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Larval morphology and chaetotaxy of *Macrogyrus oblongus* (Boisduval, 1835) (Coleoptera: Gyrinidae)

Mariano C. Michat[a] and Grey T. Gustafson[b]

[a]Laboratory of Entomology, DBBE-FCEN and IBBEA-CONICET, University of Buenos Aires, Buenos Aires, Argentina; [b]Department of Biology and Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM, USA

ABSTRACT

The larvae of the grooved whirligig beetle *Macrogyrus oblongus* (Boisduval, 1835) are described and illustrated including detailed morphometric and chaetotaxic analyses of selected structures. Larvae of *Macrogyrus* Régimbart, 1882 exhibit the characters traditionally recognised as autapomorphies of the Gyrinidae. The first instars bear egg bursters on the parietal, a potential additional autapomorphy. Putative larval autapomorphies of the tribe Dineutini are the presence of additional setae on the mandible, the absence of the seta TR2, and the presence of pore-like additional structures on the ultimate palpomeres. *Macrogyrus* larvae differ from those of the other known dineutine genera (*Andogyrus* Ochs, 1924 and *Dineutus* MacLeay, 1825) in the absence of a neck constriction and in the distal position of the pore LAc. Other useful characters to distinguish genera within Dineutini are the presence or absence of additional setae on the cardo and coxa, and the posterior margin of the lacinia dentate or smooth.

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Introduction

The genus *Macrogyrus* Régimbart, 1882 includes about 40 medium- to large-sized species distributed in Australia, New Caledonia, New Guinea, and the lesser Sunda Islands, characteristically inhabiting low-elevation, slow-moving streams from forested habitats to high-gradient rocky torrents (Miller and Bergsten 2012). It is included in the tribe Dineutini together with the extant genera *Andogyrus* Ochs, 1924, *Dineutus* MacLeay, 1825, *Enhydrus* Laporte, 1834, and *Porrorhynchus* Laporte, 1835, and several extinct genera (Gustafson and Miller 2013). Several subgenera have been described within *Macrogyrus*, although subgeneric classification is in need of revision. *Macrogyrus oblongus* (Boisduval, 1835) is a relatively common species in ponds and slower reaches of small rivers and streams in coastal, forested regions of southern Queensland, New South Wales, and Victoria, and also in the Australian Capital Territory (Watts and Hamon 2010).

The larvae of seven Australian species of *Macrogyrus* (amongst them *M. oblongus*) were documented in a pictorial guide to the Australian whirligig beetles (Watts and Hamon

CONTACT Mariano C. Michat marianoide@gmail.com

2010). In this contribution, the colour pattern of the head and prothorax was used for species identification. However, no descriptions are provided, and only the third instar was considered. Other descriptions or treatments of *Macrogyrus* larvae are lacking in the literature, with the exception of two drawings of the head of an unidentified species in the context of phylogenetic studies (Beutel 1993; Beutel and Roughley 1994). Therefore, a detailed morphological description, including chaetotaxic analysis, of all larval instars of this genus is lacking.

A system of nomenclature for the primary sensilla of larvae of the family Gyrinidae has not been fully developed yet, despite some attempts to name the setae and pores in some genera based on comparisons with the patterns observed in other adephagan families (Nilsson 1988; Arndt, Beutel, and Joost 1993; Archangelsky and Michat 2007; Michat, Archangelsky, and Fernández 2010). Although incomplete and subject to improvement based on the discovery of more gyrinid larvae, these studies provide a descriptive template to which larvae of more genera can be incorporated.

In this contribution we study all larval instars of *Macrogyrus oblongus* to provide, for the first time, a detailed description of a larva of this genus, including morphometric and chaetotaxic analyses of the cephalic capsule, head appendages, and legs. Also, we compare the morphological and chaetotaxic characters of *Macrogyrus* with those of other gyrinid genera for which the larvae have been described in detail, and discuss remarkable or interesting findings.

Material and methods

The description provided in this paper is based on six instar I, three instar II, and three instar III specimens collected at the following locality: Australia, Australian Capital Territory, Brindabella Mtns., Gibraltar Falls, 29/III/1996.

The larvae were cleared in lactic acid, dissected, and mounted on glass slides in polyvinyl-lacto-glycerol. Microscopic examination at magnifications up to 1000× and drawings were made using an Olympus CX31 compound microscope equipped with a camera lucida. Drawings were scanned and digitally inked using a Genius PenSketch tablet (KYE Corporation, Taipei, Taiwan). The material is held in the Wallis Roughley Museum of Entomology, Winnipeg, Manitoba, Canada.

The methods and terms used herein follow those employed in previous papers dealing with the larval morphology and chaetotaxy of Gyrinidae. The reader is referred to Archangelsky and Michat (2007) and Michat et al. (2010) for a complete list and additional explanations of the terms used in the present study.

