

Description of larva of *Rabocerus foveolatus* Ljungh, 1823 (Coleoptera: Salpingidae: Salpinginae)

Описание личинки *Rabocerus foveolatus* Ljungh, 1823 (Coleoptera: Salpingidae: Salpinginae)

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КЛЮЧЕВЫЕ СЛОВА: жесткокрылые, личинка, Salpingidae, Salpinginae.

ABSTRACT. The last-instar larva of *Rabocerus foveolatus* Ljungh, 1823 is described. Some notes on the composition of Salpinginae, based on larval characters, are provided.

РЕЗЮМЕ. Описана личинка последнего возраста *Rabocerus foveolatus* Ljungh, 1823. Приводятся некоторые замечания о составе подсемейства Salpinginae на основании признаков личинок.

Introduction

Salpingidae Leach, 1815 is a rather small Coleoptera family with 15 genera and 42 species known from the territory of Russian Federation [Pollock *et al.*, 2020; Markarov *et al.*, 2023]; however the number of species in genus *Aegialites* Mannerheim, 1853, seventeen according Zerche [2004], in fact can be significantly less [Haugen *et al.*, 2025]. So, the vast majority of salpingid diversity — 11 genera and 23 species — belongs to subfamily Salpinginae Leach, 1815. Larvae of 6 genera and 10 species are known, but not all of them have been adequately described [Perris, 1877; Franz, 1955; Hayashi, 1980; Nikitsky, 1980; Nikitsky, Belov, 1983]. A good example is genus *Rabocerus* Mulsant, 1859, which includes only two species: *R. foveolatus* Ljungh, 1823 and *R. gabrieli* Gerhardt, 1901, both occurring in Russia. Nikitsky [1980] provided a brief account on *R. gabrieli* larva, mentioning the structure of ninth abdominal segment, and Klausnitzer [1997] included very short characteristics of the same species in the key to

European genera; the larva of *R. foveolatus* was unknown. During the study of A.N. Severtsov Institute of Ecology and Evolution (Moscow, Russia) collection, larvae of *Rabocerus* were discovered, together with reared adults. Upon determination they appeared to be of *R. foveolatus* (Fig. 3), thus larvae were assigned to this species and the description of late-instar larva is given below.

Material and methods

The material is stored in the larval collection of the Department of Zoology and Ecology of Moscow State Pedagogical University, Moscow.

Habitus photographs were taken with a Canon EOS 40D camera with a MP-E 65 mm macro lens. Photos of slide mounts were taken with a Canon EOS6D camera attached to a Carl Zeiss AXIO Scope.A1 microscope. All photos were processed using Helicon Focus 7.0 software. Line drawings were made in CorelDRAW 12. The measurements were taken with an ocular-micrometer mounted on a MBS1 (Lomo) stereo microscope. The specimens were preserved in 70% ethanol or on slides with Faure's Berlese media and are deposited in Moscow Pedagogical State University, Moscow, Russia (MPGU).

The following abbreviations were used:

1) body sclerites:

AT — abdominal tergite, BS — basisternite, EM — epimeron, EP — epipleurite, ES — episternum, FR — frontal sclerite, HY — hypopleurite, IP — interpleurite, LIP — lateral interpleurite, LPr — lateral presternum, MPr — medial presternum, MS — mesonotum, MT — metanotum, PA — parietal sclerite, PR — pronotum, SpS — spiracular sclerite, SS — spinasternite;

2) head appendages and their parts:

At1–3 — apical mandibular teeth, Cdo — cardo, Cl — clypeus, Hp — hyaline processes, Lb — labrum, Lg — ligula, Ma — mala, Mnt — mentum, Mxa — maxillary articulating area, Pf — palpifer, Pmnt — prementum, Smnt — submentum, Stp — stipes, Tr — tormae;

3) endoskeletal structures: Aem1–3 — epimeral apodeme (numeric corresponds to segment, on which apodeme is developed), Aes1–3 — episternal apodeme, Apl1 — pleural apodeme of prothorax, F2–3 — meso- and metathoracic furca; Hypbr — hypopharyngeal bracon;

4) other abbreviations: AR — anal region, Sp — spiracle, Sa — sensorial appendage, UR — urogomphi.

Sclerites nomenclature follows Zaitsev [2024]. Due to the very weak sclerotisation, except head capsule and urogomphi, pores are extremely hard to observe, so there is a possibility that not all of them were detected.

Results and discussion

Rabocerus foveolatus Ljungh, 1823, last-instar larva
Figs 1–2, 4–23.

MATERIAL EXAMINED: *Rabocerus foveolatus*, 15 last-instar larvae, 4 reared adults: Russia, Central region, Moscow oblast, Vnukovo district, Krekshino village, 2.V.1981, leg. A. Kompantsev, det. A. Zaitsev.

Additional material studied: *Rabocerus* sp., 6 larvae: Russia, Moscow region, Volokolamsk district, near Pagubino village, 55°58'7"N, 35°54'55"E, under bark of *Alnus glutinosa*, 30.VII.2008, leg. & det. A. Zaitsev.

DESCRIPTION. Maximum body length (from anterior margin of labrum to the apex of urogomphi) 6.1 mm; head length (from the posterior edge to the apex of labrum) 0.5 mm; head width 0.65 mm; maximum width of thorax 0.8 mm; maximum width of abdomen 1.1 mm. Head 0.9 as wide as prothorax; body elongate, moderately convex; widest across abdominal segments IV–V, then tapering posterad; urogomphi present (Figs 1–2).

Body white, sclerites unpigmented; head light-yellow; mandibles yellow with brown apices. Urogomphi yellow with darkened apices and internal process. Head appendages and legs unpigmented.

Head capsule as well as body sclerites and legs are covered with simple setae of various length.

