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The new polillensis group in the lanternfly genus Pyrops: Taxonomy, distribution and host plant (Hemiptera: Fulgoridae)

Sheryl A. YAP[1], Ace Kevin S. AMARGA[2] & Jérôme CONSTANT[3]

[1] Institute of Weed Science, Entomology and Plant Pathology, College of Agriculture and Food Science, and Museum of Natural History, University of the Philippines Los Baños, Los Baños, Laguna 4031 Philippines (e-mail: sayap3@up.edu.ph)
[2] Environmental Forestry Program, College of Forestry and Natural Resources, University of the Philippines Los Baños, Los Baños, Laguna 4031 Philippines (e-mail: ace_amarga061@yahoo.com)
[3] 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, corresponding author)
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Front cover: *Pyrops polillensis* (Baker, 1925) in nature, Luzon, Mt Makiling, 12.VII.2016, disturbed specimen with wings open (photograph by R. Ruzol).

The new *polillensis* group in the lanternfly genus *Pyrops*: Taxonomy, distribution and host plant (Hemiptera: Fulgoridae)

Sheryl A. YAP[1], Ace Kevin S. AMARGA[2] & Jérôme CONSTANT[3]

1 Institute of Weed Science, Entomology and Plant Pathology, College of Agriculture and Food Science, and Museum of Natural History, University of the Philippines Los Baños, Los Baños, Laguna 4031 Philippines (e-mail: sayap3@up.edu.ph)
2 Environmental Forestry Program, College of Forestry and Natural Resources, University of the Philippines Los Baños, Los Baños, Laguna 4031 Philippines (e-mail: ace_amarga061@yahoo.com)
3 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, corresponding author)
urn:lsid:zoobank.org:author:6E6072A1-9415-4C8D-8E60-2504444DB290

Abstract

The *polillensis* group of *Pyrops* Spinola, 1839 is defined to include two Philippine species: *P. polillensis* (Baker, 1925) and *P. samaranus* (Baker, 1925) and a key to the species groups of *Pyrops* is given. *Pyrops samaranus* is reinstated as a good species from status of junior synonym of *P. polillensis* and *P. silighinii* Porion & Audibert, 2017 is proposed as a junior synonym of *P. samaranus*. An identification key is given and the male genitalia described for the first time. New distribution records are provided and *P. samaranus* is recorded for the first time from Leyte and Mindanao. The association of *P. polillensis* with *Dracontomelon dao* (Blanco) Merr. & Rolfe (Anacardiaceae) is documented, providing the first record of a host plant for a Philippine species of *Pyrops*.

Keywords: Lanternfly, Fulgoromorpha, Polillo, Philippines, Southeast Asia

Introduction

The lanternfly genus *Pyrops* Spinola, 1839 (Hemiptera: Fulgoromorpha: Fulgoridae) is widely distributed in Southeast Asia, from "Sri Lanka to the Himalayas (north India, south China), eastwards to Taiwan and Vietnam, and southwards to Sulawesi and neighbouring islands through Indonesia and the Philippines" (CONSTANT, 2015). It contains 67 species (BOURGOIN, 2017) which were distributed in species groups by different authors, based on the colour of the posterior wings (BUTLER, 1874; ATKINSON, 1885; DISTANT, 1906) or on characters of the cephalic process (BAKER, 1925; LALLEMAND, 1963). NAGAI & PORION (1996) followed LALLEMAND's (1963) view which proposed 5 species groups. Those species groups have no taxonomic value but are provisionally used to provide a clearer view of the species grouping while waiting for the establishment of more formal taxonomic ranks as genus or subgenus in the future.

Few host-plants are known but mostly Sapindales (BOURGOIN, 2017), although this could be an artefact due to the fact that the latter mostly concern cultivated trees which are easily identified. Interesting trophobiosis behaviours were also reported with cockroaches and geckos (CONSTANT, 2015).

