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Faunistic diversity of the city of Plovdiv (Bulgaria), Volume 2 - Vertebrates & Invertebrates

Ivelin Mollov, Dilian Georgiev, Ognyan Todorov (Editors)

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About the Journal

In 1970, the Natural History Museum - Plovdiv issues Volume 1 of the journal "Bulletin of the Natural Science Museum Plovdiv". In 1973 Volume 2 was released.

Before the release of the independent journal of the Natural History Museum - Plovdiv, researchers at the museum published their articles in "Annuals of the Museums in the Plovdiv Region" and from 1975 in "Bulletin of the museums in Southern Bulgaria", which was published until 1995 (a total of 21 volumes).

With the creation of the Bulletin of the Natural History Museum - Plovdiv, the Regional Museum of Natural History - Plovdiv resumed issuing its scientific journal. In the magazine accepted for posting short messages (up to 4 pages), original research papers (from 4 to 10 pages) and review articles (over 10 pages) in the above mentioned fields and shaped according to the instructions for authors.

The logo of the journal is the paleoendemic beetle *Rhodopaea angelovi* Gruev & Tomov, 1968[1], known only from a small area in the Rhodope Mountains, south of Plovdiv. The species is named after Professor Emeritus Pavel Angelov, one the first directors of the museum, who collected the type specimens.

From the Editorial Board

[1] Gruev B., V. Tomov. 1968. A new genus and species *Rhodopaea angelovi* gen. et sp. n. (Coleoptera, Chrysomelidae) from Bulgaria. Rev. Ent. URSS, XLVII(3):553-555 (in Russian with English summary).

Cover photo: View to the hills of Plovdiv. Photo: Ilian Bozhanov.

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2022, Supplement 2 - Contents

Foreword

This is volume two of the first comprehensive collective monograph on the faunistic diversity of the city of Plovdiv (South Bulgaria). It is published as Supplement 2 of the Bulletin of the Natural History Museum - Plovdiv and contains 14 articles on various vertebrate and invertebrate groups. The papers summarize both already published data and original data about recent Pisces, Amphibia, Reptilia, Aves, Mammalia, addition to the terrestrial Gastropoda, Aranea, Pseudoscorpiones and Scorpiones, Odonata, Coleoptera, Carabidae, Orthoptera and some ecological properties of epigeal and mesogeobiont invertebrates communities from the city of Plovdiv and its surroundings. This edition is Volume 2 of a two-part book and includes all of the vertebrate classes, plus the remaining articles about the invertebrates, which did not make it in the first volume. Volume 1 was published in 2018 (Bull. Nat. Hist. Mus. Plovdiv, 2018, Supplement 1).

The Editors

Mollov I., D. Georgiev, O. Todorov (Eds.)
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The Fish Species (Pisces) in the City of Plovdiv - A Review

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Abstract. Most of the materials in this paper were according to literature review, with some new information obtained through observations of the author. A total of 19 species were found in the rural zones, 24 in the suburban zone and 11 species in the urban zone.

Key words: fish, urban area, habitats, distribution.

Introduction

The fish species of the city of Plovdiv (and Maritsa River) have been studied for many years. In addition to their species composition, there is also data on their habitat distribution, origin, conservation and other aspects of their ecology.

This review article represents all known species in the city, their habitat distribution and presence in different parts of the city – rural, suburban and urban areas.

Material and Methods

Most of the materials in this paper were according to literature review, with some new information obtained through observations of the author. The literature survey was according to the papers of Georgiev (2006), Mollov et al. (2009), and Mollov & Georgiev (2015).

Results and Discussion

A total of 24 species were known from the area of Plovdiv City (Table 1) which represents 17.61% of the Bulgarian freshwater ichthyofauna.

Most of the species are native (18; 75% of all), four were considered as non-indigenous invasive (17%), and one (4%) is non-indigenous non-breeding (*Hypophtalmychthys* sp.). One of the native species (*Anguilla anguilla*) is considered extinct in Bulgaria.

The majority of the ichthyofauna of Plovdiv City is localized in Maritza River flowing through the city. It is a large river with relatively slow current forming some small ponds and floods at its banks. In the city center it is canalized and fast flowing. The dominant species are both native and invasive. The rest of the species were met occasionally and considered as rare.

Fish ponds and rice fields fed by a system of canals are placed at the Plovdiv vicinity. The fish bred in those ponds are mainly *Esox lucius, Cyprinus carpio,* and *Hypophtalmychtis* sp. In the rice fields *Carassius auratus* is thriving and reach great abundance at summer and autumn.

A total of 19 species were found in the rural zones, 24 in the suburban zone and 11 species in the urban zone. The reason for the higher species richness in the suburban and rural zones is the presence of small floods and standing water basins in this part of Maritsa River, as well as some deeper parts, inhabited by some fish species, absent in urban canalized stretch. Respectively only the reophilous species could be expected in central city stretch of the river, and both fish of running and standing waters can be met in its suburban and urban parts. Other favoring factor is the existence of the State Fishery – Plovdiv, as well as Parvenetska River and many irrigation canals, located in the suburban and rural zones of the city. Also the significant pollution from

various city sources perhaps is also a limiting factor for the fish distribution.

The ichthyofauna of Plovdiv City is rich in species, especially for a city of such large size. This is due to the presence of a large river with many floods that flows through it - the Maritsa River. The rich species diversity is due and to the many rice fields and canals at the vicinity of Plovdiv City, as well as the presence of fish farms in the same areas.

Table 1. List of the fish species registered at the city of Plovdiv City.

Species	Maritza River	Canals	Rice fields	Remarks
Alburnus alburnus	+			Common
Anguilla anguilla	+			Extinct
Aspius aspius	+			Rare
Barbus cyclolepis	+			Common
Carassius auratus	+	+	+	Invasive
Carassius carassius	+	+	+	Invasive
Chondrostoma vardarense	+			Common
Cobitis taenia	+	+	+	Common
Cyprinus carpio	+			Rare
Esox lucius	+			Rare
Gambusia affinis	+		+	Invasive
Gobio gobio	+			Common
Hypophtalmychthys sp.	+			Nonindigenous
Lepomis gibbosus	+	+	+	Invasive
Leuciscus borysthenicus	+			Rare
Leuciscus cephalus	+			Common
Proterorhinus marmoratus	+			Common
Pseudorasbora parva	+			Invasive
Rodeus sericeus amarus	+		+	Common
Rutilus rutilus mariza	+			Rare
Scardinius erythrophthalmus	+			Rare
Silurus glanis	+			Rare
Tinca tinca	+			Rare
Vimba melanops	+			Common

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Amphibians and Reptiles in the City of Plovdiv and Comparison with other Bulgarian Cities

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Abstract. The current study presents the contemporary species composition of the amphibians and reptiles in the city of Plovdiv. During the current study we identified 6 amphibian species and 9 reptile species plus 1 invasive freshwater turtle species (10 in total). A clear differentiation of the fauna of the studied cities can be seen on a geographical principle, however, it seems that not only the geographical location of the cities has an influence on the qualitative composition of the fauna, but also some specific urban factors. In general, Stara Zagora, Varna and Ruse are with highest species richness.

Key words: Amphibia, Reptilia, species richnes, urban fauna, Plovdiv.

Introduction

As urbanization is spreading rapidly, a basic challenge for conservation ecology is to understand how it affects biodiversity. The complex nature of urban land use can have a complicated influence on local biodiversity. Several studies have described the effects of urbanization on species richness, indicating that urbanization can affect species richness either positively or negatively, depending on several variables. Some of these variables include: taxonomic group, spatial scale of analysis, and intensity of urbanization (McKinney, 2008).

In the past few decades there is increasing attention to the study of various animal groups in cities, namely amphibians and reptiles, which are important part of urban biodiversity. A better understanding of the ecological processes governing the species composition and distribution of animals in an urban environment is necessary for adequate management and conservation (Husté, 2005).

The purpose of the current study is to present the contemporary species composition of the amphibians and reptiles in the city of Plovdiv and to compare it with that of other major Bulgarian cities.

Materials and Methods

For the purposes of the present study literary data were used and a series of observations in more recent years (2020-2022) in the city of Plovdiv (South Bulgaria) were conducted. Amphibians and reptiles were determined visually using the field guide of Biserkov et al. (2007). For each species are given a valid Latin name after Stojanov et al. (2011) and Fauna Europaea (de Jong et al., 2014). A cluster analysis was performed in order to compare the batracho- and herpetofauna between cities (Rho similarity index, unweighted per-group average), using the program "PAST", version 4.11 (Hammer et al., 2001).

Results and Discussion

During the current study we identified 6 amphibian species and 9 reptile species plus 1 invasive freshwater turtle species (10 in total), which is 25,00% from the Bulgarian batrachofauna and 27,78% from the Bulgarian herpetofauna, respectively (Stojanov et al., 2011; de Jong et al., 2014).

A comparative cluster analysis (based on the presence/ absence data) of the batracho- and herpetofauna of several Bulgarian cities with those of the city of Plovdiv was conducted. For Bulgaria, literary sources were used for the following cities: Sofia (Tsankov et al., 2015), Varna (Delov et al., 2005), Ruse (Undjian, 2000), Stara Zagora (Georgiev & Georgiev, 2019) and Blagoevgrad (Pulev & Sakelarieva, 2013). The data are presented in Table 1 and Fig 1 and 2.

Table 1. Species composition of the recorded amphibian and reptile species in the city of Plovdiv and literary data for the batracho- and herpetofauna of other major Bulgarian cities.

Species	Plovdiv (Current study)	Sofia	Varna	Ruse	Stara Zagora	Blagoev-grad
AMPHIBIANS						
Salamandra salamandra (Linnaeus, 1758)	-	+	-	-	+	+
Lissotriton vulgaris (Linnaeus, 1758)	-	-	+	+	+	-
Triturus ivanbureshi (Arntzen et Wielstra, 2013)	-	+	+	+	+	+
Bombina bombina (Linnaeus, 1761)	-	-	-	-	+	-
Bombina variegata (Linnaeus, 1758)	-	+	-	-	-	-
Pelobates fuscus (Laurenti, 1768)	-	-	-	+	-	-
Pelobates syriacus Boettger, 1889	+	-	-	-	-	-
Bufo bufo (Linnaeus, 1758)	+	+	+	-	+	+
Bufotes viridis (Laurenti, 1768)	+	+	+	+	+	+
Hyla arborea (Linnaeus, 1758)	-	-	-	-	-	+
Hyla orientalis Bedriaga, 1890	+	+	+	+	+	-
Pelophylax ridibundus (Pallas, 1771)	+	+	+	+	+	+
Rana dalmatina Fitzinger in Bonaparte, 1838	+	+	+	+	+	+
Rana temporaria Linnaeus, 1758	-	+	+	+	+	-
REPTILES						
Emys orbicularis (Linnaeus, 1758)	+	+	+	+	+	+
Trachemys scripta (Thunberg & Schoepff, 1792)	+	+	-	-	+	-
Testudo graeca Linnaeus, 1758	-	-	+	-	+	-
Testudo hermanni Gmelin, 1789	-	-	+	-	+	+
Mediodactylus kotschyi (Steindachner, 1870)	+	+	-	-	-	+
Mediodactylus danilewskii (Strauch, 1887)	-	+	-	+	+	-
Ablepharus kitaibelii Bibron et Bory de Saint-Vincent, 1833	-	-	-	-	+	-
Anguis fragilis Linnaeus, 1758	-	+	+	+	-	-
Pseudopus apodus (Pallas, 1775)	-	-	+	-	-	-
Darevskia praticola (Eversmann, 1834)	-	-	-	+	-	-
Lacerta agilis Linnaeus, 1758	-	+	+	-	-	-
Lacerta trilineata Bedriaga, 1886	+	-	+	+	+	-
Lacerta viridis (Laurenti, 1768)	+	+	+	+	+	+
Podarcis erhardii (Bedriaga, 1876)	-	-	-	-	-	+
Podarcis muralis (Laurenti, 1768)	+	+	+	+	+	+
Podarcis tauricus (Pallas, 1814)	-	-	-	+	+	-
Coronella austriaca Laurenti, 1768	-	+	-	+	+	-
Dolichophis caspius (Gmelin, 1789)	+	-	+	+	+	+
Elaphe sauromates (Pallas, 1814)	-	-	-	+	+	-
Natrix natrix (Linnaeus, 1758)	+	+	+	+	+	+
Natrix tessellata (Laurenti, 1768)	+	+	+	+	+	+
Platyceps najadum (Eichwald, 1831)	-	-	-	-	-	+
Zamenis longissimus (Laurenti, 1768)	+	+	+	-	+	+
Vipera ammodytes (Linnaeus, 1758)	-	-	+	-	+	+

The contemporary species composition of the amphibians and reptiles in the city of Plovdiv, doesn't differ significantly from our previous study (Mollov & Georgiev, 2015) with the exception of the record of *Zamenis longissimus* in the area between Maritsa River and The Rowing Canal. Also the invasive species (*Trachemys scripta*) was once again registered in the city of Plovdiv with two subspecies - *T. s. scripta* (individuals were observed on occasion near the bridge next to the Gerdjika Hotel) and *T. s. elegans*, which was also observed in a spill off the island of Adata, spills at the 4 km west of the city and in the Rowing Canal itself (numerous occasions). At this stage there is no data for breeding of this species in the area, but it is a possibility.

The cluster analysis shows similar results for both classes. For the amphibians (Fig. 1), the batrachofauna of Blagoevgrad is divided into an independent cluster with 45% similarity, followed by another independent cluster of the batrachofauna of the city of Plovdiv with 47% similarity. The amphibian fauna of the largest city - Sofia separates into a third independent cluster with about 57% similarity, and those of Varna, Stara Zagora and Ruse separate into a fourth cluster with about 70% similarity.

For the reptiles (Fig. 2), the herpetofauna of Ruse separates into a first independent cluster with about 33% similarity, followed by that of Stara Zagora with about 36% similarity and Varna, which forms a third independent cluster with about 38% similarity. Blagoevgrad, Sofia and Plovdiv together form a fourth cluster with about 50% similarity.

In the case of amphibians, a clear differentiation of the fauna of the studied cities can be seen on a geographical principle from the southwest-northeast direction. A similar trend is observed for the reptiles, but in the opposite direction - northeast-southwest. However, it seems that not only the geographical location of the cities has an influence on the qualitative composition of the fauna, but also some specific urban factors.

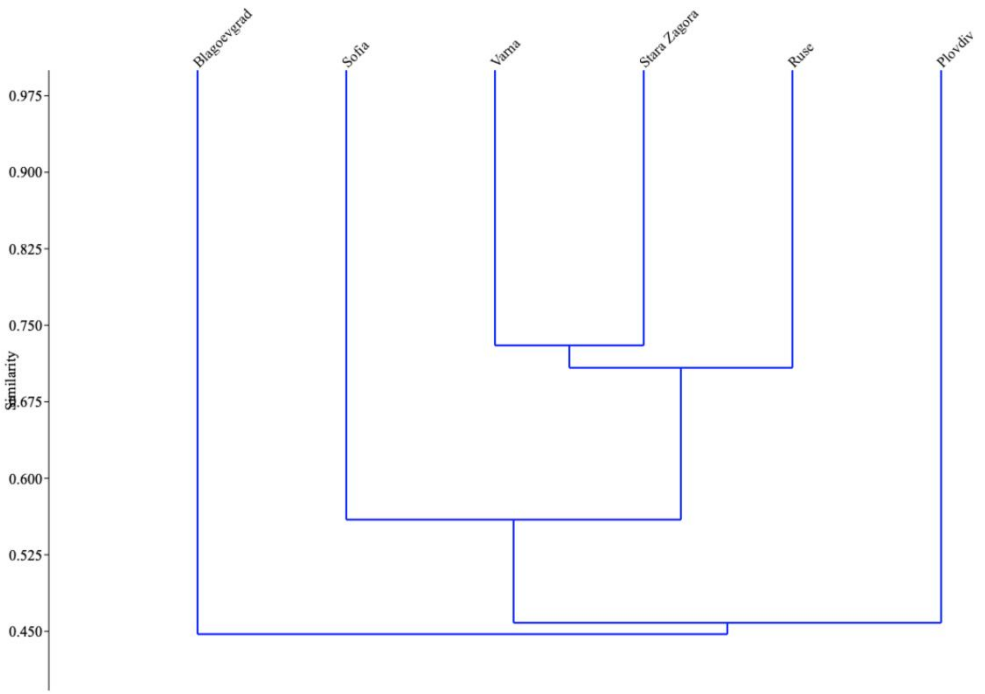

Fig. 1. Cluster analysis of the species composition of the amphibians in the city of Plovdiv and other major Bulgarian cities.

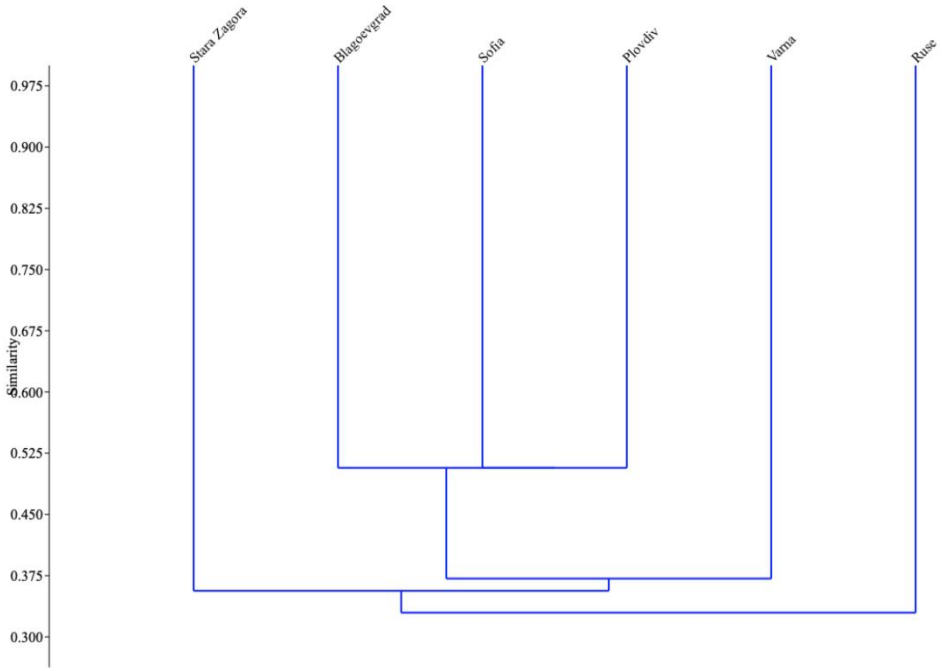

Fig. 2. Cluster analysis of the species composition of the reptiles in the city of Plovdiv and other major Bulgarian cities.

One of the principles of the Theory of Island Biogeography states that the number of species that can occur on an island depends on its area (MacArthur & Wilson, 1967). If we conditionally consider the investigated six Bulgarian cities as "islands", we can check whether this principle will apply in this case (Table 2).

Table 2. Area of the studied Bulgarian cities and the number of species of amphibians and reptiles registered in each city.

City	Area, km^2	Number of amphibian species	Number of reptile species
Blagoevgrad	28.91	7	12
Stara Zagora	85,11	10	17
Plovdiv	102,00	6	10
Ruse	127,12	8	13
Varna	238,00	8	14
Sofia	492,00	9	12

From the results presented in the table, it can be seen that in both groups of animals, this principle does not apply. A probable reason for this is most likely the fact that many other factors play a role in cities that determine the species richness of amphibians and reptiles - human population density (and hence the higher anthropogenic pressure on amphibians and reptiles), heterogeneity of suitable habitats (mostly suitable water bodies), degree of pollution and other specific urban conditions that are different for each city.

In general, Stara Zagora, Varna and Ruse are with highest species richness. This is probably due, on the one hand, to the geographical location of the cities - close proximity to the Black Sea and the Danube River (in the case of Varna and Ruse) and the close proximity of Sarnena Sredna Gora Mts. (in the case of Stara Zagora). They have a direct

effect on the presence of certain species of amphibians and reptiles, and they have a beneficial indirect effect, as they determine to a large extent the regional climatic conditions. On the other hand, the smaller human population density (compared to the city of Sofia and the city of Plovdiv), as well as probably other factors specific to these cities, which are not the subject of the present study, further shape the species composition of the batracho- and herpetofauna.

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A Checklist of the Birds of Plovdiv Municipality

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Abstract. Urban ecology studies the interactions between man and nature in urban habitats. Birds are indicators for environmental changes and fluctuations in their numbers and abundance could be indicative for habitat alterations. Birds in the Municipality of Plovdiv have never been an object of a thorough study. Here we present the first bird species list of Plovdiv municipality for the period 1850 - 2016 and their conservation and ecological status. In total, 245 bird species are registered on the territory of the municipality. We confirmed 104 breeding species, 169 species during spring and autumn migration and 125 species wintering in the study area. We confirmed 3 extinct species. The Municipality of Plovdiv with its city parks, hills and the river basin present favourable habitats for a significant number of bird species. Some of them have unfavourable conservation status.

Key words: urban ecology, green areas, bird status, bird list.

Introduction

Nowadays, the number of urban territories grows faster, as well as the number of people and the size of the megapolises (Cohen, 2006). The overconcentration of people in the cities is linked with infrastructural processes. They affect and dramatically change natural and semi-natural habitats and landscapes, shaping a new environment - the urban environment. Thus, new artificial habitats supporting specific flora and fauna are now found in the cities. They differ from the natural ones. Parks and gardens attract and support specific species. Usually, green zones in the cities are developed as recreative areas but they become very important habitats for many animal species that find their favourable conditions for reproduction, wintering, feeding, roosting and a shelter (McKinney, 2002). Nowadays, the greatest concentration of bird species in cities is found in the city parks.

The urban ecology has differentiated as a science that studies interactions between man and nature and mostly the effect of the growing urban environment on natural habitats and ecosystems. A great attention recently is paid to the carbon print and the global climate change (Mcdonnell et al., 2009). Birds are indicators for environmental changes and fluctuations in their numbers and abundance could be indicative for habitat alterations and deterioration of the human environment (Bolger, 2001; Hristov, 2015). Many studies on the urban ornithofauna have been carried out in the last decades worldwide aiming to reveal the effect of urbanization on birds in order to conserve them (Mcdonnell et al., 2009). Some of the cities where the ornithofauna is studied are:

Warsaw - 213 species, of which 140-145 breeding (Luniak, 1996), Milan - 59 breeding species (Nova, 2002), Napoli - 64 breeding species (Fraissinet, 2006), Central London - 66 breeding species (Oliver, 1997).

In Bulgaria, the ornithofauna is studied in Sofia - 243 species (Nankinov, 1982; Iankov, 1983), and according to a more recent study 260 species (Iankov, 2005), Gabrovo - 96 species (Stoianova, 1996), Smolyan - 39 breeding species (Darakchiev et al., 1987).

The birds in the city of Plovdiv have never been an object of a thorough study. Some data on the number and distribution of different species exist in graduation thesises but not in a comprehensive study (Kostova, 1986; Kasherov, 1995; Zurlova, 2005; Gergova, 2007, Petrova & Irikov, 2012; Angelova, 2014; Klimentova-Nikolova, 2014). Data on the bird species and their abundance have been collected for the Atlas of breeding birds in Bulgaria (Iankov, 2007), studies for Natura 2000 network (Plachiyski, 2007) and for the management plans for several protected areas in the city - Danov halm, Mladezhki and Bunardzhika (Municipality of Plovdiv, 2014). Some scattered data on bird species in the city are published by numerous studies (Reiser, 1894; Patev, 1950; Boev et al., 1964; Petrov, 1983; Velev, 1992; Nikolov et al., 2000; Nankinov, 2009; Dobrev et al., 2014; Popgeorgiev et al., 2015; BSPB, 2016; Dobrev et al., 2021).

In the recent study we present the first bird species list of Plovdiv municipality for the period 1850-2016 and their conservation and ecological status.

Materials and Methods

Study area

Municipality of Plovdiv is part of the Thracia-Strandzha bio-geographic region - Upper Thracian subregion, Pazardzhik-Plovdiv region (Stefanov, 2002). The territory of the city of Plovdiv covers 51.98% (54.36 km^2) of the urban area of the municipality, surrounded by 48.02% agricultural lands. The municipality has only one settlement - the city of Plovdiv which is administrative, economic and cultural center and has a population of 375 580 inhabitants (Fig. 1). The city of Plovdiv is situated on the bank of the Maritsa River, in which valley seven sienit hills lay - Mladezhki Hill (265 m); Bunardzhika Hill (258 m); Danov Hill (222 m). The three hills consist of Taxim tepe, Dzhambaz tepe and Nebet tepe (212 m); Markovo tepe hill (189 m) does not exist anymore. The municipality of Plovdiv belong to the transitional continental climatic subregion of the European climatic region (Municipality of Plovdiv management plan, 2014). Summer is hot, spring and autumn are warm and winter is mild. The annual rainfall is 757.9 mm. The green system of the city is formed by the city parks, including the hills, the vegetation along the river and smaller green areas such as small gardens and open green space between the flat blocks. All together they form a mosaic structure which scatterly covers the urban area. Two relatively large forestated city parks are situated in the boundaries of the municipality of Plovdiv - "Lauta" and "Otdih i kultura" parks (Municipality of Plovdiv management plan, 2014). Three of the hills (Bunardzhika - 22 ha, Mladezhki hill - 36.16 ha and Danov hill - 5.28 ha) have been designated as protected areas according to the Bulgarian legislation, and they are the only ones in the country, entirely situated in a highly urbanized zone (Municipality of Plovdiv management plan, 2014).

Methods

The published data on the birds observed in the city of Plovdiv, Bulgaria for the period 1850-2016 was summarized. The original data was collected between 1990 and 2016 from the territory of the municipality of Plovdiv (Table 1). The species recorded from the authors as new to the fauna of Plovdiv are marked with an asterisk (*) in the faunistic list. Species that were registered according to literature data and confirmed by the authors in the present study are marked with double asterisk (**).

The taxonomy, sequences and international English names follow the last recommendations of BirdLife International (2016). The Bulgarian names are presented according to the last bird check list of BUNARCO (2014).

Data on the bird species is presented in a table where the breeding and the conservation status are presented in columns as it follows:

Column I: Species Category

A: Species that have been recorded in an apparently wild state at least once since January 1st 1950.

B: Species that have been recorded in an apparently wild state at least once between the year 1850 and December 31st 1949, but not subsequently.

C: Species that, although originally introduced by man, either deliberately or accidentally, have established a breeding population derived from introduced stock, which has maintained itself without further ongoing introductions for at least 25 years and/ or at least three generations. Included are guests from category C populations from other countries and re-introduced species which have established populations' fulfilling the criteria of the first part of this paragraph.

Column II: Status in the breeding season

R: Regular breeding species in suitable habitats in study area.

S: Non breeding species, but using territory as feeding place or other in breeding season

0: Former regular breeding species, but no breeding records since at least 2000.

DD: Some species records are scarce with little information available and they are thus assessed as Data Deficient (DD).

Column III: Status in the non-breeding season

M/ m: Migrant and passage visitor; majority of breeding birds leave the country in winter or birds from other areas pass in good numbers (M), or with an average less than 50 individuals per year (m).

W/ w: Winter visitor; birds of mainly northern origin winter regularly at least in a certain part of the country (W); the number of wintering birds is less than 50 individuals per year (w).

V: Accidental or irregular visitor;

The letters M, W and V may be combined to clarify the status.

Column IV: IUCN Red List category (BirdLife 2016) – Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC).

Column V - Red Data Book category (Golemanski 2011) - extinct (EX), regionally extinct (RE), critically endangered (CR), endangered (EN) and vulnerable (VU).

Climate

The Plovdiv plain and municipality of Plovdiv belong to the transitional continental climatic subregion of the European climatic region (Municipality of Plovdiv management plan, 2014). Summer is hot with mean monthly temperature for the hottest month of the year of 23.2ºC and absolute maximum of 43.1ºC. Spring and autumn are warm. The mean annual temperature is 12,0ºC, and the annual temperature amplitude is 22.8ºC (Stanev, 2003). Winter is relatively warm with mean temperature of 3.8ºC.

The annual rainfall is 757.9 mm. The spring rainfall is 223.1 mm, and the summer rainfall is 234.8 mm, during the autumn, the rainfall is 162.8 mm, and 97.6 mm in the winter. (Municipality of Plovdiv management plan, 2014).

Flora

The total green area of of Plovdiv is about 930 ha. Predominant tree species are: chesnut, lime tree, plane tree, birch, sycamore, ashl, willow, albicia, etc. Municipality of Plovdiv is in the Upper Thracian lowland floristic region of Bulgaria. The floristic diversity consists of 1430 species, where 71% of the species are natural, and the rest are introduced to the region. The majority of the plants (75%) are herbaceous and 25% are ligneous (Cheshmedzhiev & Vasilev, 2009).

Waters

One of the main Bulgarian rivers - Maritsa, flows throgh the city. The Maritsa River is very important to the city and especially for the microclimate which creates allong the river valley (Municipality of Plovdiv management plan, 2014).

Green areas

The green system of the city is formed by the city parks, including the hills, the vegetation allong the river and smaller green areas such as small gardens and open green space between the flat blocks. All together they form a mosaic structure which irregularly covers the urban area. The public green areas cover 381.5 ha which represents about 75% of the total green area. Two relatively large forestated city parks are situated in the boundaries of the municipality of Plovdiv - "Lauta"and "Otdih i kultura" parks. These parks are very important elements in the green system of the city with a significant ecological role (Municipality of Plovdiv management plan, 2014).

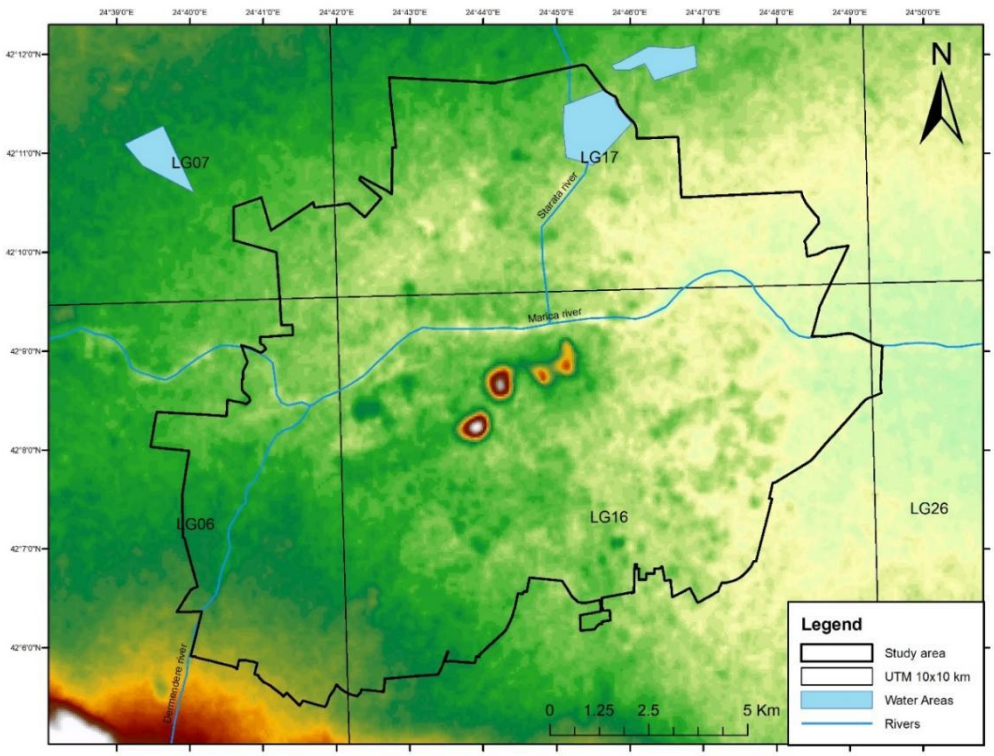

Fig. 1. Map of the study area.

Results

A total of 248 bird species are registered on the territory of municipality of Plovdiv (Table 1). The number represents 58.1 % of all bird species registered in Bulgaria (BUNARCO, 2014). We registered 137 species in different literature sources. We confirmed 107 species from the literature and found 115 new species for the avifauna of Plovdiv.

We confirmed 104 breeding species (registered as breeders at least once after 2000), that represent 40.6 % of the breeding bird species in Bulgaria (256 species, BUNARCO, 2014). Six species have extinct as breeders from Plovdiv - Eagle Owl (*Bubo bubo*), Egyptian Vulture (*Neophron percnopterus*) and the Lesser Kestrel (*Falco naumanni*) before 1950, and the Garganey (*Spatula querquedula*), Great Crested Grebe (*Podiceps cristatus*) and the Ferruginous Duck (*Aythya nyroca*) after 2000. Eleven species are with uncertain status during the breeding season - Black-headed Gull (*Larus ridibundus*), Caspian Gull (*Larus cachinnans*), Montague`s Harrier (*Circus pygargus*), Goshawk (*Accipiter gentilis*), Black Kite (*Milvus migrans*), Marsh Tit (*Poecile palustris*), Barred Warbler (*Sylvia nisoria*), Lesser Whitethroat Warbler (*Sylvia curruca*), Mistle Thrush (*Turdus viscivorus*), Song Thrush (*Turdus philomelos*), Rock Bunting (*Emberiza cia*). They have been observed but not confirmed during the breeding season. Another 11 species are regular visitors during breeding season of the municipality, utilizing the territory for feeding and roosting but not breeding - Black Stork (*Ciconia nigra*), Black-crowned Night Heron (*Nycticorax nycticorax*), Squacco Heron (*Ardeola ralloides*), Gray Heron (*Ardea cinerea*), Little Egret (*Egretta garzetta*), Pygmy Cormorant (*Microcarbo pygmaeus*), Collared Pratincole (*Glareola pratincola*), Short-toed Snake Eagle (*Circaetus gallicus*), Lesser Spotted Eagle (*Clanga pomarina*), Booted Eagle (*Hieraaetus pennatus*), Hen Harrier (*Circus*

cyaneus). The majority of the breeders belong to the order Passeriformes - 56 species (53.9%), and the rest of the orders are presented relatively equally. Recently the following species were confirmed (not included in Table 1): 1) 1. 2.2018 - Hume's Leaf Warbler (*Phylloscopus humei*) 1 ind. on the one of the hills and 2) 17.2.2019 - an adult male Long-tailed Duck (*Clangula hyemalis*) in Maritsa River and 3). 20.10.2017 - a Griffon Vulture (*Gyps fulvus*) soaring over western part of Plovdiv city

We confirmed 170 species during spring and autumn migration and 125 species wintering in the municipality of Plovdiv. The extinct species from the studied area are three: Egyptian Vulture, Lesser Kestrel and Eagle Owl. Vagrants are 35 species (Table 1).

Table 1. Species checklist in Plovdiv municipality, with their ecological and conservation status.

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
						Кокошоподобни		Order GALLIFORMES
						Фазанови	Pheasants, partridges, turkeys, grouse	Phasianidae
1	A	R	M	LC		Пъдпъдък**	Common Quail	*Coturnix coturnix*
2	A	R	w	LC	EX	Колхидски фазан**	Common Pheasant	*Phasianus colchicus*
3	A	R	W	LC		Полска яребица*	Grey Partridge	*Perdix perdix*
						Гъскоподобни		ANSERIFORMES
						Патицови	Ducks, geese, swans	Anatidae
4	A		mw	LC	VU	Ням лебед**	Mute Swan	*Cygnus olor*
5	A		w	LC	EN	Поен лебед**	Whooper Swan	*Cygnus cygnus*
6	A		w	LC	CR	Тундров лебед*	Tundra Swan	*Cygnus columbianus*
7	A		V	VU	VU	Червеногуша гъска*	Red-breasted Goose	*Branta ruficollis*
8	A		mW	LC		Голяма белочела гъска**	Greater White-fronted Goose	*Anser albifrons*
9	A		V	LC		Обикновена звънарка*	Common Goldeneye	*Bucephala clangula*
10	A		w	LC		Малък нирец*	Smew	*Mergellus albellus*
11	A		V	LC		Голям нирец*	Goosander	*Mergus merganser*
12	A		V	LC	VU	Бял ангъч*	Common Shelduck	*Tadorna tadorna*
13	A		V	LC	EX	Червеноклюна потапница*	Red-crested Pochard	*Netta rufina*
14	A		w	VU	VU	Кафявоглава потапница**	Common Pochard	*Aythya ferina*
15	A	0	m	NT	VU	Белоока потапница**	Ferruginous Duck	*Aythya nyroca*
16	A		w	LC		Качулата потапница*	Tufted Duck	*Aythya fuligula*
17	A	0	M	LC	VU	Лятно бърне**	Garganey	*Spatula querquedula*
18	A		w	LC		Клопач**	Northern Shoveler	*Spatula clypeata*
19	A		w	LC	CR	Сива патица*	Gadwall	*Mareca strepera*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
20	A		mw	LC		Фиш**	Eurasian Wigeon	*Mareca penelope*
21	A	R	MW	LC		Зеленоглава патица**	Mallard	*Anas platyrhynchos*
22	A		w	LC		Шилоопашата патица*	Northern Pintail	*Anas acuta*
23	A		MW	LC		Обикновено зимно бърне**	Common Teal	*Anas crecca*
						Гмурецоподобни		PODICIPEDIFORMES
						Гмурецови	Grebes	Podicipedidae
24	A	R	MW	LC	VU	Малък гмурец**	Little Grebe	*Tachybaptus ruficollis*
25	A	0	mw	LC	VU	Голям гмурец**	Great Crested Grebe	*Podiceps cristatus*
26	A		mw	LC	CR	Черноврат гмурец*	Black-necked Grebe	*Podiceps nigricollis*
						Гълъбоподобни		COLUMBIFORMES
						Гълъбови	Pigeons, doves	Columbidae
27	A	R	MW	LC		Полудив гълъб**	Rock Dove	*Columba livia f. domestica*
28	A	R	mw	LC	EN	Гълъб хралупар*	Stock Dove	*Columba oenas*
29	A	R	MW	LC		Гривяк**	Common Woodpigeon	*Columba palumbus*
30	A	R	M	VU		Гургулица**	European Turtle-dove	*Streptopelia turtur*
31	A	R	MW	LC		Гугутка**	Eurasian Collared-dove	*Streptopelia decaocto*
32	C	R	w	LC		Смехурка*	African Collared-dove*	*Streptopelia roseogrisea var. "risoria*
						Козодоевоподобни		CAPRIMULGIFORMES
						Същински козодои	Nightjars	Caprimulgidae
33	A	R	m	LC		Козодой**	European Nightjar	*Caprimulgus europaeus*
						Бързолетови	Swifts	Apodidae
34	A	R	M	LC		Алпийски бързолет*	Alpine Swift	*Tachymarptis melba*
35	A	R	M	LC		Блед бързолет*	Pallid Swift	*Apus pallidus*
36	A	R	M	LC		Черен бързолет**	Common Swift	*Apus apus*
						Кукувицоподобни		CUCULIFORMES
						Кукувицови	Cuckoos	Cuculidae
37	A	R	M	LC		Кукувица**	Common Cuckoo	*Cuculus canorus*
						Жеравоподобни		GRUIFORMES
						Дърдавцови	Rails, gallinules, coots	Rallidae
38	A		mw	LC		Крещалец**	Western Water Rail	*Rallus aquaticus*
39	A	R	MW	LC		Зеленоножка**	Common Moorhen	*Gallinula chloropus*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
40	A	R	MW	LC		Лиска**	Common Coot	*Fulica atra*
						Жеравови	Cranes	Gruidae
41	A		m	LC	EX	Сив жерав	Common Crane	*Grus grus*
						Щъркелоподобни		CICONIIFORMES
						Щъркелови	Storks	Ciconiidae
42	A	S	mw	LC	VU	Черен щъркел**	Black Stork	*Ciconia nigra*
43	A	R	M	LC	VU	Бял щъркел**	White Stork	*Ciconia ciconia*
						Пеликаноподобни		PELECANIFORMES
						Ибисови	Ibises, spoonbills	Threskiornithidae
44	A		mw	LC	CR	Лопатарка	Eurasian Spoonbill	*Platalea leucorodia*
45	A		m	LC	CR	Блестящ ибис**	Glossy Ibis	*Plegadis falcinellus*
						Чаплови	Herons	Ardeidae
46	A		w	LC	EN	Голям воден бик	Eurasian Bittern	*Botaurus stellaris*
47	A	R	m	LC	EN	Малък воден бик**	Common Little Bittern	*Ixobrychus minutus*
48	A	S	Mw	LC	VU	Нощна чапла**	Black-crowned Night Heron	*Nycticorax nycticorax*
49	A	S	m	LC	EN	Гривеста чапла*	Squacco Heron	*Ardeola ralloides*
50	A	S	mw	LC	VU	Сива чапла**	Grey Heron	*Ardea cinerea*
51	A		m	LC	EN	Червена чапла**	Purple Heron	*Ardea purpurea*
52	A		mw	LC	CR	Голяма бяла чапла**	Great White Egret	*Ardea alba*
53	A	S	mw	LC	VU	Малка бяла чапла**	Little Egret	*Egretta garzetta*
						Пеликанови	Pelicans	Pelecanidae
54	A		V	VU	CR	Къдроглав пеликан*	Dalmatian Pelican	*Pelecanus crispus*
						Рибоядоподобни		SULIFORMES
						Корморанови	Cormorants	Phalacrocoracidae
55	A	S	MW	LC	EN	Малък корморан**	Pygmy Cormorant	*Microcarbo pygmaeus*
56	A		MW	LC		Голям корморан**	Great Cormorant	*Phalacrocorax carbo*
						Дъждосвирцоподобни		CHARADRIIFORMES
						Стридоядови	Oystercatchers	Haematopodidae
57	A	R	mw	NT	CR	Стридояд**	Eurasian Oystercatcher	*Haematopus ostralegus*
						Саблеклюнови	Avocets, stilts	Recurvirostridae
58	A	R	M	LC	EN	Кокилобегач*	Black-winged Stilt	*Himantopus himantopus*
						Дъждосвирцови	Plovers	Charadriidae
59	A	R	Mw	LC	VU	Речен дъждосвирец**	Little Ringed Plover	*Charadrius dubius*
60	A	R	Mw	NT		Обикновена калугерица**	Northern Lapwing	*Vanellus vanellus*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
						Бекасови	Sandpipers, snipes, phalaropes	Scolopacidae
61	A		m	LC		Бойник*	Ruff	*Calidris pugnax*
62	A		m	LC		Сив брегобегач*	Temminck's Stint	*Calidris temminckii*
63	A		mw	LC	EN	Горски бекас*	Eurasian Woodcock	*Scolopax rusticola*
64	A		w	NT		Голяма бекасина	Great Snipe	*Gallinago media*
65	A		mW	LC	CR	Средна бекасина**	Common Snipe	*Gallinago gallinago*
66	A		V	LC		Малка бекасина	Jack Snipe	*Lymnocryptes minimus*
67	A		V	LC		Пепеляв брегобегач	Terek Sandpiper	*Xenus cinereus*
68	A	R	m	LC		Късокрил кюкавец**	Common Sandpiper	*Actitis hypoleucos*
69	A		mw	LC	EN	Голям горски водобегач**	Green Sandpiper	*Tringa ochropus*
70	A		V	LC		Голям червеноног водобегач	Spotted Redshank	*Tringa erythropus*
71	A		mw	LC		Голям зеленоног водобегач**	Common Greenshank	*Tringa nebularia*
72	A		mw	LC	CR	Малък червеноног водобегач**	Common Redshank	*Tringa totanus*
73	A		m	LC		Малък горски водобегач*	Wood Sandpiper	*Tringa glareola*
						Огърличникови	Coursers, pratincoles	Glareolidae
74	A	S	M	LC	EN	Кафявокрил огърличник*	Collared Pratincole	*Glareola pratincola*
						Чайкови	Gulls, terns, skimmers	Laridae
75	A		V	LC		Малка чайка*	Little Gull	*Hydrocoloeus minutus*
76	A		V	LC		Тънкоклюна чайка*	Slender-billed Gull	*Larus genei*
77	A	DD	MW	LC	EN	Речна чайка**	Black-headed Gull	*Larus ridibundus*
78	A		V	LC	VU	Малка черноглава чайка*	Mediterranean Gull	*Larus melanocephalus*
79	A		V	LC		Чайка буревестница*	Mew Gull	*Larus canus*
80	A		V	LC		Малка черногърба чайка*	Lesser Black-backed Gull	*Larus fuscus*
81	A	R	MW	LC		Жълтокрака чайка**	Yellow-legged Gull	*Larus michahellis*
82	A	DD	mw	LC		Каспийска чайка*	Caspian Gull	*Larus cachinnans*
83	A		m	LC	EN	Речна рибарка**	Common Tern	*Sterna hirundo*
84	A		m	LC	VU	Белобуза рибарка*	Whiskered Tern	*Chlidonias hybrida*
85	A		m	LC		Белокрила рибарка*	White-winged Tern	*Chlidonias leucopterus*
86	A		m	LC	CR	Черна рибарка*	Black Tern	*Chlidonias niger*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
						Совоподобни		STRIGIFORMES
						Забулени сови	Barn-owls	Tytonidae
87	A	R	w	LC	VU	Забулена сова*	Common Barn-owl	*Tyto alba*
						Совови	Typical owls	Strigidae
88	A	R	W	LC		Домашна кукумявка**	Little Owl	*Athene noctua*
89	A	R	M	LC		Чухал**	Eurasian Scops-owl	*Otus scops*
90	A	R	MW	LC		Горска ушата сова**	Northern Long-eared Owl	*Asio otus*
91	A		mw	LC		Блатна сова**	Short-eared Owl	*Asio flammeus*
92	A		w	LC		Горска улулица	Tawny Owl	*Strix aluco*
93	B	0		LC	EN	Бухал	Eurasian Eagle-owl	*Bubo bubo*
						Ястребоподобни		ACCIPITRIFORMES
						Орли рибари	Osprey	Pandionidae
94	A		m	LC	CR	Орел рибар	Osprey	*Pandion haliaetus*
						Ястребови	Hawks, eagles	Accipitridae
95	A		m	LC	VU	Осояд*	European Honey-buzzard	*Pernis apivorus*
96	B	0		EN	EN	Египетски лешояд	Egyptian Vulture	*Neophron percnopterus*
97	A	S	m	LC	VU	Орел змияр*	Short-toed Snake-eagle	*Circaetus gallicus*
98	A	S	m	LC	VU	Малък креслив орел*	Lesser Spotted Eagle	*Clanga pomarina*
99	A		V	VU	CR	Голям креслив орел*	Greater Spotted Eagle	*Clanga clanga*
100	A		V	VU	CR	Царски орел*	Eastern Imperial Eagle	*Aquila heliaca*
101	A	S	m	LC	VU	Малък орел*	Booted Eagle	*Hieraaetus pennatus*
102	A	R	mw	LC	EN	Тръстиков блатар**	Western Marsh-harrier	*Circus aeruginosus*
103	A	S	mw	LC	CR	Полски блатар**	Hen Harrier	*Circus cyaneus*
104	A		V	NT	EX	Степен блатар	Pallid Harrier	*Circus macrourus*
105	A	DD	m	LC	VU	Ливаден блатар*	Montagu's Harrier	*Circus pygargus*
106	A	R	m	LC	VU	Късопръст ястреб*	Levant Sparrowhawk	*Accipiter brevipes*
107	A	R	mw	LC	EN	Малък ястреб**	Eurasian Sparrowhawk	*Accipiter nisus*
108	A	DD	mw	LC	EN	Голям ястреб**	Northern Goshawk	*Accipiter gentilis*
109	A		V	LC	VU	Морски орел*	White-tailed Sea-eagle	*Haliaeetus albicilla*
110	A		m	NT	CR	Червена каня	Red Kite	*Milvus milvus*
111	A	DD	V	LC	VU	Черна каня**	Black Kite	*Milvus migrans*
112	A		mw	LC		Северен мишелов*	Rough-legged Buzzard	*Buteo lagopus*
113	A	R	MW	LC		Обикновен мишелов**	Eurasian Buzzard	*Buteo buteo*
114	A	R	mw	LC	VU	Белоопашат мишелов*	Long-legged Buzzard	*Buteo rufinus*
						Птици носорози		BUCEROTIFORMES

