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Belgian Journal of Entomology

New records and species in five planthopper families from Keo Seima Wildlife Sanctuary, Cambodia with checklist of Cambodian planthoppers (Hemiptera: Fulgoromorpha)

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Front cover: New Cambodian planthoppers from Keo Seima Wildlife Sanctuary (left to right): *Vizcaya longispinosa* Liang, 2002 (Delphacidae), *Macrobrachys tonkinensis* Lallemand, 1950 (Eurybrachidae) and *Vishnuloka bunonga* sp. nov. (Issidae).

New records and species in five planthopper families from Keo Seima Wildlife Sanctuary, Cambodia with checklist of Cambodian planthoppers (Hemiptera: Fulgoromorpha)

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Abstract

New records of Fulgoromorpha are given for Keo Seima Wildlife Sanctuary in Mondulhiri Province, Cambodia. The following four taxa are recorded from Cambodia for the first time: one Delphacidae, *Vizcaya longispinosa* Liang, 2002 representing also the first country record of Vizcayinae; one Eurybrachidae, *Macrobrachys tonkinensis* Lallemand, 1950, representing also the first country record of Loxocephalini (also recorded from Thailand for the first time) and two Issidae, *Hemisphaerius hippocrepis* Constant & Pham, 2011 for which intraspecific colour variations are documented for the first time and *Vishnuloka bunonga* sp. nov., here described and representing the first country record of Sarimini. New records for Mondulhiri Province are the Fulgoridae *Penthicodes pulchella* (Guérin-Méneville, 1838) and the Caliscelidae *Discote scutifer* (Fennah, 1963). Trophobiosis records with ants are documented and illustrated for two Fulgoridae, *Pyrops candelaria* (Linnaeus, 1758) and *Penthicodes atomaria* (Weber, 1801), the egg mass is also documented for the latter for the first time. The treated species are illustrated and commented and the faunal assemblage compared to that of protected areas in Dong Nai Province in Vietnam. A checklist of the 42 species of Fulgoromorpha recorded from Cambodia is provided.

Keywords: Fulgoroidea, trophobiosis, Formicidae, biodiversity, new species

Introduction

FULGOROMORPHA IN CAMBODIA AND IN MONDULKIRI PROVINCE

The planthopper fauna of Cambodia is extremely poorly documented and currently consists of 38 taxa according to FLOW (Fulgoromorpha Lists On the Web – BOURGOIN, 2019), compared to 247 taxa for Vietnam and 73 for Thailand. CONSTANT *et al.* (2016) published an illustrated checklist of the Fulgoridae of Cambodia and recorded 12 additional species to add to the 5 previously documented species.

Six species of Fulgoridae were recorded from Mondulhiri Province by CONSTANT *et al.* (2016), all of them being documented from photographs only and representing new records for the province at the time: *Aphaena* sp., *Penthicodes atomaria* (Weber, 1801) and *P. variegata* Guérin-Méneville, 1829 from O Reang district, *Pyrops candelaria* (Linnaeus, 1758) from Sen Monorom and *Pyrops ducalis* (Stål, 1863) and *Saiva gemmata* (Westwood, 1848) from Seima Forest. A preliminary study of recent material allowed the identification of

nine interesting planthoppers that represent rare or new country records, including a species of Issidae new to science.

KEO SEIMA WILDLIFE SANCTUARY

A recent expedition with the School for Field Studies allowed JC to sample in Keo Seima Wildlife Sanctuary (KSWS) in Mondulkiri Province, one of the most poorly explored zones of Cambodia in terms of insect diversity. KSWS covers 2,960 km², with the core protection area covering 1,870 km² and is located in Mondulkiri and Kratie provinces, along the border with Vietnam. The area was a logging concession in the 1990s, and after the engagement of the Wildlife Conservation Society (WCS) in biodiversity surveys from 2000, it was declared a Biodiversity Conservation area in 2002. It became a Protection Forest in 2009 because of its importance for biodiversity and ecosystem services, and a Wildlife Sanctuary in 2016 when it was transferred to the Ministry of Environment (sub-decree No.83 on Establishment of Keo Seima Wildlife Sanctuary, May 2016), along with all other protected areas (WCS, 2009; O. Griffin pers. comm., III.2019). The habitat is mostly formed by a complex mosaic of four forest types: (1) evergreen forest typical of the southern Annamite range with a tall canopy (up to 40 m) and three layers of vegetation; (2) semi-evergreen forest with similar structure as evergreen forest but with a proportion of deciduous trees that lose their leaves in the dry season; (3) mixed deciduous forest usually dominated by trees of the genus *Lagerstroemia* L. (Lythraceae), often with very open understory, the latter sometimes comprising bamboo; (4) deciduous dipterocarp forest with low canopy (20 m) and two layers of vegetation, the trees dominated by deciduous Dipterocarpaceae and the understory by grass or short bamboo. The area is particularly important for a number of threatened mammals like tiger (*Panthera tigris* L.), dhole (*Cuon alpinus* (Pallas)), yellow-cheeked crested gibbon (*Nomascus gabriellae* (Thomas)), black-shanked douc (*Pygathrix nigripes* (Milne-Edwards)), Germain's silver langur (*Trachypithecus germaini* (Milne-Edwards)), Asian elephant (*Elephas maximus* L.), gaur (*Bos gaurus* Smith), banteng (*Bos javanicus* d'Alton) and Eld's deer (*Rucervus eldii* (M'Clelland)) or birds including green peafowl (*Pavo muticus* L.), slender-billed vulture (*Gyps tenuirostris* Gray), white-rumped vulture (*Sarcogyps calvus* (Scopoli)), white-shouldered ibis (*Pseudibis davisoni* (Hume)) and giant ibis (*Pseudibis gigantea* (Oustalet)) to name just a few (WCS, 2009). Unfortunately, in addition to being virtually undocumented in terms of entomodiversity, this region, as is the case in the rest of the country as well, faces one of the highest rates of deforestation in the world (F.A.O., 2007). Illegal loggers are also very active in protected areas like KSWS where three conservation staff were murdered in January 2018 (GUARDIAN, 2018; WCS, 2018).

This paper aims to provide and comment new records of planthoppers and to describe the new species of Issidae. It is dedicated to the memory of the three persons assassinated in KSWS.

Material and methods

Male genitalia were extracted after boiling the abdomen several minutes in a 10% solution of potassium hydroxide (KOH) at about 100°C. The pygofer was separated from the abdomen and the aedeagus dissected with a needle blade for examination. The whole was then placed in glycerine for preservation in a tube attached to the pin of the specimen. The metatibiotarsal formula gives the number of spines on (side of metatibia) apex of metatibia/apex of first metatarsomere/apex of second metatarsomere. The measurements were taken as in CONSTANT (2004) with the following acronyms used:

BF = maximum breadth of the frons
BTg = maximum breadth of the tegmen
BV = maximum breadth of the vertex
LF = length of the frons in median line
LTg = maximum length of the tegmen
LT = total length (apex of head to apex of tegmina)
LV = length of the vertex in median line

The photographs of collection specimens were taken with a Leica EZ4W stereomicroscope with integrated camera, stacked with CombineZ software and optimized with Adobe Photoshop CS3; photographs from the field were taken with a Sony DSC-H300 camera. The distribution maps were produced with SimpleMappr (SHORTHOUSE, 2010); the nomenclature of the ecoregions follows OLSON *et al.* (2001). The measurements of the previously described species of *Vishnuloka* Distant, 1906 were taken from the illustrations provided by MELICHAR (1906) and GNEZDILOV (2012). For the transcription of the labels of the types, the wording on each single label is delimited by square brackets.

Morphological terminology follows O'BRIEN & WILSON (1985), except forewing venation following BOURGOIN *et al.* (2015) and with male terminalia nomenclature modified after BOURGOIN (1988) and BOURGOIN & HUANG (1990). Literature citations of the original authorities for species and higher taxa are found in FLOW (BOURGOIN, 2019) and are not included in the references for this work unless otherwise cited.

Acronyms used for the collections:

BMNH = Natural History Museum, London, U.K.
MNHN = Muséum National d'Histoire Naturelle, Paris, France.
RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium.
RUPP-CEI = Cambodian Entomology Initiatives, Royal University of Phnom Penh, Cambodia.

Results

Order **Hemiptera** Linnaeus, 1758
Suborder **Auchenorrhyncha** Duméril, 1806
Infraorder **Fulgoromorpha** Evans, 1946
Superfamily **Fulgoroidea** Latreille, 1807
Family **Caliscelidae** Amyot & Serville, 1843

Two species of Caliscelidae are currently recorded from Cambodia: *Caliscelis* (*Cerepa*) *carnavalis* Emeljanov, 2015 and *Discote scutifer* (Fennah, 1963) (FENNAH, 1963; EMELJANOV, 2015; BOURGOIN, 2019).

