

New and known records of Oppiidae (Acari, Oribatida) from Romania

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ABSTRACT

In this paper two newly recorded species of the family Oppiidae are presented, namely *Ramusella alejnicovae* (Krivolutsky and Gatilova, 1974) and *Lauropia iranica* Akrami and Subías, 2008. Additionally, recent records of two other rare species, i.e., *Multioppia* (*M.*) *perfecta* Mahunka and Topercer, 1983 and *Ramusella sengbuschi tokyoensis* (Aoki, 1974) are given. For each species, a redescription and illustration based on Romanian material is provided and compared with existing descriptions, and data regarding world distribution and ecological requirements are analyzed. In addition, the status of *Multioppia* (*Hammeroppia*) *insolita* Ivan and Vasiliu, 1999, a species considered as a possible synonym of *M. (H.) wilsoni laniseta* Moritz, 1966 (Subías 2004 updated 2018) is discussed, and reasons to deem *insolita* as a valid species are pointed out.

Keywords Oppiidae, rare species, redescription, distribution, ecology

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Introduction

The family Oppiidae is one of the largest and diverse families of oribatid mites with more than 1000 known species that populate various edaphic habitats across the world. To date, the Romanian oribatid mite fauna comprises about 90 oppiid species, whereas 22 of them were described as new species in the last two decades (e. g., Ivan and Vasiliu 1999, Vasiliu and Ivan 2009, Mahunka 2004, 2005). Some other species were recorded as faunistic novelties (e.g., Ivan 2007, Ivan and Călugăr 2013).

The list of oppiid mites comprises both frequent, eurytopic species and some uncommon, rarely collected, possibly stenotopic ones. Of the second category, four recently recorded species are included in this study, as follows: *Multioppia* (*M.*) *perfecta* Mahunka and Topercer, 1983, *Ramusella sengbuschi tokyoensis* (Aoki, 1974), *Ramusella alejnicovae* (Krivolutsky and Gatilova, 1974) and *Lauropia iranica* Akrami and Subías, 2008. In this study a brief description and illustration for each species and analysis of data regarding world distribution and ecological requirements are provided. These redescrptions based on material collected in Romania aim to illustrate species variability, both from morphological and biometrical point of view and, in some cases, to contribute to determination of their taxonomical status. In addition, the status of *Multioppia* (*Hammeroppia*) *insolita* Ivan and Vasiliu, 1999 is discussed, based on comparative analysis of diagnostic characters of this species and the close related taxa.

Materials and methods

The material used in this study was collected in the context of several projects, both by the author and other team members, as follows: O. Ivan (*Multioppia* (*M.*) *perfecta*, *Multioppia* (*H.*) *insolita*, *Ramusella sengbuschi tokyoensis*), N. Vasiliu (*Lauropia iranica*) and A. Călugăr (*Ramusella alejnicovae*). More data regarding the examined material are given in the description of each species in Results section further below.

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All material was preserved in ethanol (70%) and cleared in lactic acid (70%) in order to be examined. Measurements and descriptions are based on specimens mounted in lactic acid on temporary slides. Observations, measurements and drawings were made using a Krüss MBL 2000 microscope with a *camera lucida*. All measurements are given in micrometers. In the text, tables and figures, the following abbreviations are used: prodorsal setae – rostral (*ro*), lamellar (*le*), interlamellar (*in*) and exobothridial (*ex*) setae, sensillus (*ss*); notogastral setae (*c*, *da*, *dm*, *dp*, *la*, *lm*, *lp*, $h_1 - h_3$, $p_1 - p_3$); epimeral setae (*1a - c*, *2a*, *3a - c*, *4a - c*); genital ($g_1 \dots$), aggenital (*ag*), adanal ($ad_1 - ad_3$) and anal setae (an_1 , an_2); lyrifissures (*ia*, *im*, *iad*).

Morphological terminology used in this paper follows Grandjean (e.g., 1949, 1954), Mahunka and Zombori (1985), Weigmann (2006), Norton and Behan-Pelletier (2009). Taxonomic ranks and classification suggested by Subías and Balogh (1989) and developed by Subías and Arillo (2001), Subías (2004, updated version 2018) were used as a reference system.

Results

***Multioppia (Multioppia) perfecta* Mahunka and Topercer, 1983 (Figure 1)**

Literature used for identification — Mahunka and Topercer 1983.

Measurements — Body length 235-247, body width 120-140 (7 specimens).

Description of Romanian specimens — Body color light yellowish, cuticle smooth excepting lateral part of podosoma. Rostrum entire, widely rounded. Rostral setae relatively long (20-23), uniformly arched and ciliated. Lamellar and interlamellar setae thin and simple, similar in length (8-10). Exobothridial seta fine and simple, hardly observable in dorsal view, slightly shorter than *le* and *in* (7-8). Lamellar and translamellar lines present. Three pairs of spots visible between insertion points of *in* setae, large foveolae border lamellar lines laterally. Sensillus relatively long (40-43) fusiform, pectinate. Distal part expanded, asymmetrical, with 15-16 fine branches on lateral side, arranged in two rows convergent at the tip; each row comprises one short branch distally, 6 longer branches (longest ones in the middle) and one short branch proximally (Figure 1 B).

