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Research article

# Data on the largest specimens of *Testudo graeca ibera* Pallas, 1814 found in Bulgaria with five new records

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*In memory of Ivo,*
*whose contribution to the conservation and study of tortoises in Bulgaria is unsurpassed*

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**Abstract:** Very large specimens of *T. graeca ibera* were found in Bulgaria, but mostly in the 20th century. Presently, such tortoises are almost absent in the country. Here we summarise data about the largest spur-thighed tortoises registered in Bulgaria and provide information about five new large-sized individuals. We also draw attention to the fact that large specimens can hardly be found in the country today and discuss some possible negative effects of the extinction of these specimens on the existing populations. The maximum straight carapace length of the largest *T. graeca ibera* ever found in Bulgaria was ≈ 389 mm, but the maximum straight carapace length of the newly measured tortoises was 298 mm. Considering the rarity of such tortoises in the country today, the genes that determine the potential to reach larger sizes may gradually disappear. Thus, the institutions responsible for the conservation of nature should pay attention to areas where the presence of large-sized individuals has been established. This might help preserve the natural genome of *T. graeca ibera* in the country and therefore the existence of large individuals.

**Keywords:** Balkan Peninsula, large-sized individuals, morphometry, Reptilia, Testudinidae, spur-thighed tortoise

## Introduction

The spur-thighed tortoise, *Testudo graeca* Linnaeus, 1758, is represented by 10 subspecies, which are characterised by different sizes (Rhodin et al., 2021). One of the subspecies – *T. graeca ibera* Pallas, 1814 – occurs in Bulgaria (Stojanov et al., 2011). Its general distribution includes parts of Azerbaijan, Armenia, Russia, Georgia, Turkey, Moldova, Romania, Bulgaria, Greece, North Macedonia, Serbia, and Kosovo (Rhodin et al., 2021). In Bulgaria, *T. graeca ibera* is found throughout the country except for north-western Bulgaria, part of the Danubian Plain, Thrace, the montane depressions in western Bulgaria, and the mountains above 1300–1400 m a.s.l. (Beshkov & Nanev, 2002; Biserkov et al., 2007; Stojanov et al., 2011).

Beshkov (1997) published the first article on some very large specimens of *T. graeca ibera* found in Bulgaria, including the largest one known of the

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subspecies. Other data on large specimens registered in the country can also be found in the works of Kovatscheff (1912), Lepşi (1927), Beshkov (1984, 1993), Lazarkevich-Stancheva (1997), Undjian (2000), Stojanov et al. (2011) and Türkozan et al. (2023). Yet, such tortoises are almost absent in Bulgaria nowadays (Türkozan et al., 2023). This is mainly due to different threats that affect their habitats and the age structure of local populations (Beshkov, 1984, 1993, 2015; Petrov et al., 2004). Because of the different threats and thus deteriorated condition of many local populations in the country *T. graeca ibera* is protected by the Biological Diversity Act of Bulgaria (Appendices II and III) (BDA, 2002). It is also listed in the Red Data Book of the Republic of Bulgaria category "Endangered" (Beshkov, 2015).

The aim of the study was to (i) summarise the data about the largest tortoises found in Bulgaria and provide information about five new large specimens, (ii) draw attention to the fact that large tortoises are almost absent in the country today, and (iii) highlight the importance of such specimens for the existing populations.

## Material and methods

To our knowledge, we examined all the available published sources of information about the sizes of *T. graeca ibera* in Bulgaria. The data on the five newly measured tortoises – four live individuals and one shell of a specimen killed by a shepherd – were gathered in two different ways. Two of the tortoises were found during field surveys of the population of *T. graeca ibera* in the northwestern foothills of the Pirin Mts, Rakitna Village. The surveys started in 2021, and the area has regularly been visited since then. The other two tortoises and the shell of the dead specimen were measured in May 2023 at the Tortoise Rehabilitation and Breeding Centre (hereafter the Centre). The Centre is located in Banya Village, Burgas District, in the eastern part of Eminska Mt, which comprises the easternmost part of the Stara Planina Mts (Ivanchev, 2007).

The tortoises were measured using a calliper and an electronic scale. The following parameters were measured: maximum straight carapace length (maximum SCL) – from the first marginal scutes to the rear supracaudal edge; midline straight carapace length (midline SCL) – from the front of nuchal scute to the rear supracaudal edge; mid-body carapace width (mid-body CW) – between the seventh marginal scutes; maximum carapace width (MCW) – at the widest point; shell height (SH) – the maximum vertical height from plastron to carapace; weight (W).

## Results

Information about 16 large specimens, five of which are mentioned for the first time, was summarised. The maximum SCL of the largest specimens found until now in the country varied between 237 and ≈ 389 mm and the weight of the heaviest tortoise was ≈ 6000 g (Table 1). The maximum SCL of the newly measured tortoises varied from 241 to 298 mm (Table 1). All four live tortoises as well as the dead specimen were females. The first large tortoise was captured and measured in Rakitna Village on 4 June 2022 at 11:30 a.m. (N41°50'43.6" E23°10'24.4"; 663 m a.s.l.). It was moving across a meadow next to a dirt road. The weather was calm and the cloud cover was about 80%. The air temperature was 23°C. The second large specimen was captured and measured on 22 August 2022 at 1:35 p.m. (N41°50'40.5" E23°09'44.7"; 712 m a.s.l.) (Fig. 1B). It was standing motionless under oak trees. The weather was calm and the cloud cover was about 70%. The air temperature was 25°C. These two specimens had a maximum SCL of 241 mm and 261 mm, respectively (Table 1).

