Two New Species of Egg Parasitoids (Hymenoptera: Encyrtidae) of Wood-Boring Beetle Pests from China

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Oobius agrili sp.n. and *Avetianella xystrocerae* sp.n. (Hymenoptera: Encyrtidae) are described from China. Morphological characters of the new species are illustrated. *O. agrili* is an egg parasitoid of the emerald ash borer *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) and *A. xystrocerae* is an egg parasitoid of the wood borer *Xystrocera globosa* (Olivier) (Coleoptera: Cerambycidae). The two new species are potential biocontrol agents of economically important pest insects. The type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing (IZCAS).
KEY WORDS: Hymenoptera; Encyrtidae; *Oobius agrili* sp.n.; *Avetianella xystrocerae* sp.n.; egg parasitoid; *Agrilus planipennis*; *Xystrocera globosa*; China.

INTRODUCTION

Species of wood-boring beetles in Cerambicidae and Buprestidae can be serious pests of trees and other woody plants. For example, the emerald ash borer (EAB), *Agrilus planipennis* Fairmaire *(= A. marcopoli* Obenberger) (Coleoptera: Buprestidae), native to northeastern Asia, attacks native ash trees (*Fraxinus* spp.) growing in the open or along the forest edge (3,29). In China, this beetle does not pose a serious threat to natural stands or plantations (28). However, EAB was accidentally introduced into southeastern Michigan (USA) 10–15 years ago in solid-wood packing materials and became established by attacking the abundant ash native to the region (9). Without natural enemies and innate tree resistance, EAB has killed 8 million to 10 million ash trees in southeastern Michigan. This aggressive buprestid is now distributed throughout most of Michigan's Lower Peninsula, parts of Indiana, Ohio, Maryland, Virginia, and nearby southern Ontario of Canada due to the natural spread of EAB, and the transport of infested nursery stock and firewood. Efforts are under way in both the United States and Canada to contain and control EAB.

One long-term strategy for managing wood-boring beetles is biological control, or the introduction and establishment of the pest's pathogens, parasites, and predators. Among the most effective biocontrol agents are egg parasitoids of the family Encyrtidae (Hymenoptera: Chalcidoidea). Several of these species are in the subtribe Oobina (25,26)

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and belong to genera *Oobius* Trjapitzin (22) and *Avetianella* Trjapitzin (23). In this paper, we provide the taxonomic description and names of two new encyrtid species, *Oobius agrili* sp.n. and *Avetianella xystrocerae* sp.n., egg parasitoids of *A. planipennis* and *Xystrocera globosa* (Olivier) (Coleoptera: Cerambycidae), respectively. Prior to this report, egg parasitoids were unknown for these wood-boring beetles. Their discovery may be critical to the development of successful biological control programs for these invasive forest pests.

Slides were prepared as described by Noyes (12). The photomicrographs were obtained using a digital camera (ProgRes C10, Jenoptic Laser Systeme GmbH). The digital images were enhanced and compiled using Adobe Photoshop^{TM}. The description below is based on dried specimens mounted on cards. The terminology and morphological interpretations follow those of Noyes and Hayat (16) and Noyes (15). The type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing (IZCAS).

OOBIUS AGRILI ZHANG AND HUANG sp.n.

Description

Female (Holotype) Body length 0.95 mm (including ovipositor).

Color: Body generally dark brown with greenish sheen; antenna dark brown except F6 yellow or brownish yellow; forewing hyaline; fore coxae dark brown, sometimes apically yellow; fore tibiae and femora generally dark brown; fore tarsi yellow; mid coxae dark brown; mid tibiae with basal half or so yellow and the rest dark brown; mid femora subbasally dark brown, with extreme base and apical half or so yellow; mid tarsi yellow; hind legs generally dark brown except extreme base and apical 1/3 or so of tibia, and tarsi yellow; exserted part of ovipositor sheath dark brown.

