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New species and records of ptyctimous mites from the Oriental region

(Acari, Oribatida)

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The present study is based on ptyctimous oribatid mite materials (Acari, Oribatida) collected from China, Taiwan, Indonesia, Myanmar and Vietnam. A list of identified taxa, including 26 species from five families, is presented; of these, new records are: five species (*Atropacarus* (*Hoplophorella*) *hamatus*, *Notophthiracarus lienhardi*, *Phthiracarus lentulus*, *P. paucus*, *P. persimplex*) in the Chinese fauna, two species (*Austrotritia lebronneci* and *Atropacarus* (*Hoplophorella*) *hamatus*) in Java and Bali, six species (*Austrotritia lebronneci*, *A. robusta*, *Mesotritia maerkeli*, *Notophthiracarus robertsi*, *Oribotritia lepteces*, *Phthiracarus pondoklowii*) in Myanmar, one species (*Notophthiracarus lienhardi*) in Vietnam. *P. persimplex* is new in the Oriental Region. Two new species are described: *Phthiracarus paramindanaoensis* Niedbała spec. nov. (Phthiracaridae) (from Taiwan) differs from *Phthiracarus mindanaoensis* Niedbała, Corpuz-Raros & Gruezo, 2006 by the arrangement of genital and adanal setae and surface of prodorsum; *Plonaphacarus myanmarus* Niedbała spec. nov. (Steganacaridae) (from Myanmar) differs from *Plonaphacarus foveolatus* Liu, Wu & Chen, 2011 by the shape of adanal setae ad_2, morphology of prodorsum and formula of genital setae. The supplementary description of *Notophthiracarus robertsi* (Sheals, 1965) (Steganacaridae) is given based on material from Myanmar.

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Introduction

This work is based on a random set of previously unstudied material of ptyctimous oribatid mites (Acari, Oribatida) collected from different samples of five countries of the Oriental region (southern China, Taiwan, Indonesia, Myanmar, Vietnam). The primary goal of this paper is to present a list and new findings of the identified taxa. At present, the ptyctimous mite fauna of listed countries are moderately known (with ca 110 species from China, and separately with 8 species from Taiwan, ca 80 species from Indonesia, and more than 40 species from Vietnam) or absolutely unknown (Myanmar) (Niedbała & Liu 2018).

In the course of taxonomic identification, we found two new species, one (from Taiwan) belonging to the genus *Phthiracarus* Perty, 1841 (Phthiracaridae), and the other (from Myanmar) to *Plonaphacarus* Niedbała, 1986 (Steganacaridae). The secondary goal of this paper is to describe and illustrate these species. The generic characters of *Phthiracarus* and *Plonaphacarus*, and identification keys and analysis on geographical distribution to the Oriental species were presented by Niedbała (2000).

Additionally, the supplementary description of *Notophthiracarus robertsi* (Sheals, 1965) (Steganacaridae) is given based on material from Myanmar.

Material and methods

Material examined. List of collecting sites:

China[1]

C1 – Jiangsu Province, Nanjing city, Zhongshanling, litter, 30.V.1991 (collected by F. S. Huang);
C2 – Jiangxi Province, Lu Mt., Sanbaoshu, litter, 2.IX.1983 (collected by W. B. Yao);
C3 – Fujian Province, Wuyi Mt., Wuyigong, litter, 23.IV.1989 (collected by H. F. Wang);
C4 – Yunnan Province, Menglun, Longshanmane, litter, 02.IV.1994 (collected by X. M. Zhang & L. L. Yang);
C5 – Hainan Island, Jianfengling, litter, 1994 (collected by C. H. Liao);
C6 – Hainan Island, Wuzhishan city, Shuiman town, 18°53.527' N, 109°39.523' E, 663 m a.s.l., litter under bamboo, 14.VIII.2007 (collected by D. Liu);
C7 – Guangxi Province, Shangxi, Nanping, Changlong, 910 m a.s.l., fungi under broadleaf, 10.VI.2000 (collected by J. Chen);
C8 – Hainan Island, Jianfengling, litter, XII.1993 (collected by C. H. Liao);
C9 – Guizhou Province, Guiyang city, Huaxi, Guizhou University, litter under shrub, 13.VIII.2006 (collected by J. Chen);
C10 – Fujian Province, Jiangle county, Longqi Mt., shrub and defoliation, 08.IX.1990 (collected by H. F. Wang);
C11 – Chongqing city, Wulong county, Huolu, 660 m a.s.l., litter, 06.VII.1989 (collected by X. C. Zhang);
C12 – Yunnan Province, Pingbian county, litter, 21. XII.1992 (collector not known);
C13 – Guangdong Province, Guangzhou city, litter, 02.XI.1978 (W. B. Yao);
C14 – Anhui Province, Jiuhuashan Mt., from litter, VI.1988 (collector not known);
C15 – Guangdong Province, Zhaoqing city, Dinghushan National Nature Reserve, 23°09'35.51" N, 112°33' 15.05" E, litter of *Gnetum parvifolium*, 20.X.1997 (H. F. Wang);
C16 – Chongqing City, Youyang county, 850 m a.s.l., litter, 07.1987 (Y. Q. Cui).

