ECOLOGY, BIOTECHNOLOGY, AGRICULTURE AND FORESTRY

IN THE 21ST CENTURY

PROBLEMS AND SOLUTIONS

EDITED BY
S.STANKEVYCH, O.MANDYCH

ECOLOGY, BIOTECHNOLOGY, AGRICULTURE AND FORESTRY IN THE 21ST CENTURY: PROBLEMS AND SOLUTIONS

Edited by S. Stankevych, O. Mandych

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The monograph is a collection of the results of scientists' achievements obtained directly in real conditions. The authors are recognized specialists in their fields, as well as young scientists and graduate students of Ukraine. The studies are conceptually grouped in sections: biotechnology, ecology, agriculture, forestry, sustainable development of the economy and the principles of effective agribusiness. The monograph will be of interest to specialists in biotechnology, ecology, breeding, plant protection, agrochemistry, soil science, forestry, agribusiness, etc., researchers, teachers, graduate students and students of specialized specialties of higher educational institutions, as well as everyone who is interested in sustainable development in the agricultural sphere and Green Deal Implementation strategies.

Keywords: sustainable development, modern technologies, agricultural production, biotechnology, ecology, plant protection, forestry, agribusiness.

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FOREST GENETIC RESOURCES *IN SITU* OF BROAD-LEAVED SPECIES OF THE RIGHT-BANK FOREST-STEPPE OF UKRAINE: CURRENT STATE AND PROSPECTS FOR USING

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The intensive use of natural resources over the last centuries has led to a reduction of forest area, disruption of their genesis, and a decrease in the proportion of the main forest-forming species. Today, there are no virgin oak forests left in the plains of Ukraine [12, 17]. At the same time, a certain share of forests of natural origin remains. These forest stands are characterized by a changed morphological, tree species and age structure [8, 11, 12]. The share of forests of natural origin has been declining dramatically in recent decades. In most cases, forest stands are created in place of felled stands of natural origin [4, 6, 7].

During 2003-2023, the research was conducted on the species composition, condition and selection structure of forest genetic reserves and plus stands within the Right-Bank Forest-Steppe of Ukraine. In particular, the forest genetic reserves of Kyiv, Vinnytsia, Khmelnytsky, Kirovohrad, northern Cherkasy and Odesa regions were studied. The sample plots were established in different forests ecosystems according to field investigations [8, 9, 15].

The inventory of *in situ* forest gene sources conservation was carried out using a comprehensive methodology developed by researchers of Department of Selection, Genetics, and Biotechnology of the Ukrainian Research Institute of Forestry and Forest Melioration (URIFFM) [9, 10]. The scale of tree condition categories developed by researchers of URIFFM [9]:

category I – trees without dieback of the primary tree crown or complete compensation for its dieback out due to the growth and new formation of branches; there are no or almost no died branches in the crown,

and those that have previously died out are destroyed to varying degrees, with a full normal living part of the crown, a higher level of shoot formation and leaf surface; shoots and leaves are well developed; foliage, as a rule, is spring or regenerated, but healthy, intense green color, without powdery mildew; crowns of characteristic moderate density for oak; without stem insect pests and mushroom damage;

category II – trees with different dieback of the primary crown; there are no or few dried branches, and previously dried branches are destroyed to varying degrees; with incomplete compensation of crown drying due to growth and new shoot formation; with a normal living part of the crown, the level of shoot and leaf formation is about 75-50 %, with well-developed shoots and leaves, spring or regenerated leaves, healthy or with mild to moderate powdery mildew damage, crowns of characteristic density or thickened due to an excess of secondary branches along the primary skeleton and trunk; without stem insect pests and honey beetle;

