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## A REVIEW OF THE GENUS *LIPOLEXIS* FÖRSTER, 1862 (HYMENOPTERA, BRACONIDAE: APHIDIINAE) IN THE FAUNA OF UKRAINE

*M.O. Kaliuzhna*

*I.I. Schmalhausen Institute of Zoology NAS of Ukraine, Kyiv, Ukraine  
e-mail: kaliuzhna.maryna@gmail.com*

Genus *Lipolexis* Förster, 1862 is represented by four species in the world fauna and only one species, *Lipolexis gracilis* Förster, 1862, in the fauna of Europe, and Ukraine as well. Data on the genus *Lipolexis* and its species *L. gracilis* are presented according to available published information and material from collection of I. I. Schmalhausen Institute of Zoology, NAS of Ukraine, identified by author. *Lipolexis gracilis* is distributed generally in Palaerctic and Oriental regions, where it prefers steppified habitats. In Ukraine species is recorded in Cherkasy, Kirovohrad and Ternopil Regions, which are situated in Forest-Steppe Zone and Zone of Broadleaf Forests of Ukraine. *Lipolexis gracilis* is polyphagous species that parasitizes various aphid species mostly from subfamily Aphidinae, as well as aphids from subfamily Anoeciinae and subfamily Calaphidinae. Data on tritrophic interactions of *L. gracilis* in the fauna of Ukraine is given and possibility of species application as a biocontrol agent is discussed. In Ukraine *L. gracilis* was reared from *Aphis craccae* L., *Aphis craccivora* Koch, *Aphis fabae* Scopoli, and *Brachycaudus cardui* L. Among hosts of *L. gracilis*, there are economically important aphids, and this species was previously used as biocontrol agent of soybean aphid, *Aphis glycines* Matsumura. On our opinion this aphidiine species could be considered as potential biocontrol agent of other economically important aphid species. To facilitate identification of *L. gracilis* a new morphological character is established: this is the ratio of the forewing length and the length of C+SC+R vein. This character will facilitate identification of broken specimens.

**Key words:** aphidiines, aphid parasitoids, *Lipolexis*, tritrophic interactions, Ukraine.

### Обзор рода *Lipolexis* Förster, 1862 (Hymenoptera, Braconidae: Aphidiinae) фауны Украины.

Калюжная М.А.

Приведены данные о роде *Lipolexis*, который представлен в фауне Украины и Европы в целом, только одним видом *Lipolexis gracilis* Förster, 1862; дана обобщенная характеристика вида, которая включает в себя трофическую специализацию, спектр хозяев, стаии, распространение в Украине и мире. Для *L. gracilis* предложен новый морфологический признак, который позволит более надежно определять поврежденные экземпляры, а именно соотношение длинны переднего крыла к длине костальной жилки. Также приведены данные о тритрофических связях *L. gracilis* в фауне Украины, рассмотрена возможность использования вида в качестве агента биометода.

**Ключевые слова:** афидиины, паразитоиды тлей, *Lipolexis*, тритрофические связи, Украина.

### Огляд роду *Lipolexis* Förster, 1862 (Hymenoptera, Braconidae: Aphidiinae) фауни України.

М.О. Калюжна

Наведено відомості про рід *Lipolexis*, представлений у фауні України та Європи в цілому, лише одним видом *Lipolexis gracilis* Förster, 1862; надано загальну характеристику виду, що включає в себе трофічну спеціалізацію, спектр хазяїв, стації, поширення в Україні та світі. Для *L. gracilis* запропоновано нову морфологічну ознаку, яка дозволить більш надійно визначати пошкоджені екземпляри, а саме співвідношення довжини переднього крила до довжини костальної жилки. Також наведено дані про тритрофічні зв'язки *L. gracilis* у фауні України, розглянуто можливість використання виду в якості агента біометоду.

