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### Modern Tools for Sustainable Development of Territories. Special Topic: Project Management in the Regions of Russia

#### VEGETABLE RESOURCES MONITORING AS THE REGION'S RAW MATERIAL BASE EFFECTIVE MANAGEMENT TOOL

Ya. M. Abdushaeva (a)\*, O. V. Shtro (b), A. V. Vetkina (c)

\*Corresponding author

(a) Yaroslav-the-Wise Novgorod State University, ul. B. St. Peterburgskaya, 41, Veliky Novgorod, Russia,  
yaroslava-66@mail.ru

(b) Yaroslav-the-Wise Novgorod State University, ul. B. St. Peterburgskaya, 41, Veliky Novgorod, Russia,  
shtro\_ov@mail.ru

(c) Yaroslav-the-Wise Novgorod State University, ul. B. St. Peterburgskaya, 41, Veliky Novgorod, Russia,  
Anna.Vetkina@novsu.ru

#### *Abstract*

In accordance with the needs of the national economy, the state sets itself a number of long-term goals and main tasks in the field of reproduction and use of the mineral resource base of the regions, preservation and development of the resource potential of the Russian territories. In recent years, a number of important strategic planning and forecasting documents have been adopted in Russia that determine the strategy for effective management of the raw material base and the formation of mechanisms for improving measures to restore the natural environment, reclamation of land and plant resources. The strategic goal of developing the raw material base of the regions, taking into account the policy of resource conservation, is to overcome environmental risks and threats, taking into account the solution of the problems of economic and energy security, create conditions for sustainable socio-economic development and provide resources for Russian territories.

The article substantiates the need for a significant change in approaches to the management of raw materials in the Novgorod region. Ensuring environmental safety is one of the decisive factors for sustainable development of territories. The state of plant resources was studied and recommendations for improving natural cenoses were given. Literary and herbarium data were generalized and an analysis of the results of geobotanical studies was given, which makes it possible to identify plant communities in which resource-significant species grow that have breeding value as source material for breeding.

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**Keywords:** Ecotypes, environmental safety, flora, floristic areas, raw material base, plant cenoses.



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## **1. Introduction**

The flora of the Novgorod region is characterized by a wide variety of types of vegetation and rare plant species due to the peculiarities of the natural and geological conditions of this territory. As part of the flora, species grow that differ in their origin, geographical distribution, migration time and routes to this territory (Abdushaeva, Dzyubenko, & Nikolaeva, 2015). Many species growing in natural cenoses have a very rare occurrence, therefore, it is necessary to develop the scientific basis of the protection regime for each species, since their extinction can lead to a narrowing of the range. Preservation of plant species diversity in the flora of the Novgorod region is necessary to fulfil the international obligations of the Russian Federation under a number of agreements and treaties: the Convention on Biological Diversity and the Convention on the International Trade in Endangered Species of Flora and Fauna. The protection of certain plant species of a particular flora cannot be carried out without preserving the conditions of the place of growth of the given species to which it is adapted; it is necessary to preserve all plant communities in which it grows. First of all, rare, endemic and relict species, as well as resource-significant species of great scientific value should be preserved (Ryabchun, Kuzmishina, & Boguslavsky, 2012).

## **2. Problem Statement**

The main problem of the study is to find a solution to the question to what extent the conservation of plant resources will ensure the sustainable development of the region's raw material base. To preserve the species diversity of plants, it is necessary to study their biological characteristics of growth and development, adaptive ability, identify plant communities and their state, the degree of variability as a result of anthropogenic influences, identify plant communities for the conservation and biological control of their condition.

## **3. Research Questions**

In the article, the authors search for the answer to the following research questions:

- 3.1. How to ensure the identification of habitats of rare and endangered plant species included in the Red Book of the Novgorod region, and monitor the state of plant communities in which they grow;
- 3.2. What is the preservation of species diversity in a previously established habitat;
- 3.3. How to identify limiting factors for the restoration of rare and endangered plant species and their communities;
- 3.4. What is the effectiveness of developing measures to restore biodiversity and the rational use of meadow vegetation in order to ensure the ecological safety of territories?

