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Research article

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The new genus of stick insect *Lobofemora* from Vietnam, with the description of three new species (Phasmida: Phasmatidae: Clitumnini)

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Abstract. The new genus *Lobofemora* gen. nov. is described from Vietnam to accommodate three new species: *L. bachmaensis* sp. nov. (Bach Ma National Park, central Vietnam), *L. bidoupensis* sp. nov. (Bidoup-Nui Ba National Park, central Vietnam) and *L. scheirei* sp. nov., the type species (Cat Tien National Park and Dong Nai Biosphere Reserve, south Vietnam). It is provisionally placed in the tribe Clitumnini Brunner von Wattenwyl, 1893. The genus is the only known Clitumnini which shows tegmina and sometimes alae in the males. Females show conspicuous foliaceous lobes on the median femora. Males and females of all species and the eggs of *L. scheirei* sp. nov. and *L. bidoupensis* sp. nov. are described and illustrated. An identification key to the species and a distribution map are provided. The definition of the tribe Clitumnini *sensu* Hennemann & Conle (2008) is slightly adapted to include the new genus and the tribal placement is discussed. The male of *L. scheirei* sp. nov. is able to stridulate by rubbing the outer margins of the tegmina against the subcostal and radial veins of the alae.

Keywords. Phasmatodea, stridulation, Global Taxonomic Initiative, South-East Asia, walking stick.

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Introduction

The tribe Clitumnini Brunner von Wattenwyl, 1893 was recently re-diagnosed and revised on the generic level by Hennemann & Conle (2008). The tribe comprises fourteen genera, some of which are very species rich, e.g., *Ramulus* Saussure, 1862 (171 species, see Brock 2015) and *Entoria* Stål, 1875 (31 species, see Brock 2015). Recent expeditions to Vietnam in the frame of a Global Taxonomic Initiative project by the authors and Vietnamese colleagues have revealed three congeneric new species that could not be attributed to any known genus. Following the key of Hennemann & Conle (2008), the new genus belongs in the tribe Clitumnini showing the following typical features: small to medium sized species with body lengths ranging from 71.2 to 95.5 mm in females and 52.5 to 74.0 mm in males; elongate legs; sexual dimorphism distinct; antennae shortened with the scapus enlarged, laterally dilated

and consisting of less than 28 segments; both sexes with short, roughly cylindrical cerci; males with the anal segment consisting of two movable semitergites which are minutely dentated interiorly and lack a developed sclerotised external vomer. Furthermore, the very elongate eggs and hairy appendages on the outer border of the capitulum is a character shared with three other genera of Clitumnini.

The new genus, however, violates several characters of Clitumnini; hence, it is remarkable and interesting in several aspects. The mesothorax is less than 2.5 x the combined length of head and prothorax in females. The median segment is about as long as the metanotum. Tegmina and often alae present in males, males have teeth on the mesofemora and have a granulose thorax. Females with back of the head raised and/or conical.

The new genus is described below as *Lobofemora* gen. nov. and is currently known from different localities in Central and South Vietnam. *Lobofemora scheirei* sp. nov. was found in the lowlands of Dong Nai Biosphere Reserve and Cat Tien National Park, both located in Southern Vietnam. *Lobofemora bidoupensis* sp. nov. is described from the highlands of Bidoup-Nui Ba National Park and *Lobofemora bachmaensis* sp. nov. is recorded from Bach Ma National Park in the Annamite Mountains, Central Vietnam.

Material and methods

Due to their nocturnal behaviour, most Phasmida including the genus *Lobofemora* gen. nov. were collected at night. A light-weight and water-proof head torch, Petzl MYO RXP, was used during searching the vegetation. The females were kept alive in a plastic box for producing eggs. Hatchlings of the different species were reared to adulthood by the first author and Dr Bruno Kneubühler (Switzerland). The wild caught specimens were euthanized with ethyl acetate fumes. The specimens were then stored in airtight plastic “zip”-bags in wood chips (used in rodent cages) and sprinkled with ethyl acetate (EtOAc) to prevent rotting, mould and keeping the specimens flexible. The bags are then frozen on arrival and the specimens are mounted later on.

The egg morphology follows the terminology of Clark Sellick (1997, 1998). The description of the colouration is based on live specimens.

Acronyms used for the collections

- BMNH = Natural History Museum, London, United Kingdom
- FHC = Frank Hennemann Collection, Hohenecken, Germany
- MNHU = Museum für Naturkunde der Humboldt-Universität, Berlin, Germany
- RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium
- RMNH = Nationaal Natuurhistorisch Museum (Naturalis), Leiden, The Netherlands
- VNMN = Vietnam National Museum of Nature, Vietnamese Academy of Sciences, Hanoi, Vietnam
- ZMUH = Zoologisches Museum, Universität Hamburg, Germany
- ZSMC = Zoologische Staatssammlung München, Germany

Results

Family Phasmatidae Gray, 1835 *sensu lato*
Subfamily Clitumninae Brunner von Wattenwyl, 1893

Tribe **Clitumnini** Brunner von Wattenwyl, 1893

We follow the definition of the tribe proposed by Hennemann & Conle (2008: 67), except for the following characters:

1. The length of the median segment: Clitumnini have the median segment strongly shortened and at most $\frac{1}{4}$ the length of the metanotum; *Lobofemora* gen. nov. has the median segment about as long as the metanotum.
2. Relative length of mesothorax: Clitumnini have the mesothorax at least 2.5 x the combined length of head and prothorax; *Lobofemora* gen. nov. has the mesothorax shorter than twice the combined length of head and prothorax.

Genus *Lobofemora* gen. nov.

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Type species

Lobofemora scheirei sp. nov. by present designation.

Etymology

The name of the new genus is formed by the juxtaposition of *lobus* (Latin), meaning lobe and “femora”. The name refers to the foliaceous lobes on the median legs of the females.

Diagnosis

Differing from all other known genera of Clitumnini by the following combination of characters:

1. Females with back of head more or less strongly raised, granulate and conical.
2. Males with at least some scale-like tegmina present, sometimes with developed alae.
3. Median segment about as long as or longer than metanotum.
4. Females with conspicuous enlarged lobes on mesofemora and males occasionally with dorsal teeth on the mesofemora.
5. Mesothorax less than 2.5 x the length of head and pronotum combined.
6. Semi-tergites of males very short and broad and thorax densely granulate.

Description

Male

HEAD. Longer than wide, slightly tapering posteriorly and granulate. Vertex elongated. Dorsal portion of head flattened, with two definite spines positioned at posterior margin of eyes and projecting dorsally. Eyes circular and strongly projecting hemispherically. Scapus flattened dorso-ventrally and rounded laterally. Pedicellus cylindrical.

THORAX. Pronotum shorter than head and slightly widening posteriorly. Anterior margin incurved and raised, followed by faint, median longitudinal impression, not reaching posterior margin. Central transverse impression not reaching lateral edges of pronotum. Mesonotum granulate, widening posteriorly. Fine median longitudinal line. Tegmina completely developed or present as small scales. Alae absent, micropterous or brachypterous. Metanotum shorter than median segment. Meso- and metasternum with posteriorly, between legs, Y-shaped impression, antero-laterally resulting in two minute pseudo-foramina.

ABDOMEN. Abdominal segments slightly granulate and with fine median, longitudinal line. Tergum X with median, longitudinal carina, apically split into two semi-tergites. Inner apical rim of semi-tergites armed with several spines. Apex of semi-tergites obliquely pointing downwards. Posterolateral angles rounded. Poculum rounded, slightly projecting over apex of abdominal tergum IX. Apex of poculum narrower and rounded. No sclerotised vomer present. Cerci short, not reaching apex of tergum X, incurving, circular in cross-section, apices rounded.

LEGS. Profemora slightly longer than head and thorax combined; compressed and curved basally. Anterodorsal carina with few, small serrations.

Female

HEAD. Longer than wide, slightly tapering posteriorly and strongly granulose. Vertex elongated and with a shallow longitudinal impression. Dorsal portion of head flattened, with transverse, laterally acute ridge at posterior margin of eyes. Eyes circular and projecting hemispherically. Antennae short, with scapus strongly dorso-ventrally flattened and with lateral margins rounded. Apical half with very short segments.

THORAX. Pronotum shorter than head and granulose. Anterior margin incurved and raised, followed by median longitudinal impression, not reaching posterior margin. Transverse impression in middle, not reaching lateral edges of pronotum. Mesonotum granulose, with fine median longitudinal line. Metanotum with anterior margin weakly incurved and raised, longer than wide and strongly granulose. Meso- and metasternum as in male.

ABDOMEN. Terga granulose, with fine median, longitudinal line. Tergum X with median, longitudinal carina; notched posteriorly; posterolateral angles rounded. Epiproct elongated. Subgenital plate slightly elongated, just projecting over apex of tergum X and with median longitudinal carina; apex acute. Cerci short, not reaching apex of tergum X. Gonapophyses VIII elongated, reaching apex of epiproct.

LEGS. Profemora longer than head, pronotum and mesonotum combined; compressed and curved basally. Anterodorsal carina with small serrations. Mesofemora with posterodorsal carina, with two to three lobes, anterior one being most prominent. Protibiae longer than head and thorax combined. Mesotibiae slightly longer than mesofemora. Metatibiae shorter than profemora.

Distribution

Currently known from different localities in Central and South Vietnam (see map Fig. 1).

Species included and distribution

Lobofemora bachmaensis sp. nov. [Bach Ma National Park]

Lobofemora bidouzensis sp. nov. [Bidoup Nui Ba National Park]

Lobofemora scheirei sp. nov. [Cat Tien National Park and Dong Nai Biosphere Reserve]

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

Males

1. Alae developed, projecting over posterior margin of median segment (Fig. 6D, H) *L. scheirei* sp. nov.
– Alae scale-like or absent (Figs 2D, H; 4D, H)..... 2
2. Tegmina scale-like, flattened, just projecting over anterior margin of metanotum; alae absent (Fig. 2D, H); posterodorsal carina of mesotibiae with conspicuous triangular tooth (Fig. 2B) *L. bachmaensis* sp. nov.
– Tegmina reaching halfway along metanotum, convex; alae scale-like (Fig. 4D, H); posterodorsal carina of mesotibiae unarmed (Fig. 4B) *L. bidouzensis* sp. nov.

