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Trachelipus species (Crustacea, Isopoda, Oniscidea) in Romanian fauna: morphology, ecology, and geographic distribution

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Abstract. Specific morphological characters are re-described in 12 species of Trachelipus genus, found in Romanian fauna: *T. trilobatus* (Stein, 1859), *T. ater* (Budde-Lund, 1896), *T. varae* (Radu, 1949), *T. ratzeburgii* (Brandt, 1833), *T. bujori* (Radu, 1950), *T. difficilis* (Radu, 1950), *T. affinis* (Koch, 1841) = *T. wächtleri* (Strouhal, 1851), *T. arcuatus* (Budde-Lund, 1885), *T. rathkii* (Brandt, 1833), *T. pleonglandulatus* (Radu, 1950), *T. nodulosus* (Koch, 1838), *T. squamuliger* (Verhoeff, 1907). Descriptions are illustrated with figures for all characters. The species, which were synonymised in the past, are described comparatively (*T. varae* and *T. ater*, *T. bujori* and *T. ratzeburgii*, *T. difficilis* and *T. affinis* = *T. wächtleri*, *T. pleonglandulatus* and *T. rathkii*). The comparative descriptions emphasize that the synonymised species are valid. The variations of some morphological characters and morphological anomalies observed on the studied specimens are noted in each species. Data on the species` distribution in Romania and on their ecology are also presented. In the case of the five endemic species in Romania (*T. trilobatus*, *T. ater*, *T. varae*, *T. bujori*, *T. pleonglandulatus*) new distribution localities are reported. *T. squamuliger* was encountered for the first time in the country, in Dobruja.

Key words: *Trachelipus*, morphology, variability, distribution, relict species, endemic species, Romanian Carpathians

Introduction

The Trachelipus genus is one of the richest ones in terrestrial isopod species from Romania (e.g. Radu 1958, 1983, 1985, Tăbăcaru & Giurgincă 2013). The high number of Trachelipus species in Romania is obvious even in comparison with neighbouring zones, where recent studies serve as a comparison. Thereby, in Hungary there are only four species of this genus (e.g. Farkas & Vilisics 2013), no one endemic for that country. By contrast, in Romania numerous endemic Trachelipus species were described (see in: Radu 1985, Tăbăcaru & Boghean 1989). Nevertheless, probably due to their limited distribution range and the scarcity of faunistic and zoogeographic studies on isopods in Romania, some of these species, to our knowledge, have not been re-identified since their description. According to the literature, it seems that the Trachelipus species diversity is the highest in Romania (Radu 1958, Tăbăcaru & Boghean 1989). The determination of Trachelipus species is, however, considered difficult by different authors (Radu 1950, 1958, Tăbăcaru & Boghean 1989, Schmidt 1997). A difficulty in determining Trachelipus species, as well as species from other genus, is represented by the lack of figures of the described morphological characters (e.g. Budde-Lund 1885, Verhoeff 1901). Also, many descriptions are based on few specimens from the same locality, while the intraspecific morphological variability is being ignored (Schmidt 1997). In other publications, there are no figures for all the described characters. There are also publications in which the descriptions are complete, illustrated with appropriate figures (e.g. Schmalfuss 1975, 1979, Schmidt 1997, Strouhal 1936, 1938, 1966, Tăbăcaru & Boghean 1989, Tua 1900, Vandel 1962, Wächtler 1937, Schmalfuss & Khisametdinova 2015). Some authors propose the use of biometric measurements of the cephalic lobes, telson and the last two antenna articles (Radu 1950). Nevertheless, other researches indicate a certain degree of intraspecific variability of those morphological characters, some related to age (Radu & Tomescu 1971, Accola et al. 1993). In addition, there are cases of morphological anomalies of some paired organs, which can be confusing in the taxonomy of the species. Vilisics et al. (2005) describes such asymmetries in *T. rathkii.*

In the monograph dedicated to Trachelipus genus in Europe many species from Romania are presented (Schmidt 1997). However, some species were not treated in that paper. Moreover, the author considers that there is a brief knowledge on many species` ecology, and their distribution range in Europe is incompletely understood. In that monograph many species described in Romania by Radu (see in: Radu 1985), were synonymised. Thus, although the author has also analysed material from Romania, the synonymisation of some species was not realized by analysing some specimens, but based on some publication vices in the description of those species, which were considered as unpublished names (Schmidt 1997). In other cases, no reason for the synonymy was indicated (Schmidt 1997). The situation is complicated by the absence of appropriate studies; actually, the only monograph of the genus of which we are aware is Schmidt's (1997). Nevertheless, some species of this genus were recently studied in the eastern Black Sea coast (Schmalfuss & Khisametdinova 2015).

In the context of the large number of Trachelipus species from Romania and the high potential number of endemic species, clarifying this group in the country is extremely important, not only taxonomically but also zoogeographically. Generally, the high number of endemic species distinguishes Romanian terrestrial isopod fauna (Tăbăcaru & Giurgincă 2013). The high number of species from the country and the existence of some sparsely localized species, which were mentioned once and described inappropriately, makes the study of the whole genus from the country extremely difficult. Thus, a few years ago we decided to try to elucidate the status of Trachelipus genus in Romania. The present paper is the first contribution in this direction, aiming to present 12 species of this genus. In addition to the species presentation, we aimed to highlight the variability, the possible anomalies, as well the ecology and distribution of these species. Also, we intended to verify the validity of some previously synonymised species. Withal, these are decisive data, because without knowing the taxonomic status of Trachelipus species, the faunistic and ecological researches on the terrestrial isopods from the country will always contain errors. At the same time, the possible confirmation of the validity of many endemic species in Romania can justify the status of glacial refuge of some areas from the country, and may open the way to further phylogeographic studies. The presence of many endemic Trachelipus species in Romania means that they had refuge in the country, the Carpathian Mountains being considered a zone where many less mobile invertebrates survived and evolved (see in: Varga 2010). The Trachelipus genus is suitable for these kinds of interpretations, because even if it contains eurytopic species (e.g. Radu 1985), in Europe no invasive Trachelipus species is known (see in: Cochard et al 2010).

Materials and Methods

The research on the 12 Trachelipus species was made on specimens collected from different habitat types between the years 1990-2013, from Western, South-Western, Central Romania, Dobruja and Danube Delta. The sampling was made mostly directly with hand or tweezers, but also with pitfall traps. The specimens were conserved in alcohol 70° and studied in the laboratory. We did not analyse preserved dissections, only animals collected in the field. Sometimes the isopods were captured by chance, without the idea of serving subsequently for the present purpose. However, between the years 2011-2013 we searched for and captured individuals methodically from zones where endemic species had been described in Romania (e.g. Radu 1949, 1950, 1985). Thus, in the case of endemic species, and of other species, the studied individuals have not served other studies; the most of the distribution localities presented here are new. Yet, in the case of common species, some morphologically analysed individuals came from the material of some old ecological, previously published, researches (e.g. Tomescu 1992, Tomescu et al. 1992, 2000, 2008, 2011, Ferenți et al. 2012a, 2013a). In the case of rare and endemic species in Romania, we have mentioned the exact number of the collected individuals from each locality. In the case of the species widespread in Europe, we indicated only the geographical units from where we had available individuals.

Over 1300 microscopic slides were prepared in Canada balsam containing the whole body of males and females, segments of the body (head and telson), or appendages (antennae, male pereiopods 7 and pleopods 1). The slides were photographed under the stereomicroscope and microscope, the photographs being used as figures in the description of the species. At the description of each species, the number of the studied specimens, the collecting site, and the number of males dissected for the preparation of the microscopic slides were mentioned. The Romanian relief units map (Posea & Badea 1984) was used for the names of the geographic units of the sampling sites.

For the re-description of the specific characters, we have compared our specimens with the descriptions from the scientific literature mentioned at each species. In addition, we have described the variability of the morphological characters with taxonomic value and the morphological anomalies. The descriptions are complete for all specific morphological characters. The size of males and females mentioned at each species is based on the measurements made on our samples. The microscopic slides and the specimens that were not dissected, are conserved in alcohol, and are in the personal collection of N. Tomescu. After completing the research on the specimens, which were not determined and included in this study, the slides and specimens conserved in alcohol will be donated to the Zoological Museum of the Babeş-Bolyai University, Cluj-Napoca.

In the case of the presentation of the 12 analysed species, we paid a great attention to endemic and previously synonymised species from Romania. The greater attention was justified by the fact that these species, characteristic for the Romanian territory, could not be presented appropriately in the international literature due to reduced distribution range. In the case of widespread species, there are numerous studies, which have mostly elucidated their distribution and ecology.

Description of the species

1. *Trachelipus trilobatus* (Stein, 1859)

Porcellio trilobatus (Stein, 1859)
Porcellio trilobatus (Budde – Lund, 1885)
Trachelipus trilobatus (Stein, 1859), Schmölzer, 1965
Trachelipus (*Megepimerio*) *trilobatus* (Stein, 1859), Radu, 1985
Trachelipus trilobatus (Stein, 1859), Schmidt, 1997

Literature consulted for the description of the species: Budde-Lund 1885, Radu 1985, Schmidt 1997, Schmölzer 1965.

Examined material and sampling sites

Prisăcina Valley (upstream Băile Herculane): 1♂ 16x10.5 mm, 1♂ 11x8 mm, 1♀ 18x13 mm, 1♀ 17x12 mm, 1♀ 15x10 mm, 3♀ 12x9 mm;

Pecinişca Gorge (downstream Băile Herculane): 2♀ 19x12 mm;

Upstream Diana Spring (Băile Herculane): 1♂ 11.5x7 mm;

Munk`s Spring (Băile Herculane): 1♂ 18x11 mm, 1♂ 11.5x8 mm;

Cave upstream Haiducilor Grot (Băile Herculane): 1♀ 19x11 mm.

From these localities we have analysed five males (two dissected) and nine females.

Species description

Size: males 11x7 mm – 18x11 mm; females 12x9 mm – 19x12 mm.

Colour. The tergites are grey-brown (Fig. 1.1. a, c). The coxal plates are whitish-yellowish (Fig. 1.1. a, c). The individuals from caves seems to have more wiped colour.

Somatic characters

The body width is much greater than that of the most Trachelipus species, because of the developed pereional coxal plates and pleonal epimeres in *T. trilobatus* (Fig. 1.1., 1.2. a). The glandular pore fields are round-shaped and distanced from the lateral edge of the coxal plates (Fig. 1.1.d).

Cephalon. The cephalic lobes are well developed. The lateral lobes have a straight external edge at their basis and are oblique in the distal part. At the extremity of the lateral lobes the two sides forms a sharp angle. The median lobe is well developed, having a pentagonal shape. Between the median and lateral lobes, there are very slim spaces (Fig. 1.2. c). The eyes are well developed, consist of 22-23 ommatidia, both in gorge and cave specimens (Fig. 1.2. e_1, e_2).

Pereion. On the tergites there are numerous tubercles, which lack from the coxal plates.

Pleon. The pleonal epimeres are long, but thinner than the coxal plates (Fig. 1.1., 1.2. a). The uropods are long, their exopods exceeding much in length the end of the 5th pleonal segment`s epimeres and the end of the pleotelson. The pleotelson has a short and wide basis, but its distal part (3/4 of the total length) is thin, with sharp tip (Fig. 1.2. d).

Appendages

Antennae. The 5th antenna article is approximately equal in length with the total length of the articles 1, 2, 3, 4. The last article is longer than the penultimate one; the 3rd article presents an apophysis on its dorsal part (Fig. 1.2. b_1). The male with the size 16x10.5 mm (Prisăcina Valley) has one shorter antenna than the other, normal one; however the ratio between the articles` lengths is similar (Fig. 1.2. b_2).

Pereiopods 1-3 have dense spine rows on merus and carpus (Fig. 1.3.). On the pereiopods 4-7 the number of the spines is lower (Fig. 1.3.). At the studied specimens from Prisăcina Valley (♂ 16x10.5 mm and 11x8 mm) the pereiopod 7 carpus has no crest (Fig. 1.3. p_{7a}, p_{7b}). In a male from Munk`s Spring (18x11 mm) the carpus presents a very thin crest (Fig. 1.3. p_{7c}).

Pleopods. Male pleopod 1 exopods are triangular, with a short and thick posterior tip. On their external edge, there is a row of short spines (Fig. 1.4. a_1, a_2). Male pleopod 1 endopods have a relatively slim basal half and tufts of spines on the peak of their distal half (Fig. 1.4. b_1, b_2, c_1, c_2).

Pleopod 2-5 exopods do not present specific characters (Fig. 1.4. d-g).

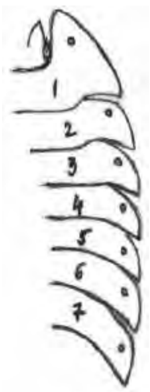
Ecology

The data on the ecology of *T. trilobatus* are relatively few and brief. Stein (1859) collected 14 individuals from the left bank of Cerna River, some under the rocks, others from the humid rock walls, close to Băile Herculane and Mehadia. Budde-Lund (1885) cites Stein (1859) regarding the collecting site. Radu (1985) mentions as the collecting place of the *T. trilobatus* specimens the grassy scree from the moist northern slopes of the Domogled Peak (Mehedinți Mountains). We have collected in all cases *T. trilobatus* individuals from areas with steep and wet limestone slopes (Fig. 1.5. a), situated around Băile Herculane town, in the hydrographic basin of Cerna River. In two cases, we found the species at the entrances of caves, or at a short distance inside them, where the external light still could penetrate (Fig. 1.5. b). The presence of this species at the entrance and first passages of the caves was previously indicated (Tăbăcaru & Giurgincă 2013). In caves, the individuals were found on walls, less on substrate, sheltering in the walls` cracks or under stones (Fig. 1.5. c-d). The specimens from caves have developed eyes and pigmented tergites, characters demonstrating that *T. trilobatus* is a troglophile species. *T. trilobatus* was also found outside the caves (more frequently than inside them), but close to some steep, almost vertical, limestone slopes. On the surface, the individuals hide under stones, in humid zones by the banks of streams, but they were also observed on limestone slopes. All surface habitats were situated in beech forests. In conclusion, *T. trilobatus* populates humid microhabitats with steep limestone slopes, zones with gorge aspect, situated in forested sectors. Although many of the previous records were from caves (Boitan & Negrea 2001, Ilie et al. 2002, Tăbăcaru & Giurgincă 2013) the species is considered only troglophilous (Tăbăcaru & Giurgincă 2013), fact confirmed by our observations.

a

b

c



d

Figure 1.1. *Trachelipus trilobatus* (Stein, 1859), **male and female dorsal and ventral view: a, b.** ♂ 16 x 10 mm, **c.** ♀ 18 x 13 mm; **d.** glandular pore fields - Prisăcina Valley.

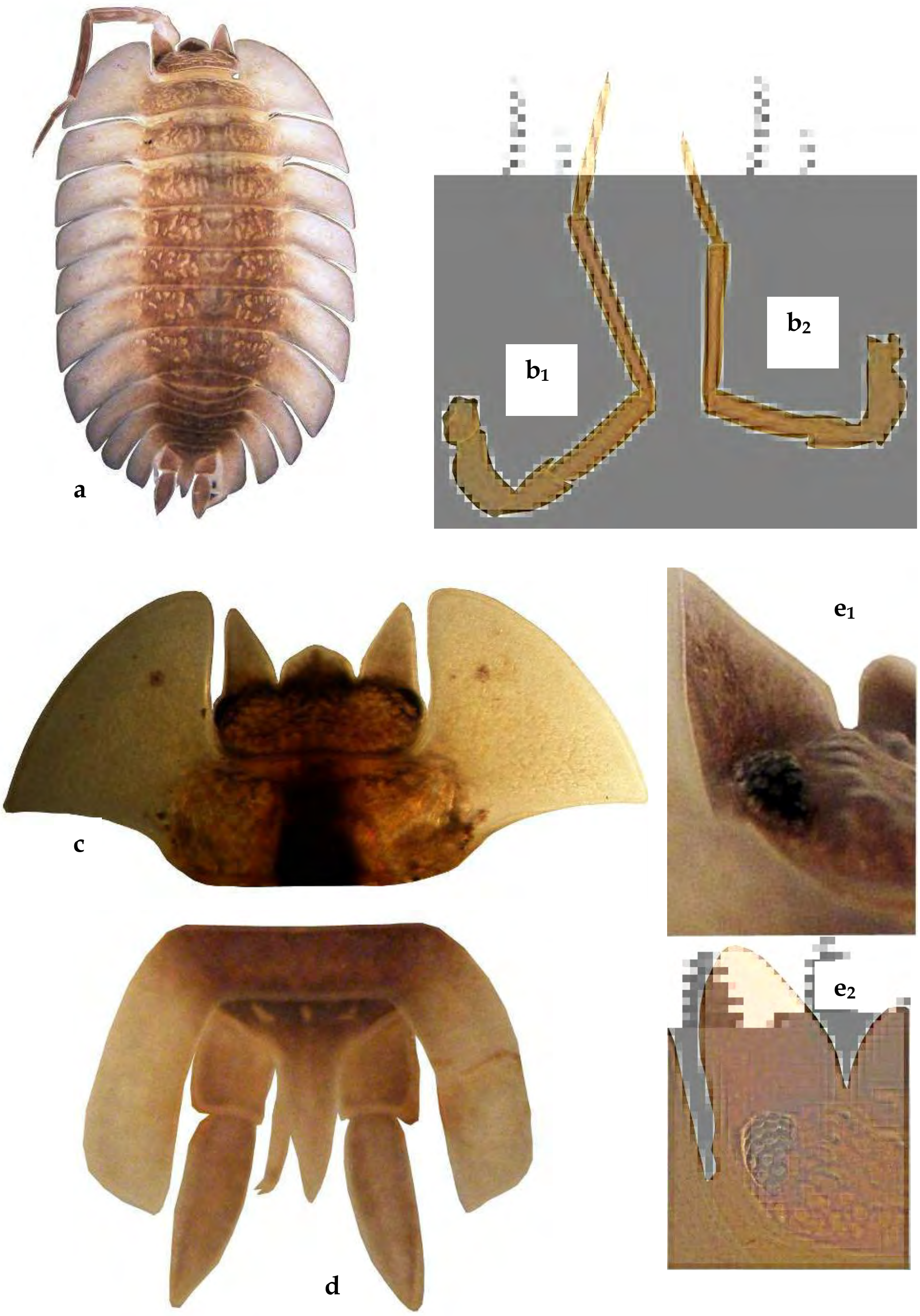


Figure 1.2. *Trachelipus trilobatus* (Stein, 1859): **a.** dorsal view, ♂ 16 x 10 mm - upstream Grota Haiducilor; **b1-b2.** male antennae (anomaly), **c.** cephalic lobes and the pereional tergite 1, **d.** telson and uropods, **e1.** the eye, ♂ 16 x 10 mm - Prisăcina Valley; **e2.** the eye of a male, ♂ 16 x 10 mm – upstream Grota Haiducilor.

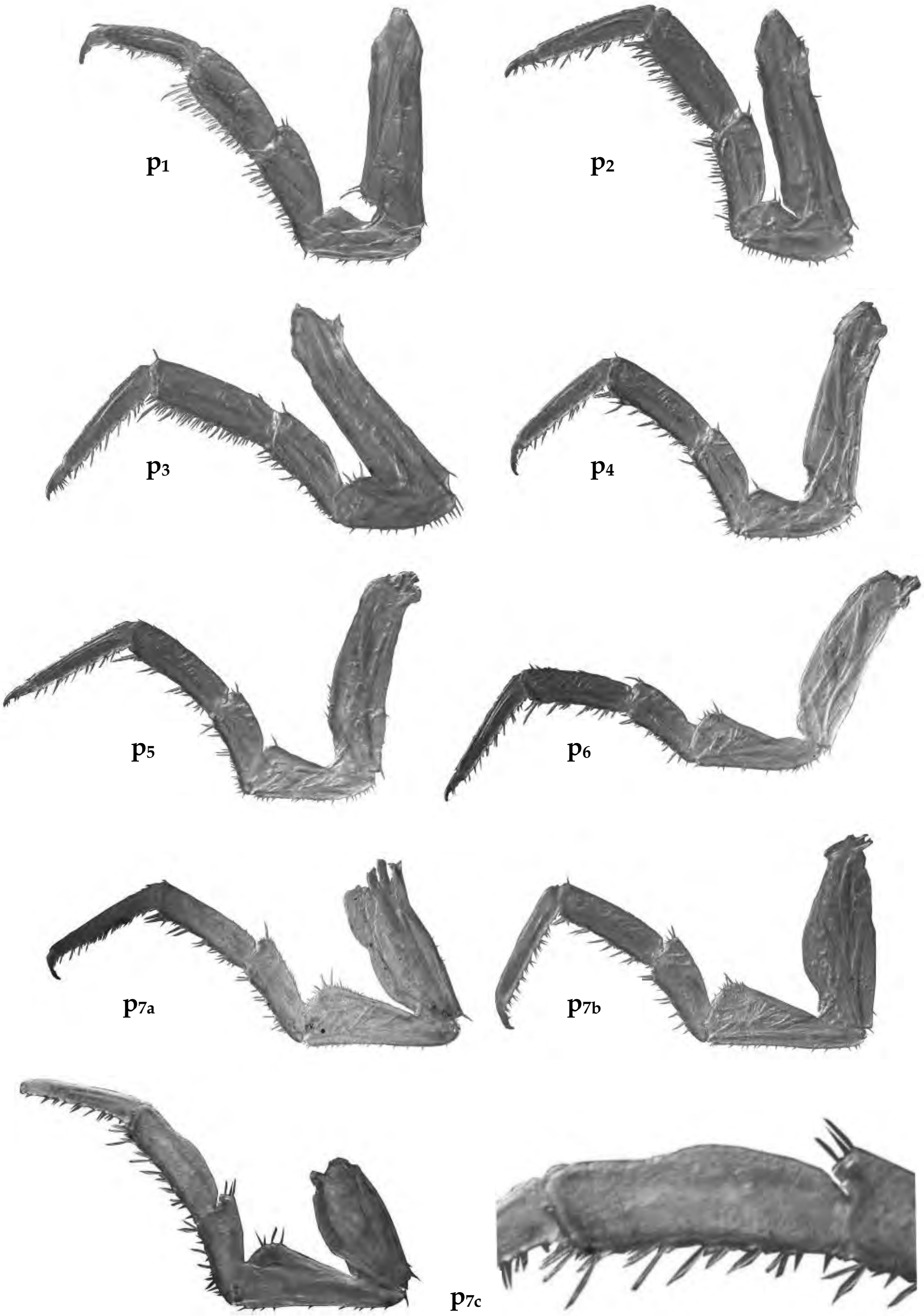


Figure 1.3. *Trachelipus trilobatus* (Stein, 1859), **pereiopods 1 – 7: p_1-p_6.** ♂ 11 x 8 mm, **p_{7a}.** ♂ 16 x 10.5 mm, **p_{7b}.** ♂ 11 x 8 mm - Prisăcina Valley; **p_{7c}.** ♂ 18 x 11 mm – Munk`s Spring.

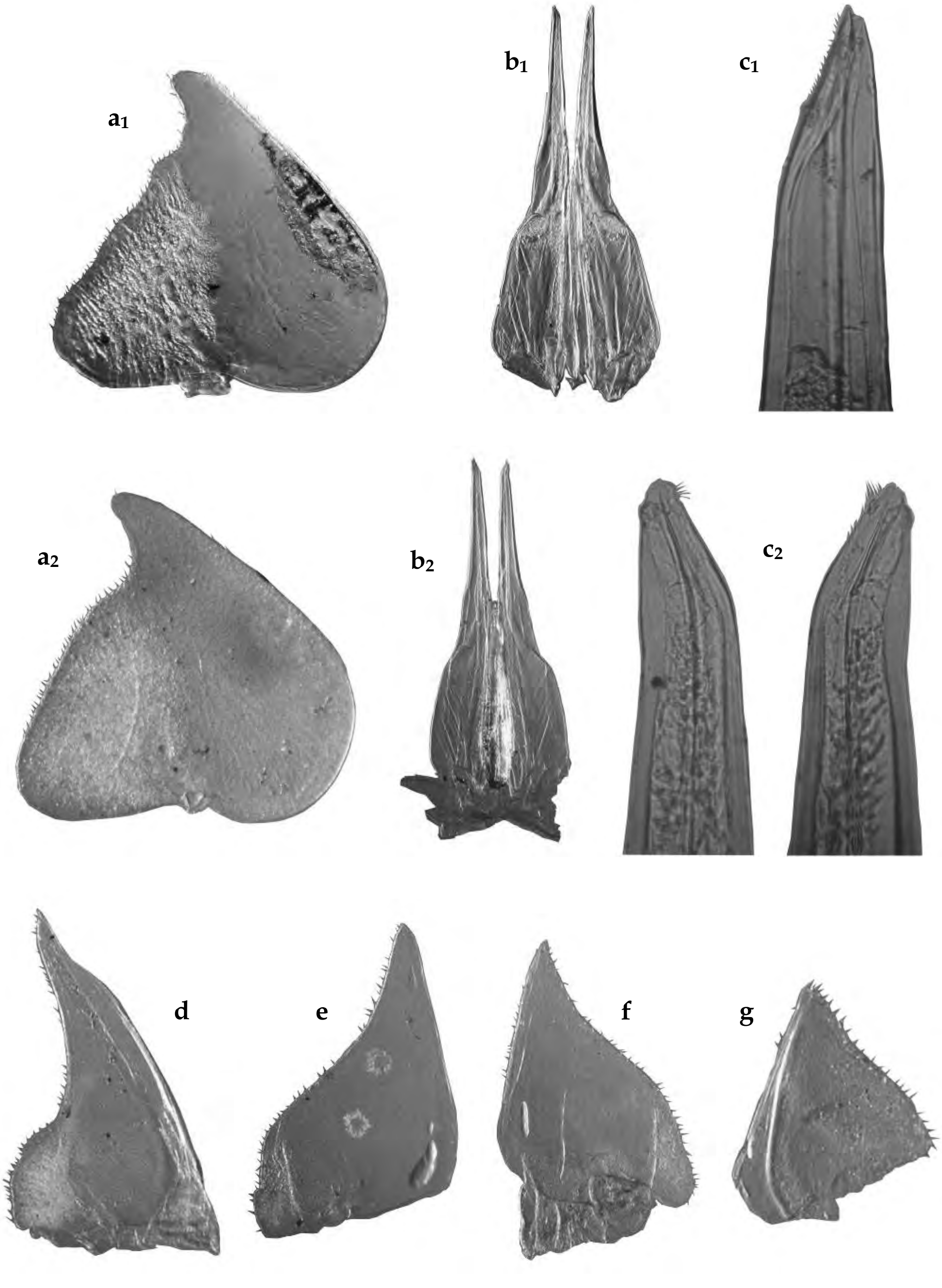


Figure 1.4. *Trachelipus trilobatus* (Stein, 1859), **male pleopods 1: a1.** pleopod - exopod 1, **b1.** pleopod - endopod 1, **c1.** apex of pleopod - endopod 1, ♂ 16 x 10.5 mm; **a2.** pleopod - exopod 1, **b2.** pleopod - endopod 1, **c2.** apex of pleopod – endopods 1, **d.** pleopod - exopod 2, **e.** pleopod – exopod 3, **f.** pleopod - exopod 4, **g.** pleopod - exopod 5, ♂ 11 x 8 mm - Prisăcina Valley.

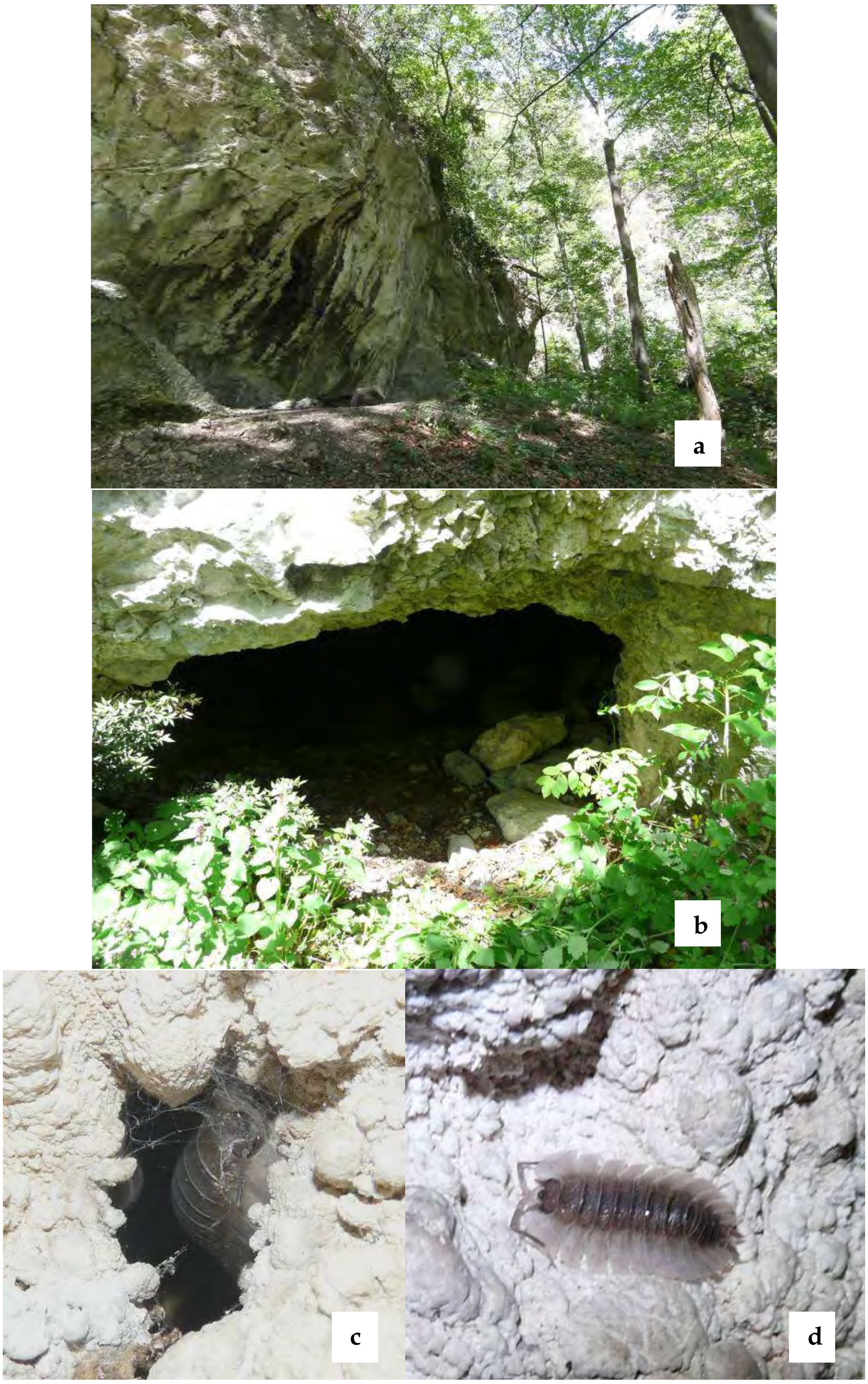


Figure 1. 5. *Trachelipus trilobatus* (Stein, 1859): **a.** habitat, limestone slope, beech wood, Munk`s Spring – Băile Herculane (photo: Țârț Mariana); **b.** cave entrance in Grota Haiducilor` vicinity, **c.** crack in the wall, **d.** *T. trilobatus* individual on the wall (photos: Ianc Raluca-Maria).

Geographic distribution

T. trilobatus is endemic in Romania (e.g. Tăbăcaru & Giurgincă 2013). Previously, it was mentioned in neighbouring areas of Băile Herculane and Mehadia (Budde-Lund 1885, Radu 1985). The species was also mentioned in Cloşani area (Ilie et al. 2002), which is situated in the eastern part of Mehedinţi Mountains, on the mountains opposite side to Băile Herculane. To our knowledge, there is only one mention of *T. trilobatus* outside this area, namely in Aninei and Locvei Mountains (Nitzu et al. 2011). Nevertheless, although the paper concerned isopods from those massifs, *T. trilobatus* was mentioned in Ponorul Pecinişcăi Cave (Nitzu et al. 2011), a cave which seems to be situated in Băile Herculane area (e.g. Boitan & Negrea 2001). Otherwise, in Pecinişcăi Gorge we also identified the species. In this way, all previous report we acknowledge indicate the species in Băile Herculane and the mountains of the area. We encountered the species exclusively in Băile Herculane region, both upstream and downstream of the locality (Fig. 1.6). In two cases *T. trilobatus* was present at the entrance and at a small distance inside caves (the cave upstream Grota Haiducilor and in Grota cu Aburi), and in four cases it was found on surface, in two gorges and in two steep limestone slope zones.

Altitude. We found the species between 180 and 500 m a.s.l., altitudes that are also valid in the case of the previously reported localities.

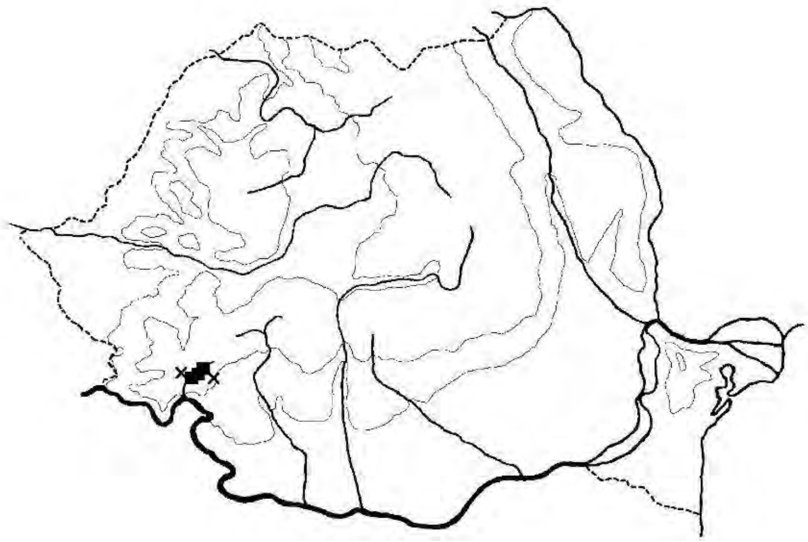


Figure 1.6. The distribution of *T. trilobatus* in Romania
(■ - distribution point mentioned in the literature and reidentified,
X – distribution point mentioned in the literature and not reidentified)

2. *Trachelipus ater* (Budde – Lund, 1896)

Porcellio ater Budde-Lund, 1896
Trachelipus ater (Budde-Lund, 1896) Radu, 1985
Trachelipus ater (Budde-Lund, 1896) Schmidt, 1997
Porcellio varae Radu, 1949
Trachelipus varae Radu, 1985

Literature consulted for the description of the species: Radu 1949, 1985; Schmölzer, 1965; Schmidt, 1997.

Examined material and sampling sites

Vâlsan River Gorge, Făgăraş Mountains (Argeş County): ♂ 14.5 x 8 mm, ♂ 14 x 7 mm, ♂ 12 x 6 mm, ♀ 15 x 9 mm, ♀ 15 x 8.5 mm;

Lotrişor Valley, Căpăţânii Mountains (Vâlcea County): ♂ 17 x 8 mm, ♀ 19.5 x 10 mm;

Turnu Roşu, Lotrului Mountains (Sibiu County): ♂ 10 x 6 mm, 2♀ 16 x 9 mm;

Bistriţa locality, Bistriţei Gorge, Căpăţânii Mountains (upper basin of Bistriţa River, Vâlcea

County): ♂ 13 x 6 mm, ♂ 12 x 6 mm, ♀ 17 x 9 mm, ♀ 12.5 x 7.5 mm;

Cheia Valley, upstream Cheia locality, Căpățânii (Vâlcea County): ♂ 12 x 6.5 mm, ♀ 15 x 9 mm;

Comanca locality, Căpățânii Mountains, (Vâlcea County): ♂ 16 x 7.5 mm;

Bujoreni Vâlcea locality, Getic Sub-Carpathians (about 6 km upstream Râmnicu Vâlcea, (Vâlcea County): ♂ 14 x 7.5 mm, ♂ 13.5 x 7 mm, ♀ 15.5 x 8.5 mm, ♀ 13.5 x 7.5 mm, ♀ 11.5 x 6.5 mm.

From these localities we have analysed 11 males (6 being dissected) and 11 females.

Species description

Size: males 12 x 6 mm – 17 x 8 mm, females 11.5 x 6 mm – 19.5 x 10 mm.

Colour. All collected specimens are dark-grey / slate-coloured in the dorsal part of the body (head, pereion, pleon) (Figs. 2.1.). The hind corners of the pereional coxal plates and pleonal epimeres have whitish-yellowish spots. The specimens from Bujoreni Vâlcea have little pinpoint spots at the base of the coxal plates and median zone of the tergites, on the 5-7 pereion segments. The spots are larger in females (Figs. 2.1. c_2).

Somatic characters

Cephalon. The lateral cephalic lobes are long and thin, oriented obliquely to the axis of the body; the external side is inclined outwards, the internal oblique side with the external lobe forming a sharp angle at their extremity. There are minor variations of the lateral lobes basis` width, even in the individuals of the same population. The median lobe is well developed, round-shaped at its distal extremity. There are variations of the median lobe's length in individuals of the same population and of different populations (Fig. 2.2.). The study on male and female specimens shows certain degree of variability of the cephalic lobes (Fig. 2.2.). The dorsal part of the head is covered with numerous tubercles.

Pereion. The pereion segments have elongated and wide coxal plates, these being longer in females (Fig. 2.1.). In the median zone of the tergites there are large and prominent tubercles compared with the tubercles of the coxal plates. The glandular pore fields are round-shaped in the specimens collected from Bistrița River's Gorge and Bujoreni Vâlcea and oval in the specimens collected from the upper basin of Vâlsan River Gorge. In all specimens, the glandular pore fields are distanced from the lateral edge of the coxal plates (Figs. 2.1. d_1, d_2).

Pleon. Segments 3-5 have elongated epimeres, but narrower than the coxal plates of the pereional segments; they have no tubercles on their surface. There are tubercles only on the median surface of the pleonal segments (Fig. 2.1.) The pleotelson has a thin distal half, with a sharp peak (Fig. 2.3. a_1, a_2).

Appendages

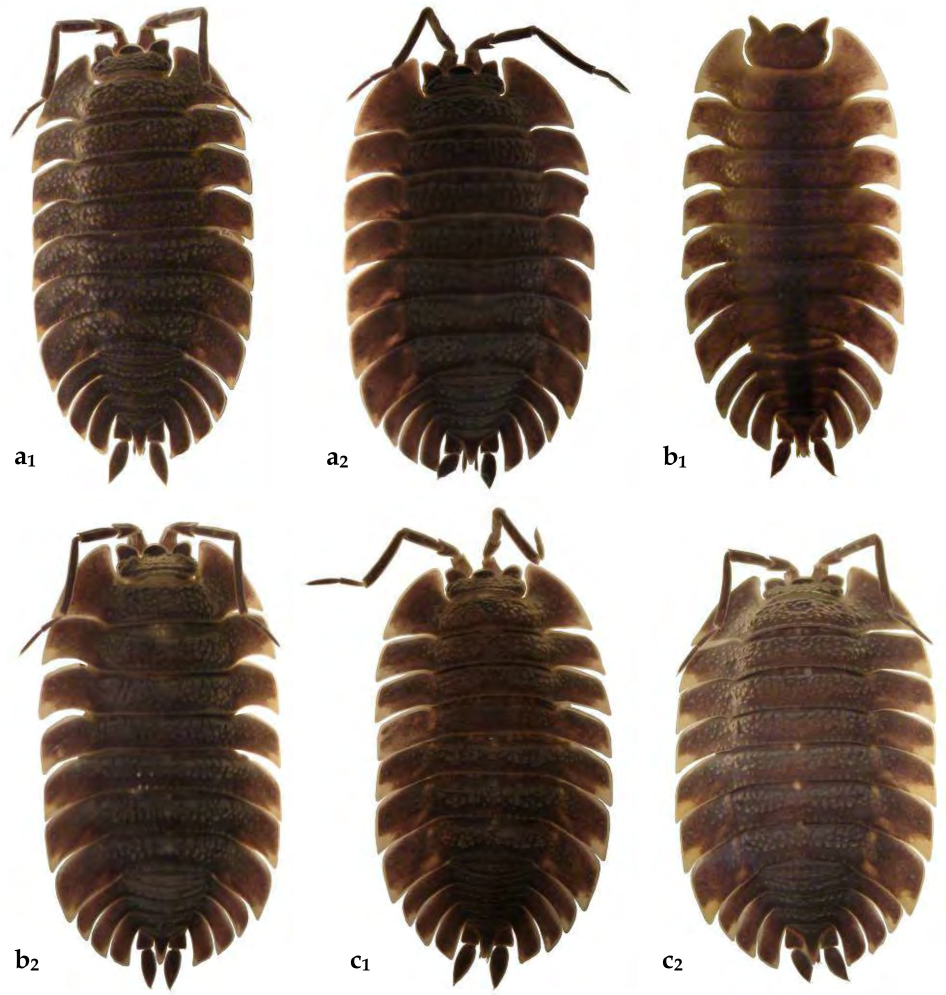
Antennae. The last antenna article is longer than the penultimate one; the ratio between the two articles varies in the six dissected males between 1.6:1 and 2.2:1 (Figs. 2.2. d_1 – d_3).

Pereiopods. The male pereiopod 7 carpus crest covers 2/3 of the carpus` length, being more prominent in males collected from Vâlsan River Gorge and Bujoreni Vâlcea, and thinner in males from Bistrița River basin (Figs. 2.3. b_2, c_2, d_2). The pereiopods 1-3 have numerous thorns and less on pereiopods 4-7 (Figs. 2.3.-2.4.).

Pleopods. Pleopod 1 exopods` basis widths are approximately equal with their length, with numerous short thorns on their external side. Their tip is short with a wide basis. In males from Vâlsan River Gorge the tip is longer and thinner on its distal half (Figs. 2.5. a_1, a_2, a_3). Pleopod 1 endopods are similar in all studied males (Figs. 2.5. b_1, c_1, d_1, b_2, c_2, d_2).

Ecology

T. ater populates forested zones in mountains and hilly areas. It was mainly identified in beech forests, but also in mixed beech/coniferous (Vâlsan River Gorge) or beech/hornbeam forests. In the areas populated by *T. ater* there are watercourses, rivers or streams, which are usually permanent and only sometimes temporary (Bujoreni Vâlcea), the species preferring habitats with high humidity. In most cases, this species was identified in gorge aspect zones, with steep limestone slopes. The habitats populated by *T. ater* are limited to areas with relict features, being represented by forested zones situated in zones with steep relief and rocky substratum. The individuals were found under fallen logs, frequently under their bark, or under fallen barks. Also, *T. ater* individuals were often present under stones at the base of steep slopes.



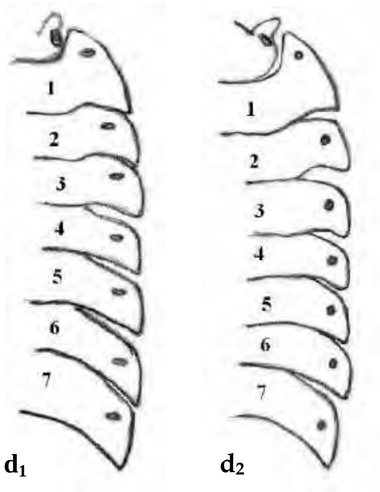


Figure 2.1. *Trachelipus ater* (Budde-Lund, 1896), **males and females, dorsal view: a_1.** ♂ 14 x 7 mm, **a_2.** ♀ 15 x 9 mm – Vâlsan River Gorge; **b_1.** ♂ 13 x 6 mm, **b_2.** ♀ 17 x 9 mm – Bistrița River Gorge; **c_1.** ♂ 14 x 7.5 mm, **c_2.** ♀ 15.5 x 8.5 mm – Bujoreni; **glandular pore fields: d_1.** ♂ 14.5 x 8 mm – Vâlsan River Gorge, **d_2.** ♂ 13 x 6 mm – Bistrița River Gorge.

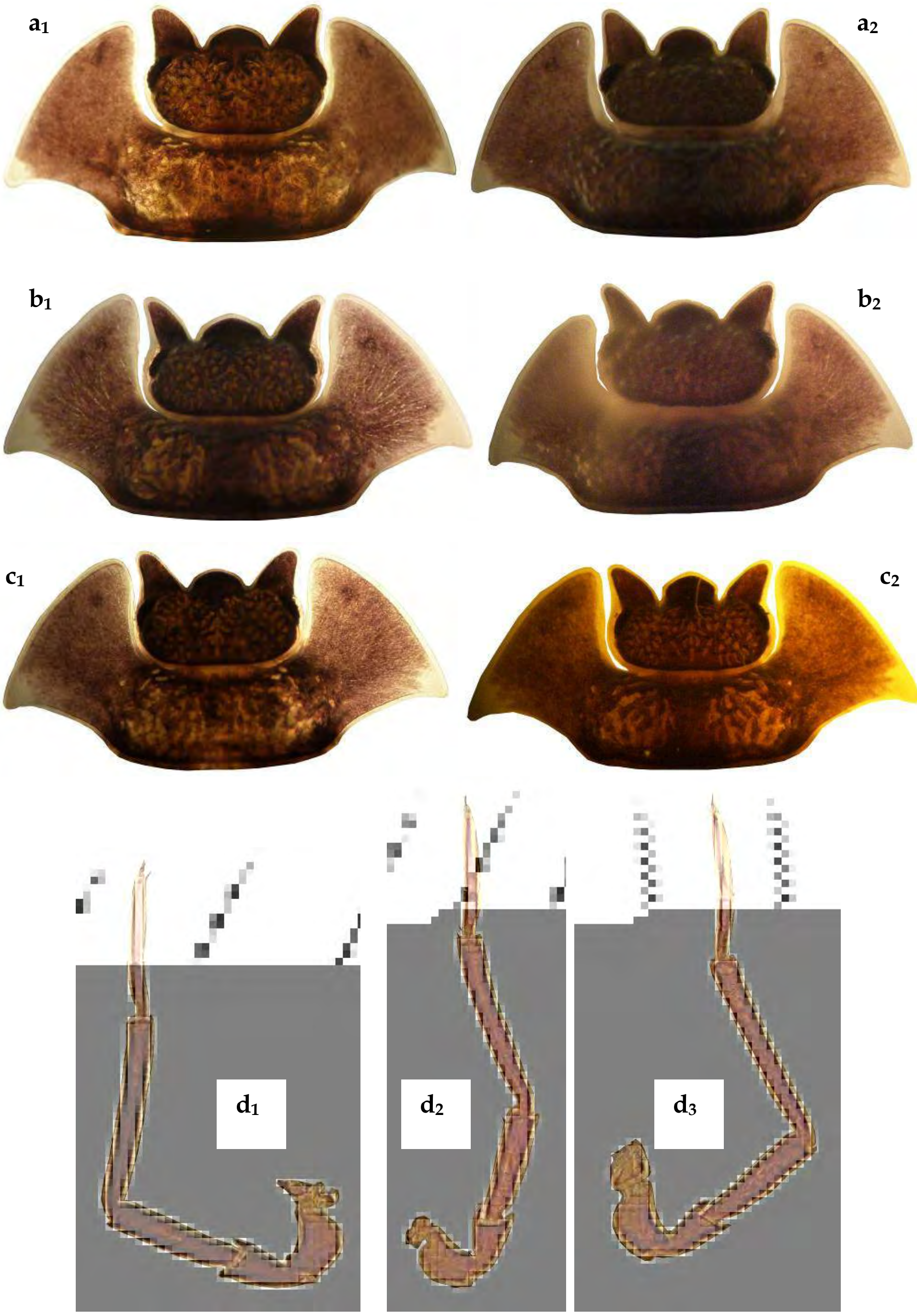


Figure 2.2. *Trachelipus ater* (Budde-Lund, 1896), **cephalic lobes: a_1.** ♂ 14 x 7 mm, **a_2.** ♂ 14.5 x 8 mm – Vâlsan River Gorge; **b_1.** ♂ 12 x 6 mm, **b_2.** ♂ 13 x 6 mm – Bistrița River Gorge; **c_1.** ♂ 14 x 7.5 mm, **c_2.** ♂ 13.5 x 7 mm – Bujoreni; **antennae: d_1.** ♂ 14 x 7 mm – Vâlsan River Gorge, **d_2.** ♂ 13 x 6 mm – Bistrița River Gorge, **d_3.** ♂ 13,5 x 7 mm – Bujoreni.

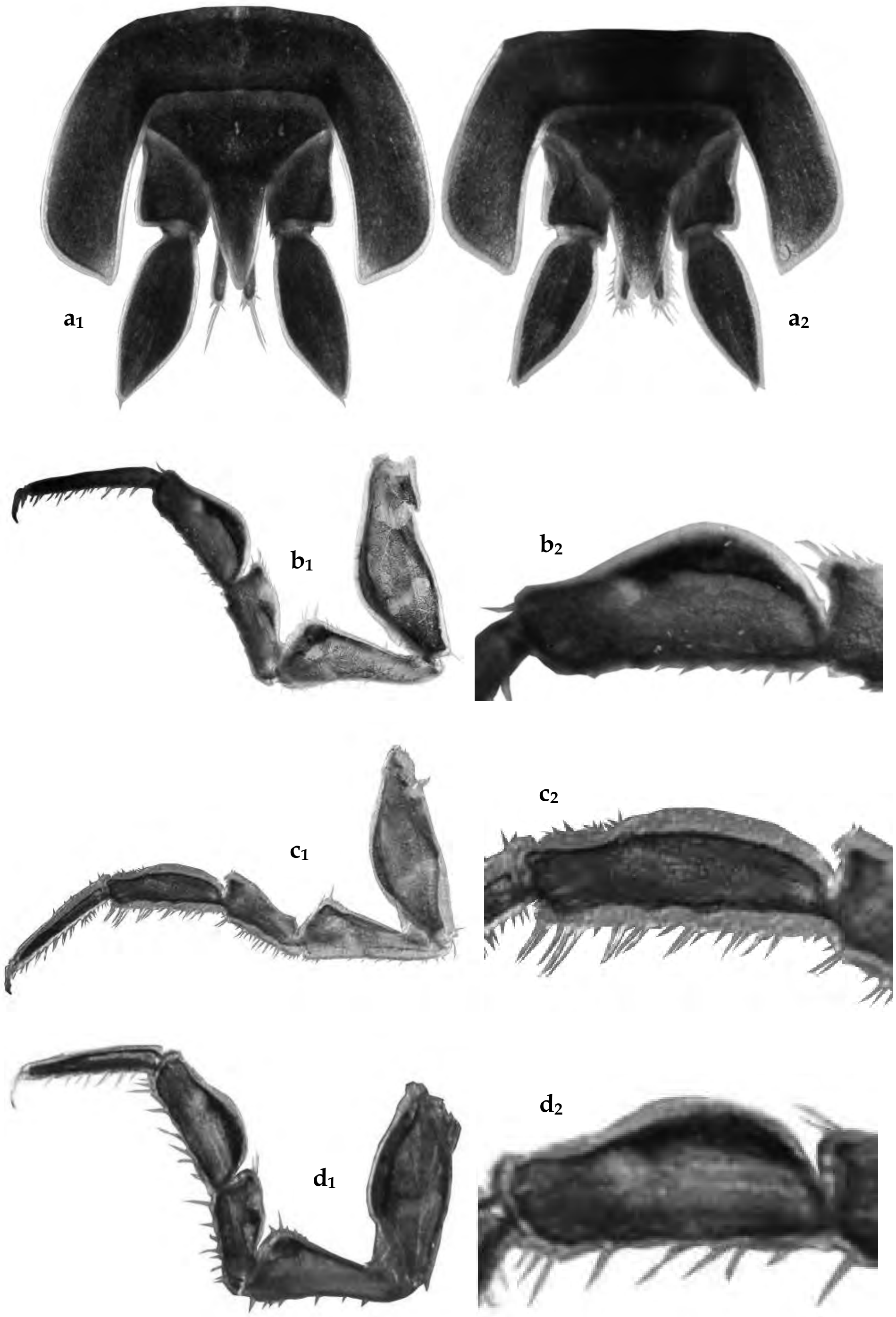


Figure 2.3. *Trachelipus ater* (Budde-Lund, 1896), **telson and uropods: a1.** ♂ 14 x 7 mm – Vâlsan River Gorge, **a2.** ♂ 13 x 6 mm – Bistrița River Gorge; **male pereiopods 7 carpus crest: b1-b2.** ♂ 14 x 7 mm – Vâlsan River Gorge, **c1-c2.** ♂ 13 x 6 mm – Bistrița River Gorge, **d1-d2.** ♂ 14 x 7.5 mm – Bujoreni.

