

RESEARCH PAPER

## Description of the mature larva and pupa of *Menephilus medius* (Coleoptera: Tenebrionidae)

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**Abstract.** The larva and pupa of *Menephilus medius* Marseul, 1876 (Coleoptera: Tenebrionidae: Stenochiinae: Cnodalonini) from southern China are associated with the adults by rearing in lab. The morphological characteristics of the mature larva and pupa of this species are described and illustrated in detail for the first time and compared with the immature stages of *Menephilus cylindricus* Herbst, 1784.

**Key words.** Coleoptera, Tenebrionidae, darkling beetles, decaying wood, immature stages, larva, natural history, polypore, pupa, China, Asia

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### Introduction

The darkling beetle genus *Menephilus* Mulsant, 1854 (Stenochiinae: Cnodalonini) is widely distributed across the Palaearctic, Oriental, Papuan, and Afrotropical Regions (KASZAB 1980, MASUMOTO 1981, SCHAWALLER 2015, AKITA & MASUMOTO 2016, SCHAWALLER & BELLERSHEIM 2024). Recent revisions of *Menephilus* species from the Palaearctic, Oriental, Papuan Region, and sub-Saharan Africa with descriptions of new species and proposing new synonymies have been published by SCHAWALLER (2015) and SCHAWALLER & BELLERSHEIM (2024).

Little is known about the larval and pupal stages of *Menephilus* species, with immature stages only known for a single species, the Holarctic *M. cylindricus* Herbst, 1784: PERRIS (1857, 1863) provided descriptions of the larva and pupa, REITTER (1911) provided a simple description of the larva and pupa, and SEIDLITZ (1893) included *Menephilus* in the key to the larvae of tenebrionid beetle genera of German fauna.

*Menephilus medius* Marseul, 1876 is widely distributed in southern China, Southeast Asia and Japan. ANDO (2015) proposed *M. atronitens* (Kulzer, 1957) from the Ogasawara

Islands (Japan) as a subspecies of *M. medius*. It differs from the nominotypical subspecies in slightly different shape of the male protibiae, somewhat different pronotum, and more closely and distinctly punctate elytral striae. However, SCHAWALLER & BELLERSHEIM (2024) pointed out that probably these are only infraspecific variation.

Recently, we discovered a population of *Menephilus medius* in China: Guizhou, inhabiting a decaying wooden table that had been stored outdoors. Through field collections and laboratory rearing, we obtained adult specimens along with mature larvae and pupae of this species. This study presents the first description and detailed illustrations of the mature larva and pupa of *M. medius*, and its comparison with immature stages of *M. cylindricus* described by previous authors.

### Material and methods

**Material depository.** Material examined in this study including larvae, pupae and adults are deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC).



**Specimen preparation.** Larvae and pupae: In this study, the larvae and pupae were fixed in hot water (> 90 °C) for half a minute, then transferred into 75% alcohol for further preservation. Using this method, the larvae remain in their original size and their darkening is prevented. Adults were narcotized with ethyl acetate, and temporarily preserved in 75% alcohol, before being dried for imaging.

**Larval feeding.** Larvae were kept in a square plastic box indoors and fed with rotten wood in which they were found. Temperature was not controlled during continued development of the larvae.

**Specimen data.** Label data are presented verbatim. The Chinese translation of each locality is provided.

**Figures.** Habitus images were taken using a Canon 5D Mark IV camera in conjunction with a MP-E 65 mm f/2.8 1–5× macro lens, and a Godox MF12 Twin Flash was used as light source. Images of the morphological details were made using a Canon 5D Mark IV camera in conjunction with a Mitutoyo Plan NIR 10 lens or a Nikon SMZ25 stereoscopic microscope with a Nikon DS-Ri2 camera. Zerene Stacker (version 1.04) was used for image stacking. All images were modified and grouped into plates in Adobe Photoshop CS5 Extended.

## Results

### *Menepphilus* Mulsant, 1854

*Menepphilus* Mulsant, 1854: 291. Type species: *Tenebrio curvipes* Fabricius, 1792 (= *Tenebrio cylindricus* Herbst, 1784), by monotypy.

### *Menepphilus medius* Marseul, 1876

(Figs 1–6)

*Menepphilus medius* Marseul, 1876

*Nyctobates striatifrons* Fairmaire, 1896. Synonymized by SCHAWALLER & BELLERSHEIM (2024).