One of the large tortoises that were measured at the Centre had been living in captivity in a garden near the city of Plovdiv for about 40 years. In 2009 the individual was translocated to the Centre and has lived there since then. It had a maximum SCL of 277 mm (Table 1). The other large tortoise from the Centre had initially been a part of a local population that was under threat of extirpation due to construction works. Therefore, the specimen was saved and translocated to the Centre in 2007. It had a maximum SCL of 278 mm (Table 1). The shell belonged to a very large tortoise that was killed by a local shepherd in the eastern part of Eminska Mt in the 1980s (Fig. 1A). Presently, the shell is in the Centre and can be seen by the people visiting the place. It had the largest size of all the five specimens – a maximum SCL of 298 mm, which placed it seventh among the largest specimens ever registered in the country (Table 1).

Table 1. Summary of the sizes and some other data of the largest specimens of *T. graeca ibera* found in Bulgaria. For abbreviations see Material and methods; f – female, m – male; n/a – not available.

| Maximum SCL | Midline SCL | CW | MC W | SH | W | Sex | Locality | Date of observation | n | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| ≈ 389 | 358 | 272 | 290 | 171 | 5860 | m (?) | vicinities of Gorni Yurutsi Village | 19 June 1987 | n/a | Beshkov, 1997 |
| 364 | 335 | 227 | 273 | 163 | n/a | m (?) | Bulgaria | n/a | n/a | Beshkov, 1997 |
| ≈ 350 | n/a | n/a | n/a | n/a | ≈ 6000 | n/a | Sliven surroundings | 28 August 1976 | n/a | Undjian, 2000 |
| 306 | n/a | n/a | n/a | n/a | n/a | f | Kresna Gorge | n/a | n/a | Stojanov et al., 2011 |
| 303 | 298 | n/a | 233 | 141 | n/a | m (?) | Sakar Mts | 10 July 1933 | n/a | Beshkov, 1997 |
| 301 | n/a | n/a | n/a | n/a | n/a | f | Kresna Gorge | n/a | n/a | Stojanov et al., 2011 |
| **298** | **288** | **200** | **225** | **152** | **n/a** | **f** | **Eminska Mt** | **in the 1980s** | **n/a** | **Present study** |
| 285 | n/a | n/a | n/a | n/a | n/a | n/a | Maleshevska Mts | n/a | n/a | Beshkov, 1984, 1993 |
| **278** | **271** | **200** | **201** | **143** | **3850** | **f** | **between Bozhurets and Balchik** | **in 2008** | **281** | **Present study** |
| **277** | **274** | **192** | **200** | **132** | **3840** | **f** | **around Plovdiv** | **in the 1970s** | **n/a** | **Present study** |
| **261** | **258** | **185.5** | **192.5** | **130** | **3585** | **f** | **Rakitna Village** | **22 August 2022** | **44** | **Present study** |
| n/a | 258 | n/a | n/a | n/a | n/a | f | Bulgaria | n/a | 1142 | Türkozan et al., 2023 |
| 250 | n/a | n/a | n/a | n/a | n/a | n/a | south-eastern Dobrogea | n/a | n/a | Lepşi, 1927 |
| **241** | **239** | **177.5** | **188** | **118** | **2995** | **f** | **Rakitna Village** | **4 June 2022** | **44** | **Present study** |
| 240 | n/a | n/a | n/a | n/a | n/a | n/a | Bulgaria | n/a | n/a | Kovatscheff, 1912 |
| 237 | n/a | n/a | n/a | n/a | n/a | f | Kresna | n/a | 149 | Lazarkevich-Stancheva, 1997 |

## Discussion

Extremely large specimens of *T. graeca ibera* have been observed in Bulgaria since the end of the 19th century (Irechek, 1899; Beshkov, 1984, 1993, 1997; Undjian, 2000; Stojanov et al., 2011). Most of the observations were made during the 20th century (Table 1). At present, such tortoises can hardly be found in the country (Türkozan et al., 2023). In fact, the size of the carapace of most tortoises in Bulgaria today varies from 150 to 250 mm (Petrov et al., 2004; Biserkov et al., 2007; Tzankov & Popgeorgiev, 2011; Türkozan et al., 2023). Türkozan et al. (2023) mentioned that the largest *T. graeca ibera* measured in Bulgaria in recent years had a midline SCL of 258 mm (n = 1142). Most of the larger individuals across the range of the subspecies are females as they usually reach larger sizes than males (Hailey et al., 1988; Willemsen & Hailey, 2003; Buică & Cogălniceanu, 2013; Arslan et al., 2021; Türkozan et al., 2023). This was also confirmed by our results since all of the five specimens that we measured were females.

Large specimens of *T. graeca ibera* were also found in Greece (Buttle, 1989; Cattaneo, 2001; Willemsen & Hailey, 2003; Wilson & Grillitsch, 2009), Turkey (Türkozan et al., 2005, 2010; Akveran

