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GROUND BEETLES OF THE TRIBE CARABINI (COLEOPTERA, CARABIDAE) IN THE MAIN MEGAPOLISES OF UKRAINE

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Ground Beetles of the Tribe Carabini (Coleoptera, Carabidae) in the Main Megapolises of Ukraine.

Putchkov, A. V., Brygadyrenko, V. V., Markina, T. Y. — We analysed the structure of the communities of the ground beetles of the tribe Carabini (Coleoptera, Carabidae) in urban environments on the examples of Kyiv, Kharkiv, Dnipro, Donetsk and Lviv. The ground beetles of this tribe in the five researched megapolises are represented by 24 species of the *Calosoma* and *Carabus* genera. The cities each have from 9 (Kharkiv, Donetsk) — 11 (Kyiv) to 14–15 (Dnipro, Lviv) registered species. Only three species (*Carabus granulatus*, *C. cancellatus*, *C. convexus*) turned out to be present in all the studied cities, where they were relatively abundant, and six (*Calosoma auro-punctatum*, *C. inquisitor*, *Carabus coriaceus*, *C. marginalis*, *C. nemoralis*, *C. scabriusculus*) were recorded reasonably frequently in most of the cities. In the parks of Kyiv and Lviv (south forest zone), forest (*Carabus coriaceus*, *C. convexus*, *C. nemoralis*) and polytopic species (*C. cancellatus*) were dominant, while the inhabitants of open biotopes (*C. granulatus*, *C. excellens*, *C. scabriusculus*) were uncommon. In Kharkiv (forest-steppe zone), the common species were both polytopic (*Carabus granulatus*, *C. cancellatus*) and forest (*C. marginalis*). In Donetsk and Dnipro (steppe zone), some steppe elements (*Carabus estreicheri*, *C. perrini*, *C. sibiricus*) occurred, but the dominant species were habitat generalist (*C. granulatus*) and certain forest species (*C. convexus*). At the same time, almost half the recorded species of the tribe were registered as rare or accidental elements in the cities studied, though typical for the natural biocenoses of the geographic region surrounding those cities. A short ecological characteristic of all species of tribe in urbocenoses is given.

Key words: *Carabus*, *Calosoma*, Ukraine, city parks, distribution, occurrence, rare species.

Introduction

Cities, especially large cities, are a specific habitat for many invertebrates, including insects. The study of the processes of entomofauna formation allows us to understand the peculiarities of interspecies interactions, their role and adaptation abilities in urban conditions, and also allows us to conduct ecological evaluation of the processes taking place in urbocenoses. The largest order of insects is beetles (Coleoptera), of which the ground beetles (Carabidae) is one of the dominant groups. Being inhabitants of all terrestrial natural and transformed ecosystems, ground beetles in urban landscapes are described in a large number of publications. These cover the questions of taxonomic and ecological structures, distribution of the main species in the urban landscapes of many cities of Central (Becker, 1977; Mader, 1980; Czechowski, 1981, 1982; Klausnitzer, 1981, 1983; Klausnitzer & Richter, 1983; Šustek, 1987, 1999, 2012; Hurka & Jedlickova, 1990; Elechtner & Klinger, 1991; Magura et al., 2004; Penev et al., 2008; Kosewska et al., 2013) and Eastern Europe (Soboleva-Dokuchaeva, 1993; Aleksandrowicz, 1997; Molodova & Kovderko, 1997; Halinowski & Aleksandrowicz, 2004, Ryzhaia, 2005; Khabibullina & Timofeeva, 2009; Halinowski, 2001, 2012; Halinowski & Krytskaya, 2014). These studies have enabled us to obtain interesting faunistic data and to evaluate the role and survival abilities of Carabidae representatives in the conditions of quasi-natural constituents — urban landscapes (parks, garden squares, gardens, etc).

