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Larval description and chaetotaxic analysis of *Gyrinus monrosi* MOUCHAMPS, 1957 (Coleoptera: Gyrinidae)

M.C. MICHAT, M. ARCHANGELSKY & L.A. FERNÁNDEZ

Abstract

The three larval instars of the Neotropical *Gyrinus* (*Oreogyrinus*) *monrosi* MOUCHAMPS, 1957 (Coleoptera: Gyrinidae) are described and illustrated for the first time including detailed morphometric and chaetotaxic analyses of the cephalic capsule, head appendages and legs. Larvae of *Gyrinus* MÜLLER, 1764 are diagnosed by the following combination of characters: cephalic capsule not constricted at level of occipital region; medial lobe of frontoclypeus with four inconspicuous teeth; presence of a mandibular retinaculum; lacinia broad, indented apically; claws with basoventral spinulae. Larvae of the subgenus *Oreogyrinus* OCHS, 1935 have the medial hooks of the abdominal segment X slightly longer than the lateral hooks, whereas in the subgenus *Neogyrinus* HATCH, 1925 the medial hooks are much shorter than the lateral ones. Regarding chaetotaxy, *Gyrinus* differs from *Andogyrus* OCHS, 1924 and *Dineutus* MACLEAY, 1828 in the absence of additional setae on the mandible, the distal position of pore MXg and the presence of seta TR2, from *Orectochilus* LACORDAIRE, 1835 in the shape of the pretarsal setae PT1 and PT2, and from all other gyrinid genera with known larvae except *Aulonogyrus* MOTSCHULSKY, 1853 in the presence of a row of robust hook-like additional setae on the dorsointernal margin of the stipes.

Key words: Coleoptera, Gyrinidae, larva, chaetotaxy, morphometry, Neotropical Region.

Introduction

Gyrinus MÜLLER, 1764 is one of the 12 genera that form the family Gyrinidae, commonly known as the whirligig beetles. This genus includes generally dark beetles and has an almost worldwide distribution, being absent from New Zealand, Polynesia and southern South America (OCHS 1969, OYGUR & WOLFE 1991, BEUTEL & ROUGHLEY 2005). In the Holarctic Region the species of *Gyrinus* live mainly in calm waters, but in South America they can be found both in calm and running waters (OCHS 1969). The adults of most species are generally active during the day, in contrast to those of other genera that are preferably active at night. *Gyrinus monrosi* MOUCHAMPS, 1957 was originally described as a subspecies of *G. argentinus* STEINHEIL, 1869 and later raised to specific rank by OCHS (1958). It has a restricted distributional range, being endemic from the Ventania formation, a mountainous system that emerges from the pampean plains in southeastern Buenos Aires Province, central Argentina.

Larvae of *Gyrinus* generally live hidden among the debris or rocks at the bottom of water bodies (OCHS 1969), and in general have received much fewer attention than the adults. This is reflected in the fact that the larval morphology is known for only a very small fraction of the approximately 140 species known as adult. Therefore, studies describing the larval morphology and chaetotaxy of members of this genus are much needed. As demonstrated over the past recent years, larval chaetotaxy within Adephaga is a particularly significant source of characters both for diagnostic and phylogenetic purposes (ALARIE et al. 2004, ALARIE & BILTON 2005, ARCHANGELSKY & MICHAT 2007, MICHAT & ALARIE 2009, MICHAT & TORRES 2009). The

development of a system of nomenclature to name primary sensilla (setae and pores) in first-instar larvae of several adephegagan families (e.g. ALARIE 1991, 1995, 1998, ALARIE et al. 2004, ALARIE & BILTON 2005, ARCHANGELSKY & MICHAT 2007) has brought great progress because it allows for exploration of new characters that are phylogenetically and diagnostically very useful. However, a system of nomenclature for the primary sensilla of larvae of Gyrinidae has not been fully developed yet, though there are some attempts to name the setae and pores in some genera based on comparisons with the patterns observed in other families (NILSSON 1988, ARNDT et al. 1993, ARCHANGELSKY & MICHAT 2007). As primary chaetotaxy has not been explored for most genera, a comprehensive treatment of gyrid sensilla is still a challenge.

In this opportunity we take advantage of the recent discovery of all larval instars of *Gyrinus monrosi* to provide a detailed description of a *Gyrinus* larva, including for the first time a detailed analysis of the chaetotaxy and morphometry of the cephalic capsule, head appendages and legs. Also, comparisons of the morphological and chaetotaxic characters of *Gyrinus* with those of other gyrid genera are presented, and remarkable or interesting features are discussed.

Material and methods

Source of material: Eight specimens of instar I, one of instar II and three of instar III of *G. monrosi* were used for the descriptions. The larvae were collected in association with adults at the following locality: Argentina, Buenos Aires Province, Sierra de la Ventana, Ernesto Tornquist Park, march and december 2006, 1) small creek tributary of Sauce Grande river (sunny flat creek with stony bottom, slow current and vegetated zones of stagnant water), 2) Ventana Creek (mountain creek of relatively high altitude, with low exposure to sun, zones of stagnant water, stony bottom and marginal vegetation). The identification of the larvae is firm since *G. monrosi* is the only species of the subgenus *Oreogyrinus* OCHS, 1935 known from Buenos Aires Province (MICHAT & ARCHANGELSKY, in press). The only other species of the genus *Gyrinus* recorded from that province is *G. (Neogyrinus) ovatus* AUBÉ, 1838 whose distributional range is separated about 500 km from the area where the studied larvae were collected. Also, larvae of the subgenus *Neogyrinus* HATCH, 1925 are easily distinguished from those of *Oreogyrinus* by the relative length of the medial and lateral hooks of the abdominal segment X (CRESPO 1989a, b).

