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# Analysis of the coenoflora of birch trees found in the Teberdinsky state natural biosphere reserve

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**Abstract.** The article presents the results of studying the coenoflora of the mountain birch forests found in the Teberdinsky State Natural Biosphere Reserve (Karachay-Cherkessia). The work shows the current state and composition of the cenoses dominated by *Betula litwinowii* Doluch on the Reserve. The material to analyse the coenoflora was based on 45 standard geobotanical descriptions of 2 types of birch forests: the birch crooked forests in the upper part of the subalpine belt and the secondary birch forests on the places of disturbed indigenous cenoses in the forest belt. The range of heights of distribution of the studied cenoses above the sea level is 1,660 m – 2,260 m. The main types of flora analysis were performed: the general characteristics of the flora, the geographical analysis, the study of the biomorphological, phytocenotic and ecological spectra. The coenoflora of the studied birch trees consists of 326 species that belong to 176 genera, 66 families and 6 classes, which is 14.5% of the flora of Karachay-Cherkessia. According to the main biomorphological features, the ecological characteristics, and the predominant geographical elements, the coenoflora of birch forests of the TSNBR is similar to the regional flora. The leading role of the *Fabaceae* family, combined with its high content of the Ancient Mediterranean elements in the coenoflora of the Reserve's birch trees, can be explained as the nature of the flora of the whole region and the increased influence of the TSNBR Mediterranean floras on the birch coenoflora formation. The significant role of species of the meadow ecological and phytocenotic group is explained by the predominance of thinned subalpine birch forests in the TSNBR.

## 1. Introduction

Nature reserves are the main centres for preserving natural biological diversity and conducting scientific research. The study of the composition and structure of individual formations is necessary to understand the processes of their development and stability, as well as ways to preserve them. The mountain birch forest is particularly of interest due to their dispersal on the upper boundary of the forest cover; the transitional character of their cenoses; the weak edificatory role of birch trees, which promotes the growth of a large number of species of different ecological-coenotic groups under its canopy, and because of the snow-retaining, the water regulation and the erosion control function of alpine birch forests.

The work is aimed to analyse the coenoflora of mountain birch forests found in the Teberdinsky Natural Reserve. The reserve is located in the Karachay-Cherkess Republic on the Northern macroslope



of the Main Caucasian Ridge and its spurs. Forests are the dominant vegetation type of the Teberdinsky Natural Reserve and cover 36% of its area [1].

The flora in the Teberda valley has been studied since the 90s of the XIX century [2]. The first floristic summary of the Teberda valley was published by E.A. Bush [3], it lists 578 species of plants. With the organization of the Teberdinsky Natural Reserve in 1936, the stage of collecting data on the flora and vegetation of the protected area has begun. The first summary of the Reserve Flora (unpublished) was compiled by D.K. Volgunov in 1938 and consisted of 1,014 species of vascular plants. The first published list of plants of the Teberdinsky State National Reserve appeared only in 1991 [4]. Nowadays, the most complete summary of the flora of the Teberdinsky Natural Reserve is made by G. Onipchenko et al. [1]. Its first edition was published in 2001. In 2011, the annotated list of species "Vascular plants of the Teberdinsky Natural Reserve" was reissued. The Natural Reserve flora already comprises 1207 species.

## 2. Materials and methods

The material was collected in 2017 and 2019 on the Teberdinsky section of the Teberdinsky State Natural Biosphere Reserve (TSNBR) in the valleys of the rivers Alibek, Dombay-Ulgen, Gonachkhir, and Amanauz. A total of 45 standard geobotanical descriptions were made. The described birch forests of the Teberdinsky Natural Reserve belong to two types: the birch crooked forests in the upper part of the subalpine belt (at the height of 1,900 to 2,300 m above the sea level) and the secondary birch forests found in the place of disturbed indigenous cenoses in the forest zone (at the height of 1,650 – 1,710 m above the sea level) [5]. The average absolute height of the distribution of the studied birch trees is 1,927 m (1,660 m – 2,260 m). In Karachay-Cherkessia, the birch crooked forests often form the upper border of the forest on the slopes of the Northern exposure [6]. The composition of the forest stand is mainly monodominant (*Betula litwinowii*), a birch is represented by a multistem form. The height of the forest stand is from 5 to 15 m, the number of trunks in one group is from 3 to 22. In the second type of birch trees, birch is represented by single- and multistem forms. The dominant species are *Betula litwinowii*, *Betula pendula* Roth, also there are *Acer trautvetteri* Medw., *Abies nordmanniana* (Steven) Spach, *Alnus incana* (L.) Moench, *Picea orientalis* (L.) Link, *Populus tremula* L. The height of the forest stand is 12–24 m, the number of trunks in one group is from 1 to 7 [7].

