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THE GROUND BEETLES (COLEOPTERA: CARABIDAE) FROM A SIGNIFICANT, BUT POORLY STUDIED REGION IN NW BULGARIA. PART 1: TAXONOMIC, FAUNISTIC AND ZOOGEOGRAPHIC NOTES

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Abstract

The paper presents results of the first study on the ground beetle fauna in the region of the Zlatiya Plateau. It aimed at clarifying the species composition and analyzing the zoogeographical structure of the carabid fauna followed by a subsequent assessment of the environmental trends and the extent of anthropogenic impact. Field work was carried out in the period March – October 2008. Ground beetles were collected with pitfall traps in 8 sampling sites representing the different types of habitats in the area. A total of 6598 adult carabid specimens were captured. They belonged to 138 species, 49 genera, and 20 tribes, representing almost 19 % of the species, 39 % of the genera and 56 % of the tribes included in the list of carabids of Bulgaria. The most species-rich was the genus *Harpalus* (25 species), followed by the genera *Amara* (14 species), *Ophonus* (13 species) and *Pterostichus* (11 species). The most abundant in specimens was the genus *Harpalus* (2461 ex.). The most abundant species were: *Harpalus tardus* (908 ex.), *Harpalus rufipes* (829 ex.), *Calathus fuscipes* (567 ex.), *Brachinus crepitans* (414 ex.), *Pterostichus melas* (355 ex.), *Abax carinatus* (348 ex.), *Ophonus laticollis* (199 ex.), *Anchomenus dorsalis* (168 ex.), *Carabus coriaceus* (168 ex.). For *Ophonus convexicollis*, a second certain location for Bulgaria was reported. Six species were new for the whole Bulgarian Danubian Plain: *Leistus ferrugineus*, *Amara sabulosa*, *Harpalus melancholicus*, *Pangus scaritides*, *Microlestes fulvibasis*, *Microlestes minutulus*. Remarkably, 120 species were new for the Western Danubian Plain, where the studied site is located. Most of the species were European-Neareastern (18 %), European and Central Asian (18 %), and Palearctic (12 %).

Key words: carabids, new species records, Western Danubian Plain, Zlatiya Plateau.

Introduction

Zlatiya or Zlatiyata is a loess plateau in the Bulgarian western Danubian Plain (Northwestern Bulgaria), situated between the Danube River and the town of Kozloduy in the north, the road connecting the town of Valchedram and the village of Hayredin to the south, and the currents of the Tsibritsa and Ogosta Rivers to the west and east, respectively. The territory includes mainly arable lands with intensively cultivated crops – predominantly wheat, sunflower and maize, and less barley, rapeseed and alfalfa. Natural vegetation is almost destroyed, with small patches preserved only along the Ogosta River and on the steep slopes around it. The territory is cut by many eroded gullies, overgrown with secondary (herbaceous) pseudo steppe vegetation, shrubs, and single trees. In separate places, the slopes of gullies are forested with black locust or are naturally grown with shoots of indigenous woody vegetation. Some of the deep ravines are intercepted and pooled by spring waters and small pools. In a similar way, but on a larger area Shishmanov Val Dam was built, once used as a leveller and fire facility of 'Kozloduy' Nuclear Power Plant, and subsequently used for irrigation purposes. Fragmented and scattered on relatively large distances, some pastures, orchards, vineyards, protective belts, and anti-erosion shafts are located near the settlements. Soils are chernozems characterized by high natural fertility and degraded to varying degrees (Galabov 1973, Zhelyazkov et al. 2004).

The depopulation of the region and the lack of grazing animals initially led to the overgrowing of most pastoral systems with ruderal nitrophilous vegetation. Subsequently, with the absorption of organic manure nitrogen and the reduction of soil fertility, a secondary derivative system formed on the eroded loess slopes. It is different from the pasture and is visually perceived as a steppe-like habitat.

The area of the plateau is 600 km^2 with an average altitude of about 100 m a.s.l. In 2008, with Order No RD-548 of 5 September, on 43,498.73 ha of the territory of the Zlatiyata two Natura 2000 zones are pronounced: SPA Zlatiyata (BG0002009), included in EU Directive 79/409, and SAC Zlatiya (BG0000336) of Directive 92/43. In 2005, BirdLife International pronounced the plateau as an Important Bird Area with code BG009 (Criteria B2, B3, and C6) and an area of 43,494.44 ha.

For territories similar to Zlatiya Plateau, the most typical are the representatives of the openly living beetles from the tribes Harpalini, Amarini and Sphodrini. In contrast, in less exposed and transitional habitats with increasing humidity, a greater proportion of the tribes Carabini, Pterostichini, Platynini and Nebriini is observed (Teofilova 2013, Kodzhabashev 2016). In biotopes with different soil and vegetation cover on highly urbanized territory of Dnipropetrovsk region with a similar environment, a rich carabid species composition of 280 species was found in a 10-year period of research (Brigadirenko 2003). During a research of Carabidae of the Danube River delta, 190 species were registered (Bašta 2002). However, the types of habitats in the mentioned studies were very different from those of Zlatiyata, so we cannot refer correctly to those data for comparison with our results. In a study of open habitat ground beetles in Belarus, using pitfall traps, 169 species were collected, many of which were macropterous steppe beetles from the tribes Harpalini and Amarini (Aleksandrowicz 2011). In habitats of the city of Kaluga, 64 ground beetle species were found, of which some Harpalini and Amarini species formed the stable, resident and most abundant part of the taxocoenoses, along with highly eurytopic species, like *Pterostichus melanarius* (Illiger, 1798) and *Limodromus assimilis* (Paykull, 1790) (Aleksanov et al. 2019).

So far, the area of Zlatiyata, and the Western part of the Bulgarian Danubian Plain has not been subjected to detailed investigations of the carabid fauna. Such studies are missing even in the adjacent Danube areas in Romania. The lack of reliable faunistic studies impedes the overall assessment of the species abundance, population size, nature of their spatial distribution, biodiversity and extent of anthropogenic impact. The present study aims to add new data to the list of Carabidae species from NW Bulgaria and to focus on clarifying the species composition and analyzing the zoogeographical structure of the carabid fauna followed by a subsequent assessment of the environmental trends and the extent of anthropogenic impact.

Materials and Methods

Field work was carried out in the period 1 March – 24 October 2008. Ground beetles were collected with pitfall traps. The traps were made of cut plastic bottles with 2 l volume and diameter of the enter hole about 12 cm, buried at the level of the substrate. As a fixation fluid, a 4 % solution of formaldehyde was used. In all sampling sites 12 traps were set with a distance of about 15 m between them. This method is suitable for ecological research on adult beetles, and mainly reflects their activity (Lövei and Sunderland 1996); there are no reasonable alternatives to this type of traps in the study of epigeic arthropod communities (Spence and Niemela 1994); it is considered that the application of this method allows approximately 95% of the species active in a radius of 50 m around the traps to be caught (Baars and Van Dijk 1984). The periods of the setting of the traps and collections were: from 01–04 March to 15–19 April 2008 (sampling period 1), from 15–19 April to 15–19 July 2008 (sampling period 2) and from 15–19 July to 20–24 October 2008 (sampling period 3). The investigations were performed at 8 different sampling sites (Fig. 1, Table 1).

Fig. 1. Location of Zlatiya Plateau in NW Bulgaria and an indication on the sampling sites.

Table 1. List and description of the studied sampling sites.

