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The lanternflies of the *Penthicodes (Ereosoma) atomaria*+ species group in Thailand: New records and host plants (Hemiptera: Fulgoridae)

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Front cover: *Penthicodes* (*Ereosoma*) *warleti* Constant, 2010, ♀ from Thailand, Ratchaburi, Suan Phueng, 5.IX.2017, K. Jaranaisakul.

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Abstract

The three species of the *Penthicodes (Ereosoma) atomaria*+ species group are present in Thailand. *Penthicodes (Ereosoma) warleti* Constant, 2010 is recorded from the country for the first time; it is also the first record of the species outside India. New records are given for *P. (Ereosoma) atomaria* (Weber, 1801) and *P. (Ereosoma) pulchella* Guérin-Ménéville, 1838, partly based on photographs available from the internet. An identification key to the species of the group is given as well as illustrations of the male genitalia to allow confirmation of identification. A distribution map is provided for each species. The first records of host plants are given for these species: *Castanopsis diversifolia* (Kurz) King ex Hook.f. (Fagaceae), *Lagerstroemia macrocarpa* Wall. ex Kurz, *L. loudonii* Teijsm. & Bin (Lythraceae) and *Ficus* sp. (Moraceae) for *P. (Ereosoma) atomaria*; *Shorea obtusa* Wall (Dipterocarpaceae), *Xylia xylocarpa* Roxb. Taub. (Fabaceae), and possibly *Cratoxylum formosum* Benth. & Hook. f. ex Dyer (Hypericaceae) and *Lagerstroemia* cf. *floribunda* (Lythraceae) for *P. (Ereosoma) pulchella*; *Castanopsis* sp. (Fagaceae) for *P. (Ereosoma) warleti*.

Keywords: host plant, planthopper, biodiversity, behaviour

Introduction

The genus *Penthicodes* Blanchard, 1845 belongs to the family Fulgoridae and is widely distributed in Southeast Asia (CONSTANT, 2010). Twelve species are known: two species in the subgenus *Penthicodes* (*farinosa* (Weber, 1801) with five subspecies and *nicobarica* (Stål, 1869)) and ten species in the subgenus *Ereosoma* (*astraea* (Stål, 1864), *atomaria* (Weber, 1801), *bimaculata* (Schmidt, 1905), *caja* (Walker, 1851) with two subspecies, *celebica* Constant, 2010, *pulchella* Guérin-Ménéville, 1838, *quadrimaculata* Lallemand, 1963 *rugulosa* (Stål, 1870), *variegata* Guérin-Ménéville, 1829 and *warleti* Constant, 2010) (CONSTANT, 2010; BOURGOIN, 2018). CONSTANT (2010) defined the *atomaria*+ group of species within *Ereosoma* based on the following characters: black spots on hind wings small, on three rows; apical black area of hind wings rounded, distinct from the grey-black margin; tegmina without numerous large black-brown markings; male with anal tube dorsoventrally flattened, laterally laminate and longer than broad. The group contains three species: *P. (Ereosoma) atomaria*, *pulchella* and *warleti*.

Four species of the genus *Penthicodes* are currently recorded from Thailand: *P. (Ereosoma) atomaria*, *P. (Ereosoma) caja*, *P. (Ereosoma) pulchella* and *P. (Ereosoma) variegata* (CONSTANT, 2010; BOURGOIN, 2018). *Penthicodes (Ereosoma) bimaculata* was mentioned from Thailand by HUTACHARERN *et al.* (2007) without detail and location. This record is probably based on a misidentification of *P. (Ereosoma) variegata* and needs confirmation.

Recently, a male and female of *P. (Ereosoma) warleti* Constant, 2010 were collected and photographed from western Thailand, allowing a positive confirmation of the identification from the male genitalia, and additional records from photographs were gathered from social medias.

This paper aims to provide the first records of *P. (Ereosoma) warleti* in Thailand and new records of *P. (Ereosoma) atomaria* and *P. (Ereosoma) pulchella* with corresponding maps, a key allowing the separation of the species as well as the first host plant records for the three species.