The main types of flora analysis were the following: the general characteristics of the flora, the geographical analysis, the study of the biomorphological and ecological spectra.

The geographical analysis was performed taking into account the system of geographical elements of the Caucasus [8, 9, 10] with the additions made by A.L. Ivanov [11] edited by D.S. Shilnikov [2].

## 3. Discussion

The coenoflora of the studied birch trees consists of 326 species, which belong to 176 genera, 66 families and 6 classes. This is 14.5% of the flora of the entire Republic and slightly lower than the corresponding values for the Kabardino-Balkar Natural Reserve; the coenoflora of the birch forests of it includes 394 species belonging to 215 genera from 67 families [12]. The top 10 families account for 71.6% of the coenoflora, that is 12% higher than of the birch forests coenoflora of the Kabardino-Balkar Natural Reserve [13]. The leading role is taken by the families which are typical of the Caucasus flora: *Fabaceae*, *Asteraceae* and *Poaceae*. The leading role of the *Fabaceae* family may indicate a significant influence of the Mediterranean and Central Asian floras on the formation of the coenoflora of mountain birch trees [14].

According to the main biomorphological features, the coenoflora of birch trees of the TSNBR is similar to the flora of the region (Table 1). The seasonal rhythm of vegetation is similar [2]. Summer-green species – the vast majority (91.6%). There are more summer-winter green and evergreen species than in the KCR flora (2.8% and 2.6% vs. 1.38%), slightly fewer ephemeras and ephemeroids (3.1% vs. 4.7%).

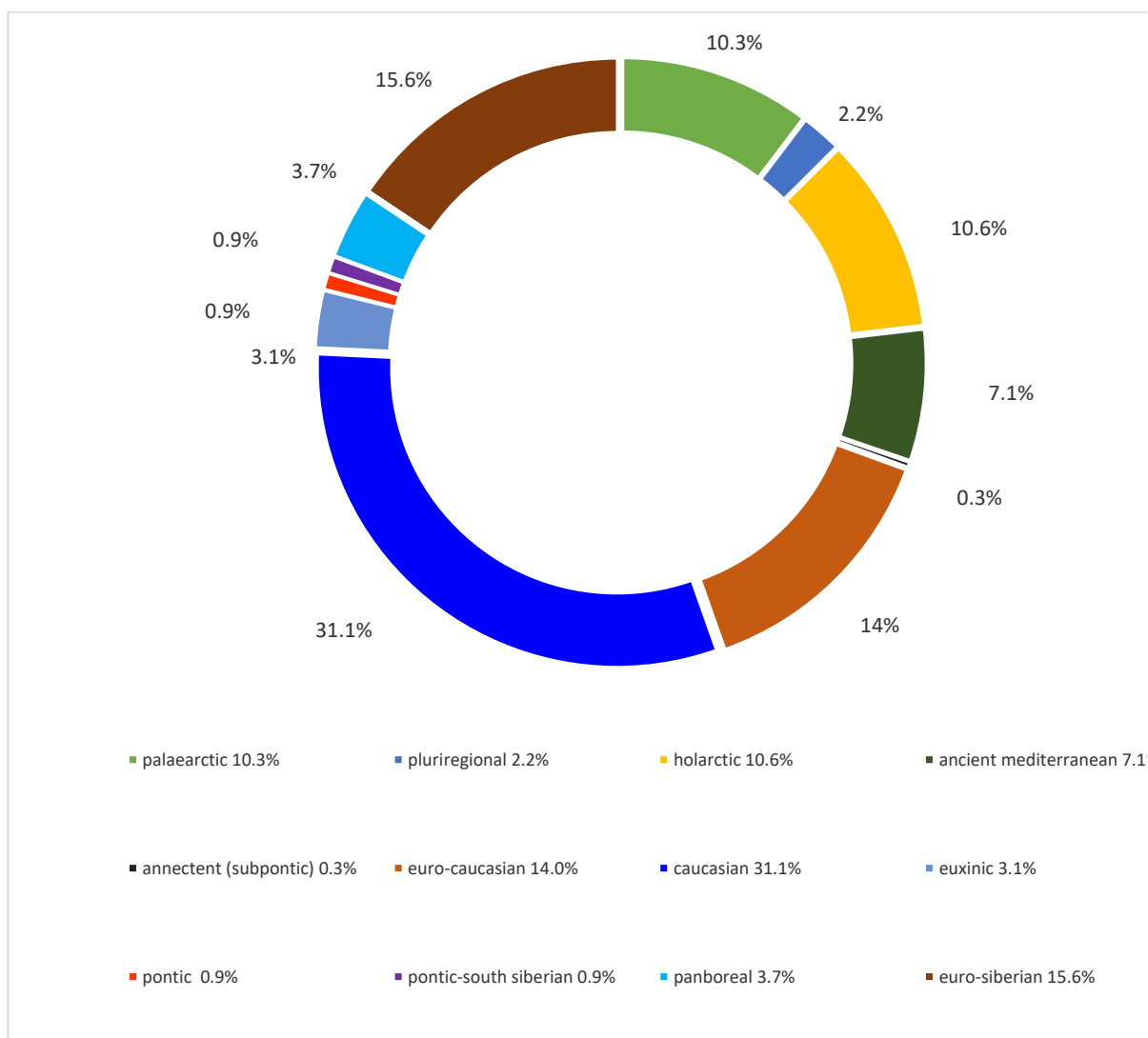
**Table 1.** The structure of coenoflora birch of TSNBR based on the main biomorphological characteristics