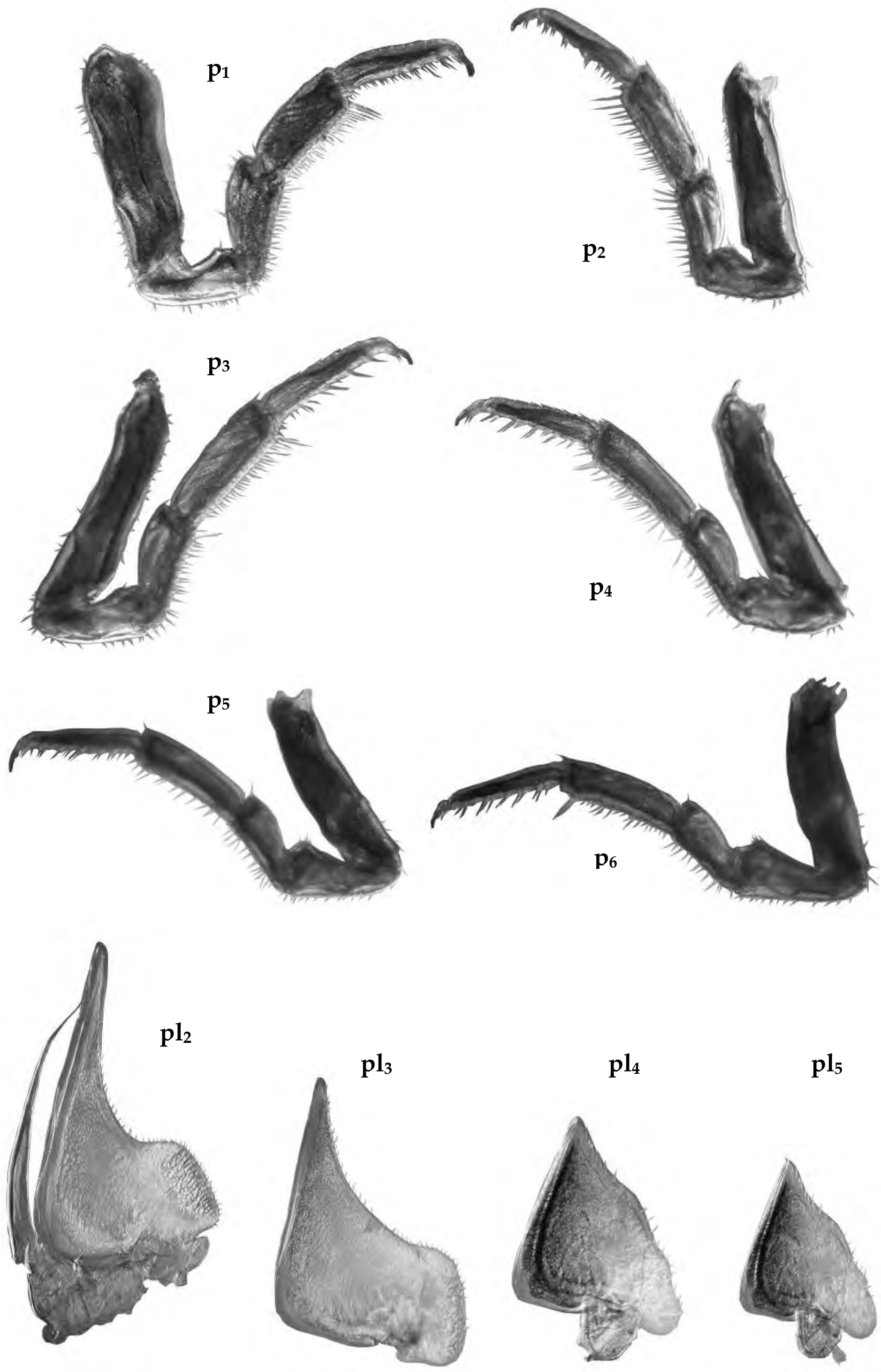


Figure 2.4. *Trachelipus ater* (Budde-Lund, 1896), **pereiopods 1 – 6: p_1–p_6.** ♂ 13 x 6 mm – Bistrița River Gorge; **pleopod 2 – 5 exopods: pl_2 – pl_5.** ♂ 14.5 x 8 mm – Vâlsan River Gorge.

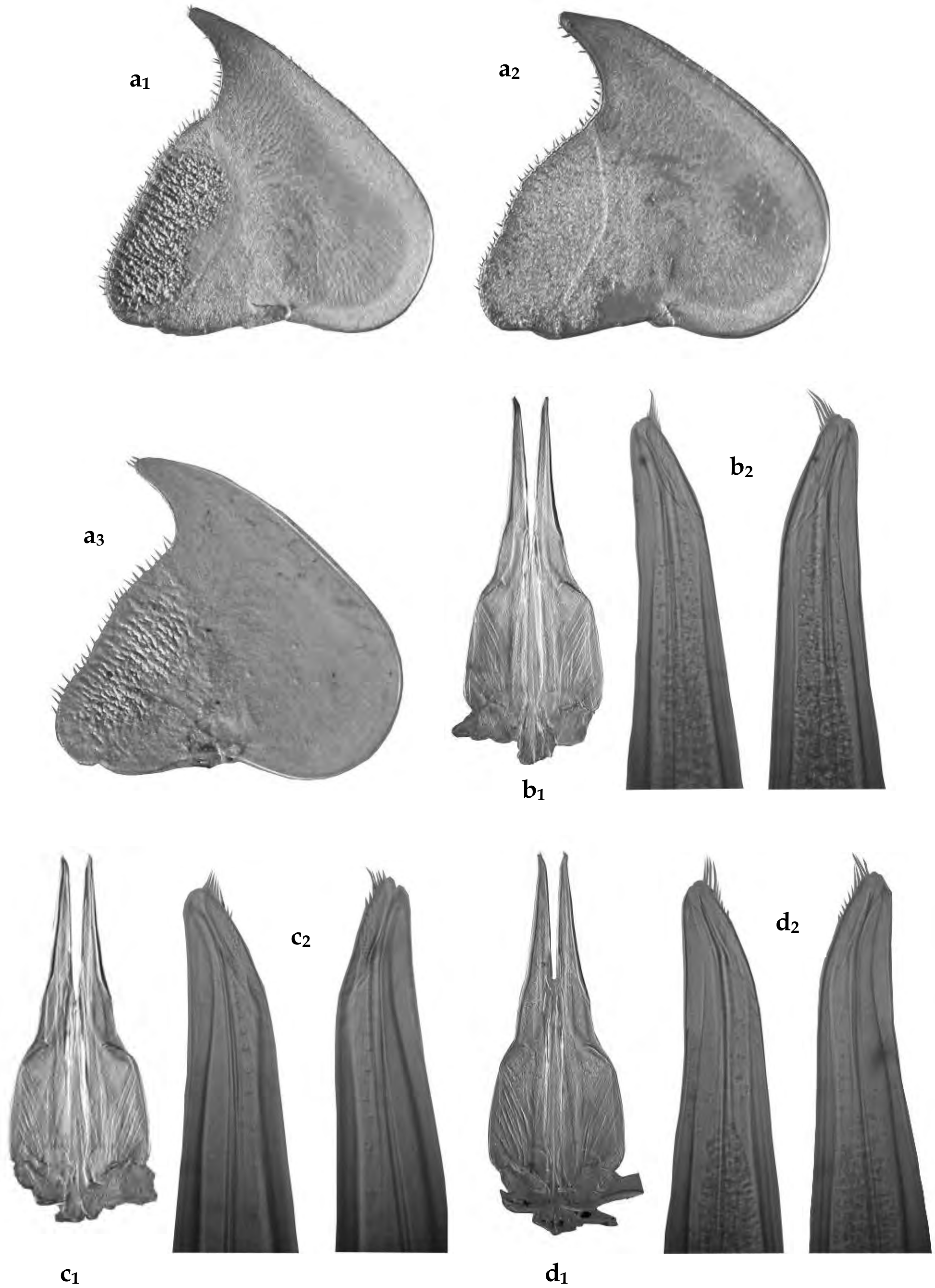


Figure 2.5. *Trachelipus ater* (Budde-Lund, 1896), **male pleopod 1 exopods:**
a_1. ♂ 14.5 x 8 mm – Vâlsan River Gorge, **a_2.** ♂ 12 x 6 mm – Bistrița River Gorge, **a_3.** ♂ 13.5 x 7 mm – Bujoreni;
endopods 1: b_1, c_1, d_1, pleopod 1 endopods` apex: **b_2, c_2, d_2** – the same males.

Geographic distribution

T. ater is present in Romania (Schmidt 1997). Schmölzer (1965) and Radu (1985) mention this species in Transylvania. Probably the localization of *T. ater* in Transylvania is based on takeover of the type locality where the species was described, namely Turnu Roşu (see in: Schmidt 1997), the above-mentioned authors not identifying the species in new localities. Turnu Roşu locality is situated at the southern limit of Transylvania, on the northern end of Olt River Gorge (Turnu Roşu Gorge), but in an area rather similar to those of Southern Carpathians than with from the Transylvanian Plateau. Alongside, the only known distribution locality of the species from the literature is Căpăţâneni (Schmidt 1997). Most likely it is the locality from Argeş County, situated upstream of Curtea de Argeş town, between Vâlsan and Olt Rivers. We have identified the species *T. ater* only in the southern parts of the Southern Carpathians and along the Oltului Gorge, as far as its northern end, extending much its known distribution area (Fig. 2.6.). The species populates the south-western Făgăraş Mountains, Lotrului Mountains, and Căpăţânii Mountains. It is possible that *T. ater* is more widespread along the southern flank of the Southern Carpathians, in zones where it has favourable habitats.

Altitude. *T. ater* has a relatively large altitudinal range, being identified between 350 m a.s.l. at Lotrişor Valley and 830 m a.s.l. in Vâlsan River Gorge. The species was not observed in plains, low hills, or in high mountain zones.

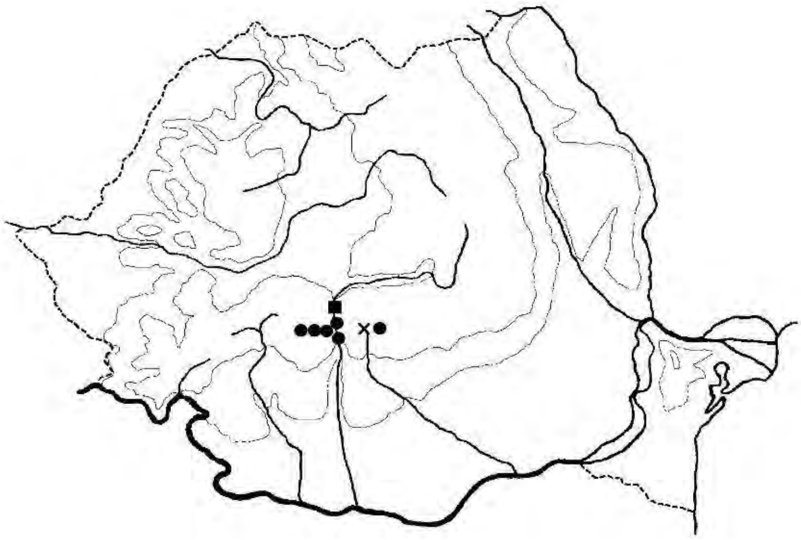


Figure 2.6. The distribution of *T. ater* in Romania
(● - new distribution localities,
■ - mentioned in the literature and reconfirmed distribution point,
X – mentioned in the literature and not reconfirmed distribution point)

3. *Trachelipus vareae* (Radu, 1949)

Porcellio vareae Radu 1949, 1950
Tracheoniscus vareae Radu, 1958
Trachelipus vareae Radu, 1970, 1985
Trachelipus vareae (Radu, 1949) Schmölzer, 1965

Literature consulted for the description of the species: Radu 1949, 1950, 1958, 1985, Schmölzer 1965, Schmidt 1997 (Schmidt 1997 synonymises the species *T. varae* (Radu 1949) with *T. ater* (Budde-Lund 1886)).

Examined material and sampling sites

Feneş Gorge, upstream Feneş locality, Trascău Mountains (Alba County) ♂ 17 x 9 mm, ♂ 16.5 x 9 mm, ♀ 16 x 9 mm;

Ampoiţa Valley, upstream Ampoiţa locality, Trascău Mountains (Alba County) ♀ 15.5 x 9.5 mm;

Întregalde Gorge, upstream Întregalde locality, Trascău Mountains (Alba County) ♂ 14.5 x 8 mm;

Brăzeşti locality, Trascău Mountains (Alba County) ♂ 13 x 7 mm, ♂ 13.7 x 7.5 mm, 3♂ 14 x 7 mm, 2 ♂ 14.5 x 8 mm, 2♀ 17 x 10 mm;

Poşaga de Sus locality, Muntele Mare Mountain, (Alba County) ♂ 14 x 8 mm, ♀ 17 x 10 mm;

Pociovaliştei Gorge, Muntele Mare Mountain, (Alba County) ♂ 17 x 8.5 mm, ♀ 18 x 10 mm, ♀ 18.5 x 10 mm;

Cibului Gorge, Metaliferi Mountains (Alba County) ♂ 17.5 x 9 mm, ♀ 20 x 10 mm.

From these localities we have analysed 14 males (five dissected) and seven females.

Species description

Size: males 12 x 6.5 mm – 17.5 x 9 mm; females 15 x 9 mm – 20 x 10 mm.

Colour. The tergites are brown-grey. The hind tip of the coxal plates and of the epimeres is whitish-yellowish. At the anterior half of the coxal plates` basis of tergites 2-7 there are yellowish spots, these being elongated on the segments 3-7 (Fig. 3.1. a, b).

Somatic characters

Cephalon. The cephalic lobes are well developed. The lateral lobes are relatively wide in their proximal half, the external side being straight, the internal side straight at its basis (1/4 of the total length) and oblique at its distal part (3/4 of the total length). The median lobe is well developed, with round-shaped external side, the spaces between the median and lateral lobes being narrow (Fig. 3.1. d).

Pereion. On the tergites there are numerous tubercles. The coxal plates are well developed. On the segments 1-3 the posterior edge of the coxal plates forms a sinuosity, curved to posterior in its extremity, but on the segments 4-7 the edge is curved directly to posterior part of the body (Fig. 3.1. a, b). The glandular pore fields are oval, distanced from the lateral edge of the coxal plates (Fig. 3.1. c).

Pleon. On the pleon`s tergites there are a lower number of tubercles. The epimeres are developed, being narrower than the coxal plates. The basal part of the pleotelson (1/3 of its total length) is wide; its distal part (2/3 of its total length) is narrow, with sharp tip. The lateral edges of the pleotelson forms an oblique angle at the limit between the proximal wide and distal sharp parts (Fig. 3.1. e).

Appendages

Antennae. The last antenna article is longer than the penultimate one (Fig. 3.1. f), the ratio between their length varying between 1.35:1 and 1.4:1.

Male pereiopods 7 ischium has its ventral part slightly curved. The carpus has a high chitin crest, which covers 2/3 of the carpus` total length (Fig. 3.1. g). On the ventral side of the merus and carpus of the pereiopods 1-3 there are dense thorn rows, these being rarer on the pereiopods 4-6 (Fig. 3.2.).

Pleopods. The pleopod 1 exopods have on their posterior extremity a short tip, oriented outwards, and at their basis a concavity (Fig. 3.3. a). The endopods` basal half width is relatively narrow in relation with their length; at the extremity of the endopods there are short thorns (Fig. 3.3. b1, b2). The pleopod 2-5 exopods have no specific morphology (Fig. 3.4. pl_2 – pl_5).

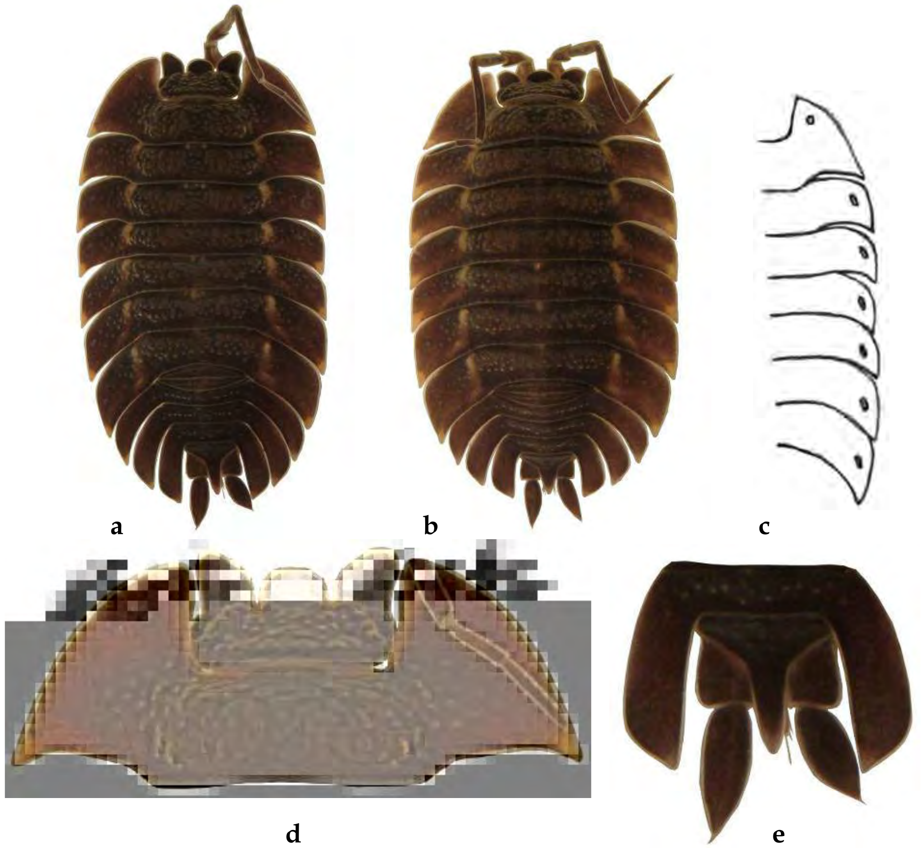
Variability of some morphological characters

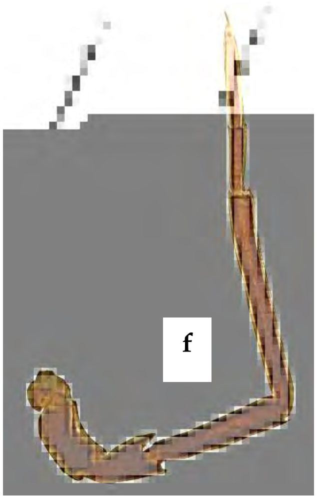
In the 14 studied males, there is a variation of the length of the yellow spots from the coxal plates` basis (Fig. 3.5. a-b). Also, the length and width of the cephalic lobes and width of the pleotelson varies (Fig. 3.5. c-g), but these variations fall in the limits of the specific characters of *T. vareae*. As well, there are variations at the pereiopod 7 carpus crest and the male pleopod 1 exopods` width and apex length (Fig. 3.6.).

Morphological anomalies were observed at the pereiopod 7 carpus crest of the male collected from Întregalde Gorge (Fig. 3.7. a) and pleopod 1 exopods of the male collected from Pociovaliştei Gorge (Fig. 3.7. b).

Ecology

The habitat of *T. vareae* is similar to that of *T. ater*. Thus, *T. vareae* also prefers forested zones, mainly beech, natural and humid forests, situated along permanent watercourses. Just as at the previous species, the habitats populated by *T. vareae* are situated in gorges and ravines with steep, almost vertical, limestone slopes. *T. vareae* seems to be more attached to zone with gorge aspect than *T. ater*. Just as in the case of *T. ater*, the individuals of *T. vareae* are sheltering under fallen logs and their bark but also under stones. In Poşaga Gorge, we have observed individuals on a humid and steep limestone wall in a forested zone. Radu (1949) mentions this species preferring the litter on the soil from beech forests in calcareous zones, with moderate humidity. Thus, the observed habitats of the species are similar to the previously identified ones (Radu 1949), *T. vareae* being strongly tied with gorge-looking habitats.





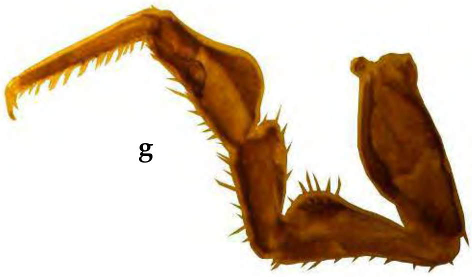


Figure 3.1. *Trachelipus vareae* (Radu,1949), **male and femele, dorsal view**: **a.** ♂ 17 x 9 mm, **b.** ♀ 16 x 9 mm; **glandular pore fields**: **c.** ♂ 17 x 9 mm – Feneş; **d. cephalic lobes**, **e. telson** and uropods, **f. antenna**, **g. male pereiopod** 7, ♂ 17 x 9 mm – Feneş.

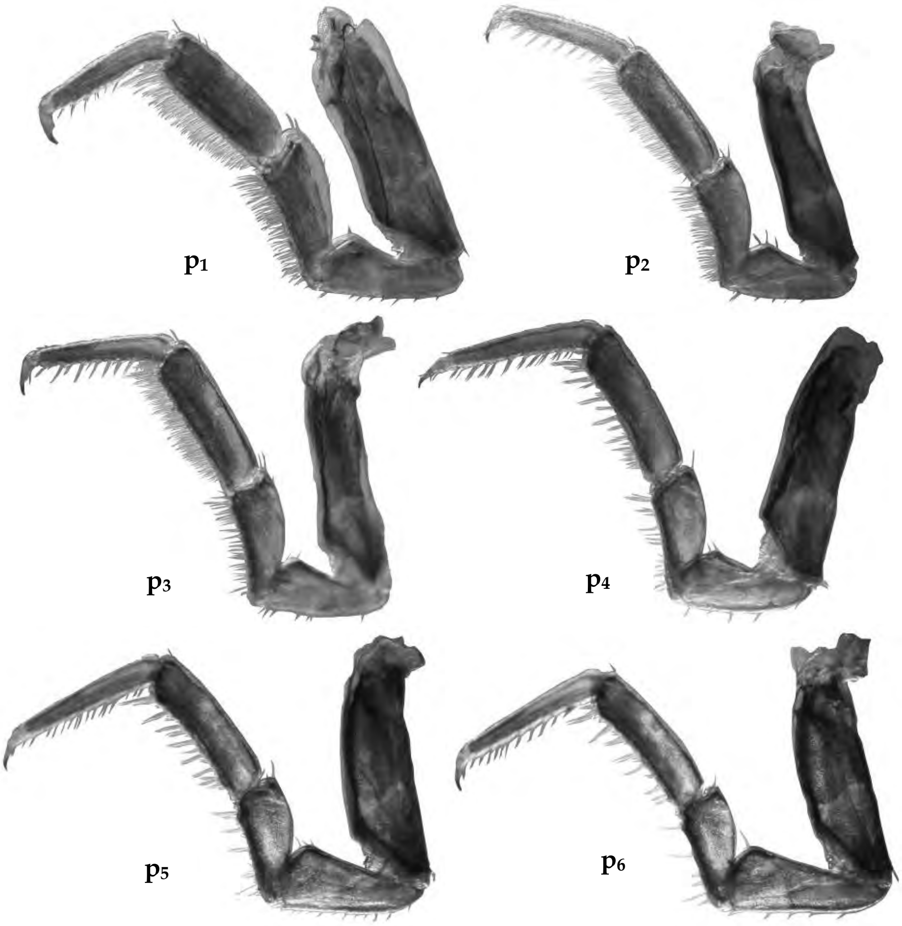


Figure 3.2. *Trachelipus vareae* (Radu,1949), **pereiopods 1 – 6: p_1–p_6.** ♂ 17 x 9 mm – Feneş.

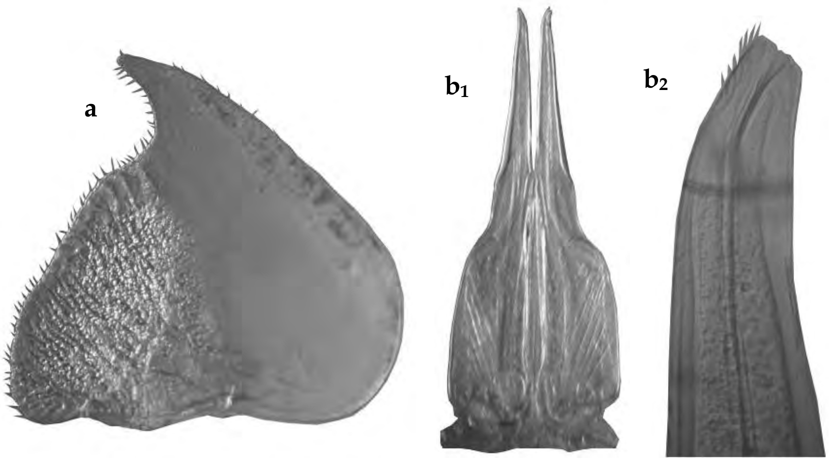


Figure 3.3. *Trachelipus vareae* (Radu,1949), **male pleopods 1**: **a.** exopod, ♂ 17 x 9 mm –Feneş, **b_1.** endopod, **b_2.** pleopod 1 endopod`s apex, ♂ 18 x 10 mm –Pociovaliştei Gorge.

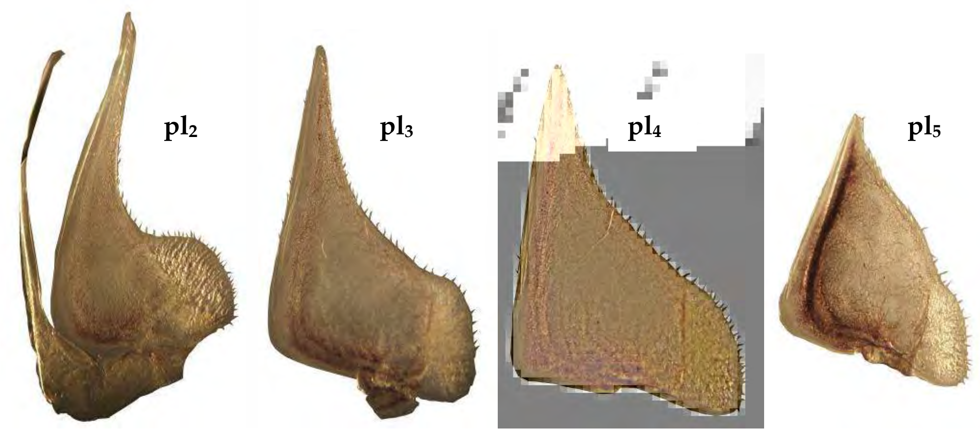


Figure 3.4. *Trachelipus vareae* (Radu,1949), **pleopod 2 – 5 exopods: pl2 – pl5.** ♂ 17 x 9 mm – Feneş.

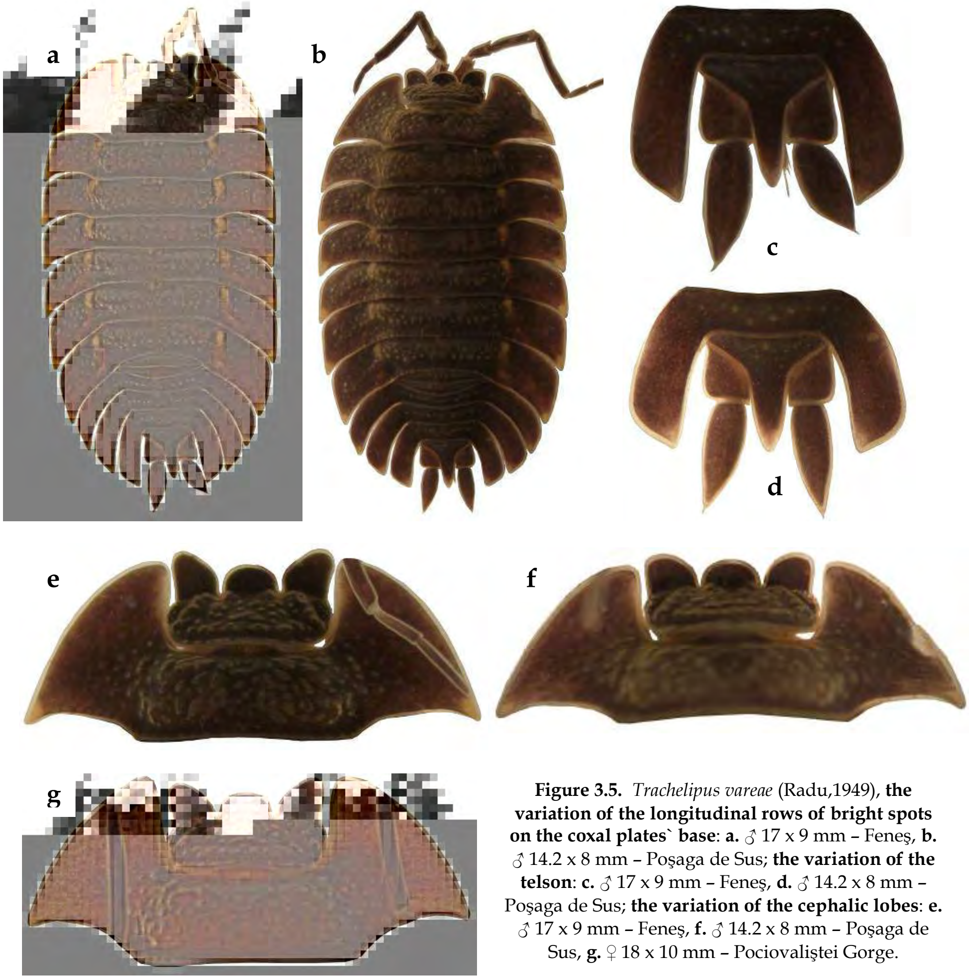


Figure 3.5. *Trachelipus vareae* (Radu,1949), **the variation of the longitudinal rows of bright spots on the coxal plates` base**: **a.** ♂ 17 x 9 mm – Feneş, **b.** ♂ 14.2 x 8 mm – Poşaga de Sus; **the variation of the telson**: **c.** ♂ 17 x 9 mm – Feneş, **d.** ♂ 14.2 x 8 mm – Poşaga de Sus; **the variation of the cephalic lobes**: **e.** ♂ 17 x 9 mm – Feneş, **f.** ♂ 14.2 x 8 mm – Poşaga de Sus, **g.** ♀ 18 x 10 mm – Pociovaliştei Gorge.

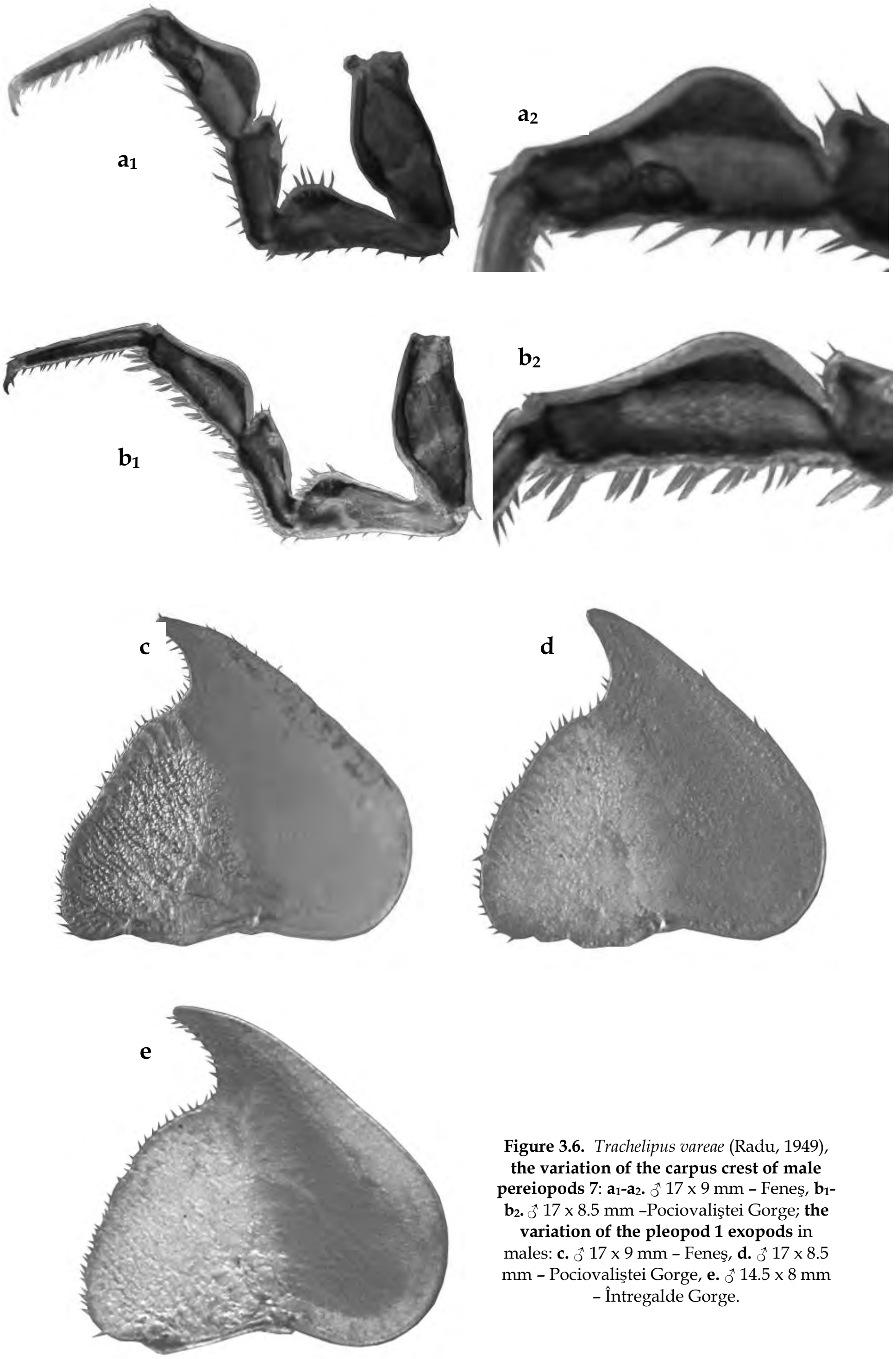


Figure 3.6. *Trachelipus vareae* (Radu, 1949), **the variation of the carpus crest of male pereiopods 7**: **a$_1$-a$_2$.** ♂ 17 x 9 mm – Feneş, **b$_1$-b$_2$.** ♂ 17 x 8.5 mm –Pociovaliştei Gorge; **the variation of the pleopod 1 exopods** in males: **c.** ♂ 17 x 9 mm – Feneş, **d.** ♂ 17 x 8.5 mm – Pociovaliştei Gorge, **e.** ♂ 14.5 x 8 mm – Întregalde Gorge.

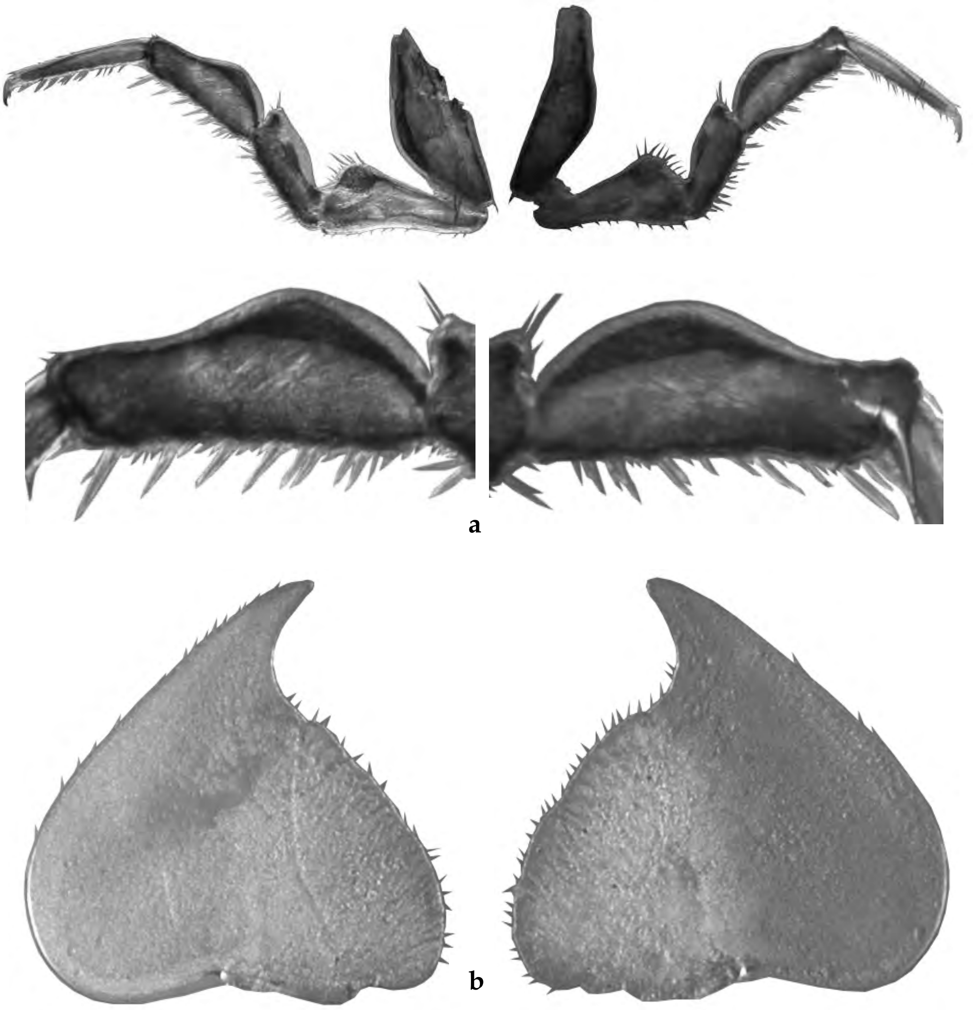


Figure 3.7. *Trachelipus vareae* (Radu,1949), **morphological anomalies**: **a.** the carpus crest of pereiopod 7, ♂ 14.5 x 8 mm – Întregalde Gorge, **b.** pleopod 1 exopods, ♂ 18 x 10 mm – Pociovaliştei Gorge.

Geographic distribution

T. vareae is endemic for Romania (Radu 1985). Radu (1949, 1950, 1958, 1985) mentions *T. vareae* from Feneş-Alba, Ruşchiţa, Lunca Cernii, Cioclovina, Merişor, Hobiţa, Turnu Roşu and Călimăneşti. In contrast, we have identified the species only in Apuseni Mountains, in more massifs. Thus, we have collected *T. vareae* from Trascău Mountains (four localities), Muntele Mare (two localities), and Metaliferi Mountains (one locality) (Fig. 3.8). We cannot exclude, however, its presence in Poiana Ruscă Mountains and Parâng Mountains, where it was previously reported (e.g. Radu 1958), although we looked for and did not identify it in these zones (Crivadiei Gorge), where we also did not identify *T. ater*. Anyway, the presence of the species at Călimăneşti and Turnu Roşu (Radu 1958) is unlikely; in Olt River Gorge *T. ater* is the only present and well represented species. Thus, *T. vareae* is distributed in gorges of mountain limestone zones of south-eastern parts of Apuseni Mountains and eventually in eastern part of Poiana Ruscă Mountains and Parâng Mountains. The distribution of the species in the last two regions must be verified.

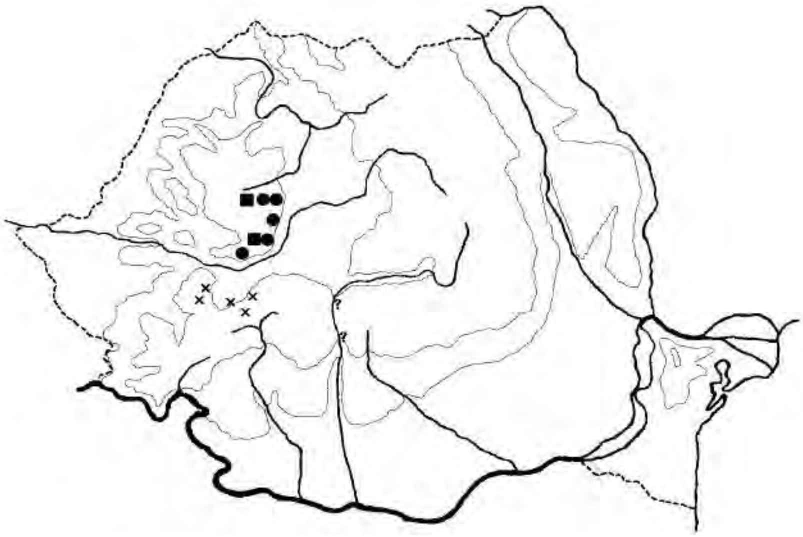


Figure 3.8. The distribution of *T. vareae* in Romania (● - new distribution localities, ■ - mentioned in the literature and reconfirmed distribution points, X – mentioned in the literature and not reconfirmed distribution points, ? – doubtful previously mentioned distribution points)

Altitude. *T. vareae* have a more reduced altitude-related range than *T. ater*, being identified between 480 m a.s.l. in Brăzeşti and 630 m a.s.l. in Feneş.

The comparative description of the specific distinctive morphological characters of *T. ater* (Budde-Lund, 1896) and *T. vareae* (Radu, 1949)

The comparative analysis of the specific morphological characters of *T. ater* and *T. vareae* shows that *T. vareae* is a valid species and cannot be synonymised with *T. ater*, as Schmidt (1997) affirms it. However, the synonymisation was not realized by the analysis of *T. vareae* individuals, but because it was considered that the first description of *T. vareae* was not made in a scientific paper, but in a verbal communication, so it was considered an unpublished name (see in: Schmidt 1997). Nevertheless, the paper in which *T. vareae* was described is indicated (see in: Schmidt 1997).

Tergites` colour is dark-grey, as slate in *T. ater*, with small, pinpoint spots at the basis of the coxal plates, spots which can be absent at some populations (Figs. 3.9. a, 3.10. a). In males and females of *T. vareae* the tergites` colour is brown-grey, with yellowish spots at the basis of the coxal plates, spots which are elongated on the segments 3-7 (Figs. 3.9. b, 3.10. b).

Cephalic lobes. The lateral lobes are narrower, with the external edge inclined laterally in *T. ater*, and wider with straight external edge in *T. vareae*. The median lobe is shorter in *T. ater* and longer in *T. vareae*. Between the median and lateral lobes, there is a large angle, of 90° in *T. ater* and a narrow space in *T. vareae* (Fig. 3.11. a, b).

Pleotelson. In *T. ater* the external sides of the pleotelson are curved proximally (Fig. 3.11. c), but in *T. varae* they forms an oblique angle at the limit between the proximal wide and distal narrow parts (Fig. 3.11. d).

Male pereiopod 7 carpus crest covers ¾ of the carpus length in *T. ater* (Fig. 3.12. a_1, a_2) and only 2/3 in *T. vareae* (Fig. 3.12. b_1, b_2).

Male pleopod 1 exopods and endopods are relatively similar (Figs. 3.13.).

Figure 3.9. Yellow spots on the coxal plates` base in males: **a.** *Trachelipus ater*, ♂ 14 x 7 mm – Vâlsan River Gorge, **b.** *Trachelipus vareae*, ♂ 17 x 9 mm – Feneş.

Figure 3.10. Yellow spots on the coxal plates` base in females: **a.** *Trachelipus ater*, ♀ 15 x 9 mm – Vâlsan River Gorge; **b.** *Trachelipus vareae*, ♀ 16 x 9 mm – Feneş.

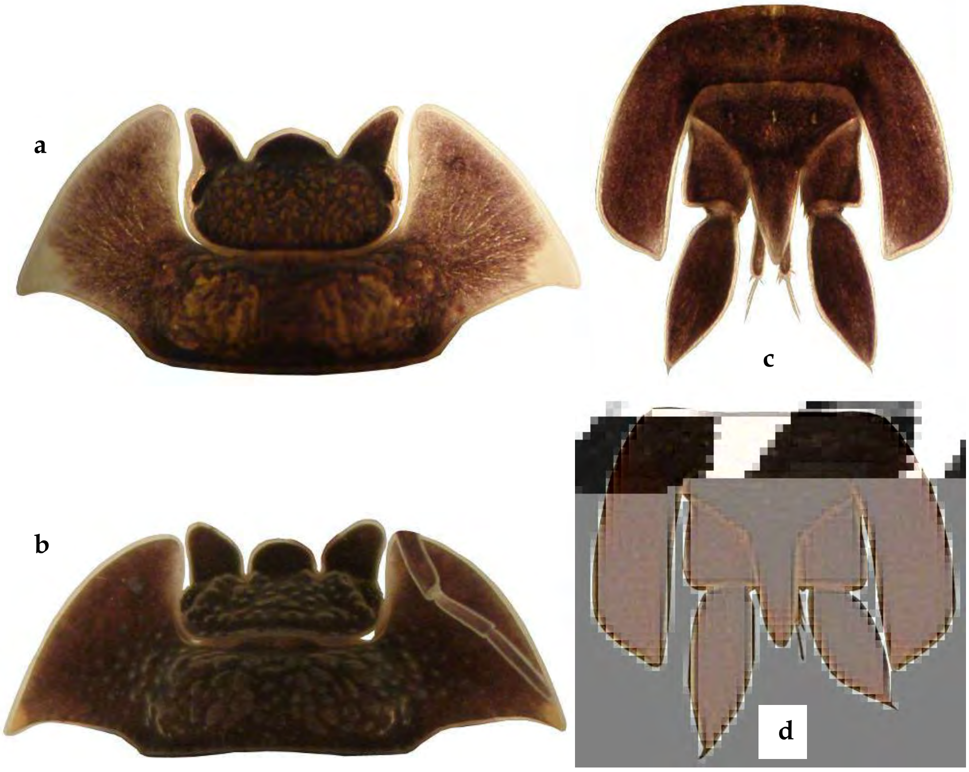


Figure 3.11. Comparison of cephalic lobes: **a.** *Trachelipus ater*, ♂ 12 x 6 mm – Bistrița River Gorge, **b.** *Trachelipus vareae*, ♂ 17 x 9 mm – Feneș; **pleotelson**: **c.** *T. ater*, ♂ 14 x 7 mm – Vâlsan River Gorge; **d.** *T. vareae*, ♂ 17 x 9 mm – Feneş.

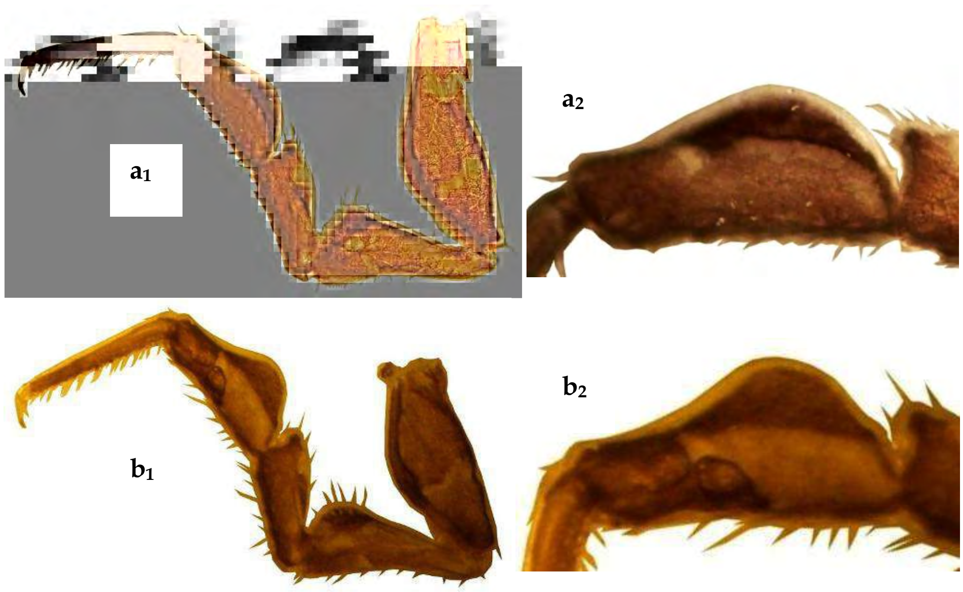


Figure 3.12. Comparison of male pereiopod 7 carpus crest: **a_1-a_2.** *Trachelipus ater*, ♂ 14 x 7 mm – Vâlsan River Gorge, **b_1-b_2.** *Trachelipus vareae*, ♂ 17 x 9 mm – Feneş.

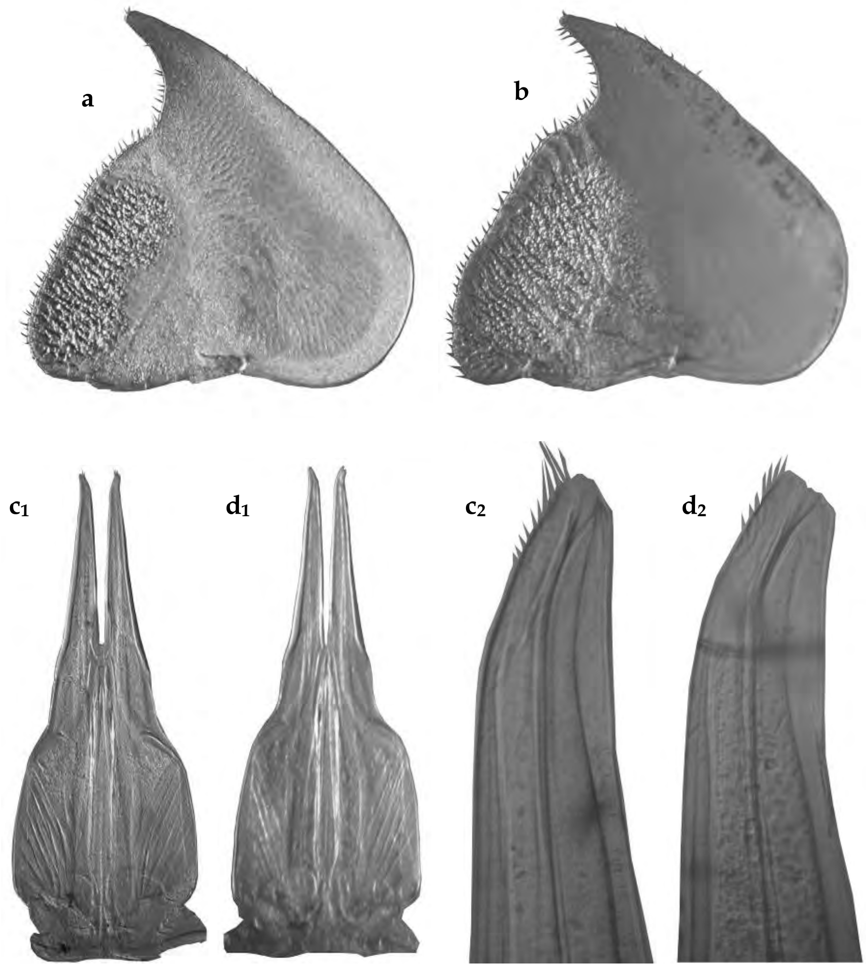


Figure 3.13. Comparison of male pleopods 1. - exopods: a. *Trachelipus ater*, ♂ 14.5 x 8 mm – Vâlsan River Gorge; **b.** *Trachelipus vareae*, ♂ 17 x 9 mm – Feneş; - **endopods**: **c_1-c_2.** *T. ater*, ♂ 13.5 x 7 mm –Bujoreni, **d_1-d_2.** *T. vareae*, ♂ 17 x 8.5 mm – Pociovaliştei Gorge.

4. *Trachelipus ratzeburgii* (Brandt, 1833)

Porcellio ratzeburgii Brandt, 1833
Porcellio ratzeburgii Budde-Lund, 1885
Tracheoniscus ratzeburgi (Brandt, 1833), Wächtler, 1837
Tracheoniscus ratzeburgi (Brandt, 1833), Radu, 1958
*Tracheoniscus ratzeburgi (*Brandt, 1833), Frankenberger, 1959
Trachelipus ratzeburgi (Brandt, 1833), Vandel, 1962
Trachelipus ratzeburgi (Brandt, 1833), Schmölzer, 1965
Trachelipus ratzeburgi (Brandt, 1833), Radu, 1985
Trachelipus ratzeburgii (Brandt, 1833), Schmidt, 1997

Literature consulted for the description of the species: Budde-Lund 1885, Wächtler 1937, Frankenberger 1959, Vandel 1962, Schmölzer 1965, Radu 1958, 1985, Schmidt 1997.

Examined material and sampling sites

Chitu valley, Jiului Gorge (Gorj County), 4♂, 1♀;

Cean locality, Tăşnad Hills (Satu-Mare County), 3♂, 1♀;

Ersig locality, Arenişului Hill (Caras-Severin County), 1♂, 1♀;

Gârliştei Gorge, Aninei Mountains (Caraş-Severin County), 5♂, 2♀;

Săcuieni locality, near Tăul Vărgat lake, Ier Plain (Bihor County), 2♂, 2♀;

Periprava locality, Danube Delta (Tulcea County), 10♂, 19♀.

From these localities, we have analysed 26 males (12 being dissected) and 28 females.

Species description

Size: males 8.5 x 4 mm – 12 x 5 mm (Periprava 7 x 3 mm – 9 x 5 mm); females 8.5 x 5 mm – 12 x 7 mm (Periprava 7 x 3 mm – 9 x 5.5 mm). The individuals from Periprava are smaller than those collected from the other regions of the country or those indicated in the literature (Radu 1985).

