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Spiders (Araneae) of the urban ecosystems of Kharkiv City (Ukraine)

N. Polchaninova*, A. Iosypchuk**, I. Fedyay***, T. Markina****

**V. N. Karazin Kharkiv National University, Kharkiv, Ukraine*
***Kherson State University, Kherson, Ukraine*
****Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine*
*****H. S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine*

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V. N. Karazin Kharkiv National University, Svobody sq., 4, Kharkiv, 61022, Ukraine. Tel.: +38-095-532-27-18. E-mail: n.polchaninova@karazin.ua

Kherson State University, Shevchenka st., 14, Ivano-Frankivsk, 76018, Ukraine. E-mail: aiosypchuk@ksu.ks.ua

Kharkiv State Academy of Physical Culture, Klochkivska, 99, Kharkiv, 61022, Ukraine. E-mail: razira1983@gmail.com

H. S. Skovoroda Kharkiv National Pedagogical University, Alchevskyh st., 29, Kharkiv, 61002, Ukraine. E-mail: t.yu.markina@gmail.com

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Urbanization is considered a significant driver of changes in ecosystems and a major factor affecting the natural environment. In-depth studies of urban areas are necessary to develop conservation management strategies and foster healthy city environments. We examined spiders, which are abundant and diverse predatory arthropods that can readily inhabit urban spaces and serve as bioindicators. A total of 153 spider species of 24 families were recorded from Kharkiv City and its suburbs. The families Linyphiidae, Gnaphosidae, and Theridiidae were the most species-rich (16.3%, 13.1%, and 9.8% of the araneofauna, respectively). Four species (*Marinarozelotes adriaticus*, *Sosticus loricatus*, *Uloborus plumipes*, and *Zodarion rubidum*) were recorded in the Kharkiv region for the first time, while 32 species were new to Kharkiv's urban ecosystems. The four species new to Kharkiv region are rare in Ukraine; besides, Kharkiv is the northernmost known locality for *M. adriaticus*. *S. loricatus* is synanthropic, while the others are presumably transported with planting material. The spider species richness was highest in Lisopark, a natural forest sector within the city (71 species), and lowest in five small green spaces in the city center (29 species combined) and at a household on the outskirts (27 species). The dominant complex of ground-dwelling spiders mirrored those in natural and semi-natural habitats: *Pardosa alacris* was dominant under tree canopies in botanical gardens, *P. lugubris* on the edges of tree plantations and some open grassy areas, *P. fulvipes* and *Alopecosa pulverulenta* on grassy slopes and park lawns, and *Xerolycosa miniata* in the most disturbed habitats in households and botanical gardens. Regarding habitat preferences, most of the spider species belonged to forest (29.2%), forest-grassland (20.9%), or grassland (12.2%) elements. Generalists made up 8.5%. This ratio of ecological groups reflects the city's geographic position on the border between the forest-steppe and steppe natural zones.

Keywords: geographical distribution; habitat preference; invertebrate diversity; species composition; spider assemblages; urban green space.

Introduction

In the modern world, the rapid expansion of urban areas is significantly changing the landscape and destroying natural ecosystems. Urban growth impacts biodiversity by altering species composition, assemblage structure, and promoting the appearance of alien species (Angold et al., 2006; McKinney, 2008; Concepción et al., 2015; Fenoglio at al., 2021). Consequently, this influences ecosystem stability and deteriorates ecological services.

Various groups of living organisms respond differently to urbanization (Egerer et al., 2017; Guetté et al., 2017). Some disappear from city areas, while others benefit from temperature changes, reduced competition, and new habitats. They are not only generalists or obligate synanthropes. Species typical of surrounding landscapes, or even rare and specialized ones, inhabit the city's green spaces, especially when these areas are well-developed and connected by green corridors (Gibb & Hochuli, 2002; Douglas & Sadler, 2011; Fattorini, 2014; Beninde, 2015). These areas can serve as shelters for endangered species and are worth including in the network of conservation priority sites (Fattorini et al., 2018).

Spiders are widely used as bioindicators in both natural and transformed ecosystems because they are abundant, diverse in species, and found in all terrestrial habitats (Nyffeler & Birkhofer, 2017; Milano et al., 2021; Fusco et al., 2024). They play a key role in food webs and provide various ecosystem services due to their abundance and global distribution. (Michalko et al., 2019; Cardoso et al., 2024). Spiders are sensitive to changes in prey availability and environmental conditions, which cause shifts in their species composition and community structure. An analysis of these shifts helps us understand the processes involved in shaping natural and man-altered communities, including urban biota, and develop measures for mitigating anthropogenic impacts and maintaining urban biodiversity (Magura et al., 2010; Fusco et al., 2024). Despite the important role of spiders in ecosystems, knowledge on spiders as components of city fauna is largely incomplete (McIntyre et al., 2001; Piquet et al., 2025).

In Ukraine, full-scale arachnological studies have been carried out only in a few cities. Lviv is best studied, with 351 species recorded (Hirna & Zhukovets, 2022). This is presumably due to the city's rich research history and the number of old parks and semi-natural forests within its boundaries. Kyiv is the next one with 298 species (E. Singayevskiy, pers. comm.). A total of 262 and 264 species are known from Chernivtsi (Fedoriak et al., 2012; Marusik et al., 2017) and Donetsk (Prokopenko, 2013; Polchaninova & Prokopenko, 2017; O. Prokopenko, pers. comm.). Other cities have been studied periodically, although research on synanthropic spiders has encompassed all administrative centers (Fedoriak, 2011; Voloshyn, 2018). As a result, spider assemblages have been proven to be indicators of technogenic pollution (Brushnivska, 2010) and the general ecological conditions of Ukrainian cities (Fedoriak, 2011; Prokopenko, 2013).

