RUDN Journal of Ecology and Life Safety
Вестник РУДН. Серия: Экология и безопасность жизнедеятельности
ISSN 2313-2310 (Print); ISSN 2408-8919 (Online)
2025 Vol. 33 No. 1 29–42
http://journals.rudn.ru/ecology

ENVIRONMENTAL MONITORING

ЭКОЛОГИЧЕСКИЙ МОНИТОРИНГ

DOI: 10.22363/2313-2310-2025-33-1-29-42
EDN: BQARRL
UDC 574.47:630:502.4(470.333)

Research article / Научная статья

On the forest biocenoses of the Green Book of the Bryansk region: biomonitoring and ecological-phytocenotic characteristics

Angelika A. Gaivoronskaya✉, Lidiya N. Anishchenko

Bryansk State Academician I.G. Petrovski University, Bryansk, Russian Federation
✉eco_egf@mail.ru

Abstract. To identify and describe the forest communities of the Green Book of the Bryansk region, the habitats of 10 natural monuments have been surveyed. Forest communities are represented by formations of oak forests and ash forests. Thanks to biomonitoring work followed by analysis of syntaxonomic diversity, observation bases have been created for 6 associations and one subassociation. The presence of biocenoses of the rare subassociation ***Mercurialo perennis – Quercetum roboris carpinetosum betuli*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015 in the nature monument "Lyubin Khutor" of the Novozybkovsky district, and the rare association ***Ulmo laevis – Fraxinetum excelsioris*** Bulokhov et Semenishchenkov 2008 for the "Ancient Park in Lyalichi" in Surazhsky district have been cited for the first time. The differentiation of habitats, presence of buffer zone, size of protected area stage of demutation restorative post-anthropogenic successions determines the diversity of the ecological-phytocenotic structure of the studied forest communities. The cenotic and structural characteristics of rare and reference forest communities correspond to the model descriptions in the Green Book. A new subassociation involving *Sanicula europaea* L. is justified by the method of ecological-floristic classification of J. Braun-Blanquet (1964). This allows to identify the heterogeneity of biotopes and the favorable phytocenotic environment of a regionally rare species. The existence of valuable biotopes of the system EUNIS-ESy system (2020): category T – Forest and other forest lands with four types: T1B, T19, T13, T1E is

established as criteria by means of units of ecological-floristic classification of forest biocoenoses. The experience gained during long-term community research of the unique environmental catalog of the Green Book will be used in the preparation and publication of similar lists that will contribute to solving the problems of protection of plant communities in Russia.

Keywords: forest communities, Green Book, rare and reference communities, syntaxonomic diversity, Non-Chernozem region of the Russian Federation

Authors' contribution. All authors made an equal contribution to the preparation of the publication.

Article history: received 07.09.2024; revised 21.10.2024; accepted 15.11.2024.

Conflicts of interest. The authors declare no conflicts of interest.

For citation: Gaivoronskaya AA, Anishchenko LN. On the forest biocenoses of the Green Book of the Bryansk region: biomonitoring and ecological-phytocenotic characteristics. *RUDN Journal of Ecology and Life Safety.* 2025;33(1):29–42. http://doi.org/10.22363/2313-2310-2025-33-1-29-42

Лесные биоценозы Зелёной книги Брянской области: биомониторинг и эколого-фитоценотические характеристики

А.А. Гайворонская✉, Л.Н. Анищенко

Брянский государственный университет имени академика И.Г. Петровского, Брянск, Российская Федерация
✉eco_egf@mail.ru

Аннотация. Для выявления и описания лесных сообществ Зеленой книги Брянской области были обследованы местообитания 10 памятников природы. Лесные сообщества представлены формациями дубрав, ясеневников. Благодаря биомониторинговым работам с последующим анализом синтаксономического разнообразия были созданы базы наблюдений для 6 ассоциаций и одной субассоциации. Впервые приведено наличие биоценозов редкой субассоциации ***Mercurialo perennis – Quercetum roboris carpinetosum betuli*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015 в памятнике природы «Любин Хутор» Новозыбковского района, редкой ассоциации ***Ulmo laevis – Fraxinetum excelsioris*** Bulokhov et Semenishchenkov 2008 – для «Старинного парка в Ляличах» Суражского района. Дифференциацией местообитаний, наличием буферной зоны, площадью охраняемых территориях, стадией демутационных восстановительных постантропогенных сукцессий определяется разнообразие эколого-фитоценотической структуры изучаемых лесных сообществ. Ценотические и структурные характеристики редких и эталонных лесных сообществ соответствуют модельным описаниям в Зелёной книге. Новая субассоциация с участием *Sanicula europaea* L. обоснована методом эколого-флористической классификации Ж. Браун-Бланке (1964). Это позволяет выявить гетерогенность биотопов и благоприятное фитоценотическое окружение регионально редкого вида. Благодаря единицам эколого-флористической классификации лесных биоценозов в качестве критериальных признаков установлено наличие ценных биотопов системы EUNIS-ESy (2020): категория T – Лесные и другие лесные земли с четырьмя

видами: T1B, T19, T13, T1E. Полученный опыт в ходе длительных исследований сообществ уникального природоохранного каталога Зелёной книги будет использован при подготовке и обнародованию аналогичных списков, которые поспособствуют решению проблем охраны растительных сообществ России.

