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### Morphology of larva of *Phaedon concinnus* STEPHENS and its distinction from larvae of allied species (Insecta: Coleoptera: Chrysomelidae)

With 9 Figures and 1 Table

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**Abstract.** The article includes the description of *Phaedon concinnus* elder instar larva, and a key to larvae of some allied species. The morphological differences between the larvae of *Ph. concinnus* and *Ph. armoraciae* are described for the first time.

**Kurzfassung.** Die Arbeit beinhaltet die Beschreibung des älteren Larvenstadiums von *Phaedon concinnus* sowie einen Bestimmungsschlüssel für die Larven nahe verwandter Arten. Die morphologischen Unterschiede zwischen den Larven von *Ph. concinnus* und *Ph. armoraciae* werden erstmals beschrieben.

#### Introduction

The chrysomelid-beetle species *Ph. concinnus* STEPHENS, 1834 is distributed in Mongolia, Siberia and N. Europe. MEDVEDEV & ZAITZEV (1978) have been the first to apply themselves to the taxonomy of this species larva but they have not pointed out the morphological differences between this larva and that of the allied species, *Ph. armoraciae* (LINNAEUS, 1758), and ascertained only ecological distinctions: *Ph. concinnus* larvae inhabit salty localities and feed on Ranunculaceae, and *Ph. armoraciae* ones inhabit unsalty localities and feed on Brassicaceae.

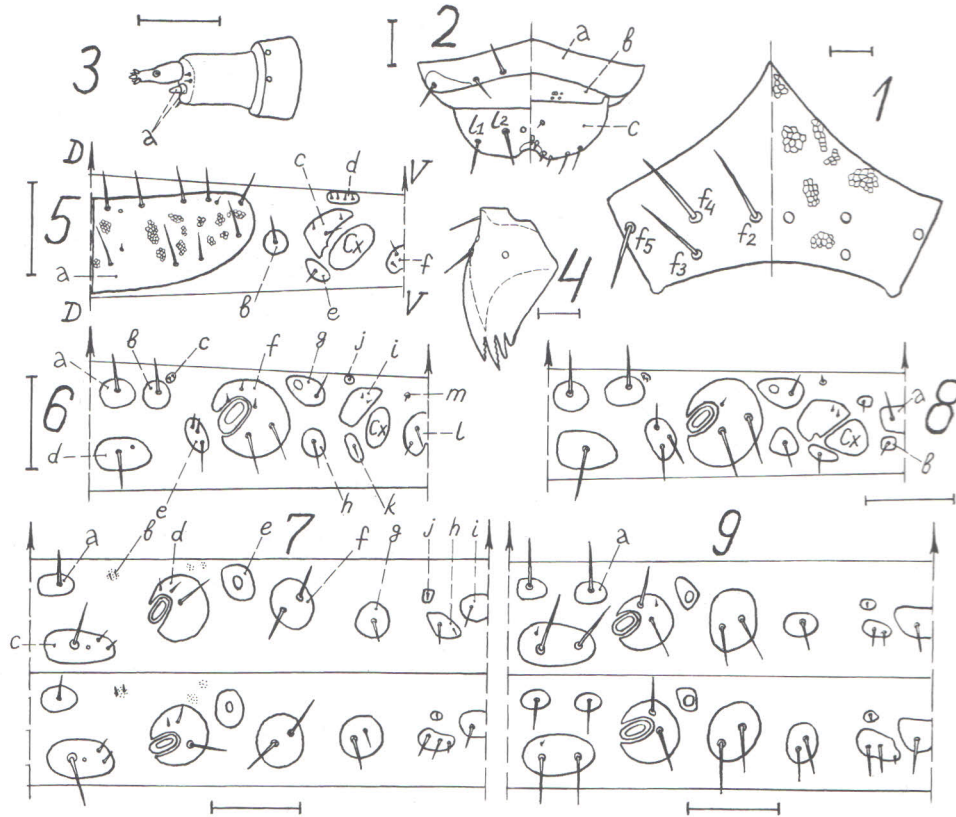
The author of the present article was successful in finding and examining of *Ph. concinnus* larvae from Karelia and Murmansk region, and *Ph. armoraciae* larvae from Moscow region. The specimens of *Ph. concinnus* larvae from Mongolia which were kindly disposed by Dr. Yu. M. ZAITZEV, have been also studied. Distinct morphological differences between larvae of both species have been found. As the total description of *Ph. concinnus* larva was absent till now, it is given here as below.

