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## Contents

- Eberhard Zielke  
Three new *Coenosia* Meigen species from Madagascar (Diptera: Muscidae) 293
- Boyan Zlatkov, Ognyan Sivilov  
Two new steppe leafrollers (Lepidoptera: Tortricidae) from Bulgaria with morphological notes 309

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# Three new *Coenosia* Meigen species from Madagascar (Diptera: Muscidae)

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<https://zoobank.org/6B6F8417-0068-4E61-9203-6D8123C6A8D6> 

**Abstract:** Three new species, *Coenosia circuita* sp. n., *Coenosia grunowiana* sp. n. and *Coenosia neaurifa* sp. n. are described from Madagascar as new to science. The identification key to the species of the Afrotropical group “*Coenosia*” created in 1940 by Van Emden has been updated and considers now 14 species.

**Keywords:** Afrotropical Region, *Coenosia*, identification key, Madagascar, Muscidae, new species

## Introduction

According to Systema Dipteroorum website (Evenhuis & Pape, 2023) around 472 species are known of *Coenosia* Meigen, 1826 (Muscidae: Coenosiinae: Coenosiini), the third largest genus in the Muscidae family after *Phaonia* Robineau-Desvoidy, 1830 and *Helina* Robineau-Desvoidy, 1830 which have 870 and 780 species, respectively. The genus is represented almost worldwide, albeit in different numbers of species and prevalence. So far, around 120 *Coenosia* species occur in the Afrotropical Region. This makes *Coenosia* the second most species-rich genus in the region after the genus *Atherigona* Rondani, 1856. In Madagascar, however, *Coenosia* is represented by only a few species, as shown by the publication on Malagasy Muscidae by Couri et al. (2006). According to the authors, only seven species have been found in Madagascar so far, in addition they described another species, new to science, from that area. Investigations carried out at the Institute of Biodiversity and Ecosystem Research (IBER), Sofia, Bulgaria on unidentified muscid material from Madagascar revealed apart from various other Muscidae several specimens of *Coenosia*. The flies were assigned to species using the identification keys to the species-groups within the genus, created by Van Em-

den (1940). Only three specimens were found belonging to the so-called group “*Coenosia*”. However, the combination of their taxonomic characteristics did neither match the five species listed in the key nor the other six species, assigned to the group “*Coenosia*” in the years following the publication of the identification key. They are therefore considered as representatives of unknown species and are hereinafter described as *Coenosia circuita* sp. n., *Coenosia grunowiana* sp. n. and *Coenosia neaurifa* sp. n. Since the number of species belonging to the group “*Coenosia*” has more than doubled since the publication by Van Emden his key was supplemented by the three newly described species and the other six taxa that had not yet been considered, which are *Coenosia brunneigena* Van Emden, 1940, *Coenosia cryptica* Paterson, 1956, *Coenosia exilis* Pont, 1969, *Coenosia flavivibrissata* Stein, 1918, *Coenosia melanomeros* Van Emden, 1951 and *Coenosia stuckenbergi* Zielke 1971. The possible assignment of *Coenosia aberrans* Couri, Pont & Penny, 2006 to this group is discussed.

## Materials and methods

The origin of the material examined as well as the processing methods and the identification of the flies

were repeatedly described in detail (e.g. Zielke, 2021a, 2016b). Therefore, some sections of “Materials and methods” have been taken verbatim from recent publications and adapted with regard to the preparation and identification of the fairly small specimens of *Coenosia*.

The unidentified muscid material was preserved in high-percent ethanol and came mainly from the remains of insect traps kept in vials at the Moravian Museum, Brno, Czech Republic. Many of the flies, particularly of the small ones, found among the remains were destroyed or had lost body parts crucial to identification. But some specimens, apart from lost setae, were only slightly or not at all damaged and suitable for further processing and identification. These flies were isolated, cleaned in 75% ethanol before being transferred to a solution of 30% ethanol for soaking. They were then mounted on a pin or a minute and marked with a locality label. In order to reduce shrinkage of the small fly bodies due to too sudden drying, the samples were dried slowly in a container at constant humidity. Added acetic acid evaporated and prevented fungal infestation. However, this was only partially successful, many of the small specimens showed more or less some shrinkage.

The identification key for the Madagascan Muscidae species published by Couri et al. (2006) was of little help as it only includes eight species, and it quickly became evident that the collection of unidentified *Coenosia* specimens from Madagascar consisted of a significantly larger number of different species. Therefore, the keys created by Van Emden (1940) were used and supplemented by *Coenosia* species from the Afrotropical Region described in the following years after the publication of the keys. For additional check-ups on species of the so-called “*Coenosia*” group sensu Van Emden (1940) the following publications on African *Coenosia* were consulted: Couri & Pont (2016a, 2016b), Paterson (1956), Pont (1969), Van Emden (1951) and Zielke (1971). In addition, the new species were also checked against the keys of the earlier authors Stein (1913), Malloch (1922) and Curran (1935), but none of the new species matched any of the species listed in these keys. Moreover, several *Coenosia* species were studied when visiting the Muscidae collection of the Natural History Museum, London in 2023. The newly described species were compared with the holotypes of similar species, and the available type material and

identified specimens of different species of the collection were used for testing the functionality of the updated key.

Morphological terminology follows McAlpine (1981), but postpedicel (Stuckenberg, 1999) is used instead of “first flagellomere” as proposed by McAlpine. As already described previously (Zielke, 2020), the width of the postpedicel seen from the lateral side is called “depth” and the greatest depth of the postpedicel is always used for comparisons and ratio calculations. The length of postpedicel is measured from the most anterior margin of pedicel till the apex of postpedicel. Unless otherwise stated, information on the width of the forehead always refers to the shortest distance between the margins of the eyes. The anterior width of frons is measured directly at the upper margin of lunule. Only the postsutural intra-alar setae are called as such. The so-called intra-alar setae of the presutural part of mesonotum are referred to as posthumeral and presutural setae. When the length of setae or hairs of the femur is compared to the depth of femur, the depth always refers to the point of insertion of the seta or hair. Body length is measured in millimetres (mm).

External morphological features of the specimens were studied using a Zeiss Stemi SV6 stereomicroscope and images were created by means of combination of a Zeiss Discovery 8 stereomicroscope and an AxioCam ERc5s camera. Helicon Focus 6 and Adobe Photoshop CS2 were applied for further processing of the images.

The holotypes of the three new species will be returned to the Moravian Museum upon completion of the study.

## Results

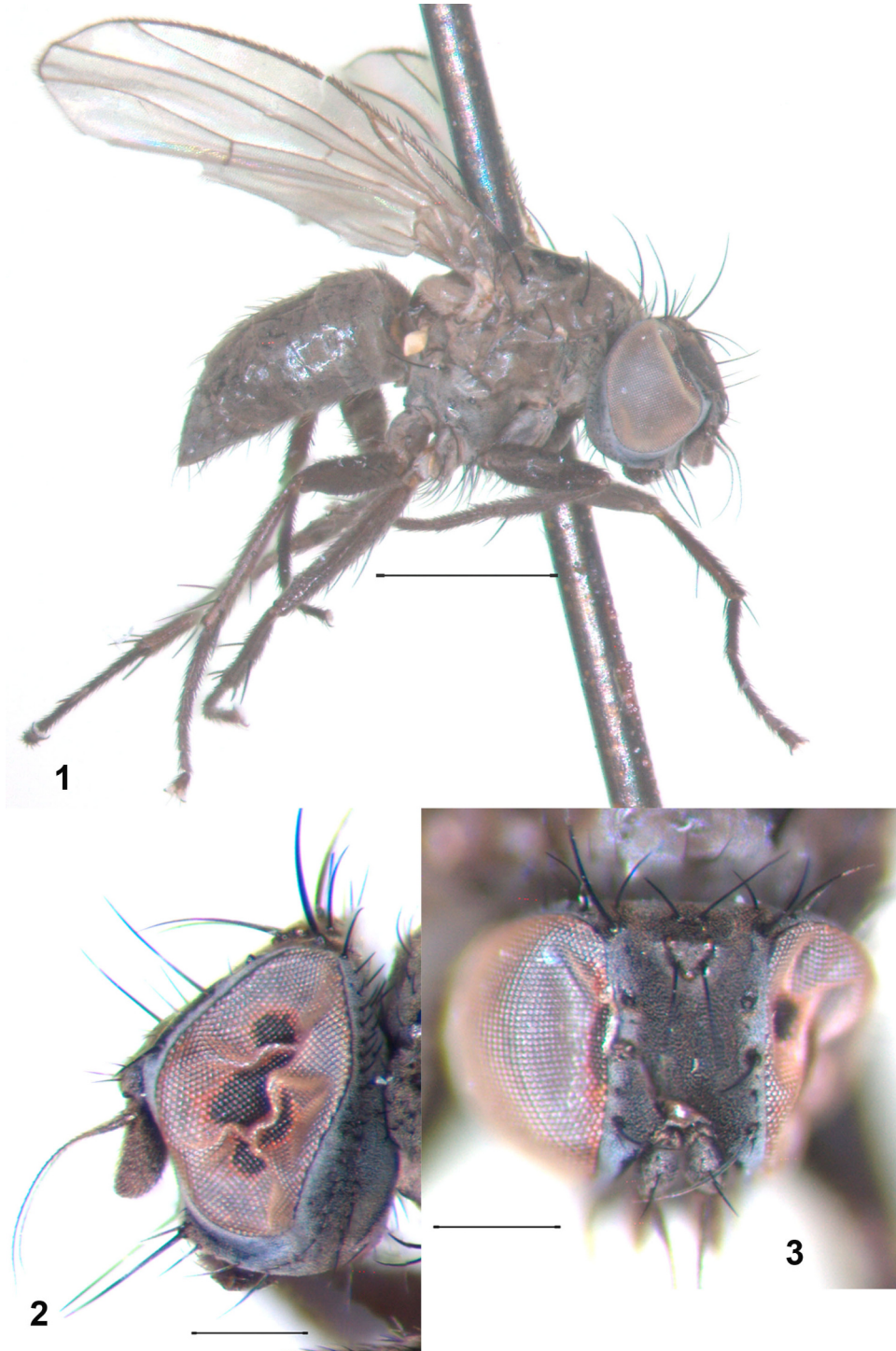
### Descriptions of new *Coenosia* species

*Coenosia circuita* sp. n. (Figs 1–3)

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Material examined: ♀ holotype; locality label reads: “Madagascar Andasibe ca. 970 m Mantadia N. P., circuit “Eulophia” S18.80373°-79871°E48.42928°-42785°, 19.01.2017, screen sweeping, P. Jansta”. The head shows some shrinkage, a few major setae are



Figs 1–3. *Coenosia circuita* sp. n., female holotype: (1) lateral view; (2) profile of head with conspicuously protruding frons; (3) anterior view of frons. Scale bars: Fig. 1, 1 mm; Figs 2 and 3, 0.25 mm.

missing, however their scars are clearly visible; otherwise, the holotype is in good condition.

