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Contribution to Knowledge of the Oribatid Mite Genus *Elaphoppia* Balogh, 1983 (Acari, Oribatida, Oppiidae)

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Abstract. The oribatid mite genus *Elaphoppia* (Oribatida, Oppiidae) comprises four species collectively distributed in the tropics and in the southern Palaearctic region. A new species — *Elaphoppia phuquocensis* sp. n. — is described, based on material collected from forest litter in southern Vietnam. The new species differs from *E. lienhardi* in the morphology of the notogastral setae *la* and *lm*. Herein, the generic diagnosis of *Elaphoppia* is revised. Also, in this paper, we present an identification key, and discuss the distribution and habitats of the known representatives of *Elaphoppia*.

Keywords: oppiid mites, taxonomy, morphology, Vietnam

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К изучению панцирных клещей рода *Elaphoppia* Balogh, 1983 (Acari, Oribatida, Oppiidae)

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Аннотация. Род панцирных клещей *Elaphoppia* (Oribatida, Oppiidae) включает 4 вида, распространенных в тропиках и южной Палеарктике. Представлено описание одного нового вида — *Elaphoppia phuquocensis* sp. n. Описание базируется на материале, собранном в лесной подстилке южного Вьетнама. Новый вид отличается от *E. lienhardi* морфологией нотогастральных щетинок *la* и *lm*. Представлены родовой диагноз *Elaphoppia*, а также идентификационный ключ и данные по распространению и местообитанию видов *Elaphoppia*.

Ключевые слова: клещи Oppiidae, таксономия, морфология, Вьетнам

Финансирование. Исследование проведено без дополнительного финансирования.

Соблюдение этических стандартов. В данном исследовании использовался только материал по членистоногим, и все необходимые этические нормы обращения с животными и их использования строго соблюдались в соответствии с международными, национальными и институциональными правилами.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией данной статьи.

Вклад авторов. Концепция, подготовка черновика, доработка и редактирование, методология, исследование, анализ данных, рисунки — ЕСГ, ХАА, КЖ.

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INTRODUCTION

The oribatid mite genus *Elaphoppia* (Acari, Oribatida, Oppiidae) was proposed by Balogh [1], with *Oppia quadripilosa* Balogh, 1961 as type species. In parallel, Aoki [2] proposed the genus *Parasynoppia* Aoki, 1983, with *Parasynoppia longisensillata* Aoki, 1983 as type species. Later, *Parasynoppia* was synonymized with *Elaphoppia* [3]. Currently, the genus comprises four species, collectively distributed in the tropics and in the southern Palaearctic region [4].

The main goals of the present paper are: to describe and illustrate a new species of *Elaphoppia* based on adults collected from Vietnam; to summarize *Elaphoppia*'s generic morphological characters; and to provide an identification key, distribution, and habitat data for the known species of *Elaphoppia*. Presently, only one species of *Elaphoppia* — *E. quadripilosa* Balogh, 1960 — has been recorded in the Vietnamese fauna [5].

METHODS

Observation and documentation. For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the gastronotum. Maximum body width refers to the maximum width of the gastronotum in dorsal view. Setae were measured from the side to avoid foreshortening. All measurements are in micrometres (µm). Formulas for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus of tarsus I included). Formulas for leg solenidia are given in square brackets, according to the sequence genu–tibia–tarsus. Paired structures are described in the singular, unless

otherwise noted. Drawings were made with a camera lucida using a Leica DM 2500 light microscope. Images were obtained with an AxioCam ICc3 camera using a Carl Zeiss transmission light microscope Axio Lab.A. Image stacks were combined using the Helicon Focus Pro (v. 8.0) suite.

Terminology. Morphological terminology used in this paper follows that of F. Grandjean: see Travé and Vachon [6] for references, Norton [7] for leg setal nomenclature, and Norton and Behan-Pelletier [8] for overview.

