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Preimaginal morphology and notes on the natural history of some Afrotropical flower flies of genus *Eumerus* Meigen 1822 (Diptera Syrphidae) including description of a new species

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Abstract

The main study objective was to build knowledge on the genus *Eumerus* in the Afrotropical region. The new species *Eumerus rufotibialis* Radenkovic et Vujic sp. nov. of the *E. obliquus* group is thus reported. Also presented are the preimaginal stages of the mentioned species and *Eumerus compactus* van Doesburg 1966 as well as *Eumerus astropilops* Hull 1964. The descriptions were elaborated using scanning electron microscopy and optical microscopy imaging; supporting images, diagnostical features and comparisons with available descriptions have been included, both for imago and preimaginal descriptions. The known host plant of the three species is indicated together with some biological notes that support their saprophagous feeding habits.

Key words: *Eumerus*, Afrotropics, hoverfly, preimaginal, new species, host plant.

Introduction

The genus *Eumerus* Meigen 1822 (Diptera Syrphidae) is among the most speciose of the Syrphidae family, with more than 300 described species worldwide (Evenhuis and Pape, 2022). It belongs to the Merodontini tribe and its phylogenetic relationships are not fully resolved (Ståhls *et al*., 2003; Mengual *et al*., 2015; Young *et al*., 2016). Doczkal and Pape (2009) stated that *Eumerus* is paraphyletic, while Chroni *et al*. (2017) revealed that the genus presented a monophyletic origin with two main lineages.

Moreover, there is a scant number of studies on the identification of Afrotropical *Eumerus* (Smit *et al*., 2017). The largest study on the subject is the comprehensive monographic manuscript key by Leif Lyneborg. The latter covers 127 species (more than half of which were considered undescribed new species) but it remained unfinished at the author's death and is still unpublished (Lyneborg *et al*., 2015). Thus, less than 70 species are known in this area. They are found mostly between Mauritania and South Africa as well as in the Atlantic and Indic islands (Grković *et al*., 2019; Ricarte *et al*., 2020). In sum, Afrotropical species are poorly studied, and the nomenclature is sometimes confusing due to limited taxonomic revisions.

Recently, Ricarte *et al*. (2020) described one new Afrotropical species: *Eumerus lyneborgi* Ricarte et Hauser 2020, of the *E. obliquus* group. They expanded the group diagnosis given for the first time by Smit *et al*. (2017) that was also followed by Gilasian *et al*. (2022).

On the other hand, there is scarce information on the biology and morphology of the *Eumerus* preimaginal stages, as preimaginal stages are available for less than 20 species of the over 300 described (Ricarte *et al*., 2017; Souba-Dols *et al*., 2020; Aracil *et al*., 2023). This limits the understanding of diversification processes, phylogeny, and hinders solving the taxonomic issues related to the genus.

We now know that *Eumerus* larvae are polyphagous, feeding on a wide variety of plant families and vegetal tissue types, including both saprophagous and apparently true phytophagous species. Breeding site diversity is not limited to the genus but is also variable intra-specifically (Souba-Dols *et al*., 2020). Some species have traditionally been considered as pests for a huge range of economically important host plants, such as Liliaceae, Amaryllidaceae and Iridaceae bulbs; Umbelliferae stems; Solanaceae tubers; Compositae roots and Orobanchaceae bulbs and roots (Souba-Dols *et al*., 2020; Aracil *et al*., 2023).

The aim of this work was to expand our knowledge of *Eumerus* diversity and life cycle in the Afrotropics. To this end, (1) we describe a new *E. obliquus* species, the *Eumerus rufotibialis* Radenkovic et Vujic sp. nov.; (2) we perform the first in-depth analysis of preimaginal morphology and larval trophic habits of the new species, *Eumerus compactus* van Doesburg 1966 and *Eumerus astropilops* Hull 1964; and (3), we compare the main diagnostic features of the studied species' preimaginal morphology.

Materials and methods

Collecting site and sampling procedure

The specimens were collected in several localities distributed across four different South African provinces: Free State, KwaZulu-Natal, Mpumalanga and Western Cape. The samples were taken in December 2012 and over several months between 2016 - 2018 (see lists of material). Larvae of the three species were reared in captivity, feeding on the plant tissues in which they were found until pupation and adult emergence. Adults

obtained from field collection and rearing larvae were killed by freezing and pinned for their identification and preservation.

Preimaginal morphology study

The terminology established by Rotheray (1991; 1993) was used for larval and pupal descriptions. The head (=cephalopharyngeal) skeleton was defined following mostly Rotheray and Gilbert (2008), except for the terms pestle and mortar and the separation of the head skeleton into three parts (mouthhooks, intermediate sclerite and basal sclerite) which followed Courtney *et al*. (2000). The morphological analysis was performed following the methodology defined by Aracil *et al*. (2022).

The micromorphology of third instar larvae and puparium was studied using cryo-scanning techniques coupled to a Field Emission Scanning Electron Microscope (cryo-FESEM) in the first case, and scanning electron microscope (S3000N Hitachi) using variable-pressure (or low vacuum) mode in the second. Third instar larvae, puparia and head skeleton morphology were analysed using a stereomicroscope (Leica M205C), and pictures were taken using an adapted camera (Leica DFC450). Preserved specimen dimensions were measured using the ImageJ informatics tool v. 1.52 (Schneider *et al*., 2012) based on the pictures previously obtained.

The following abbreviation is used in the preimaginal descriptions: PRP - Posterior respiratory process.

Taxonomic study of adults

The morphological terminology used came from Thompson (1999) for non-genital features, except for the term "pleuron (plural pleura)" which came from McAlpine *et al*. (1981), while male genitalia terminology was taken from Doczkal (1996).

The following abbreviations of museums and entomological collections are used in the text to indicate where the studied material is located: FSUNS - Faculty of Sciences, University of Novi Sad, Serbia; MZLU - Lund Museum of Zoology, Sweden; NMSA - Kwazulu-Natal Museum, Pietermaritzburg, South Africa; CEUA - Department of Environmental Sciences and Natural Resources, University of Alicante, Spain.

Morphological characters were observed using a Nikon SMZ 745T stereomicroscope (Nikon, Tokyo, Japan). To study the male genitalia, dry specimens were relaxed, and genitalia were separated from the rest of the specimen using an insect pin with a hooked tip. Genitalia were cleared through individual boiling in tubes of 10% KOH solution for 3 minutes. This was followed by brief immersion in 98% CH_3COOH to neutralise the KOH, followed by immersion in ethanol to remove the acid. After the clearing process, the structures were preserved in glycerine. A Leica MZ16 binocular microscope (Leica Microsystems, Wetzlar, Germany) was used with an FSA 25 PE drawing tube for drawings and a Leica DFC 320 digital camera (Leica Microsystems, Wetzlar, Germany) for photographs. The photographs were stacked using CombineZ software (Hadley, 2010). Measurements were taken with an eyepiece graticule or micrometre.

Results

Taxonomic studies

Eumerus obliquus group

Diagnosis: (addition to Smit *et al*., 2017 and Ricarte *et al*., 2020). The *E. obliquus* group includes a black species with a stout body, punctuated integument, with a white oblique pollinose fasciae on terga 2-4, often densely pollinose frons and face (except in female and male face of *Eumerus unicolor* Loew 1858), with a distinct white pollinose pattern on scutum and white pollinose granular scutellar rim (except in *E. unicolor* with predominantly shiny mesonotum), and characteristic metaleg, with swollen metafemur (the metatibia can also be swollen) covered with long hairs, a stocky tarsus that presents modified tarsomeres in some species (e.g. with extension in *E. lyneborgi* or distinct ridge in *Eumerus incisus* Vujic et Malidzan 2022, *Eumerus obliquus* (F. 1805) and *Eumerus vestitus* Bezzi 1912). Male genitalia features are specific to each group member but do present some similarities such as: a compact posterior surstylar lobe, an elongated interior accessory lobe of posterior surstylar lobe densely covered in pilosity; twisted anterior surstylar lobe with apical brush of hairs; bent cercus; and hypandrium with curved lateral projections.

Eumerus rufotibialis Radenkovic et Vujic sp. nov.

Description

Male (figure 1A)

Head - Eyes dichoptic, separated by 4 times width of anterior ocellus (figures 2A and 2C); pilosity dense, whitish, pile as long as scape of antenna (ca. 100 µm), with bent apex (figures 2A, 2C and 2E). Vertical triangle black, shiny except for two whitish grey pollinose spots in front of posterior ocelli and pollinose line around triangle more or less developed (also tiny longitudinal pollinose line between posterior ocelli can be present), finely punctate (figure 2C); pilosity predominantly blackish, except on anterior and posterior ends yellowish. Ocellar triangle isosceles in shape, longer than wide (figure 2C). Occiput black, pilosity yellowish dorsally, the rest whitish-light yellow; densely whitish pollinose except shiny area postero-dorsally (figures 2C and 2D). Frons coarsely punctate, shining black antero-medially, covered with dense, long, whitish microtrichia laterally and posteriorly which also cover face (figures 2A and 2C); pilosity on frons and face long, yellowish (in some specimens whitish). Facial contour concave; snout prominent (figure 2E). Antenna slenderly built (figure 3A); blackish, except scape and basal part of arista light-brown; densely pollinose except scape anteriorly and arista shiny. Basoflagellomere with oblique anterior margin, ca. 1.9 times longer than high, ca. 1.6 times longer than pedicel; fossette outer, situated on anterior end (figure 3A). Pilosity on scape and pedicel yellow, except few blackish setae dorsally.

Thorax - Scutum black, coarsely punctuate, with medium long (ca. 125 µm) yellow pile and distinct (extraordinary long) whitish pollinosity that cover anterior end (including postpronotum), transverse suture, medial vitta (in some specimens, trace of lateral vittae from inner end

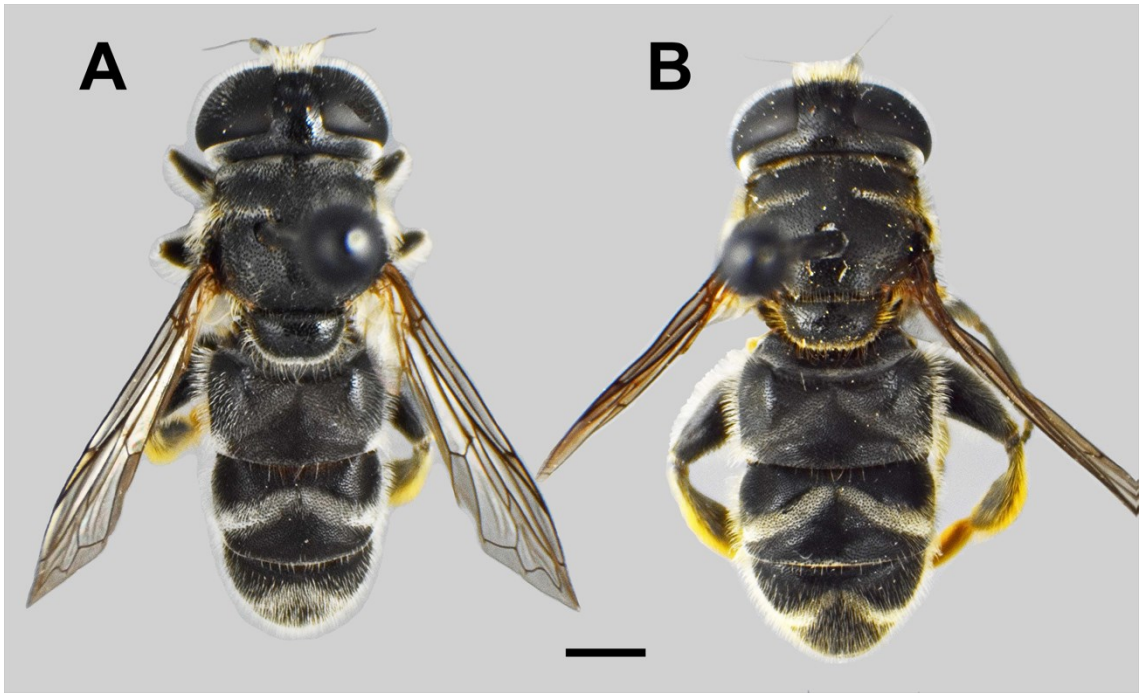

Figure 1. Adults of *Eumerus rufotibialis* Radenković et Vujić sp. nov. **A**: Male. **B**: Female. Scale bar: 1 mm.

of transverse suture to pollinose arch), postero-lateral margin, postalar callus and arched area in front of scutellum (figure 4). Scutellum black, punctate, covered with long yellow pile (almost twice longer than on scutum); scutellar rim with ca. 25 granulae, densely whitish pollinose (microtrichia also present on anterior margin of scutellum) (figure 4). Pleurae black covered with whitish pollinosity, except small shiny area on posterior anepimeron. Anepisternum, posterior katepisternum and anepimeron covered with long yellowish pile. Wing (figures 6C and 6D) uniformly grey-brownish hyaline, densely covered with microtrichia, except small bare areas in basal cells R above vena spuria basally, BM postero-basally and CuP at basal end. Alula microtrichose on entire surface. Halter yellow (dark yellow pedicel, light yellow capitulum).

