

RESEARCH PAPER

# *Kojderus maximus*, a new genus and species of Tessaratomidae (Hemiptera: Heteroptera), the first Natalicolinae from Madagascar

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**Abstract.** *Kojderus* Magnien & Gierlasiński gen. nov., with a single species, *Kojderus maximus* Gierlasiński & Magnien sp. nov. (Hemiptera: Heteroptera: Tessaratomidae), is described, being the first representative of the subfamily Natalicolinae in Madagascar. The new taxon is diagnosed and described and photographic images of habitus and genital structures of both sexes are provided. It was collected in the Ivohiboro rainforest in south-central Madagascar, which is also briefly described. An updated key to the genera of Natalicolinae is provided.

**Key words.** Hemiptera, Heteroptera, Pentatomomorpha, Tessaratomidae, Natalicolinae, morphology, new genus, new species, taxonomy, true bugs, Madagascar, Afrotropical Region

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## Introduction

Madagascar is the world's fourth-largest island located in the Indian Ocean about 400 km to the east of the eastern shores of Africa. Although originally a part of Gondwana, the Madagascar Plate broke away from it together with the Antarctic, Indian, and Australian plates. Madagascar finally separated from the Seychelles and India, leading to its current form (WIT 2003, KUSKY et al. 2007). Due to this unique history, the island is considered to be one of the greatest hotspots of biodiversity (GANZHORN et al. 2008, RALIMANANA et al. 2022), and many new species of insects are described from Madagascar every year, including many true bugs (e.g., GUILBERT 2020, KIM et al. 2020, KONDOROSY et al. 2020, ZETTEL 2020, ZETTEL & LACINY 2020, MATOCQ 2021, CHEN et al. 2022, SITES & BERGSTEN 2022, TASZAKOWSKI et al. 2022, ZÁMBÓ et al. 2022, KÓBOR 2023, MASŁOWSKI et al. 2023).

Ivohiboro Forest is located in the south-central part of the island in Fianarantsoa Province. It consists almost entirely of humid rainforest, situated on the eastern slopes of a hill located on the dry side of the main mountain range. The forest covers an area of almost 1,000 ha, with an elevation ranging between 650 and 1,500 m above sea

level. The rainforest is surrounded by savannah, as well as micropatches of dry forest (JIMENEZ et al. 2023).

Tessaratomidae is a family of tropical and subtropical Pentatomoidea which includes usually large to very large (often over 20 mm) species of true bugs. Adults and nymphs are often brightly coloured. The main characters of the family are exposed spiracles of the second abdominal segment, antennae with four segments (five in some genera, but in these cases the third segment is shorter than the first) and generally small size of the head compared to the body (RIDER et al. 2018, SCHUH & WEIRAUCH 2020, MAGNIEN 2022).

The family Tessaratomidae is divided into three subfamilies: Oncomerinae, Natalicolinae, and Tessaratominae (ROLSTON et al. 1993, KMENT & VILÍMOVÁ 2010, MAGNIEN 2024). In Madagascar, this family is currently represented by 12 species (CACHAN 1952), one belongs to the subfamily Oncomerinae (*Piezosternum rubens* Distant, 1879), and eleven belong to the tessaratomine tribe Sepinini, which is composed of the smallest Tessaratomidae species (6–15 mm). There are currently no representatives of Natalicolinae known from Madagascar (CACHAN 1952, ROLSTON et al. 1993, MAGNIEN 2024).



Natalicolinae, with only 13 previously known species, is the smallest subfamily of the Tessaratomidae. Its representatives are of medium size (20–30 mm). Members of the Natalicolinae are best diagnosed by having the hemelytral membrane lacking basal cells, the scutellum almost equilateral, two-segmented tarsi, and the ostiolar groove accompanied by two peritremal discs (ROLSTON et al. 1993, KMENT & VILÍMOVÁ 2010, SCHUH & WEIRAUCH 2020). Their background colour is greenish when alive, turning to yellowish or light brown in preserved specimens, their dorsal surface is generally flattened. Apart from the monospecific Indian genus *Empysarus* Martin, 1904, all seven remaining genera of Natalicolinae come from Sub-Saharan Africa (MAGNIEN 2024).

