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Stick insects from Vietnam: The new genus *Mycovartes* gen. nov., with two new species and two new species of *Neooxyartes* Ho, 2018 (Phasmida: Lonchodidae: Necrosiinae)

Joachim BRESSEEL^{1,*} & Jérôme CONSTANT² 

^{1,2}Royal Belgian Institute of Natural Sciences, O.D. Phylogeny and Taxonomy, Entomology,
Vautier Street 29, B-1000 Brussels, Belgium.

*Corresponding author: joachimbresseel@gmail.com

²Email: jerome.constant@naturalsciences.be

¹[urn:lsid:zoobank.org:author:3C4EF358-9716-46F0-8575-26BE1EDE4349](https://zoobank.org/author:3C4EF358-9716-46F0-8575-26BE1EDE4349)

²[urn:lsid:zoobank.org:author:6E6072A1-9415-4C8D-8E60-2504444DB290](https://zoobank.org/author:6E6072A1-9415-4C8D-8E60-2504444DB290)

Abstract. Two new species of *Neooxyartes* Ho, 2018 are described from Central Vietnam: *N. minimus* sp. nov. from Kon Ka Kinh National Park and *N. neohiraseoides* sp. nov. from Chu Yang Sin National Park. A new genus *Mycovartes* gen. nov. is described to accommodate *Oxyartes vietnamensis* Ho, 2018 resulting into the new combination *Mycovartes vietnamensis* (Ho, 2018) gen. et comb. nov. Two new species are described in the new genus: *M. khoii* gen. et sp. nov. from Chu Yang Sin and Ta Dung National Parks and *M. montanus* gen. et sp. nov. from Chu Yang Sin and Bidoup-Nui Ba National Parks. For all species, adults of both sexes, nymphs and eggs of wild and captive bred origin are described and figured. Pictures of living specimens, and distribution maps of the species of both genera are provided. The male vomer was dissected for all treated species and is described and figured. The relationship of the herein treated genera to closely related taxa is discussed and supported with recent phylogenetic studies.

Keywords. Phasmatoidea, ootaxonomy, *Nuichua*, *Oxyartes*, Da Lat Plateau, Kon Tum Plateau.

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Introduction

The Asian and Australasian subfamily Necrosiinae Brunner von Wattenwyl, 1893 is the most species-rich and ecologically diverse subfamily in Phasmatoidea Jacobson & Bianchi, 1902 (Goldberg *et al.* 2015; Robertson *et al.* 2018). The Necrosiinae have been estimated as originating approximately 30 Ma ago with their highest diversity recorded in Southeast Asia (Hennemann & Conle 2013; Goldberg *et al.* 2015; Robertson *et al.* 2018; Brock *et al.* 2024). Necrosiinae are well known for their high diversity in egg deposition methods and egg morphology (Sellick 1997a, 1997b; Robertson *et al.* 2018) possibly

resulting from multiple evolutionary drivers such as parasitism pressure (Bresseel & Constant 2021) or egg dispersal by ants (myrmecochory) (Yamada *et al.* 2021). Currently, 63 genera are known, of which 25 are recorded from Vietnam (Brock *et al.* 2024).

Molecular studies have shown that Necrosiinae represents the sister group of Lonchodinae Brunner von Wattenwyl, 1893 which recently resulted in the re-establishment and redefinition of the family Lonchodidae Brunner von Wattenwyl, 1893 (Bradler *et al.* 2014; Robertson *et al.* 2018). Unlike the Lonchodinae, there is no current consensus on subdividing Necrosiinae in different tribes (Brock *et al.* 2024)

In Bank & Bradler (2022), a well-supported “Neohirasea clade” was recovered which was comprised of: *Phaenopharos* Kirby, 1904; *Oxyartes* Stål, 1875; *Paramenexenus* Redtenbacher, 1908; *Conlephasma* Gottardo & Heller, 2012; *Nuichua* Bresseel & Constant, 2018; *Neooxyartes* Ho, 2018; *Brockphasma* Ho, Liu, Bresseel & Constant, 2014; *Neohirasea* Rehn, 1904; *Spinohirasea* Zompro, 2002 and *Andropromachus* Carl, 1913. This grouping was previously recognized on morphological grounds by different authors, such as Bresseel & Constant (2018) who suggested a close relationship between *Nuichua*, *Neooxyartes* (under the synonymic name *Pterohirasea* Bresseel & Constant, 2018) and the “Neohirasea clade”; whereas Hennemann & Conle (2008) had previously recognized a tribe, the Neohiraseini, based on the morphological similarity of *Andropromachus*, *Neohirasea*, *Spinohirasea*, *Qiongphasma* Chen, He & Li, 2002 and *Pseudocentema* Chen, He & Li, 2002.

The identification of stick insect material belonging to the *Neohirasea* clade, collected in the framework of the Global Taxonomy Initiative project “A step further in the entomodiversity of Vietnam” allowed us to discover two undescribed species of the currently monospecific genus *Neooxyartes* and a closely related new genus with two new species described below.

Material and methods

The specimens of the treated taxa are nocturnal and were collected at night with the help of lightweight and water-proof head torches: Petzl MYO RXP. The females were kept alive in a mesh pop up cage (exo terra explorarium™) for producing eggs. First generation hatchlings were reared to adulthood by Mr Tim Bollens (Belgium). The wild caught specimens were euthanized by ethylacetate fumes, then individually placed in chop stick paper envelopes and stored in airtight plastic “zip”-bags in wood chips (used in rodent cages) and sprinkled with ethylacetate (EtOAc) to prevent rotting and mould, and for keeping the specimens flexible. The bags were frozen on arrival and the specimens mounted later.

The photographs of the preserved specimens were taken with a Canon EOS 700 D camera equipped with a Sigma DG Macro lens. Photographs of the eggs, vomers and terminalia of *Neooxyartes* and *Mycovartes* gen. nov. specimens, were taken with a Leica EZ4W stereo microscope with an integrated camera, stacked with CombineZ software and optimized with Adobe Photoshop CS3. The photographs of the live specimens were taken with a Sony DSC-H300 digital camera by JC, except otherwise credited in the captions. Observations were done with a Leica MZ8 stereo microscope. Measurements were done with an electronic caliper. The distribution maps were produced with SimpleMappr (Shorthouse 2010).

The classification follows the Phasmida Species File (PSF), a continuously updated taxonomic database of the world’s stick and leaf insects (Brock *et al.* 2024).

The nomenclature for the morphological characters follows Bragg (2001); the egg morphology follows that of Sellick (1997b, 1998). Generic placement in Necrosiinae follows Bresseel & Constant (2018). The description of the colouration is based on live specimens.

Acronyms used for the collections

FH	=	Frank Hennemann collection, Bad Homburg, Germany
HKES	=	Hong Kong Entomological Society, Hong Kong
MMUE	=	Manchester Museum, Manchester University, UK
RBINS	=	Royal Belgian Institute of Natural Sciences, Brussels, Belgium
VNMN	=	Vietnam National Museum of Nature, Hanoi, Vietnam

Abbreviations

HT	=	holotype
N.P.	=	National Park
N.R.	=	Nature Reserve
PT	=	paratype

Results

Class Insecta Linnaeus, 1758
Order Phasmatodea Jacobson & Bianchi, 1902
Family Lonchodidae Brunner von Wattenwyl, 1893
Subfamily Necrosiinae Brunner von Wattenwyl, 1893

Genus *Mycovartes* gen. nov.

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Type species

Mycovartes montanus gen. et sp. nov, by present designation.

Etymology

The prefix ‘myco-’ is derived from Ancient Greek μύκης (‘múkēs’, ‘mushroom or fungus’) and refers to the mushroom-like structures on the eggs of all species in the genus, the ending ‘artes’ refers to the phenotypical resemblance of the new genus with *Oxyartes*. Gender masculine.

Diagnosis and differentiation

Elongate, slender and cryptically coloured Necrosiinae, superficially resembling the genus *Oxyartes*. *Oxyartes* males differ by the deep, cup-shaped poculum; females lack the elongate and tapering anal segment and the eggs have a capitular structure on the operculum. The new genus is most closely related to *Neooxyartes* and *Nuichua*. From *Neooxyartes* it is easily distinguished by the absence of “prosternal sensory organs” (Bresseel & Constant 2018: fig. 9) and the armature on the legs. From *Nuichua* it is separated by the cryptic body colour, the strongly laterally compressed mesofemora, the raised and undulate posteroventral carina of the metafemora, the presence of small colourful alae and the shape of the female’s anal segment which is pointed and apically incised.

Differing from other Necrosiinae by the combination of the following characters:

- 1) Elongate and slender body.
- 2) Very small, colourful, rounded alae without distinct venation.
- 3) Tegmina very small to absent.
- 4) Prosternum without “sensory area” sensu Bresseel & Constant (2018).
- 5) Anal segment of females tapering towards the posterior with distinctly incised apex, giving it an arrowhead impression in dorsal view.
- 6) Male poculum shallow, only slightly projecting over posterior margin of tergum IX and rounded posteriorly.

- 7) Variable posteromedian protuberance at least on terga VI–VII and sometimes on II–VII, often spine-like.
- 8) Posteroventral carina of the metafemora somewhat raised and undulate; meso- and metafemora with few apical teeth ventrally.
- 9) Vomer tapering towards the posterior, apex bifurcate.
- 10) Sternum VII without distinct praeopercular organ, but medially with three longitudinal carinae which are straighter and somewhat thicker posteriorly.
- 11) No specialised egg deposition method with eggs simply dropped, egg capsule oval to sub-oval, operculum without distinct capitular structure.
- 12) Egg capsule reticulated with minute mushroom-like structures/protuberances.

Description

Male and female

Medium-sized (body length up to 10 cm), typically stick-shaped insects similar to the genus *Oxyartes*. Shape fairly slender with rugose bodies and with small colourful alae in both sexes, ranging from yellow to orange; alae not reaching halfway on the median segment. Body colouration cryptic, showing a wide variation but usually consisting of different shades of brown, sometimes ornamented with green or white parts; in rare cases predominantly white.

Sexual dimorphism with ♂♂ smaller and much slenderer than ♀♀, otherwise very similar.

Head longer than wide, approximately rectangular in dorsal view and rugose. Antennae filiform, distinctly shorter than body. Thorax rugose with pro-, meso- and metanotum nearly parallel-sided. Pronotum about as long as head; mesonotum elongated, cylindrical in cross-section; metanotum short. Micropterous, tegmina, if present, scalelike, reaching bases of alae; alae present in all species with outer margin broadly rounded, inner margin straight (when wings are folded). Legs comparatively short with femora and tibiae laterally flattened. Median and abdominal segments rugose, abdominal terga with variable posteromedial armature. Females anal segment arrowhead-shaped in dorsal view, apex narrow, pointed, but distinctly incised posteromedially. Subgenital plate shallow, short, with a distinct mediolongitudinal carina. Male anal segment posteromedially indistinctly notched; ventral portion armed with minute blackish spines/tubercles near posterior margin. Poculum shallow, scoop-shaped, reaching to/slightly projecting over, the posterior margin of tergum IX; rounded posteriorly. Vomer well developed, approximately triangular; basal portion broad, narrowing toward the posterior; apicomediaally split into two teeth.

Species included

Mycovartes khoii gen. et sp. nov. [Vietnam, Chu Yang Sin N.P.; Vietnam, Ta Dung N.P.]

Mycovartes montanus gen. et sp. nov. [Vietnam, Chu Yang Sin N.P. and Bidoup-Nui Ba N.P.]

Mycovartes vietnamensis (Ho, 2018) gen. et comb. nov. [Vietnam, Kon Chu Rang N.R. and Kon plong]

Keys to the species of *Mycovartes* gen. nov.

1. Anterior margin of mesonotum unarmed, anal area of hind wing yellow (Fig. 16E)
..... *M. vietnamensis* Ho, 2018 gen. et comb. nov.
– Anterior margin of mesonotum armed with several spines, anal area of hind wing orange (Figs 6E, 13C) 2
2. Tegmina micropterous, reaching base of alae (Fig. 13C) *M. montanus* gen. et sp. nov.
– Tegmina indistinct (Fig. 6E) *M. khoii* gen. et sp. nov.

Distribution

The genus is restricted to the Truong Son Range with *Mycovartes vietnamensis* gen. et comb. nov. from the Kontum Plateau and *Mycovartes khoii* gen. et sp. nov. and *Mycovartes montanus* gen. et sp. nov. from the Dac Lac Plateau (Fig. 1).

Mycovartes khoii gen. et sp. nov.

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Figs 1–7

Diagnosis

Readily distinguishable from congenetics by the combination of the absence of tegmina and the orange colour of the anal part of the micropterous alae.

Etymology

The species epithet is a patronym dedicated to Mr Nguyễn Văn Khôi (Hanoi, Vietnam), our driver during many expeditions in the framework of the Global Taxonomy Initiative projects for over more than 10 years.

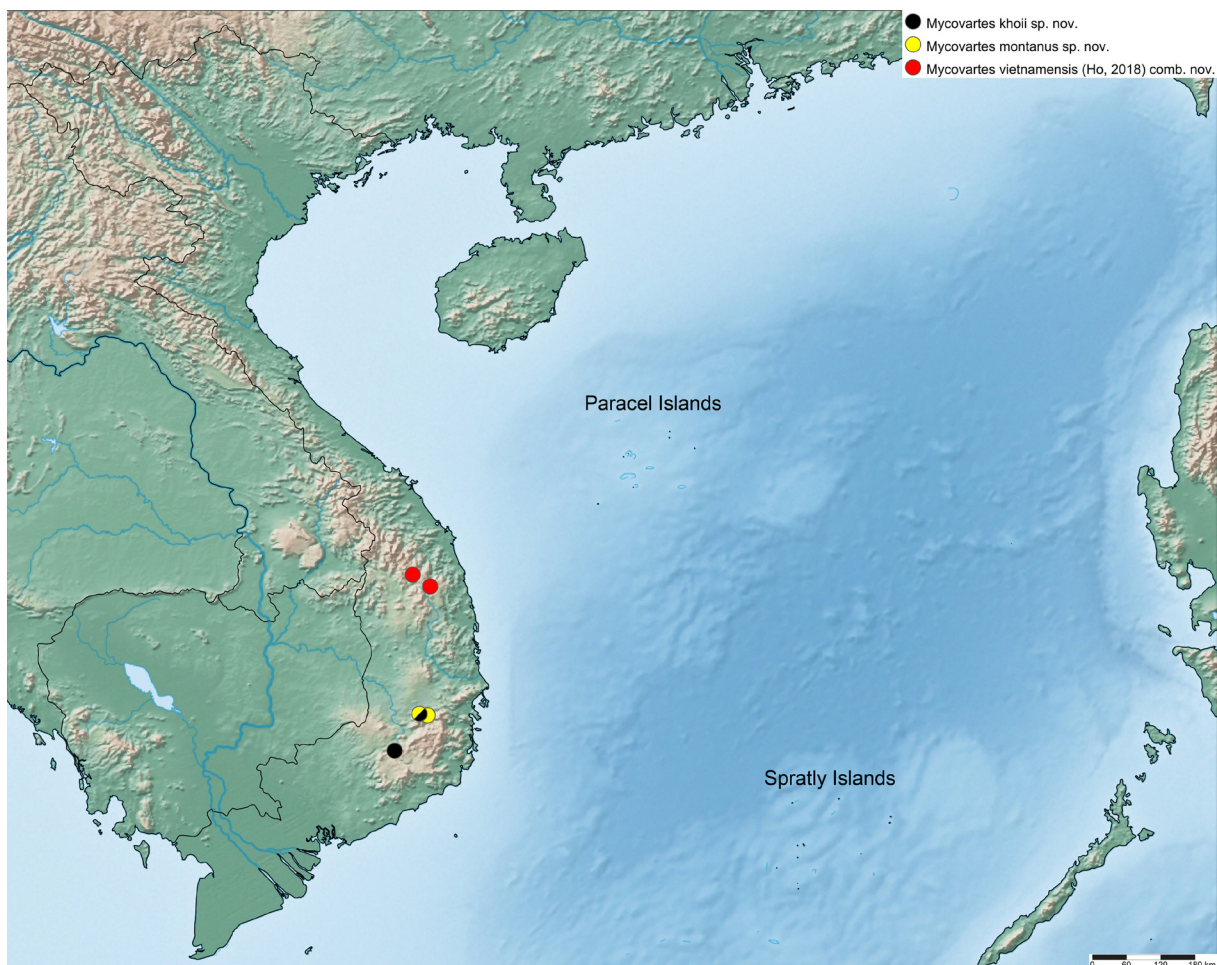


Fig. 1. *Mycovartes* gen. nov., distribution map.

Type material

Holotype

VIETNAM • ♂; Dak Lak Province, Chu Yang Sin N.P.; 12°27'24" N, 108°22'15" E; 9–15 Aug. 2019; 650–1000 m a.s.l.; GTI Project; J. Constant and J. Bresseel leg.; I.G.:34.048; RBINS.

Paratypes (19 ♂♂, 21 ♀♀)

VIETNAM – **Dak Lak Province** • 3 ♂♂, 1 ♀; same data as for holotype; RBINS • 2 ♂♂, 1 ♀; same data as for holotype; VNMN • 4 ♂♂, 5 ♀♀; same data as for holotype; ex breeding T. Bollens; 2021; RBINS • 2 ♂♂, 2 ♀♀; same data as for preceding; VNMN • 7 ♂♂, 9 ♀♀; same data as for preceding; FH 1282 1 to 16. – **Dak Nong Province** • 1 ♂, 2 ♀♀; Ta Dung N.P.; 11°52'22" N, 107°58'40" E; 5–8 Aug. 2019; GTI Project; J. Constant and J. Bresseel leg.; I.G.:34.048; RBINS • 1 ♀; same data as for preceding; VNMN.

Additional material

VIETNAM • eggs: same data as for holotype; ex breeding T. Bollens, 2021; RBINS.

Description

MEASUREMENTS. See Table 1.

Male (Figs 2, 3A, 4, 6A)

HEAD. Longer than wide, approximately rectangular in dorsal view and rugose. Dorsal portion fairly flat, with area between eyes slightly raised and granulose. Head capsule with several golden-brown tubercles. Back of head with six vague humps divided by shallow longitudinal furrows, central humps slightly more prominent. Eyes circular and strongly projecting. Antennae filiform, distinctly shorter than body with around 40 segments. Scapus dorso-ventrally flattened, lateral margins rounded, and broader than antennomeres. Pedicellus short, knob-like and circular in cross-section.

THORAX. Pronotum about as long as head, longer than wide and slightly constricted medially, anterior margin concave, posterior margin somewhat convex; with faint mediolongitudinal line and shallow transverse furrow medially. Dorsal surface with several scattered golden-brown tubercles. Mesonotum narrow and elongate with faint mediolongitudinal line, more than four times the length of pronotum. Anterior margin with four small but acute golden-brown spines; central pair not symmetrical, sometimes followed by few minute conical spines. Other portions with scattered golden-brown tubercles. Metanotum short, about two thirds of median segment with scattered golden-brown tubercles, anterior margin straight, posterior margin incurved.

WINGS. Tegmina absent. Alae very small, only slightly projecting over metanotum; costal area rugose, coloured as body; anal area orange without distinct venation.

