European Journal of Taxonomy 813: 123–154
https://doi.org/10.5852/ejt.2022.813.1741

ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2022 · Constant J. & Pham H.T.

Research article

urn:lsid:zoobank.org:pub:4957CF5B-38A4-45F6-8313-AA80C5091E50

The Lanternfly genus *Pyrops* in Vietnam: A new species from Central Vietnam, taxonomic changes, checklist, identification key (Hemiptera: Fulgoromorpha: Fulgoridae)

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Abstract. A new species of the genus *Pyrops* Spinola, 1839 (Fulgoridae), *P. buomvoi* sp. nov., is described from Ca Na, Ninh Thuan Province in Central Vietnam. It is attributed to the *candelaria* group and compared with the other species of the genus. *Pyrops lathburii* (Kirby, 1818) is proposed as a senior synonym of *P. astarte* (Distant, 1914), transferred back to the *candelaria* group from the *pyrrhorhynchus* group, and recorded from Laos for the first time. The *candelaria* and *pyrorhynchus* groups are defined and commented on. Intraspecific variation in the colour of the hind wings is recorded for the first time in *Pyrops condorinus* (Lallemand, 1960). A checklist of the 12 Vietnamese species of *Pyrops* and an illustrated key which can also be used for Laos, Cambodia and Southern Continental China, are given. *Pyrops buomvoi* sp. nov. is the first new species of *Pyrops* discovered in Indochina for more than 50 years. Intraspecific colour variation in the species of *Pyrops* is briefly discussed.

Keywords. Planthopper, Fulgoroidea, instraspecific variation, Indochina.

Constant J. & Pham H.T. 2022. The Lanternfly genus *Pyrops* in Vietnam: A new species from Central Vietnam, taxonomic changes, checklist, identification key (Hemiptera: Fulgoromorpha: Fulgoridae). *European Journal of Taxonomy* 813: 123–154. https://doi.org/10.5852/ejt.2022.813.1741

Introduction

The family Fulgoridae Latreille, 1807 (Hemiptera Linnaeus, 1758, Fulgoromorpha Evans, 1946) contains the largest and most spectacular planthoppers, the lanternflies, and are among the most iconic of all insects. It groups 142 genera and 774 species worldwide, distributed mostly in the wet tropics but with some

genera extending to the temperate regions. About 300 described species, representing about 40% of the diversity of the family inhabit the Oriental Region (Bourgoin 2021). The Vietnamese fauna of Fulgoridae comprises 36 species in 9 genera, with 11 species belonging to the genus *Pyrops* Spinola, 1839 (Pham 2011; Constant & Pham 2017; Constant & Jiaranaisakul 2021). The genus *Pyrops* is widely distributed in Southeast Asia and very speciose, with nearly 70 species described so far but their biology and natural history remain poorly documented except for a few species (Bourgoin 2021). The genus contains six species groups which were defined by Baker (1925) and Yap *et al.* (2017); the latter authors also provided an identification key to the species groups. All Vietnamese species of *Pyrops* were described more than a century ago, except for two of them, *P. condorinus* (Lallemand, 1960) and *P. itoi* (Satô & Nagai, 1994); the latter, originally described from Malaysia, was recorded from Vietnam only very recently (Constant & Jiaranaisakul 2021) based on specimens collected in 2012.

The study of material in the collections of North Carolina State University, Raleigh, USA, allowed the recognition of a new species among Vietnamese *Pyrops*, while the study of type material in the collections of BMNH revealed a new synonymy within the genus. Furthermore, the study of recent material of *P. condorinus* in the collections of VNMN showed colour variation of the hind wings in this species. The present paper aims to describe the new species, compare it with the morphologically most similar ones and provide a checklist of and an illustrated key to the Vietnamese species of *Pyrops*. It also proposes a new synonymy and discusses intraspecific colour variation in some species.

Material and methods

The male genitalia were dissected as follows: the pygofer was cut from the abdomen of the softened specimen with a needle blade, and then boiled for about one hour in a 10% solution of potassium hydroxide (KOH) at about 100°C. Some drops of saturated alcoholic Chlorazol black solution were added for contrasting (Carayon 1969). The pieces were examined in ethanol, and then placed in glycerine with the pinned specimen for preservation. Observations were made using a Leica MZ8 stereo microscope. Pictures were taken with a Canon EOS 700 D camera with Sigma DG Macro lens, a Leica EZ4W stereo microscope with integrated camera was used for the male genitalia photographs. The photographs were stacked with CombineZ software and optimized with Adobe Photoshop CS3 software. The inflation of the phallus was not done due to the difficulty obtaining replicable results and because it is not required to separate the species of *Pyrops*.

For the transcription of the labels of the types, the wording on each single label is delimited by quotation marks.

The distribution map was produced with SimpleMappr (Shorthouse 2010). The suprageneric classification follows Wang *et al.* (2021).

The measurements were mainly taken as in Constant (2004) with the additions of Constant (2015) for *Pyrops* and the following abbreviations are used:

BF = breadth of the frons
BPrH = breadth of the cephalic process at half length
BTg = breadth of the tegmen
LF = length of the frons
LPr = length of the cephalic process
LTg = length of the tegmen
TL = total length

(LF, LPr and TL measured to/from ante-ocular carina at the base of the cephalic process.)

Acronyms used for the collections

BMNH = Natural History Museum, London, United Kingdom
FSAG = University of Liège, Gembloux Agro-Bio Technologies, Gembloux, Belgium
RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium
VNMN = Vietnam National Museum of Nature, Hanoi, Vietnam

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Hemiptera Linnaeus, 1758
Suborder Auchenorrhyncha Duméril, 1806
Infraorder Fulgoromorpha Evans, 1946
Superfamily Fulgoroidea Latreille, 1807
Family Fulgoridae Latreille, 1807
Subfamily Aphaeninae Blanchard, 1847
Tribe Pyropsini Urban & Cryan, 2009

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. Type species: *Pyrops candelaria* (Linnaeus, 1758) by original designation.

The *candelaria* species group

The characters of this group mainly follow Baker's (1925: 348) definition:
(1) cephalic process long and slender, usually strongly upcurved, sometimes oblique to nearly straight;
(2) apex of cephalic process compressed laterally, rarely very slightly swelling at apex;
(3) tegmina with transverse bands or transversely aligned spots or markings;
(4) hind wings variously coloured.

The group contains the type species of the genus *Pyrops*, *P. candelaria*, and is the most species-rich group within the genus. Nagai & Porion (1996) listed 25 species in the group and more recently a number of species were added: *P. rogersi* (Distant, 1906) was transferred from the *pyrorhynchus* species group by Constant & Mohan (2017), *P. maquilinganus* (Baker, 1925) was transferred from the *effusus* species group by Constant (2015) and eight additional species were described: *P. auratus* Constant, 2021, *P. azureus* Constant & Mohan, 2017, *P. jasmini* Chew Kea Foo, Porion & Audibert, 2010, *P. jiangfenglingensis* Wang, Xu & Qin, 2018, *P. kozlovi* Porion & Audibert, 2020, *P. nishiguroi* Nagai, Porion & Audibert, 2017, *P. nishiyamai* Nagai & Porion, 2002 and *P. priscillae* Nagai, Porion & Audibert, 2016 (Bourgoin 2021). Finally, *Pyrops lathburii* (Kirby, 1818) is here transferred to the *candelaria* species group, from the *pyrorrhynchus* species group.

It is widely distributed in the Oriental Region: from Sri Lanka it extends over northern India, southern China, Taiwan, all Indochina, the Philippines, Malaysia and Indonesia southwards to Sulawesi.

The *pyrorhynchus* species group

The *pyrorhynchus* species group, as defined by Baker (1925: 347), contains species characterized by:
(1) large, stout, elongate body;
(2) long stout cephalic process, not tapering apically, with width in dorsal view about equal along distal ⅘ and height in lateral view about equal along distal ⅘; upper margin in lateral view abruptly bent beyond mid-length (apical part often slightly higher in lateral view); apically brightly coloured, yellow to red;
(3) anteocular carina slightly extending on vertex;
(4) hind wings bright blue on basal ⅓, with apex and posterior margin broadly black.

According to Baker (1925), the group contained *P. incertus* Schmidt, 1923, *P. pyrorhynchus* (Donovan, 1800) and *P. pythicus* (Distant, 1891). Lallemand (1963) added seven species to the group by broadening its interpretation without providing any justification, and Nagai & Porion (1996) followed his views. More recently, Constant & Mohan (2017) transferred one of these species, *P. rogersi* (Distant, 1906), from the *pyrorhynchus* to the *candelaria* group, and two additional ones, *P. lathburii* (Kirby, 1818) and *P. astarte* (Distant, 1914), are synonymized and moved to the *candelaria* group in the present work. As a result, the *pyrorhynchus* group currently contains the following taxa: *P. pythicus pythicus*, *P. pythicus incertus* (Schmidt, 1923), *P. ruehli* (Schmidt, 1926), *P. intricatus* (Walker, 1957), *P. intricatus albobasalis* (Lallemand, 1963), *P. zephyrius* (Schmidt, 1907) and *P. dohrni* (Schmidt, 1905). The status of both latter species will need to be assessed in the future as they do not fully agree with Baker's (1925) definition, for example, the basal third of the posterior wings is not bright blue.

Pyrops buomvoi sp. nov.
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Figs 1–3

Diagnosis

The species can be separated from all other species of *Pyrops* by the following combination of characters:
(1) posterior wings milky white with apex and area along sutural margin black brown, with brown area paler and narrower towards basosutural angle (Fig. 1B);
(2) cephalic process elongate and very slender, moderately curved dorsad (Fig. 1C–G);
(3) head yellow with dorsum and sides of cephalic process reddish (Fig. 1);
(4) tegmina with 3 irregular yellow bands on basal half, the two more distal ones formed from rows of elongate markings (Fig. 1B).

Differential diagnosis

The other species of *Pyrops* showing white posterior wings with dark brown or black apical portion are *P. atroalbus* (Distant, 1918), *P. condorinus* (Lallemand, 1960), *P. connectens* (Atkinson, 1885), *P. dohrni* (Schmidt, 1905), *P. horsfieldii* (Westwood, 1839), *P. lathburii* (Kirby, 1818), *P. vitalisius* (Distant, 1918) and *P. watanabei* (Matsumura, 1913) but none of them shows a black band along the posterior margin of the hind wing extending to the basosutural angle and none of them possess a very slender cephalic process.

All other species of *Pyrops* showing a very slender cephalic process, i.e., *P. hamdjahi* Nagai & Porion, 2002, *P. hashimotoi* Nagai & Porion, 2002 and *P. valerian* Nagai & Porion, 2002 have brightly coloured base of posterior wings, red, blue and orange, respectively.

Etymology

The species epithet *buomvoi* is a Vietnamese name for the species of the genus *Pyrops*, with '[*con*] *buom*' meaning 'butterfly' and '[*con*] *voi*' meaning 'elephant'. The name literally means 'butterfly-elephant' and is used as a name in apposition.

Material examined

Holotype

VIETNAM • ♂ (dissected, portion of cephalic process missing); Annam, Cana; [11°22′16″ N, 108°51′11″ E]; 18–22 Aug. 1932; alt. 0–600 m; *Pinus merhusii* belt; M. Poilane leg.; "Annam-Cana, Prov. Phanrang, VIII-18-22-1932", "Pinus merkusii belt – alt. 0-600M", "M Poilane Coll"; VNMN.

Paratype (Fig. 1)

VIETNAM • ♀; same collection data as holotype; I.G. 34472; RBINS.

Measurements and ratios

TL: ♂ (n = 1): 29.6 mm, ♀ (n = 1): 30.9 mm; TL+process: ♀ (n = 1): 41.3 mm; LTg/BTg = 2.79; BF/BPrH = 5.4; LPr/LF = 3.43; LPr/BPrH = 19.

Description

Head. Yellow with clypeus slightly darker; dorsum and sides of cephalic process reddish; back-side of head and markings around eyes, extending to ocelli, dark brown (Fig. 1C, E–G). Cephalic process elongate and very slender, strongly tapering basally, slightly less than 1.5 times as long as frons and clypeus combined in perpendicular view of frons (Fig. 1G), moderately curved anterodorsad and rather uniform in breadth in lateral view (Fig. 1D); distinct broadening visible in ventral and dorsal views at apical ¾ of process (Fig. 1C, G), at same level, ventral margin slightly sinuate in lateral view (Fig. 1E). Two longitudinal carinae on frons extending on sides of cephalic process up to apex (Fig. 1E–G). Median, ventral carina on apical ⅔ of cephalic process (Fig. 1F–G). Vertex with weak carina extending from middle of disc to base of cephalic process; straight carina along posterior margin (Fig. 1C). Frons subquadrate (Fig. 1F). Clypeus elongate, triangular, smooth with median carina on anteclypeus (Fig. 1F–G). Labium brown-black, elongate and slender, surpassing posterior trochanter (Fig. 1A). Antennae brown, short, with pedicel bulbous (Fig. 1E–G).

