

## Bulgarian Eupelmidae (Hymenoptera: Chalcidoidea): new records, phenology and habitat data

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**Abstract.** Thirty-nine species of Eupelmidae belonging to seven genera and three subfamilies are listed. Ten of them are new for the fauna of Bulgaria and three for the Balkan Peninsula. New hosts and plant associates are established. Phenology of 37 species is studied. The highest imaginal activity is recorded in late spring (May), summer (June, July, August) and early autumn (September), and the highest variety of species is established during the three summer months, especially in August. The longest imaginal activity among the genera is observed in *Eupelmus* (seven months) and *Anastatus* (six months). The studied species are divided into six phenological groups and among them the summer phenological group is the most numerous. As a result of this study, 20 species (51.2 % of the total number) are found in a habitat of type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*). About 77% (30 species) of the species are recorded only in the oak zone.

**Key words:** Eupelmidae, Bulgaria, Balkan Peninsula, faunistic data, new hosts and plant associates.

### Introduction

Eupelmidae Walker, 1833 (Hymenoptera: Chalcidoidea) is a worldwide distributed family (Fusu et al. 2015, Kissayi & Benhalima 2017), with the highest variety of species in tropical regions (Kalina 1984, Gibson 1995, Fusu 2009, Kissayi & Benhalima 2017). In the world fauna, the family is represented with more than 1000 recognized species (Noyes 2018) classified in 43 extant genera and three subfamilies (Gibson 1989, 2017, 2018).

Calosotinae Bouček, 1958 comprises eight genera (Gibson 1989) whose species preferentially parasitize xylophagous beetles, although some *Calosota* Curtis species are also primary or hyperparasitoids of insects in grass stems (Gibson 1989, 1997, 2010).

Neanastatinae Kalina, 1984 includes four extant genera (Gibson 1989, 2009, 2013), with at least three of them having quite varied host ranges, including coleopterans, dipterans and crickets (Gibson 2009, 2013).

Eupelminae Walker, 1833 is composed of 31 genera (Gibson 2017, 2018) and is the most diverse of the three subfamilies of Eupelmidae. The spectrum of hosts of Eupelminae is extremely varied, including eggs of spiders and preimaginal stages (eggs, larvae, pupae) of many insects belonging to various orders (Gibson 1995, 1997).

Eupelmidae is distributed throughout Europe, with the highest number of species in Spain – 67, followed by France with 52, Italy – 49 and Hungary – 43 (Noyes 2018).

Eupelmidae is poorly studied on the Balkan Peninsula. In the works of Argyriou & Marakis (1973), Bouček (1977), Kalina (1988), Tsankov et al. (1999), Marković & Stojanović (2003), Askew et al. (2006, 2013), Gibson (2011), Fusu (2013, 2017), Al khatib et al. (2014), Boyadzhiev et al. (2015), Gibson & Fusu (2016), Fusu et al. (2018), etc. are reported a total of: 40 species for Croatia, 26 for Greece, 17 for Serbia, 9 for Montenegro, 5 for Macedonia, 5 for Bosnia and Herzegovina, 3 for Slovenia and 1 for Albania.

So far for the fauna of Bulgaria, 37 species are reported (Donev 1986, Harizanova 1997, Antov & Stojanova 2015, Gibson & Fusu 2016, Fusu 2017), but two of them (*Eupelmus* (*Macroneura*) *maculatus* (Fèrrière, 1954) and *E. (Macroneura)*

*muellneri* Ruschka, 1921) are possibly the result of misidentifications (Fusu 2017).

Little is known about the phenology and habitats of the eupelmid wasps due to the absence of extensive investigations. Faunistic data that can be used for phenological analysis were previously given by Bouček (1967), Angelov (1970), Pélov (1975), Kalina (1981a), Donev (1986), Antov & Stojanova (2015), Gibson & Fusu (2016), Fusu (2017), and Stojanova & Antov (2018).

The aim of this paper is to present new faunistic data and information on the phenology and habitat of the eupelmid wasps in Bulgaria.

### Material and methods

The material for this study was collected during the period 1996-2016 in different regions of Bulgaria and includes 883 specimens from over 150 locations. The altitude of the locations ranged from 2 m (Black Sea Coast: NW of Lozenets Vill.) to 2500 m (Rila Mts: below Kovach Peak).

Imagoes were collected mainly by sweeping in grasslands, and setting up Malaise and Moericke traps. Trophic relationships between eupelmid and their hosts were established by collecting galls, seeds and other plant material. These were put in plastic boxes until the imagoes emerged. Imagoes were fixed in ethyl alcohol and studied later in the laboratory.

Identification of the species was based on the keys by Nikolskaya (1952), Bouček (1967), Kalina (1981b, 1988), Gibson (1995, 2010, 2011, 2017), Askew & Nieves-Aldrey (2000, 2004, 2006), Gibson & Fusu (2016) and Fusu (2017).

The list of species established in this study includes the following data: the valid taxon name; published data for Bulgaria; examined material with locations, altitudes, date, number and sex of the specimens; the name of the host (in case of rearing); the method of collection if different from sweeping, and the name of the collector (if different from the authors). For the species which are not determined by the authors, the name of the specialist who had identified them is indicated. Comments on biology are given for the reared species. New species records for Bulgaria are marked with an asterisk (\*) in the faunistic list and new species for the Balkan Peninsula with double asterisk (\*\*). The insects are preserved as card-mounted specimens in the authors' collection (University of Plovdiv).

*Eupelmus* (*Eupelmus*) *weilli* Fusu & Gibson, 2016 was photographed under an Olympus SZ51 stereo microscope supplied with a

Canon PowerShot SD990 IS digital camera and with an insect manipulator (Boyadzhiev et al. 2012). The photo was processed by Zerene Stacker software and subsequently edited by manually combining, adjusting and cleaning in Adobe Photoshop.

For the analysis of eupelmids distribution in plant zones in Bulgaria, Velchev et al. (1982) is followed with modifications. In this study the xerothermic oak forests, along with mesophilic and xeromesophilic oak-hornbeam forests are combined in an oak zone and the subalpine and alpine vegetation in an alpine zone.

The investigation of the seasonal dynamics is based on the records of species present during the different months.

The identification of habitats was done following Tzonev & Gussev (2013).

## Results

### Faunistic list

#### Subfamily CALOSOTINAE Bouček, 1958

##### *Calosota* Curtis, 1836

###### \**Calosota acron* (Walker, 1848)

Material examined. Strandzha Mts: Vitanovo Reserve, 540 m, 30.VIII.2000, 1 ♀, Malaise trap (S. Petrov).

Comments: This is the first record from Bulgaria.

###### \**Calosota aestivalis* Curtis, 1836

Material examined. Strandzha Mts: Ropotamo River, 35 m, 12.V.1971, 1 ♀ (P. Angelov), (Det. G. A. P. Gibson, 2013).

Comments: This is the first record from Bulgaria.

###### \**Calosota dusmeti* Bolivar y Pieltain, 1929

Material examined. Belasitsa Mts: Belasitsa Hut, 693 m, 27.VI-05.VII.2002, 1 ♀, Malaise trap (O. Todorov). Stara Planina Mts: Arbanasi Vill., 417 m, 01.VIII.2015, 1 ♀.

Comments: This is the first record from Bulgaria.

##### *Calosota grylli* Erdős, 1955

*Calosota grylli*: Donev (1986), Gibson (2010).

Material examined. Black Sea Coast: Sinemorets Vill., Silistar Protected Area, 28 m, 13.VI.2015, 5 ♀, 2 ♂. Danubian Plain: Koshov Vill., 135 m, 28.VII.2015, 3 ♀; Cherven Vill., 154 m, 29.VII.2015, 1 ♀. Rhodope Mts: the Valley of the Arda River, NE of Madzharovo, 160 m, 28.V-08.VI.2001, 1 ♀, Malaise trap (H. Etarska); Besaparski Hills, Byaga Vill., 350 m, 16.VI.2002, 1 ♀; Novakovo Vill., 484 m, 31.V.2015, 1 ♀; Popovets Vill., 374 m, 02.VI.2015, 1 ♀; Dabovets Vill., 183 m, 03.VI.2015, 1 ♀; Odrintsi Vill., 241 m, 04.VI.2015, 3 ♀; 5 km S of Ivaylovgrad, 200 m, 04.VI.2015, 2 ♀, 3 ♂; Ivaylovgrad, 2 km N of Odrintsi Vill., 241 m, 04.VI.2015, 1 ♀. Sakar Mts: Topolovgrad, 314 m, 18.VIII.2015, 15 ♀, 3 ♂; 382 m, 19.VIII.2015, 4 ♀. Sredna Gora Mts: Verinsko Vill., 770 m, 27.VIII.2015, 4 ♀, 1 ♂. Stara Planina Mts: Troyan, Turlata loc., 540 m, 09.VII.2015, 1 ♂; Veliko Tarnovo, Kartala loc., 347 m, 31.VII.2015, 3 ♀, 2 ♂. Strandzha Mts: Golyamo Krushevo Vill., 312 m, 09.VI.1988, 1 ♂ (A. Donev); Izgrev Vill., 134 m, 22.VI.2002, 2 ♀. Vitosha Mts: Vladaya Vill., 853 m, 14.VIII.2014, 1 ♀.

##### *Calosota metallica* (Gahan, 1922)

*Calosota metallica*: Gibson (2010), Antov & Stojanova (2015).

Material examined. Black Sea Coast: Sinemorets Vill., Silistar Protected Area, 28 m, 13.VI.2015, 1 ♀. Danubian Plain: Shumen Fortress, 443 m, 11.VIII.2015, 13 ♀, 1 ♂. Rhodope Mts: 5 km S of Ivaylovgrad, 200 m, 04.VI.2015, 2 ♀; Ivaylovgrad, 3 km N of Mandritsa Vill., 68 m, 04.VI.2015, 1 ♀. Sakar Mts: Topolovgrad, 314 m, 18.VIII.2015, 1 ♀; 382 m, 19.VIII.2015, 2 ♀. Stara Planina Mts: Arbanasi Vill., 417 m, 01.VIII.2015, 1 ♀. Strandzha Mts: Izgrev Vill., 134 m, 22.VI.2002, 1 ♀ (Det. G. A. P. Gibson, 2013). Vlahina Planina Mts: above St. Yoan Rilski Monastery, 1150 m, 20.VI.2005, 1 ♀ (O. Todorov).

###### \**Calosota obscura* Ruschka, 1921

Material examined. Rhodope Mts: Sini Vrah Hut, 1050 m, 18.II.2001, 4 ♀ emerged from stems of *Verbascum* sp.

Comments: We reared *C. obscura* from stems of *Verbascum* sp. (Scrophulariaceae) along with curculionid beetles (new plant associate) and suppose that the species develop as parasitoid of beetle larvae. This is the first record from Bulgaria. The real hosts of this species remain undetermined because it is frequently reared from the stems of herbaceous plants inhabited by larvae of Coleoptera and gall wasps (Askew & Nieves-Aldrey 2006).

##### *Eusandalum* Ratzeburg, 1852

###### *Eusandalum walkeri* (Curtis, 1836)

*Eusandalum walkeri*: Bouček (1967).

Material examined. Danubian Plain: Tabachka Vill., the Valley of Cherni Lom River, 110 m, 27.VII-10.VIII.2004, 1 ♀, Malaise trap (T. Ivanova). Vitosha Mts: Sofia, Slatina loc., 430 m, 04-11.VIII.2003, 1 ♀, Blue Moericke trap (T. Ljubomirov).

#### Subfamily EUPELMINAE Walker, 1833

##### *Anastatus* Motschulsky, 1859

###### \*\**Anastatus bernardi* Ferrière, 1954

Material examined. Black Sea Coast: NW of Lozenets Vill., 2 m, 26.VIII.2004, 1 ♀ (T. Ljubomirov) (Det. G. A. P. Gibson, 2013).

Comments: This is the first record from Bulgaria and the Balkan Peninsula.

##### *Anastatus bifasciatus* (Geoffroy, 1785)

*Anastatus bifasciatus*: Zanati (1978), Tsankov (1981, 1990), Tsankov & Mirchev (1983), Zacharieva (1983), Vidal (1993), Tsankov et al. (1996a, b, 1997, 1998a, b), Zaharieva-Pentcheva & Georgiev (1997), Mirchev et al. (1998a, b, 2003, 2012, 2014a, b), Stojanova & Antov (2018).

Material examined. Black Sea Coast: Ahtopol, 25 m, 21.VII.1968, 1 ♀ (P. Angelov); Tsarevo, 10 m, 02.VI.1997, 1 ♀. Rhodope Mts: Novakovo Vill., 480 m, 08.VII.1968, 1 ♀ (A. Germanov). Stara Planina Mts: Gabrovo, Sokolski Monastery, 672 m, 24.X.2004, 1 ♀ (O. Todorov). Strandzha Mts: Golyamo Bukovo Vill., 231 m, 02.VI.1968, 1 ♀ (P. Angelov), (Det.

G. A. P. Gibson, 2013); Ropotamo River, 35 m, 01.VIII.2013, 1 ♀, Malaise trap (S. Petrov).

***Anastatus catalonicus*** Bolivar y Pieltain, 1935

*Anastatus catalonicus*: Pélov (1975).

Material examined. Danubian Plain: Granichar Vill., 40 m, 20.V-11.VI.2011, 6 ♀, Malaise trap (N. Karaivanov). Stara Planina Mts: NE of Veliko Tarnovo, 385 m, 29.V-27.VI.2011, 2 ♀, Malaise trap (E. Sarov). Strandzha Mts: Ropotamo River, 35 m, 15.VIII.2012, 2 ♀, Malaise trap (S. Petrov).

***Anastatus japonicus*** Ashmead, 1904

*Anastatus disparis*: Tchorbadjiev (1928), Tschorbadjiev (1928), Thompson (1955), Stefanov et al. (1958), Stefanov (1959), Stefanov & Keremedziev (1961), Keremidchiev (1965), Keremidchiev & Ganchev (1971), Keremidchiev & Gantshev (1973), Michev (1974), Herting (1976), Gantshev et al. (1980). *Anastatus japonicus*: Antov & Stojanova (2015).

