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Parasitoids (Hymenoptera: Pteromalidae, Eulophidae, Braconidae) of the leaf blotch miner moth *Acrocercops brongniardella* (Lepidoptera: Gracillariidae) in the Ufa City outskirts

Паразитоиды (Hymenoptera: Pteromalidae, Eulophidae, Braconidae) дубовой широкоминирующей моли *Acrocercops brongniardella* (Lepidoptera: Gracillariidae) из очагов близ г. Уфы

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KEY WORDS: Chalcidoidea, Ichneumonoidea, *Aprostocetus ermolaevi*, parasitoids, rate of parasitism.
КЛЮЧЕВЫЕ СЛОВА: Chalcidoidea, Ichneumonoidea, *Aprostocetus ermolaevi*, паразитоиды, зараженность паразитоидами.

ABSTRACT. The assemblage of hymenopteran parasitoids of larvae and pupae of leaf blotch miner moth *Acrocercops brongniardella* (Fabricius, 1798) (Lepidoptera: Gracillariidae) developing on the oak (*Quercus robur*) was studied in the Ufa City during 2023. Ten species of *A. brongniardella* parasitoids, *Sympiesis sericeicornis*, *Pediobius cassidae*, *P. pyrgo*, *P. saulius*, *Aprostocetus ermolaevi* **sp.n**., *Baryscapus pospelovi*, *Minotetrastichus frontalis*, *Oomyzus* sp. (Eulophidae), *Pteromalus semotus* (Pteromalidae), and *Pholetesor circumscriptus* (Braconidae) were identified. Eight species of them, *Pediobius cassidae*, *P. pyrgo*, *P. saulius*, *Aprostocetus ermolaevi*, *Baryscapus pospelovi*, *Oomyzus* sp., *Pteromalus semotus* and *Pholetesor circumscriptus* were recorded as the parasitoids of the leaf blotch miner moth for the first time. One species, *Aprostocetus ermolaevi* **sp.n**. was described as new for science from the area of Ufa City. The mortality of *A. brongniardella* preimaginal stages from parasitoids was 23.9%.

РЕЗЮМЕ. В 2023 г. исследован комплекс паразитоидов гусениц и куколок дубовой широкоминирующей моли (*Acrocercops brongniardella*, Lepidoptera, Gracillariidae) в г. Уфа (Республика Башкортостан). Всего выявлено 10 видов наездников: *Sympiesis sericeicornis*, *Pediobius cassidae*, *P. pyrgo*, *P. saulius*, *Aprostocetus ermolaevi* **sp.n**., *Baryscapus pospelovi*, *Minotetrastichus frontalis*, *Oomyzus* sp. (Eulophidae), *Pteromalus semotus* (Pteromalidae) и *Pholetesor circumscriptus* (Braconidae). Восемь видов (*Pediobius cassidae*, *P. pyrgo*, *P. saulius*, *Aprostocetus ermolaevi*, *Baryscapus pospelovi*, *Oomyzus* sp., *Pteromalus semotus* и *Pholetesor circumscriptus*) были впервые отмечены в качестве паразитоидов этого минера. Описан новый вид эвлофид: *Aprostocetus ermolaevi* **sp.n**. Смертность преимагинальных стадий *A. brongniardella* от паразитоидов составила 23,9%.

Introduction

The leaf blotch miner moth *Acrocercops brongniardella* (Fabricius, 1798) (Lepidoptera, Gracillariidae) is a common native species associated with oak forests

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in Europa [Utkina, Rubtsov, 2019]. In the southern part of its range, the miner forms both periodic and chronic outbreaks. Chronic oak defoliation by this miner in early summer can lead to a tree radial growth decrease by 25−50%. This causes a weakening and death of plants as a result by xylophages and pathogens infestation [Padiy, Zavada, 1988]. In the last decade, the expansion of the *A. brongniardella* range has been noted in a number of regions of the Russian Federation [Musolin *et al*., 2022]. In 2013, this species was first detected in the green spaces of Omsk [Chursina *et al*., 2016], in 2016 and 2018, this miner was also found in Yekaterinburg and St Petersburg [Selikhovkin *et al*., 2020; Zamshina, 2023].

A. brongniardella has one generation per season. The emergence of adults from diapause coincides phenologically with oak foliage expansion. Females lay eggs one at a time along the midrib and lateral veins on the adaxial epidermis of the leaf. The total number of eggs laid on one leaf in Bashkiria can reach 25 [Valuev, Ismagilov, 2020], but is usually in the range of up to 5 or 6 examples. The caterpillar of the first instar forms a serpentine mine. Subsequently, such separate larvae mines are merged into one common large mine. Caterpillars of older instars eat the spongy and palisade parenchyma of the leaf and form a blotch mine. The total time of the caterpillar development is about a month. Pupation of *A. brongniardella* occurs outside the mine. In this case, the caterpillars emerge from the mine and descend on a web to any objects under the tree. Pupation occurs in a flat silk cocoon. The pupal stage continues about 20 days.

The hymenopteran parasitoids assemblage of *A. brongniardella* has been studied rather poorly. Previously carried out random collections allowed to detect only some of their representatives. Thus, *Rhysipolis decorator* (Haliday, 1836) (Braconidae) was found in the U.K. [Shaw, Askew, 1976]. *Sympiesis gordius* (Walker, 1839) (Eulophidae) was discovered in Czech Republic, Slovakia, Bulgaria and Sweden [Bouček, 1959; Čapek, 1963; Ivanov, Slavov, 1986; Hansson, 1987]. *Pholetesor viminetorum* (Wesmael, 1837) was recorded in Hungary (Braconidae) [Papp, 1988]. *Cirrospilus pictus* (Nees, 1834) and *Pnigalio agraules* (Walker, 1839) (Eulophidae) were indicated for Italy [Lo Duca *et al*., 2002]. *Rhysipolis decorator* (Haliday, 1836), *R. meditator* (Haliday, 1836) and *Oncophanes minutus* (Wesmael, 1838) (Braconidae) were discovered in Turkey [Beyarslan, 2017].

The only actually comprehensive study of parasitoids *A. brongniardella* was carried out in Ukraine [Zerova, 2001; Nikitenko *et al*., 2004; 2005]. A total of 23 parasitoids species were reared from the miner: *Cirrospilus lyncus* Walker, 1838, *C. pictus*, *Elachertus inunctus* Nees, 1834, *E. lateralis* (Spinola, 1808), *Necremnus leucarthros* (Nees, 1834), *Pnigalio pectinicornis* (Linnaeus, 1758), *P. soemius* (Walker, 1839), *Sympiesis acalle* (Walker, 1848), *S. gordius*, *S. sericeicornis* (Nees, 1834), *Chrysocharis pentheus* (Walker, 1839), *Minotetrastichus frontalis* (Nees, 1834) (Eulophidae); *Dolichogenidea dilecta* (Haliday, 1834), *D. laevissima* (Ratzeburg, 1848), *D. longicauda* (Wesmael, 1837), *Oncophanes minutus* (Wesmael, 1838) (Braconidae); *Scambus planatus* (Hartig, 1838), *Encrateola laevigata* (Ratzeburg, 1848), *Eudelus scabriculus* (Thomson, 1884), *E. simillimus* (Taschenberg, 1865), *Gelis parens* (Schwarz, 1998), *G. proximus* (Förster, 1850), and *Diadegma holopygum* (Thomson, 1887) (Ichneumonidae). In addition, the representatives of the genera *Pholetesor* Mason, 1981 (Braconidae), *Bathytrix* Förster, 1869, and *Mesochorus* Gravenhorst, 1829 (Ichneumonidae) were indicated [Zerova, 2001; Nikitenko *et al*., 2004; 2005].

