

urn:lsid:zoobank.org:pub:CA852E68-BCE4-4735-BF5D-A63F5D33B5F3

# Belgian Journal of Entomology

## **Updating lanternflies biodiversity knowledge in Cambodia (Hemiptera: Fulgoromorpha: Fulgoridae) by optimizing field work surveys with citizen science involvement through Facebook networking and data access in FLOW website**

Jérôme CONSTANT<sup>1</sup>, Sophany PHAUK<sup>2</sup> & Thierry BOURGOIN<sup>3</sup>

<sup>1</sup> Royal Belgian Institute of Natural Sciences, O.D. Phylogeny and Taxonomy, Entomology, Vautier street 29, B-1000 Brussels, Belgium (corresponding author: e-mail: jerome.constant@naturalsciences.be)  
urn:lsid:zoobank.org:author:6E6072A1-9415-4C8D-8E60-2504444DB290

<sup>2</sup> Royal University of Phnom Penh, Cambodian Entomology Initiatives, Department of Biology, Faculty of Science, Cambodia (e-mail: phauk.sophany@rupp.edu.kh)

<sup>3</sup> Museum National d'Histoire Naturelle, Sorbonne Universités, Institut Systématique, Evolution, Biodiversité (ISYEB), UMR 7205 MNHN-CNRS-UPMC-EPHE, CP50, 57 rue Cuvier, F-75231, Paris cedex 5, France (e-mail: bourgoin@mnhn.fr)

# **Updating lanternflies biodiversity knowledge in Cambodia (Hemiptera: Fulgoromorpha: Fulgoridae) by optimizing field work surveys with citizen science involvement through Facebook networking and data access in FLOW website**

Jérôme CONSTANT, Sophany PHAUK & Thierry BOURGOIN

ISSN : 1374-5514 (Print Edition)

ISSN : 2295-0214 (Online Edition)



Le Belgian Journal of Entomology est édité par la Société royale belge d'Entomologie, association sans but lucratif, fondée le 9 avril 1855.

Siège social : rue Vautier 29, B-1000 Bruxelles

De Belgian Journal of Entomology is uitgegeven door de Koninklijke Belgische Vereniging voor Entomologie, vereniging zonder winstoogmerk, opgericht op 9 april 1855.

Sociale zetel : Vautierstraat 29, B-1000 Brussel

Les publications de la Société sont financées avec le concours de la Fondation Universitaire de Belgique

De publicaties van de Vereniging worden gefinancierd met de steun van de Universitaire Stichting van België.

In compliance with Article 8.6 of the ICZN, printed versions of all papers are deposited in the following libraries :

- Bibliothèque royale de Belgique, 4 Boulevard de l'Empereur, B-1000 Bruxelles
- Bibliothèque de l'Institut royal des Sciences naturelles de Belgique, Rue Vautier 29, B-1000 Bruxelles
- American Museum of Natural History Library, Central Park West at 79th street, New York, NY 10024-5192, USA
- Bibliothèque centrale du Museum national d'Histoire naturelle, 38 rue Geoffroy Saint-Hilaire, 75005 Paris, France
- Muséum d'Histoire naturelle, Bibliothèque, 1 Route de Malagnou, CH 1208 Genève, Suisse.
- Zoological Record, Thomson Reuters, Publication Processing, 1500 Spring Garden Street, Fourth Floor, Philadelphia PA 19130, USA

# Updating lanternflies biodiversity knowledge in Cambodia (Hemiptera: Fulgoromorpha: Fulgoridae) by optimizing field work surveys with citizen science involvement through Facebook networking and data access in FLOW website

Jérôme CONSTANT<sup>1</sup>, Sophany PHAUK<sup>2</sup> & Thierry BOURGOIN<sup>3</sup>

<sup>1</sup>Royal Belgian Institute of Natural Sciences, O.D. Phylogeny and Taxonomy, Entomology, Vautier street 29, B-1000 Brussels, Belgium (corresponding author: e-mail: jerome.constant@naturalsciences.be)

urn:lsid:zoobank.org:author:6E6072A1-9415-4C8D-8E60-2504444DB290

<sup>2</sup>Royal University of Phnom Penh, Cambodian Entomology Initiatives, Department of Biology, Faculty of Science, Cambodia (e-mail: phauk.sophany@rupp.edu.kh)

<sup>3</sup>Museum National d'Histoire Naturelle, Sorbonne Universités, Institut Systématique, Evolution, Biodiversité (ISYEB), UMR 7205 MNHN-CNRS-UPMC-EPHE, CP50, 57 rue Cuvier, F-75231, Paris cedex 5, France (e-mail: bourgoin@mnhn.fr)