**Ключові слова:** афідіїни, паразити попелиць, *Lipolexis*, тритрофічні зв'язки, Україна.

**Introduction.** Aphidiines (Hymenoptera, Braconidae: Aphidiinae) are solitary endoparasitoids of aphids; some aphidiine species are important as biocontrol agents that are used to manage pest aphids throughout the world (Starý, 1970; Tobias and Chiriac, 1986; Davidyan, 2007; Yu et al., 2012). Before the beginning of our research, data on aphidiines of Ukraine was rather scarce (Kaliuzhna, 2015, 2017). Now we continue to fill the gap in the knowledge of this evolutionary interesting and practically important braconid subfamily in Ukraine.

Genus *Lipolexis* Förster, 1862 is distributed worldwide and includes four species: *Lipolexis gracilis* Förster, 1862, *L. myzackaiae* Pramanik & Raychaudhuri, 1984, *L. oregmae* Gahan, 1932, *L. wuyiensis* Chen, 1981. Only one species, *L. gracilis*, is registered in Europe (Yu et al., 2012). *Lipolexis* is included in tribe Trioxini, however this genus has rather complicated phylogenetic position that needs further clarification (Žikić et al., 2017). For the fauna of Ukraine *Lipolexis* was recorded by Tobias and Chiriac (1986) for Crimea (but no material was mentioned) and by the author for the Forest-Steppe Zone of Ukraine (Kaliuzhna, 2015; Kaliuzhna and Zubenko, 2013). Previously review of data on *Lipolexis* from the fauna of Ukraine was absent.

**Material and methods.** Material was collected from 2010 until 2018 by sweeping in various regions of Ukraine or rearing in laboratory from infested aphids collected in a field. Morphological characters were examined on slides under upright Olympus CX41 microscope with mounted camera Olympus C3040. The morphological terminology follows the Hymenoptera Anatomy Ontology (Yoder et al., 2010), and Sharkey & Wharton (1997). Material is deposited in I.I. Schmalhausen Institute of Zoology, NAS of Ukraine (SIZK). Geographical coordinates were found through Google Earth Pro, version 7.3.2.5491 (64-bit), and show location of the settlement indicated on the label.

### Results and discussion.

#### *Lipolexis gracilis* Förster, 1862

*Lipolexis chinensis* Chen, 1980; *Lipolexis palpator* (Gautier et Bonnamour, 1931); *Lipolexis pieltaini* (Quilis, 1931)

**Material:** Kirovohrad region: 1 ♂, near v. Pidlisne [48°47'7.97"N, 32°15'11.87"E], forest, meadows near forest, sweeping, 15.07.2011 (M. Kaliuzhna). Cherkasy Region: Horodyshe District: 1 ♂, v. Buda-Orlovetska [49°18'2.79"N, 31°37'20.76"E], reared from *Aphis craccae* L. on *Vicia sylvatica* L., 4.08.2011 (O. Zubenko); Kamianka District: 1 ♀, v. Hrushkivka [49° 5'22.02"N, 32°12'18.71"E], steppified meadows, reared from *Aphis craccivora* Koch on *Medicago procumbens* Bess., 3.07.2011 (O. Zubenko); 1 ♂, v. Kosari [49° 2'20.53"N, 32°11'20.05"E], steppified meadows, reared from *Aphis craccivora* Koch on *Trifolium aureum* Poll., 3.07.2011 (O. Zubenko); Cherkasy District: 1 ♀, v. Moshny [49°31'18.48"N, 31°43'46.24"E], forest edge, reared from *Aphis fabae* Scop. on *Genista tinctoria* L. 3.08.2011 (O. Zubenko); Shpola District: 1 ♀, v. Syhnaivka [49° 3'4.42"N, 31°29'41.29"E], upland meadows, reared from *Brachycaudus cardui* L. on *Cirsium arvense* (L.) Scop., 7.07.10 (O. Zubenko); Ternopil Region: Zalizhchiky District: 1 ♀, v. Horodok [48°37'43"N, 25°51'21"E], 14-15.07.2017, sweeping (O. Martynov).

