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Research article

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DNA barcoding of *Aphelopus* Dalman (Hymenoptera, Dryinidae) from China, with descriptions of four new species

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[3] urn:lsid:zoobank.org:author:1EAE4622-8F64-484C-B439-76F9838F936F
[4] urn:lsid:zoobank.org:author:31BDDDCD-CA33-403F-AC01-2C769ADD08D4
[5] urn:lsid:zoobank.org:author:133EA7D3-0560-4CF2-973F-815E3F10CD32
[6] urn:lsid:zoobank.org:author:3F870526-E9B2-4318-A094-1533029AB6D3
[7] urn:lsid:zoobank.org:author:9465CC48-7A17-405A-AB27-2575A603AA3A

Abstract. Species of the genus *Aphelopus* Dalman (Hymenoptera, Dryinidae) are important natural enemies of leafhoppers. The genus is relatively diverse in China, with 35 recorded species. In order to further make use of these important parasitoids in biological control programs, species of *Aphelopus* collected across China are studied using an integrative approach (combined DNA barcoding and morphology). Of the 17 studied species, two are newly recorded from China: *A. nivealis* Mita & Olmi, 2014 and *A. prolatus* Mita & Olmi, 2014, and four are described as new to science: *A. incognitus* Chen, Olmi & Guglielmino sp. nov., *A. maculiala* Olmi, Chen & Ødegaard sp. nov., *A. taianensis* Olmi, Ødegaard & Chen sp. nov., and *A. zaifui* Olmi, Chen & Liu sp. nov. The total number of *Aphelopus* species known from China is raised from 35 to 39. Keys to the Oriental and Eastern Palaearctic species of *Aphelopus* are modified to include the new species. Application of DNA barcoding in the species delimitation of Dryinidae is discussed.

Keywords. Chrysidoidea, Oriental, Eastern Palaearctic, identification key, *COI* gene.

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Introduction

Aphelopus Dalman, 1823 (Hymenoptera, Dryinidae) is a cosmopolitan genus of parasitoids attacking Typhlocybinae Kirschbaum, 1868 (Hemiptera, Cicadellidae). Many of their hosts are important insect pests (Guglielmino *et al*. 2013). The genus comprises 78 species (Guglielmino *et al*. 2017), present in all the zoogeographic regions except Antarctica. Xu *et al*. (2013) and Guglielmino *et al*. (2017) listed 30 species from the Oriental region, of which 29 are from China. Olmi & Xu (2015) added further six species from Eastern Palaearctic China, bringing the total number of species known from China to 35.

Further development of these important parasitoids in biological control programs against leafhoppers requires accurate identification of the species. However, the taxonomy of Dryinidae Haliday, 1833 is challenging because many species are morphologically similar and require a careful examination of detailed morphological characters, especially the male genitalia. Intraspecific morphological variation and extreme sexual dimorphism are the two main issues which hamper research on the systematics of Dryinidae (Olmi *et al*. 2021), including that of the genus *Aphelopus*. In addition, too few researchers rear dryinids and many species were described based on a single specimen or a small number of specimens, making it difficult to understand if a morphological or colour difference falls within the range of variability of a species or indicates a new taxon. The lack of rearing also means that it is difficult to associate conspecifics based on morphology, as males and females of the same species are usually completely different. DNA markers, such as the mitochondrial cytochrome c oxidase 1 (*COI*) gene, have become an important species identification tool for insects (Hebert *et al*. 2003a, 2003b). The importance of DNA sequences in the taxonomy and systematics of Dryinidae as well as the molecular identification of their host associations has been recognized by some researchers (see Mita & Matsumoto 2012; Mita *et al*. 2013; Tribull 2015; Chen *et al*. 2020; Olmi *et al*. 2021). By analyzing *COI* sequences, Mita & Matsumoto (2012) discovered the male of *Gonatopus javanus* (Perkins, 1912), a species previously known only from females. Similarly, based on *COI* sequences, Mita *et al*. (2013) found that *Haplogonatopus oratorius* (Westwood, 1833) and *H. apicalis* Perkins, 1905, whose females and males had previously been confused, were separate species. In addition, Chen *et al*. (2020) discovered the previously unknown host of *Gonatopus viet* Olmi, 1986, by a comparison of *COI* sequences of females and immature larvae extracted from host thylacia. More recently, Olmi *et al*. (2021) associated female, male, larva, and the host of *Bocchus scobiolae* Nagy, 1967, by *COI* sequences.

However, a DNA barcode database is still lacking for the Chinese fauna of Dryinidae. To fill this gap, one of the coauthors (HC) started a research campaign with the objectives to collect specimens of dryinids across China, identify the species by morphological characters and build a DNA database for these important parasitoids. This paper is the first result of the ongoing research campaign.

Material and methods

Collection and identification

Malaise traps (MT) have been set up in many provinces of China (Fig. 1). Specimens were kept in 100% ethanol and collected monthly. Samples were then brought to the laboratory and stored at -20°C. The species of *Aphelopus* were identified using the available keys present in Xu *et al*. (2013) and Olmi & Xu (2015) and based on morphological characters.

Repositories

The material from China studied in this paper is deposited in the Museum of Biology at Sun Yat-sen University, Guangzhou, China (SYSBM) and the South China Agricultural University, Guangzhou, China (SCAU). The specimen numbers start with SCAU when they were donated by SCAU to SYSBM. Specimens of *A. atratus* (Dalman, 1823) and *A. prolatus* Mita & Olmi, 2014, respectively from Norway and Sweden, are deposited in the University Museum, Norwegian University of Science and Technology, Trondheim, Norway (NTNU) and Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRS), respectively. All the types of the species of *Aphelopus* known from the Oriental and Palaearctic regions were examined by direct observation.

Descriptions

Species descriptions follow the terminology used by Olmi *et al*. (2019). The measurements reported are relative, except for the total body length (head to abdominal tip, without the antenna and the sting), expressed in millimeters. In the descriptions POL is the distance between inner edges of the lateral ocelli; OL is the distance between inner edges of a lateral ocellus and the median ocellus; OOL is the distance from the outer edge of a lateral ocellus to the eye; OPL is the distance from the posterior

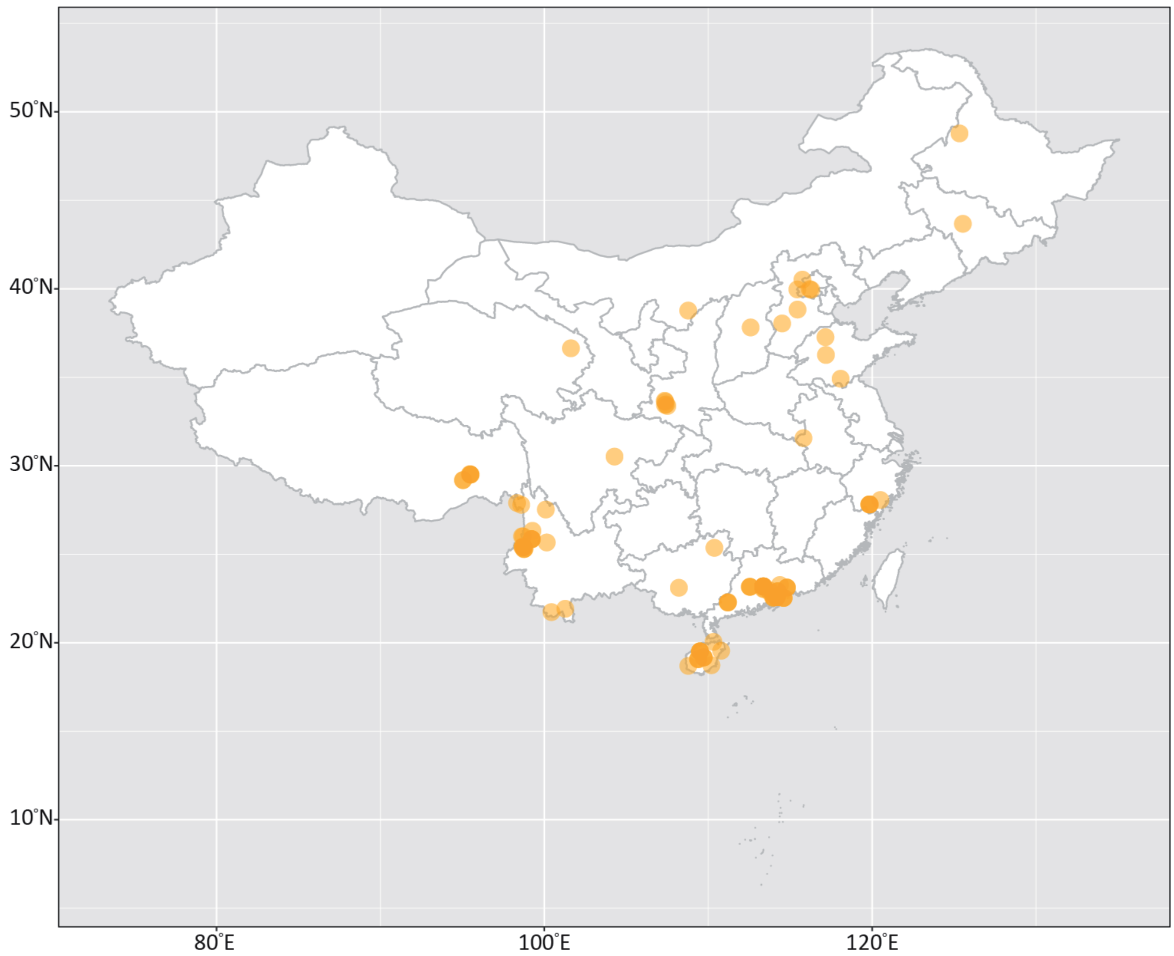

Fig. 1. Distribution map of Malaise traps set up in China. Each orange dot represents one trap.

edge of a lateral ocellus to the occipital carina; TL is the distance from the posterior edge of an eye to the occipital carina. The term "metapectal-propodeal disc" is here used in the sense of Kawada *et al*. (2015). It corresponds to the term "dorsal surface of propodeum" sensu Olmi & Xu (2015) and Xu *et al*. (2013). The term "propodeal declivity" sensu Kawada *et al.* (2015), used here, corresponds to the term "posterior surface of propodeum", sensu Xu *et al*. (2013) and Olmi & Xu (2015).

Imaging

Multifocal images were made using a mirrorless Sony Alpha 6300 camera with cross table Proxxon KT 70 or a Leica M205C multifocal equipment and a Nikon SMZ25 microscope with a Nikon DS-Ri 2 digital camera system. Images were then post-processed with Adobe Photoshop CS6 Extended.

***COI* barcoding**

Genomic DNA of the material from China was extracted from the entire specimen using a DNeasy Blood & Tissue Kit (QIAGEN, Inc.), following a nondestructive DNA extraction protocol as described in Taekul *et al*. (2014). Voucher specimens (Supp. File 1) are deposited in the Museum of Biology at Sun Yat-sen University, Guangzhou, China (SYSBM). The 'barcode' region of the mitochondrial cytochrome oxidase subunit 1 (*COI*) was amplified using the LCO1490/HCO2198 primer pair (Folmer *et al*. 1994). Polymerase chain reactions (PCRs) were performed using Tks Gflex™ DNA Polymerase (Takara) and conducted in a T100™ Thermal Cycler (Bio-Rad). Thermocycling conditions were as follows: an initial denaturing step at 94°C for 1 min, followed by 5 cycles of 98°C for 10s, 45°C for 15s, 68°C for 30s; 35 cycles of 98°C for 10s, 52°C for 15s, 68°C for 30s and an additional extension at 68°C for 5 mins. Amplicons were directly sequenced in both directions with forward and reverse primers on an Applied Biosystem (ABI) 3730XL by TsingKe Biological Technology (Beijing, China). Chromatograms were assembled into contigs in Geneious ver. 11.0.3. The assembled sequences were translated to amino acids using the invertebrate mitochondrial code to check for stop codons and frame shifts, and were blasted against the GenBank database to check for contamination and pseudogenes (e.g., nuclear mitochondrial DNA, NUMT) as implemented in Geneious ver. 11.0.3. All sequences generated from this study are deposited in GenBank (accession numbers see Table 1), except the sequences of *Aphelopus atratus* (Dalman, 1823) and *A. prolatus* Mita & Olmi, 2014, respectively from Norway and Sweden, which are uploaded in the BOLD System (Ratnasingham & Hebert 2007): sequence ID for *Aphelopus prolatus*: NSMTP249-15.COI-5P; for *Aphelopus atratus*: NODRY067-14.COI-5P.

COI sequences were aligned by codons using MUSCLE implemented in MEGA7 (Kumar *et al*. 2016). The aligned sequences were then analyzed using RAxML as implemented in Geneious ver. 11.0.3 to generate a maximum likelihood (ML) tree. The model used was GTRGAMMA+I. Automatic bootstopping criterion was selected as the appropriate number of bootstraps; 300 replicates were run. *Bocchus thorpei* Olmi, 2007 (Hymenoptera, Dryinidae), from New Zealand, was used as an out-group based on the phylogenetic topologies recovered by Tribull (2015) (COI sequence of *B. thorpei* was downloaded from GenBank, NZAC04036596).

