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Research article

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Six new species of *Zaischnopsis* Ashmead (Hymenoptera: Chalcidoidea: Eupelmidae) from China based on morphological and molecular data

Hao TANG^{1,#}, Jingtao JIANG^{2,#}, Tong WU³, Jun DENG⁴ & Lingfei PENG^{5,*}

^{1,2,3,4,5}Biological Control Research Institute, Fujian Agriculture and Forestry University; China Fruit Fly Research and Control Center of FAO/IAEA; Key Laboratory of Biopesticide and Chemical Biology, Ministry of Education; State Key Laboratory of Ecological Pest Control for Fujian and Taiwan Crops, Fuzhou, 350002, China.

[#]These authors contributed equally to this work

*Corresponding author: lingfeipeng@fafu.edu.cn

¹Email: Nai_idea@163.com

²Email: qingjiaowo_hlj@163.com

³Email: 321489624@qq.com

⁴Email: tiancai1282008@126.com

¹[urn:lsid:zoobank.org/author:598BA68F-A0F3-4178-A1CF-E5C1092D5EC3](https://urn.lsid:zoobank.org/author:598BA68F-A0F3-4178-A1CF-E5C1092D5EC3)

²[urn:lsid:zoobank.org/author:B6BBA076-E759-4D14-BDA9-1C5253D8E09A](https://urn.lsid:zoobank.org/author:B6BBA076-E759-4D14-BDA9-1C5253D8E09A)

³[urn:lsid:zoobank.org/author:9E8C9841-03ED-4AF9-841C-162DB849096E](https://urn.lsid:zoobank.org/author:9E8C9841-03ED-4AF9-841C-162DB849096E)

⁴[urn:lsid:zoobank.org/author:90A3F65D-8A1B-4B81-96AA-B1884E19E2EA](https://urn.lsid:zoobank.org/author:90A3F65D-8A1B-4B81-96AA-B1884E19E2EA)

⁵[urn:lsid:zoobank.org/author:6E704DED-7FBD-4844-A335-64B77B2D18CD](https://urn.lsid:zoobank.org/author:6E704DED-7FBD-4844-A335-64B77B2D18CD)

Abstract. Six new species of *Zaischnopsis* Ashmead (Hymenoptera: Eupelmidae) from China are described, *Zaischnopsis covid* Jiang & Peng sp. nov., *Zaischnopsis fuscolivida* Tang & Peng sp. nov., *Zaischnopsis lii* Jiang & Peng sp. nov., *Zaischnopsis pacis* Jiang & Peng sp. nov., *Zaischnopsis campaniformis* Tang & Peng sp. nov., and *Zaischnopsis zhongi* Jiang & Peng sp. nov. All the new species are described and illustrated based on females, and partial mitochondrial cytochrome oxidase subunit I (*COI*) sequences are provided for the six new species as well as for the previously described *Z. fumosa* Peng & Xiang. Females of all the species of *Zaischnopsis* recorded from China are differentiated in a key.

Keywords. DNA barcode, Palearctic Region, SEM, eupelmids, key.

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Introduction

Zaischnopsis Ashmead, 1904 is classified in the subfamily Eupelminae Walker, 1833 (Hymenoptera: Eupelmidae) with 41 species worldwide (Noyes 2021), previously recorded from all zoogeographic

regions except the Palaearctic Region. *Zaischnopsis* was first described as *Ischnopsis* Ashmead, 1896 with *I. ophthalmica* Ashmead, 1896 as type species; however, *Ischnopsis* Ashmead is preoccupied by *Ischnopsis* Wallingham, 1881 and Ashmead (1904) therefore proposed the replacement name *Zaischnopsis*. Bouček (1988) synonymised *Zaischnopsis* under *Anastatus* Motschulsky, 1859, but Gibson (1995) reestablished *Zaischnopsis* as a valid name based on morphological differences. To date, males have not been described for any species of *Zaischnopsis*. This is because species of *Zaischnopsis* exhibit distinct sexual dimorphism as do all other eupelmine genera, the sexes being so dissimilar that usually they remain unassociated unless reared together (Gibson 1995). The phylogenetic relationships of *Zaischnopsis* were discussed by Gibson (1995). Females of some species appear to intergrade with females of *Brasema* Cameron, 1884 and *Anastatus*, indicating that the three genera are closely related and could form some pattern of nested paraphyly (Gibson 1995: figs 517–518).

In this study, six new species of *Zaischnopsis* are recognized morphologically among females collected by Malaise traps or by sweeping in China; two of the species were collected from the Palaearctic Region of China and thus represent the first records of *Zaischnopsis* from this region. The *COI* sequences from 14 specimens of the six new species and *Z. fumosa* Peng & Xiang, 2018 are also provided.

Material and methods

Sampling of specimens

Specimens were collected from 2013 to 2020 by Malaise trap or sweeping in the field, and then stored in 95% ethanol at -20°C until DNA extraction, specimens were numbered with a unique DNA voucher as “DNA XXX”. All type specimens are stored in the Biological Control Research Institute, Fujian Agriculture and Forestry University, Fuzhou, China (FAFU) (<http://biocol.org/urn:lsid:biocol.org:col:12855>).

Imaging and morphological terminology

Descriptions were based on specimens examined with a Leica M165C stereo microscope and a Leica LED 5000 HDI dome light source, and imaged with a Leica MC170 HD digital camera attached to the microscope. Serial images were combined with Zerene Stacker and Adobe Photoshop was used to edit pictures and enhance clarity. Scanning electron photomicrographs were obtained from pinned, coated or uncoated specimens using a HITACHI SU3500 scanning electronic microscope in SE or UVD mode. Terms for structure and sculpture, and their abbreviations follow Peng *et al.* (2018). Descriptions of new species are based on the holotype, any major intraspecific variation is discussed under variation section.

DNA extraction, amplification and sequencing

Genomic DNA was extracted from the entire specimen using the DNeasy Blood & Tissue Kit (Qiagen) following the manufacturer’s protocol, with some modifications: the specimen was pricked with an insect pin at the gaster to make a hole, and incubated at 56°C overnight. The *COI* barcode fragment was amplified using the primers LCO1490 (5'-GGTCAACAAATCATAAAGATATTG-3') and HCO2198 (5'-TAAACTTCAGGGTGACCAAAAAAT-3') (Folmer *et al.* 1994). PCRs were performed on a volume of 50 µl containing 5 µl 10× Ex-Taq Buffer (Sangon Biotech, Shanghai, China), 2 µl each primer (10 µM), 0.5 µl Ex-Taq, 4 µl dNTP Mix, 33.75 µl ddH₂O and 4 µl DNA template. PCR amplification was employed with initial denaturation at 94°C for 1 min, followed by 5 cycles of 1 min at 94°C for denaturation, 1 min and 30 s at 50°C for annealing and 1 min at 72°C for extension, and one more circulation followed by 35 cycles of 1 min at 94°C for denaturation, 1 min and 30 s at 54°C for annealing and 1 min at 72°C for extension, with a final extension at 72°C for 5 min. After electrophoresis with 0.8% agarose gel, the target DNA was sent to Sangon Biotech (Shanghai, China) for sequencing.

Sequence data analyses

Geneious R11 (Auckland, New Zealand) was used to check the quality of the peak pattern, manually correct and spline the sequencing results, and export them as FASTA format for subsequent analysis.

Table 1. Accession numbers and length of *COI* sequences of species in *Zaischnopsis* Ashmead, 1904.

Species	Accession numbers	Specimen ID	Length of <i>COI</i> sequences
<i>Zaischnopsis covid</i> sp. nov.	MZ868002	425	759
<i>Zaischnopsis covid</i> sp. nov.	MZ868005	661	813
<i>Zaischnopsis covid</i> sp. nov.	MZ868006	668	825
<i>Zaischnopsis fumosa</i> Peng & Xiang, 2018	MZ852000	76	570
<i>Zaischnopsis fumosa</i> Peng & Xiang, 2018	MZ852001	84	585
<i>Zaischnopsis fumosa</i> Peng & Xiang, 2018	MZ852003	538	798
<i>Zaischnopsis fuscolivida</i> sp. nov.	MZ868001	85	516
<i>Zaischnopsis lii</i> sp. nov.	OK036283	671	627
<i>Zaischnopsis lii</i> sp. nov.	MZ867998	647	826
<i>Zaischnopsis lii</i> sp. nov.	MZ867999	670	826
<i>Zaischnopsis pacis</i> sp. nov.	MZ867997	437	826
<i>Zaischnopsis campaniformis</i> sp. nov.	MZ868003	640	822
<i>Zaischnopsis campaniformis</i> sp. nov.	MZ868004	641	771
<i>Zaischnopsis zhongi</i> sp. nov.	MZ868000	673	636

The sequences were aligned with ClustalW in MEGA ver. 7.0 (Kumar *et al.* 2016) and then confirmed whether they could be successfully translated into amino sequences without termination codons or frameshift mutations by using MEGA. We also analysed the DNA sequence compositions and calculated the pairwise genetic distance based on the Kimura-2-parameter model (Kimura 1980). To further verify our morphological identification, ABGD web (<https://bioinfo.mnhn.fr/abi/public/abgd/abgdweb.html>) was used to delimit the species, and the results proved to be consistent with our identification results. All of the sequences were submitted to GenBank, with the accession numbers given in Table 1.

Abbreviations

LOL	=	minimal distance between anterior and a posterior ocellus
MPOD	=	maximum diameter of posterior ocellus
Mt	=	metasomal tergum
MV	=	marginal vein
OOL	=	minimal distance between posterior ocellus and inner orbit
PMV	=	postmarginal vein
POL	=	minimal distance between the posterior ocelli
SMV	=	submarginal vein
STV	=	stigmatal vein

Results

COI sequence analysis

COI was successfully amplified for 14 specimens, with the sequences ranging from 516 to 826 bp (Table 1). Sequences containing 510 base pairs were recovered for the studied species, which included 208 variable sites and 302 conserved sites. *COI* interspecific distances ranged from 14.9% to 23.8% (Table 2). Variable sites included 146 parsimony informative sites and 62 singleton sites. In the whole sequences structure, the A, G, C and T base compositions were 29.2%, 14.7%, 11.8% and 44.3%, respectively, and showed clearly a A+T base preference, meeting the basic characteristics of base composition of insect mitochondrial genes. The NJ tree (Neighbor-Joining) (Fig. 11) was constructed using MEGA with the default settings and showed the same results with ABGD website.

Table 2. Pairwise genetic distances for *COI* gene sequences of species examined. Abbreviations: cov = *Zaischnopsis covid* Jiang & Peng sp. nov.; lii = *Z. lii* Jiang & Peng sp. nov.; fum = *Z. fumosa* Peng & Xiang, 2018; fus = *Z. fuscolivida* Tang & Peng sp. nov.; zho = *Z. zhongi* Jiang & Peng sp. nov.; cam = *Z. campaniformis* Tang & Peng sp. nov.; pac = *Z. pacis* Jiang & Peng sp. nov.

species	cov(425)	cov(661)	cov(668)	liw(670)	liw(671)	liw(647)	fum(76)	fum(84)	fum(538)	fus(85)	zho(673)	tin(640)	tin(641)
cov(661)	0.045												
cov(668)	0.049	0.036											
lii(670)	0.201	0.207	0.217										
lii(671)	0.196	0.202	0.212	0.006									
lii(647)	0.204	0.210	0.220	0.060	0.062								
fum(76)	0.159	0.149	0.171	0.225	0.217	0.231							
fum(84)	0.159	0.159	0.176	0.225	0.217	0.236	0.016						
fum(538)	0.169	0.161	0.179	0.238	0.230	0.234	0.036	0.032					
fus(85)	0.183	0.171	0.186	0.217	0.217	0.212	0.176	0.184	0.176				
zho(673)	0.174	0.179	0.194	0.234	0.226	0.234	0.196	0.204	0.212	0.206			
cam(640)	0.169	0.174	0.186	0.201	0.194	0.225	0.191	0.204	0.204	0.201	0.186		
cam(641)	0.164	0.166	0.182	0.198	0.190	0.215	0.182	0.195	0.195	0.201	0.182	0.002	
pac(437)	0.171	0.176	0.169	0.212	0.207	0.204	0.169	0.172	0.174	0.194	0.204	0.184	0.174

Taxonomy

Class Insecta Linnaeus, 1758
 Order Hymenoptera Linnaeus, 1758
 Superfamily Chalcidoidea Latreille, 1817
 Family Eupelmidae Walker, 1833
 Subfamily Eupelminae Walker, 1833
 Genus *Zaischnopsis* Ashmead, 1904

Generic diagnosis

Females are characterized by the following characters (Gibson 1995, 2005): body usually dark with various metallic lusters, but sometimes yellow to brown; head with ventral margin of torulus lower than lower orbit, scrobal depression deep or not but dorsally delimiting linear or only very narrow region along upper inner orbit; antenna with scape sometimes slender though often variably compressed; clypeus flat; mandible tridentate; pronotum usually subtriangular and divided medially; mesoscutum usually flat with anterior and lateral parts slightly raised, posterior part slightly concave; mesopectus with setae, acropleuron usually bare; fore wing usually hyaline at base, infusate beyond base of parastigma, and sometimes with one or more lighter colored band or spots behind marginal vein; mesotibia with oblique apical groove and with dark apical pegs in a patch; gaster elongate, base of gaster usually without white region unlike species of *Anastatus*; syntergum apically reflexed into fingernail like flange.