The spider studies in Kharkiv were initiated by I. Krynicki, who recorded three species from the city buildings (*Tegenaria domestica*), *Drassus cinereus*, and *Epeira ancora*), one species from the private gardens *Ebrechtella tricuspidata*)), and one (*Argiope bruennichi*) from the botanical garden (Krynicki, 1837). Of these, *Epeira ancora* was described as new to science, but later it was synonymized with *Steatoda bipunctata* (World Spider Catalog, 2025). Based on the species description in the paper, T. Thorell classified *Drassus cinereus* as a species new to science, naming it *Drassus* (modern genus *Drassodes*) *charcoviae* (Thorell, 1875). The material was lost; no other *Drassodes* species except *D. pubescens* has been recorded from the Kharkiv region. Therefore, we consider *D. charcoviae* a nomen dubium (Polchaninova & Prokopenko, 2013, 2019), although it is listed as

accepted in the World Spider Catalog. The further papers on the spiders of Kharkiv Province (Reingard, 1874, 1877; Thorell, 1875) mentioned Kharkiv as a location but did not specify city boundaries or habitats. Therefore, we do not include the recorded species in the spider list of urban ecosystems. The next study of the spider fauna of Kharkiv was conducted only a century later. In the 1980s, an oak forest on the outskirts was examined, yielding 29 species. In 2008, 49 spider species were collected in the botanical garden of Kharkiv National University (Polchaninova, 2009), and later an arboretum on the northern edge of the city contributed 21 species (Polchaninova & Slutsky, 2013). Considering other sporadic collections, the latest review listed 117 spider species recorded from Kharkiv's urban ecosystems (Polchaninova & Prokopenko, 2017); four species from apartment buildings found by Fedoriak (2011) were omitted from this list.

Meanwhile, the entomofauna of Kharkiv is well-studied, particularly the true bug communities and the ground-dwelling beetle communities. Investigating the green spaces at the urbanization gradient, the authors analyzed seasonal dynamics (Fedyay & Markina, 2019; Komaromi et al., 2019), ecological and faunistic structures of beetle and bug communities (Putchkov et al., 2017a; Fedyay et al., 2018; Putchkov & Komaromi, 2018), and the faunas of beetle families in the Ukrainian megapolises (Puchkov et al., 2020a; Putchkov et al., 2019, 2020b). Based on the results obtained, insect assemblages were recommended as bioidicators of urban environments (Kunakh & Fedyay, 2020; Putchkov et al., 2017b).

The present paper aims to summarize knowledge about spiders in the city of Kharkiv, add new records, discuss the distribution of rare species, and characterize the taxonomic and ecological structure of spider assemblages in the city's green spaces.

Materials and methods

Kharkiv is the second-largest industrial city in Ukraine, covering an area of 350 km². It is situated in the south of the forest-steppe zone, which influences the mixture of forest and steppe landscapes around the city. Over the years, spiders have been collected from city parks, an arboretum, botanical gardens, households, a forest on the outskirts, residential areas, and technical structures. Data on the collection periods, localities, and collectors are organized in a table (Table 1).

Table 1
Collecting localities of spiders
in the green spaces of Kharkiv City and its vicinity

No.	Locality	Period of studies	Collector(s)
	City center		
1	Museum of Nature of KhNU	2025	M. Velyka, O. Kaidalov
2	'Old' botanical garden of KhNU	1834	I. Krynicki
		2025	M. Velyka, O. Kaidalov
3	Observatory of KhNU	2025	M. Velyka, O. Kaidalov
4	Zoological garden	2025	M. Velyka, O. Kaidalov
5	RIFFM	2019	N. Komaromi
	City peripheral zone		
6	'New' botanical garden of KhNU	2008	N. Polchaninova; T. Markina and students of KNPU
		2012	O. Shatrovsky and students of NUUEKhN.
		2015	N. Polchaninoca and D. Tymokhina
7	Botanical garden of KhNPU	2019	N. Komaromi
8	Forest in Sortirovka	1980s	N. Polchaninova
9	Lisopark	1980s, 2019	N. Polchaninova
	City surroundings		
10	Arboretum named after G. M. Vysotsky	2014–2019	O. Slutsky
11	Households	2019–2020	N. Komaromi

Note: RIFFM – Research Institute of Forest and Forest Melioration named after G. M. Vysotsky; NUUEKh – O. M. Beketov National University of Urban Economy in Kharkiv; KhNU – V. N. Karazin Kharkiv National University; KhNPU – H. S. Skovoroda Kharkiv National Pedagogical University.

The study sites in the city center are small areas with old trees and sparse herbaceous vegetation, except for the green lawn of the Observatory. Localities 8 and 9 are sectors of the oak forest located in residential areas. The botanical garden of KhNU was established in 1804; the 'old' area in the center covers 5.5 ha, including greenhouses and administrative buildings. We sampled spiders on an open grassy plot and under the trees. The 'new' section was founded in 1962 as an exposition of plants from various geographical regions. The garden features plantations of coniferous and deciduous trees, glades, and slopes with meadow vegetation covering an area of 36.6 ha.