Results

Molecular analysis

The present study generated 23 *COI* sequences with an average of 658 bp. Including the sequences of *A. atratus* and *A. prolatus*, the 25 studied *COI* sequences were found to belong to 17 species, of which four are described as new below. Genetic distances of the sequences are in Supp. file 1. Intraspecific distances of the *COI* sequences generally are less than 3%, with the exception of *A. prolatus*, which has two haplogroups (from Sweden and China, respectively) and the distance between the two haplogroups is 5.6%. Interspecific distances range between 5.6% and 25.4%. Each species recovered on the tree is clearly separated from all neighboring species, as shown in Fig. 2.

Table 1. List of sequenced taxa and accession numbers.

Code	Species	Sex	Locality	GenBank accession No.
SCAU 3011667	*Aphelopus albifacialis*	female	Yunnan, 21°44.745′ N, 100°26.07′ E	MZ151314
SCAU 3048845	*Aphelopus albifacialis*	female	Guangdong, 22°34′49.375″ N, 114°10′22.012″ E	MZ151315
SCAU 3011737	*Aphelopus albiclypeus*	male	Yunnan, 23°1′16.943″ N, 104°3′52.524″ E	MZ151316
SCAU 3011794	*Aphelopus incognitus* sp. nov.	female	Beijing, 39°59′12.588″ N, 116°11′27.456″ E	MZ151317
SCAU 3011673	*Aphelopus incognitus* sp. nov.	male	Yunnan, 27°53′47″ N, 99°38′22″ E	MZ151318
SCAU 3040513	*Aphelopus maculiala* sp. nov.	male	Yunnan, 26°19′26.980″ N, 99°15′23.821″ E	MZ151319
SCAU 3011637	*Aphelopus maculiceps*	female	Sichuan, 30°31′17″ N, 104°17′0″ E	MZ151320
SCAU 3040507	*Aphelopus malayanus*	female	Guangdong, 23°2′925″ N, 113°21′25″ E	MZ151321
SCAU 3011672	*Aphelopus mangshanensis*	male	Yunnan, 27°53′47″ N, 99°38′22″ E	MZ151322
SCAU 3040438	*Aphelopus niger*	female	Guangdong, 23°3′9″ N, 113°23′23″ E	MZ151323
SCAU 3040508	*Aphelopus nivealis*	female	Guangdong, 23°3′9″ N, 113°23′23″ E	MZ151324
SCAU 3049357	*Aphelopus nivealis*	female	Guangdong, 22°34′13.476″ N, 113°59′35.412″ E	MZ151325
SCAU 3011639	*Aphelopus penanganus*	female	Heilongjiang, 48°46′55″ N, 125°19′53″ E	MZ151326
SCAU 3040426	*Aphelopus prolatus*	female	Shandong, 37°16′4″ N, 117°9′10″ E	MZ151327
SCAU 3011685	*Aphelopus prolatus*	female	Shandong, 37°16′4″ N, 117°9′10″ E	MZ151328
SCAU 3011690	*Aphelopus sabahnus*	female	Guangdong, 23°2′55″ N, 113°23′12″ E	MZ151329
SCAU 3040510	*Aphelopus spadiceus*	male	Yunnan, 26°19′26.436″ N, 99°16′32.246″ E	MZ151330
SCAU 3011647	*Aphelopus taianensis* sp. nov.	male	Shandong, 36°12′ N, 117°5′ E	MZ151331
SCAU 3040509	*Aphelopus wushensis*	female	Guangdong, 23°3′9″ N, 113°23′23″ E	MZ151332
SCAU 3044042	*Aphelopus wushensis*	female	Yunnan, 21°44.745′ N, 100°26.07′E	MZ151333
SCAU 3042343	*Aphelopus zaifui* sp. nov.	male	Yunnan, 25°51′14.969″ N, 99°14′23.737″ E	MZ151334
SCAU 3042339	*Aphelopus zaifui* sp. nov.	male	Yunnan, 25°40′02.028″ N, 100°8′51.432″ E	MZ151335
SCAU 3011659	*Aphelopus zhaoi*	female	Yunnan, 21°45.037′ N, 100°26.715′ E	MZ151336

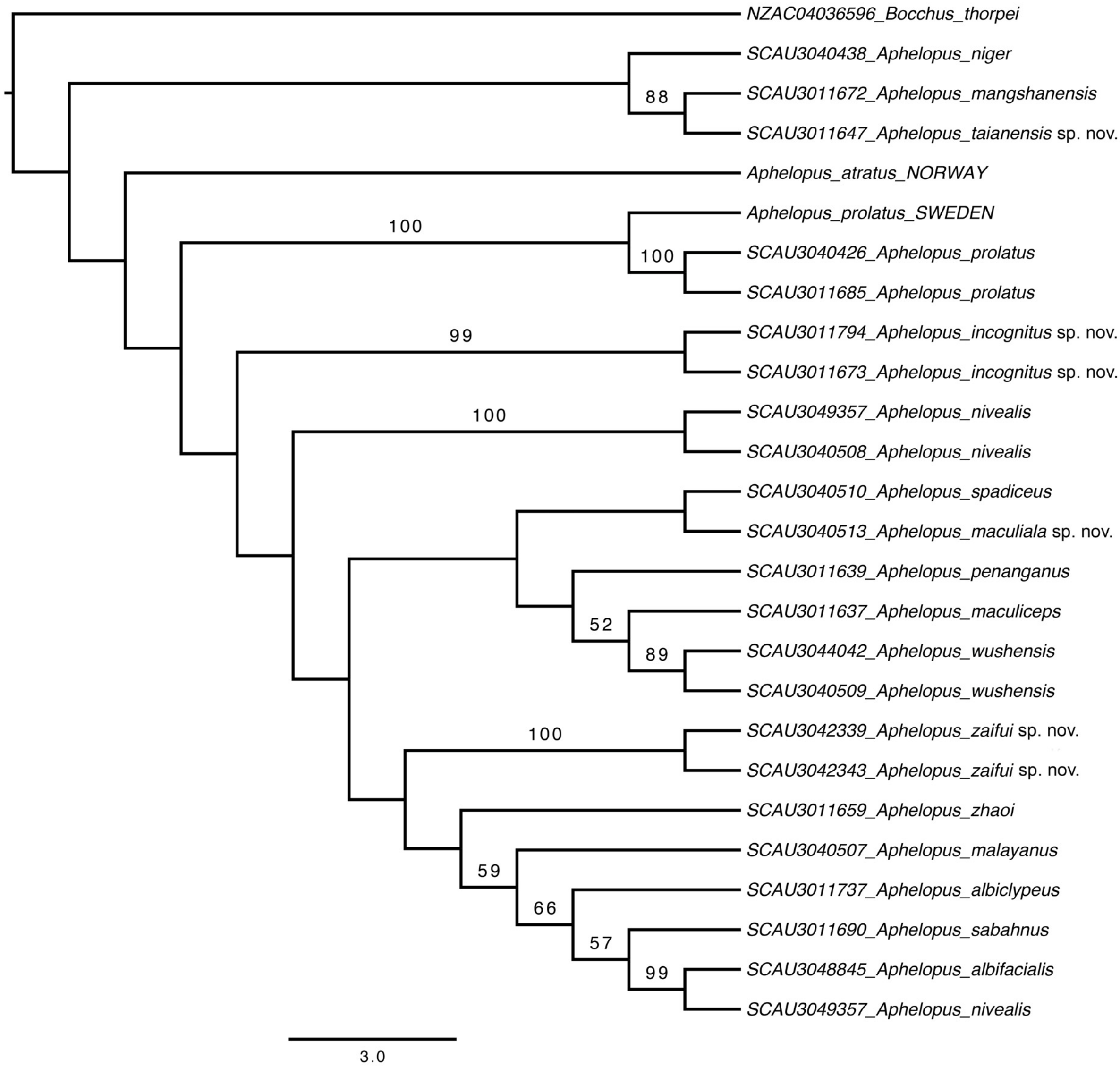

Fig. 2. Maximum likelihood tree demonstrating the clustering of *Aphelopus* Dalman, 1823 COI barcodes. Bootstraps values of 50 and above are indicated.

Taxonomy

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Superfamily Chrysidoidea Latreille, 1802
Family Dryinidae Haliday, 1833
Subfamily Aphelopinae Perkins, 1912

Genus ***Aphelopus*** Dalman, 1823

See Xu *et al*. (2013) and Olmi & Xu (2015) for taxonomic details on the genus.

Aphelopus incognitus Chen, Olmi & Guglielmino sp. nov.
urn:lsid:zoobank.org:act:A917F029-3AF2-451F-9B6B-CC215432441C
Figs 3–4, 8A

Diagnosis

Female with head mostly testaceous, mesosoma mostly brown, notauli reaching about 0.6 × length of mesoscutum (Fig. 4D); OPL longer than OOL (Fig. 4C); frontal line incomplete, absent in front of anterior ocellus. Male with head black, antennal setae much shorter than breadth of antennomeres, mesosoma black, notauli reaching about 0.75–0.80 × length of mesoscutum, fore wing hyaline, metasoma brown-testaceous, basivolsella with outer process and two subdistal bristles (Fig. 8A).

Etymology

The species is named '*incognitus*' (Latin adjective meaning 'unknown') because it was first recognized as a new species by *COI* sequences. Otherwise it would remain unnoticed, because morphologically it is extremely similar to closely related species such as *A. maculiclypeus* Xu, He & Olmi, 1999 and *A. spadiceus* Xu & He, 1997.

Material examined

Holotype

CHINA • ♂; Yunnan, Shangri-la, Gaoshan Botanical Garden; 27°53′47″ N, 99°38′22″ E; 30 May–5 Aug. 2018; Jie Zeng leg.; MT; SCAU 3011673 (SYSBM).

Paratypes

CHINA • 2 ♀♀; Beijing, Haidian District, Xiangshan Park; 195 m a.s.l.; 39.98683° N, 116.19096° E; 21–28 Aug. 2012; Li-Zhou Song and Wan-Guang Du leg.; MT; SCAU 3011794, SCAU 3040705 (SYSBM) • 1 ♀; same locality as for preceding; 28 Aug.–4 Sep. 2012; SCAU 3040691 (SYSBM).

Description

Male (Fig. 3)

Fully winged (Fig. 3A–B); length 2.1 mm. Head black, except mandible testaceous; antenna brown; mesosoma black; metasoma and legs brown-testaceous. Antenna filiform; antennal setae much shorter than breadth of antennomeres; antennomeres in following proportions: 5:4:5:6:6:7:6:7:7:9. Head (Fig. 3C) dull, granulate; frontal line incomplete, absent in front of anterior ocellus; POL = 6; OL = 3; OOL = 4; OPL = 3; TL = 4; greatest breadth of lateral ocellus as long as OL; occipital carina complete, not excavated behind the ocellar triangle. Mesoscutum and mesoscutellum dull, granulate. Notauli incomplete, reaching approximately 0.7 × length of mesoscutum (Fig. 3D). Metanotum unsculptured. Metapectal-propodeal complex with disc dull, reticulate rugose; propodeal declivity with two longitudinal keels, median area shiny, unsculptured and lateral areas rugose. Fore wing hyaline, without dark transverse bands. Basivolsella (Fig. 8A) with two subdistal bristles and outer medial process. Tibial spurs 1/1/2.

Female (Fig. 4)

Fully winged (Fig. 4A–B); length 1.9 mm. Head (Fig. 4C) testaceous, except large brown spot on temple, vertex and posterior half of frons (with short testaceous arms along orbits); antenna brown, except scape and pedicel yellow; mesosoma dark brown, except propleuron and lateral regions of pronotum testaceous; metasoma brown-testaceous; legs testaceous. Antenna clavate; antennomeres in following proportions: 5:4:5:5:5:5:4:4:4:7. Head dull, granulate; frontal line incomplete, absent in front of anterior ocellus; POL = 5; OL = 4; OOL = 4; OPL = 5; TL = 3; greatest breadth of lateral ocellus shorter than OPL (2:5); occipital carina complete, not excavated behind ocellar triangle. Mesoscutum dull, granulate.

Notauli incomplete, reaching about 0.6 × length of mesoscutum (Fig. 4D). Mesoscutellum dull, slightly granulate. Metanotum shiny, unsculptured. Disc of metapectal-propodeal complex reticulate rugose; propodeal declivity with two longitudinal keels, median area shiny and unsculptured and lateral areas rugose. Fore wing hyaline, without dark transverse bands. Tibial spurs 1/1/2.

Remarks

The female and male association of the new species is supported by the *COI* sequences, which are 99.2% identical between both sexes. This new species has been collected both in the Oriental (Yunnan) and Eastern Palaearctic (Beijing) region. In the Oriental region, following the above diagnosis, the female of *A. incognitus* Chen, Olmi & Guglielmino sp. nov. is close to that of *A. ochreus* Olmi, 1984. However, in the new species, the notauli reach about 0.6 × length of mesoscutum (Fig. 4D); OPL is longer than OOL (Fig. 4C); the frontal line is incomplete, absent in front of the anterior ocellus (in *A. ochreus*, the notauli are complete or reaching about 0.75–0.80 × length of mesoscutum; OPL is shorter than OOL; the frontal line is complete). Following the description of *A. incognitus* Chen, Olmi & Guglielmino sp. nov., the key to females of Oriental *Aphelopus* published by Xu *et al*. (2013) should be modified by replacing couplet 4 as follows.