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
						Папунякови	Hoopoes	Upupidae
115	A	R	M	LC		Папуняк**	Common Hoopoe	*Upupa epops*
						Синявицоподобни		CORACIIFORMES
						Пчелоядови	Bee-eaters	Meropidae
116	A	R	M	LC		Обикновен пчелояд**	European Bee-eater	*Merops apiaster*
						Синявицови	Rollers	Coraciidae
117	A	R	m	LC	VU	Синявица*	European Roller	*Coracias garrulus*
						Земеродни рибарчета	Kingfishers	Alcedinidae
118	A	R	mw	LC		Земеродно рибарче**	Common Kingfisher	*Alcedo atthis*
						Кълвачоподобни		PICIFORMES
						Кълвачови		Picidae
119	A	R	m	LC		Въртошийка**	Eurasian Wryneck	*Jynx torquilla*
120	A		w	LC	EN	Сив кълвач**	Grey-faced Woodpecker	*Picus canus*
121	A	R	W	LC		Зелен кълвач**	Eurasian Green Woodpecker	*Picus viridis*
122	A	R	w	LC	VU	Черен кълвач*	Black Woodpecker	*Dryocopus martius*
123	A		w	LC		Среден пъстър кълвач*	Middle Spotted Woodpecker	*Leiopicus medius*
124	A	R	w	LC		Малък пъстър кълвач**	Lesser Spotted Woodpecker	*Dryobates minor*
125	A	R	W	LC		Сирийски кълвач**	Syrian Woodpecker	*Dendrocopos syriacus*
126	A	R	W	LC		Голям пъстър кълвач**	Great Spotted Woodpecker	*Dendrocopos major*
						Соколоподобни		FALCONIFORMES
						Соколови	Falcons, caracaras	Falconidae
127	B	0		LC	CR	Белошипа ветрушка	Lesser Kestrel	*Falco naumanni*
128	A	R	mw	LC		Черношипа ветрушка**	Common Kestrel	*Falco tinnunculus*
129	A		m	NT	CR	Червеногa ветрушка*	Red-footed Falcon	*Falco vespertinus*
130	A		V	LC	EN	Средиземноморски сокол	Eleonora's Falcon	*Falco eleonorae*
131	A		w	LC		Малък сокол*	Merlin	*Falco columbarius*
132	A	R	m	LC	VU	Сокол орко*	Eurasian Hobby	*Falco subbuteo*
133	A		V	EN	CR	Ловен сокол*	Saker Falcon	*Falco cherrug*
134	A	R	w	LC	EN	Сокол скитник*	Peregrine Falcon	*Falco peregrinus*
						Врабчоподобни		PASSERIFORMES
						Авлигови		Oriolidae
135	A	R	M	LC		Авлига**	Eurasian Golden Oriole	*Oriolus oriolus*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
						Сврачкови	Shrikes	Laniidae
136	A	R	M	LC		Червеногърба сврачка**	Red-backed Shrike	*Lanius collurio*
137	A	R	m	LC		Черночела сврачка*	Lesser Grey Shrike	*Lanius minor*
138	A		mw	LC	CR	Сива сврачка*	Great Grey Shrike	*Lanius excubitor*
139	A	R	m	LC		Червеноглава сврачка*	Woodchat Shrike	*Lanius senator*
140	A	R	m	LC	VU	Белочела сврачка*	Masked Shrike	*Lanius nubicus*
						Вранови	Crows and jays	Corvidae
141	A	R	MW	LC		Сойка**	Eurasian Jay	*Garrulus glandarius*
142	A	R	MW	LC		Сврака**	Eurasian Magpie	*Pica pica*
143	A	R	MW	LC		Чавка**	Eurasian Jackdaw	*Corvus monedula*
144	A		MW	LC		Посевна врана**	Rook	*Corvus frugilegus*
145	A	R	mw	LC		Гарван*	Common Raven	*Corvus corax*
146	A	R	MW	LC		Сива врана**	Carrion Crow	*Corvus corone*
						Синигерови	Tits and chickadees	Paridae
147	A		w	LC		Черен синигер*	Coal Tit	*Periparus ater*
148	A		V	LC		Жалобен синигер*	Sombre Tit	*Poecile lugubris*
149	A	DD	mw	LC		Лъскавоглав синигер**	Marsh Tit	*Poecile palustris*
150	A		V	LC		Матовоглав синигер*	Willow Tit	*Poecile montanus*
151	A	R	W	LC		Син синигер**	Eurasian Blue Tit	*Cyanistes caeruleus*
152	A	R	W	LC		Голям синигер**	Great Tit	*Parus major*
						Торбогнездни синигери	Penduline-tits	Remizidae
153	A	R	m	LC	VU	Торбогнезден синигер*	Eurasian Penduline-tit	*Remiz pendulinus*
						Чучулигови	Larks	Alaudidae
154	A	R	mw	LC	EN	Дебелоклюна чучулига*	Calandra Lark	*Melanocorypha calandra*
155	A		m	LC		Горска чучулига*	Woodlark	*Lullula arborea*
156	A	R	MW	LC		Полска чучулига*	Eurasian Skylark	*Alauda arvensis*
157	A	R	MW	LC		Качулата чучулига**	Crested Lark	*Galerida cristata*
						Шаварчеви	Reed-warblers	Acrocephalidae
158	A		m	LC	VU	Градински присмехулник*	Icterine Warbler	*Hippolais icterina*
159	A	R	M	NT		Блед присмехулник**	Olivaceous Warbler	*Iduna pallida*
160	A		V			Водно шаварче	Aquatic Warbler	*Acrocephalus paludicola*
161	A		M	LC		Крайбрежно шаварче*	Sedge Warbler	*Arrocephalus schoenobaenus*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
162	A	R	M	LC		Мочурно шаварче*	Marsh Warbler	*Acrocephalus palustris*
163	A	R	m	LC		Блатно шаварче*	Common Reed-warbler	*Acrocephalus scirpaceus*
164	A	R	M	LC		Тръстиково шаварче*	Great Reed-warbler	*Acrocephalus arundinaceus*
						Цвъркачеви	Grasshopper-warblers and grassbirds	Locustellidae
165	A		m	LC		Тръстиков цвъркач*	Savi's Warbler	*Locustella luscinioides*
166	A	R	m	LC	VU	Речен цвъркач	River Warbler	*Locustella fluviatilis*
167	A		m	LC		Полски цвъркач	Common Grasshopper-warbler	*Locustella naevia*
						Лястовицови	Swallows and martins	Hirundinidae
168	A	R	M	LC		Градска лястовица**	Northern House Martin	*Delichon urbicum*
169	A	R	M	LC		Червенокръста лястовица*	Red-rumped Swallow	*Cecropis daurica*
170	A	R	M	LC		Селска лястовица**	Barn Swallow	*Hirundo rustica*
171	A	R	M	LC		Скална лястовица*	Eurasian Crag Martin	*Ptyonoprogne rupestris*
172	A	R	M	LC		Брегова лястовица**	Collared Sand Martin	*Riparia riparia*
						Певци	Leaf-warblers	Phylloscopidae
173	A		Vm	LC		Източен планински певец*	Eastern Bonelli's Warbler	*Phylloscopus orientalis*
174	A		M	LC		Буков певец*	Wood Warbler	*Phylloscopus sibilatrix*
175	A		V	LC		Жълтовежд певец	Yellow-browed Warbler	*Phylloscopus inornatus*
176	A		M	LC		Брезов певец*	Willow Warbler	*Phylloscopus trochilus*
177	A	R	Mw	LC		Елов певец*	Common Chiffchaff	*Phylloscopus collybita*
						Храстови шаварчета	Bush-warblers	Scotocercidae
178	A	R	w		EN	Свилено шаварче*	Cetti's Warbler	*Cettia cetti*
						Дългоопашати синигери	Long-tailed tits	Aegithalidae
179	A	R	W	LC		Дългоопашат синигер*	Long-tailed Bushtit	*Aegithalos caudatus*
						Коприварчеви	Old World warblers and parrotbills	Sylviidae
180	A	R	M	LC		Голямо черноглаво копривarче**	Eurasian Blackcap	*Sylvia atricapilla*
181	A	R	m	LC	EN	Градинско копривarче*	Garden Warbler	*Sylvia borin*

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182	A	DD	m	LC		Ястребогушо коприварче*	Barred Warbler	*Sylvia nisoria*
183	A		V	LC	VU	Източно орфеево коприварче*	Eastern Orphean Warbler	*Sylvia crassirostris*
184	A	DD	M	LC		Малко белогушо коприварче**	Lesser Whitethroat	*Sylvia curruca*
185	A		V	LC		Червеногушо коприварче*	Subalpine Warbler	*Sylvia cantillans*
186	A	R	M	LC		Голямо белогушо коприварче**	Greater Whitethroat	*Sylvia communis*
						Дърволазкови	Treecreepers	Certhiidae
187	A	R	w	LC		Градинска дърволазка*	Short-toed Treecreeper	*Certhia brachydactyla*
188	A		w	LC		Горска дърволазка**	Eurasian Treecreeper	*Certhia familiaris*
						Зидаркови	Nuthatches	Sittidae
189	A	R	W	LC		Горска зидарка**	Eurasian Nuthatch	*Sitta europaea*
						Орехчета	Wrens	Troglodytidae
190	A		MW	LC		Орехче**	Northern Wren	*Troglodytes troglodytes*
						Водни косове	Dippers	Cinclidae
191	A		w	LC		Гурлю*	White-throated Dipper	*Cinclus cinclus*
						Скорецови	Starlings	Sturnidae
192	A	R	MW	LC		Обикновен скорец**	Common Starling	*Sturnus vulgaris*
193	A		V	LC	VU	Розов скорец*	Rosy Starling	*Pastor roseus*
						Дроздови	Thrushes	Turdidae
194	A	DD	MW	LC		Имелов дрозд*	Mistle Thrush	*Turdus viscivorus*
195	A	DD	Mw	LC		Поен дрозд*	Song Thrush	*Turdus philomelos*
196	A		w	NT		Беловежд дрозд*	Redwing	*Turdus iliacus*
197	A	R	MW	LC		Кос**	Eurasian Blackbird	*Turdus merula*
198	A		MW	LC		Хвойнов дрозд**	Fieldfare	*Turdus pilaris*
199	A		V	LC		Черногуш дрозд	Black-throated Thrush	*Turdus atrogularis*
						Мухоловкови	Old World flycatchers and chats	Muscicapidae
200	A		M	LC		Сива мухоловка*	Spotted Flycatcher	*Muscicapa striata*
201	A	R	W	LC		Червеногръдка**	European Robin	*Erithacus rubecula*
202	A		V	LC		Синьогушка*	Bluethroat	*Cyanecula svecica*
203	A		m	LC		Северен славей*	Thrush Nightingale	*Luscinia luscinia*
204	A	R	M	LC		Южен славей**	Common Nightingale	*Luscinia megarhynchos*
205	A		m	LC	VU	Червеногуша мухоловка*	Red-breasted Flycatcher	*Ficedula parva*

№	I	II	III	IV	V	Bulgarian Names (2014)	International English Names (2016)	Scientific Names
206	A		M	LC	VU	Полубеловрата мухоловка*	Semi-collared Flycatcher	*Ficedula semitorquata*
207	A		M	LC		Жалобна мухоловка*	European Pied Flycatcher	*Ficedula hypoleuca*
208	A		M	LC	CR	Беловрата мухоловка**	Collared Flycatcher	*Ficedula albicollis*
209	A	R	Mw	LC		Домашна червеноопашка**	Black Redstart	*Phoenicurus ochruros*
210	A		wm	LC	VU	Градинска червеноопашка*	Common Redstart	*Phoenicurus phoenicurus*
211	A		mw	LC		Ръждивогушо ливадарче*	Whinchat	*Saxicola rubetra*
212	A	R	Mw	LC		Европейско черногушо ливадарче*	Common Stonechat	*Saxicola torquatus*
213	A	R	M	LC		Сиво каменарче*	Northern Wheatear	*Oenanthe oenanthe*
214	A	R	M	LC		Ориенталско каменарче*	Isabelline Wheatear	*Oenanthe isabellina*
215	A		V	LC		Испанско каменарче*	Black-eared Wheatear	*Oenanthe hispanica*
						Кралчеви	Kinglets and firecrests	Regulidae
216	A		mW	LC		Жълтоглаво кралче*	Goldcrest	*Regulus regulus*
217	A		mw	LC		Червеноглаво кралче*	Common Firecrest	*Regulus ignicapilla*
						Копринаркови	Waxwings	Bombycillidae
218	A		V	LC		Копринарка	Bohemian Waxwing	*Bombycilla garrulus*
						Завирушкови	Accentors	Prunellidae
219	A		mw	LC		Сивогуша завирушка*	Dunnock	*Prunella modularis*
						Врабчови	Old World sparrows	Passeridae
220	A	R	MW	LC		Домашно врабче**	House Sparrow	*Passer domesticus*
221	A	R	Mw	LC		Испанско врабче**	Spanish Sparrow	*Passer hispaniolensis*
222	A	R	MW	LC		Полско врабче**	Eurasian Tree Sparrow	*Passer montanus*
						Стърчиопашкови	Pipits and wagtails	Motacillidae
223	A		M	LC		Горска бъбрица*	Tree Pipit	*Anthus trivialis*
224	A		MW	NT		Ливадна бъбрица*	Meadow Pipit	*Anthus pratensis*
225	A		MW	LC		Водна бъбрица*	Water Pipit	*Anthus spinoletta*
226	A		m	LC		Полска бъбрица*	Tawny Pipit	*Anthus campestris*
227	A	R	M	LC		Жълта стърчиопашка*	Western Yellow Wagtail	*Motacilla flava*
228	A		mw	LC		Планинска стърчиопашка*	Grey Wagtail	*Motacilla cinerea*
229	A	R	Mw	LC		Бяла стърчиопашка**	White Wagtail	*Motacilla alba*

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						Чинкови	Finches	Fringillidae
230	A	R	MW	LC		Обикновена чинка**	Common Chaffinch	*Fringilla coelebs*
231	A		MW	LC		Планинска чинка*	Brambling	*Fringilla montifringilla*
232	A	R	MW	LC		Черешарка**	Hawfinch	*Coccothraustes coccothraustes*
233	A		w	LC		Червенушка*	Eurasian Bullfinch	*Pyrrhula pyrrhula*
234	A	R	MW	LC		Зеленика**	European Greenfinch	*Chloris chloris*
235	A	R	MW	LC		Обикновено конопарче**	Common Linnet	*Linaria cannabina*
236	A	R	MW	LC		Щиглец**	European Goldfinch	*Carduelis carduelis*
237	A		MW	LC	VU	Елшова скатия**	Eurasian Siskin	*Spinus spinus*
						Снежни овесарки	Longspurs	Calcariidae
238	A		V	LC		Снежна овесарка	Snow Bunting	*Plectrophenax nivalis*
						Овесаркови	Old World buntings	Emberizidae
239	A	R	M	LC		Черноглава овесарка**	Black-headed Bunting	*Emberiza melanocephala*
240	A	R	MW	LC		Сива овесарка**	Corn Bunting	*Emberiza calandra*
241	A	DD	V	LC		Сивоглава овесарка*	Rock Bunting	*Emberiza cia*
242	A	R	m			Градинска овесарка*	Ortolan Bunting	*Emberiza hortulana*
243	A	R	mw	LC		Зеленогуша овесарка**	Cirl Bunting	*Emberiza cirlus*
243	A		MW	LC		Жълта овесарка*	Yellowhammer	*Emberiza citrinella*
245	A		MW	LC		Тръстикова овесарка*	Reed Bunting	*Emberiza schoeniclus*

In the IUCN red list registered species are include in the following categories: EN - 2 species, VU - 6 species, NT - 9 species, LC - 224 species.

In the Red data book of the republic of Bulgaria are included 88 species in the following categories: EX - 4 species, CR - 21 species, VU - 39 species, EN - 24 species.

Discussion

The recent study presents the first complete bird species checklist of the municipality of Plovdiv. The number of the bird species (248) ranks the city of Plovdiv amongst the richest not only in Bulgaria but also in Europe. The Maritsa River, the hills and big city parks on the other hand contribute to the high number of the breeding bird species (104) creating favourable breeding habitats. Compared to Sofia the number of the breeders is less but the study area is twice smaller as well (Iankov, 2005). In contrast with other animal species, the fragmentation of natural and semi-natural habitats does not create such an insuperable obstacle to birds (Niemela et al., 2009). From this point of view the Maritsa River and the hills form specific island habitat in the city centre and support conditions for a number of breeding, wintering and migrating bird species, offering them a place for breeding, roosting and feeding. Most probably this is one of the reasons to explain the high number of wintering and migrating species recorded. The number of the wintering and migrating bird species in Sofia is respectively 118 and 217 (Iankov, 2005). Considering not only the

number of the species but also the number of the population of a certain species, Plovdiv is probably one of the most important places for several of the species, not only on a national but also on a European scale. The city supports the largest wintering congregation site of the Pygmy Cormorant (*Microcarbo pygmaeus*) in the inside of the country (Plachiyski et al., 2014, Dobrev et al., in press), the largest wintering congregation site of the Rook in Bulgaria and Eastern Europe (Dobrev et al., 2014), as well as the largest wintering congregation site for the Long-eared owl in Bulgaria and south-eastern Europe (Klimentova-Nikolova, 2014, Dobrev et al., 2021). The diversity in the environment and the microhabitats in the city most probably support the high diversity of bird species. Some species are in the IUCN Red List which underlines the importance of the study area for the bird diversity not only in Bulgaria but in Europe, too. Three species (Eagle Owl, Lesser Kestrel and Egyptian Vulture) have completely extinct from the breeding avifauna of Plovdiv. The reason for this is the urbanization and growth of the city after the 1900. These species have specific requirements for the selection of nesting sites. In the past, the owl nested on the rocks of the hills, which at that time lied in the outskirts of the city, and are now in the city centre. It is similar for the Egyptian Vulture and the Lesser Kestrel. Three other species (Great Crested Grebe, Garganey and Ferruginous Duck) have extinct from the breeding avifauna of the city, probably due to habitat change, but can still be observed outside breeding season.

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Mammals in the City of Plovdiv

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Abstract. Most of the materials in this paper were according to literature review, with some new information included (about the species *Meles meles* and *Felis silvestris*, recently registered at the rural areas of Plovdiv). A total of 38 species were known from the area of Plovdiv city.

Key words: mammals, urban area, distribution.

Introduction

The mammals of the city of Plovdiv have been studied for more than fifteen years. In addition to their species composition, there is data in the literature on their habitat distribution and other aspects of their ecology.

This review article briefly presents all identified species in the city and their registration in different parts of the city – rural, suburban and urban areas.

Material and Methods

Most of the materials in this paper were according to literature review, with some new information included (about the species *Meles meles* and *Felis silvestris*, recently registered at the rural areas of Plovdiv). The literature survey was according Georgiev (2006), Mollov et al. (2009), Stoycheva et al. (2009), and Mollov & Georgiev (2015).

Results and Discussion

A total of 38 species were known from the area of Plovdiv city (Table 1).

The identified bat species in Plovdiv are 14 (42.4% of the known species of Bulgaria). Most of the species were found in areas between blocks of flats covered by tree vegetation and in dense park woods with low anthropogenic pressure. Considering ultrasound detector records most abundant bat species are *Nyctalus noctula*, *Pipistrellus pipistrellus* and *P. kuhli*. The rest of the species are relatively rare or are seasonally abundant (as *V. murinus*, *P. nathusii*).

At the city center of Plovdiv some bat species found proper roosting sites in buildings as *Pipistrellus kuhlii*, *Hypsugo savii* and *Nyctalus noctula*. One hibernating individual of *Pipistrellus kuhlii* was found in a classroom of a school.

The bat species found proper roosting sites in inhabitable buildings (mainly blocks of flats) crevices as *Pipistrellus kuhlii*, *Hypsugo savii*, *Nyctalus noctula*, and *Tadarida teniotis*. All species were registered by ultrasound detectors passing trough or hunting in these areas with an exception of *Myotis emarginatus*/*M. alcathoe*.

From the terrestrial small mammals there are 15 species (33.3% of the known species of Bulgaria) known till now in the city. The rodents are on first place with 9 species, the insectivores are 5, and *Lepus capensis* is the only representative of the lagomorphs. The dormice species are not registered in the city but considering the suitable habitats in some parks and river bank forests the *Dryomys nitedula* and *Glis glis* can be expected there. Also it can be supposed that *Muscardinus avellanarius* can be

found at vineyards and other proper habitats around the city.

The rocky and wood areas of the Plovdiv hills are inhabited by *Erinaceus roumanicus*, *Crocidura* spp., *Lepus capensis*, *Sciurus vulgaris*, *Microtus* sp., *Sylvaemus* sp., *Martes foina*. All bat species were registered by ultrasound detectors passing trough or hunting in these areas.

Data on species abundance and exact distribution is scarce. It can be noted that in pellets of *Asio otus* mostly *Microtus arvalis* - complex are found. Most rich on species are the hilly areas, open grasslands at suburban areas and the banks of Maritza River along its stretch.

The invasive *Myocastor coypus* is distributed all along the Maritza River.

Carnivores are represented by *Martes foina* in all parts of the city (even in most central urbanized area) and *Vulpes vulpes*, *Canis aureus*, *Mustela nivalis*, *Meles meles*, and *Felis silvestris* in the rural areas. The Maritza River is inhabited by a constant population of *Lutra lutra*.

Table. 1. Mammal species registered in Plovdiv City.

Species	Urban	Suburban	Rural
Erinaceus concolor	+	+	+
Talpa europea	-	+	+
Neomys anomalus	-	-	+
Crocidura leucodon	+	+	+
Crocidura suaveolens	+	+	+
Myotis blythii	-	+	-
Myotis emarginatus	+	-	-
Myotis mystacinus-complex	+	-	-
Myotis daubentonii	-	+	-
Eptesicus serotinus	+	+	-
Pipistrellus pipistrellus	+	+	+
Pipistrellus kuhlii	+	+	+
Pipistrellus pygmaeus	+	+	+
Pipistrellus nathusii	+	+	+
Hypsugo savii	-	+	-
Nyctalus noctula	+	+	+
Nyctalus lasiopterus	+	-	+
Nyctalus leisleri	-	+	-
Vespertilio murinus	-	+	-
Barbastella barbastellus	+	-	-
Plecotus sp.	+	+	+
Tadarida teniotis	+	+	+
Lepus capensis	-	+	+
Martes foina	+	+	+
Mustela nivalis	-	+	+
Meles meles	-	-	+
Lutra lutra	+	+	+
Vulpes vulpes	-	+	+

Felis silvestris	-	-	+
Sciurus vulgaris	+	+	-
Spermophillus citellus	-	+	+
Nannospalax leucodon	-	-	+
Microtus arvalis - complex	+	+	+
Arvicola terestris	+	+	+
Rattus norvegicus	+	+	+
Mus musculus	+	+	+
Sylvaemus sp.	+	+	+
Myocastor coypus	+	+	+
Total species:	24	30	28

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Research and Conservation of Bats (Mammalia, Chiroptera) in the Plovdiv City Urban Area: Current State and Future Perspectives

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Abstract. The city of Plovdiv has suitable conditions for wildlife due to the presence of a large river and some seminatural and natural habitats. Abundant bat fauna with 20 species is observed within the city limits. Bats could be found roosting in parks and rock crevices, as well as near residential buildings. The presence of numerous bat colonies in close proximity to a large human settlement would inevitably lead to conflicts. In this article, we present the current state of the bat research in Plovdiv, the threats they face, and the current efforts towards their conservation. The major threats to bat populations in Plovdiv are roost destruction, disturbance, and injuries. Currently, the main efforts towards bat conservation are focused on information campaigns and to a lesser extent - physical removal and rehabilitation of threatened bats. We suggest that further actions such as the establishment of a rescue team, frequent monitoring, installation of bat-friendly structures in buildings, and better coordination between institutions should be taken to increase the tolerance and ensure the safe co-inhabitancy between bats and humans in Plovdiv.

Key words: Chiroptera, Plovdiv, bats, conservation, urban fauna.

Introduction

Plovdiv is the second largest city in Bulgaria, located on an area of 102 km^2 in the Upper Thracian Valley, Southern Bulgaria (Plovdiv Municipality, 2021). Although for the most part, Plovdiv is a compact highly urbanized space, large green areas are located within the city. The "Otdih i Kultura" park, "Lauta" park, and the "Tsar-Simeonova Gradina" park are providing valuable natural habitats. The large Maritsa River flows thru the city and lush vegetation could be found around the river banks. The rowing canal - a water area with a length of 2.2 km is located near the river (Plovdiv Municipality, 2021). The most characteristic features of Plovdiv are its six hills - the so-called "Tepeta". The hills are formed in syenite rocks, contain areas with well-preserved broadleaf forest, and 3 of them ("Danov halm", "Mladezhki halm", and "Halm na Osvoboditelite") are declared protected areas (Georgiev, 1996). The presence of natural rock cliffs, wetlands, as well as spacious parks, make Plovdiv a suitable habitat for various animals, including several species of bats. From the 33 bat species in Bulgaria, 20 could be found around the city of Plovdiv (Benda et al., 2003; Mollov & Georgiev, 2015; Stoycheva et al., 2009; Tilova et al., 2003).

The current research shows, that bats are adapting well to urban dwelling and their species richness is increasing towards the urba-

nized areas, compared with the rural areas outside of the city (Mollov et al., 2009). This could be explained by the dominance of agricultural land outside the city, which makes the urban landscape one of the few places with preserved woodland and available roosting spaces and feeding areas (Mollov et al., 2009). The presence of numerous bat colonies in close proximity to a large human settlement ensures an inevitable contact between the two groups. Observations of bats from Plovdiv are constantly reported to local authorities or conservation NGOs, mainly from citizens' signals about distressed individuals and roosting colonies near homes. There are data available on conflicts between bats and people and the threats the urban bat populations are facing. In addition, citizen science platforms are gathering data on bats in the city (i.e. iNaturalist). So far, these data haven't been published, which prevents the possibility of being analysed and used for future conservation actions. The purpose of this article is to summarize and systematize the available information about bats in Plovdiv, provide additional data on observations, and discuss the main threats to bat populations and the possibilities for their conservation.

Materials and Methods

We performed an extensive review of the available literature sources on bats in the city of Plovdiv only considering the urbanized area (Fig. 1). We looked into known search engines (for example "Google Scholar") for the keywords "Chiroptera", "bats", "Plovdiv", "Thracian Valley" and combinations among them in both Bulgarian and English. We also checked the citizen science platform iNaturalist (2021) for observations of bats in Plovdiv.

We gathered original data from direct observations of bats and traces of their activity (guano, insect remains, skulls, etc) in the period 2010 - 2021. We used the following methods for the targeted study of bats: direct visual observations, roost search, ultrasound recordings, capturing with mist nets. We used field guides (Dietz & von Helversen, 2004; Dietz & Kiefer, 2016) to identify the observed bats. Where possible we photographed the observed individuals in their roosts. On few occasions, we captured bats with mist nets. The mist nets were placed in a suitable habitat at dusk and remained open for 3 hours. All captured bats were released after identification. We operated under permits No 524/ 03.06.2013; No 591/ 22.07.2014; No 645/ 13.08.2015; No 827/ 19.03.2020. We followed the research techniques and safety protocols, described by Kunz & Parsons (2009). In addition, we collected information about bat presence and reports of bats in distress from the database of the non-governmental organization (NGO) Green Balkans (Green Balkans, 2021a).

We did ultrasound recording on several places with a variety of habitats (open areas, areas with shrubs, deciduous and mixed forests, etc.) or places concentrating high bat diversity (reservoirs, swarming sites). Records were conducted in fair weather conditions only. We used bat detector "Petterson Tranquillity", with time expansion factor 10, in automatic recording mode and inter shaft 320 ms. The transformed audio files were recorded in wave format on an Olympus LS11E digital recorder. The specialized software "BatSound", version 3.1 was used for the analysis of the sonograms. To determine the sounds, various parameters were measured, such as peak frequency, the frequency with minimum and maximum energy, duration, the interval between sounds. As the method of analysing sounds has its limitations and in some cases does not allow accurate identification by species (due to natural overlap in the characteristics of sounds emitted by two or more species), the possible species (combinations of species to which the sound belongs) are indicated, for example, "*Nyctalus leisleri* (Kuhl, 1817) or *Vespertilio murinus* Linnaeus, 1758" or "*Pipistrellus pygmaeus* (Leach, 1825) or *Miniopterus schreibersii* (Kuhl, 1817)", in addition to commenting and assessing whether the habitats are suitable for any of the species. We analyzed spatial data and created maps using Orange software (Demsar et al., 2013). Part of our data are published for the management plans of the 3 natural landmarks (Dimov, 2017; Dimitrov et al., 2015). Our raw data are deposited in an online repository Figshare and available upon request at the following address: (https:/ / figshare.com/ projects/ Research_and_conservation_of_Bats_Mammalia_Chiroptera_in_Plovdiv_urban_area_current_state_and_future_perspectives/ 127790).

Results

We found 12 relevant publications on the topic of the bat fauna in the city of Plovdiv, published after 2003. The records earlier than 2003 are systematized by Benda et al. (2003). From the publications, mentioning bats, 9 are peer-reviewed, and 3 are management plans. The typical specimen for the species *Myotis mystacinus bulgaricus* Heinrich, 1936 is described from the city (Heinrich, 1936), later to be accepted as a synonym of *M. mystacinus aurascens* Kusjakin, 1935 (Benda et al., 2003). The most significant original research on bats in the city of Plovdiv is done by Stoycheva et al. (2009), which applied different methods of fieldwork and confirmed the presence of 14 species of bats. A big hibernaculum of the common noctule bat (*Nyctalus noctula* (Schreber, 1774)) was discovered under a bridge in 2005 (Tilova et al., 2008). The latest records on bats in the city are known from the research on the action plans of the protected areas of the hills "Danov halm", "Mladezhki halm" and "Halm na Osvoboditelite" (Dimov, 2017, Dimitrov et al., 2015). From the articles that present original research and new data on bats from Plovdiv, 2 studies (Tilova et al., 2008, Simov et al., 2006) mention only one species - *Nyctalus noctula*. The systematized research of species diversity, based on literature data and new reports and their conservation status (IUCN, 2021, Golemanski et al., 2011) is presented in Table 1.

Table 1. Diversity of bats in Plovdiv, their conservation status globally (GL), in Europe (EU), and Bulgaria (BG), and the source of records. *IUCN status - LC = least concern, NT = Near threatened, VU = Vulnerable, DD = Data deficient. **Source of observation - Benda et al. (2003) (B03), Tilova et al. (2005) (ET05), Stoycheva et al. (2009) (SS09), Authors' observations (AP, SD) and Green Balkans database (GB).

Species	IUCN*			Source**
	Gl	EU	BG	
Molossidae				
European free-tailed bat (*Tadarida teniotis* (Rafinesque, 1814))	LC	LC	DD	SS09, AP, SD
Rhinolophidae				
Greater Horseshoe Bat (*Rhinolophus ferrumequinum* (Schreber, 1774))	LC	NT	NT	B03
Vespertilionidae				
Western Barbastelle (*Barbastella barbastellus* (Schreber, 1774))	NT	VU	VU	B03
Greater Mouse-eared Bat (*Myotis myotis* (Borkhausen, 1797))	LC	LC	NT	B03
Lesser Mouse-eared Myotis (*Myotis blythii* Tomes, 1857)	LC	NT	NT	B03, SS09
Geoffroy's Bat (*Myotis emarginatus* (E. Geoffroy Saint-Hilaire, 1806))	LC	LC	VU	SS09
Steppe Whiskered Bat (*Myotis aurascens* (Kuhl, 1817))	LC	LC	-	B03
Whiskered bat (*Myotis mystacinus complex*)	LC	LC	-	ET05
Daubenton's Myotis (*Myotis daubentonii* (Kuhl, 1817))	LC	LC	-	SS09
Common Pipistrelle (*Pipistrellus pipistrellus*)	LC	LC	LC	B03, SS09, AP, GB
Soprano Pipistrelle (*Pipistrellus pygmaeu*s (Leach, 1825))	LC	LC	-	SS09,
Nathusius' Pipistrelle (*Pipistrellus nathusii* (Keyserling & Blasius, 1839))	LC	LC	LC	SS09, GB, AP
Kuhl's Pipistrelle (*Pipistrellus kuhlii* Kuhl, 1817)	LC	LC	-	ET05, SS09, GB, AP
Savi's Pipistrelle (*Hypsugo savii* Bonaparte, 1837)	LC	LC	LC	SS09, SD, GB
Serotine bat (*Eptesicus serotinus* (Schreber, 1774))	LC	LC	LC	B03, SS09,
Common noctule (*Nyctalus noctula*)	LC	LC	LC	B03, SS09, AP, GB
Giant Noctule (*Nyctalus lasiopterus* (Schreber, 1780))	VU	DD	VU	B03
Lesser noctule bat (*Nyctalus leisleri,* (Kuhl, 1817))	LC	LC	VU	B03, SS09
Gray Big-eared Bat (*Plecotus austriacus* (J.B. Fischer, 1829))	NT	NT	LC	SS09, AP
Particoloured Bat (*Vespertilio murinus*, Linnaeus, 1758)	LC	LC	LC	SS09, GB

There are 20 species of bats, reported for the city of Plovdiv (Table 1). The species - *Barbastella barbastellus*, *Nyctalus lasiopterus* and *Rhinolophus ferrumequinum* are reported only once and haven't been confirmed in recent studies. The most common species is the common noctule bat (*Nyctalus noctula*), reported as widespread by Stoycheva et al. (2009), and frequently observed by citizens. The pipistrelles (*P. pipistrellus, P. pygmaeus, P. kuhlii*) and the serotine bat (*Eptesicus serotinus*) are also widespread. Due to the limitations of the method of acoustic surveys, some taxa are not identified to species level. They remain in our records as a complex of species with similar characteristics, for example *Nyctalus noctula/lasiopterus*, *Pipistrellus nathusii/kuhli* and *N. noctula/N. leisleri /V. murinus / E. serotinus*. The observations with known locations are presented in Fig. 1. Although the free-tailed bat (*Tadarida teniotis*) is well-known in the city from acoustic records, the species hasn't been reported from direct observations up to now. We report one individual inside a rock crevice at the "Trihalmie" area in the city center. The crevice is a part of a popular rock climbing route. We observed one individual of *Hypsugo savii* in the same crevice in a different period. There are few records of maternity colonies in Plovdiv, one colony of *Hypsugo savii* (Stoycheva et al., 2009), one colony of *Pipistrellus kuhlii,* and one record of *P. pipistrellus*. The rest of the observations of summer colonies are not confirmed to species (for example - a summer colony of 50 small vespertilionid bats in the "Hadzhi Asan" quarter of town). There are almost no data on the size of the populations for any of the species. An exception is the information, presented in Tilova et al. (2008).

Fig. 1. Known locations of bats in Plovdiv City.

Although there are many signals regarding bats in Plovdiv, very few of them are properly recorded as most are lacking details such as location, caller ID, or photos. The signals are received by nature conservation NGOs, operating in the city (Green Balkans). Some of the situations, for example, a signal, that a bat flew into a house, resolve naturally with the bat escaping, and are not recorded in a database. The most significant threat for bats is roost destruction during construction works as it could affect a large number of individuals. The most famous case of bat colony damaged by construction works is described in detail by Tilova et al. (2008) when more than a thousand bats had to be relocated due to the destruction of their roost. The best documented threat are injuries

(N = 54). We have records of 54 bats from Plovdiv, admitted for rehabilitation at the Wildlife Rescue Centre in Stara Zagora, between the years 2010 and 2021 (Green Balkans, 2021a). However, there are no details on the origin of their injuries. Another issue occurs when a bat colony is roosting very close to humans (on a balcony, attic, etc.). Then people want to get rid of bats due to fear of contamination and diseases. In Table 2 we present the documented cases of human bat conflicts and injured bats.

Table 2. Documented threats to bats in Plovdiv City.

Case	Number of documented events
Roosts destroyed by construction works	1
Conflict with a colony in a home	3
Bat entering a home or office	1
Bats in rock climbing routes	2
Injured/ distressed bat	54

The measures taken towards the conservation of bats are a large-scale information campaign, including public events (Green Balkans, 2021b) and informational materials Green Balkans, 2021c). Another conservation action is the placement of 18 bat houses on trees in the "Mladezhki halm" area (Stoycheva, 2011). Volunteers from local conservation NGOs (Green Balkans) are answering signals for problematic bat colonies, trying to resolve the conflicts without moving the bats. Based on the limited capacity and the complication of the situation, this action is limited to the most urgent cases. In Fig. 2 we present photographs from rescue operations of distressed bats. The responsible institution for protected species such as bats is the Regional Inspectorate of Environment and Water (RIEW) Plovdiv. The RIEW is often relying on support from NGOs, especially for cases that need consultation from experts.

Fig. 2. Bat observations in Plovdiv: 1. *Plecotus austriacus* roosting in a bunker; 2. *Pipistrellus pipistrellus,* found in a house; 3. A juvenile bat, found in a house; 4. Bat roost in a crack on a balcony. 5. *Nyctalus noctula.*, found on the ground in a park; 6. Lactating female *Pipistrellus pipistrellus* with a pup. 7. *Tadarida teniotis* roosting in a rock crevice. 8. *Pipistrellus kuhlii* found in a house. Photo credit: Green Balkans.

Discussion

Although urbanization is often regarded as a major threat to wildlife, our data show that bat fauna in Plovdiv is abundant and thriving in the city environment. Urbanization might provide advantages for some species of bats, as they find more suitable roosts, food sources, warmer environments, and experience less predation (Ancillotto et al., 2015; Voigt et al., 2015; Mollov et al., 2009). Some species of bats, such as the forest-dwelling *Plecotus austriacus* and *Barbastella barbastellus* are likely inhabiting the city due to the destruction of suitable habitats nearby as the Plovdiv hills and parks are one of the last remains of the once abundant lowland forests in the area. Other species, such as the noctule, the serotine bat, and the pipistrelles are rock-dwellers, that find suitable roosts in the cracks between the numerous old soviet buildings. The pipistrelle bats are synanthropic species that most likely inhabit Plovdiv all year round (Godlevska et al., 2020, Paunović et al., 2016; Benda et al., 2016; Juste et al., 2016). The common noctule bat, which roosts in buildings and structures is a migratory species that breeds in Ukraine and uses Bulgaria as a wintering place (Csorba et al., 2016). As bats are becoming well-adapted to synanthropic life, and at the same time their natural habitats are being destroyed at an alarming rate, bats and humans will remain coexisting in the urban environment for the unforeseeable future.

The observation of *Hypsugo savii* and *Tadarida teniotis* on a rock climbing route hints at the excellent opportunity to expand the knowledge on rock-dwelling bat species, by using the approach of rock climbing. This practice is already initiated in other countries (Davis et al., 2017) and the experience could be applied in Plovdiv as rock climbing is very popular in the city (Stoyanov, 2021). If such initiative is taken, a thoughtful and delicate diplomatic approach is needed to ensure the balance between recreational activities and conservation. We need to make sure that we are learning from past mistakes as in previous attempts to preserve rock-dwelling fauna, prohibitions lead to conflicts and withdrawal of the climbing community from conservation activities (Petrov, 2011). Outdoor activities and rock climbing could provide invaluable information on the distribution of bats and other rock fauna, where standard research methods are not applicable, and we should use this opportunity, especially with the fast-developing features of citizen science platforms.

As encounters between bats and people are getting more frequent, it is urgent to take targeted, specific and sustainable measures to ensure the resolving of any current and future conflicts. The information campaign called "Bat Night" is slowly achieving its goals and the attitudes of people toward bats are becoming more positive. Some of the signals in our database are from concerned citizens, who found a bat and want to help it. Yet, if inconvenience or financial loss is involved, people are much less likely to protect bats. People, who are planning construction work in their homes are less than happy when presented with the information that bats should not be removed. Up to now, such cases are rarely resolved and information about outcomes is missing. All bat species in Bulgaria are protected by law (MOEW, 2018), and their killing, destruction of roosts, and disturbance are strictly prohibited. Unfortunately, the protection remains mostly on paper and it is rarely enforced. There is a complete lack of monitoring and control over the presence of bats in urban zones, and there are no protocols for their safe relocation. If measures are not taken, a large number of bats could be annihilated during the planned remediation of the panel buildings, or during other renovation works, as it already happens in other parts of the country (Dnevnik, 2017). As the planned extensive campaign of building restoration is approaching, there is an urgent need for a capable administrative structure, which would make sure the work is executed safely and would potentially rescue threatened bat colonies. As synanthropic bats are not likely to move away and their presence in Plovdiv is providing valuable ecosystem service as pest-control (Kunz et al., 2011), we need to make sure that we do not deprive them of their roosts. Future construction works and renovations should be executed, following the established standards of bat-friendly buildings (Marnell & Presetnik, 2010). The joint efforts of institutions to promote tolerance and understanding will not only benefit bats but

also ensure that Plovdiv will become a sustainable and green city, which could serve as an example and admiration.

