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The stick insect genus *Medauroidea* Zompro, 2000: Taxonomic note and extension to Laos and Cambodia with one new species, *M. romantica* sp. nov. (Phasmida: Phasmatidae: Clitumninae)

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Front cover: *Medauroidea romantica* sp. nov., left: pair mating in Cambodia, Preah Vihear province, BeTreed Adventures, 16.X.2017; right: egg with heart-shaped micropylar plate (photographs by J. Constant).

The stick insect genus *Medauroidea* Zompro, 2000: Taxonomic note and extension to Laos and Cambodia with one new species, *M. romantica* sp. nov. (Phasmida: Phasmatidae: Clitumninae)

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Abstract

A new species of *Medauroidea* Zompro, 2000, *M. romantica* sp. nov., is described from Phnom Tnout mountain, Preah Vihear Province in Cambodia from males, females and eggs, the latter showing a heart-shaped micropylar plate. Male, female, eggs, habitat and colour variation in females are illustrated, and a distribution map is provided. It is the first record of the genus in Cambodia. *Ramulus brongniarti* (Brunner von Wattenwyl, 1907) is transferred to *Medauroidea* and the new combination *M. brongniarti* (Brunner von Wattenwyl, 1907) comb. nov. is subsequently proposed. This represents the first record of the genus in Laos. *Ramulus imperialis* (Brunner von Wattenwyl, 1907) is proposed as a junior synonym of *M. brongniarti*, being the female of the latter. A lectotype is designated for *R. imperialis*. Both latter taxa are illustrated from their type specimens. This paper brings the total number of stick insects taxa formally recorded from Cambodia and Laos to three genera and three species and to two genera and two species, respectively.

Keywords: Phasmatodea, Medaurini, Indochina, Global Taxonomic Initiative, biodiversity.

Introduction

The stick insect fauna of Cambodia is extremely poorly known with only two species formally recorded from the country: *Orestes mouhotii* (Bates, 1865) (BRESSEEL & CONSTANT, 2018) and *Ramulus detrectans* (Brunner von Wattenwyl, 1907). The records of *Calvisia* (*Calvisia*) *torquata* (Bates, 1865) and *Necroscia annulipes* (Gray, 1835) were both from Chantaboun, the latter based on the type locality of its junior synonym *N. pictipes* (Bates, 1865); they were erroneously attributed to Cambodia but the location actually lies in Thailand (BRESSEEL & CONSTANT, 2017b) which was also clearly stated by MOUHOT (1864). Furthermore, the type location of *Ramulus brongniarti* (Brunner von Wattenwyl, 1907), attributed to Cambodia (BROCK *et al*., 2018), actually lies in Laos (GEISER & NAGEL, 2013). As a comparison, the fauna of Vietnam comprises 117 species, and that of Thailand, 40 species (BROCK *et al*., 2018). However, recent fieldwork in the country conducted by staff of RUPP and RBINS in the framework of Global Taxonomic Initiative projects, notably "A step further in the entomodiversity of Cambodia", revealed that the stick insect diversity of Cambodia is much richer than currently documented. The identification of specimens collected during the last 2017 expedition revealed a new species of the genus *Medauroidea* Zompro, 2000. This expedition especially focused on the Central Indochina dry forests ecoregion, i.e. mostly the dry dipterocarp forest which is a very typical habitat in Cambodia

although nearly undocumented in terms of entomofauna. The specimens were collected at "BeTreed Adventures" which protects 6,400 hectares of Cambodian "savannah" land, or dry dipterocarp forest in Phnom Tnout mountain. The conservation efforts in this place are supported through ecotourism and the area is home to endangered and threatened species of Cambodian wildlife e.g. banteng (*Bos javanicus*), pileated gibbons (*Hylobates pileatus*), silver langurs (*Trachypithecus germaini*), barking deer (*Muntiacus muntjak*), sambar deer (*Rusa unicolor*) and many species of birds. It is also home of Angkorian era "cave-temples", and the quarries where the ancients carved out their stone.

While examining other species described from the region, it was apparent from further research that *Ramulus brongniarti* (Brunner von Wattenwyl, 1907), described from male specimens from Lakhon, "Cambodia", belongs to the genus *Medauroidea*, and that *Ramulus imperialis* (Brunner von Wattenwyl, 1907), described from the same location, represents its female.

The present paper aims to describe the new species as *Medauroidea romantica* sp. nov., to update the taxonomic and distributional status of *Ramulus brongniarti* and to propose *R. imperialis* as a junior synonym of the latter.

Material and methods

Due to their nocturnal behaviour, like most Phasmida, the specimens of *Medauroidea romantica* sp. nov. were collected at night. A light-weight and water-proof head torch: Petzl MYO RXP was used during collecting. The females were kept alive in a mesh pop up cage (exo terra explorarium™) for producing eggs. The wild caught specimens were euthanized by an injection with ethanol. The specimens were then stored in airtight plastic "zip"-bags in wood chips (used in rodent cages) sprinkled with etylacetate (EtOAc) to prevent rotting, mould and to keep the specimens flexible. The bags were frozen on arrival and the specimens mounted later on.

Photographs of the new species were taken with a Canon 700D camera equipped with a Sigma 50 mm Macro lens (adults), or with a Leica EZ4W stereomicroscope with integrated camera (eggs), stacked with CombineZ software and optimized with Adobe Photoshop CS3.

For the transcription of the labels of the types, the wording on each single label is delimited by square brackets. The distribution map was produced with SimpleMappr (SHORTHOUSE, 2010). Observations were made with a Leica MZ8 stereomicroscope; measurements with an electronic calliper.

The nomenclature for the morphological characters follows BRAGG (2001); the egg morphology follows that of CLARK SELLICK (1997; 1998). The description of the colouration is based on live specimens.