4. Notauli complete or reaching about 0.6–0.8 × length of mesoscutum (Fig. 4D) .... 4'
– Notauli reaching at most 0.5 × length of mesoscutum 5

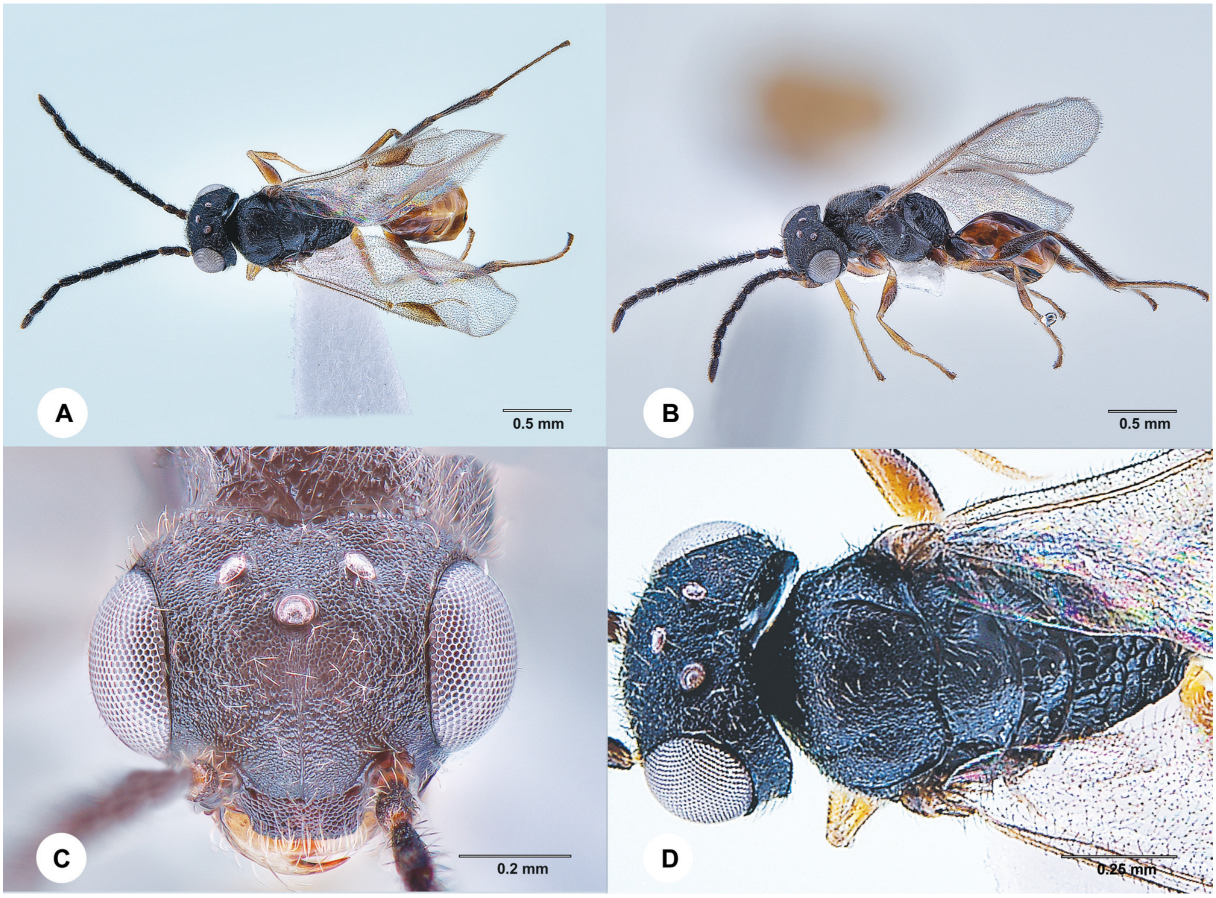

Fig. 3. *Aphelopus incognitus* Chen, Olmi & Guglielmino sp. nov., ♂, holotype (SCAU 3011673). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head, frontal view. **D**. Head and mesosoma, dorsal view.

4’. Notauli complete, or reaching about 0.75–0.80 × length of mesoscutum; OPL shorter than OOL; frontal line complete .... ***A. ochreus*** Olmi, 1984
– Notauli incomplete, reaching about 0.6 × length of mesoscutum (Fig. 4D); OPL longer than OOL (Fig. 4C); frontal line incomplete, absent in front of anterior ocellus ....
.... ***A. incognitus*** Chen, Olmi & Guglielmino sp. nov.

In the same Oriental region, following the above diagnosis, the male of *A. incognitus* Chen, Olmi & Guglielmino sp. nov. is close to that of *A. maculiclypeus* Xu, He & Olmi, 1999. However, in *A. incognitus* Chen, Olmi & Guglielmino sp. nov., POL is less than twice as long as OPL (Fig. 3C) and OPL is about as long as greatest breadth of lateral ocellus (in *A. maculiclypeus*, POL twice as long as OPL and OPL about twice as long as greatest breadth of lateral ocellus). Following the description of *A. incognitus* Chen, Olmi & Guglielmino sp. nov., the key to males of Oriental *Aphelopus* published by Xu *et al.* (2013) should be modified by replacing couplet 29 as follows.

29. Antennal setae much shorter than breadth of antennomeres (Fig. 3A) .... 29’
– Antennal setae about as long as breadth of antennomeres 30

29’. Head with POL twice as long as OPL; OPL about twice as long as greatest breadth of lateral ocellus .... ***A. maculiclypeus*** Xu, He & Olmi, 1999
– Head with POL less than twice as long as OPL (Fig. 3C); OPL about as long as greatest breadth of lateral ocellus .... ***A. incognitus*** Chen, Olmi & Guglielmino sp. nov.

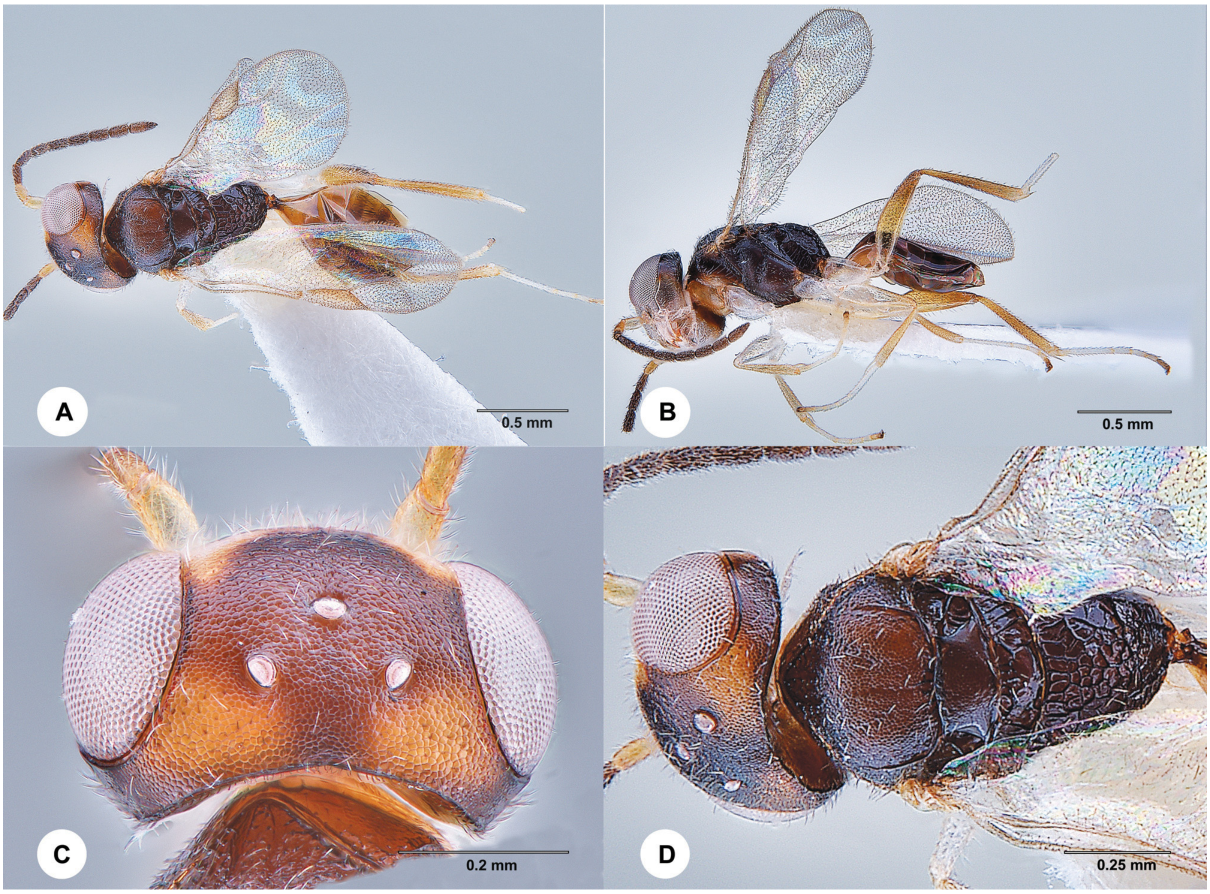

Fig. 4. *Aphelopus incognitus* Chen, Olmi & Guglielmino sp. nov., ♀, paratype (SCAU 3011794). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head, dorsal view. **D**. Head and mesosoma, dorsal view.

In the Eastern Palaearctic region, following the above diagnosis, the female of *A. incognitus* Chen, Olmi & Guglielmino sp. nov. is close to that of *A. maetoi* Olmi, 1995. However, in *A. incognitus* Chen, Olmi & Guglielmino sp. nov., the frontal line (Fig. 3C) is incomplete, absent in front of anterior ocellus, whereas in *A. maetoi* it is complete. Following the description of *A. incognitus* Chen, Olmi & Guglielmino sp. nov., the key to females of Eastern Palaearctic *Aphelopus* published by Olmi & Xu (2015) should be modified by replacing couplet 8 as follows:

8. Head with almost entire face white or testaceous (Olmi & Xu 2015: pl. 5d) ....***A. querceus*** Olmi, 1984
– Head with anterior third or half of face white or testaceous (Fig. 4C) .... 8'

8'. Frontal line complete .... ***A. maetoi*** Olmi, 1995
– Frontal line incomplete, absent in front of anterior ocellus (Fig. 4C) ....***A. incognitus*** Chen, Olmi & Guglielmino sp. nov.

In the same Eastern Palaearctic region, following the above diagnosis, the male of *A. incognitus* Chen, Olmi & Guglielmino sp. nov.is close to that of *A. spadiceus* Xu & He in Xu *et al*., 1997. However, in *A. incognitus* Chen, Olmi & Guglielmino sp. nov., the basivolsella shows an outer process in medial position (Fig. 8A), whereas it is in distal position in *A. spadiceus* (Olmi & Xu 2015: pl. 5j). Following the description of *A. incognitus*, Chen, Olmi & Guglielmino sp. nov. the key to males of Eastern Palaearctic *Aphelopus* published by Olmi & Xu (2015) should be modified by replacing couplet 9 as follows:

9. Frontal line complete ....***A. querceus*** Olmi, 1984
– Frontal line widely incomplete, not present near clypeus, or almost complete, not present in front of anterior ocellus (Fig. 3C) .... 9'

9'. Basivolsella with outer basal process located in distal position (Fig. 8E) ....***A. spadiceus*** Xu & He, 1997
– Basivolsella with outer basal process located in medial position (Fig. 8A) ....***A. incognitus*** Chen, Olmi & Guglielmino sp. nov.

Aphelopus maculiala Olmi, Chen & Ødegaard sp. nov.
urn:lsid:zoobank.org:act:F4CFEE19-3614-417C-B703-BB7F5D0762BB
Figs 5, 8B

Diagnosis

Male with head and mesosoma black, notauli reaching about 0.7 × length of mesoscutum (Fig. 5C), fore wing with one infuscate patch beneath pterostigma (Fig. 5F), metasoma black to dark brown, distivolsella not in the form of a long straight rod (Fig. 8B); basivolsella with distal apex not widened (Fig. 8B).

Etymology

The specific name is a composition of the Latin names '*macula*' (= 'spot') and '*ala*' (= 'wing').

Material examined

Holotype

CHINA • ♂; Yunnan, Lanping Dist., Mt Lasha; 26.324161° N, 99.256617° E; 2700 m a.s.l.; 10–20 Jul. 2018; Jin-Ku Li leg.; boskage; MT; SCAU 3040513 (SYSBM).

Paratype

CHINA • 1 ♂; Yunnan, Tengchong, Jietou; 12 May 2009; Jie Zeng leg.; SCAU 3049744 (SYSBM).

