

Acarologia

A quarterly journal of acarology, since 1959
Publishing on all aspects of the Acari

All information:

<http://www1.montpellier.inra.fr/CBGP/acarologia/>
acarologia-contact@supagro.fr



**Acarologia is proudly non-profit,
with no page charges and free open access**

Please help us maintain this system by
encouraging your institutes to subscribe to the print version of the journal
and by sending us your high quality research on the Acari.

Subscriptions: Year 2021 (Volume 61): 450 €

<http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php>

Previous volumes (2010-2020): 250 € / year (4 issues)

Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d'avenir » programme (Labex Agro: ANR-10-LABX-0001-01)



Supporting agricultural research
for sustainable development

Acarologia is under **free license** and distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.

Four new species records of *Antennoseius* and *Anystipalpus* (Acari: Mesostigmata: Ascidae) phoretic on Carabidae beetles from France

Farid FARAJI^{1,2}, Stefan-Bogdan DEHELEAN¹, Mike VUYK¹ and Frank BAKKER¹

(Received 23 June 2016; accepted 28 September 2016; published online 04 April 2017; edited by Marie-Stéphane TIXIER)

¹ MITOX Consultants/Eurofins, Science Park 408, 1098 XH Amsterdam, The Netherlands. faridfaraji@eurofins-mitox.com; bogdandehlean@eurofins-mitox.com; mikevuyk@eurofins-mitox.com; frankbakker@eurofins-mitox.com

² Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Science Park 904, 1098 XH Amsterdam, The Netherlands.

ABSTRACT — *Antennoseius pannonicus* Willmann, *A. pseudospinosus* Eidelberg, *Anystipalpus livshitsi* (Eidelberg) and *A. pericola* Berlese, collected from carabid beetles in southwest France, are new species records of ascid mites of France. The two species of *Antennoseius* are re-described and new host associations are provided. An attempt has been made to describe the spermathecal apparatus of these two genera for the first time.

KEYWORDS — Ascidae; Carabidae; France; new species records; *Antennoseius*; *Anystipalpus*

ZOOBANK — [363F78B5-C0AC-471B-A658-EC47C6912F10](https://zoobank.org/363F78B5-C0AC-471B-A658-EC47C6912F10)

INTRODUCTION

According to the catalogue of Moraes *et al.* (2016), *Antennoseius* includes 61 described species mainly inhabiting soil, litter, moss, humus, salt marshes and nests of rodents, birds and ants (Lindquist and Walter 1989; Karg 1993; Gwiazdowicz 2007; Beaulieu *et al.* 2008; Gwiazdowicz and Haitlinger 2010; Gwiazdowicz and Halliday 2010; Kazemi and Moraza 2013; Trach 2013). Not much is known about the feeding habits of these mites. The two noticeable studies are the works by Lindquist and Walter (1989) and Beaulieu *et al.* (2008) finding nematodes, Collembola and astigmatic mites as prey sources.

A few species of *Antennoseius* have been shown to have two female morphological morphs: smooth (phoretic) and granular (free-living) (Lindquist and

Walter 1989; Beaulieu *et al.* 2008). This phenomenon might reveal more synonymies in this group of mites. Lindquist and Moraza (2009) re-described *Anystipalpus* and by describing two new species considered four members in that genus. Some species of *Antennoseius* Berlese, 1916 and *Anystipalpus* Berlese, 1911 are known from adult females phoretic under elytra of carabid beetles and the tegmina of labidurid earwigs (Lindquist and Moraza, 2009; Table 1).

This paper intends to re-describe two species of *Antennoseius* and report two species of *Anystipalpus*, which have been found during a study in southwest France in 2014–15. The data provided in this study refer only to the phoretic morph of these four species. More data are given on the frequency and abundance of these four species.

TABLE 1: Species of *Antennoseius* Berlese, 1916 and *Anystipalpus* Berlese, 1911 associated with carabid beetles.

Phoretic mite species	Carabidae host species ^b	Distribution	References
<i>Antennoseius</i> (A.) <i>belorussicus</i> Eidelberg, 1990	70	Belarus	Eidelberg, 1990
<i>Antennoseius</i> (A.) <i>bullitus</i> Karg, 1969	20, 24, 36, 42, 44, 47	Hungary ^a , Ukraine, Poland, Romania ^a	Trach 2013; Haitlinger 1991; Kontschán 2007; Călugăr 2010; Stănescu and Juvara- Baş 2005
<i>Antennoseius</i> (A.) <i>bytinskii</i> Costa, 1969	74	Israel	Costa, 1969
<i>Antennoseius</i> (A.) <i>calathi</i> Fain, Noti & Dufrêne, 1995	22, 67	Belgium	Fain <i>et al.</i> 1995
<i>Antennoseius</i> (A.) <i>dungeri</i> Karg, 1965	6, 38, 41, 42, 47, 54	Ukraine, Slovakia ^a	Trach 2013; Kalúz <i>et al.</i> 2013
<i>Antennoseius</i> (V.) <i>kamalii</i> Moraza & Kazemi, 2009	13, 41, 55	Iran, Ukraine	Moraza and Kazemi, 2009; Trach 2013
<i>Antennoseius</i> (A.) <i>longisetus</i> Eidelberg, 2000	2., 4, 7, 26, 33, 49, 62	Republic of Moldova, Ukraine, Kazakhstan, Tajikistan, Iran, Ukraine, Italy	Eidelberg, 2000; Kazemi and Moraza 2013
<i>Antennoseius</i> (A.) <i>maltzevi</i> Eidelberg, 1994	20, 28, 45		Eidelberg, 1994; Gwiazdowicz and Haitlinger, 2010
<i>Antennoseius</i> (A.) <i>masoviae</i> Sellnick, 1943	14 18, 20, 23, 45, 53	Israel, Iran, Belgium, Sweden ^a	Costa 1969; Kazemi and Moraza 2013 Fain <i>et al.</i> 1995; Lundqvist 1991
<i>Antennoseius</i> (A.) <i>matalini</i> Eidelberg, 2001	11	Republic of Moldova	Eidelberg, 2001
<i>Antennoseius</i> (A.) <i>matsjuki</i> Eidelberg, 2001	4	Republic of Moldova	Eidelberg, 2001
<i>Antennoseius</i> (V.) <i>multisetus</i> Eidelberg, 2000	32, 63, 64, 65	Republic of Moldova, Ukraine, Russia	Eidelberg, 2000
<i>Antennoseius</i> (A.) <i>olallae</i> Haitlinger, 2011	Unidentified species	Argentina	Haitlinger, 2011
<i>Antennoseius</i> (V.) <i>ovaliscutalis</i> Eidelberg, 2000	4, 7, 38, 45, 62, 72	Republic of Moldova, Ukraine, Russia, Kazakhstan	Eidelberg, 2000
<i>Antennoseius</i> (A.) <i>pannonicus</i> Willmann, 1951	6, 10 (this study), 12 (this study), 11 (this study), 16 (this study), 20 (this study), 38, 40 (this study), 41 (this study), 45 (this study), 51 (this study), 52 (this study), 55, 62 (this study), 69 (this study), 71 (this study), 70 (this study), 75 (this study)	Ukraine, France (this study)	Trach 2013
<i>Antennoseius</i> (V.) <i>perseus</i> Beaulieu, Déchêne & Walter, 2008	21, 76, 77	Canada	Beaulieu <i>et al.</i> 2008
<i>Antennoseius</i> (A.) <i>ponticus</i> Trach & Makarova, 2008	42, 46	Ukraine	Trach and Makarova, 2008; Trach 2013
<i>Antennoseius</i> (A.) <i>pseudospinosus</i> Eidelberg, 1990	11, 20 (this study), 45, 51 (this study), 52 (this study), 62 (this study), 70 (this study), 73	Ukraine, France (this study)	Eidelberg, 1990
<i>Antennoseius</i> (V.) <i>pyrophilus</i> Beaulieu, Déchêne & Walter, 2008	3, 21, 76, 77	Canada	Beaulieu <i>et al.</i> 2008
<i>Antennoseius</i> (A.) <i>quadrispinosus</i> Gwiazdowicz & Haitlinger, 2010	Unidentified species	Mexico	Gwiazdowicz and Haitlinger, 2010
<i>Antennoseius</i> (A.) <i>sabulicola</i> Bregetova, 1977	29	Russia ^a , Iran	Bregetova 1977; Kazemi and Moraza 2013
<i>Antennoseius</i> (A.) <i>sharonovi</i> Eidelberg, 1989	45	Ukraine, Iran	Eidelberg, 1989; Kazemi and Moraza 2013; Sklyar, 1994
<i>Antennoseius</i> (A.) <i>similis</i> Eidelberg, 2001	1, 38, 44	Kazakhstan	Eidelberg, 2001
<i>Anystipalpus kazemii</i> Lindquist & Moraza, 2009	Unidentified species	Iran	Lindquist and Moraza, 2009
<i>Anystipalpus labiduricola</i> Lindquist & Moraza, 2009	Unidentified species	Iran	Mehrzad <i>et al.</i> 2011
<i>Anystipalpus livshitsi</i> (Eidelberg, 1989)	1, 5, 6, 7, 8, 9, 11, 15, 16 (this study), 17, 18, 19, 20, 27, 30, 31, 33, 34, 35, 37, 38, 39, 41, 42, 43, 45 (this study), 47, 48, 50, 54, 55, 57, 60, 62 (this study), 66, 68 (this study), 69 (this study), 70, 71 (this study), 78	Ukraine, Iran, Kazakhstan, Republic of Moldova, France (this study)	Eidelberg, 1989; Lindquist and Moraza, 2009; Bahrami <i>et al.</i> 2011; Trach 2013
<i>Anystipalpus pericicola</i> Berlese, 1911	17, 18, 19, 25, 30, 39, 45 (this study), 56, 58, 59, 60, 61, 66, 75 (this study)	Italy, Ukraine, France (this study), Iran	Lindquist and Moraza, 2009; Eidelberg 1990
<i>Anystipalpus stepposus</i> Trach, 2012	38, 54, 55, 59	Ukraine	Trach, 2012

a- Country where the species has been recorded but not in association with carabid beetles.

