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**Taxonomic composition  
and systematic structure of  
dendroflora of the national  
natural park «Burabay»**

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**«Бурабай» ұлттық табиғи  
паркіндегі дендрофлораның  
таксономиялық құрамы және  
систематикалық құрылымы**

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**Таксономический состав и  
систематическая структура  
дендрофлоры национального  
природного парка «Бурабай»**

The article presents the results of research carried out in the national park «Burabay» (2010–2015), gives the taxonomic analysis of the tree and shrub flora and provides with the information on the composition and systematic structure of park dendroflora. The flora of the State National Natural Park «Burabay» includes 94 species of woody plants. They belong to 30 families, 53 genera and 2 divisions. The dendroflora comes up to 14.6% of the total flora of the park. The dominant in amount and genera are the families: Rosaceae; Salicaceae; Grossulariaceae. The ratio of the number of species and genera in flora can be the indicator of allochthonous and autochthonous trends in flora development. The more the average number of species in a genus is, the more obvious the autochthonous processes in the formation of the flora have been expressed, the lower this index is, the greater role the migrations of species played in the process of florogenesis. A negative value of the independence index obtained in the study of flora in the SNNP «Burabay» shows the predominance of allochthonous trends in the development of dendroflora and a large role of species migration. It was made the analysis of vitality of the tree-shrub flora.

**Key words:** national park, dendroflora, systematic structure, taxonomic composition, arboriflora.

Мақалада «Бурабай» ұлттық паркінде жүргізілген зерттеу нәтижелері ұсынған (2010–2015), ағашты және бұталы өсімдіктердің таксономиялық талдауы берілген және парктің дендрофлорасының құрамы мен систематикалық құрылымы туралы ақпарат келтірілген. «Бурабай» Мемлекеттік Ұлттық табиғи паркі флорасында ағашты өсімдіктердің 94 түрі есептелінген. Бұлар 30 тұқымдастарына, 53 туыстарына және 2 бөлімге жатады. Дендрофлора бүкіл парк аумағынан 14,6% құрайды. Туыс пен түрлердің басым саны бойынша Rosaceae, Salicaceae, Grossulariaceae тұқымдастары ерекшеленеді. Флорадағы түрлер мен туыстар санының арақатынасы флора дамуындағы аллохтонды және автохтонды тенденциялардың көрсеткіші болып табылады. Туыстағы түрлердің орташа саны не ғұрлым көп болса, сол ғұрлым флора қалыптасуындағы автохтондық процесстер күштірек көрсетілген, бұл көрсеткіш не ғұрлым төмен болса, сол ғұрлым флорогенез процессіндегі түрлер миграциялары үлкен ролін атқарған. «Бурабай» МҰТП флорасын зерттегенде алынған автономдық көрсеткішінің теріс мағынасы дендрофлора қалыптасуындағы аллохтондық тенденцияның басым болуын және түрлер миграциясының үлкен ролін дәлелдейді. Сонымен қатар ағашты-бұталы флорасының тіршілік қабілеттілігіне талдау жасалынды.

**Түйін сөздер:** ұлттық парк, дендрофлора, систематикалық құрылым, таксономиялық құрамы, арборифлора.

В статье представлены результаты исследований, проведенных в национальном парке «Бурабай» (2010–2015), дан таксономический анализ древесных и кустарниковых растений и представлена информация о составе и систематической структуре дендрофлоры парка. Во флоре Государственного Национального природного парка «Бурабай» насчитывается 94 вида древесных растений. Они относятся к 30 семействам, 53 родам и 2 отделам. Дендрофлора составляет 14,6% от всей флоры парка. По доминирующему количеству родов и видов выделяются семейства: Rosaceae; Salicaceae; Grossulariaceae. Соотношение числа видов и родов во флоре может служить показателем аллохтонных и автохтонных тенденций в развитии флоры. Чем больше среднее число видов в роде, тем сильнее были выражены автохтонные процессы в становлении флоры, чем ниже этот показатель, тем большую роль играли миграции видов в процессе флорогенеза. Отрицательное значение показателя автономности, полученное при изучении флоры ГНПП «Бурабай», говорит о преобладании аллохтонной тенденции в становлении дендрофлоры и большой роли миграции видов. Был сделан анализ жизнеспособности древесно-кустарниковой флоры.