Material and Methods

External morphology was observed under a stereoscopic microscope and measures were taken with a digital Vernier caliper. Photographs of the specimen were taken with a Canon EOS 7D camera with Canon EF 100mm f/2.8 Macro USM lens, and stacked using the software Zerene Stacker. The map was produced with SimpleMappR (SHORTHOUSE, 2010). The identification of the specimens was made using the keys given by CONSTANT (2010). The collection specimens examined in this study are deposited in Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom province, Thailand.

Abbreviation

FB = Facebook social network

Results

Family **Fulgoridae** Duméril, 1820
 Subfamily **Aphaeninae** Blanchard, 1847
 Tribe **Aphaenini** Distant, 1906
 Genus ***Penthicodes*** Blanchard, 1845
 Subgenus ***Ereosoma*** Kirkaldy, 1906

Identification key to the species of the *Penthicodes (Ereosoma) atomaria*+ species group

1. Head and pronotum pale yellow-brown, mesonotum black-brown (Fig. 1 E)..... 2
 - Head and thorax uniformly coloured (Fig. 7 D); tegmina with small dark brown spots on membrane and costal cell without 2 large black spots, showing only small dark brown spots (Fig. 7 D); legs with pale rings (Fig. 7 D).....
*Penthicodes (Ereosoma) pulchella* (Guérin-Ménéville, 1838)
2. Tegmina without large spots on costal cell but 2 larger spots on disc (Fig. 1 E); legs with pale rings (Fig. 1 E)..... *Penthicodes (Ereosoma) warleti* Constant, 2010
 - Tegmina with membrane unspotted and usually 2 large spots on costal cell (Fig. 5); legs uniformly dark brown to black (Fig. 5).....
*Penthicodes (Ereosoma) atomaria* (Weber, 1801)

***Penthicodes (Ereosoma) warleti* Constant, 2010** new country record
Figs 1–2, 3 I–L, 4

Penthicodes (Ereosoma) warleti Constant, 2010.

MATERIAL EXAMINED: THAILAND: 1♂, 1♀ (Fig. 1): Ratchaburi, Suan Phueng, 5.IX.2017, night collecting, K. Jaranaisakul.

MATERIAL EXAMINED FROM PHOTOGRAPHS: THAILAND: 1 ex. (Fig. 2 A): Kanchanaburi, 11.X.2011, K. Jaranaisakul; 1 ex. (Fig. 2 C–D): Nakhon Ratchasima, Khao Yai National Park, 23.III.2015, R. Hongsaeng; 1 ex. (Fig. 2 E): Petchabun, Nam Nao National Park, 15.IV.2012, N. Makbun; 1 ex. (Fig. 2 F): Surat Thani, Khao Sok National Park, IV.2008, A. Mommerency.

DIAGNOSIS. Tegmina yellow-brown with white patch only along sutural margin on nodal line of cross-veins; marked with numerous small black-brown spots on disc and membrane, some spots on veins are v-shaped; 2-3 bigger black spots on disc between veins Sc and R1-R2; disc of hind wing reddish with 11 black spots in 3 rows and 4 white spots on apicocostal half of disc; abdominal tergites red, sometimes black mediobasally.

The species is close to *P. (Ereosoma) atomaria* and *P. (Ereosoma) pulchella* from which it can be separated based on the following characters of the male genitalia:

- (1) posterior margin of gonostyli slightly truncate in lateral view (Fig. 3 I) [rounded in *P. (Ereosoma) atomaria* and *P. (Ereosoma) pulchella* (Fig. 3 A, E)];
- (2) lateral margin of anal tube curved in lateral view (Fig. 3 I) [angularly curved in *P. (Ereosoma) atomaria* (Fig. 3 A) and slightly curved in *P. (Ereosoma) pulchella* (Fig. 3 E)];
- (3) anal tube in dorsal view strongly narrowing at proximal 1/3, then with margins parallel to apex (Fig. 3 K) [progressively narrowing from proximal 1/3 in *P. (Ereosoma) atomaria* (Fig. 3 C) or from base in *P. (Ereosoma) pulchella* (Fig. 3 G)];
- (4) gonostyli shorter and broader in posteroventral view (Fig. 3L) than in *P. (Ereosoma) atomaria* (Fig. 3 D) and *P. (Ereosoma) pulchella* (Fig. 3 H).