Conclusions

Plovdiv has a very rich bat fauna, and some of the species are roosting very close to human homes. To mitigate any conflicts and ensure the safe con-inhabitancy, we need to plan and take conservation actions. The destruction of bat colonies during construction is the gravest threat that we are aware of and should be addressed immediately. We suggest that governmental institutions work together with experts and nature conservation NGO's and find a solution to this problem. The loss of available roosts is another certain threat that bat colonies will face if actions are not taken, due to the removal of the cracks of the old soviet-style buildings. Currently, there are no data on the populations' size of bat species, the most important roosts, threats, or any seasonal changes, which prevents any reasonable action towards their conservation. In Table 3 we present the current and potential threats that bats in Plovdiv are facing and propose actions to address each issue. Finally, we express the need for a qualified research and rescue team to be formed, to be able to adequately monitor bat colonies and help distressed individuals. However, bat research is related to serious health hazards and only individuals who fulfill all requirements, namely - relevant education, skills, experience, up-to-date rabies vaccinations, and a valid research permit, should be allowed to handle bats.

Table 3. Threats towards bats in Plovdiv City and recommended conservation actions.

Threats	Conservation actions
Killing of bats during renovation works	Safely removal and relocation of bats by qualified experts. Information campaign among construction companies.
Disturbance during vulnerable periods (reproduction or hibernation)	If the presence of a maternity/ hibernation colony is confirmed, construction work or other disturbance is to be postponed.
Loss of roosts in man-made structures, due to renovation/ demolition	Construction of alternative roosts. Establishment of rules for bat-friendly construction. Placing of compensatory bat boxes near destroyed roosts.
Loss of forest habitats due to the reduction of the large urban and suburban parks	Compensatory afforestation. Preservation of biotope trees. Placing bat houses where trees are not suitable roosts.
Lack of knowledge on species diversity, population size, dynamics, and threats.	Establishment of a monitoring program. Popularization of citizen science as a tool for bat research and conservation. Keeping meticulous and detailed records for accidents and injury reports.
Disturbance of bats in natural rock roosts	Information campaign and encouragement of collaboration projects, involving outdoor enthusiasts.
Lack of tolerance and prejudice towards bats in the cities	Information campaign.
Illegal killing, handling, and keeping of bats	Penalties, according to legislation. Control by RIEW.
Predation by house cats	Reducing the population of feral cats.

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Species Composition and Distribution of the Vertebrates at Maritsa River in the City of Plovdiv

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Abstract. In recent years, over-exploitation, urbanization, pollution, removal of riparian vegetation, among other human activities, threaten some of the richest ecosystems - rivers. Many vertebrates are the first to feel the effects of the negative impact and are forced to leave the modified, uninhabitable habitats. A comprehensive study of vertebrates on the Maritsa River has not been conducted for more than 10 years. This study provides new data on the species composition and distribution of the vertebrates along the Maritsa River in the city of Plovdiv.

Key words: Maritsa River, vertebrates, fish, amphibians, reptiles, birds, mammals, river ecosystem.

Introduction

In this century, cities around the world continue to change to meet the needs of a growing population. As of 2014, 54% of the world's population lives in cities and one of the biggest challenges of the 21st century is managing urban growth (Singh, 2013).

Urbanization is evolving so fast that animals cannot adapt in time. Their habitats are destroyed or they leave them on their own, driven out by human activity. Mollov et al. (2009) argue that urbanization is often the cause of the extinction of native species and has a complex impact on the biodiversity of the area. It can affect species richness positively or negatively.

As Leopold (1968) writes, of all the changes in the landscape caused by land use affecting the hydrobiology of an area, urbanization is the strongest. One of the most sensitive organisms to changes, caused by urbanization is vertebrates. Due to their size and biology, it is possible to notice their absence in places where hundreds of representatives of a certain group are usually present. Many vertebrate species also inhabit the Maritsa River in the Plovdiv area (Georgiev et al., 2015; Mollov & Georgiev, 2015). Many waterfowl spend the winter in the Maritsa River, many of which are globally endangered and rare (Kostadinova & Gramatikov, 2007). Changes along the river in Plovdiv City can lead to the loss or change of species and habitats, as well as in ecosystem conditions (Georgiev et al., 2015). In the past, episodic studies of vertebrate fauna have been conducted in the Maritsa River, near Plovdiv (Georgiev et al., 2015; Mollov & Georgiev, 2015; Gecheva et al., 2011, etc.). However, the rapid growth rate of urbanization and the increase in anthropogenic pressure require updating the data on the current state of vertebrate fauna. The ecology of certain species requires seasonal research for more complete and accurate information. A better understanding of the ecological processes on which the species composition and distribution

of vertebrates in urban conditions depends is necessary for making adequate decisions for the protection and management of the urban environment, which determines the relevance of the current work.

Materials and Methods

The main method for determining the species composition of vertebrates in the study area is through linear transects (Gregory et al., 2004) on the northern and southern banks of the Maritsa River in the study area.

The study of different classes of animals is carried out by different methods, depending on their characteristics. Underwater animal traps have been used for the fish (Pisces) (Bock et al., 2009).

In the period 01.12.2019 - 31.08.2020 a survey was conducted with 64 fishermen in order to obtain additional information about the species composition of fish found in the study area.

For the amphibians (Amphibia) and the reptiles (Reptilia), animal underwater traps were used (Bock et al., 2009) and direct linear transect observations with coordinate surveys (Tsankov et al., 2014). Amphibians and reptiles are visually identified using the works of Biserkov et al. (2007) and Tsankov et al. (2014). In some cases, registered amphibians and reptiles were caught by hand or with the help of a net for their more precise determination and released at the same place. Some of the individuals are identified by the sounds they make, their eggs or larvae, skin-sheds.

For the birds (Aves), direct observations on a linear transect were used, recognizing the species by the songs of the male individuals during the breeding season. The birds were divided into three types: nesting (permanent), wintering and migrating (after Kostadinova & Gramatikov, 2007).

For the mammals (Mammalia), direct observations and recognition of traces of vital activity (steps, tracks, feces, food remains) by linear transect were used (after Popov et al. 2007).

For the purposes of the current work we also used data from fishing competitions organized by "Olympic 2002" Fishing Association.

The geographical coordinates of each individual were recorded on site with the SmartBirds Pro (2020) application.

ArcGIS 10.2 software was used to create the maps (ESRI, 2014). The Fauna Europaea database (deJong et al., 2014) was used for the current names of the species.

The field work in the present study was conducted at Maritsa River in Plovdiv City, between Adata Island and the protected area "Noshtuvka na malak kormoran". The territory is a protected area under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (NATURA 2000) and Directive 2009/147/EC on the conservation of wild birds. The study period was from October 2019 to September 2020.

Results and Discussion

During the current study we identified 103 vertebrate species, of which 7 were new to the area (3 reptiles and 4 mammals).

Pisces

During the research in the studied area 4 species of fish from 3 families were recorded, which is 1.9% of the Bulgarian freshwater ichthyofauna (Karapetkova & Zhivkov, 1995) (Table 1).

Table 1. Results of the conducted research for the species composition of the fish in the Maritsa River in the city of Plovdiv.

Species	Previous studies (Georgiev et al. 2015; Mollov & Georgiev, 2015)	Surveys of fishermen (December 2019 – August 2020)	Data from fishing competitions (2018-2019)	Current study
Cyprinidae				
Barbus cyclolepis	+	+	+	+
Pseudorasbora parva	+	-	-	-
Carassius gibelio	+	+	-	-
Cyprinus carpio	+	-	-	-
Rutilus rutilus	+	-	-	-
Rhodeus sericeus amarus	+	-	-	+
Gobio gobio	+	+	-	-
Alburnus alburnus	+	+	-	-

Leuciscus cephalus	+	+	+	-
Leuciscus borysthenicus	+	-	-	-
Chondrostoma vardarense	+	-	-	-
Vimba melanops	+	-	-	-
Aspius aspius	+	+	-	-
Chondrostoma nasus	-	+	-	-
Ctenopharyngodon idella	-	+	-	-
Scardinius erythrophthalmus	-	+	-	-
Vimba vimba	-	+	-	-
Tinca tinca	+	-	-	-
Carassius auratus	+	-	-	-
Carassius carassius	+	-	-	-
Hypophtalmychtys sp.	+	-	-	-
Rutilus rutilus mariza	+	-	-	-
Anguillidae				
Anguilla anguilla	+	-	-	-
Cobitidae				
Cobitis taenia	+	-	-	+
Centrarchidae				
Lepomis gibbosus	+	-	-	-
Salmonidae				
Salmo trutta	-	+	-	-
Cottidae				
Cottus gobio	-	+	-	-
Percidae				
Sander lucioperca	-	+	-	-
Siluridae				
Silurus glanis	-	+	+	-
Clarias gariepinus	-	+	-	-
Esocidae				
Esox lucius	+	+	+	-
Gobiidae				
Proterorchinus marmoratus	+	+	-	+
Poeciliidae				
Gambusia affinis holbrooki	+	-	-	-

We received up-to-date data on the species composition of the ichthyofauna in the region from the aquatic traps and the surveys with fishermen. Aquatic traps caught the following species: *Barbus cyclolepis, Cobitis taenia, Rhodeus sericeus amarus* and *Proterorchinus marmoratus*. The survey conducted with fishermen in the area, as well as data from the fishing competitions, complemented the current picture of the fish species in the area. It is noteworthy that among the species that have not been recorded recently is the European eel (*Anguilla anguilla*). It is mentioned as part of the ichthyofauna of Plovdiv by Mollov & Georgiev (2015).

Species not mentioned in the literature so far are fish such as *Chondrostoma nasus, Scardinius erythrophthalmus* and *Vimba vimba,* which can also be found in the IUCN Red List. According to fishermen, the *Scardinius erythrophthalmus* can often be confused with the almost identical *Rutilus rutilus*. Another similar case is formed by the data on *Cyprinus carpio*. According to other fishermen, the carp caught in this part of the Maritsa River are actually species used for stocking.

Amphibia & Reptilia

During the research, in the study area were found 1 species of amphibians from 1 family, which is 5.56% of the amphibian fauna of Bulgaria and 10 species of reptiles from 4 families, which is 27.78% of the reptiles in Bulgaria (Biserkov et al., 2007) (Table 2). The table shows the species composition of amphibians and reptiles in the Maritsa River in Plovdiv.

The two species of toads (*Bufo bufo* and *Bufotes viridis*) were not found on the river banks, but in the immediate vicinity of the Rowing Canal - Plovdiv. We assume that they are also found along the river banks.

Compared to previous studies, a decrease in the species composition of amphibians has been observed. From all of the anurans listed in Table 2, only one was recorded in the study area - the Marsh Frog (*Pelophylax ridibundus*). It is possible that the

increased pollution and the decrease in the species composition of amphibians are related.

Three new reptile species have been recorded in the study area - *Dolichophis caspius* and *Zamenis longissimus*. The third species is the invasive yellow-eared slider (*Trachemys scripta scripta*). Two individuals were spotted on an island near the bridge next to the Gerdjika Hotel. The red-eared slider (*Trachemys scripta elegans*) was also observed in a spill off the island of Adata. At this stage there is no data to breed in the area. Distribution maps of the recorded species of amphibians and reptiles are given in Appendix 1.

Aves

We recorded 77 species of birds from 42 families in the study area, which is 18.83% of the birds in Bulgaria (BUNARCO, 2009) (Table 3).

Table 2. Species composition of the amphibians and reptiles in the Maritsa River in the city of Plovdiv.

Species	Previous studies (Georgiev et al. 2015; Mollov & Georgiev, 2015)	Current study
Amphibia		
Bufonidae		
Bufo bufo	+	*?*
Bufotes viridis	+	*?*
Pelobatidae		
Pelobates syriacus	+	-
Hylidae		
Hyla orientalis	+	-
Ranidae		
Pelophylax ridibundus	+	+
Rana dalmatina	+	-
Reptilia		
Emydidae		
Emys orbicularis	+	+
Trachemys scripta scripta	-	+
Trachemys scripta elegans	-	+
Colubridae		
Dolichophis caspius	-	+
Natrix natrix	+	+
Natrix tessellata	+	+
Zamenis longissimus	-	+
Lacertidae		
Lacerta viridis	+	+
Podarcis tauricus	-	+
Gekkonidae		
Mediodactylus kotschyi rumelicus	-	+

Table 3. Species composition of the birds at Maritsa River in the city of Plovdiv.

Species	Previous studies (Georgiev et al. 2015; Mollov & Georgiev, 2015)	Current study
Podicipedidae		
Podiceps cristatus	+	-
Tachybaptus ruficollis	+	+
Phalacrocoracidae		
Microcarbo carbo	+	+
Microcarbo pygmaeus	+	+

Ardeidae	-	
Nycticorax nycticorax	+	+
Ixobrychus minutus	+	-
Egretta garzetta	+	+
Egretta alba	+	+
Ardea cinerea	-	+
Anatidae		
Anas platyrhynchos	+	+
Anas querquedula	+	-
Anas crecca	+	+
Anas penelope	-	+
Cygnus cygnus	-	+
Cygnus olor	-	+
Accipitridae		
Accipiter nisus	+	-
Buteo buteo	+	+
Accipiter gentilis	-	+
Falconidae		
Falco tinnunculus	+	+
Phasianidae		
Perdix perdix	-	+
Rallidae		
Fulica atra	+	+
Gallinula chloropus	+	+
Haematopodidae		
Haematopus ostralegus	+	-
Scolopacidae		
Actitis hypoleucos	+	+
Gallinago gallinago	-	+
Tringa ochropus	-	+
Laridae		
Larus michahellis	-	+
Larus argentatus	+	-
Sternidae		
Sterna hirundo	+	-
Columbidae		
Columba palumbus	+	+
Streptopelia turtur	+	-
Streptopelia decaocto	+	+
Strigidae		
Otus scops	+	+

Athene noctua	+	-
Alcedinidae		
Alcedo atthis	+	+
Meropidae		
Merops apiaster	+	+
Coraciidae		
Coracias garrulus	+	-
Upupidae		
Upupa epops	+	+
Picidae		
Jynx torquilla	+	-
Picus viridis	+	+
Picus canus	+	-
Dendrocopos major	+	+
Dendrocopos minor	-	+
Dendrocopos syriacus	+	-
Dryocopus martius	-	+
Hirundinidae		
Riparia riparia	+	+
Hirundo rustica	-	+
Delichon urbica	-	+
Hirundo daurica	-	+
Ptyonoprogne rupestris	-	+
Laniidae		
Lanius collurio	+	+
Lanius minor	-	+
Troglodytidae		
Troglodytes troglodytes	+	+
Muscicapidae		
Erithacus rubecula	-	+
Luscinia megarhynchos	+	+
Phoenicurus ochruros	-	+
Saxicola torquata	+	-
Muscicapa striata	+	-
Ficedula albicollis	-	+
Turdidae		
Turdus merula	+	+
Turdus viscivorus	+	-
Acrocephalidae		
Acrocephalus palustris	+	-
Acrocephalus arundinaceus	+	-

Sylviidae		
Hippolais olivetorum	+	-
Hippolais pallida	+	-
Sylvia atricapilla	+	+
Sylvia communis	+	-
Sylvia curruca	+	+
Aegithalidae		
Aegithalos caudatus	+	+
Paridae		
Parus major	+	+
Cyanistes caeruleus	+	+
Poecile montanus	-	+
Poecile palustris	-	+
Remiz pendulinus	+	-
Sittidae		
Sitta europaea	+	-
Emberizidae		
Emberiza cirlus	+	-
Emberiza calandra	-	+
Fringillidae		
Fringilla coelebs	+	+
Carduelis carduelis	+	+
Coccothraustes coccothraustes	+	-
Carduelis chloris	+	+
Sturnidae		
Sturnus vulgaris	+	+
Oriolidae		
Oriolus oriolus	+	+
Passeridae		
Passer domesticus	-	+
Passer montanus	-	+
Corvidae		
Garrulus glandarius	+	+
Pica pica	+	+
Corvus monedula	+	+
Corvus frugilegus	+	+
Corvus cornix	+	+
Phylloscopidae		
Phylloscopus collybita	-	+
Alaudidae		
Galerida cristata	-	+

Motacillidae		
Anthus spinoletta	-	+
Motacilla alba	-	+
Motacilla cinerea	-	+
Motacilla flava	-	+
Apodidae		
Apus melba	-	+
Apus pallidus	-	+
Apus apus	-	+
Charadriidae		
Charadrius dubius	-	+
Ciconiidae		
Ciconia ciconia	-	+
Cinclidae		
Cinclus cinclus	-	+

Among the species of conservation importance is *Microcarbo pygmaeus*, for which the protected area "Noshtuvka na malyk kormoran" has been declared, as well as a large part of the birds wintering in the river. In 2014, the globally endangered and protected *Branta ruficollis* was even spotted in the study area by the director of the Regional Natural History Museum - Plovdiv, Dr. Ognyan Todorov. The bird was not noted by any of the methods we used to determine the species composition of birds on the Maritsa River in Plovdiv and therefore is not present in Table 3.

Fifty eight of the identified bird species are present in Annex III of the Bulgarian Biodiversity Act, 13 are categorized as "endangered" or "vulnerable" in the Red Data Book of the Republic of Bulgaria, and 42 are included in Directive 2009/147/EC on the conservation of wild birds. Being a large river, the Maritsa attracts many important species for conservation and their monitoring is important.

There are several places of conservation importance for birds in the study area:

- Protected area "Noshtuvka na malyk kormoran", which since 2006 is a resting place for the globally endangered and protected species *Microcarbo pygmaeus* - the western border of the study area;

- The colonies *Merops apiaster* and *Riparia riparia,* located to the east of the protected area "Noshtuvka na malyk kormoran".

- Adata Island, where migrating cormorants currently use for rest - the eastern border of the study area.

The change in the resting site of the cormorants was announced by the Bulgarian Society for the Protection of Birds (BSPB) at the end of 2019 and confirmed during the mid-winter survey of wild birds in February 2020, in which we also took part. It is assumed that the reason for the change of the resting site is the disturbance by hunters and fishermen, as well as heavy traffic on the adjacent road.

No new bird species were found in the study area. Still, there were some interesting observations. A lone male species *Anas penelope*, which is not typical of the country's wintering species, was found in May in the urban part of the study area (near the bridge next to the "Gerdjika" Hotel).

During the mid-winter survey of wild birds, a decrease in the number of wintering species along the Maritsa River in the study area was recorded. Even near the Adata Island, where species such as the endangered *Anas strepera* were previously observed, in this year's study, there were only *Microcarbo pygmaeus*, *Anas crecca* and few *Motacilla cinerea*.

Decline is found not only in wintering birds. Compared to the literature, the species

composition of all birds is significantly reduced. Reasons for this may be increased urbanization, pollution, human disturbance and the warmer winter in the country. At the end of the winter we also managed to see *Pica pica* feeding on cormorant carcasses. The distance and condition of the carcass did not allow to determine the type of cormorant. In the spring of 2020, the research was hampered by quarantine imposed by the COVID-19 pandemic. However, several species such as *Ficedula albicollis* were identified during the migratory season.

Mammalia

Eleven species of mammals from 8 families were identified in the study area, which is 10.89% of the mammals in Bulgaria (Popov et al., 2007) (Table 4). Distribution maps of the recorded species of mammals are given in Appendix 1.

Table 4. Species composition of mammals along the Maritsa River in the city of Plovdiv.

Species	Previous studies (Georgiev et al. 2015; Mollov & Georgiev, 2015)	Current study
Soricidae		
Neomys fodiens	+	-
Crocidura suaveolens	-	+
Mustelidae		
Lutra lutra	+	+
Cricetidae		
Arvicola terrestris	+	-
Myocastoridae		
Myocastor coypus	+	+
Vespertilionidae		
Nyctalus noctula	+	-
Pipistrellus kuhli	+	-
Pipistrellus pipistrellus	+	-
Hypsugo savii	+	-
Eptesicus		
Eptesicus serotinus	+	-
Muridae		
Mus macedonicus	-	+
Apodemus agrarius	-	+
Rattus norvegicus	-	+
Canidae		
Vulpes vulpes	-	+
Talpidae		
Talpa europaea	+	+
Sciuridae		
Spermophilus citellus	-	+
Sciurus vulgaris	-	+
Leporidae		
Lepus europaeus	-	+

Among the conservationally important mammal species are *Lutra lutra* and *Spermophilus citellus* stand out due to their status in the Bulgarian and international conservation legislation. The European ground squirrel in the study area was located near a cow farm and the animals are taken out to graze in the territory inhabited by the European ground squirrel. At this stage, it is not exactly clear what the impact of animal husbandry has on *Spermophilus citellus* in the area.

For the first time, we report four new species for the study area: *Crocidura suaveolens*, *Mus macedonicus*, *Apodemus agrarius* and *Rattus norvegicus*. It can be noted,

that species that are currently being registered in the study area, are typical for urbanized areas or inhabiting landfills. The rodents such as *Mus macedonicus* and *Rattus norvegicus* were found near the 6th kilometer bridge on the south bank of the Maritsa River, where a cow farm and small dumps are located, creating perfect living conditions for these species.

Many mammals were identified only by traces. This is the case with the otter (*Lutra lutra*), which presence was registered by food remains, feces, footprints and tracks. Despite the nocturnal studies, no direct observation of the otter has occurred. Clusters of mussel shells were found mainly in the suburbs, west of Plovdiv. *Myocastor coypus* and its tracks were found in both urban and suburban areas of the study area. Even a dead specimen was found near the island of Adata in early December 2019. *Myocastor coypus* are often seen near bridges in the city and some of them even go ashore, close to the people. As an invasive species, *M. coypus* have been found to damage riparian vegetation in other countries. In the current study, no damage to the vegetation in the area caused by the nutria was observed.

Threats

The following threats and conservation problems were identified during the present study.

Pollution with household waste

On most of the two banks of the Maritsa River in Plovdiv City, as well as in the river itself, pollution with household waste was registered. There were piles of garbage and dumps in some places. The waste is left by fishermen and tourists. There is also waste dragged from the river from upstream.

In the last two years, campaigns have been carried out to clean the banks of the river and its bed. The first one was organized by us in 2019. After the end of the campaign, over 100 120-liter bags were collected in two days. Despite the emergence of other similar cleaning campaigns and public awareness campaigns on the importance of the area, the formation of new landfills and pollution of places that have already been cleaned are often observed.

Livestock

There is a cow farm in the area of the 6th kilometer at the "Noshtuvka na malak kormoran" Protected Area, where dozens of animals are kept. For this reason, the river is organically polluted and much of the surrounding vegetation is destroyed. Personal observations have shown that in the suburban part of the river there are no traces of wild animals in places where it is full of traces of cattle. The large number of domestic animals kept by the breeders in the area often reaches the riparian vegetation. During the research, there were cases in which we had to pass between dozens of cows grazed, almost unattended.

Invasive species

Among the registered invasive species in the study area were the fish *Pseudorasbora parva*, the red-eared slider (*Trachemys scripta elegans*) and yellow-eared slider (*Trachemys scripta scripta*) from the reptiles, and *Myocastor coypus* from the mammals. *T. s. scripta* was registered for the first time in this area of the Maritsa River in Plovdiv City. The two invasive turtle species pose a direct threat to the European Pond turtle (*Emys orbicularis*), as well as to amphibian and fish species in the river. At this stage, there are no data on the reproduction of invasive turtle species in the study area.

Myocastor coypus has become an inconvenient species in some parts of the world because it destroys wetland vegetation, undermines water control structures and feeds on crops (Litjens, 1980). They are thought to spread parasites that affect humans and livestock (Moutou, 1997) and can adversely affect other wildlife (Gebhardt, 1996). None of these effects were identified during the studies.

Reconstruction of the Maritsa River

The project for modernization of the Maritsa River envisages extensions of the alley network, which allow approaching the riverbed. It is planned to build playgrounds and areas for street fitness, as well as recreation areas with benches. The proposed option is enriched by adding new widenings of the project alleys, beach areas and beach sports with the relevant facilities, building connections through alleys between the existing stairwells near the wall and the project alleys. Something that is not mentioned by most media is the "narrowing" of the riverbed. From 140 meters wide, it will be folded to 50 meters. The photo, which

presented the project, shows the total destruction of natural riparian vegetation.

In 2019, the project was stopped after signals submitted by the Bulgarian Society for the Protection of Birds and the "Olympic 2002" Fishing Club. Earlier this year, it was announced that the project would resume. At this stage, nothing is mentioned about the project, but its implementation would destroy an entire ecosystem.

The lack of government support and dialogue with experts has repeatedly threatened wildlife. The current study shows the huge biodiversity in the urban area and the destruction of the Maritsa River in this way would harm or drive away hundreds of species of animals that maintain the rich ecosystem.

Conclusions

The Maritsa River attracts dozens of wintering bird species, shelters endangered mammals and provides much-needed green space for big cities. Its importance to the nature and health of the city of Plovdiv has been proven many times over the years. However, the number of threats to it and its biodiversity is growing every year. Pollution, habitat destruction and urbanization are just some of the threats to one Bulgaria's largest rivers.

Environmentalists in Plovdiv City face a great challenge and a great responsibility - to inform the local population about the importance of the river not only for its diversity, but also for the city and its people. Ignorance has already proven to be one of the greatest threats to nature worldwide. Neglecting it can have even more fatal consequences.

And the consequences for the Maritsa River in Plovdiv are already visible - the relocation of *Microcarbo pygmaeus* from their usual wintering resting site to Adata Island, the reduction of wintering species of birds at the river, the poisoning of a section of the river near Plovdiv and others.

It is uncertain whether it is possible to restore the river's biodiversity, but conserving what is left depends entirely on the actions that society and environmentalists will take in the next few years.

Acknowledgments

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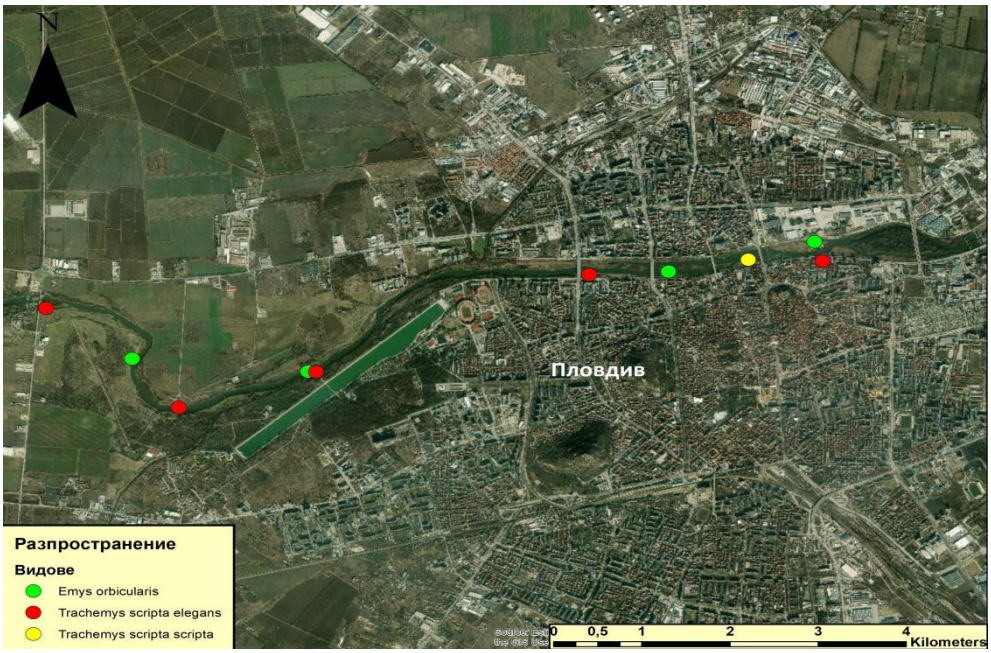
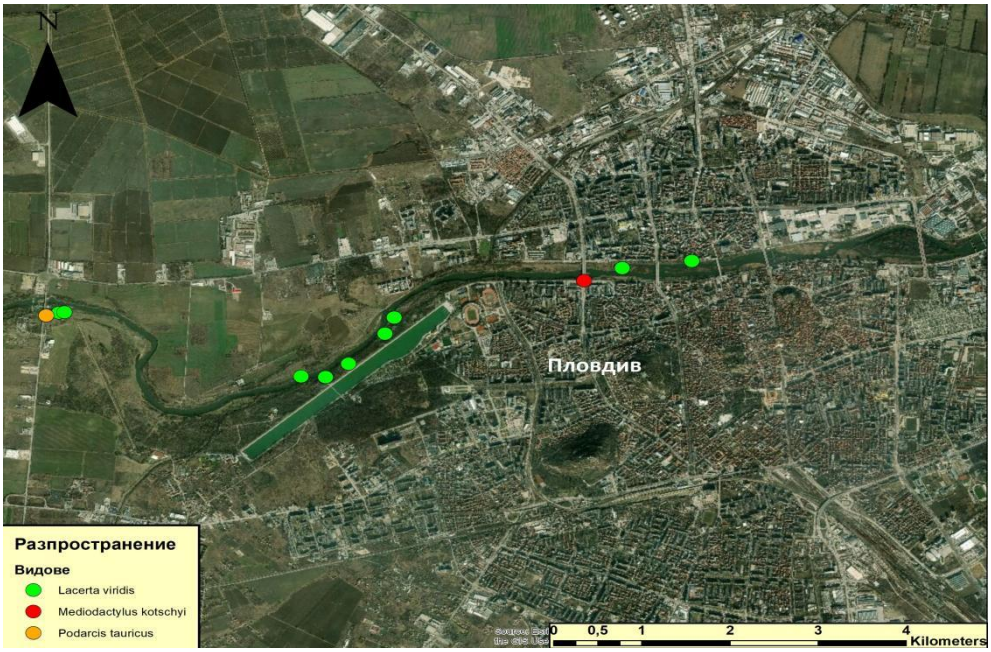
Appendix 1 - Distribution of the identified vertebrate species in the study area (2019-2020).

1 – *Pelophylax ridibundus*

2 – Testudines



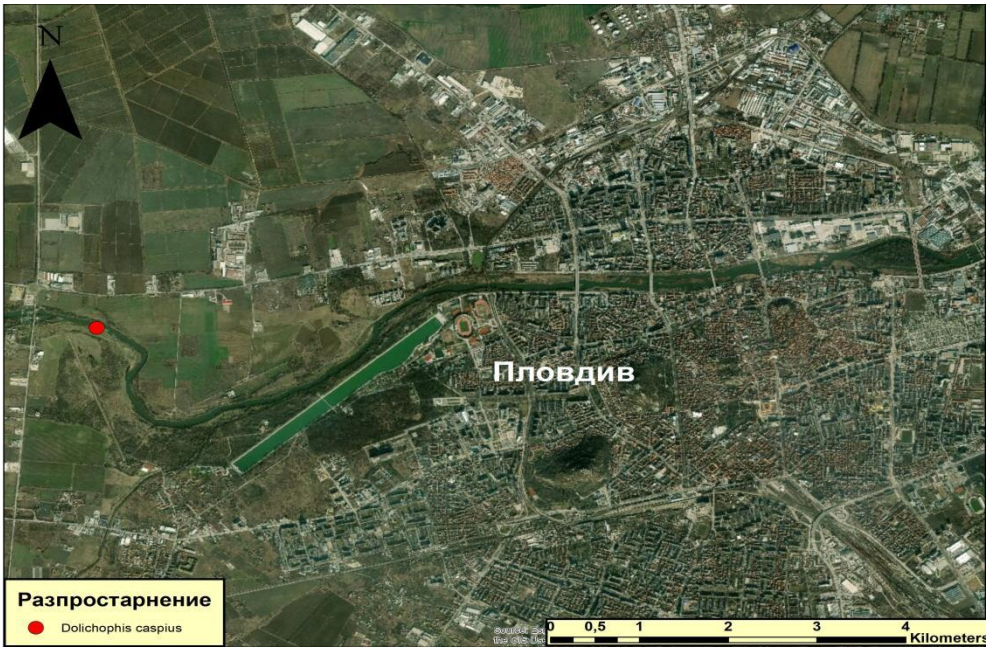
3 – Lacertilia



4 – *Natrix sp.*

5 – *Zamenis longissimus*

6 – *Dolichophis caspius*



7 – Mammalia

8 - Micromammalia

9 – *Talpa europaea*

10 – *Lutra lutra* and *Myocastor coypus*

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Additions to the Check List of the Terrestrial Snails (Mollusca: Gastropoda) of Plovdiv City

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Abstract. Five species were added to the list of the terrestrial snails of Plovdiv City. Now, a total of 94 species are known from the area of the city.

Key words: Gastropoda, urban habitats, lowland.

Introduction

The first records of snails from Plovdiv were reported by Kobelt (1906). These were followed by many other publications later summarized by Irikov (2018). The author reported and many new records to this area. However, he accidentally omitted some of the previously published papers - Schneppat et al. (2011) and Georgiev (2014) consisting records of a total of 4 species. Here I add these records together with one new original one.

Material and Methods

Most of the materials in this paper were according to literature review, with some new information obtained through observations of the author.

Results and Discussion

Five species were added to the list of the terrestrial snails of Plovdiv City. Now, a total of 94 species are known from the area of the city.

Family Zonitidae

Discus rotundatus (Müller, 1774) - reported by Georgiev (2014) for Rahat Tepe, N42°09'06" E24°45'06", 175 m a.s.l.

Oxychilus draparnaudi (Beck, 1837) - reported as "cf. *draparnaudi*" by Georgiev (2014) for Rahat Tepe, N42°09'06" E24°45'06", 175 m a.s.l.

Family Limacidae

Limax graecus Simroth, 1889 - "cf. *graecus*" by Schneppat et al. (2011) for Maritza River banks, near Zaharna Fabrika area, N42°09'16.22" E24°43'19.00", 164 m a.s.l.

Family Milacidae

Tandonia totevi (Wiktor, 1975) - reported by Schneppat et al. (2011) for Maritza River banks, near Zaharna Fabrika area, N42°09'16.22" E24°43'19.00", 164 m a.s.l.

Family Arionidae

Arion vulgaris (Moquin-Tandon, 1855) species complex - new record for Plovdiv City: collected during 2010, 2011 (Georgiev leg.), 2012 (leg. Georgiev, Dedov & Schneppat) at the area of Ruski Pazar, in a small *Populus* sp. plantation, N42°09'26.9" E24°43'05.2". The taxonomic status of this invasive pest species is unresolved. The first invasive specimen was misidentified as *A. lusitanicus* (Mabille, 1868). The name *A. vulgaris* (Moquin-Tandon, 1855) has by some authors been used as a replacement (Anderson, 2005).

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Odonata of the City of Plovdiv and its Surroundings

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Abstract. Updated list of the dragonflies (order Odonata) of the city of Plovdiv and its environs contains 26 species from 7 families: Aeshnidae (4), Libellulidae (9), Gomphidae (4), Calopterygidae (2), Coenagrionidae (3), Lestidae (3) and Platycnemididae (1).

Key words: fauna, dragonflies, damselflies, Plovdiv City, Bulgaria.

Introduction

First data about Odonata of Plovdiv we find in the publication of Klapalek (1894), but the order has not been subject of a special study in the city of Plovdiv and the data are relatively a little. The only specialized study of the species is that of an Angelov (1960). Here are presented both well-known literature data and some new records.

The information used in the current study is from the following literature sources Klapalek (1894), Petkov (1921, 1914), Urbanski (1947), Angelov (1960), Beshovski (1964), Rusev (1966), Dumont (1977), Rusev et al. (1981), Uzunov et al. (1981), Marinov (2001).

Material and Methods

The information presented in this paper is a summary of the above listed literary sources, as well as of personal observations. New data are on the base of observations of D. Dimitrov. The valid species names are according to "World Odonata Checklist" (Paulson et al., 2022).

Checklist

Suborder Anisoptera

Family Aeshnidae

Aeshna affinis Vander Linden, 1820

Known locality: „Otdih i kultura" Park, adult, gender unspecified (Angelov, 1960).

Aeshna mixta Latreille, 1805

Known locality: City of Plovdiv, 24.08.1938, adult, male (Urbanski, 1947).

Anax parthenope (Selys, 1839)

Known locality: City of Plovdiv, 21.08.1938, adult, gender unspecified (Urbanski, 1947).

Anax ephippiger (Burmeister, 1839)

Known locality: City of Plovdiv, 04.09.1970, adult, male (Marinov, 2001).

Family Libellulidae

Crocothemis erythraea (Brullé, 1832)

Known locality: City of Plovdiv, 21.08.1938 and 23.08.1938 adults, females (Urbanski, 1947).

Libellula fulva Müller, 1764

Known locality: City of Plovdiv, 06.1906, adult, gender unspecified (Petkov, 1914).

New record: Maritza River west of Plovdiv, UTM LG16, 42.154072N 24.721869E, 24.5.2022, 2 male and 1 female; Maritza River west of Plovdiv, UTM LG06, 42.141429N 24.690245E, 5.6.2022, 1 male (D. Dimitrov observation).

Orthetrum albistylum (Selys, 1848)

Known localities: "Otdih i kultura" Park (Angelov, 1960); city of Plovdiv (Petkov, 1921); city of Plovdiv, 21.08.1938 and 23.08.1938, adults, females (Urbanski, 1947).

New record: "Tsar Simeonova gradina" Park, UTM LG16, 42.142092N 24.748918E, 05.07.2019, 1 female; Maritza River west of Plovdiv, UTM LG06, 42.149587N 24.667275E, 19.6.2022, 1 male (D. Dimitrov observation).

Orthetrum brunneum (Fonscolombe, 1837)

Known locality: city of Plovdiv, 23.08.1938, adult, female (Urbanski, 1947).

New record: River stream southeast of Plovdiv, UTM LG16, 42.098319N 24.789190E, 23.7.2021, 1 female (D. Dimitrov observation).

Orthetrum cancellatum (Linnaeus, 1758)

New record: Maritza River west of Plovdiv, UTM LG16, 42.148133N 24.708658E, 24.5.2022, 1 male; Maritza River west of Plovdiv, UTM LG16, 42.153911N 24.721026E, 19.6.2022, 1 male (D. Dimitrov observation).

Orthetrum coerulescens (Fabricius, 1798)

Known locality: city of Plovdiv, 26.06.1912, adult, female, Buresh leg. (according Marinov, dissertation, unpublished).

New record: River stream southeast of Plovdiv, UTM LG16, 42.098319N 24.789190E, 23.7.2021, 6 male and 4 female (D. Dimitrov observation).

Sympetrum depressiusculum (Selys, 1841)

Known locality: city of Plovdiv, adult, gender unspecified (Petkov, 1921).

Sympetrum fonscolombii (Selys, 1840)

Known locality: "Otdih i kultura" Park, adult, gender unspecified (Angelov, 1960).

New record: Maritza River west of Plovdiv, UTM LG06, 42.141292N 24.693745E, 28.07.2019, 1 male (D. Dimitrov observation).

Sympetrum meridionale (Selys, 1841)

Sympetrum meridionalis Selys: Angelov (1960).

Known localities: "Otdih i kultura" Park (Angelov, 1960); city of Plovdiv, 24.08.1938, adult, male (Urbanski, 1947).

Family Gomphidae

Stylurus flavipes (Charpentier, 1825)

Known localities: "Otdih i kultura" Park (Angelov, 1960); Maritsa River by the city of Plovdiv, 14.07.1955, larva (Rusev, 1966); Maritsa River below the city of Plovdiv (Rusev et al., 1981); Maritsa River above the city of Plovdiv (Uzunov et al., 1981).

Gomphus vulgatissimus (Linnaeus, 1758)

Known locality: Maritsa River above the city of Plovdiv (Uzunov et al., 1981).

Onychogomphus forcipatus (Linnaeus, 1758)

Known localities: city of Plovdiv (Petkov, 1921), 23.08.1938, adult, female (Urbanski, 1947).

Ophiogomphus cecilia (Geoffroy in Fourcroy, 1785)

Ophiogomphus serpentines Charp.: Angelov (1960), Petkov (1914), Urbanski (1947).

Known localities: "Otdih i kultura" Park (ANGELOV, 1960); channel of the State fishery company in the city of Plovdiv, 11.05.1956, larva (Beshovski, 1964), city of Plovdiv (Petkov, 1914, Beshovski, 1964); city of Plovdiv, 23.08.1938, adult, male (Urbanski, 1947); Maritsa River below the city of Plovdiv (Uzunov et al., 1981).

Suborder Zygoptera

Family Calopterygidae

Calopteryx splendens (Harris, 1780)

Agrion splendens Harris: Angelov (1960).

Known localities: "Otdih i kultura" Park (Angelov, 1960); Maritsa River by the city of Plovdiv, 07.10.1955, larva (Beshovski, 1964); Maritsa River by the city of Plovdiv, 23.08.1938, adult, female (Urbanski, 1947); Maritsa River below the city of Plovdiv (Rusev et al., 1981); Maritsa River above the city of Plovdiv (Uzunov et al., 1981).

New records: Maritza River to the pedestrian bridge, UTM LG16, 42.154582N 24.752768E, 02.06.2018, 2 males end 1 female; Near the bridge of V. Aprilov Boul., UTM LG16, 42.153858N 24.731537E, 16.06.2019, 1 male, 42.153675N 24.726612E, 12.07.2019, 1 female; Maritza River west of Plovdiv, UTM LG06, 42.141680N 24.694719E, 28.07.2019, 2 males (D. Dimitrov observation).

Calopteryx virgo (Linnaeus, 1758)

Known locality: Maritsa River below the city of Plovdiv, 15.06.1947, larva (Rusev, 1966).

New records: Maritza River west of Plovdiv, UTM LG16, 42.147125N 24.707961E,

24.05.2022, 2 males end 1 female (D. Dimitrov observation).

Family Coenagrionidae

Coenagrion puella (Linnaeus, 1758)
Known locality: Maritsa River by the city of Plovdiv, 12.06.1972, adult, gender unspecified (Dumont, 1977).

Ischnura elegans (Vander Linden, 1820)
Known localities: Maritsa River by the city of Plovdiv, 03.08.1893, adult, gender unspecified (Klapalek, 1894); 23.08.1938, adult, male (Urbanski, 1947).

Ischnura pumilio (Charpentier, 1825)
Known locality: Maritsa River by the city of Plovdiv, adult, gender unspecified (Petkov, 1921).

Family Lestidae

Lestes barbarus (Fabricius, 1798)
Lestes barbara F.: Angelov (1960).
Known locality: ""Otdih i kultura" Park (Angelov, 1960).

Lestes dryas Kirby, 1890
Known locality: "Otdih i kultura" Park (Angelov, 1960).

Sympecma fusca (Vander Linden, 1820)
Sympicna fusca Vand.: Angelov (1960).
Known locality: "Otdih i kultura" Park (Angelov, 1960).

Family Platycnemididae

Platycnemis pennipes (Pallas, 1771)
Known localities: Maritsa River by the city of Plovdiv (Petkov, 1921, Rusev, 1966), 23.08.1938, adult, male (Urbanski, 1947); Maritsa River below the city of Plovdiv, 05.06.1947, larva (Rusev et al., 1981).
New records: Near the bridge of V. Aprilov Boul., UTM LG16, 42.154120N 24.729588E, 05.07.2019, 8 males and 4 females; 42.153898N 24.729477E, 12.07.2019 2 males (D. Dimitrov observation).

