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ANALYSIS OF SPECIES DIVERSITY OF FORESTS ON THE TERRITORY OF KHARKIVSKA OBLAST

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Abstract. The paper presents the findings of a study of species diversity of forests in the Kharkivska Oblast. The study was conducted on the territory of ten forestry enterprises and the State Enterprise Kharkiv Forest Research Station and the Homilsha Woods National Nature Park on an area of 282.3 thousand ha (area is subordinated to the State Forest Resources Agency of Ukraine). The purpose of the study was to analyse the species diversity and typological structure of forests in the Kharkivska Oblast. The study of species diversity was carried out based on analysis of the subcompartment database of the VO Ukrderzhlisproekt. The plantations were classified by the trophotope on the territory of the research facility in accordance with the main methodological provisions of the Ukrainian forestry and forest typology. A diagrammatic map of forests and dominant species (common oak and Scots pine) was compiled using the MapInfo Professional 12.5 software package and a vector map of 12 forestries in the Kharkivska Oblast. It has been established that 56 species of trees grow in the Kharkivska Oblast. Among these tree species, the predominant ones are common oak (53.4%) and Scots pine (32.7%). The distribution of plantations by trophotope is characterised by certain features. For example, dubrava conditions prevail in the stands (65.6% of the total area covered by forest vegetation), subor forests are 3.5 times less represented, and sudubravas and pine forests are the least common. Among the forest types, the most common are fresh maple-linden dubravas (43.7%) and fresh oak-pine subors (18.9%). The practical significance of the study is that the analysis of species diversity and typological structure of forests must be taken into account during the planning, organisation, and conduct of forestry activities in the Kharkivska Oblast

Keywords: common oak, Scots pine, tree species, forest site types, trophotope, state enterprise, national nature park

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INTRODUCTION

The species diversity of forests is declining under the influence of human economic activity and climate change. This impact is global and irreversible [1]. There is a significant probability of changes in the most common species (Scots pine and common oak) of Ukraine, which in turn will lead to the transformation or even destruction of forest natural ecosystems that exist today [2]. If some decisive action is not taken now, further adaptation to climate change will require significant efforts and financial costs [3].

Forests for their intended purpose and location perform mainly water-conserving [4], protective [5], health-improving [6], aesthetic [7], educational and other functions [8]. Forests have sanitary and recreational value, cause a positive effect on climate, soil conditions, and water resources [9], reduce the effects of water [10] and wind erosion [11; 12], and is also a source of forest resources [13]. The formation and distribution of forest depends on the geomorphological structure, soil conditions, terrain and climatic features. All these factors must be taken into account during the planning, organisation, and management of forestry activities [14].

A significant number of papers, both by Ukrainian [15-17] and foreign [18-20] scientists, are devoted to the study of the species and typological structure of forests. In Ukraine, studies of the typological diversity of forests were mainly conducted within natural areas: Polissya, Forest-Steppe and Steppe. Regarding the study of species diversity of forests in the Kharkivska Oblast, recently such studies have been almost non-existent [21; 22]. The scientific novelty of the findings lies in the fact that the species and typological structure (by forest site types, trophotopes, and forest types) of forest plantations in Kharkivska Oblast was analysed for the first time, including diagrammatic maps of predominant species (Scots pine and common oak). The *purpose* of the study was to identify the features of the species diversity of forests in the Kharkivska Oblast.

To achieve the stated goal, the following research objectives were set:

— to analyse the distribution of plantations by tree species and forest types;

— to compile a map of forests and predominant species (Scots pine and common oak);

— to determine the number of tree species, forest site types, and trophotopes on the territory of forestry enterprises in Kharkivska Oblast.

MATERIALS AND METHODS

Species diversity of forests of state forestry enterprises located in the Kharkivska Oblast, which are subordinated to the State Forest Resources Agency of Ukraine, was determined based on the forest inventory materials as of 01.01.2016. The subcompartment databases of Ukrderzhlisproekt were converted using the NewUnPackOHOTA software package, which was developed at the URIFFM named after G.M. Vysotsky [23].