Results

Description of the larvae of *Macrogyrus oblongus* (Boisduval, 1835)

Diagnosis

Larvae of *Macrogyrus* can be distinguished from those of other known gyrinid genera by the following combination of characters: cephalic capsule not constricted at level of occipital region (Figures 1A, 1B, 3F); occipital suture absent; coronal suture short; medial lobe of FR with four relatively well defined teeth (Figures 1A, 3F); lacinia serrate on posterior

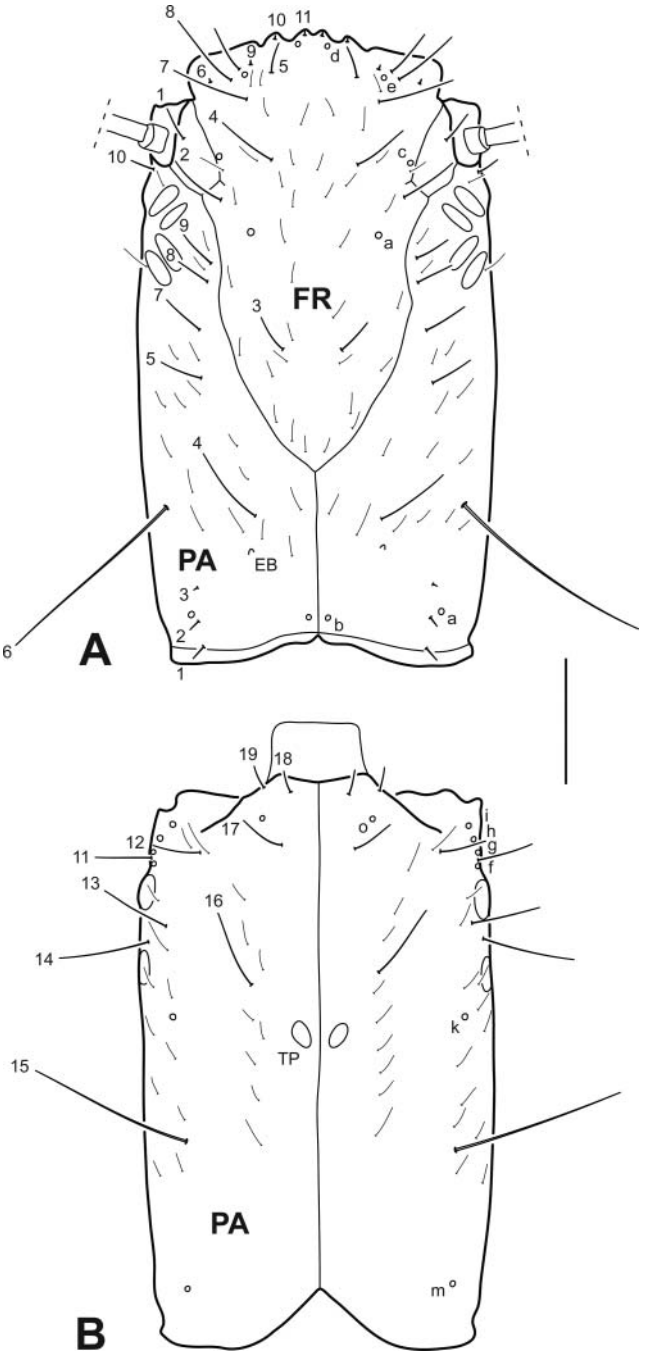

Figure 1. *Macrogyrus oblongus* (Boisduval, 1835), first-instar larva: (A) cephalic capsule, dorsal view; (B) cephalic capsule, ventral view. Numbers and lowercase letters indicate primary setae and pores, respectively. Additional setae not labelled. EB — egg bursters; FR — frontoclypeus; PA — parietal; TP — tentorial pits. Scale bar = 0.20 mm.

margin, not indented apically (Figure 2C and 2D); claws lacking basoventral spinulae (Figure 3A and 3B); tracheal gills bearing long spinulae; terminal hooks subequal in length (Figure 3C); seta FR3 short, hair-like (Figure 1A); seta PA6 long, hair-like (Figure 1A); MN with additional setae (instar I) (Figure 2E); cardo with a single additional seta (Figure 2D); pore MXg proximal (Figure 2D); pore MXj distal (Figure 2C); MP1, MP2, and LP1 lacking minute pore-like additional structures (Figure 2C and 2D); pore LAc distal (Figure 2F); seta CO12 medial (Figure 3B); CO lacking additional setae (Figure 3A and 3B); seta TR2 absent (Figure 3A); seta TR5 long (Figure 3B); CO with secondary setae (instars II and III); abdominal segment X lacking ventral spinulae (Figure 3C).

