Zootaxa 3790 (3): 451–465
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3790.3.4
http://zoobank.org/urn:lsid:zoobank.org:pub:D0D76C12-B028-4AA4-ACE8-4F3932012277

Description of three new species of *Ooencyrtus* (Hymenoptera: Encyrtidae) from China

XU ZHANG[1], YAN-ZHOU ZHANG[1,2], YING WANG[1], FU-QIANG CHEN[1], FANG YU[1] & QING-SONG ZHOU[1]
[1]*Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing 100101, China*
[2]*Corresponding author. E-mail: zhangyz@ioz.ac.cn*

Abstract

Hymenoptera parasitoids of Megaloptera, particularly the family Corydalidae, are rarely found. *Ooencyrtus* Ashmead is a genus that attacks eggs of many orders of Insecta, including Megaloptera. Here, three species, *O. longicauda* **sp. n.**, *O. noyesi* **sp. n.** and *O. protohermeasis* **sp. n**. are described. Two of them, *O. longicauda* and *O. protohermesis* were reared from eggs of corydalids (Megaloptera: Corydalidae). The three new species and *O. yoshidai* Noyes & Hirose are included in the newly established *protohermesis* species-group of *Ooencyrtus* because of shared similar morphological characters and what is apparently a shared host family (unknown for *O. noyesi*).

Key words: taxonomy, Chalcidoidea, egg-parasitoids, Megaloptera, Corydalidae

Introduction

Due to their aquatic life style, Megaloptera are poorly known insects across much of their range (Daly *et al.* 1998) and their Hymenoptera parasitoids are rarely recorded. Several species of Trichogrammatidae are reported as egg parasitoids of Sialidae (Aurivillius 1897; Salt 1937, 1939; Thompson 1951; Peck 1963; Herting & Simmonds 1978; Pinto 1999; Yashiro *et al.* 2012). Noyes & Hirose (1997) described *O. yoshidai* based on material reared from eggs of *Protohermes grandis* (Thunberg) (Megaloptera: Corydalidae) in Japan, marking the first record of parasitoids from Corydalidae. In the family Encyrtidae, members of *Ooencyrtus* are well-known as egg parasitoids (Noyes & Hayat 1984; Huang & Noyes 1994; Zhang & Huang 2004; Zhang & Huang 2005), and currently comprise about 300 species worldwide (Noyes 2013). *Ooencyrtus* species have been cited as egg parasitoids of various insect groups, mainly Lepidoptera and Heteroptera, but also Coleoptera, Neuroptera, pupae of Syrphidae and as hyperparasitoids on Dryinidae (Noyes & Hayat 1984; Huang & Noyes 1994; Prinsloo 1987; Noyes 2013).

In our current investigation of Chinese Encyrtidae we discovered three species very close to *O. yoshidai* Noyes & Hirose. Among them, *O. longicauda* and *O. protohermesis* were reared from eggs of Corydalidae (Megaloptera). All four species apparently share a similar suite of morphological characters and, except for *O. noyesi* whose host is unknown, an unusual host, and we therefore propose to erect the *protohermesis* species-group for them. The COI and 28S D2 sequences of *O. protohermesis* are obtained and blasted in Genbank and BOLD. A brief biology of *O. protohermesis* is also given.

Material and methods

Specimens of *O. protohermesis* were reared from egg mass of *Protohermes xanthodes* Navás (Megaloptera: Corydalidae) (Fig. 41), found by FQ Chen on plant leaves near a river in Huai Rou, Beijing (40.408ºN, 116.617ºE). The egg mass was brought to the Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences (IZCAS), and kept at room temperature. About a week later, the parasitoids emerged and were killed and preserved in 95% ethanol. Material of *O. longicauda* were reared from an egg mass of