**Habitats:** Steppe and meadows, rarely forest edges and gardens (Starý, 1965, 2006; Starý and Lukáš, 2009).

**Distribution:** Europe, North Africa, Turkey, Iran, Middle East, Russia (European part, Siberia, Far East); Central Asia, China, Japan, Korea, India, Pakistan, Thailand (Yu et al., 2012).

**Trophic specialization:** polyphagous.

**Hosts:** Subfamily Aphidinae: species of genera *Acyrtosiphon*, *Aphis*, *Brachycaudus*, *Capitophorus*, *Dysaphis*, *Liosomaphis*, *Lipaphis*, *Macchiatiella*, *Melanaphis*, *Metopeurum*, *Myzus*, *Rhopalosiphum*, *Semiaphis*, *Toxoptera*, *Toxopterina*; Subfamily Anoeciinae: species of genus *Anoecia*; Subfamily Calaphidinae: species of genera *Myzocallis*, *Therioaphis* (Starý, 1965, 2006; Starý and Lukáš, 2009; Yu et al., 2012).

**Notes on bionomy:** *Lipolexis gracilis* belongs to steppe complex of aphidiine species (Tobias and Chiriac, 1986; Starý, 1965). It is a parasitoid of many aphid species from three aphid subfamilies (see the list of hosts above). Among them, there are economically important aphids, such as *Aphis craccivora* Koch, *A. fabae* Scopoli, *A. gossypii* Glover, *Brachycaudus helichrysi* (Kalt.), *Myzus cerasi*

(Fabr.) (Starý, 2006; Starý and Lukáš, 2009) and *Aphis ruborum* (Börner) (Havelka et al., 2012).

In Ukraine *L. gracilis* was reared mostly from *Aphis* spp. as well as from *Brachycaudus cardui* L. (table 1).

*Lipolexis gracilis* was previously considered as biocontrol agent of soybean aphid, *Aphis glycines* Matsumura (Heimpel et al., 2004). Moreover, P. Starý considered *L. gracilis* as a valuable biological control agent of economically important aphids because of its ability to colonize agricultural fields early in the growing season (Starý, 1966 by Heimpel et al. 2004).

On our opinion, this aphidiine species could be considered as potential biocontrol agent of economically important aphid species in Ukraine (Kaliuzhna, 2017).

Table 1

Tritrophic interactions of *Lipolexis gracilis* in the fauna of Ukraine

Aphid	Plant
<i>Aphis craccae</i> L.	<i>Vicia sylvatica</i> L.
<i>Aphis craccivora</i> Koch	<i>Medicago procumbens</i> Bess.
	<i>Trifolium aureum</i> Poll.
<i>Aphis fabae</i> Scop.	<i>Genista tinctoria</i> L.
<i>Brachycaudus cardui</i> L.	<i>Cirsium arvense</i> (L.) Scop.

**Notes on morphology of *Lipolexis gracilis*:** *L. gracilis* is identified via several diagnostic characters. These are specific shape of ovipositor sheath (curved downwards and with little dilation on apex) and venation pattern (fig. 1), sculpture of propodeum and petiole (Starý, 1959; Tobias and Chiriac, 1986). However, there are reports of other researchers that *L. gracilis* is not a single species, but rather species group, because of ambiguities of morphological characters and quite wide host range (Poodineh et al., 2012). This hypothesis makes searching for the new diagnostic characters very actual. Recently we have initiated comparative review of aphidiine morphology, especially the body parts being traditionally neglected and rarely used in aphidiine taxonomy (Kaliuzhna, 2016). New characters will help to facilitate identification of specimens, which do not have important body parts with traditional diagnostic characters (it could be male specimens or broken specimens of both sexes).

Venation of *L. gracilis* is characterized as "hook type" (Žikić et al., 2017) and in general is similar with representatives of genera *Diaeretiella*, *Adialytus*, *Trioxys*, *Binodoxys* and some others (fig. 2).

