Nature Conservation Potential of Nizhne-Bannovsky Natural Monument

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Abstract: Study of protected areas' components is an important stage of conserving their biodiversity. So far the plant community structure and population of the protected plants in most of the natural monuments of the Saratov Region have been explored to an insignificant extent. This research aims at investigating the current condition of the cenopopulations of the protected plant species and plant communities in need of protection in Nizhne-Bannovsky Natural Monument. This natural monument is one of the largest in the region and comprises a whole range of habitats. The article colligates the data collected by the authors during years of studying the landscapes, individual plant communities and cenopopulations of 24 plant species of Nizhne-Bannovsky Natural Monument. The study employs a multiscale approach to evaluating the protected plants' habitats: from landscape elements to individual plant communities. The research uses standard methods of studying plant communities and cenopopulations. The study of the plant communities needing protection was based on the criteria adopted by the Saratov Region Green Data Book. Classification of the cenopopulations by their stability was based on replacement index. It was found out that most protected species are limited to steppe habitats and marlstone outcrops. The chances of most cenopopulations for conservation within the mentioned habitats were estimated as sufficient. The ratio of young prereproductive plants in such populations exceeds that of reproductive and old individuals. It is demonstrated that Nizhne-Bannovsky Natural Monument has a significant potential in conserving rare plant species, as well as rare and exemplary plant communities. Protected plants are mostly represented by steppe species, while the area's predominant type of rare plant communities is exemplary forests.

Keywords: nature conservation, rare species, vegetation, cenopopulations, plant communities, Saratov Region, biodiversity.

Introduction

One of the ways to address the issue of biodiversity conservation at the regional level is establishment of natural monuments. As compared to nature reserves and wildlife sanctuaries they have a smaller size and lower intensity of scientific research conducted on their territory [1]. Establishment and maintenance of specially protected nature areas is one of the mechanisms to ensure conservation of the natural level of biodiversity. The Saratov Region locates upwards of 80 natural monuments featuring various specialization. Many of these have been

established for protection of individual plant or animal species, some being designated to conservation of entire landscapes. The existing protected areas of the Saratov Region can provide the species with permanent or temporal protection and act as sanctuaries to restore population of many of the region's vulnerable species [2]. Nizhne-Bannovsky Natural Monument is one of the region's largest. It is located in the Krasnoarmeysky District and covers a picturesque and strongly dissected section of the eastern bench of the Volga Upland's southern part. The multitude of habitats is conditioned by the area's strongly dissected landscape and diversity of the parent rocks. Efficient conservation of rare plants and communities implies understanding of the regularities and specifics of their distribution according to the habitat conditions. The number and diversity of habitat types often influences the variety of rare plant species and communities dependent on peculiar conditions [4,5].

Recent years witnessed a number of individual studies addressing some of the area's protected plant species [6], ravine vegetation [7], cenopopulations of *Hedysarum grandiflorum* and communities which include the latter [8,9]. But a comprehensive assessment of the natural monument's significance in the region's phytodiversity conservation is yet to be conducted.

This research aims at studying the current state of cenopopulations of the protected plants species and those in need of protection in Nizhne-Bannovsky Natural Monument.

Methods and Materials

The article summarizes the data collected by the authors over years of studying the landscapes, individual communities and cenopopulations of the protected plant species of Nizhne-Bannovsky Natural Monument. We used a multiscale approach to evaluating the protected plants' habitats: from landscape elements to individual plant communities. The capability of such approach of providing the most comprehensive coverage of the issue and its utmost reliability in determination of the possible ways of conserving plants species was demonstrated by a number of studies [10-12].

The research followed the universally acknowledged phytosociology methods, the dominant-determinant principle being implemented in naming the plant communities. The protected plants' categories and status are cited by the Saratov Region Red Data Book 2nd Edition [13].

The data obtained on each of the studied species included its typical habitat, density and cenopopulation status. All the cenopopulation studies were conducted under generally accepted procedures [14-18]. For classification of the cenopopulations we employed the approach suggested by Zhukova [19]. The latter is based upon the replacement index evaluation and subdivision of cenopopulations into increasing, unstable and temporarily declining ones. The study covered a total of 200 cenopopulations of 24 protected plant species.

Our study of the plant communities in need of protection was guided by the criteria adopted in the Saratov Region Green Data Book [20]. The following rarity categories are used for ranking plant communities:

1 (E) – (exceptional) includes the plant communities unique for the region and known by 1 or 2 locations only, conservation of which justifies establishment of specially protected nature areas.