Ключевые слова: лесные сообщества, Любин Хутор, Старинный парк в Ляличах, редкие и эталонные сообщества, синтаксономическое разнообразие, Нечерноземье РФ

Вклад авторов. Все авторы сделали эквивалентный вклад в подготовку публикации.

История статьи: поступила в редакцию 07.09.2024; доработана после рецензирования 21.10.2024; принята к публикации 15.11.2024.

Заявление о конфликте интересов. Авторы заявляют об отсутствии конфликта интересов.

Для цитирования: *Гайворонская А.А., Анищенко Л.Н.* Лесные биоценозы Зелёной книги Брянской области: биомониторинг и эколого-фитоценотические характеристики // Вестник Российского университета дружбы народов. Серия: Экология и безопасность жизнедеятельности. 2025. Т. 33. № 1. С. 29–42. http://doi.org/10.22363/2313-2310-2025-33-1-29-42

Introduction

The Green Books of regions known for Siberia, Samara and Bryansk region, Ukraine, are created based on a conceptual rule of theoretical and applied ecology about priority of conservation of communities – biotopes for the growing of rare species of flora and fauna. These fundamental works, which synthesize the results of vegetation conservation studies of biogeographic areas with detailed development of classification of communities based on the method of ecological-floristic classification, less often – dominant approach, provide basic biomonitoring and identification of development directions in natural processes [1; 2].

The aim of the work is to present parameters of forest specially protected natural territories (SPNT) in the Bryansk region during the implementation of bio-monitoring of the regional Green Book.

The Green Book of the Bryansk region in 2012 revealed the database of plant communities of various categories of environmental importance, considering the peculiarity of the floral composition, the participation of rare species, the uniqueness of the coenostructure, the size, and dynamics of coenoareas, degree of impairment [1]. The perspective of this paper includes the description of dynamic processes, clarification of the location of communities, ecological-botanical characteristics of the edificatory and rare species. Expert study of indicators reflecting the specificity of plant communities in the regional Green Book, will optimize and take to a new level the protection of flora elements, approach to decisions on inventory of biofuels, carry out change accounting during demutting succession [6; 8]. Subsequently, based on the biomonitoring data bases, decisions can be made about the environmental status of facilities, age status of rare species,

effectiveness of conservation measures of natural facilities, and regulating the use of agricultural land to reduce negative impacts on the biota and biotope communities.

Materials, methods, and research methodologies

To solve the problem of the composition of plant communities of different categories of the regional Green Book model sites are laid out in 10 protected areas; on some of them – permanent key sites – observations were carried out since 2015, temporary sites for biodiversity inventories describe forest communities not previously identified in surveys. For the biomonitoring, natural protected sites were taken into account, providing, in particular, territorial protection of communities of the Green Book: Nature monument Ryovny (Navlinsky district, 18 ha, landscape), Ryovny Oak Groves (Navlinsky district, 68 ha, complex), Dobrunsky Slopes (Bryansk district, 10 ha, landscape), "Lyubin Khutor" (Novozybkovsky district, 164 ha, forest), Brasovskaya Oak Grove (Brasovsky district, 430 ha, botanical), Sevskaya Oak Grove (Sevsky district, 457 ha, landscape), Vladimirskaya Oak Grove (Komarichsky district, 54 ha, botanical), Desyatukha Oak Grove (Starodubsky district, 20 ha, landscape), Semetskaja Oak Grove (Pochepsky district, 92 ha, complex), "Ancient Park in Lyalichi" (Surazhsky district, 63 ha, complex).[1]

On the monitoring routes there were described elements of forest vegetation cover, fixed elements of flora, including rare and invasive species, conducted geobotanical description of plant communities according to the method of ecological-floristic classification J. Braun-Blanquet (1964) [3] at key test sites of 400 m^2. In the study, there was revealed a complete floral composition, noted an abundance of species, and the consistency of forest biotypes. In the case of the cameral data processing, syntactic tables were compiled, projective coverage of species was indicated in the scores given by the combined scale of abundance-coverage J. Braun-Blanquet [3]. Environmental factors expression scores were calculated using H. Ellenberg scales (1992) [10]. The titles of syntaxons correspond to the Code of phytosociological nomenclature, considered modern works on syntaxonic solutions in the classification of forest communities [4; 9; 12; 13].

For the analysis of the indicators of the floral diversity, the indicators – α-diversity (floristic saturation) were defined, calculated values of the Shannon –

[1] Resolution of the Administration of the Bryansk region dated 28.07.2010. No. 755 "On the approval of regulations and passports of specially protected natural territories in Bryansk, Gordeevsky, Djatkovskoye, Zlynkovskoye, Karachevsky, Klimovskoy, Klintsovsky, Komarichsky, Krasnogorsk, Navlinsk, Novozybkov, Pochepov, Roghedinsky, Sevsky, Starodubsky, Surazhsky, Unechsky districts of Bryansk region". (In Russ.). Available from: https://brn-gov.ru/doc/10996 (accessed: 06.07.2024).