**Etymology:** The epithet is a female adjective referring slightly modified to the circuit where it was collected.

**Description (female):** Head. Ground-colour dark to blackish, depending on incidence of light partly dusted greyish. Dichoptic; eye practically bare, facets of about equal size. Frons almost parallel-sided (Fig. 3) slightly dilated towards vertex, longer than wide,

and almost as wide as one eye; frontal vitta at midlength about four times as wide as fronto-orbital plate; frontal triangle poorly demarcated, in lateral view reaching the level between the two long fronto-orbital setae. Basis of parafacial almost as wide as depth of postpedicel, tapering downwards throughout its length to about a quarter of the depth of the postpedicel. Facial ridge in lower half about as wide as parafacial. Fronto-facial stripe slightly widened to lower vertex and more distinct to the lower margin of eyes, where it is marginally but distinctly wider than frons. Frons longer than face. In profile anterior part of head angular-shaped (Fig. 2); frons conspicuously protruding by almost twice the depth of postpedicel; gena below lowest eye margin about as wide as depth of postpedicel; mouth margin approximately at the same level as the lower margin of the eye. Frontal vitta depending on incidence of light dark brown or blackish, more or less dusted brownish or greyish-brown (Fig. 3); fronto-orbital plate, parafacial, face and gena predominantly dusted greyish, peristomal corner brownish, sparsely dusted. Antenna uniformly dark brown, postpedicel at certain incidence of light very sparsely dusted greyish-brown, pedicel at certain viewing angles densely dusted greyish. Antenna not reaching mouth margin, falling short of margin by the depth of postpedicel. Postpedicel about 2.5 times as long as its depth and twice as long as pedicel. Arista at least 2.5 times as long as length of postpedicel, the longest dorsal hairs almost as long as the diameter of the slightly dilated basis of arista. Fronto-orbital plate with three inclinate fronto-orbital setae; the anterior and the upper seta long, the middle seta distinctly shorter, two or three interstitial seta-like hairs about half as long as the middle seta. Inner vertical seta conspicuously strong, longer than the other setae of the head including the vibrissal seta. Outer vertical seta about half as long as the inner seta and shorter than the postvertical seta which is about as long as the two diverging ocellar setae, the latter ones somewhat shorter than the fronto-orbital seta. Proboscis with prementum shiny dark brown, labella brown slightly longer than depth of proboscis; palpus dark.

**Thorax.** Ground-colour predominantly brownish (Fig. 1) depending on incidence of light dusted brownish or brownish-grey or somewhat shiny. Mesonotum and scutellum uniformly dusted brownish without any stripes. Pleura predominantly dark and densely dusted brownish or at certain incidence of light brownish-grey. Acrostichals very

sparse but fairly long, in two rudimentary irregular rows; 1+3 strong dorsocentral setae; postpronotal setae 2, fairly strong, the outer one clearly longer and stronger than the inner seta; posthumeral seta 1, presutural seta 1, both strong, the presutural seta significantly longer; notopleural setae 2, the posterior somewhat shorter; pre-alar seta absent; intra-alar 2, strong; one strikingly long supra-alar seta and three post-alar seta. Proepisternal and proepimeral setae strong, the lower proepimeral seta distinctly weaker, curved downward, not surrounded by hairs. Katepisternal setae in an equilateral triangle, the latter with a few erect hairs on its surface, the lower seta clearly weaker. Anepisternal setae 1+5, the anterior seta fairly short, the setae of the posterior row strong but of different length, practically without distinct interstitial hairs. Scutellum each with a pair of scars of strong and long apical and lateral setae, about equally strong, no other scars of setae or setulae detectable on the surface of scutellum.

**Wings.** Membrane hyaline without a distinct tinge; tegula and basicosta brownish, veins brown; costa reaching apex of vein M; costal spine distinct almost as long as cross-vein r-m. Vein R4+5 very slightly divergent from apex and vein M; cross-vein r-m slightly basad of the point where vein R1 enters costa; vein A1 distinctly shorter than half the distance from its base to the wing margin. Calypters fairly small; upper calypter greyish hyaline, margin with a narrow brown frame; lower calypter matt greyish at certain viewing angle with a dark frame, triangular-shaped and with a rounded apex, almost 1.5 times as long as upper calypter. Haltere pale yellow.

**Legs.** Primarily brown (Fig. 1), somewhat shiny and without yellow knees; at certain incidence of light coxae densely dusted pale grey. Fore femur with a complete row of strong posterodorsal setae the longest ones almost as long as depth of femur, and a row of posteroventrals distinctly shorter than depth of femur. Fore tibia with a distinct posteroventral seta at middle third, almost one third as long as length of tibia. Mid femur in basal half a strikingly strong anterior seta longer than depth of femur and one strong anteroventral seta almost as long as depth of femur and at least one strong posteroventral seta almost as long as the anteroventral one, two preapical posterior to posterodorsal bristles. Mid tibia about at midlength with a strong posterodorsal seta and slightly more distal a very strong anterodorsal seta almost half as long as tibia. Hind femur with a

complete row of strong anterodorsal setae, longer than depth of femur, and with two strong anteroventral setae in apical third, in basal half two fairly short anteroventral setae and two posteroventral hairs about half as long as depth of femur, and a preapical posterodorsal seta. Hind tibia with a rather strong and long anterodorsal seta in midlength and a short anteroventral seta clearly beyond it, preapical one dorsal and one anterodorsal seta each, both setae somewhat shorter than the median anterodorsal seta.

Abdomen. Oval-shaped, apex of last tergite pointed (Fig. 1); predominantly dark, densely dusted brownish, without a specific pattern, at certain incidence of light tergites with a distinct greyish tinge. The lateral and ventral parts of tergites concolourous with the dorsal surface. Marginal setae of tergites 3 to 5 fairly short, about one third as long as the length of the corresponding tergite, only the discals of tergite 5 about half as long as tergite.

Female genitalia. Not investigated.

Measurements: Body length 3.2 mm, length of wings 2.9 mm.

Male. Not known.

Diagnosis: *Coenosia circuuta* sp. n. runs in Van Emden's key to *Coenosia fordi* Van Emden, 1940, however it differs from the latter by a striking conspicuously protruding frons, approximately twice the depth of postpedicel; the gena below the lowest part of eye margin is about as wide as depth of postpedicel; the legs are primarily brown, somewhat shiny, the knees are dark; the apical part of postpedicel is rounded and not acuminate at tip. On the other hand, *C. fordi* has not such a protruding frons; the gena is at least 1.5 times as wide as depth of postpedicel; not mentioned by Van Emden (1940) but clearly visible at holotype and the four paratypes the apex of postpedicel is clearly acuminate; at least the dark femora predominantly dusted greyish, all knees very narrowly yellowish coloured.

*Coenosia grunowiana* sp. n. (Figs 4–6)

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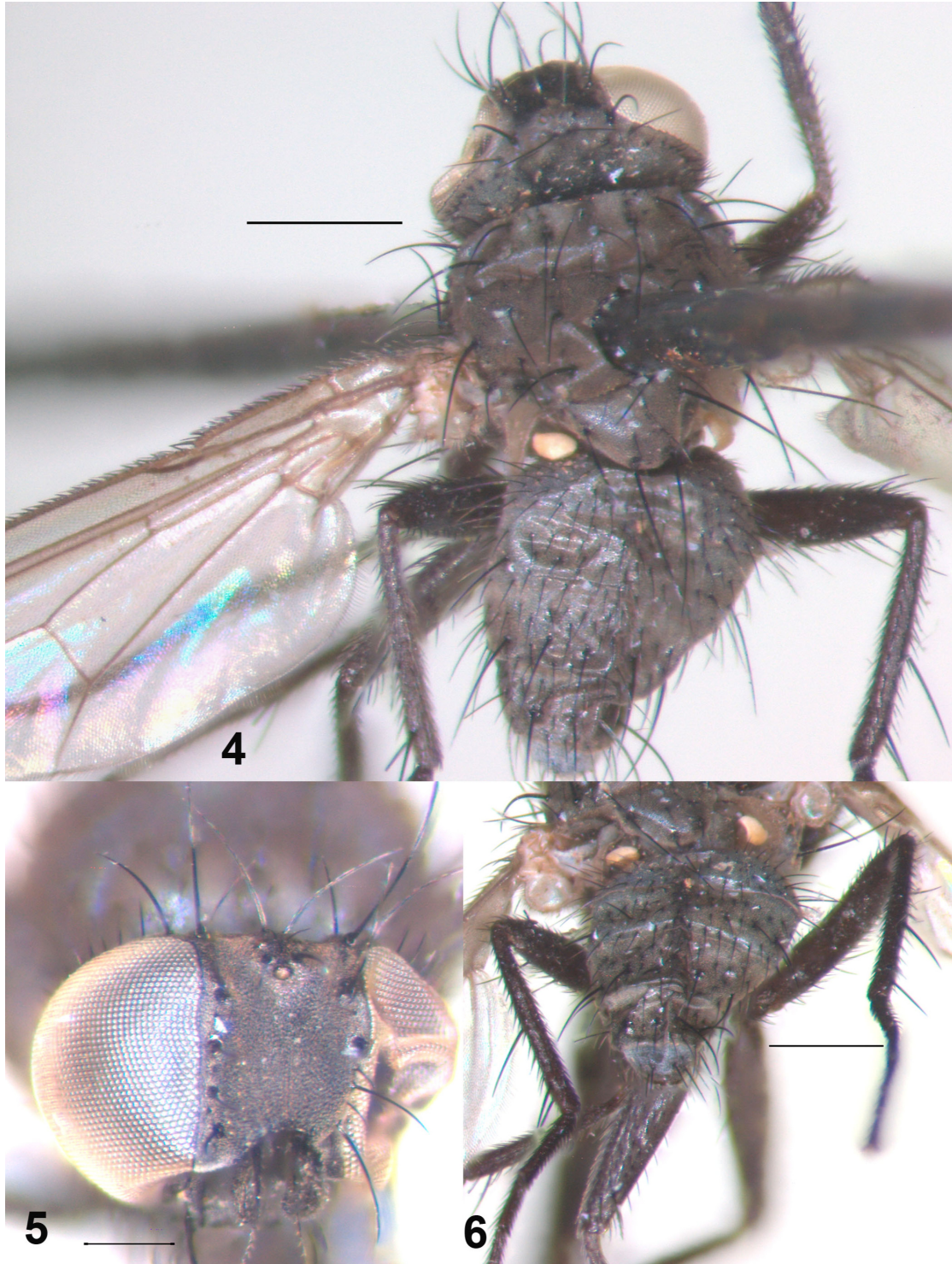
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Material examined: ♂ holotype; locality label reads: "Madagascar Montagne D'Ambre N. P. 1040 m, S12°31'23" E49°10'15", YPT, 13-18.I.2016, leg. P. Banar". The left eye is shrunk and the base of

antennae somewhat covered by anterior margin of frons. Otherwise, the male is in a good condition.