Acronyms used for the collections:

MNHN = Muséum National d'Histoire Naturelles, Paris, France.
NHMW = Naturhistorisches Museum Wien, Wien, Austria.
RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium.
RUPP = Royal University of Phnom Penh, Cambodian Entomology Initiative, Cambodia.

Abbreviations:

HT: holotype
PT: paratype
ST: syntype

Taxonomy

Family **Phasmatidae** Gray, 1835
Subfamily **Clitumninae** Brunner von Wattenwyl, 1893
Tribe **Medaurini** Hennemann & Conle, 2008

Genus ***Medauroidea*** Zompro, 2000

Medauroidea ZOMPRO, 2000: 68 [described; compared with *Medaura* and *Ramulus*].
Type species: *Clitumnus extradentatus* Brunner von Wattenwyl, 1907, by original designation.

The definition of the genus given by ZOMPRO (2000) with the additional characters provided by BRESSEEL & CONSTANT (2017a) is here followed.

DISTRIBUTION. China, Vietnam, Cambodia*, Laos* and Thailand (* = new country records).

Species included (8) and distribution

M. chenshuchuni Ho, 2017	[China, Guanxi]
M. brongniarti (Brunner von Wattenwyl, 1907) comb. nov.	[Laos*]
= *Ramulus imperialis* (Brunner von Wattenwyl, 1907) syn. nov.	
M. dolichocercata (Bi & Wang, 1998)	[China, Henan]
M. extradentata (Brunner von Wattenwyl, 1907)	[Vietnam, Phuc-Son]
= *Cuniculina annamensis* (Brunner von Wattenwyl, 1907)	
M. nyamalensis (Chen, Shang & Pei, 2000)	[China, Xizang]
M. polita (Chen & He, 1997)	[China, Sichuan]
M. regula (Brunner von Wattenwyl, 1907)	[Vietnam, Than-Moi]
M. romantica sp. nov.	[Cambodia*, Preah Vihear]

***Medauroidea brongniarti* (Brunner von Wattenwyl, 1907) comb. nov.**

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Figs 1–3

Clitumnus brongniarti BRUNNER VON WATTENWYL, 1907: 193 [described].
Cuniculina imperialis BRUNNER VON WATTENWYL, 1907: 204 [described] **syn. nov.**

Baculum imperialis – BROCK, 1998: 34 [transferred to *Baculum*].
Ramulus brogniarti – OTTE & BROCK, 2005: 193 [misspelling of *brongniarti*, catalogued and transferred to *Ramulus*].
Ramulus imperialis – OTTE & BROCK, 2005: 303 [catalogued and transferred to *Ramulus*].

MATERIAL EXAMINED

TYPE MATERIAL. LAOS: holotype ♂ of *Clitumnus brongniarti* (Fig. 1): [Museum Paris, Lakhon, Harmand 1878] [53] [900, 78] [53. *Clitumnus Brongniarti* Br.] [Syntype] [MNHN-EO-PHAS407] (MNHN).

