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Original paper

Light and scanning electron microscopy of an ischnoceran louse, *Felicola rohani*, and an amblyceran louse, *Heterodoxus spiniger* (Phthiraptera: Insecta) from the Indian grey mongoose, *Herpestes edwardsii*

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ABSTRACT. The ischnoceran louse, *Felicola rohani* Werneck, 1956 is reported for the first time from India on the Indian grey mongoose – *Herpestes edwardsii* (Geoffroy Saint-Hilaire, 1818) and the amblyceran louse, *Heterodoxus spiniger* (Enderlein, 1909) is recorded for the first time from that host species. The lice were collected from freshly accidentally killed specimen of the host, preserved and kept at the Museum of Estuarine Biology Regional Centre, Zoological Survey of India, Gopalpur-on-sea, Ganjam Odisha. Detailed morphological descriptions of the lice, based on light and scanning electron microscopy, are presented in this paper.

Keywords: Amblycera, Ischnocera, Phthiraptera, *Felicola rohani*, *Heterodoxus spiniger*, new record, *Herpestes edwardsii*, India

Introduction

Lakshiminarayana [1] has provided a synoptic list of avian Phthiraptera of India and neighbouring countries. Price et al. [2] published a world checklist of phthirapteran ectoparasites. Chewing lice of the genus *Felicola* Ewing, 1929 comprise 55 species ectoparasitic on mammals worldwide. Among them, 54 species are found on carnivores and one species is found on primates [3–7]. Timm and Price [5] divided the genus *Felicola* into four subgenera: *Felicola* Ewing, 1929; *Lorisicola* Bedford, 1936; *Paradoxuroecus* Conci, 1942 and *Suricatoecus* Bedford, 1932, each including 18, 13, 13 and 11 species, respectively. *Felicola* (*Felicola*) *rohani* Werneck, 1956 has been recorded from three species of the genus *Herpestes*, including *H. edwardsii* (Geoffroy Saint-Hilaire, 1818) [2]. These species have been reported from Africa, Arabia, Sri Lanka and Nepal.

The genus *Heterodoxus* Le Souëf and Bullen, 1902 comprises 24 species, all parasitic on Australian marsupials [2]. However, one of them, *Heterodoxus spiniger* (Enderlein, 1909), also infests several species of the carnivore families Canidae and Viverridae, including the domestic dog, *Canis familiaris* Linnaeus, 1758 [8–16]. It is an active, fast running louse, generally found on the proximal end of the hair shaft (near the skin) in the postero-dorsal region of the host body [17]. Descriptions of *H. spiniger* have been provided by [15,18– 22]. A complete list of its hosts has been given by Emerson and Price [23].

The aim of this report is to provide information on the occurrence of *Felicola rohani* and *Heterodoxus spiniger* on the Indian grey mongoose, *Herpestes edwardsii* in India, with descriptions of the two louse species based on light and scanning electron microscopy.

Materials and Methods

A total of eight specimens of both louse species were collected from an accidentally killed Indian

Table 1. Measurements (mm) of *Felicola rohani* and *Heterodoxus spiniger* parasitizing the Indian grey mongoose, *Herpestes edwardsii*

Characters	*Felicola* (*Felicola*) *rohani*		*Heterodoxus spiniger*
	Male	Female	Female
HL	0.30	0.31	0.36
HW	0.33	0.32	0.54
PL	0.07	0.07	0.27
PW	0.23	0.27	0.45
PTL	0.08	0.09	–
PTW	0.28	0.31	–
ML	–	–	0.08
MW	–	–	0.32
MTL	–	–	0.26
MTW	–	–	0.37
AL	0.62	0.55	1.09
AW	0.47	0.53	0.67
GL	0.36	–	–
SL	0.12	0.06	–
SW	0.07	0.04	–
TL	1.06	1.02	2.05

