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Larval morphology of genus *Megacephala* LATREILLE, 1802

(Coleoptera: Cicindelidae)

With 18 figures and 1 table

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Zusammenfassung

Die Larvalmerkmale der Gattung *Megacephala* LATREILLE werden beschrieben und ein Larvenbestimmungsschlüssel für 5 der 6 Untergattungen vorgelegt. Larven von *Megacephala* sind durch die Y-förmig Gularsuture (ein Merkmal aller Megacephalini) und das fehlende Doppelsclerit ventral am Prämentum charakterisiert. Nur die Untergattung *Phaeoxantha* besitzt einen gezähnelten Clypeus, den wahrscheinlich plesiomorphen Zustand dieses Merkmals im Verwandtschaftskreis. Die Untergattung *Tetracha* umfaßt mindestens zwei verschiedene Artengruppen, die sich durch ihre Chaetotaxie am Pronotum und Abdomen deutlich unterscheiden.

Summary

A description of larval characters of the genus *Megacephala* LATREILLE and a larval key to five of the six subgenera are given. The most characteristic larval characters of *Megacephala* are the Y-shaped gular suture (known from all Megacephalini) and the lack of an oval double sclerite on the prementum. The anterior margin of the clypeus of the subgenus *Phaeoxantha* is serrated, which is probably the plesiomorphic character state. The subgenus *Tetracha* includes at least two distinct species groups, which are distinguished by the chaetotaxy of the pronotum and abdomen.

Introduction

Genus *Megacephala* LATREILLE is one of the distinctive tiger beetle groups in the tribe Megacephalini (see HUBER, 1994 for the detailed history of the nomenclature of this group). About 90 species from 6 subgenera of genus *Megacephala* are now known (WIESNER, 1992). The classification of this taxon, however, is based on adult characters only. The knowledge of *Megacephala* larvae is limited. Brief descriptions are available for only 4 species of 2 subgenera (HAMILTON 1925, COSTA et al. 1988, PUTCHKOV 1995). The study of larvae can be very useful in improving the taxonomical state and knowledge of the phylogenetic relationship of genera and subgenera (PUTCHKOV & CASSOLA 1994).

The authors had the opportunity to examine a number of *Megacephala* larvae over the last few years. It is the aim of this paper to describe larval characters of the genus in detail and to give

a key to five of the subgenera, which represent the large majority of species of the genus *Megacephala*. Only larvae of the monotypic subgenus *Metriocheila* THOMSON from South America remain undescribed.

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Materials and methods

The studies are based on the larval collection of both authors, the collections of DEI (German Entomological Institute, Eberswalde) and the INPA (Manaus). Larvae and instars of the following species were examined: *Megacephala (Phaeoxantha) klugi* CHAUDOIR (instars 1-3), *M. (Tetracha) sobrina* DEJEAN (instars 1-3), *M. (Tetracha) spinosa* BRULLÉ, (instars 1-3), *M. (Tetracha) bilunata* KLUG (3rd instar), *M. (Tetracha) brasiliensis* KIRBY (3rd instar), *M. (Tetracha) carolina* LINNÉ (3rd instar); *M. (Pseudotetracha) australis* (CHAUDOIR) (3rd instar), *M. (Grammognatha) euphratica* LATREILLE & DEJEAN, (instars 1-3), *M. (Megacephala s.str.) spec.* (3rd instar).

Larvae of *Amblycheila* SAY, *Omus* ESCHSCHOLTZ, *Manticora* FABRICIUS, *Oxycheila* DEJEAN, and representatives of all subtribes of Cicindelini were available for comparison (PUTCHKOV & ARNDT 1994).

The nomenclature follows WIESNER (1992), terms of morphology and chaetotaxy follow KNISLEY and PEARSON (1984) as well as PUTCHKOV & CASSOLA (1994).

Larval characters of genus *Megacephala* LATREILLE

Instars II and III

Head with nasale produced, wide, anterior margin smooth or waved, limited on outer sides by 2 large teeth; 6 stemmata of characteristic size and position (see KNISLEY & PEARSON 1984), stemmata I and II very large, almost subequal in size; stemma V and VI very small; coronal suture very short or absent; frontal suture strongly curved in middle part; ridge on posterior part of frontale transverse, continued with ridge of vertex, bearing 2 distinct tubercles and 3-4 setae; gular suture Y-shaped; posteroventral margin of the head W-shaped. Antenna separated from mandibles by an undistinct, narrow chitinous bar; antennomeres I and II much thicker than antennomeres III and IV; antennomeres I and II each with more than 6 setae, antennomere IV almost 2 times shorter than antennomere III; maxilla with ventral part of cardo triangular, bearing 1-2 setae; inner margin of stipes with more or less distinct elevation in the middle, a sclerotized bar with setae dorsoapically; lacinia absent; maxillary palpus four-segmented and