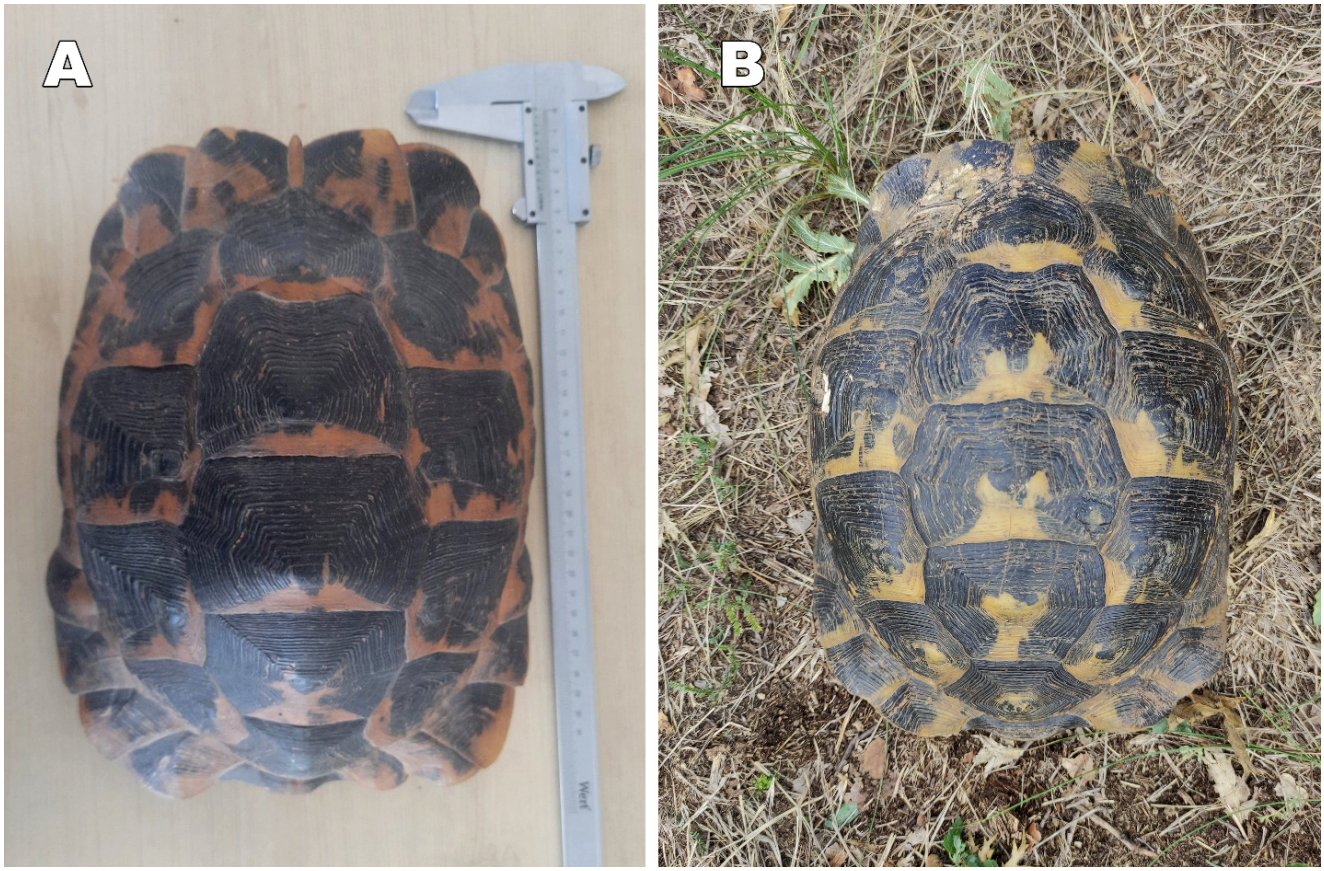


Fig. 1. The shell of the tortoise killed by a shepherd in the 1980s (on the left) and one of the specimens found in Rakitna Village (on the right).

& Ayas, 2019), Romania (Cogălniceanu et al., 2010), and Russia (Krasnodar) (Leontyeva et al., 2001). Nevertheless, as in Bulgaria, such records tend to be very rare (Willemsen & Hailey, 2003; Cogălniceanu et al., 2010; Türkozan et al., 2010).

In Bulgaria, in particular, the reason for the almost complete absence of contemporary data on large specimens may be attributed to the different threats to local populations throughout the country. According to Beshkov (1984, 1993), the most serious threat to *T. graeca ibera* in Bulgaria is the destruction and degradation of natural habitats. This threat affects all the age groups in populations equally. As the second most significant threat Beshkov (1984, 1993) mentioned the illegal collection of specimens for various purposes. For example, for consumption, use of blood and eggs to "cure" serious diseases, and internal and external trade.

When collectors search for tortoises, they focus mainly on larger individuals as they are easier to find and bring more benefits than smaller ones (Beshkov, 1984, 1993). This illegal practice is known to have occurred since the end of the 19th century (Hristovitsch, 1892). Thus, it is not unusual that very large tortoises are almost absent in the country today. We hypothesise that when these tortoises disappear, the genes that determine the potential to reach larger sizes will disappear as well. It can therefore be suggested that the maximum size of *T. graeca ibera* in the country will gradually become smaller.

For this reason, the institutions responsible for the conservation of nature should pay attention to the territories in which the presence of large-sized individuals has been established. This is particularly important when these institutions: plan to designate new protected areas; prepare and implement a new action plan for conserving the species; need to change the current action plan, i.e. to carry out adaptive management, etc. This might help preserve the natural genome of *T. graeca ibera* in the country.

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Research article

# Psyllids (Hemiptera: Psylloidea) in the entomological collection of the National Museum of Natural History, Bulgarian Academy of Sciences

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**Abstract:** The entomological collection of the National Museum of Natural History at the Bulgarian Academy of Sciences in Sofia (NMNHS) preserves a total of 89 specimens representing 25 species of jumping plant lice (Hemiptera: Psylloidea). These were recorded and digitised in the Specify platform as part of the Distributed System of Scientific Collections project (DissCo-BG). This paper summarises all available data on these specimens. Twenty-four species were collected in Bulgaria, one species in Greece. Voucher specimens for Psylloidea published in a historical treatise on the Bulgarian fauna of Hemiptera by Dimitar Joakimov were not found in the NMNHS and are most likely lost. However, Joakimov's collection, later acquired and supplemented by the museum, contains unpublished material, including three species reported here for the first time from Bulgaria: *Aphalara maculipennis* Löw, 1886, *Cacopsylla ulmi* (Foerster, 1848) and *Dyspersa abdominalis* (Flor, 1861).

**Keywords:** Balkan Peninsula, Bulgaria, DissCo-BG, faunistics, jumping plant lice, NMNHS

## Introduction

Jumping plant lice or psyllids (Hemiptera: Psylloidea) are small phytophagous insects that feed on the phloem of mainly dicotyledonous plants. There are over 4000 described species of psyllids worldwide, with the greatest diversity found in the tropics (Burckhardt et al., 2021). The Palaearctic psyllid fauna is considered well studied, with about 400 known species in Europe (Burckhardt, 2013; Serbina et al., 2015), of which less than a hundred have been reported from Bulgaria so far (Pramatarova et al., 2021).