Abbreviations: AL-Abdomen Length, AW-Abdomen Width, GL-Genitalia Length, HL-Head Length, HW-Head Width, ML-Mesothorax Length, MTL-Metathorax Length, MTW-Metathorax Width, MW-Mesothorax Width, PL-Prothorax Length, PTL-Pterothorax Length, PTW-Pterothorax Width, PW-Prothorax Width, SL-Scape Length, SW-Scape Width, TL-Total Length

grey mongoose, which was brought to the Museum of Estuarine Biology Regional Centre, Zoological Survey of India, Gopalpur-on-sea, Ganjam Odisha, to be preserved by taxidermy. The dead Indian grey mongoose was found on the road near the EBRC, ZSI Office on 10th June, 2019. The louse sample was separated by species, developmental stages and sex, under Stereozoom Trinocular Microscope (Model-Magnus-MS 24, Make-India). For the light microscopic study, specimens were macerated with 20% KOH, washed with distilled water, treated with acetic acid, stained with aqueous acid fuchsin, dehydrated in ethanol series, cleared in xylene and mounted in Canada balsam. For the scanning electron microscope (SEM) study, specimens were fixed in 2.5% gluteraldehyde, post fixed in 0.25M phosphate buffer, critically dried, arranged on metal stub, covered with double sided cello tape, gold coated in Neo Coater 100-240V, and examined under a JCM-6000 Scanning Electron Microscope. All measurements were made in Mag Cam DC-5 Camera. Measurements are given in millimetres (Table 1). Collected specimens were deposited in the Museum of Estuarine Biology Regional Centre, Zoological Survey of India, Gopalpur-On-Sea, Ganjam, Odisha.