2 (R) – (rare plants communities) comprises truly rare plant communities known within the region by 3-5 locations.

3 (H) – (habitat of rare plants species) embraces the communities as habitats of the rare plant species demonstrating affinity for this particular community and the communities dominated by protected plant species.

4 (S) – (standard) consists of the communities which significance is due to their being exemplary for the region, featuring minimum human-induced disorders and complex structure.

Results and Discussion

The research resulted in detection of 24 plant species listed in the Saratov Region Red Data Book 2nd edition. Seven of these are protected on the national level. Most of the studied species are limited to steppe habitats and marlstone outcrops (*see Table 1*).

For each of the protected species we defined a typical community to which it tends to belong most often. The typical community of certain species inhabiting chalk and marlstone outcrops defies definition

TABLE 1.
Description of Protected Plant Species of Nizhne-Bannovsky Nature Memorial

Name	Habitat	Typical communities	Density, individuals/m²
1 (E) – endangered species			
Juniperus sabina L.	marl slopes and ravine floors	–	–
Pedicularis physocalyx Bunge	steppe slopes	Ass.: Poa angustifolia, Festuca valesiaca - Variiherbetum	1–3
Tulipa gesneriana L.	steppe slopes	Ass.: Festuca valesiaca, Stipa pennata	3–10
2 (V) – vulnerable species			
Adonis vernalis L.	steppe slopes	Ass.: Festuca valesiaca	1–14
Adonis wolgensis Stev.	steppificated slopes of gulches, forest margins	Ass.: Poa angustifolia, Festuca valesiaca + Stipa capilata, Variiherbetum	2–43
Anemone sylvestris L.	shrub steppes	Ass.: Poa angustifolia – Variiherbetum с участием Amygdalus nana	6–19
Astragalus dasyanthus Pall.	steppe slopes	Ass.: Stipa capillata, Festuca valesiaca	5–20
Campanula persicifolia L.	sparse oak forests, windbreaks	Ass.: Quercus robur –Variiherbetum, Quercus robur – Convallaria majalis	2–7
Ephedra distachya L.	chalk and marl slopes, carbonate soil steppes	Ass.: Stipa pennata, Festuca valesiaca	–
Fritillaria ruthenica Wikstr.*	steppificated forests, ecotones, steppes	Ass.: Quercus robur – Poosum, Betula pendula – Variiherbetum,	20–108
Iris pumila L.*	steppe slopes	Ass.: Festuca valesiaca, Stipa pennata, Festuca valesiaca + Galatella villosa	–
Matthiola fragrans Bunge*	chalk and marl slopes	–	7–20
Primula macrocalyx Bunge	sparse forests	Quercus robur – Aegopodium podagraria	2–5
Pulsatilla patens (L.) Mill.	steppe slopes	Ass.: Galatella villosa + Festuca valesiaca, Stipa pennata	1–7
Pulsatilla pratensis (L.) Mill.	steppe slopes	Ass.: Festuca valesiaca, Festuca valesiaca - Variiherbetum	1–5
Silene hellmannii Claus*	chalk outcrops	–	5–8
Stipa pennata L.*	steppe slopes	Ass.: Festuca valesiaca, Stipa pennata, Festuca valesiaca – Variiherbetum, Stipa capilata	–
3 (R) – rare species			
Atraphaxis replicata Lam.	chalk and marl slopes	–	2–7
Epipactis helleborine (L.) Crantz	forest communities of gulch floors and slopes	Ass.: Tilia cordata – Aegopodium podagraria	1–3
Hedysarum grandiflorum Pall.*	carbonate soil steppes, chalk outcrops	Ass.: Festuca valesiaca, Stipa pennata	6–23
Hyssopus cretaceus Dubjan.*	marl slopes	–	3–10
Inula oculus-christi L.	steppe slopes	Ass.: Festuca valesiaca, Stipa pennata, Festuca valesiaca + Galatella villosa	–
Linaria incompleta Kuprian.	steppe slopes	Ass.: Poa angustifolia, Festuca valesiaca - Variiherbetum	2–14
Platanthera bifolia (L.) Rich.	forest communities of gulch floors and slopes	Ass.: Tilia cordata – Convallaria majalis	1–2
Rosa villosa L.	steppificated slopes and floors of gulches	Ass.: Variiherbetum	–
Viola ambigua Waldst. & Kit.	chalk and marl slopes, carbonate soil steppes	Ass.: Festuca valesiaca	9–16