Thorax. Pronotum yellow with two small, impressed brown points on disc on each side of obsolete median carina, disc slightly wrinkled (Fig. 1C); pair of weak parallel carinae along lateral margin of pronotum and on dorsal portion of lateral lobe of pronotum (Fig. 1E–F); elongate lateral marking along anterior margin of lateral lobe of pronotum, not reaching ventral margin, brown behind eye, turning to black-brown ventrad, behind ocelli; subtriangular black-brown marking in middle of ventral margin of lateral lobe of pronotum (Fig. 1E–G). Mesonotum yellow with brown markings along anterior margin, small black-brown point near base of scutellum along posterior margin and elongate, oblique, black-brown marking extending laterad from intersection between peridiscal carina and posterior margin; median and peridiscal carinae weak, median one stopped before base of scutellum; disc slightly wrinkled between peridiscal carinae; base of scutellum impressed; lateral fields smooth (Fig. 1C). Tegulae yellow (Fig. 1C–F).

Tegmina (Fig. 1B). Brown with dense reticulum of pale yellow veins and cross-veins; corium with subbasal transverse yellow band followed by two transverse rows of slightly transverse yellow markings (markings can merge together), the more basal one irregular with the marking on disc along clavus, displaced distad (hence the two rows together more or less forming an X-shaped pattern); yellow markings more intensely margined with brown membrane with about 12 irregular round yellow spots (including 2 in costal cell), more distal ones smaller. Tegmina elongate, broadening from base towards apex, rather narrow, with costal margin broadly rounded in distal half, apical margin oblique and apical angles rounded.

Hind wings (Fig. 1B). Milky white with apex and sutural margin largely brown-black; brown-black area getting paler and narrower from apex towards base along sutural margin and stopping at basosutural angle; veins in brown-black area progressively turning from black-brown in distal portion, to whitish at basosutural angle; veins in milky white area concolourous. Hind wings strongly broader than tegmina.

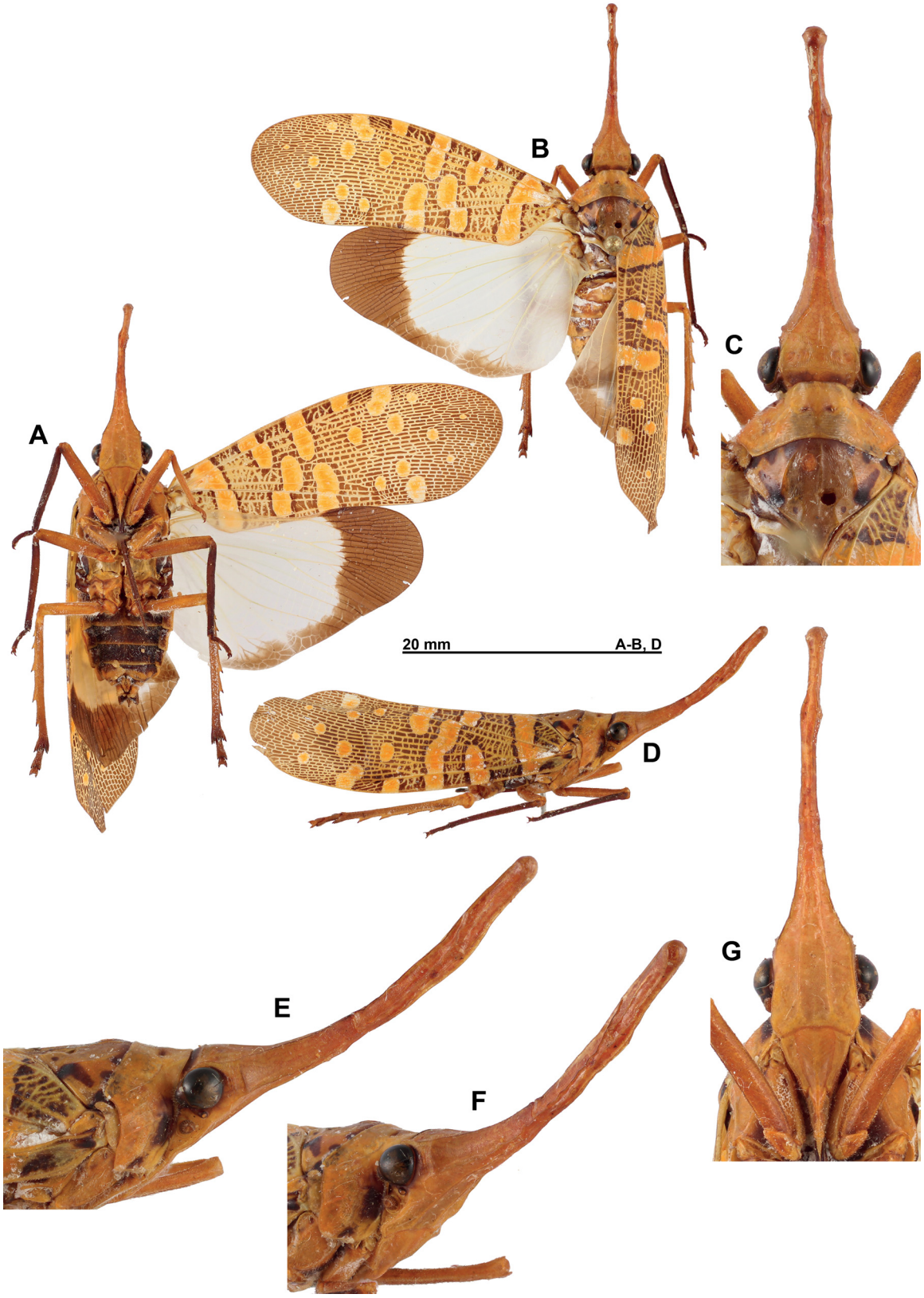

Fig. 1. *Pyrops buomvoi* sp. nov., paratype ♀ (RBINS). **A**. Habitus, ventral view. **B**. Habitus, dorsal view. **C**. Head and thorax, dorsal view. **D**. Habitus, lateral view. **E**. Head and thorax, lateral view. **F**. Head and thorax, anterolateral view. **G**. Head, perpendicular view of frons. C, E–G = not to scale.

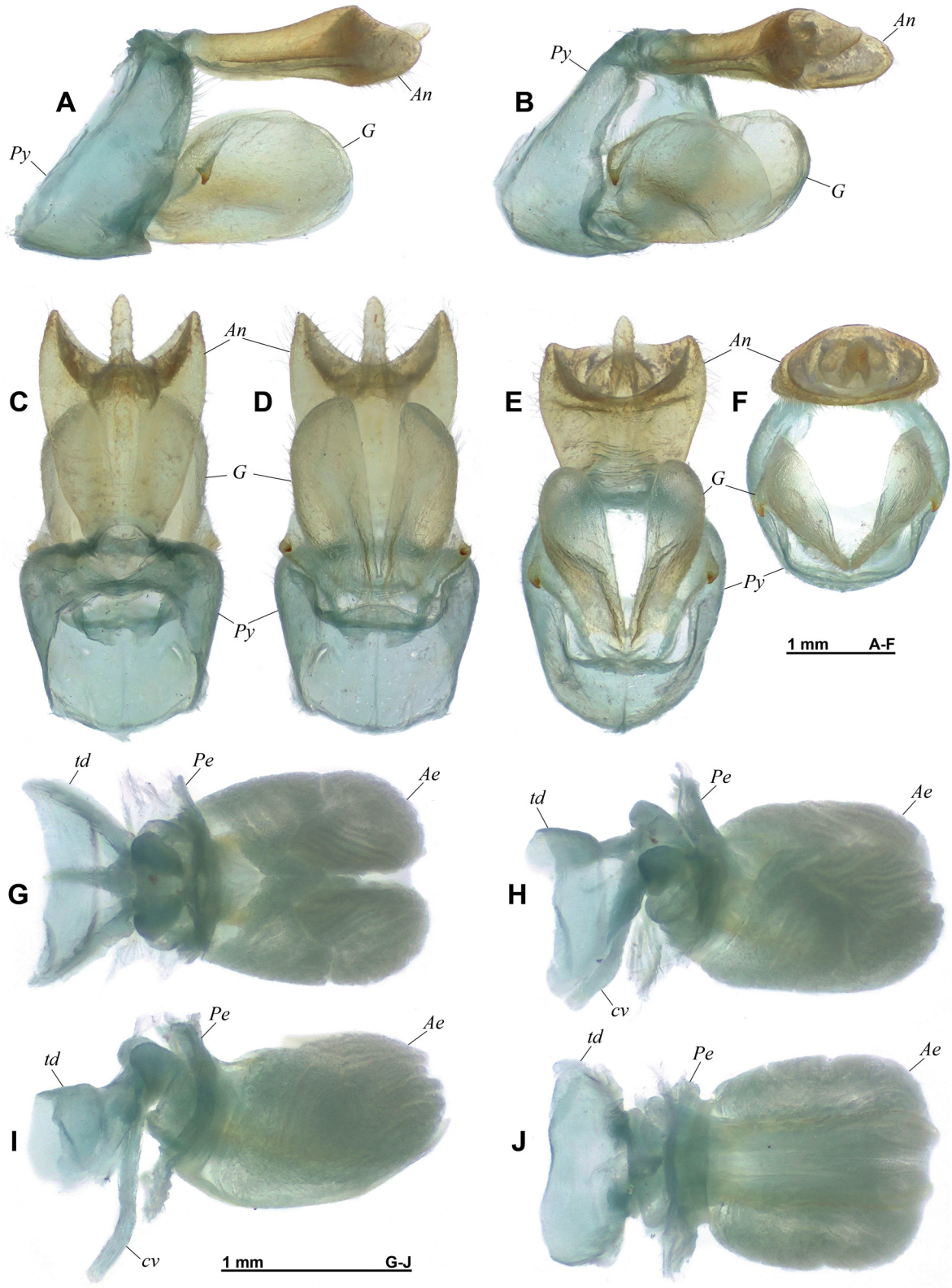

Fig. 2. *Pyrops buomvoi* sp. nov., holotype, male genitalia (VNMN). **A–F**. Pygofer, anal tube and gonostyli. **A**. Lateral view. **B**. Posterolateral view. **C**. Dorsal view. **D**. Ventral view. **E**. Posteroventral view. **F**. Caudal view. **G–J**. Aedeagus. **G**. Dorsal view. **H**. Laterodorsal view. **I**. Lateral view. **J**. Ventral view. *An* = anal tube; *Ae* = aedeagus; *cv* = connective; *G* = gonostyli; *Pe* = periandrium; *Py* = pygofer; *td* = tectiductus.

Legs (Fig. 1A–B). All coxae, trochanters and femora orangish; pro- and mesotibiae and all tarsi dark brown; metatibiae orangish basally progressively turning to brown on distal ⅓. Pro- and mesofemora broader than corresponding tibiae. Metatibiae with 5–6 lateral spines.

Abdomen (Fig. 1A–B). Terga yellowish; sterna black-brown, narrowly yellow along posterior margin; genital segments black-brown and yellowish.

Male terminalia (Fig. 2). Pygofer higher than long, with posterior margin broadly rounded, sinuate on ventral ¼ in lateral view (Fig. 2A). Gonostyli (Fig. 2 A–B, D–F) elongate, 1.64 times as long as high in lateral view, not surpassing apex of anal tube; dorsal margin broadly rounded, with a small elongate lobe in middle; in lateral view, apical margin rounded and ventral margin straight; fused ventrally on basal ⅕; lateral hooks of gonostyli short, moderately curved and pointing anteroventrally. Aedeagus membranous with pair of elongate ventral endosomal processes widening on distal half (Fig. 2 G–J); connective rod-shaped (Fig. 2I); tectiductus well-developed, subtriangular with anterior margin concave in dorsal view, strongly concave ventrally (Fig. 2G–J). Anal tube (Fig. 2 A–C, F) elongate and dorsoventrally flattened, 1.4 times as long as broad in dorsal view (about as broad as long in mid-length), broadest at ⅔ of total length (Fig. 2C); lateral margins broadly rounded (Fig. 2C) and apical margin deeply, roundly notched in dorsal view (Fig. 2C); anal column elongate and narrow, surpassing anal tube posteriorly (Fig. 2A, C–D).

Distribution

Vietnam, Ninh Thuan Province (Fig. 3).

Biology

The species was collected at an altitude between 0–600 m above sea level, in a zone of *Pinus merkusii* Jungh. & de Vriese (Pinaceae Spreng. ex Rudolphi). However it seems very unlikely that this tree could be a host plant of the species as no species of *Pyrops* has ever been recorded feeding from conifers (Bourgoin 2021).

Fig. 3. *Pyrops buomvoi* sp. nov., distribution map.

Pyrops condorinus (Lallemand, 1960)
Figs 4–5

Fulgora spinolae f. *condorina* Lallemand, 1960: 7 (described) [type in FSAG].

