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Research Article

Winter Activity of Fungus Gnats (Diptera: Mycetophilidae) in Critically-endangered Mediterranean Habitats in Bulgaria

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Abstract: Adult fungus gnats inhabit predominantly humid forest areas; however, they are sometimes found also in drier forest habitats, generally avoiding wetter environments. In European temperate climate, they are mainly active during the period from April to September. However, in the most south-western regions of Bulgaria where Mediterranean and Sub-Mediterranean habitats are found, it has been established that specific conditions during the winter might be a precondition for the extremely high abundance of fungus gnats in the area. Our study was conducted using tree and soil traps. A total of 28,557 specimens were collected during the winter months (November 2002, 2003, 2018; December 2002, 2003, 2018 and January 2003, 2019). Several species of the genera *Phronia* Winnertz, 1863, *Coelosia* Winnertz, 1863 and *Boletina* Staeger, 1840, were found to be dominant during that time, with *Stigmatomeria crassicornis* (Stannius, 1831) being reported for the first time for the fauna of Bulgaria.

Key words: fungus gnats, winter activity, Bulgaria

Introduction

Fungus gnats are representatives of the families Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae and Mycetophilidae, which belong to the superfamily Sciaroidea (Insecta: Diptera: Nematocera). There are over 226 genera in the world, with more than 4,100 species (Bechev 2000b). Ninety-six genera are known in the Palaearctic Region, with more than 1,500 species overall (Bechev 1999c) and around 1,140 species in Europe. So far, 317 species of fungus gnats are known in Bulgaria (Bechev 2006b, 2010, Bechev & Pavlova 2012, 2016, Kurina & Chandler 2018). Fungus gnats are distributed all over the world – from Greenland and Svalbard to Subantarctic islands. Fungus gnats are also called mycetophilids because their larvae develop in the mycelium of (predominantly terrestrial) fungi (Chandler & Blasco-Zumeta 2001) and are common in different forest ecosystems. Typically, fungus gnats inhabit moderately humid forest habitats and are rarely found in dry forests, generally avoiding areas with high humidity. In the European temperate climate, they are active mainly during the period between April and September. Due to this fact, many studies have been carried out at that time or in humid habitats (Bechev 2000a). In the south-western part of Bulgaria, the Sub-Mediterranean climate is strongly represented, allowing for the existence of habitats with Mediterranean and Sub-Mediterranean vegetation, forming xerophytic habitats. Since fungus gnats are not commonly found in dry environments, many studies have overlooked these areas. In this article, we present the results of a study on the winter activity of fungus gnats of the family Mycetophilidae

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in habitats dominated by the kermes oak *Quercus coccifera* L. in Bulgaria.

Faunal and ecological studies of the kermes oak communities are currently incomplete and future research is needed to fully characterise the habitat (National Biodiversity Conservation Strategy – NBCS). Kermes oak communities are areas of greatest importance, determined by summary data on species richness, endemic and rare taxa (NBSC). Furthermore, they are classified as critically endangered under the Red-Data Book of habitats of the Republic of Bulgaria with code 23F5, covering evergreen, hard-leaved shrubs and low forests (pseudomaquis) dominated by the kermes oak *Quercus coccifera* L. (Gusev 2015).

Materials and Methods

The material for the present study was collected in the periods 02.11–03.12.2002 (in short, November 2002); 03.12.2002–11.01.2003 (December 2002); 11.01.2003–08.02.2003 (January 2003); 08.11–06.12.2003 (November 2003); 07.12.2003–11.01.2004 (December 2003); 02.11–04.12.2018 (November 2018); 04.12.2018–07.01.2019 (December 2018); 07.01–06.02.2019 (January 2019). The study was conducted in the communities of kermes oak near Kamenitsa Village (170–240 m a.s.l., UTM: BG FM71, 41.642666°N, 23.170961°E), Strumyani Municipality, Blagoevgrad Region (Fig. 1). The material from 2002–2004 was collected within the framework of the project "Studies on biodiversity of model animal groups in communities of kermes oak (*Quercus coccifera* L.), anthropogenic impact assessment and proposing protection measures" (Langourov & Simov 2006); the material from 2018–2019 was collected by the first author. The material was collected using two stationary invertebrate trapping methods: tree traps and soil traps as well as their combination (see Langourov & Simov 2006). In the 2002–2004 survey, 15 tree and 15 soil traps were placed (Fig. 2) for a period of two years and the material was collected monthly. Modified Moericke traps were used (Langourov 2001): conical white plastic banks with a base diameter of 65 mm, an opening of 88 mm and height of 118 mm. A solution of 4% formaldehyde was used as a preservative. The collected material was stored before and after the identification in tubes with 75% ethanol. The collection methodology was repeated in 2018–2019, using ten tree and ten soil traps with propylene glycol as preservative and two control traps with 4% formaldehyde solution.

The material was identified using the available keys (Søli et al. 2000, Zaitzev 2003) and specialised articles. For most species, temporary preparations of the genitalia were prepared. The arrangement of the subfamilies and the genera follows Bechev (2000b) and Kjærandsen (2019) unless otherwise stated. Information for each species in-

Fig. 1. Location of the study area near Kamenitsa Village, Strumyani Municipality, Blagoevgrad Region (map: Garmin BaseCamp Version 4.6.2)

B

Fig. 2. Modified Moericke traps – Langourov type (Langourov 2001). A – tree trap, B – soil trap.

cludes valid taxa name, bibliography and synonyms for Bulgaria, date of collection, type of trap used, number of specimens, vertical distribution and seasonal activity in Bulgaria (months of the year with Roman letters). The species marked with an asterisk (*) is reported for the first time for Bulgarian fauna.

The data from meteorological stations for the region of Kamenitsa Village provided by the National Institute of Meteorology and Hydrology were used in the analysis of the results (NIMH 2019). PAST software (Hammer et al. 2001) was used to process statistically the obtained results and to calculate Shannon Index for species diversity and Simpson Domination Index.

Results

Faunistic list

Family Mycetophilidae Newman, 1834

Subfamily Mycomyinae Edwards, 1925

***Mycomya* (*Mycomya*) *cinerascens* (Macquart, 1826)**

Records for Bulgaria: Väisänen 1984: 175, Bechev 1985: 37, 1997: 12, 2000a: 58, 2002: 104, 2006a: 708, 2010:7.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 08.11–06.12.2003, tree traps: 1♂, soil traps: 1♂; 7.12.2003–11.01.2004, tree traps: 2♂♂.

Vertical distribution: 550–1740 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–X (Bechev 2010); XI, XII (this study).

***Mycomya* (*Mycomya*) *marginata* (Meigen, 1818)**

Records for Bulgaria: Väisänen 1984: 234, Bechev 1985: 38, 1997: 12, 2000a: 58, 2002: 104, 2006a: 708, 2010: 8.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 16♂♂, 24♀♀; 03.12.2002–11.01.2003, tree traps: 36♂♂; 24♀♀; 11.01.2003–08.02.2003, tree traps: 32♂, 12♀♀; soil traps: 1♂.