Head (Figs 4–12) prognathous, posterior edge distinctly emarginated, 0.8 as long as wide. Epicranial suture absent, frontal sutures U-shaped, almost reaching antennal sockets (Fig. 4). Frontoclypeal suture indistinct. Stemmata five on each side, pigmented; anterior three arranged in transverse row just behind the antennal sockets and a pair located posteriorly (Fig. 6).

Clypeus trapezoidal, about 0.4 as long as wide, uniformly sclerotised; each side with lateral micro- and macroseta as well as single pore located between them (Fig. 4). Clypeolabral suture distinct. Labrum (Fig. 7) about 0.3 as long as wide; its lateral margins rounded anteriorly; dorsally with five setae on each side: single macroseta on anterior margin, single micro- and two macrosetae close to the lateral edge as well as single macroseta approximately in the middle part. Moreover, three pores present on each side. Ventrally labrum with four marginal mesosetae on each side. Epipharynx (Fig. 7) on each side with four conical and three small campaniform sensilla in central area. Tormae present, weakly sclerotised (Fig. 7); leiotorma and dextiotorma symmetrical, connected to each other approximately at the midlevel.

Surface of frontal sclerite smooth; each side with five setae and two pores: two macro- and two microsetae located in the anterior part with pore between macrosetae, single microseta lies posteriorly with pore situated close to it (Fig. 4). Each parietal sclerite dorsally (Fig. 4) with three macro-, five meso- and seven microsetae as well as three pores. Ventrally each parietal sclerite with three macrosetae, three mesosetae and two pores (Fig. 5).

Antenna (Fig. 8) weakly sclerotised, with three antennomeres, 0.25 as long as head capsule length. Antennomere I rectangular, 0.75 as long as wide, lacks setae, with two dorsal pores. Antennomere II 1.4 as long as antennomere I and 1.7 as long as wide, dorsally with two subapical mesosetae and single pore; ventrally with two subapical mesosetae as well as two conical sensorial appendages: one larger, 0.55 as long as antennomere III, other very small, located nearby. Antennomere III 0.7 as long as antennomere II and 3.2 as long as wide; dorsally with three subapical meso- and one microseta; single dorsal pore present; apical part with elongated sensillum.

Mandibles (Figs 9–11) symmetrical, 1.5 as long as basal width; apex tridentate, single subapical tooth present on dorsal side, basal region on inner margin with several hyaline processes. Dorsal surface of outer edge of each mandible with single macroseta, adjacent pore and three microsetae; basal area with microseta and pore; also single medial pore present.

Maxilla (Fig. 12) with transverse cardo, which is not “divided” by the internal sclerotization; dorsally with single mesoseta on the distal part; maxillary articulating area membranous, without sensilla. Stipes ventrally smooth, with three macro- and two mesosetae, as well as two pores. Dorsal side of stipes mostly membranous, with two groups of microasperities. Mala with inner edge slightly narrowed apically; ventral surface (Fig. 12) with 7 setae and single pore: four stout apical macrosetae, 2 slender subapical macrosetae and single mesoseta on inner margin. Dorsally (Fig. 12) mala with 8 setae: three apical macrosetae and five stout macrosetae on inner margin).

Maxillary palps three-jointed, palpifer membranous, with microseta on outer edge (Fig. 12). Palpomere I 0.9 as long as wide; ventrally with two subapical pores. Palpomere II 1.2 as long as palpomere I and 1.2 as long as wide; ventrally with subapical meso- and microseta, as well as subapical pore. Apical part of palpomeres I–II with several dorsal spines. Palpomere III 1.15 as long as palpomere II and twice as long as wide; with microseta on inner edge; dorsally with digitiform sensillum. Apex of palpomere III with a group of six short conical sensilla surrounding a longer one.

Labium (Fig. 12). Ligula absent. Prementum ventrally on each side with one macro- and one microseta as well as single pore. Labial palps two-jointed. Palpomere I 1.15 as long as wide, ventrally with 1 basal microseta on the outer edge and single subapical pore. Palpomere II almost 0.9 as long as palpomere I and 1.6 as long as wide, with single ventral pore; its apex with a group of six short conical sensilla surrounding a longer one.

Mentum distinct, trapezoidal, membranous, ventrally each side with single macroseta and pore. Submentum fused with gula; on each side with single macroseta. Hypopharynx (Fig. 12) with patches covered in microtrichia; hypopharyngeal sclerome reduced, bracon well-defined.

Thorax (Figs 1–2, 13–16). About 0.3 as long as total body length, widest across metathorax. Prothorax 0.7 as long as wide, 1.3 as long as meso- and metathorax.

Prothorax with a pair of large slightly pigmented pronotal sclerites with rugulose surface (Fig. 1); ecdysial line distinct. Each pronotal plate (Fig. 13) with five macro-, six meso- and

two microsetae as well as four pores. Membranous area surrounding pronotal plates smooth.

