig. 7A). Frons with two very indistinct keels situated close to each other at apical and basal parts (Figs 6A, 7B). Scapus evenly covered with short setae, pedicellus with numerous sensilla placoidea, among which there are fine setae embedded in cavities and arched towards the apex (Fig. 8A). Less numerous and irregularly distributed spines are embedded in cavities surrounded by cuticular fringe. Round or oval platelles are composed of several dozen hooked setae pointed towards antennal tip. Each platella is surrounded by cuticular crown divided into teeth, which are bent inwards (Fig. 8B). Rostrum reaches beyond the line between hind coxae; its second segment is about three times longer than its apical segment.

Coloration of dorsal surface. Tip of the head in dorsal view with two distinct (especially in females) black spots separated by pale keel. Pronotum with four dark spots (less visible in males). Scutum with broad central stripe, uniformly pigmented with yellow ridges in male. Hind coxae uniformly yellowish, post-tibial calcar and tarsi pale (in male calcar black and apical part of tibiae and tarsi greenish). Along claval anal vein A2, two dark spots (well visible in male), bases of veins R and especially M

and Cu with white sections (less visible in male), longitudinal veins uniformly yellow at apical part (greenish in male) (Fig. 5A–B).

Coloration of frons. Central and lateral carinae of frons uniformly yellowish. Surfaces between keels with five longitudinal dark patches (median patch is the longest one) in the lower part and a few irregular spots in the lateral and apical part. Carinae of clypeus yellowish, the area between keels darker in the upper part of clypeus.

The scapus uniformly pale, second segment with two dark stripes (similar to other species of this genus) (Fig. 6A).

Morphology of male genitalia of *U. inermis*

Posterior margin of pygofer almost straight, with narrow and extremely shallow incisions for genital styles (one-sixth the length of pygofer – Fig. 12A–B). Anal tube relatively short, slightly wider than half its length (lateral view – Fig. 12A). Genital style distinctly broader apically, with a short, rounded apex, which is bent to the outer side. Inner margin of genital style with short and strong teeth apically (Fig. 9B). Apexes of connective short, rounded and directed upwards (in form of a shallow “Y” – Fig. 9B). Connective shaft almost as thick as apical processes. Theca of aedeagus well developed with two distinct lobe-like processes at the apex. The shaft of aedeagus almost evenly thick along its length, in circular form (regular) with a characteristic straight process, which is broadened and rounded apically. Apex of aede-

