D.V. IEPIKHIN
V. Vernadsky Taurida National University
Academic V.I. Vernadsky Street, 4, Simferopol, Crimea, 95007, Ukraine
edvbio@yahoo.com

THE SPONTANEOUS FLORA OF SIMFEROPOL: AN OVERVIEW

Key words: spontaneous flora, urban flora, Simferopol, alien flora, alien species

Abstracts

Spontaneous flora of Simferopol (Ukraine) comprises 731 species of higher vascular plants, which belong to 412 genera, 102 families, 6 classes and 4 divisions.

Results of structural analysis showed that the systematic structure and the areal groups in urban flora of Simferopol were similar to the floras of temperate latitudes of the Holarctic, i.e. close to the flora of the Ancient Mediterranean. The Simferopol flora is transforming through increased role of woody species (trees), herbaceous perennial, biennials and annuals monocarpices, wide areal species as well as reduction of percentage of narrow areal, significant adventization. Flora of city replenished by 144 species of plants. Spectrum of adventive fraction revealed an increase in anthropogenic transformation processes.

Introduction

Location of Simferopol in the Crimean foothills, with its unique natural vegetation complexes, with a several Crimean endemic species and rare communities, and the diversity of landscapes, provided the city with the presence of a rich and diverse flora and vegetation. At the same time, Simferopol is the administrative, industrial and cultural center of Crimea, with a well-developed transportation network.

Previous to the studies reported here, data on the vegetation cover of Simferopol were fragmented. A comprehensive analysis of the flora and spontaneous vegetation in Simferopol, as interrelated components of the urban ecosystem, have not been performed during the existence of the city. Therefore, a comprehensive study of the current state of vegetation in Simferopol was needed.

The floristic studies have been conducted recently in many cities of various physiographic zones of Ukraine (Vasil'eva-Nemertsalova, 1996; Moysiyenko, 1999; Melnik, 2001; Mosyakin & Yavorska, 2003; Kagalo et al., 2004; Arkushyna, 2007; Zavyalova, 2010).

The subject of the present study is the spontaneous urban flora of Simferopol, its structure, and syntaxonomy of plant communities.

Materials and methods

The urban flora was studied by the route-profile method. An analysis of species diversity has been made using the traditional systematic, eco- and biomorphological, and

geographic-historical methods. Eco-bio-morphological analyses and comparisons with the regional flora were based on data provided in the *Biological Flora of Crimea* (Golubev, 1996).

An annotated synopsis of the flora was compiled following (Mosyakin, Fedoronchuk, 1999), with some exceptions.

Results and discussion

During the processing of original and literature data, the list of taxa was compiled, which contained 731 species of vascular plants belonging to 412 genera, 102 families, 6 classes, and 4 divisions. That constitutes almost 26 % of the Crimean flora of vascular plants. The so-called proportion of the flora (the ratio of the average number of species in the genus, in the family, and the average number of genera in the family) is 1/4.1/7.3 (Table 1). The average number of species in the family is 7.3, while the generic coefficient is 1.8. Division *Magnoliophyta* includes 725 species (99.3 %) belonging to 82 families and 336 genera, of which 596 genera (81.5 %) belong to the class *Magnoliopsida* (dicots), and 129 species (17.8 %), to *Liliopsida* (monocots). The species richness of the urban flora of Simferopol (vascular plants) is lower than that in cities on the south of Ukraine: for example, Odessa has 866 species (Vasil'eva-Nemertsalova, 1996), 964 species are reported for Kherson (Moysienko, 1999) and 909 species from Mykolayiv (Nikolaev in the Russian-based transliteration) (Melnik, 2001).