Information on *A. brongniardella* parasitoids in the Russian Federation was limited to a single publication. *Gelis agilis* (Fabricius, 1775) and *G. proximus* (Foerster, 1850) were found in the Samara Province in 1932 [Veber, 1932].

This paper presents the results of our study of parasitoid assemblage (Hymenoptera, Pteromalidae, Eulophidae, Braconidae) of leaf blotch miner moth *A. brongniardella* premature stages from the outskirts of Ufa City.

Material and Methods

The assemblage of premature stages of *A. brongniardella* parasitoids was studied in the oak forest of Ufa City outskirts (54˚60′N, 56˚11′E) (Fig. 1). A chronic outbreak of the miner has been existing at this site for the last 20 years [Valuev, Ismagilov, 2020]. For this purpose, on June 15, 2023, miner cocoons were collected once from the leaves of plant located under the crown of oaks (*Quercus robur* Linnaeus, 1753) for the study. The cocoons were cut out with scissors and placed in labeled plastic containers. The collected material was quickly transported to the Biological Station of Udmurt State University, Izhevsk. The cocoons were kept under constant conditions (temperature 22–25 °C, humidity 65%, photoperiod 18:6 h). Emergence of *A. brongniardella* adults and parasitoids was recorded daily. Altogether, 422 cocoons were collected, 197 specimens of *A. brongniardella* and 101 specimens of parasitoids were reared. The parasitoids were identified by O.V. Kosheleva (Eulophidae), E.V. Tselikh (Pteromalidae) and S.A. Belokobylskij (Braconidae). All specimens are deposited in the Zoological Institute of the Russian Academy of Sciences (Saint Petersburg, Russia; ZISP). Description of a new species *Aprostocetus ermolaevi* sp.n. is prepared by O.V. Kosheleva.

The morphological terminology used in description of the new species follows Graham [1987]. Following abbreviations are used in the text: POL — posterior ocellar line, shortest distance between the posterior ocelli; OOL — ocello-ocular line, minimum distance between posterior ocellus and eye margin; OD — diameter of lateral ocelli; F1–F3 — funicular segments; C1–C3 — claval segments; SM — submarginal vein; M — marginal vein; ST — stigmal vein and PM — postmarginal vein.

The study used Google map and "The Pedunculate Oak (*Quercus robur*) Distribution Map" developed by the "European Forest Genetic Resources Programme".

The following parameters were calculated:

$V = B / N \times 100$, where V is the survival rate of *A. brongniardella* preimaginal stages, B is the number of adult moths reared from cocoons, and N — the total number of the collected cocoons.

$P = W / N \times 100$, where P is the rate of infestation by parasitoids of the *A. brongniardella* premature stages, W — the total number of the parasitoids reared, and N — the total number of the collected cocoons.

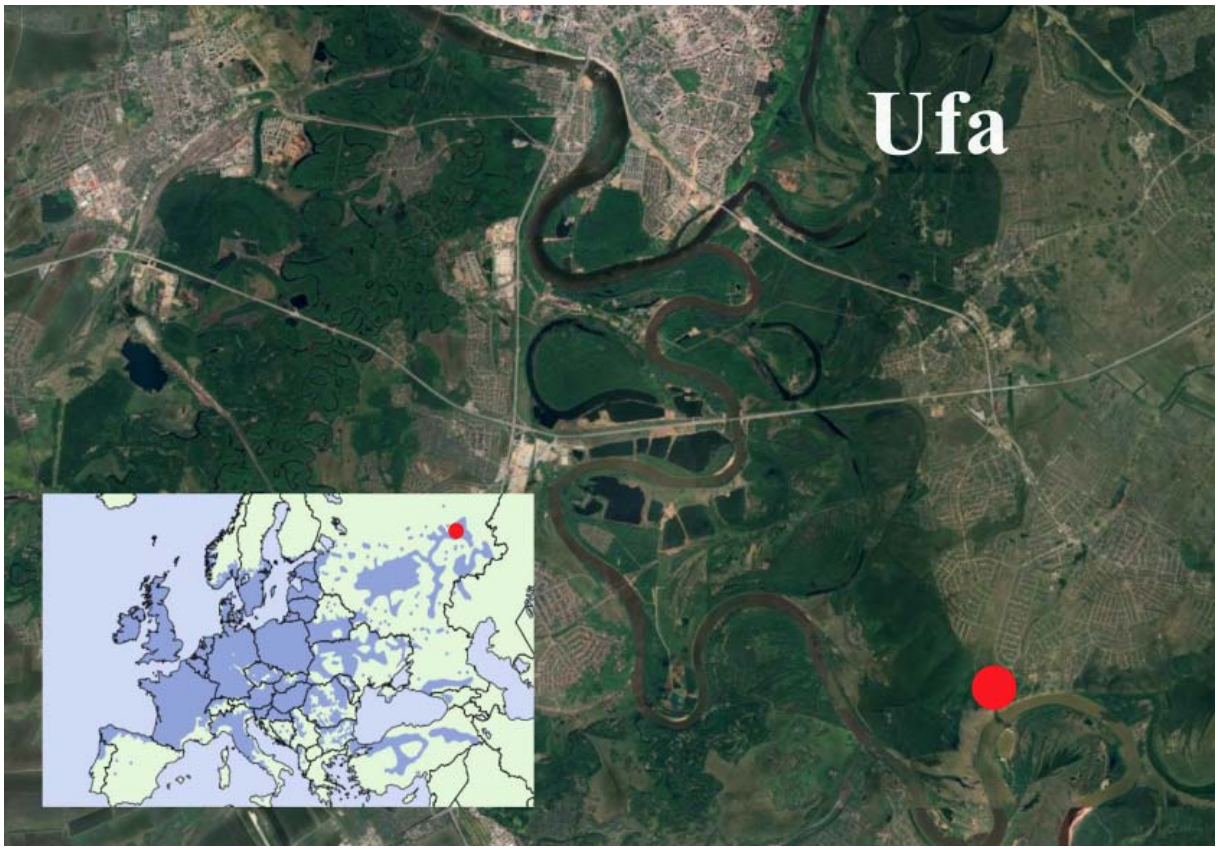

Fig. 1. The study region. In the inset, the range of *Qercus robur* is shown in blue; the study region is marked with a red dot.
Рис. 1. Район исследования. На вставке ареал *Qercus robur* выделен синим цветом, место проведения исследования — красной точкой.

