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Larval Morphology of *Mochtherus luctuosus* Putzeys (Coleoptera: Carabidae: Lebiinae: Lebiini: Pericalina) with Notes on Their Biology

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Abstract. The mature larval morphology of *Mochtherus luctuosus* Putzeys is described and illustrated. The examined larvae were collected from under the bark of a stump of a dead, broad-leaf tree. It was observed that one of them preyed on a living pupa of *Uleiota arboreus* Reitter under the bark.

Key words: bark of dead tree, predation, pupation, *Uleiota arboreus*.

Introduction

The pericaline carabids generally live on fungus-grown dead trees or leaf litter and are active nocturnally (Shpeley & Ball 2000). Although only a few pericaline species having unique behavior (e.g. *Eurycoleus macularius* (Chevrolat) exclusively preying on endomychid beetles and showing primitive ectoparasitoidism; see Erwin & Erwin 1976) were studied in their natural histories in detail, the biology of most pericaline species is not well known. Van Emden (1942) provided a comprehensive larval key to carabid genera including the following pericaline genera: *Arsinoe* Laporte, *Catascopus* Kirby?, *Coptodera* Dejean, *Lobodontus* Chaudoir?, *Mochtherus* Schmidt-Göbel, *Mormolyce* Hagenbach, *Thyreopterus* Dejean? (the genera with question marks had been identified with less reliability). Additionally, the larval morphology of *E. macularius* was later described by Erwin (1975). However, no further larval descriptions of the Pericalina have been published in recent decades.

I had a chance to obtain larvae of *Mochtherus luctuosus* Putzeys. On the larval morphology of this genus, there has been only one description for *M. tetraspilotus* (MacLeay) provided by Gardner (1936). The larval morphology of *M. luctuosus* is described in this paper for the first time.

Materials and methods

Three mature larvae of the *M. luctuosus* were collected from under the bark of a stump of a dead, broad-leaf tree with some larvae and one pupa of *Uleiota arboreus* Reitter (Cucujoidea, Silvanidae) on August 2nd, 2020. The stump was located near Naragawa River of Narukawa-keikoku Valley, Kihokuchô Town, Ehime Pref., Japan (33°13'16.0"N 132°37'23.6"E). Two of them were collected and preserved in ethanol in the field for morphological observation. For the identification of the larvae, one of them was transported to the laboratory and reared to the adult stage in a plastic film bag with some pieces of a bark of the stump where these larvae were found, a piece of a mealworm (*Tenebrio* larva) cut into about 5 mm for food and a wet tissue. This plastic bag was retained in the shade of the laboratory until emergence at room temperature. Identification was based on the adult morphology. The exuvia of the last instar of the rearing individual was preserved in ethanol and used for the morphological study.

Observations of external characters and dissections were made under a stereoscopic microscope (Nikon SMZ 1270). One larva was soaked in 10% solution of potassium hydroxide at room temperature overnight and dissected using fine insect pins to detach mouthparts for observation. The soaked body and dissected parts were mounted in Euparal on a slide and observed under an optical microscope (Nikon

