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Subscriptions: Year 2023 (Volume 63): 450 €

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Previous volumes (2010-2021): 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)

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TWO NEW SPECIES OF ORIPODOIDEA (ACARI: ORIBATIDA) FROM VIETNAM

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(Received 12 January 2011; accepted 07 February 2011; published online 30 June 2011)

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ABSTRACT — Two new species of oribatid mites of the superfamily Oripodoidea, *Peloribates spiniformis* n. sp. and *Zygoribatula prima* n. sp., are described from dark loamy soil of Lagerstroemia forest of Cat Tien National Park (southern Vietnam). *Peloribates spiniformis* n. sp. can be included in the *Peloribates* species group having very short notogastral setae, however it clearly differs from other species by having interlamellar setae that are medio-distally dilated (setiform or spiniform in the other species). *Zygoribatula prima* n. sp. is the first species of *Zygoribatula* recorded from Vietnam; it can be included in the species group having a striate notogaster, but differs from other species by the specific localization of the striae. *Peloribates rangiroaensis* Hammer, 1972 is recorded for the first time in Vietnam. An identification key to all Vietnamese species of *Peloribates* is presented.

KEYWORDS — oribatid mites; new species; record; *Peloribates*; *Zygoribatula*; Vietnam

INTRODUCTION

In the course of faunistic studies of the oribatid fauna of Cat Tien National Park (southern Vietnam) we found representatives of two new species of the superfamily Oripodoidea, one belonging to the genus *Peloribates* Berlese, 1908 and the other to *Zygoribatula* Berlese, 1916.

Peloribates is a large genus of the family Haplozetidae that was proposed by Berlese (1908) with *Oribata peloptoides* Berlese, 1888 as type species. Currently, it comprises more than 80 species that collectively have a cosmopolitan (except Antarctica) distribution. The known Vietnamese fauna of *Peloribates* has included four species: *P. pseudoporosus* Balogh and Mahunka, 1967, *P. kaszabi* Mahunka, 1988, *P. gressitti* Balogh and Mahunka, 1967, and

P. stellatus Balogh and Mahunka, 1967 (Balogh and Mahunka 1967; Golosova 1983; Mahunka 1988; Krivolutskiy *et al.* 1997; Vu 2007). *Peloribates pseudoporosus* and *P. stellatus* are currently recorded only from Vietnam. *Peloribates kaszabi* was known only from Vietnam, until it was recently found in India (Bayartogtokh and Chatterjee 2010). *Peloribates gressitti* is currently recorded from Vietnam and the Philippines.

In addition to the new species, we also have found the first representatives of *Peloribates rangiroaensis* Hammer, 1972 known from Vietnam. This species is distributed in the eastern Palearctic region, southeastern China and Polynesia (Subías, 2004, online version 2010). Specimens are collected in the same place where new species are collected

(see below "Material examined" sections).

Zygoribatula is a large genus of the family Oribatulidae that was proposed by Berlese (1916) with *Oribatula connexa* Berlese, 1904 as type species. Currently, it comprises more than 90 species that collectively have a cosmopolitan distribution. For the Vietnamese fauna *Zygoribatula* has been recorded once, represented by an unidentified species (Golosova 1983). Thus, the new species is the first identified member of *Zygoribatula* recorded for Vietnam.

MATERIALS AND METHODS

Collection localities and habitats of the new species are characterized in the "Material examined" sections. Specimens were studied in lactic acid, mounted in temporary cavity slides for the duration of the study and then stored in 70% alcohol in tubes.

All body measurements are presented in micrometers. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, to avoid discrepancies caused by different degrees of notogastral distension. Notogastral width refers to the maximum width in dorsal aspect. Length of body setae was measured in lateral aspect. Some paratypes of each species were dissected for detailed studies (gnathosoma, ovipositor, legs).

Formulae for leg setation are given in parentheses according to sequence of trochanter-femur-genu-tibia-tarsus (femulus included). Formulae for leg solenidia are given in square brackets according to sequence of genu-tibia-tarsus.

DESCRIPTIONS OF NEW SPECIES

Peloribates spiniformis n. sp. (Figures 1 – 3)

With characters of *Peloribates* as summarized by Corpuz-Raros (1981) and Balogh and Balogh (1984, 1992).

Diagnosis

This species is characterized by the following combination of traits: body size 332 – 348 x 182; body

surface foveolate; interlamellar setae medio-distally dilated, barbed; sensilli with long stalk and oblong head, rounded distally, with small barbs; 14 pairs of short, spiniform, straight, smooth notogastral setae; claws of legs finely serrated on dorsal edges.