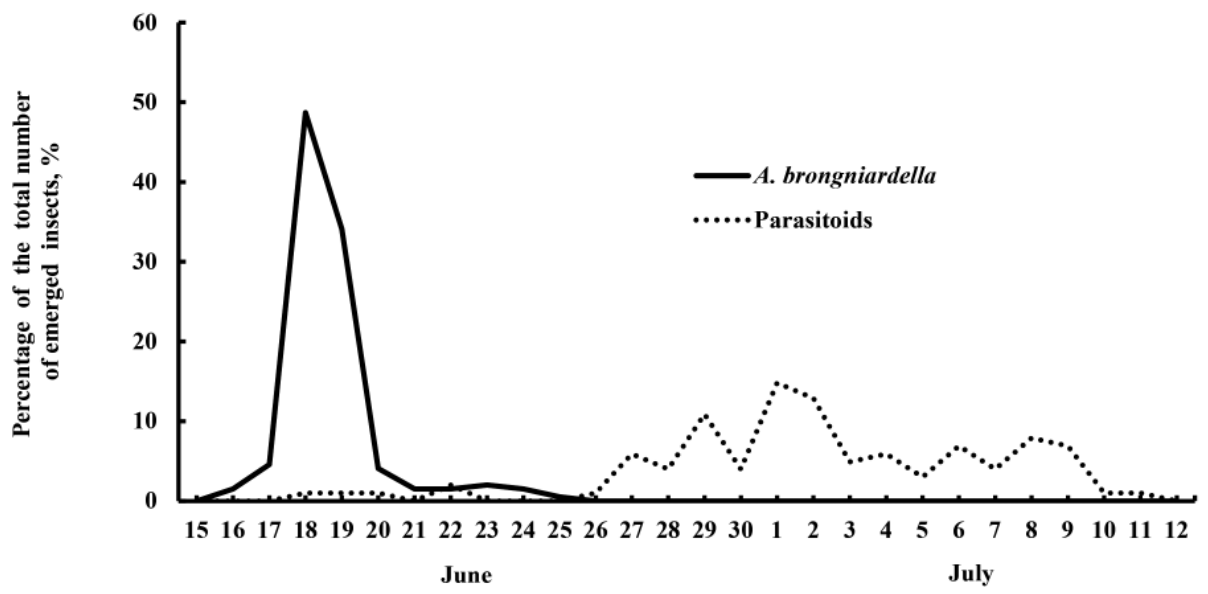

Fig. 2. Dynamics of emergence of *Acrocercops brongniardella* and its parasitiods in the field laboratory: material from Ufa City, 2023.
Рис. 2. Динамика выхода из куколок моли *Acrocercops brongniardella* и ее паразитоидов в условиях полевой лаборатории (г. Уфа, 2023 г.).

Results and discussion

Under the conditions of the field laboratory, adults of the Ufa population of *A. brongniardella* emerged from June 16 to June 25, 2023 (with a peak on June 18), and parasitoids emerged from June 18 to July 11 (with a peak on July 1) (Fig. 2). The survival rate of miner pupae was 46.7%. Their total mortality was 53.3%, and the mortality from parasitoids was 23.9%.

Our study resulted in discovery of nine species of parasitoids of *A. brongniardella*: *Sympiesis sericeicornis* (Nees, 1834), *Pediobius cassidae* Erdös, 1958, *P. pyrgo* (Walker, 1839), *P. saulius* (Walker, 1839), *Aprostocetus ermolaevi* **sp.n**, *Baryscapus pospelovi* (Kurdjumov, 1912), *Minotetrastichus frontalis* (Nees, 1834) (Eulophidae), *Pteromalus semotus* (Walker, 1834) (Pteromalidae) and *Pholetesor circumscriptus* (Nees, 1834) (Braconidae). In addition, a single specimen of the genus *Oomyzus* Rondani, 1870 (Eulophidae) was also reared, for which the species identity could not be determined.

Aprostocetus ermolaevi Kosheleva **sp.n.**
Fig 3.

MATERIAL: Holotype, female, Russia: Republic of Bashkortostan, Ufa, ex. *Acrocercops brongniardella* (F.), tube N 101, 1.VII.2023 (I.V. Ermolaev leg.) (ZISP): Paratypes: same label as in holotype, but "tube N 55, 1.VII.2023"; "tube N 58, 1.VII.2023"; "tube N 89, 3.VII.2023"; "tube N 120, 6.VII.2023" (I.V. Ermolaev leg.), 4 females (ZISP).

DESCRIPTION. FEMALE. Body length 1.51–1.86 mm.

Colour. Body dark brownish; face upper, and mouth-edge testaceous; upper angle of mesopleuron and dorsellum yellowish. Antennae fuscous, scape and pedicel darkened dorsally. Coxae black; trochanters pale; fore and mid femora yellowish, their base testaceous, mainly dorsally, hind femora brownish, their tips yellowish; tibiae and tarsi yellow, except apical segments of all tarsi brown. Tegula fuscous to black. Wings hyaline, venation pale yellowish or testaceous.

Head 0.93–0.98 times as broad as mesoscutum, 2.42–2.63 times as broad as long (in dorsal view). POL 1.43–1.57 times OOL, OOL 1.75–1.97 times OD. Eyes 1.5–1.6 times as long as broad (dorsal view). Malar space 0.48–0.56 times height of eye, malar sulcus nearly straight. Mouth 1.31–1.36 times malar space. Antenna with scape 0.65–0.78 times height of eye, scape 3.00–3.17 times as long as broad, not or just reaching lower edge of median ocellus; pedicel plus flagellum 1.10–1.13 times breadth of mesoscutum; pedicel 1.60–1.75 times as long as broad and 0.89 times as long as F1; funicle proximally only slightly stouter than pedicel, F1 1.80–2.00 times, F2 1.60–1.80 times, F3 1.50–1.60 times as long as broad respectively; clava slightly broader than F3, as long as or slightly longer than F2 plus F3, 3.07 times as long as broad, acutely pointed, with C1 1.15 times as long as broad, spine 0.40 times length of C3; multiporous plate sensilla sparse on funicle, moderately numerous on clava, uniseriate.

