

A checklist of Encyrtidae (Hymenoptera: Chalcidoidea) from Yongxing Island, South China Sea, with description of a new species

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Abstract: In order to investigate the species diversity of Encyrtidae on Yongxing Island of Sansha in Hainan, China, encyrtids were collected from the Island during 2017–2020. Based on morphological traits, 10 species were recorded, including one new species: *Ooencyrtus yongxingensis* sp. nov., and two species newly recorded to China: *Adelencyrtus mangiphila* (Risbec, 1952) and *Metaphycus agarwali* Hayat and Subba Rao, 1981. A checklist of Encyrtidae on Yongxing Island is also provided.

Key words: Tetracneminae; taxonomy; Sansha

中国南海永兴岛跳小蜂科名录及一新种（膜翅目：小蜂总科）

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摘要: 为全面调查中国海南省三沙市永兴岛的跳小蜂科物种多样性, 于 2017~2020 年期间采集了永兴岛的跳小蜂。经鉴定, 共发现跳小蜂 10 种, 包含 1 新种: *Ooencyrtus yongxingensis* Zu & Xue sp. nov. 及 2 中国新记录种: *Adelencyrtus mangiphila* (Risbec, 1952), *Metaphycus agarwali* Hayat and Subba Rao, 1981。文中还提供了永兴岛跳小蜂科名录。

关键词: 四突跳小蜂亚科; 分类; 三沙

Introduction

In recent years, due to the negative effects of chemical control, the use of biological control by natural enemies has become the focus of attention. Encyrtidae is a family of Hymenoptera parasitic wasps with 495 valid genera. 535 species in 131 genera are known in

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China (Noyes 2019; Wu *et al.* 2021; Zu *et al.* 2018; Zu *et al.* 2020a, b; 2021). *Ooencyrtus* species are widely distributed globally, with 343 known species worldwide and 36 known in China (Noyes 2019). A large number of encyrtids have been associated with biological control programmes throughout the world, most successfully in warmer climates (Noyes 2010).

Yongxing Island is located in Xisha District, Sansha City, Hainan, China. It is also the largest island (about 2.6 km²) of the Xisha Islands and exists in a tropical marine monsoon climate (Jiang *et al.* 2021). However, because of its unique geographical location, the species diversity of Encyrtidae has been poorly studied, with no records from Yongxing Island. Therefore, it is of great significance to carry out research on the species diversity of the Encyrtidae in Yongxing Island in order to support the ecological viability of Sansha.

A total of 45 specimens of Encyrtidae were collected. This study is the first to report 7 genera and 10 species from Yongxing Island, including one new species and two new Chinese records.

Material and methods

This study is based on specimens of Encyrtidae collected by Malaise trapping, yellow pan trapping, sweeping, light trapping and rearing from Yongxing Island during 2017–2020. All specimens were dissected and mounted on slides following the method described by Noyes (1982). Morphological terminology and abbreviations follow Noyes (2010). Photographs were taken in layers under the microscope by running the OLYMPUS Cellsens Standard program. The images were synthesized using Helicon Focus 6.70, and then optimized by Photoshop CC. All research specimens were deposited in the Insect Research Laboratory of Tianjin Agricultural University, China.

The following abbreviations are used in the text: F1–6 — funicle segments 1–6; AOL — minimum distance between a posterior ocellus and anterior ocellus; OCL — minimum distance between a posterior ocellus and occipital margin; OD — longest diameter of an ocellus; OOL — minimum distance between a posterior ocellus and eye margin; POL — minimum distance between posterior ocelli; FWL — length of fore wing excluding marginal fringe; FWW — maximum width of fore wing excluding marginal fringe; SMV — submarginal vein; MV — marginal vein; PMV — postmarginal vein; SV — stigmal vein; HWL — length of hind wing excluding marginal fringe; HWW — width of hind wing, measured at widest point, excluding marginal fringe; MT — length of mid tibia; OL — length of ovipositor; GL — length of gonostylus; BMNH — The Natural History Museum, London, England; IARI — Indian Agricultural Research Institute, Delhi, India; IEE — Instituto Espanol de Entomologia, Madrid, Spain; MNHN — Muséum National d'Histoire Naturelle, Paris, France; NEFU — Northeast Forestry University, Harbin, China; NIES — National Institute of Agro-environmental Sciences, Ibaraki, Japan; KYUN — Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka 812-8581, Japan; ORSTOM — Office de La Recherche Scientifique et Technique Outre-Mer, Paris, France; TJAU — Tianjin Agricultural University, Tianjin, China; USNM — United States Museum of Natural History, Washington D.C., USA; ZDAMU — Department of Zoology, Aligarh Muslim University, Aligarh, India.

