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A NEW SPECIES OF *PSEUDOTOCEPHEUS* BALOGH 1960 (ACARI, ORIBATIDA, OTOCEPHEIDAE) FROM *DIPTEROCARPUS ALATUS* IN VIETNAM, WITH A KEY TO THE KNOWN SPECIES OF THE GENUS FROM THE ORIENTAL REGION

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A new mite species of the genus *Pseudotocepheus* (Oribatida, Otocepheidae), collected from the bark of *Dipterocarpus alatus* in the Cat Tien National Park, southern Vietnam, is described. *Pseudotocepheus cattienensis* sp. n. differs from *P. setiger* in a smaller body size, a fusiform bothridial seta, two pairs of medial prodorsal condyles, poorly developed medial notogastral condyles, the lamellar seta being distinctly removed from the bothridium, a tuberculate posterior part of the notogaster, and a setiform seta *d* on leg femora I and II. In addition, an identification key to the species of *Pseudotocepheus* from the Oriental Region is given.

Keywords: oribatid mites, taxonomy, morphology, arboreal habitat, tropical forest, Cat Tien National Park, Vietnam

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The oribatid mite genus *Pseudotocepheus* (Acari, Oribatida, Otocepheidae) was proposed by Balogh (1960), with *Pseudotocepheus paulinai* Balogh, 1960 as type species. The main generic traits were summarized by Ermilov (2016). The genus comprises 46 species (including uncounted *P. mahunkai* (Pérez-Íñigo, Baggio 1980)), which are distributed in the Afrotropical, Australasian and Oriental regions (Subías, 2004, 2022). Among the oribatid mite materials collected from different trees in Vietnam, we found one presumably arboreal new species of *Pseudotocepheus*. The main goal of our paper is to describe and illustrate this new species under the name *Pseudotocepheus cattienensis* sp. n. Earlier, one species of the genus was found in Vietnam (see summarized data in Corpuz-Raros, Ermilov, 2020): *P. setiger* Hammer 1972.

The identification keys to representatives of *Pseudotocepheus* from the Australasian and Neotropical regions were presented in Ermilov and Minor (2019) and Ermilov (2016), respectively. An additional goal of our paper is to present an identification key to the known species of this genus from the Oriental region.

MATERIALS AND METHODS

S p e c i m e n s. Samples of bark were collected via climbing trees (using spikes and other special equipment) and removing outer bark. Mites were subsequently extracted by high-pressure flushing and further heptane flotation under laboratory conditions. Detailed descriptions of arboreal acarofauna collection and extraction techniques are presented in Salavatulin (2019).

O b s e r v a t i o n a n d d o c u m e n t a t i o n. Specimens were mounted in lactic acid on temporary cavity slides for the identification of all taxa, as well as measurement and illustration of the new species. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster. Notogastral width refers to the maximum width of notogaster in dorsal view. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (femulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus. Drawings were made with a camera lucida using a Leica transmission light microscope “Leica DM 2500”.

Terminology and conventions. Morphological terminology used in this paper mostly follows that of F. Grandjean: see Travé and Vachon (1975) for references; Norton (1977) for leg setal nomenclature; Mahunka and Zombori (1985) for body setal nomenclature; and Norton and Behan-Pelletier (2009) for overview.

