SOME BIOLOGICAL AND ECOLOGICAL ASPECTS OF THE FLORA IN THE CIMIȘLIA URBAN ECOSYSTEM, REPUBLIC OF MOLDOVA

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Abstract. The urban ecosystem of Cimișlia is located in the southern part of the Republic of Moldova, on the banks of the Cogâlnic River, approximately 68 km from the capital city, Chișinău. The southern region of the country is characterized by rolling plains, alternating with relatively low hills and wide valleys that form the drainage basins of the Botna, Cogâlnic, and Ialpug rivers. Ecological issues in urban ecosystems require comprehensive study to highlight evolutionary pathways at a global scale. The process of urbocenosis formation begins with the reduction of species populations, disappearance of species with narrow ecological amplitude and low ecological plasticity, and the manifestation of invasive behavior by allochthonous species. Understanding floristic diversity in urban ecosystems is crucial for sustainable planning, ecosystem functioning, and improving quality of life. Plants act as air filters in urban environments, provide oxygen, ensure population comfort, and mitigate noise pollution. This article focuses on the assessment of floristic diversity and the study and analysis of biological indices, life forms, and ecological groups in relation to the humidity and trophic factors of the vascular flora in the city of Cimișlia. The biological spectrum of the flora in the studied ecosystem is represented by ruderal, spontaneous, and segetal-ruderal species. The predominance of ruderal and segetal-ruderal species indicates a high degree of anthropogenic influence under urban ecosystem conditions.

Keywords: urban ecosystem, biological index, biomorph, humidity, trophicity.

Rezumat. Unele aspecte biologice și ecologice ale florei din ecosistemul urban Cimișlia, Republica Moldova. Ecosistemul urban Cimișlia este situat în partea de sud a Republicii Moldova, pe malul râului Cogâlnic, la o distanță de 68 km de capitala Chișinău. Partea de sud a republicii prezintă o câmpie ondulată, o alternare a dealurilor cu altitudini relativ joase, cu văi largi, care formează bazinele de scurgere ale Botnei, Cogâlnicului și Ialpugului. Problemele ecologice a ecosistemelor urbane necesită un studiu complex pentru a evidenția căile evoluției în aspect global. Procesul de formare a urbocenozelor începe cu reducerea efectivului speciilor, dispariția speciilor cu amplitudine ecologică îngustă și cu o plasticitate ecologică redusă, speciile alohtone își manifestă caracterul invaziv etc. Cunoașterea diversității floristice din ecosistemul urban are o importanță majoră pentru planificarea durabilă, funcționarea unui ecosistem și îmbunătățirea calității vieții. Plantelor le revine rolul de filtru al aerului din mediul urban, furnizor de oxigen, asigură confortul populației, atenuează zgomotul etc. Prezentul articol constă în evaluarea diversității floristice, în studiul și analiza indicilor biologici, biomorfelor, grupelor ecologice în raport cu factorul umiditatea, troficitatea florei vasculare din orașul Cimișlia. Spectrul biologic al florei ecosistemului cercetat este reprezentat de specii ruderale, spontane și segetal-ruderale. Predominarea speciilor ruderale și segetal-ruderale indică gradul înalt de acțiunea factorului antropogen în condiții de urboecosistem.

Cuvinte cheie: ecosistem urban, indice biologic, biomorfă, umiditate, troficitate.

INTRODUCTION

The city of Cimișlia is situated in the southern region of the Republic of Moldova, along the banks of the Cogâlnic River, approximately 68 km from the capital, Chișinău. This area is characterized by an undulating plain with alternating low-altitude hills and wide valleys, forming the drainage basins of the Botna, Cogâlnic, and Ialpug rivers. The South Moldavian Plain features a relatively gently fragmented relief, intersected by valleys and ravines of the hydrographic network that ultimately drain into the Prut River, the Danube, the Black Sea, and, in the eastern part, the Dniester River (URSU et al., 2022). The elevation gradually decreases from 300-250 meters in the northern part to 150-100 meters in the southern extremity (TITICA, 2015).

In the context of urban development and its interaction with the environment, rapid population growth and concentration, combined with the expansion and diversification of technological processes—especially chemical industries in agriculture and manufacturing—have led to significant ecological imbalances. The natural capacity of ecosystems to self-regulate is increasingly compromised, and the distribution of pollutants across the territory poses serious environmental threats (ALPOPI, 2008). In recent years, urbanization has accelerated at an unprecedented pace, with anthropogenic activities being the primary factor contributing to the decline in overall floral diversity.