Pro- and mesolegs blackish with brownish knees, white greyish pollinose, covered predominantly with yellowish long pile, except on pro- and mesofemora antero-dorsally with short black pile, and apically on tarsi with some black pile. Metafemur moderately incrassate (ca. 2.7 times longer than high) (figure 5A), blackish, covered by yellowish pile, except few short black adpressed pile on apex; dorsal surface dulled by white-greyish pollinosity; preapical antero-ventral flange well developed, with 11-13 strong, black spiny setae, postero-ventral surface with ca. 6-9 similar setae (figure 5B). Metatibia blackish, with distinct anteroventral carina in basal half; pilosity golden-yellowish and remarkably long and dense (figure 6A). Metatarsus cylindrical, first three tarsomeres with golden-yellowish pile, while apical two tarsomeres with black pile dorsally (figure 6A)

Abdomen (figure 7A) - Moderately broad (ca. 1.9 times longer than wide), nearly parallel-sided on segments 2 and 3. Terga black, punctuate; terga 2-4 with a pair of oblique, white pollinose fasciae almost touching at midline and on terga 2 and 3 at postero-lateral corner connected with white pollinose line of posterior margin; additional white microtrichia on tergum 1, lateral convex areas of tergum 2 and lateral margins of terga 3 and 4. Pilosity on tergum 1 yellowish, on tergum 2 yellowish except area behind pollinose fasciae with short black pile, on tergum 3 pilosity black on black areas, yellowish on white pollinose areas, on tergum 4 mixed yellowish and black on anterior black areas; lateral and posterior margins of all terga and posterior part of tergum 4 with a longer, yellowish pilosity. Genital capsule (tergum 8) predominantly covered with black pile, except small pollinose area below cerci with yellowish pile. Sterna 2 and 3 narrow (almost half width of segments), brown, covered with thin whitish sparse pile (longer on sternum 2), sternum 4 (figure 7C) wider than long, simple, with small incision postero-medially and yellow pile on posterior margin becoming longer towards postero-lateral corners (in some specimens, sternum 4 medially with more or less black pilosity).

Genitalia (figure 8) - Anterior surstylar lobe (figures 8A and 8B) curved, with fine, thin pile on interior margin (brush like apically). Interior accessory lobe of posterior surstylar lobe (figures 8A and 8B) densely covered in pilosity and on posterior end with brush like projection (figure 8B) (anterior connection to posterior lobe with thorn like protrusion, (figure 8A). Posterior surstylar lobe simple, slightly tapering, with convex ventral margin and rounded apex (figures 8A and 8B). Cerci bent, covered with dense thin pile (figure 8B). Hypandrium simple, but with curved lateral projections (figures 8C and 8D); hamus with bent apex (figures 8C and 8D); ejaculatory apodeme narrow (figures 8C and 8D); phalloapodeme three-winged near the base (figure 8D).

Female (figure 1B)

Like the male, except for usual sexual dimorphism and the following characteristics: frons broad (ca. 0.3 times width of head) (figure 2B); pollinosity on vertex more developed along eye margin (figure 2D); slightly shorter basoflagellomere (ca. 1.8 times longer than high) (figure 3B); slightly broader abdomen (ca. 1.7 times longer than wide) (figure 7B).

Variability

Pollinosity on vertex and scutum can be less developed in both sexes.

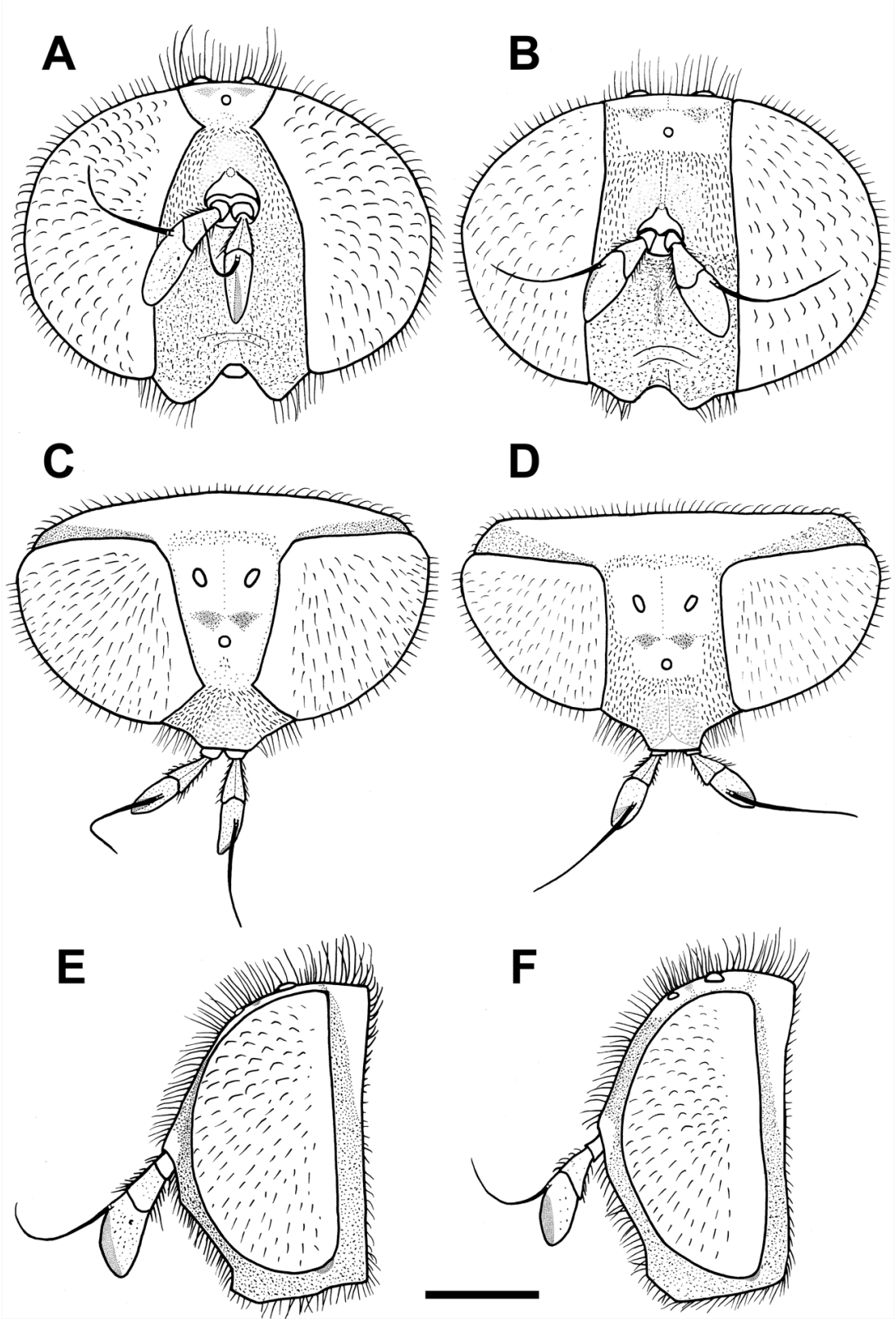

Figure 2. Head of *Eumerus rufotibialis* Radenković et Vujić sp. nov. **A**: Male, anterior view. **B**: Female, anterior view. **C**: Male, dorsal view. **D**: Female, dorsal view. **E**: Male, lateral view. **F**: Female, lateral view. Scale bar: 2 mm.

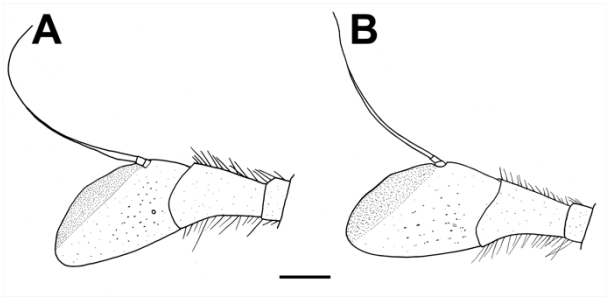

Figure 3. Antenna of *Eumerus rufotibialis* Radenković et Vujić sp. nov., lateral view. **A**: Male. **B**: Female. Scale bar: 0.2 mm.

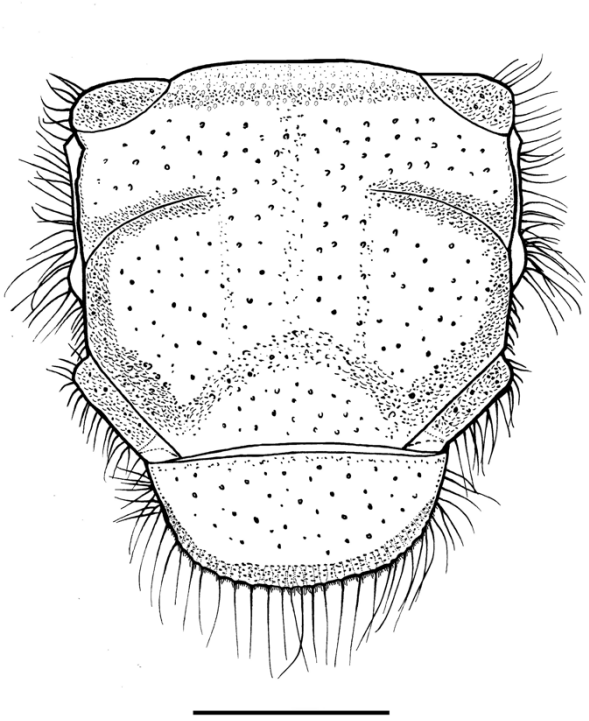

Figure 4. Scutum of *Eumerus rufotibialis* Radenković et Vujić sp. nov., dorsal view. Scale bar: 1 mm.

Diagnosis

Black, medium-sized (7-10 mm), dichoptic species, with punctate integument, three pairs of oblique pollinose fasciae on terga 2-4 (figures 1A and 1B). Metatibia and metatarsus (1-3 tarsomeres) covered with long, dense, golden-yellow pile dorsally (figures 5A, 5C and 6A-B). In appearance similar to species *E. lyneborgi* from *E. obliquus* group, especially the pollinosity pattern (figure 1; Figs. 4 and 6 in Ricarte *et al*., 2020), but clearly different regarding dichoptic eyes of male (figures 2A and 2C) (holoptic in *E. lyneborgi*: Fig. 2A in Ricarte *et al*., 2020), long golden-yellow pilosity of metatibia (figures 6A and 6B) (whitish and shorter in *E. lyneborgi*: Figs. 4B, 6B in Ricarte *et al*., 2020), simple metatarsus shape (figures 5A-C) (in *E. lyneborgi* metatarsomere 2 with a long spur-like posterior expansion: Fig. 3 in Ricarte *et al*., 2020), as well in male genitalia features: inner side of surstylar lobe covered with fine pile, lacking strong black setae (figures 8A and 8B) (in *E. lyneborgi* with conspicuously strong black setae: Fig. 8 A, B in Ricarte *et al*., 2020).

