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OCCURRENCE OF *ULMUS* L. IN THE DIFFERENT FOREST SITE CONDITIONS OF EASTERN UKRAINE

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The "Ukrderzhlisproekt" Ukrainian State Forest Management Planning Association Database by 2017 was analysed for Donetsk, Kharkiv and Sumy Regional Forest and Hunting Management Administrations (RFHMA) to recognize the distribution of forest-covered area, area with *Ulmus* sp. as a main forest-forming species, and area of subcompartments with *Ulmus* sp. in the stand composition by forest site condition (FSC) types. Forests of Donetsk, Kharkiv and Sumy RFHMA are located in 16, 17 and 16 FSC types, with *Ulmus* sp. in 14, 13 and 11 FSC types, and with *Ulmus* sp. as the main forest-forming species in 11, 9 and 8 FSC types, respectively. *U. minor* is the most common; *U. glabra* is the least common. *U. pumila* dominates in Donetsk RFHMA and is absent in Sumy RFHMA. *U. laevis* is most common in Kharkiv RFHMA. *U. minor* prefers fresh and dry fertile FSC. *U. laevis* in Donetsk RFHMA prefers dry and fresh fertile FSC types, in Kharkiv RFHMA fresh fertile FSC types, in Sumy RFHMA fresh relatively poor, relatively fertile and fertile FSC types. *U. pumila* In Donetsk RFHMA prefers dry relatively fertile FSC, in Kharkiv RFHMA fresh fertile FSC, in Sumy RFHMA fresh relatively poor FSC, fresh relatively fertile FSC and moist fresh relatively fertile FSC. *U. glabra* prevails in moist relatively fertile FSC types, and in Kharkiv RFHMA also widely spread in fresh fertile FSC types.

K e y w o r d s : elms, *Ulmus minor, Ulmus laevis, Ulmus pumila, Ulmus glabra,* forest-forming species.

Introduction. In the forest fund of the State Forest Resources Agency of Ukraine, elm (*Ulmus* sp.) forests occupy less than 0.1 % (Zakharchuk 2014, General characteristics of Ukrainian forests 2022). In different countries, elms are part of the forest and protective stands and are also widely used in landscaping settlements (Collin & Bozzano 2015, Matuszkiewicz 2015, Thomas et al. 2018). Wood, leaves, and bark have been used in the economy for centuries (Napierała-Filipiak et al. 2016). In the forest stands with elm in the composition, pine litter decomposition, as well as nitrogen and phosphorus cycling in the ecosystem, are accelerated (Matuszkiewicz 2015).

Out of more than 30 species of the *Ulmus* genus, three species are the most common in Europe: wych elm (*Ulmus glabra* Huds.), European white elm (fluttering elm) (*U. laevis* Pall.) and field elm (*U. minor* Mill.) (Collin & Bozzano 2015). Moist and damp fertile forest site conditions are considered optimal for these species (Diekmann 1996), with *U. glabra* confined to more humid conditions in the forest zone (Skolskyi 2013) and *U. minor* also to ravines and watersheds in the coppices in the Forest-Steppe (Napierała-Filipiak et al. 2016). In the southern regions of Ukraine, *U. pumila*, which is of Asian origin, is also common (Gensiruk 1992, Zhigalova 2016). Elm species have many geographic and ecological forms, are capable of interbreeding (Maslovata et al. 2016), and have many synonyms (Collin & Bozzano 2015, Zhigalova 2016).

After the mass decline of elm trees in the 1960s and 1970s, foresters did not see any prospects for their use for some time (Brasier 1991, Menkis et al. 2016, Jürisoo et al. 2019). Dutch elm disease (DED) was found to attack mature stands of *U. minor*, the latter though recovered by sprouts and root suckering in hedgerows (Collin & Bozzano 2015). *U. glabra* is susceptible to DED, propagated by seeds, has slight sprouting and has no suckering. *U. laevis* is less affected by DED than by environmental disturbance. *U. pumila* is the most resistant to DED but hybridizes with *U. minor* (Collin & Bozzano 2015, Santini & Faccoli 2015).