Abbreviations and notations. *Prodorsum*: *cos* = costula; *ir* = interlamellar ridge; *lr* = lateral ridge; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial setae, respectively; *exv* = vestige of second exobothridial seta. *Notogaster*: *cr* = crista; *c*, *la*, *lm*, *lp*, *h*, *p*₁–*p*₃ = setae; *ia*, *im* = lyrifissures; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h* = subcapitular setae; *sup*, *inf*, *d*, *l*, *cm*, *acm*, *ul*, *su*, *vt* = palp setae; *ω* = palp solenidium; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a*–*1c*, *2a*, *3a*–*3c*, *4a*–*4c* = epimeral setae; *PdI* = pedotectum I; *dis* = discidium. *Anogenital region*: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal setae, respectively; *iad* = adanal lyrifissure; *po* = preanal organ. *Legs*: *ω*, *φ*, *σ* = solenidia; *e* = famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = setae.

TAXONOMY

Generic diagnosis of *Elaphoppia*

With character states of Oppiidae [8]. *Measurements*: Small, length about 200–250. *Integument*. Without heavy sculpturing and ornamentation. *Prodorsum*.

Rostrum rounded or with teeth and incisions. Costulae short, convergent but well distanced from each other. Transcostula absent. Lateral prodorsal ridge present, lineate. Interbothridial region with two longitudinal ridge-like structures. Interbothridial muscle sigillae absent. Postbothridial tubercles present. Rostral seta medium-sized, setiform. Lamellar seta tiny. Interlamellar seta long, setiform. Lamellar seta inserted closer to *in* than to *ro*. Bothridial seta very long, with elongate, ciliate head. *Notogaster*. Anterior notogastral margin developed, nearly straight. Humeral tooth absent. Crista present but faint. Seven or eight pairs of notogastral setae: *c*, *h*, and *p*₁–*p*₃ short, acicular; *la* and *lm* long, setiform, sometimes swollen distally; *lp* absent or present (short, acicular or medium-sized, setiform). *Gnathosoma*. Subcapitulum diarthric. Palp setation 0–2–1–3–8(+∞). Palp solenidion bacilliform, located in distal half, pressed to surface. Chelicera chelate-dentate. *Epimeral and lateral podosomal regions*. Epimere IV of normal length. Epimeral border IV present. Epimeral setal formula 3–1–3–3. Epimeral setae setiform. Pedotectum I represented by vestigial lamina. Discidium present, slightly developed. *Anogenital region*. Five pairs of genital, one pair of aggenital, two pairs of anal, and three pairs of adanal setae. All anogenital setae setiform. Adanal seta *ad*₁ posterolateral, *ad*₂ lateral, *ad*₃ anterolateral to anal plate, distance *ad*₃–*ad*₃ longer than *ag*–*ag* and *ad*₂–*ad*₂. Adanal lyrifissure located close and parallel to anal aperture. *Legs*. Tarsus I with 20 setae (*I'* and *v'* present). Tarsus II with 16 setae (*I''* present) and two solenidia.

Elaphoppia phuquocensis Ermilov,
Khaustov et Kontschán sp. n.

(Fig. 1–4)

M a t e r i a l. Holotype (female) and three paratypes (three females): southern Vietnam, Kiên Giang Province, Phú Quốc Island, litter in a mixed forest.

The holotype is deposited in the collection of the Senckenberg Museum of Natural History, Görlitz, Germany. Three paratypes are deposited in the collection of the University of Tyumen, Museum of Zoology, Tyumen, Russia. All specimens are preserved in 70% solution of ethanol with a drop of glycerol.

A d d i t i o n a l m a t e r i a l. Seven females: same data as for the type material. All specimens (preserved in 70% solution of ethanol with a drop of glycerol) are in the personal collection of the first author.

D i a g n o s i s. Body length 217–233. Rostrum with incisions and teeth. Bothridial seta bilaterally ciliate. Seven or eight pairs of notogastral setae present; *lp* absent or present. Notogastral setae *c*, *lp*, *h*, and *p*₁–*p*₃ acicular; *la* and *lm* (both 94–105) setiform, blunt, barbed. Leg solenidion ϕ of tibia IV peculiarly curved.

