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Description of the first instar larva of *Thalassophilus longicornis* (Coleoptera: Carabidae: Trechodina)

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Abstract. The first instar larva of *Thalassophilus longicornis* (Sturm, 1825) is described, representing the second species of Trechodina known in the larval stage. A preliminary diagnosis of the genus *Thalassophilus* Wollaston, 1854 on the basis of larval features is given. Lack of the lacinia, pores PR_c, PR_e, PR_i, PR_j on the pronotum, ME_d, ME_e on the meso- and metanotum, seta ES_1 on the metanotum and pore TE_b on all abdominal tergites in *Thalassophilus* are typical features for all known Trechitae larvae. On the other hand two unequal claws with a very long single claw seta, absence of the pore PA_b on parietale, setae EM_1 on meso- and metanotum, seta EP_1 on ninth abdominal segment and some other unique larval features within Trechitae show the isolated position of *T. longicornis* within all other known Trechitae larvae.

Larva, description, morphology, Coleoptera, Carabidae, Trechodina, *Thalassophilus*, Palaearctic region

INTRODUCTION

The group of the subtribes Perileptina, Trechina and Trechodina is, from a taxonomic viewpoint, one of the most intricate within the Carabidae. Undoubtedly, these taxa are more related to each other, than to other Trechitae tribes known in the larval stage (Bembidiini, Tachyini, Pogonini) and some authors consider them as a large tribe Trechini (s. l.) (Jeannel 1926, Kryzhanovskij 1983). Phylogenetic relationships between these three groups are treated by various specialists in different ways, as discussed by Belousov & Kabak (1993).

The subtribe Trechodina occur „gondwanienne indo-africano-australo-malgache, avec un genre (*Thalassophilus*) emirge en Europe ou la limite nord de son aire a été remaniee par le Glaciaire" (Jeannel 1926). Now some new interesting data have been published Trechodina from Russian Far East (Moravec & Wrase 1995, Ueno et al. 1995). Very little has been published about the larvae of Trechodina and the third instar larva have been described only of *Amblystogenium pacificum* (Putzey, 1870) (larva was originally described as *A. murcipenne* Enderlein, 1905) (Drygalski 1909, Womersley 1937, Jeannel 1941). This taxon was included by van Emden (1942) in his study of Carabidae larvae.

MATERIAL AND METHODS

This study is based on a single raised ex ovo first instar larva of *Thalassophilus longicornis*. Adults were collected by the author on April 14, 1995, on the sand-alluvial beach of the middle course of the Belaja River (West Caucasus). The larva was obtained on May 26 and fixed on May 28.

The larva was mounted on a permanent microscope slide with Fora-Berlese liquid and studied under a light stereo microscope at 200 or 900×. Notation of the primary setae and pores follows Bousquet & Goulet (1984). An asterisk (*) after a number means that the homology of the seta is uncertain. The larva is deposited in the author's collection.

For comparison larvae of the following taxa were studied: Bembidiini (45 spp.: genera *Bembidion* Latreille, 1802 and *Asaphidion* Des Gozis, 1886), Tachyini (7 spp.: genera *Tachys* Stephens, 1829, *Paratachys* Casey, 1918, *Elaphropus* Motschulsky, 1839, *Porotachys* Netolitzky, 1914 and *Tachyta* Kirby, 1837), Pogonini (10 spp.,: genera *Cardioderus* Dejean, 1829, *Pogonus* Nicolai, 1822 and *Pogonistes* Chaudoir, 1870), Trechini (12 spp.: genera *Trechus* Clairville, 1806, *Aepus* Samouelle, 1819 and *Epaphius* Stephens, 1827) (first instar larvae of the tribe Trechini were studied only for *Epaphius secalis* (Paykull, 1790) and *Aepus robini* (Laboulbene, 1849).

RESULTS

Description of the first instar larva of *Thalassophilus longicornis* Sturm, 1825

Habitus (Fig. 1). Larva slightly sclerotized, very slight; tergites without keels; main part of setae longer than in usual Trechitae larvae.