Notogaster with 13 pairs of setae fine, simple and short (15-18) excepting *c* that is minute, but discernible. Distribution of notogastral setae is characteristic for *Multioppia* subgenus, thus *dm* occurs behind *im* lyrifissure (Vasiliu and Ivan 2009).

Ventral side shows no differences from the original description (Mahunka and Topercer 1983). Epimeres well defined, with polygonal ornamentation in medial part; epimeral setae simple and short, placed according to the formula 3:1:3:3, setae *3c* and *4c* longer than the medial ones. Genito-anal region with usual configuration and the setal formula 5:1:2:3, all these setae fine and simple.

Remark — The main characters of this species were found in Romanian specimens. However, some differences from the original description should be noticed, i.e., the shape of translamellar line (straight, with obvious lateral angles in type material) and sensillus with ciliation apparently on both sides (Mahunka and Topercer 1983, Figures 7, 9), distinct from the sensillus structure above described based on Romanian material.

Distribution and ecology — *Multioppia perfecta* was described from Slovakia (cultivated soil). Currently, it is considered a Central and South European element (Subías 2004, updated 2018), but apart from Romania this species was not yet mentioned in the fauna of other countries in this region (e.g., Hungary, Germany, Czech Republic, Poland, Austria) (Mahunka and Mahunka-Papp 2004; Miko 2006, 2016; Niedbala and Olszanowski 2008; Krisper *et al.* 2017). In Romania it was firstly recorded in some grassland ecosystems (both hayfields and pastures) from the North-Eastern region (Ivan 2007), and recently it was collected from the soil of *Robinia pseudoacacia* plantation, on degraded land, in the same region of the country (Ferești-Velnița, Vaslui county, 46°47'36"N, 27°43'49"E, 13.05.2015). However, occurrence analysis of *M. perfecta* shows that it is not a common species, its requirements being not clear;