Taxonomy

Check list to species of Encyrtidae on Yongxing Island, South China Sea

- Ooencyrtus yongxingensis* Zu & Xue **sp. nov.**
Adelencyrtus mangiphila (Risbec, 1952)
Metaphycus agarwali Hayat and Subba Rao, 1981
Anagyrus diversicornis (Howard, 1894)
Anagyrus pseudofuscus Zu, 2018
Aenasius arizonensis (Girault, 1915)
Adelencyrtus bifaciatus (Ishii, 1923)
Arrhenophagus albitibiae Girault, 1915
Blepyrus insularis (Cameron, 1886)
Ooencyrtus papilionis Ashmead, 1905

1. *Ooencyrtus yongxingensis* Zu & Xue **sp. nov.** (Figs 1, 3A)

Description. Female. Length, 1.27 mm (excluding ovipositor). Body generally black with sheen. Antenna brown, with radicle and pedicel dark brown; wings completely hyaline; legs with all femora apically, all tibia and tarsi yellowish white.

Head. In frontal view (Fig. 1A), about 1.02× as wide as high; frontovertex 0.27× head width, with piliferous punctures; ocelli forming an angle of about 70°; posterior ocellus closer to eye margin than to occipital margin; antennal torulus with its dorsal margin well below lower margin of eyes and separated from mouth margin by about 0.67× as long as its own height; malar space about 0.49× as long as eye length. Antenna (Fig. 1B) with scape slender, very slightly expanded in the middle, 6.53× as long as broad; pedicel 1.75× as long as broad, 1.63× as long as F1; F1–F4 longer than broad, F5 subquadrate, F6 slightly broader than long; clava 3-segmented, 1.80× as long as broad, and a little longer than last three funicle segments combined. Maxillary palpus 4-segmented, labial palpus 3-segmented. Mandible with two pointed teeth and a broad truncation. Measurements (µm): head high, 500; head width, 510; frontovertex width, 138; OD, 30; POL, 70; OOL, 8; OCL, 50; AOL, 60; eye length, 370; malar space, 180; length (width) – radicle, 65(23); scape, 248 (38); pedicel, 70 (40); F1, 43 (35); F2, 45 (33); F3, 45 (35); F4, 48 (40); F5, 45 (43); F6, 48 (53); and clava, 153 (85).

Thorax. Mesoscutum (Fig. 1C) 0.60× long as wide, with silvery-white setae and shallow imbricate-reticulate sculpture; scutellum 0.67× long as wide, with deeper punctate-reticulate sculpture, becoming elongate on sides. Fore wing (Fig. 1D) about 2.21× long as width and reaching beyond apex of gaster; basal naked area small and open posteriorly; linea calva open posteriorly, uninterrupted; filum spinosum with four setae; postmarginal vein very slightly longer than marginal vein, and shorter than half of stigmal vein; hind wing (Fig. 1E) 3.75× long as broad. Length of mid tibial spur (Fig. 1F) 0.30× as long as mid tibia and shorter than corresponding basitarsus. Measurements (µm): FWL, 1050; FWW, 475; SMV, 370; MV, 23; PMV, 25; SV, 73; HWL, 750; HWW, 200; MT, 480; mid tibial spur, 145; mid basitarsus, 160.

Gaster. conspicuously shorter than thorax; ovipositor (Fig. 1C) exerted, and its full length 0.77× as long as mid tibia, 4.93× longer than gonostylus. Measurements (µm): OL, 370; GL, 75. [MT, 480].

Male. Unknown.

Holotype. ♀ [TJAU; on slide], **China**, Hainan, Sansha City, Yongxing Island,

01-VII-2017, Xianyong ZHOU, Malaise trapping. **Paratype.** ♀, same data as holotype.
Host. Unknown.

