



<http://dx.doi.org/10.11646/zootaxa.3793.4.2>

<http://zoobank.org/urn:lsid:zoobank.org:pub:C1A50B2E-BE36-41A7-B3CA-16E9AC9DA705>

## Revision of the Embolemidae of Japan (Hymenoptera: Chrysidoidea), with description of a new genus and two new species

MASSIMO OLMI<sup>1,4</sup>, TOSHIHARU MITA<sup>2</sup> & ADALGISA GUGLIELMINO<sup>3</sup>

<sup>1</sup>Tropical Entomology Research Center, Via De Gasperi 10, Viterbo, 01100 Italy. E-mail: [olmi@unitus.it](mailto:olmi@unitus.it)

<sup>2</sup>Laboratory of Entomology, Faculty of Agriculture, Tokyo University of Agriculture, 1737 Funako, Atsugi-shi, Kanagawa, Japan. E-mail: [tkp\\_ex@hotmail.com](mailto:tkp_ex@hotmail.com)

<sup>3</sup>Department of Agriculture, Forests, Nature and Energy, University of Tuscia, Viterbo, 01100 Italy. E-mail: [guglielm@unitus.it](mailto:guglielm@unitus.it)

<sup>4</sup>Corresponding author

### Abstract

Seven species of Embolemidae are recognized in Japan. They belong to two genera: *Embolemus* Westwood 1833 and *Trogloembolemus* Olmi, Mita et Guglielmino, **gen. nov.** (type species *T. fujiei* Olmi, Mita et Guglielmino, **sp. nov.**) *Embolemus honshuensis* Olmi, Mita et Guglielmino, **sp. nov.** (Japan, Honshu) and *Trogloembolemus fujiei* Olmi, Mita & Guglielmino, **sp. nov.** (Japan, Honshu) are described and figured. A key to the genera and species of Japan is presented. *Trogloembolemus fujiei* **sp. nov.**, collected in the soil at a depth of two metres and almost blind, is the first species of Embolemidae with troglobitic habitus.

**Key words:** *Trogloembolemus fujiei*, *Embolemus honshuensis*, Honshu, troglobiont, key, new species, new genus

### Introduction

Embolemidae (Hymenoptera: Chrysidoidea) are parasitoids of nymphs of planthoppers (Hemiptera: Auchenorrhyncha) (Olmi 1996; Varrone & Olmi 2012; Guglielmino & Bückle 2013; Olmi *et al.* 2014b). Two genera of extant Embolemidae are known: *Embolemus* Westwood, 1833, parasitoids of nymphs of Cixiidae living in the soil and feeding on roots (Varrone & Olmi 2012) and *Ampulicomorpha* Ashmead, 1893, parasitoids of nymphs of Achilidae living in rotten logs and feeding on hyphal sheets of shelf fungi (Bridwell 1958; Wharton 1989; Guglielmino & Bückle 2013). In addition, there are three fossil genera: *Baissobius* Rasnitsyn, 1975 and *Embolemopsis* Olmi *et al.*, 2010, known from compression fossils of the Russian Far East and Mongolia (Rasnitsyn 1975, 1996; Olmi *et al.* 2010), and *Cretembolemus* Olmi *et al.*, 2014b, from the Orapa kimberlitic deposits (Botswana).

The two above extant genera have very different females (micropterous in *Embolemus*, macropterous in *Ampulicomorpha*). On the contrary, the macropterous males are very similar, so that van Achterberg & van Kats (2000) synonymized the two genera. The question if they are synonyms or not is actually still not solved, mainly because the two genera are apparently well separated biologically (Olmi *et al.* 2014b). Studies on the DNA of both genera are currently being conducted by the authors.

Four species of the genus *Embolemus* have been recorded from Japan: *E. walkeri* Richards, 1951 (Yasumatsu 1954, 1960; Hirashima & Yamagishi 1975), *E. ruddii* Westwood, 1833 (Olmi 1996), *E. hachijoensis* Hirashima & Yamagishi, 1975, and *E. pecki* Olmi, 1997.