In Ukraine, scattered studies of this type (with different levels of thoroughness) have been conducted in a number of megapolises — Kyiv (Putchkov et al., 2003, 2016, 2017; Kirichenko & Danylkiv, 2011), Kharkiv (Putchkov et al., 2016, 2017), Lviv (Rizun & Khrapov, 2001; Rizun & Diedus, 2016) and Dnipro (Faly & Brygadyrenko, 2014; Brygadyrenko, 2015, 2016). However, all the above mentioned studies provide general data on Carabidae regarding a particular city or even its particular territories. Also, a fuller understanding of the peculiarities of the formation of a city carabidofauna (as with other groups of insects) requires a generalized analysis of their ecological-faunistic structure in similar, but geographically remote urban ecosystems, which would allow one to determine the patterns in the reaction of the insects to the conditions of the environment. Despite the fact that the Carabini tribe is the most studied, data on most Carabini species in Ukrainian urbocenoses are insufficient and fragmented (Putchkov, 2018; Putchkov et al., 2003; Diedus, 2016; Putchkov & Shumov, 2016).

The objective of this article to compare the species composition, ecological peculiarities, occurrence and pattern of formation of complexes of ground beetles on the example of the Carabini tribe in the urbocenoses of large Ukrainian cities.

Material and methods

This article is based on our research in Kyiv (1999–2001, 2015–2017, Lysa Hora and Hodosiivsky parks), Kharkiv (2014–2017, Peremoha, Mashynobudivnykiv, Zeleny Hay, Karpovsky Sad, Lisopark parks) and in Dnipro (1993–2017). In addition, we used data on Donetsk (kindly provided by V. V. Martynov for 2003–2004 in Putylivka, Sherbakivka, Rakovka, and Lenkom parks) and literature data on two parks in Lviv (Rizun & Khrapov, 2001; Rizun & Diedus, 2016; Diedus, 2016). The beetles were collected, mostly, using pit-fall traps (plastic cups of 0.2 or 0.5 l, filled with 10 % solution of acetic acid or 4 % solution of formalin) and manually from natural shelters and recording during route surveys. The extraction of the beetles from the traps was made at 10–15 day intervals starting from May till late August (Kyiv, Donetsk) or September (Kharkiv, Dnipro). 10–30 pit-fall traps were placed in each biotope. Counts were also undertaken for some agroecosystems (private plots, uncultivated areas, gardens) and woodland shelter belts on the outskirts of Kharkiv and Kyiv.

For evaluating the similarities in the composition of insects in particular areas, we used the Jaccard similarity coefficient and (for comparison) the Czekanowski-Sorensen index, and for the indicators of species richness, diversity and occurrence, we used the familiar indices of Shannon, Pielou, Margalef, Menhinick (Brygadyrenko, 2015). In the cluster analysis in the Statistica 8.0 pack (StatSoft Inc., USA), we used the single linkage in Euclidean distance. Additionally (on the example of Kyiv), we conducted a comparative period analysis of the occurrence of *Carabus* species using data collected in the late 90s and nowadays.

In total, we caught and processed around 1,500 individuals of Carabini ground beetles. According to the number (relative to the total number collected), we divided the beetles into four groups: abundant or dominant species (over 5 % of the total number of individuals caught belonging to the superfamily), common or subdominant (0.5–5.0 %), rare (less than 0.5 %) and single specimen species (less than 3 individuals during all years of the study). In some cases, we used the term “superdominant” (over 30 % of the total number of caught beetles).

In addition, the quantitative characteristic of the species occurrence is provided for the frequency of occurrence of groups (superdominants, transgradient (evenly distributed across several contiguous ecological gradients), dispersive species and species with diffusive spreading) using the representative analysis which allows determination of the differences in the pattern of the path of certain ecologically different species to the cities and in the extent of their distribution in relation to certain areas (Klausnitzer, 1983, 1990). The characteristic of the ecological structure (biotopic, hygropreference) is provided for imagoes using our observations and using the literature data (Putchkov, 2008, 2011, 2018). The classification of the tribe is made according to the Catalogue of the Palearctic beetles (Bousquet et al., 2003).