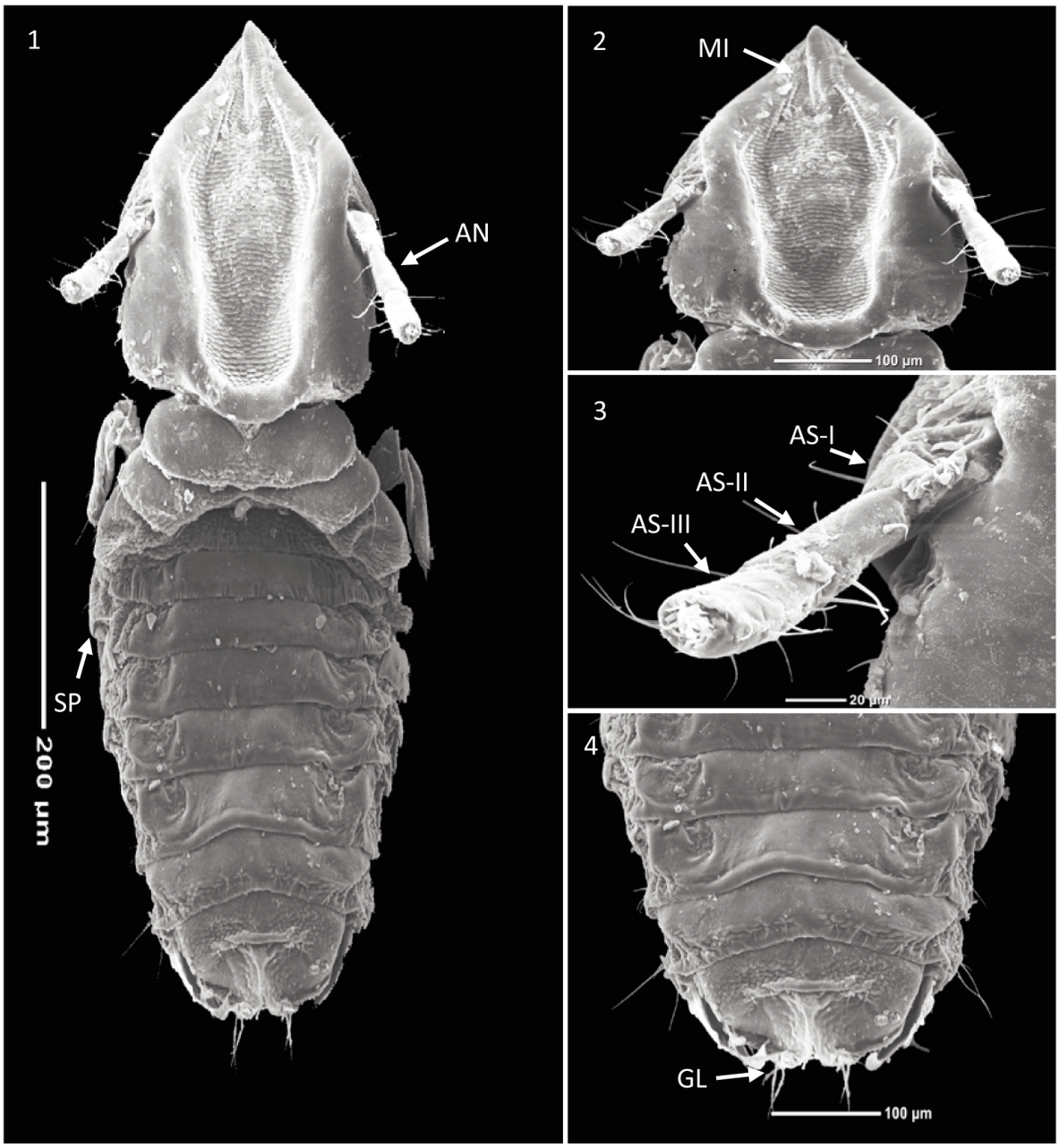
Results and Discussion

***Felicola* (*Felicola*) *rohani* Werneck, 1956**

Type host: *Herpestes edwardsii*

Female (Plate I figs 1–4; Plate II figs 1–5)

Head shape pentagonal and slightly longer than wide, with a medio-anterior indentation; abdomen oval, with each abdominal segment having a single row of short setae. Three pairs of spiracles present on abdominal segments III to V. Legs as in other species of the genus, but with two strong spines on the distal ends of the tibias. Seven pigmented transverse sclerites, on the abdominal segments and