**Material examined.** 2 ♂♂ 2 ♀♀, 3 larvae, 'China: Guizhou, Guiyang City (贵阳市), Huaxi District (花溪区), South Campus of Guizhou University (贵州大学南校区), 15.IV.2025, H: ~1100 m, Ri-Xin Jiang leg.' (GUGC); 2 pupae, with the same label as above, additional label of pupa: '20.IV.2025 pupated' (GUGC); 2 ♂♂, with the same label as above, additional label: '23.IV.2025 pupated, 01.V.2025 enclosed adult' (GUGC).

**Description.** *Mature larva.* *Body* (Figs 2A–C) elongate, columnar and nearly parallel-side. Dorsal surface light yellow with areas near both ends of pronotum and posterior margin of mesonotum, metanotum and tergites I–VIII brownish yellow; mandibles, apex of claw and urogomphi black. Surface dorsally wrinkled and suffused with large and round punctures, punctures on surface of tergites VII–IX much larger than those on other abdominal segments.



Fig. 1. Adults of *Menepphilus medius* Marseul, 1876. A – dorsal habitus of male; B – aedeagus, ventral view; C – dorsal habitus of female. Scale bars: 0.5 mm in B, and 5 mm in A and C.



Fig. 2. Habitus of mature larva of *Menephilus medius* Marseul, 1876. A – dorsal view; B – lateral view; C – ventral view. Scale bars: 5 mm in A–C.

