Trees and Bushes in the Bolshoi Uran River Basin (Orenburg Region)

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Abstract. The article analyzes the tree and shrub flora of the B. Uran river basin. An inventory of the flora was carried out, characteristics were given according to floristic spectra (taxonomic, ecological, phytocenotic, etc.), and a list of plants was compiled. It is established that 42 wild species of trees and shrubs belonging to 15 families grow on the studied territory. The most common family is Rosaceae, the largest genera are Salix and Populus. The availability of moisture was determined by the predominance of mesophytic forest vegetation. The chorological analysis of the flora indicates a significant presence of adventitious wild-growing species. The analysis of the species structure of phytocenoses indicates an anthropogenic succession.

1. Introduction

According to the level of anthropogenic load on the natural environment, the territory of the Urals within the Orenburg region is in third place in the Ural region. The gradual depletion of flora leads to a decrease in productivity and a decrease in vegetation cover [1–4]. Therefore, at the present stage, the problem of studying and preserving the nature of the steppes, of which its flora is an inseparable part, is urgent [5–9]. The flora of the Orenburg steppes has been studied since the XVIII century to the present, but there is no comprehensive information about it, since ecological and climatic factors, anthropogenic load, and so on are changing.
The share of trees and shrubs accounts for 6.5% of the flora of the region. Trees form woodlands, albeit small, but very important for the steppe regions. Two species are included in the Red Book of the Orenburg region [10-14]. In addition, many trees and shrubs are of great practical importance. All this makes the beginning of the study of the area's tree and shrub flora.

Purpose of the research: Purpose of the study: to study the species composition and identification of species in need of protection in forest phytocenoses of the Bolshoi Uran river floodplain; to carry out a systematic and geographical analysis of the tree and shrub flora in the Bolshoi Uran floodplain and to assess the degree of its anthropogenic transformation.

2. Research object and methodology

The basin of the B. Uranus River is located in the southeast of the East European Plain. Administratively, the territory is in the Orenburg region. In its physical and geographical position, the territory is included in the Verkhnesamarskiy syrt-hilly region of the Obshsyrtovaya pre-Ural steppe province. The basin area is about 2200 km². The territory is stretched mainly from west to east.

The relief of the territory has a number of features. A characteristic feature of the relief is the asymmetry of the slopes. The southern slopes are generally steep and abrupt. On the southern slopes, real and stony steppes developed. The northern slopes are always gently sloping, elongated, smoothly turning into a watershed plateau at the top. The northern slopes, due to less heating, contain more mesophilic elements than the southern ones. Meadow steppes are widespread on the northern slopes.

The climate of the region under study is characterized by with continental features, with long, cold winters, short springs, dry and hot summers, and long autumn. The listed climate features lead to the formation of steppe flora and vegetation. In places of sufficient moisture, usually in conditions of lowering the relief, one can find small birch-aspen pegs. Gully forests of oak and linden are much less common.

The Big Uran River flows through the study area from east to west. Its length is about 155 km. The presence of the river determines the development of aquatic and semi-aquatic vegetation.

The main type is represented by chernozem of various texture and thickness. The humus content is insignificant. Soils have different mechanical, chemical composition and humus content, which affects the diversity of flora.

Literary sources were used to determine the species and establish their belonging to certain groups [15-20]. The species composition and distribution of species were identified during field research. During the walking research, floristic lists were compiled. Field studies covered the vegetation cover in the vicinity of most settlements. Also, tracts and natural monuments were examined.

3. Results and Discussion

The tree and shrub flora of the B. Uran River basin includes 42 species of wild plants, which belong to 29 genera and 15 families. The largest families are Rosaceae - 13 species, Salicaceae - 7 species, Fabaceae - 4 species. 7 families are represented by one species - Fagaceae, Grossulariaceae, Tiliaceae, Elaeagnaceae, Sambucaceae, Viburnaceae. The largest genera Salix - 4 species, Populus - 3 species.