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Ground Beetles (Coleoptera: Carabidae) Found in the City and Surroundings of Plovdiv (Central Bulgaria)

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Abstract. Bulgarian carabid fauna is relatively well studied but there are still many species and regions in the country lacking enough research. The present study compiles a list of Carabidae species from the city of Plovdiv and its surroundings. The species list is completed on the basis of the available bibliographic data and material collected during field trips in the city of Plovdiv and some of the nearest villages. A total of 167 species are found. They belong to 56 genera and 25 tribes. This represents, respectively, 22% of all established for Bulgarian carabid fauna species, 44% of the genera and 68% of the tribes. *Notiophilus rufipes* Curtis, 1829, *Bembidion atlanticum* Wollaston, 1854, *Bembidion dentellum* (Thunberg, 1787), *Bembidion azurescens* Dalla Torre, 1877, *Sinechostictus effluviorum* Peyron, 1858, *Broscus cephalotes* (Linnaeus, 1785), *Agonum viduum* (Panzer, 1796), *Stenolophus abdominalis* Gené, 1836, *Licinus silphoides* (P. Rossi, 1790), *Paradromius linearis* (Olivier, 1795), genera *Sinechostictus* Motschulsky, 1864, *Broscus* Panzer, 1813 and *Paradromius* Fowler, 1887, and tribe Broscini are new for the Upper Thracian Lowland. The richest tribe is Harpalini containing 35% of all species. Zoogeographical analysis shows that the Mediterranean (33%) and Northern Holarctic (29%) complexes prevail. In relation to carabids' life forms, the ratio between zoophages and mixophyitophages in the region of Plovdiv is 57%: 43%, close to the characteristic for the meadow steppes from the Forest-steppe zone of Eurasia. Humidity preferences analysis shows the largest share of the mesoxerophilous carabids (36% of all species). Macropterous carabids are 67% of all species.

Key words: carabids, check list, Plovdiv, Upper Thracian Lowland.

Introduction

Ground beetles (Coleoptera: Carabidae) represent one of the largest beetle families with cosmopolitan distribution and with decisive importance for the functioning of ecosystems. They are relatively well studied in Bulgaria (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995; Teofilova, *in prep*.), but many regions remain poorly researched, and there are still many gaps in our knowledge about them.

The region of the city of Plovdiv is situated in the Plovdiv field, a part of the Upper Thracian Lowland. The climate is Transitional-Continental with mild winters and very hot and dry summers.

This region is been studied actively over the years, but systematical and thorough researches of the city fauna are missing. From the beginning of the 20th century until now, 30 authors have published more than 30 studies concerning the carabid fauna of the whole region of the Upper Thracian Lowland. So far, 256 species (34% of all Bulgarian Carabidae species) are known there (Teofilova, *in prep*.).

Twenty of these sources contain data about the ground beetles from the city of Plovdiv and its surroundings. During the first stage of the research in the region, before 2020, about 90 species were reported. More recent data, after 2020, are published from different habitats (arable lands, pastures, rural territories) near the villages of Katunitsa, Yagodovo, Kostievo and Radinovo, in close proximity of the city of Plovdiv (Teofilova, 2021a; b; d; e; f). This way, the number of the species from the vicinity of Plovdiv increased to 147.

The aim of the present study is, by uniting all published data and recently collected material, to compile a list of Carabidae species from the city of Plovdiv and its surroundings, where such research is quite scarce.

Material and Methods

A synopsis and a critical overview of the literature concerning the ground beetles of the studied territory are made. The species list is completed on the basis of the available bibliographic data and material collected during field work in and near Plovdiv, carried out in the period from 1991 to 2022. The main data about carabids in the studied region are from these literary sources and in most cases there is no detailed information about the habitats where the beetles have been collected. Recently collected beetles are mostly from random catches. This new material is collected by means of different sampling methods, such as handpicking, pitfall trapping and light attraction. In the species list are included data from the villages of Yagodovo, Katunitsa, Kostievo, and Radinovo, which are located at some distance from the Plovdiv City center (10, 12, 11, and 7 km, respectively).

Some species from the literature are recorded from localities given just as "Plovdiv", and they might not be included in the real geographical boundaries of the city, but we have to accept they are located in the immediate vicinity.

According to their zoogeographical belonging, the ground beetle species are classified in zoogeographical categories and complexes according to the classification adopted in Teofilova & Kodzhabashev (2020b). Species are also classified into three groups according to their hind wing development: macropterous (always possessing wings), wing dimorphic/ polymorphic (only part of the population being fully winged), and brachypterous (wingless), according to the classification of Den Boer, et al. (1980). According to their ecological requirements in terms of humidity, the established carabid species were divided into six categories (Teofilova, 2018): hygrophilous, meso-hygrophilous, mesophilous, mesoxerophilous, xerobionts, and eurybionts.

The systematic list follows Kryzhanovskij et al. (1995) and the nomenclature is in accordance with Löbl & Löbl (2017).

Some of the captured animals are deposited in the author's collection in the Institute of Biodiversity and Ecosystem Research (Bulgarian Academy of Sciences, Sofia), and some are in the private collection of Vasil Genchev (Plovdiv).

Results

The results from the study revealed that near Plovdiv 167 species of ground beetles occur. They belong to 56 genera and 25 tribes. This represents, respectively, 22% of all established for Bulgarian carabid fauna species, 44% of the genera and 68% of the tribes (Teofilova, *in prep.*). *Notiophilus rufipes* Curtis, 1829, *Bembidion atlanticum* Wollaston, 1854, *Bembidion dentellum* (Thunberg, 1787), *Bembidion azurescens* Dalla Torre, 1877, *Sinechostictus effluviorum* Peyron, 1858, *Broscus cephalotes* (Linnaeus, 1785), *Agonum viduum* (Panzer, 1796), *Stenolophus abdominalis* Gené, 1836, *Licinus silphoides* (P. Rossi, 1790), *Paradromius linearis* (Olivier, 1795), genera *Sinechostictus* Motschulsky, 1864, *Broscus* Panzer, 1813 and *Paradromius* Fowler, 1887, and tribe Broscini are new for the Thracian Lowland. The richest tribe is Harpalini (59 species, 36% of all species), followed by Bembidiini (14 species), Pterostichini (12 species), Zabrini (12 species), Lebiini (12 species), and Carabini (10 species). *Harpalus* Latreille, 1802 (28 species), *Amara* Bonelli, 1810 (10 species), *Bembidion* Latreille, 1802 (12 species), and *Ophonus* Dejean, 1821 (8 species) are species-richest genera.

Species list:

Carabidae Latreille, 1802
Cicindelinae Latreille, 1802
Cicindelini Latreille, 1802

1. *Cicindela (Cicindela) hybrida hybrida* Linnaeus, 1758
Data: Plovdiv (Angelov, 1964).
2. *Cicindela (Cicindela) campestris campestris* Linnaeus, 1758
Data: Philippopel (Apfelbeck, 1904); Plovdiv (Angelov, 1964).
Material: Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 26.III.2021, 1 ♂, leg. Vasil Genchev.

Omophroninae Bonelli, 1810
Omophronini Bonelli, 1810

3. *Omophron (Omophron) limbatum* (Fabricius, 1777)
Data: Plovdiv (Hieke & Wrase, 1988).
Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 10-11.V.2021, 2 ♀ 2 ♂, leg. Vasil Genchev; N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 21.VII.2022, 2 ♀ 1 ♂, leg. Vasil Genchev.

Nebriinae Laporte, 1834
Nebriini Laporte, 1834
4. *Leistus (Pogonophorus) spinibarbis rufipes* Chaudoir, 1843
Data: Plovdiv (Hieke & Wrase, 1988).
5. *Nebria (Nebria) brevicollis* (Fabricius, 1792)
Data: Kostievo, pasture (Teofilova, 2021f).
Material: N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 30.IX.2022, 2 ♀ 1 ♂, leg. Vasil Genchev.

Notiophilini Motschulsky, 1850

6. *Notiophilus biguttatus* (Fabricius, 1779)
Data: Kostievo, oilseed rape field (Teofilova, 2021f).
7. *Notiophilus rufipes* Curtis, 1829
Material: Plovdiv, Bunardzhika Hill, 42°08'43"N, 24°44'15"E, 231 m, 9.VI.2021, 1 ♀; Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 5.IX.2021, 1 ♀, leg. Vasil Genchev.
Note: New for the Thracian Lowland.
8. *Notiophilus substriatus* G.R. Waterhouse, 1833
Data: Yagodovo vill. (Teofilova, 2021d).
Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 20.V.2021, 1 ♀, leg. Vasil Genchev.

Carabinae Latreille, 1802
Carabini Latreille, 1802

9. *Calosoma (Calosoma) sycophanta sycophanta* (Linnaeus, 1758)
Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960).
Material: Plovdiv, the Old Town, 42°08'57"N, 24°45'09"E, 194 m, 5.VI.1991, 1 ♂; S Yagodovo vill., 42°07'42"N, 24°51'20"E, 152 m, 18.VI.1992, 1 ♀, leg. Vasil Genchev.
10. *Calosoma (Calosoma) inquisitor inquisitor* (Linnaeus, 1758)
Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960).
Material: Plovdiv, Bunardzhika Hill, 42°08'43"N, 24°44'15"E, 240 m, 14.IV.2017, 1 ♀, leg. Vasil Genchev.
11. *Calosoma (Campalita) auropunctatum auropunctatum* (Herbst, 1784)
Data: Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f).
Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 22.VI.2000, 1 ♀1 ♂, 12.VII.2001, 1 ♂; E Yagodovo vill., field, 42°06'22"N, 24°51'23"E, 161 m, 1.V.1998, 1 ♀; E Yagodovo vill., field, 42°06'32"N, 24°51'37"E, 160 m, 1.V.1998, 1 ♂, leg. Vasil Genchev.
12. *Carabus (Carabus) granulatus granulatus* Linnaeus, 1758
Material: N Katunitsa vill., near Chaya River, 42°06'58"N, 24°52'01"E, 168 m, 9.V.2015, 1 ♀, leg. Vasil Genchev.
13. *Carabus (Trachycarabus) scabriusculus bulgarus* Lapouge, 1908
Data: Philippopel (Breuning, 1928); Plovdiv (Hieke & Wrase, 1988).
14. *Carabus (Archicarabus) montivagus montivagus* Palliardi, 1825
Data: Plovdiv (Guéorguiev & Guéorguiev, 1995).
15. *Carabus (Archicarabus) wiedemanni wiedemanni* Ménétriés, 1836
Data: Philippopel (Breuning, 1928); Plovdiv (Buresch & Kantardjieva, 1928; Hieke

& Wrase, 1988; Kryzhanovskij, *unpublished results*).

16. *Carabus (Tomocarabus) convexus gracilior* Géhin, 1885

Data: Philippopel (Apfelbeck, 1904; Breuning, 1928); Plovdiv (Rambousek, 1912; Buresch & Kantardjieva, 1928; Hieke, Wrase, 1988).

17. *Carabus (Procrustes) coriaceus kindermanni* Waltl, 1838

Data: Plovdiv (Rambousek, 1912; Buresch & Kantardjieva, 1928; Hieke & Wrase, 1988); "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 6.VI.1998, 1 ♀, 15.IX.1999, 1 ♀, 15.VII.2001, 2 ♂, 15.IX.2009, 1 ♀, 23.X.2009, 1 ♀; Plovdiv, Regatta Venue, 9.VII.2021, 1 ♀, leg. Vasil Genchev.

18. *Carabus (Procerus) scabrosus scabrosus* Olivier, 1790

Data: Plovdiv (Buresch & Kantardjieva, 1928; Hieke & Wrase, 1988).

Elaphrinae Latreille, 1802
Elaphrini Erichson, 1837

19. *Elaphrus (Elaphrus) riparius* (Linnaeus, 1758)

Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960).

20. *Elaphrus (Elaphroterus) aureus aureus* P. W. J. Müller, 1821

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 3 ♂, leg. Vasil Genchev.

Scaritinae Bonelli, 1810
Scaritini Bonelli, 1810

21. *Scarites (Parallelomorphus) terricola terricola* Bonelli, 1813

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 23.VI.2001, 1 ex., 30.VI.2002, 1 ex.; E Yagodovo vill., field, 42°06'32"N, 24°51'37"E, 160 m, 15.VI.2003, 1 ex., leg. Vasil Genchev.

Clivinini Rafinesque, 1815

22. *Clivina (Leucocara) laevifrons* Chaudoir, 1842

Data: Plovdiv surroundings (Kryzhanovskij, *unpublished results*).

Dyschiriini W. Kolbe 1880

23. *Dyschirius latipennis* Seidlitz, 1867

Data: Plovdiv (Guéorguiev, 1989).

24. *Dyschiriodes (Dyschiriodes) nitidus nitidus* (Dejean, 1825)

Data: Plovdiv (Kryzhanovskij, *unpublished results*).

25. *Dyschiriodes (Dyschiriodes) chalybaeus gibbifrons* Apfelbeck, 1899

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

Broscinae Hope, 1838
Broscini Hope, 1838

26. *Broscus (Broscus) cephalotes* (Linnaeus, 1785)

Material: E Yagodovo vill., field, 42°06'32"N, 24°51'37"E, 160 m, 25.VI.2003, 1 ♂ 1 ♀, 26.VI.2003, 1 ♀, leg. Vasil Genchev.

Note: New species, genus and tribe for the Upper Thracian Lowland.

Trechinae Bonelli, 1810
Trechini Bonelli, 1810

27. *Trechus (Trechus) quadristriatus* (Schrank, 1781)

Data: Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

Material: N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 30.IX.2022, 2 ♀ 1 ♂, leg. Vasil Genchev.

28. *Trechus (Trechus) irenis* Csiki, 1912

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

Tachyini Motschulsky 1862

29. *Tachys (Paratachys) bistriatus* (Duftschmid, 1812)

Data: Plovdiv (Hieke & Wrase, 1988); Kostievo, pasture (Teofilova, 2021f).

30. *Tachyura (Sphaerotachys) hoemorroidalis* (Ponza, 1805)

Data: Kostievo, pasture (Teofilova, 2021f).

Material: N Katunitsa vill., 42°06'58.4"N,

24°52'00.9"E, 161 m, 21.VII.2022, 2 ♀, leg. Vasil Genchev.

Bembidiini Stephens, 1827

31. *Asaphidion flavipes* (Linnaeus, 1761)

Data: Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field (Teofilova, 2021f).

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 3 ♀, leg. Vasil Genchev.

32. *Bembidion (Odontium) striatum* (Fabricius, 1792)

Data: Plovdiv (Hieke & Wrase, 1988).

33. *Bembidion (Metallina) properans* (Stephens, 1828)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 2.IV.2021, 1 ♂, leg. Vasil Genchev.

34. *Bembidion (Notaphus) semipunctatum* (Donovan, 1806)

Data: Plovdiv (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

35. *Bembidion (Notaphus) varium* (Olivier, 1795)

Data: Ferdinandovo (Parvenets vill. near Plovdiv) (Apfelbeck, 1904).

36. *Bembidion (Eupetodromus) dentellum* (Thunberg, 1787)

Material: N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 16.VII.2022, 1 ♂, leg. Vasil Genchev.

Note: New species for the Upper Thracian Lowland.

37. *Bembidion (Philochthus) guttula* (Fabricius, 1792)

Data: Kostievo, pasture (Teofilova, 2021f).

38. *Bembidion (Emphanes) azurescens azurescens* Dalla Torre, 1877

Material: N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 16.VII.2022, 1 ♀, leg. Vasil Genchev.

Note: New species for the Upper Thracian Lowland.

39. *Bembidion (Trepanes) articulatum* (Panzer, 1796)

Data: Philippopel (Apfelbeck, 1904).

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 1 ♂, 42°06'14"N, 24°51'52"E, 161 m, 27.V.2021, 1 ♀, leg. Vasil Genchev; N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 16.VII.2022, 1 ♂, leg. Vasil Genchev.

40. *Bembidion (Bembidion) quadrimaculatum quadrimaculatum* (Linnaeus, 1761)

Data: Plovdiv (Hieke & Wrase, 1988).

41. *Bembidion (Ocydromus) atlanticum atlanticum* Wollaston, 1854

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 1 ♀ 1 ♂, leg. Vasil Genchev; N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 21.VII.2022, 1 ♂, leg. Vasil Genchev.

42. *Bembidion (Peryphanes) dalmatinum dalmatinum* Dejean, 1831

Material: W Katunitsa vill., 42°06'14"N, 24°51'52"E, 161 m, 27.V.2021, 1 ♀, leg. Vasil Genchev.

43. *Bembidion (Peryphanes) castaneipenne* Jacquelin du Val, 1852

Material: W Katunitsa vill., 42°06'14"N, 24°51'52"E, 161 m, 27.V.2021, 1 ♀ 1 ♂, leg. Vasil Genchev.

44. *Sinechostictus (Sinechostictus) effluviorum* Peyron, 1858

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 2 ♀ 1 ♂, leg. Vasil Genchev.

Harpalinae Bonelli, 1810

Pterostichini Bonelli, 1810

45. *Poecilus (Poecilus) cupreus cupreus* (Linnaeus, 1758)

Data: Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f).

46. *Poecilus (Poecilus) lepidus lepidus* (Leske, 1785)

Data: Plovdiv (Hieke & Wrase, 1988).

47. *Poecilus (Poecilus) anatolicus* (Chaudoir, 1850)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

48. *Poecilus (Poecilus) versicolor* (Sturm, 1824)

Data: Plovdiv (Hieke & Wrase, 1988).

49. *Pedius inquinatus* (Sturm, 1824)

Data: Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

50. *Pterostichus (Adelosia) macer macer*

(Marsham, 1802)

Data: "3 km W von Plovdiv" (Hieke & Wrase, 1988); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

Material: Yagodovo vill., 42°06'27.4"N, 24°50'40.9"E, 160 m, 2.VII.2022, 1 ♀, leg. Vasil Genchev.

51. *Pterostichus (Pseudomaseus) anthracinus anthracinus* (Illiger, 1798)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

52. *Pterostichus (Pseudomaseus) nigrita nigrita* (Paykull, 1790)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912).

53. *Pterostichus (Phonias) strenuus* (Panzer, 1796)

Data: Radinovo (Teofilova, 2021f).

54. *Pterostichus (Melanius) aterrimus aterrimus* (Herbst, 1784)

Data: near Plovdiv, 200 m (Vasilev, 1988a).

55. *Pterostichus (Petrophilus) melanarius bulgaricus* (Lutshnik, 1915)

Data: Plovdiv (Guéorguiev & Guéorguiev, 1995).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 7.III.2019, 1 ♂, 22.IX.2020, 1 ♂, leg. Vasil Genchev.

56. *Molops (Molops) dilatatus dilatatus* Chaudoir, 1868

Data: Plovdiv (Guéorguiev & Guéorguiev, 1995).

Sphodrini Laporte, 1834

57. *Calathus (Calathus) fuscipes* (Goeze, 1777)

Data: Philippopel (Apfelbeck, 1904); Yagodovo vill. (Teofilova, 2021a); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 20.V.2021, 1 ♀, leg. Vasil Genchev; N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 7.IX.2022, 1 ♂, leg. Vasil Genchev.

58. *Calathus (Neocalathus) ambiguus ambiguus* (Paykull, 1790)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

59. *Calathus (Neocalathus) erratus erratus* C. R. Sahlberg, 1827

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

60. *Calathus (Neocalathus) melanocephalus melanocephalus* (Linnaeus, 1758)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

61. *Calathus (Neocalathus) cinctus* Motschulsky, 1850

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

62. *Dolichus halensis* (Schaller, 1783)

Data: "6 km W von Plovdiv" (Hieke & Wrase, 1988).

63. *Sphodrus leucophthalmus* (Linnaeus,1758)

Data: Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Kryzhanovskij, *unpublished results*).

Material: Yagodovo vill., 42°06'38"N, 24°51'04"E, 159 m, house yard, 11:15, under stone, 12.VII.2001, 1 ♂, leg. Vasil Genchev.

64. *Laemostenus (Pristonychus) cimmerius weiratheri* J. Müller, 1932

Material: N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 23.IV.2022, 1 ♂, 16.VI.2022, 1 ♂, leg. Vasil Genchev.

Platynini Bonelli, 1810

65. *Oxypselaphus obscurus* (Herbst, 1784)

Data: Plovdiv (Vasilev, 1988a; Guéorguiev & Guéorguiev, 1995); Plovdiv, 200 m (Wrase, 1991).

66. *Anchomenus dorsalis dorsalis* (Pontoppidan, 1763)

Data: Plovdiv (Hieke & Wrase, 1988); Yagodovo vill. (Teofilova, 2021a); Kostievo, oilseed rape field (Teofilova, 2021f).

Material: W Yagodovo vill., 42°06'12"N, 24°50'16"E, 162 m, 30.III.2021, 1 ♀, leg. Vasil Genchev.

67. *Agonum (Olisares) angustatum* Dejean, 1828

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 1 ♀, leg. Vasil Genchev.

68. *Agonum (Olisares) viduum* (Panzer, 1796)

Material: W Katunitsa vill., 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 2 ♀, leg. Vasil Genchev.

Zabrini Bonelli, 1810

69. *Amara (Zezea) fulvipes* (Audinet-Serville, 1821)

Data: Radinovo (Teofilova, 2021f).

70. *Amara (Amara) aenea* (De Geer, 1774)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

71. *Amara (Amara) anthobia* A. Villa et G. B. Villa, 1833

Data: "6 km W von Plovdiv", Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field (Teofilova, 2021f).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 2.IV.2021, 1 ♂; Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 5.IX.2021, 1 ♀, leg. Vasil Genchev.

72. *Amara (Amara) convexior* Stephens, 1828

Data: Plovdiv (Hieke & Wrase, 1988).

73. *Amara (Amara) eurynota* (Panzer, 1796)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

74. *Amara (Amara) ovata* (Fabricius, 1792)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

75. *Amara (Amara) similata* (Gyllenhal, 1810)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

76. *Amara (Paracelia) serdicana* Apfelbeck, 1904

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Guéorguiev & Guéorguiev, 1995).

77. *Amara (Bradytus) fulva* (O. F. Müller, 1776)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912).

78. *Amara (Curtonotus) aulica* (Panzer, 1796)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

79. *Zabrus (Zabrus) tenebrioides* (Goeze, 1777)

Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960); Plovdiv (Hieke & Wrase, 1988); Kostievo, pasture; Radinovo (Teofilova, 2021f).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 5.VI.2021, 1 ♀, leg. Vasil Genchev; W Yagodovo vill., 42°06'52.3"N, 24°49'42.2"E, 158 m, 31.V.2022, 1 ♂, leg. Vasil Genchev.

80. *Zabrus (Pelor) spinipes spinipes* (Fabricius, 1798)

Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960).

Material: E Yagodovo vill., field, 42°06'32"N, 24°51'37"E, 160 m, 23.VI.1998, 1 ♀, leg. Vasil Genchev; W Katunitsa vill., 42°06'14"N, 24°51'52"E, 161 m, 30.VI.1998, 1 ♀, 12.VII.1998, 2 ♂, leg. Vasil Genchev.

Harpalini Bonelli, 1810

81. *Anisodactylus (Anisodactylus) binotatus* (Fabricius, 1787)

Data: Radinovo (Teofilova, 2021f).

82. *Anisodactylus (Anisodactylus) nemorivagus* (Duftschmidt, 1812)

Data: Plovdiv (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

83. *Anisodactylus (Pseudodichirius) intermedius* Dejean, 1829

Data: Kostievo, pasture (Teofilova, 2021f).

84. *Gynandromorphus etruscus* (Quensel en Schönherr, 1806)

Data: Radinovo (Teofilova, 2021f).

85. *Diachromus germanus* (Linnaeus, 1758)

Data: Plovdiv (Rambousek, 1912); "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960).

86. *Stenolophus (Stenolophus) teutonus* (Schrank, 1781)

Data: Katunista (Teofilova, 2021e).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 3.V.2021, 1 ♀2 ♂, leg. Vasil Genchev.

87. *Stenolophus (Stenolophus) abdominalis persicus* Mannerheim, 1844

Material: W Katunitsa vill., 42°06'14"N, 24°51'52"E, 161 m, 27.V.2021, 1 ♀, leg. Vasil Genchev.

88. *Acupalpus (Ancylostria) interstitialis*

Reitter, 1884

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

89. *Acupalpus (Acupalpus) meridianus* (Linnaeus, 1760)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

90. *Parophonus (Parophonus) maculicornis* (Duftschmid, 1812)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

91. *Parophonus (Parophonus) dejeani* (Csiki, 1932)

Data: Plovdiv (Hieke & Wrase, 1988); Plovdiv, 200 m (Vasilev, 1992).

Material: Plovdiv, Regatta Venue, 9.VII.2021, 1 ♂, leg. Vasil Genchev.

92. *Parophonus (Parophonus) planicollis* (Dejean, 1829)

Data: Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

93. *Parophonus (Parophonus) laeviceps* (Ménétriés, 1832)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

94. *Parophonus (Parophonus) mendax* (P. Rossi, 1790)

Data: Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

95. *Ophonus (Metophonus) laticollis* Mannerheim, 1825

Data: Philippopel (Apfelbeck, 1904).

96. *Ophonus (Metophonus) rupicola* (Sturm, 1818)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

97. *Ophonus (Metophonus) rufibarbis* (Fabricius, 1792)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Hieke & Wrase, 1988).

98. *Ophonus (Hesperophonus) azureus* (Fabricius, 1775)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988); Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

99. *Ophonus (Hesperophonus) subquadratus* (Dejean, 1829)

Data: Kostievo, pasture (Teofilova, 2021f).

100. *Ophonus (Hesperophonus) cribricollis* (Dejean, 1829)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

101. *Ophonus (Ophonus) stictus* Stephens, 1828

Data: Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

102. *Ophonus (Ophonus) sabulicola* (Panzer, 1796)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

Material: N Yagodovo vill., 42°07'42.3"N, 24°51'20.1"E, 152 m, 19.IX.2022, 1 ♂, leg. Vasil Genchev.

103. *Harpalus (Cephalophonus) cephalotes* Fairmaire et Laboulbène, 1854

Data: "Plovdiv, 300 m" (Vasilev, 1992); Plovdiv (Guéorguiev & Guéorguiev, 1995).

104. *Harpalus (Semiophonus) signaticornis* (Duftschmid, 1812)

Data: "near Plovdiv, 200 m" (Vasilev, 1988a); Plovdiv (Guéorguiev & Guéorguiev, 1995); Kostievo, oilseed rape field (Teofilova, 2021f).

105. *Harpalus (Pseudophonus) rufipes* (De Geer, 1774)

Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960); Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f).

Material: Plovdiv, Regatta Venue, 9.VII.2021, 1 ♀, leg. Vasil Genchev.

106. *Harpalus (Pseudoophonus) griseus* (Panzer, 1796)

Data: "3 km W von Plovdiv", "6 km W von Plovdiv", Plovdiv (Hieke & Wrase, 1988).

107. *Harpalus (Cryptophonus) tenebrosus tenebrosus* Dejean, 1829

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

108. *Harpalus (Harpalus) rufipalpis rufipalpis* Sturm, 1818

Data: Plovdiv (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

109. *Harpalus (Harpalus) honestus* (Duftschmid, 1812)

Data: Plovdiv (Hieke & Wrase, 1988).

110. *Harpalus (Harpalus) rubripes* (Duftschmid, 1812)

Data: Plovdiv (Hieke & Wrase, 1988);

Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f); Katunitsa (Teofilova, 2021e).

111. *Harpalus (Harpalus) attenuatus* Stephens, 1828

Data: Plovdiv (Hieke & Wrase, 1988); Kostievo, pasture (Teofilova, 2021f).

112. *Harpalus (Harpalus) atratus* Latreille, 1804

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

113. *Harpalus (Harpalus) serripes serripes* (Quensel, 1806)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988); Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f); Yagodovo (Teofilova, 2021e).

114. *Harpalus (Harpalus) flavicornis flavicornis* Dejean, 1829

Data: Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

115. *Harpalus (Harpalus) pumilus* Sturm, 1818

Data: Kostievo, pasture (Teofilova, 2021f).

Material: W Yagodovo vill., 42°06'12"N, 24°50'16"E, 162 m, 30.III.2021, 1 ♂; Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 2.IV.2021, 1 ♂; Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 12.IV.2021, 1 ♀, leg. Vasil Genchev.

116. *Harpalus (Harpalus) froelichi* Sturm, 1818

Data: "6 km W von Plovdiv" (Hieke, Wrase, 1988); Plovdiv (Guéorguiev, Guéorguiev, 1995).

117. *Harpalus (Harpalus) tardus* (Panzer, 1796)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

118. *Harpalus (Harpalus) albanicus* Reitter, 1900

Data: Plovdiv (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995); Kostievo, pasture; Radinovo (Teofilova, 2021f).

Material: Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 26.III.2021, 2 ♂; W Yagodovo vill., 42°06'12"N, 24°50'16"E, 162 m, 30.III.2021, 1 ♂; Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 2.IV.2021, 2 ♂, leg. Vasil Genchev.

119. *Harpalus (Harpalus) latus* (Linnaeus, 1758)

Data: "Umgebung Plovdiv" (surroundings) (Hieke & Wrase, 1988); Plovdiv (Guéorguiev & Guéorguiev, 1995).

120. *Harpalus (Harpalus) fuscicornis* Ménétriés, 1832

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

121. *Harpalus (Harpalus) smaragdinus* (Duftschmid, 1812)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988); Kostievo, oilseed rape field (Teofilova, 2021f).

122. *Harpalus (Harpalus) cupreus fastuosus* Faldermann, 1836

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

123. *Harpalus (Harpalus) dimidiatus* (P. Rossi, 1790)

Data: Plovdiv (Hieke & Wrase, 1988).

124. *Harpalus (Harpalus) caspius* (Steven, 1806)

Material: W Yagodovo vill., 42°06'12"N, 24°50'16"E, 162 m, 30.III.2021, 1 ♀, leg. Vasil Genchev.

125. *Harpalus (Harpalus) pygmaeus* Dejean, 1829

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995); Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

126. *Harpalus (Harpalus) punctatostriatus* Dejean, 1829

Data: Kostievo, pasture (Teofilova, 2021f).

127. *Harpalus (Harpalus) hospes hospes* Sturm, 1818

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field (Teofilova, 2021f).

128. *Harpalus (Harpalus) affinis* (Schrank, 1781)

Data: Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field (Teofilova, 2021f).

129. *Harpalus (Harpalus) distinguendus distinguendus* (Duftschmid, 1812)

Data: Plovdiv (Hieke & Wrase, 1988); Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

Material: Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 5.IX.2021, 1 ♀, leg. Vasil Genchev.

130. *Harpalus (Harpalus) saxicola* Dejean, 1829

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

131. *Acinopus (Acinopus) picipes* (Olivier, 1795)

Data: Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

Material: Plovdiv, near the old town, 42°08'47"N, 24°45'15"E, 185 m, 12.VII.2021, 1 ♂, leg. Vasil Genchev.

132. *Acinopus (Osimus) ammophilus* Dejean, 1829

Material: Yagodovo vill., house yard, 42°06'22"N, 24°50'47"E, 162 m, 22.VI.2002, 1 ♀, 25.VI.2002, 1 ♀, 26.VI.2002, 2 ♀, leg. Vasil Genchev.

133. *Acinopus (Oedematicus) megacephalus* (P. Rossi, 1794)

Data: Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

Material: NW Yagodovo vill., near road, 42°07'27"N, 24°49'32"E, 156 m, 7.VII.2010, 1 ♂, leg. Vasil Genchev.

134. *Carterus (Carterus) gilvipes* (Piochard de la Brûlerie, 1873)

Data: Kostievo, pasture (Teofilova, 2021f).

135. *Carterus (Carterus) dama* (P. Rossi, 1792)

Data: Yagodovo (Teofilova, 2021e); Kostievo, oilseed rape field (Teofilova, 2021f).

136. *Ditomus calydonius calydonius* (P. Rossi, 1790)

Data: Yagodovo (Teofilova, 2021e).

137. *Dixus clypeatus* (P. Rossi, 1790)

Data: Kostievo, pasture (Teofilova, 2021f).

138. *Dixus eremita* (Dejean, 1825)

Data: Kostievo, pasture (Teofilova, 2021f).

139. *Dixus obscurus* (Dejean, 1825)

Data: Katunitsa (Teofilova, 2021e).

Material: N Katunitsa vill., near Chaya River, 42°06'58"N, 24°52'01"E, 165 m, 12.XI.2021, 1 ♂, leg. Vasil Genchev.

Chlaeniini Brullé, 1834

140. *Chlaenius (Dinodes) decipiens* (L. Dufour, 1820)

Data: Plovdiv (Rambousek, 1912); Kostievo, oilseed rape field (Teofilova, 2021f).

141. *Chlaenius (Trichochlaenius) aeneocephalus aeneocephalus* Dejean, 1826

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

142. *Chlaenius (Chlaenius) festivus festivus* (Panzer, 1796)

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912; Hieke & Wrase, 1988).

143. *Chlaenius (Chlaeniellus) flavipes* Ménétriés, 1832

Data: Philippopel (Apfelbeck, 1904); Plovdiv (Rambousek, 1912).

144. *Chlaenius (Chlaeniellus) vestitus* (Paykull, 1790)

Material: W Katunitsa vill., 42°06'14"N, 24°51'52"E, 161 m, 27.V.2021, 1 ♀, 42°06'13"N, 24°51'51"E, 160 m, 11.V.2021, 1 ♀; N Katunitsa vill., near Chaya River, 42°06'58"N, 24°52'01"E, 165 m, 14.VIII.2021, 2 ♂, leg. Vasil Genchev.

Oodini LaFerté-Sénectère, 1851

145. *Oodes (Oodes) helopioides helopioides* (Fabricius, 1792)

Data: Plovdiv (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

Licinini Bonelli, 1810

146. *Licinus (Licinus) cassideus cassideus* (Fabricius, 1792)

Data: "bei Plovdiv" (Hieke & Wrase, 1988).

147. *Licinus (Licinus) silphoides* (P. Rossi, 1790)

Material: N Katunitsa vill., 42°06'58.4"N, 24°52'00.9"E, 161 m, 16.VI.2022, 2 ♂, leg. Vasil Genchev.

Note: New species for the Upper Thracian Lowland.

Lebiini Bonelli, 1810

148. *Lebia (Lebia) scapularis scapularis*

(Geoffroy, 1785)

Data: Plovdiv (Hieke & Wrase, 1988).

149. *Lebia (Lebia) marginata* (Geoffroy, 1785)

Data: Plovdiv (Hieke & Wrase, 1988; Guéorguiev & Guéorguiev, 1995).

150. *Dromius (Dromius) agilis* (Fabricius, 1787)

Data: Plovdiv (Hieke & Wrase, 1988; Vasilev, 1988b).

151. *Paradromius (Manodromius) linearis linearis* (Olivier, 1795)

Material: N Katunitsa vill., near Chaya River, 42°06'58"N, 24°52'01"E, 165 m, 14.VIII.2021, 1 ♂, 16.VII.2022, 1 ♀, leg. Vasil Genchev.

Note: New species and genus for the Upper Thracian Lowland.

152. *Syntomus obscuroguttatus* (Duftschmid, 1812)

Data: Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f).

153. *Syntomus pallipes* (Dejean, 1825)

Data: Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

Material: Plovdiv, near Regatta Venue, 42°09'10"N, 24°43'23"E, 162 m, 12.IV.2021, 1 ♂, 5.IX.2021, 1 ♀, leg. Vasil Genchev.

154. *Microlestes corticalis* (L. Dufour, 1820)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

155. *Microlestes fissuralis* (Reitter, 1901)

Data: Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 2.IV.2021, 1 ♀, leg. Vasil Genchev.

156. *Microlestes fulvibasis* (Reitter, 1901)

Data: Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

157. *Microlestes maurus maurus* (Sturm, 1827)

Data: Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

158. *Microlestes minutulus* (Goeze, 1777)

Data: Kostievo, oilseed rape field and pasture; Radinovo (Teofilova, 2021f).

159. *Lionychus (Lionychus) quadrillum* (Duftschmid, 1812)

Data: "6 km von Plovdiv" (Hieke & Wrase, 1988).

Dryptini Bonelli, 1810

160. *Drypta (Drypta) dentata* (P. Rossi, 1790)

Data: Plovdiv, 200 m (Vasilev, 1992); Yagodovo (Teofilova, 2021b).

Material: Yagodovo vill., house yard, 42°06'38"N, 24°51'04"E, 159 m, 20.V.2021, 1 ♀, leg. Vasil Genchev.

Zuphiini Bonelli, 1810

161. *Zuphium olens* (Rossi, 1790)

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

Brachininae Bonelli, 1810

Brachinini Bonelli, 1810

162. *Brachinus (Brachinus) berytensis* Reiche et Saulcy, 1855

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

163. *Brachinus (Brachinus) crepitans* (Linnaeus, 1758)

Data: "6 km von Plovdiv" (Hieke, Wrase, 1988); Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f).

164. *Brachinus (Brachinus) ejaculans* Fischer von Waldheim, 1828

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

165. *Brachinus (Brachinus) elegans* Chaudoir, 1842

Data: Kostievo, oilseed rape field (Teofilova, 2021f).

166. *Brachinus (Brachinus) psophia* Audinet-Serville, 1821

Data: "6 km von Plovdiv" (Hieke & Wrase, 1988); Plovdiv (Guéorguiev & Guéorguiev, 1995); Kostievo, oilseed rape field; Radinovo (Teofilova, 2021f).

167. *Brachinus (Brachynidius) explodens* Duftschmid, 1812

Data: "Otdih i kultura" (Rest and Culture) Park (Angelov, 1960); Kostievo, oilseed rape field and pasture (Teofilova, 2021f).

?*Paussus (Scaphipaussus) turcicus* I. Frivaldszky von Frivald, 1835

Data: Plovdiv surroundings (Kryzhanovskij, *unpublished results*).

Note: It is possible that record to be referring to "Krichim", as in Hieke & Wrase (1988) and Guéorguiev & Guéorguiev (1995).

Discussion

The taxonomic structure of the carabid fauna from the vicinity and the city of Plovdiv is built from mostly ecologically plastic beetles occurring in various and often highly anthropogenically affected habitats, such as agrocoenoses, gardens and parks. These are many of the representatives of the tribes Harpalini and Zabrini (e.g. Kryzhanovskij, 1983), containing 42.5% of the species found.

Zoogeographical analysis on species level reveals that elements from all five main zoogeographical complexes occur in the city of Plovdiv and its surroundings. Mediterranean (*sensu lato*) faunal type prevails (56 species, 33% of all). It is closely followed by the Northern Holarctic and European-Siberian complex (48 species, 29%). European complex consists of 36 species (21%), European-Asiatic complex has 25 species (15%), and the Endemic complex is represented by only two Balkan endemics (1%): *Trechus irenis* and *Molops dilatatus* (Fig. 1). Northern Holarctic and European-Siberian complex includes species distributed mainly in the northern regions of the Holarctic, mostly in Europe and Siberia; European complex includes mostly forest dwelling species connected to the middle and southern parts of Europe; European-Asiatic complex includes species which ranges lie between the Eurosiberian and Mediterranean zones; Mediterranean complex includes species distributed in the region of the so-called 'Ancient Mediterraneum' (Popov, 1927; Kryzhanovskij, 1965, 1983, 2002); Endemic complex includes species with limited ranges. Greatest numbers of species are European-Neareastern, Palaearctic, and European-Central Asian zoogeographical elements (Table 1).

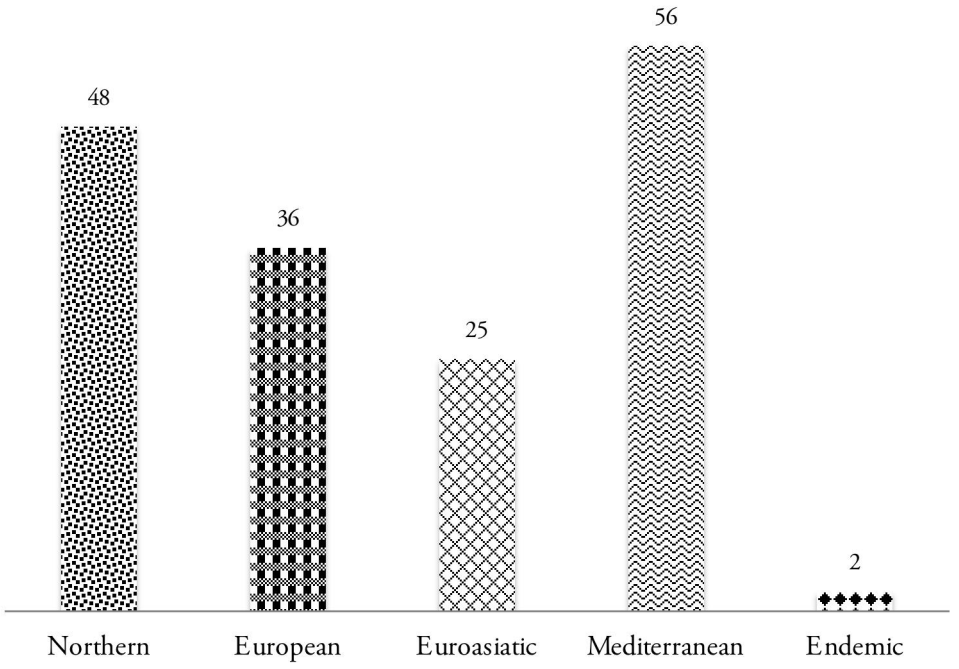

Fig. 1. Number of species found in every of the zoogeographical complexes in the carabid fauna from the region near the city of Plovdiv.

Table 1. Zoogeographical categories of the ground beetles from the region near the city of Plovdiv (on species level).

Complex	Zoogeographical element	Number of species	% of all
Northern Holarctic and European-Siberian	Holarctic	4	2.4
	Palaearctic	21	12.6
	Western Palaearctic	9	5.4
	European-Siberian	10	6.0
	European and West Siberian	4	2.4
European	European-Neareastern	25	15.0
	European	1	0.6
	Central and Eastern European and Neareastern	4	2.4
	Central European and Neareastern	5	3.0
	Central and Eastern European	1	0.6
Euroasiatic	Euroasiatic steppe and forest-steppe complex	9	5.4
	European and Central Asian	16	9.6
Mediterranean	European-Central Asian-Mediterranean	11	6.6
	European-Neareastern-Mediterranean	12	7.2
	Mediterranean-Central Asian	4	2.4
	Northmediterranean-Central Asian	2	1.2
	Mediterranean-Neareastern	1	0.6
	Mediterranean	3	1.8
	Eastmediterranean	2	1.2
	Pontic-Submediterranean	1	0.6
	Northmediterranean	8	4.8
	Balkan-Central Asian	1	0.6
	Balkan-Neareastern	11	6.6
Endemic	Balkan endemic	2	1.2

Such high numbers (one third of all) of Mediterranean species were also found in carabid fauna from Cape Emine at the Black Sea coast (Teofilova *et al.* 2015), the Sarnena Sredna Gora Mts. (Teofilova & Kodzhabashev, 2020b), pseudomaquises in SW Bulgaria (Teofilova, 2020), and the Eastern Rhodope Mts. (Teofilova & Kodzhabashev, 2020a). All these regions in Bulgaria are under strong Mediterranean climatic effect.

The ground beetles from the studied region relate to two classes of life forms proposed by Sharova (1981), with a slight predominance of the class Zoophagous with 96 species (57%) (Fig. 2). Mixophytophagous are 71 species (43%). This ratio between the classes is most similar to that in the meadow steppes from the Forest-steppe zone of Eurasia (Sharova, 1981), Eastern Rhodope Mts. (Teofilova & Kodzhabashev, 2020a), habitats near Cape Emine (Teofilova et al., 2015) and unvegetated, sparsely vegetated, and bryophyte- or lichen-vegetated cliffs, rock faces and rock pavements in the inland areas in Bulgaria (Teofilova, 2019a). It is also close to that in semi-desert regions of Eurasia (Sharova, 1981), and differs from the established in the typical mountain regions in Bulgaria (e.g. Teofilova,

2016; Teofilova, 2018; Teofilova, 2019b; Teofilova & Kodzhabashev, 2021b). Lower share of the zoophages was found in pseudomaquises in SW Bulgaria, where it revealed the effect of the xerothermic Transitional-Mediterranean environmental factors (Teofilova, 2020).