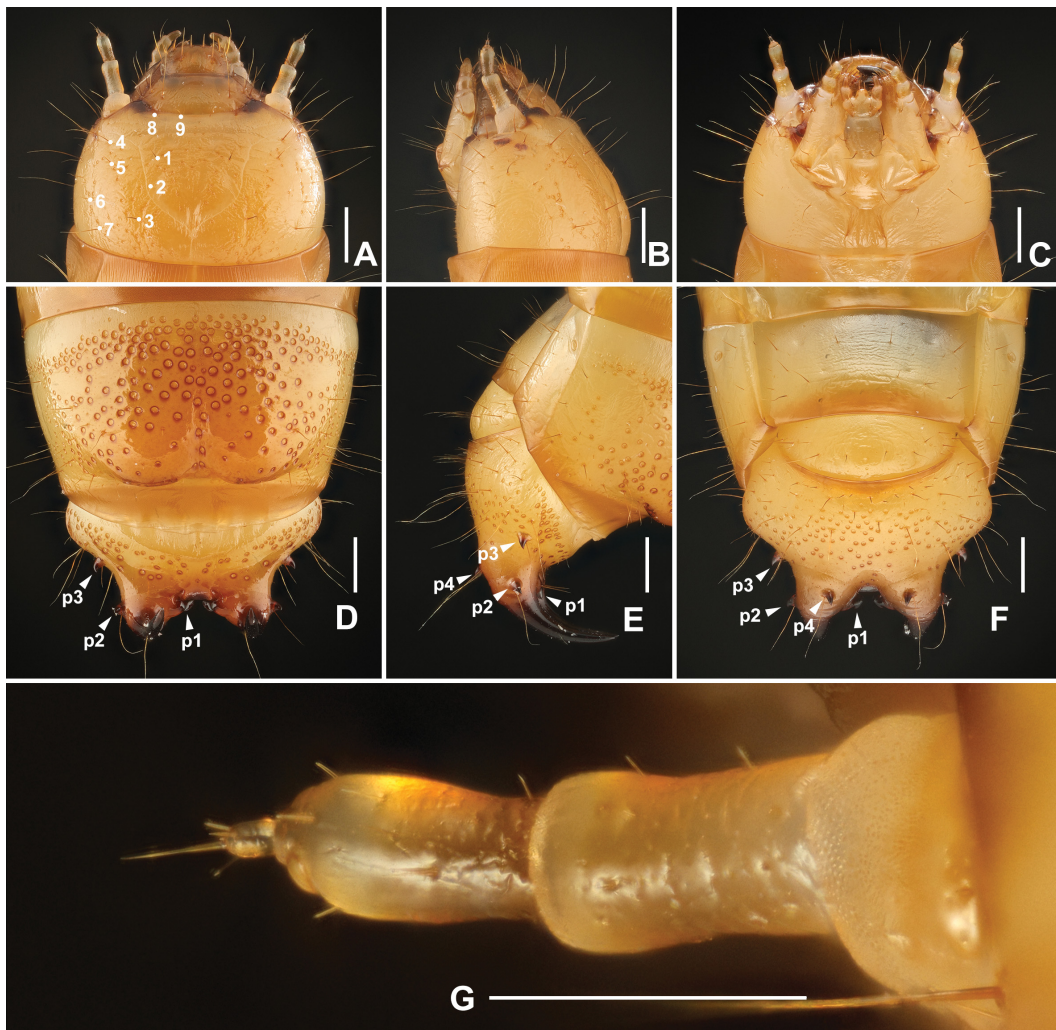


Fig. 3. Diagnostic features of mature larva of *Menephilus medius* Marseul, 1876. A–C – head (A – dorsal view, B – lateral view; C – ventral view); D–E – tergites VIII and IX (D – dorsal view, E – lateral view); F – tergite IX, ventral view; G – antenna. Scale bars: 0.5 mm in A–G.