The entomological collection of the National Museum of Natural History of the Bulgarian Academy of Sciences in Sofia (NMNHS) is one of the richest in the Balkan Peninsula (Popov, 1991) and includes about 20000 Hemiptera specimens (N. Simov, pers. comm.). The core of the historical Hemiptera collection was formed by material collected by Dimitar Joakimov (1864–1952), Nikola Nedjalkov (1852–1919) and Pencho Drenski (1886–1963) (Popov, 1999). Joakimov (1909) was also the first to publish faunistic data on psyllids from Bulgaria; he listed 17 species of Psylloidea from the country. However, due to numerous later changes in psyllid taxonomy, some of the species listed by Joakimov (1909) are doubtful and require a revision.

The aim of this paper is to identify the Psylloidea material available in the NMNHS and to summarise all relevant data.

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Fig. 1. *Aphalara maculipennis* Löw, 1886, female.

## Material and methods

All the material studied is in the entomological collection of the National Museum of Natural History, Bulgarian Academy of Sciences, Sofia (NMNHS). Several specimens were originally mounted on cardboard plates, while most of the others were pinned on entomological pins or minutiae on pieces of elderberry (*Sambucus* sp.) pith. The minutiae were often badly corroded and brittle. Therefore, as part of this study, some specimens of the psyllids were remounted and glued on cardboard plates. Some series of specimens were originally mounted on a single piece of elderberry pith and bore a handwritten label or just a number (cited by us in square brackets in the list of material below), probably corresponding to Joakimov's field notes, which are now no longer available. These specimens have been separated for identification and digitisation on a piece of white polyethylene foam, with new labels referring to the original. All specimens were digitised on a Specify collection management platform (https://www.specifysoftware.org/) as part of the Distributed System of Scientific Collections project (DissCo-BG). Each specimen was labelled with software-generated labels containing toponyms and collectors in Cyrillic script transliterated according to NMNHS collection rules. Separate labels were provided with human and machine readable, newly generated individual identification numbers according to NMNHS collection rules (e.g. BG-NMNHS-ENT-00000000001377 and QR code with the same content). In addition, a third label was applied with the current taxonomic identification of the specimen. All original labels of the specimens were kept on the pins. The transliterated locality and collector data of the specimens are used in the Results section.

The monographs by Ossiannilsson (1992) and Vondráček (1957) were mainly used for the identification of psyllids. Burckhardt et al. (2021), Cho et al. (2022) and Ouvrard (2023) were used for the classification and nomenclature of the psyllids.

## Results

Aphalaridae Löw, 1879

Aphalarinae Löw, 1879

*Aphalara maculipennis* Löw, 1886 (Fig. 1)

Material examined: 1 ♀, no locality data, 18.08.1902, (BG-NMNHS-ENT-000000001378), [originally identified as *Aphalara* sp., No. 46, 30].

Fig. 2. *Aphalara* cf. *polygoni* Foerster, 1848, female.

Comments: *Aphalara maculipennis* is widespread in the Palaearctic region, including most of Europe, and is associated with *Persicaria* and *Polygonum* spp. (Polygonaceae) (Burckhardt & Lauterer, 1997; Ouvrard, 2023). Although the examined specimen from NMNHS bears no locality information, it is likely that it was collected in Bulgaria. In this case, this would be the first record of *A. maculipennis* from Bulgaria. The occurrence of *A. maculipennis* in Bulgaria has also been confirmed by recently collected material (Pramatarova et al., unpubl.).

*Aphalara nigrimaculosa* Gegechkori, 1981

Material examined: 1 ♀, no locality data, 28.07.1902, (BG-NMNHS-ENT-000000001377), [originally identified as *Psylla* sp., No. 15, 31].

Comments: Joakimov (1909) reported *Aphalara exilis* (Weber & Mohr, 1804) from Bulgaria (Sofia). However, his record might actually refer to *A. nigrimaculosa,* as both species are very similar, and the report was published before the taxonomic revision of the group by Burckhardt & Lauterer (1997). The latter authors also reported *A. nigrimaculosa,* but not *A. exilis* from Bulgaria. Apart from Bulgaria, *A. nigrimaculosa* is known from the Caucasus and Greece (Burckhardt & Lauterer, 1997).

*Aphalara* cf. *polygoni* Foerster, 1848 (Fig. 2)

Material examined: 1 ♀, locality data illegible, 27.09.1902, (BG-NMNHS-ENT-000000001379).

Comments: *Aphalara* Foerster is considered a taxonomically difficult genus due to the minor morphological differences between species (Ossiannilsson, 1992; Burckhardt & Lauterer, 1997). Without additional male specimens or data on the host plant, the present material cannot be reliably identified.

Carsidaridae Crawford, 1911

Homotominae Heslop-Harrison, 1958

*Homotoma ficus* (Linnaeus, 1758)

Material examined: 5 ♂♂, 6 ♀♀, Greece, Thasos, 25.04.1943, P. Drenski leg., (BG-NMNHS-ENT-000000001428 – BG-NMNHS-ENT-000000001436, BG-NMNHS-ENT-000000001438 – BG-NMNHS-ENT-000000001440).

Comments: Probably native to western Asia, introduced with its host plant, *Ficus carica* into many countries of the Mediterranean (including also Greece), western, central and southeastern Europe,

Middle East, Caucasus, Transcaucasia, and USA (Soors et al., 2020; Ouvrard, 2023).

