Conservation and Restoration Prospects of Semi-Natural Plant Communities when Creating Parks in the Southern Russia’s Steppe (a Case Study of the 70th Anniversary of Victory Park)

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Abstract. Preserving the least transformed vegetation cover plots and using them as park zones when expanding urban development areas is one of the most promising areas of urban planning. There is very little experience in creating such parks in steppe regions. This study is the basis for the development project of the first park of this type in the Rostov Region. The goal of the study is to analyze the vegetation cover in the 70th Anniversary of Victory Park to identify valuable plant communities with a high preservation and to include them subsequently in to the Park’s landscape project. For this purpose, we carried out a detailed zoning of the vegetation in the territory, revealed its relationship with the soil cover, the terrain, and the anthropogenic pressure. To collect and process data, we used generally accepted methods of botanical research. We carried out a comparative analysis of the systematic, ecological, and phytocoenotic spectra of the associations identified. In the territory of one land unit, we found coenopopulations of two protected species: Bellevalia sarmatica and Iris pumila. A low wild grass overgrowing and a relative high abundance of steppe grasses and herbs in some areas of species suggest a likely prospect for the territory to become virgin over the next 10 to 15 years. Based on the results of our study, we have identified areas which, if preserved and maintained, will allow to create close-to-steppe vegetation zones in the Park.

1. Introduction
The processes of urban growth and suburban landscape urbanization suggests different approaches to determining the place and role of "green infrastructure" included in urban settlements. In the European part of Russia, there is a common practice of partial preservation of natural and slightly transformed vegetation plots in urbanized areas and using them as the basis for the green frame of a growing city. Most often, these are woodlands, which are assigned the status of urban forests. Those of them that have the greatest value due to their good preservation, high biological diversity, or outstanding landscape value, subsequently acquire the status of specially protected natural areas [1].

However, such an approach cannot be used when developing the green infrastructure of cities located in woodless regions, including in the steppe zone of southern Russia. Resuming the long-term urban planning policy in new economic conditions involves the construction of micro-districts and residential areas on sites alienated from the agricultural land stock which has been subjected, to a
greater or lesser extent, to a significant anthropogenic transformation. Traditionally, the system of public green spaces created in such residential areas was limited to street landscaping. At the end of the 2010s, a new approach emerged that is used in planning the "green frame" of Krasnodar and Sevastopol and which implies the integration of agricultural landscapes into the urban area [2].

The architectural and planning design of the existing parks and squares in Rostov-on-Don does not imply preserving or restoring fragments of natural or close-to-natural plant communities in these territories. Such an opportunity can be implemented when designing park and recreational zones arranged when building new residential areas on lands included in the urban territory. Therefore, one of the priorities in the development of landscape projects for such parks should be floristic and phytocoenotic survey of the territory to identify the most valuable plots, to assess their significance, and prospects for their restoration.

The goal of this study is to analyze the vegetation cover in the 70th Anniversary of Victory Park to find valuable plant communities with a high preservation and their subsequent inclusion in the Park’s landscape design.

2. Problem setting
The plan for the long-term development of the territory in the northern part of Rostov-on-Don allocated for multi-story residential buildings (the Suvorovsky micro-district) provided, among other things, for creating a park and recreational zone. The decree on creating the Park "In Honor of the 70th Anniversary of Victory in the Great Patriotic War of 1941–1945" (hereinafter referred to as the 70th Anniversary of Victory Park) in the Suvorovsky micro-district was issued in October 2014. According to the original plan, the Park surface area was supposed to be 4 hectares; however, it was soon increased, and currently its area is 16.5 hectares. In line with the terrain features, the planning structure of the Park was developed based on the principle of multi-tiered terraces and stairs.