A number of species are found in plantings and in abandoned villages. They are not included in this article. These include Ribes aureum, Malus domestica and some other species.

Moisture availability is one of the most important environmental indicators. Mesophytes (21 species) predominate in the ecological spectrum of the Bolshoy Uran River basin, which is associated with the peculiarities of trees and shrubs, which are generally demanding for moisture. The smallest proportion are xerophytes – 2 species. The share of xeromesophytes is 9 species. Mesohygrophytes and mesoxerophytes each have 5 species.

There are 5 phytocenotic groups in the B. Uranus river basin. The first place belongs to forest species (24 species), these include Quercus robur, Tilia cordata, Padus avium and others. The second place belongs to forest-steppe species (8 species). These include Rosa majalis, Prunus spinosa and others. The steppe group includes 7 species. These are such species as Cerasus fruticosa, Amygdalus nana and others. The petrophytic group includes 2 species. These are Atraphaxis frutescens and
Cotoneaster melanocarpus. The meadow-forest group includes 1 species. This includes *Genista tinctoria*.

Geographic elements are shown in Table 1. The table shows that the largest share is occupied by the Eurasian and European groups, and the smallest share is the Holarctic, East European, Trans-Volga-Kazakhstan, Pontic-Trans-Volga-Kazakhstan. The chorological analysis of the flora makes it possible to reveal the features of its genesis and to establish the connections of this flora with other flora. Three species are adventive for the area. These are *Ulmus pumila, Acer negundo, Elaeagnus angustifolia*. The first two species are actively introduced into natural communities, displacing native species. *Elaeagnus angustifolia* is still small in number.

It should be noted that some species are located on the periphery of their range. For example, *Quercus robur, Ulmus laevis, Acer platanoides, Tilia cordata* and some others grow in the southeast of the range. *Atraphaxis frutescens* grows in the north of the range.

| Geographical elements             | Number of species |
|-----------------------------------|-------------------|
| Eurasian                          | 15                |
| European                          | 9                 |
| Ancient Mediterranean             | 6                 |
| Eurosiberian                      | 4                 |
| Mediterranean                     | 2                 |
| Asian                             | 2                 |
| Holarctic                         | 1                 |
| Eastern European                  | 1                 |
| Zavolzhsko-kazakhstan             | 1                 |

The results of the analysis of the spectrum of botanical-geographical groups established for the latitudinal gradient are shown in table 2.

| Latitude group       | Number of species |
|----------------------|-------------------|
| Stepnaya             | 9                 |
| Forest-steppe        | 10                |
| Nemoral              | 19                |
| Nemoral-boreal       | 4                 |

The largest number of species belongs to the nemoral flora. These are species typical for deciduous forests. These include *Quercus robur, Ulmus laevis, Tilia cordata* and other species. The least represented is the nemoral-boreal flora. These are species typical for the southern taiga and mixed forests. In this case, these are *Salix caprea, Betula pubescens, Alnus glutinosa, Viburnum opulus*. The steppe and forest-steppe flora contain approximately the same number of species.

Many types of trees and shrubs play a significant role in human economic activity. This includes medicinal plants, food, decorative, melliferous, etc. The main group is formed by food plants - these are *Rubus idaeus, R. caesius, Cerasus fruticosa* and others. Medicinal plants - *Rosa majalis, Genista tinctoria*. Ornamental Plants – *Spiraea crenata, Rosa glabifolia, Amygdalus nana*. Honey plants – *Spiraea hypericifolia, S. Crenata*. It should be noted that many plant species can include several
economically useful properties. For example, *Rubus idaeus* is nutritional and medicinal; *Rosa majalis* - decorative, food, melliferous. The wood of local tree species is rarely used as a building material.

A number of tree and shrub species can play a significant role in the formation of plant communities. We will indicate some representatives. In forest communities, *Betula pendula, Populus tremula, Quercus robur*, and other species sometimes act as dominants and co-motives. In petrophytic steppes – *Atraphaxis frutescens*. Thickets of steppe shrubs form *Spiraea crenata, S. Hypericifolia, Cerasus fruticose, Amygdalus nana*.

