The current state of wood and shrubby vegetation in the parks of Novgorod region and measures for their conservation

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Abstract. Park art as an element of cultural heritage is of great importance for the Novgorod land. The article presents the results of a survey of parks in Novgorod region. An assessment was made using the vital condition index. Measures are proposed to improve the condition of tree-shrub species.

1. Introduction

Novgorod land is a unique historical formation [1]. The city of Veliky Novgorod has more than a thousand years of age. In the 12–15 centuries, vast Novgorod lands ranged from the White Sea and the Ural Mountains in the north and east, to the Baltic Sea and the origins of the Volga in the west and south. The trading Hanseatic ties of Veliky Novgorod in the Middle Ages [2], as well as, subsequently, the advantageous location between the two capitals of the Russian state contributed to the cultural enrichment of Novgorod land, despite the gradual loss of political and economic importance by Veliky Novgorod.

Park art as an element of the universal cultural heritage is of great importance. Originating in ancient Babylon and China [3, 4], it continues to remain relevant to our time. In the territory of the modern Novgorod region, you can now see a number of samples of traditional park art:

- monastery parks (monastery gardens), which here can be considered the first and most ancient examples of parks;
- parks of noble estates 18 - beginning of the 20th century;
- park plantings of the “new time”, including examples of landscaping in Veliky Novgorod and other settlements of the region in the post-war period.

The Department of Forestry (since September 2019 - the Department of Forestry and Land Resources) of Yaroslav-the-Wise Novgorod State University (NovSU) has been periodically conducting research on park objects in Veliky Novgorod and Novgorod region for the past decade as part of its scientific and educational activities [5, 6].

2. Materials and methods

To study and evaluate the state of vegetation objects, traditional methods of forestry and forest biological observations were used. The route accounting method was employed in regular parts of the park (alleys). In the inter-alley spaces, in the landscape parts of the park, a continuous enumeration or laying of test sites was used. Categories of the state of trees were determined and the vital condition index (VCI) was
calculated using the method of V.A. Alekseev [7]. Next, we developed recommendations for the conservation of tree-shrub plantings of parks.

Table 1. Brief description of woody plant species of the examined parks in Novgorod region.

| Plant species                  | Park of the Anthoniev Monastery | Manor Park “Speranskaya Myza” | Park of S.V. Rakhmaninov’s estate “Oneg” | Plantings of the Novgorod Kremlin (inside the Kremlin walls) |
|-------------------------------|---------------------------------|-------------------------------|------------------------------------------|---------------------------------------------------------------|
|                               | the number of trunks, pcs.      | the number of trunks, pcs.    | the number of trunks, pcs.               | the number of trunks, pcs.                                     |
|                               | D, cm H, m                      | D, cm H, m                    | D, cm H, m                               | D, cm H, m                                                    |
| Tilia cordata Mill.           | 288                             | 65                            | 464                                      | 308                                                          |
|                               | 42.6                            | 19.4                          | 26.7                                     | 45.8                                                         |
| Betula pendula Roth           | 189                             | 2                             | 15                                       | 15                                                          |
|                               | 36.6                            | 18.8                          | 20.7                                     | 20.6                                                         |
| Betula pubescens Ehrh.        | 108                             | 2                             | 2                                        | 2                                                           |
| Acer platanoides L.           | 132                             | 1                             | 52.9                                     | 2.5                                                         |
|                               | 22.4                            | 15.5                          | 22.9                                     | 22.9                                                         |
| Populus balsamifera L.        | 109                             | 13                            | 39.6                                     | 5                                                           |
|                               | 53.1                            | 17.6                          | 51.6                                     | 21.0                                                         |
| Malus domestica Borkh.        | 90                              | 8.3                           | 35                                       | 21.9                                                        |
| Malus baccata (L.)Borkh.      | 2                               | 2                             | 6.1                                      | 5.5                                                          |
| Fraxinus excelsior L.         | 62                              | 3                             | 45.6                                     | 43.6                                                        |
|                               | 34.1                            | 18.0                          | 27.3                                     | 21.3                                                         |
| Fraxinus pennsylvanica Marshall | 1                              | 1                             | 54.0                                     | 21.0                                                         |
| Aesculus hippocastanum L.     | 48                              | 3                             | 39.0                                     | 17.0                                                         |
| Thyja occidentalis L.         | 37                              | 12                            | 23.4                                     | 6.8                                                          |
| Salix cprea L.                | 30                              | 11.3                          | 3.0                                      | 6.8                                                          |
| Salix alba L.                 | 23                              | 14.2                          | 2                                        | 54.5                                                         |
| Sorbus aucuparia L.           | 18                              | 25.1                          | 7                                        | 26.1                                                         |
| Pyrus communis L.             | 15                              | 11.9                          | 1                                        | 33.0                                                         |
| Quercus robur L.              | 9                               | 4                             | 39.3                                     | 13.0                                                         |
| Picea pungens Engelm.         | 5                               | 13.4                          | 22.3                                     | 17.8                                                         |
| Picea abies (L.)Karst.        | 1                               | 25                            | 31.6                                     | 10.5                                                         |
| Populus tremula L.            | 5                                | 17                            | 41.1                                     | 41.3                                                         |
| Populus avium Mill.           | 4                                | 18.8                          | 27.8                                     | 21.3                                                         |
Larix sibirica *Ledeb.*