One species of the genus *Ampulicomorpha*, *A. hachijoensis* (Hirashima & Yamagishi, 1975), was recorded by Olmi (1996). However, this species has now been transferred correctly to the genus *Embolemus* (van Achterberg & van Kats 2000).

In 2012 and 2013, the authors had the opportunity to study many specimens collected in Japan and to revise the entire fauna of Embolemidae of that country. The results of this study are reported below.

2. Dorsal anterior surface of propodeum shiny, smooth, weakly granulated, not rugose (Fig. 2B) ..... *Embolemus honshuensis* Olmi, Mita et Guglielmino, **sp. nov.**
- Dorsal anterior surface of propodeum dull, rugose (Figs 3B, 4B) ..... 3
3. Dorsal surface of propodeum with median depression situated at border between anterior and posterior surface (Fig. 4C) ....  
..... *Embolemus walkeri* Richards
- Dorsal surface of propodeum without median depression situated at border between anterior and posterior surface (Fig. 3C) ..  
..... *Embolemus krombeini* Olmi

#### Males (unknown in the species not present in the key to the males)

1. Proximal membranous process of paramere without papillae or sensorial filaments, at most with short hairs (Figs 1A, B) ....  
..... 2
- Proximal membranous process of paramere with papillae (Fig. 1C) or sensorial filaments (Fig. 1D) ..... 3
2. Dorsal membranous process of paramere with mosaic drawing (Fig. 1A) .. *Embolemus hachijoensis* Hirashima et Yamagishi
- Dorsal membranous process of paramere without mosaic drawing (Fig. 1B) ..... *Embolemus krombeini* Olmi
3. Proximal membranous process of paramere with papillae (Fig. 1C) ..... *Embolemus pecki* Olmi
- Proximal membranous process of paramere with sensorial filaments, without papillae (Fig. 1D) .....  
..... *Embolemus sensitivus* Xu, Olmi et Guglielmino

#### Conclusions

The Embolemidae of Japan are insufficiently known. Six of the seven species recorded in this paper are known on the basis of only one sex, so that it is probable that two of the above females of *Embolemus* (*E. honshuensis* and *E. walkeri*) are the opposite sexes of two of the three species known only on the basis of male specimens (*E. pecki*, *E. sensitivus*, and *E. hachijoensis*). Because of the big difference between females and males, only rearing or DNA analysis should solve the problem of discovering the opposite sexes. However, the biology of the Japanese embolemids is completely unknown. As in other countries, we can suppose that the hosts of *Embolemus* are nymphs of Cixiidae living in the soil and feeding on roots. However, no researchers have tried to discover hosts and opposite sexes in Japan yet. For *Trogloembolemus fujiei*, the hosts are probably nymphs of Cixiidae living in caves.

The most common European species of *Embolemus*, *E. ruddii*, present in almost all Europe, was recorded from Japan by Olmi (1996). However, the results of this study suggest that *E. ruddii* is absent in Japan. *E. ruddii* is present in almost all Europe (Olmi 1996). The male genitalia of *E. ruddii* (Fig. 1E) are very different from those of *E. pecki*, *E. sensitivus* and *E. hachijoensis*, because of the different shape of the proximal membranous process of the paramere.

#### Acknowledgements

Many thanks to Dr. Satoshi Kamitani for sending on loan the embolemids deposited in the Entomological Laboratory, Kyushu University, Japan. We are also grateful to Mr. Fujie (Laboratory of Insect Biodiversity and Ecosystem Science, Graduate School of Agricultural Science, Kobe University, Kobe, Japan) for the gift of the only known specimen of *Trogloembolemus fujiei*. Many thanks to Dr. Alessandro Marletta (Department of Biological, Geological and Environmental Sciences, Animal Biology section, University of Catania, Italy) and Mr. Massimo Vollarò (DAFNE Department, University of Tuscia, Viterbo, Italy) for taking respectively the multifocal and unifocal photos presented in this paper. The authors are grateful to Prof. Denis J. Brothers (University of KwaZulu-Natal, Pietermaritzburg, South Africa) and the subject editor Dr Arkadij S. Lelej for their valuable comments and suggestions.