Spiders were mainly collected using pitfall traps with 4% formalin as preservative. We chose five monitoring sites, where ground-dwelling spiders were collected during the vegetation season. Botanical garden of KhNU: 1) slope with grassy vegetation, 2) edge of tree plantation, 3) tree plantation under the canopy; botanical garden of KhNPU: 4) lawn between trees and shrubs; households: 5) edge of the vegetable garden, a strip with ruderal and meadow vegetation. In the arboretum named after G. M. Vysotsky, net sweeping was the main method. Hand collecting in all sites added the material, especially in Lisopark, where the forest litter was sifted through a sieve.

The species list follows the nomenclature of the World Spider Catalogue (2025). The ecological groups of spiders are distinguished based on the species' habitat distribution in the forest-steppe zone of the East European Plain (Polchaninova & Prokopenko, 2013, 2017). We specified species occurring in 1) forests (f), 2) forests and various grasslands (f-g), 3) forests and mesic grasslands i. e. mesic meadows, meadow steppe (f-mg), 4) forests and wetlands (f-w), 6) forests, wetlands, and mesic grasslands (f-w-mg), 5) grasslands (g), 6) mesic grasslands and wetlands (mg-w), 7) forests or grasslands and various buildings (f-b/g-d), 8) generalists (g), 9) synanthropes (syn), and a small group of species with indefinite preferences (un).

Alpha diversity of the ground-dwelling spiders on monitoring plots was estimated using the Shannon, Margalef, and Pielou indices, which are widely used in ecological studies, thereby enabling a comparison of the results (Magurran, 1991). The indices were calculated in the PAST program. The bootstrap analysis with 999 iterations was used for calculating the statistical significance of the differences in the index values (Hammer et al., 2001). We used the Sorensen similarity index (Magurran, 1991) to compare the spider species compositions in different parts of the city green space. Dominant complexes in spider assemblages were distinguished by the Tischler scale and included species in the status of eudominant ($n \geq 10\%$ of collected individuals) and dominant ($5 < n < 10\%$) (Tischler, 1949).

Results

The current list of spiders of Kharkiv's urban ecosystems comprises 153 species of 24 families (Table 2). The most speciose families are as follows: Linyphiidae (25 species, 16.3% of the urban araneofauna), Gnaphosidae (20 species, 13.1%), Theridiidae (15 species, 9.8%), Lycosidae (14 species, 9.2%), Salticidae (14 species, 9.2%), Araneidae (12 species, 7.8%), Thomisidae (12 species, 7.8%). Compared with the spider fauna of the Kharkiv region: Linyphiidae (23.0%), Gnaphosidae (11.5%), Theridiidae (8.4%), Lycosidae (8.8%), Salticidae (9.1%), Araneidae (7.3%), Thomisidae (6.6%), only the proportion of Linyphiidae decreased by 6% in the urban fauna. The contributions of the other families remained stable or decreased slightly.

Four recorded species (*Marinarozelotes adriaticus*, *Zodarion rubidum*, *Sosticus loricatus*, and *Uloborus plumipes*) are new to the araneofauna of the Kharkiv region, and a further 32 species are new to Kharkiv City. New species were found in both semi-natural habitats (Lisopark and the botanical gardens) and highly urbanized small green areas in the city center and outskirts.

The 'new' botanical garden is studied best (Table 1), with 63 species collected. Nevertheless, the richest spider community inhabits the Lisopark, with 71 species recorded despite periodical studies. The similarity of their species compositions is low (K Sorensen = 40%). The main differences lie in the Gnaphosidae species (two of the 16 are common) and Lycosidae (three of the 12), occurring on the grassy slopes and lawns in the garden. Lyniphiidae has much in common

(12 species out of 19), as most of the species occur under the tree canopy of both habitats.

The poorest areas are the green spaces in the city center and household garden plots (29 and 27 species, respectively); the species similarity index for these areas is 42.9%. Spider assemblages of the city were the richest on the lawn of the Observatory (21 species) and the poorest in the zoological garden (3 species). The 'old' botanical garden gave 18 species, collected in three plots on the lawn and under the trees. Six species were widely distributed in the green city space: herb/tree-dwelling *Araneus diadematus*, *Mangora acalypha*, *Dictyna arundinacea*, and *Linyphia triangularis*, and ground-dwelling *Pardosa lugubris*, *Trochosa terricola*.

Spiders of apartment buildings were collected in different years. They are primarily represented by synanthropes that are widespread in many Ukrainian cities (Fedoriak, 2011). Investigation of the dry part of the city's sewer system, a technical structure that rarely comes to the attention of arachnologists, revealed seven common species in four families (Table 2) and one species of the genus *Carpathonesticus*, which is presumably new to science.

Ecological groups of spiders were distinguished based on the species' habitat preferences. The most numerous groups are forest and forest-grassland species, accounting for 22.9% and 20.1% of the total species found (Fig. 1). In the latter group, 22 out of 32 species inhabit forests and mesic grasslands; seven species are found in forests and various grasslands, while three species occur in open forests and dry grasslands. Although generalist species are common, they do not dominate, comprising 8.5%.