Instar I (Figures 1A, 1B, 2A–G, 3A–E)

Colour. Cephalic capsule testaceous except brown dorsal macula covering FR (except a reduced posterior area) and brown ventral macula covering anterior half of PA (except lateral margins); MN brown, remaining head appendages testaceous; prothoracic sclerite brown on anterior half, testaceous on posterior half; narrow transverse dorsal sclerite between pronotum and mesonotum light brown, darker on central portion; rest of thorax and legs testaceous; abdomen testaceous except terminal hooks light brown.

Body. Elongate, parallel sided, head and pronotum strongly sclerotised, rest of thorax and abdomen soft. Measurements and ratios that characterise the body shape are shown in Table 1.

Head. Cephalic capsule (Figure 1A and 1B). Subrectangular, longer than broad, parallel-sided, lacking neck; occipital foramen slightly emarginate dorsally, more deeply emarginate ventrally; occipital suture absent; coronal suture short; frontal sutures U-shaped, extending to antennal bases; posterior tentorial pits visible ventromedially; whole surface with reticulation; FR elongate, anterior margin with three lobes; medial lobe slightly produced anteriorly, with four relatively well defined teeth; lateral lobes well developed, truncate, not projected beyond medial lobe; PA with minute rounded egg bursters on posterior surface, and six stemmata at each side, four dorsal, forming a trapezoid, and two ventral. Antenna (Figure 2A and 2B). Moderately long, slender, slightly longer than HW, composed of four antennomeres; A1 shortest, A2, A3, and A4 longest, subequal in length; A3 with two minute structures (probably spinulae or pores) on ventrodistal surface, and two subapical flat plates on inner margin, distal one interpreted as the sensorium (A3') which does not protrude; A4 with a subapical flat sensorial plate on inner margin, accompanied by two minute structures (probably spinulae or pores). Mandible (Figure 2E). Relatively elongate, curved, broad basally, distal half projected inward, apex sharp; inner margin toothed on distal third; retinaculum absent, although one of the teeth may be interpreted as that structure; mandibular channel present. Maxilla (Figure 2C and 2D). Well developed, prominent; cardo strongly developed, subquadrate, bearing a group of minute spinulae on dorsal surface; stipes short, broad, subtrapezoidal, bearing a lacinia and GA on distal inner margin and a PPF on distal outer margin; lacinia well developed, slender, inner margin slightly dentate; GA elongate, two-segmented, basal segment shorter, globose, distal segment longer, narrow, apically pointed; PPF short, palpomere-like, projected apicodorsally in a subtriangular process; MP long, composed of three palpomeres separated by oblique joints; MP1 shortest, MP2 slightly longer than MP1, MP3