Liviidae Löw, 1879

Euphyllurinae Crawford, 1914

*Psyllopsis fraxinicola* (Foerster, 1848)

Material examined: 2 ♂♂, 8 ♀♀, Sofia, 08.07.1926, (BG-NMNHS-ENT-000000001400 – BG-NMNHS-ENT-000000001401 – BG-NMNHS-ENT-000000001409), [No. 38].

Comments: Widespread in Europe, Caucasus, Middle East and North Africa, introduced into North and South America, Australia and New Zealand (Ouvrard, 2023). From Bulgaria, published by Głowacka & Harizanov (1983).

Liviinae Löw, 1879

*Livia junci* (Schrank, 1789)

Material examined: 2 ♂♂, 5 ♀♀, Vitosha Mt, upper valley of the Dragalevska river, 07.1905, (BG-NMNHS-ENT-000000004349 – BG-NMNHS-ENT-000000004354), [originally identified as *Livia juncorum*].

Comments: Widespread in the Palaearctic region (Ouvrard, 2023). From Bulgaria, reported by Joakimov (1909), Klimaszewski (1965), Vondráček (1953), Głowacka (1989) and Głowacka & Harizanov (1983).

Psyllidae Latreille, 1807

Psyllinae Latreille, 1807

*Arytaina maculata* (Löw, 1886)

Material examined: 1 ♀ (without head), Bansko, Banderitsa river, 11.08.1923, (BG-NMNHS-ENT-000000001381) [identified as *Psylla* sp.].

Comments: *Arytaina maculata* is widespread in southeastern Europe (Malenovský et al., 2011), including Bulgaria (Klimaszewski, 1965, 1970; Głowacka, 1989; Pramatarova et al., 2021).

*Cacopsylla breviantennata* (Flor, 1861)

Material examined: 1 ♂, no locality and date, (BG-NMNHS-ENT-000000001426) [identified as *Aphalara calthae* var. *maculipennis*]; 1 ♀, (BG-NMNHS-ENT-000000001427) [No. 41]; 1 ♀, Boyanski waterfall, 27.09.1909, (BG-NMNHS-ENT-000000004357), [originally identified as *Psylla breviantennata,* No. 17].

Comments: Distributed in central and southern Europe, Turkey and Caucasus (Ouvrard, 2023). Recorded from Bulgaria by Klimaszewski (1970).

*Cacopsylla crataegi* (Schrank, 1801)

Material examined: 1 ♂, no locality data, 18.08.1902, (BG-NMNHS-ENT-000000001380); 1 specimen (without head and terminalia), Straldzhalsko lake, 30.05.1907, (BG-NMNHS-ENT-000000004355) [originally identified as *Psylla crataegi*]; 1 ♂, Pancharevo, 14.05.1908, (BG-NMNHS-ENT-000000004356), [originally identified as *Psylla crataegi*].

Comments: Widespread in the Palaearctic region (Ouvrard, 2023). Reported from Bulgaria by Joakimov (1909), Klimaszewski (1965) and Pramatarova et al. (2021).

*Cacopsylla melanoneura* (Foerster, 1848)

Material examined: 3 ♂♂, 2 ♀♀, 1 specimen without abdomen, Vitosha Mt, 01.11.1923, (BG-NMNHS-ENT-000000001382 – BG-NMNHS-ENT-000000001387), [identified as *Psylla melanoneura,* field No 42]; 1 ♀, Sofia, 06.04.1909, Velikdenov leg., (BG-NMNHS-ENT-000000001388); 1 ♀ (without head), Boyanski waterfall, 27.09.1909, (BG-NMNHS-ENT-000000004360); 1 ♀, Kamen del, 23.10.1905, (BG-NMNHS-ENT-000000004359), [originally identified as *Psylla pyrisuga*].

Comments: Widespread in the Palaearctic region (Ouvrard, 2023). Reported from Bulgaria by Joakimov (1909) and several other authors (see Pramatarova et al., 2021). The specimen from

Fig. 3. *Cacopsylla ulmi* (Foerster, 1848), female.

"Kamen del" location may correspond to the record of '*Psylla melanoneura*' in Joakimov (1909).

*Cacopsylla pruni* (Scopoli, 1763)

Material examined: 1 ♀, Turiya, 19.09.1922, (BG-NMNHS-ENT-000000001389).

Comments: Widespread in Europe, Caucasus, Transcaucasia and Middle East (Ouvrard, 2023). From Bulgaria, recorded by Klimaszewski (1965), Harisanow (1966), Głowacka & Harizanov (1983) and Głowacka (1989).

*Cacopsylla pulchra* (Zetterstedt, 1838)

Material examined: 1 ♂, Sofiisko opitno pole, 30.04.1921, (BG-NMNHS-ENT-000000001390), [No. 42].

Comments: Widespread in the Palaearctic region, including Bulgaria (Głowacka & Harizanov, 1983; Percy & Cronk, 2020; Pramatarova et al., 2021).

*Cacopsylla pyri* (Zetterstedt, 1838)

Material examined: 1 ♂, 1 specimen without abdomen, Aleko hut, 08.10.1920, (BG-NMNHS-ENT-000000001391, BG-NMNHS-ENT-000000001393), [No. 38].

Comments: Widespread in Europe and western Asia (Cho et al., 2017). From Bulgaria, reported by Klimaszewski (1965), Harizanov (1966) and Głowacka & Harizanov (1983).

*Cacopsylla pyrisuga* (Foerster, 1848)

Material examined: 1 ♀, Sofia, 01.03.1903, (BG-NMNHS-ENT-000000001394); 1 ♂, Sofia, 15.04.1900, (BG-NMNHS-ENT-000000004358); 1 ♂, 1 ♀, 1 nymph, Stara Zagora, on pear, 26.05.1936, (BG-NMNHS-ENT-000000002582 – BG-NMNHS-ENT-000000002584).

Comments: Widespread in Europe and western Asia (Cho et al., 2017). From Bulgaria, reported by Joakimov (1909) and several other authors (see Pramatarova et al., 2021).