Table 2

Taxonomic structure and ecological groups of spiders of the urban ecosystems of Kharkiv City

Species	Urban green space						RB/TE	Ecological groups
	City center	peripheral zone			surroundings			
		BG1	BG2	LP	Arb	HH		
Agelenidae								
Agelena labyrinthica (Clerck, 1757)	–	1	–	1	1	1	–	f-g
Agelenopsis potteri (Blackwall, 1846)	–	–	–	–	1	–	1	f-b
Eratigena agrestis (Walckenaer, 1802)	–	–	–	–	1	–	–	g-b
Tegenaria domestica (Clerck, 1757)	–	–	–	–	–	–	1^	syn
T. lapicidinarum Spassky, 1934	–	–	1	1	–	1	1^	f-g
Anyphaenidae								
Anyphaena accentuata (Walckenaer, 1802)	–	–	–	1	–	–	–	f
Araneidae								
Araneus angulatus Clerck, 1757	–	–	–	1	1	–	–	f
A. diadematus Clerck, 1757	1	1	1	1	1	1	–	f
A. quadratus Clerck, 1757*	–	1	–	–	–	–	–	g
Araniella cucurbitina (Clerck, 1757)	–	–	–	1	–	–	–	f-mg
Argiope bruennichi (Scopoli, 1772)	–	1	1	–	1	–	–	g
Cercidia prominens (Westring, 1851)	–	–	–	1	1	–	–	gen
Cyclosa conica (Pallas, 1772)	–	–	–	1	1	–	–	f
Gibbaranea bituberculata (Walckenaer, 1802)*	–	–	1	1	–	–	–	f-mg
Larinioides ixobolus (Thorell, 1873)	–	–	–	–	–	–	1	syn
Mangora acalypha (Walckenaer, 1802)	–	1	1	1	1	1	–	gen
Zilla diodia (Walckenaer, 1802)	–	–	–	1	–	–	–	f
Cheiracanthiidae								
Cheiracanthium erraticum (Walckenaer, 1802)	–	–	–	–	–	–	1	gen
Ch. mildei L. Koch, 1864	–	–	–	–	–	–	1	syn
Clubionidae								
Clubiona caerulescens L. Koch, 1867	–	–	–	1	–	–	–	f
C. pallidula (Clerck, 1757)	–	–	–	1	–	–	–	f
Dictynidae								
Dictyna arundinacea (Linnaeus, 1758)	–	1	1	1	1	1	–	gen
D. uncinata Thorell, 1856	–	–	–	1	1	–	–	f
Nigma walckenaeri (Roewer, 1951)	–	–	–	–	–	–	1	f
Dysderidae								
Harpactea rubicunda (C. L. Koch, 1838)	1	1	1	–	–	1	–	f-mg
Gnaphosidae								
Callilepis nocturna (Linnaeus, 1758)	–	1	1	1	–	–	–	f-mg
Drassodes pubescens (Thorell, 1856)	–	–	1	1	–	–	–	f-mg
Drassyllus praeficus (L. Koch, 1866)	–	1	1	–	–	1	–	g
D. pusillus (C. L. Koch, 1833)	1	1	1	–	–	1	–	f-mg
D. villicus (Thorell, 1875)*	1	–	–	1	–	–	–	f
Gnaphosa leporina (L. Koch, 1866)*	–	–	–	–	–	1	–	g
Haplodrassus kulczynskii Lohmander, 1942	1	1	1	–	–	–	–	g
H. signifer (C. L. Koch, 1839)	–	1	1	–	–	1	–	f-mg
H. silvestris (Blackwall, 1833)	–	1	–	1	–	–	–	f
H. umbratilis (L. Koch, 1866)*	–	–	1	1	–	–	–	f-mg
Marinarozelotes adriaticus (Caporiacco, 1951) **	1	–	–	–	–	1	–	un
Micaria formicaria (Sundevall, 1831)	–	–	–	–	1	–	–	f-mg
Scotophaeus quadripunctatus (Linnaeus, 1758)	–	–	–	1	–	–	–	f-b
Sosticus loricatus (L. Koch, 1866)**	–	–	–	–	–	1	–	syn
Trachyzelotes pedestris (C. L. Koch, 1837)*	–	–	–	1	–	–	–	f-g
Zelotes aeneus (Simon, 1878)*	–	–	–	–	–	1	–	un
Z. electus (C. L. Koch, 1839)	1	1	1	–	–	–	–	g
Z. fuscus (Thorell, 1875)	–	1	1	–	–	–	–	f-mg
Z. latreillei (Simon, 1878)	–	1	1	–	–	–	–	f-mg
Z. longipes (L. Koch, 1866)	1	1	1	–	1	–	–	g
Hahniidae								
Hahnia nava (Blackwall, 1841)	–	1	–	–	–	–	–	f-g
H. ononidum Simon, 1875*	1	–	–	–	–	–	–	f
Linyphiidae								
Abacoproeces saltuum (L. Koch, 1872)	–	–	–	1	1	–	–	f

