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External morphology of postembrionic stages of *Lutrilichus javanicus* (Acariformes: Chirodiscidae) from *Melogale moschata* (Carnivora: Mustelidae) from Vietnam

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ABSTRACT

Mites of the family Chirodiscidae (Acariformes: Sarcoptoidea) are permanent mono- or stenoxenous symbionts of mammals living in the fur of their hosts. Among three genera included in the tribe Schizocarpini (Labidocarpinae), members of the genus *Lutrilichus* Fain inhabit small carnivores of the families Mustelidae and Viverridae (Carnivora). The external morphology of postembrionic stages of *Lutrilichus javanicus* Fain, 1970 (Acariformes: Chirodiscidae), collected from *Melogale moschata* (Gray, 1831) (Mustelidae) in Vietnam, is described. This is the second report of this mite species, previously known from a single female specimen from *Melogale orientalis* Blanford, 1888 in Java, and the first description of the immature stages in the genus *Lutrilichus*.

Keywords Acari, fur mites, Schizocarpini, parasites, systematics

Zoobank <http://zoobank.org/9BA16FB7-71A7-4A07-8BBF-7083E5021B41>

Introduction

The family Chirodiscidae (Acariformes: Sarcoptoidea) includes approximately 230 species in 26 genera and four subfamilies (Bochkov 2010). These mites are permanent mono- or stenoxenous symbionts of mammals that live in the fur of their hosts. The tribe Schizocarpini (Labidocarpinae) includes three genera, *Schizocarpus* Trouessart from beavers (Rodentia: Castoridae) (60 species), *Soricilichus* Fain (3 species) from African shrews of the subfamily Crocidurinae (Soricomorpha: Soricidae), and *Lutrilichus* Fain (5 species) from small carnivores of the families Mustelidae and Viverridae (Carnivora) (Fain 1970, 1971, 1981; Fain *et al.* 1974; Bochkov *et al.* 2016). In mites of this tribe, the external morphology of immature instars strongly differs in male and female lines of development. Larvae are hexapode with well-developed legs III having a full set of setae typical for this stage in chirodiscids. Male protonymphs and tritonymphs also bear the full set of setae and have well-developed legs III and IV. All these preimaginal stages of the male line live independently. At the same time, female proto- and tritonymphs are sacciform, the number of their idiosomal setae is strongly reduced compared to those of the male line, and their legs III and IV are primordial or absent. They are apparently not able to live independently and are always found attached to males with the posterior end of the opisthosoma (Fain 1971).

The external morphology of the immature stages in chirodiscid genera *Schizocarpus* and *Soricilichus* was studied in detail by Dubinina (1964) and Bochkov *et al.* (2016), respectively. At the same time, the immature stages of *Lutrilichus* have never been studied specifically.

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In this paper, the external morphology of all postembryonic stages of *Lutrilichus javanicus* Fain, 1970 collected from fur of *Melogale moschata* (Gray) (Carnivora: Mustelidae) in Vietnam is described. This mite species was previously known from a single female specimen (holotype, housed in the Natural History Museum, London, UK) from *Melogale orientalis* Blanford, from Java (Fain 1970; 1981).

Materials and methods

The host of mite specimens used in the present study, the Chinese ferret badger, *Melogale moschata*, was collected by my colleague, A.V. Abramov (Zoological Institute of the Russian Academy of Sciences, Saint-Petersburg, Russia), in the zoological survey in northern Vietnam carried out by the Vietnam-Russia Tropical Center (Ho Chi Minh City — Moscow) in 2013. Mites were gathered by AB from the ethanol-preserved host with fine forceps under dissection microscope, placed in 96% ethanol, and then mounted in Hoyer's medium according to standard methods (Evans 1992). Drawings were made with a Leica microscope equipped with differential interference contrast optics and a camera lucida.