Methods: Specimens were cleared in lactic acid, dissected and mounted on glass slides with polyvinyl-lacto-glycerol. Observation (at magnifications up to 1,000 ×) and drawings were made using an Olympus CX31 compound microscope equipped with a camera lucida. Drawings were scanned and digitally edited. The material is held in the larval collection of M.C. Michat (Laboratory of Entomology, Buenos Aires University, Argentina).

Morphometric Analysis: We employed the terms used in previous papers dealing with the larval morphology of Gyrinidae, Hygrobiidae, Aspidytidae and Dytiscidae (ALARIE et al. 2004, ALARIE & BILTON 2005, ARCHANGELSKY & MICHAT 2007, MICHAT & TORRES 2009). Paired structures of each individual were considered independently. The following measurements were taken (with abbreviations shown in parentheses). Total length (excluding terminal tracheal gills) (TL); maximum width (excluding tracheal gills) (MW); head length (HL) (total head length including the frontoclypeus, measured medially along the epicranial stem); maximum head width (HW); length of frontoclypeus (from anterior margin to the joint of frontal and coronal sutures) (FRL); occipital foramen width (maximum width measured along dorsal margin of occipital foramen) (OCW); coronal suture length (COL); length of mandible (MNL) (measured from laterobasal angle to apex); width of mandible (MNW) (maximum width measured at base); length of maxillary palpifer (PPF); length of galea (GA). Length of antenna (A), maxillary (MP) and labial

(LP) palpi were derived by adding the lengths of the individual segments; each segment is denoted by the corresponding letter(s) followed by a number (e.g., A1, first antennomere). The maxillary palpus was considered as being composed of three segments united to the stipes through a palpifer (ARCHANGELSKY & MICHAT 2007). Length of leg, including the longest claw (CL), was derived by adding the lengths of the individual segments; each leg is denoted by the letter L followed by a number (e.g., L1, prothoracic leg); the length of trochanter includes only the proximal portion, considered from the base to the beginning of the femur; the leg was considered as being composed of six segments (LAWRENCE 1991). Length of terminal hooks of abdominal segment X, separated in medial hook (MH) and lateral hook (LH). These measurements were used to calculate several ratios that characterise body shape.

Chaetotaxic Analysis: Primary (present in first-instar) and secondary (added in later instars) setae and pores were distinguished in the cephalic capsule, head appendages and legs. Sensilla were coded by two capital letters, in most cases corresponding to the first two letters of the name of the structure on which they are located, and a number (setae) or a lower case letter (pores). The following abbreviations were used: AN, antenna; CO, coxa; FE, femur; FR, frontoclypeus; LA, labium; MN, mandible; MX, maxilla; PA, parietal; PT, pretarsus; TA, tarsus; TI, tibia; TR, trochanter.

Setae and pores present in the first-instar larva of *G. monrosi* were labeled by comparison with previous papers dealing with the primary chaetotaxy of members of the families Gyrinidae, Carabidae, Dytiscidae, Hygrobiidae and Aspidytidae (BOUSQUET & GOULET 1984, NILSSON 1988, ALARIE 1991, 1995, 1998, ALARIE et al. 1990, 2004, ALARIE & BILTON 2005, ARCHANGELSKY & MICHAT 2007, MICHAT & TORRES 2009). Homologies were recognised using the criterion of similarity of position (WILEY 1981). The cephalic capsule of first instars of *G. monrosi* is characterised by the presence of several additional setae that obscure the establishment of homologies with the ancestral systems of other adepghan families. For this reason, an additional criterion for homology was implemented based on the fact that some setae (considered as ancestral) are more similar to those of other parts of the body, i.e. more robust, broader at the base and progressively narrowing to the tip, and with a larger socket. Other setae (considered as additional) are more inconspicuous, very thin, similar in diameter through the whole length, and with a smaller socket (about half the width of a regular socket). These additional setae can also be recognised because they do not always appear on both sides of the cephalic capsule or because they do not always appear in all specimens. Therefore, the presence of a thicker seta was considered as an argument for homology when more than one seta present in *G. monrosi* were potentially homologous with a given seta of other adepghan families. Setae FR1, FR2, FR4, FR5, FR7, PA4, PA5, PA7, PA8, PA9, PA10, PA13 and PA14 were homologised using the criterion mentioned above, in addition to the positional criterion. The ancestral chaetotaxy pattern thus established for the cephalic capsule is in good agreement with that observed in other Adephaga. Setae located at the apices of the maxillary and labial palpi were extremely difficult to distinguish due to their position and small size. Accordingly, they are not well represented in the drawings.

Results

Description of the larval instars of *Gyrinus monrosi* MOUCHAMPS, 1957:

Diagnosis. Cephalic capsule not constricted at level of occipital region (instars I–III) (Figs. 2–3, 16); medial lobe of FR with four inconspicuous teeth (instars I–III) (Figs. 2, 16); mandibular retinaculum present (instars I–III) (Fig. 8); lacinia indented apically (instars I–III) (Figs. 6–7); claws with basoventral spinulae (instars I–III) (Figs. 11–12); tracheal gills of abdominal

segments I–II with less spinulae than those of segments III–IX (instars I–III) (Fig. 1); medial hooks of abdominal segment X somewhat larger than lateral hooks (instars I–III) (Figs. 13–15); MN without additional setae (instar I) (Fig. 8); stipes with six robust hook-like additional setae on dorsointernal margin (instars I–III) (Fig. 6); pore MXg distal (instar I) (Fig. 7); seta TR2 present (instar I) (Fig. 11); legs without secondary setae and pores (instars II–III); abdominal segment X with few ventral setae (instars I–III) (Fig. 13).

Description, instar I (Figs. 1–15). Colour. Body scarcely pigmented, without colour pattern; evenly pale yellow, distal half of mandible darker, head appendages, legs and tracheal gills paler.