The body colour is dark grey-brown. At the base of the coxal plates of the pereional segments 2 – 7 there are yellow spots, longer on the segments 6 – 7. The posterior tips of the coxal plates are yellow-reddish. Laterally from the median zone of the pereional tergites there are two fine yellowish pattern strips (Fig. 4.1. a, b).

Somatic characters

Cephalon. The cephalic lobes are well developed. The external sides of the lateral lobes are inclined to exterior. The median lobe has its distal edge semi-circular. There are numerous tubercles on the head (Fig. 4.2. a).

Pereion. There are numerous tubercles on the tergites, which are fewer and smaller on the coxal plates. The posterior edges of the coxal plates on the segments 1 – 3 are sinuous, and on the segments 4 – 7 are curved (Fig. 4.1. a, b). The glandular pore fields are round-shaped and distanced from the coxal plates edge (Fig. 4.1. c).

Pleon. On the tergites 3 – 5 of the pleon there are small yellowish spots, situated laterally of the median zone (Fig. 4.1. a, b). The pleotelson does not exceed the epimeres` extremity of the segment 5 (Fig. 4.2. b).

Appendages

Antennae. The last antenna article is almost twice longer than the penultimate one (Fig. 4.2. c).

Male pereiopod 7 ischium`s ventral edge is lightly curved. The carpus has a proeminent dorsal crest, which covers ¾ of their total length (Fig. 4.2. d). On the ventral edge of the pereiopods 1 – 4 merus and carpus there are dense thorn rows, reduced in number on pereiopods 5 – 7 (Fig. 4.3.).

Pleopods. Male pleopod 1 exopods are wider than their length; the posterior side`s tip is short and relatively thick (Fig. 4.4. a). The extremity of the endopods is sharp, with terminal hair tufts (Fig. 4.4. b1, b2). The pleopod 2 – 5 exopods shape is like in the other Trachelipus species (Fig. 4.5. pl_2 – pl_5).

Intraspecific morphological variability

We observed morphological variability of body parts and of some appendages, which fits into the limits of specific characters. The cephalic lobes and telson vary in length and width (Fig. 4.6.). The male pereiopod 7 carpus crests have different length and shape (Fig. 4.7.). In male pleopod 1 exopods vary in the width in relation with length, respectively the apex's general shape and the length (Fig. 4.8.).

Morphological anomalies were observed in male pereiopod 7 carpus crests. In a male the crest on a pereiopod is much smaller (Fig. 4.9. a), in another male one pereiopod`s carpus crest is absent (Fig. 4.9. b).

Ecology

Vandel (1962) characterizes *T. ratzeburgii* as a sylvan species, which is present in the forests of mountain and plain areas too. Radu (1985) also mentions that *T. ratzeburgii* is a sylvan species, present in the forests of any altitudes up to 2500 m a.s.l. According to the literature, we also found this species only in forested zones, both on plain, low hilly and mountain areas. Though, contrary to Radu`s data (1985) *T. ratzeburgii* was not encountered at very high altitudes. The species mainly populates natural forests, both oak, beech, or hornbeam, but at Periprava it was collected from a poplar plantation. Unlike the above-mentioned species, it was not found in all cases in zones with high humidity. *T. ratzeburgii* can survive in less humid zones too. Thus, at Cean *T. ratzeburgii* was encountered in a relatively dry oak forest, situated on a low hilltop. However, generally the species is present in relatively humid places, near watercourses. *T. ratzeburgii* was collected from under fallen logs and especially from under their bark.

Geographic distribution

T. ratzeburgii is present in Central and South-Eastern Europe (Schmidt 1997, Flasarova 1995, 1999, Schmalfuss 2003). In Western Europe, it is present up to France (Vandel 1962). It appears that it lacks from the eastern zones of the continent (Kuznetsova & Gongalsky 2012), Romania being situated at the eastern limit of the species` distribution range. In Romania *T. ratzeburgii* is considered to have a large distribution range, but without any distribution locality being indicated (Radu 1958). We have collected it from Western and South-Western Romania, starting with Banat Mountains and until the northern Apuseni Mountains, but also from the eastern part of the country, from Danube Delta (Fig. 4.10). Thus, *T. ratzeburgii* seems to be present in the whole country indeed, but only in forested areas. Previously it was reported in Dornei Depression (Tomescu et al. 2005), Hidişelului Hills (Tomescu et al. 2008), Crasnei Hills (Ferenți et al. 2012b), Beiuş town (Bodin et al. 2013) or Pădurea Craiului Mountains (Ianc & Ferenți 2014).

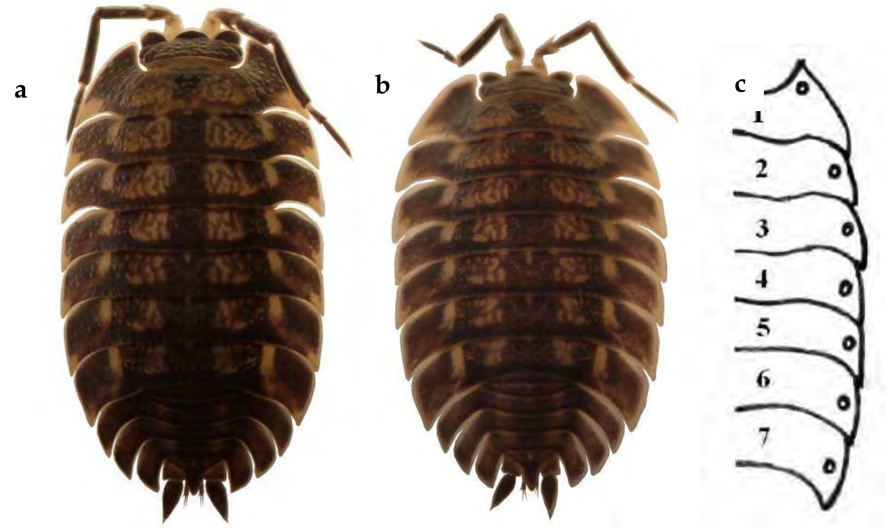


Figure 4.1. *Trachelipus ratzeburgii* (Brandt, 1833), **male and femele, dorsal view**: **a.** ♂ 10 x 5 mm, **b.** ♀ 10 x 5 mm; **c. glandular pore fields** – Ersig.

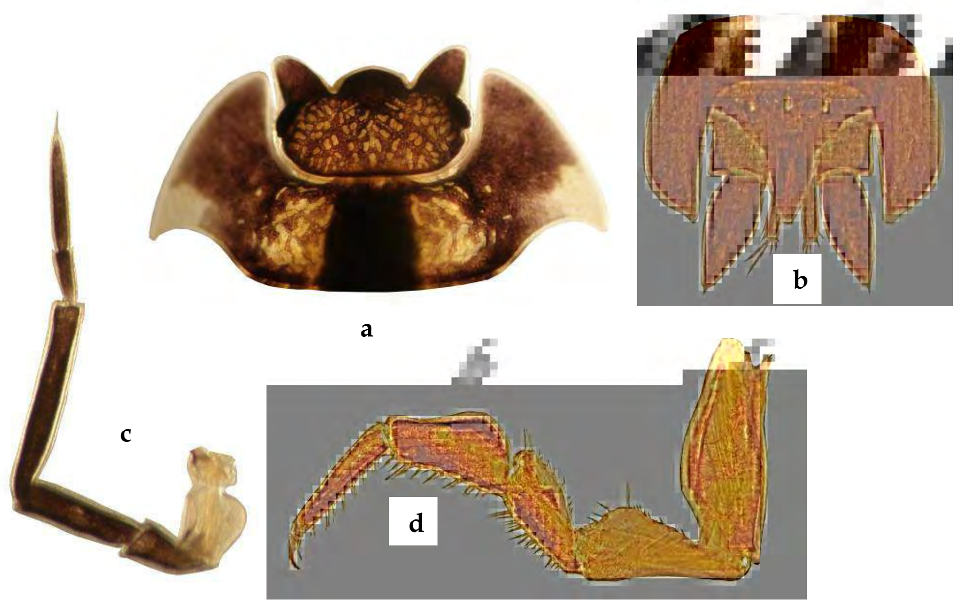


Figure 4.2. *Trachelipus ratzeburgii* (Brandt, 1833): **a. cephalic lobes**, **b. telson**, **c. antenna**, **d. male pereiopod 7**, ♂ 10 x 5 mm – Ersig.

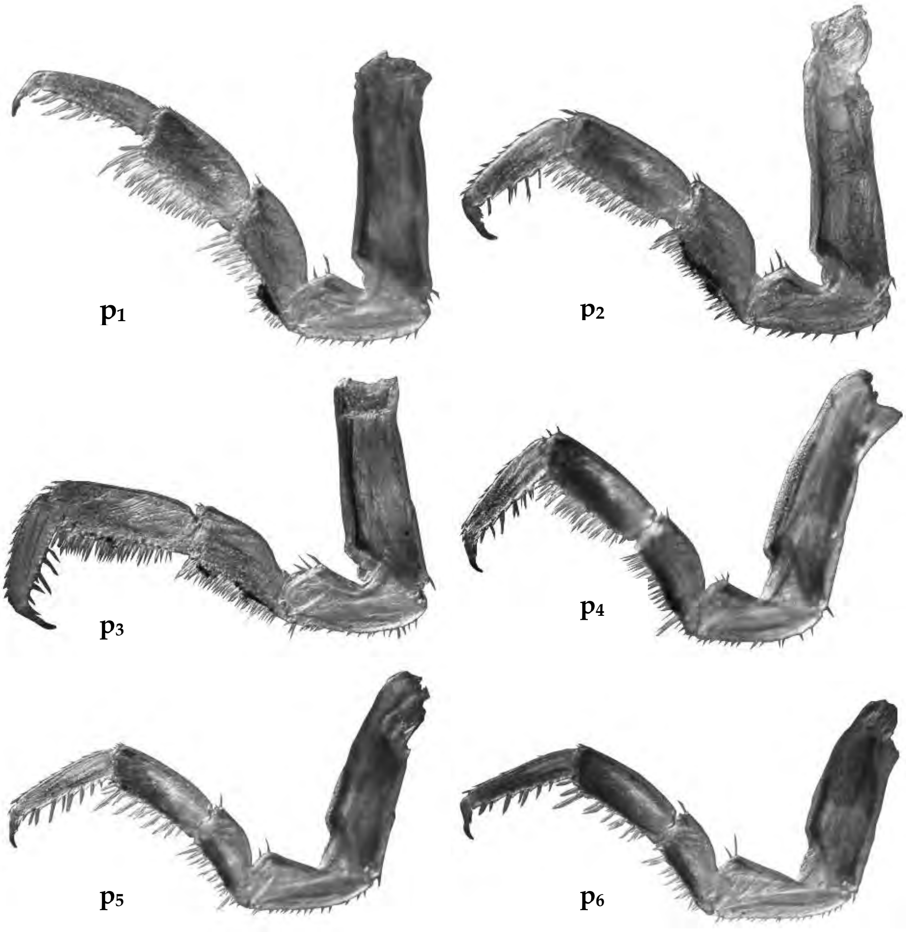


Figure 4.3. *Trachelipus ratzeburgii* (Brandt, 1833), **pereiopods 1 – 6: p_1–p_6.** ♂ 9 x 4.5 mm – Săcuieni.

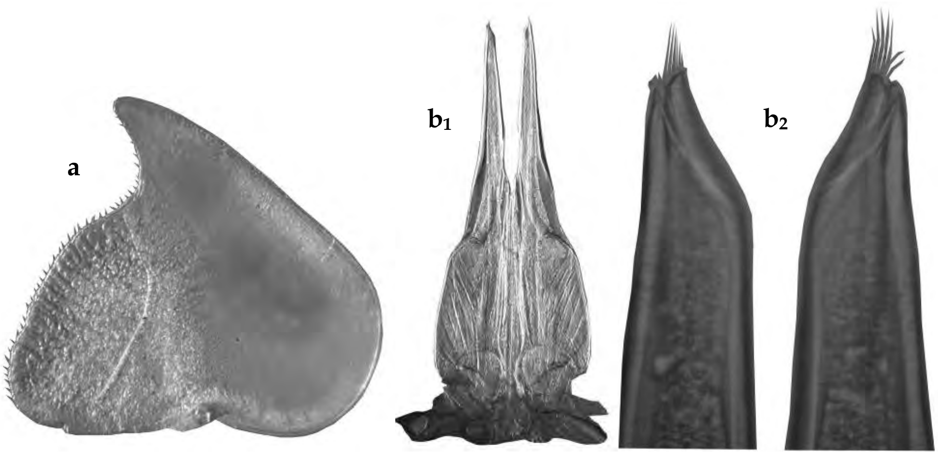


Figure 4.4. *Trachelipus ratzeburgii* (Brandt, 1833), **male pleopods 1: a.** exopods, ♂ 10.5 x 5 mm – Gârliştei Gorge, **b_1.** endopods, **b_2**. the apex of the pleopod 1 endopods, ♂ 10 x 5 mm – Ersig.

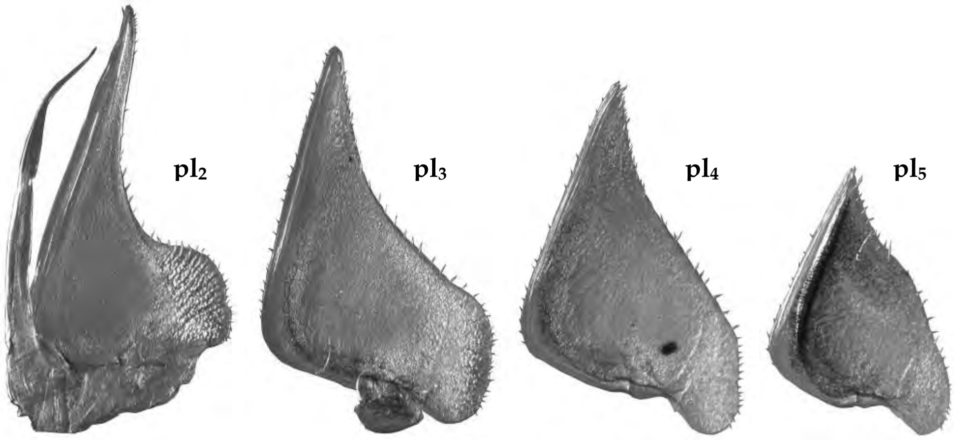


Figure 4.5. *Trachelipus ratzeburgii* (Brandt, 1833), **pleopod 2 – 5 exopods: pl_2 – pl_5.** ♂ 9 x 4.5 mm – Săcuieni.

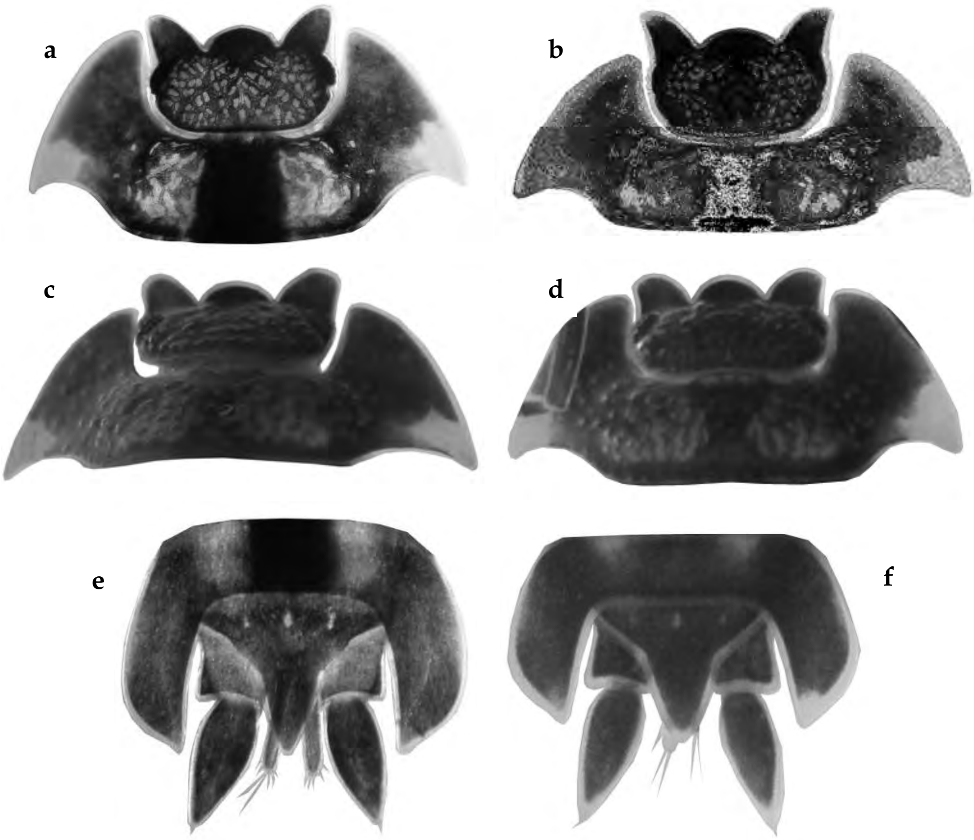


Figure 4.6. *Trachelipus ratzeburgii* (Brandt, 1833), **morphological variation in males**: **cephalic lobes**: **a.** ♂ 10 x 5 mm – Ersig, **b.** ♂ 9.5 x 5 mm – Cean, **c.** ♂ 10.5 x 5 mm, **d.** ♂ 8.5 x 4 mm – Gârliştei Gorge; **telson**, **e.** ♂ 10 x 5 mm –Ersig, **f.** ♂ 9.8 x 5 mm – Gârliştei Gorge.

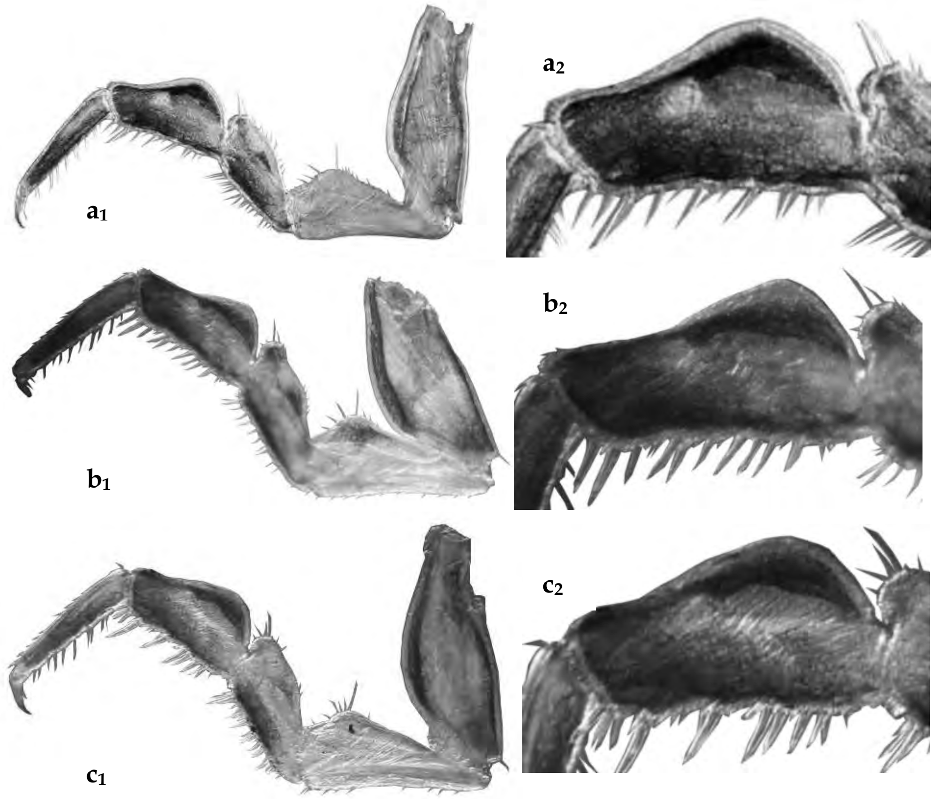


Figure 4.7. *Trachelipus ratzeburgii* (Brandt, 1833), **the variation of the carpus crest on male pereiopods 7**: **a1-a2.** ♂ 10 x 5 mm – Ersig, **b1-b2.** ♂ 10.5 x 5 mm – Gârliştei Gorge, **c1-c2.** ♂ 9 x 4.5 mm – Săcuieni.

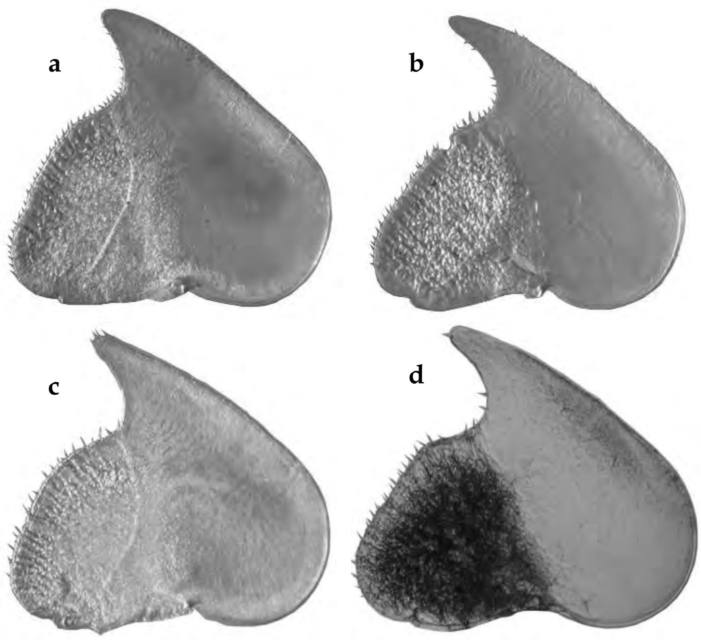
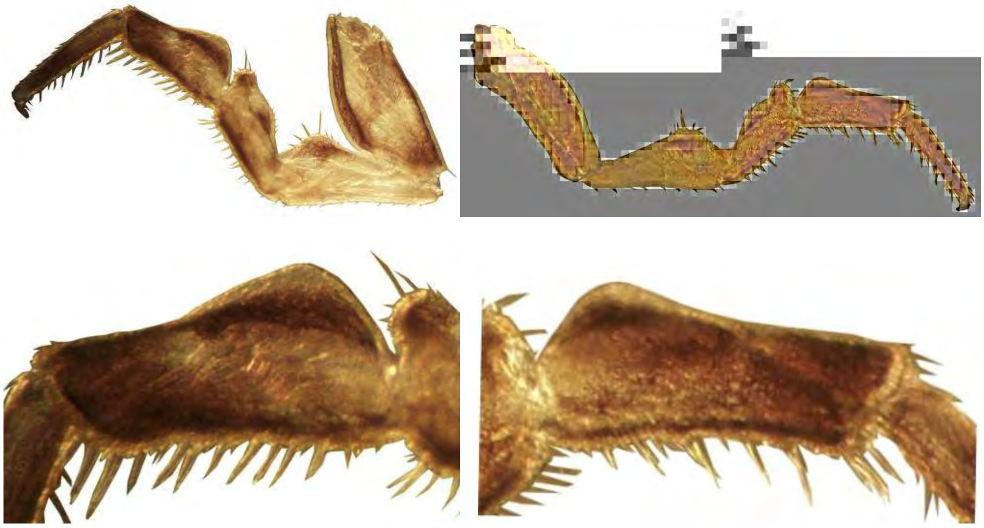


Figure 4.8. *Trachelipus ratzeburgii* (Brandt, 1833), **variation of male pleopod 1 exopods**: **a.** ♂ 10.5 x 5 mm – Gârliştei Gorge, **b.** ♂ 11 x 5.5 mm – Săcuieni, **c.** ♂ 10 x 5 mm – Ersig, **d.** ♂ 9.3 x 4.5 mm – Cean.



a

b

Figure 4.9. *Trachelipus ratzeburgii* (Brandt, 1833),
morphological anomalies of the carpus crest on male pereiopods 7:
a. ♂ 10.5 x 5 mm – Gârliştei Gorge, **b.** ♂ 9,3 x 4,5 mm – Cean.

Altitude. *T. ratzeburgii* was encountered from 1 m (Danube Delta) to 460 m altitude (Chitu, on Jiului Gorge). By Tomescu et al. (2005) it was found at higher altitudes (about 800 m) too, in Dorna Depression. Thus, the presence of the species at 2500 m altitude (Radu 1985) seems doubtful, as there are no forests at that altitude in Romania.

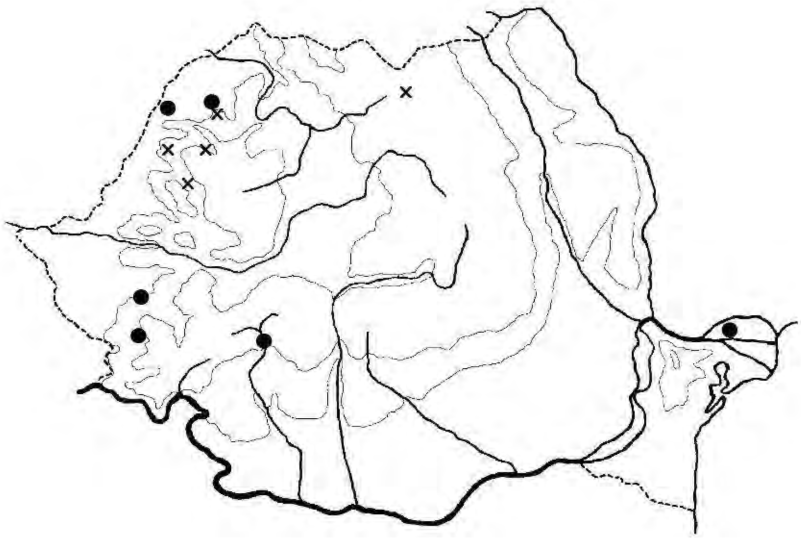


Figure 4.10. The distribution of *T. ratzeburgii* in Romania (● - new distribution localities, X – mentioned in the literature and not reconfirmed distribution points)

5. *Trachelipus bujori* (Radu, 1950)

Tracheoniscus bujori Radu, 1950
Tracheoniscus bujori (Radu, 1950) Radu, 1958
Tracheoniscus bujori (Radu, 1950) Radu & Tomescu, 1970
Trachelipus bujori (Radu, 1950) Radu, 1985
Trachelipus bujori (Radu, 1950) Schmölzer, 1965

Literature consulted for the description of the species: Radu 1950, 1958, 1985, Radu & Tomescu 1970, Schmölzer 1965, Schmidt 1997 (synonymises the species *Trachelipus bujori* with *Trachelipus ratzeburgii*).

Examined material and sampling sites

Meri, Jiului Gorge (Gorj County), 4♂, 2♀;

Dubova locality, Almăjului Mountains (Caraş-Severin County), 1♂;

Gârliştei Gorge, Aninei Mountains, (Caraş-Severin County), 2♂, 2♀;

Herneacova locality, Lipova Hills (Timiş County), 2♂, 2♀;

Charlottenburg locality, between Lipova Hills and Vinga Plain (Timiş County), 2♂, 2♀;

Prunişor locality, Sebiş Depression (Arad County), 1♂, 1♀;

Hinova locality, Stârmina Hill, Bălăciţei Piedmont (Mehedinți County), 1♂, 1♀.

From these localities we have analysed 13 males (9 being dissected) and 10 females.

Species description

Size: males 9 x 5 mm – 12 x 5 mm, females 11 x 6.5 mm – 12 x 7 mm.

Colour. The tergites of the males are dark-grey, on females are light-grey. At the base of the coxal plates from the pereion segments 2 – 7 there are elongated, yellow spots. The posterior extremities of the coxal plates from pereion segments 1 – 7 are also yellow. On the sides of the pleonal tergites 3 – 5 there are small yellow spots (Fig. 5.1. a, b).

Somatic characters

Cephalon. The cephalic lobes are developed; the lateral lobes have their side inclined outwards. The spaces from the base of the lateral and median lobes are very narrow, sharp-angled (Fig. 5.2 a). There are variations in the size of the cephalic lobes.

Pereion. The posterior sides of the coxal plates of the segment 1 – 3 are sinuous, but of the segments 4 – 7 are curved to the posterior part of the body (Fig. 5.1. a, b). The glandular pore fields are round-shaped situated at an evident distance from the external side of the coxal plates (Fig. 5.1. c).

Pleon. The pleotelson is relatively short, at its base there are three small yellow spots (Fig. 5.2. b).

Appendages.

Antennae. The last article is twice longer than the penultimate one (Fig. 5.3. a).

Pereiopods. The ventral side of the male pereiopod 7 ischium is slightly concave. The carpus of the male pereiopod 7 has relatively uniform curved crest, with ¾ length of the carpus` length (Fig. 5.3. b). There are variations in the carpus crest height and shape. The pereiopods 1 – 6 do not present specific characters. On these appendixes, the spine density on the merus and carpus differs (Fig. 5.5.).

Pleopods. The male pleopod 1 exopods are wider than their length, the apex of the posterior extremity is short and thick (Fig. 5.4. a). The endopods` proximal half is narrow, with straight exterior side, inclined obliquely. At their distal extremity, there is a relatively long hair tuft (Fig. 5.4. b1, b2). The pleopod 2 exopods have wide base, with an external lobe. The exopods 3 – 5 resemble those from the other species (Fig. 5.4. pl. 2, pl. 5).

Figure 5.1. *Trachelipus bujori* (Radu, 1950), **male and female, dorsal view**: **a.** ♂ 10.8 x 5.5 mm, **b.** ♀ 11 x 6.5 mm; **c.** glandular pore fields: ♂ 10.8 x 5 mm – Herneacova.

Figure 5.2. *Trachelipus bujori* (Radu, 1950): **a. cephalic lobes**, **b. telson**, ♂ 10.8 x 5.5 mm – Herneacova.

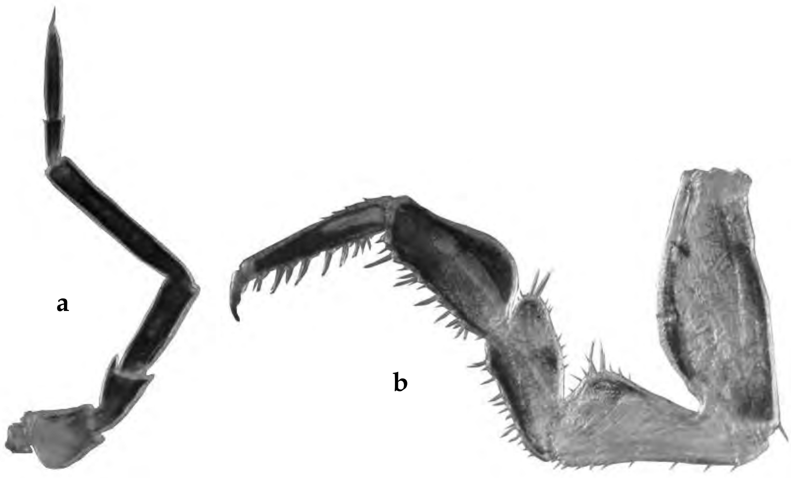


Figure 5.3. *Trachelipus bujori* (Radu, 1950): **a. antenna**, ♂ 10.8 x 5.5 mm – Herneacova, **b. male pereiopod 7**, ♂ 10.5 x 5 mm – Meri.

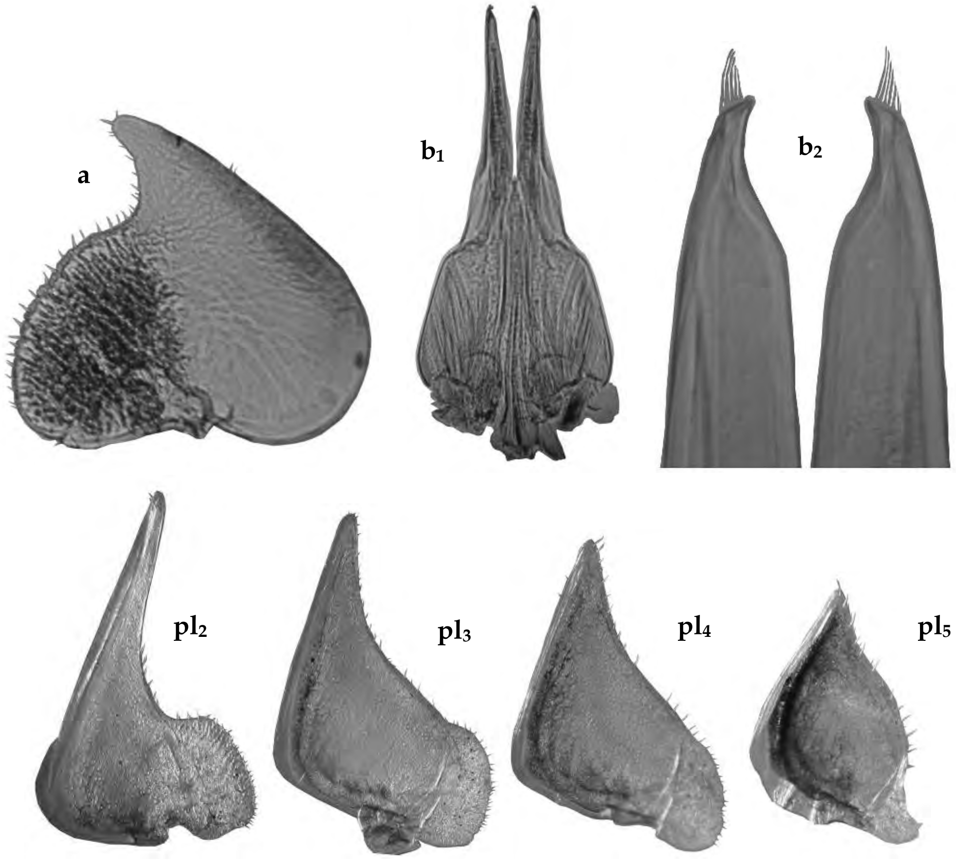


Figure 5.4. *Trachelipus bujori* (Radu, 1950), **male pleopods 1: a.** exopod, **b_1.** endopod, **b_2**. the apex of the pleopod 1 endopods, ♂ 10.5 x 5 mm – Meri; **pleopods 2 – 5 exopods: pl_2 – pl_5.** ♂ 12 x 5 mm – Gârliştei Gorge.

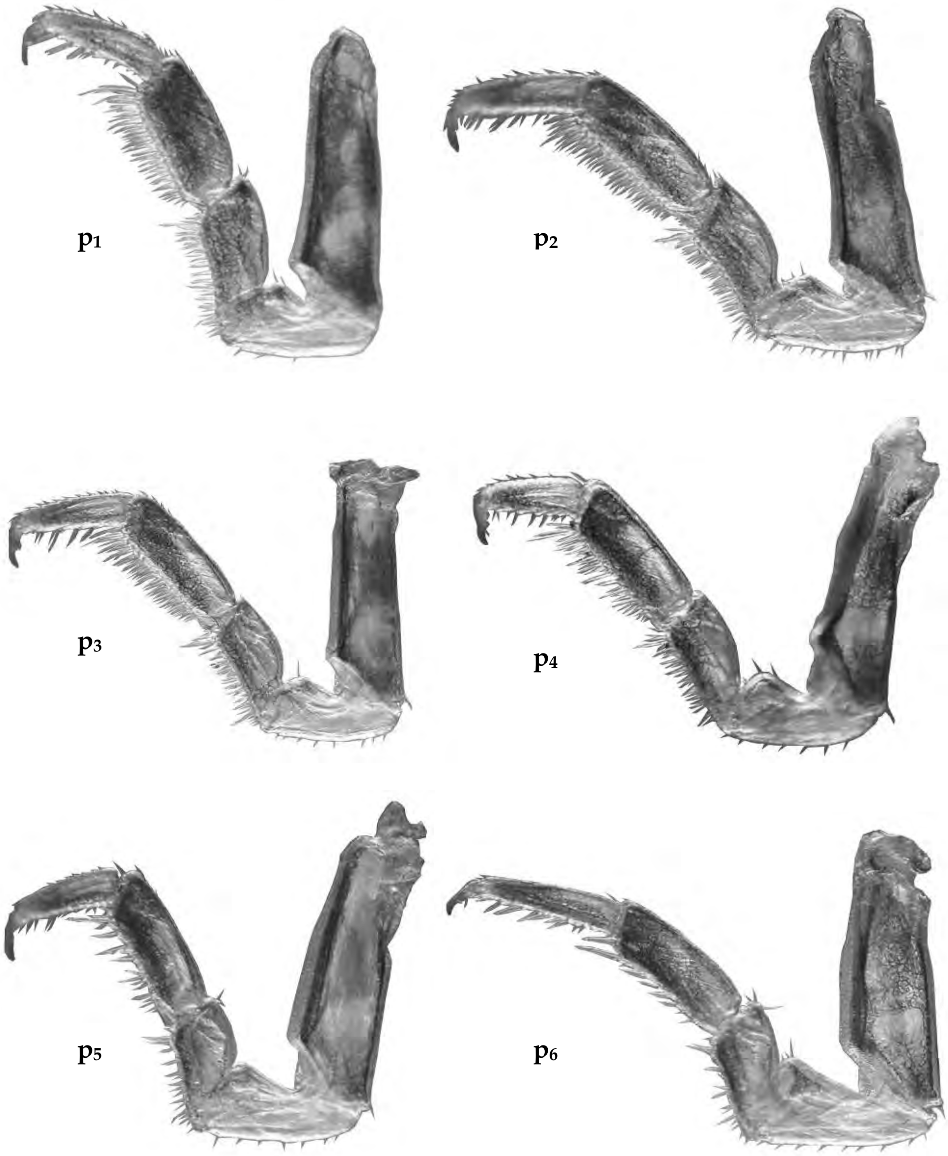


Figure 5.5. *Trachelipus bujori* (Radu, 1950), **pereiopods 1 – 6: p_1–p_6.** ♂ 10.5 x 5 mm – Dubova.

Intraspecific morphological variability

Cephalic lobes vary in length, but the space between the median and lateral lobes is very narrow in the case of all males (Fig. 5.6. a – e).

Pleotelson varies in length and width (Fig. 5.7. a – d).

Male pereiopod 7. The carpus crest varies in height on both pereiopods (Fig. 5.9. a – d).

Male pleopod 1 exopods vary in length and width of the apex from the posterior extremity (Fig. 5.8. a – d).

Morphological anomalies were observed in three males and a female. In a male collected from Hinova the pleonal 1-2 tergites are longer than in normal specimens, thus the distance between the last pereional segment`s coxal plates and the pleonal segment 3 epimeres is larger (Fig. 5.10. b). In a female the distal part of the pleotelson is very short (Fig. 5.11. c). In a male the carpus crest of a pereiopod 7 is thinner than the paired pereiopod (Fig. 5.11. a), but in other male the length and width of the pleopod 1 exopods differ (Fig. 5.11. b).

Ecology

The habitat of *T. bujori* is similar to the one of the previous species. Thus, all specimens, collected by us and by Radu (1950), come from forests. Generally, *T. bujori* populates oak forests, but it is also present in beech forests of high altitudes or even in zones with low altitude beech forests, like the Stârmina Hill (Paşcovschi 1967). Generally, the habitats populated by *T. bujori* are humid. As in the case of *T. ratzeburgii*, the *T. bujori* individuals shelter under fallen logs and their bark.

Geographic distribution

T. bujori is endemic in Romania (Radu 1985). It was identified by Radu (1950) in the areas surrounding Bulza and Coşteiu localities (Poiana Ruscă Mountains). Later it was found in Jiului Gorge (Tomescu et al. 2011). We have found this species on a much larger area, both north and south of the above-mentioned localities. Thus, *T. bujori* is distributed along the Danube, in Hinova area, until Sebiş town in Arad County. The species occupies roughly the Banat Mountains, the western part of Southern Carpathians, Poiana Ruscă Mountains and the hills north to this, and the south-western part of Apuseni Mountains. We have collected *T. bujori* from: Parâng Mountains, Almăjului Mountains, Aninei Mountains, Lipova Hills, the limit between Lipova Hills and Vinga Plain, Bălăciţei Piedmont (Fig. 5.12.). Thereby, while the species still seems endemic, it is not as strictly localized, as it was previously considered (Radu 1985).

Altitude. *T. bujori* was found from 120 m altitude at Hinova until 360 m altitude at Meri, in Jiului Gorge. The previously reported localities (Radu 1950) fit to this altitudinal range.

Figure 5.6. *Trachelipus bujori* (Radu, 1950), **the variation of the cephalic lobes: a.** ♂ 10.8 x 5.5 mm – Herneacova, **b.** ♂ 15 x 7 mm – Hinova, **c.** ♂ 11 x 5.5 mm – Prunişor, **d.** ♂ 10 x 5.5 mm – Charlottenburg, **e.** ♂ 10.5 x 5 mm – Dubova.

Figure 5.7. *Trachelipus bujori* (Radu, 1950), **the variation of the telson: a.** ♂ 10.8 x 5.5 mm – Herneacova, **b.** ♂ 15 x 7 mm – Hinova, **c.** ♂ 10.5 x 5 mm – Meri, **d.** ♂ 10.5 x 5 mm – Dubova.

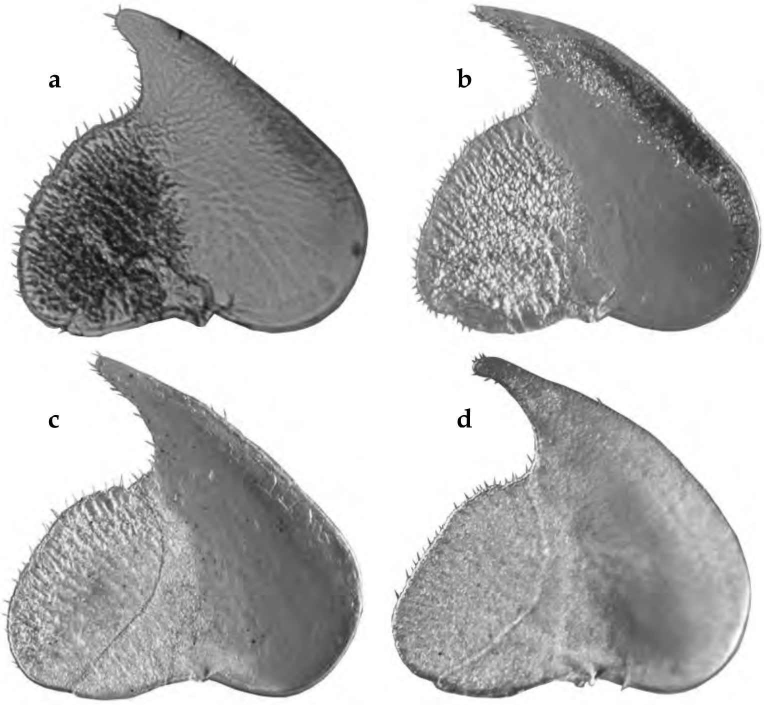


Figure 5.8. *Trachelipus bujori* (Radu, 1950), **the variation of male pleopod 1 exopods: a.** ♂ 10.5 x 5 mm – Meri, **b.** ♂ 11 x 5.5 mm – Prunişor, **c.** ♂ 10 x 5.5 mm – Charlottenburg, **d.** ♂ 10.8 x 5.5 mm – Herneacova.

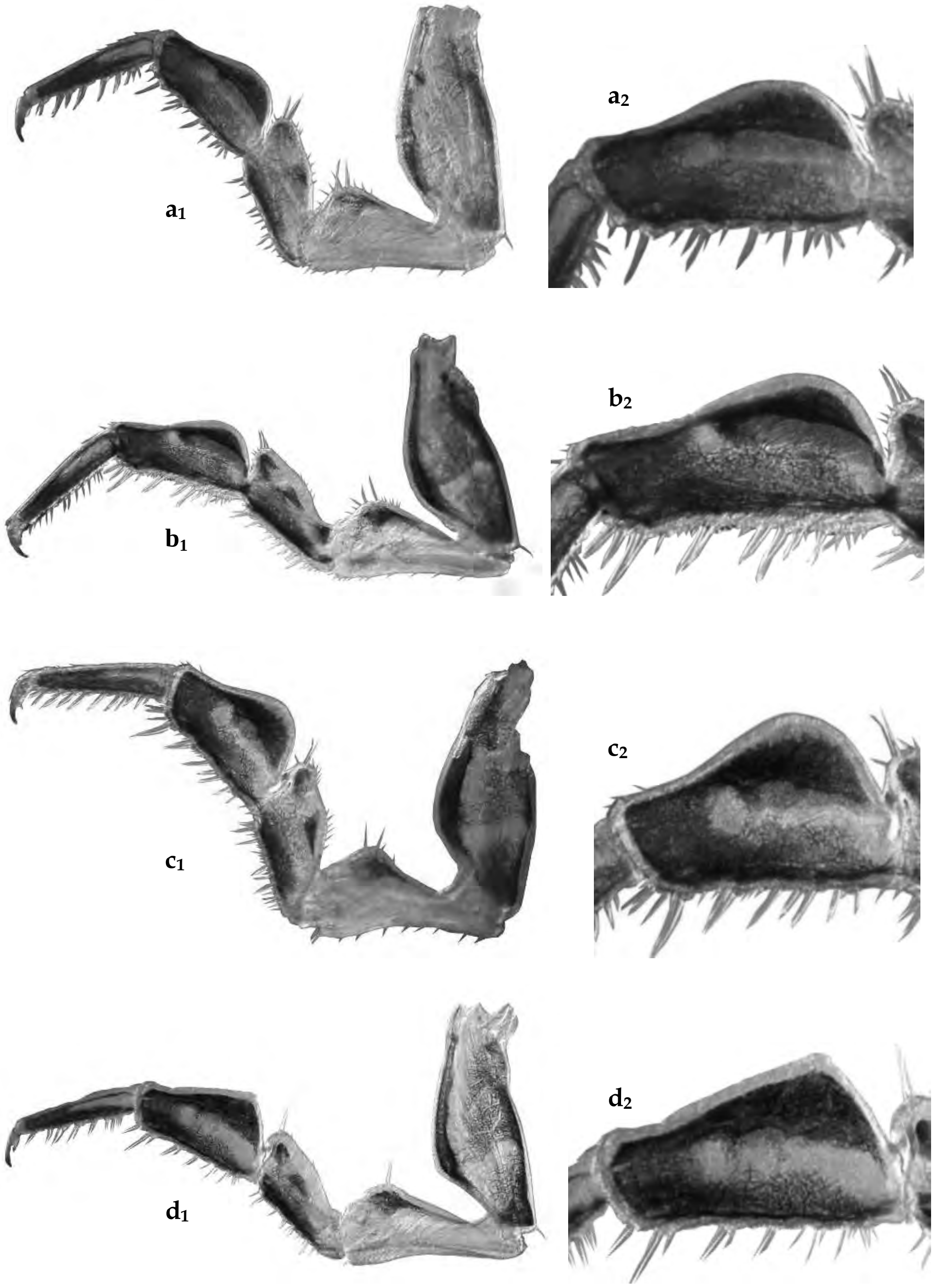


Figure 5.9. *Trachelipus bujori* (Radu, 1950), **the variation of male pereiopod 7 carpus crest: a_1-a_2.** ♂ 10.5 x 5 mm – Meri, **b_1-b_2.** ♂ 11 x 5.5 mm – Prunişor, **c_1-c_2.** ♂ 12 x 5 mm – Gârliştei Gorge, **d_1-d_2.** ♂ 15 x 7 mm – Hinova.

Comparative description of the distinctive morphological specific characters of *T. ratzeburgii* (Brandt, 1833) and *T. bujori* (Radu, 1950)

Schmidt (1997) synonymizes *T. bujori* Radu, 1950 with *T. ratzeburgii* (Brandt, 1833). In our research, we found morphological differences between *T. ratzeburgii* and *T. bujori*, so we can affirm that *T. bujori* is a valid species.

The tergites` colour, the spots on the base of coxal plates and glandular pore fields' position are similar in both species (Fig. 5.13.)

The median cephalic lobe is shorter at *T. ratzeburgii* and longer at *T. bujori*. The lateral lobes are longer, narrower at *T. ratzeburgii*, shorter, and wider at *T. bujori*. Between the median and lateral lobes, there is a large angle of about 90° at *T. ratzeburgii*, and a narrow space, smaller than 40° at *T. bujori* (Fig. 5.14. a, b).

The distal part of the pleotelson is narrower in the most of the males and females of *T. ratzeburgii*, and wider at *T. bujori* (Fig. 5.14. c, d).

The male pereiopod 7 carpus crest is shorter at *T. ratzeburgii* (about 2/3 of the carpus` length) and longer at the *T. bujori* males (about 3/4 of the carpus` length) (Fig. 5.15. a_1, a_2, b_1, b_2). The differences are obvious also in the male pleopod 1 exopods` shape and width (Fig. 5.16. a, b) and in the pleopod 1 exopods` tip (Fig. 5.16. c_1, c_2, d_1, d_2). The described and illustrated differences are obvious in the cephalic lobes, in the pereiopod 7 carpus crest and in the male pleopod 1 endopods` tip and exopods` shape. These differences confirm the validity of the species *T. bujori* Radu, 1950.

We have found both species cohabitating in only one habitat, namely on Gârliştei Gorge (Aninei Mountains). The collected males have distinct characters, specific for *T. ratzeburgii* and *T. bujori*. Although, they were not found in the same habitat, the two species occur together also in Jiului Gorge. The distribution of the *T. ratzeburgii* species is the wider in Romania, actually, including the distribution area of *T. bujori*, which occurs insularly in the area of the widely distributed species, from which it probably had evolved.

Figure 5.10. *Trachelipus bujori* (Radu, 1950), m**orphological anomaly of the body shape: a.** normal shape, ♂ 10.8 x 5.5 mm – Herneacova, **b.** abnormal shape with a gap between pereion and pleon, ♂ 15 x 7 mm – Hinova.

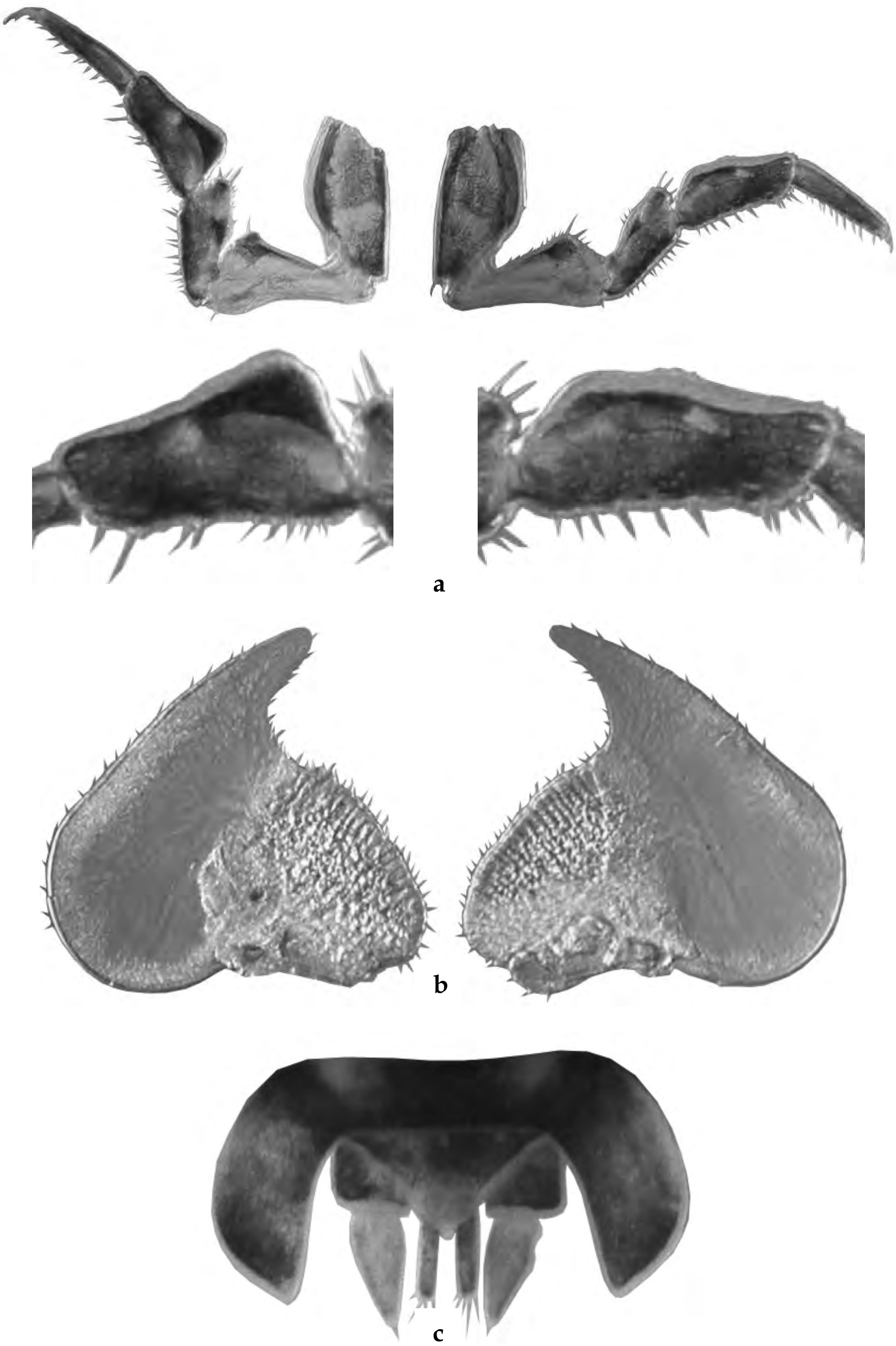


Figure 5.11. *Trachelipus bujori* (Radu, 1950), **morphological anomalies:**
a. pereiopod 7 carpus crest, ♂ 10.8 x 5.5 mm – Herneacova; **b.** pleopod 1 exopods, ♂ 10.5 x 5 mm – Dubova;
c. pleotelson, ♀ 12 x 7 mm – Gârliştei Gorge.