#### **4. Purpose of the Study**

The main objective of the study is to analyze literary and herbarium materials, as well as reconnaissance surveys of the flora of the Novgorod region, collect data on the locations of populations of rare plant species, obtain information about their distribution and the state of populations of economically valuable plants (Privalov, Grib, & Matys, 2012; Minyaev, 1991). The data obtained will make it possible to more fully identify the diversity of plant communities in which the studied plants grow, and their ecological plasticity, study the characteristics of the genus and species diversity to develop effective management decisions of ensuring environmental safety.

#### **5. Research Methods**

The study was based on transdisciplinary methods that allowed conducting geobotanical studies of the flora of the Novgorod region using the specific flora technique. The object of the study was plants growing in natural habitats. To determine the types of plants, literary sources and determinants were used (Tsvelev, 2000). Distribution and affiliation of species in the flora of the Novgorod region were specified by herbarium collections of the Botanical Institute of RAS named after V.L. Komarov (St. Petersburg, LE), All-Russian Research Institute of Plant Production named after N.I. Vavilov (WIR), St. Petersburg State University (LECB) in the amount of 3799 sheets.

When conducting the study, empirical methods were used: questioning, observation, conversations, interviews, which made it possible to identify problems of resource conservation and resource provision. Based on empirical studies, an electronic database in Microsoft Excel format was compiled and point-by-point digital maps of species distribution in the ArcView system format were developed for floristic districts of the Novgorod region, which are the most important tools for creating mechanisms for efficient management of the region's raw material base and improvement of measures to restore the natural environment and ecological protection of territories.

#### **6. Findings**

In accordance with the problem posed, the authors of the article conducted a study that made it possible to establish priority areas of impact on the conservation of plant resources of the region to ensure sustainable socio-economic development. To preserve the biodiversity of plant resources in the flora of the Novgorod region, it is necessary to monitor them, which will contribute to further conservation at the level of species, genus, populations in natural agrolandscapes. Plant resources are potential sources of valuable traits for use in breeding programs (Smekalova, 2007; Smykal, Hradilova, & Trneny, 2017; Urazaliev, Yessimbekova, Mukin, Chirkin, & Ismagulova, 2018; Hammer, Laghetti, & Drenzo, 2019; Loskutov, Shelenga, Konarev, Shavarda, Blinova, & Dzubenko, 2016).

For the first time an expedition to study floristic vegetation was organized of the Novgorod province in 1894. In 1905 floral excursions in Valdai district were organized. At the beginning of the 20th century, there were 827 species of flowering and vascular spore plants, of which 14 species were legumes (taking into account the eastern districts that are not included in the modern borders of the region).

In the 80s, 965 native species grew in the flora of the Novgorod region, which are represented by 408 genera united in 101 families. The study of the flora and vegetation of the Novgorod region was carried out by employees of the NovSU named after Yaroslav the Wise: E.A. Yurova (1982-2005), E.M. Litvinova (1993-2017); N.G. Uralskaya (1996-2007); Ya. M. Abdushaeva (from 2000 to the present), which made it possible to collect data and create a Red Book of the Novgorod Region indicating the habitats of rare and relict species.

We found that the anthropogenic impact on the species composition of floristic complexes was associated with a decrease in the number of native species and the introduction of adventive species. The introduction of adventive species occurred as a result of plowing up of natural lands and reclamation, which led to changes in soil moisture capacity and in the level of groundwater, as well as to a decrease in moisture-loving species, and the introduction of mesophytes. In addition, there occurred liming of acidic soils and introduction of high doses of mineral fertilizers, which contributed to the introduction of competitive plant species in the flora of the Novgorod region and a change in natural cenosis.

Currently, the formation of vegetation in floristic regions is influenced by weather and soil conditions that determine their abundance and occurrence in natural cenoses. Every year, there is a decrease in the water level in the Volkhov and Msta rivers, where meadow massifs are located, which reduces the amount of sludge deposited and, accordingly, worsens the nutritional regime of natural meadows.