Key to females of *Zaischnopsis* from China

1. Fore wing infusate beyond level of parastigma, gradually lightened distally but without hyaline cross-band or spot (Fig. 2E) *Z. fuscolivida* Tang & Peng sp. nov.
 – Fore wing infusate beyond level of parastigma and with hyaline cross-band or spot(s) behind marginal vein (Figs 1E, 3F, 4E, 5E, 6E) 2
2. Fore wing with single hyaline cross-band behind marginal vein (Fig. 4E) 3
 – Fore wing with one or two hyaline spots behind marginal vein (Figs 1E, 3F, 5E, 6E) 6
3. Hyaline cross-band of fore wing very narrow, about $\frac{1}{5}$ to $\frac{1}{6}$ width of basal infusate region (Peng *et al.* 2018: fig. 19) *Z. fumosa* Peng & Xiang, 2018
 – Hyaline cross-band of fore wing wide, usually about $\frac{1}{2}$ to $\frac{1}{3}$ width of basal infusate part (Fig. 4E) 4
4. Head and mesosoma coppery-green (Fig. 2C); antenna with scape normal, not expanded (Fig. 2G) *Z. pacis* Jiang & Peng sp. nov.
 – Head and mesosoma dark brown with slight purple luster; antenna with scape foliaceously dilated (Peng *et al.* 2018: fig. 33) 5
5. Metatibia with dorsal margin dark brown to black, though possibly superficially appearing white because of dense white setae (Peng *et al.* 2018: fig. 37); propodeum with plical region medially very short (Peng *et al.* 2018: fig. 39) *Z. tubatius* (Walker, 1852)
 – Metatibia with basal half of dorsal margin white (Peng *et al.* 2018: fig. 8; cf. Fig. 5A); propodeum with plical region comparatively longer (Peng *et al.* 2018: fig. 2) *Z. candetibia* Peng & Xiang, 2018
6. Fore wing with two hyaline triangular spots behind marginal vein, one anterior and one posterior (Fig. 1A); plical region comparatively long, distance between inner margins of spiracles only about $3.4\times$ as wide as median length of plical region (Figs 1I, 10A) *Z. covid* Jiang & Peng sp. nov.

- Fore wing with one hyaline spot behind marginal vein anteriorly; plical region comparatively short, distance between inner margin of spiracles $7.3\text{--}10\times$ as wide as median length of plical region 7
- 7. Fore wing with hyaline spot behind marginal vein triangular (Fig. 5E); antenna with eighth funicular ring-like, width about $2\times$ length (Fig. 5F); scrobal depression bell-shaped, with abrupt margins (Figs 5C, 7E) *Z. campaniformis* Tang & Peng sp. nov.
- Fore wing with hyaline spot behind marginal vein round (Fig. 6E) or irregular in shape (Fig. 3F); antenna with eighth funicular no more than $1.6\times$ as wide as long (Figs 3G, 6G); scrobal depression varied (Fig. 3D) 8
- 8. Fore wing spot behind marginal vein inconspicuous and irregular (Fig. 3F); scrobal depression comparatively broad, with rounded rather than abrupt margins (Figs 3C, 7C), dorsal margin of scrobal depression closed to anterior ocellus by distance about $0.2\times$ diameter of anterior ocellus (Figs 3D, 6D) *Z. lii* Jiang & Peng sp. nov.
- Fore wing spot behind marginal vein hyaline and round; scrobal depression with abrupt margins, dorsal margin of scrobal depression separated from anterior ocellus by distance equal to or more than diameter of anterior ocellus (Fig. 6D) 9
- 9. Scutellum coppery, mesoscutum with dense white setae (Peng *et al.* 2018: fig. 22)
..... *Z. nivalinota* Peng & Xiang, 2018
- Scutellum greenish, mesoscutum with sparse brown setae (Fig. 6B)
..... *Z. zhongi* Jiang & Peng sp. nov.

Zaischnopsis covid Jiang & Peng sp. nov.

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Figs 1, 7A, G, 8A, D, 9A–B, 10A

Diagnosis

Head with scrobal depression deep, dorsal margin separated from anterior ocellus by distance equal to $2.3\times$ diameter of anterior ocellus (Fig. 7A), frons smooth to very shallowly coriaceous (Fig. 7G); OOL: POL: LOL: MPOD = 1.0: 4.0: 3.5: 2.5; antennal clava about $2\times$ as long as wide (Fig. 1G). Legs with tibiae black to dark brown, metatibia with basal one third bright yellow to white, dorsally with white hair-like setae (Fig. 1A). Fore wing disc infusate with dark setae beyond level of parastigma and gradually lightened distally, except with region of orange-brown setae beyond parastigma basal to triangular hyaline region, and with anterior and posterior region of white setae behind marginal vein distally (Fig. 1E). Propodeum with anterior margin broadly V-shaped, plical region comparatively long (Figs 1I, 10A).

Etymology

The species name is in reference to the COVID-19 virus, which caused global panic.

Material examined

Holotype

CHINA – Shaanxi Prov. • ♀; 陕西省延安市富县子午岭自然保护区八面窑 [Bamianyao, Ziwuling natural reserve, Fuxian County, Yan'an]; 3 Sep. 2018; Malaise trap; DNA 661; FAFU.

Paratypes

CHINA – Shaanxi Prov. • 4 ♀♀; 陕西省延安市富县子午岭自然保护区陈家河 [Chenjiahe, Ziwuling natural reserve, Fuxian County, Yan'an]; 30 Aug.–4 Sep. 2018; Malaise trap; FAFU • 2 ♀♀; 陕西省延

安市富县子午岭自然保护区石灰沟 [Shihuigou, Ziwuling natural reserve, Fuxian County, Yan'an]; 13 Aug.–4 Sep. 2018; Malaise trap; FAFU • 1 ♀; 陕西省延安市富县子午岭自然保护区桦树沟 [Huashugou, Ziwuling natural reserve, Fuxian County, Yan'an]; 11 Aug.–3 Sep. 2018; Malaise trap; FAFU • 1 ♀; 陕西省洛南县 [Luonan]; 21 Dec. 2018; DNA 668; FAFU. – **Zhejiang Prov.** • 1 ♀; 浙江临安 [Lin'an]; 25 May 2015; DNA 425; FAFU.

Description

Female

LENGTH. About 4.0 mm.

HEAD (Fig. 1C–D, F). Mostly dark with greenish-yellow metallic luster intermixed with variably distinct purple under some angles of light, as follows: scrobal depression bluish-green (Fig. 1C), interantennal prominence purple with slight golden metallic luster (Fig. 1C), parascrobal region and lower face greenish-purple with slight golden metallic luster (Fig. 1C), frons (Fig. 1C–D) dark purple with ocellar triangle slightly green (Fig. 1D), vertex dark purple, and temple greenish-purple (Fig. 1D). Setae (Figs 1C–D, F, 7A, G) of lower face, interantennal prominence, upper part of parascrobal region, frons, vertex and occiput hair-like and brown, lower part of parascrobal region with two rows of lanceolate white setae (Fig. 8A), and setae of gena lanceolate and brown (Fig. 8D); maxillary and labial palpi black (Fig. 1C). Head in frontal view (Fig. 1C) $1.21 \times$ as wide as high; in dorsal view (Fig. 1D) width $1.86 \times$ length, with interocular distance $0.24 \times$ head width and less than width of eye; in lateral view (Fig. 1F) $1.34 \times$ as high as long. Eye height $1.32 \times$ eye width in lateral view; distance between eyes below $2.30 \times$ distance between eyes above; malar space $0.44 \times$ eye height; distance between toruli greater than distance between torulus and clypeal margin, and greater than distance between torulus and orbit. OOL: POL: LOL: MPOD = 1.0: 4.0: 3.5: 2.5. Face (Figs 1C, 7A) with upper parascrobal region narrow, interantennal region finely imbricate (Fig. 8A); scrobal depression deep, reticulate-rugose, separated from anterior ocellus by distance equal to $2.30 \times$ diameter of anterior ocellus; lower orbit above level of ventral margin of torulus; lower face coriaceous; gena longitudinally imbricate (Fig. 8D); vertex and temple transversely imbricate; frons smooth to very finely coriaceous (Fig. 7A, G). Scape and pedicel of antenna (Figs 1G, 9A–B) with greenish-yellow metallic luster, flagellum dark brown; scape normal, not expanded; relative length(width) of scape = 45(7), pedicel 10(7.5), 1st to 8th funiculars: 5(7), 17(6.5), 17(8), 20(8.5), 13(10.5), 11(11.5), 10(11.5), 8.5(11.5), clava 23.5(11.5).

MESOSOMA. Pronotum in dorsal view (Fig. 1B), with coppery to greenish-yellow metallic luster medially and bright purple luster laterally, setae dark brown and hair-like; divided medially, subtriangular, imbricate. Mesoscutum (Fig. 1B) almost flat but slightly convex anteriorly and concave posteriorly, and with lateral lobe carinate posteriorly, with anterior convex region and lateral lobes reddish-brown, posterior depressed region with bright blue metallic luster, setae brownish and hair-like except setae of posterior depressed region white and lanceolate. Scutellar-axillar complex (Fig. 1B) with coppery to golden luster, setae brown, disc flat with coarsely reticulate sculpture arranged longitudinally in scutellum and transversely in axillae; scutellum $1.51 \times$ as long as broad. Prepectus (Fig. 1H) coppery-brown with metallic greenish-yellow luster; tegula (Fig. 1B) with dark brown hair-like setae; mesopectus purple with slight green metallic luster, with sparse, long white hair-like setae anteriorly, and denser patch of long white hair-like setae posteriorly underneath acropleural sulcus; acropleuron (Fig. 1H) coppery with greenish-yellow metallic luster. Mesopectus reticulate anterior to acropleural sulcus, acropleuron entirely sculptured, transversely reticulate-imbricate. Propodeum (Figs 1I, 10A) dark with blue metallic luster, anterior margin broadly V-shaped, plical region comparatively long, rugose and bare except for one patch of setae anterior to spiracle, callus smooth and bare except for long white hair-like setae laterally. Fore wing (Fig. 1E) extended to near apex of gaster, with costal cell dorsally bare except for dark setae in infusate region in front of parastigma; basal cell hyaline but slight infusate basally with brown setae, mediocubital fold with dark setae; disc with white setae in anterior and posterior triangular hyaline regions

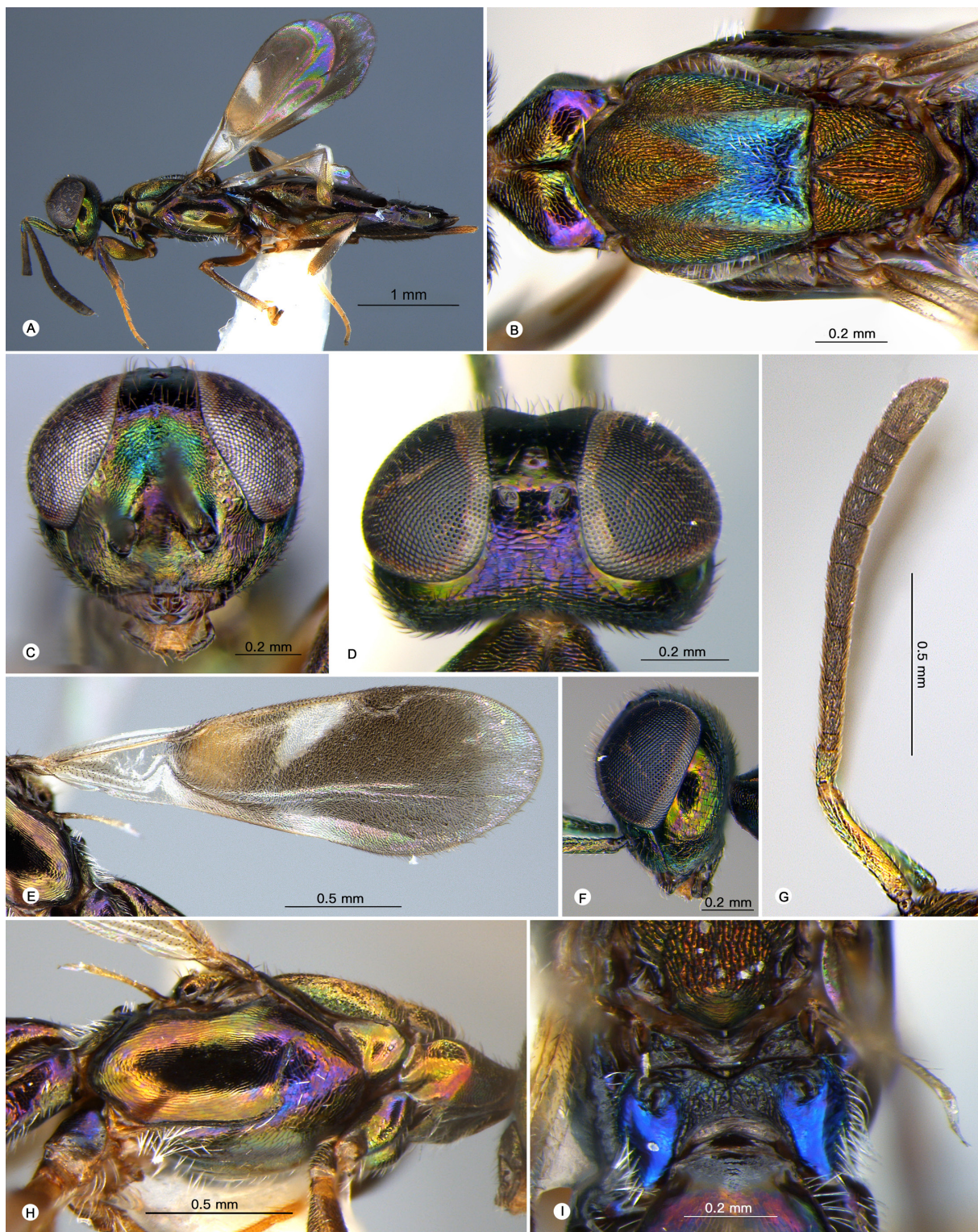


Fig. 1. *Zaischnopsis covid* Jiang & Peng sp. nov. **A.** Body, lateral view. **B.** Mesosoma, dorsal view. **C.** Head, front view. **D.** Head, dorsal view. **E.** Fore wing. **F.** Head, lateral view. **G.** Antenna. **H.** Mesosoma, lateral view. **I.** Propodeum.