Code	Location	Sampling site description	Coordinates	Alt., m a.s.l.	Period
I	2 km SE of Zlatiya vill.	Harvested, not plowed wheat field, overgrown with nitrophilous weeds and ruderal vegetation.	N 43°43'46" E 23°31'18"	141	1, 2
II	~ 5 km E of Zlatiya vill.	Overgrown with marsh hygrophilous vegetation shore of a micro dam, built through subdivision of a gully with a small natural water source. The reservoir was heavily overgrown with reeds, bulrush (*Typha* L.) and willows (*Salix* L.), and the steep banks were afforested with Black locust (*Robinia pseudoacacia* L.).	N 43°44'03" E 23°35'06"	105	1, 2, 3
III	~ 5 km E of Zlatiya vill.	Pseudo-steppe-like habitat, located along the eroded slope of the ravine around the same micro dam, near the Black locust plantation. The territory was overgrown with xerothermic herbaceous vegetation, in places with shrubs and single trees.	N 43°44'01" E 23°35'15"	111	1, 2, 3
IV	1.4 km NE of Daneva melnitsa Site, near Hayredin vill.	The habitat was in the floodplain of the Ogosta River and was occupied by riparian woody vegetation – white poplar (*Populus alba* L.), alder (*Alnus* spp.), mulberry (*Morus* spp.) and elderberry (*Sambucus nigra* L.). The undergrowth consisted of *Amorpha fruticosa* L., elderberry, nettle and other meso-hygrophilic climbing and creeping plant species.	N 43°37'06" E 23°41'49"	55	1, 2, 3
V	NE Hayredin vill.	Old mesophilic mixed deciduous forest on an eastern slope, dominated by European oak (*Quercus robur* L.). Traps were located on the slope and reached the ridge part, which was an abandoned field.	N 43°37'04" E 23°41'49"	65	1, 2, 3
VI	SW coast of the Shishmanov Val Dam	Pannonian loess steppe grass habitat (code 6250/EUNIS code E1.2C1) situated on a loess hilly base and probably formed on an abandoned pasture after its degradation. At the time of research, it was a mesoxerophilic grassland with a pronounced gradient of humidity from the shore of the dam to the hill. As a result of the felling of the woody vegetation in the distant past, the superficial soil layer eroded, and in places were formed erosive furrows and small ravines.	N 43°44'27" E 23°36'54"	100	2, 3
VII	W Kozloduy, near the coast of the Danube River	Loess steppe habitat similar to the previous, but located between a loess hill and a vertical loess bank of the Danube River. Traps were located on a steep, landslide loess shaft, formed by the erosion processes of the shoreline of the river. The vegetation was similar to that of the previous habitat.	N 43°47'08" E 23°37'34"	65	2, 3
VIII	E Hayredin vill.	Actively grazed pasture with bushes and an active colony of sousliks (*Spermophilus citellus* L.). The terrain was well drained due to its ridge location. The vegetation was of pasture grass communities that withstand high-intensity grazing and prolonged trampling by livestock.	N 43°35'48" E 23°40'26"	67	2, 3

Captured animals were determined with the help of several main literature sources: Trautner and Geigenmüller (1987), Hůrka (1996), Arndt et al. (2011), Kryzhanovskij (Fauna Bulgarica – Carabidae, manuscript), and were deposited in the first author's collection in the Institute of Biodiversity and Ecosystem Research (Bulgarian Academy of Sciences, Sofia).

The systematic list follows Kryzhanovskij et al. (1995).

According to their zoogeographical affiliation, the ground beetle species were classified in zoogeographical categories and complexes according to Kryzhanovskij (1965, 1983, 2002), Vigna Taglianti et al. (1999), Casale and Vigna Taglianti (1999) and Kodzhabashev and Penev (2006), with modifications, done by the authors of the present study. The used zoogeographical complexes were: Northern Holarctic and European-Siberian complex, including species distributed mainly in the northern regions of the Holarctic, mostly in Europe and Siberia; European complex, including mostly forest dwelling species connected to the middle and southern parts of Europe; European-Asiatic complex, including species whose ranges fall between the Eurosiberian and Mediterranean zones; Mediterranean (*sensu lato*) complex, including species distributed in the so-called region of the 'Ancient Mediterraneum' (Popov 1927; Kryzhanovskij 1965, 1983, 2002); Endemic complex, including species with limited ranges.

Results

Taxonomic structure and ground beetle diversity

During the study, a total of 6598 adult carabid specimens were captured. Beetles belonged to 138 species, classified into 49 genera and 20 tribes. This figure represents almost 19 % of the species, 39 % of the genera and 56 % of the tribes included in the full list of Carabidae of Bulgaria, and 37 % of the species, 58 % of the genera and 65 % of the tribes established in the Danubian Plain (Teofilova and Guéorguiev, unpublished results). The complete check list of the established species with their full name, author and year of description, zoogeographic category, life form, state of wings development, and ecological group in the relation of the humidity is presented in the Appendix. All ecological data will be discussed in the forthcoming second part of this study.

Our investigation presents some new data about carabid diversity in Bulgaria. For *Ophonus convexicollis*, a second certain location for the country was given (for more details see Teofilova et al. 2020). Six species were new for the fauna of the Bulgarian Danubian Plain: *Leistus ferrugineus*, *Amara sabulosa*, *Harpalus melancholicus*, *Pangus scaritides*, *Microlestes fulvibasis* and *Microlestes minutulus*. Except for *L. ferrugineus*, all other species are characteristic for open xerothermic habitats, covered with herbaceous vegetation, and can be assigned to the group of the steppe species.

Remarkably, 120 species were ascertained to be new for the fauna of the Western Bulgarian Danubian Plain (calculations are according to the catalogue of Bulgarian carabids – Teofilova and Guéorguiev, unpublished results), where the studied site is located. Only *Calosoma auropunctatum*, *Carabus ullrichi*, *C. coriaceus*, *Asaphidion flavipes*, *Bembidion quadrimaculatum*, *Dolichus halensis*, *Amara aenea*, *A. anthobia*, *A. consularis* and *Chlaenius festivus* were previously reported in the literature about this region.

Representatives of 20 tribes were collected (tables 2 and 3). The most species-rich was the tribe Harpalini, probably due to the high presence of inhabitants of the open habitats (Fig. 2). The same pattern was also noticed with the abundance of the ground beetles – the largest number of specimens was established for the same tribe (Fig. 3).

Table 2. Comparison between the carabid faunas of Bulgaria, the whole Danubian Plain, and the present research.

Tribe	Bulgaria		Danubian Plain		Zlatiya	
	No sp.	%	No sp.	%	No sp.	%
Cicindelini	15	2.0	9	2.4	2	1.4
Omophronini	1	0.1	1	0.3	-	-
Nebriini	13	1.7	3	0.8	3	2.2
Notiophilini	10	1.3	3	0.8	1	0.7
Carabini	28	3.7	19	5.1	5	3.6
Cychrini	1	0.1	1	0.3	-	-
Elaphrini	4	0.5	3	0.8	1	0.7
Loricerini	1	0.1	-	-	-	-
Siagonini	1	0.1	-	-	-	-
Scaritini	2	0.3	2	0.5	-	-
Clivinini	4	0.5	4	1.1	-	-
Dyschiriini	31	4.1	13	3.5	1	0.7
Broscini	3	0.4	-	-	-	-
Apotomini	1	0.1	-	-	-	-
Trechini	55	7.4	7	1.9	1	0.7
Tachyini	19	2.5	9	2.4	1	0.7
Lovriciini	1	0.1	-	-	-	-
Bembidiini	98	13.1	47	12.7	4	2.9
Pogonini	13	1.7	2	0.5	-	-
Patrobini	1	0.1	1	0.3	-	-
Pterostichini	56	7.5	27	7.3	15	10.9
Sphodrini	23	3.1	15	4.0	9	6.5
Platynini	37	5.0	17	4.6	3	2.2
Zabrini	58	7.8	33	8.9	16	11.6
Harpalini	156	20.9	97	26.1	51	40.0
Perigonini	1	0.1	1	0.3	-	-
Panagaeini	2	0.3	2	0.5	2	1.4
Callistini	15	2.0	10	2.7	4	2.9
Oodini	2	0.3	1	0.3	-	-
Licinini	11	1.5	8	2.2	4	2.9
Masoreini	1	0.1	1	0.3	-	-
Odacanthini	1	0.1	-	-	-	-
Lebiini	56	7.5	26	7.0	11	8.0
Dryptini	1	0.1	1	0.3	1	0.7

Tribe	Bulgaria		Danubian Plain		Zlatiya	
	No sp.	%	No sp.	%	No sp.	%
Zuphiini	5	0.7	1	0.3	-	-
Brachinini	18	2.4	7	1.9	3	2.2
Paussini	1	0.1	-	-	-	-
Total No sp.	746		371		138	

Table 3. Number of specimens and species in the different tribes of Carabidae collected in the different sampling sites (I–VIII, Table 1).