D e s c r i p t i o n. Measurements. Body length 225 (holotype), 217–233 (paratypes). Body width 127 (holotype), 113–127 (paratypes).

Integument (Fig. 2a; 4e). Body color light brown. Body surface nearly smooth, but intercostular region and lateral part of body between bothridium and acetabula I–IV partially with dense tubercles (diameter up to 2).

Prodorsum (Fig. 1a, 1b; 2a; 4a, 4b). Rostrum with two short and two long incisions. Medial part of rostrum tridentate (Fig. 1a, 1b; 4a). Costulae and interbothridial ridge-like structures well developed. Lateral prodorsal ridge distinct, straight. Rostral (17–19), interlamellar (41–45), and exobothridial setae setiform, roughened (Fig. 4a, 4b, 4e). Lamellar seta (4) acicular. Bothridial seta (94–15) with long stalk and shorter head, bearing cilia bilaterally (Fig. 4b). Alveolar vestige of second exobothridial seta close and lateral to exobothridial seta (Fig. 4e). Postbothridial tubercle distinct.

Notogaster (Fig. 1a, 1c; 2a, 2b; 4c). Anterior part of notogaster nearly straight medially. Crista vaguely defined. Seven or eight pairs of notogastral setae present; *lp* usually absent or sometimes present. Setae *c*, *lp*, *h*, and *p*₁–*p*₃ (4) acicular (Fig. 4c). Setae *la* and *lm* (both 94–105) setiform, blunt, barbed. Only lyrifissures *ia* and *im* visible (*ip*, *ih*, and *ips* not found).

Gnathosoma (Fig. 2c–e). Subcapitulum size 56–60 × 49–52. Subcapitular setae (*a* 15; *m*, *h* 22–24) setiform, roughened. Adoral seta (4) spiniform. Palp length 34–37. Postpalpal seta (4) spiniform. Chelicera length 56–60. Cheliceral setae (*cha* 19; *chb* 11) setiform, barbed.

Epimeral and lateral podosomal regions (Fig. 1c; 2a; 4d). Epimeral setae *1a*, *2a*, and *3a* (13–15) setiform, nearly smooth. Other setae (19–26) setiform, roughened. Discidium slightly developed.

Anogenital region (Fig. 1c; 2a, b; 4d). Genital (11–13), aggenital (22), anal (15–17), and adanal (22) setae setiform, nearly smooth. Adanal lyrifissure distinct.

Legs (Fig. 3a–d; 4f). Claw of each leg smooth. Porose area on all leg segments not visible. Formulas of leg setation and solenidia: I (1–5–2–4–20) [1–2–2], II (1–5–2–4–16) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]. Homology of setae and solenidia indicated in Table 1. Setae *p'* and *p''* of tarsi II–IV spiniform. Seta *s* of tarsus I eupathidial. Solenidion σ of genu III fusiform. Solenidion ϕ of tibia IV peculiarly curved.

R e m a r k s. *Elaphoppia phuquocensis* sp. n. is similar to *E. lienhardi* (Mahunka, 2001) [9] in having a dentate and incised rostrum. However, the new species differs from *E. lienhardi* in the morphology of the notogastral setae *la* and *lm* (simple distally versus swollen distally).

E t y m o l o g y. The species name *phuquocensis* refers to its place of origin, Phú Quốc Island.