## Abstract

The first checklist of the species of Fulgoridae occurring in Cambodia is provided and commented on. For this inventory, involvement of citizen science, notably via the use of the social network Facebook to collect faunistic data allowed to update this list from 5 to 17 species with 12 of them being new records for the country: *Aphaena* sp., *Dichoptera* sp., *Kalidasa nigromaculata* (Gray, 1832), *Penthicodes variegata* (Guérin-Méneville, 1829), *Polydictya tricolor* (Westwood, 1845), *Polydictya* sp., *Pyrops condorinus* (Lallemand, 1960), *P. peguensis* (Schmidt, 1911), *P. spinolae* (Westwood, 1842), *P. viridirostris* (Westwood, 1848), *Saiva gemmata* (Westwood, 1848) and *Zanna* sp. Four species are only recorded from citizen science sources, the relevance of which in such study is explained and discussed. First records of trophobiotic interactions with Blattodea are given and illustrated for *Penthicodes atomaria* (Weber, 1801) and *Saiva gemmata*. The nymph of *S. gemmata* is illustrated for the first time and host-plants are documented for several species. *Pyrops condorinus* (Lallemand, 1960) is reinstated as a valid species from previous status of subspecies of *P. spinolae* (Westwood, 1842). In order to provide wider and longer term access to the data, and to anchor the scientific knowledge of such a project, a selection of photographs used in the present study have also been made available in FLOW website (BOURGOIN, 2016) on the webpage of the corresponding species.

**Keywords:** Facebook; citizen science; planthopper; lanternbug; Indochina; trophobiosis; host-plant.

## Introduction

Only one genus and three species of Fulgoridae were recorded from Cambodia by NAGAI & PORION (1996): *Pyrops candelaria* (Linnaeus, 1758), *P. coelestinus* (Stål, 1863) and *P. ducalis* (Stål, 1863) until CONSTANT (2010) who recently added a second genus, *Penthicodes* Blanchard, 1845 with two species, *P. atomaria* (Weber, 1801) and *P. pulchella* (Guérin-Méneville, 1838) to the list of Cambodian Lanternflies.

However, we recently identified material of planthopper Fulgoridae of the collections of the Cambodian Entomology Initiatives (CEI) at the Royal University of Phnom Penh (RUPP). We also conducted joint fieldwork by a staff of RUPP and the Royal Belgian Institute of Natural Sciences (RBINS) to study the Cambodian entomofauna, and particularly Fulgoromorpha. This was completed by the examination of photographs sent by several insect enthusiasts in Cambodia after a call for contribution on a social network, a Facebook page dedicated to Cambodian nature. As a result, 12 species of Fulgoridae were recorded for the first time in the country.

The present paper aims at providing a first checklist of the species of Fulgoridae of Cambodia with comments on their distribution, together with a short list of species which might occur in the country according to their currently recorded distribution. It also provides a number of new behavioural, ecological and ethological information on the treated species.

### Material and methods

The nomenclature mainly follows NAGAI & PORION (1996) and BOURGOIN (2016: FLOW). Data were provided by the collections of RUPP and RBINS, by a 10 days collecting trip in April-May 2015 with staff from both institutes (RBINS funding: taxonomy & phylogeny: entomology) and by a call for contribution posted on the social network Facebook in the “Natural Cambodia” group on the 18th of May 2015 to send observations documented by photographs (Fig. 1). The pictures were sent to the first author by email, renamed under the following standardized format:

Genus\_species\_Country\_Province\_Locality\_DayMonth[in Roman]Year\_FirstNameSurname  
e.g.: *Pyrops peguensis*\_Cambodia\_KampongSpeu\_Chambok\_5v2015\_JeromeConstant.

When the contributor could not identify the species by himself, a name was not filled in and a reply was sent with the identification. If the name given by the contributor was wrong, the correct identification was sent.





Accordingly, in the list of material, a clear distinction is made between collection records and observation data (photos of specimens *in natura*) which therefore will not be accessible for further studies as collection specimens. However, a selection of photographs examined in the present study have also been made available on FLOW website (BOURGOIN, 2016) on the webpage of the corresponding species.


### Acronyms used for the collections

NHRS = Naturhistoriska Riksmuseet, Stockholm, Sweden.

RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium.

RUPP = Royal University of Phnom Penh, Department of Biology, Faculty of Sciences, Phnom Penh, Cambodia.

 Natural Cambodia   Jerome  Accueil

 **Jerome Constant**  
18 mai, 17:18

**\*\*LANTERNFLIES FROM CAMBODIA\*\* WE NEED YOUR HELP!!**  
Dear all, I am preparing together with [Sophany Phauk](#) a paper on the Fulgoridae from Cambodia. We would like to gather as much data as possible. If you have any pictures, even of species you believe common, please send them to me on my email ([jerome.constant@naturalsciences.be](mailto:jerome.constant@naturalsciences.be)), renamed in the following way: Genus species\_Country\_Province\_Village\_DayMonthYear\_NameOfAuthor  
example:  
Pyrops  
candelaria\_Cambodia\_SiemReap\_AngkorTemples\_25iii2015\_JeromeConstant  
No problem if you don't know the name of the species, I'll send it to you...  
If you have additional data, e.g. the name of the host tree, they are of course welcome!  
Thanks a lot for your contribution!!  
(some examples of what Fulgoridae look like...)