Major disruptions to biodiversity arise from industrial and construction developments, habitat fragmentation, ecosystem degradation, deforestation of urban green spaces, and heavy traffic—identified as the main sources of exhaust emissions and noise pollution. These factors lead to changes in the structure and abundance of plant species, reducing the variety of flora and causing the loss of native species (ВЕРШИНИН, 2007). Additionally, natural factors such as droughts, floods, and snowless winters further influence floristic diversity. For example, drought conditions cause soil drying, structural alterations, increased pathogenic microorganisms, and accumulation of micropollutants.

Understanding the floristic diversity within urban ecosystems is crucial for sustainable urban planning, maintaining ecosystem functionality, and enhancing the quality of life for residents. Plants serve essential roles as air filters, oxygen producers, providers of thermal comfort, and noise buffers in urban environments.

Studies conducted in urban ecosystems internationally emphasize the significance of biological and ecological indices, such as soil trophicity and moisture, which influence species composition and floristic diversity. These indices reflect species' adaptations to environmental conditions, including resource availability and stress factors, and provide a comprehensive understanding of the impact of abiotic factors.

Trophicity, which reflects the nutrient level of the substrate, is a key factor influencing species composition and the distribution of ecological groups. Under eutrophic conditions (nutrient-rich soils), nitrophilous species and those with invasive potential are favored, leading to a reduction in spontaneous species diversity and an increase in ruderal and segetal-ruderal species. For example, studies from Germany have demonstrated that eutrophic soils support a pronounced growth of nitrophilous and ruderal species, which promotes invasive species such as *Ambrosia artemisiifolia* L., known for its allergenic effects on urban populations (MÜLLER-SCHÄRER et al., 2014) In Romania, these effects have been documented by (LERU et al., 2019), emphasizing their impact on respiratory health.

Data on humidity, trophicity, and the spectrum of life forms are useful for predicting changes in floristic composition under the influence of climate change and urbanization.

The monitoring of ecological indices has been utilized as a tool in the management of urban green spaces, aiding in the identification of areas vulnerable to invasion and ecological degradation (KOWARIK, 2011). This integrated management approach, based on the analysis of trophic and moisture factors, contributes to biodiversity conservation and the protection of urban population health.

This study aims to evaluate the floristic diversity of the Cimișlia urban ecosystem by identifying the main biological groups and the overall biological spectrum of the flora within this environment.

MATERIAL AND METHODS

In 2024, research on floristic diversity was carried out at six stations established within the town of Cimișlia:
I – small river, tributary of the Cogâlnic river, George Coșbuc Street;
II – small river, tributary of the Cogâlnic river, Nicolae Iorga Street;
III – Cogâlnic river, downstream of Cimișlia;
IV – landfill site in the town of Cimișlia;
V – Cogâlnic river, right tributary within Cimișlia;
VI – Cogâlnic river, upstream of Cimișlia.

The surveys were carried out during the vegetation period (april–september), using the linear transect method, which involves recording the sequence of plant individuals along a line or path, with its length adjusted according to the type of vegetation studied (CRISTEA, 2004). Additionally**,** bibliographic research and documentation were used to analyze and establish the historical state of biodiversity in urban ecosystems. This method focused on gathering and reviewing existing data to understand how biodiversity restoration activities are implemented, and for the physical and geographical characterization of the vegetation and landscape (BULIMAGA & PORTARESCU, 2019). For the identification of higher plant species, the following works were consulted: (CIOCÂRLAN, 2000; NEGRU, 2007; ГЕЙДЕМАН, 1986).

RESULTS AND DISCUSSIONS

The urban ecosystem of Cimișlia, located in the southern part of the Republic of Moldova along the Cogâlnic river, was studied at six research sites. The floristic spectrum identified within this ecosystem comprises 118 species, grouped into 98 genera and 41 families of magnoliophytes. The most representative families are Asteraceae, Poaceae, and Fabaceae, with 29, 16, and 11 species, respectively. The predominance of these vascular plant groups is also typical for other urban ecosystems in the central and northern regions of the Republic of Moldova. Floristic diversity in these urban ecosystems ranges from 52 species in the urban ecosystem of Telenești to 143 species in the urban ecosystem of Bălți (BULIMAGA et al., 2016; CERTAN et al., 2021).