Females

1. Mesofemora with two lobes on posterodorsal carina: more basal one prominent; more apical one present as subapical triangular spine (Fig. 3D); vertex projecting posteriorly, almost reaching halfway along pronotum length (Fig. 3E, I) *L. bachmaensis* sp. nov.
– Mesofemora with three lobes on posterodorsal carina: most basal one most prominent and gradually becoming smaller; most apical one present as subapical triangular spine (Figs 5D, 7D); vertex rounded or slightly elongated posteriorly, not surpassing $\frac{1}{3}$ of pronotum length (Figs 5E, I; 7E, I) 2

2. Posterodorsal carina of profemora armed with two enlarged triangular bispinose teeth; medioventral carina of metatibiae armed with two small triangular lobes anteriorly (Fig. 5D); vertex rounded posteriorly (Fig. 5E, I) *L. bidouzensis* sp. nov.
- Posterodorsal carina of profemora unarmed; medioventral carina of metatibiae without triangular lobes anteriorly (Fig. 7D); vertex slightly elongated posteriorly (Fig. 7E, I)..... *L. scheirei* sp. nov.

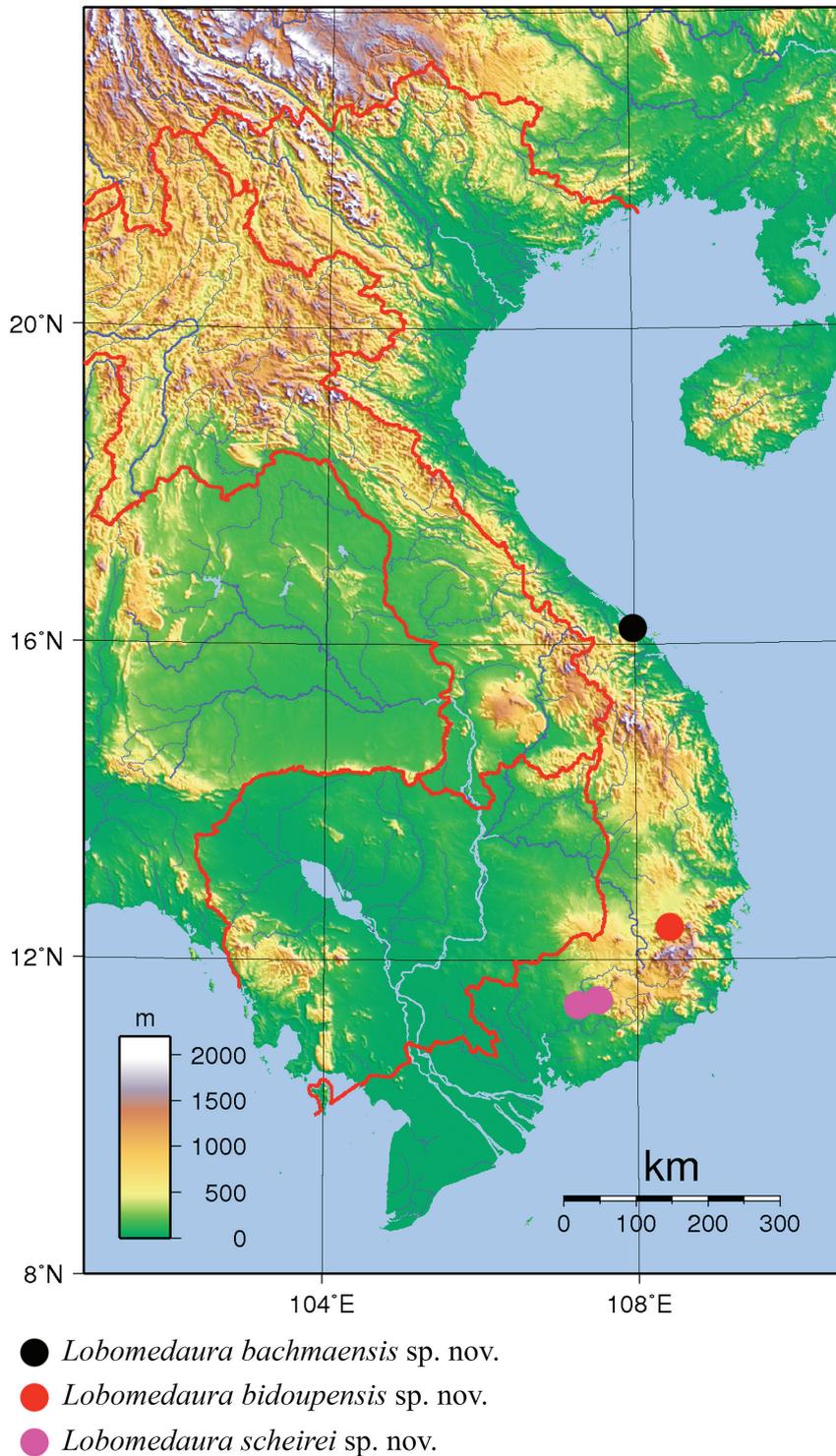


Fig. 1. Distribution map of the species of *Lobofemora* gen. nov.

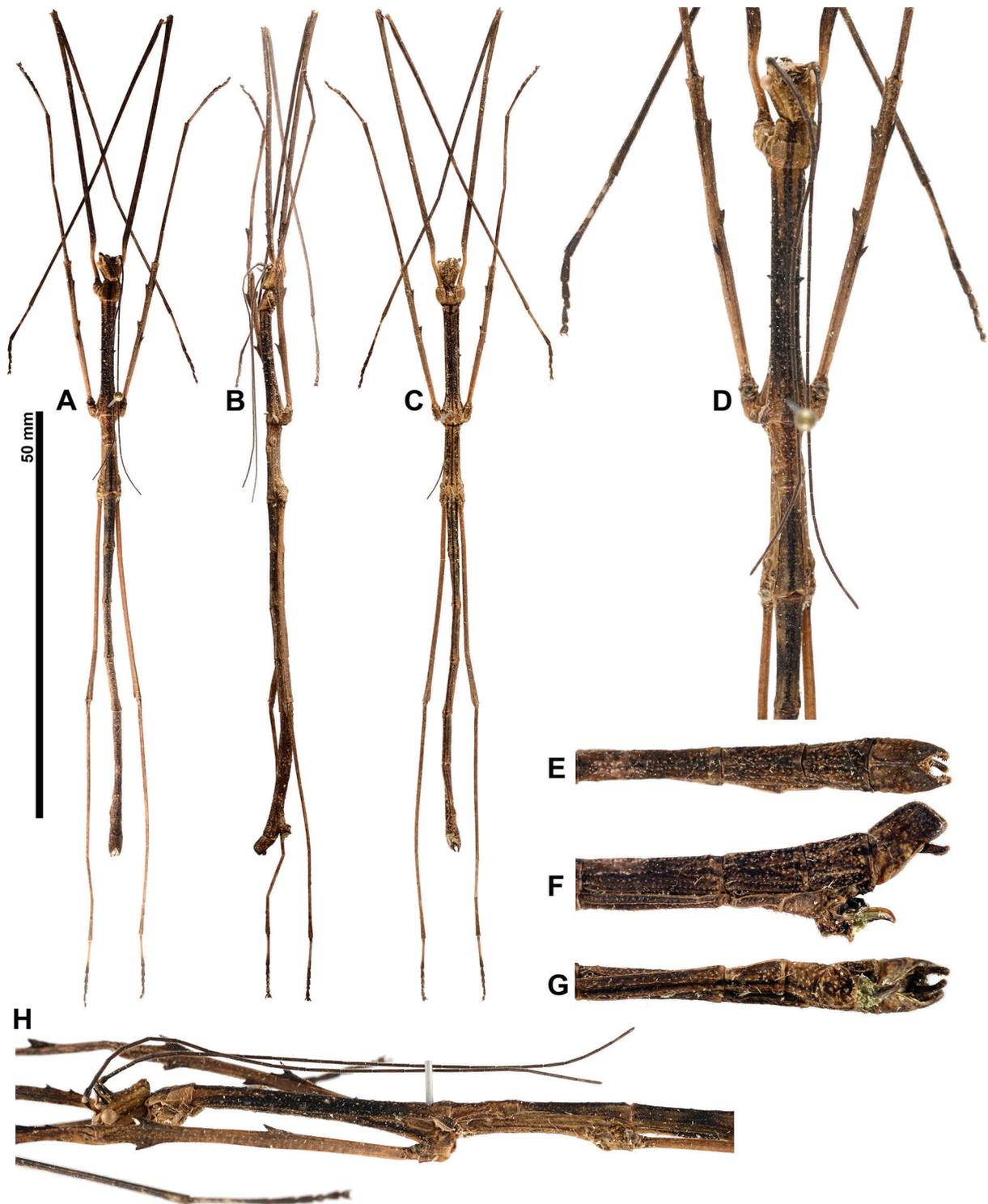


Fig. 2. *Lobofemora bachmaensis* sp. nov. ♂, holotype. **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Anterior part of body, dorsal view. **E.** Apex of abdomen, dorsal view. **F.** Apex of abdomen, lateral view. **G.** Apex of abdomen, ventral view. **H.** Anterior part of body, lateral view. D–H = not to scale.