Subfamily **Ommatidiotinae** Fieber, 1875
Tribe **Augilini** Baker, 1915

Genus ***Discote*** Emeljanov, 2013

Discote EMELJANOV, 2013: 217. Type species: *Augilodes scutifer* Fennah, 1963 by original designation and monotypy.

DISTRIBUTION. Continental Southeast Asia: Cambodia and Vietnam.

NOTE. This genus is monotypic.

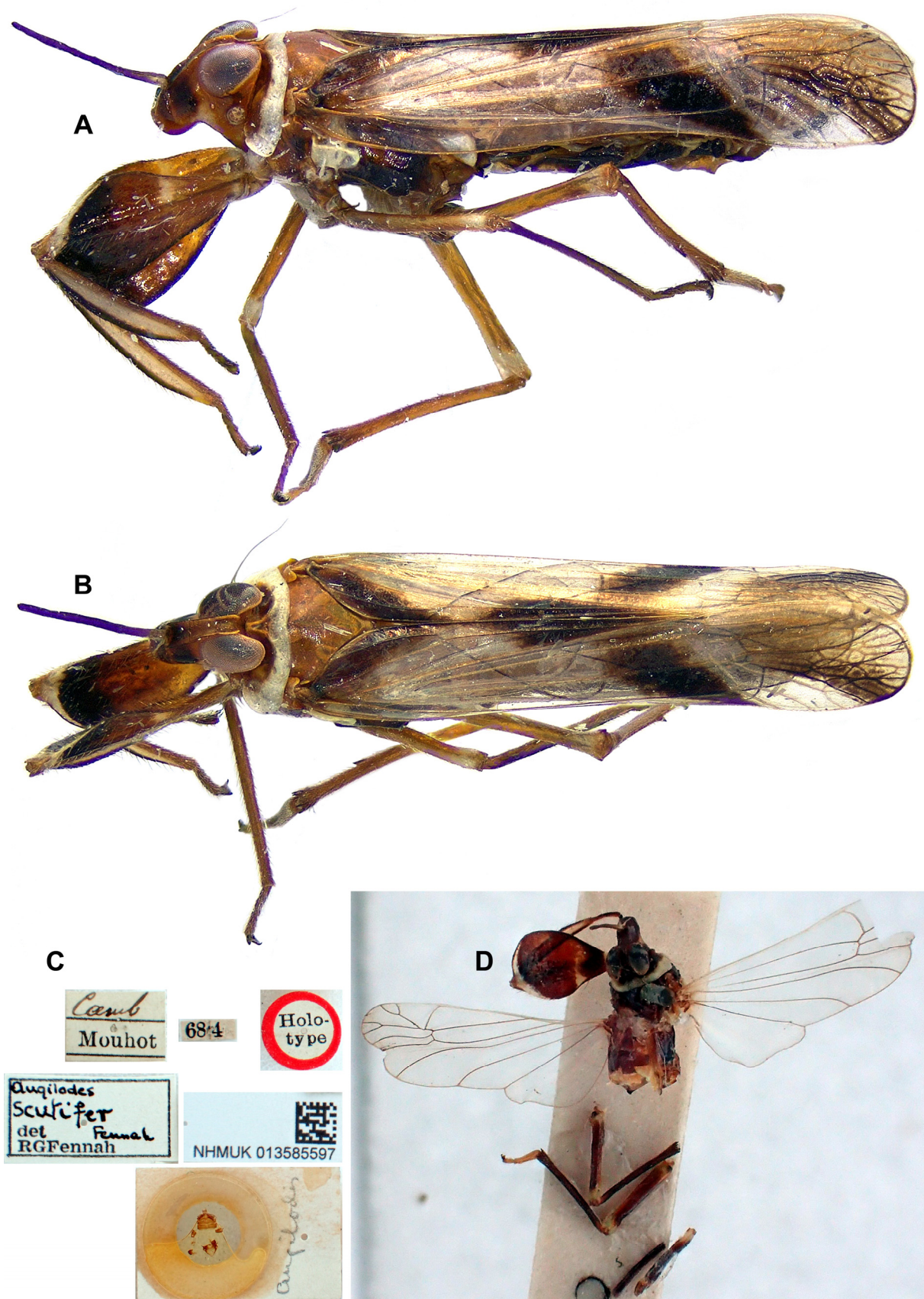


Fig. 1. *Discote scutifer* (Fennah, 1963). A, female from KSWs, habitus, lateral view. B, female from KSWs, habitus, dorsal view. C, holotype (BMNH), labels. D, holotype (BMNH), dorsal view (photographs C–D © M. Webb, BMNH).

***Discote scutifer* (Fennah, 1963)**

Fig. 1.

Augilodes scutifer FENNAH, 1963: 729 [description], fig. 3 A–B, D–L.

Augilodes scutifer – WANG *et al.*, 2002: 94 [key].

Discote scutifer – EMELJANOV, 2013: 217 [transferred to *Discote* Emeljanov, 2013], figs 2–3.

MATERIAL EXAMINED

CAMBODIA: 1♀ (Fig. 1 A–B): Mondulhiri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (RBINS).

MATERIAL EXAMINED FROM PHOTOGRAPHS

CAMBODIA: holotype ♀ (Fig. 1 C–D): Cambodia, Mouhot (BMNH).

NOTE. The species was described by FENNAH (1963) in the genus *Augilodes* Fennah, 1963 based on a mutilated female specimen collected by H. Mouhot in Cambodia 150 years ago, without a precise collecting location (Fig. 1). It was later recorded from South Vietnam (Dong Nai Province, Vinh Cuu District, Ma Da – 11°15'33"N 107°04'19"E) by EMELJANOV (2013) who described the genus *Discote* to accommodate this species and provided a description of the tegmina. The male genitalia and probable sexual dimorphism need documentation for this species. This will allow a better comparison of the genus with *Augilodes* Fennah, 1963.

Family **Delphacidae** Leach, 1915

Three species of Delphacidae are recorded from Cambodia: *Nilaparvata lugens* (Stål, 1854), *Sogatella furcifera* (Horváth, 1899) and *Sogatella kolophon* (Kirkaldy, 1907) (BOURGOIN, 2019). The former two are the well-known and highly destructive ‘ricehoppers’ (the brown planthopper and white-backed planthopper, respectively) (e.g., ASCHE & WILSON 1990, MATSUKAWA *et al.*, 2018). The latter is a pantropical cosmopolitan species recorded from a variety of grasses (e.g., BONFILS *et al.*, 1994).

Subfamily **Vizcayinae** Asche, 1990

Genus ***Vizcaya*** Muir, 1917

Vizcaya MUIR, 1917: 351. Type species: *Vizcaya bakeri* Muir, 1917 by original monotypy.

Vizcaya – METCALF, 1943: 68 [catalogued]. — ASCHE, 1990: 158 [revision, new species, key to species; placement in the Delphacidae: Vizcayinae]. — LIANG, 2002: 610 [new species, key to species]. — URBAN *et al.*, 2010: 684, 686 [phylogenetic placement].

DISTRIBUTION. Southeast Asia: India to southern China and Taiwan, southwards to Sulawesi through the Greater and Lesser Sunda Islands and the Philippines.