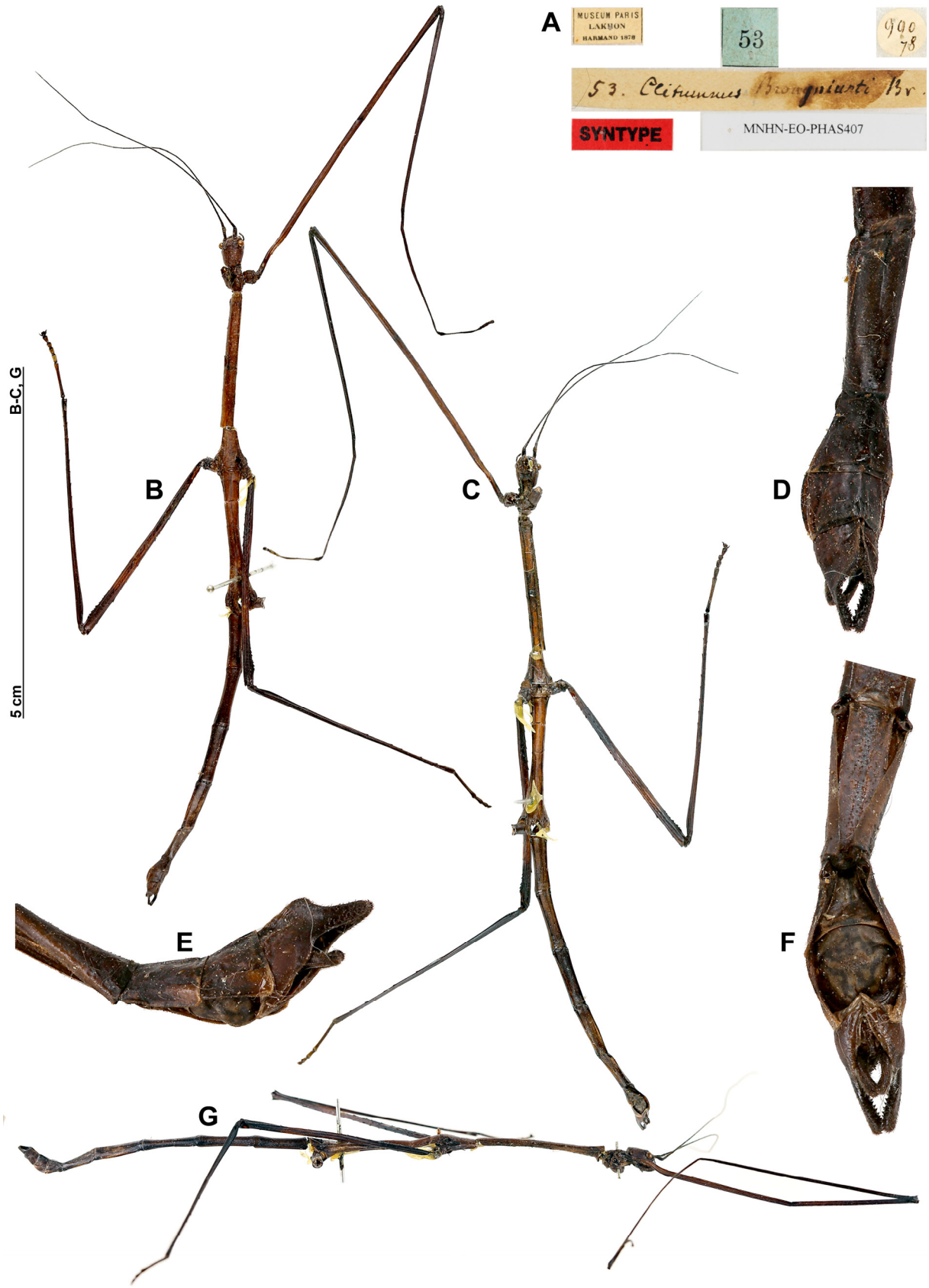

Fig. 1. *Medauroidea brongniarti* (Brunner von Wattenwyl, 1907), holotype ♂ (photographs by E. Delfosse). A, labels. B, habitus, dorsal view. C, habitus, ventral view. D, terminalia, dorsal view. E, terminalia, lateral view. F, terminalia, ventral view. G, habitus, lateral view.

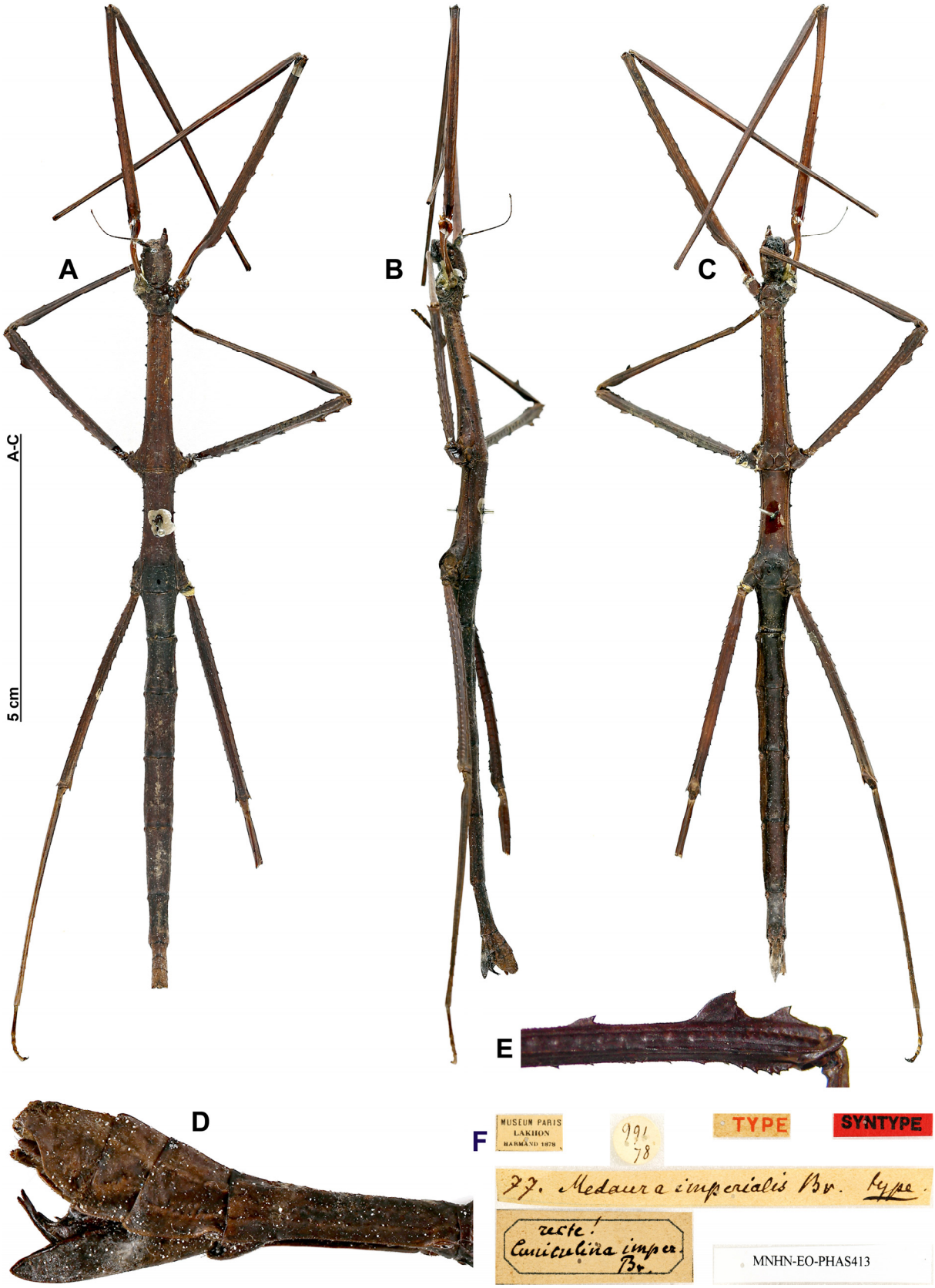

Fig. 2. *Medauroidea brongniarti* (Brunner von Wattenwyl, 1907), lectotype ♀ of *Ramulus imperialis* (Brunner von Wattenwyl, 1907) (photographs by E. Delfosse). A, habitus, dorsal view. B, habitus, lateral view. C, habitus, ventral view. D, terminalia, lateral view. E, distal half of metafemur, lateral view. F, labels.

Fig. 3. *Medauroidea brongniarti* (Brunner von Wattenwyl, 1907) and *M. romantica* sp. nov., distribution map.