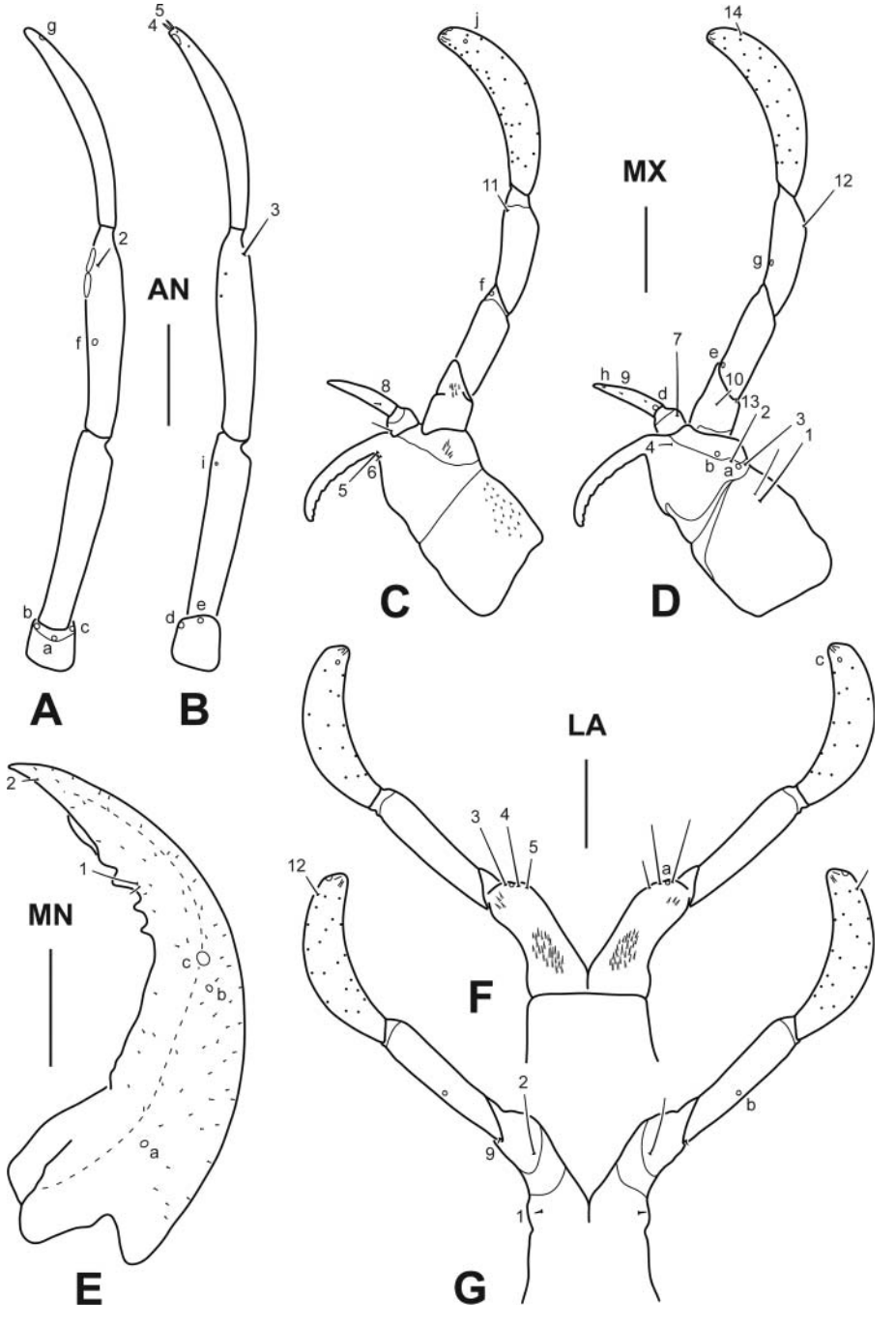

Figure 2. *Macrogyrus oblongus* (Boisduval, 1835), first-instar larva: (A) right antenna, dorsal view; (B) left antenna, ventral view; (C) right maxilla, dorsal view; (D) left maxilla, ventral view; (E) right mandible, dorsal view; (F) labium, dorsal view; (G) labium, ventral view. Numbers and lowercase letters indicate primary setae and pores, respectively. Additional setae and pores not labelled. Scale bar = 0.10 mm.