* – species listed in the Russian Federation Red Data Book

TABLE 2.
Cenopopulations of Certain Rare Species Classified by Replacement Index

Species	Number of cenopopulations			Total number of cenopopulations
	increasing	unstable	temporarily declining	
Adonis wolgensis	11	3	1	15
Adonis vernalis	4	1	–	5
Atraphaxis replicata	8		2	10

TABLE 3.
Information on the Natural Monument's Plant Communities Relevant as Regional Specimens

Community	Habitat	Frequency of occurrence within the borders of the natural monument
Quercus robur – Calamagrostis epigeios	interfluves and upper shaded slopes, as well as, less frequently, middle slopes of gulches	rare
Quercus robur – Poa angustifolia	interfluve areas and gulch slopes, mostly in their upper and middle parts	normal
Quercus robur – Convallaria majalis	shadow-facing slopes and, less frequently, dry valley floors	normal
Quercus robur – Aegopodium podagraria	dry valley floors, upper and middle slopes	normal
Quercus robur – Brachypodium pinnatum	interfluves and upper sunlight-facing slopes	rare
Tilia cordata – Convallaria majalis	dry valley floors, shaded gulch slopes	normal
Tilia cordata – Aegopodium podagraria	dry valley floors and lower shaded slopes	normal
Stipa capillata + Festuca valesciaca participated by Tulipa gesneriana and Iris pumila	interfluves, middle and upper sunlight-facing slopes	rare
Poa angustifolia – Variiherbetum	interfluves	not rare
Stipa pennata + Festuca valesiaca	interfluves, middle and upper sunlight-facing slopes	not rare
Stipa pennata + Variiherbetum	interfluves, middle and upper sunlight-facing slopes	not rare

due to the stiff slopes' sparse vegetation cover. In such cases the matter for discussion is confined to separate plant groups consisting primarily of the studied species (*Matthiola fragrans, Juniperus sabina, Atraphaxis replicata, Hyssopus cretaceus*).

The largest cenopopulations were registered for *Fritillaria ruthenica*, *Adonis wolgensis, Adonis vernalis, Atraphaxis replicata, Hedysarum grandiflorum, Stipa pennata, Ephedra distachya*. The smallest cenopopulations are those of *Epipactis helleborine* and *Platanthera bifolia*, which consist of 1-3 individuals.

The cenopopulations of three plant species (*Adonis wolgensis, Adonis vernalis, Atraphaxis replicata*) were also examined for age structure. Most of the *Adonis wolgensis* and *Adonis vernalis* populations are mature and include all principal age groups with unequal membership distribution, the population age structure being dominated by middle-aged reproductive individuals with significant participation of virginile individuals. The *Atraphaxis replicata* populations are young with all the principal age groups unequally represented in their age structure, the latter being dominated by virginile individuals. The old plants proportion does not exceed 2-5 per cent of the total population size.

The estimation of the studied cenopopulations' surviving outlook for the given habitat is represented in *Table 2*.

11 out of the 14 studied *Adonis wolgensis* populations can be considered increasing. *Adonis vernalis* and *Atraphaxis replicata* demonstrate an 80% ratio of increasing cenopopulations dominated by young reproductive plants.

The plant communities causing nature conservation concerns are represented within the borders of the studied natural monument mostly by forests. There are also four exemplary steppe communities and one habitat of protected plant species (Stipa capillata + Festuca valesiaca participated by *Tulipa gesneriana* and *Iris pumila*). The generalized information on these communities, listed in the Saratov Region Green Data Book, is supplied in *Table 3*.

The region-unique community status can be assigned to the community dominated by *Juniperus Sabina.* The community meets the criteria for status 1(E) which is attributed to the plant communities unique for the region and known by 1 or 2 locations only, conservation of which justifies establishment of specially protected nature areas. The Saratov Region's only known *Juniperus sabina* habitat is the Mozzhevelovy ravine, located within the borders of Nizhne-Bannovsky Natural Monument.

Conclusions

Thus Nizhne-Bannovsky Natural Monument has a promising outlook for conservation of rare plants species and rare and exemplary plant communities. Protected plants are represented mostly by steppe species. The predominant type of rare plant communities is exemplary forests. The area shows a lot of promise for studying the multitude of the southern Volga Uplands' vulnerable species and their habitats. Further monitoring of the conditions of the protected species populations and habitats can facilitate establishment of the most efficient ways of their conservation.

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