

URBAN FLORA: NEW REPORTS FOR BUCHAREST'S FLORA

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Abstract: The concept of urban flora refers to the plant life that exists within city environments, encompassing the types of plants found in urban areas and how they interact with the unique challenges and conditions here (e.g. anthropic habitats with limited and controlled space, pollution, heat, drought), which can favour some species and restrict others. The first references to the Bucharest's flora date from 1876, and since then the dynamics of the number of species registers a continuum. As a result of the implementation of "UrbFloraBuc" project during 2023-2024, we report 12 new species of which five are native and seven are allochthonous, and data on their distribution and habitats within the city. This study makes valuable contributions to the knowledge of Bucharest flora, emphasizing, on the one hand, the importance of the urban environment as a conservation space for rare (native) species, and on the other hand, raising an alarm signal on the need for an early detection of the allochthonous species, to the extent that the latter could become problematic in the urban environment.

Keywords: Romania, native plants, alien plants, biodiversity, autochthonous, allochthonous

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Introduction

The urbanization process is often associated with a low biodiversity, with a reduced number of plant and animal species, and a uniformity of them (Goddard et al. 2010). However, habitats in the urban environment can provide favourable conditions for a number of species, whether native or alien (Sánchez & Lara 2024). The allochthonous flora is mostly represented by ornamental plants (Mehraj et al. 2021), but some can pose health or economic problems (Rai & Singh 2020). The native flora of cities is more commonly represented by plants in the weed category (Aronson et al. 2014), but rarities that need to be protected can also appear (McKinney 2008). Thus, the knowledge of urban flora is of particular importance both from the perspective of biodiversity conservation and from the social one (Niemelä 1999).

Data on Bucharest's flora has been published by Brândză (1876, 1879-1883), Grecescu (1880, 1898), Panțu (1908, 1909, 1910, 1912, 1931), Morariu (1937, 1939, 1941, 1943, 1944, 1946, 1949, 1960), Săvulescu (1952-1972), Nagodă (2015). Recently, Nagodă et al. (2013) and Anastasiu et al. (2017) published data regarding flora from Natural Park Văcărești, a natural protected area located very close of the central area of Bucharest.

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As part of the project “Urban flora and its characteristics in Bucharest and surroundings (UrbFloraBuc)”, funded under the ICUB GRANTS FOR YOUNG RESEARCHERS program, numerous plants, both native and alien, were inventoried in Bucharest during 2023-2024. In this paper we provide the distribution data of the species for which there have been no reports so far, as well as information on the habitats in which they have been identified. We also discuss the source of these plants, but also the survival prospects of the identified populations. We hope that our data will not only be meant to complete the floristic list of Bucharest but will also contribute to increasing awareness of the need to protect urban biodiversity.

Material and methods

During the years 2023 and 2024, we carried out an extensive process of inventorying the flora in Bucharest, with the main purpose of assessing the plant diversity of a capital city that has expanded and developed a lot in recent decades.

Bucharest, with a surface of 240 km², is located in the Romanian Plain and crossed by two rivers: Dâmbovița and Colentina (Fig. 1). The average altitude is 85 m. The climate is temperate – continental. The highest annual average temperature for the period 1901-2000 was 22.9°C, recorded in July, and the average monthly minimum temperature was -2.2°C, in January. In 2022, the average monthly maximum temperature was 25.7°C, and the average monthly minimum temperature was 2°C, also recorded for January. Regarding precipitation, the annual average was 502.7 mm for the period 1901-2000 and 408.1 mm for 2022 (Andrei 2024).