Study was conducted in several stages. At the first stage, materials of forest inventory of ten state-owned enterprises (SE Balakliyske forestry, SE Blyzniukivske forestry, SE Vovchanske forestry, SE Hutyanske forestry, SE Zhovtneve forestry, SE Zmiivske forestry, SE Izyumske forestry, SE Krasnogradske forestry, SE Kupyanske forestry, SE Chuguevo-Babchanske forestry), Kharkiv Forest Research Station, and Homilsha Woods National Nature Park were put together and analysed (Fig. 1). These materials (databases) were grouped by certain indicators. The filtering of information was carried out in the following sequence: tree species, forest site types, trophotopes, and forest types. The analysis of these data was performed using appropriate computer software (*Microsoft Excel* 2010), as well as geoinformation technologies (*MapInfo Professional 12.5. Beta*). The silvicultural and typological analysis of forests was carried out in accordance with the main methodological provisions of the forestry and ecological (Ukrainian) consensus group of forest typology [24].

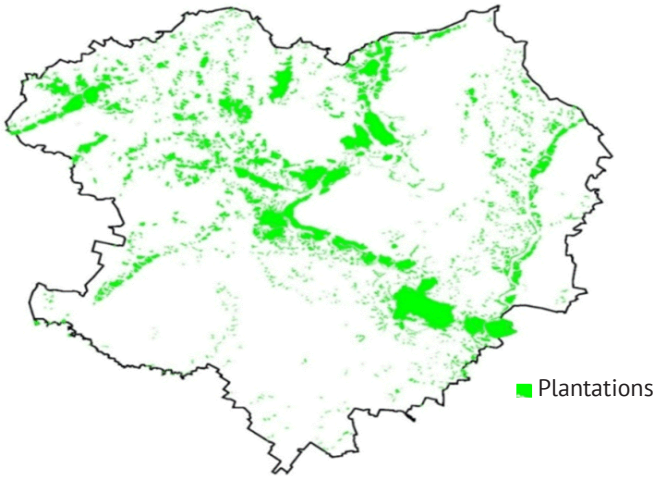

Figure 1. *Diagrammatic map of forest distribution in the Kharkivska Oblast*

At the second stage, diagrammatic map of forests, distribution of predominant tree species (common oak and Scots pine) in the Kharkivska Oblast has been compiled. It was done using *MapInfo Professional 12.5. Beta* and vector map of Ukraine. Thus, the geographical coordinates of the extreme points of the survey plot: in the North – 37° 29'33'', 50° 27'26'', in the South – 36° 17'50'', 48° 31'56'', in the West – 34° 51'27'', 49° 59'11'', and in the East – 38° 05'36'', 49° 50'43''. The total area of the investigated forests, which are subordinated to the State Forest Resources Agency of Ukraine, is 282.3 thousand hectares. The distribution of forests in the Kharkivska Oblast is uneven. They are mostly located in the floodplain of the Siverskyi Donets river and its tributaries.

RESULTS AND DISCUSSION

Species composition of forests in the Kharkivska Oblast is quite diverse. Thus, the largest concentration of species is in SE Izyumske forestry (37 species of trees) and SE Zhovtneve forestry (36 species of trees), and the least – in SE Chuguevo-Babchanske forestry (21 species of trees) and the Homilsha Woods NNP (16 species of trees), respectively (Table 1). A total of 18 forest site types have been identified on the territory of research facility. Thus, most of them are concentrated in the Izyumske forestry (18 site types), and the least – in the Homilsha Woods NNP (8 site types).

The distribution of forests in the Kharkivska Oblast by trophotopes is characterised by certain peculiarities. Thus, the plantations are dominated by dubrava site type (65.6% of the total area covered by forest vegetation), 3.5 times less represented are subors (18.3%), and the least represented are sudubravas (9.9%) and pine forests 6.2%).

