

## Plant bugs of the tribe Orthotylini (Heteroptera: Miridae: Orthotylinae) in Thailand, with descriptions of five new species

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**Abstract.** Plant bugs of the tribe Orthotylini (Miridae: Orthotylinae) occurring in Thailand are documented, along with an annotated checklist and updated distributional records. Ten species in four genera, *Cyrtorhinus* Fieber, 1858, *Melanotrichus* Reuter, 1875, *Orthotylus* Fieber, 1858 and *Pseudoloxops* Kirkaldy, 1905 are now recognised. Five new species: *Cyrtorhinus indochinanus* new species, *Melanotrichus thaimaritimus* new species, *Pseudoloxops hibiscus* new species, *P. leopardalis* new species and *P. pardellus* new species, are described. Ten Asian species of *Orthotylus* are transferred to *Melanotrichus*. A key is provided to facilitate the identification of orthotyline genera and species known in Thailand. The faunal composition of the Thai Orthotylini is also discussed. Photographs of live individuals are shown for all treated species.

**Key words.** Heteroptera, Miridae, Orthotylini, new species, Thailand

### INTRODUCTION

Orthotylini is a large plant bug tribe in the subfamily Orthotylinae (Heteroptera: Miridae), comprising approximately 260 valid genera (including *Falconia* and *Zanchius* groups that evidently require tribal level status) (Cassis & Schuh, 2012; Forero, 2009). The taxa of this group are known globally but the majority occurs predominantly in the Holarctic Region (Schuh, 1995, 2002–2013). However, numerous undescribed taxa are still present in the southern hemisphere and Old World tropics, as indicated by recent works by Balukjian (2013), Eyles (2005), Hazali (2013), and Linnavuori (1994).

In Southeast Asia (from Indochina to Indonesia, west of the Wallacea), the orthotyline fauna (excluding taxa of *Zanchius* group) is relatively small, represented only by five genera, such as *Adfalconisca* Carvalho, 1983, *Cyrtorhinus* Fieber, 1858, *Melanotrichus* Reuter, 1875, *Orthotylus* Fieber, 1858, and *Pseudoloxops* Kirkaldy, 1905. Currently, four species in three genera, *Cyrtorhinus lividipennis* Reuter, 1885, *Orthotylus taksini* Yasunaga & Yamada, 2009, *Pseudoloxops ayutthaya* Yasunaga & Yamada, 2009, and *P. lateralis* (Poppus, 1915) are known from Thailand or Indochina (Yasunaga & Takai, 2017; Yasunaga & Yamada, 2009). In contrast, more than 50 species have been documented from the Indian subcontinent and the warm temperate and

subtropical climate zones in China, Japan and Taiwan (Distant, 1904, 1911; Liu & Zheng, 2014; Yasunaga, 1999; Yasunaga et al., 2001).

Continuing intensive field investigations in Thailand by the first author and several colleagues between 2008 and 2015 have hitherto yielded 10 species belonging to Orthotylini (sensu stricto), including five undescribed species. The present paper provides an annotated checklist of the taxa now known in Thailand and describes five new species: *Cyrtorhinus indochinanus* new species, *Melanotrichus thaimaritimus* new species, *Pseudoloxops hibiscus* new species, *P. leopardalis* new species and *P. pardellus* new species. A key is provided to facilitate the identification of orthotyline genera and species known in Thailand (and Indochina). The fauna of the tribe Orthotylini in Thailand and the taxonomic status of the genus *Melanotrichus* are discussed; 10 Asian species are transferred from *Orthotylus* to *Melanotrichus*.

### MATERIAL AND METHODS

Most of the specimens examined in this study were collected by the first author and his colleagues. The collecting site ‘Sakaerat Environmental Research Station, Sakaerat Biosphere Reserve, Ministry of Science and Technology, Nakhon Ratchasima Provinces, Thailand’, is abbreviated as ‘‘SERS’’, because many specimens treated in this paper were collected from this locality (<http://www.tistr.or.th/sakaerat/index.php>). The specimens examined are deposited in the following institutions and personal collections, unless otherwise stated:

AMNH: American Museum of Natural History, New York, USA

BMNH: Natural History Museum, London, UK

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CNC: Canadian National Collection, Ottawa, Ontario, Canada  
 DOAT: Entomology & Zoology Group, Plant Protection Research and Development Office, Department of Agriculture, Bangkok, Thailand  
 HNHM: Hungarian Natural History Museum, Budapest, Hungary  
 NIAES: Division of Informatics and Inventory, Institute of Agro-Environmental Sciences (NARO), Tsukuba, Ibaraki, Japan  
 NMNS: National Museum of Natural Science, Taichung, Taiwan  
 TYCN: T. Yasunaga Collection, Nagasaki, Japan

Matrix code labels are attached to the holotypes and some additional representative specimens, which uniquely identify each specimen, and are referred to as 'unique specimen identifiers' (USIs). The USI codes (e.g., AMNH\_PBI 012345) comprise an institution and project code (AMNH\_PBI) and a unique number (012345). These data were digitised on the Arthropod Easy Capture (formerly the Planetary Biodiversity Inventory) database maintained by the American Museum of Natural History, New York, USA (<http://research.amnh.org/pbi/>) and are also searchable on the 'Heteroptera Species Pages' (<http://research.amnh.org/pbi/heteropterasespeciespage/>). Images of the type series for species originally described from Taiwan are provided by NMNS on the website 'Integrated insect types database of Taiwanese species' (<http://twinsecttype.nmns.edu.tw/>); the permission to use Fig. 9K was given by NMNS (Drs. M. L. Chan and J. F. Tsai).

All measurements were made by ocular micrometer and are given in millimeters. The synonymic lists for known taxa are omitted, as comprehensive catalogs are now available (Aukema et al., 2013; Kerzhner & Josifov, 1999; Schuh, 1995; Schuh, 2002–2013 online catalog). Terminology of the genitalia principally follows Davis (1955), Schwartz (2011) and Yasunaga (1999). The following abbreviations are used in the text and figures. Pygophore and parameres: HP: hypophysis; LP: left paramere; PP: pygophoral (knoblike) process; RP: right paramere; SB: sensory lobe. Endosoma and adjacent structures: PT: phallosome; SD: seminal duct. Female genitalia: DLP: dorsal labiate plate; DOS: dorsal structure; IRL: interramal lobe; IRS: interramal sclerite; PWB: posterior wall of bursa copulatrix; RMP: ramal plate; RA1, RA2: ramus of 1st or 2nd valvula; SCR: sclerotised ring; VA1, VA2: 1st or 2nd valvula; and VLP: ventral labiate plate.

## TAXONOMY

### Tribe Orthotylini Van Duzee, 1916

**Discussion.** The subfamily Orthotylinae is currently composed of six tribes, but Cassis & Schuh (2012) argued that the definition of the nominotypical tribe Orthotylini was uncertain due to the presence of paraphyletic groups. Many taxa within the Orthotylini possess significantly enlarged male parameres (comparing with small pygophore, cf. Figs. 2A, D, 11A), and uniquely developed male endosomal sclerites (Fig.

10H) and female interramal lobes (Fig. 12A, C). Schuh (1974) suggested a number of recognisable natural groups, including *Zanchius* and its allied genera in the Orthotylini. We have sampled numerous Oriental taxa belonging to the *Zanchius* group (e.g., *Zanchius* Distant, 1904; *Itacorides* Miyamoto, 1965; *Latizanchius* Lu & Zheng, 2001; *Malaccocorisella* Yasunaga, 1999). Nonetheless, we will treat these taxa separately in our subsequent work (Duwal & Yasunaga in prep), as *Zanchius* group should belong to a distinct tribe (Cassis & Schuh, 2012). Species of the *Zanchius* group have unique characters that are obviously different from those of other orthotyline members, e.g., dorsally flattened head with small, anteriorly directed eyes removed from pronotum, delicate, often semitransparent forewings (Fig. 8I), and largely membranous endosoma with simple spiculi. Most species of the *Zanchius* group are considered to be predators preying predominantly on auchenorrhynchans (e.g., Liu & Zheng, 2014; Yasunaga, 1999; Yasunaga et al., 2001).

The fauna of the Orthotylini in Thailand and neighbouring countries of Indochina appears less speciose, compared with those revealed in other regions of the Old World and Pacific islands. Among more than 300 mirid species found mostly in Thailand, only 10 belong to Orthotylini. Based on available records, we presume that the Himalayas and adjacent ranges may be rich in Orthotylini. A relatively large number of Orthotylini taxa occur in southwest China, north of the Himalayan range (Liu & Zheng, 2014) and subalpine zones of Nepal (Yasunaga & Duwal, unpublished data). Four genera, *Orthotylus*, *Cyrtorhinus*, *Melanotrichus* and *Pseudoloxops*, are now recognised in Thailand (also in Indochina); all of these are widely distributed in the Old World. Owing to the lack of Palearctic element, the Indochinese orthotyline fauna is assumed to be represented primarily by a small minority of cosmopolitan taxa (e.g., *Cyrtorhinus*, *Orthotylus*). Among 10 described species of *Cyrtorhinus*, *C. caricis* (Fallén, 1807) is the only cool temperate zone inhabitant; eight congeners are known from Africa and Oceania (Schuh, 2002–2014); and *C. lividipennis* is widely dispersed over the Indo-Pacific region and temperate eastern Asia, possibly attributable to its unique ability for long-distance aerial migration (see Drake & Reynolds, 2012; Riley et al., 1987; Yasunaga, 1999). The finding of a new species in the present paper, *C. indochinanus*, presumed to be indigenous to Indochina, is significant.

*Orthotylus* is one of the largest genera in the family Miridae, with more than 250 described species worldwide; remarkable adaptive radiation has been documented in the Hawaii Islands, the Ethiopian and the western Palearctic Regions (Schuh, 2002–2014). Eight subgenera were proposed for classification of the Old World members (Kerzhner & Josifov, 1999), but they are not applicable to the tropical and New World species, and some of them evidently require generic rank. *Melanotrichus* was originally proposed as a subgenus of *Orthotylus* (see Reuter, 1875). However, the monophyly of this group is well supported by the unique characters obviously different from those exhibited by the nominotypical *Orthotylus* or other related genera (tiny size; presence of both dark simple setae and sericeous scalelike setae; small

eyes; short male parameres; and simple endosoma, cf. Figs. 4, 5). Thus, *Melanotrichus* was already upgraded to generic rank (e.g., Henry & Wheeler, 1988; Wheeler & Henry, 1992). The preponderance of the evidence suggests that *Melanotrichus* should be treated as an independent genus, although it is clear that a comprehensive revision of these widespread taxa is needed. According to this classification of *Melanotrichus*, we propose the following new combinations for species occurring in the Oriental and eastern Palearctic regions (all transferred from *Orthotylus*): *Melanotrichus choii* (Josifov, 1976), new combination; *M. convexus* (Liu & Zheng, 2014), new combination; *M. elegantulus* (Liu & Zheng, 2014), new combination; *M. leukus* (Liu & Zheng, 2014), new combination; *M. longulus* (Liu & Zheng, 2014), new combination; *M. minutus* (Jakovlev, 1877), new combination; *M. orientalis* (Poppius, 1915), new combination; *M. parvulus* (Reuter, 1879), new combination; *M. rubidus* (Puton, 1874), new combination; and *M. schoberiae* (Reuter, 1876), new combination.

