

Features of The Biomorphological Structure of Grozny Urban Flora

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Abstract – The life form, or a plant habitus as a set of adaptive features reflecting the impact of environmental factors is one of the important indicators of environmental habitat conditions. The study of urban floras identifies directions, dynamics and nature of the anthropogenic transformation of phytobiota and is of interest due to biodiversity conservation and historical significance for understanding phlorogenesis. The purpose of our study is to identify features of the biomorphological structure of the flora of Grozny, reflecting the adaptive potential of its phytobiota. The object is to identify life forms of the vascular plants of Grozny. The work analyzes field data obtained during expeditionary studies of the local flora. The methodological basis is the classification of climamorph suggested by C. Raunkier and the linear system of life forms developed by V.N. Golubev. The modern flora of Grozny includes 737 species which belong to 392 genera, 92 families and 3 divisions of higher vascular plants. The results of the study on the biomorphological structure show the prevalence of hemicryptophytes (51.28%) and polycarpic herbs (52.1%) in the urban flora. There are a lot of plants forming rhizomes (95 species) which is typical of natural communities of middle latitudes. The flora is of mesophytic nature, retains zoning features. It is forest-steppe hemicryptophyte-terophytic and similar to the regional flora. There are no saprophytes and an insignificant share of hamefits. Synanthropization of the flora is due to the apophytic fraction and its adventitization.

Keywords – Grozny; urban flora; vascular plants; life forms of plants; habitus; synanthropism.

I. INTRODUCTION

Biomorphological analysis of species is an important component in studying the flora and vegetation, and comparing biomorphological spectra of regional and local floras. It provides valuable information about the ecological specificity of the flora system under study. This is due to the fact that biomorphs as an indicator of adaptive characteristics of organisms and their composition are an important indicator of plant habitats which make it possible to analyze the relationship of the system of soil-climatic, cenotic growth conditions and the nature of adaptation to these conditions.

The first ideas about the life forms of plants were expressed by Theophrast over 300 years BC. They developed into a section of science called physiognomy. Since then, researchers have been dealing with plant biomorph classifications [1–5, 7, 8, 12, 14–16].

II. METHODS AND MATERIALS

This article summarizes the research on the flora inventory of Grozny. In [11], we characterized the systematic and geographical structure of its urban flora. The work is based on extensive data obtained during expeditionary studies of the flora of Grozny within the administrative boundary of the city for 2009-2017.

Grozny, the capital of the Chechen Republic, grew up from the fortress built on June 22, 1818 on the left steep bank of the Sunzhi River. The area of the city is located in the eastern part of the Alkhan-Churt valley and in the north-eastern part of the Sunzhen foothill plain, along the banks of the Sunzha River, the right tributary of the Terek. In accordance with the floristic zoning, the territory belongs to the Chechen-Ossetian district and covers part of the Terek-Sunzhen district of the Caucasian province of the Eastern Caucasus. The city is located at an altitude of 110-190 m above the sea level, with coordinates of 43 ° 18'43 " north latitude and 45 ° 41'20 " east longitude. The area of the urban land within the administrative boundary is 324.16 square km. The population is 280 thousand people (as of January 1, 2014) which is 21% of the population of the republic.

The purpose of the study is to identify features of the biomorphological structure of the flora of urbanized areas, reflecting the adaptive potential of Grozny phytobiota.

The object is vascular plants of Grozny and their life forms.

In analyzing life forms, we used the most universal system of climamorphs developed by K. Raunkier [4], based on the location of regeneration buds relative to the earth surface and the method for protecting them in unfavorable (dry or cold) conditions. This criterion is of great importance for the

urbanized environment, since one of the most important factors for plants in the city conditions is permanent trampling. Due to this, the soil changes its physical and chemical composition and its structure becomes denser. Plants can grow only due to the low location of regeneration buds and the ability of the root system to exist and function in an environment with a low level of oxygen. That is why representatives of *Plantago* L., *Trifolium* L. and *Taraxacum* Wigg, and species of the *Poaceae* Barnhart grow in cities [6].

The additional analysis based on the linear system of life forms proposed by V.N. Golubev [16] and the evolutionary-ecological system developed by I.G. Serebryakov [7] was carried out. The latter is consistent with the idea of the correspondence of an organism to its environment [9].