In total, 18 types of forest sites have been identified in the forests of the Kharkivska Oblast, in particular, in pine forests there are 3 site types, and in subors, sudubravas and dubravas – 5 site types in each. Pine forests with poor growing conditions are present on the territory of 10 enterprises, and their share varies from 0.3% (SE Kharkiv Forest Research Station) to 27.7% (SE Izyumske forestry). On the territory of two enterprises (SE Blyzniukivske forestry and Homilsha Woods NNP) pine woods are not detected at all. Subor types are commonit on the territory of all enterprises, and their share varies from 0.3% (Homilsha Woods NNP) to 32.3% (SE Izyumske forestry). Sudubrava types are present on the territory of all enterprises, and their share ranges from 2.1% (SE Kharkiv Forest Research Station) to 25.4% (SE Hutyanske forestry). In dubrava (rich) conditions, plantations grow on the territory of all enterprises, and their share varies from 25.1% (SE Izyumske forestry) to 94.4% (Homilsha Woods NNP). After analysing the distribution of plantating by trophotopes in the Kharkivska Oblast (Fig. 2), it was determined that the natural conditions are favourable for growing high-yielding plantations of common oak and Scots pine.

Table 1. *Distribution of forest areas in the Kharkivska Oblast*

State-owned enterprise	Number		Area	
	tree species	forest site types	ha	%
SE Balakliyske forestry	29	17	22,650.0	8.0
SE Blyzniukivske forestry	25	11	5,350.8	1.9
SE Vovchanske forestry	27	16	25,830.0	9.1
SE Hutyanske forestry	30	16	27,686.1	9.8
SE Kharkiv Forest Research Station	33	14	19,753.7	7.0
SE Zhovtneve forestry	36	16	45,321.8	16.1
SE Zmiivske forestry	28	17	23,752.1	8.4
SE Izyumske forestry	37	18	43,101.8	15.3
SE Krasnogradske forestry	28	15	12,083.3	4.3
SE Kupyanske forestry	33	18	33,633.1	11.9
Homilsha Woods NNP	16	8	3167.7	1.1
SE Chuguevo-Babchanske forestry	21	15	19,999.0	7.1
Total	56	18	282,329.4	100.0