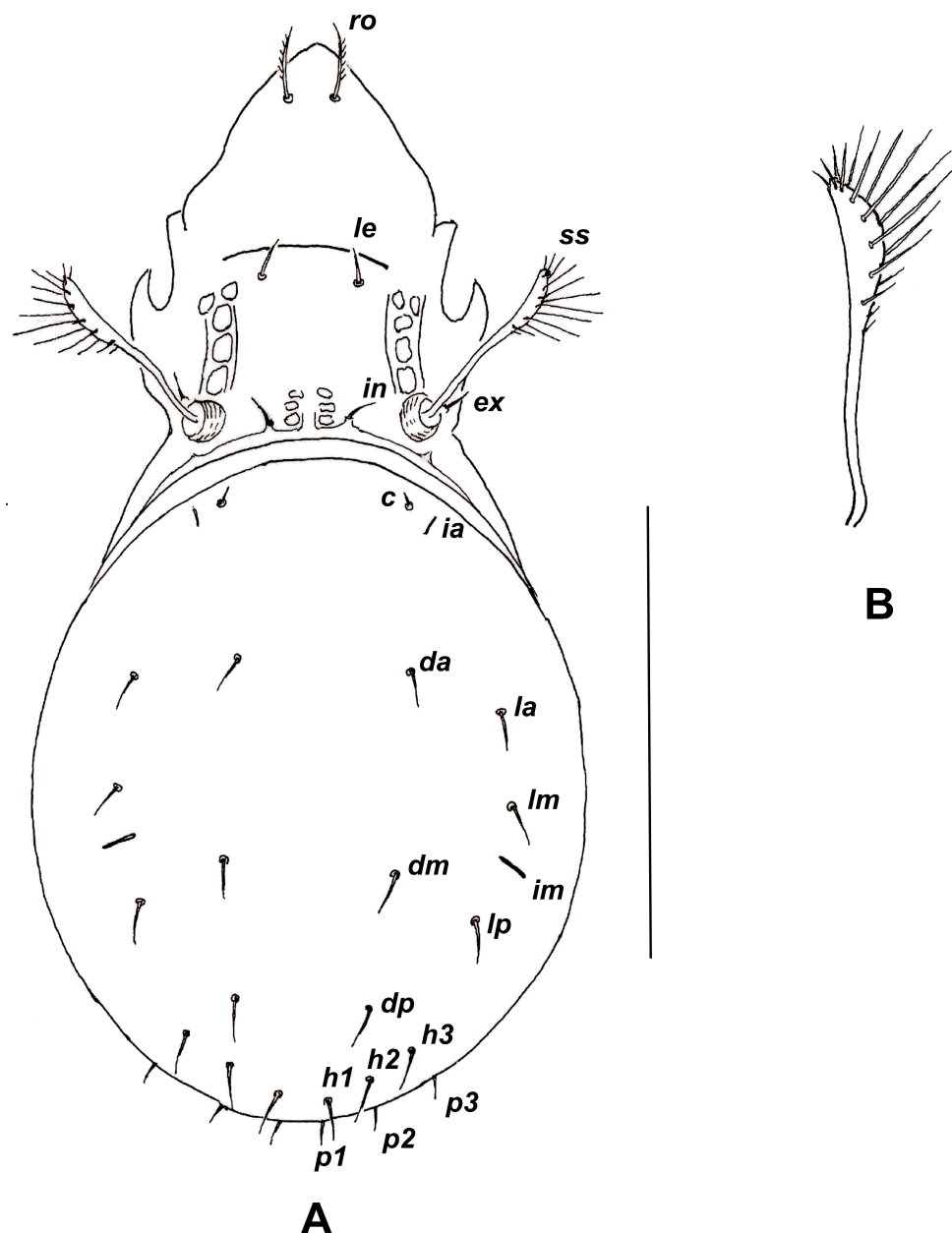


Figure 1 *Multioppia (M.) perfecta*: A – dorsal view (scale bar 100 μm); B – sensillus (detail)

probably it has a discontinuous distribution in the Central and Southeastern Europe, depending on some peculiar bio-edaphic conditions.

***Multioppia (Hammeroppia) insolita* Ivan and Vasiliu, 1999 (Figure 2)**

The main diagnostic characters of this species compared with the close related taxa are summarized in Table 1. The shape of sensillus (Figure 2), granulated surface of mentum and epimeres 1 and 2, and the length of epimeral setae of *b* and *c* series differentiate this species from *M. wilsoni* Aoki, 1964 species group, especially from *M. wilsoni laniseta* Moritz, 1966. Subsequent redescrptions of *M. laniseta* (Miko 2006, Seniczak *et al.* 2014) support the above mentioned differences, particularly in terms of sensillus shape.

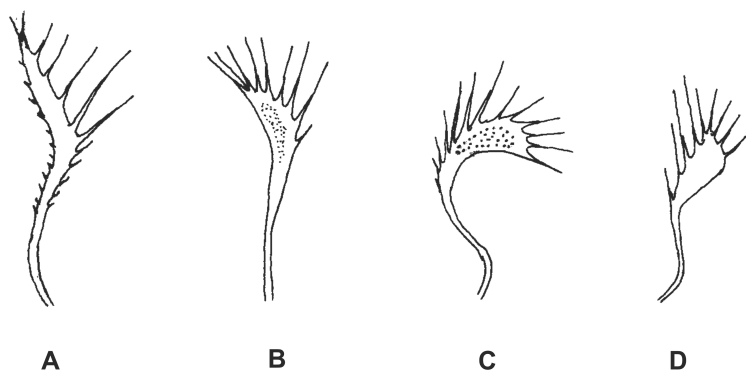


Figure 2 Sensillus: A – *Multioppia* (*H.*) *insolita*; B – *Multioppia* (*H.*) *wilsoni* (after Aoki 1964); C – *Multioppia* (*H.*) *wilsoni laniseta* (after Moritz 1966); D – *Multioppia* (*H.*) *wilsoni hungarica* (after Mahunka 1983)

Table 1 Main distinctive characters of *Multioppia* (*Hammeroppia*) *insolita* and *Multioppia* (*Hammeroppia*) *wilsoni*

Character/ species, reference	<i>Multioppia</i> (<i>H.</i>) <i>insolita</i> Ivan and Vasiliu, 1999**	<i>M. (H.) wilsoni</i> Aoki, 1964*	<i>M. (H.) wilsoni laniseta</i> Moritz, 1966*	<i>M. (H.) wilsoni hungarica</i> Mahunka, 1983*
Measurements (µm)	330-360 x 186-230	264-365 x 135-187	324 x 159	334-367 x 179-192
Prodorsal setae	<i>ex</i> ≈ <i>le</i> (23) < <i>in</i> (25) < <i>ro</i> (33); all setae barbed	<i>ro</i> bent, ciliated; <i>le</i> (almost smooth) = <i>in</i> ; <i>ex</i> < <i>le</i>	<i>in</i> (19) < <i>le</i> (25) < <i>ro</i> (32); all setae ciliated	<i>ex</i> < <i>le</i> (40) < <i>in</i> (46) < <i>ro</i> ; all setae barbed
Sensillus	fusiform elongated and pectinate, with 8-9 unequal branches and spines on the opposite part	provided unilaterally with 9 branches: 6 anterior almost equal, 2 longer and 1 short branch proximally	distal half expanded and curved, with 7-9 branches on lateral side and 5 equal ones anteriorly	clavate, with 8-10 shorter (anteriorly) or longer (in middle) branches
Notogastral setae	12 pairs of setae similar in length (30), all barbed; alveoli of <i>c</i> seta visible	12 pairs of smooth setae; no mention regarding alveoli of <i>c</i> seta	12 pairs of setae, all ciliated; alveoli of <i>c</i> seta present	12 pairs of setae finely barbed; alveoli of <i>c</i> seta present; anterior setae much shorter than posterior ones (52-56)
Epimeres	epimeres 1, 2 and mentum granulated; epimeral setae of <i>b</i> and <i>c</i> series twice as long (25-30) as medial ones	partially reticulated; epimeral setae relatively short and simple (as seen in Figure 8)	medial half reticulated; 3 <i>c</i> and 4 <i>c</i> barbed, remaining ones simple and shorter	with large foveolae; epimeral setae simple
Genito-anal setae	<i>ag</i> and <i>ad</i> setae 2/3 as long as notogastral setae; <i>ad</i> barbed; <i>an</i> simple, shorter than <i>ad</i>	<i>ad</i> ₃ distinctly barbed	<i>ag</i> simple and short; <i>an</i> and <i>ad</i> barbed, as long as notogastral setae	only <i>ad</i> barbed

