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To the biology of *Acerocnema breviseta* (Zetterstedt, 1846) (Diptera: Scathophagidae), with description of immature stages

К биологии *Acerocnema breviseta* (Zetterstedt, 1846) (Diptera: Scathophagidae), с описанием преимагинальных стадий

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КЛЮЧЕВЫЕ СЛОВА: Diptera, Scathophagidae, *Acerocnema*, *breviseta*, личинка, пупарий, описание, биология.

ABSTRACT. The biology of *Acerocnema breviseta* (Zetterstedt, 1846) was studied. Larvae were collected in Moscow Region (Russia) in May by the way of sorting the seeds of *Corydalis solida* (Papaveraceae). Mature larvae at that moment left the fruits before pupation. The morphology of the third instar larva and puparium was studied and described for the first time for the genus and species.

РЕЗЮМЕ. Изучена биология мухи-скатофагиды *Acerocnema breviseta* (Zetterstedt, 1846). Личинки были обнаружены при сортировке семян хохлатки плотной *Corydalis solida* (Papaveraceae). Взрослые личинки в тот момент покидали плоды перед окукливанием. Изучена морфология личинки 3-го возраста и пупария, которые впервые для рода и вида описываются в данной работе.

Introduction

Acerocnema Becker, 1894 is one of the small genera within the family Scathophagidae, which until the present time has comprised 15 species distributed in the Holarctic Region [Iwasa, 2014; Ozerov, Krivosheina, 2018; Chagnon, Sinclair, 2021]. Nine species are registered in Russia [Ozerov, Krivosheina, 2023].

The data on the biology of *Acerocnema* species are very poor. Adults were mainly captured on flowering *Corydalis* plants but only for *Acerocnema macrocera* (Meigen, 1826) females ovipositing eggs on fruits of *Corydalis solida* were observed in Europe [Mortelmans, Devillers, 2014].

Our study is related to the description of the third instar larva and puparium of the *Acerocnema breviseta* (Zetterstedt, 1846), which is done for the first time for the genus and species.

Terminology follows Zimin [1948] and Teskey [1981].

Material and Methods

The collection of the imaginal material took place in 2012, 2019, 2023 and 2024 in the Moscow region (Shakhovskoy district, outskirts of Andreevskoe village (55.9815°N 35.5972°E), Burtsevo vicinity (55.9814°N 35.5972°E) and the outskirts of Rozhdestveno village (55.9349°N 35.6289°E), as well as in Moscow in Filevsky Park (55.7424°N, 37.4 392°E) on flowering plants of *Corydalis solida* (Papaveraceae) or near them. In total, 12 ♂♂ and 13 ♀♀ were collected. All adults of both sexes were determined as *Acerocnema breviseta* (Figs 1–3).

The first 6 larvae were collected 15.V.2023 in Moscow region, Burtsevo vicinity (55.9814°N 35.5972°E)) during sorting of seeds of *Corydalis solida*; 5 larvae pupated; one larva and one puparium were fixed in alcohol [alcohol 1]. On the 17.V.2023, at the same place, three more larvae were added to this test tube with a larva in alcohol. Two more larvae were found in Moscow region, env. Rozhdestvenno (55.9349°N 35.6289°E) on the 18.V.2023. One of the larvae was eating a *Corydalis* seed (Fig. 12); both larvae were fixed in alcohol [alcohol 2].

On the night of 30.VI.2023 out of four puparia, two were placed in the refrigerator (upper compartment in the door,

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t° = 4.8–5.8 °C), the other two were left in test tubes in a room at a temperature of ~20 °C.

On the 16.VII.2023 puparia from the refrigerator (two puparia) were moved to the freezer (t° = –15 … –18 °C) for a period of 4 weeks (until 13.VIII.2023).

