

Redescription of the female of *Oobius depressus* (Girault) (Hymenoptera: Encyrtidae), newly found in Michigan, U.S.A.

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Abstract

A female of *Oobius depressus* (Girault) (Hymenoptera: Encyrtidae), collected in a modified Malaise trap in the canopy of a black locust tree, *Robinia pseudoacacia*, at Rose Lake State Wildlife Area in Bath Charter Township, Clinton Co., Michigan, U.S.A., is re-described and illustrated. This species was previously known only from the type series of headless specimens of both sexes from the type locality in Morristown, Henry Co., Illinois, U.S.A. These type specimens were from a single cohort of locust borer, *Megacyllene robiniae* (Forster) (Coleoptera: Cerambycidae), eggs collected and reared over one hundred years ago. An updated taxonomic key to females of native and introduced species of the genus *Oobius* Trjapitzin, which now includes *O. depressus*, is provided.

Recently, Triapitsyn et al. (2015) revised the Nearctic species of the genus *Oobius* Trjapitzin (Hymenoptera: Encyrtidae), which are egg parasitoids of Buprestidae and Cerambycidae (Coleoptera). Two members of this genus, *O. agrili* Zhang & Huang and *O. longoi* (Siscaro), have been introduced into the U.S. as classical biological control agents of *Agrilus planipennis* Fairmaire (Buprestidae) and *Phoracantha semipunctata* (Fabricius) (Cerambycidae), respectively (Hanks et al. 1995, Bauer et al. 2015). Another potential biological control agent of *A. planipennis*, *O. primorskyensis* Yao & Duan, has been imported into quarantine in Newark, Delaware, U.S.A. from the Far East of Russia; it is currently in culture, but has not yet been released as it is still being evaluated for host-specificity and other bionomic factors (Yao et al. 2016). Nearctic species of *Oobius* are poorly studied, and their importance as natural enemies of native wood-boring beetles, including a number of pests of forest and ornamental trees, is unclear. One species, *O. depressus* (Girault), was not included by Triapitsyn et al. (2015) in the taxonomic key to Nearctic females because its identity was at that time unclear without knowing the details of its female antennal characters.

Oobius depressus was described from the type series of three females and two males reared from eggs of the locust borer, *Megacyllene robiniae* (Forster) (Cerambycidae), on 8 December 1914 in Morristown, Henry Co., Illinois, U.S.A. (Girault 1916). There is no record of this species being re-collected since. The original description of *O. depressus* is poor and without any illustrations; unfortunately, the slide with the heads and fore wings of each sex (Girault 1916) could not be found in the National Museum of Natural History, Washington, District of Columbia, U.S.A. (USNM) and is presumed lost. To facilitate recognition of

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this species, Triapitsyn et al. (2015) provided illustrations of the scutellum and habitus of the female (without head and antennae) in dorsal view.

The uncertain identity of *O. depressus* required attention considering its potential importance as a natural control agent of locust borer, a serious pest of black locust, *Robinia pseudoacacia* L., that limited plantings of this valuable tree (Linsley 1964, Solomon 1995). Comprehensive identification tools are also important for *Oobius* species to ensure correct identification of *O. agrili* when evaluating its establishment and impacts at release sites throughout the expanding range of *A. planipennis* (Bauer et al. 2015). Therefore, we attempted to collect this species for the first time in 100 years since its original rearing, and allow the inclusion of *O. depressus* in an updated key to the females of the described Nearctic species of *Oobius* (Triapitsyn et al. 2015). For that, we had to have at least one female specimen of this species with intact antennae, because antennal characters are used in the relevant couplets of the key.