III. RESULTS

Annual and biennial plants dominate in the age structure of plant species in urbanized areas. Terophytes dominate in the biomorphological structure, the share of Hamefits and cryptophytes gradually decreases [10].

The analysis of climamorphic species of urban flora of Grozny based on the K. Raunkier's system identified the prevalence of hemicryptophytes - 378 species (51.28%): perennial herbaceous plants - *Plantago lanceolata* L., *Taraxacum officinale* Wigg., *Thalictrum minus* L., *Salvia tesquicola* Klok. et Pobed., *Urtica dioica* L., *Trifolium pratense* L.; annuals plants - *Arctium lappa* L., *Carduus acanthoides* L., *Centaurea diffusa* Lam., *Chondrilla juncea* L., *Tragopogon dubius* Scop., *Medicago lupulina* L., *Oenothera biennis* L.

One more dominant life form of plants is terophytes, which constitute 28.49% of the total number of species (*Stachys annua* (L.) L., *Setaria pumila* (Poir.) Schult., *Medicago orbicularis* (L.) Bartalini, *Thlaspi arvense* L., *Atriplex tatarica* L., *Xanthium strumarium* L., *Stellaria media* (L.) Vill., *Veronica persica* Poir. et al.).

Cryptophytes make up 8.96% (66 species), of which cryptophytes-geophytes are *Equisetum ramosissimum* Desf., *E. arvense* L., *Scilla siberica* Haw., *Asparagus officinalis* L., *Orchis tridentata* Scop., *Gagea chanae* Grossh., *Allium paniculatum* L. et al. Cryptophyte-hydrophytes are as follows: *Schoenoplectus lacustris* (L.) Palla, *Sch. tabernemontanii* (C.C. Gmel.) Palla, *Typha latifolia* L., *Carex riparia* Curt., *Thelypteris palustris* Schott, *Equisetum palustre*, etc.

Hamefits make up 1.36% or 10 species of the total number of species. They are represented by shrubs (*Ephedra procera* Fisch. et C.A. Mey., *E. distachya* L., *Kochia prostrata* (L.) Schrad.) Shrubs (*Solanum persicum* Willd. ex Roem., *S. pseudopersicum* Pojark.) and cushion plants (*Herniaria besseri* Fisch. ex Hornem, *Teucrium chamaedrys* L., *Teucrium polium* L., *Thymus marschallianus* Willd. etc.).

73 species or 9.91% of all urban flora are represented by tree-shrub forms. The internal structure of phanophytes is as follows: nanofanerofity - 24 species, 3.26% (*Viburnum opulus*, *Berberis vulgaris* L., *Rosa canina* L., *Ligustrum vulgare* L., *Salix fragilis* L., *Lycium barbarum* L., *Viscum album* L., *Vitis sylvestris* C.C. Gmel. ets); microfanerophytes - 23 species,

3.12% (*Euonymus europaea* L., *Frangula alnus* Mill., *Cerasus vulgaris* Miller, *Prunus spinosa* L., *Padus avium* Mill., *Salix caprea* L., *Crataegus monogyna* Jacq., *Ulmus minor* Mill. etc.) ; mesofanerofity - 16 species, 2.17% (*Corylus avellana* L., *Acer campestre* L., *Robinia pseudoacacia* L., *Populus nigra* L., *Juglans nigra* L., *Salix babylonica* L., *Sorbus aucuparia* L.); megafanerofity - 10 species, 1.36% (*Acer pseudoplatanus* L., *A. platanoides* L., *A. tataricum* L., *Tilia caucasica* Rupr., *Populus alba* L. etc.).

As a result of the analysis of distribution of species by groups of the biomorphological spectrum (according to K. Raunkir), the flora of Grozny can be characterized as forest-steppe hemicryptophyte-terophytic. It should be noted that the role of the Terophytes is increasing. Their distribution is due to the synanthropization of flora.

According to the linear system of life forms developed by V.N. Golubev, 73.2% of urban flora species belong to the perennials (trees and herbs), which is typical of the mifflr zone of the Holarctic [13].

In the general spectrum of the biomorphs, herbaceous plants make up 650 species or 88.2%. Polycarpaceous herbs (384 species or 52.1%) are dominant due to the aboriginal core of the flora.

The share of annuals is 25.64%. The share of spring annuals is 8.41%, while the share of winter annuals is 17.23%. This life form characteristic of post-forest and meadow-steppe communities is evidence of the widespread representation of weed vegetation in the area composed of annuals.