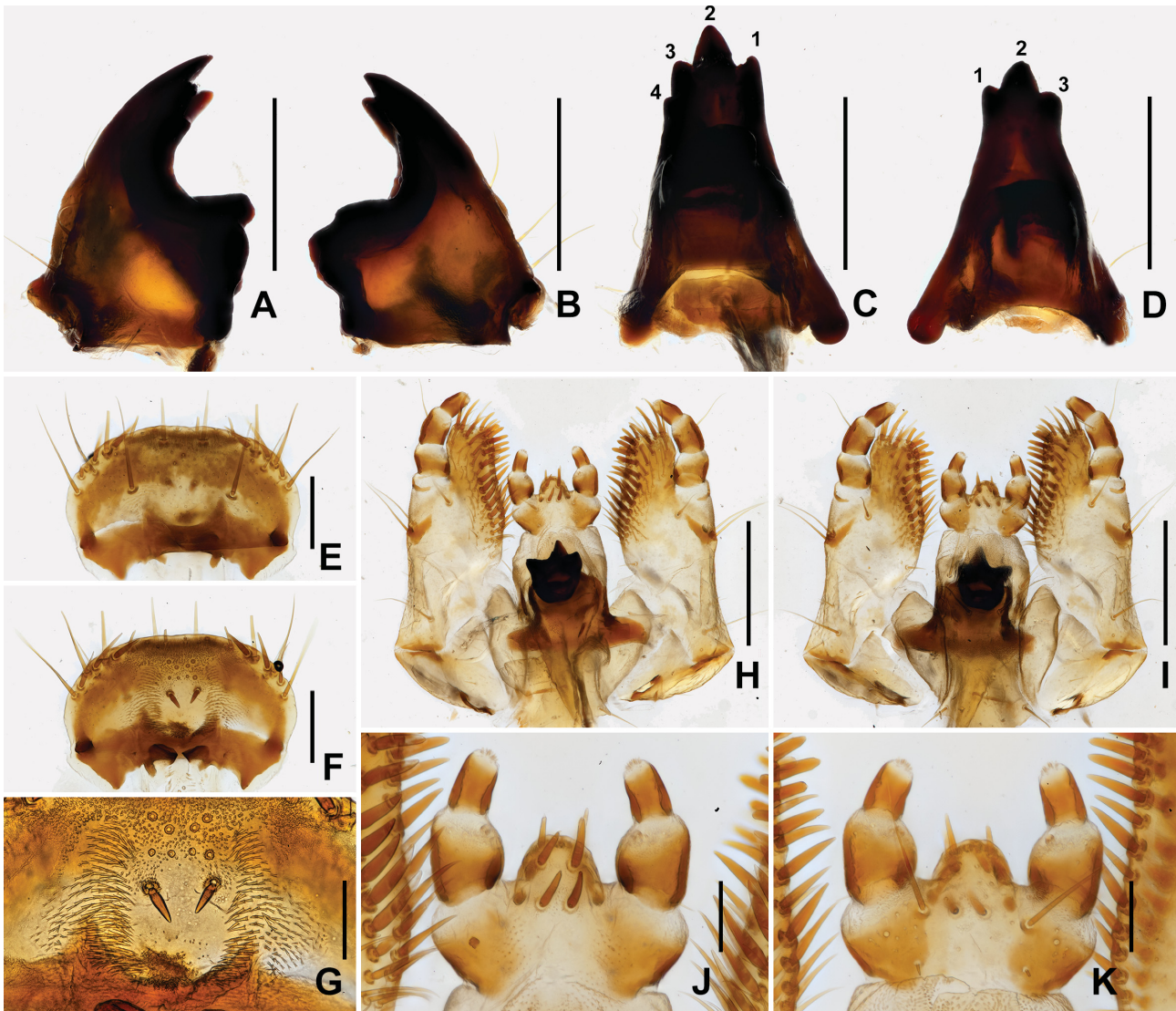


Fig. 4. Mouth parts of mature larva of *Menophilus medius* Marseul, 1876. A – left mandible, dorsal view; B – right mandible, dorsal view; C – left mandible, right lateral view; D – right mandible, left lateral view; E–G – labrum (E – dorsal view, F – ventral view, G – disc of ventral view); H–I – ventral mouthparts (H – dorsal view, I – ventral view); J–K – prementum and labial palps (J – dorsal view, K – ventral view). Scale bars: 0.1 mm in G, J–K, 0.2 mm in E–F and 0.5 mm in A–D, H–I.

*Head* (Figs 3A–C) narrower than prothorax, widest near basal 1/3, weakly prognathous, slightly convex dorsally, posterior edge of head capsule slightly emarginate, lateral sides rounded. Dorsal surface of head sparsely wrinkled, densely covered with small punctures mixed with large round punctures. Disc of head with three pairs of short setae (Fig. 3A, white spots 1–3), lateral areas with four pairs of setae, inner two short (Fig. 3A, white spots 5–6), outer two much longer (Fig. 3A, white spots 4 and 7), anterior margin emarginate in middle, with two pairs of short setae (Fig. 3A, white spots 8–9), lateral portions with few long setae mixed with short setae. Epicranial stem short (Fig. 3A), frontal arms U-shaped, about 3/4 length of head capsule, apical half curved outward. Ocelli black (Fig. 3B), divided into two parts, anterior one larger than posterior one. Frontoclypeal suture (Fig. 3A) distinct, curved. Clypeus (Fig. 3A) transverse, widest in basal 1/3; anterior margin nearly straight, lateral margin declining; disc weakly wrinkled, and finely covered with small punctures; each lateral por-

tion with four long setae, two of them located near lateral margin. Labrum (Figs 3A, 4E) transverse, widest in middle, disc with pair of long setae; dorsal surface finely covered with small punctures; anterior margin rounded, middle with pair of long setae; lateral parts with round margins, covered with several pairs of setae of different lengths. Epipharynx (Figs 4F–G) with pair of medial short setae, four pairs of sensory papillae symmetrically located before medial setae, anterior margin with pair of short median setae. Antenna (Fig. 3G) 3-segmented; antennomere I transverse, short; antennomere II slightly longer than antennomere III, surface covered with sparse small punctures and short setae; antennomere III narrower than antennomere II, surface sparsely covered with small punctures and short setae, with two sensoria, larger one about 1/5 length of antennomere III, another one rounded, weakly raised.

*Mouth parts* (Figs 4A–K). Mandibles (Figs 4A–D) strongly sclerotized, distinctly asymmetrical, broad at base and narrowing to apex, each mandible with three long

setae near outer margin; molae distinct and in different form on each mandible; left mola with distinct distal tooth, armed ventrally with several blunt teeth, right molar teeth smaller than left, armed with several blunt teeth; apex of left mandible (Fig. 4C) bearing four teeth, apex of right mandible (Fig. 4D) bearing three teeth. Inner portions of maxillae (Figs 4H–I) with two rows of strong long setae, setae on apical portions distinctly longer than those on other parts, outer portions of strong long setae with thin and short setae. Ventral surface of stipes (Fig. 4I) with four long setae, three of them located at base of maxillary palps, another one located near base of stipes. Maxillary palps (Figs 4H–I) with three segments, palpomere I about as long as wide; palpomere II longer than wide, with pair of long setae; palpomere III shorter and narrower than palpomere II. Submentum (Fig. 4H) sclerotized, transverse. Hypopharyngeal sclerome (Fig. 4H) well developed, tridentate, with concavity in middle. Mentum (Fig. 4I) dorsally with two pairs of long setae. Ventral surface of prementum (Fig. 4K) with two pairs of setae; two of them located at base, very short; another two setae long, located near anterior margin. Ligula (Fig. 4J) with three pairs of strong and short setae on dorsal side, anterior margin rounded. Labial palps (Figs 4H–I) 2-segmented, first segment enlarged, longer than wide, second segment narrower and shorter than first one.