Body (Fig. 1). Elongate, parallel-sided, head and pronotum strongly sclerotized, rest of body soft. Measurements and ratios that characterise the body shape are shown in Table 1.

Head. Cephalic capsule (Figs. 2–3). Subrectangular, parallel-sided, longer than broad; maximum width at stemmata, not constricted at level of occipital region; occipital foramen slightly emarginate ventrally; occipital suture absent; coronal suture short; frontal sutures U-shaped, extending to antennal bases; posterior tentorial pits visible ventromedially; dorsal and lateral surfaces (except anterior half of FR) covered with minute spinulae; FR elongate, anterior margin divided into three lobes; medial lobe produced anteriorly, with four inconspicuous teeth each bearing a spiniform seta; lateral lobes well developed, truncate, not projected beyond medial lobe; PA with six stemmata at each side, four visible dorsally, elongate, forming a trapezoid, two visible ventrally, somewhat more rounded; egg bursters present dorsally, formed by three small cuticular spines on each posterolateral surface of PA. Antenna (Figs. 4–5). Long, slender, longer than HW, composed of four antennomeres; A1 the shortest and widest, A4 the longest and narrowest, A2 and A3 subequal in length, slightly shorter than A4; A3 with two minute spinulae on ventrodiscal 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. Mandible (Fig. 8). Short, curved, broad basally, distal half projected inward, apex sharp; retinaculum present; mandibular channel present. Maxilla (Figs. 6–7). Short, robust; cardo strongly developed, subquadrate, bearing a group of minute spinulae on dorsal surface; stipes short, broad, subtriangular, bearing a group of small dorsal spinulae at the base of PPF, and a lacinia and GA on inner margin; lacinia well developed, broad, roughly hook-shaped, indented apically; GA elongate, two-segmented, basal segment the longest, globose, distal segment somewhat shorter, narrow; PPF short, broad, palpomere-like, projected apicodorsally in a subtriangular process; MP short, composed of three palpomeres; MP1 and MP2 the shortest, subequal in length, MP3 the longest. Labium (Figs. 9–10). Prementum divided longitudinally into two subcylindrical halves fused basally, bearing minute spinulae on dorsal surface; LP short, composed of two palpomeres; LP2 about twice as long as LP1.

Thorax (Fig. 1). Long, narrow, terga convex; pronotum the longest, somewhat shorter than meso- and metanotum combined, mesonotum somewhat longer than metanotum; protergite well developed, subovate, covering almost the whole segment dorsally, anterior and posterior margins truncate, lateral margins rounded; membrane between pronotum and mesonotum with a single narrow transverse sclerite; both sclerites with sagittal line, without anterotransverse carina; meso- and metaterga without sclerites; ventral surface membranous except for small sclerites on the regions of articulation of coxae; spiracles absent. Legs (Figs. 11–12). Long, slender, composed of six segments; L3 the longest, L1 the 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 on L1 and L2, claws subequal in length on L3; ventral surface of FE, TI and TA with short spinulae, more developed on L1, reduced on meso- and metatarsus; claws with basoventral spinulae.

Table 1: Measurements and ratios for the three larval instars of *Gyrinus monrosi*. For abbreviations, see above, under “Material and Methods”.

Measure	Instar I (n = 3)	Instar II (n = 1)	Instar III (n = 3)
TL (mm)	6.20–6.50	11.00	8.30–14.50
MW (mm)	0.55–0.60	0.90	0.90–1.20
HL (mm)	0.56–0.57	–	0.96–0.99
HW (mm)	0.37	–	0.57–0.61
FRL (mm)	0.45–0.47	–	0.77–0.81
OCW (mm)	0.31	–	0.53–0.60
COL (mm)	0.10–0.11	0.16	0.18–0.19
HL/HW	1.52–1.55	–	1.56–1.69
HW/OCW	1.19–1.21	–	1.00–1.06
COL/HL	0.18–0.20	–	0.19–0.20
FRL/HL	0.80–0.82	–	0.80–0.82
A/HW	1.31–1.36	–	1.19–1.27
A1/A3	0.38–0.44	0.46–0.47	0.48–0.51
A2/A3	0.96–1.07	1.17–1.24	1.24–1.36
A4/A3	1.10–1.22	1.00–1.03	0.86–0.97
MNL/MNW	2.20–2.42	–	2.29–2.46
MNL/HL	0.38–0.40	–	0.33–0.35
A/MP	2.33–2.44	2.57–2.61	2.55–2.92
GA/MP1	1.20–1.33	1.08	0.94–1.25
PPF/MP1	1.00–1.11	0.85–0.92	0.89–1.00
MP1/MP2	0.82–1.00	1.08	1.06–1.21
MP3/MP2	2.00–2.30	2.00	1.43–1.64
MP/LP	1.17–1.31	1.20–1.26	1.32–1.41
LP2/LP1	1.62–1.91	1.41–1.44	1.22–1.29
L3 (mm)	1.14–1.17	1.75–1.76	2.32–2.34
L3/L1	1.21–1.25	–	1.41–1.46
L3/L2	1.08–1.10	1.13–1.14	1.14–1.18
L3/HW	3.06–3.20	–	3.78–4.09
L3 (CO/FE)	1.23–1.34	1.24	1.17–1.21
L3 (TI/FE)	0.76–0.83	0.78–0.81	0.75–0.78
L3 (TA/FE)	0.96–1.02	0.93	0.84–0.86
L3 (CL/TA)	0.65–0.70	0.56–0.57	0.48–0.53
MH/LH	1.00–1.10	1.15–1.26	1.02–1.20

Abdomen (Fig. 1). Long, narrow, entirely membranous, ten-segmented; segments I–VIII similar in shape and size, bearing a tracheal gill on posterolateral angle; segment IX narrower, bearing two tracheal gills on posterolateral angle; tracheal gills slender, plumose, those of segment IX somewhat 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 (Fig. 13) the smallest and narrowest, pygopod-like, arising on posteroventral surface

of segment IX, not carrying gills but bearing four strongly sclerotized terminal hooks, medial hooks (Fig. 14) somewhat larger than lateral hooks (Fig. 15).

