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### The Oriental lanternfly *Pyrops itoi* (Satô & Nagai, 1994): New synonymy and distribution records (Hemiptera: Fulgoromorpha: Fulgoridae)

Jérôme CONSTANT<sup>1</sup> & Kawin JARANAIKUL<sup>2</sup>

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

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

<sup>2</sup> Rabbit in the Moon Foundation, 399, Village No. 3, Suan Phueng, Ratchaburi, 70180, Thailand.

E-mail: [kawin2127@gmail.com](mailto:kawin2127@gmail.com)

urn:lsid:zoobank.org:author:E70BBC6F-D963-4EA9-9109-933DD4C83CC8



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Front cover: *Pyrops itoi* (Satô & Nagai, 1994). Thailand, Phetchaburi, Kaeng Krachan National Park, 23.III.2013. © N. Phansuwan.

# The Oriental lanternfly *Pyrops itoi* (Satô & Nagai, 1994): New synonymy and distribution records (Hemiptera: Fulgoromorpha: Fulgoridae)

Jérôme CONSTANT<sup>1</sup> & Kawin JIARANAISAKUL<sup>2</sup>

<sup>1</sup> Royal Belgian Institute of Natural Sciences, O.D. Phylogeny and Taxonomy, Entomology, Vautier street 29, B-1000 Brussels, Belgium. E-mail: [jerome.constant@naturalsciences.be](mailto:jerome.constant@naturalsciences.be) (corresponding author)  
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<sup>2</sup> Rabbit in the Moon Foundation, 399, Village No. 3, Suan Phueng, Ratchaburi, 70180, Thailand.  
E-mail: [kawin2127@gmail.com](mailto:kawin2127@gmail.com)  
urn: lsid:zoobank.org:author:E70BBC6F-D963-4EA9-9109-933DD4C83CC8

## Abstract

*Pyrops itoi* (Satô & Nagai, 1994), described from Malaysia is fully redescribed and proposed as a senior synonym of *Pyrops shiinaorum* Nagai & Porion, 2002, described from northern Thailand. The male genitalia of the species are illustrated and described for the first time. Numerous new distribution records are given and documented with specimens or photographs, allowing the extension of the range of the species to Cambodia, China, and Vietnam. Diagnostic characters allowing easy recognition of the species, a distribution map and the first records of host trees (in the families Sapindaceae and Lecythidaceae) are provided.

**Keywords:** Indochina, Fulgoroidea, Lanternfly, planthopper, *Pyrops cultellatus*

## Introduction

The genus *Pyrops* Spinola, 1839 is widely distributed in Southeast Asia and currently contains nearly 70 species (BOURGOIN, 2020). *Fulgora itoi* Satô & Nagai, 1994 was described from a single female collected by Ken Ito in the Cameron Highlands in Malaysia (SATÔ & NAGAI, 1994). The placement in *Fulgora* L., 1767 was obviously wrong and NAGAI & PORION (1996) transferred the species to the genus *Saiva* Distant, 1906 but without any justification. The question of the identity of *Fulgora* had been resolved by the *Opinion* 322 of the International Commission of Zoological Nomenclature long before (ICZN, 1955), and the genus contains the Neotropical “peanut-headed” lanternflies. Later, LIANG (1998) transferred the species to the genus *Pyrops* but again without any explanation, and without considering NAGAI & PORION’S (1996) work. Another species, *Pyrops shiinaorum* Nagai & Porion, 2002 was shortly described by NAGAI & PORION (2002) from a series of specimens from Wiang Pa Pao, Chiang Rai, Thailand. This description did not contain illustration of male genitalia and the species was compared with *P. itoi*, of which the authors state that “the shape of its cephalic development is very different”, without any detail on these differences. The examination of the holotype of each of the two species did not allow us to find any difference in the shape of the cephalic process or any other characters and we consider them as synonyms. Furthermore, recent results from our fieldwork and photograph mining from different websites, notably from Facebook social network groups, have led to fill the distribution gap between the two type localities and to the addition of China, Cambodia and Vietnam to the distribution of *P. itoi*.

The present paper aims to fully redescribe *P. itoi*, to propose *P. shiinaorum* as a junior synonym and to provide illustrations of habitus and of the male genitalia of the species for the first time, and new records based on collection specimens and photographs in the field, biological data and a distribution map.

## Material and methods

The male genitalia were extracted after boiling the abdomen some 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 corresponding specimen. The photographs of collection specimen were taken with a Canon 700D camera equipped with a Sigma 50 mm Macro lens; a Leica EZ4W stereomicroscope with integrated camera was used for the male genitalia photographs. The stacking was done with CombineZ software and optimized with Adobe Photoshop CS3. Several distribution data and pictures were gathered from posted on the internet, notably on the social network Facebook. The map was produced with SimpleMappr (SHORTHOUSE, 2010).