*Thorax* (Figs 2A–B). Thoracic tergites transverse. Pronotum shorter than meso- and metanotum combined; surface shiny and modified with thin crease, disc with small round punctures and several sparse short setae; lateral margins of pronotum sinuate, with several setae of different lengths; portions of anterior and posterior margins

smooth and shiny. Mesonotum transverse, about twice as wide as long; disc wrinkled, surface covered with several long setae and sparse small and round punctures; portion of posterior margin smooth and shiny; lateral portions with several setae of different lengths. Metanotum longer than mesonotum, surface generally like mesonotum. Mesothorax with pair of long-oval spiracles, prothorax and metathorax without spiracles. Coxal cavities widely separate. Legs well developed, 5-segmented, surface covered with sparse setae of different lengths, claws strongly sclerotized, apex black.

*Abdomen* (Figs 2A–C) slightly shorter than three times length of thorax. Tergites I–VI similar in form, transverse; surface weakly wrinkled, covered with sparse small round punctures, and sparse setae of different lengths; posterior portion smooth and shiny. Tergite VII similar to tergites I–VI in form, surface covered with large round punctures, much larger than punctures of tergites I–VI; punctures on disc larger than those on other portions of tergite VII. Posterior half of tergite VIII distinctly raised and forming two round nodules in middle; surface covered with large round punctures, larger on disc and smaller on other portions of tergite VIII. Tergite IX finely covered with large rounded punctures; urogomphi curved, strongly bending towards dorsal side, apex acute; each side of tergite IX with four pairs of small but well-developed projections, two pairs of them located on each side of base of urogomphi (Figs 3D–F: P1 and P2), pair of them located on ventral base of urogomphi (Fig. 3F: P4), and pair of them located in middle of lateral sides of tergite IX (Figs 3D–F: P3). Tergites I–VIII with pair of long-oval spiracles which are smaller than spiracles of mesothorax.



Fig. 5. Habitus of pupa of *Menepihilus medius* Marseul, 1876. A – ventral view; B – lateral view; C – dorsal view. Scale bars: 5 mm in A–C.