Figs 1–4. **Plate I** SEM photographs of adult female *Felicola* (*F.*) *rohani*. 1. Habitus dorsal view. 2. Enlarged view of head. 3. Enlarged view of antennae. 4. Enlarged view of terminalia. (Abbr: AN-Antennae, AS-Antennal segment, GL-Genitalia, MI-Medio-anterior indentation, SP-Spiracles).

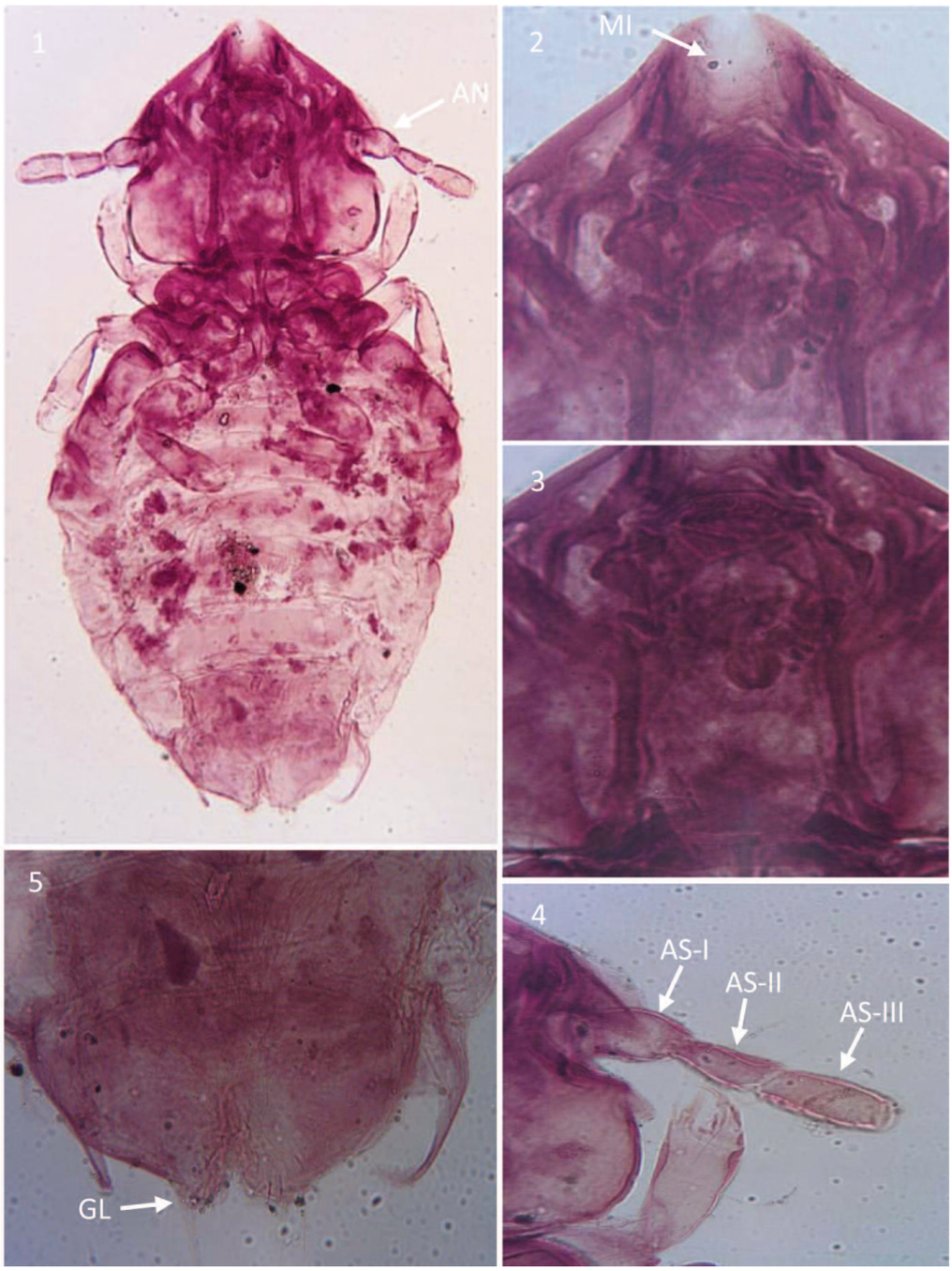
on the terminalia. Sternites entirely devoid of pigment, except in the genital region. The apex of the IX segment is bifurcated into two posterior lobes.

