

Description of the Third-instar Larva of *Aphodius bimaculatus* (Laxmann) (Coleoptera, Scarabaeidae)

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Abstract—The third-instar larva of *Aphodius bimaculatus* (Laxmann) is described from the material collected in Belarus. The larva differs from other species of the subgenus *Acrossus* in the convex clypeus with a complex structure and in the coloration of the head.

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Aphodius (Acrossus) bimaculatus (Laxmann, 1770) is one of the largest species of the genus *Aphodius* Ill. in the Russian fauna. It can be easily distinguished from the congeners by its distinctive coloration: black pronotum with orange sides, reddish orange elytra with dark apices and black spots, and bicolor, black and orange legs and abdomen.

The geographic range of the species includes Russia from St. Petersburg, Yaroslavl, Tyumen, Novosibirsk, and Krasnoyarsk in the north to the Crimea, Stavropol, and Baskunchak Lake in the south (Kabakov and Frolov, 1996), and to Tomsk Prov., Krasnoyarsk Terr., and Altai in the east. It was recorded from most of Europe (except for southern and southwestern parts), Ukraine, northern Kazakhstan, and Kirghizia. Recently it was found in eastern Kazakhstan (Zinchenko et al., 2002).

The beetles are rare throughout the range of the species. Most of the museum specimens, especially those from Western Europe, were collected more than 50 years ago. The range of the species decreases and now it is very rare or has become extinct in localities where it was relatively common in the first half of the 20th century.

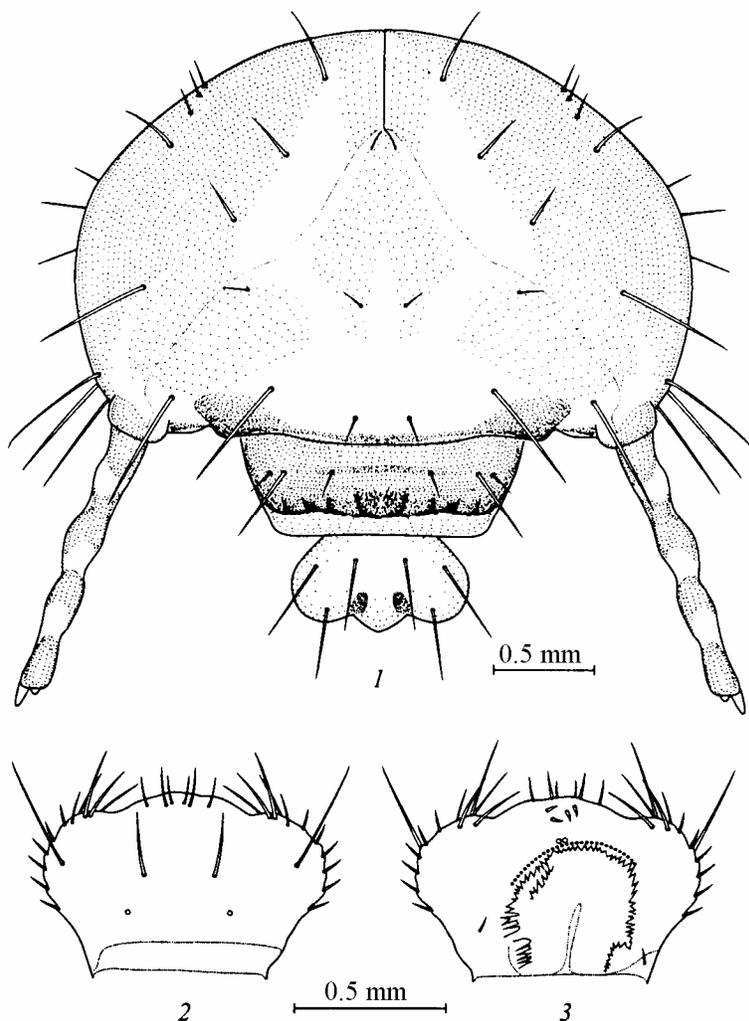
At present, *A. bimaculatus* is included in the Red List of the Russian Federation, category 2—endangered species (Nikitskyi, 2001). The reasons for reduction of its populations are unknown but it is possible that they are not related to reduction of the habitats because this species mostly inhabits pastures and feeds on cattle and horse dung. In our opinion, that this species more likely to be sensitive to toxic chemicals used in agriculture. This is indirectly supported by the fact

that the reduction of populations, at least in Russia, corresponds to the beginning of the wide utilization of chemicals in agriculture. A negative impact of these chemicals, particularly pesticides, on dung beetles is reported in the literature. On-going research in some countries is aimed at reduction of this impact and limiting the use of the most toxic chemicals in agriculture.