Vertical distribution: 350–1740 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–IX, XI (Bechev 2010); I, XII (this study).

***Mycomya* (*Mycomya*) *prominens* (Lundström, 1913)**

Records for Bulgaria: Väisänen 1984: 61, Bechev 1997: 12, 2002: 104, 2006a: 708, 2010: 9.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 08.11–6.12.2003, tree traps: 1♂; 07.12.2003–11.01.2004, tree traps: 1♂; 1♀.

Vertical distribution: 950 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: VI (Bechev 2010); XI–XII (this study).

***Mycomya* (*Mycomya*) *tenuis* (Walker, 1856)**

Records for Bulgaria: Väisänen 1984: 116, Bechev 1985: 38, 1997: 12, 2000a: 58, 2002: 105, 2010: 10.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 10♂♂, 4♀♀; soil traps: 2♀♀.

Vertical distribution: 350–1740 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–VIII (Bechev 2010); XI (this study).

Subfamily Sciophilinae Dziedzicki, 1885

***Sciophila rufa* Meigen, 1830**

Records for Bulgaria: Bechev 1986b: 57, 1986c: 60, 1989b: 161, 1997: 13, 1999a: 38, 2000a: 59, 2002: 108, 2010: 22; Kolarov & Bechev 1995: 18.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 41♂♂, 11♀♀, soil traps: 2♀♀; 03.12.2002–11.01.2003, tree traps: 3♂, 1♀; 11.01.2003–08.02.2003, tree traps: 1♂, 1♀.

Vertical distribution: 350–1740 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–IX, XI (Bechev 2010); I, XII (this study).

Subfamily Gnoristinae Edwards, 1925

***Boletina gripha* Dziedzicki, 1885**

Records for Bulgaria: *B. dispecta* Dziedzicki: Bechev 1986a: 73. *B. gripha* Dziedzicki: Bechev 1986b: 58, 1997: 13, 2000a: 59, 2002: 87, 2004: 736, 2010: 13.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 215♂♂, 543♀♀, soil traps: 1♀; 03.12.2002–11.01.2003, tree traps: 120♂♂, 89♀, soil traps: 1♀; 11.01.2003–08.02.2003, tree traps: 65♂♂, 34♀♀; soil traps: 3♂♂, 1♀; 07.12.2003–11.01.2004, tree traps: 147♂♂, 121♀♀; soil traps: 4♀♀.

Vertical distribution: 300–2390 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: III–VIII, XI, XII. (Bechev 2010); I (this study).

***Boletina nigricoxa* Staeger, 1840**

Records for Bulgaria: Bechev 2000a: 59, 2002: 88, 2004: 736, 2006a: 704, 2010: 13.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, tree traps: 150♂♂.

Vertical distribution: 300–1700 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: III–VI (Bechev 2010); XII (this study).

***Coelosia flava* (Staeger, 1840)**

Records for Bulgaria: Bechev 1986b: 57, 1997: 14, 2000a: 59, 2002: 88, 2010: 15.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 1056♂♂, 957♀♀; soil traps: 86♂♂, 51♀♀; 03.12.2002–11.01.2003, tree traps: 450♂♂, 540♀♀, soil traps: 163♂♂, 65♀♀; 11.01.2003–08.02.2003, tree traps: 340♂♂, 245♀♀, soil traps: 40♂♂, 64♀♀; 08.11–6.12.2003, tree traps: 44♂♂,26♀♀, soil traps: 125♂♂, 62♀♀; 7.12.2003–11.01.2004, tree traps: 1683♂♂, 1451♀♀, soil traps: 257♂♂, 164♀♀.

Vertical distribution: 1250 m a.s.l. (Bechev 2010), 170–240 m a.s.l. (this study).

Seasonal activity: VII (Bechev 2010); I, XI, XII (this study).

Subfamily Leiinae Edwards, 1925

***Docosia gilvipes* (Walker, 1856)**

Records for Bulgaria: Bechev 1989a: 156, 1997: 14, 2000a: 59, 2002: 89, 2004: 737, 2006a: 705, 2010:23.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 46♂♂, 10♀♀; soil traps: 1♀; 03.12.2002–11.01.2003, tree traps: 98♂♂, 40♀♀; 11.01.2003–08.02.2003, tree traps: 26♂♂, 18♀♀; 7.12.2003–11.01.2004, tree traps: 1♂.

Vertical distribution: 300–1500 m a.s.l. (Bechev 2010), 170–240 m a.s.l. (this study).

Seasonal activity: IV–VIII (Bechev 2010); I, XI, XII (this study).

***Leia bimaculata* (Meigen, 1804)**

Records for Bulgaria: *Neoglaphyroptera fascola* Meigen: Nedelkov 1912: 179. *Leia bimaculata* (Meigen): Bechev 1985: 38, 1989b: 162, 1997: 14, 1999a: 38, 2000a: 60, 2002: 90, 2004: 737, 2006a: 705, 2010: 23.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 14♂♂, 4♀♀; soil traps: 7♀♀; 08.11–6.12.2003, soil traps: 1♀.

Vertical distribution: 250–1500 m a.s.l. (Bechev 2010), 170–240 m a.s.l. (this study).

Seasonal activity: V–X (Bechev 2010); XI (this study).

Subfamily Mycetophilinae Newman, 1834

Tribe Exechiini Edwards, 1925

***Allodia* (*Allodia*) *ornaticollis* (Meigen, 1818)**

Records for Bulgaria: Bechev 1997: 15, 1998: 62, 2000a: 60, 2002: 91, 2010: 26.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, soil traps: 39♂♂, 13♀♀; 07.12.2003–11.01.2004, tree traps: 2♂♂, 2♀♀; soil traps: 1♂, 1♀; 04.12.2018–07.01.2019, tree traps: 1♂.

Vertical distribution: 10– 800 m a.s.l. (Bechev 2010).

Seasonal activity: IV, V, VII, X, XI (Bechev 2010); XII (this study).

***Allodia* (*Brachicampta*) *alternans* (Zetterstedt, 1838)**

Records for Bulgaria: Bechev 1997: 15, 1998: 62, 2000a: 60, 2002: 91, 2010:26.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 62♂♂, 30♀♀; 03.12.2002–11.01.2003, tree traps: 65♂♂, 45♀♀; 11.01.2003–08.02.2003, tree traps: 6♂♂, 3♀♀.

Vertical distribution: 350–1250 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–X (Bechev 2010); I, XI, XII (this study).

***Allodia* (*Brachycampta*) *pistillata* (Lundström, 1911)**

Records for Bulgaria: Bechev 1997: 15, 1998: 62, 2000a: 60, 2002: 91, 2010: 27.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–04.12.2018, tree traps: 1♂, 1 ♀.

Vertical distribution: 350–1250 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: VI, VII, X (Bechev 2010); XI (this study).

***Allodiopsis domestica* (Meigen, 1830)**

Records for Bulgaria: Bechev 1990: 87, 1997: 15, 2000a: 60, 2002: 91, 2010: 28.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 08.11–6.12.2003, soil traps: 1♂, 2♀♀.

