

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

A.A. Khaustov<sup>1</sup>, J.-H. Lee<sup>2</sup>, Y.-S. Lee<sup>3</sup> and J.R. Kim<sup>4</sup>

<sup>1</sup>Tyumen State University, Tyumen, Russia; e-mail: alex1973khaustov@gmail.com

<sup>2</sup>Animal and Plant Quarantine Agency (QIA), South Korea; e-mail: acarologist@korea.kr

<sup>3</sup>Gyeonggi Agricultural Research and Extension Service, South Korea; e-mail: yslee75@gg.go.kr

<sup>4</sup>National Academy of Agricultural Science, RDA, South Korea; e-mail: jr2004@snu.ac.kr

**ABSTRACT:** A new species of the genus *Pediculaster* Vitzthum, 1931 (Acari: Pygmephoroidae: 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: Pygmephoroidae) 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 Pygmephoroi-

dea 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).

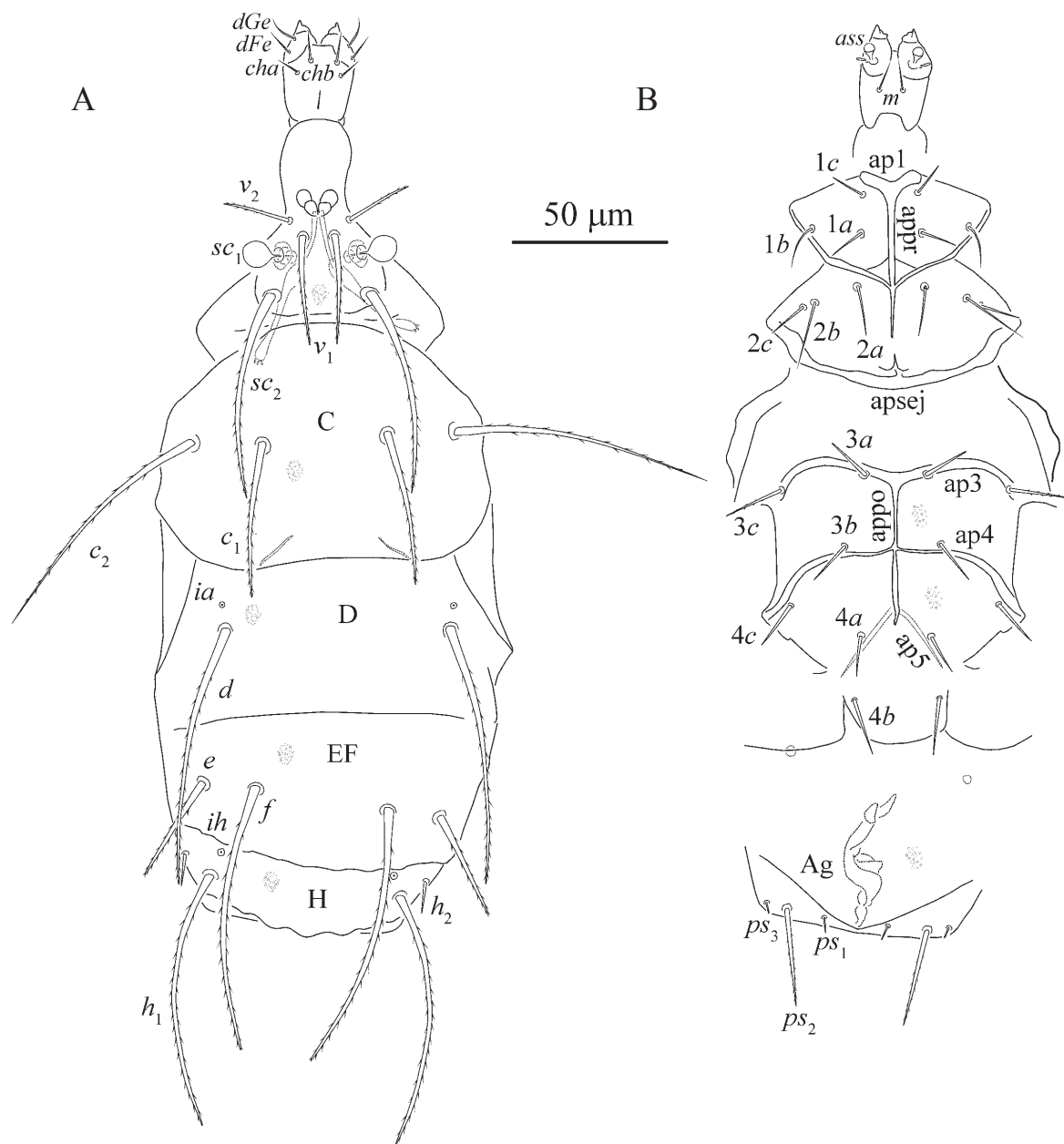


Fig. 1. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: A — idiosomal dorsum, B — idiosomal venter.