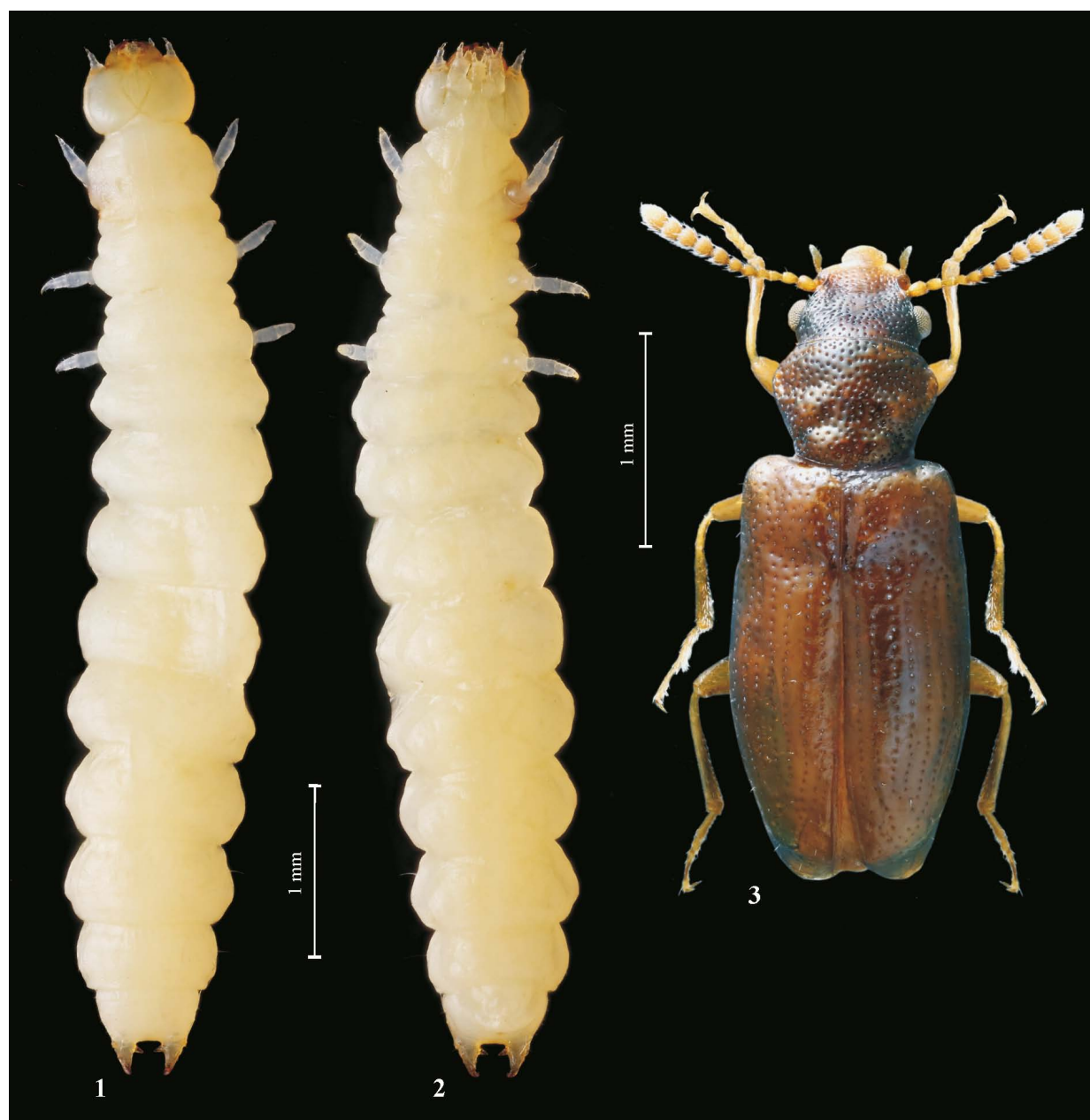
Meso- and metanotum with rugulosed surface; ecdysial line barely seen but present; each meso- and metanotal plate with four macro-, three meso-, five (mesonotum) or four (metanotum) microsetae as well as single visible pore (Fig. 13). Anterior to meso- and metanotum a group of four microsetae and pore present. Membranous area smooth.

Prothoracic episternum and epimeron weakly sclerotized, with two and single microseta respectively (Fig. 14). Presternum consists of three sclerites; medial one is the largest, bearing one macro- and two mesosetae on each side. Each lateral sclerite with single mesoseta.

Meso- and metathoracic episternum with one meso- and two microsetae each; epimeron similar to that on prothorax (Fig. 14). Each meso- and metathoracic epipleurite with single mesoseta. Each meso- and metathoracic interpleurite subdivided into two sclerites: interpleurite and lateral interpleurite. On mesothorax each interpleurite bearing single meso- and microseta; each lateral interpleurite with two mesosetae. Each metathoracic interpleurite and lateral interpleurite with single mesoseta (Fig. 14).

