O‘ZBEKISTON MILLIY UNIVERSITETI XABARLARI, 2026, [1]
ISSN 2181-7324

BIOLOGIYA
http://journals.nuu.uz
Natural sciences

UDK: 581.9 (575.1)

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SAMARQAND SHAHAR FLORASINI O‘RGANISHDA TO‘R TIZIMLI XARITALASHNING O‘RNI

Annotatsiya
Mazkur maqolada shaharlarda o‘simlik turlarini saqlab qolishning global strategiyasi doirasida urbonafloraning holatini baholashda to‘r tizimli xaritalash usulining qo‘llanilishi yoritilgan. Ushbu usul samarali biohujjatlash amaliyoti sifatida tahlil qilinib, uning afzalliklari va ayrim cheklovlari ochib berilgan. Shuningdek, ma’lumotlarni tizimli ravishda jamlash va ularni ilmiy muomalaga kiritishdagi ahamiyati asoslangan. Tadqiqot O‘zbekiston florasini to‘r tizimli xaritalash konsepsiyasi asosida amalga oshirilgan. Shu jarayonda Samarqand shahri urbanoflorasini o‘rganishga alohida e’tibor qaratilgan. Tadqiqot hududi har biri 1×1 km maydondan iborat bo‘lgan 174 ta kvadratga ajratilgan. 2024–2025-yillarda olib borilgan dala kuzatuvlari davomida shahar florasiga oid birlamchi materiallar to‘planib, ularning tahlili urbanofloraning tarkibi va tarqalish xususiyatlarini baholash imkonini berdi.
Kalit so‘zlar: biogeografiya, bioxilma-xillik, fazoviy tahlil, flora, indeks, iNaturalist, to‘r tizimli xarita, urbanoflora.

РОЛЬ СЕТЧАТОГО КАРТИРОВАНИЯ В ИЗУЧЕНИИ УРБАНОФЛОРЫ ГОРОДА САМАРКАНДА

Аннотация
В данной статье рассматривается применение сетчатого картирования как инструмента оценки состояния урбанофлоры в рамках глобальной стратегии сохранения растительных видов в городах. Данный метод анализируется как эффективная практика биодокументирования с выявлением его преимуществ и отдельных ограничений. Особое внимание уделено значению систематического сбора данных и их введению в научный оборот. Исследование выполнено в соответствии с концепцией сетчатого картирования флоры Узбекистана. В рамках работы особое внимание уделено изучению урбанофлоры города Самарканда. Территория исследования была разделена на 174 квадрата площадью 1×1 км каждый. В ходе полевых исследований, проведённых в 2024–2025 годах, были собраны первичные флористические материалы, анализ которых позволил оценить состав и особенности пространственного распределения урбанофлоры.
Ключевые слова: биогеография, биоразнообразие, пространственный анализ, флора, индекс, iNaturalist, сетчатое картирование, урбанофлора.

THE ROLE OF GRID-BASED MAPPING IN THE STUDY OF THE URBAN FLORA OF SAMARKAND CITY

Annotation
This article examines the application of grid-based mapping as a tool for assessing the condition of urban flora within the framework of global strategies for the conservation of plant species in cities. The method is analyzed as an effective bio-documentation practice, highlighting its advantages as well as certain limitations. Particular attention is given to its role in the systematic collection and scientific integration of data. The research was conducted within the framework of the national grid-mapping concept for the flora of Uzbekistan. In this context, special emphasis was placed on the study of the urban flora of Samarkand. The study area was divided into 174 grid cells, each measuring 1×1 km. Field investigations carried out during 2024–2025 resulted in the collection of primary floristic data, the analysis of which made it possible to assess the composition and spatial distribution patterns of the urban flora.
Keywords: biogeography, biodiversity, spatial analysis, flora, index, iNaturalist, grid-based mapping, urban flora.