Tribe	I		II		III		IV		V		VI		VII		VIII		Total	
	N	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*
Cicindelini	2	5	-	-	-	-	-	-	-	-	2	20	2	7	-	-	2	32
Nebriini	-	-	1	5	1	7	1	22	2	25	-	-	-	-	-	-	3	59
Notiophilini	-	-	-	-	-	-	1	26	1	3	-	-	-	-	-	-	1	29
Carabini	1	7	3	53	2	44	4	101	3	92	1	5	1	10	1	4	5	316
Elaphrini	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Dyschiriini	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	1	3
Trechini	-	-	1	9	1	31	1	7	1	55	-	-	-	-	1	1	1	103
Tachyini	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Bembidiini	-	-	2	8	-	-	2	13	-	-	-	-	-	-	-	-	4	21
Pterostichini	-	-	11	61	3	4	5	254	5	462	-	-	1	1	-	-	15	782
Sphodrini	4	10	1	1	4	4	5	66	4	123	5	628	5	23	5	31	9	886
Agonini	-	-	3	13	1	1	2	163	2	20	-	-	-	-	-	-	3	197
Amarini	3	3	7	75	8	44	9	166	6	23	2	28	4	14	3	10	16	363
Harpalini	11	152	25	342	19	713	18	582	12	492	32	458	22	252	21	233	51	3224
Panagaenini	-	-	2	24	2	7	-	-	-	-	-	-	-	-	-	-	2	31
Callistini	1	2	1	2	1	1	-	-	-	-	1	3	-	-	-	-	4	8
Licinini	-	-	3	21	3	6	2	2	1	2	1	1	1	4	-	-	4	36
Lebiini	1	1	5	8	4	8	3	14	1	1	7	28	-	-	1	2	11	62
Dryptini	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	1
Brachinini	1	2	2	10	1	73	3	179	2	161	2	15	1	2	1	1	3	443
Total	24	182	70	637	51	944	56	1595	40	1459	53	1186	37	313	33	282	138	6598

Note: *N* – number of species, *n* – number of specimens.

The taxonomic structure of the carabid complex showed a clear qualitative and quantitative predominance of the openly living species from the tribes Harpalini, Amarini and Sphodrini (totally over 60 %) over the predominantly forest or extrazonal coastal species from the tribes Agonini, Pterostichini, Nebriini, and Carabini.

The results of the quantitative data of the taxonomic structure (Fig. 3) showed even more convincingly the predominance of the xero-thermophilic faunistic elements from open habitats. Similarly to the qualitative data, the proportions of the quantitative significance of the tribes Pterostichini, Carabini, and Agonini can be attributed to the relatively good preservation of the forest fauna in refugia located around the river of Ogosta, regardless their relatively small size. Similarly, with relatively identical qualitative and quantitative proportions, intra-and extra-zonal

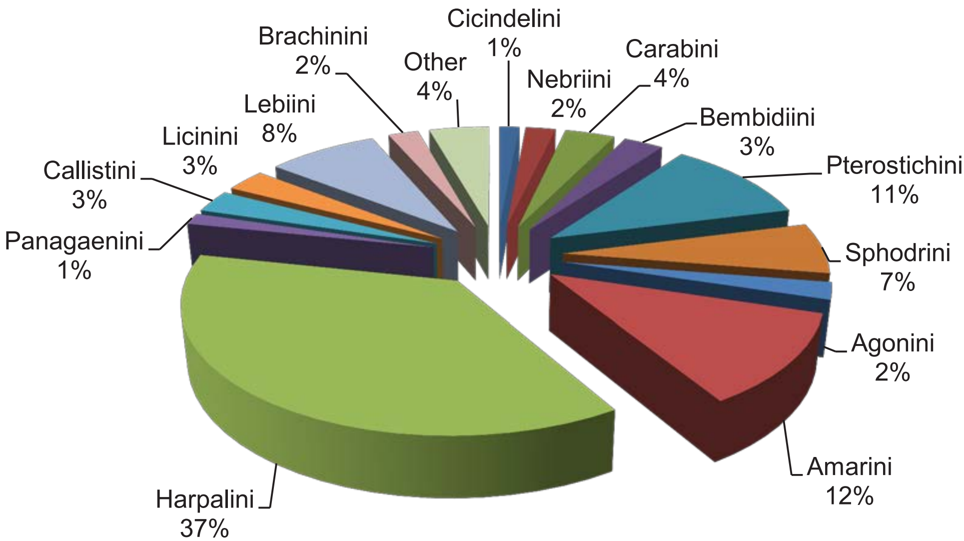

Fig. 2. Number of species in the different tribes.

Note: Section 'Other' includes tribes Notiophilini, Elaphrini, Dyschiriini, Trechini, Tachyini, Dryptini, each one represented by a single species.

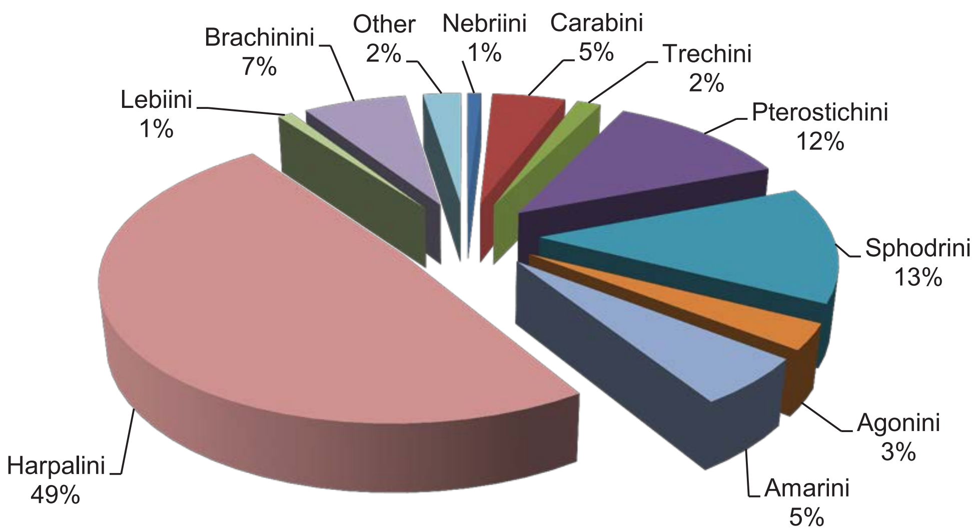

Fig. 3. Number of specimens in the different tribes.

Note: Section 'Other' includes all species, represented by less than 50 specimens (tribes Cicindelini, Notiophilini, Elaphrini, Dyschiriini, Tachyini, Bembidiini, Panagaenini, Callistini, Licinini, Dryptini).

coastal species were represented. They have survived in the preserved coastal habitats of rivers and artificial ponds.

The results obtained for the entire carabid complex showed that the most species-rich was the genus *Harpalus* (25 species), followed by the genera *Amara* (14 species), *Ophonus* (13 species), *Pterostichus* (11 species). Genera *Microlestes* and *Calathus* were represented by six species, and the genus *Carabus* – by four. Three species were found both in the genera *Bembidion* and *Brachinus*. With two species were presented the genera *Leistus*, *Zabrus*, *Stenolophus*, *Acinopus*, *Dixus*, *Panagaeus*, *Chlaenius*, *Licinus*, *Badister*, *Lebia*, *Synthomus*. Only one species was established for each of the genera *Cylindera, Cicindela*, *Nebria*, *Notiophilus*, *Calosoma*, *Elaphrus*, *Dyschiriodes*, *Trechus*, *Tachys*, *Asaphidion*, *Stomis*, *Myas*, *Poecilus*, *Abax*, *Dolichus, Laemostenus*, *Platyderus*, *Agonum*, *Limodromus*, *Anchomenus*, *Anisodactylus*, *Acupalpus*, *Anthracus, Parophonus*, *Pangus, Ablystomus, Callistus*, *Ditomus*, *Cymindis* and *Drypta*.