Material and Methods

Collecting. Linsley (1964, p. 83) summarized the following about the habits of locust borer adult: "In the fall when the goldenrod is in full bloom, the adults are found feeding on the pollen of this plant. They lay the eggs beneath the bark scales of black locust, the young larvae hatching before the leaves fall and overwintering in the outer corky bark". Because eggs of *M. robiniae* are very difficult to find, especially parasitized ones, and adult female beetles apparently visit black locust trees only for a short time to oviposit, we attempted to collect adult locust borers and egg parasitoids using a canopy insect trap, a modification of a Malaise trap that has both bottom (good for capturing wood-boring and other arboreal Coleoptera) and top (good for capturing micro-Hymenoptera and other insects) collection jars. One such trap, manufactured by Sante Traps (Lexington, Kentucky, U.S.A.; description is available at www.santetraps.com), was hung in the canopy of a live black locust tree, surrounded by many other conspecific trees, at Rose Lake State Wildlife Area in Bath Charter Township, Clinton Co., Michigan from 15 August to 28 October 2015 (Fig. 1). Both collection jars were filled with 90% ethanol that was emptied and re-filled periodically (about every 15–20 days); collected samples were stored in a freezer at -18°C until shipped to the Entomology Research Museum, University of California, Riverside, California, U.S.A. (UCRC). There, the samples were sorted by V. V. Berezovskiy under a dissecting microscope.

Also, S. V. Triapitsyn and Michael White of Chicago, Illinois, made a short collecting trip on 23 August 2015 to the type locality of *O. depressus* in Morristown. Unfortunately, no black locust trees could be located there or in the proximal vicinity.

Taxonomic study. The specimen documented in this study was critically point dried, point-mounted, and labeled. It was then measured, photographed, dissected, and slide-mounted in Canada balsam, followed by examination under a Zeiss Axioskop 2 plus compound microscope using Nomarski differential interference contrast optics. Stereomicroscopic images were taken and compiled using Auto-Montage by Syncroscopy.

Terms used for morphological features are those of Gibson (1997). Abbreviations used are: F = antennal funicle segment; mps = multiporous plate sensillum or sensilla on the antennal flagellar segments (= longitudinal sensillum or sensilla or sensory ridge(s) of other authors). Body length was measured exclusive of the exerted part of the ovipositor.

Results

Only one parasitoid specimen belonging to the genus *Oobius*, fortunately a female, was found (in the bottom jar sample dated 6 October 2015) in the samples collected by the canopy insect trap. It matched perfectly both the original description of *O. depressus* and the illustrations of this species in Triapitsyn et al. (2015). It is re-described and illustrated below. Based on the useful information obtained, this species is included in the updated taxonomic key to females of the Nearctic species of *Oobius* that follows its redescription.

Also, it is interesting to note that only one specimen of the locust borer, a male, was collected in the same canopy trap (on 31 August 2015). This voucher specimen was pinned, labeled, and deposited in the UCRC.

Oobius depressus (Girault, 1916)

Figs. 2–8

Habrolepoidea depressa Girault 1916: 343–344. Lectotype female [USNM], examined (Triapitsyn et al. 2015).

Oobius depressus (Girault): Triapitsyn et al. 2015: 36–37 (taxonomic history, information on the type material, discussion), 41 (illustrations).

Material examined. U.S.A., Michigan, Clinton Co., Bath Charter Township, 42°47'55.5"N 84°22'50.8"W, 259 m, 6.x.2015, T. R. Petrice [1 female, UCRC (UCRC ENT 383312)].

Redescription. FEMALE (non-type specimen from Michigan). Body (Figs 3, 4) notably flattened, shining black; with some slight violet reflections on mesoscutum and scutellum; propodeum partially whitish; antenna dark brown to black; fore wing venation brown to dark brown except stigmal vein contrastingly lighter (light brown); legs mostly dark brown except apical half or so of protibia and pretarsus light brown.

Frontovertex and scape striate, pronotum weakly reticulate, mesoscutum and axilla with faint mesh-like sculpture [very difficult to see both in an alcohol-preserved and a dry-mounted specimen], scutellum almost smooth. Pubescence on head and mesosoma mostly light-colored; scutellum also with a pair of longer, fine, subapical setae.

Head (Fig. 6) very short (much wider than long), with ocelli in a very obtuse triangle, posterior ocellus touching eye margin. Occipital margin narrowly rounded. Transfacial and inner orbital sutures present. Mandible with 2 acute and 1 rather truncate teeth (Fig. 2); palpal formula 4-3.

Antenna (Fig. 5) inserted slightly below lower eye margin. Radicle a little more than 0.2x total scape length, rest of scape 4.2x as long as wide, narrowing apically. Pedicel longer than any funicle segment, about 2.0x as long as wide, and shorter than the combined length of F1–F3. F1 and F2 about as long as wide and subequal, F3 a little longer than F1 or F2 and slightly wider than long, F4–F6 subquadrate and subequal to each other; F1 and F2 without mps, F3 with 1 mps, F4 with 3 or 4 mps, F5 with 4 mps, and F6 with 5 mps. Clava 2.3x as long as wide, as long as combined length of F4–F6 plus about half length of F3; claval segments obliquely divided; first (basal) claval segment with 4 mps, second with 5 mps, and third with 4 (or, possibly, with as many as 5) mps; apical claval segment obliquely truncate ventrally.