category III – trees with strong or complete dieback of the primary crown, dry branches of different age and preservation; there are dieback branches; crown dieback is not compensated by the growth and formation of branches (due to weak crown- regenerative capacity and subsequent damage and dieback); branching, shoot formation and the number of leaves is about 40-25 % of the norm; leaves are spring or regenerated, without or with various powdery mildew damage; part of the crown with shoots is large, but liquefied due to weak growth of the crown volume by living branches with shoots, or vice versa, severely reduced and thickened due to an excess of small secondary branches on the basis of primary branches and trunk; some trees are infested with goldenrod and activating mushroom;

category IV – with strong or complete drying out of the primary crown; dieback branches of different age and preservation, many dieback branches, including secondary branches on the primary skeleton and trunk; branch formation is weak, coverage of the primary skeleton and trunk with branches with shoots is sparse; the living part of the crown usually consists of single secondary branches on the basis of primary branches and trunk; branching, shoot formation and leaf surface are very much reduced and make up about 15 % or less of the normal; the overall shape and density of the crown is lost; the trunk is inhabited by bullion, there is sapwood; with signs of vascular damage; the base of the trunk and root legs are affected by honey mushroom to varying degrees;

category V – dieback tree decline during the last autumn-winter period and vegetation; with full preservation of dried parts (leaves, shoots,

branches); previously dried shoots and branches are destroyed to varying degrees; to varying degrees infested with insect pests and affected by mushroom; the wood of the dried part of the trunk is damaged and destroyed by mustaches, mushrooms and other fungi, and the previously dried part is destroyed to varying degrees by them;

category VI – dieback tree decline a year or more ago; dry branches are destroyed to varying degrees; the trunk is damaged by sapwood, mustachians; sapwood is destroyed by mushrooms and other fungi; from about 6-10 years of age, trees begin to fall out.

Tree selection categories were determined of the modified scale developed by scientists of the URIFFM. The first selection category (candidates for plus trees) are the best for the whole complex of traits. They exceed the average indicators in DBH by at least 30 % and in height by 10 % in the forest stand. They are straight-trunked, full-grown, with good knotting and overgrowth, a compact, well- developed crown, and excellent trunk quality. They are business grade. Trees are in excellent or good condition (1-2 categories of condition), highly resistant to insect pests, diseases and unfavorable environmental conditions [9].

The second category (candidates for plus trees, synonymous with the best normal trees) – have high-quality trunks that meet the requirements of plus trees of the first category, with a slight excess of the average height and DBH for the corresponding stand (but not less), or with the same excess in DBH and height as in the first category, have some minor defects in the trunks (average knotting, slightly increased convergence, slight obliquity, slight curvature of the trunk, etc.) Marketability – business. The trees are in excellent or good condition.

The third category (normal trees) has a DBH and height approximately equal to the average for the stand. They may have trunk defects (medium or poor knotting, increased deflection, slanting, trunk curvature, etc.). Marketability – business and semi-business. Trees are in good or satisfactory condition.

The fourth category (minus trees) is poor in terms of growth, quality and condition, or one of these characteristics. They are classified as semi-food and firewood in terms of marketability. This includes all stunted trees, as well as all trees of any size with pronounced defects - crooked, knotty, slanted, diseased, etc.

The predominant main forest-forming species of the studied forest genetic reserves included in the Right-Bank Forest-Steppe are English oak, with a share of 37.7 %, and forest European beech, with a share of 26.8 %.

A significant share is also made up of stands with a predominance of common ash, which accounts for 7.6 %. Other forest genetic reserves are represented by the predominant participation of these species, which belong to the aboriginal species (Fig. 1) [22, 23].