* data extracted from original description; ** data from original description, verified on lately collected material.

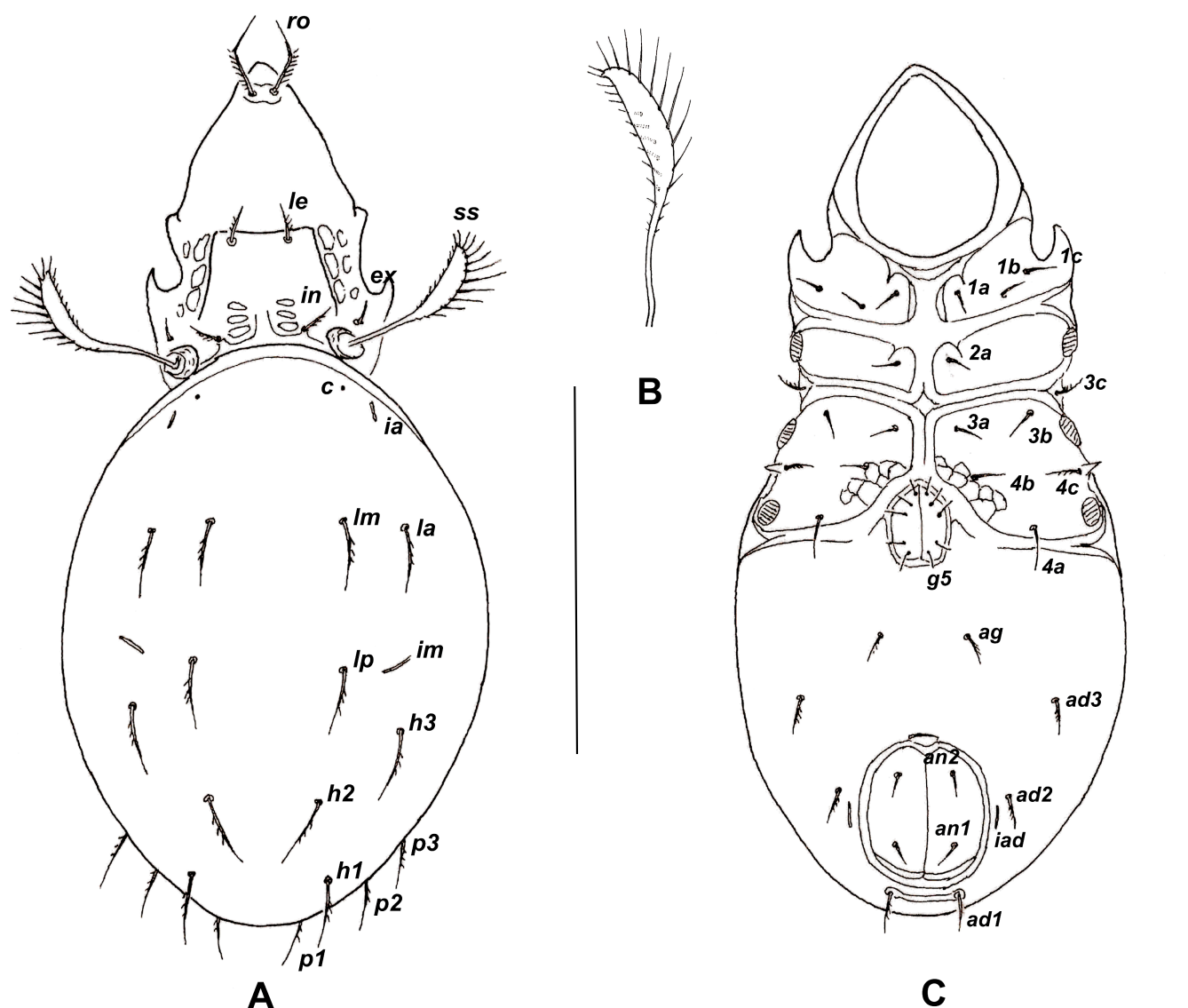


Figure 3 *Ramusella sengbuschi tokyoensis*: A – dorsal view; B – sensillus (detail); C – ventral view (A, C – scale bar 100 μ m)