Abbreviations and notations. Prodorsum: *cos* – costula; *tcos* – transcostula; *tu* – tutorial carina; *ro*, *le*, *in*, *bs*, *ex* – rostral, lamellar, interlamellar, bothridial, and exobothridial seta, respectively; *co.pm*, *co.pl* – medial and lateral prodorsal condyle, respectively. Notogaster: *co.nm*, *co.nl* – medial and lateral notogastral condyle, respectively; *c*, *la*, *lm*, *lp*, *h*, *p* – setae; *ia*, *im*, *ip*, *ih*, *ips* – lyrifissures; *gla* – opisthonotal gland opening. Gnathosoma: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; ω = palp solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. Epimeral and lateral podosomal regions: *1a*, *1b*, *1c*, *2a*, *3a*, *3c*, *4a*, *4b*, *4c* = epimeral setae; *z* = aperture of supracoxal gland; *Pd I*, *Pd II* – pedotectum I, II, respectively. Anogenital region: *g*, *ag*, *ad*, *an* – genital, aggenital, adanal, and anal seta, respectively; *iag*, *iad* – aggenital and adanal lyrifissure, respectively. Legs: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, and tarsus, respectively; ω , ϕ , σ = solenidia; ε = famulus; *v*, *ev*, *bv*, *l*, *d*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv* – setae.

Pseudotocepheus cattienensis

Ermilov et Salavatulin sp. n.

(Figs 1–3)

Type material. Holotype (♀) and two paratypes (1♂, 1♀): Vietnam, Dong Nai Province, Dong Nai Biosphere Reserve, Cat Tien National Park, 11°26'30" N, 107°25'56" E, about 130 m a.s.l., bark of the *Dipterocarpus alatus* tree at the height of 25.5 m (sample 13-3), 20.06.2021–04.07.2021 (collected by V.M. Salavatulin and A.A. Kudrin).

The holotype and paratypes are deposited in the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in ethanol with a drop of glycerol.

Diagnosis. Body length: 540–645. Dorsal side of prodorsum with large, dense foveolae; notogaster and anogenital region with small, sparse, poorly visible foveolae; posterior part of notogaster densely tuberculate. Costula reaching insertion of lamellar seta. Transcostula present. Rostral seta setiform, barbed; lamellar, interlamellar and notogastral setae thickened, erect, mediolaterally heavily shortly ciliate (and indistinctly bushed); interlamellar seta distinctly removed from bothridium. Two pairs of medial prodorsal condyles present; medial notogastral condyles present but poorly developed. All genital setae needleform; aggenital setae filiform, slightly roughened; adanal and anal setae filiform, erect, slightly barbed; *ad*,

located in preanal position. Adanal lyrifissure oblique. Leg setae *u* on all tarsi filiform (not thorn-like).

Description. Measurements. Body length: 645 (holotype), 540 (paratype, male), 645 (paratype, female); notogaster width: 285 (holotype), 225 (paratype, male), 300 (paratype, female). Body length/width ratio: 2.1–2.4.

Integument. Body color light brown, but all legs, genital plates, subcapitular genae and rutelli, and distal part of chelicerae dark brown. Body surface microgranulate (well visible under high magnification, 10 × 100); dorsal side of prodorsum (between costulae) and lateral part of epimeres I, II with large, dense foveolae (diameter up to 11); notogaster (except posterior part), anogenital region, subcapitular mentum, and lateral side of prodorsum with small, sparse, poorly visible foveolae (diameter up to 7); posterior part of notogaster and lateral part of body (between bothridium and acetabula II, III) with dense tubercles (diameter up to 11).

Prodorsum. Rostrum broadly rounded. Costula long, reaching insertion of lamellar seta but slightly developed mediodistally. Transcostula lineate, convex medially. Tutorial carina present, short, poorly observed. Rostral seta (79–90) setiform, barbed, curving and directed anteromedially. Lamellar (79–90) and interlamellar (56–71) setae thickened, erect, mediolaterally heavily shortly ciliate (and indistinctly bushed); interlamellar seta distinctly distant from bothridium. Exobothridial seta (4) needleform. Bothridial seta (their length out of bothridium: 64–67) fusiform, slightly barbed. One pair of lateral and two pairs of medial prodorsal condyles simple, tubercle-like; medial condyles connected mediobasally; medial and lateral condyles located separately.