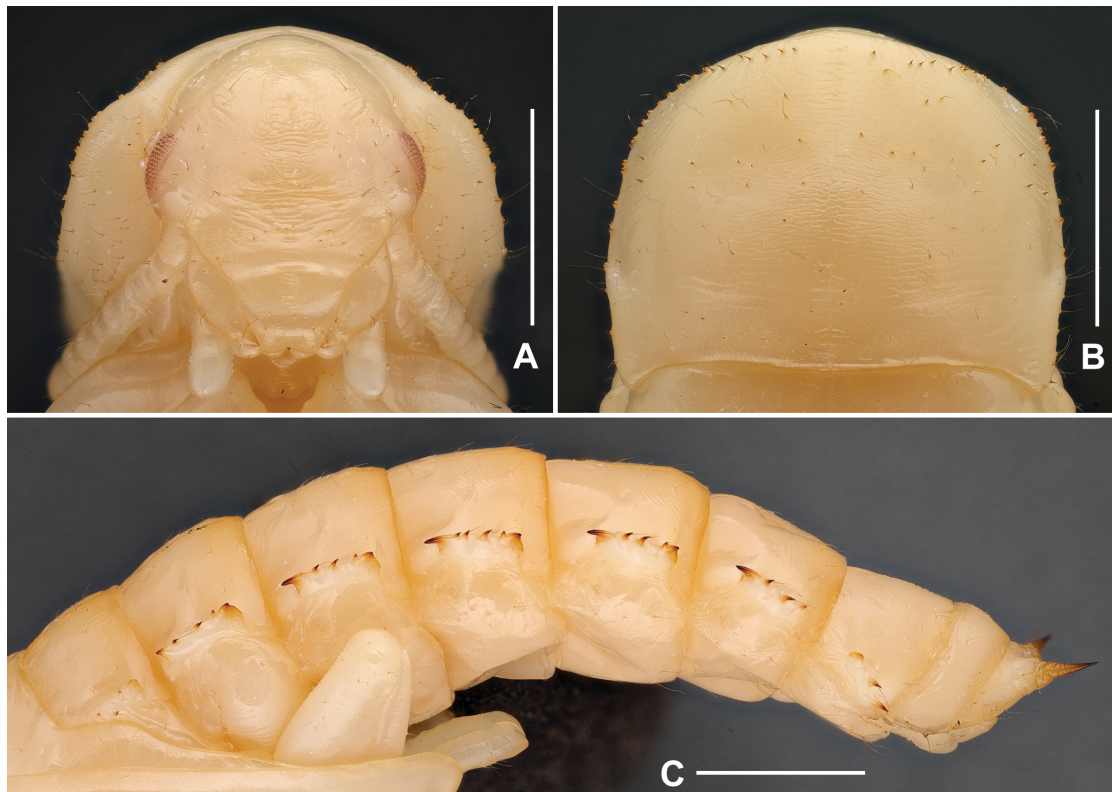


Fig. 6. Diagnostic features of pupa of *Menepihilus medius* Marseul, 1876. A – head; B – pronotum; C – abdomen, lateral view. Scale bars: 2 mm in A–C.

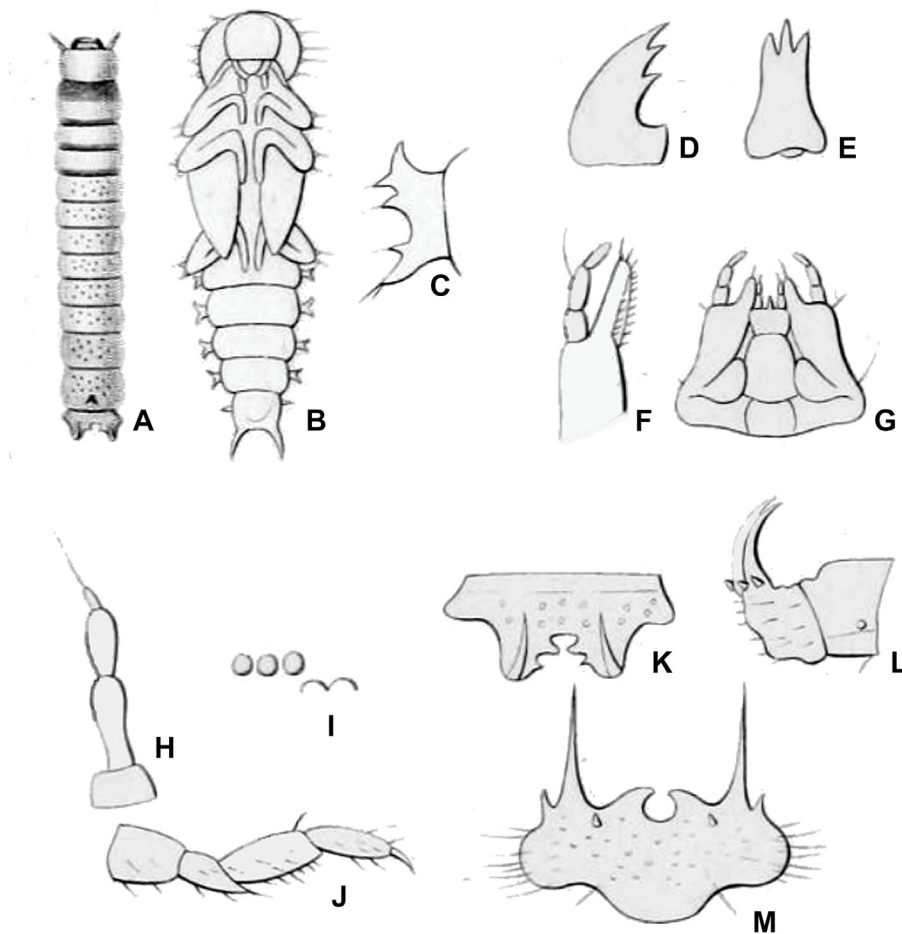


Fig. 7. Diagnostic features of larva and pupa of *Menepihilus cylindricus* Herbst, 1784 (adapted from PERRIS 1863). A – larva, dorsal view; B – pupa, ventral view; C – lateral abdominal projections; D–E – mandible (D – dorsal view, E – right lateral view); F – maxilla with maxillary palp; G – mouthparts, ventral view; H – antenna; I – ocelli; J – leg; K–M – tergite VIII and IX (K – dorsal view, L – lateral view; M – posterior view).