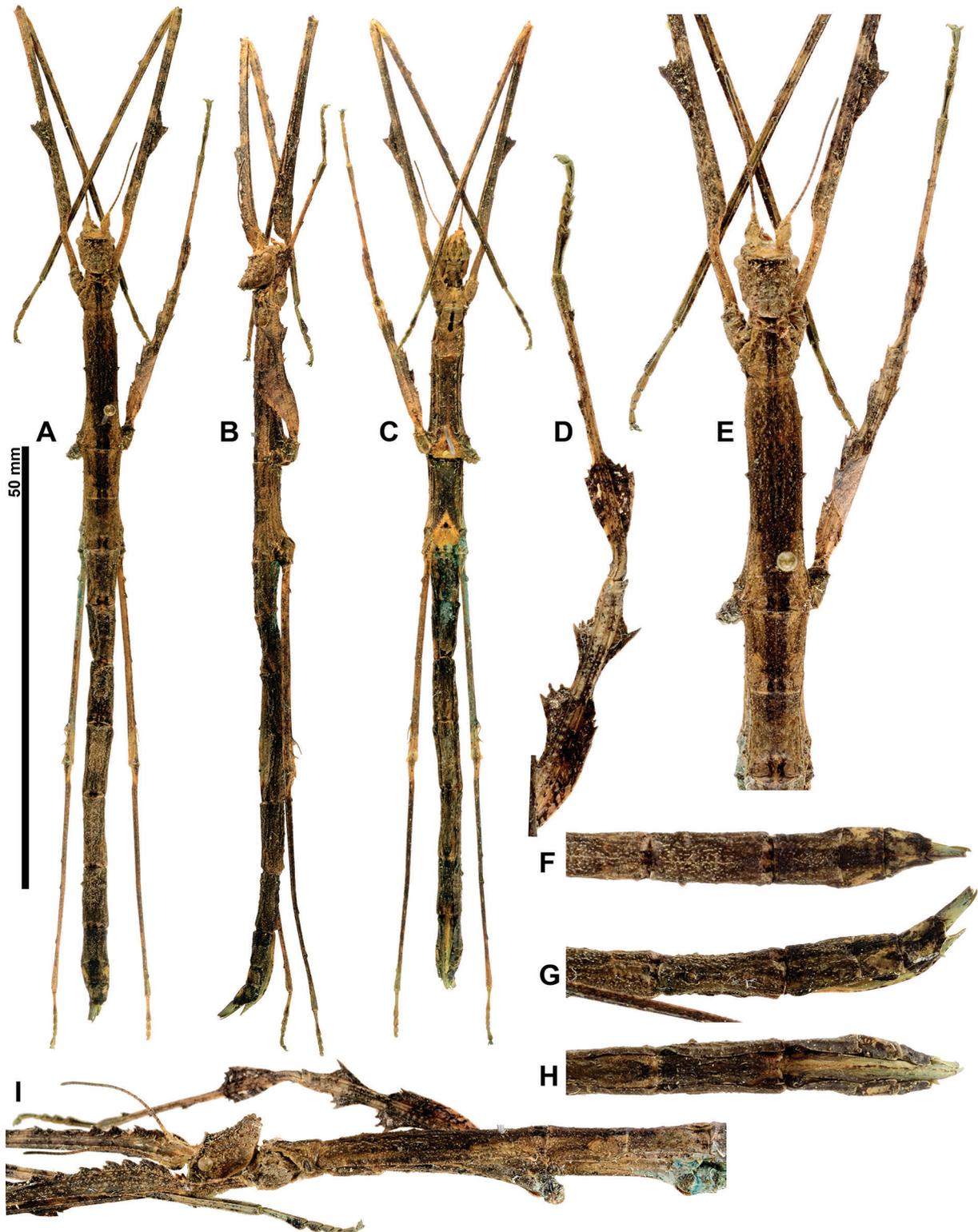


Fig. 3. *Lobofemora bachmaensis* sp. nov. ♀, paratype. **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Right median leg, detail. **E.** Anterior part of body, dorsal view. **F.** Apex of abdomen, dorsal view. **G.** Apex of abdomen, lateral view. **H.** Apex of abdomen, ventral view. **I.** Anterior part of body, lateral view. D–I = not to scale.

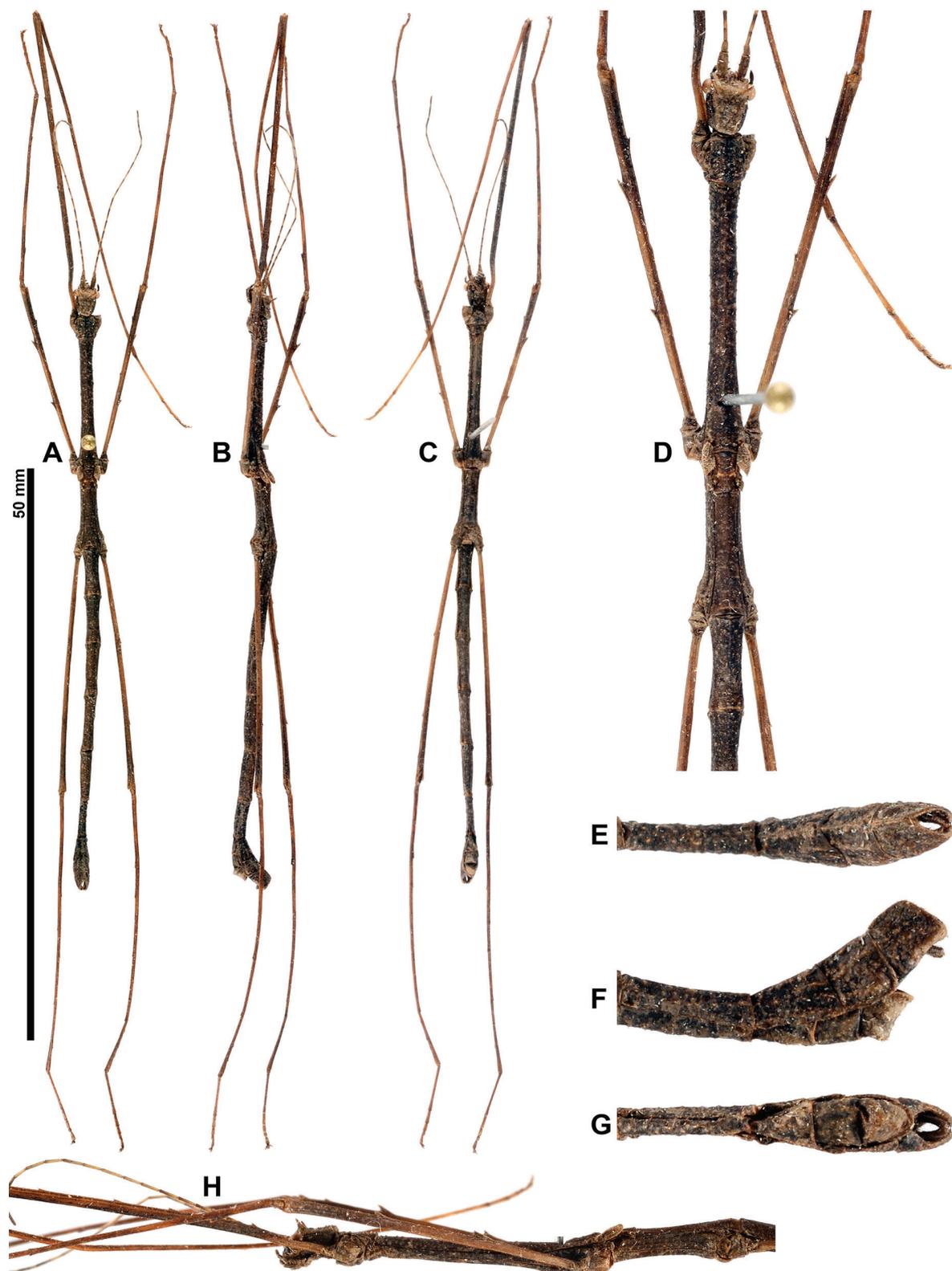


Fig. 4. *Lobofemora bidouensis* sp. nov. ♂, holotype. **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Anterior part of body, dorsal view. **E.** Apex of abdomen, dorsal view. **F.** Apex of abdomen, lateral view. **G.** Apex of abdomen, ventral view. **H.** Anterior part of body, lateral view. D–H = not to scale.