^b- 1. *Acinopus picipes* (Olivier), 2. *Aganum* sp., 3. *Agonum placidum* (Say), 4. *Amara apricaria* Paykull, 5. *Amara aulica* (Panzer), 6. *Amara consularis* (Duftschmid), 7. *Amara convexuscula* (Marsham), 8. *Amara ingenua* Duftschmid, 9. *Amara majuscula* (Chaudoir), 10. *Anchomenus dorsalis* (Pontoppidan), 11. *Anisodactylus signatus* (Panzer), 12. *Badister meridionalis* Puel, 13. *Bembidion jedlickai* Fassati, 14. *Bembidion lampros* (Herbst), 15. *Brachinus brevicollis* Motschulsky, 16. *Brachinus crepitans* (Linnaeus), 17. *Brosicus semistriatus* (Dejean), 18. *Calathus ambiguus* Paykull, 19. *Calathus distinguendus* Chaudoir, 20. *Calathus fuscipes* (Goeze), 21. *Calathus ingratus* Dejean, 22. *Calathus micropterus* (Duftschmid), 23. *Carabus hemprichii* Rapuzzi, 24. *Carabus intricatus* Linne, 25. *Chlaenius aeneocephalus* Dejean, 26. *Chlaenius flavicornis* Fischer, 27. *Chlaenius nigricornis* (Fabricius), 28. *Cymindis lineata* (Quensel in Schonherr), 29. *Cymindis pallidula* Chaudoir, 30. *Cymindis variolosa* Fabricius, 31. *Dinodes cruralis* Fischer von Waldheim, 32. *Dolichus halensis* (Schaller), 33. *Dyschirius chalybaeus* Putzeys, 34. *Harpalus affinis* (Schrank), 35. *Harpalus albanicus* Reitter, 36. *Harpalus anxius* (Duftschmid), 37. *Harpalus atratus* Latreille, 38. *Harpalus calceatus* (Duftschmid), 39. *Harpalus caspius* (Steven), 40. *Harpalus dimidiatus* (Rossi), 41. *Harpalus distinguendus* (Duftschmid), 42. *Harpalus froelichi* Sturm, 43. *Harpalus griseus* (Panzer), 44. *Harpalus rubripes* (Duftschmid), 45. *Harpalus rufipes* (Degeer), 46. *Harpalus serripes* (Quensel), 47. *Harpalus zabroides* Dejean, 48. *Harpalus stevenii* Dejen, 49. *Idiomelas morio* (Menetries), 50. *Lichinus cassideus* (Fabricius), 51. *Nebria brevicollis* (Fabricius), 52. *Nebria salina* Fairmaire et Laboulbène, 53. *Olisthopus rotundatus* Paykull, 54. *Ophonus azureus* (Fabricius), 55. *Ophonus diffinis* (Dejean), 56. *Ophonus rebellus* (Schauberger), 57. *Ophonus rufibarbis* (Fabricius), 58. *Ophonus ruficollis* (Sturm), 59. *Ophonus sabulicola* (Panzer), 60. *Ophonus subquadratus* (Dejean), 61. *Percus* sp., 62. *Poecilus cupreus* (Linne), 63. *Pogonistes rufocinctus* (Dejean), 64. *Pogonistes littoralis* Duftschmid, 65. *Pogonistes luridipennis* Germar, 66. *Pterostichus crenuliger* Chaudoir, 67. *Pterostichus diligens* (Sturm), 68. *Pterostichus macer* (Marsham), 69. *Pterostichus madidus* (Fabricius), 70. *Pterostichus melanarius* (Illiger), 71. *Pterostichus niger* (Schaller), 72. *Pterostichus stricticollis* (Solsky), 73. *Pterostichus vernalis* (Panzer), 74. *Scarites striatus* Dejean, 75. *Scybalicus oblongiusculus* (Dejean), 76. *Sericoda bembidioides* Kirby, 77. *Sericoda quadripunctata* (Degeer), 78. *Zabrus tenebrioides* (Goeze).

MATERIALS AND METHODS

The study was conducted in an arable field in Villeneuve de Mezin, Lot-et-Garonne, southwest France sown with winter wheat. The carabid beetles were captured using funnel pitfall traps modified after Barber (1931) in late 2014 and 2015 during 12 sampling dates. In total 76 carabid species were identified using the work of Hůrka (1996) and Freude *et al.* (2004). All individuals were checked for mites under the elytra and wings. Sixteen out of 76 species of carabid had mites associated with them.

Mite specimens were cleared in a mixture of Nesbitt and lactophenol solutions 1:1, and mounted in modified Hoyer's medium as described by Faraji and Bakker (2008). Drawings were made with the aid of a camera lucida (drawing tube) attached to an Olympus phase contrast microscope. The setal notations for the idiosoma follow Lindquist & Evans (1965), and leg chaetotaxy follows Evans (1963). Ranges of measurements are given in micrometers. The voucher specimens of mites are deposited in the Acari collection of Mitox Consultants, Amsterdam Science Park.

The number of carabid beetles carrying at least one mite of the genera *Antennoseius* or *Anystipalpus* was recorded at different sampling dates. To know about the abundance of mite species of these two genera, all mites were mounted.

TAXONOMY

Antennoseius Berlese

Antennoseius Berlese, 1916: 303.

Type species: *Antennoseius delicatus* Berlese, 1916, by original designation.

For the genus diagnosis see Moraes *et al.* (2016).

Antennoseius (*Antennoseius*) *pannonicus* Willmann, 1951 (Figures 1-4, 8A)

Antennoseius pannonicus Willmann, 1951: 109.

Antennoseius pannonicus. Athias-Henriot, 1961: 461;

Ryke, 1962: 662; Karg, 1971: 298; 1977: 4; 1993: 305; Farrier & Hennessey, 1993: 23.

Antennoseius (*Antennoseius*) *pannonicus*. Bregetova, 1977: 248; Beaulieu *et al.*, 2008: 47; Lindquist & Moraza, 2009: 34; Moraes *et al.*, 2016: 73.

Female — five specimens measured.

Dorsal idiosoma (Figure 1A) — Idiosoma oval, 565 (530 – 590) long; dorsal shield divided and reticulate over entire surface; podonotal shield 294 (288 – 300) long and 240 (238 – 243) wide at *j5* level, with 19 pairs of dorsal setae (*r2* seta on the shield) and 7 pairs of pore-like structures (with no distinction made between poroids and glandular pores); *j1* short 10 (9–10), *j2*, *j3*, *j4* and *j5* modified, short and spinelike 15 – 18, *z1* 20 – 21; opisthonotal shield 249 (235 – 263) long and 233 (230 – 238) wide at *J2* level, with 15 pairs of dorsal setae and 8 pairs of pore-like structures; *J2* 35 (34 – 38), *Z5* 35 (32 – 38); lateral soft integument with 4 pairs of *r* setae (*r3–6*), *r3* 27 (25 – 28) and 21 – 22 pairs of *R* – *UR* setae, dorsal idiosomal setae smooth, except *Z5* and most *R* – *UR* setae are slightly barbed.

Peritreme — Extending anteriorly to level of seta *s1*, at venter, anterior to coxa I (Figures 1A & 1B). Peritrematal-exopodal plate nearly smooth with three to four longitudinal lines near posterior end of stigma, widened and notched posteriorly; pores on peritrematal-exopodal plate not visible.

Ventral idiosoma (Figure 1B) — All ventral setae smooth; tritosternum 108 (105 – 110) long with paired laciniae, free for about three-fourths of total length and pilose, subrectangular base 16 – 18 long and 12 – 13 wide medially; two pairs of subtriangular sclerotized presternal plates; sternal shield 145 (138 – 149) long along midline, 111 (110 – 112) wide at *st2* level; with 2 pairs of sternal setae (*st3* off the shield) and three pairs of lyrifissures; *st1* 35 (33 – 38) long; with a prominent brownish crown-shape configuration between *st1* setae, posterior part of sternal shield between lyrifissures *iv2* and *iv3* weakly sclerotized and laterally eroded; epigynal shield 58 (55 – 60) at greatest width, evenly rounded posteriorly with setae *st5* on lateral margins; paragenital poroids *iv5* on soft cuticle; endopodal plates weakly developed (except for region between coxae I and II, where fused with sternal shield), posterior