Chaetotaxy. Frontoclypeus (Fig. 2). 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 (FR4, FR7), one long hair-like seta (FR8) and one pore (FRe); lateral margin with two short hair-like setae (FR1, FR2) and one pore (FRa) on distal third and one long hair-like seta (FR3) on basal third; surface of FR with several short hair-like additional setae. Parietal (Figs. 2–3). Dorsal surface with one short hair-like seta (PA10) anterior to the ocular area, two short hair-like setae (PA8, PA9) between dorsal stemmata, three short hair-like setae (PA4, PA5, PA7) and one long spine-like seta (PA6) posterior to the ocular area, one pore (PAc) contiguous to frontal suture, three short spine-like setae (PA1, PA2, PA3) and one pore (PAa) on posterolateral angle, and several short hair-like additional setae; ventral surface with two minute setae (PA18, PA19), one relatively short hair-like seta (PA17) and one pore (PAo) on anteromedial area, one short hair-like seta (PA11), one very short hair-like seta (PA12) and four pores (PAf, PAg, PAh, PAi) on anterolateral angle, one short hair-like seta (PA13) between ventral stemmata, one short hair-like seta (PA14), one long spine-like seta (PA15), one pore (PAk) and two short hair-like additional setae posterior to ocular area, and one short hair-like seta (PA16) on central portion. Antenna (Figs. 4–5). A1 with three pores (ANa, ANb, ANc) on dorsal surface and two pores (ANd, ANe) on ventral surface; A2 with one minute seta (labeled ANi) on ventrodorsal portion; 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 ventrodorsal portion; A4 with one pore (ANg) on ventrodorsal portion and two minute spine-like setae (AN4, AN5) at the apex. Mandible (Fig. 8). Proximal half with three pores (MNa, MNb, MNc) on dorsomedial surface; distal half with one short hair-like seta (MN2) and one relatively longer hair-like seta (MN1) on dorsal surface. Maxilla (Figs. 6–7). Cardo with one short hair-like seta (MX1) on ventral surface; stipes with one short hair-like seta (MX3) on dorsoexternal margin, one relatively longer hair-like seta (MX2) and two pores (MXa, MXb) on ventroexternal margin, one minute seta (MX4) ventrally at the base of the lacinia, and an increasing row of six robust hook-like additional setae on dorsointernal margin (MX5 and MX6 could be included in this row); proximal segment of GA with one short hair-like seta (MX7) on anteroventral margin and one short spine-like additional seta on posterodorsal margin; distal segment of GA with one short hair-like seta (MX9) on anterodorsal margin, one short spine-like seta (MX8) on dorsoproximal portion, two pores (MXd, MXh) on ventral surface, one short hair-like additional seta at the apex, and two minute additional structures on ventral surface; PPF with one short hair-like seta (MX10) on ventral margin; MP1 with one pore (MXe) on dorsoproximal portion, one pore (MXf) on dorsodistal margin, and one minute seta (MX13) on ventroproximal portion; MP2 with two short hair-like setae (MX11, MX12) and two pores (MXg, MXi) on ventral surface; MP3 with one short hair-like seta (MX14) on ventroexternal margin, one pore (MXj) on dorsointernal margin, and several minute pore-like additional structures mostly on dorsal surface. Labium (Figs. 9–10). Prementum with three short hair-like setae (LA3, LA4, LA5), one minute seta (LA6) and one pore (LAa) on dorsodistal surface, one short hair-like seta (LA2) and one minute spine-like seta (LA9) on ventrodorsal surface, and one short spine-like seta (LA1) on ventroproximal surface; LP1 with one pore (LAb) on ventrointernal margin; LP2 with one short hair-like seta (LA12) and one pore (LAc) on ventroexternal margin, and several minute pore-like additional structures mostly on dorsal surface. Thorax (Fig. 1). Thoracic terga with several spine-like and hair-like setae on the surface. Legs (Figs. 11–12). Anterior surface of CO with six very short spine-like setae (CO1, CO2, CO3, CO4, CO5, CO17) and one very short hair-like seta (CO18) on proximal portion, two short spine-like setae (CO6, CO7) and one pore (COa) on medial portion, and three short spine-like setae (CO8, CO9, CO10) on distal portion; posterior surface of CO with four very short spine-like setae (CO13, CO14, CO15, CO16) and five minute

pore-like additional structures on proximal portion, and two short spine-like setae (CO11, CO12) and one pore (COd) on distal portion; anterior surface of TR with four short spine-like setae (TR1, TR2, TR3, TR7), one long spine-like seta (TR4), five pores (TRa, TRb, TRc, TRd, TRe) and one additional pore; posterior surface of TR with two short spine-like setae (TR5, TR6) and two pores (TRf, TRg); anterior surface of FE with one short spine-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 three short spine-like setae (FE4, FE5, FE6) on distal portion; anterior surface of TI with one short spine-like seta (TI1) on proximal portion and three short spine-like setae (TI2, TI3, TI4) on distal portion; posterior surface of TI with one short spine-like seta (TI5), one short seta (TI6, which is hair-like in L1 and spine-like in L2 and L3), one long hair-like seta (TI7) and one pore (TIa) on distal portion; anterior surface of TA with three short spine-like setae (TA2, TA3, TA4), one minute seta (TA7) and three pores (TAb, TAc, TAd) on distal portion; posterior surface of TA with two short spine-like setae (TA5, TA6), one short hair-like seta (TA1) and three pores (TAa, 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 short spine-like seta (PT2) on basoventral portion. Abdomen. Segments I–VIII (Fig. 1) with several long spine-like and hair-like setae on dorsal and ventral surfaces; segment IX (Fig. 1) with long spine-like setae mostly on lateral and ventral surfaces; segment X (Fig. 13) with two short spine-like setae, two long spine-like setae and two pores on ventral surface; hooks (Figs. 13–15) with two pores at mid-length of ventral margin.