Fig. 1. Call to collaboration to the study of Fulgoridae of Cambodia posted on Facebook on May 18<sup>th</sup>, 2015.

Family **Fulgoridae** Latreille, 1807Genus *Aphaena* Guérin-Méneville, 1834*Aphaena* sp. new country record

Fig. 2 A–E

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=genus&id=8207>

MATERIAL EXAMINED. 6♂, 2♀: Kampong Speu, Kirirom N.P., 9-12.V.2015, J. Constant & V. Sougnez (RBINS).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Koh Kong, Tatai, 26.V.2011, G. Chartier; 1 ex: Koh Kong, Tatai, 5.III.2012, G. Chartier; 1 ex: Pursat, Cardamom, 2.I.2009, J. Holden; 1 ex: Siem Reap, Banteay Srei District, Tbeng Lech Village, 15.XI.2014, S. De Greef; 1 ex: Mondulkiri, O Reang District, 21.V.2015, B. Barca; 1 ex: Preah Sihanouk Province, Sihanoukville env., Kbal Chhay Waterfall env. (secondary tributary), 19.IV.2010, 10°40'29-26" N, 103°36'30-32" E, O. Kosterin.

## NOTE

Taxonomy of the genus *Aphaena* is currently unsatisfactory. The taxon is spread in most of South East Asia including the Greater Sunda and Bali, but it is not recorded in the Philippines, Lesser Sunda and Sulawesi. The group containing the species *A. consimilis* (Distant, 1914), *A. discolor* Guérin-Méneville, 1834, *A. dissimilis* (Distant, 1906), *A. satrapa* (Gerstaecker, 1895) and *A. submaculata* (Hope, 1840) and their subspecies as treated by LALLEMAND (1963) and NAGAI & PORION (1996), needs a full revision.

The specimens collected in Cambodia were sitting on small trees of the family Simaroubaceae which seem to be the host-plant of the species.

Genus *Dichoptera* Spinola, 1839*Dichoptera* sp. new country record

Fig. 2 F–G

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=genus&id=20281>

MATERIAL EXAMINED. 1♂: Kampong Speu, Chambok, 4-8.V.2015, J. Constant & V. Sougnez (RBINS).

## NOTE

The genus needs to be revised and the species defined on male genitalia characters. The taxon is spread in all Oriental Region with 5 species recorded from the continent (including Taiwan). The specimen found in Chambok is a male and might represent a new species.

Genus *Kalidasa* Kirkaldy, 1900*Kalidasa nigromaculata* (Gray, 1832) new country record

Fig. 2 H

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=9406>

MATERIAL EXAMINED. 3♀: Siem Reap, Angkor, 21.IX.2014, C.E.I. Team (RUPP).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Siem Reap, Angkor, 15.VII.2014, D.R. Jump; 1 ex: Siem Reap, Angkor, 10.VIII.2014, S. De Greef; 1 ex: idem, 14.VII.2014; 1 ex: idem, 27.VII.2014.

NOTE

The species is recorded from China, Myanmar, Thailand, Vietnam and Andaman islands (NAGAI & PORION, 1996).

Genus *Penthicodes* Blanchard, 1845

NOTE

*Penthicodes* species are mainly nocturnal and should be actively searched for at night time by scanning the tree trunks with a torch.

*Penthicodes atomaria* (Weber, 1801)

Fig. 2 I.

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=18762>

MATERIAL EXAMINED. 1♀: Siem Reap, Angkor Thom, XI.2005, D.R. Jump (RBINS); 1♂: idem, VIII.2003 (RBINS); 1♂: Kompong Speu, Aural Mountains (Cardamom), day collecting, 29.I.2006, O. Yothin (RBINS); 1♂: Siem Reap, Kbal Spean, 18.XII.2004, day collecting, I. Var (RBINS); 1♂: idem, 19.XII.2004, D.R. Jump (RBINS); 1♀: Takeo, Kirivong Mountain, 10.XII.2014, C.E.I. Team (RUPP).

MATERIAL EXAMINED ON PHOTOGRAPHS. 2 ex: Cardamom Mts, 4.VIII.2013, A. Anker; 1 ex: Siem Reap, Angkor, 12.X.2014, S. De Greef; 1 ex: Mondulkiri, O Reang District, 15.X.2014, B. Barca.

NOTE

The species is recorded from Bhutan, Cambodia, China, India, Indonesia (Java, Sumatra, Borneo, Lombok), Laos, Malaysia, Thailand, Vietnam (CONSTANT, 2010).

One specimen was observed and photographed during trophobiotic interaction with a cockroach (Blattaria) in the Cardamom Mountains. This is the first record of trophobiotic interaction for *P. atomaria*.

Specimens of *P. atomaria* should be collected or at least documented by high quality photographs to avoid confusion with *P. warleti* Constant, 2010 (see also CONSTANT, 2010 for a key to the species of *Penthicodes*). The latter species is currently known from very few specimens and might occur in Cambodia.