<i>On the growing season:</i>	Number of species	Share, %
1. Summer-green species	296	91.6
2. Summer-winter green species	9	2.8
3. Evergreen species	8	8.6
4. Ephemeroids and ephemeroids	10	3.1
<i>On the biomorphological characteristics:</i>		
1. Trees	14	4.3
2. Shrubs	21	6.5
3. Subshrubs	4	1.2
4. Half-shrubs	1	0.3
5. Polycarpic herbs, including	259	80.2
tap-root	70	21.7
brush-root	8	2.5
Rhizoma-shortened brush-root	14	4.3
rhizoma-shortened	55	17
rhizoma-lengthened	76	23.5
loose-cespitate	9	2.8
stiff-cespitate	6	1.8
creeping	2	0.6
lianoid	2	0.6
root-sprouts	1	0.3
tuber-forming	9	2.8
bulbaceous	4	1.2
succulent	3	0.9
7. Monocarpic herbs, including	24	7.4
perennials	5	1.5
biennials	4	1.2
annuals	15	4.6

As the flora of the whole region, the coenoflora of mountain birch forests of the TSNBR is characterized by a range of Raunkiaer's life forms which are typical for the temperate zone: about 75% of all types of flora are hemicryptophytes. The participation of other life forms is insignificant: phanerophytes account for just over 10%, while therophytes and cryptophytes account for 6% each. Trees and shrubs in the coenoflora of birch trees are considered to be more than in the flora of KCR. There are significantly fewer monocarpic herbs (7.4% vs. 23.2%), and slightly more polycarpic herbs (80.2%) than in the regional flora (71%). In the top three: rhizomatous and rod-root forms (Table 2).

**Table 2.** The spectrum of life forms (according to K. Raunkiaer) of plant species of birch forests in the TSNBR

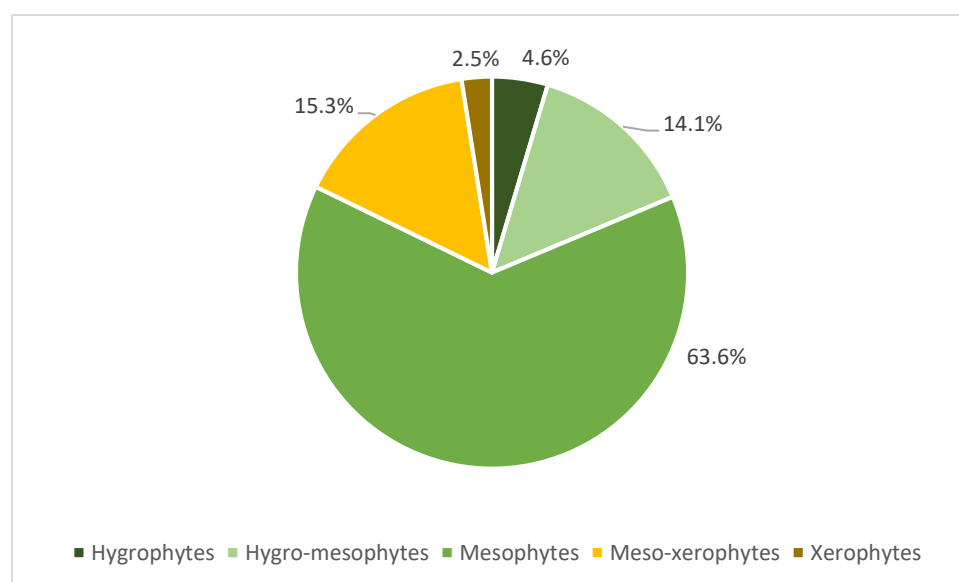
Life form	Number of species	Share, %
1. Phanerophytes, including	37	11.46
mega-	3	0.93
meso-	11	3.41
micro-	4	1.24
nano-	19	5.88
2. Chamaephytes	8	2.48
3. Hemicryptophytes	242	74.92
4. Cryptophytes	22	6.81
geophytes	19	5.88
5. Therophytes	14	4.33