Notogaster. One pair of lateral and one pair of medial notogastral condyles simple, tubercle-like; medial condyles poorly developed. All notogastral setae (49–64) thickened, erect, mediolaterally heavily shortly ciliate (and indistinctly bushed). All lyrifissures and opisthonotal gland opening distinct; *ia* located posterolateral to seta *c*; *gla* anterior to *im*.

Gnathosoma. Subcapitulum size: 120–135 × 86–90; subcapitular setae (*a*: 22–26; *m*, *h*: 37–45) filiform, slightly barbed. Palp (length: 64–67) with setation 0–2–1–3–8(+ ω); postpalpal seta (7) spiniform, slightly roughened. Chelicera length: 120–135; cheliceral setae (*cha*: 37–41; *chb*: 19–22) filiform, barbed.

Epimeral and lateral podosomal regions. Apodemes I, II, III and sejugal apodeme well developed. Epimeral setal formula: 3–1–3–3; setae *1a*, *2a*, *4b* (15–19) needleform; *1b*, *3b* (49–52), *3a*, *4a* (26–30) filiform, slightly roughened; *1c* (49–52) filiform, slightly barbed; *3c*, *4c* (22) filiform, erect, slightly barbed. Pedotectum I represented by small lamina. Discidia triangular, round distally.

Anogenital region. Aggenital lyrifissure located lateral to genital aperture. All genital setae (11–15) needleform; aggenital setae (30–34) filiform, slightly