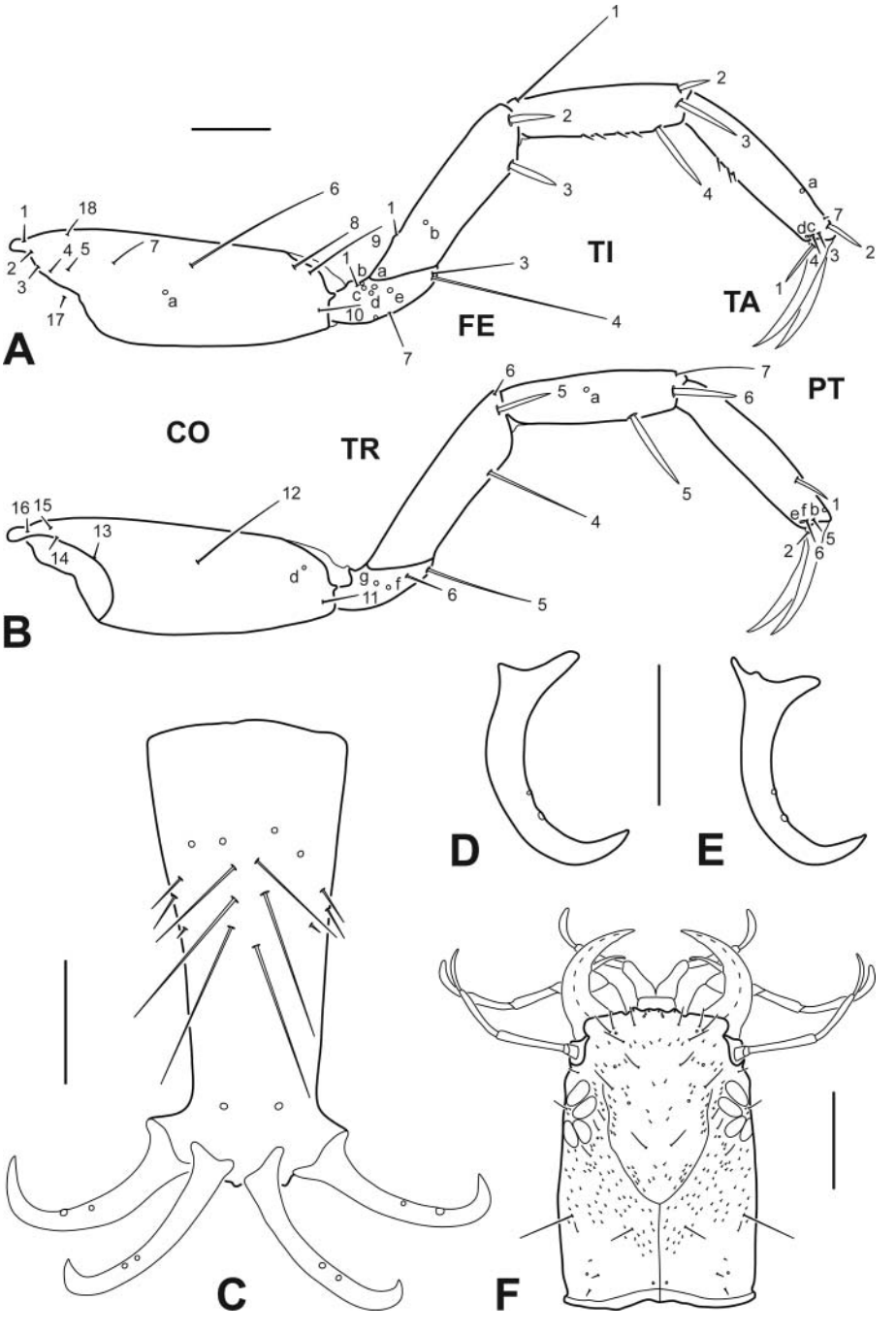

Figure 3. *Macrogyrus oblongus* (Boisduval, 1835): (A—E) first-instar larva: (A) left metathoracic leg, anterior view; (B) right metathoracic leg, posterior view; (C) abdominal segment X, ventral view; (D) medial hook, lateral view; (E) lateral hook, lateral view; (F) third-instar larva, head, dorsal view. Numbers and lowercase letters indicate primary setae and pores, respectively. Additional pore on trochanter and sensilla on abdominal segment X not labelled. Scale bars = 0.15 mm for Figures A—E and 0.70 mm for Figure F.

Table 1. Measurements and ratios for the larvae of *Macrogyrus oblongus* (Boisduval, 1835).

Measure	Instar I ($n = 3$)	Instar II ($n = 3$)	Instar III ($n = 3$)
TL (mm)	8.60–12.00	11.30–18.40	16.40–29.60
MW (mm)	0.60–0.90	1.00–1.70	1.90–2.80
HL (mm)	0.96–0.99	1.40–1.44	2.12–2.22
HW (mm)	0.59–0.61	0.88–0.92	1.46–1.49
FRL (mm)	0.69–0.73	1.01–1.04	1.44–1.51
OCW (mm)	0.51–0.55	0.75–0.80	1.38–1.42
COL (mm)	0.27–0.28	0.38–0.40	0.67–0.71
HL/HW	1.56–1.69	1.56–1.58	1.46–1.49
HW/OCW	1.12–1.16	1.14–1.19	1.05–1.06
COL/HL	0.27–0.28	0.27–0.28	0.32–0.33
FRL/HL	0.72–0.73	0.72–0.73	0.67–0.68
A/HW	1.04–1.13	1.01–1.04	0.89–0.93
A1/A3	0.19–0.22	0.21–0.23	0.23–0.26
A2/A3	0.88–0.93	1.18–1.21	1.34–1.44
A4/A3	1.05–1.10	0.91–0.93	0.76–0.79
MNL/MNW	2.87–3.14	2.67–2.87	2.82–2.92
MNL/HL	0.44–0.45	0.43–0.46	0.44–0.45
A/MP	1.29–1.33	1.25–1.33	1.29–1.34
GA/MP1	0.75–0.80	0.60–0.63	0.45–0.49
PPF/MP1	0.65–0.68	0.43–0.57	0.39–0.46
MP1/MP2	0.81–0.83	0.96–1.00	1.12–1.13
MP3/MP2	1.42–1.59	1.19–1.29	0.93–0.94
MP/LP	1.25–1.33	1.39–1.48	1.42–1.49
LP2/LP1	1.05–1.14	0.88–0.89	0.61–0.67
L3 (mm)	2.14–2.17	3.09–3.26	4.76–5.07
L3/L1	1.26–1.29	1.31–1.34	1.35–1.36
L3/L2	1.10–1.12	1.11–1.13	1.14
L3/HW	3.49–3.69	3.45–3.63	3.27–3.41
L3 (CO/FE)	1.42–1.47	1.35–1.38	1.31–1.37
L3 (TI/FE)	0.82–0.84	0.77–0.78	0.75–0.76
L3 (TA/FE)	0.88–0.93	0.79–0.81	0.70–0.73
L3 (CL/TA)	0.61–0.67	0.49–0.51	0.48–0.53
MH/LH	0.94–1.00	1.06–1.07	1.00–1.02

longest. Labium (Figure 2F and 2G). Well developed, prominent; prementum divided longitudinally into two subcylindrical halves fused basally, each half bearing minute spinulae on dorsal surface and projected apicodorsally in a subtriangular process; LP long, composed of two subequal palpomeres separated by oblique joints.