Cephalic capsule (Figs 2, 3) subquadrate (width 0.30 mm, length 0.29 mm); flat, parallel-sided anteriorly and slightly convergent posteriorly; ocellar tubercules, ocelli, postocellar and cervical grooves absent; egg-bursters and teeth-like or pointed microsculpture on head absent; epicranial suture long (ratio epicranial suture length / head length 0,18); frontal suture slightly covered; apical part of frontale wide and less protruding; nasale (Fig. 8) less protruding, with two rows of teeth anteriorly.

Microsculpture on parietale transverse; covering all of parietale (including near seta PA_9, and lateral and ventral surfaces); shape of parietal microsculpture equal dorsally, ventrally, and laterally; frontale with transverse microsculpture in basal part (at base of setae FR_2 and FR_3); frontale along medial line smooth, without microsculpture; clypeus with slightly developed transverse microsculpture.

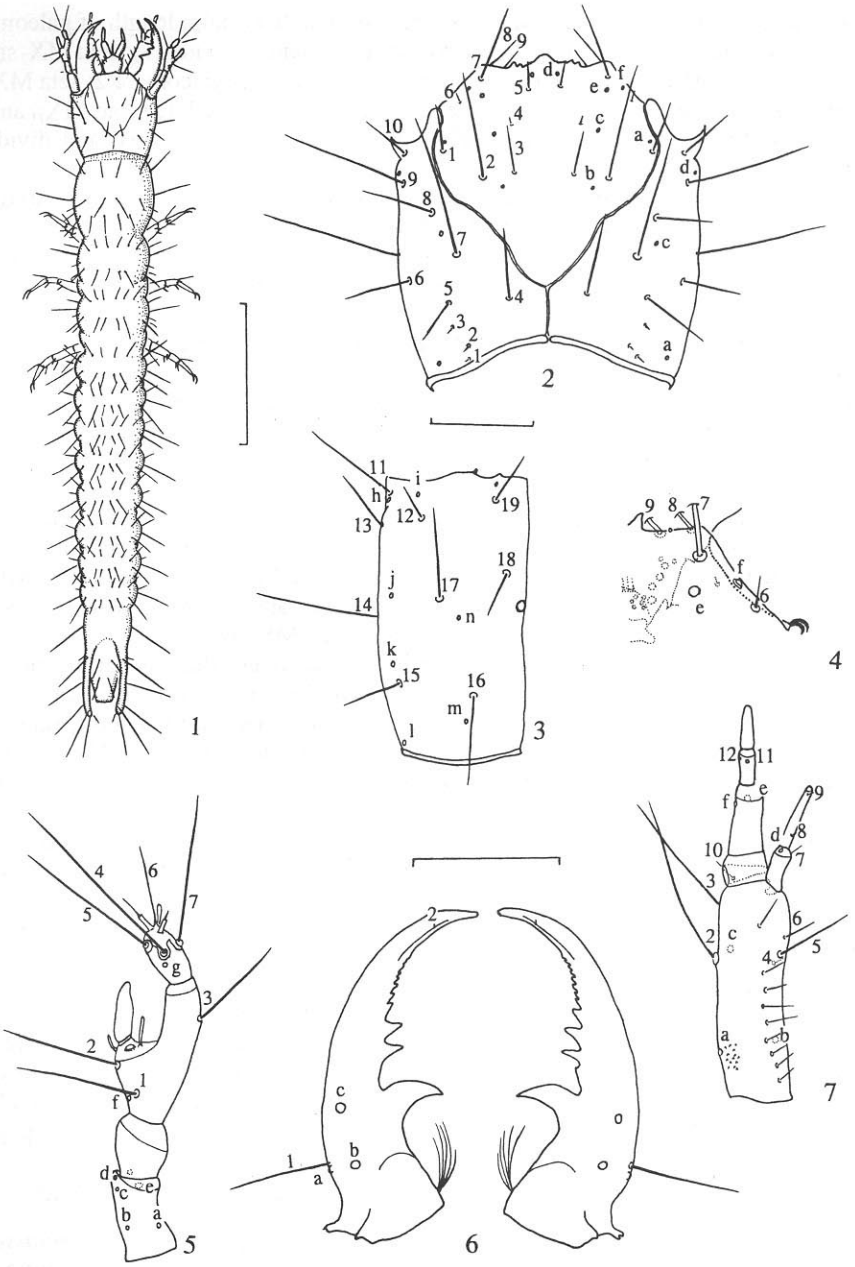
Chaetotaxy of cephalic capsule: all primary setae and pores (except PA_b) present; additional sensilla absent; length of seta PA_3 = 0.5 length PA_1; length of setae PA_4 and PA_{10} = 0.6–0.8 length PA_7; setae PA_7 and PA_{14} longest on head; distance $PA_n - PA_{16}$ = 3× distance $PA_n - PA_{17}$; setae FR_1 and FR_3 long, subequal to PA_5 and = 0.5 length FR_2; setae FR_1 and FR_2 not together, distance $FR_2 - FR_3$ = 1.5× distance $RF_1 - FR_2$ and = 2× distance $FR_3 - FR_3$; pore FR_b and seta FR_3 drawn to gether, distance from frontal suture to FR_b = 2.5× distance $FR_b - FR_3$; seta FR_4 very small, subequal to seta FR_6; pore FR_c and seta FR_5 drawn together; length of seta FR_4 = 0.3 length FR_5; setae FR_4 and FR_5 not draw together, distance $FR_4 - FR_4$ = 2× distance $FR_5 - FR_5$; pore FR_e at level of pore FR_f; seta FR_6 at margin of frontale; ventral surface of paraclypeus with two small setae on each side (Fig. 4); small sensillum between pores FR_8 and FR_9 present; seta FR_{10} longer then FR_{11}; anterior angles of hypopharynx with 12 round sensilla on each side (Fig. 4).