The largest number of specimens was also found in genus *Harpalus* (2461 ex.). Highly abundant were also the genera *Calathus* (782 ex.), *Ophonus* (583 ex.), *Brachinus* (443 ex.), *Pterostichus* (389 ex.), *Amara* (350 ex.), *Abax* (348 ex.) and *Carabus* (309 ex.). It is interesting to note that the number of specimens caught was not directly dependent on the number of species established in the genus concerned.

The most abundant species were: *Harpalus tardus* (908 ex.), *Harpalus rufipes* (829 ex.), *Carabus coriaceus* (168 ex.), *Brachinus crepitans* (414 ex.), *Pterostichus melas* (355 ex.), *Abax carinatus* (348 ex.), *Calathus fuscipes* (567 ex.), *Harpalus rubripes* (135 ex.), *Anchomenus dorsalis* (168 ex.), *Trechus quadristriatus* (103 ex.), *Carabus ullrichi* (120 ex.), *Calathus ambiguus* (127 ex.), *Ophonus laticollis* (199 ex.), *Amara anthobia* (118 ex.), *Harpalus subcylindricus* (110 ex.), *Harpalus caspius* (93 ex.). Twenty four species (17 %) were represented by a single specimen.

Zoogeographic structure

The zoogeographical analysis showed that the European and the Northern Holarctic and European-Siberian complexes prevailed, encompassing, respectively 39 (28%) and 37 (27%) of all established carabid species (Fig. 4). European-Asiatic complex consisted 31 species (22%), and the Mediterranean complex had 30 species (22 %). Endemic complex was represented only by one subendemic species (1 %).

The greatest number of species had the European-Neareastern, European-Central Asian, and Palaearctic zoogeographic categories (Table 4). These three categories were also the most abundant, as Palaearctic species were represented by one-third of all specimens (more than 2000) and European-Central Asian and European-Neareastern had, respectively, 26 % and 16 % of all specimens.

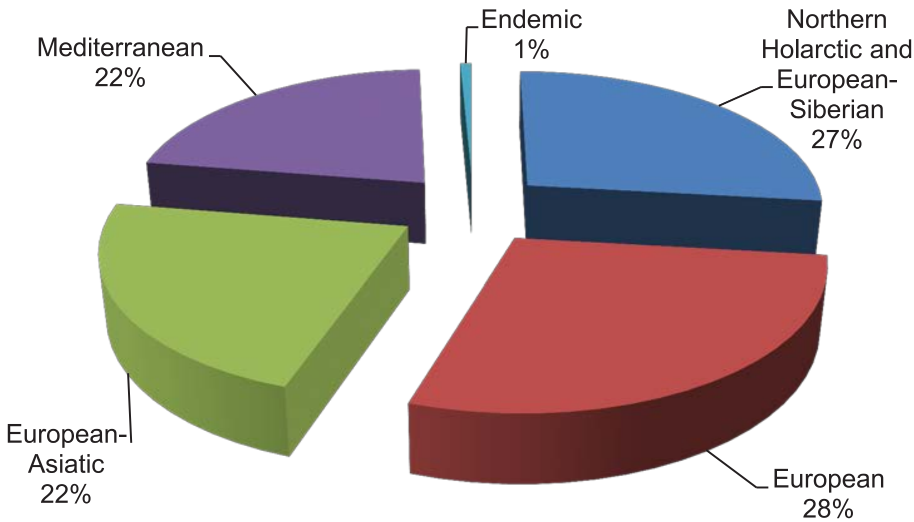

Fig. 4. Number of species in the different zoogeographic complexes.

Table 4. Zoogeographical categories of the ground beetles in the Zlatiya Plateau

Zoogeographical complex	Code	Zoogeographical element	Species	
			No	%
Northern Holarctic and European-Siberian	OLA	Holarctic	6	4
	PAL	Palaearctic	14	10
	WPAL	Western Palaearctic	6	4
	E-SI	European-Siberian	9	7
	E-WSI	European and West Siberian	2	1
European	E-PAS	European-Neareastern	25	18
	EUR	European	1	1
	CE-PAS	Central European and Neareastern	5	4
	CEE-PA	Central and Eastern European and Neareastern	2	1
	CE-E	Central and Eastern European	6	4
Euroasiatic	E-AS	Euroasiatic steppe and forest-steppe complex	7	5
	E-CAS	European and Central Asian	24	17
Mediterranean	E-CA-M	European-Central Asian-Mediterranean	9	7
	E-PA-M	European-Neareastern-Mediterranean	10	7
	CA-MED	Central Asian-Mediterranean	2	1
	MED-PA	Mediterranean-Neareastern	2	1
	NM-CAS	Northmediterranean-Central Asian	2	1
	NMED	Northmediterranean	3	2
	B-PAS	Balkan-Neareastern	2	1
Endemic	BAL-K	Balkan subendemic (Balkan-Carpathian)	1	1

Discussion

For the territory of Bulgaria the collection of 138 species for only one year and in a relatively small and compact territory, such as Zlatiya Plateau, indicates that the carabid fauna there can be evaluated as very rich. This fact is probably resulting from the landscape diversity (Petrov 1985, 1997) and the strongly expressed humidity gradient caused by the rivers Ogosta, Tsibritsa, and the Danube, on the one side, and the local xero-mesophilous habitats, on the other.

Similar to our results about the number and composition of the established carabids, using the method of collecting with pitfall traps, were also obtained in other regions of northern Bulgaria (Kodzhabashev and Penev 1998, Popov and Krusteva 1999, Teofilova et al. 2015, Kodzhabashev 2016). This method is widely used in ecological studies, despite the critics on the need for lengthy research periods and its unsuitability for catching small-sized species. In the analysis of the concrete carabid fauna, we will use as a comparison the data from similar studies in northern Bulgaria carried out with the same method.

Considering the full species compositions of the carabid fauna of Bulgaria and the Western Danubian Plain (Teofilova and Guéorguiev, unpublished results) (Table 2) and the fact that with this method for one year of sampling approximately 65 % of the species occurring in the given territory could be captured (Teofilova 2013, Kodzhabashev 2016), the probable species composition of the carabid fauna in the region in case of complete, long-term studies would grow up to 320–330 species and would be comparable to that of well researched regional faunas such as that of the Southern Dobrudzha (Kodzhabashev and Penev 1998, 2006), or even the fauna of large regions such as the whole Danubian Plain. Similar calculations were done about the carabid fauna of Dnipropetrovsk region, suggesting 180 additional species not found so far (Brigadirenko 2003). Table 2 demonstrates the differences in the proportions of the larger taxa, which is relevant to our analysis and conclusions.

Similar results about the taxonomic structure demonstrating the prevalence of tribe Harpalini were obtained for Southern Dobrudzha (Kodzhabashev and Penev 2006), Bulgarian Black Sea coast (Popov and Krusteva 1999, Teofilova et al. 2012, Teofilova et al. 2015) and Eastern Rhodope Mts. (Teofilova and Kodzhabashev 2020). Such taxonomic structure is typical for the forest-steppe zone in northern Bulgaria (Kodzhabashev and Penev 2006), where the natural forest-steppe landscape has gradually merged into a landscape of the open agricultural territories – fields and pastures. With the emergence of new habitats, a new faunistic complex has been formed and many xero-thermophilic species have expanded from south to north and from east to west, colonizing the newly deforested open spaces. The original taxonomic structure has probably undergone changes related to the transformation of the landscape, the increase of open areas, soil erosion, the felling of the vast forests and the droughting due to the reduced flows of the rivers of Ogosta and Tsibritsa, and the transition to more intensive land use. These changes have catalysed the expansion of invasive steppe Asian and thermophilic Mediterranean fauna, having enhanced taxonomic participation in the structure of the carabid fauna of the Zlatiya Plateau.