Accepted by G. Gibson: 11 Mar. 2014; published: 22 Apr. 2014

Molecular studies

The COI and 28S D2 sequences of *O. protohermesis* were successfully generated with high quality. However, PCR of the target gene of *O. noyesi* and *O. longicauda* failed, probably due to DNA degradation. No variation was found in the five *O. protohermesis* individuals sequenced for either 28S or COI. Blasting the 28S D2 sequences in Genbank only gave an 89.4% similarity matched with *Ooencyrtus johnsoni* (Howard) (Genbank NO. AY599321). Similarly, the COI sequences gave no close matches (over 95% similarity) on BOLD, but gave an 89.9% similarity with one undescribed *Ooencyrtus* species (Genbank Accession NO. KC149976) resulting from the work of Guerrieri *et al.* (unpublished) when blasted in Genbank.

Discussion

The three newly described *Ooencyrtus* species and *O. yoshidai* share the following suite of morphological characters: tridentate mandibles, sculpture of scutellum shallower than that of mesoscutum, clearly exserted ovipositor (except *O. protohermesis*), and mesopleuron posteriorly not expanded to propodeum in males (except possibly *O. protohermesis* for which males are unknown). Sexual dimorphism of the mesopleuron is unique within Encyrtidae. Because of this and because they apparently share Corydalidae as hosts, although this has yet to be shown for *O. noyesi*, we erect the *protohermesis* species-group within *Ooencyrtus* for the four species.

According to Noyes and Hirose (1997), the parasitism rate by *O. yoshidai* can exceed 50%, but we observed rates of only 6.6% for *O. longicauda* (9 of 136 eggs parasitized, Figs 41; larva, Fig. 40) and 6.8% for *O. protohermesis* (23 of 336 eggs parasitized, Fig. 43; larva, Fig. 42). Noyes and Hirose (1997) hypothesized that the parasitoids likely attacked the eggs of *P. grandis* at an early age and probably even during host egg deposition because the ovipositing female of *P. grandis* covers the egg mass with a protective secretion soon after they have been deposited. However, this requires more study. In addition, the parasitoid emergence is coincident with host eclosion, suggesting the immature stages of the parasitoid last as long as the egg stage of host.

Blasting the 28S D2 sequence in Genbank gave an 89.4% similarity match with *O. johnsoni*. This is due to a small number of nucleotide sequences of *Ooencyrtus* species in NCBI, which include only 48 nucleotide sequences of a few *Ooencyrtus* species. For a large group of economically important natural enemies such as *Ooencyrtus*, obtaining more molecular sequences, particularly barcodes, may prove invaluable for future identification.

Acknowledgements

We thank Associate Professor Xing-Yue Liu (China Agricultural University) for help to identification of *Protohermes* spp. This project was supported by the National Natural Science Foundation of China (NSFC grant no. 31272350), and by the Ministry of Science and Technology of China (MOST grant no. 2011FY120200, 2012FY111100). Special thanks are due to Dr. John S. Noyes (The Natural History Museum, London, England) for his help in preparing this paper.

References

Annecke, D.P. & Mynhardt, M.J. (1973) New and little known African Encyrtidae, with descriptions of two new genera (Hymenoptera: Chalcidoidea). *Journal of the Entomological Society of Southern Africa*, 36, 211–228.

Ashmead, W.H. (1900) On the genera of chalcid-flies belonging to the subfamily Encyrtinae. *Proceedings of the United States National Museum*, 22, 323–412.
http://dx.doi.org/10.5479/si.00963801.22-1202.323

Aurivillius, C. (1897) En ny svensk äggparasit. *Entomologisk Tidskrift*, 18, 249–255.