On the 13.VIII.2023 the puparia from the freezer were moved below to a compartment with a temperature of 4.8–5.8 °C for a period of 4 months (until 13.XII.2023). Then the larvae were kept at temperature 23–25 °C. Special care was taken to ensure that the substrate in which the larvae were located (*Sphagnum* sp.) was moist.

We managed to hatch only one fly which emerged on the 13.I.2024 and was determined as *Acerocnema breviseta.*

Results

BIOLOGY. Adults of both sexes (Figs 1–3) are found during spring (last April – early May). The flies are encountered in places with *Corydalis solida* (L.) Clairv., 1811 (fam. Papaveraceae) (Figs 4–6).

The life history of this species can be summarized as follows: adults emerge from overwintering pupae from the middle of April and, after mating, lay eggs to seeds of *Corydalis solida* from the late of April to early of May. Larvae apparently penetrate the seed of *Corydalis solida* (Fig. 4) to consume its contents through the micropyle (Fig. 12).

Mature (three instar) larvae leave the fruit and form their puparia in wet soil. There is only one generation a year; puparia are formed in middle–late May and overwinter at this stage.

DESCRIPTION OF IMMATURE STAGES. **Third instar larva**. Body length 4.7 mm, maximal width 1.2 mm. Body shape cylindrical, tapering anteriorly. Creamy white, integument regularly covered with transparent spinules (Fig. 11). Creeping welts are not developed. Anterior spiracles bicornuate, each cornu with 7–8 papillae (Fig. 9). Cephalopharyngeal skeleton strongly sclerotized and massive (Fig. 8). Mandibles large without accessory dents. Hypopharynx short. Pharyngeal sclerite with dorsal cornu longer than the ventral. Dorsal cornu with narrow thin long window. Ventral cornu with large open window.

Terminal segment of the body with two short respiratory tubes. Spiracular plates flat without developed spines, each with three identical radial spiracular openings (Fig. 10). Terminal segment with 5 pairs of tubercles. Perianal pad transverse, anus is situated in a longitudinal cleft.

Puparium. Body length 4.0 mm, maximal width 1.1 mm. Body shape cylindrical, tapering and bilobed anteriorly (Fig. 16). Brown, integument regularly covered with dark spinules. Creeping welts are not developed. Anterior spiracles bicornuate, each cornu with 7–8 papillae. Cephalopharyngeal skeleton as in third instar larva (Fig.8). Terminal segment of the body (Figs 13–15) with two short respiratory tubes. Spiracular plates flat without developed spines, each with three radial spiracular openings (Fig. 10). Terminal segment with 5 pairs tubercles 4 of them (dorsal, lateral, subventral, subanal) are large and fleshy, ventral tubercles are small (Figs 13–15). Perianal pad brown, transverse, anus is situated in a longitudinal cleft (Figs 15, 16).

Figs 1–3. *Acerocnema breviseta* (Zetterstedt), adults: 1 — male (collection specimen), lateral view; 2 — male on a stem of *Corydalis solida*; 3 — female in grass near *Corydalis solida*.
Рис. 1–3. *Acerocnema breviseta* (Zetterstedt), имаго: 1 — самец (коллекционный экземпляр), сбоку; 2 — самец на стебле *Corydalis solida*; 3 — самка на траве около *Corydalis solida*.