*Cacopsylla ulmi* (Foerster, 1848) (Fig. 3)

Material examined: 1 ♂, 2 ♀♀, Lyulin Mt, 24.06.1924, (BG-NMNHS-ENT-000000001395, BG-NMNHS-ENT-000000001396, BG-NMNHS-ENT-000000001397); 1 ♂ (without head), Turiya, 21.08.1909, (BG-NMNHS-ENT-000000004362), [originaly identified as *Psylla ambigua*].

Comments: Widespread in the Palaearctic region, associated with *Ulmus* spp. (Gegechkori & Loginova, 1990; Ouvrard, 2023). New record for Bulgaria.

Fig. 4. *Dyspersa abdominalis* (Flor, 1861), female.

*Cacopsylla* sp.

Material examined: 1 ♀, Lyulin Mt, 24.06.1924, (BG-NMNHS-ENT-000000001392).

Comments: Due to its poor condition, the specimen cannot be identified.

*Psylla alni* (Linnaeus, 1758)

Material examined: 1 ♂, 3 ♀♀, Predel, 02.08.1921, (BG-NMNHS-ENT-000000002528 – BG-NMNHS-ENT-000000002531).

Comments: Widespread in the Holarctic realm (Ouvrard, 2023), as well as in Bulgaria (Klimaszewski, 1965, Głowacka & Harizanov, 1983, Głowacka, 1989).

*Psylla foersteri* Flor, 1861

Material examined: 1 ♂, 1 ♀, Pancharevo, VIII, N. Nedyalkov leg. (BG-NMNHS-ENT-000000001398, BG-NMNHS-ENT-000000001399); 1 ♂, Knyazhevo (BG-NMNHS-ENT-000000004348) [originally identified as *Psylla foersteri*].

Comments: Widespread in the Palaearctic region (Gegechkori & Loginova, 1990; Ouvrard, 2023), as well as in Bulgaria (Joakimov, 1909; Klimaszewski, 1965; Głowacka & Harizanov, 1983; Głowacka, 1989; Pramatarova et al., 2021).

Triozidae Löw, 1879

*Bactericera albiventris* (Foerster, 1848)

Material examined: 3 ♂♂, 2 ♀♀, Vitosha Mt, 01.11.1923, (BG-NMNHS-ENT-000000001410 – BG-NMNHS-ENT-000000001414), [identified as *Trioza albiventris,* No. 40].

Comments: Widespread in the Palaearctic region (Ouvrard, 2023), as well as in Bulgaria (Joakimov, 1909; Głowacka & Harizanov, 1983; Głowacka, 1989).

*Dyspersa abdominalis* (Flor, 1861) (Fig. 4)

Material examined: 1 ♂, 4 ♀♀, Vitosha Mt, 01.11.1923, (BG-NMNHS-ENT-000000001417 – BG-NMNHS-ENT-000000001420, BG-NMNHS-ENT-000000001437), [No. 39].

Comments: Widespread in the Palaearctic region, associated with *Achillea millefolium* and perhaps also some other Asteraceae (Ossiannilsson, 1992; Cho et al., 2022; Ouvrard, 2023). New record for Bulgaria.

*Dyspersa* sp.

Material examined: Sofia, 24.10.1923, 1 specimen without abdomen (BG-NMNHS-ENT-000000001425), [identified as *Trioza chrysanthemi* Löw, 1878].

Comments: Reliable identification was not possible due to the poor condition of the specimen, which is missing its abdomen.

*Eryngiofaga dlabolai* (Vondráček, 1957)

Material examined: 1 ♀, Sofiisko opitno pole, 20.04.1921, (BG-NMNHS-ENT-000000001415), [identified as *Trioza biforcipata* Šulc [sic], No. 44].

Comments: Known from Eastern Europe and the Caucasus (Loginova, 1977). Joakimov (1909) reported "*Trioza mesotela* Flor" [misspelled, currently valid as *Eryngiofaga mesomela* (Flor, 1861)] from Turiya in Bulgaria. Based on additional material recently collected in Bulgaria, Joakimov's (1909) record probably refers to *E. dlabolai* (Pramatarova et al., 2021).

*Heterotrioza chenopodii* (Reuter, 1876)

Material examined: 1 ♀ , Varna, 14.11.1961, N. Karnojizjy leg., (BG-NMNHS-ENT-000000002642).

Comments: Widespread in the Palaearctic region (Ouvrard, 2023), introduced to North America (Horton et al., 2018). Reported from several localities across Bulgaria (Głowacka & Harizanov, 1983, Głowacka, 1989, Harizanov & Lauterer, 1968, Klimaszewski,1965).

*Phylloplecta trisignata* (Löw, 1886)

Material examined: 1 ♀, locality data illegible, 08.09.1927, (BG-NMNHS-ENT-000000001416); 2 ♂♂, Turiya, 02.09.1903, (BG-NMNHS-ENT-000000004362 – BG-NMNHS-ENT-000000004362), [originally identified as *Trioza trisignata*].

Comments: Widespread in southern Europe and Turkey (Ouvrard, 2023). From Bulgaria, reported by Joakimov (1909) and Głowacka (1989).

*Trioza urticae* (Linnaeus, 1758)

Material examined: 3 ♂♂, 1 ♀, Vitosha Mt 01.11.1923, (BG-NMNHS-ENT-000000001421 – BG-NMNHS-ENT-000000001424).

Comments: Widespread in the Palaearctic region (Ouvrard, 2023), as well as in Bulgaria (Klimaszewski, 1965; Głowacka & Harizanov, 1983; Głowacka, 1989).