LEGS. Profemora incurved basally and laterally flattened; all carinae present, with minute setae. Anterodorsal carina somewhat raised with pair of minute teeth distally. Mesofemora straight basally and laterally flattened; almost one third shorter than profemora. Medioventral carina indistinct, outer ventral carinae with pair of minute spines. Metafemora slightly longer than profemora, shaped as mesofemora. Protibiae slightly longer than profemora, somewhat laterally flattened. All carinae with minute stiff black setae. Mesotibiae about as long as mesofemora, metatibiae distinctly longer than corresponding femora. Meso- and metatibiae shaped as protibiae.

ABDOMEN. Median segment rugose, about one third longer than metanotum. Terga II–IX rugose, with posteromedian tubercle to flattened spine. Terga II–V more or less of same length, terga VI–X gradually shortening. Tergum II with posteromedian small spine, III–V with posteromedian armature gradually

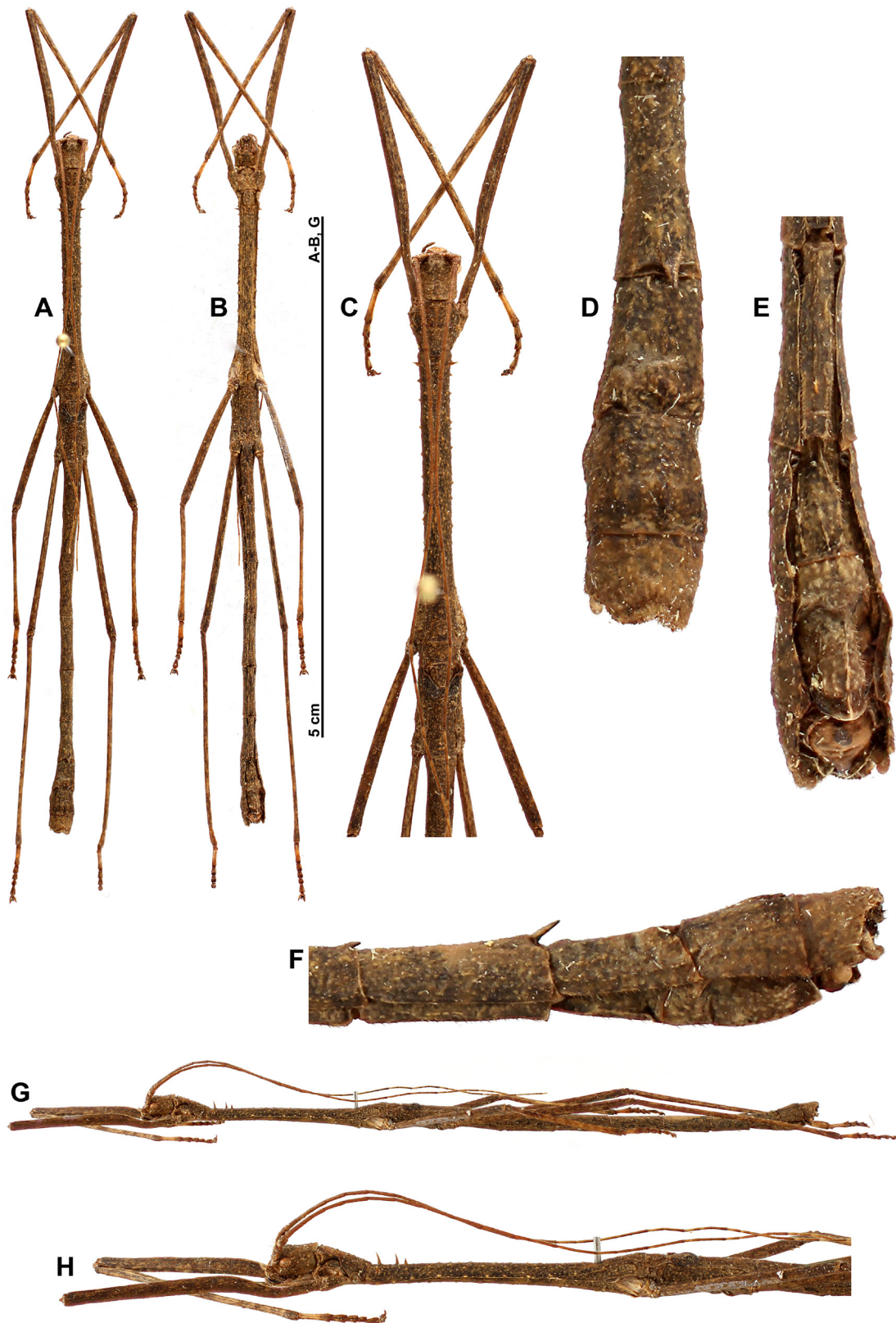


Fig. 2. *Mycovartes khoii* gen. et sp. nov., holotype, ♂ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, ventral view. **C.** Head and thorax, dorsal view. **D.** Terminalia, dorsal view. **E.** Terminalia, ventral view. **F.** Terminalia, lateral view. **G.** Habitus, lateral view. **H.** Head and thorax, lateral view.



Fig. 3. *Mycovartes khoii* gen. et sp. nov. in situ. **A.** ♂ from Chu Yang Sin N.P. **B.** ♀ from Ta Dung N.P.

decreasing in size; IV and V often with indistinct tubercle posteromedially. Tergum VI slightly shorter than preceding segments with minute spine posteromedially, VII with flattened, small but acute spine posteromedially projecting over its posterior margin. Tergum VIII distinctly shorter than VII, somewhat trapezoidal with posteromedian hump; tergum IX with indistinct median carinae ending in blunt hump posteromedially. Anal segment somewhat tectiform with posteromedian shallow notch, lateral margins sinuate; ventral portion armed with minute blackish spines/tubercles. Poculum shallow, reaching to/ slightly projecting over posterior margin of tergum IX and rounded posteriorly. Posteriorly with short mediolongitudinal carina. Vomer well developed, approximately triangular; basal portion broad, somewhat swollen, slightly narrowing toward the posterior and gently converging with the posterior half; posterior portion gradually narrowing with two asymmetrical upcurving teeth (Fig. 4). Cerci short, reaching apex of anal segment, round in cross-section with apex rounded and incurving.

Female (Figs 3B, 5, 6B–E)

HEAD. Longer than wide, more or less rectangular in dorsal view and rugose. Dorsal portion fairly flat, head capsule with several goldish coloured tubercles. Back of head with six vague humps divided by shallow longitudinal furrows, central humps slightly more prominent. Eyes circular and projecting. Antennae filiform with between 40 and 50 segments, distinctly shorter than the body, not reaching halfway along the abdomen. Scapus somewhat dorsoventrally flattened, lateral margins rounded and broader than antennomeres. Pedicellus short, knob-like and circular in cross-section.

THORAX. Pronotum about as long as head and visibly longer than wide. Anterior margin concave, posterior margin almost straight, somewhat rounded; lateral margin distinctly concave. Dorsally with

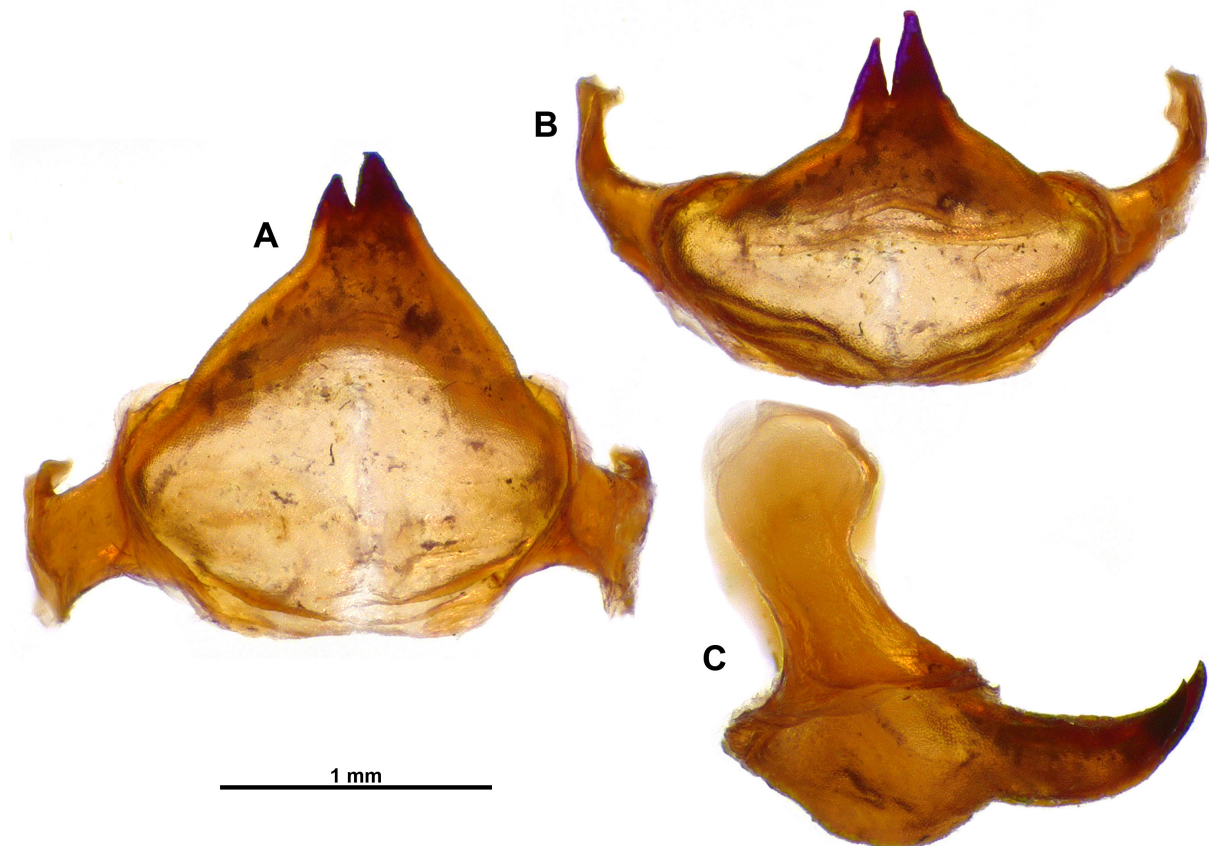


Fig. 4. *Mycovartes khoii* gen. et sp. nov., ♂ vomer. **A.** Ventral view. **B.** Posteroventral view. **C.** Lateral view.

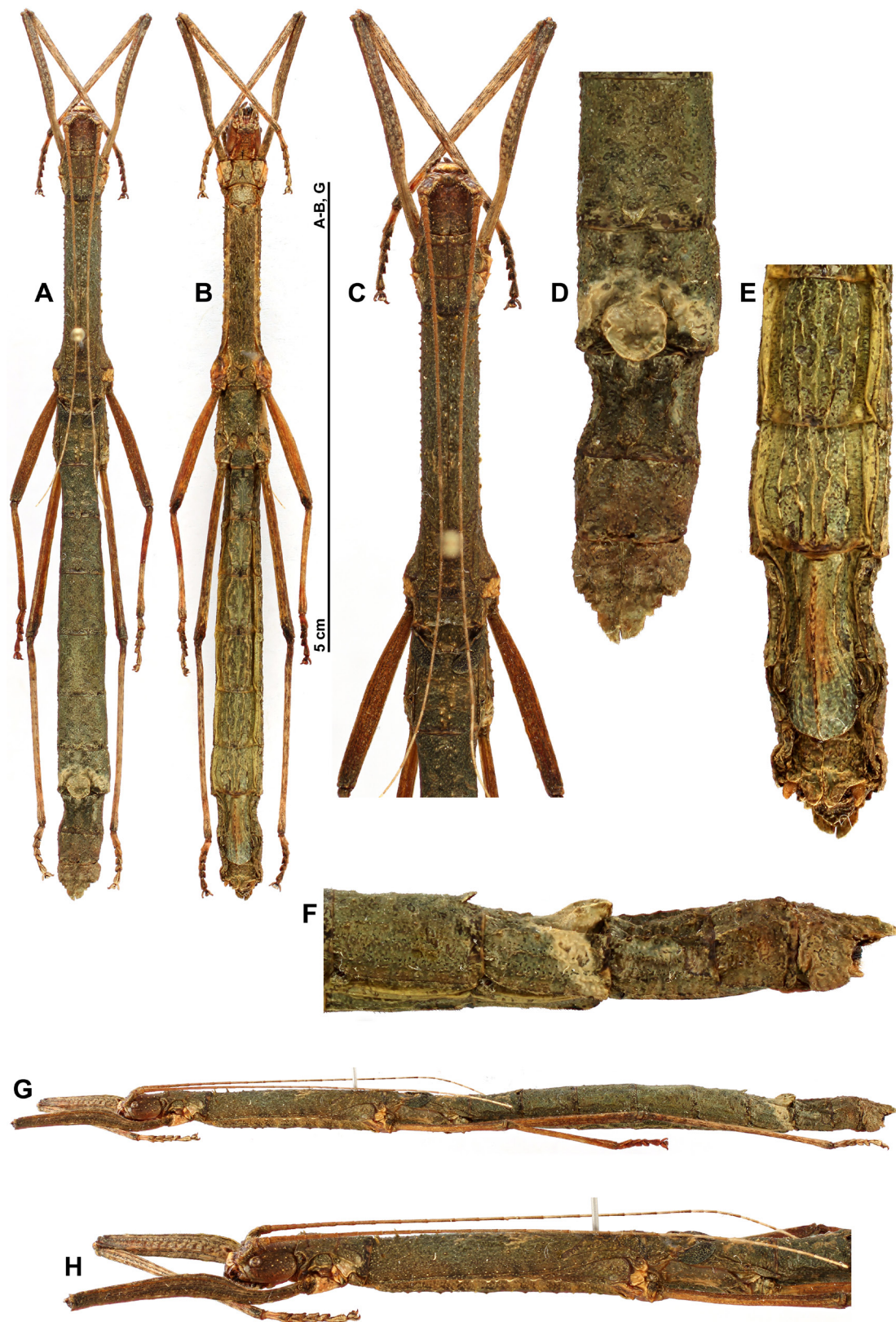


Fig. 5. *Mycovartes khoii* gen. et sp. nov., paratype, ♀ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, ventral view. **C.** Head and thorax, dorsal view. **D.** Terminalia, dorsal view. **E.** Terminalia, ventral view. **F.** Terminalia, lateral view. **G.** Habitus, ventral view. **H.** Head and thorax, lateral view.

faint mediolongitudinal line and shallow transverse, slightly incurved, furrow medially. Dorsal surface with several scattered golden-brown tubercles; anterior margin with four tubercles. Mesonotum elongate with faint mediolongitudinal line, slightly shorter than four times the length of pronotum. Anterior margin with four small, narrow but acute spines; spine arrangements variable, sometimes followed by few minute conical spines. Other portions with scattered golden-brown tubercles. Mesopleura with longitudinal carina armed with minute lobes. Metanotum short, about two thirds the length of median segment with scattered golden-brown tubercles, anterior margin straight, posterior margin incurved.

WINGS. Tegmina absent. Alae very small, only slightly projecting over metanotum; costal area rugose, coloured as body; anal area orange without distinct venation; outer margin rounded, inner margin straight.

LEGS. Profemora incurved basally and laterally flattened; all carinae present, armed with minute setae. Anterodorsal carina somewhat raised and indistinctly sinuate. Mesofemora straight basally and laterally flattened; slightly shorter than profemora. Medioventral carina indistinct, posteroventral carinae with pair of minute spines posteriorly. Metafemora slightly longer than profemora, shaped as mesofemora. Protibiae slightly longer than profemora, somewhat laterally flattened and carinate. Mesotibiae slightly shorter than mesofemora. Metatibiae longer than corresponding femora. Meso- and metatibiae shaped as protibiae.

ABDOMEN. Median segment rugose, about one third longer than metanotum. Abdominal terga rugose; terga II–VI more or less of same length, VII–IX gradually shortening. Abdominal terga II–IX rugose with posteromedian armature; posteromedial process on these terga ranging from absent to a small granule, hump or minute flattened spine or to a broad circular process. Largest armature present on tergum VII; armature on all terga subject to strong variation. Tergum VIII distinctly shorter than VII, somewhat trapezoidal with posteromedian small hump; tergum IX with indistinct median carinae ending in blunt hump posteromedially. Anal segment arrowhead-shaped in dorsal view, basal portion broad and laterally somewhat rounded, thereafter narrowing towards the posterior with lateral margins strongly crenulate; apex narrow, pointed, but distinctly incised posteromedially. Subgenital plate short, reaching posterior margin of tergum IX, with distinct mediolongitudinal carina; posterior half with lateral margins rounded; posterior margin rounded with tiny triangular protuberance medially. Sternum VII without distinct praeopercular organ, medially with three irregular longitudinal carinae which are straighter and somewhat thicker posteriorly. Cerci short, not reaching apex of anal segment, tapering towards the posterior with a blunt, slightly incurved apex.

Nymph (Fig. 6F)

Newly hatched nymphs slender and predominantly pale brown. Head bigger than pronotum, with darker postocular- and mediolongitudinal stripes. Mediolongitudinal darker stripe continuing on pro- and mesonotum though less distinct. Mesonotum, median segment and abdominal terga II–IX with small black posteromedian marking. Antennae brown with last two segments whitish. Legs coloured as body with apex of metafemora blackish.

Egg (Fig. 7)

Measurements (in mm): length: 2.5; width: 1.8; height: 2.0.

Capsule more or less oval with polar area somewhat flattened towards the dorsal surface, distinctly smaller than both other species in the genus. Colouration pale brown with unevenly dispersed and irregularly shaped black markings (sometimes almost absent); pale brown areas on capsule surface with minute, pale, mushroom-like armature. Micropylar plate positioned almost centrally on capsule but slightly displaced towards polar area; drop-shaped in outline, with anterior margin tapered and posterior margin rounded (somewhat variable); surface smooth with mediolongitudinal carina. Micropylar cup

small. Micropylar plate posteriorly followed by a definite mediolongitudinal black line reaching polar area. Polar area blackish with pale center and unarmed. Operculum oval and convex; central portion with minute, pale, mushroom-like excrescences; portion with armature broader when compared with the two congeneric species. Other portions of operculum coloured darker than center and with somewhat thickened opercular rim.

Biology

The species was collected in mountainous tropical evergreen rainforest, at medium altitude (650–1000 m a.s.l.). The specimens were observed on low vegetation and seemed to feed on a variety of plant species. The eggs are dropped to the ground.



Fig. 6. *Mycovartes khoii* gen. et sp. nov. **A.** ♂, dorsal view. **B.** ♀, dorsal view. **C.** ♀ terminalia, dorsal view. **D.** ♀ terminalia, dorsolateral view. **E.** ♀ wings. **F.** Newly hatched nymph. Photographs ©T. Bollens.



Fig. 7. *Mycovartes khoii* gen. et sp. nov., eggs (RBINS). A. Lateral view. B. Dorsal view. C. Operculum. D. Ventral view. E. Dorsolateral view. F. Anterolateral view. G. Posterodorsal view. H. Polar area. I. Variation.

Table 1. Measurements (mm) of *Mycovartes khoii* gen. et sp. nov.

