GENERAL ASPECTS OF THE SYNANTHROPIC FLORA OF BATUMI (GEORGIA/SAKARTVELO)

Irakli Mikeladze
PhD in Biology, Senior Researcher, Institute of Phytopathology and Biodiversity of Batumi Shota Rustaveli State University
Email: irakli.mikeladze@bsu.edu.ge.
ORCID: https://orcid.org/0000-0003-1200-6787
Davit Baratashvili
Doctor of Biological Sciences
Full Professor at Faculty of Natural Sciences and Health Care of Batumi Shota Rustaveli State University
Email: baratashvili.daviti@bsu.edu.ge.
ORCID: https://orcid.org/0000-0003-4912-4330
Marine Bakuridze
PhD Student at Batumi Shota Rustaveli State University
Email: bakuridzemarine@gmail.com
ORCID: https://orcid.org/0009-0008-3733-7359

Abstract: The intensification of anthropogenic factors in natural and anthropogenically transformed ecosystems has led to the enhancement of synanthropization processes and the formation of synanthropic flora in urban landscapes. This paper presents an assessment of the distribution patterns and species composition of the synanthropic (anthropophytic) flora of Batumi City based on available literature data and ongoing field observations.

The study was conducted within the administrative boundaries of the city and includes urban, semi-urban, and peri-urban zones. Vegetation surveys were carried out during botanical expeditions using standard floristic methods.

The obtained data allow the evaluation of the spatial distribution of synanthropic flora, habitat specificity, and its relationship with urbanization processes. Special attention is paid to Batumi's role as a "hotspot" for the spread of alien and potentially invasive plant species due to its geographical location, transport connections, and tourist activity.

The results provide a basis for urban flora monitoring, biodiversity conservation, and the development of invasive species management strategies.

Keywords: synanthropization; synanthropic flora; urban flora; alien plants; invasive plants.

***

Introduction. Anthropogenic impact on natural ecosystems has led to the formation of one of the most significant phenomena-synanthropization. Synanthropization (from Greek *synanthropos* - "living together with humans") is an ecological process that reflects the adaptation of plant and animal species to environments modified by human activity.

This process represents one of the clearest forms of interaction between humans and nature and reflects the response of biotic components to anthropogenic pressure (Kornas, 1966, 1982, 1983; Faliński, 1972; Kowarik, 1990; Binggeli, 1994; Jackowiak, 2023). According to Kornas, synanthropization is a complex of modern and historical changes in vegetation caused by human activity, primarily affecting flora and plant communities (Kornas, 1966, 1982, 1983).

Synanthropic species are human-associated species that have changed throughout all stages of civilization development and will continue to change in the future.

A special role in the process of synanthropization is played by urbanization, agricultural intensification, transport development, land-use changes, and infrastructure projects. Cities, villages, and industrial areas create specific environments in which synanthropic species establish their habitats. These processes have facilitated the rapid spread of many plant and animal species.

Although many synanthropic species provide benefits to human well-being, for example, they reduce erosion along roadsides and degraded areas; absorb dust and heavy metals; regulate microclimate; absorb CO_2 and produce oxygen; serve as food sources for pollinators and shelter for small organisms; possess medicinal properties and are used as food undesirable species often accompany them in anthropogenic landscapes. These frequently cause biodiversity loss, disruption of ecological balance, and intensification of invasive processes.

In the context of ongoing global climate change, clarifying the species composition of synanthropic flora is especially important. Climate change is considered a major factor that may exacerbate the problem of alien species in the future. For instance, very high temperatures may negatively affect some alien species that were introduced in the past and adapted to existing climatic conditions. However, even slight temperature increases may enable many alien species to overcome climatic barriers and colonize new areas.

Ultimately, climate change may influence the invasion, establishment and spread of invasive species and lead to ecological, economic and human health problems.

Based on the above, the aim of this study is to analyze existing literature on the distribution patterns and species composition of the synanthropic/anthropophytic flora of Batumi and to provide material and technical support for practical transect based field studies**.**

Methodology. The study was conducted within the administrative boundaries of Batumi City and aimed to investigate synanthropization processes through long-term monitoring. The study area was divided into urban, semi-urban and peri-urban zones according to the intensity of anthropogenic impact.

Vegetation surveys were carried out during botanical field expeditions from 2024 to 2025 and included background inspections and route-based records.