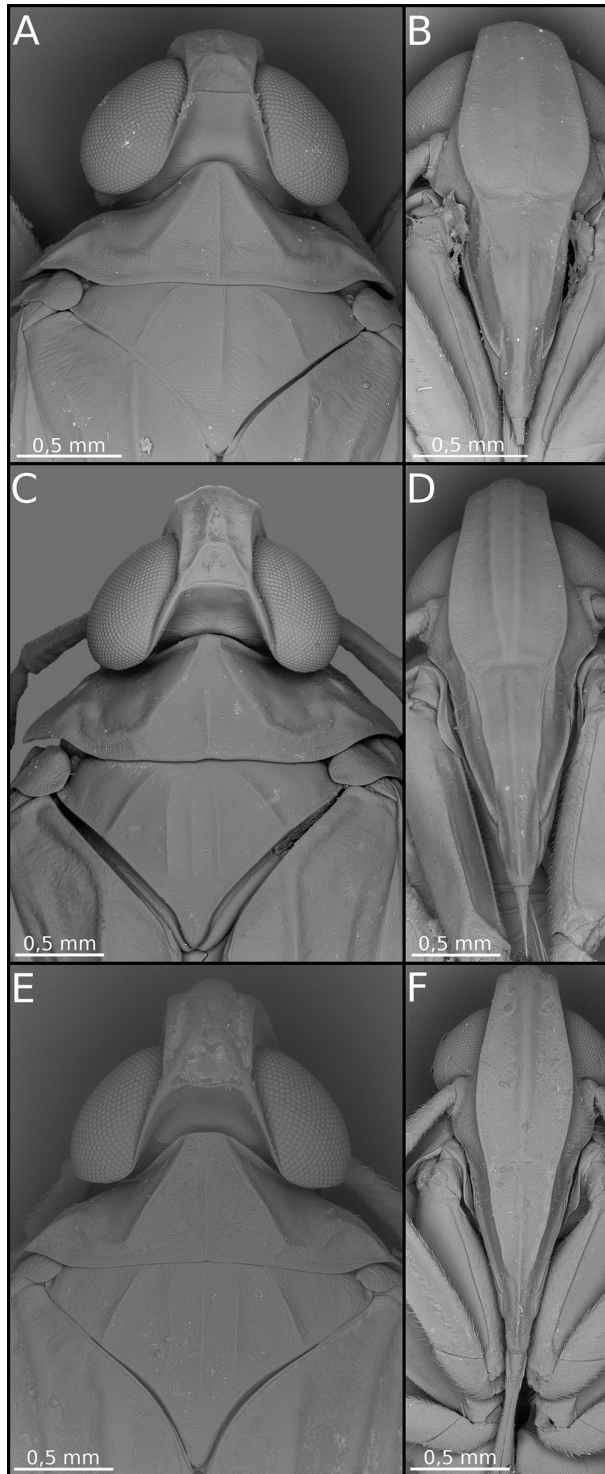


Fig. 7. Representatives of the genus *Ugyops* Guérin-Ménéville, 1834. **A, C, E.** Heads, prothorax and scutellum, dorsal view; SEM. **B, D, F.** Heads in front view; SEM. **A–B.** *Ugyops inermis* Distant, 1920, ♂. **C–D.** *Ugyops nemestrinus* Fennah, 1969, ♂. **E–F.** *Ugyops taranis* Fennah, 1964, ♂.

gus membranous, granular in structure without spines or processes, endowed with a subapical gonopore (Fig. 9A)

Ugyops nemestrinus Fennah, 1969

(Figs 5C, 6B, 7C–D, 8C–E, 10A–B, 12C–D)

Ugyops nemestrinus is an endemic species known from New Caledonia (Fennah 1969). In terms of body size, specimens of this species are quite large relative to other species of this genus. Its body length is about 7–9 mm. The morphological features of the male were very poorly illustrated (Fennah 1969). Our work presents an exhaustive supplement to the aforementioned deficiencies. The biology of this species is poorly known.

Material examined

1 ♂ (Fig. 5C) // *Ugyops nemestrinus* Fennah // C. Gebicki det. 2015; New Caledonia (N) // 21°08.941' S, 165°19.407' E // Aoupinié (refuge) // 30.03.2008, 400 m // netting, beating // leg. R. Dobosz; 5915/26751 // coll. Upper Silesian Museum // (USMB) Bytom, Poland.

Description of external features of *U. nemestrinus*

Occiput clearly smaller than vertex (Fig. 7C). Frons with two distinct keels, keels slightly convex and diverge towards apex of the head. Fronto-clypeal suture distinct and slightly arcuated. Labrum slender, sharply pointed (Figs 6B, 7D). Second antennal segment covered with sensilla placoidea over its entire length (except for its basal part) (Fig. 8C). Sensilla placoidea surrounded by cuticular ridge with large spines placed vertically. Setae and rather large spines irregularly distributed among sensilla placoidea, tiny tubercles absent (Fig. 8E). Rostrum reaches beyond the line between hind coxae (Fig. 8D).

Coloration of dorsal surface. Apical part of vertex with two rather small dark spots merging with each other. Pronotum and scutum with broad vertical median and reddish strip. Four irregular reddish spots at the back edge of pronotum. All pairs of legs more or less uniformly brightly colored. All longitudinal veins of forewings uniformly yellow, wing cells transparent and colorless (Fig. 5C).

Coloration of frons. Four carinae dark, areas among keels uniformly bright colored without patches. Carinae of clypeus dark yellow, cells between them uniformly yellow (Fig. 6B).

Morphology of male genitalia of *U. nemestrinus*

Posterior margin of pygofer slightly undulating with narrow and very shallow incisions for genital styles (one-tenth length of pygofer – Fig. 12C–D); stem of stylus slightly broader than that in *U. inermis*. Anal tube relatively narrow, almost three times as long as wide (lateral view – Fig. 12D). Genital styles slightly broadened and rounded apically. Apexes of genital styles narrowed, distinctly longer than those in *U. inermis* and bent to-

