

The state of mountain forest ecosystems in the Bashkir Nature Reserve (Southern Urals)

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Abstract. Environmental monitoring of specially protected natural reservations in Russia makes it necessary to analyze periodically the parameters of natural reservations to identify the state of components of nature. The Bashkir Nature Reserve is located in the Southern Urals. The availability of materials on forest management in 1956, 1969, 1979, and 2016 is one of the special features of the scientific fund of the Bashkir Nature Reserve. The analysis of these materials showed stable positive dynamics of the development of coniferous and small-leaved deciduous forestry and its current state.

1 Introduction

In recent years, an analysis of the available information about the processes occurring in natural communities is necessary due to the increased frequency of natural disasters. It is especially important to pay attention to the ecological state of mountain forests as the most vulnerable biocenoses.

The purpose of this study is to determine the state and dynamics of mountain forest ecosystems in the Bashkir Nature Reserve (Southern Urals), taking into account the main forest management indicators for 60 years.

2 General characteristics of the reserve

The Bashkir State Nature Reserve Forestry is a specially protected natural area (SPNA). It has a special environmental, scientific, cultural, aesthetic, and recreational significance. This unique area of the South Ural nature was withdrawn from economic use by decisions of state authorities. The reserve has a special protection regime.

The mountain forests of the Bashkir Nature Reserve are classified as a protected category and have a special protection status. These forests have a significant role as a regulator of surface water runoff and a factor contributing to water seepage into the soil.

The territory of the reserve is geographically assigned to the central mountainous region of the Southern Urals (Fig.1).

The territory is represented by a compact forest area with a length of 23 km (from north to south), and 31 km (from east to west). The geographical location of the forestry is determined by the coordinates:

- from north to south between 53°30' and 53°15' northern latitude,

- from west to east between 57°43' and 58°11' eastern longitude.

It can be divided into two sharply different parts: the western one, represented by the strongly dissected Southern Kraka massifs, and the eastern one with the subdued relief of the Ural-Tau ridge. The topographic elevation data of the Southern Kraka massif is 700-929 m, the Ural-Tau ridge is 800-943 m above sea level. There is an extensive depression zone (500-650 m) between these geological objects.

Geologically, the Ural-Tau ridge is composed of the oldest rocks (gneiss, quartzite, various highly metamorphosed crystalline shales). The area of the Southern Kraka massif is represented by siliceous shales, quartzitic sandstones. In some places, there are horizons of limestone and tuff.



Fig. 1. General view of the Bashkir Nature Reserve (Southern Urals).

All forests of the Bashkir State Nature Reserve forestry are classified as protected forests according to article 10 (part 2) of the Forest Code of the Russian Federation (Federal Law No. 200-FZ /4/ of 04.12.2006).

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The reserve forest stands are located on SPNA with a special forestry regime aimed at maximum preservation of natural objects in the natural state (in accordance with paragraph 19 of the Forest Management Instruction approved by the order of the Forestry Agency of Russian Federation No.516 of 12.12.2011 and with articles 102 (part 2) and 103 (part 1) of the Forest Code of the Russian Federation).

Protected forests exist in order to preserve the environment, water protection, protective, sanitary-hygienic, health-improving and other functions. Forest stands can be used provided that this use is compatible with the purpose of these forests and their useful functions.

The Bashkir State Nature Reserve forestry has a special regime for forest protection and forestry management by its status and type in regulatory documents (concerning SPNA). The regime is defined by the Land Code of the Russian Federation, the Forest Code of the Russian Federation, Federal Law No. 33, as well as regulatory legal acts of the subject of the Russian Federation and the Republic of Bashkortostan. The specifics of the use, protection, and reproduction of forests in the Bashkir State Nature Reserve are defined by the Order of the Ministry of Natural Resources No. 181/21/.

3 Analysis of forest stands parameters

As of January 2016, there are 28946.5 ha (68.8%) of coniferous-dominated forest in planted area and 7342.9 thousand m³ (73.5%) in volume, 13140.2 ha (31.2%) of small-leaved forest in planted area and 2640.9 thousand m³ (26.5%) in volume in the Bashkir Nature State Reserve forestry (Table 1, 2).

At present, ripe and overripe plantings predominate by age structure and make up 57.1% of the lands covered with forest vegetation (including overripe – 29.1%), ripening stand – 25.0%, middle-aged – 17.0%, young stand is practically absent and occupy only 0.9% of the area. Young trees were formed on burnt areas after large forest fires in 1975. The main predominant species of forestry are European red pine (25570.1 ha – 60.8%) and European white birch (10350.7 ha – 24.6%).

Forest capacity is characterized by a fairly high growth class (bonitet) – 2.8. Forest stands of I-II growth classes make up 37.2% of the forest area, III-IV growth classes – 61.3%, V-Vb growth classes – 1.5 %.

Siberian larch and Grey alder plantations of natural origin have low forest capacity. European red pine, European white birch and aspen plantations have high capacity.

