ISSN 0013-8738, Entomological Review, 2017, Vol. 97, No. 6, pp. 723–729. © Pleiades Publishing, Inc., 2017.
Original Russian Text © T.O. Markova, E.V. Kanyukova, M.V. Maslov, N.V. Repsh, 2017, published in Entomologicheskoe Obozrenie, 2017, Vol. 96, No. 3, pp. 418–428.

# Immature Stages of *Molipteryx fuliginosa* (Uhler) (Heteroptera, Coreidae) in the South of the Russian Far East

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Received November 2, 2016

**Abstract**—The morphology of the egg and the I–V-instar nymphs of *Molipteryx fuliginosa* (Uhler) was studied based on the observations made under near-natural conditions in Primorskii Territory since the emergence of overwintered adults till the appearance of adults of the new generation, including egg production, maturation and molt at each nymphal instar. The egg and the nymphal instars are described and the distinguishing characters of *Molipteryx fuliginosa* and *Coreus marginatus* (Linnaeus) are given.

**DOI:** 10.1134/S0013873817060021

*Molipteryx fuliginosa* (Uhler, 1860) is the only representative of the genus *Molipteryx* Kiritshenko, 1916 in the fauna of Russia. The genus comprises four species distributed in Southeast Asia. *Molipteryx fuliginosa* was described from Japan and later found in Korea, China, and continental regions of Primorskii Territory of Russia; there was also one record from the south of Khabarovsk Territory. Single findings of the species in the Russian Far East had been reported earlier (Kerzhner and Kanyukova, 1998; Kanyukova and Vinokurov, 2009), and data on its new localities were added subsequently (Kanyukova, 2012; Kanyukova and Ostapenko, 2013). Outbreaks of *M. fuliginosa* were recorded in 2012 and 2015 in some regions of Primorskii Territory, and feeding of the bugs on raspberry shrubs (*Rubus* sp.) was observed (Kanyukova, 2012; Markova et al., 2016b).

This species is presently quite common in Primorskii Territory; summarized data on its distribution and the map of its numerous Russian localities were published by Markova and co-authors (2016b). The biotopic distribution and specific ecological features of *M. fuliginosa* were studied in Ussuriisk District in the south of Primorskii Territory (Markova et al., 2016a). The bugs were found in 6 forest stands and in 4 open areas subjected to heavy anthropogenic pressure. The highest abundance was recorded in homestead land plots while only single individuals were found in urban lawns and flowerbeds as well as in crop fields. The species extends along the roadsides into the forest cenoses where it colonizes transitional communities. The bugs prefer moderately insolated mesophytic associations and can be only occasionally found in xerophytic biotopes. Besides blackberry and raspberry shrubs (*Rubus* spp.), the host plants include the great burnet *Sanguisorba officinalis* L., the roadside agrimony *Agrimonia striata* Michx. (Rosaceae), and the thistles *Cirsium pendulum* Fisch. and *C. setosum* (Willd.) Bess. (Asteraceae).

The characteristic of the genus *Molipteryx*, the characters distinguishing it from *Derepteryx* White, 1839, the key to the two species known at that time, and detailed diagnoses of both sexes of *M. fuliginosa* (originally described from a single female) were provided by Kirichenko (1916). In the key to the Chinese bugs (Hsiao, 1977) the genus *Molipteryx* was erroneously regarded as a synonym of *Derepteryx* (Kerzhner and Kanyukova, 1998). *Molipteryx fuliginosa* was included in the list of economically significant insects of China (Zhang, 1985) under the name *D. fuliginosa*, with the following host plants indicated for it: *Liquidambar formosana* Hance (Altingiaceae), *Rhus chinensis* Mill. (Anacardiaceae), *Petasites* sp. (Asteraceae), *Rubus* sp., and *Potentilla fragarioides* L. (Rosaceae).

Other authors listed it under the same name among the pests of *Camellia oleifera* Abel (Theaceae) (Luo et al., 2014), *Bambusa* sp. (Poaceae, Bambusoideae) (Wang et al., 2002), and *Oryza* sp. (Poaceae) (Chen et al., 2014), but did not describe its biology or the nature and extent of inflicted damage. According to the personal communication of Dr. David Redei (Nankai University, China), no outbreaks of *M. fuliginosa* have been recorded in China, and the species may cause only occasional and insignificant damage, if any at all.