The present paper describes *Kojderus* Magnien & Gierlasiński gen. nov., and a new species, *Kojderus maximus* Gierlasiński & Magnien sp. nov. Images of habitus, male and female genitalia of the new taxon are provided.

### Material and methods

The focus-stacked colour photographs were prepared with a Panasonic Lumix digital camera, and Helicon Focus software. The genitalic structures were obtained either using the above equipment, or using a Tucsen GT 12 camera on a Paralux microscope fitted with Zeiss objectives. Images were combined using the Helicon Focus 8.2 software. The figures were prepared using Adobe Photoshop CS6 graphic editor and Graphic Converter 12. Measurements were made with Delta Optical software and presented in millimeters (mm).

Male genitalia were separated from the insect body using standard entomological pins and a hypodermic needle (0.45 × 16 mm). Then, they were placed in a 5% solution of KOH for 24 hours (room temperature) and viewed with a stereoscopic microscope to separate the aedeagus from the genital capsule, and to remove parts of the cuticle that obscure the view. Genitalia were stored in a microtube and pinned with the corresponding specimen.

The terminology for morphology follows SCHUH & WEIRAUCH (2020).

The studied specimens were collected during the expeditions to Madagascar, organized and managed by the international research station Centre ValBio. Detailed label data are cited in their original form. A backward slash (\) separates the rows on the label, and a double backslash (\\) separates individual labels.

Abbreviations of the depositories:

MNHN Muséum national d'Histoire naturelle, Paris, France;  
NHC Natural History Collections, Adam Mickiewicz University, Poznań, Poland.

### Taxonomy

Family Tessaratomidae Stål, 1865

Subfamily Natalicolinae Stål, 1870

Genus *Kojderus* Magnien & Gierlasiński gen. nov.

**Type species.** *Kojderus maximus* Gierlasiński & Magnien sp. nov. by present designation.

**Diagnosis.** Large sized Natalicolinae characterized by the following combination of characters: the second antennomeres as long as the first and only about half the length of the third antennomeres; the mesosternal carina very low, at most only slightly protruding from the mesosternum; meso- and metacoxae contiguous, the metasternal carina elevated, but not extended between coxae; spots on coria weakly marked; meso- and metafemora very short, only slightly longer than a quarter of the metasternum width.

**Differential diagnosis.** See the key to genera below.

**Description.** *Colouration.* Dorsal surface including head yellowish-brown. Eyes black. Antennae: Antennomeres I and II yellowish-brown; III and IV reddish-brown. Labium yellowish-brown. Pronotum yellowish-brown. Scutellum yellowish-brown with strongly contrasting reddish tip. Hemelytra yellowish-brown with small yellowish spots, basal margins of hemelytra reddish-black; inner margin of each clavus with small, elongate black spot at level of scutellar apex; hemelytral membranes transparent. Legs with femora yellowish-brown, tibiae and tarsi dark yellowish-brown, apices of claws black. Abdomen yellowish-brown with reddish black margins.

*Vestiture.* Dorsum, eyes, pronotum, and scutellum without setae. All antennomeres with short, dense setae. Abdominal trichobothria located in front of transverse furrow near spiracles mesially. Femora with few short, scattered setae, mainly on inferior surfaces; tibiae with dense, short setae.

*Texture.* Head, pronotum, and scutellum impunctate; hemelytra with fine, indistinct punctation; propleura impunctate.

**Etymology.** The genus is named after the first author's friend, Dariusz Kojder, who has been a constant companion during field research. The gender is masculine.

### *Kojderus maximus* Gierlasiński & Magnien sp. nov.

(Figs 1–4)

**Material examined.** HOLOTYPE: ♂, “Madagaskar \ Ivohiboro Forest \ 22°34'57.5" S 46°42'25.5" E \ 30.10.2023 \ leg. A. Kepel & A. Lange” (MNHN). PARATYPE: ♀, “Madagaskar \ Ivohiboro Forest, 937 m \ 22°34'59.22" S 46°42'21.18" E \ 6.11.2023 \ leg. K. Wiśniewski” (NHC).