slightly shorter or equal galea; palpifer attached with galeomere I, with 4-6 setae in 2nd instar and 7-10 setae in 3rd instar, maxillary palpomere I with spine on lateroapical margin; galeomere I with 3-5 setae laterally in 3rd instar and 2-3 setae in 2nd instar, galeomere II with 5-10 setae dorsoapically; area between prementum and labial palpes membranous, double sclerite lacking; labial palpomere I with 1-8 thin setae, sclerotized spines lacking; labial palpomere II with 1 seta below the middle. Hypopharynx of typical structure, large, overlapping the prementum dorsally and densely covered with small hairs.

Pronotum with slanting furrows in anterior half, anterior margin even or concave, lateral edge narrow (Figs 1, 3-6).

Abdominal sclerites slightly distinct. Epipleuron, hypopleuron and coxal lobe (laterosternite) each consisting of 2 parts (Fig. 9). Abdominal segment V with 2 drop-shaped hooks, median hook with 1-2 stout setae, inner hook with 2 fine setae basally; parts of tergites are fused (Figs 10, 12, 13, 15, 16), hump of tergite V large, strongly produced and in part directed backwards. Posterior margin of sternite IX at least with 8-10 long setae. Pygopod conically, multisetos, at least with 25-30 setae on apical margin (Figs 17, 18).

Table 1 Measurements of examined *Megacephala* species, all data in mm, average in parenthesis.

	Head width	Frontal width	Pronotal width	Pronotal length
<i>M. (Phaeoxantha) klugi</i>				
L ₃	5.63-5.92 (5.75)	3.52-3.70 (3.54)	5.74-6.20 (5.91)	3.63-4.07 (3.80)
L ₂	3.56, 3.78	2.07, 2.22	3.37, 3.67	2.15, 2.22
L ₁	2.37	1.44	2.22	1.37
<i>M. (Gramm.) euphratica</i>				
L ₃	5.30-5.50 (5.42)	2.65-2.92 (2.82)	5.00-5.30 (5.14)	3.30-3.60 (3.40)
L ₂	3.00-3.20 (3.07)	1.63-1.75 (1.69)	2.80-3.08 (2.99)	1.90-2.02 (1.97)
L ₁	2.10	1.25	2.05	1.30
<i>M. (Pseudotetr.) australis</i>				
L ₃	4.37	2.96	4.44	2.96
<i>M. (Tetracha) spinosa</i>				
L ₃	4.52-4.82 (4.69)	2.59-2.67 (2.62)	4.44-4.82 (4.67)	2.78-2.89 (2.84)
L ₂	3.19-3.25 (3.22)	1.78-1.85 (1.83)	2.78-3.19 (3.04)	1.78-1.85 (1.80)
L ₁	2.07	1.26	2.00	1.26
<i>M. (T.) sobrina</i>				
L ₃	4.00-4.22 (4.13)	2.44-2.78 (2.59)	3.93-4.22 (4.09)	2.07-3.11 (2.54)
L ₂	2.78-2.96 (2.86)	1.74-1.85 (1.78)	2.59-2.81 (2.73)	1.89-2.11 (2.00)
L ₁	1.60	1.00	1.57	1.10
<i>M. (T.) bilunata</i>				
L ₃	3.11, 3.19	1.81, 1.85	2.89, 2.96	1.96, 2.04
<i>M. (T.) carolina</i>				
L ₃	3.25	2.14	3.38	2.14
<i>M. (T.) brasiliensis</i>				
L ₃	2.67	1.52	2.44	1.57