Ulmus laevis *Pall.*

Ulmus glabra *Huds.*

Alnus glutinosa (*L.*) *Gaertn.*

Dendroflora as a whole

| Categories of tree condition | Distribution of examined trees according to condition categories, pcs./% |
|-----------------------------|------------------------------------------------------------------------|
|                            | Park of the Anthoniev Monastery | Manor Park “Speranskaya Myza” | Park of S.V. Rakhmaninov’s estate “Oneg” | Plantings of the Novgorod Kremlin (inside the Kremlin walls) |
| 1 – no signs of weakening (healthy) | 38 | 3.6 | 15 | 63 |
| 2 – weakened | 695 | 63.8 | 72.5 | 68.8 |
| 3 – severely weakened | 275 | 26.1 | 21.9 | 19.5 |
| 4 – drying out | 30 | 2.8 | 1.6 | 1.6 |
| 5 - dead wood of the current year (fresh) | 0 | 0 | 0 | 0 |
| 6 - dead wood of previous years (old) | 27 | 2.5 | 1.4 | 0.2 |
| Total | 1065 | 69 | 570 | 635 |

*average diameter, cm
*average height, m

The park of the Antoniev Monastery can be considered a typical example of a monastery park within the Trade side of modern Veliky Novgorod. Currently, in the study area there are educational buildings of NovSU Institute for the Humanities. In June-September 2014, teachers and students of the Department of Forestry, on the instructions of NovSU administration, conducted an inventory of park vegetation. Here you can still find elements of linden alleys of the 19th century among trees planted in the postwar period. Medieval monastery plantings have not been preserved.

3. Results and discussion

We took into account 1065 trunks of woody plants of 17 species (table 1). The distribution of the examined trees of the park by condition categories and the calculated indices of the vital condition of the stands are presented, respectively, in tables 2 and 3. The state of tree stands for the territory of Antonovo Park can be characterized as “weakened”, since the value of VCI is 2.38.

Table 2. Distribution of trees in the examined parks of Novgorod region by status categories.