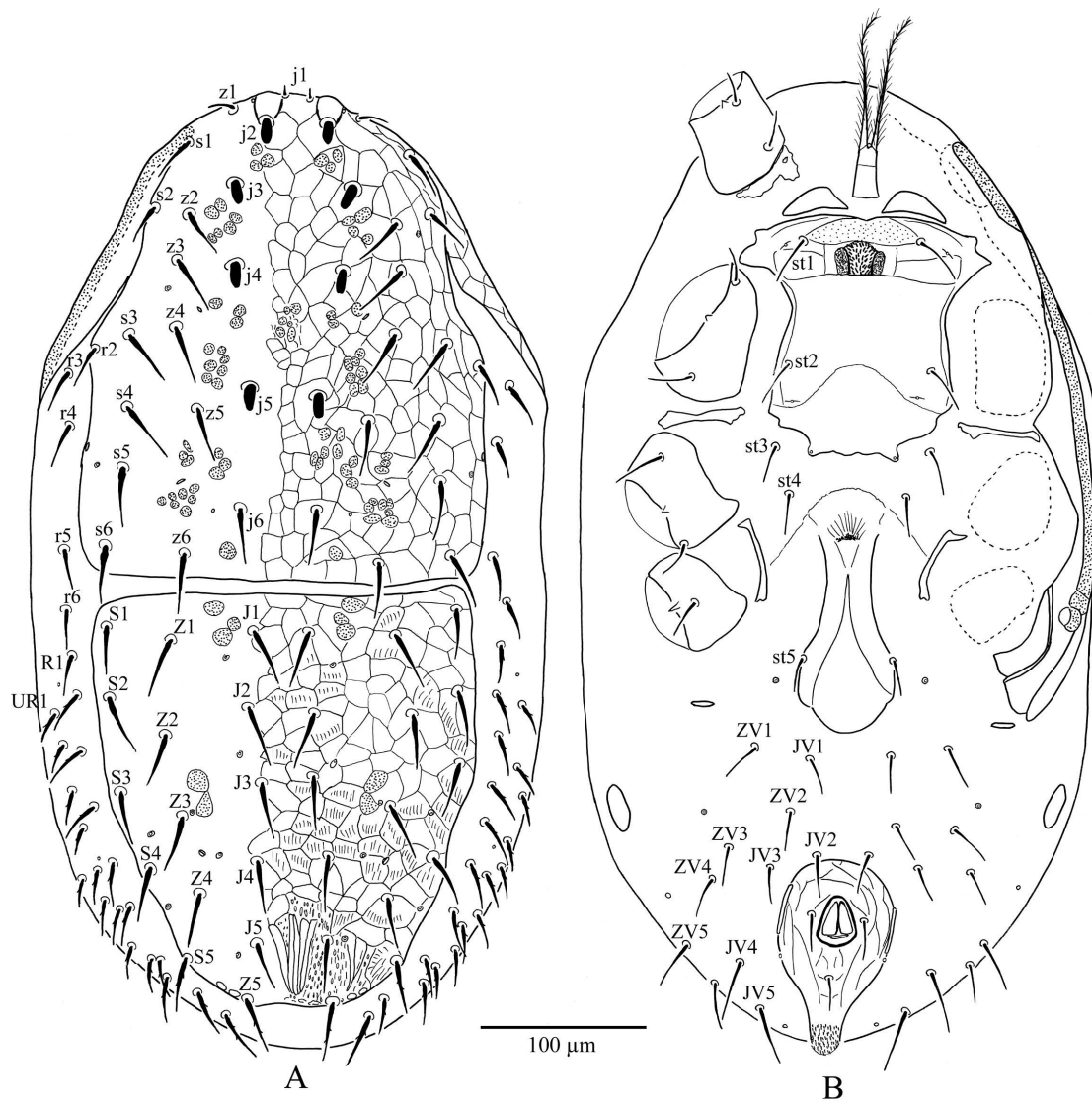


FIGURE 1: *Antennoseius (Antennoseius) pannonicus*, adult female: A – Idiosoma, dorsal view; B – Idiosoma, ventral view.

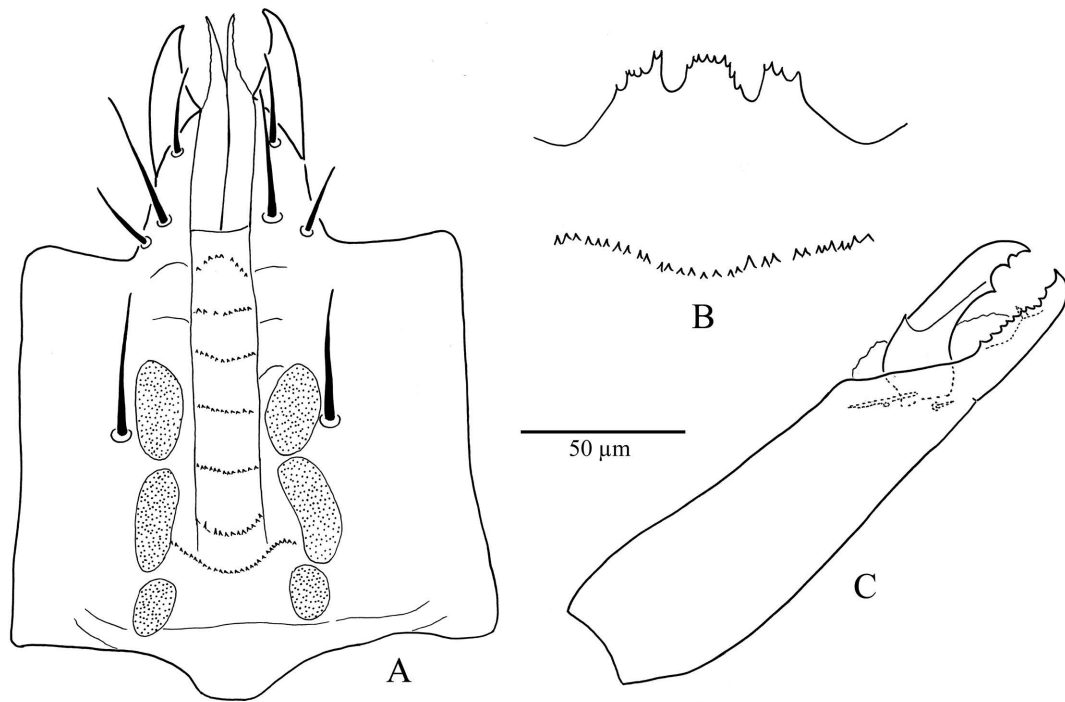


FIGURE 2: *Antennoseius* (*Antennoseius*) *pannonicus*, adult female: A – Subcapitulum; B – Tectum; C – Chelicera, lateral paraxial view.

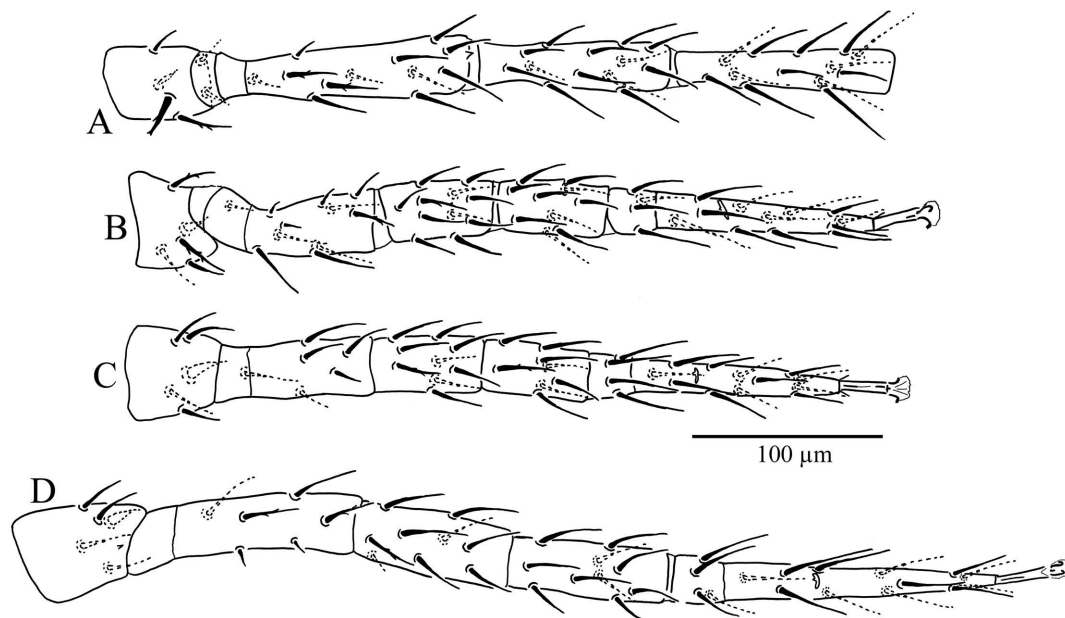


FIGURE 3: *Antennoseius* (*Antennoseius*) *pannonicus*, adult female: A – Leg I (excluding tarsus); B – Leg II; C – Leg III; D – Leg IV.



FIGURE 4: *Pterostichus madidus* (Fabricius) carrying some *Antennoseius* (*Antennoseius*) *pannonicus* under the elytra.

section represented by one pair of strips between coxae III and IV parallel to epigynal shield and the other pairs positioned transversely between coxae II and III; anal shield weakly reticulate and pear-shaped 109 (102 – 115) long and 69 (65 – 73) of greatest width, with three circumanal setae and gland pores *gv3* on shield margin; ten pairs of setae (*JV1-5* and *ZV1-5*) on soft cuticle laterad of anal shield; with two pairs of metapodal plates, the smaller pair posteriad of peritrematal plate, the larger pair oval (about 28x10).

Gnathosoma — Tectum (Figure 2B) with anterior margin serrate and with three short projections, dorsal surface with a transverse line of denticles; deutosternum with a smooth transverse line between *h3* followed by 7 denticulate transverse lines, denticulate lines 2 – 6 with 12 – 14 denticles, line 7 with 9 – 10 denticles and curved, proximalmost line longer with 25 – 30 denticles (Figure 2A); palp-coxal setae (*pc*) 27 – 29, hypostomal setae *h1* 25 – 26, *h2* 10 – 12, and *h3* 26 – 27, all smooth; corniculi horn-like; internal malae slightly fimbriated laterally; fixed cheliceral digit with setiform pilus denticilis and a row of about 10 teeth, movable digit tridentate (Figure 2C); palp apotele two-tined.

Legs (Figure 3) — Lengths, Leg I 607 (600 – 610), leg II 420 (410 – 430), leg III 410 (400 – 420), leg IV 557 (550 – 560); most of leg setae smooth except

some setae lightly barbed, dorsal seta of trochanter I slightly thickened and barbed, ventral setae of trochanters I-IV slightly thickened; setation of legs I – II – III – IV: coxae 2 – 2 – 2 – 1, trochanters 6 – 5 – 5 – 5, femora 12 – 11 – 6 – 6, genua 13 (2 3/1 3/2 2) – 11(2 3/1 2/1 2) – 9 (2 2/1 2/1 1) – 9 (2 2/1 3/0 1), tibiae 13 (2 3/1 3/2 2) – 10 (2 3/1 2/1 1) – 8 (2 2/1 1/1 1) – 10 (2 2/1 2/1 2), tarsus II-IV 3 3/2 3/2 3+*mv,md*.