Although the Philippines are composed of more than 7,600 islands and considered as one of the megadiversity hotspots with a great variety of habitats (AMBAL *et al*., 2012), only 21 species of Fulgoridae are recorded from the Archipelago, representing less than 3% of the specific richness of the family. The taxonomy and biology of the group remain also very poorly known.
The genus *Pyrops* is the best represented in the country and includes 12 species: *P. aeruginosus* (Stål, 1870), *P. agusanensis* (Baker, 1925), *P. fumosus* (Baker, 1925), *P. lautus* (Stål, 1870), *P. maquilinganus* (Baker, 1925), *P. nishiguroi* Nagai, Porion & Audibert, 2017, *P. nishiyamai* Nagai & Porion, 2002, *P. philippinus* (Stål, 1870), *P. polillensis* (Baker, 1925), *P. priscilliae* Nagai, Porion & Audibert, 2016, *P. silighinii* Porion & Audibert, 2017 and *P. zephyrius* (Schmidt, 1907).

However, a critical review of the historical taxonomy of *P. polillensis* revealed that *P. samaranus*, considered as a junior synonym (NAGAI & PORION, 1996), is actually a good species, which appears to be a senior synonym of the recently described *P. silighinii* Porion & Audibert, 2017. Moreover, the two species are closely related and different enough from the other species in the genus to even justify the definition of a new species group to include them.

Host-plants were unknown for any species of Philippine Fulgoridae until the recent paper of CONSTANT & ALISTO (2015) who provided the first data for *Penthicodes astraea* (Stål, 1864) and *Scamandra hermione* Stål, 1864 and still nothing was known for the spectacular species of *Pyrops*. A recent survey of insects at Mt. Makiling Forest Reserve, Luzon, a well known entomological destination in the Philippines, allowed the surprising discovery of a population of *Pyrops polillensis* (Baker, 1925) and the first identification of a host tree.

The present paper aims therefore to provide a key to the species groups of *Pyrops*, to define the new *Pyrops polillensis* species group and review the taxonomy of both species included, to describe their respective male genitalia and provide an identification key as well as a distribution map. We also provide the first record of a host plant in a Philippine species of *Pyrops*.

Material and methods

Survey and monitoring of insects and their relatives was conducted last July 2016 at Mt. Makiling Forest Reserve, Los Baños, Laguna, Philippines. The lanternflies were collected using insect net and were pinned for further examination. Male genitalia were removed from the abdomen and cleaned with ethanol. Observation and genitalia photographs of *P. polillensis* were done under Leica A60 microscope. A Canon EOS 450D camera was used to take the photos of the insect in nature.
The distribution map was produced with SimpleMappr (SHORTHOUSE, 2010).

Acronyms used for the collections
BMNH = Natural History Museum, London, United Kingdom.
MHNL = Centre de conservation et d'étude des collections, Musée des Confluences, Lyon, France.
RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium.
UPLB = Museum of Natural History, University of the Philippines Los Baños, Philippines.
USNM = National Museum of Natural History, Washington D.C., U.S.A.

Results

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.

The definition of the genus given by CONSTANT (2015) is followed. See this work also for a historical review of the genus-level nomenclature of *Pyrops*.

Identification key to the species groups of Pyrops

The following key is based on LALLEMAND (1963), BAKER (1925), CONSTANT (2015) and CONSTANT & PHAM (2017).

1. Apex of cephalic process narrower than the rest 2
- Apex of cephalic process rounded, slightly to strongly inflated, sometimes coloured differently from the rest of the process, in this case usually bright red or yellow 3

2. Medium-sized species. Cephalic process elongate and slender, narrowing basally, strongly curved dorsad and with apex clearly narrowing and laterally compressed, never red dorsally and yellow ventrally ..... *candelaria* group
- Large-sized species. Cephalic process robust, regularly narrowing from base towards apex, laterally compressed on all length, always red dorsally and yellow ventrally .... *sultanus* group

3. Apex of cephalic process strongly inflated; posterior wings white, violet or blue basally ... 4
- Apex of cephalic process slightly dilated; posterior wings blue basally 5

4. Black area of posterior wings limited to distal half of posterior margin or absent .... *clavatus* group
- Black area of posterior wings extending along all posterior margin ..... *polillensis* group

