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A DESCRIPTION OF THE FIRST INSTAR OF *MATUS OVATUS* (COLEOPTERA: DYTISCIDAE)

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Abstract

The first instar of *Matus ovatus* Leech is described and illustrated. The analysis of the primary chaetotaxy of legs, head, and last abdominal segment of *M. ovatus* revealed no significant differences between this species and the previously described *M. bicarinatus*. Undescribed primary anatomical features of the tribe Matini presented herein include (1) a tentative identification of anterior tentorial pits and fragments of the anterior tentorial arms, (2) anterior protergal modifications and chaetotaxy, and (3) complete sclerotization of the seventh abdominal segment. Differences in mandibular morphology permit identification of first instars of *M. ovatus* and *M. bicarinatus* in the eastern United States.

Key Words: *Matus ovatus,* larval morphology, immature stage, Dytiscidae

Resumen

Primer estadio de *Matus ovatus* Leech se de describen e ilustran. El análisis de la quetotaxia principa de las piernas, la cabeza, y el ultimo segmento abdominal de *M. ovatus* no revélo diferencias significativas entre esta especia y la na descrito anteriormente *M. bicarinatus*. No descritos características anatómicas primaria de la tribu Matini presentaron en el presente incluyen (1) Una identificación provisional de pozos tentorial anterior y fragmentos de los brazos tentorial anterior, (2) protergal modificaciones anterior y quetotaxia, y (3) esclerotización completa del séptimo segmento abdominal. Las diferencias en la morfología de la mandíbula permitir la identificación del primer estadio de *M. ovatus* y *M. bicarinatus* en el este de Estados Unidos.

Translation provided by the authors.

Matus Aubé, endemic to North America, includes 4 species, *M. bicarinatus* (Say)*, M. leechi* Young*, M. ovatus* Leech, and *M. relictus* Young (Young 1953; Larson et al. 2000). Detailed descriptions of third instars of *Matus ovatus* Leech (Wolfe & Roughley 1985), second instars *M. leechi*, and first, second, and third instars of *M. bicarinatus* (Alarie 1995, 1998; Alarie et al. 2001) are available. Analyses of first instar (primary) morphology has provided information for the development and testing of systematic hypotheses (e.g., Nilsson 1988; Alarie 1995, 1998; Alarie et al. 2001, 2002, 2009). However, primary morphology is available only for *M. bicarinatus.* The objective of this study was to provide the results of an analysis of external morphology of the heretofore undescribed first instar of *M. ovatus* that is inclusive of, but not restricted to, chaetotaxy.

Materials and Methods

Larvae described were collected between 31 V 2007 and 5 VI 2007 from a marsh site in Monroe County, (N33°6.47', W83°47.89'), GA, USA. Larvae were identified as *M. ovatus* on the basis of distribution records (Turnbow & Smith 1983), associations with third instars described by Wolfe & Roughley (1985), and by comparison to descriptions of first instars of *M. bicarinatus* (Alarie 1995, 1998; Alarie et al. 2001).

Descriptions are based on 10 (unless otherwise specified) first instars randomly selected from a larger cohort preserved in 70% glycerated alcohol. Head lengths were measured dorsally from the posterior margin of the head capsule along the coronal suture to the anterior margin of the frontoclypeus, excluding the frontoclypeal sensilla. Head widths were measured dorsally from the widest point. Gape measurements were taken ventrally from the center of the ball of the right and left mandibular articulations, and mandibular length was measured ventrally from the apex of the mandible to the center of the ball of articulation (Wall et al. 2006). Because of the pseudochelate structural modifications, 2 lengths were taken for each pro- and mesothoracic tibia. One length was determined by measuring each from its articulation with the femur to its abutment with the tarsus, and a second length was taken that included the tibial extensions resulting in the pseudo-chelate modifications. Measurements for all other structures were taken along either the greatest lengths or greatest widths. Total leg lengths were calculated based on the sums of the lengths of the coxae, femora, tibiae (excluding lengths that included pseudo-chelate modifications), and tarsi.