In the description below, the idiosomal setation follows Griffiths *et al.* (1990) with modifications for coxal setae by Norton (1998), and leg setation follows Grandjean (1939). All measurements are in micrometers (µm) and were taken as follows: body length = length from the palpal apices line to the posterior margin of the body; idiosomal width = lateral width at the level of setae *cp*; length of dorsal shields = maximum length, measured along the median line of the shields; length of the posterior legs = length from the most proximal point of the trochanter to the apex of the tarsus, excluding the pretarsus.

Results

Family Chirodiscidae Trouessart, 1892

Subfamily Labidocarpinae Gunther, 1942

Tribe Schizocarpini Fain, 1971

Genus *Lutrilichus* Fain, 1970

Lutrilichus javanicus Fain, 1970 (Figures 1-7)

Lutrilichus javanicus Fain, 1970: 300, 1981: 43, figs. 3, 4; Fain *et al.* 1974: 944.

Material examined — 10 males, 10 females, 10 male larvae, 10 female larvae, 5 male protonymphs, 10 female protonymphs, 10 male tritonymphs, 10 female tritonymphs, and numerous specimens retained in ethanol (ZISP, AVB 17-1103-001) from the Chinese ferret badger *Melogale moschata* (Gray) (Carnivora: Mustelidae) (ZISP, AVA 13-169), VIETNAM: Son La Province, Phu Yen District, Suoi To Commune, Suoi Khang Village, ca. 10 km NW of Phu Yen, 21°20'13.2"N, 104°36'29.7"E, alt 1100 m, 31 May 2013, coll. A.V. Abramov. Mites are deposited in the Museum of Zoology, the University of Michigan, Ann Arbor, USA (UMMZ), and Zoological Institute of the Russian Academy of Sciences, Saint-Petersburg, Russia (ZISP).

Male larva — (10 specimens, Figure 1) — Body 270–380 long and 165–255 wide. *Gnathosoma*. Gnathosoma having structure typical for Chirodiscidae with full complement of setae. Palps two-segmented, enclosed by membrane. Pseudorutellar membranes of subcapitulum weakly developed, dorsal lobes not developed. Palpal setae: *dTi*, *dTiI*′, *dTa*, *ω*, *ul*′, and *ul*′′; subcapitular setae: *elcp* and *subc*. *Idiosoma*. Idiosoma slightly flattened from lateral sides, completely covered by transverse striae. Propodonal shield very short about 10 long, in shape of narrow transverse band. Hysteronotal shield absent. Hysteronotal gland openings *gl* distinct. Posterior margin of opisthosomal widely rounded. Laterocoxal setae *scx*

Figure 1 *Lutrlichus javanicus* Fain, 1970, male larva. A – Lateral view; B – Leg III in ventral view. Scale bars: A = 100 μm; B = 50 μm.

Figure 2 *Lutriliichus javanicus* Fain, 1970, male nymphs. (A, B) protonymph: A – Lateral view; B – Leg IV in ventral view. (C–F) deutonymph: C – Lateral view; D – Coxal fields III, E – Tarsus and tibia IV in dorsal view; F – Tarsus IV in ventral view. Scale bars: A, C = 100 µm; B, D – F = 50 µm.

absent. Anal opening situated ventrally. Lengths of setae: *si* 50–88, *se* 60–80, *c1* 55–63, *c2* 48–58, *cp* 45–50, *c3* 40–65, *d1* 33–45, *d2* 40–60, *e1* 50–65, *e2* 58–78, *h2* 150–210, *1a* and *3a* 15–20. Each pair of coxal apodemes *1a* and *2a*, fused in Y-shaped structures. Coxal apodemes *3a* fused medially in arch-like structure. *Legs*. Legs I and II with 5 segments: trochanter without setae, femur with seta *vF*, genu with setae *cG* and *mG*, tibia with seta *gT* and solenidion ϕ , tarsus with paired tarsal flaps and solenidion ωI . Legs III well developed, with full set of articulated segments: trochanter, femur, genu, tibia and tarsus with pretarsus. Ambulacral disc of pretarsus III with acute terminal protrusion. Leg III setation: genu: solenidion σ , tibia: seta *kT* and solenidion ϕ , tarsus: setae *w*, *r*, *s*, *f*, *e*, *d*. Setae *sIII* and *wIII* shaped as longitudinally striated spurs.