In the forests of Ukraine, the occurrence of elm species in relation to their resistance to various natural and anthropogenic factors has been little studied (Maslovata et al. 2016, Yavny & Puzrina 2018, Puzrina & Yavny 2020). Taking into account the increased mortality of English oak (*Quercus robur* L.) and common ash (*Fraxinus excelsior* L.) in many regions (Brown et al. 2018, Davydenko et al. 2019, Enderle et al. 2019, Gagen et al. 2019) and a high ecological value of *Ulmus* sp. (Collin

& Bozzano 2015, Matuszkiewicz 2015), it is necessary to assess their current distribution in the forest fund of individual regions and their sustainability.

The aim of the research was to assess the features of the elm stands distribution in the forest fund of three Regional Forest and Hunting Management Administrations (RFHMA) in the east of Ukraine.

Materials and methods. The "Ukrderzhlisproekt" Ukrainian State Forest Management Planning Association Database (by 2017) was analysed for the forest fund of Donetsk, Kharkiv and Sumy RFHMAs using SQL-query and converting it to the *.xls files. All these regions are located in eastern Ukraine and represent different natural zones: Donetsk region is entirely in the Steppe zone, Kharkiv region is partly in the Forest-Steppe and Steppe zones, and Sumy region is partly in Polissya and Forest-Steppe zones (Gensiruk 1992).

The analysis of the database revealed a presence of four species of *Ulmus* sp. All these species have a lot of names-synonyms. Thus, the Ukrainian name "berest" in different sources corresponds to the species *U. minor*, *U. pumila*, and *U. laevis*. As the researchers in Kyiv region (Puzrina & Yavny 2020), we identified the species with the name "berest" as *U. minor* in our analysis of the database.

Therefore, we studied the occurrence of such four elm species:

U. laevis Pall. (white elm, spreading elm, or fluttering elm) – in Ukrainian "gladky";

U. glabra Huds. (wych elm, Scotch elm) – in Ukrainian "shorstky", or "goly";

U. minor Mill. (field elm) – in Ukrainian "berest";

U. pumila L. (Siberian elm) – introduced Asian elm species – in Ukrainian "dribnolysty", "nyzky".

The distribution by types of forest site conditions was assessed in accordance with the Ukrainian school of forest typology (Migunova 1993) for the entire area covered with forest vegetation, for subcompartments with the presence of *Ulmus* sp. in the stand composition and for subcompartments with *Ulmus* sp. as the main forest-forming species, using χ^2-test (Atramentova & Utevskaya 2008).

Results and Discussion. In the forest fund of Donetsk and Sumy RFHMAs, 16 types of forest site conditions (FSC) and in Kharkiv RFHMA 17 types were registered (Tables 1–3). Very dry FSC were only found in the Donetsk RFHMA, and wet ones in Kharkiv and Sumy RFHMAs. The forest fund of Donetsk RFHMA is dominated by dry and fresh fertile FSC as well as dry relatively fertile FSC (each of these FSC types accounts for more than 20 %) (Table 1). In the forest fund of Kharkiv RFHMA, fresh fertile FSC types make nearly half the area (43.9 %). The proportion of fresh relatively fertile FSC types is also quite high (19.2 %) (Table 2). In the forest fund of Sumy RFHMA, fresh FSC type dominates, with a proportion increasing from relatively fertile to fertile FSC type (from 20.7 to 37.6 %) (Table 3).

Table 1

Distribution of the forested area and area with *Ulmus* sp. by forest site conditions in the forest fund of Donetsk RFHMA as of 2017 (%)

Hygrotope indices	Forested area (92,364.6 ha)				*Ulmus* sp. as the main forest-forming species (932.5 ha)				*Ulmus* sp. in the stand composition (8,227.1 ha)			
	Trophotope indices				Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D	A	B	C	D
0	–	0.1	2.8	1.2	–	1.6	7.4	0.7	–	0.2	3.6	0.5
1	2.3	1.6	20.6	29.1	–	3.0	22.9	27.8	–	2.5	24.9	21.3
2	8.2	3.7	1.6	22.1	0.3	0.8	3.7	21.4	0.1	0.2	2.2	27.0
3	–	0.6	0.3	4.1	–	–	–	10.3	–	–	1.2	14.3
4	–	–	1.6	0.1	–	–	–	–	–	–	1.9	0.1
5	–	–	–	–	–	–	–	–	–	–	–	–

Elms as the main forest-forming species in the forest fund of Donetsk RFHMA are represented in 11 FSC types, prevailing in the most common FSC. At the same time, elms in the forest stand composition in Donetsk RFHMA are found in 14 FSC types, including wet and damp relatively fertile FSC types as well as wet fertile FSC type (Table 1). In the forest fund of Kharkiv RFHMA, the elms as the main forest-forming species are found in 9 FSC types and in the forest stand composition in 13 FSC types, prevailing in fresh fertile FSC type (Table 2).