*Pseudoloxops* was originally proposed for a single European species, *P. coccineus* (Meyer-Dür, 1843). Subsequent workers described more than 40 species; the majority of congeners are known from the Pacific islands where the genus is considered to have radiated extensively, with many species that remain undescribed (Balukjian, 2013; Hazali, 2013; Schuh, 2002–2014). In the Oriental Region, including subtropical climate zone of eastern Asia, *Pseudoloxops* is represented by 10 species (Liu & Zheng, 2014; Yasunaga & Takai, 2017; Yasunaga et al., 2001). This work adds three new species to the Thai fauna. Many congeners exhibit two-tone, brilliant yellow-rouge pattern and species identification is usually performed by the external characters alone. However, the monophyly of *Pseudoloxops* is still uncertain because of excessive interspecific variation in the male genitalia (cf. Fig. 10).

**ANNOTATED CHECKLIST OF THE TRIBE  
ORTHOTYLINI KNOWN FROM THAILAND**  
(New distributional records indicated by an asterisk\*)

**Tribe Orthotylini Van Duzee, 1916**

**Genus *Cyrtorhinus* Fieber 1858**

- C. indochinanus* Yasunaga, new species — Thailand (Nakhon Nayok, Nakhon Ratchasima), Myanmar (Yangon).  
*C. lividipennis* Reuter, 1885 (Figs. 1C, D, 2A–C, 3A, B, 6C, D) — Thailand (almost the whole country), Cambodia\* (Siem Reap), China, India, Indonesia, Laos\* (Vientiane), Korea, Myanmar\* (Ayeyawady, Yangon), Malaysia, Nepal\* (Kathmandu Valley), Philippines, Sri Lanka, Taiwan, Vietnam; widely known from the Indo-Pacific. Note: This famous predator of economically important cicadellid and delphacid rice pests is known to migrate from eastern Indochina or southeastern China to Japan and Taiwan over the East China Sea, availing of the summer (southwest or west-southwest) monsoon, along with migrant populations of the prey leafhoppers.

**Genus *Melanotrichus* Reuter, 1875**

- M. thaimaritimus* Yasunaga, new species — Thailand (coasts along the Gulf of Siam, with vegetation of *Sueada maritima*: Bangkok, Chon Buri, Samut Prakan, Samut Sakhon).

**Genus *Orthotylus* Fieber, 1858**

- Orthotylus taksini* Yasunaga & Yamada, 2009 (Fig. 1E, F) — Thailand (Chaiyaphum\*, Nakhon Nayok\*, Nakhon Ratchasima). Note: This is a typical member of *Orthotylus*, most closely related to eastern Palearctic *O. fuscipennis* Yasunaga or *O. kurilensis* Kerzhner, judging from the small size, and similar shape of the male and female genitalia; *O. taksini* is presumed to have been isolated in Indochina from a Palearctic lineage after the Pleistocene, as supposed for *Psallus buddha* Yasunaga, 2010 (Phylinae), a single tropical Oriental species within the large Palearctic genus *Psallus* Fieber, 1858 (Yasunaga, 2010).

**Genus *Pseudoloxops* Kirkaldy, 1905**

- P. ayutthaya* Yasunaga & Yamada, 2009 (Fig. 8A–C) — Thailand (Nakhon Ratchasima\*, Phranakhon-Sri-Ayutthaya). Note: This uniquely pale green species is known to be associated with inflorescence of a fabaceous broadleaf, *Leucaena* sp. (Fig. 8A, B); the final-instar immature form has the reddish margins of pronotum (Fig. 8C).  
*P. hibiscus* Yasunaga, new species — Thailand (Rayong: Ban Phe coast).  
*P. lateralis* (Poppius, 1915) (Figs. 7C, D, 9C, D, K, 10E, F) — Thailand (Chaiyaphum\*, Mae Hong Son\*, Nakhon Ratchasima), Taiwan. Note: This species was recently reported from Thailand and is suspected to be a senior synonym of *P. marginatus* Zou, 1987 known from Hainan Island, China (Yasunaga & Takai, 2017).  
*P. leopardalis* Yasunaga, new species — Thailand (Nakhon Ratchasima).  
*P. pardellus* Yasunaga, new species — Thailand (Chaiyaphum, Nakhon Ratchasima).  
*P. pericarti* Yasunaga & Yamada, 2009 (Fig. 8D) — Thailand (Nakhon Ratchasima).

**KEY TO GENERA AND SPECIES OF  
ORTHOTYLINI IN THAILAND**

1. Antennal segment II entirely (or at least basal half) fuscous; pronotum somewhat campanulate, with anterior half (lateral margin of calli) constricted, distinctly demarcated from posterior half; scutellum pale, with a fuscous, longitudinal mesal stripe ..... 2 (*Cyrtorhinus*)  
 – Antennal segment II pale brown, creamy yellow or pale green, sometimes with a few pale red rings; pronotum not constricted, trapeziform; scutellum sometimes with orange-red mark but without any dark stripe ..... 3
2. Antennal segment I about as long as mesal length of head in dorsal view (cf. Fig. 1C); calli usually shiny pale brown; inner margin of clavus pale; each tibia almost uniformly pale, without dark base (or faintly with tiny spot at knee in some specimens as in Fig. 1D); abdomen pale, without dark lateral margin (Fig. 6C, D) ..... *Cyrtorhinus lividipennis*  
 – Antennal segment I distinctly longer than mesal length of head in dorsal view (cf. Fig. 1C); calli usually brown or fuscous; inner margin of clavus narrowly infuscate (Fig. 1A); base of each tibia always infuscate; abdomen usually with darkened lateral margin (Fig. 6A, B) ..... *C. indochinanus*, new species



3. Antennal segment I pale brown or pale green as in other parts of body.....4  
 – Antennal segment I deep red, sanguineous or fuscous.....5 (*Pseudoloxops*)
4. Dorsal surface with both silvery scalelike setae and dark simple setae; labium short, not reaching apex of mesocoxa; monophagous, restricted to halophilic *Sueada maritima* along coastal zones of the Gulf of Siam (Fig. 4H).....  
 .....*Melanotrichus thaimaritimus*, new species  
 – Dorsal surface with brownish simple setae only, lacking scalelike setae (Fig. 1E, F); labium long, reaching apex of metacoxa; inhabiting broadleaf forests.....*Orthotylus taksini*
5. Dorsal surface partly or uniformly scattered with reddish or brownish, small spots .....6  
 – Dorsal surface shiny and smooth, lacking such scattered spots.....8
6. Dorsum generally pale brown, without distinctive red or sanguineous pattern; embolium and cuneus uniformly pale brown (Fig. 8D, E).....*Pseudoloxops pericarti*  
 – Dorsum clearly bicolourous (rouge and yellow); embolium and cuneus largely rouge or sanguineous.....7
7. Antennal segments II and III uniformly creamy yellow, lacking reddish ring or stripe; apical half of scutellum (except for extreme apex) yellowish; reddish pattern on hemelytron densely spotted, not M-shaped (Fig 7E)...*P. leopardalis*, new species  
 – Antennal segments II and III more or less with pale reddish rings; apical half of scutellum with orange-red mark; reddish pattern on hemelytron usually forming clear M-shape (Fig. 8F–H).....*P. pardellus*, new species
8. Embolium sanguineous or deep red (Figs. 7C, D, 9K).....  
 .....*P. lateralis*  
 – Embolium pale green (pale brown in dried specimens).....9
9. Pronotum and hemelytron uniformly shiny pale green, immaculate (Fig. 8A, B); associated with *Leucaena* sp. (Fabaceae).....*P. ayuthaya*  
 – Lateral margin of pronotum and apex of cuneus darkened (Fig. 7A, B); inhabiting *Hibiscus tiliaceus* L. (Malvaceae) at seashore (Fig. 4I).....*P. hibiscus*, new species

**DESCRIPTIONS OF NEW SPECIES**

*Cyrtorhinus indochinanus*, new species  
 (Figs. 1A–C, 2D–G, 3C, D, 6A, B)

**Material examined.** Holotype male, THAILAND: Nakhon Nayok, Sarika, N14°18'07" E101°18'09", at light, 14–15 December 2011, T. Yasunaga (DOAT) (AMNH\_PBI 00380548). Paratypes: THAILAND: Nakhon Nayok, same data as for holotype, 4 females (TYCN); same data, except for date 19–20 December 2010, T. Yasunaga, 1 male, 11 females (AMNH, CNC, TYCN); Nakhon Ratchasima, SERS, N14°30'27" E101°55'39", 410 m alt., light trap, 21 August 2008, T. Yasunaga & B. Shishido, 2 females (TYCN) (00380549); same locality, light trap, 26 February 2009, T. Yasunaga, 1 female (TYCN); same locality, light trap, 24 December 2012, T. Yasunaga, 1 female (TYCN).

**Additional specimen.** MYANMAR: Yangon, Mingaladon Township, W shore of Hlowga Lake, N16°59'55" E96°05'51", on Cyperaceae sedge, 31 March 2015, T. Yasunaga, 1 female (TYCN) (00380550).

**Diagnosis.** Recognised by the comparatively large size (Fig. 1C); olive green general colouration (Fig. 1A, B); largely fuscous head and pronotum; fuscous spot at base of each tibia (at knee, Fig. 1A–C); pale ventral surface of abdomen usually with a dark margin (Fig. 6A, B); and well-developed, elongate parameres (Fig. 2D–G) and ovipositor (Fig. 3C).

**Description.** Body generally fuscous with olive green hemelytron, comparatively large, elongate oval, (in male) parallel-sided; dorsal surface weakly shiny, with uniformly distributed, simple, short setae. Head brown to fuscous, matte, shorter than antennal segment I in dorsal view (Fig. 1C); eyes somewhat projected laterally. Antenna blackish brown; apex of each segment I and II whitish brown; apical half of segment II sometimes brown; segments III and IV filiform. Labium shiny pale brown, reaching or slightly exceeding apex of mesocoxa; apex of segment IV darkened. Pronotum rather matte, campanulate, constricted at anterior half, with calli, short mesal stripe and posterior corner more or less pale in female; scutellum with clear, fuscous, mesal stripe; pleura largely fuscous, except for creamy yellow scent efferent system. Hemelytron shiny, fading to yellowish or stramineous in dry-preserved specimen; membrane dark smoky, with semitransparent posterior half. Coxae and legs pale stramineous or yellowish brown (Fig. 6A, B); all femora pale green in live or fresh specimen (Fig. 1A–C); base of each tibia with a clear fuscous spot; each tarsomere III darkened apically. Abdomen greenish white (light yellow brown in dried specimen, Fig. 6B), darkened laterally. Male genitalia (Fig. 2D–G): Pygophore bullet-shaped, somewhat bulbous; parameres symmetrical in general shape (Fig. 2D, E); hypophysis of right paramere thumb-like, not margined (Fig. 2G); endosoma simple, nearly straight (Fig. 2D). Female genitalia (Fig. 3C, D): Generally large-sized; ovipositor elongate, with sharp, saw-edged valvula I (Fig. 3C); interramal lobe developed, spinulate on its entire surface (Fig. 3D).

**Measurements.** Male/female: Total body length 2.94–3.09/3.25–3.39; width of head across eyes 0.69–0.71/0.71–0.74; width of vertex 0.29–0.30/0.33–0.35; lengths of antennal segments I–IV 0.45–0.50, 1.20–1.35, 1.05–1.26, 0.75/0.40–0.43, 1.06–1.08, 1.02–1.05, 0.69–0.74; total length of labium 1.03–1.07/1.06–1.10; basal width of pronotum 0.81–0.84/0.93–0.96; maximum width across hemelytra 0.97–1.05/1.15–1.47; and lengths of metafemur, tibia and tarsus 1.20–1.35, 1.63–1.67, 0.43–0.45/1.20–1.32, 1.63–1.68, 0.40–0.42.

**Etymology.** Named for its occurrence in Indochina (Thailand and Myanmar); Latinised as an adjective.

**Biology.** Unknown; all available specimens were collected using UV light traps, except for one adult female that was found on sedge at lakeside in Yangon, Myanmar.