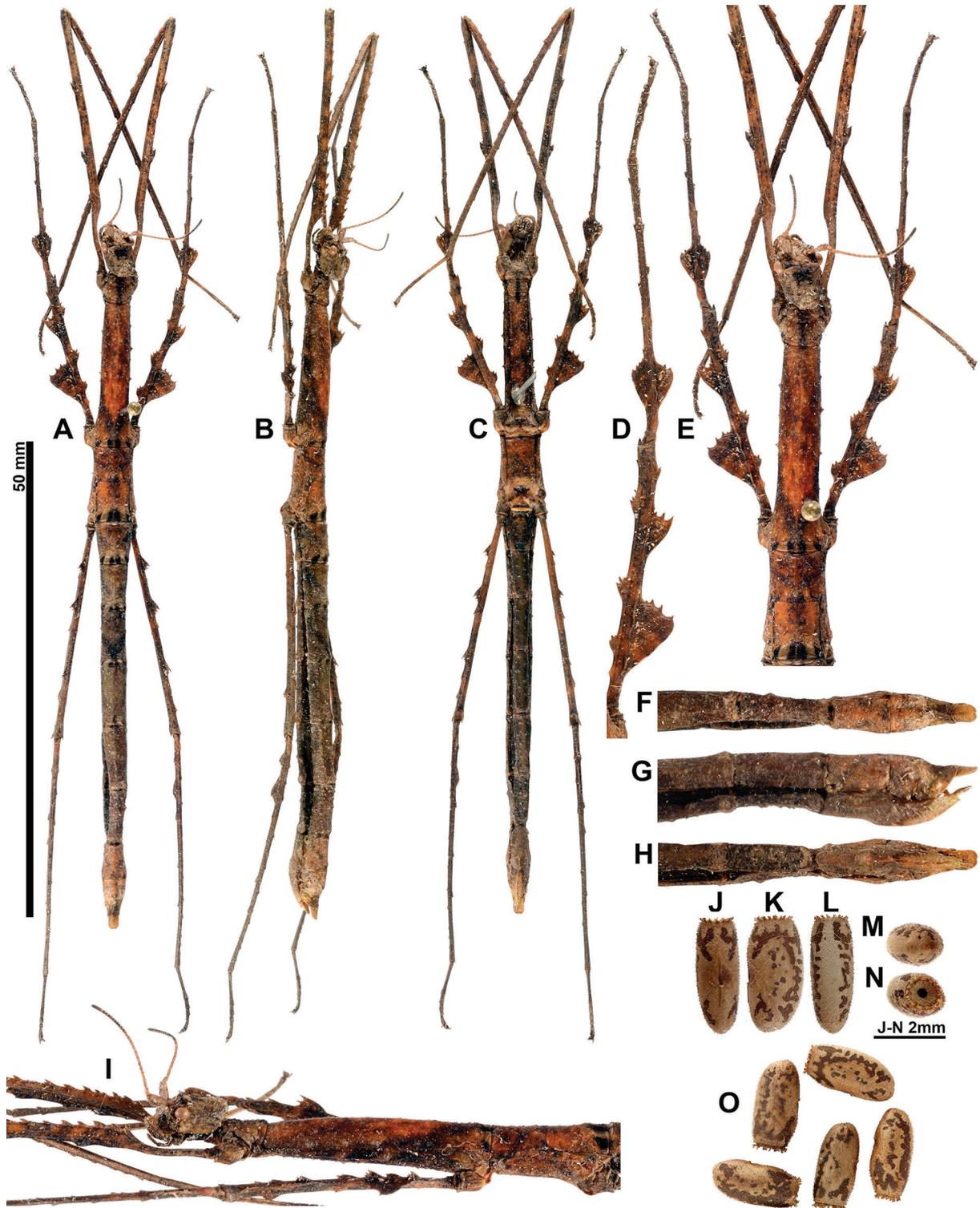


Fig. 5. *Lobofemora bidouensis* sp. nov. A–I. ♀, paratype. A. Habitus, dorsal view. B. Habitus, lateral view. C. Habitus, ventral view. D. Right median leg, detail. E. Anterior part of body, dorsal view. F. Apex of abdomen, dorsal view. G. Apex of abdomen, lateral view. H. Apex of abdomen, ventral view. I. Anterior part of body, lateral view. J–N. Egg. J. Detail of micropylar plate. K. Lateral view. L. Ventral view. M. Detail of polar area. N. Detail of operculum. O. Eggs. D–I, O = not to scale.



Fig. 6. *Lobofemora scheirei* sp. nov. ♂, holotype. **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Anterior part of body, dorsal view. **E.** Apex of abdomen, dorsal view. **F.** Apex of abdomen, lateral view. **G.** Apex of abdomen, ventral view. **H.** Anterior part of body, lateral view. D–H = not to scale.

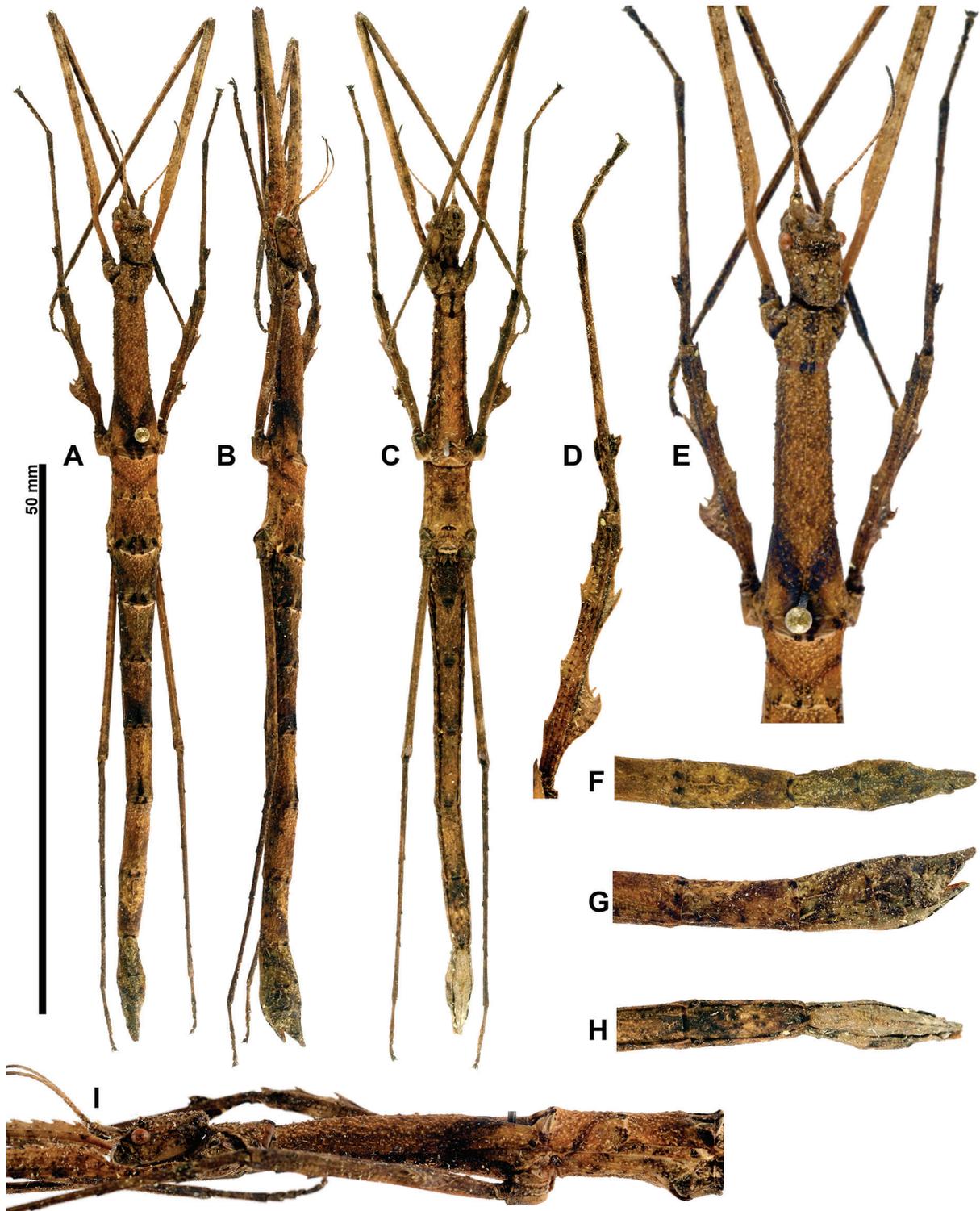


Fig. 7. *Lobofemora scheirei* sp. nov. ♀, paratype. **A.** Habitus, dorsal view. **B.** Habitus, lateral view. **C.** Habitus, ventral view. **D.** Right median leg, detail. **E.** Anterior part of body, dorsal view. **F.** Apex of abdomen, dorsal view. **G.** Apex of abdomen, lateral view. **H.** Apex of abdomen, ventral view. **I.** Anterior part of body, lateral view. D–I = not to scale.

Lobofemora bachmaensis sp. nov.

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Figs 1, 2, 3, 10A–C

Etymology

The species epithet refers to the type-locality, Bach Ma National Park in central Vietnam.

Type material

Holotype

VIETNAM: ♂: “Coll. I.R.Sc.N.B., C Vietnam, Bach Ma N.P., 16°12’N 107°52’E, 12-17.vii.2011, leg. J. Constant & J. Bresseel, I.G.: 31.933” (RBINS).

Paratypes (1 ♂, 3 ♀♀, 1 ♀ nymph)

VIETNAM: same collection data as for holotype (RBINS; 1 ♂, 1 ♀: VNMN).

Description

Male (Fig. 2)

MEASUREMENTS. See Table 1.

BODY. Complete body more or less uniformly brown with blackish markings, sometimes with vague longitudinal darker line. Basitarsi and curved anterior part of profemora paler. Prosternum with conspicuous black, longitudinal median line.

HEAD. Longer than wide, slightly tapering posteriorly and granulose. Vertex elongated, projecting over anterior margin of pronotum. Dorsal portion of head flattened, with two definite spines projecting dorsally at posterior margin of eyes. Eyes circular and strongly projecting hemispherically. Antennae projecting over posterior margin of median segment, with 23 segments. Scapus strongly flattened dorso-ventrally and laterally rounded. Pedicellus cylindrical.

THORAX. Pronotum almost rectangular and granulose, shorter than head and slightly widening posteriorly. Anterior margin incurved and raised, followed by faint, median longitudinal impression, not reaching posterior margin. Central transverse impression not reaching lateral edges of pronotum. Mesonotum about five times as long as pronotum and strongly granulose, widening posteriorly; three larger, spinose tubercles on each side, with largest one in middle; fine median longitudinal line. Tegmina with inner portion blackish and outer portion pale cream coloured, short, flattened and just projecting over anterior margin of metanotum; apically rounded. Alae absent. Metanotum with faint median line, shorter than median segment.

ABDOMEN. Abdominal segments II–V gradually increasing in length; V–VI about the same length, slightly granulose and with fine median, longitudinal line. Granules more concentrated along median line. Tergum VII shorter than tergum II. Tergum VIII about half as long as tergum II, slightly widening posteriorly. Tergum IX shorter than VIII and tectiform. Tergum X about as long as VIII and with median longitudinal carina; apically split into two semi-tergites. Inner apical rim of semi-tergite armed with several spines; apex obliquely pointing downwards. Posterolateral angles rounded. Poculum rounded, slightly projecting over apex of abdominal tergum IX. Apex of poculum narrower and rounded. Cerci short, not reaching apex of tergum X, incurving, circular in cross-section, with apices rounded.