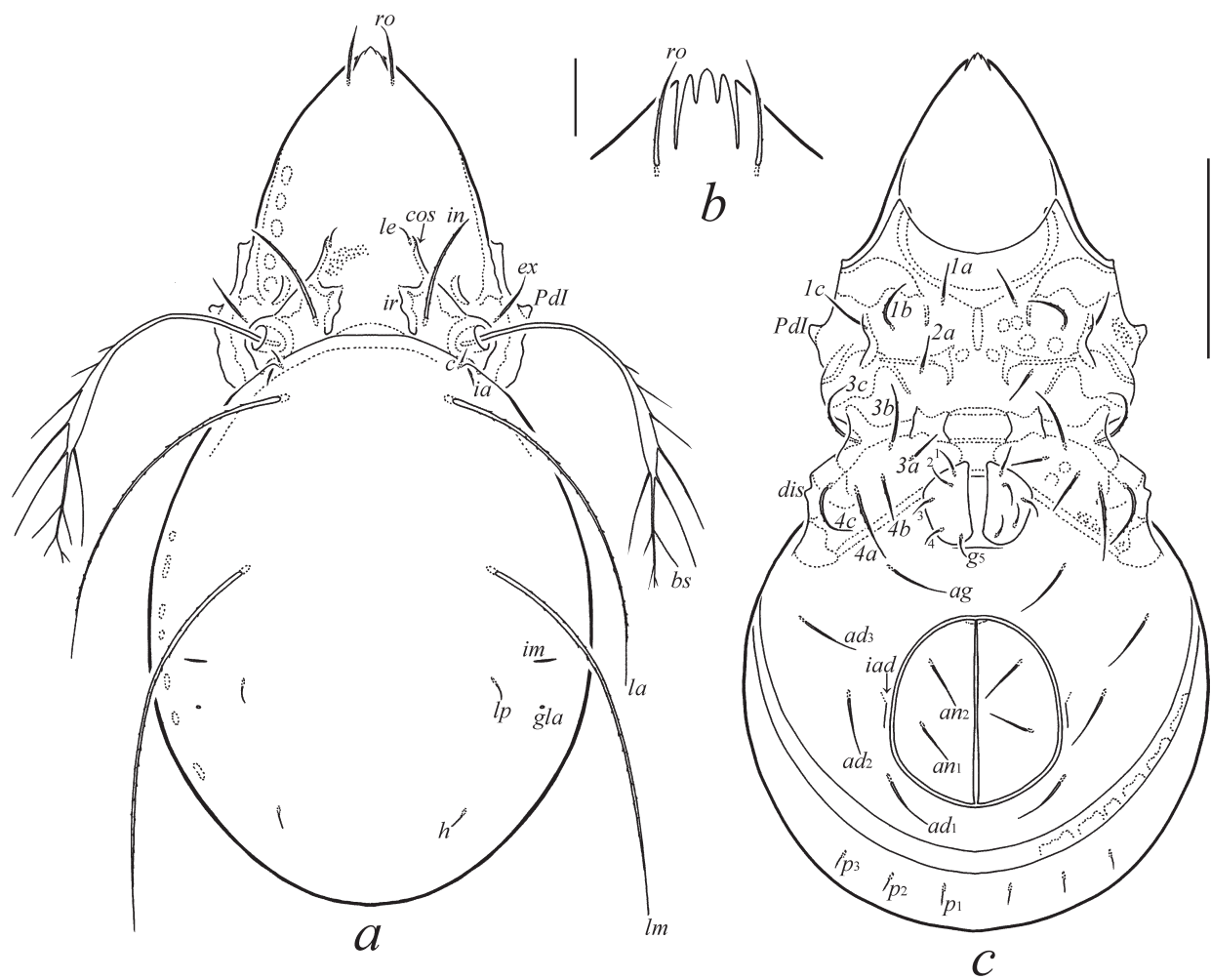


Fig. 1. *Elaphoppia phuquocensis* sp. n., adult: *a* – dorsal view (legs omitted); *b* – rostrum, anterior view; *c* – ventral view (gnathosoma and legs omitted). Scale bar, μm : *a*, *c* – 50; *b* – 10

Рис. 1. *Elaphoppia phuquocensis* sp. n., взрослая стадия: *a* – дорсально (ноги не нарисованы); *b* – рострум, фронтально; *c* – вентрально (гнатосома и ноги не нарисованы). Масштаб, мкм: *a*, *c* – 50; *b* – 10

Table 1. Leg setation and solenidia of adult *Elaphoppia phuquocensis* sp. n.

Таблица 1. Хетом ног взрослой стадии *Elaphoppia phuquocensis* sp. n.