Similar to our results, the most species rich were the genera *Harpalus* (8 species) and *Calathus* (4 species) in an ecological study of the carabid communities in a fodder's mixture field in North Poland (Aleksandrowicz et al. 2009). The most species-rich was the genus *Harpalus* (17 species) in a study in Cefa Nature Park (Romania) too (Dehelean et al. 2012). Also, according to our research, *Calathus fuscipes* was among the most abundant species in suburban areas near Skopje (Gorgievska et al. 2009). Large numbers of specimens have been established for *Trechus quadristriatus* and *Anchomenus dorsalis* too by Dehelean et al. (2012).

The large percentage of species represented by a single specimen doesn't seem unusual, as it was also established in other studies (Coddington et al. 2009, Ferro et al. 2012, Teofilova 2013). Explanations of the presence of species represented by single specimens may be different – an insufficient number of samples or inappropriate collecting methods, as well as peculiarities in phenology or actual rarity of the species concerned (Novotný and Basset 2000, Coddington et al. 2009). On the other hand, some species that usually fall in the pitfall traps had very low significance in our research. Such species very often have an indicative value and conservation significance or may indicate the beginning of a species expansion and invasion. Exceptionally interesting is the complete absence of some species that are very common in neighboring areas. For example, in an intensive agricultural area near the village of Grivitsa (near Pleven) Popov and Krusteva (1988) established some widely spread species in Bulgaria, such as *Calosoma inquisitor* (Linnaeus, 1758), *Carabus montivagus* Palliardi, 1825, *Carabus scabriusculus* Olivier, 1795, and *Anisodactylus signatus* (Panzer, 1796), not recorded in our study.

One of the frequent disputes about the naturalness of the habitats in Zlatiyata includes the contemporary steppe-like habitats. The probable causes of their appearance are two: degradation of forest habitats after the felling of autochthonous forest vegetation or transformation of the primary steppe and subsequent secondary succession after cessation of almost all agricultural and livestock husbandry activities. The current steppe vegetation is mainly developed on unsuitable for agriculture inclined and eroded terrains or abandoned pastures, developing on a heavily drained and eroded loess base. Such are the loess landslide shafts on the Danube river coast, near the town of Kozloduy, and the steep coastal surroundings of Shishmanov Val Dam, which probably represent abandoned xerophilic pastures. Only in these habitats we found some rare steppe species, such as the newly established *Ophonus convexicollis, Harpalus melancholicus, Pangus scaritides*, *Microlestes fulvibasis*, as well as some stenotopic thermophilic xerobionts, as *O. subquadratus, O. melleti, H. tenebrosus, Acinopus ammophilus, A. picipes, Dytomus calydonius, Dixus clypeatus, D. obscurus, Chlaenius decipens*, *M. corticalis, M. negrita*, and *Cymindis lineata*. Most of these species have low relative significance and belong to the groups of the single, occasional or sporadic species. Pseudosteppe plant communities have been formed a long time ago and have acquired a specific appearance that predetermines specific micro-habitats inhabited by rare and extrazonal ground beetles, which are considered to be of conservation significance and a subject to strict protection.

Specific mesophilous forest species established in the forest refugia in Zlatiyata were: *Leistus rufomarginatus, Carabus ullrichi, C. convexus, Myas chalibaeus,* *Pterostichus melas, Abax carinatus, Platyderus rufus*. Most of these species were presented with single specimens, but as they were only found in this habitat type, they can be considered qualitative indicators. Riparian biotopes are inhabited by specific complexes of extrazonal coastal hygrophilous carabid species, many of which are rare due to special requirements for the conditions of the environment (e.g. *Elaphrus uliginosus*, *Dyschiriodes globosus*, *Pterostichus leonisi*, *P. elongatus*, *P. ovoideus*, *Agonum viduum*, *Stenolophus* ssp., etc.).

In the agrocoenoses we found mainly ecologically plastic eurytoptic species. The specific microclimate shaped by the land use regime, cereal monocultures and constant tempering also supports some stenotopic thermophilic xerobionts. Typical eurybionts (*Harpalus rufipes*, *H. rubripes*, *H. caspius*), usually eudominants, coexist with steppic stenobionts, some of which represented by a very small number of specimens (*Ophonus diffinis*, *H. fuscicornis*, *H. pygmaeus*, *H. hospes*, *Chlaenuis decipiens*).

It is probable that cultural and grassy agrocoenoses have long ago evolved into expansion corridors and peculiar agro-refugia for Asian steppe and Medterranean xero-thermophilic species, very often wrongly considered as conservationally significant. Given their survival in an aggressive environment, we consider that this type of secondary generated fauna should be treated as invasive and a threat to the indigenous faunistic complexes and elements. Similar observations were discussed in a study of steppe carabids in Belarus (Aleksandrowicz 2011).

The species newly established for the region have specific habitat requirements and six of them (*Ophonus convexicollis*, *O. schaubergerianus*, *Harpalus melancholicus*, *Pangus scaritides*, *Microlestes minutulus*, and *M. fulvibarbis*), along with 11 other species (e.g. *Calatus distinguendus*, *Acinopus ammophilus*, *Ditomus calydonius*, *Dixus clypeatus*, *D. obscurus*, *Chlaenius decipiens*, *Microlestes negrita*, *M. plagiatus*, *Cymindis lineata*) can be considered as indicative for the secondary loess steppe communities. Most of these species are xerotermophiles originally established for the southern regions of Bulgaria (Popov and Krusteva 1999). Their recent distribution is probably a consequence of global landscape and climate changes. During our investigation these species were recorded at least in one of the three steppe-like habitats and in none of the others except the pasture.

Zoogeographic structure of the species from Zlatiyata demonstrated some common features with that from the Eastern Rhodope Mts. (Teofilova and Kodzhabashev 2020), where the most species-rich were also the European-Neareastern, European-Central Asian and Palaearctic categories. The established zoogeographical qualitative and quantitative structures were somewhat similar, indicating a relatively homogeneous distribution of species and specimens in the study area. Combined qualitative values of the four zoogeographical complexes two by two, showed that the northern biota dominated over the southern by ~55 % to ~45 %, and in quantitative terms the percentages were exactly reversed. Probably many of the expanding thermophilic species are in process of colonization and the great variety of open habitat beetles is due to suitable agro-habitats. The loess steppes differ from the cultivated fields in species composition and specificity, with the prevailing of the Balkan-Neareastern and Mediterranean-Central Asian zoogeographical forms.

The quantitative zoogeographical structure was characterized by a relatively high percentage of the Palaearctic elements (33%), due to the great abundance of some eurybiont species, as well as some of the intrazonal species occurring in the waterside areas, and some forest species preserved in forest refugia located on steep river banks and slopes. From the group of the southern biota, relatively abundant were the species with European-Central Asian and European-Neareastern distribution, most of which are plastic open habitat forms. A similar distribution of the zoogeographic complexes of the carabids was also found in the eastern part of the Danubian Plain (Kodzhabashev and Penev 2006, Kodzhabashev 2016).

Conclusions

The analyses of the established carabid fauna in the region of Zlatiya showed the changes that have occurred due to anthropogenic impacts related to changes in landscape and land-use regime. As autochthonous and primary the forest and intrazonal riparian fauna can be considered. Due to the relatively long period of existence of the loess steppes, developed as a result of the felling of large forest areas and their subsequent use for pasture farming and intensive agriculture, a specific carabid complex of mainly xerophilous thermophiles was formed there. Some of them expand their ranges to the north, as a consequence of global climatic and landscape changes. Probably due to their initial stage of colonization, these newly established species are rare, being recorded with single findings.

It is difficult to assess whether a residual indigenousness or an onset of invasive expansion is the reason for the low density of most xero-thermophilic species. The lack of previous studies and recent data on the habitats' genesis in the western part of the Danubian Plain makes it difficult to objectively determine the conservation significance of the rare species. Their assessment can only be based on the modern distribution and analysis of data from similar studies in neighbouring or similar territories.

Following the principle of the ecological requirements to specific environmental factors, we will consider that all rare species are of conservation significance and require priority protection of their habitats.