Mesosoma (Fig. 7) shorter than gaster. Mesoscutum about 1.5x as wide as long. Scutellum somewhat depressed, wider than long, shorter than mesoscutum.

Wings (Fig. 8) not abbreviated, fore wing extending beyond apex of gaster. Fore wing about 2.1x as long as wide, hyaline; marginal setae very short; disc densely setose, linea calva interrupted posteriorly by a row of setae, filum

spinosum present (2 spine-like setae). Hind wing about 3.4x as long as wide, hyaline; longest marginal seta about 0.1x maximum wing width.

Mesotibial spur slightly shorter than mesobasitarsus.

Ovipositor (Fig. 7) occupying about 0.6x length of gaster, exerted beyond gastral apex by about 0.1x total ovipositor length; ovipositor length:metatibia length ratio 1.5:1. Outer plate of ovipositor with 1 subapical seta.

Measurements (mm, as length or length:width, taken from the slide-mounted specimen unless stated otherwise). Body (of the dry-mounted specimen prior to slide-mounting): 1.238; head (of the dry-mounted specimen prior to slide-mounting): 0.132; mesosoma: 0.547; gaster: 0.707; ovipositor: 0.492. Antenna: radicle: 0.07; rest of scape: 0.233; pedicel: 0.079; F1: 0.03; F2: 0.03; F3: 0.036; F4: 0.051; F5: 0.051; F6: 0.052; clava: 0.183. Fore wing: 0.984:0.461; hind wing: 0.738:0.215.

MALE. Known and described (Girault 1916) but not illustrated.

Diagnosis. Among the Nearctic species of *Oobius*, *O. depressus* differs from *O. whiteorum* Triapitsyn, known from Pennsylvania, U.S.A. from eggs of *Agrilus anxius* Gory (Coleoptera: Buprestidae) on European white birch trees, *Betula pendula* Roth (Triapitsyn et al. 2015), to which it is somewhat similar, by a relatively more flattened body (Fig. 4) and by a larger body size in females. According to Girault (1916), the body length of *O. depressus* is 1.15 mm (our specimen is a little larger), whereas females of *O. whiteorum* are at most 0.75 mm. Also, F1 through F3 progressively increase in width in *O. depressus*, whereas these three funicular segments are subequal in both width and length in *O. whiteorum*; the ovipositor is 1.5x length of metatibia in the former and 1.3x length of metatibia in the latter species. *Oobius depressus* is particularly similar to another Nearctic species, *O. dahlsteni* (Trjapitzin) from California, U.S.A., which was well described by Trjapitzin (1971) and more recently was illustrated by Triapitsyn et al. (2015), and whose host(s) is/are unknown; these two taxa differ mainly in the proportions of the female antennal segments, as indicated in the key below.