LAOS: lectotype ♀ of *Cuniculina imperialis* (Fig. 2 – here designated in order to provide a stable reference for the species): [Museum Paris, Lakhon, Harmand 1878] [991, 78] [Type] [77. *Medaura imperialis* Br. Type] [recte! *Cuniculina imper*. Br.] [Syntype] [MNHN-EO-PHAS413] (MNHN); paralectotype ♀ of *Cuniculina imperialis* (examined from photographs – BROCK *et al*., 2018): [Museum Paris, Lakhon, Harmand 1878] [23.335] [Collectio Br.v.W.] [det. Br.v.W. *Cuniculina imperialis*] (NHMW).

NOTES:
(1) the species is here transferred to the genus *Medauroidea* based on the following characters: body elongate and slender; head elongate, dorsally flattened and vertex split by a shallow median groove; subgenital plate convex, not reaching end of abdomen, anal segment notched. The species can easily be distinguished from other species in the genus. The dorsal carinae of the mesofemora are armed with saw-like spines, in females they are lobe-like

posteriorly (Fig. 2 E). The medioventral carina of the mesofemora is raised posteriorly and armed with several small spines.
(2) Brunner von Wattenwyl originally placed a label on the two female syntypes with the manuscript name *Medaura imperialis*. A second label was later added to correct the name to *Cuniculina imperialis*.
(3) Male and female of this species were described by Brunner von Wattenwyl, 1907 as two separate species, attributed to two different genera. However, the type specimens of *Clitumnus brongniarti* and *Cuniculina imperialis* share the same collection data. This, combined with the typical sexual dimorphism pattern as observed in the other *Medauroidea* species, leads us to consider the taxa as representing the two sexes of the same species.
(4) The locality Lakhon is situated in Laos, in the vicinity of Tha Khaek, Khammuane Province (GEISER & NAGEL, 2013).

DISTRIBUTION. Laos: Khammuane Province (Fig. 3).

***Medauroidea romantica* sp. nov.**

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Figs 3–10

ETYMOLOGY. The species epithet refers to the "romantically" heart-shaped micropylar plate observable on the eggs of this species.

TYPE MATERIAL. CAMBODIA: holotype ♂ (Figs 4 A, 5): [Cambodia, Preah Vihear prov., BeTreed Adventures, 16-21.X.2017, 13°29'44"N 104°42'36"E, GTI Project, Leg. J. Constant & X. Vermeersch, I.G.: 33.551] (RBINS).
Paratypes (20♂♂, 23♀♀): same data as holotype (18♂♂, 21♀♀: RBINS; 2♂♂, 2♀♀: RUPP).

ADDITIONAL MATERIAL. 6 eggs: same data as holotype (RBINS).

DESCRIPTION

MALE (Figs 4 A, 5, 8 A)

Measurements: see table 1.
Body: relatively constant in colour. Head pale brown, dorsally with a black mediolongitudinal line in the posterior portion and with a black postocular line. Thorax and abdominal terga with a distinct black mediolongitudinal line. Mediolongitudinal line fainting towards the posterior. Pronotum light brown, meso- and metanotum orange-brown centrally, with anterior and posterior portions light brown. Granules on lateral margins of meso- and metafemora whitish. Median segment and abdomen light brown. Profemora pale basally, darker distally; protibiae pale brown. Mid and hind legs pale brown with a slight greenish tinge.
Head: distinctly longer than wide, narrowing towards the posterior; dorsally relatively flat, with a small raised area between eyes; behind raised area a mediolongitudinal line and two diverging rows of small granules reaching occiput. Eyes quite small, circular and strongly projecting. Behind eyes on genae, few small granules. Antennae short, consisting of 22 segments. Scapus elongated, strongly flattened dorsoventrally and with lateral margins rounded. Pedicellus shorter and distinctly narrower than scapus. Antennal segment III about as long as following two segments combined. Apical antennomere slightly longer than the two preceding ones combined.

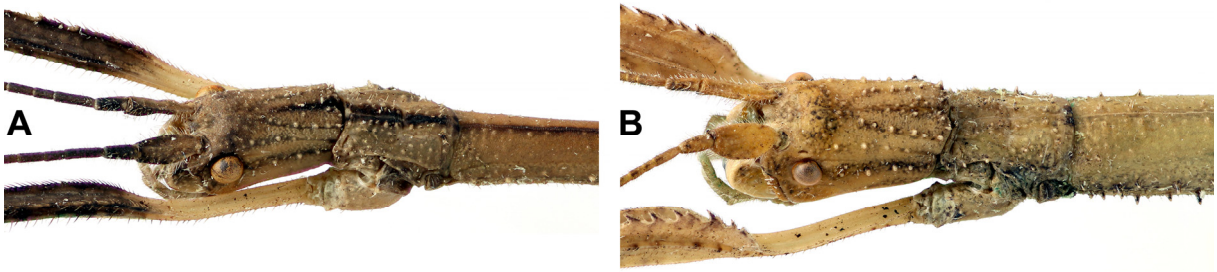

Fig. 4. *Medauroidea romantica* sp. nov., cephalic and prothoracic armature. A, ♂. B, ♀.

Thorax: pronotum slightly widening towards the posterior; shorter than head and tuberculose. Anterior margin incurved, slightly raised and armed with few granules; followed by a mediolongitudinal impression in the prozona. Central transverse impression indistinct, slightly concave, not reaching lateral margins. Lateral margins armed with few granules. Prozona rugose, with two irregular longitudinal rows of granules. Mesonotum more or less parallel-sided, about seven times as long as pronotum, smooth dorsally, laterally with several conical tubercles, more concentrated anteriorly. Mesopleura smooth. Metanotum parallel-sided, slightly longer than half the mesonotum and smooth. Metapleura as mesopleura.
Legs: profemora about as long as meso- and metanotum combined; compressed and curved basally; all carinae present; anterodorsal carina with small serrations basally, other carinae unarmed. Mesofemora slightly longer than mesonotum; medioventral carina with some minute teeth posteriorly. Metafemora slightly shorter than profemora, armed as mesofemora. Protibiae carinate, slightly longer than profemora and unarmed. Mesotibiae about as long as mesofemora and distinctly carinate; medioventral carina with one to three tiny spines. Metatibiae about as long as profemora and armed as mesotibiae.
Abdomen: median segment about two thirds of metanotum in length, longer than wide and unarmed. Abdominal terga smooth; terga II–V slightly increasing in length; V–VI about the same length; VII slightly decreasing in length; VIII distinctly shorter; IX distinctly shorter than VIII; X split into two semi-tergites, its inner portion armed with minute, black, hook-like spines. Semi-tergites strongly tapering from lateral view, apically acute. Vomer small, present as elongate sclerite, slightly projecting over base of cerci, not reaching halfway of cerci; apex blunt. Cerci elongated, more or less cylindrical, slightly incurving, not reaching apex of semi-tergites.