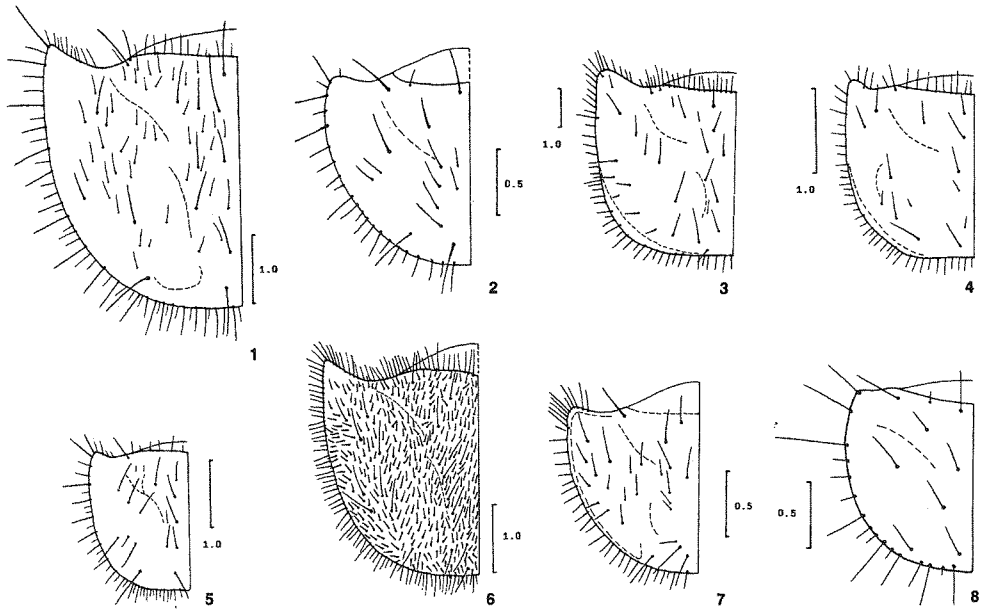
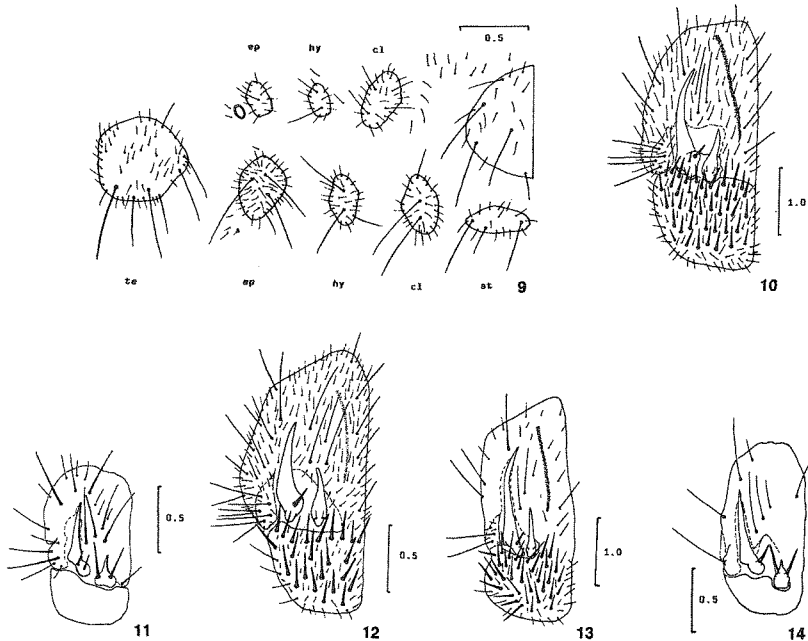


Fig. 1-8 Pronotum, left side, scales in mm: 1-2 *M. (Phaeoxantha) klugi*. L₃, L₁. - 3 *Megacephala* s.str. spec. L₃. - 4 *M. (Pseudotetracha) australis*. L₃. - 5 *M. (Tetracha) bilunata*. L₃. - 6 *M. (Tetracha) sobrina*. L₃. - 7 *M. (Tetracha) spinosa*. L₁. - 8 *M. (Grammognatha) euphratica*. L₁.



← Fig. 9 *M. (Tetracha) bilunata*. Sclerites of abdominal segment III, right side, L₃; cl - coxal lobe (= laterosternite), ep - epipleuron, hy - hypopleuron, st - sternites, te - tergite. - Fig. 10-14 Abdominal tergite V and hooks, scales in mm: 10-11 *M. (Phaeoxantha) klugi*. L₃, L₁. - 12 *M. (Tetracha) bilunata*. L₃. - 13-14 *M. (Tetracha) spinosa*. L₃, L₁.

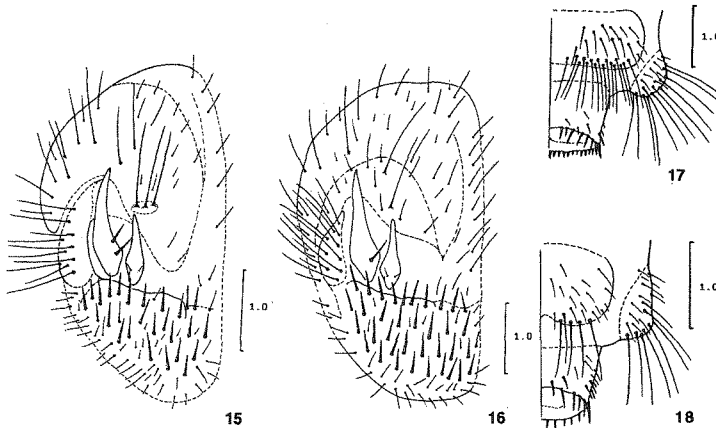


Fig. 15-16 Abdominal tergite V and hooks: 15 *M. (Grammognatha) euphratica*. L₃. - 16 *M. (Pseudotetracha) australis*. L₃. - Fig. 17 *Megacephala* s. str. spec. Abdominal sternite IX and pygopod, right side, L₃. - Fig. 18 *M. (Grammognatha) euphratica*. Abdominal sternite IX and pygopod, right side, L₃ (All scales in mm).