Species	Urban green space						RB/TE	Ecological groups
	City center	peripheral zone			surroundings			
		BG1	BG2	LP	Arb	HH		
Anguliphantes angulipalpis (Westring, 1851)*	–	1	–	1	–	–	–	f
Centromerus incilium (L. Koch, 1881)*	–	1	–	–	–	–	–	f
C. sylvaticus (Blackwall, 1841)*	–	1	–	1	–	–	–	f-w
Ceratinella brevis (Wider, 1834)	–	1	1	1	–	–	–	f-w
Dicymbium nigrum (Blackwall, 1834)	–	1	–		–	–	–	f-w
Diplocephalus picinus (Blackwall, 1841)	–	1	–	1	–	–	–	f-w
Diplostyla concolor (Wider, 1834)	–	1	–	1	–	–	–	f-w-mg
Entelecara acuminata (Wider, 1834)	–	1	–	1	–	–	–	f-b
E. erythropus (Westring, 1851)	–		–	–	1	–	–	f-b
Erigone dentipalpis (Wider, 1834)	–	1	–	–	–	–	–	f-w-mg
Gongylidium rufipes (Linnaeus, 1758)	–	–	–	1	–	–	–	f-w
Lepthyphantes leprosus (Ohlert, 1865)	–	–	–	–	–	–	1	syn
Linyphia tenuipalpis Simon, 1884	–	–	1	–	–	–	–	f-mg
L. triangularis (Clerck, 1757)	1	1	1	1	1	–	–	f-w-mg
Macrargus rufus (Wider, 1834)	–	–	–	1	–	–	–	f
Megalepthyphantes pseudocollinus Saaristo, 1997	–	–	–		–	–	1	f
Neriene clathrata (Sundevall, 1830)	–	1	1	1	–	1	1^	f-w-mg
N. montana (Clerk, 1757)	–	–	–	1	–	–	1^	f-w-tr
N. radiata (Walckenaer, 1841)	–	–	–	–	1	–	–	f
Tenuiphantes flavipes (Blackwall, 1854)	–	1	–	1	–	–	–	f-w
Thyreosthenius parasiticus (Westring, 1851)	–	–	–	1	–	–	–	f-mg
Walckenaeria alticeps (Denis, 1952)	–	1	–	1	–	–	–	f-w
W. antica (Wider, 1834)	–	1	–	1	–	–	–	f-w
W. atrotibialis (O. Pickard-Cambridge, 1878)	–	1	–	1	–	–	–	f-w
Liocranidae								
Agroeca brunnea (Blackwall, 1833)*	–	–	–	1	–	–	–	f
A. cuprea Menge, 1873	–	1	1	–	–	–	–	g
A. lusatica (L. Koch, 1875)*	–	1	–	–	–	–	–	f-mg
Liocranoeca striata (Kulczyński, 1882)	1	–	–	–	–	–	–	f
Lycosidae								
Alopecosa cuneata (Clerck, 1757)	1	1	1	–	–	1	–	g
A. cursor (Hahn, 1831)*	–	–	1	–	–	–	–	g
A. farinosa (Herman, 1879)	1	1	1	–	–	–	–	g
A. pulverulenta (Clerck, 1757)	1	1	1	–	–	–	–	f-g
Pardosa agrestis (Westring, 1861)	1	1	1	–	–	1	–	g
P. alacris (C. L. Koch, 1833)*	1	1	–	1	–	–	–	f
P. fulvipes (Collet, 1876)*	–	1	–	–	–	–	–	g
P. lugubris (Walckenaer, 1802)	1	1	1	1	1	1	–	gen
P. paludicola (Clerck, 1757)	1	–	–	–	1	–	–	mg-w
P. palustris (Linnaeus, 1758)	1	1	–	–	–	–	–	mg-w
Trochosa ruricola (De Geer, 1778)	1	1	1	–	–	1	–	gen
T. terricola Thorell, 1856	1	1	1	1	–	1	–	gen
Xerolycosa miniata (C.L. Koch, 1834)	1	1	1	–	–	1	–	f-g
X. nemoralis (Westring, 1861)	–	–	–	1	–	–	–	f-mg
Miturgidae								
Zora nemoralis (Blackwall, 1861)	–	–	–	1	–	–	–	f
Z. silvestris Kulczyński, 1897	–	–	–	1	–	–	–	f
Z. spinimana (Sundevall, 1833)	–	–	–	1	–	–	–	f-w-mg
Nesticidae								
Carpathonesticus sp.	–	–	–	–	–	–	1^	syn
Oxyopidae								
Oxyopes heterophthalmus (Latreille, 1804)	–	–	–	–	1	–	–	g
Philodromidae								
Philodromus cespitum (Walckenaer, 1802)*	–	–	–	1	1	1	–	gen
Ph. dispar Walckenaer, 1826	–	–	1	1	–	–	–	f
Thanatus arenarius L. Koch, 1872	–	–	1	–	–	–	–	g
Th. formicinus (Clerck, 1757)*	1	–	–	–	1	–	–	f-mg
Pholcidae								
Pholcus alticeps Spassky, 1932	–	–	–	–	–	–	1	syn
Ph. phalangioides (Fuesslin, 1775)	–	–	–	–	–	–	1^	syn
Ph. ponticus Thorell, 1875	–	–	–	–	–	–	1	syn
Phrurolithidae								
Phrurolithus festivus (C. L. Koch, 1835)	–	1	–	1	–	–	–	f-w-mg
Pisauridae								
Pisaura novicia (L. Koch, 1878)*	–	1	–	1	–	1	–	f-mg
Salticidae								
Asianellus festivus (C. L. Koch, 1834)	–	1	1	–	–	–	–	g
Ballus chalybeius (Walckenaer, 1802)	–	1	–	1	–	–	–	f
Carrhotus xanthogramma (Latreille, 1819)*	–	–	–	–	1	–	–	f-g
Dendryphantes rudis (Sundevall, 1833)	–	–	–	–	1	–	–	f
Euophrys frontalis (Walckenaer, 1802)*	–	–	1	–	–	–	–	f-g
Evarcha arcuata (Clerck, 1757)	–	–	–	1	1	–	–	f-mg
E. falcata (Clerck, 1757)	–	–	–	1	–	–	–	f-w-mg
Heliophanus auratus C.L. Koch, 1835	–	–	–	–	1	–	–	gen
H. cupreus (Walckenaer, 1802)	–	–	1	1	–	1	–	gen
Phlegra fasciata (Hahn, 1826)	–	1	1	–	–	–	–	f-g
Pseudicius encarpatus (Walckenaer, 1802	–	–	–	1	–	–	–	f
Pseudeuophrys erratica (Walckenaer, 1826)*	–	–	1	–	–	–	–	f