Male (Plate III figs 1–4; Plate IV figs1–5)

External morphology similar to that of the female. Pronotum with 1 long latero-postero seta on each side. Pteronotum with 1–2 short setae at each corner. Abdominal segment II with one short tergocentral setae on each side. Six very short tergal setae on the abdominal segments III–VIII. Tergite IX with 06–07 mm long setae on each side of the bifurcated apical end.

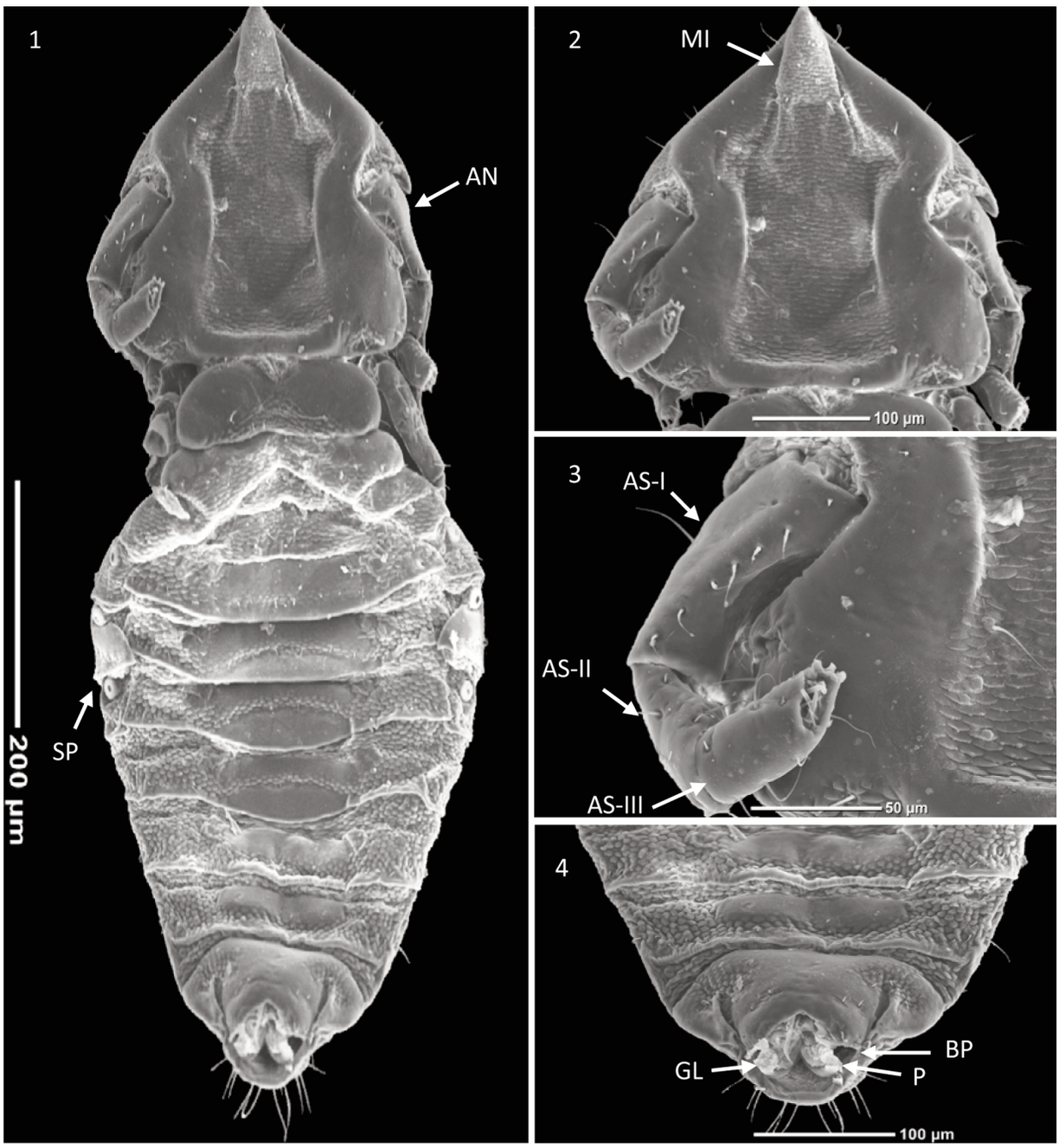
The antennal scape enlarged, abdomen more oval than female. Genitalia with a straight parallel basal apodeme, lateral struts associated with large spinose, Parameres apically tapered, blunt and basally fused with flat basal margin, lacking indentation. Mesomeral arch with prominent broad blunt apical process.