The preimaginal phases of *M. fuliginosa* were not previously described, except for the photos of two nymphal instars published in the *Field Guide to Japanese Bugs* (Tomokuni et al., 1993) with a very brief commentary in Japanese. Its development cycle was studied under the laboratory conditions during one season in South Korea (Park, 1996), but no data on the egg and nymphal morphology were published. It was noted that *M. fuliginosa* produced one generation a year, occurred since early May to late September, and overwintered at the adult stage. The few plant species on which the bug was found in South Korea were also listed, including raspberry.

Since *M. fuliginosa* is known to colonize, among other habitats, also homestead land plots with planted raspberry and blackberry shrubs, this species should be monitored as a potential pest of cultivated Rosaceae in Primorskii Territory. Identification of insect pests based on the eggs and immatures is needed for predicting the potential damage to cultivars and for implementing control measures.

We have observed the development of the preimaginal phases of *M. fuliginosa* in Primorskii Territory under near-natural conditions since the emergence of overwintered adults till the appearance of adults of the new generation, including oviposition and the development and molt of each nymphal instar. This communication contains the descriptions of the egg and the nymphal instars; the remaining data on the species' biology will be published separately. Besides, the photo of the adult male is published herein for the first time (only the females were illustrated in all the works cited above).

## MATERIALS AND METHODS

This work is based on our observations and material collected in Ussuriisk and Chuguyevsky districts of Primorskii Territory from April to October 2015 and 2016. For data comparison, we observed the bugs under near-natural conditions in open-air cages and also under natural conditions in forest plots and anthropogenically transformed cenoses. In the first variant, individual raspberry shrubs (*Rubus* sp.) 1.5 m tall were covered with transparent and air-permeable zipped netting which was fixed on a frame above the shrub and extended to the ground so as to enclose an area within a 1-m radius, which allowed the insects to move freely and provided sufficient trophic resources. During observations in such cages, we recorded the timing of copulation, the number of eggs per batch, their position and attachment, and also observed the complete cycle of nymphal development.

According to Puchkova (1957), the eggs of leaf-footed bugs have a relatively simple shape which can be characterized by three measurements: the length $H$ (the distance between the extreme points of the anterior and posterior ends), the width $D$ (the greatest distance between the lateral surfaces), and the height $h$ (the greatest distance between the dorsal and ventral surfaces). The ratio $K = h/H$ describes the degree of elongation of the egg, and the ratio $K_1 = h/D$ describes the degree of its oblateness. The mean values (designated by $m$ in the text below) were determined from measurement of more than 20 eggs; the deformed eggs were not measured.

After the end of oviposition the adults were removed from the cage, and the subsequent egg maturation and nymphal molts were observed. The eggs found in the nature were placed in small cages together with the plant fragments or screened off with netting directly on the spot and left for further observations. The descriptions and measurements of the nymphs are based on freshly killed specimens which retained their natural shape and color. We placed the insects on sheets of coordinate paper and recorded the date of measurement, the time of development of each nymphal instar, and the length and width of the specimen. As a rule, more than 10 specimens of each instar were measured, not including the deformed ones. Several nymphs were fixed in 75% ethanol for later examination while most of the reared nymphs were placed in cages and allowed to develop. The reared adults were sexed and then released into the nature.

## DESCRIPTION OF THE IMMATURE STAGES

### *The Egg*

By their shape, structure of the micropyle, and mode of oviposition the eggs of bugs of the subfamily Coreinae belong to the coreinoid morphological type (Puchkova, 1955, 1957, 1966; Puchkov and Puchkova,

1956). The eggs of *M. fuliginosa* also belong to this type; they are rather large, rounded-cuneate, rounded-triangular in cross-section with three distinct surfaces, with slightly convex lateral sides and rounded ribs (Fig. 1). In our material the egg shape varied from rounded to almost pyramidal with rounded sides and a truncated tip. Depending on the position of the embryo, the anterior (more rounded in *M. fuliginosa*) and posterior (slightly pointed) ends of the egg can be distinguished. The dorsal surface faces the substrate and is slightly concave, whereas the ventral surface has two spherically curved lateral facets converging at an angle. The chorion retains its shape after hatching (Fig. 2).