Every year, anthropogenic factors increase the influence on the changes in the species composition of the created agrolandscapes. The absence of haying leads to thinning of the grass stand and the formation of sections of soil not covered by plants, and also contributes to the development of wood and shrub vegetation in the meadows. Grazing can activate the decomposition of turf and other organic substances, which helps to improve the moisture capacity in the 20-cm layer of soil, where the bulk of the roots are located. The death of the roots improves the water and air regime of the soil.

According to the results of geobotanical studies, it was found that the flora of the Novgorod region is represented by 113 families, 554 genera and 1590 species (Table 01). The maximum number of genera in a family in the flora of the Novgorod region are taken by: *Asteraceae* Dumort. 76 (14.4%), *Poaceae* Barnh. 48 (9.1%), *Brassicaceae* Burnett. 33 (6.3%), and by the number of species the most numerous are *Asteraceae* Dumort. 223 (14.0%), *Rosaceae* 130 (8.2%), *Poaceae* 116 (7.3%).

**Table 01.** Distribution of genera and species of families in the flora of the Novgorod region

% of the total number of species	Number of species, pcs.	% of the total number of genera	Number of genera, pcs.	Families
10.70	126	14.40	76	<i>Asteraceae</i>
9.80	115	9.10	48	<i>Poaceae</i>
5.50	65	6.30	33	<i>Brassicaceae</i>
4.20	49	4.60	24	<i>Caryophyllaceae</i>
3.20	38	3.80	20	<i>Lamiaceae</i>
4.30	51	3.40	18	<i>Fabaceae</i>
3.30	39	3.40	18	<i>Ranunculaceae</i>
6.70	79	3.00	16	<i>Cyperaceae</i>
5.60	66	2.80	15	<i>Rosaceae</i>

In the flora of the Novgorod region, 10 families have a level of generic richness above the average, while 49 families have a level below the average and cover 72% of genera, 32 families are monogeneric. With regard to species richness, it was found that more than half of the identified families are represented by one species.

Studying the characteristics of the distribution of species in floristic regions will allow us to identify numerous populations in floristic terms, ensure that subsequent changes are taken into account, and conduct continuous monitoring in the future. The formation of the species diversity of the vegetation cover and soil type was influenced by the shape of the relief. As a result of the analysis of the distribution of species, it was found that the maximum number of species grows in the Mstinsky, Nizhne-Lovatsky and Ilmensky floristic regions (Table 02). The floristic richness of the above numbered areas is due, first of all, to the geographical location and earlier colonization of these territories by the Slavs, as well as to the presence of large meadow massifs of different levels of moisture. The Mstinsky floristic region covers almost all of the Msta river basin, including the northern part. Small segments of the Msta floodplain found in the Berezovsky stretch, the Valdai Upland, where there are limestone outcrops and rich pine forests, are well-drained. The vegetation of this meadow is from mesohydrophilic to mesophilic, indicator association is fescue-alfalfa with a copious admixture of *Medicago falcate* L. This meadow massif along the Msta River and below the mouth of the Uver River to the village of Rovnoye has been maintaining species diversity for many years. Meadows are in satisfactory condition.

**Table 02.** The number of flora species in the floristic areas

Floristic areas	Flora, pcs.	%
Mstinsky	1308	84.40
Nizhne-Lovatsky	1232	79.50
Ilmensky	1224	79.00
Valdaisky	1222	78.90
Verkhne-Volkhovsky	1201	77.50
Kobozhe-Mologsky	1186	76.60
Nizhne-Shelonsky	1162	75.00
Verkhne-Luzhsky	1160	74.90

In addition to the lower part of the Lovat basin, the basins of the Polist River and other rivers flowing into Lake Ilmen from the south-east are also included in the Nizhne-Lovatsky district. A feature of the species diversity of this region is the presence of an extensive floodplain in the Parfinsky district, the presence of brackish groundwater outlets in the vicinity of Staraya Russa, where many halophilic plants are found. Today the Ilmensky district is well developed, especially the coastal territory of Lake Ilmen. The population of many species is associated with the presence of limestone outcrops and the carbonate content of the soil cover. The territory is 5 km wide in the southwest and up to 30 km in the east. In the south-west of the region, near the village of Korostyn and in the lower reaches of the Psizh river, there are limestone outcrops with rare calciphytic species.