Weaver index to reflect the heterogenicity of the coenoflora, using data on percentage abundance covering the species in community descriptions and α-diversity elements.

Research findings

The biomonitoring of forest communities from the Green Book of the Bryansk region is conducted to evaluate the distribution of phytocoenoses of various associations on SPNT, to identify negative factors that negatively affect the state of macrocomplexes, to forecast the development of forest plantations with significant value in environmental protection; to draw up a map of the extent of monitored communities. In the area of nature monuments for biomonitoring, 6 associations and one subassociation were characterized as having significant value as a focal unit. The following are classified as reference trees (indicative for forest biocenosis of the central Russia): communities of associations ***Mercurialo perennis – Quercetum roboris*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015, communities of associations ***Geo rivale – Quercetum roboris*** Semenishchenkov in Bulokhov et Semenishchenkov 2008 – class ***Carpino-Fagetea*** Jakus ex Passarge 1968, order ***Fagetalia sylvaticae*** Pawlowski, Sokolowski et Wallisch 1928, alliance ***Querco roboris – Tilion cordatae*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015, communities of associations ***Vaccinio myrtilli*** – ***Quercetum roboris*** Bulokhov et Solomeshch 2003 – class ***Quercetea robori-Petratae*** Br.-Bl. Et Tx. et Oberd. 1957, order ***Quercetalia roboris*** Tx. 1931, alliance ***Vaccinio myrtilli – Quercion roboris*** Bulokhov et Solomeshch 2003. Rare communities, characteristic of habitats with specific ecological factors, rich in species, belong to the class communities ***Carpino-Fagetea*** – association ***Lathyro nigri – Quercetum roboris*** Bulokhov et Solomeshch 2003, order ***Quercetalia pubescenti-petraeae*** Klika 1933, alliance ***Betonico officinalis – Quercion roboris*** Goncharenko et Semenishchenkov in Goncharenko et al. 2020, and association ***Ulmo laevis – Fraxinetum excelsioris*** Bulokhov et Semenishchenkov 2008 (alliance ***Querco roboris – Tilion cordatae***, order ***Fagetalia sylvaticae***). In nature monuments a rare community of flood plain forests was studied– association ***Filipendulo ulmariae*** – ***Quercetum roboris*** Polozov Solomeshch 1999 in Semenishchenkov 2015 – class ***Alno glutinosae – Populetea albae*** Fukarek et Fabijanić 1968, order ***Alno – Fraxinetalia excelsioris*** Passarge 1968, alliance ***Faxino – Quercion roboris*** Passarge 1968 [1; 4]. The main phytocoenotic characteristics of communities are described below.

All forest communities are biocoenosis in specific habitats, for instance, on river valleys, slopes of beams, plain areas with subsidence between the ravine landscape, often in the places of carbonate rock yield. Development of reference and rare group forest biocoenosis is determined by the ecological characteristics

of edifiers and dominants. Also considered in the community analysis are characterized by unique location of the cropped landscapes and habitat factors, creating a range of geographically diverse species that make up the lists of protected elements of flora [1].

Only in the habitats of the nature monument "Lyubin Khutor" communities of subassociations ***Mercurialo perennis – Quercetum roboris carpinetosum betuli*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015 described, in the habitats "Ancient Park in Lyalichi" (P. Zawadovodsky estate) – community of the association ***Ulmo laevis – Fraxinetum excelsioris*** Bulokhov et Semenishchenkov 2008. The reference communities of associations ***Mercurialo perennis – Quercetum roboris*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015, ***Vaccinio myrtilli*** – ***Quercetum roboris*** Bulokhov et Solomeshch 2003 and ***Geo rivale – Quercetum roboris*** Semenishchenkov in Bulokhov et Semenishchenkov 2008, territorially identified for SPNT, floristically and structurally correspond to descriptions of inventory characteristics in the Green Book of the Bryansk region; only their location that do not mentioned in the document is noted.

In the acidophyte pine-broad-leaved forests of the association ***Vaccinio myrtilli*** – ***Quercetum roboris*** coenoflora is represented by 76 species, average α diversity – 35 species per 400 m^2 in the gyro-mesofy broad-leaved forests of the association ***Geo rivale – Quercetum roboris*** coenoflora of 72 species, average α-diversity – 32 species; in the mesofy of nemoral grass broad-leaved forest biocoenosis ***Mercurialo perennis – Quercetum roboris*** coenoflora onsists of 68 species, average α-diversity – 30 species. In the coenoflora of forest phytocoenoses on SPNT species of regional Red Book are described – *Digitalis grandiflora*, *Sanicula europaea, Lilium martagon*, plants of monitoring list – *Pyrethrum corymbosum*, *Anthericum ramosum*, *Epipactis helleborine*. Fragmented reference communities in protected areas without a buffer zone provide biotopes for fewer rare and conservation-sensitive species; registered species are represented by small coenopopulations of reduced vitality [6; 7].