Thorax. Long, narrow, subcylindrical; pronotum longest and narrowest, meso- and metanotum subequal; protergite well developed, covering almost whole segment dorsally, anterior margin truncate, lateral and posterior margins rounded; membrane between pronotum and mesonotum with a single narrow transverse sclerite; both sclerites with sagittal line, lacking anterior transverse carina; meso- and metaterga lacking sclerites; ventral surface membranous except for two small sclerites on anterior half of prothorax, and small sclerites on the regions of articulation of coxae; spiracles absent. Legs (Figure 3A and 3B). Long, slender, composed of six segments; L3 longest, L1 shortest; CO elongate, robust, TR short, entire, FE, TI, and TA slender, subcylindrical, PT with two long, slender, slightly curved claws, posterior claw shorter than anterior claw; tibiae and tarsi with ventral spinulae.

Abdomen. Ten-segmented, long, narrow, subcylindrical, entirely membranous; segments I–VIII similar in shape and size (segment VIII somewhat smaller), bearing a tracheal gill on posterolateral angle; segment IX visibly narrower, bearing two tracheal gills on

posterolateral angle; tracheal gills slender, plumose, those of segment IX longer than the others; all tracheal gills bearing both an anterior and a posterior row of long setiform spinulae, those of segment I and, to a lesser extent segment II with less spinulae; segment X (Figure 3C) smallest and narrowest, pygopod-like, arising on posteroventral surface of segment IX, lacking gills and ventral spinulae, carrying four strongly sclerotised terminal hooks which are subequal in length (Figure 3C–E).

Chaetotaxy. Frontoclypeus (Figure 1A). Medial lobe of anterior margin with two spine-like setae (FR10, FR11), one short hair-like seta (FR5), and one pore (FRd); lateral lobe of anterior margin with two minute spine-like setae (FR6, FR9), two short hair-like setae (FR7, FR8), and one pore (FRe); lateral margin with two short hair-like setae (FR1, FR2) and two pores (FRa, FRc) on distal third and one short hair-like seta (FR3) on basal third; central portion with one short hair-like seta (FR4); surface with numerous short hair-like additional setae. Parietal (Figure 1A and 1B). Dorsal surface with one short hair-like seta (PA10) posterior to antennal base, a longitudinal row of four short hair-like setae (PA5, PA7, PA8, PA9) close to frontoclypeal margin, one short hair-like seta (PA4) and one long hair-like seta (PA6) on basal third, close to egg bursters, and three short spine-like setae (PA1, PA2, PA3) and two pores (PAa, PAb) basally; ventral surface with three short hair-like setae (PA17, PA18, PA19) and one pore (PAo) on anteromedial region, four short hair-like setae (PA11, PA12, PA13, PA14) and four pores (PAf, PAg, PAh, PAi) on anterolateral angle, one short hair-like seta (PA16) and one pore (PAk) at mid length, one long hair-like seta (PA15) on basal third, and one pore (PAm) basally; dorsal and ventral surface with several short hair-like additional setae (except on basal region). Antenna (Figure 2A and 2B). A1 with three pores (ANa, ANb, ANc) on dorsal surface and two pores (ANd, ANe) on ventral surface; A2 with one minute pore (ANi) on ventroapical region; A3 with one pore (ANf) on dorsomedial region, one short hair-like seta (AN2) on dorsodistal portion and one short hair-like seta (AN3) on ventrodistal portion; A4 with one pore (ANg) on dorsodistal portion and two minute spine-like setae (AN4, AN5) at apex. Mandible (Figure 2E). Dorsal surface with one pore (MNa) on basal fourth, two pores (MNb, MNc) at mid length, one long hair-like seta (MN1) on distal third, and one short hair-like seta (MN2) near tip; dorsal surface with numerous minute additional setae. Maxilla (Figure 2C and 2D). Cardo with one short hair-like seta (MX1) and one short hair-like additional setae on ventral surface; stipes with two short hair-like setae (MX2, MX3) and two pores (MXa, MXb) on ventroexternal margin, one very short seta (MX4) ventrally near base of lacinia, and one short hair-like seta (MX5) and one minute seta (MX6) dorsally at base of lacinia; proximal segment of GA with one short hair-like seta (MX7) on anteroventral margin and one short hair-like additional seta on posterodorsal margin; distal segment of GA with one minute seta (MX8) on dorsoproximal surface, two pores (MXd, MXh) on ventroproximal and ventrodistal surface respectively, and one minute seta (MX9) ventrally on distal third; PPF with one short hair-like seta (MX10) on ventral margin; MP1 with one pore (MXe) and one minute seta (MX13) on ventroproximal portion, and one pore (MXf) on dorsodistal portion; MP2 with one pore (MXg) on ventroproximal portion and two short hair-like setae (MX11, MX12) on dorsodistal and ventrodistal portions respectively; MP3 with one pore (MXj) and one short hair-like seta (MX14) near apex; MP3 with several minute pore-like additional structures both on dorsal and ventral surface. Labium (Figure 2F and 2G). Prementum with three short hair-like