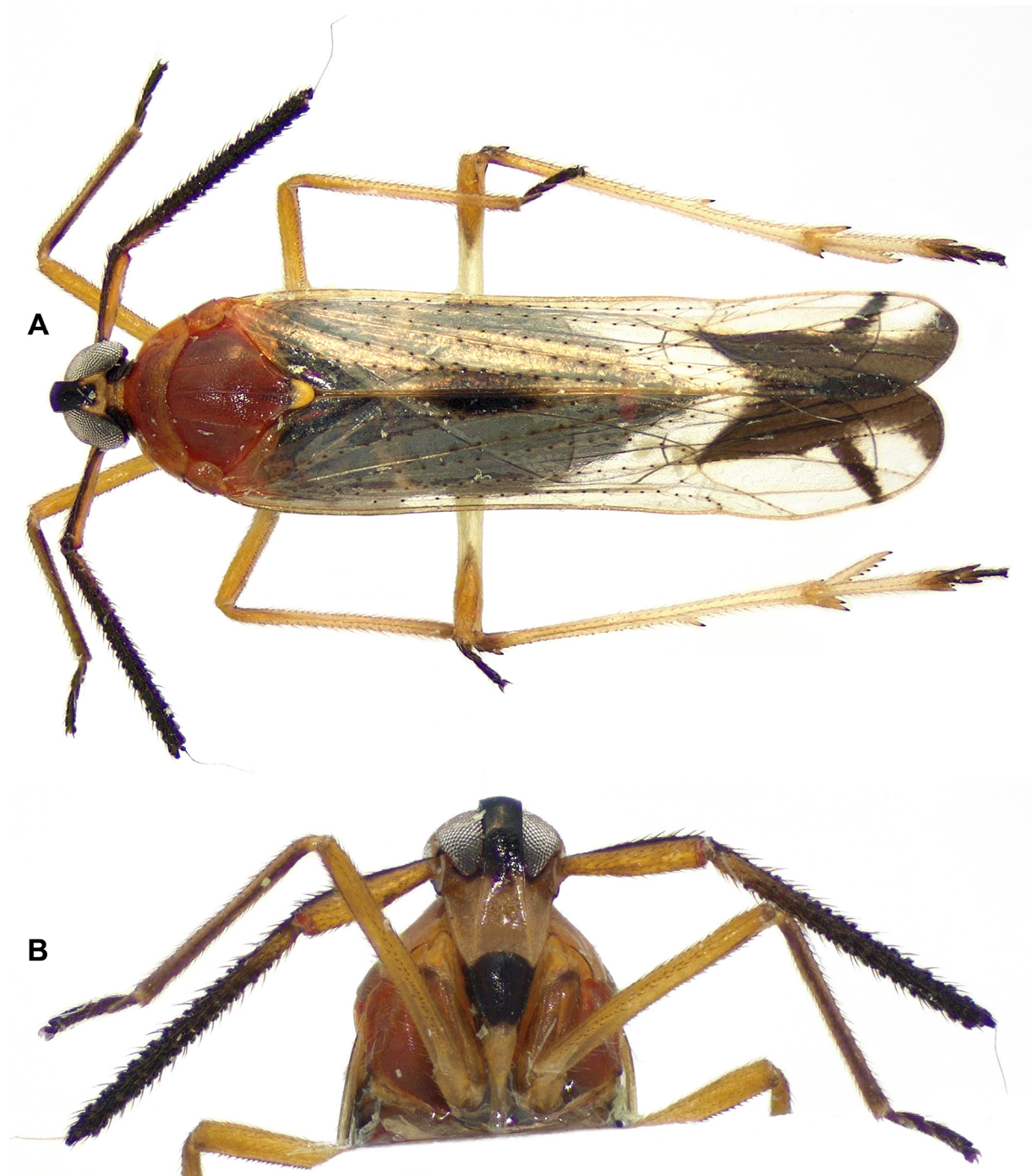


Fig. 2. *Vizcaya longispinosa* Liang, 2002, ♀. A, habitus dorsal view. B, head, anteroventral view.

Species included

1. *Vizcaya adornata* Asche, 1990 [Indonesia: Sulawesi].
2. *Vizcaya aschei* Liang, 2002 [southern India: Tamil Nadu (as Madras)].
3. *Vizcaya bakeri* Muir, 1917 [Philippines: Luzon].
4. *Vizcaya latifrons* Liang, 2002 [Taiwan].
5. *Vizcaya lombokensis* Liang, 2002 [Indonesia: Lombok Island].
6. *Vizcaya longispinosa* Liang, 2002 [southwestern China: Yunnan; Cambodia].
7. *Vizcaya oreia* Asche, 1990 [Indonesia: Sumatra, Thailand, Vietnam].
8. *Vizcaya piccola* Asche, 1990 [Malaysia: Borneo, Thailand].
9. *Vizcaya vindaloo* Asche, 1990 [southern India: Travancore].

Vizcaya longispinosa Liang, 2002 new country record
Fig. 2

Vizcaya longispinosa LIANG, 2002: 615 [described, compared with *V. oreia*]; figs 3–4, 15–18, 24–27, 40–41, 54–59.

MATERIAL EXAMINED

CAMBODIA: 1♀ (Fig. 2): Monduliri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (RBINS).

NOTE. This is the first record of a species of Vizcayinae in Cambodia. This new record extends the distribution of *V. longispinosa* to the south (the species was described from Yunnan Province in China) but the species identification should be confirmed by study of the genitalia when a male becomes available.

Family **Eurybrachidae** Stål, 1862

Three species of Eurybrachidae are recorded from Cambodia: *Ancyra histrionica* Stål, 1863, *Messena nebulosa* Stål, 1863 and *Thessitus mortuifolia* Stål, 1863 (BOURGOIN, 2019), all three originally described from this country but without a precise location.

Subfamily **Eurybrachinae** Stål, 1862
Tribe **Loxocephalini** Schmidt, 1908

Genus **Macrobrachys** Lallemand, 1950

Macrobrachys LALLEMAND, 1950: 150 [described, compared with *Thessitus* Walker, 1862].
Type species: *Macrobrachys tonkinensis* LALLEMAND, 1950 by monotypy.

Macrobrachys – METCALF, 1956: 29 [catalogued]. — CONSTANT, 2006: 45 [described, placed in Eurybrachinae: Loxocephalini].

DISTRIBUTION. Southeast Asia: Cambodia, Thailand and Vietnam.

Macrobrachys tonkinensis Lallemand, 1950 new country record
Figs 3–5

Macrobrachys tonkinensis LALLEMAND, 1950: 150 [described].

Macrobrachys tonkinensis – METCALF, 1956: 29 [catalogued]. — CONSTANT, 2006: 46 [described], fig. 2 [distribution map], pl. 1 A–D [habitus, frons and posterior leg illustrated].

MATERIAL EXAMINED

CAMBODIA: 5♀♀ (Fig. 3): Monduliri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (4♀♀: RBINS; 1♀: RUPP).



Fig. 3. *Macrobrachys tonkinensis* Lallemant, 1950, ♀♀ in nature in Keo Seima W.S. A–C, 15.XI.2018 (at night). D–F, 22.XI.2018 (in the day). G–H, 22.XI.2018 (at night).