Spermathecal Apparatus — This species has apparently type A complex (laelapid) of sperm access system (Figure 8A); sacculus vestibules finger-shaped with relatively wider duct, situated between coxae III and IV.

Male — Not phoretic and not found.

Specimens examined — 23 June 2015: 8♀♀ on *Harpalus rufipes* (Degeer); 20♀♀ on *Poecilus cupreus* (Linne); 3♀♀ on *Pterostichus madidus* (Fabricius); 23 Sep. 2015: 3♀♀ on *Calathus fuscipes* (Goeze); 12♀♀ on *Harpalus calceatus* (Duftschmid); 1♀ on *Nebria salina* Fairmaire et Laboulbene; 18♀♀ on *Pterostichus madidus* (Fabricius); 3♀♀ on *Scybalicus oblongiusculus* (Dejean); 04 Aug. 2015: 3♀♀ on *Harpalus distinguendus* (Duftschmid); 1♀ on *Pterostichus melanarius* (Illiger), all collected by Bogdan Dehelean in Villeneuve de Mezin, Lot-et-Garonne, South West France.

Remarks — The prominent brownish crown-shape configuration on the sternal shield of *A. pan-nonicus* is a unique feature that allows identification of this species by just using a dissecting microscope. Descriptions of legs, tectum and hypostome, which were lacking in the original description by Willmann (1951) are provided here. Figure 4 shows the position of mites under the elytra of a carabid beetle.

Antennoseius (Antennoseius) pseudospinosus
Eidelberg, 1990.
(Figures 5 – 7, 8B)

Antennoseius (Antennoseius) pseudospinosus, Eidelberg, 1990: 78; Moraes *et al.*, 2016: 73.

Female — five specimens measured.

Dorsal idiosoma (Figure 5A) — Idiosoma oval, 412 (400 – 435) long; dorsal shield divided and strongly reticulate over entire surface with some short striations especially around setae and behind *J*₄, dorsal shield setae all setiform; podonotal shield 228 (225 – 235) long and 208 (200 – 215) wide at *j*₅ level, with 19 pairs of dorsal setae (*r*₂ seta on the shield), pore-like structures difficult to observe; *j*₁ 17 (15 – 18), *z*₁ 12 (11 – 13); opisthonotal shield 183 (175 – 195) long and 183 (180 – 185) wide at *J*₂ level with 15 pairs of dorsal setae and 8 pairs of pore-like structures; *J*₂ 32 (31–33), *Z*₅ 35 (32 – 38); lateral soft integument with 4 pairs of *r* setae (*r*_{3–6}), *r*₃ 23 (22 – 24) and 16 pairs of *R* – *UR* setae, most setae on opisthonotal shield and *R* – *UR* setae slightly barbed.

Peritreme — Extending anteriorly to level of seta *z*₁ (Figure 5A). Peritrematal-exopodal plate reticulate with a line extending behind stigma, slightly widened and notched posteriorly.

Ventral idiosoma (Figure 5B) — All ventral setae smooth; tritosternum 90 (89 – 90) long with paired laciniae, free for about two-thirds of total length and pilose, subrectangular base 17 – 18 long and 10 – 11 wide medially; with two pairs of narrow sclerotized presternal plates; sternal shield 114 (113 – 115) long along midline (ignoring anterior concavity), 42 (40 – 45) wide at *st*₂ level; mid anterior part with a depression, shield with two parallel longitudinal lines in the middle, posterior margin of sternal

shield concave, with three pairs of sternal setae and two pairs of lyrifissures (*iv*₃ apparently absent in all 23 mounted specimens); *st*₁ 25 (24 – 25) long, *st*₁ and *st*₂ slightly thicker than *st*₃ and *st*₄ narrower than *st*₃; epigynal shield 42 (40 – 45) at greatest width, evenly rounded posteriorly with setae *st*₅ on lateral margins; paragenital poroids *iv*₅ on soft cuticle; endopodal plates weakly developed (except for region between coxae I and II, where fused with sternal shield), posterior section represented by one pair of strips between coxae III and IV parallel to epigynal shield and the other pairs positioned transversely between coxae II and III; anal shield weakly reticulate and pear-shaped 85 (78 – 88) long and 59 (55 – 63) of greatest width, with three circumanal setae and gland pores *gv*₃ on shield margin; ten pairs of setae (*JV*_{1–5} and *ZV*_{1–5}) on soft cuticle laterad of anal shield; opisthogastric venter with two pair of metapodal plates, the smaller pair posteriad of peritrematal plate, the larger pair subcircular (about 17×13).

Gnathosoma — Tectum (Figure 6B) with anterior margin serrate and with three short projections, dorsal surface with a transverse line of denticles; deutosternum with a smooth transverse line between *h*₃ followed by 7 denticulate transverse lines, denticulate lines with 5 – 9 denticles, line 7 curved and proximalmost line longer (Figure 6A); palpcoxal setae (*pc*) 18 – 20, hypostomal setae *h*₁ 25, *h*₂ 12 – 13, and *h*₃ 17 – 19, all smooth; corniculi horn-like; internal malae slightly fimbriated laterally; fixed cheliceral digit with setiform pilus dentilis and a row of about 15 – 16 teeth, movable digit tridentate (including a tiny subapical denticle)(Figure 6C); palp apotele two-tined.

Legs (Figure 7) — Lengths, Leg I 385 (380 – 390), leg II 300 (290 – 310), leg III 273 (270 – 280), leg IV 350 (345 – 360); all leg setae smooth except some setae lightly barbed, dorsal seta of trochanter I slightly thickened and barbed apically; setation of legs I – II – III – IV: coxae 2 – 2 – 2 – 1, trochanters 6 – 5 – 5 – 5, femora 12 – 11 – 6 – 6, genua 13 (2 3/2 3/1 2) – 11(2 2/1 3/1 2) – 9 (2 2/1 2/1 1) – 9 (2 2/1 2/1 1), tibiae 13 (2 3/1 3/2 2) – 10 (2 3/1 2/1 1) – 8 (2 2/1 1/1 1) – 10 (2 2/1 2/1 2), tarsus II–IV 3 3/2 3/2 3+*mv,md*.

Spermathecal Apparatus — Sacculus vestibules

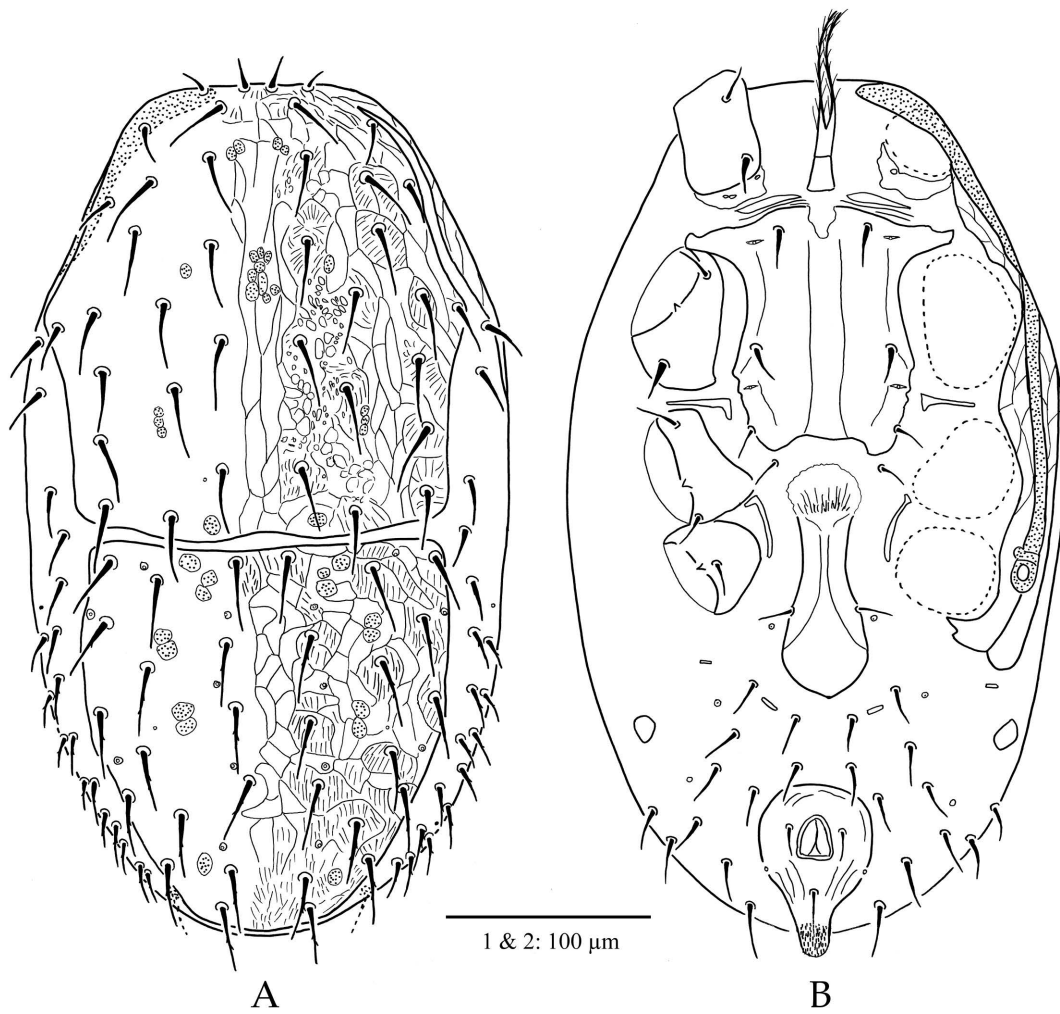


FIGURE 5: *Antennoseius* (*Antennoseius*) *pseudospinosus*, adult female: A – Idiosoma, dorsal view; B – Idiosoma, ventral view.