Results and discussion

In total, in the studied Ukrainian megapolises, 24 species of two genera: *Calosoma* (3) and *Carabus* (20 species) (table 1) were registered, including 11 in the urbocenoses of Kyiv, 9 in Donetsk and Kharkiv, 14 in Dnipro, and 15 in Lviv. The differences in the number of species are more likely to be related to the duration of recording (two years both in Donetsk and Kharkiv; five to more years in the rest of the cities) than to impoverishment of fauna in certain megapolises. This is proved by the fact that the majority of the registered species (around 15 in total) are extremely rare in the studied urbocenoses (table 1), and their appearance there is occasional. The relative number of the rest of the species fluctuated from dominant to rare. Only three species (the habitat generalist *Carabus granulatus*, *C. cancellatus* and the forest *C. convexus*) turned out to be present in relatively high numbers in all the megapolises. Two other species of the genus *Calosoma* (*C. auropunctatum*, *C. inquisitor*) and four of *Carabus* (*C. nemoralis*, *C. violaceus*, *C. marginalis*, *C. scabriusculus*) were often recorded in the parks of some of the studied cities (but their abundance varied).

The diversity of tribe the Carabini (expressed in the Shannon index) in the megapolises of Ukraine was higher in the parks of Kyiv, Dnipro and Lviv due to higher number of the registered species (especially that of rare species). Comparison of the Margalef and Menchinik indices gave similar results. The values of the indicators were at their maximum in Dnipro and Lviv (the megapolises with the highest number of recorded species), but minimum in Kharkiv and Donetsk, where the number of species was more than one third lower than in the other megapolises (table 1). However, the high values of the Pielou index for all cities were almost at the same level, which could indicate a significant oligo-dominance of the Carabini species composition in each megapolis. Only 2–3 (rarely 4) species were found to be permanently abundant (regardless of the plot or year of the survey) in any particular city.

On the whole, the species range of the tribe significantly depends on the ecological zonal correspondence of the different species. In general, in the urbocenoses of Kyiv (south of the forest and the north of the forest-steppe zones) typical forest (*C. coriaceus*, *C. convexus*, *C. nemoralis*) and relatively polytopic species (*C. cancellatus*) are common, while the inhabitants of open biotopes (*C. granulatus*, *C. excellens*, *C. scabriusculus*) occur more rarely. In the biotopes of Kharkiv (forest-steppe zone), the common species are both polytopic (*C. granulatus*, *C. cancellatus*) and some ecologically flexible forest species (*C. marginalis*). In Donetsk and Dnipro (steppe zone), some steppe elements occur (*C. estreicherii*, *C. errans*), but the dominant species are habitat generalist meadow (*C. granulatus*) and some forest (*C. convexus*) inhabitants. This, to some extent, indicates the character of these territories as transitional between the steppe and the forest-steppe zones.

The peculiarities of the species composition of the tribe in the different megapolises were proved by a simple analysis of their faunistic similarities (table 2). According to the gradient east/north–south, it turned out to be lowest for Lviv/Donetsk and Dnipro (0.14–0.22 and 0.25–0.36 according to the Jaccard and Czekanowski-Sørensen indices respectively) and also for Kharkiv (0.26 and 0.42). The average values were registered for Kyiv/Dnipro, Lviv/Kyiv (0.39 and 0.56), Kharkiv/Dnipro and Donetsk (0.35–0.46 and 0.52–0.67 respectively). The highest similarity was observed for Kyiv and Kharkiv (0.54 and 0.70). This tendency was proved after comparing the species composition of the tribe with other (relatively close territorially) cities, for example in Ukraine and Belarus. The level of similarities of Carabini in the urbocenoses of Kyiv and Gomel (Halinouski, Krytskaya, 2015) was 0.62 and 0.73. For Kharkiv and Lviv/Gomel, the values were slightly lower (0.46–0.63 and 0.37–0.54 respectively). The lowest similarity was found after comparing Carabini of the urbocenoses of Gomel/Dnipro and Donetsk — 0.19–0.32 and 0.25–0.40. Similar results were obtained after comparing the species composition of the tribe in these megapolises of Ukraine and Minsk (Aleksandrowicz, 1997; Halinouski, Aleksandrowicz, 2004, Halinouski, 2001, 2012).