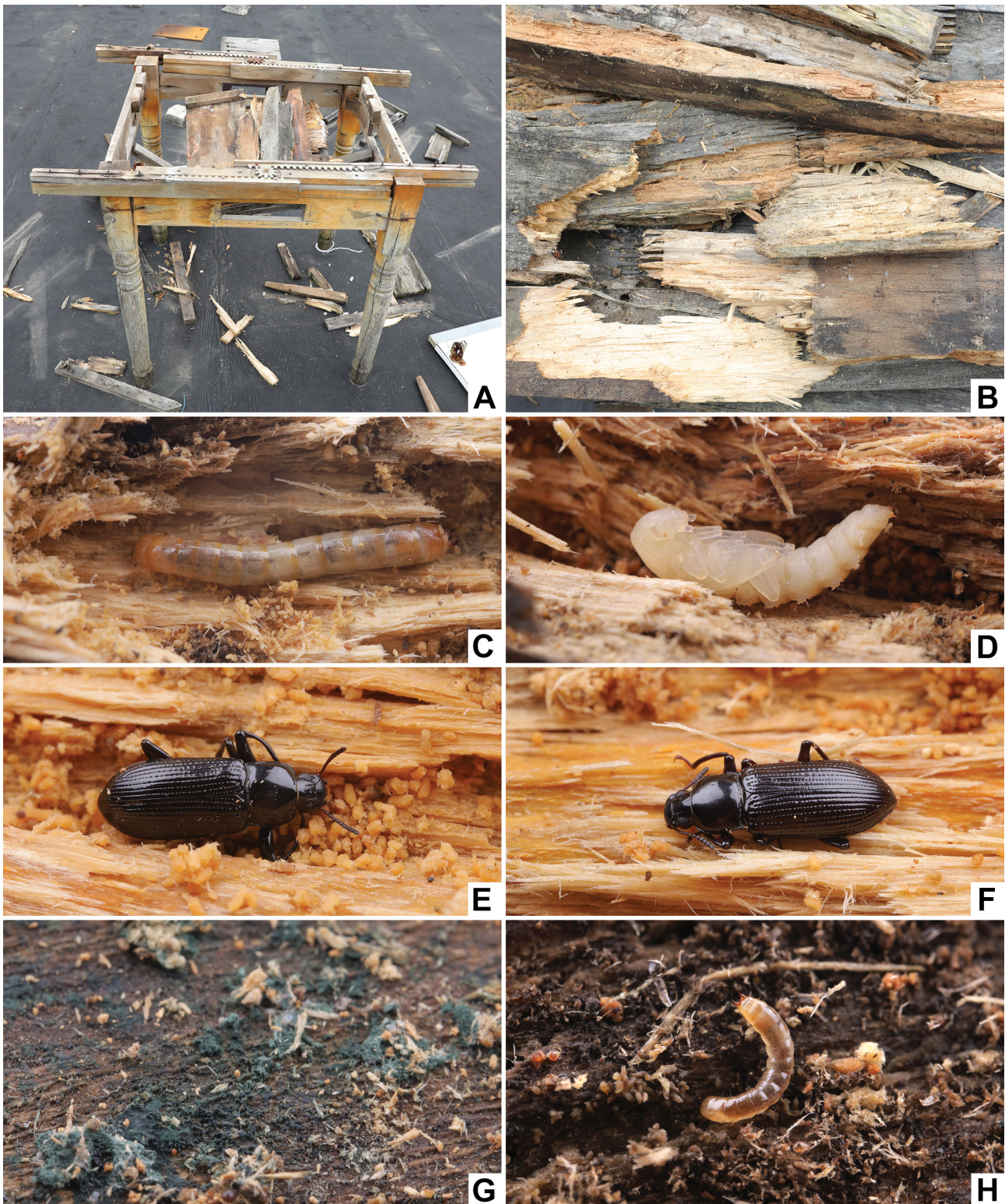


Fig. 8. Habitat of *Menepphilus medius* Marseul, 1876. A – the decaying wooden table preserved outdoors where the population lives; B – microenvironment; C – larva; D – pupa; E – adult, male; F – adult, female; G – mold proliferating on the surface of the decaying wood under laboratory conditions; H – first instar larvae born under laboratory conditions.