Appendages of head with all primary setae and pores; without additional sensilla.

Antenna (Fig. 5): proportions of articles 1.6:1.3:3.0:1.3; apical part of antennomere 3 very long, its lateral surface sclerotized; sensilla on antennomeres 3 and 4 well developed; both bell-like sensilla on antennomere 3 long (ratio length / width 4–6); sensorial appendage on antennomere 3 very elongated, as long as antennomere 4; all three basiconical sensilla of antennomere 4 dorsal and very long.

Mandibles (Fig. 6) slightly covered; retinaculum perpendicular; penicillum not extended to retinaculum; terebra with 2–3 larger and 9–12 smaller teeth; dorsal keel slightly developed; dorsal surface near pore MN_b smooth, without teeth.

Maxillae (Fig. 7): cardo without teeth; stipes narrow (ratio length / width 3.5); without large teeth on base; with 12–15 small teeth of microsculpture at level MX_a; dorsal side fully sclerotized, without membranous surface; pore MX_c slightly apical to MX_2; group gMX with 9–11 setae; apical seta of this group beyond level of MX_6; other setae of gMX basally level of MX_4; seta MX_6 small, its length = 0.5 length of MX_5; seta MX_4 small, its apex not extending to inner



Figs 1–7. First instar larva of *Thalassophilus longicornis* (Sturm). 1 – general view. 2 – cephalic capsule (dorsal view). 3 – cephalic capsule (ventral view). 4 – right anterior angle of frontale. 5 – left antenna. 6 – mandibles. 7 – left maxilla. Notation of the primary setae and pores follows Bousquet & Goulet (1984). Scale bars: Fig. 1 – 0.5 mm; Figs 2, 3 – 0.1 mm; Figs 5, 6, 7 – 0.1 mm.

margin of s tipes; galea long, its length = 2/3 length of maxillary palp; length of galeomere 1 = 0.5 length of galeomere 2; galeomere 2 very narrow (ratio length / width 9); seta MX_7 small, no longer than width of galeomere 2; seta MX_8 in proximal quarter of galeomere 2; seta MX_9 situated at top of galeomere 2; proportions of maxillary palpomeres 1:2:1:1, setae MX_{11} and MX_{12} very small, no longer than 0.1 width of palpomere 3; palpomere 4 normal, not divided into secondary sclerites.

Labium (Fig. 9) with very small teeth on lateral sides of dorsal surface; ligula protruding, not sclerotized (Fig. 10); palpomere 2 normal, not divided into secondary joints; seta LA_2 long, extending to apex of palpomere 1; setae LA_3 and LA_4 small, subequal in width to base of palpomere 1; seta LA_5 on dorsal side of ligula; setae LA_5 and LA_6 flat, not extending to apex of palpomere 1.

Thorax (Fig. 13): transverse microsculpture developed only on pretergites of meso- and metanotum; additional sensilla absent.