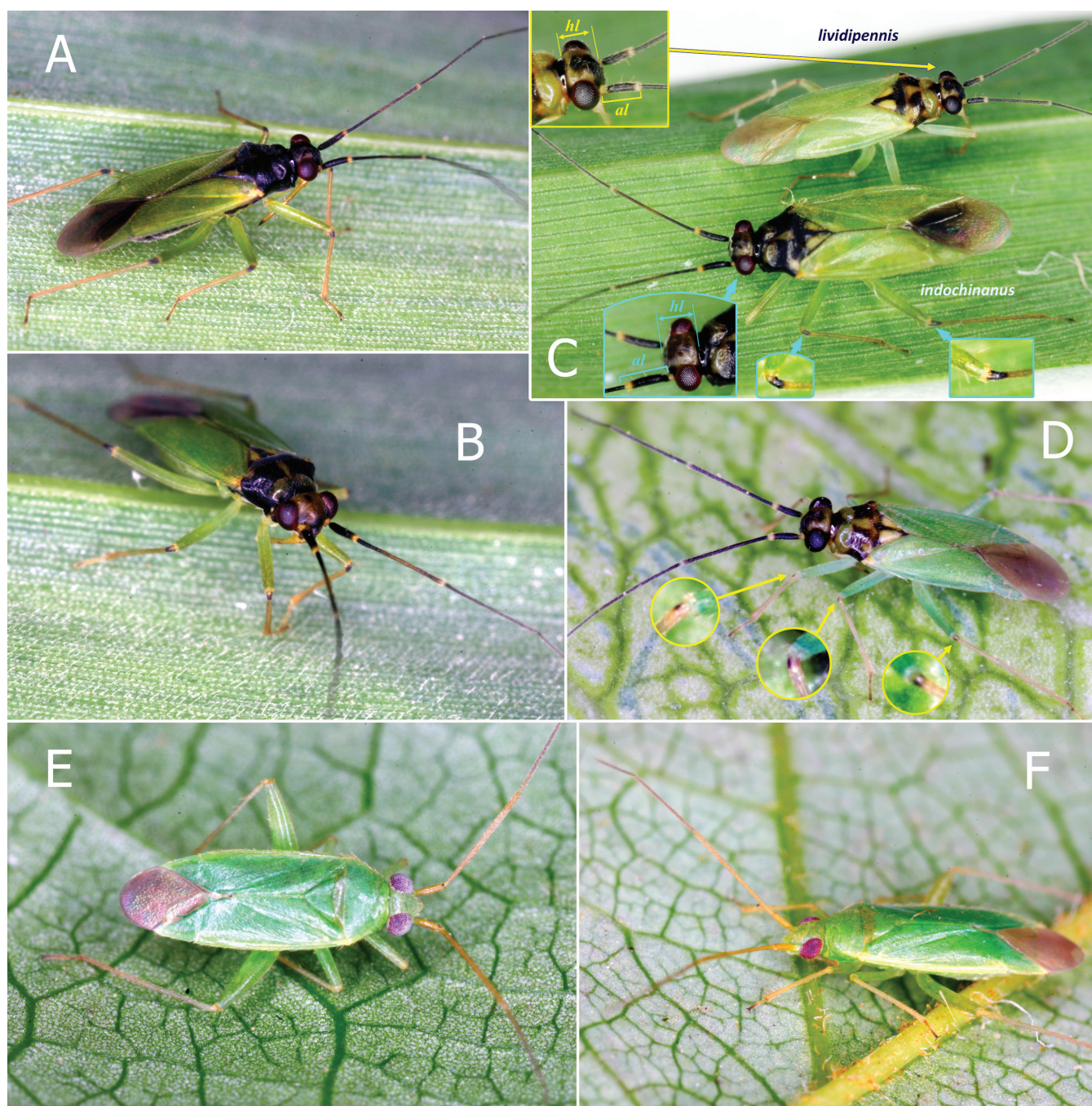


Fig. 1. Habitus images of Thai orthotylini. A, *Cyrtorhinus indochinanus*, male (Nakhon Nayok); B, *Cyrtorhinus indochinanus*, female; C, *Cyrtorhinus indochinanus*, female (lower) with *C. lividipennis*, female (SERS); D, *C. lividipennis*, male (SERS); E, *Orthotylyus taksini*, male (SERS); F, *Orthotylyus taksini*, female (SERS).

**Remarks.** Based on the similar general appearance and genitalic structures, this new species appears to be most closely related to *C. lividipennis* (cf. Fig. 1C), from which *C. indochinanus* can be distinguished by the characters mentioned in the key, and the bulbous pygophore, larger parameres, and elongate ovipositor (1.5 times as long as that of *C. lividipennis*) with sharpened valvula I.

One female specimen from Myanmar (not included in the type series) has a generally paler head and pronotum; it is currently considered simply as a pale variant. This individual was captured by sweep-netting sedge, together with a few delphacid planthoppers.

***Melanotrichus thaimaritimus*, new species**  
(Figs. 4A–H, 5, 6E–H)

**Material examined.** Holotype male, THAILAND: Samut Prakan, Bang Pu, N13°31'07" E100°38'57"E, sweep-netting *Sueada maritima*, 21 December 2011, T. Yasunaga (AMNH\_PBI 00380551) (DOAT). Paratypes: THAILAND: Bangkok, Choen Tha Phae, N13°33'02" E100°25'20", *Sueada maritima*, 20 December 2011, T. Yasunaga, 2 males, 1 female (TYCN); Samut Prakan, same data as for holotype, except for date 15 June 2013, 10 males, 3 females (TYCN); same data, except for date 19 September 2013, 17 males, 18 females & 8 October 2013, 3 males, 7 females (DOAT,



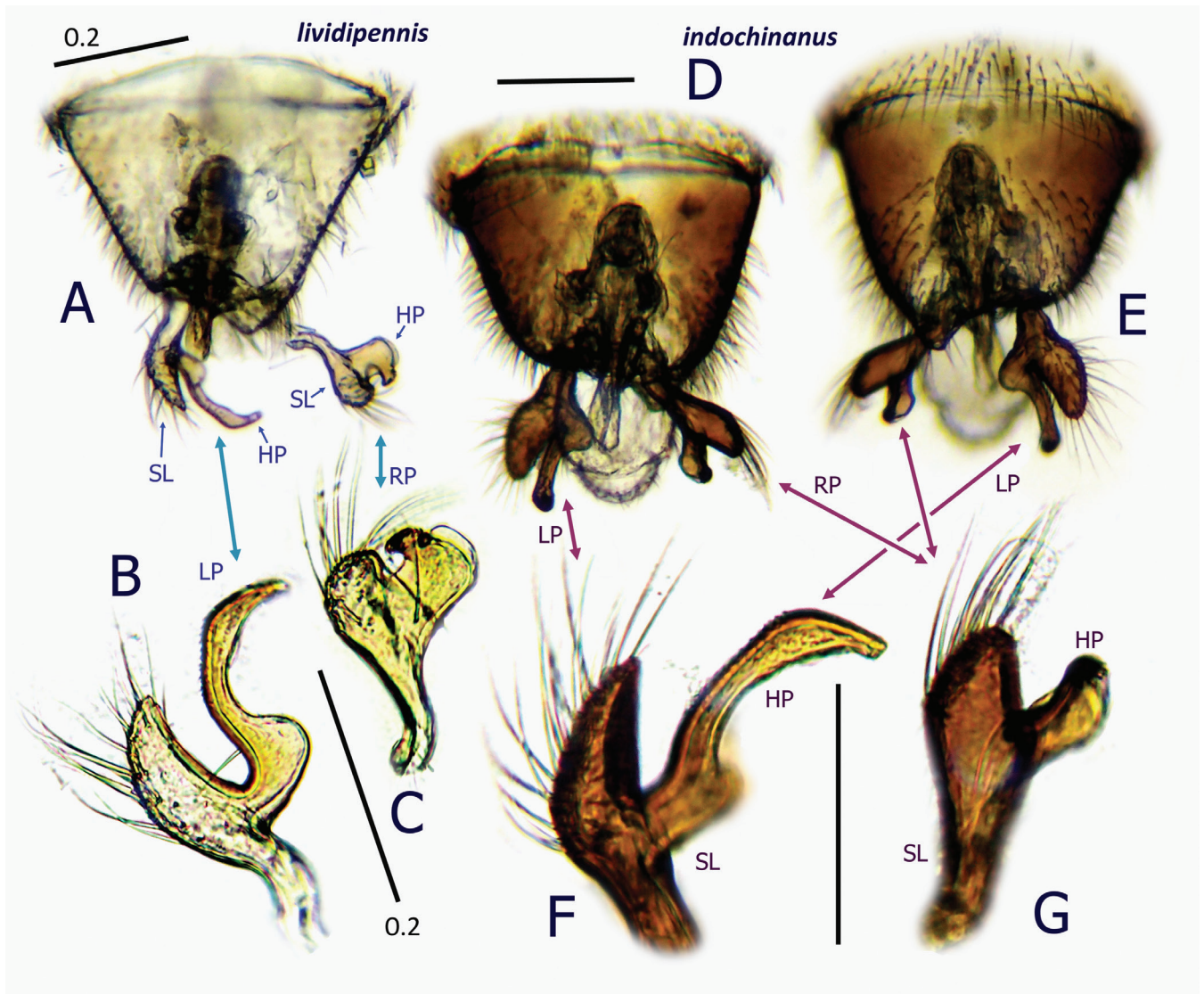


Fig. 2. Male genitalia of *Cyrtorhinus* species. A–C, *Cyrtorhinus lividipennis*; D–G, *C. indochinanus*. A, D, Pygophore, dorsal view; E, Pygophore, ventral view; B, F, right paramere; C, G, left paramere. Scale bars = 0.2 mm.

TYCN); Chon Buri, Bang Saen, N13°18'11.5" E100°55'08.8", *Sueada maritima*, 27–28 March 2010, T. Yasunaga, 33 males, 43 females (AMNH, CNC, TYCN) (3 females, 00380552).

**Diagnosis.** Recognised by small, elongate oval (male) or suboval (female) body; uniformly pale green basic colouration (but easily fading to pale brown after preservation, cf. Fig. 6E vs. 6F); densely distributed sericeous, reclining, scalelike setae (but easily rubbed off as in Fig. 6E, F); small eyes; short labium reaching middle of mesocoxa; C-shaped left paramere with blunt-tipped hypophysis and broad sensory lobe (Fig. 5A); inflated sensory lobe and rather wide hypophysis of right paramere; and developed female interramal lobe (Fig. 5E).

**Description.** Body generally pale green but partly or entirely stramineous brown in dry-preserved specimen, small, elongate oval (male) or suboval (female); dorsal surface weakly shiny, with densely distributed, sericeous, reclining, scalelike setae and sparsely distributed, simple, brown, semierect setae. Head short, slightly pointed in front; eyes small. Antenna pale reddish brown; segment I pale green in

live or fresh specimen; segment II longer than basal width of pronotum. Labium shiny pale brown, short, reaching middle of mesocoxa; apex of segment IV darkened. Pronotum and hemelytron shiny if sericeous setae rubbed off (Fig. 6F); membrane semitransparent, with more or less smoky posterior part. Coxae and legs pale brown but pale green in live or fresh specimen; all tibia and tarsi pale brown; apex of each tarsus darkened. Male genitalia (Fig. 5A–C): left paramere curled, C-shaped, with blunt-tipped hypophysis and broad sensory lobe (Fig. 5A); right paramere with inflated sensory lobe and rather wide hypophysis; endosoma simple. Female genitalia (Fig. 5D–F): Sclerotised ring decrescent, very tiny (Fig. 5D); posterior wall with developed interramal lobe (Fig. 5E).