A. bimaculatus has been known since the XVIII century, yet its larva was not described due probably to the rarity of the species. In 1995, a population of the species was found in Belarus (Frolov, 1995). The beetles collected in the following years were bred in the laboratory and we could examine the morphology of the larvae and compare them to the larvae of other *Acrossus* species.

Beetles and larvae of *A. bimaculatus* were collected near Rudensk (Belarus, Minsk Distr.) in horse dung. Sixteen 3rd-instar larvae were examined including six reared from the eggs laid by the beetles collected on 29.IV.2000. The remaining larvae were collected in the field on 8.VI.2001. Larvae treatment and preparation follows Frolov (2000).

Description of 3rd-instar larva. Head width 3.10 ± 0.14 mm, length (without clypeus and labrum) 2.24 ± 0.11 mm. Head surface shiny, shagreened, yellowish brown, with unclear pattern of small brown spots and 4 symmetrical dark spots in middle of frons and on pleural sclerites near frontal sutures. Medial parts of pleural sclerites and base and apex of frons darker than rest part of head. Frontal sutures visible as fine lines (Fig. 1).



Figs. 1–3. *Aphodius bimaculatus* (Laxmann), 3rd-instar larva: (1) head (without mouthparts); (2, 3) labrum [(2) dorsal, (3) ventral side].

Length of epicranial suture approximately half height of frons. Each pleural sclerite with 8 long setae: 3 near palpifer, 4 at center, and 1 near epicranial suture. On periphery of pleural sclerite, 3 shorter setae and few small setae without definite location and number present. Head with 5 pairs of setae: 2 short at center of frons, 1 short medially, and 2 long laterally.

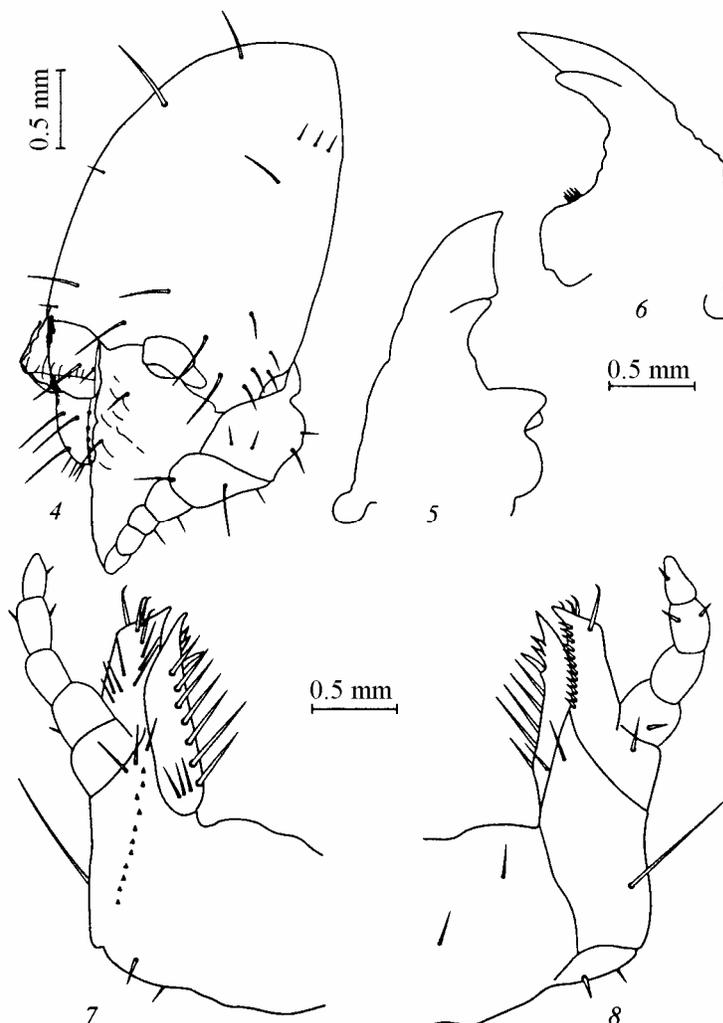
Clypeus trapezoidal, brown, with pair of long and pair of very short setae laterally, and pair of short setae medially. Basal part of clypeus (preclypeus) convex, with symmetrical tubercles, heavily sclerotized (Fig. 1, 4).

Labrum (Fig. 2) three-lobed, with 38 setae: 16 relatively short setae on anterior margin, 2 long on dorsal side, 6 short on ventral side of lateral margins, and 2 long setae on dorsal surface in middle. Ventral side of

labrum with 4 short setae near anterior margin and 2 basally (Fig. 3).