Fulgora spinolae 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).
Pyrops condorinus – Constant *et al.* 2016: 10 (recorded from Cambodia, taxonomy, host plant), fig. 3E (live specimen).

Material examined

Holotype
VIETNAM • ♂ of *Fulgora spinolae condorina* Lallemand, 1960 (dissected) (Fig. 4); Cochinchine, P. Condore; 14 Aug. 1924; R. Vitalis de Salvaza leg.; "Cochinchine, P. Condore, le 14.VIII.1924, R. Vitalis de Salvaza", "Type", "Holotype ♂ Fulgora spinolae f. condorina Lallemand, 1960, Jérôme Constant det."; FSAG.

Note: "P. Condore" stands for "Poulo Condore", a former name of Con Son Island in Con Dao Archipelago off Southern Vietnam.

Additional material
VIETNAM • 1 ♂ (dissected) (Fig. 5); Kiên Giang Province, Phu Quoc National Park; 10°19′30″ N, 103°57′00″ E; 14 Apr. 2013; H.T. Pham leg.; VNMN.

Remark

Intraspecific variation of the colour of the disc of the hind wings exists in this species, with specimens showing either bright yellow hind wings (Fig. 4) or milky white hind wings (Fig. 5). Conspecificity of both forms was confirmed by the study of the male genitalia.

Pyrops lathburii (Kirby, 1818)
Figs 6–8, 14

Fulgora lathburii Kirby, 1818: 450 (described, compared with *Pyrops rogersi* (Distant, 1906)) [type in BMNH].
Fulgora astarte Distant, 1914: 409 (described) [type in BMNH]. **syn**. **nov**.

Fulgora lathburii – Guérin-Méneville 1829: pl. 58 fig. 2 (illustrated). — Latreille 1837: pl. 68 fig. 2 (illustrated). — Spinola 1839: 234 (as "*Fulgora lathburyi*", treated as a dark form of *Pyrops candelaria* Linné, 1758 (error!)). — Westwood 1839: 139 (described). — Comte 1840: pl. 68 (listed, illustrated). — Guérin-Méneville 1844: 357 (notes), pl. 58 fig. 2 (illustrated). — White 1844: 425 (recorded from Hong-Kong). — Burmeister 1845: unnumbered page, under genus *Fulgora*, subgenus *Pyrops* (as a variety of *Fulgora* (*Pyrops*) *candelaria* (error!)). — Guérin-Méneville 1845: xcvi (as "*Fulgora lothburii*", close to *Pyrops cyanirostris* Guérin-Méneville, 1845). — Stål 1870: 741 (as "*Fulgora lathburi*", compared with *Pyrops philippinus* Stål, 1870). — Butler 1874: 97 (listed with species with orange posterior hind wings). — Gadeau de Kerville 1881: 43 (listed as "*Fulgora lalhburi*" in "Série I", species with orange wings, in a census of light-emitting insects). — Atkinson 1885: 129 (described). — Distant 1906: 186 (keyed, nomenclature, described, as "*Fulgora lathburi*"). — Schmidt 1911: 161 (as "*Fulgora lathburi*", compared with *Pyrops peguensis* Schmidt, 1911). —

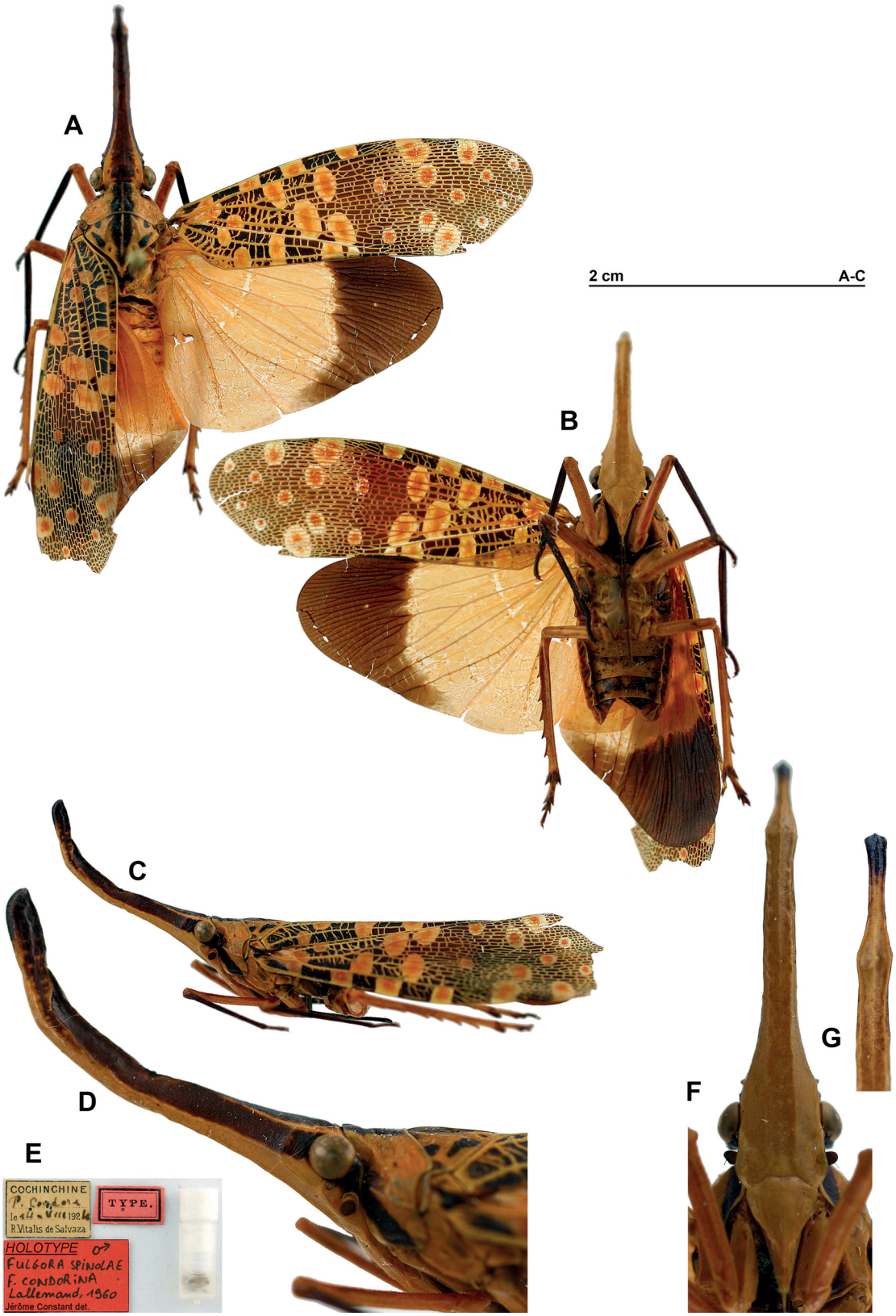

Fig. 4. *Pyrops condorinus* (Lallemand, 1960), holotype ♂ (FSAG). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Labels and genitalia tube. **F**. Head, perpendicular view of frons. **G**. Apex of cephalic process, anteroventral view. D–G = not to scale.

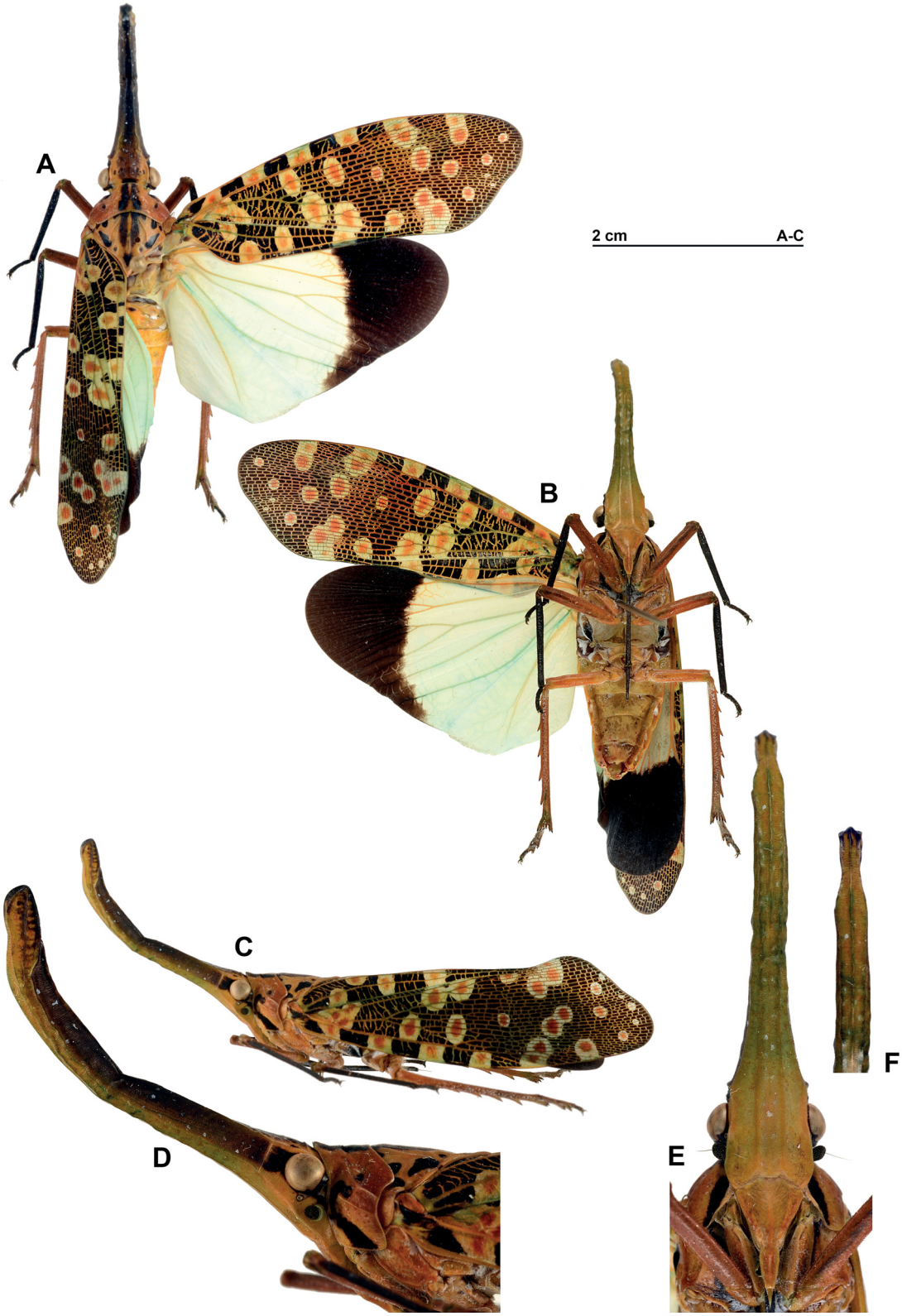

Fig. 5. *Pyrops condorinus* (Lallemand, 1960), ♂, Vietnam, Phu Quoc N.P., 14 Apr. 2013 (VNMN). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F.** Apex of cephalic process, anteroventral view. D–F = not to scale.

Schmidt 1919: 126 (as "*Fulgora lathburi*", listed from Canton (= Guangzhou)). — Baker 1925: 349 (keyed inside the *candelaria* species group), 351 (notes), pl. 3 fig. 2 (dorsal habitus), pl. 4 fig. 6 (lateral habitus). — Lallemand 1963: 86 (transferred to the *pyrorhynchus* species group, keyed, described), pl. xi figs 1–3 (male terminalia).

Flata lathburii – Germar 1830: 46 (described).

Hotinus lathburii – Amyot & Audinet-Serville 1843: 491 (transferred to *Hotinus* Amyot & Audinet-Serville). — Walker 1851: 266 (listed, recorded from Silhet (= Sylhet, Bangladesh)). — Dohrn 1859: 57 (listed in catalogue as "*Hotinus lathburi*"). — Girard 1885: 859 (as "*H. lathburi*", described).

Pyrops lathburii – Schaum 1850: 64 (transferred to *Pyrops* Spinola, 1839). — Nagai & Porion 1996: 25 (catalogued, recorded from Assam and Thailand), figs 194, 196, 198 (dorsal habitus). — Liang 1998: 43 (listed). — Pham 2011: 318 (recorded from Vietnam). — Constant 2015: 9 (note on intraspecific colour variation) — Constant *et al.* 2016: 15 (in list of species to look for in Cambodia). — Constant & Pham 2017: 18 (host plant). — Wang *et al.* 2018: 297 (keyed), 301 (nomenclature, measurements, description of male genitalia, diagnostic characters; records in China), figs 18–29 (colour variation, details of head, male terminalia). — Constant 2021: 14 (compared with *Pyrops philippinus* (Stål, 1870)). — Jiaranaisakul & Constant 2021: 18 (in list of species to look for in Khao Krachom Mountain, Thailand).