Nevertheless, *L. gracilis* has very characteristic forewing venation with wide triangular stigma, long R1 and r&RS veins (fig. 2, a). The latter vein is very long, almost reaching forewing edge. The forewing of *L. gracilis* is clearly different from *Diaeretiella* (fig. 2, e) and *Diaeretus* spp. (fig. 2, f),

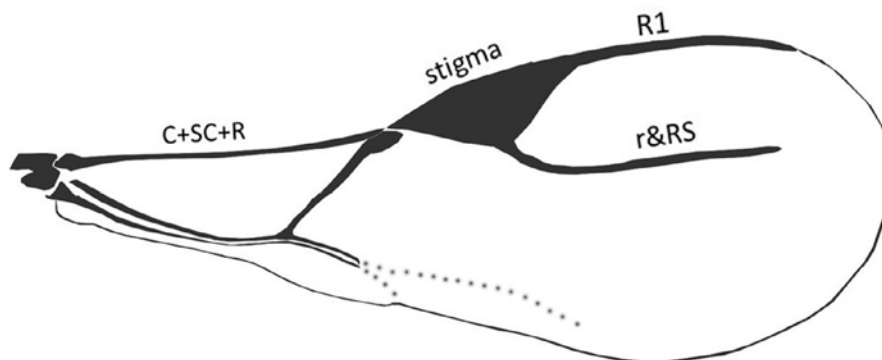
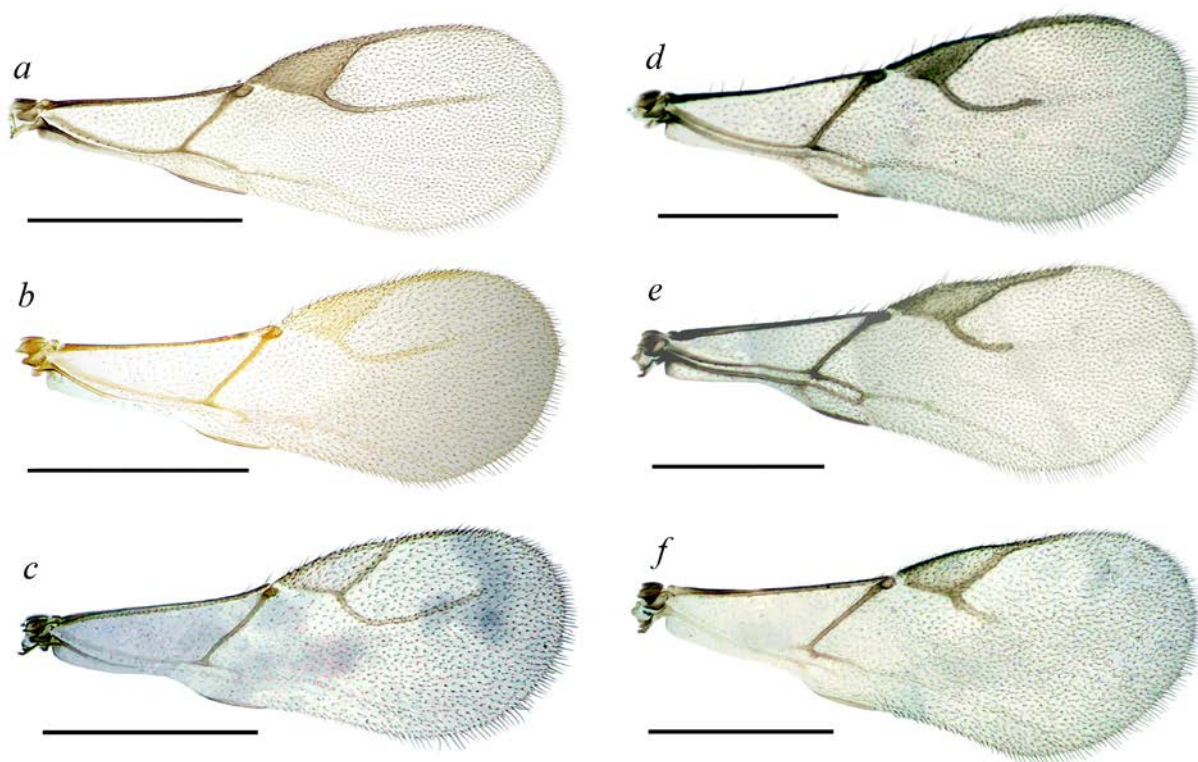