Instar I

The following character states are different from second instar larvae:

Ridge on caudal part of head less distinct, without setae. Antennomere II with 2-3 setae, palpifer without or with 1-3 setae dorsolaterally, spine on maxillary palpomere I small, galeomere I with 1 seta, galeomere II with 3-6 setae, labial palpomere I without setae.

Pronotum distinctly rounded posteriorly, anterior margin with 4 setae (Figs 2, 7, 8).

Sclerotized areas of abdomen distinct, only hypopleuron with 2 separate sclerites. Inner hooks with 2 long setae, central spine of inner hooks long and slender, caudal part of tergite V without setae (Figs 11, 14). Pygopod with more than 20 setae dorsally, ventrally setae lacking or a few setae present.

Discussion

The preliminary studies of the larval morphology confirm the recent classification of the genus *Megacephala* LATREILLE (WIESNER 1992). Some of the subgenera are characterized by specific features. Only the larva of subgenus *Phaeoxantha* CHAUDOIR has a waved anterior margin of nasale, as present also in larvae of *Omus* ESCHSCHOLTZ and *Amblycheila* SAY, which is probably plesiomorphic.

Subgenus *Tetracha* HOPE contains at least two groups of species according to larval characters. The first group including *M. sobrina* DEJEAN and *spinosa* BRULLÉ is characterized by head and

pronotum with numerous white setae, more slender body and median hooks, inner margin of stipes with prominent elevation, abdominal sternite IX and pygopod multisetos. The second group including *M. carolina* LINNÉ, *virginica* LINNÉ, *brasiliensis* KIRBY and *bilunata* KLUG is characterized by head and pronotum with only several dark, long setae, a wider body and shorter median hooks, inner margin of stipes with indistinct elevation, abdominal sternite IX and pygopod with fewer, but longer setae. This group is morphologically similar to the known larvae of subgenera *Pseudotetracha* FLEUTIAUX and *Grammognatha* MOTSCHULSKY. Examination of further material is need to determine if the subgenus *Tetracha* is a polyphyletic group.

Key to larvae of the subgenera of *Megacephala* LATREILLE

Instar I

- 1(2) Anterior margin of nasale waved; antennomere II with 3 setae, maxillary palpomere I with distinct large spine lateroapically, epipleuron with 7-8 setae; median hook with 2 setae basally, distal part of tergite V with 14-17 setae (Fig. 11); posterior margin of sternite IX with 8 setae; apical margin of pygopod with about 20 setae. Tergites of abdominal segment V always fused; pronotum with 12-14 setae per half (Fig. 2) . . .
 *Phaeoxantha* CHAUDOIR (*klugi* CHAUDOIR)
- 2(1) Anterior margin of nasale smooth; antennomere II with 2 setae, maxillary palpomere I with small spine lateroapically, epipleuron with less than 7 setae; median hooks with 1 seta basally, distal part of tergite V with less than 10 setae; posterior margin of sternite IX with 6 setae; apical margin of pygopod with distinctly less than 20 setae, pronotum with 7-25 setae per half.
- 3(4) Pronotum with 7-8 setae (Fig. 8); abdominal segment V with distinct separated parts of tergite, distal part with 8-9 setae, caudolateral part with 3 long setae, apical margin of pygopod with 8 setae.
 *Grammognatha* MOTSCHULSKY (*euphratica* LATREILLE & DEJEAN)
- 4(3) Pronotum with distinct more than 10 setae per half (Fig. 7); tergal parts of abdominal segment V fused or attached, distal part with 4-6 setae, caudolateral part with 1-2 long setae (Fig. 14); apical margin of pygopod with 10-16 setae.
 *Tetracha* HOPE (*sobrina* DEJEAN, *spinosa* BRULLÉ)

Instars II and III

- 1(2) Anterior margin of clypeus waved; inner margin of stipes basally with 5-6 spines in 3rd instar and 3-4 spines in 2nd instar; pronotum with about 15 long setae and 40-50 fine setae in 3rd instar and 20-25 fine setae in 2nd instar per half (Fig. 1).
 *Phaeoxantha* CHAUDOIR
- 2(1) Anterior margin of clypeus smooth; inner margin of stipes with 2-4 spines basally; pronotum with less than 40 setae per half, these long and black (Figs 3-5) OR with more than 100 setae, most of them short and white (Fig. 6).