**Diagnosis.** *Kojderus maximus* Gierlasiński & Magnien sp. nov. is recognized by the following combination of characters: General colouration yellowish-brown; first and second antennomeres short, third antennomeres longest and slightly flattened; basal margins of hemelytra reddish-black, inner margin of each clavus with a small, elongate black spot at the level of scutellar apex; scutellum with strongly contrasting reddish tip; lateral margins of abdomen reddish black. For additional structural characters, see the generic diagnosis.

**Description.** *Male.* *Colouration, vestiture and texture:* See the genus description.

*Structure.* Eyes: ocular index (eye width / vertex width) 0.25. Antennae: antennomere I 0.30× as long as head width, 0.50× as long as interocular distance; antennomere II 0.40× as long as head width, antennomere III longest, flattened, 1.15× as long as head width. Pronotum: maximum width of pronotum 1.75× as long as length of pronotum, lateral



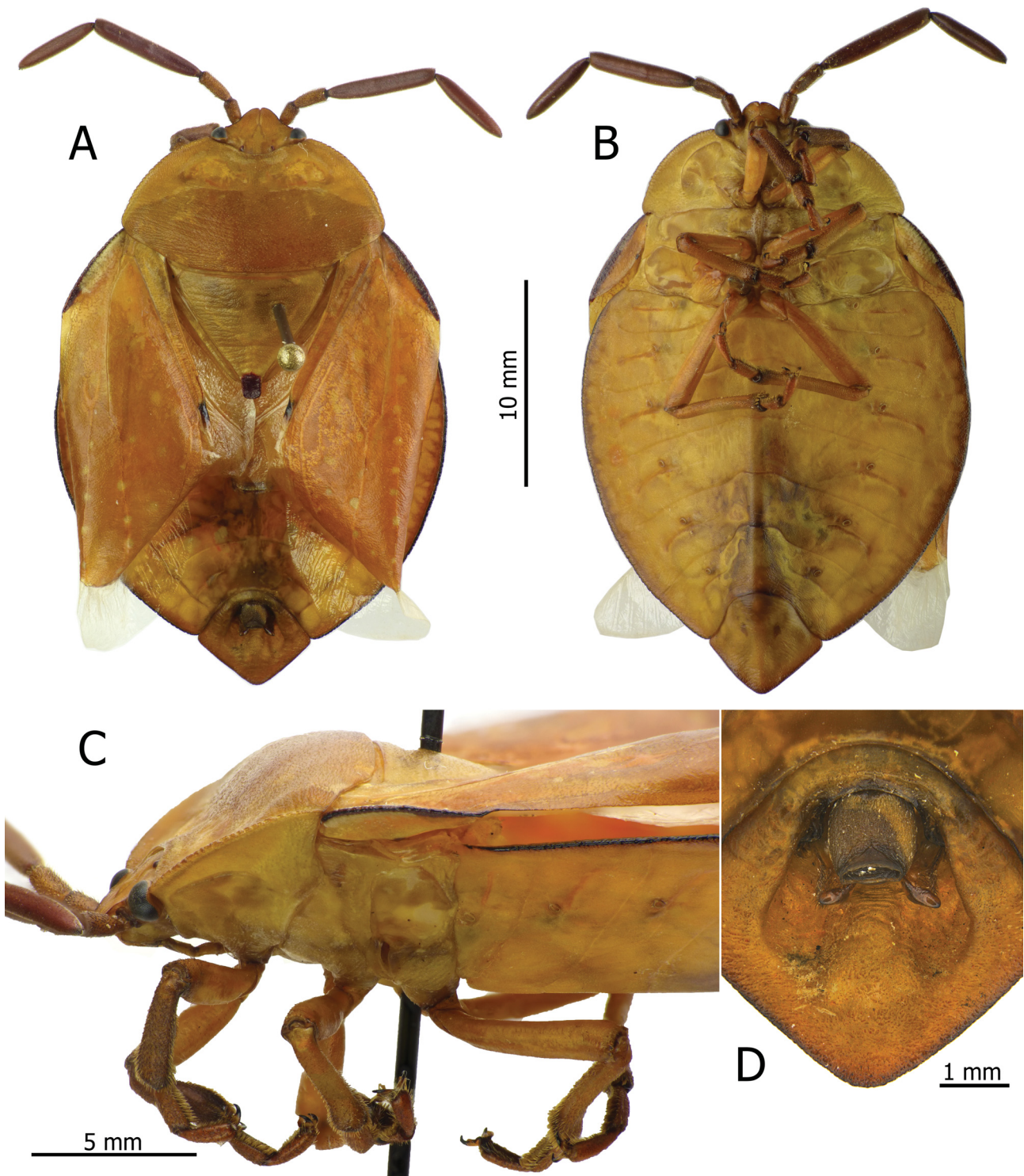


Fig. 1. *Kojderus maximus* Gierlasiński & Magnien sp. nov., holotype, male: A – dorsal view, B – ventral view, C – lateral view, D – genital capsule, dorsal view.

margins delicately serrate. Metathoracic scent efferent system with tongue-shaped peritremes, with long, narrow ostioles; mesopleural evaporatoria nearly inconspicuous, metapleural evaporatoria occupying greater part of metapleural surfaces.

**Male genitalia.** Pygophore (Fig. 1D) almost quadrangular, proctiger and parameres lying in bilobate depression of otherwise flattened upper surface, aedeagus (Figs 3A, B) of same construction as in other species of subfamily,

fitted with two pairs of processes, dorsal one membranous, sclerotised at anteriorly pointed apex, posterolateral one short, with sclerotised apex shortly pointed; parameres (Fig. 3C) similar in shape to those of *Haplosterna*, apophysis of each slightly more broadly rounded, sensorial lobe with long setae.

**Female.** Mostly same as in male unless stated otherwise. **Colouration.** Antennomeres III and IV more reddish. Yellowish spots on hemelytra more irregular. All femora,