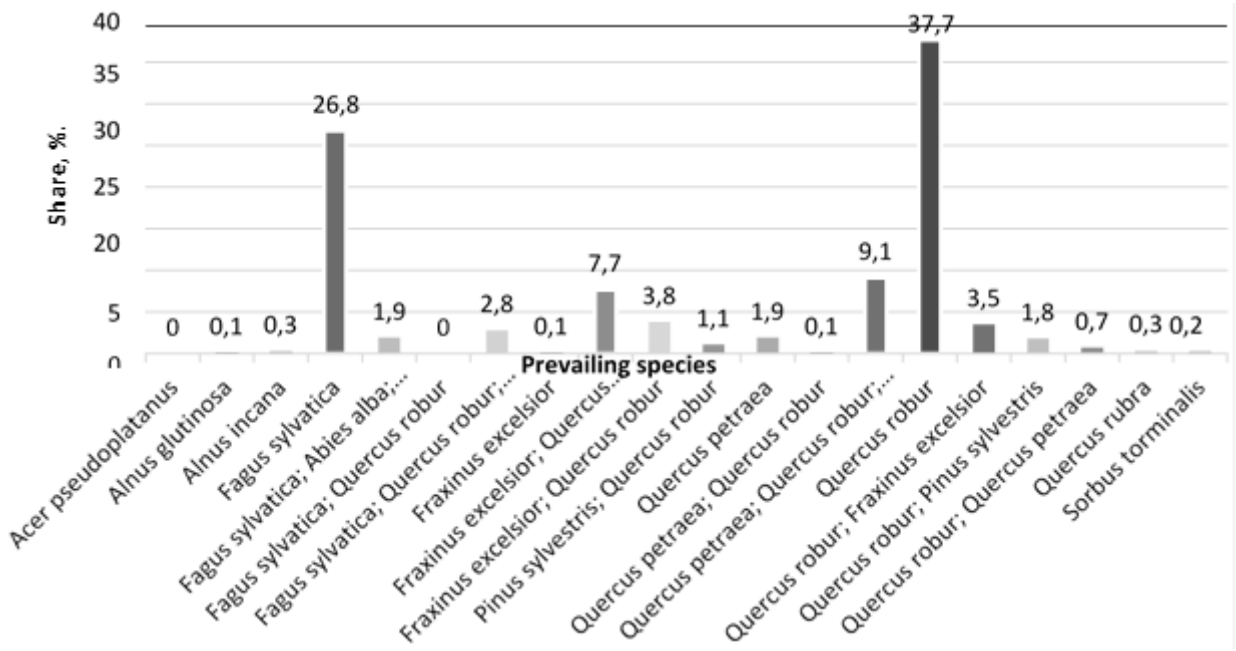

Fig. 1 Distribution of forest genetic reserves of the Right-Bank Forest-Steppe by predominant species

The largest number of genetic reserves are of English oak – 44 and European beech – 40 (37.3 % and 33.9 %, respectively). The number of stands of other forest-forming species is insignificant and amounts to 10-50%. The total area of genetic reserves and plus stands of English oak is 1529.2 hectares, and European beech – 1084.3 hectares. The area of stands dominated by common ash is 155.9 hectares (Table 1).

Forest gene reserves in Vinnytsia region were selected mainly in 1970-1980. According to the State Register (SR), 15 genetic reserves of English oak with a total area of 1285.3 hectares and 14 plots of plus stands with a total area of 530.3 hectares have been designated [1-3, 5]. Information on the available forest genetic reserves is presented in Table 2.

The largest areas of English oak forest gene reserves mostly are located in the south of the Vinnytsia region, in particular in the State Enterprise (SE) "Obodivske" – 204.0 ha, SE "Chechelnytske Forestry" – 186.1 ha. Significant oak forest genetic reserves are also concentrated in SE "Zhmerynske Forestry", SE "Tulchynske Forestry" and SE "Kryzhopilske Forestry".

Table 1

The number and area of forest genetic reserves by main forest-forming species in the conditions of the Right-Bank Forest-Steppe of Ukraine