Multioppia (Hammeroppia) insolita was firstly identified in litter of *Quercus frainetto* forest from Olt county (Southern Romania). It is a really rare species, being found subsequently as few specimens in some forest plantations from the Danube Delta (Ivan *et al.* 2006), and recently in the soil of *Robinia pseudoacacia* plantation, on degraded land in Vaslui county (Eastern Romania) (Ferești-Săratu, 46°45'59"N, 27°42'48"E, 13.05.2015).

***Ramusella (Ramusella) sengbuschi tokyoensis* (Aoki, 1974) (Figure 3)**

Literature — Hammer 1968 [*Ramusella sengbuschi*]; Aoki 1974 [*Oppia tokyoensis*]; Mahunka and Topercer 1983 [*Ramusella tuberculata*]; Subías and Arillo 2001 [*Ramusella (Ramusella) sengbuschi*].

Measurements — given in Table 2.

In the context of some ecological investigations carried out in different ecosystem types from North Eastern Romania, some species were recorded for the first time in the country, and

Table 2 Distinctive characters of *Ramusella* (*Ramusella*) *sengbuschi* subspecies

Character / subspecies reference	<i>Ramusella</i> (<i>R.</i>) <i>sengbuschi</i> <i>sengbuschi</i> Hammer, 1968		<i>Ramusella</i> (<i>R.</i>) <i>sengbuschi</i> <i>tokyoensis</i> (Aoki, 1974)		
	original description	Subías and Arillo, 2001	original description	<i>Ramusella</i> (<i>R.</i>) <i>tuberculata</i> Mahunka and Topercer, 1983	specimens collected from Romania
Measurements (µm)	240	225-294 x 105-160	229-242 x 105-123	235-260 x 138-146	237-247 x 120-127
Rostral setae	bent, densely feathered proximally and smooth in distal part; close origins, on a dark band	bent, each inserted on a tubercle	bent, ciliated in the middle portion, inserted on small apophyses connected by a transverse ridge	thick, ciliated, curved inwards; insertions near each other, on a transversal tubercle	(25) bent, densely ciliated in proximal part; close insertions, on tubercles fused transversally
Lamellar setae	thin, length comparable with <i>le-le</i> distance	short, finely barbed	weakly barbed	thin, ciliated	(15-18) weakly barbed
Interlamellar setae	erect, as long as <i>le</i>	short, finely barbed	weakly barbed	thin, ciliated	(15-18) weakly barbed
Sensillus	club-shaped, flat, with 10-13 branches, the middle ones very long	fusiform, of medium length, with 10-11 branches, the middle ones longer	strongly curved; the swollen apical portion with 9-11 long outer spines and minute inner spines	distal part lanceolate, with 11 long cilia	(35-40) fusiform clavate, with 12 branches, longer in the middle, and spines on the opposite part
Lamellar, translamellar lines	both lines present	both lines present, translamellar line less obvious	fine lamellar line, translamellar one absent	both lines present as a fine, weak, angular formation	both lines present, translamellar line less obvious
Notogastral setae	thin, slightly barbed, moderately long; <i>c</i> reduced to alveoli	relatively short, barbed; no mention regarding <i>c</i> seta	seta <i>c</i> not observable; remaining setae almost smooth (as seen in Figure 4)	ciliated, <i>c</i> reduced to alveoli	(18-20) ciliated; <i>c</i> reduced to alveoli
Ventral setae	no mention regarding the aspect of setae; <i>ad</i> ₃ preanal, <i>ad</i> ₂ off <i>iad</i> lyrifissure	short, fine and smooth	no mention regarding the aspect of ventral setae	epimeral, aggenital and adanal setae long, ciliated	medial epimeral setae shorter (8-10) than lateral ones (13), <i>3c</i> and <i>4c</i> ciliated; <i>ag</i> and <i>ad</i> (13-15) ciliated

among them *Ramusella (R.) sengbuschi* Hammer, 1968 (Ivan and Călugăr 2013). Detailed review of this faunistic material evidenced some differences from both the original description (Hammer 1968) and the later one provided by Subías and Arillo (2001), especially in the structure of sensillus, i.e., the presence of spines on its inner part (Figure 3 B). The main characters observed in our specimens are included in Table 2, in comparison with closely related taxa (Subías 2004, updated 2018).