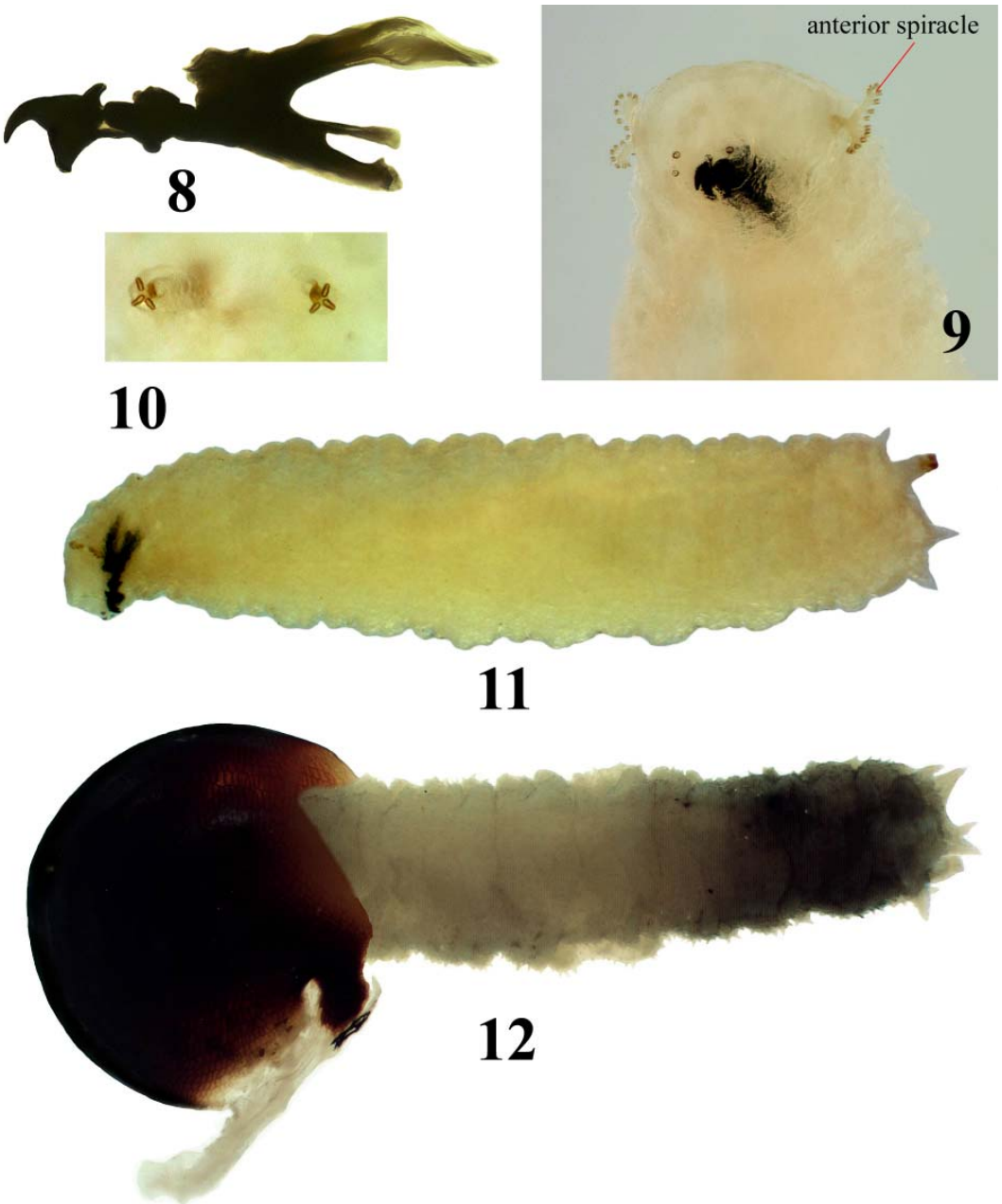
Figs 4–7. *Corydalis solida* (L.) Clairv.: 4 — general view; 5 — inflorescence with flowers; 6 — same, with fruits; 7 — fruits (on the left, an open fruit with seeds).
Рис. 4–7. *Corydalis solida* (L.) Clairv.: 4 — общий вид; 5 — соцветие с цветками; 6 — то же, с плодами; 7 — плоды (слева вскрытый плод с семенами).

Discussion

Despite the name of the family Scathophagidae, or “dung flies”, larvae only from genera *Scathophaga* Meigen, 1803 and *Scatomyza* Fallén, 1810 live in dung; the known representatives of the other genera are mainly phytophagous [Ferrar, 1987].