This species is incorporated into the identification key to African species of the *E. obliquus* species group provided by Ricarte *et al*. (2020). The species is included in the second step of the key as follows, the rest of the key remains intact, and the third step indicated here is equivalent to the second step of the original key:

1. Face below antennae polished black, with scarce pollinosity; scutum shiny, without a pattern of pollinose markings or only with a faint vestigial pattern; tarsomeres 4 and 5 of all legs black, contrasting conspicuously with the reddish brown tarsomeres 1-3; male eyes separated by a distance equalling the width of the anterior ocellus . . . . . *E. unicolor*
- Face below antennae always densely pollinose; scutum with a conspicuous pattern of pollinose markings, more reduced but still conspicuous in *E. incilis* [see figures 39 and 40 in Smit *et al*. (2017)]; tarsi of all legs either uniform in colour or with a dark gradient towards the apex; male eyes holoptic or largely dichoptic (distance equalling four times the width of the anterior ocellus) 2
2. Metatibia covered with long, dense, golden-yellow pile dorsally (figures 6 A, 6B); male eyes widely dichoptic (distance equalling four times the width of the anterior ocellus) (figures 2 A, 2C) . . . . . *E. rufotibialis* sp. nov.
- Metatibia covered with whitish pile dorsally; male eyes holoptic . . . . . 3 (step 2 in original key Ricarte *et al*. [2020])

Type material

Holotype: ♂. South Africa, Western Cape, Kirstenbosch National Botanical Garden, 33.989358S 18.43116E, 170 m a.s.l., 04.II.2016, ♂ ZA2_053, leg. A. Vujić, S. Radenković and N. Veličković (FSUNS).

Paratypes: South Africa, KwaZulu-Natal, Howick: Kwela Lodge, next to the road, 29.497583S 30.363111E, 950 m a.s.l., 23.IX.2015, ♂ C - 33, pupa: 02.XI.2015, adult emergence: 25.XI.2015, 2♂ pupa: 09.XI.2015, adult emergence: 04.XII.2015, ♂ pupa: 30.X.2015, adult emergence: 17.X.2015, ♀ pupa: 25.X.2015, adult emergence: 10.X.2015, ♀ pupa: 25.X.2015, adult emergence: 17.X.2015, ♀ pupa: 30.X.2015, adult emergence: 17.X.2015 (CEUA); Midmar crushers, 29.572736S 30.157680E, 15.XII.2012, ♀ G2161-AF04, ♀ G2162, ♂ G2164, ♂, G2165, ♂ G2166, ♂ G2168, leg. A. Vujić (FSUNS); Umgeni Valley Nature Reserve, 29.483836S 30.261044E, 20.XII.2016, ♂ ZA3_095, ♂ ZA3_098, ♂ ZA3_102, ♂ ZA3_103, ♂ ZA3_107, ♂ ZA3_109, leg. A. Vujić, S. Radenković, N. Veličković and T. Petanidou (FSUNS); KwaZulu-Natal: Otto's Bluff road, 29.500777S 30.36381E, 22.IX.2015, ♂ ZA 1_293, ♂ ZA1_295, ♂ ZA1_296; 29.506455S 30.36662E, 19.X.2015, ♂ ZA1_044, leg. A. Vujić *et al*. (FSUNS); Queen Elizabeth Park Nature Reserve, garden nursery, 29.609097S 30.337694E, 13.XII.2012, ♂ G2066, ♂ G2076, ♂ G2096-AF03, ♀ G2097-GUN8, ♂ G2098, ♂ G2099, ♂ G2101-EU117, ♀ G2103-GUN9, ♂ G2105, ♀ G2109-EU118, ♀ G2110, leg. A. Vujić and S. Radenković; 29.566356S 30.3199E, 19.X.2015, ♀ ZA1_037,

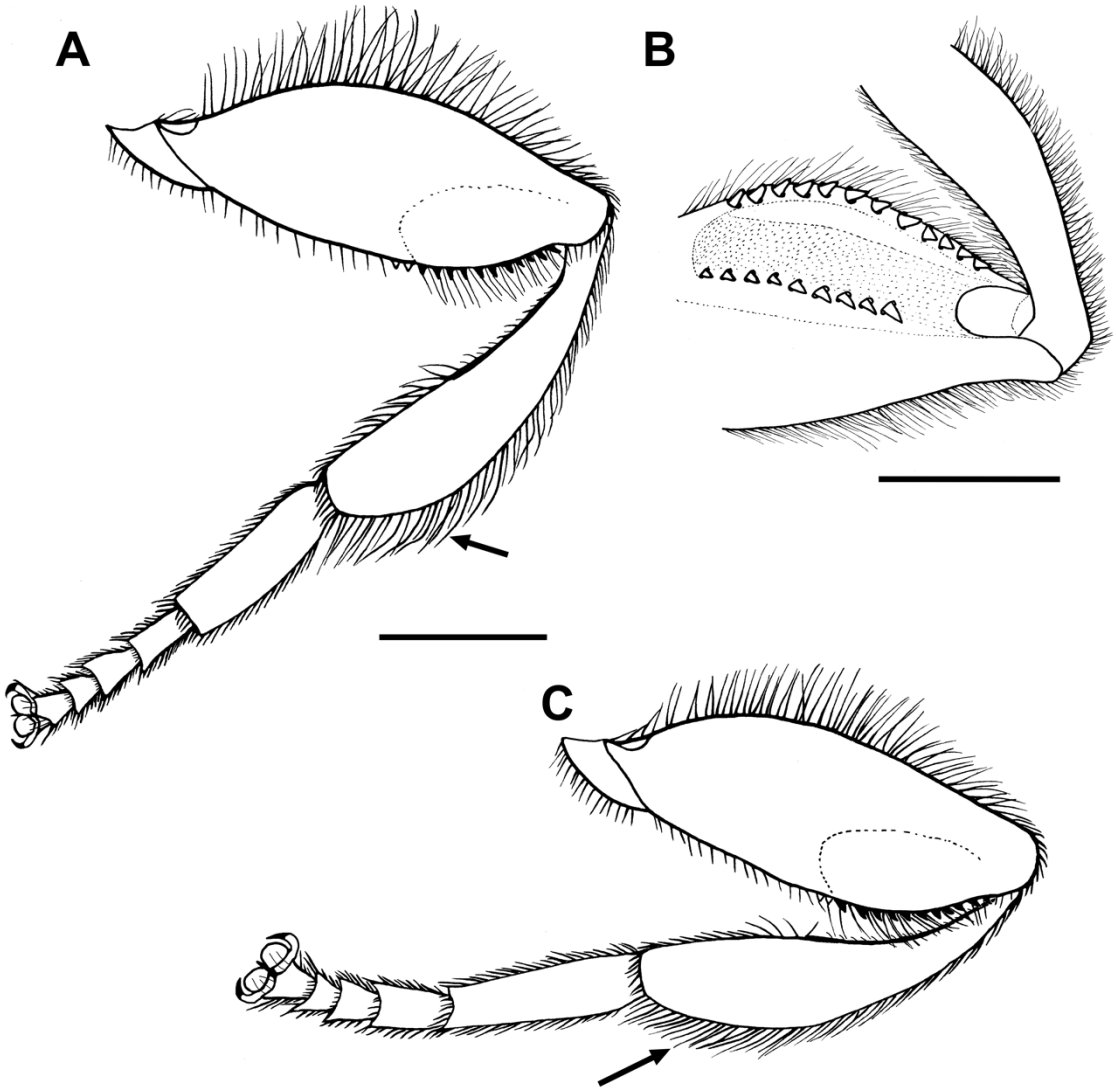

Figure 5. Metaleg of *Eumerus rufotibialis* Radenković et Vujić sp. nov. **A**: Male, anterior view. **B**: Male metafemur, ventral view. **C**: Female, anterior view. Arrow shows a long pile in metatibia. Scale bars: 1 mm (**A**, **C**) and 0.5 mm (**B**).

♂ ZA1_038, ♂ ZA1_040, leg. A. Vujić *et al*. (FSUNS); KwaZulu-Natal, Drakensberg Mountain: Cathedral Peak, 28.946593S 29.20566E, 07.XII.2012, ♂ ZA1_211, ♂ ZA1_212, ♀ ZA1_213, ♀ ZA1_214, leg. Vujić *et al*., ♀ G2185, leg. C. Pérez-Bañón (FSUNS); Maclear, Woodcliffe Guest Farm, 30.993013S 28.168057E, 1400 m a.s.l, 08.II.2016, ♀ ZA2_076, leg. A. Vujić, S. Radenković and N. Veličković (FSUNS); Mpumalanga, Waterval Boven near Elands river, 25.6345S 30.326065E, 1400 m a.s.l., 06.IV.2018, ♂ ZA5_244, leg. A. Vujić, J. Ačanski and B. Lothrop; Western Cape: Bontebok National Park, 34.072007S 20.441193E, 04.XII.2016, ♀ ZA3_138, leg. A. Vujić, S. Radenković, N. Veličković and T. Petanidou (FSUNS); Kirstenbosch National Botanical Garden, 33.989358S 18.43116E, 170 m a.s.l., 23.X.2015, ♂ ZA1_111, ♂ ZA1_112, ♂ ZA1_113, ♂ ZA1_114, ♂ ZA1_115, ♀ ZA1_117, leg. Vujić *et al*. 04.II.2016, ♂ ZA2_051, ♂ ZA2_052, ♂ ZA2_053, ♂ ZA2_054, ♂ ZA2_055, ♂ ZA2_056, ♀ ZA2_057, ♀ ZA2_058, leg. A. Vujić, S. Radenković and N. Veličković (FSUNS).

Biology

Adults were observed in February, April, September, October, and December, flying in open areas among host plant *Aloe candelabrum* A. Berger (Asphodelaceae) where larvae were found feeding on rotten leaves and stems (figure 17A). Four males and three females emerged after a pupation period of around three weeks (16-25 days) in captivity.

Distribution

Species recorded in South Africa (Mpumalanga, KwaZulu-Natal, Western Cape).

Etymology

Name is derived from the Latin adjective *rufus* meaning reddish and the noun *tibia* - segment of the leg between femur and tarsus, which refers to the conspicuously orange long pilosity on metatibia.

Note: In Lyneborg's manuscript key mentioned above, this new species is named ''*Eumerus stuckenbergi*'', but

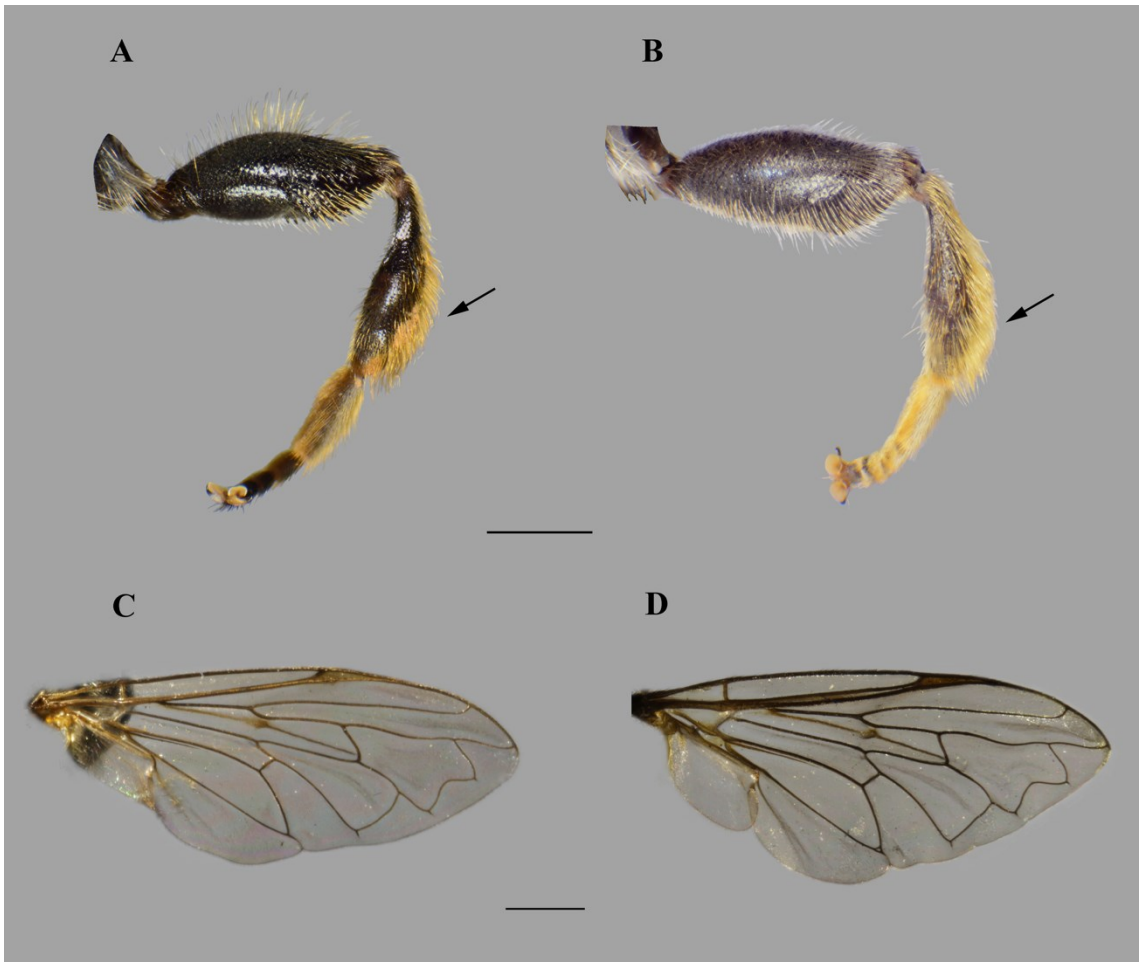

Figure 6. Metaleg and wing of *Eumerus rufotibialis* Radenković et Vujić sp. nov. **A**: Metaleg, anterior view, male. **B**: Metaleg, anterior view, female. **C**: Wing, dorsal view, male. **D**: Wing, dorsal view, female. Arrow shows an orange pile on metatibia. Scale bar: 1 mm.

it was never published. To avoid confusion with material labelled by Lyneborg himself, we decided to use a different name for this taxon.