There are 87 species of tree perennials (11.8%): *Quercus robur* L., *Carpinus caucasica* Grossh., *Acer platanoides* L., *Alnus incana* (L.) Moench, *Fraxinus excelsior* L., *Pyrus caucasica* Fed., *Euonymus latifolia* (L.) Mill., *Ulmus sukaczewii* Andron., *U. Minor*, etc.

The share of shrubs is 4.48% (33 species): *Lonicera caprifolium* L., *Amygdalus nana* L., *Viburnum lantana* L., *Swida australis* (C.A. Mey.) Pojark. ex Grossh., *Sambucus nigra* L. etc.

The tree-shrub transition form makes up 13 species (1.76%): *Hippophaë rhamnoides* L., *Mespilus germanica* L., *Salix triandra* L., *Crataegus ambigua* C.A. Mey. ex A.K. Becker, *C. pentagyna* Waldst. et Kit., *Rhamnus cathartica* L., *Prunus cerasifera* Ehrh. and etc.

The minority groups are as follows: Shrubs (0.14%), semi-shrubs (0.51%) and small semi-shrubs (0.84%). This phenomenon observed in other urban floras is quite natural, since this group of life forms is one of the least urban resistant ones.

By spatial location of the shoots in urban flora, erectile forms are dominant (656 species, or 89.01%). The share of creeping, lianoid and "tumbleweed" plant forms is 10.45%. The share of epiphytes (*Potamogeton natans* L., *Lemna minor* L.) and idihydrophytes (*Potamogeton filiformis* Pers., *P. crispus* L.) is 0.54%.

By the structure of shoots, semi-creeper plants are dominant - 394 species (53.46%). The share of nozzled plants is 39.21%

(289 species), rosette plants - 7.33% of the total number (54 species).

By the methods of shoot growth, the sympodial method is characteristic of 55.5% (409 species), the monopodial one - 9.89% (73 species), while the dichotomous method is characteristic of *Thelypteris palustris* Schott. 34.46% of species are monocarpic.

By the feeding method, autotrophic plants dominate in the urban flora of Grozny - 98.23% (724 species). Parasites (*Cuscuta approximata* Bab., *C. epithymum* (L.) L., *C. europaea* L., *Orobanche caryophyllacea* Smith, *O. coerulea* Steph., *Phelypanche purpurea* (Jacq.) Soják, *Ph. ramosa* (L.) Pomel.) and semi-parasites (*Thesium arvense* Horv., *Melampyrum arvense* L., *Odontites vulgaris* Moench, *Rhinanthus minor* L., *Rh. vernalis* (N. Zing.) Schischk. et Serg.) account for only 1.77%. There are no saprophytes in the urban flora of Grozny.

The number of taproot plants is 453 (61.47%); most of them have roots that penetrate deep into the soil. Brush-root plants make up 38.53% (284 species); 130 species have a root system of average penetration depth.

Vegetative reproduction as a form of asexual reproduction is the most ancient and widespread in various groups of plants. In the flora of Grozny, in 224 species (30.38%) biomorphological features of vegetative reproduction are observed, however, species that have no pronounced signs of vegetative reproduction prevail (69.62%). The most numerous group of rhizome-forming plants makes up 95 species (12.89%). The share of long rooted plants is 9.36%: with a brush root system - 62 species (*Bolboschoenus maritimus* (L.) Palla, *Carex riparia* Curt., *Schoenoplectus litoralis* (Schrad.) Palla, *Brachypodium pinnatum* (L.) Beauv., *Elytrigia repens* (L.) Nevski, *Poa sylvicola* Guss., and others); with a tap-root system - 8 species (*Campanula bononiensis* L., *Amoria ambigua* (Bieb.) Soják, *Glycyrrhiza glabra* L., *Vicia cracca* L., *Galium verum* L., *Viola odorata* L., etc.).

The second largest group of plants reproducing due to root shoot formation makes up 32 species (4.34%). These are herbaceous perennials found in meadow and ruderal cenosis (*Achillea nobilis* L., *Falcaria vulgaris* Bernh., *Acroptilon repens* (L.) DC., *Chondrilla juncea* L., *Sonchus arvensis* L., *Artemisia austriaca* Jacq., *Coronilla varia* L., *Cirsium arvense* (L.) Scop., *Lactuca tatarica* (L.) C.A. Mey., *Convolvulus arvensis* L., *Linaria genistifolia* (L.) Mill., etc.). Woody plants forming root shoots are as follows: *Rubus idaeus* L., *Prunus spinosa* L., *Populus tremula* L., *P. nigra* L., *Ailanthus altissima* (Mill.) Swingle.