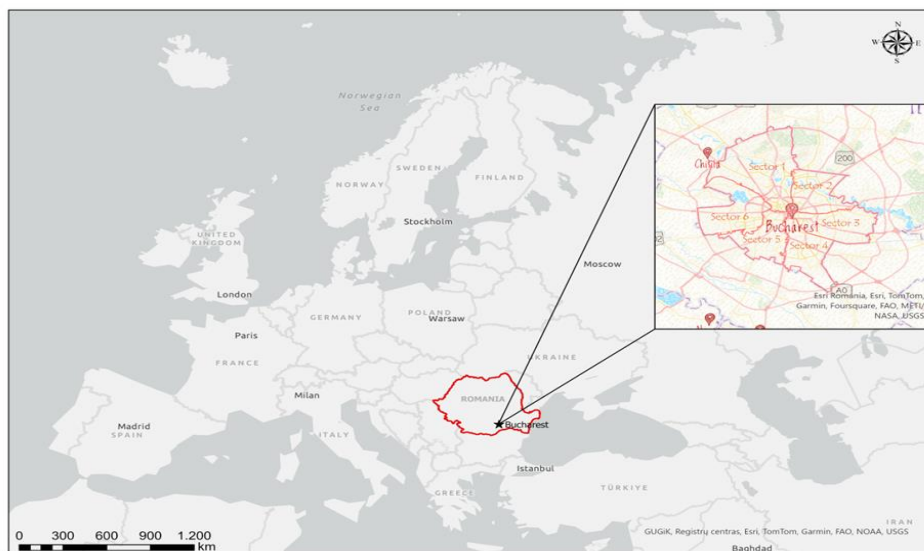


Fig. 1. Bucharest's geographical position in Europe and Romania, and its sector division

The surveys focused on different areas of Bucharest, such as the city centre, major boulevards, residential neighbourhoods, parks, Botanic Garden “D. Brandza”, and university campuses. The inventory period spanned from March to October.

The nomenclature is consistent with the Plants of the World Online database (2024).

The collected vouchers are stored in the Herbarium of the Botanic Garden “D. Brandza” of the University of Bucharest (BUC).

Results and discussion

During the urban flora inventory activities in Bucharest, carried out between 2023-2024, we identified 12 spontaneous and subsponaneous taxa that have not been reported so far from this city. Of these, five are autochthonous (*Cardamine flexuosa*, *Cephalanthera damasonium*, *Orchis purpurea*, *Paeonia peregrina*, *Sagina apetala* subsp. *apetala*), and seven are allochthonous (*Claytonia perfoliata*, *Dysphania pumilio*, *Eclipta prostrata*, *Polycarpon tetraphyllum* subsp. *tetraphyllum*, *Silene pendula*, *Tulipa agenensis*, *Viola sororia*).

Autochthonous plants:

Cardamine flexuosa With. (*C. sylvatica* Link) (Brassicaceae) (Fig. 2) is an annual or biennial plant, frequently spread on moist soils, poor in limestone, from the hilly to the mountainous area (Sârbu et al. 2013). According to the distribution data provided by Oprea (2005), the plant has not been reported from Bucharest and the counties of southern and southeastern Romania. Globally, the native distribution includes Europe, Türkiye, Iran, and North Africa (POWO 2024). The species is introduced in areas of Asia, America, southern Africa, eastern Australia (POWO 2024).



Fig. 2. *Cardamine flexuosa*, detail with leaves, flowers, fruits
(© Paulina Anastasiu)



Fig. 3. Recently arranged horticultural residential area, where *Cardamine flexuosa* was recorded
(© Paulina Anastasiu)

During 2023, we identified the plant in several large pots in which ornamental trees and shrubs were grown, placed in a new residential area in the south of Bucharest – AFI Tech Park, Sector 5 (Progresului Str.) (Fig. 3). It seems that the species appears predominantly in new residential areas, a second place where it was present being in a residential neighbourhood in Sector 1, in landscaped green spaces. The source is most likely the soil used for growing ornamental plants. The species will be able to survive as long as it finds the necessary humidity conditions, being a wetland-loving species.