FEMALE (Figs 4 B, 6, 8 B–E)

Measurements: see table 1.
Body: females are very variable in colour, but always have a dorsal mediolongitudinal stripe on thorax and abdomen. Stripe varies in colour from green to black. Body and leg colouration can range from different shades of brown or green to black. Head and legs colouration is independent from body colouration and from one another.
Head: distinctly longer than wide, narrowing towards the posterior; dorsally relatively flat, with a small raised area between eyes; behind raised area a mediolongitudinal line and two diverging rows of blunt tubercles reaching occiput. Occiput with a higher concentration of tubercles. Eyes quite small and circular. Behind eyes on genae, two to five blunt tubercles, and two to six tubercles dorsolaterally. Antennae short, consisting of 24 segments. Scapus elongated, strongly flattened dorsoventrally and with lateral margins broadly rounded. Pedicellus shorter, narrower and flat dorsally. Antennal segment III longer than the following two combined, antennomere IV distinctly shorter than V. Apical antennomere longer than the two preceding antennomeres combined.

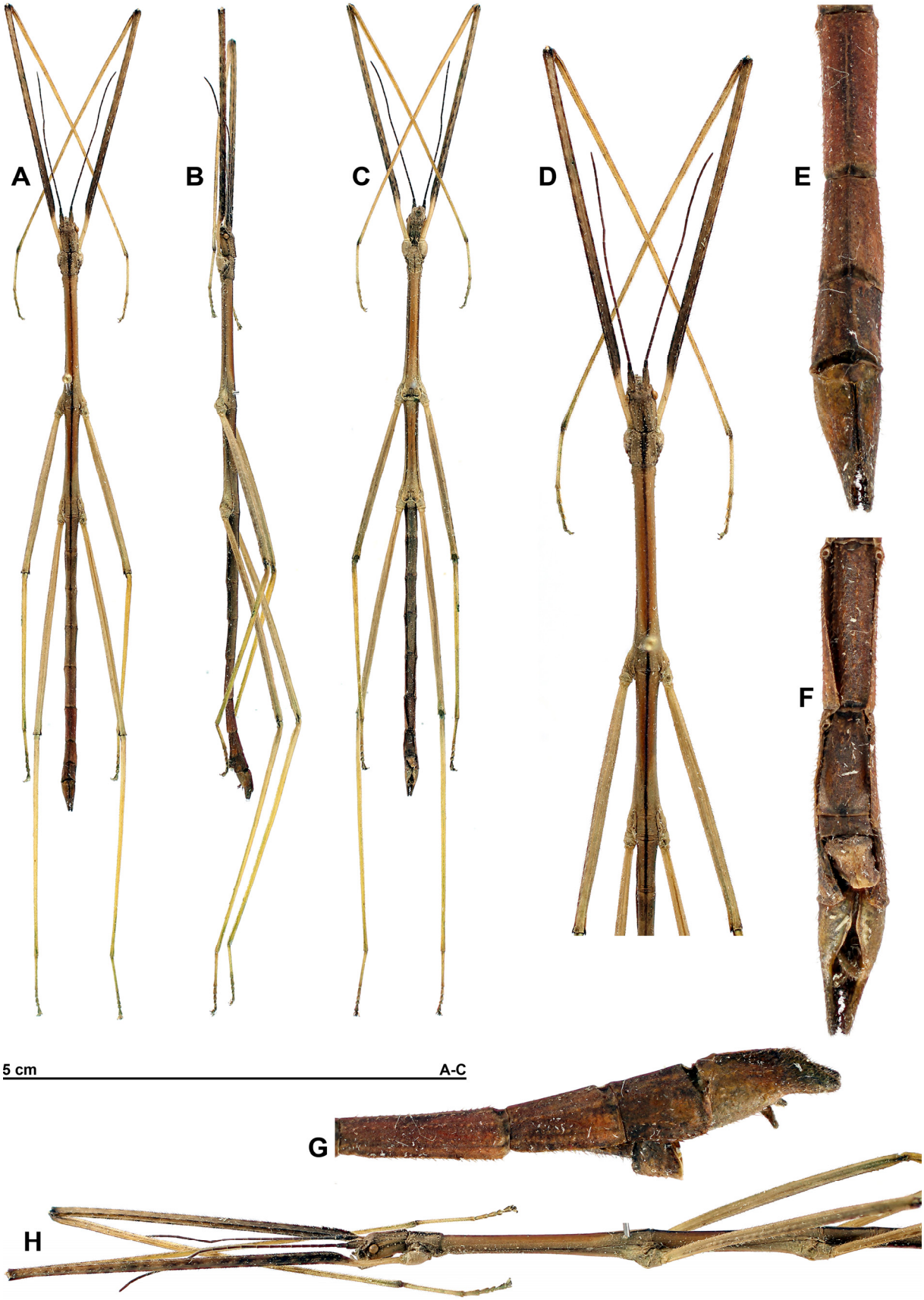

Fig. 5. *Medauroidea romantica* sp. nov., holotype ♂. A, habitus, dorsal view. B. habitus, lateral view. C, habitus, ventral view. D, head and thorax, dorsal view. E, terminalia, dorsal view. F, terminalia ventral view. G, terminalia, lateral view. H, head and thorax, lateral view.