The share of plants with specialized storage organs is 2.58% (19 species). Most of these plants are early-spring ephemeroïds - species found in forests and steppes (*Lathyrus tuberosus* L., *Paeonia tenuifolia* L., *Ranunculus illyricus* L., etc.) and onion geophytes (*Muscari neglectum* Guss., *Gagea pusilla* (F.W. Schmidt) Schult. et Schult. fil., *Scilla siberica* Haw., *Tulipa gesneriana* L.).

In the flora of Grozny, there are 13 species (1.76%) reproducing due to aboveground and underground stolons (*Cynodon dactylon* (L.) Pers., *Agrostis stolonifera* L., *Ranunculus repens* L., *Poa palustris* L., *Potentilla reptans* L.,

Physalis alkekengi L., *Fragaria vesca* L., *Rubus caesius* L., etc.).

The number of currant-forming (dense-coustan) species is 13 (1.76%). These are various ingredients of steppe and meadow-forest communities (*Juncus effusus* L., *Carex hordeistichos* Vill., *Koeleria cristata* (L.) Pers., *Elytrigia intermedia* (Host) Nevski, *Festuca valesiaca* Gaudin, *F. rupicola* Heuff., *Stipa capillata* L., *S. pulcherrima* C. Koch, *S. lessingiana* Trin. et Rupr., *S. pennata* L., etc.).

The group of plants forming tubers is 2.03% (15 species). Plant with root tubers (11 species) are as follows: *Orchis tridentata* Scop., *Platanthera chlorantha* (Cust.) Reichenb., *Typha angustifolia* L., *Filipendula vulgaris* Moench, *Phlomis tuberosa* (L.) Moench, *Rumex obtusifolius* L., *R. crispus* L., *Ficaria vernalis* Reichenb., *Potentilla recta* L., etc. Plants with stem-bearing tubers are as follows: *Arum orientale* Bieb., *Crocus reticulatus* Stev. ex Adams, *Chaerophyllum bulbosum* L., *Corydalis marschalliana* (Pall. ex Willd.) Pers.

The vegetation analysis of the flora of Grozny identified a large number of summer green plants (47.22%) and a significant number of summer-winter green plants (29.18%). There is a small number of winter and spring ephemeroïds - 15 species, or 2.03% of the total number of species (*Scilla siberica* Haw., *Arum orientale* Bieb., *Gagea chanae* Grossh., *Tulipa gesneriana* L., *Orchis tridentata* Scop., *Poa sylvicola* Guss., *Corydalis marschalliana* (Pall. ex Willd.) Pers., *Ranunculus oxyspermus* Willd. and others). The share of late summer-autumn ephemera and ephemeroïds is significant (17.23%) (*Holosteum umbellatum* L., *Anisantha sterilis* (L.) Nevski, *Fumaria schleicheri* Soy.-Willem., *Papaver arenarium* Bieb., *P. commutatum* Fisch. et C. A. Mey., *P. dubium* L., *Ceratocephala falcata* (L.) Pers., etc.). The group of evergreens consists of 32 species (4.34%).

The flowering rhythm analysis showed that more than half of the species flow in spring and summer (from April to August). This is in complete agreement with meteorological observations, taking into account the climate warming trend and regular summer droughts. The presence of *Albizia julibrissin* Durazz which is typical of regions with a subtropical climate speaks for the climate warming trend.

IV. CONCLUSION

Based on the spectra of biomorphs in the system of K. Raunkier and V.N. Golubev and their ratios, it was identified that herbaceous plants make up 88.2% of the flora whose core is a native fraction. The dominance of autotrophic and erectoid forms of plants, a decrease in the share of hamephites and a lack of f saprophytes were identified. Thus, analysis of the biomorphological structure of the urban flora showed a predominance of hemicryptophytes and polycarpic herbs characteristic of natural communities of temperate latitudes. A high share of therophytes and monocarpics is due to the synanthropisation of the flora caused by disturbed vegetation cover of the urban area.

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