5. Cephalic process very elongate and slightly curved dorsally, with apex contrasting bright red or yellow ..... *pyrorhynchus* group
- Cephalic process short and strongly curved dorsally, with apex not brightly coloured .... *effusus* group

The *polillensis* species group

CONSTANT (2015) excluded *P. polillensis* (Baker, 1925) from the *clavatus* species group of *Pyrops* without assigning it to another group. It appears now necessary to propose a new species group within *Pyrops* to include the two closely related Philippine species *P. polillensis* and *P. samaranus* (Baker, 1925).
The combination of the following characters is given to define the group:
(1) medium sized species.
(2) cephalic process rather short, slightly longer than the pro- and mesonotum combined, progressively narrowing towards apex and strongly swollen apically (Figs 1 B–D, 5 C–D).
(3) broad black area of the hind wing extending all along the posterior margin (Figs 2 A, 5 A).

DISTRIBUTION. Philippines.

Identification key to the species of the *Pyrops polillensis* group

- Posterior wings with black area along posterior margin progressively narrowing towards posterobasal angle (Fig. 2 A); tegmina uniformly coloured (Fig. 1 B, D); tegmina, pro- and mesonotum covered in white waxy secretion (Fig. 1 A)..... ***Pyrops polillensis*** (Baker, 1925)
- Posterior wings with black area along posterior margin not narrowing towards posterobasal angle (Fig. 5 A); tegmina with broad anteapical brown transverse area followed by narrow black line along apical margin (Fig. 5 A, C); body not covered in white waxy secretion (Fig. 5 A) .....***Pyrops samaranus*** (Baker, 1925)

Pyrops polillensis (Baker, 1925)
(Figs 1–2, 3 A–C, 4)

Fulgora polillensis BAKER, 1925: 361 [keyed; described in the *P. clavatus* group]; pl. 1 fig. 2, pl. 2 fig. 2 [habitus]; pl. 9 fig. 1 [tegmen]; pl. 10 fig. 1 [posterior wing].

Laternaria polillensis – METCALF, 1947: 202 [catalogued].
Fulgora polillensis – LALLEMAND, 1963: 89 [keyed, described, possible synonym of *P. samaranus* (Baker, 1925)].
Pyrops polillensis – NAGAI & PORION, 1996: 26 [catalogued; senior synonym of *P. samaranus* (error)]; pl. 18 fig. 225 [habitus]. – LIANG, 1998: 44 [listed]. – CONSTANT & PHAM, 2017: 2 [historical classification]; 4 [removed from *P. clavatus* group]. – PORION & AUDIBERT, 2017: 1 [compared with *P. silighinii*]; figs 1–2 [habitus and head].

non *Pyrops polillensis* – NAGAI & PORION, 1996: pl. 11 fig. 167 [habitus (erroneously identified specimen of *P. samaranus*)].

TYPE MATERIAL EXAMINED. PHILIPPINES: 2♂♂, 2♀♀ syntypes (examined from photographs, Fig. 1): Island Polillo, Baker (USNM).

ADDITIONAL MATERIAL. PHILIPPINES: 2♂♂, 2♀♀: Luzon, Laguna, Los Baños, Mt Makiling, College of Forestry and Natural Resources' Experimental Station, 12.VII.2016, 430 m, on *Dracontomelon dao*, S. Yap leg. (UPLB) coordinates: 14°08'17.17"N 121°12'20.51"E; 11♀♀: Luzon, Sierra Madre, Aurora, IX.2007 (RBINS) coordinates: 15°37'N 121°21'E; 1♀: Luzon, Cagayan, Santa Ana, V.2014 (RBINS) coordinates: 18°28'N 122°09'E.

Fig. 1. *Pyrops polillensis* (Baker, 1925). A–D, syntypes. A, dorsal view, left to right: female, 2 males, female. B, female, lateral view. C, female, normal view of frons. D, male, lateral view. E, label (photographs by A. Kennedy). F, specimen in nature, Luzon, Isabela, Maconacon Forest, 23.VII.2012 (photograph by O. Ramos).