Table 2

Distribution of the forested area and area with *Ulmus* sp. by forest site conditions in the forest fund of Kharkiv RFHMA as of 2017 (%)

Hygrotope indices	Forested area (289,360 ha)				*Ulmus* sp. as the main forest-forming species (635.2 ha)				*Ulmus* sp. in the stand composition (20,081.9 ha)			
	Trophotope indices				Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D	A	B	C	D
0	–	–	–	–	–	–	–	–	–	–	–	–
1	2.0	1.9	1.3	12.1	–	0.4	15.9	27.2	–	–	2.5	19.7
2	6.2	19.2	7.0	43.9	–	0.6	7.4	33.8	0.1	1.6	5.4	52.0
3	0.0	0.6	1.1	3.1	–	1.2	6.7	6.8	–	0.3	3.1	12.9
4	–	0.1	0.8	0.5	–	–	–	–	–	0.1	1.3	0.9
5	–	–	0.1	0.2	–	–	–	–	–	–	–	0.1

The distribution of elms as the main forest-forming species is limited to hygrotopes 1–3, while in the forest stand composition they are found in damp relatively poor, relatively fertile and fertile FSC, as well as in moist fertile FSC type (Table 2). In the forest fund of Sumy RFHMA, elms are found as the main forest-forming species in 8 FSC types and in the forest stand composition in 11 FSC types, prevailing in fresh fertile FSC type (62.4 and 73.2 % of the area) (Table 3).

Table 3

Distribution of the forested area and area with *Ulmus* sp. by forest site conditions in the forest fund of Sumy RFHMA as of 2017 (%)

Hygrotope indices	Forested area (262,762 ha)				*Ulmus* sp. as the main forest-forming species (324.7 ha)				*Ulmus* sp. in the stand composition (35,608.1 ha)			
	Trophotope indices				Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D	A	B	C	D
0	–	–	–	–	–	–	–	–	–	–	–	–
1	0.3	0.2	0.1	0.5	–	–	0.9	4.3	–	0.1	0.1	1.4
2	2.0	20.7	23.3	37.6	–	0.5	12.8	62.4	–	2.9	13.0	73.2
3	–	1.6	6.6	2.0	–	–	7.7	10.7	–	0.2	4.3	3.6
4	–	0.2	2.7	1.3	–	–	–	0.8	–	–	0.4	0.8
5	–	–	0.4	0.3	–	–	–	–	–	–	–	–

A comparison of the distribution of the area covered with forest vegetation in the forest fund of the analysed regions according to FSC indicates significant statistical differences (Table 4). At that, such distribution in Donetsk RFHMA differs to the greatest extent from that in Sumy RFHMA (the largest value of $\chi^2_{fact.}$) and to a lesser extent from that in Kharkiv RFHMA, and the similarity of the distribution of the area by FSC in both Sumy and Kharkiv RFHMAs is the greatest, although it differs significantly.

At the same time, the distribution of the area of stands, where elm is the main forest-forming species, is the closest in Donetsk and Kharkiv RFHMA, and the distribution of the area of stands with the elms in the forest stand composition is the closest in Kharkiv and Sumy RFHMAs. The data obtained are due to the fact that the presence of elm in the stand composition depends on environmental conditions, and the subjective factor affects determining the main species, that is, the economy is carried out by taking into account the most valuable species.