setae (LA3, LA4, LA5) and one pore (LAa) on dorsodistal surface, one short hair-like seta (LA2) on ventrodistal surface, and one minute seta (LA1) on ventroproximal surface; LP1 with one minute seta (LA9) on ventroproximal portion and one pore (LAb) on ventroexternal margin; LP2 with one pore (LAc) and one short hair-like seta (LA12) near apex; LP2 with several minute pore-like additional structures both on dorsal and ventral surface. Thorax. Surface of thoracic terga with several hair-like setae. Legs (Figure 3A and 3B). Anterior surface of CO with six short spine-like setae (CO1, CO2, CO3, CO4, CO5, CO17) and two short to very short hair-like setae (CO7, CO18) on proximal portion, one long hair-like seta (CO6) and one pore (COa) on medial portion, and three short hair-like setae (CO8, CO9, CO10) on distal portion; posterior surface of CO with four very short spine-like setae (CO13, CO14, CO15, CO16) on proximal portion, one long hair-like seta (CO12) on medial portion, and one short spine-like seta (CO11) and one pore (COd) on distal portion; anterior surface of TR with one short hair-like seta (TR1) on dorsal margin, one long (TR4) and one short (TR3) hair-like setae on ventrodistal margin, five pores (TRa, TRb, TRc, TRd, TRe) on central portion, and one short hair-like seta (TR7) and one additional pore on ventral margin; posterior surface of TR with one long spine-like seta (TR5) and one short hair-like seta (TR6) on ventrodistal margin, and two pores (TRf, TRg) on central portion; anterior surface of FE with one short hair-like seta (FE1) and one pore (FEb) on proximal portion, and two short spine-like setae (FE2, FE3) on distal portion; posterior surface of FE with one long spine-like seta (FE4), one short spine-like seta (FE5), and one short hair-like seta (FE6) on distal portion; anterior surface of TI with one long hair-like seta (TI1) on proximal portion and three short spine-like setae (TI2, TI3, TI4) on distal portion; posterior surface of TI with one pore (TIa) on central portion, and two short spine-like setae (TI5, TI6) and one long hair-like seta (TI7) on distal portion; anterior surface of TA with three short spine-like setae (TA2, TA3, TA4), one minute seta (TA7), and three pores (TAa, TAc, TAd) on distal portion; posterior surface of TA with three short spine-like setae (TA1, TA5, TA6) and three pores (TAb, TAe, TAf) on distal portion; anterior surface of PT with one short spine-like seta (PT1) on basoventral portion; posterior surface of PT with one very short spine-like seta (PT2) on basoventral portion. Abdomen. Segments I–IX with some short hair-like setae on dorsal and ventral surfaces; tracheal gills with one distal pore and one long hair-like seta at tip; ventral surface of segment X (Figure 3C) with four pores and several setae on basal half and two pores on distal half; terminal hooks (Figure 3D and 3E) with two pores at distal half to distal third of ventral margin.

Instar II

As instar I except for the following features:

Colour. Same pattern but somewhat darker in general.

Body. Measurements and ratios that characterise the body shape are shown in Table 1.

Cephalic capsule. Egg bursters absent.

Antenna. A2 the longest, A3 and A4 subequal in length, somewhat shorter than A2.

Maxilla. MP1 and MP2 subequal in length, somewhat shorter than MP3.

Labium. LP1 slightly longer than LP2.

Abdomen. Tracheal gills of segments I and II with densely distributed spinulae.

Chaetotaxy. Cardo with four to five short hair-like secondary setae; CO with an anterodorsal row of few short hair-like secondary setae; ventral surface of TR sometimes with one short hair-like secondary seta.

Instar III (Figure 3F)

As instar II except for the following features:

Colour. Same pattern but somewhat darker in general.

Body. Measurements and ratios that characterise the body shape are shown in Table 1.

Antenna. Slightly shorter than HW; A3 longer than A4.

Maxilla. MP1 longest, MP2 and MP3 subequal in length, somewhat shorter than MP1.

Labium. LP1 considerably longer than LP2.

Abdomen. Spiracles present on dorsolateral margin of segments I–III.

Chaetotaxy. Cardo with seven to eight short hair-like secondary setae; anterodorsal row of secondary setae on CO more numerous; ventral surface of CO with few short hair-like secondary setae; ventral surface of TR with one to two short hair-like secondary setae.