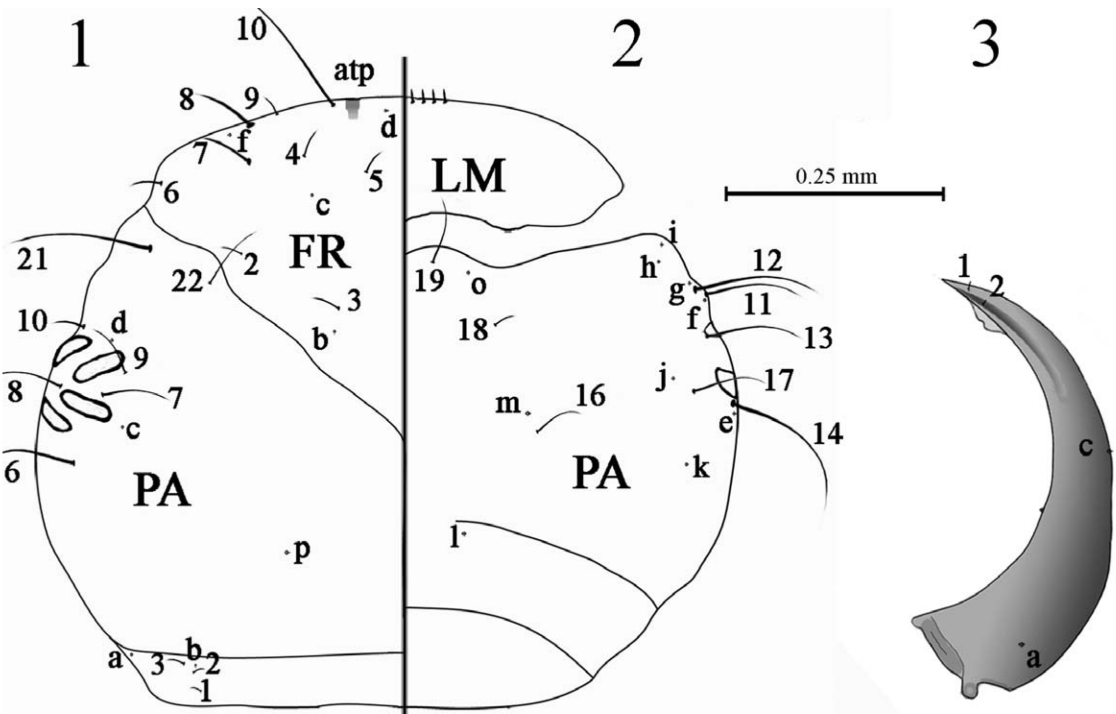
Identification and coding of primary sensilla was based on Nilsson (1988) and Alarie (1995, 1998). Other morphometric terminology utilized is based on Snodgrass (1935), Bousquet & Goulet (1984), and Larson et al. (2000).

Description of the First Instar of *M. ovatus* (Figs. 1-3)

Body. General shape subcylindrical, vermiform with membranous areas generally translucent and sclerotized areas reddish-brown (alcohol preserved specimens).

Head (Figs. 1 and 2). Ovoid with lateral margins inflated laterally, resulting in a continuous arc between bases of antennae and postoccipital suture, occipital region short, defined anteriorly by a prominent occipital suture, posteroventral emargination subtle, length 0.66-0.72 mm ($\bar{x}$ = 0.70 ± 0.02 mm); maximum width, 0.66-0.78 mm ($\bar{x}$ = 0.72 ± 0.04 mm), near cranial midpoint; gape (Wall et al. 2006), 0.46-0.68 mm ($\bar{x}$ = 0.55 ± 0.07); coronal suture, length 0.24-0.44 mm ($\bar{x}$ = 0.31 ± 0.05 mm); frontoclypeus broadly triangular with pair of eggbursters, length 0.36-0.44 ($\bar{x}$ = 0.40 ± 0.02 mm); 8 small spiniform frontoclypeal sensilla present anteriorly; anterior tentorial pits (Fig. 1) (tentative) on or near the clypeolabral suture (Snodgrass 1935), contiguous with remnants of anterior arms (Beutel 1994); adnasale absent (Alarie 1998; Alarie et al 2001); extensively sclerotized labrum directed posteroventrally; capsule with numerous spinulae both dorsally and ventrally; temporal spines absent; posterior tentorial pits visible ventrally; corneal lenses (Shepley-James et al. 2009) arranged in 2 columns of 3 each, lenses nearly equal in size. Antenna. Length**,** 0.46-0.50 mm ($\bar{x}$ = 0.47 ± 0.02 mm); antennomere (AN); AN1, 0.08-0.10 mm ($\bar{x}$ = 0.09 ± 0.01 mm), AN2, 0.12-0.15 mm ($\bar{x}$ = 0.14 ± 0.01 mm), AN3, 0.17-0.21 mm ($\bar{x}$ = 0.18 ± 0.01 mm), with prominent finger-like accessory appendage (A3´), AN4, 0.06-0.08 mm ($\bar{x}$ = 0.07 ± 0.01 mm).