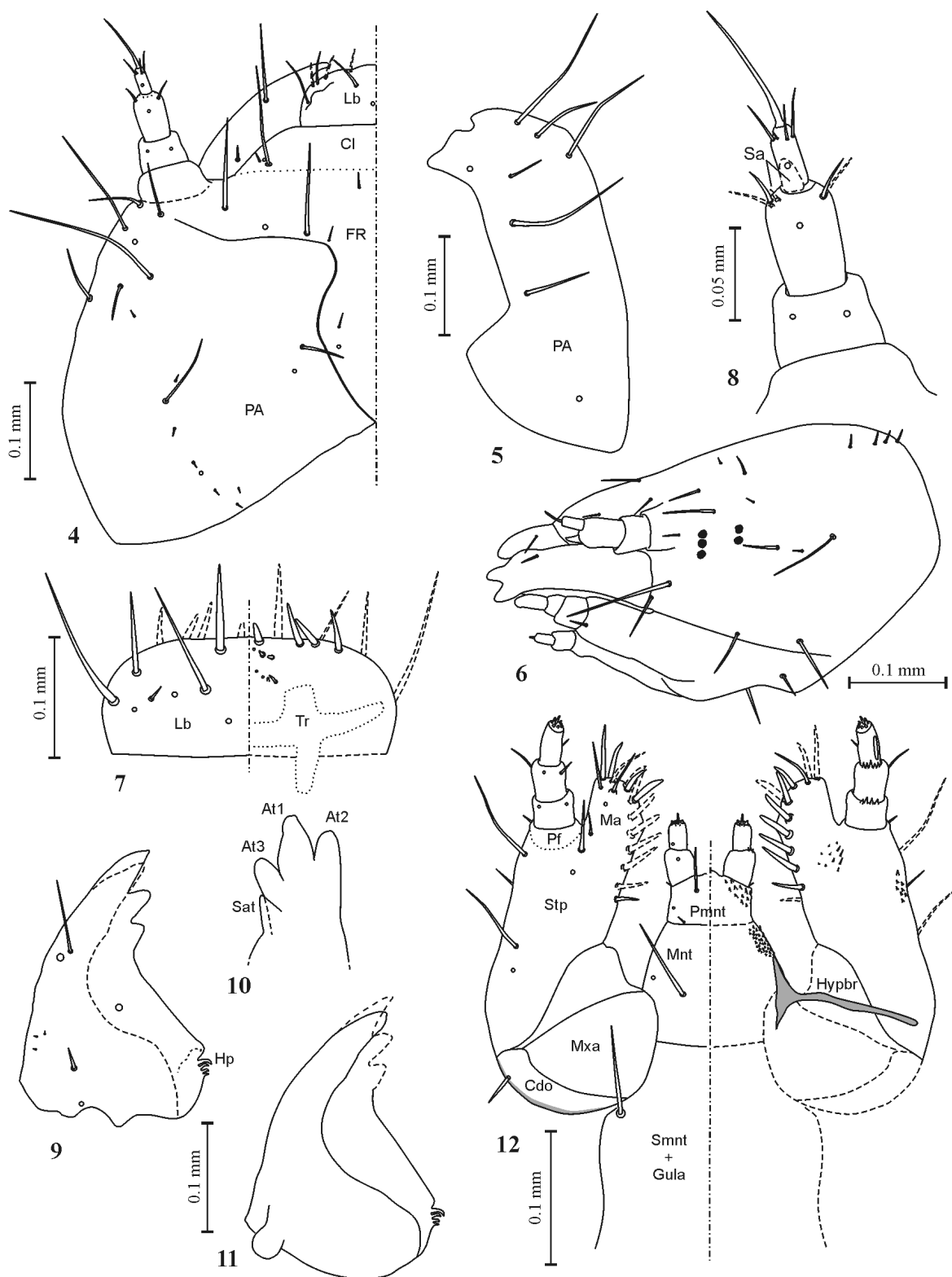
Mesothoracic spiracle located on lateral interpleurite, annular-biforous, not protruding (Fig. 16). Rudimental metathoracic spiracle not visible.

Meso- and metathoracic spinasternite without setae; basisternite on each side with one macro- and mesoseta (Fig. 14).