Description

Measurements — Body length 340 (holotype), 332 – 348 (mean 337, three paratypes); body width 182 (holotype), 182 (three paratypes).

Integument — Body color light brown to brown. Surface of body, leg femora and trochanters III, IV foveolate. Foveolae oval or round (up to 10 in length or diameter) (Figure 4).

Prodorsum — (Figure 1A; Figure 2A–F). Rostrum broadly rounded anteriorly. Lamellae longer than half of prodorsum, distally with weakly developed lateral tooth. Rostral (*ro*, 41 – 45) and lamellar (*le*, 53 – 61) setae setiform, barbed. Interlamellar setae (*in*, 20) medio-distally dilated, barbed. Exobothridial setae (*ex*, 8) setiform, slightly thickened, barbed. Sensilli (*ss*, 52 – 60) with long stalk (28 – 32) and oblong head (24 – 28), rounded distally, with small barbs.

Notogaster — (Figure 1A). Dorsosejugal suture weakly developed, hardly visible. Pteromorphae short, movable. Fourteen pairs of short (4 – 6), spiniform, straight, smooth notogastral setae. Four pairs of minute sacculi, visible with difficulty. Opisthonotal gland opening (*gla*) and lyrifissures developed in typical arrangement for genus.

Lateral part of body — (Figure 2A). Tutorium (*tu*) long. Sublamellar line weakly developed. Sublamellar areae porosae (*Al*, 8 – 10) rounded or oval. Pedotecta I and II small. Discidia (*di*) triangular.

Anogenital region — (Figure 1B; Figure 2G, H). Two pairs anal (*an*₁, *an*₂, 4), three pairs adanal (*ad*₁ – *ad*₃, 4 – 6), one pair aggenital (*ag*, 4 – 6) and five pairs of genital setae (*g*₁ – *g*₅ 4) slightly thickened, smooth. Lyrifissures *iad* in typical position for genus.

Epimeral region — (Figure 1B). Apodemes 2, sejugal, 3 and circumpedal carina well-developed. All epimeral setae setiform, weakly barbed; setae *3c* longest (24), *3a* shortest (6).

FIGURE 1: *Peloribates spiniformis* n. sp. A – dorsal view, legs removed; B – ventral view, legs, palps and setae of subcapitulum removed. Scale bar 100 μ m.

Gnathosoma — (Figure 3A–C). Subcapitulum longer than wide: 69 – 73 x 57 – 61. Hypostomal setae setiform, barbed, different little in length (12 – 16). Lateral lips with two pairs of adoral setae (6 – 8), setiform, barbed. Palps (length 53 – 61) with setation 0-2-1-3-9(+1 ω). All setae (except some on tarsi) barbed. Chelicerae (length 73 – 82) chelate-dentate; cheliceral setae setiform, barbed, *cha* (20 – 24) longer than *chb* (12 – 16).

Legs — (Figure 3D–F). Morphology similar to other species of *Peloribates* (Beck 1964; Bayartogtokh 2000; Bayartogtokh and Smelyansky 2008). Tarsi with three claws, weakly serrated on dorsal sides; median claw thicker than lateral claws. Formulae of leg setation and solenidia: I (1-5-3-4-19) [1-2-2], II

(1-5-3-4-15) [1-1-2], III (2-3-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homology of setae and solenidia indicated in Table 1. All setae barbed or with short cilia. Famulus short, straight, blunt-ended. Solenidia ω_1 on tarsi I, ω_1 and ω_2 on tarsi II, σ on genua II and III rod-shaped; other solenidia setiform.

Material examined — Holotype (female), paratypes (three specimens: two females and one male) were obtained from southern Vietnam, 11°25' N, 107°25' E, Cat Tien National Park, 149 m above sea level, in dark loamy soil of *Lagerstroemia* forest, February–March 2009, collected by A.E. Anichkin.

Type deposition — The holotype is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia;

FIGURE 2: *Peloribates spiniformis* n. sp. A – lateral view of prodorsum, legs, gnathosoma and epimeral setae removed; B – foveolae of anterior part of prodorsum; C – rostral setae; D – lamellar seta; E – interlamellar seta; F – sensillus; G – genital plate, right; H – anal plate, right. Scale bar (A) 50 μ m, scale bars (B, E) 10 μ m, scale bars (C+D, F, G, H) 20 μ m.

two paratypes are deposited in the collection of the Center for Biodiversity Resources Education and Development (CEBRED), Hanoi National University of Education, Hanoi, Vietnam; one paratype is in the personal collection of the first author (Center of Independent Examinations–NN, Nizhny Novgorod, Russia).