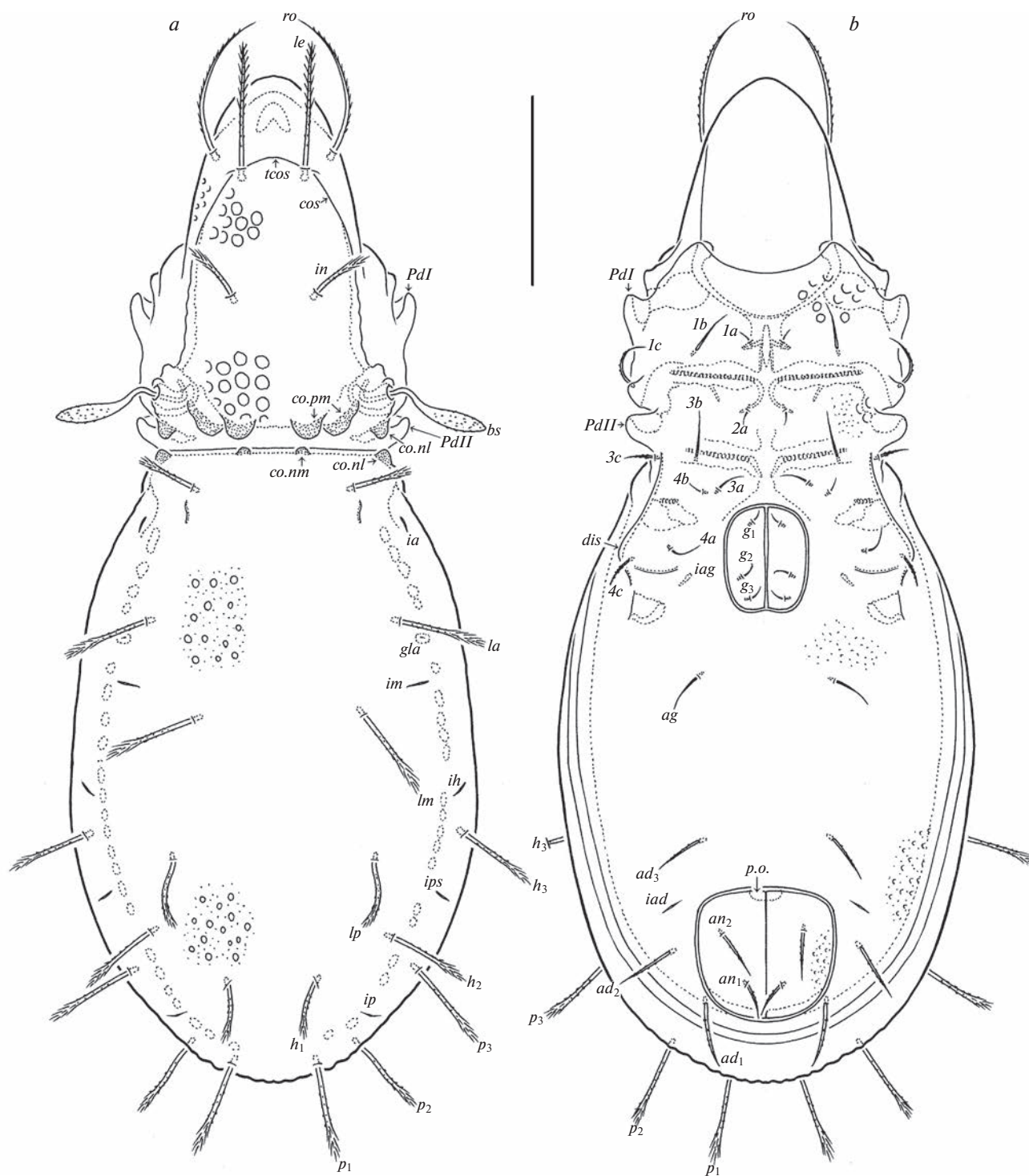


Fig. 1. *Pseudotocepheus cattienensis* sp. n., adult: *a* – dorsal view, *b* – ventral view (gnathosoma and legs not shown). Scale bar 100 μ m.

roughened; adanal (ad_1 , ad_2 : 45–52; ad_3 : 34–37) and anal (an_1 : 22; an_2 : 26–30) setae filiform, erect, slightly barbed; ad_3 located in preanal position, distance ad_3 – ad_3 shorter than ad_2 – ad_2 ; distance an_1 – an_1 shorter

than an_2 – an_2 . Adanal lyrifissure oblique, located lateral to anal plate and slightly distanced from it.

Legs. Claw of all leg strong, slightly barbed on dorsal side. Dorsal side of tarsi I–IV without teeth. Dorsoparaxial porose area on femora I–IV well developed