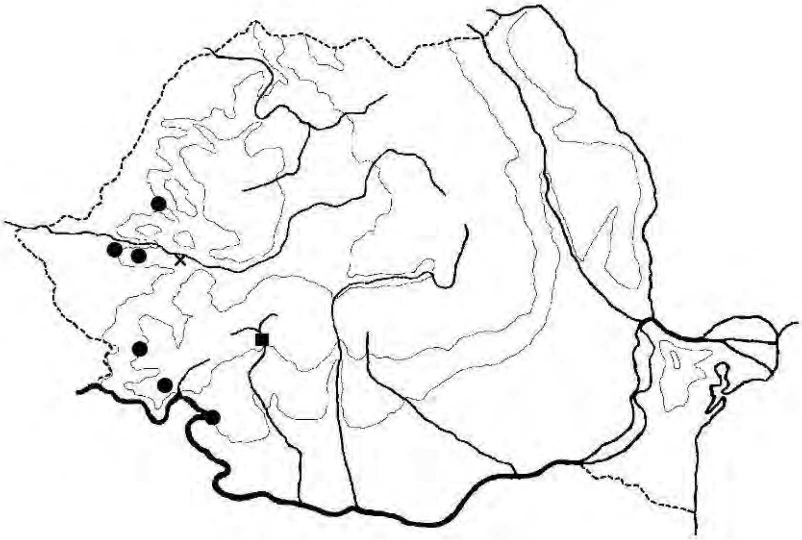


Figure 5.12. The distribution of *T. bujori* in Romania (● - new distribution localities, ■ - mentioned in the literature and reconfirmed locality, X – mentioned in the literature and not reconfirmed locality).

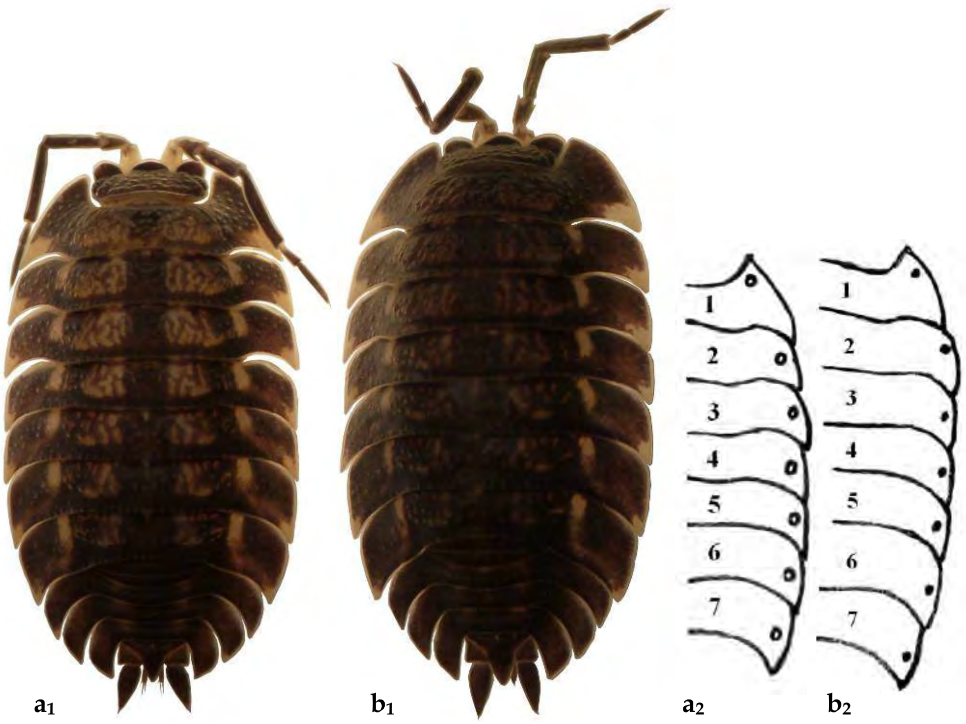


Figure 5.13. Comparison of the dorsal view and glandular pore fields:
a1-a2. *Trachelipus ratzeburgii*, ♂ 10 x 5 mm – Ersig, **b1-b2.** *Trachelipus bujori*, ♂ 10.8 x 5.5 mm – Herneacova.

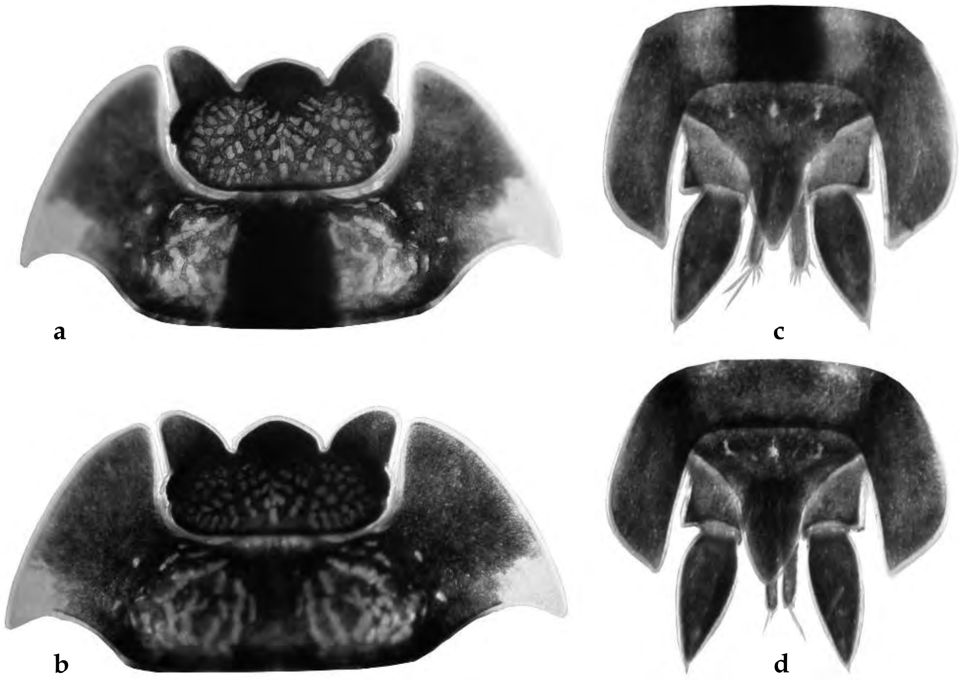


Figure 5.14. Comparison of cephalic lobes: a. *Trachelipus ratzeburgii*, ♂ 10 x 5 mm, – Ersig, **b.** *Trachelipus bujori*, ♂ 10.8 x 5.5 mm – Herneacova; **telson: c.** *Trachelipus ratzeburgii*, ♂ 10 x 5 mm, **d.** *Trachelipus bujori*, ♂ 10.8 x 5.5 mm (the same males)

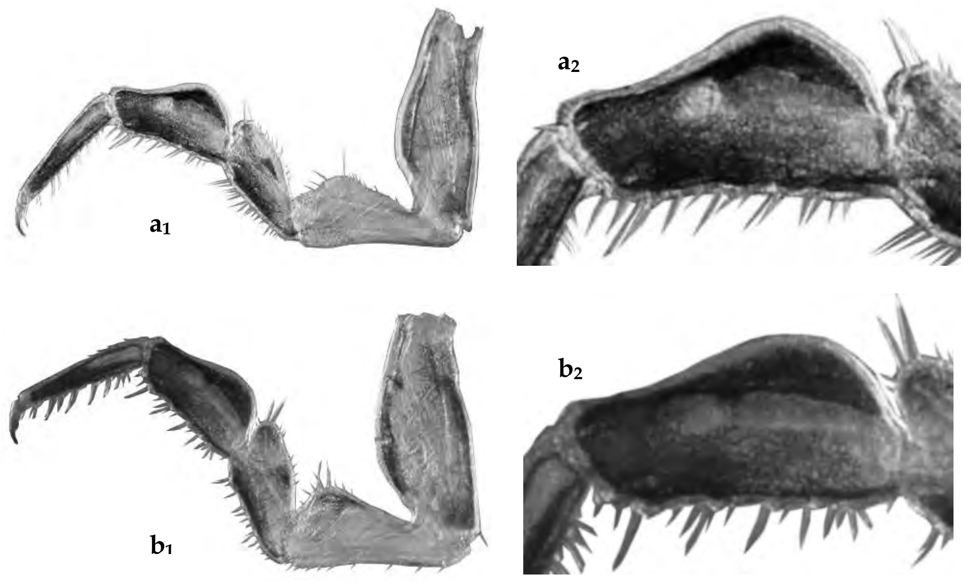


Figure 5.15. Comparison of male pereiopods 7: a1-a2. *Trachelipus ratzeburgii*, ♂ 10 x 5 mm – Ersig, **b1-b2.** *Trachelipus bujori*, ♂ 10.5 x 5 mm – Meri.

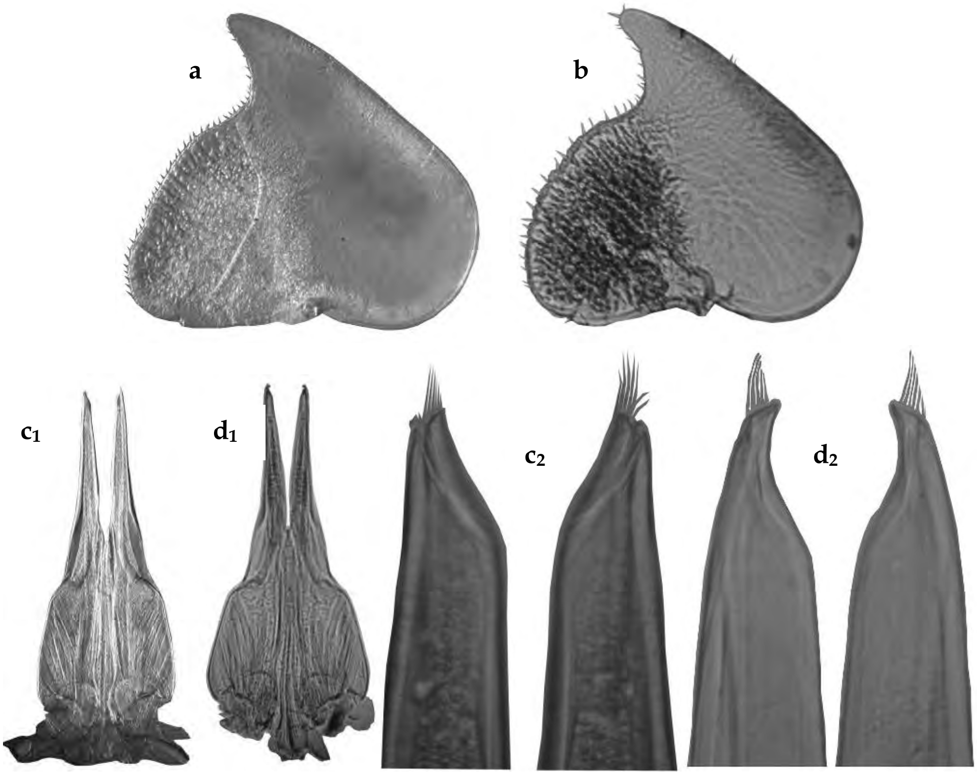


Figure 5.16. Comparison of male pleopod 1 exopods:
a. *Trachelipus ratzeburgii*, ♂ 10.5 x 5 mm – Gârliştei Gorge, **b.** *Trachelipus bujori*, ♂ 10.5 x 5 mm – Meri;
comparison of male pleopod 1 endopods: c_1-c_2. *Trachelipus ratzeburgii*, ♂ 10 x 5 mm – Ersig,
d_1-d_2. *Trachelipus bujori*, ♂ 10.5 x 5 mm – Meri.

6. *Trachelipus difficilis* (Radu, 1950)

Tracheoniscus difficilis Radu, 1950
Tracheoniscus difficilis angulatus Radu, 1950
Tracheoniscus difficilis rotundatus Radu, 1950
Trachelipus difficilis (Radu, 1950), Schmölzer, 1965
Trachelipus difficilis angulatus Radu, 1985
Trachelipus difficilis rotundatus Radu, 1985
Trachelipus difficilis rotundatus (Radu, 1950), Tomescu & Accola, 1992
Trachelipus difficilis (Radu, 1950) Schmidt, 1997
Trachelipus radui Tomescu & Olariu 2000, syn. nov.

Literature consulted for the description of the species: Radu 1950, 1985, Schmölzer 1965, Tomescu & Accola 1992, Schmidt 1997, Tomescu & Olariu 2000.

Examined material and sampling sites

The studied individuals were collected between 1990-2012 from 19 forested habitats situated in nine mountain units: Oaş Mountains, Bârgău Mountains, Călimani Mountains, Stănişoarei Mountains (Eastern Carpathians); Bihor Mountains, Bătrâna Mountains, Gilău Mountains, Arieşului Mountains, Muntele Mare Mountain, Trascău Mountains (Western Romanian Carpathians); Baia Mare Depression; four hilly areas: Feleac Hills, Tăşad Hills, Codrului Hills, Igneşti Hills; and a plain area: Livada Plain.

The species is common in the forests of the above-mentioned geographic units. We have analysed 98 males (48 dissected) and 61 females.

Species description

Size: males: 8.5 x 5 mm – 14 x 6 mm; females: 9 x 5 mm – 14 x 7 mm.

Colour. Tergites are brown – grey. At the base of the coxal plates there are white-yellow oval spots, which form two lateral lines on the entire length of the pereion. In the median zone of the tergites there is a dark-coloured strip, and there is a fine yellow-white reticulated pattern on the sides. There are small yellowish spots at the pleonal segments 3-5, situated laterally to the median. The posterior tops of the coxal plates are whitish (Fig. 6.1. a). There are three white-yellowish spots at the base of the telson (Fig. 6.1. a, c, 6.2. b).

Somatic characters

Cephalon. The lateral lobes are laterally tilted and round shaped at their distal extremity. The median lobe is short and round-shaped (Fig. 6.2. a). There are numerous nodules and white-yellowish spots on the head.

Pereion. The posterior sides of the coxal plates have an obvious sinuosity on the 1-3 pereion segments. The back of the segments 4-7 are curved to the posterior part (Fig. 6.1. a, c). The glandular pore fields are small, round shaped, being spaced of the external side of the coxal plates (Fig. 6.1. b).

Pleon. There are white-yellowish spots laterally to the median on the pleonal segments 3-5, which are darker on males (Fig. 6.1. a). The pleotelson is short, with widened proximal half (Fig. 6.2. b).

Antennae. The ratio of the length between the last and penultimate article varies within 1.1:1 and 1.7:1. The last article of most of the males is longer than the penultimate one (Fig. 6.2. c).

Male pereiopods 7 ischium have straight (Fig. 6.3. b_1) or slightly concave (Fig. 6.3. a_1) ventral edge. The carpus crest varies in shape and height, at all males the crest length being 2/3 of the carpus length (Fig. 6.3. a_1, a_2).

Pleopods. First exopods have sharp distal apex, oriented obliquely relative to the basal side (Fig.6.4. a). The basal half of the endopods` 1 external lateral side is curved, having short thorns at its distal extremity (Fig. 6.4. b_1, b_2). The pleopod 2-5 exopods have no specific morphology (Figs. 6.4. pl_2 – pl_5). With the exception of the endopods, the body regions and appendages with taxonomic importance present inter- and intrapopulational variations, which fall in limits of specific characters, but they suggest that cannot support the validity of the two subspecies: angulatus and rotundatus. Thereby, these variations also exist in males from the same population but do not occur at all characters mentioned by Radu in 1950 and 1985. The variation of the characters and the anomalies will be described and analysed as follows.

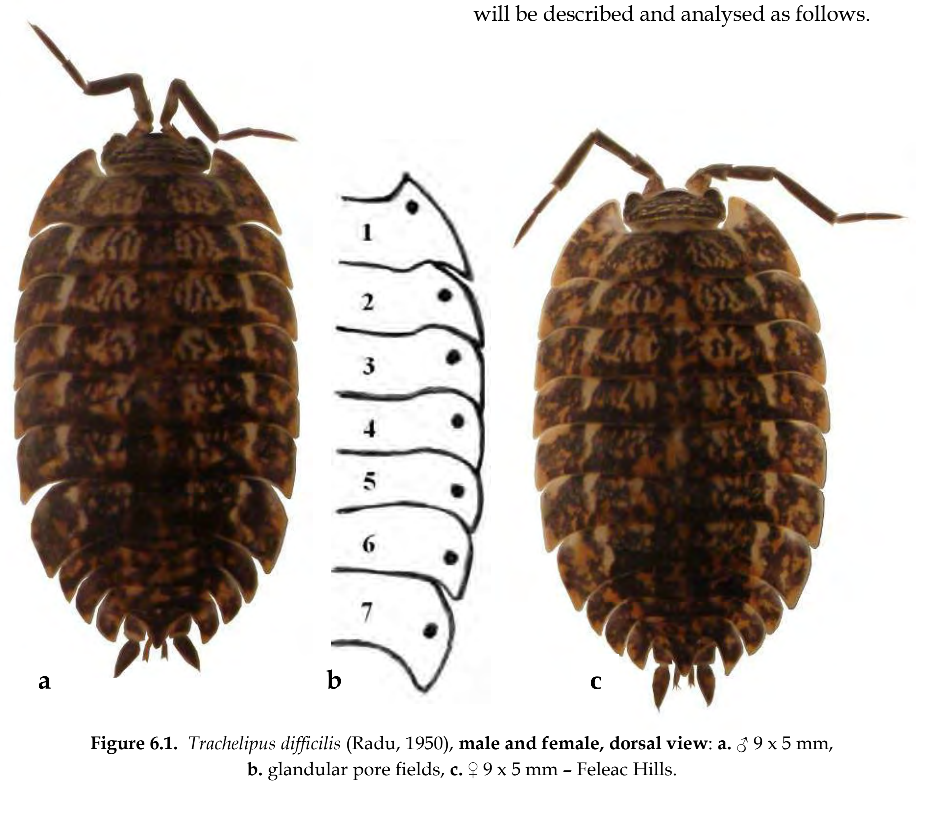


Figure 6.1. *Trachelipus difficilis* (Radu, 1950), **male and female, dorsal view**: **a.** ♂ 9 x 5 mm, **b.** glandular pore fields, **c.** ♀ 9 x 5 mm – Feleac Hills.

Figure 6.2. *Trachelipus difficilis* (Radu, 1950: **a. cephalic lobes, b. telson**, **c. antenna**, ♂ 9 x 5 mm – Feleac Hills.

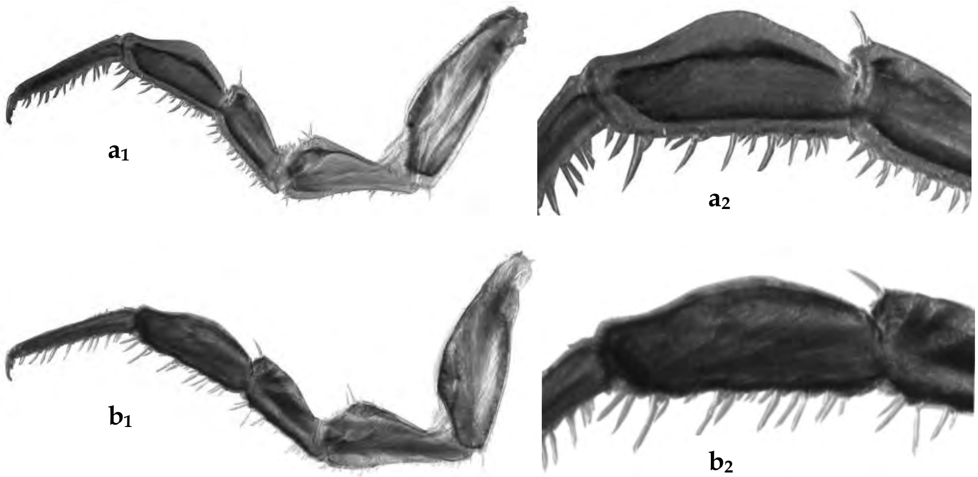


Figure 6.3. *Trachelipus difficilis* (Radu, 1950), **pereiopods 7:** **a_1-a_2.** ♂ 11.5 x 6 mm – Muntele Mare Mountains; **b_1-b_2.** ♂ 12 x 6.5 mm – Codrului Hills.

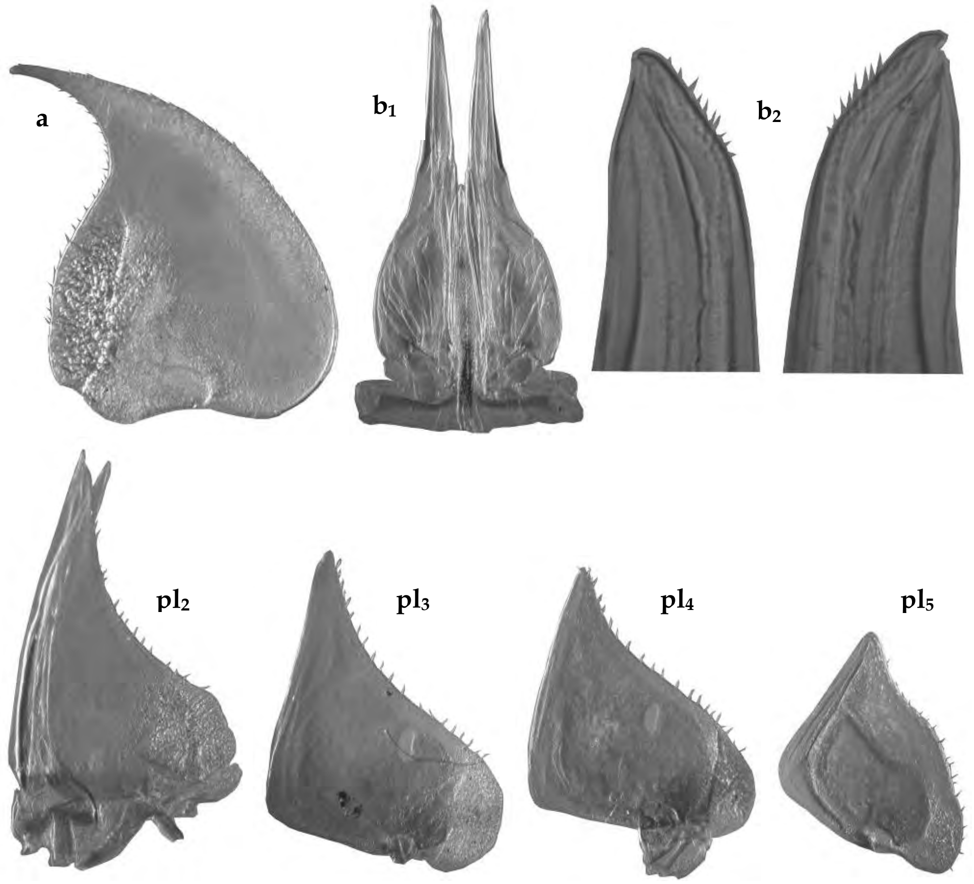


Figure 6.4. *Trachelipus difficilis* (Radu, 1950), **male pleopods** 1: **a.** exopod, ♂ 10 x 5 mm – Feleac Hills; **b_1.** endopod, **b_2.** pleopod 1 endopods` apex, **pl_2 – pl_5.** pleopods 2 – 5 exopods, ♂ 12 x 6.5 mm – Codrului Hills.

Intraspecific morphological variability

The variation of the cephalic lobes` shape and size. In the majority of the studied males the lateral cephalic lobes are short, wide, with round shaped extremity (Figs. 6.5. a, b). In males from some habitats (Scărița-Belioara and Crucişor) the lateral cephalic lobes are long and thin (Figs. 6.5. c, d). The median cephalic lobe of males varies both between different populations and in the same population. The majority of the males have a short, round-shaped median cephalic lobe (Fig. 6.5. a), *rotundatus* form – Radu, 1950 (morphological variety). In a relatively few number of males, the median lobe has an oblique angled distal edge (Fig. 6.5. b, d), *angulatus* form – Radu 1950 (morphological variety). These variations occur in males collected in the same habitats (Scărița-Belioara, Crucişor, Baia Mare Depression, Făgetul Clujului, etc.). We believe that Radu (1950) collected too few specimens from few habitats and could not apprehend that the median cephalic lobe's shape represents an intraspecific variety. The different forms of the cephalic lobes do not prove the existence of two subspecies, the other specific characters being similar.

Pleotelson. In the majority of males and females, the pleotelson is short, with widened proximal half (Fig. 6.6. a). In the case of the specimens from Scarita-Belioara and Ignesti, there are males with short pleotelson, but also males with longer pleotelson with thinner proximal half (Fig. 6.6. b).

Male pereiopods 7 present variations in height and curve of the carpus crest. In all males the length of the carpus crest is approximately 2/3 of the carpus length (Fig. 6.7.).

Pleopods. Male pleopod 1 exopods vary in internal and external curve shape and pleopods` width. In all males, the apex has an oblique position relative to basal edge of the pleopods, specific character for *T. difficilis* (Fig. 6.8.).

Morphological anomalies

The anomaly of body shape was observed in 13% of the males and 4 females collected from an oak forest from Codrului Hill, Satu-Mare County. In two males, the pleonal 1-2 tergites were longer than the normal length. Between the coxal plates of the pereional tergites 7 and the pleonal 3 tergite epimeres there is a large space, unlike of the specimen with the normal configuration (Fig. 6.9.).

The anomaly of the pereiopod 7 carpus crest was observed in three males. In each male the carpus chitin crest was different from that of the paired pereiopod`s, which had normal crest (Fig. 6.12.). The anomaly of the pleopod 1 exopods was observed in two males. In one male there was a difference regarding the apex`s length (Fig. 6.10.), but in the other male there were differences both in the apex and the curvature of the external edge (Fig. 6.11.).

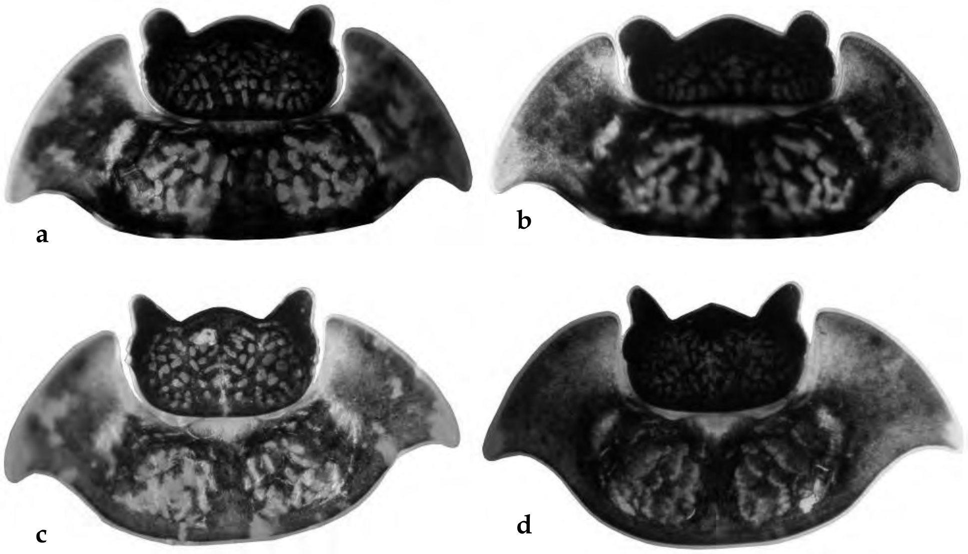


Figure 6.5. *Trachelipus difficilis* (Radu, 1950), **the variation of the cephalic lobes**: **a.** ♂ 9 x 5 mm, **b.** ♂ 10 x 5 mm – Feleac Hills, **c.** ♂ 10 x 5 mm, **d.** ♂ 12.5 x 6.5 mm – Muntele Mare Mountain.

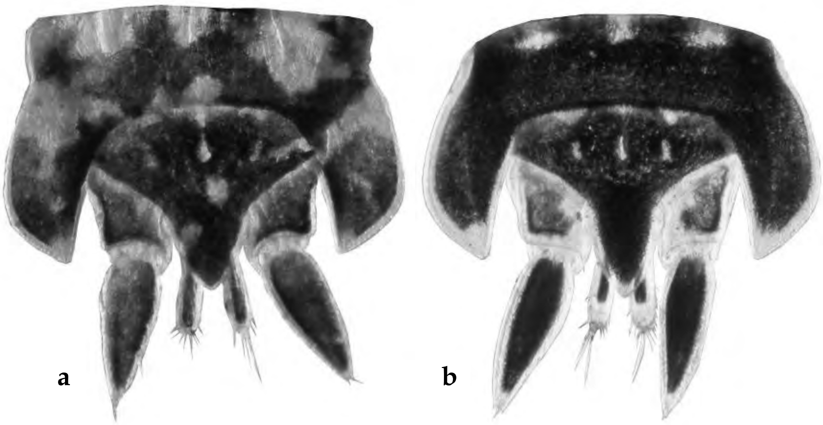


Figure 6.6. *Trachelipus difficilis* (Radu, 1950), **the variation of the telson**: **a.** ♂ 10 x 5 mm, **b.** 11 x 5 mm – Muntele Mare Mountain.

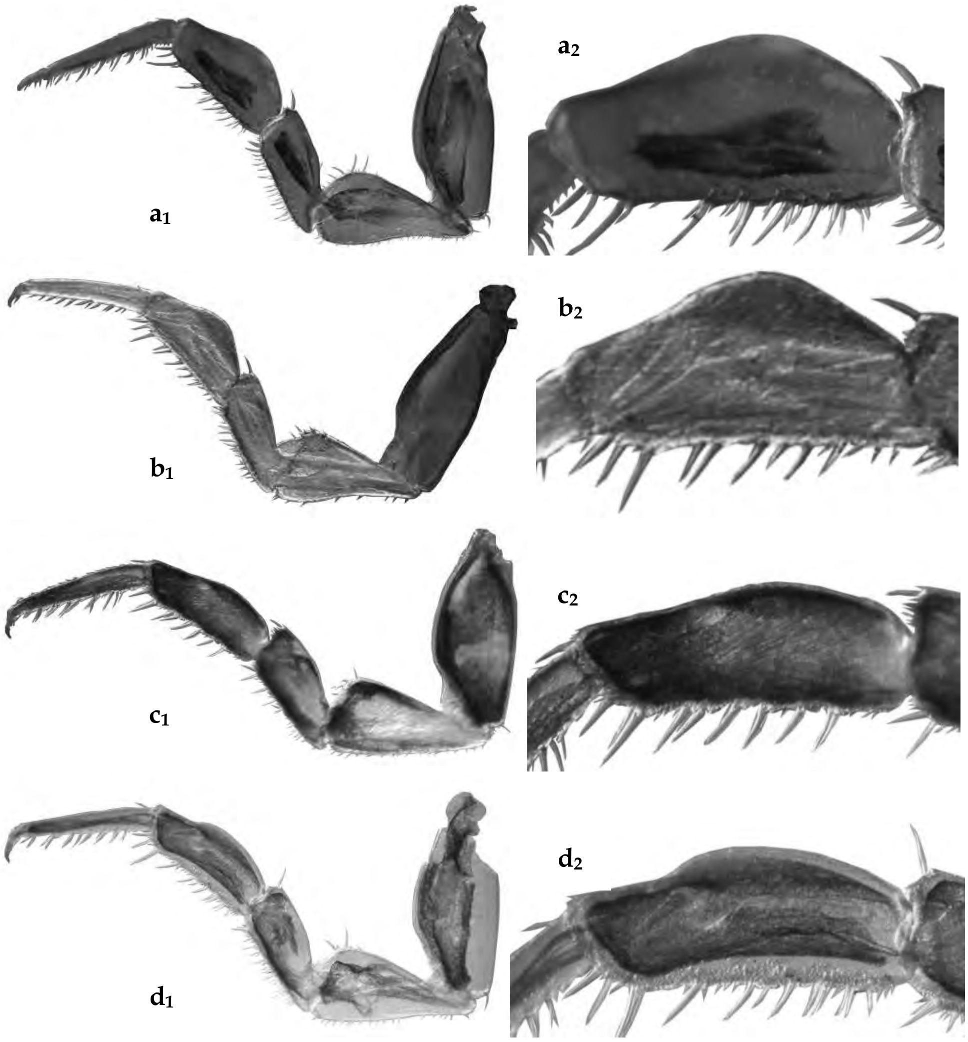


Figure 6.7. *Trachelipus difficilis* (Radu, 1950), **the variation of the male pereiopod 7 carpus crest**:
a1-a2. ♂ 10 x 5 mm – Bârgău Mountains, **b1-b2.** ♂ 10 x 5.5 mm – Baia Mare Depression,
c1-c2. ♂ 9 x 5 mm – Feleac Hills, **d1-d2.** ♂ 10.8 x 5.4 mm – Muntele Mare Mountain.

Remarks

For the description of the specific morphological characters and intraspecific variability of *T. difficilis* Radu, 1950 we have studied 98 males and 61 females collected from different geographical units. The study of the specific morphological characters of *T. difficilis* certifies the synonymy of *Trachelipus radui* Tomescu & Olariu 2000 with *T. difficilis*. The description of *T. radui* was made on a low number of males collected from a spruce forest from Crucea locality, Stănişoarei Mountains, Eastern Carpathians. At that moment, bibliographical data about the specific morphological characters` variability of the species *T. difficilis* were not known. *T. difficilis* is a species in which the intrapopulational and interpopulational variability seems stronger than in other Trachelipus species. Comparing the described specific morphological characters in *T. radui* with the variability of the characters of *T. difficilis*, we found that males studied for *T. radui* fit in the limits of the morphological variability of *T. difficilis* Radu, 1950.

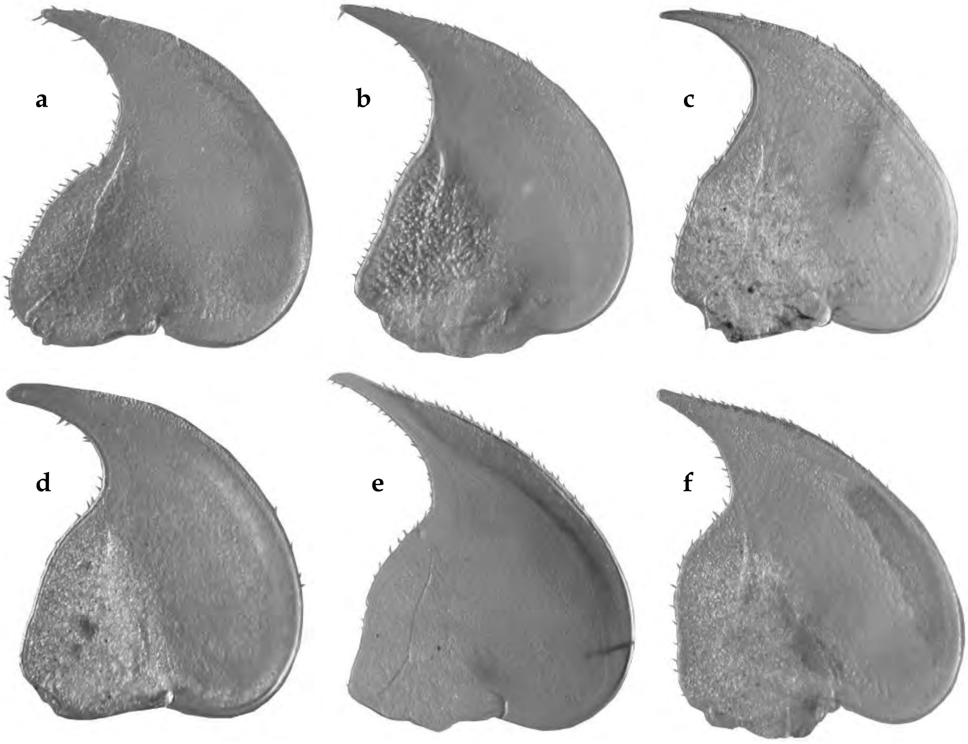


Figure 6.8. *Trachelipus difficilis* (Radu, 1950), **the variation of male pleopod 1 exopods**: **a.** ♂ 9 x 5.5 mm – Muntele Mare, **b.** ♂ 9 x 5 mm – Codrului Hills, **c.** ♂ 11.5 x 5.5 mm – Muntele Mare, **d.** ♂ 9 x 5 mm – Bihor Mountains, **e.** ♂ 10 x 5 mm – Bârgău Mountains, **f.** ♂ 12 x 6.5 mm – Codrului Hills.

Ecology

Radu (1950) mentions that *T. difficilis* specimens were collected manually in forests (under fallen logs) between the localities Săvârşin, Bulza, Coşteiu and Pietroasa-Fărăşeşti. Those localities are situated in the eastern parts of Arad and Timiş Counties. By quantitative ecological researches, *T. difficilis* is a sylvan species that live in all forest types from mountain areas, low hills, and even plains from Romania (Accola et al. 1993, Ferenţi & Covaciu-Marcov 2012, Ferenţi et al. 2012a, 2013b, Tomescu 2010; Tomescu & Accola 1992b; Tomescu et al. 1992, 1995, 2008). The individuals live under litter, fallen logs and under the bark of fallen trees. The populations of *T. difficilis* live only in humid forests from plains and hills with low altitude, even below 200 m (e.g. Ferenţi et al. 2013b).

Geographic distribution

T. difficilis is present in Poland, Slovakia, Hungary and western Romania (Schmalfuss 2003), being considered a Carpathian endemism (see in: Vilisics 2008). However, *T. difficilis* was also reported in Belarus and southern Crimea (Kuznetsova & Gongalsky 2012). It was mentioned in different zones of Romania (Fig. 6.13.), although it was considered initially limited to a small area from the western part of the country (Radu 1985). Thus, it occurs frequently in western Romania, from Maramureş County (Vilisics 2008), Oaş Mountains (Ferenţi & Covaciu-Marcov 2012, Ferenţi et al. 2013c) and Tur River basin where it is present even in plain (Ferenţi et al. 2012a, 2013b). It was reported in Tărcăiţei Hills (Tomescu et al. 2008), Pădurea Craiului Mountains (Ianc & Ferenţi 2014), Zărandului Mountains (Radu 1950), Turzii Gorge (Accola et al. 1993), Poiana Ruscă Mountains (Radu 1950), Piatra Craiului Mountains (Giurgincă et al. 2006), Vârghisului Gorge (Giurgincă & Vănoaică 2006-2007), Jiului Gorge (Tomescu et al. 2011). It was identified as *T. radui* in Stănişoarei Mountains from the Eastern Carpathians (Tomescu & Olariu 2000, see in Remarks).

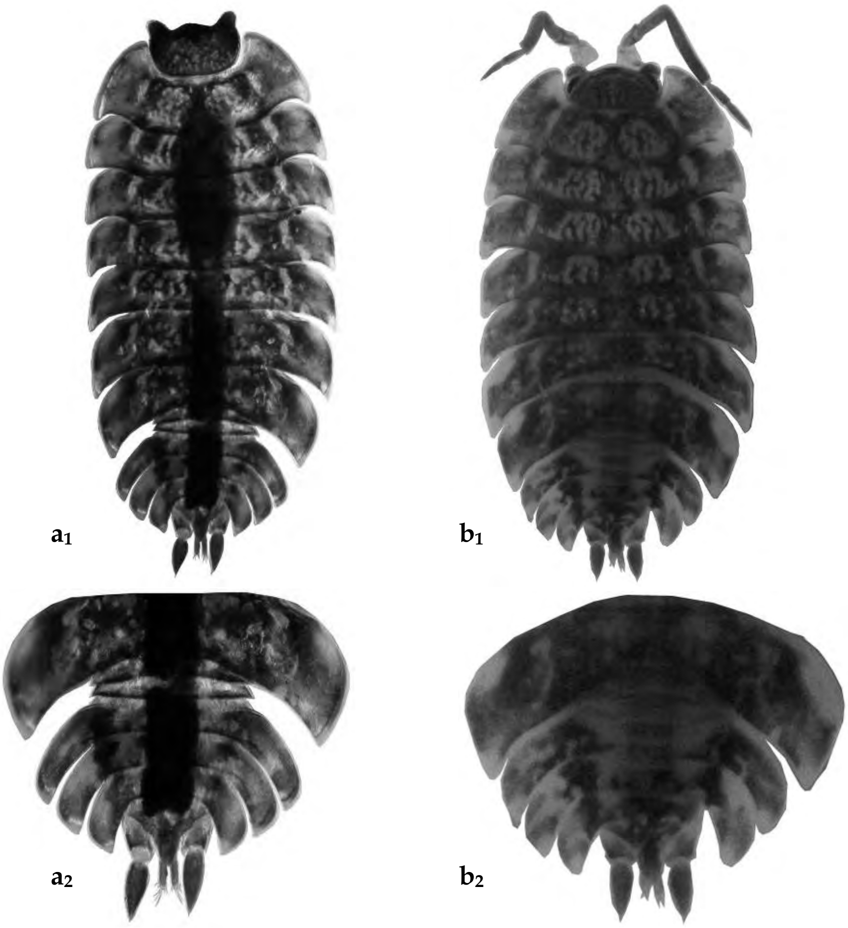


Figure 6.9. *Trachelipus difficilis* (Radu, 1950), **morphological anomaly of the body shape**: **a1-a2.** abnormal shape, ♂ 11 x 5 mm, **b1-b2.** normal shape, ♂ 9 x 5 mm – Codrului Hills.

Figure 6.10. *Trachelipus difficilis* (Radu, 1950), **morphological anomalies of the pleopod 1 exopods,** ♂ 12 x 6.5 mm – Codrului Hills.

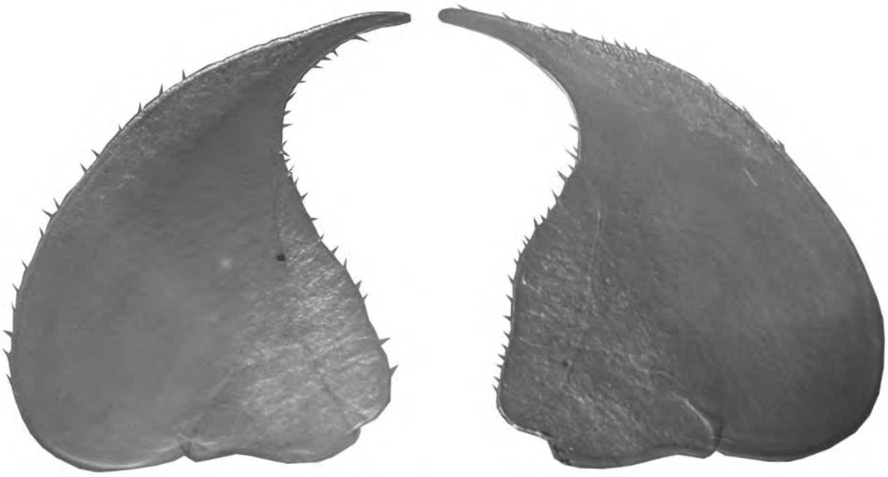


Figure 6.11. *Trachelipus difficilis* (Radu, 1950),
morphological anomalies of the pleopod 1 exopods, ♂ 11 x 5 mm – Oaş Mountains.

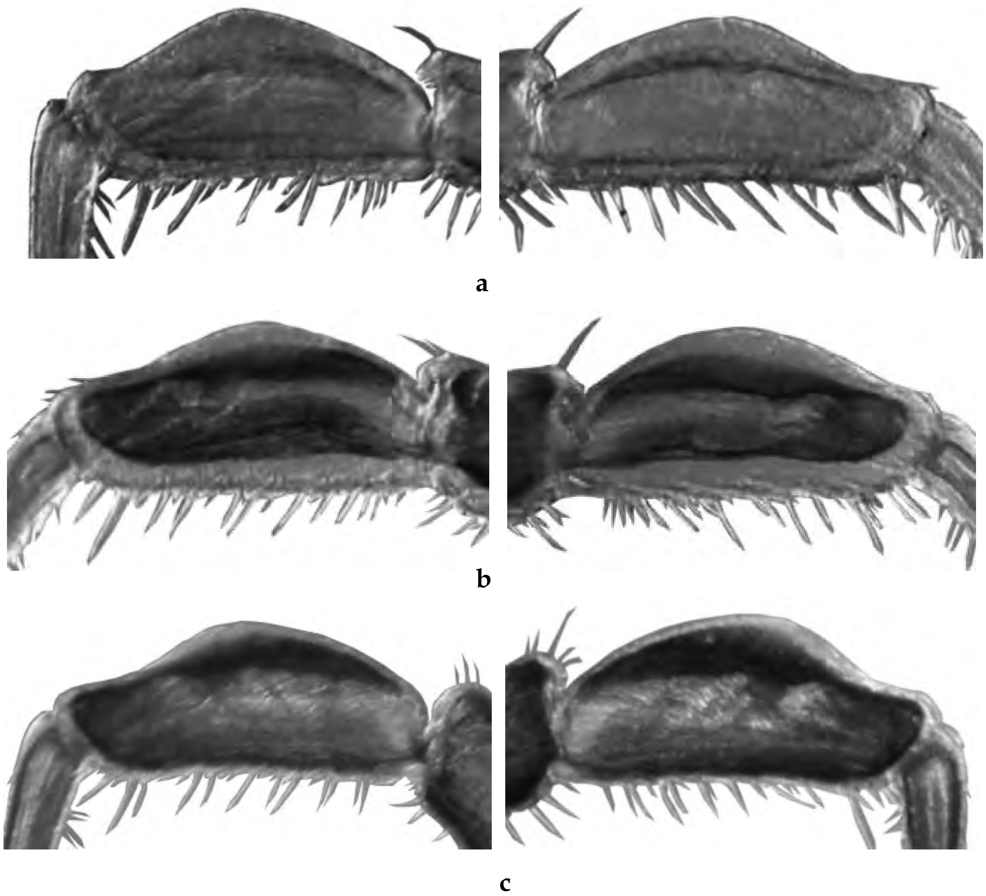


Figure 6.12. *Trachelipus difficilis* (Radu, 1950), **morphological anomaly of the pereiopod 7 carpus crest**: **a.** ♂ 14 x 6 mm – Baia Mare Depression, **b.** ♂ 12.5 x 5 mm – Muntele Mare Mountain, **c.** ♂ 11.4 x 5.8 mm – Muntele Mare Mountain.

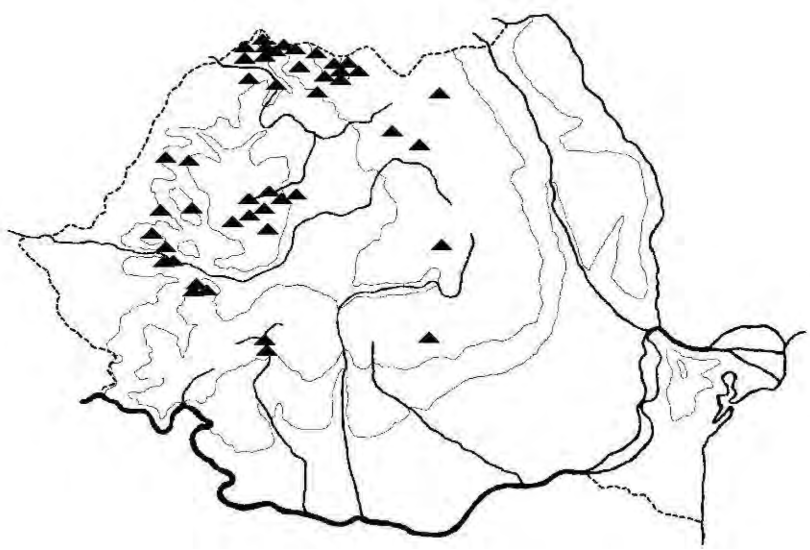


Figure 6.13. The distribution of *T. difficilis* in Romania (own results and literature data)

Altitude. By our results and the literature, *T. difficilis* is present in Romania between 130 m altitude in north-western region of the country, in Tur River basin (Ferenți et al. 2013b) and 1350 m altitude in Parâng Mountains (Tomescu et al. 2011).

7. *Trachelipus affinis* (Koch, 1841) = *T. wächtleri* (Strouhal, 1951)

Porcellio affinis Koch, 1841 (cited by Budde-Lund, 1885)
Porcellio affinis (Koch, 1841) Budde-Lund, 1885
Tracheoniscus affinis Wächtler, 1937
Tracheoniscus affinis (Koch, 1841) Radu, 1939
Tracheoniscus affinis (Koch, 1841) Radu, 1958
Tracheoniscus wächtleri Strouhal, 1951
Trachelipus wächtleri (Strouhal, 1951) Schmölzer, 1965
Trachelipus wächtleri (Strouhal, 1951) Radu, 1985
Trachelipus difficilis (Radu, 1950) Schmidt, 1997

Literature consulted for the description of the species: Budde-Lund 1885, Wächtler 1937, Radu 1939, 1950, 1958, 1985, Schmölzer 1965, Schmidt 1997 (Schmidt, 1997 – considers synonymy between species *T. wächtleri* and *T. difficilis*, Radu, 1950).

Remarks. *T. affinis* is a species name, which had been used for a long time for a particular Trachelipus group, present in the forests of Eastern and Central Europe, including Romania (see in: Strouhal 1951). Later the name *T. affinis* was considered as not valid, the specimens presented initially as this species belonging in reality to another known species (see in: Strouhal 1951, Schmidt 1997). On this basis, the name *T. wächtleri* had been proposed, without any morphological description (Strouhal 1951). Later, *T. wächtleri* was synonymised with *T. difficilis* (Schmidt 1997). After analysing the material we have collected from Romania, we observed morphological differences between the *T. difficilis* individuals (in wide sense), of which some fit to the specific limits presented for *T. affinis* = *T. wächtleri*. Thereby, we found individuals of which morphological characters match with those considered characteristic for *T. affinis* and presented as such by Wächtler (1937). Afterwards, Frankenberger also presented specimens with the same morphological characters (1959). Hereupon, we will describe the individuals we have analysed, and which presented the respective characters, as a valid species, *T. affinis* = *T. wächtleri*.

Examined material and sampling sites

The studied material was collected between 1990 – 2012, from 23 forest habitats situated in 13 mountain units: Oaş Mountains, Suhard Mountains, Rarău Mountains, Bârgăului Mountains, Călimani Mountains (Eastern Carpathians); Parâng Mountains, Vâlcan Mountains (Southern Carpathians); Bihor Mountains, Bătrâna Mountains, Gilău Mountains, Arieşului Mountains, Muntele Mare, Trascău Mountains (Western Romanian Carpathians); three depressions: Dorna Depression, Baia-Mare Depression, Beiuş Depression; two hilly areas: Feleacului Hills and Tăşad Hills.

We studied 118 males (42 dissected) and 41 females.

Species description

Size: males 8 x 4.5 mm – 12.3 x 7 mm, females 8 mm – 13 mm.

Colour. In males the dorsal part of the body is swarthy-grey, dark-grey, with two yellow-orange mottled bands situated sidewise of the median area, which has a dark-grey colour. At the base of the coxal plates, there are yellow-orange elongated spots, which form two bands at the sides of the body (Fig. 7.1. a, b). The posterior corners of the coxal plates are yellow. In some males, the spots from the border of the coxal plates are smaller on pereionites 1, 5, 6, 7 (Fig. 7.1. a). On females the tergites are light coloured and more variable, even light-grey – brown-grey.

Somatic characters

Cephalon. The lateral lobes are well developed, of a near-rectangular shape, tilted sideways. The median lobe is less developed (Fig. 7.2. a). There are variations of the lateral and median lobes inside of the population and between different populations. There are numerous yellow-orange spots on the head.

Pereion. The posterior side of tergites 1-4, on the coxal plates, presents pronounced sinuosity. The posterior sides of the segments 5-7 are curved toward the rear of the body (Fig. 7.1. a – c). The glandular pore fields are round-shaped and are nearly adjacent to the lateral margin of the coxal plates (Fig. 7.1. c).

Pleon. There are small, yellow-orange spots on the lateral parts of the segments 3-5.

The pleotelson is short, with a wide distal half at the base (Fig. 7.2. b).

Appendages

Antennae. The ratio of the last two articles varies. There were studied males with equal length of the two articles (Fig. 7.2. c) as well as males with last longer than penultimate article, the ratio ranging from 1.1:1 to 1.4:1.