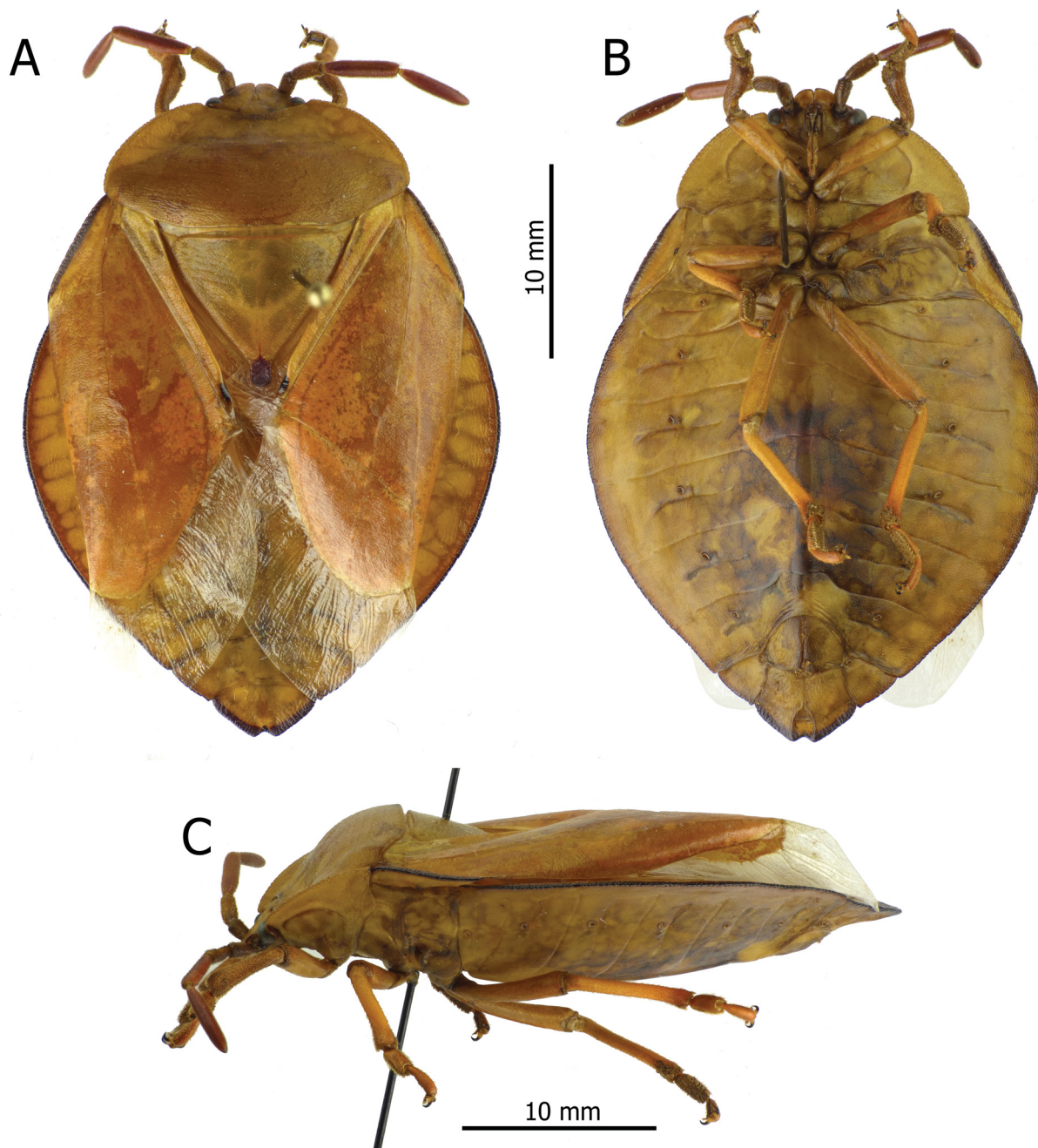


Fig. 2. *Kojderus maximus* Gierlasiński & Magnien sp. nov., paratype, female: A – dorsal view, B – ventral view, C – lateral view.

tibiae, and tarsi yellowish-brown.

**Structure.** Eyes: ocular index (eye width / vertex width) 0.24. Antennae: antennomere I 0.26× as long as head width, 0.40× as long as interocular distance; antennomere II 0.36× as long as head width, antennomere III flattened, 0.82× as long as head width. Pronotum: maximum width of pronotum 1.76× as long as length of pronotum, lateral margins delicately serrate.

**Female genitalia** (Fig. 4). Spermatheca of usual natalicoline type; apical receptacle (distal bulb) almost spherical without basal “neck”, intermediate part (pump apparatus) with two well-developed flanges; spermathecal duct bipartite, anterior duct slender, about two times shorter than posterior one, posterior duct much wider, its

anterior region strongly dilated, about three times wider than narrowest part, with umbrella-shaped rod structure, rear part somewhat folded; sclerified rings visible, but only lightly contrasted.

**Measurements** (in millimetres). Male (n = 1) / female (n = 1). Body length: 28.00 / 34.00; width (across middle part of abdomen): 19.00 / 24.00. Head length: 2.90 / 3.20; width including compound eyes: 4.90 / 5.00; vertex width 3.00 / 3.30; eye dorsal width 0.75 / 0.80; distance between ocelli 1.30 / 1.50. Antenna. Length of antennomeres: I – 1.50 / 1.30, II – 1.90 / 1.80, III – 5.60 / 4.10, IV – 4.20 / 3.80. Pronotum length: 7.50 / 8.50; anterior width: 5.00 / 5.50; posterior pronotal width (across humeral angles) 13.00 / 15.00. Scutellum: anterior width: 8.50 / 10.00;