#### *Phaedon concinnus* STEPHENS, 1834

##### Elder instar larva

**Description.** Body of specimens fixed in alcohol brown with darker sclerites and legs, lighter ventral side and thin longitudinal stripe devoid of microstructure at middle of thorax segments dorsal side, brownish black brilliant head; the body is covered with light reddish setae. Integument microstructure presented by rounded, oval or irregular small plates, distance between them less than their width. Microstructure gets to sides of sclerites. Sclerites more or less convex, their margins undistinguished. Body length about 5 mm, cephalic capsule 1.0 mm wide.

Head. Parietale with 6 ocelli, 9–10 long setae (3 – along frontal suture, 4–5 – laterally, 2 – behind base of antenna) and 2 short setae at each side. Frontale (Fig. 1) with 8 long setae, seta f<sub>1</sub>



Figs. 1–7: *Phaedon concinnus* STEPH. larva, structural details. 1: frontale: chaetotaxy (left side), integument microstructure (right side) ( $f_2$ – $f_5$  – frontal setae); 2: clypeus and labrum: dorsal (left side), ventral (right side) view (a – chitinized part of clypeus, b – membranous part of clypeus, c – labrum); 3: antenna (a – sensorial process); 4: right mandible: face view; 5: prothorax (D–D – middle of dorsal side, V–V – middle of ventral side, Cx – place of coxa, a–b, d–f – sclerites: a – pronotal, b – epipleural, d – lateral intercalar, e – hypopleural, f – sternal, c – trochantin); 6: mesothorax (a–h, j–m – sclerites: a – inner anterior tergal, b – lateral anterior tergal, c – secondary dorsal, d – inner posterior tergal, e – lateral posterior tergal, f – dorsolateral, g – anterior epipleural, h – posterior epipleural, j – lateral intercalar, k – hypopleural, l – sternal, m – praesternal, i – trochantin); 7: abdominal segments 1 and 2 (a, c–j – sclerites: a – inner anterior tergal, c – posterior tergal, d – dorsolateral, e – upper epipleural, f – lower epipleural, g – hypopleural, h – parasternal, i – sternal, j – praesternal, b – dark spot occupied lateral anterior tergal sclerite place). – Figs. 8–9: Larva of *Phaedon armoraciae* L., structural details. 8: mesothorax (a–b – sclerites: a – middle sternal, b – lateral sternal); 9: abdominal segments 1 and 2 (a – lateral anterior tergal sclerite). Scale in Figs. 1–4 – 0.1 mm, 5–9 – 0.5 mm.

absent,  $f_4$  behind  $f_3$ . Clypeus (Fig. 2, a, b) with 6 setae on upper side of chitinized part and 2 groups of 4–7 short setae on lower side of membranous part. Anterior margin of labrum (Fig. 2, c) with small half-round depression, bottom of which is thickened. Base of labrum almost straight, without posterior angle, lateral angles narrowly drawn out. Labrum with 2 pores and 4 discal setae (Fig. 2,  $l_1$ ,  $l_2$ ) on upper side, 2 setae on disk and 4 short ones at bottom of anterior depression on lower side, 4 long and 4 short setae anteriorly. 1st antennal joint (Fig. 3) short, cylindrical, with 2 pores; 2nd joint cylindrical, 1–1.5 times longer than wide, with 3 short setae and short, 2-jointed, conical sensorial process (Fig. 3, a) at apex; 3rd joint bottle-formed, with