Etymology: The epithet "*grunowiana*" is a feminine adjective and it is my great pleasure to name this new species after Cornelia Grunow of the Editorial board of "Beiträge zur Entomologie", also known as "Contributions to Entomology" from the Senckenberg Deutsches Entomologisches Institut (SDEI). Cornelia Grunow retired end of 2022 and I would like to take this opportunity to thank her for the always friendly help in completing my submitted manuscripts for printing. Be it that the manuscripts and illustrations had to be converted into a printable format, or, just as essential, that competent experts had to be found to review the manuscript, and who often contributed valuable comments improving the article.

Description (male): Head. Ground-colour depending on viewing angle dark brown or black, only small parts dusted greyish. Dichoptic; eye with few microscopically very small hairs, facets of about equal size. Frons about parallel-sided, longer than wide and as wide as width of an eye (Fig. 5); frontal vitta at midlength at least seven times as wide as fronto-orbital plate, frontal triangle barely distinguishable from frontal vitta, the anterior tip about at level between of third inclinate fronto-orbital seta and reclinate orbital seta. Parafacial at basis of antenna about as wide as depth of postpedicel, strongly tapering in upper quarter and about one third as wide as depth of postpedicel in lower half. Frontofacial stripe almost parallel-sided, only slightly widened to lower margin of eyes, where it is marginally wider than frons. Face not longer than frons. In profile, anterior part of frons protruding by about the depth of postpedicel; gena about two thirds as wide as depth of postpedicel; level of mouth margin about at the level of the lower margin of the eye. In frontal view, fronto-orbital plates dark greyish, frontal vitta depending on incidence of light dark brown or black, parafacial and face predominantly dark brown, gena dark brown. Postpedicel dark brown, at certain incidence of light very sparsely dusted greyish, pedicel dark brown, sparsely dusted greyish at apex. Antenna not reaching mouth margin. Postpedicel about three times as long as deep. Arista about twice as long as length of postpedicel, the longest dorsal hairs about as long as the diameter of the slightly dilated basis of arista. Fronto-orbital plate with three inclinate fronto-orbital setae; the anterior



Figs 4–6. *Coenosia grunowiana* sp. n., male holotype: (4) dorsal view, presutural mesonotum with short dark stripes; (5) head with rather wide frons; (6) dorsal view of abdomen with median dark longitudinal stripe. Scale bars: Fig. 4, 0.5 mm; Figs 5 and 6, 0.2 mm.

and the upper seta fairly strong and about as long as the ocellar seta, the middle seta distinctly shorter, two interstitial seta-like hairs about half as long as the

middle seta. Inner vertical seta conspicuously strong and about as long as the height of an eye and longer than the other setae of the head including the vibrissal



seta. Outer vertical seta about half as long as the inner seta and shorter than the postvertical seta which is not quite as long as the two diverging ocellar setae. Proboscis with prementum shiny dark brown, labella brown slightly longer than depth of proboscis; palpus short and slender, slightly clavate, basal third or half dark brown and glossy, apical part brownish-grey.

Thorax. Predominantly brownish, at certain incidence of light with a greyish tinge. Presutural mesonotum dusted greyish-brown with three brown stripes (Fig. 4), the median one along the acrostichal hairs, the paramedian stripes along the presutural dorsocentral setae, barely reaching the transverse suture. Pleura primarily dusted brownish, at certain incidence of light with a greyish tinge. Acrostichals sparse but strong and some are fairly long, in two irregular rows; 1+3 strong dorsocentral setae; postpronotal setae 2, fairly strong, the outer one about twice as long as the inner seta; posthumeral seta 1, presutural seta 1, both setae strong, the presutural seta significantly longer; notopleural setae 2, the posterior somewhat shorter; intra-alar 2 strong ones; one strong and strikingly long supra-alar seta and one long post-alar seta detectable. Scutellum with a pair each of strong and long apical and lateral setae, about equally long, a pair of very short preapical and basal setae about one sixth as long as the lateral and apical setae, no other setulae on the surface of scutellum. Proepisternal and proepimeral setae moderately strong, the lower proepimeral seta curved downward, not surrounded by hairs. Katepisternal setae in an equilateral triangle, the latter with a few erect hairs on its surface, lower and anterior setae about equally strong, posterior setae somewhat longer. Anepisternal setae 1+5, the anterior seta fairly short, the setae of the posterior row strong and of different length, a few interstitial seta-like hairs, about half as long as the setae.

Wings. Membrane sub-hyaline, slightly smoky; tegula pale brownish, basicosta somewhat yellowish, veins brown; costa reaching apex of vein M, costal spine not prominent but almost as long as cross-vein r-m, the bristles of costa up to the height of cross-vein dm-cu standing on gap, the distance between the bristles longer than their length; cross-vein r-m slightly basad of the point where R1 enters costa; vein A1 strikingly short, at most a fifth as long as the distance from its base to the wing margin. Calypters fairly small, greyish hyaline, margins at certain incidence of light with a somewhat darker frame; the

lower calypter narrow, slightly elongate, and parallel-sided, rounded at apex and somewhat projecting. Halteres yellow.

Legs. Uniformly brown, somewhat shiny, without yellow knees (Figs 4 and 6). Fore femur with an almost complete row of strong posterodorsal setae barely as long as depth of femur and a row of posteroventrals longer than depth of femur. Fore tibia with a moderate posteroventral seta in middle third, barely one third as long as length of tibia. Mid femur with three anterior setae in middle third, the middle seta strong and longer than depth of femur, the two other setae barely as long as depth of femur, in basal third three anteroventrals, one of which about as long as depth of femur, the two others about half as long, and some short posteroventrals of which two or three setae almost as long as the anteroventrals, two preapical posterior to posterodorsal bristles. Mid tibia with a distinct posterodorsal seta at midway and a strong and longer anterodorsal slightly beyond. Hind coxa without setae on posterior inner surface. Hind femur with a complete row of strong, slightly curved anterodorsal setae, about as long as depth of femur, and with two strong anteroventral setae in apical third, the most apical seta longer than depth of femur, in basal half about four short anteroventrals, barely half as long as depth of femur, one distinct posteroventral seta at midlength of femur almost as long as depth of femur, and a preapical posterodorsal seta. Hind tibia with a rather strong anterodorsal seta at midlength and a fairly fine anteroventral seta clearly beyond it, a preapical dorsal seta clearly longer than the median anterodorsal seta, and with a preapical anterodorsal seta about half as long as the dorsal seta.

Abdomen. Somewhat depressed, oblong-oval-shaped; predominantly dusted greyish, depending on viewing angle with a brown median longitudinal stripe extending from posterior part of syntergite 1+2 to apical margin of tergite 4 (Fig. 6). At certain incidence of light apical part of tergite 4 and in apical half of tergite 5 more brownish. The lateral and ventral parts of tergites greyish. Marginal setae of syntergite 1+2 not very distinct, tergite 3 laterally with two long and strong marginals, and tergite 4 with a complete row of long and strong marginals setae, the longest setae of tergite 3 and 4 about as long as the length of the associated tergite, tergite 5 with a row of discal setae, almost as long as the marginals of tergite 4, and a row of distinct marginals about half as long as the discals. Sternites concolourous with tergites. Sternite 1 bare.

Male genitalia. Since the male of *Coenosia grunowiana* sp. n. is clearly distinguished from the other known taxa of the genus on the basis of several other taxonomic characters, the hypopygium is not needed for identification purposes. Therefore, it deemed wiser not to extract the genitalia, to avoid inflicting damage on the hitherto only available specimen of the species.

Measurements: Body length 2.4 mm, length of wings 2.3 mm.

Female. Not known.

Diagnosis: Many *Coenosia* species are relatively small with a body length between three and five mm, but *Coenosia grunowiana* sp. n. is strikingly small with barely 2.5 mm. Using Van Emden's key to the *Coenosia* group the new species ends at couplet 7(8) with *C. fordii* which has also a certain similarity with the newly described *Coenosia circuita* sp. n. Both species differ from *Coenosia grunowiana* sp. n. by a brown thorax depending on incidence of light dusted greyish or brownish-grey, mesonotum without longitudinal stripes; gena at least about as wide as depth of postpedicel; the lower calypter triangular-shaped and abdomen uniformly dark, dusted brown or greyish-brown, without a distinct pattern; whereas *Coenosia grunowiana* sp. n. is marked by a thorax predominantly brownish with a greyish tinge, the mesonotum is dusted greyish brown with three brown longitudinal stripes in the presutural part barely reaching transverse suture; the gena is only about 2/3 as wide as depth of postpedicel and the lower calypter is narrow, somewhat elongate and projecting; the abdomen is predominantly dusted greyish, at certain viewing point with a brown median longitudinal stripe from syntergite 1+2 to apical margin of tergite 4, and the head profile is mainly round and not angular-shaped with a conspicuously protruding frons as in *Coenosia circuita* sp. n.

*Coenosia neaurifa* sp. n.