Mouthparts. Mandible, (Fig. 3), length 0.41-0.57 mm ($\bar{x}$ = 0.45 ± 0.05 mm) with pronounced lateral and medial arcs, angle of attack ≈45° (Wall et al. 2006), well-developed mandibular channel, a single prominent distal tooth on the anteroventromedial edge, minute proximal tooth or teeth on some specimens. Maxilla. Cardo plate-like and



Figs. 1-3. *Matus ovatus*. 1, Cranium dorsal view; 2, Cranium, ventral view; 3, Mandible, ventral view. Legend: atp, anterior tentorial pit: FR, frontoclypeus; LM, labrum; PA, parietal. Spiniform and setiform sensilla are identified by numbers with lower case letters used identify campaniform (pore-like) sensilla (Alarie 1998)

triangular; stipes prominent and sub-triangular; finger-like galea subequal in length to that of palpomere (PL); PL1, 0.10- 0.13 mm ($\bar{x}$ = 0.11 ± 0.01 mm), PL2, 0.10- 0.12 mm ($\bar{x}$ = 0.10 ± 0.01 mm), PL3, 0.14- 0.18 mm ($\bar{x}$ = 0.16 ± 0.01 mm). Labium. Prementum short, concave medially, width approximately twice its length; PL1, 0.10- 0.21 mm ($\bar{x}$ = 0.17 ± 0.04 mm), PL2, 0.17- 0.21 mm ($\bar{x}$ = 0.19 ± 0.01 mm).

Thorax (n = 9). Protergum, medial dorsal length 0.36-0.58 mm ($\bar{x}$ = 0.49 ± 0.06 mm), widest posteriorly, bearing 4 prominent sensilla anterolaterally and posterior to antecostal suture, with a precostal inflection widest laterally (Fig. 4); respective meso-, and metatergal dorsal lengths, 0.27-0.38 mm ($\bar{x}$ =0.34 ± 0.04 mm), 0.27-0.38 mm ($\bar{x}$ =0.33 ± 0.05 mm); meso- and metaterga widest medially with prominent sensilla; spiracles absent. Legs (n = 8). Respective total lengths of pro-, meso-, and metalegs, 1.25-1.44 mm ($\bar{x}$ = 1.33 ± 0.06 mm), 1.20- 1.46 mm ($\bar{x}$ = 1.35 ± 0.09 mm), 1.70- 2.09 mm ($\bar{x}$ = 1.90 ± 0.12 mm); metaleg anterior claw shorter than posterior; metatibia and metatarsaus with discreet anteroventral spinulae; respective lengths of pro-, meso-, and meta individual segments: coxae, 0.44-0.50 mm ($\bar{x}$ = 0.47 ± 0.02 mm), 0.42-0.55 mm ($\bar{x}$ = 0.49 ± 0.05 mm), 0.52-0.67 mm ($\bar{x}$ = 0.61 ± 0.05 mm); trochanters, 0.13-0.20 mm ($\bar{x}$ = 0.18 ± 0.02 mm), 0.18-0.22 mm ($\bar{x}$ = 0.20 ± 0.01 mm), 0.19-0.26 mm ($\bar{x}$ = 0.22 ± 0.02 mm); femora, 0.39-0.48 mm ($\bar{x}$ = 0.44 ± 0.03 mm), 0.44-0.51 mm ($\bar{x}$ = 0.47 ± 0.02 mm), 0.44-0.56 mm ($\bar{x}$ = 0.50 ± 0.04 mm); tibiae (excluding pseudo-chelate anomaly), 0.13-0.20 mm ($\bar{x}$ = 0.17 ± 0.02 mm), 0.11-0.23 mm ($\bar{x}$ = 0.17 ± 0.04 mm), 0.37-0.46 mm ($\bar{x}$ = 0.41 ± 0.03 mm); tarsi, 0.20-0.24 mm ($\bar{x}$ = 0.23 ± 0.01 mm), 0.19-0.34 mm ($\bar{x}$ = 0.24 ± 0.05 mm), 0.26-0.44 mm ($\bar{x}$ = 0.39 ± 0.06 mm); respective pro and mesotibial lengths including pseudo-chelate anomaly, 0.23-0.39 mm ($\bar{x}$ = 0.35 ± 0.05mm), 0.26-0.51 mm ($\bar{x}$ = 0.38 ± 0.07mm).