Description, instar II. As instar I except for the following features. Body. Measurements and ratios that characterise the body shape are shown in Table 1. Cephalic capsule. Spinulae absent; egg bursters absent. Antenna. A2 the longest, A3 and A4 subequal in length, slightly shorter than A2. Labium. LP2 about 1/3 longer than LP1. Thorax. Segments subequal in length. Legs. Claws basoventral spinulae restricted to anterior claw of L1. Abdomen. Tracheal gills of segments I and II with less spinulae. Chaetotaxy. Basal half of external margin of MN with four minute secondary setae. Central portion of meso- and metasterna with several short spine-like secondary setae. Dorsal surface of abdominal segment IX with several short spine-like secondary setae.

Description, instar III (Fig. 16). As instar II except for the following features. Colour. Cephalic capsule and MN light brown. Body. Measurements and ratios that characterise the body shape are shown in Table 1. Cephalic capsule (Fig. 16). Occipital foramen deeply emarginate ventrally. Antenna. A4 slightly shorter than A3. Labium. LP2 slightly longer than LP1. Abdomen. Tracheal gills of segment I almost devoid of spinulae, those of segment II with few spinulae. Spiracles present on dorsolateral margin of segments I–III.

Discussion

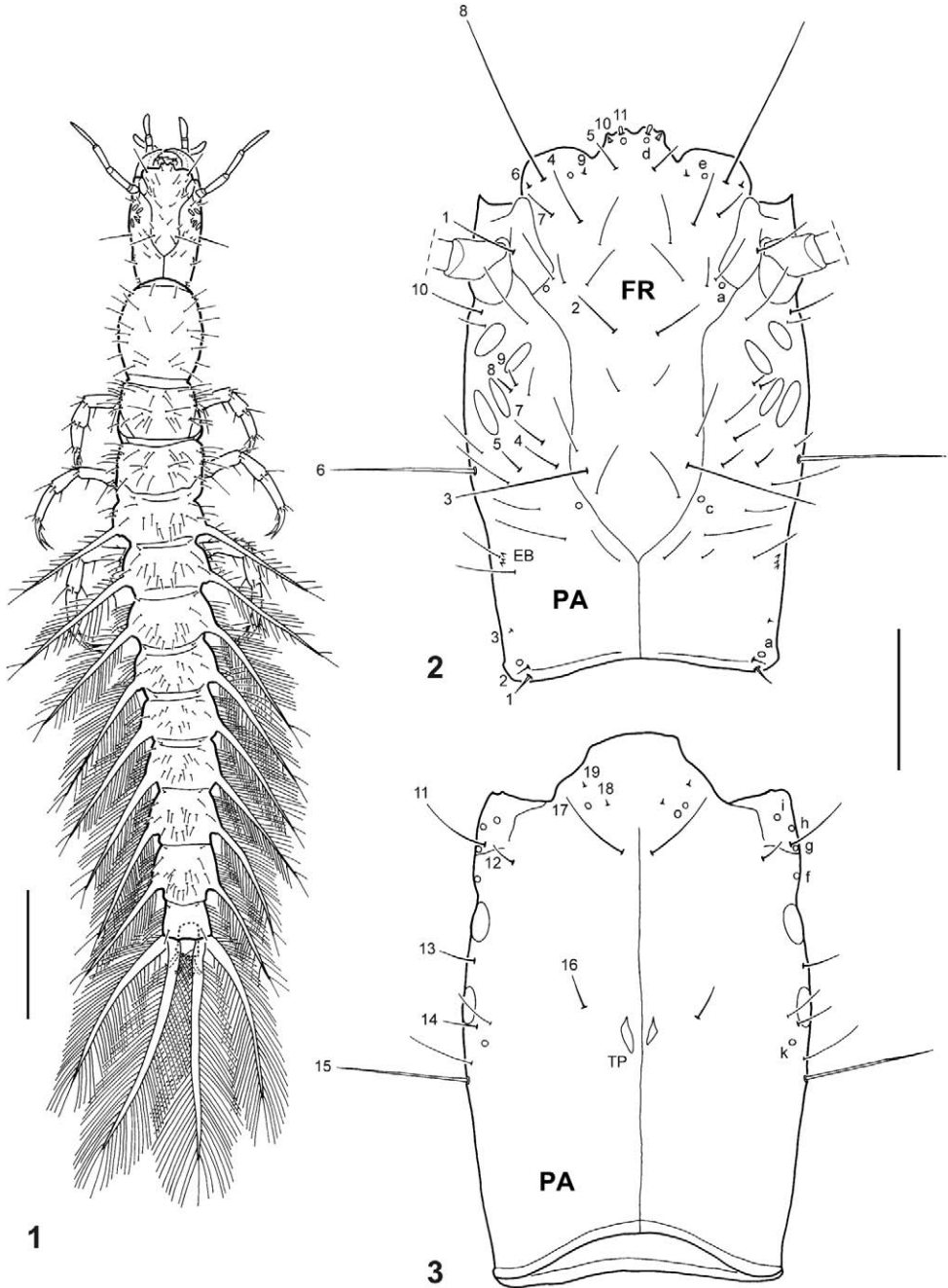
The family Gyrinidae includes 12 genera worldwide (BEUTEL & ROUGHLEY 2005). Of these, the larvae of eight are known, which have been described or treated with a different degree of detail: *Andogyrus* OCHS, 1924 (BACHMANN 1961, 1966; ARNDT et al. 1993; ARCHANGELSKY & MICHAT 2007), *Dineutus* MACLEAY, 1828 (WILSON 1923), *Gyretes* BRULLÉ, 1835 (COSTA et al. 1988), *Gyrinus* (COSTA et al. 1988, CRESPO 1989a, b), *Macrogyrus* RÉGIMBART, 1883 (BEUTEL & ROUGHLEY 1993), *Orectochilus* LACORDAIRE, 1835, *Orectogyrus* RÉGIMBART, 1884, *Aulonogyrus* MOTSCHULSKY, 1853 (see BERTRAND 1963, 1972 and references therein). A detailed description of the primary leg chaetotaxy of members of *Gyrinus* and *Orectochilus* was presented by NILSSON (1988). The larvae of the remaining four genera (*Enhydrus* LAPORTE, 1834, *Heterogyrus* LEGROS, 1953, *Metagyrrinus* BRINCK, 1955, *Spanglerogyrus* FOLKERTS, 1979) are unknown. Larvae of *Gyrinus* are characterised by: 1) cephalic capsule not constricted at level of occipital region; 2) shape of medial lobe of frontoclypeus; 3) mandibular retinaculum present;