Length of	HT ♂	♂♂	♀♀
Body	66.2	56.4–69.1	83.1–85.8
Head	3.3	3.2–3.8	5.2–5.6
Pronotum	3.5	3.2–3.8	5.1–5.5
Mesonotum	17.6	14.6–17.1	19.6–19.8
Metanotum	2.8	2.5–2.9	3.7–3.9
Median segment	4.2	3.5–4.4	5.4–5.5
Tegmina	–	–	–
Alae	2.1	1.7–2.2	3.4–3.6
Profemora	15.5	13.0–15.7	15.8–15.9
Mesofemora	11.6	9.8–12.1	13.3–13.5
Metafemora	16.8	13.8–17.2	17.9–18.8
Protibiae	17.0	14.2–17.2	16.3–16.9
Mesotibiae	11.5	9.7–11.5	11.7–12.5
Metatibiae	20.1	16.8–20.8	19.7–21.1

In captivity, the species accepts *Rubus* sp. and other Rosaceae Juss., *Corylus avellana* L. and *Carpinus betulus* L. (Betulaceae Gray) as food plants.

Distribution

This species is known from Chu Yang Sin N.P. and Ta Dung N.P. Both localities are situated on the Da Lat Plateau (also known as the Langbian plateau) in the Southern Annamites (Fig. 1).

Mycovartes montanus gen. et sp. nov.

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Figs 1, 8–14

Diagnosis

Readily distinguishable from both congeneric species by the presence of scale-like tegmina that reach the base of the micropterous alae.

Etymology

The species epithet ‘*montanus*’ is the adjective derived from the Latin word ‘*mons*’ meaning ‘mountain’ and refers to the high altitude where this species was collected.

Type material

Holotype

VIETNAM • ♂; Dak Lak Province, Chu Yang Sin N.P.; 1600 m a.s.l.; 12°27'24" N, 108°22'15" E; 12–14 Aug. 2019; GTI Project; ex breeding Tim Bollens 2019; J. Constant and J. Bresseel leg.; I.G.:34.048; RBINS.

Paratypes (1 ♂, 5 ♀♀)

VIETNAM – **Dak Lak Province** • 1 ♂, 1 ♀; same data as for holotype; RBINS • 1 ♀; Chu Yang Sin N.P.; 1600 m a.s.l., 12°27'24" N, 108°22'15" E; 12–14 Aug. 2019; GTI Project; J. Constant and

J. Bresseel leg.; I.G.:34.048; RBINS. – **Lam Dong Province** • 1 ♀; same data as for preceding; VNMN • 1 ♀; Bidoup-Nui Ba N.P.; 12°26' N, 108°30' E; 21–25 Jul. 2014; night collecting; J. Constant and J. Bresseel leg.; GTI Project; I.G.: 32.779; RBINS • 1 ♀; same data as for preceding; ex breeding K. Rabaey, 2015; RBINS.

Additional material

Eggs

VIETNAM • Lam Dong Province, Bidoup-Nui Ba N.P.; 12°26' N, 108°30' E; 21–25 Jul. 2014; night collecting; J. Constant and J. Bresseel leg.; GTI Project; I.G.: 32.779; ex breeding K. Rabaey, 2015; RBINS.

Description

MEASUREMENTS. See Table 2.

Male (Figs 8–10, 13A–B)

HEAD. Longer than wide, approximately rectangular in dorsal view and rugose. Dorsal portion fairly flat, with area between eyes slightly raised and granulose. Head capsule with several golden-brown tubercles. Back of head with six vague humps divided by shallow longitudinal furrows, central humps slightly more prominent. Eyes circular and strongly projecting. Antennae filiform, distinctly shorter than body with around 40 segments. Scapus dorsoventrally flattened, lateral margins rounded and broader than antennomeres. Pedicellus short, knob-like and circular in cross-section. Pre-apical antennomeres very short.

THORAX. Pronotum about as long as head, longer than wide and slightly constricted medially, anterior margin concave, posterior margin somewhat convex; with faint mediolongitudinal line and shallow transverse furrow medially. Dorsal surface with several scattered orange to reddish brown tubercles. Mesonotum elongate, more or less parallel-sided and more than four times the length of pronotum. Anterior margin with four conical reddish brown spines; central pair not symmetrical; dorsally with several, reddish brown conical spines scattered over its surface except for posterior portion; lateral margins lined with, more or less evenly spaced, golden-brown tubercles. Metanotum short, about two thirds of median segment and unarmed, anterior margin straight, posterior margin concave.

WINGS. Tegmina short, micropterous, reaching bases of alae; distinctly raised, almost tectiform. Alae very small, only slightly projecting over metanotum; costal area rugose, coloured as body; anal area orange red without distinct venation. Outer margin broadly rounded, inner margin straight.

LEGS. Profemora incurved basally and laterally flattened; all carinae present, with minute setae. Mesofemora laterally flattened, medioventral carina indistinct, outer ventral carinae with pair of minute spines. Metafemora slightly longer than profemora, shaped as mesofemora. Protibiae slightly longer than profemora, somewhat laterally flattened. All carinae with minute stiff black setae. Mesotibiae about as long as mesofemora, metatibiae distinctly longer than corresponding femora. Meso- and metatibiae shaped as protibiae.

ABDOMEN. Median segment rugose, about one third longer than metanotum. Abdominal terga II–IX rugose with variable armature; posteromedial process ranging from absent to a small granule, hump or minute flattened spine or to a broad triangular process as can be observed on tergum VII in holotype; armature on terga subject to strong variation. Tergum VIII distinctly shorter than VII, somewhat trapezoidal; tergum IX with indistinct median carinae ending in blunt hump posteromedially. Anal segment with basal part parallel-sided, later narrowing with lateral margins concave, posterior portion with posteromedian shallow notch; ventral portion with minute blackish spines/tubercles near posterior

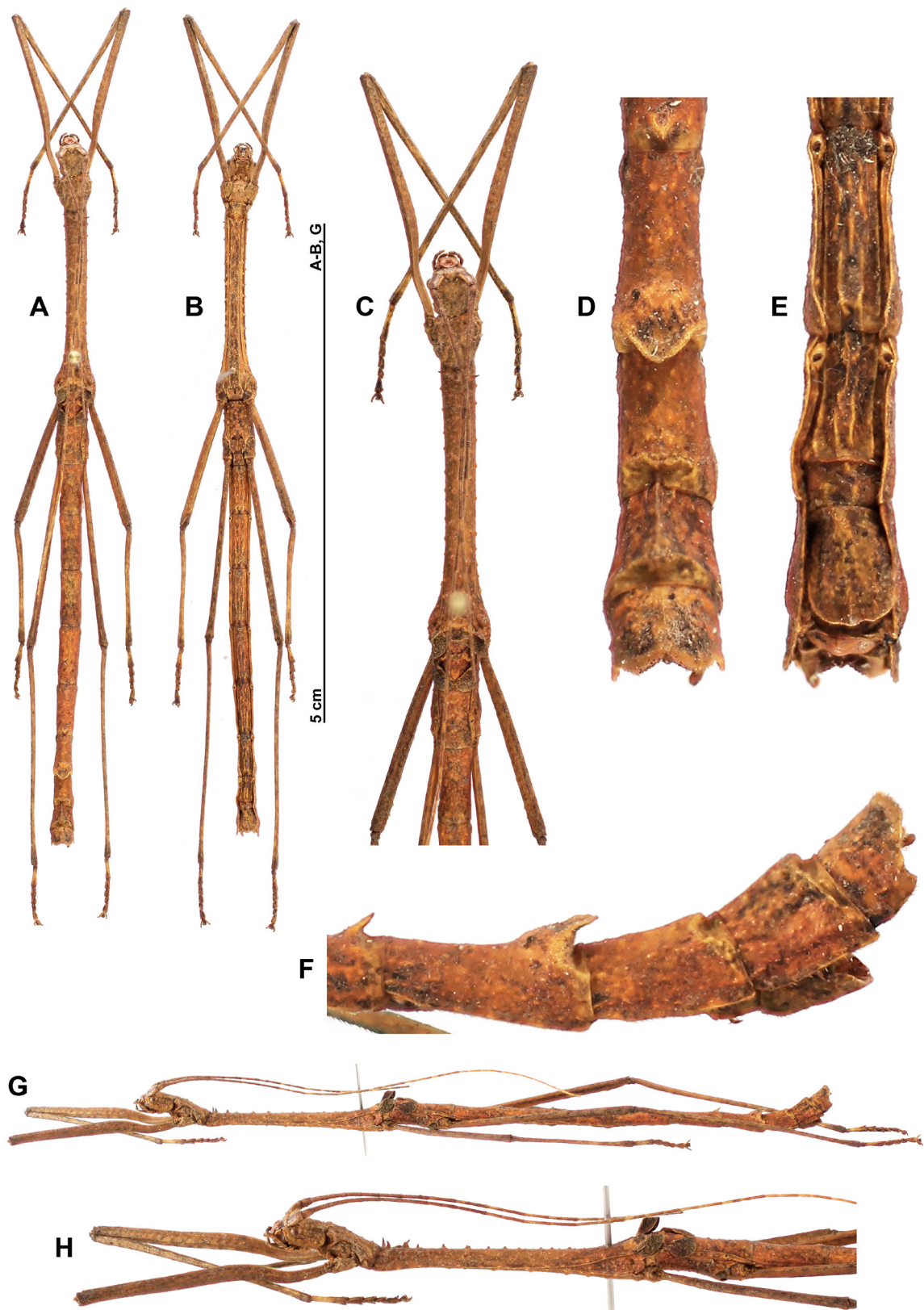


Fig. 8. *Mycovartes montanus* gen. et sp. nov., holotype, ♂ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, ventral view. **C.** Head and thorax, dorsal view. **D.** Terminalia, dorsal view. **E.** Terminalia, ventral view. **F.** Terminalia, lateral view. **G.** Habitus, lateral view. **H.** Head and thorax, lateral view.



Fig. 9. *Mycovartes montanus* gen. et sp. nov., ♂ in situ from Chu Yang Sin N.P. A. Lateral view. B. Head and thorax, lateral view. C. Head and thorax, dorsal view.

margin. Poculum shallow, spoon-shaped, reaching to slightly projecting over posterior margin of tergum IX and rounded posteriorly. Vomer well developed, approximately triangular; basal portion broad, somewhat swollen, slightly narrowing toward the posterior; posterior portion more strongly narrowing, medially split resulting into two, approximately symmetrical upcurving teeth (Fig. 10). Cerci short, reaching apex of anal segment; broad basally, narrowing in posterior half, approximately round in cross-section with apices rounded and incurving.

Female (Figs 11–12, 13B–C)

HEAD. Longer than wide, approximately rectangular in dorsal view and rugose. Dorsal portion fairly flat, with area between eyes slightly raised and granulose. Head capsule with several golden-brown tubercles. Back of head with six vague humps divided by shallow longitudinal furrows, central humps slightly more prominent. Eyes small, circular and strongly projecting. Antennae filiform with approximately 40 segments, distinctly shorter than the body. Scapus dorsoventrally flattened, lateral margins rounded and broader than antennomeres. Pedicellus short, knob-like and circular in cross-section.

THORAX. Pronotum about as long as head, longer than wide, anterior and lateral margins concave, posterior margin somewhat convex; with faint mediolongitudinal line and shallow transverse furrow medially. Dorsal surface with several scattered tubercles. Mesonotum elongate, approximately parallel-sided and about four times the length of pronotum. Anterior margin with pair of conical spines centrally, sometimes with 3–4 conical spines. Dorsal surface with several scattered tubercles. Metanotum short, about two thirds of median segment, unarmed and rugose.

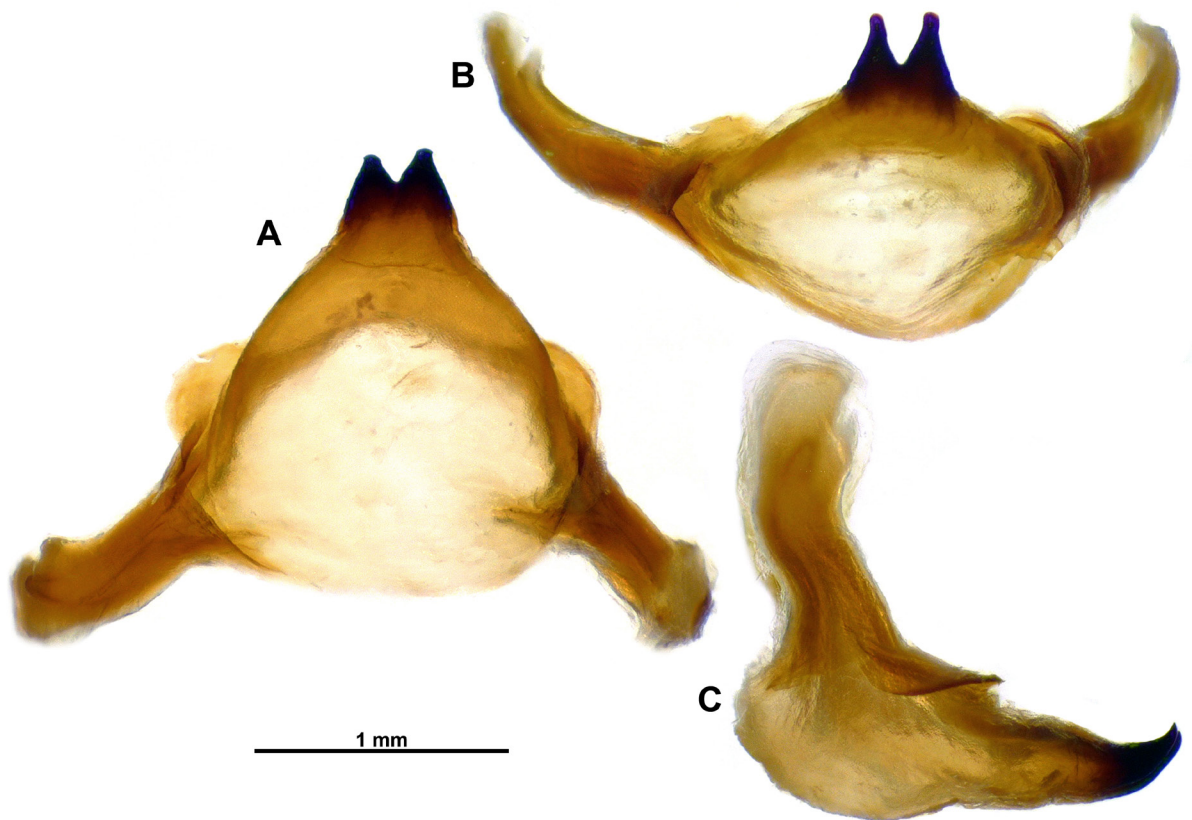


Fig. 10. *Mycovartes montanus* gen. et sp. nov., ♂ vomer. **A.** Ventral view. **B.** Posteroventral view. **C.** Lateral view.

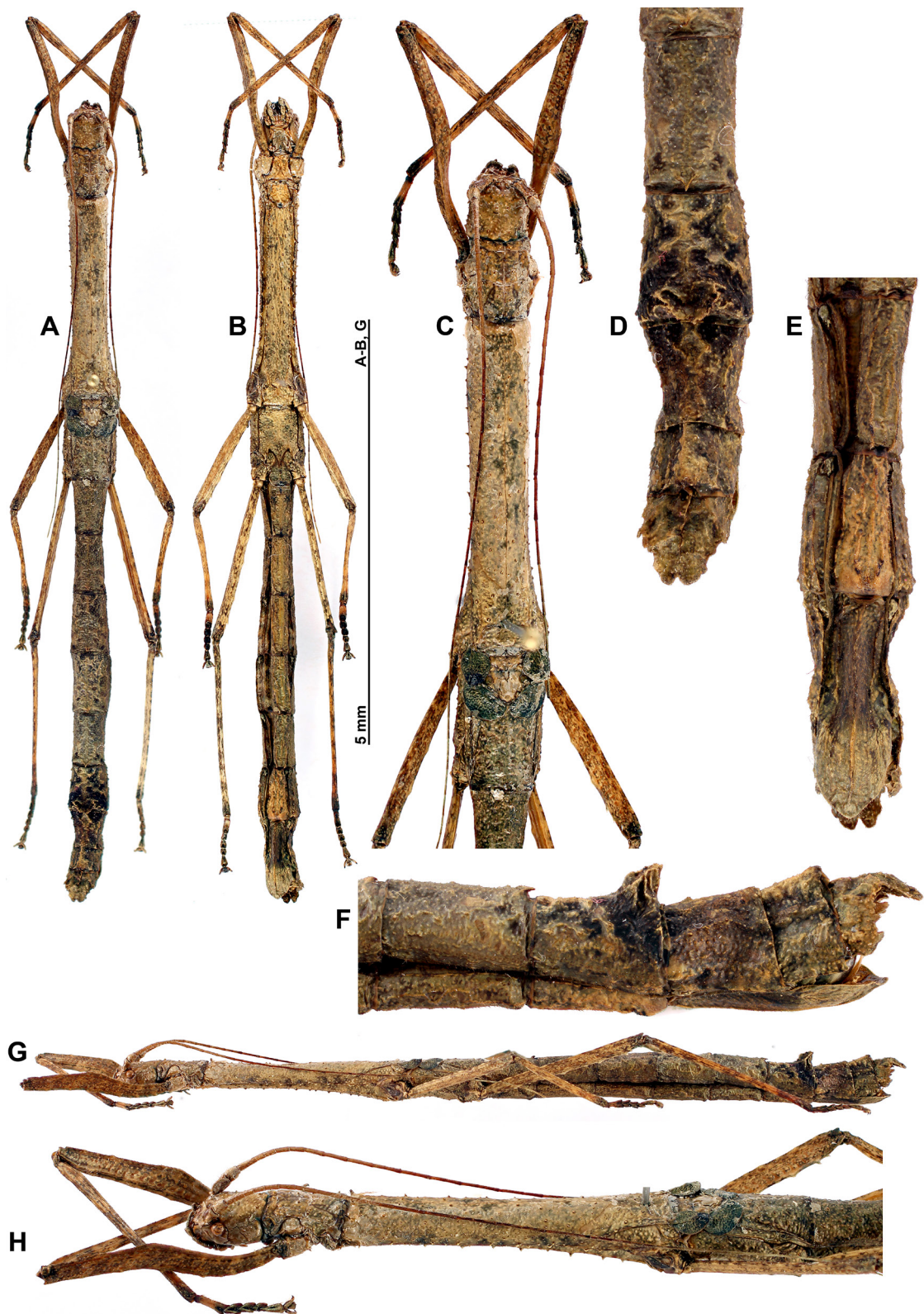


Fig. 11. *Mycovartes montanus* gen. et sp. nov., paratype, ♀ from Bidoup-Nui Ba N.P. (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, ventral view. **C.** Head and thorax, dorsal view. **D.** Terminalia, dorsal view. **E.** Terminalia, ventral view. **F.** Terminalia, lateral view. **G.** Habitus, ventral view. **H.** Head and thorax, lateral view.