**Measurements** (in mm;  $n = 3$ ): Length of head from anterior clypeal margin to occipital constriction 1.35–1.40; maximum width of head 2.19–2.32; length of pronotum along midline 1.98–2.15; maximum width of pronotum 2.50–2.82; length of mesonotum along midline 1.18–1.31; maximum width of mesonotum 2.73–2.98; length of metanotum along midline 1.33–1.60; maximum width

of metanotum 2.87–3.06; length of abdominal tergite IX along midline in dorsal view, not including urogomphi 0.40–0.49; maximum width of abdominal tergite IX 2.19–2.31.

**Pupa. Body** (Figs 5A–C) mainly creamy-yellowish, eyes dark brown. Dorsum slightly convex, sides subparallel to segment VII of abdomen.

**Head** hypognathous (Figs 5A–C, 6A), hidden from dorsal view. Dorsal surface smooth and modified with transverse crease and sparse setae of different lengths. Frons and vertex covered with sparse long erect setae, setae on other parts shorter. Apical margin of clypeus rounded, with several short setae. Labrum with several long setae, anterior margin emarginate. Eyes large, oval, brown. Antenna narrower in basal 1/3, getting wider in apical 2/3, surface covered with sparse setae of different lengths.

**Thorax.** Pronotum (Figs 5B–C, 6B) transverse, surface modified with transverse crease and sparse granules bearing short setae. Anterior and lateral margins curved, along with granules bearing short setae. Posterior margin without granules or setae. Posterior angles acute, with apex blunt. Mesonotum and metanotum narrower and shorter than pronotum, surface covered with sparse short setae.

**Legs** (Fig. 5A) simple, surface smooth, covered with sparse short setae.

**Abdomen.** Abdominal spiracles round. Surface of tergites I–VII (Fig. 6C) with sparse short setae. Lateral margins of tergite I (Fig. 6C) with four short projections, anterior three small, each bearing short seta, posterior one wide, without seta. Lateral margins of tergites II–V (Fig. 6C) with five projections, inner three small, each bearing short seta; other two projections much larger, without seta. Lateral margin of tergite VI (Fig. 6C) with four short projections, anterior one larger, without seta, other three much smaller, each bearing short seta. Lateral margin of tergite VII (Fig. 6C) with three short projections, anterior one larger, round, without seta, other two much smaller and each bearing short seta. Lateral margin of tergite VIII (Fig. 6C) with very small projection, bearing short seta. Tergite IX (Fig. 6C) sparsely with several short setae, and posteriorly with pair of subplate urogomphi.

**Differential diagnosis.** The mature larvae of *Menepphilus medius* and *M. cylindricus* are similar in general habitus (PERRIS 1857, 1863; REITTER 1911). They can be distinguished from each other by different modifications of tergite IX: i) projections on the inner side of base of urogomphi not curved inward in *M. medius* (distinctly curved inward in *M. cylindricus*); ii) lateral sides of tergite IX with two small projections in *M. medius* (with only one small projection in *M. cylindricus*); iii) the ventral projection of tergite IX weakly curved in *M. medius* (strongly curved to dorsal side in *M. cylindricus*). Pupa of *Menepphilus medius* and *M. cylindricus* can be distinguished by different form of the posterior projection of tergite II–V, which is wide and nearly triangular in *M. medius* and much narrower in *M. cylindricus*.

**Biology.** Biological information on the genus *Menepphilus* remains scarce. REITTER (1911) noted that larvae and adults live under the bark of old oaks and willow stumps, as well as under the shingles of house roofs. Based on our observations, adults of *M. medius* feed on fruiting fungal bodies growing on decaying wood surfaces, regardless

of their fresh or dried state, while the larvae function as typical decomposers of decaying wood. Although adults successfully laid eggs and larvae hatched in the laboratory (Fig. 8H), we were only able to provide them with the decaying wood from which adults were collected, and cannot evaluate their preference for the state or type of decaying wood. Under laboratory conditions, mold often proliferates on the surface of decaying wood (Fig. 8G), and completing the entire life cycle of *M. medius* in laboratory setting remains quite challenging.

**Distribution.** Southern China (Fujian, Jiangxi, Guangxi, Zhejiang, Guizhou, Taiwan), Japan, Vietnam, Laos, West Malaysia (SCHAWALLER & BELLERSHEIM 2024).

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