MATERIAL EXAMINED FROM PHOTOGRAPHS. PHILIPPINES: 1 ex. (Fig. 1 F): Luzon, Isabela, Maconacon Forest, 17°22'27"N 122°08'42"E, 23.VII.2012, O. Ramos.

ADDITIONAL DATA. PHILIPPINES: Polillo, centre of the island (BAKER, 1925) coordinates: 14°52'N 121°56'E; Luzon, Quirino (PORION & AUDIBERT, 2017) coordinates: 16°16′48″N, 121°34′48″ E.

Fig. 2. *Pyrops polillensis* (Baker, 1925) in nature, Luzon, Mt Makiling, 12.VII.2016. A–B, disturbed specimen with wings open. C, pair on trunk of *Dracontomelon dao*. D, *Dracontomelon dao* trees (photographs A–C by R. Ruzol).

MALE GENITALIA. Dark brown with dorsal portion of pygofer and basodorsal portion of gonostyli paler. Pygofer higher than long, with posterior margin slightly sinuate in lateral view (Fig. 3 A). Anal tube slightly elongate, 1.20 times as long as broad, broader at 2/3 of total length (Fig. 3 B); lateral margins slightly sinuate (Fig. 3 B) and apical margin strongly notched in dorsal view (Fig. 3 B). Gonostyli elongate with ventral margin slightly curved and posterior margin rather acutely rounded in lateral view (Fig. 3 A); mediobasal lateral hook projecting lateroventrally and strongly pointed, with a broadly developed basal portion (Fig. 3 A, C).