but infusate with dark setae beyond level of parastigma except for region of orange brown setae within dark brown setae beyond parastigma basal to hyaline region, and gradually lightened distally to more hyaline apex; stigmal vein distinctly bent so as to parallel leading wing margin distally; SMV: MV: PMV: STV = 17: 22: 10: 5. Fore leg (Fig. 1A) with femur and tibia black, tarsus brown; middle leg with femur and tibia dark brown, tarsus brown except rows of pegs black, spur brown and shorter than basitarsus; femur of hind leg dark brown, basal one third of tibia bright yellow to white, dorsally with white hair-like setae, tarsus yellowish-brown, basitarsus as long as following two tarsomeres combined.

GASTER (Fig. 1A). Elongate-lanceolate, longer than mesosoma, dark brown with metallic luster, except apex of syntergum and apex of ovipositor sheaths brown; syntergum tapered to rounded apex; ovipositor sheaths exerted for distance equal to length of basal metatarsomere.

Remarks

There are three species from the Oriental region whose females have two hyaline spots behind the marginal vein of the fore wing, *Z. biharensis* (Narendran, 2004) (Narendran *et al.* 2007: fig. 8), *Z. bathericus* Narendran, 2007 (Narendran *et al.*: 2007: fig. 12), and *Z. covid* sp. nov. (Fig. 1A); the former two species are found only in India (Narendran *et al.* 2007). The fore wing apical angle of *Z. biharensis* is more acute than in the other two species (Peng *et al.* 2018: fig. 49), and the two hyaline spots of *Z. biharensis* are round, not triangular as in the other two species. The fore wing of *Z. bathericus* has one irregularly shaped brown spot behind the parastigma (Peng *et al.* 2018: fig. 50), not round as in *Z. covid* at the same position. The frons of most of the Oriental species of *Zaischnopsis* is reticulate or coriaceous, but the frons of *Z. covid* is almost smooth (Fig. 7A, G).

Distribution

China: Shaanxi (Palearctic); Zhejiang (Oriental).

Variation

Females vary in length from about 3.3–4.2 mm. Color of the pedicel variable, blue to light green; clava about 0.42–0.70 × as wide as long.

Zaischnopsis fuscolivida Tang & Peng sp. nov.

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Figs 2, 7B, 8E–F, 9C–D, 10B

Diagnosis

Head with dorsal margin of scrobal depression not delimited, ventral part of scrobal depression smooth (Fig. 7B); antennal clava about 2.6 × as long as wide (Fig. 2G). Legs with mesotibia and metatibia yellowish brown (Fig. 2A). Fore wing disc infusate with light brown setae beyond level of parastigma and gradually lightened distally, without hyaline region with white setae behind marginal vein (Fig. 2E). Propodeum with anterior margin broad U-shaped; plical region short (Figs 2I, 10B).

Etymology

The species name is a combination of the Latin words ‘*fusca*’, ‘dark colored’, and ‘*lividus*’, ‘bluish’, in reference to the dark blue mesoscutum.

Material examined

Holotype

CHINA – Shaanxi Prov. • ♀; 陕西省延安市富县子午岭自然保护区石灰沟 [Shihuigou, Ziwouling natural reserve, Fuxian County, Yan’an]; 27–30 Aug. 2018; Malaise trap; DNA 675; FAFU.

Paratypes

CHINA – **Shaanxi Prov.** • 3 ♀♀; 陕西省延安市富县子午岭自然保护区石灰沟 [Shihuigou, Ziwuling natural reserve, Fuxian County, Yan'an]; 13 Aug.–4 Sep. 2018; Malaise trap; FAFU • 4 ♀♀; 陕西省延安市富县子午岭自然保护区桦树沟 [Huashugou, Ziwuling natural reserve, Fuxian County, Yan'an]; 11 Aug.–3 Sep. 2018; Malaise trap; FAFU • 1 ♀; 陕西省延安市富县子午岭自然保护区陈家河 [Chenjiahe, Ziwuling natural reserve, Fuxian County, Yan'an]; 30 Aug.–4 Sep. 2018; Malaise trap; DNA 687; FAFU • 1 ♀; 陕西省延安市富县子午岭自然保护区八面窑 [Bamianyao, Ziwuling natural reserve, Fuxian County, Yan'an]; 20 Aug. 2018; Malaise trap; FAFU. – **Zhejiang Prov.** • 1 ♀; 浙江省清凉峰自然保护区龙塘山 [Longtangshan, Qingliangfeng natural reserve]; Jul. 2013, Malaise trap; DNA 85; FAFU.

Description

Female

LENGTH. About 4.5 mm.

HEAD (Fig. 2C–D, F). With blue metallic luster intermixed with variably distinct purple and green lusters under some angles of light, as follows: scrobal depression dark blue (Fig. 2C), interantennal prominence blue or with slight metallic purple luster (Fig. 2C), parascrobal region and lower face greenish-purple with golden metallic luster (Fig. 2C), frons dark purple, vertex and temple dark purple with slight green luster (Fig. 2D). Setae of face (Fig. 7B), gena (Fig. 8E–F), interantennal prominence and occiput hair-like and brown, parascrobal region with two rows of hair-like brown setae (Fig. 7B); maxillary and labial palpi dark brown (Fig. 2C). Head in frontal view $1.25 \times$ as wide as high; in dorsal view width $1.65 \times$ length, with interocular distance $0.25 \times$ head width and less than width of eye; in lateral view $1.38 \times$ as high as long. Eye height $1.05 \times$ eye width in lateral view; distance between eyes below $2.84 \times$ distance between eyes above; malar space $0.53 \times$ eye height; distance between toruli greater than distance between torulus and clypeal margin, and similar to distance between torulus and orbit. OOL: POL: LOL: MPOD = 1.0: 5.0: 4.6: 4.0. Face (Figs 2C, 7B) with parascrobal region very narrow, interantennal region longitudinally reticulate, scrobal depression deep and \cap -like, smooth ventrally and finely imbricate dorsally, dorsal margin not delimited; lower orbit above level of ventral margin of torulus; lower face alutaceous-imbricate to coriaceous (Fig. 7B); vertex and temple transversely imbricate; frons imbricate to coriaceous. Antennal (Figs 2G, 9C–D) scape and pedicel with bluish-green metallic luster, 1st to 4th funicular segments with greenish-yellow to rusty metallic luster, with light brown to white setae, 5th to 8th funicular segments dark brown, with dark brown setae; scape normal, not expanded; relative length(width) of scape = 38(6), pedicel 12(4.5), 1st to 8th funiculars: 5(4), 14.5(4), 14.5(5), 16(5.5), 12.5(6), 12.5(7), 11.5(7), 9(7), clava 22(8.5).

MESOSOMA. Pronotum in dorsal view (Fig. 2B), dark purple with metallic luster; setae dark brown and hair-like; divided medially, subtriangular, imbricate. Mesoscutum (Fig. 2B) almost flat but slightly convex anteriorly, and with lateral lobes carinate posteriorly, metallic blue with middle part of anterior convex region and lateral lobes slightly yellowish-green, setae of anterior convex region and lateral lobes brownish and hair-like, setae of posterior depressed region and lower part of lateral lobes white and lanceolate. Scutellar-axillar complex coppery except lateral surface of scutellum somewhat blue, setae brown, disc of scutellar-axillar complex (Fig. 2B) flat with coarsely reticulate pattern arranged longitudinally in scutellum and transversely in axillae; scutellum $1.38 \times$ as long as broad. Prepectus (Fig. 2H) dark brown with slight yellow luster, tegula with dark brown hair-like setae; mesopectus greenish-purple, with long white hair-like setae linearly arranged along acropleural sulcus; acropleuron dark purple with green metallic luster. Mesopectus reticulate anterior to acropleural sulcus, acropleuron with distinctly transverse reticulate-imbricate sculpture. Propodeum (Figs 2H–I, 10B) dark with yellowish-blue metallic luster, anterior margin broad U-shaped; plical region short, reticulate-rugose, with three setae near inner margin of spiracle and one patch of setae anterior of spiracle, callus coriaceous

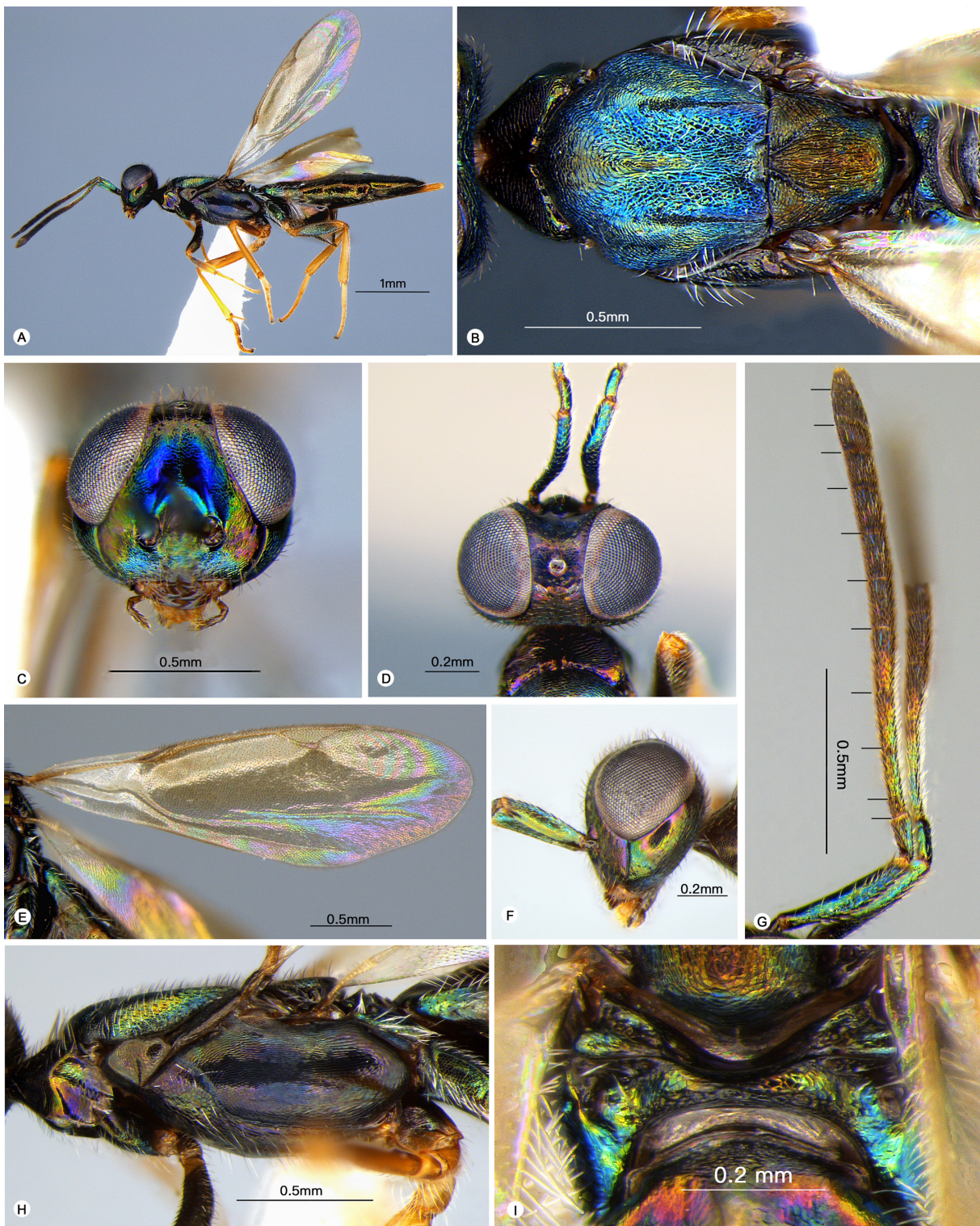


Fig. 2. *Zaischnopsis fuscolivida* Tang & Peng sp. nov. **A.** Body, lateral view. **B.** Mesosoma, dorsal view. **C.** Head, front view. **D.** Head, dorsal view. **E.** Fore wing. **F.** Head, lateral view. **G.** Antenna. **H.** Mesosoma, lateral view. **I.** Propodeum.

and bare, with long white hair-like setae laterally. Fore wing (Fig. 2E) with costal cell dorsally bare except for dark setae in infusate region in front of parastigma; basal cell hyaline with light brown setae, mediocubital fold with sparse, light brown setae; disc with setae light brown and gradually lightened distally, without hyaline region with white behind marginal vein; fore wing extended near apex of gaster, stigmal vein slightly bent distally; SMV: MV: PMV: STV = 17.5: 22.5: 16.5: 7. Fore leg (Fig. 2A) with femur black, knee brown, tibia with basal half dark brown and apical half yellowish-brown, tarsus yellowish-brown; middle leg with femora brown, tibia yellowish-brown, tarsus white to light brown except rows of pegs dark brown and spur brown, mesotibial spur shorter than basitarsus; femur of hind leg dark with green metallic luster, knee brown, tibia yellowish-brown, tarsus yellowish-brown, basitarsus as long as following two tarsomeres combined.

