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

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Abstract. The first instar larva of *Thalassophilus longicornis* (Stern, 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 PR₁, PR₂, PR₃, PR₄ on the pronotum, MEₛ, MEₑ on the meso- and metanotum, seta ES₁ on the metanotum and pore TE 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 PA₁ on parietale, setae EM₁ on meso- and metanotum, seta EP₁ 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*, Palaeartec 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 (Bembidini, Tachyini, Pogonini) and some authors consider them as a large tribe Trechini (s. 1.) (Jeanne 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 occurr „gondwanienne indo-australo-austral-malgache, avec un genre (*Thalassophilus*) emigre en Europe ou la limite nord de son aire a été remanie par le Glaciaire“ (Jeanne 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 *Amblystogentum pacificum* (Putzey, 1870) (larva was originally described as *A. murcipenne* Enderlein, 1905) (Drygalski 1909, Womersley 1937, Jeanne 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-Berlesse liquid and studied under a light stereo microscope at 200 or 900X. 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 Goës, 1886), Tachyini (7 spp.; genera Tachys Stephens, 1829, Paratachys Casey, 1918, Elaphropus Moschulusky, 1839, Porotachys Netolitzky, 1914 and Tachysa Kirby, 1837), Pogonini (10 spp.; genera Cardioderus Dejean, 1829, Pogonius Nicolai, 1822 and Pogonistes Chaudoir, 1870), Trechini (12 spp.; genera Trechus Clairville, 1806, Aepus Samouelle, 1819 and Epaphis Stephens, 1827) (first instar larvae of the tribe Trechini were studied only for Epaphis secundus (Paykull, 1790) and Aepus robbi (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 frontal 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 PA₈, and lateral and ventral surfaces); shape of parietal microsculpture equal dorsally, ventrally, and laterally; frontal with transverse microsculpture in basal part (at base of setae FR₂ and FR₃); frontal along medial line smooth, without microsculpture; clypeus with slightly developed transverse microsculpture.

Chaetotaxy of cephalic capsule: all primary setae and pores (except PA₈) present; additional sensilla absent; length of seta PA₃ = 0.5 length PA₁; length of setae PA₄ and PA₁₀ = 0.6–0.8 length PA₁; setae PA₁ and PA₁₄ longest on head; distance PAₐ – PAₐ₆ = 3 × distance PAₐ – PA₁₇; setae FR₁ and FR₁₃ long, subequal to PA₄ and = 0.5 length FR₃; setae FR₁ and FR₂ not together, distance FR₂ – FR₃ = 1.5 × distance RF₁ – FR₂ and = 2 × distance FR₃ – FR₅; pore FR₅ and seta FR₅ drawn to gether, distance from frontal suture to FR₅ = 2.5 × distance FR₅ – FR₃; seta FR₅ very small, subequal to seta FR₅; pore FR₅ and seta FR₅ drawn together; length of seta FR₄ = 0.3 length FR₄; setae FR₅ and FR₆ not drawn together, distance FR₅ – FR₆ = 2 × distance FR₄ – FR₆; pore FR₅ at level of pore FR₅; seta FR₆ at margin of frontal; ventral surface of paraclypeus with two small setae on each side (Fig. 4); small sensillum between pores FR₅ and FR₆ present; seta FR₁₅ longer then FR₁₁; 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; penicillium not extended to retinaculum; terebra with 2–3 larger and 9–12 smaller teeth; dorsal keel slightly developed; dorsal surface near pore MN₅ 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 MX₅; dorsal side fully sclerotized, without membranous surface; pore MX₅ slightly apical to MX₅; group gMX with 9–11 setae; apical seta of this group beyond level of MX₅; other setae of gMX basally level of MX₅; seta MX₆ small, its length = 0.5 length of MX₅; seta MX₇ 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, small, no longer than width of galeomere 2; seta MX, in proximal quarter of galeomere 2; seta MX, situated at top of galeomere 2; proportions of maxillary palpomers 1:2:1:1, setae MX11 and MX12 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 LA3 long, extending to apex of palpomere 1; setae LA3 and LA4 small, subequal in width to base of palpomere 1; seta LA5 on dorsal side of ligula; setae LA3 and LA4 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, PR, PR, PR, and ?PS3); setae PR4, PR12 and PR14 subequal to each other; seta PR16 removed basally; seta PR7 comparatively long, subequal to 4 diameters of seta PR8 at base; pore PR7 beyond to level of PR8; 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 ME2 and ME3); setae ME10 on meso- and metanotum comparatively long, subequal to 3 diameters of seta ME11 at base; length of seta ME14 = 0.8 length ME13; setae ME13, ME14 and pores ME2, ME1 removed to medial line; lateral and ventral surfaces of meso- and metatorax with setae ST1, ST5, PL1, TS1, MS1, MS2, MS3, MS4, MS5; setae ES1, EM1, and ?MS1 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 TA1 in proximal one-sixth of tarsus; tibia short; setae TI1 and TI1 very thin and long; setae TI2, TI3, TI4, TI5, and TI6 thick and short; setae TI6 and TI1 longer than TI2, TI3, and TI6; setae FE1 very small; length of seta FE2 = 3× length FE1; setae FE3 and FR6 thin and long; setae FE4 and FE5 thick and short; seta TR1 long, subequal to TR3.

