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A NEW SPECIES OF THE GENUS *PEDICULASTER* (ACARI: HETEROSTIGMATINA: PYGMEPHORIDAE) FROM COMMERCIAL OYSTER MUSHROOM HOUSES IN KOREA

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ABSTRACT: A new species of the genus *Pediculaster* Vitzthum, 1931 (Acari: Pygmephoroidea: Pygmephoridae), *P. neutarii* sp. n. is described from edible oyster mushrooms, *Pleurotus ostreatus*, in South Korea. A potential significance of the new species as pest of edible fungi is discussed.

KEY WORDS: Acari, Heterostigmata, systematics, female dimorphism, pest, mushrooms

INTRODUCTION

The mite genus *Pediculaster* Vitzthum, 1931 (Acari: Pygmephoroidea) is one of the largest in the family Pygmephoridae, with about 100 described species in the world fauna (Khaustov 2011; Khaustov et al. 2013). Mites of the genus *Pediculaster* inhabit a great variety of habitats, e.g. soil, litter, mosses, dung, nest material, decaying organic material (Camerik and Kheradmand 2010). Some species are considered as pests of mushrooms in commercial mushroom-houses (Cross, Kaliszewski 1988). *Pediculaster*-mites are characterized by the presence of two morphologically different forms of females: non-phoretic or "normal" and phoretic (Camerik et al. 2006; Martin 1978). Most species of *Pediculaster*-mites are described based on phoretic females, while non-phoretic females are known only for a few species (Camerik 2001; Camerik et al. 2006; Martin 1978). At present only *Pediculaster koreensis* (Mahunka and Rack, 1977) was described from the Korean peninsula (Mahunka and Rack 1977). During a study of mites on edible mushrooms in Korea by the junior authors, a new species *Pediculaster neutarii* sp.n. with both morphological forms was found. This paper describes phoretic and non-phoretic female forms of the new species, *P. neutarii* sp.n.

MATERIALS AND METHODS

Mites were collected from mushrooms and mounted in Hoyer's medium. The terminology of idiosoma and legs follows Lindquist (1986); the nomenclature of subcapitular setae and the designation of cheliceral setae follow Grandjean (1944, 1947), respectively. The system of Pygmephoroidea follows Khaustov (2004, 2008). All measurements are given in micrometers (μm). For leg chaetotaxy the number of solenidia is given in parentheses. The type material is deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. Photographs were taken with a digital camera AxioCam ICc 3, Carl Zeiss, Germany and a compound microscope AXIO Lab.A1, Carl Zeiss, Germany.

SYSTEMATICS

Family Pygmephoridae Cross, 1965

Genus *Pediculaster* Vitzthum, 1931

Type species: *Pygmephorus mesembrinae* Canestrini, 1881, by original designation.

Pediculaster neutarii Khaustov, Lee, Lee et Kim sp. n.

Figs 1–7

Description. **Phoretic female** (Figs 1–4). Length of idiosoma 250 (215–265), width 110 (100–125). Gnathosoma (Figs 1–2). Gnathosomal capsule widened distally. Dorsally with 2 pairs of needle-like setae. Setae *cha* 7 (6–8) slightly shorter than *chb* 9 (9–10). Dorsal median apodeme present, weakly developed. Ventral gnathosoma with 1 pair of subcapitular setae *m*. Palps freely articulated to gnathosomal capsule, with setae *dFe* and *dGe* dorsolaterally, Setae *dGe* slightly longer than *dFe*. Ventrally with large accessory setigenous structure (*ass*) and well-developed solenidion. Palps terminated with a small claw. Pharyngeal pump 1 small, situated on the level of posterior margins of trochanters I; pharyngeal pumps 2 and 3 well-developed, subequal, situated closely to each other (Fig. 2).