Vertical distribution: 700–1250 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV, VI (Bechev 2010); XI (this study)

***Brevicornu* (*Brevicornu*) *fissicauda* (Lundström, 1911)**

Records for Bulgaria: Bechev 1991: 28, 1997: 15, 2000a: 60, 2002: 92, 2010: 29.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, soil traps: 44♂♂, 18♀♀; 03.12.2002–11.01.2003, tree traps: 37♂♂, 23♀♀; 07.12.2003–11.01.2004, tree traps: 3♂♂, 4♀♀, soil traps: 1♂.

Vertical distribution: 350–1250 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–VIII (Bechev 2010); XI, XII (this study).

***Cordyla brevicornis* (Staeger, 1840)**

Records for Bulgaria: Nedelkov 1912: 179; Bechev 1985: 39, 1997: 15, 2000a: 61, 2002: 93, 2006a: 706, 2010: 31.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, tree traps: 24♂♂, 12♀♀; 04.12.2018–07.01.2019, tree traps: 1♂.

Vertical distribution: 600–1500 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: VIII–X (Bechev 2010); XII (this study).

***Cordyla crassicornis* Meigen, 1818**

Records for Bulgaria: Bechev 1996: 20, 1997: 15, 2000a: 61, 2002: 93, 2010: 31.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, soil traps: 1♂; 07.12.2003–11.01.2004, soil traps: 2♂♂.

Vertical distribution: 5–600 m a.s.l. (Bechev 2010).

Seasonal activity: III, V–VII, XI (Bechev 2010); XII (this study).

***Cordyla fusca* Meigen, 1804**

Records for Bulgaria: Bechev, 1996: 20; 1997: 16; 1999a: 38; 2000a: 61; 2002: 93; 2010: 32.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 12♂♂.

Vertical distribution: 350–1100 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: VII (Bechev 2010); XI (this study).

***Cordyla nitens* Winnertz, 1863**

Records for Bulgaria: Bechev 1996: 20, 1997: 16, 1999a: 38, 2000a: 61, 2002: 93, 2010: 32.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 4♂♂, 18♀♀, soil traps: 7♂♂, 2♀♀; 11.01.2003–08.02.2003, tree traps: 3♂♂; 08.11–6.12.2003, tree traps: 2 ♂♂; 07.12.2003–11.01.2004, tree traps: 1♀.

Vertical distribution: 350–1100 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: V, VI (Bechev 2010); I, XI, XII (this study).

***Exechia fusca* (Meigen, 1804)**

Records for Bulgaria: Bechev 1996: 20, 1997: 16, 1999a: 38, 2000a: 61, 2002: 93, 2010: 34.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 52♂♂, 13♀♀; 11.01.2003–08.02.2003, tree traps: 12♂♂, 13♀♀; 08.11–6.12.2003, tree traps: 2♀♀; 07.12.2003–11.01.2004, soil traps: 2♂♂, 4♀♀.

Vertical distribution: 350–1100 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: VII (Bechev 2010); I, XI, XII (this study).

***Exechiopsis (Exechiopsis) magnicauda* (Lundström, 1911)**

Records for Bulgaria: Bechev 1986a: 73, 1997: 16, 2000a: 61, 2002: 95, 2010: 37.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 13♂♂, 2♀♀.

Vertical distribution: 700–1250 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: V–X (Bechev 2010); XI (this study).

****Stigmatomeria crassicornis* (Stannius, 1931)**

New species for Bulgaria.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, tree traps: 1♂, 5♀♀; 11.01.2003–08.02.2003, tree traps: 2♀♀; 07.12.2003–11.01.2004, tree traps: 3♀♀, soil traps: 4♀♀; 4.12.18–07.01.19, tree traps: 1♂.

Vertical distribution: 170–240 m a.s.l.

Seasonal activity: I, XI, XII.

***Synplasta gracilis* (Winnertz, 1863)**

Records for Bulgaria: *Allodiopsis (G.) excogitata* (Dziedzicki): Bechev 1991: 27, 1997: 15, 2000a: 60. *Synplasta exogitata (Dziedzicki)*: Bechev 2002: 96. *S. gracilis* (Winnertz, 1863): Bechev 2003: 98, 2010: 40.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, soil traps: 2♂♂.

Vertical distribution: 900–1250 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV, IX (Bechev 2010); XII (this study).

***Tarnania fenestralis* (Meigen, 1818)**

Records for Bulgaria: *Rymosia fenestralis*: Burghele-Balacesco 1966: 302, 305. *Tarnania fenestralis* (Meigen): Bechev 1985: 39, 1997: 17, 1999a: 39, 2000a: 62, 2002: 97, 2004: 738, 2006a: 706, 2010: 41.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, tree traps: 15♂♂.

Vertical distribution: 100–1250 m a.s.l. (Bechev 2010).

Seasonal activity: V, VI, VIII–X (Bechev 2010); XII (this study).

***Tarnania nemoralis* (Edwards, 1941)**

Records for Bulgaria: Bechev 1991: 27, 1997: 17, 2000a: 62, 2002: 97, 2010: 41.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 07.01–06.02.2019, tree traps: 1♂.

Vertical distribution: 400–1200 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV (Bechev 2010); I (this study).

Tribe Mycetophilini Newman, 1834

***Dynatosoma fuscicorne* (Meigen, 1818)**

Records for Bulgaria: Bechev 1991: 28, 1997: 17, 2000a: 62, 2002: 97, 2004: 738, 2010: 41.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 56♂♂, 13♀♀; 03.12.2002–11.01.2003, tree traps: 16♂♂.

Vertical distribution: 350–1700 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–VII, IX (Bechev 2010); XI, XII (this study).

***Mycetophila fungorum* (De Geer, 1776)**

Records for Bulgaria: *M. punctata* Meigen: Nedelkov 1912: 179. *M. fungorum* (De Geer): Bechev 1985: 39, 1989b: 162, 1997: 17, 1999a: 39, 2000a: 62, 2002: 98, 2004: 738, 2006a: 707, 2010: 45.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 320♂♂, 314♀♀, soil traps: 5♂♂, 10♀♀; 03.12.2002–11.01.2003, tree traps: 67♂♂, 73♀♀; 11.01.2003–08.02.2003, tree traps: 45♂♂, 18♀♀, soil traps: 5♂♂; 07.12.2003–11.01.2004, tree traps: 5♂♂, 11♀♀.

Vertical distribution: 150–1700 m a.s.l. (Bechev 2010).

Seasonal activity: IV–XI (Bechev 2010); I, XII (this study).

***Mycetophila marginata* Winnertz, 1863**

Records for Bulgaria: Bechev 1985: 39, 1997: 17, 2000a: 62, 2002: 99, 2004: 738, 2006a: 707, 2010: 46.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 286♂♂, 185♀♀, soil traps: 12♂♂, 9♀♀; 03.12.2002–11.01.2003, tree traps: 167♂♂, 61♀♀, soil traps: 11♂♂, 11♀♀; 11.01.2003–08.02.2003, tree traps: 13♂♂, 4♀♀; 08.11–6.12.2003, soil traps: 3♂♂, 2♀♀; 7.12.2003–11.01.2004, tree traps: 7♂♂, 6♀♀, soil traps: 2♂♂, 2♀♀.