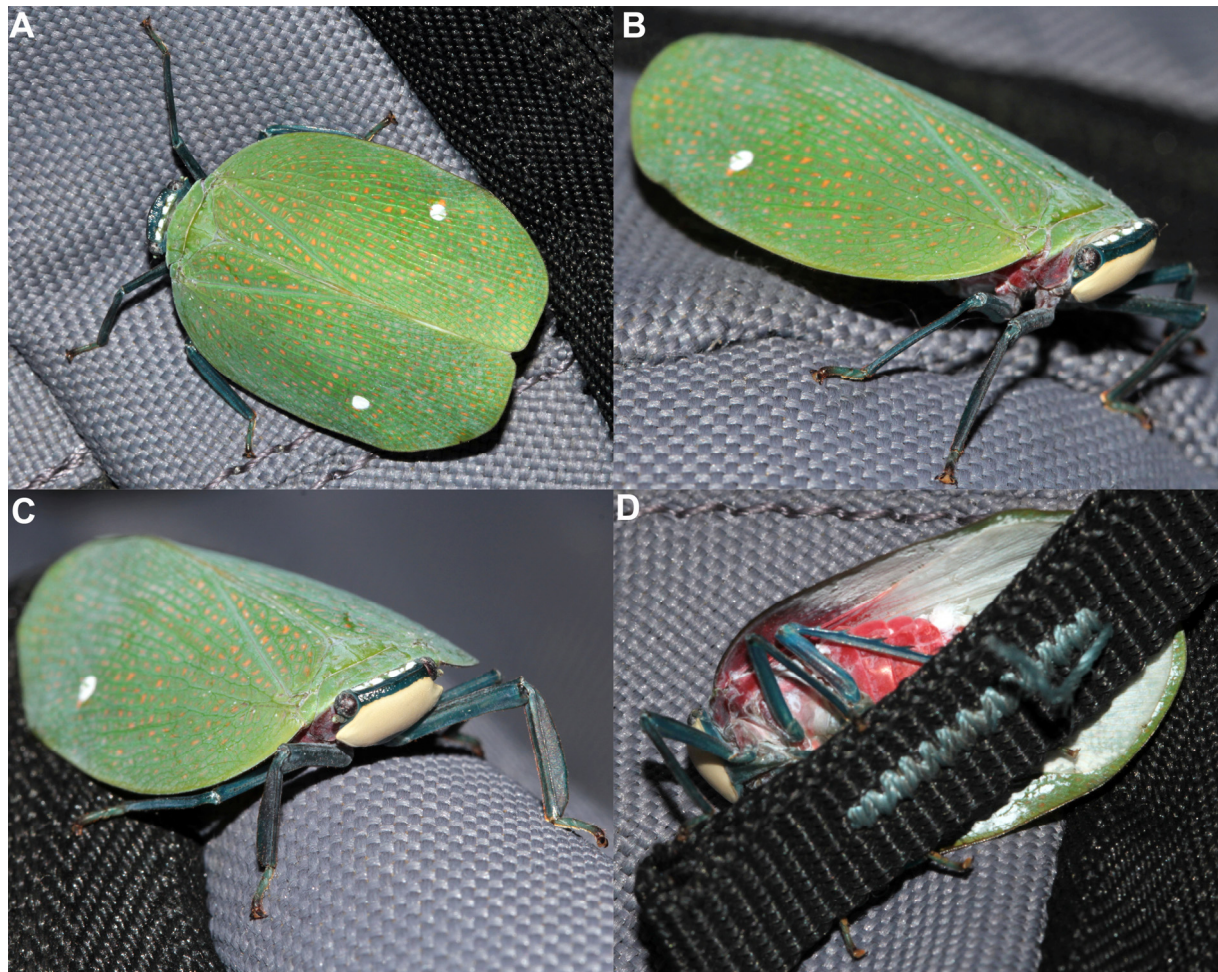


Fig. 4. *Macrobrachys tonkinensis* Lallemant, 1950, ♀ in nature in Khao Soi Dao W.S. A–D, 15.XI.2014 (photographs © I. Dugdale & P. Phetsri).



Fig. 5. *Macrobrachys tonkinensis* Lallemant, 1950, distribution map.

MATERIAL EXAMINED FROM PHOTOGRAPHS

THAILAND: 1♀ (Fig. 4): Khao Soi Dao Wildlife Sanctuary, 15.XI.2014, Ian Dugdale & Punjapa Phetsri.

NOTE. In the female holotype of *Macrobrachys tonkinensis* Lallemand, 1950, as well as in the second female specimen of the species in the MNHN collection, the green colour is completely faded and the tegmina of the specimens are orange (CONSTANT, 2006). In the newly collected specimens as well it was observed that the green colour is very prompt to fade and turn into orange although the specimens were mounted just a few days after collecting.

The specimens in KSWs were all found sitting on broad leaves, both in daytime and night. However, they were not observed feeding on the leaves and no male was found despite an intensive search. The proposed conspecific treatment of the specimens from Vietnam, Cambodia and Thailand requires confirmation based on the examination of genitalia when males become available. Indeed, closely related species of Loxocephalini can sometimes be separated by the examination of the male genitalia only as it was shown e.g., for the genus *Amychodes* Karsch, 1895 (CONSTANT, 2004). The material listed above represents the first record of the tribe Loxocephalini in Cambodia.

Family **Fulgoridae** Latreille, 1807

An illustrated checklist of the Fulgoridae of Cambodia was recently published by CONSTANT *et al.* (2016). Seventeen species were recorded from Cambodia, with 6 of them being documented from Monduliri Province.

Subfamily **Aphaeninae** Blanchard, 1847Genus *Aphaena* Guérin-Ménéville, 1834*Aphaena* sp.

Fig. 6 A

MATERIAL EXAMINED

CAMBODIA: 1♀ (Fig. 6 A): Monduliri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (RBINS).

NOTE. This female was found sitting on a trunk in an area cleared by illegal logging.

Genus *Penthicodes* Blanchard, 1845*Penthicodes atomaria* (Weber, 1801)

Fig. 6 C–D

MATERIAL EXAMINED

CAMBODIA: 3♂♂, 4♀♀ (Fig. 6 C): Monduliri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (RBINS).



Fig. 6. Fulgoridae spp., in nature in Keo Seima W.S. A, *Aphaena* sp., ♀. B, *Pyrops candelaria* (Linnaeus, 1758), ♂ showing trophobiotic interaction with ants. C–D, *Penthicodes atomaria* (Weber, 1801). C, ♀ showing trophobiotic interaction with ant. D, egg mass.

NOTE. The specimens were all found in an area of reasonably well preserved forest, most of them at night time. An egg mass with 72 eggs was discovered near an adult female on a small tree trunk (Fig. 6 D). Trophobiosis with ants of the genus *Crematogaster* Lund, 1831 was observed and documented for one specimen (Fig. 6 C). The ants were sitting still behind the lanternfly, presumably waiting for the honeydew it regularly projects while feeding.

Penthicodes pulchella (Guérin-Méneville, 1838)

MATERIAL EXAMINED

CAMBODIA: 2♂♂, 3♀♀: Mondulkiri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (RBINS).

NOTE. The specimens were all found together on a big tree trunk at night time. This is the first record of this species in Mondulkiri Province. It was illustrated by CONSTANT *et al.* (2016: Fig. 2 J).

Pyrops candalaria (Linnaeus, 1758)

Fig. 6 B

MATERIAL EXAMINED

CAMBODIA: 1♂ (Fig. 6 B): Mondulkiri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (RBINS).

NOTE. The specimen was found on a big tree trunk at night. Trophobiosis with ants of the genus *Camponotus* Mayr, 1861 was observed and documented for this specimen (Fig. 6 B). The ants were sitting still behind the lanternfly, presumably waiting for honeydew. The previous record of this species in Mondulkiri Province was from Sen Monorom; this species is often found on cultivated trees of the family Sapindaceae (litchi and longan trees).

Family **Issidae** Spinola, 1839

A single species of Issidae is currently recorded from Cambodia: *Hemisphaerius interclusus* Noualhier, 1896 (BOURGOIN, 2019).

Subfamily **Hemisphaeriinae** Melichar, 1906

Tribe **Hemisphaeriini** Melichar, 1906

Genus ***Hemisphaerius*** Schaum, 1850

Hemisphaerius SCHAUM, 1850: 71. Type species: *Hemisphaerius coccinelloides* (Burmeister, 1834).

DISTRIBUTION. Southeast and eastern Asia, from Sri Lanka to Japan and Taiwan and southwards in the Greater and Lesser Sunda and the Philippines to Sulawesi, Maluku and New Guinea.

NOTE. The genus *Hemisphaerius* Schaum, 1850 consists of 91 species (BOURGOIN, 2019) and is in need of a comprehensive revision.