GASTER (Fig. 2A). Elongate-lanceolate, longer than mesosoma, dark brown with metallic luster, except apex of syntergum and apex of ovipositor sheaths brown; syntergum tapered to rounded apex; ovipositor sheaths exerted for distance slightly shorter than length of basal metatarsomere.

Remarks

The fore wing of females *Z. fuscolivida* sp. nov. lack any hyaline spot or band, which distinguishes them from those of other species of *Zaischnopsis* from China. Females do resemble *Z. locustae* (Girault, 1919), recorded only from Java, Indonesia, but females of *Z. locustae* have white setae on the vertex and temple (Peng *et al.* 2018: figs 53, 56) versus brown for *Z. fuscolivida* (Fig. 2C), and the metatibia is dark brown except the basal half of the dorsal margin which is white (Peng *et al.* 2018: fig. 57) versus yellowish-brown (Fig. 2A).

Distribution

China: Shaanxi (Palearctic); Zhejiang (Oriental).

Variation

The length of the females varies from about 4.3 to 5.8 mm. The color of the pedicel is variable, blue to yellowish-green; the shape of the posterior ocellus is sometimes rhomboid or oval, the OOL varies from 0.14 to 0.31 × as wide as MPOD.

Zaischnopsis lii Jiang & Peng sp. nov.

[urn:lsid:zoobank.org:act:AD097B05-9AAD-4311-A849-49AE9AB8BFF3](https://zoobank.org/act:AD097B05-9AAD-4311-A849-49AE9AB8BFF3)

Figs 3, 7C, I, 8G, K–O, 9E–F

Diagnosis

Head with dorsal margin of scrobal depression separated from anterior ocellus by distance equal to 0.23 × diameter of anterior ocellus (Fig. 3C); OOL: POL: LOL: MPOD = 1.0: 7.2: 8.9: 10.4; antennal clava 3 × as long as width, and margins between each clava segment sinuate (Fig. 9F). Metatibia yellowish-brown to brown, basal half of dorsal margin milky white (Fig. 3A). Fore wing disc infusate with dense brown setae beyond level of parastigma and gradually lightened distally except for one inconspicuous and irregular shaped hyaline spot behind marginal vein (Fig. 3F). Propodeum with anterior margin broadly V-shaped; plical region comparatively long (Figs 3I, 10C).

Etymology

Named in honor of Li Wenliang (12 Oct. 1986–7 Feb. 2020), an ophthalmologist, who was one of the first people to warn about the outbreak of COVID-19, but passed away after being infected with COVID-19 in Wuhan. He won the China youth Wusi Medal.

Material examined**Holotype**

CHINA – **Guangxi Prov.** • ♀; 广西省大瑶山自然保护区圣堂山 [Shengtangshan, Dayaoshan natural reserve]; 15 Aug. 2019; Pang Guilin leg.; DNA 647; FAFU.

Paratypes

CHINA – **Shaanxi Prov.** • 1 ♀; 陕西省安康市旬阳坝蝎子沟 [Xiezigou, Xunyangba, Ankang City]; 25 Jul.–22 Oct. 2017; Malaise trap; DNA 670; FAFU • 1 ♀; same collection data as for preceding; DNA 671; FAFU.

Description**Female**

LENGTH. About 6.0 mm.

HEAD (Fig. 3C–E). Dark with purple and green metallic luster under some angles of light, with scrobal depression dark blue (Fig. 3C), interantennal prominence dark purple to black (Fig. 3C), parascrobal region and lower face greenish-purple (Fig. 3C), frons black, and vertex and temple black to dark green (Fig. 3D). Setae (Fig. 7C, I) of lower part of parascrobal region, interantennal prominence and lower face white and lanceolate, setae of upper part of parascrobal region, frons (Fig. 7I), gena (Fig. 8G), vertex and occiput brown and hair-like; maxillary and labial palpi dark brown (Fig. 3C). Head in frontal view $1.22 \times$ as wide as high; in dorsal view width $1.73 \times$ length, with interocular distance $0.20 \times$ head width and less than width of eye; in lateral view $1.40 \times$ as high as long. Eye height about $1.12 \times$ width in lateral view; distance between eyes below $3.35 \times$ distance between eyes above; malar space $0.46 \times$ eye height; distance between toruli greater than distance between torulus and clypeal margin, and greater than distance between torulus and orbit. OOL: POL: LOL: MPOD = 1.0: 7.2: 8.9: 10.4. Face (Figs 3C, 7C) with parascrobal region very narrow, interantennal region reticulate, scrobal depression deep and \cap -like, imbricate to reticulate, dorsal margin delimited, separated from anterior ocellus by distance equal to $0.23 \times$ diameter of anterior ocellus; lower orbit above level of dorsal margin of torulus; lower face reticulate; vertex coriaceous posterior to ocelli, temple imbricate; frons imbricate to coriaceous. Antennal (Figs 3G, 9E–F) scape and pedicel with yellowish-purple metallic luster, 1st to 3rd funicular segments with slight purple luster, and other segments dark brown, setae brown; scape normal, not expanded; relative length(width) of scape = 40(10), pedicel 9.5(5), 1st to 8th funiculars: 6(4), 15.5(5), 19(5), 22(6.5), 15.5(7.5), 14(8), 11(8), 8(9), clava 30(10).

MESOSOMA. Pronotum in dorsal view (Fig. 3B), with dark purple metallic luster, setae brown and hair-like; divided medially, pentagonal, reticulate. Mesoscutum (Figs 3B, 8K) almost flat but slightly convex anteriorly and concave posteriorly, and with lateral lobes carinate posteriorly, yellowish-green with lateral lobes slightly purple, anterior convex region with white hair-like setae (Fig. 8L), setae of posterior depressed region light brown and lanceolate (Fig. 8M), and lateral lobe with setae white and lanceolate (Fig. 8N). Scutellar-axillar complex (Fig. 3B) rusty with slight green luster, setae brown and hair-like (Figs 3B, 8O); disc flat (Figs 3B, 8K) with coarsely reticulate pattern arranged longitudinally in scutellum and transversely in axillae; scutellum $1.5 \times$ as long as broad. Prepectus (Fig. 3H) black with green to purple metallic luster; tegula with light brown hair-like setae; mesopectus dark purple, with long white hair-like setae linearly arranged along acropleural sulcus; acropleuron black with purple and green metallic luster. Mesopectus reticulate anterior to acropleural sulcus, acropleuron distinctly imbricate. Propodeum (Figs 3H–I, 10C) black with blue metallic luster, anterior margin broadly V-shaped; plical region long, reticulate, with one patch of setae anterior of spiracle, callus almost smooth and bare, but with long white hair-like setae laterally. Fore wing (Fig. 3F) with costal cell dorsally bare except for dark brown setae in infuscate region in front of parastigma; basal cell hyaline, with long brown setae, but slight infuscate at base, mediocubital fold with sparse brown setae; disc infuscate behind parastigma

and stigma vein, with dense brown setae and gradually lightened distally, with one inconspicuous and irregularly shaped hyaline region behind marginal vein; fore wing extended near apex of gaster, stigmal vein distinctly bent distally to parallel anterior margin, with SMV: MV: PMV: STV = 11.0: 10.0: 7.0: 3.6. Fore leg (Fig. 3A) with knee brown, femur and tibia black, tarsus yellowish-brown; middle leg with femur black, tibia and tarsus yellowish-brown, spur black, tibial spur shorter than basitarsus; hind leg

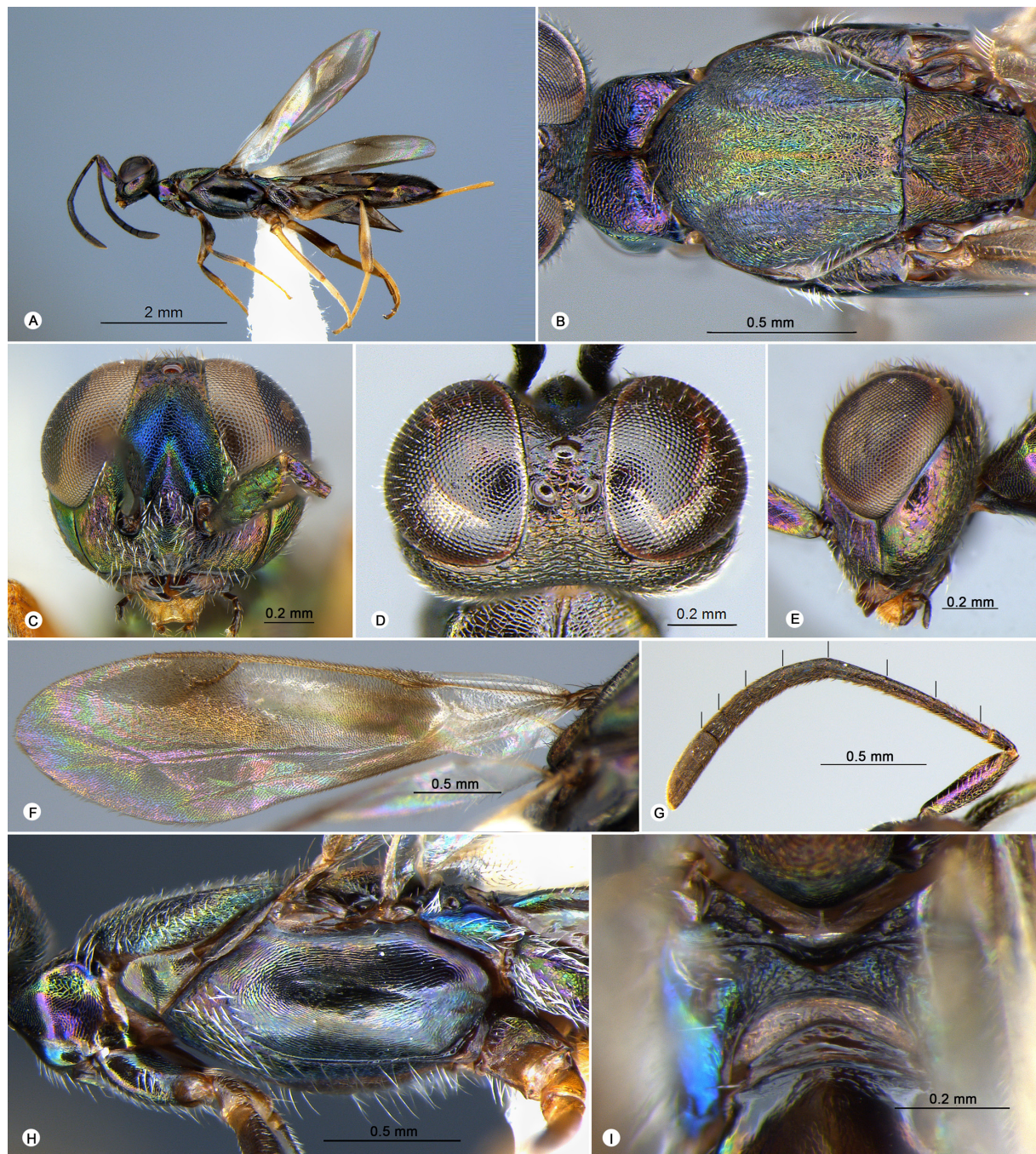


Fig. 3. *Zaischnopsis lii* Jiang & Peng sp. nov. **A.** Body, lateral view. **B.** Mesosoma, dorsal view. **C.** Head, front view. **D.** Head, dorsal view. **E.** Head, lateral view. **F.** Fore wing. **G.** Antenna. **H.** Mesosoma, lateral view. **I.** Propodeum.

with femur black except basal part brown, knee brown, tibia yellowish brown to brown, basal half of dorsal margin milky white, tarsus brown, basitarsus longer than the following two tarsomeres combined.