Introduction. The expansion of human economic activity, along with the rapid processes of industrialization and urbanization, has led to significant transformations of natural ecosystems. The conversion of natural landscapes, fragmentation of habitats, and increasing anthropogenic pressure have resulted in a reduction of floristic diversity [2]. This phenomenon is particularly evident in urban areas, where the transformation of urban flora is characterized by changes in species composition and structure, a decline in native species, and the widespread distribution of adventive and invasive species [6].

The conservation of plant species in cities, monitoring of their ecological status, and ensuring the rational use of bioresources have become pressing issues today. Therefore, there is a growing need to develop an effective methodology for assessing the condition of urban flora, identifying species composition, and systematically documenting them [14]. Such an approach plays a crucial role in ensuring the sustainability of urban ecosystems, planning green infrastructure, and shaping strategies for biodiversity conservation.

The advancement of Geographic Information Systems (GIS) technologies has significantly expanded the possibilities for digitizing biodiversity data, developing databases, and conducting spatial analyses [11]. GIS tools enable the acquisition of accurate and reliable information on plant distribution ranges, species richness, ecological groups, and their relationship with environmental conditions. Moreover, these technologies facilitate data visualization, the creation of thematic maps, and geospatial modeling [3]. In turn, this supports evidence-based decision-making and contributes to the improvement of environmental management systems.

At present, the grid mapping method is widely applied as one of the most advanced and effective approaches for studying plant diversity and biodiversity documentation [8]. This method is based on dividing the study area into cells (grids) of a defined size and identifying and assessing the floristic composition within each cell. Such an approach makes it possible to determine the spatial patterns of species distribution, evaluate levels of floristic richness, and identify insufficiently studied areas.

Grid-based mapping of urban flora has been highly developed in European countries, particularly in Italy, France, and Germany, where this experience has produced significant outcomes in improving urban ecology and ensuring the effective management of green spaces [6,7]. This method allows for an accurate representation of the spatial distribution of urban plant species, assessment of anthropogenic impacts, and the development of scientifically grounded recommendations for biodiversity conservation.

Based on the above considerations, the main objective of this study is to conduct a comprehensive spatial and statistical analysis of the flora of Samarkand city using a grid mapping methodology. The results of the research will serve as a scientific basis for identifying patterns of plant species distribution within the urban area, assessing the level of floristic richness, and developing future strategies for biodiversity conservation and green space management.

- Literature review. Since the second half of the 20th century, Western European countries have widely implemented the practice of studying local floras based on territorial grid systems [10]. The introduction of the grid mapping method enabled researchers to determine the geographical distribution of plant species, assess their spatial diversity, and collect and analyze floristic data in a standardized format. The effectiveness of this approach led to the development of a major floristic project at the European level — *Atlas Florae Europapeae*. Within the framework of this atlas, the territory of Europe was divided into 50 × 50 km grid squares, and species distribution ranges were systematically mapped [4].

By 2018, 17 volumes of this fundamental publication had been released [5], providing a significant scientific foundation for the systematic study of European flora and biodiversity conservation research. Drawing on the experience of this project, many European countries implemented national grid-based floristic mapping initiatives. Each country selected grid sizes according to its territorial extent, natural and climatic conditions, and floristic richness. For example, 10 × 10 km grids were used in the United Kingdom and Ireland; 4 × 4 km in Belgium and Luxembourg; 5 × 5 km in the Netherlands; 10 × 10 km in Spain and Portugal; 6 × 10 km in Germany; and 3 × 5 km in Slovenia.

In addition to natural floras, grid-based mapping of urban floras has also been highly developed in Europe. In particular, studies conducted in Paris, Rome, and Hamburg occupy a leading position in urban floristic research. The methodological approaches applied in Hamburg demonstrated high effectiveness in spatial analysis and ecological assessment of urban flora [12].