Species	Urban green space						RB/TE	Ecological groups
	City center	peripheral zone			surroundings			
		BG1	BG2	LP	Arb	HH		
Salticus scenicus (Clerck, 1757)	–	–	–	–	1	–	1	f-b
Sibianor tantulus (Simon, 1868)	–	–	–	1	–	–	–	f
Sparassidae								
Micrommata virescens (Clerck, 1757)	–	–	–	1	–	–	–	f-mg
Tetragnathidae								
Metellina segmentata (Clerck, 1757)*	–	–	–	1	1	–	–	f-w
Pachygnatha degeeri Sundevall, 1830	1	1	–	–	–	–	–	mg-w
P. listeri Sundevall, 1830*	–	1	–	–	–	–	–	f-w
Theridiidae								
Asagena meridionalis Kulczyński, 1894	–	–	–	1	–	–	–	f-w
A. phalerata (Panzer, 1801)	1	1	1	–	–	–	–	f-mg
Dipoena melanogaster (C. L. Koch, 1837)	–	–	–	–	1	–	–	f
Enoplognatha ovata (Clerck, 1757)	–	1	–	1	1	–	–	f-w-mg
Episinus angulatus (Blackwall, 1836)	–	1	–	–	1	–	–	f-w
Parasteatoda tabulata (Levi, 1980)	–	–	–	–	–	–	1	syn
P. tepidariorum (C. L. Koch, 1841)	–	–	–	–	–	–	1^	syn
Platnickina tincta (Walckenaer, 1802)*	–	–	–	–	1	–	–	f-w
Robertus lividus (Blackvall, 1836)*	–	–	–	–	1	–	–	f-w
Steatoda albomaculata (De Geer, 1778)*	–	–	1	–	–	–	–	g
S. bipunctata (Linnaeus, 1758)	–	–	–	–	–	–	1	syn
S. castanea (Clerck, 1757)	–	–	–	–	–	–	1	syn
S. grossa (C. L. Koch, 1838)	–	–	–	–	–	–	1^	syn
S. triangulosa (Walckenaer, 1802)	–	–	–	–	–	–	1	syn
Theridion varians Hahn, 1833*	–	–	–	1	–	–	–	f
Thomisidae								
Cozyptila blackwalli (Simon, 1875)	–	–	–	1	–	–	–	f
Ebrechtella tricuspidata (Fabricius, 1775)	–	1	–	1	1	1	–	f-w-mg
Misumena vatia (Clerck, 1757)	–	1	1	1	1	1	–	gen
Ozyptila atomaria (Panzer, 1801)	–	–	–	–	1	–	–	f-mg
O. praticola (C. L. Koch, 1837)	–	1	–	1	1	–	–	f
O. scabricula (Westring, 1851)	1	1	1	–	–	–	–	g
Tmarus piger (Walckenaer, 1802)	–	–	–	1	1	–	–	f-mg
Xysticus cristatus (Clerck, 1757)*	1	–	1	1	–	1	—	gen
X. kochi Thorell, 1872	1	1	–	–	–	1	—	gen
X. lanio C. L. Koch, 1835	–	–	1	1	1	–	–	f
X. luctator L. Koch, 1870	–	1	–	1	–	–	–	f
X. ulmi (Hahn, 1831)*	–	–	–	1	–	–	–	f-w
Titanoecidae								
Titanoeca schineri L. Koch, 1872	–	1	–	–	–	–	–	f-g
Uloboridae								
Uloborus plumipes Lucas, 1846**	–	–	–	–	–	–	1	syn
Zodariidae								
Zodarion rubidum Simon, 1914**	1	–	1	–	–	–	–	un
Total species	29	63	46	71	40	27	23	29

Note: BG1 – botanical garden of KhNU ('new' territory), BG2 – botanical garden of KhNPU, LP – Lisopark, Arb – arboretum named after G. M. Vysotsky, HH – households, RB/TE – residential buildings and technical structures; for the abbreviations of ecological groups, see Materials and Methods. Species new to the Kharkiv region are marked with two asterisks (**), and new to Kharkiv City, with one asterisk (*). Species found in the sewage system are marked with a caret (^) in the RB/TE column.