Table 1. Species of tribe Carabini in the megapolises of Ukraine

Species of tribe Carabini	Parks in the cities				
	Kyiv	Kharkiv	Dnipro	Donetsk	Lviv
<i>Calosoma</i> (s. str.) <i>inquisitor</i> (Linnaeus, 1758)	1	2-3	1	2-3	-
<i>C. (Campalita) auropunctatum</i> (Herbst, 1784)	1	1	2	1	-
<i>C. (Campalita) denticolle</i> Gebler, 1833	-	-	1	-	-
<i>Carabus (Archicarabus) nemoralis</i> O. F. Müller, 1764	2-4	3-4	-	-	1
<i>C. (s. str.) arcensis</i> Herbst, 1784	-	-	-	-	1-3
<i>C. (s. str.) granulatus</i> Linnaeus, 1758	2-3	2-3	3-4	2-4	2-4
<i>C. (Chaetocarabus) intricatus</i> Linnaeus, 1761	-	-	-	-	1
<i>C. (Hydrocarabus) variolosus</i> Fabricius, 1787	-	-	-	-	1
<i>C. (Linnocarabus) clathratus</i> Linnaeus, 1761	-	-	1	-	1
<i>C. (Megodontus) violaceus</i> Linnaeus, 1758	1	1	-	-	1
<i>C. (Morphocarabus) excellens</i> Fabricius, 1798	2-4	-	1	-	-
<i>C. (Oreocarabus) glabratus</i> Paykull, 1790	-	-	-	-	1-3
<i>C. (Oreocarabus) hortensis</i> Linnaeus, 1758	1	-	-	-	1
<i>C. (Orinocarabus) linnei</i> Panzer, 1810	-	-	-	-	1-2
<i>C. (Procrustes) coriaceus</i> Linnaeus, 1758	2-4	1	-	-	2-3
<i>C. (Pachystus) hungaricus scythus</i> Motschulsky, 1847	-	-	1	-	-
<i>C. (Tachypus) cancellatus</i> Illiger, 1798	2-4	2-3	3-4	1-2	2-3
<i>C. (Tomocarabus) convexus</i> Fabricius, 1775	2-4	1	1	2-4	1
<i>C. (Tomocarabus) marginalis</i> Fabricius, 1794	-	1-3	1	1	-
<i>C. (Trachycarabus) estreicheri</i> Fischer von Waldheim, 1820	-	-	1	1-3	-
<i>C. (Trachycarabus) perrini</i> Dejean, 1831	-	-	-	1	-
<i>C. (Trachycarabus) scabriusculus</i> Olivier, 1795	2-3	-	3-4	-	1-3
<i>C. (Trachycarabus) sibiricus</i> Fischer von Waldheim, 1820	-	-	1	1-2	-
<i>C. (Trachycarabus) besseri</i> Fischer von Waldheim, 1820	-	-	1	-	1
Total number of species	11	9	14	9	15
Diversity indices					
Shannon	3.323	3.015	3.560	3.040	3.778
Pielou	0.961	0.951	0.935	0.959	0.967
Margalef	3.170	2.825	4.178	2.856	4.437
Menchinick	2.063	1.940	2.741	1.969	2.888

Notes. 1 — occasional, 2 — rare; 3 — common (subdominant); 4 — abundant (dominant).