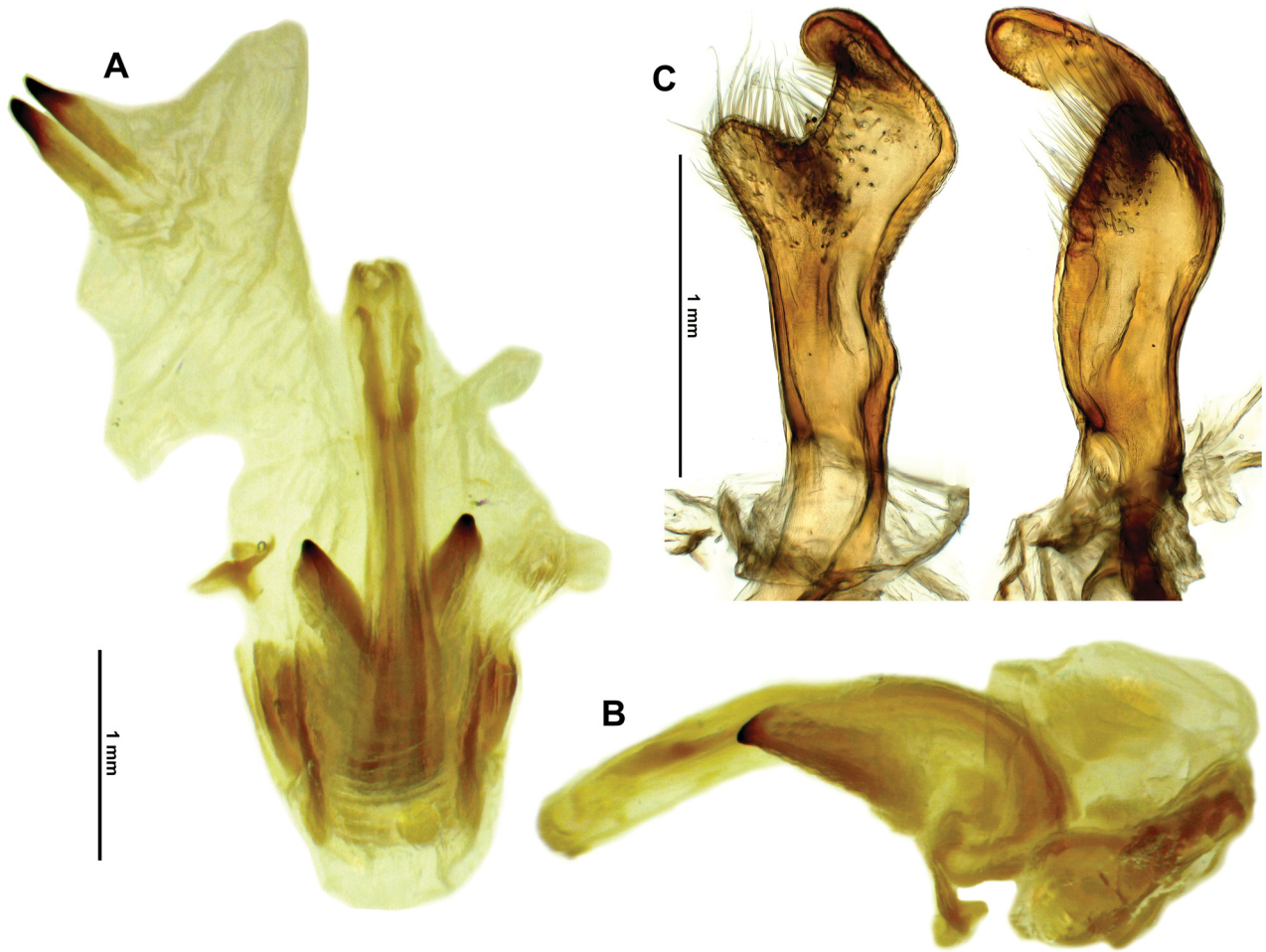


Fig. 3. *Kojderus maximus* Gierlasiński & Magnien sp. nov., male genitalia: A – aedeagus, dorsal view; B – aedeagus, lateral view; C – paramere.