#### References

- Achterberg, C. van & Kats, R.J.M. van (2000) Revision of the Palaearctic Embolemidae (Hymenoptera). *Zoologische Mededelingen*, 74, 251–269.
- Agassiz, L. (1846) *Nomenclatoris Zoologici Index Universalis*. Jent et Gassmann, Soloduri, 1135 pp.

- Ashmead, W.H. (1893) Monograph of the North American Proctotrypidae. *Bulletin of the United States National Museum*, 45, 1–472.  
<http://dx.doi.org/10.5479/si.03629236.45.1>
- Belokobylskij, S.A. (1990) Embolemidae is a new to the Soviet Far East fauna family of bethylids wasp (Hymenoptera: Bethyloidea). In: Lelej, A.S. (Ed.), *News of the insect systematic of Soviet Far East*. Far Eastern Branch of the USSR Academy of Sciences, Vladivostok, pp. 64–70. [in Russian]
- Belokobylskij, A.S. (1995) [Family Embolemidae – Embolemids]. In: Lehr, P.A. (Ed.), *Key to insects of the Russian Far East. Vol. 4. pt. 1*. Sankt Petersburg: Nauka, pp. 176–179. [in Russian]
- Belokobylskij, S.A. & Lelej, A.S. (2012) [Family Embolemidae – Embolemids]. In: Lelej, A.S. (Ed.), *Annotated catalogue of the insects of Russian Far East. Vol. I. Hymenoptera*. Dalnauka, Vladivostok, pp. 398. [in Russian]
- Berland, L. (1928) *Hyménoptères Vespiformes. II. Faune de France. Vol. 19*. Librairie de la Faculté des Sciences, Paris, 208 pp.
- Bouček, Z. (1957) Embolemidae. In: Kratochvíl, J. (Ed.), *Klíč zvířeny ČSR, 2*. Nakladatelství ČSAV, Praha, pp. 333.
- Bridwell, J.C. (1958) Biological notes on *Ampulicomorpha confusa* Ashmead and its fulgoroid host (Hymenoptera: Dryinidae and Homoptera: Achilidae). *Proceedings of the Entomological Society of Washington*, 60, 23–26.
- Brues, C.T. (1933) The parasitic Hymenoptera of the Baltic Amber. Part I. In: André, K. (Ed.), *Bernstein-forschungen (Amber Studies)*, 3. De Gruyter, Berlin und Leipzig, pp. 4–178.
- Bürgis, H. (1987) Die Wespe *Embolemus antennalisein* seltener Fund aus Hessen. *Natur und Museum*, 117(1), 12–19.
- De Romand, B.E. (1846) Notice sur un insecte nouveau. *Annales de la Société Entomologique de France (Bulletin)*, Deuxième Série, 4, XXXII.
- De Santis, L. & Vidal Sarmiento, J.A. (1977) Nuevos Embolemidos de la Republica Argentina. *Provincia de Buenos Aires, Comisión de Investigaciones Científicas (CIC), Informe 18*, La Plata, 1–12.
- Förster, A. (1856) *Hymenopterologischer Studien, 2. Chalcidiae und Proctotrupii*. Ernst ter Meer, Aachen, 152 pp.
- Guerrero, E.R. (1999) Embolemidae, nueva familia de Aculeata para las islas Canarias (Hymenoptera, Chrysidoidea). *Vieraeta*, 27, 301.
- Guglielmino, A. & Bückle, C. (2013) Description of the mature larva of *Ampulicomorpha schajovskoyi* De Santis & Vidal Sarmiento (Hymenoptera: Chrysidoidea: Embolemidae). *Zootaxa*, 3637, 385–393.  
<http://dx.doi.org/10.11646/zootaxa.3637.3.10>
- Hilpert, H. (1989) Zum Vorkommen einiger Dryiniden in Südwestdeutschland sowie Bemerkungen zu *Embolemus ruddii* Westwood, 1833 (Hymenoptera, Bethyloidea, Dryinidae, Embolemidae). *Spixiana*, 11 (3), 263–269.