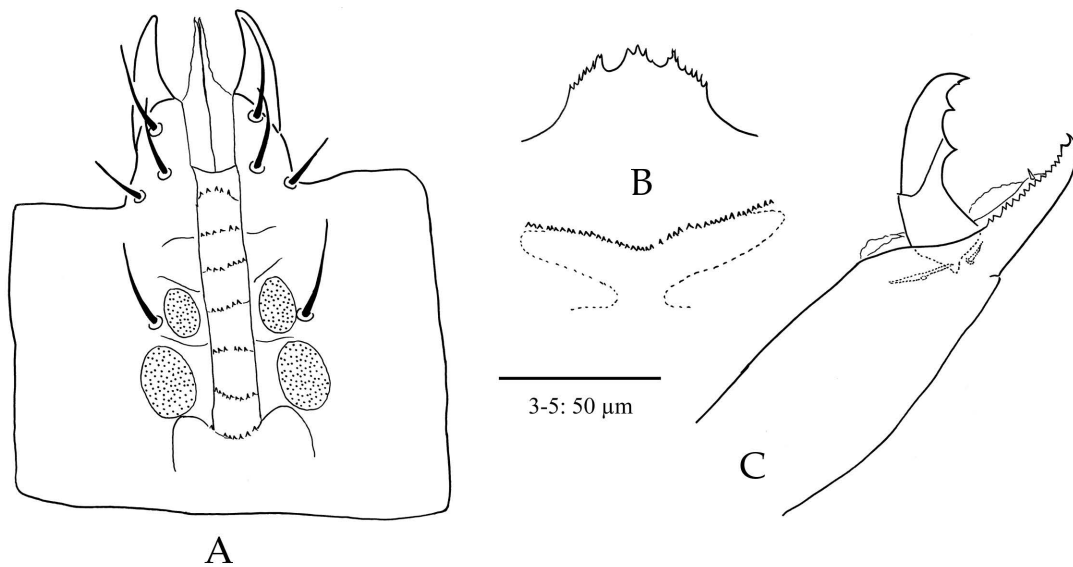


FIGURE 6: *Antennoseius* (*Antennoseius*) *pseudospinosus*, adult female: A – Subcapitulum; B – Tectum; C – Chelicera, lateral paraxial view.

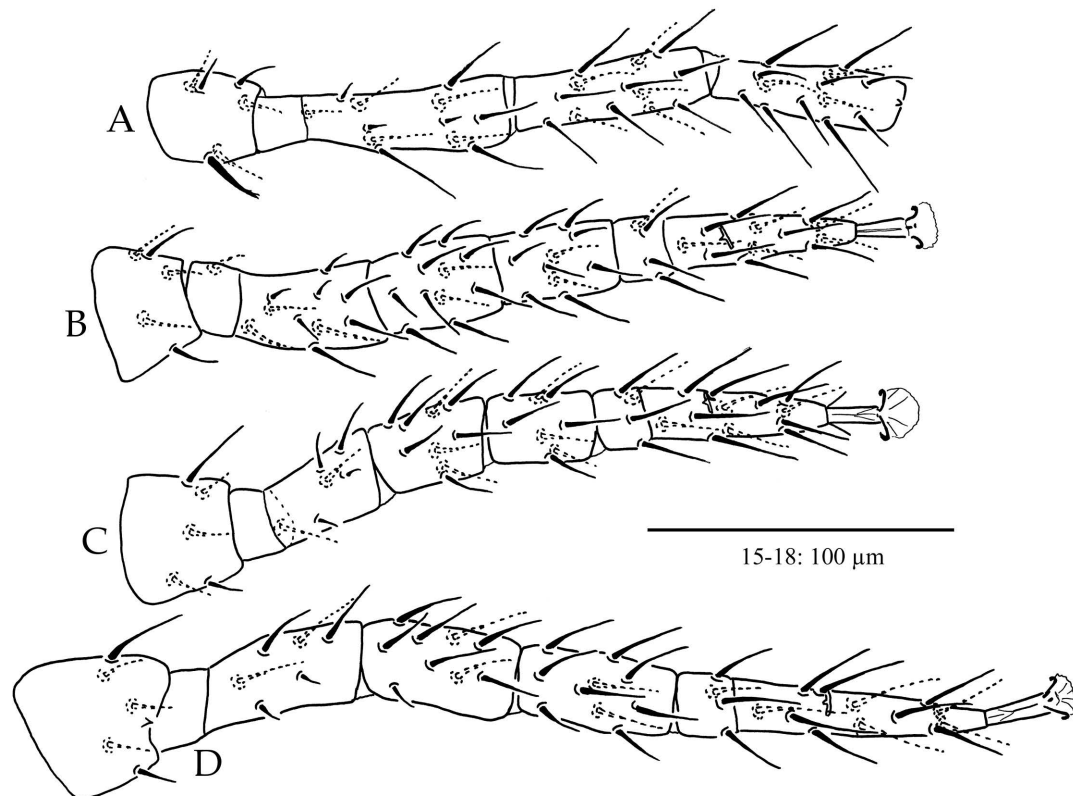


FIGURE 7: *Antennoseius* (*Antennoseius*) *pseudospinosus*, adult female: A – Leg I (excluding tarsus); B – Leg II; C – Leg III; D – Leg IV.

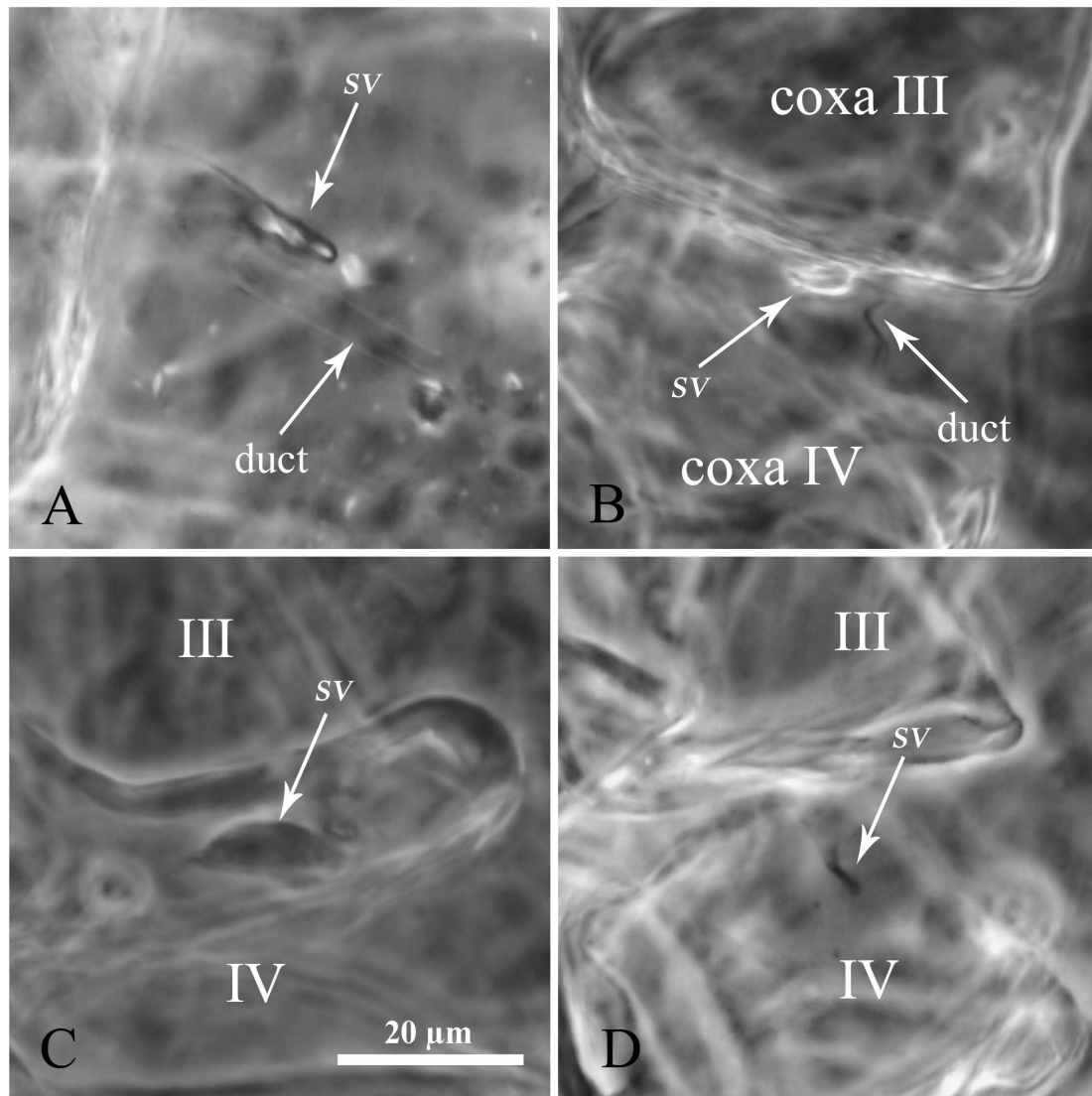


FIGURE 8: Female spermathecal apparatus: A – *Antennoseius (Antennoseius) pannonicus*; B – *Antennoseius (Antennoseius) pseudospinosus*; C – *Anystipalpus livshitsi*; D – *Anystipalpus percicola*, sacculus vestibules (sv).

of this species is short and comma-shaped with narrow duct (Figure 8B). The sacculus vestibules stays most of the time attached to the margin of coxa III.

Male — Not phoretic and not found.

Specimens examined — 13 April 2015: 7♀♀ on *Poecilus cupreus* (Linne); 27 April 2015: 4♀♀ on *Poecilus cupreus* (Linne); 23 Sep. 2015 2♀♀ on *Calathus fuscipes* (Goeze); 16 Nov. 2015: 2♀♀ on *Nebria brevicollis* (Fabricius), 8♀♀ on *Nebria salina* Fairmaire et Laboulbene, all collected by Bogdan Dehelean in Villeneuve de Mezin, Lot-et-Garonne, South West France.