Pereiopods. Male pereiopods 7 have the ventral edge of the ischium slightly concave, rarely straight. The carpus has a large crest, its length being equal with that of the carpus. The crest is equally curved, the carpus` maximum height pertaining to its median part (Fig. 7.3. a, a_1). On the merus and carpus of pereiopods 1-4 there are numerous thorns in dense rows, these being fewer and shorter on pereiopods 5-7 (Fig. 7.4.).

Pleopods. The male pleopod 1 exopods have greater length than width, the distal apex is sharp as a horn, being parallel with the exopod`s base (Fig. 7.5. a). The endopods have external lateral side from the basal half as a straight line, oriented obliquely towards the rear. The endopods` distal tip has short spines (Fig. 7.5. b_1, b_2). The pleopod 2-5 exopods have no specific morphological characters (Fig. 7.5. pl_2 – pl_5).

Intraspecific morphological variability

The body colour is lighter in some males, the spots from the base of coxal plates being longer and wider (Fig. 7.6. a). In other males, the tergites are darker and speckled softer, with shorter and narrower spots on the base of coxal plates (Fig. 7.6. b).

The lateral head lobes, in the most of males are relatively short and wide (Fig. 7.7. a). In males from Scăriţa Belioara these are longer and narrower (Fig. 7.7. b).

The pleotelson is short, with broad base in the vast majority of males (Fig. 7.2. b). In the males from Scăriţa Belioara the pleotelson is longer and narrower (Fig. 7.7. c – d).

In males, the width of the pleopod 1 exopods and the length of their posterior apex vary (Fig. 7.8.). In all cases, the horn orientation is parallel with the base of the horn.

Morphological anomalies were observed exclusively on male pereiopods 7. In a male from Oaş Mountains (9 x 4.5 mm) the left pereiopod 7 carpus has no crest, which is present at the right pereiopod 7 carpus (Fig. 7.9. a_1, a_2). In another male from the same population, the crest's height is unequal within the two pereiopods (Fig. 7.9. b_1, b_2).

Ecology

T. affinis = *T. wächtleri* is a sylvan species, inhabiting all forest types from mountain areas and hills over 300 m a.s.l. and mountain depressions. Also, *T. affinis* = *T. wächtleri* was found in mountain hayfields neighbouring forests (Tomescu et al. 2000, 2001, 2002). *T. affinis* = *T. wächtleri* individuals were not identified in samples from hilly forests below 300 m, slope forests with southern or eastern exposure, where the soil humidity decreases over summer, forests from plains, pine plantations, hayfields from hilly and mountain areas (Mureşan et al. 2003, Hotea & Hotea 2009, 2010, Tomescu et al. 2011). The populations of this species inhabit forests with moderate soil humidity even during summer. The individuals live under litter and fallen logs. The *T. affinis* = *T. wächtleri* individuals were collected under the bark of fallen logs and cut tree stumps in wetland forests (Tomescu – PhD thesis 1974, Radu & Tomescu 1976). The rich material obtained in our previous researches (Radu & Tomescu 1976, 1980-1981, Dolniţchi-Olariu & Tomescu 1997, Tomescu 2010, Tomescu et al. 2000, 2001, 2002, 2008, 2011, Hotea et al. 2003, Mureşan et al. 2003, Hotea & Hotea 2008, 2009) allowed choosing a large number of *T. affinis* = *T. wächtleri* males and females for this study. We could also establish the habitats in which the populations of this species live and cohabitate with other terrestrial isopod species. *T. difficilis* and *T. affinis* = *T. wächtleri* coexisted in 12 of the 23 habitats where the studied individuals were sampled

Geographic distribution

Budde-Lund (1885) mentioned the presence of *Porcellio affinis* = *Trachelipus wächtleri* in Wien and Galitia. Verhoeff (1907) reports the species from different zones of Transylvania. According to Schmölzer (1965), *T. affinis* = *T. wächtleri* exists in Slovakia and Transylvanian Mountains. Radu (1985) mentioned Verhoeff`s affirmations due to the distribution of the species in Transylvania, Moldova (Romania), Poland and Central Europe. Schmalfuss (1979) cites the species in Chios Island, Greece. In Romania the species was found in Sinaia area (Radu 1939), where it was mentioned as *Tracheoniscus affinis*. Recently it was identified in Dorna area from Eastern Carpathians (Dolniţchi-Olariu & Tomescu 1997), Gutâi Mountains (Hotea et al. 2003), Baia-Mare Depression (Hotea & Hotea 2008, 2010), Oaşului Depression and Igniş Mountains (Hotea & Hotea 2009), Tărcăiţei and Hidişelului Hills (Tomescu et al. 2008). The species was mentioned in numerous zones from Arieş (Tomescu et al. 2000, 2002, Mureşan et al. 2003) and Someş Rivers` basin (Tomescu et al. 2001, 2005). The species was encountered even in Dobruja (Tăbăcaru & Boghean 1989, Giurgincă & Ćurčić 2003). We have collected *T. affinis* = *T. wächtleri* in forests and hayfields from mountain areas (Southern Carpathians, Eastern Carpathians, Western Carpathians) and forests situated in mountain depressions and hills over 300m a.s.l. from Transylvania (Fig. 7.11.).

Altitude. According to the literature, the species was found in Romania between approximately 15 m altitude in Mangalia area from Dobruja (Giurgincă & Ćurčić 2003) and 1200 m at Scăriţa-Belioara (Tomescu et al. 2000).

Comparative description of the distinctive morphological specific characters of *T. difficilis* (Radu, 1950) and *T. affinis* (Koch, 1841) = *T. wächtleri* (Strouhal, 1851)

The coxal plates have a pronounced sinuousity on the 1-3 pereion segments in *T. difficilis* (Fig. 7.12. a_1, a_2), and on the 1-4 pereion segments in *T. affinis* = *T. wächtleri* (Fig. 7.12. b_1, b_2).

The glandular pore fields are distanced from the lateral edge of the coxal plates in *T. difficilis* (Fig. 7.12. a_2), and bonded to the lateral edge in *T. affinis* = *T. wächtleri* (Fig. 7.12. b).

The male pereiopod 7 carpus crest length is ¾ of the carpus` total length (Fig. 7.13. a) in *T. difficilis*, but in *T. affinis* = *T. wächtleri* is almost equal with the carpus` length (Fig. 7.13. b).

The pleopod 1 exopods have their sharp apex oriented obliquely to the pleopods` basal side *in T. difficilis* (Fig. 7.13. c), but the apex is oriented parallel to the pleopods` basal side in *T. affinis* = *T. wächtleri* (Fig. 7.13. d).

The external side of the basal half of male pleopod 1 endopods is curved in *T. difficilis* (Fig. 7.13. e), and is straight in *T. affinis* = *T. wächtleri* (Fig. 7.13. f).

We appreciate that the above-mentioned morphological characters are arguments for considering *T. difficilis* and *T. affinis* = *T. wächtleri* as valid species.

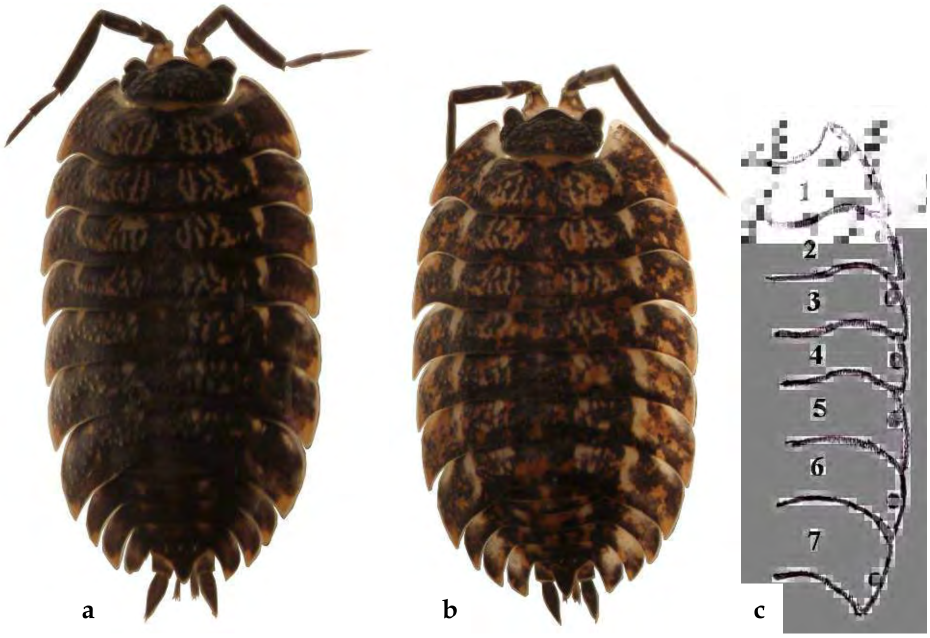


Figure 7.1. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951): **male and femele, dorsal view**: **a.** ♂ 10 x 5 mm, **b.** ♀ 11 x 6.5 mm, **c.** glandular pore fields – Feleacului Hills

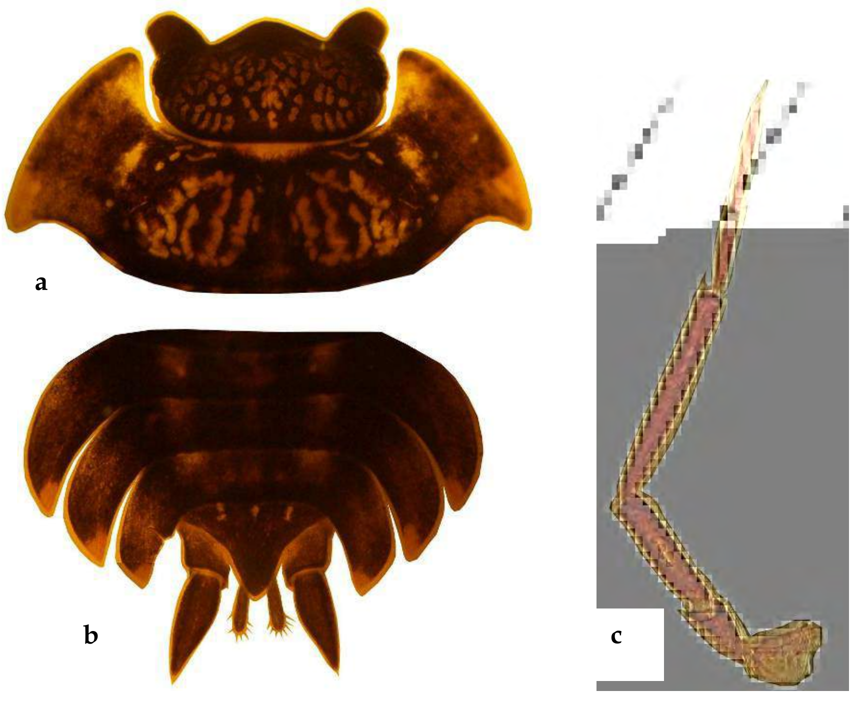


Figure 7.2. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951): **a cephalic lobes**, **b. telson**, ♂ 10 x 5 mm – Feleacului Hills; **c. antenna**, ♂ 10.5 x 5 mm – Oaş Mountains.

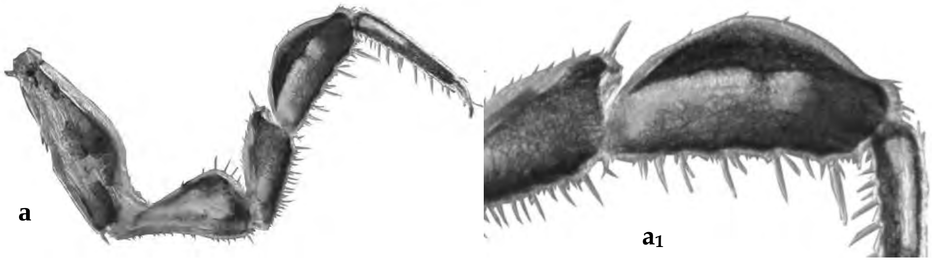


Figure 7.3. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951):
a. pereiopods 7, a_1. the carpus crest, ♂ 10 x 5 mm – Feleacului Hills.

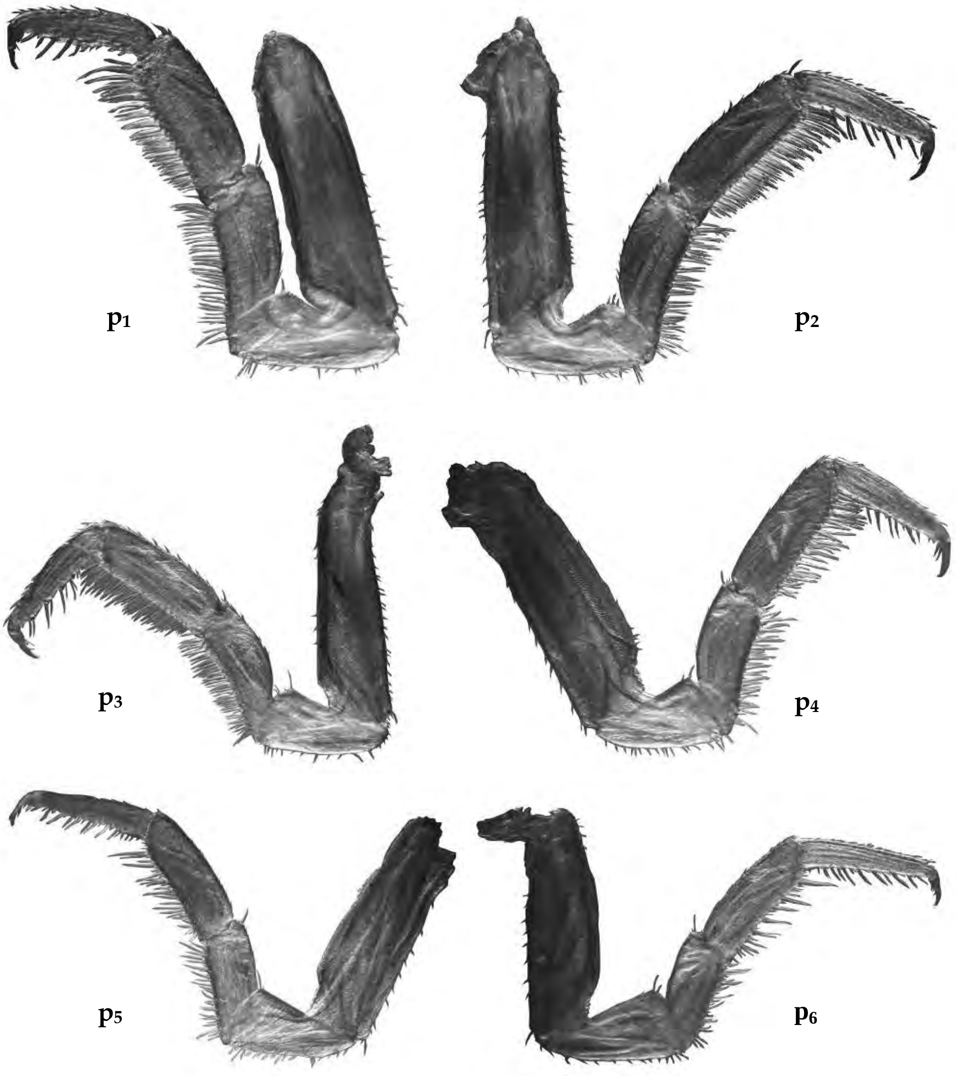


Figure 7.4. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951),
pereiopods 1-6: p_1 – p_6. ♂ 9 x 4.5 mm – Dorna Depression.

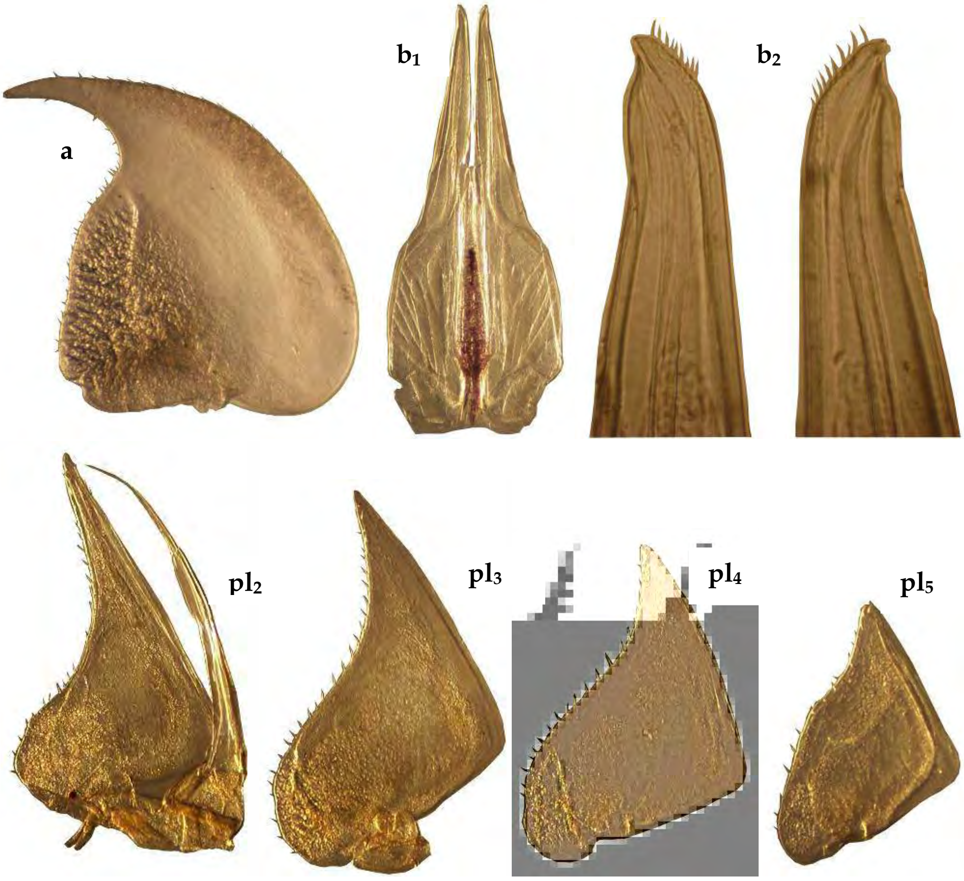


Figure 7.5. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951): **male pleopods 1**: **a.** exopods, ♂ 10 x 5 mm – Feleacului Hills; **b₁.** endopods, **b₂.** the apex of the pleopod 1 endopods, ♂ 10.5 x 5 mm – Oaş Mountains; **pl₂ – pl₅. pleopod 2 - 5 exopods,** ♂ 10.5 x 5 mm – Călimani Mountains.

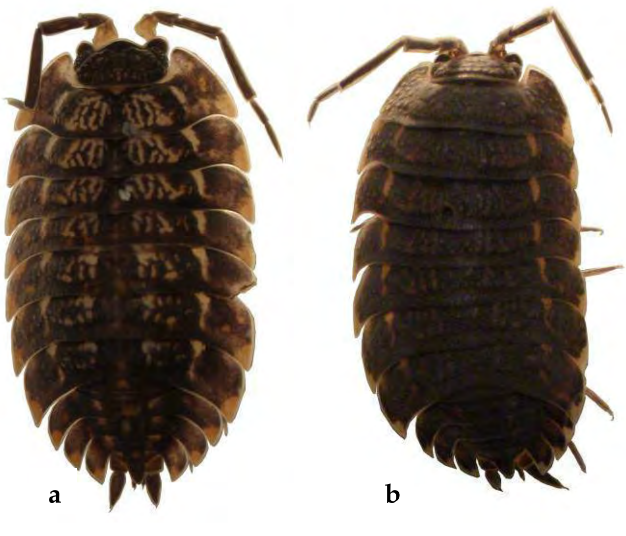


Figure 7.6. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951), **morphological variations**: **body colour**, **a.** ♂ 8 x 4.5 mm – Feleac Hills, **b.** ♂ 12 x 6 mm – Călimani Mountains.

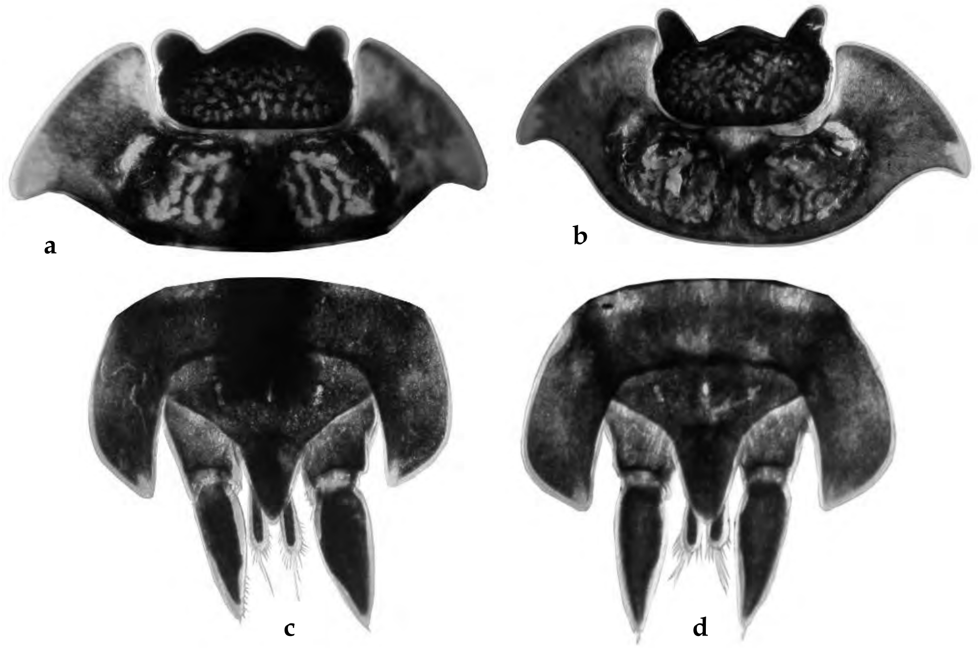


Figure 7.7. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951), **morphological variations**: **cephalic lobes**, – **a.** ♂ 8 x 4.5 mm – Feleac Hills, **b.** ♂ 12.3 x 5.5 mm – Muntele Mare; **telson**, **c.** ♂ 11.4 x 5.8 mm, **d.** ♂ 12.3 x 5.5 mm – Muntele Mare Mountains.

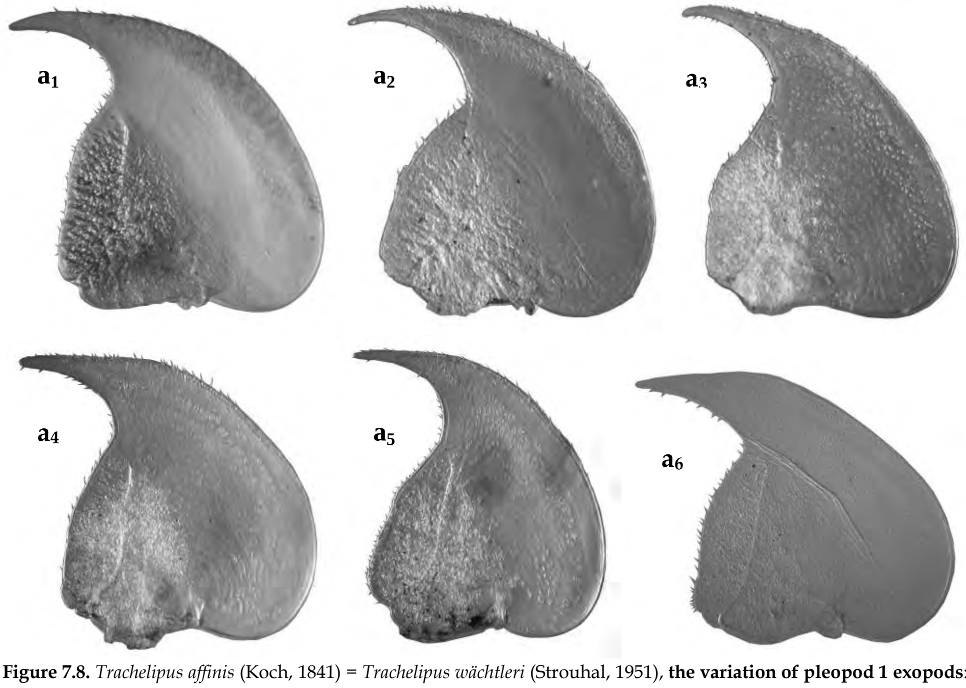


Figure 7.8. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951), **the variation of pleopod 1 exopods**: **a_1.** ♂ 10 x 5 mm – Feleac Hills, **a_2.** ♂ 10.5 x 5 mm – Călimani Mountains, **a_3.** ♂ 10.5 x 5 mm – Oaş Mountains, **a_4.** ♂ 12.3 x 5.5 mm – Muntele Mare Mountains, **a_5.** ♂ 11.4 x 5.8 mm – Muntele Mare Mountains, **a_6.** ♂ 12 x 7 mm – Tăşad Hills.

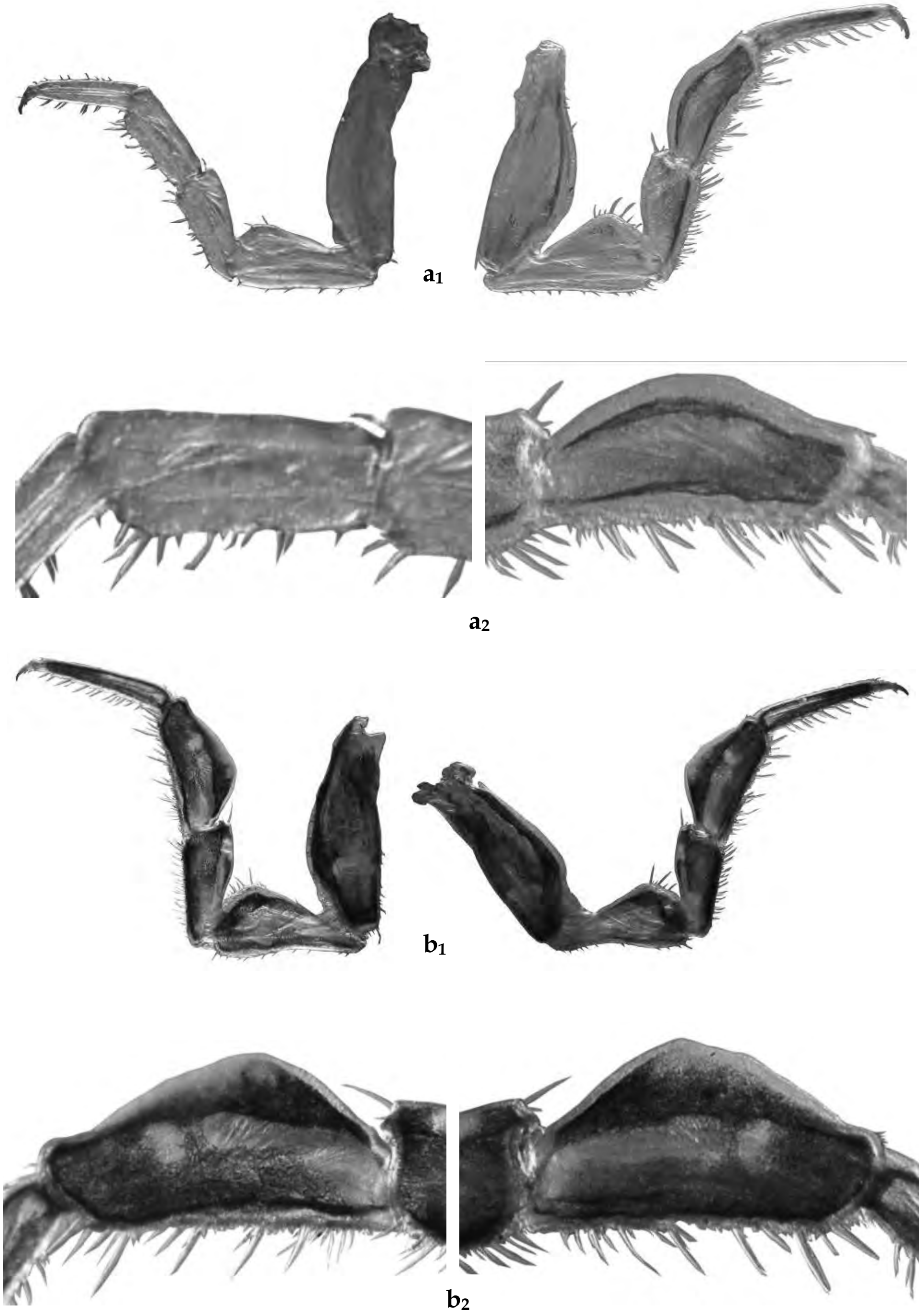


Figure 7.9. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951): **morphological anomalies of the pereiopod 7 carpus crest**: **a1, a2.** ♂ 9 x 4.5 mm, **b1, b2.** ♂ 12.2 x 6 mm – Oaş Mountains.

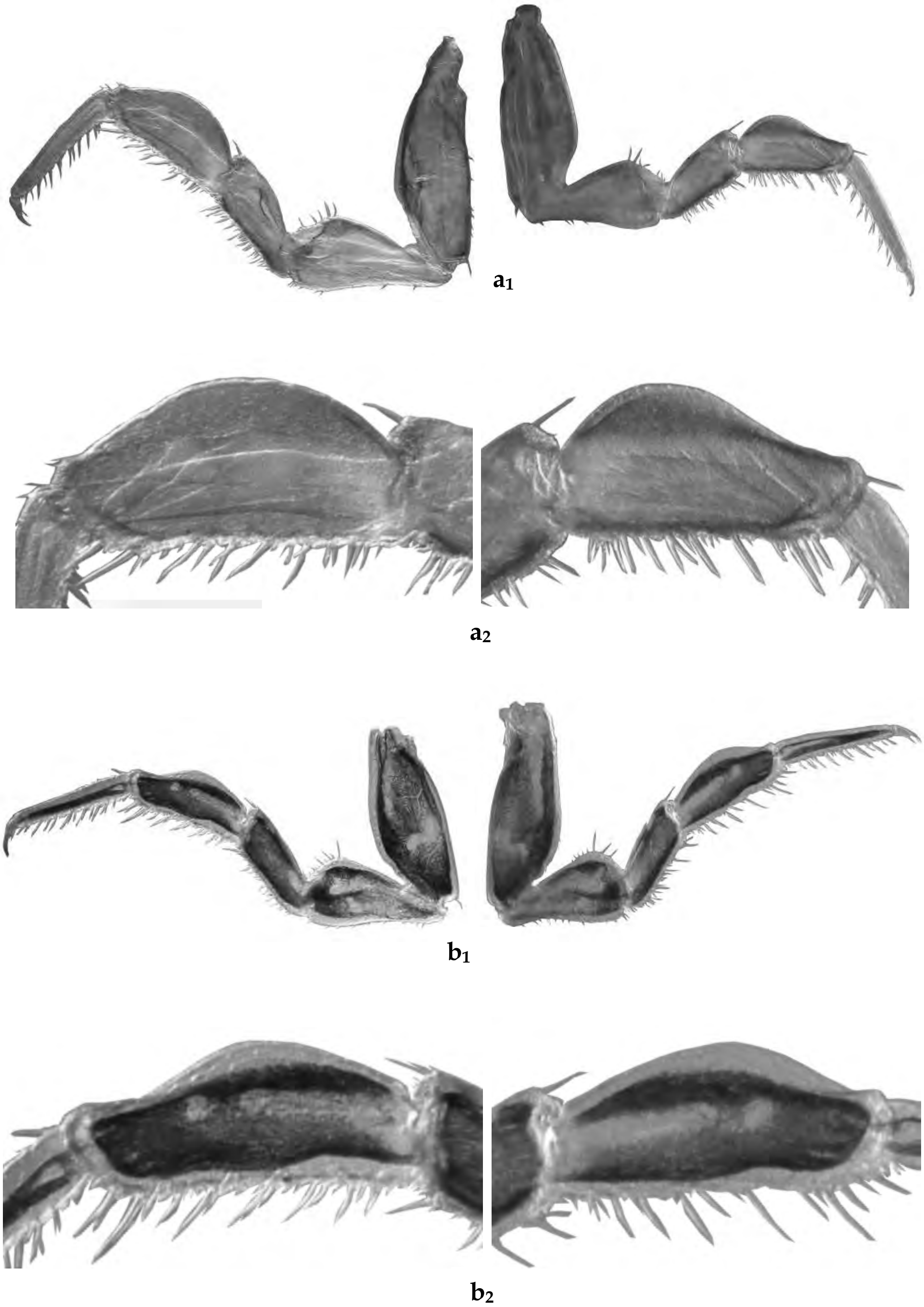


Figure 7.10. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951):
morphological anomalies of the pereiopod 7 carpus crest: **a_1, a_2.** ♂ 10.5 x 6 mm – Baia Mare Depression;
b_1, b_2. ♂ 11.5 x 5 mm – Călimani Mountains.

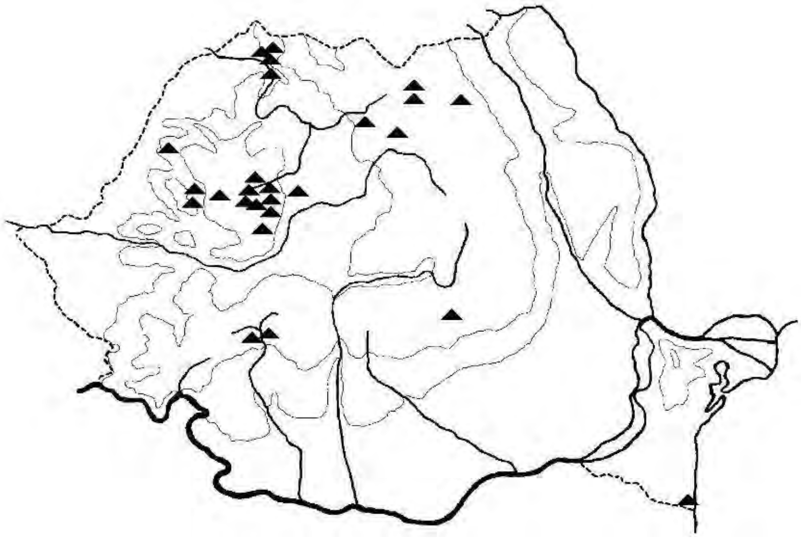


Figure 7.11. The distribution of *T. affinis = T. wächtleri* in Romania (our results and literature data)

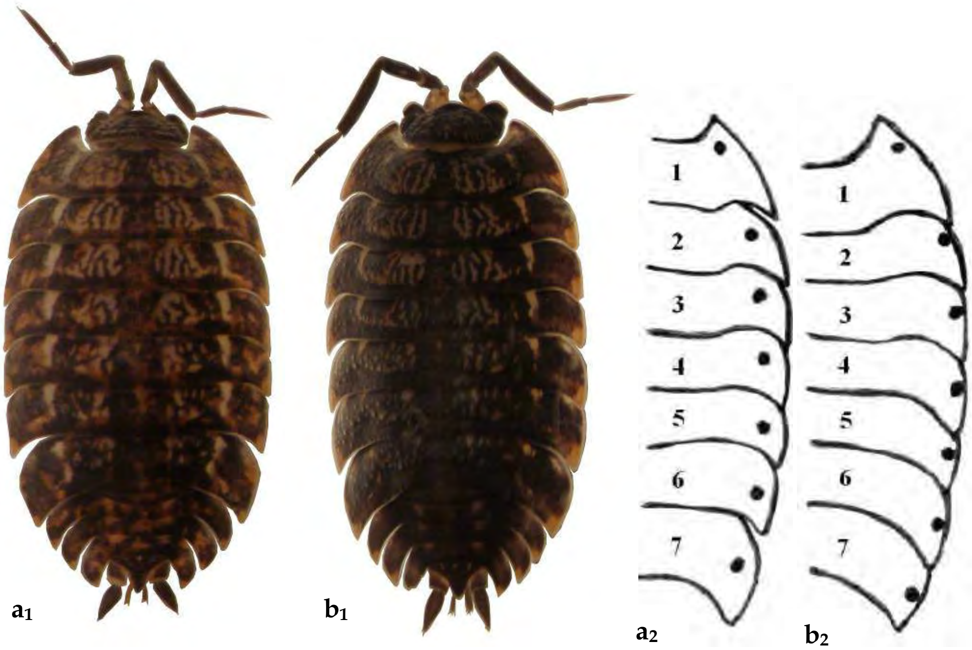


Figure 7.12. Comparison of the dorsal view and glandular pore fields:
a_1, a_2. *Trachelipus difficilis* (Radu, 1950), ♂ 9 x 5 mm – Feleac Hills;
b_1, b_2. *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951): ♂ 10 x 5 mm – Feleac Hills.

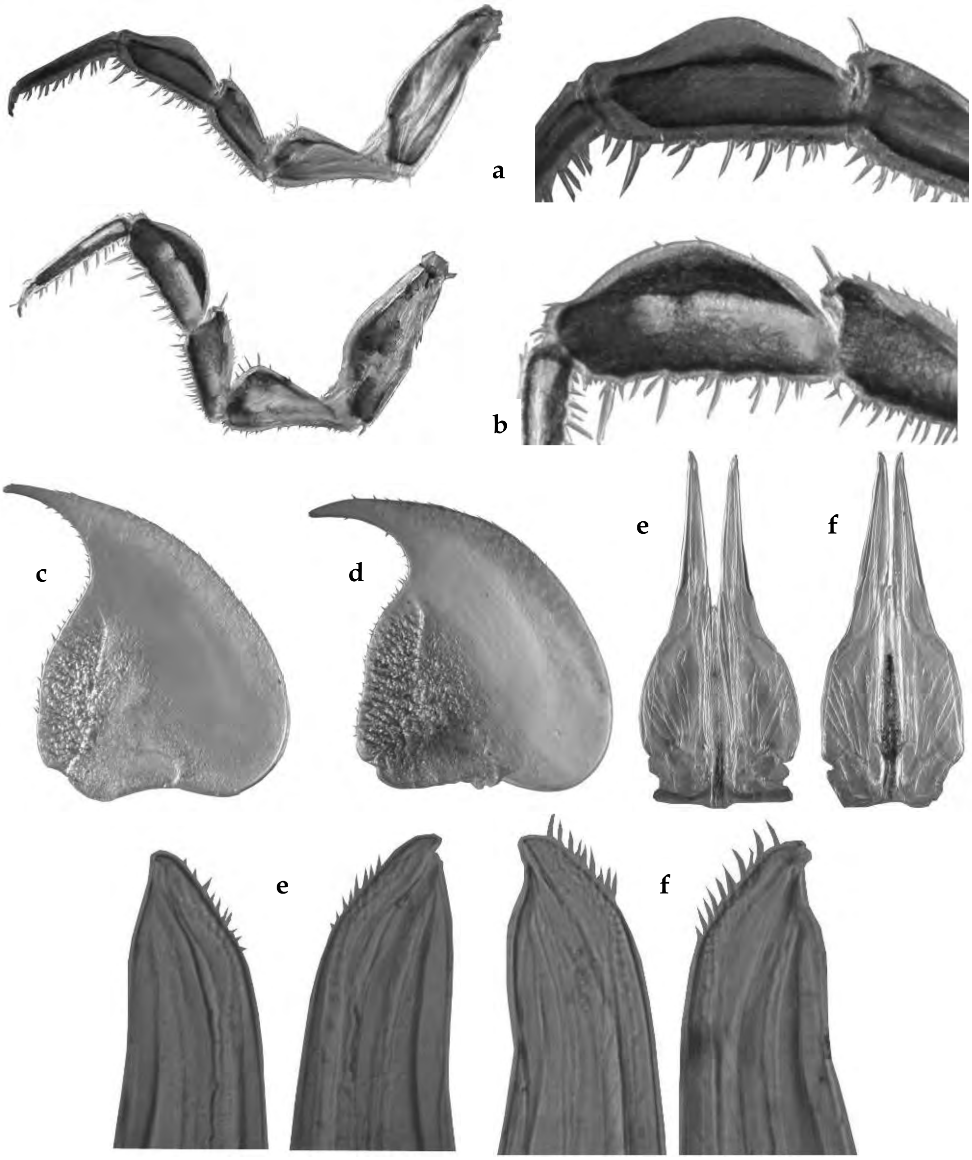


Figure 7.13. Comparison of the appendages of *Trachelipus difficilis* (Radu, 1950) and *Trachelipus affinis* (Koch, 1841) = *Trachelipus wächtleri* (Strouhal, 1951), **male pereiopods 7**, **a.** *T. difficilis*, ♂ 11.5 x 6 mm – Muntele Mare Mountain, **b.** *T. affinis* = *T. wächtleri*, ♂ 10 x 5 mm – Feleac Hills; **male pleopod 1 exopods**, **c.** *T. difficilis*, ♂ 10 x 5 mm – Feleac Hills, **d.** *T. affinis* = *T. wächtleri*, ♂ 10 x 5 mm – Feleac Hills; **the male pleopod 1 endopods` apex**, **e.** *T.difficilis*, ♂ 12 x 6.5 mm – Codrului Hills, **f.** *T. affinis* = *T. wächtleri*, ♂ 10.5 x 5 mm – Oaş Mountains.

<u>8. *Trachelipus arcuatus* (Budde-Lund, 1885)</u>

Porcellio arcuatus Budde-Lund, 1885
Tracheoniscus arcuatus (Budde-Lund, 1885) Wächtler, 1937
Tracheoniscus arcuatus (Budde-Lund, 1885) Radu, 1939
Tracheoniscus arcuatus (Budde-Lund, 1885), Radu, 1950
Trachelipus arcuatus (Budde-Lund, 1885) Schmölzer, 1965
Trachelipus arcuatus (Budde-Lund, 1885) Radu, 1985

Trachelipus arcuatus (Budde-Lund, 1885) Schmidt, 1997

Literature consulted for the description of the species: Budde-Lund 1885, Wächtler 1937, Radu 1939, 1958, 1985, Schmölzer 1965, Schmidt 1997.

Examined material and sampling sites

The specimens were collected from Dorna Depression, Parâng Mountains (Jiului Gorge), Baia-Mare Depression, Arieş River Basin, Clujului Hills, Cernei Mountains, Maliuc locality - Danube Delta.

There were analysed 32 males (11 dissected) and 22 females.

Species description

Size: males 9 x 4.5 mm – 14 x 7.3 mm, females 9 x 5 mm – 15 x 8 mm

Colour: in males is dark grey-brownish, with yellow-orange spots at the base of the coxal plates, elongated on the tergites 2-4 and small/absent on the tergites 5-7 (Fig. 8.1. a). There are numerous yellow-orange spots on the surface of the pereion`s and pleon`s tergites of females (Fig. 8.1. b). The colour of the body varies in both males and females.

Somatic characters

Cephalon. The lateral cephalic lobes incline laterally. The median lobe is less developed (Fig. 8.2. a).

Pereion. The posterior sides of the coxal plates are sinuous on the segments 1-3 and curved towards the posterior part of the body on the segments 4-7 (Fig. 8.1. a – c). The glandular pore fields are oval, smoothly distanced from the lateral side of the coxal plates (Fig. 8.1. c)

Pleon. The tergites have a few yellowish spots in males (Fig. 8.1. a), but are more numerous and larger in females (Fig. 8.1. b). The pleotelson is relatively short; its tip does not exceed the tip of the last epimeres (Fig. 8.2. b).

Appendages

Antennae. The last antenna article is longer than the penultimate one (Fig. 8.2. c). The ratio between the two articles varies between 1.2:1 and 1.4:1.

Pereiopods. The inferior side of the ischium on the male pereiopod 7 is concave; the carpus chitinous crest is prominent with ½ of its length (Fig. 8.3. a_1, a_2). Pereiopods 1-6 have no specific morphological characters (Fig. 8.4.).

Pleopods. Male pleopod 1 exopods` external side is concave on its posterior part, the sharp tip is relatively long, oriented obliquely (Fig. 8.5. a). This is an important morphological character, which differs from *T. rathkii*, where the pleopod 1 exopods` tip is short and thick (Fig. 9.3. a). The endopods have their narrow extremities a tuft of fine spines, which exceed the endopods` tip (Fig. 8.5. b_1, b_2). The pleopod 2-5 exopods have no specific morphological characters (Fig. 8.5. pl_2 – pl_5).

Intraspecific morphological variability

The body colour of males varies, more obvious being the variation of the yellow-orange spots on the base of the coxal plates (Fig. 8.6. a - b).

The cephalic lobes vary in size and shape (Fig. 8.7. a – b).

The telson varies in the width of its distal half (Fig. 8.7. c – d).

The male pereiopod 7 carpus crests` heights vary (Fig. 8.7. e1, e2, f1, f2).

Morphological anomalies

Anomalies of some paired organs were found in some male specimens. In two males, the anomaly was at the antennae with shorter and thinner articles, but in one male, the abnormal antenna was devoid of pigment (Fig. 8.8. a – b). In a male, anomaly was found at the pereiopod 7 carpus crest's shape and the pigmentation of its articles (Fig. 8.8. c). In another male anomaly was found at the pleopod 1 exopods sharp tip`s length (Fig. 8.8. d).

Ecology

T. arcuatus is considered a sylvan species (Tomescu et al. 2005), although other authors regard it as a less exigent species (Radu 1985). Thereby, many of the species` records are indeed from forests in Romania (e.g. Ivanov 2011, Tomescu et al. 2008, 2011) The species was found in humid, afforested areas in North-Western Romania (Ferenți & Dimancea 2012, 2013, Ferenți et al. 2012c), and in cities, too (Giurgincă 2006). We collected the species in forests under fallen logs, bark and other shelters. *T. arcuatus* is present in afforested areas with abundant herbaceous vegetation, swamps, or canal edges (Ferenți & Dimancea 2012, 2013).

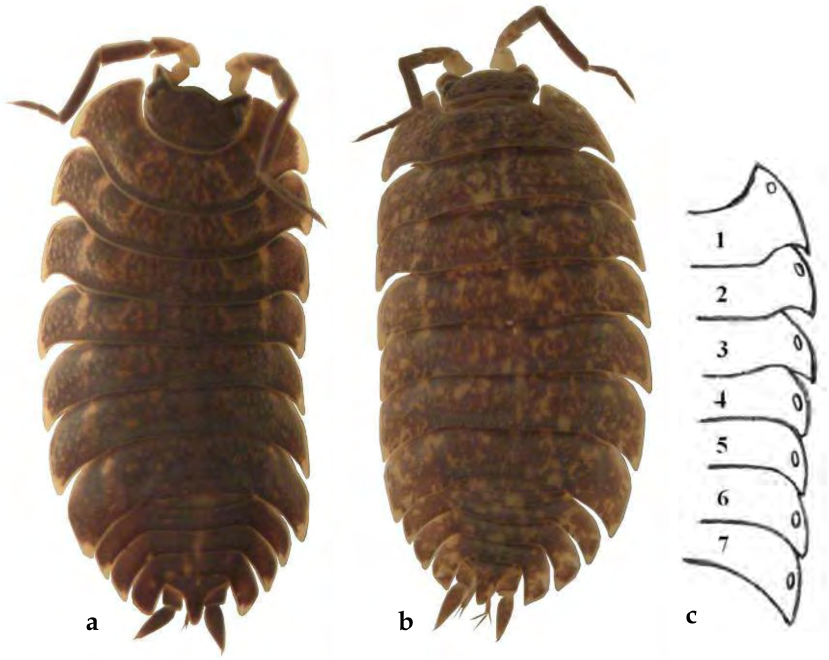


Figure 8.1. *Trachelipus arcuatus* (Budde-Lund, 1885), **male and female dorsal view**: **a.** ♂ 12 x 5.5 mm, **b.** ♀ 15 x 7 mm; **c.** glandular pore fields – Parâng Mountains.

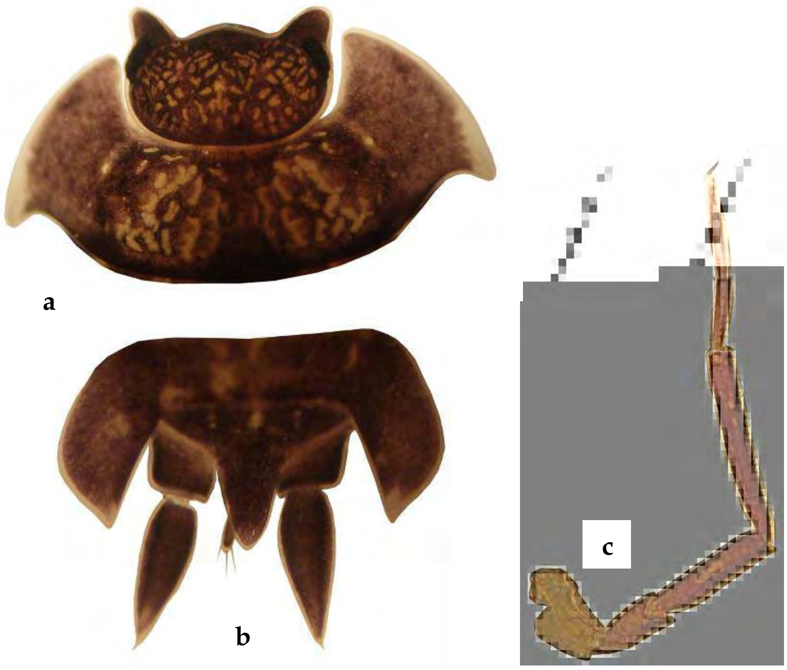


Figure 8.2. *Trachelipus arcuatus* (Budde-Lund, 1885), **a. cephalic lobes b. telson**, **c. antenna**, ♂ 12 x 5.5 mm – Parâng Mountains.

Figure 8.3. *Trachelipus arcuatus* (Budde-Lund, 1885): **a_1. male pereiopod 7**, **a_2. the carpus crest**, ♂ 12 x 5.5 mm – Parâng Mountains.

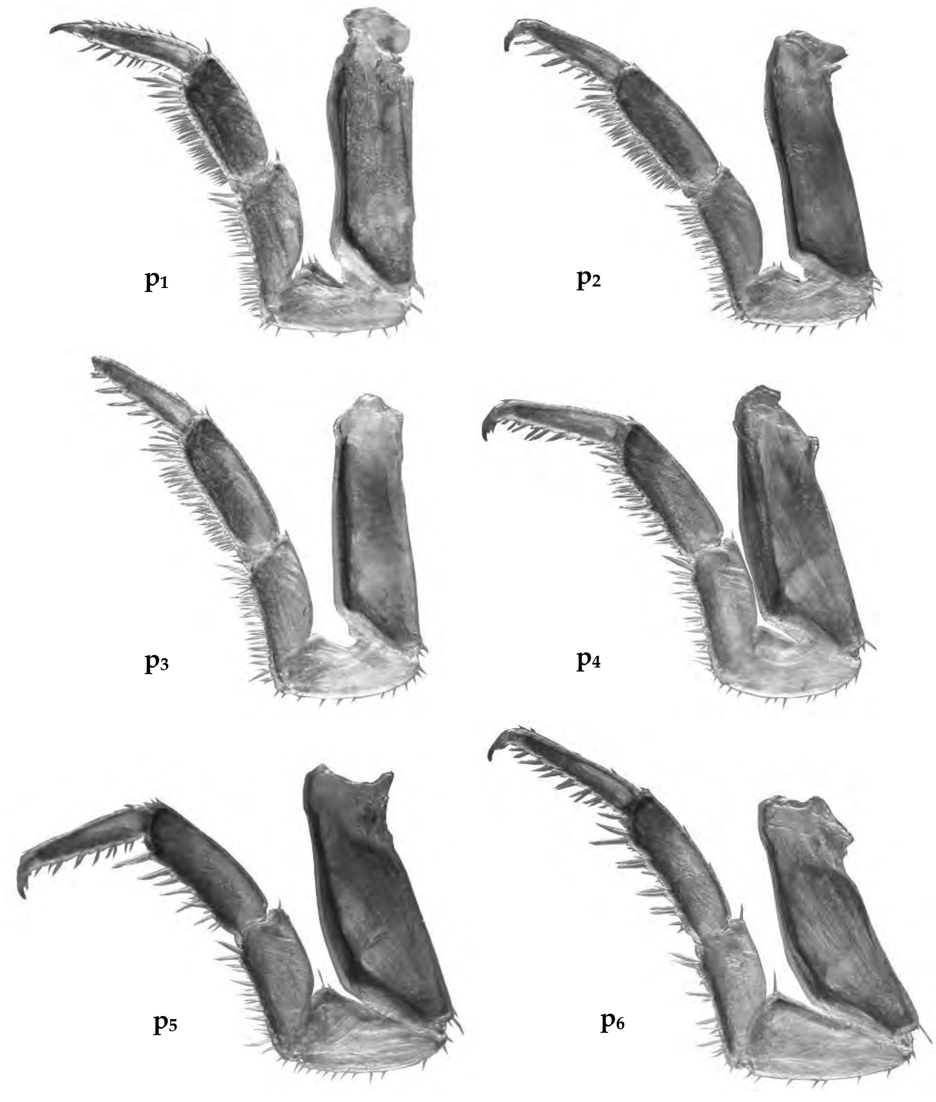


Figure 8.4. *Trachelipus arcuatus* (Budde-Lund, 1885), **pereiopods 1 – 6: p_1–p_6.**, ♂ 12 x 5.5 mm – Parâng Mountains.