Mesosoma 1.30 times as long as broad. Pronotum 0.13–0.17 times as long as mesoscutum. Mid lobe of mesoscutum about as broad as long; median line indistinct or extremely fine and superficial; with 4–5 adnotaular setae on each side. Scutellum 1.47–1.54 times as broad as long, moderately convex; distance between submedian lines 1.43–1.57 times distance between them and sublateral lines; submedian lines curving outwards anteriorly, then running parallel, enclosed space 1.89–1.90 times as long as broad; setae equal sizes, its anterior pair 2.60–3.30 times distad from anterior edge of scutellum as from posterior seta. Dorsellum 2.83–2.92 times as broad as long. Propodeum medially about as long as dorsellum; median carina distinct, with a triangular basal fovea, expanding posteriorly. Legs medium length; hind coxae, twice as long as broad; hind femora 3.9–4.0 times as long as broad; spur of mid tibia equal in length to basitarsus. Fore wing 2.18–2.30 times as long as broad; costal cell 0.85 length of *M*, 10.8–11.7 times as long as broad; *SM* with 4 dorsal setae; *M* 3.44–3.70 length of *ST*, its front edge with 13 setae; *ST* at about 45–50°, nearly straight, stigma small; *PM* as short stub or rudimentary; speculum moderate-sized, extend as a very narrow strip below *M* as far as *ST*; bare area present between *PM* and *ST;* cilia 0.5 times length of *ST*. Hindwing obtuse; cilia 0.28–0.32 breadth of wing.

Metasoma. Gaster longitudinal-oval, 1.03–1.15 times as long as head plus mesosoma, 1.40–1.57 times as long as mesosoma, slightly narrower than mesosoma, 2.02–2.42 times as long as broad, slightly acuminate; last tergite 1.06–1.15 times as long as broad; ovipositor sheaths projecting slightly; longest seta of each cercus twice length of next longest seta, curved in the middle; tip of hypopygium at 0.54–0.60 length of gaster.

MALE. Unknown.

HOST. *Acrocercops brongniardella* (Fabricius) (Gracillariidae).

ETYMOLOGY. The name refers to the collector of this new species, Dr. Ivan V. Ermolaev (Izhevsk, Russia) who studied leaf-mining insects and its parasitoid complexes in Russia.

DIAGNOSIS. *Aprostocetus ermolaevi* **sp.n**. is similar to *A. femoralis* (Sundby, 1957) by the scape distinctly shorter than eye; the antennal funicle proximally only slightly stouter than pedicel and thickening slightly distal, the clava about as long as F2 plus F3, the claval spine nearly half length of C3 (see Graham [1987: fig. 435)], the pedicel plus flagellum about as long as breadth of mesoscutum, and the speculum extending as a narrow wedge below *M* [Graham, 1987: 318]. A new species differs from *A. femoralis* by the pedicel shorter, 1.60–1.75 times as long as broad (Fig. 3H) (more than twice as long as broad in *A. femoralis*), the dorsellum 2.87–2.92 times as broad as long (Fig. 3D) (not more than 2.5 times in *A. femoralis*), and the gaster longitudinal-oval, 2.02–2.42 times as long as broad (lanceolate, 3.00–4.25 times as long as broad in *A. femoralis*).

Sympiesis sericeicornis is a solitary primary or sometimes secondary ectoparasitoid of the larvae and pupae of leaf-mining insects [Bouček, Askew, 1968]. It is one of the most common representatives in parasitoid complexes of the family Gracillariidae. This parasitoid is ecologically associated with 120 species of this family (Universal Chalcidoidea Database, 2024). *S. sericeicornis* is also known as the pupal hyperparasitoid of *Pholetesor circumscriptus* [Delucchi, 1958]. The species is widespread in Eurasia and North America [Belokobylskij *et al*., 2019]. Special studies [Meyhöfer *et al*., 1994, 1997] have shown that when searching for a host, the female *S. sericeicornis* uses both chemical and mechanical (vibrations that occur during the movement of a caterpillar) signals. This species was previously noted as a parasitoid of *A. brongniardella* in Ukraine. The percentage of *S. sericeicornis* in the parasitoid complex of the Ufa moth population was 6.2%.

Species of the genus *Pediobius* Walker, 1846 are primary or often secondary (rarely even tertiary) solitary endoparasitoids of larvae and pupae of various insects [Bouček, Askew, 1968]. In our collections, three species of this genus, *Pedio-*