*Penthicodes pulchella* (Guérin-Méneville, 1838)

Fig. 2 J

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=18761>

MATERIAL EXAMINED. 1♀: Angkor Thom, Siem Reap prov., 25-27.II.2005, D.R. Jump (RBINS) coordinates: 13°27'N 103°52'E; 1♂: Phnom Kulen N.P., Kbal Spean, 24.VII.2004, P. Grootaert (RBINS) coordinates: 13°41'N 104°00'E.

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Siem Reap, Angkor, 18.IX.2013, S. De Greef.

NOTE

The species is recorded from Andaman Islands, Cambodia, China, India, Indonesia: Java, Sumatra, Myanmar, Taiwan, Thailand, Vietnam (CONSTANT, 2010).



Fig. 2. **A–G**, *Aphaena discolor*. **A–B**, specimen on his host-tree, Kirirom, 9.V.2015 (J. Constant). **C**, habitat in Kirirom, 9.V.2015 (J. Constant). **D**, Pursat, Cardamom, 2.I.2009 (J. Holden). **E**, Koh Kong, Tatai, 5.III.2012 (G. Chartier). **F–G**, *Dichoptera* sp. Chambok, 5.V.2015 (J. Constant). **H**, *Kalidasa nigromaculata*, Siem Reap, Angkor, 10.VIII.2014 (S. De Greef). **I**, *Penthicodes atomaria* tended by a cockroach, Cardamom Mts, 4.VIII.2013 (A. Anker). **J**, *P. pulchella*, Siem Reap, 18.IX.2013 (S. De Greef). **K**, *P. variegata*, Mondulkiri, O Reang District, 19.V.2015 (B. Barca). **L–M**, *Polydictya tricolor*, Siem Reap, Angkor, 1.VIII.2013 (S. De Greef). **N–O**, *Polydictya* sp., 8 km NNW Angkor, 6.XI.2013 (E. Smith).



***Penthicodes variegata*** (Guérin-Méneville, 1829) new country record

Fig. 2 K

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=18759>

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Mondulkiri, O Reang District, 19.V.2015, B. Barca.

NOTE

The species is recorded from Bhutan, N India, Malaysia, Myanmar, Thailand and Vietnam (CONSTANT, 2010).

Genus ***Polydictya*** Guérin-Méneville, 1844

***Polydictya tricolor*** (Westwood, 1845) new country record

Fig. 2 L–M

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=9242>

MATERIAL EXAMINED. 1♂: Siem Reap, Angkor Thom, day catch, 23.V.2003, leg. J. Constant, K. Smets & P. Grootaert (RBINS).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Siem Reap, Angkor, 1.VIII.2013, S. De Greef.

NOTE

The species is recorded from India, Assam and Vietnam (NAGAI & PORION, 1996).

***Polydictya* sp.** new country record

Fig. 2 N–O

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=genus&id=6499>

MATERIAL EXAMINED. 2♀: Siem Reap, Angkor, 21.IX.2014, C.E.I. Team (RUPP); 25♂, 1♀: Siem Reap, Angkor Thom, VIII.2003, D.R. Jump (RBINS).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: 8km NNW of Angkor, 9.XI.2013, E. Smith; 1 ex: idem, 6.XI.2013; 1 ex: Angkor, 21.X.2009, R. Seaman; 1 ex: Siem Reap, Angkor, 21.IX.2014, S. De Greef.

NOTE

This species of *Polydictya* pertains to a group of very close species containing *P. basalis* (Hope, 1843) described from Sylhet in Myanmar, *P. uniformis* (Walker, 1857) from Borneo and *P. johanna*e Lallemand, 1956 from Phu Quoc Island in Vietnam.

The group needs to be revised and the male genitalia of the species accurately described, including the sclerified processes of the phallobase (see also CONSTANT, 2015a for examples of male genitalia of *Polydictya*). This revision is currently frozen due to the lack of a male specimen of *P. johanna*e which was described on a single female.

Genus *Pyrops* Spinola, 1839*Pyrops candelaria* (Linnaeus, 1758)

Fig. 3 A–B

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=17304>

MATERIAL EXAMINED. 3♀: Kampong Speu, Chambok, 1.IX.2014, C.E.I. Team (RUPP).

MATERIAL EXAMINED ON PHOTOGRAPHS. 2 ex: Sen Monorom, 22.II.2014, J. Highwood; 1 ex: Kampot, Teuk Chhou, 2.II.2013, G. Allen; 9 ex: Kampong Tralach, 21.IX.2013, O. Rodriguez; 4 ex: Battambang, Reaksmei Songha, IV.2009, Lisa Arensen.

## NOTE

The species is recorded from India, Sikkim, Assam, China, Cambodia, Thailand, Vietnam and Malaysia (NAGAI &amp; PORION, 1996).

It is commonly found, often in high numbers, on litchi and longan trees (Sapindaceae) which seem to be its preferred host plants.