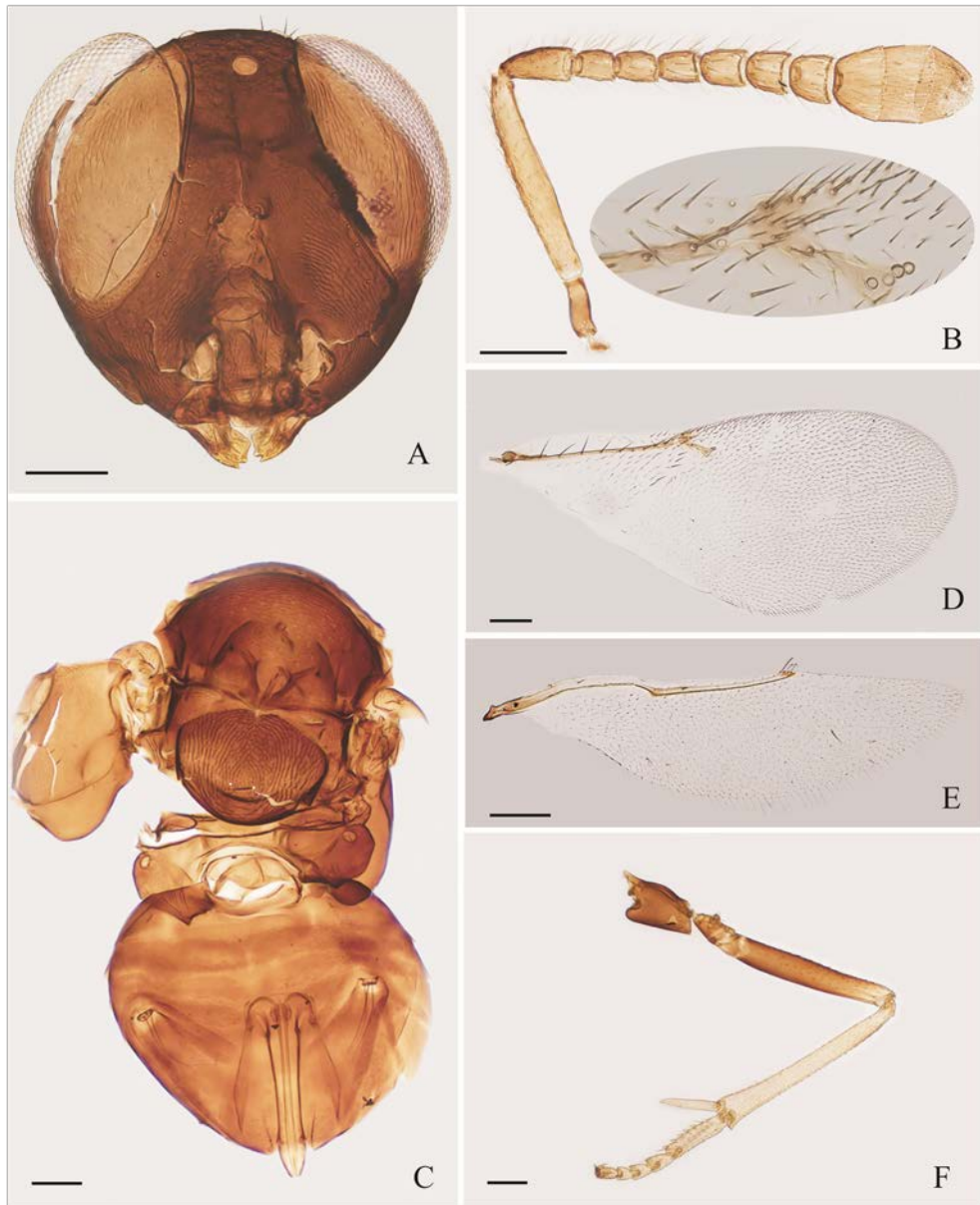


Figure 1. *Ooencyrtus yongxingensis* Zu & Xue **sp. nov.**, ♀, holotype. A. Head, frontal view; B. Antenna; C. Thorax and gaster, dorsal view; D. Fore wing; E. Hind wing; F. Mid leg. Scale bars = 100 μ m.

