Reserved autochthonous dendrosozophytes of the plain part of the forest area of Ukraine

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Abstract

Nowadays, in the aspect of solving the problem of loss of biodiversity and ensuring its protection, the coverage of inventory studies of species representing rare phytodiversity and regions that may experience or are experiencing certain negative natural or anthropogenic influences is of significant theoretical and practical importance. Among them is Ukraine, whose territory has become an example of large-scale transformation of natural complexes under the influence of war, including in the zone of forest vegetation dominance.

The paper presents a comparative analysis of the floristic composition of autochthonous species of tree-morphic and lignified plants, which are included in the official "red lists" of all levels (international, state-wide and regional (regional)) and which grow on the territory of Ukraine within the mixed zone (Ukrainian Polissia) and broad-leaved forests zone of Ukraine in territories with nature protection status. At the same time, based on generally accepted methods, the taxonomic, phytomorphological by H. Raunkier, biomorphological, geographical, ecological structure of the flora of the specified group of plants, in relation to which the term "autochthonous dendrosozophytes" was used, was analyzed.

It has been established that the autochthonous protected dendrosozophytes of the deciduous forest area of Ukraine, in comparison with the Ukrainian Polissia, are represented not only by more species (87 vs. 58), but also in the system of structural floristic analysis, usually by a higher number of gradations. For almost all floristic structures the species composition of both regions showed a rather high degree of similarity in the aspect of distribution by the corresponding gradations of the maximum (often close to it) proportion of plants.

The dendroflora of these two regions turned out to be the most similar in terms of the representation of plants of different biomorphs and life forms according to Raunkier. The similarity of the taxonomic structure was manifested in the fact that plants of the *Rosaceae*, *Fabaceae*, *Ericaceae*, *Salicaceae* families play a significant role in the composition of the flora of both regions. For the dendrosozoflora, the fact that the largest specific weight of it is made up of plants that are subject to protection at the regional level is also evident. There are clearly expressed differences between the compositions of dendrosozophytes of these regions in the phytogeographic structure, in relation to different geoelements. In the Ukrainian Polissia plants of European and in the area of deciduous forests of Ukraine plants of boreal geoelements there prevail. Some differences are observed in the ecological structure, namely in the extent to which they belong to the xerophytic and hygrophytic hygrogroups. There is also a noticeable difference in the distribution of the proportion of species of transitional hygrogroups. In the species composition of the deciduous forests of Ukraine there is a slightly higher proportion of plants that tend to dry and insufficient moist areas. The results of a comparison of the leading features of the autochthonous protected dendrosozoflora of the Ukrainian Polissia and broad-leaved forests testify to the existence of objectively indicate that there are specific features in each of these regional plant groups. Part of them is a natural consequence of the features of eco-conditions, geographical location of the regions, the evolution of the regional flora formation. Accordingly, all nature protection and restoration measures in the territory of the forest zone should be such as to preserve both its own rare phytodiversity and not to disturb its established structural features characteristic of the regions.

Introduction

The dependence of the existence of society on the state of the biosphere is a generally recognized truth (Convention on Biological Diversity 1992; Report of the United Nations 1992; Resolution 2011) and the problems of loss and protection of biodiversity in general and phytodiversity in particular have now become one of the main ones for the world community. Thousands of publications are dedicated to them (Leakey, Roger 1996; Butchart et al. 2010; Rands et al. 2010; Raven et al. 2011; Morgera, Tsioumani 2011; Kolbert, 2014; Díaz et al. 2019; Cavender-Bares et al. 2020). Available scientific developments testify that it is urgent to study and develop issues related to the establishment of regularities of the functioning of the phytosphere on a global scale (Connell 1978; Bezemer, Van der Putten 2007; Thompson et al. 2009; Keppel et al. 2011; Parmesan, Hanley 2015; McLaughlin et al. 2017) and regional (Knapp, 2010; Kuzemko et al. 2016; Dengler, Boch, 2008; Asmat et al., 2022) levels, its response to environmental changes and adaptation to them. At the same time, phytoinventory research itself does not lose its importance (Shankar, Rawat 2011; Mseddi et al. 2021; Asmat et al. 2021), which make it possible to establish its quantitative and qualitative characteristics within the limits of one or another territory. Of particular theoretical and practical importance is the coverage by inventory studies of species representing rare biodiversity (Brigham, Schwartz 2003; Pykälä et al. 2005; Prasad et al. 2010; Tienes et al. 2010; Vitt et al. 2016; Zhou et al. 2023) and regions that may experience or are experiencing certain negative impacts in particularly significant volumes (McNeely 2008; Williams et al. 2008; Md Nazrul Islam, Md Al-Amin 2019). Their number now includes Ukraine, whose territory has become an example of the

large-scale spread of military ecocide (Ronaldo et al. 2022; Gardashuk 2022), including in the zone dominated by forest vegetation (AB). First of all, the region with the spread of mixed forests suffered a significant direct and indirect impact of the war (B) (Fig, 1), namely its central part and the territory belonging to the Left Bank of Ukraine. In the south, the Forest Zone (AB) borders the Forest Steppe Zone (C), which also fell into the zone of military operations: on the Left Bank of Ukraine, a number of natural complexes located on the border of mixed forests and Forest Steppe were affected by the war: for example, the regional landscape park "Seymskyi" was affected.

The forest zone covers about 24% of the territory of Ukraine, including natural complexes of mixed and broad-leaved forests, respectively, accounting for 17% and 7% (Sherstiuk, Popovych 2018; Popovych, Savoskina, Ustimenko etc. 2017) Both mixed and broad-leaved forests are centers of distribution of many rare plants, among which autochthonous dendrosozophytes are a special group: tree-morphic and lignified plants of local flora that have different levels of protection (from regional to international) and grow in territories with nature conservation status. The natural complexes of some of them were also affected by the war. Among the largest territories with nature protection status, these are, first of all, the Desnyansko-Starogutskyi National Park (area 16215.1 ha) and the Chernobyl Radiation-Ecological Biosphere Reserve (area 226964.7 ha). Not far from this biosphere reserve and the zone of military operations, there is another nature conservation area of considerable size: the regional landscape park "Mizhrichynskyi" (102472.95 hectares). Within each of these three territories of the nature reserve, 5–15 plant species belonging to autochthonous dendrosozoites grow. In particular, 15 species of dendrosozophytes were found on the territory of the Desyanyan-Starogut National Park: 4 of them are species included in the "Red Book of Ukraine" (*Betula humilis* Schrank, *Salix lapponum* L., *Salix starkeana* Willd., *Salix myrtilloides* L.) and 11 are species subject to regional protection *Juniperus communis* L., *Alnus incana* (L.), *Andromeda polyfolia* L., *Arctostaphylos uva-ursi* (L.) Spreng., *Carpinus betulus* L., *Cerasus fruticosa* (Pall.) Woron., *Dianthus pseudosquarrosus* (Novak) Klokov, *Genista germanica* L., *Oxycoccus palustris* Pers., *Salix myrsinifolia* Salisb., *Salix rosmarinifolia* L., *Vaccinium uliginosum* L.).