The measurements of *M. fuliginosa* eggs (in mm) are variable: $H$ = 2.31–2.80 ($m$ = 2.55); $D$ = 1.34–2.03 ($m$ = 1.74); $h$ = 1.32–1.92 ($m$ = 1.59); the mean value of $K$ is 0.62 (nearly all the representatives of Coreinae have $K$ = 0.6); the mean value of $K_1$ is 0.91; $D/H$ = 0.68. Eggs of *M. fuliginosa* are bronze-brown in color. The chorion has reticulate golden sculpture composed of polygons (mostly tetragons and pentagons), resembling a honeycomb or chain armor. The micropylar ring is positioned closer to the blunt anterior end, at a distance of 1/5–1/4 the egg length from it. The ring looks like a belt that is paler than the background egg color, with 64 to 69 (m = 68) small black micropylar tubercles arranged irregularly along its entire length. Eggs of *M. fuliginosa* are noticeably longer and wider than those of *Coreus marginatus* (Linnaeus, 1758), the largest species of the family Coreidae in the Russian fauna, which have the measurements $H$ = 1.72, D = 1.09 (Fig. 3) and bear 15–17 micropylar tubercles (Puchkova, 1957).

Eggs are laid openly onto the stems and leaves of plants, the plastic parts and netting of the cages, and dry twigs, more often singly or in loose groups. Eggs of one batch are not adjacent or glued together. They are of the recumbent type (Puchkova, 1955; Puchkov and Puchkova, 1956) and are attached to the substrate with a thin film-like base consisting of translucent secretion. In most cases, the entire egg surface was covered with pale liquid female's secretion that pooled under the egg and quickly solidified. Oviposition of *M. fuliginosa* was recorded from the last decade of May to the first decade of August. On average, a female lays about 28 eggs during its whole life span. The egg phase lasts from 12 to 32 days, depending on the ambient temperature. The nymph hatches via an oval cover slanted onto the ventral surface of the egg; the apical margin of the cover passes through the anterior end of the egg and traverses the micropylar ring.