Below is an annotated list of plants. It gives the name of the plant, life form, geographical elements, occurrence and distribution.

**Family Salicaceae – Willow**
1. *Populus alba* L. (Silver poplar). Tree. Mediterranean. Forest. Seldom.
2. *Populus nigra* L. (Black poplar). Tree. Eurasian. Forest. Sporadically. Mainly near settlements and as separate plantings near rivers.
3. *Populus tremula* L. (Poplar trembling). Tree. Eurasian. Forest. Usually. Forms small birch-aspen splits.
4. *Salix alba* L. (White willow). Tree. Eurasian. Forest. Usually. Forms small stripes along rivers.
5. *Salix caprea* L. (Goat willow). Tree. Eurasian. Forest. Sporadically.
6. *Salix cinerea* L. (Ash willow). Tree. Eurosiberian. Forest. Usually.
7. *Salix viminalis* L. (Rod-shaped willow). Tree. Eurasian. Forest. Usually.

**Family Betulaceae – Birch**
1. *Betula pendula* Roth. (Hanging birch). Tree. Eurosiberian. Forest. Usually.
2. *Betula pubescens* Ehrh. (Fluffy birch). Tree. Eurosiberian. Forest. Seldom. Gusikhinsky forests.
3. *Alnus glutinosa* (L.) Gaertn. (Black alder). Tree. European. Forest. Seldom. In the lower reaches of the river. B. Uranus.

**Family Fagaceae – Beech**
1. *Quercus robur* L. (Petiolate oak). Tree. European. Forest. Seldom. Tract Oak bush, Birch bush.

**Family Ulmaceae – Elm**
1. *Ulmus laevis* Pall. (Smooth elm). Tree. European. Forest. Seldom. Tract Oak bush, Birch bush. Gusikhinsky forests.
2. *Ulmus pumila* L. (Small-leaved elm). Tree. Asiatic. Steppe. Usually.

**Family Polygonaceae – Buckwheat**
1. *Atraphaxis frutescens* (L.) K. Koch (Shrub curl). Bush. Ancient Mediterranean. Petrophytic. Sporadically.

**Family Grossulariaceae - Gooseberries**
1. *Ribes nigrum* L. (Black currant). Bush. Eurasian. Forest. Seldom. On the banks of streams and in some forests.

**Family Rosaceae – Rose**
1. *Spiraea crenata* L. (Spirea crenate). Bush. Ancient Mediterranean. Steppe. Sporadically.
2. *Spiraea hypericifolia* L. (St. John's worm spirea). Bush. Ancient Mediterranean. Steppe. Usually.
3. *Rosa glabripolia* C.A. Mey. exRupr. (Glaucous rose). Bush. Trans-Volga-Kazakh. Forest-steppe. Usually.
4. *Rosa majalis* Herrm. (Rose of May). Bush. Eastern European. Forest-steppe. Usually.
5. *Rubus idaeus* L. (Common raspberry). Bush. Eurasian. Forest. Seldom.
6. *Rubus caesius* L. (Gray blackberry). Bush. Eurasian. Forest. Usually.
7. *Sorbus aucuparia* L. (Common mountain ash). Tree. European. Forest. Seldom.
8. *Crataegus sanguinea* Pall. (Hawthorn is blood red). Tree d. European. Forest. Seldom. Oak bush. Barchuk tract.
9. *Cotoneaster melanocarpus* Fisch. exBlytt (Black dogwood). Bush. Eurasian. Petrophytic. Sporadically.
10. *Padus avium* Mill. (Common bird cherry). A tree, less often a shrub. Eurasian. Forest. Seldom.
11. *Cerasus fruticosa* Pall. (Steppe cherry). Bush. Ancient Mediterranean. Steppe. Usually.
12. *Amygdalus nana* L. (Low almond). Bush. Ancient Mediterranean. Steppe. Usually.
13. *Prunus spinosa* L. (Prickly plum). Bush. Ancient Mediterranean. Forest-steppe. Seldom. The Oak Bush tract.