Over the next 3 years, the approved park project was only partially implemented: large-scale planting of deciduous trees was carried out; a mountain bike trail was built on the slope of the southeastern exposure; on the bottom of a gully, two artificial ponds have been arranged that are fed from natural springs. In addition, it was decided to continue developing the natural park concept while preserving the natural landscape and planting plants typical for the Don region. To identify the general floristic diversity, to map the vegetation cover in the territory of the emerging park, and to highlight the areas that are most valuable in floristic and phytocoenotic terms, a study was carried out in the summer of 2020 with its results presented below.

3. Materials and Methods
Semi-natural vegetation means a vegetation cover that has been transformed as a result of more or less long human (predominantly spontaneous) activity, but retained many structural and taxonomic features that bring it closer to natural communities and ensure its stability amid a constant anthropogenic pressure [3].

The Park’s territory occupies the slopes of the southern and southeastern exposures of a short gully as part of the right-bank gully system of the Temernik River, and a section of the watershed line between the valley of the Temernik River and the Sukhoy Chaltyr gully, adjacent to the gully on the north side. Due to the pronounced ravine-and-gully terrain, it has not been significantly affected by urbanization processes (figure 1).

The study of the Park's vegetation cover was carried out simultaneously with the study of soils. We selected soil samples to determine the main soil diagnostic indicators: the hygroscopic and field humidity; the humus content using the wet ashing method; pH in soil suspension and water extract; carbonates according to Kudrin, labile phosphorus and exchange potassium according to Machigin [4]. About 72% of the area are native soils, represented by chernozems with varying values of washout and humus content (Haplic Chernozems (Calcic)), and sod and warp soils of gullies. Anthropogenically transformed soils are widespread in the most developed southern part of the Park, with urban stratozems (Urbic Technosols) [5] on meadow soils; scalped and replanted meadow soils in the lower
part of the slopes and along the gully bottom which result from the arrangement of artificial reservoirs, and replanted washed-off chernozems (Calcic Chernozems Novic Technic) [5] along the near-watershed margin. The northwestern part of the Park, where agricultural buildings were located before it was included into the park and recreational zone, is covered by replanted urban stratozems, formed on ordinary medium-thick chernozems (Urbic Technosolsmolic) [5]. On the steepest and heavily washed-off upper slopes and crests, there are small outcrops of loess-like loams.

![Figure 1](image_url)  
*Figure 1. Boundaries of the park and recreational zone.*

Our study of the vegetation cover in the 70th Anniversary of Victory Park to include an inventory of the species composition of the Park’s flora and the identification of the main land units based on the general species composition and dominant species. The survey was carried out in June and July 2020 using the route-travelling method. At the first stage, we have outlined the boundaries of the floristic land units with indication of their landscape confinement. Then, we carried out an inventory of flora within each land plot, except for artificial old growing stands of trees with a relatively small surface area and fragments of natural shrub vegetation with a poor species diversity, and a vast area in the southeastern part of the Park transformed when creating artificial lawns. The species abundance was assessed on the Drude scale. Species identification was carried out in the field or during office processing according to the regional key to plants [6]. The type of plant communities was established based on the data of the collective monograph *Natural Conditions and Resources of the Rostov Region* [7]. The ecological groups of plants in terms of the moisture factor are presented according to the Warming system [8]. To determine the spectrum of phytocoenotypes, we used the system applied, in particular, in the studies by G.M. Zozulin [9, 10] and in the thesis by D.V. Vakhnenko [11].

By spontaneous flora, we mean a set of plant species (native and introduced) that grow in some territory "spontaneously", i.e. without human intervention.

The ranking of land plots to determine their priority was based on the following criteria: the closeness of the floristic composition and the vegetation cover structure of the plots to the features of natural steppe and gully-and-steppe communities; the general floristic diversity with a focus on areas enriched with steppe species and a special attention to protected plant species; a low abundance of ruderal species; the resistance to the wild-grass overgrowing; the anti-erosion value; the aesthetic
perception of the general appearance of the land plot vegetation: preservation of decorativeness in different seasons.

The plant names are listed according to the summary by S.K. Cherepanov [12].