Genetic reserves (predominant breeds)	Quantity, pcs.	Share of quantity, %	Area, ha	Share of square, %
Acer pseudoplatanus	1	0,8	1,8	0,0
Alnus glutinosa	1	0,8	3,3	0,1
Alnus incana	1	0,8	13	0,3
Fagus sylvatica	40	33,9	1084,3	26,8
Fagus sylvatica; Abies alba; Quercus robur	1	0,8	75,8	1,9
Fagus sylvatica; Quercus robur	1	0,8	1	0,0
Fagus sylvatica; Quercus robur; Abies alba	1	0,8	114,8	2,8
Fraxinus excelsior	2	1,7	5,5	0,1
Fraxinus excelsior; Quercus petraea; Quercusrobur	2	1,7	312	7,7
Fraxinus excelsior; Quercus robur	3	2,5	155,9	3,8
Pinus sylvestris; Quercus robur	1	0,8	44,1	1,1
Quercus petraea	5	4,2	78,4	1,9
Quercus petraea; Quercus robur	1	0,8	2,5	0,1
Quercus petraea; Quercus robur; Fraxinus ex.	3	2,5	368,5	9,1
Quercus robur	44	37,3	1529,2	37,7
Quercus robur; Fraxinus excelsior	5	4,2	143,1	3,5
Quercus robur; Pinus sylvestris	2	1,7	73	1,8
Quercus robur; Quercus petraea	2	1,7	28	0,7
Quercus rubra	1	0,8	13	0,3
Sorbus torminalis	1	0,8	6,1	0,2
Total	118	100	4053,3	100,0

The data on the location and area of plus stands of English oak are given in Table 3.

The plus stands is concentrated in the conditions of the SE «Kryzhopilske Forestry» (399.1 hectares). The plus stands were also selected in the SE «Chechelnitske Forestry» (110.5 ha) and SE «Illinetske Forestry» (20.7 ha).

The main indicators of the current state of forest genetic reserves and plus stands are the productivity and representation of target tree species in

the composition. The mensuration characteristics of plus stands and forest genetic reserves in Vinnytsia region are presented in Table 4.

Table 2

Location and area of forest genetic reserves of English oak in Vinnytsia region

№ n/a	Species	Area, ha	Location of the forest genetic reserve in Ukraine	
			Forestry, forestry	quarter/ allotment
1	*Quercus robur*	20,0	Vinnytsia, Vinnytsia	2/4, 5, 10
2	*Quercus robur*	54,0	Vinnytsia, Voronovytske	9/1, 60/1, 61/1
3	*Quercus robur*	135,1	Vinnytsia, Prybuzka	12/5, 10, 13, 3/11, 12, 16, 17, 18, 21
4	*Quercus robur*	186,1	Chechelnytske, Britavske	54/4, 55/1, 56/1, 57/4, 61/1
5	*Quercus robur*	3,7	Bershadske, Sumy	11/9
6	*Quercus robur*	204,0	Obodivske, Tsybulivske	6/2, 7/2; 16/1, 17/1
7	*Quercus robur*	194,5	Zhmerynske, Zhmerynske	73/2, 3, 74/1-5, 75/3, 76/1-3
8	*Quercus robur*	106,4	Kryzhopilske, Rudnytske	54/2, 3, 7; 5/1, 3, 6, 58/1, 2
9	*Quercus robur*	20,5	Tulchynske, Bratslavske	6/4
10	*Quercus robur*	9,5	Tulchynske, Bratslavske	11/5
11	*Quercus robur*	137,9	Tulchynske, Bratslavske	35/2, 8, 9, 36/8, 9, 37/3-5, 8, 9, 38/2, 6, 39/1, 40/1
12	*Quercus robur*	72,9	Tulchynske, Shpykivka	91/2, 17, 92, 4, 12, 93/8
13	*Quercus robur*	37,4	Khmilnytske, Litynske	42/2
14	*Quercus robur*	94,2	Khmilnytske, Litynske	52/4, 53/2, 5; 54/9, 14
15	*Quercus robur*	9,1	Mohyliv-Podilskyi, Moyivske	6/3, 19/3
Total		1285,3	-	-