Material examined. Strandzha Mts: Ropotamo River, 35 m, 01.VII.2012, 1 ♀, Malaise trap (S. Petrov); 01.IX.2012, 30 ♀, Malaise trap (S. Petrov); 26.VI.2013, 1 ♀, Malaise trap (S. Petrov); 01.VIII.2013, 7 ♀, Malaise trap (S. Petrov); 02.VIII.2013, 1 ♀, Malaise trap (S. Petrov); Veleka River, 38 m, 15.VIII.2012, 1 ♀, Malaise trap (S. Petrov); 01.VIII.2013, 1 ♀, Malaise trap (S. Petrov).

**\*\**Anastatus oscar*** (Ruthe, 1859)

Material examined. Osogovo Mts: Granitsa Vill., 800 m, 20.IX.2009, 5 ♀.

Comments: This is the first record from Bulgaria and the Balkan Peninsula.

***Calymmochilus Masi***, 1919

***Calymmochilus dispar*** Bouček & Andriescu, 1967

*Calymmochilus dispar*: Bouček & Andriescu (1967), Bouček (1977), Trjapitzin (1978), Stojanova & Antov (2018).

Material examined. Danubian Plain: Shumen Plateau Nature Park, 480 m, 12.VIII.2015, 1 ♀. Rhodope Mts: Besaparski Hills, SW of Novo Selo Vill., 350 m, 28.V.2000, 1 ♂; 2 km SW of Novo Selo Vill., 380 m, 16.VI.2002, 1 ♂.

***Eupelmus Dalman***, 1820

***E. (Episolindelia) australiensis*** (Girault, 1913)

*Eupelmus zangherii*: Bouček (1965). *Eupelmus australiensis*: Antov & Stojanova (2015).

Material examined. Danubian Plain: Shumen Fortress, 443 m, 11.VIII.2015, 1 ♀. Rhodope Mts: Izgrev Hut, 1800 m, 04.VIII.1985, 1 ♀ (S. Petrov); Byala Cherkva Hut, 1650 m, 26.VI.1996, 3 ♀; 17.VIII.1996, 1 ♀ (Det. G. A. P. Gibson, 2013); Zagrazhden Vill., 1000 m, 02.VII.1996, 18 ♀; Zagrazhden Vill., Karakulas (to Kriva chuka), 1380 m, 08.VII.1996, 31 ♀; Krichim, 350 m, 23.VI.1997, 1 ♀; Snezhanka Peak, 1925 m, 21.VII.1999, 5 ♀; Pamporovo, below Studenets Hut, 1700 m, 21.VII.1999, 2 ♀; Smolyanski Ezera Hut, 1500 m, 21.VII.1999, 10 ♀; Pamporovo, 1550 m, 22.VII.1999, 3 ♀; Besaparski Hills, SW of Novo Selo Vill., 350 m, 24.V.2000, 1 ♀; 5 km S of Novo Selo Vill., 300 m, 27.VI.2010, 2 ♀; Shiroka Polyana Dam, 1600 m, 28.VII.2000, 1 ♀; Stoykite Vill., 1300 m, 29.VII.2000, 1 ♀;

Sedlovina Vill., 248 m, 02.VI.2015, 1 ♀; Ivaylovgrad, 3 km N of Mandritsa Vill., 68 m, 04.VI.2015, 1 ♀. Rila Mts: Marichin Tsirkus, 2400 m, 01.VIII.1998, 1 ♀; below Kovach Peak, 2500 m, 02.VIII.1998, 18 ♀; Kobilino Branishte, 2145 m, 03.VIII.1998, 9 ♀; below Sredonos Peak, 1800 m, 04.VIII.1998, 2 ♀. Sredna Gora Mts: Panagyurishte, Opticoelectron Plant, 621 m, 25.IX.2014, 1 ♀. Stara Planina Mts: Ribaritsa Vill., 641 m, 06.VII.2015, 2 ♀; Troyan, Chavdar Stadium, 441 m, 08.VII.2015, 1 ♀; Troyan, Turlata loc., 540 m, 09.VII.2015, 1 ♀; Arbanasi Vill., 417 m, 01.VIII.2015, 1 ♀; Chernovrah Vill., 561 m, 02.VIII.2015, 10 ♀. Strandzha Mts: 2 km SW of Izgrev Vill., 150 m, 07.VII.2000, 3 ♀; Izgrev Vill., 134 m, 23.VI.2003, 1 ♀.

***E. (Episolindelia) cicadae*** Giraud, 1872

*Eupelmus cicadae*: Antov & Stojanova (2015).

Material examined. Strandzha Mts: Gramatikovo Vill., 284 m, 28.VI.1988, 1 ♀ (A. Donev); 2 km SW of Izgrev Vill., 150 m, 07.VII.2000, 1 ♀; Izgrev Vill., 134 m, 22.VI.2002, 1 ♀.

**\**E. (Episolindelia) fuscipennis*** Förster, 1860

Material examined. Belasitsa Mts: Belasitsa Hut, 693 m, 27.VI-05.VII.2002, 1 ♀, Malaise trap (O. Todorov). Strandzha Mts: Ropotamo River, 35 m, 26.VI.2013, 1 ♀, Malaise trap (S. Petrov).

Comments: This is the first record from Bulgaria.

***E. (Episolindelia) linearis*** Förster, 1860

*Eupelmus linearis*: Antov & Stojanova (2015).

Material examined. Danubian Plain: Shumen Fortress, 443 m, 11.VIII.2015, 1 ♀. Pirin Mts: the Valley of Mesta River, 10 km after Dobrinishte, 860 m, 21.IX.2004, 1 ♀ (S. Petrov). Rhodope Mts: Hrabrino Vill., 550 m, 07.VII.1985, 1 ♀ (S. Petrov); Besaparski Hills, Byaga Vill., 350 m, 16.VI.2002, 4 ♀; 3 km N of Isparihovo Vill., 300 m, 12.VIII.2010, 1 ♀; Daskalovo Vill., 550 m, 19.VI.2002, 1 ♀ (P. Boyadzhiev); Popovets Vill., 374 m, 02.VI.2015, 1 ♀; 5 km S of Ivaylovgrad, 200 m, 04.VI.2015, 1 ♀. Sredna Gora Mts: Verinsko Vill., 770 m, 27.VIII.2015, 1 ♀. Stara Planina Mts: Veliko Tarnovo, Kartala loc., 347 m, 31.VII.2015, 5 ♀. Strandzha Mts: Kosti Vill., 68 m, 07.VII.2000, 1 ♀; Izgrev Vill., 134 m, 23.VI.2003, 1 ♀. Thracian Lowland: Chirpan, 168 m, VII.1967, 1 ♀ (A. Germanov).

***E. (Eupelmus) annulatus*** Nees, 1834

*Eupelmus annulatus*: Tsankov et al. (1991), Melika et al. (2002), Antov & Stojanova (2015), Gibson & Fusu (2016).

Material examined. Maleshevska Planina Mts: S of Krupnik Vill., 1460 m, 15.VIII.2003, 1 ♀ (T. Ljubomirov). Rhodope Mts: Daskalovo Vill., 550 m, 06.X.1996 coll. galls, 1 ♀ em. from *Andricus quercustozae* (Bosc) (Cynipidae) galls in X-XI.1996. Strandzha Mts: Ropotamo River, 35 m, 01.IX.2012, 1 ♀, Malaise trap (S. Petrov).

Comments: *Eupelmus annulatus* was previously reared from *A. quercustozae* galls on *Quercus* sp. (Fagaceae) (Antov & Stojanova 2015) which corresponds to the results of the present study. In Bulgaria *E. annulatus* is reported for the first time as a parasitoid of *Hexomyza schineri* (Giraud) (Diptera: Agromyzidae) (Tsankov et al. 1991). A primary parasitoid of Curculionidae, Cynipidae, Diprionidae, Psychidae and Tortricidae, and sometimes a hyperparasitoid via Braconidae and Ichneumonidae (Gibson & Fusu 2016).

**E. (*Eupelmus*) *atropurpureus*** Dalman, 1820

*Eupelmus atropurpureus*: Angelov (1970), Antov & Stojanova (2015), Gibson & Fusu (2016).

Material examined. Danubian Plain: Koshov Vill., 135 m, 28.VII.2015, 1 ♀; Cherven Vill., 154 m, 29.VII.2015, 1 ♀; Shumen Fortress, 443 m, 11.VIII.2015, 3 ♀. Osogovo Mts: Eremia Vill., 620 m, 04.IX.2015, 1 ♀. Pirin Mts: 2 km NW of Hadzhidimovo, 700 m, 08.IX.2006, 1 ♀ (Det. G. A. P. Gibson, 2015). Rhodope Mts: Besaparski Hills, 2 km SW of Novo Selo Vill., 380 m, 16.VI.2002, 1 ♀; Byaga Vill., 350 m, 16.VI.2002, 2 ♀. Sredna Gora Mts: Panagyurishte, Opticoelectron Plant, 621 m, 25.IX.2014, 1 ♀. Stara Planina Mts: Arbanasi Vill., 417 m, 01.VIII.2015, 1 ♀; Chernovrah Vill., 561 m, 02.VIII.2015, 1 ♀.

**E. (*Eupelmus*) *azureus*** Ratzeburg, 1844

*Eupelmus annulatus*: Stojanova (2006). *Eupelmus spongipartus*: Askew et al. (2013). *Eupelmus azureus*: Antov & Stojanova (2015), Gibson & Fusu (2016), Stojanova & Antov (2018).

Material examined. Black Sea Coast: Silistar Protected Area, 22 m, 01.X.2008, 1 ♀ em. from *Andricus lucidus* (Hartig) galls; 1 ♀ em. from *Andricus kollari* (Hartig) galls on *Quercus* sp. Kazanlak Hollow: Tulovo Vill., 326 m, 22.XI.2001, 7 ♀, 2 ♂ em. from *Andricus quercuscalicis* (Burgsdorff) galls on *Quercus* sp. Osogovo Mts: Granitsa Vill., 559 m, 13.IV.2015 coll. galls, 3 ♀ em. from *Diplolepis rosae* (L.) galls on *Rosa* sp. on 24.IV.2015; 04.III.2016, 1 ♀ em. from *D. rosae* galls on *Rosa* sp.; Eremia Vill., 620 m, 05.III.2016 coll. galls, 1 ♀ em. from *D. rosae* galls on *Rosa* sp. on 22.III.2016. Rhodope Mts: Daskalovo Vill., 550 m, 06.X.1996, 1 ♀ em. from *Andricus caputmedusae* (Hartig) galls on *Quercus* sp.; Momina salza Hut, 500 m, 15.II.1997, 5 ♀; Boykovo Vill., 1100 m, 06.II.2000, 1 ♀ em. from Cynipidae galls on *Quercus* sp.; Topolovo Vill., 450 m, 07.III.2000, 4 ♀, 2 ♂ em. from Cynipidae galls on *Quercus* sp. Sakar Mts: Cherepovo Vill., 498 m, 29.IX.2008, 2 ♀ em. from *Andricus coriarius* (Hartig) galls on *Quercus* sp. Sredna Gora Mts: Moruley Hut, 590 m, 26.I.1997, 1 ♀; Varben Vill., 460 m, 17.XI.1998, 5 ♀ em. from *A. quercuscalicis* galls; 15.IV.1999, 1 ♀, 4 ♂ em. from *A. quercuscalicis* galls (Det. G. A. P. Gibson, 2015); 25.III.2000, 1 ♀ em. from *A. caputmedusae* galls; 20 ♀, 15 ♂ em. from *A. quercuscalicis* galls on *Quercus* sp. Strandzha Mts: Veleka River, 38 m, 07.VI.1999, 3 ♀ em. from *Biorhiza pallida* (Olivier) galls on *Quercus* sp.; 5 km NE of Bolyarovo Vill., 192 m, 01.X.2002, 1 ♀ em. from *A. caputmedusae* galls on *Quercus* sp.

**Comments:** We reared *E. azureus* from *A. caputmedusae*, *A. coriarius*, *A. kollari*, *A. lucidus*, *A. quercuscalicis*, *B. pallida* galls on *Quercus* sp., *D. rosae* galls on *Rosa* sp., and from unidentified Cynipidae galls on *Quercus* sp. All established host records confirm that *E. azureus* is a parasitoid in cynipid galls more frequently on *Quercus* than on *Rosa*. In Bulgaria this species (as *E. annulatus*) is reared from *Andricus lignicolus* (Hartig) and *Cynips quercusfolii* L. (Cynipidae) galls (Stojanova 2006). Later *E. azureus* (as *E. spongipartus*) was associated with *A. kollari* (asexual) galls on *Quercus robur* L., *Andricus solitarius* (Fonscolombe) (asexual) galls on *Quercus petraea* (Matt.) Liebl. and *Andricus tomentosus* (Trotter) (asexual) (Cynipidae) galls (Askew et al. 2013). Furthermore, it emerged also from *A. caputmedusae*, *A. lucidus*, *A. quercustozae* and *B. pallida* galls on *Quercus* sp. (Antov & Stojanova 2015). A parasitoid in Cynipidae (Hymenoptera) galls main-

ly on *Quercus* and less often on *Rosa* and *Castanea* (Gibson & Fusu 2016).

**E. (*Eupelmus*) *confusus*** Al khatib, 2015

*Eupelmus confusus*: Al khatib et al. (2014), Gibson & Fusu (2016), Stojanova & Antov (2018).