Remarks — The original description of *A. pseudospinosus* provided by Eidelberg (1990) is poor with a mistake. He mentioned podonotal shield with 21 pairs of setae. His figure clearly shows *r4* and *r5* on the shield. The specimens collected in this study however have 19 pairs of setae (setae *r4* and *r5* off the shield). Dr. Viacheslav Trach confirmed the presence of 19 pairs of podonotal setae on his collected specimens from Ukraine (Pers. Comm. with the senior author).

Anystipalpus Berlese

Anystipalpus Berlese, 1911: 184.

Type species: *Anystipalpus pericola* Berlese, 1911, by original designation.

For the genus diagnosis see Lindquist & Moraza (2009) and Moraes *et al.* (2016).

Anystipalpus livshitsi (Eidelberg, 1989)

Antennoseius livshitsi Eidelberg, 1989: 74.

Anystipalpus livshitsi. Lindquist & Moraza, 2009: 3; Moraes *et al.*, 2016: 76.

Antennoseius ukrainicus Sklyar, 1994: 484 (Synonymy by Lindquist & Moraza, 2009: 18). — *Antennoseius* (*Antennoseius*) *ukrainicus*. Beaulieu *et al.*, 2008: 52.

Specimens examined — 27 April 2015: 1♀ *Poecilus cupreus* (Linne); 04 Aug. 2015: 1♀ on *Harpalus rufipes* (Degeer); 23 Sep. 2015: 6♀♀ on *Brachinus crepitans* (Linnaeus), 8♀♀ on *Harpalus rufipes* (Degeer), 27♀♀ on *Poecilus cupreus* (Linne), 2♀♀ on *Pterostichus macer* (Marsham); 16 Nov. 2015: 2♀♀ on

Pterostichus madidus (Fabricius), 2♀♀ on *Pterostichus melanarius* (Illiger), all collected by Bogdan Dehelean in Villeneuve de Mezin, Lot-et-Garonne, South West France.

Spermathecal Apparatus — Sacculus vestibules sack-shaped, relatively larger and more sclerotized than the other three species found in this study (Figure 8C).

Remarks — Lindquist and Moraza (2009) gave a complete re-description for this species.

Anystipalpus pericola Berlese, 1911

Anystipalpus pericola Berlese, 1911: 185.

Anystipalpus pericola. Lindquist & Moraza, 2009: 14; Moraes *et al.*, 2016: 76.

Antennoseius (*Antennoseius*) *nataliae* Eidelberg, 1990: 75 (Synonymy by Lindquist & Moraza, 2009: 14).

Antennoseius (*Antennoseius*) *nataliae*. Beaulieu *et al.*, 2008: 52.

Specimens examined — 04 Aug. 2015: 2♀♀ on *Harpalus rufipes* (Degeer); 23 Sep. 2015: 2♀♀ on *Scybalicus oblongiusculus* (Dejean), all collected by Bogdan Dehelean in Villeneuve de Mezin, Lot-et-Garonne, South West France.

Spermathecal Apparatus — Proximal part of sacculus vestibules narrow, sclerotized and then funnel-shaped (Figure 8D).

Remarks — Lindquist and Moraza (2009) gave a complete re-description for this species.

Key* to the species of the genera *Antennoseius* and *Anystipalpus* associated with carabid beetles

1. Palpus of normal length, at most one-third as long as leg I, with palptibia less than two times as long as palptarsus; sternal shield lyrifissures *iv1-iv3* present (some species without *iv3*, Figure 3B); tibia IV with ten setae (*pl2* present).....*Antennoseius* Berlese.....2
- Palpus slender, elongated, about half as long as leg I; palptibia two to three times as long as palptarsus; sternal shield lacking lyrifissures *iv1*, *iv3*, and sometimes *iv2*; tibia IV with nine setae (*pl2* absent).....*Anystipalpus* Berlese.....3

2. Leg I with pretarsus and a pair of small to well-developed claws... *Antennoseius* (*Vitzthumia*) Thor 6
— Leg I lacking pretarsus and claws *Antennoseius* (*Antennoseius*) Berlese..... 10

3. Podonotal shield with eight pairs of strongly thickened, smooth, spinelike setae; sternal lyrifissures *iv1-iv3* absent 4
— Podonotal shield without enlarged, modified setae; one pair of sternal lyrifissures, *iv2*, present ... 5

4. Thickened dorsal setae shorter (half as long) than other podonotal setae, and with rounded, blunt tips; epigynal shield drop-shaped, its lateral margins widened posteriorly; setae *pd* on trochanter I, *pd2* on femur I and *pd1-pd3* on genu I, short, thick, bluntly spine-shaped..... *Anystipalpus livshitsi* Eidelberg, 1989
— Thickened dorsal setae about as long as other podonotal setae, and with distal half of length tapered, acutely pointed; epigynal shield tongue-shaped, its lateral margins nearly parallel; setae *pd* on trochanter I and *pd1* on femur I acutely pointed, slightly spine-shaped..... *Anystipalpus kazemii* Lindquist and Moraza, 2009

5. Dorsal shield setae moderately short, *J1 - J4* about half as long as intervals between their bases; epigynal shield with posterior margin rounded; tarsus II with three posterolateral setae modified, spine-shaped; coxa I with both setae bluntly spine-shaped; genu I with *pd3* a short blunt spine, femur I with *pd2* a longer pointed spine..... *Anystipalpus pericola* Berlese, 1911
— Dorsal shield setae moderately long, *J1 - J4* nearly as long as intervals between their bases; epigynal shield with posterior margin bluntly pointed; tarsus II without modified setae; coxa I with one seta (*av*) bluntly spinelike; genu and femur I without bluntly spinelike setae..... *Anystipalpus labiduricola* Lindquist and Moraza, 2009

6. Podonotal shield with setae strongly thickened, spine-shaped or spur-shaped; setae of

coxae I and/or II spine-shaped or swollen basally..... *Antennoseius* (*V.*) *perseus* Beaulieu *et al.*, 2008

— Podonotal shield with none of the setae thicker than others; setae of coxae I and II slender, setiform..... 7

7. Podonotal shield with at least 30 pairs of short, smooth setae, unpaired setae present (neotrichia present)..... *Antennoseius* (*V.*) *multisetus* Eidelberg, 2000
— Podonotal shield with 18 – 20 pairs of setae.... 8

8. Palptibia and palpgenu with respectively one and two strongly thickened, short, smooth, spur-like dorso-distal setae; podonotal shield with 20 pairs of setae; anterior margin of tectum smooth or with very few denticles..... *Antennoseius* (*V.*) *pyrophilus* Beaulieu, Déchéne and Walter, 2008
— Palptibia and palpgenu with normal dorso-distal setae; anterior margin of tectum with numerous denticles 9

9. Setae *j1* swollen and serrate, conspicuously different in shape from surrounding setae, and about 1.5 times longer than other dorsal setae..... *Antennoseius* (*V.*) *ovaliscutalis* Eidelberg, 2000
— Setae *j1* sparsely barbed and similar in shape and length to surrounding setae..... *Antennoseius* (*V.*) *kamalii* Moraza and Kazemi, 2009

10. Podonotal shield with some setae strongly thickened, spine-shaped or spur-shaped 11
— Podonotal shield with all setae setiform (*j1* might distally expanded) 18

11. Podonotal shield with four pairs of setae strongly thickened, spine-shaped or spur-shaped (*j1* should be ignored)..... 12
— Podonotal shield with five, six or eight pairs of setae strongly thickened, spine-shaped or spur-shaped (*j1* should be ignored)..... 14

12. Seta *j5* strongly thickened and spur-like; sternal shield with a prominent brownish crown-shape configuration between *st1* setae; coxae leg I and II without modified setae.....
..... *Antennoseius (A.) pannonicus*
Willmann, 1951

— Seta *j5* setiform; sternal shield without a prominent brownish crown-shaped configuration between *st1* setae; coxae leg I and II with one modified seta..... 13

13. Modified setae of podonotal shield with sharp tips; opisthonotal shield with 16 pairs of setae as well as two unpaired *Jx* setae.....
..... *Antennoseius (A.) bytinskii*
Costa, 1969

— Modified setae of podonotal shield with blunt tips; opisthonotal shield with 15 pairs of setae.....
..... *Antennoseius (A.) quadrispinosus*
Gwiazdowicz and Haitlinger, 2010

14. Podonotal shield with eight pairs of short and thickened setae *Antennoseius (A.) maltzevi*
Eidelberg, 1994

— Podonotal shield with five or six pairs of short and thickened setae 15

15. Podonotal shield with five pairs of short and thickened setae 16

— Podonotal shield with six pairs of short and thickened setae 17

16. *z5* short and thickened and *z4* setiform.....
..... *Antennoseius (A.) masoviae*
Sellnick, 1943

— *z5* setiform and *z4* short and thickened.....
..... *Antennoseius (A.) ponticus*
Trach & Makarova, 2008

17. Seta *j5* setiform and *s1* short and thickened; coxae legs I and II with one short and thickened seta.....
..... *Antennoseius (A.) sabulicola*
Bregetova, 1977

— Seta *j5* short and thickened and *s1* setiform; coxae legs I and II with setiform setae.....