Laternaria lathburii – Metcalf 1947: 197 (transferred to *Laternaria* Linné, 1964, catalogued).

Fulgora astarte – Distant 1918: 198 (listed from Indochina), 199 (allied to *Pyrops vitalisius* Distant, 1918). — Lallemand 1963: 85 (placed in the *pyrorhynchus* species group, keyed, described).

Laternaria astarte – Metcalf 1947: 186 (transferred to *Laternaria* Linné, 1964, catalogued).

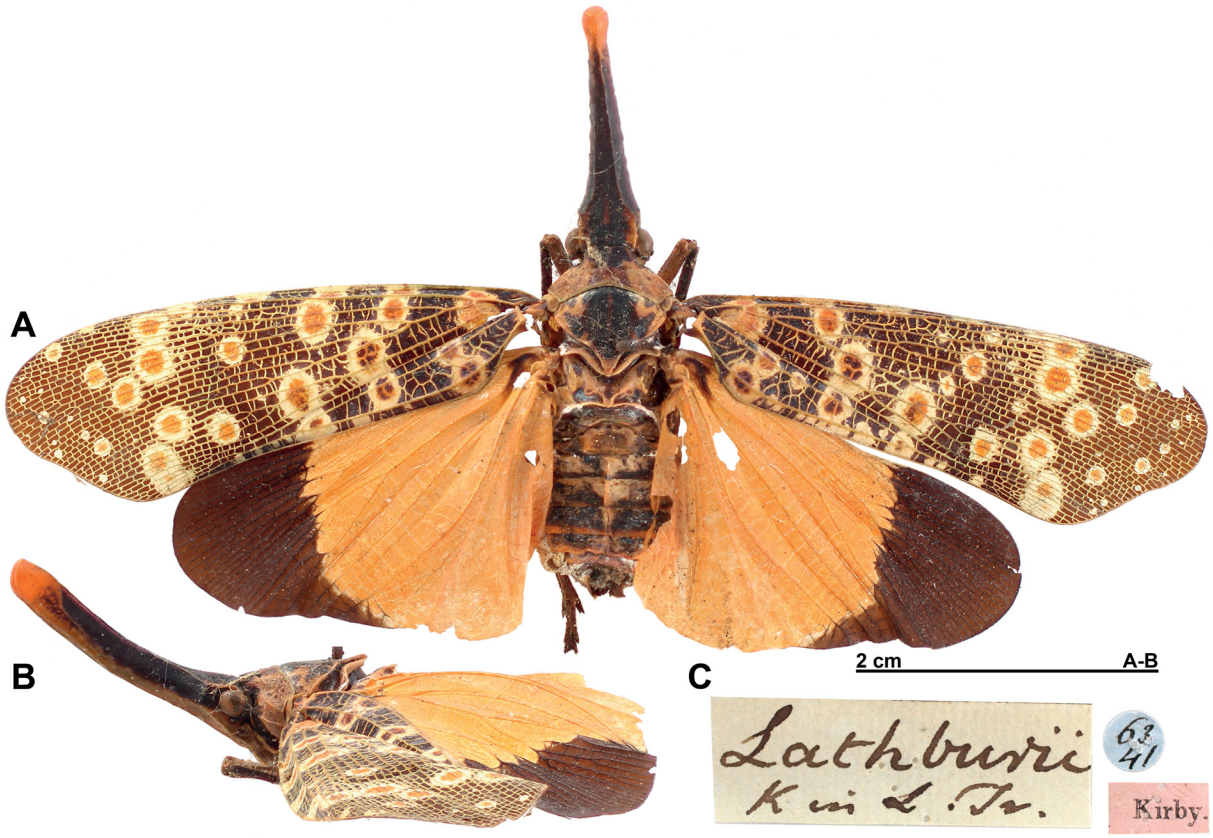

Fig. 6. *Pyrops lathburii* (Kirby, 1818), lectotype ♀ (BMNH). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Labels.

Pyrops astarte – Nagai & Porion 1996: 25 (transferred to *Pyrops*, catalogued, recorded from Vietnam and Thailand), figs 195, 197, 199 (dorsal habitus). — Pham & Ta 2004: 58 (in key to Fulgoridae of Vietnam). — Liang 1998: 42 (listed). — Pham 2011: 318 (record from Vietnam). — Constant 2021: 14 (compared with *Pyrops philippinus* (Stål, 1870)).

Note: Wang *et al.* (2018) erroneously mentioned that the species was attributed to the *pyrorhynchus* group in Constant & Pham (2017).

Material examined

Lectotype of *Fulgora lathburii* Kirby, 1818 (Fig. 6), here designated to provide a stable reference for the taxonomy of the group

CHINA • ♀; [China]; [D. Lathbury leg.]; "63 / 41", "Lathburii K in L. Tr.", "Kirby."; BMNH.

Note: The specimen was collected in China by D. Lathbury according to Kirby (1818). The code "63 / 41" refers to an entry in the Accession Register in BMNH starting on page 803 of the register and bearing

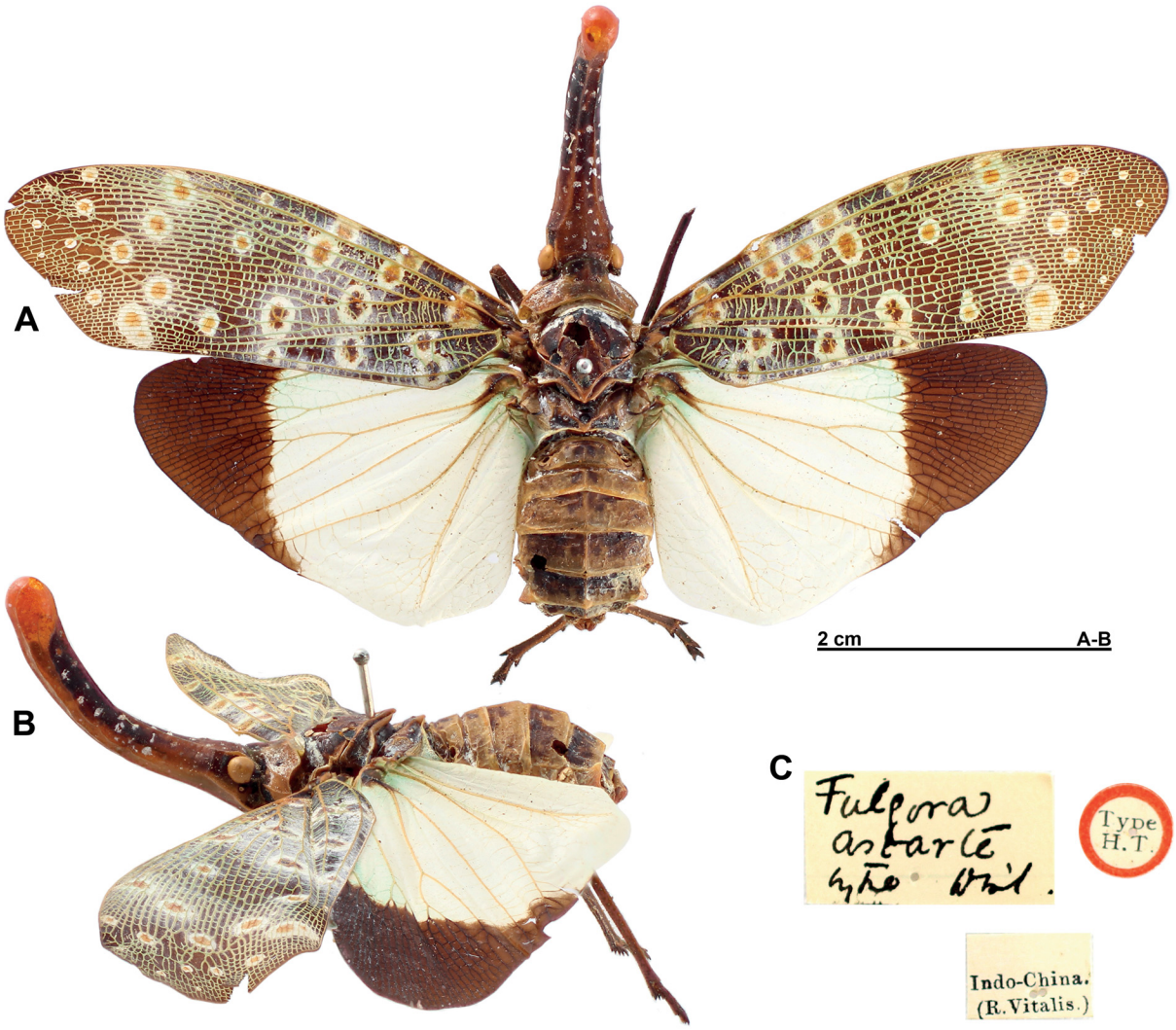

Fig. 7. *Pyrops astarte* (Distant, 1914), holotype ♀ (BMNH). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Labels.

a comment "These insects are the types of Mr Kirby's Century of Insects [...]" (V. Lemaître pers. com., Jul. 2021).

Holotype of *Fulgora astarte* Distant, 1914 (Fig. 7)
VIETNAM • ♀; Indochina, [Lào Cai]; R. Vitalis leg.; "Indo-China (R. Vitalis)", "Fulgora astarte Type Dist.", "Type H.T."; BMNH.

Note: The specimen was collected in Laokay (= Lào Cai) in North Vietnam according to Distant (1914).

Additional material
LAOS • 1 ♀; Vientiane; [17°58′ N, 102°36′ E]; I.G. 23.993; RBINS.

THAILAND • 1 ♀; Phrae Province; May 2004; ex coll. Neef de Sainval; I.G. 30.731; RBINS • 1 ♂, 1 ♀; Chiang Rai Province; Wiang Pa Pao; [19°20′54″ N, 99°30′24″ E]; 10–15 Apr. 2008; ex coll. A. Chaminade; I.G. 31.467; RBINS.

VIETNAM • 3 ♂♂, 4 ♀♀; Cao Bang Province, Phia Den; [22°34′26″ N, 105°52′29″ E]; 8 Aug. 2010; J. Constant and P. Limbourg leg.; day time; I.G. 31.668; RBINS • 5 ♂♂, 8 ♀♀; Tay Yen Tu Nature Reserve; 21°11′10″ N, 106°43′25″ E; 7–11 Jul. 2013; J. Constant and J. Bresseel leg.; I.G. 32.454; RBINS • 3 ♂♂; Bac Giang Province, Tay Yen Tu NR, Tram Dong Thong; 3 Jul. 2010; H.T. Pham leg.; VNMN • 1 ♀; [Hai Phong Province], Cat Ba National Park; 20°48′00″ N, 107°00′20″ E; 12–16 Jul. 2013; J. Constant and J. Bresseel leg.; day time; I.G. 32.454; RBINS • 5 ♀♀; [Vinh Phuc Province], Me Linh Biodiversity Station; [21°23′04″ N, 105°42′44″ E]; 20–24 Aug. 2010; J. Constant and P. Limbourg leg.; I.G. 31.668; RBINS • 1 ♀; [Vinh Phuc Province], Me Linh Biodiversity Station; [21°23′04″ N, 105°42′44″ E]; 29 Aug. 2010; J. Constant and P. Limbourg leg.; I.G. 31.668; RBINS • 2 ♂♂, 3 ♀♀; Vinh

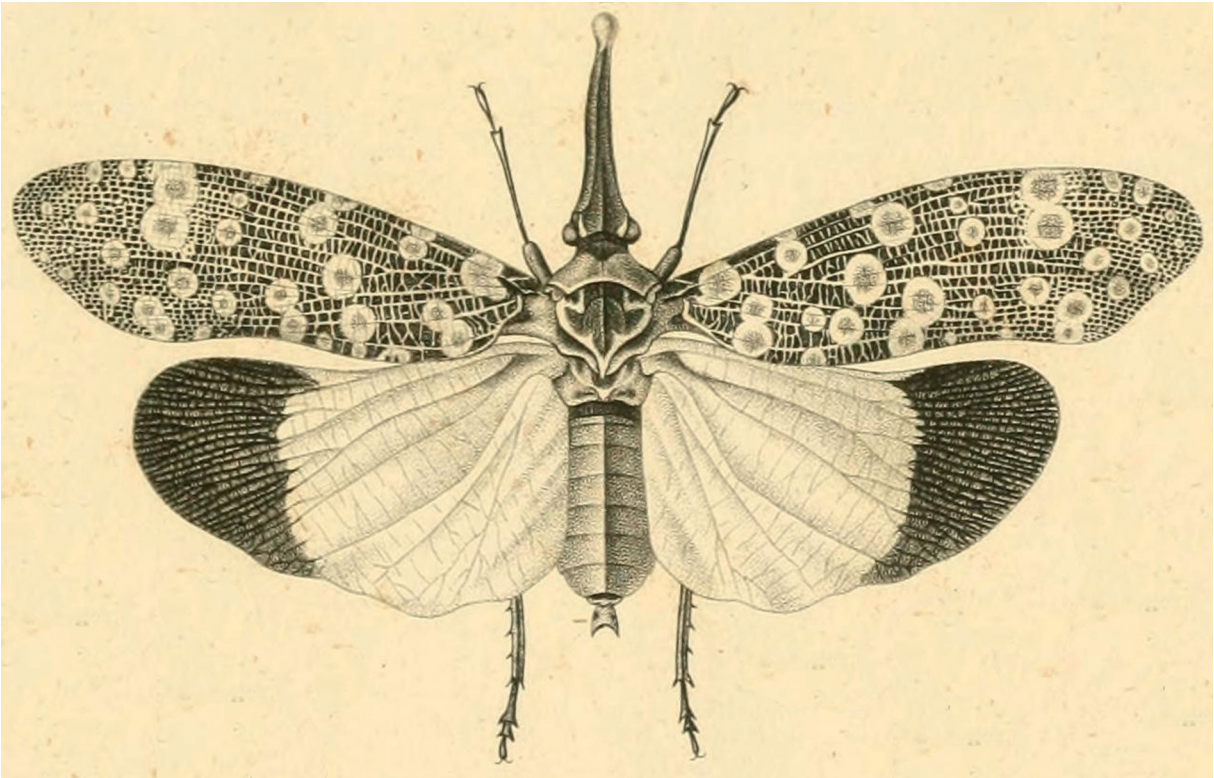

Fig. 8. *Pyrops lathburii* (Kirby, 1818), habitus illustration in Guérin-Méneville (1829).