4. Discussion of Results

Following our survey, the Park’s vegetation cover has been divided into 11 land units with its schematic map shown in figure 2. The land units have been numbered in accordance with table 1. For a number of reasons (an insignificant surface area, a poor species diversity, the artificial nature of the grass stand), the land units 8, 9, and 11 have not been further studied in more detail.

![Schematic map of the vegetation cover in the 70th Anniversary of Victory Park.](image)

The total abundance of the spontaneous flora in the Park territory was 168 species of 126 genera of 38 families of flowering plants. The range of the leading families generally corresponds to their composition in the regional flora, whereas families dominating in the number of species (Asteraceae, Poaceae, Brassicaceae, Fabaceae) completely correspond to the ranking of the family-and-species spectrum of the Rostov Region’s flora. The dominant genera of the Park’s flora include Festuca (4 species), Centaurea (4 species), Artemisia, Cirsium, Elytrigia, Galium, and Verbascum (3 species each).

The ecological and phytocoenotic analysis of the Park’s spontaneous flora (figure 3, 4) confirms the complexity of the vegetation cover in this territory as a whole and allows us to conclude that it is based on the natural vegetation of gully-and-ravine systems characterized by a great variety of plant groups within a limited area [7].

Since the plant communities in the land units 2, 3, and 4 that are close to natural steppe coenoses in terms of their species composition and structural characteristics are of greatest interest from the point of view of the prospects for conservation and subsequent restoration, their structural parameters have been considered in more detail. The volume of this paper does not allow for a detailed analysis of all other units.
Table 1. Description of the vegetation cover units in the 70th Anniversary of Victory Park.

| Unit number on the map | Plant community type | Unit surface area, sq. m | Taxonomic structure |
|------------------------|-----------------------|-------------------------|---------------------|
|                        |                       |                         | number of species   |
|                        |                       |                         | number of genera    |
|                        |                       |                         | number of families   |
| 1                      | Middle-aged wheatgrass and wild-grass idle field | 68595.6                | 114                 |
| 2                      | Old-aged forbs-and-wheatgrass idle field         | 8647.4                  | 67                  |
| 3                      | Sod-and-gras sheep rescue and feather grass steppe | 3832.5                | 51                  |
| 4                      | Polydominant community with a predominance of steppe forbs and the prospect of steppe formation | 10177.3                | 64                  |
| 5                      | Complex wheatgrass and forbs community            | 9986.8                  | 53                  |
| 6                      | Young weed idle field planted with *Fraxinus excelsior* L., *F. pennsylvanica* Marsh., *Acer pseudoplatanus* L., *A. platanoides* L., *Sorbus aucuparia* L., *S. intermedia* (Ehrh.) Pers. | 19252.8                | 26                  |
| 7                      | Three-year wild-grass idle field planted with *Fraxinus* spp., *Acer* spp., *Tilia cordata* Mill. | 15971.7                | 39                  |
| 8                      | Shrub thickets based on *Prunus stepposa* Kotov   | 6680.0                  | N/A                 |
| 9                      | Old-aged artificial tree plantations with a predominance of *Robinia pseudoacacia* L. | 808.98                 | N/A                 |
| 10                     | Young wild-grass idle field                       | 4853.57                 | 68                  |
| 11                     | Artificial lawns with separate-group thickening of grass stand with predominance of *Lolium perenne* L. | 17141.36               | N/A                 |

Figure 3. Ecological structure of the Park’s flora and some plant land units in terms of the moisture factor.
Figure 4. Representation of the dominant groups of phytocoenotic types in the Park’s flora and some plant land units.

Plant communities in the land units 2, 3, and 4 represent the final stages of the succession series of the steppe vegetation restoration. Their brief description is given below.