Taiwan

T – Yilan county, Yuanshan township, Fushan Botanical Garden, 24°45.724' N, 121°35.098' E, 679 m a.s.l., leaves on *Castanopsis indica*, 21.XI.2009 (collected by J.-R. Liao).

Indonesia

I1 – Java, Cibodas volcano, 1800 m a.s.l., detritus from woody fern, 29.VIII.1979 (collected by J. Błoszyk);
I2 – Java, Cibodas volcano, 2700 m a.s.l., sifted liter from forestry leafy leaves and moss, 23.VIII.1979 (collected by J. Błoszyk);
I3 – Bali, Tulamben, 8°16'46.51" S, 115°35'44.48" E, dry litter under trees of Parkia type, 07.VI.2016 (collected by K. Faleńczyk-Koziróg);
I4 – as I3, but 8°16'50.48" S, 115°35'47.86" E.

Myanmar (Burma)

M1 – Southern Chin State, road to South of Nat Ma Taung National Park, 21°10'07.5" N, 93°54'53.5" E, 2543 m a.s.l., pristine primary forest with rich understory, leaf litter, 16.V.2014 (collected by P. Jäger);
M2 – Southern Chin State, Nat Ma Taung National Park, road Kampetlet-Mindat, 21°12'33.8" N, 94°01'26.8" E, 2150 m a.s.l., disturbed primary forest, 11.V.2014 (collected by P. Jäger).

Vietnam

V – Hanoi, Thank-Tri, Thu-Le, zoogarden, bamboo stand, sample of bamboo litter and soil, 07.X.1988 (collected by J. Starý).

Methods

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width of the notogaster in dorsal view. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers.

The identification and the illustrations of mite specimens were performed under a phase contrast microscope "Olympus BX50", equipped with a drawing attachment.

The following abbreviations are used on the figures: *ro*, *le*, *in*, *ss*, *ex* – rostral, lamellar, interlamellar, bothridial and exobothridial setae, respectively; *c*, *d*, *f*, *h*, *ps* – notogastral setae; *an*, *ad* – anal and adanal setae, respectively; *ia*, *im*, *ip*, *ips* – notogastral lyrifissures; *h* – subcapitular seta, *d* – dorsal seta of femur I.

Morphological terminology used in this paper follows that of F. Grandjean: see Travé & Vachon (1975) for references and Norton & Behan-Pelletier (2009) for overview.

The following abbreviation is used for collection: DATE – Department of Animal Taxonomy and Ecology, Adam Mickiewicz University, Poznań, Poland.

1 Specimens from China were submerged in permanent slides and determined together with Dr. Dong Liu during his stay on 05–23.XI.2009 on DATE.

List of identified ptyctimous mites[2]

Mesoplophoridae

Apoplophora pantotrema (Berlese, 1913). Locality: I1 (5 specimens including two deutonymphs). Distribution: Australian and Oriental regions.

Oribotritiidae

Austrotritia lebronneci (Jacot, 1934). Localities: I2 (4 specimens), M2 (3 specimens). Distribution: Australian and Oriental regions. First record of the species in Indonesia and Myanmar.

Austrotritia robusta Niedbała & Corpuz-Raros, 1998. Localities: M1 (21 specimens), M2 (3 specimens). Distribution: Australian and Oriental regions. First record of the species in Myanmar.

Indotritia javensis (Sellnick, 1923). Locality: V (1 specimen). Distribution: Semicosmopolitan.

Indotritia undulata Bayoumi & Mahunka, 1979. Locality: C1 (1 specimen). Distribution: Oriental region.