## Conclusion

A total of 89 specimens of 25 species of Psylloidea deposited in the NMNHS entomological collection are catalogued for the first time. Although some specimens were not labelled with precise locality information, based on knowledge of the origin of the collection (Popov, 1991, 1999), it is likely that the material of 24 species originated from Bulgaria and one – *Homotoma ficus* (Linnaeus, 1758) – from Greece. Unfortunately, voucher specimens for the historical records of the Psylloidea published by Joakimov (1909) could not be found in the NMNHS. Joakimov's collection, acquired by NMNHS in 1922 (Popov, 1991) and apparently supplemented since then, contains only previously unpublished specimens. Some of these specimens belong to the same species published by Joakimov (1909) and confirm his records (*Livia junci, Cacopsylla crataegi, C. melanoneura, C. pyrisuga, Psylla foersteri, Bactericera albiventris,* and *Phylloplecta trisignata*), while some other specimens were originally misidentified (*Cacopsylla breviantennata, Eryngiofaga dlabolai*). Three of the species preserved in the NMNHS are reported here for the first time from Bulgaria: *Aphalara maculipennis, Cacopsylla ulmi* and *Dyspersa abdominalis*. All three species are widely distributed in the Palaearctic region (Ouvrard, 2023) and two of them (*A. maculipennis* and *C. ulmi*) are already known from neighbouring countries of Bulgaria (Dobreanu & Manolache, 1962; Jerinić-Prodanović, 2010; Drohojowska & Burckhardt, 2014), so their occurrence in Bulgaria was expected. Recent intensive fieldwork by the authors, as well as the examination of numerous material of Psylloidea in the collections of other institutions, have yielded much additional data on the psyllid fauna of Bulgaria, which will be discussed in detail in another paper.

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Research article

# *Chrysoesthia sexguttella* (Thunberg, 1794), a new species for Bulgaria (Insecta: Lepidoptera: Gelechiidae)

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**Abstract:** *Chrysoesthia sexguttella* (Thunberg, 1794) is reported for the first time from Bulgaria. The species was found on *Spinacia oleracea* in Vinarovo Village, Vidin Province, Northwestern Bulgaria. Set moth and female genitalia are illustrated.

**Keywords:** faunistics, genitalia, Microlepidoptera

## Introduction

Similarly to other Microlepidoptera families, the fauna of the family Gelechiidae is poorly known in Bulgaria. According to the Lepiforum e.V. (2023) 11 species from genus *Chrysoesthia* Hübner, 1825 are listed for Europe: *C. aletris* (Walsingham, 1919), *C. atriplicella* (Amsel, 1939), *C. bosae* (Walsingham, 1908), *C. drurella* (Fabricius, 1775), *C. eppelsheimi* (Staudinger, 1885), *C. falkovitshi* Lvovsky & Piskunov, 1989, *C. gaditella* (Staudinger, 1859), *C. halimionella* Bidzilya & Budashkin, 2015, *C. hispanica* Karsholt & Vives, 2014, *C. sexguttella* (Thunberg, 1794) and *C. verrucosa* Tokár, 1999. *Chrysoesthia halimionella* is the latest described species in Europe, similar to *C. sexguttella* (Bidzilya & Budashkin, 2015). For Bulgaria, only *C. drurella* is listed (Karsholt & Riedl, 1996; Karsholt, 2013).

A single gelechiid moth was observed and collected by the first author on 07.05.2023 in a private yard in Vinarovo Village, Vidin Province. The specimen was found on *Spinacia oleracea*.

This paper presents the first record of *Chrysoesthia sexguttella* (Thunberg, 1794) in Bulgaria.

## Methods

The moth was set and photographed under a stereomicroscope Stemi 2000-c (Zeiss) equipped with an EOS 1300D (Canon) camera and diffuse light source. The genitalia were prepared according to Robinson (1976) and photographed through an Amplival (Carl Zeiss Jena) compound microscope with an EOS 2000D (Canon) camera attached. The morphological description follows Gregersen & Karsholt (2022).

## Results and discussion

*Chrysoesthia sexguttella* (Thunberg, 1794)

Material: 1 ♀, Bulgaria, Vidin Province, Vinarovo Village, 44.0988°N, 22.8127°E, 147 m a.s.l., 7.v.2023, on *Spinacia oleracea,* genitalia slide No. 1/3.8.2023, in the collection of Institute of Biodiversity and Ecosystem Research, Sofia, Bulgaria.

Morphological notes (based on collected material, Fig. 1): Wingspan 8.5 mm, forewing length 4.0 mm.

