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First description of the male of the millipede *Eurygyrus euboeus* (Verhoeff, 1901) (Diplopoda: Callipodida: Schizopetalidae)

PAVEL STOEV
National Museum of Natural History, Tsar Osvoboditel Blvd. 1, 1000 Sofia - Bulgaria. E-mail: stoev@nmnh.bas.bg

Abstract

The external morphology and the shape of gonopods of the male of *Eurygyrus euboeus* (Verhoeff, 1901), a species hitherto known only from a single female specimen collected more than 100 years ago on the Greek island of Euboea, is documented for the first time. The structure of gonopods indicates that the species belongs to the *E. xanthinus* group, and is closely related to the Anatolian species *E. ochraceus* C.L. Koch, 1847. The new find extends the species' range ca. 60 km in a northwestern direction.

Key words: taxonomy, identification key, *Eurygyrus xanthinus* group, Euboea, Greece

Introduction

The East Mediterranean millipede genus *Eurygyrus* C.L. Koch, 1847 is comparatively well studied from a taxonomic standpoint, although the phylogenetic relationships among the species have never been an object of comparative analysis. Four contemporary works, Hoffman & Lohmander (1964), Hoffman (1973), Glaubrecht & Spelda (1993), and Stoev & Enghoff (2004), provide information on the general morphology of the genus, and (re-)descriptions of older and new species. The last-mentioned paper presents the first, but still provisional, key for identification of the species in the genus. Currently *Eurygyrus* is known to comprise 18 species and two subspecies with uncertain status distributed from the region of Lake Van (Turkey), Palestine, Syria and Lebanon in the East to the Taygetos Mts in Greece in the West.

Yet, the morphology of some species of *Eurygyrus* remains poorly documented. This is the case for *E. euboeus*, a species hitherto known only from the female type specimen collected on the Greek island of Euboea (Verhoeff, 1901). Originally attributed to the genus *Lysiopetalum* Brandt, 1840, the species was transferred to *Eurygyrus* by Hoffman & Lohmander (1964). In connection with the description of a new species from Peloponnese, Stoev & Enghoff (2004) re-examined and briefly re-described the unique holotype specimen preserved in the Museum für Naturkunde, Humboldt Universität zu Berlin (ZMB) (see also Moritz & Fischer, 1974). Since males have never been found, this species and *Eurygyrus nicarius* (Verhoeff, 1901), another species also known only from a single female, were excluded from the identification key of Stoev & Enghoff (2004) based solely on the shape of gonopods.

In the present paper, the male of *E. euboeus* is described for the first time. The description is based on material collected on the island of Euboea by A. Riedel, and preserved in the Field Museum of Natural History, Chicago (FMNH).

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Methods

Drawings were made with the aid of a camera lucida mounted on a Wild microscope, type 181300. Close up photos were taken under an Olympus SZH 10 research microscope with an Olympus U-PMTVC Q-Color 3 camera, and were processed using the program Adobe Photoshop 7.0.

Taxonomic part

Family Schizopetalidae Verhoeff, 1909

Genus *Eurygyrus* C.L. Koch, 1847

Eurygyrus euboeus (Verhoeff, 1901)

Lysiopetalum (probably *Brölemannia*) [sic!] *euboeum* Verhoeff, 1901, Archiv für Naturgeschichte, 67 (1): 257 (see also p. 247).

Holotype: adult female (ZMB)

Type locality: Stura, southern part of Euboea, Greece.

Material examined: 1 ad. female, Greece, Euboea, Steni Dirfios/ Ano Steni, calcareous rocks next to village, 27.iv.1978, A. Riedel leg. (FMNH-INS 0000 013 368). – 1 ad. male, 1 juv., Greece, Euboea, Steni Dirfios/ Ano Steni, south slope of Dirfis Mts, calcareous rocks, pine forest, 25.iv.1978, A. Riedel leg. (FMNH-INS 0000 013 373).

Description. Adult male: length ca. 85 mm, maximum width (10th pleurotergite) ca. 5 mm, 46 pleurotergites + telson. Pleurotergites (PTs) in cross-section almost as high as broad or slightly higher.