**Ключевые слова:** национальный парк, дендрофлора, систематическая структура, таксономический состав, арборифлора.

**TAXONOMIC  
COMPOSITION AND  
SYSTEMATIC STRUCTURE  
OF DENDROFLORA  
OF THE NATIONAL  
NATURAL PARK  
«BURABAY»**

Forests have the significant importance in nature and in human life. The main value of forests is that this is one of the most important kinds of renewable natural resources. The total forest area of the world is 3.4 billion ha. or 27% of the world's land area [1].

The conservation and restoration of forests should become one of the top priorities of our country, because according to the state register of forest fund as of 01.01.2013, the total area of forested land in Kazakhstan is 12.5 million hectares, the forest cover is 4,6% of the total area of our country. According to this indicator, Kazakhstan is a sparsely wooded state. Of the total forest area almost 70% are haloxylon and mallee scrubs of the desert zone, and forests of conifers and hardwoods cover an area of just 3.7 million ha. In the western and central parts of the country, due to the extremely dry climate, there are almost no forests. Approximately 80% of the reserves of softwood and hardwood accrue to the northern and north-eastern part of the country.

With the increasing use of natural resources, due to the increasing pace of economic development of the country the further improvement of the territorial nature protection becomes more urgent. The same conditions determine the need for further development of forestry and especially of protected natural territories in the Republic of Kazakhstan as an effective system of conservation of biological diversity of the state.

The State National Natural Park «Burabay» has the status of environment-oriented and scientific institution, included in the system of protected areas of national significance and is administered by the Department of Presidential Affairs of Kazakhstan.

The SNNP «Burabay» is situated in the forest steppe, where pine and mixed forests combine with steppe meadows and meadow steppes. Therefore, the population of trees and shrubs is specific. Currently, a complex of natural and anthropogenic factors has a decisive impact on the number and distribution over the territory of a large number of plant species. Anthropogenic and natural factors have a direct or indirect impact on species diversity and abundance of natural organisms. Anthropogenic press, now reached the level exceeding the action of natural factors began to exert an increasing influence on the environment. One of the main reasons of the strong anthropogenic pressure on the natural park is the fact that on the

territory of the SNNP «Burabai» there is a resort area, and at the same time, for a long time on the territory of the region they held the introduction of woody plants. Therefore there is a need to obtain scientific evidence on the current state of vegetation in general, and of dendroflora in particular.

Administratively, the territory of the SNNP «Burabay» is located in Burabay and Yenbekshilder areas of Akmola region.

In the SNNP there are 10 forestry as structural units: Akylbayskoe, Borovskoe, Katarkolskoe, Zolotoborskoe, Mirnoe, Barmashinskoe, Priozernoe, Bulandinskoe, Temnoborskoe and Zhalayyrskoe Forestries [2].

The State National Natural Park «Burabay» is located in the most elevated part of the northern margin of Kazakh Upland.

The mountain relief is most represented in the western part. Here, in the form of an arc stretches the ridge Kokshetau bounded on all sides by large lakes. In the northern part the mountain range reaches its greatest height. The top of the ridge is Mount Kokshetau (Sinyucha) which reaches a height of 947.6 m above sea level. Further south, there are Mountains Burabay, Zheke-Batyr respectively with heights of 690.0 m and 826.2 m above sea level. In the southern part of the ridge the height of the mountains lowers to 400 – 500 m. In this area there are such large lake as Borovoe, Shuchye, Maloe and Bolshoe Chebachye, Maybalik and Katarkol.

The climate of the survey area is sharply continental, with hot summers and cold winters with little snow. The annual precipitation is 250 – 295 mm in the lowland, up to 400 mm in the upland. The stable period with average daily temperatures above 5°C lasts from late April to early October. The average temperature in June is 18-20°C the maximum one is 38-40°C. The average temperature of January is 17-18°C, the absolute maximum is -30°C. The average relative humidity is 50%.

Soils and the soil cover are characterized by considerable heterogeneity, due to the strong

fragmentation of the topography, the variety of soil-forming rocks, the differences of climate and vegetation. In the hill-plain belt (at altitudes of 280-400 m) they distinguish ordinary medium-humic and southern low-humic black soils.

In the mountain-forest zone (400-700 m) are formed the following main types of soils: bor primitive petromorphic, bor forest petromorphic, bor sod petromorphic, gray forest, meadow forest, meadow-chernozemic, ordinary and lithic black soils, alluvial meadow, peat-bog. Steppe areas form complexes with birch groves on gray forest soils and malt [3].