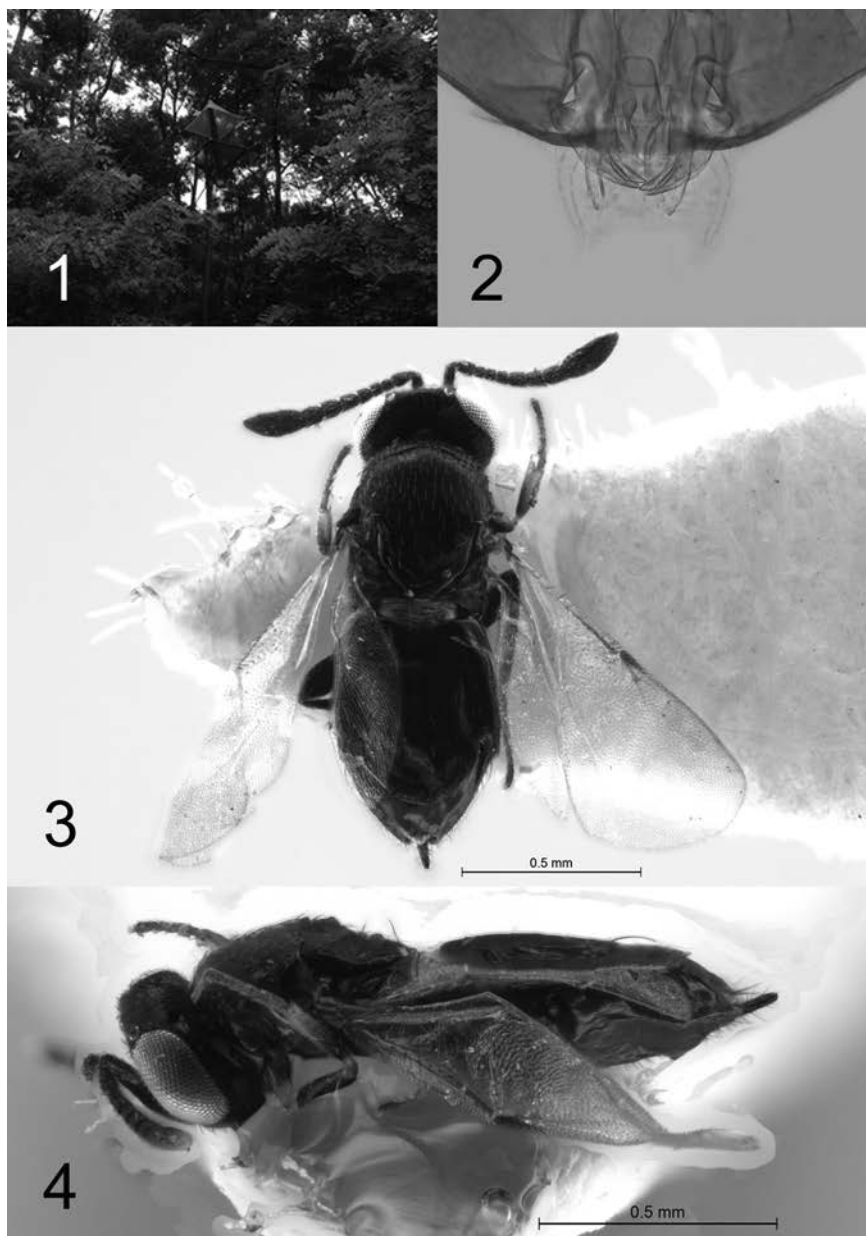
Oobius depressus cannot be possibly confused with *O. primorskyensis* which has all legs with tarsi 4-segmented (Yao et al. 2016), in case of its possible release and establishment in North America.

Distribution. U.S.A.: Illinois (Girault 1916) and Michigan (new record).