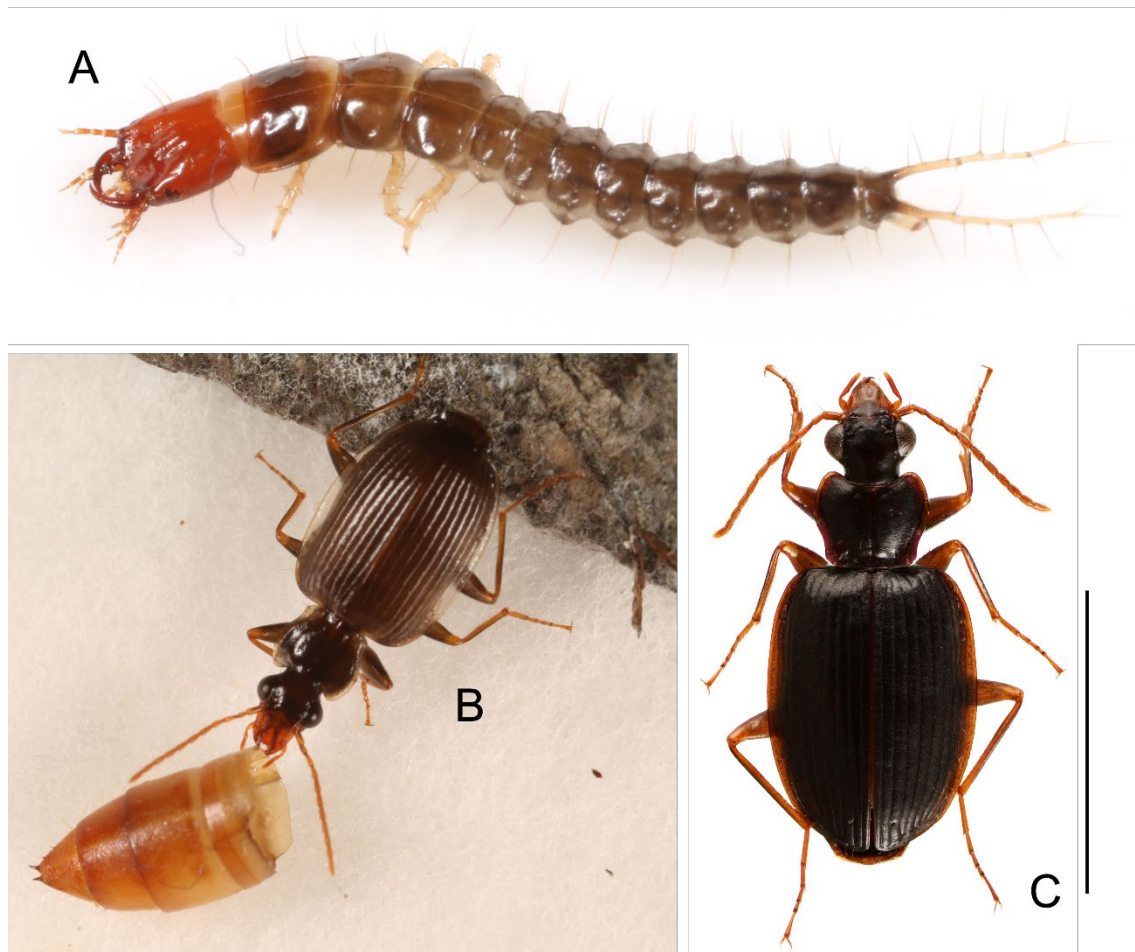


FIGURE 1. *Mochtherus luctuosus* Putzeys. A, Dorsolateral habitus of living larva; B, the emerged teneral adult, feeding on a piece of mealworm; C, dorsal habitus of the adult. Scale bar: 5.0 mm for C.

Eclipse Ci-L). Photographs of the adult (Fig. 1B-C) and the living larva (Fig. 1A) were taken with a digital camera (Canon EOS 7D) fitted with a macro-objective (MP-E 65 mm).

Morphological terminology follows Luff (1993) and Lawrence *et al.* (2010). Material examined is deposited in the Ehime University Museum, Matsuyama, Japan (EUMJ).

Results and Discussion

Description of mature larva

Mochtherus luctuosus Putzeys, 1875 (Figs 1A, 2–3)

Identification. The larva was successfully reared to adulthood (Fig. 1B). The larva pupated and emerged between September 1st to 7th, 2020. The emerged adult was identified as *M.*

luctuosus by comparison with descriptions of Ohkura (1985)

Diagnosis. The larva of this species is very similar to the larva of *M. tetraspilotus*. It can be distinguished by the subparallel head (slightly expanded behind the middle in *M. tetraspilotus*), the triangular nasale (with narrow medial trapezoidal protrusion with gradual slope or teeth of various sizes on both sides in *M. tetraspilotus*) and the rounded adnasalia (somewhat rectangular in *M. tetraspilotus*) (see Gardner 1936).

Description. Body (Figs 1A and 2A) elongate, subparallel; head dark orange; pronotum dark reddish brown; meso-, metathoraxes and abdomen mostly blackish brown except cream colored legs, urogomphi and 10th abdominal segment.