Male protonymph — (5 specimens, Figure 2A, B) — Body 310–390 long and 210–265 wide. *Idiosoma*. Propodonotal shield about 10 long. One pair of genital papillae, setae *f2*, *h3*, *ps1*, *ps2*, *ps3*, and *g* added on idiosoma. Setae *f2* situated closer to bases of *h2* than *ps2*. Lengths of setae: *si* 70–90, *se* 80–100, *c1*, *c2*, *cp*, *c3*, *d1*, *d2*, *e1*, and *e2* 70–100; *f2*, *ps1*, *ps2*, and *ps3* 10–20; *h2* 100–120; *h3* 80–100. Coxal apodemes *IVa* fused medially into arch-like

Figure 3 *Lutrlichus javanicus* Fain, 1970, female larva. A – Dorsal view; B – Ventral view; C – Leg III in ventral view. Scale bars: A, B = 100 μ m; C = 50 μ m.

structure. *Legs*. Legs IV with five articulated segments added. Pretarsus IV present. Setae *d*, *w*, and *r* of tarsus IV present, other segments of legs IV without setae. Seta *w*IV shaped as longitudinally striated spur.

Male tritonymph — (10 specimens, Figure 2C–F) — Body 410–450 long and 250–300 wide. *Idiosoma*. Propodonal shield 10–15 long. Second pair of genital papillae, coxal setae *4a* and *4b* added on idiosoma. Lengths of setae: *si* 78–90, *se* 80–100, *c1* 50–70, *c2* 70–90, *cp* 45–70, *c3* 60–65, *d1* 45–50, *d2* 70–90, *e1* and *e2* 60–70, *f2* 18–25, *h2* 140–180, *h3* 80–100, *ps1* 5–10, *ps2* 23–28, *ps3* 38–53. *Legs*. Seta *s*III on trochanter III, seta *kT*III on tibia III, and setae *e*IV and *f*IV on tarsus IV added.

Male — (10 specimens, Figures 5A and 6) — Body 365–425 long, 205–265 wide. *Idiosoma*. Propodonal shield 10–18 long. Idiosomal dorsum covered with numerous transverse striae.

Figure 4 *Lutrulichus javanicus* Fain, 1970, female nymphs. (A, B) protonymph: A – Lateral view; B – Leg I in ventral view. C – Tritonymph in lateral view. Scale bars: A, C = 100 μ m; B = 50 μ m.

Hysteronotal shield shaped of transverse band, situated posterior to setae *e1*, 25–35 in length along midline. Setae *ps3* situated between adanal suckers. Opisthosomal lobes widely rounded. Lengths of idiosomal setae: *si* 80–100, *se* 100–115, *c1* 78–93, *c2* 93–105, *cp* 70–120, *c3* 40–65, *d1* 40–60, *d2* 80–95, *e1* – microsetae, *e2* 70–100, *f2* 80–85, *h2* 130–180, *h3* 130–170, *ps1* 110–120, and *ps2* 100–125. Aedeagus about 11 long. Adanal sclerites absent. Legs III 110–140 long, with setation as in male tritonymph. Legs IV 70–90 long, consisting of 4 segments, femur and genu fused. Solenidion σ III added on genu III. Tarsi IV bearing setae *d*, *w*, and *r*, tibia IV with solenidion ϕ IV, other segments of legs IV without setae. Seta *w*IV shaped as longitudinally striated spur.