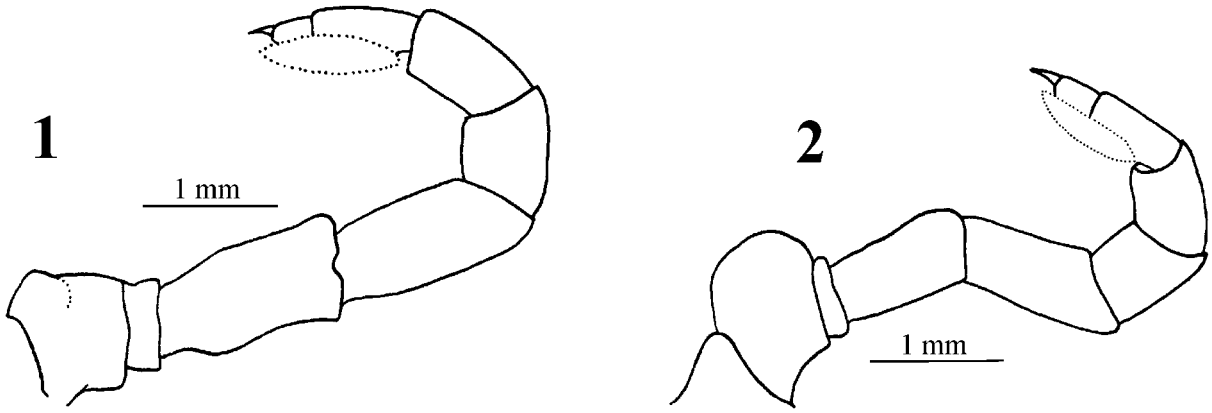
Body colour: generally brown-yellowish; prozonites light brown-greyish; metazonites darker than prozonites, light to dark brownish, with posterior dark brown band. A yellow mid-dorsal moniliform stripe (spots larger on prozonites, tapering towards posterior edge of metazonites) from collum to body end. Collum with same colour pattern as remaining PTs. Ozopores encircled by a lighter, yellowish spot. Antennae light brown, first and seventh antennomeres yellow; legs yellow-light brownish. Frontal part of head strongly concave, densely covered with dark setae. Edge between dorsal surface and frontal concavity light brown; frontal concavity yellow, labral edge brown. Ocellaria in triangle composed of 41 ocelli. Tömösváry organs brown, of same size as an ocellus, placed between ocellaria and antennal base. Antennae moderately long, extending beyond the posterior edge of the fourth PT when folded backward.

Crests on anterior PTs poorly developed, more pronounced in the midst of the middle and posterior PTs. About 20 crests between ozopores on 7th PT. Ozopores in a pit in the middle of a crest. Setal pattern: Table 1.

TABLE 1. Partial chaetotaxy in *E. euboeus*.

	Anterior setae	Posterior setae
Collum	*a, b, c, d, e, f, g + a, b, c, d, e, f, g*	*h+h*
2nd PT	*a, b, c, d, e, f, g, h, i, j + a, b, c, d, e, f, g, h, i, j*	*k+k*
3rd PT	*a, b, c, d, e, f, g, h, i, j + a, b, c, d, e, f, g, h, i, j*	*k+k*
4th PT	*a, b, c, d, e, f, g, h, i, j + a, b, c, d, e, f, g, h, i, j*	*k+k*
5th PT	*a, b, h + a, b, c, j*	*c, d, e, f, g, i + d, e, f, g, h, i, k*
6th PT	*a+a*	*b, c, d, e, f, g, h, i, j, k, l + b, c, d, e, f, g, h, i, j, k, l*
7th PT	*a+a*	*b, c, d, e, f, g, h, i, j, k, l + b, c, d, e, f, g, h, i, j, k, l*
8th PT	-	*a, b, c, d, e, f, g, h, i, j, k + a, b, c, d, e, f, g, h, i, j, k*

First and second leg-pairs markedly shorter, third slightly shorter than subsequent legs. Tarsi of leg-pairs 1–3 single; bi-articulated from 4th to ultimate pair. Tarsi of leg-pair 4–7 with well-developed pads, (less so on 3rd leg), which get thinner towards the ultimate legs. Extension of pads varying: confined to tarsi on leg-pairs 4–5, a small tuft appearing at the posterior side of the postfemora on leg-pairs 6–7; further back pads gradually extending until covering the whole ventral surface of postfemora on middle and hind legs. All legs densely covered with long fine setae ventrally. Coxae of leg-pairs 4–6, normal, not swollen, with very small, apically rounded ventromedial projection pointing cephalad (Fig. 1). Coxa of leg-pair 7 swollen mesally (Fig. 2). Hypoproct tripartite, composed of larger trapezoidal middle plate, bearing a pair of macrosetae, and two triangular ones lateral to it, each having a seta. Anal valves subdivided into smaller dorsal and bigger ventral plates, latter densely setose along free margins. Spinnerets very small, each with a moderately long macroseta on tip.