Head: Frontovertex about half head width, with distinct irregular reticulate sculpture or ridges (Fig. 1); eyes clothed in translucent setae which are shorter than diameter of an eye facet; ocelli forming an angle $\sim$120°; posterior ocelli separated from inner eye margin by less than half their diameter, separated from occiptal margin by about their own diameter; face with 'H'-shaped membranous lines; antenna (Fig. 2) with scape subcylindrical, 4 times as long as maximum width; pedicel 2.5 times as long as wide; F1–F5 small and transverse, clearly smaller than F6, which is 1.1 times as long as broad; clava 3 times as long as maximum width, apically strongly obliquely truncate, the truncate part nearly half the clava length; linear sensilla on F6 and on each claval segment with the following distribution: 1, 3, 4, 3; malar space 2/5 eye length; mandible with 3 teeth (Fig. 3); maxillary palpi 3-segmented, labial palpi one-segmented (Fig. 4).

Thorax: Thorax in lateral view slightly depressed; in dorsal view, mesoscutum with reticulate sculpture, scattered with small piliferous punctures; axillae clearly separated from each other; scutellum covered with fine elongated or striated reticulate sculpture which give a velvety appearance; forewing (Fig. 5) about twice as long as maximum width; marginal vein 1.5 times as long as broad; postmarginal vein about 1.2 times as long as marginal vein; stigmal vein about as long as marginal vein; legs with all tarsi 4-segmented; mid tibia spur slightly shorter than first tarsal segment (Fig. 6).

Gaster: About as long as thorax (excluding ovipositor); cercal plates located in middle of gaster; hypopygium with apex reaching apex of gaster; ovipositor (Fig. 7) about 1.3 times as long as mid tibia and 2.2 times as long as gonostyli; ovipositor sheath distinctly exserted, the exserted part about 1/3 gaster length.

Male Similar to female except genitalia and the following: antenna (Fig. 8) with pedicel about or slightly shorter than first funicular segment; all funicular segments longer than broad and clothed in relatively long hairs; clava solid, with apex slightly obliquely truncated; forewing (Fig. 9) with marginal vein punctiform; postmarginal vein slightly shorter than stigmal vein.

Variation: Very little variation in material available.

Host: *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae).

Distribution: China.

Holotype: female, China: Jilin: Changchun, 15–23.VII.2004, ex. egg of *A. planipennis*, coll. Li-Wen Song (IZCAS).

Paratypes: 7 females, 3 males, same data as in holotype; 2 females, China: Beijing: Beianhe, 20.VI.2003, coll. Yan-Zhou Zhang (IZCAS).

Remarks

Most genera of the subtribe Oobiina have membranous lines on the face except the monotypic genus *Orianos* Noyes (13,20). The subtribe Oobiina is also characterized by a similar wing venation, an interrupted linea calva, and a similar sculpture of the head and thoracic dorsum (20). Included genera are *Oobius* Trjapitzin, *Avetianella* Trjapitzin, *Szelenyiola* Trjapitzin, *Chrysomelechthrus* Trjapitzin, and *Orianos* Noyes (7,13,16,22–27). All species of the subtribe have a similar biology in common in that they are egg parasitoids of Cerambycidae, Buprestidae and Chrysomelidae (Coleoptera) (14,16,18,20,25), except that *Oobius striatus* Annecke is an egg parasitoid of *Hyperechia marshalli* Austen (Diptera: Asilidae) (1).

Oobius Trjapitzin (22) is a widely distributed genus with currently eight described species (see Table 1). Species of *Oobius* can be confused with that of *Avetianella* Trjapitzin (23) by similar membranous lines on the face and similar sculpture of thoracic dorsum. However, *Oobius* has 3-segmented maxillary palpi and one-segmented labial palpi; *Avetianella* has 4-segmented maxillary palpi and 3-segmented labial palpi (26).