MEASUREMENTS. ♂: body length: 16.9 mm (anterior margin of vertex to apex of abdomen); tegmina: 19.1 mm; hind wing: 12.4 mm.

BIOLOGY. One specimen was collected on a trunk of *Castanopsis* sp. (Fagaceae).

DISTRIBUTION. N. India and Thailand (Fig. 4).



Fig. 1. *Penthicodes (Ereosoma) warleti* Constant, 2010. A–D, ♂. A, habitus, dorsal view. B, head and prothorax, lateral view. C, habitus, ventral view. D, head, pro- and mesonotum, dorsal view. E, ♀, habitus, dorsal view.

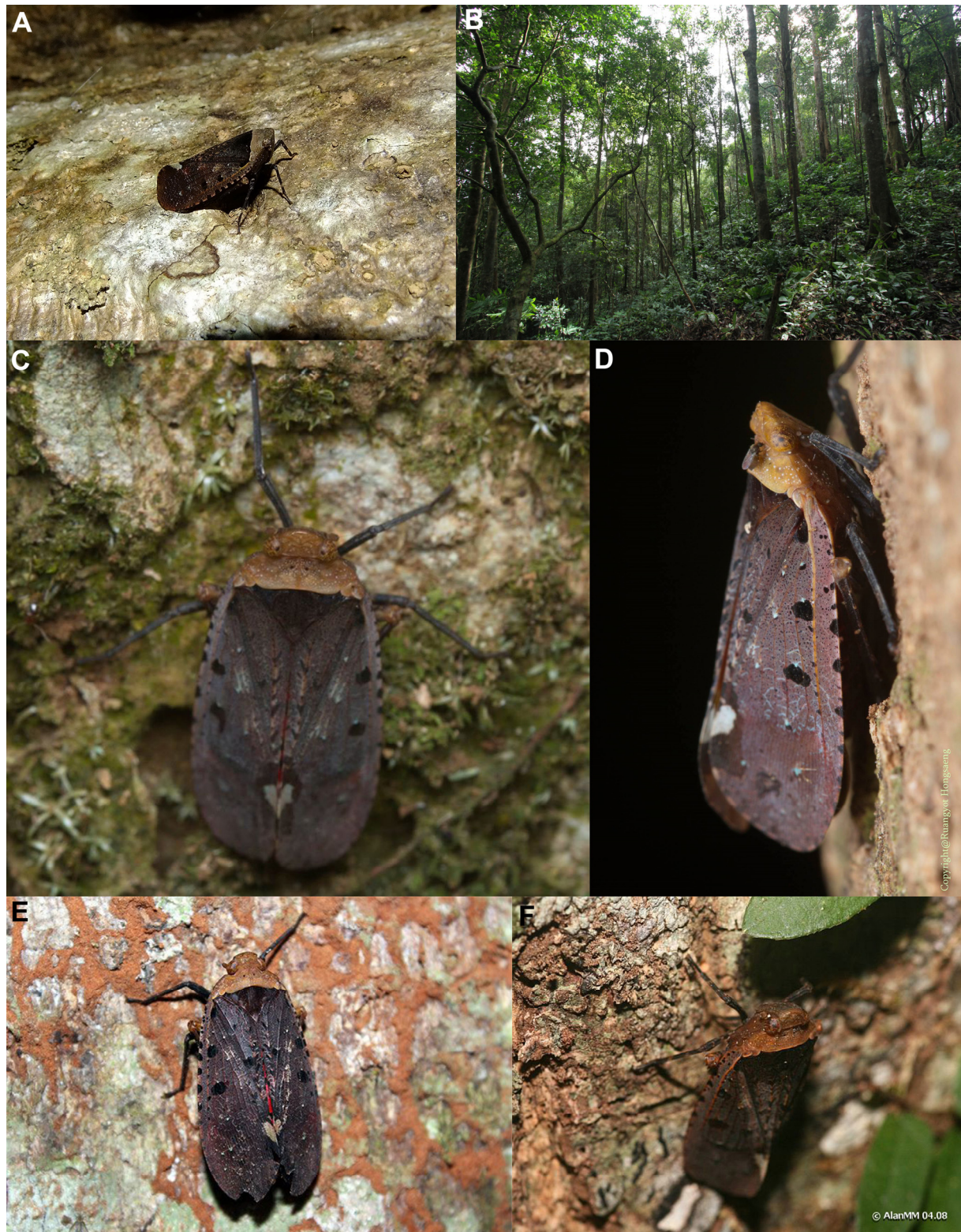


Fig. 2. *Penthicides (Ereosoma) warleti* Constant, 2010 in nature. A, Ratchaburi, Suan Phueng, 11.X.2011 (photograph by K. Jiaranaisakul). B, habitat in Suan Phueng, 27.X.2017 (photograph by K. Jiaranaisakul). C–D, Nakhon Ratchasima, Khao Yai National Park, 23.III.2015 (photograph by R. Hongsang). E, Petchabun, Nam Nao National Park, 15.IV.2012 (photograph by N. Makbun). F, Surat Thani, Khao Sok National Park, IV.2008 (photograph by A. Mommerency).