The area of the Park has a high level of biodiversity, which is determined by a number of objective reasons: a wide variety of environmental, climatic and other conditions, the genesis of the flora and vegetation, the situation on the border of two climatic zones: forest steppe and steppe, landscape features. All this gives the specificity and originality to the flora of the region. The forest formations such as *Pinus sylvestris* L., *Betula pendula* Roth and *Betula pubescens* Ehrn., *Populus tremula* L. dominate there.

In the natural park «Burabay» they grow 644 species of advanced in complexity vascular plants [4].

As a result of studies, they were found 94 species of advanced in complexity vascular plants of tree and shrub flora belonging to 29 families, 54 genera and 3 divisions: PINOPHYTA, MAGNOLIOPHYTA, GNETOPHYTA. The dendroflora composes 14.6% of total flora of the park.

The list of dendroflora was compiled on the ground of herbarium collections of the author, as well as of the analysis of herbarium specimens stored in the Herbarium of Kostanay State University named after A. Baitursynov and the Institute of Plants and Animal Ecology (Ekaterinburg).

In the flora under study, the overwhelming majority of species are included in the class MAGNOLIOPHYTA, which accounts for 93.6% (Table 1).

**Table 1** – The taxonomic analysis of dendroflora of the SNNP «Burabay»

Taxa	The species number	% of total species number	The genera number	% of total genera number	The families number	% of total families number
PINOPHYTA	5	5.3	4	7.4	2	6.7
MAGNOLIOPHYTA	88	93.6	49	90.7	27	90
GNETOPHYTA	1	1.1	1	1.9	1	3.3
Total:	94	100	75	100	30	100

Angiosperms are represented by only one class MAGNOLIOPSIDA, of which there are 88 species belonging to 49 genera and 26 families.

The lowest number of species is the part of the Division PINOPHYTA (5,3%), consisting of one class – PINOPSIDA, which includes two families: PINACEAE and CUPRESSACEAE. The

Division GNETOPHYTA takes only 1.1% of the total arboriflora because it is represented by only 1 species – *Ephedra distachya* L., belonging to the family *Ephedraceae*. The spectrum of arboriflora families in the National Park is quite diverse. The families the most rich with species: *Rosaceae*, *Salicaceae*, *Grossulariaceae* (Table 2).

**Table 2** – Systematic structure of arboriflora of the SNNP «Burabay»

№	Family name	The genera number	% of total genera number	The species number	% of total species number
1	<i>Rosaceae</i>	13	24%	20	21,3%
2	<i>Salicaceae</i>	2	3,8%	12	12,8%
3	<i>Grossulariaceae</i>	2	3,8%	6	6,4%
4	<i>Asteraceae</i>	1	1,9%	5	5,4%
5	<i>Lamiaceae</i>	1	1,9%	4	4,3%
6	<i>Betulaceae</i>	2	3,8%	3	3,2%
7	<i>Caprifoliaceae</i>	2	3,8%	3	3,2%
8	<i>Cupressaceae</i>	2	3,8%	3	3,2%
9	<i>Elaeagnaceae</i>	2	3,8%	3	3,2%
10	<i>Fabaceae</i>	2	3,8%	3	3,2%
11	<i>Sapindaceae</i>	1	1,9%	3	3,2%
12	<i>Ulmaceae</i>	1	1,9%	3	3,2%
13	<i>Chenopodiaceae</i>	2	3,8%	2	2,1%
14	<i>Pinaceae</i>	2	3,8%	2	2,1%
15	<i>Pyrolaceae</i>	2	3,8%	2	2,1%
16	<i>Ericaceae</i>	2	3,8%	2	2,1%
17	<i>Rhamnaceae</i>	2	1,9%	2	2,1%
18	<i>Berberidaceae</i>	1	1,9%	2	2,1%
19	<i>Nitrariaceae</i>	1	1,9%	2	2,1%
20	<i>Solanaceae</i>	1	1,9%	2	2,1%
21	<i>Boraginaceae</i>	1	1,9%	1	1,06%
22	<i>Brassicaceae</i>	1	1,9%	1	1,06%
23	<i>Celastraceae</i>	1	1,9%	1	1,06%
24	<i>Cornaceae</i>	1	1,9%	1	1,06%
25	<i>Ephedraceae</i>	1	1,9%	1	1,06%
26	<i>Frankeniaceae</i>	1	1,9%	1	1,06%
27	<i>Polygonaceae</i>	1	1,9%	1	1,06%
28	<i>Adoxaceae</i>	2	3,8%	2	1,06%
29	<i>Tiliaceae</i>	1	1,9%	1	1,06%
Total:		54	100%	94	100%

The analysis of species distribution according to a family let to reveal the largest groups. The top position in terms of species occupies the family *Rosaceae* (20 species). For this indicator, it is more than the following family *Salicaceae*.