**Measurements.** Male/female: Total body length 2.45–2.60/2.64–2.77; width of head across eyes 0.55–0.59/0.60–0.62; width of vertex 0.28–0.30/0.37–0.38; lengths of antennal segments I–IV 0.19–0.23, 0.76–0.84, 0.65–0.72, 0.27–0.30/0.19–0.23, 0.76–0.89, 0.75–0.77, 0.33–0.36; total length of labium 0.58–0.60/0.67–0.71; basal width

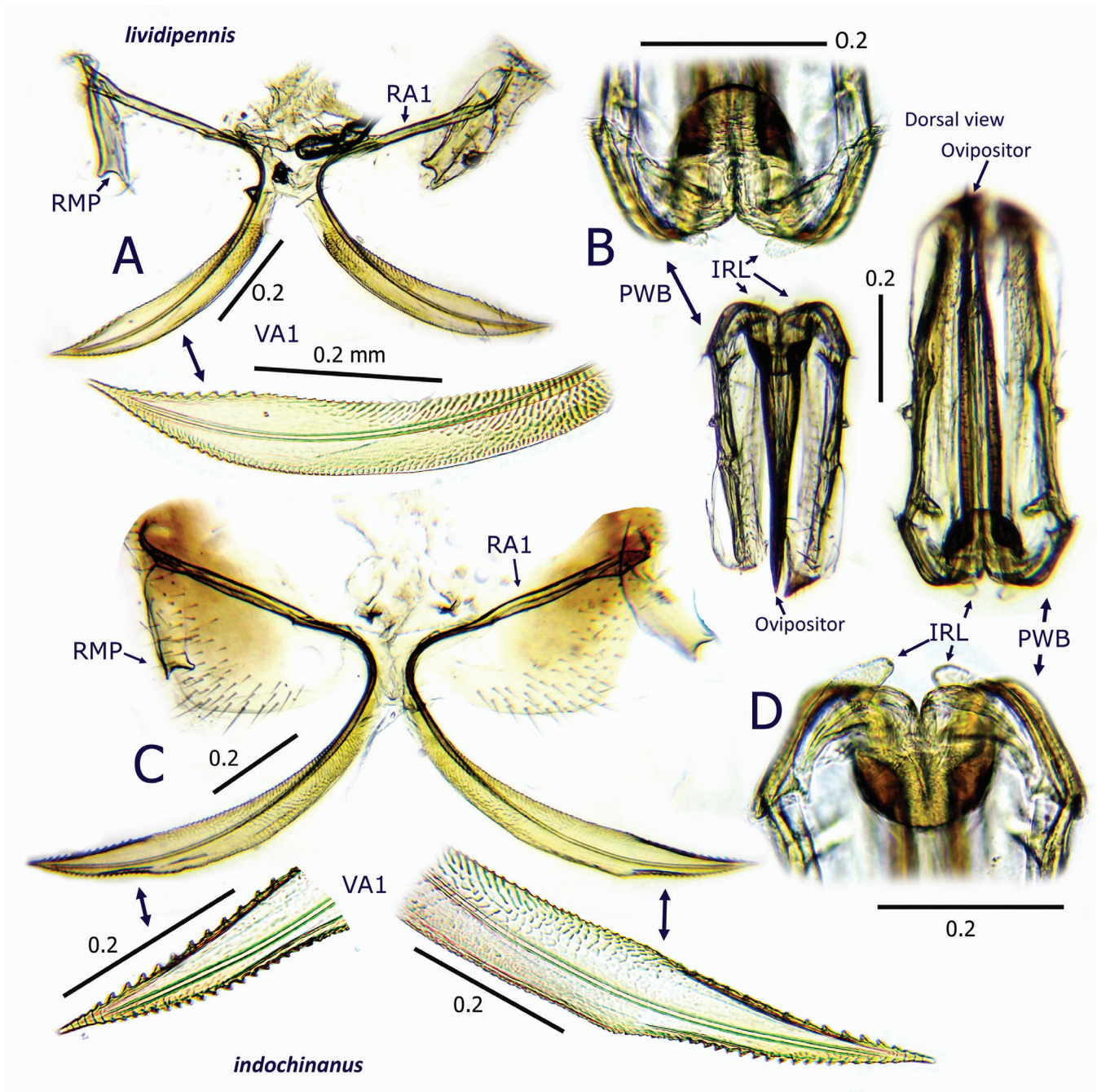


Fig. 3. Female genitalia of *Cyrtorhinus* species. A, B, *Cyrtorhinus lividipennis*; C, D, *C. indochinanus*. Scale bars = 0.2 mm.

of pronotum 0.73–0.77/0.73–0.78; maximum width across hemelytra 0.88–0.92/0.97–1.08; and lengths of metafemur, tibia and tarsus 0.87–0.90, 1.14–1.17, 0.34–0.38/0.88–0.92, 1.18–1.26, 0.39–0.42.

**Etymology.** Named for Thailand, in combination with the Latin adjective *maritimus* [= of the sea], referring to the unique halophilic habitat of this new species; an adjective.

**Biology.** This species was confirmed to be associated with the breeding host *Sueada maritima* (L.) Dumort (Amaranthaceae) along the northern coast of the Gulf of Siam (Fig. 4H). Both adults (Fig. 4A–D) and immature forms (Fig. 4E–G) were seen almost throughout a year, and this mirid is thus assumed to have a multivoltine life cycle. However, populations were

observed to decrease in the late dry season (January through February) and the hot summer season (April through May). Recently, rapid urbanisation and development of beach resorts seriously threaten and reduce the limited habitats (*Sueada maritima* vegetation) for this plant bug; this halophyte is officially designated as an endangered plant in southeastern Japan (Shishido & Yasunaga, 2016).

**Remarks.** Judging from the similarly small size and C-shaped left paramere, this new species is assumed to be sister to *M. choui* (Josifov, 1976) known to inhabit *Saricornia* spp. and *Sueada maritima* in Korea, northeastern China and southwestern Japan (Hyogo and Nagasaki Prefectures) (Shishido & Yasunaga, 2016). However, the latter species, inhabitant of temperate and cool temperate climate zones,



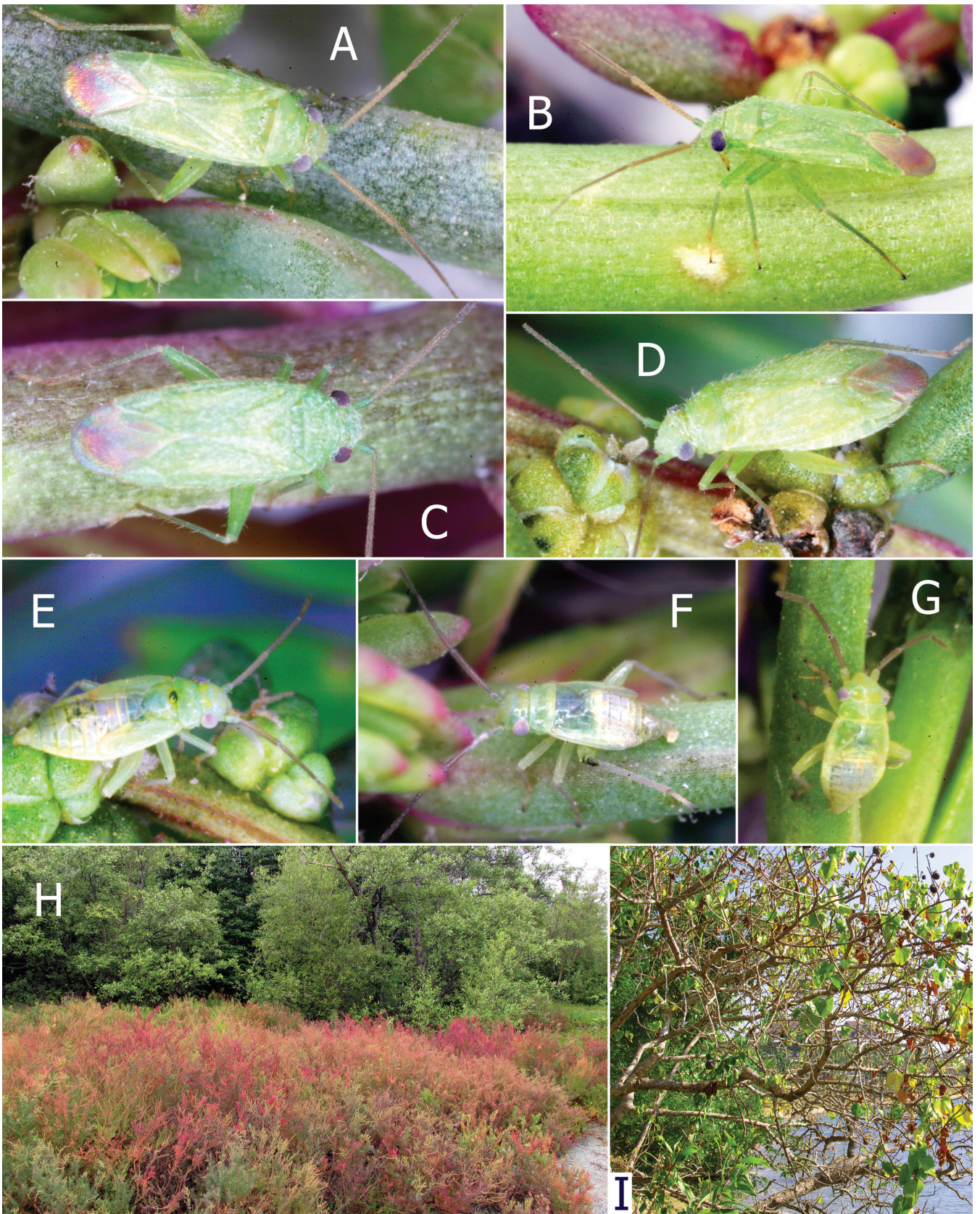


Fig. 4. Habitus (A–G) and habitat (H, I) images of Thai ortotyline. A, B, *Melanotrichus thaimaritimus*, adult male; C, D, *M. thaimaritimus*, adult female; E, *M. thaimaritimus*, male final-instar nymph; F, *M. thaimaritimus*, female final-instar nymph; G, 3rd instar nymph; H, colony of a halophyte, *Sueada maritima* (Bang Pu, Samut Prakan), habitat of *M. thaimaritimus* (Bang Pu, Samut Prakan); I, *Hibiscus tiliaceus* tree (Ban Phe, Rayong), on which *Pseudoloxops hibiscus* was found.