Head (Fig. 2B-C) rectangular, subparallel, dorsoventrally flattened, without neck, laterally

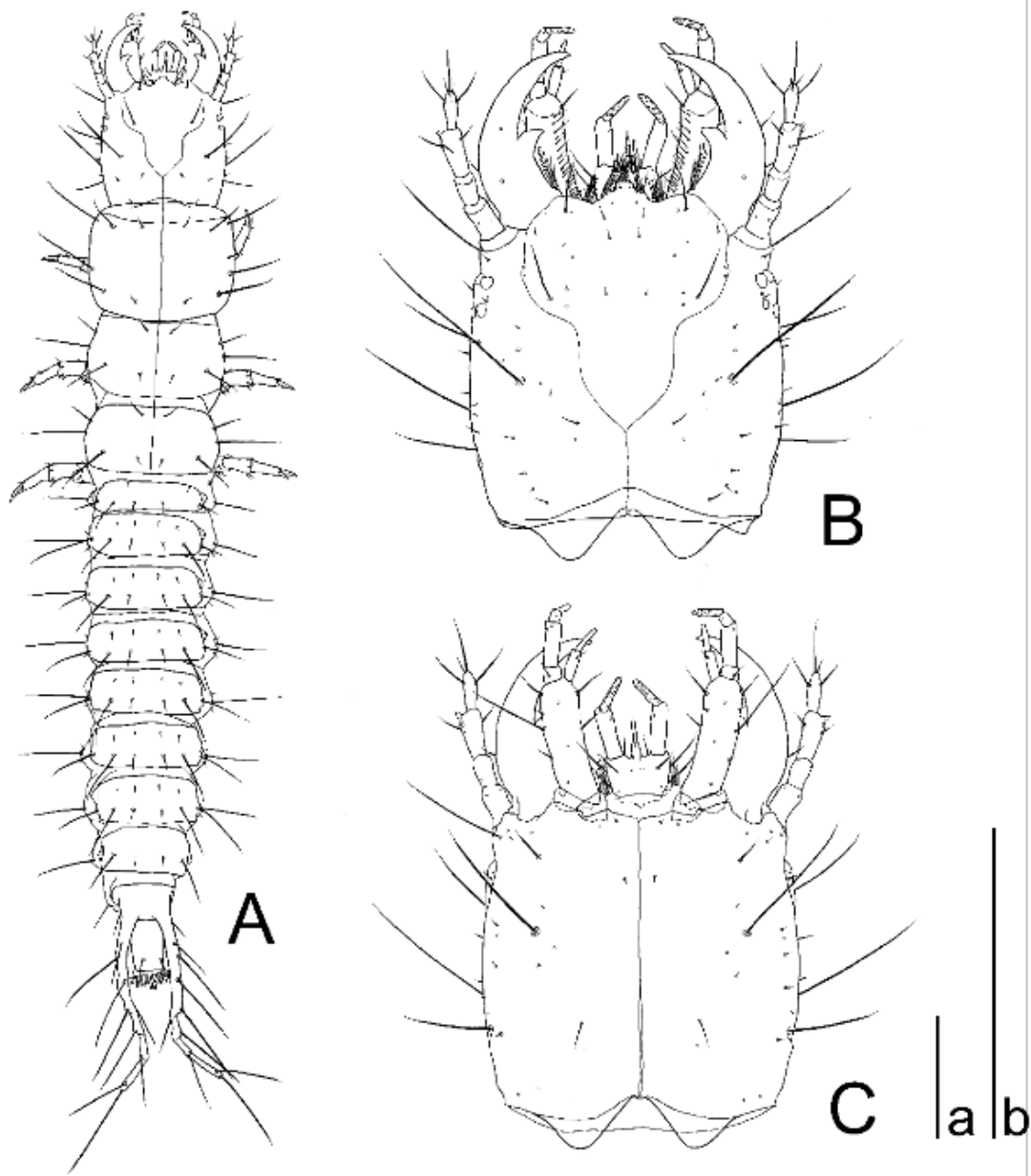


FIGURE 2. Mature larva of *Mochtherus luctuosus* Putzeys. A, Dorsal habitus; B, head, dorsal view; C, head, ventral view. Scale bars: 1.0 mm; a for A; b for B–C.