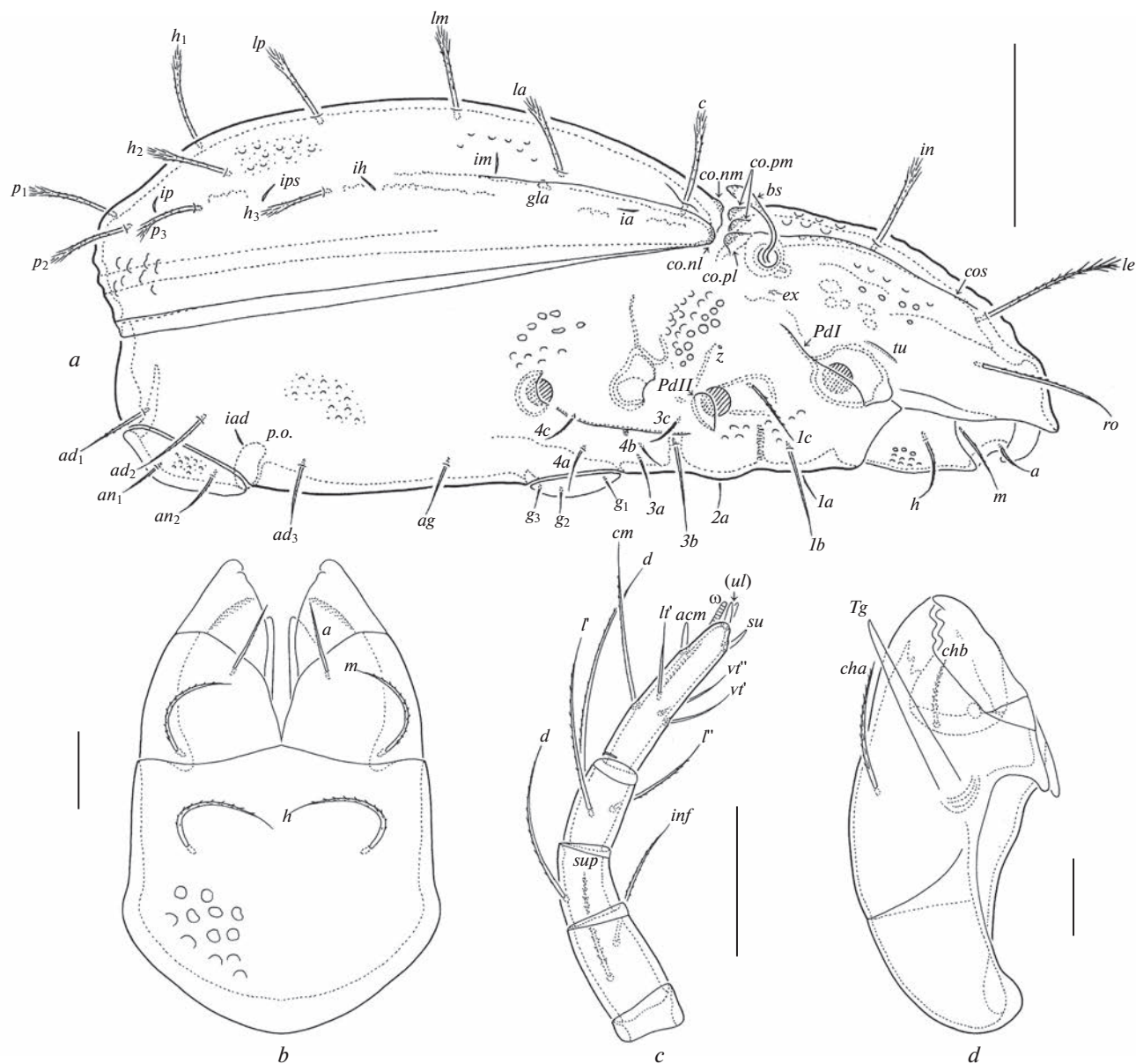


Fig. 2. *Pseudotocepheus cattienensis* sp. n., adult: *a* – right lateral view (legs not shown); *b* – subcapitulum, ventral view; *c* – palp, left, paraxial view; *d* – chelicera, left, paraxial view. Scale bar (μm): *a* – 100; *b*–*d* – 20.

versus not observed on trochanters III, IV. Formulas of leg setation and solenidia: I (1–4–3–4–16) [1–2–2], II (1–4–3–3–15) [1–1–2], III (2–3–0–2–15) [1–1–0], IV (1–2–1–2–15) [0–1–0]; homology of setae and solenidia indicated in Table 1. Solenidia ϕ_1 on tibia I and ϕ on tibia II setiform; ω_2 on tarsus II filiiform; other solenidia slightly bacilliform. Famulus short, erect, swollen and truncate distally, inserted between solenidium ω_1 and seta ft'' . Setae *u* on all tarsi filiiform (not thorn-like). Distal setae of tarsi I–IV (e.g., *p* except leg I; *ft* on leg IV; and *it*, *tc*, *u*, *a*) swollen distally.

Comparison. *Pseudotocepheus cattienensis* sp. n. is morphologically most similar to *P. setiger* Ham-

mer, 1972 in having: large and dense foveolae on the prodorsum; small and sparse foveolae on the notogaster; all prodorsal and notogastral condyles; and medium-sized, thickened, erect, mediodistally heavily shortly ciliate (and indistinctly bushy) lamellar, interlamellar and notogastral setae. However, the new species differs from the latter in: smaller body size (length: 540–645 versus 730); fusiform, narrowed distally (versus clavate, rounded distally) bothridial seta; two pairs (versus one pair) of medial prodorsal condyles; poorly developed (versus well developed) medial notogastral condyles; localization of lamellar seta (distinctly distant from bothridium versus located close to bothridium); tuberculate (versus not tubercu-