Eumerus compactus van Doesburg 1966

Material studied

Reared specimens: South Africa, Kwazulu-Natal, Howick, Kwela Lodge, 29.497583S 30.363111E, 950 m a.s.l., 23.IX.2015, ♂ pupa: 13.X.2015, adult emergence: 29.X.2015; ♀ pupa: 15.X.2015, adult emergence: 29.X.2015, leg. A. Aracil, C. Pérez-Bañón, A. Campoy (CEUA) - see also supplemental material.

Biology: Adults were observed in February, September, October, and November, flying in open areas. *E. rufotibialis* sp. nov. and *E. compactus* larvae were found together in a rotten *A. candelabrum*, feeding inside the leaves and the stem (figure 17A). All preimaginal stages of both species were collected in the Kwela Lodge area (950 m a.s.l.) in Howick town, Kwazulu-Natal province (29.497583S 30.363111E). Pupation period was approximately two and a half weeks (16-19 days) in captivity.

Distribution: Species recorded in South Africa (Grahamstown, Mpumalanga, KwaZulu-Natal) and Democratic Republic of the Congo (Elisabethville Katanga).

Eumerus astropilops Hull 1964

(= *Eumerus hypopygialis* Doesburg 1966, = *Eumerus nigrocoeruleus* Hull 1964) (Lyneborg *et al*., 2015)

Material studied

Reared specimens: South Africa, KwaZulu-Natal, Drakensberg Mountain, Cathedral Peak, 28.963027S 29.184083E, 29.IX.2015, ♂, pupa: 30.X.15, adult emergence: 17.X.15; ♂, C - 21, pupa: 22.X.2015, adult emergence: 12.XI.2015, ♀ C - 24, pupa: 30.X.2015, adult emergence: 18.XI.2015 leg. A. Aracil, C. Pérez-Bañón, A. Campoy (CEUA); KwaZulu-Natal, Royal Natal National Park, 28.686472S 28.928555E, 30.IX.2015, 1 ♂ ZA1_265, pupa: 30.IX.2015, adult: 03.X.2015, leg. A. Aracil, C. Pérez-Bañón, A. Campoy (CEUA) - see also supplemental material.

Biology: Adults were observed in February, March, April, September, October, and December, flying in open areas. Preimaginal stages of *E. astropilops* were found feeding on rotten epigeal bulbs of *Merwilla plumbea* (Lindl.) Speta (subfamily Scilloideae of Asparagaceae) (figures 17B and 17C), in Drakensberg Park, and Royal Natal National Park. Pupation period took approximately three weeks (17-25 days) in captivity.

Distribution: Species recorded in South Africa (Free State, Mpumalanga, KwaZulu-Natal) and Kenya (Mt Kenya).

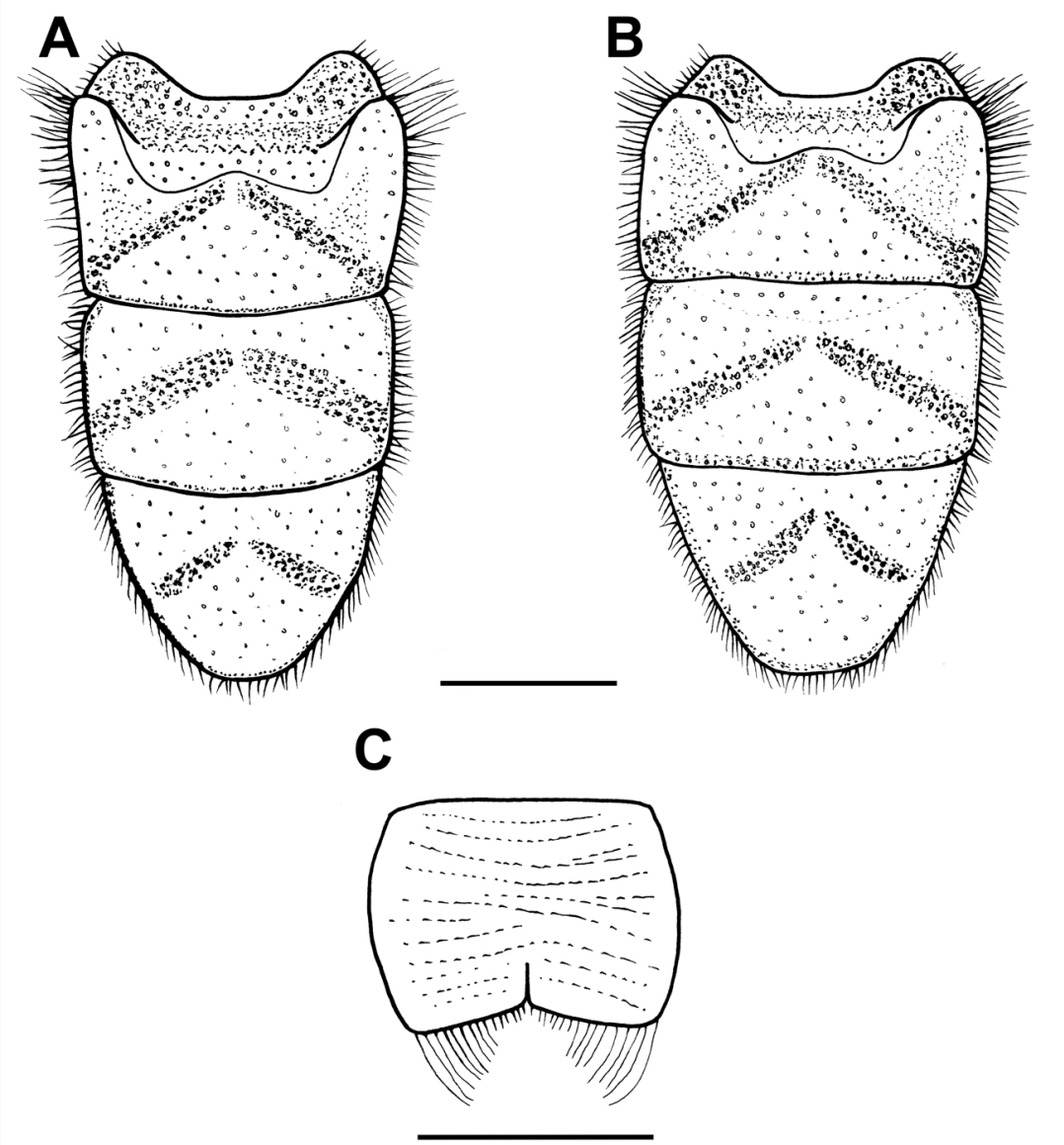

Figure 7. Abdomen of *Eumerus rufotibialis* Radenković et Vujić sp. nov., dorsal view. **A**: Male, **B**: Female. **C**: Sternum four of male. Scale bar: 1 mm.

Preimaginal morphology

The preimaginal morphology of *E. astropilops*, *E. compactus* and *E. rufotibialis* sp. nov. shares many characteristics. To thus avoid unnecessary repetition, we present a general description of the shared characters, and describe the major differences of each species afterwards.

Overall larva appearance (figure 9) - Body surface fully coated in minute, sclerotized and dark brown spicules directed backwards; slightly scattered on the ventral surface, less abundant around the prolegs.

Pseudocephalon and thorax (figures 10 and 11) - Dorsal lip consisting of two separated lobes, fused to mandibular lobes, covered by long setae distributed in longitudinal lines (figures 10A-D, 11B). Lateral lips well developed, covered by long and thin setae up to the ventral lip (figures 10A-D, 11B, 11C). Two lobes forming ventral lip, internal lobe (inside preoral cavity) covered with setae or papillae, external lobe (outside preoral cavity) smooth with a pair of sensilla located at the central part (figures 10A, 10C, 11B, 11C). Well-developed antenno-maxillary organs placed between dorsal lip and dorsal surface of the prothorax (figures 10A, 10C, 11B). Two cylindrical structures on top of two fleshy, rounded, and smooth cushions, both cushions placed above a thickened area. Antenna and maxillary palpi clearly identified, bearing both several satellite sensilla on top (figures 10A, 10C, 11B). Anterior fold of the prothorax with a narrow band of small, directed backwards and weakly sclerotized spicules; comprising less than five rows of spicules and reaching the first pair of dorsal sensilla. Dorsal surface of prothorax with 5 longitudinal grooves (figure 11A). Lateral margin of mesothorax with two patches of sclerotized spicules surrounding 4th and 5th segmental sensillae. Mesothoracic prolegs well developed, bearing long and robust crochets arranged in multiples rows (figure 10A). Anterior spiracles small, weakly sclerotized, light brown in colour, with smooth surface, cylindrical in shape and rounded at the top (figure 12).