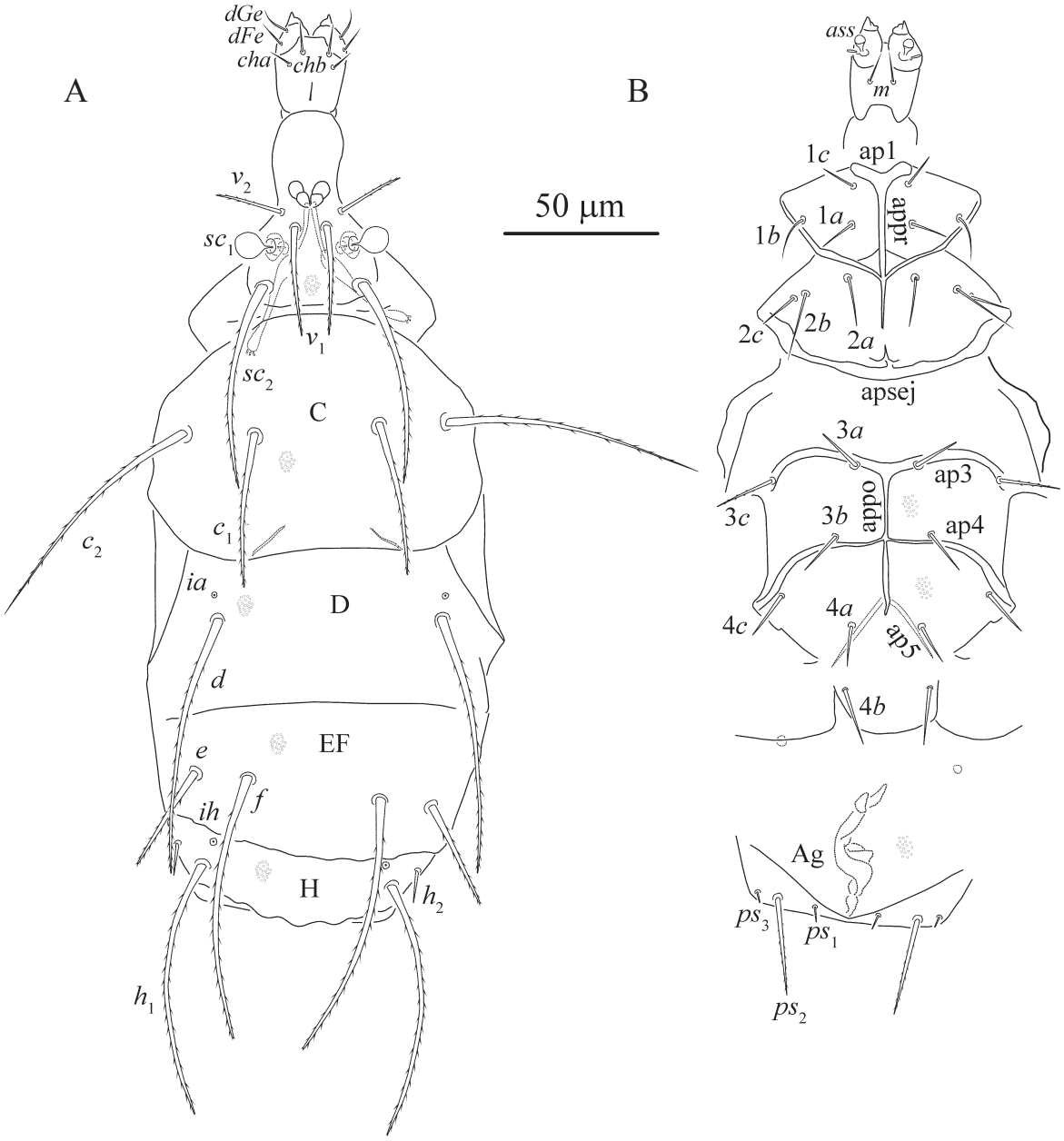

Fig. 1. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: A — idiosomal dorsum, B — idiosomal venter.

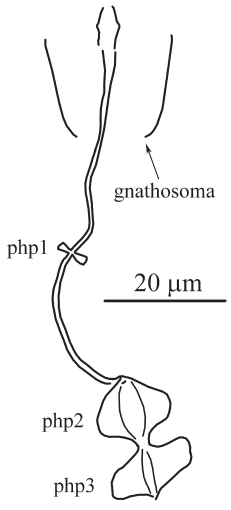

Fig. 2. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: pharyngeal pumps.