Campbell, B.C., Steffen-Campbell, J.D. & Werren, J.H. (1993) Phylogeny of the *Nasonia* species complex (Hymenoptera: Pteromalidae) inferred from an internal transcribed spacer (ITS2) and 28S rDNA sequences. *Insect Molecular Biology*, 2, 225–237.
http://dx.doi.org/10.1111/j.1365-2583.1994.tb00142.x

Chesters, D., Wang, Y., Yu, F., Bai, M., Zhang, T.X., Hu, H.Y., Zhu, C.D., Li, C.D. & Zhang, Y.Z. (2012) The integrative

taxonomic approach reveals host specific species in an encyrtid parasitoid species complex. *PloS ONE*, 7(5), e37655. http://dx.doi.org/10.1371/journal.pone.0037655.
Daly, H.V., Doyen, J.T. & Purcell, A.H. (1998) *Introduction to insect biology and diversity, 2nd ed.* Oxford University Press, USA, 696 pp.
Ferrière, C. (1947) A chalcidoid egg parasite of an Australian buprestid. *Bulletin of Entomological Research*, 37, 629–631. http://dx.doi.org/10.1017/s0007485300030121
Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek, R. (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular marine biology and biotechnology*, 3 (5), 294–299.
Gahan, A.B. & Fagan, M.M. (1923) The type species of the genera of Chalcidoidea or chalcid-flies. *Bulletin of the United States National Museum, Washington*, 124, 1–173. http://dx.doi.org/10.5479/si.03629236.124.i
Gibson, G.A.P. (1997) Chapter 2. Morphology and terminology. *In*: Gibson, G.A.P., Huber, J.T. & Woolley, J.B. (Eds.), *Annotated keys to the genera of Nearctic Chalcidoidea (Hymenoptera)*. NRC Research Press, Ottawa, Ontario, Canada, pp. 16–44.
Girault, A.A. (1915) Australian Hymenoptera Chalcidoidea - VII. The family Encyrtidae with descriptions of new genera and species. *Memoirs of the Queensland Museum*, 4, 1–184.
Hebert, P.D.N., Cywinska, A., Ball, S.L. & deWaard, J.R. (2003) Biological identifications through DNA barcodes. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, 270, 313–321. http://dx.doi.org/10.1098/rspb.2002.2218
Herting, B. & Simmonds, F.J. (1978) *A catalogue of parasites and predators of terrestrial arthropods. Section A. Host or Prey/ Enemy. Vol. V. Neuroptera, Diptera, Siphonaptera.* Commonwealth Agricultural Bureaux, Commonwealth Institute of Biological Control. Farnham Royal, England, 156 pp.
Howard, L.O. (1910) On some parasites reared or supposed to be reared from the eggs of the gypsy moth. *Technical Series, Bureau of Entomology, United States Department of Agriculture*, 19 (1), 1–12.
Huang, D.W. & Noyes, J.S. (1994) A revision of the Indo-Pacific species of *Ooencyrtus* (Hymenoptera: Encyrtidae), parasitoids of the immature stages of economically important insect species (mainly Hemiptera and Lepidoptera). *Bulletin of The Natural History Museum (Entomology Series)*, 63 (1), 1–136.
Noyes, J.S. (1982) Collecting and preserving chalcid wasps (Hymenoptera: Chalcidoidea). *Journal of Natural History*, 16, 315–334. http://dx.doi.org/10.1080/00222938200770261
Noyes, J.S. (1985) A review of the Neotropical species of *Ooencyrtus* Ashmead, 1900 (Hymenoptera: Encyrtidae). *Journal of natural history*, 19 (3), 533–554. http://dx.doi.org/10.1080/00222938500770331
Noyes, J.S. (2004) *Metaphycus* and related genera, parasitoids of scale insects (Coccoidea) and whiteflies (Aleyrodidae). Encyrtidae of Costa Rica (Hymenoptera: Chalcidoidea). *Memoirs of the American Entomological Institute*, 73 (2), 1–460.
Noyes, J.S. (2013) Universal Chalcidoidea Database. Available from: http://www.nhm.ac.uk/chalcidoids (accessed 1 October 2013)
Noyes, J.S. & Hayat, M. (1984) A review of the genera of Indo-Pacific Encyrtidae (Hymenoptera: Chalcidoidea). *Bulletin of the British Museum (Natural History) (Entomology)*, 48, 131–395.
Noyes, J.S. & Hirose, Y. (1997) A new species of *Ooencyrtus* (Hymenoptera: Encyrtidae) from Japan, parasitic in the eggs of *Protohermes grandis* (Megaloptera: Corydalidae). *Japanese Journal of Entomology*, 65 (1), 200–203.
Peck, O. (1963) A catalogue of the Nearctic Chalcidoidea (Insecta: Hymenoptera). *Canadian Entomologist (Supplement),* 30, 1–1092.
Perkins, R.C.L. (1906) Leaf-hoppers and their natural enemies (Pt. VIII. Encyrtidae, Eulophidae, Trichogrammatidae). *Bulletin of Hawaiian Sugar Planters' Association Experiment Station (Entomology Series),* 1 (8), 239–267.
Pinto, J.D. (1999) Systematics of the North American species of *Trichogramma* Westwood (Hymenoptera: Trichogrammatidae). *Memoirs of the Entomological Society of Washington*, 22, 1–287.
Prinsloo, G.L. (1987) A revision of the genus *Ooencyrtus* Ashmead (Hymenoptera: Encyrtidae) in sub-saharan Africa. *Entomology Memoir, Department of Agriculture and Water Supply, Republic of South Africa*, 67, 1–46.
Risbec, J. (1954) Chalcidoïdes et proctotrupoïdes de l'Afrique occidentale française (4e supplément). *Bulletin de l'Institut Français d'Afrique Noire (A)*, 16, 1035–1092.
Salt, G. (1937) The egg-parasite of *Sialis lutaria*: A study of the influence of the host upon a dimorphic parasite. *Parasitology*, 29, 539–553. http://dx.doi.org/10.1017/s0031182000025063
Salt, G. (1939) Further notes on *Trichogramma semblidis*. *Parasitology*, 30, 511–522. http://dx.doi.org/10.1017/s0031182000026056
Thompson, W.R. (1951) *A catalogue of the parasites and predators of insect pests. Section 1, Parasite host catalogue, Part 11, Neuroptera, Odonata, Orthoptera, Psocoptera, Siphonaptera, Thysanoptera.* Commonwealth Agricultural Bureaux, Commonwealth Institute of Biological Control, Ottawa, Ontario, Canada, 35 pp.
Timberlake, P.H. (1920) Descriptions of new genera and species of Hawaiian Encyrtidae (Hymenoptera). II. *Proceedings of the*