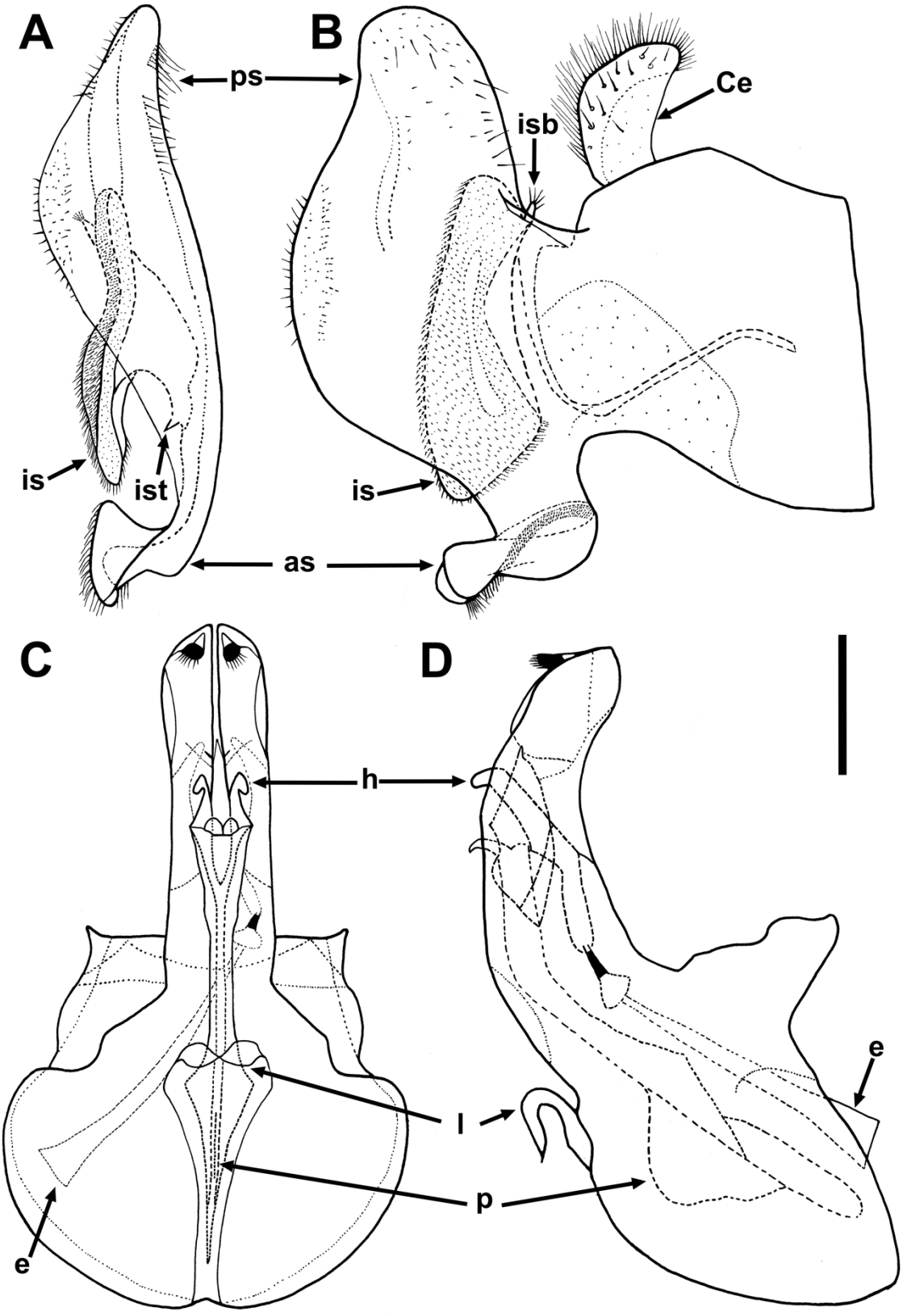

Figure 8. Male genitalia of *Eumerus rufotibialis* Radenković et Vujić sp. nov. **A**: Surstylar lobe, ventral view. **B**: Epandrium, lateral view. **C**: Hypandrium, ventral view. **D**: Hypandrium, lateral view. Abbreviations: As - anterior surstylar lobe; ce - cercus; e - ejaculatory apodeme; h - hamus; is - interior accessory lobe of posterior surstylar lobe; isb - brush like projection on interior accessory lobe of posterior surstylar lobe; ist - thorn like protrusion on interior accessory lobe of posterior surstylar lobe; l - lateral projections; p - phalloapodeme; ps - posterior surstylar lobe. Scale bar: 0.2 mm.

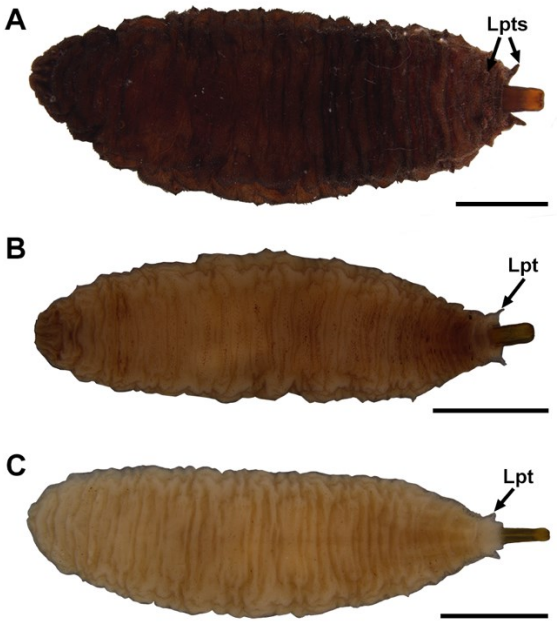

Figure 9. Dorsal view of third instar larvae. **A**: *Eumerus rufotibialis* Radenković et Vujić sp. nov. **B**: *E. compactus*. **C**: *E. astropilops*. Scale bars: 2 mm.

Head skeleton (figure 13) - Mouthhooks are sclerotized and elongated but not well developed and not prominent externally, fused to the mandibular lobes. Mandibular lobes external, well developed, big and fleshy; bearing ridges covering the whole structure, ridges densely covered by bristles, forming a comb-shaped structure (figures 10C, 10D, 11B, 11C). Basal sclerite almost twice as long as broad, dorsal cornu wide (double than ventral cornu), giving the structure a rectangular shape. Intermediate sclerite well sclerotized, in contact with dorsal bridge, less sclerotized. Cibarium located at the base of the ventral cornu, 9 transversal ridges at the base, across all the structure. Posterior end of ventral cornu bearing sclerotized plaques, forming the mortar and small semi-sclerotized membrane at the upper part, the pestle.

Abdomen - Primordia of pupal spiracles present on the dorsal surface of first abdominal segment. Dorsally, 1-6th abdominal segments bearing three folds each, 1st and 2nd segmental sensilla present on the second fold and 3rd and 4th segmental sensilla slightly posterior. On the 7th abdominal segment, three folds present, bearing first segmental sensilla on the second fold and 2nd and 3rd on the third fold. Well-developed prolegs present on 1-7th abdominal segments, elliptical in shape and very close to each other, covered by spicules bearing slightly sclerotized crochets arranged in 2 rows directed backward, being bigger in the first line with a range between 5 and 8 crochets on it (figures 14A-B). Locomotory organs of 7th abdominal segment fused and with crochets directed forward.

Chaetotaxy - Prothorax with 11 pairs of sensillae; mesothorax and metathorax with 8 pairs; abdominal segments 1-7 with 9 pairs; anal segment with 8 pairs of sensillae.

Overall puparium appearance - Subcircular in cross-section, rounded anterior extreme, tapered posteriorly and flattened ventrally. Rough integument with larval segmentation persisting as transverse folds. Pupal spiracles projected from middle of operculum upper part.

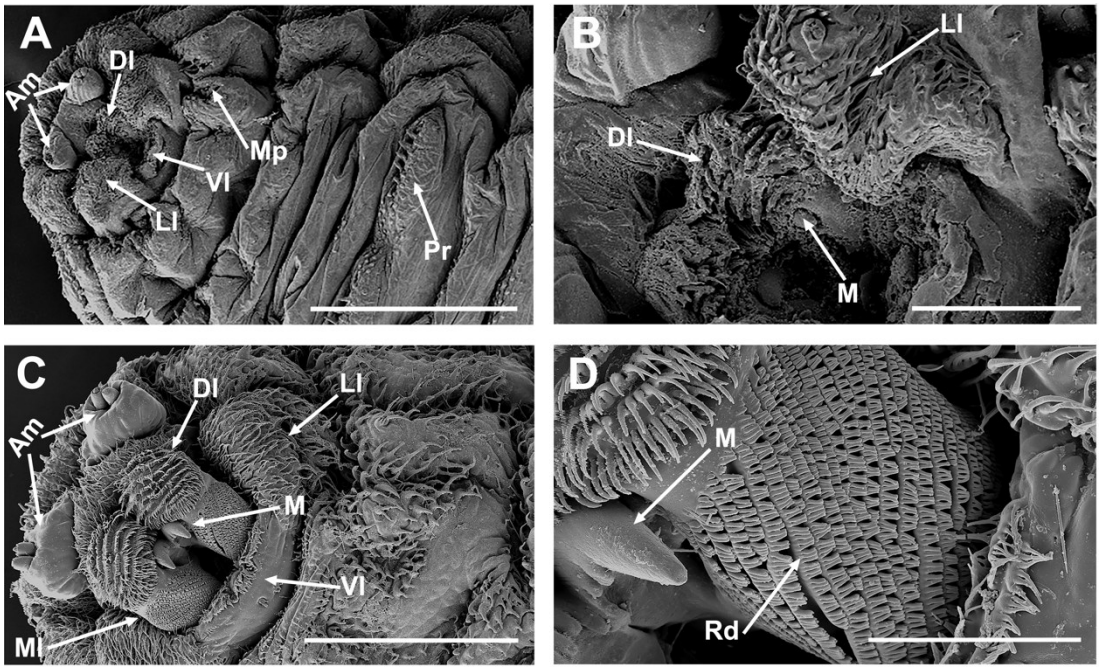

Figure 10. Thorax, third instar larvae. **A**: *E. rufotibialis* sp. nov., ventral view. **B**: *E. rufotibialis* sp. nov., oral opening detail. **C**: *E. astropilops* thorax, ventral view. **D**: *E. astropilops*, detail of mandibular lobe. Abbreviations: Am - antennomaxillary organs; Dl - dorsal lip; Ll - lateral lip; M - mouthhooks; Ml - mandibular lobe; Mp - mesothoracic prolegs; Pr - prolegs; Rd - ridges; Sn - sensillae; Vl - ventral lip. Scale bars: 1 mm (**A**), 200 μm (**B**), 500 μm (**C**) and 100 μm (**D**).

Preimaginal description of *Eumerus rufotibialis* sp. nov.

Overall larva appearance - Length including PRP 11.1 ± 0.63 mm, maximum width 4.3 ± 0.24 mm and maximum height 3.1 ± 0.17 mm (N = 5). Larvae dark brown in colour. Fusiform, sub-elliptical in cross-section, tapered anteriorly and posteriorly and flattened ventrally. Integumental spicules more abundant on larvae posterior part (figure 9A).

Pseudocephalon, thorax and head skeleton - Dorsal lip densely covered by setae reaching up to the basal part of the antenno-maxillary organs (figures 10A, 10B); ventral lip inner lobe covered by short setae. Anterior spiracles cylindrical with two spiracular openings at the top (figure 12A). Mandibular lobes with more than 15 ridges covering its surface; mouthhooks present 2-3 small protuberances in the inner part, as accessory teeth (figures 13A and 13D1).

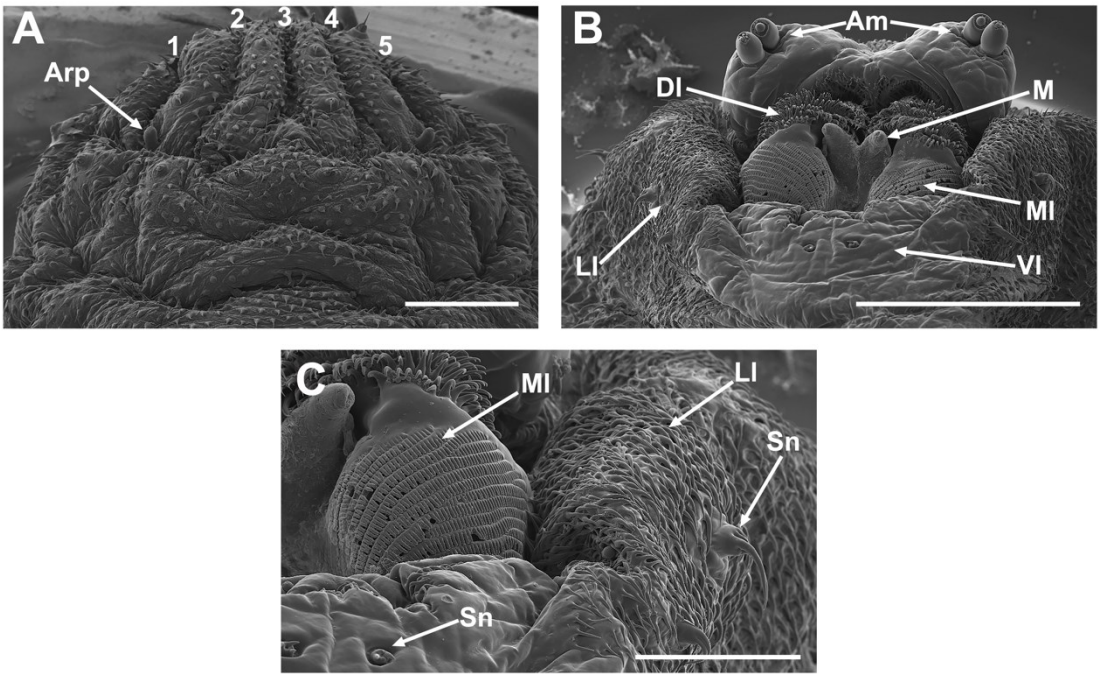

Figure 11. Thorax of *E. compactus*, third instar larvae. **A**: Dorsal view. **B**: Ventral view. **C**: Detail of mandibular lobe and lateral lip. Abbreviations: Am - antenno-maxillary organs; Arp - anterior spiracles; Dl - dorsal lip; Ll - lateral lip; M - mouthhooks; Ml - mandibular lobe; Mp - mesothoracic prolegs; Pr - prolegs; Rd - ridges; Sn - sensillae; Vl - ventral lip. Scale bars: 300 μm (**A** and **B**), 100 μm (**C**).