In general, having complete information about the state of their rare dendroflora is not only a component of measures aimed at deepening knowledge about the biodiversity of the regions, but also a basis for organizing monitoring studies and carrying out post-war restoration of their natural complexes.

The purpose of the publication is: to carry out a comparative analysis and to establish the characteristic features of the floristic composition of autochthonous species of tree-morphic and lignified plants, which are included in the official "red lists" of all levels (international, state-wide and regional) and which grow within the boundaries of the Ukrainian Polissia and the broad-leaved zone forests of Ukraine in territories with nature protection status.

Materials and methods

Broad-leaved (Fig. 1, A) and mixed (Fig. 1, B) forests were studied within Ukraine. The region of distribution of the latter is also called Ukrainian Polissia. First of all, based on the study of literary sources (Andriyenko, Shelyag-Sosonko 1983; Melnyk 2000; Andrienko 2010; Sokolova, Chopyk 2010; Lukash, Andrienko 2011; and many others) and own field research, which generally lasted from 1980 to 2018, summaries of autochthonous species of dendrosozoflora were compiled, respectively, for mixed and broad-leaved forests of Ukraine.

At the same time, dendrosozophytes included those species of local flora that are officially included in the following documents: The Red List of the International Union for Conservation of Nature and Natural Resources (The IUCN Red List), the European Red List of Animals and Plants that are in danger of extinction on a global scale (European Red List 1992; European Red List of Vascular Plants, 2011), annex to the Berne Convention (Convention on Biological Diversity 1992; The Red Book of Ukraine 2009) and to the lists of species which are under protection at the regional level (Official lists of regionally rare plants 2012).

Currently, these lists of autochthonous dendrosozoflora are also published in several monographic publications, prepared with the participation of the authors of this publication (Dendrosozological catalog, 2017; Sherstuk, Popovych 2018; Popovych, Sherstiuk, Pokotilova 2019). Formed abstracts of the flora became the material for the analysis, the results of which are presented in this publication. The nomenclature of taxa given in this publication is submitted according to S. L. Mosyakin and M. M. Fedoronchuk (Mosyakin, Fedoronchuk 1999).

The analysis of the taxonomic structure of the autochthonous dendrosozophyte flora of the Ukrainian Polissia was carried out in accordance with the methodological approaches of A. I. Tolmachev (Tolmachev 1986). The clarification of the biomorphological

structure was carried out on the basis of the approaches of I. G. Serebryakov (Serebryakov 1964), and the determination of the belongingness of plants to different types of life forms - according to H. Raunkier (Raunkiaer 1937). The geographical analysis is based on the scheme of botanical and geographical zoning of the Earth, developed by H. Moisel and co-authors (Meusel, Jager E, Weinert 1965; Meusel H, Jager E, Rauschertet S 1978) with additions by A. L. Takhtajyan (Schmid R, Takhtajan AL, Crovello TJ, Cronquist A (1978)).

The ecological structure was analyzed according to classical methods based on the division of plant species into groups taking into account their relationship to one of the leading abiotic factors: moisture conditions. The diversity of ecological groups of species is accepted according to "Ecoflora of Ukraine" (Musienko 2006; Laptev 2001; Yakubenko, Popovych, Grigoryuk etc. 2016). The phytocoenotype structure was determined based on the results of the analysis of the belonging of the plants of the studied group to different phytocoenotypes, in particular dominants, co-dominants and asectators (Myrkin, Rosenberg 1978; Rabotnov 1992).

Results

To know the essence of any regional flora, a reliable tool is structural analysis which allows us to understand its basic features and to distinguish features, especially in a comparative aspect. Undoubtedly, the analysis of only the rare fraction of the flora does not give a complete picture of the structure of the regional flora as a whole. However, it provides an opportunity to pay attention to the degree of regional rarity and, accordingly, the scientific value of flora. In the system of structural analysis, first of all, the representation in the composition of two regional floras of plants of different taxonomic groups was studied. Among the autochthonous dendrosozophytes of the Ukrainian Polissia, both gymnosperms (2 species) and angiosperms (56 species) of plants have been identified. Overall, the dendrosozophytes studied in this region belong to 17 families (Sherstuk, Popovych 2018). Among the gymnosperms only *Picea abies* (L.) Karst. and *Juniperus communis* L. are respectively representatives of two different genera and families (*Pinaceae* and *Cupresaceae*) (table. 1).

In the species of arboreal area of deciduous forests of Ukraine, the gymnosperm division is also represented by two species (*Ephedra distachya* L., *Juniperus communis*), which also belong to two different families (*Ephedraceae* and *Cupressaceae*, respectively). In this region we have found 85 species of angiosperms (Popovych, Sherstyuk, Pokotilova 2019). In general, species of the studied group of plants in the deciduous forests area of Ukraine belong to 26 families (Table 2).