GASTER (Fig. 3A). Elongate-lanceolate, longer than mesosoma, dark brown to black with metallic luster, except apex of syntergum and ovipositor sheaths brown; syntergum tapered to rounded apex; ovipositor sheaths exerted for distance as long as length of basal three metatarsomeres.

Remarks

The fore wing color pattern of females of *Z. lii* sp. nov. resembles to some extent that of some females of *Z. zhongi* sp. nov., but they are distinguished by their \cap -like scrobal depression shape compared to the much narrower scrobal depression of females of *Z. zhongi* (Fig. 7F). Further, the clava of *Z. lii* is much longer than that of females of the other new species described in this paper, and the margin between each clava segment is S-shaped curved (Fig. 9F).

Distribution

China: Shaanxi (Palearctic); Guangxi (Oriental).

Variation

The length of females of this new species varies from about 5.7 to 6.1 mm; one paratype has the scape slightly expanded, the relative length(width) is 36(10); hind legs of the paratype are bright orange, except the outer sides of the femora are black.

Zaischnopsis pacis Jiang & Peng sp. nov.

[urn:lsid:zoobank.org:act:0AC6CF99-6551-46D3-B103-9FB0F85BFCCB](https://zoobank.org/urn:lsid:zoobank.org:act:0AC6CF99-6551-46D3-B103-9FB0F85BFCCB)

Figs 4, 7D, 8C, H, 9I, 10D

Diagnosis

Head with dorsal margin of scrobal depression separated from anterior ocellus by distance equal to $0.77 \times$ diameter of anterior ocellus (Fig. 4D); OOL: POL: LOL: MPOD = 1.0: 10.3: 9.5: 9.7; antennal clava $2.3 \times$ as long as wide (Fig. 4F). All tibiae black, with white setae (Fig. 4A). Fore wing disc infuscate with dark brown setae beyond level of parastigma and gradually lightened distally, except for one hyaline cross band behind marginal vein (Fig. 4E). Propodeum with anterior margin V-shaped; plical region very short, the V-shaped emargination extending to propodeal foramen (Fig. 10D).

Etymology

From the Latin word '*pax*' ('peace'), we pray for world peace.

Material examined

Holotype

CHINA – Zhejiang Prov. • ♀; 浙江省清凉峰自然保护区龙塘山 [Longtangshan, Qingliangfeng natural reserve]; Aug. 2013; Malaise trap; FAFU.

Paratype

CHINA – Zhejiang Prov. • 1 ♀; same collection data as for holotype; DNA 437; FAFU.

Description

Female

LENGTH. About 5.2 mm.

HEAD (Fig. 4C–D, F, H). Black with mostly purple and green metallic luster, as follows: scrobal depression, interantennal prominence, parascrobal region and lower face black to very dark purple (Fig. 4C), frons, vertex and temple with purple and green metallic luster (Fig. 4D). Setae (Fig. 7D) of face (Fig. 8C) and gena (Fig. 8H) white and lanceolate, setae of frons, vertex and occiput brown and hair-like, parascrobal region (Figs 7D, 8C) with two or three rows of white lanceolate setae ventrally and one row dorsally; maxillary and labial palpi dark brown (Fig. 4C). Head in frontal view $1.28 \times$ as wide as high; in dorsal view width $1.84 \times$ length, with interocular distance $0.18 \times$ head width and less than width of eye; in lateral view $1.49 \times$ as high as long. Eye height about equal to width in lateral view; distance between eyes below $3.88 \times$ distance between eyes above; malar space $0.46 \times$ eye height; distance between toruli greater than distance between torulus and clypeal margin, but close to the distance between torulus and orbit. OOL: POL: LOL: MPOD = 1.0: 10.3: 9.5: 9.7. Face with parascrobal region very narrow, interantennal region reticulate, scrobal depression deep and \cap -like, imbricate, with dorsal margin delimited, separated from anterior ocellus by distance equal to $0.77 \times$ diameter of anterior ocellus; lower orbit below level of dorsal margin of torulus; lower face coriaceous (Fig. 7D); vertex and temple coriaceous to imbricate. Antenna dark brown, scape with blue metallic luster (Figs 4F, 9I); scape normal, not expanded; relative length(width) of scape = 40(9), pedicel 9.5(5), 1st to 8th funiculars: 5(5), 13.5(6.5), 18(7), 15(10.5), 11(10.7), 9.7(11.5), 11.5(11), 9(11), clava 28(12).

MESOSOMA. Pronotum in dorsal view (Fig. 4B), dark with slight green metallic luster, setae brown and hair-like; divided medially, pentagonal, imbricate. Mesoscutum (Fig. 4B) slightly convex anteriorly and concave posteriorly, and with lateral lobe carinate posteriorly, dark with slight greenish-purple metallic luster, anterior convex region with setae white and hair-like, setae of posterior depressed region and lateral lobe white and lanceolate. Scutellar-axillar complex (Fig. 4B) dark purple, setae brown and hair-like; disc flat (Fig. 4B) with coarsely reticulate pattern arranged longitudinally in scutellum and transversely in axillae; scutellum $1.38 \times$ as long as broad. Prepectus (Fig. 4G) dark purple with margins slight yellow; tegula dark brown with white hair-like setae; mesopectus dark purple, with long white hair-like setae in a patch anterolaterally; acropleuron reddish-purple with green metallic luster. Mesopectus reticulate anterior to acropleural sulcus, acropleuron with very fine longitudinally imbricate sculpture medially but more coriaceous to reticulate anteriorly, posterior region coriaceous but with slight reticulate pattern. Propodeum (Fig. 10D) black with slight green metallic luster, anterior margin V-shaped; plical region very short, the V-shaped emargination extending to propodeal foramen, reticulate, with one patch of setae adjacent to spiracle anteriorly, callus obscurely coriaceous and bare, with long white hair-like setae laterally. Fore wing (Fig. 4E) extended to near apex of gaster, with costal cell dorsally bare except for dark brown setae in infuscate region in front of parastigma; basal cell hyaline with long white setae except infuscate basally with brown setae, mediocubital fold with sparse white setae; disc infuscate with dense brown setae except hyaline distally beyond level of postmarginal vein, and with one hyaline cross-band with white setae behind marginal vein distally. Fore wing stigmal vein distinctly bent anteriorly to parallel anterior margin; SMV: MV: PMV: STV = 10.0: 6.5: 6.0: 2.0. Fore leg (Fig. 4A, G) black, except tarsus brown; middle leg black, tibia with dense white setae, except tarsus white to light yellow, spur yellowish-brown, mesotibial spur shorter than basitarsus of middle leg; hind leg black with dense white setae on tibia, except tarsus white to light yellow, with basitarsus longer than the following two tarsomeres combined.

GASTER (Fig. 4A). Elongate-lanceolate, longer than mesosoma, dark brown to black with metallic luster, except apex of syntergum and ovipositor sheaths brown; syntergum tapered to rounded apex; ovipositor sheaths slightly exerted.

Remarks

Females of this new species resemble those of *Z. tubatius* (Walker, 1852) because both have dense white setae on the metatibia and a complete hyaline cross-band on the fore wing, but *Z. pacis* sp. nov.

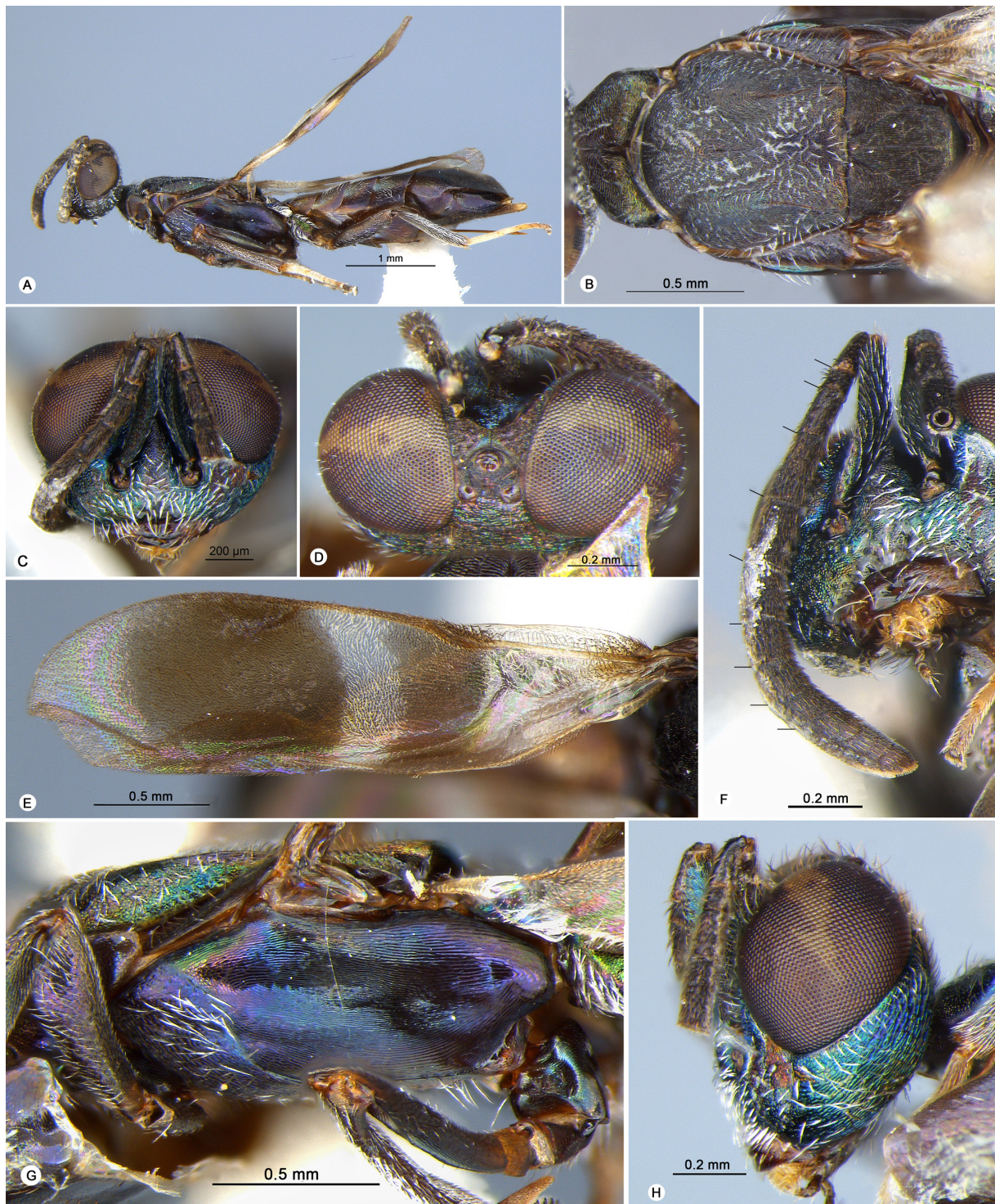


Fig. 4. *Zaischnopsis pacis* Jiang & Peng sp. nov. **A.** Body, lateral view. **B.** Mesosoma, dorsal view. **C.** Head, front view. **D.** Head, dorsal view. **E.** Fore wing. **F.** Antenna. **G.** Mesosoma, lateral view. **H.** Head, lateral view.

is distinguished by its darker body color, and the scape (Fig. 4F) not being foliaceously dilated as for females of *Z. tubatius* (Peng *et al.* 2018: fig. 32).

Distribution

China: Zhejiang (Oriental).

Zaischnopsis campaniformis Tang & Peng sp. nov.

[urn:lsid:zoobank.org:act:9ED76BA3-DD89-47DA-B9AD-8B2140D19904](https://zoobank.org/act:9ED76BA3-DD89-47DA-B9AD-8B2140D19904)

Figs 5, 7E, H, 8B, I, 9G–H, 10E

Diagnosis

Head with scrobal depression bell-shaped, dorsal margin separated from anterior ocellus by distance equal to $1.53 \times$ diameter of anterior ocellus (Figs 5C, 7E); OOL: POL: LOL: MPOD = 1.0: 7.0: 12.5: 10.0; antennal clava short, about $1.6 \times$ as long as wide (Fig. 5F). Tibiae black, except metatibia with basal half of dorsal margin milky-white (Fig. 5A). Fore wing disc infusate with dark brown setae beyond level of parastigma except gradually lightened distally where more hyaline, and with one subtriangular hyaline spot behind marginal vein distally (Fig. 5E). Propodeum with anterior margin broadly U-shaped; plical region comparatively long (Figs 5I, 10E).

Etymology

From the Latin word ‘*campana*’ (‘bell’) in reference to the bell-shape of scrobal depression (Fig. 5C).

Material examined

Holotype

CHINA – **Guangxi Prov.** • ♀; 广西省上思县十万大山自然保护区 [Shiwandashan national park, Shangsi County]; 27 Aug. 2019; Li Tao leg.; DNA 640; FAFU.

Paratype

CHINA – **Guangxi Prov.** • 1 ♀; same collection data as for holotype; DNA 641; FAFU.

Description

Female

LENGTH. About 5.1 mm.