Pronotum with all primary setae and pores (except PR_c, PR_e, PR_i, PR_j, and $?PS_2$); setae PR_4, PR_{12} and PR_{14} subequal to each other; seta PR_{10} removed basally; seta PR_7 comparatively long, subequal to 4 diameters of seta PR_6 at base; pore PR_f beyond to level of PR_8; episternites, epimerites and sternites of pronotum with all primary setae and pores.

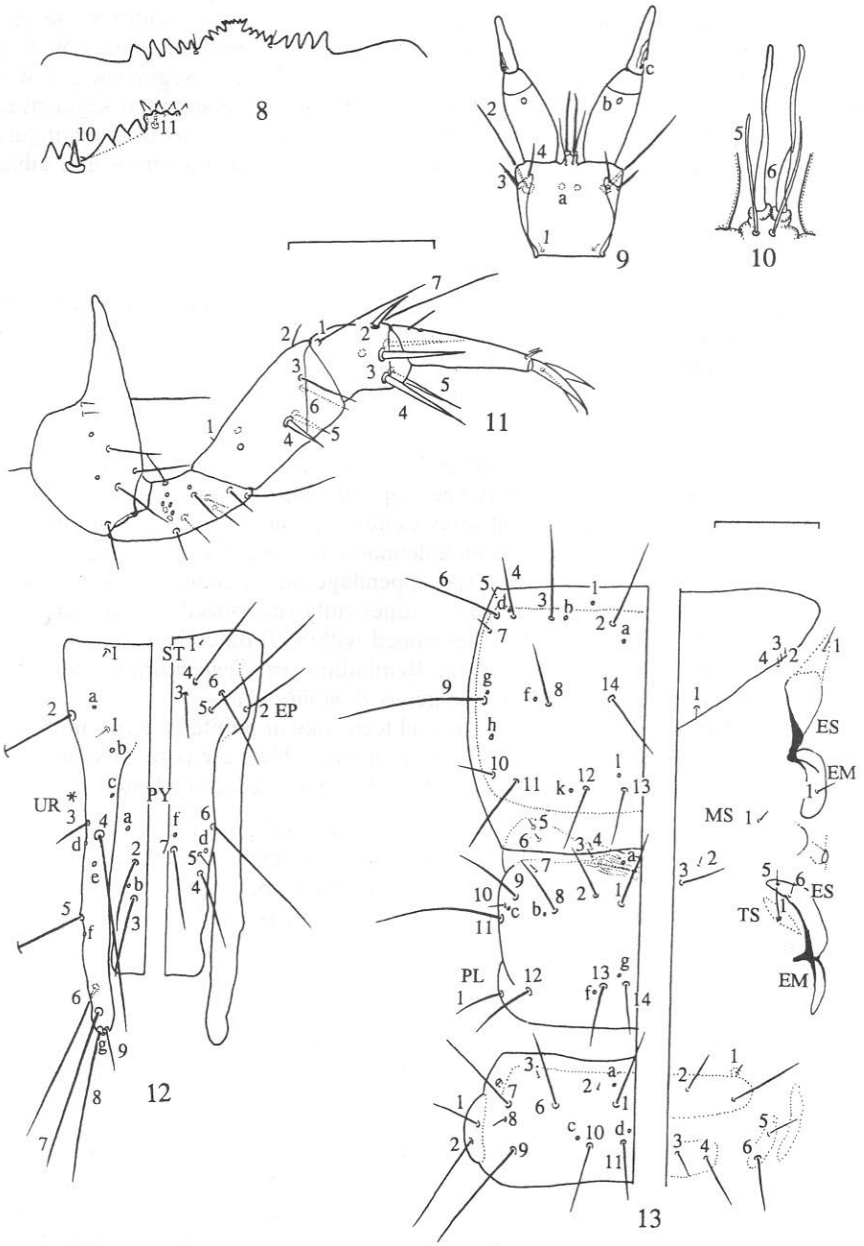
Meso- and metanotum with all primary setae and pores on tergites (except pores ME_d and ME_e); setae ME_{10} on meso- and metanotum comparatively long, subequal to 3 diameters of seta ME_{11} at base; length of seta ME_{14} = 0.8 length ME_{13}; setae ME_{13}, ME_{14} and pores ME_g, ME_f removed to medial line; lateral and ventral surfaces of meso- and metatorax with setae ST_5, ST_6, PL_1, TS_1, MS_1, MS_2, MS_3, MS_5, MS_6; setae ES_1, EM_1, and $?MS_4$ absent.