Fig. 3. *Pseudotocepheus cattienensis* sp. n., adult: *a* – leg I, right, antiaxial view, *b* – leg II, without tarsus, right, antiaxial view, *c* – leg III, without tarsus, left, antiaxial view; *d* – leg IV, left, antiaxial view. Scale bar 50 µm.

late) posterior part of notogaster; and setiform (versus dilated mediodistally) seta *d* on leg femora I, II.

E t y m o l o g y. The specific name *cattienensis* refers to the place of origin, Cat Tien National Park.

GENERAL REMARKS

Species of the family Otocephidae prefer to live mainly in forest soil-litter, as well as in various ground substrates (e.g., Aoki, 1967; Corpuz-Raros, Ermilov,

Table 1. Leg setation and solenidia of adult *Pseudotocepheus cattienensis* sp. n.

Leg	<i>Tr</i>	<i>Fe</i>	<i>Ge</i>	<i>Ti</i>	<i>Ta</i>
I	<i>v'</i>	<i>d</i> , (<i>l</i>), <i>bv''</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>), ε , ω_1 , ω_2
II	<i>v'</i>	<i>d</i> , (<i>l</i>), <i>bv''</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>v'</i> , <i>l'</i>	<i>d</i> , <i>l'</i> , <i>ev'</i>	σ	(<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>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>)

Roman letters refer to normal setae, Greek letters – to solenidia (except ε = famulus). Single prime (') marks setae on the anterior and double prime (") – setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae.

2019, 2020). Some otocepheids (for example, *Fissicepheus curvisetosus* Kubota, 2001) are considered arboreal dwellers (Kubota, 2001). We assume that *P. cattienensis* sp. n. is a representative of arboreal fauna because 1) it was collected from tree bark at the height of 25.5 m, and 2) it has not been registered in the Cat Tien National Park previously, where soil-litter mite fauna has been sufficiently well studied (Ermilov, 2015). However, our assumption is preliminary and requires confirmation because 1) all three specimens of this species were recovered from the same tree, and 2) despite the height of the collection locale, it is possible that the new species migrated along the tree trunk from soil-litter, which is known for some species of Otocepheidae, e.g., *Fissicepheus coronarius* Aoki 1967; *Pseudotocepheus pauliensis* Pérez-Íñigo, Baggio 1993; *Pseudotocepheus* sp. (Aoki, 1967; Proctor et al., 2002; Karasawa, Hijii, 2008; Accattoli et al., 2013).

KEY TO KNOWN SPECIES OF *PSEUDOTOCEPHEUS* FROM THE ORIENTAL REGION

1 Three or four pairs of slightly developed medial prodorsal condyles or thickenings instead them; medial and lateral notogastral condyles not developed; all notogastral setae flagellate; adanal lyrifissure transverse or inverse oblique to anal plate; body length: 632–781 *P. amonstruosus* Mahunka 1973 (= *P. septemtuberculatus* Balogh, Mahunka 1978; = *P. simplex* Pérez-Íñigo, Baggio 1980; = *P. transversalis* Mahunka 1978) [see Mahunka, 1973, 1978; Balogh, Mahunka, 1978; Pérez-Íñigo, Baggio, 1980]. Distribution: Afrotropical and Neotropical regions, Sri Lanka

– One or two pairs of well developed medial prodorsal condyles; medial and lateral notogastral condyles developed; notogastral setae setiform or rod-like, or thickened; adanal lyrifissure oblique or parallel to anal plate 2

2 Two pairs of medial prodorsal condyles 3

– One pair of medial prodorsal condyles 4

3 Lamellar, interlamellar and notogastral setae thickened, mediolaterally heavily shortly ciliate (and indistinctly bushed); medial notogastral condyles poorly developed; notogastral foveolae small versus dorsal prodorsal foveolae large; posterior part of

notogaster tuberculate; body length: 540–645 *P. cattienensis* sp. n. Distribution: Vietnam