Mandibles triangular, asymmetrical. Left mandible slightly longer than right one, its scissorial part wider (Figs. 5, 6). Base of mandible pale brown, scissorial and molar parts almost black.

Maxillae symmetrical (Figs. 7, 8). Cardo with 4 short setae: 2 on ventral side and 2 on lateral margin near base of stipes. Ventral side of stipes with long proximal and short distal setae, dorsal side with row of 11 stridulatory teeth and 3 short setae near base of palpifer. Palpifer without stridulatory teeth, with 1 short setae ventrally. Maxillary palp 4-segmented. Its 1st and 4th segments with 1 seta each, 3rd one with 2 setae. Ventral side of galea with longitudinal row of 12 short setae. Dorsal side and apex of galea with 11



Figs. 4–8. *Aphodius bimaculatus* (Laxmann), 3rd-instar larva: (4) head, lateral view; (5, 6) mandibles, ventral view [(5) left, (6) right]; (7, 8) maxilla [(7) dorsal, (8) ventral side].

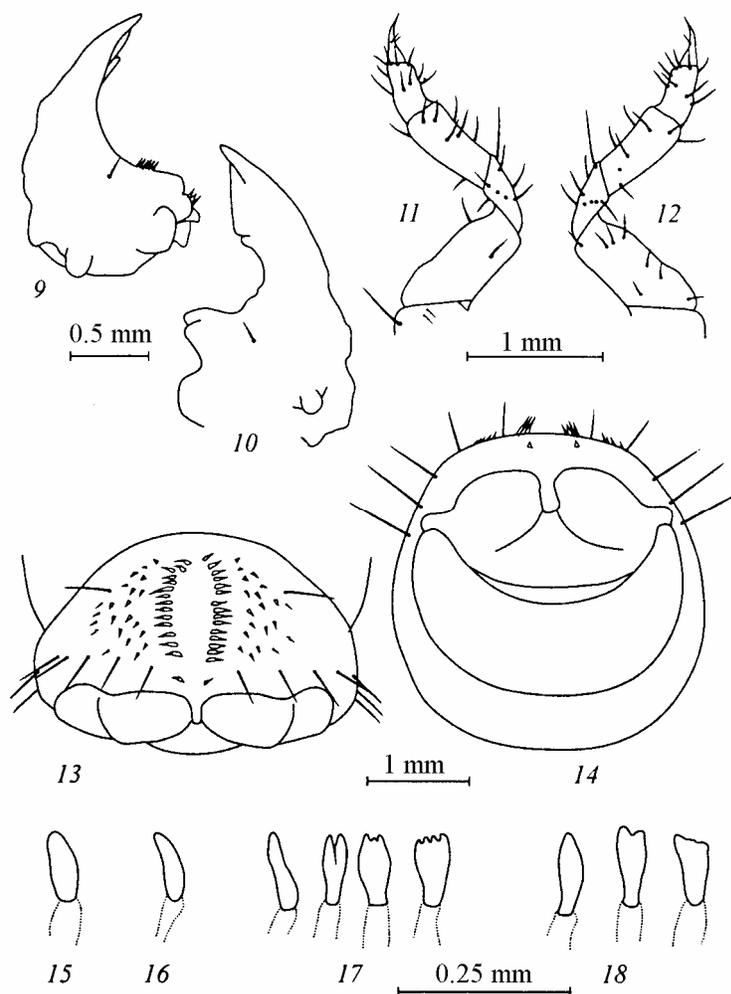
relatively long setae; 4 apical setae slightly curved apically. Dorsal side of lacinia with 7 long thick setae medially and 3 short setae basally, ventral side with 1 long thick seta apically and 1 short seta basally. Apex of lacinia 3-dentate.

Legs subequal in length, fore leg slightly shorter than others. Each leg with 38 seta: coxa with 9 small, trochanter with 1 long and 6 shorter, femur with 8, tibia with 13, and tarsus with 2 setae (Figs. 11, 12).

Central part of anal sternite (Fig. 13) with 2 rows of relatively long, heavily sclerotized spinules, rounded apically (Fig. 16). Rows subparallel apically and becoming closer to each other basally. Anal sternite also with smaller 18–25 spinules at each side of medial rows. Lower anal lobe sinuate in middle and laterally (Fig. 14).

Differential diagnosis. In addition to *A. bimaculatus*, larvae of five species of the subgenus *Acrossus* are described: *A. rufipes* (L.), *A. depressus* Kug., *A. luridus* (F.), (Madle, 1935; Medvedev, 1952; Krell, 1997), *A. gagatinus* Mén. (Medvedev, 1964), and *A. planicollis* Reitt. (Dzhambazishvili and Medvedev, 1974). Larvae of all species, including *A. bimaculatus*, share two characters diagnostic for the subgenus *Acrossus*: two distinct rows of spinules on anal sternite differing from lateral spinules, and modified setae on abdominal tergites I–V (supporting setae), situated on conical tubercles.