Vertical distribution: 300–2000 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–X (Bechev 2010); I, XI, XII (this study).

***Mycetophila ocellus* Walker, 1848**

Records for Bulgaria: Bechev 1991: 29, 1997: 18, 2000a: 62, 2002: 99, 2004: 738, 2006a: 707, 2010: 47.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 215♂, 103♀♀.

Vertical distribution: 350–2000 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV–X (Bechev 2010); XI (this study).

***Phronia basalis* Winnertz, 1863**

Records for Bulgaria: Bechev 1999b: 39, 2002: 100, 2010: 50.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, tree traps: 6210♂♂, 4393♀♀; 11.01.2003–08.02.2003, tree traps: 2456♂♂, 1789♀♀, soil traps: 67♂♂, 45♀♀.

Vertical distribution: 100–200 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: V (Bechev 2010); I, XII (this study).

***Phronia biarcuata* (Becker, 1908)**

Records for Bulgaria: *P. nitidiventris* (van der Wulp): Bechev, 1999b: 40; 2000a: 63. *P. biarcuata* (Becker): Bechev, 2002: 100; 2010: 50.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 132♂♂, 108♀♀; 03.12.2002–11.01.2003, tree traps: 342♂♂, 267♀♀, soil traps: 70♂♂, 19♀♀.

Vertical distribution: 350–1200 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV, VI, VII (Bechev 2010); XI, XII (this study).

***Sceptonia cryptocauda* Chandler, 1991**

Records for Bulgaria: Bechev 1994: 26, 1995: 10, 1997: 18, 2000a: 63, 2002: 101, 2010: 53.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–04.12.2018, tree traps: 1♂, soil traps: 1♀.

Vertical distribution: 280–800 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV, VII, IX, X (Bechev 2010); XI (this study).

***Sceptonia flavipuncta* Edwards, 1925**

Records for Bulgaria: Bechev 1994: 26, 1995: 10, 1997: 18, 2000a: 63, 2002: 101, 2010: 53.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 03.12.2002–11.01.2003, tree traps: 10♂♂.

Vertical distribution: 10–1000 m a.s.l. (Bechev 2010).

Seasonal activity: IV–IX (Bechev 2010); XII (this study).

***Sceptonia membranacea* Edwards, 1925**

Records for Bulgaria: Bechev 1994: 27, 1995: 12, 1997: 18, 2000a: 63, 2002: 101, 2006a: 708, 2010: 54.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 13♂♂, 5♀♀, soil traps: 2♂♂, 1♀.

Vertical distribution: 10–1500 m a.s.l. (Bechev 2010).

Seasonal activity: V–VIII, X (Bechev 2010); XI (this study).

***Trichonta venosa* (Staeger, 1840)**

Records for Bulgaria: Bechev 1990: 88, 1997: 19, 2000a: 64, 2002: 103, 2010: 57.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 10♂♂; 03.12.2002–11.01.2003, tree traps: 15♂♂, 10♀♀; 11.01.2003–08.02.2003, tree traps: 6♂♂; 07.01–06.02.2019, tree traps: 1♂.

Vertical distribution: 1000 m a.s.l. (Bechev 2010); 170–240 m a.s.l. (this study).

Seasonal activity: IV (Bechev 2010); I, XI, XII (this study).

***Trichonta vitta* (Meigen, 1830)**

Records for Bulgaria: Bechev 1990: 88, 1997: 19, 2000a: 64, 2002: 103, 2010: 57.

Material examined: Strouma Valley; 2 km S from Kamenitsa, 02.11–03.12.2002, tree traps: 6♂♂, 3♀♀; 03.12.2002–11.01.2003, tree traps: 15♂♂, 4♀♀.

Vertical distribution: 100–1000 m a.s.l. (Bechev 2010).

Seasonal activity: III–VII, IX (Bechev 2010); XI, XII (this study).

Data are summarised in Appendix 1.

In the course of this study two different types of preservatives were used: formaldehyde and propylene glycol. No significant differences in quantity of specimens were found between the two preservatives and no attractive effect on the fungus gnats or other groups of Arthropoda was observed.

The numbers of collected fungus gnat specimens in different types of traps (tree and soil) used in the study are shown in Table 1. For the whole period of the study, 27,095 specimens were collected in tree traps and 1470 specimens in soil traps.

A Venn diagram (Fig. 3) was constructed using data from 2002–2003 winter months and showing the species diversity of fungus gnats in the studied area. Two species were recorded in all months: *Coelosia flava*, with 7869 specimens and *Mycetophila marginata*, with 781 specimens. Five species were found during four of the months: *Boletina gripha* (1344 specimens), *Mycetophila fungorum* (873 specimens), *Docosia gilvipes* (240 specimens), *Cordyla nitens* (37 specimens) and *Exechia fusca* (98 specimens).

The Shannon Index takes into account the number of specimens as well as the number of species. It ranges from zero (0) for communities with a single species to infinity for communities with many species, each with several individuals. The index had the highest values in November 2002, December 2002 and January 2003 (Fig. 4) when the greatest diversity of species was established, some of which were recorded with many specimens. The results from 2018/2019 also presented high values of the indices; however, they had the largest error bars due to low numbers of collected species, each represented by a single individual. In November 2003 and December 2003, the lowest values of species diversity indices were recorded. Considering these results, we could assume the community was most diverse during November 2002, as shown by the abundance and even distribution of species.

The Simpson Index, giving information about the dominance of species and ranging from 0 (all spe-

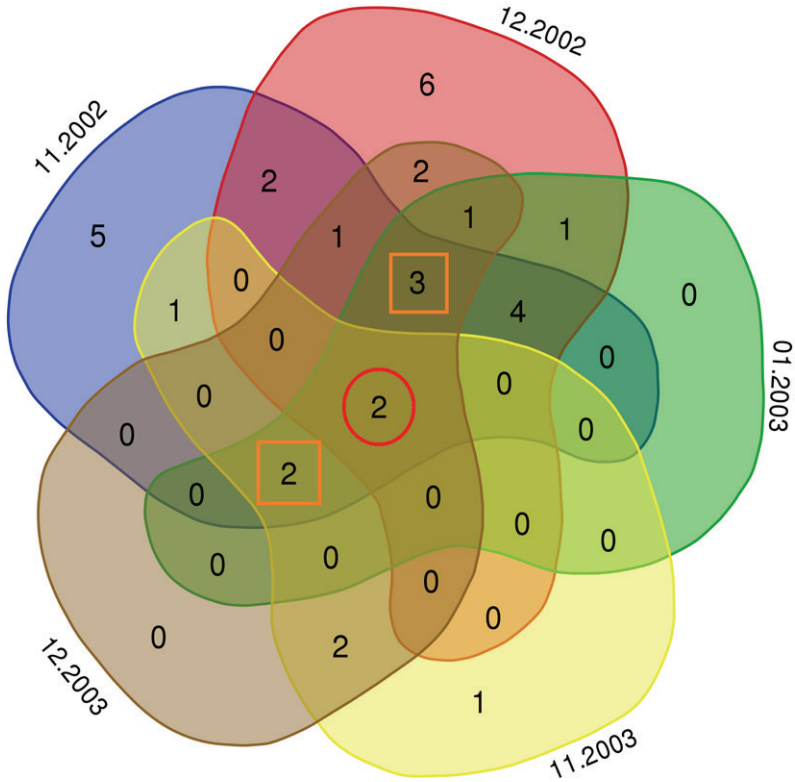

Fig. 3. Venn-diagram of species recorded in November–December 2002 and January, November, December 2003. Legend: ◯ species recorded in all five months; ▭ species recorded in four months.