The cluster analysis (fig. 1) also illustrates the maximum faunistic similarity of Carabini for Kyiv and Kharkiv or Dnipro and Donetsk, i. e. the cities located in a similar geographical zone. The greatest differences from these four megapolises were observed for the fauna of Lviv, which is characterized by a number of taxa typical for Western Ukraine (*C. linnei*, *C. intricatus*) or the inhabitants of forests, which are not common in other regions of the country (*C. glabratus*, *C. arcensis*). This is proven by the pattern

Table 2. Faunistic similarity of Carabini tribe in the main megapolises of Ukraine (on the right — according to Jaccard; on the left — according to Czekanowski-Sørensen)

Megapolises	Kyiv	Kharkiv	Dnipro	Donetsk	Lviv
Kyiv	-	0.67	0.39	0.33	0.39
Kharkiv	0.80	-	0.35	0.46	0.33
Dnipro	0.56	0.52	-	0.53	0.22
Donetsk	0.50	0.67	0.70	-	0.14
Lviv	0.54	0.50	0.36	0.25	-

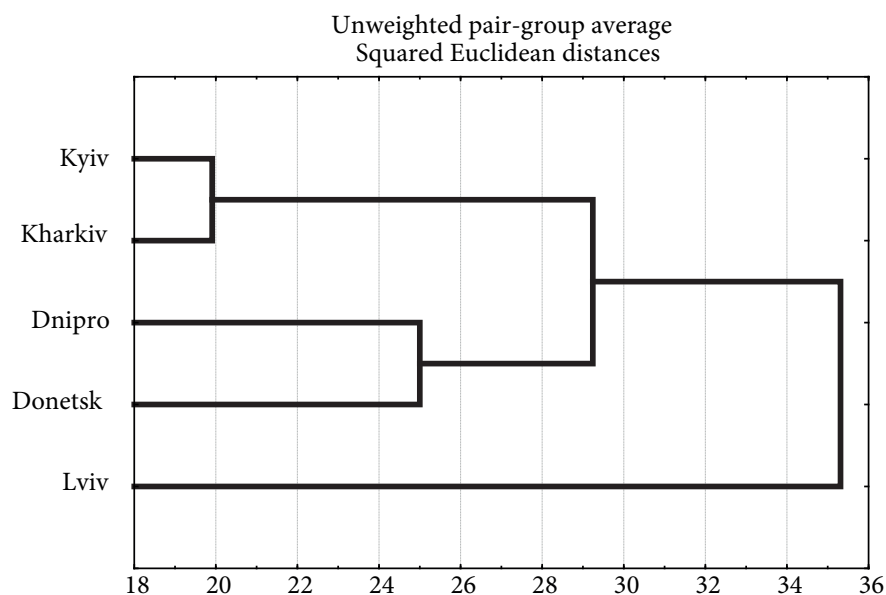


Fig. 1. Cluster analysis of the similarities in the Carabini tribe in the parks of the Ukrainian megapolises.

of Carabini similarities, formed due to the peculiarities of the distribution (ranges) of a number of taxa typical for one or another climatic region, and also due to their ecological characteristics.

Despite the fact that the share of the species by abundance was characterized by a certain similarity, it significantly varied between certain megapolises. In the parks of Kyiv (at different times and at separate locations), the superdominants were *Carabus cancellatus* and *C. coriaceus*; in Kharkiv — *C. nemoralis*, and in Donetsk — *C. convexus*. The relatively common (sometimes abundant) species were *Carabus granulatus* (almost everywhere), *C. coriaceus* and *C. nemoralis* (Kyiv), *C. nemoralis*, *C. cancellatus* and *Calosoma inquisitor* (Kharkiv, Donetsk). Besides this, *C. excellens* (Kyiv), *C. estreicherii* (Donetsk), *C. scabriusculus* (Kyiv, Dnipro), *C. glabratus*, *C. linnei* (Lviv) were sometimes common. At the same time, almost a half of tribe's species were rare or occasional.

Below, we provide a short ecological-faunistic characteristic and a comparative analysis of all registered species of the tribe (taxa are presented in alphabetical order), found in the parks of Kyiv, Kharkiv, Dnipro, and Donetsk.