Most of families are typical to the studied and Holarctic floras (Tolmachev, 1974, 1986). More than half of the families of the urban flora (52) are represented by one genus, 37 of them contain one species each. The above-average level of species diversity (7.3 and higher) is characteristic for 20 families, which contain 74.8 % of species. The remaining families (81) comprise 25.2 % of the total number of species. The first three families (in terms of their species number) contain 234 species (32.3 %), the first eleven families include 445 species (61.4 %), and 15—497 species (68.6 %). Species of the families *Asteraceae* (14.5 %), *Poaceae* (11.0 %), *Fabaceae* (6.8 %), *Lamiaceae* (5.8 %), *Brassicaceae* (5.4 %), *Rosaceae* (4.4 %), *Apiaceae* (3.3 %), *Caryophyllaceae* (3.2 %), and *Scrophulariaceae*, *Chenopodiaceae*, *Boraginaceae* (2.3 % each) are dominant in the studied flora by their species richness. The positions of the leading eight families are in gen-

Quantitative distribution of taxonomic units and major proportions of the urban flora of Simferopol

Division, class	Family	Genus	Species	Ratio	Generic coefficient
Equisetophyta	1	1	3	1 : 1 : 3	3
Polypodiophyta	1	1	1	1 : 1 : 1	1
Pinophyta	1	1	1	1 : 1 : 1	1
Magnoliophyta	98	406	725	1 : 4.2 : 7.4	1.8
Magnoliopsida	82	334	596	1 : 4.1 : 7.3	1.8
Liliopsida	16	72	129	1 : 4.5 : 8.0	1.8
Generally	101	411	730	1 : 4.1 : 7.3	1.8

eral characteristic for the natural zonal flora of Crimea (Golubev, 1996), which makes it similar to the Mediterranean flora. Unlike the zonal flora, the studied flora showns an increase in the shares of *Lamiaceae*, *Polygonaceae* and *Chenopodiaceae*, and a lesser role of *Rosaceae* and *Liliaceae*. The listing of the top twenty families does not include *Cyperaceae*, the family characteristic for the floras of the Arctic and boreal regions. *Rubiaceae*, *Orchidaceae* and *Alliaceae* also fall beyond the list of leading twenty families, as compared to the flora of the Crimean Peninsula (Golubev, 1996).

The highest numbers of species are registered in species-rich genera, such as *Centaurea* L. (11 species, 1.5 %), *Medicago* L. (9 species, 1.2 %), *Carex* and *Salvia* — (8 species or 1.1 % each). A significant place is occupied by the genus *Acer* — (7 species, 1.0 %). This fact is explained by high naturalization of introduced species. A characteristic feature of generic spectrum is its heterogeneity. It is composed of mainly Mediterranean, Boreal-nemoral and synanthropic genera.

The geographical analysis was made based on the typological system of Rubtsov and Privalova (1961; see also Golubev, 1996). The alien (adventive, non-native) elements prevail in the geographical structure of the urban flora of Simferopol, comprising of 144 species (19.7 %). The following range groups are also well represented: Euro-Mediterranean-West Asian species — 91 (12,5 %), Palaearctic — 65 (8.9 %), Euro-Mediterranean — 56 (7.7 %), Holarctic — 53 (7.3 %), West Palaearctic — 50 (6.8 %), Mediterranean-West Asian — 39 (5.3 %), Pontic — 32 (4.4 %), Mediterranean-West Asian-Eurasian steppe — 30 (4.1 %), and Pontic-Kazakhstan — 20 (2.7 %). The Ancient Mediterranean geographical elements (120 species, 16.4 %) and the transitional Euro-Mediterranean ones (152 species, 20.8 %) are predominant among range groups.

Analysis of the geographical structure of the urban flora showed the dominance of wide-range groups over narrow-range ones. Thus, the total proportion of the Holarctic geographic elements (including Palaearctic, West Palaearctic, etc.) is 26.7 % (195 species). At the same time, the rate of narrow-range groups of the Ancient Mediterranean origin is lower as compared to the flora of Crimea, especially for such groups as Pontic, Crimean-Caucasian, Crimean-Caucasian-Asia Minor, Crimean-Balkan-Asia Minor, Crimean-Asia Minor and the Crimea-Caucasian-Balkans ones.