**Figure 1.** The spectrum of geographical elements of the birch trees coenoflora

The coenoflora of birch forests of the TSNBR is boreal and general-holarctic, which is typical for the flora of the North Caucasus [15, 2]. It, as well as the flora of the whole KCR, is characterized by a significant predominance of boreal species, which account for more than 69.5% of the total composition of the flora (Figure 1). According to this indicator, the coenoflora of the TSNBR birch forests is also similar to the coenofloras of the KBSNBR birch forests in which the boreal species – 72.3% [13]. Within this group of geoelements, the Caucasian species are most of all (31.1%). There are twice as many Ancient Mediterranean species in the coenoflora of birch forests of the TSNBR than in the flora of KBSNBR – 7.1% against 3.3%, which can be explained by their high participation in the flora of the entire region [2]. 3 species are endemic to the Greater Caucasus: *Betula raddeana*, *Gentiana angulosa* M. Bieb., *Heracleum asperum* (Hoffm.) M. Bieb., *Pedicularis sibthorpii* Boiss.. [16]

There are more general antarctic (holarctic and palearctic) elements in the coenoflora of the Reserve's birch trees than in the flora of the Republic (20.9% vs. 16.6%).

The ecological analysis of the coenoflora showed the predominance of mesophytes (Figure 2). Few species are typical of habitats with excessive moisture: less than 5% of hygrophytes. There are even fewer types of dry habitats in the coenoflora of birch trees – only 2.5%. The transitional ecological groups are significantly represented: hygro-mesophytes – 14%, meso-xerophytes – 15%.



**Figure 2.** The distribution of the elements of the TSNBR's birch coenoflora by reference to moisture

Concerning soil fertility, the types of habitats of medium trophicity also predominate: mesotrophic – 63%. There are no more than 13% of species gravitating to rich food conditions, and 24% of species of poor habitats.

Compared to the birch coenoflora of the Kabardino-Balkar Natural Reserve, the meadow species of the ecological-coenotic group are more common than forest one in the coenoflora of birch formation of the Teberdinsky Natural Reserve (Table 3). There are quite a lot of species in the coenoflora of the marginal ecological-coenotic group. This fact may be explained by the predominance of subalpine thinned birch forests in the studied sample, which have conditions favourable for heliophytes and optional heliophytes.

**Table 3.** The ratio of ecological-coenotic groups in the coenoflora of birch trees of the TSNBR.

The ecological-coenotic group	Number of species	Share, %
1. Forest	101	36.2
2. Meadow	111	39.4
3. Marginal	30	11
4. Ruderal	18	6.4
5. Rock	13	4.6
6. Steppe	7	2.5

## 5. Conclusion

The coenoflora of mountain birch forests of the Teberdinsky Natural Reserve is rich and diverse (326 species belonging to 176 genera, 66 families). However, it is poorer than the corresponding coenoflora of the Kabardino-Balkar Natural Reserve. According to the main biomorphological features, ecological characteristics, and prevailing geographical elements, the coenoflora of birch trees of the TSNBR is similar to the flora of Karachay-Cherkessia. The coenoflora of birch forests of the TSNBR is boreal and general holartarctic, mainly mesophytic, with a predominance of the meadow ecologo-coenotic group. The leading role of the *Fabaceae* family, combined with its high content of the Ancient Mediterranean elements in the coenoflora of the Reserve's birch trees, can be explained as the nature of the flora of the whole region and the increased influence of the TSNBR Mediterranean floras on the birch coenoflora formation. The significant role of the meadow ecological and phytocenotic group is explained by the predominance of thinned subalpine birch forests in the TSNBR.

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