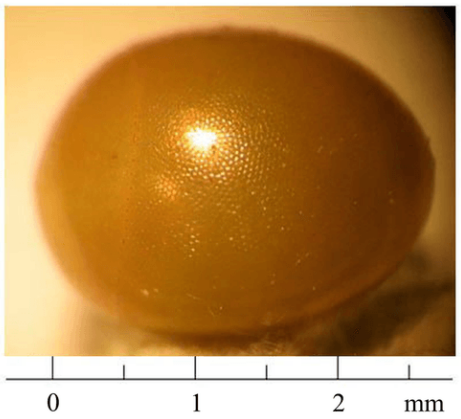



**Fig. 1.** *Molipteryx fuliginosa* (Uhler), egg in lateral view.

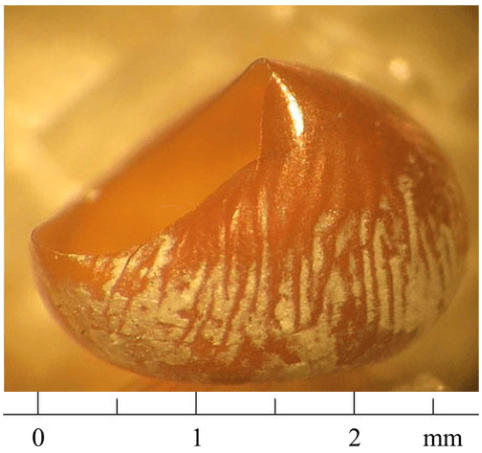



**Fig. 2.** *Molipteryx fuliginosa* (Uhler), empty egg chorion.

### *The Nymph*

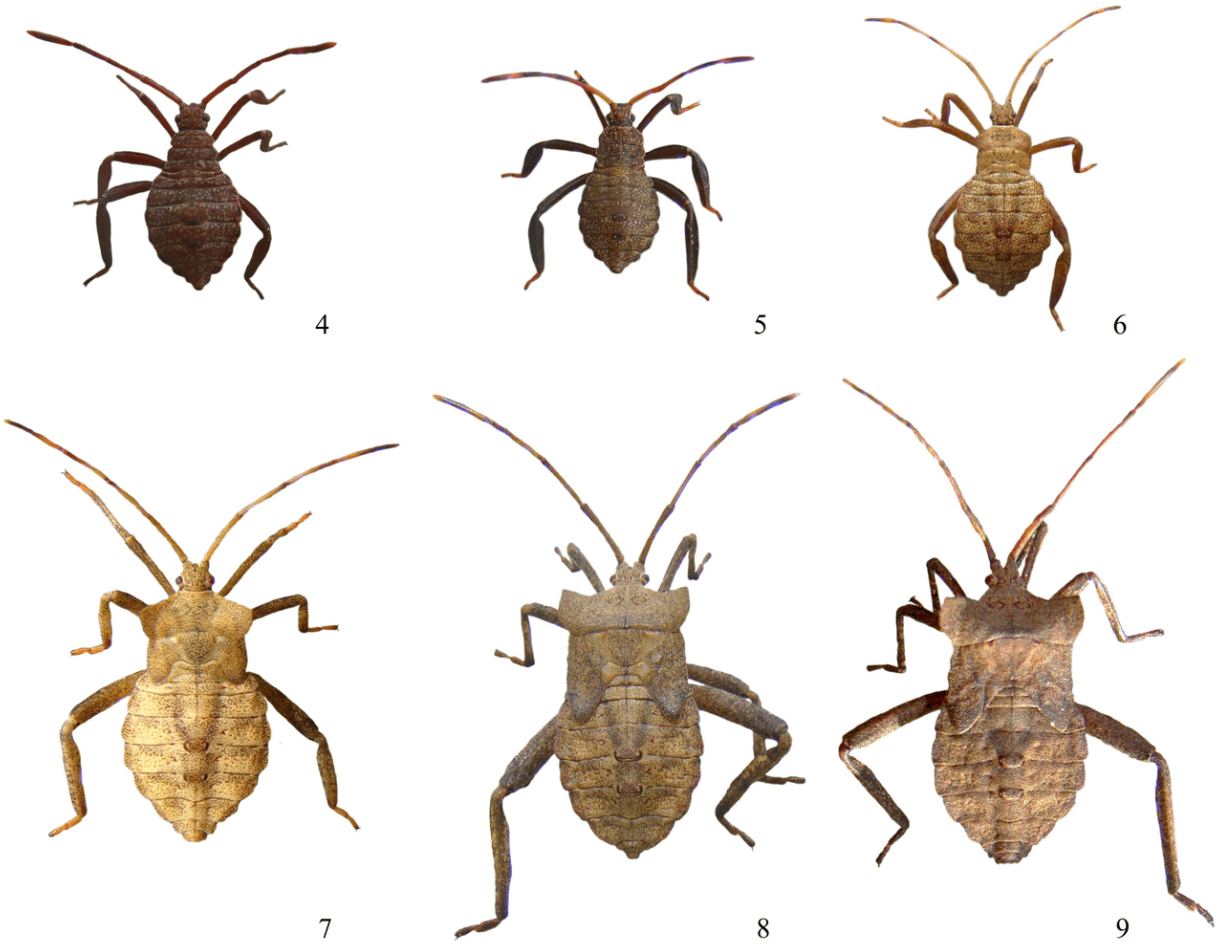
The nymph of *M. fuliginosa* develops with five instars (Figs. 4–9). Body shape of nymph generally similar to that of adult (Fig. 10). Body narrowing anteriorly, broadly oval posteriorly, 1.9–2.2 times as long as wide; head relatively small; antennae, middle and hind legs noticeably longer than body. Body surface dull, uniformly colored, yellow brown to dark brown or almost black in some nymphs. Head, pro-, meso-, metanotum, tergites, and sternites bear irregularly arranged, small, light colored, rounded setigerous spots; at II and III instars most spots in anterior body part merge and body coloration becomes lighter. At IV instar some specimens acquire rusty-colored coating on legs, body, and head. Median parts of thorax and abdomen slightly paler than main coloration at the


**Fig. 3.** Females with laid eggs: (*A*) *Coreus marginatus* (L.); (*B*) *Molipteryx fuliginosa* (Uhler).

beginning of I instar, of same color at the end of that instar. In dark-colored specimens, light spots less noticeable, body and legs dark, only antennae and tarsomeres light. Lateral margins of tergites at I and II instars with rows of 2 to 9 black setae, disappearing at III instar. Dorsum with pale hairs, becomes densely pubescent at V instar.