Table 1
Taxonomic structure of the flora of protected autochthonous dendrosozophytes of the Ukrainian Polissia

№	Family	Species	Number of species, pcs	Percentage, %
1	*Rosaceae*	*Crataegus laevigata* (Poir.) DC	19	32.8
		Crataegus ukrainica Pojark.		
		Cotoneaster melanocarpus Fisch. ex Blytt		
		Rubus orthostachys G. Braun		
		Rubus plicatus Weihe et Nees		
		Spiraea crenata L.		
		Spiraea hyperecifolia L.		
		Spiraea media Franz Schmidt		
		Spiraea picoviensis Besser		
		Cerasus fruticosa (Pall.) Woron.		
		Ceracus avium (L.) Moench		
		Rosa andrzejowskii Steven		
		Rosa glabrifolia C.A. Mey		
		Rosa gorenkensis Bess.		
		Rosa x olgae Chrshan. & Barbar		
		Rosa glauca Pour.		
		Rosa ciesielskii Blocki		
		Rosa deseglisei Boreau		
		Rosa jundzillii Besser		
2	*Fabaceae*	*Genista germanica* L.	8	13.8
		Genistella sagittalis (L.) Gams		
		Chamaecytisus austriacus (L.) Link		
		Chamaecytisus borysthenicus (Grun.) Klásková		
		Chamaecytisus lindemannii (V. Krecz.) Klásková		
		Chamaecytisus podolicus (Blocki) Klásková		
		Chamaecytisus ratisbonensis (Schaeff.) Rothm.		
		Lembotropis nigricans (L.) Griseb.		
3	*Ericaceae*	*Andromeda polifolia* L.	5	8.6
		Ledum palustre L.		
		Arctostaphylos uva-ursi (L.) Spreng		
		Rhododendron luteum Sweet		
		Chamaedaphne calyculata (L.) Moench		

№	Family	Species	Number of species, pcs	Percentage, %
4	*Salicaceae*	*Salix lapponum* L. *Salix myrsinifolia* Salisb. *Salix rosmarinifolia* L. *Salix starkeana* Willd. *Salix myrtilloides* L.	5	8.6
5	*Betulaceae*	*Betula humilis* Schrank *Betula obskura* A. Kotula incl. *Alnus incana* (L.) Moench *Carpinus betulus* L.	4	6.9
6	*Vacciniaceae*	*Vaccinium uliginosum* L. *Oxycoccus palustris* Pers. *Oxycoccus microcarpus* Thurcz. ex Rupr.	3	5.2
7	*Caprifoliaceae*	*Lonicera xylosteum* L. *Linnaea borealis* L.	2	3.5
8	*Cistaceae*	*Helianthemum nummularium* (L.) Mill *Helianthemum ovatum* (Viv.) Dun.	2	3.5
9	*Thymelaeaceae*	*Daphne mezereum* L. *Daphne cneorum* L.	2	3.5
10	*Pinaceae*	*Picea abies* (L.) Karst.	1	1.7
11	*Cupressaceae*	*Juniperus communis* L.	1	1.7
12	*Araliaceae*	*Hedera helix* L.	1	1.7
13	*Brassicaceae*	*Aurinia saxatilis* (L.) Desv.	1	1.7
14	*Caryophyllaceae*	*Dianthus psedosquarrosus* (Novak.) Klok.	1	1.7
15	*Grossulariaceae*	*Ribes alpinum* L. s. l.	1	1.7
16	*Pyrolaceae*	*Chimaphila umbellata* (L.) W. Barton	1	1.7
17	*Viscaceae*	*Viscum austriacum* Wiesb.	1	1.7
All			**58**	**100**

Table 2
Taxonomic structure of flora of autochthonous protected dendrosozophytes of broad-leaved forests of Ukraine

№	Family	Species	Number of species, pcs	Percentage, %
1	*Rosaceae*	*Sorbus torminalis* (L.) Crantz.	32	36.7
		Cerasus fruticosa (Pall.) Woron.		
		Ceracus avium (L.) Moench		
		Crataegus x dunensis Cinovskis		
		Crataegus laevigata (Poir.) DC		
		Crataegus lypskyi Klok.		
		Crataegus ukrainica Pojark.		
		Cotoneaster melanocarpus Fisch. exBlytt		
		Amygdalus nana L.		
		Rubus bertramii G. Braun		
		Rubus constrictus P. J & Lefevre		
		Rubus ulmifolius Schott		
		Rubus saxatilis L.		
		Rubus rudis Weiheet Nees		
		Rubus apricus Wimmer		
		Rubus orthostachys G. Braun		
		Rubus plicatus Weiheet Nees		
		Rubus schleicheri Weiheex Tratt		
		Spiraea crenata L.		
		Spiraea hyperecifolia L.		
		Spiraea picoviensis Besser		
		Spiraea polonica Blocki		
		Spiraea media Franz Schmidt		
		Rosa andrzejowskii Steven		
		Rosa pimpinellifolia L.		
		Rosa nitidula Bess.		
		Rosa bugensis Chrshan.		
		Rosa bisserata Merat		
		Rosa prutensis Chrshan.		
		Rosa glauca Pour.		
		Rosa czackiana Besser		
		Rosa jundzillii Besser		

№	Family	Species	Number of species, pcs	Percentage, %
2	*Fabaceae*	*Astragalus monspessulanus* L.	12	13.7
		Genista germanica L.		
		Sarotamnus scoparius (L.) Koch.		
		Chamaecytisus austriacus (L.) Link		
		Chamaecytisus albus (Hacq.) Rothm.		
		Chamaecytisus blockianus (Pawl.) Klásková		
		Chamaecytisus lindemannii (V. Krecz.) Klásková		
		Chamaecytisus paczoskii (V. Krecz.) Klásková		
		Chamaecytisus podolicus (Blocki) Klásková		
		Chamaecytisus roschelii (Wierzb.) Rothm.		
		Caraganas cythica (Kom.) Pojark.		
		Lembotropis nigricans (L.) Griseb.		
3	*Ericaceae*	*Andromeda polifolia* L.	5	5.6
		Ledum palustre L.		
		Calluna vulgaris (L.) Hull		
		Arctostaphylos uva-ursi (L.) Spreng		
		Rhododendron luteum Sweet		
4	*Salicaceae*	*Salix lapponum* L.	5	5.6
		Salix myrsinifolia Salisb.		
		Salix silesiaca Willd.		
		Salix starkeana Willd.		
		Salix myrtilloides L.		
5	*Vacciniaceae*	*Vaccinium vitis-idaea* L.	4	4.4
		Vaccinium uliginosum L.		
		Oxycoccus palustris Pers.		
		Oxycoccus microcarpus Thurcz. exRupr.		
6	*Betulaceae*	*Betula klokovii* Zaverucha	4	4.4
		Betula humilis Schrank		
		Betula obskura A. Kotula incl.		
		Alnus incana (L.) Moench		
7	*Cistaceae*	*Helianthemum nummularium* (L.) Mill	3	3.3
		Helianthemum canum (L.) Hornem. s.l		
		Helianthemum ovatum (Viv.) Dun.		
8	*Caprifoliaceae*	*Lonicera xylosteum* L.	2	2.9
		Linnaea borealis L.		