LEGS. Profemora slightly longer than head and thorax combined; compressed and curved basally. Anterodorsal carina with few, small serrations. Serrations mostly anteriorly. Other carinae unarmed. Mesofemora slightly shorter than head, pro- and mesonotum combined. Posterodorsal carina with two

enlarged triangular spines, one central and one subapical. Anteroventral carina with single triangular subapical spine. Metafemora longer than mesofemora, but shorter than profemora. Protibiae longer than profemora and unarmed. Mesotibiae slightly longer than mesofemora. Posterodorsal carina with triangular spine in basal half. Anterodorsal carina with minute subapical spine. Ventral carinae unarmed. Metatibiae with minute saw-like spines in apical half on the outer carinae.

Female (Figs 3, 10A–C)

MEASUREMENTS. See Table 1.

BODY. Complete body more or less uniformly brown with blackish markings, sometimes with vague longitudinal darker line. Basitarsi and curved anterior part of profemora paler. Prosternum with conspicuous black, longitudinal median line.

HEAD. Longer than wide, slightly tapering posteriorly and strongly granulose. Vertex elongated, almost reaching halfway pronotum. Vertex with enlarged granules apically and asymmetrical: vertex split by shallow longitudinal impression, right hump slightly more pronounced than left one. Dorsal portion of head flattened, with transverse, laterally acute ridge at posterior margin of eyes. Eyes circular and projecting hemispherically. Antennae short, with 25 segments. Scapus strongly flattened dorso-ventrally and rounded laterally. Pedicellus slightly flattened dorso-ventrally. Apical half with very short segments, apical segment about as long as three preceding segments together. Genae granulose.

THORAX. Pronotum trapezoidal, widening posteriorly; shorter than head and slightly granulose. Anterior margin incurved and raised, followed by median longitudinal impression, not reaching posterior margin. Central transverse impression not reaching lateral edges of pronotum. Mesonotum about four times as long as pronotum and strongly granulose, with fine median longitudinal line. Lateral edges with some larger blunt tubercles. Metanotum with anterior margin weakly incurved and raised, longer than wide and strongly granulose. Median segment 1.5 times longer than wide and granulose.

ABDOMEN. Abdominal segments II–VI gradually increasing in length, granulose and with fine median, longitudinal line. Tergum VII about as long as tergum II; sometimes with stalked, irregularly shaped tubercles. Tergum VIII shorter than tergum II, slightly widening posteriorly. Posterior margin weakly incurved. Tergum IX with anterior margin slightly convex, posterior margin slightly narrower and tectiform. Tergum X about as long as IX and with median, longitudinal carina; notched posteriorly and with posterolateral angles rounded. Epiproct elongated, slightly shorter than abdominal tergum X and with median, longitudinal carina; tectiform and apically rounded. Subgenital plate elongated, slightly projecting over apex of tergum X, with median longitudinal carina; apex acute. Cerci short, not reaching apex of tergum X. Gonapophyses strongly elongated, reaching apex of epiproct.

LEGS. Profemora longer than head, pronotum and mesonotum combined; compressed and curved basally. Anterodorsal carina with small serrations, more prominent anteriorly. Posterodorsal carina indistinct with sometimes (two out of three specimens) an enlarged triangular lobe. Ventral carina present and unarmed. Mesofemora with postero-dorsal carina with two lobes; anterior one most prominent. Anterior lobe resulting in different spines; other lobe with one apical spine. Anteroventral carina with three lobes. Basal lobe less prominent and inconspicuous; median and subapical ones with several spines. Posteroventral carina with base more prominent and one subapical lobe. Metafemora with posterodorsal carina sparsely serrated with triangular spines. Posteroventral carina with small triangular lobe basally and with two spines subapically; the latter strongly elongated and “wire”-like (absent in one of the females). Protibiae longer than head and thorax combined. Dorsal carina with small, inconspicuous triangular lobes. Mesotibiae about as long as mesofemora. Posterodorsal carina with conspicuous lobe basally; anterodorsal carina with minute triangular spine near apex. Medioventral carina with conspicuous lobe mirroring the one on posterodorsal carina, and with minute black serrations. Metatibiae shorter than

Table 1. Measurements (mm) of *Lobofemora bachmaensis* sp. nov. HT = holotype; PT = paratype(s).

	HT ♂	PT ♀♀	PT ♂
Body	74.0	87.3–95.5	69.2
Head	4.1	6.5–7.5	3.6
Pronotum	2.4	3.6–4.2	2.8
Mesonotum	14.0	15.3–16.6	12.8
Metanotum	3.7	5.5–6.0	3.7
Median segment	6.2	5.8–6.2	6.0
Profemora	34.8	31.6–32.1	29.6
Mesofemora	17.1	16.2–17.0	16.3
Metafemora	24.5	22.9–25.1	22.3
Protibiae	39.7	35.5–36.7	30.9
Mesotibiae	18.4	16.7–17.6	19.2
Metatibiae	29.4	27.3–28.2	27.0
Tegmina	0.8	–	

profemora; posteroventral carina with few triangular serrations; posterodorsal carina with subapical triangular spine.

Egg

Unknown.

Distribution

So far only known from Bach Ma National Park in central Vietnam (Fig. 1).

Lobofemora bidoupensis sp. nov.

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Figs 1, 4, 5, 8, 10D–G

Etymology

The species epithet refers to the type-locality, Bidoup-Nui Ba National Park in central Vietnam.

Type material

Holotype

VIETNAM: ♂: “Coll. I.R.Sc.N.B., Vietnam, Lam Dong prov., Bidoup-Nui Ba N.P., 12°26’N 108°30’E, 21-25.vii.2014, night coll., Leg. J. Constant & J. Bresseel, GTI Project, I.G.: 32.779” (RBINS).

Paratypes (10 ♂♂, 4 ♀♀)

VIETNAM: 6 ♂♂, 1 ♀: same collection data as for holotype (RBINS); 4 ♂♂, 3 ♀♀: “Coll. I.R.Sc.N.B., ex breeding J. Bresseel 2015, origin: Vietnam, Lam Dong prov., Bidoup-Nui Ba N.P., 12°26’N 108°30’E, 21-25.vii.2014, J. Constant & J. Bresseel, GTI Project, I.G.: 32.779” (RBINS; 1 ♂, 1 ♀: VNMN).

Description

Male (Figs 4, 8F–G, 10D)

MEASUREMENTS. See Table 2.

BODY. Base of femora pale brown, darkening towards apex. Tibiae mottled black and pale brown. Head with dorsal surface pale brown. Body darker brown with some black markings.

HEAD. Longer than wide, slightly tapering posteriorly and granulose. Vertex slightly elongated. Dorsal portion of head flattened with two spines projecting dorsally at posterior margin of eyes. Eyes circular and strongly projecting hemispherically. Antennae with 21 segments. Scapus strongly flattened dorso-ventrally and rounded laterally. Pedicellus cylindrical. Upper part of genae granulose.

THORAX. Pronotum longer than wide, almost rectangular and granulose, shorter than head; anterior margin incurved, followed by median longitudinal impression not reaching posterior margin; short, central, transverse impression not reaching lateral edges of pronotum. Mesonotum about six times as long as pronotum and strongly granulose, widening posteriorly, with fine median longitudinal line. Tegmina brown, short and slightly tapering posteriorly, not projecting over metanotum. Alae present as small scales, brown.

ABDOMEN. Abdominal segments II–V gradually increasing in length, V–VI about the same length, slightly granulose. Tergum VII shorter than tergum III. Tergum VIII about half as long as tergum II, slightly widening posteriorly. Tergum IX shorter than VIII and tectiform. Tergum X about as long as VIII and with median longitudinal carina; apically split into two semi-tergites. Inner apical rim of semi-tergite armed with several spines. Apex of semi-tergites obliquely pointing downwards; posterolateral angles rounded. Poculum rounded, slightly projecting over apex of abdominal tergum IX. Apex of poculum narrower and rounded. Cerci short, not reaching apex of tergum X, cylindrical in cross-section, with apices rounded.

LEGS. Profemora slightly longer than head and thorax combined; compressed and curved basally; dorsal carinae with few, minute spines; ventral carinae unarmed. Mesofemora longer than pro- and mesonotum combined; posterodorsal carina with two triangular spines and minute spine subapically; other carinae with few minute spines. Metafemora longer than head, pro-, meso- and metanotum combined; posterodorsal carina with four minute spines. Protibiae longer than profemora and unarmed. Mesotibiae slightly longer than mesofemora; medioventral carina with conspicuous, small triangular lobe. Metatibiae with minute saw-like spines in apical half on all carinae; medioventral carina with conspicuous triangular spine in anterior half.

Female (Figs 5, 8A–E, 10E–G)

MEASUREMENTS. See Table 2.

BODY. Complete body ranging from uniformly brown to mottled brown-black with some green and white markings. Prosternum with conspicuous black, longitudinal line.

HEAD. Longer than wide, slightly tapering posteriorly and granulose. Vertex slightly elongated and slightly asymmetrical: vertex split by shallow longitudinal impression; right portion slightly more pronounced than left one. Dorsal portion of head flattened, with transverse, laterally acute ridge at posterior margin of eyes; ridge split centrally by longitudinal depression. Eyes circular and projecting hemispherically. Antennae short with 24–26 segments. Scapus strongly flattened dorso-ventrally and rounded laterally, with outer lobe more prominent. Pedicellus slightly cylindrical; first antennomere about as long as the following two segments combined. Apical half with very short segments; apical segment about as long as four preceding segments combined. Upper part of genae tuberculate.