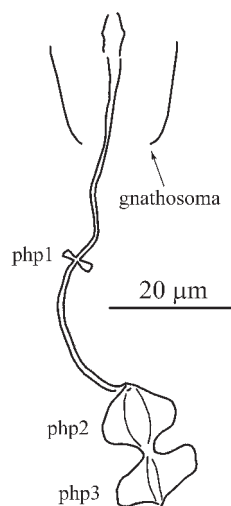


Fig. 2. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: pharyngeal pumps.

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

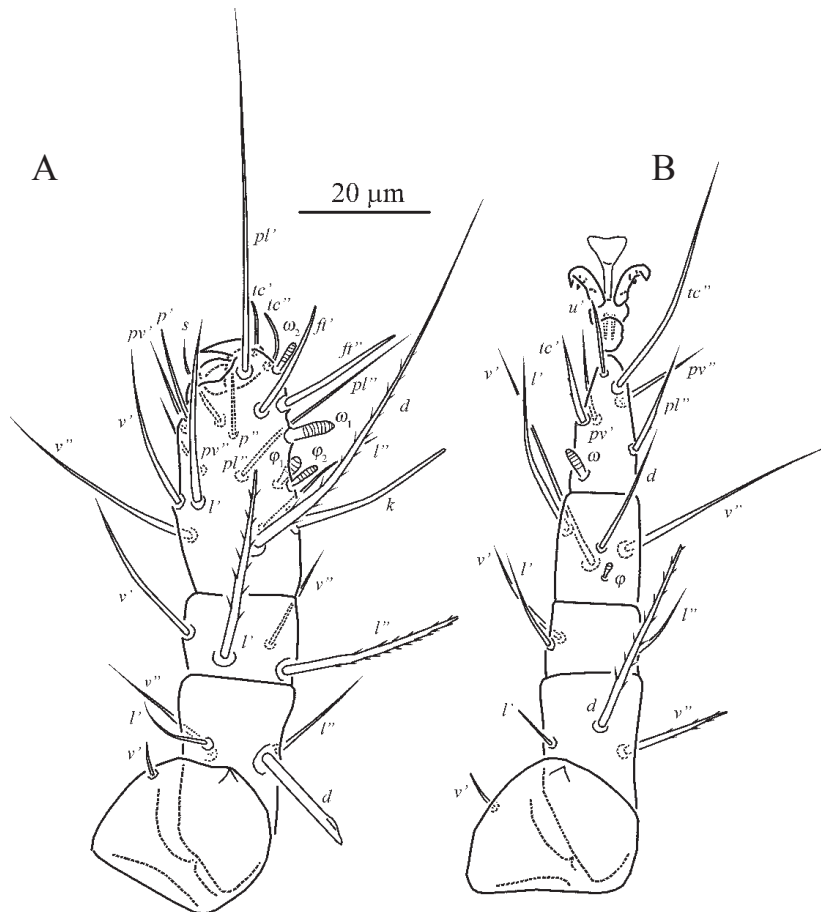


Fig. 3. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: A — leg I, B — leg II.