Cephalanthera damasonium (Mill.) Druce (Orchidaceae) is a perennial plant with native distribution in Europe, North Africa (Algeria), Türkiye, Palestine, Lebanon-Syria, Iran, North Caucasus, Transcaucasus, South-Central China, East Himalayas, Myanmar (POWO 2024). In Romania, it is common in forest habitats (Sârbu et al. 2013). Oltean et al. (1994) include *Cephalanthera damasonium* in the Red List with status “nt” – not threatened.

Although it was mentioned from forests near Bucharest (e.g. Pustnicu forest, according to Paucă et al. 1972), the plant was not reported for areas in the city.



Fig. 4. *Cephalanthera damasonium* in Herăstrău Park
(© Paulina Anastasiu)



Fig. 5. *Cephalanthera damasonium* in a garden of a block of flats, in Sector 6
(© Mihaela Urziceanu)

In recent years, *Cephalanthera damasonium* can be seen as spontaneous in the Botanic Garden “D. Brandza” of the University of Bucharest, where it has a subpopulation of dozens of specimens. In 2023 we found two specimens of *Cephalanthera damasonium* in Herăstrău Park (Fig. 4), in an area planted mainly with native trees (hornbeams, maples, oaks, linden). In 2024 we found numerous individuals of *Cephalanthera damasonium* in the same park. We have also observed it in the gardens of some blocks of flats in Sector 6, with a significant population of over 100

specimens (Fig. 5). The population of *Cephalanthera damasonium* in Bucharest has a real chance of survival if the care works of spaces with woody vegetation, such as those in the Botanic Garden and the Herăstrău Park, will not involve mowing or pulling plants from the herbaceous carpet.

Orchis purpurea Huds. (Orchidaceae) is a sporadic perennial plant of forest habitats from lowland and hilly areas (Sârbu et al. 2013). According to POWO (2024), the native range covers Europe and Algeria. This orchid is reported from forests near Bucharest, respectively in Ilfov County: Otopeni, Chitila, Mogoșoaia, Cernica, Pasărea, Pustnicu, Ciolpani, Buftea (Paucă et al. 1972).



Fig. 6. *Orchis purpurea* in Botanic Garden “D. Brandza”, neglected places (© Paulina Anastasiu)

In Bucharest, it was identified by our team in the following places: (1) wild, undisturbed areas of the Botanic Garden “D. Brandza” – a specimen that was first observed in 2022 and also bloomed in 2023 (Fig. 6); (2) the courtyard of the Village Museum, a specimen found by the student Bianca Tudose, during the study for her bachelor's thesis. Care work on some spaces, especially repeated mowing to keep plants at a certain height, can affect the viability of the species in the places where it has been identified. In the Botanic Garden we stopped mowing in the area where we identified *Orchis purpurea*, so that the plant could be seen blooming in 2024 as well. Unfortunately, we did not notice more than one ripe fruit.

Paeonia peregrina Mill. (Paeoniaceae) is a Balkan species, whose range extends to the Republic of Moldova and Ukraine (POWO, 2024). In Romania, the peony grows spontaneously in the forests of the south of the country (Sârbu et al. 2013), in Dobrogea and in the southern part of Moldova (Oprea 2005). It is included in the Romanian Red List as a rare, vulnerable plant (Oltean et al. 1994). At European level, it is considered to have Least Concern status (Chadburn 2014).

Paeonia peregrina has been identified in several cemeteries in Bucharest (Evangelical Cemetery, Berceni "Buna Vestire" Cemetery, Ghencea Cemetery) (Fig. 7), being planted on graves or on the edge of cemetery alleys. The mother plants, surrounded by numerous seedlings (Fig. 8), probably come either from the Comana forest or bought from street vendors who in the past brought plants from the forests in the Romanian Plain to Bucharest. *Paeonia peregrina* has a great chance of survival in Bucharest, in places undisturbed by excessive care work. In the Botanic Garden "D. Brandza", plants introduced decades ago bloom and bear fruits, and numerous seedlings can be observed annually around the mother plants.