№	Family	Species	Number of species, pcs	Percentage, %
9	*Grossulariaceae*	*Ribes alpinum* L. s. l. *Ribes lucidum* Kit	2	2.9
10	*Thymeleaceae*	*Daphne mezereum* L. *Daphne cneorum* L.	2	2.9
11	*Araliaceae*	*Hedera helix* L.	1	1.1
12	*Brassicaceae*	*Aurinia saxatilis* (L.) Desv.	1	1.1
13	*Cornaceae*	*Cornus mas* L.	1	1.1
14	*Caryophyllaceae*	*Dianthus psedosquarrosus* (Novak.) Klok.	1	1.1
15	*Celastraceae*	*Euonymus nana* Bieb. Incl.	1	1.1
16	*Cupressaceae*	*Juniperus communis* L.	1	1.1
17	*Ephedraceae*	*Ephedra distachya* L.	1	1.1
18	*Lamiaceae*	*Scutellaria verna* Besser.	1	1.1
19	*Linaceae*	*Linum besarabicum* (SăvuletRayss) Klokovex Juz.	1	1.1
20	*Loranthaceae*	*Loranthus europaeus* Jacq.	1	1.1
21	*Pyrolaceae*	*Chimaphila umbellata* (L.) W. Barton	1	1.1
22	*Rhamnaceae*	*Rhamnus tinctoria* Waldst. etKit.	1	1.1
23	*Staphyleaceae*	*Staphylea pinnata* L.	1	1.1
24	*Tiliaceae*	*Tilia platyphyllos* Scop.	1	1.1
25	*Fagaceae*	*Quercus petraea* (Mattuschka) Liebl.	1	1.1
26	*Viscaceae*	*Viscum austriacum* Wiesb.	1	1.1
	Разом		**87**	**100**

Among the autochthonous dendrosozophytes of the Ukrainian Polissia and areas of deciduous forests of Ukraine, shrubs (37 species, 63.8% and 55 species, 63.2% respectively) predominate in the spectrum of biomorphotypes. In particular, the Ukrainian Polissia is characterized by *Betula humilis* Schrank, *Lonicera xylosteum* L., *Genista germanica* L., *Genistella sagittalis* (L.) Gams, *Salix lapponium* L., *Salix myrtilloides* L. and others, and the deciduous forests area of Ukraine is characterized by *Amygdalus nana* L., *Rubus rudis* Weihe et Nees. and other.

Phytomorphological analysis of the species composition of autochthonous dendrosozophytes using thelife-forms fundamental classification by H. Raunkier showed that among the studied group of plants both for the Ukrainian Polissia and for the area of deciduous forests of Ukraine, the largest is the group of phanerophytes, part of which is 69.0% and 65.5% respectively (Table 3).

Table 3
Life forms of autochthonous dendrosozophytes of Polissia and broad-leaved forests of Ukraine

№	Life form (according to H. Raunkier)	Polissia		Broad-leaved forests	
		species		species	
		number	%	number	%
1	Phanerophytes	40	69.0	57	65.5
2	Chamaephytes	16	27.6	23	26.4
3	Hemicryptophytes	2	3.4	7	8.1
	All	58	100	87	100

In the first region it is represented by 40 species (*Picea abies, Cerasus fruticosa* (Pall.) Woron., *Alnus icana* (L.) Moench, *Juniperus communis* and others), in the second region this group is represented by 57 species (*Sorbus torminalis* (L.) Crantz, *Tilia platyphyllos* Scop., *Cornus mas* L., *Euonymus nana* Bieb. Inc. and others). In Polissia chamaephytes possess much less part (27.6% – 16 species (*Aurinia saxatilis* (L.) Devs, *Helianthemum nummularium* (L.) Mill, *Andromeda polifolia* L. and others) and 26.4% are of 23 species (*Astragalus monspessulanus* L., *Ephedra distachya, Scutellaria verna* Besser. and others) in deciduous forests of Ukraine, with only two species of hemicryptophytes in the Polissia region (3.4%, *Rubus orthostachys* G. Braun, *R. plicatus* Weihe et Nees), and in the area of deciduous forests this group is represented by seven species (8.1%, *Rubus bertramii* G. Braun, *R. ulmifolius* Schott, *R. apricus* Wimmer, etc.). The group of phanerophytes was not only the largest, but also the most diverse in its internal structure. In both regions there are meso-, micro-, and nanophytes, and in Polissia several macrophanerophytes were also added. Among the species of Polissia the presence of varieties of phanerophytes decreases in the following order: nanophanerophytes (75.0%) →mesophanerophytes (12.5%) → microphanerophytes (10%) → macrophanerophytes (2.5%) In turn, for the deciduous forest area such decrease can be observed in the following sequence: nanofanerophytes (68.4%) → microphanerophytes (17.6%) → mesophanerophytes (14.0%).

According to the analysis, among the protected autochthonous dendrosozophytes of the Ukrainian Polissia and areas of deciduous forests of Ukraine there dominate by species with a European type of habitat. In Polissia their share reaches 43.1% (25 species: *Hedera helix* L., *Betula obscura* A. Kotula, *Aurinia saxatilis* and others), and in deciduous forests there are 47.1% (41 species: *Crataegus lypskyi* Klok., *Loranthus europaeus* Jacq., *Rosa prutensis* Chrshan and others) (Table 4). There is observed a very significant proportion of species with Eurasian range: 17.2% (10 species – *Rhododendron luteum* Sweet., *Cotoneaster melanocarpus* Fisch. Ex Blytt., *Salix starkeana* Willd. and others) in Polissia and 18.4% (16 species – *Rosa pimpinellifolia* L., *Euonymus nana* and others) in the area of deciduous forests. In both regions the share of Holarctic species (6.9% each) is quite significant, while in Polissia there are also boreal (8.6%) types of habitats.