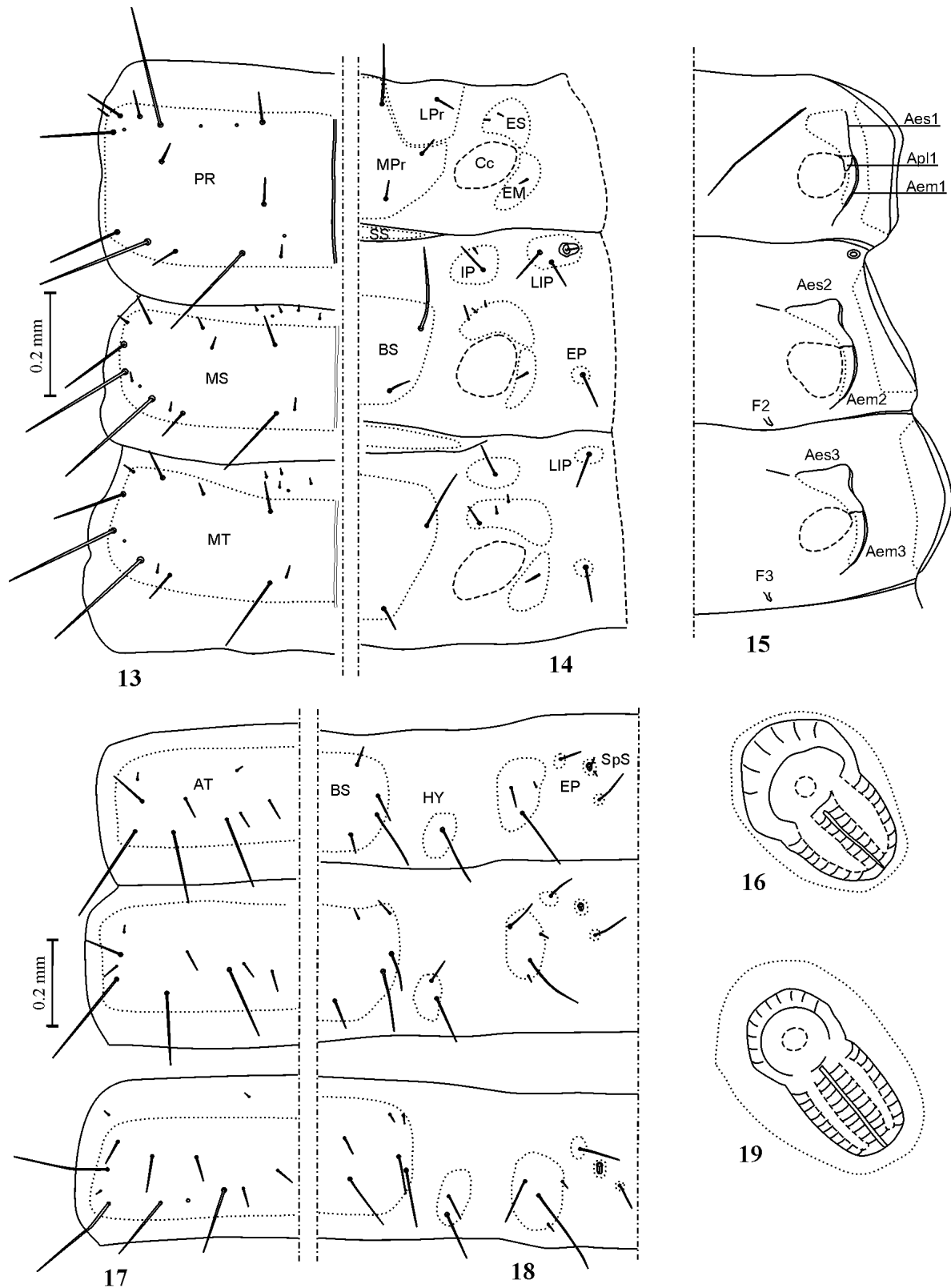


Figs 1–3. *Rabocerus foveolatus*, habitus: 1–2 — last-instar larva: 1 — dorsal view; 2 — ventral view; 3 — adult, dorsal view.

Рис. 1–3. *Rabocerus foveolatus*, габитус: 1–2 — личинка последнего возраста: 1 — сверху; 2 — снизу; 3 — имаго, сверху.



Figs 4–12. *Rabocerus foveolatus*, last-instar larva: 4, — head, dorsal; 5 — parietal sclerite, ventral; 6 — head (showing the position of stemmata, not all setae are drawn), lateral; 7 — labrum and epipharynx, left — dorsal view, right — ventral view; 8 — antenna, dorsal; 9 — mandible, dorsal; 10 — mandible, ventral, 11 — apex of mandible; 12 — labio-maxillary complex and hypopharynx, left — ventral view, right — dorsal view.
Рис. 4–12. *Rabocerus foveolatus*, личинка последнего возраста: 4 — голова, сверху; 5 — парietальный склерит, снизу; 6 — голова (показано положение глазков, не все хеты изображены); 7 — верхняя губа и эпифаринкс, слева — сверху, справа — снизу; 8 — антенна, сверху; 9 — мандибула, сверху; 10 — мандибула, снизу; 11 — вершина мандибулы, 12 — лабио-максиллярный комплекс и гипофаринкс, слева — снизу, справа — сверху.



Figs 13–19. *Rabocerus foveolatus*, last-instar larva: 13 — thorax, dorsal; 14 — thorax, ventral; 15 — thoracic endoskeleton; 16 — thoracic spiracle; 17 — abdominal segments I–II, VII, dorsal; 18 — abdominal segments I–II, VII, ventral; 19 — abdominal spiracle VIII. 15–16, 19 — not to scale.

Рис. 13–19. *Rabocerus foveolatus*, личинка последнего возраста: 13 — грудные сегменты, сверху; 14 — грудные сегменты, снизу; 15 — эндоскелет груди; 16 — грудное дыхальце; 17 — брюшные сегменты I–II, VII, сверху; 18 — брюшные сегменты I–II, VII, снизу; 19 — дыхальце VIII брюшного сегмента. 15–16, 19 — не в масштабе.

Thoracic endoskeleton (Fig. 15). Prothorax with rather small, triangular pleural apodemes; episternal and epimeral apodemes standard-sized for beetles in general, furcae absent. Meso- and metathorax with well developed elongated episternal apodemes, standard-sized epimeral apodemes, pleural apodemes reduced; furcae present, short; spinae absent. Thoracic endoskeleton of *Rabocerus* is nearly identical to that of *Lissodema* Curtis, 1833 and *Salpingus* Illiger, 1802, but clearly differs from *Istrisia* Lewis, 1895 which prothoracic pleural apodeme is much larger and has different shape as well as significantly longer furcae [Zaitsev, 2009; unpublished data].

Legs (Fig. 20) five-jointed, rather short; all three pairs similar in structure and chaetotaxy, covered in simple setae of various length; length ratio of its joints to coxa is 0.6 : 1 : 1 : 0.4. Coxa with 15 setae: dorsally with one macro- and two microsetae; ventrally with two microsetae; anteriorly with four meso- and four macrosetae; posteriorly with two microsetae; single anterior pore present. Trochanter with five setae: one dorsal microseta, two ventral macrosetae, one anterior and one posterior mesoseta; seven pores present: four anterior and three posterior. Femur with 12 setae: dorsally with four micro- and two mesosetae; ventrally with four macro- and one mesoseta; anteriorly with one mesoseta; single anterior pore present. Tibiotarsus with nine setae: dorsally with two macro-, two meso- and one microseta; ventrally with one meso- and microseta; one microseta anteriorly; one microseta posteriorly. Pretarsus with single elongated claw bearing one meso- and one microseta.

Abdomen (Figs 1–2, 17–19, 21–23). About 0.7 as long as total body length, widest across abdominal segments IV–V, then narrowing posteriorly. Each abdominal segment (AS) I–VII with weakly-sclerotized, rugulosed tergite; abdominal tergite I with three macro-, four meso- and two microsetae on each side. Abdominal tergites II–VI with additional lateral microseta; abdominal tergites VII–VIII with additional micro- and mesoseta (Fig. 17). Each epipleurite of AS I–VII consists of three sclerites: one larger convex, with one macro-, one meso- and 1–2 microsetae; two smaller, each with single mesoseta (Fig. 18). Epipleurite of AS VIII with one of the smaller sclerites, located posterior from spiracle, reduced.

Each hypopleurite of AS I with single macroseta; on AS II–VIII with single macro- and mesoseta (Fig. 18). Abdominal basisternites I–VIII faintly sclerotised, with smooth surface; basisternite I with one macro- and three mesosetae on each side; basisternites II–VI with one additional microseta; basisternites VII–VIII moreover with one mesoseta (Fig. 18). Membranous area surrounding sclerites with numerous microasperities. Abdominal spiracles similar to those on mesothorax, on AS VII–VIII their accessory chambers significantly elongated (Fig. 19). Spiracular sclerite (probably homologous to lateral interpleurite) on AS I with two microsetae, those on AS II–VIII lack setae.