The spectrum of biological indices. The studied sites include the following groups: ruderal species – 52%, spontaneous species – 36%, and segetal-ruderal species – 12% (Fig. 1). *Ambrosia artemisiifolia* L., *Elytrigia repens* (L.) Gould, *Sonchus arvensis* L., *Acer negundo* L., and *Grindelia squarrosa* (Parsh) Dun. are invasive species found at the outskirts of the city and near the roads crossing the urban ecosystem of Cimișlia. The spontaneous species *Aegilops cylindrica* Host., from the Poaceae family, grows abundantly near the city landfill site. It should be noted that this species is increasingly encountered at the periphery of urban ecosystems in the Republic of Moldova. In the coming years, it is possible that this species will further penetrate and adapt to urban ecosystem conditions due to its high adaptability to ongoing climate changes.

The floristic diversity of the Cimișlia urban ecosystem, located in the steppe zone of the South Moldavian Plain, shows that the flora of these urban environments differs significantly from the typical spontaneous zonal flora of natural steppe ecosystems. The biological spectrum of the studied flora is composed mainly of ruderal, spontaneous, and segetal-ruderal species. The dominance of ruderal and segetal-ruderal species reflects the strong influence of anthropogenic factors under urban ecosystem (urboecosystem) conditions. The major floristic groups are represented by the families Asteraceae and Poaceae, whose dominant presence has also been recorded in other urban ecosystems throughout the Republic of Moldova.

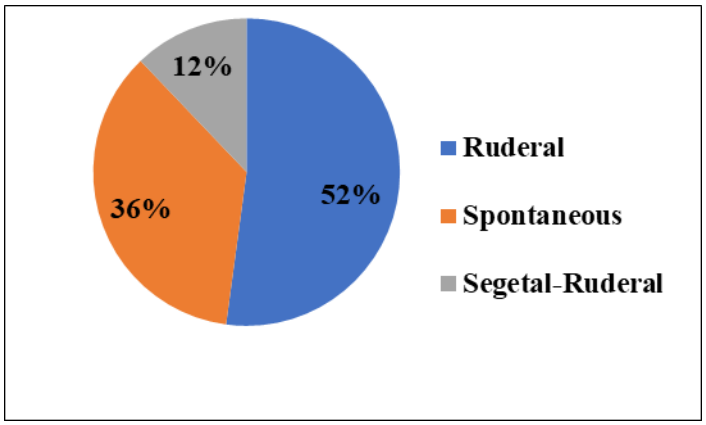

Figure 1. Percentage ratio of biological indices of vascular flora in the Cimișlia urban ecosystem.

The spectrum of biomorphs. The spectrum of biomorphs of the species growing in the studied sites within the town of Cimișlia is quite diverse (Fig. 2). The largest proportion is represented by hemicryptophytes, which account for 41% of the total. These are perennial herbaceous plants whose overwintering buds are located at the soil surface. The second most abundant biomorph categories are therophytes and phanerophytes, each comprising 17% of the total. The phanerophyte species *Elaeagnus angustifolia* L., previously identified in other urban ecosystems (CERTAN et al., 2024), is also present in the green spaces of Cimișlia, although it is more frequently found on the town's outskirts. Over recent decades, this species has become invasive throughout the Republic of Moldova. Geophytes represent 10% of the total flora, while hemitherophytes account for 8%, and therophytes-hemicryptophytes for 6%. Chamaephytes make up only 1% of the total biomorph spectrum.