Table 3

Location and area of forest plus stands of English oak in Vinnytsia region

No. of the sample plot of plus stands	Area, ha	Location of the plus plantation		
		Forestry	Location in forest area	
1	57,1	Kryzhopilske	39	3
2	19,0	Kryzhopilske	40	1
3	2,5	Chechelnitske	68	2 (3)
4	44,0	Chechelnitske	71	1
5	64,0	Chechelnitskoye	70	2
6	12,7	Illinetske	36,37	5,6
7	8,0	Illinetske,	36,37	3, 2
8		Nemyrivske		
9	31,5	Kryzhopilske	40	2, 3, 4, 5
10	40,6	Kryzhopilske	41	1, 2, 3, 4
11	49,4	Kryzhopilske	42	1, 2, 3, 7
12	39,2	Kryzhopilske	43	1, 2, 3, 4
13	70,8	Kryzhopilske	44	1, 2, 3, 4, 5, 6, 7, 9, 11
14	37,5	Kryzhopilske	68	3
15	54,0	Kryzhopilske	55	1
Total	530,3	-	-	-

The constant presence of sessile oak (*Quercus petraea (Matt.) Lieb*) (10-40% units) was noted in the most forest stands of the southern part of the Vinnytsia region. Therefore, in this case, it is advisable to distinguish sessile oak along with English oak. A significant number of oak trees also represents by hybrid forms.

Most of the forest gene reserves were unsuccessfully selected in the 1980s. These are mainly stands growing in ravines and gullies where forest management is difficult. These areas include forest genetic reserves of the SE “Kryzhopilske Forestry” (part of the reserve), SE “Tulchynske Forestry”, SE “Vinnytske Forestry”.

The oak trees account for less than 20-30% in most stands of forest genetic reserves.

Some of the forest gene reserves are represented by forest plantation of 60-70 years of age (SE “Tulchynske Forestry”). Such reserves should be

excluded from the SR. The most highly productive are the plus stands and forest genetic reserves of SE "Vinnytsa", SE "Zhmerynka" SE "Illinetsi", SE "Tulchyn".

Table 4

Mensuration characteristics of plus stands and forest genetic reserves in Vinnytsia region

Location	Tree species composition of the stands	A, years	DBH, cm	H, м	Growing stock ($m^3 \cdot ha^{-1}$)
SE "Chechelnytske Forestry"					
1/68,1	*Quercus robur* – 50% *Carpinus betulus* – 30% *Quercus petraea* – 20%	120	50,1	28,0	419
2/55,1	*Quercus robur* – 50% *Quercus petraea* – 20% *Fraxinus excelsior* – 20% Carpinus betulus – 10%	120	42,6	26,5	430
3/57,4	*Quercus robur* – 70% *Quercus petraea* – 10% *Carpinus betulus* – 10%	120	43,5	26,5	499
4/71,1	*Quercus robur* – 40% *Carpinus betulus* – 20% *Fraxinus excelsior* – 20% *Quercus petraea* – 10% *Acer campestre* – 10%	120	50,9	26,5	324
SE "Obodivske Forestry"					
5/6,1	*Quercus robur* – 30% *Fraxinus excelsior* – 20% *Tilia cordata* – 20% *Carpinus betulus* – 20% *Quercus petraea* – 10%	120	47,5	26,5	365
6/17,1	*Quercus robur* – 30% *Tilia cordata* – 30% *Fraxinus excelsior* – 20% *Carpinus betulus* – 20%	120	43,2	27,5	389
SE "Bershadske Forestry"					
7/11,8	*Quercus robur* – 60% *Fraxinus excelsior* – 20% *Carpinus betulus* – 10%	130	57,8	30,5	538