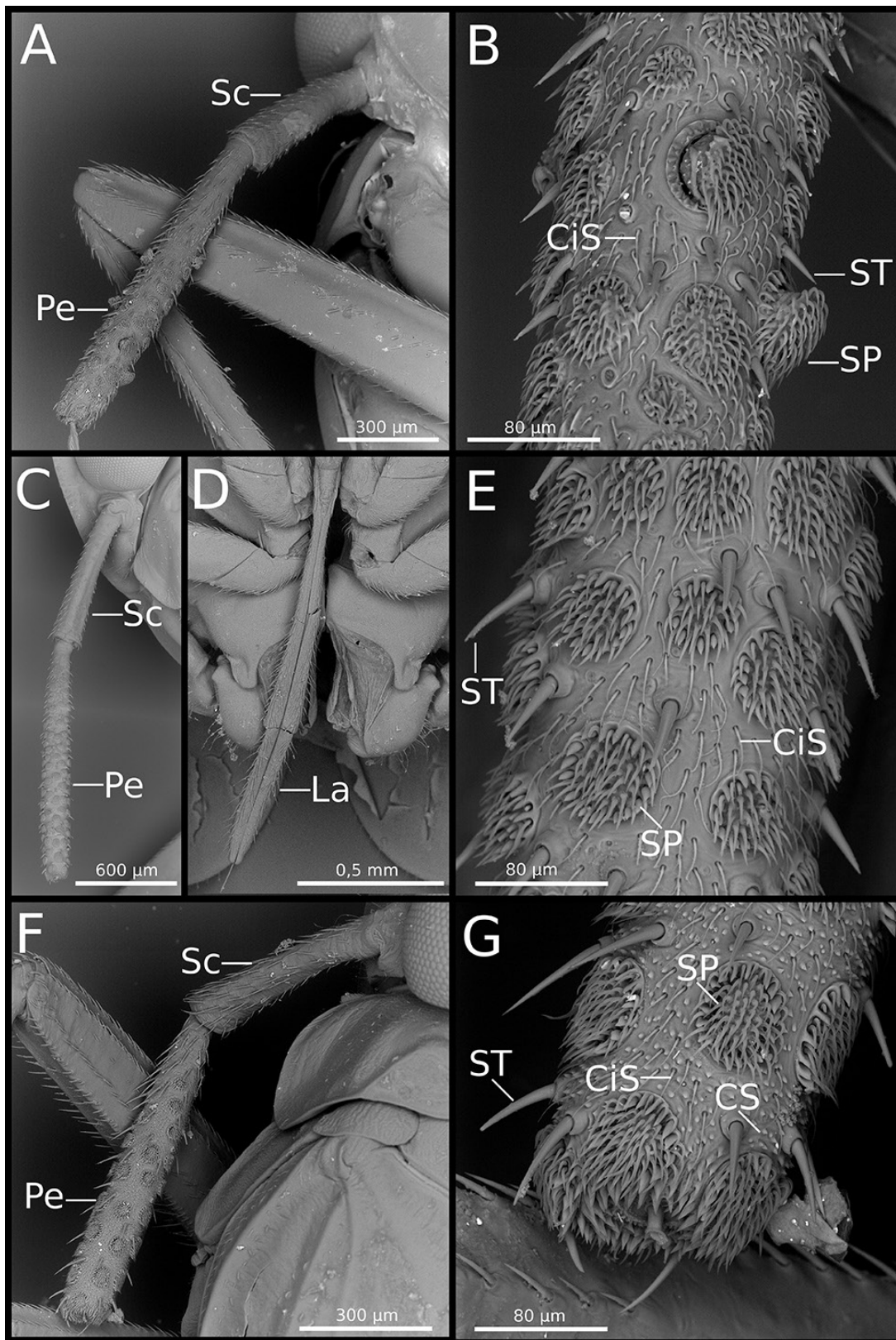


Fig. 8. Antennae of representatives of the genus *Ugyops* Guérin-Méneville, 1834 from New Caledonia. **A–B.** *Ugyops inermis* Distant, 1920, ♂. **C–E.** *Ugyops nemestrinus* Fennah, 1969, ♂. **F–G.** *Ugyops taranis* Fennah, 1964, ♂. **D.** Distal part of labium (*U. nemestrinus*). Abbreviations: SC = scapus; Pe = pedicellus; Cis = ciliate structure; CS = conoidal structure; SP = sensilla placoidea; ST = sensilla trichoidea; La = labium.