Table 4
Quantitative spectrum of species of autochthonous reserve dendrosozoflora of the Ukrainian Polissia and broad-leaved forests by habitat types

№	Range type	Polissia		Broad-leaved forests	
		species		species	
		number	%	number	%
1	European	25	43.5	41	47.1
2	European mountain	1	1.7	-	-
3	Central European	-	-	3	3.5
4	European-West Siberian	2	3.4	-	-
5	European-South Siberian	-	-	1	1.1
6	East European-West Siberian	1	1.7	-	-
7	Eastern European	1	1.7	-	-
8	North European-West Siberian	1	1.7	-	-
9	Southeast European endemic	-	-	1	1.1
10	Eurasian disjunctive	1	1.7	-	-
11	Eurasian	10	17.2	16	18.4
12	South Siberian	1	1.7	-	-
13	Boreal	5	8.6	1	1.1
14	Holarctic	4	6.9	6	6.9
15	Euorasian	-	-	4	4.7
16	Nomadic	2	3.4	2	2.3
17	Circumboreal	2	3.4	3	3.5
18	Black Sea endemic	1	1.7	-	-
19	Mediterranean	-	-	2	2.3
20	Sub-Mediterranean	-	-	2	2.3
21	Southern Black Sea endemic	-	-	1	1.1
22	Narrow Eastern Carpathian-Podilskyi endemic	1	1.7	-	-
23	South-West Podilsk endemic	-	-	1	1.1
24	Podolsky endemic	-	-	3	3.5
	All	**58**	**100**	**87**	**100**

The autochthonous dendrosozophytes of the Ukrainian Polissia Conservation Areas represent 24, and the deciduous forest areas represent 36 geoelements (Table 5). The highest number ofplants species (11 species, 19.0%) in the Polissia Nature Reserve belongs to the European geoelement (*Alnus incana, Aurinia saxatilis, Dianthus pseudosquarrosus* (Novak.) Klok. and others). Six of these species (10.3%) were of boreal (*Juniperus communis*, *Andromeda polifolia*, *Picea abies* and others) and five of these species (8.6%) were of panboreal (*Chimaphila umbellata* (L.) W. Barton., *Salix myrsinifolia* Salisb, *Vaccinium uliginosum* L. and others). In the area of deciduous forests of Ukraine, the largest share (12.6%) consists of plant species of boreal geoelement (11 species: *Salix silesiaca* Willd., *Viscum austriacum* Wiesb., *Ribes alpinum* L. s.l., etc.). Another species distribution is as follows: nine species are of (10.4%, *Quercus petraea* (Mattuschka) Liebl., *Tilia platyphyllos*, *Rubus plicatus*, and others) nemoral geoelement, eight species are (9.2%, *Rhamnus tinctoria* Waldst. Et Kit., *Rubus constrictus* P. J & Lefevre, R. schleicheri Weihe ex Tratt and others) of Central European nemoral geoelement, seven species are of (8.0%, *Sarotamnus scoparius* (L.) Koch., *Oxycoccus palustris* Pers. and others) panboreal

and five species are of (5.8%, *Chamaecytisus austriacus* (L.) Link, *Scutellaria verna* and others) steppe geoelements. The remaining geoelements of both regions are represented by 1–3 species.

Table 5
Quantitative spectrum of species distribution of autochthonous protected dendrosozoflora of the Ukrainian Polissia and broad-leaved forests by geoelements

№	Geoelement	Polissia		Broad-leaved forests	
		species		species	
		number	%	number	%
1	Boreal	6	10.3	11	12.6
2	Paleoboreal	1	1.7	2	2.3
3	Panboreal	5	8.6	7	8.0
4	Boreal monathan	-	-	1	1.1
5	Western paleoboreal	1	1.7	1	1.1
6	Holarctic boreal	2	3.4	1	1.1
7	Holarctic	1	1.7	2	2.3
8	Eurasian boreal	3	5.3	-	-
9	Eurasian	3	5.3	-	-
10	Eurasian petrophytic	1	1.7	-	-
11	Eurasian steppe	1	1.7	-	-
12	Eurasian disjunctive nemoral	-	-	1	1.1
13	European	11	19.0	-	-
14	European nemoral	2	3.4	-	-
15	European steppe	1	1.7	-	-
16	European disjunctive	-	-	1	1.1
17	European disjunctive petrophytic	-	-	1	1.1
18	European-South Siberian nemoral	1	1.7	-	-
19	Western European	-	-	1	1.1
20	Western European nemoral	3	5.3	3	3.5
21	Nemoral	4	6.9	9	10.4
22	Nomadic	1	1.7	-	-
23	Nomadic steppe	-	-	1	1.1
24	South European-West Asian steppe	1	1.7	1	1.1
25	Steppe	3	5.3	5	5.9
26	Steppe petrophytic	-	-	1	1.1
27	Petrophytic	-	-	3	3.5
28	Petrophytic boreal	-	-	1	1.1
29	Eastern European	-	-	1	1.1
30	Eastern European nemoral	2	3.4	2	2.3
31	Eastern European petrophytic	-	-	1	1.1
32	East European steppe	-	-	1	1.1

№	Geoelement	Polissia		Broad-leaved forests	
		species		species	
		number	%	number	%
33	East European steppe petrophytic	1	1.7	-	-
34	Eastern European nemoral montan	-	-	1	1.1
35	Central European steppe	1	1.7	1	1.1
36	Central European-Balkan-Asia Minor nemoral	-	-	1	1.1
37	Central European boreal	2	3.4	3	3.5
38	Central European nemoral	-	-	8	9.2
39	Central European montane nemoral	1	1.7	1	1.1
40	Central European-Balkan-Eastern Carpathian nemoral	-	-	1	1.1
41	Central-southern European steppe	-	-	1	1.1
42	Mediterranean-East European nemoral	-	-	1	1.1
43	Mediterranean-Central Asian Pontic	-	-	1	1.1
44	Sub-Mediterranean	-	-	1	1.1
45	Pontic	-	-	1	1.1
46	Circumeuxian immoral	-	-	1	1.1
47	Unspecified	-	-	7	8.0
	All	**58**	**100**	**87**	**100**