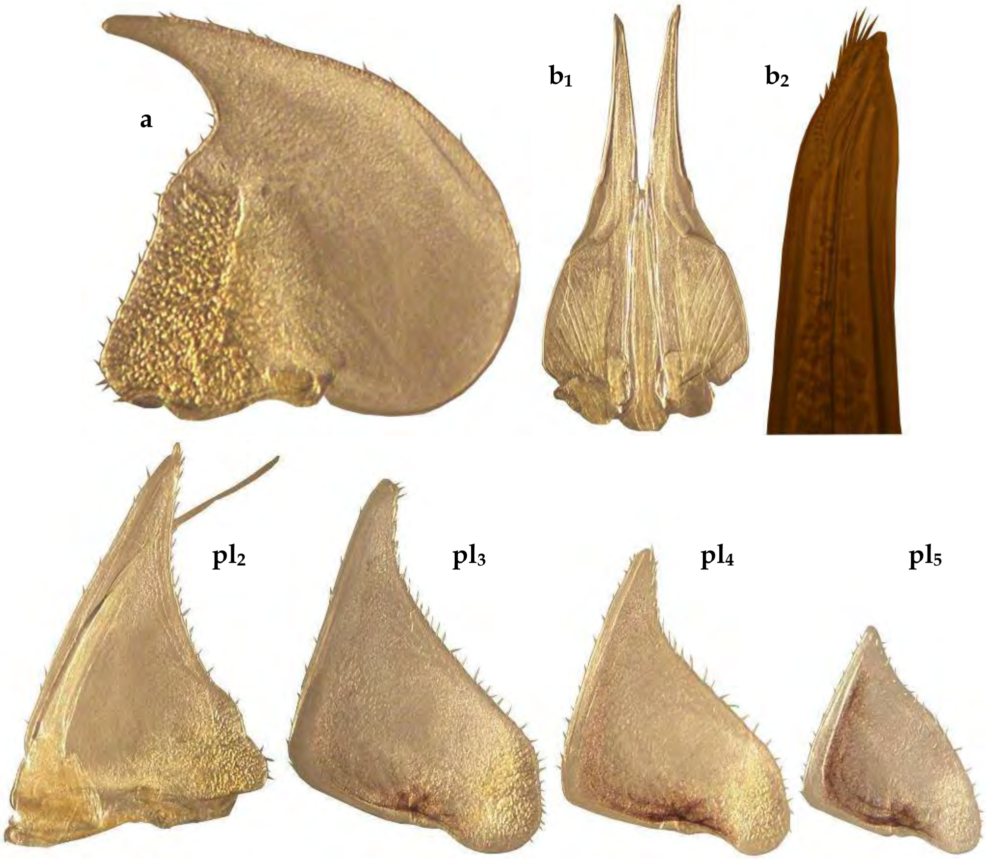


Figure 8.5. *Trachelipus arcuatus* (Budde-Lund, 1885), **male pleopod 1**: **a.** exopod **b_1.** endopod, **b_2**. the apex of the pleopod 1 endopods; **pl_2 – pl_5. pleopod 2-5 exopods**, ♂ 12 x 5.5 mm – Parâng Mountains.

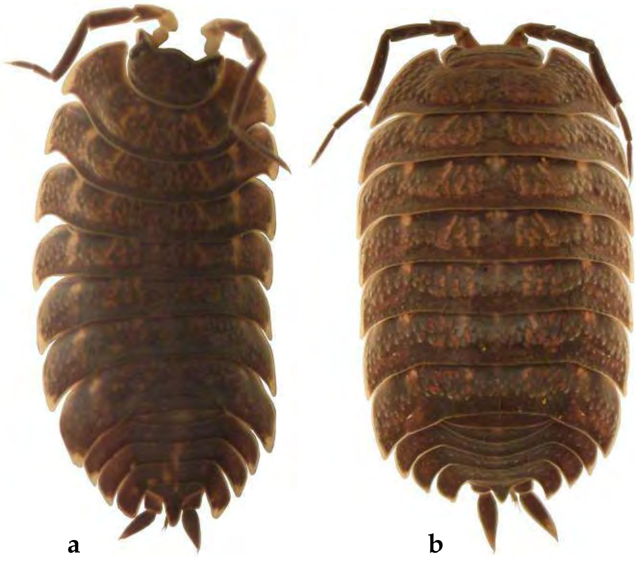


Figure 8.6. *Trachelipus arcuatus* (Budde-Lund, 1885), **the variation of the yellow spots on the coxal plates base in males**: **a.** ♂ 12 x 5.5 mm – Parâng Mountains, **b.** ♂ 14 x 7.3 mm – Parâng Mountains.

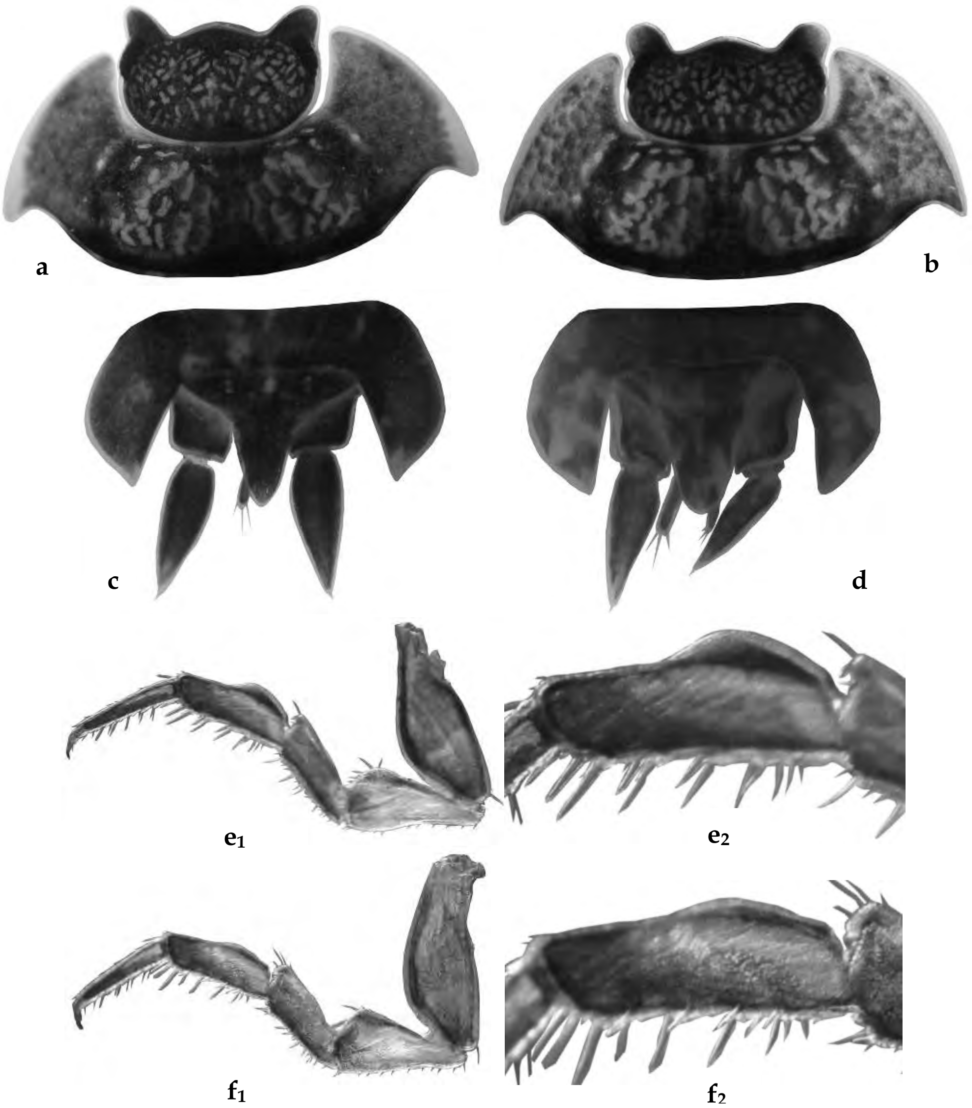


Figure 8.7. *Trachelipus arcuatus* (Budde-Lund, 1885), **the variation of cephalic lobes**:
a. ♂ 12 x 5.5 mm – Parâng Mountains **b.** ♂ 13.5 x 5.5 mm – Parâng Mountains; **the variation of the telson:**
c. 12.5 x 5 mm, **d.** ♀ 15 x 7 mm – Parâng Mountains; **the variation of male pereiopod 7 carpus crest:**
e_1-e_2. ♂ 12 x 5.5 mm – Parâng Mountains, **f_1-f_2.** ♂ 11 x 4.5 mm – Cernei Moutains.

Geographic distribution

Schmidt (1997) mentioned the species from Italy, Switzerland, Austria, Serbia, and northern Greece. *T. arcuatus* is present in Slovakia, Slovenia, Croatia, Bosnia and Hercegovina, Macedonia, Albania, Romania (Schmalfuss 2003). The species was frequently recorded in Romania, but without mentioning any distribution locality (Radu 1985). *T. arcuatus* was observed in different regions in the country: Danube Delta (Tomescu 1992), Danube Gorge (Radu & Tomescu 1975), Dobruja (Giurgincă & Ćurčić 2003, Giurgincă et al. 2009), Oaş Mountains (Hotea & Hotea 2009, Ferenţi et al. 2013c), Tur River basin (Ferenţi et al. 2013b), Someşului Plain (Ferenţi & Dimancea 2012), Arieş River basin (Mureşan et al. 2003), Dorna Depression (Tomescu et al. 2005), Hidişelului Hills and Bihorului Mountains (Tomescu et al. 2008), Pădurea Craiului Mountains (Ianc & Ferenţi 2014), Mehedinţi Plateau (Giurgincă et al. 2010), Aninei-

Locvei Mountains (Nitzu et al. 2011), Cloşani karst area (Ilie et al. 2002), Prahova County (Nitzu et al. 1998-1999), Carei Plain (Ferenți et al. 2012c), Vlăsiei Plain (Ivanov 2011), Beiuşului Depression (Bodin et al. 2013), near Săvârşin and Coşteiu localities (Radu 1950) and Sinaia area (Radu 1939). The individuals from the present study were collected in Transylvania, Dobruja, Oltenia, northern Moldova, regions that do not extend its known distribution range in the country (Fig. 8.9.).

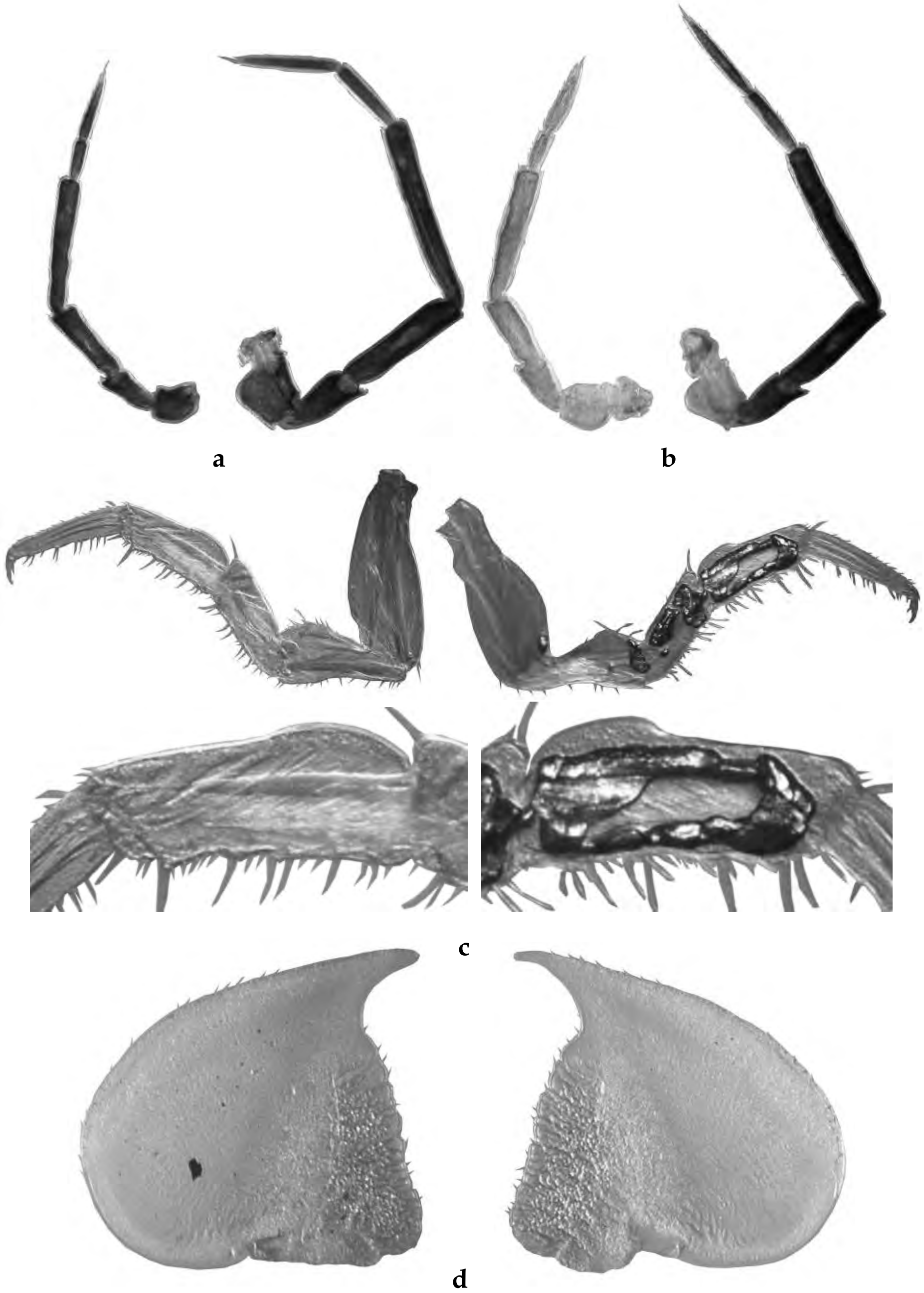


Figure 8.8. *Trachelipus arcuatus* (Budde-Lund, 1885), **morphological anomalies: antennae**: **a.** ♂ 11 x 5.5 mm, **b.** ♂ 11 x 5.5 mm – Parâng Mountains; **pereiopod 7 carpus crest**, **c.** ♂ 8 x 4 mm – Clujului Hills; **pleopod 1 exopods**: **d.** ♂ 11 x 5.5 mm – Parâng Mountains.

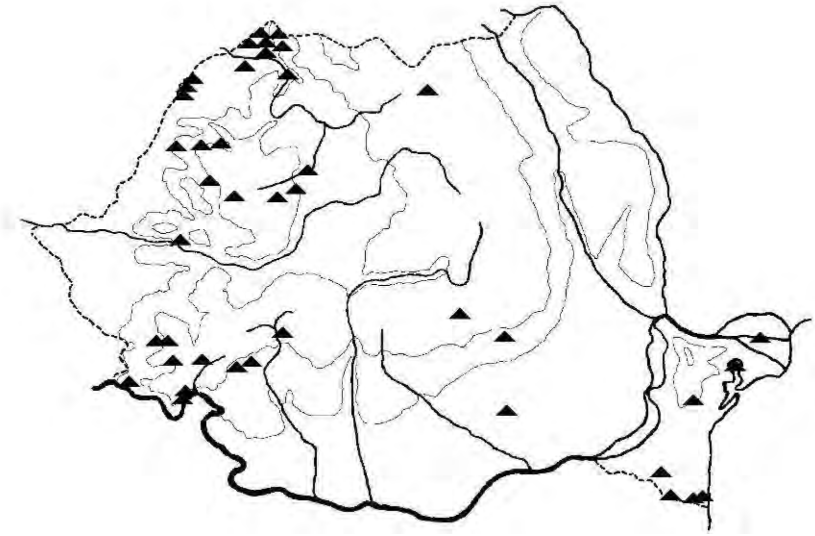


Figure 8.9. The distribution of *T. arcuatus* in Romania (our results and literature data)

Altitude. The species is present from 3 m (Maliuc in Danube Delta) to 1500 m (Sinaia) altitude (Radu 1939).

9. *Trachelipus rathkii* (Brandt, 1833)

Porcellio rathkei Brandt, 1833
Euporcellio rathkei (Brandt, 1833), Verhoeff, 1907
Tracheoniscus rathkei (Brandt, 1833), Wachtler, 1937
Tracheoniscus rathkei (Brandt, 1833), Radu, 1958
Tracheoniscus rathkei (Brandt, 1833), Frankenberger, 1959
Trachelipus rathkei (Brandt, 1833), Vandel, 1962
Trachelipus rathkei (Brandt, 1833), Schmolzer, 1965
Trachelipus rathkei (Brandt, 1833), Radu, 1985
Trachelipus rathkii (Brandt, 1833), Schmidt, 1997

Literature consulted for the description of the species: Frankenberger 1959, Radu 1985, Schmölzer 1965, Schmidt 1997, Vandel 1962, Verhoeff 1907, Wächtler 1937.

Examined material and sampling sites

The studied specimens were collected from the following locations: Zaida Floodplain, Vatra Dornei locality (Suceava County), Argestru locality (Suceava County), Pojorâta locality (Suceava County), Cacica locality (Suceava County), Baia-Mare Depression (Maramureş County), Resighea locality (Satu-Mare County), Crucişor locality (Satu-Mare County), Milova locality (Arad County), Piatra Corbului (Bistriţa Năsăud County), Colibiţa locality (Bistriţa Năsăud County), Vultureni locality (Cluj County), Brăzeşti locality (Alba County), Călan Spa locality (Hunedoara County), Cândeţ, Comanda and Lainici - Jiului Gorge (Gorj County), Small Island of Brăila (Brăila County), Caraorman and Maliuc, Danube Delta (Tulcea County), Doloşmanu Hill (Tulcea County).

From these locations we have analysed 89 males (20 dissected) and 33 females.

Species description

Size: males 6.5 x 3 mm – 11.5 x 5 mm; females: 7.3 x 3 mm – 13.5 x 6 mm. The smallest adult specimens were collected from Caraorman – Danube Delta.

Colour. The dorsal part of the body is dark-brown in males. On the base of the coxal plates, there are yellow-orange spots, which together form lateral longitudinal lines on the pereional segments. On the tergites there is a clear yellowish pattern shape (Fig. 9.1. a). Females have light-brown tergites, with a yellowish pattern shape (Fig. 9.1. b).

Somatic characters

Cephalon. The lateral cephalic lobes are relatively short, inclined laterally. The median lobe is short, between the lateral and median lobes there are oblique angled spaces (Fig. 9.2. a).

<u>Pereion.</u> The coxal plates` posterior sides of the tergites 1-3 form weak sinuosity, the coxal plates are curved directly to the posterior part of the body on the tergites 4-7 (Fig. 9.1. a, b). The glandular pore fields are oval on the segments 2-7, and circular on the 1st segment. They are situated at a short distance from the lateral side of the coxal plates (Fig. 9.1. c).

<u>Pleon.</u> On the 3rd and 4th pleonal epimeres there are very small glandular pore fields, very close to the epimeres` external sides (Fig. 9.1. c). In some males, they are very difficult to observe, as well in female in which the pleonal segments are light-brown with numerous yellow spots. The pleotelson`s distal half is short, its sides forms an oblique angle at the limit of their proximal wide and distal narrow halves (Fig. 9.2. b).

<u>Appendages</u>

<u>Antennae</u> have their last article longer than the penultimate one (Fig. 9.2. c).

<u>Male pereiopod 7</u> ischium`s ventral side is slightly concave. The carpus has a prominent crest, with and oblique angled tip. Its proximal side is slightly curved, while the distal one is straight. The crest's length does not exceed ½ of the carpus length (Fig. 9.2. d_1, d_2). Pereiopods 1-6 do not present specific morphological characters. Pereiopods 1-3 have dense spine rows on merus and carpus and there are fewer spines on the pereiopods 4-6 (Fig. 9.5).

<u>Male pleopod 1.</u> Exopods` apex is short and relatively thick (Fig. 9.3. a). Endopods` extremities have rows of short spines (Fig. 9.3. b_2). Pleopods 2-5 do not present specific morphological characters (Fig. 9.4. pl_2 – pl_5).

Intraspecific morphological variability

<u>The cephalic lobes` shape and size.</u> The most of males and females have their cephalic lobes like in the figures 9.2. a and 9.6. a. Lateral cephalic lobes of males are variable, they may be shorter and narrower (Fig. 9.6. b), shorter and wider (Fig. 9.6. e) or longer and narrower (Fig. 9.6. c, d). In some males, the median cephalic lobe was more developed in an oblique angle shape (Fig. 9.6. c, d).

<u>Male pereiopod 7 carpus crest</u> varies in length. In a single male, the crest was longer (Fig. 9.8. b1, b2) than the normal length (Fig. 9.8. a_1, a_2).

<u>Male pleopod 1 exopods</u> vary in apex's length on the posterior part (Fig. 9.7. c – e).

Morphological anomalies were found in four males. In a male the pleotelson was very short (Fig. 9.9. b). In three males, we observed anomalies of the pereiopod 7 carpus crest, such as its lack (Fig. 9.9. a) or its size and length (Fig. 9.10. a, b).

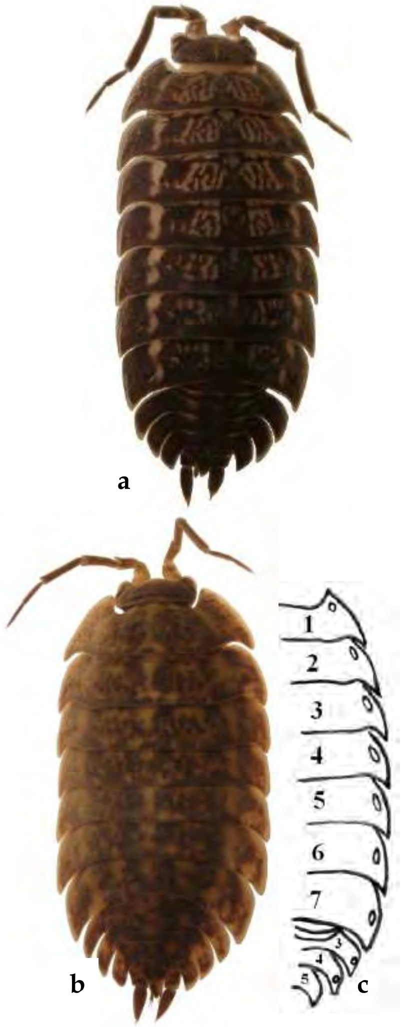


Figure 9.1. *Trachelipus rathkii* (Brandt, 1833), **male and female dorsal view**: **a.** ♂ 11.5 x 5.5 mm – Milova, **b.** ♀ 13 x 6.5 mm – Small Island of Brăila; **c.** glandular pore fields: ♂ 9 x 4 mm – Small Island of Brăila.

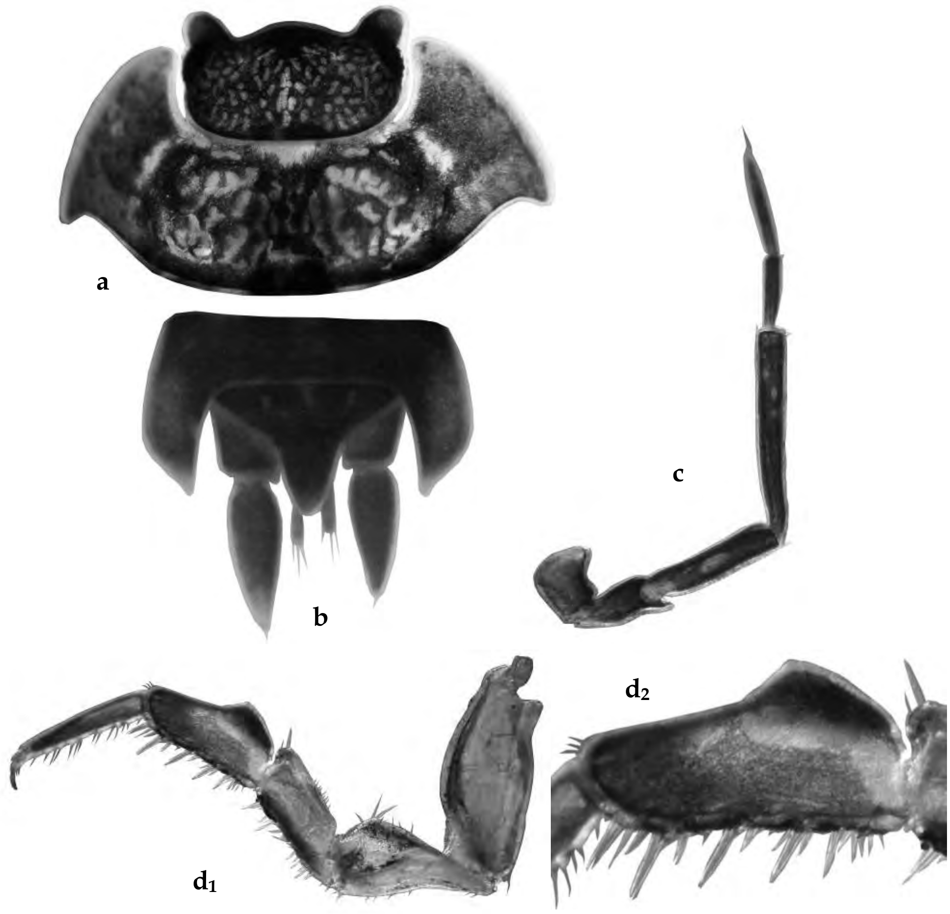


Figure 9.2. *Trachelipus rathkii* (Brandt, 1833). **a. cephalic lobes**, ♂ 10 x 4.5 mm – Lainici, **b. telson**, ♂ 9 x 4 mm – Small Island of Brăila, **c. antenna**, **d_1. pereiopod 7**, **d_2. the carpus crest**, ♂ 11.5 x 5.5 mm – Milova.

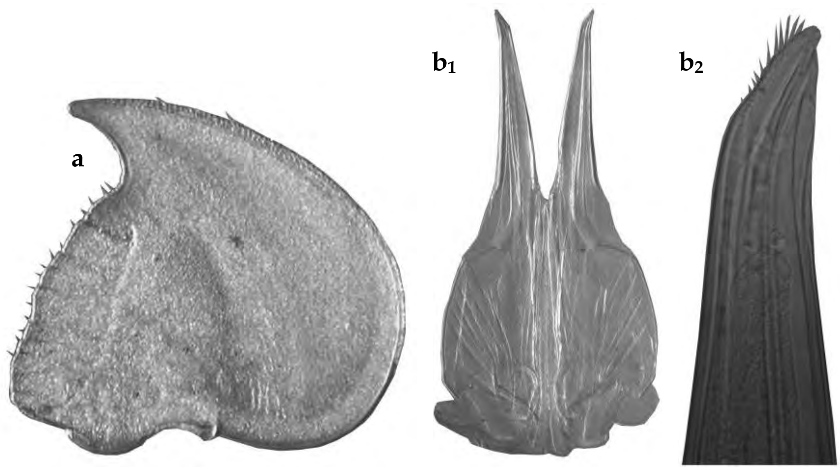


Figure 9.3. *Trachelipus rathkii* (Brandt, 1833), **male pleopods 1**: **a.** exopod, ♂ 11.5 x 5.5 mm – Milova, **b_1.** endopods, **b_2.** the apex of pleopod 1 endopods, ♂ 10 x 4.5 mm – Baia Mare Depression.

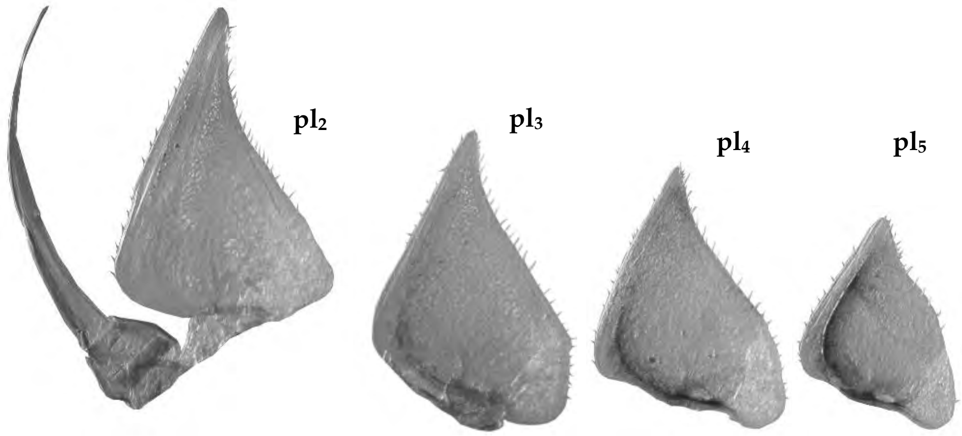


Figure 9.4. *Trachelipus rathkii* (Brandt, 1833), **pleopod 2-5 exopods**: **pl_2 – pl_5.** ♂ 9 x 4 mm – Small Island of Brăila.

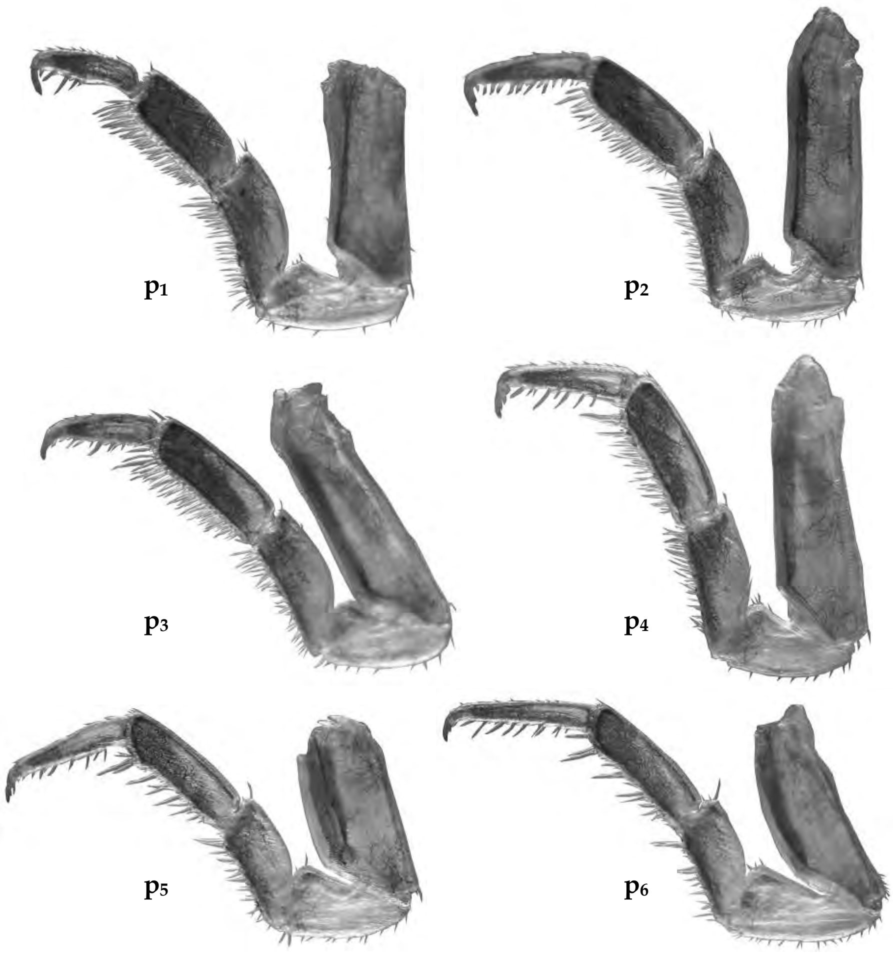


Figure 9.5. *Trachelipus rathkii* (Brandt, 1833). **p_1–p_6. pereiopods 1 – 6**, ♂ 10 x 4.5 mm – Lainici.

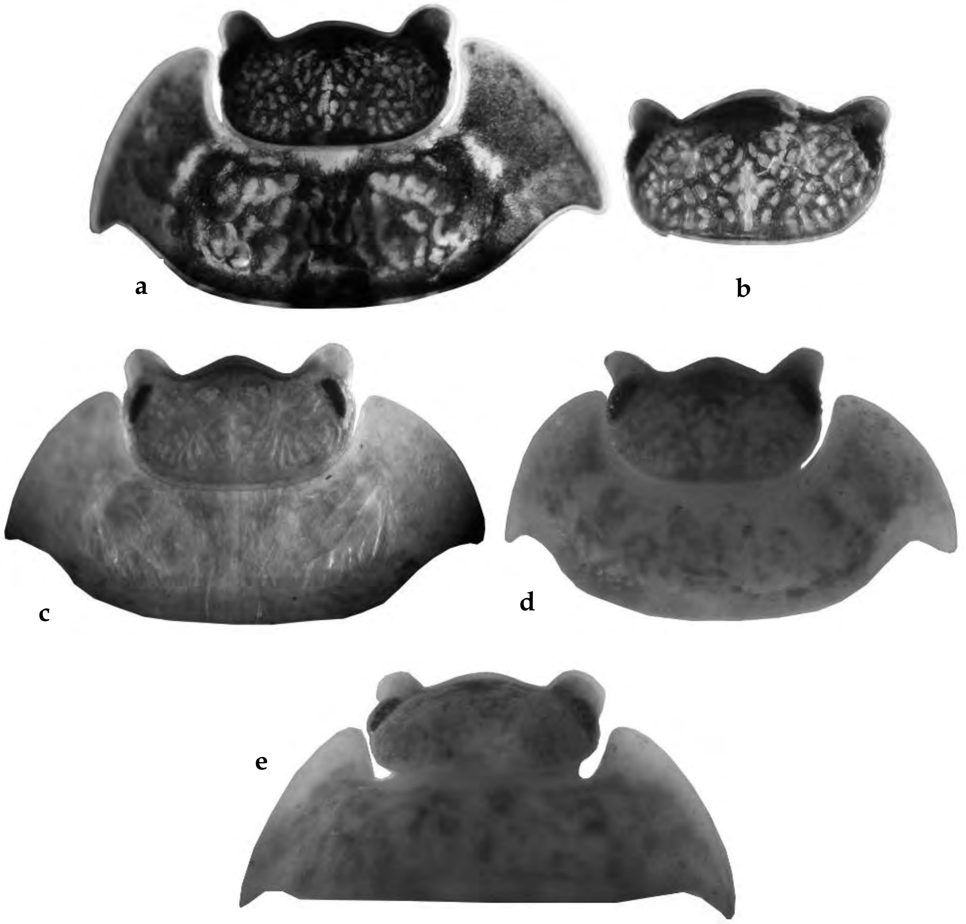


Figure 9.6. *Trachelipus rathkii* (Brandt, 1833), **the variation of the cephalic lobes: a.** ♂ 10 x 4.5 mm – Lainici, **b.** ♂ 7.5 x 3.5 mm – Resighea, **c.** ♂ 9 x 4 mm – Maliuc, **d.** ♂ 11 x 5 mm, **e.** ♀ 11 x 5.5 mm – Baia Mare Depression.

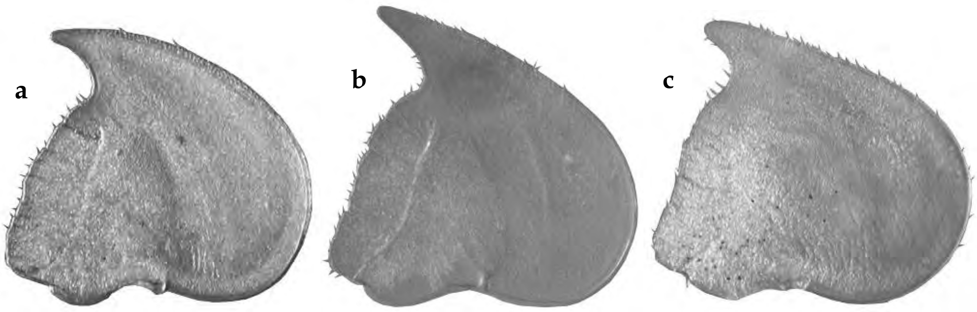


Figure 9.7. *Trachelipus rathkii* (Brandt, 1833), **morphological variations: pleopod 1 exopods**, **a.** ♂ 11.5 x 5.5 mm – Milova, **b.** ♂ 10 x 4.5 mm – Baia Mare Depression, **c.** ♂ 10 x 4.5 mm – Lainici.

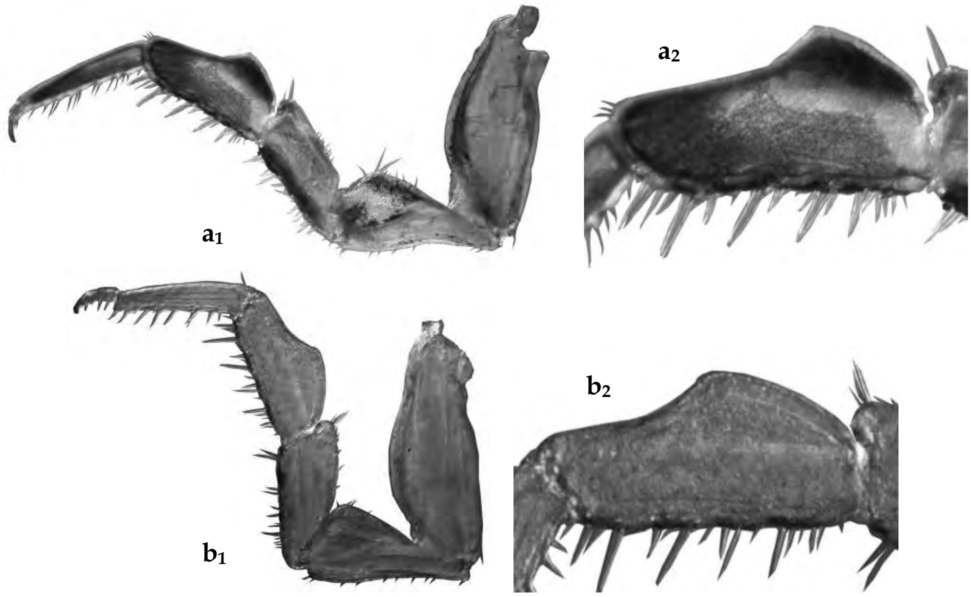
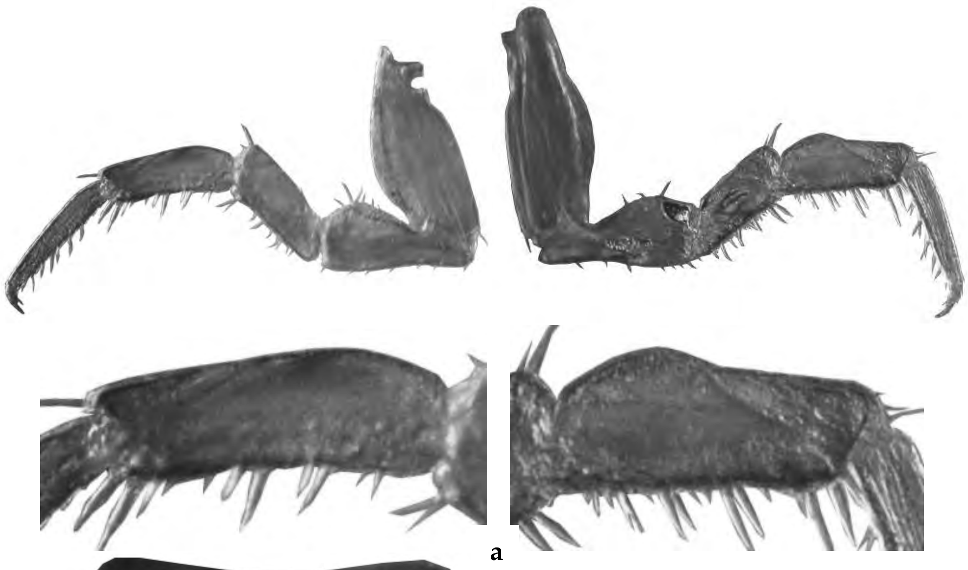


Figure 9.8. *Trachelipus rathkii* (Brandt, 1833), **morphological variations: pereiopod 7 carpus crest**, **a_1, a_2.** ♂ 11.5 x 5.5 mm – Milova, **b_1, b_2.** ♂ 9 x 4 mm – Maliuc.



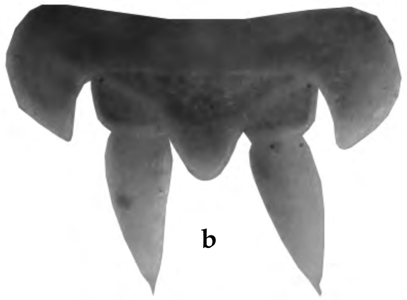


Figure 9.9. *Trachelipus rathkii* (Brandt, 1833), **morphological anomalies**: **a. pereiopod 7 carpus crest**, ♂ 7.5 x 3.5 mm – Crucişor, **b. telson**, ♂ 11 x 5 mm – Baia Mare Depression.

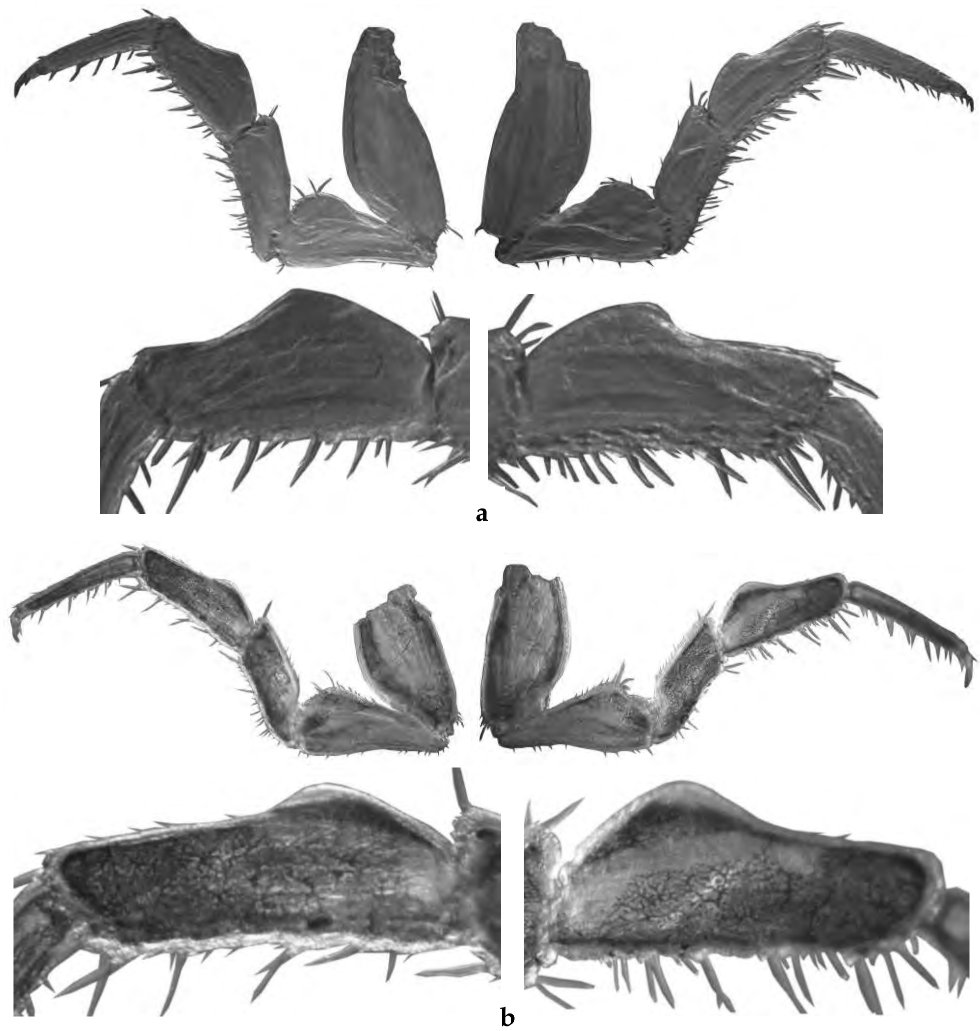


Figure 9.10. *Trachelipus rathkii* (Brandt, 1833), **morphological anomalies of the pereiopod 7 carpus crest**: **a.** ♂ 10 x 4.5 mm – Baia Mare Depression, **b.** ♂ 10 x 4.5 mm – Lainici.

Ecology

T. rathkii is a cosmopolitan and eurytopic species, which lives in habitats with different ecological characteristics (Vandel 1962). Radu (1985) considers that it is a eurytopic species, living in habitats with different humidity, under the litter, fallen logs or stones, etc. Schmidt (1997) claims that *T. rathkii* prefers open habitats, not being found in forests. We collected this species in open habitats, grasslands with shrubbery or rare trees, forests with rare trees, with sandy and dry soil (Caraorman – Danube Delta), apple orchards, house gardens. The ecological diversity of the habitats in which *T. rathkii* was collected confirms its eurytopic character.

Geographic distribution

T. rathkii has large distribution in Europe and North America (Bulurovitch 1953, Flasarova 1991, 1995, 1999, Schmalfuss 1979, Vandel 1962, Schmidt 1997). It seems to be rare or even absent in the Mediterranean region (Schmidt, 1997). It is widespread in Romania, being present from the Danube Delta (Tomescu 1992) and Dobruja (Tăbăcaru & Boghean 1989, Giurgincă & Ćurčić 2003), until the north-western part of the country, in Maramureş (Vilisics 2008), in Oaş Mountains (Ferenţi et al. 2013c), Tur River basin (Ferenţi et al. 2013b), Someşului Plain (Ferenţi & Dimancea 2012) or Carei Plain (Tomescu et al. 2008, Ferenţi et al. 2012c). In addition, it was found in Danube Gorge (Radu & Tomescu 1975), in Arieş River basin (Mureşan et al. 2003), or in Transylvanian Plateau, in Sibiu area (Tomescu et al. 1979). It also populates mountain areas, like Pădurea Craiului Mountains (Ianc & Ferenţi 2014) or Jiului Gorge (Tomescu et al. 2011). The species is present inclusively in cities like Bucharest (Giurgincă 2006). These distribution data and the localities where we collected *T. rathkii* demonstrate that this species is distributed on the entire Romanian territory (Fig. 9.11).

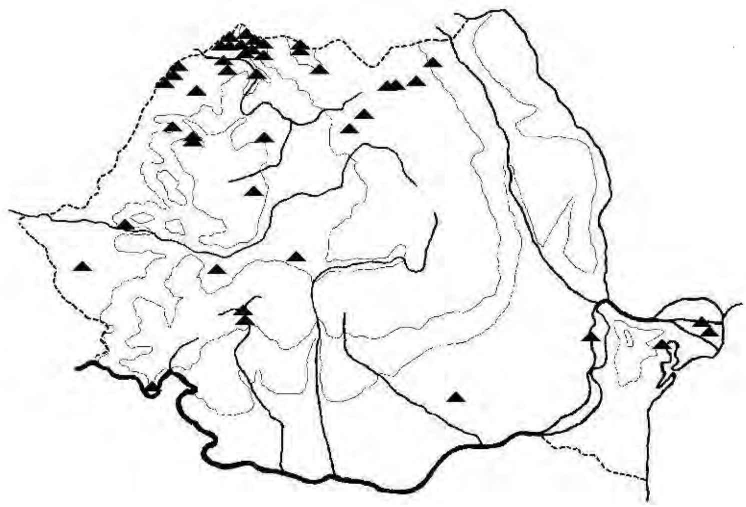


Figure 9.11. The distribution of *T. rathkii* in Romania (our results and literature data)

Altitude. *T. rathkii* was encountered between 1 m (Danube Delta) and 900 m (Parâng Mountains, in Jiului Gorge) altitude (Tomescu et al. 2011). However, it has altitudinal data from 1100 and 1800 m, without mentioning any locality (Radu 1985).

10. *Trachelipus pleonglandulatus* (Radu, 1950)

Tracheoniscus pleonglandulatus Radu, 1950
Trachelipus pleonglandulatus (Radu, 1950) Schmölzer, 1965
Trachelipus pleonglandulatus (Radu, 1950) Radu, 1985

Literature consulted for the description of the species: Radu 1950, 1985, Schmölzer 1965, Schmidt 1997 (Schmidt 1997 synonymises the species *T. pleonglandulatus* with the species *T. rathkii*).

Examined material and sampling sites

Lainici, Parâng Mountains, Jiului Gorge (Gorj County);

Miniş Gorge, upstream Bozovici locality, Semenic Mountains (Caraş Severin County);

Băile Herculane, near the shore of Lake Prisaca (Caraş Severin County);

Băile Herculane, Prisaca Dam, (Caraş Severin County);

Băile Herculane, Pecinişca Gorge, Cernei Mountains (Caraş Severin County);

Baia de Aramă locality, near Bulba cave, Mehedinţi Tableland (Mehedinţi County);

Divici locality, Locvei Mountains (Caraş Severin County).

From these locations 28 males (10 dissected) and 20 females were analysed.

Species description

Size: males 10 x 4.5 mm – 16.3 x 7 mm; females 13 x 6.5 mm – 15 x 8 mm.

Colour. The tergites are grey-rusty. There are elongated yellow spots on the coxal plates` base, which forms two lateral lines on the pereion`s lateral part. In males, the spots` median part is narrowed on the segments 2-6 and the yellow spots` two halves are completely separated on the segment 7 (Fig. 10.1. a). In females, the spots are separated in two on the segments 5-7 (Fig. 10.1.b). There are yellow spots on the median part of the tergites, which are more discrete in males, and more obvious in females, surrounded with yellow fine pattern shape. The spots are sinuous, representing the place of the thoracic muscles` insertion on tergites (Fig. 10.1. a, b).

Somatic characters

Cephalon. The lateral cephalic lobes are inclined laterally, with round-shaped tips. The median lobe is short, with round distal side (Fig. 10.2. a).

Pereion. The posterior sides of the coxal plates on the segments 1-3 are sinuous, on the segments 4-7 are curved toward the posterior part of the body (Fig. 10.1.). The glandular pore fields are oval, bounded proximal with a chitinous crease (Fig. 10.1. c).

Pleon. On the epimeres of segments 3-5 there are oval glandular pore fields, clearly visible under the stereomicroscope (Fig. 10.1. c). The pleotelson`s distal half is short, such as in *T. rathkii* (Fig. 10.2. b).

Appendages

Antennae. The last antenna article is longer than the penultimate one; the ratio between their lengths is 1.4:1 in most of the individuals (Fig. 10.2. c).

Pereiopods. The inferior side of the ischium of the male pereiopod 7 is straight. The carpus chitinous crest is less high than in *T. rathkii*, but with a large curvature (Fig. 10.3. a_1, a_2). The pereipods 1-3 merus` and carpus` have on their ventral side dense rows of thorns, which are rarer on pereiopods 4-6 (Fig. 10.4.).

Pleopods. The male pleopod 1 exopods have on their posterior part a relatively long sharp tip, oriented externally (Fig. 10.5. a). The endopods have on their extremities two rows of thorns, the last ones being longer (Fig. 10.5. b_1, b_2). Pleopods 2-5 do not present specific morphological characters (Fig. 10.5. pl_2-pl_5).

Intraspecific morphological variability

The yellow spots on the base of the coxal plates are small dots, compared with the elongated spots found in most individuals of *T. pleonglandulatus* (Fig. 10.6. a – c). On the cephalic lobes, the width and length vary (Fig. 10. 7. a – c). The male pereiopod 7 carpus crest`s length varies (Fig. 10.8. a1, $a_2$, $b_1$, $b_2$). The male pleopod 1 exopods lengths vary as well as the thickness of the exopods` posterior parts` sharp apex (Fig. 10.9. a – c).

Morphological anomalies were observed in few males. In a male 16.3 x 6.8 mm the pereiopod 7 carpus crest is straight and longer than in the paired pereiopod (Fig. 10.10. a). In other male 15 x 6 mm the left pleopod 1 exopod`s sharp apex is thicker than in the paired one (Fig. 10.10. b).

Ecology

T. pleonglandulatus is present in rocky areas, even in gorges and ravine-like zones, situated in mountain, hilly or plateau units. It is present on steep and vertical limestone slopes in Minişului Gorge, near the Bigăr Waterfall. *T. pleonglandulatus* was also identified in a limestone, karst zone in Baia de Aramă. Generally, in these zones the individuals were found in beech, oak, or hornbeam forests. However, *T. pleonglandulatus* populates an open area at Divici, situated on the bank of a small stream, even if there are southern oak forests in the vicinity. Thus, the species seems to be mainly sylvan, but it can also populate open areas near forested zones.