In the vicinity of Novgorod, many alien and introduced species grow. In the near-river part of the floodplain along the bank of the river Msta in the Novgorod region, *Medicago falcate* L., *Lotus corniculatus* L., *Trifolium pretense* L., *T. Repens* L., *T. Montana* L., *Astragalus danicus* Retz. are found

in clumps and diffusely. Below the village of Kholynya, on the banks of the Msta River, *Medicago falcate* L., *Lotus corniculatus* L. are less common, and the population of *Lathyrus pratensis* L. is found in separate clumps. In the vicinity of the village of Novoye Selo, in the meadows, grassland is of low value in terms of feed, *Deschampsia cespitosa* L. prevails, and in the terrace part of the floodplain there is *Carex hirta* L., and only along the banks of the Msta river, in the riverbed part of the floodplain, there are continuous thickets of *Medicago falcate* L., *Trifolium pratense* L. and *T. Repens* L. in clumps. Moreover, *Medicago falcate* L. in some places goes far to dry meadows. The good preservation of the above listed species, apparently, is explained by the presence of haying and farm animals grazing, and the complete absence of former river-beds. The Verkhne-Luzhsky district includes a basin of the upper course of the Luga River; in the vicinity of the village of Batetsky and the station of Peredolskaya there are limestone outlets where numerous calciferous species grow: *Anthylliss chiwereckii* Blocki, *A. arenaria* Jus., *Trifolium aureum* L., *T. montana* L. The environs of the village of Batetsky, rich in carbonate soils and, correspondingly, in species diversity, are located 30–50 km southwest of Veliky Novgorod, gradually turning into the Ilmen-Volkhov lowland. The weakly wavy surface of the western part of the plain is disturbed by the shallow ridges of carbonate and rocky moraine extended from West to East. In this area, in most cases, meadows are multi-grassy – fine-grained with an admixture of legumes. The natural habitats in the vicinity of the village of Batetsky are very severely disturbed in some places due to the development of carbonate crushed stone moraine in the area, especially near the village of Raglitsa.

In the studied area, 55 species of plants are in critical condition, 58 are under the threat of extinction, 272 are vulnerable, and 23 are in a state close to threatened, which are destroyed as a result of being collected as medicinal and ornamental plants. They can disappear as a result of violation and destruction of the conditions of their place of growth.

Adventitious species penetrate due to human activities, their resettlement occurs as a result of unintentional introduction, or wildness of cultivated plants. According to Mirkin and Naumova (2001), it was noted that the percentage of extinct native species is inversely proportional to the size of the territory and is directly proportional to the degree of action of the anthropogenic factor. First of all, under the influence of anthropogenic factors, rare species, species located on the border of their range, and species of wet habitats disappear. When analyzing adventitious species by the way of introducing them into the flora, as a result of this study, it was found that the maximum number of ergasiofigophytes prevails in this territory, which is quite natural for the urban environment and settlements.

## 7. Conclusion

- 7.1. To preserve species diversity, it is recommended to preserve the natural self-regulating ecosystem along the banks of the Lovat, Msta and Mologa rivers, in which more than 82% of plant species grow.
- 7.2. An anthropogenically modified ecosystem has been identified – the shore of Lake Ilmen, the Volkhov, Pola, Pitba and Shelon rivers, where more than 30% of species grow.
- 7.3. Less common communities of calcephilic species were identified in the Batetsk and Borovichi districts.

- 7.4. Ecosystems of the Ilmensky clint, the banks of the Psizha river in the Starorussky and Shimsky regions, where thermophilic species and species demanding soil fertility grow, have been studied.
- 7.5. The analysis of plant species of the floodplain located along the banks of the Volkhov River, where species located at the northern borders of its range are found, has been carried out.

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