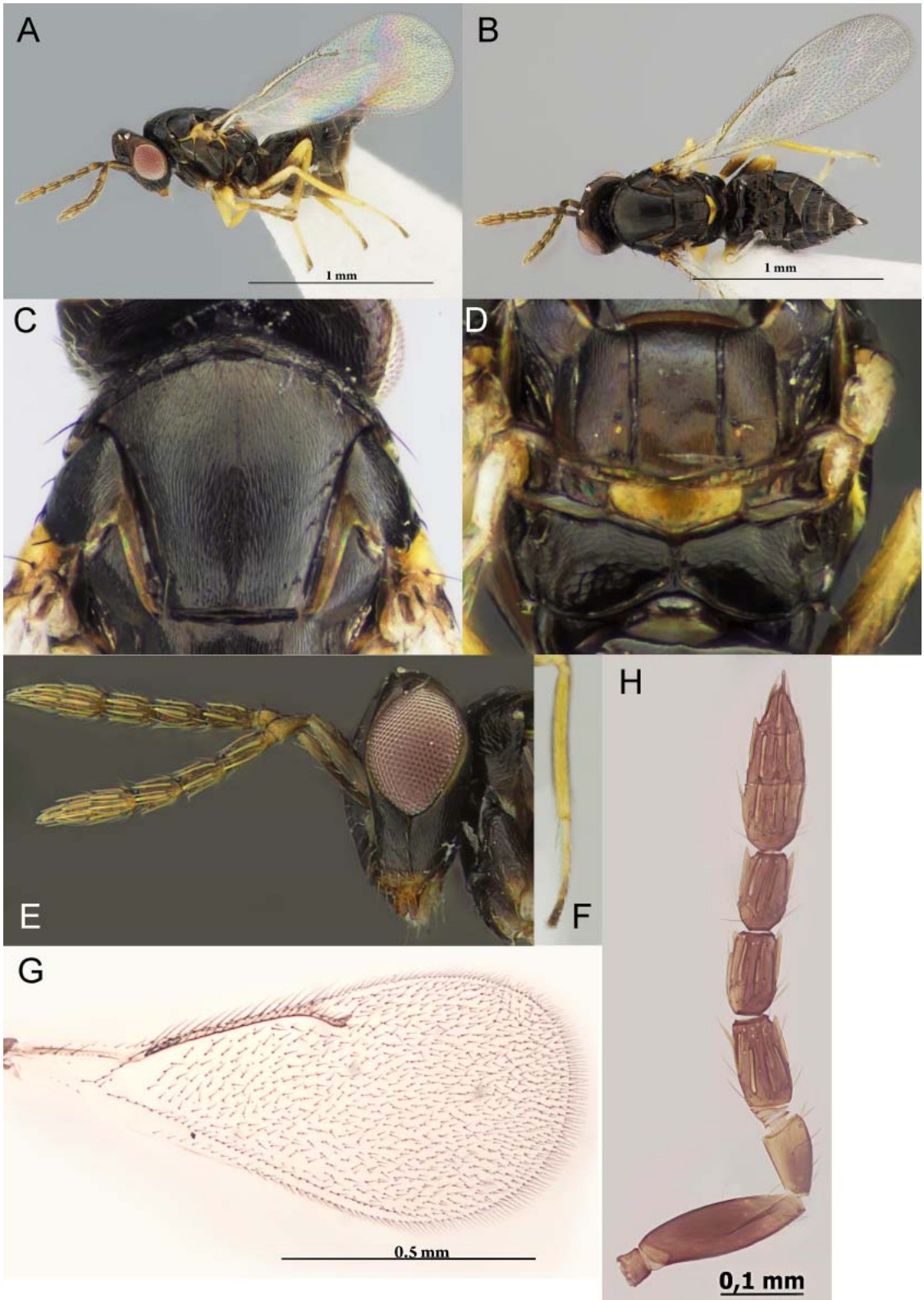

Fig. 3. *Aprostocetus ermolaevi* **sp.n**., female: holotype (A–C, E–H), paratype (D, F): A, B — habitus (A — lateral view; B — dorsal view); C — mid lobe of mesoscutum, dorsal view; D — mesosoma (part), dorsal view; E — head with antennae, lateral view; F — mesotibia and mesotarsus; G — forewing; H — antenna.

Рис. 3. *Aprostocetus ermolaevi* **sp.n**., самка, голотип (A–C, E–H), паратип (D, F): A, B, — габитус (A — вид сбоку; B — вид сверху); C — срединная лопасть мезоскутума, вид сверху; D — мезосома (часть), вид сверху; E — голова и антенны, вид сбоку; F — голень и лапка средней ноги; G — переднее крыло; H — антенна.

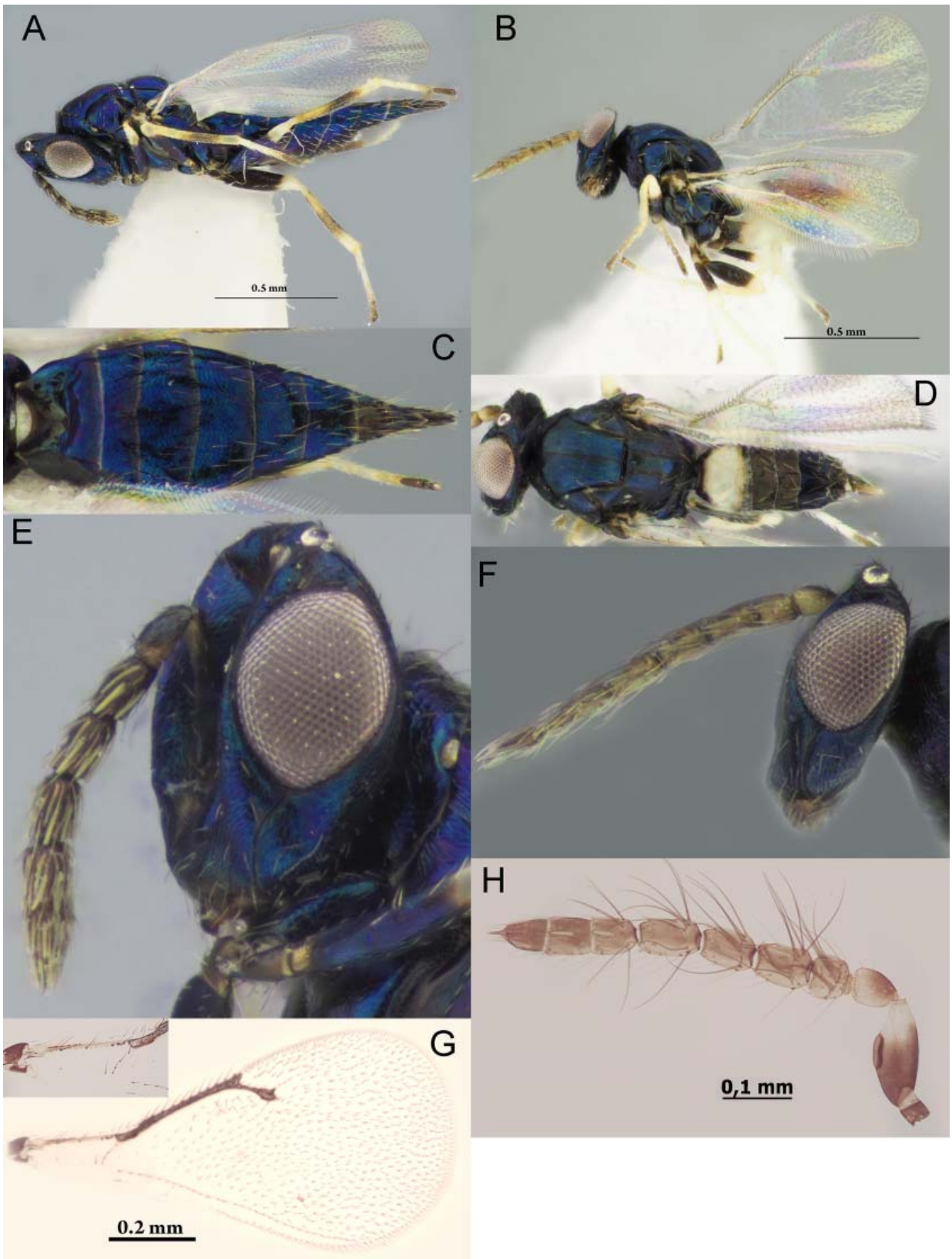

Fig. 4. *Baryscapus pospelovi* (Kurdjumov, 1912), female (A, C, E, G), male (B, D, F, H): A, B, D — habitus (A, B — lateral view; D — dorsal view); C — gaster, dorsal view; E, F — head with antenna, lateral view; G — forewing; H — antenna.
Рис. 4. *Baryscapus pospelovi* (Kurdjumov, 1912), самка (A, C, E, G), самец (B, D, F, H): A, B, D — габитус (A, B — вид сбоку; D — вид сверху); C — гастер, вид сверху; E, F — голова и усик, вид сбоку; G — переднее крыло; H — усик.

bius cassidae, *P. pyrgo* and *P. saulius* were identified. All these species have a Palaearctic distribution [Universal Chalcidoidea Database, 2024], but *P. pyrgo* has also been found in South America [Schoeninger *et al*., 2015]. *P. saulius* is known as the hyperparasitoid of *Pholetesor circumscriptus* [Delucchi, 1958]. In addition, this species was even noted as a tertiary parasitoid: *P. saulius* infests *Sympiesis sericeicornis*, which in its turn develops on *Ph. circumscriptus* [Viggiani, 1964]. All three species of the genus *Pediobius* are reported for the first time as parasitoids of *A. brongniardella*. If the percentage of *P. cassidae* in the complex of parasitoids of the Ufa population of the miner was only 1.0, then the percentages for *P. pyrgo* and *P. saulius* were 8.3 and 24.7%, respectively.