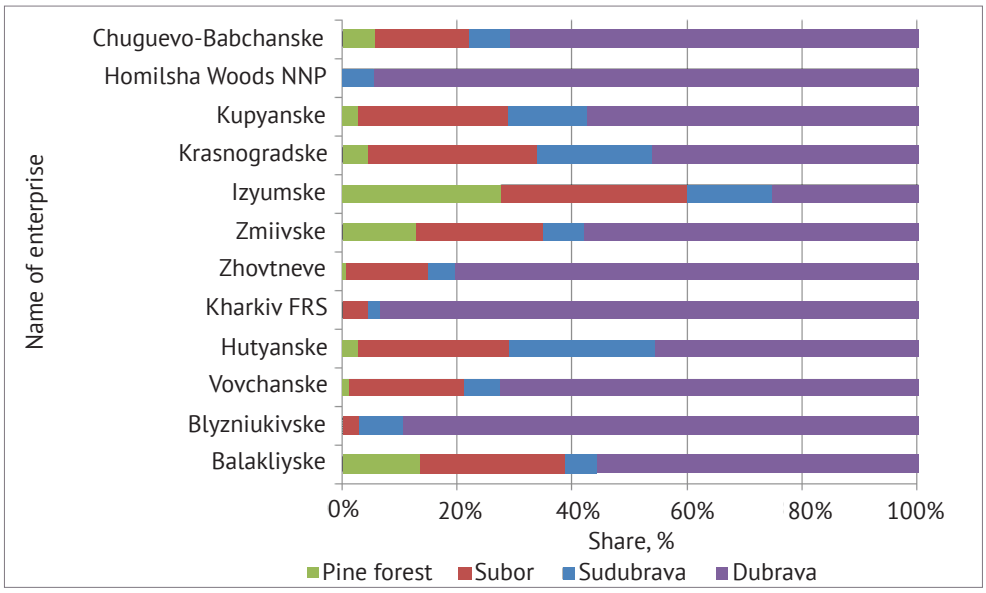

***Figure 2**. Distribution of plantation areas of enterprises by trophotopes, %*

In each type of forest sites, foresters have allocated a different number of forest types. The pine forests are represented by four, the subors by seven, the sudubravas by eleven, and the dubravas by thirteen forest types. A total of 35 forest types were identified: one was very dry, six were dry, ten were fresh, nine were moist, five were wet, and four were damp (Table 2). The typological variety of forests in the Kharkivska Oblast is quite diverse. Thus, the most common type of forest is fresh maple-linden dubrava (43.9% of the total area covered with forest vegetation), a slightly smaller share is fresh oak-pine subor (18.9%) and dry maple-linden dubrava (11.9%).

***Table 2**. Forest types in the Kharkivska Oblast*

Forest type		Area	
Name	**Index**	**ha**	**%**
Very dry pine forest	A_0–P	19.2	0.01
Dry pine forest	A_1–P	5,543.4	2.0
Fresh pine forest	A_2–P	17,131	6.1
Moist pine forest	A_3–P	11.5	0.0
Dry oak-pine subor	B_1–oP	5,243.2	1.9
Dry eroded oak subor	B_1–Oe	4.9	0.0
Fresh oak-pine subor	**B_2–oP**	**53,285.8**	**18.9**
Moist oak-pine subor	B_3–oP	1,348.9	0.5
Moist floodplain sedge subor	B_3–Sf	201.1	0.1
Wet oak-pine subor	B_4–oP	142.8	0.1
Damp birch-pine subor	B_5–bP	4.3	0.002
Dry eroded Tatarian maple sudubrava	C_1–TmOe	3,602.1	1.3
Fresh oak sudubrava	C_2–O	919.3	0.3
Fresh eroded linden sudubrava	C_2–lOe	2,072.6	0.7
Fresh linden-oak-pine sudubrava	C_2–loP	15,571.8	5.5
Fresh floodplain oak sudubrava	C_2–Of	1,525.8	0.5
Moist maple-linden sudubrava	C_3–mlO	287.8	0.1

Continuation of table 2

Forest type		Area	
Name	**Index**	**ha**	**%**
Moist linden-oak-pine sudubrava	C_3–loP	1,330.0	0.5
Moist floodplain oak sudubrava	C_3–Of	1,619.8	0.6
Wet alder sudubrava	C_4–A	2,062.7	0.7
Wet poplar-willow sudubrava	C_4–pW	236.5	0.1
Damp alder sudubrava	C_5–A	155.0	0.1
Dry elm-Tatarian maple dubrava	D_1–eTmO	711.0	0.3
Dry maple-linden dubrava	**D_1–mlO**	**33,608.6**	**11.9**
Fresh elm-Tatarian maple dubrava	D_2–eTmO	404.1	0.1
Fresh maple-linden dubrava	**D_2–mlO**	**123239.2**	**43.7**
Fresh ash-linden dubrava	D_2–alO	103.0	0.04
Fresh floodplain elm-Tatarian maple dubrava	D_2–etmOf	1,042.5	0.4
Moist maple-linden dubrava	D_3–mlO	707.9	0.3
Moist ash-linden dubrava	D_3–alO	1,144	0.4
Moist floodplain elm-Tatarian maple dubrava	D_3–etmOf	7,204.4	2.6
Wet alder dubrava	D_4–A	1,110.3	0.4
Wet floodplain poplar-willow dubrava	D_4–pWf	177.8	0.1
Damp alder dubrava	D_5–A	518.9	0.2
Damp floodplain willow dubrava	D_5–Wf	38.2	0.01
Total			100.0

The greatest typological diversity is characteristic of the forests of the State Enterprise Izyumske forestry (34 forest types), and the least – for the forests of the Homilsha Woods NNP (12 forest types). The small number of forest types is explained by the homogeneity of geomorphological, soil, and climatic conditions of plantation within the relevant forestry enterprises (Fig. 3).