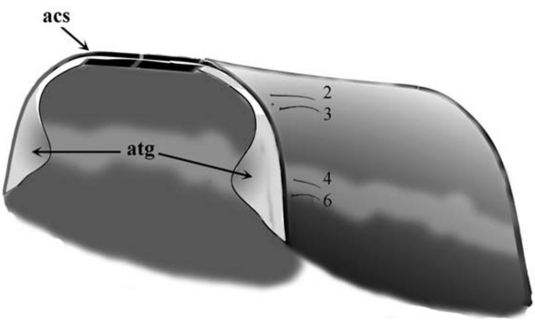


Fig. 4. *Matus ovatus*. Protergum, anterolateral view. Legend: atg, acrotergite; acs, antecostal suture Sensilla are identified by numbers (Bousquet & Goulet 1984).

Abdomen: Segments 1-5 sclerotized dorsally, segment 6 sclerotized dorsally and laterally below dorsopleural line, otherwise membranous; segments 1-6 each with prominent antecostal suture and bearing long, broadly dispersed, robust sensilla; segments 7 and 8 heavily and completely sclerotized, dorsal length of segment 8, 0.92-1.30 mm ($\bar{x}$ = 1.18 ± 0.12 mm), siphon length 0.38-0.62 mm ($\bar{x}$ = 0.54 ± 0.08 mm). Urogomphus. One-segmented, length 0.48- 0.60 mm ($\bar{x}$ = 0.55 ± 0.05 mm).

Chaetotaxy. Primary ancestral and additional sensilla in general as attributed to *M. bicarinatus* on legs, last abdominal segments, urogomphi (Alarie 1995; Alarie et al. 2001), cranium, and cranial appendages (Alarie 1998; Alarie et al. 2001). Differences between *M. ovatus* and *M. bicarinatus* include: Mandible, MN_b not found; femur with 2 additional AV primary sensilla; mesofemoral FE_5 short and spine-like, *vs.* elongate and hair-like (Alarie 1995), or coded for phylogenetic analyses as short and spine-like (Alarie et al. 2001).

Bionomics. First instars of *M. ovatus* were present in small numbers between 25 IV 2008 and 7 VI 2008 in localized areas of a relatively large anthropomorphic marsh. Mature larvae of *Hydrovatus* sp. indet. were frequently collected along with the *Matus* larvae. This lentic system supported dense populations of aquatic macrophytes, including *Egeria densa* Planchon and *Alternanthera philoxeroides* (Mart.) Griseb., with large amounts of sedimentary and detrital materials suspended in the water column. The temporal distribution of larvae indicates that *M. ovatus* commenced oviposition at this site in late Apr and that this activity continued until at least early Jun.

Discussion

Structures present on first instars of *M. ovatus* but not reported for *M. bicarinatus* because of experimental design or objectives (Alarie 1995, 1998; Alarie et al 2001) include (1) apparent anterior tentorial pits (Fig. 1) on or near the clypeolabral suture (Snodgrass 1935), (2) an anterior protergal inflection (Fig. 4) that appears to accommodate an articulation of the roughly ovoid cranium with the protergum; and (3) robust anterolateral protergal sensilla that may be homologous to those reported for first instars of Carabidae (Bousquet & Goulet 1984). The seventh abdominal segment of *M. ovatus* is completely sclerotized. However, the seventh abdominal segment of Matini larvae, including *M. bicarinatus*, was described (Alarie et al. 2001) as having a ventral plate distinct from the tergite.

In southeastern Canada and the U.S. east of the Mississippi River (Larson et al. 2000; Epler 2010), larvae with pseudo-chelate tibial modifications, crania that are less than 0.8 mm in width, and frontoclypeal egg bursters, but with neither temporal spines nor spiracles, will be first instars of either *M. ovatus* or *M. bicarinatus*. Mandibles of first instars of *M. bicarinatus* possess multiple teeth on the ventromedial surface (Alarie 1998; Alarie et al. 2001), whereas first instars of *M. ovatus* possess a single prominent tooth with an occasional minute proximate tooth or teeth on some specimens (Fig. 3). This provides an accessible and objective non-chaetotaxal character for identification of first instars of *M. ovatus* and *M. bicarinatus* within the geographic limits noted above.

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