Leg	Tr	Fe	Ge	Ti	Ta
I	v'	d, (l), bv'', v''	(l), σ	(l), (v), ϕ_1 , ϕ_2	(fi), (tc), (it), (p), (u), (a), s, (pv), v', (pv), l'', e, ω_1 , ω_2
II	v'	d, (l), bv'', v''	(l), σ	(l), (v), ϕ	(fi), (tc), (it), (p), (u), (a), s, (pv), l'', ω_1 , ω_2
III	l', v'	d, l', ev'	l', σ	l', (v), ϕ	(fi), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	l', (v), ϕ	fi'', (tc), (p), (u), (a), s, (pv)

Notes. Roman letters refer to normal setae, Greek letters to solenidia, e – famulus. Single prime (') marks setae on the anterior and double prime (") setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae.

Примечания. Римскими буквами обозначены щетинки, греческими – соленидии, e – фамулюс. Один штрих (') обозначает щетинки на внутренней стороне сегментов ног, а два штриха (") – на наружной стороне. Скобки обозначают пару щетинок.

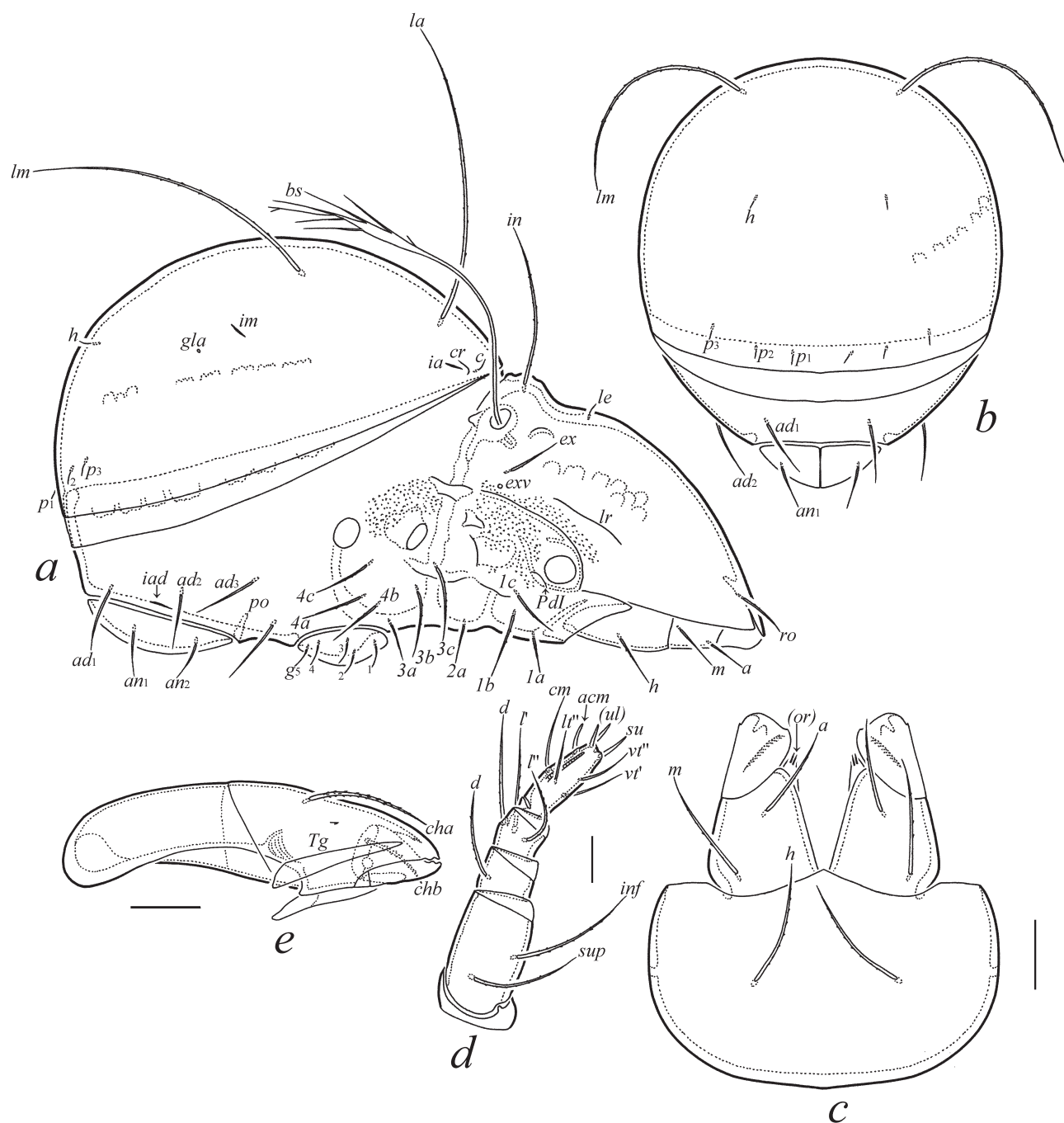


Fig. 2. *Elaphoppia phuquocensis* sp. n., adult: *a* – right lateral view (legs omitted); *b* – posterior view; *c* – subcapitulum, ventral view; *d* – palp, right, antiaxial view; *e* – chelicera, left, paraxial view. Scale bar, μm : *a*, *b* – 50; *c*, *e* – 10; *d* – 5

Рис. 2. *Elaphoppia phuquocensis* sp. n., взрослая стадия: *a* – латерально (ноги не нарисованы); *b* – каудально; *c* – субкапитулум, вентрально; *d* – правая пальпа, антиаксиально; *e* – левая хелицера, параксиально. Масштаб, мкм: *a*, *b* – 50; *c*, *e* – 10; *d* – 5