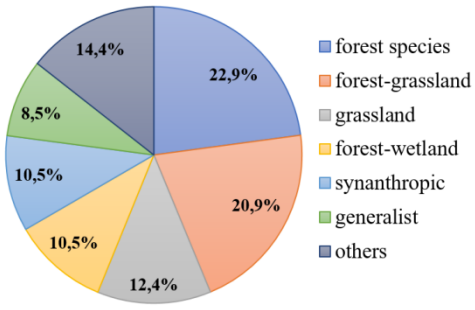

Fig. 1. Contribution of ecological groups of spiders to the araneofauna of Kharkiv City

An analysis of spider assemblages in the monitoring plots revealed differences in their dominance structure and alpha diversity (Table 3). Only one species, *Pardosa lugubris*, was a common eudominant, being most abundant on the forest edge (51.7% of collected individuals). Under the tree canopy, it ranks second to a closely related species *P. alacris* (47.9%), while on the open slope, *P. fulvipes* became the most abundant (48.1%). In the vegetable garden and on the lawn at KhNPU, the first eudominant was *Xerolycosa miniata* (36.6% and 22.1%, respectively). The latter assemblage had the most balanced structure, with a dominant complex of six species and the highest evenness index. It is also characterized by higher alpha diversity (Table 3). The spider assemblages on the three monitoring plots in the botanical garden of KhNU differed in the number of species and individuals. However, all of them had low alpha diversity due to the superdominance of one species.

Discussion

Based on literature data and personal observations, 153 spider species were recorded from Kharkiv city and its vicinity. This preliminary list is expected to be expanded through further research. In all the well-studied Ukrainian cities, Linyphiidae is the most species-rich family, comprising over 25% of the araneofaunas (Prokopenko, 2000; Fedoriak et al., 2012; Hirna & Zhukovets, 2022). Gnaphosidae is the second most species-rich family in Donetsk (13% of the fauna) due to the city's location in the steppe zone, where this family is most speciose (Polchaninova & Prokopenko, 2013). In Kyiv, Lycosidae and Gnaphosidae have very close proportions (7–8%), while in Chernivtsi, the second place is shared between Lycosidae and Theridiidae (10–11%). The proportion of main families in Kharkiv araneofauna is closer to that in Donetsk, as the city is located at the border of the Forest-Steppe and Steppe. The faunas of tiger and ground beetles of Donetsk and Kharkiv are also more similar to each other than to the faunas of Kyiv, Dnipro, or Lviv (Putchkov et al., 2020b).

Changes in microclimatic conditions in cities, as well as the introduction of plant and technical materials, promote the spread of species

from different geographical regions (Douglas & Sadler, 2011; Fattorini, 2014; Concepción et al., 2015; Chatelain et al., 2023). The spider species new to the Kharkiv region, collected during our study, have different origins.

Zodarion rubidium has spread throughout Europe, inhabiting open grassy, stony habitats and various buildings. *Sosticus loricatus* is synanthropic. *Uloborus plumipes* is spreading in natural Mediterranean habitats and greenhouses in Central and Northern Europe (Nentwig et al., 2025). *Marinarozelotes adriaticus* is an Ancient Mediterranean species whose range stretches from Italy to North-Western China (Song et al., 2004; WSC, 2025). In the East European Plain, it has been recorded from the semi-desert zone and the south of the steppe. Most likely, it was brought to the forest-steppe with planting material, since it was found only in gardens. Interestingly, this was not a single find; the species was quite numerous in the new localities and reached a dominant status in the spider assemblage of a local garden for two years, which suggests the sustainability of its population. In Ukraine, *M. adriaticus* was registered in the Dnipropetrovsk region on mining waste dumps (Prokopenko & Zhukov, pers. data), and in the south of Donetsk, Zaporizhzhia, and Kherson regions in natural habitats (Polchaninova & Prokopenko, 2013; Polchaninova & Iosypchuk, 2024). Two sites in Khakiv City are its northernmost known localities.

The introduced American species, *Agelenopsis potteri*, is also common in Kharkiv city and region. First recorded in Ukraine's Luhansk region in 2001, it was subsequently found in the Kharkiv and Donetsk regions (Polchaninova & Prokopenko, 2013). Presently, it is known in seventeen regions of Ukraine (Singayevskiy et al., 2025). *A. potteri* occurs in the same natural habitats as the native species *Agelena labyrinthica*, but often inhabits various buildings and urbanized habitats. *Parasteatoda tabulata* originates from tropical Asia and has spread widely in Europe, America, and Central and Eastern Asia (Nentwig et al., 2025). In Ukraine, it is a synanthrope. The synanthropization of southern species spreading northwards is a well-known phenomenon (Klausnitzer, 1983; Douglas & Sadler, 2011). Among the spiders in Kharkiv city, another example is *Cheiracanthium mildei*, which is found in forest and grassland habitats in southern Ukraine but only in buildings in the north.