Representatives of the genus *Aprostocetus* Westwood, 1833 are primary, but sometimes secondary, endoparasitoids, specializing in gall former hosts from the families Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera) [Graham, 1987]. Both latter groups are well represented among oak phyllophages. Our material revealed for the first time that the new species *Aprostocetus ermolaevi* sp. n. is ecologically associated with *A. brongniardella*. The percentage of this species in the parasitoid complex of the Ufa miner population was 5.2%.

Baryscapus pospelovi is an endoparasitoid that infests the caterpillars of a number of the lepidopteran families [Graham, 1991], including the green oak tortrix *Tortrix viridana* Linnaeus, 1758. In addition, the species has been noted as a secondary parasitoid of representatives of the families Pteromalidae (including *Pteromalus semotus*), Eulophidae and Braconidae [Graham, 1991]. *B. pospelovi* is distributed in the Western Europe and Russia [Belokobylskij *et al*., 2019]. The species was first recorded as a parasitoid not only for the community ecologically associated with *A. brongniardella*, but the entire family Gracillariidae [Universal Chalcidoidea Database, 2024]. The percentage of *B. pospelovi* in the parasitoid complex of the Ufa miner population was only 1.0%. The newly collected specimen of male of *B. pospelovi* corresponds to the redescription by Graham [1991] in most its characters, however differs in having a short scape, ventral plaque, and funicular segments, but has a funicular segment and claval segment with longer subbasal row of long setae (Fig. 4H). The newly collected specimen of female is very similar to European specimens of *B. pospelovi* by the shape of gaster [which is 2.60−2.74 times as long as broad (Fig. 4C)], the speculum large (Fig. 4G) and the ovipositor sheaths slightly projecting (Fig. 4C). However, the newly collected specimens were reared from leaf miners (Gracillariidae), common hosts of *B. nigroviolaceus* (to which the collected specimens are also morphologically similar), but previously known hosts of *B. pospelovi* are lepidopterans from the family Yponomeutidae and its primary parasites from Braconidae, Pteromalidae and Eulophidae.

Minotetrastichus frontalis is a gregarious ectoparasitoid of mining lepidopterans caterpillars and pupae. It is known as a secondary and tertiary parasitoid of Eulophidae and Braconidae [Graham, 1987], and was also recorded as a hyperparasitoid of *Pholetesor circumscriptus* [Delucchi, 1958]. The biology features of this parasitoid were studied during its interaction with the lime leaf miner *Phyllonorycter issikii* (Kumata, 1963) (Gracillariidae) [Yefremova, Mishchenko, 2012]. The females of *M. frontalis* lay eggs in the mine of *Ph. issikii*, directly on the host larva or next to it. The parasitoid has no specific localization on the host body. From one to five larvae of *M. frontalis* may develop on one caterpillar or pupa of *Ph. issikii* [Yefremova, Mishchenko, 2012]. Our studies showed that *M. frontalis* was restricted to the broad-leaved forests and was absent north of 57°N [Ermolaev *et al*., 2018]. The species was already recorded as a parasitoid of *A. brongniardella* in Ukraine [Zerova, 2001; Nikitenko *et al*., 2004, 2005]. *M. frontalis* dominated parasitoid of *A. brongniardella* in the Ufa population; its percentage consist 44.4%.

Members of the genus *Oomyzus* Rondani, 1870 are endoparasitoids of Coleoptera larvae and pupae, less frequently Neuroptera, Diptera and Lepidoptera [Graham, 1991]. A representative of the genus is listed for the first time as a parasitoid of *A. brongniardella*. The percentage of the species in the parasitoid complex of the Ufa miner population was only 1.0%.

Pteromalus semotus is a solitary, predominantly primary ectoparasitoid of various Lepidoptera caterpillars [Graham, 1969]. In addition, the species is often recorded as a hyperparasitoid of primary parasitoids from the family Braconidae [Harvey *et al*., 2012]. *P. semotus* is a widespread Palaearctic species, however it was also introduced to New Zealand for the biological control of certain Lepidoptera [Todorov *et al*., 2022]. The species is listed for the first time as a parasitoid of *A. brongniardella*. The percentage *P. semotus* in parasitoid complex of the Ufa miner population was 7.2%.

Pholetesor circumscriptus is a solitary endoparasitoid of caterpillars. It is a common parasitoid of many leaf-mining Lepidoptera from families Coleophoridae, Elachistidae, Gracillariidae and Tischeriidae [Whitfield, 2006; Belokobylskij *et al*., 2019]. This species is widespread throughout the Palaearctic [Nixon, 1973; Yu *et al*., 2016]. Our study of the chronic outbreak of the aspen leaf blotch miner moth *Phyllonorycter apparella* (Herrich-Schäffer, 1855) (Gracillariidae) [Ermolaev *et al*., 2022] showed that *Ph. circumscriptus* acts as a kind of species edificator. The species emergence creates conditions for the miner parasitoids complex complication, both owing increased competition of primary parasitoids and owing to the manifestation of new hyperparasitism cases [Ermolaev *et al*., 2022]. In the Ufa miner population *Ph. circumscriptus* can potentially be infested by *S. sericeicornis*, species of *Pediobius* and *M. frontalis* (Fig. 5). This species is first recorded as a parasitoid *A. brongniardella*. However, the percentage of *Ph. circumscriptus* in parasitoid complex of the Ufa miner population was very low, only 1.0%.

Conclusion

The first comprehensive study of *A. brongniardella* in Russian Federation, carried out in Ufa City outskirts, made possible reared and identified ten species of entomophagous hymenopteran parasitoids. This assemblage included eight species of family Eulophidae and one species each from families Pteromalidae and Braconidae, eight of them representing the first records for this host, namely *Pediobius cassidae*, *P. pyrgo*, *P. saulius*, *Aprostocetus ermolaevi* sp.n., *Baryscapus pospelovi*, *Oomyzus* sp., *Pteromalus semotus* and *Pholetesor circumscriptus*. One species, *Aprostocetus ermolaevi* **sp.n**. was described as new for science from the area of study. The mortality of *A. brongniardella* caterpillars and pupae from parasitoids consist 23.9%.

Competing interests. The authors declare no competing interests.