Land unit 2. An old-aged forbs-and-wheatgrass idle field in the upper flat part of the gully slope. The environment-forming species is Elytrigia repens (L.) Nevski. The composition of forbs is dominated by steppe (including weed-steppe), meadow-steppe, and shrub-steppe (confined to shrub communities, mainly based on Prunus stepposa) species: Xeranthemum annuum L., Achillea stepposa Klok. et Krytzka, Medicago romanica Prod., Linum austriacum L., Agrimonia eupathoria L., Alcea rugosa Alef., etc. Only in this area, we found Oxytropis pilosa (L.) DC, Acinos arvensis (Lam.) Dandy, Centaurea adpressa Lede. The species diversity and abundance of wild weeds and wild ephemerals are very small. For Tanacetum vulgare L. and Lactuca serriola L., the abundance sp2; for Carduus acanthoides L., Thymelaea passerine (L.) Coss. et Germ., Bromus japonicas Thunb., sp1. In the composition of the grass stand with average values of abundance, we noted steppe grasses: Stipa lessingiana Trin. et Rupr. (cop1), Festuca pseudovina Hack. ex Weisb. (cop1), Melica transsilvanica Schur (cop1). The full list of herbaceous plant species in this land unit includes 67 of 57 genera of 20 families.

Land unit 3. A sod-and-grass sheep fescue and feather grass steppe on dry steep slopes. The community includes 51 species of higher vascular plants from 44 genera of 17 families. The coenosis-forming species is Stipa lessingiana with a high share of steppe grasses: Festuca pseudovina, Melica transsilvanica etc. In the driest areas of slopes with washed-off or incompletely developed soils, the share of forbs is small. However, in adjacent areas, that are also included in the selected community, we observed a fairly high diversity of plant species of steppe forbs, among which the most abundant are Xeranthemum annuum (cop2), Medicago romanica (cop2), Linum austriacum (cop1), Nigella arvensis L. (cop1), etc. Elytrigia intermedia (Host) Nevski, Linum tenuifolium L., Onobrychis tanaonica Spreng. and Plantago media L. are represented only in this association in the Park territory.

Land unit 4. A polydominant community with a predominance of steppe forbs and the prospect of steppe formation. The territory is characterized by a low wild-grass overgrowing and a relatively high abundance of the following types of steppe grasses in some areas: Stipa lessingiana (cop2) and Festuca valesiaca Gaudin (cop2). Structurally, the vegetation cover of this unit is highly mosaic. Within this land unit, we found 64 plant species of 55 genera of 24 families. Bellevalia sarmatica
(Pall. ex Georgi) Woronow, *Iris pumila* L., *Bupleurum rotundifolium* L., *Galatella dracunculoides* (Lam.) Nees, *Inula britannica* L., *Koeleria cristata* (L.) Pers. and *Teucrium polium* L. grow only in this area of the Park. Of greatest interest is the discovery of *Bellevalia sarmatica* and *Iris pumila*; these are rare species with a federal protection status [16].

The results of our comparative analysis of the ecological and coenotic structure of the flora in the considered land units correlate with their phytocoenotic features. The structure of the flora in these units in relation to the moisture factor is generally more xerophytic as compared to the share of the corresponding groups in the composition of the Park’s spontaneous flora as a whole (figure 3). In the composition of the old-aged forbs-and-wheatgrass idle field (land unit 2), the share of mesoxerophytes and xeromesophytes is the same, which is comparable to the weight of these groups in the vegetation cover of the park in general. The flora of the steppe and steppe-like areas (3 and 4, respectively) is dominated by the mesoxerophyte group, with an increased share of xerophytes.

The structure of the flora in the analyzed units in terms of the phytocoenotic composition (figure 4), as compared to the general structure of the Park’s spontaneous flora, is characterized by an increase in the share of ecocoenotic elements of steppe and steppe-confined communities, combined with a decrease in the relative content of phytocoenotic elements of the weed series for the land units 3 and 4. An increased share of ecocoenotic elements confined to petrophilic and shrub communities that is observed in the same associations reflects the complex nature of the initial gully vegetation of this territory.