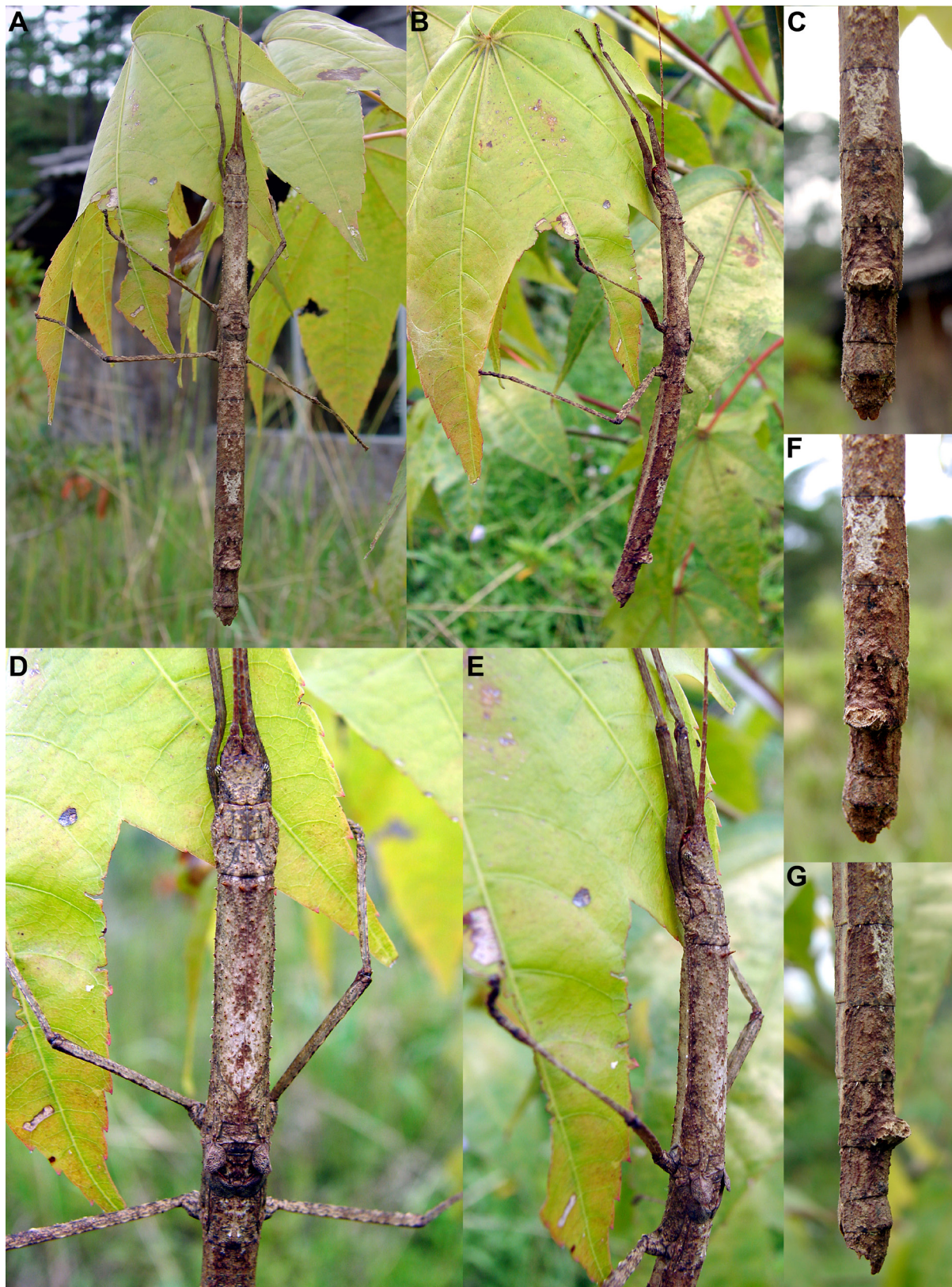


Fig. 12. *Mycovartes montanus* gen. et sp. nov., ♀ in situ from Bidoup-Nui Ba N.P. A. Dorsal view. B. Lateral view. C. Terminalia, dorsal view. D. Head and thorax, dorsal view. E. Head and thorax, dorsolateral view. F. Terminalia, dorsolateral view. G. Terminalia, lateral view.

WINGS. Tegmina short, micropterous, reaching bases of alae, with indistinct hump medially, almost circular in dorsal view. Alae very small, somewhat incurving, only slightly projecting over metanotum; costal area rugose, coloured as body; anal area bright orange without distinct venation. Outer margin broadly rounded, inner margin straight.

LEGS. Profemora incurved basally and laterally flattened; all carinae present, with minute setae. Anterodorsal and posteroventral carinae slightly raised and sinuate. Mesofemora laterally flattened, medioventral carina indistinct, posteroventral carinae slightly raised with few minute humps and with pair of minute spines distally; metafemora shaped as mesofemora. Protibiae about as long as profemora, somewhat laterally flattened; all carinae present and with minute stiff dark setae. Mesotibiae slightly shorter and metatibiae slightly longer than corresponding femora. Meso- and metatibiae straight, armed as protibiae.

ABDOMEN. Median segment rugose, almost twice as long as metanotum. Abdominal terga rugose; terga II–V all similar in length, VI–IX gradually shortening. Abdominal terga II–IX rugose with posteromedian armature; posteromedial process on these terga ranging from absent to a small granule, hump or minute flattened spine or to a broad circular or triangular process. Largest armature often on tergum VII sometimes absent; armature on all terga subject to strong intraspecific variation. Tergum VIII distinctly shorter than VII, somewhat trapezoidal with posteromedian small hump; tergum IX with indistinct median carinae ending in blunt hump posteromedially. Anal segment arrowhead-shaped in dorsal view, basal portion parallel-sided, later narrowing towards the posterior; apex elongate, narrow and distinctly incised posteromedially. Subgenital plate short, distinctly projecting over posterior margin of tergum IX with distinct mediolongitudinal carinae, not reaching apex of abdomen; lateral margins rounded; posterior margin somewhat rounded, later tapering towards the posterior and ending triangularly.

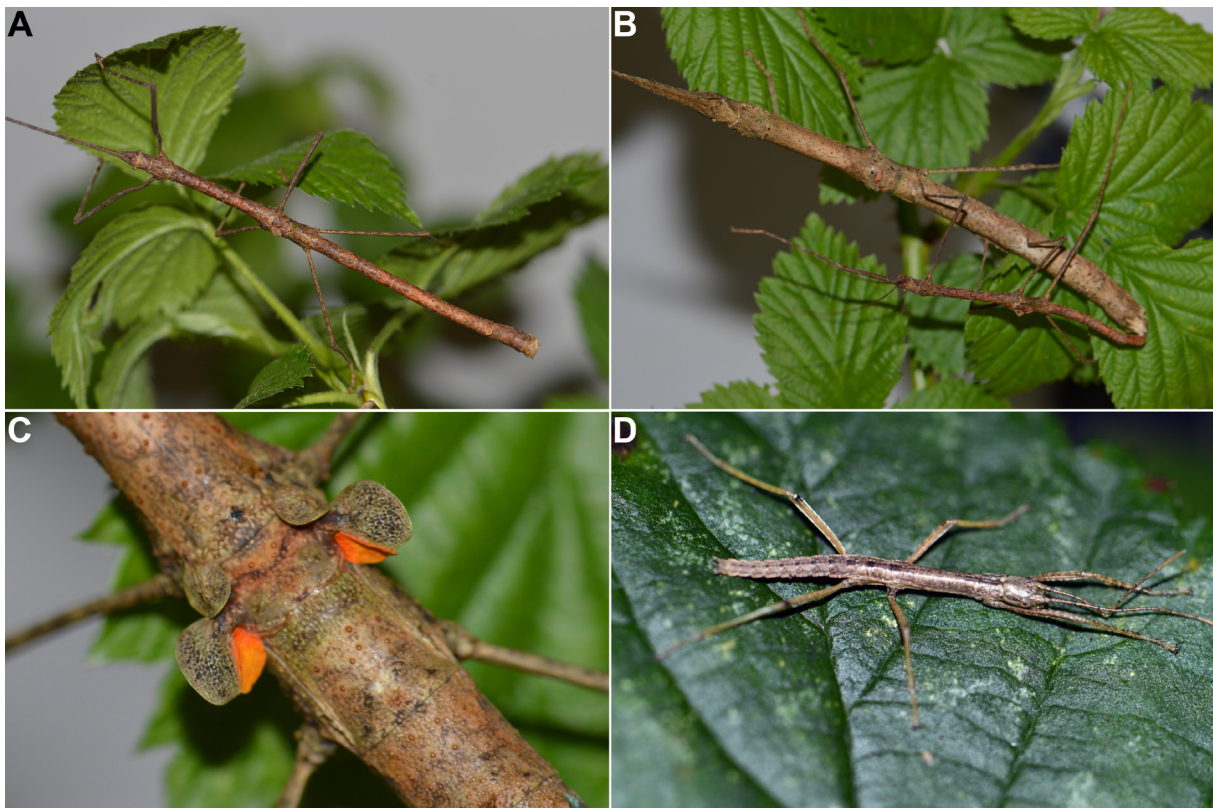


Fig. 13. *Mycovartes montanus* gen. et sp. nov. **A.** ♂, dorsal view. **B.** Mating pair. **C.** Wings. **D.** Newly hatched nymph. Photographs ©T. Bollens.

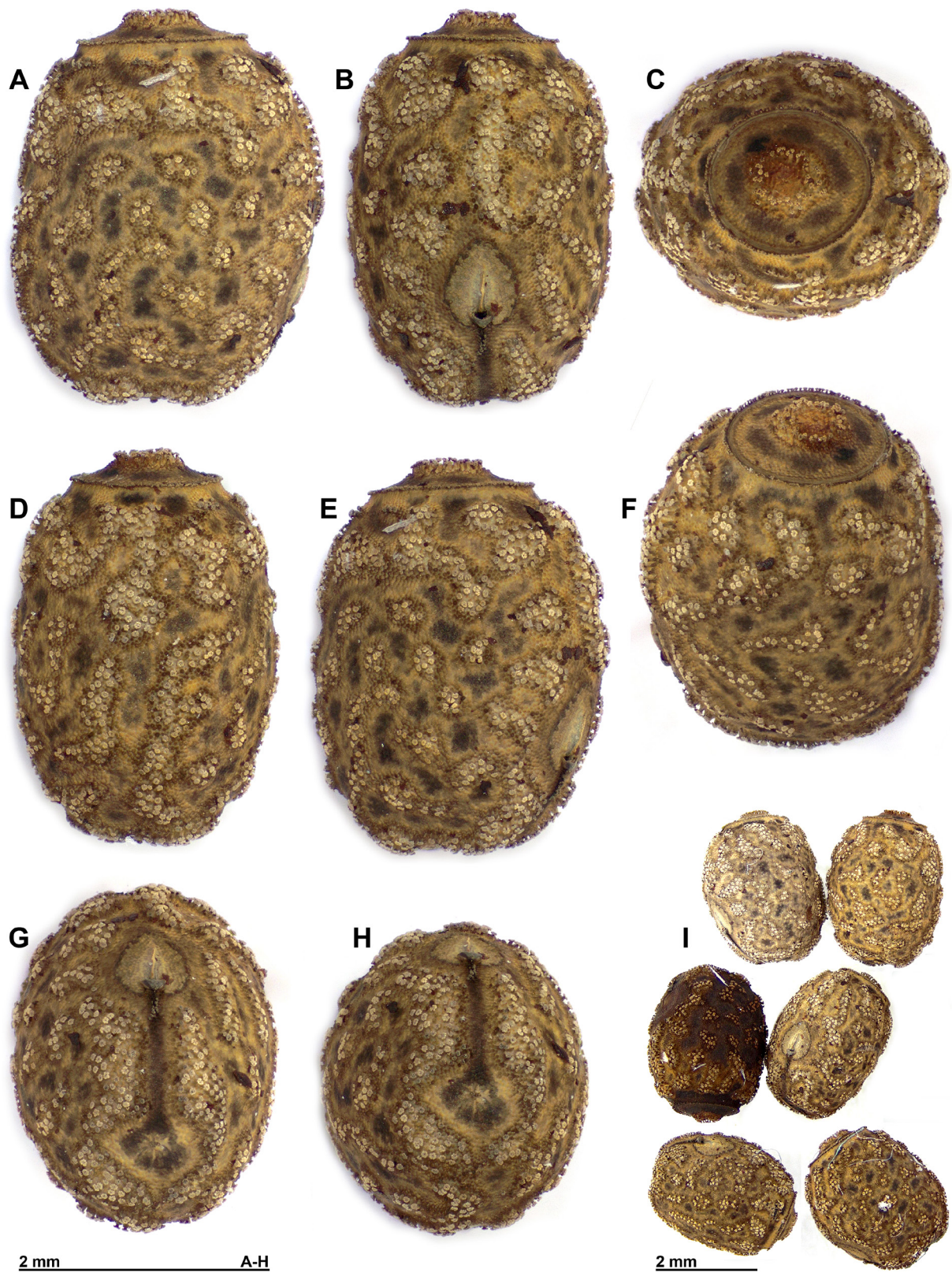


Fig. 14. *Mycovartes montanus* gen. et sp. nov., eggs (RBINS). **A.** Lateral view. **B.** Dorsal view. **C.** Operculum. **D.** Ventral view. **E.** Dorsolateral view. **F.** Anterolateral view. **G.** Posterodorsal view. **H.** Polar area. **I.** Variation.

Table 2. Measurements (mm) of *Mycovartes montanus* gen. et sp. nov.

Length of	HT ♂	PT ♂♂	PT ♀♀
Body	70.8	70.2	69.4–93.9
Head	3.6	3.7	5.8–6.0
Pronotum	3.8	3.9	5.7–5.8
Mesonotum	17.7	17.8	22.2–23.2
Metanotum	2.9	2.9	3.2–3.3
Median segment	4.5	4.5	6.3–6.4
Tegmina	2.4	1.7	2.0–2.6
Alae	2.4	2.5	3.8–3.9
Profemora	16.4	15.6	15.8–16.6
Mesofemora	12.7	12.0	13.7–14.2
Metafemora	18.9	18.1	18.7–19.8
Protibiae	18.3	16.3	15.7–16.1
Mesotibiae	12.3	11.0	11.8–12.3
Metatibiae	22.9	19.5	21.0–21.4

Sternum VII without distinct praeopercular organ, medially with three irregular longitudinal carinae which are straighter and somewhat thicker posteriorly. Cerci short, not reaching apex of anal segment and incurving.

Nymph (Fig. 13D)

Newly hatched nymphs strongly resembling the nymphs of *Mycovartes khoii* gen. et sp. nov. but somewhat stockier and with the markings on mesonotum, median segment and abdominal terga II–IX more distinct.

Egg (Fig. 14)

Measurements (in mm): length: 3.1; width: 2.1; height: 2.4.

Capsule more or less oval with dorsal surface more convex than ventral surface; the polar area slightly indented; colouration cream with a variable network of dark grey markings (sometimes almost absent); cream-coloured areas on capsule surface distinctly granular and with irregularly shaped clusters of minute, pale, mushroom-like protuberances. Micropylar plate notably displaced towards polar area; small, drop-like with anterior portion tapered and posterior margin rounded and indented; surface smooth with a rather long mediolongitudinal carina. Micropylar cup small. Micropylar plate posteriorly followed by a definite mediolongitudinal, dark line reaching polar area. Polar area blackish with pale center, armed with small central cluster of mushroom-like protuberances. Operculum subcircular and convex; central portion with minute, pale, mushroom-like excrescences. Other portions of operculum coloured darker than the center and with a somewhat thickened opercular rim.

Biology

The species was collected in mountainous tropical evergreen rainforest, at a rather high altitude (1600 m a.s.l.). The specimens were observed on low vegetation and seemed to feed on a variety of plant species. The eggs are dropped to the ground.

In captivity, the species accepts *Rubus* sp. and other Rosaceae as food plants.

Distribution

This species is known from Chu Yang Sin N.P. and Bidoup-Nui Ba N.P., both localities are situated on the Da Lat Plateau (also known as the Langbian plateau) in the Southern Annamites (Fig. 1).

Mycovartes vietnamensis (Ho, 2018) gen. et comb. nov.
Figs 1, 15–18

Oxyartes vietnamensis Ho, 2018: 4 [described].

Diagnosis

The species is easily recognised by the bright yellow anal fan of the micropterous alae.

Notes

Ho (2018) attributed this species to the genus *Oxyartes*, mainly because of the general body shape and the small and colourful alae. The species is here transferred to the new genus *Mycovartes* gen. nov. because of the egg and genital morphology: the egg operculum lacks raised capitular structure, males have the poculum shallow and not bulgy as in *Oxyartes*, females have the anal segment arrowhead-shaped in dorsal view with a medially split apex and a comparatively shorter, spoon-shaped subgenital plate.

The egg and newly hatched nymph are described for the first time. Dried and live specimens of both sexes are here figured for comparison (Figs 15–16).

Material examined

Holotype

VIETNAM • ♀ (examined from photographs); Gia Lai Province, Kon Chu Rang N.R., ca 40 km N of K' Bang Town; 14°30'19" N, 108°32'28" E; 24 May–2 Jun. 2016; 1020 m a.s.l.; A.V. Abramov leg.; F3476.6; MMUE.

Paratypes

VIETNAM • 2 ♂♂, 2 ♀♀; same data as for holotype; F3476.7-8 and F3476.41-42; MMUE & HKES.

Additional material

VIETNAM – **Gia Lai Province** • 10 ♂♂, 12 ♀♀; Kon Chu Rang N.R.; 14°28'28" N, 108°32'27" E; 600–1200 m a.s.l.; 13–20 Jul. 2018; GTI project; J. Constant, J. Bresseel and X. Vermeersch leg.; I.G.:33.769; RBINS • 5 ♂♂, 5 ♀♀; same data as for preceding; VNMN • 14 ♂♂, 11 ♀♀, eggs; same data as for preceding; ex breeding Tim Bollens, 2019; RBINS. – **Kon Tum Province** • 1 ♀; Kon Plong, Mang Kanh; 14°39'43" N, 108°15'45" E; 16–20 Aug. 2019; GTI Project; J. Constant and J. Bresseel leg.; I.G.: 34.048; RBINS.

Supplementary description

MALE TERMINALIA (Fig. 17). Vomer well developed, body elongate, triangular, almost flat; basal portion broad, slightly narrowing toward the posterior and gently converging with the posterior portion; posterior portion strongly narrowing and elongate, posteromedially split ending into two elongate teeth.

Nymph (Fig. 16F)

Newly hatched nymphs are slender and predominantly light brown. Head bigger than pronotum, with black postocular line. Legs pale, femora with slightly darker markings on the posterior half. Antennae blackish, tipped with white.



Fig. 15. *Mycovartes vietnamensis* (Ho, 2018) gen. et comb. nov. in situ. A–B. Mating pair in Kon Chu Rang N.R. C. ♀ nymph from Kon Plong.

Egg (Fig. 18)

Measurements (in mm): length: 3; width: 2.1; height: 2.4.