Mesotritia maerkeli Sheals, 1965. Localities: M1 (2 specimens), M2 (2 specimens). Distribution: Oriental and Palaearctic regions. First record of the species in Myanmar.

Oribotritia anceps Niedbała, 2000. Locality: C2 (1 specimen). Distribution: Nepal, northern China.

Oribotritia chichijimensis Aoki, 1980. Locality: C3 (1 specimen). Distribution: Oriental region, northern China.

Oribotritia lepteces Niedbała, Corpuz-Raros & Gruèzo, 2006. Locality: M2 (8 specimens). Distribution: Australian and Oriental regions. First record of the species in Myanmar.

Euphthiracaridae

Acrotritia koreensis Mahunka, 1997. Localities: C1 (1 specimen), C4 (1 specimen). Distribution: Palaearctic and Oriental regions.

Acrotritia refracta (Niedbała, 1998). Locality: C5 (1 specimen). Distribution: Tropical region.

Acrotritia sinensis Jacot, 1923. Localities: C6 (1 specimen), C7 (1 specimen). Distribution: Tropical and Subtropical regions.

Phthiracaridae

Phthiracarus anonymus Grandjean, 1934. Locality: I2 (2 specimens). Distribution: Semicosmopolitan.

Phthiracarus lentulus (C. L. Koch, 1841). Localities: C8 (1 specimen), C9 (1 specimen), C10 (1 specimen), C11 (1 specimen). Distribution: Holarctic region. First record of the species in China.

Phthiracarus paramindanaoensis Niedbała spec. nov. Locality: T (1 specimen).

Phthiracarus obscurus Niedbała, 1986. Locality: I2 (2 specimens). Distribution: Australian and Oriental regions.

Phthiracarus paucus Niedbała, 1991. Locality: C12 (1 specimen). Distribution: Tropical and Subtropical regions. First record of the species in China.

Phthiracarus persimplex Mahunka, 1982. Locality: C13 (1 specimen). Distribution: eastern Palaearctic region. First record of the species in the Oriental region.

Phthiracarus pondoklowii Niedbała, 2004. Locality: M1 (1 specimen). Distribution: Borneo. First record of the species in Myanmar.

Steganacaridae

Atropacarus (*Hoplophorella*) *hamatus* (Ewing, 1909). Localities: C16 (1 specimen), I3 (3 specimens), I4 (1 specimen). Distribution: Semicosmopolitan. First record of the species in China and Indonesia.

Atropacarus (*Hoplophorella*) *vitrinus* (Berlese, 1913). Locality: I4 (2 specimens). Distribution: Tropical and Subtropical regions.

Notophthiracarus lienhardi Mahunka, 1996 (Chinese specimen has 15 instead 17 pairs of notogastral setae). Localities: C6 (1 specimen), V (3 specimens). Distribution: Oriental region. First record of the species in China and Vietnam.

Notophthiracarus robertsi (Sheals, 1965). Locality: M1 (8 specimens). Distribution: Caucasus, India, Nepal. First record of the species in Myanmar.

Plonaphacarus kugohi (Aoki, 1959). Locality: C14 (1 specimen). Distribution: Tropical and Subtropical regions.

Plonaphacarus myanmarus Niedbała spec. nov. Locality: M1 (1 specimen).

Plonaphacarus scrupeus Niedbała, 1989. Locality: C15 (1 specimen). Distribution: Oriental region.

Systematics

Phthiracarus paramindanaoensis Niedbała spec. nov.

Fig. 1A–F

Description

Measurements. Prodorsum: length 278, width 207, height 109; setae of prodorsum: *ss* 53, *in* 104, *le* 94, *ro* 38, *ex* 43; notogaster: length 480, width 399, height 269; setae of notogaster: c_1 71, c_1/c_1-d_1 = 0.6, c_3 40, h_1 and ps_1 56; genitoaggenital plate 126 × 78, anoadanal plate 152 × 63.

[2] All specimens are deposited in DATE.