Hawaiian Entomological Society, 4, 409–437.
Yashiro, N., Hirose, Y., Honda, J.Y., Takeuchi, Y. & Yashiro, T. (2012) A new species of *Trichogramma* (Hymenoptera: Trichogrammatidae) parasitic on eggs of the alderfly *Sialis melania* (Neuroptera: Sialidae) from Japan, with comments on its phylogeny and male wing polymorphism. *Entomological Science*, 15, 189–196. http://dx.doi.org/10.1111/j.1479-8298.2011.00496.x
Zhang, Y.Z. & Huang, D.W. (2004) *A review and an illustrated key to genera of Encyrtidae (Hymenoptera: Chalcidoidea) from China*. Science press, Beijing, China, 166 pp.
Zhang, Y.Z., Li, W. & Huang, D.W. (2005) A taxonomic study of Chinese species of *Ooencyrtus* (Insecta: Hymenoptera: Encyrtidae). *Zoological Studies*, 44 (3), 347–360.
Zhang, Y.Z., Si, S.L., Zheng, J.T., Li, H.L., Yu, F., Zhu, C.D. & Vogler, A.P. (2011) DNA barcoding of endoparasitoid wasps in the genus *Anicetus* reveals high levels of host specificity (Hymenoptera: Encyrtidae). *Biological Control*, 58 (3), 182–191. http://dx.doi.org/10.1016/j.biocontrol.2011.05.006