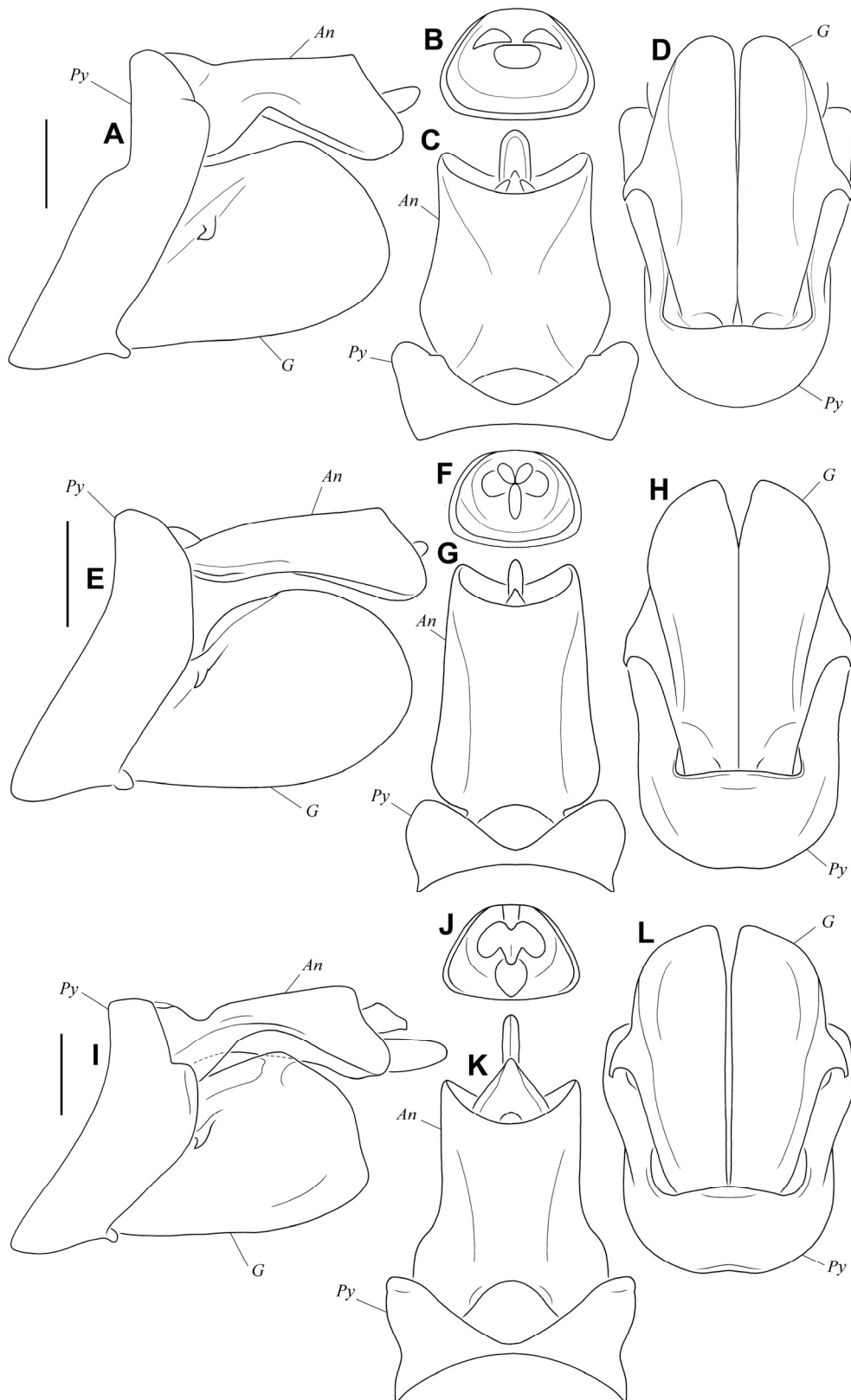


Fig. 3. *Penthycodes (Ereosoma)* spp. Male genitalia. A–D. *P. (Ereosoma) atomaria*. A, pygofer, anal tube and gonostyli, left lateral view. B, anal tube, posterior view. C, anal tube and pygofer, dorsal view. D, pygofer and gonostyli, posteroventral view. E–H. *P. (Ereosoma) pulchella*. E, pygofer, anal tube and gonostyli, left lateral view. F, anal tube, posterior view. G, anal tube and pygofer, dorsal view. H, pygofer and gonostyli, posteroventral view. I–L. *P. (Ereosoma) warleti*. I, pygofer, anal tube and gonostyli, left lateral view. J, anal tube, posterior view. K, anal tube and pygofer, dorsal view. L, pygofer and gonostyli, posteroventral view. An: anal tube; G: gonostyli; Py: pygofer. Scale 2 mm.



Fig. 4. *Penthicides (Ereosoma) warleti* Constant, 2010, map of the records in Thailand.

***Penthicodes (Ereosoma) atomaria* (Weber, 1801)**

Figs 3 A–D, 5–6

Cicada atomaria Weber, 1801.

Aphaena nigropunctata Guérin Méneville, 1838.

Penthicodes picta Blanchard, 1849.

Penthicodes atkinsoni Schmidt, 1923.

MATERIAL EXAMINED: 1♂: Chiang Rai, Doi Tung, 24.VII.2017, K. Jaranaisakul; 1♂: idem, 14.VIII.2017.