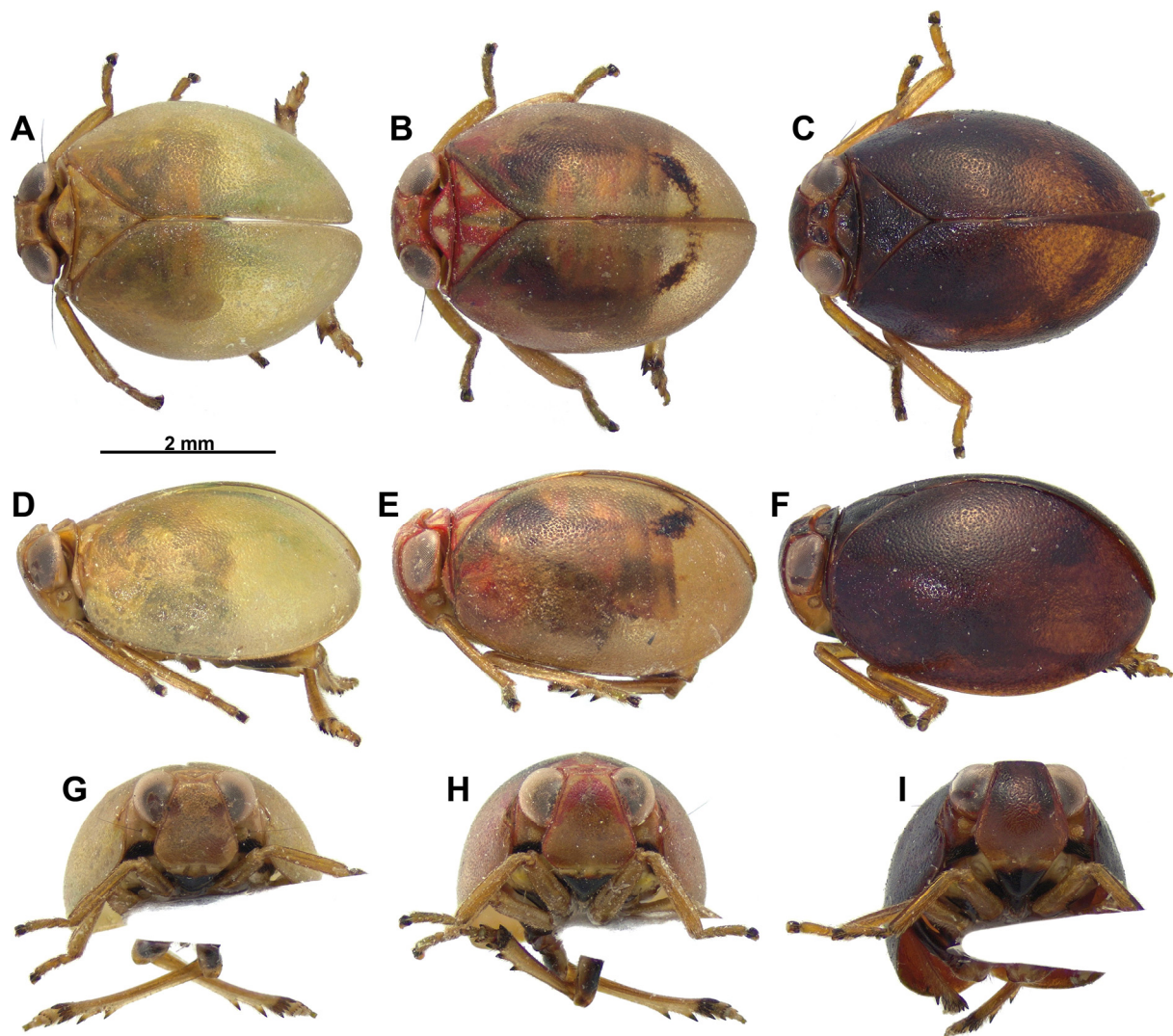


Fig. 7. *Hemisphaerius hippocrepsis* Constant & Pham, 2011, ♂♂, intraspecific colour variation. A–C, habitus, dorsal view. D–F, habitus, lateral view. G–I, habitus, normal view of the frons. A, D, G, pale specimen. B, E, H, medium specimen. C, F, I, dark specimen.

***Hemisphaerius hippocrepsis* Constant & Pham, 2011 new country record**

Fig. 7

Hemisphaerius hippocrepsis CONSTANT & PHAM, 2011: 112 [description], figs 7–14, 19–22.

Hemisphaerius hippocrepsis – GNEZDILOV, 2013: 1024 [biology], 1028 [material examined].

MATERIAL EXAMINED

CAMBODIA: 4♂♂, 12♀♀: Mondulkiri Province, Keo Seima Wildlife Sanctuary, near O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919 (3♂♂, 10♀♀: RBINS; 1♂, 2♀♀: RUPP).

NOTE. The species was described from Ma Da, Dong Nai Province in South Vietnam (CONSTANT & PHAM, 2011) and later recorded from Cat Tien National Park, Dong Nai Province by GNEZDILOV (2013), very close to the type location. Gnezdilov collected 4 specimens from plants of the undergrowth in the forest. The specimens collected in KSWS

represent the first record of the species in Cambodia and were found in similar habitat. The species was also present in a location where the forest was cleared by illegal logging. The series of specimens from Cambodia provides information about the intraspecific colour variation, which actually ranges from nearly entirely stramineous specimens to nearly entirely black ones, with the typical horseshoe-shaped marking on the tegmina missing or weak in the extreme pale and dark forms (Fig. 7).

Tribe **Sarimini** Wang, Zhang & Bourgoin, 2016

Genus *Vishnuloka* Distant, 1906

Vishnuloka DISTANT, 1906a: 345. Type species: *Vishnuloka prominula* Distant, 1906.

Delia MELICHAR, 1906: 265. Type species: *Delia deserta* Melichar, 1906. Junior homonym of *Delia* Robineau-Desvoidy, 1830.

Ardelia MELICHAR, 1907: 324, *nom. nov. pro Delia* Melichar, 1906, *nec Delia* Robineau-Desvoidy, 1830; synonymized by GNEZDILOV (2012: 240).

Vishnuloka – METCALF, 1958: 484 (catalogued). — GNEZDILOV, 2012: 240 [synonymy; lectotypes; key to species]. — GNEZDILOV *et al.*, 2014: 81 [listed doubtfully from Vietnam]. — MENG *et al.*, 2016: 3 [keyed], 12 [diagnosis].

DISTRIBUTION. Southeast Asia: northern India, Myanmar, Cambodia and Sumatra.

NOTES. The genus *Vishnuloka* Distant, 1906 is here placed in the tribe Sarimini Wang, Zhang & Bourgoin, 2016 based on the following diagnostic tribal characters given by WANG *et al.* (2016): 3 lobed hind wing with Pcu-A1 lobe more or less as wide as ScP-R-MP-Cu lobe and Pcu single or branched. Pcu and A1 anastomosing on a short or longer distance. A2 not branched. GNEZDILOV (2012) treated the record of *Vishnuloka deserta* (Melichar, 1906) given by LALLEMAND (1942) as being from North Vietnam and stated that this record was dubious for this species and probably referred to an undescribed genus. However, Lallemand failed to give a precise location for the material he had identified that might as well come from China, and Gnezdilov actually did not examine this material. Moreover, the recent discovery of the genus in Cambodia does not allow *a priori* exclusion of its presence in Vietnam and/or China although the species identification given by Lallemand (a species known from Indonesia) requires verification.

Species included

1. *Vishnuloka bunonga* sp. nov. [Cambodia: Mondulkiri].
2. *Vishnuloka deserta* (Melichar, 1906) [Indonesia: Sumatra].
3. *Vishnuloka prominula* Distant, 1906 [India: Sikkim; Myanmar: Tenasserim].

Vishnuloka bunonga sp. nov.

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Figs 8–10

ETYMOLOGY. The species epithet refers to the Bunong ethnic group, who inhabit the same area as the new species in Mondulkiri Province.