There are nine families containing from 3 to 6 species: *Grossulariaceae*, *Asteraceae*, *Lamiaceae*, *Betulaceae*, *Caprifoliaceae*, *Cupressaceae*, *Elaeagnaceae*, *Fabaceae*, *Sapindaceae*, *Ulmaceae*. There are eighteen families with 1-2 species: *Chenopodiaceae*, *Pinaceae*, *Pyrolaceae*, *Ericaceae*, *Rhamnaceae*, *Berberidaceae*, *Nitrariaceae*, *Solanaceae*, *Boraginaceae*, *Brassicaceae*, *Celastraceae*, *Cornaceae*, *Ephedraceae*, *Frankeniaceae*, *Polygonaceae*, *Adoxaceae*, *Tiliaceae*.

From what has been said it follows that about 41% of arboriflora in the National Park «Burabay» consist of representatives of 2 large families and 10 families with an average (3 to 6) number of species. There are 17 families (59% of all families of dendroflora) containing from 1 to 2 species.

The species composition of trees and shrubs in Borovskoe and Barmashinskoe forestries is the most diverse. According to the data listed in Table 3, in Barmashinskoe forestry there are 59.6%, and in Borovskoe – 55.3% of all species of trees and

shrubs growing in the national park. The main tree species in the territory of the above forestry, as well as in the entire National Park, are *Pinus sylvestris* L., *Betula pendula* Roth., *Betula pubescens* Ehrh. Quite common are: *Cerasus tomentosa* (Thunb.) Wall., *Cerasus fruticosa* (Pall.) G. Woron, *Padus avium* Mill., *Malus baccata* (L.) Borkh. and *Malus domestica* Borkh. On the territory of Barmashinskoe forestry it grows a rare species which is in the «List of rare and endangered species of plants» (The Resolution of Government of the Republic of Kazakhstan dated October 31, 2006 № 1034) with a particularly valuable timber – *Alnus glutinosa* (L.) Gaertn.

The lowest number of species is represented in Zolotoborskoe (34%), Katarkolskoe and Bulandinskoe forest areas (in 40.4%) of park dendroflora. Here there are such trees and shrubs as *Orthilia secunda* (L.) House., *Populus tremula* L., *Ribes nigrum* L., *Rosa acicularis* Lindl., *Sorbus sibirica* Hedl. In the territory of Akylbayskoe forestry there is 43.6% of arboriflora, while in Mirnoe and Priozernoe forest areas the figures are 41.5% and 40.4%, respectively. On the territories of these forest areas they find the species of the genus *Acer*, *Rosa* and *Salix*.

**Table 3** – Species diversity of trees and shrubs in forestries of the SNNP

Name of forestry	Species number	Name of forestry	Species number
Akylbayskoe	41	Mirnoe	39
Borovskoe	52	Barmashinskoe	56
Katarkolskoe	33	Priozernoe	38
Zolotoborskoe	32	Bulandinskoe	33

Family spectra reflect only the external features of flora, while the internal structure of it is characterized by generic spectra.

Among the genera *Salix* is a predominant species (Table 4). The common representatives of this kind are *Populus balsamifera* L., *P. alba* L., *P. tremula* L., *Salix acutifolia* Willd., *S. alba* L., *S. bebbiana* Sarg., *S. caprea* L., *S. caspica* Pall., *S. cinerea* L., *S. lapponum* L., *S. pentandra* L., *S. rosmarinifolia* L.

Among the most numerous family *Rosaceae* a leading place occupies the genus *Rosa*, widely represented in the steppe communities. The following types of this genera are: *Rosa acicularis* Lindl., *Rosa laxa* Retz., *Rosa majalis* Herrm., *Rosa spinosissima* L.

The greatest part in park dendroflora takes 1-2 species genera, they compose 46 or 85% of total genus number. Thus, the number of monotypic genera is represented by more than half of all found genera of dendroflora on the study area.