*Pyrops coelestinus* (Stål, 1863)

Fig. 3 C–D

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=17366>

MATERIAL EXAMINED. Holotype ♀: Cambodja, Stevens (NHRS); 1♂: idem; 2♂, 2♀: Chambok, 1.IX.2014, C.E.I. Team (RUPP).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Kampot, Kep, 30.XI.2012, L. Masseur; 1 ex: Kampot, Kep, 30.VIII.2014, H. Janody.

## NOTE

The species is recorded from Cambodia and Vietnam (NAGAI &amp; PORION, 1996).

STÅL (1863) described the species on one female from “Cambodja” and we provide here the first precise data for the species in the country.

*Pyrops condorinus* (Lallemand, 1960) comb. rev., new country record

Fig. 3 E

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=subspecies&id=17557>*Fulgora spinolae condorina* LALLEMAND, 1960: 7 [described].*Fulgora spinolae* f. *condorina* LALLEMAND, 1963: 76 [keyed].*Pyrops condorina* NAGAI & PORION, 1996: 24 [catalogued]; 29 [taxonomic note]; pl. 12 fig. 170 [type illustrated].*Pyrops spinolae condorinus* LIANG, 1998: 45 [taxonomic note].

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Angkor, 15.VII.2014, D.R. Jump; 1 ex: Angkor, 30.IV.2014, S. De Greef; 1 ex: Koh Kong, Tatai, 17.VIII.2011, G. Chartier; 2 ex: Koh Kong, Tatai, 24.V.2015, G. Chartier.

## NOTE

The species was described from Vietnam, Con Dao Island (LALLEMAND 1960), as a subspecies of *Pyrops spinolae* (Westwood, 1842). It was later treated as a distinct species by NAGAI & PORION (1996) who examined and illustrated the type. LIANG (1998) did not follow

this view and erroneously considered *P. condorinus* as a subspecies of *P. spinolae*. Our examination of the type specimen of *P. condorinus* confirmed the view of NAGAI & PORION (1996) and the combination *P. condorinus* (Lallemand, 1960) is here reinstated.

The species was observed on *Sandoricum koetjape* (Burm.f.) Merr. (Meliaceae) (pers. com. G. Chartier, Dec. 2015).

***Pyrops ducalis* (Stål, 1863)**

Fig. 3 F

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=17425>

MATERIAL EXAMINED. 1 syntype ♂, 1 syntype ♀: Cambodja, Stevens (NHRS).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Elephant Mts, II.2002, A. Sochivko; 2 ex: Mondulkiri, Seima Forest, 13.V.2015, B. Barca.

NOTE

The species is recorded from Cambodia and Vietnam (NAGAI & PORION, 1996; PHAM, 2011).

STÅL (1863) described the species on specimens from “Cambodja” and we provide here the first precise data for the species in the country.

***Pyrops peguensis* (Schmidt, 1911) new country record**

Fig. 3 G–I

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=17502>

MATERIAL EXAMINED. 1♂: 8 km N of Sre Noi (road to Anlong Vaeng), 29-30.V.2003, dry dipterocarp forest, day collecting, J. Constant & K. Smets (RBINS); 1♀: Kampong Speu, Chambok, 4-8.V.2015, J. Constant & V. Sougnez (RBINS).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Pursat, Tumpor, Cardamom, 12.VIII.2009, Pine Forest, 500-600 m, J. Holden.

NOTE

The species is recorded from Myanmar and Thailand (METCALF, 1947; NAGAI & PORION, 1996).

Both records in Cambodia are from dry dipterocarp forest on trees showing partly burnt bark where the species is very well camouflaged.

***Pyrops spinolae* (Westwood, 1842) new country record**

Fig. 3 J

<http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=17556>

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Ratanakiri, Veun Sai Siem Pang, 23.II.2015, A. Gomez-Monge.

NOTE

The species is recorded from Myanmar, Vietnam, India, Malaysia, China, Taiwan (METCALF, 1947; NAGAI & PORION, 1996).



Fig. 3. **A–B**, *Pyrops candalaria*. **A**, Chambok, 1.IX.2014 (S. Phauk). **B**, Kampong Tralach, 21.IX.2013 (O. Rodriguez). **C–D**, *P. coelestinus*, Chambok, 1.IX.2014 (S. Phauk). **E**, *P. condorinus*, Koh Kong, Tatai, 24.V.2015 (G. Chartier). **F**, *P. ducalis*, Mondulkiri, Seima Forest, 13.V.2015 (B. Barca). **G–I**, *P. peguensis*. **G**, Tumpor, Cardamom, 12.VIII.2009 (J. Holden). **H**, Chambok, 5.V.2015 (J. Constant). **I**, *idem*, biotope. **J**, *P. spinolae*, Ratanakiri, Veun Sai Siem Pang, 23.II.2015 (Marduk). **K**, *P. viridirostris*, Chambok, 7.V.2015 (J. Constant). **L–N**, *Saiva gemmata*. **L**, nymph, Chambok, 7 May 2015 (J. Constant). **M**, adult tended by a cockroach, Chambok, 7.V.2015 (J. Constant). **N**, Mondulkiri, Seima Forest, 13.V.2015 (B. Barca). **O–Q**, *Zanna* sp. **O–P**, Koh Kong, Tatai, 1.XI.2012 (G. Chartier). **Q**, Kampot, 21.XII.2013 (K.W. Meier-Doernberg).