Among the most drastic changes in the environment in the region, the felling of lowland mesophilic forests, ploughing of land for agricultural purposes and changes in the natural hydrologic regime of the rivers can be noted. Priority in protection of the conservationally significant habitats in the region should have forest refugia (remnants of mesophilic and floodplain forests), secondary steppe refugia (formed probably after the felling of forests and subsequent soil erosion) and riparian habitats.

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Appendix

List of Carabidae species established in the Zlatiya plateau region.

No	Species	Range type	Life form	WD	HP	Number of specimens in the different sampling sites								(n_i/N). 100, %	*F*, %
						I	II	III	IV	V	VI	VII	VIII		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	Tribe Cicindellini														
1	*Cylindera* (*Cylindera*) *germanica* (Linnaeus, 1758)	E-PAS	1.2.4	m	M	1					18	1		0.3	37.5
2	*Cicindela* (*Cicindela*) *campestris* Linnaeus, 1758	PAL	1.2.4	m	MX	4					2	6		0.18	37.5
	Tribe Nebriini														
3	*Leistus* (*Pogonophorus*) *rufomarginatus* (Duftschmid, 1812)	EUR	1.3(1).1	D	M					1				0.015	12.5
4	**Leistus* (*Leistus*) *ferrugineus* (Linnaeus, 1758)	E-SI	1.3(1).2	D	M		5	7						0.18	25
5	*Nebria* (*Nebria*) *brevicollis* (Fabricius, 1792)	E-PAS	1.3(1).1	D	MH				22	24				0.7	25
	Tribe Notiophilini														
6	*Notiophilus rufipes* Curtis, 1829	E-PAS	1.3(1).1	m	M				26	3				0.44	25
	Tribe Carabini														
7	*Calosoma* (*Campalita*) *auropunctatum* (Herbst, 1784)	E-CAS	1.2.2	m	MX	7								0.11	12.5
8	*Carabus* (*Eucarabus*) *ullrichi* Germar, 1824	CE-E	1.2.2	b	M		2	6	82	30				1.82	50
9	*Carabus* (*Carabus*) *granulatus* Linnaeus, 1758	E-SI	1.2.2	D	MH		8		1					0.14	25
10	*Carabus* (*Tomocarabus*) *convexus* Fabricius, 1775	E-PAS	1.2.2	b	MX				9	3				0.18	25
11	*Carabus* (*Procrustes*) *coriaceus* Linnaeus, 1758	E-PAS	1.2.2	b	E		43	38	11	57	5	10	4	2.55	87.5
	Tribe Elaphrini														
12	*Elaphrus* (*Neoelaphrus*) *uliginosus* Fabricius, 1792	E-CAS	1.2.3	m	H		1							0.015	12.5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Tribe Dyschiriini														
13	*Dyschirius* (*Eudyschirius*) *globosus* Herbst, 1784	PAL	1.4.2(1)	D	MH		3							0.045	12.5
	Tribe Trechini														
14	*Trechus* (*Trechus*) *quadristriatus* (Schrank, 1781)	E-CA-M	1.3(1).2	m	E		9	31	17	45			1	1.56	62.5
	Tribe Tachyini														
15	*Tachys* (*Paratachys*) *bistriatus* (Duftschmid, 1812)	E-PA-M	1.3(1).4	m	MH		1							0.015	12.5
	Tribe Bembidiini														
16	*Asaphidion flavipes* (Linnaeus, 1760)	WPAL	1.2.3	m	MH				12					0.18	12.5
17	*Bembidion* (*Metallina*) *lampros* (Herbst, 1784)	OLA	1.3(1).2	D	M				1					0.015	12.5
18	*Bembidion* (*Philochthus*) *inoptatum* Schaum, 1857	CE-PAS	1.3(1).1	m	H		1							0.015	12.5
19	*B.* (*Bembidion*) *quadrimaculatum* (Linnaeus, 1761)	PAL	1.3(1).1	m	MH		7							0.11	12.5
	Tribe Pterostichini														
20	*Stomis* (*Stomis*) *pumicatus* (Panzer, 1796)	E-PAS	1.3(1).2	D	MH		10	1	5	2				0.27	50
21	*Myas* (*Myas*) *chalybaeus* (Palliardi, 1825)	BAL-K	1.3(2).1	b	M					1				0.015	12.5
22	*Poecilus* (*Poecilus*) *cupreus* (Linnaeus, 1758)	E-AS	1.3(2).1	m	E		24	1	1					0.39	37.5
23	*Pterostichus* (*Platysma*) *niger* (Schaller, 1783)	E-AS	1.3(2).1	D	MH		1	2		3				0.09	37.5
24	*Pterostichus* (*Argutor*) *cursor* (Dejean, 1828)	E-CAS	1.3(1).2	m	H		2							0.03	12.5
25	*Pterostichus* (*Argutor*) *leonisi* Apfelbeck, 1904	CE-E	1.3(1).2	m	H		1							0.015	12.5
26	*Pterostichus* (*Adelosia*) *macer* (Marsham, 1802)	E-CAS	1.3(2).1	m	M		1							0.015	12.5
27	*Pt.* (*Pseudomaseus*) *anthracinus* (Illiger, 1798)	E-PAS	1.3(2).1	D	H		8							0.12	12.5
28	*Pt.* (*Pseudomaseus*) *nigrita* (Paykull, 1790)	PAL	1.3(2).1	D	H				2					0.03	12.5
29	*Pterostichus* (*Phonias*) *strenuus* (Panzer, 1796)	E-SI	1.3(1).2	D	MH		6							0.09	12.5
30	*Pterostichus* (*Phonias*) *ovoideus* (Sturm, 1824)	E-SI	1.3(2).1	D	MH		5							0.08	12.5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
31	*Pt.* (*Melanius*) *elongatus* (Duftschmid, 1812)	E-CA-M	1.3(2).1	m	H		2							0.03	12.5
32	*Pt.* (*Petrophilus*) *melanarius* (Illiger, 1798)	E-SI	1.3(2).1	D	E		1							0.015	12.5
33	*Pterostichus* (*Feronidius*) *melas* (Creutzer, 1799)	CEE-PA	1.3(2).1	b	MX				77	278				5.38	25
34	*Abax* (*Abacopercus*) *carinatus* (Duftschmid, 1812)	CE-E	1.3(2).1	b	M				188	159		1		5.27	37.5
	Tribe Sphodrini														
35	*Calathus* (*Calathus*) *distinguendus* Chaudoir, 1846	B-PAS	1.3(1).2	D	MX						2		3	0.08	25
36	*Calathus* (*Calathus*) *fuscipes* (Goeze, 1777)	PAL	1.3(1).2	D	E			1	4	104	429	7	22	8.59	75
37	*Calathus* (*Neocalathus*) *ambiguus* (Paykull, 1790)	E-CAS	1.3(1).2	m	MX	1					125	1		1.92	37.5
38	*C.* (*Neocalathus*) *erratus* C. R. Sahlberg, 1827	E-AS	1.3(1).2	D	MX						50			0.76	12.5
39	*Calathus* (*Neocalathus*) *mollis* (Marsham, 1802)	E-PA-M	1.3(1).2	D	X	1			1					0.03	25
40	*Calathus* (*Neocalathus*) *cinctus* Motschulsky, 1850	E-PAS	1.3(1).2	D	MX	2	1	1	1		22	1	3	0.47	87.5
41	*Dolichus halensis* (Schaller, 1783)	PAL	1.3(1).2	m	MX			1		3		2	1	0.11	50
42	*Laemostenus* (*Pristonychus*) *terricola* (Herbst, 1783)	E-PAS	1.3(1).6	D	M	6		1	1	2		12	2	0.36	75
43	*Platyderus* (*Platyderus*) *rufus* (Duftschmid, 1812)	CE-E	1.3(1).2	b	M				60	13				1.11	25
	Tribe Agonini														
44	*Agonum* (*Olisares*) *viduum* (Panzer, 1796)	E-SI	1.3(1).1	m	H		3			1				0.06	25
45	*Limodromus assimilis* (Paykull, 1790)	E-SI	1.3(1).2	m	MH		2		23					0.38	25
46	*Anchomenus dorsalis* (Pontoppidan, 1763)	PAL	1.3(1).1	m	E		8	1	140	19				2.55	50
	Tribe Zabrini														
47	*Amara* (*Zezea*) *tricuspidata* Dejean, 1831	E-CA-M	2.2.1	m	M		1							0.015	12.5
48	*Amara* (*Amara*) *aenea* (De Geer, 1774)	OLA	2.3.1	m	E	1	2	7	5		27	10	1	0.8	87.5
49	*A.* (*Amara*) *anthobia* A. Villa et G. B. Villa, 1833	E-PAS	2.1.1	m	MX				114	3			1	1.79	37.5
50	*Amara* (*Amara*) *convexior* Stephens, 1828	E-CAS	2.3.1	m	MX		58	22	9	7				1.45	50