Calosoma (s. str.) *inquisitor* is distributed throughout Ukraine, except the steppe territories. It is a forest polyzonal species and a broad mesophile. It is found in most broad-leaved park plantations in almost all Ukrainian megapolises as a usual representative, i. e. it is an urban transgradient, the high number of which is typical for different park areas. In Kyiv and Donetsk its abundance equaled 1.1–1.5 % and in the urbocenoses of Kharkiv — 9.4 % of the total abundance of the tribe. The abundance of the species significantly increases during the periods of mass breeding of a number of lepidopterans — pests of leaves in arboriculture.

Calosoma (*Campalita*) *auropunctatum*. Distributed throughout Ukraine, a meadow-steppe mesophilous species which is a typical component of the carabidofauna of agrocenoses (especially in fields) (Putchkov, 1991, 2018). Only found in small numbers in the urbocenoses of any of the megapolises (abundance did not exceed 0.5 % of the total count of the tribe).

Calosoma (Campalita) denticolle. Distributed throughout Ukraine, except the northern most part of Polissia and the Carpathians. A meadow-steppe mesoxerophilous species. Found in very low numbers in a few urbocenoses in Dnipro. Also relatively uncommon in natural environments.

Carabus (Archicarabus) nemoralis. In Ukraine, occurs in the Carpathians, Polissia, the northern part of the forest-steppe. A forest species, mesophilous with a broad ecological spectrum in relation to moisture. One of the commonest species in the parks of Kyiv and Kharkiv. Superdominant in a number of cases, accounting for 75 % of abundance of all Carabini at one site (Karpovsky sad, Kharkiv). Typical transgradient species. Tends to live in broad-leaved plantations (oak groves, maple associations with dense shrub layer and dense grass stand). It was rare in the parks of Kyiv in the late 1990s, but is common nowadays (table 3).

Carabus (s. str.) granulatus. Distributed throughout Ukraine. Polytopic (ecologically flexible meadow-forest) polyzonal mesohygrophilous species which prefers open areas. One of the most abundant representatives of the *Carabus* genus in Ukraine. Currently, registered in urbocenoses of all studied cities as a typical species (2 to 18 % of the total count of the tribe). Was rare in the parks of Kyiv in the late 1990s (table 3), but nowadays is registered in the most surveys (at the level of rare or common) and can be classified as a dispersive subdominant.

Carabus (Limnocarabus) clathratus. Distributed throughout Ukraine, except dry steppes. Polyzoal meadow species, mesohygrophile. Registered in small numbers in a few urbocenoses of Dnipro and Lviv.

Carabus (Megodontus) violaceus. Distributed throughout Ukraine, except dry steppes and Crimea. Forest-meadow, mesophile species. Registered in very low numbers as an occasional element in parks of most studied megapolises (except Donetsk). However, in private plots and gardens on the outskirts of Kyiv, the species is recorded as common (sometimes dominant), which allows us to consider it a dispersive element.

Carabus (Morphocarabus) excellens. In Ukraine — Prykarpattia, South Polissia to the northern subzone of the steppe, but mainly in the forest-steppe. Meadow, mesophile species. Earlier (the late 90s), it was one of the dominant species (up to 50 % of the total number of individuals of the genus) only in the Lysa Hora park (Kyiv). There, its population was one of the highest in Ukraine and was represented by the full range of its color morphs. In the records of 2015–2016, this species was recorded as common only in separate cases

Table 3. Occurrence and ecological characteristic of *Carabus* species over a time period (based on the example of parks in Kyiv)

Species	Occurrence*		Ecological groups	
	1999–2001	2015–2017	Preferred biotopes	Hygropreference
<i>C. cancellatus</i>	1	3–4	polytopic	mesophilous
<i>C. coriaceus</i>	2–3	3–4	forest	mesophilous
<i>C. convexus</i>	1	2–3	forest	mesophilous
<i>C. excellens</i>	3–4	1	meadow	mesophilous
<i>C. granulatus</i>	1–2	2–3	polytopic	mesohygrophilous
<i>C. nemoralis</i>	1	2–3	forest	mesophilous
<i>C. scabriusculus</i>	2–3	–	meadow-steppe	mesophilous
<i>C. violaceus</i>	–	1	meadow-forest	mesophilous

* The same as in table 1.