Legs (Fig. 11): with two unequal claws (anterior claw longer than posterior one); with a single claw seta subequal to posterior claw; all other articles with all primary setae and pores, without additional sensilla; seta TA_1 in proximal one-sixth of tarsus; tibia short; setae TI_1 and TI_7 very thin and long; setae TI_2, TI_3, TI_4, TI_5, and TI_6 thick and short; setae TI_4 and TI_5 longer than TI_2, TI_3, and TI_6; seta FE_1 very small; length of seta FE_2 = 3× length FE_1; setae FE_3 and FR_6 thin and long; setae FE_4 and FE_5 thick and short; seta TR_6 long, subequal to TR_7.

Abdomen (Figs 12, 13): first abdominal segment with all primary setae and pores (except pore TE_b and one setae of ST_5 or ST_6), without additional sensilla; segments 2–8 with all primary setae and pores (except setae TE_4, TE_5 and pore TE_b), segments 2–7 with one additional seta on median sclerites on each side; eigth segment without additional setae; length of seta TE_{11} = 0.9 length TE_{10}; setae TE_9 comparatively long, subequal to 3 diameters of seta TE_{10} at base; tergites 1–8 smooth, without microsculpture, base of urogomphi and dorsal side of pygidium with slightly developed pointed microsculpture; urogomphi (Fig. 12) thin and straight; their length = 1.2 length of pygidium; urogomphi and pygidium with all primary setae and pores (except EP_1 on ninth abdominal segment); sternal sclerite of ninth abdominal segment with a single unsymmetrical additional seta on left side; seta UR_3* near UR_4; setae UR_3* and UR_9 comparatively long, their length = 2× width of apex of urogom phi; seta PY_6 long, extending to apex of pygidium.

Preliminary larval diagnosis of the genus *Thalassophilus* Wollaston, 1854

Within the supertribe Trechitae (sensu Kryzhanovskij 1983) only the larva of *Thalassophilus longicornis* is characterized by: egg-bursters and teeth-like or pointed microsculpture on the head absent; transverse microsculpture on parietale covering all the sclerites (including place near seta PA_9, lateral and ventral surfaces); shape of transverse microsculpture subequal on all surface of parietale; pore PA_b absent; sensorial appendage on antennomere 3 very elongate (ratio le ngth / width 3.5); seta MX_8 in proximal quarter of galeomere 2; galea very long, its length



Figs 8–13. First instar larva of *Thalassophilus longicornis* (Sturm). 8 – nasale. 9 – labium. 10 – ligula. 11 – leg. 12 – urogomphi and pygidium (dorsal and ventral view). 13 – pronotum, mesonotum and fourth abdominal segment (dorsal and ventral view). Notation of the primary setae and pores follows Bousquet & Goulet (1984). Scale bars: Figs 9, 11 – 0.1 mm; Figs 12, 13 – 0.1 mm.

0.6 length of maxillary palp; galeomere 2 very narrow (ratio length / width 9); setae ME_{13}, ME_{14} and pores ME_f, ME_g removed to median line; setae EM_1 on meso- and metanotum absent; legs with two unequal claws; single claw seta very long; abdominal segments 2–7 with one additional seta on median sclerite on each side; seta EP_1 on ninth abdominal segment absent; seta UR_3* near UR_4. Additionally, the larva of *Thalassophilus longicornis* is distinguishable from all Trechini larvae known to me by the normal maxillary palpomere 4 and labial palpomere 2, which are no divided into secondary sclerites.

DISCUSSION

The lack of lacinia, pores PR_c, PR_e, PR_i, PR_j on pronotum, ME_d, ME_e on meso- and metanotum, seta ES_1 on metanotum and pore TE_b on all abdominal tergites of *Thalassophilus* are typical features for all Trechitae larvae known to me.