THORAX. Pronotum trapezoidal, widening posteriorly; shorter than head and granulose. Anterior margin incurved and raised, followed by median longitudinal impression not reaching posterior margin. Central transverse impression not reaching lateral edges of pronotum. Mesonotum about four times as long as pronotum and strongly granulose, slightly widening posteriorly, with fine median longitudinal line. Metanotum subquadrate with anterior margin weakly incurved and raised; strongly granulose and with median tubercle subapically. Median segment slightly longer than wide, anterior portion slightly

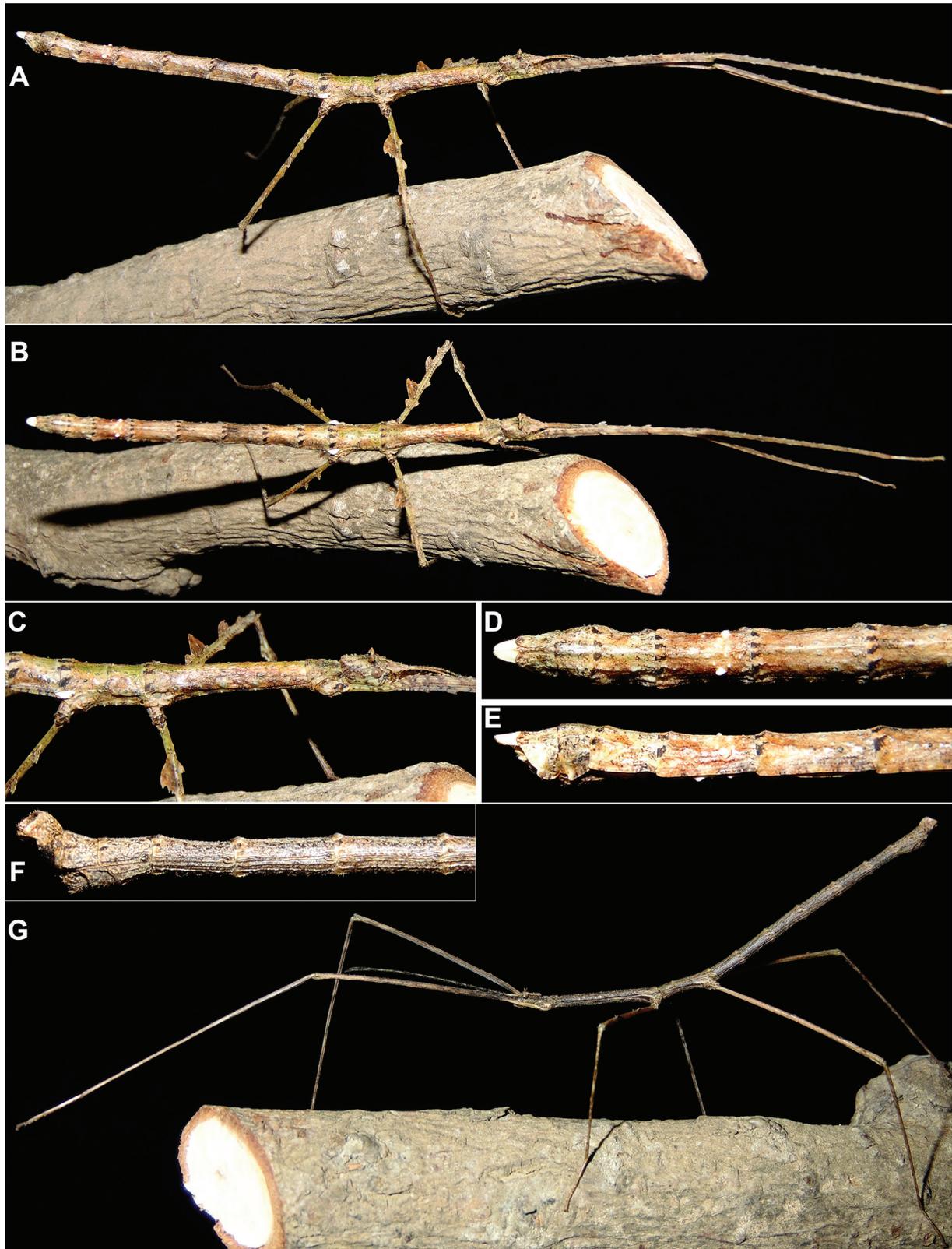


Fig. 8. *Lobofemora bidoupensis* sp. nov., captive reared specimens (photographs by the authors). **A–E.** ♀. **A.** Lateral view. **B.** Dorsal view. **C.** Anterior part of body, lateral view. **D.** Apex of abdomen, dorsal view. **E.** Apex of abdomen, lateral view. **F–G.** ♂. **F.** Apex of abdomen, lateral view. **G.** Lateral view.

granulose. Mesosternum with posteriorly, between legs, Y-shaped impression resulting into two small pseudo-foramina. Metasternum with posteriorly, between legs, X-shaped impression resulting in two small pseudo-foramina anteriorly.

ABDOMEN. Abdominal segments II–V gradually increasing in length, granulose and with fine median, longitudinal line; larger granules along median line. Terga V–VI nearly equal in length. Tergum VII shorter than VI. Tergum VIII shorter than tergum VI, slightly widening posteriorly; posterior margin weakly incurved. Tergum IX with anterior margin slightly convex; posterior margin slightly narrower. Tergum X slightly longer than IX and with median, longitudinal carina; strongly notched posteriorly; posterolateral angles rounded. Terga IX–X with lateral edges more pronounced and lobe-like. Epiproct elongated; about $\frac{2}{3}$ as long as abdominal tergum X and with very shallow apical notch. Subgenital plate elongated, slightly projecting over apex of tergum X; apical half with median longitudinal carina; apex rounded. Cerci short, not reaching of apex tergum X, cylindrical in cross-section, with apices rounded. Gonapophyses strongly elongated, reaching apex of epiproct.

LEGS. Profemora longer than head, pro-, meso- and metanotum combined; compressed and curved basally; anterodorsal carina with small serrations, more prominent anteriorly; posterodorsal carina armed with two enlarged triangular bispinose teeth; posteroventral carina sometimes with few serrations anteriorly. Mesofemora with postero-dorsal carina with three definite lobes; anterior one most prominent and gradually becoming smaller; anterior and central lobes resulting in different spines; other lobe with one apical spine; anterodorsal carina with few, small triangular lobes resulting in different minute spines; anteroventral carina with three small lobes resulting in minute spines. Posteroventral carina with one small lobe in apical half. Metafemora with posterodorsal carina armed with four triangular spines resulting in minute small spines; anterodorsal carina sometimes with some minute spines; posteroventral carina with few small spines. Protibiae about as long as head and thorax combined; posterodorsal carina with few inconspicuous triangular lobes; anterodorsal carina with small serrations over its complete length; posteroventral carina with few minute spines. Mesotibiae slightly longer than mesofemora; posterodorsal carina with conspicuous lobe anteriorly and few small serrations posteriorly; medioventral carina with conspicuous lobe mirroring the one on posterodorsal carina and with minute black serrations; other carinae with few, small serrations. Metatibiae shorter than profemora; dorsal carinae and postero- and anteroventrally with minute serrations; medioventral carina armed with two small triangular lobes basally.

Egg (Fig. 5J–O)

MEASUREMENTS (in mm). Length: 3.0–3.5; width: 1.2; height: 1.5.

Elongate-oval, general colouration, light brown with black patches. Capsule oval in cross section, with the surface granulose. Anteriorly with short brown fringes along the anterior margin of the capsule. Dorsal side slightly concave. Micropylar plate more or less inverted heart shaped, with a median impression posteriorly. Anteriorly triangular, then widening, posterolateral angles only slightly projecting over micropylar cup. Micropylar cup definite, followed by relatively long median line. Micropylar plate and median line coloured as capsule. Ventral side slightly convex. Polar area with shallow indentation. Operculum slightly darker than capsule, with central dark, circular marking.

Distribution

So far only known from Bidoup-Nui Ba National Park in central Vietnam (Fig. 1).

Table 2. Measurements (mm) of *Lobofemora bidoupensis* sp. nov. HT = holotype; PT = paratype(s).

	HT ♂	PT ♀♀	PT ♂
Body	52.5	71.2–77.8	55.0
Head	2.7	4.5–4.7	2.7
Pronotum	1.8	2.6–2.7	2.0
Mesonotum	11.2	13.6–16.4	11.7
Metanotum	1.8	3.6–3.9	2.5
Median segment	4.7	4.3–4.4	4.4
Profemora	26.3	25.1–29.2	28.2
Mesofemora	15.8	15.8–15.5	16.9
Metafemora	20.3	21.3–24.5	21.5
Protibiae	31.1	30.1–33.1	33.8
Mesotibiae	17.8	16.6–18.4	19.3
Metatibiae	25.0	25.3–27.0	27.1
Tegmina	1.4	–	

Lobofemora scheirei sp. nov.

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Figs 6, 7, 9, 10H–J

Etymology

The species epithet refers to the Flemish TV show presenter Mr Lieven Scheire. We dedicate this new species to Lieven both in recognition of his efforts in raising public awareness of science (including taxonomy), especially for young people, in his TV shows, and as a present for his recent wedding.

Type material

Holotype

VIETNAM: ♂: “Coll. I.R.Sc.N.B., Vietnam, Dong Nai Biosphere Res. 11°18’N 107°06’E, 25.vi-6.vii.2012, night collecting, Leg. J. Constant & J. Bresseel, I.G.: 32.161” (RBINS).

Paratypes (39 ♂♂, 28 ♀♀, 17 eggs)

VIETNAM: 12 ♂♂, 12 ♀♀: same collection data as for holotype (RBINS; 1 ♂, 1 ♀: VNMN); 5 ♂♂, 5 ♀♀: “Coll. I.R.Sc.N.B., Vietnam, Cat Tien N.P., 11°26’N 107°26’E, 6-16.vii.2012, Leg. J. Constant & J. Bresseel, I.G.: 32.161” (RBINS; 1 ♂, 1 ♀: VNMN); 12 eggs: “Coll. I.R.Sc.N.B., ex breeding J. Bresseel i.2015, origin: Vietnam, Cat Tien N.P., 11°26’N 107°26’E, 6-16.vii.2012, J. Constant & J. Bresseel” (RBINS; 2: VNMN); 22 ♂♂, 11 ♀♀, 5 eggs: “Ex culture F. Hennemann 2015, Origin: S-Vietnam, Lam Dong Prov., Cat Tien N.P., 11°26’N 107°26’E, leg. J. Constant & J. Bresseel 6.-16.VII.2012” (3 ♂♂, 1 ♀: MNHU; 3 ♂♂, 1 ♀: ZMUH; 4 ♂♂, 1 ♀: ZSMC; 3 ♂♂, 1 ♀: RMNH; 4 ♂♂, 2 ♀♀: BMNH; 5 ♂♂, 5 ♀♀, 5 eggs: FHC).