(up to 5 % of the total abundance of the tribe), and in 2017, only single individuals were sporadically recorded in thinned-out shrub habitats (table 3). Currently, the species can be characterized as exclusive (confined almost entirely to one community), but relatively subdominant (over 90 % of the individuals were found in a single plot).

Carabus (Oreocarabus) hortensis. In Ukraine — Zakarpattia (absent in the mountain part of the Carpathians), Polissia and forest-steppe (more often in the west). Nemoral mesophile species. Single specimens were recorded in a few urbocenoses of Kyiv (gardens) and Lviv.

Carabus (Pachystus) hungaricus scythus. In Ukraine, occurs throughout the steppe zone, but more common in the south zone of the Left Bank. Typical steppe, mesoxerophilic species. Recorded in low numbers in a few urbocenoses of Dnipro.

Carabus (Procrustes) coriaceus. In Ukraine, occurs in the Carpathians, Polissia, forest-steppe and the northern subzone of the steppe (Donetsk Ridge). Typical forest mesophile. In Lviv and Kyiv — constantly common or abundant species (1.2–8.0 and 9.0–25.4 % of the total abundance of the tribe respectively). The beetle dominated in large parks on the outskirts of the city with prevalence of broad-leaved trees (especially hornbeam), including forest areas with shrub vegetation. In urbocenoses of Kyiv, the species can be classified as an exclusive superdominant, prevailing only in insignificantly disturbed parks such as Holosiivsky and Lysa Hora.

Carabus (Tachypus) cancellatus. Distributed throughout Ukraine. Polytopic mesophile species. Was rare in the 1990s in the parks of Kyiv (table 3). Currently, it is the dominant species of the genus, its percentage being 20–60 % of the total abundance. In the urbocenoses of Kharkiv, it was always a subdominant, and in general, can be classified as a transgradient species.

Carabus (Tomocarabus) convexus. Distributed throughout Ukraine except dry steppes and Crimea. Forest mesophile species. In the past (the 1990s) the species was rare in the parks of Kyiv (table 3). Currently, it is one of the dominant species, especially in mixed broad-leaved tree plantations (Lysa Hora, Holosiivsky parks). In the urbocenoses of Donetsk, it was recorded as a superdominant species only in Rakivka park (over 50 % of the total abundance of the tribe). Therefore, for the abovementioned urbocenoses, it can be classified as an exclusive superdominant.

Carabus (Tomocarabus) marginalis. Distributed throughout Ukraine (but locally), except steppes and Crimea. Forest mesophilous species. Recorded as a rare or sporadically common species in some parks of Kharkiv (mostly in Lisopark). Recorded in low numbers (no higher than 0.1 % of the total abundance of the tribe) recorded in tree plantations in the outskirts of Donetsk (though common in forest biotopes of the area of Yasynuvata, a suburb of Donetsk). In general, the species is characterized as an exclusive subdominant.

Carabus (Trachycarabus) besseri. In Ukraine, it occurs only in Western Podolia, the Right-Bank forest-steppe (south) and steppe zones. Meadow-steppe relatively mesophilous species. Single specimens of the species were recorded in low numbers in a few urbocenoses of Dnipro.

Carabus (Trachycarabus) estreicheri. In Ukraine — more often in the forest-steppe zone (especially eastern) and in the northern subzone of the steppe. Meadow-steppe moderate mesophile. Was infrequently (sometimes up to 0.5 % of the total abundance of the family) recorded in a few parks of Donetsk (Putylivka park).