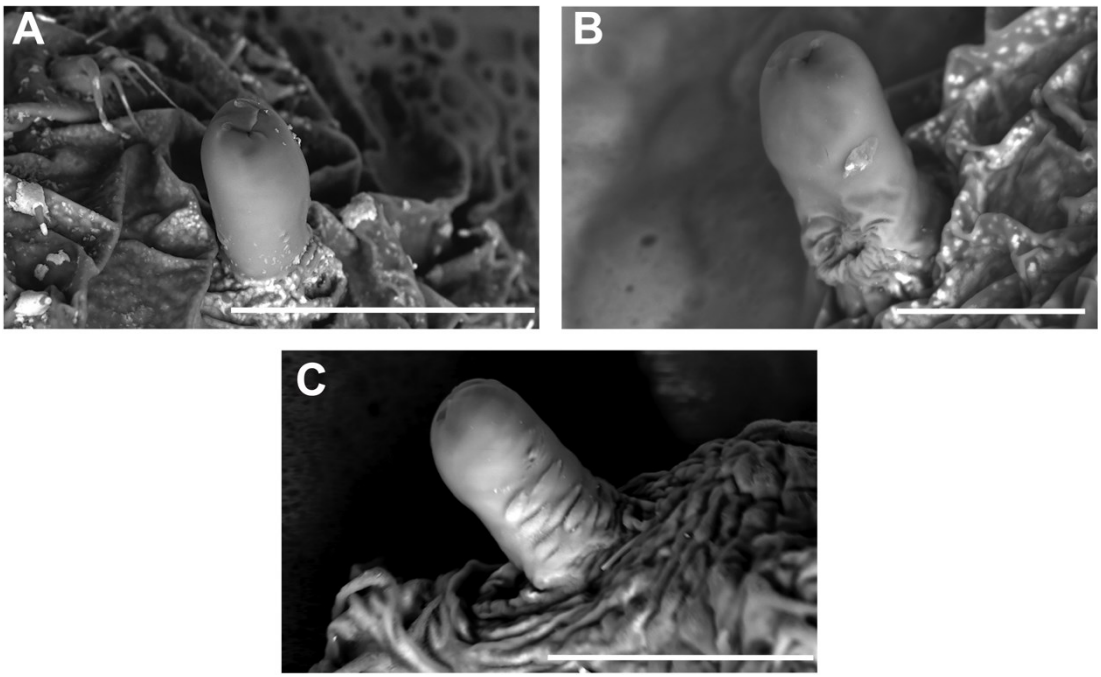

Figure 12. Anterior spiracles. **A**: *Eumerus rufotibialis* Radenković et Vujić sp. nov. **B**: *E. compactus*. **C**: *E. astropilops*. Scale bars: 200 μm (**A**), 50 μm (**B**) and 100 μm (**C**).

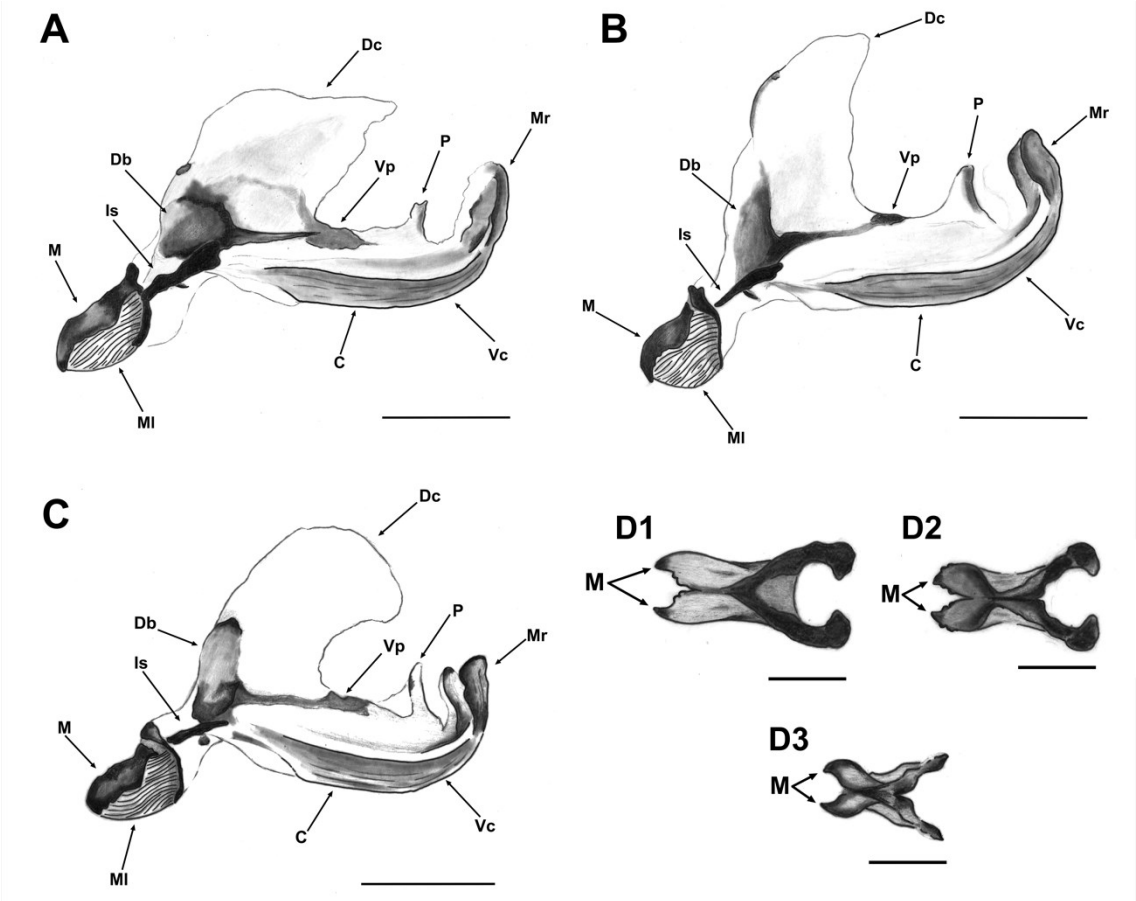

Figure 13. Head skeleton of third instar larvae schemes. **A**: *Eumerus rufotibialis* Radenković et Vujić sp. nov., lateral view. **B**: *E. compactus*, lateral view. **C**: *E. astropilops*, lateral view. **D1-3**: Mouthhooks, dorsal view, *E. rufotibialis* sp. nov. (**D1**), *E. astropilops* (**D2**) and *E. compactus* (**D3**). Abbreviations: C - cibarium; Db - dorsal bridge; Dc - dorsal cornu; Is - intermediate sclerite; M - mouthhooks; Ml - mandibular lobe; Mr - mortar; P - pestle; Vc - ventral cornu; Vp - vertical plate. Scale bar: 500 μm (**A, B** and **C**) and 100 μm (**D**).

Abdomen - Segmental sensilla placed on top of a small fleshy papillae, gradually enlarging in the last four segments. Anal segment presents four folds and two pairs of fleshy lappets (figure 9A). First pair located dorsally, facing upwards (1st segmental sensilla) and second pair located ventrally, facing backwards, parallel to the posterior respiratory process (segmental sensilla 4th on top and 5th at the base).

Overall puparium appearance - Length including PRP 8.4 ± 0.93 mm, maximum width 3.7 ± 0.56 mm and maximum height 3.6 ± 0.44 mm (N = 7). Dark brown in colour. Pupal spiracles separated, three times their length.

PRP - Length 0.81 ± 0.03 mm, width at the base 0.68 ± 0.10 mm, at the apex 0.56 ± 0.08 mm (N = 5). Dark, reddish brown in colour. Progressively tapered, thickened at the very apex (figure 15A). Faint transversal ridge at three fifths of its length. Wrinkled surface from the base to the transversal ridge; from transversal ridge to next fifth, coriaceous surface fully covered by small dents; distal fifth smoother and slightly rough (figure 15A). Spiracular plate with 3 pairs of spiracular openings arranged around two rounded central scars. First and third pair sinuous, second pair horseshoe shaped. Four pairs of branched spiracular setae with 4-6 branches, two openings close to the second pair of spiracular setae (figure 15B).

Pupal spiracles - Length 0.49 mm ± 0.04 long (N = 9). Curved and cylindrical, tapered at the apex, with a rounded prominence on top with slightly granulated surface, reddish-brown in colour. Dorsal and lateral areas mostly covered (around 80%) by irregularly distributed, rounded-shaped tubercles. Ventral area not bearing tubercles, one appearing at the apex of the area in some cases (figure 16A). Each tubercle bearing 4-7 oval spiracular openings. Spiracular surface smooth (figure 16B).

Preimaginal material studied - A total of 12 larvae were collected in the field, five were preserved for morphological studies and 7 were left to develop and pupate.

Preimaginal description of *Eumerus compactus* van Doesburg 1966

Overall larva appearance - Length including PRP 8.6 ± 0.84 mm, maximum width 1.9 ± 0.37 mm and maximum height 1.9 ± 0.24 mm (N = 27). Fusiform, subcircular in cross-section, slightly tapered anteriorly, tapered posteriorly, and flattened ventrally. Cream to light brown in colour, more yellowish after fixation (figure 9B).

Pseudocephalon, thorax and head skeleton - Dorsal lip covered by transversal lines of long and robust setae, reaching up to the base of the antenna-maxillary organs (figure 11B); ventral lip inner lobe covered by papillae

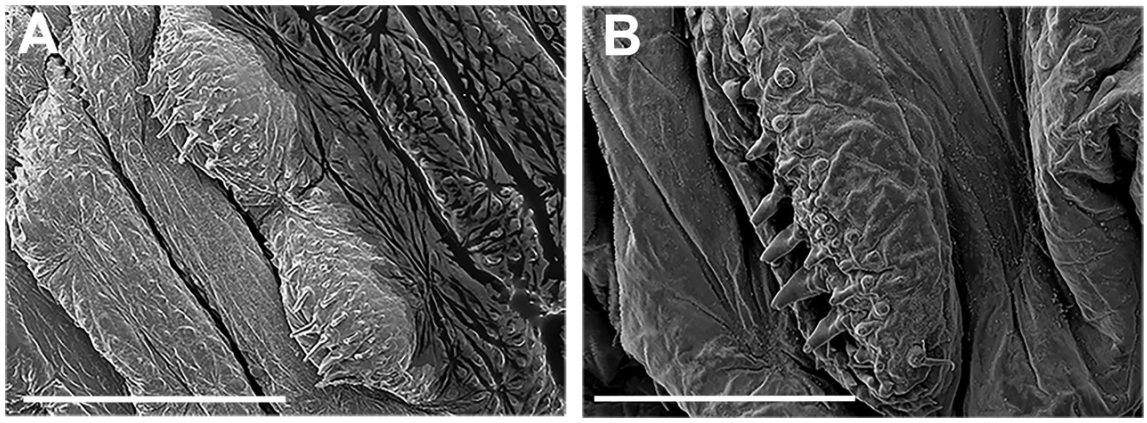

Figure 14. Abdominal prolegs. **A**: *E. compactus*. **B**: *Eumerus rufotibialis* Radenković et Vujić sp. nov.. Scale bars: 400 μm (**A**) and 300 μm (**B**).