Material examined. Belasitsa Mts: Belasitsa Hut, 693 m, 27.VI-05.VII.2002, 1 ♀, Malaise trap (O. Todorov). Danubian Plain: Ruse, Sever railway station, 20 m, 13.IX.2010, 1 ♀ em. from *Robinia pseudoacacia* L. pods (T. Ljubomirov). Maleshevska Planina Mts: Gorna Breznitsa Vill., 510 m, 17.IV.2003, 8 ♀ em. from Cynipidae galls on *Rosa* sp. Pirin Mts: Sandanski, 283 m, 04.IX.2010, 1 ♀. Rhodope Mts: Asen's Fortress, 350 m, 20.IV.1997, 2 ♀ em. from *Colutea arborescens* L. fruits. Sredna Gora Mts: Banya Vill., 400 m, 01.I.2006, 2 ♀ em. from Cynipidae galls on *Rosa* sp.; Verinsko Vill., 770 m, 22.II.2016 coll. galls, 1 ♀ em. from *D. rosae* galls on *Rosa* sp. on 07.III.2016. Strandzha Mts: to Izgrev Vill., 123 m, 03.VI.1996, 1 ♀.

**Comments:** We reared *E. confusus* from fruits of *C. arborescens* (Fabaceae), unidentified Cynipidae galls on *Rosa* sp., *D. rosae* galls on *Rosa* sp. and pods of *R. pseudoacacia*. The association with *C. arborescens* is newly recorded. In Bulgaria this species emerged from *Acer campestre* L. (Aceraceae), *Althaea* sp. (Malvaceae), seeds of *Amorpha fruticosa* L. and *Amorpha* sp. (Fabaceae), Asteraceae inflorescences, *Aylax hypaei* (Trotter) (Hymenoptera: Cynipidae) galls on *Hypocoum imberbe* Sibth. & Sm. (Papaveraceae), *Centaurea* sp. (Asteraceae), seeds of *Cuscuta monogyna* Vahl (Convolvulaceae) and pods of *R. pseudoacacia* L. (Fabaceae) (Stojanova & Antov 2018). This species attacks a wide variety of insect hosts belonging to Diptera, Hymenoptera and Lepidoptera (Al khatib et al. 2014, Gibson & Fusu 2016).

**E. (*Eupelmus*) *kiefferi*** De Stefani, 1898

*Eupelmus kiefferi*: Gibson & Fusu (2016).

Material examined: Belasitsa Mts: near Petrichka River, 96 m, 20.VII-23.X.2002, 2 ♀, Malaise trap (O. Todorov). Black Sea Coast: Varna-Burgas, 150 m, 25.IV.1973, 1 ♀ em. from *A. lignicolus* galls on *Quercus* sp. on 05.VII.1973 (L. Vassileva) (Det. G. A. P. Gibson, 2015). Rhodope Mts: Topolovo Vill., 450 m, 07.III.2000, 1 ♀ em. from Cynipidae galls on *Quercus* sp. Sredna Gora Mts: Panagyurishte, 610 m, 17.IV.1999, 1 ♀ em. from Cynipidae galls on *Rosa* sp. Strandzha Mts: Veleka River, 38 m, 01.VIII.2013, 1 ♀, Malaise trap (S. Petrov). Vitosha Mts: Kladnitsa Vill., 1006 m, 05.XI.2011, 1 ♀ em. from *D. rosae* galls on *Rosa corymbifera* Borkh. on 06.XII.2011 (I. Todorov) (Det. G. A. P. Gibson, 2015); Marchaevo Vill., 917 m, 20.III.2016 coll. galls, 2 ♀ em. from *D. rosae* galls on *Rosa* sp. on 31.III.2016.

**Comments:** We saw and reared specimens from *A. lignicolus* galls on *Quercus* sp., Cynipidae galls on *Quercus* sp. and *Rosa* sp., and *D. rosae* galls on *R. corymbifera* and *Rosa* sp. Hosts of this parasitoid include a wide range of insects belonging to the orders Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera (Gibson & Fusu 2016).

**E. (*Eupelmus*) *lanceolatus*** Gibson & Fusu, 2016

*Eupelmus lanceolatus*: Gibson & Fusu (2016).

Material examined. Black Sea Coast: Ahtopol, 25 m, 01-15.VIII.2004, 1 ♀, Malaise trap (O. Todorov). Strandzha Mts:

Ribarnika, 311 m, 15.VIII.2012, 2 ♀, 1 ♂, Malaise trap (S. Petrov); Ropotamo River, 35 m, 01.IX.2012, 1 ♀, Malaise trap (S. Petrov).

\**E. (Eupelmus) matranus* Erdős, 1947

Material examined. Strandzha Mts: Ropotamo River, 35 m, 02.VIII.2013, 1 ♀, Malaise trap (S. Petrov). Thracian Lowland: Chirpan, 168 m, 11.V.1968, 1 ♀ (A. Germanov).

Comments: This is the first record from Bulgaria.

*E. (Eupelmus) microzonus* Förster, 1860

*Eupelmus microzonus*: Popov (1968), Nieves-Aldrey & Melika (2005), Stojanova (2005), Antov & Stojanova (2015), Antov et al. (2017a, b), Stojanova & Antov (2018).

Material examined. Black Sea Coast: Tsarevo, 10 m, 08.VI.2004, 1 ♀ em. from *Potentilla* sp.; 11.VI.2014, 1 ♀. Danubian Plain: Koshov Vill., 135 m, 28.VII.2015, 1 ♀; Cherven Vill., 154 m, 29.VII.2015, 2 ♀; Shumen Fortress, 443 m, 11.VIII.2015, 13 ♀; Shumen Plateau, 480 m, 12.VIII.2015, 2 ♀. Rhodope Mts: Krichim, 350 m, 23.VI.1997, 1 ♀; Besaparski Hills, from Isperihovo Vill. to Ognyanovo Vill., 330 m, 07.V.2000, 1 ♀; W of Kapitan Dimitriev Vill., 300 m, 01.VII.2000, 1 ♀; Byaga Vill., 350 m, 16.VI.2002, 1 ♀; Daskalovo Vill., 550 m, 19.VI.2002, 1 ♀ (P. Boyadzhiev); 15.IX.2004, 1 ♀ (P. Boyadzhiev). Sakar Mts: Topolovgrad, 314 m, 18.VIII.2015, 11 ♀; 382 m, 19.VIII.2015, 13 ♀. Sredna Gora Mts: Verinsko Vill., 743 m, 13.VIII.2014, 2 ♀; 770 m, 27.VIII.2015, 3 ♀; between Panagyurishte and Strelcha, 659 m, 24.IX.2014, 4 ♀; Panagyurishte, before the branch for Oborishte loc., 680 m, 25.IX.2014, 8 ♀; Panagyurishte, Opticoelectron Plant, 621 m, 25.IX.2014, 3 ♀. Stara Planina Mts: Veliko Tarnovo, Kartala loc., 347 m, 31.VII.2015, 4 ♀; 14.VII.2016, 3 ♀; Arbanasi Vill., 417 m, 15.VII.2016 coll. seeds, 2 ♀ em. from *Dianthus giganteus* d'Urv (Caryophyllaceae) seeds on 26.VII.2016, 4 ♀ em. on 02.VIII.2016. Strandzha Mts: to Izgrev Vill., 123 m, 03.VI.1996, 1 ♀; Kosti Vill., 68 m, 07.VII.2000, 1 ♀ (Det. G. A. P. Gibson, 2015); Vitanovo Reserve, 540 m, 17.VII.2000, 1 ♀, Malaise trap (S. Petrov). Vitosha Mts: Vladaya Vill., 853 m, 14.VIII.2014, 1 ♀.

Comments: We reared *E. microzonus* from *Potentilla* sp. and seeds of *D. giganteus*. In Bulgaria it is reported as a parasitoid on the larvae and pupae of *Eurytoma onobrychidis* Nikolskaya (Hymenoptera: Eurytomidae) and of some dipterans of the fruit trees, hymenopteran seed-eaters of the sainfoin and clover, wheat flies species and coleopterans (Popov 1968). Stojanova (2005), Nieves-Aldrey & Melika (2005), Antov & Stojanova (2015), Antov et al. (2017a) and Stojanova & Antov (2018) reared it from *A. hypaei* (Cynipidae) galls on *H. imberbe*. The species emerged also from seeds of *D. giganteus* (Antov & Stojanova 2015, Antov et al. 2017b) and from *Centaurea stoebe* L. and *Centaurea* sp. (Asteraceae) (Stojanova & Antov 2018). Polyphagous parasitoid whose hosts include various insects belonging to orders Coleoptera, Diptera, Hymenoptera and Lepidoptera (Lotfalizadeh & Hashemi 2015, Gibson & Fusu 2016, Noyes 2018).

\**E. (Eupelmus) pini* Taylor, 1927

Material examined. Belasitsa Mts: near Petrichka River, 96 m, 20.VII-23.X.2002, 1 ♀, Malaise trap (O. Todorov).

Comments: This is the first record from Bulgaria.

*E. (Eupelmus) urozonus* Dalman, 1820

*Eupelmus urozonus*: Popov (1968), Pélov (1975), Tsankov & Markova (1992), Vidal (1993), Tsankov et al. (1995), Georgiev & Pelov (1995, 1996), Markova (1997), Pelov (1999), Mirchev et al. (2001), Georgiev (2004), Georgiev et al. (2004), Stojanova (2006), Pelov et al. (2007), Tomov & Hristov (2007), Todorov et al. (2012), Askew et al. (2013), Antov & Stojanova (2015), Gibson & Fusu (2016), Antov et al. (2017a, b), Stojanova & Antov (2018).

Material examined. Belasitsa Mts: near Petrichka River, 96 m, 20.VII-23.X.2002, 1 ♀, Malaise trap (O. Todorov). Black Sea Coast: Ahtopol, 25 m, 14-18.VII.2002, 1 ♀, Malaise trap (O. Todorov). Maleshevska Planina Mts: Gorna Breznitsa Vill., N of Momina Skala, 910 m, 17.V.2003 coll. fruits, 1 ♀ em. from *Rosa* sp. fruits on 20.V.2003. Osogovo Mts: Granitsa Vill., 800 m, 12.IX.2009, 2 ♀; 559 m, 04.III.2016, 1 ♀ em. from *D. rosae* galls on *Rosa* sp.; Eremia Vill., 620 m, 05.III.2016 coll. galls, 1 ♀ em. from *D. rosae* galls on *Rosa* sp. on 18.III.2016. Rhodope Mts: Bratsigovo, 492 m, 01.V.1967, 1 ♀ (A. Germanov); Zagrazhden Vill., Karakulas (to Kriva chuka), 1380 m, 08.VII.1996, 3 ♀; Hrabrino Vill., 529 m, 06.II.2000, 2 ♀ em. from Cynipidae galls on *Rosa* sp.; 1 ♀ em. from *C. quercusfolii* galls on *Quercus* sp.; 1 ♀ em. from Cynipidae galls on *Quercus* sp.; Bachkovo Vill., 350 m, 12.X.2001, 3 ♀ em. from Cynipidae galls on *Rosa* sp.; Kuklen, 350 m, 23.X.2005, 1 ♀ em. from Cynipidae galls on *Rosa* sp.; Chervenata Stena Reserve, 700 m, 26.X.2005, 3 ♀ em. from Diptera galls on *Fagus* sp.; N of Smolyan, 1500 m, 25.XI.2007, 1 ♀ em. from *Andricus* sp. galls; Smolyan, 1100 m, 12.X.2011, 4 ♀ em. from galls on *Fagus* sp. Sredna Gora Mts: Moruley Hut, 590 m, 26.I.1997, 6 ♀ em. from Cynipidae galls on *Rosa* sp.; Varben Vill., 460 m, 17.XI.1998, 2 ♀ em. from *A. quercuscalicis* galls on *Quercus* sp.; 15.IV.1999, 2 ♀ em. from *A. quercuscalicis* galls on *Quercus* sp.; Verinsko Vill., 770 m, 22.II.2016 coll. galls, 4 ♀ em. from *D. rosae* galls on *Rosa* sp. on 07.III.2016. Vitosha Mts: Marchaevo Vill., 917 m, 20.III.2016 coll. galls, 4 ♀ em. from *D. rosae* galls on *Rosa* sp. on 29.III.2016.

Comments: We reared *E. urozonus* from *Andricus* sp., *A. quercuscalicis*, *C. quercusfolii* galls on *Quercus* sp., *D. rosae* galls on *Rosa* sp., Diptera galls on *Fagus* sp., unidentified Cynipidae galls on *Rosa* sp. and *Quercus* sp. and fruits of *Rosa* sp. Popov (1968) reported *E. urozonus* as an important parasitoid of *Apterona crenulella* (Bruand) (Lepidoptera: Psychidae) in Bulgaria. The species is ascertained on the larvae of some cynipid wasps, seed-eaters, tenthrinids, lepidopterans, flies and coleopterans (Popov 1968). Pélov (1975) indicated this species as a parasitoid of *B. pallida* (Cynipidae). Pelov (1999) reared it from seeds of *Betula pendula* Roth (Betulaceae) damaged by *Semudobia betulae* (Winnertz) (Diptera: Cecidomyiidae). Tsankov & Markova (1992), Tsankov et al. (1995) and Markova (1997) reared it from cocoons of *Stereonychus fraxini* (De Geer) (Coleoptera: Curculionidae). Georgiev & Pelov (1995, 1996) reported *E. urozonus* as a parasitoid of the larvae of *Phyllocnistis suffusella* (Zeller) (Lepidoptera: Gracillariidae). Mirchev et al. (2001) reported it as a parasitoid of the larvae and pupae of *Gelechia senticetella* (Staudinger) (Lepidoptera: Gelechiidae). Georgiev (2004) reared *E. urozonus* from larvae of *H. schineri* (Agromyzidae) collected on *Populus tremula* L. (Salicaceae) and Georgiev et al. (2004) reared it from *Saperda populnea* (L.) (Coleoptera:

Cerambycidae) galls on *P. tremula*. The species emerged from *A. lignicolus*, *A. lucidus* and *C. quercusfolii* galls (Stojanova 2006). Pelov et al. (2007) reared this species from seeds of spring barley damaged by *Oscinella frit* (L.) (Diptera: Chloropidae). Tomov & Hristov (2007) ascertained *E. urozonus* as a part of the parasitoid complex of *Cameraria ohridella* Deschka & Dimic (Lepidoptera: Gracillariidae) on *Aesculus hippocastanum* L. (Sapindaceae). Askew et al. (2013) associated it with *Cynips quercus* (Fourcroy) (asexual) on *Quercus frainetto* Ten. and *Neuroterus anthracinus* (Curtis) (asexual) on *Q. petraea*. Todorov et al. (2012), Antov & Stojanova (2015) and Antov et al. (2017a, b) recorded it from *D. rosae* (Cynipidae) galls on *Rosa* sp. A polyphagous species that develops as a parasitoid on a wide variety of insect hosts belonging to Coleoptera, Diptera, Hymenoptera, Lepidoptera and Neuroptera (Gibson & Fusu 2016). Some of the old host records from Bulgaria could be connected with other species in the *E. urozonus* species complex, because before Gibson (2011) and Al khatib et al. (2014), several *Eupelmus* species including *E. kiefferi* and *E. confusus* were identified as *E. urozonus*.