Abdominal tergite IX dorsally with fine sclerotized ridge in anterior part; each side with tubercle near the base of urogomphi, bearing macroseta; with five macro-, two meso- and ten microsetae (Fig. 21). Lateral region with five macro-, one meso- and one microseta (Fig. 23). Ventrally abdominal tergite IX on each side with five meso- and three microsetae (Fig. 22). Urogomphi well developed, widely separated, distinctly upturned; about 1.5 as long as basal width; their surface mostly smooth; each with elongated internal processus (Figs 21, 23). Each urogomphus dorsally with three meso- and two microsetae; two pores present: one located at the base of internal processus, other near the base of upturned part of urogomphus. Lateral region of each urogomphi with two macrosetae; ventrally each urogomphus with two macro-, five meso- and

two microsetae (Figs 21–23). Sternite IX with two meso- and one microseta (Fig. 22). Abdominal segment X about 0.4 as long as abdominal segment IX, its tergite with three mesosetae on each side; anal region membranous (Figs 22–23).

Biology. No data on habitat were present on the original label, however the author collected a number of unrealed *Rabocerus* larvae (which are identical to described above) under the cork layer of black alder together with *Salpingus planirostris* Fabricius, 1787 larvae. No scoliid adults or larvae were present, so it's most likely that *Rabocerus* larvae are xylo- or mycetophagous.

COMPARATIVE REMARKS. Klausnitzer [1997] mentioned the following characteristics of *R. gabrieli* larva in the key to genera of European fauna: “Spiracles with elongated, posteriorly oriented accessory chambers; labial palps distinctly separated from each other by the well-developed bisetose ligula. Urogomphi with preapical inner tooth. Antennomere III distinctly longer than II”. Unfortunately, no illustrations have been provided, except the one redrawn from Nikitsky [1980], showing the dorsal side of AS VIII–IX. If the mentioned above features are correct (in which the author of the present paper seriously doubts), then larvae of *R. gabrieli* are to be distinguished from *R. foveolatus* by the antennomere III longer than II and the presence of bisetose ligula.

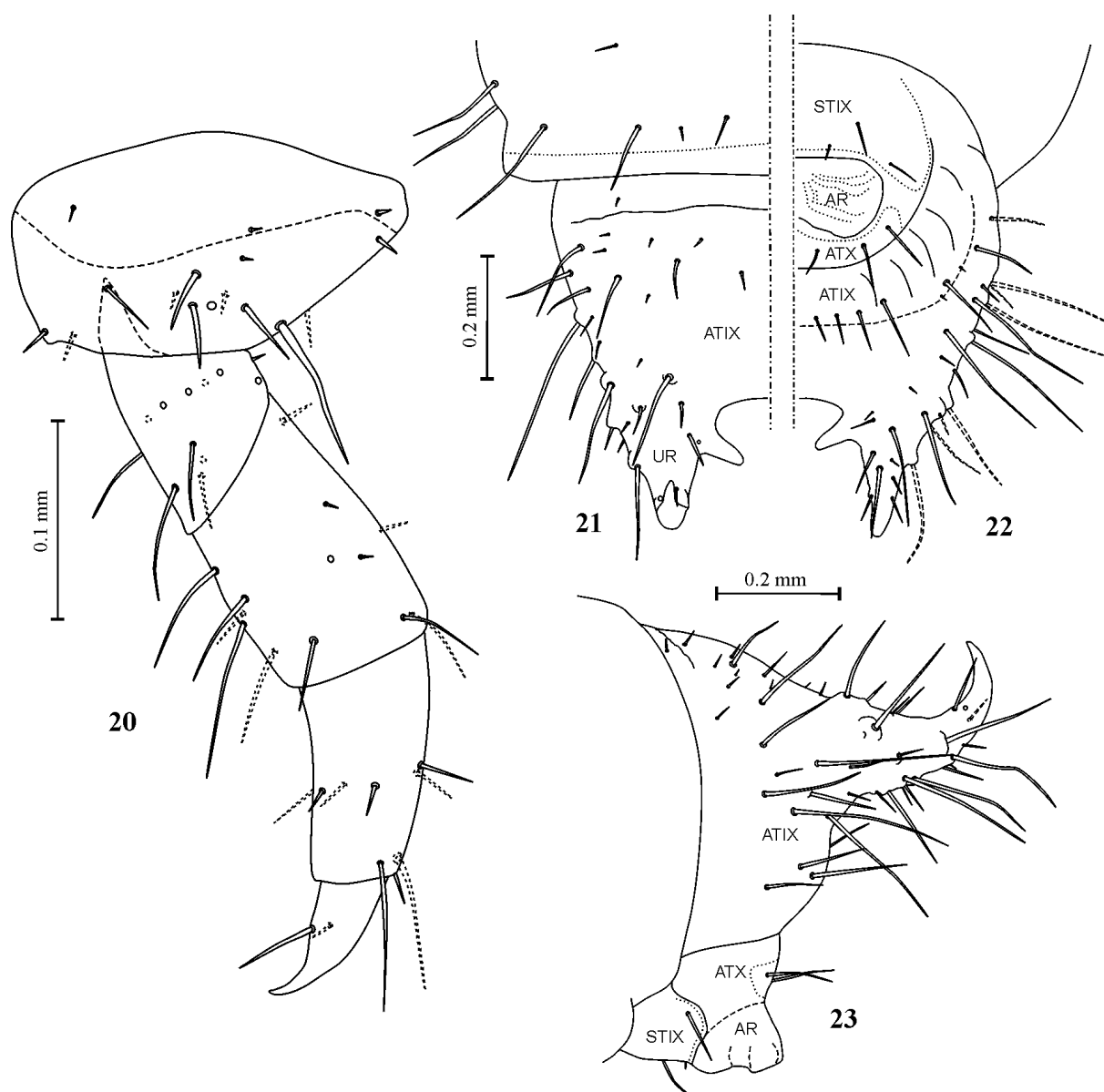
Notes on the composition of Salpinginae based on larval characters