The morphological terminology for the male genitalia follows BOURGOIN & HUANG (1990). The measurements were taken as in CONSTANT (2004) with the additions of CONSTANT (2015) for the genus *Pyrops* and the following abbreviations are used:

BF	=	maximum breadth of the frons
BTg	=	maximum breadth of the tegmen
BPrH	=	breadth of the cephalic process at half length
LF	=	length of the frons in median line (excluding cephalic process)
LPr	=	length of the cephalic process
LTg	=	maximum length of the tegmen
TL	=	total length (apex of head to apex of tegmina)

(LF, LPr and TL measured to/from anteocular carina at the base of the cephalic process)

Acronyms used for the collections:

EUM	=	Entomological Laboratory, Ehime University, Matsuyama, Japan
KUKPS	=	Department of Entomology, Faculty of Agriculture, Kasetsart University Kamphaeng Saen Campus, Nakhon Pathom, Thailand
RBINS	=	Royal Belgian Institute of Natural Sciences, Brussels, Belgium
VNMN	=	Vietnam National Museum of Nature, Hanoi, Vietnam.

## Taxonomy

**Order Hemiptera Linnaeus, 1758**  
**Suborder Auchenorrhyncha Duméril, 1806**  
**Infra-order Fulgoromorpha Evans, 1946**  
**Superfamily Fulgoroidea Latreille, 1807**  
**Family Fulgoridae Latreille, 1807**

**Genus *Pyrops* Spinola, 1839**

*Pyrops* SPINOLA, 1839: 231.

TYPE SPECIES: *Pyrops candelaria* (Linnaeus, 1758) by subsequent designation by DUPONCHEL (1840: 200).

*Hotinus* AMYOT & SERVILLE, 1843: 490 [synonymized by BLANCHARD 1845: 425].

TYPE SPECIES: *Pyrops candelaria* (Linnaeus, 1758) by original designation.

See also CONSTANT (2015) for a historical review of the genus-level nomenclature of *Pyrops*.

DIAGNOSTIC CHARACTERS. The definition of the genus given by CONSTANT (2015) is followed: head with cephalic process, sometimes very long, narrowing progressively beyond the eyes; apically it can be dilated or even spherical. Vertex about 4 times as broad as an eye. Before eyes, genae truncate with a transverse carina which sometimes extends to vertex. Two longitudinal carinae on frons, a third median one starting on base of cephalic process. Frontoclypeal suture usually slightly bisinuate; median carina on clypeus. Pronotum with median carina (sometimes obsolete) and a small but strongly impressed point on each side of it. Mesonotum with median and peridiscal carinae, sometimes obsolete. Tegmina at most 3 times as long as broad, with apical margin more or less rounded and with transverse veinlets on all surfaces. Clavus open and elongate, vein Pcu+A1 extending far towards apex. Legs slender.

***Pyrops itoi* (Satô & Nagai, 1994)**  
(Figs 1–7)

*Fulgora itoi* SATÔ & NAGAI, 1994: 310 [described]; figs 5, 11 [holotype cephalic process and habitus].

*Saiva itoi* NAGAI & PORION, 1996: 23 [catalogued; transferred to *Saiva* Distant, 1906]; pl. 10: fig. 135 [holotype habitus].

*Pyrops shiinaorum* NAGAI & PORION, 2002: 6 [described]; pl. 2: fig. 11 [paratype habitus]. Holotype in EUM. **syn. nov.**

*Pyrops shiinaorum* – HUTACHARERN *et al.*, 2007: 88 [listed].

NOTE. The caption of the fig. 11 of *Pyrops shiinaorum* in NAGAI & PORION (2002) erroneously mentions that the specimen originates from Borneo, Crocker Range while the description section clearly mentions that the entire type series originates from northern Thailand.

DIAGNOSIS. The species can be separated from all other species of *Pyrops* by the following combination of characters:

- (1) cephalic process elongate and narrow but subcylindrical in cross-section and not laterally flattened; smoothly and regularly curved dorsally (Fig. 1D–E);
- (2) head green (Fig. 1D–E);
- (3) posterior wings bright yellow (Fig. 1A);
- (4) tegmina entirely light green with yellow spots (Fig. 1A–C).

DIFFERENTIAL DIAGNOSIS. The closest species is *Pyrops cultellatus* (Walker, 1857), which is known from its nominal subspecies from Borneo and from the subspecies *P. cultellatus yoshiakii* Nagai & Porion, 2002 from Peninsular Malaysia and Sumatra (NAGAI & PORION, 2002; see illustrations pl. 2, figs 9–10). It can be separated from *P. itoi* by characters (1): the cephalic process of *P. cultellatus* is laterally flattened from the middle to the apex (slender and round in *P. itoi*) and (2): *P. cultellatus* shows the black lines over eyes extending from antecular carina to half of cephalic process (no black line or only very short black line on antecular carina in *P. itoi*).