Table 1. Number of specimens of the family Mycetophilidae collected in tree and soil traps.

	Nov 2002	Dec 2002	Jan 2003	Nov 2003	Dec 2003	Nov 2018	Dec 2018	Jan 2019
Mycetophilids in tree traps	4988	13428	5144	76	3451	3	3	2
Mycetophilids in soil traps	198	404	226	197	444	1	0	0

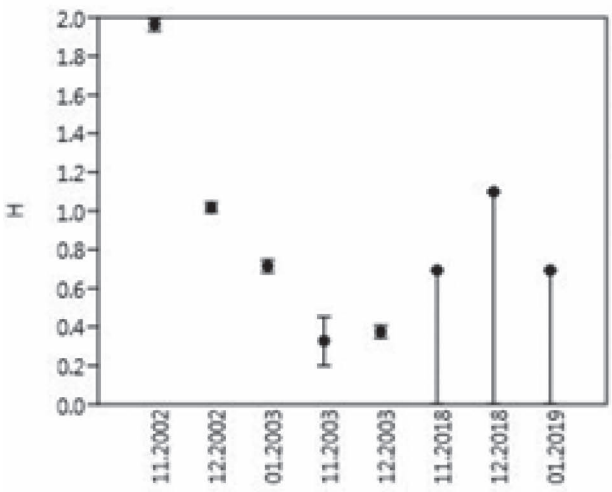

Fig. 4. Shannon Index of fungus gnats in winter in Kamenitsa Village. Legend: vertical axis (H) – values of Shanon Index; horizontal axis – months of the study; ┤ – error bars.

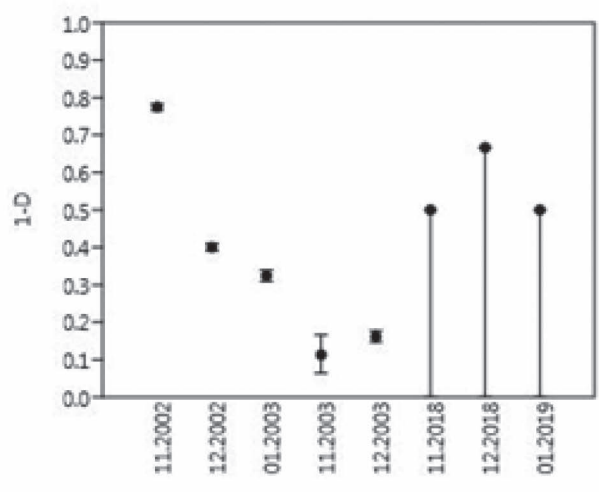

Fig. 5. Simpson index – Dominance index of fungus gnats during winter month in Kamenitsa village
Legend: Vertical axis (1-D) – values of Simpson index; Horizontal axis – months of the study; ┤ – error bars.

cies equally represented) to 1 (one species completely dominating the community), had the lowest value in November 2002 (Fig. 5). The most numerous species was *Coelosia flava* with 2150 specimens; however, it did not dominate over the other species, since they were also represented by high numbers of individuals. *Phronia basalis* was the most abundant species in December 2002 (with 10,603 specimens) and in January 2003 (with 4357 specimens). The total numbers of specimens of the remaining species had medium values during these months compared to those in November 2002 and November 2003, which resulted into medium values of the index. The numbers of the species in November and December 2003 were small but the values of the Simpson Index were high due to the expressed domination of *Coelosia flava*. The season of 2018–2019 was characterised by large error bars and the index values were close to zero as mycetophilid communities in these months were represented by two or three species, each with one or two individuals only; therefore, no an expressed species dominance was observed in these months. Considering the values of the Shannon Index and the Simpson Index, we could assume that the community was most stable during November 2002, when it was characterised by the greatest abundance and diversity and had no expressed dominance of any species.

Discussion

This study provides data about 28,557 specimens of 35 fungus gnat species and 20 genera. The most abundant species, *Phronia basalis* (14,960 specimens), a Western-Palaearctic species, has been found to be active during only two months: December 2002 and January 2003. *Stigmatomeria crassicornis* is a newly-recorded species for the fauna of Bulgaria. This species has been reported from Romania (Kolcsár & Salmela 2017) and Greece (Chandler et al. 2005), making its presence in Bulgaria expected; it has a Holarctic distribution and it is frequently found in Europe (Kjærandsen et al. 2007, Chandler 2013). With the addition of *S. crassicornis*, fungus gnats' diversity in Bulgaria reaches 318 species.

Our results show that tree traps are a much more efficient for collecting fungus gnats than soil traps. Tree traps have been placed on kermes oaks at 1–2 m above the ground. Due to the high number of collected specimens, we could speculate that this is the preferred air flight zone of mycetophilids. Although tree traps have been found to gather more individuals, fungus gnats are also abundant near the ground (as shown by insects collected with soil traps) where they feed or develop from larvae into imagoes.

The species found in all winter months of 2002–2003 in the studied area are *Coelosia flava* and *Mycetophila marginata*, frequently recorded and widespread in the Western Palearctic and Western Europe, respectively. *Boletina gripha*, *Mycetophila fungorum*, *Docosia gilvipes*, *Cordyla nitens* and *Exechia fusca* have been registered in all months and are also widespread Palaearctic and Holarctic species. The above-mentioned species are typical eurybionts, with high ecological plasticity and relatively high abundance in winter months in the studied area.

It has been hypothesised that the high abundance of fungus gnats recorded in 2002–2003 is due to weather conditions. We have obtained data from the National Institute of Meteorology and Hydrology (NIMH 2019) accounting for monthly precipitation and average temperature in the studied area (Figs. 4, 5). The figures show that November and December 2002 as well as January 2003 are months with heavy rainfall and average temperature between 5 and 10°C. Considering the biological requirements of the fungus gnats, which develop in warm and humid conditions, a correlation can be made between weather conditions in the winter months of 2002–2003 and the high number of specimens collected during that time.