Fig. 7. *Paeonia peregrina* in "Buna Vestire" Cemetery
(© Petronela Camen-Comănescu)



Fig. 8. *Paeonia peregrina* seedlings in Evangelical Cemetery
(© Petronela Camen-Comănescu)

Sagina apetala Ard. subsp. *apetala* (Caryophyllaceae) is an annual plant that often goes unnoticed due to its small size, only 3-10 cm (Sârbu et al. 2013) (Fig. 9). The native range of this species is Europe to NW, India, Macaronesia, N. Africa to Ethiopia (POWO 2024). It is introduced in areas of America, Africa and Asia (POWO 2024).

In our country, it has been mentioned from the counties of Mehedinți, Iași, Suceava, but also from the mountains of Călimani, Maramureș, Codru-Moma (Sârbu et al. 2013). According to Sârbu et al. (2013), *Sagina apetala* subsp. *apetala* is an

Atlantic-Mediterranean species, which grows in Romania from the oak forest area to the subalpine floor. *Sagina apetala* subsp. *apetala* is included in the national red list as a rare plant (Oltean et al. 1994).



Fig. 9. *Sagina apetala* subsp. *apetala* between pavement stones in historical city centre of Bucharest – habitus (© Paulina Anastasiu)

During the research carried out in Bucharest, *S. apetala* subsp. *apetala* was recorded in the historical city centre, growing between pavement stones (Fig. 9), with a small number of flowering and fruiting specimens (Fig. 10). The species was also observed along roadsides, in sidewalk gaps, and in the Drumul Taberei neighbourhood (Sector 6) and the Vatra Luminoasă area (Sector 2). The potential source could be the soil used for the cultivation of ornamental plants, soil that does not have a controlled provenance. Considering the ecological preferences of the plant, namely high humidity and high tolerance to temperature variations (Sârbu et al. 2013), we estimate that the plant has chances of survival in the places where it has been identified.

Allocthonous plants:

Claytonia perfoliata Donn ex Willd. (Montiaceae) was observed on March 3rd, 2024 (Fig. 11), and April 15, 2024 (Fig. 12), in the cracks of a sidewalk on Căldărușani Str., Sector 1, Bucharest. In March, the plants were in the vegetative stage, and by April, they had reached the flowering and early fruiting stages, with six specimens noted. A voucher for *C. perfoliata* has been deposited at the Herbarium of the Botanic Garden “D. Brandza”, University of Bucharest (BUC



Fig. 10. *Sagina apetala* subsp. *apetala* – detail with flower and fruits (© Paulina Anastasiu)

410857). *Claytonia perfoliata* has previously been recorded in Romania only in Jibou, Sălaj County, as noted by Negrean et al. (2017) in the context of its cultivation in botanical gardens.

Claytonia perfoliata is an annual plant native to North America from where it has been introduced in several areas of Europe, in South America, New Zealand and Australia (POWO 2024). The plant is not cultivated in the collections of the Botanic Garden “D. Brandza” and does not have decorative qualities to be cultivated in parks, so we assume that the source of its presence is contaminated soil, used in horticulture.



Fig. 11. *Claytonia perfoliata* - early vegetative stage (prevernal), March 3rd, 2024 (© Mihaela Urziceanu)



Fig. 12. *Claytonia perfoliata* - flowering and fruiting stage (vernal), April 15, 2024 (© Mihaela Urziceanu)

Dysphania pumilio (R.Br.) Mosyakin & Clemants (Amaranthaceae) is an annual or perennial plant, up to 40 cm tall, with a branched and creeping habit. Unlike other species of the genus, the leaves are small (≤ 3 cm) (Ciocârlan 2009), with pronounced sinuated edges. The native distribution is in Australia and Tasmania (POWO 2024), from where it has been introduced and naturalized currently in several countries in Africa, America, Asia, and Europe (POWO 2024). Although it does not appear to be present in Romania according to the POWO database (2024), *Dysphania pumilio* was first reported in 1993 from the Danube Delta by Chytry (Sîrbu & Oprea 2011), later being mentioned both in new regions of the Danube Delta [Crișan and Partizani – on the

Sulina branch, Crapina, Maliuc-Mila 28, Sulina, Caraorman, and in Galați County (Galați, Cotul Pisicii)] (Sîrbu & Oprea 2011).