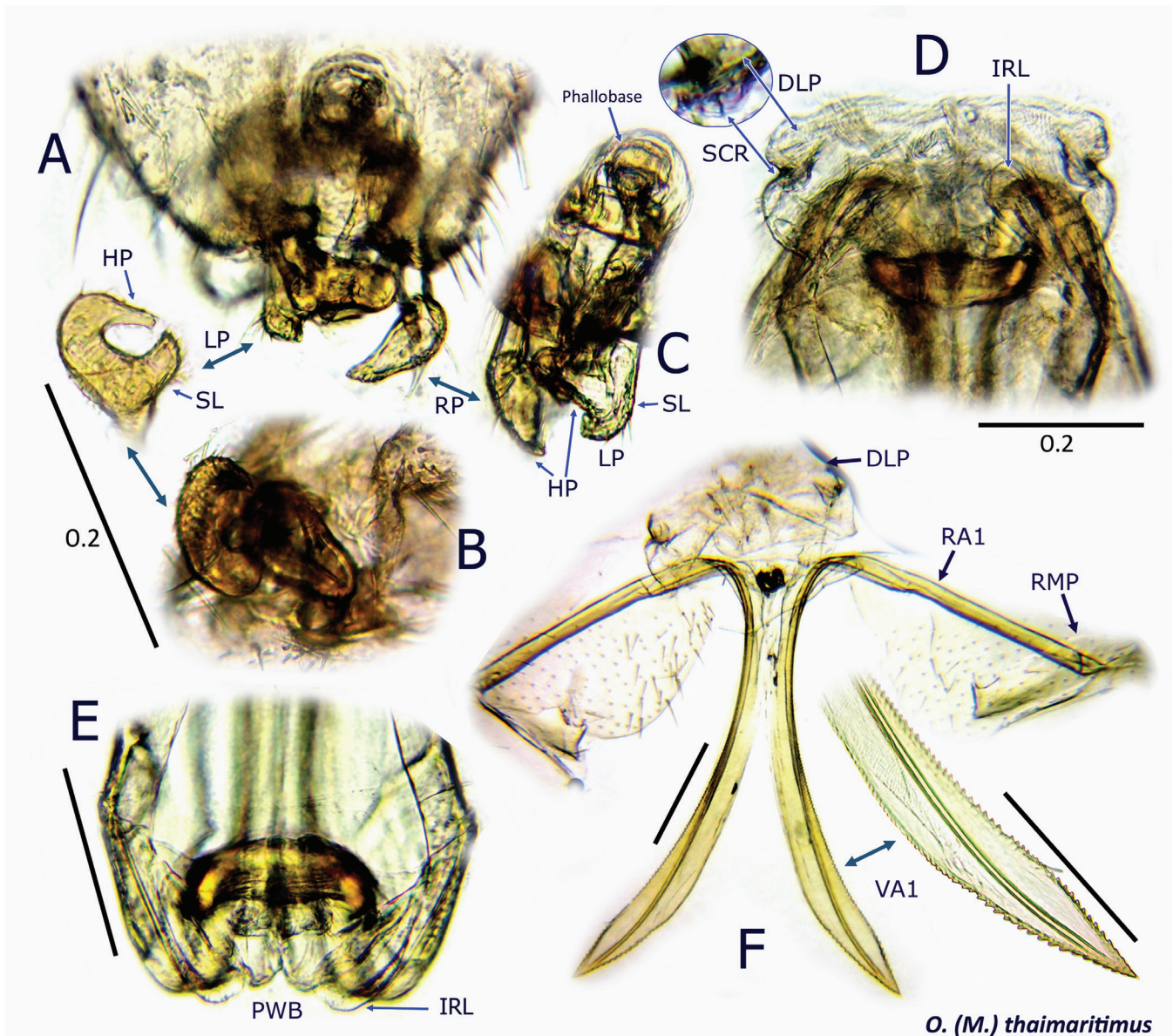


Fig. 5. Male (A–C) and female (D–F) genitalia of *Melanotrichus thaimaritimus*. A, Pygophore with parameres, dorsal view; B, Pygophore with parameres, caudal view; C, Pygophore with parameres, ventral view; D, bursa copulatrix, dorsal view; E, posterior wall, anterior view; F, bursae and valvulae in ventral view. Scale bars = 0.2 mm.

has the shorter antennal segment II (less than basal width of pronotum), more strongly curled left paramere with acute, short hypophysis, narrower right paramere and shorter interramal lobe (Liu & Zheng, 2014; Shishido & Yasunaga, 2016). Several additional halophilic members of *Melanotrichus*, associated with species of *Sueada* or *Salicornia*, are also reported in Mediterranean Europe (Wagner & Weber, 1978) and the Nearctic Region (Henry, 1991).

***Pseudoloxops hibiscus*, new species**  
(Figs. 4I, 7A, B, 9A, B, 10A–D)

**Material examined.** Holotype male, THAILAND: Rayong, Ban Phe coast, N12°35'E 101°25', 0 m, on *Hibiscus tiliaceus* L., 27–29 December 2013, T. Yasunaga, B. Shishido (DOAT) (AMNH\_PBI 00380543). Paratypes: THAILAND: same data as for holotype, 1 female (TYCN) (00380544).

**Diagnosis.** Recognised by the generally pale green (whitish brown in dried specimen, cf. Fig. 9A, B), subparallel-sided body (Fig. 7A, B); fuscous-red anterior portion of head and apex of cuneus; uniformly pale brown antennal segments II–IV; reddish lateral margins of pronotal calli; sanguineous veins of forewing membrane; apically notched pygophoral process (Fig. 10A); flat, minutely serrate hypophysis of right paramere (Fig. 10C); squared sensory lobe of left paramere (Fig. 10D); broadened phallosome; and two slender, long spiculi of endosoma (Fig. 10B).

**Description.** Body largely pale green, subparallel-sided; female larger than male; dorsal surface not spotted, with uniformly distributed, silky, semierect setae. Head fuscous red anteriorly, weakly pointed in front; eyes comparatively enlarged. Antennal segment I rouge, in male with two fuscous (inner and lateral) stripes; segments II–IV pale brown, except for extreme base of II rouge. Labium shiny

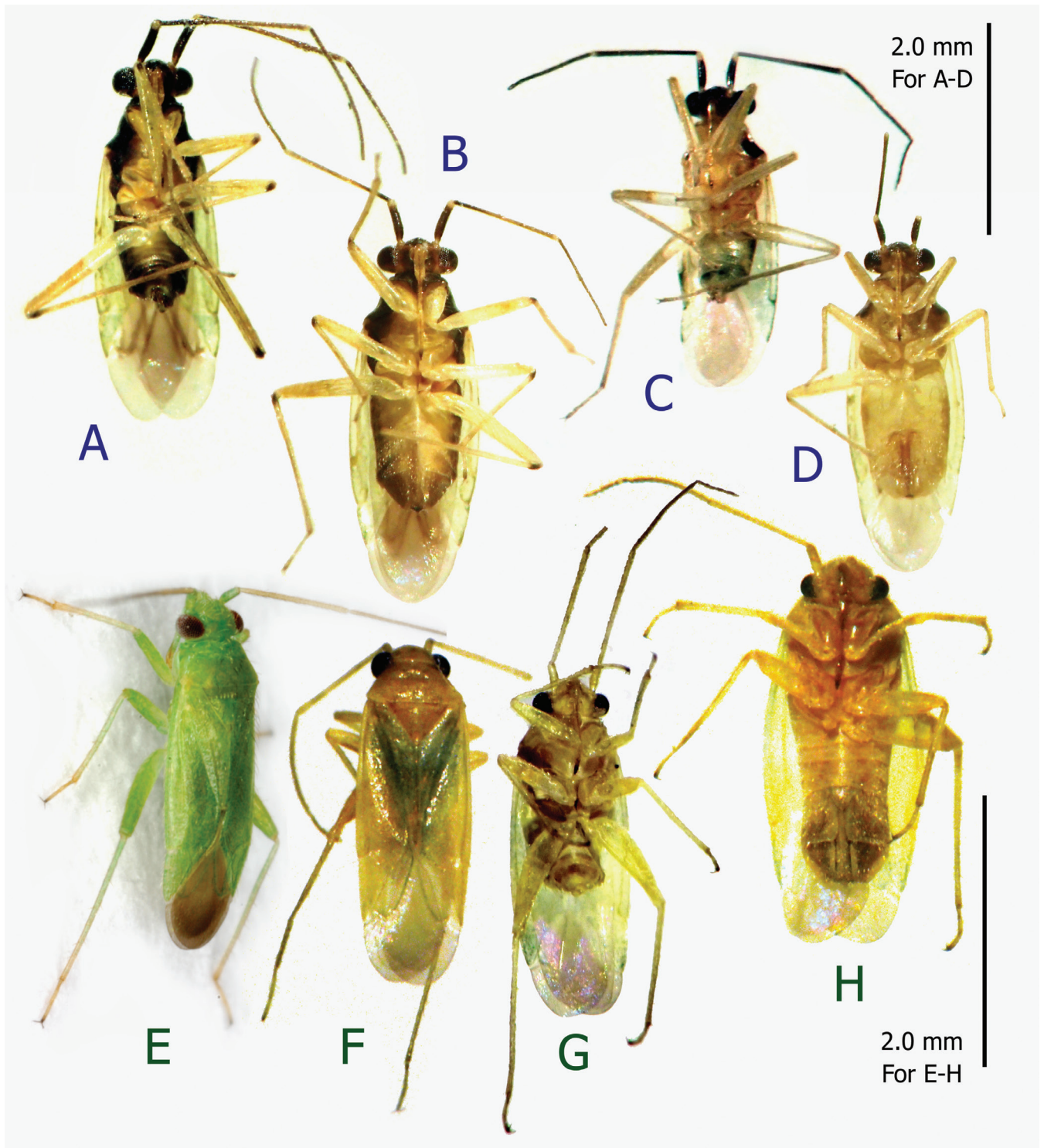


Fig. 6. Habitus images of Thai orthotylines, dried specimens (except for E in live). A, *Cyrtorhinus indochinanus*, holotype male, ventral view; B, *Cyrtorhinus indochinanus*, female; C, *C. lividipennis*, male (Nakhon Nayok); D, *C. lividipennis*, female (SERS); E, F, *M. thaimaritimus*, male (Samut Prakan); G, *M. thaimaritimus*, ventral view; H, *M. thaimaritimus*, female (Samut Prakan).

pale brown, reaching apex of mesocoxa; apex of segment IV reddish brown. Pronotum pale green (pale yellowish brown in dried specimen), with reddish margin at lateral sides of calli; mesoscutum tinged with brown. Hemelytron shiny, smooth, without dark spots; apex of cuneus fuscous red; basal inner part of male cuneus with a rouge, short, oblique stripe; membrane pale smoky brown, darkened along sanguineous veins. Coxae and legs whitish brown; apical part of each femur faintly tinged with orange; proportion

of meta-tarsomeres I–III as 4: 6: 7. Abdomen wholly pale brown (pale green in live or fresh specimen). Male genitalia (Fig. 10A–D): Pygophore with sharp apical margin and distally serrate pygophoral process (Fig. 10A); right paramere thickened, with triangular, spinulate subapical part of sensory lobe and flat, narrow, minutely serrate hypophysis (Fig. 10C); left paramere with squared sensory lobe and medially bent, rather broad hypophysis (10D); phallosome broadened; endosoma with two elongate, slender spiculi (Fig. 10B).