MATERIAL EXAMINED FROM PHOTOGRAPHS: THAILAND: 1 ex. (Fig. 5 A): Chiang Rai, Doi Tung, 14.X.2017, K. Jaranaisakul; 1 ex. (Fig 5 B): Ratchaburi, Suan Phueng, 5.II.2018, K. Jaranaisakul; 1 ex.: Chantaburi, 12.VIII.2012, N. Makbun; 1 ex.: Chiang Mai, Doi Pui, 2006, R. Midtgaard; 1 ex.: Yala, Betong, 18.XII.2014, S. Atdhabhan; 1 ex.: Ban Nai Phlao, 10.I.2016, V. Braznell [FB]; 1 ex.: Chaiyaphum, Phu Kiew Wildlife Reserve, I.2016, L. Worthington [FB]; Chiang Mai, Omkoi, 6.XII.2014, A. Kampanetch [FB]; 1 ex.: Surat Thani, Khao Sok National Park, 19.XII.2016, C. Huebner [FB]; 1 ex.: idem, 28.VI.2015; 1 ex.: idem, 28.XII.2015.

BIOLOGY. One specimen was collected from *Castanopsis diversifolia* (Kurz) King ex Hook.f. (Fagaceae) (Fig. 5 A) and more than ten specimens were observed on the same species of tree. This allows us to count it within the host plants of the lanternfly. *Penthicodes (Ereosoma) atomaria* was also found on other species of tree, such as *Lagerstroemia macrocarpa* Wall. ex Kurz (Lythraceae) (Fig. 5 B), *Lagerstroemia loudonii* Teijsm. & Bin (Lythraceae) and *Ficus* sp. (Moraceae), confirming that it is probably polyphagous.

DISTRIBUTION. Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Thailand (Fig. 6) and Vietnam (CONSTANT, 2010).