TABLE 1. Host index of *Oobius* species

Host	Parasitoid (*Oobius* sp.)
Unknown	*Oobius anomalus* Guerrieri, Garonna & Viggiani (8)
COLEOPTERA	
Buprestidae	
Agrilus cuprescens Ménétriés	*Oobius zahaikevitshi* Trjapitzin (27)
Agrilus gloriosulus (Pringuey)	*Oobius abditus* Annecke (1, 19)
	Oobius funestus Annecke (1, 19)
Agrilus lopatini Alex.	*Oobius zahaikevitshi* Trjapitzin (27)
Agrilus planipennis Fairmaire	*Oobius agrili* sp.n. Zhang and Huang
Agrilus roscidus (Kiesenwetter)	*Oobius zahaikevitshi* Trjapitzin (27)
Agrilus shamyl (Obenberger)	*Oobius zahaikevitshi* Trjapitzin (27)
Agrilus viridis (Linnaeus)	*Oobius zahaikevitshi* Trjapitzin (22, 27)
Sphenoptera laticeps Jakovlev	*Oobius taybekovi* Myartseva & Trjapitzin (11, 27)
Cerambycidae	
Cerambyx cerdo Linnaeus	*Oobius rudnevi* (Novicky) (22, 27)
DIPTERA	
Asilidae	
Hyperechia marshalli Austen, 1902	*Oobius striatus* Annecke (1)