An eco-biomorphological analysis of the flora was based on a linear system of «life forms» developed by Golubev (1972; 1996). The following main characteristics were selected: main biomorph, relation to soil salinity, light, and water regimes.

The main biomorphs spectrum showed prevailing herbaceous plants (83.7 %). Polycarpous herbs contain 339 species (46.5 %) and the group of annuals contains 216 species (29.6 %). The number of subshrub species (31, 4.2 %) is lower than that for the flora of Crimea. The ratio of trees (4.4 %) and shrubs (5.9 %) is higher due to active naturalization of introduced species with shrubby or arboreal life forms.

Halophytic species are represented in the urban flora by 33 species (4.5 %), which is not typical to the Crimean Foothills zone.

Heliophytes (465 species, 64.1 %) predominate in the flora of the city. This parameter is almost identical to that for the flora of Crimea (61.7 %), but a somewhat increasing number of scioheliophytes (205 species, 27.9 %) should be noted.

In relation to humidity, dominnt groups are xeromesophytes (314 species, 42.9 %), which roughly corresponds to the regional flora. The proportion of xerophytes to mesophytes and hydrophytes for the urban flora is 8.4:3.7:0.4. These parameters show a significant prevalence of xeromorphic plants in the studied flora. If compared to the regional flora, mesophytization of the flora of Simferopol is noticeable, while in comparison to urban floras of the South-East of Ukraine it shows some xerophytization.

Our research added to the flora of the city 144 plant species belonging to 124 genera and 49 families; that constitute almost 20 % of the total urban flora. Also, 18 families and 87 genera are represented only by alien species. The highest numbers of alien species are registered in *Asteraceae* (21 species, 14.8 % of the total number of alien species in the flora), *Rosaceae* (11 species, 7.7 %), *Poaceae* (10 species, 7.0 %), *Chenopodiaceae* and *Fabaceae* (8 species or 5.6 % each), *Brassicaceae* (7 species, 4.9 %), *Aceraceae* (6 species, 4.2 %), *Amaranthaceae* (5 species, 3.5 %), and *Solanaceae* (4 species, 2.8 %).

According to the main biomorphs, the dominant group is herbaceous plants (93 species, 63.4 %), while spring annuals and polycarpous herbaceous plants together show a comparable share (38 species, 26.4 % and 37 species, 25.7 %, respectively). Trees and shrubs constitute 28 (19.1 %) and 20 (14.1 %) species, correspondingly. The proportion of annuals is ca. 2.5 times higher in the anthropogenic element of the flora, which is especially true for spring annuals (10.8 %, as compared to 26.4 % of that group in the urban flora).

Distribution of species in relation to the light regime showed dominance of heliophytes (60.6 %), which is by 3.5 % lower than in the urban flora. Scioheliophytes constitute 33.1 % and sciophytes — 0.7 %.

The spectrum of hygromorphs in the alien (adventive) fraction and its comparison with urban flora indicates an increase of mesophytes (by 8.7 %), the lower proportion of mesoxerophytes (by 3.5 %) and euxerophytes (by 2.3 %), and the smaller contribution of hygrophytes (by 2.2 %) and hydrophytes (1.7 %).

According to the degree of naturalization, epoecophytes (species occupying mainly disturbed habitats) are prevailing (54.2 %). Other groups are less represented: ergasiophytes — 21.8 %, ephemerophytes — 19.0 %, and agriophytes — 4.9 %. Such proportions of naturalization groups are quite typical for large cities in the southern part of Ukraine (Moysienko, 1999; Melnik, 2001).

The most intensive processes of invasion proceeded in the 20th century, as evidenced by the predominance of euneophytes — 75.3 %. The other two chronologic elements — archeophytes (before the 16th century) and neophytes (the 16th — beginning of the 20th centuries) are represented by 11.3 % and 13.4 %, respectively. The distribution pattern of taxa by their mode of immigration is as follows: ergasiophytes (plants that escaped from cultivation) — 64.8 %, akolyutophytes (species introduced accidentally as a result of transformation of vegetation) — 17.6 %; xenophytes (species which has brought accidentally as a result of economic activity) — 17.6 %.