Family *Fabaceae* – Legumes
1. *Genista tinctoria* L. (Drok dye). Bush. European. Meadow forest. Usually.
2. *Caragana frutex* (L.) K. Koch (Caragana shrub). Bush. Eurasian. Forest-steppe. Usually.
3. *Astragalus cornutus* Pall. (Astragalus horned). Bush. Pontic-Trans-Volga-Kazakh. Steppe. Seldom. The outskirts of the villages of Pretoria, V. Kunakbay, Stepanovka, Kubanka, Kichkass, Gabrafiiko, Sredneuransky.
4. *Chamaecytisus ruthenicus* (Fisch. Ex Vorosch.) Klask. (Russian rakitnik). Bush. Mediterranean. Forest-steppe. Usually.

Family *Aceraceae* – Maple
1. *Acer negundo* L. (Ash-leaved maple). Tree. Holarctic. Forest. Usually.
2. *Acer platanoides* L. (Holly-leaved maple). Tree. European. Seldom. Tract Oak and Birch bush.

Family *Rhamnaceae* – Buckthorn
1. *Frangula alnus* Mill. (Buckthorn is fragile). Bush. Eurasian. Forest. Soradically.
2. *Rhamnus cathartica* L. (Gester laxative). Eurasian. Forest. Soradically.

Family *Tiliaceae* – Linden
1. *Tilia cordata* Mill. (Heart-shaped linden). Tree. European. Forest. Seldom. Tract Oak and Birch bush.

Family *Elaeagnaceae* – Lokhovye
1. *Elaeagnus angustifolia* L. (Narrow-leaved loch). Tree. Asiatic. Steppe. Seldom.

Family *Sambucaceae* – Elderberries
1. *Sambucus racemosa* L. (Red elderberry). Shrub, less often a small tree. European. Forest-steppe. Seldom. Tract Oak and Birch bush.

Family *Viburnaceae* – Viburnaceae
1. *Viburnum opulus* L. (Viburnum vulgaris). Bush. Eurasian. Eurasian. Forest. Soradically.

Family *Caprifoliaceae* – Honeysuckle
1. *Lonicera tatarica* L. (Tatar honeysuckle). Bush. Eurasian. Forest-steppe. Soradically.
2. *Lonicera xylosteum* L. (Common honeysuckle). Bush. European. Forest. Seldom.

Floodplain forest phytocenoses in the steppe zone perform an important water protection function. Each such phytocenosis is unique since a large number of factors influence the formation of its structure [1-4]. However, due to the increasing anthropogenic load, many species are reducing their abundance, and some are under the threat of extinction [5-14]. Our research shows the need to reduce the anthropogenic impact on forest phytocenoses of the Bolshoi Uran River floodplain.

4. Conclusion
The vegetation of natural ecosystems at all levels (individual species, cenopopulations, plant communities, flora, etc.) is experiencing constantly increasing anthropogenic pressure. To date, the process of impoverishment of the local flora is progressing almost everywhere. Currently, the species diversity of tree and shrub vegetation in the floodplain of the Bolshoy Uran River is determined by several factors, such as the availability of moisture, genesis and human influence. The border position between the steppe and forest-steppe zones determines the presence of several latitudinal groups in the composition of phytocenoses.

References
[1] Kalyakina R G, Filippova A V and Ryabukhina M V 2020 The current state of forest stands under anthropogenic impacts on the example of the Orenburg Urals IOP Conference Series: Materials Science and Engineering 962(4) 042010
[2] Kalyakina R G, Ryabukhina M V and Maiski R A 2018 Influence of Orenburg gas condensate field development on ecological and biological condition of landscape-botanical complexes IOP Conf. Ser. Mater. Sci. and Engineer. Electr. edition. 451(1) 012194
[3] Kalyakina R G, Ryabinina Z N, Bastaeva G T, Lyavdanskaya O A, and Rjabuchina M V 2020 Plant Communities of Economically Valuable Forest-Forming Species of the Orenburg Region Journal of Physics: Conference Series 1655(1) 012022