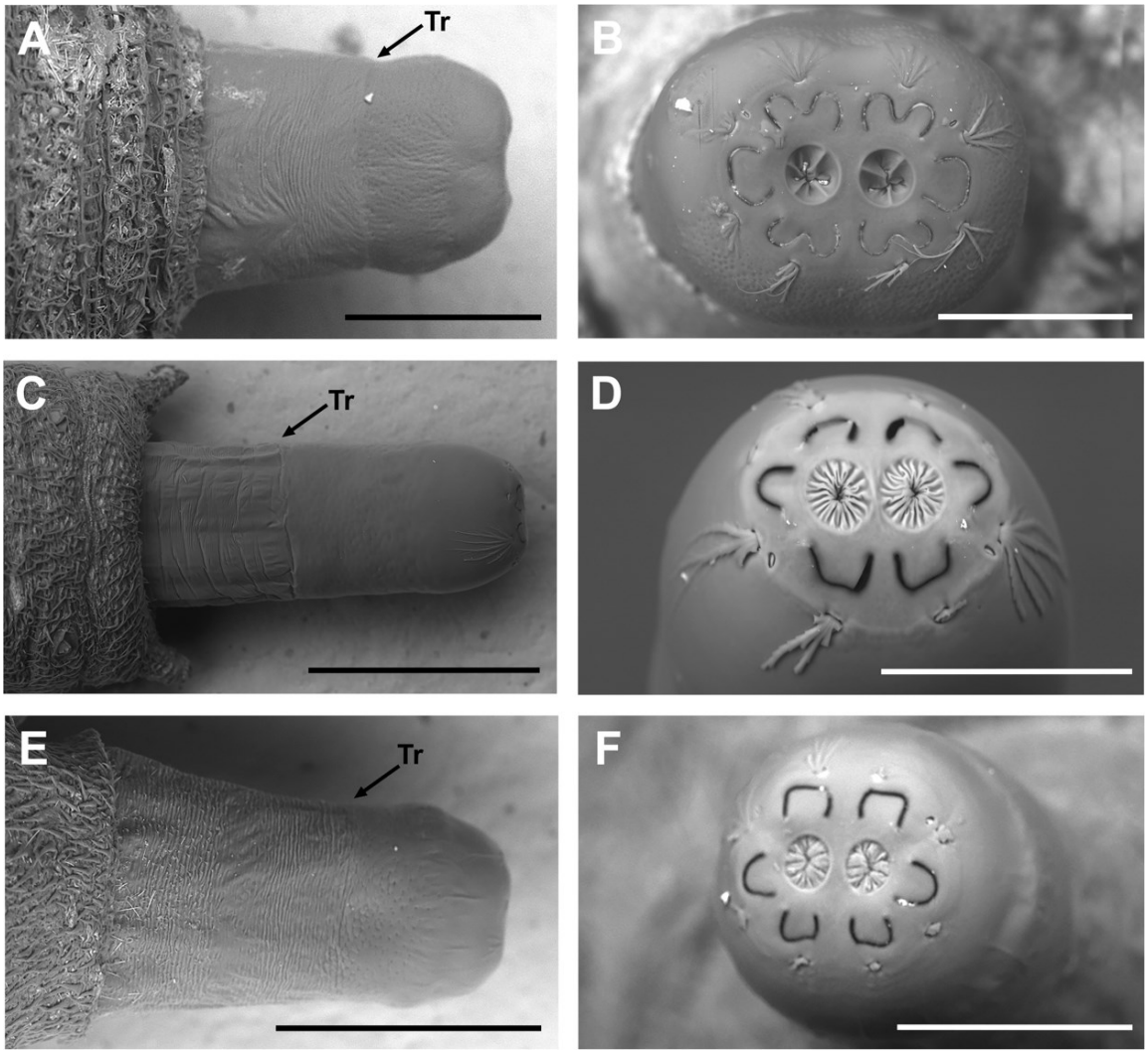

Figure 15. Posterior respiratory process. **A**: *Eumerus rufotibialis* Radenković et Vujić sp. nov., dorsal view. **B**: *E. rufotibialis* sp. nov., vertical view. **C**: *E. compactus*, dorsal view. **D**: *E. compactus*, vertical view. **E**: *E. astropilops*, dorsal view. **F**: *E. astropilops*, vertical view. Abbreviation: Tr - transversal ridge. Scale bars: 500 μm (**A**, **C** and **E**), 250 μm (**B** and **F**) and 200 μm (**D**).

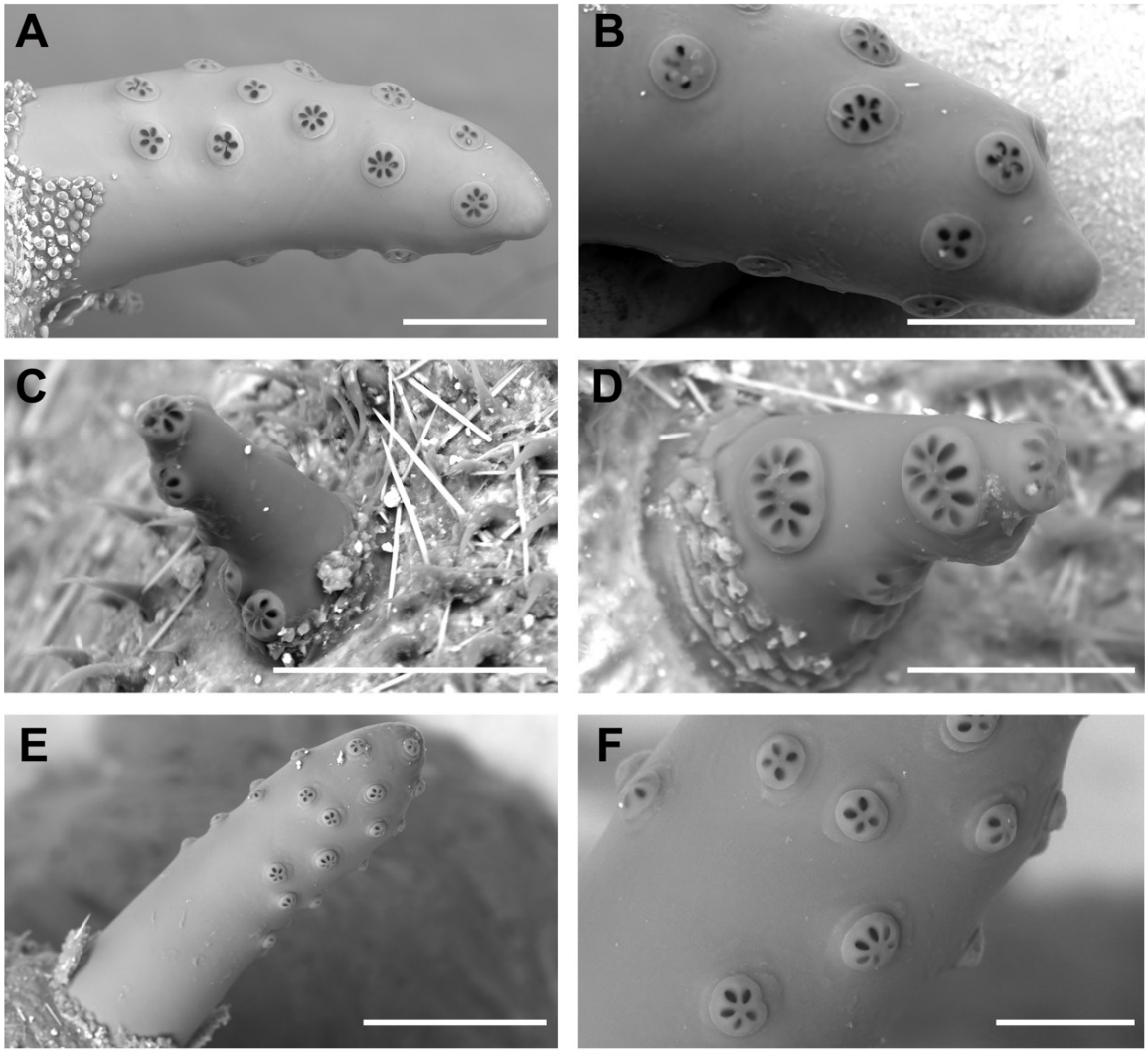

Figure 16. Pupal spiracles. **A**: *Eumerus rufotibialis* Radenković et Vujić sp. nov., dorsal view. **B**: *E. rufotibialis* sp. nov., detail of tubercles and apex. **C**: *E. compactus*, dorsal view. **D**: *E. compactus*, lateral view. **E**: *E. astropilops*, dorsal view. **F**: *E. astropilops*, detail of tubercles. Scale bars: 100 μm (**A**, **B** and **C**), 200 μm (**E**) and 50 μm (**D** and **F**).

with grouped long setae at the tip. Mandibular lobes bearing around 20 ridges covering the whole surface (figure 11C). Anterior spiracles process with two spiracular openings and a wrinkled scar present at the base, on the external part of the structure (figure 12B). Mouthhooks with small protuberances as accessory teeth, present both internally and externally (figures 13B and 13D2).

Abdomen - Folds of 4-7th segments much thinner and aggregated than the other segments. First, second and third segmental sensillae located on top of small basal papillae, increasing in size towards 7th abdominal segment. Dorso-lateral segmental sensillae (4th, 5th and 6th) with well-developed papillae, all surrounded by apical setae, increasing in size towards the posterior end of the larva. Anal segment with a pair of fleshy lappets, located on both lateral sides ventrally, directed slightly downwards, bearing 4th and 5th segmental sensillae (figure 9B).

Overall puparium appearance - Length including PRP 6.9 ± 0.45 mm, maximum width 2.6 ± 0.29 mm and maximum height 2.3 ± 0.39 mm (N = 30). Light brown in colour. Pupal spiracles separated seven times the length of one spiracle.

PRP - Length 0.87 ± 0.07 mm, width at the base 0.36 ± 0.04 mm, at the apex 0.25 ± 0.04 mm (N = 6). Shiny, light brown in colour. Sub-elliptical in cross section. Faint transversal ridge at two fifths of its length. Presents transversal wrinkles from the base to the transversal ridge; from ridge to next two fifths, coriaceous and with small holes; distal fifth smooth (figure 15C). Spiracular plate with 3 pairs of horse-shoe shape spiracular openings arranged around two rounded central scars. Four pairs of branched spiracular setae with 5-6 branches, two openings close to the second pair of spiracular setae (figure 15D).

Pupal spiracles - Length 0.11 ± 0.01 mm long (N = 25). Sub-conical structures tapered and pointed apically (figure 16C); shiny, light brown in colour. Dorsal and lateral areas covered by big, irregularly distributed, rounded-shaped tubercles covering the whole spiracle length, ventral area with no tubercles; whole surface smooth, not presenting ornamentation (figure 16D). Each tubercle bearing 6-11 oval spiracular openings.

Preimaginal material studied - A total of 127 larvae were collected in the field, 27 were preserved for morphological studies and 100 were left to develop and pupate.