Within the CIS countries, scientific studies based on grid mapping have also been conducted. Notably, in the doctoral dissertation titled *“Spatial Structure of the Flora of the Vladimir Region”* (2014), A.P. Sergein applied this method to conduct an in-depth analysis of the spatial characteristics of flora structure [8]. The results confirmed the high scientific value of grid mapping in determining plant distribution patterns and evaluating ecological characteristics.

In recent years, the growth of scientific capacity and the development of digital technologies have created opportunities to conduct floristic research in Uzbekistan using modern geoinformation approaches. As an initial experience, in 2018 a grid-based map consisting of 277 squares measuring 5 × 5 km was developed for the western branches of the Zarafshan Range [15]. This work laid the foundation for large-scale national projects in floristic mapping and biodiversity research.

As a result, in 2021 Uzbekistan became the first country in Central Asia to develop a grid-based map of its flora, comprising 19,240 indices with a spatial resolution of 5 × 5 km [9]. This project enabled the study of plant species distribution across the republic within a unified spatial framework.

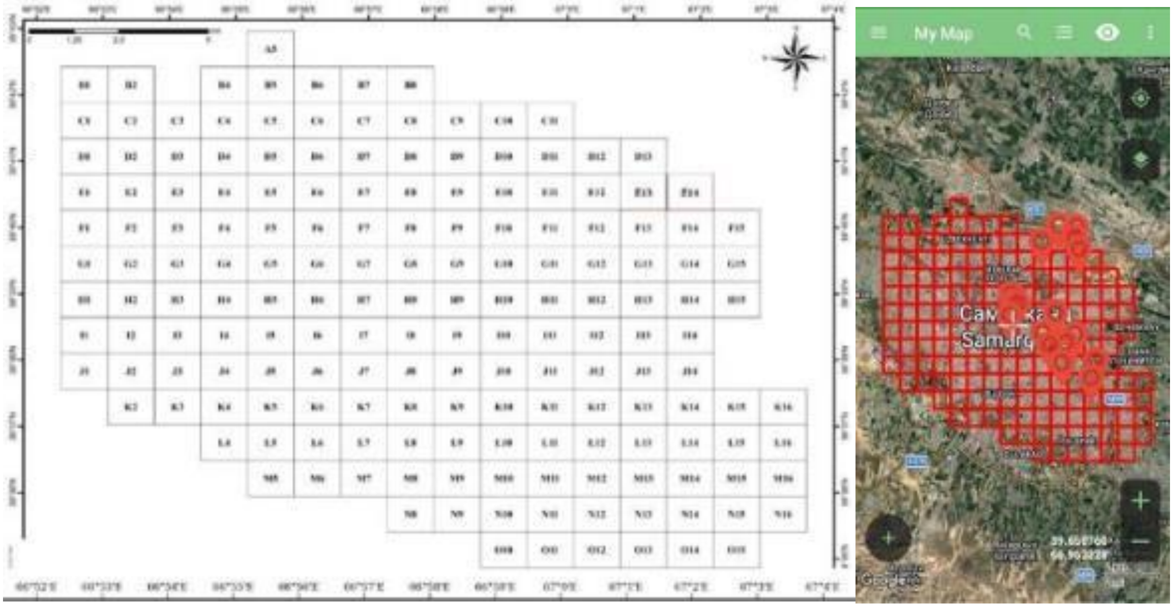
At the next stage, the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan launched a state-funded research program for 2021–2024 entitled *“Grid Mapping of the Flora of the South-Western Hissar, Hissar-Darvaz and Panj Foreland Districts (Surkhandarya Region Section)”* [1]. The territory of Surkhandarya region was selected as the study area due to its high floristic richness, significant proportion of endemic and rare species, and the availability of an extensive primary database.

Currently, within the framework of this project, more than 69,914 herbarium records representing over 2,500 species are being analyzed across 884 grid indices, using indicators such as species richness and collection density.