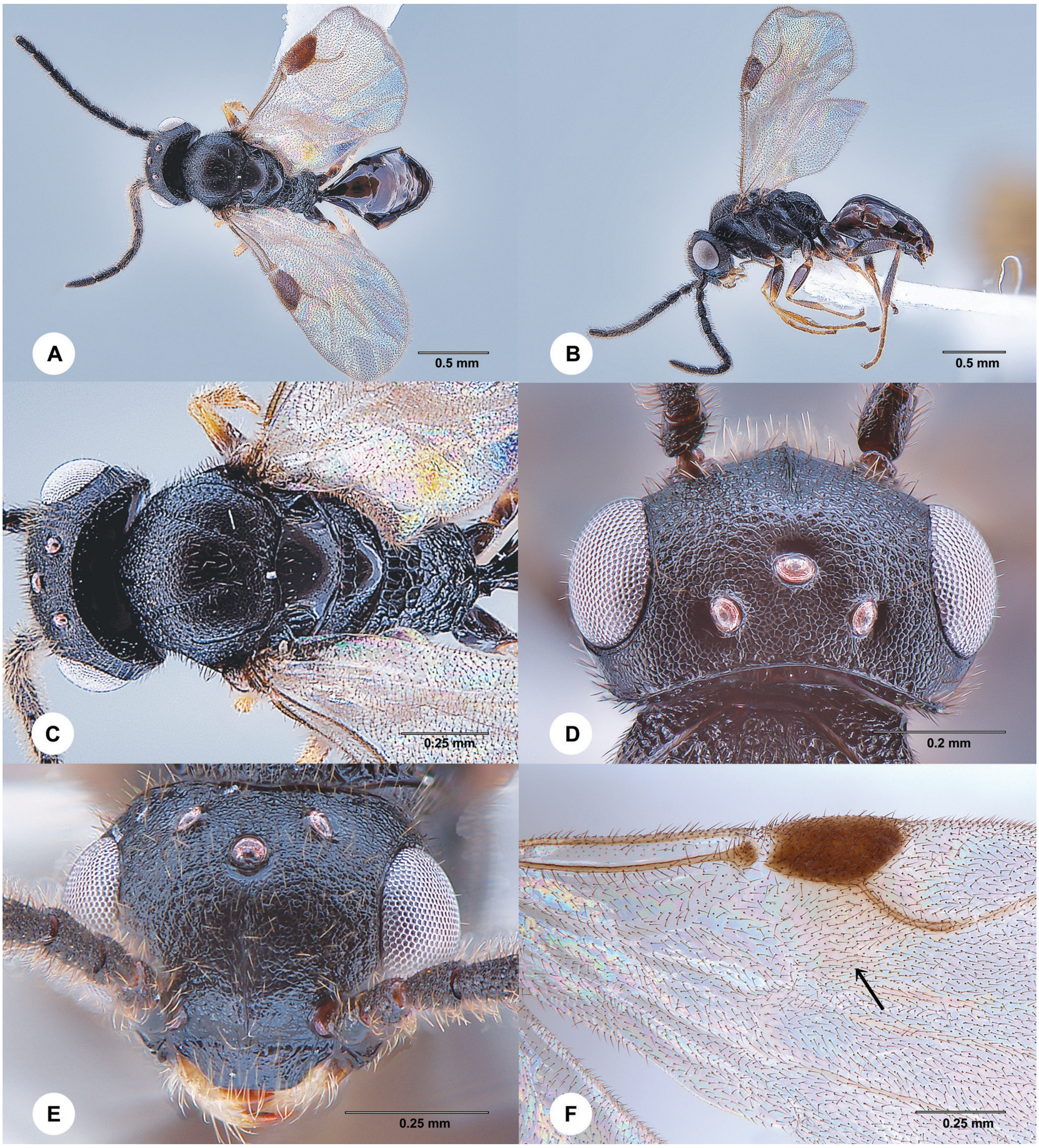

Fig. 5. *Aphelopus maculiala* Olmi, Chen & Ødegaard sp. nov., ♂, holotype (SCAU 3040513). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head, dorsal view. **E**. Head, frontal view. **F**. Fore wing, arrow shows infuscate patch beneath pterostigma.

Description

Male

Fully winged (Fig. 5A–B); length 2.3 mm. Head black, except mandible testaceous; antenna brown-black; mesosoma black; metasoma black to dark brown; leg black to dark brown, except tarsus and fore tibia testaceous. Antenna filiform, with setae about as long as breadth of antennomeres; antennomeres in following proportions: 5:5:6:7:7:8:8:7:8:12; length/breadth ratio of ninth antennomere: 8:2. Head (Fig. 5D–E) dull, granulate; frontal line incomplete, shortly absent in front of anterior ocellus; POL = 7; OL = 3; OOL = 5; OPL = 2; TL = 4; greatest breadth of lateral ocellus about as long as OPL; occipital carina complete. Mesoscutum dull, granulate. Notauli incomplete, reaching about 0.7 × length of mesoscutum (Fig. 5C). Mesoscutellum and metanotum shiny, unsculptured. Metapectal-propodeal disc reticulate rugose; propodeal declivity with two longitudinal keels and median area shiny, unsculptured. Fore wing (Fig. 5F) hyaline, except a small infuscate patch beneath pterostigma. Basivolsella (Fig. 8B) with distal outer process and two subdistal bristles; distal apex of aedeagus not tridentate. Tibial spurs 1/1/2.

Female

Unknown.

Remarks

According to Xu *et al*. (2013), the male of *Aphelopus spadiceus* usually has a hyaline fore wing, except a specimen from China (Yunnan, Tengchong, Jietou, 12.v.2009, Jie Zeng leg., 1 ♂, SCAU) showing a small infuscate patch beneath the pterostigma. The above specimen has been considered only a variety of *A. spadiceus* by Xu *et al*. (2013). However, a comparison between *COI* sequences of two males of *A. spadiceus* from China, 26.324161° N, 99.256617° E, one with a hyaline fore wing and the other with an infuscate patch (Fig. 5F), showed that the two specimens belong to two separate species. This result persuaded us to describe the specimen with an infuscate patch on the fore wing as a new species named *A. maculiala* Olmi, Chen & Ødegaard sp. nov. (although the genitalia of the new species is similar to that of *A. spadiceus*). The fore wing of the new species shows a small infuscate patch, so that it is more similar to *A. xanthopus* Xu, He & Olmi, 1999, than to *A. spadiceus*. However, in *A. maculiala* Olmi, Chen & Ødegaard sp. nov. the face is completely black (Fig. 5D), whereas in *A. xanthopus* it is whitish between the antennal toruli. Following the description of *A. maculiala* Olmi, Chen & Ødegaard sp. nov., the key to males of the Oriental *Aphelopus* published by Xu *et al*. (2013) should be modified by replacing couplet 21 as follows:

20. Fore wing with one infuscate patch beneath pterostigma (Fig. 5A) 21
– Fore wing hyaline, without dark patches or bands 22

21. Face with area between antennal toruli whitish ....***A. xanthopus*** Xu, He & Olmi, 1999
– Face completely black (Fig. 5D) ....***A. maculiala*** Olmi, Chen & Ødegaard sp. nov.

Aphelopus taianensis Olmi, Ødegaard & Chen sp. nov.
urn:lsid:zoobank.org:act:407CE45D-7B8C-426C-9145-A2A45E9BE81C
Figs 6, 8C

Diagnosis

Male with head black, except mandible testaceous; mesosoma black; notauli incomplete, reaching approximately 0.5× length of mesoscutum; aedeagus distally not tridentate (Fig. 8C); basivolsella very narrow (Fig. 8C), without distal outer process, with two subdistal bristles and one lateral outer pointed apophysis; distivolsella not in the form of a long straight rod.

Etymology

The new species is named after Taian City, where it has been collected.

Material examined

Holotype

CHINA • ♂; Shandong, Taian; 36°12′ N, 117°5′ E; 20 Jul. 2015; Qing-Tao Gong leg.; apple orchard; MT; SCAU 3011647 (SYSBM).

Description

Male (Figs 6, 8C)

Fully winged; length 1.8 mm. Head black, except mandible testaceous; antenna brown, except scape and pedicel testaceous; mesosoma black; metasoma brown; legs yellow. Antenna filiform; antennomeres in following proportions: 3:4:3:4:5:5.5:5:6:6:10. Head dull, granulated; frontal line incomplete, absent shortly in front of anterior ocellus; occipital carina complete; POL = 6; OL = 3; OOL = 3; OPL = 1.5; TL = 2; greatest breadth of lateral ocellus about as long as TL. Mesoscutum and mesoscutellum dull, granulated. Notauli incomplete, reaching approximately 0.5 × length of mesoscutum (Fig. 6C). Metanotum shiny, unsculptured. Metapectal-propodeal complex dull, reticulate rugose, with two complete longitudinal keels on posterior surface; posterior surface with median area unsculptured and

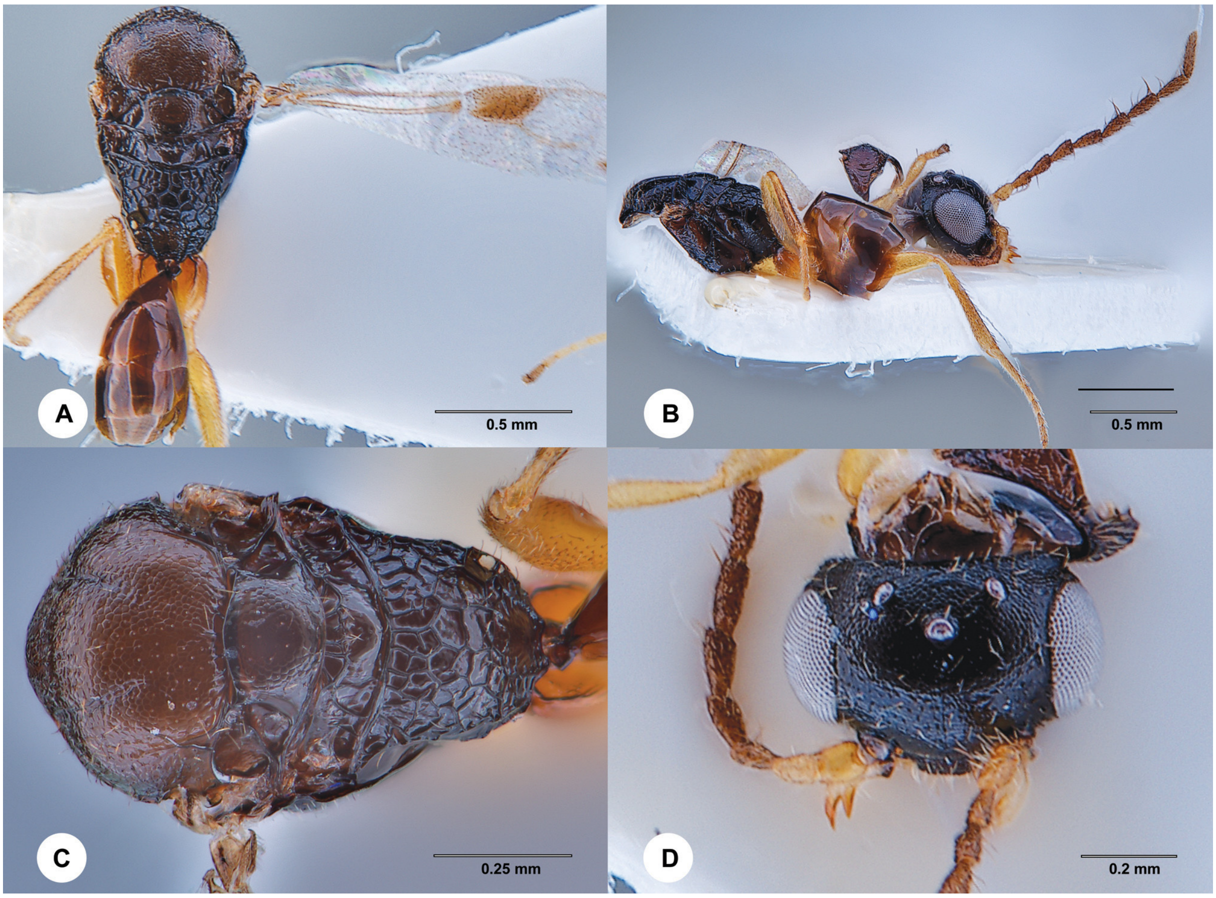

Fig. 6. *Aphelopus taianensis* Olmi, Ødegaard & Chen sp. nov., ♂, holotype (SCAU 3011647). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Mesosoma, dorsal view. **D**. Head, anterodorsal view.

lateral areas rugose. Fore wing hyaline, without dark transverse bands. Basivolsella (Fig. 8C) very narrow, without distal outer process, with one lateral outer pointed apophysis and two subdistal bristles situated on top of each other. Tibial spurs 1/1/2.

Female

Unknown.

Remarks

From the above diagnosis, *A. taianensis* Olmi, Ødegaard & Chen sp. nov. is close to *A. nepalensis* Olmi, 1984. However, in the new species, the basivolsella (Fig. 8C) is very narrow and with one lateral pointed apophysis (very wide and without lateral pointed apophysis in *A. nepalensis* (Olmi & Xu 2015: pl. 4k). Following the description of *A. taianensis* Olmi, Ødegaard & Chen sp. nov., the key to males of Oriental *Aphelopus* published by Olmi & Xu (2015) should be modified by replacing couplet 15 as follows:

15. Notauli reaching approximately 0.65 × length of mesoscutum .... ***A. nigriceps*** Kieffer, 1905
– Notauli reaching approximately 0.5 × length of mesoscutum (Fig. 6C) .... 15'

15'. Basivolsella very wide, without lateral pointed apophysis, with two subdistal bristles situated on either side of each other (Olmi & Xu 2015: pl. 4k) .... ***A. nepalensis*** Olmi, 1984
– Basivolsella very narrow, with one lateral pointed apophysis and two subdistal bristles situated on top of each other (Fig. 8C) ....***A. taianensis*** Olmi, Ødegaard & Chen sp. nov.