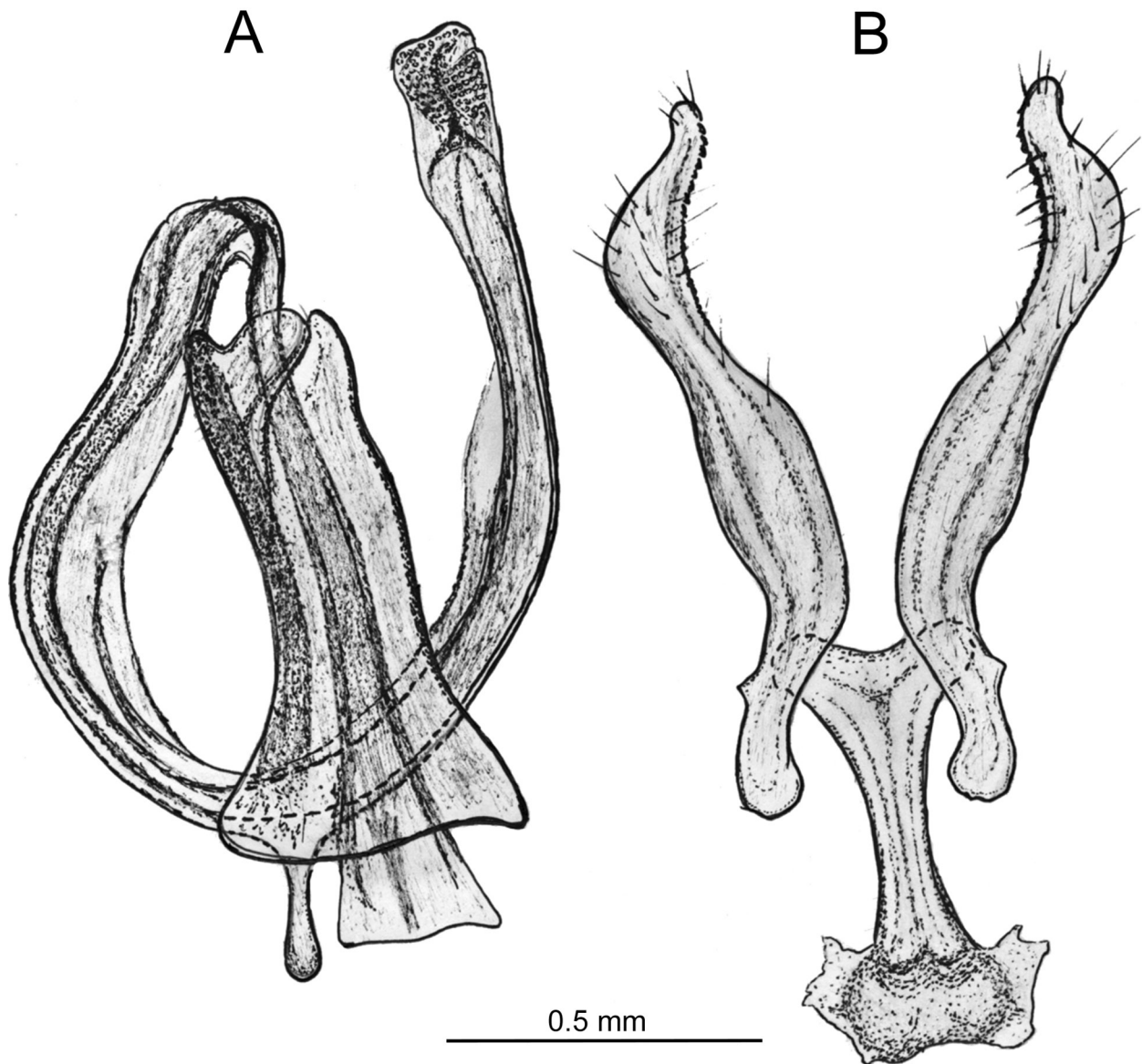


Fig. 9. *Ugyops inermis* Distant, 1920, male genitalia. **A.** Aedeagus lateral view. **B.** Gonostyles with connective, ventral view.

wards the outer side. Inner margin of genital style covered with indistinct teeth in apical part (Fig. 10B). Apexes of connective short and rounded (stouter than those in *U. inermis* and not “Y”-shaped). Stem of connective slightly thinner than its apex. Theca of aedeagus without distinct, regular lobe-like processes apically. Aedeagus relatively short, bent elliptically, almost evenly thick along its length with a characteristic thin spine; the spine not broadened at the apex, slightly bent towards the base of aedeagus. Apex of aedeagus membranous, granular in structure without spines or processes, endowed with a subapical gonopore (Fig. 10A).

***Ugyops taranis* Fennah, 1964**

(Figs 5D, 6C, 7E–F, 8F–G, 11A–B, 12E–F)

Ugyops taranis is a small representative of its genus that reaches about 4–5 mm in length. It is endemic to New Caledonia (Fennah 1964). The species was described based on two females. The male morphological features are given here for the first time, despite the fact that Fennah had access to a male from the Gressitt's collections at a later date (Fennah 1969). The biology of the species remains unknown.

Material examined

1 ♂ (Fig. 5D) // *Ugyops taranis* Fennah // C. Gębicki det. 2015; New Caledonia (S) // 22°10.7' S, 166°30.4' E // Mt