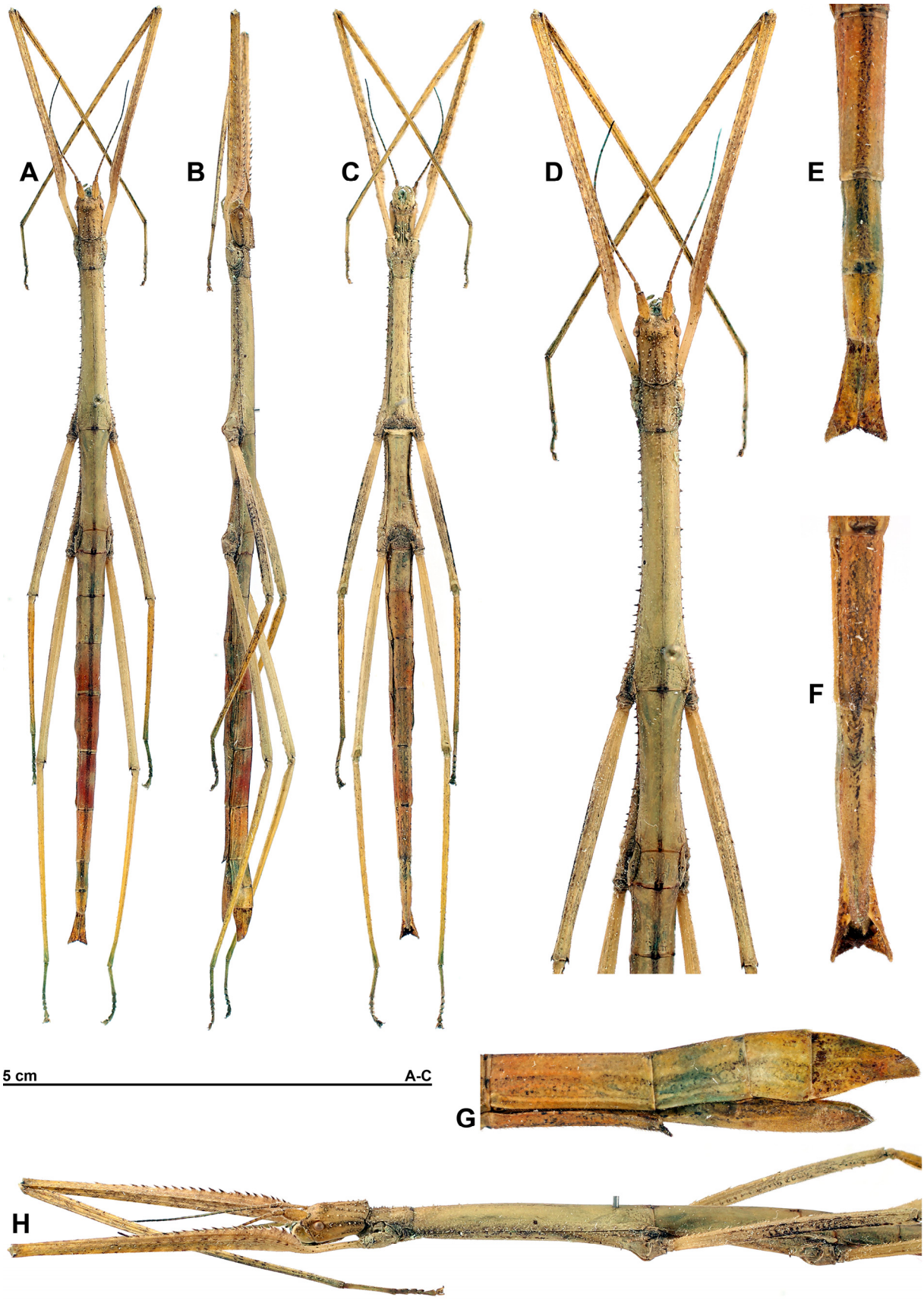

Fig. 6. *Medauroidea romantica* sp. nov., paratype ♀. A, habitus, dorsal view. B. habitus, lateral view. C, habitus, ventral view. D, head and thorax, dorsal view. E, terminalia, dorsal view. F, terminalia ventral view. G, terminalia, lateral view. H, head and thorax, lateral view.

Thorax: pronotum slightly widening towards the posterior; shorter than head and tuberculose. Anterior margin incurved, slightly raised and armed with blunt tubercles; followed by a mediolongitudinal line. Central transverse impression slightly concave, not reaching lateral margins. Lateral margins armed with some conical tubercles, the largest one anteriorly. Dorsal surface rugose, with two irregular longitudinal rows of blunt tubercles; tubercles more pronounced anteriorly. Sublaterally with few tubercles. Mesonotum more or less parallel-sided, about five times as long as pronotum, with some irregularly scattered tubercles in the anterior portion and with a fine mediolongitudinal line; laterally with several conical tubercles, more concentrated anteriorly. Mesopleura with a longitudinal row of evenly spaced tubercles. Metanotum slightly longer than half the mesonotum and more or less smooth dorsally. Lateral margins as in mesonotum. Metapleura as mesopleura.
Legs: profemora slightly shorter than meso- and metanotum combined; compressed and curved basally. All carinae present, anterodorsal and posteroventral carinae strongly flattened laterally and raised. Anterodorsal carina with distinct serrations, especially in basal half. Other carinae unarmed. Mesofemora slightly shorter than mesonotum, dorsal carinae serrated, especially in basal half. Outer ventral carinae smooth, medioventral carina with some small teeth posteriorly. Metafemora about as long as mesonotum, armed as mesofemora. Protibiae carinate, slightly longer than meso- and metanotum combined, distinctly carinate and unarmed. Mesotibiae slightly longer than mesofemora and distinctly carinate; medioventral carina laterally flattened and slightly raised; medio- and anteroventral carinae with one to three minute spines in posterior half. Metatibiae slightly shorter than meso- and metanotum combined, armed as mesotibiae.
Abdomen: median segment about one fourth of metanotum in length, transverse and unarmed. Abdominal terga smooth; terga II–V slightly increasing in length; V–VI about the same length: VII slightly shorter; VIII distinctly shorter, slightly shorter than pronotum; IX distinctly shorter than VIII; X slightly shorter than VIII, with mediolongitudinal carina, with posterior margin notched and with posterolateral angles pointed. Abdominal sterna II–VI smooth. Sternum VII with a distinct praeopercular organ shaped as an elongated black spine projecting over anterior margin of subgenital plate. Subgenital plate elongated, slightly compressed laterally, reaching about halfway of tergum X; posteriorly with a short mediolongitudinal carina; posterior margin more or less triangular from ventral view. Cerci small, laterally compressed, not reaching apex of tergum X.