The richness of the coenoflora and the increase in species density indicate that there is a change in demutation and in the indigenous communities.

The biotopes of the nature monument "Lyubin Khutor" phytocoenosis of rare subassociation ***Mercurialo perennis – Quercetum roboris carpinetosum betuli*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015 are described, which were formed by the spontaneous growth of an old estate park with rare invasive plants, including a European hornbeam. The subpopulation of coenoflora includes 45 species, average α-diversity – 21 species per 400 m^2. The forest plantations are dark, with a bright decided layer, with a slight renewal of the hornbeam and the English oak. Due to the community's growing in the area of demutation and the depletion of biodiversity because

of the absence of species diaspora, the invasiveness of some species-transformers is less than that considered for the model description of the Green Book. Rare species on the regional list of protected species are not noted in the coenoflora.

For biotopes of the nature monument "Ancient Park in Lyalichi" of the Surazhsky district mesofiteical nemoral grass ash forests rarely encountered association ***Ulmo laevis – Fraxinetum excelsioris*** Bulokhov et Semenishchenkov 2008 are described, which also got shaped when the landscape and park work ceased in the middle of the 20th century. The species composition of the association's coenoflora – 47 species, average α-diversity – 17 species per 400 m^2. The regionally protected species listed for these phytocoenoses in the Green Book materials are not identified. Xeromesophytic forests of communities ***Lathyro nigri – Quercetum roboris*** Bulokhov et Solomeshch 2003 are described for the habitats of the south and center of the Bryansk region on SPNT: coenoflora is represented by 80 species, average α-diversity – 57 species per 400 m^2. Forests serve as a reference for species of significant importance in terms of their environment-forming and sozoological meanings. Communities have been less affected by nature-changing activities due to the location on slopes of beams, as well as development on relatively rich carbonate soils. Hygromesozotic flood plain forests, rare dispersed, registered as communities of association ***Filipendulo ulmariae – Quercetum roboris*** Polozov et Solomeshch 1999 in Semenishchenkov 2015 are characterized by a low number of species in the coenoflora – 38, low α-diversity – 24 species per 400 m^2. From the model descriptions of the Green Book of the Bryansk region, the analyzed phytocoenology characteristics of the descriptions differ from the absence of protected species, low plant diversity due to changes resulting from post-antropogenic recovery, recreational changes and natural successional transformations. Ecological-phytocoenolological features of the communities studied differ for natural monuments habitats (Table 1).

When analysing biodiversity characteristics for forest plant communities, differences in the number of species of coenoflora of each habitat and α-diversity were noted: these indicators are determined directly by the category of phytocoenosis and the totality of environment-forming environmental factors. The number of species in the descriptions at the reference sites and in general constituting the forest community in random descriptions is also influenced by the nature-forming activities that affect all biocenoses of the old-developed region. To the greatest extent forest communities of the Green Book of the region experience anthropogenic impact in the habitats of nature monuments "Dobrunsky Slopes" (Bryansk district), "Dubrava Desyatukha" (Starodubsky district), "Vladimirskaya Dubrava" (Komarichsky district). Representation of phytodiversity elements in communities of different associations, as well as species saturation is also determined by the area of protected areas, the presence

of a buffer zone and phytocoenotic environment in it – factors of plant species diasporas, including rare flora elements. Thus, relatively low values of biodiversity indicators were revealed for thermophilic oak trees of the nature monuments "Dobrunsky Slopes", "Dubrava Desyatukha", "Ryovny", "Ancient Park in Lyalichi"[2]. In the biotopes of these protected areas, the Green Book monitoring communities have undergone the most significant changes – structural and functional. Due to the impossibility of changing the organisational and legal status of natural monuments and the extreme degree of transformation of landscapes in the areas where protected areas are located, it is necessary to continuously monitor dynamic processes in reference and rare communities [8].

Table 1. **Indicators of biodiversity elements of forest communities in protected areas**