Geographic distribution

T. pleonglandulatus was considered endemic in Poiana Ruscă Mountains region (Radu, 1985). It was initially encountered in the following localities: Săvârşin, Bulza, Coşteiu, Pietroasa, Poiana Prislopului, Culmea Luncanilor, Fărăşeşti, Ruşchita and Steiu-Haţeg (Radu 1950). Later, the species was reported only twice, at Mraconia on Danube Gorge (Radu & Tomescu 1975) and in Cloşani area near Baia de Aramă (Ilie et al. 2002). We collected specimens from Parâng Mountains, Semenic Mountains, Mehedinți Mountains, Locvei Mountains and Mehedinți Tableland. Thus the species seems to be distributed in the entire south-western area of Romania, approximately in zones with sub Mediterranean influences (Mândruț 2006), populating mostly the Banat Mountains, Poiana-Ruscă Mountains and the western part of the Southern Carpathians (Fig. 10.11).

Altitude. The species was identified between 100 m altitude at Divici and 400 m altitude at Lainici. Some of the previously mentioned localities from Poiana Ruscă Mountains (Radu 1985) are situated at higher altitudes, of about 600 m.

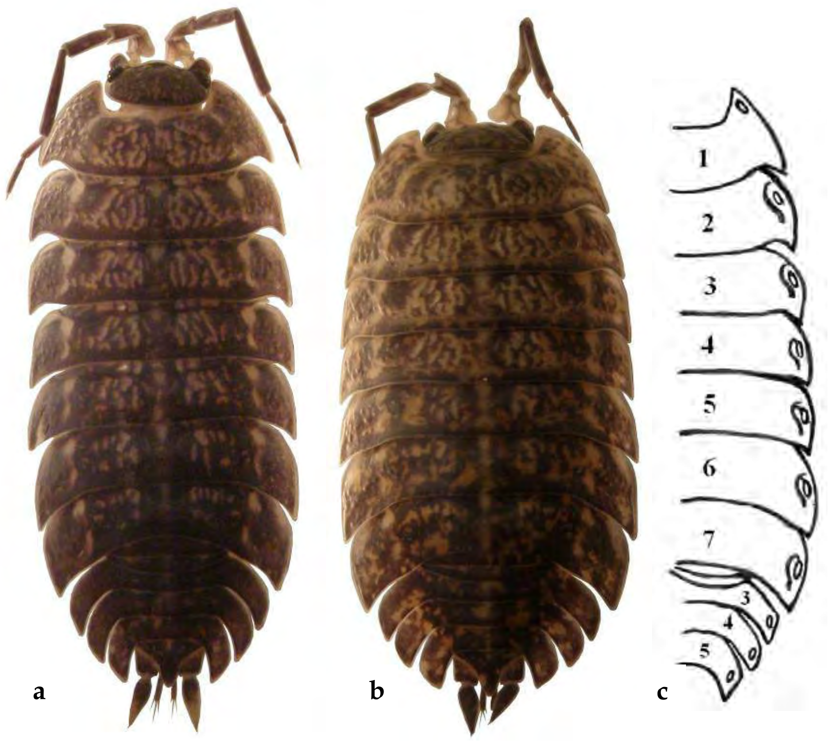


Figure 10.1. *Trachelipus pleonglandulatus* (Radu, 1950): **male and female dorsal view**: **a.** ♂ 15 x 6 mm, **b.** ♀ 15 x 8 mm; **c.** glandular pore fields – Pecinişca Gorge.

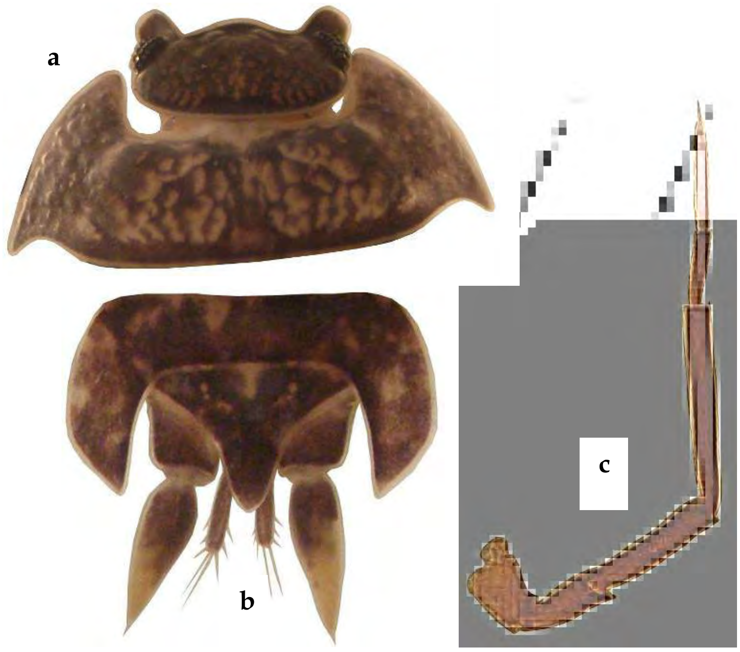


Figure 10.2. *Trachelipus pleonglandulatus* (Radu, 1950): **a. cephalic lobes b. telson**, **c. antenna** ♂ 15 x 6 mm – Pecinişca Gorge.

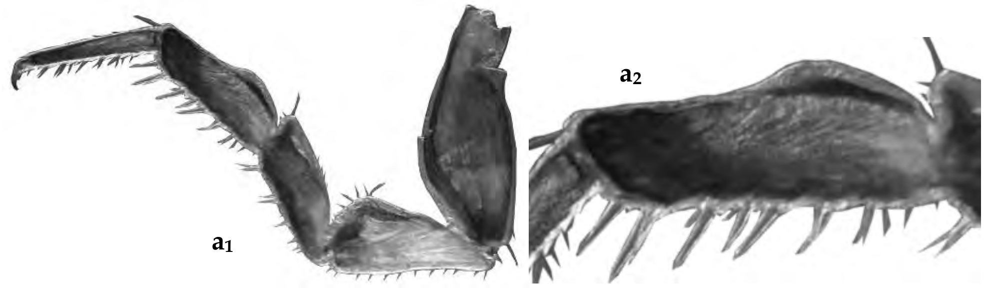


Figure 10.3. *Trachelipus pleonglandulatus* (Radu, 1950): **a_1. pereiopods 7**, **a_2. the carpus crest**, ♂ 15 x 6 mm – Pecinişca Gorge.

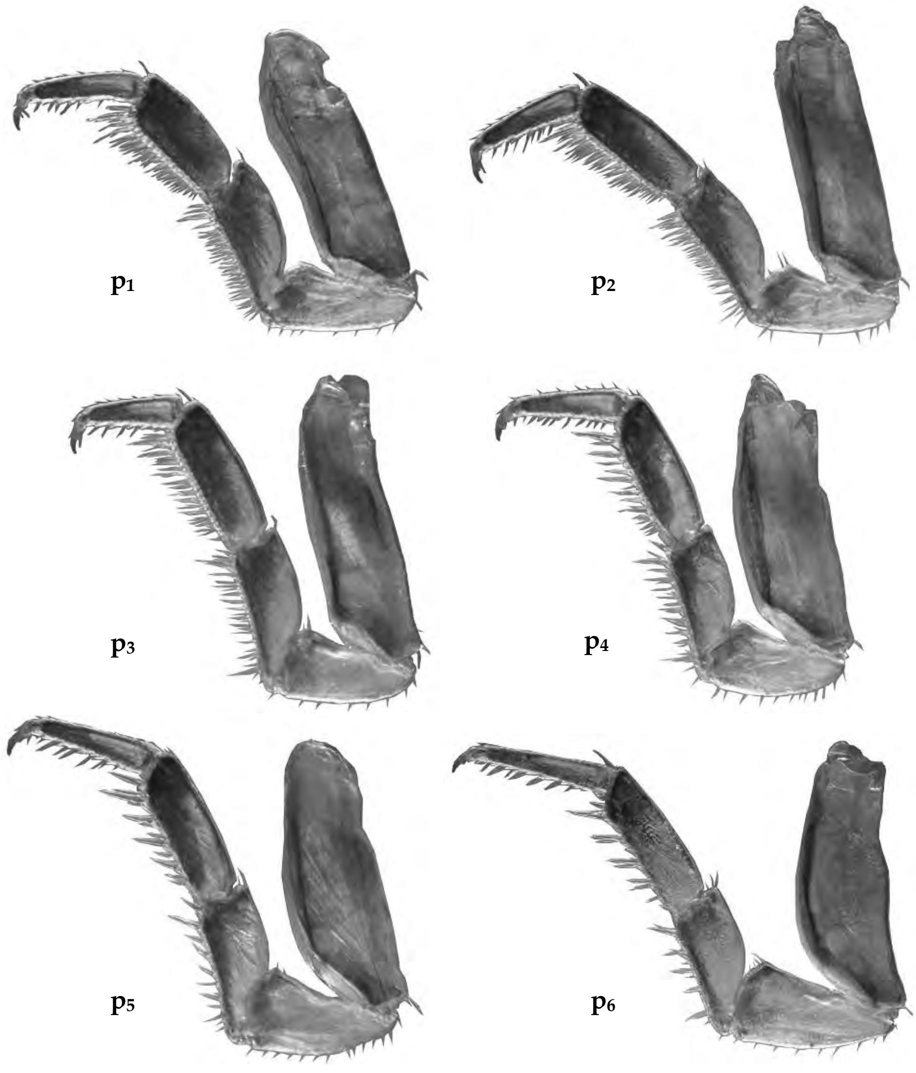


Figure 10.4. *Trachelipus pleonglandulatus* (Radu, 1950): **p_1–p_6. pereiopods 1 – 6**, ♂ 15 x 6 mm – Pecinişca Gorge.

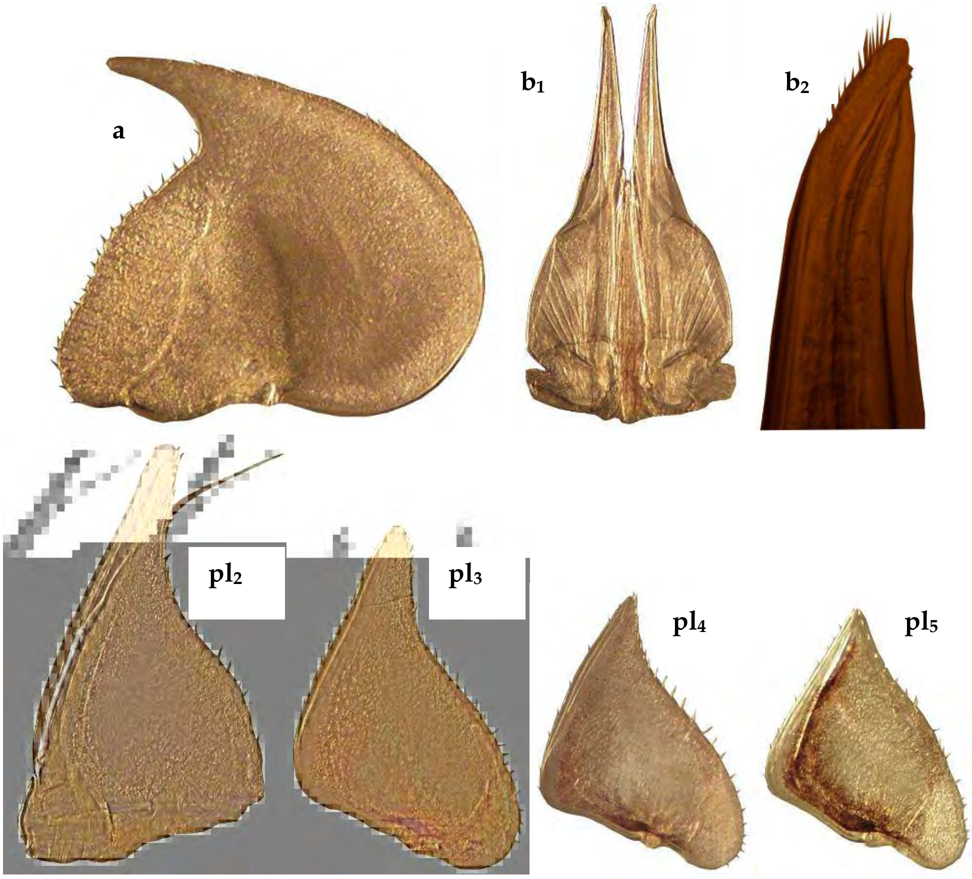


Figure 10.5. *Trachelipus pleonglandulatus* (Radu, 1950): **male pleopod 1**: **a.** exopod **b**$_{1}$. endopods, **b**$_{2}$. the apex of the pleopod 1 endopods; **pl**$_{2}$ **– pl**$_{5}$**. pleopod 2–5 exopods,** ♂ 15 x 6 mm – Pecinişca Gorge.

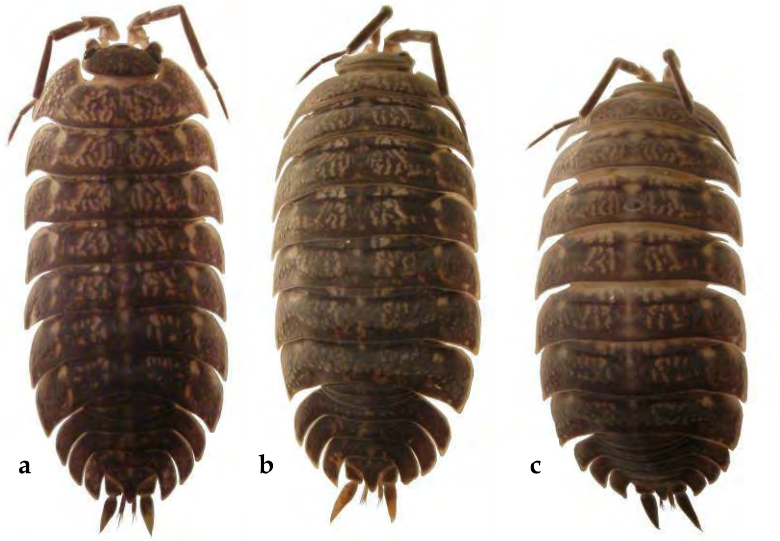


Figure 10.6. *Trachelipus pleonglandulatus* (Radu, 1950): **the variation of the yellow spots on the coxal plates` base**: **a.** ♂ 15 x 6 mm – Pecinişca Gorge, **b.** ♂ 16.3 x 6.8 mm, **c.** ♀ 15 x 6.5 mm – Băile Herculane.

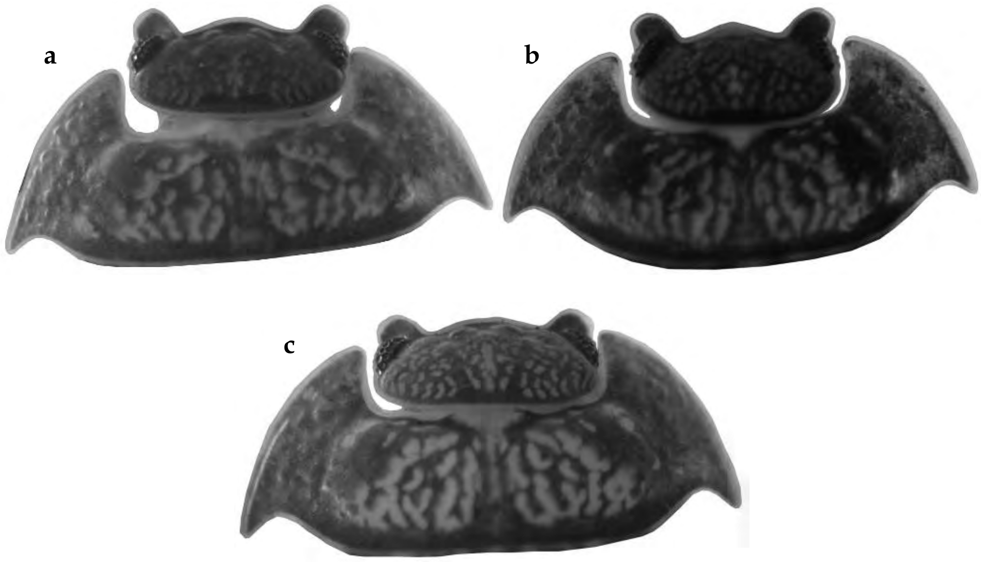


Figure 10.7. *Trachelipus pleonglandulatus* (Radu, 1950), **morphological variation of the cefalic lobes**: **a.** ♂ 15 x 6 mm – Pecinişca Gorge, **b.** ♂ 12.5 x 6 mm, **c.** 12.5 x 5 mm – Băile Herculane;

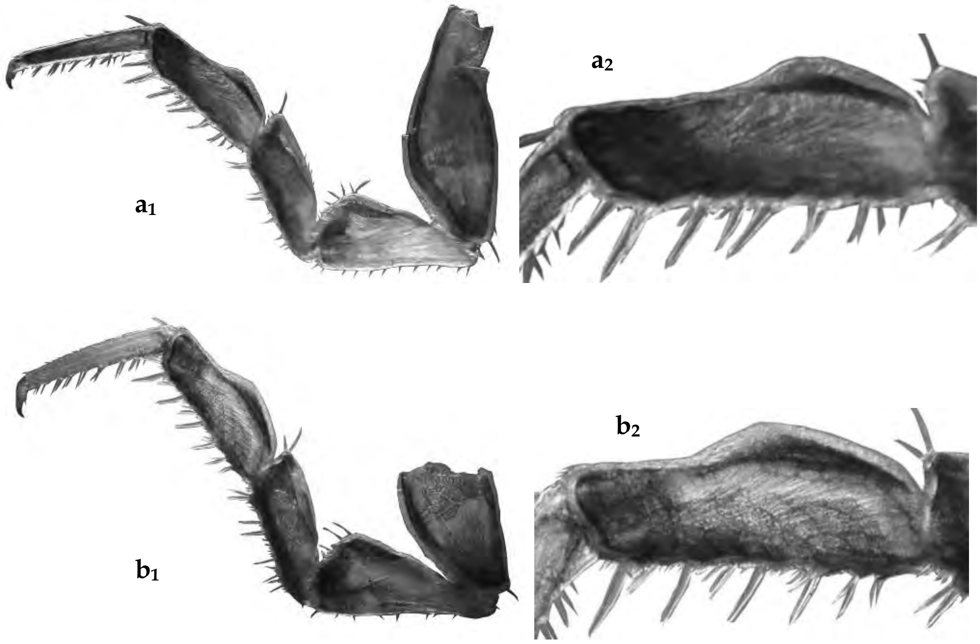


Figure 10.8. *Trachelipus pleonglandulatus* (Radu, 1950), **morphological variation**: **male pereiopod 7 carpus crest:** **a_1, a_2.** ♂ 15 x 6 mm – Pecinişca Gorge, **b_1, b_2.** ♂ 12.5 x 6.5 mm – Băile Herculane.

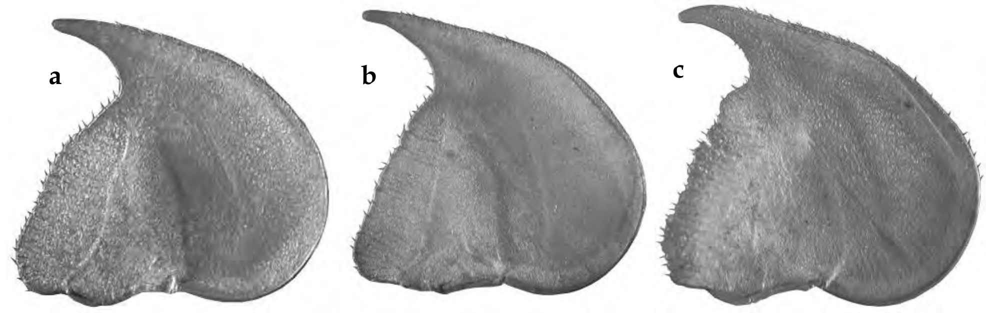


Figure 10.9. *Trachelipus pleonglandulatus* (Radu, 1950), **the pleopod 1 exopods**: **a.** ♂ 15 x 6 mm – Pecinişca Gorge, **b.** ♂ 12.5 x 6.5 mm, **c.** ♂ 16.3 x 6.8 mm – Băile Herculane.

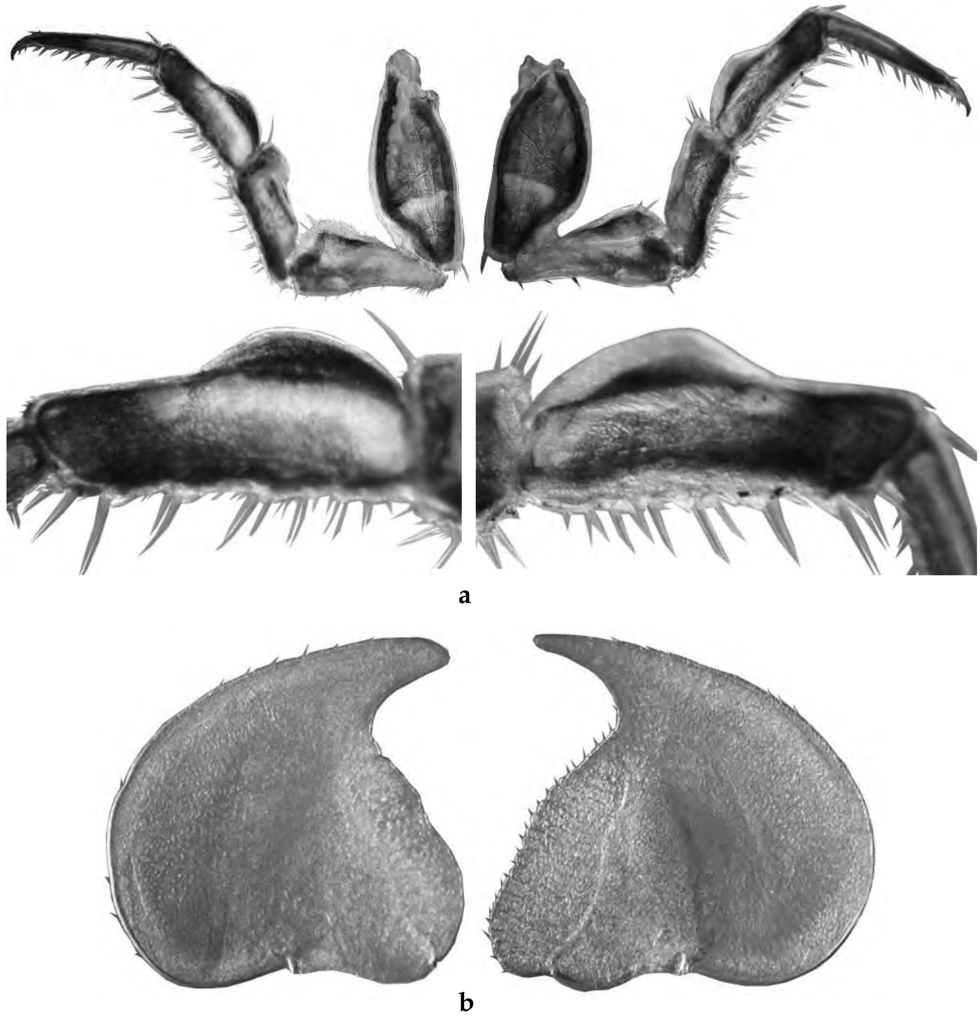


Figure 10.10. *Trachelipus pleonglandulatus* (Radu, 1950): **morphological anomalies**: **a.** the length of the left pereiopod 7 carpus crest, ♂ 15 x 6 mm, **b.** the left pleopod 1 exopod, ♂ 15 x 6 mm – Pecinişca Gorge.

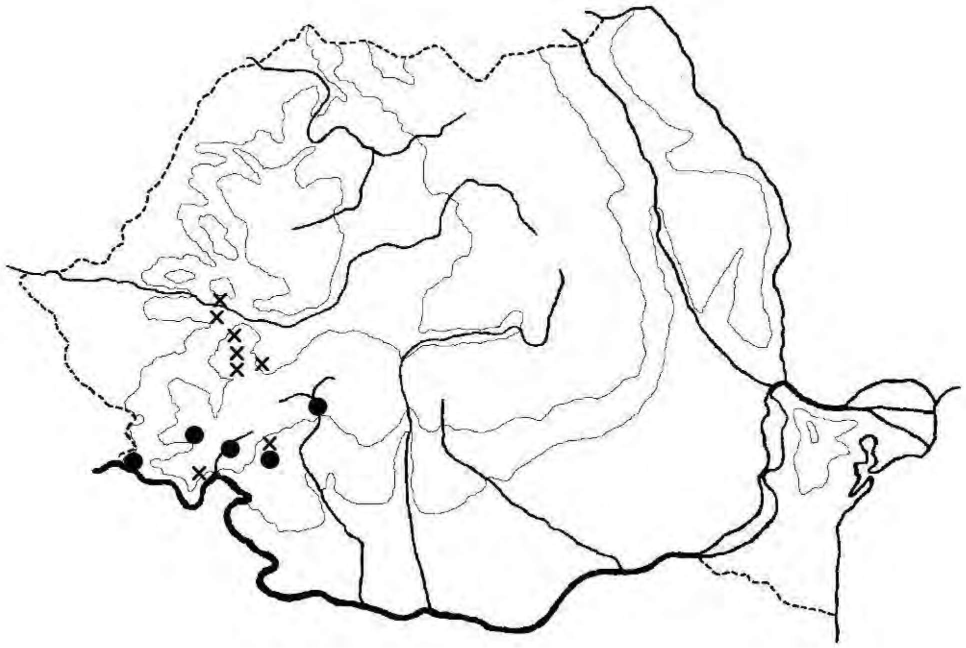


Figure 10.11. The distribution of *T. pleonglandulatus* in Romania
(● - new distribution localities,
X – mentioned in the literature and not reconfirmed distribution points)

Comparative description of the distinctive morphological specific characters of *T. rathkii* (Brandt, 1833) and *T. pleonglandulatus* (Radu, 1950)

Even if *T. pleonglandulatus* was synonymised with *T. rathkii*, this is close by some characters to *T. arcuatus* (Radu 1950). The detailed study on a high number of males and females of *T. rathkii* (Brandt, 1833) and *T. pleonglandulatus* (Radu, 1950), collected from different geographical units helped us to identify and describe the morphological characters which differentiate the two species. The yellow spots on the coxal plates` base are wider in *T. rathkii* (Fig. 10.12. a_1) and narrow in *T. pleonglandulatus* (Fig. 10.12. b_1). In *T. pleonglandulatus* there are males and females with dot-shaped spots, situated in the anterior part of the coxal plates (Fig. 10.6. b, c). The glandular pore fields on the pereion are oval in both species, but they are surrounded proximally with visible chitinous creases in *T. pleonglandulatus*, which are absent in *T. rathkii*. In *T. pleonglandulatus* on the pleonal segments 3-5 there are oval, clearly visible glandular pore fields (Fig. 10.12. b_2). In some males of *T. rathkii* there are small, round glandular pore fields only on the segments 3 and 4 (Fig. 10.12. a_2). In other studied males of *T. rathkii* there are no glandular pore fields on the pleon.

Male pereiopods 7 ischium's ventral side is slightly concave in *T. rathkii*; the carpus crest is prominent with oblique angled apex and straight distal side (Fig. 10.13. a). Males pereiopod 7 ischium's` ventral side is straight in *T. pleonglandulatus*. The carpus crest is slim with a large curvature on both sides (Fig. 10.13. b). The male pleopod 1 exopods` tip is short and thick in *T. rathkii* (Fig. 10.14. a). In *T. pleonglandulatus* males, it is longer and thinner (Fig. 10.14. b). The endopods differ in the two species by their form and structure of the chitinous creases on their extremities (Fig. 10.14. c_2, d_2). The morphological differences between *T. rathkii* and *T. pleonglandulatus* are obvious, but their observation is not an easy task, a detailed study on a high number of males being necessary.

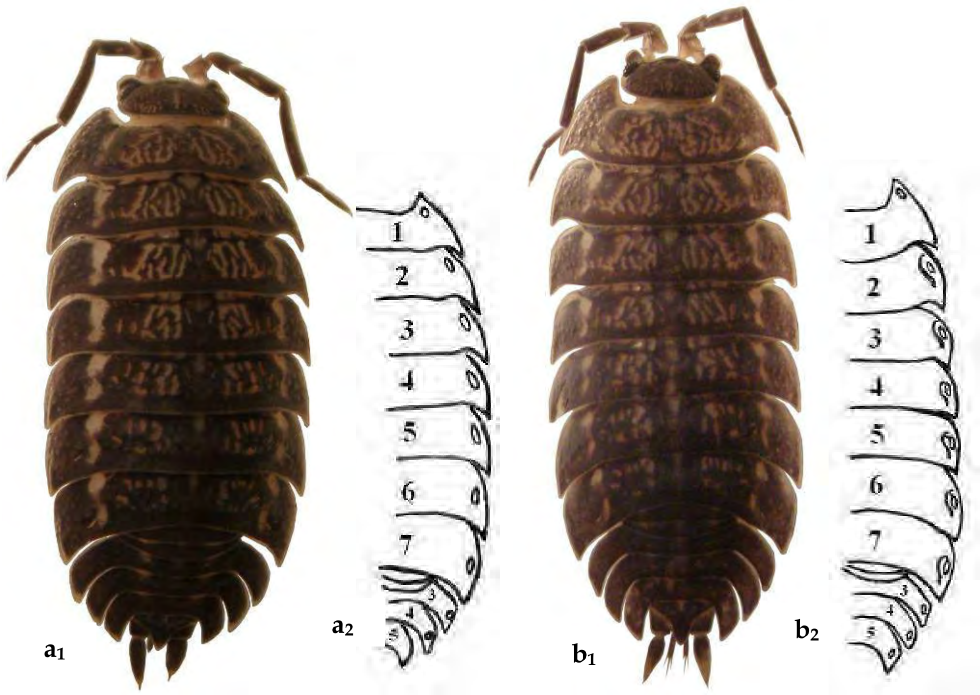


Figure 10.12. Comparison of the dorsal view and glandular pore fields: **a_1, a_2.** *Trachelipus rathkii* (Brandt, 1833), ♂ 11.5 x 5.5 mm – Milova, **b_1, b_2.** *Trachelipus pleonglandulatus* (Radu, 1950): ♂ 15 x 6 mm – Pecinişca Gorge.

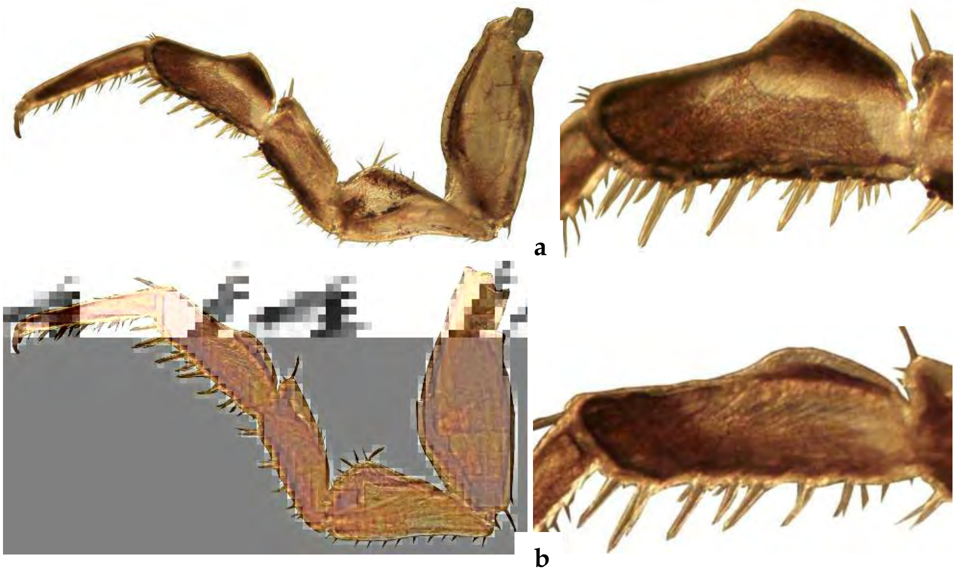


Figure 10.13. Comparison of male appendages in *Trachelipus rathkii* (Brandt, 1833) and *Trachelipus pleonglandulatus* (Radu, 1950), **pereiopod 7**: **a.** *T. rathkii*, ♂ 11.5 x 5.5 mm, **b.** *T. pleonglandulatus*, ♂ 15 x 6 mm.

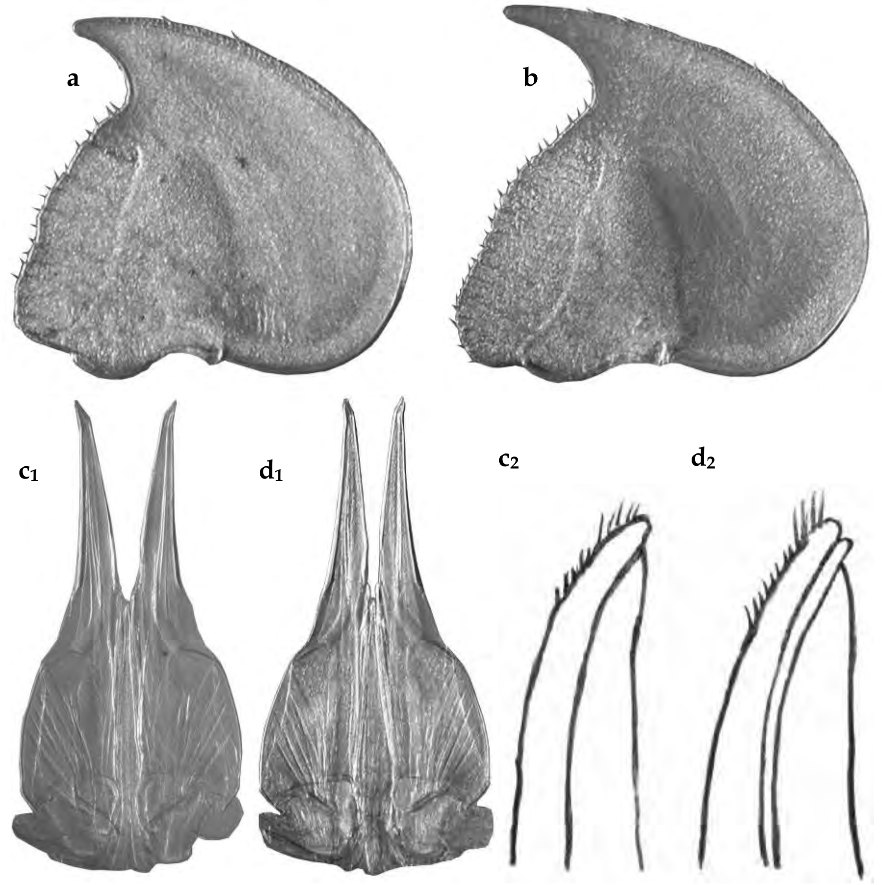


Figure 10.14. Comparison of male appendages in *Trachelipus rathkii* (Brandt, 1833) and *Trachelipus pleonglandulatus* (Radu, 1950), **pleopod 1 exopods**: **a.** *T. rathkii*, ♂ 11.5 x 5.5 mm, **b.** *T. pleonglandulatus*, ♂ 15 x 6 mm; **the pleopod 1 endopods and their apex**: **c_1, c_2.** *T. rathkii*, ♂ 11.5 x 5.5 mm – Milova, **d_1, d_2.** *T. pleonglandulatus*, ♂ 15 x 6 mm – Pecinişca Gorge.

11. *Trachelipus nodulosus* (Koch, 1838)

Porcellio nodulosus Budde-Lund, 1885
Euporcellio balticus Verhoeff, 1907
Tracheoniscus balticus (Verhoeff, 1907), Wächtler, 1937
Tracheoniscus balticus (Verhoeff, 1907); Radu & Tomescu, 1971
Tracheoniscus nodulosus (Koch, 1838); Frankenberger, 1959
Trachelipus nodulosus (Koch, 1838), Schmölzer, 1965
Trachelipus nodulosus (Koch, 1838); Radu, 1985
Trachelipus nodulosus (Koch, 1838), Schmidt, 1997

Literature consulted for the description of the species: Budde-Lund 1885, Verhoeff 1907, Wächtler 1937, Frankenberger 1959, Schmölzer 1965, Radu & Tomescu 1971, Radu 1985, Schmidt 1997.

Examined material and sampling sites

The material was collected from the following locations: Scăriţa-Belioara (Alba County); Poşaga locality (Alba County); Turzii Gorge, (Cluj County); Tureni locality (Cluj County); Floreşti locality (Cluj County); Vultureni locality (Cluj County); Nireş locality (Cluj County); Cluj-Napoca locality (Cluj County); Baia-Mare Depression (Maramureş County); Răbăgani locality (Bihor County); Şuştiu locality (Bihor County); Beiuş locality (Bihor County); Moneasa locality (Arad County); Ineu locality (Arad County); Popina Island (Tulcea County).

We studied 77 males (20 dissected) and 31 females.

Species description

Size: males 9 x 4.5 mm – 15 x 6 mm; females 9 x 5 mm – 17 x 7 mm.

Colour: The tergites are dark-brown, with yellow-orange marbling. There are yellow spots at the base of the coxal plates, which are elongated on the segments 2 – 5, shorter on the segments 6 – 7 and absent on the 1st pereional segment. The colour of the pleonal tergites is uniform (Fig. 11.1. a, b). The length of the spots from the coxal plates` basis and the marbling from the tergites vary in both females and males.

Somatic characters

Cephalon. The lateral cephalic lobes are wide and relatively short, laterally inclined. The median lobe is short, with a round-shaped external side, having large and oblique-angled spaces between the median and lateral lobes (Fig. 11.2. a).

Pereion. The posterior sides of the coxal plates are sinuous on the segments 1 – 3, and curved towards the posterior side on the segments 4 – 7 (Fig. 11.1. a, b). The glandular pore fields are round-shaped, being distanced from the external side of the coxal plates (Fig. 11.1. c).

Pleon. The distal half of the pleotelson is narrow and relatively long, the tip of the pleotelson exceeding in length the extremities of the last coxal plates (Fig. 11.2. b).

Appendages

Antennae. The last antenna article is longer than the penultimate one (Fig. 11.2. c). The ratio between the two articles varies in males and females between 1.1:1 and 1.4:1.

Pereiopods. The ventral side on the male pereiopod 7 ischium is straight in some males and slightly concave in other ones (Fig. 11.3. a_1). The carpus crest covers 2/3 of the carpus length (Fig. 11.3. a_2). On the pereiopods 1-6 the spines density varies (Fig. 11.4.).

Pleopods. The male pleopod 1 exopods` posterior extremity tip is long and thin. The external side of the exopods is slightly concave in its posterior part (Fig. 11.5. a). The pleopod 1 endopods have on their extremities a tuft of long apical spines, and a row of short sub apical spines (Fig. 11.5. b_1, b_2). The pleopods 2 – 5 have no specific, particular characters (Fig. 11.5. pl_2 – pl_5).

Intraspecific morphological variability

The most of the studied males have dark-brown tergites, with fine and discrete marbling of the pereional tergites (Fig. 11.6. a). There are a few males, which are dark-brown with a more pronounced pattern shape (Fig. 11.6. b). The colour varies much in females, most of them having on the tergites numerous yellow spots of different shape and size (Fig. 11.6. c).

The lateral cephalic lobes vary in width and length (Fig. 11.7. a, b). The distal half of the pleotelson varies in width (Fig. 11.7. c, d). Also, the lateral edge's shape and the tip's length of the male pleopod 1 exopods vary (Fig. 11.8. a – c).

Morphological anomalies

The tergites 1 and 2 of the pleon present in two males were longer than normally registered in males and females. In the two males, between the coxal plates of the pereional tergite 7 and the epimeres of the pleonal tergite 3 there is a large space (Fig. 11.9. b_1, b_2, c_1, c_2). In the specimens with normal morphological conformation, this space is very small (Fig. 11.9. a_1, a_2).

The anomaly of the median cephalic lobe was observed in two males collected from Poşaga (Alba County). In this case the median cephalic lobe has a slight invagination on the median zone of the distal side (Fig. 11.10. a, b).

The anomaly of the pleotelson was observed in a female collected from the Baia-Mare Depression, in which the pleotelson was very short and wide (Fig. 11.10. c).

The anomaly of the pereiopod 7 was observed in two males. In one male the pereiopod 7 has thinner and less pigmented articles (Fig. 11.11. a), in another male the pereiopod 7 carpus crests` length was different (Fig. 11.11. b).

Ecology

T. nodulosus is considered a xerophilous species (e.g. Radu 1985, Farkas 2010), which lives in open habitats (pastures, grasslands, etc.). In some of our previous research, we did not find this species in grasslands from mountain areas (Tomescu et al. 2002, 2011). However, at least three sampling sites are situated in mountain areas (Scărița Belioara, Poşaga and Moneasa). The species appeared in open areas with steep slopes, rocky soil, and rare herbaceous vegetation in these localities (Scărița – Belioara) even resulted from clear cuts, or in anthropogenically modified zones. Also, in other cases in Romania, the species entrance in mountain areas was associated with clear-cut and replacement of forests with open areas (Ianc & Ferenți 2014). *T. nodulosus*`s ability to accommodate in disturbed habitats is indicated by its identification in urban areas (Giurgincă 2006, Bodin et al. 2013) or in the vicinity of thermal waters from western Romania (Ferenți et al. 2013a).

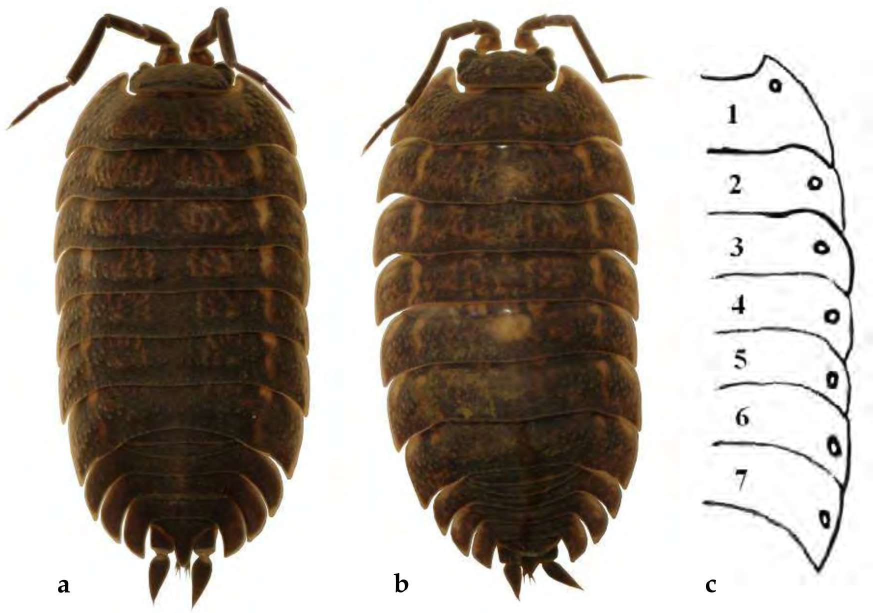


Figure 11.1. *Trachelipus nodulosus* (Koch, 1838), **male and female dorsal view**: **a.** ♂ 13 x 6.5 mm, **b.** ♀ 17 x 7 mm; **c.** glandular pore fields – Cluj-Napoca

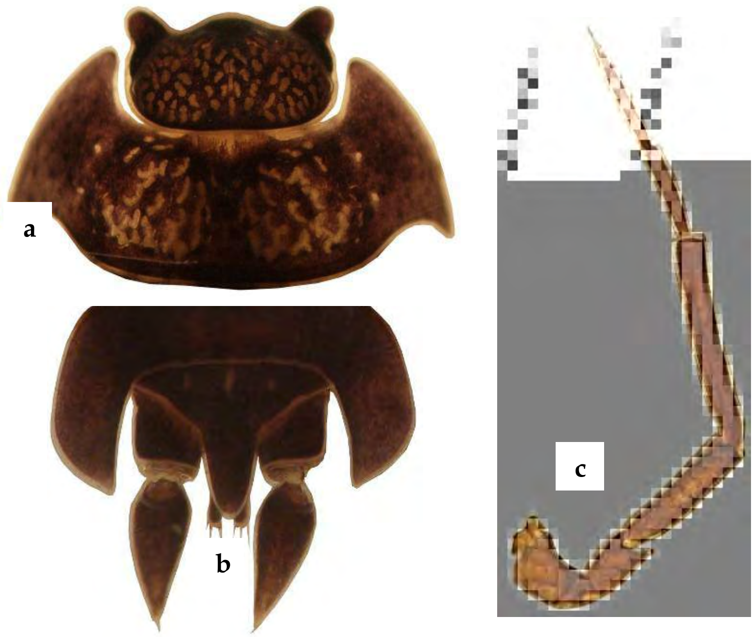


Figure 11.2. *Trachelipus nodulosus* (Koch, 1838), **a. cephalic lobes**, ♂ 11.2 x 5.8 mm – Popina Island, **b. telson**, **c. antenna** ♂ 13 x 6.5 mm – Cluj-Napoca.

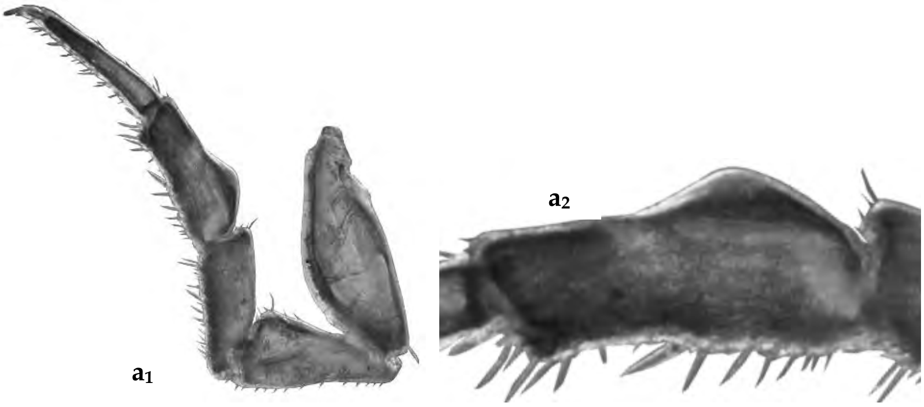


Figure 11.3. *Trachelipus nodulosus* (Koch, 1838): **a_1. pereiopods 7**, **a_2. the carpus crest**, ♂ 13 x 6.5 mm – Cluj-Napoca.

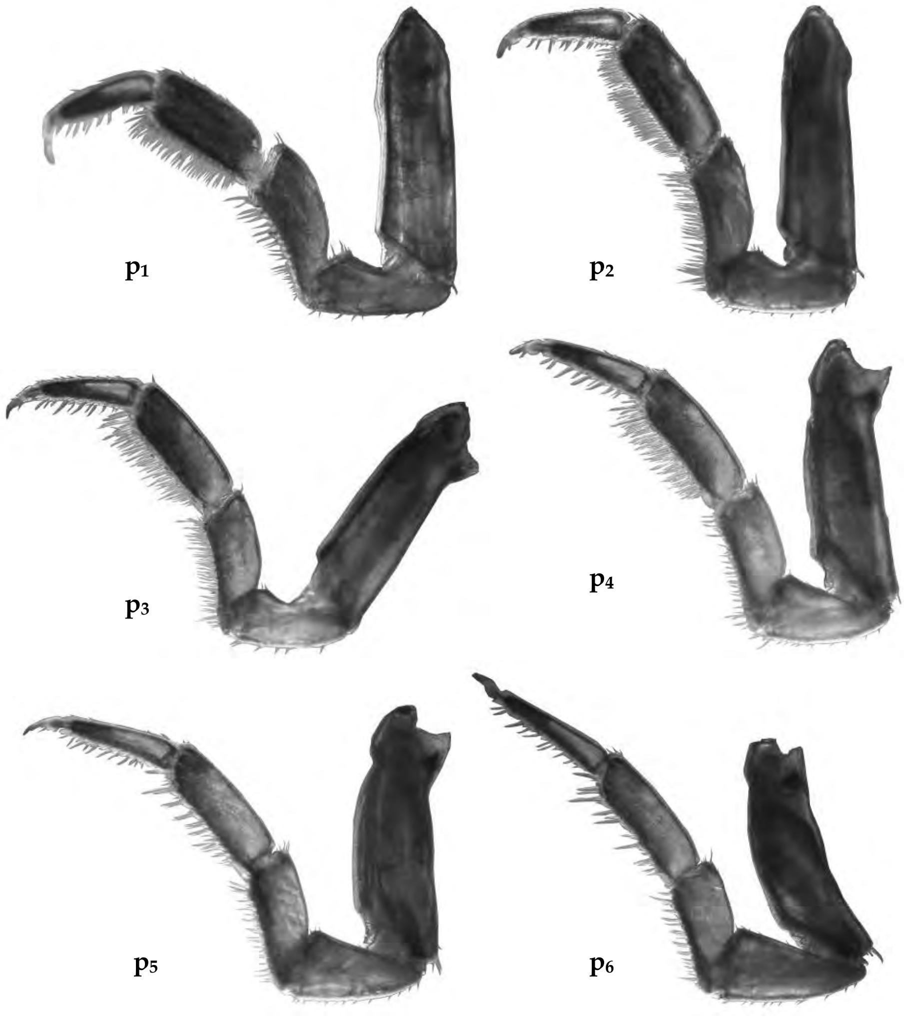


Figure 11.4. *Trachelipus nodulosus* (Koch, 1838), **p_1–p_6. pereiopods 1 – 6**, ♂ 13 x 6.5 mm – Cluj-Napoca.

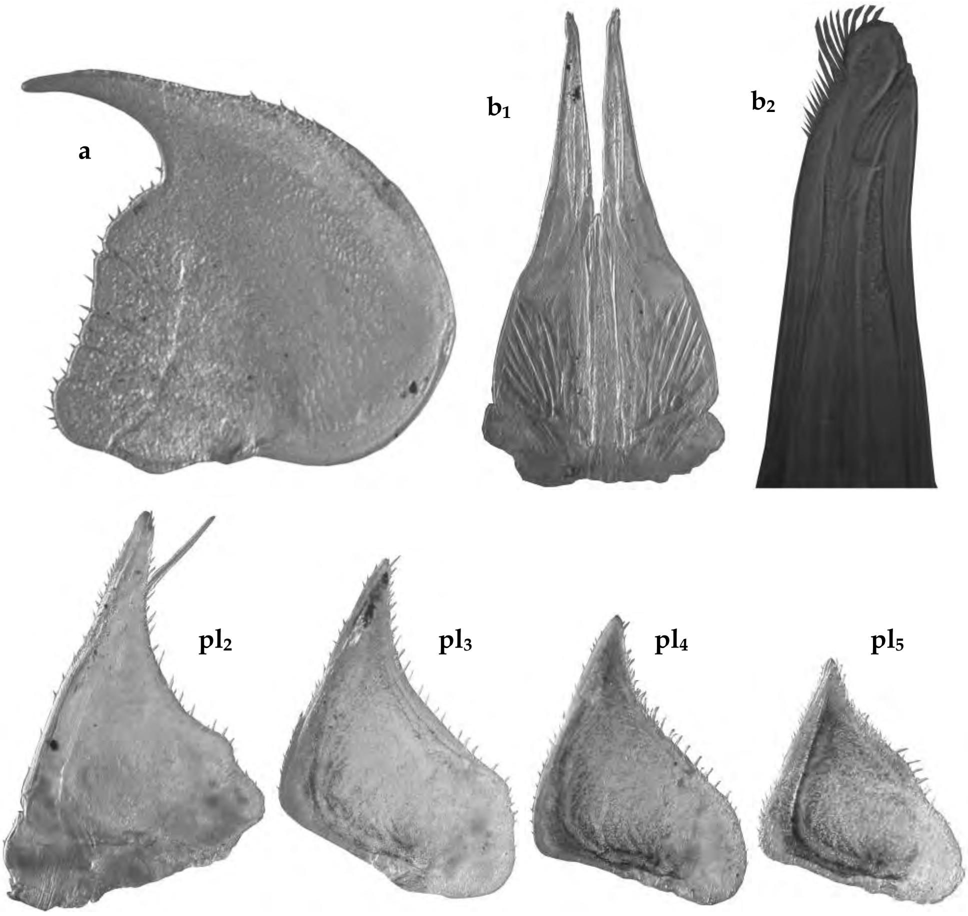


Figure 11.5. *Trachelipus nodulosus* (Koch, 1838), **male pleopods 1**: **a.** exopod **b_1.** endopods, **b_2.** pleopod 1 endopods` apex; **pl_2 – pl_5. pleopod 2-5 exopods**, ♂ 13 x 6.5 mm – Cluj-Napoca.