Phuc Province, Dao Tru, Lap Thach; 17 May 2001; V.T. Hoang leg.; VNMN • 3 ♀♀; Vinh Phuc Province, Me Linh; 24 Apr. 2001; V.T. Hoang leg.; VNMN • 2 ♂♂, 17 ♀♀; Vinh Phuc Province, Me Linh; 26 May 2001; V.T. Hoang leg.; VNMN • 1 ♂, 4 ♀♀; Vinh Phuc Province, Me Linh; 23 Apr. 2007; H.T. Pham leg.; VNMN • 1 ♂, 1 ♀; Vinh Phuc Province, Me Linh; 30–31 May 2007; H.T. Pham leg.; VNMN • 7 ♀♀; Vinh Phuc Province, Me Linh; 26 Jul. 2008; H.T. Pham leg.; VNMN • 2 ♀♀; Vinh Phuc Province, Me Linh; 11 Jun. 2009; H.T. Pham leg.; VNMN • 1 ♂, 10 ♀♀; Vinh Phuc Province, Me Linh; 21 May 2010; H.T. Pham leg.; VNMN • 13 ♀♀; Vinh Phuc Province, Me Linh; 22 May 2010; H.T. Pham leg.; VNMN • 3 ♂♂, 27 ♀♀; Vinh Phuc Province, Me Linh; 4–5 Jun. 2010; H.T. Pham leg.; VNMN • 9 ♀♀; Vinh Phuc Province, Me Linh; 10 Aug. 2011; V.T. Hoang leg.; VNMN • 1 ♀; Vinh Phuc Province, Me Linh; 1 Jun. 2012; V.T. Hoang leg.; VNMN • 8 ♀♀; Vinh Phuc Province, Me Linh; 9–10 Jun. 2012; V.T. Hoang leg.; VNMN • 4 ♀♀; Vinh Phuc Province, Me Linh; 12 Aug. 2011; V.T. Hoang leg.; VNMN • 1 ♀; Vinh Phuc Province, Tam Dao N.P.; May 1998; V.T. Hoang leg.; VNMN • 1 ♀; Vinh Phuc Province, Tam Dao N.P.; Apr. 1999; V.T. Hoang leg.; VNMN • 1 ♀; Vinh Phuc Province, Tam Dao N.P.; May 2003; H.T. Pham leg.; VNMN • 1 ♀; Hanoi, Hoan Kiem; 20 Aug. 2003; V.T. Hoang leg.; VNMN • 2 ♀♀; Thua Thien-Hue Province, Phong Dien, near VNMN station; 16°35′12″ N, 107°20′31″ E; 8–9 Apr. 2017; J. Constant and J. Bresseel leg.; I.G. 33.447; RBINS • 2 ♂♂, 1 ♀; Quang Ninh Province, Dong Son-Ky Thuong nature reserve; 21°11′00.4″ N, 107°07′23.8″ E; 575 m a.s.l.; 26 Jul. 2020; H.T. Pham leg.; VNMN.

Remark

Intraspecific colour variation of the disc of the hind wings exists in this species, with specimens showing bright yellow hind wings and others, milky white. The colour of the tegmina also varies to a great extent, from very dark forms, nearly black with yellow spots ringed with white, to very pale forms, nearly white with yellow spots or even nearly white with cloudy darker, brownish markings in place of the yellow spots. Conspecificity of the different forms was confirmed by the study of the male genitalia and corroborated by the fact that the different forms are sympatric, as illustrated by a series from Chiang Mai collected in June 1992 in Nagai & Porion (1996: figs 194–199). The comparison of the illustrations of the types specimens (Figs 6A, 7A) with the line illustration of Guérin-Méneville (1829) (Fig. 8) which matches both type specimens is also very convincing.

Distribution

Northeastern India, southern China, northern Thailand, Laos, North and Central Vietnam. The species is recorded here from Laos for the first time.

Checklist of the Vietnamese species of Pyrops *Spinola, 1839*

Pyrops atroalbus (Distant, 1918)
Pyrops buomvoi sp. nov.
Pyrops candelaria (Linné, 1758)
Pyrops clavatus (Westwood, 1839)
Pyrops coelestinus (Stål, 1863)
Pyrops condorinus (Lallemand, 1960)
Pyrops ducalis (Stål, 1863)
Pyrops itoi (Satô & Nagai, 1994)
Pyrops lathburii (Kirby, 1818)
Pyrops spinolae (Westwood, 1842)
Pyrops viridirostris (Westwood, 1848)
Pyrops vitalisius (Distant, 1918)

Identification key to the species of Pyrops *of Vietnam, Laos, Cambodia and Southern Continental China*

1. Cephalic process strongly inflated apically (Figs 9–11) 2
– Cephalic process not strongly inflated apically (Figs 12–19) 3

2. Abdomen black ventrally (Fig. 9B); tegmina pale yellow-white on disc and with 3 black spots in costal area before nodal line (Fig. 9A); cephalic process yellow (Fig. 9) ..... ***Pyrops atroalbus*** (Distant, 1918)
– Abdomen red ventrally (Figs 10B, 11B); tegmina largely black on disc (Fig. 10A), or in the pale forms, bluish white on disc and without black spots in costal area (Fig. 11A, F); cephalic process red-brown to black (Figs 10–11) ..... ***Pyrops clavatus*** (Westwood, 1839)

3. Head entirely green, hind wings bright yellow basally or entirely yellow-orange (Figs 12–13) 4
– Head not entirely green, hind wings yellow, white or blue basally (Figs 14–19) 5

4. Hind wings bright yellow with apical third black (Fig. 12A); ground colour of distal half of tegmina black (Fig. 12A); anterior and median legs largely black (Fig. 12A–C) ..... ***Pyrops viridirostris*** (Westwood, 1848)
– Hind wings entirely bright yellow-orange (Fig. 13A); ground colour of distal half of tegmina green (Fig. 13A); anterior and median legs green (Fig. 13A–C) ..... ***Pyrops itoi*** (Satô & Nagai, 1994)

5. Cephalic process black or brown-black dorsally, yellowish ventrally (Figs 4–5, 14–15); pro- and mesonotum with median black or dark brown markings (Figs 4–5, 14–15) 6
– Cephalic process yellow-red to red-brown dorsally, paler, yellow to dark red ventrally (Figs 16–19); pronotum unicolourous, mesonotum sometimes with small brown-black markings on sides (Figs 16–19) 8

6. Apex of cephalic process coloured like the rest of the process (Figs 4–5, 15) 7
– Apex of cephalic process yellow to orange-red, strongly contrasting (Figs 6–7, 14) ..... ***Pyrops lathburii*** (Kirby, 1818)

7. Tegmina narrower: LTg/BTg = 2.9 (Figs 4A, 5A); spots on basal half of tegmina not fused into bands (Figs 4A, 5A); cephalic process narrower (LPr/BPrH > 9) (Figs 4–5); hind wings bright yellow (Fig. 4A) or white basally (Fig. 5A) ..... ***Pyrops condorinus*** (Lallemand, 1960)
– Tegmina broader: LTg/BTg = 2.53 (Fig. 15A); spots on basal half of tegmina fused into transverse bands (Fig. 15A); cephalic process broader (LPr/BPrH < 8) (Fig. 15); hind wings always bright yellow basally (Fig. 15A) ..... ***Pyrops spinolae*** (Westwood, 1842)

8. Hind wings white with sutural margin bordered with black up to the anal lobe (Fig. 1A); cephalic process very narrow (LPr/BPrH = 19) (Fig. 1) ..... ***Pyrops buomvoi*** sp. nov.
– Hind wings white, bright yellow or blue with only apical third black (Figs 16A, 17A, 18A, 19A); cephalic process broader (LPr/BPrH < 10) (Figs 16–19) 9

9. Hind wings bright yellow basally (Fig. 16A); cephalic process bright red, yellow ventrally (Fig. 16); yellow spots on membrane of tegmina (Fig. 16A) ..... ***Pyrops candelaria*** (Linné, 1758)
– Hind wings white or blue basally (Figs 17A, 18A, 19A); cephalic process dark red-brown and dark red ventrally or dark red, orange ventrally and at apex (Figs 17–19); yellow spots on membrane of tegmina (Figs 18–19) or not (Fig. 17) 10

10. Tegmina without yellow spots on membrane (Fig. 17A); cephalic process dark red, orange ventrally and at apex (Fig. 17); hind wings pale blue to white basally (Fig. 17A); basal half of tegmina whitish with white-margined green spots in transverse rows, sometimes fused in bands (Fig. 17A) ..... ***Pyrops ducalis*** (Stål, 1863)
– Tegmina with yellow spots on membrane (Figs 18A, 19A); cephalic process dark red-brown, dark red ventrally (Figs 18–19); hind wings white or blue basally; basal half of tegmina dark green or dark blue-green with yellow spots (Figs 18A, 19A) 11

11. Hind wings blue basally (sometimes faded to nearly white in collections specimens) (Fig. 18A); cephalic process very elongate and strongly curved dorsad (Fig. 18); ground colour of tegmina dark blue-green (Fig. 18A) ..... ***Pyrops coelestinus*** (Stål, 1863)
– Hind wings white basally (Fig. 19A); cephalic process very elongate and curved dorsad (Fig. 19); ground colour of tegmina green (Fig. 19A) ..... ***Pyrops vitalisius*** (Distant, 1918)

Discussion

The Vietnamese fauna of Fulgoridae now comprises 37 species in 9 genera, with 12 belonging to the genus *Pyrops* Spinola, 1839 (Bourgoin 2021). From the total, 8 species (22%) were recently described, after 2008, in the framework of our Global Taxonomy Initiative project "A step further in the entomodiversity of Vietnam".

Intraspecific colour variation in the species of *Pyrops* is documented for seven species so far: *P. clavatus* (Westwood, 1839), *P. condorinus* (Lallemand, 1960), *P. ishiharai* (Satô & Nagai, 1994), *P. lathburii* (Kirby, 1818), *P. peguensis* (Schmidt, 1911), *P. sultanus* (Adams & White, 1847) and *P. watanabei* (Matsumura, 1913) (Nagai & Porion 1996; Constant & Pham 2017).

In the genus, the colour variation shows different patterns and affects different parts of the insect's body. It can be classified into the five following categories:
(1) head: from nearly black to reddish (*P. clavatus* – Constant & Pham 2017);
(2) tegmina: basal third black or reddish (*P. sultanus* – Nagai & Porion 1996);
(3) tegmina: from nearly all black to nearly all white (*P. clavatus* and *P. lathburii* – present study; Nagai & Porion 1996; Constant & Pham 2017), or with black zones on white background more or less developed (*P. watanabei* – Constant & Pham 2017);
(4) posterior wings: yellow, orange or red (*P. peguensis* – Nagai & Porion 1996), or orange or red (*P. ishiharai* – Nagai & Porion 1996);
(5) posterior wings: bright yellow or white (*P. condorinus* and *P. lathburii* – present study; Nagai & Porion 1996).

These variations are not linked with the distribution as the different variants can be found sympatrically, even in the same group on a host tree (Constant & Pham 2017 and unpublished data), which also excludes seasonal variation. A link to the age of the specimen cannot be excluded but this phenomenon requires more study in the field before any hypothesis can be proposed. Molecular studies might also provide some clues leading to a better understanding.