***E. (Eupelmus) vindex* Erdős, 1955**

*Eupelmus vindex*: Gibson & Fusu (2016).

Material examined. Derventski Heights: Srem Vill., 152 m, 07.VI.2004, 1 ♀ (O. Todorov). Sredna Gora Mts: Krasnovo Vill., 380 m, 21.V.1967, 1 ♀ (A. Germanov), (Det. G. A. P. Gibson, 2015); N of Zhelezare Vill., 276 m, 21.V.1968, 1 ♀ (A. Germanov). Thracian Lowland: Parvomay, 140 m, 20.IV.1967, 1 ♀ (A. Germanov), (Det. G. A. P. Gibson, 2015).

**\*\**E. (Eupelmus) weilli* Fusu & Gibson, 2016 (Figure 1)**

Material examined. Belasitsa Mts: Kongura Reserve, above Belasitsa Hut, 700-850 m, 29.VI-15.VII.2004, 1 ♀, Malaise trap (O. Todorov).

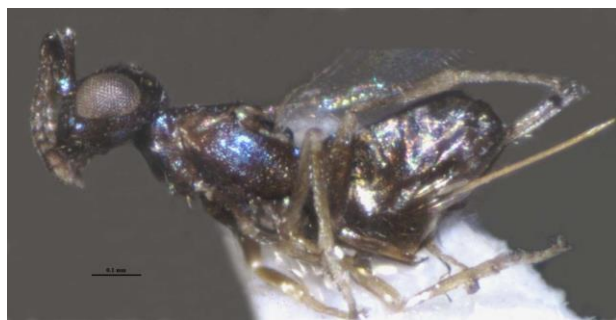


Figure 1. *Eupelmus weilli*, ♀. Lateral habitus.

**Comments:** This species was recently described only from two female specimens collected from Libya and Yemen which differ somewhat in morphological characters (Gibson & Fusu 2016). Our specimen is more similar to the Yemen female than the holotype from Libya, but some differences were found.

**Description.** The Bulgarian female has dark brown body and length 1.3 mm. The scrobal depression is shiny and smooth without meshlike sculpture. The prepectus and tegula are brown. The costal cell of the fore wing has only one row of setae. Mesotibia with row of three apical pegs; all tarsomeres with symmetrical pattern of pegs; mesobasitarsus with seven pegs on each side arranged into two rows in lat-

eral view, second tarsomere with six pegs, third tarsomere with four pegs, and fourth tarsomere with one minute peg on either side. Gaster without distinctly V-like shape of the syntergum. Hypopygium extending half of length of gaster. Ovipositor sheaths bicoloured, with very short dark brown basal and longer light brown apical region separated by pale region. The length of ovipositor sheaths =  $0.75 \times$  length of metatibia and  $0.66 \times$  length of marginal vein.

This is the first record from Bulgaria, the Balkan Peninsula and Europe.

***E. (Macroneura) aseculatus* (Kalina, 1981)**

*Macroneura aseculata*: Kalina (1981a). *Eupelmus aseculatus*: Antov & Stojanova (2015), Antov et al. (2017a), Fusu (2017), Stojanova & Antov (2018).

Material examined. Black Sea Coast: Ahtopol, 25 m, 01-15.VIII.2004, 1 ♀, Malaise trap (O. Todorov); Tsarevo, 64 m, 15.VI.2014, 1 ♀; Sinemorets Vill., Silistar Protected Area, 28 m, 13.VI.2015, 1 ♀. Rhodope Mts: Ivaylovgrad, 2 km N of Odrintsi Vill., 241 m, 04.VI.2015, 2 ♀; 3 km N of Mandritsa Vill., 68 m, 04.VI.2015, 1 ♀.

***E. (Macroneura) barai* Fusu, 2017**

*Eupelmus vesicularis*: Antov & Stojanova (2015), Antov et al. (2017b). *Eupelmus barai*: Fusu (2017).

Material examined. Black Sea Coast: Tsarevo, 10 m, 08.VI.2004, 1 ♀ em. from *Potentilla* sp. Danubian Plain: Koshov Vill., 135 m, 28.VII.2015, 2 ♀; Shumen Fortress, 443 m, 11.VIII.2015, 2 ♀. Osogovo Mts: Vrattsa Vill., Dervena loc., 959 m, 08.VII.2014, 4 ♀; Granitsa Vill., 559 m, 13.IV.2015 coll. galls, 1 ♀ em. from *D. rosae* galls on *Rosa* sp. on 22.IV.2015; 04.III.2016 coll. galls, 2 ♀ em. from *D. rosae* galls on *Rosa* sp. between 17-21.III.2016; Eremia Vill., 600 m, 04.IX.2015, 6 ♀ em. from *Astragalus glycyphyllos* L. pods; 620 m, 05.III.2016 coll. galls, 3 ♀ em. from *D. rosae* galls on *Rosa* sp. between 18-22.III.2016. Rhodope Mts: to Persenk Hut, 1700 m, 13.VIII.1996, 1 ♀; Besaparski Hills, SW of Novo Selo Vill., 350 m, 28.V.2000, 1 ♀; E of Glavinitsa Vill., 300 m, 01.VII.2000, 2 ♀, 3 ♂ em. from galls on *Euphorbia* sp.; above Kapitan Dimitriev Vill., 305 m, 16.VI.2002, 1 ♀; 2 km SW of Novo Selo Vill., 350 m, 16.VI.2002, 5 ♀; Byaga Vill., 350 m, 16.VI.2002, 3 ♀; Novakovo Vill., 484 m, 31.V.2015, 1 ♀; 3 km E of Kardzhali, 282 m, 02.VI.2015, 2 ♀; Popovets Vill., 374 m, 02.VI.2015, 1 ♀; 5 km N of Malki Voden Vill., 130 m, 03.VI.2015, 1 ♀; 2 km S of Ivaylovgrad, 211 m, 04.VI.2015, 1 ♀; Odrintsi Vill., 241 m, 04.VI.2015, 1 ♀. Sredna Gora Mts: Verinsko Vill., 743 m, 13.VIII.2014, 81 ♀; 770 m, 27.VIII.2015, 2 ♀; 770 m, 22.II.2016 coll. galls, 1 ♀ em. from *D. rosae* galls on *Rosa* sp. on 16.III.2016; between Panagyurishte and Strelcha, 659 m, 24.IX.2014, 1 ♀; Panagyurishte, before the branch for Oborishte loc., 680 m, 25.IX.2014, 5 ♀; Panagyurishte, Opticoelectron Plant, 621 m, 25.IX.2014, 2 ♀. Stara Planina Mts: above Gorni Stoevtsi Vill., Rata loc., 817 m, 22.VII.2014, 1 ♀; Vrachanski Balkan Nature Park, 709 m, 20.VIII.2014, 1 ♀; Darmantsi Vill., 312 m, 21.VIII.2014, 1 ♀; Troyan, Turlata loc., 540 m, 09.VII.2015, 1 ♀; Arbanasi Vill., 417 m, 01.VIII.2015 coll. galls, 3 ♀ (sweep net); 2 ♀ em. from *Lasioptera eryngii* (Vallot) galls on *Eryngium campestre* L. on 16.VIII.2015; 15.VII.2016 coll. seeds, 6 ♀ em. from *D. giganteus* seeds between 26.VII-02.VIII.2016; Veliko Tarnovo, Kartala loc., 347 m, 14.VII.2016, 2 ♀; Chernovrah Vill., 561 m, 02.VIII.2015, 2 ♀.

Strandzha Mts: Kosti Vill., 68 m, 26.VI.1986, 1 ♀ (A. Donev). Vitosha Mts: Marchaevo Vill., 918 m, 14.VIII.2014, 2 ♀; 917 m, 20.III.2016 coll. galls, 2 ♀ em. from *D. rosae* galls on *Rosa* sp. between 31.III-01.IV.2016; Vladaya Vill., 853 m, 14.VIII.2014, 1 ♀.

**Comments:** Plant associates with *A. glycyphyllos* (Fabaceae), *D. giganteus* (Caryophyllaceae), *Euphorbia* sp. (Euphorbiaceae) and *Potentilla* sp. (Rosaceae) and host associate with *D. rosae* (Cynipidae) are reported here for the first time. *E. barai* is reported for Bulgaria from galls on *Artemisia* (Asteraceae) and Cynipidae galls on *Rosa* sp. (Fusu 2017). It is a parasitoid with a very wide range of hosts: Curculionidae (Coleoptera), Cecidomyiidae and Tephritidae (Diptera), Cynipidae, Diprionidae and Eurytomidae (Hymenoptera), Coleophoridae, Millieridae, Tortricidae and Yponomeutidae (Lepidoptera) (Fusu 2017).

***E. (Macroneura) falcatus* (Nikolskaya, 1952)**

*Macroneura falcata*: Bouček (1966), Kalina (1981a). *Eupelmus falcatus*: Antov & Stojanova (2015), Fusu (2017).

Material examined. Black Sea Coast: Tsarevo, 10 m, 23.VI.2002, 1 ♀. Danubian Plain: Granichar Vill., 40 m, 20.V-11.VI.2011, 1 ♀, Malaise trap (N. Karaivanov); Koshov Vill., 135 m, 28.VII.2015, 3 ♀; Cherven Vill., 154 m, 29.VII.2015, 3 ♀; Shumen Fortress, 443 m, 11.VIII.2015, 30 ♀. Osogovo Mts: Eremia Vill., 620 m, 04.IX.2015, 1 ♀. Rhodope Mts: Besaparski Hills, Novo Selo Vill., 350 m, 16.VI.2002, 1 ♀; Byaga Vill., 350 m, 16.VI.2002, 1 ♀. Sakar Mts: Topolovgrad, 314 m, 18.VIII.2015, 1 ♀; 382 m, 19.VIII.2015, 4 ♀. Sredna Gora Mts: Verinsko Vill., 743 m, 13.VIII.2014, 1 ♀. Stara Planina Mts: Arbanasi Vill., 417 m, 01.VIII.2015, 4 ♀; Veliko Tarnovo, Kartala loc., 347 m, 14.VII.2016, 1 ♀; Dryanovo Monastery, 520 m, 03.VIII.2015, 1 ♀.

***E. (Macroneura) impennis* (Nikolskaya, 1952)**

*Eupelmus impennis*: Fusu (2017).

Material examined. Black Sea Coast: Sinemorets Vill., Silistar Protected Area, 28 m, 13.VI.2015, 1 ♀. Danubian Plain: Koshov Vill., 135 m, 28.VII.2015, 1 ♀. Rhodope Mts: Besaparski Hills, NE of Glavinitsa Vill., 300 m, 01.VII.2000, 1 ♀; NW of Kostilkovo Vill., 347 m, 24.IX.2012, 1 ♀ (O. Todorov); Novakovo Vill., 484 m, 31.V.2015, 1 ♀; 3 km E of Kardzhali, 282 m, 02.VI.2015, 1 ♀. Sredna Gora Mts: Krasnovo Vill., 21.V.1967, 1 ♀ (A. Germanov); Panagyurishte, before the branch for Oborishte loc., 680 m, 25.IX.2014, 1 ♀; Verinsko Vill., 770 m, 27.VIII.2015, 1 ♀. Stara Planina Mts: Chernovrah Vill., 561 m, 02.VIII.2015, 1 ♀. Strandzha Mts: Ropotamo River, 35 m, 26.VI.2013, 1 ♀, Malaise trap (S. Petrov).

***E. (Macroneura) messene* Walker, 1839**

*Eupelmus vesicularis*: Stojanova (2005), Antov & Stojanova (2015). *Eupelmus messene*: Fusu (2017), Stojanova & Antov (2018).

Material examined. Black Sea Coast: Primorsko, 12 m, 18.VIII.1983, 1 ♀ (A. Donev). Danubian Plain: Silistra, 58 m, 26.V.1996, 1 ♀; Shumen Fortress, 443 m, 11.VIII.2015, 2 ♀. Osogovo Mts: Vratitsa Vill., Dervena loc., 959 m, 08.VII.2014, 1 ♀; Eremia Vill., 600 m, 04.IX.2015, 2 ♀ em. from *A. glycyphyllos* pods; Granitsa Vill., 559 m, 04.III.2016 coll. galls, 3 ♀ em. from *D. rosae* galls on *Rosa* sp. between 17-21.III.2016. Rhodope Mts: Izvor Vill., 560 m, 26.IV.1968, 1 ♀ (A. Ger-

manov); Komuniga Vill., 664 m, 08.VII.1968, 1 ♀ (A. Germanov); Gornoslav Vill., 600 m, 11.VII.1968, 1 ♀ (A. Germanov); Huhla Vill., 200 m, 27.VI.2001, 2 ♀, em. from *Tragopogon* sp.; Ivaylovgrad, 3 km N of Mandritsa Vill., 68 m, 04.VI.2015, 1 ♀. Sredna Gora Mts: Strelcha, 500 m, 18.V.1967, 1 ♀ (A. Germanov); Gate of Trajan, 794 m, 10.IX.1968, 3 ♀ (A. Germanov). Stara Planina Mts: Yamna Vill., 800 m, 25.VII.1968, 1 ♀ (A. Germanov); Veliko Tarnovo, Kartala loc., 347 m, 31.VII.2015, 1 ♀. Strandzha Mts: Kosti Vill., 68 m, 26.VI.1986, 1 ♀ (A. Donev). Thracian Lowland: Parvomay, Byala Reka Vill., 155 m, 15.IX.1968, 1 ♀ (A. Germanov).

