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Flora dynamics and the problem of vegetation cover protection in the Volga basin

Summary

The general data of flora dynamics in the Volga basin and problems of its protection are presented. The flora dynamics is characterized through: a) introduction of alien or non-native species, b) disappearance of certain species, c) appearance of new taxons. The red book of the Volga basin is one of the tools useful for protection of vegetable cover. The red book underlies principles of protection of rare species through preservation of their environment.

Key words: Volga basin, vegetation, alien species, species extinction, vegetation protection.

1. Introduction

Determination of priorities in the sphere of conservation and development of principles of protection and restoration of biological diversity is very important issue, in particular for the territories with high level of anthropogenic load (Rozenberg 2009, 2011). The Volga river and its basin represent the unique territory not only on Russian or European scale, but in the world scale as well. The Volga river is the world's largest river of endorheic basin (no outflow to other external

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bodies of water). It is the largest river in Europe and the fifth one in Russia. Its basin occupies 62% of the European part of Russia and about 13% of the territory of Europe. For example, the Volga basin area amounts to three times the area of Sweden. Ten zonal types of vegetation cover are present on the territory of the Volga basin – from north taiga woodland to typical deserts. The ecological studies of zonality in Russia were for the first time developed on the territory of the Volga basin (Rozenberg 2009, 2011, Senator *et al.* 2012). The Volga river is the national symbol of Russia and a metaphoric embodiment of the Russian soul.

At the same time the ecosystems of the Volga basin suffers enormous load. Ten from 22 Russian metropolitan agglomerations with a population of 1 million or more are located here, including Samara and Togliatti agglomeration, Nizhny Novgorod and the largest one – Moscow. Here lives more than 40% of the population of Russia, 45% of industrial and 50% of agricultural production are produced within this territory, 38% of farmlands are located here. The Volga is the most regulated river of the former USSR. The Volga-Kama cascade of reservoirs is the largest in Europe and one of the largest in the world. Volga and Kama share over a half of all goods turnover of river transport of Russia. More than 90% sturgeon and half of the whole fish in internal water bodies of Russian Federation is caught in the Volga basin.

The existing ecological situation causes some sort of anxiety and demands to assume the urgent measures for the preservation of natural components, in particular, biological diversity which is the bases of ecosystem functioning in the Volga basin. It especially regards flora as a very dynamic system.

2. Introduction of alien or non-native species

The process of introduction of alien species into flora is the most indicative from the point of view of flora dynamics (Saksonov 2000, Gorchakovskiy 1979). This process proceeds very actively and is stimulated by intensive anthropogenic impact on natural complexes.

The data concerning the number of alien species of flora in a number of administrative units in the territory of the Volga basin are presented in Table 1. This indicator varies from 12% in Saratov region to 39% in Tver region, thus making the average of 25%.

Floristic exploration of the regions indicated in Table 1 is uneven. There is also no uniform approach to determine an alien flora component. Therefore it is difficult to provide a better understanding of the number of alien species of flora in the territory of the Volga basin. Nevertheless, the data given in Table 1 prove the high share of participation of alien species in floristic complexes of Volga basin.

Tab. 1. Number of plant species, number of alien plant species and their share in the flora of some administrative units on the territory of the Volga basin. * – regions which are partially located on the territory of the Volga basin.

Region	Plant species	Alien species	%
Kaluga*	1280	204	15.9
Kirov*	1470	402	27
Lipetsk *	1086	306	28.1
Mordovia, republic	1401	387	27.6
Penza*	1445	350	24.2
Samara	1872	420	22.4
Saratov*	1492	184	12.3
Tatarstan, republic	1610	330	20.5
Tver*	1735	682	39.3
Ulyanovsk	1729	413	23.8

3. Extinction of certain flora elements

Other feature of flora dynamics is the extinction of its particular elements. One should notice that there is no single approach to understanding of the term „extinct”. Different authors define it in different way. Because to prove the extinction in modern flora of the specified species is extremely difficult (except for direct destruction of habitats), we use the term „apparently extinct”. Table 2 shows the

date of apparently extinct species in a number of administrative units. As it can be seen recently 14 species of vascular plants vanished from the territory of The Republic of Tatarstan, 19 species from The Mari El Republic and 28 species from Lipetsk region.

Tab. 2. Number of apparently extinct species of vascular plants in some regions of the Volga basin. * – regions which are partially located in the territory of the Volga basin.

Region	Number of extinct species	Region	Number of extinct species
Bashkortostan, republic.*	7	Samara	28
Volgograd*	14	Tambov*	7
Lipetsk*	28	Tatarstan republic	14
Mari El, republic	19	Tver*	11
Mordovia, republic	13	Tula*	5
Moskow	10	Ulyanovsk	10
Penza*	4	Chuvashia, republic	4
Rjazan*	3	Yaroslavl	9

The Samara Bend (Samarskaja Luka) is the most investigated from floristic point of view place in the Volga basin. The history of its exploration has more than 275 years and is connected with names of such scientists as Peter Simon Palas, Ivan Lepyokhin and Sergei Korzhinskii. It is a unique territory of universal value. It has a form of a large hairpin bend of the middle Volga river at the confluence of the Samara river. It sharply differs from adjacent territories in environmental contrast and the level of biological diversity.