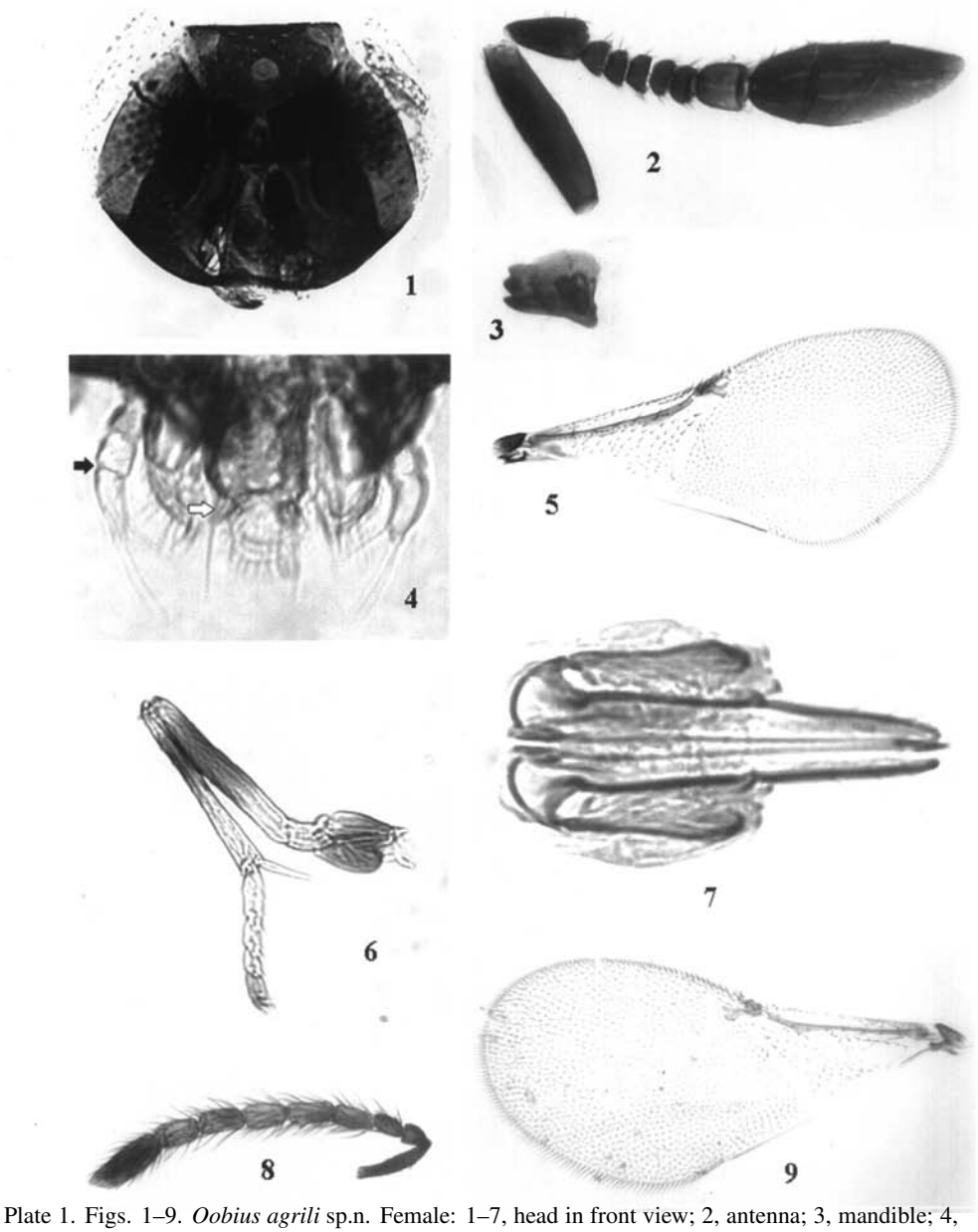

Plate 1. Figs. 1–9. *Oobius agrili* sp.n. Female: 1–7, head in front view; 2, antenna; 3, mandible; 4, maxillary palpus (marked by a black arrow) and labial palpus (marked by a white arrow); 5, forewing; 6, mid leg; 7, ovipositor; Male: 8–9: 8, antenna; 9, forewing.