The degree of hind wing development allows distinguishing of three groups of carabids: brachypterous (hind wings shorter than elytra or missing), macropterous (winged), and dimorphic (some individuals have fully developed wings, others only vestigial ones). The macropterous beetles represent 67% (112 species) of all collected carabid species. Pteridimorphic species are 21% of all (34 species), and brachypterous are only 6% (11 species). For ten species (6%) there is no data about their wing morphology (Fig. 2). As a comparison, the ratio between the winged, dimorphic and wingless species is, respectively, 73%, 17% and 10% in Bulgarian rapeseed (*Brassica napus* L.) fields (Teofilova, 2021c), 69%, 22% and 8% in Zlatiya Plateau (Teofilova & Kodzhabashev, 2020c), and 57%, 22% and 16% in the Sarnena Gora Mts. (Teofilova & Kodzhabashev, 2020b). While wingless carabid assemblages are characteristic of ecologically homogeneous and stable environments, where resources are sufficient for beetles' entire life cycle (such as mountain forest habitats), the proportion of flight capable pioneer species increases with increasing disturbance (see Teofilova & Kodzhabashev, 2020b).

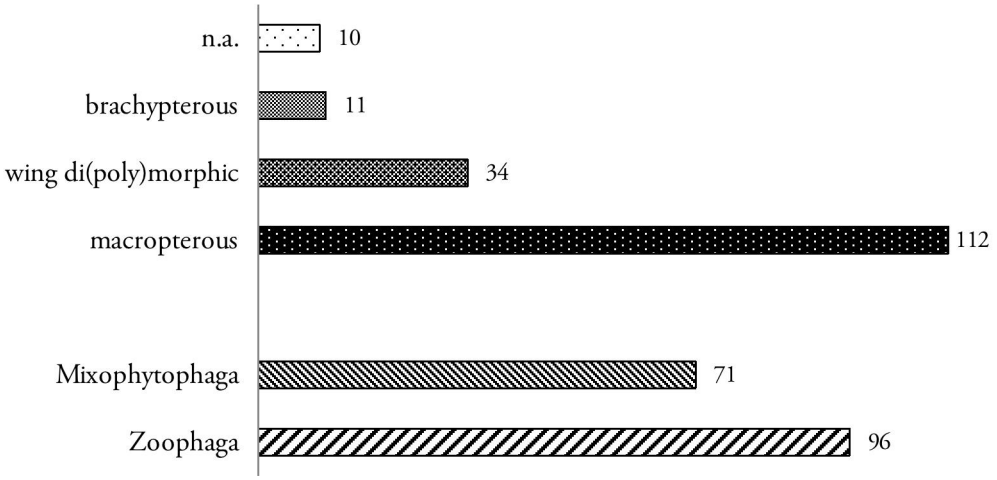

Fig. 2. Number of species found in the two life-form's classes and in the wing development categories of the carabid fauna from the region near the city of Plovdiv.

Humidity preferences analysis shows that in the studied region the mesoxerophilous carabids have the largest share (60 species, 36% of all). Mesophilous are 25 species (15%), mesohygrophilous are 24 species (14%), hygrophilous are 29 species (17%), 17 species are xerophilous (10%), and 12 species (7%) are eurybiontic in relation of the humidity. In fact, of all Bulgarian eurybionths, only *Pterostichus (Feronidius) melas* (Creutzer, 1799) was not recorded during this study, but considering its distribution and the state of research in the region, its occurrence here is quite possible. In synanthropic habitats, usually there is an increased percentage of eurybionts, which are mostly ecologically plastic species with extensive Palaearctic or Eurasian ranges, tolerant to a wide range of environmental conditions and their frequent changes (Kryzhanovskij, 1983). The share of eurytopic species in the region of Cape Emine is 9% (Teofilova et al., 2015), and in Zlatiya Plateau it is 11% (Teofilova & Kodzhabashev, 2020c).

The present study demonstrates the

predominantly mesoxerophilic nature of the habitats, probably resulting from the large percentage of open territories, occupied mainly by agricultural lands. Similar pattern was also found in the region of the Chirpan Heights (NE from Plovdiv) (Teofilova & Kodzhabashev, 2021), in the Eastern Rhodope Mts. (Teofilova & Kodzhabashev, 2020a) and pseudomaquises in SW Bulgaria (Teofilova, 2020). Mesoxerophiles are mostly inhabitants of open areas, such as arable lands, pastures, hay meadows and clearings, and natural dry grasslands. This carabid fauna is a mix of naturally occurring and ecologically plastic species, some of which in process of initial invasive expansion (Kryzhanovskij, 1983).

Conclusions

The region of the city of Plovdiv and all its surroundings are highly anthropogenically affected by urbanization and agriculture. This is reflected in the taxonomical, zoogeographical and ecological structure of the carabid complex established in this area, containing many ecologically tolerant, plastic, and eurytopic species. In the same time, the presence of some preserved semi-natural habitats, as the city parks and the Maritsa and Chaya River banks falling under the Natura 2000 zones, favour the survival of some intra- and extrazonal stenotopic carabids, such as many riparian or hygrophilous species.

The ground beetle fauna of Bulgaria is relatively well studied, and this region has been an object of some research in the past and in more recent times. Still, further detailed studies would complete the knowledge on the diversity and ecology of this group. It is quite possible that the carabid fauna is even more diverse. For general conclusions many more localities have to be examined systematically.

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Review of the Spiders, Pseudoscorpions and Scorpions in the Region of Plovdiv, S Bulgaria (Arachnida: Araneae, Pseudoscorpiones & Scorpiones)

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Abstract. Although Plovdiv is the second largest city in Bulgaria and on its territory, there are many natural habitats of high conservation importance, there is still almost no data on the species composition of the arachnid fauna. Our study is the first attempt to summarize available published and to provide original data about three orders of arachnids. The following number of the investigated taxa of arachnids was established: spiders: 312 species from 33 families, pseudoscorpions: 4 species from 4 families and one scorpion species (from Euscorpiidae family). New for the region of Plovdiv are 280 species, thirteen spider species are newly recorded for the country and five of them are first records from the Balkans as well. *Lathys spasskyi* seems to be a first record from Europe and *Zelotes harmeron* is the first published record from the European mainland. The high total number of species presented here, as well as the many new country records, show that the studies of arachnids in cities have been unjustifiably neglected.

Key words: Balkans, Bulgaria, new country record, taxonomy, Thrace, Upper Thracian lowland.

Introduction

Plovdiv is the second largest city in Bulgaria and is located in the western part of the Upper Thracian lowland, on the both banks of the Maritsa River. The outskirts of Plovdiv consist mainly of open agricultural landscapes, pastures, orchards, villages, warehouses and service areas. In the city and its surroundings there are many parks, protected areas and Natura 2000 sites with high conservation values. This provides a variety of habitats, which implies a rich fauna.

No any study of the arachnids in the Plovdiv region has been published to date. The only historical species reports (21 spiders & 2 pseudoscorpions) can be found in the papers of Drensky (1913, 1936), Jurinic & Drensky (1917), Shikrenov (1961), Dimitrov (1993) and Petrov (1997) and recently (12 more spiders as part of this research) in Naumova (2019), Geci & Naumova (2021), Naumova & Deltshev (2021) and Naumova et al. (2021). So, to date only 35 species (33 spiders and 2 pseudoscorpions) were known from the region of Plovdiv.

The aim of this study is to summarize and provide all available data about the presence of three orders of arachnids in Plovdiv city and its closest surrounds and to present original photographs of the spiders species *Afraflacilla epiblemoides* (Chyzer, 1891), *Atypus muralis*

Bertkau, 1890, *Dysdera osellai* Alicata, 1973, *Erigone dentosa* O. Pickard-Cambridge, 1894, *Ero koreana* Paik, 1967, *Ipa terrenus* (L. Koch, 1879), *Lathys spasskyi* Andreeva & Tystshenko, 1969, *Pritha parva* Legittimo, Simeon, Di Pompeo & Kulczycki, 2017, *Tegenaria faniapollinis* Brignoli, 1978, *Trachelas minor* O. Pickard-Cambridge, 1872, *Zelotes eugenei* Kovblyuk, 2009 and *Z. harmeron* Levy, 2009 to facilitate their identification.

Material and Methods

All specimens of arachnids were collected by hand, by sweeping grass or with pitfall traps (with formaldehyde) from 1927 to 2021 but mainly in the last four years. Specimens were preserved in 70-95% ethanol and deposited (indicated in Table 1) in the Institute of Biodiversity and Ecosystem Researches (IBER) and The National Museum of Natural History (NMNH) at the Bulgarian Academy of Sciences.

The digital images were taken with a Canon EOS 1100D digital camera attached to Carl Zeiss Amplival microscope and processed using Photoshop CS6 software. The nomenclature follows the World Spider Catalog (2021), Harvey (2013) and Kovařík et al. (2020). All taxa are listed alphabetically. The collectors were presented by their initials as follows: D. Georgiev (DG), G. Glushkov (GG), I. Delev (ID), S. Indzhov, I. Mollov (IM), M. Naumova (MN), O. Todorov (OT), P. Drensky (PD), P. Mitov (PM), S. Popova (SP), T. Teofilova (TT), V. Genchev (VG).

Other abbreviations used in the paper include: ♂ - male; ♀ - female; hc - hand collected; j -juvenile/s; L - locality; Pl - Plovdiv city; RNHM - Regional Natural History Museum; sa - subadult, Sur - surrounds.

The collecting sites (alphabetically) are presented in Table 1 and mapped on Fig. 1. The data in Table 1 includes the localities with numbers 1 to 31, in the city of Plovdiv, followed by sites with numbers 32 to 53 from the nearest villages (1-10 km from the town) and related data (UTM-code, exact or approximate coordinates (decimal), elevation (m a.s.l.), collecting method, collectors and depository). All records from Plovdiv, without exact location were tentatively added to emblematic region Stariya Grad place (The Old town) with number 29a and approximate coordinates.

Table 1. The localities where the arachnids have been collected in the Plovdiv region.

N	Locality	UTM	coordinates	Alt.	Method	coll./Author	deposit
			City of PLOVDIV				
1	Bratska Mogila place	LG16	N 42.1435, E 24.7178	168	sweeping	DG	IBER
2	Bunardzhik hill	LG16	N 42.1447, E 24.7394	190-236	soil traps, hc	IM, MN, PD, VG	IBER
3	Central, I	LG16	N 42.1482, E 24.7301	170	hc	VG	IBER
4	Central, II	LG16	N 42.1497, E 24.7247	163	hc	VG	IBER
5	Central, Maritsa River	LG16	N 42.1527, E 24.7230	161	hc	VG	IBER
6	Central, RNHM	LG16	N 42.1490, E 24.7430	173	hc	VG	IBER
7	Central, Sity center	LG16	N 42.1514, E 24.7415	166	hc	GG	IBER
8	Danov Halm (Sahat Tepe) hill (The Clocktower)	LG16	N 42.1463, E 24.7469	185-210	hc, soil traps	CD, IM, MN, SP	NMNH, IBER
9	Dzhendem Tepe (Mladezhki Halm) hill	LG16	N 42.1498, E 24.7496	168	soil traps	IM	IBER
10	Gagarin ward	LG17	N 42.1628, E 24.7544	167	hc	MN	IBER
11	Grebnata baza Place	LG16	N 42.1495, E 42.1495		hc	MN, VG	IBER
12	Han Asparuh ward	LG16	N 42.1412, E 24.7912	163	hc	MN	IBER
13	Hisar Kapiya place	LG16	N 42.1486, E 24.7541	177	hc	PD	NMNHS
14	Izgerv ward	LG16	N 42.1485, E 24.7842	159	hc	MN	IBER
15	Iztochna Promishlena Zona ward	LG16	N 42.1521, E 24.7730	158	hc	MN	IBER
16	Kamenitsa 1 ward	LG16	N 42.1395, E 24.7559	159	hc	Naumova et al. (2021)	IBER
17	Kapana ward	LG16	N 42.1503, E 24.7485	168	hc	VG	

18	Kyuchuka ward	LG16	N 42.1102 , E 24.7275	168	hc	Naumova & Deltshev (2021)	IBER
19	Lauta Park I	LG16	N 42.1352, E 24.7716	159	soil traps	ID, IM	IBER
20	Lauta Park II	LG16	N 42.1381, E 24.7824	158	hc	PM	IBER
21	Marasha ward	LG16	N 42.1507, E 24.7371	166	hc	MN	IBER
22	Maritsa river, a rivershore in Karshiaka ward	LG16	N 42.1541, E 24.7279	160	hc	MN, SP	IBER
23	Maritsa river, 4th km, suburban	LG16	N 42.1420, E 24.6990	165	soil traps	ID	IBER
24	Maritsa river, 6th km, rural	LG16	N 42.1502, E 24.6797	160	soil traps	ID	IBER
25	Maritsa river, Gerdzhika, urban	LG16	N 42.1540, E 24.7340	159	soil traps	ID	IBER
26a	Nebet Tepe hill	LG16	N 42.1508, E 24.7534	189	hc	VG	IBER
26b	Nebet Tepe hill, Maritsa River	LG16	N 42.1541, E 24.7511	161	hc	VG	IBER
26c	Nebet Tepe hill, Stariya Grad I	LG16	N 42.1493, E 24.7540	185	hc	VG	IBER
26d	Nebet Tepe hill, Stariya Grad II	LG16	N 42.1499, E 24.7540	187	hc	VG	IBER
27	North region, raspberry plantation	LG17	N 42.1763, E 24.7619	161	-	-	NMNHS
28	Promishlena Zona Izgrev ward	LG16	N 42.1479, E 24.8081	162	hc	VG	IBER
29a	Stariyat grad place I	LG16	N 42.1420, E 24.7480	165	hc	GG, PD	-
29b	Stariyat grad place II	LG16	N 42.1482, E 24.7301		-	Dimitrov (1993)	-
30	Trakia ward	LG16	N 42.1341, E24.7849	165	hc, obs.	Naumova & Deltshev (2021)	IBER
31	Yuzhna Promishlena Zona waed	LG16	N 42.1274, E 24.7714	160	hc	-	IBER
			SURROUNDS				
32	Bresovitsa village	LG06	N 42.1035, E 24.6529	180	hc	PD	-
33	Katunitsa village, Chaya River	LG26	N 42.1162, E 24.8669		hc	VG	IBER
34	Kostievo village	LG07	N 42.0933, E 24.8185	165	Soil traps	TT	IBER
35	Krumovo village	LG16	N 42.0976, E 24.8149	162	hc	CD	NMNH
36	Sadovo village	LG26	N 42.1300, E 24.9233	143	hc	BP	NMNH
37	Tsaratsovo village	LG17	N 42.2109, E 24.6991	178	Soil traps	IM	IBER
38	Yagodovo village, a yard	LG26	N 42.1107, E 24.8510		hc	VG	IBER
39	Yagodovo village, cemetery	LG26	N 42.1160, E 24.8496		hc	VG	IBER
40	Yagodovo village, Chaya River I	LG26	N 42.1038, E 24.8645		hc	VG	IBER
41	Yagodovo village, Chaya River II	LG26	N 42.1140, E 24.8659		hc	VG	IBER
42	Yagodovo village, Chaya River III	LG26	N 42.1087, E 24.8656		hc	VG	IBER
43a	Yagodovo village, East I	LG26	N 42.1070, E 24.8542	161	hc	VG	IBER
43b	Yagodovo village, East II	LG26	N 42.1060, E 24.8520		hc	VG	IBER
43c	Yagodovo village, East III	LG26	N 42.1069, E 24.8557		hc	VG	IBER
44	Yagodovo village, N field I	LG26	N 42.1284, E 24.8556	152	hc	VG	IBER
45a	Yagodovo village, N field II	LG26	N 42.1312, E 24.8493	153	hc	VG	IBER
45b	Yagodovo village, N field III	LG26	N 42.1320, E 24.8429	154	hc	VG	IBER
46a	Yagodovo village, North I	LG26	N 42.1181, E 24.8532	157	hc	VG	IBER
46b	Yagodovo village, North II	LG26	N 42.1148, E 24.8526	160	hc	VG	IBER
46c	Yagodovo village, North III	LG26	N 42.1151, E 24.8516	150	hc	VG	IBER
47	Yagodovo village, North IV	LG26	N 42.1234, E 24.8527	157	hc	VG	IBER
48	Yagodovo village, North V	LG26	N 42.1260, E 24.8430	156	hc	VG	IBER
49	Yagodovo village, South I	LG26	N 42.0998, E 24.8481	164	hc	VG	IBER
50	Yagodovo village, South II	LG26	N 42.1010, E 24.8472	165	hc	VG	IBER
51	Yagodovo village, West I	LG26	N 42.1033, E 24.8378	162	hc	VG	IBER
52	Yagodovo village, West II	LG26	N 42.1128, E 24.8387	161	hc	VG	IBER
53	Yagodovo village, West III	LG26	N 42.1145, E 24.8284	158	hc	VG	IBER

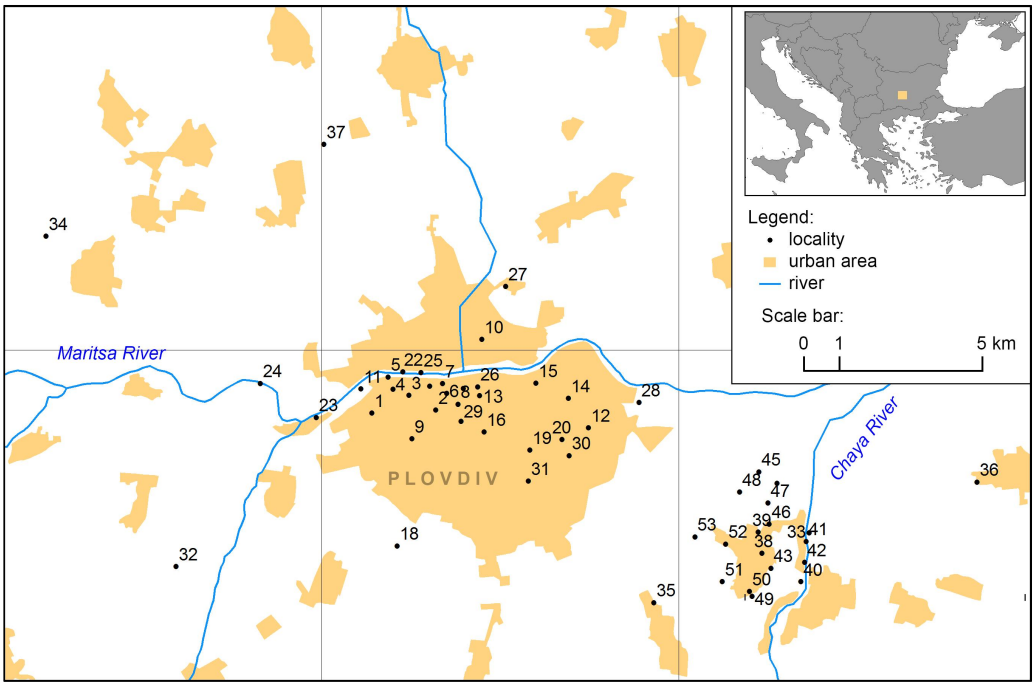

Fig. 1. Map with the localities in Plovdiv where the arachnids have been collected (for details see Table 1).

Results

During this study the following number of the investigated taxa of arachnids was established: spiders: 312 species from 33 families (Agelenidae-7, Amaurobiidae-3, Anyphaenidae-1, Araneidae-27, Atypidae-1, Cheiracanthiidae-6, Clubionidae-2, Dictynidae-8, Dysderidae-8, Eresidae-2, Filistatidae-2, Gnaphosidae-30, Hahniidae-1, Linyphiidae-37, Liocranidae-3, Lycosidae-34, Mimetidae-3, Miturgidae-4, Oecobiidae-1, Oxyopidae-2, Philodromidae-13, Pholcidae-4, Phrurolithidae-3, Pisauridae-1, Salticidae-40, Scytododae-2, Tetragnathidae-9, Theridiidae-32, Thomisidae-19, Titanoecidae-3, Trachelidae-1, Uloboridae-1, Zodariidae-2); pseudoscorpions: 4 species from 4 families (Cheliferidae-1, Chernetidae-1, Chtoniidae-1, Neobisiidae-1) and one scorpions from the family Euscorpiidae. New for the region of Plovdiv are 280 species (marked with an asterisk). Thirteen spider species are newly recorded for the country (marked with 2 asterisks) and five of them are first records from the Balkans as well (marked with 3 asterisks). *Lathys spasskyi* Andreeva & Tystshenko, 1969 seems to be a first record from Europe and *Zelotes harmeron* Levy, 2009 is the first published record from the European mainland. One speciecies from a genus *Scytodes* Latreille, 1804 seems to be new for the science and will be described in separate paper.

The records of *Dysdera erythrina* (Walckenaer, 1802) from Plovdiv, Bunardzhika (Drensky, 1913: 87 (sub *D. cambridgei*), Drensky, 1936: 12, Jurinitch & Drensky, 1917:125) is listed here as *D.* sp. *erythrina* – complex. The material from Plovdiv cannot be located (probably lost) and in accordance with Řezáč et al., (2018) the species have been excluded from the Bulgarian checklist of spiders. The revision of *erythrina* species complex in the Balkans is in the future.

Three spider species are included in the list below as uncertain records: *Neon pictus* Kulczyński, 1891 from the hills Bunardzhika & Sahat Tepe (Jurinitch & Drensky, 1917: 135), *Ozyptila rauda* Simon, 1875 from Sahat Tepe (Drensky, 1913: 101 sub *Oxyptila r.* Simon, 1875) and *Cheiracanthium margaritae* Sterghiu,

1985 (described by a single female specimen in Romania) and reported (also by single female) from Plovdiv (Dimitrov, 1993: 74). They have not been reported over again and it is quite possible to be a result of misidentifications. Since the materials of these species cannot be located (probably lost), they are included in the list below, with a question mark (?) and need conformation.

Table 2. List of arachnids. *Legend:* S - status: * - new for the Plovdiv region, ** - new country record, *** - species new for the Balkans, # - species nov., ? - uncertain record, L - locality (number = to the number in Table 1 and Fig. 1), j - juvenile, sa - subadult, Pl - Plovdiv city, Sur - surrounds.

S	Taxa	L (sex, date)	Pl	Sur
	ARANEAE			
	Agelenidae			
*	*Agelena orientalis* C. L. Koch, 1837	38 (1 ♀, 16.08.2018, 1 ♀, 28.08.2018), 41 (2 ♀, 14.08.2021), 42 (1 ♀, 4 sa ♂, 08.09.2018)		+
	Allagelena gracilens (C. L. Koch, 1841)	11 (1 ♂, 16.07.2021), 29a (Drensky, 1913, sub *A. similis*, Drensky, 1936), 33 (1 ♂, 25.07.2021), 44 (1 ♀, 25.03.2020), 46b (1 ♀, 29.08.2020)	+	+
*	*Eratigena agrestis* (Walckenaer, 1802)	23 (1 ♂, 30.06-14.07.2020), 31 (1, 22.02.1988)	+	
*	*Maimuna vestita* (C. L. Koch, 1841)	2 (1 ♀, 19.04.2017), 6 (1 ♀, 18.02.2022), 7 (1 ♀, 02-03.2018), 8 (1 ♂, 1 ♀, 20.03.2018), 15 (1 ♂, 11.11.2016), 38 (3 ♂, 8 ♀, 1 sa ♀, 1 j, 16-30.03.2018, 1 ♀, 11-15.04.2018, 1 ♂, 21.2.2021)	+	+
**	*Tegenaria faniapollinis Brignoli,* 1978	5 (1 ♂, 26.03.2021), 38 (1 ♀, 1 sa ♀, 16.06.2021, 3 ♀, 19.06.2021, 1 ♂, 28.10.2021, 2 ♂, 17.02.2022)	+	+
*	*Tegenaria hasperi* Chyzer, 1897	4 (1 ♂, 30.06.2021), 23 (1 ♀, 01-30.09.2020), 24 (1 ♀, 01-30.09.2020 , 1 ♀, 30.06-14.07.2020), 25 (1 ♀, 30.06-14.07.2020), 33 (2 ♀), 38 (16.06.2019)	+	+
	Tegenaria parietina (Fourcroy, 1785)	6 (1 ♀, 25.10.2018), 29a (1 ♂, 25.12.2018, 1 j, 03.10.1927), 32 (Jurinic & Drensky, 1917), 38 (2 ♀, 16-30.03.2018, 1 ♂, 04.10.2018)	+	+
	Amaurobiidae			
*	*Amaurobius erberi* (Keyserling, 1863)	2 (1 ♀, 19.04.2017, 1 ♀, 2 j, 01-04.05.2018), 6 (2 ♂, 18.02.2022), 8 (1 ♂, 1 ♀, 13.02.1988, 2 ♂, 4 ♀, 20.03.2018), 15 (1 ♀, 1 j, 11.11.2016), 22 (1 ♀, 20.03.2018), 26c (2 ♀, 27.04.2018), 38 (6 ♂, 9 j, 16-30.03.2018, 1 ♂, 02.04.2018, 2 ♀, 11-15.04.2018, 1 ♂, 3 ♀, 08-21.04.2019, 2 ♀, 11-21.05.2019, 2 ♂, 28.10.2020, 1 ♀, 06.11.2020)	+	+
*	*Amaurobius ferox* (Walckenaer, 1830)	38 (1 ♀, 05.2018)		+
*	*Amaurobius pallidus* L. Koch, 1868	19 (1 ♂, 01-31.05.2021), 20 (3 ♂, 3 ♀, 1 j, 18.04.2017)	+	
	Anyphaenidae			
*	*Anyphaena accentuata* (Walckenaer, 1802)	33 (1 ♂, 23.04.2022, 1 ♂, 1 ♀, 02.05.2022)		
	Araneidae			
*	*Aculepeira ceropegia* (Walckenaer, 1802)	33 (1 ♂, 16.06.2022), 38 (1 ♀, 01.07.2020, 1 ♀, 03.07.2020)		+
*	*Agalenatea redii* (Scopoli, 1763	38 (1 ♂, 08-21.04.2019, 1 j , 15.04.2018)		+
*	*Araneus angulatus* Clerck, 1757	29a (1 sa ♀, 03.10.1927), 38 (1 ♀, 19.08.2018), 44 (3 ♂, 1 ♀, 10-12.07.2018)	+	+
*	*Araneus diadematus* Clerck, 1757	29a (1 ♀, 09.11.2018, 1 ♀, 15.11.2018, 1 ♀, 01.09.2019), 38 (1 ♀, 14.08.2018, 1 ♀,	+	+

		29.09.2018), 44 (1 ♀, 21.10.2018, 1 ♂, 27.08.2021)		
*	*Araniella cucurbitina* (Clerck, 1757)	9 (1 ♂, 2 ♀, 17.06.2021), 33 (1 ♀, 16.06.2019), 40 (1 ♂, 1 ♀, 04.06.2021)	+	+
*	*Araniella opisthographa* (Kulczynski, 1905)	27 (1 ♂, 1 ♀, 27.10.1988), 38 (1 ♀, 28.05-08.06.2019)	+	+
*	*Argiope bruennichi* (Scopoli, 1772)	44 (1 ♀, 10-12.07.2018), 48 (1 ♂, 18.07.2018)		+
*	*Argiope lobata* (Pallas, 1772)	14 (1 ♀, 18.08.2021), 28 (1 ♀, 25.07.2018)	+	
*	*Cercidia prominens* (Westring, 1851)	38 (1 ♀, 11.08.2020, 1 ♂, 30.08.2020)		+
*	*Cyclosa conica* (Pallas, 1772)	35 (1 ♀, 04.1988)		+
*	*Cyclosa oculata* (Walckenaer, 1802)	38 (1 ♂, 27-29.05.2018, 1 ♀, 31.07.2020, 1 ♀, 02.08.2020, 2 ♀, 30.08.2020)		+
*	*Gibbaranea bituberculata* (Walckenaer, 1802)	19 (1 ♀, 26.05.2011), 40 (2 ♀, 10-11.05.2021)	+	+
*	*Gibbaranea gibbosa* (Walckenaer, 1802)	38 (1 ♂, 08-21.04.2019)		+
*	*Gibbaranea ullrichi* (Hahn, 1835)	38 (1 ♀, 11-18.05.2018, 1 , ♂, 20.03.2019		+
*	*Hypsosinga pygmaea* (Sundevall, 1831)	38 (1 ♀, 04-14.07.2019, 1 ♀, 16.07.2021)		+
*	*Hypsosinga sanguinea* (C. L. Koch, 1844)	38 (2 ♂, 25.04-05.05.2019, 1 ♀, 27.04.2019, 1 ♀, 04.05.2019, 1 ♀, 22.06.2021), 39 (1 ♂, 12.07.2021)		+
*	*Larinioides ixobolus* (Thorell, 1873)	42 (2 ♀, 08.09.2018)		+
*	*Larinioides patagiatus* (Clerck, 1757	44 (1 ♀, 25.03.2020, 1 ♀, 15.10.2020, 1 ♀, 04.09.2021)		+
*	*Larinioides suspicax* (O. Pickard-Cambridge, 1876)	33 (2 ♀, 30.05.2018)		+
*	*Leviellus stroemi* (Thorell, 1870)	25 (1 ♂, 20.05-29.06.2020),33 (1 ♂, 25.07.2021)	+	+
*	*Mangora acalypha* (Walckenaer, 1802)	1 (6 ♀, 03-04.06.2017), 2 (1 ♂, 1 ♀, 01-04.05.2018), 19 (1 ♀, 26.05.2011), 33 (1 ♂, 25.07.2021), 35 (1 ♀, 04.1988), 38 (1 sa ♀, 11-15.04.2018, 1 ♂, 04-14.07.2019), 40 (1 ♀, 04.06.2021)	+	+
	Neoscona adianta (Walckenaer, 1802)	33 (1 ♀, 18.07.2021), 38 (1 ♀, 03-10.07.2018), 44 (Geci & Naumova, 2021)		+
	Neoscona byzanthina (Pavesi, 1876)	33 (1 ♀, 05.09.2022), 44 (Geci & Naumova, 2021), 45a (Geci & Naumova, 2021, 1 ♀, 1 sa ♀, 27.08.2021), 53 (Geci & Naumova, 2021)		+
*	*Neoscona subfusca* (C. L. Koch, 1837)	38 (2 ♀, 03-10.07.2018)		+
*	*Nuctenea umbratica* (Clerck, 1757)	38 (1 ♀, 30.07.2018)		+
*	*Singa nitidula* C. L. Koch, 1844	44 (1 ♀, 24.05.2021)		+
*	*Zilla diodia* (Walckenaer, 1802)	2 (1 ♂, 01-04.05.2018), 3 (1 ♀, 24.06.2021), 38 (1 ♀, 25.04-05.05.2019, 2 ♂, 23.08.2019)	+	+
	Atypidae			
*	*Atypus muralis* Bertkau, 1890	43a (1 ♂, 23.06.2021)		+
	Cheiracanthiidae			
*	*Cheiracanthium elegans* Thorell, 1875	33 (2 ♂, 18.07.2021)		+
*	*Cheiracanthium erraticum* (Walckenaer, 1802)	19 (1 ♀, 26.05.2011), 44 (1 ♂, 09.05.2019)	+	
?	*Cheiracanthium margaritae* Sterghiu, 1985	29b (Dimitrov, 1993)	+	
*	*Cheiracanthium mildei* L. Koch, 1864	6 (2 sa ♂, 5 j, 18.02.2022), 29a (1 j, 03.10.1927), 38 (30.05.2018)	+	+
*	*Cheiracanthium pennyi* O. Pickard-Cambridge, 1873	13 (1 ♀, 25.08.1928)	+	
*	*Cheiracanthium punctorium* (Villers, 1789)	38 (1 ♂, 25.07.2020), 44 (2 ♂, 1 ♀, 10-12.07.2018)		+
	Clubionidae			
*	*Clubiona frutetorum* L. Koch, 1867	24 (1 ♀, 30.06-14.07.2020), 33 (1 ♀, 25.07.2021)	+	+
*	*Clubiona lutescens* Westring, 1851	23 (1 ♀, 01-30.09.2020), 24 (2 ♂, 1 ♀, 20.05-29.06.2020, 1 ♀, 30.06-14.07.2020)	+	

	Dictynidae			
	Brigittea civica (Lucas, 1850)	3 (1 ♂, 22.05.2021), 6 (1 ♂, 18.02.2022), 11 (1 ♀, 17.06.2021), 13 (2 ♀, 25.08.1928), 29a (Drensky, 1936 sub *Dictyna c.*), 38 (1 ♂, 18.06.2020), 50 (2 ♂, 26.05.2019)	+	+
*	*Brigittea vicina* (Simon, 1873)	38 (3 ♀, 20.06.2020)		+
*	*Dictyna arundinacea* (Linnaeus, 1758)	22 (4 sa ♀, 20.03.2018), 33 (1 ♂, 2 ♀, 04.07.2019), 38 (2 ♂, 18-26.06.2019)	+	+
*	*Dictyna major* Menge, 1869	44 (2 ♀, 10-12.07.2018)		+
*	*Dictyna uncinata* Thorell, 1856	5 (1 ♂, 26.06.2021), 27 (5 ♀, 27.10.1988), 40 (1 ♂, 10-11.05.2021)	+	+
***	*Lathys spasskyi* Andreeva & Tystshenko, 1969	26c (1 ♀, 27.04.2018)	+	
*	*Lathys stigmatisata* (Menge, 1869)	35 (1 ♀, 04.1988)		+
*	*Nigma walckenaeri* (Roewer, 1951)	38 (1 ♂, 14.10.2019)		+
	Dysderidae			
*	*Dysdera crocata* C. L. Koch, 1838	2 (1 ♀, 18.09.2017)	+	
	Dysdera sp. *erythrina* complex	29a (Drensky, 1913 sub *D. cambridgei*, Drensky, 1936, Jurinitch & Drensky, 1917)	+	
*	*Dysdera lata* Reuss, 1834	38 (1 ♂, 3 ♀, 11-15.04.2018, 1 ♂, 28.08.2018, 1 ♀, 16.07.2019, 1 ♂, 1 ♀, 15.05.2021, 1 ♀, 21.05.2021, 1 ♀, 10.11.2021)		+
*	*Dysdera longirostris* Doblika, 1853	23 (2 ♂, 20.05-29.06.2020, 1 ♀, 30.06-14.07.2020, 1 ♀, 1 j, 01-30.09.2020), 33 (1 ♀, 23.04.2022, 1 ♂, 16.06.2022)	+	
***	*Dysdera osellai*	26c (1 ♂, 27.04.2018, 1 ♂, 28.10.2018)	+	
*	*Harpactea babori* (Nosek, 1905)	2 (1 ♀, 19.04.2017, 2 ♀, 3 sa ♂, 18.09.2017, 3 ♂, 3 ♀, 01-04.05.2018), 9 (1 ♀, 19.09.2017), 23 (1 ♂, 30.06-14.07.2020)	+	
	Harpactea lepida (C. L. Koch, 1838)	29a (Drensky, 1913 (sub *Harpactes seidelii* [sic]); Drensky, 1936)	+	
*	*Harpactea rubicunda* (C. L. Koch, 1838)	23 (1 ♂, 20.05-29.06.2020, 1 ♂, 1 ♀, 30.06-14.07.2020)	+	
	Eresidae			
*	*Eresus kollari* Rossi, 1846	30 (1 ♂, 10.10.2018)	+	
	Eresus moravicus Rezac, 2008	10 (1 ♀, 15.07.2021), 11 (Naumova & Deltshev, 2021), 18 (Naumova & Deltshev, 2021), 26c (Naumova & Deltshev, 2021), 37 (1 ♂, 12.09.2013), 38 (1 ♂, 27-29.05.2018), 43b (Naumova & Deltshev, 2021), 50 (1 ♂, 26.05.2019, Naumova & Deltshev, 2021),	+	+
	Filiistatidae			
	Pritha parva Legittimo, Simeon, Di Pompeo & Kulczycki, 2017	3 (1 ♂, 1 sa ♀, 22.05.2021, 1 ♂, 15.06.2021), 38 (Naumova & Deltshev, 2021, 1 j, 01.07.2020)	+	+
*	*Filistata insidiatrix* (Forsskål, 1775)	38 (1 sa ♀, 28.06.2022)		
	Gnaphosidae			
*	*Aphantaulax trifasciata* (O. Pickard-Cambridge, 1872)	33 (1 ♀, 18.07.2021), 38 (1 ♂, 19.06.2021)		+
*	*Civizelotes gracilis* (Canestrini, 1868)	9 (1 ♀, 17.06.2021), 38 (1 ♂, 16.06.2021, 1 ♂, 19.06.2021)	+	+
*	*Drassodes cupreus* (Blackwall, 1834)	22 (2 sa ♂, 20.03.2018)	+	
*	*Drassodes lapidosus* (Walckenaer, 1802)	11 (1 ♀, 09.07.2021), 25 (1 ♂, 20.05-29.06.2020), 38 (1 ♂, 01.05.2021, 1 ♀, 25.05.2021)	+	+
*	*Drassodes lutescens* (C. L. Koch, 1839)	38 (1 ♀, 11-15.04.2018)		+
*	*Drassodes pubescens* (Thorell, 1856)	25 (1 ♂, 20.05-29.06.2020)	+	

*	*Drassyllus praeficus* (L. Koch, 1866)	2 (1 ♂, 01-04.05.2018), 9 (1 ♀, 17.06.2021), 23 (5 ♂, 2 ♀, 20.05-29.06.2020, 1 ♀, 30.06-14.07.2020, 1 sa ♀, 01-30.09.2020), 24 (1 ♂, 20.05-29.06.2020), 25 (1 ♂, 20.05-29.06.2020), 38 (1 ♂, 14-20.05.2020, 1 ♂, 28.05.2021), 44 (1 ♀, 10-12.07.2018)	+	+
*	*Gnaphosa lucifuga* (Walckenaer, 1802)	38 (1 ♀, 05.07.2021), 43a (1 ♂, 1 ♀, 27.06.2021, 1 ♂, 29.06.2021, 1 sa ♀, 24.09.2021)		+
*	*Gnaphosa rufula* (L. Koch, 1866)	34 (3 ♂, 1 ♀, 14.05-02.06.2017)		+
*	*Haplodrassus bohemicus* Miller & Buchar, 1977	24 (1 ♂♀, 20.05-29.06.2020)	+	
*	*Haplodrassus signifer* (C. L. Koch, 1839)	25 (2 ♂, 20.05-29.06.2020), 34 (1 ♀, 14.05-02.06.2017), 38 (2 ♂, 11-15.04.2018, 2 ♂, 08-21.04.2019, 1 ♀, 23.08.2019)	+	+
*	*Marinarozelotes malkini* (Platnick & Murphy, 1984)	23 (1 ♀, 30.06-14.07.2020), 34 (1 ♂, 14.05-02.06.2017), 38 (1 ♀, 03-10.07.2018, 1 ♀, 07.07.2021)	+	+
*	*Micaria albovittata* (Lucas, 1846)	24 (1 ♂, 30.06-14.07.2020), 25 (1 ♂, 20.05-29.06.2020), 38 (1 ♂, 25-31.07.2020, 1 ♂, 18.05.2021, 1 ♀, 13.06.2020), 47 (1 ♂, 1 ♀, 29.07.2019)	+	+
*	*Micaria coarctata* (Lucas, 1846)	11 (1 ♂, 09.07.2021), 38 (1 ♀, 16.07.2019)	+	+
*	*Micaria dives* (Lucas, 1846)	38 (1 ♂, 05.06.2021)		+
**	*Micaria micans* (Blackwall, 1858)	25 (1 ♂, 1 ♀, 30.06-14.07.2020)	+	
*	*Micaria pulicaria* (Sundevall, 1831)	38 (1 ♂, 23.08.2019)		+
*	*Nomisia exornata* (C. L. Koch, 1839)	26c (1 ♂, 27.04.2018)	+	
*	*Scotophaeus scutulatus* (L. Koch, 1866)	5 (1 ♂, 30.10.2022), 6 (3 ♀, 18.02.2022), 29a (1 ♂, 18.09.1983), 33 (1 ♂, 06.09.2021), 38 (1 ♂, 1 ♀, 29.09.2018, 1 ♀, 11-21.05.2019, 1 ♀, 06.11.2020, 1 ♀, 16.05.2021)	+	+
*	*Trachyzelotes pedestris* (C. L. Koch, 1837)	3 (1 sa ♀, 26.02.2021), 11 (1 ♂, 09.07.2021), 25 (3 ♂, 20.05-29.06.2020), 50 (1 ♂, 26.05.2019)	+	+
**	*Turkozelotes mccowani* (Chatzaki & Russell-Smith, 2017)	34 (4 ♂, 1 ♀, 14.05-02.06.2017)		+
*	*Urozelotes rusticus* (L. Koch, 1872)	7 (1 ♂, 02-03.2018), 38 (2 ♂, 14-15.06.2020)	+	+
*	*Zelotes apricorum* (L. Koch, 1876)	23 (1 ♂, 1 ♀, 30.06-14.07.2020, 1 ♂, 01-30.09.2020)	+	
*	*Zelotes electus* (C. L. Koch, 1839)	5 (1 ♂, 26.03.2021), 38 (1 ♂, 19.03.2021)	+	+
*	*Zelotes erebeus* (Thorell, 1871)	47 (1 ♂, 17.09.2021)		+
**	*Zelotes eugenei* Kovblyuk, 2009	24 (2 ♂, 1 ♀, 30.06-14.07.2020, 1 ♂, 2 ♀, 01-30.09.2020), 25 (1 ♀, 20.05-29.06.2020, 1 ♂, 30.06-14.07.2020), 38 (1 ♂, 1 ♀, 11-15.04.2018, 1 ♀, 18.04.2019, 1 ♀, 20.06.2020, 1 ♀, 25.07.2020), 50 (1 ♂, 17.08.2019)	+	+
**	*Zelotes harmeron* Levy, 2009	43c (1 ♀, 15.07.2021)		+
*	*Zelotes hermani* (Chyzer, 1897)	9 (1 ♂, 19.09.2017), 22 (1 ♀, 20.03.2018), 23 (4 ♂, 1 ♀, 01-30.09.2020), 24 (1 ♂, 30.06-14.07.2020), 25 (5 ♂, 01-30.09.2020), 38 (1 ♂, 28.08.2018, 1 ♂, 20.10.2021), 39 (1 ♂, 19.09.2021), 43a (1 ♂, 15.06.2020)	+	+
*	*Zelotes longipes* (L. Koch, 1866)	33 (1 ♂, 21.08.2021), 38 (1 ♂, 29.09.2018, 2 ♀, 1 sa ♀, 25.04-05.05.2019, 1 ♀, 23.08.2019)		+
*	*Zelotes tenuis* (L. Koch, 1866)	11 (1 ♀, 09.07.2021), 38 (1 ♂, 1 ♀, 27-29.05.2018, 3 ♂, 28.05-08.06.2019, 1 ♀, 18-26.06.2019, 1 ♀, 16.07.2019, 1 ♂, 14-20.05.2020, 2 ♀, 17.07.2020, 1 ♂, 31.05.2021, 1 ♂, 1 ♀, 19.06.2021)	+	+
	Hahniidae			
*	*Hahnia nava* (Blackwall, 1841)	38 (1 ♀, 25.05.2021)		+
	Linyphiidae			