Based on the results of our survey conducted to prepare the future landscape project of the Park, the selected territories have been ranked according to the suggested preservation priorities. The first preservation priority has been assigned to areas of the sod-and-grass sheep fescue and feather grass steppe (land unit 3) and the polydominant community with a predominance of steppe forbs and the prospect of steppe formation (land unit 4). The value of these areas is due to the following factors: the general high preservation of the steppe community composition and structure; a rather outstanding species diversity of plants within a small surface area; and a low degree of anthropogenic transformation. In addition, in the land unit 4, we found two types of plants with a federal protection status. A low wild-grass overgrowing and a relative high abundance of steppe grasses suggest a likely prospect for the territory to become virgin over the next 10 to 15 years. When drawing up a dendroproject, it should be borne in mind that, to minimize its impact on grassy communities, the nearest large trees can be planned at a distance of no closer than 10 m to avoid shading.

The second-priority areas include the land unit 2: an old-aged forbs-and-wheatgrass idle field in the upper flat part of the gully slope. The expediency of preserving this unit is due to the relative homogeneity and uncontaminated vegetation cover, a high plant species diversity, and the predominance of steppe-confined species. If this area is kept intact, we can expect that wild-grass species will disappear from the grass stand followed by an increase in the abundance of steppe grasses up to the final demutation.

We should mention separately the land unit 5 located near the southeastern border of the Park and presented by a wheatgrass and forbs community. The least transformed fragments of this unit are wheatgrass idle fields, whereas in more deeply transformed areas, there is a developed herb community dominated by *Verbasum ovalifolium* Donn ex Sims and *Linaria genistifolia* (L.) Mill. The above unit is of interest due to a low abundance of weed species (sp1, sp2). Only there, we found such species as *Silene wolgensis* (Hornem.) Besser ex Spreng., *Solidago virgaurea* L., and *Hieracium echioïdes* Lumn. According to V.V. Fedyaeva [10], indigenous climax communities based on rhizome species of wheatgrass can be represented in the Rostov Region either by non-saline meadows of medium moisture south of the lower reaches of the Don River or by meadow communities in deep depressions on upland soils in the subarea of dry sod-and-grass steppes. The forbs-and-wheatgrass discovered by us can be included in these types of coenoses neither due to its ecotopic confinements nor the forbs composition; therefore, it cannot be recognized as the final stage of demutation. In this regard, there is a high probability that, subject to the absence of anthropogenic disturbances,
demutation is possible in this area up to the stage of a forbs-and-wheatgrass idle field with subsequent prospects of steppe formation. This made it possible to assign this area a third preservation priority.

Areas of blackthorn (land unit 9) are of interest as fragments of natural shrub vegetation that are maximally resistant to the harsh conditions of the steppe zone and possess certain anti-erosion properties.

The vegetation cover formed in the land units 1, 6, 7, and 10 is represented by weed communities dominated by tall rough wild grasses: *Tanacetum vulgare*, *Carduus acanthoides*, *Onopordum acanthium* L., *Cyclachaena xanthifolia* (Nutt.) Freesen., *Artemisia absinthium* L. etc. These land plots can be transformed in any way that is provided for by the architectural and planning design for the territory transformation.

5. Conclusion
New conceptual solutions for park and recreational spaces that are suggested by modern international and domestic park-building practice allow not only to involve green areas in the process of expanding biological diversity and protection of certain rare plant species, but also to solve the tasks of preserving natural and close-to-natural communities reflecting the features of the regional vegetation cover. The Park named “In Honor of the 70th Anniversary of Victory in the Great Patriotic War of 1941–1945” is the first facility of this type to be created in the Rostov urban area. The results of this study demonstrate the preservation of fragments of weakly transformed plant communities in the territory allotted for a recreational park zone with species composition and structural characteristics that are close to those typical for steppe and gully-and-steppe coenoses. The approved project for the Park development has been prepared taking into account the recommendations made and involves the preservation of the selected valuable areas of vegetation cover.

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