The ratio of the number of species and genera in the flora may be an indicator of allochthonous and autochthonous trends in flora development. The more the average number of species in the genus is, the more autochthonous processes in the development of the flora are marked, the lower the index is, the greater role the migrations of species played in the process of florogenesis [5].

Malyshev L.I. showed that the ratio of the number of species and genera is determined by a curvilinear relation [6].

**Table 4** – Generic spectra in the number of species of tree and shrub flora in the SNNP «Burabay»

№	The genera names	The species number	% of total species number	№	The names of genera	The species number	% of total species number
1	Salix	9	9,6	28	Comarum	1	1,06
2	Artemisia	5	5,4	29	Cotoneaster	1	1,06
3	Ribes	5	5,4	30	Ephedra	1	1,06
4	Rosa	4	4,3	31	Euonymus	1	1,06
5	Thymus	4	4,3	32	Frangula	1	1,06
6	Acer	3	3,2	33	Frankenia	1	1,06
7	Populus	3	3,2	34	Grossularia	1	1,06
8	Ulmus	3	3,2	35	Hippophae	1	1,06
9	Berberis	2	2,1	36	Kalidium	1	1,06
10	Betula	2	2,1	37	Larix	1	1,06
11	Caragana	2	2,1	38	Linnaea	1	1,06
12	Cerasus	2	2,1	39	Onosma	1	1,06
13	Crataegus	2	2,1	40	Orthilia	1	1,06
14	Elaeagnus	2	2,1	41	Oxycoccus	1	1,06
15	Juniperus	2	2,1	42	Padus	1	1,06
16	Lonicera	2	2,1	43	Pentaphylloides	1	1,06
17	Malus	2	2,1	44	Physocarpus	1	1,06
18	Nitraria	2	2,1	45	Pinus	1	1,06
19	Solanum	2	2,1	46	Rhamnus	1	1,06
20	Spiraea	2	2,1	47	Rubus	1	1,06
21	Alnus	1	1,06	48	Sambucus	1	1,06
22	Alyssum	1	1,06	49	Sorbus	1	1,06
23	Amelanchier	1	1,06	50	Swida	1	1,06
24	Astragalus	1	1,06	51	Thuja	1	1,06
25	Atraphaxis	1	1,06	52	Tilia	1	1,06
26	Atriplex	1	1,06	53	Vaccinium	1	1,06
27	Chimaphila	1	1,06	54	Viburnum	1	1,06

Therefore, he proposed a more accurate indicator to estimate the ratio of autochthonous and allochthonous trends during florogenesis. The indicator of flora autonomy (A) is the relative difference between the actual (S) and calculated (S1) numbers of species:

In this case, the estimated number of species is determined by empirical quadratic equation:

$$S1 = 314.1 + 0.0045383 \times G^2$$

where G is the number of genera in the flora hence  $S1 = 314,1 + 0.0045383 \times (30)^2 = 318.18447$

$$A = -224.18447$$

The negative value of the autonomy indicator obtained in the study of arboriflora in the SNNP «Burabay» shows the predominance of allochthonous trends in the development of dendroflora and a great role of migration of species.

### References

- 1 Zhukova, A.I. Grigoriev, I.V. Grigorieva, O.I., Ledjaeva, A.S. Forestry resursovedenie / Tutorial. – St. Petersburg: SPbLTA 2008.
- 2 The Chronicles of Nature SSPE «Burabay» Burabay 2010.
- 3 Bobrovnik V.P., Wittmann R.A. Soil cover treeless valleys and holmogornyh surfaces Kokchetav Upland // Proc. Kazakh Research Institute of Forestry and agroforestry. -1975. – T. IX. – S. 31 – 41.
- 4 Sultangazina G.J., Flora of National Park «Burabay» / Sultangazina, G.J., Khrustalyova, I.A., Kupriyanov, A.N., Adekenov, S.M. – Ros. Academy of Sciences, Sib. Branch, Institute of Human Ecology [et al.]. – Novosibirsk: Publishing House of SB RAS, 2014 – 242c. – Ill. [Text]
- 5 Malyshev, L.I. The dependence of the floristic richness of the external conditions and historical factors // Bot. Well. – 1969. – T.54. – № 8. – S. 1137-1147
- 6 Malyshev L.I. The genesis of alpine floras of Siberia. – Math. AN SSSR. Ser. biol. Sciences, 1976. – Vol. 2. – №10. – S. Ivanov 47-55, 1998.