Etymology. The specific epithet refers to the collecting location.

Diagnosis. Female. Length, excluding ovipositor, 1.25–1.27 mm. Body generally black, shiny, except scape and flagellum brown; all femora apically, all tibia and tarsi yellowish white. Frontovertex slightly more than one quarter of head width; malar space about half of eye length; scape about 6.53 \times long as broad; F1–F4 longer than broad, F5 subquadrate, F6

slightly broader than long; scutellum $0.67\times$ long as wide; fore wing hyaline, $2.21\times$ long as broad; marginal vein nearly equal to postmarginal vein; ovipositor about $0.77\times$ as long as mid tibia, exerted. Male. Unknown.

Remarks. This new species is very close to *O. guamensis* Fullaway, 1946, but differs as follows: scutellum $0.67\times$ as long as width, apex rounded ($1.02\times$, apex sharp in *guamensis*), scape $6.53\times$ longer than broad ($5\times$ in *guamensis*), and frontoververtex $0.27\times$ head width ($0.25\times$ in *guamensis*).

This species is also similar to *O. corbetti* Ferriere, 1931, However, it can be separated from *O. corbetti* by the following characteristics: scape $6.53\times$ longer than broad ($4\times$ in *corbetti*), postmarginal vein $0.34\times$ as long as stigmal vein (just a little shorter in *corbetti*), frontoververtex $0.27\times$ head width ($0.25\times$ in *corbetti*).

2. *Adelencyrtus mangiphila* (Risbec, 1952) (Figs 2A, 2B, 3B), new record from China

Coccidencyrtus mangiphila Risbec, 1952: 48. Lectotype ♀ (designated by Noyes & Prinsloo, 1998: 80), Madagascar, MNHN, not examined.

Specimens examined. ♀ [on slide], **China**, Hainan, Sansha City, Yongxing Island, 05–11-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, Malaise trapping.

Host. *Phenacaspis dilatata* (Hemiptera: Diaspididae).

Distribution. China; Madagascar.

3. *Metaphycus agarwali* Hayat and Subba Rao, 1981 (Figs 2C, 2D, 3C), new record from China

Euaphycus latiscapus Shafee, Alam & Agarwal, 1975: 84. Holotype ♀, India, ZDAMU, not examined. Preoccupied in *Metaphycus* by *latiscapus* Alam, 1972 (= *M. mashhoodi* Noyes & Woolley, 1994: 1332).

Metaphycus agarwali Hayat & Subba Rao, 1981: 115. Replacement name for *Metaphycus latiscapus* (Shafee, Alam & Agarwal, 1975) nec Alam, 1972.

Specimens examined. 3♀ [1♀ on slide, 2♀ in alcohol], **China**, Hainan, Sansha City, Yongxing Island, 05-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, Malaise trapping.

Host. *Marsipococcus marsupialis*, *Pulvinaria maxima* (Hemiptera: Coccidae).

Distribution. China; India.

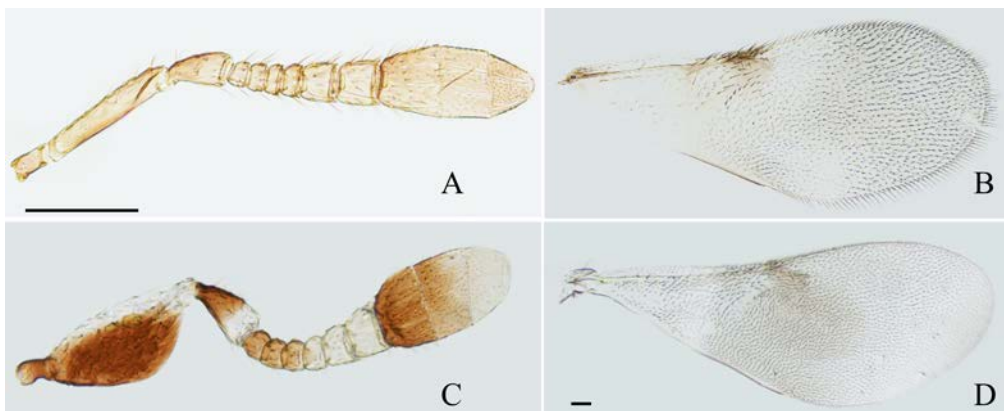


Figure 2. Two newly recorded Chinese species. A, B. *Adelencyrtus mangiphila* (Risbec, 1952), ♀; C, D. *Metaphycus agarwali* Hayat and Subba Rao, 1981, ♀. A, C. Antenna; B, D. Fore wing. Scale bars = 100 μm .