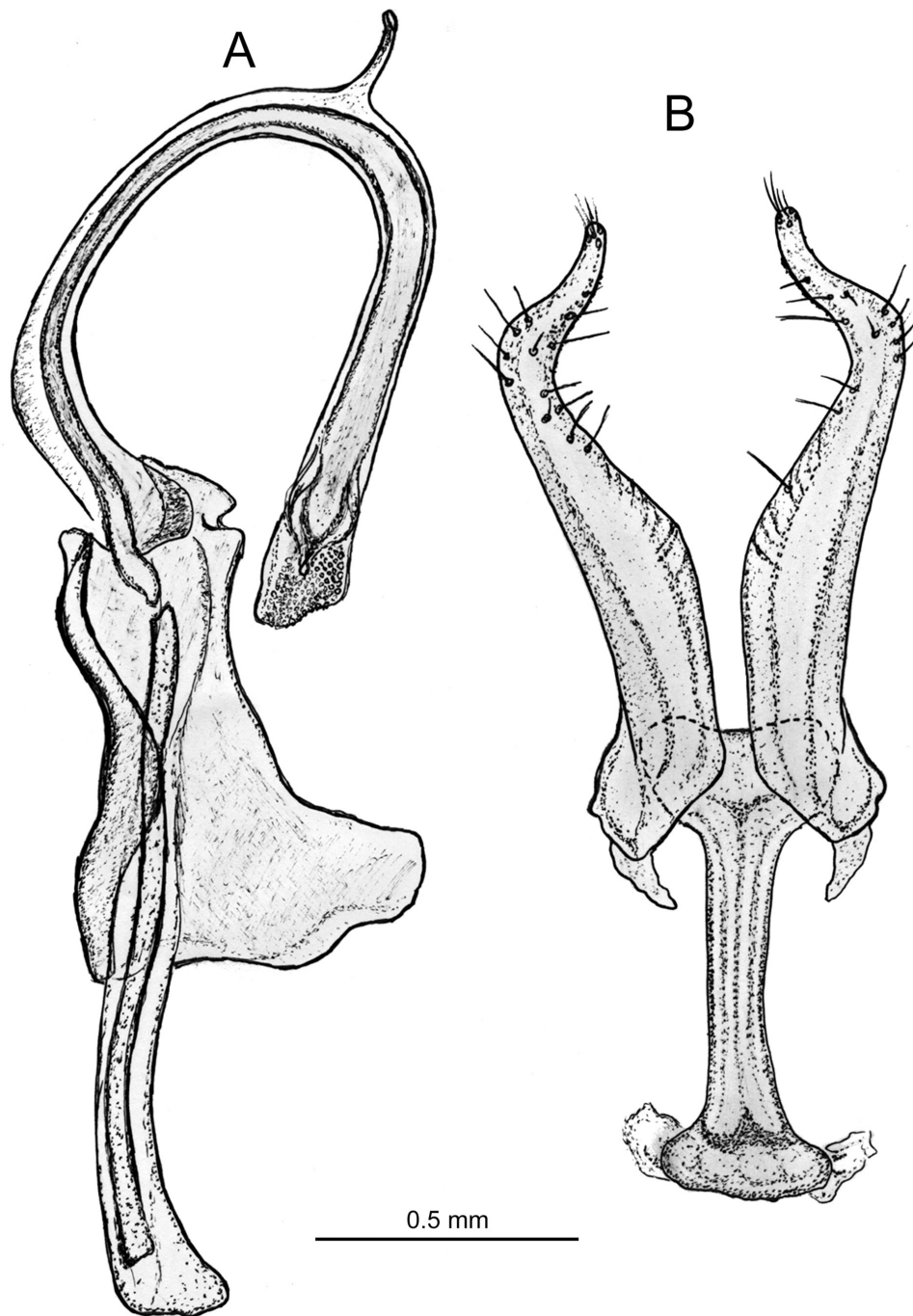


Fig. 10. *Ugyops nemestrinus* Fennah, 1969, male genitalia. **A.** Aedeagus lateral view. **B.** Gonostyles with connective, ventral view

Koghi 450–500 // 16.12.2006 rainforest, netting // leg. R. Dobosz; 5915/6668 // coll. Upper Silesian Museum // (USMB) Bytom, Poland.

Description of external features of *U. taranis*

Apical part of vertex distinctly convex (Fig. 7E). Discrete keel slightly convex, broadened in the apical part. Fronto-clypeal suture straight, barely visible. Labrum

relatively short (Figs 6C, 7F). First antennal segment relatively long, covered with long dense hair. Second antennal segment almost entirely covered with regularly distributed sensilla placoidea (Fig. 8F). Rather large spines and setae irregularly distributed among sensilla placoidea, numerous minute immovable tubercles visible among sensilla placoidea (Fig. 8G).