4) lacinia broad, indented apically; 5) claws with basoventral spinulae. This combination separates the genus from the other genera with known larvae. On the other hand, larvae of the subgenus *Oreogyrinus* (see also CRESPO 1989a) have the medial hooks of the abdominal segment X slightly longer than the lateral hooks, whereas in the subgenus *Neogyrinus* (CRESPO 1989b) the medial hooks are much shorter than the lateral hooks.

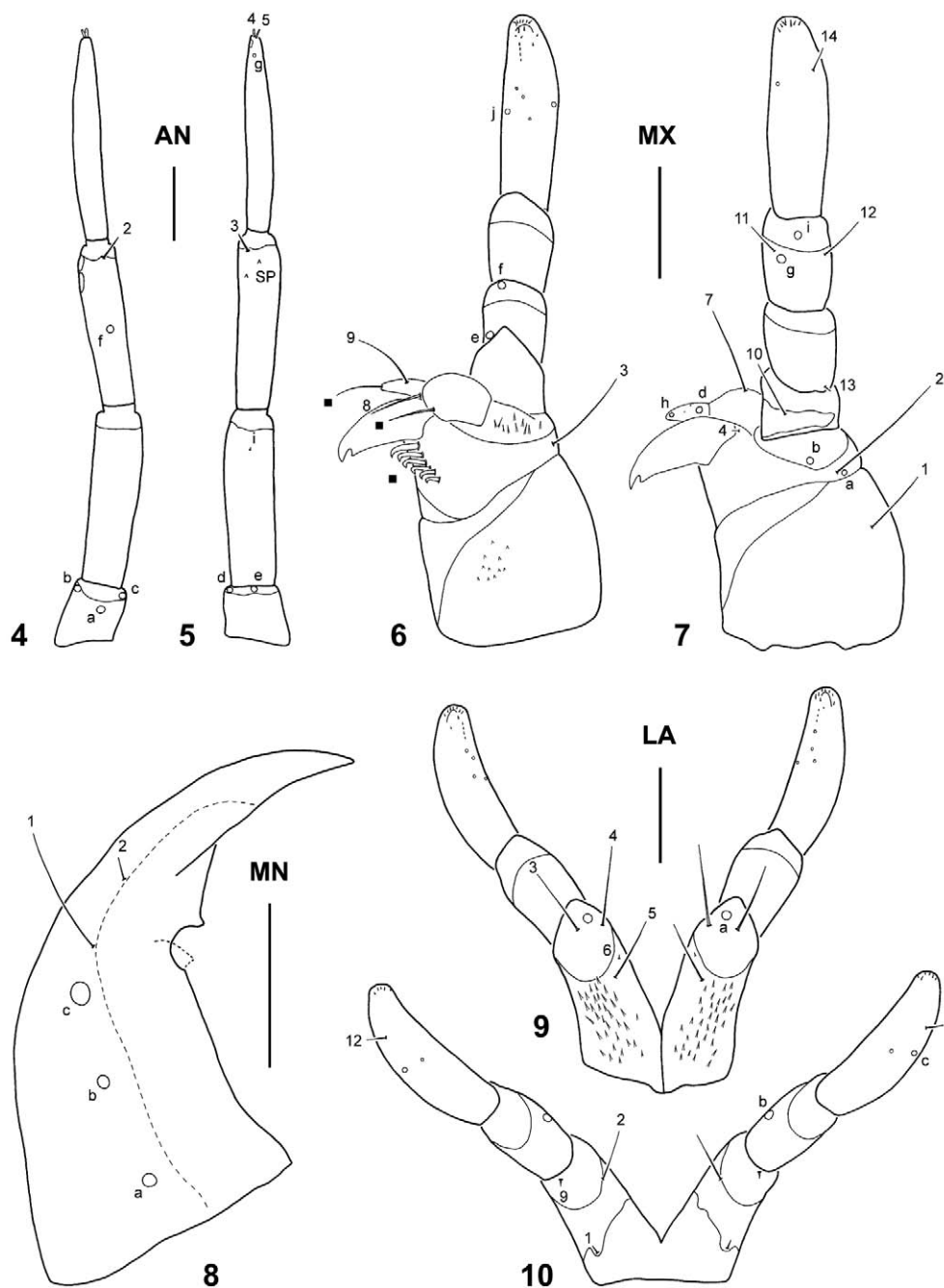
The presence of egg bursters in the first-instar larvae of *Gyrinus* is noteworthy. The structure is formed by three small cuticular spines, and is present dorsally on the posterolateral surface of the parietal, in contrast to other families of Adephaga (e.g. Dytiscidae, Haliplidae, Aspidytidae) in which the egg bursters are located on the frontoclypeus. After finding them in *G. monrosi* we looked back at the first instars of *Andogyrus* and *Dineutus* and were able to find them (formed by a single blunt cuticular spine) in approximately the same position as in *Gyrinus*. The absence of these structures in second and third instars of the three examined genera reinforces the hypothesis that they function as egg bursters.