| Categories of tree condition | Distribution of examined trees according to condition categories, pcs./% |
|-----------------------------|------------------------------------------------------------------------|
|                            | Park of the Anthoniev Monastery | Manor Park “Speranskaya Myza” | Park of S.V. Rakhmaninov’s estate “Oneg” | Plantings of the Novgorod Kremlin (inside the Kremlin walls) |
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Recently, in the cultural, environmental, scientific and educational spheres, interest in ancient manors and manor parks has grown. In the Novgorod region, there are over 150 manor parks. A typical example of a preserved manor park located in the vicinity of Veliky Novgorod is the Speranskaya Myza manor park. The history of the manor park is closely connected with the name of the largest statesman of Russia
in the first half of the XIX century Mikhail Mikhailovich Speransky. The park to our time has been preserved only partially. Most of the trees in the park are lindens, which are about 200 years old. From the manor buildings there were only stone foundations. Field work was carried out in 2014 by students under the direction of Associate Professor of the Department of Forestry of NovSU Smirnov I.A. The generalized results of the survey of the preserved alleyways of the park are presented in tables. The total index of the vital condition of trees is the worst result for the examined parks – 2.46. This can be explained by the presence of old-age trees with a weakened state and reduced stability in the alleyways of the Speranskaya Myza manor park. Nevertheless, these trees are of the greatest value, since they meet the goals of creating the park, preserve its layout, and are a historical object. The plants of the initial plantations should be kept as long as possible, if they do not pose a direct threat to park visitors with their state.

Table 3. The vital condition index (VCI) by tree species in the examined parks of Novgorod region.

| Plant species                  | Park objects in Novgorod region/value of VCI |          |          |          |
|-------------------------------|---------------------------------------------|----------|----------|----------|
|                               | Park of the Anthoniev Monastery | Manor Park “Speranskaya Myza” | Park of S.V. Rachmaninov’s estate “Oneg” | Plantings of the Novgorod Kremlin (inside the Kremlin walls) |
| Tilia cordata Mill.            | 2.28                                        | 2.43     | 2.18     | 2.06     |
| Betula pendula Roth            | 2.25                                        | 2.50     | 2.00     | 1.50     |
| Betula pubescens Ehrh.         |                                             |          |          |          |
| Acer platanoides L.            | 2.21                                        | 3.00     | 2.17     |          |
| Populus balsamifera L.         | 2.80                                        | 4.85     | 2.00     |          |
| Malus domestica Borkh.         | 2.42                                        |          | 2.49     |          |
| Malus baccata (L.)Borkh.       |                                             |          | 2.00     |          |
| Fraxinus excelsior L.          | 2.16                                        | 3.00     | 2.33     | 1.98     |
| Fraxinus pennsylvania Marshall |                                             |          |          | 2.00     |
| Aesculus hippocastanum L.      | 2.44                                        |          |          | 2.00     |
| Thyja occidentalis L.          | 2.00                                        |          |          | 2.08     |
| Salix cprea L.                 | 2.60                                        |          |          |          |
| Salix alba L.                  | 3.35                                        |          | 3.00     |          |
| Sorbus aucuparia L.            | 2.67                                        |          | 2.71     |          |
| Pyrus communis L.              | 2.13                                        |          | 1.00     |          |
| Quercus robur L.               | 2.33                                        |          | 2.75     |          |
| Picea pungens Engelm.          | 2.00                                        |          |          | 2.48     |
| Picea abies (L.)Karst.         |                                             |          |          | 2.00     |
| Populus tremula L.             | 3.00                                        |          | 2.65     | 2.67     |
| Padus avium Mill.              | 3.00                                        |          | 3.00     |          |
| Larix sibirica Ledeb.          | 2.00                                        |          | 3.00     |          |
| Ulmus laevis Pall.             |                                             |          | 2.42     | 2.20     |
| Ulmus glabra Huds.             |                                             |          |          | 2.14     |
| Alnus glutinosa (L.)Gaertn.     |                                             |          | 1.67     |          |
| Dendroflora as a whole         | 2.38                                        | 2.46     | 2.28     | 2.13     |

The original woody parkland of the Oneg estate, which in the second half of the 19th century belonged to the family of the great Russian composer Sergei Vasilyevich Rachmaninov, unlike the Speransky Myza manor park, has not been preserved. Our research conducted in 2006-2008 showed that the vast majority of trees in the park have an average age of about 70 years. The high value of the vital condition index in a number of tree species (poplar, oak, aspen) can be explained by the process of
gradual swamping. Also, the overgrowth origin of most trees leads to a decrease in the biological stability of the stands.