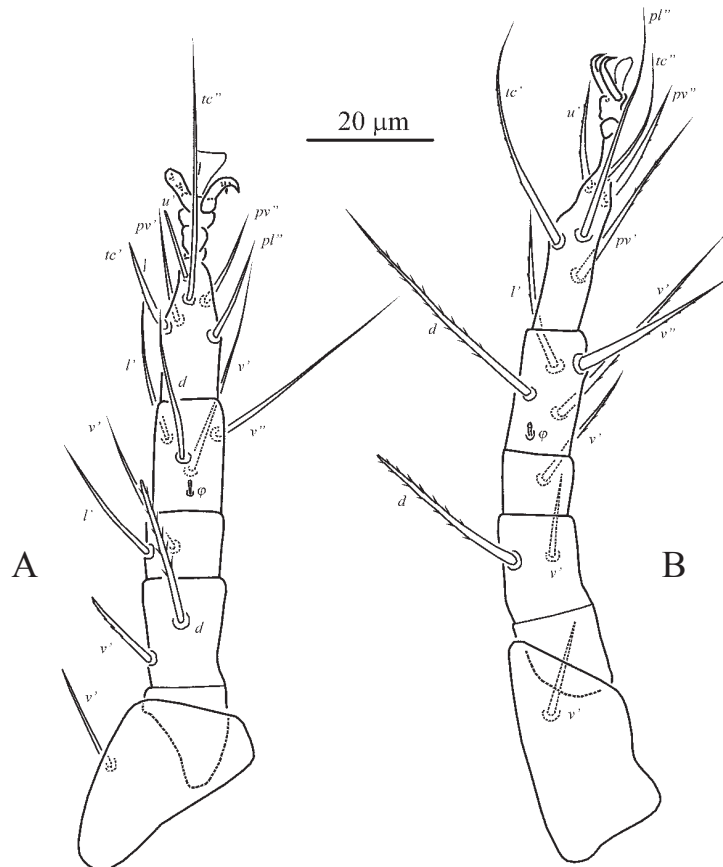


Fig. 4. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., phoretic female: A — leg III, B — leg IV.

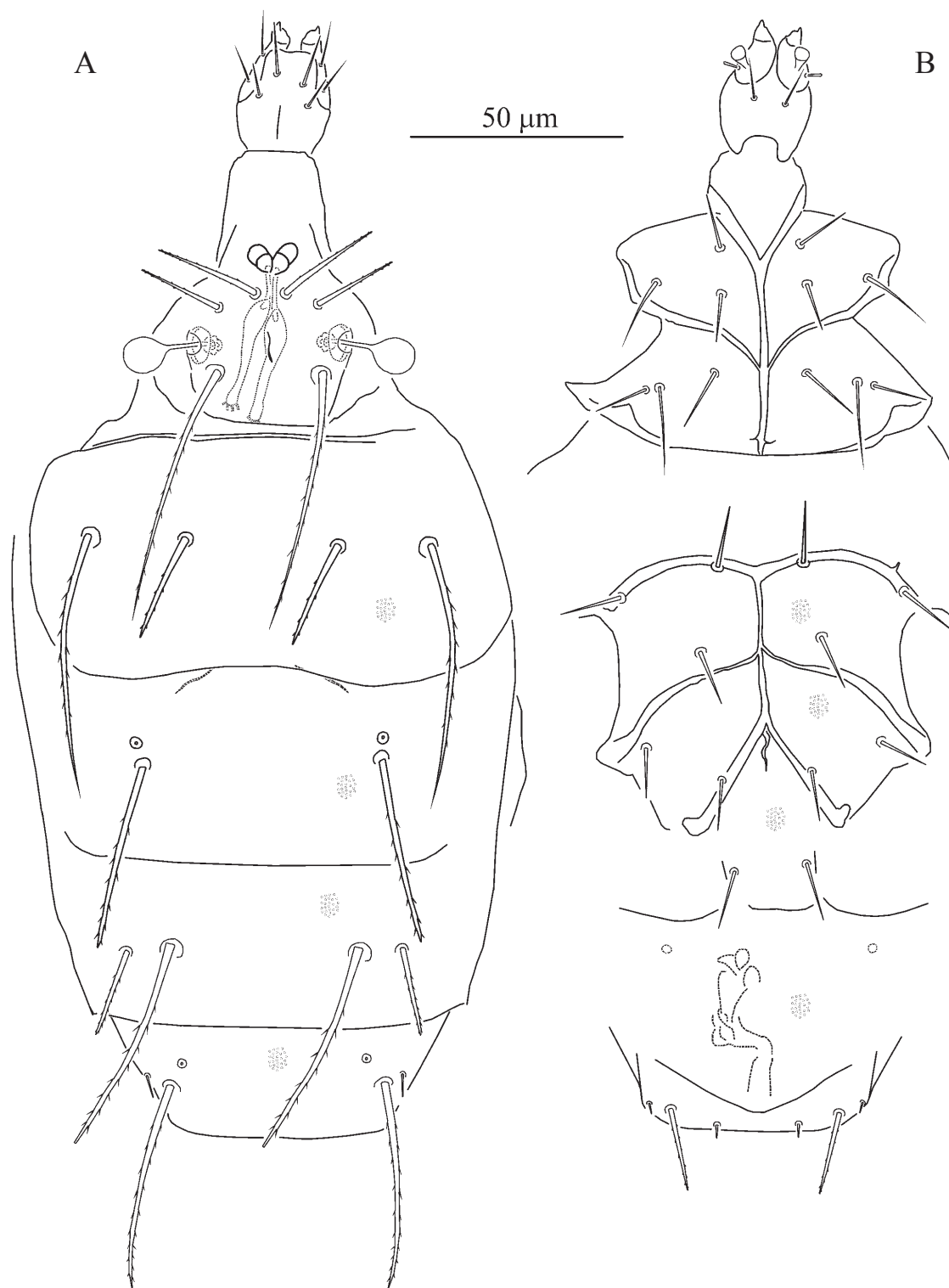


Fig. 5. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., non-phoretic female: A — idiosomal dorsum, B — idiosomal venter.