Fig. 5. *Penthicodes (Ereosoma) atomaria* (Weber, 1801) in nature (photographs by K. Jaranaisakul). A, on *Castanopsis diversifolia* (Fagaceae). B, on *Lagerstroemia macrocarpa* (Lythraceae).



Fig. 6. *Penthicides (Ereosoma) atomaria* (Weber, 1801), map of the records in Thailand.

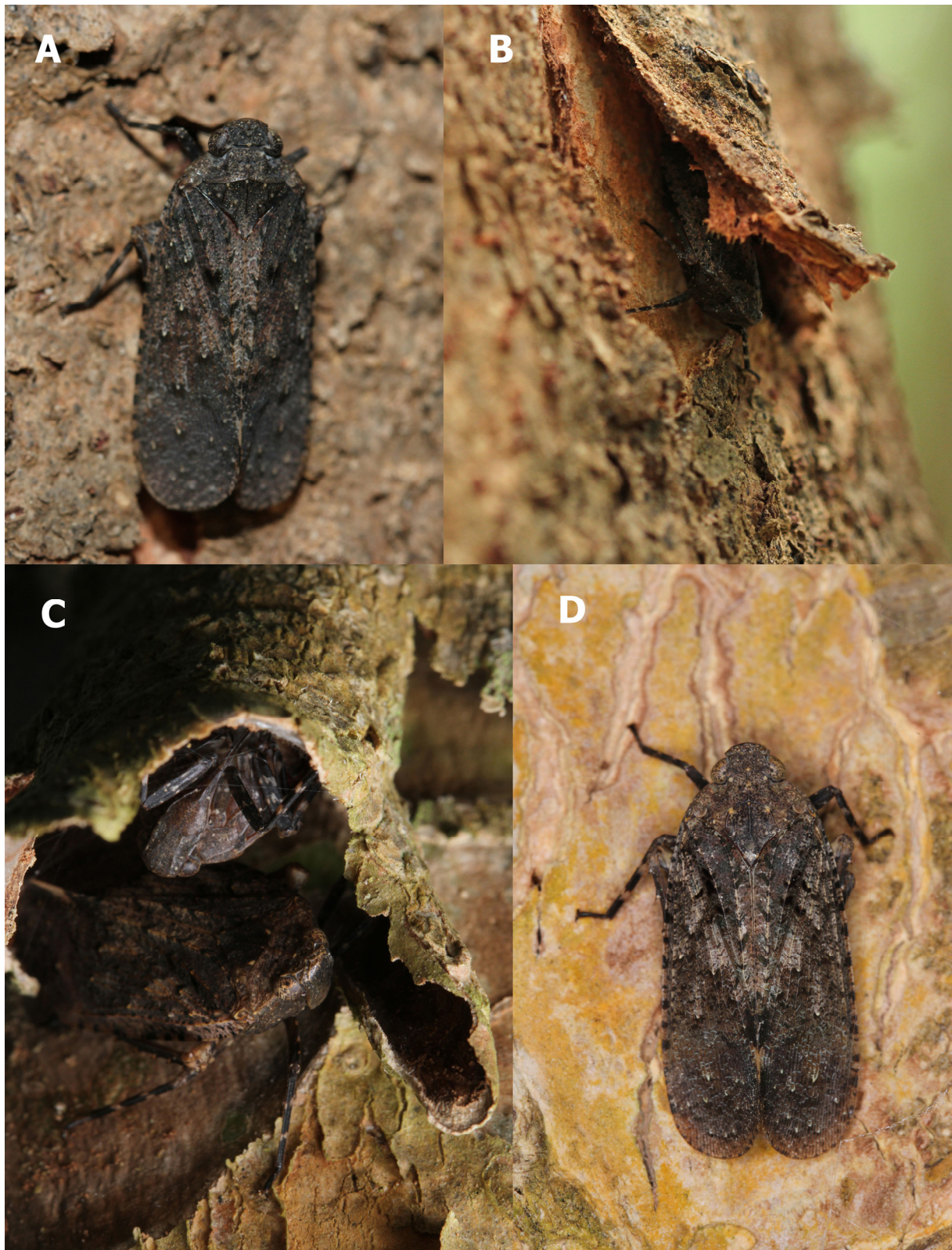


Fig. 7. *Penthicodes (Ereosoma) pulchella* Guérin-Méneville, 1838 in nature (photograph by K. Jaranaisakul). A, on *Shorea obtusa* (Dipterocarpaceae). B, hiding behaviour under the bark of *Shorea obtusa*. C, on *Lagerstroemia cf. floribunda* (Lythraceae). D, hiding behaviour under the bark of *Lagerstroemia cf. floribunda*.