In June - September 2013 The Forestry Department of Yaroslav-the-Wise Novgorod State University commissioned by the Federal State Institution of Culture “Novgorod State United Museum-Reserve” conducted a survey of the territory of the Novgorod Kremlin in order to assess the current state of tree-shrub vegetation. The species diversity of the woody plants of the Novgorod Kremlin is maximum, and the living condition is the best for the parks considered in this article. Nevertheless, it should be noted that tree plantings in some parts of the Kremlin have a high density. This leads to the fact that the development of tree trunks and crowns is with violations. The Novgorod Kremlin with a high level of anthropogenic load and a deeply changed natural environment is characterized by a weakening of the state and a decrease in the biological stability of the stands, as well as for other similar territories [8].

Table 4. A brief description of the shrubs of the examined parks in Novgorod region.

| Shrub species                          | Park of the Anthoniev Monastery | Manor park “Speranskaya Myza” | Park of S.V. Rakhmaninov’s estate “Oneg” | Plantings of the Novgorod Kremlin (inside the Kremlin walls) |
|---------------------------------------|---------------------------------|--------------------------------|------------------------------------------|---------------------------------------------------------------|
| Corylus avellana L.                   | seldom satisf.                  | seldom satisf.                 | often satisf.                            | some satisf.        |
| Ribes nigrum L.                       | seldom satisf.                  | seldom satisf.                 | some satisf.                            | some satisf.        |
| Ribes rubrum L.                       | seldom satisf.                  | seldom satisf.                 | some satisf.                            | some satisf.        |
| Rosa acicularis Lindl.                | often satisf.                   | sporadically satisf.           | some satisf.                            | some satisf.        |
| Rosa rugosa L.                        | satisf.                         | sporadically satisf.           | some satisf.                            | some satisf.        |
| Crataegus sanguinea Pall.             | often satisf.                   | satisf.                        | some satisf.                            | some satisf.        |
| Cotoneaster lucidus Schlecht.         | often satisf.                   | satisf.                        | some satisf.                            | some satisf.        |
| Caragana arborescens Lam.             | often suppressed                | seldom suppressed              | some suppressed                         | some suppressed     |
| Philadelphus coronarius L.            | seldom suppressed               | supressed                     | some suppressed                         | some suppressed     |
| Sambucus racemosa L.                  | seldom satisf.                  | often satisf.                  | some supressed                          | some satisf.        |
| Sambucus nigra L.                     | satisf.                         | sporadically satisf.           | some supressed                          | some satisf.        |
| Lonicera tatarica L.                  | seldom suppressed               | seldom supressed               | some supressed                          | some satisf.        |
| Syringa vulgaris L.                   | seldom supressed                | seldom supressed               | some supressed                          | some satisf.        |
| Grossularia uva-crispa (L.) Mill.     | seldom supressed                | seldom supressed               | some supressed                          | some satisf.        |
| Viburnum opulus L.                    | supressed                      | supressed                     | some supressed                          | some satisf.        |
| Rhamnus cathartica L.                 | often satisf.                   | satisf.                        | some satisf.                            | some satisf.        |

*a satisfactory
*b suppressed
4. Conclusion and recommendations

The tree plantings in the parks of Novgorod Region are negatively affected by cracks in the trunks as a result of frost and mechanical damage of various origins, drying out of branches, violation of the crown and rot of the trunk. Also, lesions by mushrooms are often found, which is characteristic of old broad-leaved trees [9]. Nevertheless, it is old trees that are of the greatest value [10]. We recommend for trees of categories 2 and 3 (“weakened” and “strongly weakened”): to process places of damage with rot, to close hollows and cracks, to trim the crowns, to fight against pests. Also a good preventive measure will be to attract birds to the parks with the help of feeders and artificial nesting. For “dying” trees (category 4), these protective measures may not be effective. If you plan to replace them, we recommend using species that will work well with those already in the park.

The characteristics of the vital condition and occurrence of shrub species in the parks of Novgorod region are given in table 4. Many of them require updating or thinning for decorative purposes and shaping. Inhibited dying plants are best removed.

Part of the measures recommended by us to improve the condition of the examined park complexes were implemented in 2014–2017 by the student subbotniks of NovSU, employees of the Forestry Committee of Novgorod Region, and volunteers.

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