At each location, the presence of synanthropic plant species and the type of habitat were recorded. Species identification was performed using standard floristic methods and compared with modern taxonomic databases (POWO - https://powo.science.kew.org/).

Discussion. Synanthropization is the result of anthropogenic pressure and has its roots in ancient times. Nevertheless, its scientific conceptualization and inclusion within terminological frameworks occurred relatively late. Changes in flora and vegetation caused by human activity have been the subject of systematic phytosociological studies for more than 170 years (Watson, 1847; Candolle, 1855; Jackowiak, 2023). These studies laid the foundation for the concept of synanthropic flora and for the scientific interpretation of ecological mechanisms of anthropogenic transformation.

In the second half of the 20th century, anthropogenic changes in flora and vegetation became a central focus of geobotanical research, particularly in Central Europe, where the consequences of human activity became increasingly visible and dramatic (Thellung, 1915, 1919, 1925). Research covered a wide range of habitats and vegetation types, including forests (Augusto et al., 2003; Zerbe, 2022), river valleys (Tockner & Stanford, 2002; Nobis et al., 2016), water bodies (Gołdyn, 2010; Olson et al., 2014), meadows and grasslands (Pavlů et al., 2011; Wesche et al., 2012), agricultural lands (Baessler & Klotz, 2006; Rühl et al., 2015), cities (Jackowiak, 1989; Kowarik, 1995; Pyšek, 1998; Kühn et al., 2004), rivers (Jehlík et al., 2019), seaports (Jehlík, 1981), railways (Brandes, 1983; Wittig, 2002; Wrzesień, 2006; Jehlík, 2017), and roads (Lippe & Kowarik, 2007).

In Georgia, scientific data on synanthropic plants are limited. The first systematic studies of flora date back to the second half of the 19th century and are associated with investigations of the flora and vegetation of the Caucasus, Colchis, and Georgia in general. However, targeted research on synanthropic flora is rare, especially for Batumi City.

Existing data on the synanthropic flora of Batumi are fragmentary and mainly derive from studies of native and alien plants conducted within the Adjara floristic region (Dmitrieva, 1967; Gabrichidze, 1976; Dmitrieva, 1990a, 1990b; Davitadze, 2001; Davitadze, 2002). A relatively small number of studies concern floristic surveys of Batumi's landfill and ruderal habitats (Mikeladze & Sharabidze, 2020; Mikeladze et al., 2025).

As a result of studies on the ruderal habitats of Batumi, 271 plant species have been recorded, representing important elements of the synanthropic flora, since drawing a strict boundary between ruderal and synanthropic species is practically impossible (Mikeladze & Zoidze, 2024). Background surveys further indicate that the number of synanthropic plant species is even higher.

Background analysis indicates that in recent decades Batumi has experienced intensive urbanization expressed in the construction of new residential districts, hotels, coastal infrastructure, recreational zones, parks, and squares. These processes are accompanied by large-scale construction activities and the transport of various materials both within the city and from abroad.

Diverse introduction pathways associated with urban greening and private gardening ensure the continuous inflow of alien planting material into the urban environment.

Batumi's role as a "hotspot" for the spread of synanthropic plants is further strengthened by its geographical location and high transport and tourism connectivity. As one of the major port cities of the Black Sea region and an important transport hub, Batumi experiences intensive movement of people and goods, increasing the probability of unintentional introduction of alien plant species. Tourist flows further enhance human-mediated dispersal within the city and surrounding areas.

In addition to commercial introduction pathways, traditional and cultural practices, particularly the planting of ornamental plants in cemeteries and memorial sites play an important but often underestimated role in the establishment of alien species. Some of these species subsequently escape cultivation and occupy nearby disturbed habitats (construction sites, abandoned plots, roadside zones, canal banks, and coastal areas).

The combined influence of geographical location, transport infrastructure, tourism, and local greening traditions synergistically promotes the establishment and spread of synanthropic and potentially invasive plant species, significantly affecting the species composition, spatial structure, and dynamics of Batumi's synanthropic flora.

Conclusions. The present study confirms that synanthropization represents one of the key ecological processes shaping the urban landscape of Batumi and is closely linked to urbanization, transport infrastructure development, tourism activities, and greening practices.

Analysis of available literature and field observations indicates that Batumi's synanthropic flora is characterized by high species diversity and includes a substantial proportion of both native and alien plant species.