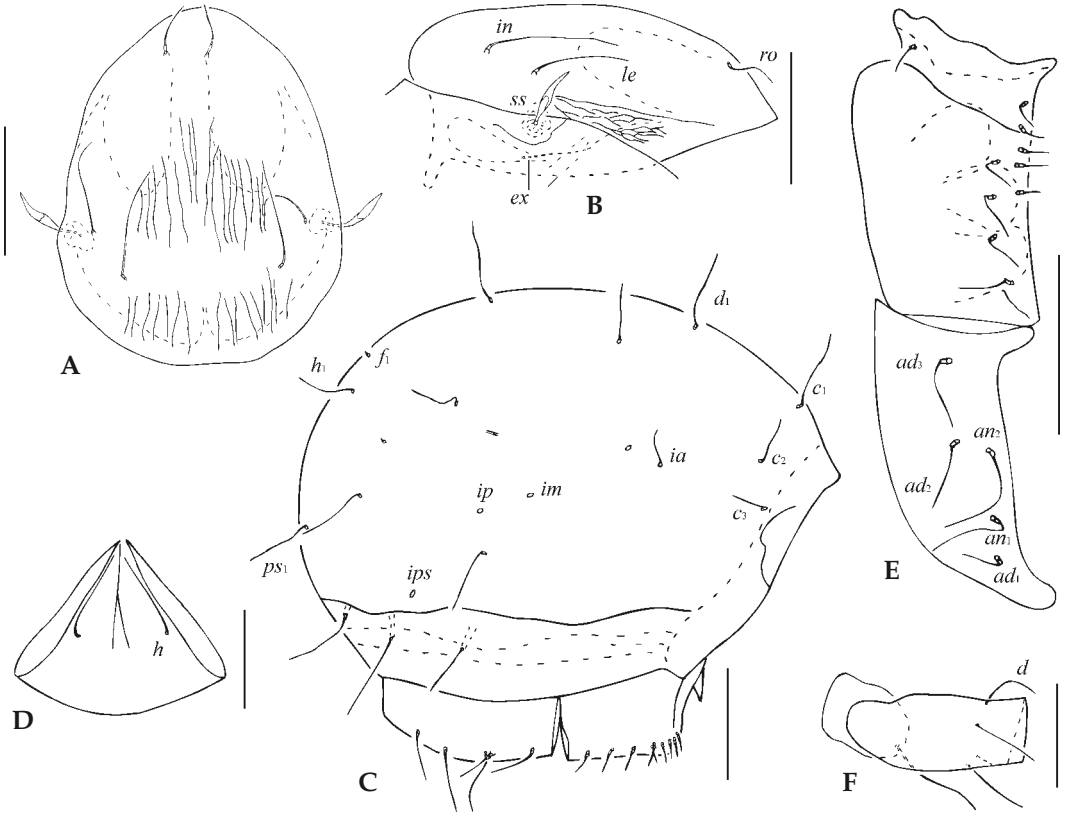

Fig. 1A–F. *Phthiracarus paramindanaoensis* Niedbała spec. nov. (holotype): **A.** Prodorsum, dorsal view. **B.** Prodorsum with anterior part of notogaster, lateral view. **C.** Opisthosoma, lateral view. **D.** Mentum of subcapitulum. **E.** Ventral plates, right genitoaggenital and anoadanal plates. **F.** Trochanter and femur of leg I. Scale bars: 100 µm (A–C, E), 50 µm (D, F).

Integument. Colour brownish. Integument densely porose.

Prodorsum with sigillar fields narrow and long, median longer than laterals. Surface is covered with fine median and posterior furrows usually unnoticed in genus *Phthiracarus*. Lateral carinae long. Sensilli smooth, short, fusiform, pointed distally. Setae fine, attenuate, interlamellar and lamellar (*in* > *le*) setae longer than rostral and exobothridial setae (*ex* > *ro*).

Notogaster with 15 pairs of fairly short ($c_1 < c_1 – d_1$) setae, c_1 and c_2 remote from anterior border, c_3 near border. Vestigial setae f_1 positioned anterior of h_1. Four pairs of lyrifissures (*ia*, *im*, *ip* and *ips*) present.

Ventral region. Setae *h* of mentum slightly longer than distance between them. Genito-aggenital plates with nine pairs of setae with formula: 9 (4 + 3): 2. Ano-adanal plates each with five well-developed setae, anal setae longer than adanal setae, ad_1 and ad_2 located near paraxial border, ad_2 lateral and anterior of an_2.

Legs. Formulae of setae and solenidia of "complete type". Setae *d* on femora I long, curved and remote from distal end of article.