The species of Mediterranean (46 species, 31.7 %) and American (40, 28.2 %) origin are prevailing. From the latter ones, the most numerous group is taxa of North American origin (31 species, 21.8 %). Transitional Euro-Mediterranean range groups and Holarctic species are also significantly represented: 7 and 12 species (4.7 % and

8.3 %), correspondingly, while the group of Eastern and South-East Asian origin contains 19 species (13.2 %).

Conclusions

The urban flora of Simferopol is represented by 731 species of vascular plants belonging to 412 genera, 102 families, 6 classes, and 4 divisions. Among them, 144 species are reported for the first time for the territory of the city. In terms of floristic richness, the urban flora of Simferopol is very similar to the floras of other cities of Southern Ukraine. Abnormally high floristic richness is a typical feature of urban floras, including the studied one (26 % of the flora of Crimea in the area constituting just 0.4 % of the total area of the Crimean Peninsula). The urban flora of Simferopol is similar in its systematic structure and predominance of range groups to the floras of temperate latitudes of the Holarctic, i.e. with zonal floras, and is close to the flora of the Ancient Mediterranean region. The shift of the position of some families in terms of their species richness leads to transformation of the urban flora and its convergence with the synanthropic flora of Ukraine, and with other urban floras. As to the regional flora, the increase of the role of trees, herbaceous perennials, biennials and annual monocarpic species is demonstrated. Effects of powerful human-induced factors upon the flora of the city are revealed in the appearance of intrazonal features, changing of structure spectra, and appearance many species of alien plants.

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Recommended for publication by S.L. Mosyakin

Submitted 01.06.2012

Д.В. Єпіхін

Таврійський національний університет імені В.І. Вернадського

СПОНТАННА ФЛОРА СІМФЕРОПОЛЯ (ЗАГАЛЬНИЙ ОГЛЯД)

Спонтанна флора м. Сімферополя (Україна) налічує 731 вид вищих судинних рослин, які належать до 412 родів, 102 родин, 6 класів і 4 відділів.

Результати аналізу показали, що за систематичною структурою і домінуванням ареалогічних груп урбанофлора Сімферополя подібна до флор помірного поясу Голарктики, тобто до зональної, яка тяжіє до флори Давнього Середземномор'я. Трансформація флори виявляється у зростанні кількості деревних і трав'яних багаторічних, а також дворічних та однорічних монокарпіків, збільшенні широкоареальних видів і зменшенні частки вузькоареальних, значній адвентизації. Флора міста поповнилася 144 видами рослин. Спектри адвентивної фракції свідчать про посилення процесів антропогенної трансформації.

Ключові слова: *спонтанна флора, урбанофлора, Сімферополь, адвентивна флора, заносні види.*

Д.В. Епихин

Таврический национальный университет имени В.И. Вернадского

СПОНТАННАЯ ФЛОРА СИМФЕРОПОЛЯ (ОБЩИЙ ОБЗОР)

Спонтанная флора г. Симферополя (Украина) насчитывает 731 вид высших сосудистых растений, которые принадлежат к 412 родам, 102 семействам, 6 классам и 4 отделам.

Результаты анализа показали, что по систематической структуре и преобладанию ареалогических групп урбанофлора Симферополя сходна с флорами умеренного пояса Голарктики, т.е. с зональной, тяготеющей к флоре Древнего Средиземноморья. Трансформация флоры проявляется в повышении количества древесных и травянистых многолетних, а также двулетних и однолетних монокарпиков, увеличении широкоареальных видов и уменьшении доли узкоареальных, значительной адвентизации. Флора города пополнилась 144 видами растений. Спектры адвентивной фракции свидетельствуют об усилении процессов антропогенной трансформации.

Ключевые слова: спонтанная флора, урбанофлора, Симферополь, адвентивная флора, заносные виды.