large pore at side and 5 short setae on apex. Mandibles (Fig. 4) with 1 pore at face, 2 setae and 1 pore at dorsum, and 5 teeth, 1st one (outer) curved to inner side of mandible, 2nd and 3rd ones serrated on their inner border, 5th one (inner) rounded, others sharp. Parietal and frontal surfaces of head with sparse groups of 4–14 irregular cells. Cardo without setae; stipes with 2 long setae, 1 short one, and 1 pore; 1st joint of maxillar palp with 2 setae, 2nd joint with 1 pore, 3rd joint with 1–3 setae, 4th joint with 2 short setae and 1 pore at side, and 11 small spinules at apex; masticatory blade (galea + lacinia) with 1 pore at side, 7 setae at apex, and 3–5 ones at inner side. Weak-chitinized submentum with 2 setae; mentum slightly stronger chitinized than submentum, with 2 long and 2 short setae, and 2 pores; mental sclerite with 2 long and 2 short setae; praementum with group of 6–7 short setae and 2 pores; 1st joint of labial palp plane, with 1 short seta and 1 pore, 2nd joint conical with rounded apex, slightly curved inside, with 1 pore on the outside near apex, and 7–9 small spinules and 1 pore at top.

Prothorax (Fig. 5). Pronotal sclerite (Fig. 5, a) is divided into 2 parts by longitudinal light stripe, with sparse groups of irregular cells, with 9–11 long and 2 short setae and 2 pores at anterior margin, and 6–7 long setae, 2–3 ones shorter than the previous ones, and 2–4 shortest setae near posterior margin; epipleural sclerites (Fig. 5, b) small, rounded, with 1 seta; trochantins (Fig. 5, c) with 1 long and 2–3 short setae; hypopleural sclerites (Fig. 5, e) with 1 seta; sternal sclerite (Fig. 5, f) small, roundly-cordate, with 2 long and 2 short (or 4 equal) setae; lateral intercalary sclerites (Fig. 5, d) transverse, with 4–5 short setae.

Meso- (Fig. 6) and metathorax. Inner (Fig. 6, a) and lateral (Fig. 6, b) anterior tergal sclerites small, rounded, drawn together or partly connected, each with 1 seta; secondary rudimentary dorsal sclerites (Fig. 6, c) with 1–2 short setae; inner posterior tergal sclerites (Fig. 6, d) larger than anterior ones, somewhat transverse, with 1 seta and 1 pore; lateral posterior tergal sclerites (Fig. 6, e) somewhat longitudinal, with 1 long and 2 short setae; dorsolateral sclerites (Fig. 6, f) large, rounded, very convex, with 2 long and 3–4 short setae and gland-formed opening; anterior epipleural sclerites (Fig. 6, g) transverse, roundly triangular, with 1 seta, seldom with 2 ones on metathorax, with spiracle on meso- and spiracle rudiment on metathorax; posterior epipleural sclerites (Fig. 6, h) small, rounded, with 1 seta; trochantins (Fig. 6, i) with 2–3 short setae; lateral intercalary sclerites (Fig. 6, j) very small, rounded, with 1 short seta; hypopleural sclerites (Fig. 6, k) with 1 seta; sternal sclerite (Fig. 6, l) larger than that on prothorax, rounded, with triangular depression posteriorly, with 2 long and 2 short setae (1 specimen with sternal sclerite divided in 3 parts on metathorax); praesternal sclerites (Fig. 6, m) very small, with 1 short seta.

Legs. Coxa with 4–6 long, 8–9 short setae; trochanter with 3–4 long, 1 short seta and 5–6 pores; femur with 5 long and 2 short setae; tibio-tarsus with 7 setae; claw with wide base, slightly curved in apical part, with weak obtuse projection and seta on lower side, without helonium.