– Lamellar, interlamellar and notogastral setae rod-like, barbed; medial notogastral condyles well developed; notogastral and dorsal prodorsal foveolae large; posterior part of notogaster not tuberculate; body length: 602–823 *P. mahunkai* (Pérez-Íñigo, Baggio 1980) (= *P. longus* Mahunka 1973) [see Mahunka, 1973; Pérez-Íñigo, Baggio, 1980]. Distribution: Sri Lanka

4 All notogastral setae medium-sized (*lm* not reaching insertion of *lp*), thickened; adanal seta *ad*₃ in preanal position, distance *ad*₃–*ad*₃ shorter than *ad*₂–*ad*₂ 5

– All notogastral setae long (*lm* extending anteriorly beyond insertion *lp*), rod-like or setiform; adanal seta *ad*₃ in adanal position, distance *ad*₃–*ad*₃ longer than *ad*₂–*ad*₂ 6

5 Bothridial seta clavate, rounded distally; lamellar, interlamellar and notogastral setae mediolaterally heavily shortly ciliate (and indistinctly bushed); body length: 730 *P. setiger* Hammer 1972 [see Hammer, 1972]. Distribution: Tahiti, Congo, Vietnam

– Bothridial seta fusiform, narrowed distally; lamellar, interlamellar, and notogastral setae barbed; body length: 703–709 *P. hammerae* Chakrabarti, Kundu 1978 [see Chakrabarti et al., 1978]. Distribution: India

6 Bothridial seta bacilliform; notogastral seta *p*₁ comparatively long, setiform versus other notogastral setae medium-sized, rod-like; body length: 1020–1135 *P. contractus* Grobler 1997 [see Grobler, 1997]. Distribution: South Africa, India

– Bothridial seta fusiform, narrowed distally; all notogastral setae long, setiform 7

7 Costula reaching insertion of lamellar seta but not extending anteriorly beyond of it; transcostula present; medial prodorsal condyles separated; adanal lyrifissure oblique to anal plate; body length: 1000–1018 *P. gobletus* Chakrabarti, Mondal 1978 [see Chakrabarti et al., 1978]. Distribution: India

– Costula extending anteriorly beyond insertion of lamellar seta; transcostula absent; medial prodorsal condyles connected basally; adanal lyrifissure parallel to anal plate; body length: 850–958 *P. orientalis* Mondal,

Kundu 1984 [see Mondal, Kundu, 1984]. Distribution: Oriental region.

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НОВЫЙ ВИД *PSEUDOTOCEPHEUS* BALOGH 1960 (ACARI, ORIBATIDA, OTOCERPHEIDAE) С *DIPTEROCARPUS ALATUS* ВО ВЬЕТНАМЕ И КЛЮЧ К ИЗВЕСТНЫМ ВИДАМ РОДА В ОРИЕНТАЛЬНОМ РЕГИОНЕ

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Представлено описание нового вида рода *Pseudotocepheus* (Oribatida, Otocepheidae), собранного с коры дерева *Dipterocarpus alatus* в национальном парке Кат Тьен (южный Вьетнам). *Pseudotocepheus cat-tienensis* sp. n. отличается от *P. setiger* следующими признаками: меньшими размерами тела; веретенной трихоботрией; двумя парами медиальных продорсальных мышечков; ламеллярной щетинкой, значительно удаленной от ботридия; простой щетинкой *d* на бедрах ног I, II. В дополнение составлен идентификационный ключ к известным видам рода *Pseudotocepheus* в Ориентальном регионе.

Ключевые слова: панцирные клещи, таксономия, морфология, арбореальное местообитание, тропический лес, национальный парк Кат Тьен, Вьетнам