Natural monuments	Number of species of coenoflora	α-diversity	Shannon index	Number of invasive species
	Association Mercurialo perennis – Quercetum roboris			
1 Ryovny	59	28.2 ± 2.6	1.54	2
2 Ryovny Oak Groves	72	34.5 ± 2.7	1.52	1
7 Semetskaya Oak Grove	68	33.4 ± 2.9	1.46	1
10 Ancient Park in Lyalichi	59	29.2 ± 2.5	1.41	1
	Association Geo rivale – *Quercetum roboris*			
4 Brasovskaya Oak Grove	75	38.5 ± 3.3	2.22	1
7 Semetskaya Oak Grove	74	37.1 ± 3.0	2.14	1
8 Dubrava Desyatukha	67	29.9 ± 2.7	1.16	3
	Association Lathyro nigri – *Quercetum roboris*			
2 Ryovny Oak Groves	77	59.3 ± 3.5	2.21	2
4 Brasovskaya Oak Grove	72	58.2 ± 3.7	2.14	2
5 Sevskaya Oak Grove	69	51.5 ± 3.1	2.10	2
6 Vladimirskaya Oak Grove	65	50.8 ± 3.4	1.95	2
8 Desyatukha Oak Grove	61	45.3 ± 3.0	1.67	3
9 Dobrunsky Slopes	59	44.9 ± 3.1	1.62	3
	Association *Filipendulo ulmariae – Quercetum roboris*			
1 Ryovny	37	29.4 ± 2.1	1.14	1
8 Dubrava Desyatukha	32	26.5 ± 2.0	1.10	2
9 Dobrunsky Slopes	30	22.8 ± 1.8	1.07	2
	Association *Vaccinio myrtilli – Quercetum roboris*			
4 Brasovskaya Oak Grove	79	38.2 ± 3.1	2.52	1
7 Semetskaya Oak Grove	75	33.9 ± 3.0	2.49	1
	Association *Ulmo laevis – Fraxinetum excelsioris*			
10 Ancient Park in Lyalichi	47	6.5 ± 1.1	1.14	2
	Subassociation *Mercurialo perennis – Quercetum roboris carpinetosum betuli*			
3 Lyubin Khutor	45	20.7 ± 1.3	1.28	2

Source: compiled by A.A. Gaivoronskaya, L.N. Anishchenko.

[2] Resolution of the Bryansk region Administration of 28.07.2010 No. 755 "On Approval of Regulations and Passports of Specially Protected Natural Areas in the Bryansk, Gordeev, Dyatkovo, Zlynkovo, Karachev, Klimovsky, Klintsovsky, Komarichsky, Krasnogorsky, Navlinsky, Novozybkovsky, Pochepsky, Rognedinsky, Sevsky, Starodubsky, Surazhsky, Unechsky Districts of the Bryansk region". (In Russ.). Available from: htps://brn-gov.ru/doc/10996 (accessed: 10.08.2024).

The inventory of phytodiversity elements in SPNTs of the Non-Chernozem region of the Russian Federation, including communities of different categories of the regional Green Book, is based on the ecological and floristic classification, which allows us to identify the correlation of syntaxonomic units with the categories of the EUNIS habitat classification. Despite the fact that the key biotope is the central concept of the pan-European nature information system, all habitats are directly diagnosed by plant communities, the typology of which is most fully described by the system of J. Braun-Blanquet. According to the improved classification of habitats of the European expert system EUNIS-ESy, created by leading phytocoenologists of Europe under the leadership of M. Chytrý (2020), belong to type T – Forest and other woodlands. This diverse group is heterogeneous and in protected areas of the old-developed region includes 4 classes [9; 11]. These are categories T1B – acidophytic forests with *Quercus*: association ***Vaccinio myrtilli – Quercetum roboris*** Bulokhov et Solomeshch 2003 (reference community); T19 – temperate and sub-Mediterranean thermophilic deciduous forests: mesophytic non-moral herbaceous broadleaved forests – ***Mercurialo perennis – Quercetum roboris*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015 (reference community), hygro-mesophytic broadleaved forests – ***Geo rivale – Quercetum roboris*** Semenishchenkov in Bulokhov et Semenishchenkov 2008 (reference community), xeric-mesophytic broadleaved forests – ***Lathyro nigri – Quercetum roboris*** Bulokhov et Solomeshch 2003, mesophytic non-moral herbaceous ash forests – ***Ulmo laevis – Fraxinetum excelsioris*** Bulokhov et Semenishchenkov 2008; T13 – temperate deciduous coastal forest: Hygro-mesophytic floodplain oak woodland communities of the ***Filipendulo ulmariae – Quercetum roboris*** Polozov Solomeshch 1999 in Semenishchenkov 2015 (rare community). Indirectly, forests with common hornbeam regenerating during demutational shifts in the presence of diaspores can be classified as T1E – forests with *Carpinus*: subassociation ***Mercurialo perennis – Quercetum roboris carpinetosum betuli*** Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015 (rare community) [11]. Since all the communities characterised during biomonitoring within the protected areas have small areas and were formed in the course of natural forest formation processes, including biological disturbances and anthropogenic impact, their structural and species characteristics have undergone changes compared to the model descriptions [5]. These changes are reflected in the characteristic synoptic table as an inventory catalogue of phytocoenoses and biotope characteristics: these “slice” descriptions of communities are of great prognostic value in the prospective monitoring of forest vegetation succession. The characteristic table of the subassociation ***Geo rivale – Quercetum roboris saniculetosum europae*** demonstrates a set of species dominated by *Quercus robur*, which indicate that the subassociation community belongs to the ecological and biological group of

hygro-mesophytic forests of the southern Non-Chernozem region of the Russian Federation (Table 2).