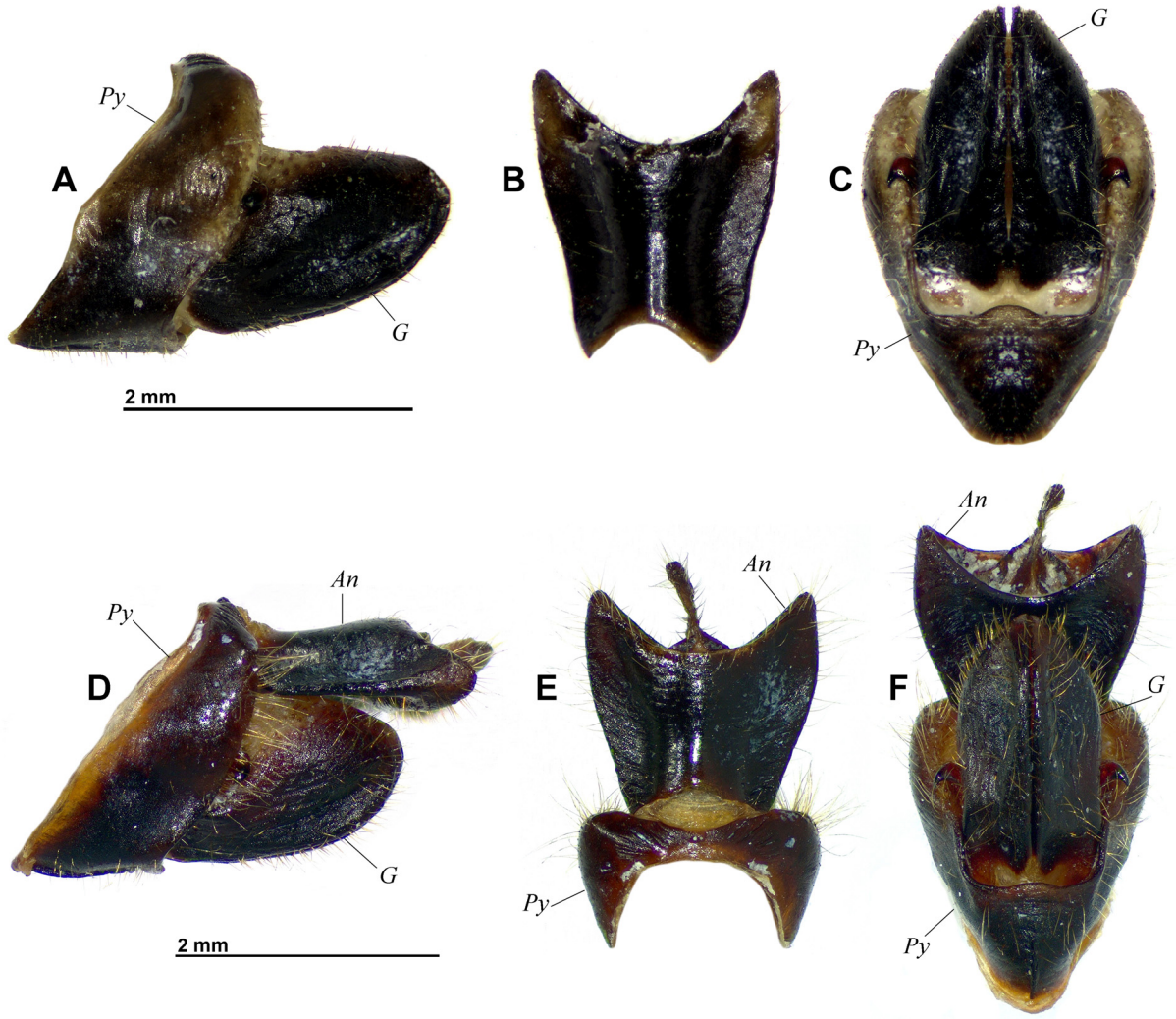

Fig. 3. *Pyrops polillensis* species group, male genitalia. A–C, *Pyrops polillensis*. A, pygofer, anal tube and gonostylus, left lateral view. B, anal tube and pygofer, dorsal view. C, gonostyli and pygofer, posteroventral view. D–F, *Pyrops samaranus*. D, pygofer, anal tube and gonostylus, left lateral view. E, anal tube and pygofer, dorsal view. F, gonostyli and pygofer, posteroventral view. *An*, anal tube – *G*, gonostylus – *Py*, pygofer.

NOTE. BAKER (1925) reported that the species was "common in the forests of central Polillo". Its relation to *P. samaranus* is explained under the latter. The first record of *P. polillensis* outside Polillo was given by NAGAI & PORION (1996: fig. 225) who illustrated a specimen from North Luzon. Recent material in the collections of MHNL, RBINS and UPLB provide a better view of the distribution of the species which appears to be widespread in the eastern part of Luzon. A rather large population was recently observed on a trunk of the hardwood tropical tree *Dracontomelon dao* (Blanco) Merr. & Rolfe (Anacardiaceae) at Mt Makiling (Fig. 2), representing the southernmost record of the species as well as the first record of a host plant. Six pairs were observed on the tree (Fig. 2 C), indicating that July might be the reproduction period of the species. During a second survey of the same tree in September 2017, no specimen was observed.

DISTRIBUTION. Philippines: Luzon and Polillo (Fig. 4).

Fig. 4. *Pyrops polillensis* species group, distribution map in the Philippines.