*	*Abacoproeces saltuum* (L. Koch, 1872)	23 (1 ♂, 20.05-29.06.2020)	+	
*	*Acartauchenius scurrilis* (O. Pickard-Cambridge, 1873)	2 (1 ♀, 18.09.2017), 8 (1 ♂, 17.09.2017), 35 (1 ♀, 04.1988), 38 (1 ♂, 26-30.04.2018)	+	+
**	*Agyneta punctata* Wunderlich, 1995	34 (1 ♂, 14.05-02.06.2017)		+
*	*Agyneta rurestris* (C. L. Koch, 1836)	8 (1 ♀, 13.02.1988), 12 (1 ♀, 11.11.2016), 31 (1 ♀, 22.02.1988), 35 (1 ♀, 04.1988), 38 (1 ♂, 1 ♀, 23.08.2019, 1 ♂, 10.02.2022), 40 (1 ♂, 1 ♀, 04.06.2021)	+	+
*	*Canariphantes nanus* (Kulczyński, 1898)	9 (1 ♀, 17.06.2021)	+	
*	*Centromerus sylvaticus* (Blackwall, 1841)	19 (1 ♀, 01-31.05.2021)	+	
*	*Ceratinella brevipes* (Westring, 1851)	24 (1 ♀, 30.06-14.07.2020)	+	
*	*Cresmatoneta mutinensis* (Canestrini, 1868)	25 (1 ♀, 01-30.09.2020), 38 (1 sa ♂, 21-26.10.2018, 1 ♂, 08-21.04.2019)	+	+
*	*Dicymbium nigrum* (Blackwall, 1834)	38 (1 ♂, 13.06.2020)		+
*	*Diplostyla concolor* (Wider, 1834)	19 (1 ♀, 01-31.05.2021), 20 (1 ♂, 18.04.2017), 22 (1 ♂, 20.03.2018), 23 (2 ♀, 01-30.09.2020), 24 (2 ♂, 1 ♀, 30.06-14.07.2020, 1 ♀, 01-30.09.2020), 25 (6 ♂, 9 ♀, 30.06-14.07.2020), 38 (1 ♂, 04-14.07.2019)	+	+
*	*Erigone dentipalpis* (Wider, 1834)	38 (1 ♂, 25.04-05.05.2019)		+
***	*Erigone dentosa* O. Pickard-Cambridge, 1894	33 (1 ♂, 18.07.2021)		+
*	*Frontinellina frutetorum* (C. L. Koch, 1835)	2 (1 ♂, 3 ♀, 01-04.05.2018), 38 (2 ♀, 11-18.05.2018, 1 ♀, 15.08.2018, 1 ♀, 05.06.2021)	+	+
*	*Gnathonarium dentatum* (Wider, 1834)	33 (1 ♀, 16.07.2022)		
*	*Gongylidium rufipes* (Linnaeus, 1758)	24 (2 ♀, 30.06-14.07.2020, 2 ♀, 01-30.09.2020)	+	
*	*Improphantes decolor* (Westring, 1861)	11 (1 ♀, 19.04.2017)	+	
*	*Ipa terrenus* (L. Koch, 1879)	38 (1 ♀, 16-30.03.2018, 1 ♂, 22.04.2019)		+
*	*Linyphia triangularis* (Clerck, 1757)	38 (1 ♀, 09.11.2018), 44 (1 ♀, 20.10.2020)		+
*	*Microctenonyx subitaneus* (O. Pickard-Cambridge, 1875)	38 (2 ♀, 11-15.04.2018, 1 ♀, 03.07.2018)		+
	Microlinyphia impigra (O. Pickard-Cambridge, 1871)	38 (Naumova et al., 2021)		+
*	*Microlinyphia pusilla* (Sundevall, 1830	38 (1 ♀, 03-10.07.2018, 1 ♂, 08-21.04.2019, 1 ♂, 11-21.05.2019, 1 ♂, 18-26.06.2019, 1 ♂, 04-14.07.2019, 1 ♀, 1 sa ♀, 10-11.08.2020)		+
*	*Neriene clathrata* (Sundevall, 1830)	5 (1 ♂, 21.04.2021), 23 (1 ♀, 30.06-14.07.2020), 24 (1 ♀, 30.06-14.07.2020), 25 (1 ♀, 30.06-14.07.2020) 38 (1 ♀, 16-30.03.2018, 2 ♀, 10-11.08.2020)	+	+
*	*Neriene furtiva* (O. Pickard-Cambridge, 1871)	38 (1 ♀, 25.05.2020, 1 ♀, 25-31.07.2020)		+
*	*Oedothorax apicatus* (Blackwall, 1850)	33 (1 ♀, 16.06.2019)		+
*	*Ostearius melanopygius* (O. P.-Cambridge, 1879)	38 (1 ♀, 1 j, 16-30.03.2018, 1 ♂, 03-10.07.2018)		+
*	*Pelecopsis elongata* (Wider, 1834)	2 (1 ♂, 18.09.2017), 15 (1 ♀, 11.11.2016)	+	
*	*Prinerigone vagans* (Audouin, 1826)	31 (1 ♂, 1 ♀, 22.02.1988), 33 (1 ♂, 12.09.2021), 38 (1 ♂, 13.06.2020), 40 (1 ♀, 10-11.05.2021, 2 ♀, 27.05.2021)	+	+
*	*Sintula retroversus* (O. P.-Cambridge, 1875)	2 (4 ♀, 2 sa ♂, 18.09.2017), 38 (1 ♂, 3 ♀, 21-26.10.2018)	+	+
*	*Stemonyphantes lineatus* (Linnaeus, 1758)	47 (1 ♂, 07.10.2022)		
*	*Syedra gracilis* (Menge, 1869)	19 (1 ♂, 1 sa ♀, 01-31.05.2021)	+	
*	*Tenuiphantes tenebricola* (Wider, 1834)	2 (2 ♂, 09.06.2021)	+	
*	*Tenuiphantes tenuis* (Blackwall, 1852	9 (1 ♂, 19.09.2017, 1 ♂, 4 ♀, 1sa ♀, 17.06.2021), 23 (2 ♀, 30.06-14.07.2020), 33 (1 ♀, 04.07.2019), 38 (1 ♀, 11-15.04.2018, 2 ♀, 25.04-05.05.2019, 2 ♂, 11-21.05.2019, 3 ♀, 1 sa ♂, 1sa ♀, 23.08.2019, 1 ♂, 15.05.2021)	+	+
*	*Trichoncoides piscator* (Simon, 1884)	11 (1 ♀, 17.06.2021), 31 (1 ♀, 22.02.1988), 34 (1 ♂, 14.05-02.06.2017), 35 (1 ♀, 14.11.2021), 38 (1 ♂, 21-26.10.2018, 1 ♀, 26.07.2021), 46c (1 ♂, 25.05.2018)	+	+

*	*Trichoncus affinis* Kulczynski, 1894	37 (1 ♂, 12.09.2013)		+
*	*Trichoncus hackmani* Millidge, 1955	11 (1 ♂, 09.07.2021), 38 (1 ♂, 01.07.2021)	+	+
*	*Trichoncus saxicola* (O. Pickard-Cambridge, 1861)	38 (1 ♀, 15.05.2021)		
	Walckenaeria capito (Westring, 1861)	29a (Drensky, 1913 sub *Walckenaëria* [sic] *c*., Drensky, 1936)	+	
	Liocranidae			
*	*Agroeca cuprea* Menge, 1873	8 (1 ♂, 17.09.2017, 1 ♀, 20.03.2018), 25 (2 ♀, 20.05-29.06.2020, 2 ♂, 3 ♀, 01-30.09.2020), 38 (1 ♀, 11-15.04.2018, 1 ♀, 09.04.2019, 2 ♀, 22.04.2019, 1 ♀, 15.05.2021, 1 ♀, 08.06.2021)	+	+
***	*Liocranoeca spasskyi* Ponomarev, 2007	34 (36 ♂, 4 ♀, 14.05-02.06.2017)		+
	Mesiotelus tenuissimus (L. Koch, 1866)	29a (Drensky, 1913, 1936), 38 (1 ♀, 16-30.03.2018, 1 ♀, 11-15.04.2018, 1 ♀, 26-30.04.2018, 1 ♀, 23.08.2019, 1 ♀, 27.02.2021, 1 ♂, 04.08.2021), 44 (1 ♀, 23.08.2019)	+	+
	Lycosidae			
*	*Alopecosa albofasciata* (Brullé, 1832)	2 (1 ♀, 25.05.2018), 33 (1 ♀, 27.05.2021), 38 (1 , 28.05.2019)	+	+
*	*Alopecosa cuneata* (Clerck, 1757)	38 (1 ♂, 15.12.2018)		+
*	*Alopecosa farinosa* (Herman, 1879)	29a (1 ♂, 14.03.2021), 38 (1 ♀, 28.04.2019), 51 (2 ♂, 30.03.2021)	+	+
*	*Alopecosa pulverulenta* (Clerck, 1757)	25 (18 ♂, 1 ♀, 20.05-29.06.2020)	+	
*	*Alopecosa taeniopus* (Kulczynski, 1895)	25 (1 ♂, 2 ♀, 01-30.09.2020), 38 (1 ♀, 18.03.2019)	+	+
*	*Arctosa cinerea* (Fabricius, 1777)	24 (1 ♂, 20.05-29.06.2020), 33 (1 ♂, 09.04.2022, 1 ♂, 23.04.2022)	+	
*	*Arctosa leopardus* (Sundevall, 1833)	5 (1 ♂, 11.05.2021), 40 (1 ♀, 1 sa ♂, 10-11.05.2021, 2 ♂, 27.05.2021)	+	+
*	*Arctosa variana* C. L. Koch, 1847	38 (1 ♀, 13.06.2021)		+
*	*Aulonia albimana* (Walckenaer, 1805)	4 (1 sa ♂, 05.03.2021), 19 (2 ♂, 1 sa ♀, 01-31.05.2021), 22 (1 j, 20.03.2018), 23 (2 ♂, 20.05-29.06.2020), 24 (6 ♂, 20.05-29.06.2020), 25 (33 ♂, 2 ♀, 20.05-29.06.2020), 38 (2 ♀, 11.05-21.05.2019, 1 ♂, 28.05-08.06.2019, 1 ♂, 14-20.05.2020)	+	+
	Geolycosa vultuosa (C. L. Koch, 1838)	2 (1 ♀, 14.05.2021), 29a (1 ♂, 1 sa ♀, 03.10.1927, 1 ♂, 1 sa ♀, 04.10.1927), 32 (Jurinich & Drensky, 1917 sub *Trochosa infernalis*), 38 (1 ♀, 16-30.03.2018, 1 ♀, 11-18.05.2018), 39 (1 ♀, 03.10.2018), 47 (1 ♂, 23.10.2020)	+	+
*	*Hogna radiata* (Latreille, 1817)	1 (1 sa ♀, 03-04.06.2017), 29a (1 ♀, 20.08.2019), 43a (1 ♀, 05.07.2021), 44 (1 ♀, 10-12.07.2018)	+	+
	Lycosa praegrandis C. L. Koch, 1836	32 (Drensky, 1915 sub *Tarentula p*.)		+
*	*Pardosa agrestis* (Westring, 1861)	24 (9 ♂, 5 ♀, 30.06-14.07.2020), 31 (1 ♂, 22.02.1988), 33 (2 ♂, 16.06.2019, 2 ♂, 18.07.2021), 34 (1 ♂, 1 ♀, 14.05-02.06.2017), 38 (1 ♀, 18-26.06.2019), 43a (1 ♂, 29.06.2021), 45b (3 ♂, 09.05.2019), 51 (2 ♂, 30.03.2021)	+	+
*	*Pardosa agricola* (Thorell, 1856)	24 (1 ♀, 20.05-29.06.2020, 7 ♀, 2 sa ♂, 01-30.09.2020), 29a (2 ♂, 5 ♀, 05.09.1988)	+	
*	*Pardosa alacris* (C. L. Koch, 1833)	23 (1 ♂, 1 ♀, 20.05-29.06.2020)	+	
*	*Pardosa amentata* (Clerck, 1757)	25 (2 ♀, 30.06-14.07.2020), 33 (1 ♀, 18.07.2021), 38 (2 ♂, 3 ♀, 13.06.2020), 40 (2 ♂, 2 ♀, 10-11.05.2021, 1 ♂, 1 ♀, 27.05.2021)	+	+
*	*Pardosa atomaria* (C. L. Koch, 1847)	33 (1 ♀, 18.07.2021, 1 ♀, 12.09.2021)		+

		5 (2 ♂, 21.04.2021), 23 (3 ♂, 8 ♀, 20.05-29.06.2020, 1 ♀, 30.06-14.07.2020), 24 (2 ♀, 20.05-29.06.2020, 5 ♀, 30.06-14.07.2020), 33 (2 ♀, 04.07.2019, 3 ♂, 18.07.2021), 34 (2 ♂, 14.05-02.06.2017), 38 (1 ♂, 2 sa ♂, 5 sa ♀, 16-30.03.2018, 1 ♀, 03.04.2018, 1 ♂, 1 ♀, 11-15.04.2018, 1 ♀, 11-18.05.2018, 1 ♀, 23.08.2019, 1 sa ♂, 1 sa ♀, 08.11.2020, 1 ♂, 1 ♀, 12-13.04.2021, 1 ♂, 19.06.2021), 40 (2 ♀, 04.06.2021), 44 (1 ♀, 30.05.2021), 51 (2 ♂, 30.03.2021)		
*	*Pardosa hortensis* (Thorell, 1872)		+	+
*	*Pardosa lugubris* (Walckenaer, 1802)	19 (36 ♂, 6 ♀, 1 sa ♀, 01-31.05.2021), 25 (1 ♂, 20.05-29.06.2020), 33 (2 ♀, 16.06.2019), 38 (1 ♂, 1 ♀, 11-15.04.2018), 40 (1 ♂, 10-11.05.2021)	+	+
*	*Pardosa monticola* (Clerck, 1757)	45b (2 ♀, 2 sa ♂, 09.05.2019)		+
*	*Pardosa nebulosa* (Thorell, 1872)	11 (1 ♀, 09.07.2021), 33 (1 ♀, 16.06.2019, 1 ♂, 04.07.2019, 1 ♀, 14.06.2021)	+	+
*	*Pardosa paludicola* (Clerck, 1757)	22 (2 ♂, 2 ♀, 1 sa ♀, 20.03.2018), 51 (1 ♀, 30.03.2021)	+	+
*	*Pardosa proxima* (C. L. Koch, 1847)	1 (3 ♀, 03-04.06.2017), 22 (1 ♀, 20.03.2018), 24 (8 ♂, 9 ♀, 30.06-14.07.2020), 25 (4 ♂, 5 ♀, 30.06-14.07.2020), 38 (1 ♀, 18-26.06.2019, 1 ♀, 01.07.2020), 50 (1 ♀, 27.05.2019)	+	+
*	*Pardosa pullata* (Clerck, 1757)	40 (1 ♀, 27.05.2021)		+
*	*Pirata piraticus* (Clerck, 1757)	40 (2 ♂, 1 ♀, 10-11.05.2021, 2 ♀, 27.05.2021)		+
*	*Pirata tenuitarsis* Simon, 1876	40 (1 ♀, 27.05.2021)		+
*	*Piratula hygrophila* (Thorell, 1872)	23 (16 ♂, 20.05-29.06.2020), 40 (,3 ♂, 2 ♀, 10-11.05.2021, 1 ♂, 2 ♀, 27.05.2021)	+	+
*	*Piratula latitans* (Blackwall, 1841)	23 (9 ♂, 20.05-29.06.2020), 40 (2 ♂, 3 ♀, 10-11.05.2021, 2 ♂, 1 ♀, 27.05.2021)	+	+
*	*Trochosa hispanica* Simon, 1870	23 (32 ♂, 1 sa ♀, 20.05-29.06.2020, 2 ♀, 01-30.09.2020), 24 (1 ♂, 20.05-29.06.2020, 3 ♂, 1 ♀, 01-30.09.2020), 25 (26 ♂, 4 ♀, 20.05-29.06.2020), 38 (1 ♀, 11-15.04.2018, 1 ♂, 11-18.05.2018, 1 ♂, 14.04.2021)	+	+
*	*Trochosa robusta* (Simon, 1876)	34 (1 ♂, 3 ♀, 14.05-02.06.2017)		+
	Trochosa ruricola (De Geer, 1778)	9 (1 ♂, 19.09.2017), 23 (2 ♂, 1 ♀, 20.05-29.06.2020, 2 ♀, 30.06-14.07.2020), 24 (2 ♀, 30.06-14.07.2020, 1 ♂, 01-30.09.2020), 25 (1 ♂, 3 ♀, 20.05-29.06.2020, 1 ♂, 9 ♀, 30.06-14.07.2020, 5 ♂, 2 ♀, 01-30.09.2020), 32 (Jurinich & Drensky, 1917, Drensky, 1936), 38 (2 ♂, 1 ♀, 16-30.03.2018)	+	+
	Trochosa terricola Thorell, 1856	11 (1 ♂, 19.04.2017), 32 (Jurinich & Drensky, 1917, Drensky, 1936), 40 (1 ♀, 10-11.05.2021)	+	+
*	*Xerolycosa miniata* (C. L. Koch, 1834)	24 (1 ♂, 1 ♀, 30.06-14.07.2020), 29a (1 ♂, 1 ♀,), 38 (1 ♂, 25.04-05.05.2019, 2 ♂, 11-21.05.2019, 1 ♀, 14-20.05.2020, 1 ♀, 25-31.07.2020), 44 (1 ♀, 30.05.2021), 45b (3 ♂, 09.05.2019)	+	+
	Xerolycosa nemoralis (Westring, 1861)	29a (Drensky, 1936), 32 (Drensky, 1936). 38 (1 ♂, 25.05.2021)	+	+
	Mimetidae			
*	*Ero aphana* (Walckenaer, 1802)	38 (1 ♀, 01.06.2019, 1 ♂, 28.05-08.06.2019)		+
***	*Ero koreana* Paik, 1967	33 , (2 ♀, 16.07.2022)		
*	*Ero tuberculata* (De Geer, 1778)	8 (1 ♀, 17.09.2017)	+	
	Miturgidae			

*	*Zora armillata* Simon, 1878	38 (1 ♂, 23.08.2019), 51 (1 ♀, 23.05.2021)		+
*	*Zora manicata* Simon, 1878	23 (1 ♂, 20.05-29.06.2020), 38 (1 ♂, 21.05.2019, 1 ♀, 30.05.2021)	+	+
*	*Zora nemoralis* (Blackwall, 1861)	25 (1 ♀, 01-30.09.2020)	+	
*	*Zora parallela* Simon, 1878	38 (1 ♀, 13.04.2021)		+
	Oecobiidae			
*	*Oecobius maculatus* Simon, 1870	4 (1 ♂, 30.06.2021), 26b (1 ♂, 05.06.2020), 26c (1 ♀, 19.07.2021), 38 (1 ♀, 11.06.2019, 2 ♂, 18-20.06.2020, 1 ♀, 02.08.2020, 1 ♀, 19.06.2021)	+	
	Oxyopidae			
*	*Oxyopes heterophthalmus* (Latreille, 1804)	19 (1 ♂, 1 sa ♂, 1 sa ♀, 26.05.2011), 33 (1 ♀, 16.06.2019), 38 (1 ♂, 14-20.05.2020), 44 (1 ♀, 11.07.2020), 52 (1 ♂, 29.05.2019)	+	+
*	*Oxyopes lineatus* Latreille, 1806	1 (1 ♂, 4 sa ♂, 3 sa ♀, 03-04.06.2017), 19 (13 j, 26.05.2011), 33 (1 ♀, 16.06.2019, 1 ♂, 1 ♀, 18.07.2021), 38 (2 j, 16-30.03.2018, 2 j, 11-15.04.2018, 1 ♂, 1 sa ♀, 27-29.05.2018, 1 ♀, 03-10.07.2018, 1 ♀, 17.06.2020)	+	+
	Philodromidae			
*	*Philodromus albidus* Kulczyński, 1911	9 (1 ♀, 17.06.2021)	+	
*	*Philodromus aureolus* (Clerck, 1757)	38 (1 ♀, 24.03, 30.05.2019)		+
*	*Philodromus collinus* C. L. Koch, 1835	42 (1 ♀, 13.06.2019)		+
*	*Philodromus longipalpis* Simon, 1870	2 (1 ♂, 20.06.2021), 11 (1 ♀, 09.07.2021), 23 (1 ♀, 30.06-14.07.2020), 33 (3 ♂, 16.06.2019, 1 ♀, 04.07.2019, 2 ♂, 2 ♀, 18.07.2021, 2 ♀, 25.07.2021, 1 ♀, 21.08.2021), 38 (1 ♀, 03-10.07.2018, 1 ♂, 1 ♀, 13-14.06.2019, 1 ♀, 18.06.2019, 1 ♀, 25.06.2019, 2 ♂, 18-26.06.2019, 1 ♂, 13.06.2020, 1 ♂, 20.06.2020), 48 (1 ♂, 21.06.2019)	+	+
*	*Philodromus marmoratus* Kulczyński, 1891	40 (1 ♂, 04.06.2021), 44 (1 ♂, 30.05.2021)		+
*	*Philodromus poecilus* (Thorell, 1872)	6 (1 j, 18.02.2022), 20 (1 ♀, 18.04.2017), 38 (1 ♂, 24.03.2019, 1 ♂, 20.04.2018, 1 ♀, 22.06.2020), 40 (1 ♂, 17.06.2020)	+	+
*	*Philodromus rufus* Walckenaer, 1826	38 (2 ♀, 14-20.05.2020)		+
*	*Thanatus arenarius* L. Koch, 1872	25 (1 ♂, 20.05-29.06.2020), 40 (1 ♂, 27.05.2021),	+	+
*	*Thanatus atratus* Simon, 1875	25 (1 ♀, 30.06-14.07.2020), 33 (1 ♀, 21.08.2021), 38 (1 ♂, 1 ♀, 13-15.06.2019), 39 (1 ♀, 17.07.2021), 43a (1 ♂, 27.06.2021), 45b (1 ♂, 13.06.2019)	+	+
*	*Thanatus formicinus* (Clerck, 1757)	38 (1 ♀, 23.06.2018)		+
*	*Thanatus vulgaris* Simon, 1870	1 (1 ♀, 1 sa ♀, 03-04.06.2017), 11 (1 ♂, 1 ♀, 09.07.2021)	+	
*	*Tibellus macellus* Simon, 1875	1 (1 ♀, 03-04.06.2017)	+	
*	*Tibellus oblongus* (Walckenaer, 1802)	6 (1 sa ♀, 14.05.2021), 19 (7 ♂, 8 ♀, 10 j, 26.05.2011), 38 (1 ♀, 11.11.2018, 1 ♂, 13.06.2020, 1 ♂, , 09.05.20211 ♂, 06.06.2021)	+	+
	Pholcidae			
	Holocnemus pluchei (Scopoli, 1763)	7 (1 ♀, 1 j, 02-03.2018), 11 (1 ♀, 2 j, 17.06.2021), 13 (1 ♀, 25.08.1928), 26c (1 ♀, 27.04.2018), 29a (Drensky, 1913 sub *H. rivulatus*, Drensky, 1936)	+	
*	*Pholcus opilionides* (Schrank, 1781)	38 (1 ♀, 2 j, 16-30.03.2018, 1 ♀, 21-26.10.2018)		+
*	*Pholcus phalangioides* (Fuesslin, 1775)	7 (1 ♀, 02-03.2018), 38 (1 ♂, 16-30.03.2018, 1 ♀, 11-15.04.2018)	+	+

*	*Spermophora senoculata* (Dugès, 1836)	26c (19.07.2021, 1 ♀), 38 (3 j, 16.03.-30.04.2018, 1 ♂, 25.04-05.05.2019, 1 j, 11-21.05.2019), 50 (1 ♀, 26.05.2019)	+	+
	Phrurolithidae			
*	*Phrurolithus festivus* (C. L. Koch, 1835)	25 (1 ♀, 30.06-14.07.2020), 34 (2 ♂, 14.05-02.06.2017), 38 (1 ♂, 8 sa ♀, 11-15.04.2018, 1 ♀, 27-29.05.2018, 1 ♂, 1 ♀, 03-10.07.2018, 1 ♂, 08-21.04.2019)	+	+
*	*Phrurolithus pullatus* Kulczyński, 1897	38 (1 sa ♂, 1 sa ♀, 16-30.03.2018, 1 ♂, 1 ♀, 26-30.04.2018, 1 ♂, 21-26.10.2018, 1 ♂, 1 sa ♀, 11-18.05.2018, 1 ♀, 28.05-08.06.2019, 2 ♂, 2 ♀, 23.08.2019)		+
*	*Phrurolithus szilyi* Herman, 1879	5 (1 ♂, 21.04.2022), 38 (1 ♂, 1 sa ♀, 11-18.05.2018)	+	+
	Pisauridae			
*	*Pisaura mirabilis* (Clerck, 1757)	23 (1 ♀, 20.05-29.06.2020, 1 j, 01-30.09.2020), 24 (1 ♂, 1 j, 20.05-29.06.2020), 25 (1 ♂, 1 ♀, 20.05-29.06.2020), 33 (22 ♀, 16.06.2019), 38 (1 ♂, 1 sa ♂, 26-30.04.2018, 1 ♂, 11-18.05.2018)	+	+
	Salticidae			
*	*Aelurillus v-insignitus* (Clerck, 1757)	40 (1 ♀, 29.04.2019)		+
	Afraflacilla epiblemoides (Chyzer, 1891)	38 (1 ♂, 03.10.2018, 1 ♂, 1 ♀, 25.03.2020, 1 ♂, 05.08.2020, 1 ♂, 14.08.2020, 1 j, 25.09.2020), 47 (NAUMOVA *et al.* 2021, 1 ♂, 08.07.2019, 1 ♂, 1 ♀, 25.03.2020, 1 ♂, 1 ♀, 05.08.2020, 1 j, 25.09.2020)		+
*	*Attulus distinguendus* (Simon, 1868)	38 (1 ♂, 11-18.05.2018)		+
	Attulus saltator (O. Pickard-Cambridge, 1868)	29a (Drensky, 1913 sub *Attus s.*, Drensky, 1936 sub *Sitticus s.*)	+	
*	*Ballus chalybeius* (Walckenaer, 1802)	38 (1 ♀, 08-21.04.2019, 1 ♂, 25.04-05.05.2019, 1 ♀, 28.05-08.06.2019, 1 ♀, 23.06.2021), 40 (1 ♂, 27.05.2021)		+
	Carrhotus xanthogramma (Latreille, 1819)	29a (Drensky, 1913 sub *P. bicolor*, Drensky, 1936), 38 (1 ♂, 21.03.2019)	+	+
	Chalcoscirtus infimus (Simon, 1868)	29a (Jurinitch & Drensky, 1917 sub *Chalcoscoitus* [sic] (*Calliethera* [sic]) *i.*)	+	
*	*Euophrys frontalis* (Walckenaer, 1802)	9 (1 ♀, 19.09.2017), 38 (1 ♂, 14-20.05.2020)	+	+
*	*Euophrys herbigrada* (Simon, 1871)	23 (1 ♀, 30.06-14.07.2020)	+	
*	*Evarcha arcuata* (Clerck, 1757)	1 (1 ♂, 03-04.06.2017), 33 (1 ♀, 25.07.2021), 38 (3 ♂, 11-15.04.2018, 1 ♀, 25.04-05.05.2019, 1 ♂, 13.06.2020), 40 (1 ♂, 04.06.2021)	+	+
*	*Heliophanus auratus* C. L. Koch, 1835	33 (2 ♀, 18.07.2021, 4 ♀, 25.07.2021, 1 ♀, 12.09.2021), 38 (1 ♂, 11-15.04.2018, 1 ♀, 25.04-05.05.2019, 1 ♀, 15.09.2019, 1 ♀, 07.08.2021), 45b (1 ♀, 09.05.2019)		+
*	*Heliophanus cupreus* (Walckenaer, 1802)	5 (2 ♂, 21.04.2021), 38 (2 ♂, 11-15.04.2018, 1 ♀, 25.04-05.05.2019)	+	+
*	*Heliophanus flavipes* (Hahn, 1832)	1 (1 ♂, 03-04.06.2017), 19 (2 ♂, 1 ♀, 2 sa ♀, 26.05.2011)	+	
*	*Heliophanus kochii* Simon, 1868	2 (1 ♂, 01-04.05.2018, 1 ♀, 14.05.2021), 8 (1 ♂, 3 sa ♀, 20.03.2018), 26c (1 ♂, 19.07.2021), 38 (1 ♀, 27-29.05.2018, 1 ♀, 03-10.07.2018, 1 ♀, 15.08.2018, 1 ♀, 11-21.05.2019, 1 ♂, 20.05.2021)	+	+
*	*Heliophanus lineiventris* Simon, 1868	38 (1 ♀, 23.06.2018)		+
*	*Heliophanus melinus* L. Koch, 1867	2 (1 ♂, 30.05.2018), 38 (1 ♂, 1 ♀, 04.06.2020), 49 (2 ♂, 2 ♀, 02.06.2020)	+	+

*	*Heliophanus patagiatus* Thorell, 1875	33 (1 ♂, 1 sa ♀, 18.07.2021, 1 ♂, 3 ♀, 25.07.2021, 1 ♂, 17.08.2021)		+
	Icius hamatus (C. L. Koch, 1846)	4 (1 ♂, 05.03.2021, 1 ♀, 21.04.2021), 16 (Naumova et al., 2021)	+	
	Leptorchestes sikorskii Prószyński, 2000	39 (Naumova et al. 2021, 1 sa ♂, 12.04.2020, 1 ♂, 11.07.2020, 1 ♂, 19.06.2021, 1 ♂, 21.06.2020, 1 ♂, 01.08.2020, 1 ♂, 10.07.2021), 52 (Naumova et al., 2021)		+
*	*Macaroeris flavicomis* (Simon, 1884)	38 (1 ♀, 04.07.2019)		+
*	*Macaroeris nidicolens* (Walckenaer, 1802)	38 (1 ♂, 03.04.2019, 1 ♀, 25.04.2019, 1 ♂, 11.05-21.05.2019, 1 ♂, 28.05-08.06.2019)		+
*	*Marpissa muscosa* (Clerck, 1757)	29a (Drensky, 1936)	+	
*	*Marpissa nivoyi* (Lucas, 1846)	38 (1 ♂, 27-29.05.2018, 1 ♂, 14-20.05.2020)		+
	Marpissa radiata (Grube, 1859)	32 (Drensky, 1913 sub *Marptusa r.*)		+
*	*Menemerus semilimbatus* (Hahn, 1829)	2 (1 ♂, 01-04.05.2018), 21 (1 j, 10.10.2021), 26c (1 ♂, 26.06.2016), 29a (1 ♀, 1 j, 25.08.2021), 38 (4 sa ♀, 16-30.03.2018, 1 ♂, 11-15.04.2018)	+	+
*	*Menemerus taeniatus* (L. Koch, 1867)	38 (2 sa ♀, 16-30.03.2018, 2 ♀, 1 sa ♂, 1 ♂, 03-10.07.2018, 1 ♀, 25.04-05.05.2019, 1 ♀, 11.05-21.05.2019), 46a (1 ♀, 28.09.2018), 52 (1 ♂, 29.05.2019)		+
?	*Neon pictus* Kulczyński, 1891	2 (Jurinic & Drensky, 1917), 8 (Jurinic & Drensky, 1917)	+	
	Pellenes allegrii Caporiacco, 1935	38 (Naumova et al., 2021)		+
*	*Pellenes brevis* (Simon, 1868)	38 (1 ♀, 23.06.2018)		+
*	*Pellenes nigrociliatus* (Simon, 1875)	38 (1 ♀, 08-21.04.2019)		+
*	*Pellenes seriatus* (Thorell, 1875)	47 (1 ♂, 1 ♀, 13.5.2022)		
*	*Philaeus chrysops* (Poda, 1761)	49 (1 sa ♂, 1 sa ♀, 29.09.2018)		+
*	*Phintella castriesiana* (Grube, 1861)	33 (1 ♂, 30.06.2018, 1 ♂, 16.06.2019, 1 ♀, 18.07.2021)		+
*	*Phlegra fasciata* (Hahn, 1826)	2 (1 ♂, 01-04.05.2018), 24 (5 ♂, 2 ♀, 30.06-14.07.2020), 38 (1 ♂, 11-21.05.2019), 40 (1 ♀, 29.04.2019), 44 (1 ♂, 09.05.2019)	+	+
	Pseudeuophrys obsoleta (Simon, 1868)	2 (1 ♀, 3 j, 18.09.2017, 1 ♀, 01-04.05.2018, 1 ♀, 09.06.2021), 5 (1 ♀, 21.04.2021), 9 (2 j, 18.09.2017), 25 (1 j), 29a (Drensky, 1913, sub *Euophrys o.*, Drensky, 1936), 38 (1 ♂, 25.04-05.05.2019), 47 (1 ♀, 05.08.2020)	+	+
*	*Pseudicius encarpatus* (Walckenaer, 1802)	33 (1 ♀, 18.07.2021), 38 (1 ♀, 08.08.2019, 1 ♀, 20.06.2020, 1 ♂ , 28.08.2020), 40 (1 ♀, 10-11.05.2021)		+
*	*Saitis tauricus* Kulczyński, 1904	2 (1 ♂, 01-04.05.2018, 1 ♀, 27.07.2018), 5 (1 ♀, 26.03.2021), 6 (1 j, 18.02.2022), 38 (3 ♂, 1 ♀, 14 j, 16-30.03.2018, 2 ♂, 11-15.04.2018, 1 ♀, 27-29.05.2018, 1 ♀, 26.05.2020)	+	+
*	*Salticus unicolor* (Simon, 1868)	2 (1 ♀, 09.06.2021), 5 (1 ♂, 21.04.2021), 38 (1 ♂, 25.05.2019, 1 ♂, 1 ♀, 14-20.05.2020, 1 ♀, 20.06.2020, 1 ♀, 23.06.2021)	+	+
**	*Talavera aperta* (Miller, 1971)	38 (1 ♂, 1 ♀, 15.05.2021)		+
*	*Talavera logunovi* Kovblyuk & Kastrygina, 2015	38 (1 ♂, 1 ♀, 15.05.2021)		+
	Scytodidae			
#	*Scytodes sp.*	38 (1 ♂, 1 ♀, 19.06.2021)		+
*	*Scytodes thoracica* (Latreille, 1802)	2 (1 ♂, 2 ♀, 4 j, 18.09.2017, 1 ♂, 01-04.05.2018), 6 (1 j, 18.02.2022), 9 (1 ♀, 18.09.2017), 23 (1 ♂, 20.05-29.06.2020), 25 (1 ♂, 1 ♀, 30.06-14.07.2020), 38 (1 ♀, 04.04.2018), 42 (1 ♀, 08.09.2018)	+	+

	Tetragnathidae			
*	*Metellina mengei* (Blackwall, 1869)	5 (1 ♂, 21.04.2021), 38 (1 ♂, 2 ♀, 11-15.04.2018)	+	+
*	*Metellina segmentata* (Clerck, 1757)	35 (1 ♀, 04.1988)		+
*	*Pachygnatha clercki* Sundevall, 1823	5 (1 ♀, 26.03.2021), 25 (1 ♀, 30.06-14.07.2020), 33 (1 ♀, 18.07.2021), 38 (1 ♂, 16-30.03.2018), 40 (1 ♂, 10-11.05.2021)	+	+
*	*Pachygnatha degeeri* Sundevall, 1830	23 (1 ♂, 4 ♀, 20.05-29.06.2020, 3 ♂, 3 ♀, 30.06-14.07.2020, 1 ♂, 2 ♀, 01-30.09.2020), 24 (1 ♀, 20.05-29.06.2020, 1 ♂, 1 ♀, 30.06-14.07.2020), 25 (2 ♀, 30.06-14.07.2020), 31 (1 ♂, 22.02.1988), 38 (3 ♀, 3 j, 21-26.10.2018, 1 ♂, 18-26.06.2019, 1 ♀, 04-14.07.2019, 4 ♂, 1 ♀, 23.08.2019, 1 ♀, 30.08.2020)	+	+
*	*Tetragnatha extensa* (Linnaeus, 1758)	1 (1 ♂, 1 ♀, 03-04.06.2017), 33 (1 ♂, 17.08.2021), 38 (2 ♂, 14-20.05.2020), 40 (1 ♀, 10-11.05.2021, 1 ♂, 2 ♀, 27.05.2021)	+	+
*	*Tetragnatha montana* Simon, 1874	33 (1 ♀, 18.07.2021), 38 (1 ♂, 1 ♀, 27-29.05.2018), 40 (1 ♂, 10-11.05.2021)		+
*	*Tetragnatha nigrita* Lendl, 1886	33 (1 ♀, 18.07.2021, 1 ♂, 25.07.2021)		+
*	*Tetragnatha obtusa* C. L. Koch, 1837	13 (3 ♀, 25.08.1928), 33 (1 ♀, 18.07.2021), 38 (1 ♀, 20.06.2020), 50 (1 ♂, 26.05.2019)	+	+
*	*Tetragnatha pinicola* L. Koch, 1870	38 (1 ♀, 28.05.2021)		+
	Theridiidae			
*	*Asagena meridionalis* Kulczynski, 1894	38 (1 ♀, 18.02.2019)		+
*	*Asagena phalerata* (Panzer, 1801)	2 (2 ♂, 1 sa ♂, 18.09.2017), 9 (1 ♂, 19.09.2017), 12 (1 j, 11.11.2016), 24 (2 ♂, 20.05-29.06.2020, 1 ♂, 30.06-14.07.2020), 25 (1 ♂, 30.06-14.07.2020), 38 (1 ♂, 08-21.04.2019, 3 ♂, 14-20.05.2020, 1 ♀, 25-31.07.2020, 1 ♂, 16.06.2021), 40 (1 ♂, 04.06.2021)	+	+
	Cryptachaea riparia (Blackwall, 1834)	38 (1 ♂, 25.04-05.05.2019, 1 ♂, 1 ♀, 28.05-08.06.2019, 2 ♂, 1 ♀, 18-26.06.2019, 1 ♂, 14-20.05.2020, 1 ♂, 03.07.2020, 1 ♂, 19.07.2020, 1 ♂, 1 ♀, 10.08.2020), 44 (NAUMOVA *et al.*, 2021)		+
*	*Enoplognatha latimana* Hippa & Oksala, 1982	33 (1 ♀, 25.07.2021), 38 (1 ♂, 1 ♀, 18-26.06.2019)		+
*	*Enoplognatha ovata* (Clerck, 1757)	38 (1 ♀, 03-10.07.2018)		+
*	*Enoplognatha penelope* Hippa & Oksala, 1982	9 (2 ♂, 3 ♀, 1 sa ♂, 17.06.2021), 33 (1 ♂, 16.06.2019), 38 (1 ♂, 28.05-08.06.2019, 1 ♂, 18-26.06.2019, 1 ♂, 17.06.2020,), 44 (1 ♀, 10-12.07.2018)	+	+
*	*Enoplognatha quadripunctata* Simon, 1884	2 (2 sa ♀, 19.04.2017), 9 (2 ♀, 17.06.2021), 38 (1 ♀, 26-30.04.2018, 2 ♂, , 1 ♀, 25-31.07.2020)	+	+
*	*Enoplognatha thoracica* (Hahn, 1833)	38 (1 ♀, 13.06.2019)		+
*	*Episinus angulatus* (Blackwall, 1836)	38 (1 ♂, 13.06.2019)		+
*	*Episinus truncatus* Latreille, 1809	2 (1 ♀, 27.07.2018), 8 (1 ♂, 1 ♀, 17.09.2017), 20 (1 sa ♀, 18.04.2017), 38 (1 ♀, 18-26.06.2019, 1 ♂, 1 ♀, 25-31.07.2020)	+	+
*	*Heterotheridion nigrovariegatum* (Simon, 1873)	2 (1 ♂, 1 ♀, 09.06.2021), 9 (1 ♂, 17.06.2021), 38 (1 ♂, 27-29.05.2018, 1 ♂, 1 sa ♀, 28.05-08.06.2019)	+	+
*	*Neottiura herbigrada* (Simon, 1873)	2 (1 ♂, 14.05.2021)	+	
*	*Neottiura suaveolens* (Simon, 1880)	38 (1 ♀, 18-26.06.2019, 1 ♀, 08.06.2021)		+
*	*Parasteatoda lunata* (Clerck, 1757)	3 (1 ♂, 24.06.2021), 5 (1 ♀, 05.08.2020), 20 (1 sa ♀, 18.04.2017), 44 (1 ♀, 25.03.2020)	+	+
*	*Parasteatoda simulans* (Thorell, 1875)	38 (1 ♀, 11-18.05.2018)		+

*	*Parasteatoda tepidariorum* (C. L. Koch, 1841)	29a (1 ♀, 24.08.2019)	+	
*	*Phylloneta impressa* (L. Koch, 1881)	2 (2 ♀, 27.07.2018), 38 (1 ♂, 2 ♀, 1 sa ♂, 03-10.07.2018, 1 ♂, 28.05-08.06.2019, 1 ♂, 18-26.06.2019), 42 (1 ♀, 08.09.2018), 48 (3 ♀, 18.07.2018)	+	+
*	*Platnickina tincta* (Walckenaer, 1802)	38 (1 ♂, 14-20.05.2020)		+
*	*Robertus arundineti* (O. P.-Cambridge, 1871)	25 (1 ♂, 20.05-29.06.2020)	+	
*	*Robertus frivaldszkyi* (Chyzer, 1894)	2 (1 ♀, 01-04.05.2018)	+	
*	*Sardinidion blackwalli* (O. P.-Cambridge, 1871)	2 (1 ♀, 09.06.2021), 3 (1 ♂, 22.05.2021, 1 ♀, 15.06.2021), 38 (1 ♂, 11-18.05.2018, 1 ♂, 1 ♀, 28.05-08.06.2019, 2 ♂, 14-20.05.2020)	+	+
*	*Simitidion simile* (C. L. Koch, 1836)	2 (1 ♂, 09.06.2021), 9 (1 ♀, 17.06.2021)	+	
	Steatoda albomaculata (De Geer, 1778)	32 (Jurinic & Drensky, 1917 sub *Lithyphantes corollatus*, Drensky, 1936), 38 (1 ♂, 18-26.06.2019, 1 ♂, 1 ♀, 20.10.2019)		+
*	*Steatoda bipunctata* (Linnaeus, 1758)	6 (1 ♀, 18.02.2022), 25 (1 sa ♀, 01-30.09.2020)	+	
*	*Steatoda paykulliana* (Walckenaer, 1805)	5 (1 ♂, 26.03.2021, 1 sa ♀, 28.04.2021), 44 (1 ♂, 1 ♀, 16.04.2019)	+	+
*	*Steatoda triangulosa* (Walckenaer, 1802)	7 (2 ♀, 6 j, 02-03.2018), 22 (1 ♀, 20.03.2018), 33 (1 ♀, 12.09.2021), 29a (1 ♀, 16.08.2021), 38 (5 ♀, 3 j, 16-30.03.2018, 1 ♀, 11-18.05.2018)	+	+
*	*Theridion adrianopoli* Drensky, 1915	6 (2 sa ♂, 2 sa ♀, 18.02.2022), 11 (1 ♀, 19.04.2017, 1 ♀, 17.06.2021), 38 (5 ♀, 11-21.05.2019, 3 ♂, 23.08.2019, 1 ♂, 03.05.2021)	+	+
*	*Theridion cinereum* Thorell, 1875	33 (2 ♂, 2 ♀, 21.08.2021, 2 ♀, 12.09.2021)		+
	Theridion melanurum Hahn, 1831	11 (1 ♀, 17.06.2021), 20 (1 ♀, 18.04.2017), 32 (Drensky, 1913, 1936 sub *T. undulatum*), 38 (2 ♂, 18.03.2019), 52 (6 ♀, 29.05.2019)	+	+
*	*Theridion mystaceum* L. Koch, 1870	8 (1 ♂, 1 ♀, 14.05.2021), 38 (2 ♂, 11-15.04.2018)	+	+
*	*Theridion pinastri* L. Koch, 1872	33 (1 ♀, 18.07.2021)		+
*	*Theridion varians* Hahn, 1833	38 (3 ♀, 27-29.05.2018, 2 ♂, 2 ♀, 28.05-08.06.2019, 2 ♂, 18-26.06.2019)		+
	Thomisidae			
*	*Bassaniodes caperatus* (Simon, 1875)	38 (1 ♂, 23.08.2019)		+
*	*Diaea dorsata* (Fabricius, 1777)	33 (1 ♂, 18.04.2022), 38 (1 ♂, 14.04.2022)		
*	*Diaea livens* Simon, 1876	33 (3 ♂, 25.07.2021), 38 (1 sa ♂, 16-30.03.2018)		+
	Ebrechtella tricuspidata (Fabricius, 1775)	27 (2 ♀, 27.10.1988), 32 (Jurinic & Drensky, 1917 *Misumena t.*, Drensky, 1936), 38 (1 ♂, 25.07.2021), 44 (1 ♀, 04.09.2021)	+	+
*	*Heriaeus hirtus* (Latreille, 1819)	38 (1 sa ♀, 25.04-05.05.2019, 1 ♂, 28.05-08.06.2019, 1 ♀, 15.06.2019),		+
*	*Heriaeus simoni* Kulczyński, 1903	48 (1 ♀, 13.06.2019)		+
*	*Misumena vatia* (Clerck, 1757)	1 (1 ♀, 03-04.06.2017), 19 (3 j, 26.05.2011), 38 (1 ♂, 23.08.2019), 44 (2 sa ♀, 10-12.07.2018)	+	+
*	*Ozyptila confluens* (C. L. Koch, 1845)	2 (22 ♂, 4 ♀, 1 sa ♂, 1 sa ♀, 18.09.2017), 8 (27 ♂, 17.09.2017), 9 (19 ♂, 18.09.2017, 32 ♂, 3 ♀, 1 sa ♀, 19.09.2017), 23 (9 ♂, 01-30.09.2020), 25 (2 ♂, 01-30.09.2020)	+	
*	*Ozyptila praticola* (C. L. Koch, 1837)	20 (1 ♀, 18.04.2017), 23 (6 ♂, 1 ♀, 20.05-29.06.2020), 24 (1 ♂, 20.05-29.06.2020, 1 ♀, 30.06-14.07.2020, 1 sa ♀, 1 sa ♂, 01-30.09.2020), 38 (3 ♂, 1 ♀, 11-21.05.2019, 1 ♀, 25-31.07.2020)	+	+
?	*Ozyptila rauda* Simon, 1875	8 (Drensky, 1913, 1936 sub *Oxyptila r.*)	+	