**Comments:** In addition to plant and host associates given by Fusu (2017), we indicate the following: pods of *A. glycyphyllos*, *Tragopogon* sp. and galls of *D. rosae*. *E. messene* is reported from *A. hypaei* (Cynipidae) galls on *H. imberbe* in Bulgaria (Fusu 2017). Fusu (2017) listed hosts of *E. messene*: Curculionidae (Coleoptera), Cecidomyiidae (Diptera), Braconidae, Cynipidae, Diprionidae and Eurytomidae (Hymenoptera), Tischeriidae, Tortricidae and Yponomeutidae (Lepidoptera).

***E. (Macroneura) rameli* Fusu, 2017**

*Eupelmus rameli*: Fusu (2017).

Material examined. Rhodope Mts: above Hrabrino Vill., 580 m, 10.I.1999, 1 ♀ em. from *Centaurea* sp.; Besaparski Hills, SW of Novo Selo Vill., 350 m, 18.VI.2000, 1 ♀; Velingrad, Kleptuza Protected Area, 780 m, 27.VII.2000, 2 ♀. Strandzha Mts: Izgrev Vill., 134 m, 23.VI.2003, 1 ♀.

**Comments:** The associate with *Centaurea* sp. (Asteraceae) is newly recorded. The hosts of this species are unknown (Fusu 2017).

***E. (Macroneura) vesicularis* (Retzius, 1783)**

*Eupelmella vesicularis*: Angelov (1970), Pélov (1975). *Macroneura vesicularis*: Tsankov et al. (1996a, b, 1997), Mirchev et al. (1998b), Pelov et al. (2007). *Eupelmus vesicularis*: Stojanova (2006), Todorov et al. (2012), Fusu (2017). The most of the records were likely based on *E. barai* and *E. messene* that prior to Fusu (2017) were included under *E. vesicularis*.

Material examined. Rhodope Mts: Velingrad, Kleptuza Protected Area, 780 m, 27.VII.2000, 1 ♀; Batak Dam, 1107 m, 27.VII.2000, 1 ♀; Yagodina Vill., 1100 m, 29.VII.2000, 1 ♀; Chudnite Mostove Hut, 1500 m, 20.VIII.2000, 2 ♀; Momchil Yunak Hut, 1750 m, 22.VIII.2000, 3 ♀. Stara Planina Mts: Troyan, Chavdar Stadium, 441 m, 08.VII.2015, 3 ♀.

***E. (Macroneura) vladimiri* Fusu, 2017**

*Macroneura impennis*: Kalina (1981a). *Eupelmus impennis*: Antov & Stojanova (2015). *Eupelmus vladimiri*: Fusu (2017), Stojanova & Antov (2018).

Material examined. Black Sea Coast: Primorsko, 12 m, 18.VIII.1983, 1 ♀ (A. Donev); Sinemorets Vill., 30 m, 06.VI.1988, 1 ♀ (A. Donev); Silistar Protected Area, 25 m, 16.X.2014 coll. galls, 1 ♀ em. from *A. lucidus* galls on *Quercus* sp. on 19.II.2015; Tsarevo, 10 m, 11.VI.2014, 1 ♀; 69 m, 15.VI.2014, 1 ♀. Rhodope Mts: Madzharovo, 245 m, 30.VII-15.VIII.2004, 1 ♀, Malaise trap (O. Todorov); NW of Kostilkovo Vill., 347 m, 24.IX.2012, 2 ♀ (O. Todorov); 3 km E of Kardzhali, 282 m, 02.VI.2015, 1 ♀. Sakar Mts: Topolovgrad, 382 m, 19.VIII.2015, 2 ♀. Strandzha Mts: Kosti Vill., 68 m, 24.VI.1986, 1 ♀ (A. Donev); Izgrev Vill., 134 m, 22.VI.2002, 1 ♀.

Table 1. Monthly activity of Eupelmidae in Bulgaria according to present study.

Genera	Month/Number of species											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
<i>Calosota</i>					2	3		2	4			
<i>Eusandalum</i>							1	1				
<i>Anastatus</i>					1	3	2	4	2	1		
<i>Calymmochilus</i>					1	1		1				
<i>Eupelmus</i>				2	9	16	18	17	15	3		
<i>Merostenus</i>				1		1	1	1				
<i>Metapelma</i>						1	1	1	1	1		
Total number of genera	0	0	0	2	4	6	6	7	3	3	0	0
Total number of species	0	0	0	3	13	25	25	29	18	5	0	0

Table 2. Comparative analysis of monthly activity based on data from present study and literature data derived from: 1 - Bouček (1967), 2 - Angelov (1970), 3 - Kalina (1981a), 4 - Antov &amp; Stojanova (2015), 5 - Fusu (2017).

Taxon	Literature data	Data of present study
<i>Calosota metallica</i> (Gahan, 1922)	VII, VIII <sup>4</sup>	VI, VIII
<i>Eusandalum walkeri</i> (Curtis, 1836)	VI <sup>1</sup>	VII, VIII
<i>Eupelmus (Eupelmus) atropurpureus</i> Dalman, 1820	IV <sup>2</sup> , VI <sup>4</sup> , VIII <sup>4</sup>	VI, VII, VIII, IX
<i>E. (Macroneura) aesculatus</i> (Kalina, 1981)	VI <sup>3,5</sup> , VII <sup>3</sup> , VIII <sup>5</sup>	VI, VIII
<i>E. (Macroneura) vesicularis</i> (Retzius, 1783)	IV <sup>2</sup> , V <sup>5</sup> , VI <sup>2</sup> , VII <sup>2</sup> , VIII <sup>5</sup>	VII, VIII
<i>E. (Macroneura) vladimiri</i> Fusu, 2017	V, VI, VII, VIII <sup>5</sup>	VI, VII, VIII, IX

**Comments:** We reared *E. vladimiri* from *A. lucidus* (Cynipidae) gall on *Quercus* sp. (new host and plant associates). In Bulgaria the species is recorded as emerged from *L. eryngii* (Cecidomyiidae) galls on *E. campestre*, *A. hypecoi* (Cynipidae) galls on *H. inberbe* and *Papaver* seed capsules (Fusu 2017). A primary parasitoid of Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera), associated with *Apomyelois ceratoniae* (Zeller) (Lepidoptera: Pyralidae) (Fusu 2017).

***Merostenus* Walker, 1837**

***Merostenus excavatus* (Dalman, 1820)**

*Merostenus excavatus*: Harizanova (1997).

Material examined. Rhodope Mts: Orehovo Vill., 900 m, 13.VIII.1996, 1 ♀ (Det. G. A. P. Gibson, 2013); Asenovgrad, Gorni Voden loc., 400 m, 03.VI.1999, 1 ♀. Stara Planina Mts: Ogosta Dam, 175 m, 09.IV.2005, 1 ♀ (A. Antonov); Ribaritsa Vill., 641 m, 06.VII.2015, 1 ♀.

**Subfamily NEANASTATINAE Kalina, 1984**

***Metapelma* Westwood, 1835**

***Metapelma nobile* (Förster, 1860)**

*Metapelma nobile*: Antov & Stojanova (2015).

Material examined. Belasitsa Mts: S of Belasitsa Hut, 740 m, 01-10.VIII.2002, 1 ♀, Malaise trap (O. Todorov). Danubian Plain: Razgradski Heights, Trabach Vill., 220 m, 19.IX-02.X.1999, 1 ♀, Malaise trap (K. Ivanov). Rhodope Mts: Madzharovo, 245 m, 15-30.VI.2004, 1 ♀, Malaise trap (O. Todorov). Stara Planina Mts: Banitsa Vill., 275 m, 01-05.VI.2013, 1 ♀, Malaise trap (L. Toshkov). Strandzha Mts: Ropotamo River, 35 m, 01.VII.2012, 1 ♀, Malaise trap (S. Petrov).

### Phenology

The study of the seasonal activity of the family is based on

the collection data of the imagoes in nature (Appendix 1). Both *C. obscura* and *E. (Eupelmus) azureus* are excluded from the analysis as they were reared from their hosts in the laboratory. All species collected with Malaise traps in a period that covers two months were reported to be active during both months, regardless of the number of specimens.

Eupelmidae species in Bulgaria were most active from late spring (May), summer (June, July, August) and early autumn (September) (Table 1). The highest number of species was collected in August – 29, followed by June and July, both with 25 species, September with 18 and May with 13 species. In April and October three and five species were established, respectively. The seasonal activity of the different genera is shown in Table 1.

The species belonging to *Eupelmus*, *Merostenus*, *Calosota*, *Anastatus* and *Calymmochilus* appeared in spring (April and May). In June, July and August the number of the genera and species was the highest. During the winter months no specimens were found.

The study of duration of imaginal activity showed that four species have an activity of one month (Appendix 1). The highest number of species had an activity of two months – 11 species. Five species were found to be active during three months, nine species – four months, seven species – five months. Only one species was found to have six month activity. The longest imaginal activity among the genera was observed in *Eupelmus* (seven months), followed by *Anastatus* (six months) (Table 1).

In addition to our results, the review of the published faunistic data for Bulgaria showed that some eupelmid species have extended imaginal activity (Table 2).

The analysis of the data in Table 2 showed that *C. metallica*, *E. walkeri* and *E. (Macroneura) aesculatus* have an activity of three months and *E. (Eupelmus) atropurpureus*, *E. (Macroneura) vesicularis* and *E. (Macroneura) vladimiri* – five months. The results of our study, in a combination with the literature data of these species, showed that four species have an activ-



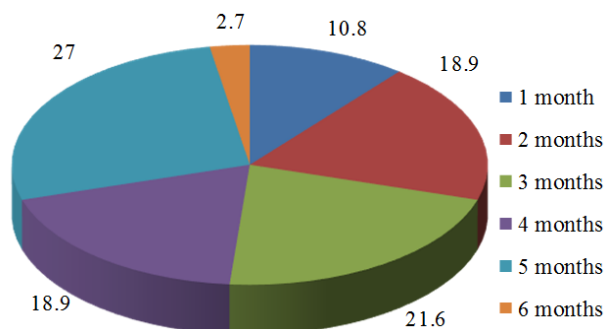


Figure 2. Duration of imaginal activity of Eupelmidae species in Bulgaria expressed as a percentage of the total number of species used in the analysis.

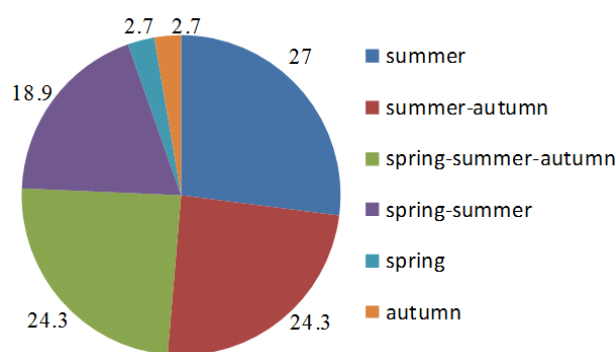


Figure 3. Phenological groups of Eupelmidae expressed as a percentage of the total number of species used in the analysis.

ity of one month (Figure 2). Seven species were active during two months. The species with an activity of three months were eight. Seven species were active during four months and ones with an activity of five months were the most numerous – 10 species. Only one species was registered with six months of activity.

The established species were divided into six phenological groups on the basis of adult activity combining the data from our study and the published data. The most numerous is the summer group (VI-VIII) with 10 species followed by the summer-autumn (VI-XI) and the spring-summer-autumn (III-XI) groups with nine species each. The spring-summer (III-VIII) group consists of seven species and the spring (III-V) and autumn (IX-XI) groups contain only one species each (Figure 3).

#### Habitat

As a result of this study, the following 20 species were found to be present in a habitat of the type 6210 semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*): *A. oscari*, *C. dusmeti*, *C. grylli*, *C. metallica*, *C. dispar*, *E. (Episolindeia) australiensis*, *E. (Episolindeia) linearis*, *E. (Eupelmus) atropurpureus*, *E. (Eupelmus) azureus*, *E. (Eupelmus) confusus*, *E. (Eupelmus) microzonus*, *E. (Eupelmus) urozonus*, *E. (Macroneura) aseculatus*, *E. (Macroneura) barai*, *E. (Macroneura) falcatus*, *E. (Macroneura) impennis*, *E. (Macroneura) messene*, *E. (Macroneura) rameli*, *E. (Macroneura) vesicularis* and *E. (Macroneura) vladimiri*. They represent 51.2 % of the total number of the recorded species in this study. Fourteen of them were found only in the oak zone (Appendix 1).

The results of the analysis of vertical distribution are presented in Table 3. The analysis showed that the species diversity decreases with the increase of the altitude.

Thirty-eight species (97.4%) of the total number were found in the oak zone (Appendix 1). Thirty of them (76.9%) were recorded only in this zone. Eight species (20.5%) were

discovered in the beech zone, one of them (2.5%) was recorded only in this zone. In the coniferous zone three species were established (7.6%) and in the alpine zone – one species (2.5 %). No species were specific only to the latter two zones.

*Calosota obscura* was found only in the beech zone. *C. metallica*, *E. (Eupelmus) annulatus*, *E. (Eupelmus) azureus*, *E. (Eupelmus) kiefferi* and *E. (Eupelmus) urozonus* were found in both oak and beech zones. *E. (Macroneura) vesicularis* was registered in oak, beech and coniferous zones, and *E. (Macroneura) barai* in both oak and coniferous zones. Only *E. (Episolindeia) australiensis* was found in all four plant zones.