(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  $2b$  usually pointed and dis-

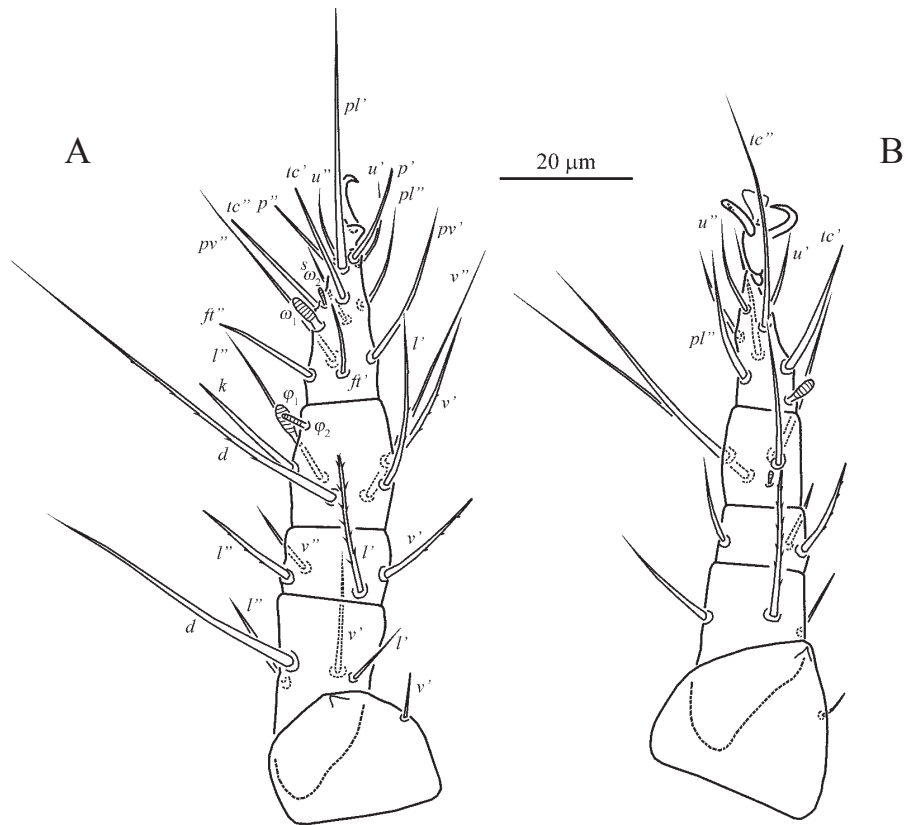


Fig. 6. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., non-phoretic female: A — leg I, B — leg II.