HEAD (Fig. 5C–D, H). Dark with blue, green or yellow metallic luster, as follows: scrobal depression metallic greenish-blue (Fig. 5C), interantennal prominence, parascrobal region and lower face more golden-green (Fig. 5C), frons golden-yellow with slight purple metallic luster (Fig. 5D), vertex and temple green with golden-yellow metallic luster under some angles of light (Fig. 5D). Setae of lower face (Fig. 5C), interantennal prominence, lower part of parascrobal region (Fig. 5C), and gena (Figs 5H, 8I) white and lanceolate, setae of upper part of parascrobal region (Figs 5C, 8B), frons (Figs 5D, 7H) and vertex (Fig. 5D) brown and hair-like; maxillary and labial palpi black (Fig. 5C). Head in frontal view $1.18 \times$ as wide as high; in dorsal view width $1.51 \times$ length, with interocular distance $0.16 \times$ head width and less than width of eye; in lateral view $1.22 \times$ as high as long. Eye height about equal to width in lateral view; distance between eyes below $4 \times$ distance between eyes above; malar space $0.51 \times$ eye height; distance between toruli greater than distance between torulus and clypeal margin, and greater than distance between torulus and orbit. OOL: POL: LOL: MPOD = 1.0: 7.0: 12.5: 10.0. Face with parascrobal region narrow, interantennal region reticulate (Fig. 7E), scrobal depression (Fig. 7E) deep and bell-shaped, imbricate, dorsal margin delimited, separated from anterior ocellus by distance equal to $1.53 \times$ diameter of anterior ocellus; lower orbit above level of dorsal margin of torulus; lower face

coriaceous; vertex and temple imbricate. Antennal (Figs 5F, 9G–H) scape and pedicel with yellowish-green metallic luster, flagellum dark brown, 1st and 2nd segments of funicle with greenish-yellow metallic luster; scape normal, not expanded; relative length(width) of scape = 40(10), pedicel 19(4.5), 1st to 8th funiculars: 4.5(5), 20(6), 20(7.5), 20(11.5), 9.5(11), 9(12), 6.5(11.5), 5.5(12), clava 22.5(14).

MESOSOMA. Pronotum in dorsal view (Fig. 5B), dark with reddish-green to blue metallic luster, setae brown and hair-like; divided medially, pentagonal, imbricate. Mesoscutum (Fig. 5B) slightly convex

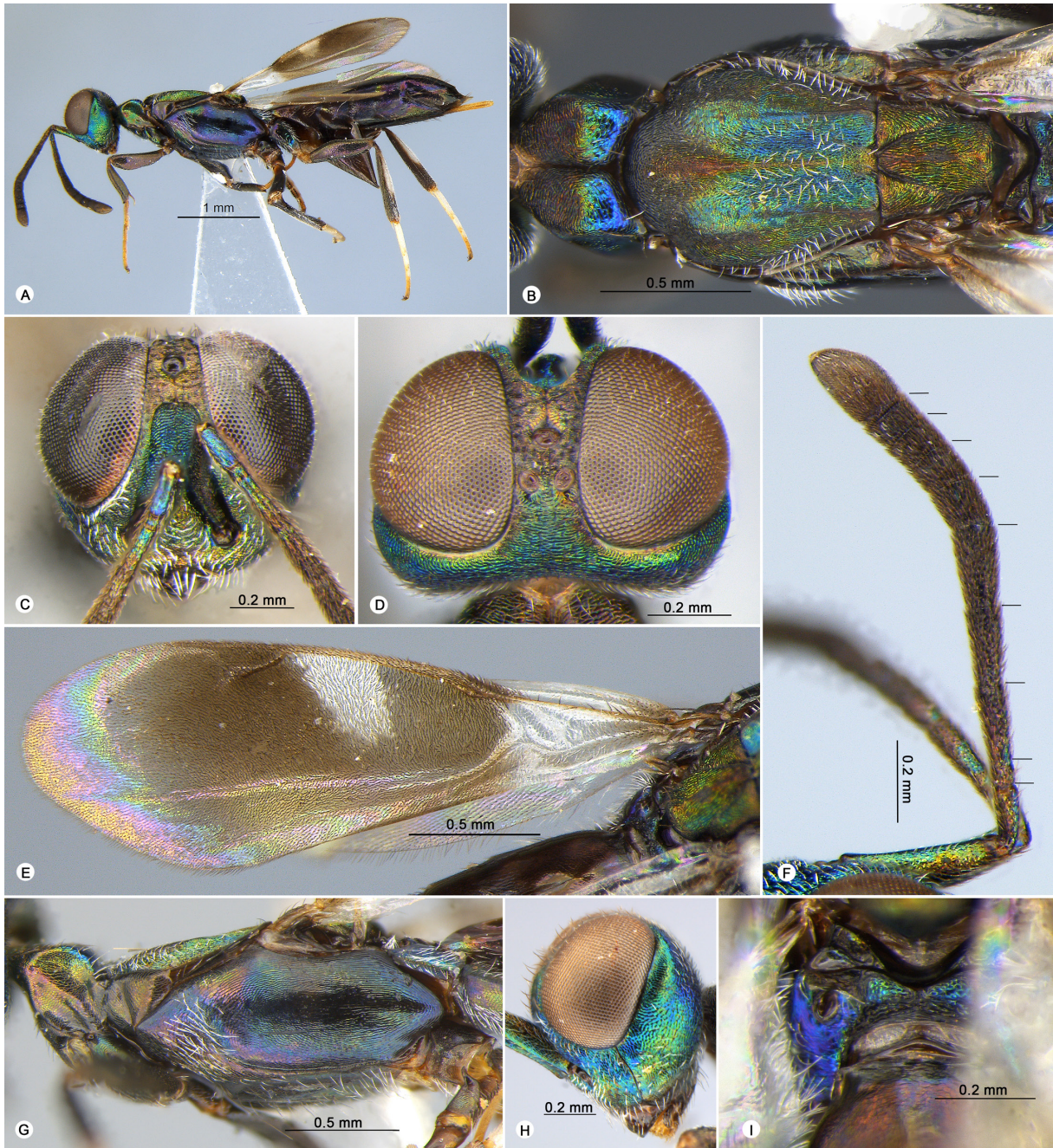


Fig. 5. *Zaischnopsis campaniformis* Tang & Peng sp. nov. **A.** Body, lateral view. **B.** Mesosoma, dorsal view. **C.** Head, front view. **D.** Head, dorsal view. **E.** Fore wing. **F.** Antenna. **G.** Mesosoma, lateral view. **H.** Head, lateral view. **I.** Propodeum.

anteriorly and concave posteriorly, and with lateral lobe carinate posteriorly; dark with slight greenish-blue metallic luster, anterior convex region dark brown with brown hair-like setae, setae of posterior depressed region and lateral lobe white and lanceolate. Scutellar-axillar complex (Fig. 5B) dark purple with green metallic luster, setae brown and hair-like; disc flat with coarsely reticulate pattern arranged longitudinally in scutellum and transversely in axillae; scutellum $1.71 \times$ as long as broad. Prepectus (Fig. 5G) dark brown to yellowish-brown; tegula dark brown with white hair-like setae; mesopectus dark purple, with long hair-like white setae; acropleuron reddish-purple with green metallic luster; mesopectus reticulate anterior to acropleural sulcus, acropleuron very finely longitudinally imbricate to coriaceous. Propodeum (Figs 5I, 10E) dark blue with slight greenish-blue metallic luster, anterior margin broadly U-shaped; plical region comparatively long, reticulate, with one patch of setae adjacent to spiracle anteriorly, callus coriaceous and bare, except with long white hair-like setae laterally. Fore wing (Fig. 5E) extended near apex of gaster, with costal cell dorsally bare except for dark brown setae in infusate region in front of parastigma; basal cell hyaline with white setae except for one small brown region with brown setae at base, mediocubital fold setose with white setae; disc infusate with dense brown setae except lightened distally, and with one hyaline spot with white setae behind marginal vein, the spot almost triangular in shape; stigmal vein distinctly bent distally so as to parallel anterior margin; SMV: MV: PMV: STV = 14.0: 12.0: 7.2: 3.7. Fore leg (Fig. 5A, G) with femur and tibia black, tarsus brown; middle leg with femur and tibia black, tarsus milky-white to light brown, spur yellowish-brown, shorter than basitarsus; hind leg with tibia black except basal half of dorsal margin milky-white, tarsus white to light brown, with basitarsus longer than the following two tarsomeres combined.

GASTER (Fig. 5A). Elongate-lanceolate, longer than mesosoma, black with metallic luster, except apex of syntergum and ovipositor sheaths brown; syntergum tapered to rounded apex; ovipositor sheath exerted slightly, for distance shorter than basitarsomere of hind leg.

Remarks

The fore wing of females of *Z. campaniformis* sp. nov. has a hyaline spot similar to *Z. zhongi* sp. nov. (Fig. 6E), but the spot is more distinctly triangular (Fig. 5E). Further, females are distinguished by the color of the anterior convex region of the mesoscutum, this being dark brown for *Z. campaniformis* (Fig. 5B) rather than green for *Z. zhongi* (Fig. 6B). Further, the pronotum of *Z. campaniformis* is distinctly bicolored (Fig. 5B), rather than yellowish-blue for *Z. zhongi* (Fig. 6B). Females of *Z. campaniformis* can also be distinguished by the color of the scrobal depression, having less luster and a more greenish pattern (Fig. 5C) rather than the dark blue color of *Z. zhongi* (Fig. 6C).

Distribution

China: Guangxi (Oriental).

Variation

The body length of the paratype is 4.9 mm; the color of the pronotum is more coppery than that of the holotype.

Zaischnopsis zhongi Jiang & Peng sp. nov.

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Figs 6, 7E, 8J, 10F

Diagnosis

Head with scrobal depression deep and \cap -shaped, dorsal margin separated from anterior ocellus by distance equal to $1.21 \times$ diameter of anterior ocellus (Fig. 7F); OOL: POL: LOL: MPOD = 1.0: 6.7: 10.7: 10.6; antennal clava short, about $1.7 \times$ as long as wide (Fig. 6F). Tibiae black to dark brown, but

metatibia with basal half milky-white (Fig. 6A). Fore wing disc infusate with dark brown setae beyond level of parastigma except gradually lightened distally, and with one hyaline spot behind marginal vein (Fig. 6E). Propodeum with anterior margin very broad V-shaped; plical region comparatively long (Figs 6I, 10F).

Etymology

Named in honor of Zhong Nanshan (20 Oct.1936–), director of the National Clinical Research Center for Respiratory Disease, an academician of the Chinese Academy of Engineering, and a leading Chinese expert in SARS and COVID-19 prevention and treatment.

Material examined

Holotype

CHINA – Sichuan Prov. • ♀; 四川省成都市天台山 [Tiantaishan, Chengdu City]; 16 Sep. 2019; DNA 673; FAFU.

Paratype

CHINA – Sichuan Prov. • 1 ♀; same collection data as for holotype; DNA 674; FAFU.

Description

Female

LENGTH. About 5.3 mm.

HEAD (Fig. 6C–D, F). Dark with blue, green or yellow metallic luster, as follows: scrobal depression with bright blue metallic luster (Fig. 6C), interantennal prominence blue with purple metallic luster medially (Fig. 6C), parascrobal region blue, lower face blue but with more coppery-violaceous ventrally, frons golden yellow with some purple metallic luster, vertex and temple green (Fig. 6D). Setae of lower face, interantennal prominence and lower part of parascrobal region (Figs 6C, 7F) white and lanceolate, setae of upper part of parascrobal region (Figs 6C, 7F), gena (Figs 6F, 8J), frons and vertex (Fig. 6D) brown and hair-like; maxillary and labial palpi black (Fig. 6C). Head in frontal view $1.20 \times$ as wide as high; in dorsal view width $1.74 \times$ length, with interocular distance $0.18 \times$ head width and less than width of eye; in lateral view $1.51 \times$ as high as long. Eye height about equal to width in lateral view; distance between eyes below $3.99 \times$ distance between eyes above; malar space $0.42 \times$ eye height; distance between toruli greater than distance between torulus and clypeal margin, and greater than distance between torulus and orbit. OOL: POL: LOL: MPOD = 1.0: 6.7: 10.7: 10.6. Face with parascrobal region narrow, interantennal region reticulate (Fig. 7F), scrobal depression (Fig. 7F) deep and \cap -shaped, imbricate, dorsal margin delimited, separated from anterior ocellus by distance equal to $1.21 \times$ diameter of anterior ocellus; lower orbit slightly lower than level of dorsal margin of torulus; lower face coriaceous; vertex and temple imbricate. Antennal (Fig. 6G) scape and pedicel green with yellowish-red metallic luster, 1st to 3rd segments of funicle with blue to rusty luster basally, 4th to 8th segments and clava dark brown; scape normal, not expanded; relative length(width) of scape = 40(7), pedicel 12.8(4.8), 1st to 8th funiculars: 5.2(5), 16(5.2), 16.5(6.5), 16(8), 13(8.5), 11(9.6), 10(10), 8(11), clava 14.5(8.5).