Etymology — The specific name "*spiniformis*" refers to the spiniform notogastral setae.

Distribution. — At present, this species is only

known from Cat Tien National Park of southern Vietnam.

Comparison — *Peloribates spiniformis* n. sp. can be included in the *Peloribates* species group with very short notogastral setae (*P. alaskensis* Hammer, 1955 from Alaska, *P. asejugal* (Pandit and Bhat-tacharya, 1999) from India, *P. canadensis* Hammer, 1952 from the Nearctic region, *P. decumanus* (Berlese, 1908) from Brazil, *P. glaber* Mihelčič, 1956 from the Mediterranean region, *P. peloptoides* (Berlese, 1888)

FIGURE 3: *Peloribates spiniformis* n. sp. A – subcapitulum; B – palp; C – chelicera; D – leg I, left, antiaxial view; E – femur and genu of leg II, right, antiaxial view; F – leg IV, right, antiaxial view. Scale bars 20 μm.

TABLE 1: Leg setation and solenidia of *Peloribates spiniformis* n. sp.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	$d, (l), bv'', v''$	$(l), v', \sigma$	$(l), (v), \phi_1, \phi_2$	$(ft), (tc), (it), (p), (u), (a), s, (pv), v', (pl), e, \omega_1, \omega_2$
II	v'	d, l_1', l_2', bv'', v''	l', v', σ	$(l), (v), \phi$	$(ft), (tc), (it), (p), (u), (a), s, (pv), \omega_1, \omega_2$
III	l', v'	d, l', ev'	l', σ	$l', (v), \phi$	$(ft), (tc), (it), (p), (u), (a), s, (pv)$
IV	v'	d, ev'	d, l'	$l', (v), \phi$	$ft'', (tc), (p), (u), (a), s, (pv)$

See Table 1 for explanation.

from the Neotropical region, *P. pseudoporosus* Balogh and Mahunka, 1967 from Vietnam, *P. tunisiensis* Mahunka, 1980 from the Mediterranean region). However, it clearly differs from all species in this group by having interlamellar setae that are medio-distally dilated (setiform or spiniform in the other species).

Key to Vietnamese species of genus *Peloribates*

An identification key to all known Vietnamese species of *Peloribates* is presented below.

1. Notogastral setae very short (not longer than diameter of bothridia) 2
 — Notogastral setae medium or long (considerably longer than diameter of bothridia) 3
2. Interlamellar setae setiform, head of sensilli with setiform tip *pseudoporosus* Balogh and Mahunka
 — Interlamellar setae medio-distally dilated, head of sensilli rounded distally *spiniformis* n. sp.
3. Interlamellar setae long, reaching rostrum 4
 — Interlamellar setae not reaching rostrum 5
4. Notogastral setae medium in size, not longer than length of sensilli, *da* obviously not reaching insertion of *la* *rangiroaensis* Hammer
 — Notogastral setae long, obviously longer than length of sensilli, *da* reaching insertion of seta *la* *kaszabi* Mahunka
5. Notogaster with irregular foveolae, *da* reaching *la* *gressitti* Balogh and Mahunka
 — Notogaster with floriform foveolae, *da* not reaching insertion of *la* *stellatus* Balogh and Mahunka

Zygoribatula prima n. sp.

(Figures 4 – 6)

With characters of *Zygoribatula* as summarized by Balogh and Balogh (1984, 1992), Grobler (1993), Weigmann (2006).

Diagnosis

This species is characterized by the following combination of character states: body size 332 – 431 x 199 – 282; notogaster with pair of longitudinal striate bands (each more than half length of notogaster, running from humeral region almost to seta *dp*, lateral to setae *da* and *dm*); anogenital region foveolate; rostrum pointed in dorsoventral view; translamella straight or slightly convex in median part; rostral, lamellar and interlamellar setae setiform, barbed; sensilli clavate, head barbed; 14 pairs of setiform, barbed notogastral setae (setae *c*₂, *da* and *la* longest); areae porosae *Aa* oblong, *A1* oblong or rounded, *A2* and *A3* rounded.

Description

Measurements — Body length 415 (holotype), 332 – 431 (mean 381, four paratypes); body width 282 (holotype), 199 – 282 (mean 244, four paratypes).