Material examined. Holotype: Taiwan, Yilan county, Yuanshan township, Fushan Botanical Garden, 24°45.724' N, 121°35.098' E, 679 m a.s.l., leaves on *Castanopsis indica*, 21.XI.2009 (collected by J.-R. Liao).

Type deposition. The holotype (in ethanol with drop of glycerol) is deposited in DATE.

Etymology. The prefix *para* is Latin meaning "near" and refers to the similarity of the new species to *Phthiracarus mindanaoensis* Niedbała, Corpuz-Raros & Gruezo, 2006 from the Philippines.

Remarks. The new species is similar to *Phthiracarus mindanaoensis* Niedbała, Corpuz-Raros & Gruezo, 2006 (Niedbała et al. 2006) from the Philippines by the shape of sensilli, length of prodorsal and notogastral setae, number and arrangement of lyrifissures

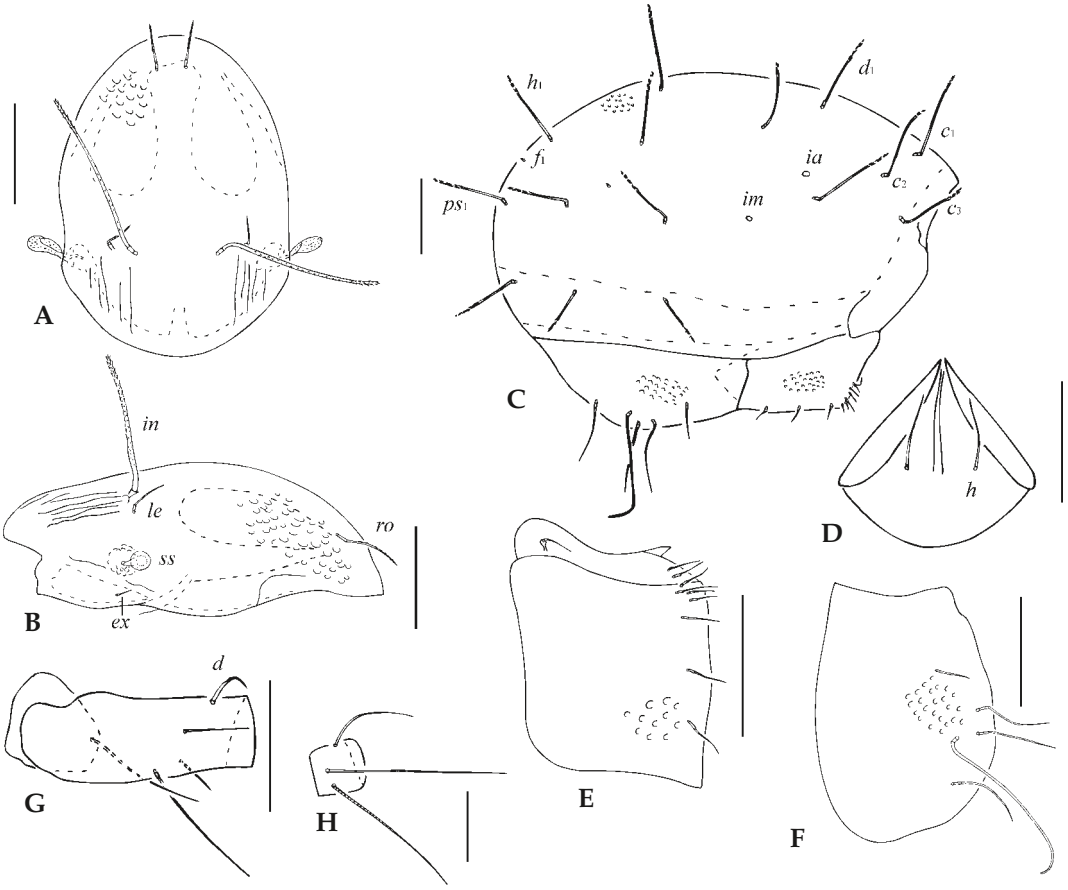

Fig. 2A–H. *Plonaphacarus myanmarus* Niedbała spec. nov. (holotype): **A.** Prodorsum, dorsal view. **B.** Prodorsum, lateral view. **C.** Opisthosoma, lateral view. **D.** Mentum of subcapitulum. **E.** Right genitoaggenital plate. **F.** Right anoadanal plate. **G.** Trochanter and femur of leg I. **H.** Tibia of leg IV. Scale bars: 100 µm (A–C, E, F), 50 µm (D, G), 25 µm (H).