According to the recent data published within the project “Adequate Management of Invasive Species in Romania”, MySmis Code 2014+120008, *Dysphania pumilio* is reported from Bucharest, historical city centre (P. Camen-Comănescu reported in 2021) (Anastasiu et al., 2023a), Danube Delta (C. Sîrbu reported in 2021) (Anastasiu et al., 2023c). According to Sîrbu et al. (2023), *Dysphania pumilio* was also found in Focșani in the year 2022, between the pavement tiles in the central zone of the city.



Fig. 13. *Dysphania pumilio* – on the pavement in the historical city centre, 2024 (© Paulina Anastasiu)

In Bucharest, it was identified in the historical old city, between pavement stones, with a small number of specimens (Fig. 13). It is quite difficult to assess the source, but most likely it is also soil used for the cultivation of ornamental plants.

Eclipta prostrata (L.) L. (Asteraceae), an annual to perennial species, native to America, is currently widespread in much of Europe, in Asia, Africa, Australia (POWO 2024). Although its range mainly comprises tropical and subtropical climatic zones, it has been distributed widely in the temperate region, which may indicate an adaptation to

increasingly evident climate change (Caković et al. 2014). For Romania, the first report was in 1998 (Dihoru & Sârbu 1998). The distribution reported so far mainly includes the Danube Delta (Anastasiu 2010), the Small Island of Brăila (Dihoru & Sârbu 1998) and the Great Pond of Brăila (Oprea 2005), the banks of the Danube in Tulcea and Galați counties (Oprea 2005).



Fig. 14. *Eclipta prostrata* observed in planters placed on the Grozăvești Bridge, Sector 6
(© Ioana-Minodora Sîrbu)



Fig. 15. *Eclipta prostrata* in the soil bale of a decorative shrub ready for planting in the Botanic Garden “D. Brandza”
(© Paulina Anastasiu)

Within the project “Adequate Management of Invasive Species in Romania”, MySmis Code 2014+ 120008, *Eclipta prostrata* was reported as follows: Dâmbovița County: Târgoviște (P. Camen-Comănescu reported in 2021), Călărași County: Oltenița, Borcea, Jegălia (M. Urziceanu reported in 2021), Ialomița County: Făcăieni, Bordujani, Fetești (M. Urziceanu reported in 2020, 2021), Tulcea County: Danube Delta (A. Cîșlariu reported in 2021, C. Sîrbu reported in 2022), Brăila County: Stăncuța (Camen-Comănescu & Mihai, 2022), Iași County: Iași, Palas Garden in irrigated flower beds (C. Sîrbu reported in 2022) (Anastasiu et al., 2023c, d).

In Bucharest, the plant is an unusual occurrence in the alien flora, being known in Romania in habitats from humid and sunny areas, often on the edge of watercourses. Sporadic, robust specimens in full anthesis were observed in 2023, vegetating in artificial conditions in planters on the Grozăvești Bridge (sector 6) (Fig. 14), as well as at the edge of some lawns at the intersection of Lujerului Passage and Iuliu Maniu Boulevard in Sector 6. As in the case of the mention in Iasi County, in Bucharest the source is represented by contaminated soil, used in horticulture. In this case, our

hypothesis was confirmed after receiving at the Botanic Garden “D. Brandza” a batch of shrubs grown in pots that had *Eclipta prostrata* plants at the base (Fig. 15). The source of the shrubs is a nursery in Giurgiu County, a county located on the left bank of the Danube where there are humid habitats favorable to the presence of *Eclipta prostrata*. It should be noted that *Eclipta prostrata* can reach sizes of up to 90 cm, under favourable conditions developing a rich branching with numerous fertile inflorescences between July and September. A single plant can produce between 10,000 and 17,000 achenes devoid of pappus, which are spread into the environment by hydrochory and epizoochory (Sîrbu & Oprea 2011).