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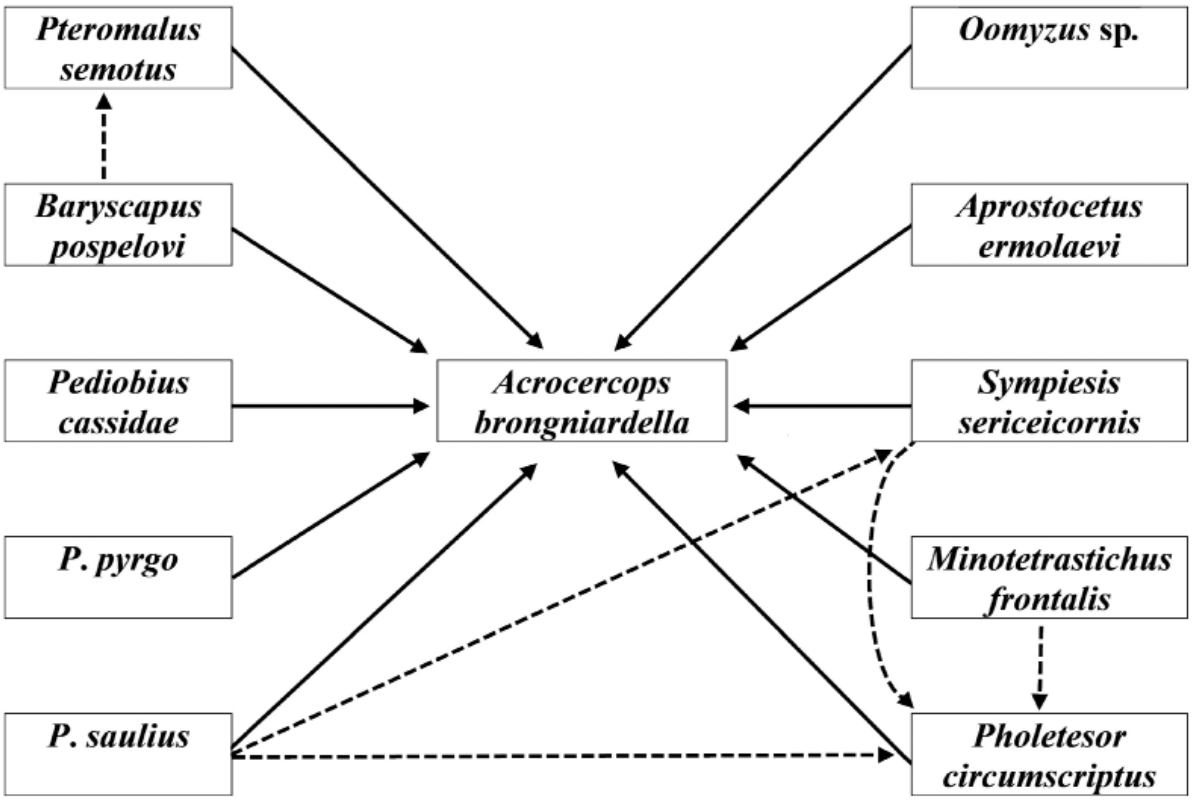

Fig. 5. Scheme the know relationships in the parasitoid assemblage of premature stages of *Acrocercops brongniardella*. Cases of primary parasitism are shown as solid lines, those of hyperparasitism, as dashed lines. The scheme is based on the material of the Universal Chalcidoidea Database [2024].

Рис. 5. Схема возможных взаимосвязей в комплексе паразитоидов пронимф и куколок *A. brongniardella*. Сплошной стрелкой показан первичный паразитизм, пунктирной — гиперпаразитизм. Схема построена на основании материалов базы данных Universal Chalcidoidea Database [2024].

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References

Belokobylskij S.A., Samartsev K.G., Il'inskava A.S. (eds.). 2019. Annotated catalogue of the Hymenoptera of Russia. Vol.2. Aprocrita: Parasitica // Proceedings of the Zoological Institute RAS. Supplement 8. 594 p.

Beyarslan A. 2017. Checklist of Turkish Doryctinae (Hymenoptera, Braconidae) // Linzer Biologische Beiträge. Vol.49. No.1. P.415−440.

Bouček Z. 1959. A study of Central European Eulophidae, I: Eulophinae (Hymenoptera) // Acta Entomologica Musei Nationalis Pragae. Vol.33. P.117−170.

Bouček Z., Askew R.R. 1968. Index of Palaearctic Eulophidae (excl. Tetrastichinae). Index of Entomophagous Insects. Paris. 260 p.

Čapek M. 1963. Verzeichnis der Parasiten, die aus schädlichen Insekten an VULH in Banska Stiavnica erzogen wurden. Teil III. Wirte von Ichneumoniden (Ichneumonidae) Chalcididen (Chalcidoidea), Proctotrupiden (Proctotrupoidea) und Bethyliden (Bethylidae) (Hym.) // Vedecké Práce VUHL, Banskáj Stiavica. Bd.4. S.239−272.

Chursina V.A., Vokhtanseva K.V., Gaivas A.A. 2016. [The leaf blotch miner moth is a previously unknown species in the city of Omsk] // Prikladnyye aspekty studencheskoy nauki. Sbornik nauchnykh trudov po materialam XV regional'noy nauchno-prakticheskoy konferentsii agrarnykh vuzov Sibirskogo federal'nogo okruga (Novosibirsk, April 28−29, 2016). Novosibirsk: "Zolotoy kolos". P.89−94 [in Russian].

Delucchi V.L. 1958. *Lithocolletis messaniella* Zeller (Lep. Gracillariidae): analysis of some mortality factors with particular reference to its parasite complex // Entomophaga. Vol.3. No.3. P.203−270.

Ermolaev I.V., Yefremova Z.A., Domrachev T.B. 2018. The influence of parasitoids (Hymenoptera, Eulophidae) on survival of the lime leafminer *Phyllonorycter issikii* (Lepidoptera, Gracillariidae) in Udmurtia // Entomological Review. Vol.98. No.4. P.407−413.

Ermolaev I.V., Yefremova Z.A., Kuropatkina Yu.S., Yegorenkova E.N. 2022. Changes in the structure of the parasitoid complex (Hymenoptera, Eulophidae, Braconidae) in an outbreak focus of the aspen leafminer (*Phyllonorycter apparella*, Lepidoptera, Gracillariidae) // Entomological Review. Vol.102. No.3. P.314−322.

Graham M.W.R. de V. 1969. The Pteromalidae of North-Western Europe (Hymenoptera: Chalcidoidea) // Bulletin of the British Museum (Natural History). Entomology Series. Supplement 16. 909 p.

Graham M.W.R. de V. 1987. A reclassification of the European Tetrastichinae (Hymenoptera: Eulophidae), with a revision of certain genera // Bulletin of the British Museum (Natural History). Entomology Series. Supplement 55. No.1. P.89−210.

Graham M.W.R. de V. 1991. A reclassification of the European Tetrastichinae (Hymenoptera: Eulophidae): revision of the remaining genera // Memoirs of the American Entomological Institute. No49. 322 p.

Hansson C. 1987. New records of Swedish Eulophidae and Pteromalidae (Hymenoptera: Chalcidoidea), with data on host species // Entomologisk Tidskrift. Vol.108. P.167−173.

Harvey J.A., Gumovsky A., Gols R. 2012. Effect of host-cocoon mass on adult size in the secondary hyperparasitoid wasp, *Pteromalus semotus* (Hymenoptera: Pteromalidae) // Insect Science. Vol.19. P.383−390.

Ivanov S., Slavov N. 1986. [An annotated list of entomophagous leaf-mining moths of the family Gracillariidae, Lyonetiidae and Nepticulidae] // Informatsionnyy byulleten' VPS MOBB. No.16. P.7−25 [in Russian, with English summary].