The city's geographical location and port function create favorable conditions for the unintentional introduction and spread of alien species, further reinforced by ornamental gardening and cultural traditions. The synergistic effect of these factors leads to the formation of Batumi as a "hotspot" for potentially invasive plants and determines the dynamic nature of its synanthropic flora.

Under conditions of global climate change, further expansion of synanthropic and alien plant species and an increase in their ecological impact are expected. Therefore, systematic study and long-term monitoring of Batumi's synanthropic flora are essential prerequisites for the timely detection of invasive processes and the sustainable management of urban ecosystems.

The obtained data provide a scientific basis for detailed inventory, spatial analysis, and forecasting of urban flora, which is important for both biodiversity conservation and sustainable urban development strategies.

References:

Gabrichidze, M. (1976). *The Green Cover of Batumi*. Batumi, pp. 5-43.

Davitadze, M. (2001). *The Adventive Flora of Adjara*. Batumi, 199 p.

Davitadze, M. (2002). *Biomorphological Analysis of the Adventive Flora of Adjara*. Proceedings of Batumi University, 215 p.

Mikeladze, I., Zoidze, L. (2024). *Ruderal flora of Batumi City: Structure and bioecological characteristics*. Black Sea Region at the Crossroads of Civilizations, 2, 697-710. https://doi.org/10.61671/bsrcc.v2i2

Augusto, L., Dupouey, J., & Ranger, J. (2003). Effects of tree species on understory vegetation and environmental conditions in temperate forests. *Annals of Forest Science*, *60*, 823-831. https://doi.org/10.1016/j.foreco.2003.01.001

Baessler, C., & Klotz, S. (2006). Effects of changes in agricultural land-use on landscape structure and arable weed vegetation over the last 50 years. *Agriculture, Ecosystems & Environment*, *115*, 43-50.

Binggeli, P. (1994). The misuse of terminology and anthropometric concepts in the description of introduced species. *Bulletin of the British Ecological Society*, *25*, 10-13.

Brandes, D. (1983). Flora und Vegetation der Bahnhöfe Mitteleuropas. *Phytocoenologia*, *11*, 31–115.

Candolle, M.A. De. (1855). *Géographie botanique raisonnée ou exposition des faits principaux et des lois concentrant la distribution géographique des plantes de l'époque actuelle*. Librarie de Victor Masson.

Dmitrieva, A. A. (1967). On the issue of alien and feral plants of the Batumi coast. *News of the Batumi Botanical Garden*, *14*, 58–65.

Dmitrieva, A. A. (1990a). *Key to the plants of Adjara* (Vol. 1). Metsniereba.

Dmitrieva, A. A. (1990b). *Key to the plants of Adjara* (Vol. 2). Metsniereba.

Faliński, J. B. (1972). Synantropizacja szaty roślinnej-Próba określenia istoty procesu i głównych kierunków badań. *Phytocoenosis*, *1*, 157-170.

Gołdyn, H. (2010). Changes in plant species diversity of aquatic ecosystems in the agricultural landscape in West Poland in the last 30 years. *Biodiversity and Conservation*, *19*, 61-80.

Jackowiak, B. (1989). Dynamik der Gefäßpflanzenflora einer Großstadt am Beispiel von Poznan/Polen. *Braun-Blanquetia*, *3*, 89-98.

Jackowiak, B. (2023). Man-made changes in the flora and vegetation of Poland: Current review. *Diversity*, *15*, 618. https://doi.org/10.3390/d15050618

Jehlík, V. (1981). Beitrag zur synanthropen (besonders Adventiv) Flora des Hamburger Hafens. *Tuexenia*, *1*, 81-97.

Jehlík, V., Dostálek, J., Frantík, T. (2019). Alien plants in Central European River ports. *NeoBiota*, *45*, 93-115.

Jehlík, V., Zaliberová, M., Májeková, J. (2017). The influence of the Eastern migration route on the Slovak flora - A comparison after 40 years. *Tuexenia*, *37*, 313-332.

Kornaś, J. (1966). Influence of man and his economic activities on the vegetation of Poland. The synanthropic flora. In W. Szafer (Ed.), *The vegetation of Poland* (pp. 93-137). Pergamon Press-PWN.