Idiosomal dorsum (Fig. 1A). Prodorsum with 3 pairs of setae, a pair of smooth capitate trichobothria, and a pair of two-chambered stigmata. All dorsal shields with numerous small dimples. Setae h_2 small smooth, needle-like, other dorsal setae distinctly barbed. Setae c_2 pointed, other dorsal setae blunt-ended. Cupules *ia* on tergite D and *ih* on tergite H large, round. Cupules *im* on tergite EF not evident. Posterior margins of tergites EF and H undulate. Length of dorsal setae: v_1 37 (30–40), v_2 23 (22–31), sc_2 65 (62–88), c_1 48 (34–52), c_2 82 (71–97), *d* 81 (62–94), *e* 39 (27–45), *f* 84 (72–91), h_1 78 (70–81), h_2 11 (7–11). Distances between setae: v_1–v_1 9 (8–11), v_2–v_2 20

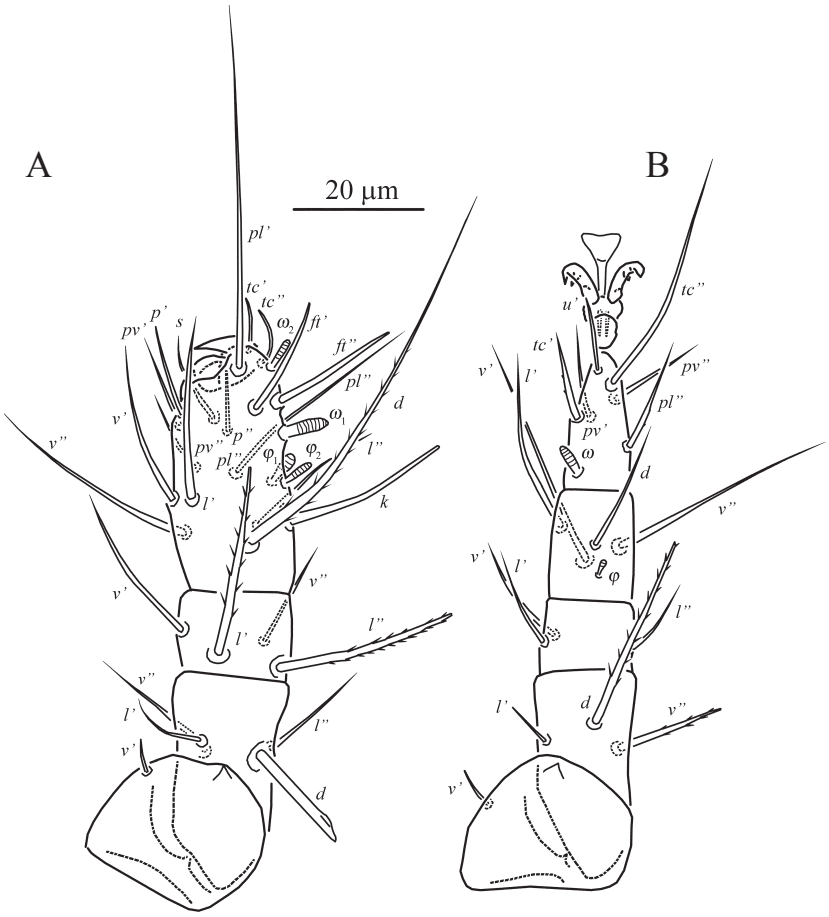

Fig. 3. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: A — leg I, B — leg II.