MATERIAL EXAMINED. TYPE MATERIAL. MALAYSIA: Holotype ♀ of *Pyrops itoi* (Fig. 2): [Malaysia, Pahang, Tanah-Rata, Cameron Highlands, IV.1990 at light, Ken Ito], [Holotype *Fulgora itoi*, M. Sato et S. Nagai, 1994], [EUM type No. 733] (EUM).

THAILAND: Holotype ♂ of *Pyrops shiinaorum* (Fig. 3): [Wiangpapao, Chiang Rai, N. Thailand, May 1996], [Holotype ♂ *Pyrops shiinaorum*, Nagai & Porion, 2002] (EUM).

ADDITIONAL MATERIAL. THAILAND: 1♂: Nakhon Si Thammarat, Khao Nan National Park, 8°46'02.4"N 99°46'51.5"E, 11.III.2008, leg. N. Pinkaew (KUKPS); 1♀ (Fig. 1): Khao Soi Dao Wildlife Sanctuary, 13°05'N 102°10'E, V.2012, leg. Noppadon Makbun, I.G.: 32.186 (RBINS).

VIETNAM: 2♂♂, 1♀ (Fig. 4C): Cat Tien National Park, 11°26'N 107°26'E, 6–16.VII.2012, leg. J. Constant & J. Bresseel, I.G.: 32.161 (RBINS); 1♂: Phu Ly, Vinh Cuu, 11°22'31"N 107°08'36"E, 1.VIII.2008, leg. H.T. Pham, VC.Ho.0778, Fu.0066 (VNMN).

MATERIAL EXAMINED FROM PHOTOGRAPHS. CAMBODIA: 1 ex. (Fig. 4A): Koh Kong Province, Tatai, 1.IV.2016, G. Chartier.

CHINA: 1 ex. (Fig. 4B): Yunnan Province, Xishuangbanna Tropical Botanical Garden, 20.V.2016, W. Cheng.



Fig. 1. *Pyrops itoi* (Satô & Nagai, 1994), female from Thailand, Khao Soi Dao Wildlife Sanctuary (RBINS). A, habitus, dorsal view. B, habitus, ventral view. C, habitus, lateral view. D, head and thorax, lateral view. E, head, anteroventral view perpendicular to frons. D–E not to scale. © J. Constant.