Additional material

VIETNAM: 25 ♂♂, 23 ♀♀, 45 eggs: “Ex culture F. Hennemann 2015, Origin: S-Vietnam, Lam Dong Prov., Cat Tien N.P., 11°26’N 107°26’E, leg. J. Constant & J. Bresseel 6-16.VII.2012” (FHC).

Description

Male (Figs 6, 9I–M, 10H)

MEASUREMENTS. See Table 3.

BODY. Complete body blackish-brown. Profemora dark brown, paler basally. Protibiae light brown. Other femora pale brown with darker apex. Corresponding tibiae pale brown.

HEAD. Longer than wide, slightly tapering posteriorly and granulose. Vertex slightly elongated. Dorsal portion of head flattened, with two spines projecting dorsally at posterior margin of eyes. Eyes circular and strongly projecting hemispherically. Antennae almost reaching posterior margin of median segment, with 23 segments. Scapus strongly flattened dorso-ventrally and rounded laterally. Pedicellus cylindrical. Upper part of genae granulose.

THORAX. Pronotum trapezoidal and granulose, widening posteriorly; shorter than head; anterior margin incurved and raised, followed by median longitudinal impression not reaching posterior margin. Central transverse impression not reaching lateral edges of pronotum. Mesonotum about six to seven times as long as pronotum and strongly granulose, widening posteriorly; with fine median longitudinal line. Tegmina blackish, short and with definite hump; slightly tapering posteriorly and with apex rounded; external margin densely covered with minute tubercles. Alae projecting over apex of median segment; costal area coloured as elytra, anal area greyish brown; subcostal and radial veins densely covered with minute tubercles.

ABDOMEN. Abdominal segments II–V gradually increasing in length, V–VI about equal in length, slightly granulose and with fine median, longitudinal line; granules more concentrated along median line. Tergum VII shorter than tergum III. Tergum VIII about half as long as tergum II, slightly widening posteriorly. Tergum IX shorter than VIII and tectiform. Tergum X about as long as VIII and with median longitudinal carina; apically split into two semi-tergites. Inner apical rim of semi-tergite armed with several spines; apex obliquely pointing downwards; posterolateral angles rounded. Poculum rounded, slightly projecting over apex of abdominal tergum IX. Apex of poculum narrower and rounded. Cerci short, not reaching apex of tergum X, cylindrical in cross-section, with apices rounded.

LEGS. Profemora slightly longer than head and thorax combined; compressed and curved basally; anterodorsal carina with few, small serrations anteriorly; other carinae unarmed. Mesofemora about as long as pro- and mesonotum combined; posterodorsal carina variably with few triangular spines. Metafemora longer than head, pro-, meso- and metanotum combined and unarmed. Protibiae longer than profemora and unarmed. Mesotibiae slightly longer than mesofemora; anterodorsal carina with minute subapical spine; anteroventral carina with minute spine situated more basally than spine on anterodorsal carina; posteroventral carina with minute spine more basally than spine on anteroventral carina. Metatibiae with minute saw-like spines in posterior half on all carinae.

Female (Figs 7, 9A–H, 10I–J)

MEASUREMENTS. See Table 3.

BODY. Colouration variable. Most specimens more or less uniformly brown with some black markings; some specimens with head, legs and apex of abdomen red-brown and very pale fawn body. Prosternum with conspicuous black, longitudinal median line.

HEAD. Longer than wide, slightly tapering posteriorly and granulose. Vertex slightly elongated and asymmetrical: vertex split by shallow longitudinal impression, right hump slightly more pronounced than left one. Dorsal portion of head flattened, with transverse, laterally acute ridge at posterior margin of eyes. Eyes circular and projecting hemispherically. Antennae short, with 23–25 segments, most females possess 25 segments. Scapus strongly flattened dorso-ventrally and rounded laterally, with outer lobe more prominent. Pedicellus slightly flattened dorso-ventrally. First antennomere about as long as following two ones combined. Apical half of antenna with very short segments; apical segment about as long as four preceding segments combined. Upper part of genae granulose.



Fig. 9. *Lobofemora scheirei* sp. nov., captive reared specimens (photographs by Dr B. Kneubühler). A–H. ♀. A. Dorsal view. B. Ventral view. C. Lateral view. D. Dorsolateral view, morph whitish with head, apex of abdomen and legs chestnut brown. E. Head, lateral view. F. Apex of abdomen, dorsal view. G. Apex of abdomen, lateral view. H. Apex of abdomen, ventral view. I–M. ♂. I. Dorsal. J. Wing spread, lateral view. K. Head and thorax, lateral view. L. Apex of abdomen, lateral view. M. Apex of abdomen, dorsal view. N. Nymph. O. Eggs. P–S. Egg. P. Detail of micropylar plate. Q. Ventral view. R. Detail of operculum. S. Detail of polar area. T. Eggs laid in a slice of sponge.

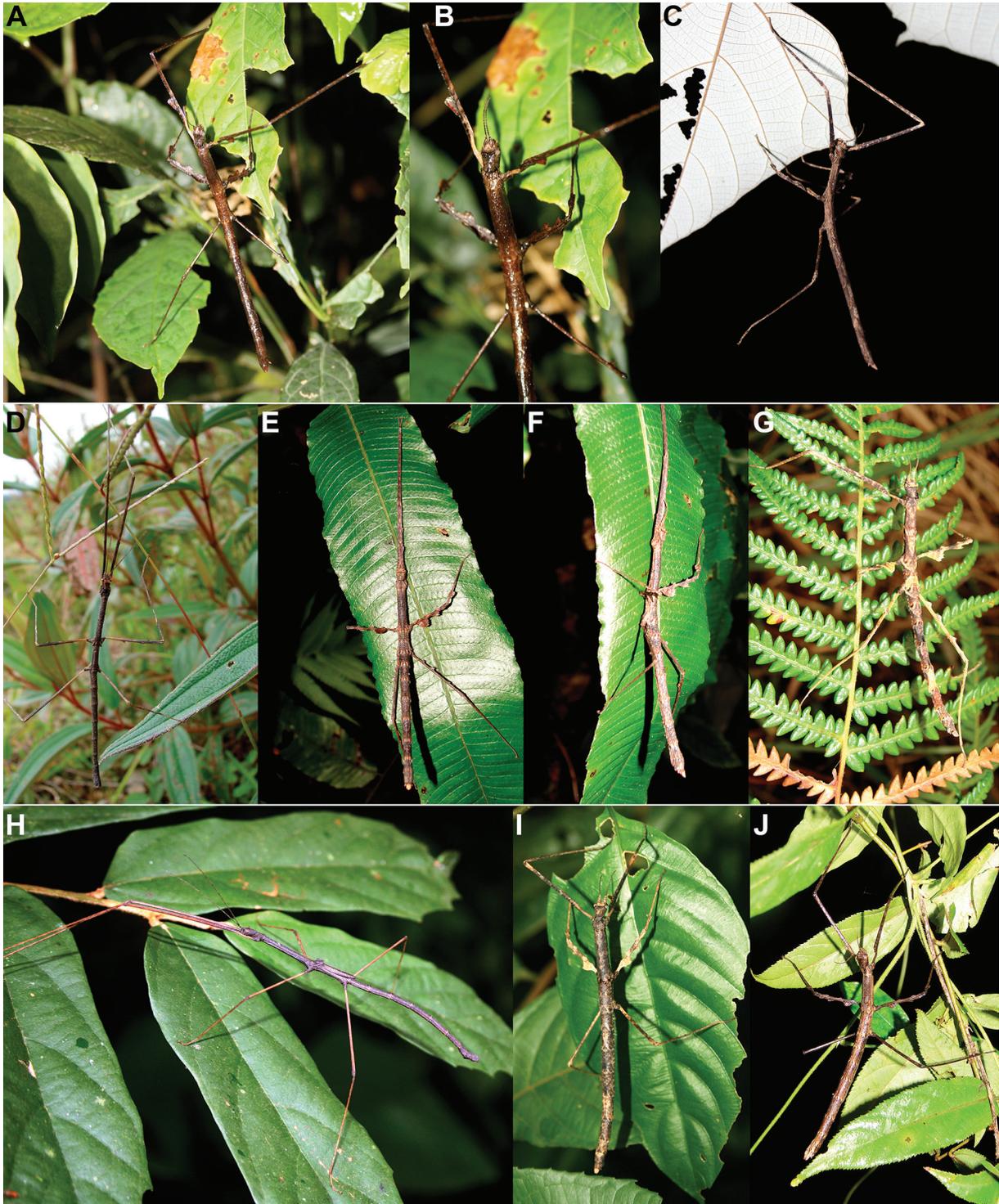


Fig. 10. *Lobofemora* gen. nov. spp., photographs *in natura* by the authors. **A–C.** *L. bachmaensis* sp. nov., Bach Ma National Park. **A–B.** ♀, 11 Jul. 2011. **C.** ♀, 14 Jul. 2011. **D–G.** *L. bidoupensis* sp. nov., Bidoup-Nui Ba National Park. **D.** ♂, 22 Jul. 2014. **E–F.** ♀, 25 Jul. 2014. **G.** ♀, 23 Jul. 2014. **H–J.** *L. scheirei* sp. nov. **H–I.** Dong Nai Biosphere Reserve, 30 Jun. 2012. **H.** ♂. **I.** ♀. **J.** ♀, Cat Tien National Park, 9 Jul. 2012.