MESOSOMA. Pronotum in dorsal view (Fig. 6B), dark with yellowish-green to blue metallic luster, setae hair-like and brown; divided medially, pentagonal, imbricate. Mesoscutum (Fig. 6B) slightly convex anteriorly and concave posteriorly, and with lateral lobe carinate posteriorly; dark with yellowish-green metallic luster, setae of mesoscutum brown and hair-like except lower portion of lateral lobe white and hair-like. Scutellar-axillar complex (Fig. 6B) with reddish-green metallic luster, setae brown and hair-like, disc flat with coarsely reticulate pattern arranged longitudinally in scutellum and transversely in axillae region; scutellum $1.58 \times$ as long as broad. Prepectus (Fig. 6H) with yellowish-green metallic luster; tegula dark brown with white hair-like setae; mesopectus dark green, with sparse, long white

hair-like setae anterolaterally; acropleuron dark purple with slight green metallic luster; mesopectus reticulate anterior to acropleural sulcus, acropleuron very finely longitudinally imbricate to coriaceous. Propodeum (Figs 6I, 10F) black with bright blue metallic luster, anterior margin very broad V-shaped; plical region comparatively long, reticulate, with patch of white setae adjacent to spiracle anteriorly and laterally, callus almost smooth and bare, with long white hair-like setae laterally. Fore wing (Fig. 6E) extended near apex of gaster, with costal cell dorsally bare except dark brown setae in infuscate region

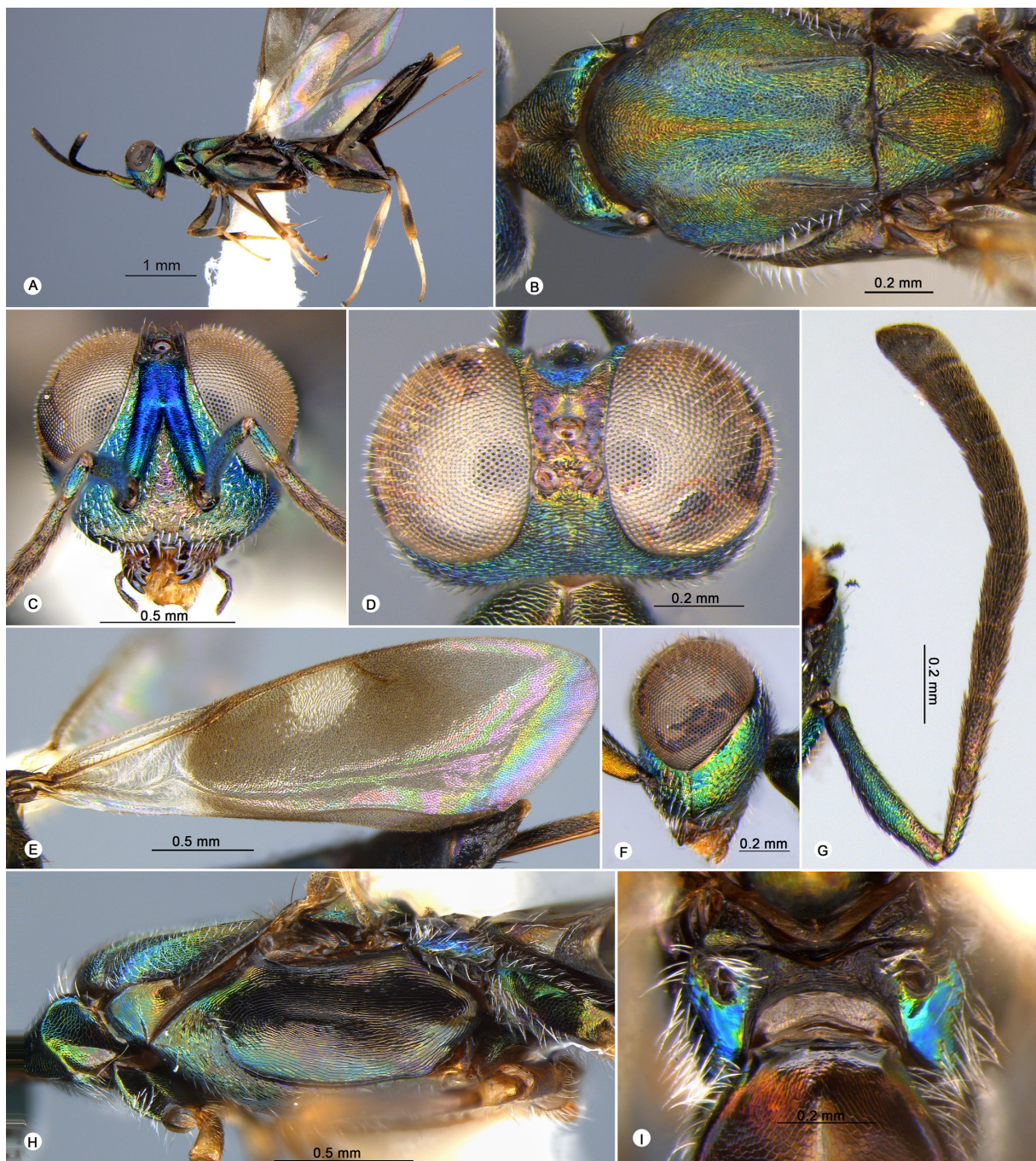


Fig. 6. *Zaischnopsis zhongi* Jiang & Peng sp. nov. A. Body, lateral view. B. Mesosoma, dorsal view. C. Head, front view. D. Head, dorsal view. E. Fore wing. F. Head, lateral view. G. Antenna. H. Mesosoma, lateral view. I. Propodeum.

in front of parastigma; basal cell hyaline with white setae except for infusate region with brown setae basally, mediocubital fold with sparse white setae; disc infusate with dense brown setae except lightened and more hyaline apically beyond level of postmarginal vein, and with one, almost round, hyaline spot with white setae behind marginal vein; fore wing stigmal vein slightly bent to anterior margin; SMV: MV: PMV: STV = 12.0: 8.6: 5.8: 2.6. Fore leg (Fig. 6A) with femur dark brown to black, knee dark brown; tibia black except apex dark brown, tarsus brown; middle leg with femur black, knee brown, tibia dark brown, tarsus milky-white, spur yellowish brown, shorter than basitarsus of middle leg; hind legs with tibia black to dark brown except basal half milky-white, tibia white to light brown, with basitarsus longer than the following two tarsomeres combined.

GASTER (Fig. 6A). Elongate-lanceolate, longer than mesosoma, black with metallic luster, except apex of syntergum black, and ovipositor sheaths brown; syntergum tapered to rounded apex, ovipositor sheaths exerted, slightly longer than basitarsus of hind leg.

Remarks

The fore wing of females of *Z. zhongi* sp. nov. has a single hyaline spot with white setae behind the marginal vein (Fig. 6E) similar to that of females of *Z. nivalinota* Peng & Xiang, 2018 (Peng *et al.* 2018:

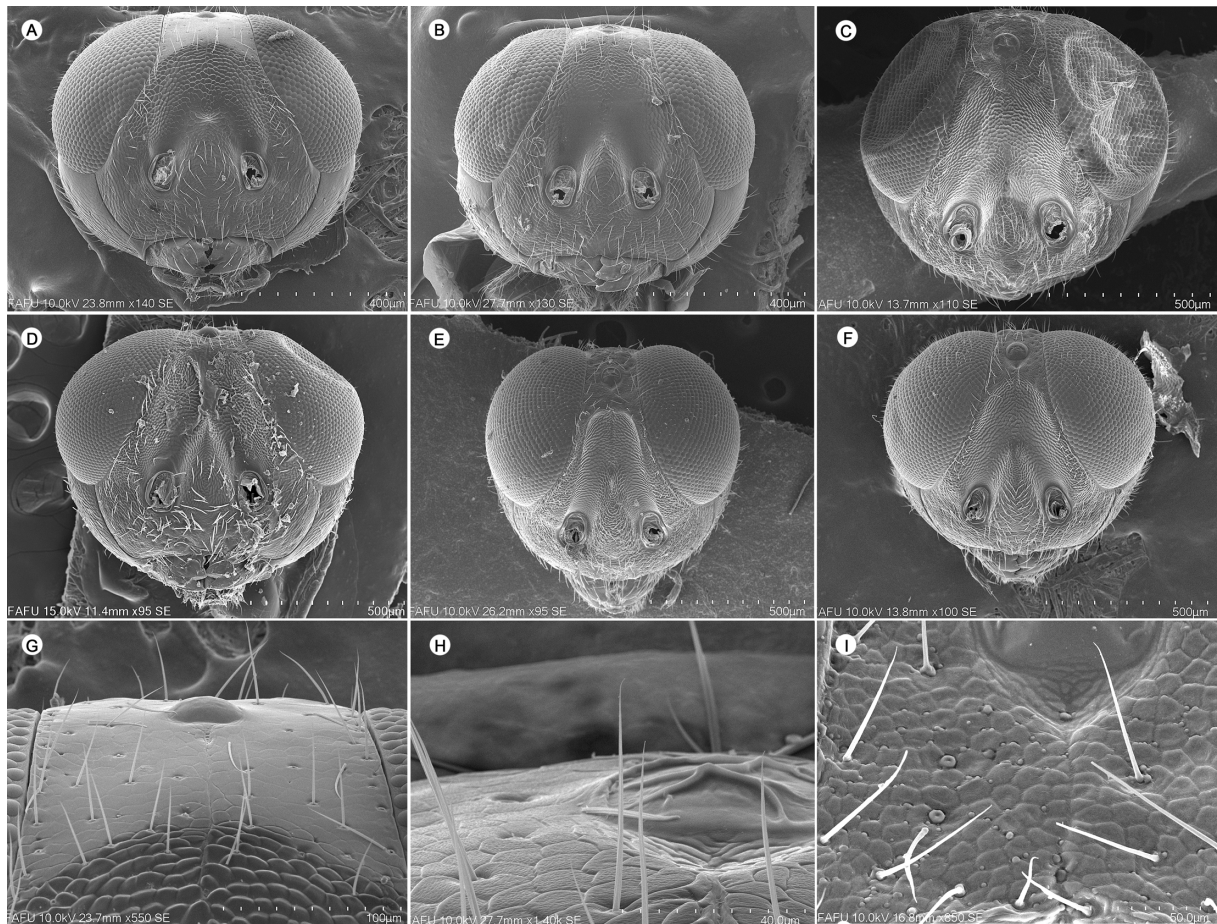


Fig. 7. SEM photos. A–F. Head. A. *Zaischnopsis covid* Jiang & Peng sp. nov. B. *Z. fuscolivida* Tang & Peng sp. nov. C. *Z. lii* Jiang & Peng sp. nov. D. *Z. pacis* Jiang & Peng sp. nov. E. *Z. campaniformis* Tang & Peng sp. nov. F. *Z. zhongi* Jiang & Peng sp. nov. G. *Z. covid*, front part of frons, show sculpture and setae. H. *Z. campaniformis*, sculpture and setae around anterior ocellus. I. *Z. lii*, front part of frons, show sculpture and setae.

fig. 26). However, females of *Z. zhongi* have the vertex and mesoscutum more yellowish and greenish (cf. Fig. 6B, D with Peng *et al.* 2018: figs 23, 25) and the concave posterior of the mesoscutum less setose (Fig. 6B) than females of *Z. nivalinota* (Peng *et al.* 2018: fig. 22). Further, the ovipositor sheaths of *Z. zhongi* are brown, whereas they are black with the apex brown for *Z. nivalinota*, and the plical region of propodeum of *Z. zhongi* is somewhat longer (Fig. 6I) than that of *Z. nivalinota* (Peng *et al.* 2018: fig. 27).

Distribution

China: Sichuan (Oriental).

Variation

The paratype is 5.4 mm in length; with only the dorsal margin of the basal half of the metatibia white, whereas the holotype (Fig. 6A) has the white region also across the lateral surfaces so as to extend to the ventral margin; the color of the antennal scape varies from yellowish-green to metallic blue.