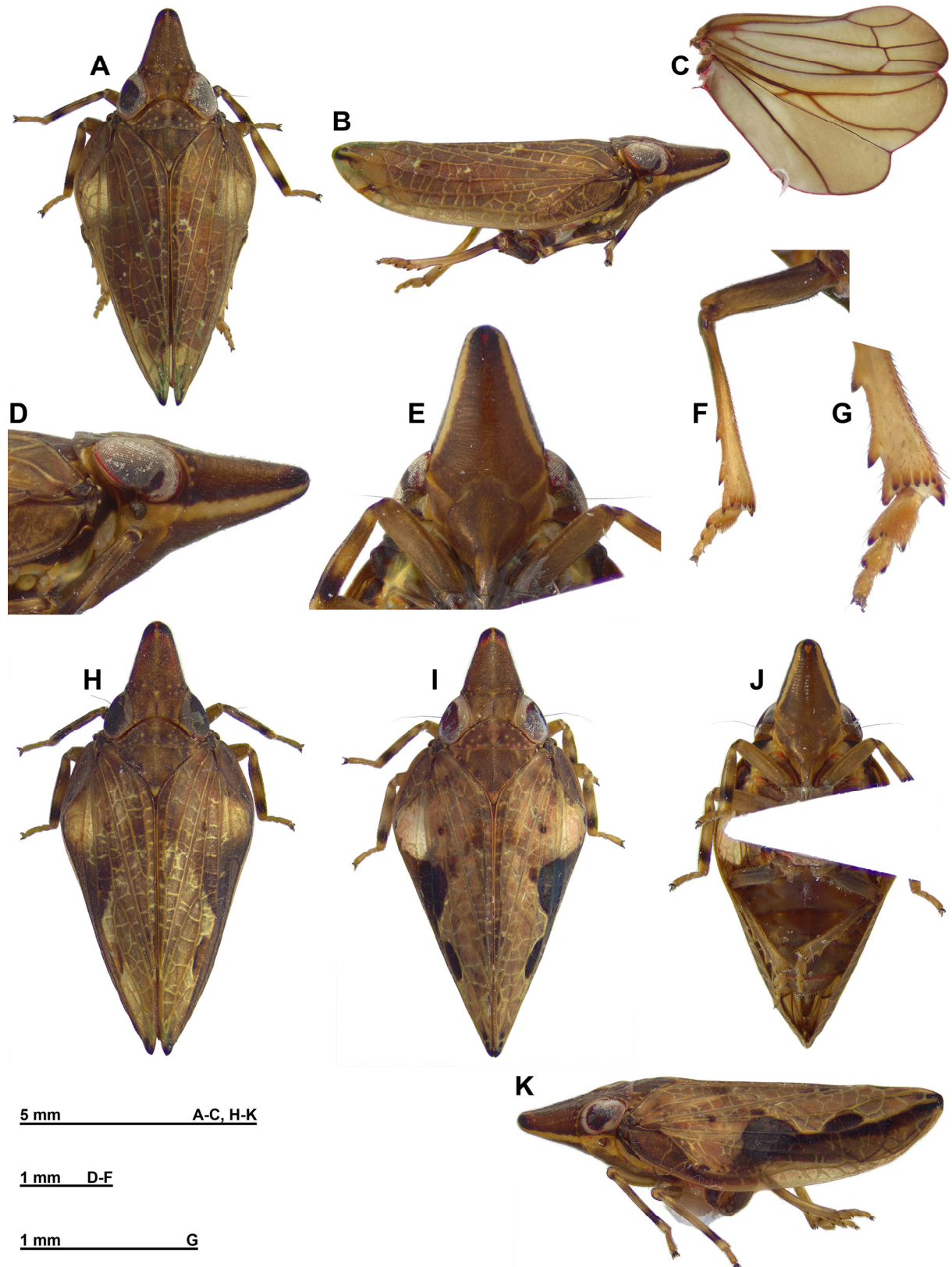


Fig. 8. *Vishnuloka bunonga* sp. nov. A–G, holotype ♂. A, habitus, dorsal view. B, habitus, lateral view. C, right posterior wing. D, head, lateral view. E, frons, normal view. F, posterior leg, ventral view. G, apex of metatibia and tarsus, detail. H, paratype ♀, moderately contrasted, dorsal view. I–K, paratype ♀, strongly contrasted. I, habitus, dorsal view. J, habitus, ventral view. K, habitus, lateral view.

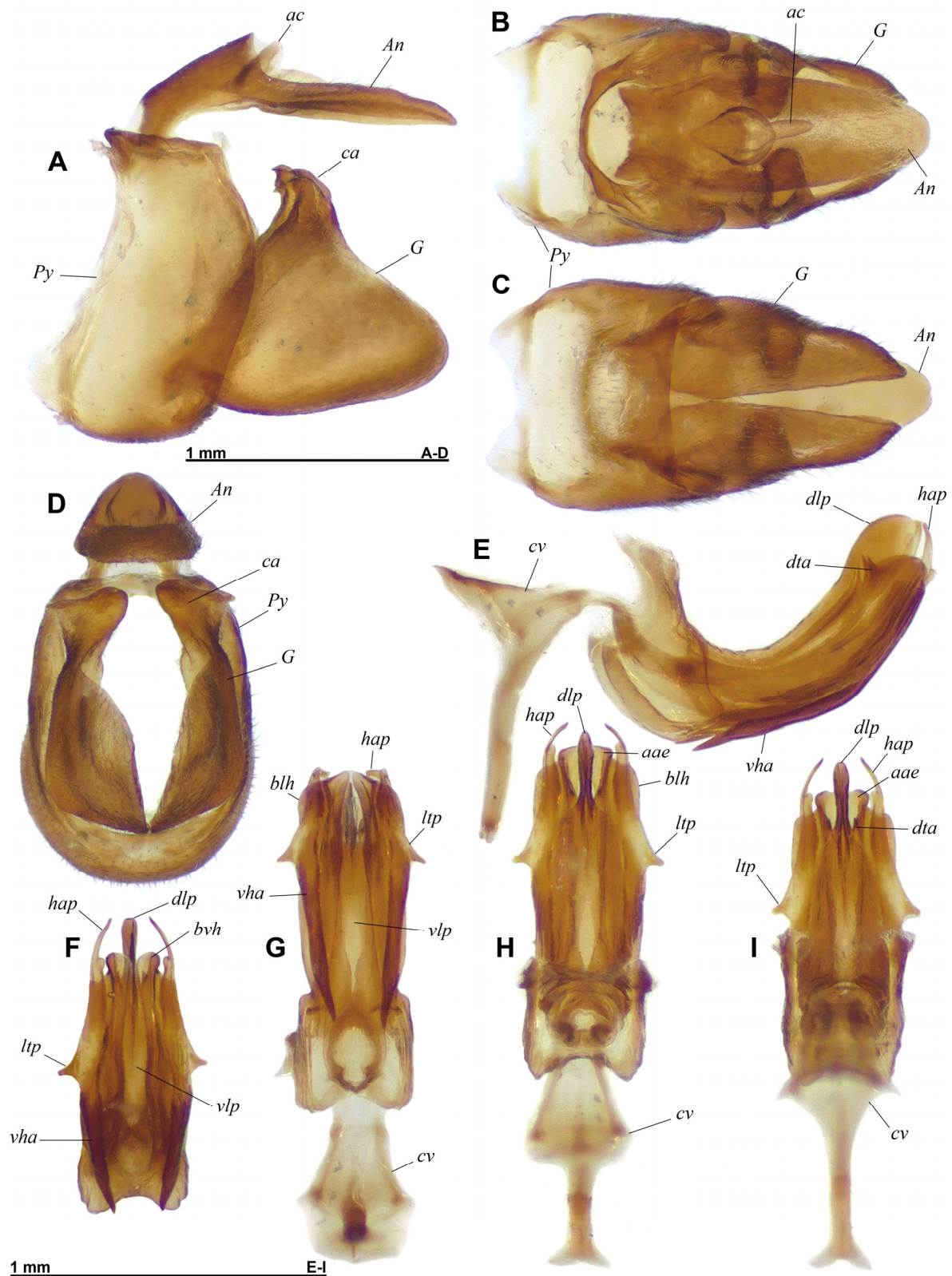


Fig. 9. *Vishnuloka bunonga* sp. nov., holotype ♂, terminalia. A–D, pygofer, anal tube and gonostyli. A, lateral view. B, dorsal view. C, ventral view. D, posterior view. E–I, aedeagus. E, lateral view. F, posteroventral view. G, ventral view. H, dorsal view. I, anterodorsal view.

ac, anal column. – aae, apex of aedeagus. – An, anal tube. – blh, basolateral lamina of hook – bvh, base of ventral hooks of aedeagus. – ca, capitulum. – cv, connective. – dlp, dorsal lobe of perianthium. – dta, dorsal tooth of aedeagus. – G, gonostylus. – hap, horn-shaped apical process of perianthium. – ltp, lateral tooth of perianthium. – Py, pygofer. – vha, ventral hooks of aedeagus. – vlp, ventral lobe of perianthium.

TYPE MATERIAL. CAMBODIA: holotype ♂ (Fig. 8 A–G): [Cambodia, Mondulhiri Prov., Keo Seima Wildlife Sanctuary, nr O Pam station, 12°11'39"N 107°01'01"E, 14–24.XI.2018, leg. J. Constant, I.G.: 33.919] (RBINS).

Paratypes: 4♂♂, 3♀♀ (Fig. 8 H–K): same collection data as holotype (2♂♂, 3♀♀: RBINS; 2♂♂: RUPP).

DIAGNOSIS. The species can be separated from the other *Vishnuloka* by its longer cephalic process, representing 1.34 times the length of the eye in lateral view (1.17 times maximum in the other species) and by its more elongate head, 1.1 times longer than broad including eyes in dorsal view (0.95 times maximum in other *Vishnuloka*).

DESCRIPTION.

Measurements and ratios: LT: ♂ (n = 5): 8.6 mm (8.40–9.04); ♀ (n = 3): 9.1 mm (8.73–9.39). LTg/BTg = 2.5; LV/BV = 0.42; LF/BF = 1.22.

Head: (Fig. 8 A–B, D–E, H–K) strongly projecting for length greater than width of eye, coniform, distally narrowed to rounded apex; back of head roundly concave. Vertex brown, weakly concave, wider than long with distal margin weakly marked with red and very narrow longitudinal mediobasal groove reaching half-length of vertex. Frons strongly elongate and protruding anteriorly into a strong conical proboscis; brown to dark brown ventrally with strongly contrasting lateroventral yellowish white vitta reaching apex of proboscis; whitish line overlaid with dark brown to black; apex of proboscis with small reddish spot ventrally. Clypeus brown, paler medially. Genae coloured, from ventral to dorsal margin, brown, yellowish white and dark brown, prolongating pattern of frons. Antennae short; scape short, ring-shaped, whitish; pedicel bulbous, dark brown, bearing many irregularly arranged rhinaria. Labium brown, narrow, not reaching posterior trochanters; last segment longer than broad, shorter than penultimate.

Thorax: (Fig. 8 A–B, D–E, H–K) brown dorsally; sides with colour pattern prolongating that of frons. Pronotum with small yellowish dots (~7–8 each side, some obscure) and 2 weakly impressed points on disc near midline; short with anterior margin rounded, carinate, following contour of head; posterior margin weakly concave, weakly notched medially. Mesonotum longer than pronotum, with disc flat, and with obsolete median carina and obsolete oblique peridiscal carinae; scutellum yellowish. Tegulae dark brown.