EGG (Fig. 7)
Measurements (in mm). Length: 3.0; length without operculum: 2.5; width: 1.5; height: 1.6.

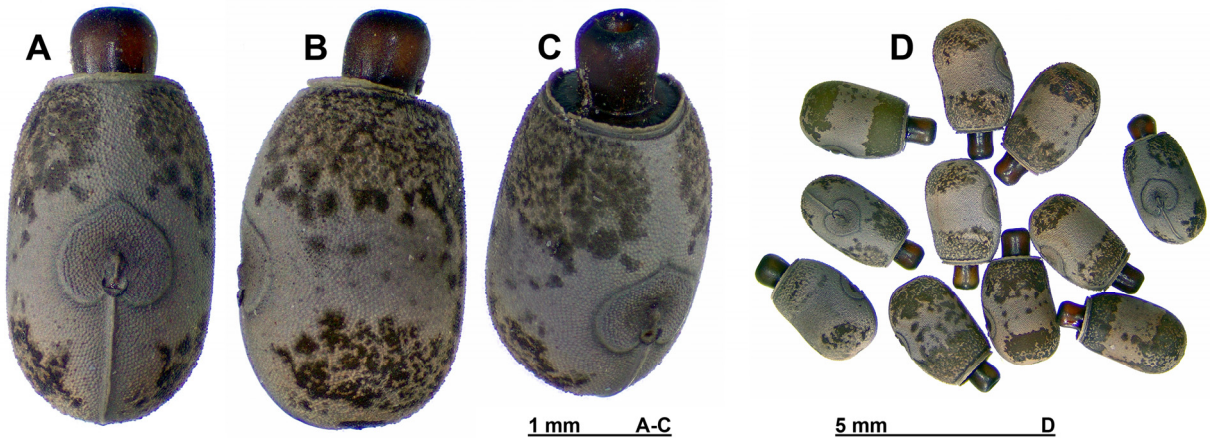

Fig. 7. *Medauroidea romantica* sp. nov., eggs. A, dorsal view. B, lateral view. C, anterodorsal view. D, colour variation, lateral and dorsal view.

Fig. 8. *Medauroidea romantica* sp. nov., colour variation in type location (photographs by J. Constant). A, ♂. B–E, ♀♀.