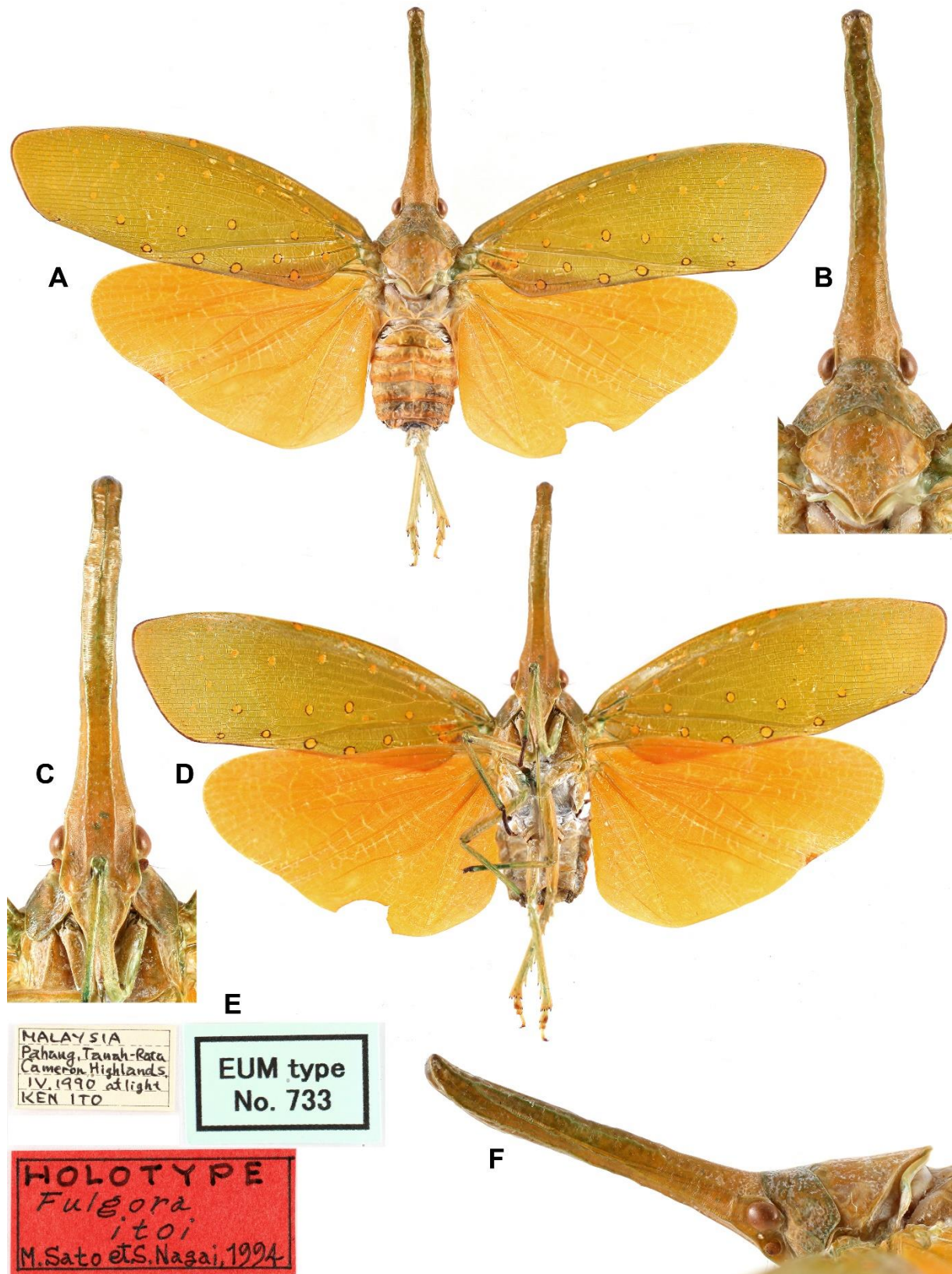


Fig. 2. *Pyrops itoi* (Satô & Nagai, 1994), female holotype (EUM). A, habitus, dorsal view. B, head and thorax, dorsal view. C, head, anteroventral view perpendicular to frons. D, habitus, ventral view. E, labels. F, head and thorax, lateral view. © J. Constant.

THAILAND: 1 ex. (Fig. 5A): Chanthaburi, Klong Paiboon Waterfall, 13.V.2014, on *Barringtonia racemosa*, P. Dawwrueng; 1 ex. (Fig. 5K): Chaiyaphum, Phu Khieo Wildlife Sanctuary, 25.III.2018, P. Saisawatdikul; 1 ex. (Fig. 5B): Chiang Mai, Doi Suthep-Pui National Park, 15.V.2017, P. Katsura; 1 ex. (Fig. 5C): Chiang Mai, Doi Suthep-Pui National Park, 28.VII.2019, P. Katsura; 1 ex. (Fig. 5D): Nakhon Ratchasima, Khao Yai National Park, 31.VII.2015, R. Hongsaeng; 1 ex. (Fig. 5E): Nakhon Ratchasima, Khao Yai National Park, 26.VI.2017, C. Tangpradit; 1 ex. (Fig. 5F): same location, 22.VI.2018, W. Chinosoeng; 1 ex. (Fig. 5G): same location, 8.VIII.2019, W.Chinosoeng ; 1 ex. (Fig. 5H): Nakhon Ratchasima, Sakaerat Environmental Research Center, 3.VI.2015, V. Lauhachinda; 1 ex. (Fig. 5I): Phetchaburi, Kaeng Krachan National Park, 23.III.2013, N. Phansuwan; 2 ex. (Fig. 5M): Ratchaburi, Khao Krachom, 27.VII.2020, B. Wongdee; 6 ex. (Fig. 5L): Tak, Thi Lo Su National Park, 27.IV.2019, P. Juytuan; 1 ex. (Fig. 5J): Uthai Thani, Huai Kha Kaeng Wildlife Sanctuary, 20.V.2011, P. Srisom.

VIETNAM: 1 ex. (Fig. 4C): Cat Tien National Park, 6–16.VII.2012, J. Constant. 1 ex. (Fig. 4D): same location, 1.V.2016, J. Holden.



Fig. 3. *Pyrops shiinaorum* Nagai & Porion, 2002, male holotype (EUM). A, habitus, dorsal view. B, labels. © H. Yoshitomi.

#### REDESCRIPTION. Measurements and ratios:

TL: ♂ (n = 4): 27.7 mm (26.3–28.6); ♀ (n = 2): 33.7 (33.5–33.9); TL+process: ♂ (n = 4): 38.3 mm (35.1–41.0); ♀ (n = 2): 45.6 (45.3–45.9); LTg/BTg = 3.03; BF/BPrH = 2.66; LPr/LF = 3.62; LPr/BPrH = 15.37.