Few of the existing descriptions have considered the chaetotaxy as a diagnostic feature. Only those by ARNDT et al. (1993) and ARCHANGELSKY & MICHAT (2007) on *Andogyrus* (the last one including also notes on *Dineutus*) and that by NILSSON (1988) treating the legs of *Gyrinus* and *Orectochilus* have emphasised the primary chaetotaxy. On the other hand, the descriptions of the larvae of two species of *Gyrinus* by CRESPO (1989a, b) included chaetotaxic characters but focused mainly on the third-instar larva. *Gyrinus* (based on *G. monrosi*) differs from *Andogyrus* and *Dineutus* in the absence of additional setae on the mandible (present in *Andogyrus* and *Dineutus*), in the distal position of pore MXg (proximal in *Andogyrus* and *Dineutus*), and in the presence of seta TR2 (absent in *Andogyrus* and *Dineutus*) (ARNDT et al. 1993, ARCHANGELSKY & MICHAT 2007). The presence of a row of robust hook-like additional setae on the dorsointernal margin of the stipes is also a characteristic feature of *Gyrinus* larvae, which separates the genus from all other gyridid genera with known larvae except *Aulonogyrus* (BEUTEL & ROUGHLEY 1993). Regarding the legs, some differences can be mentioned among the genera (see also NILSSON 1988). The absence of additional setae on the coxa separates *Gyrinus* from *Andogyrus*. Seta TA1 is hair-like and inserted distally in *Gyrinus*, is also hair-like but inserted subdistally in *Orectochilus*, and is spine-like and inserted subdistally in *Andogyrus*. Pretarsal setae PT1 and PT2 are simple in *Andogyrus* and *Gyrinus* but split in *Orectochilus*. Protibial seta TII1 is hair-like in *G. monrosi*, spine-like in *Andogyrus*, and apparently spine-like in *Orectochilus* and the *Gyrinus* species studied by NILSSON (1988). A minute seta (labeled TA7) is present in the tarsus of *G. monrosi*, which was reported as absent in *Andogyrus*, *Orectochilus* and the *Gyrinus* species studied by NILSSON (1988). However, owing to the minute size and distal position of this sensillum, it can be easily overlooked. For example, a reanalysis of the leg of *A. seriatopunctatus* (RÉGIMBART, 1883) reveals that the sensillum labeled as pore TAB is in fact a minute seta TA7, and pore TAB is more distal and was overlooked by ARCHANGELSKY & MICHAT (2007). Similarly, the pores FRd and FRf of *A. seriatopunctatus* are in fact two minute setae homologizable with FR9 and FR6 respectively, and a minute seta LA6 is present on the prementum of *G. monrosi* (represented by an extremely small pore-like structure in *A. seriatopunctatus*, close to pore LAa).

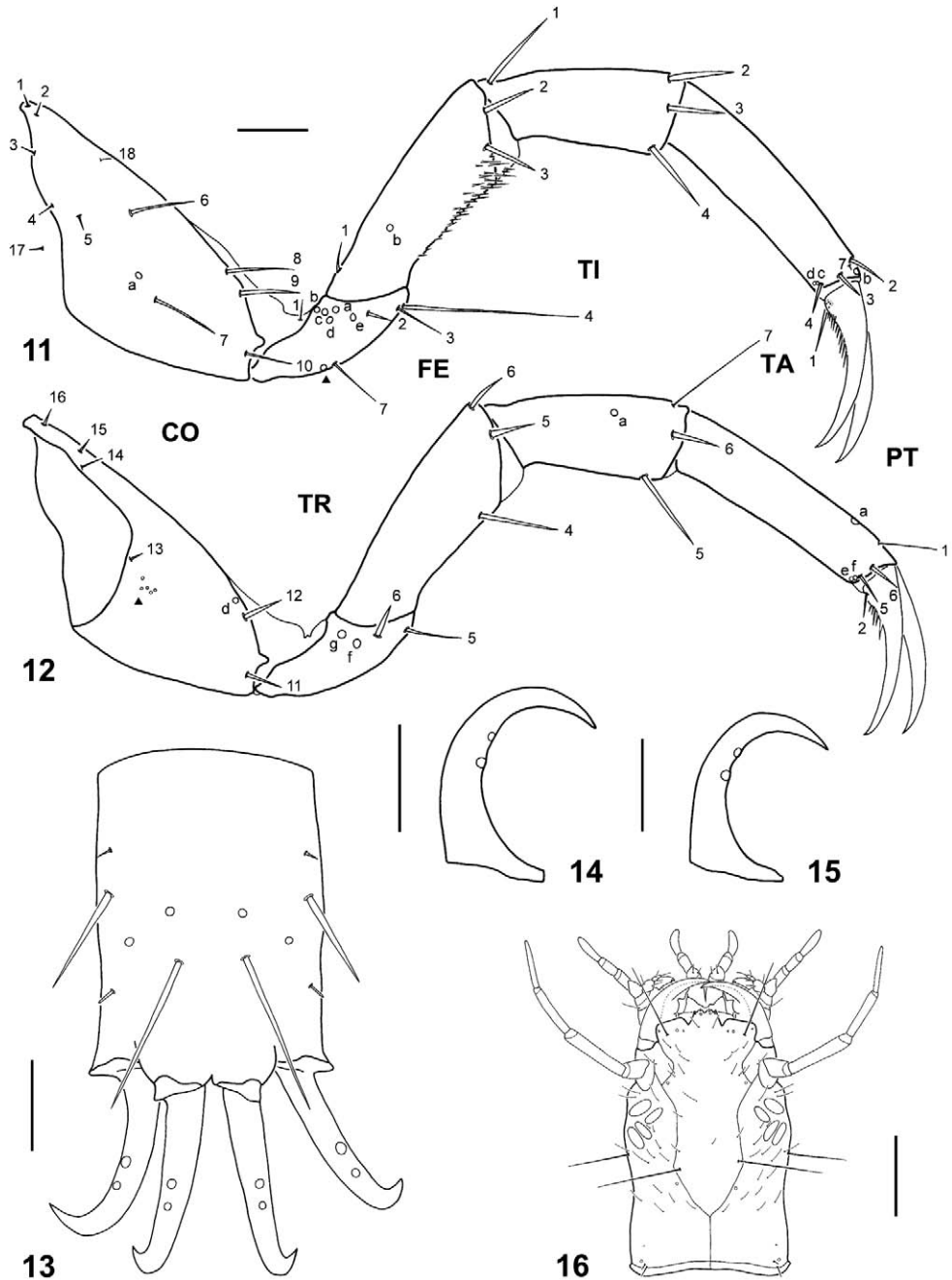
Chaetotaxy of the third-instar larva of *G. monrosi* looks very similar to that of *G. argentinus* (CRESPO 1989a), both included in the subgenus *Oreogyrinus*. This is not surprising as *G. monrosi* was previously considered to be a subspecies of *G. argentinus* until OCHS (1958) raised it to specific rank. No remarkable chaetotaxic differences were found to separate the species. According to CRESPO (1989b) the third-instar larva of *G. ovatus* (included in the subgenus *Neogyrinus*) has 0–5 robust hook-like setae on the dorsointernal margin of the stipes, which represents a difference with the larvae of *Oreogyrinus* which have six of these setae. On the other hand, instars II and III of *Gyrinus* can be distinguished from those of *Andogyrus* by the absence of secondary setae on the legs (present in *Andogyrus*) (ARCHANGELSKY & MICHAT 2007).