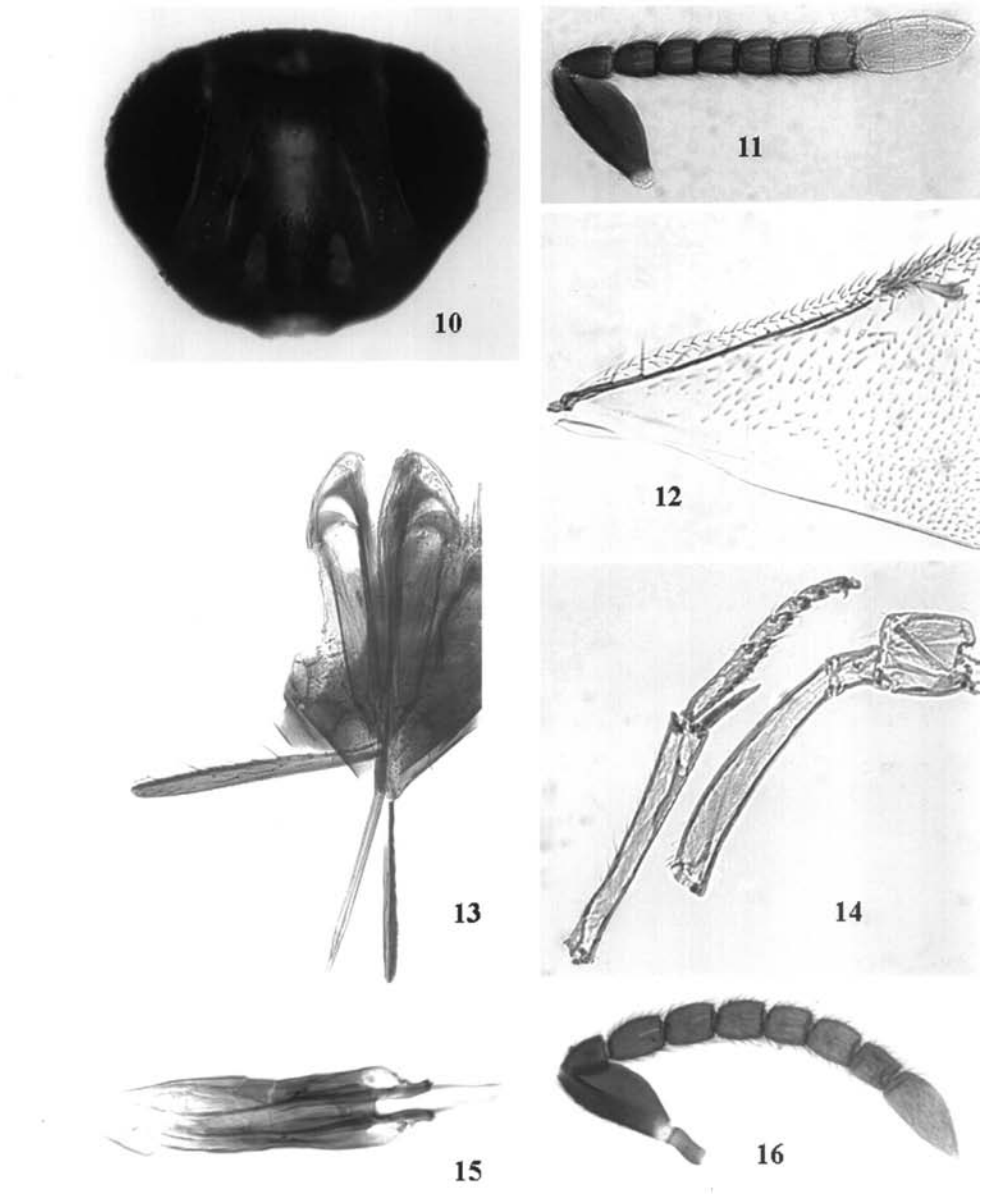

Plate 2. Figs. 10–16. *Avetianella xystrocerae* sp.n., Female: 10–14, 10, head in front view; 11, antenna; 12, forewing; 13, ovipositor; 14, mid leg; Male: 15–16: 15, genitalia; 16, antenna.

Oobius agrili sp.n. is close to *O. anomalus* Guerrieri *et al.* (8). Both species have 4-segmented tarsi and tridentate mandible. *O. agrili* can be distinguished from *O. anomalus* by antennal clava 3 times as long as maximum width and strongly obliquely truncated apically, and the truncated part at least half clava length (2.3 times as long as wide and apically more or less transversely truncated in *O. anomalus*), by linear sensilla on F6 and

on each claval segment with a distribution: 1, 3, 4, 3 (the distribution is 1, 2, 3, 3 in *O. anomalus*), by gaster about as long as thorax (gaster about 1.5 times as long as thorax in *O. anomalus*), and by all coxae dark brown (all coxae yellow in *O. anomalus*).

AVETIANELLA XYSTROCERAE ZHANG AND HUANG sp.n.

Description

Female (Holotype) Body length 1.5 mm (including ovipositor).

Color: Body generally dark brown, with green blue or blue green sheen; antenna dark brown except clava yellowish white; forewing hyaline; fore and mid legs (including coxae) yellow, hind legs yellow except coxae generally dark yellow brown; exserted part of ovipositor sheath dark brown.

Head: Frontovertex 2/5 of head width, with distinct irregular reticulate sculpture or ridges beset in small piliferous punctures; eyes clothed in translucent setae which are shorter than diameter of an eye facet; ocelli forming an angle of $\sim 100^{\circ}$; posterior ocelli separated from inner eye margin by less than half their diameter, separated from occiptal margin by about their own diameter; the membranous lines on face as in Fig. 10; antenna (Fig. 11) with scape distinctly expanded and flattened, about 2.5 times as long as broad; pedicel twice as long as broad; funicular segments gradually shortening distad, F1 about 1.2 times as long as wide, F6 subquadrate or slightly wider than long; clava 3-segmented, with apex obliquely truncated and the truncated part 1/4 clava length; malar space about 1/3 eye length; mandible with two teeth and an upper truncation; maxillary palpi 4-segmented, labial palpi 3-segmented.