Capsule slightly oval with the dorsal and ventral surfaces somewhat flattened medially and the polar area weakly indented, colouration cream with irregularly dispersed black markings that appear to be more or less fused with each other; cream areas on capsule surface with minute, pale, mushroom-like protuberances. Micropylar plate slightly displaced towards posterior pole; circular in outline and mid brown; surface minutely granular with distinct mediolongitudinal carina. Micropylar cup distinct, almost semicircular in dorsal view. Micropylar plate posteriorly followed by a definite mediolongitudinal, black line reaching posterior pole. Posterior polar area blackish with pale center and with a peg-like central

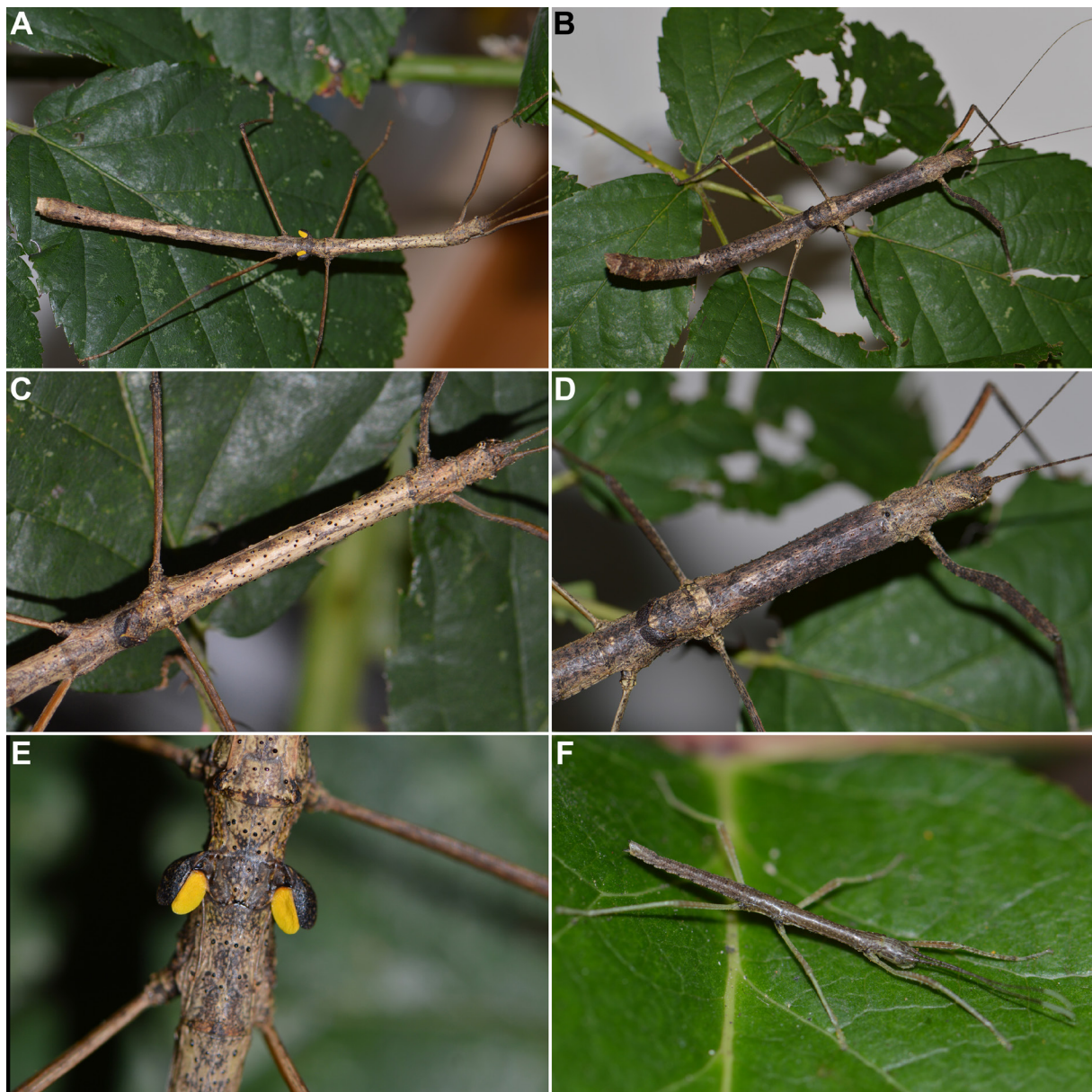


Fig. 16. *Mycovartes vietnamensis* (Ho, 2018) gen. et comb. nov. **A.** ♂, dorsal view. **B.** ♀, dorsal view. **C.** ♂, head and thorax, dorsal view. **D.** ♀, head and thorax, dorsal view. **E.** ♂, wings. **F.** Newly hatched nymph. Photographs ©T. Bollens.

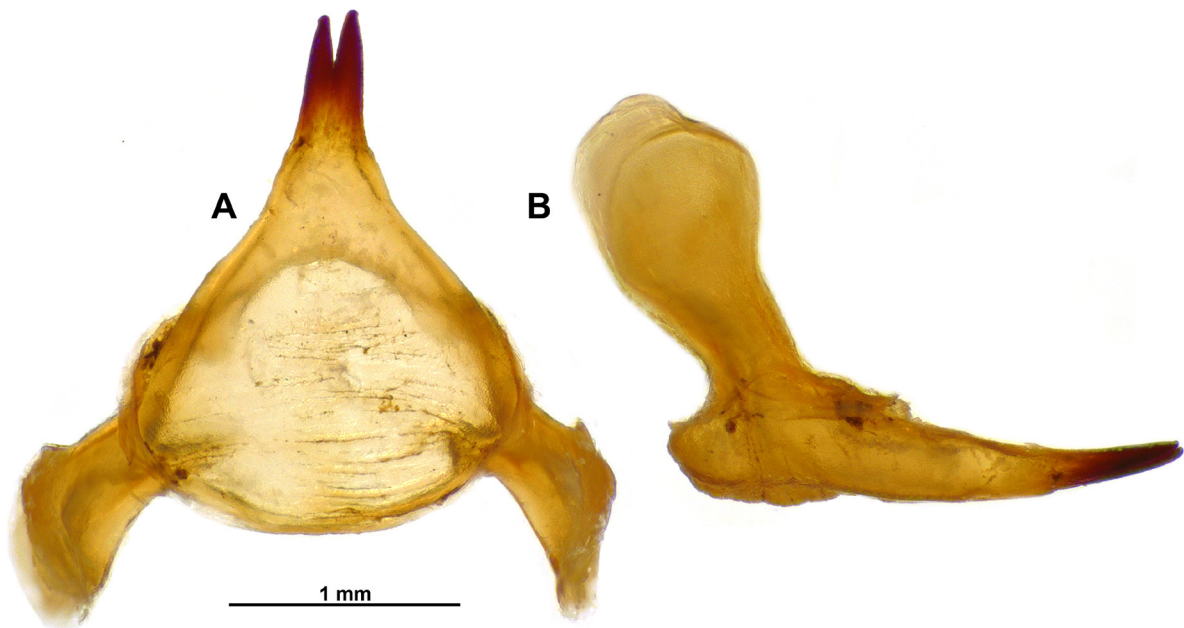


Fig. 17. *Mycovartes vietnamensis* (Ho, 2018) gen. et comb. nov., ♂ vomer. **A.** Ventral view. **B.** Lateral view.

protuberance. Operculum oval and convex; central portion distinctly more raised and with minute, pale, mushroom-like excrescences. Other portions of operculum coloured darker than center and with somewhat thickened opercular rim.

Biology

The species was collected in lower mountain tropical evergreen rainforest, at medium altitude (900–1200 m in Kon Chu Rang N.P., 700–1000 m in Kon Plong). The specimens were observed on low vegetation and seemed to feed on a variety of plant species. The eggs are dropped to the ground. In captivity, the species accepts *Rubus* sp. and other Rosaceae, *Corylus avellana* and *Carpinus betulus* (Betulaceae), as food plants.

Distribution

This species is known from its type locality Kon Chu Rang N.R. and here also recorded from the nearby Kon Plong National Forest, both localities are situated on the Kon Tum Plateau (Fig. 1).

Genus *Neoxyartes* Ho, 2018

Neoxyartes Ho, 2018: 187 [described and figured].

Pterohirasea Bresseel & Constant, 2018: 18 [described and figured]. Synonymised by Bushell (2019).

Type species

Neoxyartes zomproi Ho, 2018 by original designation.

Species included

Neoxyartes neohiraseoides sp. nov. [Chu Yang Sin N.P.]

Neoxyartes minimus sp. nov. [Kon Ka Kinh N.P., Kon Plong]

Neoxyartes zomproi Ho, 2018 [Bach Ma N.P., Ba Na N.P., Phong Dien]

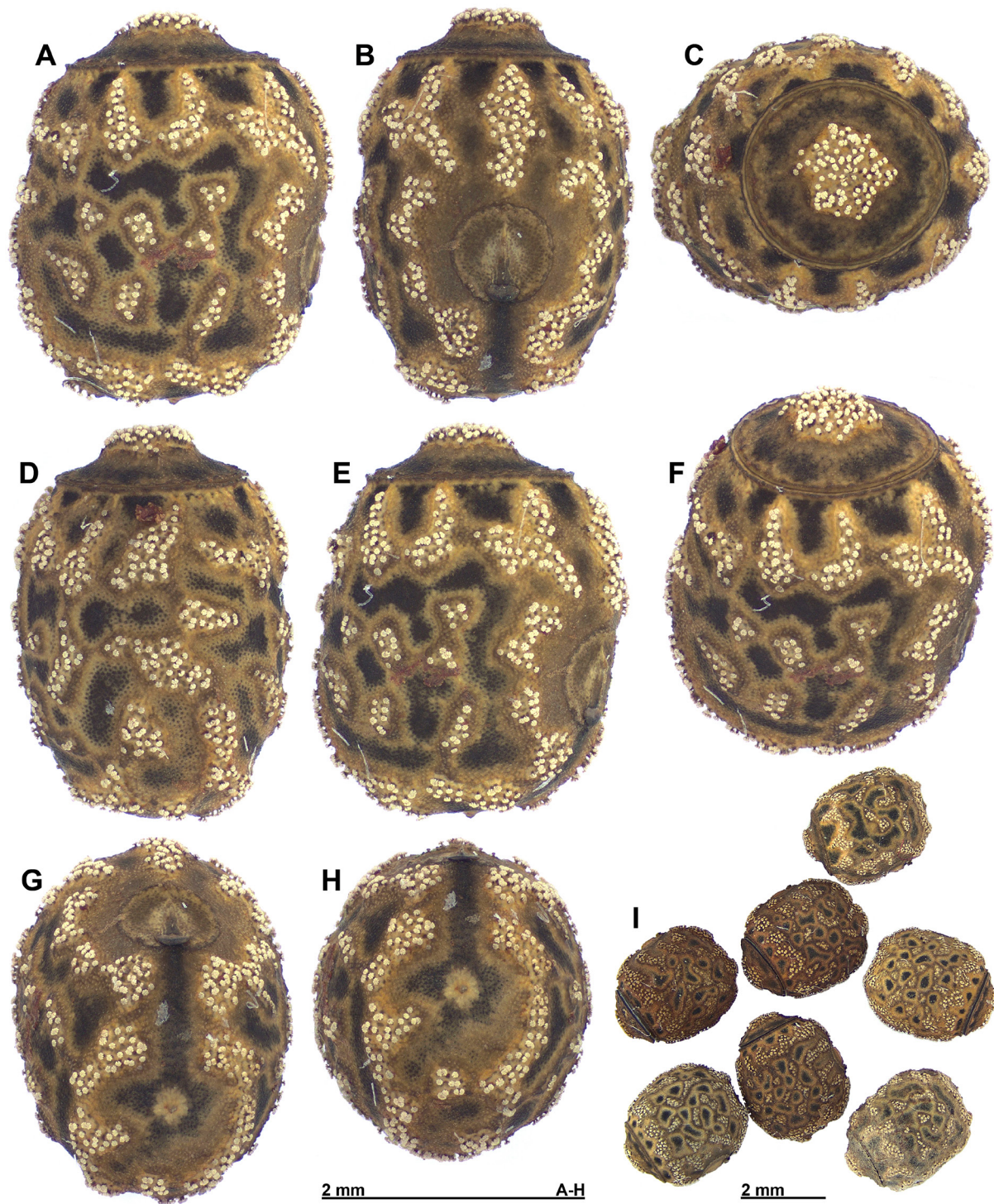


Fig. 18. *Mycovartes vietnamensis* (Ho, 2018) gen. et comb. nov., eggs (RBINS). **A.** Lateral view. **B.** Dorsal view. **C.** Operculum. **D.** Ventral view. **E.** Dorsolateral view. **F.** Anterolateral view. **G.** Posterodorsal view. **H.** Polar area. **I.** Variation.

Keys to the species of *Neoxyartes* Ho, 2018

Males

- 1. Apex of male vomer with four extremities 2
 - Male vomer apically bifurcate *N. zomproi* Ho, 2017
- 2. Small species, body length <35 mm, apterous *N. minimus* sp. nov.
 - Larger species, body length > 35 mm, with scale-like alae *N. neohiraseoides* sp. nov.

Females

- 1. Body length >60 mm, antennae with more or less evenly spaced white markings, body with dark mediolongitudinal stripe dorsally *N. zomproi* Ho, 2017
 - Body length <50 mm, antennae without white markings and body without dark mediolongitudinal stripe 2
- 2. Anal segment slightly concave posteromedially, apterous *N. minimus* sp. nov.
 - Anal segment with slightly projecting posteromedian carina, scale-like alae present *N. neohiraseoides* sp. nov.

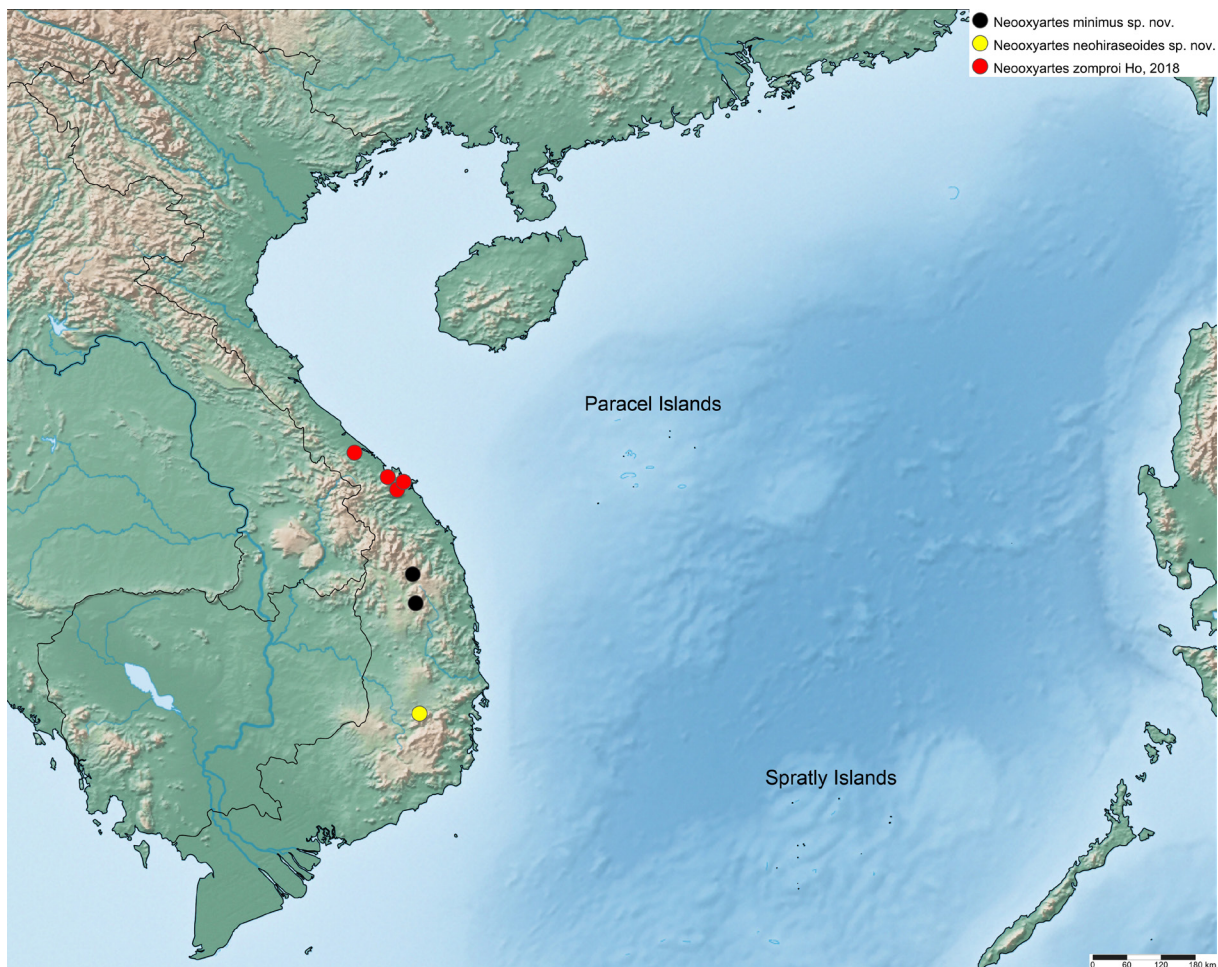


Fig. 19. *Neoxyartes* Ho, 2018, distribution map.

Distribution

The genus is restricted to the Truong Son Range with *Neooxyartes zomproi* Ho, 2017 and *Neooxyartes minimus* sp. nov. from the Kontum Plateau and *Neooxyartes neohiraseoides* sp. nov. from the Dac Lac Plateau (Fig. 19).

Neooxyartes minimus sp. nov.

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Figs 19–26

Etymology

The epithet ‘*minimus*’ is a latin word meaning ‘the smallest’. The name refers to the small body size of the species, since it currently is the smallest species in the genus.

Type material

Holotype

VIETNAM • ♂; Gia Lai Province, Kon Ka Kinh N.P.; 14°12'10" N, 108°18'40" E; 6–13 Jul. 2018; 700–1500 m a.s.l.; GTI project; J. Constant, J. Bresseel and X. Vermeersch leg.; I.G.: 33.769; ex breeding T. Bollens, 2019; RBINS.

Paratypes (21 ♂♂, 24 ♀♀)

VIETNAM – **Gia Lai Province** • 9 ♂♂, 1 ♀; same data as for holotype; RBINS • 3 ♂♂, 1 ♀; same data as for holotype; VNMN • 2 ♀♀; Kon Ka Kinh N.P.; 6–13 Jul. 2018; 700–1500 m a.s.l.; 14°12'10" N, 108°18'40" E; GTI project; J. Constant, J. Bresseel and X. Vermeersch leg.; I.G.: 33.769; RBINS • 9 ♂♂, 6 ♀♀; same data as for holotype; FH 1171 1 to 16. – **Kon Tum Province** • 1 ♀; Kon Plong, Mang Kanh; 14°39'43" N, 108°15'45" E; 16–20 Aug. 2019; GTI Project; J. Constant and J. Bresseel leg.; I.G.: 34.048; RBINS • 8 ♀♀; same data as for preceding; ex breeding Tim Bollens 2020; RBINS • 5 ♀♀; same data as for preceding; VNMN.

Description

Male (Figs 20–22, 25A–B, E)

MEASUREMENTS. See Table 3.

BODY. Colouration variable, ranging from pale to dark brown with occasionally some black mottling. Abdominal terga VI–VII often paler than rest of body, sometimes almost white. Legs coloured as body. Antennae coloured as body, tipped in white.