Most of the available descriptions of the larvae are incomplete, however on the basis of these data and having examined the larvae of *A. depressus* and *A. rufipes*, we can infer that the larva of *A. bimacula-*



Figs. 9–18. *Aphodius (Acrossus)*, 3rd-instar larva: (9, 10) mandibles, dorsal view [(9) left, (10) right]; (11, 12) fore leg [(11) inner, (12) outer side]; (13) anal sternite; (14) anal segment; (15–18) parallel rows of spinules on anal sternite; (9–14, 16) *A. bimaculatus* (Laxmann), (15) *A. depressus* Kug., (17) *A. rufipes* (L.), (18) *A. gaganinus* Mén.

tus can easily be distinguished from the larvae of other species by the convex clypeus with a complex tuberculate sculpture. In lateral view (Fig. 4), its clypeus is strongly protruding beyond the contour of the head, whereas in other species it is not or very feebly protruding. The larva of *A. bimaculatus* is similar to that of *A. rufipes* in the pale brown head, but differs from it in the presence of four small dark spots in the middle of the frons and on the pleural sclerites near the frontal sutures and in the indistinct reddish tint. In larvae of the other species, the head is darker, brown to blackish brown.

The median spinules of the anal sternite of *A. bimaculatus* are simple, with rounded or acute apices, similar to those of the larvae of *A. depressus*, *A. luridus*, and *A. planicollis* (Figs. 15, 16) but differ

from those of *A. rufipes* and *A. gaganinus*, which have part of spinules wider and laciniate apically (Figs. 17, 18).

Other morphological characters used in the diagnostic keys to the larvae of the subgenus *Acrossus* (Madle, 1935; Medvedev, 1952; Krell, 1997) are less reliable. In particular, the number of medial anal spinules is overlapping in all species and the shape of the rows vary. The shape of the frontal fossae vary considerably, unclear and in most cases cannot be described in the form suitable for comparison.

ACKNOWLEDGMENTS

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REFERENCES

1. Dzhambazishvili, Ya.S. and Medvedev, C.I., "Description of Larvae of Four Species of Scarabaeid Beetles (Coleoptera, Scarabaeidae) from Georgia," *Vestnik Zool.*, No. 5, 14–19 (1974).
2. Frolov, A.V., "Descriptions of the *Aphodius sticticus* Panzer and *A. punctatosulcatus* Sturm Larvae (Coleoptera, Scarabaeidae)," *Entomol. Obozr.* **79** (3), 619–624 (2000) [*Entomol. Rev.* **80** (7), 769–773 (2000)].
3. Frolov, A.V., "Contributions and Additions to the Faunal List of Scarabaeid Beetles of Belarus (Coleoptera, Scarabaeidae)," *Vestnik Belarus. Gos. Univ.*, Ser. 2, No. 3, 32–35 (1995).
4. Kabakov O.N. and Frolov, A.V., "A Review of Beetles of the Genus *Aphodius* Ill. (Coleoptera, Scarabaeidae), Subgenus *Acrossus* Muls. and Closely Related Genera in the Territory of Russia and Adjacent Countries," *Entomol. Obozr.* **75** (4), 865–583 (1996).
5. Krell, F.-T., "6. Überfamilie: Scarabaeoidea. Nachtrag zur 33. Familie: Scarabaeidae. 14. Gattung: *Aphodius* Illiger," B. Klausnitzer: *Die Larven der Käfer Mitteleuropas* **4** (Polyphaga, Teil 3), 106–123 (1997).
6. Madle, H., "Die Larven der Gattung *Aphodius* Ill.," *Arb. Phys. Angew. Entomol.* **2**, 289–304 (1935).
7. Medvedev, S.I., *Larvae of Lamellicorn Beetles of the Fauna of the USSR* (Moscow, Leningrad, 1952).
8. Medvedev, S.I., "Description of Larvae of *Aphodius gagatinus* Men.," *Zool. Zh.* **43**, 1724–1725 (1964).
9. Nikitskij, N.B., "*Aphodius bimaculatus* (Laxmann, 1770)," in *The Red Book of the Russian Federation* (AST Astrel', Moscow), 2001.
10. Zinchenko, V.K., Chernenko, A.V., and Chernenko, R.V., "Rare and Little-known Species of Scarabaeid Beetles (Coleoptera, Scarabaeidae) in the Fauna of Eastern Kazakhstan," *Evraz. Entomol. Zh.* **1** (2), 201–205 (2002).