- Hirashima, Y. & Yamagishi, K. (1975) Embolemidae of Japan, with description of a new species of *Embolemus* from Hachijo Island. *Esakia*, 9, 25–30.
- International Commission on Zoological Nomenclature (ICZN) (1999) *International Code of Zoological Nomenclature. Fourth Edition*. ITZN, London, i–xxx + 1–306.
- Kieffer, J.-J. (1914) *Bethylidae*. Das Tierreich, 41. R. Friedlander und Sohn, Berlin, 595 pp.
- Kieffer, J.-J. & Marshall, T.A. (1906) Proctotrypidae. In: André, E. (Ed.), *Species des Hyménoptères d'Europe et d'Algérie. Vol. 9*. Hermann, Paris, pp. 289–552.
- Krombein, K.V. (1979) Embolemidae. In: Krombein, K.V., Hurd, P.D., Smith, D.R. & Burks, B.D. (Eds.), *Catalog of Hymenoptera in America North of Mexico. Vol. 2*. Smithsonian Institution Press, Washington, D.C., pp. 1251.
- Marshall, T.A. (1873) *A catalogue of British Hymenoptera; Oxyura*. A. Napier, London, 27 pp.
- Muesebeck, C.F.W. & Walkley, L.M. (1951) Embolemidae. In: Muesebeck, C.F.W., Krombein, K.V. & Townes, H.K. (Eds.), *Hymenoptera of America North of Mexico. Synoptic catalogue. Agriculture Monograph 2*, U.S. Department of Agriculture, Washington, D.C., pp. 1043.
- Nees von Esenbeck, C.G. (1834) *Hymenopterorum Ichneumonibus affinium monographiae, 2*. J.G. Cottae, Stuttgart and Thübingen, 448 pp.
- Olmi, M. (1994) *The Dryinidae and Embolemidae (Hymenoptera: Chrysidoidea) of Fennoscandia and Denmark*. Fauna Entomologica Scandinavica, 30. E.J. Brill, Leiden, The Netherlands, 100 pp.
- Olmi, M. (1996 [“1995”]) A revision of the world Embolemidae (Hymenoptera Chrysidoidea). *Frustula entomologica, N.S.*, 17, 85–146.
- Olmi, M. (1997) A contribution to the knowledge of the Embolemidae and Dryinidae (Hymenoptera Chrysidoidea). *Bollettino di Zoologia Agraria e Bachicoltura*, Series II, 29, 125–150.
- Olmi, M. (1998) New Embolemidae and Dryinidae (Hymenoptera Chrysidoidea). *Frustula Entomologica, N.S.*, 20, 30–118.
- Olmi, M. (1999) *Hymenoptera Dryinidae – Embolemidae*. Fauna d’Italia, 37. Edizioni Calderini, Bologna, Italy, 425 pp.
- Olmi, M., Belokobylskij, S.A. & Guglielmino, A. (2014a) Revision of the family Embolemidae of Russia and Ukraine (Hymenoptera: Chrysidoidea), with description of a new species. *Annales Zoologici (Warszawa)*, 64, 97–108.  
<http://dx.doi.org/10.3161/000345414x680672>
- Olmi, M., Rasnitsyn, A.P. & Guglielmino, A. (2010) Revision of rock fossils of Dryinidae and Embolemidae (Hymenoptera: Chrysidoidea). *Zootaxa*, 2499, 21–38.
- Olmi, M., Rasnitsyn, A.P., Brothers, D.J. & Guglielmino, A. (2014b) The first fossil Embolemidae (Hymenoptera: Chrysidoidea) from Burmese amber (Myanmar) and Orapa Kimberlitic deposits (Botswana) and their phylogenetic significance. *Journal of Systematic Palaeontology*, 1–13. [on-line edition]  
<http://dx.doi.org/10.1080/14772019.2013.829533>