and vestigial setae, length of setae *h* of subcapitular mentum, arrangement of setae at femora of legs, but differs by the arrangement of genital setae (genital setae g_4 and g_5 located lateral and between setae g_6 and g_7 versus only setae g_5 lateral and between setae g_6 and g_7), adanal setae ad_2 and ad_3 situated more in paraxial border of ano-adanal plates, and ad_2 lateral and anterior of setae an_2 (versus setae ad_2 and ad_3 located more antiaxial and setae ad_2 lateral and between setae an_2 and an_3). Moreover, also the prodorsum of new species is covered with fine median and posterior furrows (versus furrows absent).

Plonaphacarus myanmarus Niedbała spec. nov.

Fig. 2A–H

Description

Measurements. Prodorsum: length 318, width 212, height 126; setae of prodorsum: *ss* 45, *in* 137, *le* 35, *ro* 58, *ex* 10; notogaster: length 616, width 404, height 384; setae of notogaster: c_1 124, c_1/c_1–d_1 = 0.9, h_1 116, ps_1 109; genitoaggenital plate 162 × 137, anoadanal plate 230 × 174.

Integument. Colour dark brown. Cuticle of body well sculptured, prodorsum and notogaster covered with weak foveoles, surface of genitoaggenital and anoadanal plates with distinct foveoles.

Prodorsum with posterior furrows. Sigillar fields narrow, long, median and laterals similar in length. Sensilli short, club-like, rough with rounded head.

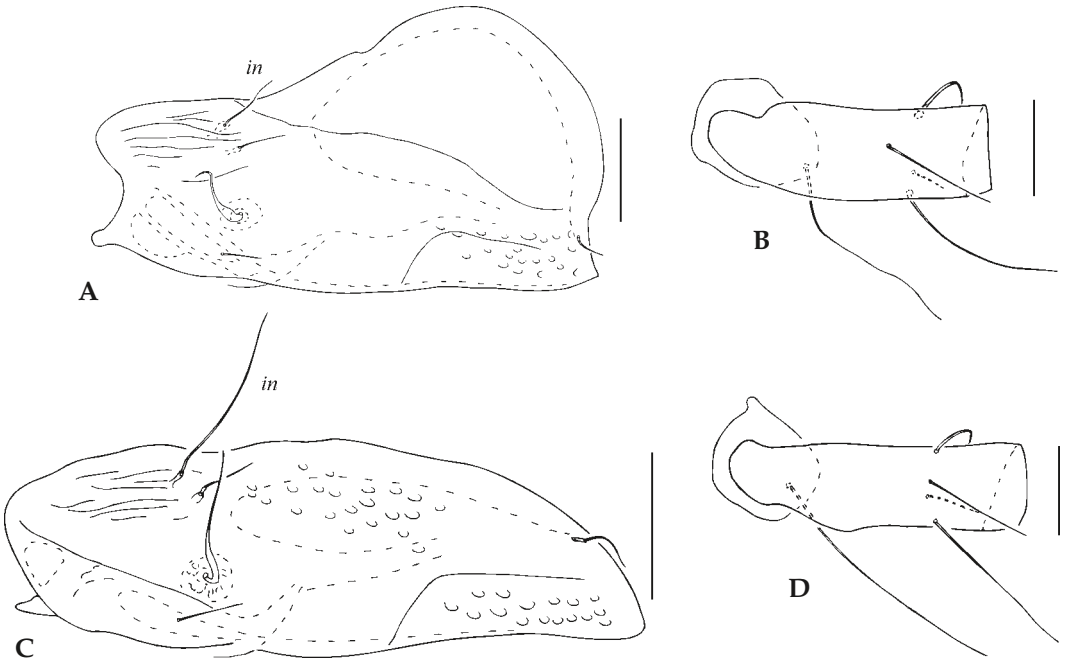

Fig. 3A–D. *Notophthiracarus robertsi* (Sheals, 1965): **A, B.** Specimen with powerful median hood. **C, D.** Specimen without median crista. **A.** Prodorsum, lateral view. **B.** Trochanter and femur of leg I. **C.** Prodorsum, lateral view. **D.** Trochanter and femur of leg I. Scale bars: 100 µm (A, C), 25 µm (B, D).