- 3(10) Pronotum with less than 30 setae per half (Figs 3-5); inner margin of stipes without elevation in the anterior part; labial palpomere I with 2-8 thin setae; appendages of head brown; median hook at most 2 times longer than inner hook (Figs 12, 15, 16); tibia not more than 1.5 times longer than wide.
- 4(5) Pronotum with more than 20 setae per half (Fig. 3); sternite IX of abdomen with more than 30 setae in posterior part; posterior margin of sternite IX with more than 15 setae per half; epipleuron of segment IX with more than 10 long setae; apical margin of pygopod with more than 35 short, stout setae (Fig. 17); maxillary palpomere II with 3 setae; galeomere II with 8-10 stout setae. . . . *Megacephala* s. str. (only third instar)
- 5(4) Pronotum with less than 20 setae on per half (Fig 4, 5); posterior margin of sternite IX with less than 12 long setae; epipleuron of segment IX with less than 10 setae; apical margin of pygopod with less than 30 stout setae (Fig. 18); maxillary palpomere II with 2 setae; galeomere II with 5-7 stout setae.
- 6(7) Caudal part of tergite V with more than 35 stout setae, median hook almost even (Fig. 16); posterior margin of sternite IX with 10-12 long setae; apical margin of pygopod with about 30 stout setae. *Pseudotetracha* FLEUTIAUX (only third instar)
- 7(6) Caudal part of tergite V with less than 35 stout setae, median hook slightly curved inside (Figs 12, 15); posterior margin of sternite IX with 8 (-10) long setae; apical margin of pygopod with less than 25 stout setae.
- 8(9) Labial palpomere I with 1-2 long setae; middle part of tergite V with small elevation bearing 3 long setae, median hook usually with 2 setae basally (Fig. 15); pronotum light brown or brown. *Grammognatha* MOTSCHULSKY
- 9(8) Labial palpomere I with 3-7 setae, some of them small; middle part of tergite V without setae bearing elevation; median hook with 1 stout setae basally (Fig. 12); pronotum usually dark-brown or black, in part with metallic shade.
 *Tetracha* HOPE (in part, only third instar)
- a(b) Pronotum dark brown without luster; all setae of pronotum black or brown; posterior part of sternite IX with 10 long setae; abdominal tergite III with about 50 setae per half (Fig. 9). *M. (T.) bilunata* KLUG
- b(a) Pronotum dark brown at least with light metallic luster; a part of setae of pronotum white; posterior part of sternite IX with 8-9 long setae; abdominal tergite III with less than 30 setae per half.
- c(d) Pronotum with 20-24 setae per half, light bronze luster and lateral part golden white. *M. (T.) brasiliensis* KIRBY
- d(c) Pronotum with 10-15 setae per half, dark purple with light luster.
- e(f) Pronotal width less than 4 mm, pronotum dark purple, number of setae on tergites I-IV not exceeding 20 per half, lateral and posterior part of pronotum pearly white. *M. (T.) carolina* (LINNÉ) (after HAMILTON 1925)
- f(e) Pronotal width at least 4.5 mm, pronotum purple or bronze with green reflection, number of setae on tergites I-IV exceeding 25 per half.
 *M. (T.) virginica* (LINNÉ) (after HAMILTON 1925)

- 10(3) Pronotum with more than 100 short white setae per half (Fig. 6); inner margin of stipes with distinct elevation in the anterior part; labial palpomere I with 1, rarely 2 setae; appendages of head yellow to light brown; median hook at least 2 times longer than inner hook (Fig. 13); tibia about 2 times longer than wide.
 *Tetracha* HOPE (in part)
- a(b) Vertex ridge on dorsoposterior part of head including the lateral tubercle with 10 or more setae on each side; abdominal tergites distinct sclerotized without numerous small setae, only long setae present; caudolateral part of tergite V with 10 or more long setae in 3rd instar and 2 long setae in 2nd instar.
 *M. (T.) spinosa* BRULLÉ
- b(a) Vertex ridge on dorsoposterior part of head including the lateral tubercle with 6 or less setae on each side; abdominal tergites little distinct with more than 20 small setae beside the long setae; caudolateral part of tergite V with 2 long setae in 2nd and 3rd instar. *M. (T.) sobrina* DEJEAN

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