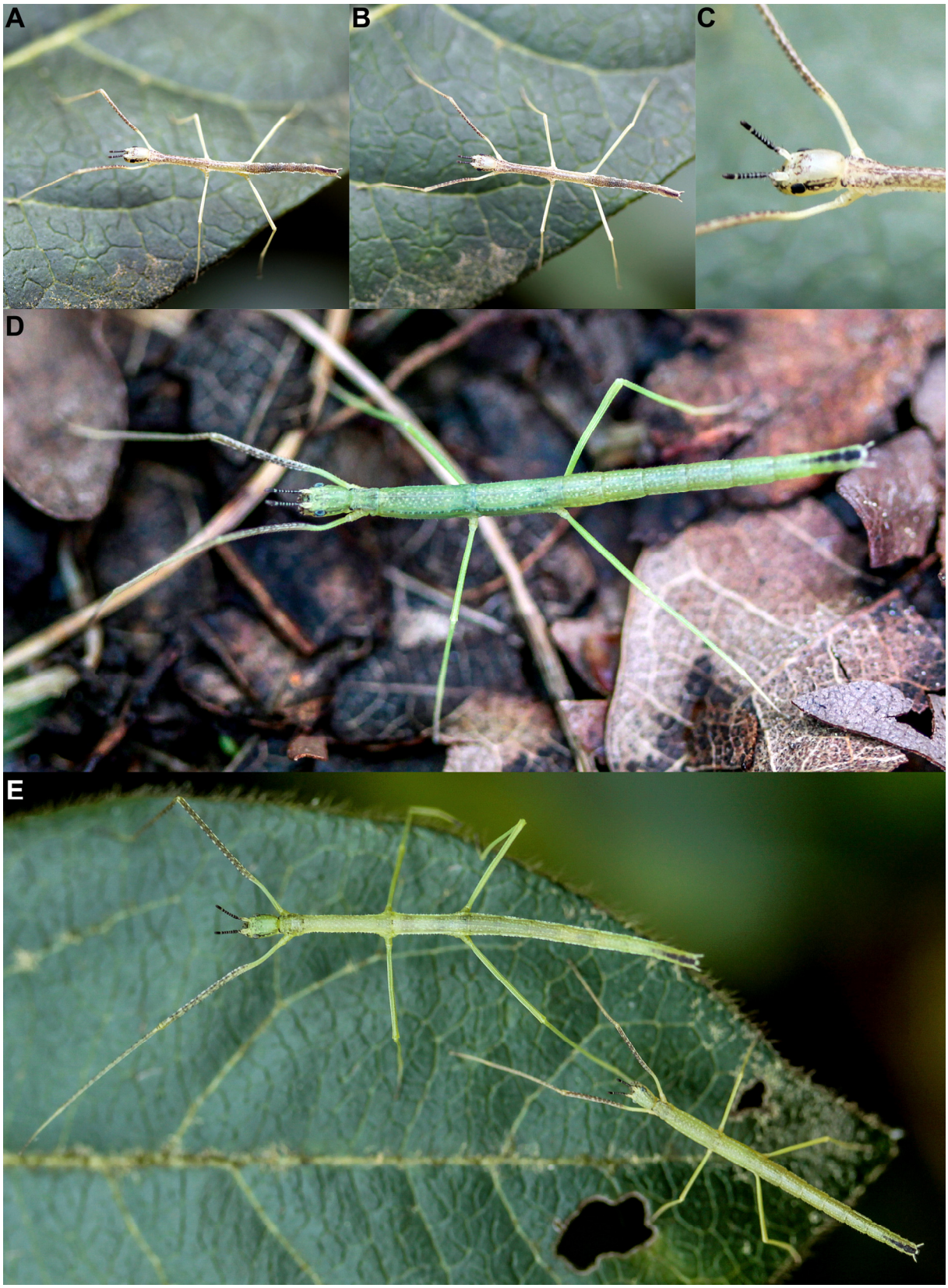

Fig. 9. *Medauroidea romantica* sp. nov., nymphs (photographs by X. Vermeersch). A–C, newborn first instar nymph. A–B, habitus. C, detail of head. D, fully grown first instar nymph, habitus. E, second instar nymph (top) and fully grown first instar nymph (bottom).

Capsule surface rugose, oval in shape and broadest at centre. Micropylar plate and surrounding area light grey with a light grey band directed to the capsule and polar area. Centrally on capsule a broad, transverse, light grey band; other portions with dark mottling. Polar area rounded. Micropylar plate inverted heart-shaped, positioned more or less centrally on capsule. Micropylar cup black and distinct, followed by a distinct, elongated median line reaching polar area. Operculum almost circular with the outer margin indistinctly raised, centrally with a pseudocapitulum. Area between outer rim and pseudocapitulum flattened, black and smooth. Pseudocapitulum dark with an indistinct brown-reddish hue, centrally with a distinct hole.

NYMPH (Fig. 9)
Measurements (in mm). Length of first instar nymph without antennae : 14.5; length including antennae: 16.0
Newly hatched nymphs are mostly pale yellowish brown with darker mottling. Head with black eyes and a dark postocular stripe, dorsally between eyes with darker mottling. Antennae with pale scapus; pedicellus and following antennomeres black; apical antennomere knob-like with pale base. Thorax with brown mottling. Anterior legs incurved and pale basally, later with some brown mottling; median and posterior legs yellowish brown. Abdominal terga darker with pale lateral margins. Posterior half of tergum VII and following terga with a mediolongitudinal dark line (Fig. 9 A–C).
Nymphs turn green relatively soon after eating, before their first moult. The eyes turn bluish. Posterior half of tergum VII and following terga with a distinct blackish, contrasting mediolongitudinal dark line (Fig. 9 D–E). Second instar nymphs as full grown first instar nymph, but measuring about 25 mm (Fig. 9 E).

Table 1. Measurements [mm] of *Medauroidea romantica* sp. nov.

Length of	**HT ♂**	**PT ♂♂**	**PT ♀♀**
Body	67.6	63.2-74.7	84.2-100.4
Head	3.9	3.8-4.3	5.9-6.1
Pronotum	2.7	2.6-3.0	3.0-3.9
Mesonotum	15.2	13.9-16.8	16.9-21.3
Metanotum	10.7	9.5-11.2	10.6-12.5
Median segment	1.8	1.6-2.2	2.7-3.3
Profemora	28.2	26.3-31.6	28.1-32.9
Mesofemora	18.7	18.2-21.8	19.5-22.6
Metafemora	24.5	23.5-28.2	24.3-29.5
Protibiae	31.5	29.5-35.6	29.2-34.7
Mesotibiae	19.2	18.7-21.7	17.3-21.0
Metatibiae	27.4	22.4-31.0	26.4-29.7

BIOLOGY. The females of *M. romantica* sp. nov. show an extremely high degree of variation in the colour of the body, a selection of which are illustrated from wild specimens (Fig. 8 B–E). The colouration of the males is less variable (Fig. 8 A). The specimens were found at night time only, individually or more often mating (Fig. 10 A–D), in disturbed habitats of dry dipterocarp forest along the trails close to BeTreed Adventures houses (Fig. 10 E). They were observed feeding on different, unidentified species of plants and bushes, usually not higher than 1.5m from the ground and the species was common in its habitat. Sampling in the rainforest covering the hills behind BeTreed settlements did not allow the collecting of a single specimen, hence the species seems to be restricted to the dry dipterocarp forest.

DISTRIBUTION. Cambodia, Preah Vihear Province (Fig. 3).

Fig. 10. *Medauroidea romantica* sp. nov. (photographs by J. Constant). A–D, specimens in nature in type location. E, typical habitat of the species.

Discussion

The results of the present study extend the distribution of the genus *Medauroidea* to two additional countries, Cambodia and Laos. Furthermore with the addition of a single species for each country, the phasmid fauna of the two countries is raised by 50 and 100 percent respectively. This reflects our nearly complete ignorance of the stick insect diversity, and of the biodiversity more generally. The number of stick insects species from Cambodia is far higher than current numbers suggest and additional taxa will progressively be described (Bresseel & Constant, unpublished). We hope that this description of *Medauroidea romantica* sp. nov. will help the initiative for protection of nature in Phnom Tnout mountain by BeTreed and its support by local and international authorities. The necessary and urgent work of discovering and describing the species is unfortunately severely impeded by the lack of taxonomical staff worldwide.

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