In addition, during 2021–2023, an applied research project entitled *“Formation Features of Urban Floras under Different Natural-Climatic and Anthropogenic Conditions (Case Study of Belarus and Uzbekistan)”* was carried out at the Institute of Botany. Within this project, the floras of Tashkent and Bukhara were studied using a grid-based mapping approach. According to the results, the territory of Tashkent was divided into 591 grid squares of 1 × 1 km, Bukhara into 85 squares, and Qarshi into 186 squares for floristic analysis. These scientific initiatives demonstrate the gradual advancement and methodological refinement of the grid mapping approach in Uzbekistan, as well as the establishment of a solid methodological foundation for its application in urban flora research.

Research methods. During field investigations, the geographic coordinates of plant occurrences were recorded using the Tracklia and Google Earth mobile applications. Cartographic analysis and mapping procedures were carried out using ArcGIS v10.6.1 (ESRI Inc., Redlands, CA, USA). For geospatial data processing, the global coordinate reference system WGS 1984 (World Geodetic System 1984) was applied [13].

Analysis and results. Urban areas are shaped by anthropogenic factors, creating dynamic ecological conditions that influence plant distribution. Although cities are generally floristically rich, species diversity can vary considerably at the local level depending on ecological features, climate, soil conditions, and the intensity of human activities. The grid-based mapping approach enables detailed analysis of urban flora, assessment of species composition across different areas, and evaluation of plant adaptation to changing environments. It helps reveal the spatial structure of urban flora and the impact of anthropogenic factors on vegetation formation.



A B

Figure 1. A – Grid-based map of Samarkand city (1 × 1 km resolution), B – Mobile visualization of the grid-based map of Samarkand city

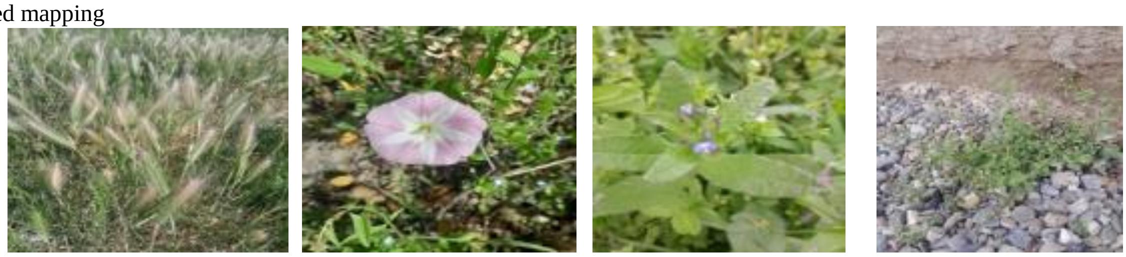
This approach enables a comprehensive assessment of both threats and opportunities affecting plant species within the urban environment. It also holds significant scientific and practical importance for the development of effective conservation and management strategies for urban flora.

Based on these considerations, the territory of Samarkand city was analyzed using a grid-based map consisting of 174 squares, each measuring 1 × 1 km (Figure 1). The designated squares were indexed using combinations of Latin alphabet letters and numbers. The KML and KMZ files of the grid-based map were integrated into the Tracklia, Google Earth mobile applications to facilitate their use during field surveys (Figure 2).

As a result of targeted field studies conducted during 2024–2025, more than 5,000 herbarium specimens were collected. According to their geospatial locations, these specimens were distributed across 150 grid indices of the mapping system. In addition, approximately 3,200 observation records representing around 350 plant species identified during fieldwork were uploaded to the global biodiversity platform iNaturalist (Figure 3, https://www.inaturalist.org/people/florist2024).

Figure 3. Data uploaded to the iNaturalist platform

Currently, the herbarium specimens collected during field surveys are undergoing detailed laboratory examination and are being entered into a specially designed database in Microsoft Excel, structured according to specific parameters developed for grid-based mapping



A B C D

Figure 4. Some plant species distributed in the urban flora of Samarkand city: A – Hordeum murinium, B – Convolvulus arvensis, C – Asperugo procumbens, D – Stellaria media

According to the grid-based mapping results, the distribution of the most widespread species across grid indices is as follows:

- Capsella bursa-pastoris – recorded in 145 grid indices
- Stellaria media – 140 grid indices
- Sonchus oleraceus – 135 grid indices
- Lamium amplexicaule – 108 grid indices

These results indicate the broad spatial distribution of synanthropic and ecologically plastic species within the urban territory of Samarkand.