Interlamellar setae long, stout, rigid, erect, covered with small scales along the length and with distinct, longer spines in distal end. Lamellar setae short, spiniform, rough. Rostral setae short, thick, covered with small spines. Exobothridial setae minute. Comparative lengths of setae: *in* > *ro* > *ss* > *le* > *ex*.

Notogaster with setae of medium size ($c_1 > c_1$–d_1) as interlamellar setae, stout, rigid, covered with small scales along the length and with distinct, longer spines in distal end. Setae c_1 and c_2 remote from anterior border, setae c_3 located near the border. Vestigial setae f_1 placed posterior to h_1. Two pairs of lyrifissures (*ia* and *im*) present.

Ventral region. Setae *h* of mentum longer than the distance between them. Genitoaggenital plates with nine pairs of genital setae with arrangement: (4 + 2): 3. Anoadanal plates each with five pairs of rough setae, setae ad_2 distinctly longer than other, equally narrowed along the length, curved distally; anal setae longer than setae ad_1 and ad_3.

Legs. Formula of setae and solenidia of "complete type". Setae *d* of femora I curved and slightly remote from distal end of segment.

Material examined. Holotype: Myanmar (Burma), Southern Chin State, road to South of Nat Ma Taung National Park, 21°10'07.5" N, 93°54'53.5" E, 2543 m a.s.l., pristine primary forest with rich understory, leaf litter, 16.V.2014 (collected by P. Jäger).

Type deposition. The holotype (in ethanol with drop of glycerol) is deposited in DATE.

Etymology. The specific name *myanmarus* refers to the Myanmar country, where the new species is collected.

Remarks. The new species is similar to *Plonaphacarus foveolatus* Liu, Wu & Chen, 2011 (see Liu et al. 2011) from the Oriental part of China by the similar shape of prodorsal and notogastral setae, but differs by the shape of long and curved adanal setae ad_2 (versus shorter and not curved), long lateral fields of prodorsum (versus lateral fields distinctly shorter than median fields) and formula of genital setae: 4 + 2: 3 (versus 4 + 3: 2). Another species from Somalia, *Plonaphacarus persimilis* Niedbała, 1994 (see Niedbała 1994), is very similar in having ad_2 setae equally narrowed, but differs by the presence of lateral carinae of prodorsum (versus lateral carinae absent), vestigial exobothridial setae (versus exobothridial setae minute), location of notogastral setae f_1 anterior of h_1 (versus posterior position), presence of four pairs of lyrifissures (versus two pairs) and formula of genital setae 4 + 3: 2 (versus 4 + 2: 3).

Notophthiracarus robertsi (Sheals, 1965)

Fig. 3A–D

In this population a specimen with a powerful median hood of prodorsum (Fig. 3A) was found much more powerful than in holotype (Sheals 1965) and specimens from Nepal (Niedbała 1982). In this specimen interlamellar (*in*) setae of prodorsum are longer than in the previously known specimens. Other specimens in the population from Myanmar do not have any median crista (Fig. 3C) and interlamellar setae are even longer. The size and other morphological characters are comparable to those described in the specimens from Nepal (Sheals 1965, Niedbała 1982).

Conclusion

The list of identified ptyctimous mites collected from the Oriental region includes 26 species from five families. 11 species recorded from continental China, 4 from Chinese Hainan Island, 1 from Taiwan, 5 from Indonesia, 7 from Myanmar, and 2 from Vietnam. Two species (*Phthiracarus paramindanaoensis* Niedbała spec. nov. from Taiwan and *Plonaphacarus myanmarus* Niedbała spec. nov. from Myanmar) are new to science; five species (*Atropacarus* (*Hoplophorella*) *hamatus*, *Notophthiracarus lienhardi*, *Phthiracarus lentulus*, *P. paucus*, *P. persimplex*) are recorded in China for the first time; two species (*Atropacarus* (*Hoplophorella*) *hamatus*, *Austrotritia lebronneci*) are recorded in Java and Bali, respectively, for the first time; six species (*Austrotritia lebronneci*, *A. robusta*, *Mesotritia maerkeli*, *Notophthiracarus robertsi*, *Oribotritia lepteces*, *Phthiracarus pondoklowii*) are recorded in Myanmar for the first time; one species (*Notophthiracarus lienhardi*) is recorded in Vietnam for the first time; and one species (*Phthiracarus persimplex*) is recorded in the Oriental region for the first time.

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