The average stand density is 0.70. Low-stand density plantings (0.3-0.4) occupy 6.6%, medium-stand density (0.5-0.7) – 54.2% and high-stand density (0.8-1.0) – 39.2% of the lands covered with forest vegetation (at that 73.5% of forests are coniferous plantations). The average stand density of coniferous stands is 0.70, small-leaved – 0.69.

There are no signs of mass degradation and drying of trees in the forest area, thus, the forest stands are classified as Class I by biological resistance (according to the classification of the Moscow Forestry Institute). The forest stands are classified as Class II by the degree of resistance to negative anthropogenic influences. Therefore, forest tending is not planned.

Table 1. The main parameters of forest stands by trees species in the Bashkir Nature Reserve (1956-2016)

Predominant species	Area, ha	Ripe and overripe, ha	Middle aged	Growth class
European red pine (<i>Pinus sylvestris</i>)				
1956 [2]	21913	8347	66	II,8
1969 [3]	24884	1585	73	II,7
1979 [4]	24426	911	77	II,3
2016 [5]	25570,1	7441	110	II,8
Siberian larch (<i>Larix sibirica</i>)				
1956 [2]	4211	3834	140	IV,1
1969 [3]	2443	1321	137	IV,0
1979 [4]	3240	1460	124	III,5
2016 [5]	3376,4	983	155	III,5
European white birch (<i>Betula pendula</i>)				
1956 [2]	19076	12321	56	II,9
1969 [3]	12903	1198	60	III,1
1979 [4]	10384	4496	72	II,9
2016 [5]	10350,7	3012	101	III,1
Aspen (<i>Populus tremula</i>)				
1956 [2]	2987	2323	59	II,9
1969 [3]	2400	4446	67	III,0
1979 [4]	2569	5085	75	III,0
2016 [5]	2326,7	-	105	-
Grey alder (<i>Alnus incana</i>)				
1956 [2]	279	-	27	IV,4
1969 [3]	252	3	42	IV,1

1979 [4]	440	26	50	IV,3
2016 [5]	462,8	-	35	-

Table 2. Total and average standing volume of forest stands by trees species in the Bashkir Nature Reserve (1956-2016)

Total standing volume, m ³	Average standing volume, m ³ /ha
European red pine (<i>Pinus sylvestris</i>)	
3566	132
4373	109
5593	-
6776	265
Siberian larch (<i>Larix sibirica</i>)	
439	106
274	105
556	-
570	169
European white birch (<i>Betula pendula</i>)	
2478,5	149
2324	140
2361	200
2070,1	-
Aspen (<i>Populus tremula</i>)	
424,2	158
396	-
-	-
549,1	236
Grey alder (<i>Alnus incana</i>)	
8,6	-
7,7	-
-	-
23	50

The analysis of the main parameters of SPNA woodlands showed:

From 1929 to 1951, this territory was a specially protected natural territory. It was created "for the purpose of preserving in an inviolable form for the scientific study of the laws of nature development of the Southern Urals with its characteristic flora and fauna, as well as the associated study of the forests of the Bashkir Autonomous Soviet Socialist Republic" [6].

From 1951 to 1957, the territory of the Bashkir Reserve in the former borders was transformed into the Yuzhno-Uzyansky forestry.

In 1957, this mountain-forest territory was transferred to a SPNA with a protected regime in the former unchanged borders.

An analysis of the forestry development with periodic forest management works shows that the composition of tree species has remained unchanged in this natural area. Coniferous species (about 80 %) occupy a large area of the reserve territory and have a stable positive dynamic for 60 years (Table 3).

The predominant species of the reserve is European red pine (Fig. 2). The total coniferous standing volume has doubled (Table 4). A slight decrease in the larch standing volume in the middle of the 20th century can be explained by technical errors during forest management works on this territory.

Table 3. Dynamics of the area of coniferous and small-leaved forestry in the Bashkir Nature Reserve, ha

Forestry	Years			
	1956 [2]	1969 [3]	1979 [4]	2016 [5]
Coniferous	26124	27327	27666	28947
Small-leaved	22342	15555	13393	13140

Table 4. The main taxational specifications of the forest area in the Bashkir Nature Reserve

Years	Middle age	Total standing volume, m ³	Average standing volume, m ³ /ha
Coniferous			
1956 [2]	75	3566	120
2016 [5]	115	7342	254
Small-leaved			
1956 [2]	53	432,8	153
2016 [5]	99	2640	201



Fig. 2. Stand of European red pine in the Bashkir Nature Reserve (Southern Urals)

The analysis of small-leaved woodlands shows a negative trend, which indicates a good regenerative succession of pine as the indigenous species. The average age of European white birch as the main species of small-leaved forest stands has increased by 46 years over the past 60 years. The indicators of the total and average standing volume of birch have also increased.

Moreover, the analysis of the dynamics of the number of forest pests was carried out on the basis of available materials in the scientific fund of the Bashkir Nature Reserve for the last 90 years. The analysis showed that stand of European red pine is periodically weakened due to the sharp reproduction of xylophages [7].

4 Conclusion

To date, the Bashkir State Nature Reserve has a stable positive dynamic of the coniferous and small-leaved forestland development. There is a good regenerative succession of indigenous species (European red pine and Siberian larch) in the forest stands.

References

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