Table 2. **Characteristic table of the subassociation *Geo rivale* – *Quercetum roboris* saniculetosum europae subass. nov. prov. hoc loco**

Description number	Tiers	1	2	3	4	5*	6	7	8	9	10	Constancy
Height of tree layer, m		22	24	26	22	22	24	25	22	23	23	
Crown density of tree layer, %		50	50	55	50	50	55	50	60	55	50	
Crown density of shrub layer, %		30	30	25	25	20	20	20	20	20	20	
Total cover of grass layer, %		45	50	55	60	55	60	60	60	55	55	
Number of species		25	30	26	26	23	24	28	25	28	25	
Characteristics soils:												
humidity		6,0	5,8	5,7	5,9	5,9	6,1	6,1	5,8	5,7	5,8	
acidity		6,8	6,7	6,4	6,4	6,4	6,5	6,2	6,4	6,4	6,5	
mineral nitrogen supply		5,4	5,4	5,5	5,5	5,6	5,4	5,7	5,7	5,8	5,6	
Diagnostic species of the association ***Geo rivale* – *Quercetum roboris***												
Quercus robur	A	2	3	2	3	2	2	2	2	2	2	V^{2}
Quercus robur	B	.	.	.	+	.	.	.	.	.	+	I^{+}
Impatiens noli-tangere	D	2	1	1	2	1	1	2	1	1	1	V^{1}
Geum rivale	D	+	+	+	+	+	+	+	+	+	+	V^{+}
Diagnostic species of the subassociation ***Geo rivale* – *Quercetum roboris saniculetosum europae***												
Sanicula europaea	D	+	1	+	+	1	+	1	1	+	+	V^{+}
Diagnostic types of the ***Querco roboris* – *Tilion cordatae alliance***												
Picea abies	A	.	+	+	.	+	.	.	.	.	.	II^{+}
Corylus avellana	C	1	+	1	+	+	+	+	+	+	+	V^{+}
Euonymus verrucosa	C	.	+	r	.	r	+	+	+	+	+	IV^{+}
Picea abies	C	+	.	r	.	.	.	.	.	.	.	I^{r}
Diagnostic species of the order ***Fagetalia sylvaticae***												
Pulmonaria obscura	D	1	+	+	+	+	1	1	+	1	1	V^{+}
Majanthemum bifolium	D	+	r	+	r	+	.	+	.	.	.	III^{+}
Athyrium filix-femina	D	r	.	.	r	r	.	.	r	.	r	III^{r}
Scrophularia nodosa	D	.	+	.	.	r	.	.	r	r	r	III^{r}
Anthriscus sylvestris	D	+	.	.	+	.	.	+	.	.	.	II^{+}
Dryopteris filix-mas	D	.	r	r	.	.	r	r	.	.	.	II^{r}
Paris quadrifolia	D	r	.	r		.	r	.	.	.	r	II^{r}
Convallaria majalis	D		+		+	.	.	.	.	+	.	II^{+}
Diagnostic species of the class ***Carpino-Fagetea***												
Acer platanoides	B	1	+	+	+	+	1	1	1	+	+	V^{+}
Lonicera xylosteum	C	r	.	+	r	.	.	r	.	r	.	II^{r}
Viburnum opulus	C	.	r	.	.	.	r	+	.	r	r	III^{r}
Mycelis muralis	D	+	+	+	+	+	+	.	+	r	r	V^{+}
Stellaria holostea	D	1	1	+	+	1	+	+	.	+	+	V^{+}
Anemona ranunculoides	D	r	r	.	r	.	r	r	+	.	+	IV^{r}
Polygonatum multiflorum	D	.	r	.	.	.	.	r	r	.	.	II^{r}
Carex pilosa	D	r	.	r	.	.	r	r	r	.	.	III^{r}
Milium effusum	D	+	.	r	.	+	.	.	.	+	+	III^{r}
Paris quadrifolia	D	r	r	.	r	r		r	r	.	.	III^{r}
Asarum europaeum	D	.	+	.	+	.	+	.	.	.	.	II^{+}
Melica nutans	D	.	r	.	r	.	.	.	.	r		II^{r}
Geum urbanum	D	r		r	.	.	.	.	.	r	r	II^{r}
Corydalis cava	D	.	r		r	.	.	+	.	.	.	II^{r}
Aegopodium podagraria	D	.	+	.	.	+	.	.		.	.	I^{+}
Lathyrus vernus	D	.	.	+	.	.	.	.	+	.	.	I^{+}
Lathyrus vernus	D	.	.	.	.	.	r	.	r	.	.	I^{r}