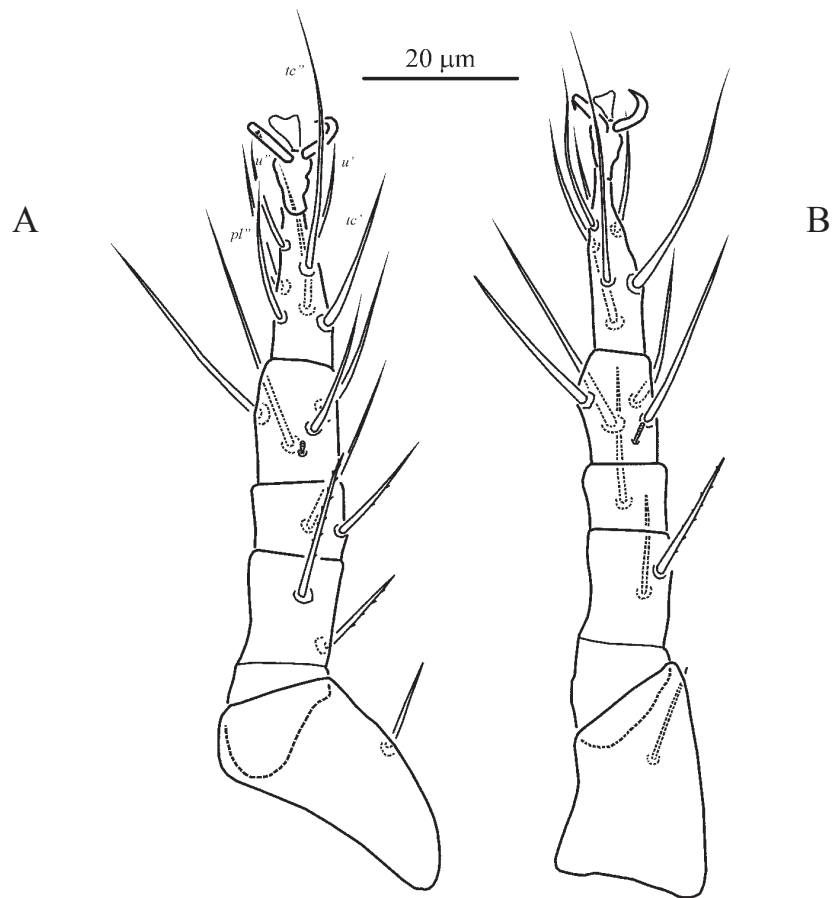


Fig. 7. *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n., non-phoretic female: A — leg III, B — leg IV.

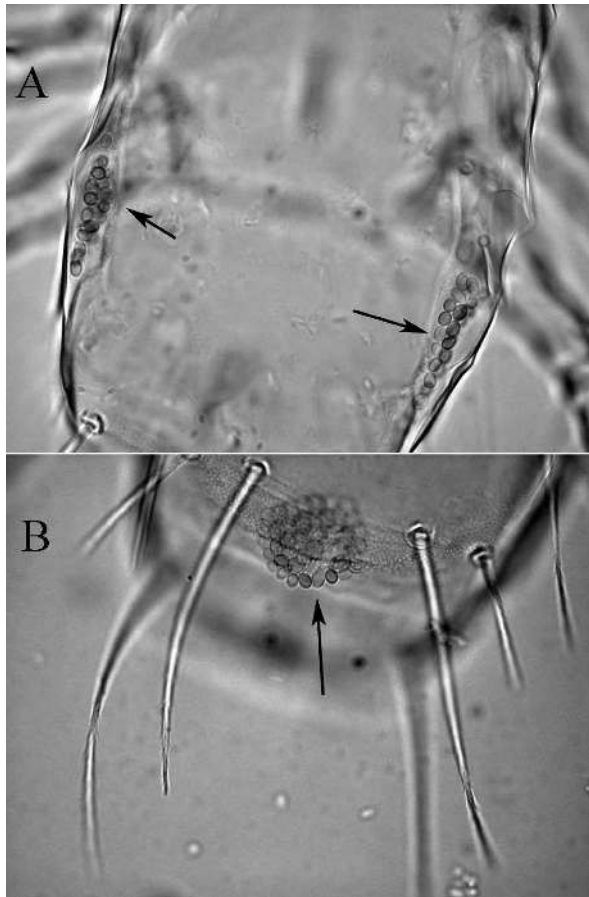


Fig. 8. Fungal spores under (A) and on (B) tergites of phoretic female of *Pediculaster neutarii* Khaustov, Lee, Lee et Kim sp. n.

tinctly longer than  $2a$ . In some specimens,  $2b$  needle-like and only slightly longer than  $2a$ . 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  $4b$  under aggenital plate. Length of ventral setae:  $1a$  12 (11–14),  $1b$  17 (14–19),  $1c$  13 (11–16),  $2a$  16 (15–18),  $2b$  25 (20–26),  $2c$  14 (14–18),  $3a$  14 (14–18),  $3b$  14 (14–16),  $3c$  20 (17–21),  $4a$  12 (11–12),  $4b$  20 (17–23),  $4c$  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  $\omega_1$  7 (7–8) >  $\omega_2$  5 (4–5) <  $\phi_1$  7 (7–8) >  $\phi_2$  5 (5–6);  $\omega_2$

and  $\phi_2$  baculiform,  $\phi_1$  clavate,  $\omega_1$  finger-shaped. Setae  $dFe$  spatulate 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. Solenidium  $\omega$  5 (5–6), finger-shaped, solenidium  $\phi$  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. Solenidium  $\phi$  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. Solenidium  $\phi$  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  $3c$  smooth. Length of ventral setae:  $1a$  9–13,  $1b$  13–22,  $1c$  10–14,  $2a$  10–16,  $2b$  17–23,  $2c$  9–12,  $3a$  11–16,  $3b$  10–15,  $3c$  11–18,  $4a$  9–13,  $4b$  11–17,  $4c$  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  $\omega_1$  4–6 >  $\omega_2$  3 <  $\phi_1$  5–7 >  $\phi_2$  3–4;  $\omega_2$  and  $\phi_2$  baculiform,  $\phi_1$  clavate,  $\omega_1$  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). Solenidium  $\omega$  4–5, finger-shaped, solenidium  $\phi$  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). Solenidium  $\phi$  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, Gyeonggi 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 2b are distinctly longer than 2a, 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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