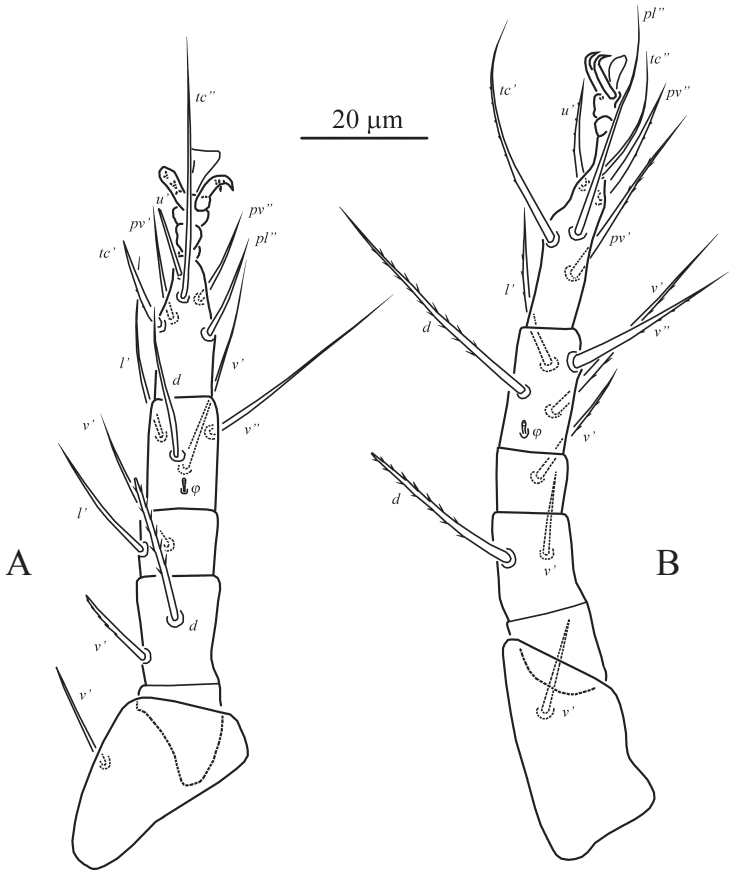

Fig. 4. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: A — leg III, B — leg IV.

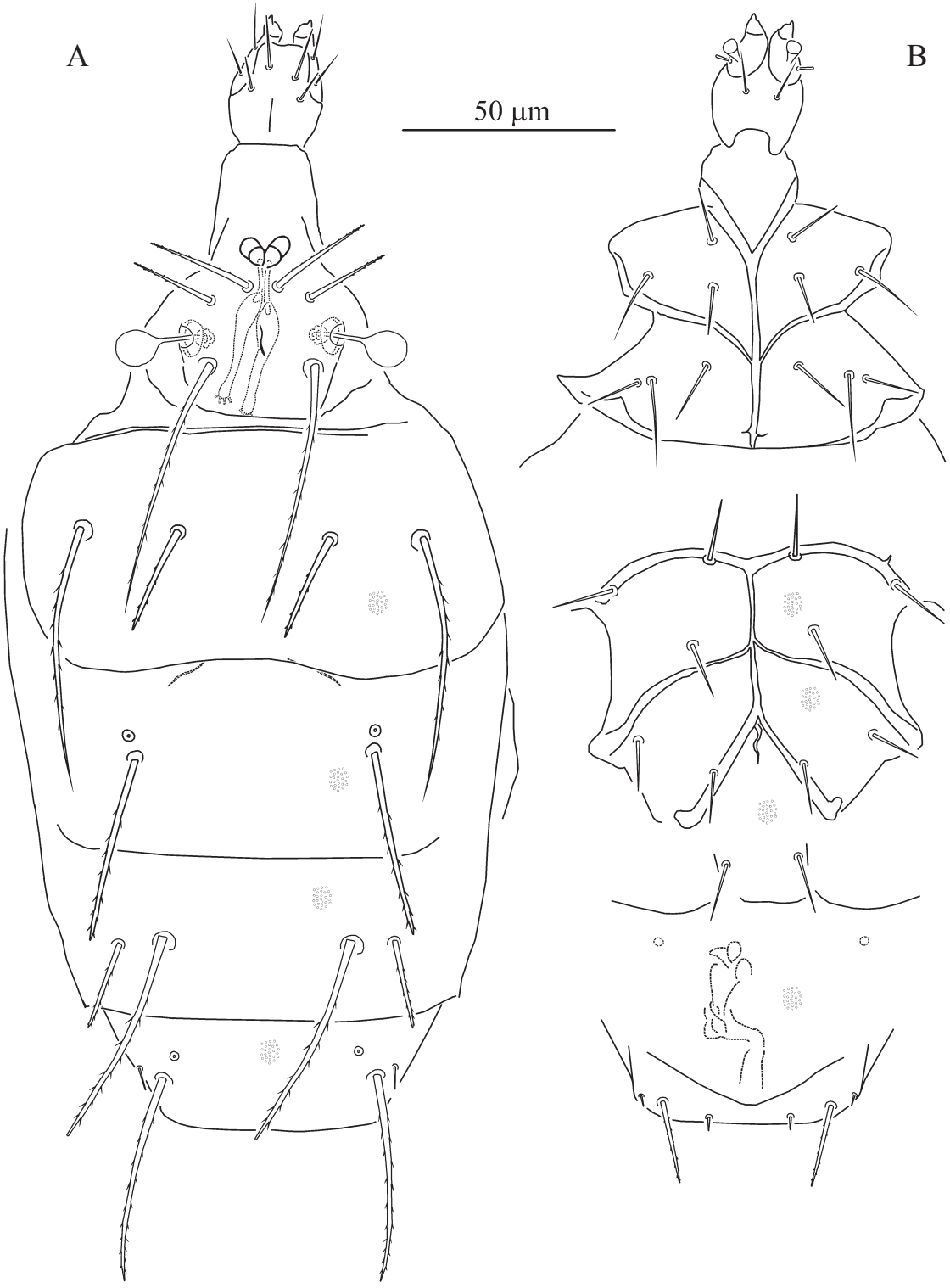

Fig. 5. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., non-phoretic female: A — idiosomal dorsum, B — idiosomal venter.