The ecological properties of the protected dendrosozophytes of the plain part of the forest zone of Ukraine have been investigated based on their relation to one of the leading ecological factors that is the level of ecotope moistening. According to this feature, woodland species of plants represent all hygrogroups and plant species of the deciduous forest zone represent 11 hygrogroups (Table 6). In both regions, plants of the mesophytic group occupy a leading place in the hygromorph spectrum. In the first of these regions their share is 28.1% (16 species: *Helianthemum ovatum* (Viv) Dun., *Linnaea borealis* L., *Daphne mezereum* L. and others), in the second it is 29.9% (26 species: *Chamaecytisus albus* (Hacq.) Rothm., *Rubus bertramii*, *R. rudis*, *Cornus mas* and others). However, there are also regional differences. Thus, among the hygrogroups of Polissia the share of plant species gradually decreases in the following order: xeromesophytes (24.6%) → hygrophytes and xerophytes (12.2% each) → mesoxerophytes (8.8%) → hygromesophytes (7.0%)→ mesohygrophytes (5.3%). Similarly, for deciduous forests, the decrease in the species composition of hygrogroups can be illustrated by the following sequence: mesoxerophytes (21.8%) → xerophytes (17.2%) → xeromesophytes (11.5%) → hygrophytes (8.1%) → hygromesophytes (3, 5%). In both regions quite significant (within 45.6% and 40%, respectively) is the total proportion of plants of different transitional hygro groups: xeromesophytes, mesoxyrophytes, mesohygrophytes, hygromezophytes, etc.

Table 6
Representation of plants of various hygromorphs among autochthonous dendrosozophytes of Polissia and broad-leaved forests of Ukraine

№	Hygromorphs	Polissia		Broad-leaved forests	
		species		species	
		number	%	number	%
1	Hygrophytes	7	12.2	7	8.0
2	Hygromezophytes	4	7.0	3	3.5
3	Mesohygrophytes	3	5.3	-	-
4	Mesohygrophytes	16	28.1	26	29.9
5	Mesoxyrophytes	5	8.8	19	21.8
6	Xeromesophytes	14	24.6	10	11.6
7	Euxerophytes	1	1.8	2	2.3
8	Xerophytes	7	12.2	15	17.4
9	On wooden substrates	-	-	1	1.1
10	On mesophytic substrates	-	-	1	1.1
11	Petrophytes	-	-	1	1.1
12	Undefined	-	-	1	1.1
13	On wooden substrates	-	-	1	1.1
	All	**58**	**100**	**87**	**100**

In the process of elucidation of the phytocenotype structure, it was found that autochthonous dendrosozophytes of the protected areas of the plain part of the forest zone of Ukraine are most often asseptors of phytocenoses. In Polissia 45 (77.6%) plant species (*Chamaecytisus lindemanii* (V. Krecz.) Klaskova, *Daphne mezereum*, *Andromeda polifolia*, *Salix lapponum* and others) play such a role, and in the area of deciduous forests they are 65 (74.7%) species (*Chamaecytisus albus*, *Ch. roschelii* (Wierzb.) Rothm., *Linum besarabicum* (Săvul et Rayss) Klokov ex Juz, *Rubus bertramii*, *R. constrictus*, *Spiraea polonica* Blocki. and others). In both regions slightly smaller shares have other phytocenotypes. Of the studied species composition of Ukrainian Polissia, the dominant group is 20.7% (12 species: *Carpinus betulus*, *Hedera helix, Ledum palustre* L., *Oxycoccus palustris* and others), and from the area of deciduous forests it is 21.8% (19 species: *Ephedra distachya, Amygdalus nana, Calluna vulgaris* (L.) Hull, *Cornus mas* and others).

Among the species studied in both regions, the largest among are of those included in the lists of species subject to official protection at the local level within the respective administrative areas. In Polissia, this proportion is 65.5% (38 species) and in the area of deciduous forests it is 62.1% (54 species). Accordingly, at the national level of protection in the first of these regions the proportion of species is 15.5% (nine species), in the second it is 23.0% (20 species). There are two species (3.5%) of Polissia dendrosozophytes that are protected at the international and national levels (*Betula humilis* and *Genistella sagitalis*). Here, eight species (13.8%) are protected at both international and regional levels at the same time (*Andromeda polifolia, Ledum palustre, Crataegus laevigata* (Poir.) DC, etc.). In the area of deciduous forests there are six (6.9%) species (*Tilia platyphyllos, Vaccinium vitis-idaea* L. and others) that are conserved together at the international and regional ranks.

Discussion

The autochthonous protected dendrosozophytes of the deciduous forest area of Ukraine, in comparison with the Ukrainian Polissia, are represented not only by more species (87 vs. 58), but also in the system of structural floristic analysis, usually by a higher number of gradations. For almost all floristic structures the species composition of both regions showed a rather high degree of similarity in the aspect of distribution by the corresponding gradations of the maximum (often close to it) proportion of plants (Table 7).

Table 7
Dominant structures' positions of species composition of protected dendrosophytoses of the plain part of the Forest zone of Ukraine

№	Regions Structure	Ukrainian Polissia	Area of deciduous forests of Ukraine
1	Systematic phytocenotype	Family: *Rosaceae, Fabaceae, Ericaceae / Salicaceae*. Genus: *Rosa, Salix, Chamaecytisus.*	Family: *Rosaceae, Fabaceae, Ericaceae / Salicaceae / Vacciniaceae* Genus: *Rosa, Rubus, Chamaecytisus*.
2	Morphological	Phanerophytes: *nano-, meso-, micro-, macro-.* Morphotypes: *shrubs, trees*	Phanerophytes: *nano-, micro-, meso-*. Morphotypes: *shrubs, trees / halfshrubs*
3	Geographical	Types of habitats: *european, eurasian, boreal*. Geoelements: *european, boreal, panboreal*	Types of habitats: *european, eurasian.* Geoelements: *boreal, nemoral, centraleuropeannemoral.*
4	Ecological	Moisture: *mesophytes, xeromesophytes, hygrophytes / xerophytes*	Moisture: *mesophytes, mesoxerophytes, xerophytes*
5	Phytocenotype	Phytocenotypes: *asectors, dominant, co-dominant*	Phytocenotypes: *asectors, dominant, co-dominant*
6	Outphytosozo-logical	International level: National level: *9 species*. Regional level: *38 species*. International and national levels: *2 species*. International and regional levels: *8 species.*	International level: National level: *20 species*. Regional level: *54 species.* International and regional levels: *6 species.*