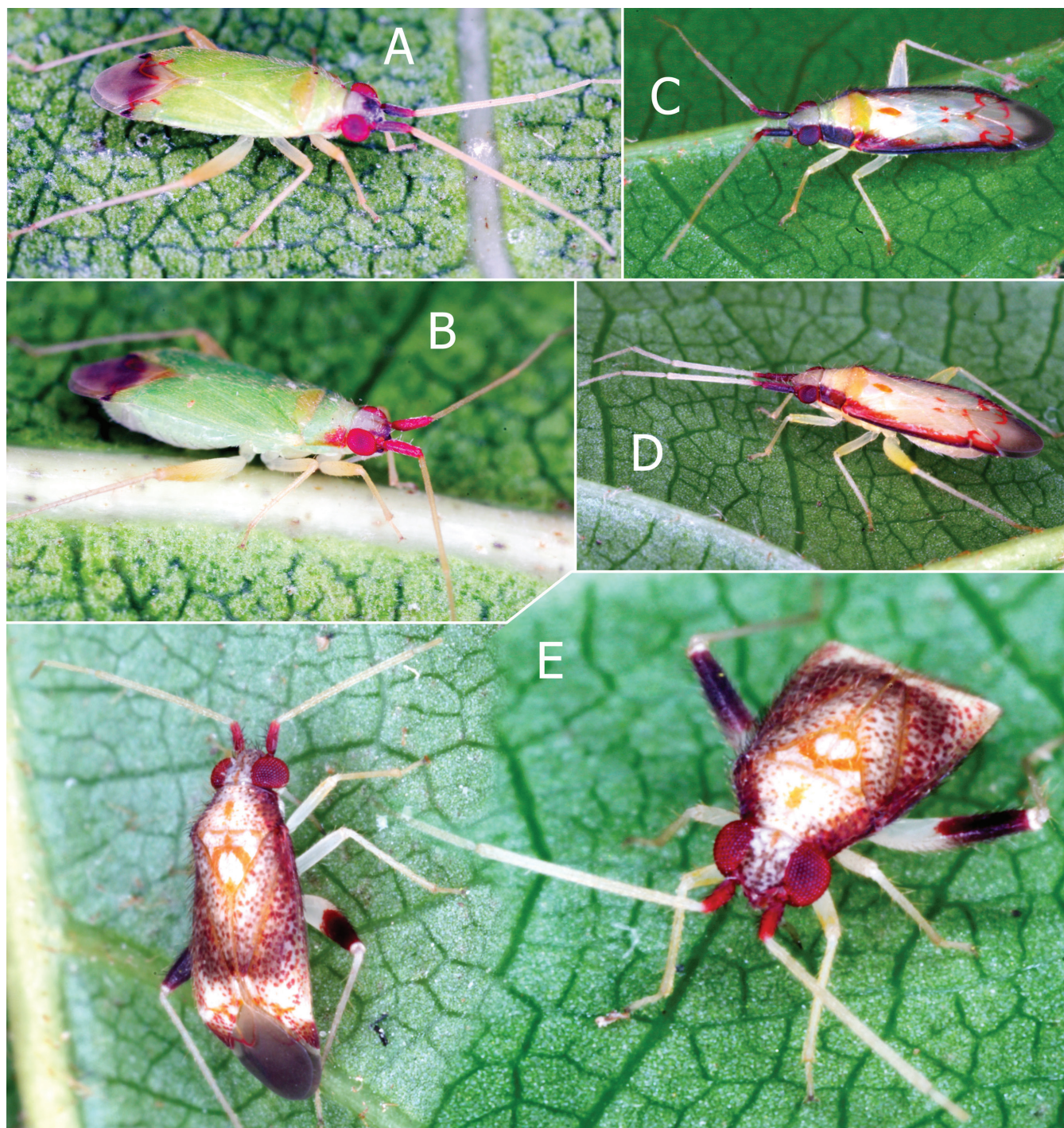


Fig. 7. Habitus images of Thai *Pseudoloxops* species. A, *P. hibiscus*, holotype male; B, *P. hibiscus*, female; C, *P. lateralis*, male; D, *P. lateralis*, female; E, *P. leopardalis*, holotype male.

Female genitalia not dissected.

**Measurements.** Male/female: Total body length 3.00/3.50; width of head across eyes 0.71/0.72; width of vertex 0.30/0.33; lengths of antennal segments I–IV 0.41, 1.40, 0.60, 0.54/0.45, 1.35, 0.62, 0.56; total length of labium 0.90/0.99; basal width of pronotum 0.89/1.05; maximum width across hemelytra 1.08/1.50; and lengths of metafemur, tibia and tarsus 1.20, 1.71, 0.30/1.35, 1.92, 0.33.

**Etymology.** Named for its plant association with *Hibiscus tiliaceus* L.; used as a noun in apposition.

**Biology.** Unknown; the two available specimens were collected by sweep-netting *Hibiscus tiliaceus* L. (Malvaceae) at a sandy shore (Fig. 4I).

**Remarks.** Based on the similar colouration and morphology (generally pale green colouration, faintly orange apical part of each femur, produced subapical sensory lobe of right paramere, broadened, apically rounded phallosome and two endosomal spiculi), *P. hibiscus* is most closely related to *P. ayuthaya*; But the latter can be distinguished from this new species by the left paramere more slender curved at middle, one of two endosomal spiculi thickened apically, and lacking



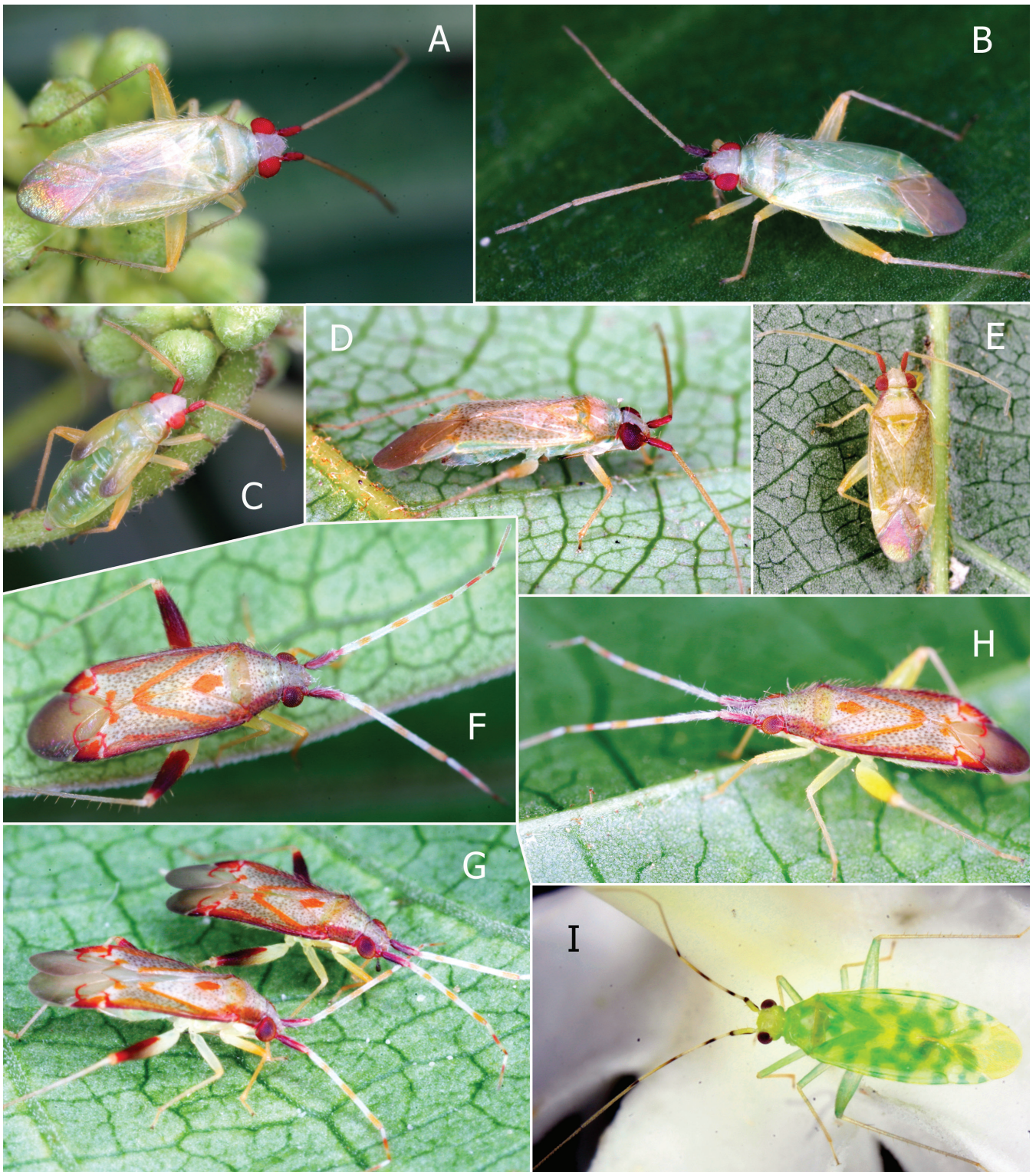


Fig. 8. Habitus images of Thai species of *Pseudoloxops* and *Zanchius* group. A, *P. ayuthaya*, male; B, *P. ayuthaya*, female; C, *P. ayuthaya*, final-instar nymph; D, *P. pericarti*, male; E, *P. pericarti* female; F, *P. pardellus*, male; G, *P. pardellus*, males; H, *P. pardellus*, female; I, unidentified species close to *Zanchius marmoratus* Zou, 1987 (SERS).



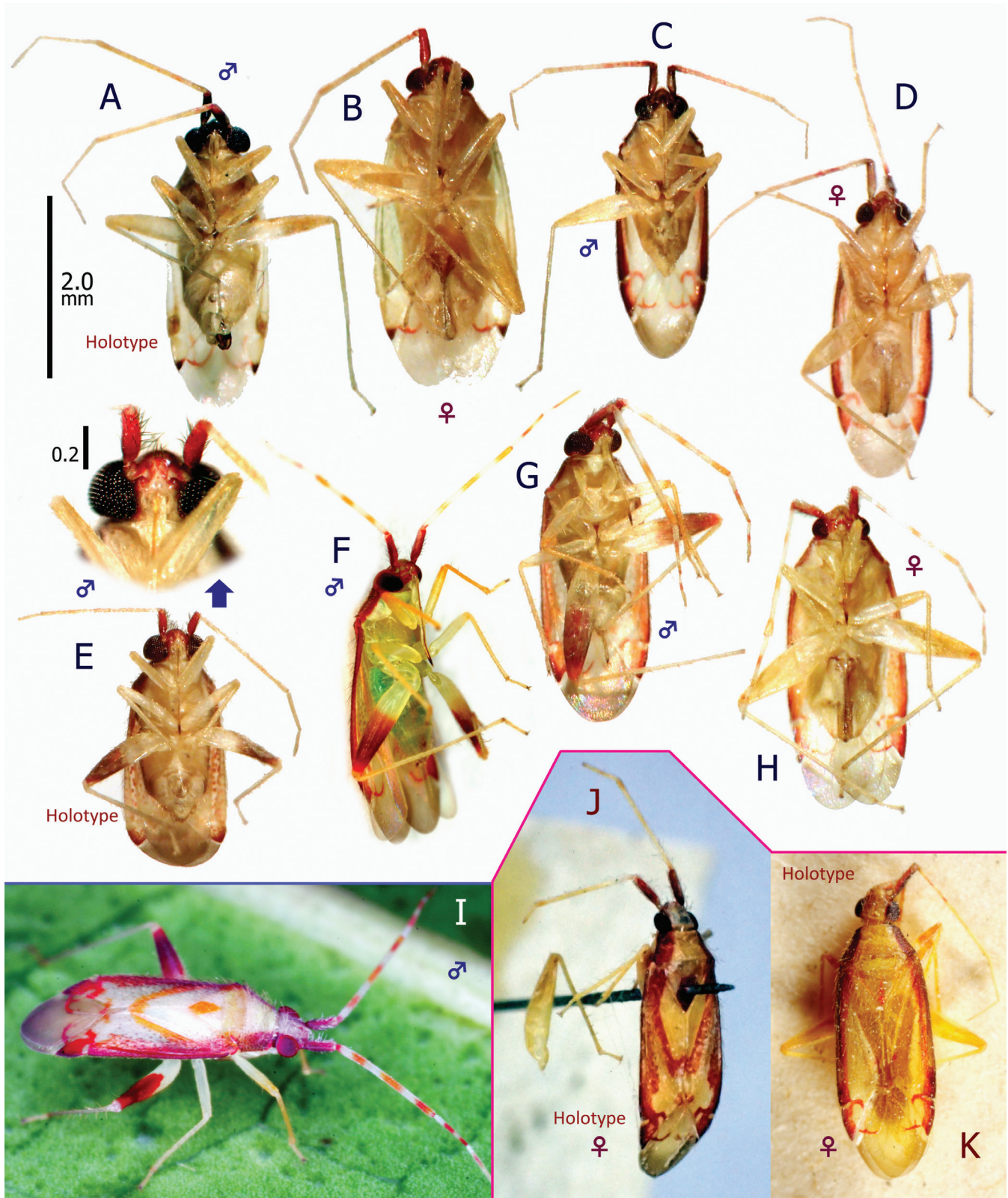


Fig. 9. Habitus images of *Pseudoloxops* species, dried specimens (except for F & I in live). A, *P. hibiscus*, holotype male; B, *P. hibiscus*, female; C, *P. lateralis*, male (SERS); D, *P. lateralis*, female (SERS); E, *P. leopardalis*, holotype male; F, G, *P. pardellus*, male; H, *P. pardellus*, female; I, *P. imperatorius* (Nagasaki, Japan); J, *P. imperatorius*, holotype female from Sri Lanka (BMNH); K, *P. lateralis*, holotype female from Taiwan (HNHM). Image (K) courtesy of NMNS.



any red pattern on the dorsum (Yasunaga & Yamada, 2009). Host preferences of these two species also differ from each other (Malvaceae and Fabaceae). In addition, *P. pericarti* resembles both *P. ayutthaya* and *P. hibiscus*, but the former is easily separable from the latter two by having the brownish hemelytron with uniformly scattered, brown, small spots (Fig. 8D, E). Sharing similar morphological characters in the male genitalia, *P. ayutthaya*, *P. hibiscus* and *P. pericarti* are presumed to constitute a monophyletic group.