Head weakly pubescent at I–III instars, densely pubescent at IV and V instars. Head dorsally dark brown; occiput at early instars with V-shaped spot, at III and IV instars with lily-shaped light pattern that becomes embossed at V instar; head near bases of antennae with yellow triangular spots, behind eyes with oval spots; eyes with yellow borders. Head ventrally almost black, in light-colored specimens with light spots at I–IV instars. Head horizontal, as long as or slightly shorter than its width including eyes. Frons weakly convex, clypeus and subgenae slanting downwards. Eyes round, protruding, head at eye level slightly wider than anterior margin of pronotum. Antennal mounds weakly protruding forwards. Proboscis grayish brown, thick at base, not pressed against head and thorax, reaching middle coxae or slightly extending beyond them. Antennae with short erect hairs, reddish or yellowish brown, 2–4th antennal segments darkened apically: apical third of 2nd segment and apical half of 3rd and 4th segments turn black by II instar while apex of 4th segment remains yellow. Antennal segments cylindrical, 1st segment thicker and slightly longer than others, 4th segment at I instar sagittally flattened, paddle-shaped, since II instar cylindrical, pointed. Average length ratio of segments 1.3 : 1 : 1 : 1.2 in I–III instars, 1.5 : 1.4 : 1.3 : 1.5 in IV instar, 1.9 : 1.7 : 1.6 : 1.8 in V instar.

Anterior margin of pronotum with light edge, at III and IV instars with 2 dark rings positioned behind this edge and transformed into uneven embossed spots at V instar; pro-, meso-, and metanotum with thin light median stripe. Pronotum slightly convex or flat, trapeziform with smooth margins, without denticles, narrower than meso- and metanotum at I and II instars, as wide as meso- and metanotum at III instar; at IV and V instars pronotum wider than meso- and metanotum, with flat angular lateral lobes dentate along anterior lateral margins, with dense pubescence. At III instar tips of wing pads almost reach posterior margin of tergite I while elytral rudiments cover only their bases; at IV instar tips of elytral rudiments extend beyond middle of tergite II and cover most of wing pads; at V instar elytral rudiments completely cover wing pads, extend beyond middle of III tergite, and become densely pubescent.




**Figs. 4–9.** *Molipteryx fuliginosa* (Uhler), nymphal instars: (4) I instar; (5) II instar; (6) III instar; (7) IV instar; (8) V instar, male; (9) V instar, female.

Thorax ventrally dark brown with light spots (at II–V instars), with thin yellow-brown edge along lateral margins; this edge distinct at the beginning of I instar and less pronounced by the end of I instar, reduced to lighter stripe at II instar, and disappearing at the end of this instar. Small oval dark spots appear at II instar laterally on pro-, meso-, and metathorax; later these spots merge with background. Thorax more rounded in cross-section in I and II instars, flattened in III–V instars. Legs reddish brown or dark brown, with light spots; tarsi lighter, yellow brown to reddish brown, claws and tip of 2nd tarsomere black. At III and IV instars legs become darker to dark brown or almost black but tarsi and bases of leg segments remain reddish brown or yellow brown (V instar). Legs relatively thick, covered with erect hairs; femora and tibiae flattened at I instar and triquetrous at later instars. Triangular preapical protrusion develops on posterior surface of all femora at II instar; spines appear on tip of this protrusion at III–V instars. Inner margin of hind tibia in male flattened, with triangular lobe appearing in its apical third at V instar.