Table 3

Dominant complexes and alpha diversity of the ground-dwelling spider assemblages in the monitoring sites of the green space of Kharkiv City

Species	BG KhNU			BG KhNPU	HH
	open slope	forest plantations		lawn between the trees	edge of vegetable garden
		edge	under the canopy		
Callilepis nocturna	–	–	–	7.01%	–
Drassyllus praeficus	–	0.60%	–	5.61%	0.41%
Haplodrassus signifier	3.90%	1.10%	–	10.30%	0.41%
Marinarozelotes adriaticus	–	–	–	–	7.72%
Alopecosa pulverulenta	5.52%	2.58%	0.37%	8.40%	–
Pardosa agrestis	–	–		–	11.40%
P. alacris	–	18.10%	47.90%	–	–
P. fulvipes	48.10%	0.60%	–	–	–
P. lugubris	22.10%	51.7%	20.10%	11.20%	22.40%
Trochosa terricola	0.55%	1.15%	7.13%	0.05%	3.70%
Xerolycosa miniata	–	0.30%	–	22.10%	36.60%
Pachygnatha degeeri	0.55%	6.32%	3.66%	–	–
Ozyptila praticola	0.55%	8.05%	12,80%	–	–
Total, species	17	26	24	26	21
Total, individuals	181	348	547	214	246
Shannon ind.	1.80 (1.58/1.96)	1.79 (1.69/1.97)	1.70 (1.64/1.84)	2.76 (2.64/2.87)	2.07 (1.97/2.24)
Pielou ind.	0.36 (0.31/0.45)	0.23 (0.21/0.28)	0.23 (0.22/0.26)	0.61 (0.54/0.68)	0.38 (0.34/0.45)
Margalef ind.	3.08 (2.50/3.08)	4.272 (4.10/4.27)	3.65 (3.65/3.65)	4.66 (4.66/4.66)	3.63 (3.63/3.63)

Note: confidence interval is given in brackets (min/max); for abbreviations, see Table 1.

Studies of Kharkiv urban entomofauna have also broadened the knowledge on species geographical distribution (Markina et al., 2018). One bug species was recorded for the first time from mainland Ukraine (Fedyay et al., 2018), and four ground beetle species had not been listed for Ukraine in the Catalogue of Palearctic Coleoptera (Komaromi et al., 2018).

In terms of habitat preferences, the spiders of Kharkiv's urban ecosystems belong to the mesophilous species that inhabit forests, grasslands, and even wetlands. As we investigated mainly the northern part of the city, surrounded by an oak forest, many forest elements were recorded from Lisopark and the botanical gardens. The spider assemblages of the park lawns with natural vegetation (such as the Observatory) were formed by widespread grassland species. The dominance structure of ground-dwellers coincides with that in the regional natural forests and meadows: prevalence of *Pardosa alacris* under the tree canopy, *P. lugubris* on the forest edges, *P. fulvipes* or *Alopecosa pulverulenta* in mesic grasslands (Polchaninova & Honcharov, 2023; Polchaninova et al., 2023), *Xerolycosa miniata* is more abundant in disturbed grasslands. The predominant species, except for the generalist *P. lugubris*, are forest, forest-grassland, or mesic grassland dwellers.

Previous research has shown that urban fauna is characterized by an increased proportion of generalist species (Gibb & Hochuli, 2002; Shochat et al., 2004) and/or species in open grassy habitats (Magura et al., 2010). In Kharkiv and its vicinity, generalist spiders were less numerous than those found in forests and grasslands. Among the ground beetles and true bugs, meadow-dwellers dominated in terms of species, while generalists prevailed in terms of individuals (Fedyay et al., 2018; Putchkov et al., 2020b). Thus, the dominant ecological group of insects coincided with that of spiders, as defined for Hungarian cities (Magura et al., 2010).

Many authors have remarked that the diversity of urban biota, including spider communities, decreases along the urbanization gradient (McKinney, 2008; Prokopenko, 2013; McNaughton et al., 2025; Piquet et al., 2025) and is influenced by anthropogenic activity even within the same city zone (Brushnivska, 2010; Sattler et al., 2010; Fedoriak, 2011; Trigos-Peral et al., 2020). Our research confirms these observations. The Lisopark fauna was richer than that of the botanical gardens. On the other hand, studies in Hungarian cities have shown that spider species richness can be significantly higher in urban areas than in suburbs due to the penetration of open-habitat dwellers from surrounding grasslands and farm fields (Magura et al., 2010). Five green spaces in the city center hosted 29 spider species, compared to 27 species in a single plot on the outskirts. The least diverse was the spider community of the zoological garden in the center. New territory planning and the prevalence of paving slabs that isolate small green spaces hinder arthropods from settling in these plots, despite their proximity to an old park and botanical garden. Conversely, a lawn with natural vegetation near the Observatory, despite being frequently mowed, supported a rich spider community dominated by grassland and forest-grassland species. Frequent lawn mowing is common in urban environments but often leads to a decline in many spider species, especially larger ones and those sensitive to disturbance (Bauer et al., 2024; Cabon et al., 2024). Therefore, it is recom-

mended to establish areas of natural grass vegetation that require infrequent mowing (so-called meadow or prairie pockets) to enhance urban biodiversity and promote ecosystem services (Delgado de la flor et al., 2020).

Conclusion

A preliminary survey of the araneofauna of Kharkiv City revealed 153 species in 24 families. Four species are new to the Kharkiv region, and 32 species to the city's urban habitats. For *Marinarozelotes adriaticus*, this is the northernmost record; other new species are rare in Ukraine. Spider species composition was the richest in Lisopark (71 species) and the poorest in the habitats of city center and outskirt households (29–27 species). In terms of habitat preferences, the forest, forest-grassland, and grassland species were the most abundant in the urban fauna. Our studies did not confirm the increased number of generalist species that is often fixed in urban ecosystems. The dominance structure of ground-dwelling spider assemblages resembled that in surrounding natural forests and grasslands.

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