*	*Pistius truncatus* (Pallas, 1772)	38 (1 sa ♀, 30.08.2019), 43a (1 ♂, 24.09.2021)		+
*	*Runcinia grammica* (C. L. Koch, 1837)	38 (1 ♂, 13.06.2020, 1 ♂, 26.06.2020), 40 (1 ♂,23.06.2018), 43c (1 ♂,05.07.2021)		+
	Synema globosum (Fabricius, 1775)	1 (1 ♀, 03-04.06.2017), 2 (1 ♀, 01-04.05.2018), 23 (1 sa ♀, 01-30.09.2020), 32 (Jurinic & Drensky, 1917 sub S. globosa), 33 (2 ♂, 16.06.2019, 1 ♀, 04.07.2019), 38 (1 ♀, 13.06.2019), 44 (1 ♀, 10.06.2019), 49 (1 ♀, 02.06.2020), 53 (1 ♀, 14.08.2019)	+	+
*	*Thomisus onustus* Walckenaer, 1805	2 (1 sa ♂, 01-04.05.2018), 33 (1 ♀, 16.06.2019), 38 (1 ♂, 18-26.06.2019)	+	+
*	*Tmarus piger* (Walckenaer, 1802)	4 (1 ♂, 05.03.2021)	+	
*	*Xysticus acerbus* Thorell, 1872	38 (2 ♀, 11-15.04.2018), 40 (1 ♀, 10-11.05.2021)		+
*	*Xysticus kochi* Thorell, 1872	1 (1 ♂, 2 ♀, 03-04.06.2017), 2 (1 ♂, 01-04.05.2018), 19 (8 ♀, 26.05.2011), 25 (7 ♂, 20.05-29.06.2020), 33 (1 ♀, 16.06.2019, 1 ♀, 04.07.2019), 38 (1 ♂, 3 ♀, 1 sa ♀, 11-15.04.2018, 1 ♂, 26-30.04.2018, 2 ♂, 08-21.04.2019, 1 ♂, 25.04-05.05.2019, 1 ♀, 18-26.06.2019, 1 ♂, 23.08.2019), 40 (1 ♂, 10-11.05.2021, 1 ♀, 04.06.2021), 44 (1 ♀, 10-12.07.2018), 45b (1 ♂, 09.05.2019), 48 (1 ♀, 04.06.2019)	+	+
*	*Xysticus laetus* Thorell, 1875	2 (1 ♂, 14.04.2021), 5 (1 ♂, 21.04.2021), 6 (1 sa ♂, 18.02.2022), 26d (1 ♀, 27.05.2021), 35 (1 ♀, 04.1988), 38 (3 ♂, 1 ♀, 3 sa ♀, 16-30.03.2018, 1 ♀, 26-30.04.2018, 1 ♀, 21-26.10.2018, 1 ♂, 08-21.04.2019, 1 ♀, 18-26.06.2019)	+	+
*	*Xysticus luctuosus* (Blackwall, 1836)	38 (1 ♂, 23.08.2019)		+
	Titanoecidae			
*	*Titanoeca quadriguttata* (Hahn, 1833)	38 (1 ♀, 16.07.2019)		+
	Titanoeca schineri L. Koch, 1872	25 (1 ♂, 1 ♀, 30.06-14.07.2020), 37 (Naumova, 2019), 38 (1 sa ♀, 16-30.03.2018 , 1 ♀, 1 sa ♂, 3 sa ♀, 4 j, 11-15.04.2018, 1 ♀, 06.07.2019, 1 ♂, 25.06.2020, 1 ♂, 03.06.2021, 1 ♀, 13.06.2021), 42 (1 ♀, 2 sa ♂, 08.09.2018)	+	+
	Titanoeca veteranica Herman, 1879	38 (Naumova, 2019), 50 (Naumova, 2019)		+
	Trachelidae			
	Trachelas minor O. Pickard-Cambridge, 1872	35 (1 ♀, 14.11.2021), 38 (Naumova et al., 2021, 1 ♀, 16.07.2019)		+
	Uloboridae			
*	*Uloborus walckenaerius* Latreille, 1805	2 (1 ♀, 01-04.05.2018), 38 (1 ♀, 16-30.03.2018, 1 sa ♂, 3 sa ♀, 11-15.04.2018)	+	+
	Zodariidae			
*	*Zodarion hauseri* Brignoli, 1984	24 (1 ♂, 20.05-29.06.2020), 38 (1 ♀, 11-15.04.2018, 2 ♀, 27-29.05.2018, 2 ♀, 03-10.07.2018, 1 ♂, 1 ♀, 25.04-05.05.2019, 1 ♂, 3 ♀, 18-26.06.2019, 1 ♂, 3 ♀, 04-14.07.2019, 2 ♀, 25-31.07.2020, 1 ♂, 1 ♀, 11.08.2020, 1 ♂, 25.05.2021, 1 ♀, 08.06.2021, 1 ♀, 27.07.2021)	+	+
*	*Zodarion morosum* Denis, 1935	8 (1 ♀, 13.02.1988), 9 (1 ♀, 19.09.2017), 23 (1 ♂, 1 sa ♂, 01-30.09.2020), 24 (3 ♂, 20.05-29.06.2020), 25 (8 ♂, 2 ♀, 20.05-29.06.2020, 1 ♂, 30.06-14.07.2020, 2 ♂, 1 sa ♂, 2 sa ♀, 01-30.09.2020), 26c (1 ♂, 27.04.2018, 1 ♂, 01.06.2021), 35 (3 ♀, 3 j, 12.12.1987), 38 (3 ♂, 1 ♀, 26-30.04.2018, 1 ♂, 1 ♀, 27-29.05.2018, 1 ♂, 11-21.05.2019, 1 ♂, 3 ♀, 28.05-08.06.2019,	+	+

	1 ♂, 18-26.06.2019, 1 ♀, 04-14.07.2019, 1 ♂, 25.05.2021, 1 ♀, 01.08.2020, 1 ♀, 16.08.2020, 1 ♀, 19.06.2021), 39 (1 ♀, 21.06.2020)	
PSEUDOSCORPIONES		
Cheliferidae		
Chelifer cancroides (Linnaeus, 1758)	36 (Petrov, 1997), 38 (2 ♂, 1 ♀, 30.03.2018)	+
Chernetidae		
Lamprochernes nodosus (Schrank, 1803)	29a (Shikrenov, 1961 sub Chelifer n. [sic], Petrov, 1997)	+
Chtoniidae		
Chthonius tetrachelatus (Preyssler, 1790)	25 (1 deuteronymph, 30.06-14.07.2020)	+
Neobisiidae		
Roncus parablothroides Hadži, 1938	25 (1 ♂, 20.05-29.06.2020)	+
SCORPIONES		
Euscorpiidae		
Euscorpius thracicus Kovařík, Lowe, Byronová & Šťáhlavský 2020	17 (1 ♀, 11.09.2018), 26a (1 ♀, 1 j ♀, 23.03.2018)	+

Interesting faunistic records

ARANEAE

Agyneta punctata was described and known from Southern Greece (Peloponnese) and Turkey. The Bulgarian record outlines its range to the North.

Afraflacilla epiblemoides (Fig. 2-4) represents the second species reports from Bulgaria after Yagodovo village (also found during this study) (Naumova et al., 2021).

Attulus distinguendus is a third record from Bulgaria after Samokov plain and Eastern Rhodopes Mts. (Deltshev et al., 2005a, Kalushkov et al., 2008). A single male specimen was found in a yard in Yagodovo village (locality 38) on 11-18.05.2018.

Fig. 2-4. *Afraflacilla epiblemoides* habitus dorsal view, *in situ*: male (2), female (3) and immature (4) (photos by © E. Batchev).

Atypus muralis (Fig. 5) is a second record from Bulgaria after North Black Sea coast (Naumova et al., 2017).

Canariphantes nanus is a second record from Bulgaria after North Black Sea coast (Naumova et al., 2021).

Fig. 5-6. Male spiders *in situ*: *Atypus muralis* (5) and *Leptorchestes sikorskii* (6) (photo by © O. Todorov), scales 0.5 mm.

Cryptachaea riparia is a second record from Bulgaria after Yagodovo village (also found during this study) (Naumova et al., 2021).

Dictyna major is a second record from Bulgaria after Dobrogea (Roşca, 1939).

Dysdera osellai (Fig. 7-9) is reported here with some reserves as the species was known only from Italy and because the members from the genus *Dysdera* Latreille, 1804 and in general from Disderidae family have a high level of endemism. However, our specimens (two males from the city of Plovdiv) fit well both in description and available drawings of *D. osellai* (World Spider Catalog, 2021).

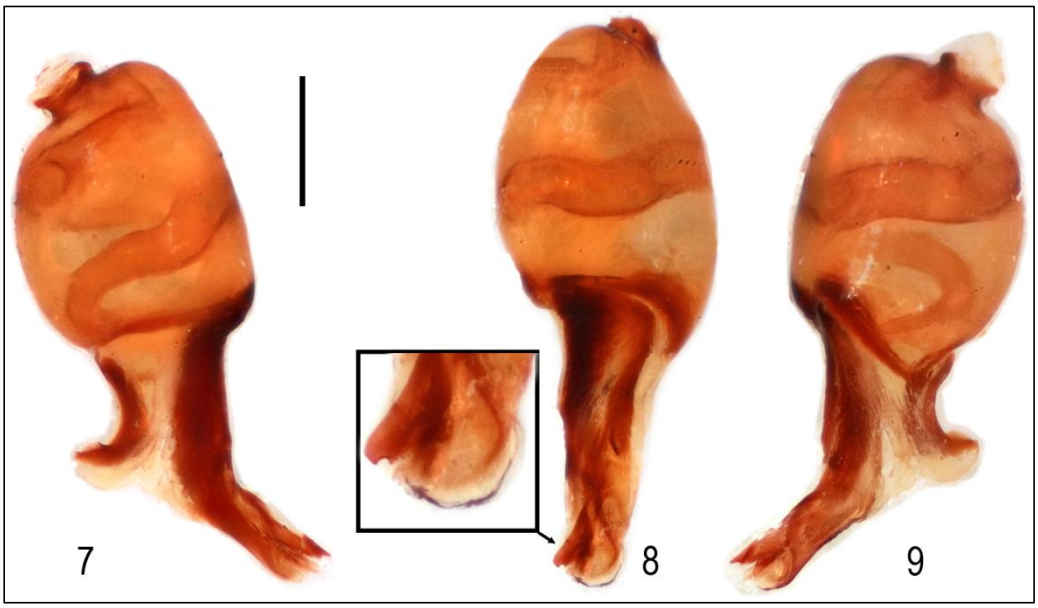

Fig. 7-9. *Dysdera osellai*, bulbus of left male palp, median (7), anterior with detail of tip (8) and lateral (9) views, scale 0.3 mm.

Erigone dentosa (Fig. 10) is a first record for the Balkans. The species is native for Guatemala and North America (Buckle et al., 2001, Crosby & Bishop, 1928, Miller, 2007) but was recently reported from few countries in Western Europe (Arco et al., 2019, Kekenbosch & Baert, 2013, Unruh, 2020). The first European record is in 2012-2013 from Belgium (Kekenbosch & Baert, 2013), followed by records in 2016 from Denmark (Lissner & Scharff, 2012) and Spain (Arco et al., 2019). All previously known localities are far from the Balkans. The single male specimen was collected in rural habitat on the riverbank of Chaya (locality 33).

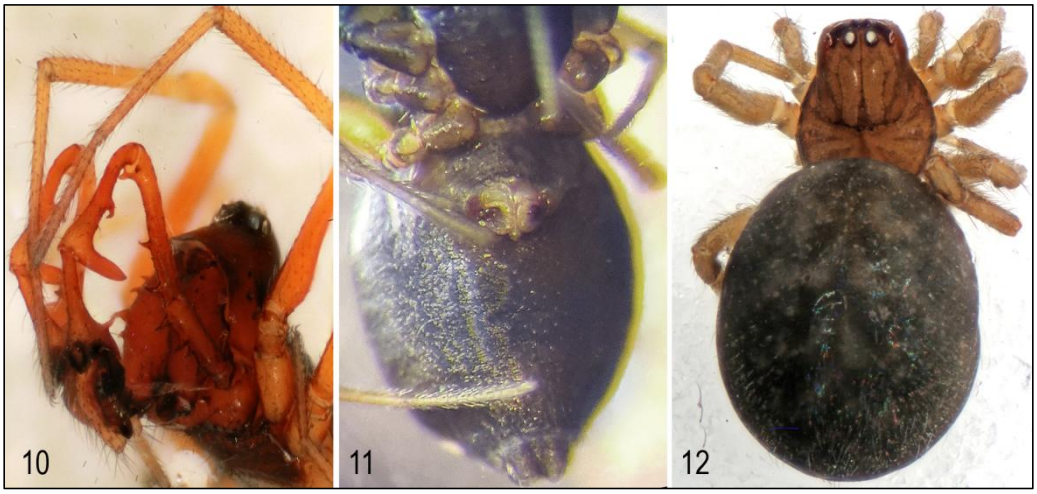

Fig. 10-12. *Erigone dentosa*, male (10), *Ipa terrenus*, female (11), *Lathys spasskyi*, female (12).

Ero koreana (Fig. 13-14) is a first record for the Balkans. The species is distributed from Ukraine (Dnipropetrovsk and Don – Donetsk Regions) to Japan (Ono, 1996, Polchaninova & Prokopenko, 2019). The material from Plovdiv outlines the westernmost limit of the known range of the species.

Fig. 13-14. *Ero koreana*, *in situ*: female (13), idem, during production of a second eggsac (14).

Gnaphosa rufula is a second record from Bulgaria after Lower Danube (Naumova et al., 2021).

Haplodrassus bohemicus is a second record from Bulgaria after Slavyanka Mts (Naumova, 2009). The single specimen collected with a soil trap on the Rivershore of Maritsa is the first recorded gynandromorph spider in Bulgaria and a first case of gynandry for the species as well (Šestáková et al., *in press*).

Ipa terrenus (Fig. 11) in Bulgaria was reported only from a high altitude in Pirin Mts. (Drensky, 1921; Deltshev, 1980; Deltshev & Blagoev, 1997) which is why it was considered an alpine element. Our finding in Thracian lowland was unexpected and shows that the ecology of the species is not well known.

Lathys spasskyi (Fig. 12) is with known distribution in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey and Uzbekistan (Nentwig et al., 2022; Zamani et al., 2021; World Spider Catalog, 2021). This is the first report from Europe as the records from Azerbaijan are away from the borders between Asia and Europe (Marusik et al., 2015).

Leptorchestes sikorskii (Fig. 6) is the second report from Bulgaria after Yagodovo village (also found during this study) (Naumova et al., 2021).

Liocranoeca spasskyi is a first record from the Balkans and so far, has been known only from Ukraine and South European Russia (Polchaninova & Prokopenko, 2019; Otto, 2020).

Micaria micans was known from Europe, Caucasus, Russia (Europe to South Siberia), Kazakhstan and Central Asia It is a new country record and the species probably has wider distribution but is very close to *M. pulicaria* and both were possibly misidentified.

Microlinyphia impigra is the second species reports from Bulgaria after Yagodovo village (also found during this study) (Naumova et al., 2021).

Oecobius maculatus is a second record from Bulgaria after Sofia (Naumova et al., 2017).

Pellenes allegrii represents the second report from Bulgaria after Yagodovo village (also found during this study) (Naumova et al., 2021).

Pritha parva (Fig. 15) represents the second species report from Bulgaria after Yagodovo village (also found during this study) (Naumova & Deltshev, 2021).

Salticus unicolor was recently reported from Bachkovo (Western Rhodopes Mts.) and Sofia (Sofia plain) (Schäfer, 2021) but seems to have much wider distribution in Bulgaria.

Scytodes sp. seem to be new for the sciences and will be regarded in separate paper.

Syedra gracilis is a second record from Bulgaria after Sashtinska Sredna Gora Mts (Naumova et al., 2021).

Talavera aperta is a second report from Balkans after Serbia (Grbić et al., 2015).

Talavera logunovi is a second report from Bulgaria after Sakar Mts (Dimitrov & Naumova, 2021).

Trachelas minor (Fig. 16) is a second report from Bulgaria after Yagodovo village (also found during this study) (Naumova et al., 2021).

Fig. 15-16. Spiders *in situ*: *Pritha parva*, male (15), *Trachelas minor*, female (16) (photos by © O. Todorov).

Tegenaria faniapollinis (Figs 17-18) is probably a troglophilic species, known mostly from caves or artificial cavities in Greece, Italy (Sicily), North Macedonia and Turkey. (Lecigne, 2021, Nicolosi & Isaia, 2017). Our specimens inhabited an artificial cavitie (service shaft) in Yagodovo village, except the single specimen from Plovdiv, founded under tree bark.

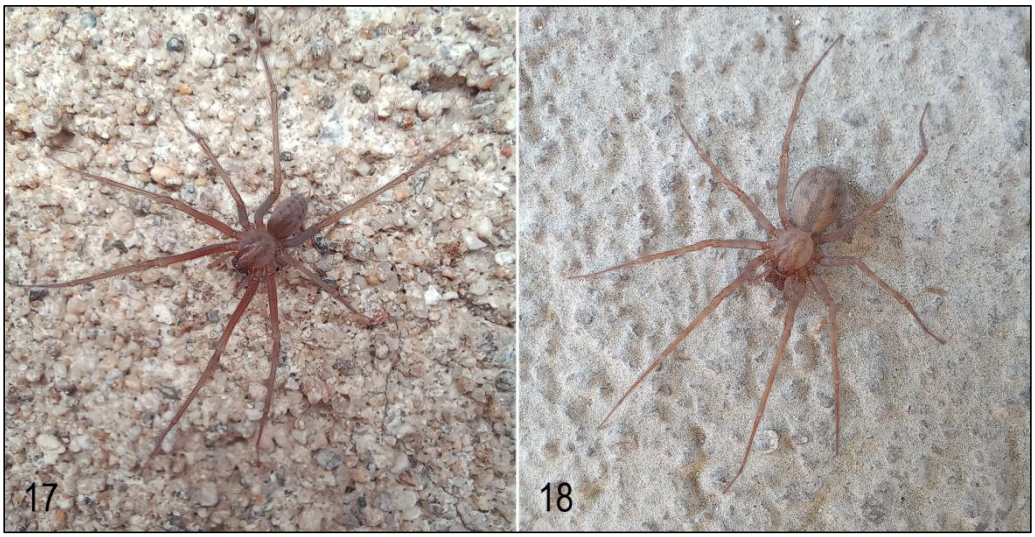

Fig. 17-18. *Tegenaria faniapollinis*, *in situ*: male (17), female (18).

Turkozelotes mccowani was recently described from Northern Greece. The first country record from Bulgaria represents the northernmost known locality so far.

Zelotes eugenei (Fig. 19-23) was previously known from Greece, Southern European Russia and Ukraine (World Spider Catalog, 2021). The discovery of *Zelotes eugenei* in South Bulgaria completes the distribution picture of this species, bridging the gap between some of the known occurrence areas.

Zelotes harmeron (Figs 24-25) was previously known from Cyprus, Insular Greece, Israel, Iran and Turkey (Bosmans et al., 2019; Levy, 2009; Seyyar et al., 2010; Zamani et al., 2020). First record from Europe after Chios Island (Russell-Smith et al., 2011). The material from the area of Plovdiv represents the northernmost finding in the whole known range.

SCORPIONES

Euscorpius thracicus is recently described species (Kovařík et al., 2020). The published data about the presence of scorpions in Bulgarian towns is scarce and includes only Sofia (with firewood?) for *E. deltshevi* Fet, Graham, Webber & Blagoev, 2014 (Fet et al., 2014). There are some reports from the outskirts or small and suburban areas of Vratsa and Yambol (*E. deltshevi*), Kresna (*E. solegladi* Fet, Graham, Webber & Blagoev, 2014) and Melnik (*E. popovi* Tropea, Fet, Parmakelis, Kotsakiozi & Stathi, 2015) (Fet et al., 2014, Tropea et al., 2015).

Discussion

In Eastern and Southeast Europe there is almost no research on urban spiders. In the Balkans, purposeful research of the responses of spiders to an urbanization gradient (urban-suburban-rural areas) has been done only in Sofia (Bulgaria), Skopje (North Macedonia), and (on the family Gnaphosidae) in Heraklion (Greece) (Antov et al., 2004; Kaltsas et al., 2014; Stefanovska et al., 2008). Compared to the results of other general studies in urban environments, summarizing all available faunistic data the araneofauna of Plovdiv shows high diversity. For example, the total number of spiders in Sofia is 306 (Antov et al., 2004; Drensky, 1913, 1936, Deltshev, 1967, Indzhov, 2020, 2021, Naumova, 2019, Naumova & Deltshev, 2021, Naumova et al., 2017, 2021, Schäfer, 2021), 118 in Skopje

(Stefanovska et al., 2008), 249 in Chernivtsi, Ukraine (Fedoriak & Zhukovets, 2010) and 141 in Rostov-na Don, Russia (Ponomarev, 2021). Despite the narrow altitude range (only 91 meters) between 145 and 236 m a.s.l., the unsystematic sampling and insignificant part of material collected by pitfall traps, the overall number of spiders established during this study is considerable and represents 182 species in the city of Plovdiv and 305 spider species after including sites in the nearest outskirts. This number could be explained by the role of Maritsa River as a path for penetration of thermophilous species, by the great diversity of habitats and with the suburban biodiversity in general. The decrease in species in urban areas is directly connected with the impoverished flora, in terms of habitat loss (McKinney, 2002) and habitat fragmentation, which leads to isolated populations in such areas (Collins et al., 2000). Suburban habitats are considered to be transitional zones between natural and urban areas and are characterized by high environmental heterogeneity, because different habitats co-occur alongside one another (McKinney, 2002). Such habitat diversity has often led to a suburban peak in species richness of plants, butterflies, mammals, birds, lizards, bumblebees and ants (Blair, 1999; Konvicka & Kadlec, 2011, Kowarik, 1995, McKinney, 2002), which supports the predictions of the intermediate disturbance hypothesis, especially in cases of mild human effect of suburban sprawl (McKinney, 2002).

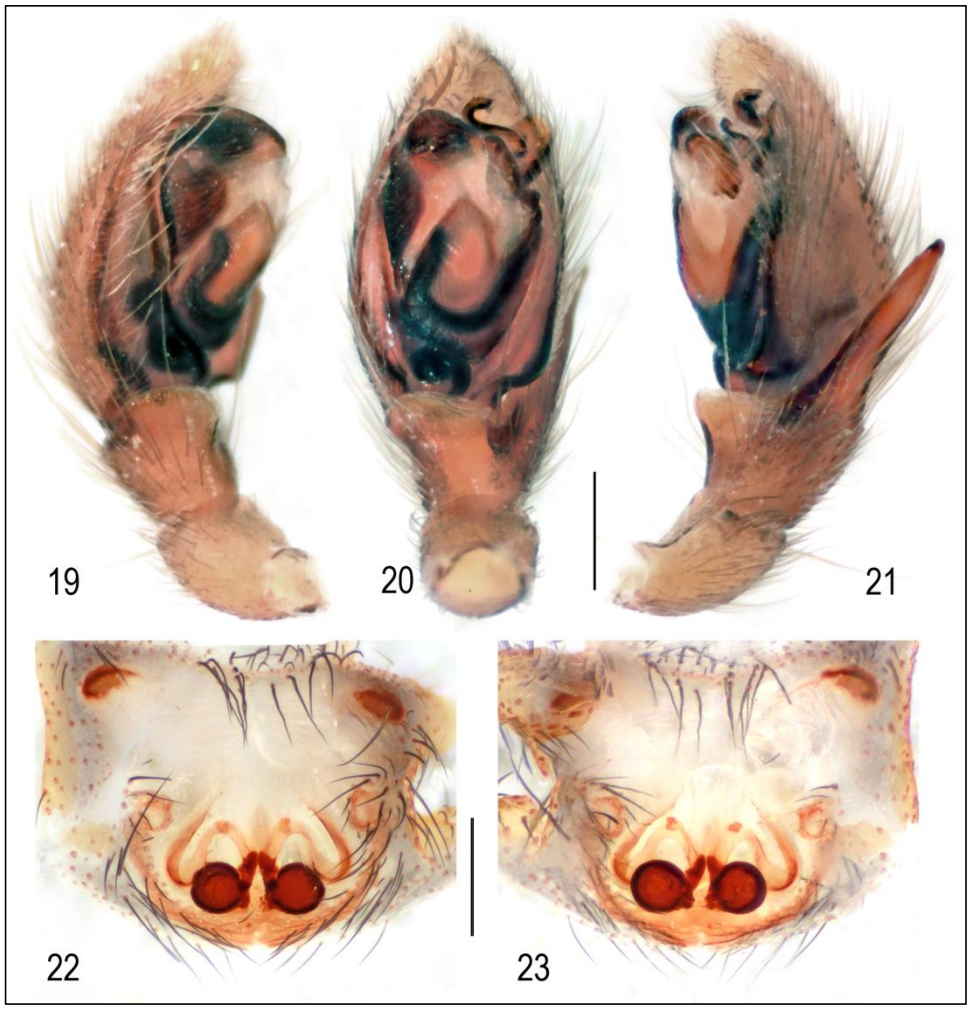

Fig. 19-23. *Zelotes eugenei*, left male palp, prolateral (19), ventral (20) and retrolateral (21) views; epigyne/ vulva ventral (22) and dorsal (23) views; scales 0.3 mm.

Fig. 24-25. *Zelotes harmeron*, female: epigyne ventral (24) and vulva dorsal (25) views; scales 0.2 mm.

Overall, the role of the allochtonious species recently greatly increasing in the semi-natural and artificial habitats, but during our study we found only six spider species deffinitely non-native to the country. The synanthropic cosmopolites *Parasteatoda tepidariorum*, *Pholcus phalangioides* and *Tegenaria domestica* have wide distribution in Bulgaria and Europe. *Ostearius melanopygius* is native for New Zealand but has established in Bulgaria for a long time. *Oecobius maculatus* shows some spreading tendencies within Europe since a few decades, but could not be defined as alien because it is native for Europe. *Erigone dentosa* is known as native for North and Central America and here was registered by a single specimen, so can be defined as introduced by humans either in disturbed natural habitats and potentially invasive (it is a good ballooner) or either to natural habitats and lack invasive tendencies. *Micaria micans* was recently distinguished from *M. pulicaria* while *Dysdera osellai*, *Lathys spasskyi*, *Liocranoeca spasskyi* and *Zelotes harmeron* can be defined as native, not yet observed species, with habitats and regions that are arachnologically unexplored at present.

Conclusion

The low number of historical records (35) and the high total number presented here (317), as well as the many species newly recorded for the country (13), show that studies of arachnids in cities have been unjustifiably neglected. It`s interesting to note that other similar researches also provided new country records, e.g., 2 (from 112) in Sofia, Bulgaria (Antov et. al., 2004) and 31 (from total 118) in Skopje, North Macedonia (Stefanovska et al., 2008). It seems that the focus of arachnological research in Southeast Europe and especially in the Balkans, at least so far, has been almost entirely on areas with high conservation values, such as various National and Nature Parks, Reserves and Biosphere Reserves, wetlands, mountains (especially highlands), etc. There are also a few researches on agroecosystems, but almost lacking typical urban research, especially faunistic. Although our study combines data collected over a long period of time, actually the main data are the result of incidental collections by hand or of short-term exponated pitfall traps in local sites. So, this study is rather preliminary and we expect that in future, investigating more types of habitats and based

on a more diverse methodology, the number of identified spider species and especially pseudoscorpions will increase significantly.

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First Records of Eyprepocnemis plorans (Charpentier, 1825) in Bulgaria (Orthoptera: Acrididae)

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Abstract. The lamenting grasshopper *Eyprepocnemis plorans plorans* (Charpentier, 1825) is first reported from Bulgaria with at least four established locations in the Thracian lowland (Plovdiv city; between Katunitsa and Yagodovo village, on the territory of Yagodovo village and north of it), along the valleys of the rivers Maritsa and Chaya. A total of 13 adult specimens were observed and 6 of them were collected between October 2020 and November 2022. Brief discussion of the probable path of colonization was also presented.

Key words: Acridoidea, Balkan Peninsula, Eyprepocnemidinae, lamenting grasshopper, Thrace.

Introduction

In Bulgaria the order Orthoptera consists of 220 species (Chobanov, 2020). The second most diverse family is Acrididae with 71 species (from about 360 species in Europe) (Heller et al., 1998, Popov, 2007, Chobanov, 2009, Cigliano et al., 2022). The genus *Eyprepocnemis* Fieber, 1853 includes 31 species and 6 additional to the nominotypical subspecies (Cigliano et al., 2022), distributed in Africa, Southern and Central Asia and Southern Europe. The geographic range of the type species *E. plorans* (Charpentier, 1825), includes Portugal, Southern Spain, Southern France, Southern Italy (with Sicily and Sardinia), Albania, Greece, European Turkey, most of Africa (including South Africa) and parts of Southwestern Asia (Israel, Iran) (Dusoulier, 2016, Hochkirch et al., 2016b, Cigliano et. al., 2022). In the Balkans, the species is known to be rather common in coastal Greece and usually inhabits wetlands like reed belts, ruderal vegetation, salty marshes, riparian strips, ditches, seldom mown grasslands etc., especially in low and hot regions, often along the coast (Wagner, 2021).

The aim of this study is to present new data about the distribution of *E. plorans plorans* in Bulgaria as a result of the combination of the fortuitous observations, citizen science and purposeful investigation of this large but undiscovered species on the territory of Plovdiv city and the adjacent areas.

Material and Methods

The specimens were registered by visual observations, digital images and handpicking. The collected specimens were preserved in 70% ethanol and deposited in the collection of the Institute of Biodiversity and Ecosystem Research, Sofia (IBER).

Fig. 1-6. Habitats in the collecting sites (the numbering coincides with that used in Material and Methods and on the map): 1 - bus-station in Plovdiv city (Locality 1), 2 - arable fields North of Yagodovo village (Locality 2), 3 - rivershore of Chaya River, near Katunitsa village (Locality 3), 4 - backyard in Yagodovo village (Locality 4), 5 and 6, - dill`s fields, Yagodovo village (Locality 5).

The collecting sites were mapped and presented on Fig. 7. Their number and related data are as follows: *locality 1:* Plovdiv city, N42.1469, E24.7265, 164 m a.s.l., about 650 m South of Maritsa River. Habitat: bus-station near small green areas (Fig. 1); *locality 2:* Yagodovo village, N42.1330, E24.8544, 151 m a.s.l. Habitat: arable fields nearby two drainage canals (Fig. 2); *locality 3:* Katunitsa-Yagodovo villages, Chaya River, N42.0966, E24.8577, 165 m a.s.l. Habitat: Rivershore with diverse vegetation (Fig. 3), locality 4: Yagodovo village, N42.1107, E24.8510, 159 m a.s.l. Habitat: Backyard (Fig. 4) and locality 5: about 800 m

West of locality 3, with approximate coordinates N42.0971, E24.8468, 165 m a.s.l.; the location and habitat are defined tentatively, as far as the specimen was found in a hypermarket in Sofia, alive, in packed dill originated from the dill fields of the product packaging company in Yagodovo village (Figs 5, 6).

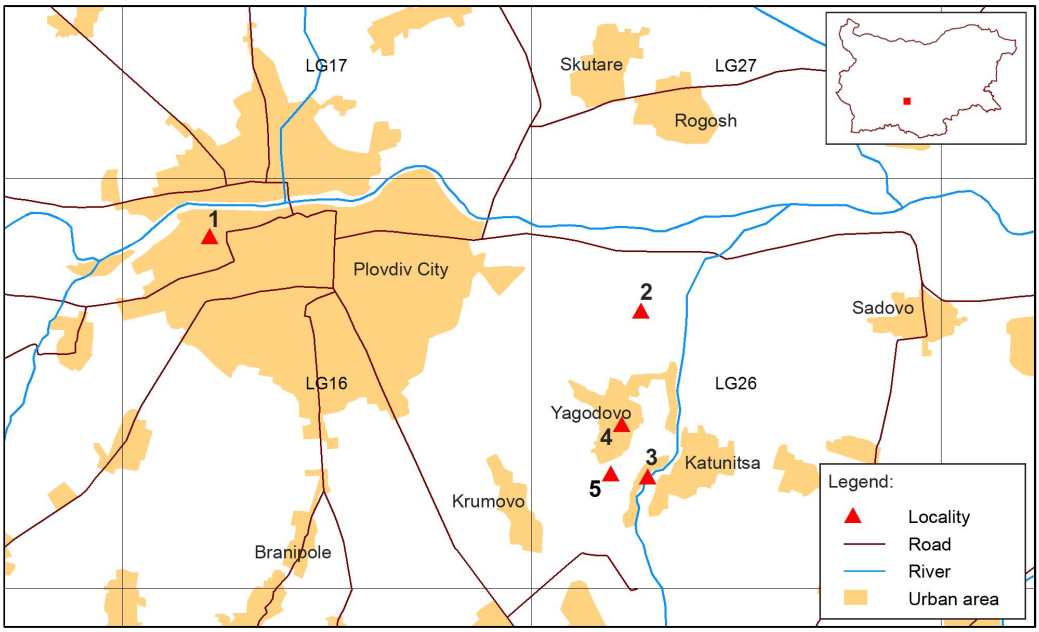

Fig. 7. Map of the localities in Plovdiv district where *Eyprepocnemis plorans* was registered (for details see Material and Methods).

Results

During our investigation, *Eyprepocnemis plorans* was found in Plovdiv city and around. This is the first record of the subfamily Eyprepocnemidinae and the genus *Eyprepocnemis* Fieber, 1853 from Bulgaria. Overall, 13 adult individuals were observed between October 2020 and November 2022, 9 of them were photographed and 6 specimens were collected.

Eyprepocnemidinae
Eyprepocnemis Fieber, 1853

E. plorans plorans (Charpentier, 1825)

Material (chronologically): 3 ad., Locality 2, 15.10.2020, V. Genchev obs.; 1 ad., idem, 20.10.2020; 1 female (found alive in a packed dill in a hypermarket in Sofia, the dill has been packaged in Yagodovo village and originates from the surrounding fields of the respective company), Locality 5, 31.08.2021, Y. Tasev photo (Fig. 8); 1 female (IBER), Locality 1, 15.09.2021, V. Genchev leg. (Fig. 9); 1 male, 2 females (IBER), Locality 3, 30.09.2021, V. Genchev leg; 1 male, idem (Fig. 10); 1 female, Locality 2, 19.09.2022, V. Genchev leg. (Fig. 11); 1 female, Locality 4, 12.10.2022, V. Genchev obs. (Fig. 12); 1 male, idem, 01.11.2022 (Fig. 13).

Discussion

In the last few decades, the European fauna is subjected to accelerating changes due to global warming, changes in habitat structure, pollution and the spread of invasive species. *Eyprepocnemis plorans* is one of the thermophilic invertebrate species that recently expands its distribution and colonized the areas north of its native range of occurrence (Massa et al., 2013; Labadessa et al., 2018). Other invertebrates also expanded their ranges in Bulgaria. For example, the alien mantis *Hierodula tenuidentata* Saussure, 1869 (= *H.*

transcaucasica Brunner von Wattenwyl, 1878) was registered in 2017 in Bulgaria (Pazardzhik district), along Maritsa River (Romanowski et al., 2019), followed by records in 2018-2022 from Plovdiv and its outskirts (including localities 3, 4 and 5 on Fig. 7) (V. Genchev, personal observations) and along Struma River Valley, Danube River and the North Black Sea coast (Zlatkov et al., 2020).

Fig. 8-13. *Eyprepocnemis plorans*: 8 - female from a package of dill (Locality 5) (photo ©Y. Tasev), 9 - female from Plovdiv city (Locality 1), 10 - male from Katunitsa village (Locality 3), 11 - female, north from Yagodovo village (Locality 2), 12 - female from Yagodovo village (Locality 4), 13 - male from Yagodovo village (Locality 4).

Hierodula tenuidentata seems to be alien species introduced to semi-natural and natural habitats by humans and with known sites of introduction isolated from the continuous distribution area of the species. Another example is the linyphiid spider *Erigone dentosa* O. Pickard-Cambridge, 1894, which originated from North and Central America, and was recently reported from several countries in Western and Northern Europe (Nentwig et al., 2022). We found it along Chaya River (locality 3 on Fig. 7) during the ongoing faunal inventory of the Plovdiv region (Naumova & Genchev, 2022). Probably it is an accidental introduction due to the presence of airport, commercial warehouses and to increased flow of people and goods.

Our data probably document a current expansion of the thermophilic grasshopper *E. plorans* from adjacent regions in Northern Greece, as far as the species have been reported from the North Aegean coast, near the Evros River delta (Ingrisch & Pavicevic, 1985; Popov & Chobanov, 2004), so the most probable invasion way in Bulgaria, should be the river valley of Maritsa (Evros). However, the new localities in Plovdiv are 170 km away from those in Northern Greece. In addition, the species has not been registered in Bulgaria so far, although the country is well studied in aspect of orthopterology. Therefore, the accidental introduction is quite credible. During our study, the existence of stable population was not confirmed with certainty (e.g. by observation of copulating specimens, egg-laying females or by nymphs at different stages), but the total number of observed individuals, the presence of the species in at least four sites, close to each other, as well as in three consecutive years, suggest an ongoing process of colonization and establishment of the species in the country.

Conclusions

Altogether, compared with the neighboring and other European countries, the orthopteran fauna of Bulgaria is well investigated and the knowledge about species

inventory, distribution patterns, habitat preferences and conservation status of the grasshoppers in the country is on a high level (Popov & Chobanov, 2004; Popov, 2007; Chobanov, 2009; 2012; 2020; Chobanov & Heller, 2010; Hochkirch et al., 2016a). However, because of the global climate change and due to the human activity, the species modulated their distribution, partly gradually and predictably, but sometimes also suddenly and unexpectedly. Recently, the lamenting grasshopper *Eyprepocnemis plorans* shows visible spreading tendencies within Europe (Massa et al., 2013; Labadessa et al., 2018), but nevertheless, it couldn't be defined as invasive or alien species, because it is native to Southern Europe. On a local level, the long-term effect of its expansion cannot be assessed at this stage, therefore a regular monitoring should be implemented.

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Ecological Properties of Epigeal Invertebrate Communities in Green Areas in the City of Plovdiv. Part 3 - Lauta Park

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Abstract. Some ecological properties of the epigeal invertebrate community in "Lauta" Park in the city of Plovdiv (Bulgaria) is presented. The predominating taxa in the epigeal invertebrate community are Diptera, Brachicera and Coleoptera, Carabidae, followed by Hymenoptera, Formicidae, Diptera, Nematocera and *Oniscus* sp. (Crustacea, Isopoda). Three species from the Coleoptera order were identified to the species level: *Dorcus parallelipipedus* (Lucanidae), *Cetonia aurata* (Scarabaeidae) and *Staphylinus caesareus* (Staphylinidae). The community of the epigeal invertebrates is most likely bidominant with moderate diversity.

Key words: fauna, Insecta, invertebrates, urban park, Plovdiv City, Bulgaria.

Introduction

The invertebrate fauna of Plovdiv City is still not studied thoroughly. Especially ecological properties of the invertebrate communities. There are separate studies on various taxonomic groups, conducted on the territory of the city. For example, Adjaroff (1924) gives a lot of data, concerning the Lepidoptera order in the city, and separate data for other insect groups could be found in the works of Angelov (1960); Paspalev et al. (1964; 1965) and others. There is one previous study, dealing with the epigeal community of "Lauta" Park (Mollov et al., 2018). In the current publication we present newly acquired data on some ecological properties of the epigeal invertebrates in "Lauta" Park in Plovdiv City.

Material and Methods

The fieldwork was conducted on the territory of „Lauta" Park, located in the eastern part of Plovdiv City in May 2021 (Fig. 1).

To capture epigeal invertebrates, pitfall traps were used (Samways et al., 2010), placing a total of 10 traps. Each trap was a two-liter plastic cylinder filled with one liter of 4% formalin solution. Drainage holes were drilled at 2/3 of the cylinder height to avoid overflow and loss of catch in case of rainfall. Traps were placed in a straight line at a distance of 10-15 m from each other without a barrier being placed between them. The traps were left for 14 days, which is the minimal recommended duration with similar studies (Borgelt & New, 2006).

When placing each trap, its exact GPS coordinates were captured (see Table 1). The collected invertebrates from each trap were transferred to 70% ethanol in laboratory conditions, sorted, counted and identified to the lowest taxonomic level possible, using available guides (Angelov et al., 1963; Angelov, 1982; Golemanski et al., 1990). The zoological nomenclature follows Fauna Europaea (de Jong et al., 2014).

The following characteristics were used to assess the composition and properties of the epigeal invertebrates community (after Magurran, 2004):

Proportion (P)

The ratio between the number of species (taxa) and the number of all species (taxa) in the community. Calculated by the following formula:

$$P_i = \frac{n_i}{N},$$

where: P_i - proportion of the taxon *i*;
n_i - number of individuals from taxon *i*;
N - number of individuals from all taxa.

Table 1. GPS coordinates of the used pitfall traps in "Lauta" Park in May 2021.

Trap No.	GPS coordinates
1	42.136776, 24.772329
2	42.136837, 24.772404
3	42.136884, 24.772503
4	42.136919, 24.772549
5	42.136961, 24.772694
6	42.136958, 24.772881
7	42.136900, 24.772930
8	42.136861, 24.773099
9	42.137026, 24.773098
10	42.137157, 24.773047

Diversity indices

To determine the diversity of the epigeal invertebrates community, we used one index of dominance (Simpson's diversity index) and one information index (Shannon's diversity index).

In the present work, the reciprocal value of the Simpson's diversity index (1/ S) was used, calculated using the formula:

$$S = \frac{1}{\sum P_i^2},$$

where: S - Simpson's diversity index;
P_i - proportion of taxon *i*.

The Simpson's evenness index (E) was calculated using the following formula:

$$E = \frac{1}{K \sum P_i^2},$$

where: E - Simpson's evenness index;
P_i - proportion of taxon *i*;
K - number of all taxa in the community.

Shannon's diversity index (H'), calculated, using the following formula:

$$H' = -\sum P_i \ln P_i,$$

where: H' - Shannon's diversity index,
P_i - proportion of taxon *i*.

Shannon's equitability index (J), calculated, using the following formula:

$$J = \frac{H'}{\ln K}$$

where: J - Shannon's equitability index;
P_i - proportion of taxon *i*;
K - number of all taxa in the community.

To calculate Simpson and Shannon's diversity and equitability indices, the Biodiversity Pro software package was used (McAleece et al., 1997).

Results and Discussion

The taxonomic composition, number of individuals and calculated diversity indices of the registered epigeal invertebrates in "Lauta" Park are presented in Table 2.

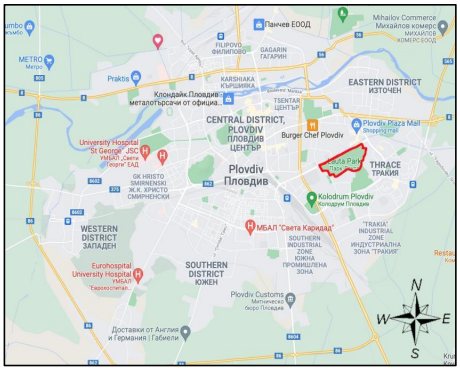

Fig. 1. Location of "Lauta" Park in the city of Plovdiv.

Table 2. Taxonomic composition, number of individuals, of the registered epigeal invertebrates in "Lauta" Park in May 2021. *Legend:* n_i - number of individuals from taxon *i*.