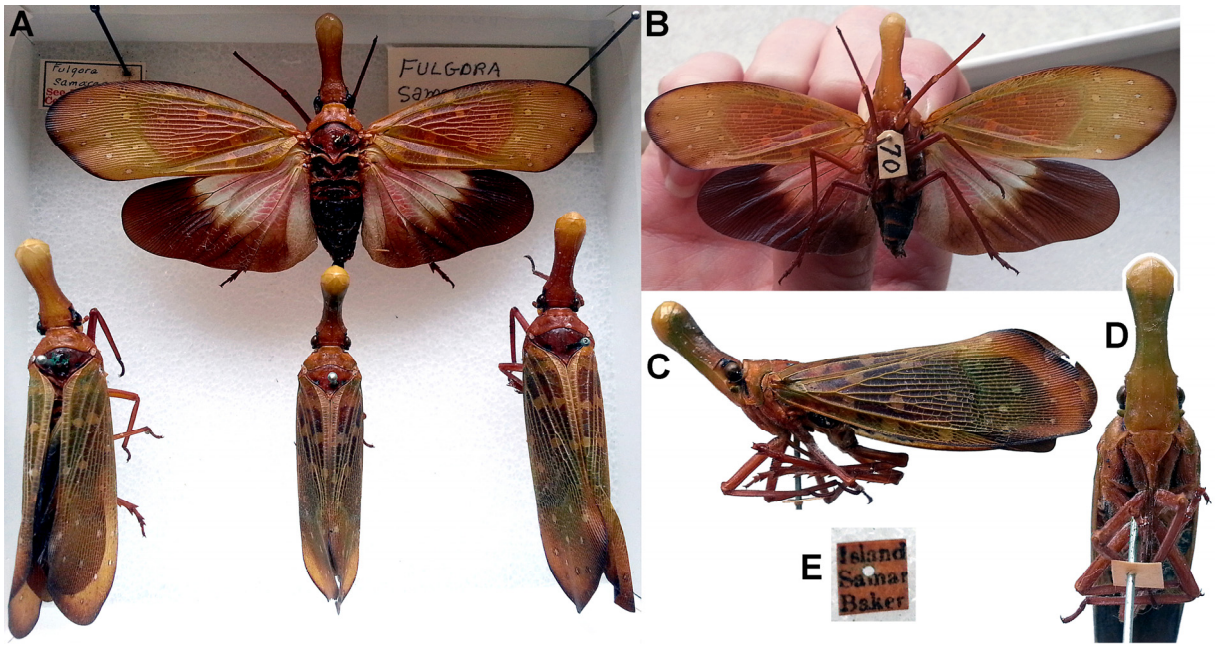

Fig. 5. *Pyrops samaranus* (Baker, 1925) syntypes. A, dorsal view, upper row: female; bottom orw, left to right: female, male, female. B, female, ventral view. C, male, lateral view. D, male, normal view of frons. E, label (photographs by A. Kennedy).

Pyrops samaranus (Baker, 1925) sp. rev.
(Figs 3 D–F, 4–5)

Fulgora samarana BAKER, 1925: 361 [keyed]; 362 [described in the *P. clavatus* group]; pl. 1 fig. 1, pl. 2 fig. 1 [habitus]; pl. 9 fig. 2 [tegmen]; pl. 10 fig. 2 [posterior wing].
Pyrops silighinii PORION & AUDIBERT, 2017: 1 [described]; figs 3–4 [habitus, head] **syn. nov.**

Laternaria samarana – METCALF, 1947: 204 [catalogued].
Fulgora samarana – LALLEMAND, 1963: 89 [keyed, described, possible synonym of *P. polillensis*].
Pyrops samarana – NAGAI & PORION, 1996: 26 [catalogued; junior synonym of *P. polillensis* (error)].
Pyrops samaranus – LIANG, 1998: 45 [listed]. – CONSTANT & PHAM, 2017: 2 [historical classification].

Pyrops polillensis – NAGAI & PORION, 1996: pl. 11 fig. 167 [habitus].

TYPE MATERIAL EXAMINED. PHILIPPINES: 1♂, 3♀♀ syntypes (examined from photographs, Fig. 5): Island Samar, Baker (USNM).

ADDITIONAL MATERIAL. PHILIPPINES: 1♂: Leyte, Mt Balocaue, VIII.2015 (RBINS) coordinates: 10°34'27"N 125°00'44"E; 1♀: Mindanao, Mt Parker, XII.2013 (RBINS) coordinates: 6°06'48"N 124°53'30"E.

ADDITIONAL DATA. PHILIPPINES: Samar, eastern Samar (BAKER, 1925) coordinates: 12°13'N 125°15'E; Mindanao: Sarangani Prov., Kiamba (PORION & AUDIBERT, 2017) coordinates: 6°01'23"N 124°38'02"E.