Table 4

Results of χ^2-test for comparison of the distribution of forested area and area with *Ulmus* sp. by forest site conditions in the forest fund of three RFHMAs of eastern Ukraine as of 2017

RFHMA	Forested area		*Ulmus* sp. as the main forest-forming species		*Ulmus* sp. in the stand composition	
	Kharkiv	Sumy	Kharkiv	Sumy	Kharkiv	Sumy
Donetsk	1,421.43	2,341.35	340.76	2,929.14	1,167.72	3,424.35
Kharkiv	–	505.47	–	1,615.55	–	944.16

Note. $\chi^2_{0.05} = 35.5$

Comparison of the distribution of the forested area and elms as the main forest-forming species by FSC for each of the regions, as well as the distribution of forested area and subcompartments with elms in the forest stand composition, shows that the differences are significant everywhere, but both pairs of distributions are the closest in Donetsk RFHMA, and the least similar in Sumy RFHMA (Table 5).

Table 5

Results of χ^2-test for comparison of the distribution of forested area and area with *Ulmus* sp. by forest site conditions in the forest fund of each of three RFHMAs of eastern Ukraine as of 2017

RFHMA	Forested area – *Ulmus* sp. as the main forest forming species	Forested area – *Ulmus* sp. in the stand composition	*Ulmus* sp. as the main forest-forming species – *Ulmus* sp. in the stand composition
Donetsk	154.78	294.36	117.74
Kharkiv	977.18	582.44	623.88
Sumy	1,240.33	1,715.13	194.59

Note. $\chi^2_{0.05} = 35.5$

At the same time, the distribution of the forest area with elm as the main species and that with elm in the forest composition are also the least different in Donetsk RFHMA, not much more in Sumy RFHMA, and most of all in Kharkiv RFHMA. The data obtained can be associated with the heterogeneity of the distribution of FSC within both Kharkiv and Sumy RFHMAs, which are located in different natural zones. In future research, such distribution will be analysed for individual forestry enterprises. The obtained results may also be affected by the different species composition of elms in certain regions and FSC.

The proportion of stand area with elms as the main forest-forming species is low – it is maximal in Donetsk RFHMA (1.01 %) and minimal in Sumy RFHMA (0.12 %), where it is possible to grow more valuable tree species (Table 6).

Table 6

Occurrence of different *Ulmus* sp. in the forest fund of each of three RFHMAs of eastern Ukraine as of 2017 (area, ha / % from all area of elm stands)

RFHMA	*U. minor*	*U. laevis*	*U. pumila*	*U. glabra*	All *Ulmus* sp.	Proportion of *Ulmus* sp. in the forested area, %
Donetsk	477.3/ 51.2	61.7 / 6.6	379.4 / 40.7	14.1 / 1.5	932.5 / 100.0	1.01
Kharkiv	504.9 / 79.5	111.6 / 17.6	15.6 / 2.5	3.1 / 0.4	635.2 / 100.0	0.22
Sumy	309.3 / 95.3	12.0 / 3.7	0 / 0	3.4 / 1.0	324.7 / 100.0	0.12
Total	1,291.5 / 68.3	185.3 / 9.8	395.0 / 20.9	20.6 / 1.0	1,892.4 / 100.0	0.28

The species composition of elms as forest-forming species differs in three regions, but in all cases *U. minor* prevails (Table 6). Its proportion increases from Donetsk to Sumy RFHMA, i.e. from south to north, from Steppe to Polissya (Table 6). In part, such a predominance of one species

may be due to its incorrect identification during forest inventory. The proportion of the Asian species *U. pumila* is maximal in Donetsk RFHMA and rather low in Kharkiv RFHMA, and this species is absent in Sumy RFHMA. *U. laevis* is most represented in Kharkiv RFHMA (17.6 %), while the proportion of *U. glabra* is low in all regions of eastern Ukraine. The latter species prefers humid conditions and lower areas in mountains (Skolskyi 2013, Napierała-Filipiak et al. 2016).

An analysis of the distribution of individual elm species by FSC types shows (Tables 7–9) that *U. minor* is represented by 13, 12, and 11 FSC types in Kharkiv, Donetsk, and Sumy RFHMAs, respectively; as the main species, it is represented by 9, 8, and 6 FSC types in Kharkiv, Sumy and Donetsk RFHMAs. This species prefers fresh and dry fertile FSC in all regions. *U. laevis* is represented by 11, 10 and 8 FSC types in Kharkiv, Donetsk, and Sumy RFHMAs, respectively, in the forest stand composition, and as the main forest-forming species in 8 FSC types in Donetsk and Kharkiv RFHMAs, and in 3 FSC types in Sumy RFHMA.