Description number	Tiers	1	2	3	4	5*	6	7	8	9	10	Constancy
Glechoma hederaceae	D	.	r	.	.	r	+	.	.	.	.	I^{r}
Viola mirabilis	D	.	.	.	r	.	.	.	.	r	.	I^{r}
Actaea spicata	D	.	r			r	.	.	.	.	.	I^{r}
Other types												
Populus tremula	A	1	+	1	+	1	1	1	1	2	2	V^{1}
Frangula alnus	C	.	+	.	+	+	+	+	.	+	+	IV^{+}
Sorbus aucuparia	C	.	r	r	.	r	.	r	.	r	.	III^{r}
Padus avium	C	.	.	.	.	.	+		+	+	.	II^{+}
Betula pendula	B	.	.	.	.	.	+	+	.	+	.	II^{+}
Veronica chamaedrys	D	+	.	.	+	.	.	.	.	+	.	II^{r}
Lysimachia nummularia	D	.	.	.	.	.	r	r	r	.	.	II^{r}
Fragaria vesca	D	r	.	.	.	.	.	.	.	r	r	II^{r}
Dryopteris carthusiana	D	r	.	.	.	.	.	.	r	.	r	II^{r}
Rubus caesius	D	.	.	r	.	.	.	r	r	.		II^{r}
Rubus idaeus	C	.	.	.	.	.	r	r	r	.	r	II^{r}
Urtica dioica	D	.	.	.	.	.	.	r	r	.	r	II^{r}
Lathyrus niger	D	.	.	+	+	.	.	.	.	.		I^{+}
Lysimachia vulgaris	D	.	.	r	.	.	.	.	.	r	.	I^{r}
Moehringia trinervia	D	.	r	.	.	r	.	.	.	.	.	I^{r}
Viola riviniana	D	.	r	r	.	.	.	.	.	.	.	I^{r}
Primula veris	D	.	r	.	.	.	.	.	.	.	r	I^{r}
Solidago virgaurea	D	.	.	.	.	.	.	.	.	.	.	I^{r}
Trientalis europaea	D	r	.	.	r	.	.	.	.	.	.	I^{r}
Pteridium aquilinum	D	.	.	.	.	.	.	.	r	r	.	I^{r}

Note. Found in one description: *Stellaria graminea* 1 (+), *Ulmus glabra* C 4 (+), *Galium odoratum* 3 (+), *Crepis paludosa* 9 (r), *Adoxa moschatellina* 7 (r).
Description points: 1-5 – Brasovskaya Oak Grove natural monument, Brasovsky district, Bryansk region. 6-8 – Semetskaya Oak Grove natural monument, Pochepsky district, Bryansk region. 9, 10 – Desyatukha Oak Grove natural monument, Starodubsky district, Bryansk region.
* – nomenclatural type of subassociation.
Layers, *h*: A – first tree sublayer. B – second tree sublayer. C – undergrowth (shrub). D – herbaceous. E – moss.
Source: compiled by A.A. Gaivoronskaya, L.N. Anishchenko.

The first sublayer of the stand is represented by English oak with admixture of *Populus tremula*, *Picea abies*, but without *Tilia cordata*, registered for biocoenoses of the main association. In sparse stands the second sublayer of *Acer platanoides*. Well-developed undergrowth is absent, it is represented by *Corylus avellana, Euonymus verrucosa, Lonicera xylosteum* – shrub layer closeness does not exceed 30% [12]. Consequently, compared to the habitats of the main association ***Geo rivale – Quercetum roboris***, the light regime of the herbaceous layer is more favourable: the remaining mosaic of the herbaceous layer is represented by few species of nemoral miscellaneous herbs and phytogenic mosaics of *Sanicula europaea* – a species of the Red Book of the Bryansk region. Subassociation communities are distributed along micro-declines, the external appearance-aspect is characterised by thinning of the stand,

often by “forest windows”. It is abiotic ecological factors of light and moisture that primarily stimulate vegetative growth and seed increase of European undergrowth.

The species saturation in the association communities varies from 23 to 30 species; the coenoflora includes 55 species. The basis of the coenoflora is represented by affine species of ***Carpino-Fagetea*** class. Thus, the identification of diverse phytocoenoses within the reference communities of the Green Book of the Bryansk region allows us to consider this phenomenon as evidence of heterogeneity of biotopic conditions in protected areas, which contribute to the increase of ɤ-diversity of the old-developed region.

Conclusion

All studied in biomonitoring rare and reference communities of forest vegetation associations in the habitats of natural monuments correspond floristically and structurally to the model descriptions of the Green Book of the Bryansk region. The dynamics of coenoflora indicators, floristic saturation, species diversity for each biocoenosis in the descriptions is determined by eco-factors: fragmentation of the territory, intensive demutational changes of plant communities, absence of a buffer zone in nature monuments and, as a consequence, diasporas of some “forest” species, nature-forming activity in the 50–70s of the 20th century and slow restoration processes. Some ecophytocoenotic indicators – Shannon – Weaver index – are also determined by the area of regional protected areas. Forest communities – xero-mesophytic, mesophytic and hygro-mesophytic forest biocoenosis – are refugia of stenotopic species: forest-steppe and steppe, southern and northern (depending on the location of communities), which makes their role in the ecological framework of the territory irreplaceable. The coenoflora of forest communities of six associations and one sub-association includes 140 species – the high floristic diversity reflects the heterogeneity of habitat conditions and the ecological and botanical uniqueness of the ecotone zone in the Bryansk region. The phytocoenotic environment of the forest vegetation of the regional Green Book contributes to the reproduction of populations of rare species: European undergrowth. Bioinventory reflection of population dynamics of the diagnostic species – allocation in the classification system of subassociation ***Geo rivale – Quercetum roboris saniculetosum europae***. In this regard, it is advisable to continue the development of syntaxonomic solutions and description of syntaxonomic diversity, which will allow to identify new syntaxonomic units, the most significant for biomonitoring of both rare and reference forest communities of the Green Book.