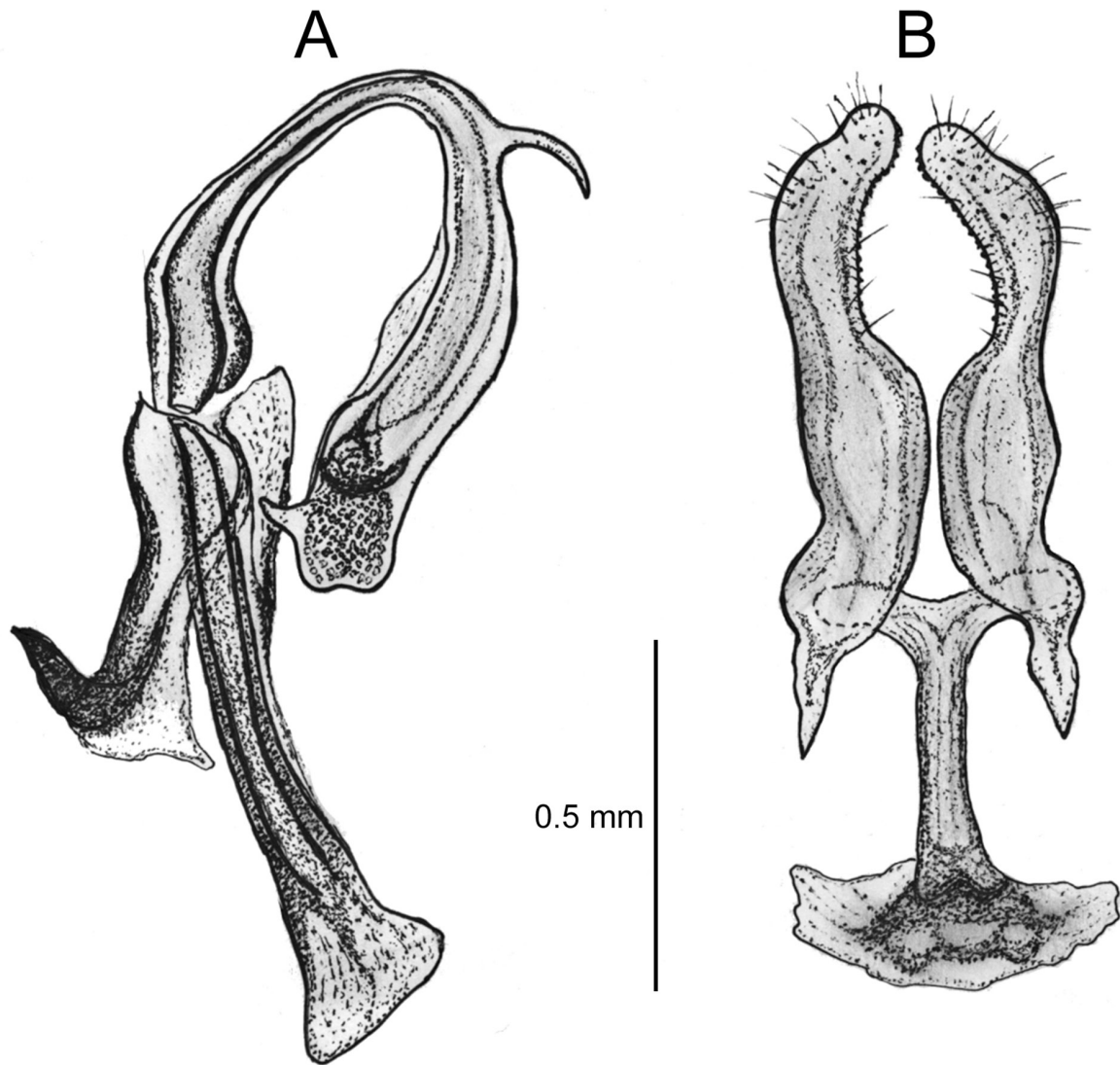


Fig. 11. *Ugyops taranis* Fennah, 1964, male genitalia. **A.** Aedeagus lateral view. **B.** Gonostyles with connective, ventral view.

Coloration of dorsal surface. Apical part of vertex with two indistinct dark spots, carinae reddish. Pronotum with two small spot in the lateral parts. Tegulae dark. Forewing longitudinal veins mostly green with short and irregularly distributed dark sections. Inner edge of clavus black for two thirds of its length and in the apical part (Fig. 5D).

Coloration of frons. Carinae of facies dark, areas between them with dark red longitudinal stripes, their median part pale. Carinae of clypeus reddish and areas pale (Fig. 6C).

Morphology of male genitalia of *U. taranis*

Posterior margin of pygofer straight with very deep incisions for genital styles (almost one-third the length of pygofer – Figs 12E, F). This is distinctly different from those in *U. inermis* and *U. nemestrinus*. Anal tube rel-

atively broad, only twice as long as wide (lateral view – Fig. 12E). Genital styles relatively short, indistinctly broadened apically, broadly rounded and directed towards the inner side. Inner margin of genital style covered with distinct, short teeth in apical part (Fig. 11B). These features are also different from those in the other two species. Apexes of connective long, slender, directed towards sides in a distinct way (forming clear “T”). Stem of connective as thick as its apical processes.

Theca of aedeagus without distinct and regular lobe-like processes apically of aedeagus relatively short, less evenly bent, broadened apically with a characteristic thin spine; the spine tapering, bent towards the apex of aedeagus. Apex of aedeagus membranous, granular in structure with a single lateral spine with a subapical gonopore (Fig. 11A).