Among Salpinginae larvae are known for *Colposis* Mulsant, 1859, *Istrisia*, *Lissodema*, *Rabocerus*, *Salpingus* and *Vincenzellus* Reitter, 1911. Those of *Colposis*, *Lissodema*, *Salpingus* and *Vincenzellus* are quite alike in general appearance [Franz, 1955; Nikitsky, 1980; Klausnitzer, 1997; Zaitsev, 2024]: they have similar shape of urogomphi, a pair of teeth on abdominal sternite IX (further — sternal teeth), symmetrical mandibles with hyaline processes on basal part of inner margin (see comments below), etc. Larvae of *Rabocerus* can be easily distinguished from them by the absence of sternal teeth and gradually narrowed urogomphi, about 1.5 as long as basal wide. The first feature separates *Rabocerus* from all other known larvae of the family, which have either a pair or a transverse row of such teeth; similar shape of urogomphi can be found in *Aglenus* Erichson, 1845 (*Agleninae* Horn, 1878), but its larva differs by the well-developed mola and ligula as well as paired sternal teeth. At the same time, *Rabocerus* larvae have symmetrical mandibles with hyaline processes, as in above mentioned four genera. However, this character not necessary indicates close relationships, but can be an adaptive feature connected with feeding on rather soft tissue. Salpinginae larvae with such mandibular structure considered to be mycetophagous [Ślipiński *et al.*, 2010]. Moreover, algophagous larvae of *Aegialites* and *Antarcticodomus* Brookes, 1951 (*Aegialitinae* LeConte, 1862) have very similar hyaline processes [Spilman, 1967; Zaitsev, 2024], and nearly identical structures can be found in other families, e.g. Zopheridae Solier, 1834 (*Hyporhagus* Thomson, 1860) [Costa *et al.*, 1988; Zaitsev, Kompantsev, 2018].

Istrisia larvae can be distinguished from other known Salpinginae by the number of features: mandibles asymmetrical, lack hyaline processes, with true mola *sensu* Lawrence [1991]; apex of mala on inner edge with 2–3 unci, well-developed malar scleroma present; urogomphi no less than 3 as long as basal wide, with 6 internal spines; transverse row of sternal teeth [Hayashi, 1969]. Similar structure of mandibles and mala can be found in *Elacatis* Pascoe, 1860 (*Othniinae* LeConte, 1861) and *Prostominia* Reitter, 1889 (*Prostominiinae* Grouvelle,

1914) [Fukuda, 1962; Hayashi, 1969], but it can be another case of parallel development, this time connected with feeding on hard tissue. Thus, the very same structures can be seen in various Tenebrionoidea families, such as Pythidae Solier, 1834, Boridae G.G. Thomson, 1859, Pyrochroidae Latreille, 1807 and Zopheridae [Hayashi, 1986; Zaitsev, Kompantsev, 2018]. So, if the characters of mandibles and mala mentioned above may not indicate a degree of relationships within the family, the structure of urogomphi, and, to a lesser extent, the number of sternal teeth can be considered one of the most important features. Thus, larvae of *Colposis*, *Lissodema*, *Salpingus* and *Vincenzellus* form a distinct group, supporting the placement of these genera in tribe Salpingini Leach, 1815. The inclusion of *Istrisia* in Salpinginae is arguable, especially since

some authors proposed its affinity with Pythidae [Ślipiński *et al.*, 2010; Yoshitomi, 2025]. Though, it should be noted that *Istrisia* larva have little in common with known Pythidae, except shared adaptive features mentioned above and transverse row of sternal teeth, however the latter character occurs not only in other Salpingidae (e.g. *Elacatis*, *Prostominia*), but also in Pyrochroidae and Tricentenotomidae Blanchard, 1845 [Hayashi, 1986; Hu *et al.*, 2020]. So, it is possible to consider the placement of *Istrisia* to separate subfamily in future studies. Larval features of *R. foveolatus*, mentioned above, cause certain difficulties in clarification of the taxonomic position of the genus. Traditionally, it belongs to Salpinginae, being a part of the tribe Salpingini. Taken into account the great similarity between four other genera and the peculiarity of *Rabocerus*



Figs 20–23. *Rabocerus foveolatus*, last-instar larva: 20 — middle leg, anterior; 21 — abdominal segment IX, dorsal; 22 — abdominal segments IX–X, ventral; 23 — abdominal segments IX–X, lateral.

Рис. 20–23. *Rabocerus foveolatus*, личинка последнего возраста: 20 — нога второй пары, спереди; 21 — IX брюшной сегмент, сверху; 22 — IX–X брюшные сегменты, снизу; 23 — IX–X брюшные сегменты, сбоку.

larvae, together with nearly identical lifestyle (the author collected *Rabocerus* sp. larvae together with those of *S. planirostris*), it can be considered to establish separate tribe for this genus. Nevertheless, the data on larvae of other genera is needed for further taxonomic studies within the subfamily.

Compliance with ethical standards

Ethical approval: No ethical issues were raised during our research.