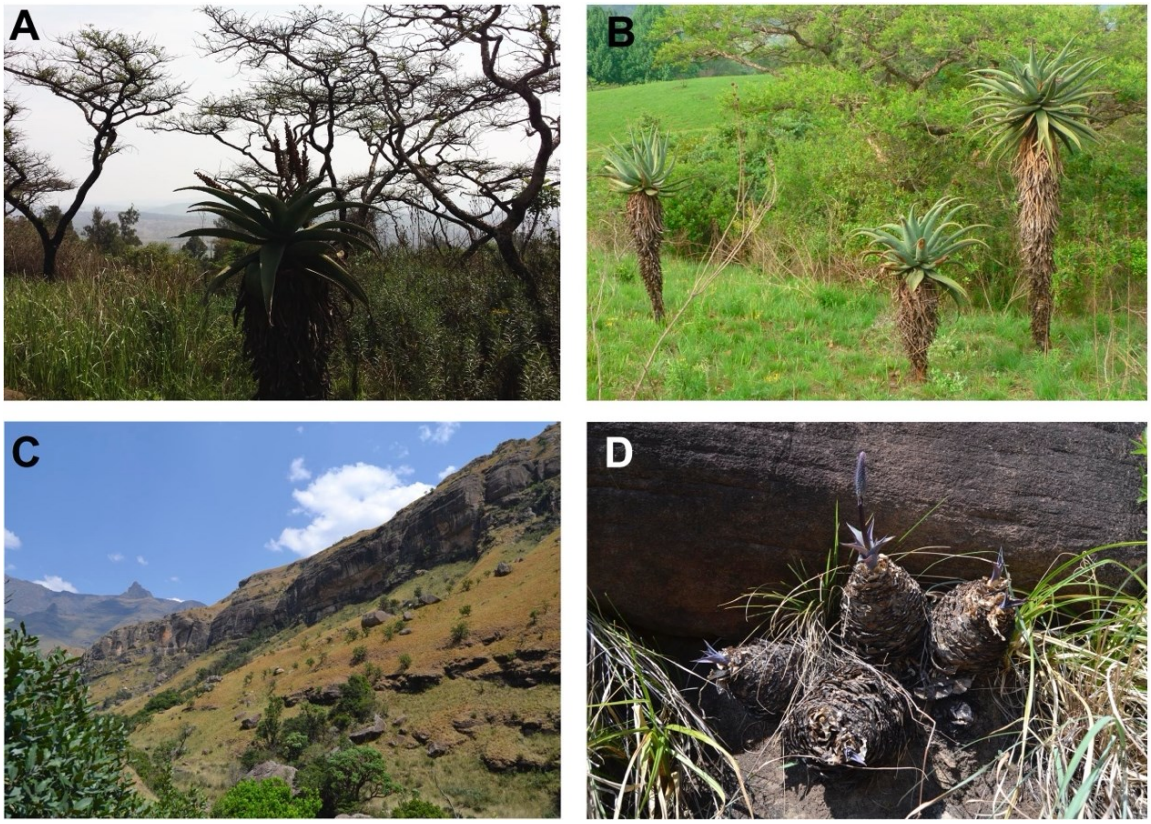

Figure 17. Plants and environments where the species were found. **A**: Environment where rotten *A. candelabrum* was sampled. **B**: *A. candelabrum* specimens. **C**: Environment where *M. plumbea* was sampled. **D**: *M. plumbea* bulbs.

Preimaginal description of *Eumerus astropilops* Hull 1964

Overall larva appearance - Length including PRP 8.1 ± 1.43 mm, maximum width 2.5 ± 0.55 mm and maximum height 1.8 ± 0.41 mm (N = 6). Fusiform, subcircular in cross-section, slightly tapered anteriorly, tapered posteriorly, and flattened ventrally. Cream to light brown in colour, darker after fixation (figure 9C).

Pseudocephalon, thorax and head skeleton - Dorsal lip bearing 10 lines of long and robust setae (figure 10C). Inner lobe of ventral lip fully covered by short setae ramified at the apex. The thickened area below the antenna-maxillary organs densely covered by long and thin setae (figure 10C). Mandibular lobes presenting around 20 ridges covering the surface (figure 10D). Anterior spiracles with coriaceous surface at the base and two spiracular openings at the apex (figure 12C). Mouthhooks not bearing accessory teeth (figures 13C and 13D3).

Abdomen- Segmental sensilla placed on top of a small fleshy papillae, gradually increasing in size until the 7th segment. Anal segment with one pair of fleshy lappets, located ventrally, directed downwards with 4th and 5th segmental sensilla on it (figure 9C).

Overall puparium appearance - Length including PRP 7.1 ± 0.63 mm, maximum width 3 ± 0.37 mm and maximum height 2.6 ± 0.42 mm (N = 12). Light brown in colour. Pupal spiracles separated three times the length of one spiracle.

Pupal spiracles - Length 0.49 ± 0.04 mm long (N = 9). Cylindrical structures, slightly tapered and rounded at the apex; reddish-brown in colour. Around 60% of dorsal and lateral areas covered by irregularly distributed, rounded-shaped tubercles; only apical third of ventral area covered by tubercles, spiracular surface smooth, slightly granulated at the apex (figure 16E). Each tubercle bearing 3-6 oval spiracular openings (figure 16F).

Preimaginal material studied - A total of 18 larvae were collected in the field, six were preserved for morphological studies and 12 were left to develop and pupate.

Discussion

Knowledge of genus *Eumerus* taxonomy is lacking, particularly in the Afrotropical Region, where it is remarkably speciose. At least half of its diversity remains to be studied (Lyneborg *et al*., 2015). In this work, we contributed to building knowledge on this genus by revealing one new species named *E. rufotibialis* sp. nov., belonging to the *E. obliquus* group. It is easily distinguishable from other species of the group through conspicuous golden-yellow, long and dense pile on hind leg (whitish in other species of the group) and widely dichoptic eyes in male. We adopted here the wider concept of the *E. obliquus* group given by Ricarte *et al*. (2020) that includes species without laterally compressed metabasitarsus, contrary to Smit *et al*. (2017) and Gilasian *et al*. (2022). We broadened, however, the group diagnosis with the male genitalia characters. According to our findings, *E. rufotibialis* sp. nov. develops in *A. candelabrum* that is endemic to

South Africa (Smith *et al*., 2016). Nevertheless, its distribution as saprophagous species can be assumed to be much wider. The general appearance of the new species is similar to the recently described species *E. lyneborgi* recorded in South Africa as well as in Namibia (Ricarte *et al*., 2020). The only species of the group that lacks characteristic pollinosity on the head and mesonotum is South African *E. unicolor* (Crosskey, 1980). All these species, as well as *Eumerus punctifrons* Loew 1857, which is distributed in Northern Africa and Arabian Peninsula (Dawah *et al*., 2020), lack the distinct ridge on hind tarsus. Much more widespread species are *E. obliquus* and *E. vestitus*, found not only in the Afrotropical region (including Arabian Peninsula) but also the Mediterranean area of the Palaearctic region (Smit *et al*., 2017). Recently, *E. obliquus* and two new species of the group (*Eumerus effossus* Gilasian et van Steenis 2022 and *Eumerus similis* Gilasian et van Steenis 2022) have been recorded in Iran (Gilasian *et al*., 2022). These species have laterally compressed metabasitarus as well as *Eumerus incilis* Smit 2017, endemic to the United Arab Emirates (Smit *et al*., 2017). The diversity of the *E. obliquus* group in the Afrotropical Region requires further investigation.

Nevertheless, very little information is available on the other two species surveyed in this study. The species *E. compactus* is closely related to *Eumerus charmatus* Smit 2017 (only known in Yemen), but both species were recently compared and can be easily separated (Smit *et al*., 2017). Apart from its description, no information is available either on the species *E. astropilops*, except for its synonymy with *E. hypopygialis* (also confirmed in this paper), and with *E. nigrocoeruleus* (Lyneborg *et al*., 2015).

Regarding larval stages, the preimaginal morphology of three studied species fits with the general overall descriptions of *Eumerus* larvae (Rotheray and Gilbert, 1999), and pupae (Ricarte *et al*., 2008), but with a different proleg morphology and number of lappets. Thus, while these latter authors define the prolegs as barely developed, this characteristic is not stable inside the genus. In fact, considering the available descriptions of the genus (unpublished data, in preparation): a) slightly less than one third of them have absent or barely developed prolegs (e.g., *Eumerus funeralis* Meigen 1822 see Rotheray and Gilbert, 1999); b) another third have no well-developed prolegs but present hooks or spicules (e.g. *Eumerus figurans* Walker 1859 see Souba-Dols *et al*., 2020); and c) the rest exhibit developed prolegs with crochets arranged in 2-4 rows (e.g. *E. obliquus* see Ricarte *et al*., 2008 and the three species studied here). The varying degree of development of the locomotory organs matches the high variability of feeding tissues in which *Eumerus* has been found breeding. This is an indicator of morphological adaptation to different plant tissues. Moreover, well-developed prolegs with crochets increase adherence to the substrate and can be helpful to move across more viscous tissues such as the rotten tissues of *A. candelabrum* or *M. plumbea*.

On the other hand, three pairs of lappets in the anal segment were established (second pair divided by two) by Rotheray and Gilbert (1999) while Ricarte *et al*. (2008) described four pairs (considering the divided lappet as two different ones). In the present description, only one pair of lappets located ventrally was detected in *E. compactus* and *E. astropilops*, (as in the case of *Eumerus etnensis* van der Goot 1964, see Pérez-Bañón and Marcos-García, 1998), but two pairs in *E. rufotibialis* sp. nov. (one dorsal and one ventral). However, the lappet definition does not seem to be a stable character for use as a diagnostical feature, as mentioned by Aracil *et al.* (2022) for *Merodon* genus, because it is not a well-defined term, nor is it sufficiently delimited for comparison purposes. For example, in the description of *Eumerus hungaricus* Szilady 1940 larvae, Ricarte *et al*. (2017) stated that three pairs of lappets were present, but the first one was "virtually absent" and the second was "inconspicuous", the third being the only one that was visible and well- developed. This is, indeed, the same morphology as that of *E. compactus* and *E. astropilops*, but we only considered "the well-developed fleshy projections on the anal segment bearing segmental sensillae on top" (Aracil *et al*., 2022) as lappet. Therefore, the segmental sensillae not placed on top of fleshy projections are not considered as lappets, just as segmental sensillae. The concept is even more uncertain in the case of genus *Eumerus* because some segmental sensillae present fleshy projections across the abdominal segments, making the anal segment projections less visible.

The morphology of the three species is similar, however some aspects are worth comparing and can be used as diagnostical features for each species. First, a wrinkled scar is present at the base of *E. compactus* anterior spiracles on the external part. This scar was also described in *Eumerus arnoldii* Stackelberg 1952 (Krivosheina and Krivosheina, 2021), while *E. astropilops* has a coriaceous surface at the base (figure 12C), which is not described in any other known species. This character may thus be useful as a diagnostical character for *E. astropilops*. Moreover, the base of the antenno-maxillary organs of *E. astropilops* is entirely covered by long and thin setae, while the other two species only have some setae at the most basal area, in contact with the dorsal lip.

The posterior respiratory process in dorsal view is totally straight in *E. compactus* but tapered and markedly thickened at the apex in *E. astropilops* and *E. rufotibialis* sp. nov.. This feature (thickness) is described here for the first time for this genus. The spiracular openings of *E. rufotibialis* sp. nov. are highly sinuous, as also, for example, in the case of *E. obliquus* and closely related species, contrary to the horse-shoe shape present in the other two species such as most species belonging to *Eumerus* (Souba-dols *et al*., 2020). Combining these two morphological aspects, *E. rufotibialis* sp. nov. can be distinguished from the rest of *Eumerus* larvae because it presents a thickened PRP at the apex and with sinuous spiracular openings (figures 15A and 15B). On the other hand, the pupal spiracles of *E. compactus* are very small, conical in shape, and bear rather big tubercles with up to 11 oval spiracular openings (figures 16C and 16D). This morphology differs from the common morphology of most *Eumerus* larvae (cylindrical, tapered in the apex and with medium-size tubercles bearing between 3-7 spiracular openings). Pupal spiracle morphology could thus be the diagnostic feature of *E. compactus* preimaginal stages.

Conclusions

Virtually no new data has been published hitherto on *E. compactus* and *E. astropilops* since their original descriptions (Hull, 1964; van Doesburg, 1966) with specimens captured in 1951-1959 (except two *E. compactus* males captured in 2015 in Royal Natal National Park, see Smit *et al*., 2017). The information presented here is therefore of special interest as it updates knowledge of the genus *Eumerus* in the Afrotropical Region. An additional contribution of the present work is the description of a new species and the study of the immature stages of three more African species. The preimaginal morphology of only two species had been previously described, using material collected in Africa, i.e., *E. obliquus* and *Eumerus compertus* Villeneuve 1924 (de Moor, 1973; Waitzbauer, 1976). Descriptions have been provided, supported by images and diagnostical features as well as comparisons with several other described species.

The known host plant of *E. rufotibialis* sp. nov. and *E. compactus* is the South African endemic *A. candelabrum* distributed across South Africa's Eastern Seaboard (Smith *et al*., 2016). The larval stages of *E. astropilops* were found in rotten bulbs of the other South African endemic species: *M. plumbea*. However, the latter species is probably far more widely distributed, due to their saprophagous habits.

As specified above, much information is still lacking for most of the known species regarding preimaginal biology, life cycle, or habitat preferences. More information on these topics would help to understand the general biology species, interactions with the host plants, and to clarify the taxonomic mysteries of the genus.

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