Antennoseius (A.) sharonovi Eidelberg, 1989
(= *Antennoseius (A.) vysotskajae* Sklyar, 1994)

18. Coxae I and II with one short and thickened seta.....
..... *Antennoseius (A.) matsjuki*
Eidelberg, 2001

— Coxae I and II with setiform setae 19

19. Anal shield with two or three pairs of setae in addition to circumanals 20

— Anal shield with only circumanal setae..... 21

20. Anal shield with two pairs of setae in addition to circumanals; dorsal body setae smooth; opisthonotal unpaired *Jx* setae present.....
..... *Antennoseius (A.) olallae*
Haitlinger, 2011

— Anal shield with three pairs of setae in addition to circumanals; dorsal body setae barbed; opisthonotal unpaired *Jx* setae absent.....
..... *Antennoseius (A.) dungeri*
Karg, 1965

21. Seta *j1* distally expanded (fan-shaped).....
..... *Antennoseius (A.) bullitus*
Karg, 1969

— Seta *j1* similar to the adjacent setae, might be shorter or barbed 22

22. Opisthonotal shield with unpaired *Jx* setae .. 23

— Opisthonotal shield without unpaired *Jx* setae..... 24

23. Fixed digit of chelicera with twelve teeth; epigynal shield droplet-shaped, narrowest part one-third of the widest part.....
..... *Antennoseius (A.) matalini*
Eidelberg, 2001

— Fixed digit of chelicera with five teeth; epigynal shield tongue-shaped, narrowest part about two-thirds of the widest part...
..... *Antennoseius (A.) similis*
Eidelberg, 2001

24. Sternal shield with two pairs of setae (*st3* off the shield).....
..... *Antennoseius (A.) calathi*
Fain *et al.*, 1995

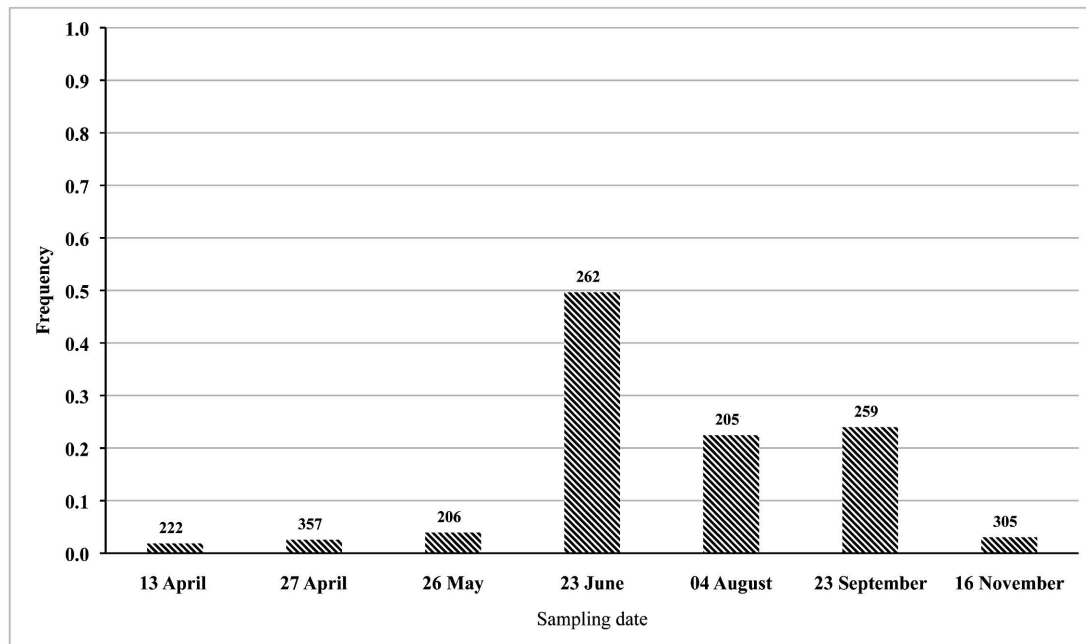


FIGURE 9: Frequency of carabid beetles carrying mites of the *Antennoseius* and *Anystipalpus* (figure above bars indicate the number of beetles checked for mites).

— Sternal shield with three pairs of setae.....25

25. Epigynal shield droplet- or spear-shaped, narrowest part less than one-third of the widest part.....*Antennoseius* (A.) *pseudospinosus* Eidelberg, 1990

— Epigynal shield tongue-shaped, narrowest part about two-thirds of the widest part.....26

26. Dorsal shield setae moderately long, J1 – J4 nearly as long as intervals between their bases.....*Antennoseius* (A.) *longisetus* Eidelberg, 2000

— Dorsal shield setae moderately short, J1 – J4 about half as long as intervals between their bases.....*Antennoseius* (A.) *belorussicus* Eidelberg, 1990

*Arranged based on the keys provided by Lindquist & Moraza (2009) and Moraza & Kazemi (2009)

DISCUSSION

No descriptions have been yet provided for the spermathecal apparatus of *Antennoseius* and *Anystipalpus*. Lindquist and Moraza (2009) and Kazemi and Moraza (2013) mentioned the spermathecal apparatus of the investigated species as not distinctly sclerotized structures. Our examination on the four collected species showed to some extent sclerotization allowing the description for four of the species collected in this work. We are not certain whether the sclerotized portion is a 'sacculus' or a sclerotized section of a longer major duct. For simplicity, we have used the term "sacculus vestibules" in this paper. Whatever they are called, it seems that each species has its own unique structural form of spermatheca that should be described. Given that the other structures of spermathecal apparatus are not distinctly sclerotized, more details could not be obtained with the microscope used in this study. For this reason, the description of the spermathecal apparatus presented in this paper should be considered provisional pending an extensive examination with an elaborate microscope.

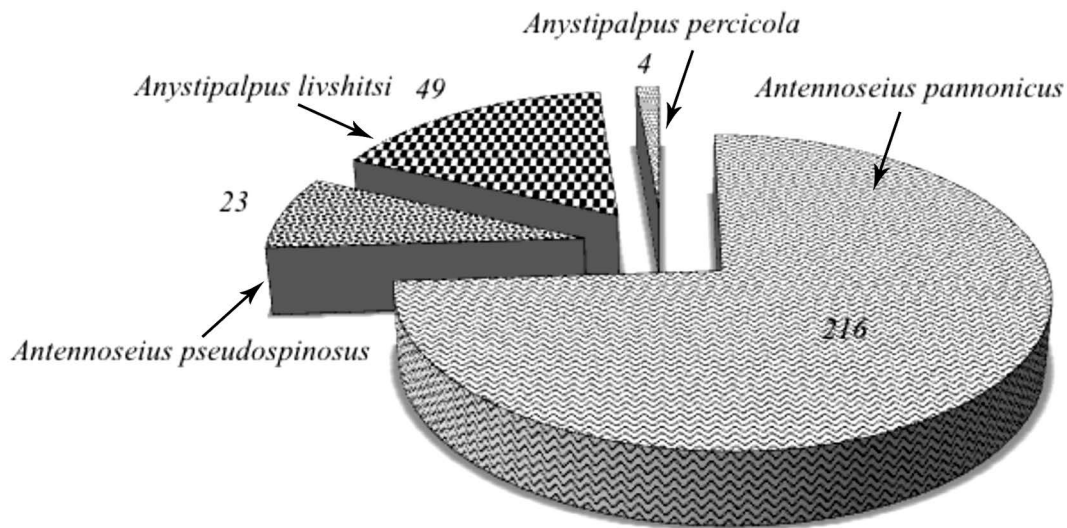


FIGURE 10: Proportion of species of *Antennoseius* and *Anystipalpus* found phoretic on carabid beetles.

The carabid beetles collected in late autumn 2014 and winter 2015 did not have any mites associated. The adult females started phoresy in 13, April 2015 with a small number of beetles carrying mites. The peak number of carabids having mites was observed on June 23, 2015, when half of the carabids had at least one mite (Figure 9). The species found most frequently in this study was *A. pannonicus* (74%) followed by *A. livshitsi* (17%). Less abundant species were *A. pseudospinosus* and *A. percicola* with 8% and 1% respectively (Figure 10).

We have found lack of host specificity for mites selecting the carabid hosts and some beetle species were the host to more than one species of these mites. The study for the frequency of carabids carrying mites was done by not identifying the species of these two genera. Therefore, a comprehensive study is needed to determine the population dynamics of each species. That should be extended to more locations in France to have a good picture of the species involved.

ACKNOWLEDGEMENTS

We are indebted to Dr. Viacheslav Trach, Department of Zoology, I.I. Mechnikov Odessa National University, Ukraine for examining specimens identified as *A. pseudospinosus* in his collection. We

are also thankful to Drs. E.E. Lindquist, E.A. Ueckermann, and two anonymous reviewers for their valuable comments and corrections. The mite species reported in this study were obtained during a project performed by Mitox Field Operations Southern Europe.

REFERENCES

- Athias-Henriot C. 1961 — Mesostigmates (Urop. Excl.) édaphiques méditerranéens (Acaromorpha, Anactinotrichida) (collect. Prof. H. Franz et C. Athias-Henriot). Première Série) — *Acarologia*, 3(4): 381-509.
- Bahrami F., Arbabi M., Vafaei Shoushtari R., Kazemi Sh. 2011 — Mesostigmatic mites associated with Coleoptera and biodiversity calculation of these mites phoretic on dung beetles in Golestan Province (north of Iran) — *Middle-East Journal of Scientific Research*, 9 (3): 345-366.
- Berlese A. 1911 — Alcuni Acari entomofili nuovi — *Redia*, 7: 183-186.
- Berlese A. 1916 — Centuria terza di Acari nuovi — *Redia*, 12: 289-338.
- Barber H.S. 1931 — Traps for cave-inhabiting insects — *J. Elisha Mitchell Sci. Soc.* 46: 259-266.
- Beaulieu F., Déchéne A.D., Walter D.E. 2008 — Phase morphs and phoresy: new species of *Antennoseius* (*Vitzthumia*) mites (Acari: Mesostigmata: Ascidae) associated with pyrophilous carabids (*Carabidae: Sericoda* spp.) in Alberta, Canada — *Zootaxa*, 1961: 37-57.