***Pyrops viridirostris*** (Westwood, 1848) new country record

Fig. 3 K

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=17560>

MATERIAL EXAMINED. 1♂: Kampong Speu, Chambok, 4-8.V.2015, J. Constant & V. Sougnez (RBINS).

NOTE

The species is recorded from India, Assam, Vietnam, Sikkim, Myanmar, Thailand and Penang Island (METCALF, 1947; NAGAI & PORION, 1996).

Genus ***Saiva*** Distant, 1906

***Saiva gemmata*** (Westwood, 1848) new country record

Fig. 3 L–N

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=species&id=9424>

MATERIAL EXAMINED. 3♂, 12♀: Kampong Speu, Chambok, 4-8.V.2015, J. Constant & V. Sougnez (RBINS); 1♂, 1♀: Kampong Speu, Chambok, 4-8.V.2015, C.E.I. Team (RUPP).

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Mondulkiri, Seima Forest, 13.V.2015, B. Barca.

NOTE

The species is recorded from Thailand, India, Sikkim and Vietnam (METCALF, 1947; NAGAI & PORION, 1996).

One specimen was observed and photographed during trophobiotic interaction with a nymph of cockroach (Blattaria) in Chambok. This is the first record of trophobiotic interaction in *S. gemmata*.

Genus ***Zanna*** Kirkaldy, 1902

***Zanna* sp.** new country record

Fig. 3 O–Q

FLOW: <http://hemiptera-databases.org/flow/?page=explorer&db=flow&lang=en&card=taxon&rank=genus&id=6578>

MATERIAL EXAMINED ON PHOTOGRAPHS. 1 ex: Koh Kong, Tatai, 1.XI.2012, G. Chartier; 1 ex: Kampot, 21.XII.2013, K.W. Meier-Doernberg.

NOTE

These are the first records of a species of *Zanna* in Cambodia (METCALF, 1947; NAGAI & PORION, 1996). It is currently impossible to identify the species just on photographs and the genus is in need of a complete revision including all types and the study of the male genitalia. Hence, it is even not sure that the two recorded specimens are conspecific.

**Discussion**

LINKING FACEBOOK SOCIAL NETWORK, CITIZEN SCIENCE HELP AND LONG TERM DATA ACCESS AND STORING THROUGH FLOW WEBSITE

The Facebook group “Natural Cambodia” was created by Mrs Tori Green in May 2013 and one administrator, Mr Stéphane De Greef, asked the first author to join the group at the end of

October 2013 to help with taxonomic expertise in entomology, especially for Fulgoromorpha. Optimizing therefore identification facilities with wider documentation provided by photos was a natural and enriching development for the group which was associated to the present inventory.

Since mid 2013, photographs of lanternflies showed up from time to time, and were posted on the group page by members sharing their observations. These represented original data on a poorly known family of insects in an even more poorly documented country. When we started our study based on collection specimens and fieldwork, we took therefore the opportunity to valorize the work and data provided by the Facebook “Natural Cambodia” group. A special call for collaboration was posted (Fig. 1) and the first author also searched the internet for additional data on Cambodian lanternflies, notably on blogs, citizen-science website (e.g. Project Noah) and photo-sharing websites (e.g. Flickr, Picasa).

As a result, we received/found 61 photographs, including 59 photographs of Fulgoridae and only 2 of misidentified members of other Fulgoromorpha families (Ricaniidae and Flatidae) provided by 18 persons (12 specially replying to the call on Facebook). Those 59 photographs represented 38 different data, one data being one species/date/location (several data were documented by more than one photograph). This allowed us to document 15 species (88% of the total number). As a comparison, the “conventional” part of the study (i.e. study of collections and fieldwork by scientific staff) documented “only” 13 species (76% of the total number).

Considering the results of the Facebook call only, 31 data were received (1-9 data per contributor; 2.7 on average) for a total of 14 species documented (1-7 per contributor; 2.3 on average). The data were all received within the month following the call, with the oldest dating back to 2009. The Facebook call alone would allow documenting more species than the conventional inventory alone, and 4 species are known from Cambodia from citizen-science sources only. The complementarity of the methods is obvious.