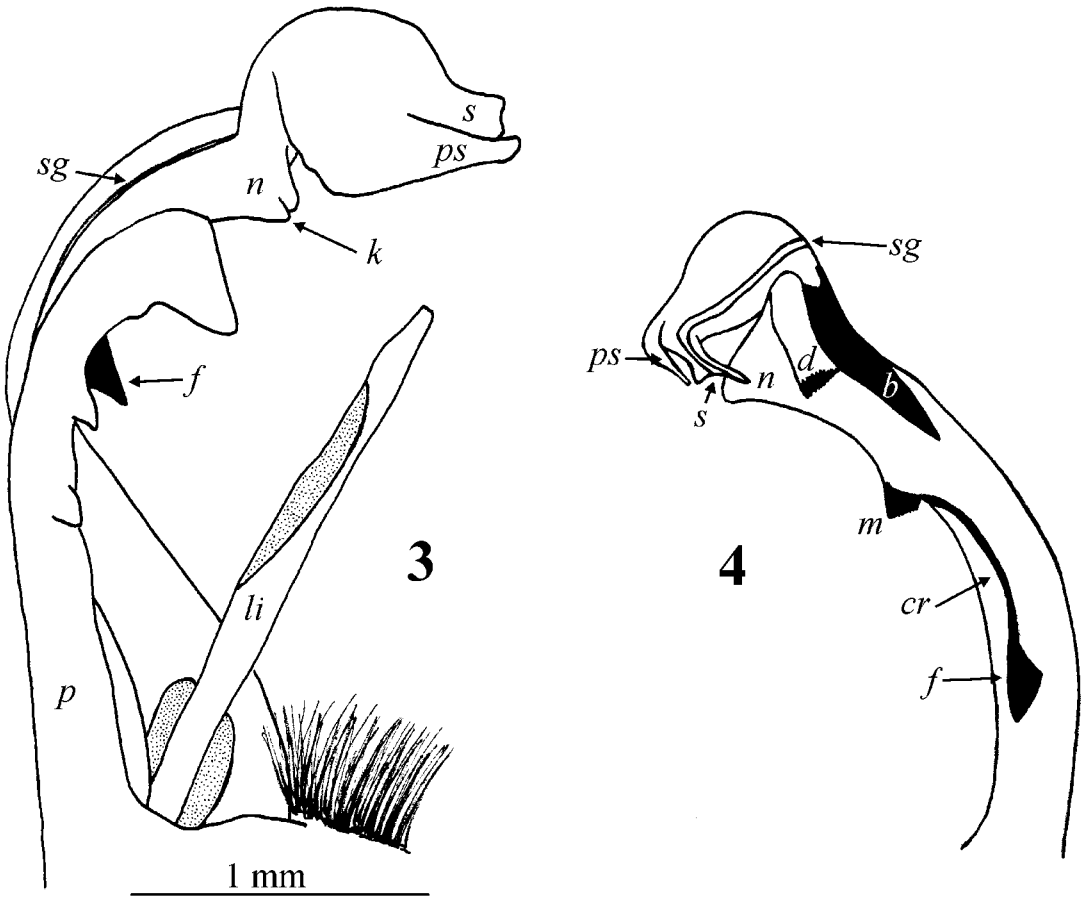


FIGURES 1–2. *Eurygyrus euboeus*: anterior view of male legs 6 and 7, respectively; leg's setation not shown.