HEAD. Longer than wide, rectangular in dorsal view; dorsal surface flattened with mediolongitudinal groove reaching occiput and posterolaterally with short groove on each side. Eyes more or less circular, slightly displaced towards dorsal surface and strongly projecting laterally. Antennae filiform with 20–22 segments ($n = 5$) and slightly projecting over front legs; scapus flattened dorsally with inner margin rounded and outer margin straight. Pedicellus shorter, about half the length of scapus, oval in cross-section. Third antennal segment about as long as scapus but distinctly narrower, segment IV about half the length of III; following segments increasing in length to about halfway the antennae and later decreasing in length; apical antennomere more elongated, club-like and about twice the length of preceding segment.

THORAX. Pronotum slightly longer than wide, somewhat shorter than head and indistinctly rugose with pair of faint granules medially on anterior and posterior margins; anterior margin indistinctly concave. Centrally with short transverse impression not reaching lateral edges. Posterior margin almost straight. Mesonotum rugose, slightly longer than two times the length of pronotum, lateral margins more or

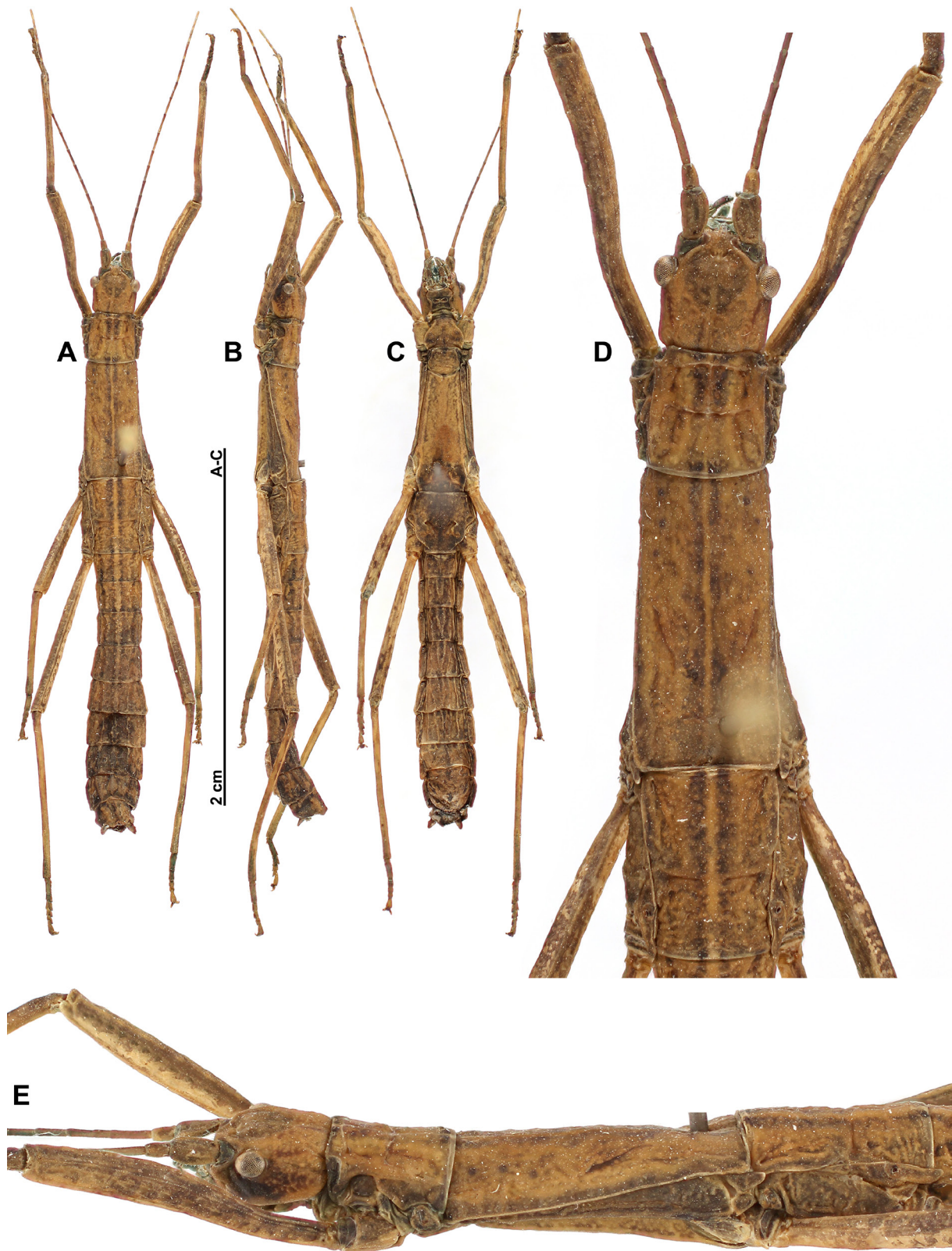


Fig. 20. *Neoxyartes minimus* sp. nov., holotype, ♂ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head and thorax, dorsal view. **E.** Head and thorax, lateral view.

less straight. Metanotum somewhat rugose, shorter than pronotum, longer than median segment; lateral margins flattened. Prosternum with anterior margin more or less straight, widening towards the posterior; posterior margin concave. Prosternum with three rough “sensory organs”, one medially and pair near bases of front legs. Wings absent.

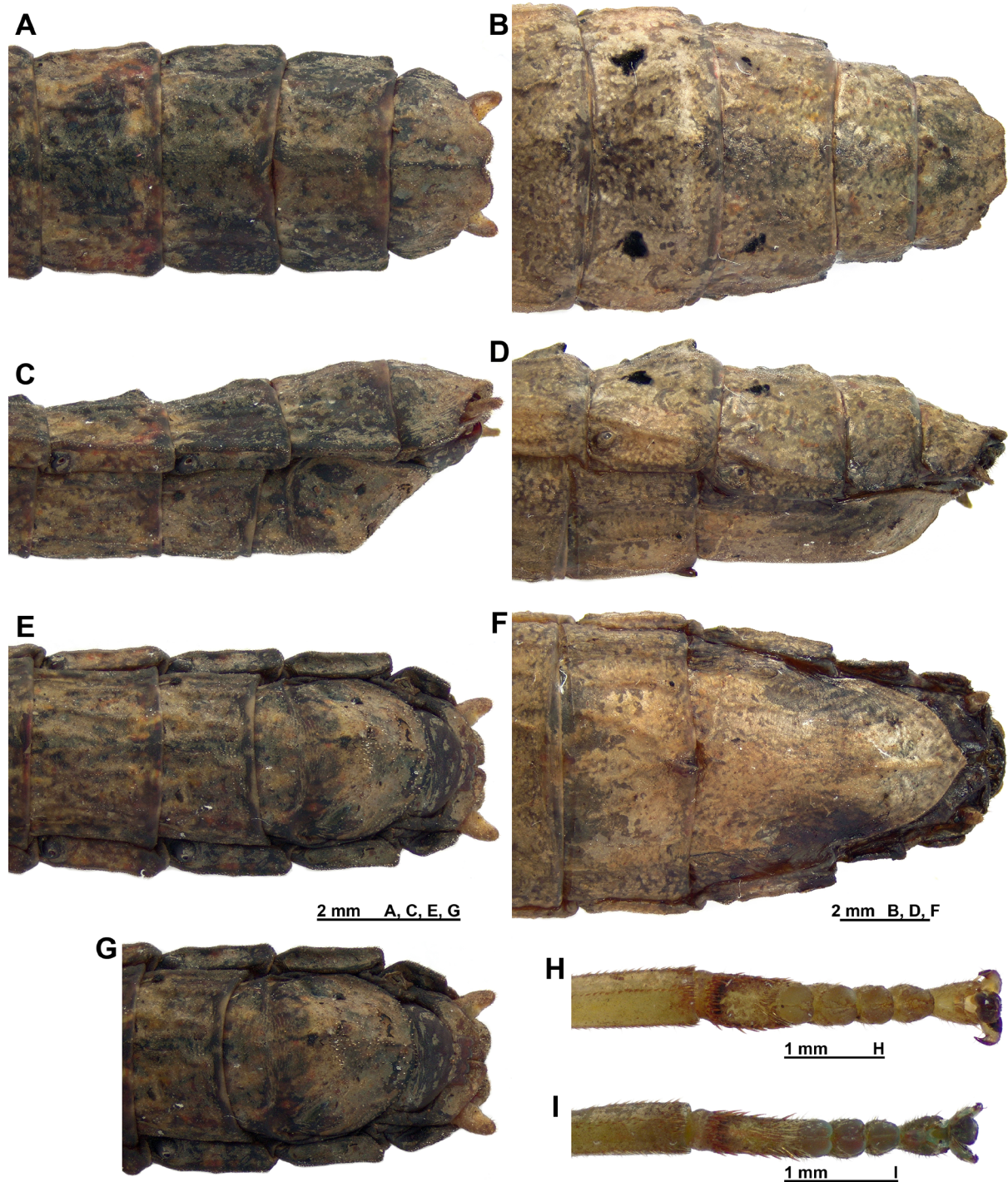


Fig. 21. *Neoxyartes minimus* sp. nov., terminalia. **A.** ♂, dorsal view. **B.** ♀, dorsal view. **C.** ♂, lateral view. **D.** ♀, lateral view. **E.** ♂, ventral view. **F.** ♀, ventral view. **G.** ♂, poculum and vomer. **H.** ♀, left posterior tarsi, **I.** ♂, left posterior tarsi.

LEGS. Profemora about as long as corresponding tibiae; compressed and curved basally; dorsal and ventral carinae present and unarmed; medioventral carina absent. Mesofemora about as long as corresponding tibiae, armed as profemora. Metafemora slightly shorter than corresponding tibiae, armed as mesofemora. Tibiae with all carinae present and unarmed.

ABDOMEN. Median segment transverse. All abdominal terga transverse and rugose with lateral margins flattened and somewhat laterally expanding; tergum II shorter than median segment; III–V indistinctly increasing in length; V and VI about the same length; following segments slightly shortening; terga VI–VII with minute posteromedian hump. Tergum X with indistinct mediolongitudinal carina, narrowing towards the posterior with shallow notches near cerci and posteromedially, lateral margins rounded. Ventral portion of posterior margin of anal segment distinctly swollen and with several minute tubercles. Posterolateral angles rounded. Poculum scoop-shaped, rounded; posterior margin flattened and broadly rounded; posterior margin projecting over base of vomer. Cerci not reaching apex of abdomen, more or less triangular with apex rounded and setose. Vomer well developed, distinctly wider than long; basal portion very broad, flattened, slightly narrowing towards posterior portion; posterior portion noticeably constricted and elongated, strongly upcurving with four elongate teeth. Posterior portion of vomer noticeably darker than anterior portion (Fig. 22).

Female (Figs 23, 24A–B, 25C–E)

MEASUREMENTS. See Table 3.

BODY. Colouration as in male.

HEAD. Longer than wide, almost rectangular in dorsal view; dorsal surface flat with short carina above eye. Vertex with mediolongitudinal groove reaching occiput and with short posterolateral groove. Eyes more or less circular, slightly displaced towards dorsal surface and strongly projecting. Antennae filiform with 23–24 segments ($n = 8$) and indistinctly projecting over front legs; shaped as in male.

THORAX. Pronotum slightly shorter than head, slightly widening towards the posterior and somewhat rugose with pair of more distinct granules medially on anterior and posterior margins. Anterior margin

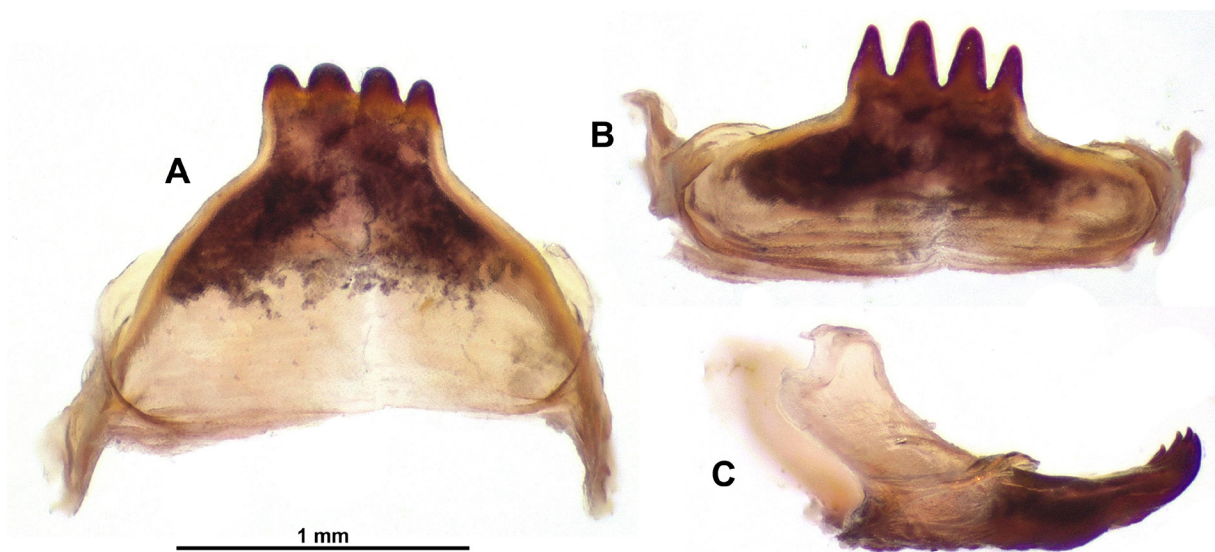


Fig. 22. *Neoxyartes minimus* sp. nov., ♂ vomer. **A.** Ventral view. **B.** Posteroventral view. **C.** Lateral view.

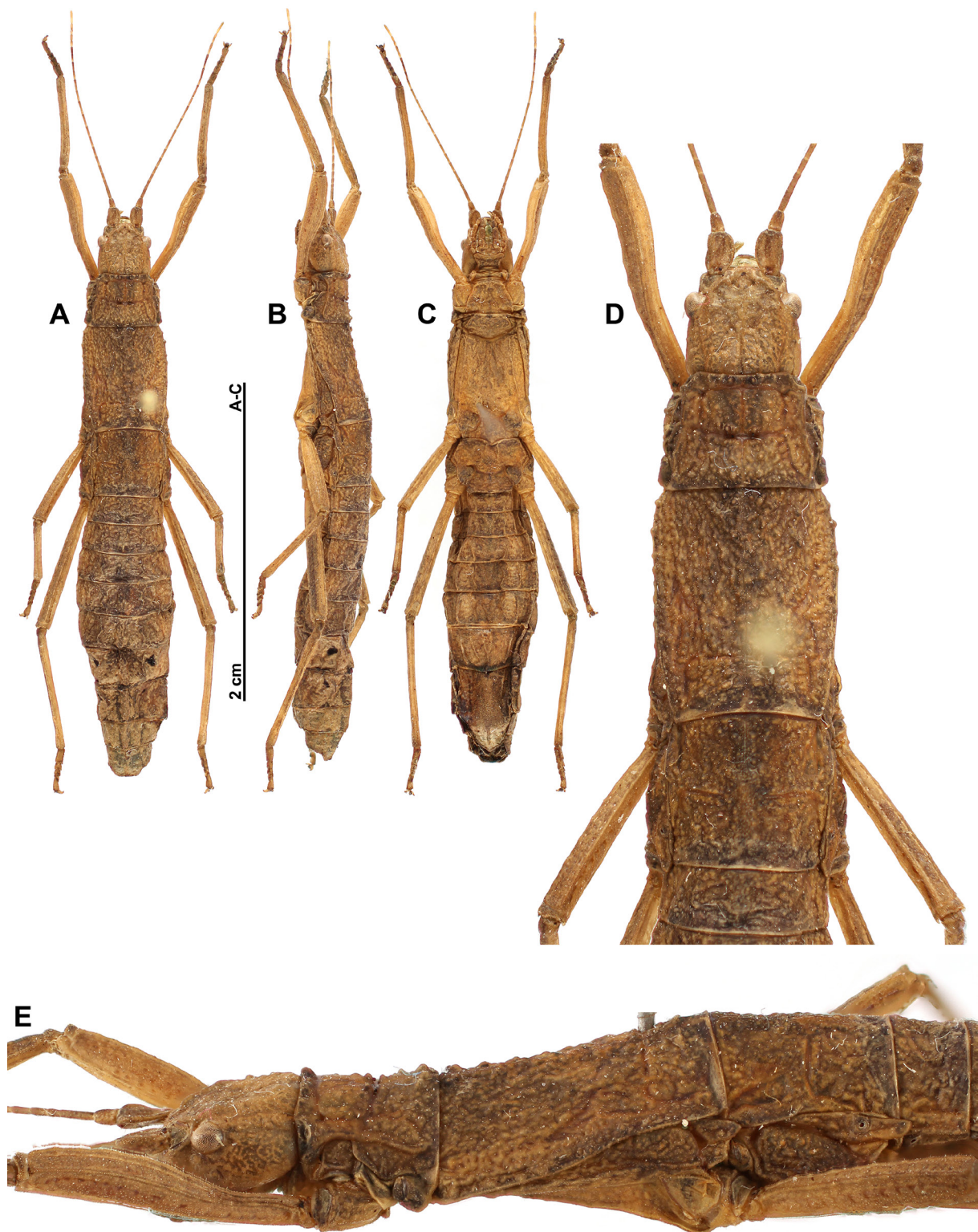


Fig. 23. *Neoxyartes minimus* sp. nov., paratype, ♀ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head and thorax, dorsal view. **E.** Head and thorax, lateral view.