However, this tool has also its limits. If it can be used for some taxa as some lanternflies here which can be identified on photographs by experienced taxonomists, it is not the case in most planthopper species for which precise identification requires the study of male genitalia. Moreover, the success of such experience also depends on some other factors as:

- (1) the quality and speed of the feedback given to the participants (here the identification of the specimens);
- (2) the implication of the taxonomist since the beginning of the process to provide correct information to the participants. This is very important to discourage well-intentioned but non-expert people, who spread wrong identifications here and there on internet. Some websites (e.g. Project Noah) suffer of this wrongly-adapted practice;
- (3) the motivation of the participants – some participants of the present project are real “insect fanatics”. This can generate some positive emulation leading to more discoveries.

The present work illustrates a very practical and spectacular achievement of citizen science and demonstrates how an innovative approach can enhance the results of scientific work. There is a real interest in society for such involvement in scientific research. Modern tools like digital camera and GPS, as well as the availability of scientific information on the internet (e.g. for this study: FLOW (BOURGOIN, 2016), Biodiversity Heritage Library...) allow citizens to contribute actively to scientific research. Unfortunately, despite the motivation of both citizens and scientists, the multiplication of such projects is currently

impeded by the general lack of taxonomists and the difficulties for young researchers to valorize such initiative in terms of scientific career.

Another aspect of such projects is their scientific ground base that relies on the validity of the identification done on only photo documents. Just as repetition of experiments validates the results in experimental sciences, allowing reproducibility of the identification is therefore fundamental to validate and anchor the scientific knowledge provided in these studies. Accordingly, FLOW website was thus used to allow wider and longer term access to the original data, to assure reproducibility of the identification (validation process), together also with adding a didactic dimension of these documents by using them to illustrate the database. In FLOW each photo was therefore stored with its identification at species level, along with collection data, identification provider's name (followed by "det.") and copyright data.

#### TROPHOBIOSIS

Trophobiotic interactions are reported for the first time for two species, *Penthicodes atomaria* and *Saiva gemmata*, both with cockroaches (Blattodea). This particular type of interaction is well documented in planthoppers but mainly associated with ants (BOURGOIN, 1997). It was reported for the first time with coackroaches and large planthoppers as Fulgoridae by ROTH & NASKRECKI (2001) and also reported by NASKRECKI & NISHIDA (2007) and CONSTANT (2015b) for different species and genera. It must actually be widespread in the family as observations in the two first papers deal with Neotropical species while the third deals with species from Borneo. Both nymphs and adults of cockroaches were observed but the records hitherto available involve only adults of Fulgorids, what could just be an artefact due to the great scarcity of observations of Fulgoridae nymphs generally. More work and observations are needed to understand the mechanisms leading to those peculiar relations and behaviours.

#### FULGORIDAE DIVERSITY OF CAMBODIA

The present list of 17 species of Fulgoridae for the fauna of Cambodia, although representing a great progress from the previous number of 5 recorded species, is probably still much under the real figure. We have listed hereunder 13 more species which, according to their currently known distribution (NAGAI & PORION 1996; CONSTANT & PHAM, 2008; CONSTANT, 2010), may also occur in Cambodia:

*Aphaena amabilis* (Hope, 1843) [India, Sikkim, Assam, Vietnam].

*Aphaena aurantia* (Hope, 1840) [India, Assam, Sikkim, Thailand].

*Aphaena najas* (Schmidt, 1906) [Thailand, Vietnam].

*Penthicodes caja caja* (Walker, 1851) [Bengladesh, N India, Laos, Myanmar, Thailand, Vietnam].

*Penthicodes warleti* Constant, 2010 [NE India].

*Polydictya vietnamica* Constant & Pham, 2008 [Vietnam].

*Pyrops lathburii* (Kirby, 1818) [India, Assam, China, Hong Kong, Thailand].

*Pyrops clavatus* (Westwood, 1839) [India, Assam, Sikkim, Myanmar, Thailand, Vietnam].

*Saiva cardinalis* (Butler, 1874) [India, Nepal, Sikkim, Assam, Vietnam].

*Saiva itoi* (Sato & Nagai, 1994) [Malaysia].

*Zanna affinis* (Westwood, 1839) [India, Nepal, Sikkim, Java, Sri Lanka, China, Hong Kong].

*Zanna chinensis* (Distant, 1893) [India, Assam China, Vietnam, Myanmar, Thailand, Taiwan].

*Zanna dalyi* (Distant, 1905) [Thailand].

### Acknowledgements

The following persons are warmly thanked for replying to our call for collaboration and/or for sharing their observations and photographs: Greg Allen, Lisa Arensen, Arthur Anker, Benjamin Barca, Gerard Chartier, Stéphane De Greef, Jack Highwood, Jeremy Holden, Hervé Janody, Daniel R. Jump, Oleg Kosterin, A. Gomez-Monge (Marduk), Laurent Masseur, Klaus Wilhelm Meier-Doernberg (Akoo Ibiza), Oyen Rodriguez, Richard Seaman, Eddie Smith, Andrey Sochivko.