- Perkins, J.F. (1976) *Hymenoptera Bethyloidea*. Handbooks for the Identification of British Insects, VI (3a). Royal Entomological Society of London, London, 38 pp.
- Rasnitsyn, A. P. (1975) [*Hymenoptera Apocrita of Mesozoic*]. Transactions of Paleontological Institute, Academy of Sciences of U.S.S.R., 147. Nauka, Moscow, 134 pp. [in Russian]
- Rasnitsyn, A.P. (1996) New early cretaceous Embolemidae (Vespida = Hymenoptera: Chrysidoidea). *Memoirs of the Entomological Society of Washington*, 17, 183–187.
- Richards, O.W. (1936) Further notes on the nomenclature of British Aculeate Hymenoptera. *Proceedings of the Royal Entomological Society of London (B)*, 5 (Pt. 9), 169–173.
- Richards, O.W. (1937) The generic names of British Hymenoptera Aculeata. In: Committee on generic nomenclature of the Royal Entomological Society of London (Ed.), *The Generic Names of British Insects*. Royal Entomological Society, London, pp. 81–149.
- Richards, O.W. (1939) The British Bethylidae (s.l.) (Hymenoptera). *Transactions of the Royal Entomological Society of London*, 89 (8), 185–344.
- Richards, O.W. (1951) New species of Bethyloidea (Hymenoptera). *The Annals and Magazine of Natural History, Ser. 12*, 4, 813–820.
- Varrone, R. & Olmi, M. (2012 ["2010–2011"]) First record of host of *Embolemus ruddii* Westwood (Hymenoptera Embolemidae). *Frustula entomologica, N. S.*, 33, 91–95.
- Walker, F. (1837) On the Dryinidae. *The Entomological Magazine*, 4, 411–435.
- Westwood, J.O. (1833) Descriptions of several new British forms amongst the parasitic hymenopterous insects. *Magazine of Natural History and Journal of Zoology, Botany, Mineralogy, Geology and Meteorology*, 2, 443–445.
- Wharton, R.A. (1989) Final instar larva of the Embolemid wasp, *Ampulicomorpha confusa* (Hymenoptera). *Proceedings of the Entomological Society of Washington*, 91 (4), 509–512.
- Xu, Z., He, J. & Olmi, M. (2001) The Embolemidae (Hymenoptera: Chrysidoidea) from China. *Entomologia Sinica*, 8, 213–217.
- Xu, Z., Olmi, M. & Guglielmino, A. (2012a) A new species of Embolemidae (Hymenoptera: Chrysidoidea) from China. *Florida Entomologist*, 95 (4), 1117–1122.  
<http://dx.doi.org/10.1653/024.095.0441>
- Xu, Z., Olmi, M. & Guglielmino, A. (2012b) A new species of *Ampulicomorpha* (Hymenoptera: Embolemidae) from China. *Florida Entomologist*, 95 (4), 1187–1191.  
<http://dx.doi.org/10.1653/024.095.0450>
- Yamane, S., Ikudome, S. & Terayama, M. (1999) *Identification guide to the Aculeata of the Nausei Islands, Japan*. Hokkaido University Press, Sapporo, Japan, 725 pp.
- Yasumatsu, K. (1954) Note on *Embolemus walkeri* Richards. *Gensei*, 3 (1/2), 1–2. [in Japanese]
- Yasumatsu, K. (1960) Notes on two species of Japanese Bethyloidea (Hymenoptera). *Esakia*, 1, 21–25.