Aphelopus zaifui Olmi, Chen & Liu sp. nov.

urn:lsid:zoobank.org:act:730357C7-2449-42BE-99A6-6DBFFE97DC67

Figs 7, 8D

Diagnosis

Male with head black, except mandible testaceous; notauli complete (Fig. 7B) or almost complete (Fig. 7F), posteriorly separated; distivolsella in the form of a long straight rod (Fig. 8D); basivolsella long and narrow, with distal apex very widened (Fig. 8D).

Etymology

The species is named after the late Prof. Zaifu Xu (SCAU), a famous specialist of Chinese Dryinidae.

Material examined

Holotype

CHINA • ♂; Yunnan, Dali, Yunlong County, Tianchi; 25.854158° N, 99.239927° E; 2933 m a.s.l., 14–28 Jun. 2020; You-Jing Gong leg.; MT; SCAU 3042343 (SYSBM).

Paratypes

CHINA • 1 ♂; Yunnan, Dali, Mt Cangshan; 25°41′16″ N, 100°8′33″ E; 25 May 2009; Jie Zeng leg.; SCAU 3040717 (SYSBM) • 1 ♂; Dali Dist., Mt Cangshan, 25.66723° N, 100.14762° E; 2300 m a.s.l.; 31 May 2020; MT; SCAU 3042339 (SYSBM).

Description

Male

Fully winged (Fig. 7A); length 2.0 mm. Head black, except mandible testaceous; antenna brown-black; mesosoma and metasoma black; fore and mid leg yellow, except club of femur brown; hind leg yellow, except part of coxa, club of femur and tibia brown. Antenna filiform, with setae about as long as breadth

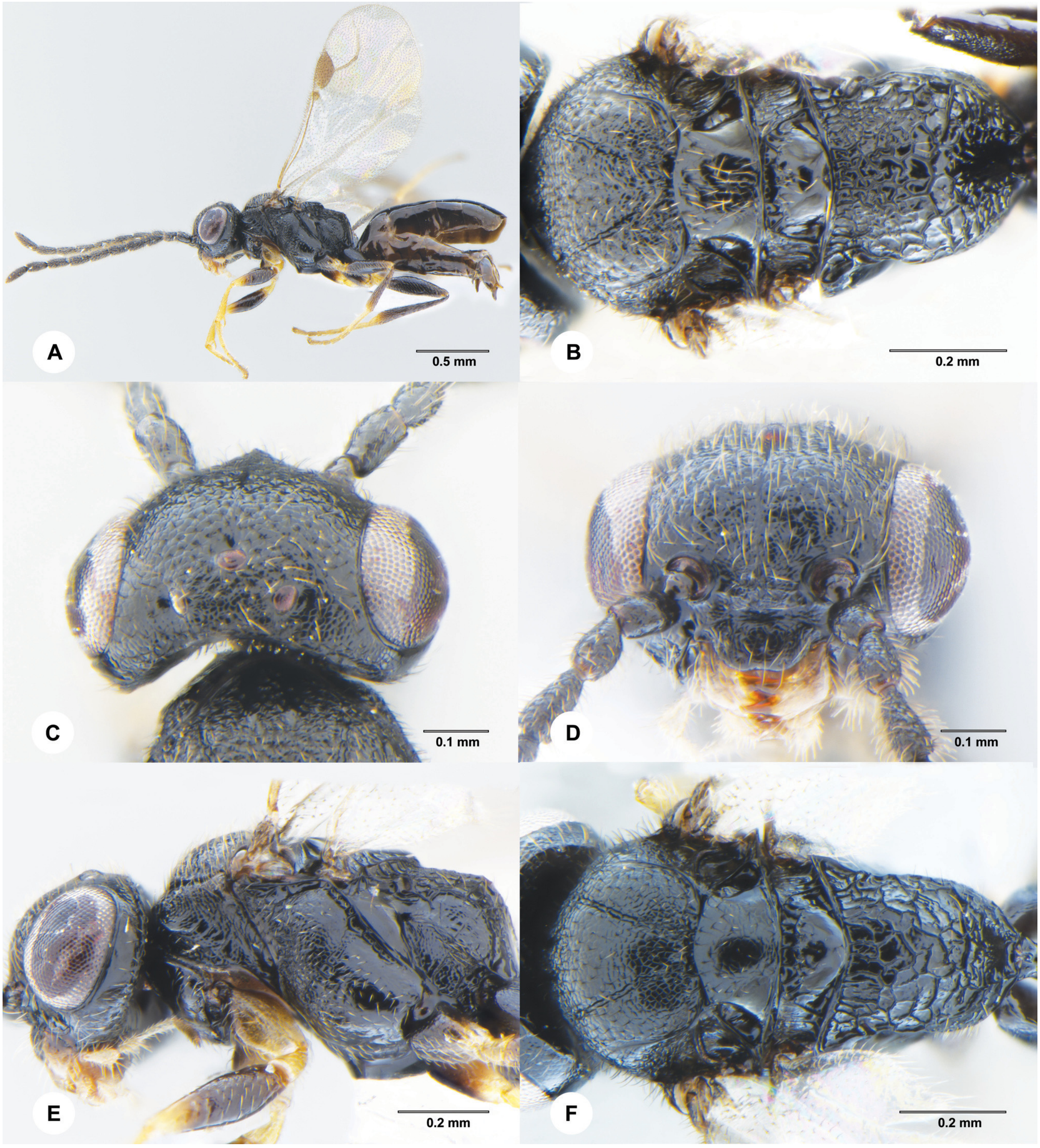

Fig. 7. *Aphelopus zaifui* Olmi, Chen & Liu sp. nov. **A–E**. Holotype, ♂ (SCAU 3042343). **A**. Habitus, dorsal view. **B**. Mesosoma, dorsal view. **C**. Head, dorsal view. **D**. Head, frontal view. **E**. Head and mesosoma, lateral view. **F**. Paratype, ♂ (SCAU 3042339), mesosoma, dorsal view.

of antennomeres; antennomeres in following proportions: 5:5:5:6:6:7:7:7:7:10; length/breadth ratio of ninth antennomere: 7:2. Head (Fig. 7C–D) dull, granulate; frontal line incomplete, present only in anterior half of frons; POL = 5; OL = 3; OOL = 3; OPL = 2; TL = 3; greatest breadth of lateral ocelli about as long as OPL; occipital carina complete. Mesoscutum (Figs 7B, F) dull, granulate. Notauli complete (Fig. 7B) or nearly complete (Fig. 7F), posteriorly separated; minimum distance between notauli slightly shorter than POL (4:5). Mesoscutellum shiny, very slightly granulate. Mesopleuron and metapleuron shiny, unsculptured. Metanotum shiny, unsculptured. Metapectal-propodeal disc reticulate rugose; propodeal declivity with two longitudinal keels and median area shiny, unsculptured. Fore wing hyaline, without

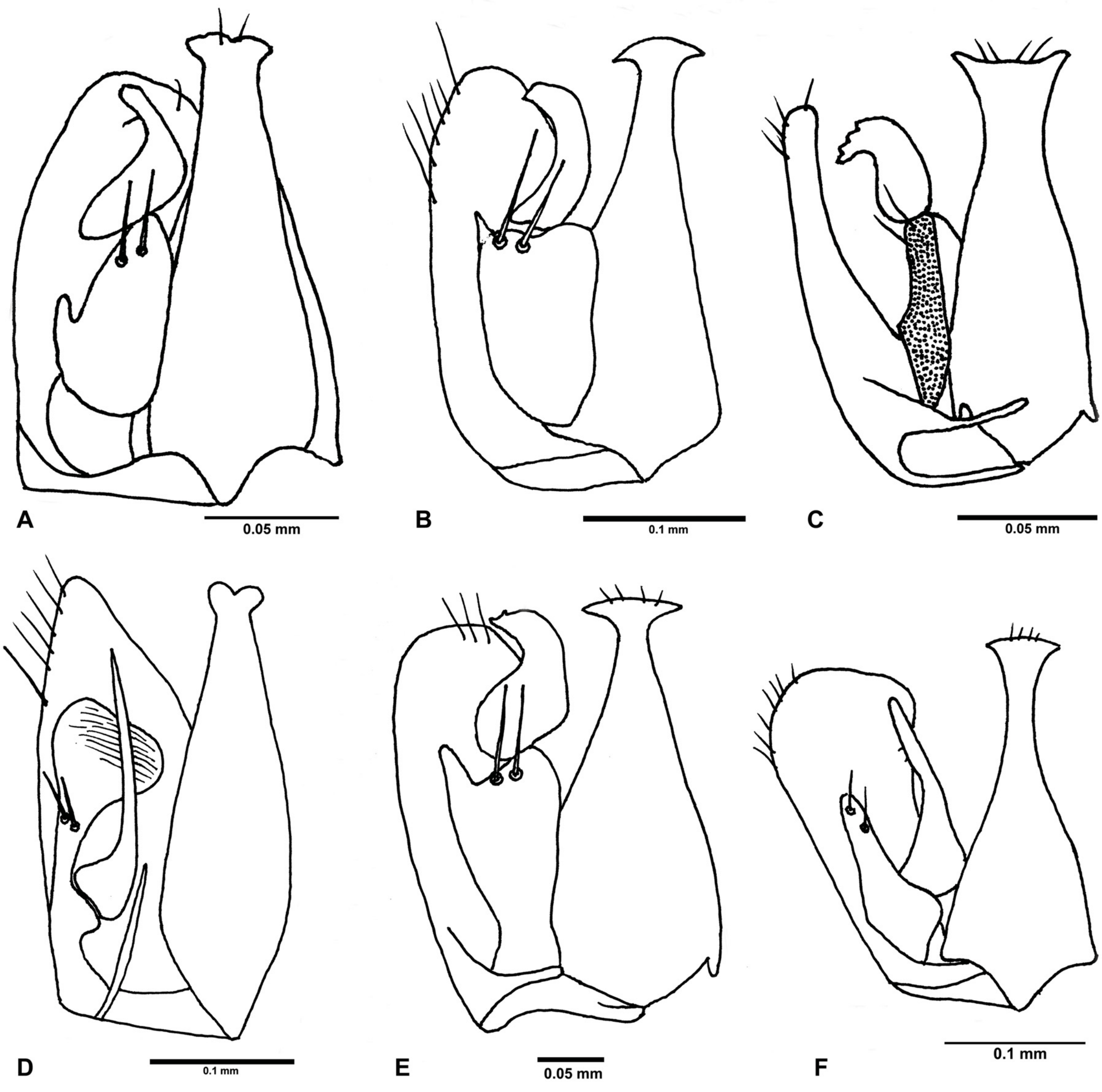

Fig. 8. Male genitalia: **A**. *Aphelopus incognitus* Chen, Olmi & Guglielmino sp. nov., ♂, holotype. **B**. *Aphelopus maculiala* Olmi, Chen & Ødegaard sp. nov., ♂, holotype. **C**. *Aphelopus taianensis* Olmi, Ødegaard & Chen sp. nov., ♂, holotype. **D**. *Aphelopus zaifui* Olmi, Chen & Liu sp. nov., ♂, paratype. **E**. *Aphelopus spadiceus* Xu & He, ♂ from China, Sichuan, Wolong. **F**. *Aphelopus serratus* Richards, 1939, ♂ from Leicester (England, UK). Right half removed.

dark transverse bands. Distivolsella in form of long straight rod (Fig. 8D); basivolsella long and narrow, with two medial bristles and distal apex very widened (Fig. 8D); distal apex of aedeagus not tridentate (Fig. 8D). Tibial spurs 1/1/2.

Female
Unknown.

Remarks

The distivolsella in the form of a long straight rod indicates that the new species is different from all known *Aphelopus* species, except *A. serratus* Richards, 1939, from the Palaearctic region. However, in *A. zaifui* Olmi, Chen & Liu sp. nov. the basivolsella has a widened apex (Fig. 8D), whereas in *A. serratus* it has a slender apex (Fig. 8F). Following the description of *A. zaifui* Olmi, Chen & Liu sp. nov., the key to males of Oriental *Aphelopus* published by Xu *et al*. (2013) should be modified by replacing couplet 1 as follows:

1. Distivolsella in the form of a long straight rod (Fig. 8D); basivolsella long and narrow, with distal apex very widened (Fig. 8D) ....***A. zaifui*** Olmi, Chen & Liu sp. nov.
– Distivolsella and basivolsella with different shape (Fig. 8A–B) .... 1'

1'. Mesosoma and metasoma totally testaceous, except petiole black ....***A. borneanus*** Olmi, 1984
– Mesosoma and metasoma partly or totally black or brown 2

Other examined material from China

Aphelopus albiclypeus Xu, He & Olmi, 1999
Fig. 9

Aphelopus albiclypeus Xu, He & Olmi, 1999: 90.

Aphelopus albiclypeus – Xu *et al*. 2013: 17.

Material examined

CHINA • 1 ♂; Yunnan, Maguan Town, Bazhai County, near dam; 23.021373° N, 104.06459° E; 1749 m a.s.l.; Jun. 2017; Li Ma leg.; forest; MT; SCAU 3011737 (SYSBM).

Distribution

China, Laos, Thailand, Vietnam (Xu *et al*. 2013).

Aphelopus albifacialis Xu & He, 1997
Fig. 10

Aphelopus albifacialis Xu & He in Xu *et al.*, 1997: 7.

Aphelopus albifacialis – Xu *et al*. 2013: 19.