- Bregetova N.G. 1977 — Family Antennoseiidae Karg, 1965. In: Ghilyarov, M.S. & Bregetova, N.G. (eds.). Key to the soil-inhabiting mites, Mesostigmata — Leningrad: Nauka, pp. 244-253.
- Călugăr A. 2010 — Faunistic researches on gamasid mites (Acari: Gamasina) from natural and anthropized forest ecosystems from the Moldavian plain — *Analele Științifice ale Universității Al. I. Cuza: Iași, seria Biologie Animală*, 56: 43-51.
- Costa M. 1969 *Antennoseius bytinskii* sp. nov., with notes on the genus *Antennoseius* Berlese (Acari: Mesostigmata) in Israel — *Israel J. Entomol.*, 4: 217-226.
- Eidelson M.M. 1989 — Two new mite species of the family Antennoseiidae (Parasitiformes, Mesostigmata) from ground beetles (Coleoptera, Carabidae) — *Bulletin of the State Nikita Botanical Gardens*, 70: 74-79. [In Russian].
- Eidelson M.M. 1990 — Three new species of carabidophilous ticks (Antennoseiidae: Mesostigmata) from the Ukraine and Byelorussia — *Byulletin Gosudarstvennogo Nikitskiy Botanicheskogo Sada*, 71: 75-82.
- Eidelson M.M. 1994 — New species of the family Antennoseiidae (Acari, Sitiformes, Gamasina) from Palearctic — *Zool. Zh.*, 73: 46-52.
- Eidelson M.M. 2000 — Three new mite species of the family Antennoseiidae (Parasitiformes, Gamasina) — *Zool. Zh.*, 79(12): 1396-1401.
- Eidelson M.M. 2001 — New mite species of the family Antennoseiidae (Parasitiformes, Gamasina) from carabid beetles — *Zool. Zh.*, 80(1): 39-44.
- Evans G.O. 1963 — Observations on the chaetotaxy of the legs in the free-living Gamasina (Acari: Mesostigmata) — *Bull. Br. Mus. (Nat. Hist.)*, Zool., 10: 277-303.
- Fain A., Noti M.I., Dufrêne M. 1995 — Observations on the mites (Acari) associated with Carabidae (Coleoptera) in Belgium. I. Annotated list of the species — *Internat. J. Acarol.*, 21: 107-122. doi:10.1080/01647959508684051
- Faraji F., Bakker F.M. 2008 — A modified method for clearing, staining and mounting plant-inhabiting mites — *Eur. J. Ent.*, 105: 793-795.
- Farrier M.H., Hennessey M.K. 1993 — Soil-inhabiting and free-living Mesostigmata (Acari-Parasitiformes) from North America. An annotated checklist with bibliography and index. North Carolina Agricultural Research Service, North Carolina State University, Raleigh, Technical Bulletin, 302: 408 pp.
- Freude H., Harde K., Lohse G.A., Klausnitzer B. 2004 — *Die Käfer Mitteleuropas*, Band 2: 521 pp.
- Gwiazdowicz D.J. 2007 — Ascid mites (Acari, Mesostigmata) from selected forest ecosystems and microhabitats in Poland — *Wydawnictwo Akademii Rolniczej Im. Augusta Cieszkowskiego, Poznań*, 1-248.
- Gwiazdowicz D.J., Haitlinger R. 2010 — *Antennoseius (Antennoseius) maltzevi* and *A. (A.) quadrispinosus* sp.n. (Acari: Ascidae) associated with carabid beetles — *Biologia*, Bratislava, 65(1): 99-103.
- Gwiazdowicz D.J., Halliday R.B. 2010 — A new species of *Antennoseius* from Australia (Acari: Mesostigmata: Ascidae) — *Annales Zoologici*, 60(1): 125-132. doi:10.3161/000345410X499605
- Haitlinger R. 1991 — List of mites occurring on insects in Poland — *Wiadomości Parazytologiczne*, 31(1): 85-90.
- Haitlinger R. 2011 — *Antennoseius (Antennoseius) olallae* sp. n. (Acari: Mesostigmata: Ascidae) from Argentina — *Zeszyty Naukowe Uniwersytetu Przyrodniczego WE Wrocławiu, Biologia Hodowla Zwierząt*, LXII, 580: 21-25.
- Hůrka K. 1996 — Carabidae of the Czech and Slovak Republics — *Kabourek, Zlin*, 565pp
- Kalúz S., Ferencik J., Vrabec M. 2013 — Study sites influenced by natural and human impacts in TANAP and their acarofauna — *Entomofauna carpathica*, 25(1): 1-12.
- Karg W. 1965 — Larvalsystematische und phylogenetische Untersuchung sowie Revision des Systems der Gamasina Leach, 1915 (Acarina, Parasitiformes). Mitteilungen aus dem Zoologischen Museum in Berlin — 41: 193-340. doi:10.1002/mmznz.19650410207
- Karg W. 1969 — Untersuchungen zur Kenntnis der Ascoidea Karg, 1965 (Acarina: Parasitiformes) mit der Beschreibung von acht neuen Arten. — *Zool. Anzeiger*, 182: 393-406.
- Karg W. 1971 — *Acari (Acarina), Milben, Unterordnung Anactinochaeta (Parasitiformes): Die freilebenden Gamasina (Gamasides), Raubmilben*. In: *Die Tierwelt Deutschlands und der Angrenzenden Meeresteile*, 59. Teil. Gustav Fischer Verlag, Jena. 475p.
- Karg W. 1977 — Die Milbengattung *Antennoseius* Berlese, 1916 (Acarina, Parasitiformes) mit einer neuen Art aus dem Leutratat bei Jena (DDR). Abhandlungen und Berichte des Naturkundemuseums Görlitz, 50(4): 1-7.
- Karg W. 1993 — *Acari (Acarina), Milben Parasitiformes (Anactinochaeta) Cohors Gamasina Leach, Raubmilben*. In: *Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und ihrer Lebensweise*. 59. Teil. 2 überarbeitete Auflage, Gustav Fischer Verlag, Jena, 523 pp.
- Kazemi S., Moraza M.L. 2013 — Mites of the genus *Antennoseius* Berlese (Acari: Mesostigmata: Ascidae) from Iran — *Persian J. Acarol.*, 2(2): 217-234.
- Kontschán J., 2007 — New and rare mesostigmatid mites to the fauna of Hungary — *Folia Historico Naturalia Musei Matraensis*, 31: 99-106.

- Lindquist E.E., Evans G.O. 1965 — Taxonomic concepts in the Ascidae, with a modified setal nomenclature for the idiosoma of the Gamasina (Acarina: Mesostigmata) — Mem. Entomol. Soc. Can. 47: 1-64. doi:10.4039/entm9747fv
- Lindquist E.E., Moraza M.L. 2009 — *Anystipalpus*, *Antennoseius* and *Vitzthumia*: a taxonomic and nomenclatural conundrum of genera (Acari: Mesostigmata: Dermanyssina), with description of four species of *Anystipalpus* — Zootaxa, 2243: 1-39.
- Lindquist E.E., Walter D.E. 1989 — *Antennoseius* (*Vitzthumia*) *janus* n.sp. (Acari: Ascidae), a mesostigmatic mite exhibiting adult female dimorphism — Can. J. Zool., 67: 1291-1310. doi:10.1139/z89-184
- Lundqvist L. 1991 — Rearing deutonymphs of *Iphidosoma fimetarium* (J. Mueller) a mesostigmatic mite associated with carabid beetles, pp: 447-452, In Schuster, R., and Murphy, P.W. (eds), The Acari: Reproduction, Development and Life-History Strategies, Chapman And Hall, London.
- Mehrzad N., Kazemi Sh., Latifi M., Ziaaddini M. 2011 — Mesostigmatic mites (Acari) associated with Coleoptera in Bam region, Iran — First Persian Congress of Acarology. p. 60.
- Moraes G.J., Britto E.P.J., Mineiro J.L. de C., Halliday B. 2016 — Catalogue of the mite families Ascidae Voigts & Oudemans, Blattisociidae Garman and Melichariidae Hirschmann (Acari: Mesostigmata) — Zootaxa, 4112 (1): 1-299. doi:10.11646/zootaxa.4112.1.1
- Moraza M.L., Kazemi S. 2009 — A new species of *Antennoseius* (*Vitzthumia*) Thor (Acari: Mesostigmata, Ascidae), associated with carabid beetles in Iran and a key to species — Internat. J. Acarol., 35(1): 59-65. doi:10.1080/01647950902884538
- Ryke P.A.J. 1962 — The genus *Antennoseius* Berlese (Acarina: Rhodacaridae) — Ann. Mag. Nat. Hist., 13(4): 657-663.
- Sellnick M. 1943 — Eine zweite neue *Antennoseius*-Art aus Ostpreussen (Acar.). Zool. Anzeiger, 143: 201-203.
- Sklyar V.B. 1994 — Homologous rows by N. I. Vavilov as a basis for classification of gamasid mites of the genus *Antennoseius* Berlese, 1916 (Acarina: Parasitiformes) — Entomologicheskoe Obozrenie, 73(2): 479-485.
- Stănescu M., Juvara-Balș I. 2005 — Biogeographical distribution of Gamasina mites from Romania (Acari: Mesostigmata) — Revue Roumaine de Biologie, Série de Biologie Animale, 50(1-2): 57-74.
- Trach V.A. Makarova O.L. 2008 — A new gamasid mite species of the genus *Antennoseius* (Parasitiformes, Ascidae) from the southwest of Ukraine — Vest. Zool., 42(2): 181-184.
- Trach V.A. 2012 — A new species of mites of the genus *Anystipalpus* (Mesostigmata, Ascidae) from the Eastern Ukraine — Vest. Zool., 46(1): 73-77.
- Trach V.A. 2013 — On the fauna of gamasid mites of the genera *Anystipalpus* and *Antennoseius* (Mesostigmata, Ascidae) of the Eastern Ukraine — Vest. Zool., 47(5): 387-393.
- Willmann C. 1951 — Untersuchungen über die terrestrische Milbenfauna im pannonischen Klimagebiet Österreichs. Sitzungsberichte der Österreichischen Akademie der Wissenschaften, Mathematisch — Naturwissenschaftliche Abteilung I, 160: 91-176.

COPYRIGHT



Faraji F. *et al.* Acarologia is under free license. This open-access article is distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.