The dendroflora of these two regions turned out to be the most similar in terms of the representation of plants of different biomorphs and life forms according to Raunkier. Although the phanerophytes of Polissia are represented by a greater number of gradations than the phanerophytes of the broad-leaved zone. The similarity of the taxonomic structure was manifested in the fact that plants of the *Rosaceae, Fabaceae, Ericaceae, Salicaceae* families play a significant role in the composition of the flora of both regions. For the dendrosozoflora, the fact that the largest specific weight in it is made up of plants subject to protection at the regional level

There have been clearly expressed differences between the compositions of dendrosozophytes of these regions in the phytogeographic structure, in particular in relation to different geoelements. In the Ukrainian Polissia plants of European and in deciduous forests of Ukraine plants of boreal geoelements there prevail. Some differences are observed in the ecological structure, namely in the extent to which they belong to the xerophytic and hygrophytic hygrogroups. There is also a noticeable difference in the distribution of the proportion of species of transitional hygrogroups. In the species composition of the deciduous forests of Ukraine there is a slightly higher proportion of plants that tend to dry and insufficient moist areas. Comparison of the results of the assessment of the structure of the flora of dendrosozophytes of Polissia and broad-leaved forests of Ukraine with other data on the structure of the flora of these regions, carried out with the coverage of different groups of phytodiversity and different territories (Lukash 2009; Lukash 2009; Kontar 2001; Churilov, Yakubenko, Popovych 2013).

Comparison of the results of the assessment of the structure of the flora of dendrosozophytes of Polissia and broad-leaved forests of Ukraine with other data on the structure of the flora of these regions, carried out with the coverage of different groups of phytodiversity and different territories, once again proved the specificity of dendrosozophytes as a separate group of plants and, accordingly, their peculiar status in the composition of biodiversity forest phytocenoses of Ukraine. At the same time, the most clearly expressed differences are characteristic of taxonomic and biomorphological structures once again proved the specificity of dendrosozophytes as a separate group of plants and, accordingly, their unique status as part of the biodiversity of forest phytocenoses of Ukraine. At the same time, the most clearly expressed differences are characteristic of or taxonomic and biomorphological structures.

Conclusions

The results of a comparison of the leading features of the autochthonous protected dendrosozoflora of the Ukrainian Polissia and broad-leaved forests indicate the presence objectively indicate that there are specific features in each of these regional plant groups. Part of them is a natural consequence of the features of eco-conditions, geographical location of the regions, the evolution of the regional flora formation. Accordingly, all nature protection and restoration measures in the territory of the forest zone should be such as to preserve both its own rare phytodiversity and not to disturb its established structural features characteristic of the regions. Compliance with this requirement is one of the prerequisites for preserving the leading features and representative nature of the region's natural complexes, as well as ensuring their sustainable functioning.

Declarations

Conflicts of Interest

The authors declare no conflict of interest.

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Figures

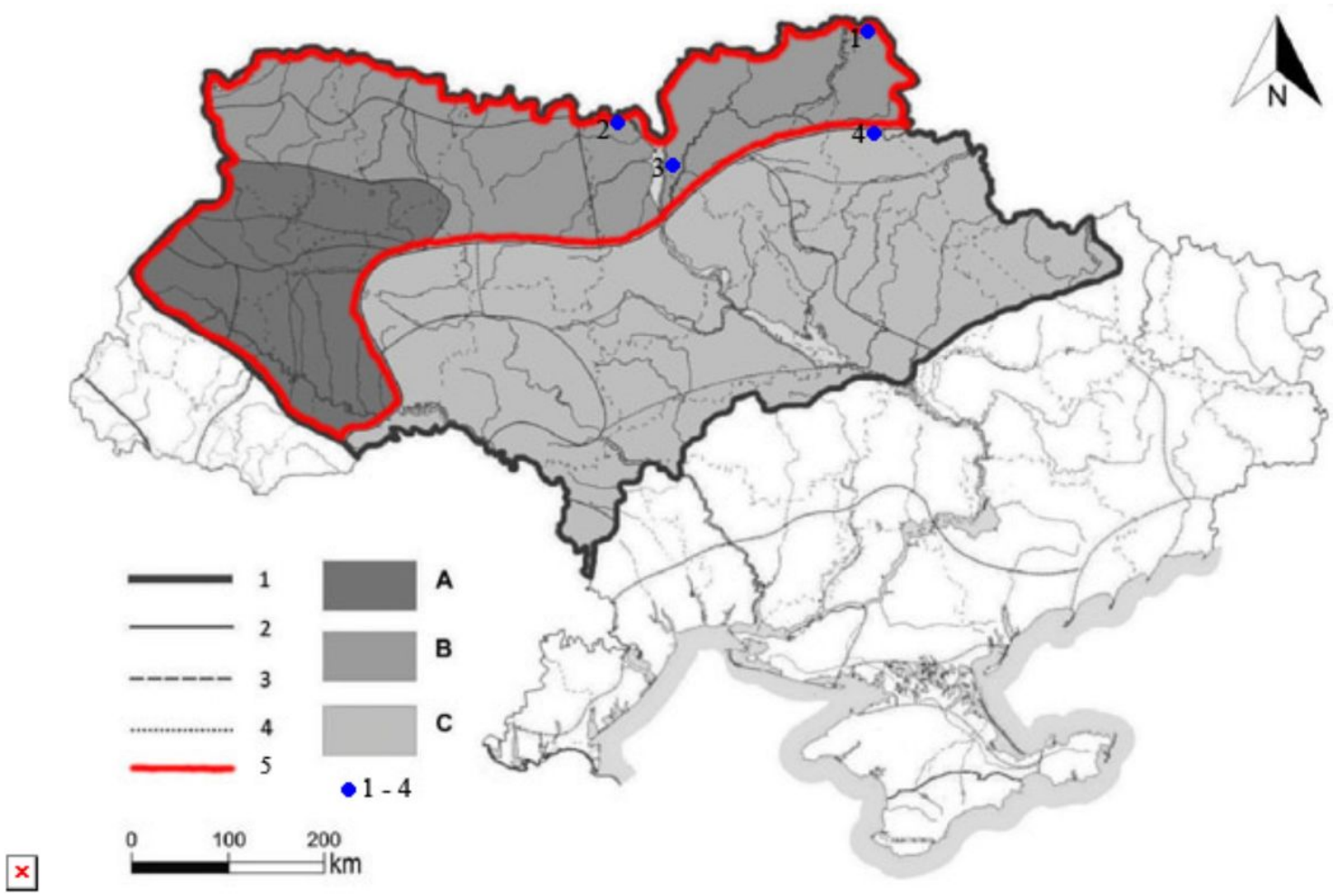
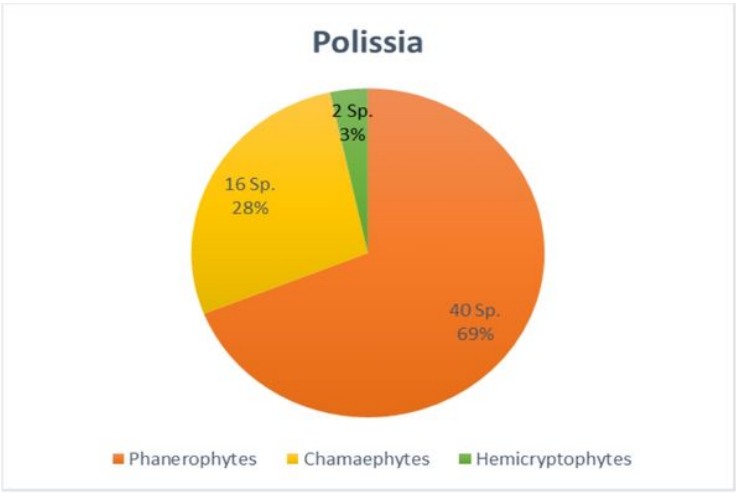