with a tubercle bearing a long seta at basal 2/5 of each side of head, with some long setae and many short setae; nasale triangular, widely protruded at apex, with truncated or concaved apex, laterally with fine teeth; adnasalia widely expanded, rounded, without teeth. Frontal arms V-shaped, curved inwards at anterior 1/3. Six stemmata present on each side (Fig. 1A). Antennae (Fig. 3A) moderate in length; antennomere 1 somewhat thick, with a few punctures; antennomere 2 shorter and thinner

than 1; antennomere 3 longest and as thin as 2, with a small sensory appendage and a group of a few tiny sensilla near apex; antennomere 4 3/4 length of 3, thin, with three long setae near apex and two short setae on apex. Mandibles (Fig. 3B) elongate, with a few short setae and punctures; retinaculum simple, stout, without teeth, arising at behind the middle of mandible; penicillus composed of long and dense hair. Maxillae (Fig. 3C) elongate; stipes with some setae of short to medium length and a very long seta on outer

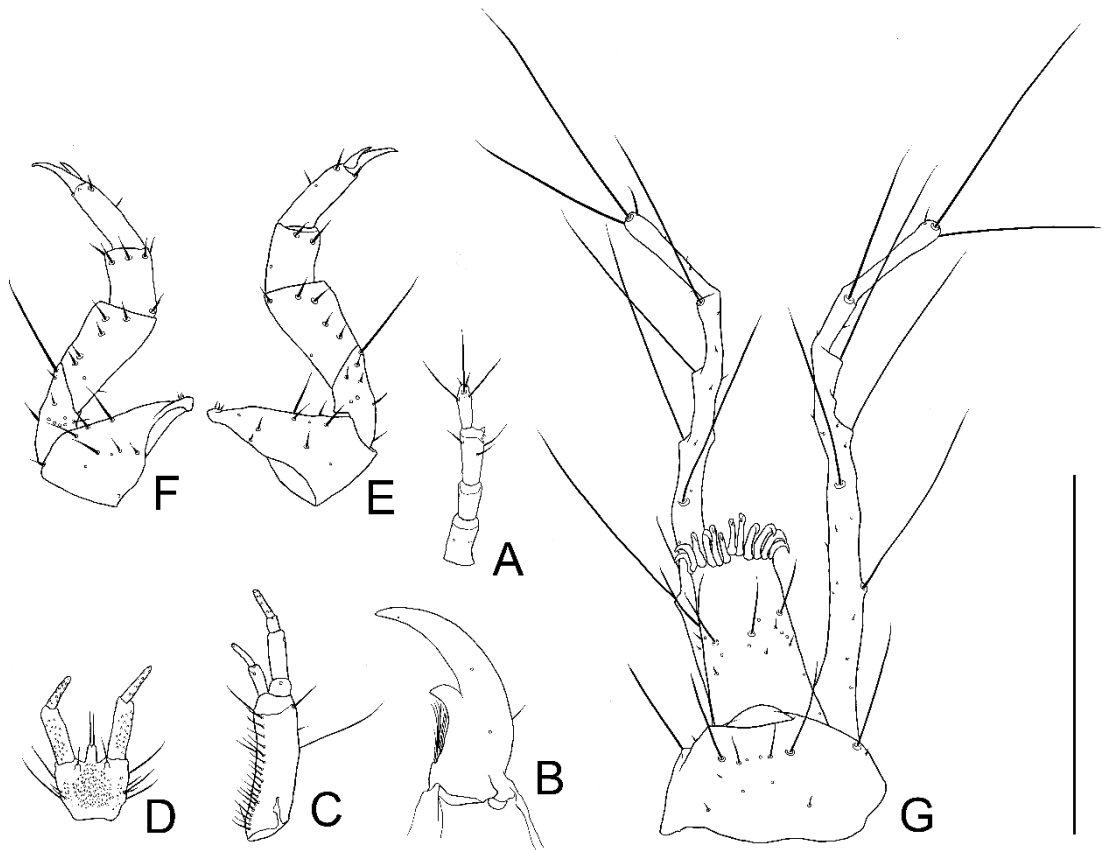


FIGURE 3. Mature larva of *Mochtherus luctuosus* Putzeys. A, Right antenna, dorsal view; B, right mandible, dorsal view; C, right maxilla, dorsal view; D, labrum, ventral view; E, right foreleg, posterior view; F, right foreleg, anterior view; G, 9th and 10th abdominal segments, ventral view. Scale bar: 1.0 mm.