Table 7

Distribution of different *Ulmus* species by forest site conditions in the forest fund of Donetsk RFHMA as of 2017 (numerator – as the main forest forming species; denominator – in the stand composition)

Hygrotope indices	Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D
	U. minor				*U. laevis*			
0	–	–	3.6 / 1.9	0.0 / 0.3	–	–	14.6 / 5.2	8.3 / 1.7
1	–	0.0 / 0.3	12.0 / 16.8	39.9 / 22.2	–	0,0 / 3.7	2.6 / 11.5	43.3 / 39.0
2	–	0.0 / 0.1	0.2 / 2.1	30.3 / 34.0	–	3.4 / 1.2	5.8 / 2.5	16.1 / 28.7
3	–	–	0.0 / 1.6	14.1 / 18.4	–	–	0.0 / 0.8	6.0 / 5.7
4	–	–	0.0 / 2.3	0.0 / 0.1	–	–	–	–
	A	B	C	D	A	B	C	D
	U. pumila				*U. glabra*			
0	–	4.0 / 0.8	11.3 / 8.4	0.4 / 0.9	–	–	–	–
1	–	7.5 / 8.4	40.8 / 47.9	10.7 / 20.1	–	–	0.0 / 22.6	11.4 / 1.8
2	0.7 / 0.2	1.5 / 0.4	7.1 / 1.5	12.2 / 9.2	0.0 / 0.1	0.0 / 0.2	16.3 / 7.1	0.0 / 26.8
3	–	–	0.0 / 0.4	3.9 / 1.8	–	–	–	72.3 / 33.2
4	–	–	–	–	–	–	0.0 / 8.1	–

In Donetsk RFHMA, *U. laevis* dominates in dry and fresh fertile FSC both as the main forest-forming species and in the forest stand composition. In Kharkiv RFHMA, *U. laevis* dominates as the main forest-forming species in dry fertile and dry relatively fertile FSCs, and in the stand composition in fresh fertile FSC. In Sumy RFHMA, *U. laevis* is the main forest-forming species in fresh relatively fertile and fertile FSCs, and in the stand composition it is presented approximately the same in the fresh relatively poor, relatively fertile and fertile FSCs (Tables 7–9).

U. pumila is represented by 12, 10 and 6 FSC types in Donetsk, Kharkiv and Sumy RFHMAs, respectively, and as the main forest-forming species, in 11 and 3 FSC types in Donetsk and Kharkiv RFHMA, and it is not a main forest-forming species in Sumy RFHMA. In Donetsk RFHMA, *U. pumila* dominates in dry relatively fertile FSC with a considerable proportion also in dry fertile FSC. In Kharkiv RFHMA, *U. pumila* is a main forest-forming species mostly in dry fertile FSC, and the 31 % of the area with this species in the composition are in fresh fertile FSC and 15.7 % in

fresh relatively fertile FSC. In Sumy RFHMA, *U. pumila* most often occurs in the stand composition in fresh relatively poor, fresh relatively fertile and moist relatively fertile FSCs (Tables 7–9).

Table 8

Distribution of different *Ulmus* species by forest site conditions in the forest fund of Kharkiv RFHMA as of 2017 (numerator – as the main forest forming species; denominator – in the stand composition)

Hygrotope indices	Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D
	U. minor				*U. laevis*			
1	–	0.5 / 0.0	11.4 / 1.9	26.3 / 20.3	–	–	34.9 / 7.9	27.0 / 19.2
2	0.0 / 0.1	0.8 / 1.6	6.1 / 4.5	39.2 / 53.8	–	0.0 / 1.1	14.2 / 13.2	12.0 / 39.5
3	–	1.5 / 0.3	7.4 / 2.6	6.9 / 12.6	–	0.0 / 0.4	4.8 / 7.1	6.8 / 9.1
4	–	0.0 / 0.1	0.0 / 1.2	0.0 / 0.8	–	–	0.0 / 1.5	0.1 / 1.0
5	–	–	–	–	–	–	–	0.3 / 0.2
	A	B	C	D	A	B	C	D
	U. pumila				*U. glabra*			
1	–	–	26.9/ 12.6	54.5 / 15.5	–	–	0.0 / 1.2	41.9 / 1.8
2	–	0.0 / 2.9	0.0 / 15.7	18.6 / 31.0	–	–	0.0 / 1.1	19.4 / 46.5
3	–	–	0.0 / 9.6	0.0 / 5.3	–	9.7 / 0.1	0.0 / 0.4	29.0 / 44.5
4	–	–	0.0 / 1.0	0.0 / 4.8	–	–	0.0 / 4.1	0.0 / 0.2
5	–	–	–	0.0 / 1.6	–	–	–	–