4. *Anagyrus diversicornis* (Howard, 1894) (Figs 3D, 3E)

Copidosoma diversicornis Howard in Riley, Ashmead & Howard, 1894: 92. Lectotype ♀ (designated by Noyes, 1979), St. Vincent, BMNH, not examined.

Litomastix diversicornis (Howard); Ashmead, 1900: 364.

Apoanagyrus diversicornis (Howard); Noyes, 1979: 147.

Anagyrus diversicornis (Howard); Noyes, 2000: 76.

Specimnes examined. 5♀ [2♀ on slides, 3♀ in alcohol], **China**, Hainan, Sansha City, Yongxing Island, 01-VII-2017, Xianyong ZHOU, light trapping; 1♂ [on slide], same as above, 01-VIII-2017, Xianyong ZHOU, Malaise trapping.

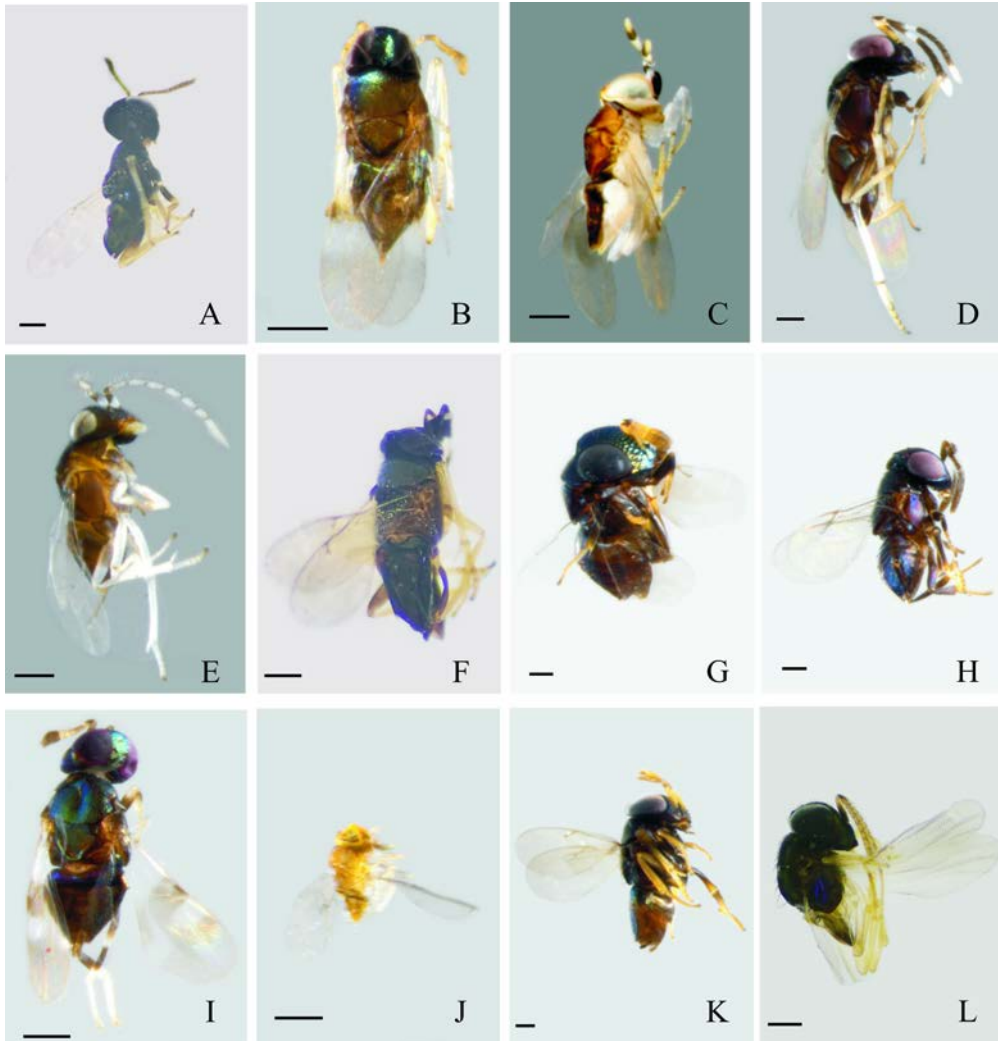


Figure 3. A. *Ooencyrtus yongxingensis* sp. nov. (♀); B. *Adelencyrtus mangiphila* (Risbec, 1952) (♀); C. *Metaphycus agarwali* Hayat & Subba Rao, 1981 (♀); D. *Anagyrus diversicornis* (Howard, 1894) (♀); E. *Anagyrus diversicornis* (Howard, 1894) (♂); F. *Anagyrus pseudofuscus* Zu, 2018 (♀); G. *Aenasius arizonensis* (Girault, 1915) (♀); H. *Aenasius arizonensis* (Girault, 1915) (♂); I. *Adelencyrtus bifaciatus* (Ishii, 1923) (♀); J. *Arrhenophagus albitibiae* Girault, 1915 (♀); K. *Blepyrus insularis* (Cameron, 1886) (♀); L. *Ooencyrtus papilionis* Ashmead, 1905 (♀). Scale bars = 200 µm.

Host. *Phenacoccus* sp., *Phenacoccus gossypii*, *Phenacoccus herreni*, *Phenacoccus manihoti*, *Pseudococcidae* indet (Hemiptera: Pseudococcidae).

Distribution. China (Hainan); United Kingdom; Iran; India; Bangladesh; Sierra Leone; Benin; Togo; Nigeria; Central African Republic; Democratic Equatorial Guinea; Burundi; Guinea; Republic of Congo; Rwanda; Kenya; Zambia; Mozambique; Malawi; United States of America; Costa Rica; Colombia; Guadeloupe; Dominica; Barbados; St. Vincent & Grenadines; Trinidad & Tobago; French Guiana; Guyana; Brazil; Chile; Paraguay; Argentina.