The flora of this region counts 1241 species of vascular plants from which 28 now are considered to be extinct (Saksonov 2006, Senator, Saksonov 2010). All these plants are stenotopic. For example, *Oxycoccus palustris*, *Drosera rotundifolia*, *Parnassia palustris*, some orchids, species from genera *Salix* and *Carex*, *Crambe aspera*, *Cleistogenes squarrosa* and *Thalictrum foetidum*, *Juniperus communis*,

Viola tanaitica, *Aulacospermum multifidum* etc. The extinction of these species is directly connected with the destruction of biotopes.

One can assume that the extinction of certain representatives of flora is rather natural phenomenon as the process of species elimination continuously takes place. However the anthropogenic transformation of ecosystems strongly accelerates this process in the Volga basin.

4. The development of new taxa

The appearance of new taxa is another feature of flora dynamics. In the territory of the Volga basin there are areas recognized to be the centers of species formation (Litvinov 1890, Lavrenko 1930, Sprygin 1941). The Zhiguli heights (Zhigulevskaya vozvyshehnost) is one of such centers. It is caused by the following reasons (Senator, Saksonov 2012):

1. A long period of continental conditions. In these conditions ancient elements of flora – relicts – are not only present in local flora, but are able to develop the local forms described in the rank of specific and intraspecific taxa.
2. The isolation of local populations is one of speciation conditions. At different stages of development of Zhiguli heights there were various types of isolation: from zonal-climatic (during glaciation) to island (sea transgressions). Now important factors of isolation are: (a) the Volga river framing Zhiguli heights gives to it a shape of peninsula, (b) paleozoic rocks of limestones and dolomite come here to the surface, (c) the anthropogenic isolation which has led to formation of special group of breaking-up areas of plants (anthropogenic relicts).
3. Mosaicity and contrast of ecological conditions. Zhiguli heights combines a number of morphologically various landscapes which, in a combination with a variety of soil and geological conditions, promote topological isolation of local populations.

5. Projects aimed to protect flora of Volga basin

Due to the above, the problem of preservation of floristic diversity and in particular of its rare component is especially urgent. Rare species overreact to the slightest changes of living conditions. Therefore they are indicators of environment changes occurring under the influence of natural and anthropogenic factors and a basis for development of preservation mechanisms of vegetation cover.

Institute of Ecology of the Volga River Basin of Russian Academy of Sciences gives particular attention to the problem of preservation of floristic diversity. It participates in creation of a number of red books of administrative units of the Russian Federation. Two large projects are implemented now: „*Flora of the Volga basin*” and „*The red book of the Volga basin*”. The first one is aimed at the detection of floristic diversity of large eco-region, the second one at the identification of its rare component and working out measures for its preservation. Here the important rule is observed: the protection of rarities, first of all, is the preservation of their environment.

The Table 3 gives the idea of a specific variety of flora of a number of administrative units. One can notice that the diversity of vascular plants in some regions of the Volga basin changes from about 1000 to nearly 2000 species.

12500 species of vascular plants grow recently in the territory of Russia according to the most general estimates (Kamelin 2004). In the flora of Eastern Europe (within the former USSR) the number of vascular plant species is equal to 6556 (Cherepanov 1995, Morozova 2008).

According to our approximate estimations the species number of vascular plants growing in the territory of the Volga basin is about 3500. Probably about 700 species of vascular plants can be included in the a red book of the Volga basin, that is 15 or 20% of the regional flora.

The development of protection mechanisms of this natural heritage is major task of ecologist working the Volga basin. In October 2009 the first conference *The red book of the Volga basin: floristic rarities* took place in the Institute of Ecology of the Volga River Basin. For

the first time in history of nature conservation in Russian the conference was devoted to the problems of creation of the red book of large eco-region.

Tab. 3. Number of species, genera and families in regional flora in the territory of the Volga basin (within Russian Federation) (Senator *et al.* 2012). * – regions which are partially located in the territory of the Volga, n.d. – no data.

Region	Number of taxons		
	Species	Genera	Families
The Upper Volga:			
Moscow, Moscow region	more than 1600	n.d.	n.d.
Yaroslavl	around 1130	n.d.	n.d.
The Middle Volga:			
Samara	1872	636	132
Mordovia, republic	1401	564	118
The Lower Volga:			
Saratov*	1491	n.d.	n.d.
Astrakchan*	1253	516	116
The Prikama (near the Kama river), the Priural (near the Ural) and the Ural:			
Udmurtia, republic	1743	604	118
Komi, republic*	1158	413	114

The second conference took place in September 2012 (Senator *et al.* 2012). It proved great interest from both Russian and foreign researchers to the implementation of the project *The red book of the Volga basin*. The coordination council of the red book of the Volga basin has been established recently. Conceptual principles together with justification of the project have been formulated. The role which the red book plays in the solution of problems connected with regional sustainable development has been estimated. Future elements of the red book of the Central Volga region are now considered, starting from the analysis of its hydrophilic flora. Preliminary lists of plants

recommended for protection in the territory of Priuralyea and the Urals, the Central and Lower Volga region are formulated. The passport of rare taxons is also prepared. The next step is the establishment of check-lists of the plants recommended for protection within the subregions of the Volga basin, their publication and wide discussion. The collected data will form a basis for electronic version of the red book of the Volga basin. The creation of this resource is rather urgent from the point of view of efficiency of implementation of the project.

Formulation of the red book is one of measures leading to vegetative cover conservation. The official red books made according to the administrative principle (at federal and regional levels) do not provide protection of biological diversity in appropriate ecological scale. Therefore the development of the red book of large ecoregions is of great interest. This task is very important from both ecological and nature protection points of view.

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