(Figs 7–9)

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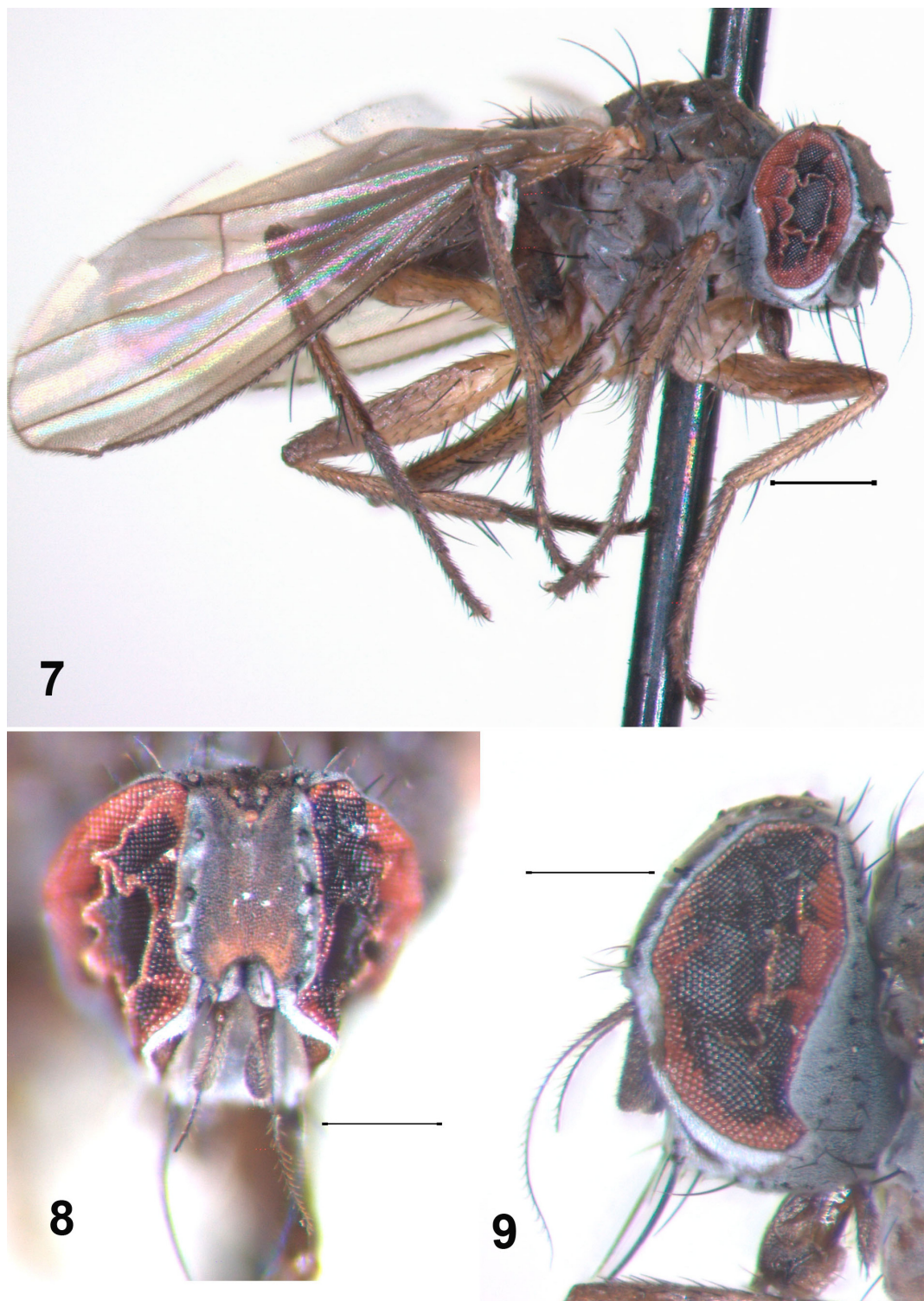
49FCA3CF-FC88-45F1-8E9A-033E5780B085 

Material examined: ♀ holotype, locality label reads: “Madagascar Andasibe ca. 950 m Analamazaotra S. R. Perinet, circuit, Indri, S18.935882°-938042°E48.419051°-419332°, 16.01.2017, screen sweeping, P. Jansta”. Aside from slightly shrunk eyes

and several missing large setae, the holotype is in fairly good condition. Since most of the scars from lost setae are clearly visible, the species was identified and described without any difficulty.

Etymology: The epithet is a female adjective, composed and abbreviated from the comment of a preliminary classification “ne (= not) *Coenosia aurifacies* van Emden, 1940” originating from the first screening of the muscid collection.

Description (female): Head. Ground-colour dark, largely densely dusted whitish-grey (Fig. 9). Dichoptic; eye practically bare, facets of about equal size. Frons (Fig. 8) slightly dilating towards anterior margin, strongly tapering from upper margin of lunule to level of pedicel, frons longer than wide, at vertex about 0.3 times as wide as maximal width of head, at upper margin of lunule about 0.38 times and clearly wider than the width of an eye; frontal vitta at midlength at least four times as wide as fronto-orbital plate at that level; frontal triangle very short, anterior tip slightly below the level of reclinate fronto-orbital seta. Basis of parafacial about two thirds as wide as depth of postpedicel, narrowing to about one third at the level shortly below the arista basis and from there parallel-sided throughout to lower end. Facial ridge in lower half about as wide as parafacial. Fronto-facial stripe at narrowest at level of pedicel, dilating upwards about to the second pair of fronto-orbital setae and then slightly narrowing towards vertex; downwards consistently dilating towards the mouth margin, where it is marginally but distinctly wider than frons. Frons somewhat longer than face. In profile (Fig. 9) anterior part of head rounded; frons not conspicuously protruding but lower mouth margin clearly behind profrons; antenna inserted about at middle of head; parafacial well visible throughout its length, gena below lowest margin of eye about as wide as depth of postpedicel; level of mouth margin about at the level of the lowest eye margin. In anterior view fronto-orbital plate dark greyish, under certain incidence of light with some patches dusted white; frontal vitta dark brown or blackish, the anterior margin above lunule somewhat dark rusty brown, in dorsal view blackish; parafacial, face, facial ridge, peristomal area and gena predominantly densely dusted whitish-grey, parafacial at level of pedicel and basis of postpedicel with a shifting weak patch-like dark shadow, varying in form and size depending on changes of viewing angle. Antenna uniformly dark brown, postpedicel at certain incidence of light



Figs 7–9. *Coenosia neurifa* sp. n., female holotype: (7) lateral view, predominantly yellowish legs; (8) frons, anterior view, pedicel predominantly dusted whitish, postpedicel brown; (9) profile of head, anterior part predominantly round. Scale bars: Fig. 7, 0.5 mm; Figs 8 and 9, 0.25 mm.

sparingly dusted greyish, pedicel at certain viewing angle densely dusted greyish. Antenna not reaching mouth margin, falling short of margin by the depth of

postpedicel. Postpedicel slightly more than three times as long as its depth and also three times as long as pedicel, not acuminate at apex (Fig. 9). Arista three

times as long as length of postpedicel, the longest dorsal hairs slightly longer than the diameter of the basis of arista. Fronto-orbital plate with four inclinate fronto-orbital setae; the anterior and the upper seta distinctly longer and stronger than the setae in between, and about two or three interstitial seta-like hairs. Inner vertical seta conspicuously strong, outer vertical seta distinctly weaker than the postvertical seta which is almost as strong as the two ocellar setae and clearly stronger and similar to the strong inclinate fronto-orbital setae. Proboscis with prementum shiny dark brown, labella brown slightly longer than depth of proboscis; palpus brown, somewhat clavate and about as long as prementum.

Thorax. Ground-colour predominantly greyish (Fig. 7). The anterior presutural part of mesonotum mainly greyish, the presutural area in front of the transverse suture, the postsutural part and scutellum almost uniformly brown, depending on incidence of light matt, dusted greyish-brown or brownish or somewhat shiny; no distinct pattern recognisable. The surfaces adjacent to mesonotum such as postpronotum, notopleuron, post-alar ridge and the lateral pleura greyish, the latter at certain incidence of light at parts with a weak brownish tinge. Anterior spiracle pale brownish. Acrostichals sparse but fairly long, in two rudimentary irregular rows; 1+3 strong dorsocentral setae; postpronotal setae 2, the outer one clearly stronger than the inner seta; posthumeral seta 1, rather small; presutural seta 1, strong and long; notopleural setae 2, the posterior somewhat shorter; intra-alars 2; supra-alar seta 1 and post-alar setae 2. Scutellum with a pair of scars each of strong and long apical and lateral setae, the scars of lateral setae conspicuously stronger, scars of the basal setae clearly recognisable, albeit distinctly smaller than the scars of the other setae; no scars of pre-apical setae or any other setae or setulae visible. Proepisternal and proepimeral setae strong, the lower proepimeral seta distinctly weaker, curved downward, without neighbouring hairs. Katepisternal setae in an unequal triangle, the lower seta distinctly closer to the posterior than to the anterior seta. The lower seta not much shorter than the two other setae, surface of the triangle with one erect seta-like hair. Anepisternal setae 1+5-6, the anterior seta distinct, the setae of the posterior row strong but of different length, practically no interstitial hairs.

Wings. Membrane hyaline with a smoky tinge; tegula and basicosta yellow, veins brown; costa

reaching apex of vein M, costal spine somewhat longer than adjacent bristles of coxa; R4+5 very slightly convergent to apex and vein M; cross-vein r-m clearly basad of the point where R1 enters costa; vein A1 very short, barely one third as long as the distance from its base to the wing margin. Calypters fairly small, both greyish hyaline; margin of upper calypter with a narrow brown frame; lower calypter with a broad whitish margin, somewhat elongate and projecting, apically rounded, about 1.5 times as long as upper calypter. Haltere pale yellow.

Legs. Coxae yellowish, densely dusted greyish-white, trochanters predominantly yellowish, partly pale brown, fore femur predominantly brownish, mid and hind femora with the basal third yellowish, increasingly brownish towards distal half or third and the apical part predominantly brownish, ventral surface with a yellowish tinge; tibiae in general yellow (Fig. 7), at certain incidence of light brownish, tarsi darker than tibiae, depending on viewing angle either dark yellow or brownish, pulvilli and claws well developed but clearly shorter than the last tarsomere. Fore femur with a complete row of strong posterodorsal setae, the longest ones almost as long as depth of femur, and with a row of posteroventral bristles, in which long setae each alternate with short setae, the long setae being longer than the depth of the femur, and the short ones are about half as long. Fore tibia with a moderately long posteroventral seta at middle third. Mid femur in basal two thirds with three or four strong anterior setae the longer ones about as long as depth of femur, and about four posteroventral setae also about as long as depth of femur, at midlength of femur one strong anteroventral seta almost as long and basad three or four setae clearly shorter than depth of femur, two preapical posterior to posterodorsal bristles. Mid tibia with a strong slightly submedian posterodorsal seta and at midlength a very strong and long anterodorsal seta. Hind coxa bare on posterior inner surface. Hind femur with a complete row of strong anterodorsal setae, almost as long as depth of femur, strong anteroventrals in apical third and one strong submedian anteroventral seta; a row of five posteroventral seta-like hairs about as long as depth of femur in basal two thirds, and a preapical posterodorsal bristle. Hind tibia with a rather strong and long anterodorsal seta at midlength and a strong but distinctly shorter anteroventral seta clearly beyond it, preapical a long dorsal and a somewhat shorter anterodorsal seta.

Abdomen. Oval, slightly depressed, and pointed at apex, predominantly brown and without a specific pattern, depending on incidence of light in parts paler or darker brown, the four anterior tergites at certain viewing angle partially somewhat sparsely dusted greyish, the last tergite is persistently dusted greyish, regardless of viewing angle. The lateral and ventral parts of tergites concolourous with the dorsal surface. Marginal setae of syntergite 1+2 and 3 fairly short, of tergite 4 somewhat longer, of tergite 5 more hair-like and not as long as the also hair-like discal setae. Sternites brownish, sternite 1 bare.