It is interesting to note that the abundance of fungus gnats has not been high in November and December 2018 and January 2019, even though rainfall levels in January 2019 have been similar to those in December 2002, i.e. the month with the highest number of specimens – 13,824. It is likely that the low abundance during 2018/2019 (not just for the fungus gnats but also for other insect groups) is provoked by various circumstances that may be a subject of further studies such as a short-term plague, biodiversity loss, climate change, etc.

Russell-Smith (1979) has studied mycetophilids in beech woodlands of Kent (England) using four traps (30 cm x 45 cm) for one year. Although his study has been done in habitats differing from those in the Mediterranean region, it provides information on the seasonal activity and optimal conditions for the development of fungus gnats. He recorded nearly 10,000 specimens in April and around 5000 in March and May. Probably such peaks in abundance of fungus gnats, which we also found in our study, are quite usual and depend on habitats and climate conditions. We have recorded the highest annual abundance of fungus gnats during November, December and January, since during that time of the year the Mediterranean habitats are humid and warm enough for the development of this group. Russell-Smith (1979) has found that *Boletina gripha* and *Phronia basalis* are among the most

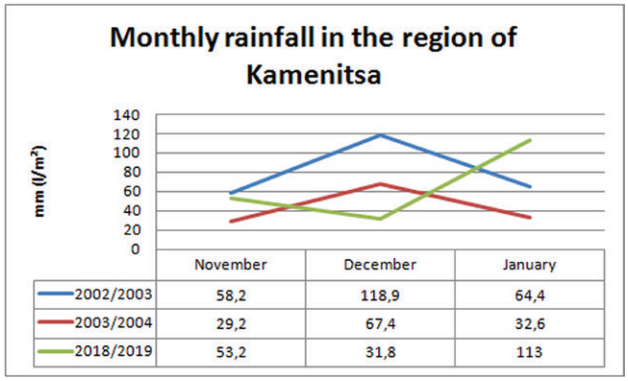

Fig. 6. Monthly precipitation mm (l/m^2) in Kamenitsa region during November, December and January (2002/2003; 2003/2004, 2018/2019).

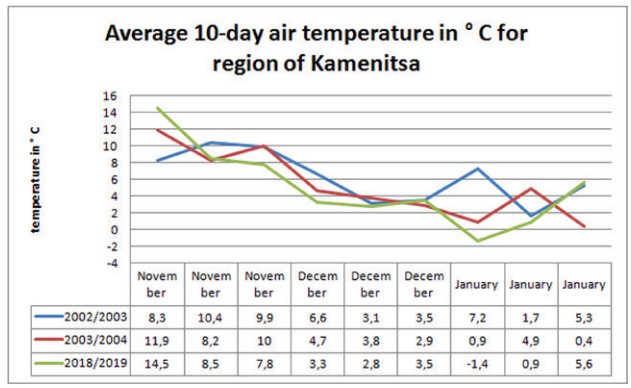

Fig. 7. Air temperature in Kamenitsa region during November, December and January (2002/2003; 2003/2004, 2018/2019). Data plotted are averages of the temperature of 10 days in ˚C.

abundant species, with more than 2000 specimens in April. The observations of Russell-Smith (1979) reveal the same dominant species as in kermes oak habitats in Bulgaria, with only *Coelosia flava* added by us. The possible explanation of the similar composition of the dominant species in these very different habitats is the fact that the dominating taxa are widespread Palaearctic species.

Winter activity of fungus gnats during November, December and January in Mediterranean regions of Spain has been reported by Chandler & Blasco-Zumeta (2001). They have present studies on specimens collected using various methods, including Moericke traps. Although mycetophilids have been shown to be active during these months, such activity was at a lower level compared to our results from the area of Kamenitsa Village.

Chandler (2009) has published results of a study on fungus gnats in Sardinia collected using Malaise traps, recording in winter months (November and December) 55 out of 105 identified mycetophilid species; among the recorded species in that study, some of the most abundant species from the region of Kamenitsa Village such as *Boletina gripha*, *Phronia basalis* and others have been listed. However, no exact information about the numbers of specimens has been given and we cannot compare the dominant species of these two studies.

Jürgenstein et al. (2015) have presented a study on the group of *Mycetophila ruficollis*, using molecular methods on materials partially collected in Greece during November and December, showing once again that the winter conditions in the Mediterranean provide optimal conditions for the development of fungus gnats.

Studies on seasonal activity have been previously conducted in Bulgaria by Bechev (2000a). The material was collected with an entomological net in the West Stara Planina (Balkan Range) at an altitude of 250–1760 m a.s.l. The fieldwork was done at 31 localities, visited periodically, mainly from March to October during 1981-1993. Bechev (2000a) has recorded the most considerable presence of fungus gnats from April to September. This might be due to favourable conditions linked to high humidity and warm temperatures, which are conserved at high altitudes even during summer months.

The results of our study, using materials from the area of the Kamenitsa Village from habitats dominated by kermes oak, show high abundance of fungus gnats in winter and this new information on the seasonal activity of mycetophilids has expanded the knowledge about their ecological plasticity. The studied area consists of habitats of Mediterranean and Sub-Mediterranean type, where summer is very dry and hot, while winter provides favourable conditions for the development of fungus gnats, i.e. sufficient rainfall combined with average temperature above zero degrees. Studies in these critically endangered habitats should be continued in order to implement sustainable methods that will preserve them in the future. In addition, more studies will be needed to obtain new data on the diversity and abundance of organism groups and their seasonal activity.

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References

Bechev D. 1985. The species of Superfamily Mycetophiloidea (Diptera) distributed in Bulgaria. Acta Zoologica Bulgarica 27: 36–40 (In Bulgarian, with English summary).

Bechev D. 1986a. New species of the superfamily Mycetophiloidea (Diptera) for the Bulgarian fauna. Acta Zoologica Bulgarica 30: 72–74 (In Bulgarian).

Bechev D. 1986b. New species of the Superfamily Mycetophiloidea (Diptera) for the Bulgarian Fauna. II. Acta Zoologica Bulgarica 32: 56–59 (In Bulgarian, with English summary).

Bechev D. 1986c. *Sciophila rufa* Meigen (Diptera, Mycetophilidae) as a host for *Orthocentrus stigmaticus* Holmgren (Hymenoptera, Ichneumonidae). Acta Zoologica Bulgarica 32: 60–61. (In Bulgarian, with English summary).

Bechev D. 1989a. New species of Mycetophiloidea (Diptera) for Bulgarian fauna. III. Travaux Scientifiques d'Universite de Plovdiv, Biologie 27: 153–159. (In Bulgarian, with English summary).

Bechev D. 1989b. Larvae of Mycetophiloidea (Diptera) established in fungi in Bulgaria. Travaux Scientifiques d'Universite de Plovdiv, Biologie 27: 161–163. (In Bulgarian, with English summary).

Bechev D. 1990. New species of Mycetophiloidea (Diptera) to the Bulgarian fauna. IV. Travaux Scientifiques d'Universite de Plovdiv, Biologie 28: 85–88. (In Bulgarian, with English summary).