Remarks: *Felicola* (*Felicola*) *rohani* is very similar to *Felicola* (*Felicola*) *inaequalis* (Piaget,



Figs 1–5. **Plate II** LM photographs of female *Felicola* (*F.*) *rohan*i. 1. Habitus. 2. and 3. Enlarged views of head. 4. Enlarged view of antenna. 5. Enlarged view of terminalia. (Abbr: AN-Antennae, AS-Antennal segment, GL-Genitalia, MI-Medio-anterior indentation, SP-Spiracles).

1880) and *Felicola* (*Felicola*) *zeylonicus* Bedford, 1936, both from other species of *Herpestes* [2]. However, its male genitalia are close to those in species of *Paradoxuroecus*. *Felicola* (*Felicola*) *rohani* is easily distinguished by having one more transverse spot on the dorsal side of the male abdomen, located on the tergite corresponding to the second pair of abdominal spiracles. It is also distinguished by the absence of dark L-shaped spots, located in the genital region of the female; and the presence of two other rectangular rectangles, which exist at the level of the inner gonapophyses. In the Asian continent, *Felicola* (*F.*) *rohani* has been recorded from *Herpestes edwardsii* in Nepal [1]. In this paper, we report it for the first time from India.



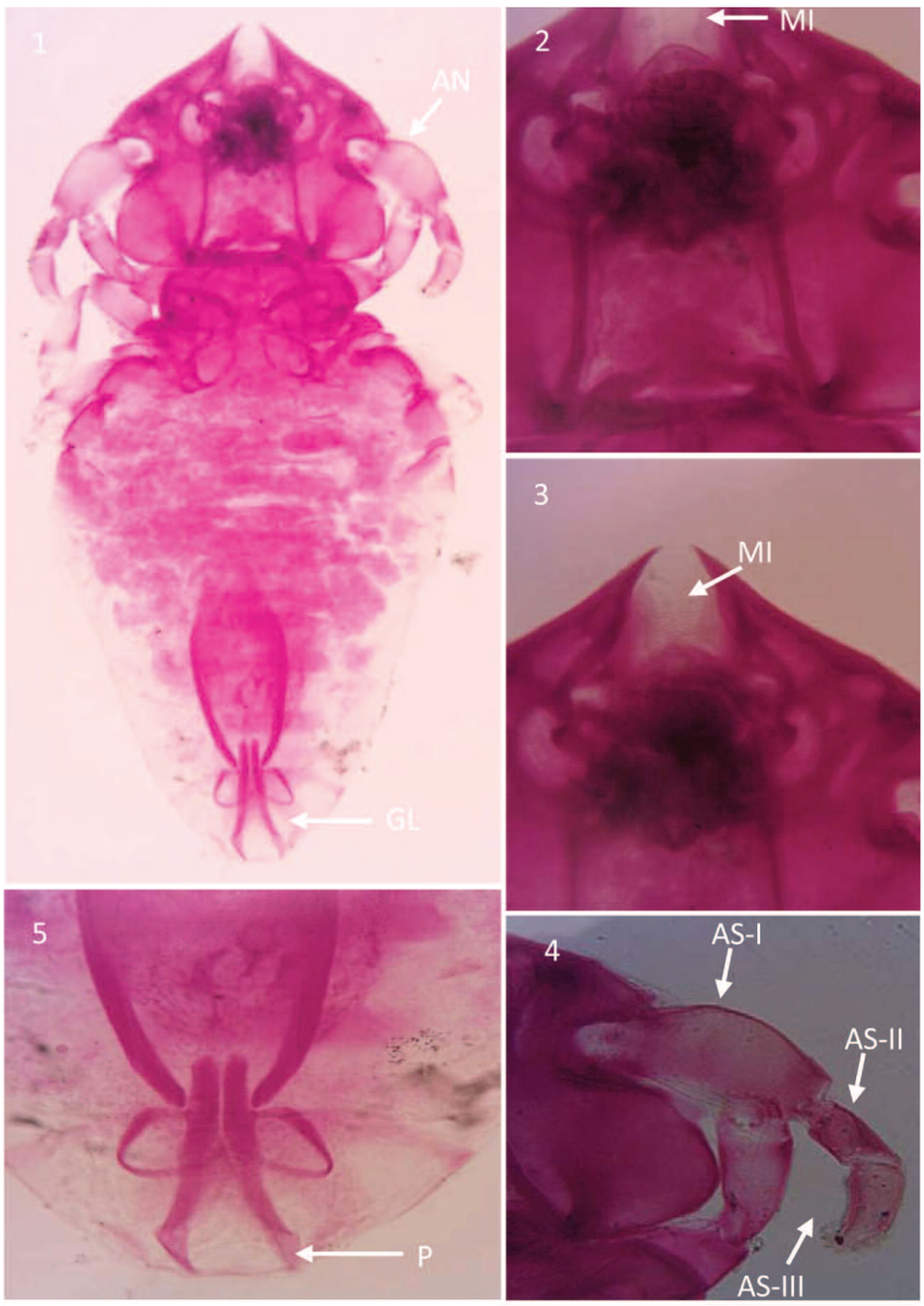
Figs 1–4. **Plate III** SEM photographs of adult male *Felicola* (*F.*) *rohani* 1. Habitus. 2. Enlarged view of head. 3. Enlarged view of antennae. 4. Enlarged view of terminalia. (Abbr: AN-Antennae, AS-Antennal segment, BP-Basal Plate, GL-Genitalia, P-Paramere, MI-Medio-anterior indentation, PP-Post-palpal process, SP-Spiracles).

***Heterodoxus spiniger*, Enderlein, 1909**

Type host: *Herpestes edwardsii*

Female (Plate V figs 1–5; Plate VI figs 1–3)

Head sub-triangular, thickened and chitinized, anterior margin of the head is rounded and posterior margin slightly concave. Temporal lobes acutely rounded. The clypeus is separated from the remaining part of the head by an undulating suture. The anterior part of labium and labial palpi bear several sensilla. The labium lies close to anterior edge of clypeus and turned inside. Head bears two post-palpal processes on the ventral side. At the anterior part of the head, four segmented slender shaped maxillary palpi are present. The antennary fossae consist of two parts: posterior large and empty basin behind the deep transverse groove and the anterior basin with antenna. The first two segments of antennae prominently protrude from the antenna fossae. The second segment of each antenna is nearly round, in distal part with quite numerous protuberances. The