U. glabra is represented by 10, 9 and 8 FSCs in Sumy, Kharkiv and Donetsk RFHMAs, respectively, and as the main forest-forming species in 4 FSCs in Kharkiv RFHMA and three FSCs per each in Donetsk and Sumy RFHMAs. In Donetsk RFHMA, *U. glabra* is a main forest-forming species in moist fertile FSC, in Kharkiv RFHMA in dry fertile FSC, and in forest composition in fresh and moist fertile FSC, in Sumy RFHMA in moist fertile FSC (Tables 7–9).

Table 9

Distribution of different *Ulmus* species by forest site conditions in the forest fund of Sumy RFHMA as of 2017 (numerator – as the main forest forming species; denominator – in the stand composition)

Hygrotope indices	Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D
	U. minor				*U. laevis*			
1	–	0.0 / 0.1	0.9 / 0.1	4.5 / 1.5	–	–	–	–
2	–	0.2 / 0.6	11.7 / 12.1	63.3 / 76.5	–	4.2 / 24.9	40.0 / 27.4	55.8 / 32.4
3	–	0.0 / 0.1	8.1 / 3.9	10.4 / 3.1	–	0.0 / 0.4	0.0 / 9.8	0.0 / 2.7
4	–	–	0.0 / 0.3	0.8 / 0.7	–	–	0.0 / 0.8	0.0 / 1.4

Continuation of Table 9

Hygrotope indices	Trophotope indices				Trophotope indices			
	A	B	C	D	A	B	C	D
	U. pumila				*U. glabra*			
1	–	–	–	–	–	–	–	0.0 / 0.3
2	–	0.0 / 34,5	0.0 / 30,4	0.0 / 5,1	–	14.7 / 11.8	14.7 / 24.9	0.0 / 24.2
3	–	–	0.0 / 25,5	0.0 / 0,4	–	0.0 / 1.5	0.0 / 8.8	70.6 / 23.6
4	–	–	0.0 / 4,1	–	–	0.0 / 0.1	0.0 / 3.0	0.0 / 1.9

Having compared for each of the regions the distribution of area with individual elm species as the main species, as well as the area of subcompartments with elm in the stand composition, we found out that all the differences are significant (Table 10).

The distribution of *U. minor* and *U. laevis* in Donetsk RFHMA is closest both by area of forest-forming species and by area of these elm species in the stand composition. Estimated χ^2 is almost everywhere higher when we compare an area with elms as the main forest-forming species than considering an area with these elms in the stand composition. Only in the pair *U. minor* – *U. laevis* in Sumy RFHMA, an estimated χ^2 the occurrence of the main forest-forming species is almost twice less than an occurrence of stands with these elms in the stand composition (Table 10). This is due to the fact that in Sumy RFHMA in such FSCs, more valuable species for forestry (*Quercus robur* L., *Fraxinus excelsior* L., etc.) are the main forest-forming ones.

Table 10

Results of χ^2-test for comparison of the distribution of area of different *Ulmus* species by forest site conditions in the forest fund of each of three RFHMAs of eastern Ukraine as of 2017 (numerator – as the main forest forming species; denominator – in the stand composition)

RFHMA	*U. minor* – *U. laevis*	*U. minor* – *U. pumila*	*U. minor* – *U. glabra*	*U. laevis* – *U. pumila*	*U. laevis* – *U. glabra*	*U. pumila* – *U. glabra*
Donetsk	595.7 / 531.2	2,857.4 / 1,980.2	5,538.1 / 785.38	2,687.1 / 2,110.1	6,087.4 / 2,398.1	6,789.3 / 2,509.9
Kharkiv	1,361.3 / 349.7	1,600.6 / 903.4	1,419.4 / 1,445.0	1,133.7 / 155.3	2,304.3 / 1,849.4	1,819.5 / 2,436.0
Sumy	1,068.4 / 2,758.9	– / 7,010.1	7,939.1 / 3,464.8	– / 1,114.3	8,850.9 / 690.9	– / 1,736.3

Note. $\chi^2_{0.05} = 35.5$

The lowest χ^2 are estimated when comparing the occurrence of *U. laevis* and *U. pumila* in the stand composition in Kharkiv RFHMA (Table 10).