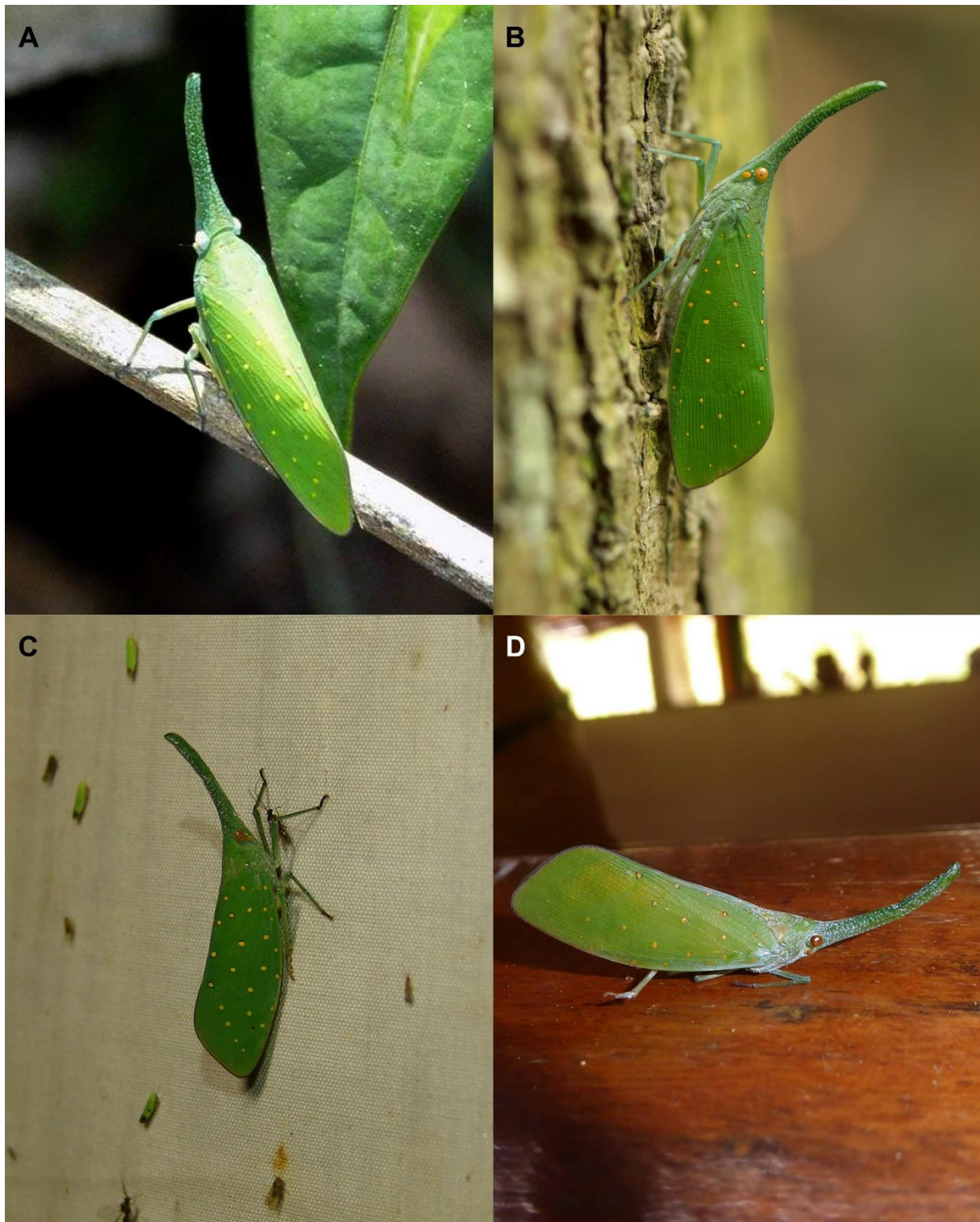


Fig. 4. *Pyrops itoi* (Satô & Nagai, 1994) in nature. A, Cambodia, Koh Kong Province, Tatai, 1.IV.2016. © G. Chartier. B, China, Xishuangbanna Tropical Botanical Garden, 20.V.2016. © W. Cheng. C, Vietnam, Cat Tien National Park, 6–16.VII.2012. © J. Constant. D, Vietnam, Cat Tien National Park, 1.V.2016. © J. Holden.

**Head:** green; rarely with very short black line over eyes; eyes and antennae dark yellow; clypeus paler than frons with smooth median carina (Fig. 1E). Cephalic process elongated, narrow and slightly curved; not laterally flattened (Fig. 1C–D); more than 2 times as long as frons and clypeus combined in perpendicular view of frons (Fig. 1E). Two longitudinal carinae on frons extending on sides of cephalic process up to apex; median, ventral carina on apical half of cephalic process (Fig. 1E). Frons subquadrate.