(17–20), sc_2–sc_2 30 (26–31), c_1–c_1 38 (34–42), c_1–c_2 22 (19–27), *d–d* 69 (57–74), *e–f* 17 (15–17), *f–f* 42 (35–43), h_1–h_1 59 (47–57), h_1–h_2 10 (9–12).

Idiosomal venter (Fig. 1B). All ventral plates with numerous small dimples. All setae of anterior sternal plate smooth. Setae *3c* weakly barbed, other setae of posterior sternal plate smooth, needle-like. Setae ps_2 distinctly barbed, blunt-ended. Setae ps_1 and ps_3 subequal or ps_1 slightly longer than ps_3, blunt-ended. Setae 2*b* usually pointed and dis-

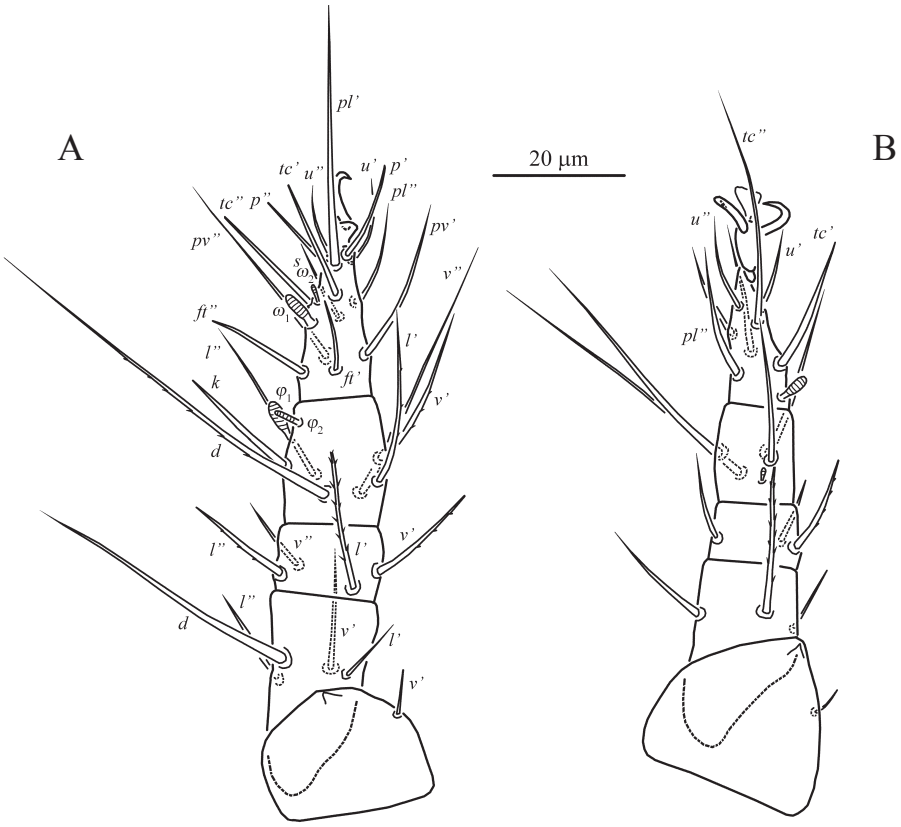

Fig. 6. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., non-phoretic female: A — leg I, B — leg II.