Integument — Body color brown. Notogaster with pair of longitudinal striate bands (each more than half length of notogaster, running from humeral region almost to seta *dp*, lateral to setae *da* and *dm*). Anogenital region foveolate (well visible under high magnification); foveolae rounded (up to 4 in diameter).

Prodorsum — (Figure 4A; Figure 5A–E). Rostrum pointed in dorsoventral view. Lamellae slightly longer than half of prodorsum. Translamella straight or slightly convex in median

FIGURE 4: *Zygoribatula prima* n. sp. A – dorsal view, legs removed; B – ventral view, legs and gnathosoma removed. Scale bar 100 µm.

part. Rostral (45 – 53), lamellar (65 – 82) and interlamellar (65 – 82) setae setiform, barbed. Exobothridial setae (24) setiform, thin, barbed. Sensilli (40 – 50) with shorter stalk (16 – 20) and longer head (24 – 30), rounded distally, barbed.

Notogaster — (Figure 4A; Figure 5F–M). Dorsejugal suture complete, convex. Humeral projections slightly developed. Fourteen pairs of setiform, barbed notogastral setae. Setae *c*₂, *da* and *la* longest (36 – 41), setae *dm* and *lm* little shorter (28 – 36), setae *dp*, *lp*, *h*₁, *h*₂ and *h*₃ short (16 – 20), setae *p*₁, *p*₂ and *p*₃ shortest (12 – 16). Four pairs of areae porosae developed dorsally: *Aa* oblong (14 – 20 × 6 – 8); *A1* oblong (12 – 14 × 6 – 8) or round (diameter 8 – 10);

A2 and *A3* rounded (diameter 6 – 10). Opisthonotal gland opening and lyrifissures developed in typical arrangement for genus.

Lateral part of body — (Figure 5A). Tutorium long. Sublamellar line well-developed. Sublamellar areae porosae rounded (4 – 6), areae porosae *Ah* oblong (12 – 20 × 4 – 6). Pedotecta I and II small. Discidia triangular.

Anogenital region — (Figure 4B; Figure 5N, O). Two pairs anal (4 – 8), three pairs adanal (8 – 12), one pair aggenital (*ag*, 4 – 6) and four pairs of genital setae (4 – 8) setiform, slightly barbed. Lyrifissures *iad* in preanal position.

FIGURE 5: *Zygoribatula prima* n. sp. A – lateral view of prodorsum, legs, gnathosoma and epimeral setae removed; B – rostrum; C – rostral setae; D – lamellar seta; E – sensillus; F – notogastral seta *c1*; G – notogastral seta *c2*; H – notogastral seta *lm*; I – notogastral seta *h3*; J – area porosa *Aa*; K – area porosa *A1* (oblong form); L – area porosa *A1* (round form); M – area porosa *A2*; N – genital plate, left; O – anal plate, left. Scale bar (A) 100 µm, scale bar (J+K+L+M) 10 µm, scale bars (B, C+D, E+F+G+H+I, N+O) 20 µm.

FIGURE 6: *Zygoribatula prima* n. sp. A – subcapitulum; B – palp; C – chelicera; D – leg I, right, antiaxial view; E – leg IV, left, antiaxial view. Scale bars 20 μm.

Epimeral region (Figure 4B). Apodemes 2, sejugal, 3 and circumpedal carina well-developed. All epimeral setae setiform, slightly barbed. Setae *1c* longest (20 – 24), other setae shorter (8 – 16).

Gnathosoma — (Figure 6A–C). Subcapitulum longer than wide: 86 x 71. Hypostomal setae setiform, barbed, *h* (24 – 32) slightly longer than *a* and *m* (20 – 28). Lateral lips with two pairs of adoral

setae (8 – 12), setiform, barbed. Palps (length 53) with setation 0-2-1-3-9(+1 ω). All setae (except some on tarsi) barbed. Chelicerae (length 94) chelate-dentate; cheliceral setae setiform, barbed, *cha* (32) longer than *chb* (20).

Legs — (Figure 6D, E). Morphology similar to that in other species of *Zygoribatula* (Grobler 1993; Bayartogtokh and Smelyansky 2008). Tarsi with

three simple claws, median claw obviously thicker than lateral claws. Formulae of leg setation and solenidia: I (1-5(4)-3-4-19) [1-2-2], II (1-5-2-4-15) [1-1-2], III (2-3-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homology of setae and solenidia indicated in Table 2. Setae *l''* on femora I absent from some specimens. All setae barbed or with short cilia. Famulus short, straight, blunt-ended. Solenidia ω_1 on tarsi I, ω_1 and ω_2 on tarsi II, σ on genua III rod-shaped; other solenidia setiform.