It is possible to distinguish three main groups of the features of the first instar larva of *Thalassophilus longicornis*:

1. The adaptive features: slightly sclerotized and very slight body; tergites without keels; all setae more long than usual for Trechitae larvae; cephalic capsule flat, parallel-sided; ocellar tubercules, ocelli, post-ocellar and cervical grooves absent; apical part of antennomere 3 very long, its lateral surface sclerotized; sensilla on antennomere 3 and 4 well developed; both bell-like sensilla on antennomere 3 long; sensorial appendage on antennomere 3 very long and narrow, as long as antennomere 4; dorsal side of stipes fully sclerotized, without membranous surface. All these features are more or less developed within all other Trechitae larvae with a special way of life (main part of Trechini; some Bembidiini (sg. *Synechostictus* Motschulsky, 1864 and *Pseudolimnaeum* Kraatz, 1888 of the genus *Bembidion*)).

Is is possible that the absence of egg-bursters and teeth-like or pointed microsculpture on the head; the absence of small teeth on dorsal surface of mandible near pore MN_b and the very narrow joints of maxillae (particularly the galeomere 2) are also adaptive features.

2. The features, sometimes marked within other Trechitae taxa: pore FR_e removed to level of pore FR_f; setae TI_1 and TI_7 very thin and long (*Aepus robini*); terebra with large teeth (*Porotachys bisulcatus* (Nicolai, 1822), *Paratachys* spp.); maxillary palpomere 4 and labial palpomere 2 normal, not divided into secondary joints, (Bembidiini, Tachyini, Pogonini); setae LA_5 and LA_6 flat (sg. *Synechostictus* and *Pseudolimnaeum* of the genus *Bembidion*); seta ES_1 on mesonotum absent (*Aepus robini*).

3. Unique features within the supertribe Trechitae: lacking of pore PA_b on parietale, setae EM_1 on meso- and metanotum and EP_1 on ninth abdominal segment; seta MX_8 in proximal quarter of galeomere 2; abdominal segments 2–7 with one additional seta on each side of median sclerite; seta UR_3* on urogomphi near UR_4.

Presence of two unequal claws with single long claw seta is of a great interest. The main part of so far known Trechitae larvae have one claw with one short claw seta. Larvae of *Perileptus areolatus* (Creutzer, 1799) (Perileptina) have two claws equal to each other with two long flat claw setae (Boldori 1936, Luff 1985). Larvae of *Amblystogenium pacificum* (Trechodina) have „the tarsus ends in two claws, one being slightly longer than other" (Womersley 1937). It is not possible now to mark one of these states as apomorphic or plesimorphic.

Lack of the setae PS_2 on pronotum and MS_4 on meso- and metanotum is a very remarkable feature. Usually, the set of setae on the ventral surface of the thorax is very constant. These setae

are present within all Trechitae larvae known to me, but I cannot find them on the single microscopical slide. It is possible that absence of these setae is only an individual aberration.

A very remarkable features of seta UR_3* must be stressed. Within all Trechitae larvae known to me the shape and location of the seta UR_3 is a generalized type (Bousquet & Goulet 1984) and are urogomphi without any additional setae. Is the short seta on the outer side of urogomphi near UR_4 homologized to the seta UR_3 or not? Can the seta UR_3 be removed to the level UR_4 or is this seta an additional sensillum and the seta UR_3 is reduced? I do not know and I hope, that future in vestigation will answer this question.

Unfortunately, it is nothing known to me about way of life of *Thalassophilus* larvae. The raising in the Petri-dish does not show behaviour of it. But morphologically, the *Thalassophilus* larva is one of the most highly specialized of all Trechitae larvae known to me. Is it microcavernicolous, intersticial or anything else? How is the morphology connected with the larval way of life? Is there any connection between the presence of two claws within Trechitae larvae and living o n sand-alluvial beaches?

From all the facts stated above, the following conclusion can be drawn. The larva of *Thalassophilus longicornis* is one of the most highly specialized of all so far known larvae of Trechitae and shares a set of adaptive features, some of them unique within Trechitae larvae. Besides that, there are some original features that are also marked within the other Trechitae groups. There are many Trechitae taxa having still unknown larval stages. Thus the relationships between *Thalassophilus* and other Trechitae cannot be discussed now. I hope, however, that these questions will stimulate carabidologists to rear and study the morphology and behaviour of Carabidae larvae, particularly Trechitae.

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