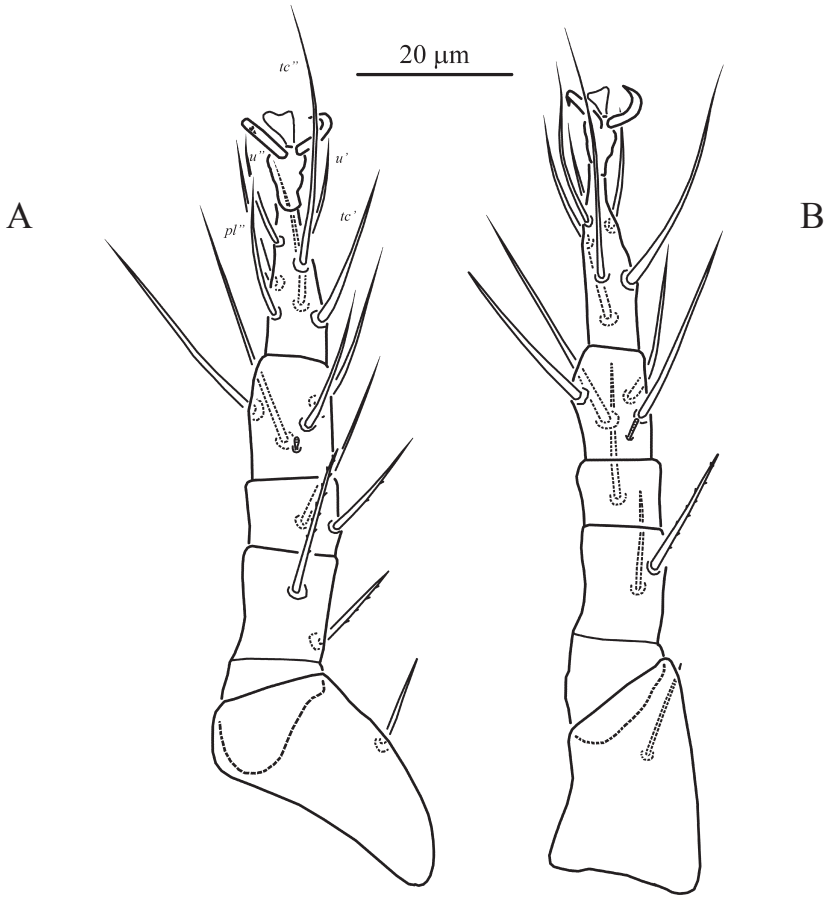

Fig. 7. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., non-phoretic female: A — leg III, B — leg IV.

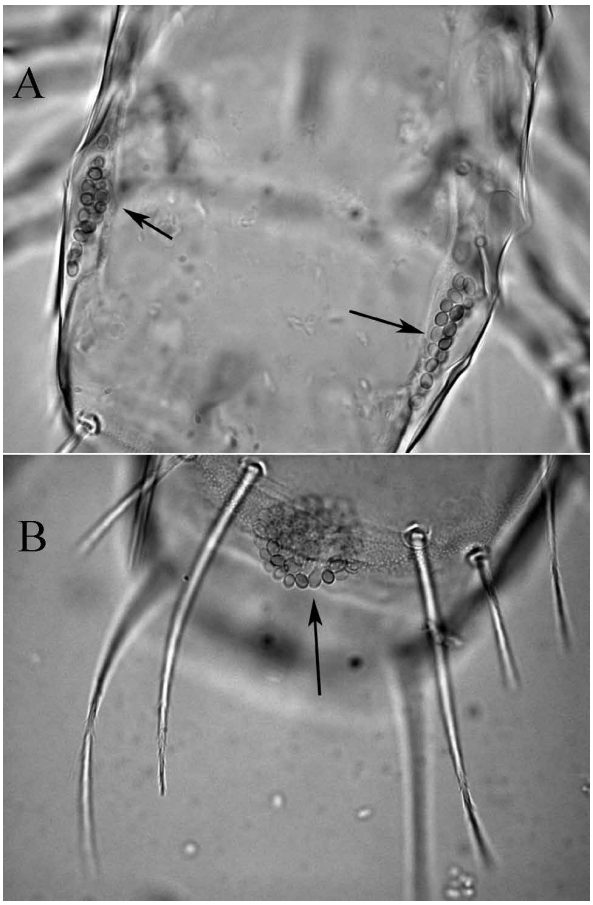

Fig. 8. Fungal spores under (A) and on (B) tergites of phoretic female of *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n.