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References

- Costa C., Vanin S.A., Casari-Chen S.A. 1988. Larvas de Coleoptera do Brasil. Museu de Zoologia, Universidade de Sao Paulo, Sao Paulo. 282 p.
- Franz J. 1955. Tannenstammlause (*Adelges piceae* Ratz.) unter einer pelzdecke von *Cucurbitaria pithyophila* (Kze. et Schm.) De Not., nebst Beobachtungen an *Aphidoletes thompsoni* Mohn (Dipt., Itonididae) und *Rabocerus mutilatus* Beck (Col., Pythidae) als Tannenlausfeinde // Ztschr. f. Pflanzenkrankheiten u. Pflanzenschutz. Bd.62. H.2. S.49–61.
- Fukuda A. 1962. Description of the larva of *Elacatis kraatzii* Reitter (Elacatidae, Coleoptera) // Kontyû. Vol.30. No.1. P.17–20.
- Haugen N.M., Gusarov V.I., Sikes D.S., Struck T.H. 2025. Insight into the phylogeny of the intertidal beetle genus *Aegialites* (Coleoptera, Salpingidae) // Zoologica Scripta. P.1–23. doi: 10.1111/zsc.70035
- Hayashi N. 1969. On the larvae of some species of small families of Cucujoidea in Japan (Coleoptera) // Insecta Matsumurana Supplement. Vol.7. P.1–9.
- Hayashi N. 1980. [Illustrations for identification of larvae of the Cucujoidea (Coleoptera) found living in dead trees in Japan] // Memoirs of the Education Institute for Private Schools in Japan. Vol.72. P.95–147 [in Japanese].
- Hayashi N. 1986. Larvae // K. Morimoto, N. Hayashi (eds.). The Coleoptera of Japan in color. Vol.1. Hoikusha Pub. Co., Osaka. 323 p.
- Hu F.-S., Pollock D.A., Telnov D. 2020. Comparative morphology of immature Trictenotoma formosana Kriesche, 1919 and systematic position of the Trictenotomidae (Coleoptera, Tenebrionoidea) // European Journal of Taxonomy. Vol.640. P.1–22. doi: 10.5852/ejt.2020.640
- Klausnitzer B.D. 1997. Familie: Salpingidae // B.D. Klausnitzer (Hrsg.). Die Larven der Käfer Mitteleuropas. Band 3, Polyphaga, Teil 2. Jena: Gustav Fischer Verlag. S.307–316.
- Lawrence J.F. 1991. Order Coleoptera (general discussion, family key, 88 family treatments) // F.W. Stehr (ed.). Immature Insects. Vol.2. Dubuque, Iowa: Kendall/Hunt Publishing Co. P.144–658.
- Makarov K.V., Sundukov Yu.N., Korotyaev B.A. 2023. [New and little-known in the Russian fauna beetles (Coleoptera) from the south of Primorskii territory] // Entomologicheskoe obozrenie. Vol.102. No.4. P.694–720. doi: 10.31857/S0367144523040081 [In Russian with English summary]
- Nikitsky N.B. 1980. [Insects – predators of bark beetles and their ecology]. Moscow: Nauka. 237 p. [In Russian]
- Nikitsky N.B., Belov V.V. 1983. [Palaeartic species of genus *Salpingus* (Coleoptera, Salpingidae)] // Zoologicheskii Zhurnal. Vol.62. No.4. P.516–529 [in Russian, with English summary].
- Perris E. 1877. Larves des Coléoptères. (Part) // Annales de la Société linnéenne de Lyon. T.23. (1876) P.1–430. 14 pls
- Pollock D.A., Löbl I., Iwan D. 2020. Family Salpingidae Leach, 1815 // Iwan D., Löbl I. (eds.). Catalogue of Palaeartic Coleoptera. Volume 5. Tenebrionoidea. Leiden: Brill. P.569–575. doi: 10.1163/9789004434998_004
- Ślipiński S.A., Lawrence, J.F., Pollock D.A., Escalona H. 2010. 11.25. Salpingidae Leach, 1815 // R.G. Beutel, R. Leschen, J. Lawrence (eds.). Handbuch der Zoologie/Handbook of Zoology. Band/Volume IV Arthropoda: Insecta. Teilband/Part 38. Coleoptera, Beetles. Morphology and Systematics (Polyphaga partim). W. DeGruyter, Berlin. P.722–729.
- Spilman T.J. 1967. The heteromorous intertidal beetles (Coleoptera: Salpingidae: Aegialitinae) // Pacific Insects. Vol.9. No.1. P.1–21.
- Yoshitomi H. 2025. Revision of the genus *Istrisia* Lewis (Coleoptera: Salpingidae) // Annales Zoologici. Vol.75. No.1. P.343–352. doi: 10.3161/00034541ANZ2025.75.1.014
- Zaitsev A.A. 2009. [Thoracic endoskeleton of Tenebrionoidea larvae (Insecta, Coleoptera) and its significance in superfamily taxonomy] // Euroasian Entomological Journal. Vol.8. P.189–204 [in Russian].
- Zaitsev A.A. 2024. Description of larva of *Aegialites kunashirensis* Zerche, 2004 (Coleoptera: Salpingidae) // Russian Entomol. J. Vol.33. No.4. P.445–456. doi: 10.15298/rusentj.33.4.05
- Zaitsev A.A., Kompantsev A.V. 2018. Description of the larva of *Monomma resinorum* Hope 1842 (Coleoptera, Zopheridae), with remarks on the composition of the family // Zoologicheskii Zhurnal. Vol.97. No.11. P.1374–1393. doi: 10.1134/S0044513418110089
- Zerche L. 2004. Revision der Gattung *Aegialites* Mannerheim (Coleoptera: Salpingidae: Aegialitinae) // Stuttgarter Beitr. Naturk. Ser.A. Nr.666. S.1–116.