Abdomen. Segments 1–6. Inner anterior tergal sclerites (Fig. 7, a) small, rounded, with 1 long seta; lateral anterior tergal sclerites mostly absent (very seldom they present at right or left side of 1st or 2nd abdominal segment), small dark spot (Fig. 7, b) with 1–2 very short setae occupying their place; posterior tergal sclerites (Fig. 7, c) (inner + lateral?) transverse, with 1 long and 2 short setae and 1 pore; dorsolateral sclerites (Fig. 7, d) very convex, rounded, with 1 long and 2 short setae and gland-shaped opening; spiracles on small rounded sclerites (Fig. 7, e) called here as „upper epipleural“ ones; epipleural sclerites (Fig. 7, f) are called here as „lower epipleural“ ones respectively, the latter ones with 2 long setae; hypopleural sclerites rounded, with 1 seta on 1st segment (Fig. 7, g), with 1 long and 1–2 short setae on 2nd–6th segments (Fig. 7); parasternal sclerites transverse, with 1 long and 1–2 short (or 2 equal) setae on 1st segment (Fig. 7, h); with 2 long and 1 short seta on 2nd–6th segments (Fig. 7); sternal sclerite (Fig. 7, i) transverse, with 2 long setae; praesternal sclerites (Fig. 7, j) very small, with 1 short seta. 7th segment differs from previous ones by its sclerotization: anterior tergal sclerites absent; right and left posterior tergal ones are connected, together with 2 long and 4–6 short setae and 2 pores; sternal sclerite is connected with parasternal ones, together with 6 long setae, 2–4 ones shorter than previous ones and 2 shortest setae. Common tergal sclerite of 8th segment with 4 long and 2–9 short setae; epipleural sclerites with 2 long setae; hypopleural sclerites with 1 long and 1 short seta; common

(left side),  
dorsal (left  
of clypeus,  
ax (D–D –  
– sclerites:  
trochantin);  
tergal, c –  
– anterior  
m – prae-  
rior tergal,  
popleural,  
gal sclerite  
ax (a–b –  
ral anterior

d part and  
of labrum  
rum almost  
ores and 4  
of anterior  
g. 3) short,  
short setae  
rmed, with

specimen	locality	abdominal segments											
		1		2		3		4		5		6	
		l	r	l	r	l	r	l	r	l	r	l	r
1	Karelia	+	+	+	+	+	+	-	+	-	-	-	-
2	---//---	+	+	+	-	-	-	-	-	-	-	-	-
3	---//---	+	-	+	+	+	-	-	-	-	-	-	-
4	--//---	+	+	+	+	-	-	-	+	+	-	-	-
5	---//---	+	+	+	+	+	+	+	-	-	-	-	-
6	Murmansk reg.	+	+	+	+	+	+	+	+	-	-	-	-
7	---//---	+	+	+	+	+	+	-	-	-	-	-	-
8	---//---	+	+	+	+	+	+	-	+	+	-	-	-
9	Mongolia	+	+	+	+	+	+	+	+	+	+	+	+
10	---//---	+	+	+	+	+	-	+	-	-	-	-	-

Table 1: Presence or absence of inner anterior tergal sclerites on abdominal segments 1–6 in *Phaedon concinnus* larva. (Abbreviations: l – left side, r – right side).

sternal sclerite with 2 very short setae anteriorly and 6–8 long setae posteriorly. 9th segment dorsally with 8–11 long and 6 short setae, ventrally with 6 long and 2 short ones.

The presence or absence of inner anterior tergal sclerites (with their setae) on 1st–6th abdominal segments is subjected to individual variability, as shown in Table 1.

**D i a g n o s i s .** *Ph. concinnus* larva is allied to larvae of *Ph. armoraciae*, *Ph. cochleariae* (FABRICIUS, 1792) and *Ph. brassicae* BALY, 1874, and differ from them with the following key:

#### Key to species

- 1(4) Anterior tergal sclerites on meso- and metathorax divided into inner and lateral ones, each with 1 seta; inner anterior tergal sclerites of abdominal segments 1–2 and, mostly, some of 3–6 present, at least, on right or left side.
- 2(3) Body covered with light, reddish setae; sternal sclerite of meso- and metathorax almost always undivided (Fig. 6, 1); lateral anterior tergal sclerites mostly absent on abdominal segments 1–6 (Fig. 7), very seldom they are present only on right or left side of segment 1 or 2; posterior tergal sclerites (Fig. 7, c) with 1 long and 2 short setae on abdominal segments 1–6. *Phaedon concinnus* STEPHENS
- 3(2) Body covered with dark brown setae; sternal sclerite of meso- and metathorax divided in 3 parts: large middle sclerite (Fig. 8, a) and 2 small lateral ones (Fig. 8, b), sometimes lateral sclerites more or less connected on mesothorax, but they never joined middle sclerite; lateral anterior tergal sclerites always present on abdominal segments 1–6, at least, on right or left side (Fig. 9, a); posterior tergal sclerites with 2 long and 1 very short, hardly visible seta on abdominal segments 1–6 (Fig. 9). *Phaedon armoraciae* (LINNAEUS)
- 4(1) Anterior tergal sclerites on meso- and metathorax undivided, with 2 setae; inner anterior tergal sclerite sometimes presents at right or left side of abdominal segment 1, always absent on segments 2–6.
- 5(6) Posterior tergal sclerites with 3 setae (1 long, 2 short) on abdominal segments 1–6. *Phaedon cochleariae* (FABRICIUS)