#### Discussion

##### Faunistic data

The number of known species of Eupelmidae for the fauna of Bulgaria is significantly increased through the current study (Table 4). A total of 39 species is present, and they belong to three subfamilies and seven genera. Of them, 10 species are new for Bulgaria, three for the Balkan Peninsula, and one for Europe.

As a result of this study, the number of the known species of Eupelmidae in Bulgaria increases from 37 to 47. Thus, Bulgaria now ranks fourth in Europe by the number of known species after Spain, France and Italy, and first on the Balkan Peninsula. The geographical position of the country, combined with various bioclimatic conditions, predetermine the existence of a rich eupelmid fauna.

##### Phenology

The seasonal activity of eupelmid species in Bulgaria shows a peak in the summer months (June, July, August) and lower values in May and September, which can be linked to vegetation growth and the seasonal life cycle of their hosts. Similar dynamic of imaginal activity can be found in Pteromalii-

Table 3. Vertical distribution of Eupelmidae species in plant zones in Bulgaria.

Plant zone	Total		Only in the zone	
	Number of species	% of the total number	Number of species	% of the total number
Oak	38	97.4	30	76.9
Beech	8	20.5	1	2.5
Coniferous	3	7.6	-	-
Alpine	1	2.5	-	-

Table 4. Faunistic results for the family Eupelmidae in Bulgaria.

Genus/Subgenus	Species in present study	New records for Bulgaria	New records for the Balkan Peninsula
<i>Calosota</i>	6	4	-
<i>Eusandalum</i>	1	-	-
<i>Anastatus</i>	5	2	2
<i>Calymmochilus</i>	1	-	-
<i>Eupelmus</i>			
<i>E. (Episolindelia)</i>	4	1	-
<i>E. (Eupelmus)</i>	12	3	1
<i>E. (Macroneura)</i>	8	-	-
<i>Merostenus</i>	1	-	-
<i>Metapelma</i>	1	-	-
Total number of species	39	10	3

dae in the grasslands of Vitosha Mountain, Bulgaria, with successful development of the populations of most pteromalid species in the period July-August (Todorov et al. 2017). Ulrich (1999) provided valuable information on the phenology and life cycles of the hymenopteran parasitoids inhabiting a semixerophytic meadow on limestone in Germany, where three main periods of occurrence – May, July and September--have been observed.

Except for *E. (Episolindelia) linearis*, *E. (Macroneura) impennis*, *C. grylli*, *M. excavatus* and *M. nobile*, whose list of known hosts is incomplete (Bouček 1977, Mohammadi et al. 2011, Noyes 2018), the rest of the species in this study that have prolonged imaginal activity lasting four, five and six months have broad host ranges, which suggests the development of several generations per year. Stahl et al. (2019) studied *A. bifasciatus* on *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae) and showed that the parasitoid completed three generations per year in northwestern Switzerland. In contrast, *A. bifasciatus* has been recorded with two generations on *Dendrolimus spectabilis* (Butler) (Lepidoptera: Lasiocampidae) in Israel and four on *Gonocerus acuteangulatus* (Goeze) (Hemiptera: Coreidae) in Italy (Genduso 1977, Halperin 1990, as cited by Stahl et al. 2019). Gantschev et al. (1980) referred to *A. japonicus* developing two generations per year. The earliest occurrence of the species in nature has been observed on 25 June. The mass flight of the parasitoid was found to coincide with the flight of its host, the gypsy moth. The second flight of the parasitoid lasted from the end of August to the end of September. *Eupelmus urozonus* is also known to be a bivoltine species (Askew 1961, Randolph 2005, as cited by László & Tóthmérész 2011).

Hence the prolonged imaginal activity observed in the genera *Anastatus* and *Eupelmus* might be a result of a bi- or polyvoltine cycle.

An imaginal activity of one month was recorded in *A. bernardi*, *A. oscari*, *C. acron* and *C. aestivalis*. Information about hosts of the first two species is absent or very scarce, while the second two species are known as parasitoids of xylophagous beetles (Bouček 1977). Published data shows that *A. oscari* (Askew & Nieves-Aldrey 2017) and *C. aestivalis* (Gibson 2010) were collected in a period of several months, which gives us a reason to believe that these species have longer imaginal activity in Bulgaria.

The obtained results are generally a reflection of Eupelmidae's preferences to the respective abiotic and biotic fac-

tors of the environment. The most appropriate combination of these factors is found in summer, late spring and early autumn.

#### Habitat

The information on the range of hosts plays a key role in more accurately predicting the distribution of the eupelmids in the different types of biotopes. Our knowledge in this area is still very limited; however, on the basis of the experience gained with these insect collections, and information on the food preference of some species, it is possible to make an educated prediction.

*Festuco-Brometalia* grassland plant communities are among the richest in species in Europe. They provide the perfect habitat for many rare and threatened species, resulting in an impressive invertebrate fauna (Calaciura & Spinelli 2008). In Bulgaria, this habitat represents the largest and most diversified group of dry grasslands communities, occurring from the planar to the mountain level up to 1000-1200 m, and includes two subtypes: dry meadows and pastures dominated by *Chrysopogon gryllus* and *Dichanthium ischaemum* and meadow steppes (Tzonev & Gussev 2013).

This type of habitat is preferred by eupelmids in Bulgaria. Twenty species have been recorded in the 6210 habitat, and 15 of them belong to the genus *Eupelmus*.

According to literature sources, gall-forming Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera) families are hosts of the majority of the recorded *Eupelmus* species. This corresponds to the results obtained by Al khatib et al. (2016), who indicates that both families constitute the essential host species for the "*Eupelmus urozonus* species group" in the West Palaearctic.

Three species of *Calosota*, one of *Anastatus* and one of *Calymmochilus* have been recorded in *Festuco-Brometalia* grasslands in Bulgaria. The information regarding the hosts of *C. dusmeti* is very scarce. It is known that this species is associated with *Aylax minor* Hartig (Hymenoptera: Cynipidae) (Askew et al. 2006). According to Bouček (1977), *C. grylli* probably parasitizes species of *Tetramesa* (Eurytomidae) in grass stems. *Calosota metallica* attacks hosts mainly belonging to Cecidomyiidae and Eurytomidae (Gibson 2010). The biology of *A. oscari* is poorly researched. *Calymmochilus dispar* is reported as a parasitoid of *Zodarion styliferum* (Simon) (Araneae, Zodariidae) in open craggy habitats with rare vegetation (Korenko et al. 2013).

The oak forests also play an important role for some eupelmid species because they provide food resources for a number of herbivorous insects and gall-inducers that are potential hosts of some taxa.

The high percentage of reported species in the oak zone indicates the warmth-loving character of the group. The oak forests are heliophilic and bright with well-developed grass floor throughout the whole vegetative period, unlike the beech forests which are shady and have a poor grass floor composed mainly from sciophytes (Gruev 1988). The number of species discovered decreases with altitude. The emergence of *C. obscura* only in the beech zone suggests that it occurs also in the oak and coniferous zones. The establishment of *E. (Macroneura) barai* in the oak and coniferous zones it is also distributed in the beech zone. The emergence of *E. (Epi-solindelia) australiensis* in all plant zones is probably due to its highly adaptive character.

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## References

- Al khatib, F., Cruaud, A., Fusu, L., Genson, G., Rasplus, J.Y., Ris, N., Delvare, G. (2016): Multilocus phylogeny and ecological differentiation of the "*Eupelmus urozonus* species group" (Hymenoptera, Eupelmidae) in the West-Palaeartic. *BMC Evolutionary Biology* 16(13): 1-20.
- Al khatib, F., Fusu, L., Cruaud, A., Gibson, G., Borowiec, N., Rasplus, J.Y., Ris, N., Delvare, G. (2014): An integrative approach to species discrimination in the *Eupelmus urozonus* complex (Hymenoptera, Eupelmidae), with the description of 11 new species from the Western Palaeartic. *Systematic Entomology* 39: 806-862.
- Angelov, P. (1970): Neue Chalcidoidea für die Fauna Bulgariens. *Travaux Scientifiques Ecole Normale Supérieure "Paisii Hilendarski" - Plovdiv* 8(1): 137-140. [in Bulgarian, Russian & German summaries]
- Antov, M., Stojanova, A. (2015): Published data and new records to the fauna of Eupelmidae (Insecta: Hymenoptera) in Bulgaria. *ZooNotes* 83: 1-11.
- Antov, M., Stoyanov, I., Stojanova, A., Staykova, T. (2017a): Allozyme variability in three *Eupelmus* species (Hymenoptera: Eupelmidae) from Bulgaria. *North-Western Journal of Zoology* 13(2): 220-226.
- Antov, M., Stoyanov, I., Stojanova, A., Staykova, T. (2017b): Genetic variability of species of the genus *Eupelmus* Dalman, 1820 (Hymenoptera: Eupelmidae) based on allozyme markers. *Acta Zoologica Bulgarica*, Supplement 8: 17-23.
- Argyriou, L.C., Marakis, B. (1973): Some data on olive midge *Clinodiplosis oleisuga* Targ. (Diptera: Cecidomyiidae) in Crete (Kriti, Mediterranean Sea). *Annales de l'Institut Phytopathologique Benaki* 10(4): 364-368.
- Askew, R.R. (1961): *Eupelmus urozonus* Dalman (Hym., Chalcidoidea) as a parasite in cynipid oak galls. *The Entomologist* 94: 196-201.
- Askew, R.R., Nieves-Aldrey, J.L. (2000): The genus *Eupelmus* Dalman, 1820 (Hymenoptera, Chalcidoidea, Eupelmidae) in Peninsular Spain and the Canary Islands, with taxonomic notes and descriptions of new species. *Graellsia* 56: 49-61.
- Askew, R.R., Nieves-Aldrey, J.L. (2004): Further observations on Eupelminae (Hymenoptera, Chalcidoidea, Eupelmidae) in the Iberian Peninsula and Canary Islands, including descriptions of new species. *Graellsia* 60(1): 27-39.
- Askew, R.R., Nieves-Aldrey, J.L. (2006): Calosotinae and Neanastatinae in the Iberian Peninsula and Canary Islands, with descriptions of new species and supplementary note on *Brasema* Cameron, 1884 (Hymenoptera, Chalcidoidea, Eupelmidae). *Graellsia* 62(1): 87-100.
- Askew, R.R., Nieves-Aldrey, J.L. (2017): Eupelmidae (Hymenoptera, Chalcidoidea) of Iberia and the Canary Islands: an annotated checklist with descriptions of some previously unrecognised males and a new species of *Calosota* Curtis, 1836. *Graellsia* 73(2): 1-17.
- Askew, R.R., Plantard, O., Gómez, J.F., Hernandez Nieves, M., Nieves-Aldrey, J.L. (2006): Catalogue of parasitoids and inquiline in galls of Aylacini, Diplolepidini and Pediaspidini (Hym., Cynipidae) in the West Palaeartic. *Zootaxa* 1301: 1-60.
- Askew, R.R., Melika, G., Pujade-Villar, J., Schönrogge, K., Stone, G.N., Nieves-Aldrey, J.L. (2013): Catalogue of parasitoids and inquilines in cynipid oak galls in the West Palaeartic. *Zootaxa* 3643(1): 1-133.
- Bouček, Z. (1965): Synonymic and taxonomic notes on some Chalcidoidea (Hymenoptera), with corrections of my own mistakes. *Acta Entomologica Musei Nationalis Pragae* 36: 543-554.
- Bouček, Z. (1966): Materialy po faune chalcid (Hymenoptera, Chalcidoidea) Moldavskoy SSR. 2. Trudy Moldavskogo Nauchno-Issledovatel'skogo Instituta Sadovodstva, Vinogradarstva i Vinodeliya. Kishinev 13: 15-38.
- Bouček, Z. (1967): Revision of Palaeartic species of *Eusandalum* Ratz. (Hym., Eupelmidae). *Acta Entomologica Bohemoslovaca* 64: 261-293.
- Bouček, Z. (1977): A faunistic review of the Yugoslavian Chalcidoidea (Parasitic Hymenoptera). *Acta Entomologica Jugoslavica*, Supplement 13: 1-145.
- Bouček, Z., Andriescu, I. (1967): Notizen über die Gattung *Calymnochilus* Masi, mit Beschreibung einer neuen Art aus Südeuropa (Hymenoptera, Eupelmidae). *Acta Entomologica Musei Nationalis Pragae* 37: 233-238.
- Boyadzhiev, P.S., Gechev, T.S., Donev, A.D. (2012): A universal microscope manipulator. *Revista Brasileira de Entomologia* 56(1): 125-129.
- Boyadzhiev, P., Dautbasic, M., Mujezinovic, O., Mirchev, P., Georgiev, G., Georgieva, M. (2015): *Baryscapus transversalis* Graham (Hymenoptera: Eulophidae) - a new species for the fauna of Bosnia and Herzegovina. *Šumarski list* 1-2: 69-71.
- Calaciura, B., Spinelli, O. (2008): Management of Natura 2000 habitats. 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) ("important orchid sites). European Commission, pp. 1-38.
- Donev, A. (1986): Eine neue familie und einige neue arten aus der Überfamilie Chalcidoidea (Hym.) für die fauna Bulgariens. *Travaux Scientifiques Université de Plovdiv "Paisii Hilendarski"* 24(1): 75-79. [in Bulgarian, Russian & German summaries]
- Fusu, L. (2009): Romanian Eupelmidae (Hymenoptera, Chalcidoidea): new cytogenetic, faunistic and host records. *North-Western Journal of Zoology* 5(2): 307-320.
- Fusu, L. (2013): A revision of the Palaeartic species of *Reikiola* (*Hirticauda*) (Hymenoptera, Eupelmidae). *Zootaxa* 3636(1): 1-34.
- Fusu, L. (2017): An integrative taxonomic study of European *Eupelmus* (*Macroneura*) (Hymenoptera: Chalcidoidea: Eupelmidae), with a molecular and cytogenetic analysis of *Eupelmus* (*Macroneura*) *vesicularis*: several species hiding under one name for 240 years. *Zoological Journal of the Linnean Society* 181(3): 519-603.
- Fusu, L., Askew, R.R., Ribes, A. (2018): Rediscovery of *Calymnochilus russoi* Gibson, 1995 (Hymenoptera, Chalcidoidea, Eupelmidae), and revision of European *Calymnochilus* Masi, 1919. *Zootaxa* 4504(4): 501-523.
- Fusu, L., Ebrahimi, E., Siebold, C., Villemant, C. (2015): Revision of the Eupelmidae Walker, 1833 described by Jean Risbec. Part 1: the slide mounted specimens housed at the Muséum national d'Histoire naturelle in Paris. *Zoosystema* 37(3): 457-480.
- Gantschev, G., Keremidtschiev, M., Mirtschev, S. (1980): Untersuchungen über *Anastatus disparis* Ruschka Eiparasit auf Schwammspinner. Wissenschaftliche Arbeiten Forsttechnische Hochschule - Sofia, Serie Forstwissenschaft 25: 43-46. [in Bulgarian, Russian & German summaries]
- Georgiev, G. (2004): Two new Chalcidoidea (Hymenoptera) parasitoids of the poplar twig-gall fly, *Hexomyza schineri* (Gir.) (Diptera: Agromyzidae) in Bulgaria. *Silva Balcanica* 5(2): 57-60.
- Georgiev, G., Pelov, V. (1995): New parasitoids on the larvae of *Phyllocnistis suffusella* Z. (Lepidoptera, Phyllocnistidae) in Bulgaria. pp. 210-215. In: Tsankov, G. (ed.), Third National Scientific Conference of Entomology, 18-20 September 1995, Sofia. [in Bulgarian, English summary]
- Georgiev, G., Pelov, V. (1996): Parasitizing peculiarities and parasitoids role in the regulating of the *Phyllocnistis suffusella* Z. (Lepidoptera, Phyllocnistidae)