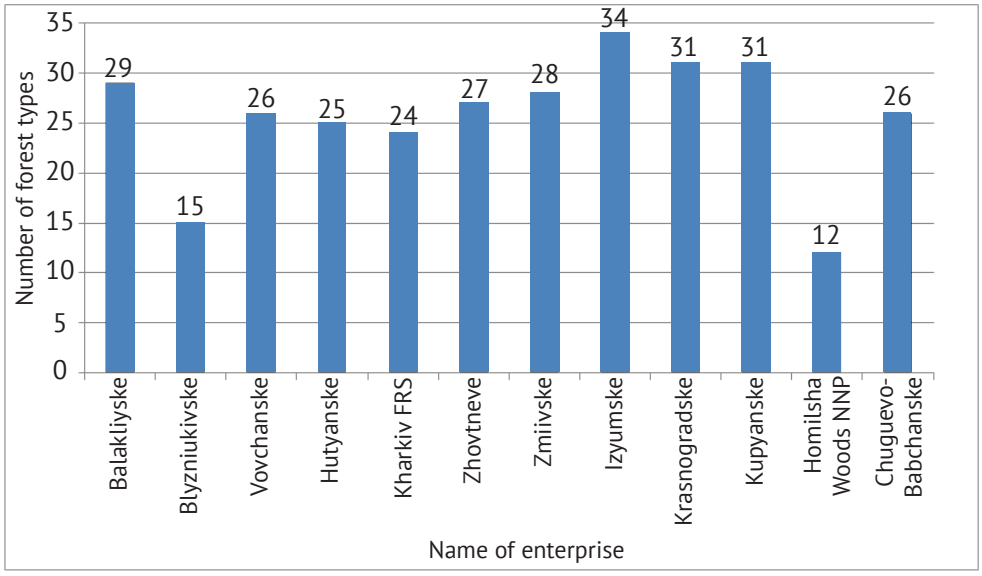

***Figure 3**. Distribution of the total number of forest types by enterprises*

The nature of the distribution of wood species on the territory of the research facility is quite uneven (Fig. 4). Thus, in the Kharkivska Oblast there are 56 species of trees, of which the most common (Table 3) are common oak (*Quercus robur* L.) – 53.4% (150798.4 ha of the total area covered by forest vegetation) and Scots pine (*Pinus sylvestris* L.) – 32.7% (92380.0 ha).

Table 3. *Distribution of areas of predominant tree species in the Kharkivska Oblast, ha**

Tree species	Total	
	ha	%
European birch	2,727.1	1.0
Common alder	4,404.9	1.6
European elm	513.2	0.2
Common oak	**150,798.4**	**53.4**
Norway maple	3,387.0	1.2
Tatarian maple	1,248.9	0.4
Big-leaf linden	1,662.9	0.6
Black locust tree (false acacia)	7,142.3	2.5
Scots pine	**92,380.0**	**32.7**
European aspen	3,997.6	1.4
Silver poplar	1,622.5	0.6
Canadian poplar	752.9	0.3
Black poplar	684.2	0.2
European ash	7,062.3	2.5
Green ash	1,640.6	0.6
Other	2,304.6	0.8
Total	282,329.4	100.0

Note: * *The table shows the data of the predominant tree species, the area of which is more than 150 ha, from the total area covered with forest vegetation on the territory of research facility*