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
51	*Amara* (*Amara*) *eurynota* (Panzer, 1796)	OLA	2.3.1	m	M		1							0.015	12.5
52	*Amara* (*Amara*) *communis* (Panzer, 1797)	E-SI	2.3.1	m	M			3	3					0.09	25
53	*Amara* (*Amara*) *familiaris* (Duftschmid, 1812)	OLA	2.1.1	m	E	1		1	1					0.045	37.5
54	*Amara* (*Amara*) *ovata* (Fabricius, 1792)	PAL	2.3.1	m	E				4					0.06	12.5
55	*Amara* (*Amara*) *saphyrea* Dejean, 1828	CE-E	2.3.1	m	MX				25	10				0.53	25
56	*Amara* (*Amara*) *similata* (Gyllenhal, 1810)	E-CA-M	2.3.1	m	E		7	2	3					0.18	37.5
57	*Amara* (*Celia*) *bifrons* (Gyllenhal, 1810)	E-CAS	2.3.1	m	MX		5	5		1	1	2		0.21	62.5
58	**Amara* (*Celia*) *sabulosa* (Audinet-Serville, 1821)	E-PAS	2.3.1	m	M			3						0.045	12.5
59	*Amara* (*Bradytus*) *consularis* (Duftschmid, 1812)	E-CAS	2.3.1(1)	m	MX					1				0.015	12.5
60	*Amara* (*Curtonotus*) *aulica* (Panzer, 1797)	E-AS	2.3.1	m	MX		1	1				1		0.045	37.5
61	*Zabrus* (*Zabrus*) *tenebrioides* (Goeze, 1777)	E-CAS	2.3.2	m	MX				1				8	0.14	25
62	*Zabrus* (*Pelor*) *spinipes* (Fabricius, 1798)	NMED	2.3.2	b	MX	1			2			1		0.06	37.5
	Tribe Harpalini														
63	*Anisodactylus* (*Anisodactylus*) *binotatus* (Fabricius, 1787)	E-AS	2.3.1	m	MH		3		1					0.06	25
64	*Stenolophus* (*Stenolophus*) *skrimshiranus* Stephens, 1828	WPAL	2.1.1	m	H		3							0.045	12.5
65	*Stenolophus* (*Stenolophus*) *mixtus* (Herbst, 1784)	PAL	2.1.1	m	H		69	1			1			1.08	37.5
66	*Acupalpus* (*Acupalpus*) *flavicollis* (Sturm, 1825)	E-CAS	2.1.1	m	MH		3							0.045	12.5
67	*Anthracus longicornis* (Schaum, 1857)	CE-PAS	2.1.1	m	H		1							0.015	12.5
68	*Parophonus* (*Parophonus*) *maculicornis* (Duftschmid, 1812)	E-PAS	2.2.1	m	M				4		1		1	0.09	37.5
69	*Ophonus* (*Metophonus*) *laticollis* Mannerheim, 1825	E-CAS	2.2.1	D	MX		1	6	99	90		3		3.02	62.5
70	*O.* (*Metophonus*) *cordatus* (Duftschmid, 1812)	E-PA-M	2.2.1	m	X				11	3	4		74	1.39	50
71	*Ophonus* (*Metophonus*) *puncticeps* Stephens, 1828	E-PA-M	2.2.1	m	MX		4	4	2	17	1	6	2	0.55	87.5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
72	*Ophonus* (*Metophonus*) *rufibarbis* (Fabricius, 1792)	WPAL	2.2.1	m	M		2		21			1		0.36	37.5
73	*O.* (*Metophonus*) *schaubergerianus* (Puel, 1937)	CEE-PA	2.2.1	m	M		1	3						0.06	25
74	*Ophonus* (*Metophonus*) *melleti* (Heer, 1837)	E-PAS	2.2.1	m	MX		1						1	0.03	25
75	*Ophonus* (*Metophonus*) *subsinuatus* Rey, 1886	E-PA-M	2.2.1	m	MX		1							0.015	12.5
76	***O.* (*Hesperophonus*) *convexicollis* Ménétriés, 1832	B-PAS	2.2.1	n.a.	MX						1			0.015	12.5
77	*O.* (*Hesperophonus*) *azureus* (Fabricius, 1775)	E-CA-M	2.2.1	D	MX		7	42	1	1	27	1	11	1.36	87.5
78	*O.* (*Hesperophonus*) *subquadratus* (Dejean, 1829)	E-CA-M	2.2.1	m	MX							1		0.015	12.5
79	*O.* (*Hesperophonus*) *cribricollis* (Dejean, 1829)	E-CAS	2.2.1	m	MX			2	2		35	20	6	0.98	62.5
80	*Ophonus* (*Ophonus*) *diffinis* (Dejean, 1829)	E-PAS	2.2.1	m	X	1								0.015	12.5
81	*Ophonus* (*Ophonus*) *sabulicola* (Panzer, 1796)	E-PAS	2.2.1	m	MX		1	5				41	20	1.02	50
82	*Harpalus* (*Semiophonus*) *signaticornis* (Duftschmid, 1812)	E-CAS	2.2.1	m	MX						20		15	0.53	25
83	*Harpalus* (*Pseudophonus*) *rufipes* (Degeer, 1774)	PAL	2.2.1	m	E	117	101	80	226	185	33	85	2	12.56	100
84	*Harpalus* (*Pseudophonus*) *griseus* (Panzer, 1797)	PAL	2.2.1	m	MX	4	3	2		2	2	2	2	0.26	87.5
85	*H.* (*Pseudophonus*) *calceatus* (Duftschmid, 1812)	PAL	2.3.1	m	X	2	4	2			5		1	0.21	62.5
86	*Harpalus* (*Cryptophonus*) *tenebrosus* Dejean, 1829	E-CA-M	2.3.1	m	MX							1	6	0.11	25
87	**H.* (*Cryptophonus*) *melancholicus* Dejean, 1829	E-PAS	2.3.1	m	MX						5			0.08	12.5
88	*Harpalus* (*Harpalus*) *rubripes* (Duftschmid, 1812)	OLA	2.3.1	m	E	4	2	20	2	1	66	22	18	2.05	100