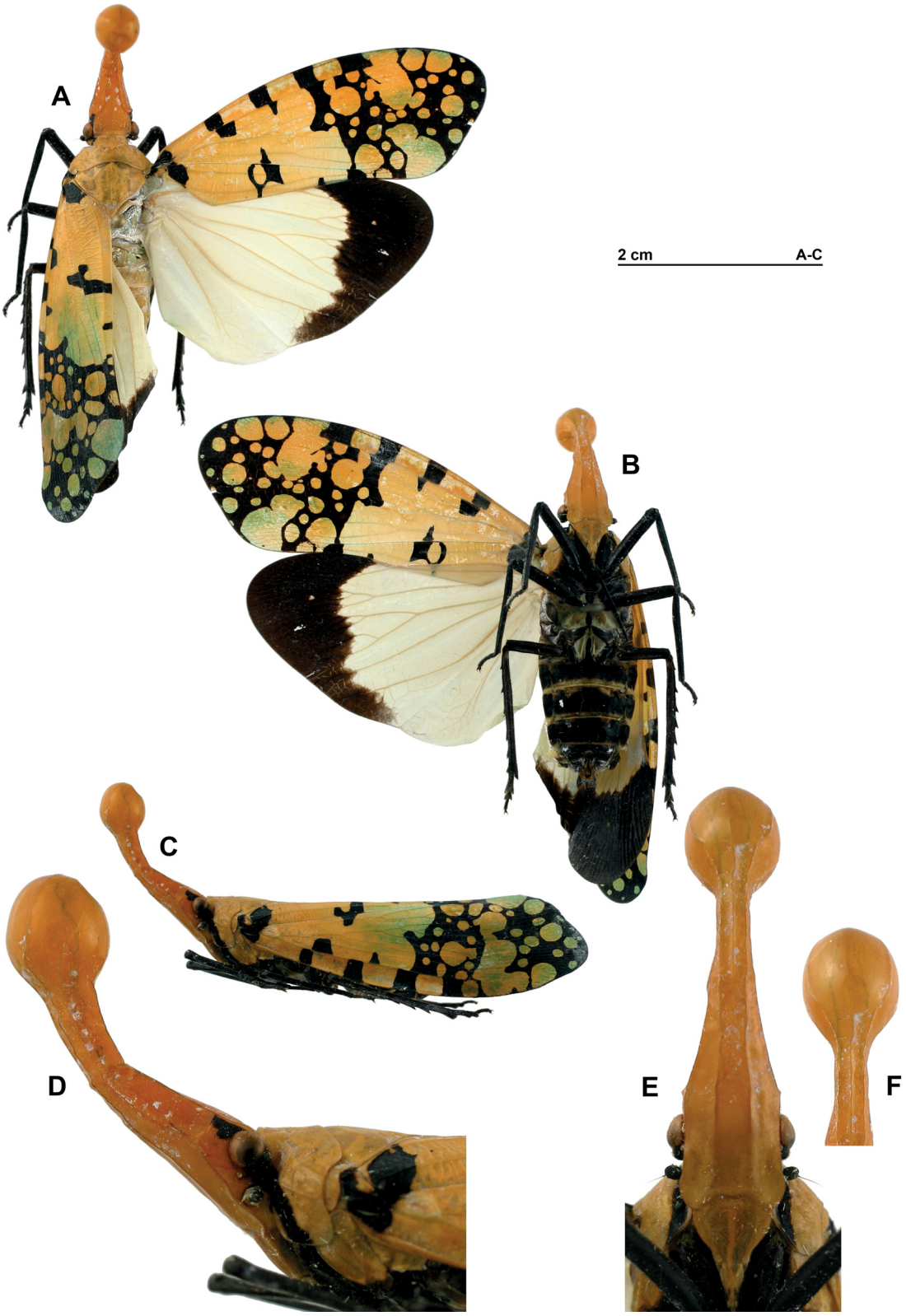

Fig. 9. *Pyrops atroalbus* (Distant, 1918), ♀, Vietnam, Quang Tri Prov., Da Krong Nature Reserve, 10 Jul. 2011 (VNMN). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

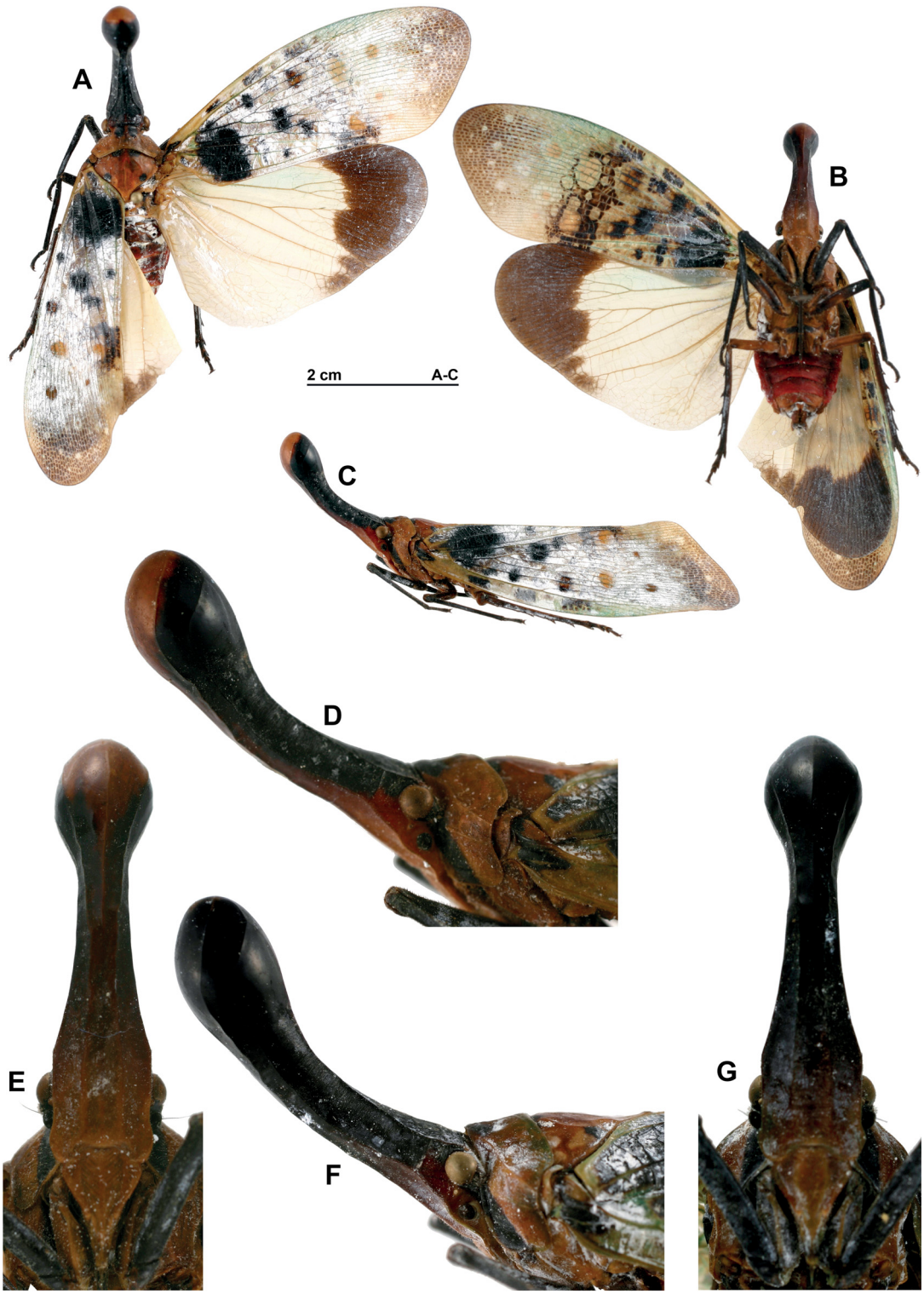

Fig. 10. *Pyrops clavatus* (Westwood, 1839), ♀♀, Thailand, Chiang Mai, Dec. 2007 (RBINS). **A–E**. Dark specimen with cephalic process brown ventrally. **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F–G**. Dark specimen with black cephalic process. **F**. Head and thorax, lateral view. **G**. Head, perpendicular view of frons. D–G = not to scale.

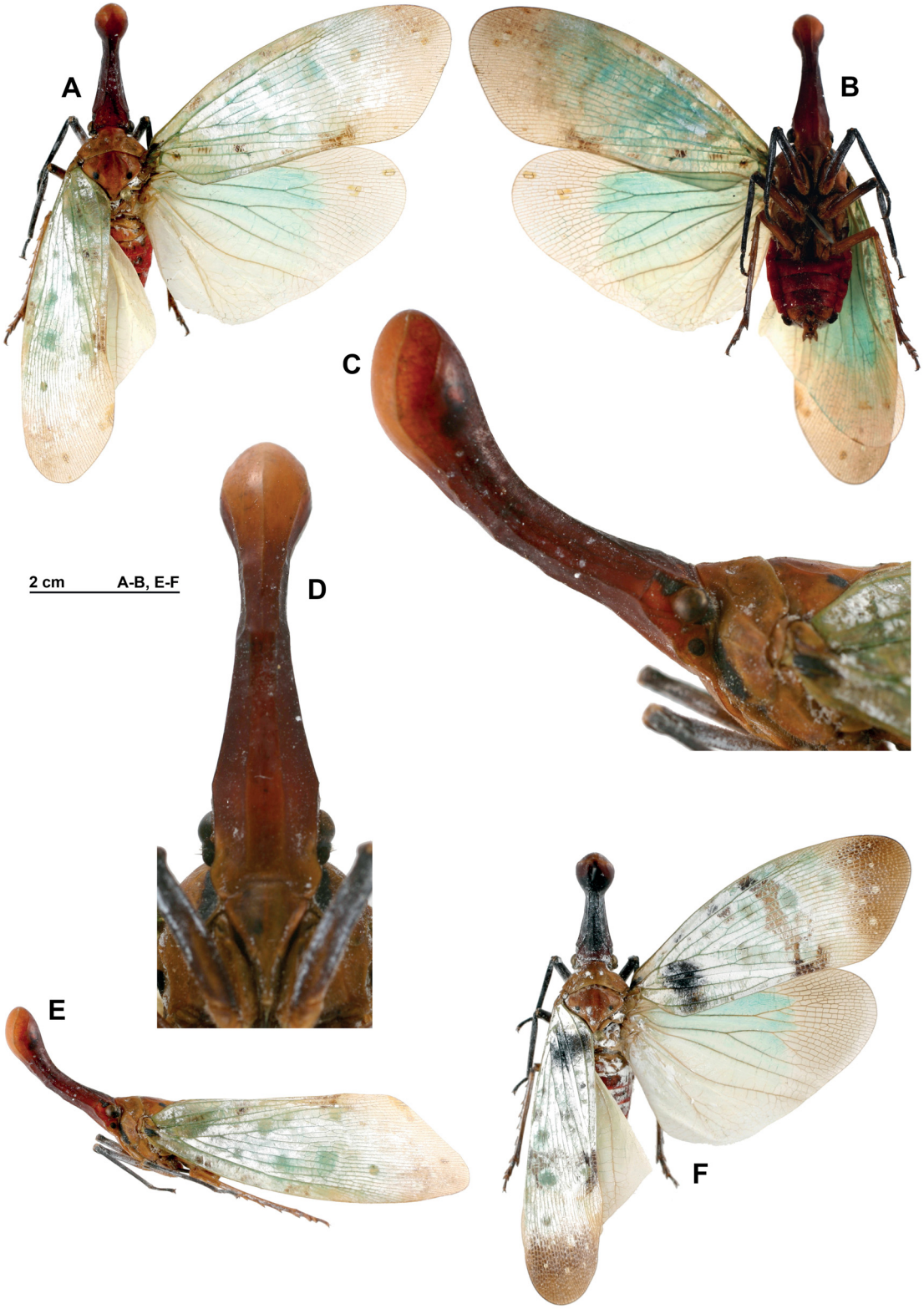

Fig. 11. *Pyrops clavatus* (Westwood, 1839), ♀♀, Thailand, Chiang Mai, Dec. 2007 (RBINS). **A–E**. Pale specimen. **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Head and thorax, lateral view. **D**. Head, perpendicular view of frons. **E**. Habitus, lateral view. **F**. Intermediate specimen with cephalic process black dorsally, habitus, dorsal view. C–D = not to scale.