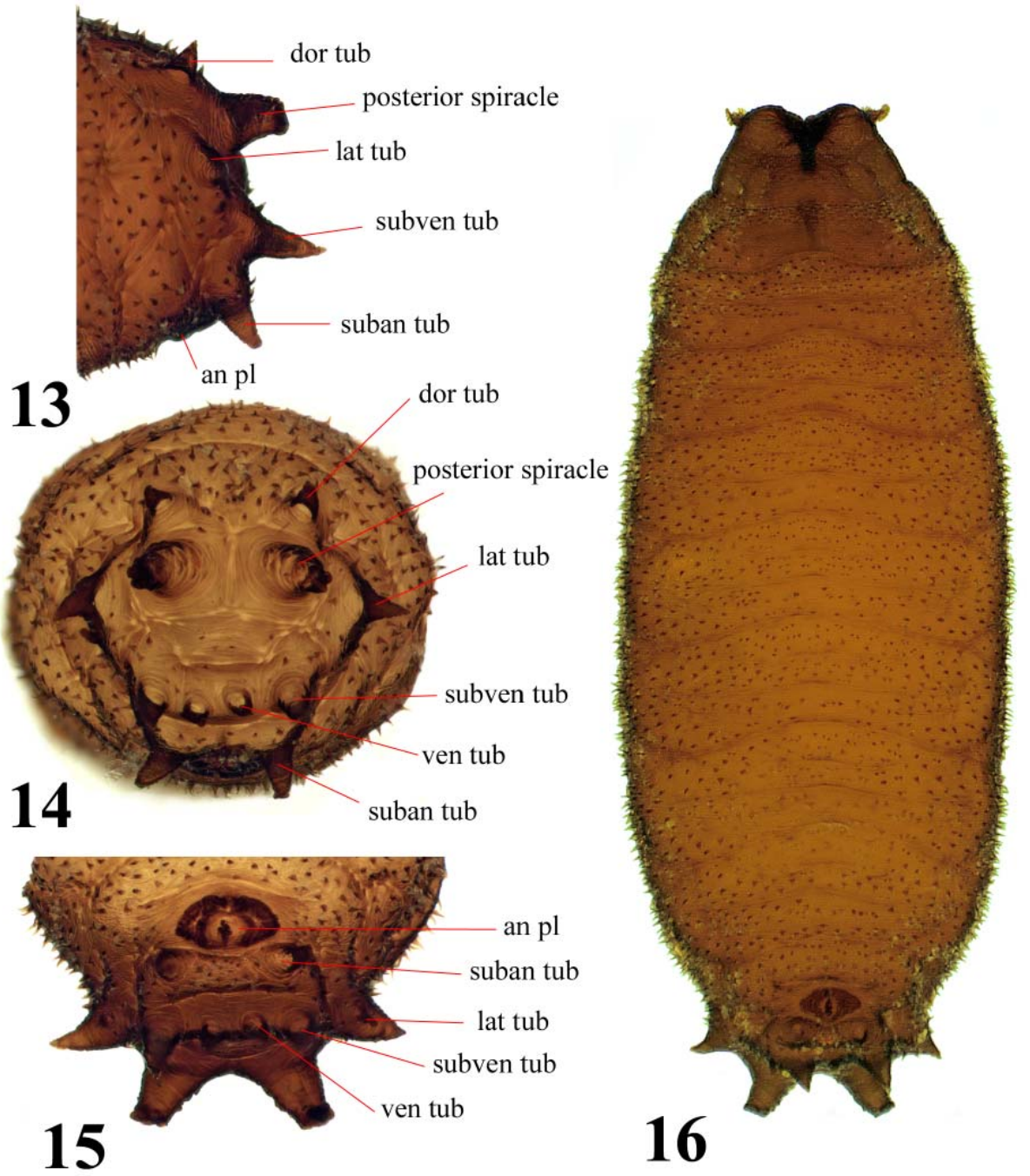
Larvae of the genus *Cordilura* Fallén, 1810 in first instar are phytophagous, but in second and third instars are saprophagous [Wallace, Neff, 1971]; some larvae, for example *Cleigastra apicalis* (Meigen, 1826), inhabiting tunnels of other insects, are supposed to be saprophagous, although some authors consider them to be scavengers or predators [Ferrar, 1987; Grochowska, 2006]; larvae of *Cosmetopus longus* are detritophagous [Ferrar, 1987]; larvae of the genus *Spaziphora* Rondani, 1856 are predaceous [Ferrar, 1987].