Material examined

CHINA • 1 ♀; Yunnan, Xishuangbanna, Menghai, Bulangshan Village, Area D, near road; 21°44.745′ N, 100°26.07′ E; 1621 m a.s.l., 20 Jun.–20 Jul. 2018; Li Ma leg.; MT; SCAU 3011667 (SYSBM) • 1 ♀; Guangdong, Shenzhen, Xianhu Botanical Garden; 22.580382° N, 114.172781° E; 31 Mar.–30 Apr. 2020; Long-Long Chen leg.; LSX447, MT-GD28; SCAU 3048845 (SYSBM).

Fig. 9. *Aphelopus albiclypeus* Xu, He & Olmi, 1999, ♂ (SCAU 3011737). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

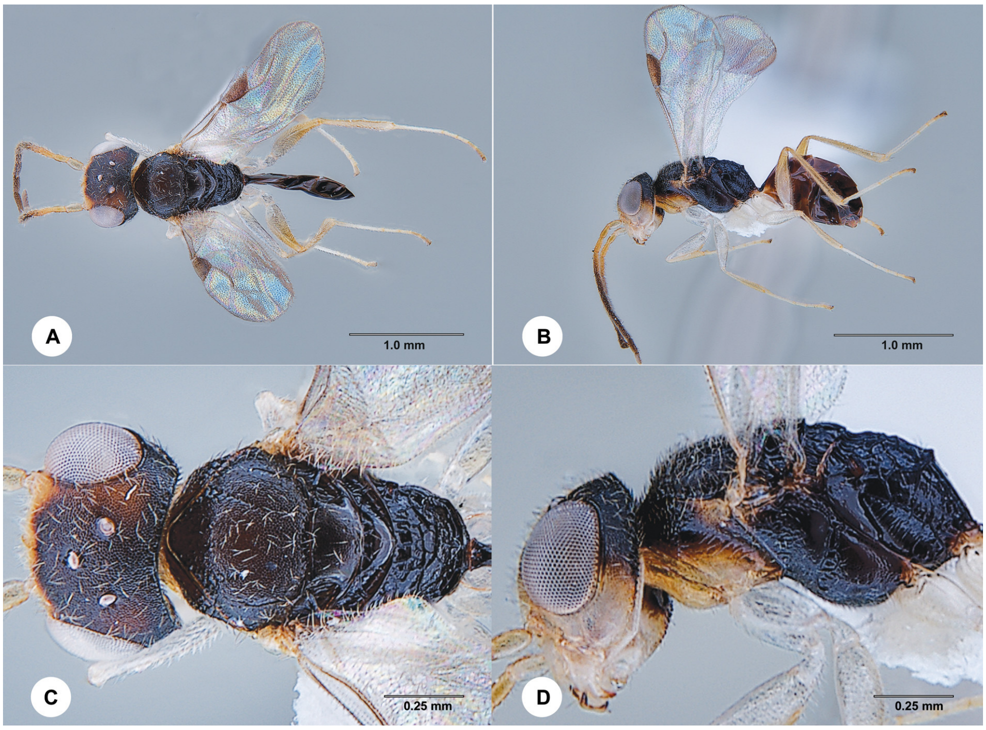

Fig. 10. *Aphelopus albifacialis* Xu & He, 1997, ♂ (SCAU 3011667). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

Distribution

China (Xu *et al*. 2013).

Aphelopus maculiceps Bergman, 1957
Fig. 11

Aphelopus maculiceps Bergman, 1957: 9.

Aphelopus maculiceps – Xu *et al*. 2013: 23.

Material examined

CHINA • 1 ♀; Sichuan, Chengdu, Longquanyi District, Baihe Town, Changsong Village; 30°31′17″ N, 104°17′0″ E; 8 Oct. 2012; MT; SCAU 3011637 (SYSBM).

Distribution

China, India, Indonesia, Vietnam (Xu *et al*. 2013).

Aphelopus malayanus Olmi, 1984
Fig. 12

Aphelopus malayanus Olmi, 1984: 66.

Aphelopus malayanus – Xu *et al*. 2013: 26.

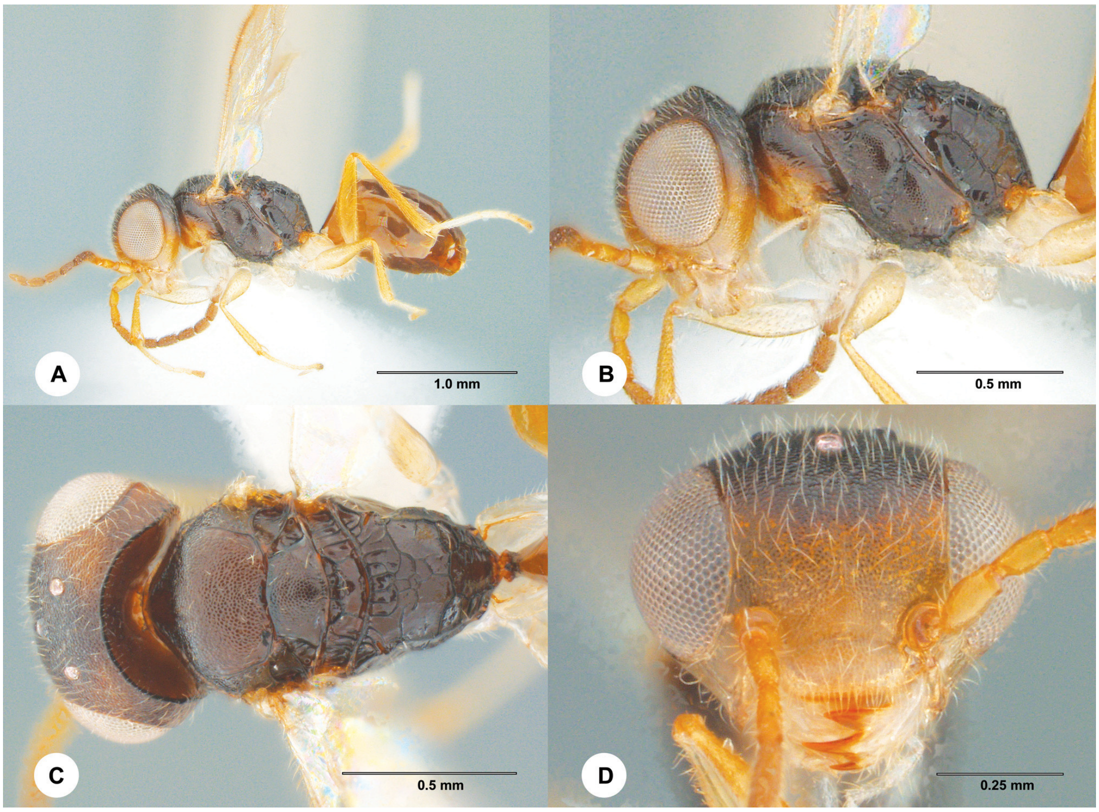

Fig. 11. *Aphelopus maculiceps* Bergman, 1957, ♂ (SCAU 3011637). **A**. Habitus, lateral view. **B**. Head and mesosoma, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head, frontal view.

Material examined

CHINA • 1 ♀; Guangdong, Guangzhou University Town; 23°2′925″ N, 113°21′25″ E; 20 Jan.–17 Feb. 2019; Hua-Yan Chen leg.; wetland; MT; SCAU 3040507 (SYSBM).

Distribution

Brunei, China, India, Indonesia, Laos, Malaysia, Nepal, Philippines, Thailand (Xu *et al*. 2013), South Korea (Kim & Lee 2016).

Aphelopus mangshanensis Xu, Olmi, Guglielmino & Chen, 2011
Fig. 13

Aphelopus mangshanensis Xu, Olmi, Guglielmino & Chen, 2011: 243.

Aphelopus mangshanensis – Xu *et al*. 2013: 27.

Material examined

CHINA • 1♂; Yunnan, Xianggelila, Gaoshan Botanical Garden; 27°53′47″ N, 99°38′22″ E; 30 May–5 Aug. 2018; Jie Zeng leg.; MT; SCAU 3011672 (SYSBM).

Distribution

China (Xu *et al*. 2013).

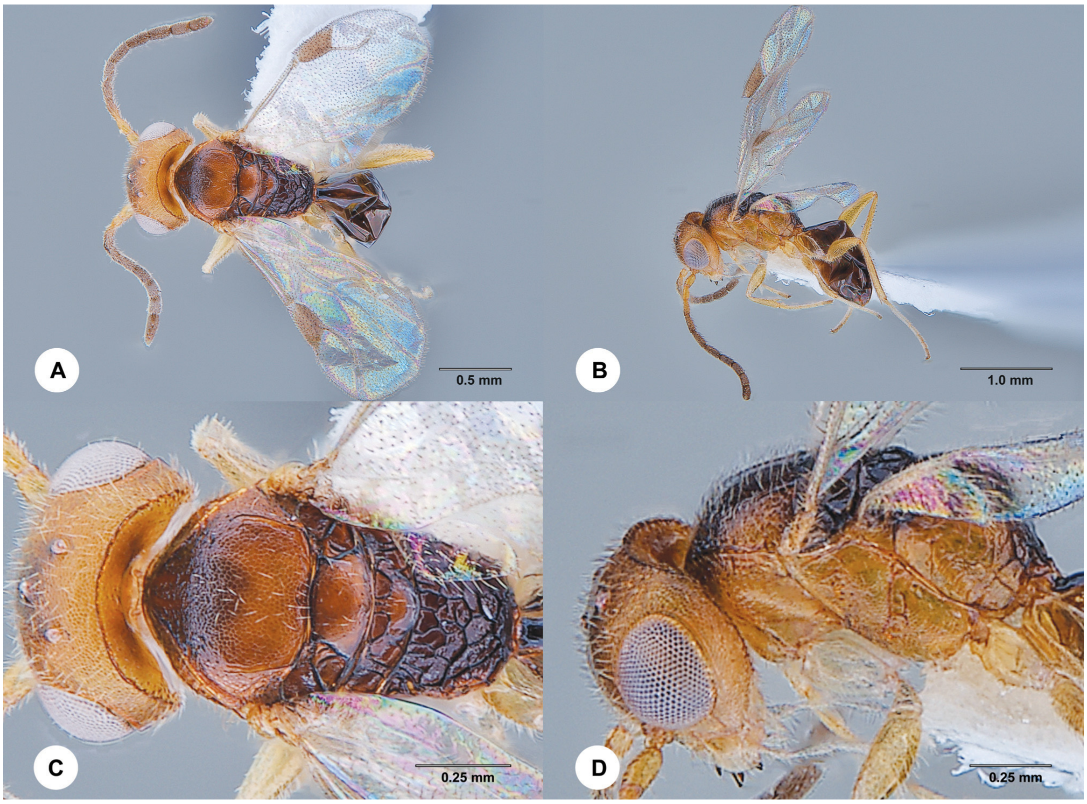

Fig. 12. *Aphelopus malayanus* Olmi, 1984, ♂ (SCAU 3040507). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

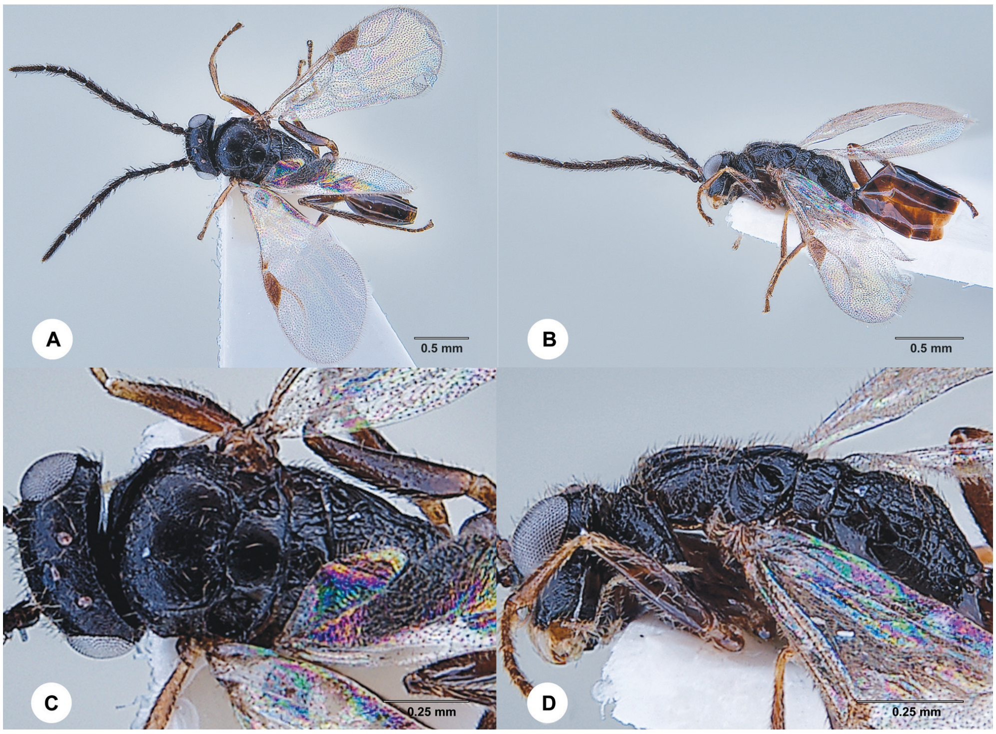

Fig. 13. *Aphelopus mangshanensis* Xu, Olmi, Guglielmino & Chen, 2011, ♂ (SCAU 3011672). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