Female genitalia. Not investigated.

Measurements: Body length 3.3 mm, length of wings 3.2 mm.

Male. Not known.

Diagnosis: The new species *Coenosia neaurifa* runs in Van Emden's key (1940) to *C. aurifacies* which also has some similarity with *Coenosia exilis* Pont, 1969. However, the latter species is marked by a rather angular head profile, the postpedicel is reaching the level of the lowest eye-margin, the fore tibia has no submedian posterior seta, the mid tibia is without a submedian anterodorsal seta and the mid femur has only one preapical posterior bristle. The head profile of *Coenosia neaurifa* sp. n. and *C. aurifacies* is more round, the postpedicel is fairly short, not reaching the lower mouth margin, fore and mid tibia have the setae present which are lacking in *C. exilis* and mid femur is armed with two preapical posterior bristles. However, *C. aurifacies* is characterised by frons and face dusted golden-grey and greyish-white respectively in females, postpedicel is only 2.5 times as long as deep but clearly acuminate at tip, the mesonotum shows three faint narrow vittae, the median one might reach base of scutellum, the coxae are dark but densely dusted grey and the hind femur shows in basal half only one strong posteroventral seta, the abdomen is densely dusted grey, tergites 3 to 5 are marked by a median dark brown narrow vitta, and tergites 3 and 4 each by a pair of round dark brown spots. In contrast to these in *Coenosia neaurifa* sp. n. frons and face are dusted predominantly greyish, but not yellowish, golden-greyish or whitish, the postpedicel is at least three times as long as deep and not acuminate but rounded at tip, the mesonotum shows no longitudinal stripes, the presutural part is predominantly dusted greyish, the postsutural part more brownish, the coxae are yellow, dusted greyish and the hind femur shows in basal two thirds about five posteroventral seta-like

hairs about as long as depth of femur, the abdomen is predominantly brown without a specific pattern, depending on incidence of light in parts paler or darker brown and sparsely dusted greyish, tergite 5 is dusted greyish independent of viewing angle.

#### Update of Van Emden's (1940) identification key to the species of the so-called "Coenosia-group"

The species belonging to this group are distinguished from the species of the other Afrotropical groups of the genus by the absence of an anterior seta, usually very close to the anterodorsal seta in the middle part of the posterior tibia. However, the females usually and the males occasionally have an anteroventral seta inserted clearly distad from the anterodorsal seta. This anteroventral seta is absent in the specimens of the other groups of the genus.

- 1 Legs at least partly yellow; anteroventral seta of hind tibia usually absent in male ..... 2
- Legs entirely black, anteroventral seta of hind tibia usually present in both sexes ..... 11
- 2 Hind tibia in both sexes without a submedian posterodorsal seta ..... 3
- Hind tibia in both sexes with at least a small submedian posterodorsal seta ..... 7
- 3 Fore tibia without a submedian posterior seta; mid femur with only 1 preapical posterior bristle; mid tibia without a submedian anterodorsal seta ..... 4
- Fore tibia with a distinct submedian posterior seta; mid femur with 2 preapical posterior bristles; mid tibia with a submedian anterodorsal seta ..... 5
- 4 Thorax with 1+3 dorsocentral setae; postpedicel reaching level of lower eye-margin; face and genae dusted silvery-white; palpi dark brown; femora yellow ..... *Coenosia exilis* Pont, 1969
- Thorax only with 0+1 dorsocentral setae, postpedicel not reaching lower eye-margin; face dusted golden-greyish; palpi yellowish-brown; fore femur dark grey with a yellow apex ..... *Coenosia stuckenbergi* Zielke, 1971
- 5 Legs predominantly yellow but coxae darker or densely dusted white, antennae and palpi brownish or darker ..... 6

- Legs including coxae uniformly pale yellow, antennae and frontal vitta strikingly orange-yellow, palpi pale yellow  
 ..... *Coenosia flavivibrissata* Stein, 1918
- 6 Frons and face at least at certain incidence of light dusted golden-grey or whitish; postpedicel 2.5 times as wide as deep, weakly but distinctly acuminate at tip; mesonotum with three faint narrow vittae, the median one can reach base of scutellum; veins R4+5 and M almost inappreciably diverging at extreme apex; coxae black and densely dusted greyish-white; hind femur in basal half with a strong posteroventral seta; abdomen densely dusted grey, tergites 3 to 5 with a median dark brown narrow vitta, tergites 3 and 4 each with a pair of round dark brown spots  
 ..... *Coenosia aurifacies* Van Emden, 1940
- Frons and face greyish, dusted at most whitish-grey, not yellowish or golden-greyish; postpedicel at least three times as long as deep, not acuminate but rounded at tip; mesonotum without longitudinal stripes, presutural part predominantly greyish, postsutural part more brownish dusted; vein R4+5 very slightly convergent to apex; coxae yellow, dusted greyish; hind femur in basal two thirds with about five posteroventral seta-like hairs about as long as depth of femur; abdomen predominantly brown without vitta or round dark spots, depending on incidence of light in parts paler or darker brown and sparsely dusted greyish, tergite 5 dusted greyish independent of viewing angle  
 ..... *Coenosia neaurifa* sp. n.
- 7 At least fore coxa and femora predominantly yellow ..... 8
- Fore coxa and femora predominantly dark and greyish dusted, but at least with distinct yellow apex  
 ..... *Coenosia melanomeros* Van Emden, 1951
- 8 Frons at vertex about one third as wide as maximal head width; tarsi independent from incidence of light dark brown to almost blackish and contrasting to distinctly paler, mostly yellow tibiae  
 ..... *Coenosia cryptica* Paterson, 1956
- Frons at vertex almost half as wide as maximal head width, tarsi yellowish or yellowish-brown but not consistently dark brown ..... 10
- 10 Parafacial and gena dusted greyish, fronto-orbital plate predominantly greyish at most with a brownish tinge, gena at least 1.5 times as wide as depth of postpedicel  
 ..... *Coenosia heterocnemis* Van Emden, 1940
- Parafacial, gena and fronto-orbital plate dusted uniformly brownish, gena barely as wide as depth of postpedicel  
 ..... *Coenosia brunneigena* Van Emden, 1940
- 11 Hind tibia without a posterodorsal seta; the lower calypter at least slightly projecting ..... 12
- Hind tibia with a distinct posterodorsal seta, calypters very small, the lower one not projecting; abdomen in dorsal view with a median dark vitta and paired large spots  
 ..... *Coenosia microcalyptera* Van Emden, 1940
- 12 Five to seven pairs of inclinate frontal setae of different length; arista almost bare, the longest hairs about half as long as of basal part of arista; male mid femur in anterior apical third to half with an area adorned with short brown microscopic pile and femora and abdomen with numerous, strikingly long, fine, curved bristly hairs  
 ..... *Coenosia tomentigera* Van Emden, 1940
- Three or four pairs of inclinate frontal setae; arista pubescent, the longest hairs as long as the thickened base is wide, male mid femur in anterior apical part without an area adorned with short brown microscopic pile; femora and abdomen without numerous, long, fine, curved bristly hairs ..... 13
- 13 Thorax brown to dark depending on incidence of light dusted greyish or brownish-grey, mesonotum without longitudinal stripes; gena about as wide as depth of postpedicel; lower calypter triangular-shaped; abdomen uniformly dark, dusted brown or greyish-brown, without a distinct pattern ..... 14
- Thorax predominantly brownish with a greyish tinge, mesonotum dusted greyish brown with three brown longitudinal stripes barely reaching transverse suture; gena about 2/3 as wide as depth of postpedicel; lower calypter narrow, somewhat elongate and projecting; abdomen predominantly dusted greyish, at certain viewing point with a brown median longitudinal stripe from syntergite 1+2 to apical margin of tergite 4 .....  
 ..... *Coenosia grunowiana* sp. n.
- 14 Anterior part of head angular-shaped; frons conspicuously protruding almost twice the depth of postpedicel, apex of postpedicel not acuminate

but round; gena below the lowest part of eye margin about as wide as depth of postpedicel; lower calypter 1.5 times as long as upper calypter; legs primarily brown, somewhat shiny without yellowish knees

..... *Coenosia circuita* sp. n.

— Anterior part of head not strikingly angular-shaped; antennal insertion only little projecting; gena 1.5 times as wide as depth of postpedicel, apex of postpedicel clearly acuminate; lower calypter slightly projecting; legs black, greyish dusted, knees with very narrow yellowish marking

..... *Coenosia fordi* Van Emden, 1940

Remarks: During a visit to the NHM, London, the following nine of the eleven known species listed in the identification key were examined and compared with the new species described: *Coenosia aurifacies*: holotype, 3 paratypes; *Coenosia brunneigena*: holotype; *Coenosia cryptica*: 2 paratypes; *Coenosia heterocnemis*: holotype; *Coenosia fordi*: holotype; *Coenosia melanomeros*: holotype and 17 paratypes; *Coenosia microcalyptra*: holotype; *Coenosia stuckenbergi*: 2 paratypes; *Coenosia tomentigera*: holotype, 4 paratypes.

In addition, a male of *C. flavivibrissata* identified by A. C. Pont was found in the entomological collection of the NHM. It was used for confirming the taxonomic characteristics listed in the identification key.

Probably, *Coenosia aberrans* Couri, Pont & Penny, 2006 should also be assigned to the “*Coenosia*-group”. Due to the unequal triangle formed by the three katepisternal setae, and the upwards directed lower proepimeral seta the species is described by the authors as a “highly aberrant” *Coenosia* specimen that has not been associated with any of the groups formed by Van Emden (1940). However, Van Emden’s description of *C. aurifacies* also reports an unequal triangle formed by the katepisternals, and this is also the case for the newly described *Coenosia neaurifa*. The lower proepimeral lower seta is occasionally directed upwards in some *Coenosia* specimens, (e.g., Zielke, 2023). Unfortunately, the original description of *C. aberrans* has been kept very sparse, possibly due to an erroneous assumption that the “peculiar” properties ensure a reliable identification. Thus, the species can

only be identified with a certain inaccuracy when using the original description for the identification of the species with the updated key. Based on the taxonomic features listed by Couri et al., *C. aberrans* ends in couplet 14 in the identification key above. It is distinguished from *Coenosia circuita* sp. n. and *C. fordi* by the unequally sided katepisternal triangle.