5. *Anagyrus pseudofuscus* Zu, 2018 (Fig. 3F)

Anagyrus pseudofuscus Zu, 2018: 197. Holotype ♀, NEFU, China (Harbin), not examined.

Specimens examined. ♀ [on slide], **China**, Hainan, Sansha City, Yongxing Island, 09-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, yellow pan trapping.

Host. *Phenacoccus solani* (Hemiptera: Pseudococcidae).

Distribution. China (Yunnan, Hainan).

6. *Aenasius arizonensis* (Girault, 1915) (Figs 3G, 3H)

Chalcaspis arizonensis Girault, 1915a: 280. Holotype, USNM, United States of America-Arizona, not examined.

Aenasius arizonensis (Girault); Noyes and Woolley, 1994: 1330.

Aenasius bambawalei Hayat, 2009: 25. Holotype ♀, IARI, India-Maharashtra. Synonymy with *arizonensis* by Fallahzadeh, Japoshvili, Abdmaleki, Saghaei, 2014: 516, not examined.

Specimens examined. 1♀ [on slide], **China**, Hainan, Sansha City, Yongxing Island, Xianyong ZHOU, 24-VII-2017, Malaise trapping; 3♂ [1♀ on slide, 2♀ in alcohol], same above, 09-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, sweeping.

Host. *Phenacoccus solenopsis*, *Pseudococcus longispinus* (Hemiptera: Pseudococcidae); *Prochiloneurus stenopterus* (Hymenoptera: Encyrtidae).

Distribution. China (Hainan, Fujian); Turkey; Pakistan; India; United States of America.

7. *Adelencyrtus bifasciatus* (Ishii, 1923) (Fig. 3I)

Anabrolepis bifasciata Ishii, 1923: 106. Lectotype ♀, (designated by Japoshvili, 2016), NIES, Japan, not examined.