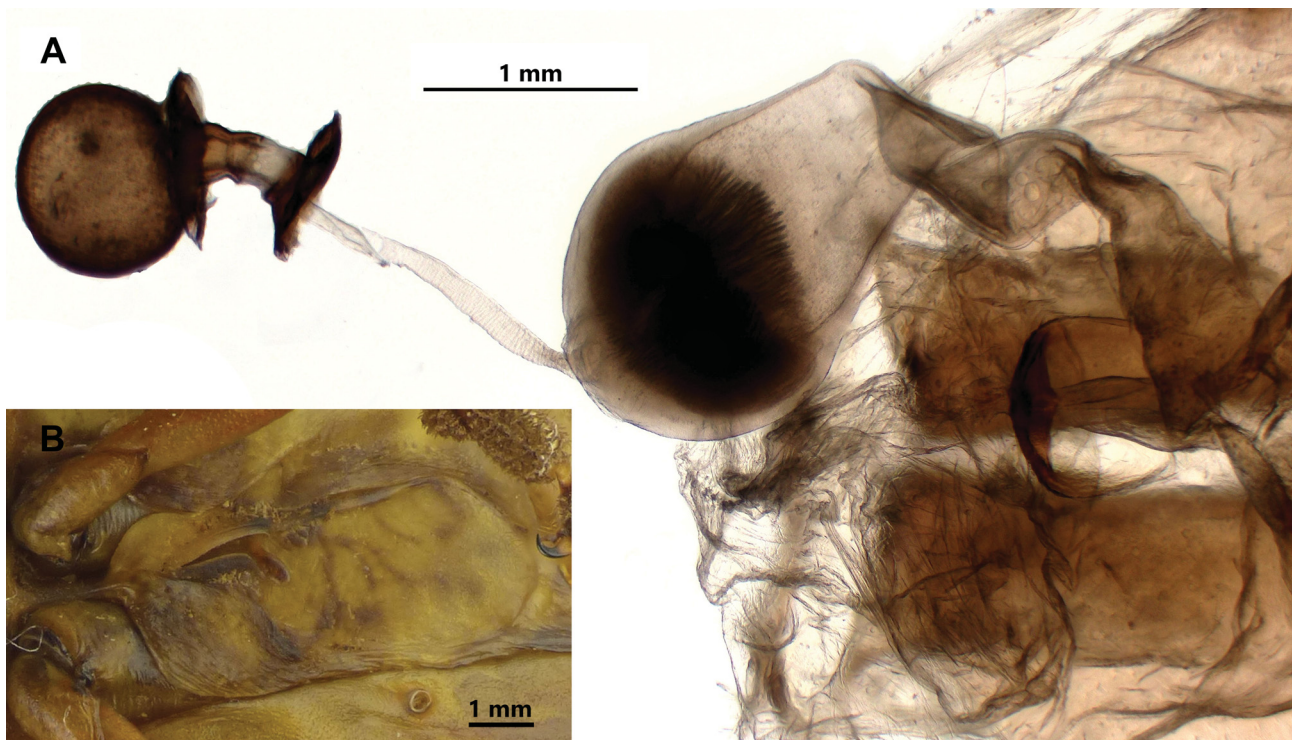


Fig. 4. *Kojderus maximus* Gierlasiński & Magnien sp. nov.: A – female genitalia; B – external scent efferent system.

length 6.50 / 8.00. Metafemur length: 5.60 / 6.10; metatibia length: 5.60 / 6.20; length of metatarsomeres: I – 1.40 / 1.80, II – 1.50 / 1.90.

**Etymology.** The name of the newly described species is the Latin adjective *maximus* (-a, -um), which refers to the size of this species, which is the largest of the subfamily, and also of all the Madagascar Pentatomoidea (cf. CACHAN 1952).

**Biology.** Unknown. Both specimens were collected in the rainforest (Fig. 5).

**Distribution.** *Kojderus maximus* Gierlasiński & Magnien sp. nov. is known from two close localities in Ivohiboro Forest, in south-central Madagascar.

**Key to the genera of Natalicolinae**

This key is modified from the one given by KUMAR (1974), with the addition of *Kojderus* Magnien & Gierlasiński gen. nov., and correction of a problem concerning the genera *Selenymenum* Montandon, 1894 and *Stevesonius* Rider, 1998 (= *Phyllocoris* Jeannel, 1913), for which it

would have given the opposite result. However, examination of Jeannel’s type of *Stevesonius acutus* Jeannel, 1913 and of his descriptive drawings (JEANNEL 1913) clearly agrees with a narrow mesosternal carina. Validity of the distinguishing characters of *Selenymenum* and *Stevesonius* is uncertain and requires further study.

The key relies on the presence of at least the first three antennomeres of one antenna. If the studied specimen is completely missing its antennae, using Table 1 should reduce the possible choices to no more than two genera. Comparing the habitus of these genera using the online catalog (MAGNIEN 2024) should allow for final identification.