- number in Bulgaria. *Forest Science* 33(1): 78-83. [in Bulgarian, English summary]
- Georgiev, G., Ljubomirov, T., Raikova, M., Ivanov, K., Sakalian, V. (2004): Insect inhabitants of old larval galleries of *Saperda populnea* (L.) (Coleoptera: Cerambycidae) in Bulgaria. *Journal of Pest Science* 77: 235-243.
- Gibson, G.A.P. (1989): Phylogeny and classification of Eupelmidae, with a revision of the world genera of Calosotinae and Metapelmatinae (Hymenoptera: Chalcidoidea). *Memoirs of the Entomological Society of Canada* 148: 3-121.
- Gibson, G.A.P. (1995): Parasitic wasps of the subfamily Eupelminae: classification and revision of world genera (Hymenoptera: Chalcidoidea: Eupelmidae). *Memoirs on Entomology, International* 5. Associated Publishers, Gainesville, Florida.
- Gibson, G.A.P. (1997): Chapter 11. Eupelmidae. pp. 430-476. In: Gibson, G.A.P., Huber, J.T., Woolley, J.B. (eds.), *Annotated keys to the genera of Nearctic Chalcidoidea* (Hymenoptera). NRC Research Press, Ottawa.
- Gibson, G.A.P. (2009): Description of three new genera and four new species of Neanastatinae (Hymenoptera, Eupelmidae) from Baltic amber, with discussion of their relationships to extant taxa. *ZooKeys* 20: 175-214.
- Gibson, G.A.P. (2010): *Calosota* Curtis (Hymenoptera, Chalcidoidea, Eupelmidae) - review of the New World and European fauna including revision of species from the West Indies and Central and North America. *ZooKeys* 55: 1-75.
- Gibson, G.A.P. (2011): The species of *Eupelmus* (*Eupelmus*) Dalman and *Eupelmus* (*Episolidelia*) Girault (Hymenoptera: Eupelmidae) in North America north of Mexico. *Zootaxa* 2951: 1-97.
- Gibson, G.A.P. (2013): The extinct Baltic amber genus *Propelma* Trjapitzin, a valid genus of Neanastatinae (Hymenoptera, Eupelmidae). *ZooKeys* 283: 59-69.
- Gibson, G.A.P. (2017): Synonymy of *Reikosiella* Yoshimoto under *Merostenus* Walker (Hymenoptera: Chalcidoidea: Eupelmidae), with a checklist of world species and a revision of those species with brachypterous females. *Zootaxa* 4255(1): 1-65.
- Gibson, G.A.P. (2018): Revision of *Lutnes* Cameron (Hymenoptera: Eupelmidae). *Zootaxa* 4415(2): 330-356.
- Gibson, G.A.P., Fusu, L. (2016): Revision of the Palearctic species of *Eupelmus* (*Eupelmus*) Dalman (Hymenoptera: Chalcidoidea: Eupelmidae). *Zootaxa* 4081(1): 1-331.
- Gruev, B. (1988): General biogeography. Science & Art, Sofia. [in Bulgarian]
- Harizanova, V. (1997): *Bathyplectes curculionis* Thoms. (Hymenoptera: Ichneumonidae) an effective parasite of the alfalfa weevil *Phytonomus variabilis* Herbst. (Coleoptera: Curculionidae) in non-sprayed fields. *Acta Entomologica Bulgarica* 3(1-2): 100-103.
- Herting, B. (1976): A catalogue of parasites and predators of terrestrial arthropods. Section A. Host or prey/enemy. Vol. 7. Lepidoptera, Part 2 (Macrolepidoptera). Commonwealth Agricultural Bureaux, Commonwealth Institute of Biological Control.
- Kalina, V. (1981a): The Palearctic species of the genus *Macroneura* Walker, 1837 (Hymenoptera, Chalcidoidea, Eupelmidae), with descriptions of new species. *Sbornik Vedeckeho Lesnickeho Ustavu Vysoke Skoly Zemedelske v Praze* 24: 83-111.
- Kalina, V. (1981b): The Palearctic species of the genus *Anastatus* Motschulsky, 1860 (Hymenoptera, Chalcidoidea, Eupelmidae), with descriptions of new species. *Silvaecultura Tropica et Subtropica* 8: 3-25.
- Kalina, V. (1984): New genera and species of Palearctic Eupelmidae (Hymenoptera, Chalcidoidea). *Silvaecultura Tropica et Subtropica* 10: 1-29.
- Kalina, V. (1988): Descriptions of new Palearctic species of the genus *Eupelmus* Dalman with a key to species (Hymenoptera, Chalcidoidea, Eupelmidae). *Silvaecultura Tropica et Subtropica* 12: 3-33.
- Keremidchiev, M., Ganchev, G. (1971): The egg-eaters and control of the pests in forests. *Gorsko Stopanstvo* 27(11): 37-41. [in Bulgarian]
- Keremidchiev, M., Gantshev, G. (1973): Artenbestand, Verbreitung, Rolle und Möglichkeiten zum Einsatz der Eierparasiten am Schwammspinner in der Forstschutzpraxis. *Forest Science* 10(5): 37-45. [in Bulgarian, Russian & German summaries]
- Keremidchiev, M. (1965): Étude de la faune entomologique d'après le type chénaies dans la Stara Planina Orientale. *Forest Science* 2(3): 205-217. [in Bulgarian, Russian & French summaries]
- Kissayî, K., Benhalima, S. (2017): First focused survey of Eupelmidae (Hymenoptera: Chalcidoidea) in Morocco with four new records. *Annales de la Société entomologique de France* (N.S.) 53(3): 211-218.
- Korenko, S., Schmidt, S., Schwarz, M., Gibson, G.A.P., Pekár, S. (2013): Hymenopteran parasitoids of the ant-eating spider *Zodarion styliferum* (Simon) (Araneae, Zodariidae). *ZooKeys* 262: 1-15.
- László, Z., Tóthmérész, B. (2011): Parasitism, phenology and sex ratio in galls of *Diplolepis rosae* in the Eastern Carpathian Basin. *Entomologica Romanica* 16: 33-38.
- Lotfalizadeh, H., Hashemi, S.M. (2015): Parasitoids (Hymenoptera: Chalcidoidea) of the seed eater weevil, *Oxytoma ochropus* (Germar) (Coleoptera: Apionidae) in Northwestern Iran. *Acta Entomologica Serbica* 20: 145-150.
- Markova, G. (1997): Biotic factors affecting *Stereonychus fraxini* (Col., Curculionidae) populations in Longoza Forest. *Acta Entomologica Bulgarica* 3-4: 89-92. [in Bulgarian, English summary]
- Marković, Č., Stojanović, A. (2003): Significance of parasitoids in the reduction of oak bark beetle *Scolytus intricatus* Ratzeburg (Col., Scolytidae) in Serbia. *Journal of Applied Entomology* 127(1): 23-28.
- Melika, G., Csóka, G., Stone, G.N., Schönrogge, K. (2002): Parasitoids reared from galls of *Andricus caliciformis*, *A. conglomeratus*, *A. coriarius*, *A. coronatus* and *A. lignicolus* in Hungary (Hymenoptera: Cynipidae). *Annales Historico-Naturales Musei Nationalis Hungarici* 94: 123-133.
- Michev, P. (1974): A control on the gypsy moth. *Gorsko Stopanstvo* 6: 22-23. [in Bulgarian]
- Mirchev, P., Georgiev, G., Boyadzhiev, P. (2014a): First record of egg parasitoids of pistachio processionary moth, *Thaumetopoea solitaria* (Freyer) (Lepidoptera: Thaumetopoeidae). *Acta Zoologica Bulgarica* 66(1): 109-113.
- Mirchev, P., Georgiev, G., Matova, M. (2014b): Comparative studies of egg parasitoids of *Thaumetopoea pityocampa* and *T. solitaria* inhabiting a common habitat in the Eastern Rhodopes. *Silva Balcanica* 15(1): 116-121.
- Mirchev, P., Georgiev, G.T., Tsankov, G. (2001): Studies on the parasitoids of *Gelechia senticetella* (Stgr.) (Lepidoptera: Gelechiidae) in Bulgaria. *Anzeiger für Schädlingkunde* 74: 94-96.
- Mirchev, P., Schmidt, G.H., Tsankov, G. (1998a): The egg parasitoids of the pine processionary moth *Thaumetopoea pityocampa* (Den. & Schiff.) in the Eastern Rhodopes, Bulgaria. *Bollettino di Zoologia Agraria e di Bachicoltura* 30(2): 131-140.
- Mirchev, P., Schmidt, G.H., Tsankov, G. (1998b): The egg parasitoids of *Thaumetopoea pityocampa* (Den. & Schiff.) (Lep., Thaumetopoeidae) in Bulgaria. *Mitteilungen aus der Biologischen Bundesanstalt für Land- und Forstwirtschaft, Berlin-Dahlem* 356: 45-52.
- Mirchev, P., Tsankov, G., Petrov, Y. (2003): Study of some aspects of the bioecology of the oak processionary moth *Thaumetopoea processionea* (Linnaeus, 1758) (Lepidoptera: Notodontidae) in North-east Bulgaria. *Silva Balcanica* 3(1): 5-10.
- Mirchev, P., Georgiev, G., Boyadzhiev, P., Matova, M. (2012): Impact of entomophages on density of *Thaumetopoea pityocampa* in egg stage near Ivaylovgrad, Bulgaria. *Acta Zoologica Bulgarica*, Supplement 4: 103-110.
- Mohammadi, R., Lotfalizadeh, H., Pashai-Rad, S. (2011): First report of two brachypterous species of *Eupelmus* (Hym.: Chalcidoidea, Eupelmidae) from Iran. *Applied Entomology and Phytopathology* 79(2): 273-276.
- Nieves-Aldrey, J.L., Melika, G. (2005): *Aylax hypecoi* Trotter (Hymenoptera, Cynipidae) in Europe: Redescription, with taxonomic and biological notes. *Journal of Natural History* 39(27): 2525-2535.
- Nikolskaya, M.N. (1952): Chalcids of the fauna of the USSR (Chalcidoidea). Academy of Sciences of the USSR, Moscow & Leningrad. [in Russian]
- Noyes, J.S. (2018): Universal Chalcidoidea Database. World Wide Web electronic publication. <<http://www.nhm.ac.uk/chalcids/>>, accessed at 2018.09.12.
- Pélov, V. (1975): Apport a l'etude de la composition d'espèces de la superfamille Chalcidoidea (Hymenoptera) en Bulgarie. *Acta Zoologica Bulgarica* 3: 59-69.
- Pelov, V. (1999): Parasitoids on birch seed gall midge (*Semudobia betulae* (Winn.) Diptera, Cecidomyiidae) in Bulgaria. *Acta Entomologica Bulgarica* 1: 72-76.
- Pelov, V., Krusteva, H., Ventsislavov, V., Nikolov, P., Krusteva, R. (2007): Parasitoids of cereal flies. *Plant Science* 44: 99-103.
- Popov, V.I. (1968): Some hymenoptera found in Bulgaria as parasites. *Wissenschaftliche Arbeiten Landwirtschaftliche Hochschule "G. Dimitrov", Agronomische Fakultät - Sofia, Serie "Pflanzenbau"* 19: 301-308. [in Bulgarian, Russian & English summaries]
- Stahl, J.M., Babendreier, D., Haye, T. (2019): Life history of *Anastatus bifasciatus*, a potential biological control agent of the brown marmorated stink bug in Europe. *Biological Control* 129: 178-186.
- Stefanov, D. (1959): Über einige biotische Faktoren die die massenhafte Verbreitung der Schwammspinner (*Lymantria dispar* L.) in unseren Wäldern einschränken. *Wissenschaftliche Arbeiten Forsttechnische Hochschule - Sofia* 7: 7-17. [in Bulgarian]
- Stefanov, D., Keremidziev, M. (1961): Möglichkeiten für die Ausnutzung einiger Raub- und Schmarotzer - Insekten (Entomophagen) für die biologische Bekämpfung des Schwammspinners (*Lymantria dispar* L.) in Bulgarien. *Wissenschaftliche Arbeiten Forsttechnische Hochschule - Sofia* 9: 157-168. [in Bulgarian, German summary]
- Stefanov, D., Keremidchiev, M., Wutov, W. (1958): Untersuchung der Gradierungen der Schwammspinner (*Lymantria dispar* L.) und Ringelspinner (*Malacosoma neustria* L.) bei uns und Feststellung ihrer Gründe. *Wissenschaftliche Arbeiten Forsttechnische Hochschule - Sofia* 6: 135-172. [in Bulgarian, German summary]
- Stojanova, A. (2005): *Glyphomerus aylax* sp. n. (Hymenoptera: Torymidae) from Bulgaria. *Revue Suisse de Zoologie* 112(1): 173-182.