Abdomen rounded, widest at tergites IV and V, dorsally flattened, ventrally convex; lateral margins of tergites protruding. Abdomen dorsally and ventrally uniformly colored, dark brown, with narrow yellow brown edge, this edge distinct at I instar, weaker at II instar, disappearing at III instar. Lateral margins of tergites II–VII darkened before edging; at I instar sternites II–VII laterally with elongate-oval dark spots that merge with background by middle of II instar. First visible tergite yellow at middle, abdomen behind it with dark median stripe. Ventrally abdomen pale at middle, with dark median stripe and lateral margins. Spiracles edged by light circles at II–V instars. Two scent gland fields present, dark brown, darker than main coloration of abdomen. Scent gland fields well developed at all instars, located between tergites IV

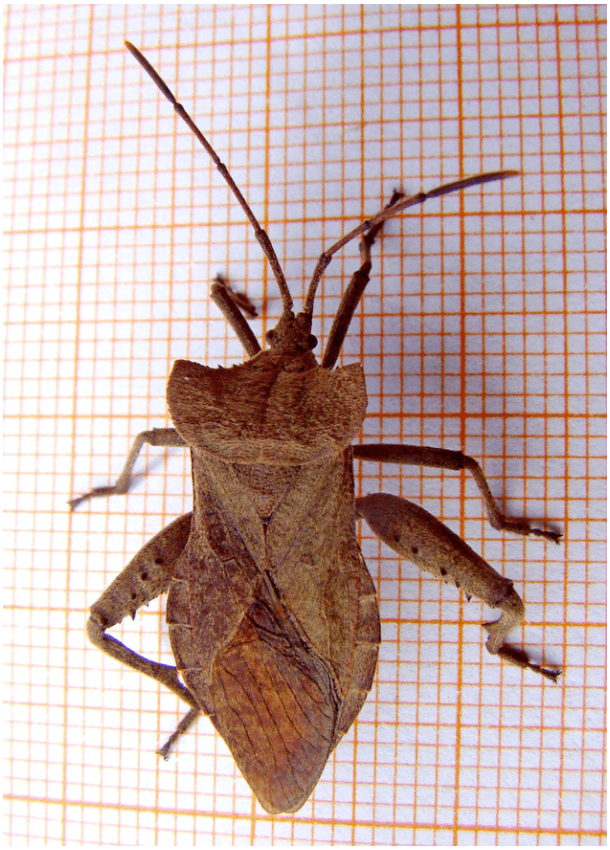


**Fig. 10.** *Molipteryx fuliginosa* (Uhler), adult male.

and V and between tergites V and VI, shaped as oval, slightly raised protrusions inserted into next tergite, with paired secretory openings surrounded with slightly thickened cuticle.

Sex dimorphism becomes apparent since V instar (Figs. 8, 9). Body of male (Fig. 10) narrower than that of female; genital capsule of male entire, without median suture, unlike that of female; hind femur of male slightly wider than that of female; nearly the whole inner margin of hind tibia of male flattened into lamellar shape, hind tibia at apical third with developing triangular lobe that is absent in female.

Nymphs of *Molipteryx fuliginosa* can be easily differentiated from those of other species of Coreidae in the Russian fauna, including the largest representative of the family, *Coreus marginatus*, by the following characters.

1. The body of *M. fuliginosa* is not covered with rigid black hairs as in *C. marginatus*. Instead, its pubescence consists of short pale hairs; rows of 2 to 9 black setae are present only laterally on tergites at the I and II instars but they disappear at the III instar.

2. The abdomen is oval and not diamond-shaped as in *C. marginatus*, it has no red median band and no red circles around the scent gland fields (I instar); the lateral margins of tergites IV–VII do not extend into triangular lobes (II and III instars) or fleshy outgrowths (IV and V instars).

3. The 1st antennal segment is not triquetrous, the 2nd and 3rd segments are not flattened into a leaf-like shape; all the segments are cylindrical, the 4th segment being flattened only at the I instar.

## ACKNOWLEDGMENTS

The authors are very grateful to Dr. David Redei (Nankai University, China) for the provided data from the Chinese literature, to N.N. Vinokurov (Institute for Biological Problems of Cryolithozone, Siberian Branch of the Russian Academy of Sciences, Yakutsk, Russia) for valuable advice and comments on the manuscript, and to V.A. Gulyaeva (Far Eastern Federal University, School of Education, Ussuriisk, Russia) for help with preparing the illustrations.

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