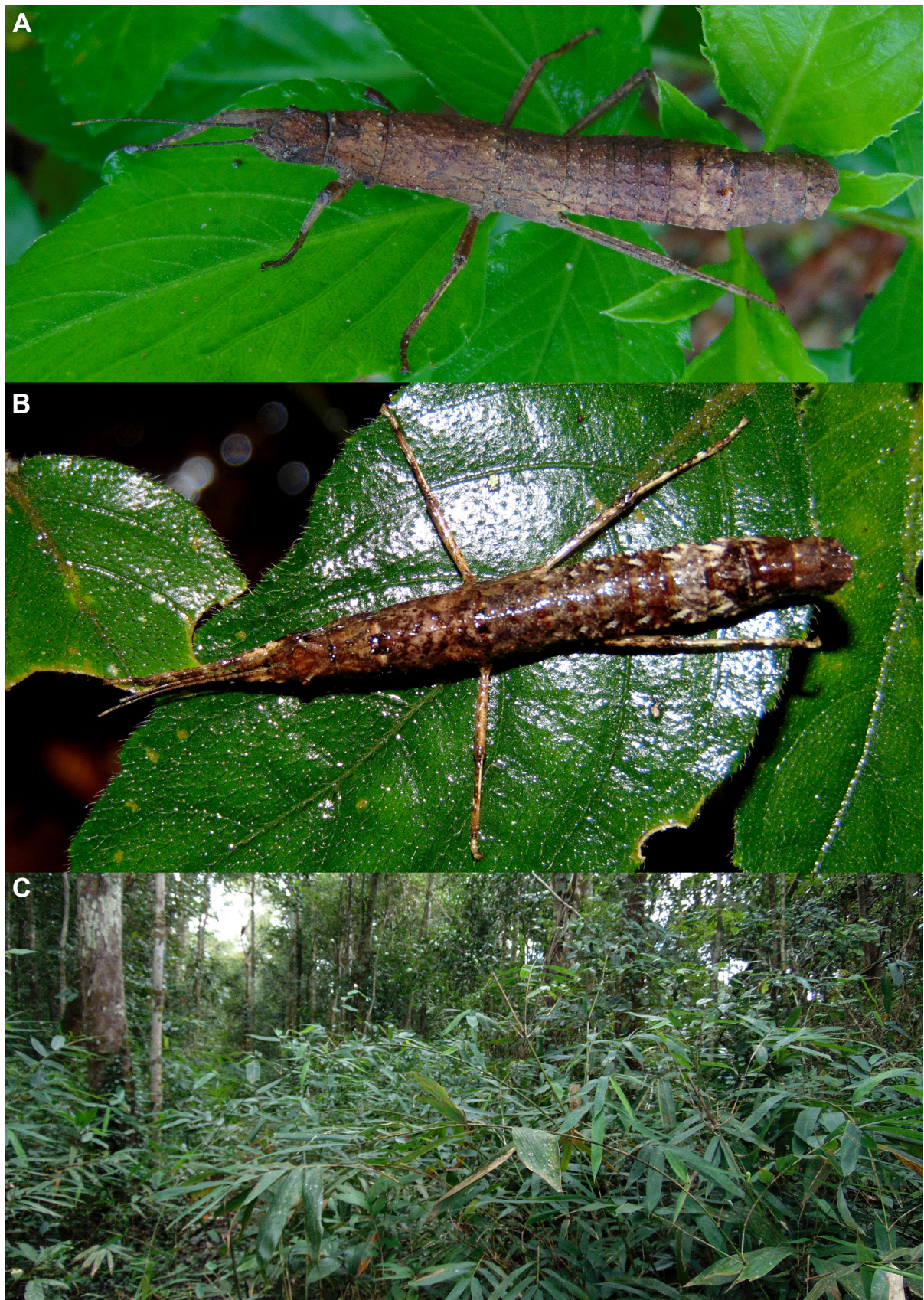


Fig. 24. *Neoxyartes minimus* sp. nov., in situ. **A.** ♀, in Kon Ka Kinh N.P. **B.** ♀, in Kon Plong. **C.** Habitat.

gently concave. Centrally with transverse impression not reaching lateral edges. Posterior margin straight. Mesonotum comparatively short and broad, roughly 1.5 times as long as wide and rugose; almost parallel-sided, indistinctly narrowing towards the posterior; posterior margin slightly incurved. Metanotum transverse, slightly longer than median segment and rugose. Prosternum with anterior margin straight, widening towards the posterior; with three rough, almost circular “sensory organs”. Apterous.

LEGS. Profemora slightly longer than mesonotum; compressed and curved basally; all carinae present and unarmed, medioventral carina indistinct; dorsal carinae discretely undulate. Mesofemora about as long as mesonotum; ventral carinae indistinct; unarmed. Metafemora slightly longer than profemora, shaped as mesofemora. Tibiae about as long to slightly longer than corresponding femora and unarmed. Protibiae more or less rectangular in cross-section; probasitarsus short, about as long as following two tarsomeres combined. Meso- and metatibiae simple, rectangular in cross section. Claws small when compared to body size; tarsomeres with small posteromedian extension.

ABDOMEN. Median segment rugose, distinctly wider than long, rectangular and slightly shorter than mesonotum. All abdominal terga transverse and rugose. Terga II–VII indistinctly widening towards the posterior, especially noticeable in living individuals. Tergum VIII narrowing, IX shorter than VIII. Terga II–IX with posteromedian granule/hump, indistinct on tergum II but increasingly enlarging towards tergum IX. Anal segment slightly longer than IX with apical portion somewhat constricted, with indistinct mediolongitudinal carina, apex nearly straight with slight medial indentation. Abdominal sternum VII with definite praeopercular organ. Praeopercular organ broad at base, later tapering and resulting in single spine. Subgenital plate reaching about apex of abdomen; apical half spoon-shaped and tapering posteriorly; posterior portion with definite median longitudinal carina. Other abdominal sterna smooth with small black marking posteromedially. Sternum VII with small praeopercular organ present as small, blackish, posteromedian spine. Subgenital plate spoon-shaped, posterior portion carinate, tapering towards the posterior and with apex somewhat triangular, not reaching posterior margin of anal segment. Cerci short not reaching apex of abdomen, flattened, narrowing towards the posterior with triangular, setose apices.

Nymph (Fig. 25F)

Newly hatched nymphs very small. Head globose, longer than pronotum with dark brown mediolongitudinal dorsal stripe and flanked by longitudinal pale stripes, postocular line orange brown and pale genae. Antennae projecting over front legs, black with few whitish rings. Pronotum with anterior margin broader than posterior margin, coloured as head with postocular line continuing on lateral margins of pronotum. Mesonotum slightly rounded laterally, coloured as pronotum. Metanotum more or less parallel-sided, coloured as mesonotum. Median segment and abdomen terga predominantly orange-brown with dark mediolongitudinal stripe. Legs with pale orange brown femora with dark apex, tibiae with dark base and dark marking centrally. Tarsi and claws whitish.

Egg (Fig. 26)

Measurements (in mm): length: 2.1; width: 1.8; height: 2.0.

Capsule almost spherical in lateral view and slightly oval in dorsal view; minutely granulose, predominantly coloured brown with network of minute, dark, mushroom-like armature; central band around egg somewhat darker than posterior area (excluding polar area) and anterior area. Micropylar plate positioned nearly centrally on capsule; almost circular, coloured darker than surrounding capsule; surface reticulated as capsule with mediolongitudinal carina starting at micropylar cup, not reaching anterior margin of micropylar plate. Micropylar cup small, cup-like. Posterior polar area as rest of capsule, somewhat darker with interrupted mediolongitudinal carina directed towards micropylar plate. Operculum oval with ventral margin more broadly rounded than dorsal margin and convex; coloured like



Fig. 25. *Neoxyartes minimus* sp. nov. **A–B.** ♂, dorsal view. **C.** ♀, dorsal view. **D.** ♀, dorsolateral view. **E.** Mating pair. **F.** Newly hatched nymph. Photographs A, C, F ©T. Bollens.

capsule with several mushroom-like, stalked granules scattered over surface. Opercular rim somewhat thickened and raised.

Biology

The species was collected in mountainous tropical evergreen rainforest, at a medium to rather high altitude (1500 m in Kon Ka Kinh N.P., 700–1000 m in Kon Plong). The specimens were observed on low vegetation and seemed to feed on a variety of plant species. The eggs are dropped to the ground.

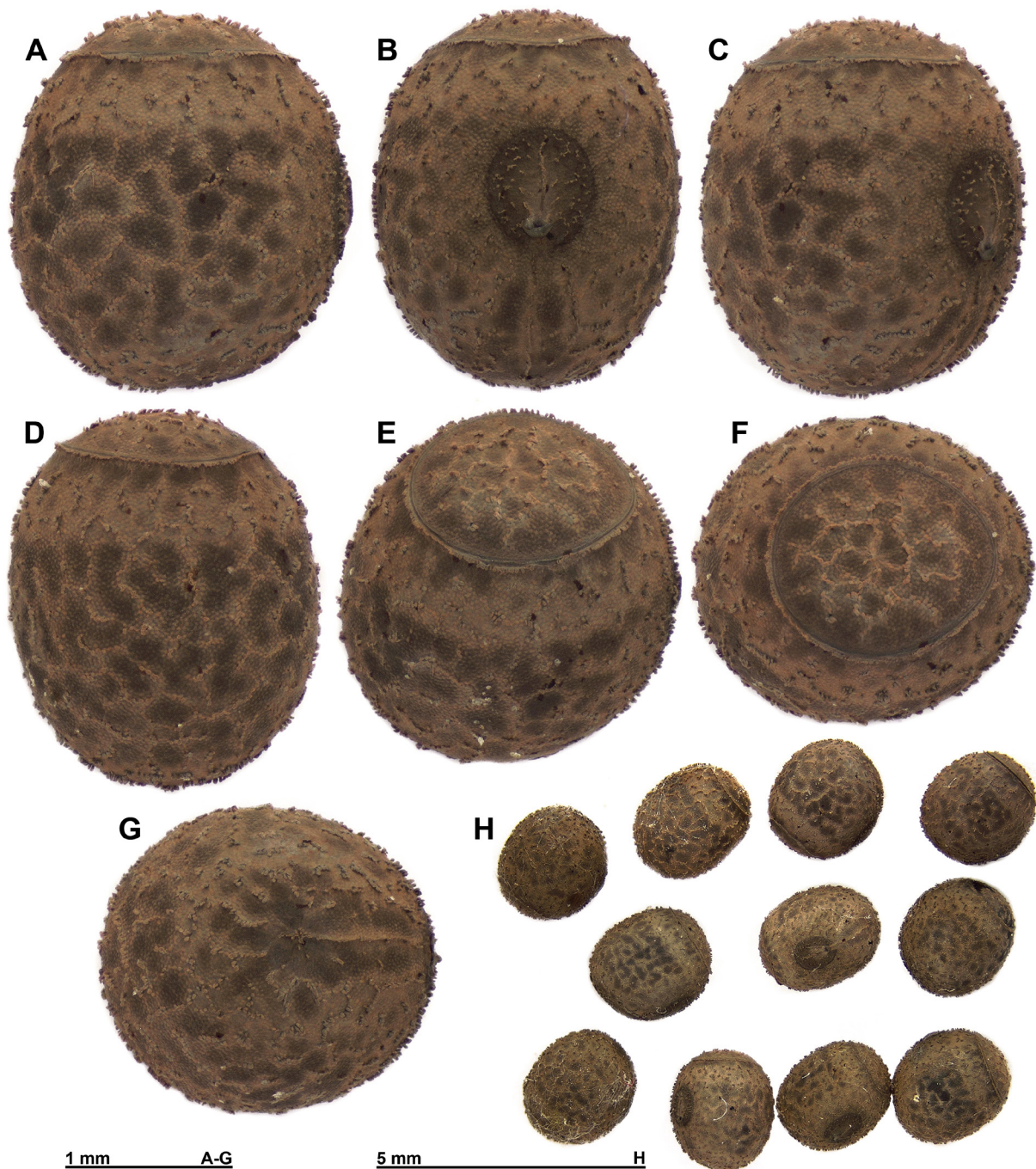


Fig. 26. *Neoxyartes minimus* sp. nov., eggs (RBINS). **A.** Lateral view. **B.** Dorsal view. **C.** Dorsolateral view. **D.** Ventral view. **E.** Anterolateral view **F.** Operculum. **G.** Polar area. **H.** Variation.

Table 3. Measurements (mm) of *Neoxyartes minimus* sp. nov.

Length of	HT ♂	PT ♂♂	PT ♀♀
Body	32.1	28.2–33.3	33.4–37.9
Head	3.0	2.6–3.6	4.1–4.2
Pronotum	2.7	2.4–2.9	3.2–3.4
Mesonotum	6.5	5.8–6.7	7.2–7.4
Metanotum	2.4	2.0–2.5	2.3–2.5
Median segment	1.8	1.5–1.9	1.8–2.1
Profemora	7.5	6.8–7.8	6.3–7.1
Mesofemora	5.8	5.7–6.1	5.5–6.1
Metafemora	8.6	7.5–9.1	7.5–7.8
Protibiae	7.8	7.0–7.8	5.7–6.7
Mesotibiae	6.1	5.7–6.1	5.1–5.3
Metatibiae	9.0	8.0–10.3	7.9–8.2

Only females were found in the field, and males were bred from eggs obtained from the wild caught females from Kon Ka Kinh N.P.; only females were bred from the eggs from the Kon Plong population, suggesting the latter population to be parthenogenetic. In captivity, the species accepts *Rubus* sp. and other Rosaceae, *Corylus avellana* and *Carpinus betulus* (Betulaceae) as food plants.

Distribution

This species is known from Kon Chu Rang N.R. (Gia Lai Province) and Mang Canh Forest, Kon Plong District (Kon Tum Province) in the central Annamite Mountains (Fig. 19).

Neoxyartes neohiraseoides sp. nov.

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Figs 19, 27–33

Etymology

The species epithet is a combination of ‘*Neohirasea*’ a genus of Necrosiinae and ‘*oides*’ from the ancient greek εἶδος (‘*eidos*’), meaning ‘likeness’. It refers to the phenotypical resemblance of this species to representatives of the genus *Neohirasea*.

Type material

Holotype

VIETNAM • ♂; Dak Lak Province, Chu Yang Sin N.P.; 12°27'24" N, 108°22'15" E; 9–15 Aug. 2019; 650–1000 m a.s.l.; GTI Project; J. Constant and J. Bresseel leg.; I.G.:34.048; RBINS.

Paratypes (25 ♂♂, 25 ♀♀)

VIETNAM • 2 ♂♂, 3 ♀♀; same data as for holotype; RBINS • 2 ♂♂, 2 ♀♀; same data as for holotype; VNMN • 2 ♂♂, 2 ♀♀; same data as for holotype; ex breeding T. Bollens, 2019; RBINS • 6 ♂♂, 6 ♀♀; same data as for holotype; ex breeding T. Bollens, 2020; RBINS • 3 ♂♂, 3 ♀♀; same data as for preceding; VNMN • 5 ♂♂, 4 ♀♀; same data as for preceding; FH 1283 1 to 9 • 5 ♂♂, 5 ♀♀; same data as for holotype; ex breeding T. Bollens, 2021; RBINS.

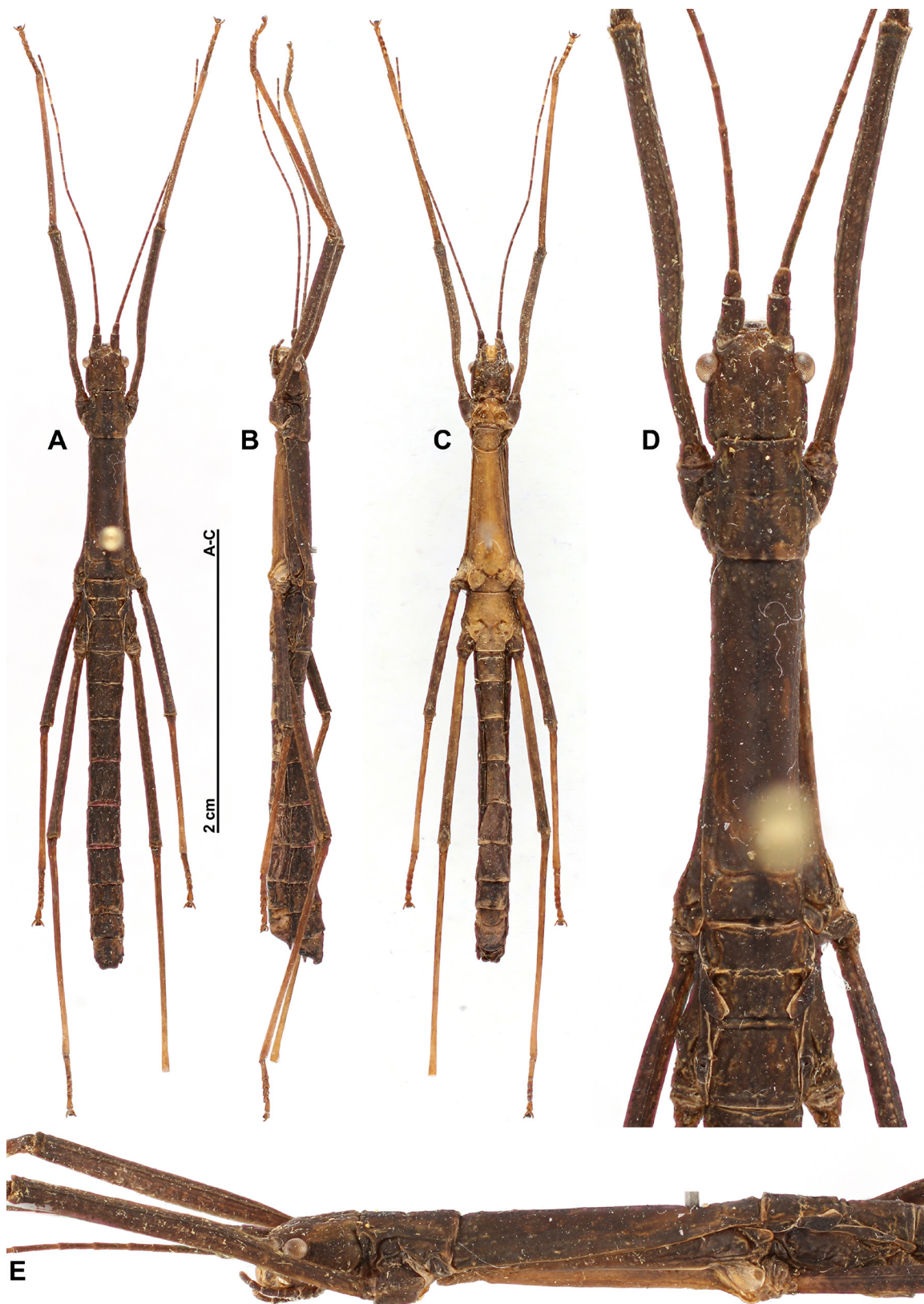


Fig. 27. *Neoxyartes neohiraseoides* sp. nov., holotype, ♂ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head and thorax, dorsal view. **E.** Head and thorax, lateral view.

Additional material

VIETNAM • eggs; same data as for holotype; ex breeding T. Bollens, 2020; RBINS.

Description

Male (Figs 27, 28A, C, E, 29, 31C–E, 32A–D)

MEASUREMENTS. See Table 4.

BODY. Colouration variable, ranging from pale brown to almost black. Pale specimens sometimes with darker mediolongitudinal line on mesonotum. Legs coloured as body, females sometimes with broad white band on meso- and metafemora; in males only with some small spots. Antennae coloured as body, tipped with white.

HEAD. Longer than wide and mainly smooth; dorsal surface flattened with mediolongitudinal groove. Vertex rounded, posterolaterally also with short groove on each side. Eyes circular and strongly projecting. Antennae filiform, slightly projecting over front legs. Scapus slightly flattened dorsoventrally and elliptical in cross-section. Pedicellus short, knob-like and round in cross-section.

THORAX. Pronotum longer than wide, slightly shorter than head and more or less smooth; anterior margin indistinctly concave. Lateral margins somewhat thickened. Median longitudinal groove starting anteriorly, not reaching posterior edge. Centrally with short transverse impression not reaching lateral edges. Posterior margin slightly rounded, almost straight. Mesonotum about three times the length of pronotum and smooth. Metanotum somewhat rugose, slightly longer than median segment with posterior margin thickened. Prosternum with anterior margin more or less straight, widening towards the posterior; posterior margin concave. Prosternum with rough paired, almost circular “sensory organs”; longitudinally divided by a median furrow.

WINGS. Tegmina absent. Alae small, reaching posterior margin metanotum; costal area blackish with inner margin reddish; anal area bright red.

LEGS. Profemora about as long as corresponding tibiae; compressed and curved basally, inner dorsal carina slightly more pronounced than other carinae, all carinae unarmed. Mesofemora about as long as corresponding tibiae, unarmed. Metafemora slightly shorter than corresponding tibiae, armature as in mesofemora. Tibiae with all carinae present and unarmed.