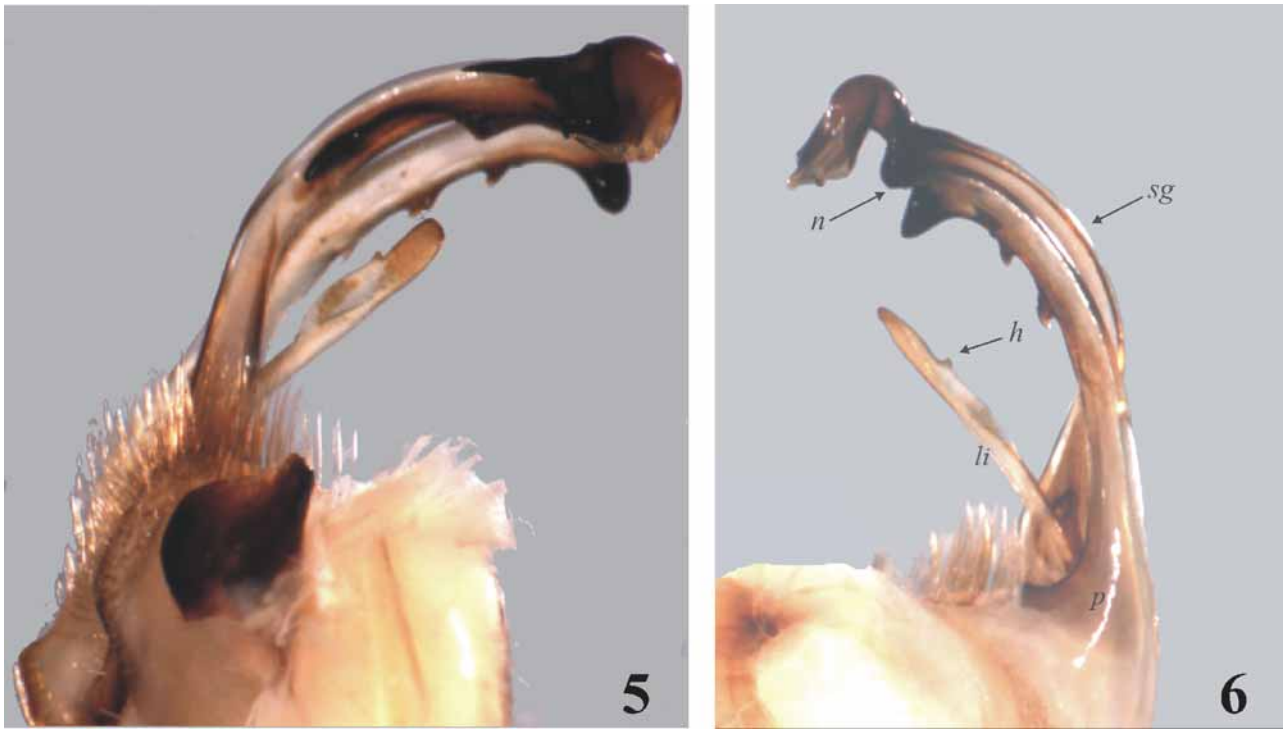
Male gonopods (Figs 3–6): Sternum chitinized, subtrapezoidal, apically rounded, perpendicular to femoroids, as high as half of the length of linomere. Posterior coxal process (*p*): approx. 4/5th of the length of the femoroidal stem, broader at base, curved anteriad; distal part extended cephalad; anterior side with three teeth pointing downwards. A small, subrectangular anterior coxal process arises at the mesal side of gonopod; its anterior side is expanded towards the sternum. A smaller setiferous lobe touches the base of femoroidal stem. Femoroid long, bow-shaped, twisted in its basal and apical parts, latter forming a process (*n*) at the base of the femoroidal shield (= posterior, enlarged part of the femoroid); a small inconspicuous tooth (*k*) on tip of *n*. Anterior side of stem with a black proximal spine (*f*), pointing downwards, and two notched processes – (*m*) and (*d*), the former arising just above the spine, the latter at the base of the shield; a black crenulate ridge (*cr*) connecting *m* and *f*. Linomere (*li*): emerging at about 1/3rd of femoroidal length or slightly higher, reaching as high as the second tooth of the posterior coxal process, apically rounded and pointing towards the femoroidal shield. Middle part of linomere broadened with a small lateral tooth (*h*). Terminal part of the femoroidal shield ending with a bifid solenomere (*s*) and a single parasolenomere (*ps*). A large and pointed process (*b*), pointing downwards, arising at mesal side of shield. Seminal groove (*sg*) well expressed and easily seen, ending at the upper branch of solenomere.

Female: Length hard to determine due to hardening and coiling, probably the same as in the male; 46 PTs + telson. Differing from male by having 3rd PT heavily enlarged and expanded ventro-laterally; coxae of anterior legs unmodified; paraprocts less setose. Colour similar to that of male. Second leg-pair unmodified. Crests on anterior PTs poorly developed, more pronounced in the midst of the middle and posterior PTs. The specimen differs from the female holotype by having well formed lateral rows of yellow spots, which do not merge with the yellowish base of PTs.