Female larva — (10 specimens, Figure 3) — Similar to male larva. Body 250–300 long and 160–205 wide. Idiosomal dorsum posterior to level of setal bases *c2* and *d1* smooth. Lengths

Figure 5 *Lutrulichus javanicus* Fain, 1970, adults in lateral view. A – Male; B – Female.

of idiosomal setae: *si* 88–120, *se* 75–125, *c1* 28–38, *c2* 80–100, *cp* 80–120, *c3* 70–85, *d1* 2–3, *d2* 25–30, *e1* 110–125, *e2* 60–90, *h2* 180–240, *la* 10–20, and *3a* 30–40. Setae *e1* thickened and situated terminally. Live independently or attached to male.

Female protonymph — (10 specimens, Figure 4A, B) — Body 255–265 long and 190–210 wide, slightly elongated sack-like. Coxal fields I smooth; coxal apodemes II–IV absent. Setae *c3*, *e1*, *e2*, *d1*, *d2*, *f2*, *3a*, *g*, *ps1*, *ps2*, and *ps3* absent. Setae *h3* added. Lengths of setae: *si* 88–93, *se* 100–110, *c1* 10–15, *c2* 5–8, *cp* 30–35, *la* about 10, *h2* and *h3* 28–35. Posterior end of opisthosoma between levels of setae *e1* and *h2* smooth, anterior margin of this area flanked with a pair of large bow-shaped opisthosomal sclerites and bears pair of rounded tubercles corresponding to male adanal suckers. Legs I strongly shortened compared to female larva, their tibia and tarsus clearly separated. Setation of legs I as in female larva, but all setae shorter. Legs II–IV absent. First pair of genital papillae added.

Figure 6 *Lutriliichus javanicus* Fain, 1970, details of male. A – Palp in ventral view; B – Cheliceral digits in lateral view; C – Coxal fields III; D – Opisthosomal lobes in dorsal view; E – Opisthosomal lobes in ventral view; F – Tarsus, tibia, and genu III in ventral view; G – Leg IV in ventral view.

Figure 7 *Lutrulichus javanicus* Fain, 1970, details of female. A – Coxal fields III; B – E Legs I–IV in ventral view, respectively.

Female tritonymph — (10 specimens, Figure 4C) — Similar to female protonymph. Body 335–350 long and 245–305 wide. *Idiosoma*. Propodonotal shield 10–15 long. Second pair of genital papillae added. Idiosomal chaetome as in female protonymph. Lengths of idiosomal setae: *si* 80–135, *se* 125–155, *c1* and *c2* 5–8, *cp* 25–50, *h2* and *h3* 20–35, *la* about 10. *Legs*. Legs I as in female protonymph. Legs II strongly reduced, several times shorter and thinner than legs I, consisting of 3 articulated segments, apical segment with 3 short setae. Legs III and IV primordial, shaped as small conical tubercles not split into segments, each bearing 1 apical microseta.

Female — (10 specimens, Figures 5B and 7) — Similar to male tritonymph except oviporus between coxal fields III. Body 440–490 long, 275–330 wide. *Idiosoma*. Propodonotal shield about 10 long. Full set of idiosomal setae occurring in adult chirodiscids excluding setae *h1* (as in male). Coxal apodemes I–III as in male tritonymph. Lengths of setae: *si* 100–125, *se*

100–120, *c1* 75–85, *c2* 80–105, *cp* 83–105, *c3* 75–85, *d1* 58–80, *d2* 85–95, *e1* 95–130, *e2* 95–125, *f2* 19–25, *h2* 135–170, *h3* 140–160, *ps1* 10–23, *ps2* 25–38, and *ps3* 50–70. *Legs.* Legs I and II as in male. Legs III and IV fully developed as in male tritonymph; setation of legs III and tibia IV as in male, tarsus IV with 5 setae *d*, *e*, *f*, *r*, and *w*. Seta *wIV* shaped as longitudinally striated spur. Ovoviviparous.

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