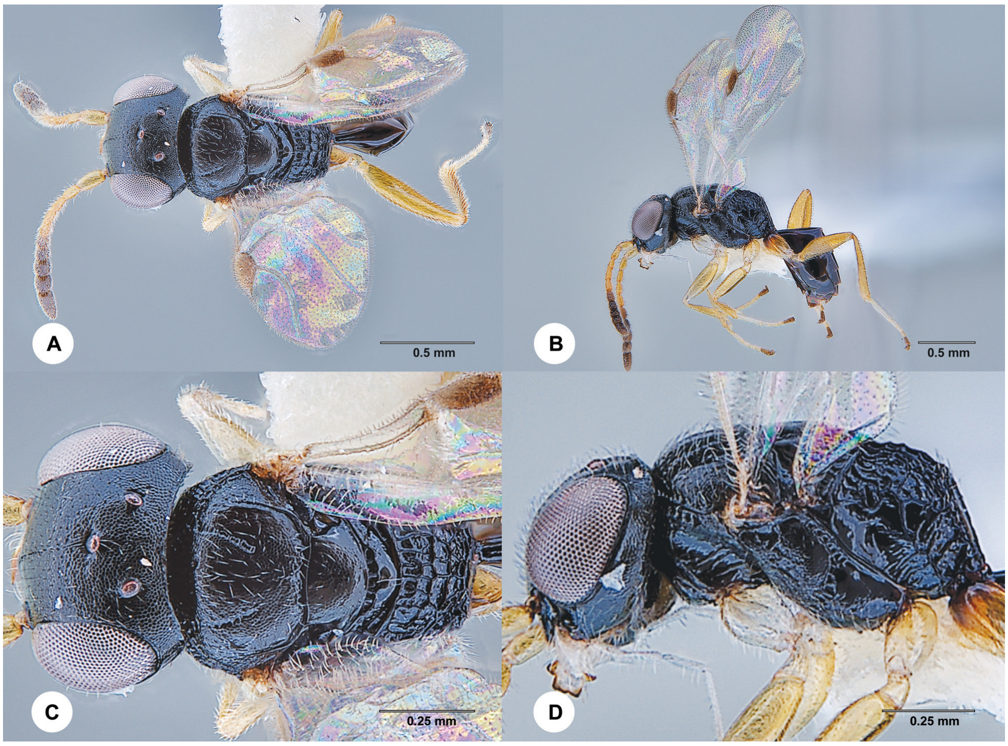

Fig. 14. *Aphelopus niger* Xu & He, 1999, ♀ (SCAU 3040438). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

Aphelopus niger **Xu & He, 1999**
Fig. 14

Aphelopus niger Xu & He, 1999: 2.

Aphelopus niger – Xu *et al*. 2013: 30.

Material examined

CHINA • 1 ♀; Guangdong, Guangzhou SYSU, bamboo garden; 23°3′9″ N, 113°23′23″ E; 23 Dec. 2018–20 Jan. 2019; Hua-Yan Chen leg.; MT; SCAU 3040438 (SYSBM).

Distribution

China (Xu *et al*. 2013).

Aphelopus nivealis **Mita & Olmi, 2014**
Fig. 15

Aphelopus nivealis Mita & Olmi, 2014: 93.

Aphelopus nivealis – Olmi & Xu 2015: 25.

Material examined

CHINA • 1 ♀; Guangdong, Guangzhou University Town, secondary forest; 23°3′9″ N, 113°23′23″ E; 20 Jan.–17 Feb. 2019; Hua-Yan Chen leg.; MT; SCAU 3040508 (SYSBM) • 1 ♀; Guangdong, Shenzhen, Mt Tanglangshan; 22.570411639° N, 113.99317344° E; LSX498, 7–30 May 2020; Long-Long Chen leg.; MT-GD7; SCAU 3049357 (SYSBM).

Distribution

Japan (Honshu), China (Guangdong) (**new record**).

Remarks

Aphelopus nivealis Mita & Olmi, 2014 was originally described from the Eastern Palaearctic region (Honshu, Japan) (see Olmi & Xu 2015). In this species there are no notauli. One of the two specimens above (from Guangdong, 22.570411639° N, 113.99317344° E) matches completely with the description of *A. nivealis*, including the body colour and the absence of notauli (Fig. 15A–B). On the contrary, the other specimen (from Guangdong, 23°3′9″ N, 113°23′23″ E) is whiter and seems to have shallow traces of notauli reaching about 0.5 × length of mesoscutum (Fig. 15C–D). The genetic distance between the two specimens is only 0.6%, suggesting that the variations are just intraspecific. These records indicate that *A. nivealis* is present both in the Eastern Palaearctic and the Oriental regions.

Aphelopus penanganus **Olmi, 1984**
Fig. 16

Aphelopus penanganus Olmi, 1984: 68.

Aphelopus penanganus – Xu *et al*. 2013: 33. — Barthélémy & Olmi 2019: 533.

Material examined

CHINA • 1 ♀; Heilongjiang, Nenjiang County, Jianshan Farm; 48°46′55″ N, 125°19′53″ E; 15 Jun. 2015; MT; SCAU 3011639 (SYSBM).

Distribution

China (Fujian, Hainan, Heilongjiang, Henan, Hong Kong, Ningxia, Taiwan, Yunnan, Zhejiang), India (Tamil Nadu), Indonesia (Sulawesi), Malaysia (Malaya, Sabah), Thailand (Chaiyaphum, Chiang Mai, Trang) (Xu *et al*. 2013; Barthélémy & Olmi 2019).

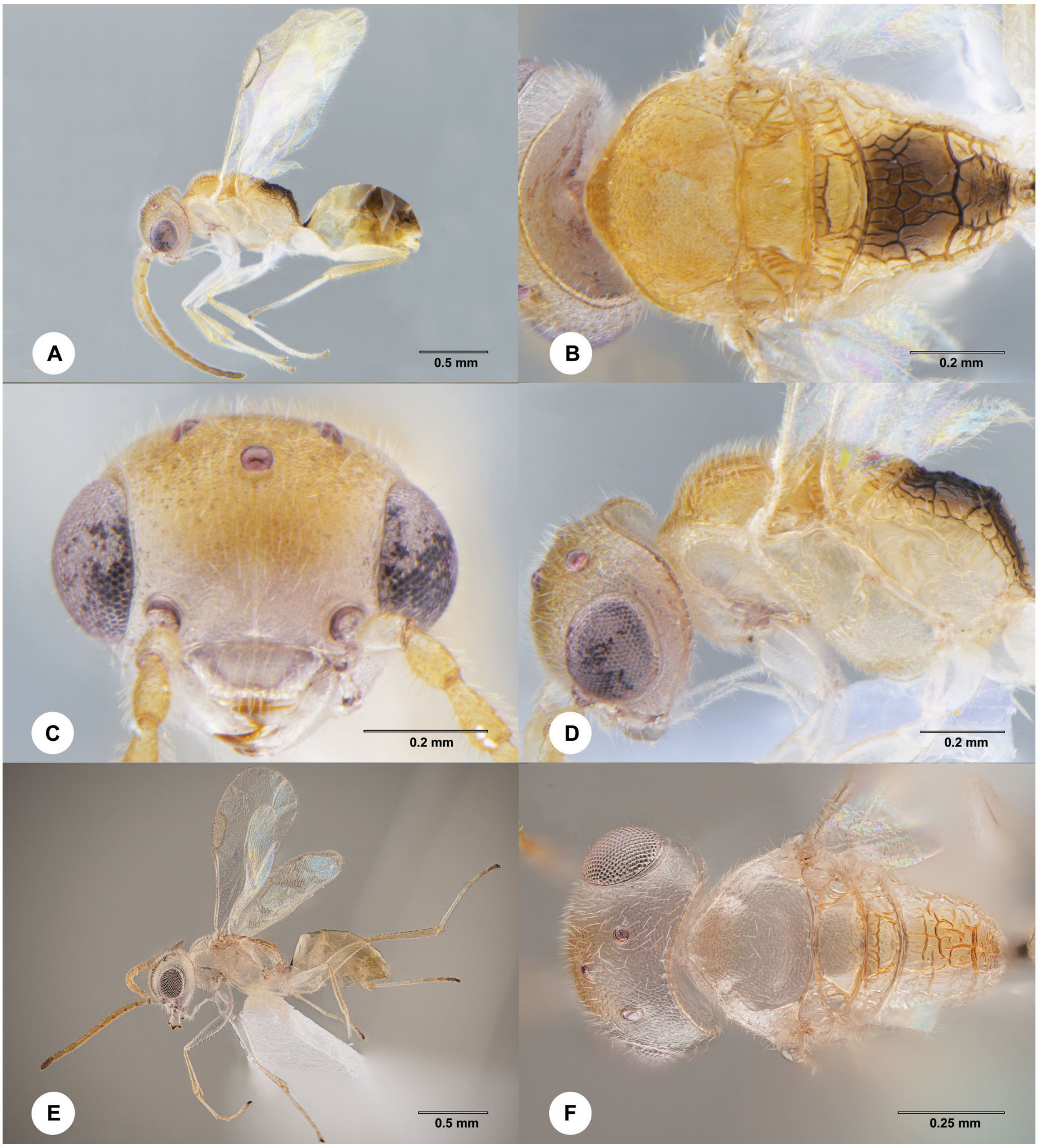

Fig. 15. *Aphelopus nivealis* Mita & Olmi, 2014. **A–B**. ♀ (SCAU 3049357) **A**. Habitus, lateral view. **B**. Mesosoma, dorsal view. **C–D**. ♀ (SCAU 3040508) **C**. Habitus, lateral view. **D**. Head and mesosoma, dorsal view.

Remarks

The presence of *A. penanganus* in China, Heilongjiang Province, indicates that this species is present both in the Eastern Palaearctic and Oriental regions.

Aphelopus prolatus Mita & Olmi, 2014
Fig. 17

Aphelopus prolatus Mita & Olmi, 2014: 91.

Aphelopus prolatus – Olmi & Xu 2015: 27.

Material examined

CHINA • 1 ♀; Shandong, Shanghe County, 37°16′4″ N, 117°9′10″ E; 19–25 May 2018; Jia-He Yan leg.; MT3; SCAU 3040426 (SYSBM) • 1 ♀; same locality as for preceding; 26 May–1 Jun. 2018; MT4; SCAU 3011685 (SYSBM).

Distribution

Japan, Sweden (Olmi & Xu 2015), South Korea (Kim & Lee 2016), China (**new record**).

Aphelopus sabahnus Olmi, 1991
Fig. 18

Aphelopus sabahnus Olmi, 1991: 113.

Aphelopus sabahnus – Xu *et al*. 2013: 35.

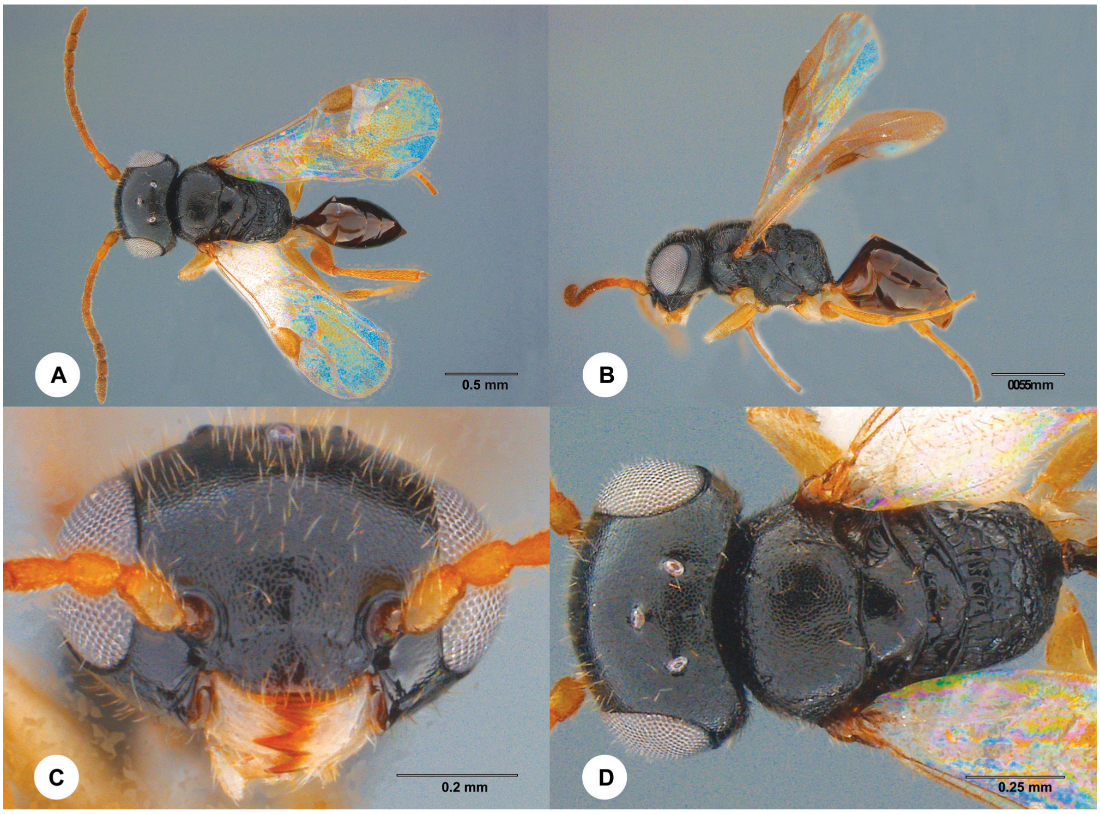

Fig. 16. *Aphelopus penanganus* Olmi, 1984, ♀ (SCAU 3011639). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head, frontal view. **D**. Head and mesosoma, dorsal view.