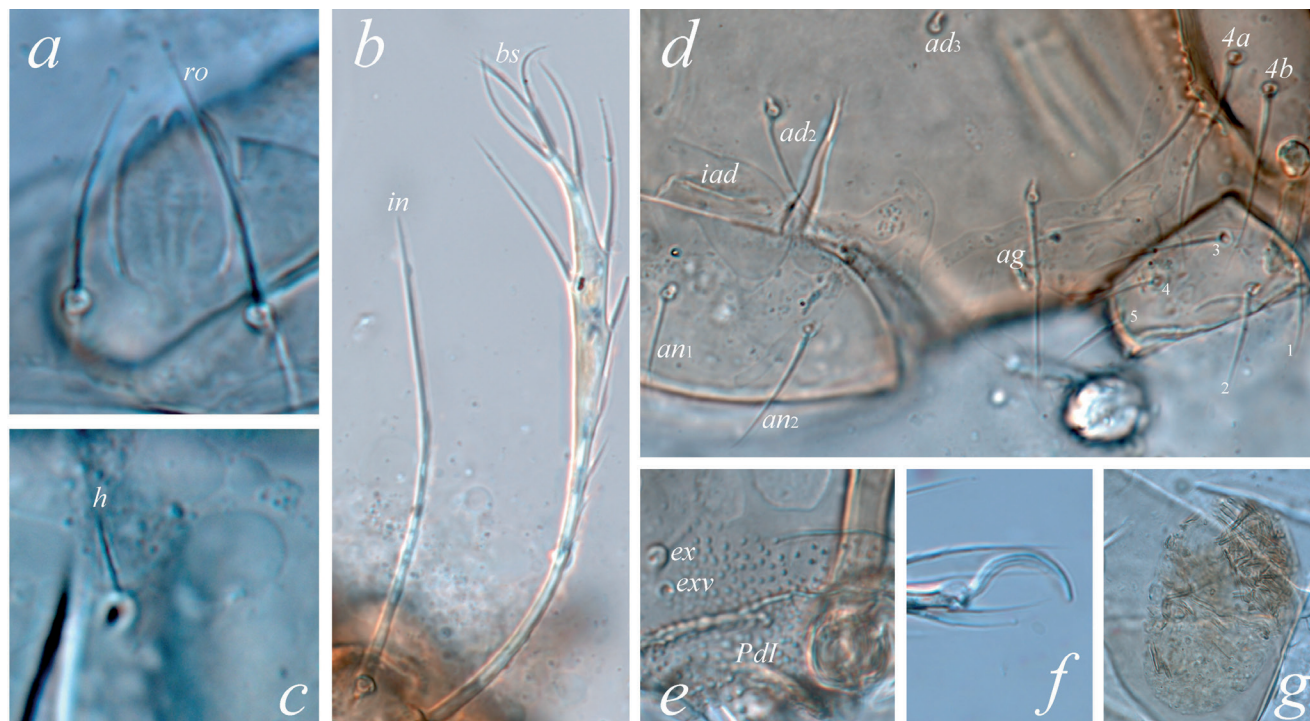


Fig. 4. *Elaphoppia phuquocensis* sp. n., dissected adult: *a* – rostrum and rostral setae, dorsal view; *b* – interlamellar and bothridial setae, lateral view; *c* – notogastral seta *h*, lateral view; *d* – right epimeral and anogenital regions partially, ventrolateral view; *e* – podosomal region and lateral part of prodorsum partially, lateral view; *f* – leg claw III, lateral view; *g* – fecal pellet

Рис. 4. *Elaphoppia phuquocensis* sp. n., расчлененная взрослая стадия: *a* – рострум и ростральные щетинки, дорсально; *b* – интерламеллярная и ботридиальная щетинки, латерально; *c* – нотогастральная щетинка *h*, латерально; *d* – эпимеральный и аногенитальный регионы частично, вентролатерально; *e* – подосомальный регион и боковая часть продорсума частично, латерально; *f* – коготь ноги III, латерально; *g* – кишечный пищевой комок

Table 2. Distribution and habitats of *Elaphoppia* species

Таблица 2. Распространение и местообитание видов *Elaphoppia*

Species	Habitats	Countries	Main references
<i>E. phuquocensis</i> sp. n.	Litter in a mixed forest	Vietnam	Present data
<i>E. lapelerii</i>	Humus and roots under maquis vegetation	New Caledonia	[10]
<i>E. lienhardi</i>	Soil in a mixed dipterocarp forest. Soil in a forest with <i>Agathis dammara</i>	Brunei	[9]
<i>E. longisensillata</i>	Soil and litter in forests	Japan, Korea, Taiwan, Philippines	[2], [12], [13], [14], [15], [16]