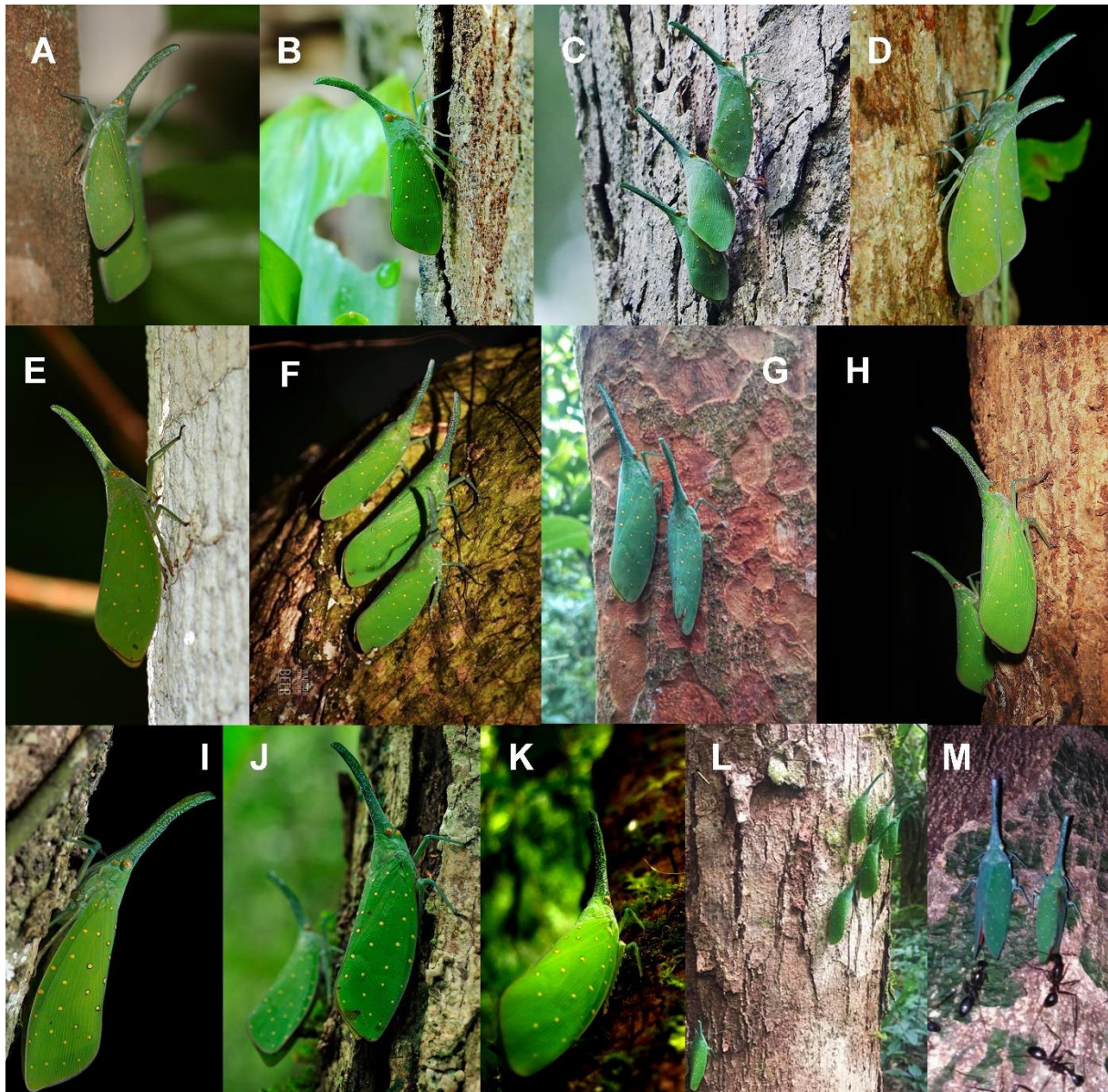


Fig. 5. *Pyrops itoi* (Satô & Nagai, 1994) in nature in Thailand. A, Chanthaburi, Klong Paiboon Waterfall, 13.V.2014. © P. Dawwrueng. B, Chiang Mai, Doi Suthep – Pui National Park, 15.V.2017. © P. Katsura. C, Chiang Mai, Doi Suthep – Pui National Park, 28.VII.2019. © P. Katsura. D, Nakhon Ratchasima, Khao Yai National Park, 31.VII.2015. © R. Hongsaeng. E, Nakhon Ratchasima, Khao Yai National Park, 26.VI.2017. © C. Tangpradit. F, Nakhon Ratchasima, Khao Yai National Park, 22.VI.2018. © W. Chinoaseng. G, Nakhon Ratchasima, Khao Yai National Park, 8.VIII.2019. © W.Chinoaseng. H, Nakhon Ratchasima, Sakaerat Environmental Research Center, 3.VI.2015. © V. Lauhachinda. I, Phetchaburi, Kaeng Krachan National Park, 23.III.2013. © N. Phansuwan. J, Uthai Thani, Huai Kha Kaeng Wildlife Sanctuary, 20.V.2011. © P. Srisom. K, Chaiyaphum, Phu Khieo Wildlife Sanctuary, 25.III.2018. © P. Saisawatdikul. L, Tak, Thi Lo Su National Park, 27.IV.2019. © P. Juytuan. M, Ratchaburi, Khao Krachom, 27.VII.2020. © B. Wongdee.