ABDOMEN. Median segment quadrate and smooth. All abdominal terga less than two times as long as wide and slightly rugose. Terga II–IX with minute posteromedian hump; tergum II about as long as median segment; III–V indistinctly increasing in length; V and VI about the same length; tergum VII distinctly shorter than VI; VIII distinctly wider than long, widening towards the posterior; tergum IX slightly shorter than VIII. Tergum X with indistinct carina in posterior portion, narrowing towards the posterior and slightly notched apically; lateral margins rounded anteriorly, straight medially and again rounded posteriorly. Ventral portion of outer margin of anal segment slightly swollen and with several black tubercles. Posterolateral angles rounded. Poculum rounded; posterior margin flattened with outer rim curving downwards; reaching about base of vomer. Cerci not reaching apex of abdomen, flattened with apex rounded and distinctly setose. Vomer well developed, about as wide as long; basal portion broad, flattened, slightly narrowing and gently converging with posterior portion; posterior portion strongly upcurving with four elongate teeth. Posterior portion of vomer noticeably darker than anterior portion (Fig. 29).

Female (Figs 28B, D, F, 30, 31F–H, 32D)

MEASUREMENTS. See Table 4.

BODY. Colouration as in male.

HEAD. Longer than wide, somewhat rugose; dorsal surface flattened with mediolongitudinal groove. Back of head rounded, posterolaterally with short groove on each side. Eyes circular and strongly projecting. Antennae filiform, scapus slightly flattened dorsoventrally, pedicellus short, knob-like and round in cross-section. Apical antennomeres white.

THORAX. Pronotum slightly shorter than head, trapezoidal and with few minute granules and median line; the number of granules varies; anterior margin concave; lateral margins somewhat thickened; ventrally with short transverse, concave impression not reaching lateral edges; posterior almost straight. Mesonotum slightly longer than head and pronotum combined, rugose with few granules and with a fine mediolongitudinal line; lateral margins slightly expanding in posterior portion. Metanotum somewhat rugose, slightly shorter than median segment and with posteromedian blunt hump. Prosternum with anterior margin straight, widening towards the posterior; with distinct paired “sensory organs”; triangular depression between “sensory organs”.

WINGS. Tegmina absent. Alae small, not reaching posterior margin of metanotum; costal area coloured as body with inner margin reddish; anal area bright red.



Fig. 28. *Neooxyartes neohiraseoides* sp. nov., terminalia. A. ♂, dorsal view. B. ♀, dorsal view. C. ♂, lateral view. D. ♀, lateral view. E. ♂, ventral view. F. ♀, ventral view.

LEGS. Profemora about as long as corresponding tibiae; compressed and curved basally; inner dorsal carina slightly more pronounced than other carinae; all carinae unarmed. Mesofemora about as long as corresponding tibiae; unarmed. Metafemora slightly shorter than corresponding tibiae, armature as in mesofemora. Tibiae with all carinae present and unarmed.

ABDOMEN. Median segment transverse with median hump. Abdominal terga distinctly transverse and rugose. Terga II–VI with posteromedian hump; terga VII–IX more or less carinate with distinct posteromedian armature, crest-like, not projecting over next segment. Anal segment with mediolongitudinal carina, wide in anterior portion and narrow in posterior part, apex with three short, rounded extremities. Sternum VII with small praeopercular organ present as small posteromedian spine. Subgenital plate spoon-shaped, posterior portion slightly tapering, apex somewhat triangular, not reaching posterior margin of anal segment. Cerci short not reaching apex of abdomen, flattened, narrowing towards the posterior with triangular, setose apex.

Nymph (Fig. 31A–B)

Newly hatched nymphs with body and legs predominantly light brown with paler mottling. Body and head with darker brown mediolongitudinal stripe dorsally. Head distinctly longer and wider than pronotum with a distinct longitudinal marking above the eye, continuing on scapus and pedicellus. Antennae blackish with apical segment pure white. Pronotum transverse, more or less parallel-sided. Legs without dark apex and dark based tibiae seen in *Neoxyartes minimus* sp. nov. Tarsi and claws whitish.

Egg (Fig. 33)

Measurements (in mm): length: 2.3; width: 1.8; height: 1.9.

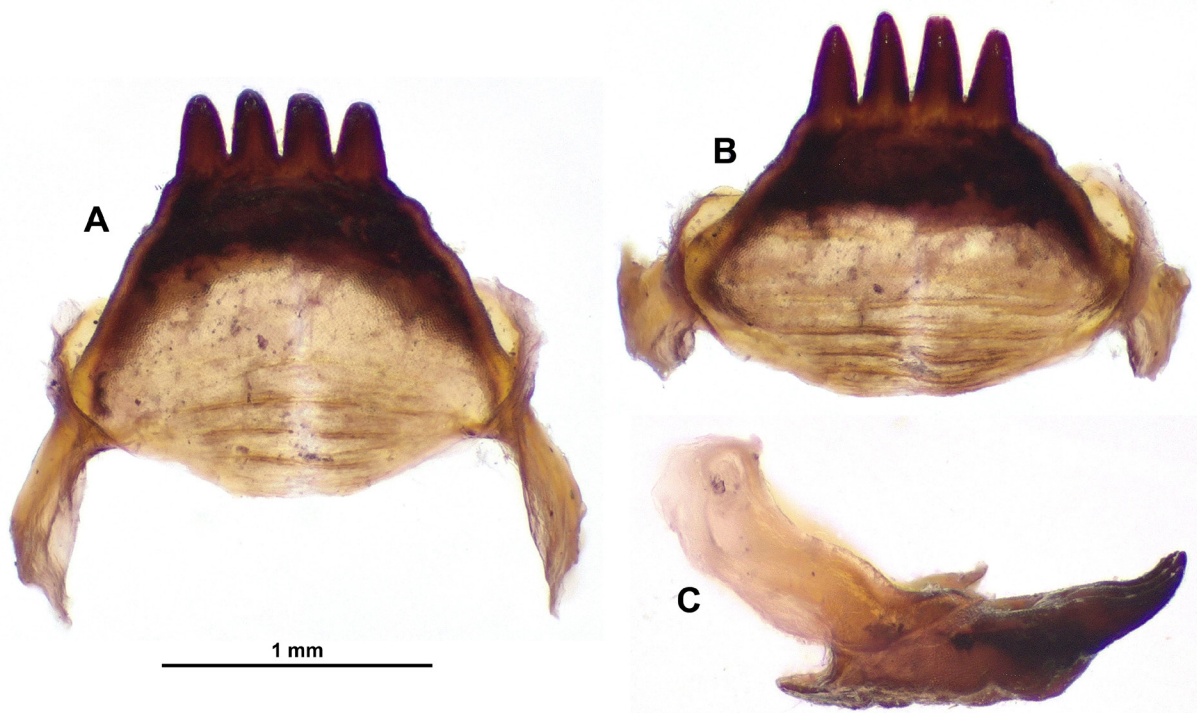


Fig. 29. *Neoxyartes neohiraseoides* sp. nov., ♂ vomer. A. Ventral view. B. Posteroventral view. C. Lateral view.

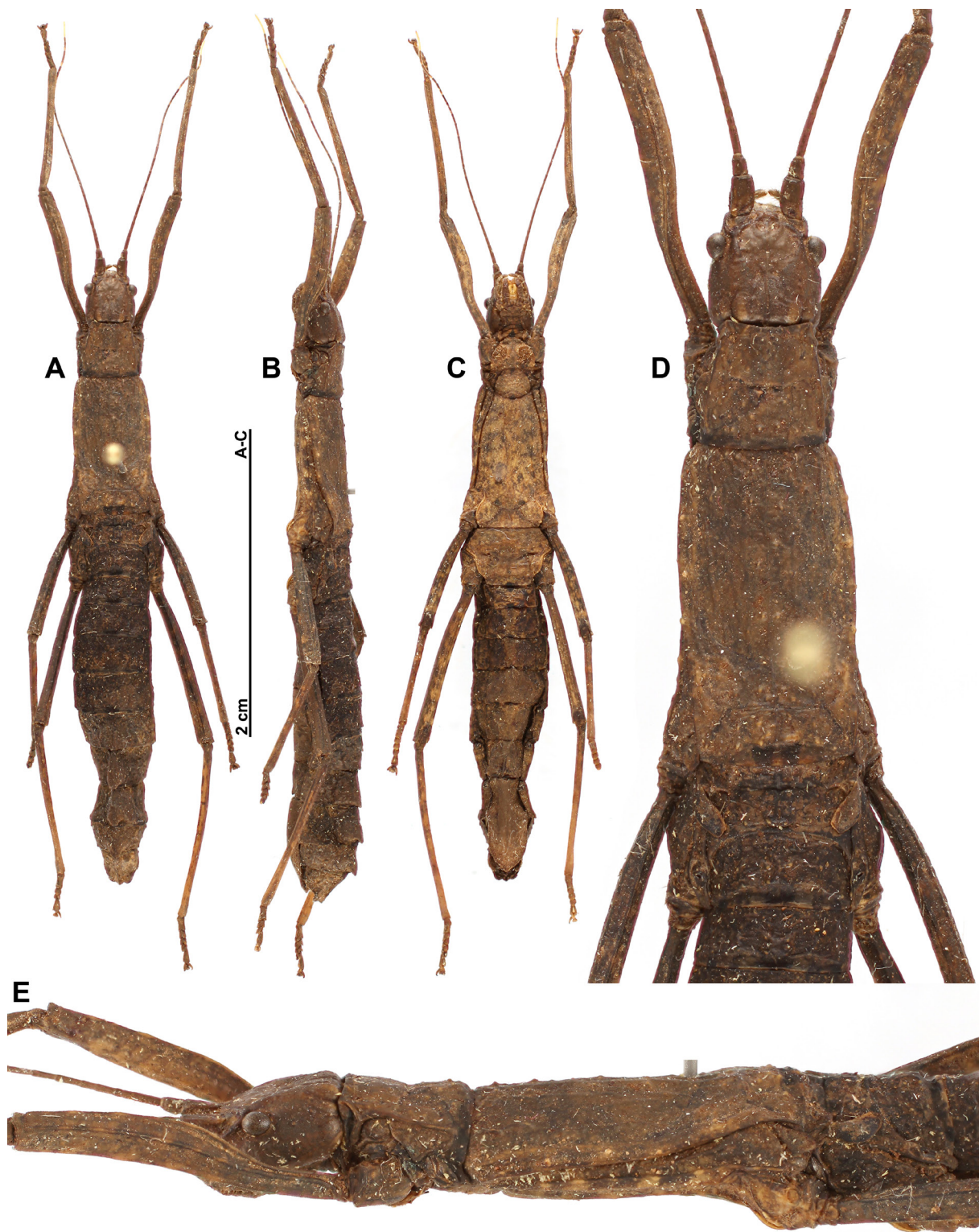


Fig. 30. *Neoxyartes neohiraseoides* sp. nov., paratype, ♀ (RBINS). **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Head and thorax, dorsal view. **E.** Head and thorax, lateral view.

Capsule more or less oval in lateral and dorsal view and minutely granulose, predominantly dark brown with network of minute, dark, stalked mushroom-like protuberances. Micropylar plate positioned nearly centrally on capsule; oval, coloured as capsule, somewhat paler centrally; surface smooth with mediolongitudinal carina starting at micropylar cup, not reaching anterior margin of micropylar plate. Micropylar cup small, cup-like. Polar area as rest of capsule. Operculum egg-shaped with ventral margin



Fig. 31. *Neoxyartes neohiraseoides* sp. nov. **A–B.** Newly hatched nymph. **C.** ♂, dorsal view. **D.** ♂, head and thorax, dorsal view. **E.** ♂, wings. **F.** ♀, dorsal view. **G.** ♀, head and thorax, dorsal view. **H.** ♀, wings. Photographs ©T. Bollens.



Fig. 32. *Neoxyartes neohiraseoides* sp. nov. in situ in Chu Yang Sin N.P. **A.** ♂, lateral view. **B.** ♂, dorsal view. **C.** ♂, head and thorax, dorsolateral view. **D.** Mating pair. **E.** Habitat.

more broadly rounded than dorsal margin and convex; coloured as capsule with several mushroom-like, stalked granules grouped in central portion. Opercular rim somewhat raised and thickened and slightly downcurved dorsally.

Biology

The species was collected in mountainous tropical evergreen rainforest, at medium altitude (around 1000 m a.s.l.). The specimens were observed on low vegetation and seemed to feed on a variety of plant species. The eggs are dropped to the ground.

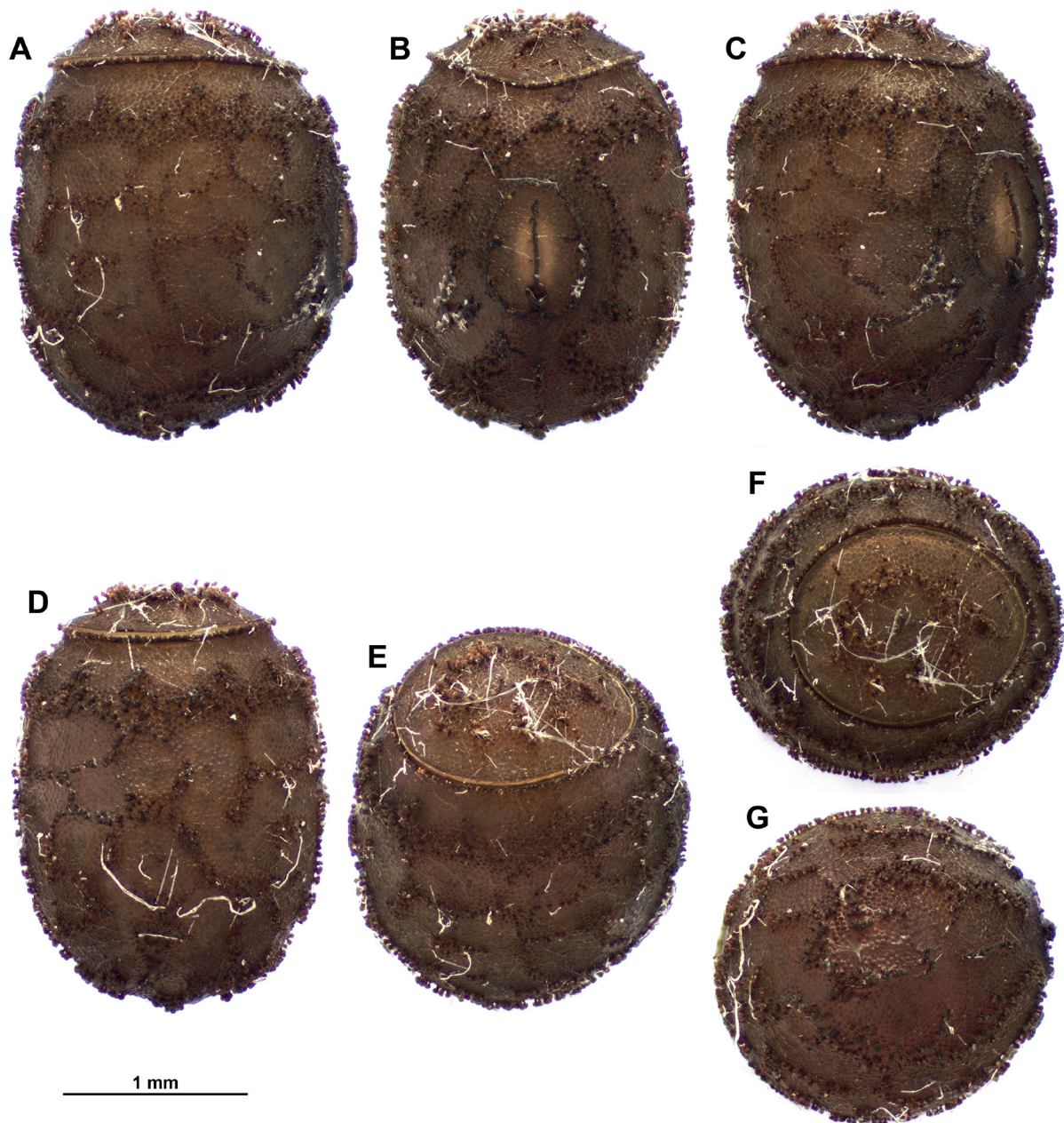


Fig. 33. *Neoxyartes neohiraseoides* sp. nov., eggs (RBINS). A. Lateral view. B. Dorsal view. C. Dorsolateral view. D. Ventral view. E. Anterolateral view F. Operculum. G. Polar area.

Table 4. Measurements (mm) of *Neooxyartes neohiraseoides* sp. nov.

Length of	HT ♂	PT ♂♂	PT ♀♀
Body	40.8	37.5–41.3	41.5–45.8
Head	3.3	3.2–3.4	4.3–4.8
Pronotum	3.1	2.9–3.2	3.5–4.2
Mesonotum	9.3	9.1–9.5	9.1–10.3
Metanotum	2.4	2.3–2.5	2.3–2.4
Median segment	2.1	2.0–2.2	2.2–2.4
Profemora	11.4	9.9–11.5	10.0–10.4
Mesofemora	9.0	8.3–9.0	7.9–8.5
Metafemora	12.8	11.4–12.2	11.5–12.4
Protibiae	11.7	10.9–12.3	10.2–10.6
Mesotibiae	9.4	8.7–9.0	8.0–8.6
Metatibiae	15.5	14.3–14.8	13.0–13.7

In captivity, the species accepts *Rubus* sp. and other Rosaceae, *Corylus avellana* and *Carpinus betulus* (Betulaceae), as food plants.

Distribution

This species is only known from Chu Yang Sin N.P. in the southern Annamite Mountains (Fig. 19).

Discussion

The genera *Neooxyartes*, *Nuichua* and *Mycovartes* gen. nov., compose a group that is here provisionally named the *Nuichua*-complex and are closely related to each other as suggested by body and egg morphology (Bresseel & Constant 2018). This coincides with recent phylogenetic results by Bank & Bradler (2022) where these three genera form a monophyletic clade with the *Neohirasea*-complex sensu Hennemann (2007) (previously known as *Neohiraseini* Hennemann & Conle, 2008) as sister group. Bank & Bradler (2022) sequenced *Oxyartes vietnamensis* resulting in a polyphyletic *Oxyartes* sensu lato. However, *vietnamensis* is here removed from *Oxyartes* and is transferred to the genus *Mycovartes* resulting in a reinstated monophyly of *Oxyartes*.

Sister to the clade combining the *Nuichua*- and *Neohirasea*-complexes is *Paramenexenus laetus* (Kirby, 1904). Care must be taken not to draw conclusions regarding the true relationships of the genus *Paramenexenus* based on this data alone, as the type species (and half of the known species) originates from Sri Lanka (Brock *et al.* 2024) and *Paramenexenus laetus* might not be congeneric. *Paramenexenus laetus* (and the closely related genera *Oxyartes* and *Phaenopharos*) can readily be separated from other members of the clade combining the *Nuichua*- and *Neohirasea*-complexes, by the occurrence of a definitely conically rounded capitular structure, rising well above the opercular rim (Sellick 1997a).

All three genera, which in total contain seven known species, seem to be restricted to the Truong Son Range with species occurring on the Kontum and Da Lat Plateaus. This was also found to be the case for the recently described genus *Pterulina* Bresseel & Constant, 2020 (Phasmatidae: Clitumninae) and coincides with the findings of Sterling & Hurley (2005) that both areas are recognized for their high endemism.

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