***Pseudoloxops leopardalis*, new species**

(Figs. 7E, 9E, 10G–J)

**Type material.** Holotype male, THAILAND: Nakhon Ratchasima, SERS, N14°30'27" E101°55'39", 410 m alt., light trap, 21–22 March 2014, T. Yasunaga & K. Yamada (DOAT) (AMNH\_PBI 00380545).

**Diagnosis.** Recognised by the small, rather ovoid body (Fig. 7E); distinctly bicolourous (deep red and whitish yellow) dorsum; densely scattered red spots on dorsum; brown stiff setae on head and lateral portions of pronotum and hemelytron; orange-red, semi-circular mark on scutellum; deep red apical half of metafemur; generally slender, elongate left paramere (Fig. 10I); and heavily sclerotised endosoma with exaggerated spiculi (Fig. 10H).

**Description.** Male: Body rather ovoid, small-sized; dorsal surface creamy yellow, largely deep red and spotted, somewhat matte, with uniformly distributed, semierect setae and densely distributed, brown, stiff setae on head, pronotum, corium and embolium. Head deep red anteriorly, slightly projected in front; eyes large, each about as wide as vertex; vertex with a faint, orange, mesal stripe; frons striolate medially; clypeus deep red. Antennal segment I rouge, with dark, stiff setae; segments II–IV whitish brown, without reddish tinge. Labium shiny pale reddish brown, slightly exceeding apex of mesocoxa; apex of segment IV reddish brown. Pronotum creamy yellow, with an orange, narrow mark and small red spots at middle and deep red margin; mesoscutum tinged with orange; scutellum creamy yellow, with orange-red, anterior, semi-circular mark and orange apex; pleura red dorsally; scent efferent system creamy yellow. Hemelytron rather matte, somewhat declivous at cuneal fracture; corium except for apical part, clavus and posterior embolium mottled with red, small spots; anterior part of embolium and posterior half of cuneus sanguineous; apex of corium with small, irregular, orange mark; membrane smoky brown, with sanguineous veins. Coxae and legs creamy yellow; apical half of metafemur deep red; proportion of meta-tarsomeres I–III as 4: 4: 5. Abdomen almost uniformly whitish brown, lateral margin of sterna tinged with reddish brown. Male genitalia (Fig. 10G–J): Pygophore subtriangular (Fig. 10G, H); left paramere simply elongate, slender, L-shaped, tapered towards apex, without a modified sensory lobe or hypophysis (Fig. 10I); right paramere hammer-shaped, subapically thickened and spinulate, with triangular, somewhat flattened hypophysis (Fig. 10J); endosoma heavily sclerotised, with three noticeable spiculi, one of which is conspicuously widened base (Fig. 10H). Female: Unknown.

**Measurements.** Male: Total body length 2.58; width of head across eyes 0.69; width of vertex 0.26; lengths of antennal segments I–IV 0.29, 1.28, 0.45, 0.30; total length of labium 0.90; basal width of pronotum 0.90; maximum width across hemelytra 1.07; and lengths of metafemur, tibia and tarsus 1.05, 1.50, 0.30.

**Etymology.** From Latin, *leopardalis* [= leopard-like], referring to the heavily spotted dorsum of this new species; an adjective.

**Biology.** Unknown; only a single male was collected using a UV light trap.

**Remarks.** This new species is superficially similar to *P. takaii* Yasunaga, 1997 known from the Ryukyus, Japan. However, the latter is a close relative of *P. imperatorius* (Distant, 1909) and the following *P. pardellus*, new species, having the sub-triangularly widened left paramere with slender, winding hypophysis, slender, simple right paramere and two short endosomal spiculi. Although the phylogenetic relationship of *P. leopardalis* to other known congeners is currently unclear, an undescribed species collected in Queensland, Australia possesses the similarly long left paramere and exaggerated spiculi (Hazali, 2013).

***Pseudoloxops pardellus*, new species**

(Figs. 8F–H, 9F–H, 11, 12C, D)

**Material examined.** Holotype male, THAILAND: Nakhon Ratchasima, SERS, N14°30'27" E101°55'39", 410 m alt., light trap, 26 September 2013, T. Yasunaga (DOAT) (AMNH\_PBI 00380546). Paratypes: THAILAND: Chaiphaphum, Chulabhom Dam, light trap, 26 October 2002, Y. Nakatani, 2 males (NIAES). Nakhon Ratchasima: same data as for holotype, 1 male, 1 female (TYCN) (00380547); same locality, 19–21 August 2008, T. Yasunaga & B. Shishido, 4 males, 2 females (AMNH, CNC, TYCN); same locality, 12–14 June 2009, T. Yasunaga & K. Yamada, 3 males (TYCN); same data as for holotype, except for date 21–22 March 2014, 2 males, 1 female (TYCN).

**Diagnosis.** Recognised by the rather elongate, flat, medium-sized body (Fig. 8F–H); distinctly bicolourous (deep red and creamy yellow) dorsum; uniformly scattered, small brown spots on dorsum; uniformly distributed, dark, simple setae and longer, pale, upright, stiff setae on head, antennal segment I, and laterally on pronotum and hemelytron; orange-red, rhombic mark on middle of scutellum; clear red M-shaped mark on hemelytron; deep red apical half of male metafemur (Fig. 9F, G); flat, triangularly widened sensory lobe and slender hypophysis of left paramere (Fig. 11C); apical flagellate spine on right paramere (Fig. 11D); and two short, flat endosomal spiculi (Fig. 11F).

**Description.** Body rather elongate, flat, medium-sized; dorsal surface somewhat matte, largely creamy yellow medially, with uniformly distributed, brown, semierect setae and brown small spots, and pale, long, stiff, upright setae on head, antennal segment I, and lateral pronotum and hemelytron.

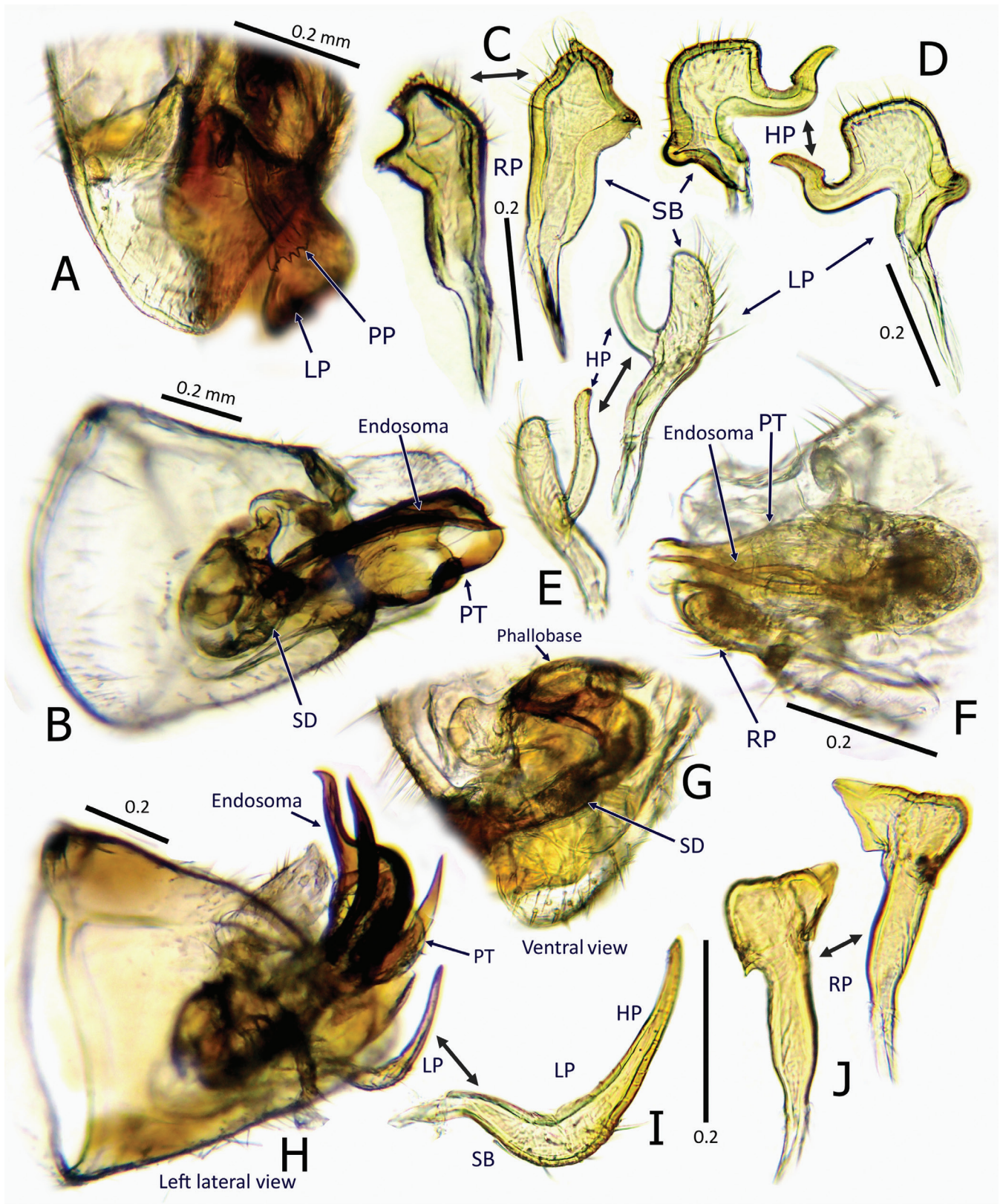


Fig. 10. Male genitalia of *Pseudoloxops hibiscus* (A–D), *P. lateralis* (E–F) and *P. leopardalis* (G–J). A, G, Apex of pygophore, ventral view; F, Apex of pygophore, dorsal view; B, H, pygophore, dorsal view; C, J, right paramere; D, E, I, left paramere. Scale bars = 0.2 mm.