Fig. 12. *Pyrops viridirostris* (Westwood, 1848), ♀, Thailand, Kanchanaburi Prov., Say Yok N.P., 4–5 Jun. 2003 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

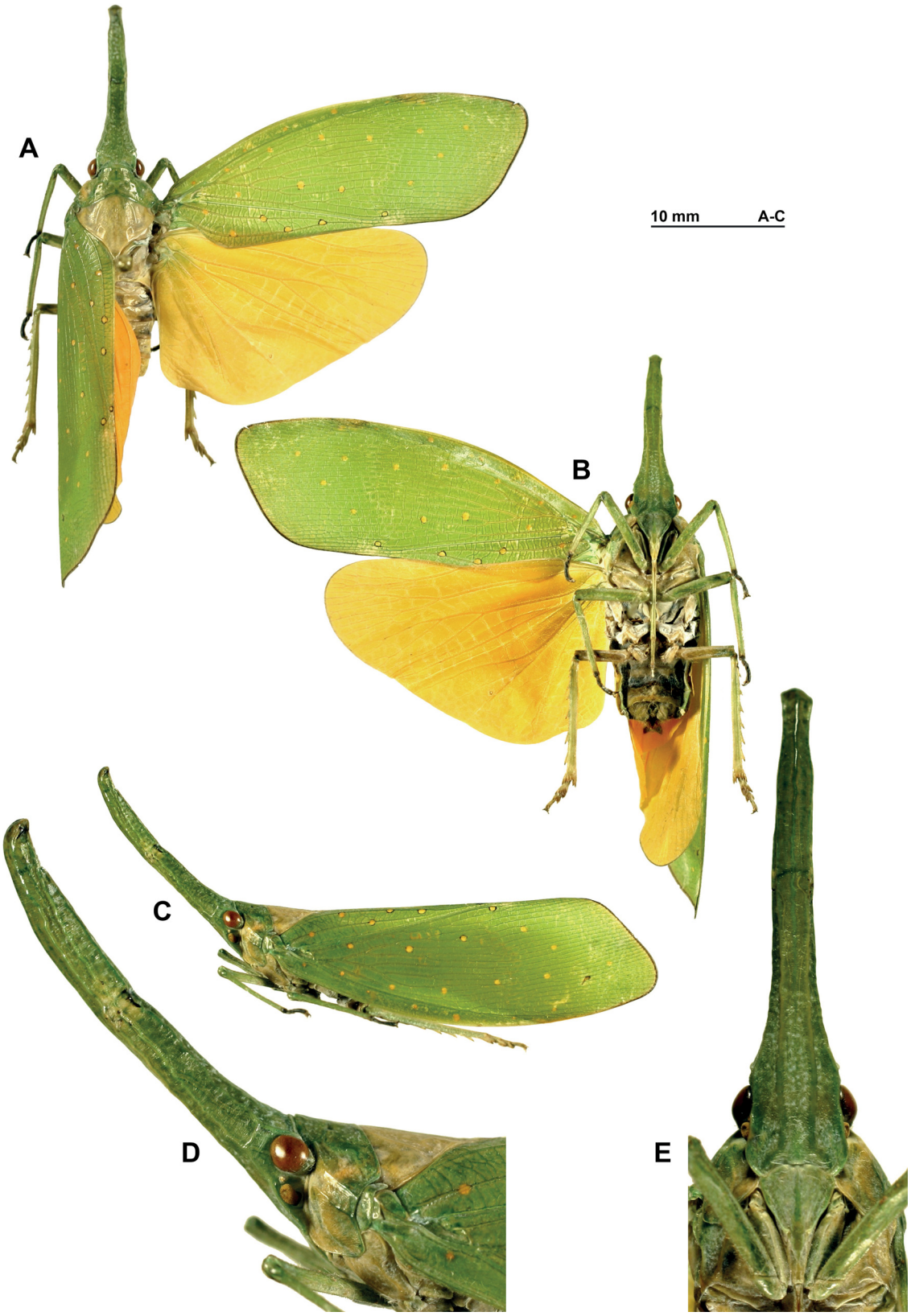

Fig. 13. *Pyrops itoi* (Satô & Nagai, 1994), ♀, Thailand, Khao Soi Dao Wildlife Sanctuary, May 2012 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. D–E = not to scale.

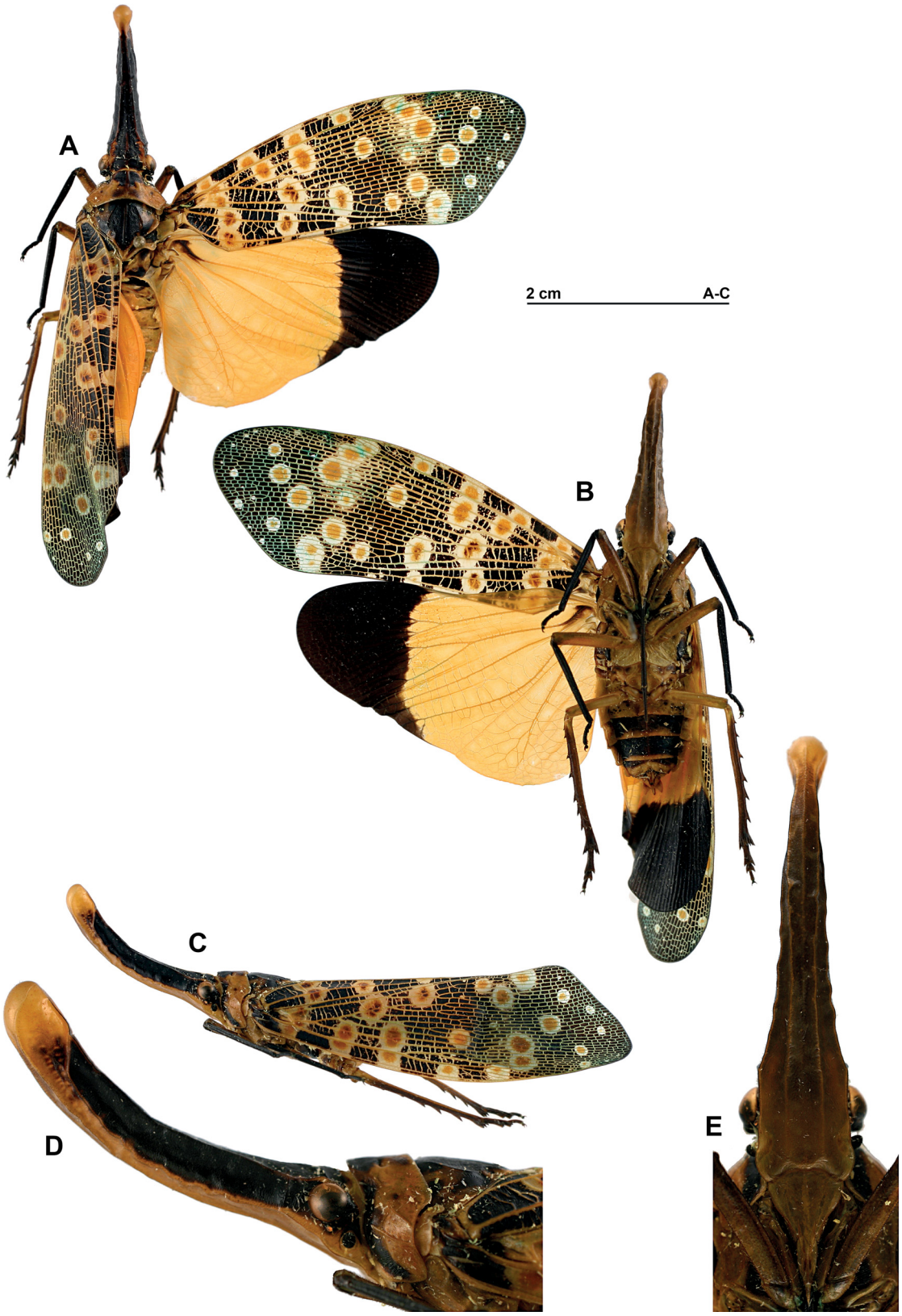

Fig. 14. *Pyrops lathburii* (Kirby, 1818), ♀, Vietnam, Cao Bang Prov., Phia Den, 8 Aug. 2010 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. D–E = not to scale.

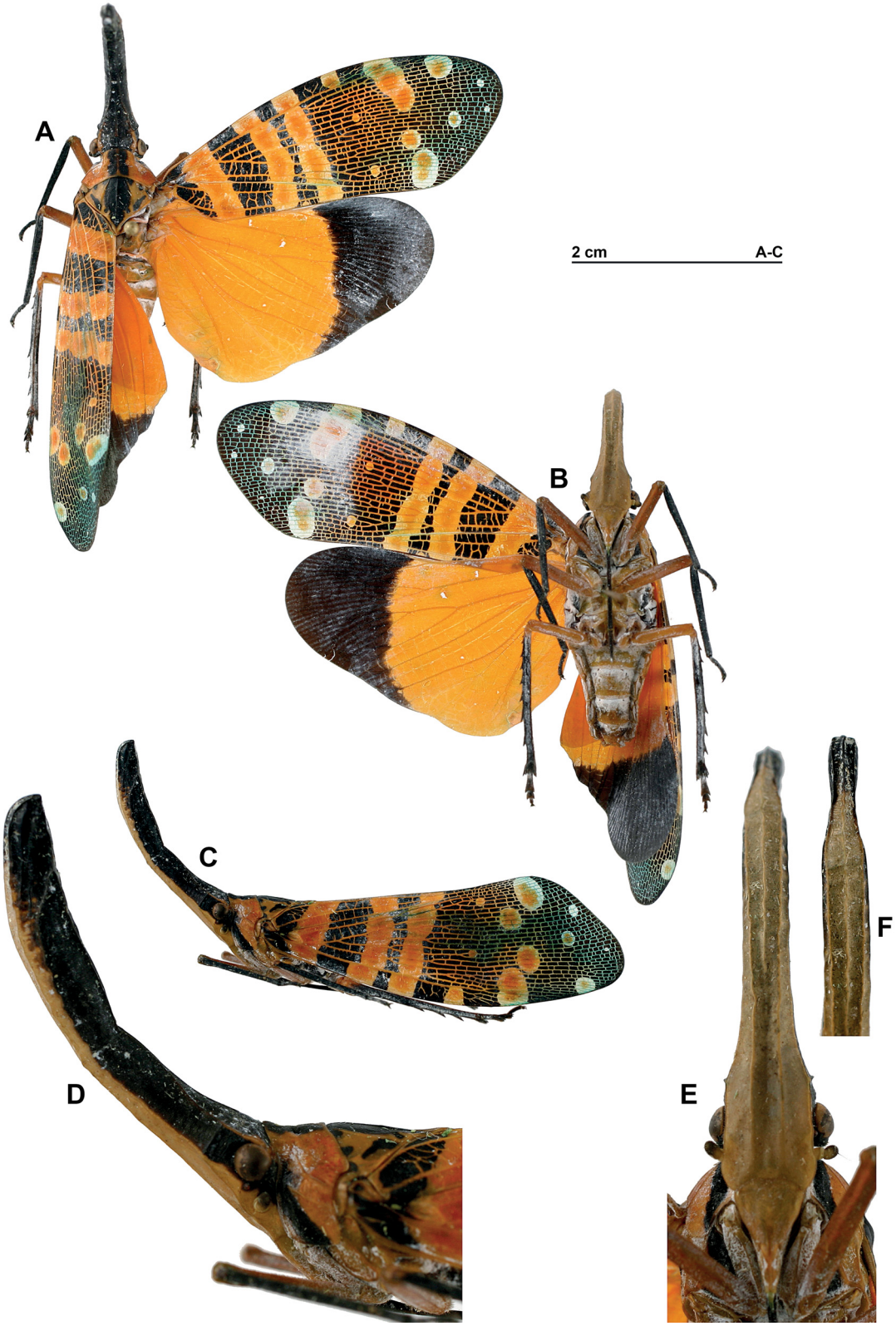

Fig. 15. *Pyrops spinolae* (Westwood, 1842), ♂, Vietnam, Vinh Phuc Prov., Me Linh Biodiversity Station, 20–24 Aug. 2010 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