Figure 1

Forest and forest-steppe zones of Ukraine. (Didukh, Shelyag-Sosonko 2003; Kuzemko 2016). 1-4 the borders of the units of geobotanical zonation of Ukraine-zones (1), provinces (2), subprovinces (3) and districts (4). Research region (5). AB-European forests zone: Central European province of broad-leaved forest (A), Eastern European province of mixed forest – Ukrainian Polissia (B), C-Forest-Steppe zone. – territories with nature conservation status: 1 – Desnyansko-Starogutskyi National Natural Park; 2 – Chernobyl Radiation-Ecological Biosphere Reserve; 3 – regional landscape park "Mizhrichynskyi"; 4 – regional landscape park "Seymskyi".



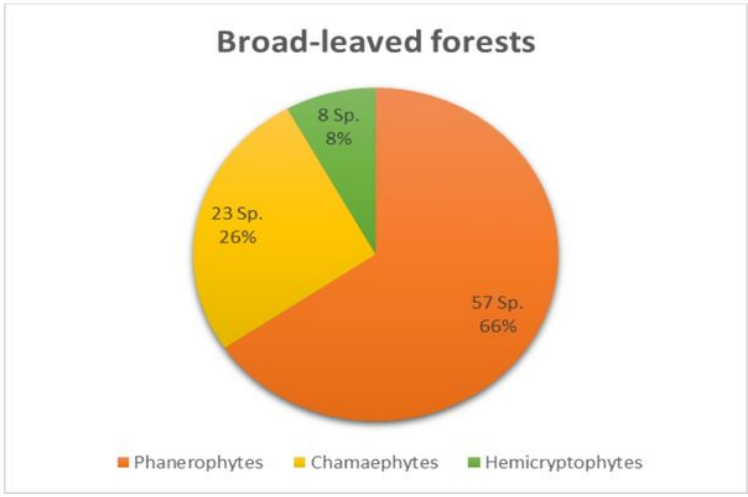
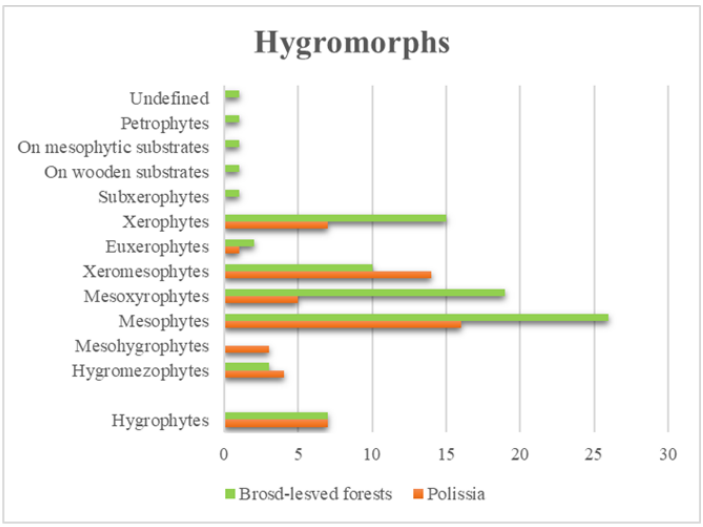
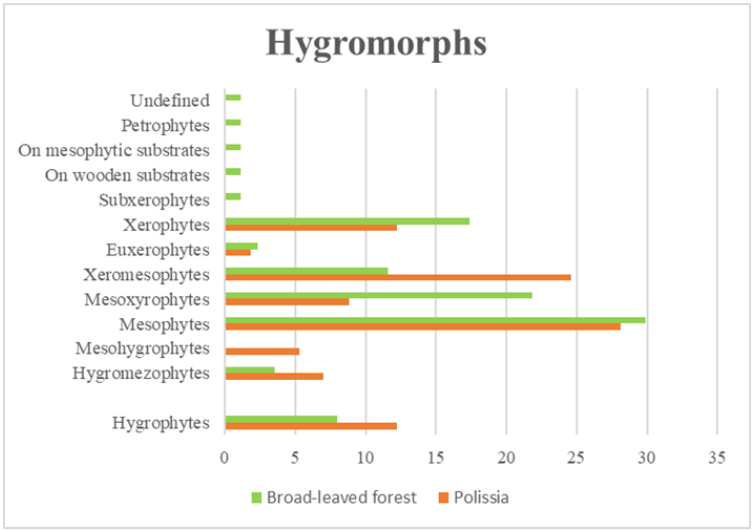


Figure 2

Life forms of autochthonous dendrosozophytes of Polissia and broad-leaved forests of Ukraine



A



B

Figure 3

Representation of plants of various hygromorphs among autochthonous dendrosozophytes of Polissia and broad-leaved forests of Ukraine (A – number of species, B – percentage)