tinctly longer than 2*a*. In some specimens, 2*b* needle-like and only slightly longer than 2*a*. Apodemes 1 (ap1) and apodemes 2 (ap2) well developed and joined with prosternal apodeme (appr); appr and sejugal (apsej) apodemes well developed; appr usually with gap in posterior part; apodemes 3 well developed, arch-like. Apodemes 4 (ap4) well developed and long, apodemes 5 present, reaching posteriad to bases of setae 4a, weakly sclerotized. Posterior margin of posterior sternal plate tripartite. Posterior margin of aggenital plate cone-like. A pair of round pits situated posterolaterally to bases of setae 4*b* under aggenital plate. Length of ventral setae: 1*a* 12 (11–14), 1*b* 17 (14–19), 1*c* 13 (11–16), 2*a* 16 (15–18), 2*b* 25 (20–26), 2*c* 14 (14–18), 3*a* 14 (14–18), 3*b* 14 (14–16), 3*c* 20 (17–21), 4*a* 12 (11–12), 4*b* 20 (17–23), 4*c* 17 (14–17), ps_1 5 (3–5), ps_2 31 (24–31), ps_3 4 (3–4). Legs (Figs 3–4). Leg chaetotaxy typical for the genus. Leg I (Fig. 3A). Tibiotarsus cylindrical, tarsal claw terminal. Length of solenidia ω_1 7 (7–8) > ω_2 5 (4–5) < φ_1 7 (7–8) > φ_2 5 (5–6); ω_2 and φ_2 baculiform, φ_1 clavate, ω_1 finger-shaped. Setae *dFe* spathulate distally. Setae *l'*, *l''* of genu I and *v'* of trochanter I blunt-ended. Leg II (Fig. 3B). Tarsus with padded claws (bifurcate at tips) and well-developed empodium. Solenidion ω 5 (5–6), finger-shaped, solenidion φ 3 (3) weakly clavate. Setae *v'* of trochanter II, *u'* of Tarsus II and all setae of femur II are blunt-ended. Leg III (Fig. 4A). Claws of same shape as on tarsus II. Solenidion φ 3 (3) weakly clavate. Setae *v'* of trochanter III, *u'* of tarsus III and all setae of femur III are blunt-ended. Femur divided into basi- and telofemur. Leg IV (Fig. 4B). Tarsal claws simple, empodium small. Solenidion φ 3 (3), weakly clavate. Setae of trochanter and femur IV blunt-ended. Femur divided into basi- and telofemur.

Non-phoretic female (Figs 5–7). Length of idiosoma 200–260, width 87–115. Gnathosoma and pharyngeal pumps as in phoretic female.

Idiosomal dorsum (Fig. 5A). Similar with that of phoretic female, but dorsal setae shorter. Posterior margins of tergites EF and H not undulate. Length of dorsal setae: v_1 20–29, v_2 15–20, sc_2 48–52, c_1 21–28, c_2 45–63, *d* 31–40, *e* 14–25, *f* 39–52, h_1 40–54, h_2 4–9. Distances between setae: v_1–v_1 8–10, v_2–v_2 20–26, sc_2–sc_2 23–30, c_1–c_1 32–42, c_1–c_2 20–21, *d*–*d* 47–63, *e*–*f* 8–11, *f*–*f* 34–49, h_1–h_1 40–56, h_1–h_2 6–7.

Idiosomal venter (Fig. 5B). Similar with that of phoretic female, but apodemes 5 longer and strongly sclerotized. Setae 3*c* smooth. Length of ventral setae: 1*a* 9–13, 1*b* 13–22, 1*c* 10–14, 2*a* 10–16, 2*b* 17–23, 2*c* 9–12, 3*a* 11–16, 3*b* 10–15, 3*c* 11–18, 4*a* 9–13, 4*b* 11–17, 4*c* 12–14, ps_1 3–4, ps_2 17–25, ps_3 3.

Legs (Figs 6–7). Leg I (Fig. 6A) 5-segmented. Tarsus I tapered distally, with simple sickle-like claw. Setae *d* of femur I long, not modified. Length of solenidia ω_1 4–6 > ω_2 3< φ_1 5–7 > φ_2 3–4; ω_2 and φ_2 baculiform, φ_1 clavate, ω_1 finger-shaped. Setae *l'*, *l*", *v'* of genu I and *v'* of trochanter I blunt-ended. Leg II (Fig. 6B). Tarsus with simple sickle-like claws and well-developed empodium. Tarsus II with 7 setae (*u"* present). Solenidion ω 4–5, finger-shaped, solenidion φ 2–3 weakly clavate. Setae *l'*, *v'* of genu II, *d* of femur II and *v'* of trochanter II blunt-ended. Leg III (Fig. 7A). Claws of same shape as on tarsus II. Tarsus III with 7 setae (*u"* present). Solenidion φ 2–3 weakly clavate. Setae of trochanter and femur III blunt-ended. Leg IV (Fig. 7B). Similar with that of phoretic female. Setae of trochanter, femur, genu and *v"* of tibia IV blunt-ended.