Figs. 1–3: *Gyrinus monrosi*, first-instar larva, 1) habitus, dorsal view, 2) cephalic capsule, dorsal view, 3) cephalic capsule, ventral view. Additional setae not labeled. EB: egg burster, TP: tentorial pit. Scale bars = 1.00 mm for Fig. 1 and 0.15 mm for Figs. 2–3.



Figs. 4–10: *Gyriinus monrosi*, first-instar larva, 4) antenna, dorsal view, 5) antenna, ventral view, 6) maxilla, dorsal view, 7) maxilla, ventral view, 8) mandible, dorsal view, 9) labium, dorsal view, 10) labium, ventral view. Solid squares refer to additional setae. SP: spinulae. Scale bars = 0.06 mm.



Figs. 11–16: *Gyrinus monrosi*, 11–15) first-instar larva, 11) metathoracic leg, anterior view, 12) metathoracic leg, posterior view, 13) abdominal segment X, ventral view, 14) medial hook, lateral view, 15) lateral hook, lateral view, 16) third-instar larva, head, dorsal view. Solid triangles refer to additional pores. Scale bars = 0.06 mm for Figs. 11–15 and 0.30 mm for Fig. 16.

The first attempts of naming the primary setae and pores of members of the family Gyrinidae were presented by NILSSON (1988) (legs of *Gyrinus* and *Orectochilus*), ARNDT et al. (1993) (cephalic capsule and head appendages of *Andogyrus*) and ARCHANGELSKY & MICHAT (2007) (cephalic capsule, head appendages and legs of *Andogyrus* and *Dineutus*). The present study on larvae of *Gyrinus* represents a further step in the process of developing a system of nomenclature for the primary sensilla of gyrid larvae. Whereas the nomenclatural patterns proposed for the antenna, mandible, maxilla, labium and legs are in general consistent among the different papers, that of the cephalic capsule is more problematic, and this is reflected in the different interpretations presented by ARCHANGELSKY & MICHAT (2007) and the present paper. These differences should be interpreted as the result of reconsiderations of the hypothesis of homology in light of new evidence. The cephalic capsule of gyrid larvae (both the frontoclypeus and parietal) bears several additional setae that, to a certain degree, obscure the ancestral pattern and aggravate the establishment of hypotheses of homology among the genera and with the chaetotaxy systems of other adepghan families. Also, the potential finding of larvae of more genera with unknown primary chaetotaxy (for example members of Orectochilini) would give way to additional reinterpretations and changes in the nomenclatural patterns. Consequently, we do not find useful at this time to formally propose a change in the nomenclature of the cephalic capsule of larvae of *Andogyrus*.

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Dr. Mariano C. MICHAT

CONICET – *Laboratorio de Entomología, Dpto. de Biodiversidad y Biología Experimental, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Av. Int. Güiraldes s/n, Ciudad Universitaria, 1428 Buenos Aires, Argentina* (marianoide@gmail.com)

Dr. Miguel ARCHANGELSKY

CONICET-LIESA, *Laboratorio de Investigaciones en Ecología y Sistemática Animal, Universidad Nacional de La Patagonia, San Juan Bosco, Sarmiento 849, 9200, Esquel, Chubut, Argentina* (hydrophiloidea@yahoo.com.ar)

Dr. Liliana A. FERNÁNDEZ

División Entomología, Museo de La Plata, Paseo del Bosque s/n, La Plata, 1900 (liliafer@fcnym.unlp.edu.ar)

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