Adelencyrtus bifasciatus (Ishii); Compere and Annecke, 1961: 57.

Specimens examined. **China**, Hainan, Sansha City, Yongxing Island, 8♀ [4♀ on slides, 4♀ in alcohol], 05–11-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, Malaise trapping; 4♀, 11-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, Light trapping; 4♀, 11-VII-2017, Xianyong ZHOU, Malaise trapping; 3♀, 07-I-2018, Xianyong ZHOU, Malaise trapping.

Host. *Ceroplastes japonicus*, *Ceroplastes rubens* (Hemiptera: Coccidae); *Aonidiella aurantii*, *Aonidiella orientalis*, *Aspidiotus glomeratus*, *Hemiberlesia lataniae*, *Lepidosaphes* sp., *Lindingaspis setiger*, *Melanaspis* sp., *Melanaspis glomerata*, *Pinnaspis* sp., *Pseudaonidia* sp., *Pseudaonidia duplex*, *Pseudaonidia trilobitiformis* (Hemiptera: Diaspididae).

Distribution. China (Hainan, Sichuan, Anhui, Jiangsu, Shanghai, Hunan, Fujian, Zhejiang, Taiwan); Japan; India; Bangladesh; Hawaii; United States of America.

8. *Arrhenophagus albitibiae* Girault, 1915 (Fig. 3J)

Arrhenophagus albitibiae Girault, 1915b : 241. Holotype ♀, USNM, Sri Lanka, not examined.

Arrhenophagus albipes Girault, 1915b : 242. Holotype ♀, USNM, Peoples' Republic of China Hong Kong, not examined. Synonymy by Annecke & Prinsloo, 1974: 38.

Specimen examined. ♀ [on slide], **China**, Hainan, Sansha City, Yongxing Island, 05–11-IX-2017, Bo CAI, Chengli WEN & Yingu WANG, Malaise trapping.

Host. *Aulacaspis yabunikkei*, *Canceraspis brasiliensis*, *Chionaspis eugeniae*, *Fiorinia pinicola*, *Fiorinia sapsosmae*, *Fiorinia vaccinia*, *Pseudaulacaspis cockerelli*, *Phenacaspis cockerelli*, *Phenacaspis eugeniae*, *Phenacaspis pudica*, *Pinnaspis aspidistrae*, *Pseudaulacaspis pentagona* (Hemiptera: Diaspididae).

Distribution. China (Hainan, Henan, Hong Kong); Russia; Japan; Sri Lanka; Western Samoa; Hawaii; United States of America; Caribbean (including West Indies).

9. *Blepyrus insularis* (Cameron, 1886) (Fig. 3K)

Encyrtus? insularis Cameron in Blackburn & Cameron, 1886: 243. Holotype ♀, Hawaii, BMNH, not examined (missing).

Blepyrus insularis (Cameron) Timberlake, 1922: 167.

Clausenia saissetiae Yasumatsu & Yoshimura, 1945: 31. Holotype ♀, Marianna Islands, KYUN, not examined. Synonymy with *Blepyrus insularis* by Kerrich, 1967.

Specimens examined. 5♀ [2♀ on slides, 3♀ in alcohol], **China**, Hainan, Sansha City, Yongxing Island, 01-VII-2017, Xianyong ZHOU, Malaise trapping.

Host. *Curinus coeruleus* (Coleoptera: Coccinellidae); *Pulvinaria maxima*, *Saissetia* sp., *Saissetia nigra* (Hemiptera: Coccidae); *Ceroputo yuccae*, *Coccidohystrix insolita*, *Ferrisia* sp., *Ferrisia virgata*, *Ferrisiana virgata*, *Maconellicoccus hirsutus*, *Phenacoccus herreni*, *Phenacoccus madeirensis*, *Phenacoccus mangiferae*, *Phenacoccus manihoti*, *Phenacoccus solenopsis*, *Planococcus citri*, *Planococcus lilacinus*, *Planococcus pacificus*, *Pseudococcus yuccae*, *Puto yuccae* (Hemiptera: Pseudococcidae); *Prodenia litura* (Lepidoptera: Noctuidae).