Van Emden studied the tribe Coenosiini of the Afrotropical Region, when *Coenosia* and *Caricea* Robineau-Desvoidy, 1830 were still considered distinct genera, i.e., *Caricea* species were characterised by a hind tibia with an anterodorsal and anterior seta each positioned very closely to each other at almost the same level in the middle part of the posterior tibia. *Coenosia* specimens, on the other hand, lacked the anterior seta of the hind tibia, but the females had instead always and the males sometimes a distal anteroventral seta, depending on the species, stronger or weaker developed. The genus *Coenosia* in sensu Van Emden is represented with numerous species in the Palaearctic Region, whereas only few *Caricea* species are described from this region. The situation in the Afrotropical Region is exactly the opposite (Van Emden, 1940). Among the large number of identified species, the majority belonged to *Caricea*, only five Afrotropical species were *Coenosia*. In addition to the group consisting of the five *Coenosia* species, Van Emden assigned most of the *Caricea* species of the region to the following eight species groups, which differ from one another by typical taxonomic features: *calopoda*-group, *humilis*-group, *niveifrons*-group, *rebmanni*-group, *strigipes*-group, *semifumosa*-group, *tigrina*-group and *vittata*-group. This subdivision into groups was adopted by subsequent authors (e. g. Paterson, 1956) and retained as “in sensu Van Emden” by several authors, for example Couri et al. (2014, 2016b), Muller (2019) and Pont (19169), even after *Caricea* had been synonymised with *Coenosia* by Hennig (1961). Muller (2019) added with the “*globuliseta*-group” another group to the total of nine existing groups. However, little has changed in the low occurrence of the so-called “*Coenosia*” in the Afrotropical Region. After more than eighty years there are now only fourteen species in the *Coenosia* group compared with more than hundred known Afrotropical species belonging to the *Caricea* concept as created by Van Emden. It cannot be ruled out that one or the other “*Coenosia* species” in sensu Van Emden was missed when the key was revised.

However, these few species which may have been overlooked can be added in the future updated version, just as errors, omissions or inconsistencies in the key will be identified and hopefully corrected in the course of use.


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I have to thank the colleagues of the Entomological Department of the Moravian Museum in Brno for providing the preserved remains of insect traps, the basis of this contribution. I am also very grateful to Nigel Wyatt, curator of the Diptera collection of the Natural History Museum, London, for generous access to the museum's Muscidae collection. The comparison of the new species with the type material of similar species facilitated the verification of the new species. Thanks are also due to Toshko Ljubomirov, responsible for the Zoological Collection of the Institute of Biodiversity and Ecosystem Research, Sofia, Bulgaria for giving me generous access to the Diptera collection of the Institute and for the facilities needed for the examination of the material.

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# Two new steppe leafrollers (Lepidoptera: Tortricidae) from Bulgaria with morphological notes

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**Abstract:** Two rare steppe species, *Ceratoxanthis rakosyella* Wieser & Huemer, 2000 and *Thiodia irinae* Budashkin, 1990, are reported for the first time from Bulgaria. They are found in endangered habitats in Northern Bulgaria. The species demonstrate peculiar genital morphology, which is discussed and illustrated. The moths, their habitats in Bulgaria and distribution are illustrated as well.

**Keywords:** faunistics, endangered habitats, genitalia, vesica

## Introduction

The steppe area of Bulgaria, originally occurring in the northern part of the country mainly along the Danube River, is largely destroyed by anthropogenic activity. Small patches are preserved mosaically mainly along steep slopes. Various types of steppe habitats in this area have been classified as relict and endangered (Biserkov et al., 2015), and some of them were regularly visited during entomological expeditions in 2020–2022. As a result a steppe moth species was found (Zlatkov & Sivilov, 2020). In the present paper we provide further records of two rare steppe species that have not been known from Bulgaria. The distributional ranges and the characteristics of the localities indicate that these species are limited to the steppes only. We also discuss the peculiar morphology of their genitalia and provide detailed illustrations.

## Methods

Two methods were used for moth collection: light trapping with mercury vapour light bulb and “blacklight” tube (for *C. rakosyella*) and netting at

daytime (for *T. irinae*). The moths were set in the field and later dissected in the laboratory under a stereomicroscope generally following Robinson (1976). A compound microscope was used for drawing and photography of the genitalia. The moths were photographed under a stereomicroscope (for a complete description of the equipment and techniques see Zlatkov & Sivilov, 2020). The map was created using Quantum GIS 3.28.1-Firenze, ESRI satellite imagery and spatial data provided by geoBoundaries (Runfola et al., 2020). The specimens were preserved in the collection of the Institute of Biodiversity and Ecosystem Research (IBER), Sofia, Bulgaria.

## Results and discussion

*Ceratoxanthis rakosyella* Wieser & Huemer, 2000

Material: 2 ♂♂, Dobrich region, Kapitan Dimitrovo, N 43.9531°, E 27.7053°, 150 m a.s.l., 19.vi.2022, leg. B. Zlatkov & O. Sivilov (IBER).

Morphological notes: Forewing length 8.7–8.8 mm (n = 2). The wing pattern is similar to other *Ceratoxanthis* spp., with a yellow background, rusty brown markings and a mosaic of pale refractive dots

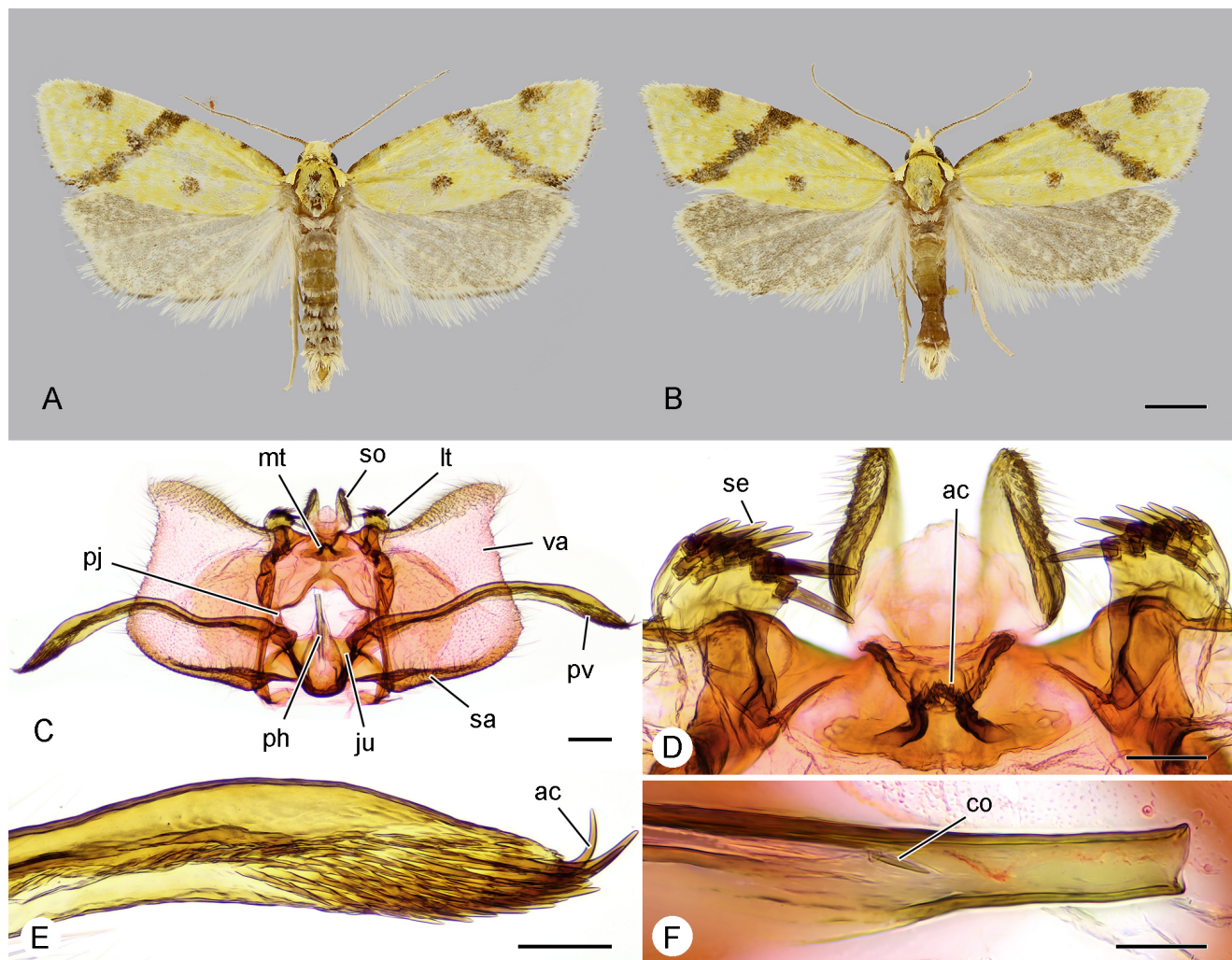


Fig. 1. *Ceratoxanthia rakosyella* males from Bulgaria – (A, B) habitus; (C) genitalia of (A); (D) details of transtilla; (E) detail of process of valva; (F) detail of phallus, apical part left oriented; (ac) acantha; (co) cornutus; (ju) juxta; (lt) lateral part of transtilla; (mt) median part of transtilla; (ph) phallus; (pj) process of juxta; (pv) process of valva; (sa) sacculus; (se) seta; (so) socius; (va) valva. Scale bars: (A, B) 2 mm; (C) 250  $\mu$ m; (D, E) 100  $\mu$ m; (F) 50  $\mu$ m.

in the distal area (Fig. 1 A, B). The male genitalia are highly specialised similarly to other species of the genus (Fig. 1 C). The socii are elliptical pads (in Fig. 1 their flat surface is laterally oriented); the transtilla is trilobed, with a small median part adorned with small acanthae apically and very large lateral parts bearing stout setae medially (Fig. 1 D); the juxta bears flat triangular lateral processes pointed dorsally; the valva is modified with two long, rod-like lateral processes exceeding the length of the valva, with a longitudinal stripe and apex covered with acanthae (Fig. 1 E); the processes are basally connected with the processes of juxta and the juxta proper; the phallus is wide at the base, coalescent with the juxta, apically

narrow and tubular, the vesica bears a small stout non-deciduous cornutus (seta) (Fig. 1 F); the valvae are nearly rectangular, with sclerotised costa and strongly sclerotised protruded sacculus, the lateral margin is incised subapically.

**Habitat and biology:** The habitat is a Danubian loess steppe on a steep slope facing South (Fig. 5). It is endangered and listed in the Red Data Book of Bulgaria (Tzonev, 2015a). Apart from the flight period (second half of May–June), the biology of the species is basically unknown.