**Thorax:** (Fig. 1A, C–E) pronotum greenish yellow. Mesonotum, lateral and ventral tergites of mesothorax pale yellow or greenish yellow in live specimens. Pro- and mesonotum slightly wrinkled; carinae of pro- and mesonotum well marked. Tegulae green.

**Tegmina:** (Fig. 1A) green with sparse yellow spots, some spots with black rim. Tegmina elongate, broadening from base towards apex, rather narrow, with costal margin broadly rounded; apical margin oblique and apical angles slightly sharp.

**Hind wings:** (Fig. 1A) bright yellow. Strongly broader than tegmina.

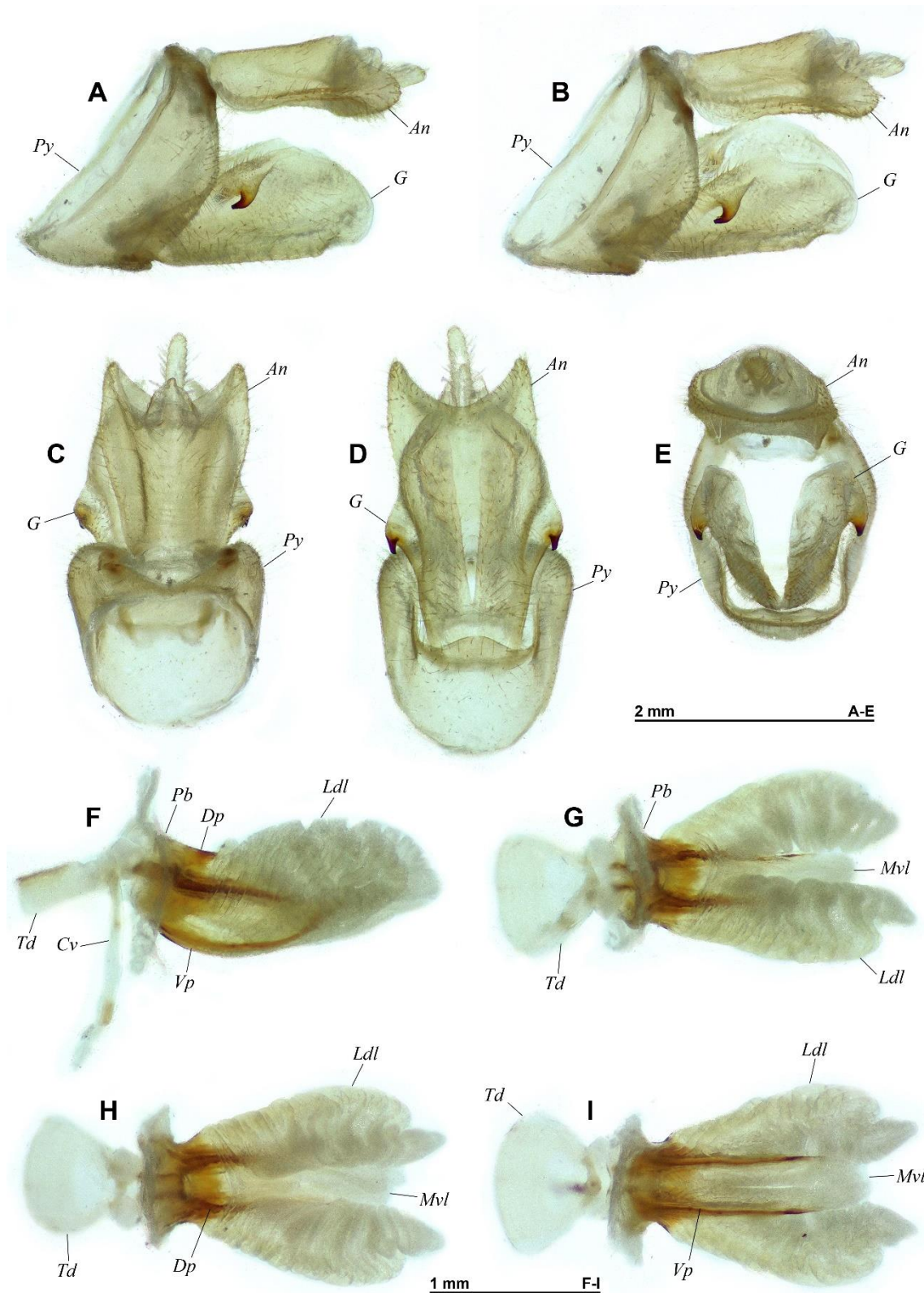


Fig. 6. *Pyrops itoi* (Satô & Nagai, 1994), male genitalia, specimen from Cat Tien N.P., Vietnam (RBINS). A, pygofer, anal tube and gonostyli, lateral view. B, pygofer, anal tube and gonostyli, laterodorsal view. C, pygofer, anal tube and gonostyli, dorsal view. D, pygofer, anal tube and gonostyli, ventral view. E, pygofer, anal tube and gonostyli, caudal view. F, aedeagus, lateral view. G, aedeagus, laterodorsal view. H, aedeagus, dorsal view. I, aedeagus, ventral view. © J. Constant.