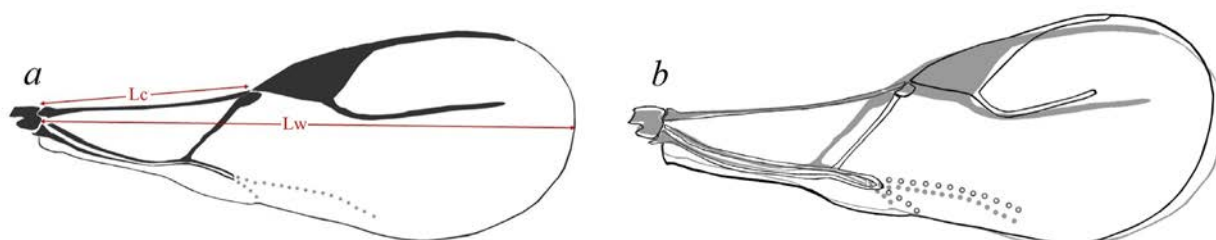
Fig. 1. Scheme of "hook type" forewing venation (*Lipolexis gracilis*).

which have short R1 and r&RS veins; difference is noticeable comparing with *Adialytus* spp. (fig. 2, d), which have long R1, but shorter r&RS vein. However, it is not so easy to describe the difference between forewings if compared with representatives of *Trioxys* (fig. 2, b) and *Binodoxys* (fig. 2, c). In this case, we recommend looking at forewing proportion. If we compare ratio of the whole length of forewing (fig. 3, a, Lw) and C+SC+R vein length (fig. 3, a, Lc), we will see, that *L. gracilis* has shorter proximal part of the forewing and longer distal part comparing to representatives of *Trioxys* and *Binodoxys* (fig. 3, b). Measurements are given in the table 2.

As we can see (table 2), Lw/Lc ratio in *L. gracilis* exceeds 2.5, however this ratio in other species does not reach 2.4. It remains a question whether this character is true to other species of *Lipolexis*. Unfortunately, we have not enough specimens of *L. gracilis* to perform appropriate statistical analysis. As the next step of research, we plan to collect more material and conduct morphometric analysis of *L. gracilis* forewing venation in comparison with representatives of genera with the same venation pattern.



**Fig. 2.** Venation of “hook type” forewings: a – *Lipolexis gracilis*, b – *Binodoxys acalephae*, c – *Trioxys pallidus*, d – *Adialytus salicaphis*, e – *Diaeretiella rapae*, f – *Diaeretus leucopterus*. Scale bar: 0,5 mm



**Fig. 3.** Diagnostic character in forewing venation: a – ratio of the length of forewing (Lw) and C+SC+R vein length (Lc); b – comparison of forewing of *Lipolexis gracilis* (grey color) and *Binodoxys acalephae* (black color).

Table 2

Average ratio of the whole length of forewing (Lw) to C+SC+R vein length (Lc)

Species	Lw/Lc ratio
<i>Lipolexis gracilis</i>	2.55
<i>Binodoxys acalephae</i>	2.26
<i>Trioxys pallidus</i>	2.32
<i>Adialytus salicaphis</i>	2.32
<i>Diaeretiella rapae</i>	2.38
<i>Diaeretus leucopterus</i>	2.37

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