[4] Maiski R A, Ryabukhina M V and Kalyakina R G 2018 Ecological and technological aspects of increasing sustainability of vegetation cover of Caspian oil and gas provinces IOP Conference Series: Materials Science and Engineering 451 012193

[5] Rjabuchina M V, Ryabinina Z N, Kalyakina R G, Gerasimenko V V and Maiski R A 2020 Some structural patterns of the stand of Scotch pine (Pinus sylvestris L.) in the conditions of Zavolzhsky-ObshchSyrt province Journal of Physics: Conference Series 1655(1) 012026

[6] Rjabuchina M, Kalyakina R and Friesen N 2019 Phylogeographic analysis of Pinus sylvestris in forest-steppe and steppe zones of the Orenburg Region Turczaninowia 22(2) 110–20

[7] Rjabuchina M V, Kalyakina RG and Friesen N 2020 Molecular genetic studies of the natural self-renewal of Pinussylvestris L. Populations on the example of the East European Plain and the southern outskirts of the Ural mountain country Turczaninowia 23(1) 116–125

[8] Ryabinina Z N, Kalyakina R G, Ryabukhina M V, Khalikov B M and Bisaliev I N 2019 Studying the structure of pricopopulations and quality of seed seeds of bushes Ural river loan IOP Conference Series: Earth and Environmental Science 341 012097

[9] Ryabinina Z N, Lyavdanskaya O A, Bastaeva G T, Lebedev S V, Kalyakina R G and Rjabuhina M V 2021 Comparative analysis of species of the genus Rosa L. On the territory of the Eastern European Plain IOP Conference Series: Earth and Environmental Science 624(1) 012015

[10] Ryabinina Z N, Bastaeva G T, Lebedev S V, Kalyakina R G, Ryabuhina M V and Hakimov E R 2020 Impact of emissions from the Orenburg gas chemical complex on the state of forest ecosystems IOP Conference Series: Earth and Environmental Science 579(1) 012095

[11] Ryabinina ZN, Bastaeva GT, Lyavdanskaya OA, Lebedev S V, Kalyakina RG and Ryabuhina MV 2020 Radial growth of artificial forest stands under the aerotechnogenic impact of the Orenburg gas chemical complex IOP Conference Series: Earth and Environmental Science 579(1) 012115

[12] Ryabinina ZN, Kalyakina RG, Petrova GV, Anhalt EMandRjabuchina MV 2020 Ecological and Phytocenological Characteristics of the Vegetation of the National Park buzuluksky Bor Journal of Physics: Conference Series 1655(1) 012027

[13] Ryabuhina M, Maiski R and Kalyakina R 2019 Transboundary air pollution and its effects on vegetation IOP Conference Series: Materials Science and Engineering 687(6) 06604

[14] Ryabinina Z N, Kalyakina R G, Ryabukhina M V, Khalikov B M and Bisaliev I N 2019 Studying the structure of pricopopulations and quality of seed seeds of bushes Ural river loan IOP Conference Series: Earth and Environmental Science 341 012097

[15] Sukachev V N and Lavrenko E M 1952 A brief guide for gebotanical research in connection with the forest shelter forest and the creation of a sustainable forage base in the southern European part of the USSR (Moscow: Academy of Sciences USSR)

[16] Flora of the European part of the USSR 1974–1979 (Leningrad: Nauka)

[17] Stankov S S and Taliev V I 1957 The determinant of higher plants of the European part of the USSR (Moscow: Soviet science)

[18] Cherepanov S K 1995 Vascular plants of Russia and adjacent states (within the former USSR) (St. Petersburg: Peace and Family)

[19] Yurtsev B A and Kamelin R V 1991 Basic concepts and terms floristics (Perm: Perm University)

[20] Dylis N V 1974 Program and methods of biogeocenological studies (Moscow: Nauka)