Carabus (Trachycarabus) perrini. In Ukraine — steppe zone, Crimea, rarely in southern forest-steppe. Steppe mesophilous species. Rarely (no higher than 0.6 % of the tribe abundance) recorded in some parks of Donetsk (Rakivka park).

Carabus (Trachycarabus) scabriusculus. Distributed throughout Ukraine, except the Carpathian uplands, dry steppes and Crimea. Meadow-steppe, but the most mesophilous species of the subgenus. One of the dominant species in the urbocenoses of Dnipro. Was recorded as common (table 3) in the parks of Kyiv (late 1990s), especially in the areas with thinned-out shrub vegetation and could be classified as an exclusive subdominant. Currently (2015–2017) has not been found in these areas.

Carabus (Trachycarabus) sibiricus. Forest-steppe, northern subzone of the steppe. In Ukraine, there are four subspecies (Bousquet et al., 2003) which were previously considered separate species (Kryzhanovskij et al., 1995). In the south of the Left Bank steppes — *C. sibiricus errans* Fischer–Waldheim, 1823; in the forest-steppe and the northern subzone of the steppe — *C. sibiricus haeres* Fischer-Waldheim, 1823, in the middle and north-east steppe of Ukraine (Dnipro and Donetsk Regions) — *C. (Trachycarabus) sibiricus fossulaticus* Obydow, 2007. The latter subspecies was recorded as a rare element in some urbocenoses of Dnipro and Donetsk, though in this area individuals have been found which are intergrades between *C. sibiricus errans* (Donetsk) and *C. sibiricus haeres* (Dnipro). Meadow-steppe, moderate mesophilous species.

Conclusions

In total, 24 species of two genera of Carabini were recorded in the studied megapolises of Ukraine. In the urbocenoses of some cities, from 9–11 (Kharkiv, Donetsk, Kyiv) to 14–15 (Dnipro, Lviv) species were found. More than a half of the species in each megapolis (6–11) were found to be rare or occasional and recorded only in parks of some cities. The status of the remaining species fluctuated from dominant to rare. Only three species were common, and sometimes numerous in all the megapolises. Six species were recorded as common or abundant in urbocenoses of some cities.

The faunistic range of the tribe in each megapolis was significantly conditioned by their zonal and ecological correspondence. In the urbocenoses of the forest and forest-steppe zones (Lviv, Kyiv, Kharkiv) the dominant species were nemoral and polytopic species, and the inhabitants of open biotopes occurred more rarely. In the southern cities (Donetsk and Dnipro), some steppe species occurred, though the dominant species were habitat generalist, meadow and some forest elements. The peculiarities of the Carabini species composition in different megapolises were proved by the analysis of their faunistic similarity. According to the west-east/north-south gradient, it was found to be lower for Lviv/Donetsk, Dnipro and Kharkiv, but average for Kyiv/Dnipro; Lviv/Kyiv or Kharkiv/Dnipro and Donetsk. The highest similarity was determined for Kyiv and Kharkiv. The indices of diversity (Shannon, Margalef, Menchinik) for the parks of some cities differed insignificantly, but were higher in Kyiv, Dnipro and Lviv, which is conditioned by the highest number of rare species. The values of Pielou evenness indicate oligo-dominance of the tribe composition in all of the cities.

The quantitative share of the species, despite being characterized by some similarities in their pattern, was also different. In general, in the urbocenoses of all the studied cities, the dominance of 2–3 species was recorded, often of ecologically different groups. On the basis of the representative analysis of the species distribution by urbocenoses (dominants and subdominants), we determined the prevalence of exclusive species (5), less often of transgradients (3) and dispersive elements (2 species), which indicates rather specific composition of the tribe in the conditions of a megapolis.

In the aspect of periods (on the example of urbocenoses in Kyiv), changes in most indicators of abundance and species diversity were observed. Up to now, the number of

meadow species (moderate mesophiles) has significantly decreased, whereas the number of some forest inhabitants and habitat generalists has increased.

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