Abdomen (Figs 12, 13): first abdominal segment with all primary setae and pores (except pore TE5 and one setae of ST5 or ST6), without additional sensilla; segments 2–8 with all primary setae and pores (except setae TE4, TE5 and pore TE1), segments 2–7 with one additional seta on median sclerites on each side; eighth segment without additional setae; length of seta TE14 = 0.9 length TE16; setae TE5 comparatively long, subequal to 3 diameters of seta TE14 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, on ninth abdominal segment); sternal sclerite of ninth abdominal segment with a single unsymmetrical additional seta on left side; seta UR1* near UR4; setae UR1* and UR6 comparatively long, their length = 2× width of apex of urogomphi; seta PY6 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 PA9, lateral and ventral surfaces); shape of transverse microsculpture subequal on all surface of parietale; pore PA9 absent; sensorial appendage on antennomere 3 very elongate (ratio length / width 3.5); seta MX9 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 ME₁₅, ME₁₆ and pores ME₇, ME₈ removed to median line; setae EM₁ 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 EP₁ on ninth abdominal segment absent; seta UR₅* near UR₄. 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 not divided into secondary sclerites.

**DISCUSSION**

The lack of lacinia, pores PR₁, PR₂, PR₅, PR₆ on pronotum, ME₉, ME₁₀ on meso- and metanotum, seta ES₁ on metanotum and pore TE₃ 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 *Pseudolimnmaea* 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 MN₁ 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 FR₂ removed to level of pore FR₁, setae TI₁ and TI₂ 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 LA₅ and LA₆ flat (sg. *Synechostictus* and *Pseudolimnmaea* of the genus *Bembidion*); seta ES₁ on mesonotum absent (*Aepus robini*).

3. Unique features within the supertribe Trechitae: lacking of pore PA₁ on parietale, setae EM₁ on meso- and metanotum and EP₁ on ninth abdominal segment; seta MX₈ in proximal quarter of galeomere 2; abdominal segments 2–7 with one additional seta on each side of median sclerite; seta UR₅* on urogomphi near UR₄.

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 *Amblystogynium pacificum* (Treechodina) 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 plesiomorphic.

Lack of the setae PS₁ on pronotum and MS₁ 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 UR₃* must be stressed. Within all Trechitae larvae known to me the shape and location of the seta UR₃ 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 UR₃ homologized to the seta UR₃ or not? Can the seta UR₃ be removed to the level UR₄ or is this seta an additional sensillum and the seta UR₃ is reduced? I do not know and I hope, that future in investigation 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, interstitial 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 on 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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