Tegmina: (Fig. 8 A–B, H–K) elongate, coriaceous, distally pointed with small black marking at apex; slightly bulging near basocostal angle; hypocostal plate absent; in males: brown with a few irregular small yellowish markings; in females: brown with darker brown to black elongate fascia along costal margin; dorsal margin of fascia sinuate. Veins: ScP+R furcate near base; MP sometimes furcate near apex; CuA furcate at 2/3 of tegmen length; Pcu and A1 fused at about half-length of clavus; Pcu+A1 reaching apex of clavus; numerous cross-veinlets.

Hindwings: (Fig. 8 C) brown with veins dark reddish brown; trilobed; Pcu-A1 lobe slightly wider than ScP-R-MP-Cu lobe; and Pcu single, anastomosing with A1 on a short distance; A2 not branched. ScP-R-MP-Cu lobe with 4 apical cells; anal area well developed.

Legs: (Fig. 8 A–B, F–K) elongate and slender; pro- and mesotibiae dorsoventrally flattened. Pro-, meso- and metacoxae dark brown. Pro- and mesofemora yellow-brown. Pro- and mesotibiae with narrow basal black ring followed by short yellow-brown portion, longer dark brown portion, subapical blackish ring and apex yellow-brown. All tarsi yellow-brown. Metafemora dark brown (Fig. 8 F). Metatibiae dark brown basally, turning to yellow-brown

towards apex; on distal half, 2 strong lateral spines with black apex; 8 apical spines with black apex. Metatarsi with basal segment with 2 strong and 2 small spines and a large pad of microsetae; second segment with spine on each side (Fig. 8 G). Metatibiotarsal formula: (2) 8/4/2.

Abdomen: (Fig. 8 J) uniform brown.

Genitalia ♂: (Fig. 9) pygofer (*Py*) higher than long (in lateral view), anterior margin concave, posterior margin convex, smoothly narrowing on dorsal 1/4; posterior margin roundly emarginate in dorsal view (Fig. 9 A–D). Gonostyli (*G*) subtriangular in lateral view, elongate in ventral view, and convex; ventral margin slightly sinuate in lateral view; posterodorsal margin incurved in lateral view; apex rounded; capitulum of gonostyli (*ca*) with strong dorsoapical tooth directed anteriorly and apicolateral laminate process directed medially, ending in a tooth anteriorly (Fig. 9 A–D). Connective well developed, bearing elongate narrow apodeme (Fig. 9 E, G–I). Periandrium strongly upcurved basally, with dorsal lobe (*dlp*) laterally flattened and apically rounded in lateral view (Fig. 9 E), bilaterally symmetrical; strong lateral tooth (*ltp*) directed laterally (Fig. 9 F–I) and horn-shaped apical process (*hap*) incurving and abruptly narrowing before apex (Fig. 9 E–I). Ventral lobe of periandrium (*vlp*) lanceolate apically (Fig. 9 F–G). Aedeagus with dorsal tooth (*dta*) on each side apically and very long ventral hooks (*vha*) folded along ventral portion of periandrium (Fig. 9 E–I); base of hooks laminate (*blh*) laterally (Fig. 9 G–I). Anal tube (*An*) elongate, about 2.5 times longer in median line than broad, with lateral margin sinuate near base and apex rounded, smoothly narrowing from base of anal column (*ac*) to apex in dorsal view; underside slightly concave; anal column at basal third (Fig. 9 A–B, D).

BIOLOGY. The specimens were collected by sweeping grass and forest undergrowth plants in an area where the forest was severely impacted by illegal logging (Fig. 10).



Fig. 10. *Vishnuloka bunonga* sp. nov., habitat in Keo Seima Wildlife Sanctuary.

Checklist of the Fulgoromorpha of Cambodia

NOTE. The reference of the first Cambodian record is given for each species. The new records from the present paper are marked with a “*”.

Family **Caliscelidae** Amyot & Audinet-Serville, 1843

Caliscelis (Cerepa) carnavalis Emeljanov, 2015 (EMELJANOV, 2015: 693)

Discote scutifer (Fennah, 1963) (FENNAH, 1963: 729)

Family **Cixiidae** Spinola, 1839

Oecleopsis petasatus (Noualhier, 1896) (NOUALHIER, 1896: 255)

Oliarus cucullatus (Noualhier, 1896) (NOUALHIER, 1896: 255)

Family **Delphacidae** Leach, 1815

Nilaparvata lugens (Stål, 1854) (CATINDIG *et al.*, 2009: 192)

Sogatella furcifera (Horváth, 1899) (CATINDIG *et al.*, 2009: 192)

Sogatella kolophon (Kirkaldy, 1907) (BARTLETT *et al.*, 2014: 143)

Vizcaya longispinosa Liang, 2002*

Family **Dictyopharidae** Spinola, 1839

Metaurus reticulatus Stål, 1866 (STÅL, 1866: 391)

Family **Eurybrachidae** Stål, 1862

Ancyra histrionica Stål, 1863 (STÅL, 1863a: 245)

Macrobrachys tonkinensis Lallemand, 1950*

Messena nebulosa Stål, 1863 (STÅL, 1863a: 246)

Messena mouhoti Distant, 1906 (DISTANT, 1906b: 203)

Thessitus mortifolia Walker, 1862 (STÅL, 1863a: 247 – as *Thessitus mortuifolia* Stål, 1863)

Family **Fulgoridae** Latreille, 1807

Kalidasa nigromaculata (Gray, 1832) (CONSTANT *et al.*, 2016: 6)

Penthicodes (Ereosoma) atomaria (Weber, 1801) (CONSTANT, 2010: 7)

Penthicodes (Ereosoma) pulchella Guérin-Méneville, 1838 (CONSTANT, 2010: 14)

Penthicodes (Ereosoma) variegata Guérin-Méneville, 1829 (CONSTANT *et al.*, 2016: 9)

Polydictya tricolor (Westwood, 1845) (CONSTANT *et al.*, 2016: 9)

Pyrops candelaria (Linné, 1758) (DISTANT, 1906a: 184)

Pyrops coelestinus (Stål, 1863) (STÅL, 1863b: 576)

Pyrops condorinus (Lallemand, 1960) (CONSTANT *et al.*, 2016: 10)

Pyrops ducalis (Stål, 1863) (STÅL, 1863b: 576)

Pyrops peguensis (Schmidt, 1911) (CONSTANT *et al.*, 2016: 11)

Pyrops spinolae (Westwood, 1842) (CONSTANT *et al.*, 2016: 11)

Pyrops viridirostris (Westwood, 1848) (CONSTANT *et al.*, 2016: 13)

Saiva gemmata (Westwood, 1848) (NOUALHIER, 1896: 255 – as *Fulgora monetaria* Noualhier, 1896)

Family **Issidae** Spinola, 1839*Hemisphaerius interclusus* Noualhier, 1896 (NOUALHIER, 1896: 256)*Hemisphaerius hippocrepis* Constant & Pham, 2011**Vishnuloka bunonga* sp. nov.*Family **Lophopidae** Stål, 1866*Podoschtroumpfa magna* Soulier-Perkins, 1998 (SOULIER-PERKINS, 1998: 612)*Pyrilla perpusilla* (Walker, 1851) (LIANG, 1997: 38)Family **Nogodinidae** Melichar, 1898*Detya fusconebulosa* Distant, 1906 (MELICHAR, 1923: 159)*Lollius mouhoti* Distant, 1909 (DISTANT, 1909: 75)*Sassula sorurcula* (Stål, 1865) (STÅL, 1865: 164)Family **Ricaniidae** Amyot & Audinet-Serville, 1843*Pochazia antica* (Gray, 1832) (ATKINSON, 1886: 53 – as *Ricania fuscata* (Fabricius, 1794)*Ricania stupida* (Wagner, 1857) (DISTANT, 1906a: 379)*Ricanoides flabellum* (Noualhier, 1896) (NOUALHIER, 1896: 256)*Ricanula limitaris* (Walker, 1857) (STÅL, 1865: 161)*Ricanula pulverosa* (Stål, 1865) (STÅL, 1865: 162)Family **Tropiduchidae** Stål, 1866*Lukabales ecarinatus* Stroinski & Szwed, 2015 (STROINSKI *et al.*, 2015: 582)*Sogana chartieri* Constant, 2019 (CONSTANT, 2019: 5)**Discussion**

SPECIES ASSEMBLAGE

Some species recorded from KSWs including *Discote scutifer* (Fennah, 1963) (Caliscelidae) and *Hemisphaerius hippocrepis* Constant & Pham, 2011 (Issidae) are also recorded from Dong Nai Province in South Vietnam: both from Ma Da in Dong Nai Biosphere Reserve and the second also from Cat Tien National Park in South Vietnam (CONSTANT & PHAM, 2011; EMELJANOV, 2013; GNEZDILOV, 2013; GNEZDILOV *et al.*, 2014). These protected areas belong to the *Southeastern Indochina dry evergreen forests* ecoregion (OLSON *et al.*, 2001 – Fig. 11) and this might explain similarities in the species assemblages of the two zones. However, the entomofauna is under investigated and the amount of available comparative data is too limited to advance any well supported conclusion.