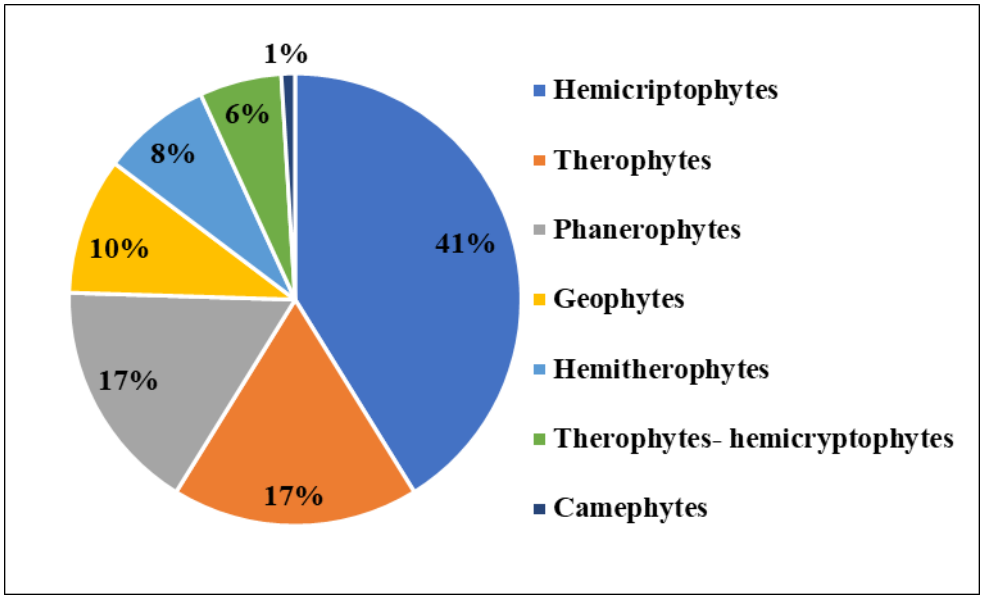

Figure 2. Percentage ratio of biomorphs in the Cimișlia urban ecosystem.

The spectrum of ecological groups in relation to the humidity factor. For the Cimișlia urban ecosystem, the analysis of ecological indices in relation to the humidity factor highlights the predominance of xeromesophytes, mesophytes; xeromesophytes and mesohygrophytes species, which account for 26%, 23% and 21%, respectively (Fig. 3). Mesophytes account for 16% of the total, and the following groups account for 5% and 4% of the total.

The spectrum of ecological groups in relation to the trophic factor. At the surveyed stations, the most representative ecological groups in relation to the substrate trophic factor are as follows: eutrophic – 49%, mesotrophic – 19%, oligotrophic – 15%, eutrophic, mesotrophic – 12%, and eurytrophic – 5% of the total (Fig. 4). Eutrophic species make up approximately 49% of all identified taxa, with the most widespread representatives in this group being *Amaranthus retroflexus* L., *Chenopodium album* L., *Atriplex tatarica* L., *Geum urbanum* L., *Cardaria draba* (L.) Desv., and others.

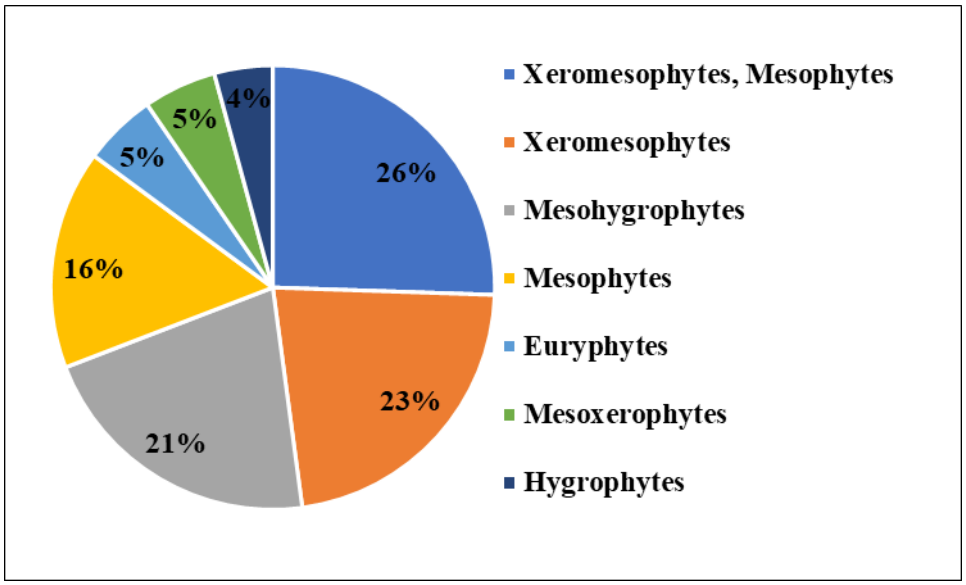

Figure 3. The spectrum of ecological groups in relation to the humidity factor.