- 6(5) Posterior tergal sclerites with 4 long setae on abdominal segments 1–4, with 3 long setae on segments 5–6. *Phaedon brassicae* BALY

#### Materials.

(If not indicated otherwise, the materials are in the author's collection).

*Ph. concinnus*: Balsam slides: Karelia, Louchi Distr., near Tschornaja Reka, White Sea littoral meadow, on *Triglochin maritima*, 12.7.1990: 5 larvae, BIENKOWSKI leg.; Murmansk reg., Kandalaksha Distr., 12 km SE of Poyakonda, White Sea littoral meadow, on *Triglochin maritima*, 26.6.-6.7.1989: 3 larvae, BIENKOWSKI leg. (dito, 6.7.1989, 6 larvae in alcohol: deposited in Staatliches Museum für Tierkunde Dresden); Mongolia, Ich- Havtgijn-Nuru, on *Ranunculus*, 23.7.1975: 2 larvae. Larvae collected in Karelia and Murmansk region, have been attributed to *Phaedon* owing to the sclerotization and the integument microstructure typical to this genus (MMEDVEDEV & ZAITZEV, 1978). They were attributed to *Ph. concinnus*, as only the adults of the single *Phaedon* species inhabit *Triglochin maritima* in the littoral meadows, where larvae were collected. Specimens from Mongolia are identical to the larvae collected by the author.

*Ph. armoraciae*: Balsam slides: Moscow reg., near Zelenograd, pond bank, on *Veronica beccabunga*, 24.6.1991: 10 larvae, ORLOVA & BIENKOWSKI leg. Available specimens correspond to the description and pictures by HENNIG (1938), and differ only with the number of long setae at the anterior margin of pronotal sclerite: 9 from 10 examined larvae have 10 setae, and only 1 specimen has 12 setae as HENNIG described.

*Ph. cochleariae*: Balsam slides: Moscow reg., Chashnikovo, on *Armoracia rusticana*, 15.7.1992: 1 larva, BIENKOWSKI leg.; Moscow reg., Bykovo, on *Rorippa sylvestris*, 16.6.1992: 1 larva, BIENKOWSKI leg.; S. Karelia, Swir valley between Lodeinoje Polje and Podporozhje, near Tashkenetsy, on Brassicaceae, 5.7.1993: 1 larva, ORLOVA & BIENKOWSKI leg. Larvae correspond to HENNIG (1938).

*Ph. brassicae*: Balsam slide: China, on Brassicaceae, 1952: 1 larva. Specimen is associated with adults.

**Biological notes.** According to the author's observations in Karelia and Murmansk region, *Ph. concinnus* inhabits the littoral meadows and river estuaries. The main host plant of the larvae and adults is *Triglochin maritima*; adults also feed on *Plantago salsa*, *Cochlearia arctica* and *Ranunculus repens*, they gnaw leaves and flowers (in nature and laboratory experiments). Adults hibernate at the edge of the forest and in osier-beds near the littoral meadows under fallen leaves, moss and in soil down to 8 cm deep. Beetles leave their hibernaculum in the end of May and beginning of June, copulate till the middle of June. Females lay eggs on leaves of *T. maritima* at 3–5 mm distance from each other. Adults occur till the middle of August. Larvae are found from the middle of June to the middle of July. Pupation likely occurs in soil. The emergence of the young generation beetles have not been observed.

#### Summary

The *Phaedon concinnus* elder instar larva is similar to that of *Ph. armoraciae* and differs from the latter with the following characters: body covered with light, reddish setae; sternal sclerite of meso- and metathorax almost always undivided; lateral anterior tergal sclerites mostly absent and posterior tergal sclerites with 1 long and 2 short setae on abdominal segments 1–6.

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