Bechev D. 1991. New species of Mycetophiloidea (Diptera) to the Bulgarian fauna. V. Travaux Scientifiques d'Universite de Plovdiv, Biologie 29: 27–30. (In Bulgarian, with English summary).

Bechev D. 1994. New species of Mycetophiloidea (Diptera) to the fauna of Bulgaria. VI. Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 30: 25–28.

Bechev D. 1995. The Palaearctic species of the genus *Sceptonia* Winnertz (Diptera: Mycetophilidae). Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 31: 7–21.

Bechev D. 1996. New species of fungus gnats (Diptera: Sciaroidea, excluding Sciaridae) to the fauna of Bulgaria. VII. Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 32: 19–21.

Bechev D. 1997. Check-list of the fungus gnats (Diptera: Sciaroidea, excluding Sciaridae) of the Balkan Peninsula. Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 33: 9–22.

Bechev D. 1998. The species of *Allodia* Winnertz on the Balkan Peninsula (Diptera, Mycetophilidae). Acta Zoologica Bulgarica 50 (1): 61–63.

Bechev D. 1999a. Biotic connections of fungus gnats (Diptera: Sciaroidea, excluding Sciaridae) in forest habitats of mount Pirin. Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 35: 37–40. (In Bulgarian).

Bechev D. 1999b. Species of the genus *Phronia* Winnertz in Bulgaria (Diptera, Mycetophilidae). Acta Zoologica Bulgarica 51 (2/3): 39–42.

Bechev D. 1999c. The zoogeogaphic classification of the Palaearctic genera of fungus gnats (Diptera: Sciaroidea, excluding Sciaridae). Studia Dpteriologica 6 (2): 321–326.

Bechev D. 2000a. Seasonal activity and vertical distribution of fungus gnats (Diptera: Sciaroidea, excluding Sciaridae) in the Western and Central parts of Stara planina ridge (Bulgaria). Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 36: 51–66.

Bechev D. 2000b. World distribution of the genera of fungus gnats (Diptera: Sciaroidea, excluding Sciaridae). Studia Dipterologica 7 (2): 543–552.

Bechev D. 2002. Check list of the fungus gnats of the families Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae and Mycetophilidae in Bulgaria (Diptera: Nematocera). Travaux Scientifiques d'Universite de Plovdiv, Biologie, Animalia 38: 81–112.

Bechev D. 2003. Corrections and additions to the check list of the fungus gnats in Bulgaria (Diptera: Sciaroidea). Travaux Scientifiques d'Universite de Plovdiv, Animalia 39: 97–99.

Bechev D. 2004. Fungus gnats (Diptera: Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae, Mycetophilidae) of the Eastern Rhodopes (Bulgaria). In: Beron P. & Popov A. (Eds.): Biodiversity of Bulgaria. 2. Biodiversity of Eastern Rhodopes (Bulgaria and Greece). Sofia: Pensoft & National Museum of Natural History, pp. 735–739.

Bechev D. 2006a. Fungus gnats (Diptera: Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae, Mycetophilidae) of the Western Rhodopes (Bulgaria). In: Beron P. (Ed.): Biodiversity of Bulgaria. 3. Biodiversity of Western Rhodopes (Bulgaria and Greece) I. Sofia: Pensoft & National Museum of Natural History, pp. 701–710.

Bechev D. 2006b. The fungus gnats of the families Bolitophilidae, Diadocidiidae, Ditomyiidae and Keroplatidae (Diptera: Sciaroidea) of Bulgaria. Scientific Studies of the University of Plovdiv, Biology, Animalia (42): 21–83.

Bechev D. 2010. On the family Mycetophilidae (Insecta: Diptera) in Bulgaria. ZooNotes, Supplement 1: 1–72.

Bechev D. & Pavlova A. 2012. *Greenomyia tomovi* sp. n. from Bulgaria (Diptera: Mycetophilidae: Leiinae) and a key to the Palaearctic species of the genus. Acta Zoologica Bulgarica 64 (2): 109–111.

Bechev D. & Pavlova A. 2016. Fungus gnats (Diptera: Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae and Mycetophiliade) of Vrachanska Planina Mountains. In: Bechev D. & Georgiev D. (Eds.): Faunistic diversity of Vrachanski Balkan Nature Park. ZooNotes, Supplement 3. Plovdiv: University Press, pp. 169–179.

Burghele-Balacesco A. 1966. Dipteres cavernicoles recueilles en Bulgarie. International Journal of Speleology (2): 303–308.

Chandler P. J. 2009. The fungus gnats (Diptera: Bolitophilidae, Keroplatidae, Mycetophilidae) of Sardinia, with description of six new species. Zootaxa 2318 (1): 450–506.

Chandler P. J. 2013. Fauna Europaea: Bolitophilidae, Keroplatidae, Mycetophilidae. In: Pape T. & Beuk P. 2013. Fauna Europaea, Diptera. https://fauna-eu.org/cdm_dataportal/taxon/a74e2a5b-0fe9-4477-ad89-1b309641bfc8 Accessed on: 20.10.2019

Chandler P. J. & Blasco-Zumeta J. 2001. The fungus gnats (Diptera, Bolitophilidae, Keroplatidae and Mycetophilidae) of the Monegros region (Zaragoza, Spain) and five other new European species of *Pyratula* Edwards and *Sciophila* Meigen. Zapateri Revista Aragonesa de Entomología (9): 1–24.

Chandler P. J., Bechev D. & Caspers N. 2006. The fungus gnats (Diptera: Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae and Mycetophilidae) of Greece, its islands and Cyprus. Studia Dipterologica 12 (2): 255–314.

Gusev C. 2015. Shrubs and low woods of of Kermes Oak (*Quercus coccifera*). In: Biserkov V., Gusev C., Popov V., Hiebaum G., Roussakova V., Pandurski I., Uzunov Y., Dimitrov M., Tzonev R., Tsoneva S. (Eds.): Red-Data Book of Republic of Bulgaria. Vol. 3. Habitats. Sofia: IBER–BAS & MOEW, pp. 254–256.

Hammer Ø., Harper D. & Ryan P. 2001. Past: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontologia Electronica 4 (1–4): 1–9. http://palaeo-electronica.org/2001_1/past/issue1_01.htm.

Jürgenstein S., Kurina O. & Põldmaa K. 2015. The *Mycetophila ruficollis* Meigen (Diptera, Mycetophilidae) group in Europe: elucidating species delimitation with COI and ITS2 sequence data. ZooKeys 508: 15–51.

Kjærandsen J. 2019. Mycetophilidae Newman, 1834. In Fungus Gnats Online. Accessed at http://sciaroidea.info/taxonomy/41634 on 20.10.2019

Kjærandsen J., Hedmark K., Kurina O., Polevoi A., Økland B. & Götmark F. 2007. Annotated checklist of fungus gnats from Sweden (Diptera: Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae and Mycetophilidae). Insect Systematics and Evolution Supplements 65: 1–128.