Polycarpon tetraphyllum (L.) L. subsp. *tetraphyllum* (Caryophyllaceae) is an annual, biannual or perennial (Dihoru & Negrean, 2009), psammophilous plant (Sârbu et al. 2013). The native distribution includes western and southern Europe, northern and northeastern Africa, the Arabian Peninsula, southern and southwestern Asia, but also some areas of South America (POWO 2024). In the Americas, southern Africa, southern and southeastern Asia, Australia, *Polycarpon tetraphyllum* subsp. *tetraphyllum* is considered introduced (POWO 2024). Although the plant is not included in the POWO database as being present in Romania, neither as native nor introduced, it has been reported since 1866 from Transylvania (Schur 1866, quoted by Sârbu & Oprea 2011, Răduțoiu et al. 2023), and in 1962 from Mehedinți County (Morariu 1963, quoted by Răduțoiu et al. 2023). Also, *Polycarpon tetraphyllum* subsp. *tetraphyllum* is included in the list of neophytes in Romania (Anastasiu & Negrean 2009b), and in the DAISIE database published in GBIF (GBIF Secretariat 2024). Dihoru & Negrean (2009) included *Polycarpon tetraphyllum* subsp. *tetraphyllum* in the national Red book with “critically endangered” status. Oltean et al. (1994) classified the species as rare and threatened. According to Răduțoiu et al. (2023), *Polycarpon tetraphyllum* subsp. *tetraphyllum* is reported for Romania from Mehedinți (Vârciorova, Orșova, Mraconia) and Dolj (Craiova, Calafat, Stanciului valley) counties.



Fig. 16. *Polycarpon tetraphyllum* subsp. *tetraphyllum* between pavement stones in historical city centre of Bucharest (© Paulina Anastasiu)



Fig. 17. *Polycarpon tetraphyllum* subsp. *tetraphyllum* between pavement stones in historical city centre of Bucharest (© Paulina Anastasiu)

We identified the taxon in the historical city centre of Bucharest, between pavement stones (Fig. 16, 17), with numerous specimens both in bloom and fruited. The plants have survived excellently over all seasons, not being removed by street sanitation works. We estimate the survival of the population of *Polycarpon tetraphyllum* subsp. *tetraphyllum* in the historical city centre of Bucharest and even expanding into areas offering similar conditions.

Silene pendula L. (Caryophyllaceae) is an annual plant often used as decorative. The native range of this species is limited to Italy, Bulgaria, Greece and Türkiye (POWO 2024). As naturalised species there are reports from America, Europe, Africa and Asia (POWO 2024). *Silene pendula* was observed on April 16, 2024, along Strada Clăbucet, Sector 1, Bucharest, in bloom (Fig. 18, 19). Five individuals were found in sidewalk cracks, and one in a tree pit. A voucher for *S. pendula* has been deposited at the Herbarium of Botanic Garden "D. Brandza", University of Bucharest (BUC 410.856). According to Sîrbu & Oprea (2011), *Silene pendula* has been reported in Romania from Iași (cultivated) by Fătu in 1871, and from Sibiu and Braşov by Schur in 1877, with additional mentions by Simonkai in 1886. It has been occasionally noted as subsponaneous in Lazaret-Sibiu and Braşov, typically found in fields and ruderal areas (Sîrbu & Oprea 2011). Anastasiu & Negrean (2009a) also reported its presence in Dobrogea. According to our observation in the Botanic Garden "D. Brandza", even if *Silene pendula* could be found as escaped from cultivation, it does not have the ability to form stable populations for a long time without repeated introductions.