Juvenile: ca. 34 mm long with 40 PTs+telson.



FIGURES 3–4. *Eurygyrus euboeus*, gonopod: 3 – antero-lateral view; 4 – mesal view.



FIGURES 5–6. *Eurygyrus euboeus*, gonopod: 5 – mesal view, 6 – lateral view.

FIGURE 7. Distribution map of *E. euboeus*.

Discussion

The inspection of gonopods showed that *E. euboeus* belongs to the group of *E. xanthinus* (Newport, 1844), which is characterized by the presence of a simple, undivided linomere and a coxal process bearing 2–5 teeth on its anterior side. As defined by Hoffman (1973) and Glaubrecht & Spelda (1993) this group so far comprises three species: *E. xanthinus*, *E. ochraceus* C.L. Koch, 1847, both known from localities situated close to the Aegean coast of Turkey, and *E. oertzeni* (Verhoeff, 1901) known from the Greek islands Karpathos and Kasos. Its monophyly is very weekly supported and is yet to be proved by applying contemporary cladistic methods. Provisionally, it seems that *E. euboeus* is most closely related to *E. ochraceus*, both species having a proximal spine on the femoroidal stem. The latter species has been described from the surroundings of the ancient city of Sardis (Sart) in Turkey (C.L. Koch, 1847) and subsequently found also in Bergama (Hoffman, 1973) and Euxinograd in Bulgaria (Verhoeff, 1926). In Bulgaria it was initially described as a new species, *Brölemannia* (*Bulgaropetalum*) *bulgaricum*, but later, having at disposal type and new material, Hoffman (1973) proposed the synonymy with *E. ochraceus*. The Bulgarian find is most likely due to human introduction since all hitherto discovered specimens come from a park (cf. Hoffman & Lohmander, 1964, Stoev & Enghoff, 2004).

The new find of *E. euboeus* is situated in Central Euboea, approximately 60 km (in a straight line) NW of the *locus typicus* (Fig. 7). From a biogegraphical point of view, the existence of an autochtonous species of *Eurygyrus* on Euboea, whose supposedly closest relative occurs in Asia Minor is of special interest and raises questions about its origin. There are many possibilities for the colonization of the island, but given the fact the millipede fauna of the North Aegean Islands and neighboring part of mainland Greece is insufficiently known and still fragmentary these questions can hardly find a satisfying answer in the near future. A female specimen of *Eurygyrus* of uncertain specific identity was recently found also on the Greek Island of Chios (in the collection of National Museum of Natural History Sofia), and it is very probable that other, yet unknown, species occur on the other Aegean islands[1].

1. The systematic position of *E. nicarius* (Verhoeff, 1901), still known only from a single female collected on Nicaria Island, Greece is uncertain.

Key for identification of the species of the *Eurygyrus xanthinus* group:

1 (2) tip of posterior coxal process serrated; sclerotized ridge at the posterior end of femoroidal stem absent; a long upward directed process emerging below the femoroidal shield; 45 PTs..... ..... E. xanthinus (Newport) (figs 34-36 in Hoffman & Lohmander, 1964)

2 (1) tip of posterior coxal process not serrated; femoroid without long upward directed process, but with sclerotized ridge bellow the femoroidal shield; 46–48 PTs..... 3

3 (4) femoroid with darkly sclerotized and hyaline spines at base (fig. 30 in Glaubrecht & Spelda, 1993); proximal spine (*f*) at the anterior side of femoroid absent ..... *E. oertzeni* (Verhoeff, 1901)

4 (3) no spines at the base of femoroid; proximal spine at anterior side of femoroid present 5

5 (6) 46 PTs; posterior coxal process as high as 4/5th of femoroidal stem; sternum subtrapezoidal, as high as half of linomere; two notched processes – (*m*) and (*d*), above proximal spine; a black crenulate ridge connecting *m* and *f*; femoroid process *n* without or with a very inconspicuous spine; linomere apically rounded..... *E. euboeus* (Verhoeff, 1901)

6 (5) 48 PTs; posterior coxal process almost as high as femoroidal stem; sternum subrectangular, as high as 3/4th of linomere; one notched process (*m*) above proximal spine; the crenate ridge between *m* and *f* absent; process *d* replaced by small downward directed spine; femoroidal process *n* with an upward directed spine; linomere apically pointed..*E. ochraceus* C.L. Koch, 1847 (figs 11–13 in Hoffman, 1973)

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