Depending on the type of diet and life habits, the larvae have morphological differences in the structure of the cephalopharyngeal skeleton and general morphology.



Figs 8–12. *Acerocnema breviseta* (Zetterstedt), third instar larva: 8 — cephalopharyngeal skeleton; 9 — cephalic segment, ventral view; 10 — posterior spiracles; 11 — general view, laterally; 12 — larva eating the seed of *Corydalis solida*.
Рис. 8–12. *Acerocnema breviseta* (Zetterstedt), личинка 3-го возраста: 8 — ротоглоточный скелет; 9 — передний конец тела, снизу; 10 — задние дыхальца; 11 — общий вид, сбоку; 12 — личинка, поедающая семя хохлатки *Corydalis solida*.

Larvae of *A. breviseta* are carpophagous and share most of the morphological characters with phytophagous larvae of the family Scathophagidae. Anterior spiracles of *A. breviseta* are of a shape close to those of *Norellisoma spinimanum* (Fallén, 1819), differing from it by the number of papillae: 7–8 on each cornu in *A. breviseta* and 13 in *N. spinimanum* [Ferrar, 1987]. Massive mouthhooks are typical of many phytophagous larvae, such as *Neochirosia atrifrons* (Coquillett, 1910), most species of *Cordilura*, *Cleigastra armillata* (Zetterstedt, 1846), *N. spinimanum*. Species of first three genera have additional tooth on the mouth hooks



Figs 13–16. *Acerocnema breviseta* (Zetterstedt), puparium: 13 — terminal segment, lateral view; 14 — same, posterior view; 15 — same, ventral view; 16 — general view, ventrally. Abbreviations: an pl — anal plate; dor tub — dorsal tubercle; lat tub — lateral tubercle; suban tub — subanal tubercle; subv tub — subventral tubercle; ven tub — ventral tubercle.

Рис. 13–16. *Acerocnema breviseta* (Zetterstedt), пупарий: 13 — задний конец тела, сбоку; 14 — то же, сзади; 15 — то же, снизу; 16 — общий вид, снизу. Сокращения: an pl — анальная пластинка; dor tub — дорсальный бугорок; lat tub — латеральный бугорок; suban tub — субанальный бугорок; subven tub — субвентральный бугорок; ven tub — вентральный бугорок.

[Ferrar, 1987]. Mouthhooks of *A. breviseta* larvae lack such tooth and this character makes them similar to the larvae of *N. spinimanum*. However ventral cornua of pharyngeal sclerite in *A. breviseta* are relatively shorter and less massive, than in *N. spinimanum*, and with open, not closed, window. Spiracular plates of posterior spiracles are without spines, each with three identical radial spiracular openings (Fig. 10). The puparium is cylindrical in shape, uniformly tapering anteriorly, and is most similar to puparia of the genus *Cordilura* Fallén, 1810. Similar shape of the puparia is known also for *Cleigastra apicalis*, described by Grochowska [2006]. However the puparia differ in the morphology of creeping welts, well developed in *C. apicalis*, but absent in *A. breviseta*. This can be explained due to the differences in the larvae habits: *C. apicalis* move actively inside tunnels of other insects and *A. breviseta* leads a semisubmerged mode of life.

Competing interests. The authors declare no competing interests.

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