Thorax: Thorax in lateral view not depressed and dorsum of thorax moderately convex; in dorsal view, mesoscutum with reticulate sculpture, scattered with distinct small piliferous punctures; axillae clearly separated from each other; scutellum with reticulate sculpture a little shallower than that on mesoscutum; forewing (Fig. 12) 2.3 times as long as maximum width; marginal vein 1.5 times as long as broad and 3/5 postmarginal vein length; postmarginal vein 5/6 stigmal vein length; mid tibia spur 2/3 first tarsal segment length (Fig. 14).

Gaster: Gaster slightly shorter than thorax (excluding exserted part of ovipositor sheath); cercal plates located in middle of gaster; hypopygium with apex slightly protruding apex of gaster; ovipositor nearly twice as long as mid tibia; gonostyli half ovipositor length (Fig. 13); ovipositor sheath distinctly exserted, exserted part of ovipositor sheath about 3/4 gaster length.

Male Body length about 1 mm; similar to female except as follows: antenna (Fig. 16) with scape expanded and flattened, and about twice as long as broad; pedicel a little shorter than F1; funicle clothed in short setae that are clearly shorter than funicular segments; clava solid and apically obliquely truncated; genitalia as in Fig. 15.

Variation: Very little variation in material available.

Host: *Xystrocera globosa* (Olivier) (Coleoptera: Cerambicidae).

Distribution: China.

Holotype: female, China: Shandong: Taian, VII.1980, ex. egg of *X. globosa*, coll. Bo-Ling Bao (IZCAS).

Paratypes: 8 females, 15 males, same data as in holotype (IZCAS).

Remarks

Avetianella Trjapitzin (23) is a widely distributed genus with currently nine described species (see as in Table 2). A generic diagnosis of *Avetianella* was given by Zhang and Huang (30). Gordh and Trjapitzin (7) provided a key to three Holarctic species, *A. buprestidis* Gordh & Trjapitzin, *A. capnodiobia* Trjapitzin, *A. dahlsteni* Trjapitzin.

In appearance, *Avetianella xystrocerae* sp.n. resembles *A. batocerae* (Ferrière) (4), which was combined from *Ooencyrtus* by Noyes (13). However, *A. xystrocera* can be separated from *A. batocerae* by the following characters: antennal scape strongly expanded and flattened, about 2.5 times as long as broad (antennal scape somewhat expanded and flattened, about 4 times as long as broad in *A. batocerae*); F1 and F2 slightly longer than wide and not smaller than following segments in size (F1 and F2 transverse and clearly smaller than following segments in *A. batocerae*); ovipositor sheath strongly exserted and the exserted part about 3/4 gaster length (ovipositor sheath slightly exserted in *A. batocerae*).

TABLE 2. Host index of *Avetianella* species

Host	Parasitoid (*Avetianella* sp.)
Unknown	*Avetianella dahlsteni* Trjapitzin (24)
COLEOPTERA	
Buprestidae	
Buprestis aurulenta Linnaeus	*Avetianella buprestidis* Gordh and Trjapitzin (7)
Capnodis tenebrionis (Linnaeus)	*Avetianella capnodiobia* Trjapitzin (23, 27)
Cerambycidae	
Agrianome spinicollis (Macleay)	*Avetianella coombsi* Schmidt and Noyes (20)
Batocera horsfieldi (Hope)	*Avetianella ambigua* (Liao) (10, 30)
Batocera rufomaculata (DeGeer)	*Avetianella batocerae* (Ferrière) (14)
Coptocercus aberrans (Newman)	*Avetianella longoi* Siscaro (2)
Epithora dorsalis (Macleay)	*Avetianella longoi* Siscaro (2)
Megacyllene robiniae (Forster)	*Avetianella depressa* (Girault) (5, 6, 17)
Phoracantha semipunctata (Fabricius)	*Avetianella longoi* Siscaro (2, 21)
Xystrocera globosa (Olivier)	*Avetianella xystrocerae* sp.n.

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