Material examined — Holotype (female), paratypes (four specimens: two females and two males) were obtained from southern Vietnam, 11°25' N, 107°25' E, Cat Tien National Park, 149 m above sea level, in dark loamy soil of *Lagerstroemia* forest, February-March 2009, collected by A.E. Anichkin.

Type deposition — The holotype is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; two paratypes are in the collection of the Center for Biodiversity Resources Education and Development (CEBRED), Hanoi National University of Education, Hanoi, Vietnam; two paratypes are in the personal collection of the first author (Center of Independent Examinations–NN, Nizhniy Novgorod, Russia).

Etymology — The specific name "*prima*" refers to the first identified species of *Zygoribatula* recorded for Vietnam.

Distribution — At present, this species is known only from Cat Tien National Park of southern Vietnam.

Comparison — *Zygoribatula prima* n. sp. can be included in the *Zygoribatula* species group having a striate notogaster (*Z. arcuatissima* Berlese, 1916

from Holarctic region, *Z. connexa* Berlese, 1904 from subtropical region, *Z. dactylaris* Subías, Ruiz and Kahwash, 1990 from western Mediterranean region, *Z. exarata* Berlese, 1916 from southern Palearctic region, *Z. galula* Mahunka, 2001 from Kenya, *Z. guadarramica* Pérez-Íñigo, 1978 from Spain, *Z. hailongensis* Wen and Zhang, 1988 from China, *Z. longilinea* Wang and Li, 1997 from China, *Z. sabulosa* Balogh, 1966 from Chad, *Z. salina* Balogh, 1966 from Ethiopian region, *Z. sayedi* Elbadry and Nasr, 1974 from Egypt, *Z. sculpturata* (Mahunka, 1989) from Kenya, *Z. smirnovi* Bulanova-Zakhvatkina, 1978 from eastern Mediterranean region, *Z. socotrensis* Mahunka, 2000 from Yemen, *Z. tritici* Elbadry and Nasr, 1974 from Egypt, *Z. vanharteni* Mahunka, 2000 from Yemen). However, it clearly differs from others in this group by the distribution of striae; the cuticle is smooth except for a pair of long, narrow bands of striation. In other species, the notogaster is covered completely by striae or they exist only in the humeral regions.

ACKNOWLEDGEMENTS

We gratefully acknowledge to Prof. Dr. Roy A. Norton (State University of New York, College of Environmental Science and Forestry, Syracuse, USA), Kerstin Franke (Senckenberg Museum für Naturkunde Görlitz, Germany), Prof. Dr. Heinrich Schatz (Institute of Ecology, Leopold-Franzens University of Innsbruck, Innsbruck, Austria), Dr. Umukusum Shtanchaeva (Caspian Institute of Biological Resources, Makhachkala, Russia), Dr. Ekaterina A. Sidorchuk (Paleontological Institute, Moscow, Russia), Dr. Matthew Colloff (CSIRO Entomology, Canberra, Australia) for help with collecting literature. We thank three anonymous re-

TABLE 2: Leg setation and solenidia of *Zygoribatula prima* n. sp.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	<i>v'</i>	<i>d</i> , (<i>l</i>), <i>bv''</i> , <i>v''</i>	(<i>l</i>), <i>v'</i> , σ	(<i>l</i>), (<i>v</i>), ϕ_1 , ϕ_2	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>), <i>v'</i> , (<i>pl</i>), <i>e</i> , ω_1 , ω_2
II	<i>v'</i>	<i>d</i> , <i>l</i> ₁ ', <i>l</i> ₂ ', <i>bv''</i> , <i>v''</i>	<i>l'</i> , <i>v'</i> , σ	(<i>l</i>), (<i>v</i>), ϕ	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>), ω_1 , ω_2
III	<i>l'</i> , <i>v'</i>	<i>d</i> , <i>l'</i> , <i>ev'</i>	<i>l'</i> , σ	<i>l'</i> , (<i>v</i>), ϕ	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>)
IV	<i>v'</i>	<i>d</i> , <i>ev'</i>	<i>d</i> , <i>l'</i>	<i>l'</i> , (<i>v</i>), ϕ	<i>ft''</i> , (<i>tc</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>)

See Table 1 for explanation.

viewers for their valuable comments. We thank the staff of Cat Tien National Park for supporting during the fieldwork.

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