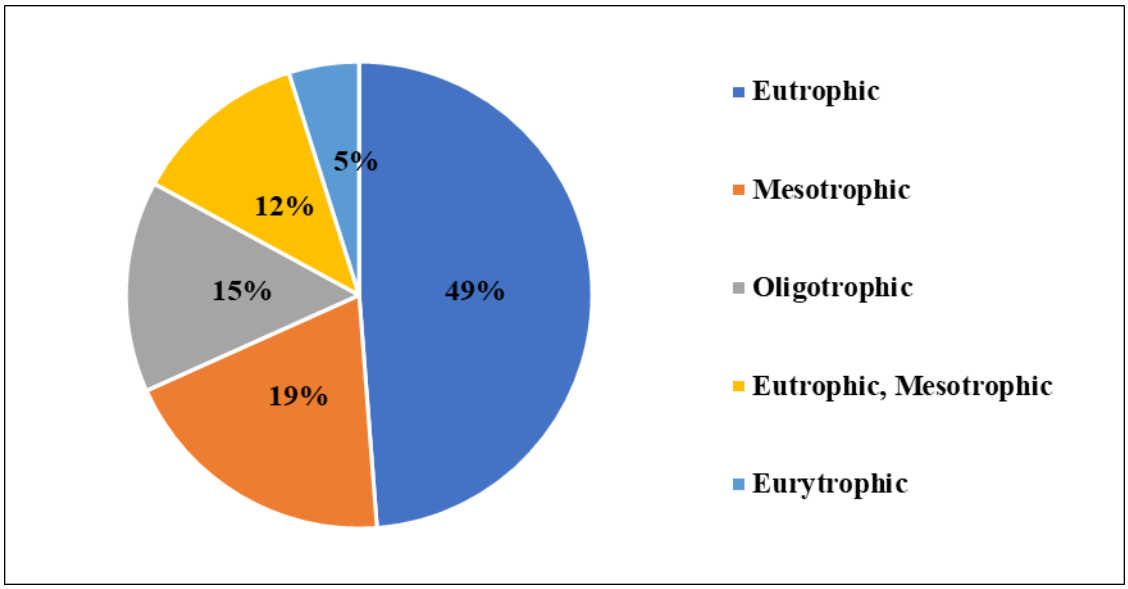

Figure 4. The spectrum of ecological groups in relation to the trophicity factor.

The study conducted in the urban ecosystem of Cimișlia indicates that the analysis of biological indices in relation to trophicity reveals a predominance of eutrophic species 49% and mesotrophic species 19%, indicating a substrate with a moderate to high nutrient level. Regarding moisture, the spectrum of xeromesophyte, mesophyte, and mesohygrophyte species reflects an adaptation to a variable moisture environment, typical of the southern urban areas of the Republic of Moldova. The research shows that variable moisture in cities directly influences floristic composition, favoring species with high ecological plasticity adapted to stressful conditions.

These correlations between biological indices and environmental factors provide a solid scientific basis for the sustainable management of urban ecosystems through the monitoring and control of invasive species, habitat restoration, and the planning of green spaces according to local ecological characteristics.

CONCLUSIONS

The largest groups in terms of floristic diversity are represented by the families Asteraceae and Poaceae, whose dominant position has also been established in other urban ecosystems in the Republic of Moldova.

As a result of anthropogenic impact in the urban ecosystem of Cimișlia, an imbalance occurs in the ratio of spontaneous species, their numbers decrease while the number of segetal and ruderal species increases. Some of these species exhibit invasive characteristics, such as *Ambrosia artemisiifolia* L., *Sonchus arvensis* L., *Elytrigia repens* (L.)

Gould, *Grindelia squarrosa* (Parsh) Dun., and *Acer negundo* L., which cause allergies during flowering and pose health risks to the population.

The phanerophyte species *Elaeagnus angustifolia* L., which has shown invasive behavior across the Republic of Moldova in recent decades, is significantly more frequent in urban ecosystems of the southern part of the country and has been identified in the majority of surveyed sites.

To improve, maintain, and conserve biological diversity, effective management of the city's floristic diversity is essential. This entails the restoration, preservation, and planting of tree and shrub species, as well as various annual and perennial plants with high ecological value and attractiveness for urban fauna.

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