Mrs Somaly Chan (Ministry of Environment of the Kingdom of Cambodia) is thanked for her help with the joint collecting trip of RUPP and RBINS and Dr Patrick Grootaert (RBINS) for his support to the joint collecting trip financed by RBINS (Entomology). Dr Vincent Sougnez (Lusigny-sur-Barse, France) is thanked for volunteering during the trip and providing a short formation to students on reptiles, and the students of Cambodian Entomology Initiative, Mssrs Sisonila Kangsun, Kimhuor Suor, Moeun Chhum, Sokchan Lorn, Kang Ly and Chhenghong Choeurn are thanked for their unlimited enthusiasm during the fieldwork. This study has also benefited from funds of the European Union for a visit to the collections of the NHRS by the first author (Synthesys project).

Finally we would like to thank particularly Species 2000-ITIS consortium for its funding support and Angel Anta, our IT-ingeneer, who re-organized DBTNT to allow a faster and easier databasing and management of photos in FLOW.

### References

- BIODIVERSITY HERITAGE LIBRARY: <http://www.biodiversitylibrary.org/> [accessed 15 September 2015].
- BOURGOIN T., 1997. - Habitat and ant-attendance in Hemiptera : a phylogenetic test with emphasis on trophobiosis in Fulgoromorpha. In Grancolas P. (ed), The origin of Biodiversity in Insects: phylogenetic tests of evolutionary scenarios. *Mémoire du Muséum national d'Histoire naturelle* 173: 109-124.
- BOURGOIN T., 2016. - FLOW (Fulgoromorpha Lists on The Web): A world knowledge base dedicated to Fulgoromorpha. V.8, updated [accessed 5 January 2016]. <http://hemiptera-databases.org/flow/>
- CONSTANT J., 2010. - The lanternfly genus *Penthicodes*: key to the species and review of the “*Ereosoma* group” with two new species and one new subspecies (Hemiptera: Fulgoromorpha: Fulgoridae). *Zootaxa* 2523: 1-26.
- CONSTANT J., 2015a. - The Lanternfly genus *Polydictya* (Hemiptera: Fulgoromorpha: Fulgoridae) from Sulawesi and neighbouring islands, with the description of three new species. *European Journal of Taxonomy* 110: 1-19. <http://dx.doi.org/10.5852/ejt.2015.110>
- CONSTANT J., 2015b. - Review of the *effusus* group of the Lanternfly genus *Pyrops* Spinola, 1839, with one new species and note on trophobiosis (Hemiptera: Fulgoromorpha: Fulgoridae). *European Journal of Taxonomy* 128: 1-23. <http://dx.doi.org/10.5852/ejt.2015.128>
- CONSTANT J. & PHAM H.T., 2008. - A new species of *Polydictya* from Vietnam (Hemiptera, Fulgoromorpha, Fulgoridae). *Nouvelle Revue d'Entomologie (N.S.)*, 25 (1) : 27-31.
- LALLEMAND V., 1960. - De quibusdam fulgoris. *Entomologische Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum Hamburg* 24: 1-7.
- LALLEMAND V., 1963. - Révision des Fulgoridae (Homoptera). Deuxième partie. faunes asiatique et australienne. *Mémoires de l'Institut royal des Sciences naturelles de Belgique* (2e série) 75: 1-99, pl. 1-11.
- LIANG A.-P., 1998 - Nomenclatorial notes on the Oriental lanternfly genus *Pyrops* Spinola (Hemiptera: Fulgoroidea: Fulgoridae). *Acta Zootaxonomica Sinica* 23(1): 41-47.
- METCALF Z.P., 1947. - *General Catalogue of the Homoptera. Fascicle IV Fulgoroidea. Part 9 Fulgoridae*. Raleigh (U.S.A.) North Carolina State College, 280 pp.
- NAGAI S. & PORION T., 1996. - *Fulgoridae 2: Catalogue illustré des faunes asiatique et australienne*. Sciences Nat, Compiègne, 80 pp., 236 figs.
- NASKRECKI P. & NISHIDA K., 2007. - Novel trophobiotic interactions in lantern bugs (Insecta: Auchenorrhyncha: Fulgoridae). *Journal of Natural History*, 41(37-40): 2397-2402.  
Doi: 10.1080/00222930701633570
- PHAM H.T., 2011. - A checklist of the family Fulgoridae (Homoptera: Auchenorrhyncha: Fulgoroidea) from Vietnam. *Proceedings of the 3rd National Scientific Conference On Ecology and Biological Resources Hanoi, 22 October 2009*: 317-321.
- PROJECT NOAH website: <http://www.projectnoah.org/> [accessed 15 September 2015]
- ROTH L. & NASKRECKI P., 2001. - Trophobiosis between a blatellid cockroach (*Macrophylldromia* spp.) and fulgorids (*Enchophora* and *Copidocephala* spp.) in Costa Rica. *Journal of Orthoptera Research*, 10: 189-194.
- STÄL C., 1863. - Hemipterorum exoticorum generum et specierum nonnullarum novarum descriptiones. *Transactions of the Entomological Society of London* (3), 1: 571-603.  
<http://biodiversitylibrary.org/page/32121525>