Distribution. China (Hainan); Israel; Cape Verde Islands; Gambia; Ghana; Guinea-Bissau; Togo; Egypt; Sudan; Nigeria; Congo; India; Sri Lanka, Bangladesh; Thailand; Philippines; Malaysia; Micronesia; Democratic Republic of Congo (Zaire); South Africa; Madagascar; Papua New Guinea; Australia; Hawaii; United States of America; Mexico; Cuba; Bahamas; Costa Rica; Colombia; Trinidad & Tobago; Guyana; West Africa.

10. *Ooencyrtus papilionis* Ashmead, 1905 (Fig. 3L)

Ooencyrtus papilionis Ashmead 1905: 4. Lectotype (designated by Huang and Noyes 1994: 79), ♀, the Philippines (USNM, not examined).

Ooencyrtus leucocerus Mercet 1922: 150. Lectotype (designated by Noyes 1981: 179), ♀, Indonesia (IEE, not examined). Synonymy with *papilionis* by Huang and Noyes 1994: 79.

Ooencyrtus malayensis Ferrière 1931: 282. Lectotype (designated by Huang and Noyes 1994: 79), ♀, Malaysia (BMNH, not examined). Synonymy with *papilionis* by Huang and Noyes 1994: 79.

Ooencyrtus cochereaui Prinsloo and Annecke 1978: 41. Holotype, ♀, New Caledonia (ORSTOM, not examined). Synonymy with *papilionis* by Huang and Noyes 1994: 79.

Ooencyrtus papilionis Ashmead: Liao *et al.* 1987: 173, Trjapitzin 1989: 201, Huang and Noyes 1994: 79.

Specimens examined. 3♀ [2♀ on slides, ♀ in alcohol], **China**, Hainan, Sansha City, Yongxing Island, 2022, Chao TANG & Bo LIU, rearing.

Host. *Riptortus* sp. (Hemiptera: Alydidae); *Amblypelta cocophaga*, *Amblypelta theobromae*, *Anasa tristis*, *Cletus* sp., *Dasynus manihotis*, *Dasynus piperis*, *Homoeocerus lucidus*, *Homoeocerus marginellus*, *Leptocorisa* sp., *Leptocorisa acuta*, *Physomerus* sp., *Physomerus grossipes* (Hemiptera: Coreidae); *Pyrilla* sp., *Pyrilla perpusilla* (Hemiptera: Lophopidae); *Phaenacantha saccharicida* (Hemiptera: Lygaeidae); *Axiagastus cambelli*,

Chrysocoris javanus, *Nezara* sp., *Nezara viridula*, *Philia* sp., *Plautia* sp., *Plautia fimbriata*, *Tessarotoma papillosa*, *Vitellus* sp. (Hemiptera: Pentatomidae); *Agonoxena argaula* (Lepidoptera: Agonoxenidae); *Danaus chrysippus*, *Tirumala limniace* (Lepidoptera: Danaidae); *Bibasis jaina*, *Erionota thrax*, *Hasora* sp. (Lepidoptera: Hesperidae); *Deudorix isocrates* (Lepidoptera: Lycaenidae); *Aroa cometaris* (Lepidoptera: Lymantriidae); *Othreis* sp., *Othreis fullonia* (Lepidoptera: Noctuidae); *Ariadne ariadne*, *Euploea core*, *Heliconius charitonius*, *Hypolimnas bolina*, *Junonia lemonias*, *Phalanta phalantha*, *Tanaecia julii* (Lepidoptera: Nymphalidae); *Papilio* sp., *Papilio aegaeus*, *Papilio agamemnon*, *Papilio demoleus*, *Papilio helenus*, *Papilio memnon*, *Papilio polytes*, *Papilio rumanzovia*, *Troides helena* (Lepidoptera: Papilionidae); *Chilo terenellus* (Lepidoptera: Pyralidae); *Cephonodes hylas* (Lepidoptera: Sphingidae); *Macrocentrus* sp. (Hymenoptera: Braconidae).

Distribution. China (Fujian, Guangdong, Hainan); Pakistan; India; Sri Lanka; Thailand; Malaysia; Philippines; Indonesia; Papua New Guinea; New Caledonia; Vanuatu; Solomon Islands; United States of America.

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