Conclusion. Urban areas are shaped by anthropogenic factors, which influence the distribution of plant species. Grid-based mapping helps systematize and visualize data, improves the efficiency of floristic research, and serves as a reliable tool for long-term monitoring. The flora of Samarkand is an important part of Uzbekistan's national grid platform, and integrating data into GBIF and the national database supports biodiversity research and the scientific management of urban ecosystems.

REFERENCES

1. Акбаров Ф.И., Тожибаев К.Ш. Сурхондарё вилояти флораси айрим эндем турларнинг биоикдимий моделини яратиш // НамДУ илмий ахборотномаси. Наманган 2022 й. №4, 127-133 Б.
2. Benito B. M., Cayuela L., Albuquerque F. S. The impact of modelling choices in the predictive performance of richness maps derived from species-distribution models: Guidelines to build better diversity models // Methods in Ecology and Evolution. – 2013. – Т. 4. – №. 4. – С. 327-335.
3. Brototi Biswas B. B., Sakshi Walker S. W., Mayank Varun M. V. Web GIS based identification and mapping of medicinal plants: a case study of Agra (UP), India. – 2017.
4. Jalas J, Suominen J, Lampinen R (eds). Atlas Florae Europaeae // №11. –1996. –The Committee for Mapping the Flora of Europe and Societas Biologica Fennica Vanamo, Helsinki.
5. Kurtto A., Sennikov A.N. Atlas Florae Europaeae Distribution of Vascular Plants in Europe // Helsinki. 2018. –9 p.
6. Celesti-Grapow L. et al. Determinants of native and alien species richness in the urban flora of Rome // Diversity and Distributions. – 2006. – Т. 12. – №. 5. – С. 490-501.
7. Muratet A. et al. The role of urban structures in the distribution of wasteland flora in the greater Paris area, France // Ecosystems. – 2007. – Т. 10. – С. 661-671.
8. Серегин А.П. 2014 г. Флора Владимирской области: анализ данных сеточного картированиуа // Товарищество нау. изд. КМК. Москва 2014. – С. 418.
9. Tojibaev, K., Khassanov, F., Turginov, O., Akbarov, F., Pulatov, S., Turdiboev, O. (2022) Endemic plant species richness of Surkhondaryo province, Uzbekistan // Plant Diversity of Central Asia. 1. 71–84.
10. Tutin TG, Heywood VH, Burges NA, Valentine DW, Walters SM, Webb DA (eds). Flora Europaea // №1. –1964. –Cambridge University Press, Cambridge., 1968–1980.
11. Peterson A. T. Predicting species' geographic distributions based on ecological niche modeling // The condor. – 2001. – Т. 103. – №. 3. – С. 599-605.
12. Schmidt K. J., Poppendieck H. H., Jensen K. Effects of urban structure on plant species richness in a large European city // Urban Ecosystems. – 2014. – Т. 17. – С. 427-444.
13. Shcherbakov A. V. et al. A grid-based database on vascular plant distribution in the Meshchersky National Park, Ryazan Oblast, Russia // Biodiversity Data Journal. – 2021. – Т. 9.
14. Wellmann T. et al. Earth observation based indication for avian species distribution models using the spectral trait concept and machine learning in an urban setting // Ecological Indicators. – 2020. – Т. 111. – С. 106029.
15. Қодиров У.Ҳ. Ургут ботаник-географик райони флораси. Автореф. дис. биология фанлари бўйича фалсафа доктори (PhD). –Тошкент, 2020. – С. 40.