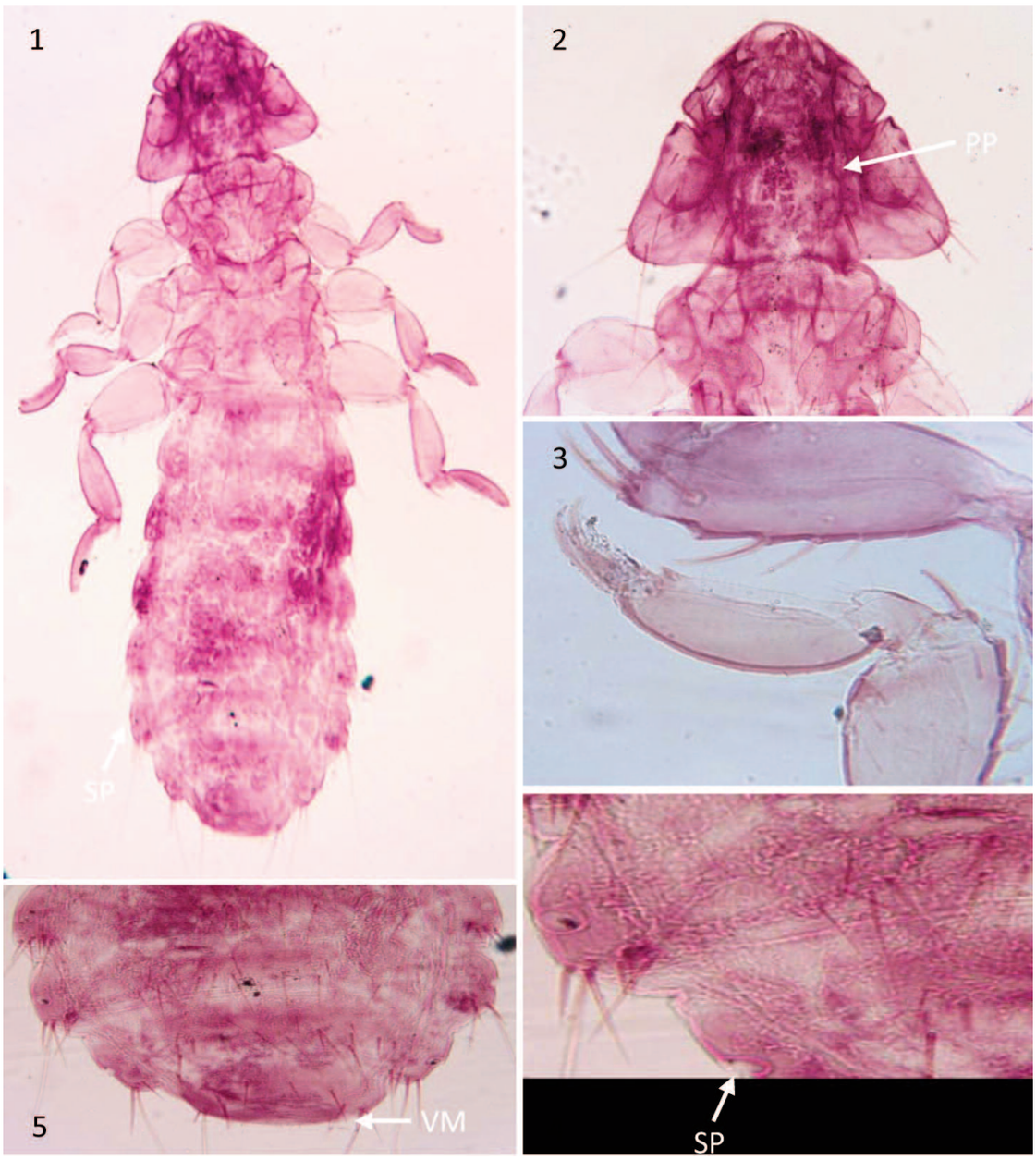


Figs 1–5. **Plate IV** LM photographs male *Felicola* (*F.*) *rohani.* 1. Habitus. 2. and 3. Enlarged views of head. 4. Figs 1–5. Enlarged view of antenna. 5. Enlarged view of genitalia. (Abbr: AN-Antennae, AS-Antennal segment, BP-Basal Plate, GL-Genitalia, P-Paramere, MI-Medio-anterior indentation, PP-Post-palpal process, SP-Spiracles).

thorax is longer and narrower than the head. The prothorax narrower than the head. Prosternum bear one seta and metasternum bear two setae. The first pair of legs is reduced. The setae are arranged in a row like comb on the legs. All claws are thin and short and their ending is curved. The abdomen is long, oval and composed of IX segments. Six pair of spiracles with a thin and long hair protruding from the opening of the spiracles.

The setae on abdominal segments II–IX are as follows: Tergal setae: II (09–11), III (08–12), IV (11–14),V (12–20),VI (16–19),VII (13–20),VIII (10–16), IX (09) Sternal setae: II (4–8), III (8–19), IV (10–18), V (13–20), VI (14–21), VII (14–26), VIII (11–16), IX (9–10) Pleural setae: II (3), III (5), IV (4),V (6), VI (6),VII (7),VIII (7), IX (5).

Female with genital papilla clearly rounded in the last abdominal segment. Vulval margin nearly straight, smooth and membranous with 7–10 marginal setae on each side.