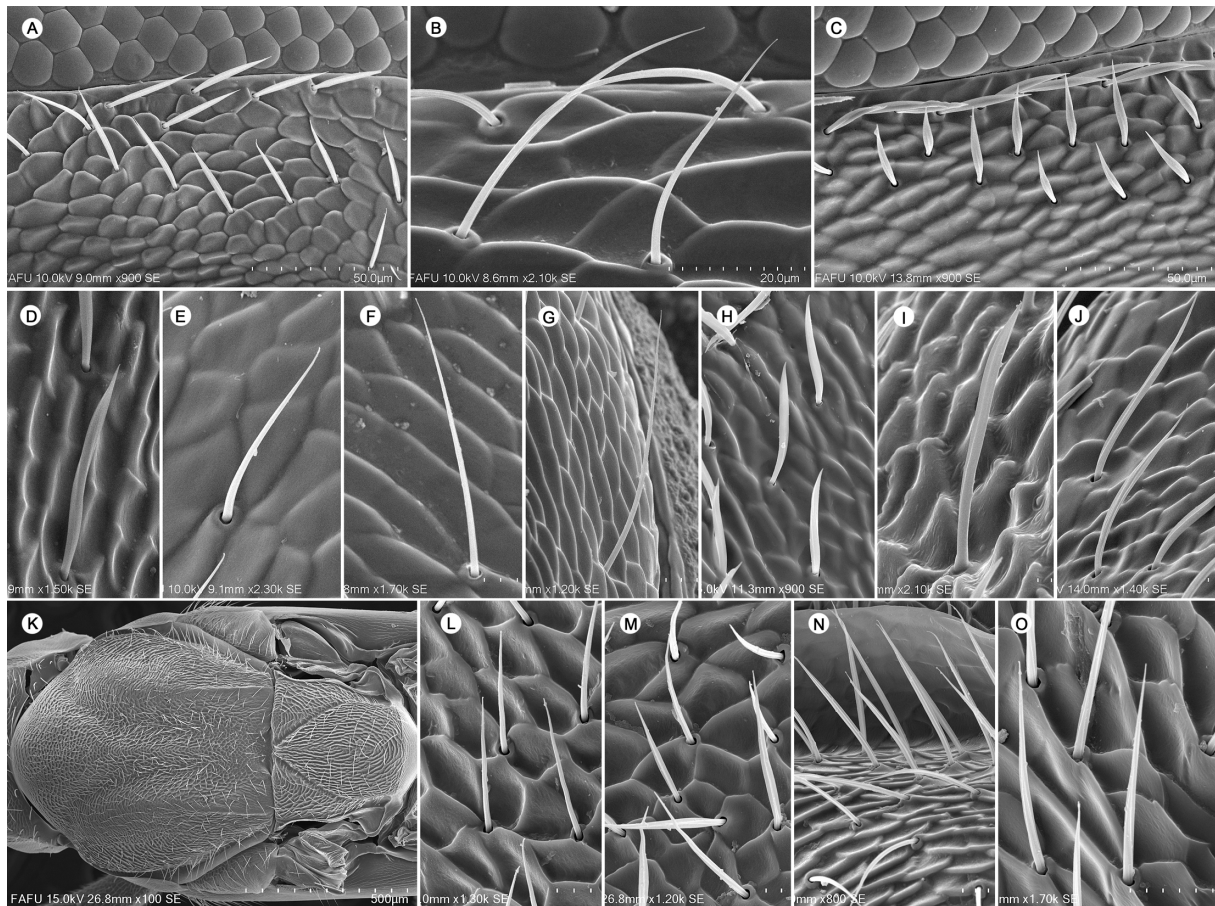


Fig. 8. SEM photos. A–C. Parascrobal region, show sculpture and setae. A. *Zaischnopsis covid* Jiang & Peng sp. nov. B. *Z. campaniformis* Tang & Peng sp. nov. C. *Z. pacis* Jiang & Peng sp. nov. D–J. Seta of gena. D. *Z. covid*. E–F. *Z. fuscolivida* Tang & Peng sp. nov. G. *Z. lii* Jiang & Peng sp. nov. H. *Z. pacis*. I. *Z. campaniformis*. J. *Z. zhongi* Jiang & Peng sp. nov. K–O. *Z. lii*. K. Mesosoma. L. Setae of anterior convex region of mesoscutal medial lobe. M. Setae of posterior depressed region of mesoscutal medial lobe. N. Setae of mesoscutal lateral lobe. O. Setae of axilla.

Discussion

The more historical method of identification of species using only morphology requires researchers to have a high degree of experience and knowledge of all previously described species, and museum specimens may be damaged due to preservation mistakes with resulting incorrect identifications. However, if only molecular data is used to identify species, researchers will have neither a deep understanding of the species nor a clear understanding of the morphological characteristics of the species. Therefore, identification of species by both morphological and molecular methods are more and more popular in modern studies, and the agreement between independent morphological and molecular evidence results in more convincing evidence of the species status. In this paper, morphological identification and bioinformatics software were used to delimit the *COI* of these species, and the combined results support the recognition of six separate species.

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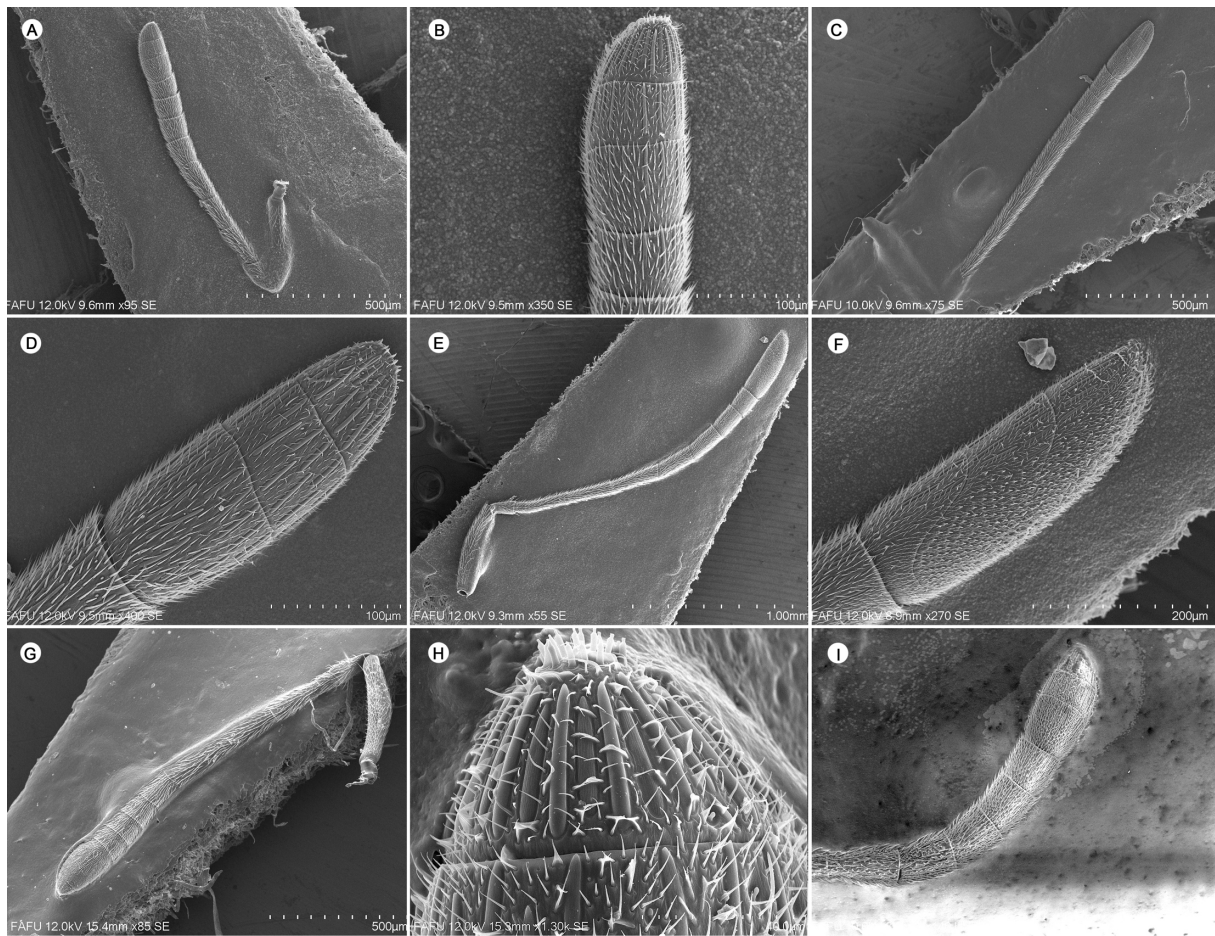


Fig. 9. SEM photos of antennae. **A–B.** *Zaischnopsis covid* Jiang & Peng sp. nov. **C–D.** *Z. fuscolivida* Tang & Peng sp. nov. **E–F.** *Z. lii* Jiang & Peng sp. nov. **G–H.** *Z. campaniformis* Tang & Peng sp. nov. **I.** *Z. pacis* Jiang & Peng sp. nov.

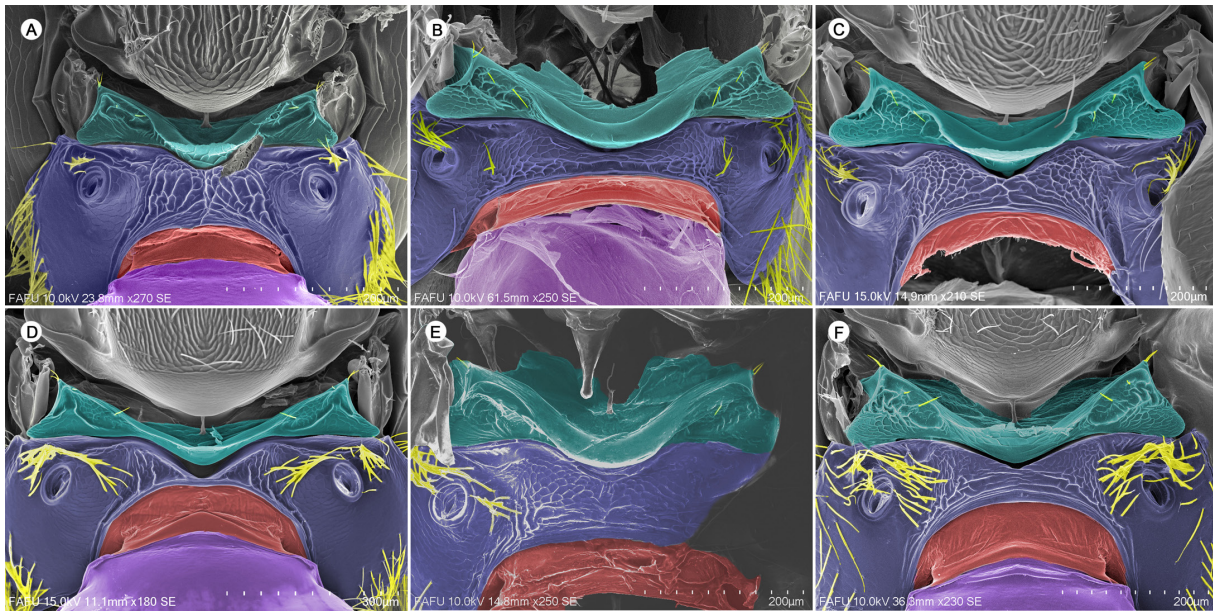


Fig. 10. SEM photos of dorsellum and propodeum. **A.** *Zaischnopsis covid* Jiang & Peng sp. nov. **B.** *Z. fuscolivida* Tang & Peng sp. nov. **C.** *Z. lii* Jiang & Peng sp. nov. **D.** *Z. pacis* Jiang & Peng sp. nov. **E.** *Z. campaniformis* Tang & Peng sp. nov. **F.** *Z. zhongi* Jiang & Peng sp. nov.

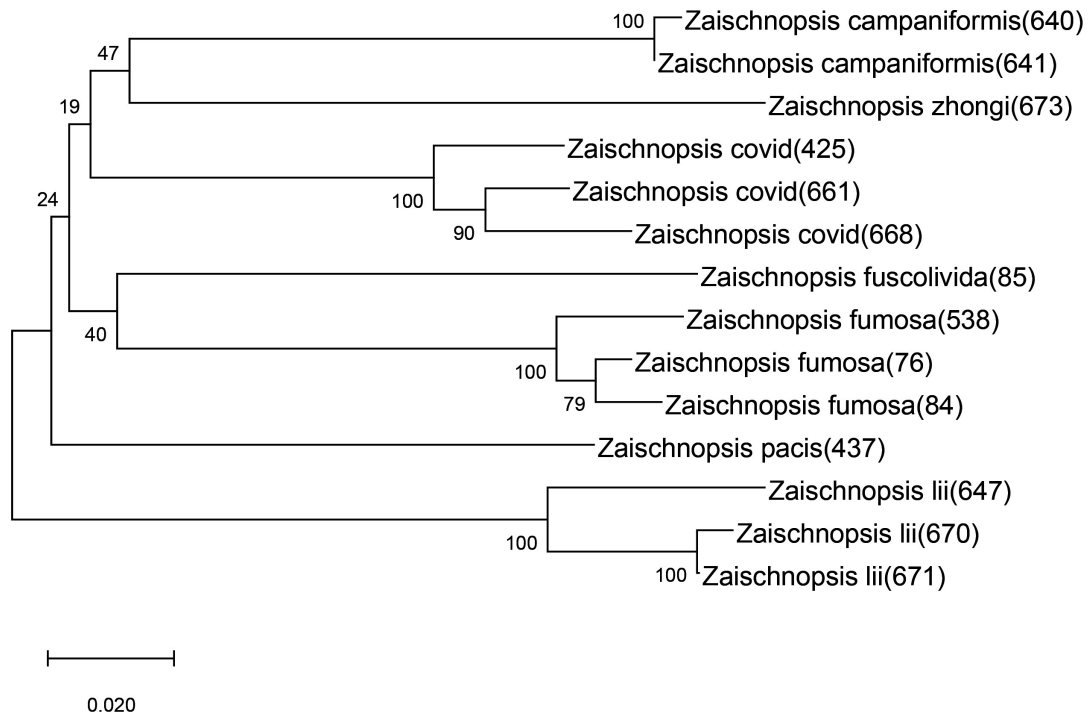


Fig. 11. The NJ tree (Neighbor-Joining) on *COI* sequences of the new species and *Z. fumosa* Peng & Xiang, 2018.

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