Fig. 18. *Silene pendula* growing in tree pits along the street
(© Mihaela Urziceanu)



Fig. 19. *Silene pendula* emerging from under courtyard
(© Mihaela Urziceanu)

Tulipa agenensis Redouté (Liliaceae) is a species of wild tulip native to the eastern regions of the Mediterranean, especially Türkiye, Cyprus, Syria and Israel (POWO 2024). In these regions, it grows in rocky and arid habitats, adapting to harsh environmental conditions. This species of tulip has been spread through the bulb trade, due to its special beauty; is mentioned as naturalized from Bulgaria, France, Greece, Portugal, Türkiye (European part), Tunisia (POWO 2024). It has spectacular, bright red flowers with a black basal spot, with yellow borders, covering a third to a half of each tepal. It is easily recognizable due to the outer tepals of the flower, significantly longer and sharper than the inner tepals (Fig. 20). In Bucharest, the species has been identified in three cemeteries (Bellu Cemetery, Evangelical Cemetery and Berceni “Buna Vestire” Cemetery) with numerous specimens, as well as in Cișmigiu Park (Fig. 21). Being a decorative plant, we appreciate that there are chances that it will not be removed during lawn care work, so we expect the survival of the identified populations.



Fig. 20. *Tulipa agenensis* – detail of the flower (© Paulina Anastasiu)

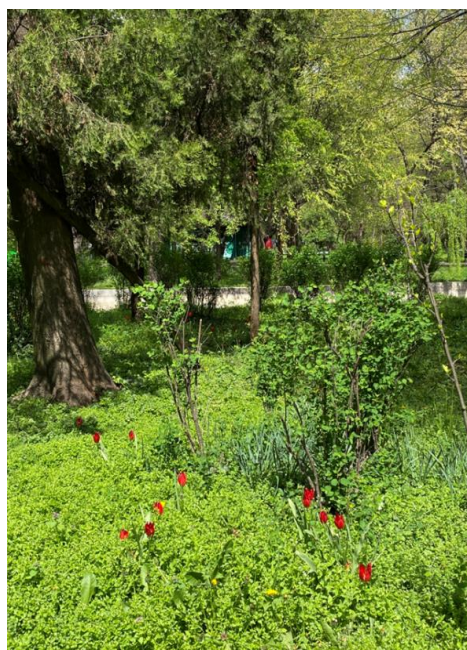


Fig. 21. *Tulipa agenensis* subspontaneous in Cișmigiu Park (© Paulina Anastasiu)

Viola sororia Willd. (Violaceae) is a perennial plant native to North America and introduced to Austria, Germany, Greece, Japan, Korea, West Siberia (POWO 2024). The three lower petals are barbed, and the neck of the corolla is white. It was cultivated as an ornamental plant in the Roman Circle of Cișmigiu Park (Sector 5) (Luca Perenne, pers. comm.), from where it became naturalised, being spread through the park in cracks in the alleys, among paving stones. For Romania, in 2020 Paul Szatmari reported *Viola sororia* var. *priceana* as subspontaneous from Pir, Satu Mare County with a population of over 500 individuals that persists for years (Anastasiu et al. 2023a).

Conclusions

The diversity of plants in the urban environment is in a continuous dynamic. Thus, following the inventories carried out between 2023 and 2024 in Bucharest, we identified several species, both native and non-native, that have settled here or that currently have the status of escaped from cultivation. Some of these species were cultivated for their ornamental qualities (e.g. *Paeonia peregrina*, *Tulipa agenensis*, *Viola sororia*), others were unintentionally introduced through the soil used for planting decorative species (e.g. *Eclipta prostrata*, *Cardamine flexuosa*). For a few other species we are not sure how they arrived in Bucharest (e.g. *Sagina apetala* subsp. *apetala*, *Polycarpon tetraphyllum* subsp. *tetraphyllum*).



Fig. 22. *Viola sororia* – habitus
(© Paulina Anastasiu)



Fig. 23. *Viola sororia* among the cobblestones in
Cișmigiu Park (© Paulina Anastasiu)

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