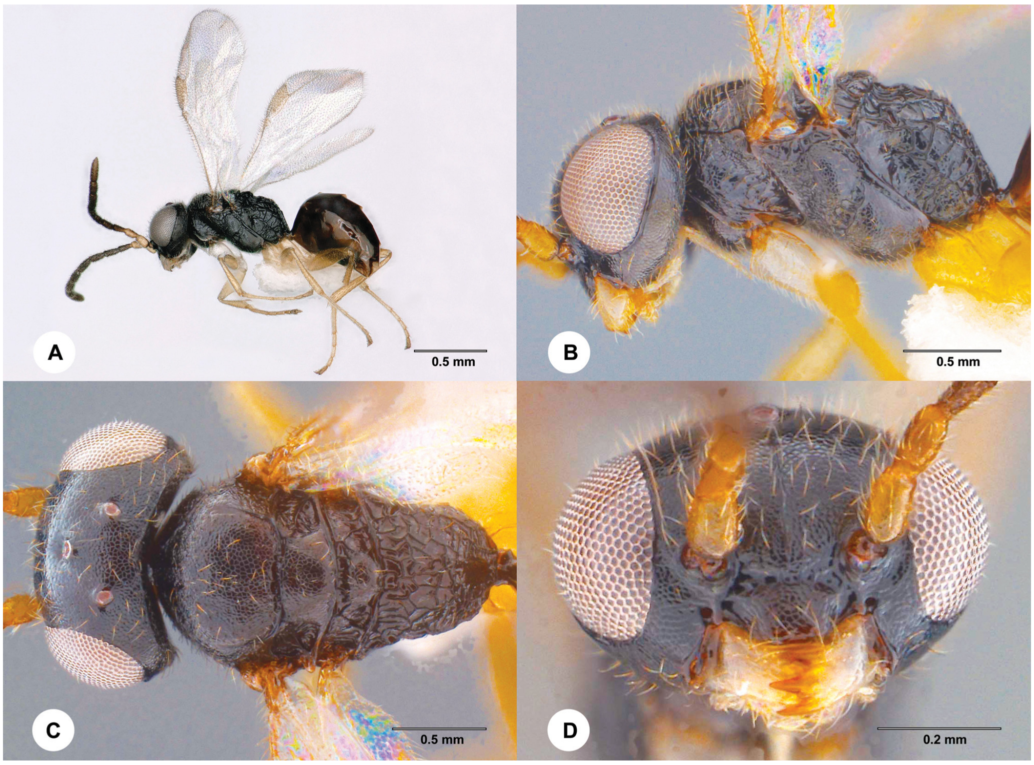

Fig. 17. *Aphelopus prolatus* Mita & Olmi, 2014, ♀ (SCAU 3011685). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head, frontal view.

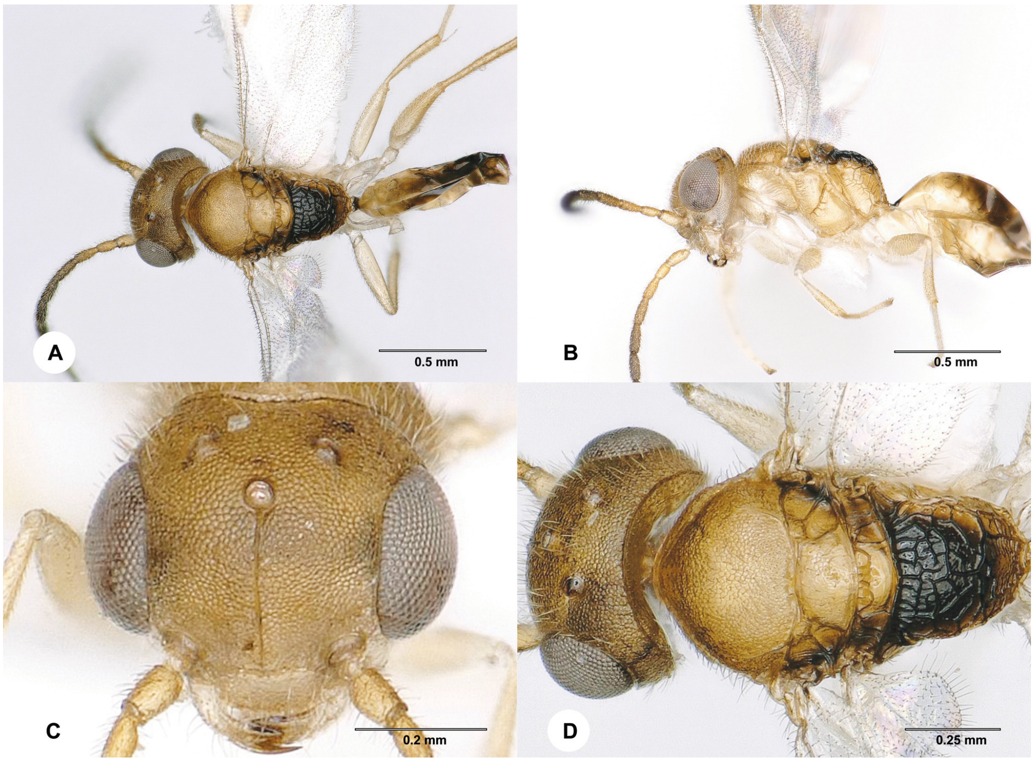

Fig. 18. *Aphelopus sabahnus* Olmi, 1991, ♀ (SCAU 3011690). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head, frontal view. **D**. Head and mesosoma, dorsal view.

Material examined

CHINA • 1 ♀; Guangdong, Guangzhou, University Town; 23°2′55″ N, 113°23′12″ E; 11–24 Nov. 2018; Hua-Yan Chen leg.; forest, MT; SCAU 3011690 (SYSBM).

Distribution

China, Malaysia (Xu *et al*. 2013).

Aphelopus spadiceus Xu & He, 1997
Figs 8E, 19

Aphelopus spadiceus Xu & He in Xu *et al*., 1997: 8.

Aphelopus spadiceus – Xu *et al*. 2013: 36.

Material examined

CHINA • 1 ♂; Yunnan, Lanping Dist., Mt Lasha; 26.324010° N, 99.275624° E; 2500 m a.s.l., 20–30 Jul. 2018; Jin-Ku Li leg.; farm land, MT; SCAU 3040510 (SYSBM).

Distribution

Brunei, China, Thailand (Olmi & Xu 2015), South Korea (Kim & Lee 2016).

Fig. 19. *Aphelopus spadiceus* Xu & He, 1997, ♂ (SCAU 3040510). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

Aphelopus wushensis Olmi, 2010
Fig. 20

Aphelopus wushensis Olmi, 2010: 12.

Aphelopus wushensis – Xu *et al*. 2013: 40.

Material examined

CHINA • 1 ♀; Guangdong, Guangzhou, SYSU, bamboo Garden; 23°3′9″ N, 113°23′23″ E; 23 Dec. 2018–20 Jan. 2019; Hua-Yan Chen leg.; MT; SCAU 3040509 (SYSBM) • 1 ♀; Yunnan, Xishuangbanna, Menghai, Bulangshan Village, Area D, near road; 21°44.745′ N, 100°26.07′ E; 1621 m a.s.l., 28 Jun–19 Jul. 2019; Li Ma leg.; MT; SCAU 3044042 (SYSBM).

Distribution

China, Philippines (Xu *et al*. 2013).

Aphelopus zhaoi Xu, He & Olmi, 1998
Fig. 21

Aphelopus zhaoi Xu, He & Olmi, 1998: 22.

Aphelopus zhaoi – Xu *et al*. 2013: 42.

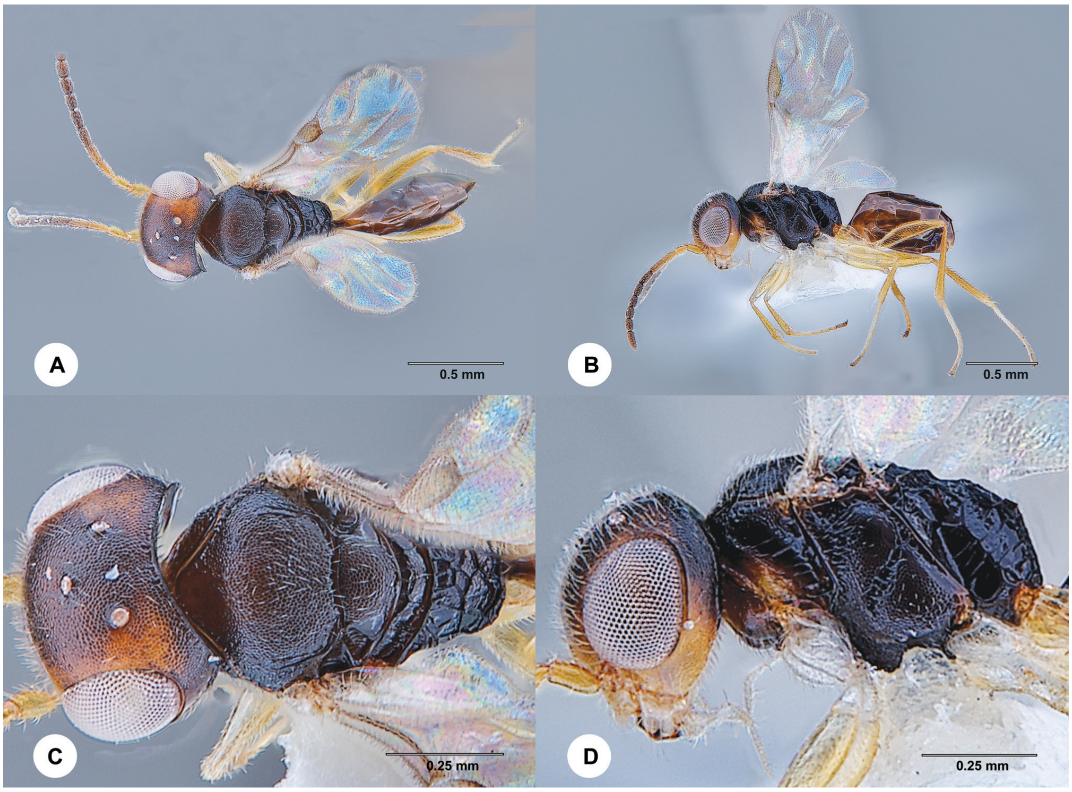

Fig. 20. *Aphelopus wushensis* Olmi, 2010, ♀ (SCAU 3040509). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

Fig. 21. *Aphelopus zhaoi* Xu, He & Olmi, 1998, ♀ (SCAU 3011659). **A**. Habitus, dorsal view. **B**. Habitus, lateral view. **C**. Head and mesosoma, dorsal view. **D**. Head and mesosoma, lateral view.

Material examined

CHINA • 1 ♀; Yunnan, Xishuangbanna, Menghai, Bulangshan Village, Area A, grass; 21°45.037′ N, 100°26.715′ E; 1683 m a.s.l.; 17 May–21 Jun. 2018; Li Ma leg.; MT; SCAU 3011659 (SYSBM).

Distribution

China (Xu *et al*. 2013).

Other material from northern Europe examined for comparison

Aphelopus atratus (Dalman, 1823)

Dryinus (*Aphelopus*) *atratus* Dalman, 1823: 15.

Aphelopus atratus (Dalman) – Olmi & Xu 2015: 14.

Material examined

NORWAY • 1 ♀; Vestfold, Stokke, Melsomvik; 59°218′ N, 10°346′ E; A. Staverløkk leg.; NTNU.

Distribution

Widely spread across all of the Palaearctic region, from Europe to Russian Far East, South Korea and Japan (Olmi & Xu 2015; Kim & Lee 2016). Probably present in northeastern China, but not found so far.

Aphelopus prolatus Mita & Olmi, 2014

Material examined

SWEDEN • 1 ♂; Småland, Gnosjö kommun, Kittlakull; 57°287′ N, 13°919′ E; 9–23 Jul. 2004; Swedish Malaise Trap Project leg.; NHRS.

Discussion

In the present study, we discovered that *A. incognitus* Chen, Olmi & Guglielmino sp. nov. shows an evident sexual dimorphism in head colour pattern (female with largely testaceous head, while male with head black), but the *COI* sequences generated from female and male specimens allowed us to confirm their association. In *A. nivealis* and *A. zaifui* Olmi, Chen & Liu sp. nov., notauli seem to be variable in appearance and length, but *COI* sequences indicated that these variations are just intraspecific. Considering that colour patterns and the length of the notauli have previously been used to separate most species of *Aphelopus*, the validity of these species should be tested by other methods such as rearing and DNA barcoding.

Our current study demonstrates that DNA barcoding is a powerful tool to enhance species delimitation and the female-male association of the same species. A more complete DNA barcode database of Dryinidae would also accelerate the discovery of host-Dryinidae associations using molecular methods (Chen *et al*. 2020; Olmi *et al*. 2021).

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Supplementary file

Supp. file 1. Genetic distances between COI sequences. https://doi.org/10.5852/ejt.2022.794.1653.5975