Conclusions. Forests of Donetsk and Sumy RFHMAs are located in 16 FSC types; forests of Kharkiv RFHMA occur in 17 FSC types. Very dry FSCs are found only in Donetsk RFHMA and wet FSCs in Kharkiv and Sumy RFHMAs. *Ulmus* sp. occurs in the forest fund of Donetsk, Kharkiv and Sumy RFHMA in 14, 13 and 11 FSC types, respectively, and as the main forest-forming species in 11, 9 and 8 FSC types, respectively.

In all regions, *U. minor* is the most common with an increasing proportion from Donetsk to Sumy RFHMA. *U. pumila* dominates in Donetsk RFHMA and is absent in Sumy RFHMA. *U. laevis* is most represented in Kharkiv RFHMA. The occurrence of *U. glabra* is low in the forest fund of all analysed RFHMAs of the east of Ukraine.

U. minor prefers fresh and dry fertile FSC types in all analysed RFHMAs. As part of stand composition, *U. laevis* in Donetsk RFHMA is represented mainly in dry and fresh fertile FSC types, in Kharkiv RFHMA in fresh fertile FSC types, in Sumy RFHMA in fresh relatively poor, relatively

fertile and fertile FSC types. In Donetsk RFHMA, *U. pumila* prevails in dry relatively fertile FSC, less common in dry fertile FSC; in Kharkiv RFHMA, it prevails in fresh fertile FSC and less in fresh relatively fertile FSC and in Sumy RFHMA, in fresh relatively poor FSC, fresh relatively fertile FSC and moist fresh relatively fertile FSC. *U. glabra* is most represented in moist relatively fertile FSC types, at that, in Kharkiv RFHMA it is also widely spread in fresh fertile FSC types.

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ПОШИРЕННЯ ВИДІВ РОДУ *ULMUS* У РІЗНИХ ЛІСОРОСЛИННИХ УМОВАХ СХОДУ УКРАЇНИ

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Проаналізовано базу даних ВО «Укрдержліспроект» станом на 2017 р. стосовно лісового фонду Донецького, Харківського та Сумського ОУЛМГ для визначення розподілу за типами лісорослинних умов (ТЛУ) площі вкритих лісовою рослинністю ділянок, площі насаджень із *Ulmus* sp. як головної породи та площі виділів із наявністю *Ulmus* sp. у складі насаджень. У лісовому фонді Донецького, Харківського та Сумського ОУЛМГ визначено 16, 17 і 16 ТЛУ, з *Ulmus* sp. у складі – 14, 13 і 11 ТЛУ, а з *Ulmus* sp. як головною лісоутворювальною породою – 11, 9 та 8 ТЛУ відповідно. *U. minor* є найбільш поширеним, *U. glabra* – найменш. *U. pumila* домінує в фонді Донецького ОУЛМГ та відсутній у Сумському ОУЛМГ. *U. laevis* найбільш поширений у Харківському ОУЛМГ. *U. minor* частіше трапляється у свіжих і сухих грудах, *U. laevis* у Донецькому ОУЛМГ – у сухих і свіжих грудах, у Харківському – у свіжих грудах, у Сумському – у свіжих суборах, сугрудах і грудах. *U. pumila* у Донецькому ОУЛМГ надає перевагу сухим сугрудам, у Харківському – свіжим грудам, у Сумському – свіжим суборам, свіжим сугрудам та вологим сугрудам. *U. glabra* надає перевагу вологим сугрудам а у Харківському ОУЛМГ – також свіжим грудам.

Ключові слова: в’язи, *Ulmus minor, Ulmus laevis, Ulmus pumila, Ulmus glabra*, головні лісоутворювальні види.

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