Kornaś, J. (1982). Man's impact upon the flora: Processes and effects. *Memorabilia Zoologica*, *37*, 11-30.

Kornaś, J. (1983). Man's impact upon the flora and vegetation in Central Europe. In W. Holzner, M. J. A. Werger, & I. Ikusima (Eds.), *Man's impact on vegetation* (pp. 277-286). Dr. W. Junk Publishers.

Kowarik, I. (1990). Some responses of flora and vegetation to urbanization in Central Europe. In H. Sukopp & S. Hejný (Eds.), *Urban ecology: Plants and plant communities in urban environments* (pp. 45-74). SPB Academic Publishing.

Kowarik, I. (1995). On the role of alien species in urban flora and vegetation. In P. Pyšek, K. Prach, M. Rejmánek, & M. Wade (Eds.), *Plant invasions: General aspects and special problems* (pp. 85–103). SPB Academic Publishing.

Kühn, I., Brandl, R., & Klotz, S. (2004). The flora of German cities is naturally species rich. *Evolutionary Ecology Research*, *6*, 749-764.

Lippe, M., & Kowarik, I. (2007). Long-distance dispersal of plants by vehicles as a driver of plant invasions. *Conservation Biology*, *21*, 986-996.

Mikeladze, I., Sharabidze, A. (2020). The flora of the Batumi landfill (Adjara, Georgia). *Ukrainian Botanical Journal. Ukr. Bot*. J. 77(6): 428-433. https://doi.org/10.15407/ukrbotj77.06.428

Mikeladze, I., Zoidze, L., Bakuridze, M. (2025). Current condition and bioecological features of widespread alien plants in Seaside Ajara (Georgia, Sakartvelo). *Black Sea Region at the Crossroads of Civilizations*, *3*(1), 829-843.

Nobis, A., Żmihorski, M., & Kotowska, D. (2016). Linking the diversity of native flora to land cover heterogeneity and plant invasions in a river valley. *Biological Conservation*, *203*, 17-24.

Olson, E. R., & Doherty, J. M. (2014). Macrophyte diversity-abundance relationship with respect to invasive and native dominants. *Aquatic Botany*, *119*, 111-119.

Pavlů, L., Pavlů, V., Gaisler, J., Hejcman, M., & Mikulka, J. (2011). Effect of long-term cutting versus abandonment on the vegetation of a mountain hay meadow (Polygono-Trisetion) in Central Europe. *Flora*, *206*, 1020-1029.

Pyšek, P. (1998). Alien and native species in Central European urban floras: A quantitative comparison. *Journal of Biogeography*, *25*, 155-163.

Rühl, A.T., Eckstein, R.L., Otte, A., & Donath, T.W. (2015). Future challenge for endangered arable weed species facing global warming: Low-temperature optima and narrow moisture requirements. *Biological Conservation*, *182*, 262-269.

Thellung, A. (1915). Pflanzenwanderungen unter dem Einfluss des Menschen. *Englers Botanische Jahrbücher*, *53*, 37-66.

Thellung, A. (1919). Zur Terminologie der Adventiv- und Ruderalflora. *Allgemeine Botanische Zeitschrift*, *24*, 36-43.

Thellung, A. (1925). Kulturpflanzen-Eigenschaften bei Unkräutern. *Veröffentlichungen des Geobotanischen Institutes Rübel*, *3*, 745-762.

Tockner, K., & Stanford, J. A. (2002). Riverine flood plains: Present state and future trends. *Environmental Conservation*, *29*, 308-330.

Watson, H. C. (1847). *Cybelle Britannica: Or British plants and their geographical relations* (Vol. IV). Longmans. 344.

Wesche, K., Krause, B., Culmsee, H., & Leuschner, C. (2012). Fifty years of change in Central European grassland vegetation: Large losses in species richness and animal-pollinated plants. *Biological Conservation*, *150*, 76–85.

Wittig, R. (2002). Ferns in a new role as a frequent constituent of railway flora in Central Europe. *Flora*, *197*, 341-350.

Wrzesień, M. (2006). Kenophytes chorologically related to the habitats of railway grounds in central eastern Poland. *Biodiversity Research and Conservation*, *1*, 92-94.

Zerbe, S. (2002). Restoration of natural broad-leaved woodland in Central Europe on sites with coniferous forest plantations. *Forest Ecology and Management*, *167*, 27-42.