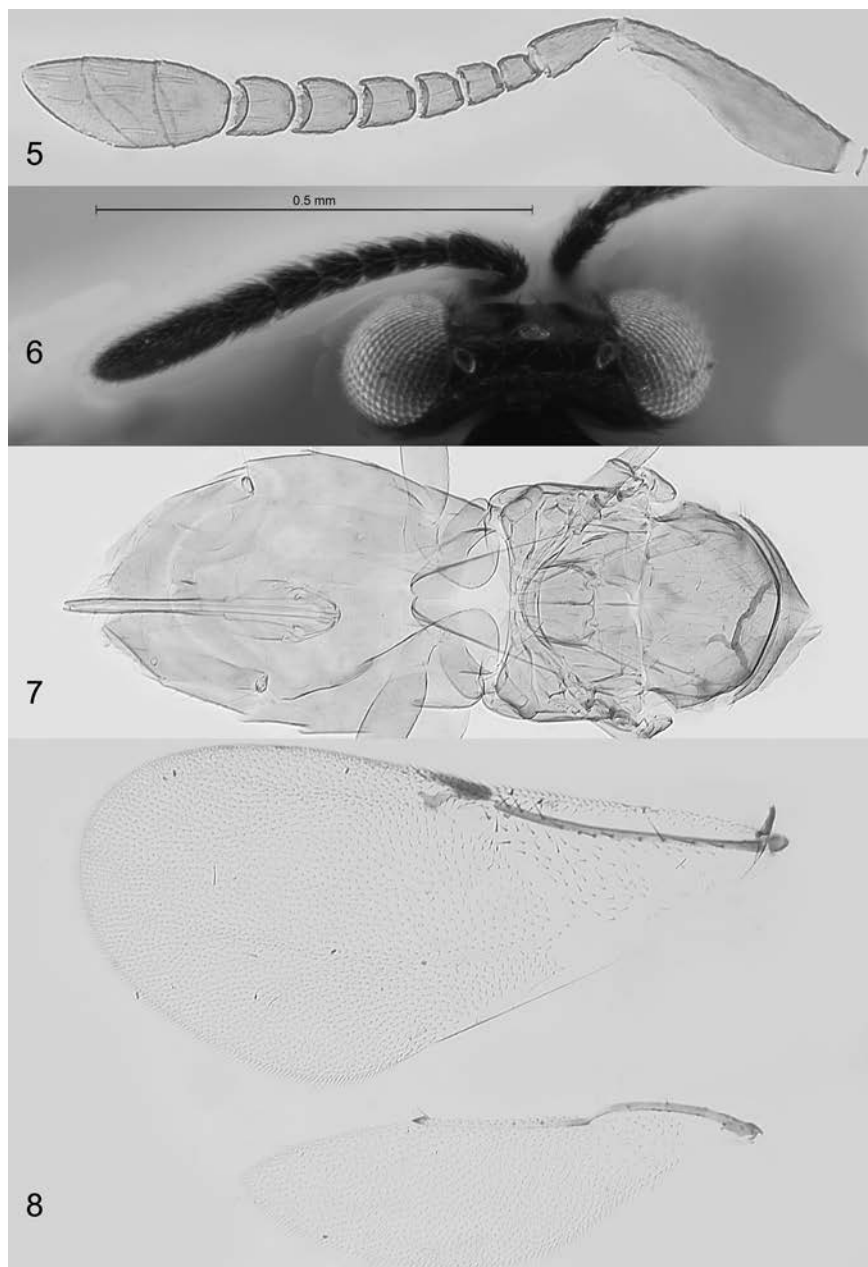
Host. *Megacyllene robiniae* (Forster) (Cerambycidae) (Girault 1916 [as *Cyllene robiniae*]).

Updated key to the described Nearctic species of *Oobius*, females
[both native and introduced, modified from Triapitsyn et al. (2015)]

- | | | |
|------|--|---|
| 1 | Tarsi 4-segmented | <i>O. agrili</i> Zhang & Huang |
| – | Tarsi 5-segmented | 2 |
| 2(1) | Clava entire..... | <i>O. nearcticus</i> (Trjapitzin) |
| – | Clava 3-segmented | 3 |
| 3(2) | Body length (dry-mounted specimens) at most 0.53 mm; mps only on F6 | <i>O. minusculus</i> Triapitsyn & Petrice |
| – | Body length (dry-mounted specimens) at least 0.66 mm; mps on F6 and other funicle segments | 4 |
| 4(3) | Mps on F5 and F6..... | <i>O. buprestidis</i> (Gordh & Trjapitzin) |
| – | Mps at least on F4-F6..... | 5 |
| 5(4) | Linea calva “open” posteriorly, uninterrupted by row of setae | <i>O. longoi</i> (Siscaro) |



Figures 1-4. 1. A modified Malaise (canopy) insect trap hanging on a black locust tree in Bath Charter Township, Michigan. 2-4. *Oobius depressus* female (non-type specimen from Michigan, dry-mounted prior to slide-mounting): 2. Mouthparts; 3. Habitus (dorsal view); 4. Habitus (lateral view).



Figures 5–8. *Oobius depressus* female (non-type specimen from Michigan): 5. Antenna; 6. Head (dorsal view) and antenna; 7. Mesosoma and metasoma; 8. Fore and hind wings.

- Linea calva interrupted posteriorly by a line (or lines) of setae 6
- 6(5) F5 and F6 each notably longer than F4 (F4 0.8x length of F5)
..... *O. whiteorum* Triapitsyn
- F5 and F6 each subequal in length to F4 (F4 more than 0.9x length of F5) 7
- 7(6) Pedicel shorter than combined length of F1-F3; clava as long as combined length of F4-F6 plus about half length of F3 (Fig. 5)
..... *O. depressus* (Girault)
- Pedicel longer than combined length of F1-F3; clava about as long as combined length of F2-F6..... *O. dahlsteni* (Trjapitzin)

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