Male and **larva** unknown.

Type material. Female holotype, slide #YL260214, oyster mushroom house, Agricultural Research & Extension Service, Hwaseong city, Gyeonggi Prov., South Korea, 26.02.2014 (Y.-S. Lee); Paratypes: 16 phoretic females, 3 non-phoretic females, same date and locality; 10 phoretic females, Kwangju city, Geyeonggi Prov., South Korea, 02.01.2013 (H.-B. Lee).

Etymology. The species name, *neutarii*, comes from the Korean name of the oyster mushroom.

Differential diagnosis. The non-phoretic females of the new species are most similar to *P. flechtmanni* (Wicht, 1970) by the two-chambered stigmata, setae 2*b* are distinctly longer than 2*a*, setae v_1 longer than v_2, setae *chb* longer than *cha*, and by the needle-like setae h_2. It differs from *P. flechtmanni* by the distinctly longer dorsal setae, setae *f* longer than distance *f–f* (*f* much shorter than *f–f* in *P. flechtmanni*), setae *d* reaching to the bases of setae *f* (distinctly not reaching the bases of *f* in *P. flechtmanni*), by the absence of round pits between setae c_1 and c_2 (present in *P. flechtmanni*), by subequal setae ps_1 and ps_3 (in *P. flechtmanni* ps_1 almost 2 times longer than ps_3) and by setae ps_2 which is about 5 times longer than ps_1 (ps_2 about 2 times longer than ps_1 in *P. flechtmanni*), and by the position of the first pharyngeal pump at the level of the posterior margins of trochanters I (first pharyngeal pump is situated inside the gnathosomal capsule in *P. flechtmanni*). Phoretic females of the new species are most similar to *P. helomyzalis* Camerik, 2006 by the two-chambered stigmata and the presence of apodemes 5. It differs from *P. helomyzalis* by the position of the first pharyngeal pump at the level of the posterior margins of trochanters I (in *P. helomyzalis*, the first pharyngeal pump is situated inside the gnathosomal capsule), by setae *e* more than 3 times longer than h_2 (in *P. helomyzalis*, *e* are about 1.5 times longer than h_2), by setae *d* almost 2 times longer than c_1 (in *P. helomyzalis*, c_1 and *d* are subequal), and by the undulate posterior margins of tergites EF and H (not undulate in *P. helomyzalis*).

DISCUSSION

Some species of *Pediculaster* are known as a mushroom pests. They usually feed on "weed" fungi in the compost in the commercial mushroom houses (Cross and Kaliszewski 1988; Kheradmand et al. 2006). The best studied and widely distributed species is *Pediculaster flechtmanni* (Wicht, 1970). Non-phoretic females of this species were described from mushrooms in Brazil (Wicht 1970). Martin (1978) redescribed non-phoretic females based on type material from Brazil. Cross and Kaliszewski (1988) studied the biology of this species and reported that it has a cosmopolitan distribution. Numerous phoretic females reared during the study of Cross and Kaliszewski, but they were not described. Kheradmand et al. (2006) also studied biology of *P. flechtmanni* and provided life table parameters for this species, but also did not described phoretic females.

Because of similarities between non-phoretic females of *P. flechtmanni* and newly described *Pediculaster neutarii* sp.n., we suppose that there is a complex of closely related species which damages fungal mycelium in commercial mushroom houses. And we consider *Pediculaster neutarii* sp.n. as a potential pest of cultivated mushrooms. Most of specimens of *P. neutarii* sp.n. were carrying numerous small round fungal spores (Fig. 8) under the tergites or on the plates.

According to observations of the junior authors, *P. neutarii* sp. n. is related to the rapid spreading of 'weed' fungi, especially *Trichoderma* sp. Sometimes, this mite swarms in commercial mushroom houses and causes unwanted contamination of cultivation bottles with green mold.

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