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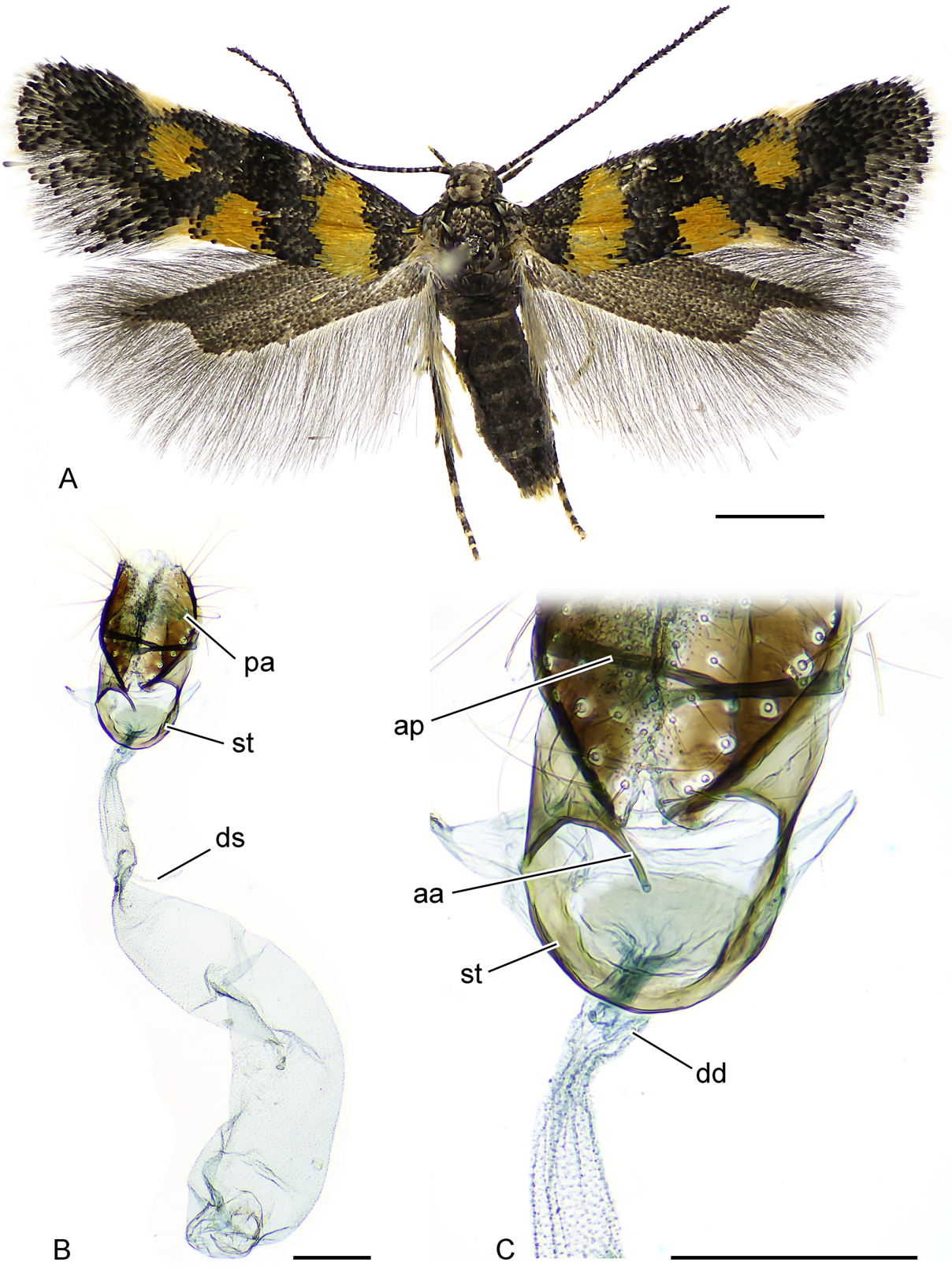


Fig. 1. *Chrysoesthia sexguttella* ♀, Bulgaria, Vinarovo, Vidin – (A) Habitus; (B) Genitalia; (C) Details of genitalia; (aa) apophysis anterior, (ap) apophysis posterior, (dd) diverticulum of ductus bursae, (ds) ductus seminalis, (pa) papilla analis, (st) sterigma. Scale bars: (A) 1 mm; (B, C) 100 μm.

Forewing pattern with large orange spots, typical for the southern populations. Female genitalia as described below. No male specimen was available for examination. A detailed description is provided by Gregersen & Karsholt (2022) as follows:

Wingspan 6–8 mm. Head and thorax irrorated blackish brown, slightly shiny; palp irrorated blackish with two whitish rings; segment 3 robust, whitish tipped. Forewing densely irrorated black with bluish tint; two silvery grey, indistinct fasciae; two or three, blackish bordered, orange spots; opposite costal/tornal spots cream white. Hindwing greyish brown. Abdomen irrorated blackish, slightly shiny. The orange spots of the forewing sometimes vary and may be very large. Most specimens from North-West Europe belong to the dark (nominotypical) form (f. *sexguttella*), whereas the more brightly coloured f. *auroguttella* (*naeviferella* auct.) is more common in the south. Male genitalia: Tegumen sub-triangular, anteriorly broad; uncus large with pair of lateral lobes; gnathos with medial part of lobe-like, membranous; valva with apical part large; sacculus moderately circular, with dense, strong denticles; phallus distally with small hook, pointing ventrally; vesica without spinules. Female genitalia: Papilla analis broad, distal half set with bristles; anterior apophysis strong, very short, sclerotised; segment VIII very short and wide with ventral, strongly protruding band on anterior margin (sterigma), surrounding antrum/ostium bursae; ostium circular (Gregersen & Karsholt, 2022).

Notes on biology: The host plants of the larvae are *Amaranthus, Atriplex, Bassia scoparia, Chenopodium* and *Spinacia* (Elsner et al., 1999). The larvae feed in a fully transparent blotch-mine with blackish frass clustered at the base or the middle and hibernate in a cocoon on the ground. The species is bivoltine and the adults fly from May to July and again in August (Gregersen & Karsholt, 2022). The habitat is ruderal vegetation, parks, gardens, roadsides, wastelands and vegetable crops (Elsner et al., 1999). Two species from genus *Agathis* Latreille, 1804 (Hymenoptera: Braconidae) and five species from genus *Pnigalio* Schrank, 1802 (Hymenoptera: Eulophidae) have been found as parasitoids of *C. sexguttella* (Triggiani, 1978; Yegorenkova & Yefremova, 2012).

Notes on distribution: *Chrysoesthia sexguttella* originally had a Palaearctic distribution from Europe to Japan (Elsner et al., 1999). The species is widespread in Europe. According to the Fauna Europaea web site (Karsholt, 2013) it is known from Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, the United Kingdom, the Netherlands, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Montenegro, North Macedonia, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland and Ukraine. Recently the species has been reported for the first time from Croatia (Šumpich, 2013). *Chrysoesthia sexguttella* is listed for the lepidopteran fauna of Turkey (Koçak & Kemal, 2009), reported from Kashmir Himalaya, India (Razak et al., 2011) and introduced to North America (Pohl et al., 2018). Also from Japan a new species *C. heringi* (Kuroko, 1961) has been described, which is similar to *C. sexguttella* (Kuroko, 1961).

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