Taxa	Trap 1 n_i	Trap 2 n_i	Trap 3 n_i	Trap 4 n_i	Trap 5 n_i	Trap 6 n_i	Trap 7 n_i	Trap 8 n_i	Trap 9 n_i	Trap 10 n_i	Total
Arachnida											
Acari, Ixodidae, *Ixodes* sp.	0	0	1	0	0	0	0	0	0	0	**1**
Crustacea											
Isopoda, Armadillidiidae, *Armadillidium* sp.	0	0	0	1	0	3	0	1	0	1	**6**
Isopoda, Oniscidae, *Oniscus sp.*	1	22	4	18	4	8	0	2	12	5	**76**
Isopoda, Porcellionidae, *Porcelio sp.*	0	0	0	2	2	1	0	1	4	3	**13**
Entognatha											
Collembola	0	2	3	11	14	1	0	0	3	5	**39**
Collembola, Sminthuridae	0	0	0	0	1	1	0	0	1	0	**3**
Gastropoda	0	0	0	0	1	0	0	0	0	0	**1**
Myriapoda											
Chilopoda, Lithobiomorpha, Lithobiidae	0	0	0	0	0	1	0	0	0	0	**1**
Insecta											
Coleoptera, Carabidae	1	11	4	9	14	7	14	49	15	49	**173**
Coleoptera, Carabidae, *Brachinus* sp.	0	1	1	1	0	0	0	0	0	0	**3**
Coleoptera, Chrysomelidae	0	0	0	0	0	0	0	1	0	0	**1**
Coleoptera, Elateridae	1	0	0	0	0	0	1	0	0	1	**3**
Coleoptera, Histeridae	0	0	0	0	1	0	0	0	0	0	**1**
Coleoptera, Lucanidae, *Dorcus parallelipipedus*	0	0	0	1	0	0	0	0	0	0	**1**
Coleoptera, Scarabaeidae	0	0	0	3	0	0	0	1	0	0	**4**
Coleoptera, Scarabaeidae, *Cetonia aurata*	0	1	0	0	0	0	0	0	0	0	**1**
Coleoptera, Silphidae	0	1	0	2	0	0	0	0	1	0	**4**
Coleoptera, Staphylinidae	0	5	1	1	7	0	1	0	0	3	**18**
Coleoptera, Staphylinidae, *Staphylinus caesareus*	0	0	0	3	2	0	0	0	0	1	**6**
Coleoptera (larvae)	0	1	2	3	0	0	0	0	1	0	**7**
Coleoptera, Staphylinidae (larvae)	0	0	0	0	2	0	0	0	0	4	**6**
Dermaptera	0	1	1	0	0	4	0	2	0	1	**9**
Dermaptera (larvae)	0	1	2	1	3	14	0	11	2	6	**40**
Diptera, Brachicera	8	22	11	56	113	10	18	11	28	151	**428**
Diptera, Nematocera	0	1	3	9	22	2	2	7	6	20	**71**
Diptera, Nematocera, Tipulidae	1	1	1	5	5	9	0	0	2	3	**27**
Hemiptera, Aphididae	0	1	0	0	1	0	0	1	0	0	**3**
Hemiptera, Cicadellidae (larvae)	0	0	0	0	1	0	0	1	1	0	**3**
Hemiptera, Heteroptera	0	0	1	0	1	0	0	0	1	0	**3**
Hemiptera, Heteroptera, Cydnidae	0	0	1	1	0	0	0	0	1	0	**3**
Hemiptera, Heteroptera (larvae)	0	2	2	1	1	1	0	0	0	0	**7**
Hymenoptera, Apidae	1	4	2	1	1	0	0	1	2	2	**14**
Hymenoptera, Diapriidae	0	1	0	0	4	1	0	0	1	0	**7**
Hymenoptera, Formicidae	6	4	5	23	10	6	3	3	8	15	**83**
Hymenoptera, Ichneumonidae	0	0	0	1	0	0	1	0	0	0	**2**
Hymenoptera, Pteromalidae	0	0	0	1	0	0	0	0	0	0	**1**
Lepidoptera (larvae)	1	0	0	0	0	0	0	1	1	1	**4**
Oligochaeta											
Opisthopora, Lumbricidae	0	0	0	0	0	0	0	1	0	0	**1**

Diversity indices	Current study	after Mollov et al. (2018)
Simpson Diversity Index (1/S)	**4.90**	7.11
Simpson Equitability (E)	**0.13**	0.41
Shanon Diversity Index (H')	**2.21**	2.28
Shanon Evenness (J)	**0.61**	0.72

From Table 2 is visible that the predominating taxa in the epigeal invertebrate community are Diptera, Brachicera and Coleoptera, Carabidae, followed by Hymenoptera, Formicidae, Diptera, Nematocera and *Oniscus* sp. (Crustacea, Isopoda). Three species from the Coleoptera order were identified to the species level: *Dorcus parallelipipedus* (Lucanidae), which is included in the IUCN Red List, under LC (least concern) category (Alexander et al., 2010); *Cetonia aurata* (Scarabaeidae) and *Staphylinus caesareus* (Staphylinidae).

The study conducted in 2015 (Mollov et al., 2018) in "Lauta" Park, showed similar results - the predominating taxa were Coleoptera, Carabidae, Collembola, Hymenoptera, Formicidae. Strong presence in the park's interior and almost absent in the ecotone area were the Dermaptera larvae, which are also present in the current study with significant numbers.

Concerning the diversity of the community - the Simpson's diversity index show a decrease, while the Shanon's diversity index is almost unchanged from the study from 2015 (Table 2). The community of the epigeal invertebrates is most likely bidominant, which was also the case in the previous study (Mollov et al., 2018).

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Ecological Properties of Epigeal Invertebrate Communities in Green Areas in the City of Plovdiv. Part 4 - MaritsaRiver

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Abstract. The current study aims to characterize and compare the epigeal invertebrates communities along the urban-rural gradient at Maritsa River on the territory of the city of Plovdiv. The predominant tree and shrub vegetation in the three studied zones is typical riparian and mainly ruderal. With the greatest number of individuals and with the highest species richness is the epigeal invertebrates community in the suburban zone. In the three studied zones, Hyemnoptera, Formicidae; Aranea and Izopoda predominate. The epigeal invertebrate community in the suburban zone is characterized by the greatest diversity, calculated using two diveristy indices. The surveyed epigeal invertebrates communities in the three urban parks do not follow the generally established dependence of declining the diversity from the periphery to the city center.

Key words: epigeal invertebrates, pitfall traps, communities, Maritsa River, urban-rural gradient, Plovdiv.

Introduction

The epigeal invertebrate fauna of Plovdiv City was studied in a series of studies in recent years (Mollov et al., 2018a; b; Antov et al., 2022). In the current publication we present newly acquired data on some ecological properties of the epigeal invertebrates communities along the urban-rural gradient at Maritsa River on the territory of the city of Plovdiv.

Material and Methods

The fieldwork was conducted on the stretch of Maritsa River in Plovdiv City in March-October 2020 (Fig. 1). We chose three sites along the urban-rural gradient, located on the south bank of Maritsa River: urban site - located in the central part of Plovdiv City, between the "Gerdzhika" Bridge and "Vasil Aprilov" Bridge; suburban site - located north of the Rowing Canal, near the mouth of Parvenetska River and rural site - Maritsa River to the west of Plovdiv City, near the 6th kilometer bridge. The urban site is in the central part of the city, where, the two banks of Maritsa River are built-up with high residential and administrative buildings. The suburban site is located in the west suburbs of Plovdiv City, and on the river banks here, there are mainly residential buildings (low rise), single-family houses and industrial buildings. The rural site is undeveloped with remaining natural open grassy-shrubs habitats.

For the determination of the vegetation we used the field guide by Delipavlov & Cheshmedzhiev (2003) and Valev et al. (1960).

To capture epigeal invertebrates, pitfall traps were used (Samways et al., 2010), placing a total of 10 traps. Each trap was a two-liter plastic cylinder filled with one liter of 4% formalin solu-

tion. Drainage holes were drilled at 2/3 of the cylinder height to avoid overflow and loss of catch in case of rainfall. Traps were placed in a straight line at a distance of 10-15 m from each other without a barrier being placed between them. The traps were left for 14 days, which is the minimal recommended duration with similar studies (Borgelt & New, 2006). This was done once every season (spring, summer and autumn).

When placing each trap, its exact GPS coordinates were captured (see Table 1). The collected invertebrates from each trap were transferred to 70% ethanol in laboratory conditions, sorted, counted and identified to the lowest taxonomic level possible, using available guides (Angelov et al., 1963; Angelov, 1982; Golemanski et al., 1990). The zoological nomenclature follows Fauna Europaea (de Jong et al., 2014).

The following characteristics were used to assess the composition and properties of the epigeal invertebrates community (after Magurran, 2004):

Proportion (P)

The ratio between the number of species (taxa) and the number of all species (taxa) in the community. Calculated by the following formula:

$$P_i = \frac{n_i}{N},$$

where: P_i - proportion of the taxon i;
n_i - number of individuals from taxon i;
N - number of individuals from all taxa.

Diversity indices

To determine the diversity of the epigeal invertebrates community, we used one index of dominance (Simpson's diversity index) and one information index (Shannon's diversity index).

In the present work, the reciprocal value of the Simpson's diversity index (1-S) was used, calculated using the formula:

$$S = 1 - \sum P_i^2 ,$$

where: S - Simpson's diversity index;
P_i - proportion of taxon i.

The Simpson's evenness index (E) was calculated using the following formula:

$$E = \frac{1}{K \sum P_i^2},$$

where: E - Simpson's evenness index;
P_i - proportion of taxon i;
K - number of all taxa in the community.

Table 1. GPS coordinates of the used pitfall traps along the urban-rural gradient at Maritsa River in 2020.

Trap No.	GPS coordinates
	Urban zone
1	42.1543286, 24.7350184
2	42.1542697, 24.7347800
3	42.1542871, 24.7346415
4	42.1544214, 24.7346335
5	42.1543863, 24.7342922
6	42.1542595, 24.7341162
7	42.1540266, 24.7336632
8	42.1539859, 24.7334630
9	42.1538643, 24.7333923
10	42.1538614, 24.7329916
	Suburban zone
1	42.1424830, 24.6986087
2	42.1426560, 24.6986463
3	42.1424929, 24.6989400
4	42.1426227, 24.6991274
5	42.1425585, 24.6993923
6	42.1425817, 24.6995696
7	42.1425648, 24.6998335
8	42.1427776, 24.6998379
9	42.1427957, 24.7000102
10	42.1427810, 24.7002083
	Rural zone
1	42.1499259, 24.6773492
2	42.1500725, 24.6776972
3	42.1500981, 24.6783510
4	42.1501299, 24.6786722
5	42.1497094, 24.6823344
6	42.1496370, 24.6826637
7	42.1496564, 24.6827840
8	42.1490815, 24.6841446
9	42.1488510, 24.6843669
10	42.1487740, 24.6844477

Shannon's diversity index (H'), calculated, using the following formula:

$$H' = -\sum P_i \ln P_i,$$

where: H' - Shannon's diversity index,
P_i - proportion of taxon *i*.

Shannon's equitability index (J), calculated, using the following formula:

$$J = \frac{H'}{\ln K}$$

where: J - Shannon's equitability index;
P_i - proportion of taxon *i*;
K - number of all taxa in the community.

To calculate Simpson and Shannon's diversity and equitability indices, as well as a cluster analysis (unweighted per-group average, Bray-Curtis similarity index) the PAST ver. 4 software package was used (Hammer et al., 2001).

Results and Discussion

Prevailing vegetation in the studied zones

The predominating tree and shrub vegetation, recorded by us in the urban zone includes: *Conium maculatum, Convulvulus arvensis, Elaeagnus angustifolia, Euphorbia cyparisias, Hordeum murinum, Juncus effusus, Lolium perenne, Malva sylvestris, Matricaria chamomilla, Phragmites australis, Plantago lanceolata, Populus alba, Populus nigra, Portulaca oleracea, Robinia pseudoacacia, Saponaria officinalis* and *Sisymbrium altissimum*, in the suburban zone: *Anchusa officinalis, Aristolochia clematitis, Calamagrostis arundinacea, Crataegus monogyna, Hordeum murinum, Lysimachia vulgaris, Malva moschata, Melissa officinalis, Morus alba, Onopordum acanthium, Parietaria officinalis, Populus alba, Prunus cerasifera, Robinia pseudoacacia, Salix alba* and *Ulmus glabra*; and for the rural zone: *Amaranthus retroflexus, Anchusa officinalis, Aristolochia clematitis, Conium maculatum, Convolvulus arvensis, Elaeagnus angustifolia, Erigeron annuus, Euphorbia cyparissias, Gleditsia triacanthos, Hordeum murinum, Lolium perenne, Malva sylvestris, Onopordum acanthium, Papaver rhoeas, Plantago lanceolata, Poa pratensis, Populus tremula, Robinia pseudoacacia, Salix alba, Sisymbrium loeselii, Taraxacum officinale, Ulmus laevis, Urtica dioica, Verbascum phlomoides* and *Vicia villosa*. The registered vegetation is presented mainly by riparian hydrophilic, as well as some decorative and ruderal trees and shrubs, wildely used in the urban parks in Plovdiv city. Individual tree and shrub species are located at a distance from each other, and the crowns of the trees do not form thick cover, allowing more light to penetrate to the ground.

Ecological analysis of the epigeal invertebrates communities

The taxonomic composition, number of individuals and calculated diversity indices of the registered epigeal invertebrates in the studied zones are presented in Table 2.

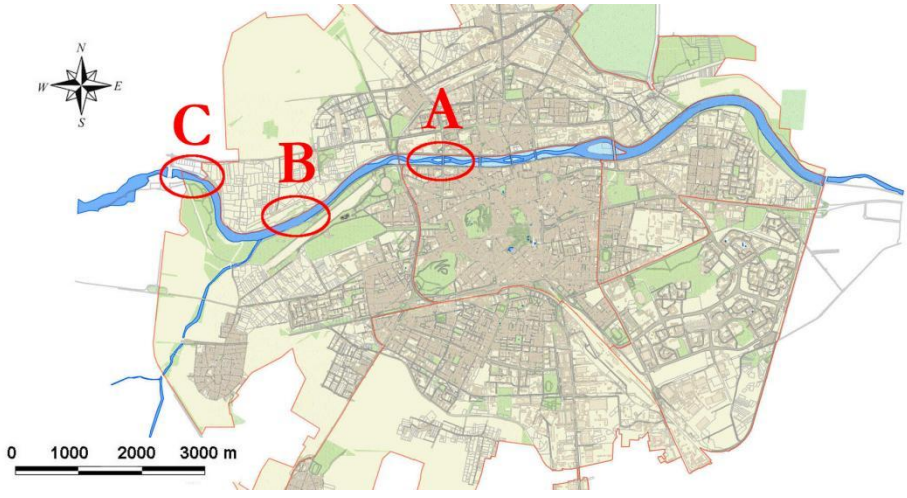

Fig. 1. Location of the studied sites along Maritsa River in the city of Plovdiv. *Legend:* A- urban site; B - suburban site; C - rural site. Explanations are in the text.

Table 2. Taxonomic composition, number of individuals, of the registered epigeal invertebrates in the three studied zones. *Legend: n_i* - number of individuals from taxon *i; Pi* - proportion of the taxon *i; Fi* - frequency of occurrence of taxon i, %; *C* - consistency.

	Taxa	Urban zone				Sub-urban zone				Rural zone			
		Number of ind. (n_i)	Proportion (P_i)	Frequency (F_i), %	Consistency (C), %	Number of ind. (n_i)	Proportion (P_i)	Frequency (F_i), %	Consistency (C), %	Number of ind. (n_i)	Proportion (P_i)	Frequency (F_i), %	Consistency (C), %
1	Acari	2	0.0010	0.100	10	22	0.0081	0.806	20	0	0.0000	0.000	0
2	Acariformes	0	0.0000	0.000	0	5	0.0018	0.183	20	0	0.0000	0.000	0
3	Annelida, *Lumbricus terrestris*	5	0.0025	0.249	30	5	0.0018	0.183	30	4	0.0022	0.225	10
4	**Araneae**	**364**	**0.1815**	**18.146**	**100**	**269**	**0.0985**	**9.850**	**100**	**231**	**0.1299**	**12.992**	**100**
5	Archaeognatha	0	0.0000	0.000	0	80	0.0293	2.929	90	2	0.0011	0.112	20
6	Blattodea	1	0.0005	0.050	10	14	0.0051	0.513	70	1	0.0006	0.056	10
7	Coleoptera, Alleculidae	0	0.0000	0.000	0	0	0.0000	0.000	0	5	0.0028	0.281	40
8	Coleoptera, Buprestidae	0	0.0000	0.000	0	0	0.0000	0.000	0	4	0.0022	0.225	30
9	Coleoptera, Carabidae	96	0.0479	4.786	100	98	0.0359	3.588	20	17	0.0096	0.956	70
10	Coleoptera, Carabidae, *Brachinus* sp.	0	0.0000	0.000	0	0	0.0000	0.000	0	1	0.0006	0.056	10
11	Coleoptera, Carabidae (larvae)	0	0.0000	0.000	0	2	0.0007	0.073	70	0	0.0000	0.000	0
12	Coleoptera, Cerambycidae	2	0.0010	0.100	20	0	0.0000	0.000	0	6	0.0034	0.337	30
13	Coleoptera, Chrysomelidae	1	0.0005	0.050	10	2	0.0007	0.073	50	3	0.0017	0.169	30
14	Coleoptera, Chrysomelidae, Alticinae	0	0.0000	0.000	0	0	0.0000	0.000	0	2	0.0011	0.112	10
15	Coleoptera, Chrysomelidae, *Cassida* sp.	0	0.0000	0.000	0	0	0.0000	0.000	0	1	0.0006	0.056	10
16	Coleoptera, Coccinellidae	1	0.0005	0.050	10	0	0.0000	0.000	0	1	0.0006	0.056	10
17	Coleoptera, Coccinellidae (larvae)	3	0.0015	0.150	10	5	0.0018	0.183	20	27	0.0152	1.519	20
18	Coleoptera, Curculionidae	11	0.0055	0.548	40	17	0.0062	0.622	10	10	0.0056	0.562	20
19	Coleoptera, Elateridae	56	0.0279	2.792	90	41	0.0150	1.501	10	89	0.0501	5.006	80
20	Coleoptera, Geotrupidae	19	0.0095	0.947	60	8	0.0029	0.293	20	30	0.0169	1.687	80
21	Coleoptera, Histeridae	0	0.0000	0.000	0	13	0.0048	0.476	30	0	0.0000	0.000	0
22	Coleoptera indet.	36	0.0179	1.794	70	56	0.0205	2.050	100	46	0.0259	2.587	60
23	Coleoptera, Laemophloeidae	0	0.0000	0.000	0	0	0.0000	0.000	0	1	0.0006	0.056	10
24	Coleoptera, Lampyridae	32	0.0160	1.595	80	2	0.0007	0.073	90	1	0.0006	0.056	10
25	Coleoptera (larvae)	1	0.0005	0.050	10	11	0.0040	0.403	30	11	0.0062	0.619	40
26	Coleoptera, Lucanidae	0	0.0000	0.000	0	2	0.0007	0.073	20	0	0.0000	0.000	0
27	Coleoptera, Nitidulidae	0	0.0000	0.000	0	0	0.0000	0.000	0	1	0.0006	0.056	10
28	Coleoptera, Raphidioptera	0	0.0000	0.000	0	3	0.0011	0.110	80	0	0.0000	0.000	0
29	Coleoptera, Scarabaeidae	0	0.0000	0.000	0	0	0.0000	0.000	0	1	0.0006	0.056	10
30	Coleoptera, Silphidae	11	0.0055	0.548	20	2	0.0007	0.073	70	18	0.0101	1.012	30
31	Coleoptera, Silphidae (larvae)	21	0.0105	1.047	10	4	0.0015	0.146	20	4	0.0022	0.225	40
32	Coleoptera, Staphylinidae	45	0.0224	2.243	90	68	0.0249	2.490	20	23	0.0129	1.294	70
33	Coleoptera, Staphylinidae (larvae)	0	0.0000	0.000	0	12	0.0044	0.439	30	1	0.0006	0.056	10
34	Coleoptera, Tenebrionidae	13	0.0065	0.648	60	61	0.0223	2.234	30	45	0.0253	2.531	100
35	Collembola	0	0.0000	0.000	0	18	0.0066	0.659	40	34	0.0191	1.912	10
36	Dermaptera	0	0.0000	0.000	0	2	0.0007	0.073	10	1	0.0006	0.056	10
37	Dermaptera, *Forficula auricularia* (larvae)	0	0.0000	0.000	0	0	0.0000	0.000	0	3	0.0017	0.169	10
38	Diptera, Asilidae	0	0.0000	0.000	0	5	0.0018	0.183	20	0	0.0000	0.000	0
39	Diptera, Brachycera	22	0.0110	1.097	80	34	0.0124	1.245	40	53	0.0298	2.981	90
40	Diptera, Brachycera, Chloropidae	0	0.0000	0.000	0	0	0.0000	0.000	0	2	0.0011	0.112	20
41	Diptera, Culicidae	1	0.0005	0.050	10	0	0.0000	0.000	0	0	0.0000	0.000	0
42	Diptera	1	0.0005	0.050	10	2	0.0007	0.073	10	2	0.0011	0.112	20
43	Diptera (larvae)	0	0.0000	0.000	0	457	0.1673	16.733	10	33	0.0186	1.856	40
44	Diptera, Muscidae	0	0.0000	0.000	0	3	0.0011	0.110	10	0	0.0000	0.000	0
45	Diptera, Mycetophilidae	0	0.0000	0.000	0	4	0.0015	0.146	10	0	0.0000	0.000	0
46	Diptera, Nematocera	1	0.0005	0.050	10	34	0.0124	1.245	100	0	0.0000	0.000	0
47	Diptera, Syrphidae	0	0.0000	0.000	0	14	0.0051	0.513	30	3	0.0017	0.169	30
48	Diptera, Tipulidae	0	0.0000	0.000	0	19	0.0070	0.696	10	6	0.0034	0.337	30

49	Dytiscidae (larvae)	0	0.0000	0.000	0	1	0.0004	0.037	30	0	0.0000	0.000	0
50	Gastropoda	6	0.0030	0.299	50	4	0.0015	0.146	20	2	0.0011	0.112	20
51	*Gryllotalpa gryllotalpa*	1	0.0005	0.050	10	0	0.0000	0.000	0	7	0.0039	0.394	40
52	Hemiptera, Cicadellidae	3	0.0015	0.147	20	3	0.0011	0.110	100	5	0.0028	0.281	40
53	Hemiptera, Cicadomorpha	15	0.0075	0.748	30	11	0.0040	0.403	10	7	0.0039	0.393	20
54	Hemiptera, Heteroptera	21	0.0105	1.047	80	5	0.0018	0.183	20	8	0.0045	0.450	50
55	Hemiptera, Heteroptera (larvae)	0	0.0000	0.000	0	3	0.0011	0.110	70	0	0.0000	0.000	0
56	Hemiptera, Heteroptera (nymph)	0	0.0000	0.000	0	1	0.0004	0.037	10	0	0.0000	0.000	0
57	Hemiptera, Heteroptera, Reduviidae	0	0.0000	0.000	0	2	0.0007	0.073	20	0	0.0000	0.000	0
58	Hemiptera, Nepidae	3	0.0015	0.147	30	0	0.0000	0.000	0	0	0.0000	0.000	0
59	Hymenoptera, Aculeata	2	0.0010	0.100	10	0	0.0000	0.000	0	1	0.0006	0.056	10
60	Hymenoptera, Apidae	5	0.0025	0.249	40	0	0.0000	0.000	0	4	0.0022	0.225	30
61	Hymenoptera, Apocrita, Vespoidea	0	0.0000	0.000	0	1	0.0004	0.037	10	0	0.0000	0.000	0
62	Hymenoptera, Evaniidae, *Prosevania* sp.	0	0.0000	0.000	0	2	0.0007	0.073	10	0	0.0000	0.000	0
63	**Hymenoptera, Formicidae**	**495**	**0.2468**	**24.676**	**100**	**540**	**0.1977**	**19.773**	**100**	**578**	**0.3251**	**32.508**	**100**
64	Hymenoptera, Ichneumonidae	0	0.0000	0.000	0	4	0.0015	0.146	30	3	0.0017	0.169	20
65	Hymenoptera	11	0.0055	0.548	50	3	0.0011	0.110	20	1	0.0006	0.056	10
66	Hymenoptera, Vespidae	1	0.0005	0.050	10	4	0.0015	0.146	30	2	0.0011	0.112	10
67	Insecta indet.	2	0.0010	0.100	20	5	0.0018	0.183	20	1	0.0006	0.056	10
68	Insecta (larvae) indet.	3	0.0015	0.147	20	31	0.0114	1.135	30	5	0.0028	0.281	30
69	**Isopoda**	**272**	**0.1356**	**13.559**	**100**	**211**	**0.0773**	**7.726**	**100**	**67**	**0.0377**	**3.768**	**90**
70	*Lacerta viridis*	0	0.0000	0.000	0	1	0.0004	0.037	10	1	0.0006	0.056	10
71	Lepidoptera	1	0.0005	0.050	10	2	0.0007	0.073	10	1	0.0006	0.056	10
72	Lepidoptera, Glossata	0	0.0000	0.000	0	0	0.0000	0.000	0	2	0.0011	0.112	20
73	Lepidoptera (larvae)	13	0.0065	0.648	30	117	0.0428	4.284	60	9	0.0051	0.506	50
74	Myriapoda	179	0.0892	8.923	100	113	0.0414	4.138	20	33	0.0186	1.856	80
75	Myriapoda, *Scutigera* sp.	0	0.0000	0.000	0	0	0.0000	0.000	0	1	0.0006	0.056	10
76	Myrmeleontidae (larvae)	1	0.0005	0.050	10	0	0.0000	0.000	0	0	0.0000	0.000	0
77	Opiliones	186	0.0927	9.272	100	244	0.0893	8.934	80	226	0.1271	12.711	90
78	Orthoptera	35	0.0174	1.745	90	11	0.0040	0.403	50	80	0.0450	4.499	100
79	Orthoptera, Caelifera	0	0.0000	0.000	0	0	0.0000	0.000	0	4	0.0022	0.225	20
80	Orthoptera, Caelifera (nymph)	0	0.0000	0.000	0	1	0.0004	0.037	10	0	0.0000	0.000	0
81	Orthoptera, Ensifera (nymph)	0	0.0000	0.000	0	2	0.0007	0.073	10	0	0.0000	0.000	0
82	Orthoptera, Ensifera, Tettigoniidae	0	0.0000	0.000	0	1	0.0004	0.037	10	0	0.0000	0.000	0
83	Orthoptera, Gryllidae	0	0.0000	0.000	0	4	0.0015	0.146	10	0	0.0000	0.000	0
84	Orthoptera, Tettigoniidae	0	0.0000	0.000	0	1	0.0004	0.037	10	0	0.0000	0.000	0
85	*Pelophylax ridibundus*	5	0.0025	0.249	50	3	0.0011	0.110	20	3	0.0017	0.169	30
86	Plecoptera	0	0.0000	0.000	0	2	0.0007	0.073	10	4	0.0022	0.225	20
87	Pseudoscorpiones	1	0.0005	0.050	10	4	0.0015	0.146	20	0	0.0000	0.000	0
	Total number of individuals	**2006**				**2731**				**1778**			
	Total number of taxa	**45**				**66**				**62**			
	Simpson (1-D)		**0.866**				**0.901**				**0.851**		
	Simson's Evenness (E)		**0.261**				**0.257**				**0.221**		
	Shannon (H')		**2.463**				**2.833**				**2.619**		
	Equitability (J)		**0.647**				**0.676**				**0.634**		

From Table 2 is visible that the predominating taxa in the epigeal invertebrate communities in the three zones are Hymenoptera, Formicidae, Aranea and Isopoda, followed by Opiliones and Myriapoda. The most taxonomic rich and most numerous is the community in the suburban zone, where the highest values of both diversity indices were recorded. Except the invertebrates, two vertebrate species were recorded - *Pelophylax ridibundus* and *Lacerta viridis*.

Analyzing to the consistency of the taxa in the three studied zones along the urban-rural gradient along Maritsa River in Plovdiv City, the following trend emerged: in urban zone there were 19 permanent, 6 additional and 20 random taxa recorded; in the suburban zone - 17 permanent, 12 additional and 37 random taxa and in the rural zone - 15 permanent, 15 additional

and 32 random taxa. It is noteworthy that the community in the urban zone is perhaps the most unstable and distinct, since it has the lowest number of permanent taxa. The other two studied zones show similar structure in means of the consistency.

From the point of view of the diversity of the communities, we registered the greatest diversity, measured with both indices in the suburban zone (Table 2). A slightly lower diversity was recorded in the rural zone, but the difference is not great. The probable reason for the lower diversity in the rural zone is the presence of a small cow farm. The animal husbandry and regular grazing from cows and horses has a severe negative impact on the shrub and grass vegetation, which influences the invertebrate communities.

Contrary to most studies (McKinney, 2008; Jones & Leather, 2012), where diversity is declining from the periphery to the city center, in our case this trend was not confirmed. The highest diversity we recorded for the community in the suburban zone, which once again can be explained with the "Intermediate disturbance hypothesis" (Connell, 1978; Blair & Launer, 1997). According to this hypothesis, at high levels of disturbance (strong anthropogenic pressure), species richness and diversity decrease, and when the level of disturbance is reduced, they rise again, but to a certain level. When the degree of anthropogenic pressure falls below certain limits, species richness and diversity again are low, in other words, the highest diversity is observed at an intermediate level of anthropogenic pressure. Assuming that in the urban zone, the anthropogenic pressure in all its forms and manifestations is the most intense, and on the outskirts of the city (rural zone) - the weakest, the "Intermediate disturbance hypothesis" could explain the highest diversity we registered in suburban zone.

As a result of the performed cluster analysis, the three zones are grouped into two clusters, based on faunistic similarity of the epigeal invertebrates communities (Fig. 2). At approximately 68% similarity the suburban zone, is separated in a single cluster. With approximately 70% similarity the urban zone and rural zone are separated in second cluster. The diversity, calculated using both indices in both zones was similar, but slightly higher in the suburban zone.

The study conducted in 2015 (Mollov et al., 2018a) similar results were obtained - the highest diversity was recorded in "Lauta" Park (in the suburban zone of the city).

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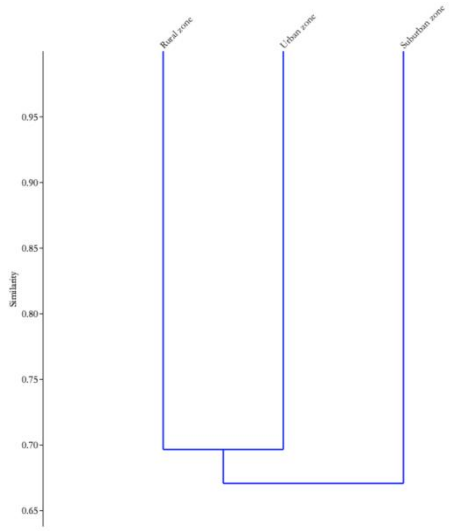

Fig. 2. Cluster analysis (Unweighted Per-Group Average Link, Bray-Curtis similarity index) in the three studied zones along the urban-rural gradient along Maritsa River in the city of Plovdiv, based on the faunal similarity.

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A Study on the Mesogeobiont Communities in Heavy Metals Polluted Area near the City of Plovdiv

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Abstract. The aim of the current work is to study the taxa composition and the ecological status of the mesogeobiont communities in the region of heavy metal pollution near Plovdiv City. In total four sample plots were selcted and one control from clean area. In the plots located in the immediate vicinity of the source of contamination, a low taxonomic diversity and abundance of the mesogeobionts was recorded. With the increase of the distance from the source of pollution, the taxonomic diversity and number of mesogeobionts increases. The structures of the mesogeobiont community located farthest from the local source of pollution and that of the control are similar. The communities of the mesogeobionts in the points with an increased level of heavy metals contamination have altered ecological structure.

Key words: invertebrates, mesogeobionts, heavy metals, pollution, Plovdiv City.

Introduction

Soil pollution is a process of accumulation of harmful substances from a natural or anthropogenic source, whose behavior and concentrations cause damage to soil functions and soil biota, regardless of whether the national norms are exceeded.

The accumulation of heavy metals in the soil occurs not only through dust particles in the air, but also through the decaying processes of plant organisms bioaccumulating heavy metals. On the other hand, the humus that is formed by these plants is a primary source of nutrients and affects the ecological structure of mesogeobiont communities, accompanied by irreversible changes in soil properties.

The change of these properties leads to the disruption of the natural circulation of matter, which leads to the disruption of the normal conditions for the development of the biocenoses, such as numbers, species richness, density of populations, etc.

In Bulgaria, one of the biggest non-ferrous and precious metal production company is "KCM 2000", which is located in the region of the city of Plovdiv. It is located on a 900-acre site between Plovdiv City and Asenovgrad Town and is the largest producer of non-ferrous metals and alloys based on lead and zinc in Central and Eastern Europe (Slavova et al., 2014). It is the activity of the enterprise that provides a prerequisite for heavy metal contamination of the nearby agricultural plots. For this, it is necessary to periodically analyze the degree of pollution and to what extent it affects the organism world.

In a series of publications, Velcheva et al. (1997, 2004) indicated the influence of heavy metals on mesogeobiont communities from different parts of the country. Lechov & Georgiev (2002) analyzed the contamination of the soil with heavy metals in the area of KCM near the city of Plovdiv and Slavova et al. (2014) present data on the species composition and some properties of epigeobiont communities in conditions of heavy metal pollution from the same area.

The aim of the current work is to study the taxa composition and the ecological status of the mesogeobiont communities in the region of KCM - Plovdiv.

Material and Methods

Selection of sampling points

For the purpose of the current study, four experimental sites were chosen, located at different distances from the source of pollution. At each sampling point, pH and temperature were measured using a pHoto Flex Set - WTW. The field work was done seasonally (summer, autumn, winter) 2010-2011.

The location of the sample plots are presented in Fig.1.

Fig. 1. Location of the four studied sample plots.

Plot 1 is located 5 kilometers north of the Plovdiv City Center before the factory itself (Fig. 1). It is located close to the road passing between Plovdiv City and Asenovgrad Town in order to comply with the condition of taking material from uncultivable areas. The vegetation at this point is represented mainly by low-stemmed grasses, shrubs and tree species.

Plot 2 is located south of the factory in the forest belt ecologically designed to purify the area from the emissions of heavy metals into the atmosphere. The vegetation at this point is represented by artificially planted tree species.

Plot 3 is located immediately after the forest belt, and the site has become an unregulated small dump for construction waste also close to the road intercity highway. The point is about a kilometer from the local source of pollution in the direction of Asenovgrad Town. The vegetation is represented mainly by low-stemmed grasses and shrubs.

Plot 4 is agricultural land located on the other side of the road (Fig. 1). The plot is cultivated and planted with different types of agricultural crops.

Control

As a control for the present study, the area of Skutare Village (Maritsa Municipality), was chosen. It is located at 14.89 km in a straight line from the City Center Plovdiv. Terrain is an uncultivable area for over 15 years.

The content of heavy metals in the soil was analyzed by ICP-MS in the analytical chemistry laboratory at the Faculty of Chemistry at University of Plovdiv "Paisii Hilendarski". A coefficient of technogenicity (Ct) was used:

$$Ct = Ca/Cn$$

where:

Ca - measured element concentration in soil;

Cn - values according to Ordinance No. 3.

Field methods

Sampling was done manually using the square sampling method. From each research point, 3 trial boxes measuring 50x50x20 cm were excavated. The upper layer of leaves was removed from each experimental "square". For a more accurate sampling, the squares were excavated in a checkerboard or S-shaped sampling with a distance of 2 meters between them (Gilyarov, 1987).

We transferred the excavated soil onto a polyethylene sheet. The invertebrates were carefully removed from the soil with tweezers. In laboratory conditions, the soil was placed in the Tullgren apparatus, which extracted the micro soil organisms. They were fixed in 70% alcohol and processed in the Laboratory of Ecology and Environmental Conservation. Soil invertebrates were assigned to a different taxonomic unit by using available identification guides (Angelov, 1982; Angelov et al., 1963, Golemanski et al., 1990) The taxonomy followed Fauna Europaea (deJong, 2014).

The following characteristics were used to assess the composition and properties of the mesogeobiont communities (after Magurran, 2004):

Proportion (P)

The ratio between the number of species (taxa) and the number of all species (taxa) in the community. Calculated by the following formula:

$$P_i = \frac{n_i}{N},$$

where: P_i - proportion of the taxon i;

n_i - number of individuals from taxon i;

N - number of individuals from all taxa.

Simpson's Diversity index

In the present work, the reciprocal value of the Simpson's diversity index (1-S) was used, calculated using the formula:

$$S = 1 - \sum P_i^2, ,$$

where: S - Simpson's diversity index;
P_i - proportion of taxon *i*.

The Simpson's evenness index (E) was calculated using the following formula:

$$E = \frac{1}{K \sum P_i^2},$$

where: E - Simpson's evenness index;
P_i - proportion of taxon *i*;
K - number of all taxa in the community.

To calculate the Simpson's diversity and evenness indices, as well as a cluster analysis (Unweighted per-group average, Bray-Curtis similarity index), the "PAST" software package was used (Hammer et al., 2001).

Results and Discussion

The measured values of temperature and pH from the soil in the studied plots are presented in Table 1.

Table 1. Measurements of pH and soil temperature from the four studied plots and the control.

Season	Plot 1		Plot 2		Plot 3		Plot 4		Control	
	pH	t, °C	pH	t, °C	pH	t, °C	pH	t, °C	pH	t, °C
Summer	8.34	25.4	7.97	25.4	7.99	25.5	8.35	25.5	8.40	25.7
Autumn	8.31	16.6	7.83	16.4	7.76	16.6	7.79	16.8	7.90	16.7
Winter	8.32	8.6	7.80	8.9	7.74	8.7	7.78	8.7	8.20	8.5

At *Plot 1,* the coefficient of technogenicity (Ct), with the amount of heavy metals, such as arsenic, mercury, zinc and copper, are below the maximum permissible concentrations according to Ordinance No. 3/2002. Lead exceeds the norms 3 times (80 mg/kg), cadmium also exceeds the norms (3 mg/kg) by a little over 1.5 times, and nickel by more than one time.

At *Plot 2,* a significant increase in the technogenicity coefficient was found, being the highest for lead (up to 56.25 mg/kg), followed by cadmium and arsenic. Only mercury and zinc did not show exceeded values compared to the norms.

At *Plot 3,* the highest technogenic coefficients are for lead and cadmium, followed by arsenic and nickel.

At *Plot 4,* the values of mercury, zinc and copper do not exceed the norms. For the rest of the metals, the highest technogenic coefficient was for lead, followed by cadmium, nickel and arsenic.

From the *control site* near the village of Skutare, the results show that the values of all studied metals are below the norms. On the basis of the mentioned analyzes of heavy metals, it was established that the soils in the examined points in the region of KCM are mainly contaminated with lead, cadmium and nickel.

Taxonomic composition and abundance of soil mesobionts in the test plots

The taxonomic composition and number of individuals found is presented in Table 2.

We recorded the highest taxonomic diversity in the plot that is the most distant from the factory (Plot 1), comparable to that in the control. Compared to it, only representatives of Lepidoptera (larvae) and Dermaptera (Table 3) were missing.

In Plot 2 only four taxa were recorded: Acari, Diplura and Collembola and Gastropoda, as well as in Plot 3 - Gastropoda, Acari, Formicidae and Coleoptera, and in Plot 4 - Aranei, Acari, Diplura and Collembola. This fact can be due both to the contamination of the soil with heavy metals from the factory, and to additional factors - an unregulated landfill, road and agricultural lands near the investigated points.

The number of recorded individuals of soil invertebrates, in general at Plot1, was even higher than that in the control (265 and 167 individuals, respectively). The values of the diversity indices between Plot 1 and the control were similar (slightly higher in Plot 1). We registered close values of the Simpson's diversity index between Plots 3 and 4, and the lowest in Plot 2.

Table 2. Taxonomic and quantitative composition recorded invertebrates and diversity indices of the communities in the individual studied plots.

Taxa	Plot 1	Plot 2	Plot 3	Plot 4	Control	Total
Nemathelminthes	6	0	0	0	1	7
Lumbricidae	14	0	0	0	17	31
Gastropoda	5	3	1	0	22	31
Oniscoidea	21	0	0	0	6	27
Chilopoda	10	0	0	0	5	15
Diplopoda	11	0	0	0	0	11
Aranei	9	0	0	2	24	35
Acari	59	7	3	6	47	122
Diplura	3	4	0	2	9	18
Collembola	24	17	0	1	13	55
Orthoptera	7	0	0	0	0	7
Formicidae	56	0	6	0	10	72
Dermaptera	0	0	0	0	3	3
Coleoptera	34	0	2	0	9	45
Lepidoptera (larvae)	0	0	0	0	1	1
Insecta indet. (larvae)	6	0	0	0	0	6
Total	265	31	12	11	167	486
Simpson (S)	0.869	0.643	0.712	0.691	0.859	-
Simpson Evenness (E)	0.70	0.83	0.94	0.92	0.70	-

From the obtained results, in general, for the whole research period, we recorded a total of 486 individuals not evenly distributed, both in terms of taxonomic composition and quantity in the studied plots. From the total of 16 recorded taxa, the highest number (14) is registered in Plot 1. In the remaining 3 points, the number of taxa was 4. Plot 1 is the furthest from the factory and in it the content of lead and cadmium has higher values. In the rest of the plots, which are located after the KCM towards Asenovgrad Town, and have a significantly higher content of heavy metals, both the taxonomic diversity and the amount of mesogeobionts decrease. A probable reason for this is the "wind rose" according to the prevailing winds that are in that direction, as well as the heavy vehicular traffic.

The performed cluster analysis showed a high similarity between the control and Plot 1 (aprox. 60%). A second cluster is formed with the remaining 3 plots, as Plot 3, differentiates itself from the Plot 2 and 4 with about 22% similarity. (Fig. 2).

The obtained results show that the soil mesogeobiont community in Plot 1 and the control has a better ecological structure compared to those from Plots 2, 3 and 4. This confirms the opinions expressed by other authors that the distance from the source of pollution is important for the degree of heavy metal pollution (Martley et al., 2004; Stafilov, 2009). We consider that the obtained close values in the results of the index of similarity between seasons is a result of the elevated concentrations of heavy metals in the studied soils.

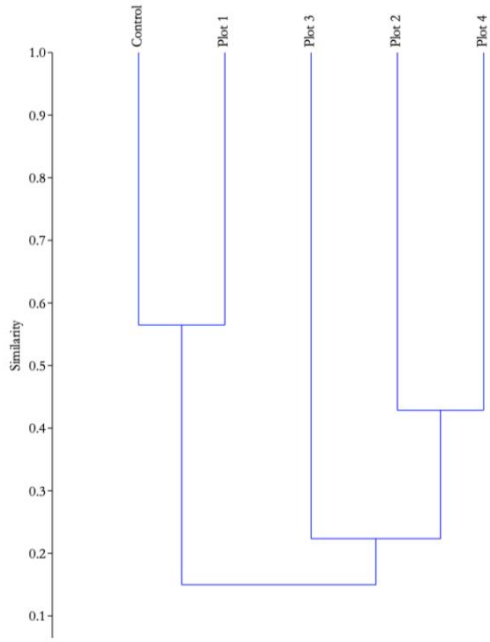

Fig. 2. Cluster analysis of the qualitative data of the soil invertebrates in the studies plots and the control (Unweighted per-group average, Bray-Curtis similarity index).

Conclusions

In the plots located in the immediate vicinity of the source of contamination, a low taxonomic diversity and abundance of the mesogeobionts was recorded. With the increase of the distance from the source of pollution, the taxonomic diversity and number of mesogeobionts increases. The structures of the mesogeobiont community located farthest from the local source of pollution and that of the control are similar. The communities of the mesogeobionts in the points with an increased level of heavy metals contamination have altered ecological structure. Similar results were obtained by Slavova et al. (2014).

The conducted research is a contribution to clarifying the influence of heavy metals on the properties and structure of soil communities.

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