lateral margin, densely with many thin setae of medium length in a longitudinal row on inner margin; lacinia absent; galea thin, with basal segment about as long as slender apical segment, with a few tiny cuticular spines on apex; maxillary palpi thin, shorter than stipes; palpifer stout, with a puncture; palpomere 1 long, as long as combined length of 2 and 3, with a somewhat large puncture near apex; palpomere 2 stout, half length of 3, with a few punctures near apex; palpomere 3 elongate, covered with campaniform sensilla. Labium (Fig. 3D); prementum widening toward distal, more or less emarginate on both sides of the ligula, densely covered with asperities, laterally with setae of various length, with paired protuberances bearing a seta of medium length near ligula; ligula strongly protruding, about 1/3 length of prementum, bearing paired long setae on apex; palpomere 1 long, thick, covered with asperities, with a large puncture near apex; palpomere 2

elongate, about 3/4 length of 1, densely covered with campaniform sensilla.

Thorax (Fig. 2A) wider than head, prothorax almost quadrate, 1.2 times as wide as long, meso- and metathoraxes transverse; tergites sclerotized, sparsely with some setae of various length near anterior margin of pronotum, lateral and posterior margins of all thoracic tergites, medially with paired setae of medium length near anterior margins of meso- and metanota. Legs (Fig. 3E-F) stout, with setose of moderate dense; coxa transverse triangular, longer and thicker than femur, with three short setae on base; trochanter slightly longer than tarsus, medially with a group of some punctures, bearing a long seta on apex; femur longer than trochanter, gradually widening toward distal; tibia stout, subparallel, 4/5 length of tarsus; tarsus elongate, with sparse setose, with a few asperities on apex; 2 claws present, anterior claw 2/3 length of tarsus, posterior claw 2/3 length of

anterior claw.

Abdomen (Figs 2A, 3G) somewhat slender, largely sclerotized, laterally with a long seta and a few short setae on each segment of 1st to 8th; tergite I longitudinally narrow, tergites I to VIII transverse, with 4 short setae along with anterior margin of each tergite II to VII, with some setae along with each posterior margin becoming longer on each side; tergite IX small, with well-developed urogomphi; urogomphi elongate, with 9 erect long setae on each urogomphus, each of them arising on a small node or tubercle, apically with 2 long and 1 short setae; 10th abdominal segment cylindrical, 2/5 length of urogomphi, with some setae of medium length, apically densely with developed anal hooks.

Specimen examined. 2 exs. (including one dissected and slide-mounted specimen), near Naragawa River, Narukawa-keikoku Valley, Kihokuchô Town, Ehime Pref., Japan, N33°13'16.0" E132°37'23.6", 2. VIII. 2020., Takahiro Yoshida leg., under bark of a stump of dead, broad-leaf tree (EUMJ); 1 exuvia of last instar (slide-mounted specimen), same place, collector and situation, the rearing larva collected in the field on 2. VIII. 2020, the exuvia preserved on 7. IX. 2020 (after emergence of adult) (EUMJ).

Biological notes. These larvae were collected from under the bark of a stump of a dead, broad-leaf tree. It was observed that one of them preyed on a living pupa of *U. arboreus*. The larvae of this species may feed on the small arthropods living under the bark of dead trees.

Although I could not observe the pupa of the rearing individual, it was pupated in the space with folded wet tissue. In the space, the exuvia of the last instar was left, but the pupal skin was not left there. The emerged adult may feed on the pupal skin. The rearing larva pupated and emerged within a week, which means the period of pupa is less than one week at room temperature.

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