MALE GENITALIA. Pygofer and anal tube dark brown; gonostyli dark brown, paler at proximodorsal angle. Pygofer higher than long, with posterior margin slightly sinuate in lateral view (Fig. 3 D). Anal tube 1.04 times as broad as long, broader at 2/3 of total length (Fig. 3 E) and strongly surpassing apex of gonostyli in lateral view (Fig. 3 D); lateral margins broadly rounded on distal half (Fig. 3 E) and apical margin strongly notched in dorsal view (Fig. 3 E). Gonostyli moderately elongate with ventral margin slightly curved and apical margin rather broadly rounded in lateral view (Fig. 3 D); mediobasal lateral hook projecting lateroventrally and strongly pointed (Fig. 3 D, F).

NOTE. BAKER (1925) described the species based on "a considerable series" from the forests on the eastern side of Samar Island. He gave a good set of characters allowing the separation of the species from *P. polillensis*. However, LALLEMAND (1963) considered the species as a potential synonym of *P. polillensis*, stating that it could be a local form or the male of the latter. NAGAI & PORION (1996) shared that view and synonymized *P. samaranus* under *P. polillensis*. However, they illustrated, under the same name *P. polillensis*, both species in their catalogue: fig. 167 actually shows a specimen of *P. samaranus* from "the Philippines" without more precision, collected by J.J. Mounsey in the BMNH collections (M. Webb pers. comm., IX.2017). Examination of photographs of syntypes and comparison to the illustrations of the recently described *P. silighinii* in the original description (PORION & AUDIBERT, 2017) combined with the study of a pair of specimens of *P. samaranus* from Mindanao and Leyte in RBINS collections, support the synonymy of *P. silighinii* under *P. samaranus*. The data from the collections of MHNL and RBINS also greatly extend southwards the distribution of the species to Leyte and the southern part of Mindanao.

DISTRIBUTION. Philippines: Samar, Leyte, Mindanao (Fig. 4).

Discussion

A field survey and monitoring in Mt. Makiling in July of 2016 allowed the identification of *Dracontomelon dao* (Blanco) Merr. & Rolfe as a host tree for a group of *P. polillensis*. This tropical tree canopy species is a native one in Cambodia, China, India, Indonesia, Malaysia, Myanmar, Papua New Guinea, Philippines, Solomon Islands, Thailand, and usually found thriving in primary or secondary, tropical lowland evergreen or semi-evergreen rain forest at an altitude of 0–500(–1000) m (ORWA *et al*., 2009). The host association of *P. polillensis* is herein documented for the first time; it also represents a new distribution record. Other distribution records come from recent collections and from citizen-science source. The latter was obtained by browsing the internet and once again confirms the importance of the method to gather original data (see also CONSTANT *et al*., 2016 for similar examples). All *Pyrops* species for which host plants are documented, are polyphagous, although some are known to show a preference for some particular species (e.g. *P. candelaria* on litchi and longan trees (CONSTANT *et al*., 2016) or *P. watanabei* on *Triadica sebifera* (CONSTANT & PHAM, 2017)). The importance of the dao tree, a hardwood species, as host plant for *P. polillensis* still needs to be assessed by further study. Six pairs were observed on the same tree (Fig. 2 C) in July, which might indicate the breeding season of the species at that period of the year. During a second survey of the same tree in September 2017, no specimen was observed.

The recent discovery of *polillensis* on their host plant and observation in the field provide a significant evidence that, although Mt. Makiling is regularly visited by scientists and naturalists, this type locality for so many Philippine taxa remains a spot of higher interest for

the Philippine fauna knowledge. It also underlines how few we still know if we want to protect it efficiently, even for this large and beautiful endemic planthopper species.

Twelve species of *Pyrops* are currently recorded in the Philippines. However, some of them are known from a single specimen collected for more than a century, and have not been recorded ever since (e.g.: *P. aeruginosus* (Stål, 1870), *P. fumosus* (Baker, 1925) and *P. zephyrius* (Schmidt, 1907)). Information on the biology, life history, behaviour, and phenology of all the species remain undocumented and should be investigated quickly, starting in their type locality and around, if it is not already too late.

Together with the new *polillensis* group, the genus *Pyrops* now contains 6 species groups, the five others being *clavatus*, *effusus*, *pyrorhynchus*, *sultanus* and *candelaria*. The latter contains the majority of species and will need to be refined by future studies.

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