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
89	*Harpalus* (*Harpalus*) *attenuatus* Stephens, 1828	E-PA-M	2.3.1	m	MX						1	1		0.03	25
90	*Harpalus* (*Harpalus*) *atratus* Latreille, 1804	E-CAS	2.3.1	D	MX				26	66		1		1.41	37.5
91	*Harpalus* (*Harpalus*) *serripes* (Quensel, 1806)	WPAL	2.3.1	m	MX		1				3		6	0.15	37.5
92	*Harpalus* (*Harpalus*) *flavicornis* Dejean, 1829	CE-PAS	2.3.1	D	MX			27	2		25	9	11	1.12	62.5
93	*Harpalus* (*Harpalus*) *pumilus* Sturm, 1818	E-CAS	2.3.1	D	MX			6			18	1		0.38	37.5
94	*Harpalus* (*Harpalus*) *subcylindricus* Dejean, 1829	E-CAS	2.3.1	m	X		2	1			106	1		1.67	50
95	*Harpalus* (*Harpalus*) *zabroides* Dejean, 1829	E-SI	2.3.2	m	X			1						0.015	12.5
96	*Harpalus* (*Harpalus*) *tardus* (Panzer, 1796)	E-CAS	2.3.1	m	E		115	457	186	111	16	7	16	13.76	87.5
97	*Harpalus* (*Harpalus*) *albanicus* Reitter, 1900	E-PAS	2.3.1	m	X		8	23	4		18	2		0.83	62.5
98	*Harpalus* (*Harpalus*) *latus* (Linnaeus, 1758)	E-AS	2.3.1	m	E		1		2	1				0.06	37.5
99	*Harpalus* (*Harpalus*) *fuscicornis* Ménétriés, 1832	WPAL	2.3.1	m	MX	1								0.015	12.5
100	*H.* (*Harpalus*) *smaragdinus* (Duftschmid, 1812)	E-AS	2.3.1	m	X						15			0.23	12.5
101	*Harpalus* (*Harpalus*) *dimidiatus* (P. Rossi, 1790)	E-PAS	2.3.1	m	MX		1		1		1			0.045	37.5
102	*Harpalus* (*Harpalus*) *caspius* (Steven, 1806)	E-PAS	2.3.1	m	X	5	6	28	2	3	8	38	3	1.41	100
103	*Harpalus* (*Harpalus*) *pygmaeus* Dejean, 1829	NMED	2.3.1	m	MX	1					1			0.03	25
104	*Harpalus* (*Harpalus*) *hospes* Sturm, 1818	CE-PAS	2.3.1	m	X	1					1			0.03	25
105	*Harpalus* (*Harpalus*) *affinis* (Schrank, 1781)	E-CAS	2.3.1	m	MX						3			0.045	12.5
106	*H.* (*Harpalus*) *distinguendus* (Duftschmid, 1812)	PAL	2.3.1	m	E	11	1		1	1	3	1		0.27	75
107	**Pangus scaritides* (Sturm, 1818)	E-PA-M	2.3.1	m	MX						1		1	0.03	25
108	*Acinopus* (*Acinopus*) *picipes* (Olivier, 1795)	NMED	2.3.2	D	MX	5					1	4	21	0.47	50
109	*Acinopus* (*Osimus*) *ammophilus* Dejean, 1829	CE-PAS	2.3.2	b	X						8		14	0.33	25
110	*Ditomus calydonius* (P. Rossi, 1790)	NM-CAS	2.3.3	m	MX							4		0.06	12.5
111	*Dixus clypeatus* (P. Rossi, 1790)	E-PA-M	2.3.3	m	X						18		2	0.3	25
112	*Dixus obscurus* (Dejean, 1825)	NM-CAS	2.3.3	m	X						10			0.15	12.5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
113	*Ablystomus metallescens* (Dejean, 1829)	MED-PA	2.1.1	m	MH			3						0.045	12.5
	Tribe Panagaeini														
114	*Panagaeus* (*Panagaeus*) *bipustulatus* (Fabricius, 1775)	E-PAS	1.3(1).1	m	MX		14	4						0.27	25
115	*P.* (*Panagaeus*) *cruxmajor* (Linnaeus, 1758)	E-WSI	1.3(1).1	m	MH		10	3						0.2	25
	Tribe Callistini														
116	*Callistus lunatus* (Fabricius, 1775)	E-CAS	1.3(1).1	m	MH	2								0.03	12.5
117	*Chlaenius* (*Dinodes*) *decipiens* (L. Dufour, 1820)	E-PA-M	1.3(1).1	m	MX						3			0.045	12.5
118	*Chlaenius* (*Chlaenius*) *festivus* (Panzer, 1796)	E-CAS	1.3(1).1	m	H		2							0.03	12.5
119	*Chl.* (*Chlaeniellus*) *nigricornis* (Fabricius, 1787)	E-PAS	1.3(1).1	m	H			1						0.015	12.5
	Tribe Licinini														
120	*Licinus* (*Licinus*) *depressus* (Paykull, 1790)	E-WSI	1.3(1).1	D	M		14	2						0.24	25
121	*Licinus* (*Licinus*) *cassideus* (Fabricius, 1792)	E-PAS	1.3(1).1	b	X			2	2		1	4		0.14	50
122	*Badister* (*Badister*) *bullatus* (Schrank, 1798)	E-PAS	1.3(1).1	m	M		4	2	1					0.11	37.5
123	*Badister* (*Badister*) *lacertosus* Sturm, 1815	E-PAS	1.3(1).2	m	MH		3		1					0.06	25
	Tribe Lebiini														
124	*Lebia* (*Lamprias*) *chlorocephala* (J. J. Hoffman, 1803)	E-CAS	1.1.3	m	M		1	1						0.03	25
125	*Lebia* (*Lebia*) *humeralis* Dejean, 1825	CE-E	1.1.3	m	M		1							0.015	12.5
126	*Syntomus obscuroguttatus* (Duftschmid, 1812)	E-PA-M	1.3(1).3	m	M		3	1	7	1				0.18	50
127	*Syntomus pallipes* (Dejean, 1825)	E-CA-M	1.3(1).3	D	MX		1		6					0.11	25
128	*Microlestes corticalis* (L. Dufour, 1820)	CA-MED	1.3(1).3	m	M						12			0.18	12.5
129	*Microlestes fissuralis* (Reitter, 1901)	E-CAS	1.3(1).3	D	M	1		2	1		2			0.09	50
130	**Microlestes fulvibasis* (Reitter, 1901)	CA-MED	1.3(1).3	b	M						2			0.03	12.5
131	**Microlestes minutulus* (Goeze, 1777)	OLA	1.3(1).3	D	MX		2	4			6		2	0.21	50

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
132	*Microlestes negrita* (Wollaston, 1854)	MED-PA	1.3(1).3	D	MX						1			0.015	12.5
133	*Microlestes plagiatus* (Duftschmid, 1812)	E-CAS	1.3(1).3	m	M						1			0.015	12.5
134	*Cymindis* (*Cymindis*) *lineata* (Quensel in Schonherr, 1806)	E-PAS	1.3(1).2	m	MX						4			0.06	12.5
	Tribe Dryptini														
135	*Drypta* (*Drypta*) *dentata* (P. Rossi, 1790)	WPAL	1.1.2	m	H			1						0.015	12.5
	Tribe Brachinini														
136	*Brachinus* (*Brachinus*) *crepitans* (Linnaeus, 1758)	PAL	1.3(1).3	D	MX	2	8	73	167	160	2	2		6.28	87.5
137	*Br.* (*Brachinus*) *psophia* Audinet-Serville, 1821	E-CA-M	1.3(1).3	m	MX				1					0.42	12.5
138	*Br.* (*Brachynidius*) *explodens* Duftschmid, 1812	E-CAS	1.3(1).3	m	MX		2		11	1	13		1	0.015	62.5
	Total:					182	637	944	1641	1413	1186	313	282		

Notes:

* – new for the Danube Plain; ** – second record for the Bulgarian fauna.

Column No 1. Consecutive number.

Column No 2. List of the species recorded in the Zlatiya plateau.

Column No 3. Zoogeographical belonging. Explanation to the codes are given in Table 4 in the Results section of the paper.

Column No 4. Life forms. Explanation to the indexes and discussion of the life forms will be presented in the next part of the paper (Part 2. Ecology).

Column No 5. WD – wing development (m – macropterous, D – di(poly)morphic, b – brachypterous, n.a. – no data). Discussion will be presented in the next part of the paper (Part 2. Ecology).

Column No 6. HP – humidity preference (H – hygrophilous, MH – mesohygrophilous; M – mesophilous, MX – mesoxerophilous, X – xerophilous, E – eurybiont). Discussion will be presented in the next part of the paper (Part 2. Ecology).

Column No 7–14. Numbers of collected ground beetles in the different sampling sites (I–VIII, Table 1).

Column No 15. Degree of dominance [(n_i/N).100]. Discussion of the dominance structure will be presented in the next part of the paper (Part 2. Ecology).

Column No 16. Frequency of occurrence [F, %]. Discussion of the occurrence will be presented in the next part of the paper (Part 2. Ecology).