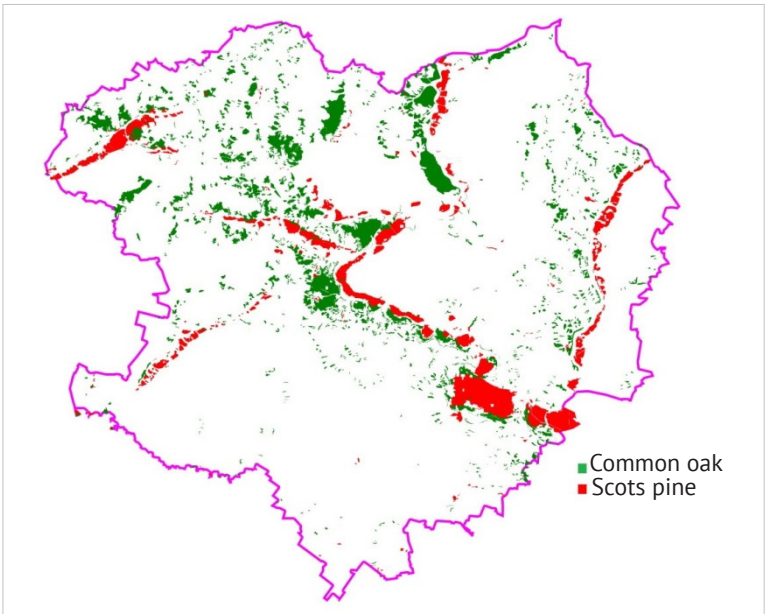

Figure 4. *Diagrammatic map of the distribution of dominant tree species in the Kharkivska Oblast*

With the increase of areas covered by forest vegetation, the number of forest types and tree species increases. This complicates the conditions for forest management activities in Kharkivska Oblast, and, in turn, increases biological diversity.

CONCLUSIONS

The species diversity of forests on the territory of the research facility is represented by 56 tree species. Among them, the largest share is occupied by common oak (53.4% of the total area covered with forest vegetation) and Scots pine (32.7%). Forest management activities on the territory of the research facility should be aimed at increasing the species diversity of forests by carrying out certain economic activities.

The trophotopes are dominated by dubrava (oak) conditions, the share of which is 65.6% of the total area covered with forest vegetation. This contributes to the cultivation of highly productive oak forests. The typological structure of forests is represented by 35 forest types. Among the forest types, the most predominant are fresh maple-linden dubravas (43.9% of the total area covered with forest vegetation), fresh oak-pine subors (18.9%) and dry maple-linden dubravas (11.9%). According to the compiled diagrammatic maps of forests it is possible to determine the actual amount of woodland and peculiarities of plantation distribution. These materials can be used when creating new forests.

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АНАЛІЗ ВИДОВОГО РІЗНОМАНІТТЯ ЛІСІВ НА ТЕРИТОРІЇ ХАРКІВСЬКОЇ ОБЛАСТІ

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Анотація. Наведено результати досліджень видового різноманіття лісів на території Харківської області. Дослідження проведено на території десяти лісогосподарських підприємств, Харківської лісової науково-дослідної станції та Національного природного парку «Гомільшанські ліси» на площі 282,3 тис. га, які знаходяться у підпорядкуванні Держлісагенства України. Метою дослідження було проаналізувати видове різноманіття та типологічну структуру лісів на території Харківської області. Дослідження видового різноманіття здійснювали на основі аналізу повидільної бази даних ВО «Укрдержліспроєкт». Класифікацію насадження за трофотопами на території дослідного об'єкта здійснювали згідно із основними методичними положеннями лісівничо-екологічної (української) школи лісової типології. Побудовано загальну схему-карту лісів і переважаючих порід (дуба звичайного та сосни звичайної) на основі програми *MapInfo Professional 12.5* і векторної карти 12 дослідних об'єктів на території Харківської області. Визначено, що на території Харківської області ростуть 56 видів деревних порід. Серед деревних порід найбільш поширеними є дуб звичайний (53,4 %) та сосна звичайна (32,7 %). Розподіл насаджень за трофотопами характеризується певними особливостями. Так, у насадженнях домінують грудові умови (65,6 % від загальної площі вкритої лісовою рослинністю земель), у 3,5 рази менше представлені субори (18,3 %), а найменш представлені є сугруди (9,9 %) і бори (6,2 %). Серед типів лісу найбільш поширеним є свіжа кленово-липова діброва (43,7 %) і свіжий дубово-сосновий субір (18,9 %). Практична цінність статті полягає в тому, що результати аналізу видового різноманіття і типологічної структури лісів необхідно враховувати під час планування, організації та проведенні лісогосподарських заходів на території Харківської області

Ключові слова: дуб звичайний, сосна звичайна, деревна порода, типи лісорослинних умов, трофотоп, державне підприємство, національний природний парк