An: anal tube – Cv: connective – Dp: dorsal process – G: gonostylus – Ldl: laterodorsal lobe of phallus – Mvl: medioventral lobe of phallus – Pb: phallobase – Py: pygofer – Td: tectiductus – Vp: ventral process.

Legs: (Fig. 1B) all legs pale green; tibiae same color or darker than corresponding femur; tarsi dark brown; coxae yellow. Metatibiae with 5-6 lateral spines.

Abdomen: (Fig. 1A–B) terga yellowish orange; sterna pale yellow; genital segments pale yellow.



Fig. 7. *Pyrops itoi* (Satô & Nagai, 1994), distribution map.

*Male genitalia*: pale yellow. Pygofer (*Py*) higher than long, with posterior margin angularly rounded at mid-height (Fig. 6A). Gonostyli (*G*) (Fig. 6A–B, D–E) elongate, 2.3 times longer than high in lateral view, with posterior margin rather narrowly rounded, not surpassing apex of anal tube; lateral hooks of gonostyli short and blunt, directed lateroventrally at base then strongly curved and pointing anteriorly (Fig. 6A–B, D–E). Tectiductus (*Td*) rather short, curved in cross-section, subtriangular and with distal margin broadly rounded; connective (*Cv*) elongate and narrow (Fig. 6F–I). Phallobase (*Pb*) short with two narrow, straight, elongate dorsal processes (*Dp* – Fig. 6F–H) and two narrow, elongate ventral processes (*Vp*) curved dorsally (Fig. 6F, I). Phallus membranous with two large laterodorsal lobes (*Ldl*) with internodistal process (Fig. 6 F–I) and two narrow, elongate medioventral lobes (*Mvl*) fused basally (Fig. 6G–I). Anal tube (*An*) elongate (Fig. 6A–C), 1.34 times longer than broad in dorsal view, broader at 3/4 of total length (Fig. 6C); lateral margins broadly rounded along distal 2/3, very slightly sinuate towards base in dorsal view (Fig. 6C); apical margin strongly notched in dorsal view (Fig. 6C).

DISTRIBUTION. Peninsular Malaysia, Thailand, Cambodia (**new country record**), China: Yunnan (**new country record**), Vietnam (**new country record**) (Fig. 7).

BIOLOGY. This species was observed on *Barringtonia racemosa* (L.) Spreng. (Lecythidaceae) in Thailand, Chanthaburi Province and on *Dimocarpus longan* Lour. (Sapindaceae) in Doi Suthep-Pui National Park in dry evergreen forest (N. Makbun pers. comm., 2020). Adults were observed from March to August according to the available data. In Cat Tien National Park in Vietnam, the species was observed in tropical rainforest and one specimen came to a light trap (J. Constant pers. obs.).

## Discussion

The present paper synonymizes *Pyrops shiinaorum* as a junior synonym of *P. itoi* and provides a number of new records of geographical range, host plants and temporal distribution for the species. Within the genus *Pyrops*, the most similar species is *Pyrops cultellatus* (Walker, 1857), with its nominal subspecies from Borneo and the subspecies *P. cultellatus yoshiakii* Nagai & Porion, 2002 from Peninsular Malaysia and Sumatra. The two species can easily be differentiated by characters of the head and cephalic process, but they share the green colour of the head, thorax and tegmina with small yellow or orange spots on the tegmina, and the uniformly bright orange (with variation from bright yellow to red) colour of the posterior wings. Moreover, *P. itoi* and *P. cultellatus yoshiakii* live sympatrically in Peninsular Malaysia, e.g. in Cameron Highlands. The geographical distribution of these taxa, forming a continuum, as well as their shared colour pattern, pleads for them forming a species-group within *Pyrops* but we conservatively do not define it here until this view is confirmed by molecular data. According to the currently known distribution, the presence of *P. itoi* can be expected in Laos and Myanmar. The data gathered from nature photographers or “citizen scientists” revealed a much wider distribution range for this species than could be estimated from collection specimens only. Additionally, the collaboration with relevant authorities is absolutely necessary, especially to access protected areas such as national parks and wildlife sanctuaries to enable further study and gather valuable data such as additional host plants, life-history and phenology.

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