Figs 1–5. **Plate V** LM photographs of female *Heterodoxus spiniger*. 1. Habitus. 2. Enlarged view of head. 3. Enlarged view of leg. 4. Enlarged view of an abdominal segment showing spiracle. 5. Enlarged view of terminalia. (Abbr: SP-Spiracles, VM-Vulval Margin).

Remarks: The specimens of *Heterodoxus spiniger* recovered from the Indian grey mongoose agree with the descriptions published by Kéler [18] and Emerson and Price [23] to a considerable extent, except minor differences in setal counts and body measurements. Up to now, *H spiniger* had not been reported from any species of *Herpestes* [2]. Therefore, the occurrence of this amblyceran louse species on *H. edwardsi* is a new host record.

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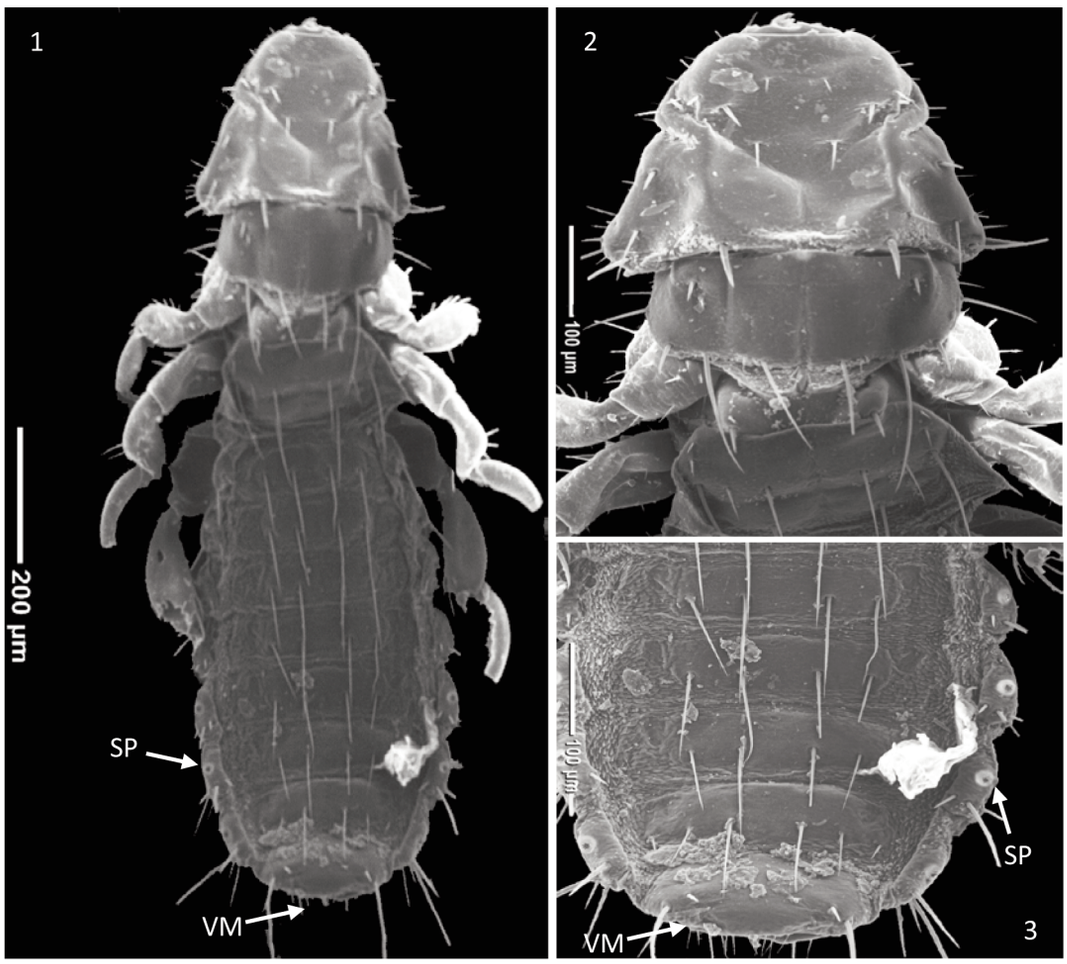

Figs 1–3. **Plate VI** SEM photographs of adult female *Heterodoxus spiniger*. 1. Habitus dorsal view. 2. Enlarged view of head. 3. Enlarged view of terminalia. (Abbr: SP-Spiracles, VM-Vulval Margin).

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