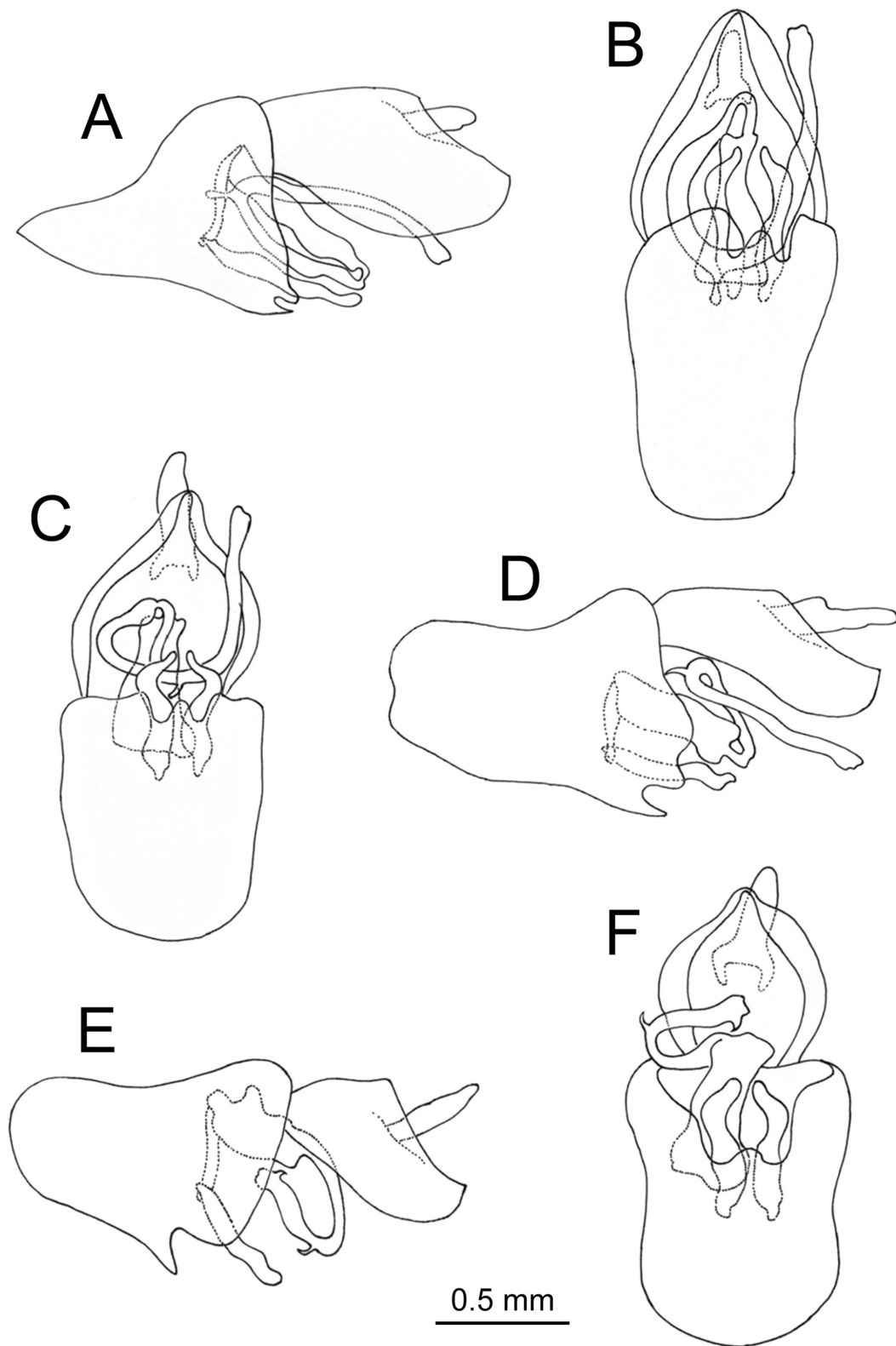


Fig. 12. External male genitalia. **A, D–E.** Lateral views. **B–C, F.** Ventral views. **A–B.** *Ugyops inermis* Distant, 1920. **C–D.** *Ugyops nemestrinus* Fennah, 1969. **E–F.** *Ugyops taranis* Fennah, 1964.

Checklist of the species of the genus *Ugyops* Guérin-Méneville, 1834 of New Caledonia (after Distant 1920, Fennah 1964, 1969, Bourgoin 2020)

Ugyops (Ugyops) alecto Fennah, 1969
Ugyops (Ugyops) atreces Fennah, 1964
Ugyops (Ugyops) houadouensis Distant, 1920
Ugyops (Ugyops) inermis Distant, 1920
Ugyops (Ugyops) lato Fennah, 1969
Ugyops (Ugyops) manturnus Fennah, 1969
Ugyops (Ugyops) menelaus Fennah, 1964
Ugyops (Ugyops) nemestrinus Fennah, 1969
Ugyops (Ugyops) taranis Fennah, 1964