***Penthicodes (Ereosoma) pulchella* (Guérin-Méneville, 1838)**

Figs 3 E–H, 7–8

Aphaena pulchella Guérin-Méneville, 1838.

Aphaena confuscus White, 1846.

Aphaena io Walker, 1851.

Aphaena nigroirrorata Stål, 1854.

Penthicodes wachsi Schmidt, 1930.

MATERIAL EXAMINED: THAILAND: 2♂♂, 6♀♀: Udon Thani, Phu Phra Bat Historical Park, 4.XII.2017, K. Jiaranaisakul.

MATERIAL EXAMINED FROM PHOTOGRAPHS: THAILAND: 1 ex. (Fig. 7 A): Udon Thani, Phu Phra Bat Historical Park, 4.XII.2017, K. Jiaranaisakul; 1 ex. (Fig. 7 B): Ratchaburi, Suan Phueng, 15.XI.2017, K. Jiaranaisakul; 1 ex. (Fig. 7 C): idem, 18.XI.2017; 1 ex.: Chiang Mai, Mae Rim District, 29.IX.2012, J. Meewasana; 1 ex: Doi Suthep-Pui, 21.X.2016, L. Day [FB]; 1 ex.: Mae Hong Son, Pai, 11.II.2017, C. Dousset [FB]; 1 ex.: Mae Wong National Park, 20.V.2015, anonymous.

BIOLOGY. The specimens from Udon Thani Province were observed and collected on *Shorea obtusa* Wall (Dipterocarpaceae) and *Xylia xylocarpa* (Roxb.) Taub. (Fabaceae) (Fig. 7 A–B). In Ratchaburi Province, all specimens were found under the bark of *Cratoxylum formosum* Benth. & Hook. f. ex Dyer (Hypericaceae) and *Lagerstroemia cf. floribunda* (Lythraceae) (Fig. 7 C) at noon; they appeared on the trunk only at night (Fig. 7 D).

DISTRIBUTION. Andaman Islands, Cambodia, China, India, Indonesia: Java and Sumatra, Myanmar, Taiwan, Thailand (Fig. 8) and Vietnam.

Discussion

Five species of *Penthicodes* are currently documented from Thailand, all in the subgenus *Ereosoma*. The record of a sixth one, *P. (Ereosoma) bimaculata* by HUTACHARERN *et al.* (2007) remains very doubtful and requires confirmation.

From photographs, *P. (Ereosoma) warleti* can be easily confused with *P. (Ereosoma) atomaria*. The identification is confirmed based on the male genitalia. One specimen of *P. (Ereosoma) warleti* was collected on a trunk of *Castanopsis* sp. (Fagaceae). In the same area (Fig. 3), specimens of *P. (Ereosoma) atomaria* were observed feeding on the same species of tree but at night. Furthermore, all *P. (Ereosoma) pulchella* were also observed and found feeding at night on their host plant. These observations confirm the already mentioned nocturnal habits of many Fulgoridae species, including species of the genus *Penthicodes* (NASKRECKI & NISHIDA, 2007; CONSTANT *et al.*, 2016).

Most fundamental aspects of the natural history of these species (e.g. phenology, nymphal stages, development, mating behaviour etc.) remain completely unknown. Although it seems widely distributed in Thailand, *P. (Ereosoma) warleti* is rarely observed, and the situation is the same for the other species, probably because no survey is pragmatically conducted on these insects. Thus, encouragement from the government and relevant authorities is needed.



Fig. 8. *Penthicodes (Ereosoma) pulchella* Guérin-Ménéville, 1838, map of the records in Thailand.

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