<i>E. quadripilosa</i>	Soil in a primary forest. Soils in mixed pine-dominated forests. Litter in a deciduous forest	Madagascar, Vietnam	[5], [11], [17]

KEY TO KNOWN SPECIES OF *ELAPHOPPIA*

1. Rostrum with teeth and incisions 2
 - Rostrum rounded 3
2. Notogastral setae *la* and *lm* swollen distally..... *Elaphoppia lienhardi* (Mahunka, 2001) [9].
 - Notogastral setae *la* and *lm* not swollen distally *Elaphoppia phuquocensis* sp. n. (data of present paper).
3. Notogastral seta *lp* medium-sized *Elaphoppia lapelerii* Balogh et Balogh, 1983 [10].
 - Notogastral seta *lp* short 4

4. Notogastral seta *lm* reaching *h*..... *Elaphoppia quadripilosa* (Balogh, 1960) [11].

– Notogastral seta *lm* not reaching *h* *Elaphoppia longisensillata* (Aoki, 1983) [2], [12].

DISTRIBUTION AND HABITATS OF *ELAPHOPPIA*

The *Elaphoppia* species are known from the Oriental and southern Palaearctic regions, Madagascar, and

New Caledonia. Of them, three species (out of five) have highly restricted geographic distributions, i.e. are endemic to a single country (*E. phuquocensis* sp. n. – Vietnam; *E. lapelerii* – New Caledonia; *E. lienhardi* – Brunei). *Elaphoppia quadripilosa* was recorded in Madagascar and Vietnam. *Elaphoppia longisensillata* is distributed in several countries, e.g., Japan, Korea, Taiwan, and the Philippines. According to the summarized data (Table 2), the *Elaphoppia* species inhabit mainly soil and litter in forest ecosystems.

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