**Faunistical notes:** The species was described from Romania, Dobrogea, Hagieni, after three males (Wieser & Huemer, 2000). Additional 5 male

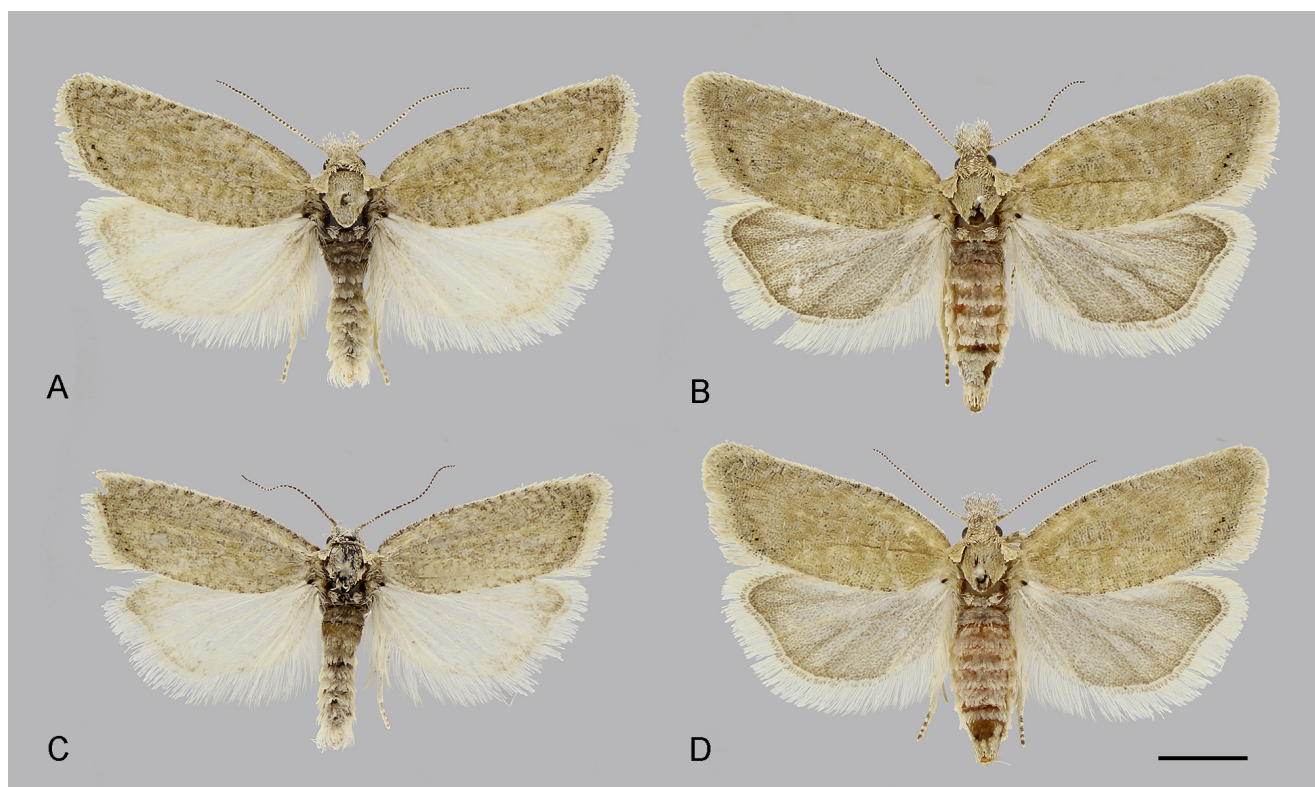


Fig. 2. *Thiodia irinae*, habitus – (A, C) males; (B, D) females; (A, B, D) Hadzhidimitrovo, 4.v.2022; (C) Kozar Belene, 5.v.2022. Scale bar 2 mm, all to scale.

specimens were collected from the same locality (Kovács & Kovács, 2006). Later Bidzilya et al. (2014) and Kavurka et al. (2021) recorded specimens from Ukraine, Lugansk region. The locality from Bulgaria is a new record for the country and the third for the species (Fig. 7). The females are unknown.

#### *Thiodia irinae* Budashkin, 1990

Material: 1 ♂, Veliko Tarnovo region, Hadzhidimitrovo, N 43.5370°, E 25.4828°, 90 m a.s.l., 6.v.2021, leg. B. Zlatkov; 1 ♀, ibid., 20.v.2021, leg. B. Zlatkov; 4 ♂♂, 9 ♀♀, ibid., 4.v.2022, leg. B. Zlatkov; 1 ♂, 2 ♀♀, Plevan region, Kozar Belene, N 43.4001°, E 25.1631°, 100 m a.s.l., 5.v.2022, leg. B. Zlatkov (all IBER).

Morphological notes: Forewing length in males 5.5–6.2 mm ( $\bar{x}$  = 5.9, n = 6), in females 5.5–6.5 mm ( $\bar{x}$  = 5.9, n = 12). The head, including palps, is covered with long fluffy scales, giving a characteristic appearance of the moth (Fig. 3 B). The forewings are with ill-defined creamy costal strigulae continuous

with irregular transverse lines, alternating with pale grey-brown lines. The speculum is creamy, with a few black dots terminally. The hindwings in males are whitish, in females they are pale grey (Fig. 2). The male genitalia are with well-developed laterally flattened uncus, the sacculus is protruding in a triangular process distally, the cucullus is bordered proximally with long stout setae (Fig. 3 A). The phallus is subcylindrical, slightly bent ventrally. The vesica is ovoid, with a stout, straight non-deciduous cornutus (seta) attached apically; a semicylindrical endophallite is located along the distal ductus ejaculatorius simplex (Fig. 4). Notably, in some other *Thiodia* spp. the vesica is reduced and bears a bundle of deciduous, flat, sigmoid cornuti. The female genitalia are with a short oviscapt, the eighth segment is sclerotised, adorned with a belt of long, thick setae (Fig. 3 C). The only signum is an elliptical, concave sclerotised plate with minute acanthae (Fig. 3 D), unlike other species from the genus with two strongly invaginated, blade-like signa.

Habitat and biology: The habitat near Hadzhidimitrovo (Fig. 6 A) is a Danubian loess steppe on a

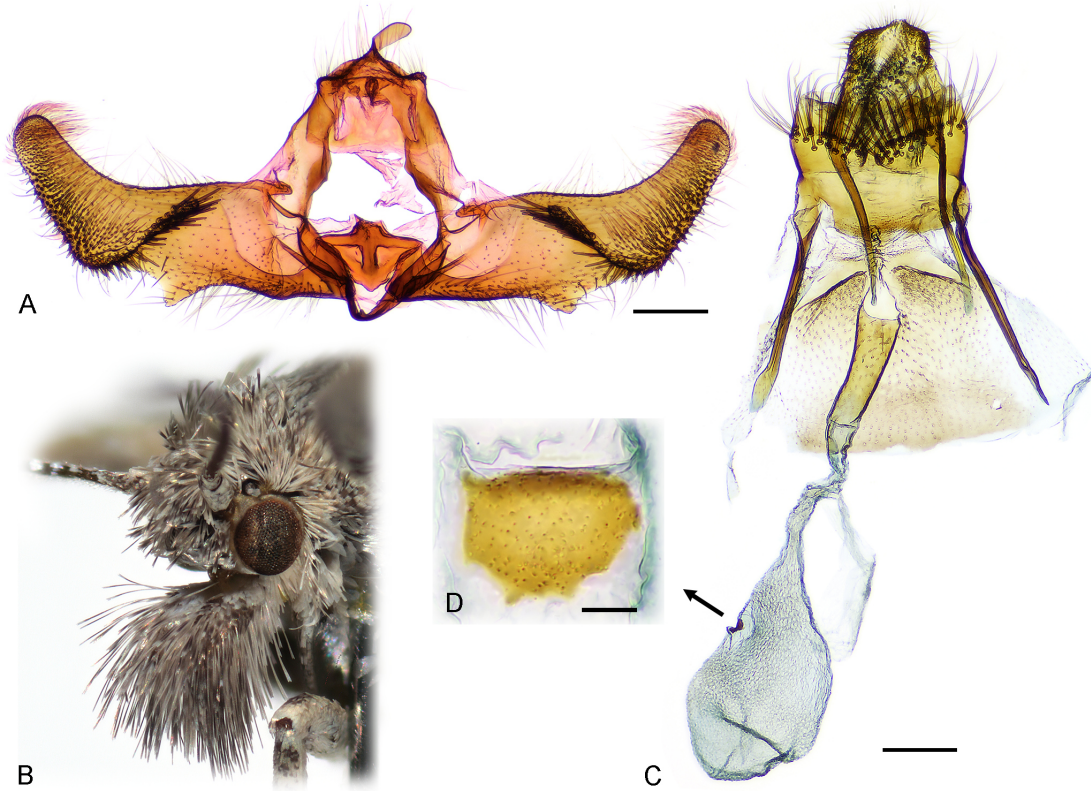


Fig. 3. Details of anatomy of *Thiodia irinae* – (A) male genitalia, fultura inferior cut transversally and phallus removed; (B) detail of head; (C) female genitalia; (D) details of signum. Scale bars: (A, C) 250  $\mu$ m; (D) 20  $\mu$ m.

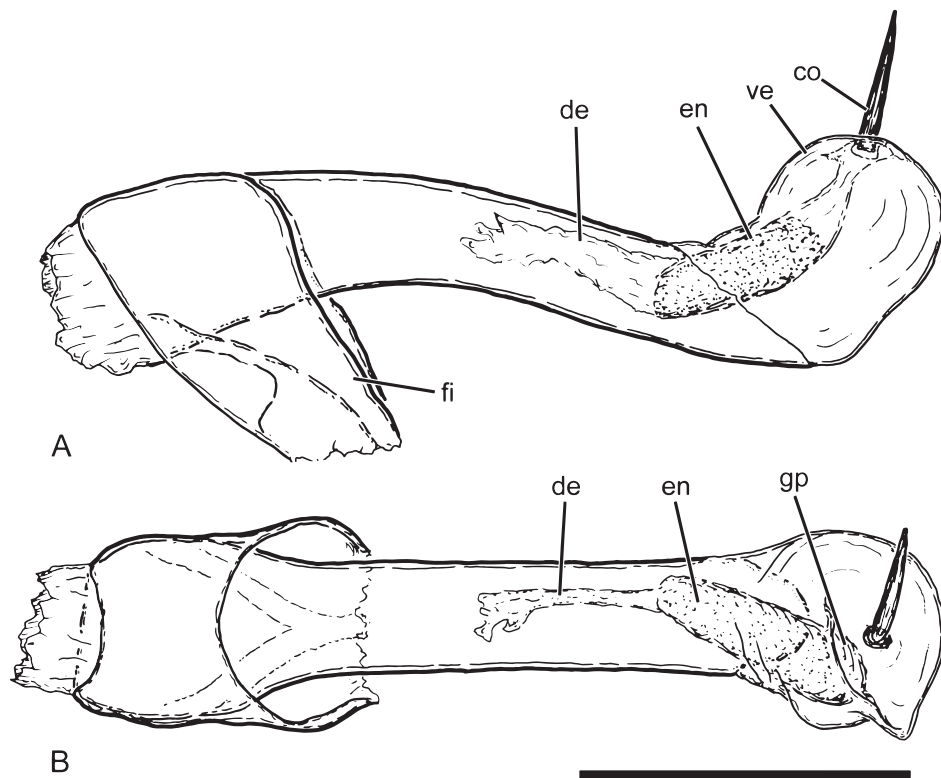


Fig. 4. *Thiodia irinae*, phallus of the specimen from fig. 3A – (A) left view; (B) dorsal view; (co) cornutus; (de) ductus ejaculatorius; (en) endophallite; (fi) fultura inferior; (gp) gonopore; (ve) vesica. Scale bar 250  $\mu$ m.