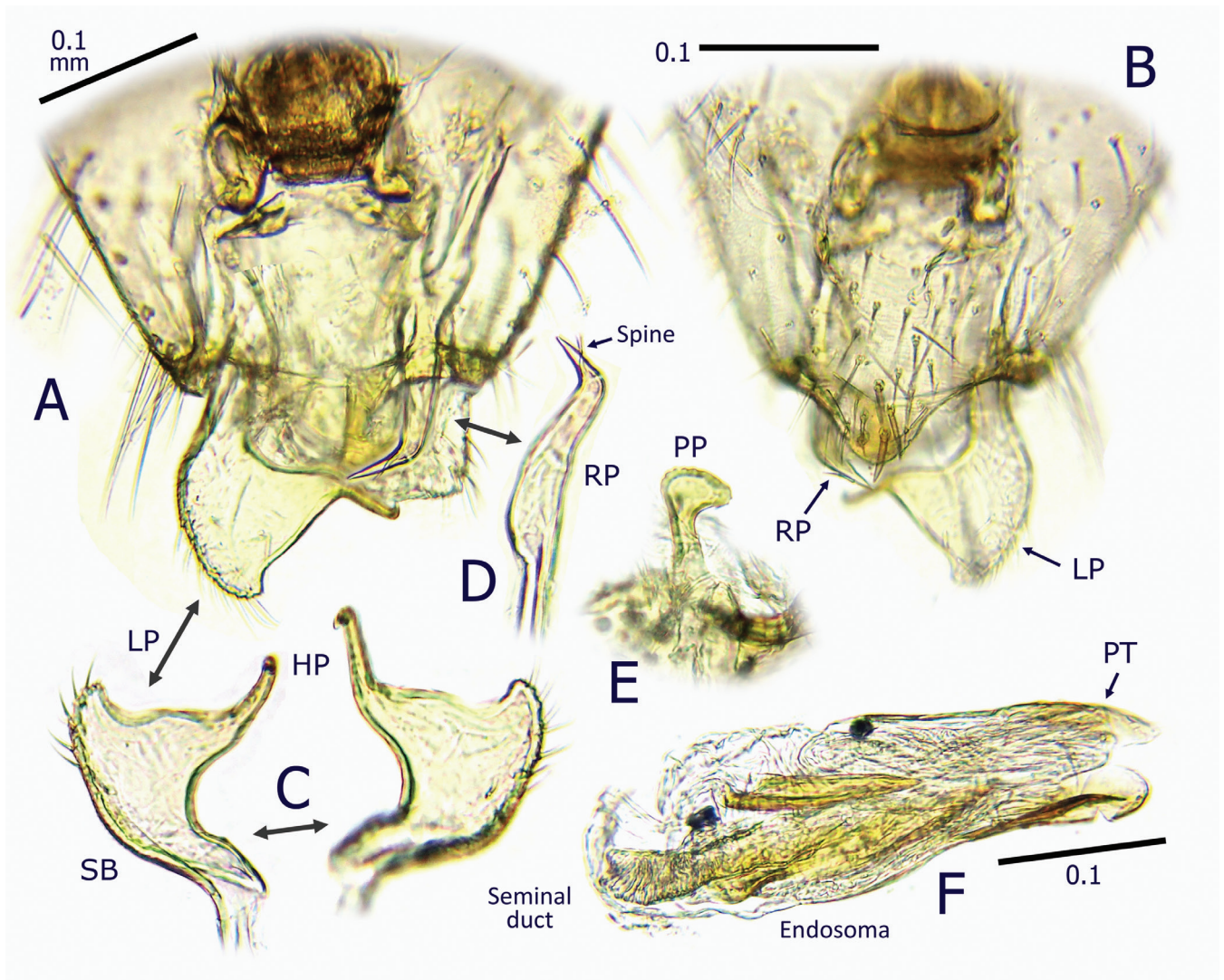


Fig. 11. Male genitalia of *Pseudoloxops pardellus*. A, Pygophore, dorsal view; B, Pygophore, ventral view; C, left paramere; D, right paramere; E, pygophoral process; F, aedeagus.

Head creamy yellow, sanguineous below level of antennal tubercles, somewhat pointed in front; eyes small; vertex and frons spotted, with faint, longitudinal, mesal sulcus. Antennal segment I deep red, with white stripe inward; segments II–IV creamy yellow; segment II with rouge extreme base and three orange-red rings each at basal 1/4, middle and apex; middle and apex of segment III and middle of IV each with red ring. Labium shiny pale brown, slightly exceeding apex of mesocoxa; apical half of segment IV reddish brown. Pronotum creamy yellow, with uniformly scattered, brown, small spots and deep red margin; mesoscutum shiny, faintly tinged with orange-brown; scutellum creamy yellow, spotted, with orange-red, rhombic mark; pleura whitish brown (greenish yellow in live or fresh specimen, cf. Fig. 9F); dorsal margin of propleuron rouge; scent efferent system creamy yellow. Hemelytron rather matte, largely whitish brown, with orange-red M-shaped mark (along lateral margins of corium) and uniformly scattered, brown, small spots; apical inner corner of corium with red, triangular, small spot; embolium and lateral margin of cuneus sanguineous; basal half of cuneus creamy yellow except for orange-red macula at middle; membrane pale grayish brown, with distally sanguineous

veins and darkened margin. Coxae and legs pale brown yellow (all femora greenish yellow in live or fresh specimen); apical half of male metafemur sanguineous; protibia usually tinged with red; proportion of meta-tarsomeres I–III as 4: 5: 5. Abdomen almost uniformly whitish brown (largely pale green in live or fresh specimen). Male genitalia (Fig. 11): Pygophore with spines at apex (Fig. 11B); left paramere with flat, triangularly widened sensory lobe and slender hypophysis (Fig. 11C); right paramere simple, tapered apically, with apical flagellate spine (Fig. 11D); endosoma widely membranous, weakly sclerotised, with two short, flat endosomal spiculi (Fig. 11F). Female genitalia (Fig. 12C, D): Sclerotised ring decrescent, thin-rimmed; apical part of valvula I sharpened (Fig. 12D); posterior wall with elongate, spinulate interramal lobe (Fig. 12C).

**Measurements.** Male/female: Total body length 2.45–2.60/2.64–2.77; width of head across eyes 0.55–0.59/0.60–0.62; width of vertex 0.28–0.30/0.37–0.38; lengths of antennal segments I–IV 0.19–0.23, 0.76–0.84, 0.65–0.72, 0.27–0.30/0.19–0.23, 0.76–0.89, 0.75–0.77, 0.33–0.36; total length of labium 0.58–0.60/0.67–0.71; basal width



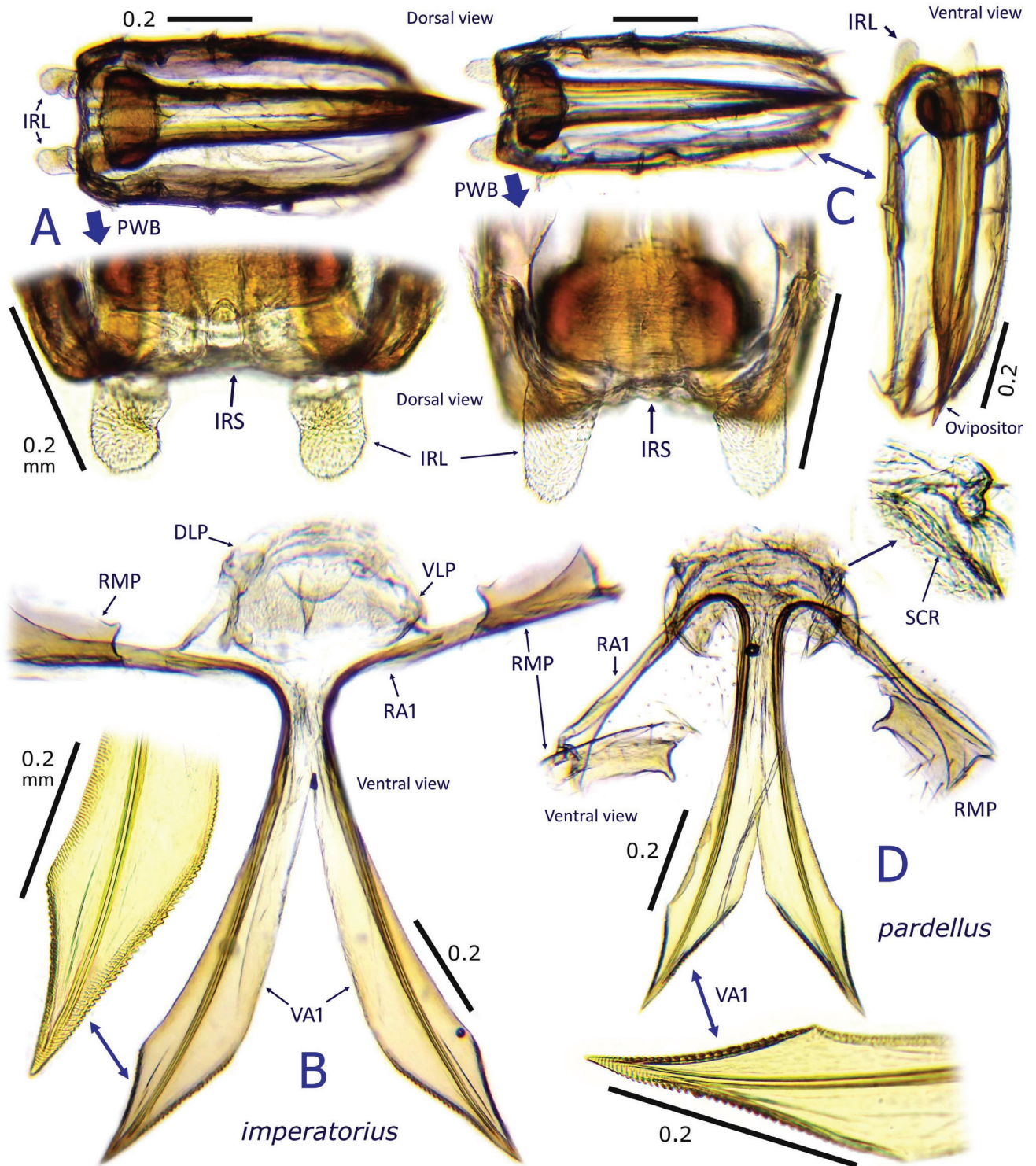


Fig. 12. Female genitalia of *Pseudoloxops imperatorius* (A, B, specimen from Okinawa, Japan) and *P. pardellus* (C, D), named on images.

of pronotum 0.73–0.77/0.73–0.78; maximum width across hemelytra 0.88–0.92/0.97–1.08; and lengths of metafemur, tibia and tarsus 0.87–0.90, 1.14–1.17, 0.34–0.38/0.88–0.92, 1.18–1.26, 0.39–0.42.

**Etymology.** From Latin, *pardus* [= panther or leopard], combined with the diminutive suffix [–ellus], referring to the uniformly spotted dorsum of this new species.

**Biology.** Unknown; all available specimens were attracted to UV light. Collection records suggest that this new species have two or more generations per year.

**Remarks.** The present new species is most closely related to *P. imperatorius* (Distant, 1909) known from Sri Lanka, southern China, Taiwan and southwestern Japan (from central Honshu to the Ryukyus) (Zheng & Lin, 2013; Liu & Zheng, 2014; Yasunaga & Takai, 2017). This widespread taxon, despite having been thus far undiscovered in Indochina, has the similar appearance (Fig. 9I) and genitalic structures, but *P. imperatorius* is distinct in having an unspotted head, mesal part of pronotum, scutellum and clavus; sensory lobe of left paramere wider; endosomal spiculi longer (Yasunaga & Takai, 2017); ovipositor longer; and interramal lobe bent at middle (Fig. 12A, B). Both *P. imperatorius* and *P. pardellus* exhibit a similar sexual dimorphism (female metafemur uniformly pale, without reddish apical part), which may support a close relationship between them.

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