PENDING TAXONOMIC ISSUES

(1) *Discote scutifer* (Fennah, 1963) – the male genitalia and probable sexual dimorphism need documentation for this species. This will allow a better comparison of the genus with *Augilodes* Fennah, 1963.

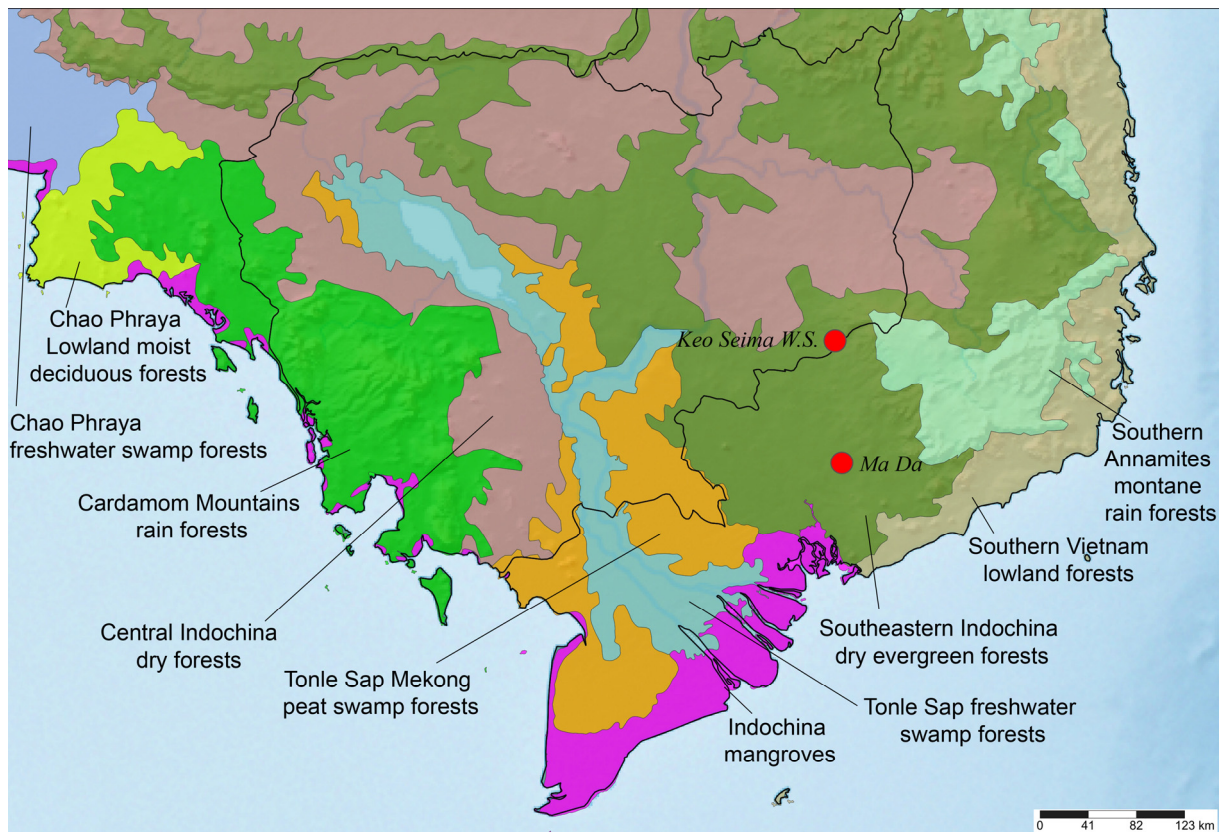


Fig. 11. Situation of Keo Seima Wildlife Sanctuary and Ma Da in respect with ecoregions.

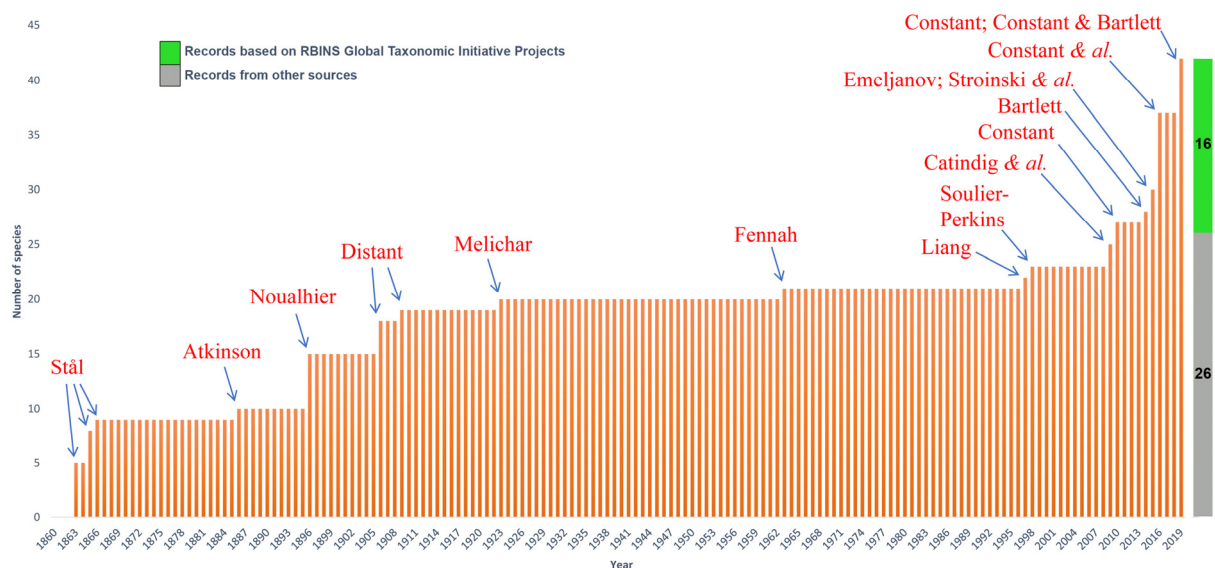


Fig. 12. Fulgoromorpha of Cambodia: cumulative totals of numbers of species recorded since 1863.

- (2) *Vizcaya longispinosa* Liang, 2002 – the species identification needs to be confirmed by the examination of male genitalia when available.
- (3) *Macrobrachys tonkinensis* Lallemand, 1950 – the species is currently known from female specimens only. The study of the male genitalia could allow a refined placement of the genus within the tribe Loxocephalini and comparison of male genitalia from different populations could determine whether they are conspecific or represent closely allied species.
- (4) *Vishnuloka* Distant, 1906 – the current treatment of the previously described species is not satisfactory and requires a complete revision of the available material and review and

redescription of species by male genitalia. Males of *Vishnuloka prominula* Distant, 1906 and *V. cuneata* Distant, 1906 need to be examined to confirm the synonymy proposed by GNEZDILOV (2012), and further compared with those of *V. deserta* (Melichar, 1906). The record of the latter species given by LALLEMAND (1942) needs to be confirmed or refuted based on the examination of the material he studied at that time.

PROGRESS IN CAMBODIAN PLANTHOPPERS DOCUMENTATION

Since the nine first Cambodian planthoppers were recorded by STÅL (1863a, b, 1865, 1866), the documentation of additional species was extremely slow, reaching only 23 species nearly 150 years after Stål's records (Fig. 12). The main contributions over these years were by NOUALHIER (1896) and DISTANT (1906a, b, 1909). However, the situation improved in the last ten years, with 19 species added since 2009. This is a change from an average of less than 0.1 added species per year in the period 1863–2008 to 1.9 in the period 2009–2019. This can be explained by the higher number of taxonomists getting access to Cambodian material in the recent years and by the recent collecting efforts in the framework of the Global Taxonomic Initiative (GTI) projects managed by RBINS. Most of the recent additional records (94% since 2010) derive from these projects, which delivered nearly 40% of the planthopper species currently recorded from Cambodia. However, a great effort is needed to identify and document additional material from this country (Constant, unpublished data).

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