- 1 Antennae pentamerous. .... 2
- Antennae tetramerous. .... 3
- 2 Antennomere II less than half as long as I. Africa. ....  
..... *Encosternum* Spinola, 1850
- Antennomere II longer than I. India. ....  
..... *Empysarus* Martin, 1904
- 3 Antennomere II about half as long as III. ....  
..... *Kojderus* Magnien & Gierlasiński gen. nov.

Table 1. Key characters for identification of the genera of Natalicolinae based on distribution, body size, structure of metasternal carina, hind femur, and length-to-width ratio.

Genus	Distribution					Size (in mm)			Metasternal carina			Hind femur (when extended laterally)			Length-to-width ratio		
	Northern Tropical Africa	Southern Tropical Africa (0–20°S)	South Africa	Madagascar	India	less than 23 mm	22–28 mm	approximately 30 mm	not extending between metacoxae	tapering posteriorly	as wide posteriorly as anteriorly	surpassing lateral body margins	reaching lateral body margins	short, not reaching body margins	less than 1.50	1.50–1.65	greater than 1.65
<i>Cyclogastridea</i>	●	●				●			●	●			●				
<i>Elizabetha</i>		●						●			●					●	
<i>Empysarus</i>					●		●				●					●	
<i>Encosternum</i>			●				●				●						●
<i>Haplosterna</i>	●	●	●			●					●		●			●	●
<i>Kojderus</i>				●				●	●					●	●		
<i>Natalicola</i>	●	●	●				●				●		●		●		
<i>Selenymenum</i>	●	●	●				●				●			●			●
<i>Stevesonius</i>		●					●				●		●				●



- Antennomere II about as long as or longer than III. ... 4
- 4 Antennomeres II and III subequal in length, abdomen ovoid. .... 6
- Antennomere II about 1.5 times longer than III, abdomen broadly rounded. .... 5
- 5 Antennae slender, long, ocelli close to each other (interocellar distance about 1/4 of head width), anterior margins of pronotum slightly concave, regularly tapering forwards. .... *Cyclogastridea* Reuter, 1884
- Antennae stouter, shorter, ocelli farther from each other, closer to the eyes (interocellar distance about 1/3 of head width), anterior margins of pronotum broadly concave, its anterior third almost perpendicular to body axis. .... *Natalicola* Spinola, 1850
- 6 Corium dotted with small white calloused tubercles. ...  
..... *Elisabetha* Schoudeten, 1916
- Corium without small white calloused tubercles. .... 7
- 7 Metasternal carina broad, extending laterally between meso- and metacoxae. ... *Haplosterna* Westwood, 1837
- Metasternal carina thin, elevated, not extending between meso- and metacoxae. .... 8
- 8 Metasternal carina broader posteriorly. ....  
..... *Selenyenum* Montandon, 1894
- Metasternal carina narrow, tapering posteriorly. ....  
..... *Stevensonius* Rider, 1998

### Discussion

The newly described genus, *Kojderus* Magnien & Gierlasiński gen. nov., belongs to the subfamily Natalicolinae as it meets the criteria provided by RIDER et al. (2018), SCHUH & WEIRAUCH (2020), KMENT & VILÍMOVÁ (2010) and MAGNIEN (2024): scutellum almost subequilateral, hemelytral membrane lacking basal cells, and two-segmented tarsi. We describe *Kojderus maximus* Gierlasiński & Magnien sp. nov. in a new genus as it was impossible to place this species within any of the described genera. Two of its features are unique among all representatives of Natalicolinae: i) the relative length of antennomeres, with antennomeres I and II subequal and antennomere III being the longest, and ii) the meso- and metacoxae are contiguous, the metasternal carina is not extending between them. The genitalia do not display great differences from the remaining representatives of the subfamily, except for the posterior ductus of the female spermatheca, the anterior part of which is completely different from any other genus already investigated by KUMAR (1969) or the authors (*Cyclogastridea* Reuter, 1884, *Elisabetha* Schoudeten, 1916, and *Haplosterna* Westwood, 1837).

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Fig. 5. The northern part of a forest in the Ivohiboro Protected Area. The forest is surrounded by grasslands and montane habitats, most of which were probably created by fires (above); spot, where the female of *Kojderus maximus* Gierlasiński & Magnien sp. nov. was collected (below) (photo by K. Wiśniewski).



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