Remarks — The material examined (5 specimens) proved to be more similar with *Ramusella tuberculata* Mahunka and Topercer, 1983, despite some differences, namely sensillus with spines on its inner part, epimeral setae relatively short, among them only 3c and 4c ciliated (in original description “sensillus with lanceolate head bearing 11 long and strong cilia” and “epimeral setae long and ciliated”). Also, comparative analysis of data in Table 2 evidences that the presumable synonymy of *tuberculata* and *tokyoensis* need thorough investigation based on the type material. However, taking into account the similarity of most characters, our material was identified as *R. (R.) sengbuschi tokyoensis*, according to the current classification of *Oppiidae* suggested and developed by Subías (2004, updated 2018).

Distribution and ecology — *Ramusella (R.) sengbuschi* Hammer was described from New Zealand, currently being considered as pantropical and subtropical element (except Ethiopian), while ssp. *tokyoensis* is supposed to be distributed in the Southern Palaearctic (Subías 2004, updated 2018). In Europe *R. (R.) sengbuschi* was recorded in Spain and Portugal, also in Italy and Greece (Subías and Arillo 2001); it was also listed in Caucasus (Shtanchaeva and Subías 2010) and in Austria, with note “sub *Ramusella tuberculata* Mahunka and Topercer, 1983” (Krisper *et al.* 2017). Literature data (Aoki 1974, Mahunka and Topercer 1983, Subías and Arillo 2001) indicate that both subspecies were reported mostly in anthropogenic habitats (urban, cultivated or contaminated soils). In Romania *R. (R.) sengbuschi tokyoensis* was found also in a cultivated soil (wheat crop, Căntălărești, Vaslui county, 46°45'58"N, 27°35'29"E, 25.05.2013), but never in natural habitats.

***Ramusella alejnicovae* (Krivolutsky and Gatilova, 1974) (Figure 4)**

Literature — Krivolutsky and Gatilova 1974 [*Oppia alejnicovae*]; Golosova 1975 [*Oppia alejnicovae*]; Mahunka 1979 [*Oppia alejnicovae*].

Measurements — Body length 270-277, body width 180-186 (5 specimens).

Description of Romanian specimens — Light brown or chestnut in color, cuticle smooth excepting lateral part of podosoma. Rostrum widely rounded, in the shape of bent beak in lateral view (Figure 4 B). Rostral setae long (36), uniformly curved and ciliated, inserting on small tubercles. In front of *ro* a transversal line can be observed. Lamellar (27) and especially interlamellar (48) setae long and finely barbed. Exobothridial seta shorter (20), also finely barbed. Thus, relation between lengths of prodorsal setae is the following: *ex* < *le* < *ro* < *in*. Lamellar lines present, bordered laterally by a series of large foveolae. Three pairs of spots are visible between insertions of *in* setae. At the basis of prodorsum, a wide chitinous bridge present transversally, surrounding bothridial cups. Sensillus long (66) with characteristic shape: distal part fusiform-clavate and bipectinate, with 7-8 branches different in length (Figure 4 A, B).

Notogaster oval with 9 pairs of setae long (35-38), thin and finely barbed; seta *c* present as alveoli. Ventral side with characteristic configuration (Figure 4 C). Epimeral setae simple and thin, placed according to the formula 3:1:3:3; lateral setae twice as long as median ones (20-23, respectively 10). Genito-anal region with the usual setal formula 5:1:2:3. All setae simple and thin, *ad* longer (23) than *ag* and *an* (18). Lyrifissure *iad* in paraanal position.

Distribution and ecology — Southern Palaearctic (Subías 2004, updated 2018). *Ramusella alejnicovae* was described from Volga territory in Russian Federation, and later reported in Southern Siberia, Mongolia and Caucasus (Bayartogtokh 2010, Shtanchaeva and Subías 2010). In terms of ecology it is considered a typical inhabitant of grassland soil in steppes (Bayartogtokh 2010). This is the first record of *R. alejnicovae* in Romania; it was found in