The study of biotopic distribution of forest phytocoenoses according to the European habitat system EUNIS has shown the presence of biotopes valuable

from the nature conservation point of view in the system of natural monuments of the region – T – "Forest and other forest lands", including oak forests of different ecological regimes with a huge environment-forming value. These forest plantations need further biomonitoring. Indirectly, the four T-category options also reflect landscape diversity, each of which includes stenotopic species as indicators of ecological conditions.

The presented studies are of great importance considering the development of the concept of key habitats and vegetation confinement to rare habitats, adaptation of the expert system EUNIS-ESy (2020) to the conditions of significant diversity of ecological conditions in Russia, and also for the re-publication of the regional Green Book with new biomonitoring bases.

References

[1] Bulohova AD. (ed.). *The Green Book of the Brjansk Region (Plant Communities Needed in Protection)*. Brjansk: Brjansk Regional Polygraphic Union; 2012. 144 p. (In Russ.)

[2] Koropachinsky IY. (ed.). *The Green Book of Siberia: Plant Communities Needed in Protection*. Novosibirsk: Nauka, Siberian Publishing House of the Russian Academy of Sciences; 1996. 396 p. (In Russ.)

[3] Braun-Blanquet J. *Pflanzensoziologie. Grundzuge der Vegetationskunde*. Vienna, New York; 1964. 865 s.

[4] Veber HJe, Moravec Ja, Theurillat J.P International code of phytosociological nomenklature. *Vegetation of Russia*. 2005;(7):3–38. (In Russ.) EDN: KCPTKD

[5] Panasenko NN, Anishchenko LN. Influence of Invasive Plants Parthenocissus vitacea and Vinca minor on Biodiversity Indices of Forest Communities. *Contemporary Problems of Ecology*. 2018;11(6):614–623. (In Russ.) https://doi.org/10.1134/S1995425518060070 EDN: MLHFYD

[6] Martynenko VB, Baisheva JeZ, Mirkin BM, Shirokih PS, Muldashev AA. On the system of plant community reviews for the development of a regional green book. *News of the Samarsk National Research University of the Russian Academy of Sciences*. 2013;15(3–4):1364–1367. (In Russ.) EDN: SAENRR

[7] Martynenko VB, Mirkin BM, Baisheva EZ, Muldashev AA, Naumova LG, Shirokih PS, Yamalov SM. Green Data Books: Concepts, Experience, and Perspectives. *Uspekhi Sovremennoi Biologii [Advances in modern biology]*. 2015;135(1):40–51. (In Russ.) EDN: TLQSFZ

[8] Sokolova TA. Criteria system development for plant associations in order to createa regional Green Book of the Rostov Oblast. *Lesovedenie*. 2020;(2):135–146. (In Russ.) https://doi.org/10.31857/S0024114820010143 EDN: TXIQAJ

[9] Chytrý M, Tichý L, Knollova I. et al. EUNIS Habitat classification: expert system, characteristic species combinations and distribution maps of European habitats. *Applied Vegetation Science*. 2020;23(4):648–675. https://doi.org/10.1111/avsc.12519 EDN: BPZOPN

[10] Ellenberg H., Weber HE, Dull R, Wirth V, Werner W, Paulssen D. *Zeigerwerte von Pflanzen in Mitteleuropa*. 2 Aufl. Göttingen: Verlag Erich Goltze GmbH & Co KG; 1992. 258 s.

[11] Rodwell JS, Evans D, Schaminée JHJ. Phytosociological relationships in European Union policy-related habitat classifications. *Rendiconti Lincei. Scienze Fisiche e Naturali*. 2018; 29:237–249. https://doi.org/10.1007/s12210-018-0690-y EDN: YHOQWD

[12] Goncharenko I, Semenishchenkov Y, Tsakalos JL, Mucina L. Thermophilous oak forests of the steppe and forest-steppe zones of Ukraine and Western Russia. *Biology*. 2020;75(3):337–353. https://doi.org/10.2478/s11756-019-00413-w

[13] Mucina L, Daniëls FJA, Dierßen K. et al. Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science*. 2016;19(1):3–264. EDN: XLIMMN

Bio notes:

Angelika A. Gaivoronskaya, Postgraduate student of the Department of Geography, Ecology and Land Management, Bryansk State Academician I.G. Petrovski University, 14 Bezhitskaya St., Bryansk, 241036, Russian Federation. E-mail: eco_egf@mail.ru

Lidiya N. Anishchenko, Professor of the Department of Geography, Ecology and Land Management, Doctor of Agricultural Sciences, Professor, Bryansk State Academician I.G. Petrovski University, 14 Bezhitskaya St., Bryansk, 241036, Russian Federation. E-mail: eco_egf@mail.ru