Lo Duca R., Massa B., Rizzo C. 2002. Importanza dei frammenti di habitatnaturale per le comunita di fillominatori (Insecta Diptera, Lepidoptera et Hymenoptera) e loro parassitoidi (Hymenoptera Eulophidae) // Atti della Accademia Roveretana degli Agiati. Serie 7. Vol.2. P.51−122.

Meyhöfer R., Casas J., Dorn S. 1994. Host location by a parasitoid using leafminer vibrations: characterizing the vibrational signals produced by the leafmining host // Physiological Entomology. Vol.19. P.349−359.

Meyhöfer R., Casas J., Dorn S. 1997. Mechano- and chemoreceptors and their possible role in host location behavior of *Sympiesis sericeicornis* (Hymenoptera: Eulophidae) // Annals of the Entomological Society of America. Vol.90. No.2. P.208−219.

Musolin D.L., Kirichenko N.I., Karpun N.N., Aksenenko E.V., Golub V.B., Kerchev I.A., Mandelshtam M Yu., Vasaitis R., Volkovitsh M.G., Zhuravleva E.N., Selikhovkin A.V. 2022. Invasive insect pest of forest and urban trees in Russia: origin, pathways, damage and management // Forests. Vol.13. No.4. Art.521.

Nikitenko G.N., Sviridov S.V., Fursov V.N. 2004. [Analysis of trophic relationships of the leaf blotch miner moth parasites and other leaf miners on oak] // Biologicheskaya zashchita rasteniy – osnova stabilizatsii agroekosistem. Krasnodar: All-Russian Research Institute of Biological Plant Protection. Issue 3. P.48−50 [in Russian].

Nikitenko G.N., Fursov V.N., Sviridov S.V., Gumovsky A.V., Kotenko A.G., Narolsky, Tolkanits V.I. 2005. [Oak leaf-mining moth and other mining lepidopterans on oak. Communication 3. Natural enemies of oak mining pests in Ukraine and adjacent territories] // Vestnik zoologii. Vol.39. No.4. P. 35−47 [in Ukrainian, with English summary].

Nixon G.E.J. 1973. A revision of the north-western European species of the *vitripennis*, *pallipes*, *octonarius*, *triangulator*, *fraternus*, *formosus*, *parasitellae, metacarpalis* and *circumscriptus*-groups of *Apanteles* Förster (Hymenoptera, Braconidae) // Bulletin of Entomological Research. Vol.63. P.163–228.

Padiy N.N., Zavada N.M. 1988. [The leaf blotch miner moth in green zone of Kyiv and environmentally friendly ways to regulate its numbers] // Zashchita Sel'skokhozyaystvennykh Kul'tur ot Vrediteley i Bolezney. Kyiv: Agricultural Academy. P.96−102 [in Russian].

Papp J. 1988. A survey of the European species of *Apanteles* Först. (Hymenoptera, Braconidae: Microgastrinae) XI. "Homologization" of the species-groups of *Apanteles* s. 1. With Mason's generic taxa. Checklist of genera. Parasitiod / host list 1. // Annales historico-naturales Musei Nationalis Hungarici. Vol.80. P.145−175.

Pedunculate Oak (*Qercus robur*) Distribution Map. 2020. European Forest Genetic Resources Programme. http://www.euforgen.org/distribution-maps

Schoeninger K., de Pádua D.G., Salvatierra L., de Olivera M.L. 2015. First record of *Pediobius pyrgo* (Walker) (Hymenoptera: Eulophidae) in South America and its emergence from egg sacs of *Latrodectus geometricus* C. L. Koch (Araneae: Theridiidae) // Entomo-Brasilis. Vol.8. No.1. P.79−81.

Selikhovkin A.V., Drenkhan R., Mandelshtam M.Yu., Musolin D.L. 2020. [Invasions of insect pests and fungal pathogens of woody plants into the northwestern part of European Russia] // Vestnik Sankt-Peterburgskogo Universiteta. Nauki o Zemle. Vol.65. No.2. P.263−283 [in Russian, with English summary].

Shaw M.R., Askew R.R. 1976. Ichneumonoidea (Hymenoptera) parasitic upon leaf-mining insects of the orders Lepidoptera, Hymenoptera and Coleoptera // Ecological Entomology. Vol.1. P.127−133.

Todorov I., Ljubomirov, T., Peneva V. 2022. Pteromalid fauna (Hymenoptera, Pteromalidae) in oilseed rape (*Brassica napus* L.) fields in Bulgaria – species composition control // BioRisk. Vol.17. P.329−342.

Universal Chalcidoidea Database. 2024. https://www.nhm.ac.uk/our-science/data/chalcidoids/database/index.dsml

Utkina I.A., Rubtsov V.V. 2019. [The leaf blotch miner moth is a long know, but still little studied species] // Izvestia Sankt-Peterburgskoy Lesotekhnicheskoy Akademii. Is.228. P.42−57 [in Russian, with English summary].

Valuev V.A., Ismagilov N.N. 2020. [*Acrocercops brongniardella* (Fabricius, 1798) (Lepidoptera: Gracillariidae) – the leaf blotch miner moth in the Republic of Bashkortostan] // Materialy po flore i faune Respubliki Bashkortostan. No.29. P.19−20 [in Russian].

Viggiani G. 1964. Morpho-biologia di *Pediobius saulius* Walk. (Hym. Eulophidae) e considerazioni sulle specie congeneri europee // Bollettino del Laboratorio di Entomologia Agraria "Filipo Silvestri". Vol.22. P.205−244.

Weber Y.H. 1932. [New widespread pest − the leaf blotch miner moth (*Coriscium brongniardellum* L.)] // Zashchita rasteniy. No.2. P.57−68 [in Russian].

Whitfield J.B. 2006. Revision of the Nearctic species of the genus *Pholetesor* Mason (Hymenoptera: Braconidae) // Zootaxa. Vol.1144. P.1−94.

Yefremova Z., Mishchenko A. 2012. The preimaginal stages of *Minotetrastichus frontalis* (Nees) and *Chrysocharis laomedon* (Walker) (Hymenoptera: Eulophidae), parasitoids associated with *Phyllonorycter issikii* (Kumata, 1963) (Lepidoptera: Gracillariidae) // Journal of Natural History. Vol.46. P.1283−1305.

Yu D.S., van Achterberg C., Horstmann K. 2016. Taxapad 2016. Ichneumonoidea 2015. Nepean, Ottawa. [database on flash-drive].

Zamshina G.A. 2023. [To the study of the invading leaf blotch miner moth *Acrocercops brongniardella* in the city of Yekaterinburg] // Fauna Urala i Sibiri. No.2. P.70−73 [in Russian, with English summary].

Zerova M.D. (ed.). 2001. [Oak leaf-mining moth (*Acrocercops brongniardella*) and other mining moths on oak (biology, entomophages and protection of oak)]. Kyiv: Nauka-Servis. No.1. 72 p. [In Ukrainian, with English summary]