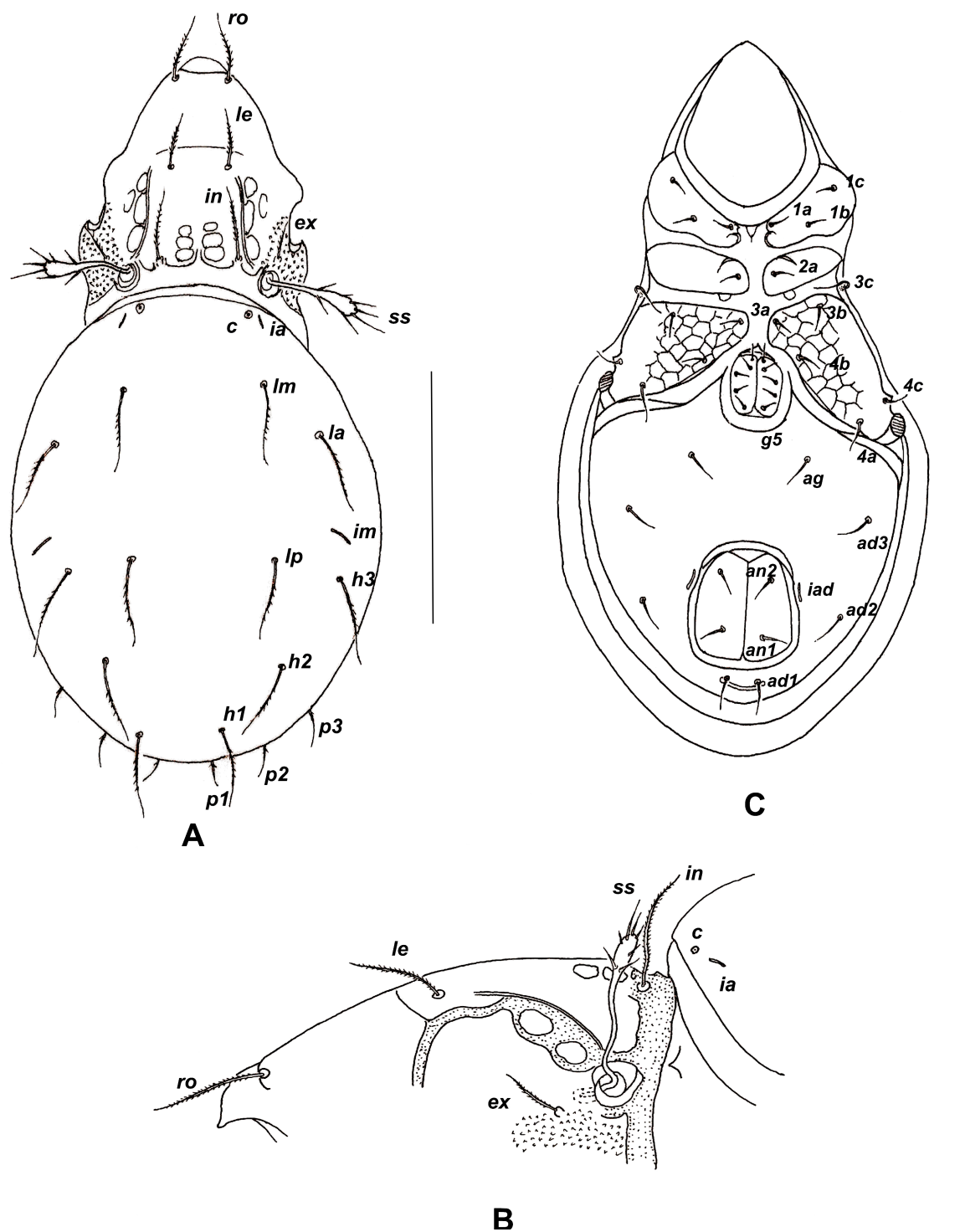


Figure 4 *Ramusella alejnicovae*: A – dorsal view; B – prodorsum in lateral view (detail); C – ventral view (A, C – scale bar 100 μ m)

the soil of tomato crops in solaria at Spătărești, Suceava county (47°25'39"N, 26°17'59"E, 11.06.2008, unpublished data), being not yet recorded in natural habitats.