Geographic distribution

T. nodulosus is present in Central and South-Eastern Europe (Germany, Hungary, Czech Republic, Slovakia, Romania, Balkan Peninsula (Flasarova 1991, 1995, 1999, Radu 1985, Schmidt 1997, Schmalfuss 2003). It lives in grasslands and pastures of hilly and plain areas in Romania, and less in mountain zones, it being reported in the past in Iaşi, Dobruja, Timişoara, Haţeg and Petroşani (Radu 1958). *T. nodulosus* is known in North-Western Romania (Hotea & Hotea 2009, Ferenţi et al. 2012a, b, c, 2013b, c, Ferenţi & Dimancea 2012), in the south-western part of the country, in Banat region (Ferenţi et al. 2013a), in Bucharest (Giurgincă 2006), but also inside the Carpathian arc in the Transylvanian Plateau (Tomescu et al. 1979). It is present in Danube Gorge zone (Radu & Tomescu 1975), Tărcăiţei Hills (Tomescu et al. 2008), Beiuş Depression (Bodin et al. 2013), Meledic Plateau from Buzău (Nitzu et al. 1998-1999) or Dobruja (Tăbăcaru & Boghean 1989, Giurgincă & Ćurčić 2003, Giurgincă et al. 2009). It was found in mountain areas in Piatra Craiului Mountains (Giurgincă et al. 2006), Vârghişului Gorge (Giurgincă & Vănoaică 2006-2007), Scăriţa-Belioara (Tomescu et al. 2000), Arieş River basin (Mureşan et al. 2003) or Pădurea Craiului Mountains (Ianc & Ferenţi 2014). Thus, *T. nodulosus* is common and widespread in the country (Fig. 11.12).

Altitude. *T. nodulosus* was encountered between 15 m altitude in Movile zone near Mangalia in Dobruja (Giurgincă & Ćurčić 2003, Giurgincă et al. 2009) and about 1200 m altitude at Scăriţa-Belioara (Tomescu et al. 2000) in Romania.

Figure 11.6. *Trachelipus nodulosus* (Koch, 1838), **variation of the body colour**: **a.** ♂ 13 x 6.5 mm – Cluj-Napoca, **b.** ♂ 13 x 6.5 mm – Floreşti, **c.** ♀ 14 x 7 mm –Cluj-Napoca.

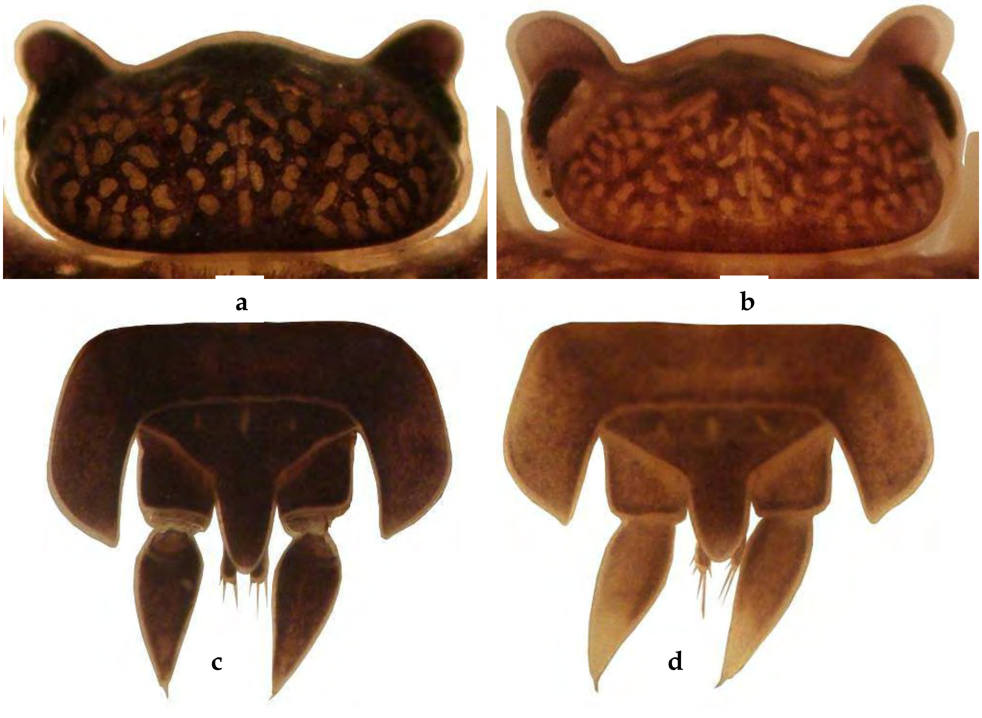


Figure 11.7. *Trachelipus nodulosus* (Koch, 1838), **morphological variation**: **cephalic lobes**, **a.** ♂ 11.2 x 5.8 mm – Popina Island, **b.** ♂ 13 x 6.5 mm – Floreşti; **telson**, **c.** ♂ 13 x 6.5 mm – Cluj-Napoca, **d.** ♂ 13 x 6.5 mm – Floreşti.

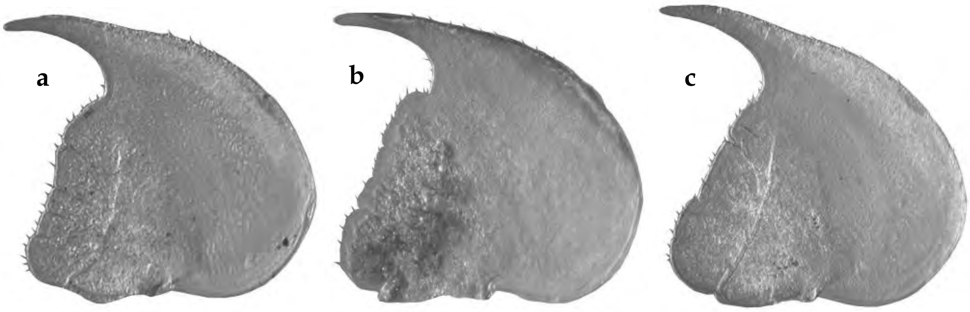


Figure 11.8. *Trachelipus nodulosus* (Koch, 1838), **pleopod 1 exopods**, **a.** ♂ 14 x 5.5 mm, **b.** ♂ 13.5 x 5.5 mm, **c.** ♂ 12 x 5.5 mm – Cluj-Napoca.

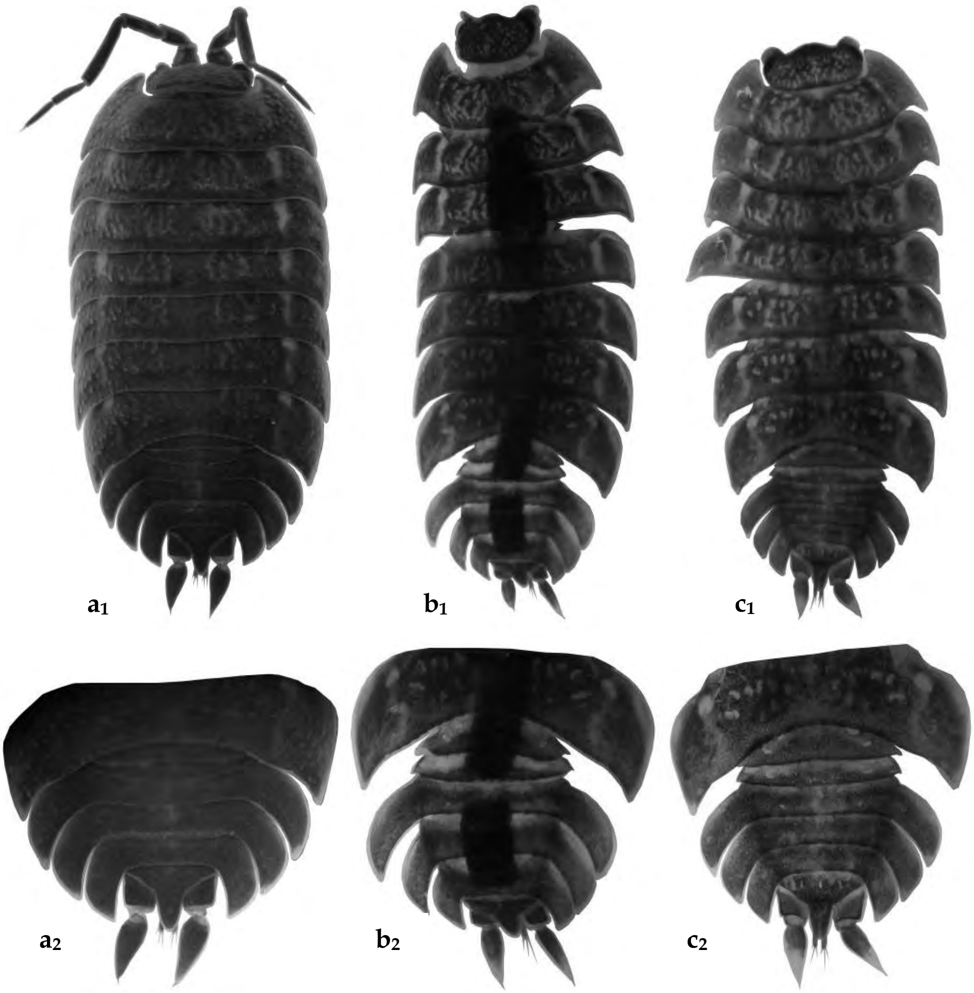


Figure 11.9. *Trachelipus nodulosus* (Koch, 1838), **morphological anomaly of the body shape**: normal shape **a_1, a_2.** ♂ 13 x 6.5 mm – Cluj-Napoca; abnormal shape, **b_1, b_2.** ♂ 15 x 6 mm – Nireş, **c_1, c_2.** ♂ 10 x 4.2 mm – Popina Island.

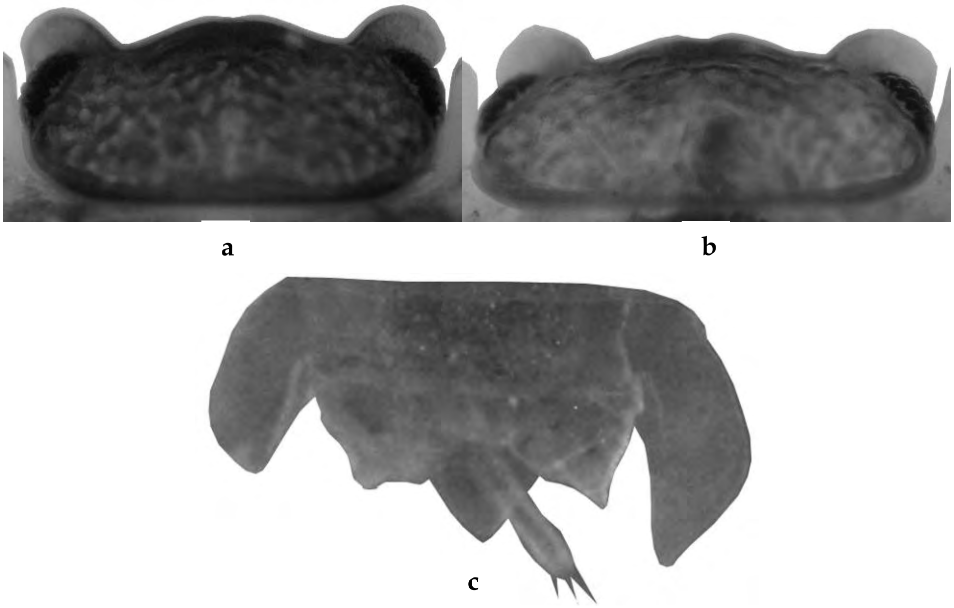


Figure 11.10. *Trachelipus nodulosus* (Koch, 1838), **morphological anomalies**: **median cephalic lobes**, **a.** ♂ 11 x 5 mm, **b.** ♀ 9.5 x 5 mm – Poşaga; **c. telson**, ♀ 9 x 4.5 mm – Baia Mare Depression.

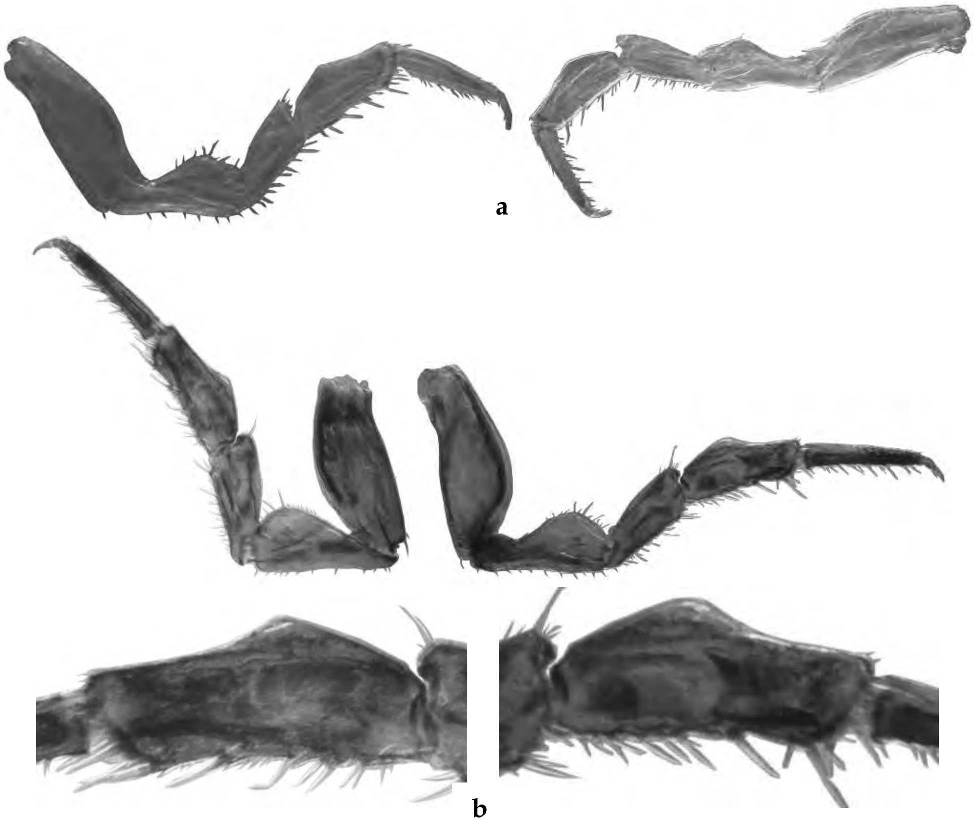


Figure 11.11. *Trachelipus nodulosus* (Koch, 1838), **morphological anomalies of male pereiopods 7**, **a.** abnormal articles, ♂ 11 x 5 mm –Baia Mare Depression, **b.** pereiopod 7 carpus crest, ♂ 13 x 6.5 mm – Cluj-Napoca.

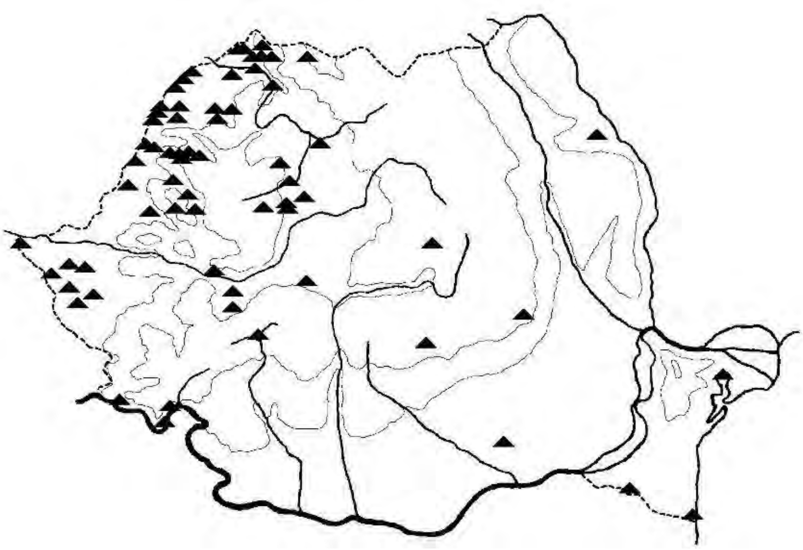


Figure 11.12. The distribution of *T. nodulosus* in Romania (our results and literature data)

12. *Trachelipus squamuliger* (Verhoeff, 1907)

Porcellio squamuliger Verhoeff, 1907
Trachelipus squamuliger (Verhoeff, 1907) Schmölzer, 1965
Trachelipus squamuliger (Verhoeff, 1907) Schmidt, 1997

Literature consulted for the description of the species: Verhoeff 1907, Schmölzer 1965, Schmidt 1997.

Examined material and sampling sites

Luncavița locality, near Valea Fagilor, Măcin Mountains (Tulcea county);

Cocoş Monastery, Măcin Mountains (Tulcea county);

Oltina Locality, Oltina Tableland (Constanța County).

We have studied 8 males (5 dissected) and 6 females.

Species description

Size. Males 9 x 4 mm – 12.5 x 6 mm; females: 9.5 x 4.5 mm – 13 x 7 mm.

Colour: There are yellow-orange spots on the coxal plates` base, longer on the pereional 2-5 tergites, shorter on the tergites 6-7 and absent on the 1st tergites (Fig. 12.1. a, b). In females on the tergites whole surface, there are large yellow-orange spots (Fig. 12.1. b). In males there is a fine, yellow-orange pattern shape which forms longitudinal strips on the pereion`s tergites (Fig. 12.1. a).

Somatic characters

Cephalon. The lateral cephalic lobes are short and wide, inclined laterally. The median lobe is very short, in some males with a slight median invagination on the distal side (Fig. 12.2. a).

Pereion. The posterior sides of the coxal plates on the segments 1-3 are sinuous, on the segments 4-7 are curved to the posterior part of the body (Fig. 12.1. a, b). The glandular pore fields are round-shaped more distanced of the lateral side of the coxal plates (Fig. 12.1. c).

Pleotelson`s distal half is short and wide (Fig. 12.2. b).

Appendages

Antennae. The last antenna article is longer than the penultimate one (Fig. 12.3. a), the lengths` ratio being between 1.2:1 – 1.5:1.

Pereiopods. Male pereiopod 7 ischium's` inferior side is slightly concave. The carpus crest represents 2/3 of the carpus` length (Fig. 12.3. b_1, b_2). Pereiopods 1-6 have no specific morphological characters. On the ventral side of merus and carpus of pereiopods 1-4 there are dense spine rows, rarer on pereiopods 5-6 (Fig. 12.6.).

Pleopods. Male pleopod 1 exopods` external side is strongly concave on the posterior part in males of over 12 mm size (Fig. 12.4. a), and without concavity in males of 9 mm size (Fig. 12.9. e).

Endopods` extremities have long terminal spines (Fig. 12.4. b_1, b_2). Pleopods 2-5 have no specific morphological characters (Fig. 12.5. $pl_2 – pl_5$).

Intraspecific morphological variability

The yellow-orange spots on the coxal plates` base have different length and width (Fig. 12.7.). Morphological differences were also observed at the cephalic lobes (Fig. 12.8.), telson (Fig. 12.9. a, b, c), and male pleopod 1 exopods (Fig. 12.9. d, e).

Ecology

T. squamuliger seems to prefer forested areas from Dobruja. It was identified mainly in oak, linden (Cocoş Monastery) or even beech (Luncaviţa) forests. We identified specimens of *T. squamuliger* in samples from open habitats. Habitat preference of *T. squamuliger* is not clear in this moment, future studies in Dobruja are necessary.

Geographic distribution

Schmidt (1997) mentioned *T. squamuliger* from Greece, Bulgaria and the European part of Turkey. Schmalfuss (1975, 1979) cites the species from Greece and Macedonia. To our knowledge, the species was not reported before in Romania, even though in Dobruja there are many recent articles on terrestrial isopods (Tăbăcaru & Boghean 1989, Giurgincă & Ćurčić 2003, Giurgincă et al. 2009). Thus, *T. squamuliger* is a new species for Romania (Fig. 12.10).

Altitude. *T. squamuliger* was found from 60 m (Oltina) to 170 m altitude (Luncaviţa) altitude.

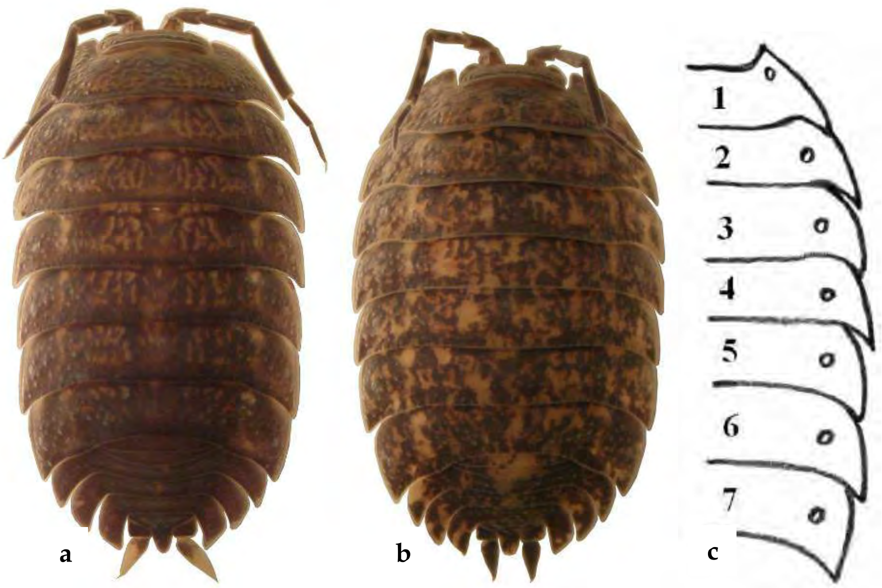


Figure 12.1. *Trachelipus squamuliger* (Verhoeff, 1907), **male and female dorsal view**: **a.** ♂ 12.5 x 6 mm, **b.** ♀ 13 x 7 mm; **c.** glandular pore fields – Cocoş Monastery.

Figure 12.2. *Trachelipus squamuliger* (Verhoeff, 1907), **a. cephalic lobes**, **b. telson**, ♂ 12.5 x 6 mm – Cocoş Monastery.

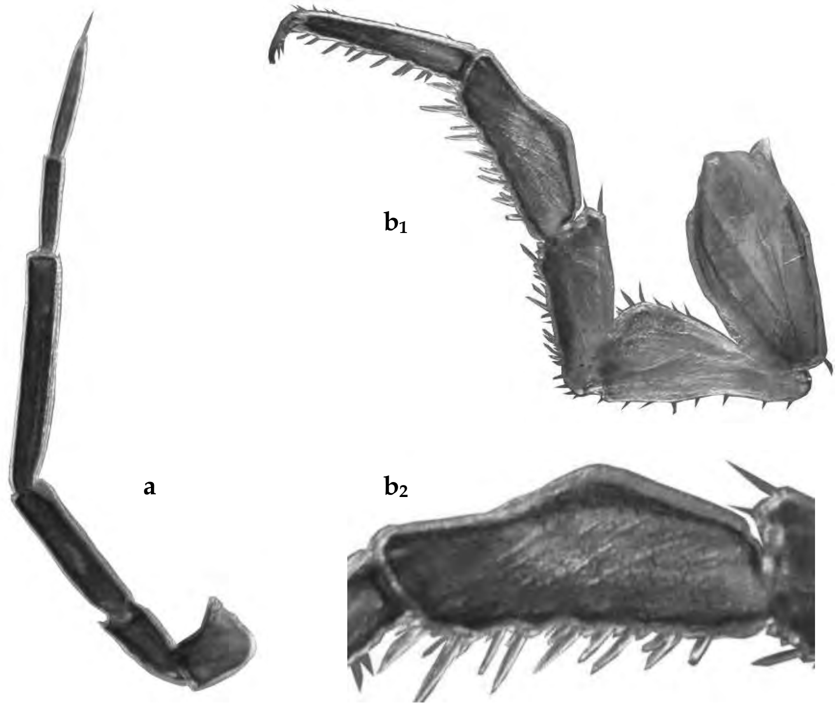


Figure 12.3. *Trachelipus squamuliger* (Verhoeff, 1907): **a. antenna**, **b1. pereiopods 7**, **b2. the carpus crest**, ♂ 12.5 x 6 mm – Cocoş Monastery.

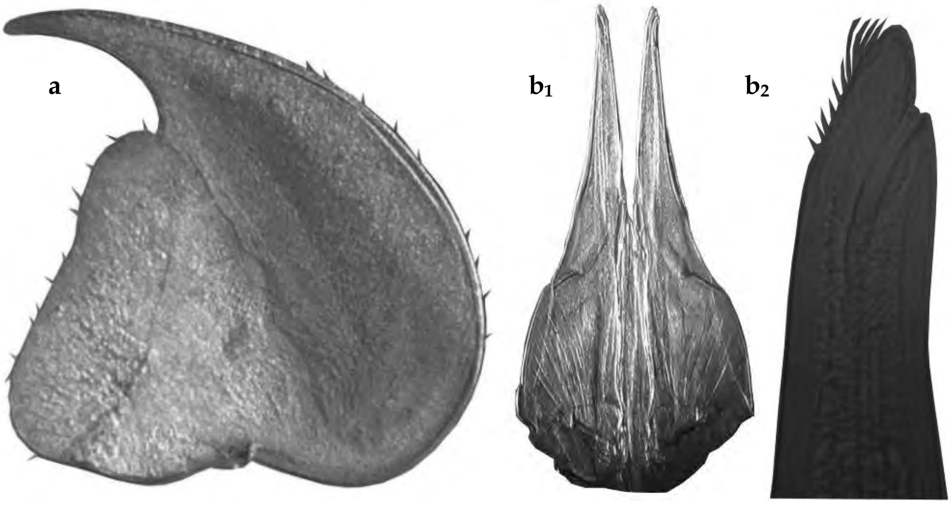


Figure 12.4. *Trachelipus squamuliger* (Verhoeff, 1907), **male pleopods 1**: **a.** exopod **b1.** endopods, **b2.** pleopod 1 endopods` apex – Cocoş Monastery.

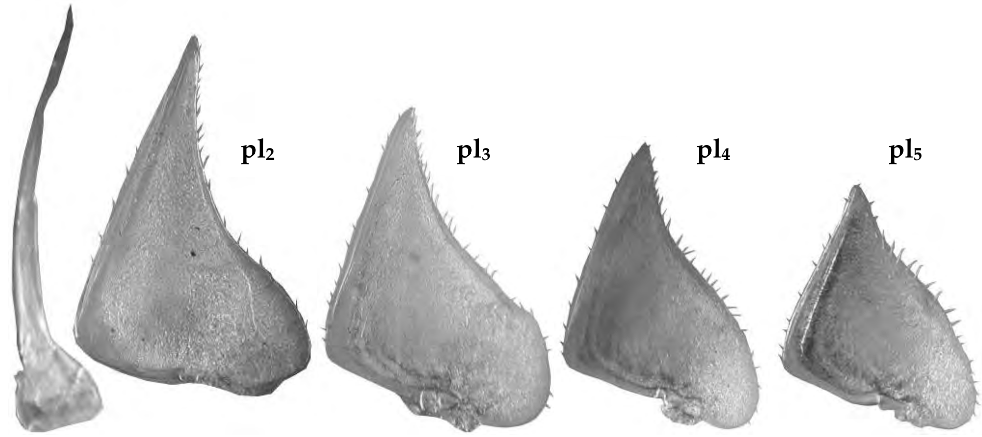


Figure 12.5. *Trachelipus squamuliger* (Verhoeff, 1907), **male pleopods 1**: **a.** exopod **b1.** endopods, **b2**. pleopod 1 endopods` apex; **pl2 – pl5. pleopod 2-5 exopodites,** ♂ 12.5 x 6 mm – Cocoş Monastery.

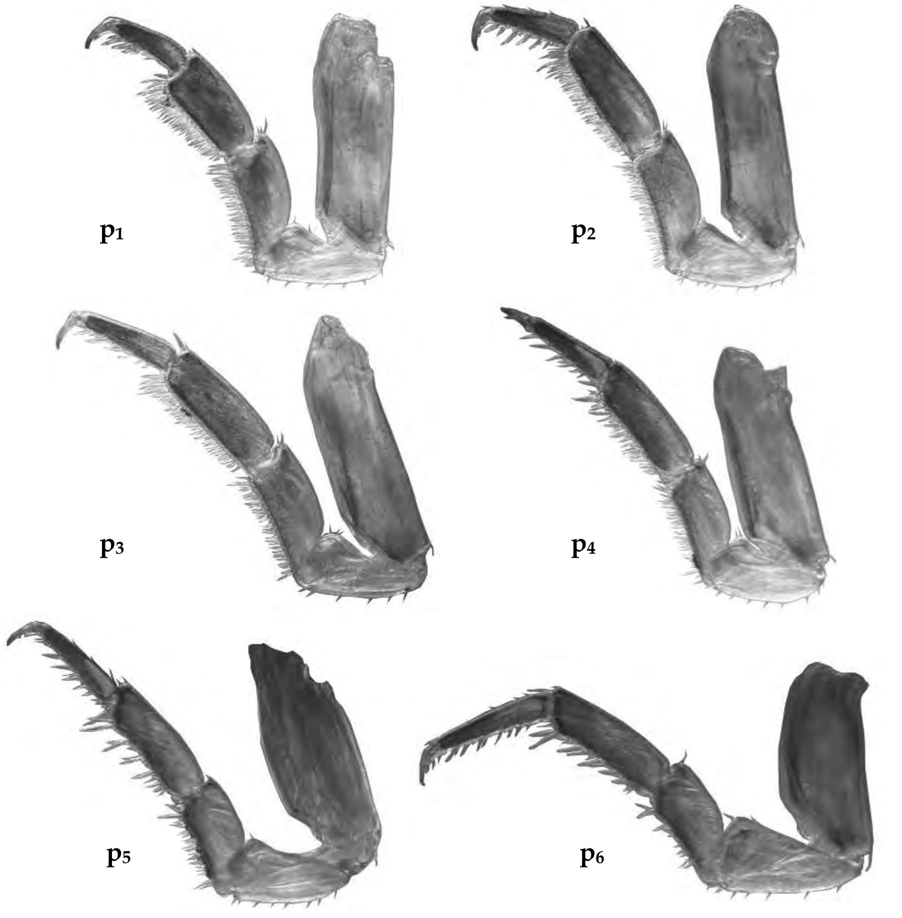


Figure 12.6. *Trachelipus squamuliger* (Verhoeff, 1907), **pereiopods 1 – 6**: **p1–p6.** ♂ 12.5 x 6 mm – Cocoş Monastery.

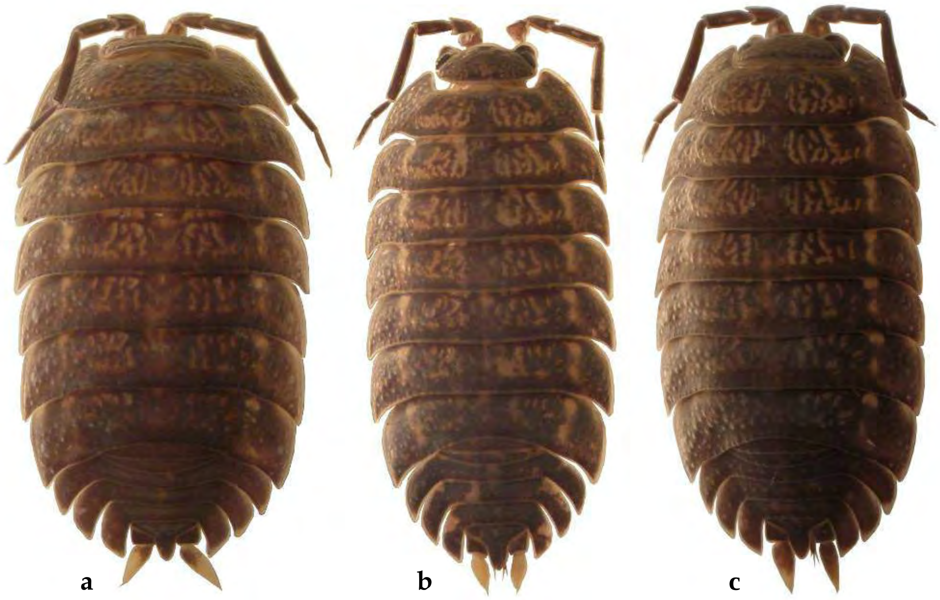


Figure 12.7. *Trachelipus squamuliger* (Verhoeff, 1907), **the variability of the yellow spots on the coxal plates` base in males**, **a.** ♂ 12.5 x 6 mm – Cocoş Monastery, **b.** ♂ 9.2 x 4.2 mm, **c.** ♂ 12.5 x 6 mm – Luncaviţa.

Figure 12.8. *Trachelipus squamuliger* (Verhoeff, 1907), **the variation of the cephalic lobes**, **a.** ♂ 12.5 x 6 mm – Cocoş Monastery, **b.** ♂ 9.2 x 4.2 mm, **c.** ♂ 12.5 x 6 mm – Luncaviţa.

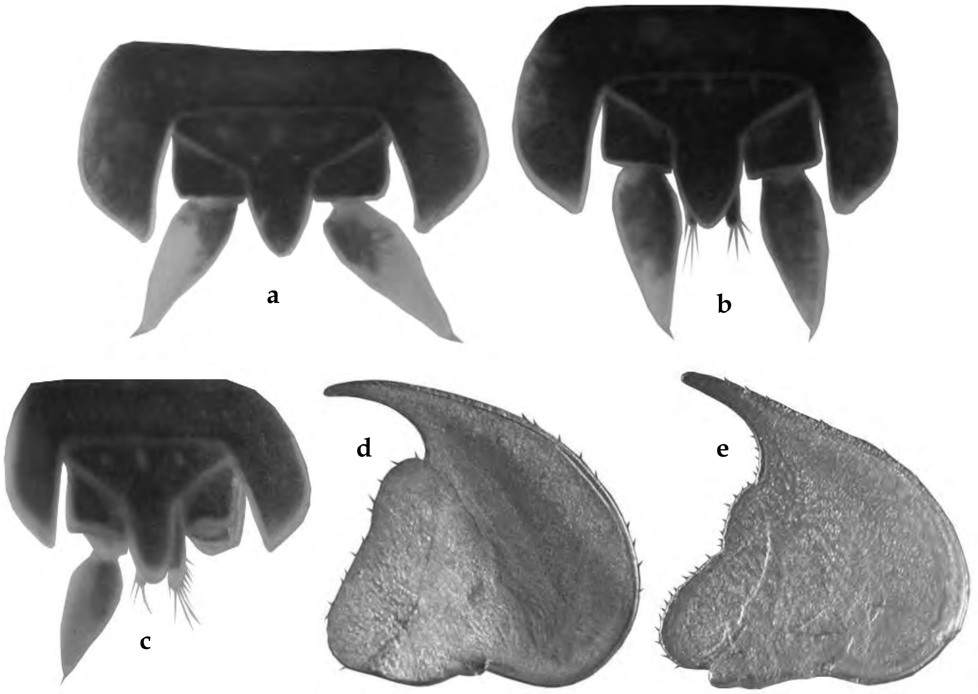


Figure 12.9. *Trachelipus squamuliger* (Verhoeff, 1907), **morphological variation**: **telson**, **a.** ♂ 12.5 x 6 mm – Cocoş Monastery, **b.** ♂ 12.5 x 6 mm – Luncaviţa, **c.** ♂ 9 x 4 mm – Oltina; **pleopod 1 exopods**, **d.** ♂ 12.5 x 6 mm – Cocoş Monastery, **e.** ♂ 9 x 4 mm – Oltina.

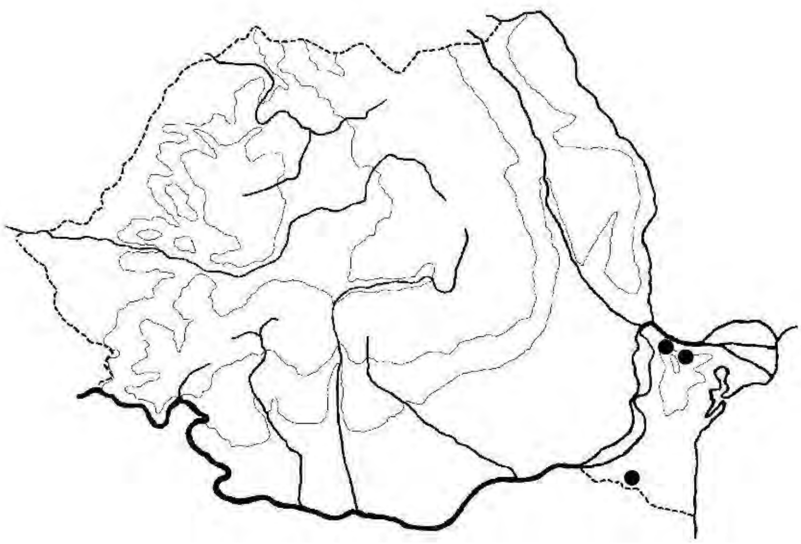


Figure 12.10. The distribution of *T. squamuliger* in Romania
(● - new recorded distribution points)

Discussion

The identification of Trachelipus species is quite difficult (Radu 1950, Tăbăcaru & Boghean 1989, Schmidt 1997), even if they have larger sizes (Radu 1985). The descriptions of Trachelipus species are often short, without figures (Budde-Lund 1885, Verhoeff 1901, 1907), or made on few individuals. In other cases, the few figures do not show important morphological characters with taxonomic value (Frankenberger 1959, Schmölzer 1965). Such difficulties in determination or errors in the description of some species were presented in detail by different authors (Radu 1950, Schmidt 1997). Even more, the specific morphological characters appear progressively through the postembryonic development (e.g. Radu & Tomescu 1971, Tomescu & Accola 1992a). Thus, adult males are necessary for determining of the species, but sometimes they can be easily confused with juvenile males.

We observed a certain degree of variability of some specific characters. However, these variations affect only one or two morphological characters, while the others have the typical shape for the species. Variability was identified both in males from the same populations and in males from different populations. There is a certain degree of variability in the shape and size of the cephalic lobes, male pereiopod 7 carpus crests, pleopod 1 exopods` apex and less in the telson. We have not observed variations in glandular pore fields` position on the coxal plates or in male pleopod 1 endopods. We also identified anomalies of some morphological characters (antennae, male pereiopod 7 and pleopod 1 exopods). The ignorance of these variations, which later proved to be simple variations of the same species, can be the cause of the incorrect description of some species (Schmidt 1997)

Radu (1985) presents 18 Trachelipus species and subspecies for Romania. Some of them, like *T. rathkii valachicus*, *T. fontisherculis* and *T. trachealis* were not identified by Radu in his researches (Radu 1985). As their descriptions are scarce without figures and made on a low number of males (see for example Budde-Lund, 1885 for *T. trachealis*), the studied specimens might have belonged to other known species. In addition, the past literature often has only vague indications concerning localities the respective species come from, fact, which makes the verification of their validity difficult. For example, *T. trachealis* is indicated from Moldova (Budde-Lund 1885), an extremely large surface, which makes difficult the re-identification of those animals and the verification of their validity.

Additionally to the species presented by Radu (1985), Tăbăcaru and Boghean (1989) describe from a cave in Dobrogea the troglobiont species *T. troglobius*. Thus, Romania has the greatest number of Trachelipus, which exists in Europe (Tăbăcaru & Boghean 1989). A number of 12 species were considered endemic for Romania (see in: Radu 1985). Nevertheless, Schmidt (1997) synonymises seven species mentioned by Radu (1985) to be present in Romania, of which 5 species were described by Radu. However, in this monograph were also omitted species from Romania, like *T. fontisherculis* or *T. subspinulatus* (see in: Schmidt 1997), the last one being described by Radu at Moneasa (Radu 1985). Thus, after the synonymisation, the species number from Romania was reduced, according the latest data in our country being present only 10 species, a number that still places the genus at the first place in Romania, on a par with the Haplophthalmus genus (Tăbăcaru & Giurgincă 2013). Nevertheless, some authors had omitted some species of this genus that were described in the country, some of them being synonymised, others being very difficult to find, thus the real number of the Trachelipus species from Romania is impossible to know exactly at this moment. At the same time, the species number from Romania is increasing in the present, not certainly by the description of new species, but by identifying some species present in the neighbouring countries. This is the case of *T. squamuliger*, which was just reported in Romania. In addition, we found that *T. varae* Radu, 1948, *T. bujori* Radu, 1950 and *T. pleonglandulatus* Radu 1950 are valid species, there being obvious differences from the species they were synonymised with.

There are five endemic of 12 Trachelipus species that we studied for Romania: *T. trilobatus, T. ater, T. vareae, T. bujori* and *T. pleonglandulatus*. The high number of endemic species could be explained by the Romanian relief, with large mountain areas, which favoured the isolation of some isopod populations, subsequently the formation of new species. Between the endemic species in Romania, by their particular aspect (but similar to each other) and limited distribution range, the first three are distinguished. In fact their status, or at least in some species, was also observed in the past, these being considered to have a Mediterranean aspect (Radu 1958). *T. trilobatus, T. ater, T. vareae* are the biggest Trachelipus species from Romania (Radu 1958), they being tied to gorge-looking zones, with forests. By our present knowledge, they have vicarious distribution range. Not by chance, the three species appear to be distributed only in the southern part of Southern Carpathians and partially in Western Romanian Carpathians, zones that were considered glacial refuges (e.g. Magri et al. 2006, Schmitt et al. 2007, Fijarczyk et al. 2011). Otherwise, the Carpathians are considered a glacial refuge for invertebrates with low mobility (Varga 2010), which is, obviously, the case of terrestrial isopods too.

Of the three above-mentioned species, the most particular one is *T. trilobatus*. This is not only the widest Trachelipus species from Romania, but also the one with the most restricted distribution range (with the exception of the troglobiont *T. troglobius*). This species is reported until now only in Cerna River basin, in Băile Herculane zone and in Mehedinți Mountains. In the case of other groups from Băile Herculane zone, like earthworms, there are differences from the other areas from Carpathians, endemic and relict species being present (e.g. Pop 1980). *T. trilobatus* seems to be really quartered exclusively in this region, even if this limitation is difficult to accept, because in the neighbouring regions there are other, apparently favourable habitats. Thus, we have searched it repeatedly in limestone zones with steep slopes and deep valleys in the Danube Gorge, situated at just 30 km south of Băile Herculane. Between the two zones there is no geographic barrier, the Cerna River that crosses Băile Herculane, flows into the Danube at approximately 18 km south of these. However, despite the repeated investigations we had not encounter the species in Danube zone. This is surprising, because the Danube Gorge also shelters, beyond the endemic ones, mountain species at extremely low altitudes (e.g. Paşcovschi 1956, Covaciu-Marcov et al. 2009). Also, *T. trilobatus* seems to be absent north of Mehadia locality, where we sought it in vain in gorge looking zones between Mehadia and Cruşovăţ, along Globu River. Thus, the species seems to be strictly limited to Băile Herculane and Mehedinți Mountains zone, even though at Băile Herculane it is frequent at least in its characteristic habitats. Explaining this limited distribution area is difficult, but the species particular aspect, even compared with other close species, indicates probably the isolation of this species in the region in the distant past, where it probably survived the glacial periods, subsequently its colonization on new regions being unsuccessful. The particular aspect of this species should not probably be interpreted as being the original shape, rather a result of its long evolution in conditions from Herculane, the flattened habitus and large width serving for its easy hide under stones or cracks in the caves` walls. Thus, *T. trilobatus* is not necessarily the archaic form but a more specialized one. In the same time, it is a relict species, which survives in a limited zone, in restrictive habitats.

The other two species, *T. ater* and *T. varae*, are very similar morphologically, but clearly different of *T. trilobatus*. *T. ater* seems to be distributed only in the central part of the Southern Carpathians, while *T. varae* inhabits the eastern part of the Apuseni Mountains, and possibly a limited zone at the northern part of Southern Carpathians and eastern part of Poiana Ruscă Mountains. Anyway, the two related species seems to be completely separated geographically in the present. In addition, to our knowledge, they are completely separated from *T. trilobatus*. The resemblance of the two species indicates their recent separation to different zones of Carpathian Mountains, probably after the last glacial maximum. The zones the two species populates are recognized as glacial refuges (e.g. Schmitt et al. 2007, Fijarczyk et al. 2011). Thus, in the area of *T. ater* from Vâlsan River, the endemic *Romanichthys valsanicola* is present (see in: Telcean et al. 2011), this fact indicates the long period in which this zone had served as a refuge. There are endemic Orthopteran species in the southern Carpathians, in Făgăraş and Cozia Mountains, that are considered to survive in that region at least in the last glacial period (see in: Kenyeres et al. 2009). As much as in the southern Carpathians, there are numerous endemic taxons in the Apuseni Mountains too, for example among earthworms (Pop et al. 2010). In the case of earthworms, there are even vicariant species between Apuseni Mountains and southern Carpathians (Pop et al. 2010). The situation that also seems to be similar for isopod species *T. vareae* and *T. ater*. Although this vicariance was explained through some geologic phenomenon at earthworms (Pop et al. 2010), in the case of terrestrial isopods it is more probably that the last glacial periods isolated in different mountain valleys distinct populations from *T. ater* group. Due to the isolation, *T. vareae* evolved in the eastern parts of Apuseni Mountains. Probably, there were refuges for some tree species in the valleys from Apuseni Mountains (e.g. Bodnariuc et al. 2002), in the region even being possible to exist a refuge for beech (e.g. Magri et al. 2006). Even if *T. vareae* was mentioned south of Apuseni Mountains (Radu 1958), we considered that the species distribution range is really limited to Apuseni Mountains, and the sightings from Poiana Ruscă Mountains and southern Carpathians probably refer to *T. ater*. This presumption is based on the fact that even Radu, who described *T. vareae*, did not make any difference between this species and *T. ater*. Radu (1958) mentioned *T. vareae* from Olt River Gorge, at Turnu Roşu (so in terra tipica of *T. ater*) and at Călimăneşti, where only *T. ater* is present and frequent. Thus, probably Radu in fact encountered *T. ater*, but mentioned *T. vareae* in the other areas south from Apuseni Mountains. In these conditions, the limitation of *T. vareae* in Apuseni Mountains seems valid, but the populations from Poiana Ruscă Mountains and southern Carpathians should be investigated.

The almost exclusive distribution of the three species in gorge like areas pointed out their relict character. The majority of Carpathian endemic species were found in geothermal waters or in karst areas (Varga 2010). Certainly, these isopod species survived in the Carpathians in the glacial periods, probably even in their present distribution range. Alongside the occupied habitats, this is supported by the fact that any of these three species was not encountered in other areas and in other habitat types. At least *T. vareae*`s scattered distribution in special habitats was recorded before (Radu 1950). Even indirectly, these data underline the fact that some areas acted like glacial refuges in Romanian Carpathians (e.g. Mraz et al. 2007, Wielstra et al. 2013, Ronikier et al. 2008, Fijarczyk et al. 2011, Zieliński et al. 2014). Probably, *T. trilobatus, T. ater, T. vareae* have a common ancestor before the glacial periods that had been distributed in large areas in the Carpathian Mountains and their surrounding hills. The glacial events fragmented the former distribution range, and only some populations survived in isolated and more shielded areas. Probably, the ancestor of *T. trilobatus* was isolated first, while the other two species had not been separated for a time, their disjunction having happened more recently. In this way, it explains why *T. trilobatus* is the most peculiar species. Not even the disjunction between *T. ater* and *T. vareae* is more recent, but also these two species evolved in conditions and habitats close between them and more distant from the ones of *T. trilobatus*.

Nevertheless, it is difficult to understand why these species or others related to them were not encountered southwards of Romania, in the mountain regions of Serbia and Bulgaria. This phenomenon may be the consequence of the insufficient studies in those regions, or the absence of these Trachelipus species. It is unlikely that potential glacial refuge for species with such ecological requirements lack southwards of Romania. Nevertheless, including in the case of cavernicolous terrestrial isopods there are important differences between Romania in the countries south of it (see in: Tăbăcaru & Giurgincă 2013). It is possible that these species or their ancestor never existed south of Romania. In this case, truly their aspect is not a Mediterranean one, but a relict one, Romania being a speciation centre of this genus (Radu 1958). The three species certify the existence of isolated refuge areas in Romanian Carpathians (e.g. Schmitt et al. 2007). Recently, relict populations of some mountain terrestrial isopods were recorded in different Romanian plains (Ferenți et al. 2012c, 2013b, Ferenți & Covaciu-Marcov 2014). There are no phylogeographical studies upon Romanian isopod species, contrary to other groups, especially vertebrates (e.g. Babik et al. 2005, Fijarczyk et al. 2011, Wielstra et al. 2013, Zieliński et al. 2014), but even invertebrates (e.g. Schmitt et al. 2007, Homburg et al. 2013). However, in the case of isopods, there are generally few phylogeographical studies, that focus only on some regions, like Greece (e.g. Poulakakis & Sfenthourakis 2008, Parmakelis et al. 2008, Kamilari et al. 2014).

The other two Romanian endemic species, *T. bujori* and *T. pleonglandulatus*, have larger distribution ranges and they occupy more common habitats, especially forests. They are present in Banat Mountains, western sectors of Southern Carpathians and in the south-western parts of Apuseni Mountains. If these species are truly absent southwards of Romania, they had evolved somewhere in their present distribution range, most probably in southern parts. Unlike the previous three species, the more common habitats occupied by *T. bujori* and *T. pleonglandulatus* cannot rule out their presence southwards of Romania. *T. bujori* and *T. pleonglandulatus* seems to be present in the same regions of Romania, *T. bujori* being distributed a little more to the north.

The great similarity between *T. bujori* and *T. ratzeburgii* probably indicates that *T. bujori* evolved from an isolated *T. ratzeburgii* population. The similarity between this species, that are not distinguishable with the naked eye as in the case of *T. trilobatus, T. ater* and *T. vareae*, indicate the short period of separation and distinct evolution, probably only in the last glacial maximum. Unlike the three species tied to restrictive habitats, *T. bujori* is a sylvan species, and it extended its distribution range after the glacial period and got overlapped it with the ancestral species, *T. ratzeburgii*. This not even had a much larger distribution range (e.g. Vandel 1962), but it is much better represented also in Romania, reaching the eastern parts of the country. The insular distribution of *T. bujori* in the distribution range of its parental species, *T. ratzeburgii*, resembles the case of the newt subspecies *Lissotriton vulgaris ampelensis*. This is also isolated in the distribution range of the nominate subspecies in Apuseni Mountains region, where it probably survived more glacial cycles (e.g. Babik et al. 2005). They may have formed similarly under the pressure of the same environmental factors.

The presence of endemic sylvan Trachelipus species in Romania underlines the existence of forest refuges in the region. Such refuges were recently pointed out in the Carpathian Mountains (see a review in: Varga 2010). The species whose distribution ranges exceed the country's territory are generalist, with wide ecological valence. In their cases, we do not notice ecological or morphological differences compared with the literature data (e.g. Vandel 1962, Radu 1985). Among the species with large distribution ranges, *T. ratzeburgii* seems to be at its eastern distribution range limit in Romania and *T. squamuliger* at its northern distribution range limit. In the case of two species (*T. ratzeburgii* and *T. rathkii*), the specimens from Danube Delta were smaller compared to other population from the country. Among *T. ratzeburgii* females from Periprava, some specimens with the size of 7 x 3 mm had marsupium, hence were sexually mature. The size of females and males from Periprava varied between 7 x 3 mm and 9 x 5.5 mm. Thus, the females from Danube Delta reproduce at smaller size than their species usually do.

In Romania there are probably more species from this genus than we presented here. Many species that were previously described here were not found in the field, even if sometimes we investigated the localities from where they were described. Moreover, we also collected specimens that could not be assigned to any species described in the literature. The high number of endemic species and their narrow distribution range indicate that Romania is really an evolution centre for this genus, many species surviving here in the glacial periods and afterwards evolving divergently.

Conclusions

The detailed re-description of the specific characters of 12 Trachelipus species present in Romanian fauna highlights the clear morphological differences between *T. trilobatus*, *T. ater, T. varae, T. ratzeburgii, T. bujori, T. difficilis, T. affinis* = *T. wächleri, T. arcuatus, T. rathkii, T. pleonglandulatus, T. nodulosus, T. squamuliger*.

Regarding the intra-specific variability, one or two characters vary, the remaining morphological characters being identical with the type species. There are intra- and interpopulational variations of the cephalic lobes, telson, male pereiopod 7 carpus crest and pleopod 1 exopods. Variations of male pleopod 1 exopods and glandular pore fields` position on the coxal plates were not observed. In a low number of individuals morphological anomalies were observed on the pleon segments 1 and 2, telson, antennae, male pereiopods 7 and pleopods 1.

The comparative description of the specific morphological characters illustrated with figures shows that the synonymised species *T. varae, T. bujori*, *T. affinis* = *T. wächtleri* and *T. pleonglandulatus* are valid species. There are obvious differences from the species they were synonymised with.

T. radui is synonym with *T. difficilis*. *T. trilobatus, T. ater, T. varae, T. bujori* and *T. pleonglandulatus* are endemic for the Romanian fauna. *T. squamuliger* is a new species for the Romanian fauna, being collected from deciduous forests from Măcin Mountains and adjacent areas of Dobruja.

T. arcuatus, T. affinis = *T. wachtleri*, *T. ratzeburgii*, *T. difficilis* are present in forest habitats. *T. rathkii* is a eurytopic species, *T. nodulosus* is a xerophilous one distributed on the entire territory of Romania. They live in natural and anthropogenic open habitats.

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