THORAX. Pronotum trapezoidal, widening posteriorly; shorter than head and granulose; anterior margin incurved and raised, followed by median longitudinal impression not reaching posterior margin. Central transverse impression not reaching lateral edges of pronotum. Posterior margin with small posteromedian tubercle. Mesonotum about 3.7 times as long as pronotum and strongly granulose, widening posteriorly; fine median longitudinal line; tiny vestigial wing remnants posterolaterally. Metanotum with anterior margin weakly incurved and raised, subquadrate and strongly granulose. Median segment slightly longer than wide; anterior portion strongly granulose. Meso- and metasternum with posteriorly, between legs, Y-shaped impression resulting in two small pseudo-foramina.

ABDOMEN. Abdominal segments II–VI gradually increasing in length, granulose and with fine median, longitudinal line; larger granules along median line. Tergum VII about as long as tergum III; sometimes with stalked, irregularly shaped tubercles. Tergum VIII shorter than tergum II, slightly widening posteriorly; posterior margin weakly incurved. Tergum IX with anterior margin slightly convex; posterior margin slightly narrower. Tergum X about as long as IX and with median, longitudinal carina; strongly notched posteriorly; posterolateral angles rounded. Terga IX–X with lateral edges more pronounced and lobe-like. Epiproct elongated, about $\frac{2}{3}$ as long as abdominal tergum X, and with median, longitudinal carina; tectiform and with shallow apical notch. Subgenital plate elongated, slightly projecting over apex of tergum X; apical half with median longitudinal carina; apex rounded. Cerci short, not reaching apex of tergum X, cylindrical in cross-section, with apices rounded. Gonapophyses strongly elongated, reaching apex of epiproct.

LEGS. Profemora longer than head, pronotum and mesonotum combined; compressed and curved basally; anterodorsal carina with small serrations, more prominent anteriorly; posterodorsal carina indistinct; posteroventral carina sometimes with few minute serrations. Mesofemora with three lobes on posterodorsal carina; anterior one most prominent and gradually becoming smaller; anterior lobe resulting in different spines; two other lobes with one apical spine; antero-ventral carina with three small lobe-like spines; posteroventral carina with one small lobe-like spine in apical half. Metafemora with anterodorsal carina sparsely serrated; other carinae unarmed. Protibiae longer than head and thorax combined; posterodorsal carina with inconspicuous triangular lobe positioned at about basal $\frac{1}{4}$ of length; anterodorsal carina with few minute serrations. Mesotibiae slightly longer than mesofemora; posterodorsal carina with conspicuous lobe at about basal $\frac{1}{4}$ of length; dorsal carinae with minute black spine near apex; medioventral carina with conspicuous lobe mirroring the one on posterodorsal carina and with minute black serrations; postero- and anteroventral carinae with minute black serrations. Metatibiae shorter than profemora; all ventral carinae with minute black serrations; dorsal carinae sparsely armed with minute black serrations, more concentrated subapically.

Nymph (Fig. 9N)

Newly hatched nymphs are about 17 mm long and have comparatively long legs. Antennae short, slightly longer than head. Body entirely mottled green, brown and black.

Egg (Fig. 9O–S)

MEASUREMENTS (in mm). Length: 4.0; width: 1.2; height: 1.5.

Elongate-oval, general colouration light brown with black markings. Capsule oval in cross section, with the surface granulose and with a net-like sculpturing. Anteriorly with short brown fringes along the anterior margin of the capsule. Dorsal side slightly concave. Micropylar plate more or less bi-lobate with a median impression anteriorly and posteriorly. Anteriorly triangular, then widening; lateral expansions axe-shaped, with posterolateral angles projecting over micropylar cup. Micropylar cup definite, blackish and followed by relatively long median line. Micropylar plate and median line coloured as capsule.

Table 3. Measurements (mm) of *Lobofemora scheirei* sp. nov. HT = holotype; PT = paratypes.

	HT ♂	PT ♀♀	PT ♂♂
Body	66.5	72.3–79.9	56.3–73.4
Head	3.3	5.4–5.5	2.5–3.4
Pronotum	2.1	3.7–3.8	1.9–2.1
Mesonotum	14.3	13.2–15.7	11.1–14.8
Metanotum	Covered by wings	3.9–4.1	Covered by wings
Median segment	Covered by wings	4.2–4.9	Covered by wings
Profemora	30.0	24.6–26.9	25.2–31.2
Mesofemora	17.1	15.0–16.0	14.1–17.1
Metafemora	23.5	19.3–21.4	18.8–22.2
Protibiae	36.0	30.9–31.6	30.0–37.0
Mesotibiae	19.5	15.7–16.0	16.0–19.2
Metatibiae	27.5	24.3–24.9	23.2–27.6
Tegmina	2.8	–	1.9–2.9
Alae	9.4	–	8.5–9.5

Ventral side slightly convex. Polar area with shallow indentation. Operculum slightly darker than capsule, with deep central impression.

Distribution

So far only known from Cat Tien National Park and Dong Nai Biosphere Reserve in south Vietnam (Fig. 1).

Biological observations

Several eggs of this species hatched and nymphs were reared in captivity using ferns (Dryopteridaceae), which seem to be their natural foodplant. Substitute plants like bramble (*Rubus* L. spp., Rosaceae), beech (*Fagus sylvatica* L., Fagaceae) and *Hypericum* L. spp. (Hypericaceae) are also well accepted in captivity in Europe. This species is easy to maintain in captivity. Females try to stick their eggs into cracks and holes. Sponges cut into slices are suitable as substrate for this (Fig. 9T). Only few eggs will lay on the cage floor (pers. comm. B. Kneubühler, Jan. 2015). To collect eggs from wild caught females, paper tissue was used as substrate for egg laying.

Males are capable of stridulating, but in order to do so, they have to completely open their wings. When wings are open, the alae are not flat as in most stick insects, but have the outer margin curved downwards (Fig. 9J). By rubbing the outer margins of the tegmina against the subcostal and radial veins of the alae they are able to produce sound. The stridulation occurs when the specimens are disturbed.

Discussion

The currently known distribution of the genus *Lobofemora* gen. nov. is restricted to the southern half of Vietnam. The three new species were found at altitudes ranging from close to sea level (in Bach Ma National Park) up to 1600 m (in Bidoup-Nui Ba National Park).

From our observations in the field and in culture, it appears that the colouration in males is very constant, while females show more variable patterns and colours.

When identifying specimens of *Lobofemora* gen. nov., one must be aware that regenerated legs do not show the specific features of the “normal” specimens: lobes and spines are less developed and can even be absent.

The tribal placement of *Lobofemora* gen. nov. suggested herein is based on a set of characters which key out to the tribe Clitumnini Brunner von Wattenwyl, 1893. This due to having shortened antennae, that are not longer than the profemora, with a considerably broadened scapus; profemora that are triangular in cross-section with the anterodorsal carina strongly raised and the medioventral carina conspicuously displaced towards the anteroventral carina; females with strongly elongated lower gonapophyses (gonapophyses VIII) which clearly project over the apex of the subgenital plate; eggs are elongate and bullet-shaped, with an open internal micropylar plate and a well developed median line and lacking a central capitulum. Furthermore, eggs have a hairy rim on the border of the capitulum. Males lack an external vomer.

However, as mentioned above the definition of the Clitumnini had to be adapted to include this genus. The genus actually shares and violates several morphological characters with both Clitumnini and Medaurini Hennemann & Conle, 2008. Therefore, the genus has a fairly isolated position within the tribe.

The beak-like ovipositor is shared with several other genera in Clitumnini, e.g., *Entoria* Stål, 1875, *Metentoria* Brunner von Wattenwyl, 1907 and *Rhamphophasma* Brunner von Wattenwyl, 1893.

The aberrant and remarkable characters exhibited by *Lobofemora* gen. nov., with especially the length of the median segment and presence of tegmina and vestigial or shortened alae in the males, are unique within the entire tribe Clitumnini and warrant further investigation.

As usual for stick insects that have wings in one or both sexes, the median segment is fairly long in relation to the metanotum, an additional feature which distinguishes *Lobofemora* gen. nov. from all currently known genera of the tribe Clitumnini.

Traditionally, the presence of wings has *a priori* been regarded as a plesiomorphic character, but Whiting *et al.* (2003) have shown that wings within the Phasmatodea can not only be lost but also recovered during the evolutionary process of certain clades, a hypothesis which is supported by several examples and has already received acceptance by certain subsequent authors (e.g. Hennemann & Conle 2008). The decision on whether the presence of wings in the males of *Lobofemora* gen. nov. is plesiomorphic or apomorphic for the tribe Clitumnini is difficult to make at present and certainly warrants a detailed phylogenetic analysis of this and potentially closely related taxa. If it is regarded as an autapomorphy of *Lobofemora* gen. nov., this would be a further and very striking example for the recovery of wings in stick insects and support the hypothesis of Whiting *et al.* (2003), since all other known taxa of the very diverse and speciose tribe Clitumnini and also the related Medaurini are exceptionally wingless. Another fact that makes the presence of wings in *Lobofemora* gen. nov. even more remarkable is the capability of the winged males of *L. scheirei* sp. nov. to stridulate. This striking specialization is also not found in the winged males of the supposedly closely related tribe Pharnaciini (regarded as a subordinate taxon of the subfamily Clitumninae by Hennemann & Conle 2008) and hence is unique in that entire subfamily. The sounds are produced by rubbing the tegmina against the radial and subcostal veins of the alae, which bear numerous very minute tooth-like structures. Morphologically this is an analogy to the wing structures, e.g., seen in certain winged taxa of the predominantly New Guinean genus *Dimorphodes* Westwood, 1859 (Phasmatidae: Xeroderinae: Xeroderini), members of the Mascarean tribe Achriopterini or the New World genus *Pterinoxylus* Audinet-Serville, 1838 (Cladomorphae: Hesperophasmatini). It is hoped that future phylogenetic studies will deal with the interesting new genus described herein to clarify its taxonomic and phylogenetic position.

However, one must be aware that most genera in Clitumnini need to be redefined and several appear to be polyphyletic in their present configuration. For that reason, it is of utmost importance that DNA-based phylogenetic studies contain, for each genus, at least the type species to be well supported.

Acknowledgments

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