Fig. 5. Loess steppe at Kapitan Dimitrovo, the habitat of *Ceratoxanthia rakosyella*, 19.vi.2022.

steep slope (Tzonev, 2015a). In areas with strong erosion calcareous (Aptian marl) outcrops are partially exposed, where the larval host plant (*Galatella villosa*, Asteraceae; Budashkin, 1990) forms large patches. The habitat at Kozar Belene (Fig. 6 B) is a continental petrophytic saline steppe on Aptian marl sediments (Tzonev, 2015b). At both localities the moths were swept out with an entomological net from the larval host plant where they rested (Fig. 6 C, D). In general they are not active flyers, their flight is only a couple of metres. The peak of activity is in the late afternoon. The flight period is May–June.

Faunistical notes: The species was described from the Crimean Peninsula, Karadag. Later it was found in several localities in Ukraine (Meganom Cape, St Iliya Cape, Kazantyp, Nanikove, Dvuyakornaya Bukhta, Chauda Cape); Zaporizhzhia region (Rozumivka, Pryvitne, Khortytsia Island); Dnipro region (Dnipro Airport); Russia: Astrakhan region (Bolshoe Bogdo Mts); Southern Ural (Orenburg region – Donskoje, Chelyabinsk region – Amurskii) (Budashkin, 1990, 2006, 2009; Bidzilya et al., 2003, 2013; Nedoshivina,

2007; Nuppenon, 2012; Zhakov, 2012; GBIF, 2023). New species for Bulgaria (Fig. 7).

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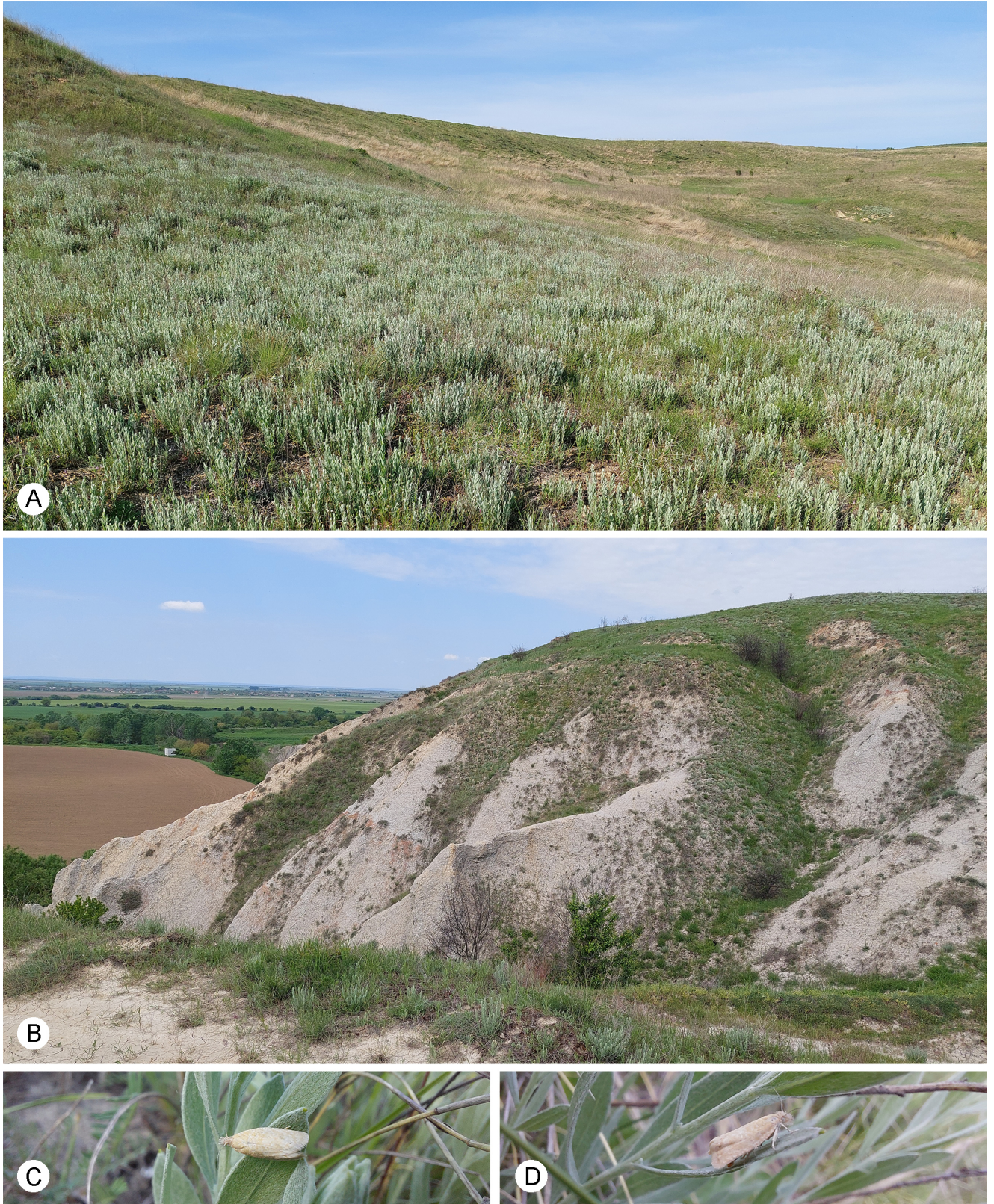


Fig. 6. Habitat of *Thiodia irinae* – (A) loess steppe near Hadzhidimitrovo with *Galatella villosa* in the foreground, the larval host plant of the moth, 4.v.2022; (B) continental petrophytic saline steppe at Kozar Belene, 5.v.2022; (C, D) moths resting on leaves of *G. villosa*.



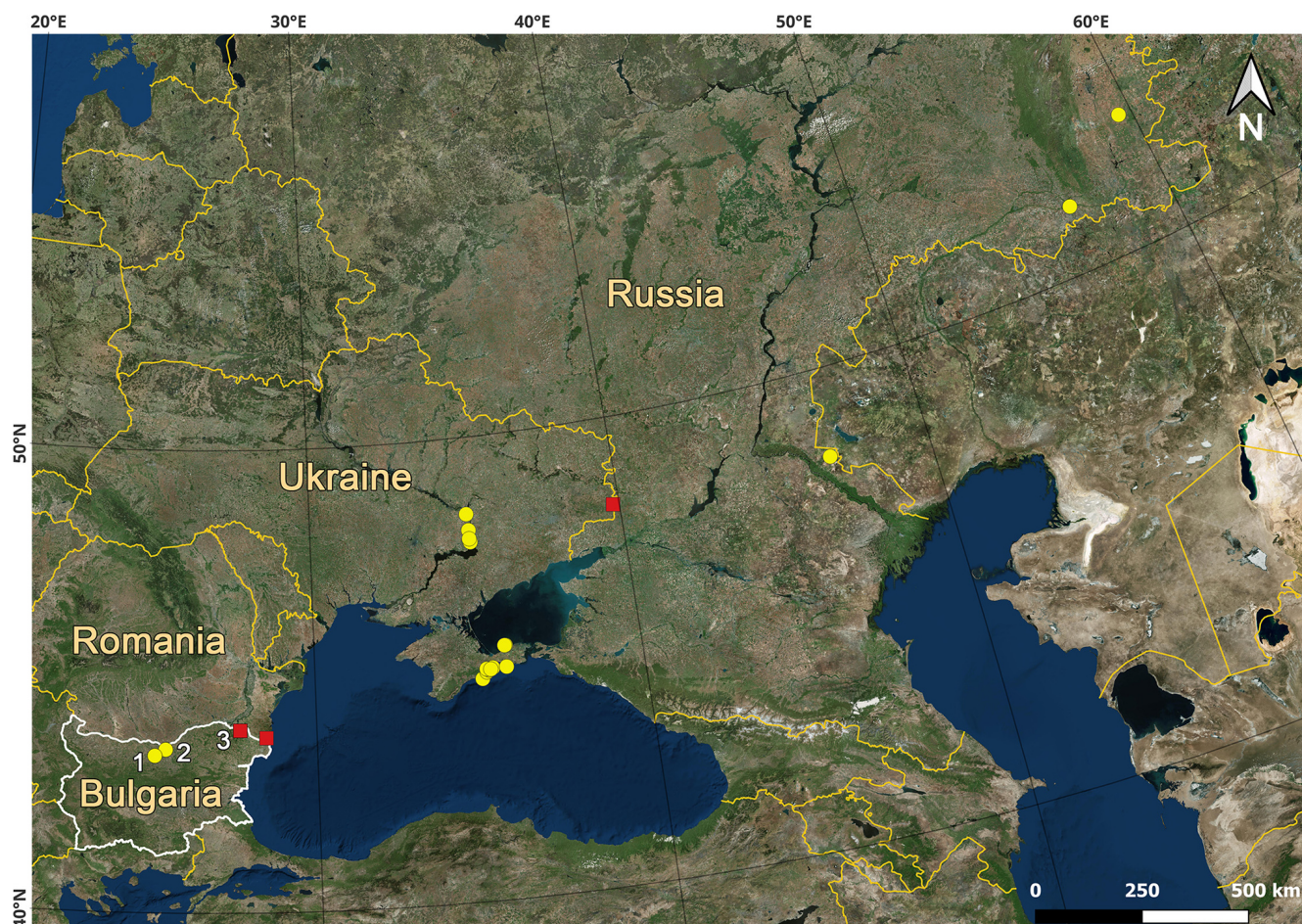


Fig. 7. Distribution of *Ceratoxanthia rakosyella* (red squares) and *Thiodia irinae* (yellow circles). The numbers indicate the localities in Bulgaria – (1) Kozar Belene; (2) Hadzhidimitrovo; (3) Kapitan Dimitrovo.

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