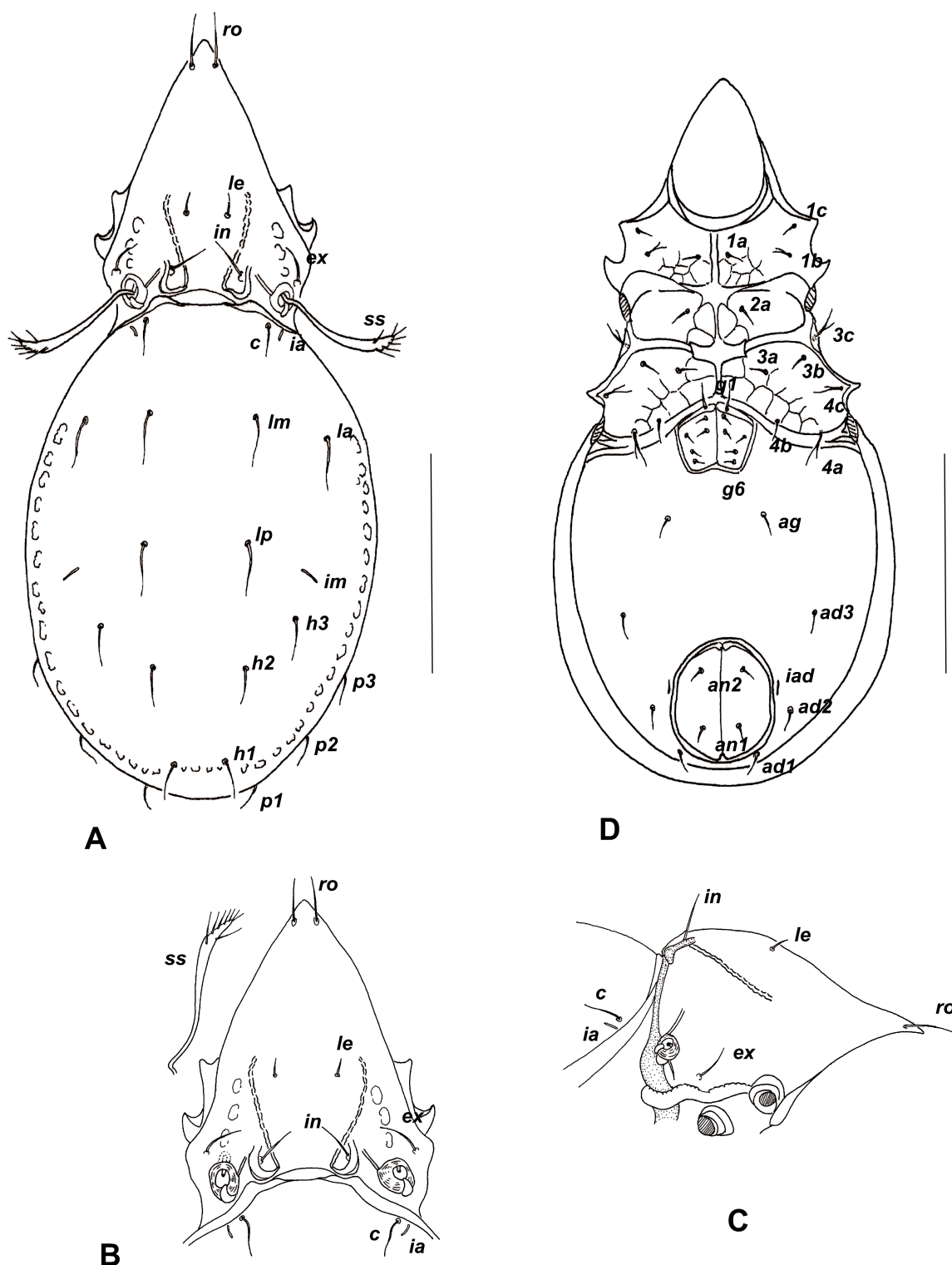


Figure 5 *Lauroppia iranica*: A – dorsal view; B – prodorsum in dorsal view (detail); C – prodorsum in lateral view (detail); D — ventral view (A, D – scale bar 100 μ m)

***Lauroppia iranica* Akrami and Subías, 2008 (Figure 5)**

Literature — Akrami and Subías 2008.

Measurements — Body length 370, body width 206 (1 specimen).

Description of Romanian specimen — Light brown in color, body surface smooth. Rostrum entire, prominent. Prodorsal setae thin, with the following relation between their lengths: $le (10) < ex (20) < in (23) < ro (28)$. Costulae present with characteristic shape: posterior part semicircular, surrounding the insertion of *in* seta, and distal part, weakly shaped, divergent, extended beyond the insertion of *le* seta; a narrow chitinous stripe between bothridium and costula can be also observed (Figure 5 B, C). Sensillus long (55), its distal part fusiform – elongated and bipectinate, with 7 thin and short branches. Notogaster oval elongated with anterior margin straight and crista present. Ten pairs of thin and simple notogastral setae; *la*, *lm*, *lp* longer than remaining ones (*c*, *h* and *p* series) (20, 13, respectively). Ventral side with characteristic configuration (Figure 5 D). Epimeral setae thin, placed according to the formula 3:1:3:3. Lateral setae, except *lc* longer (13) than median ones (8); *lb*, *3c*, *4a* and *4c* bifurcated. Genito-anal region with the setal formula 6:1:2:3. All setae simple, thin and short, *ad* and *ag* slightly longer (10) than *an* (8); g_1 twice as long as $g_2 - g_6$. Lyrifissure *iad* in paraanal position.

Remark — Analyzing the original description of *L. iranica* (Akrami and Subías 2008), some differences appeared remarkable in the examined material, especially the larger body size (370 x 206 beside 330 x 170 in Iranian specimens), but also the aspect of some prodorsal setae (*ro*, *in* and *ex*) described as “finely barbed” or “with some barbs” that were not observed as such. However, all the other characters mentioned by authors in their description are found in Romanian material, thus it was assigned to this species.

Distribution — *Lauroppia iranica* was described from Iran and no other citations of this species are available so far, when we mention it as a first record for Romanian fauna. It was identified in an earlier collection from Cheia, Constanța county (44°29'7"N, 28°26'30"E, 28.04.1993; registered as *Lauroppia* sp.), in the soil of a xerophilous grassland, currently included in Natura 2000 site ROSCI 0215. It can be assumed that this species remained here in a refuge, after the Black Sea transgression in Quaternary, thus this new record is also significant from zoogeographical point of view.

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