- Stojanova, A. (2006): Chalcid wasps (Hymenoptera: Chalcidoidea) from the collection of Dr. L. Vassileva-Samnalieva at the Institute of Zoology, Bulgarian Academy of Sciences. *Acta Zoologica Bulgarica* 58(1): 57-72.
- Stojanova, A.M., Antov, M.I. (2018): The chalcid wasp fauna (Hymenoptera: Chalcidoidea: Eurytomidae, Eupelmidae, Ormyridae and Torymidae) of the city of Plovdiv. pp. 57-68. In: Mollov, I.A., Georgiev, D.G., Todorov, O.B. (eds.), Faunistic diversity of the city of Plovdiv (Bulgaria), Volume 1 - Invertebrates, Bulletin of the Natural History Museum - Plovdiv, Supplement 1. Plovdiv University Press, Plovdiv.
- Tchorbadjiev, P. (1928): Les animaux parasites sur les plantes cultivées en Bulgarie en 1927. *Information on Agriculture* 9(3/4): 3-52. [in Bulgarian, French summary]
- Thompson, W.R. (1955): A catalogue of the parasites and predators of insect pests. Section 2. Host parasite catalogue, Part 3. Hosts of the Hymenoptera (Calliceratid to Evaniid). Commonwealth Agricultural Bureaux, Commonwealth Institute of Biological Control, Ottawa, Ontario, Canada.
- Todorov, I.A., Askew, R.R., Parvanov, D. (2017): Pteromalid fauna (Chalcidoidea: Pteromalidae) in the grasslands of Vitosha Mountain, Bulgaria: generic composition, diversity, abundance and phenology. *Acta Zoologica Bulgarica* 69(1): 37-42.
- Todorov, I., Stojanova, A., Parvanov, D., Boyadzhiev, P. (2012): Studies on the gall community of *Diplolepis rosae* (Hymenoptera: Cynipidae) in Vitosha Mountain, Bulgaria. *Acta Zoologica Bulgarica*, Supplement 4: 27-37.
- Tomov, R., Hristov, B. (2007): Parasitoids of *Cameraria ohridella* Deschka et Dimic (Lep.: Gracillariidae) in artificial stands of horse-chestnut of Bulgaria. Proceeding of the International Conference "Alien Arthropods in South East Europe - crossroad of three continents", 19-21 September 2007, Sofia, pp. 77-87.
- Trjapitzin, V.A. (1978): Eupelmidae. pp. 228-236. In: Medvedev, G.S. (ed.), Keys to the insects of the European part of the USSR. III. Hymenoptera. Part II. Nauka, Leningrad. [in Russian]
- Tsankov, G. (1981): The egg-eaters of *Thaumetopoea pityocampa* Schiff. and *Rhyacionia buoliana* Schiff. and possibilities of their utilization in the biological control. *Forest Science* 18(6): 28-35. [in Bulgarian, Russian & English summaries]
- Tsankov, G. (1990): Egg parasitoids of the pine processionary moth, *Thaumetopoea pityocampa* (Den. & Schiff.) (Lep., Thaumetopoeidae) in Bulgaria: Species, importance, biology and behaviour. *Journal of Applied Entomology* 110(1): 7-13.
- Tsankov, G., Markova, G. (1992): Parasitoids of *Stereonychus fraxini* De Geer in Longoza Forest. *Forest Science* 29(2): 56-61. [in Bulgarian, Russian & English summaries]
- Tsankov, G., Mirchev, P. (1983): The effect of some plant-protective means upon the egg-parasite complex on pine processionary moth (*Thaumetopoea pityocampa* Schiff.). *Forest Science* 20(6): 84-89. [in Bulgarian, Russian & English summaries]
- Tsankov, G., Schmidt, G.H., Mirchev, P. (1996a): Structure and parasitism of egg-batches of a processionary moth population different from *Thaumetopoea pityocampa* (Den. & Schiff.) (Lep., Thaumetopoeidae) found in Bulgaria. *Bollettino di Zoologia Agraria e di Bachicoltura* 28(2): 195-207.
- Tsankov, G., Schmidt, G.H., Mirchev, P. (1996b): Parasitism of egg-batches of the pine processionary moth *Thaumetopoea pityocampa* (Den. & Schiff.) (Lep., Thaumetopoeidae) in various regions of Bulgaria. *Journal of Applied Entomology* 120: 93-105.
- Tsankov, G., Schmidt, G.H., Mirchev, P. (1998a): Studies on the egg parasitism in *Thaumetopoea pityocampa* over a period of four years (1991-1994) at Marikostino/Bulgaria. *Anzeiger für Schädlingskunde, Pflanzenschutz und Umweltschutz* 71(1): 1-7.
- Tsankov, G., Schmidt, G.H., Mirchev, P. (1998b): Distribution of egg parasitoids of the pine processionary moth *Thaumetopoea pityocampa* (Den. et Schiff.) (Lep., Thaumetopoeidae) and their impact in the southwestern region of Bulgaria. *Forest Science* 35(3-4): 5-17.
- Tsankov, G., Stalev, Z., Pelov, V. (1995): New information upon species constitution of parasitoid complex on larvae and pupae of *Stereonychus fraxini* Deg. *Acta Entomologica Bulgarica* 1: 29-34. [in Bulgarian, English summary]
- Tsankov, G., Georgiev, G., Pelov, V., Trenchev, G. (1991): Parasitoids on *Hexomyza schineri* (Gir.) (Diptera, Agromyzidae) in Bulgaria. pp. 207-212. In: Tsankov, G. (ed.), Proceedings of the First National Entomological Conference, 28-30 October 1991, Sofia. [in Bulgarian, English summary]
- Tsankov, G., Douma-Petridou, E., Mirchev, P., Georgiev, G., Koutsaftikis, A. (1997): Comparative studies on populations of the pine processionary moth (*Thaumetopoea pityocampa* Den. & Schiff., Lepidoptera: Thaumetopoeidae) in Bulgaria and Greece. I. Biometrical and ecological indices of the species at the egg stage from the biotopes in Marikostinovo, Bulgaria and Kalogria-Achaia, Greece. *Acta Entomologica Bulgarica* 1-2: 79-87.
- Tsankov, G., Douma-Petridou, E., Mirchev, P., Georgiev, G., Koutsaftikis, A. (1999): Spectrum of egg parasitoids and rate of parasitism batches of the pine processionary moth *Thaumetopoea pityocampa* (Den. & Schiff.) in the northern Peloponnes/Greece. *Journal of the Entomological Research Society* 1(2): 1-8.
- Tschorbadjiev, P. (1928): Bemerkungen über einige schädlichen Insekten in Bulgarien, beobachtet während der Jahren 1926 und 1927. *Mitteilungen der Bulgarischen Entomologischen Gesellschaft* (Sofia) 5: 125-134. [in Bulgarian]
- Tzonev, R., Gushev, C. (2013): Guidance for identification and effective management of grasslands (pastures, meadows, permanently grassed areas) - object of conservation and commercial use in Bulgaria. *Bulgarian Society for Protection of Birds, Environmental series - Book 23*, Sofia. [in Bulgarian]
- Ulrich, W. (1999): Phenology and life cycles of the parasitic Hymenoptera of a dry meadow on limestone. *Polskie Pismo Entomologiczne* 68(4): 383-405.
- Velchev, V., Ganchev, S., Bondev, I. (1982): Vegetation belts. pp. 439-443. In: Galabov, Zh. (ed.), *Geography of Bulgaria. Physical geography. Natural conditions and resources*. Bulgarian Academy of Sciences, Sofia. [in Bulgarian]
- Vidal, S. (1993): Determination list of entomophagous insects. No 12. Bulletin. Section Regionale Ouest Palaearctique, Organisation Internationale de Lutte Biologique.
- Zacharieva, A. (1983): Untersuchung über die Artenzusammensetzung und die Rolle der Parasiten des weißen Weidenschmetterlings (*Stilpnotia salicis*) in Bulgarien. *Wissenschaftliche Arbeiten Hochschule für Forstwirtschaft - Sofia, Serie "Grünanlagen und Umweltschutz"* 27/28: 107-113. [in Bulgarian, Russian & German summaries]
- Zaharieva-Pentcheva, A., Georgiev, G.T. (1997): Parasitoids of the satin moth *Stilpnotia salicis* (L.) (Lepidoptera: Lymantriidae) in Bulgaria. *Bollettino di Zoologia Agraria e di Bachicoltura*, Ser. II 29(1): 81-90.
- Zanati, E.M. (1978): Promising egg parasites of *Malacosoma neustria*. *Gorsko Stopanstvo* 34(4): 39-43. [in Bulgarian]

Appendix 1. The collection data of the imagoes in nature (A – alpine zone; B – beech zone; C – coniferous zone; O – oak zone).

Taxa	Plant zones				Seasonal activity
	O	B	C	A	
Subfamily CALOSOTINAE Bouček, 1958					
<i>Calosota</i> Curtis, 1836					
<i>C. acron</i> (Walker, 1848)	+				VIII
<i>C. aestivalis</i> Curtis, 1836	+				V
<i>C. dusmeti</i> Bolivar y Pieltain, 1929	+				VI, VII, VIII
<i>C. grylli</i> Erdős, 1955	+				V, VI, VII, VIII
<i>C. metallica</i> (Gahan, 1922)	+	+			VI, VIII
<i>C. obscura</i> Ruschka, 1921		+			reared
<i>Eusandalum</i> Ratzeburg, 1852					
<i>E. walkeri</i> (Curtis, 1836)	+				VII, VIII
Subfamily EUPELMINAE Walker, 1833					
<i>Anastatus</i> Motschulsky, 1859					
<i>A. bernardi</i> Ferrière, 1954	+				VIII
<i>A. bifasciatus</i> (Geoffroy, 1785)	+				VI, VII, VIII, X
<i>A. catalonicus</i> Bolivar y Pieltain, 1935	+				V, VI, VIII
<i>A. japonicus</i> Ashmead, 1904	+				VI, VII, VIII, IX
<i>A. oscar</i> (Ruthe, 1859)	+				IX
<i>Calymmochilus</i> Masi, 1919					
<i>C. dispar</i> Bouček & Andriescu, 1967	+				V, VI, VIII
<i>Eupelmus</i> Dalman, 1820					
<i>E. (Episolidelia) australiensis</i> (Girault, 1913)	+	+	+	+	V, VI, VII, VIII, IX
<i>E. (Episolidelia) cicadae</i> Giraud, 1872	+				VI, VII
<i>E. (Episolidelia) fuscipennis</i> Förster, 1860	+				VI, VII
<i>E. (Episolidelia) linearis</i> Förster, 1860	+				VI, VII, VIII, IX
<i>E. (Eupelmus) annulatus</i> Nees, 1834	+	+			VIII, IX
<i>E. (Eupelmus) atropurpureus</i> Dalman, 1820	+				VI, VII, VIII, IX
<i>E. (Eupelmus) azureus</i> Ratzeburg, 1844	+	+			reared
<i>E. (Eupelmus) confusus</i> Al khatib, 2015	+				VI, VII, IX
<i>E. (Eupelmus) kiefferi</i> De Stefani, 1898	+	+			VII, VIII, IX, X
<i>E. (Eupelmus) lanceolatus</i> Gibson & Fusu, 2016	+				VIII, IX
<i>E. (Eupelmus) matranus</i> Erdős, 1947	+				V, VIII
<i>E. (Eupelmus) microzonus</i> Förster, 1860	+				V, VI, VII, VIII, IX
<i>E. (Eupelmus) pini</i> Taylor, 1927	+				VII, VIII, IX, X
<i>E. (Eupelmus) urozonus</i> Dalman, 1820	+	+			V, VII, VIII, IX, X
<i>E. (Eupelmus) vindex</i> Erdős, 1955	+				IV, V, VI
<i>E. (Eupelmus) weilli</i> Fusu & Gibson, 2016	+				VI, VII
<i>E. (Macroneura) aesculatus</i> (Kalina, 1981)	+				VI, VIII
<i>E. (Macroneura) barai</i> Fusu, 2017	+		+		V, VI, VII, VIII, IX
<i>E. (Macroneura) falcatus</i> (Nikolskaya, 1952)	+				V, VI, VII, VIII, IX
<i>E. (Macroneura) impennis</i> (Nikolskaya, 1952)	+				V, VI, VII, VIII, IX
<i>E. (Macroneura) messene</i> Walker, 1839	+				IV, V, VI, VII, VIII, IX
<i>E. (Macroneura) rameli</i> Fusu, 2017	+				VI, VII
<i>E. (Macroneura) vesicularis</i> (Retzius, 1783)	+	+	+		VII, VIII
<i>E. (Macroneura) vladimiri</i> Fusu, 2017	+				VI, VII, VIII, IX
<i>Merostenus</i> Walker, 1837					
<i>M. excavatus</i> (Dalman, 1820)	+				IV, VI, VII, VIII
Subfamily NEANASTATINAE Kalina, 1984					
<i>Metapelma</i> Westwood, 1835					
<i>Metapelma nobile</i> (Förster, 1860)	+				VI, VII, VIII, IX, X