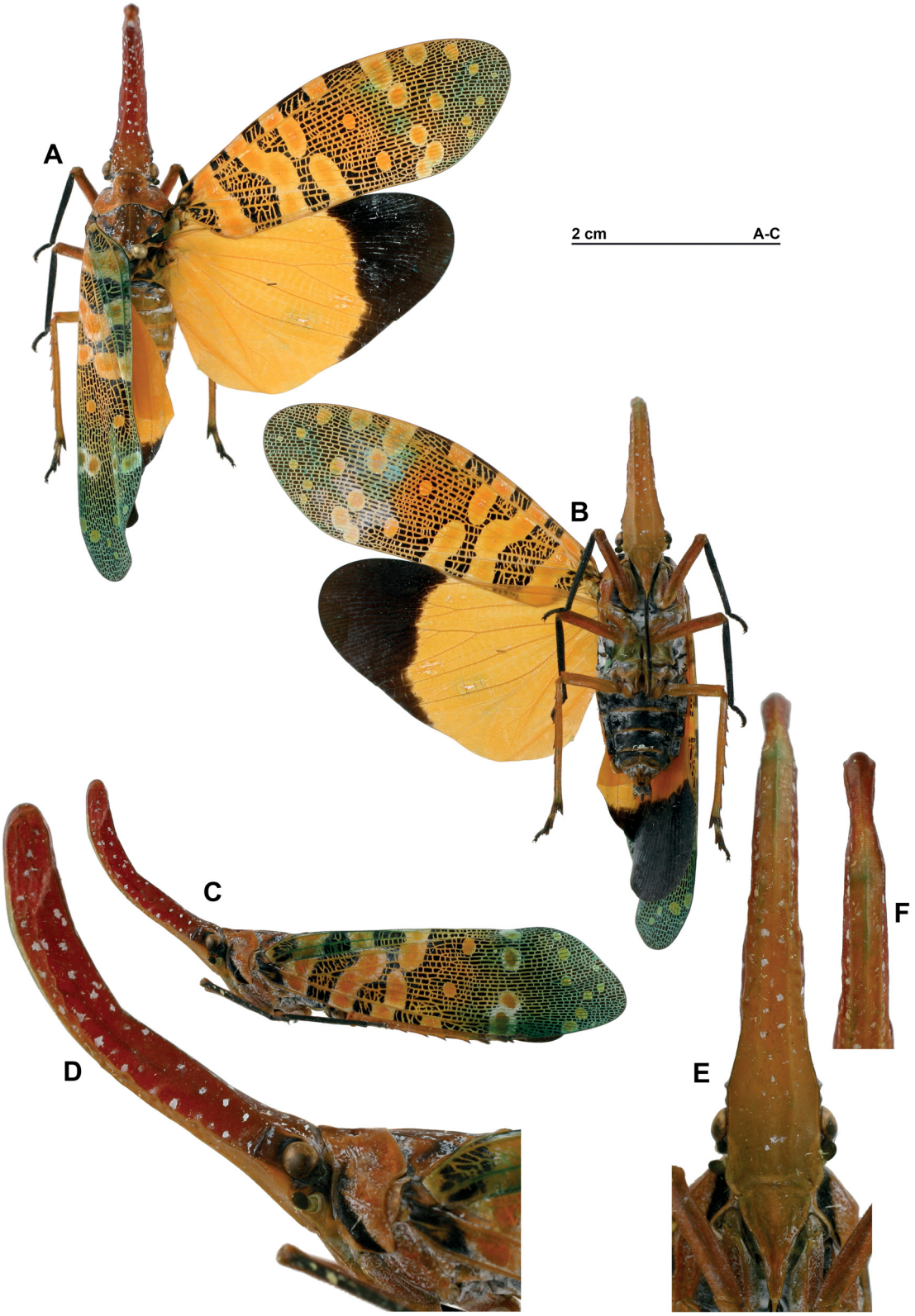

Fig. 16. *Pyrops candelaria* (Linné, 1758), ♀, Vietnam, Vinh Phuc Prov., Me Linh Biodiversity Station, 20–24 Aug. 2010 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

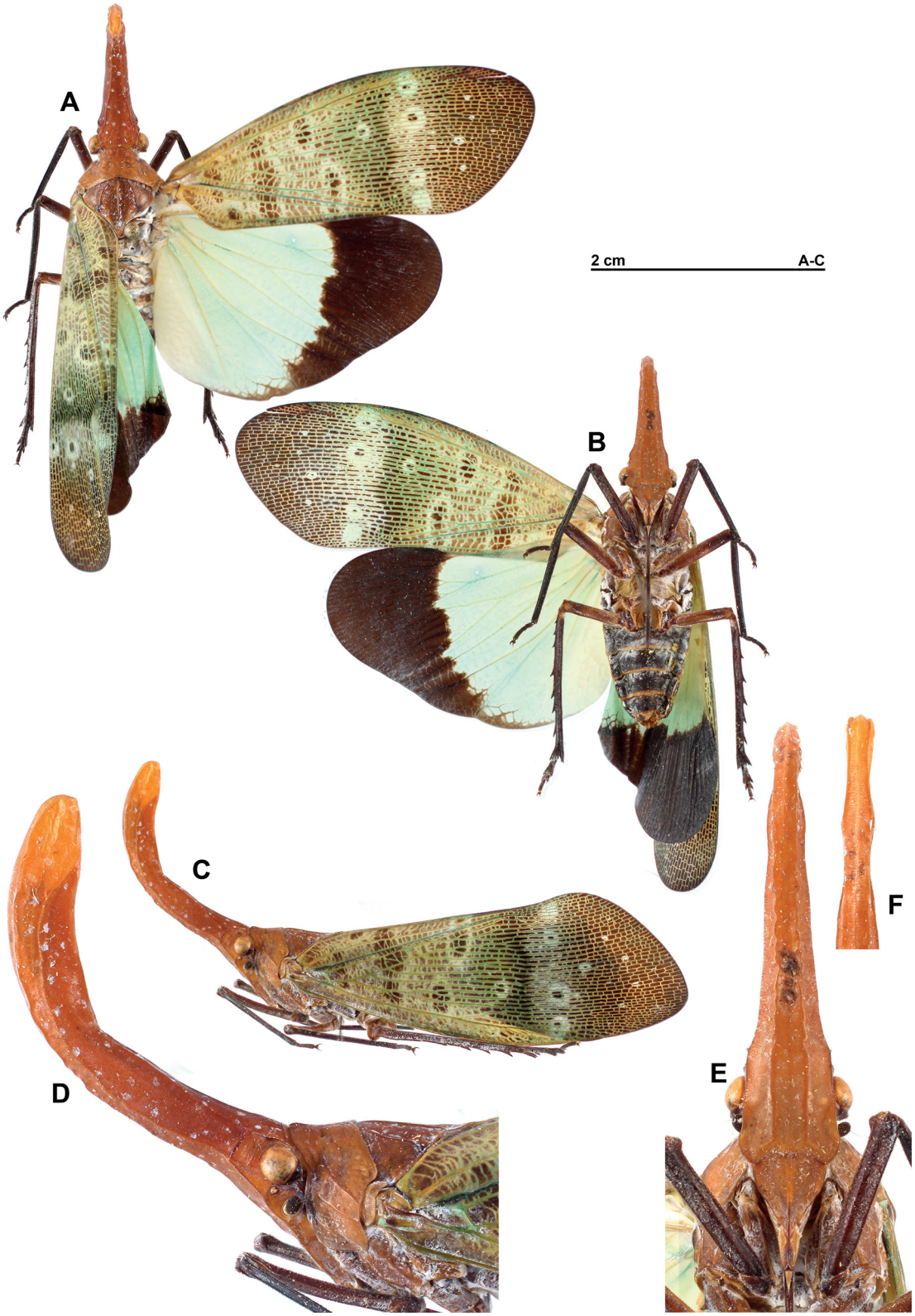

Fig. 17. *Pyrops ducalis* (Stål, 1863), ♂, Vietnam, Dong Nai Biosphere Reserve, 25 Jun.–6 Jul. 2012 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

Fig. 18. *Pyrops coelestinus* (Stål, 1863), ♀, Vietnam, Dong Nai Prov., Vinh Cuu, Phu Ly, 27 Jul. 2008 (VNMN). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

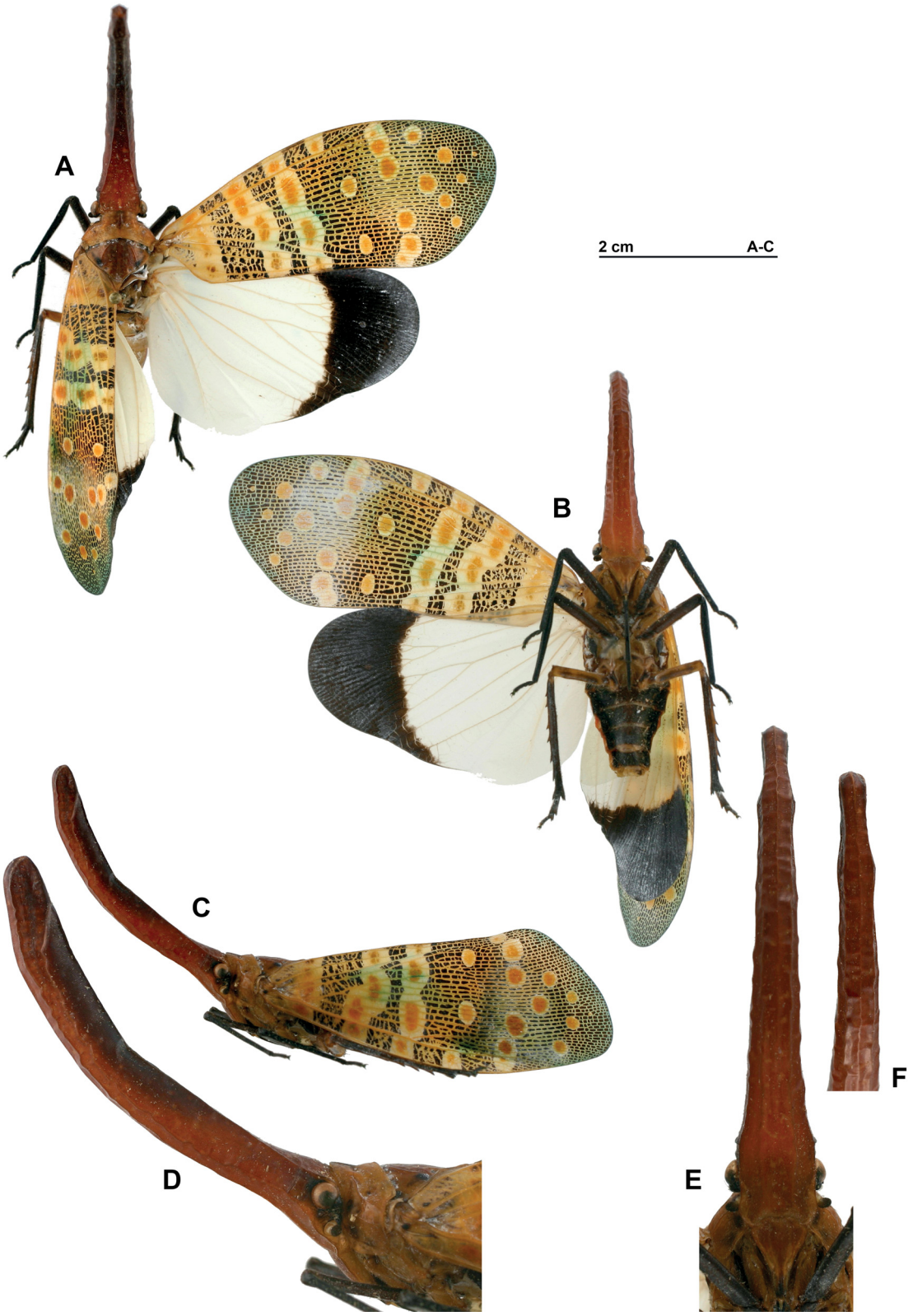

Fig. 19. *Pyrops vitalisius* (Distant, 1918), ♂, Vietnam, Ninh Binh Prov., Cuc Phuong N.P., 11–18 Jul. 2010 (RBINS). **A**. Habitus, dorsal view. **B**. Habitus, ventral view. **C**. Habitus, lateral view. **D**. Head and thorax, lateral view. **E**. Head, perpendicular view of frons. **F**. Apex of cephalic process, anteroventral view. D–F = not to scale.

Acknowledgements

We thank Mr Joachim Bresseel (RBINS), Mr Van Dat Nguyen (VNMN), Mr Xavier Vermeersch (RBINS), Mr Pol Limbourg (RBINS), Mr Thanh Trung Vu (VNMN), Mr Hoang Vu Tru (Institute of Ecology and Biological Resources, Hanoi, Vietnam) for their help and permanent enthusiasm during the collecting trips in Vietnam; Mr Bob Blinn (North Carolina State University, Raleigh, USA), Mrs Jeannine Bortels (FSAG), Mrs Valérie Lemaître (BMNH) and Mr Mick Webb (BMNH) for providing specimens, photographs, information and/or access to collections under their care; Miss Mado Berthet (RBINS) for improving the plates of habitus; Dr Frederik Hendrickx, Dr Patrick Grootaert, Dr Marie-Lucie Susini Ondafe and Dr Luc Janssens de Bisthoven (RBINS), Prof. Dr Trung Minh Nguyen (VNMN) and the authorities of the protected areas we were authorized to sample, for supporting our Global Taxonomy Initiative projects in Vietnam; Prof. Thierry Bourgoin (MNHN) and Prof. Murray J. Fletcher (Orange Agricultural Institute, Australia) for reviewing the manuscript. This paper is a result of the projects "A step further in the Entomodiversity of Vietnam" supported through grants issued by the capacity building Programme of the Belgian Global Taxonomy Initiative National Focal Point that runs under the CEBioS programme with financial support from the Belgian Directorate-General for Development Cooperation (DGD). The present study was also supported by the Vietnam National Foundation for Science and Technology Development (NAFOSTED), Vietnam for the second author.

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Manuscript received: 28 November 2021
Manuscript accepted: 19 January 2022
Published on: 15 April 2022
Topic editor: Tony Robillard
Section editor: Christopher H. Dietrich
Desk editor: Radka Rosenbaumová