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REFERENCES

- Altner H, Prillinger L (1980) Ultrastructure of Invertebrate Chemo- Thermo-, and Hygroreceptors and its Functional Significance. *International Review of Cytology* 67: 69–139
- Asche M (1985) Zur Phylogenie der Delphacidae Leach, 1815 (Homoptera Cicadina Fulgoromorpha). Teil I et II. *Marburger Entomologische Publikationen* 2 (1): 1–910
- Bourgoin T (2020) FLOW (Fulgoromorpha Lists on The Web); a world knowledge base dedicated to Fulgoromorpha. Version 8 updated 2020.12.26. Online at <https://hemiptera-data-bases.org/flow/> [last accessed 16 Mar. 2021]
- Distant WL (1920) Rhynchota from New Caledonia Part II. Homoptera. *Annals and Magazine of Natural History* 9 (6): 456–470
- Donaldson JF (1979) Revision of the genus *Notuchus* Fennah (Homoptera: Fulgoroidea: Delphacidae). *Journal of the Australian Entomological Society* 18: 181–185
- Donaldson JF (1983) Revision of the Australian Asiracinae (Homoptera: Fulgoroidea: Delphacidae). *Journal of the Australian Entomological Society* 22: 277–285
- Donaldson JF (1987) *Notuchus howensis* sp. n. (Homoptera: Fulgoroidea: Delphacidae) from Lord Howe Island. *Journal of the Australian Entomological Society* 26: 81–83
- Donaldson JF (1988) Further studies on Asiracinae (Homoptera: Delphacidae) in Australia and New Caledonia. *Journal of the Australian Entomological Society* 27: 133–141
- Fennah RG (1964) New species of *Ugyops* (Fulgoroidea: Delphacidae). *Bulletin of the British Museum (Natural History), Entomology* 15 (5): 117–143
- Fennah RG (1965) Delphacidae from Australia and New Zealand (Homoptera: Fulgoroidea). *Bulletin of the British Museum (Natural History), Entomology* 17: 1–59
- Fennah RG (1969) Fulgoroidea (Homoptera) from New Caledonia and the Loyalty Islands. *Pacific Insects Monographs* 21: 1–116
- Fennah RG (1973) A new species of *Notuchus* (Homoptera, Fulgoroidea, Delphacidae) from Lord Howe Island. *Records of the Australian Museum* 28: 265–267
- Fennah RG (1980) A cavernicolous new species of *Notuchus* from New Caledonia (Homoptera: Fulgoroidea: Delphacidae). *Revue Suisse Zoologie* 87: 757–759
- Gębicki C, Szewdo J (2000) A fossil Ugyopine planthopper from Baltic Amber (Hemiptera: Fulgoroidea: Delphacidae). *Polskie Pismo Entomologiczne* 69: 389–395
- Gorczyca J, Wolski A, Taszakowski A (2019) Redescription and new records of the monotypic genus *Trynocoris* Herring, 1976 (Heteroptera: Miridae: Cylapinae: Fulviini). *Zootaxa* 4623 (1): 51–60
- Hoch H, Asche M, Burwell Ch, Monteith GM, Wessel A (2006) Morphological alteration in response to endogeic habitat and ant association in two new planthopper species from New Caledonia (Hemiptera: Auchenorrhyncha: Fulgoromorpha: Delphacidae). *Journal of Natural History* 40 (32–34): 1867–1886
- Holzinger WE, Kammerlander I, Nickel H (2003) The Auchenorrhyncha of Central Europe. Vol. 1: Fulgoromorpha, Cicadomorpha, excl. Cicadellidae, Brill, Leiden / Boston
- Kanturski M, Karcz J, Wiczorek K (2015) Morphology of the European species of the genus *Eulachnus* (Hemiptera: Aphididae: Lachninae) – A SEM comparative and integrative study. *Micron* 76: 23–36
- Knight WJ (1965) Techniques for use in the identification of leafhoppers (Homoptera, Cicadellidae). *Entomologist's Gazette* 16: 129–136
- Muir FAG (1923) Two species of Delphacidae (Homoptera) from Kermadec Archipelago. *Transactions and Proceedings of the New Zealand Institute* 54: 257
- Schneeberg K, Bauernfeind R, Pohl H (2017) Comparison of cleaning methods for delicate insect specimens for scanning electron microscopy. *Microscopy Research & Technique* 80 (11): 1199–1204
- Stacconi MVR, Romani R (2011) Antennal Sensory Structures in *Scaphoideus titanus* Ball (Hemiptera: Cicadellidae). *Microscopy Research and Technique* 75 (4): 458–466
- Urban JM, Bartlett CR, Cryan JR (2010) Evolution of Delphacidae (Hemiptera: Fulgoroidea): combined-evidence phylogenetics reveals importance of grass host shifts. *Systematic Entomology* 35 (4): 678–691
- Zhu Q, Wu N, Brożek J, Dai W (2019) Antennal Morphology and Sexual Dimorphism of Antennal Sensilla in *Callitettix versicolor* (Fabricius) (Hemiptera: Cercopidae). *Insects* 10 (2): 1–16