Discussion

The larvae of *Macrogyrus* share with the other known gyrinid genera several unique character states that are considered autapomorphies of the family: well-developed cardo, completely divided prementum, presence of lateral abdominal tracheal gills, and presence of four terminal hooks on the pygopod (Beutel and Roughley 1994, 2005). A less sclerotised body, presence of one additional sensorial plate on the third antennomere, close to typical (although not protruding) sensorial plate, and a well-developed lacinia can also be mentioned as very characteristic features (possibly autapomorphies) of gyrinid larvae (Archangelsky and Michat 2007). As mentioned by Michat et al. (2010), the first instars of *Gyrinus* Geoffroy, 1762 and *Andogyrus* bear spiniform egg bursters on the posterolateral surface of the parietal. This is interesting and may represent an additional autapomorphy for the family, as long as in the other adephagan families the egg bursters are located on the frontoclypeus (first instar of Meruidae not known). The presence of very small egg bursters in the first instar of *Macrogyrus* (Figure 1A), located in approximately the same position as in *Gyrinus* and *Andogyrus*, reinforces the hypothesis that this character state may be extended within Gyrinidae.

First-instar larvae of *Macrogyrus* share with other known members of the tribe Dineutini (i.e., *Dineutus* and *Andogyrus*; Arndt et al. 1993; Archangelsky and Michat 2007) the presence of numerous very short to minute additional setae on the dorsal and external surfaces of the mandible (Figure 2E). Information for this character outside Dineutini is scarce as the first instar of only one non-dineutine genus (*Gyrinus*; Michat et al. 2010) is known. Although the first instar of *Gyrinus* lacks additional setae on the

mandible, the phylogenetic significance of this character remains to be tested when young larvae of more genera are studied. On the other hand, the three known genera of Dineutini lack the primary seta TR2 on the trochanter (Figure 3A). This seta is present in the known members of Gyrinini (three species of *Gyrinus*; Nilsson 1988; Michat et al. 2010) and Orectochilini (one species of *Orectochilus* Dejean, 1833; Nilsson 1988). Another character to follow with attention is the presence in *Macrogyrus*, *Dineutus*, and *Andogyrus* of numerous minute pore-like additional structures on the ultimate maxillary and labial palpomeres (Figure 2C, 2D, 2F, and 2G). So far, outside the Dineutini these structures were evaluated in *Gyrinus*, which presents only a few of them, almost entirely restricted to the dorsal surface of distal half (Michat et al. 2010). Beutel and Roughley (1994) mentioned an extremely long and slender cardo as a synapomorphy of the three dineutine genera mentioned above. According to our observations, this character is not so clear in the first instar, with *Macrogyrus* exhibiting a cardo only slightly longer than *Gyrinus* (compare figures 6 and 7 in Michat et al. 2010 with Figure 2C and 2D in the present paper). In the first instars of *Andogyrus* and *Dineutus* the difference is more obvious with respect to *Gyrinus*, and the character is certainly more clear in the third instar, for which it can be regarded as another potential autapomorphy of Dineutini.

The following characters are potentially useful to distinguish genera within the tribe Dineutini, keeping in mind that we are using a single species as representative of the genera. Larvae of *Macrogyrus* lack a distinct neck constriction (Figures 1A, 1B, 3F), whereas those of *Andogyrus* and *Dineutus* are characterised by the presence of a more or less developed neck constriction. The inner (or posterior) margin of the lacinia is slightly but distinctly dentate in *Macrogyrus* (Figure 2C and 2D) and *Andogyrus*. In *Dineutus* this margin is smooth. An additional seta on the cardo is present in *Macrogyrus* (Figure 2D) and *Dineutus*, which is absent in *Andogyrus*. The labial primary pore LAc is distal in *Macrogyrus* (Figure 2F) but submedial in *Andogyrus* and *Dineutus*. Additional setae are present on the coxa in *Andogyrus*. These setae are lacking in *Macrogyrus* (Figure 3A and 3B) and *Dineutus*. The distribution of these characters produces no clear picture about the phylogenetic relationships amongst the dineutine genera. A formal analysis including more genera as well as outgroup taxa should be conducted to study this aspect in more detail.

The present paper provides the first detailed description of all larval instars of a species of *Macrogyrus*. The lack of similar treatments for other species of the genus, however, prevents any attempt of evaluation of the morphological and chaetotaxic characters useful in species identification within the genus. As mentioned above, the mature larvae of seven Australian *Macrogyrus* species were documented in a pictorial guide to the Australian whirligig beetles (Watts and Hamon 2010). In this contribution, using photographs of the head and prothorax in dorsal view, the authors give the colour pattern of the head and pronotum as a useful character for species identification. However, no morphological treatment is provided, and therefore comparisons in the context of this study are not possible. Additional studies, including first-instar chaetotaxy, are necessary to discover useful characters for species separation.

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