Kolarov J. & Bechev D. 1995. Hymenopterenparasiten (Hymenoptera) auf Pilzmücken (Mycetophiloidea, Diptera). Acta Entomologica Bulgarica 2: 18– 20.

Kolcsár L-P. & Salmela J. 2017. New taxonomic and faunistic records of fungus gnats (Insecta, Diptera) from Montenegro, Romania, and Serbia. Biodiversity Data Journal. Check List 13 (5): 533–559. https://doi.org/10.15560/13.5.533

Kurina O. & Chandler P. 2018. New European records of *Ditomyia macroptera* Winnertz (Diptera: Ditomyiidae) with notes on its distribution. Biodiversity Data Journal 6: 2–8.

Langourov M. 2001. Faunistic, ecological and zoogeographic studies of the family Phoridae (Diptera, Brachycera) of Vitosha Mountains. PhD Dissertation. Sofia: Institute of Zoology. 171 p. (In Bulgarian)

Langourov M. & Simov N. 2006. Study of the biodiversity of mobile animal groups in communities of kermes oak (*Quercus coccifera* L.). Historia Naturalis Bulgarica 17: 166. (In Bulgarian).

Nedelkov N. 1912. Sixth contribution to the entomological fauna of Bulgaria. Journal of Bulgarian Academy of Sciences (2): 177–218. (In Bulgarian).

NIMH 2019. Special meteorological report for Kamenitsa region for 2002/2003 and 2018/2019. Sofia: National Institute of Meteorology and Hydrology, 9 p.

Russell-Smith A. 1979. A study of fungus flies (Dipteral Mycetophilidae) in beech woodland. Ecological Entomology 4(4): 355–364.

Søli G. E. E., Vockeroth J. R. & Matile L. 2000. Families of Sciaroidea. In: Papp L. & Darvas B. (Eds.): Contributions to a Manual of Palaearctic Diptera (with Special Reference to Flies of Economic Importance). Appendix. Budapest: Science Herald, pp. 49–92.

Väisänen R. 1984. A monograph of the genus *Mycomya* Rondani in the Holarctic region. Acta Zoologica Fennica 177: 1–346.

Zaitzev A. I. 2003. Fungus gnats (Diptera, Sciaroidea) of the fauna of Russia and adjacent regions. Part II. Dipterological Research 14(2–4): 77–386.

Appendix 1. Identified species, with their winter activity (published and new data), number of male and female specimens in tree or soil traps and vertical distribution in Bulgaria (published and new data).

Taxa	Winter activity	Trap /specimens ♂, ♀		Vertical distribution, m a.s.l.
		tree	soil	
Subfamily Mycomyinae				
Mycomya (Mycomya) cinerascens (Macquart, 1826)	XI; XII	3♂♂	1♂	170–1740
Mycomya (Mycomya) marginata (Meigen, 1818)	I; XI; XII	473♂♂, 256♀♀	28♂♂, 24♀♀	170–950
Mycomya (Mycomya) prominens (Lundström, 1913)	XI; XII	2♂♂, 1♀		170–950
Mycomya (Mycomya) tenuis (Walker, 1856)	XI	10♂♂, 4♀♀	2♀♀	170–1740
Subfamily Sciophilinae				
Sciophila rufa Meigen, 1830	I; XI; XII	45♂♂, 13♀♀	2♀♀	170–1740
Subfamily Gnoristinae				
Boletina gripha Dziedzicki, 1885	I; XI; XII	547♂♂, 787♀♀	3♂♂, 7♀♀	170–2390
Boletina nigricoxa Staeger, 1840	XII	150♂♂		170–1700
Coelosia flava (Staeger, 1840)	I; XI; XII	3573♂♂, 3219♀♀	671♂♂, 406♀♀	170–1250
Subfamily Leiinae				
Docosia gilvipes (Walker, 1856)	I; XI; XII	171♂♂, 68♀♀	1♀	170–1500
Leia bimaculata (Meigen, 1804)	XI	14♂♂, 4♀♀	8♀♀	170–1500
Subfamily Mycetophilinae				
Tribe Exechiini				
Allodia (Allodia) ornaticollis (Meigen, 1818)	XII	3♂♂, 2♀♀	40♂♂, 14♀♀	10–800
Allodia (Brachicampta) alternans (Zetterstedt, 1838)	I; XI; XII	133♂♂, 78♀♀		170–1250
Allodia (Brachycampta) pistillata (Lundström, 1911)	XI	1♂, 1♀		170–1250
Allodiopsis domestica (Meigen, 1830)	XI	1♂, 2♀♀		170–1250
Brevicornu (Brevicornu) fissicauda (Lundström, 1911)	XI; XII	84♂♂, 45♀♀	1♀	170–1250
Cordyla brevicornis (Staeger, 1840)	XII	25♂♂, 12♂♂		170–1500
Cordyla crassicornis Meigen, 1818	XII		3♂♂	5–600
Cordyla fusca Meigen, 1804	XI	12♂♂		170–1100
Cordyla nitens Winnertz, 1863	I; XI; XII	9♂♂, 19♀♀	7♂♂, 2♀♀	170–1100
Exechia fusca (Meigen, 1804)	I; XI; XII	64♂♂, 28♀♀	2♂♂, 4♀♀	170–1100
Exechiopsis (Exechiopsis) magnicauda (Lundström, 1911)	XI	13♂♂, 2♀♀		170–1250
****Stigmatomeria crassicornis*** (Stannius, 1931)	I; XI; XII	2♂♂, 10♀♀	4♀♀	170–240
Synplasta gracilis (Winnertz, 1863)	XII		2♂♂	170–1250
Tarnania fenestralis (Meigen, 1818)	XII	15♂♂		100–1250
Tarnania nemoralis (Edwards, 1941)	I	1♂		170–1200
Tribe Mycetophilini				
Dynatosoma fuscicorne (Meigen, 1818)	XI; XII	72♂♂, 13♀♀		170–1700
Mycetophila fungorum (De Geer, 1776)	I; XI; XII	437♂♂, 416♀♀	10♂♂, 10♀♀	150–1700
Mycetophilaarginata Winnertz, 1863	I; XI; XII	473♂♂, 256♀♀	28♂♂, 24♀♀	150–2000
Mycetophila ocellus Walker, 1848	XI	215♂♂, 103♀♀		150–2000
Phronia basalis Winnertz, 1863	I; XII	8666♂♂, 6182♀♀	67♂♂, 45♀♀	100–240
Phronia biarcuata (Becker, 1908)	XI; XII	474♂♂, 375♀♀	70♂♂, 19♀♀	170–1200
Sceptonia cryptocauda Chandler, 1991	XI	1♂	1♀	170–800
Sceptonia flavipuncta Edwards, 1925	XII	10♂♂		10–1000
Sceptoniaembranacea Edwards, 1925	XI	13♂♂, 5♀♀	2♂♂, 1♀	10–1500
Trichonta venosa (Staeger, 1840)	I; XI; XII	32♂♂, 10♀♀		170–1000
Trichonta vitta (Meigen, 1830)	XI; XII	21♂♂, 7♀♀		100–1000