	Tilia cordata – 10%				
SE “Kryzhopilske Forestry”					
8/40,1	*Quercus petraea* – 30% *Quercus robur* – 20% *Carpinus betulus* – 20% *Acer platanoides* – 10% *Fraxinus excelsior* – 10% *Tilia cordata* – 10%	110	48,1	27,0	448
9/39,2	*Quercus robur* – 40% *Fraxinus excelsior* – 30% *Quercus petraea* – 10% *Carpinus betulus* – 10% *Tilia cordata* – 10%	110	43	26,0	323
10/55,8	*Quercus petraea* – 40% *Carpinus betulus* – 30% *Quercus robur* – 20% *Fraxinus excelsior* – 10%	105	47,3	27,0	429
11/58,2	*Fraxinus excelsior* – 40% *Carpinus betulus* – 40% *Quercus robur* – 10% *Quercus petraea* – 10%	110	46,1	27,5	305
SE “Tulchynske Forestry”					
12/39,1	*Quercus robur* – 80% *Carpinus betulus* – 20%	100	45,8	26,5	484
13/35,2	*Quercus robur* – 90% *Carpinus betulus* – 10%	65	28,7	26,5	434
14/11,9	*Quercus robur* – 80% *Carpinus betulus* – 20%	110	37,0	27,0	394
15/92,6	*Carpinus betulus* – 40% *Fraxinus excelsior* – 30% *Quercus robur* – 20% *Tilia cordata* – 10%	110	44,6	28,5	270
SE “Mohyliv-Podilskye Forestry”					
16/19,3	*Quercus robur* – 80% *Carpinus betulus* – 10% *Cerasus avium* – 10%	85	35,4	23,0	385
SE “Illinetske Forestry”					
17/36,3	*Quercus robur* – 90% *Carpinus betulus* – 10%	110	47,3	29,5	519

SE “Khmilnytske Forestry”					
18/42,2	*Quercus robur* – 50% *Carpinus betulus* – 30% *Tilia cordata* – 10% *Acer pseudoplatanus* – 10%	105	53,2	28,0	236
19/53,2	*Tilia cordata* – 70% *Quercus robur* – 30%	105	46,3	28,5	488
SE “Zhmerynske Forestry”					
20/74,3	*Quercus robur* – 80% *Carpinus betulus* – 20%	130	44	2	404
SE “Vinnytske Forestry”					
21/72,5	*Fraxinus excelsior* – 70% *Carpinus betulus* – 20% *Tilia cordata* – 10%	95	41,7	28,5	341
22/13,10	*Quercus robur* – 90% *Carpinus betulus* – 10%	110	43	28,5	508
23/59,1	*Quercus robur* – 30% *Carpinus betulus* – 30% *Tilia cordata* – 20% *Fraxinus excelsior* – 20%	105	56	29,0	288
24/60,1	*Quercus robur* – 40% *Carpinus betulus* – 30% *Fraxinus excelsior* – 10% *Acer platanoides* – 10% *Tilia cordata* – 10%	95	56	28,5	409

The analysis of mensuration characteristics of the established sample plots in genetic reserves and plus stands showed that there have been no significant changes in the tree species composition and productivity of stands over the past 20 years. There are natural trends in the growth of the average height and diameter of the stands. A two-unit decrease in the share of the main species was detected in SE “Bershadske Forestry”, SE “Chechelnytske Forestry”, SE “Mohyliv-Podilske Forestry”, SE “Khmilnykske Forestry”, SE “Tulchynske Forestry”. A decrease in completeness was noted in the SE “Kryzhopilske Forestry”, and SE “Khmilnykske Forestry”.

A complex of abiotic and biotic environmental factors has negatively affected forest genetic reserves over the last decades. This results in deterioration and decline of trees. The icebreaker in 2000 was the most

significant abiotic factors affecting the region's forest ecosystems. The most of forest stands and tree crowns were damaged by ice in the southern part of the Vinnytsia region. Today, there is an intensive growth of phytomass and restoration of the crowns of damaged trees. The main factors that have significantly affected the sustainability of forest ecosystems in the region are also periodic damage by a complex insect pests and disease. Negative weather and climate conditions (insufficient moisture) in recent years have aggravated the situation.

Additional indicators were used to assess the damage and recovery of stands. The influence of negative factors on the change in the selection categories of stands was also determined. According to the data presented in Table 5, damage of stands by ice ranges from 72 % in the south to 12 % in the north of the region.

Table 5

The state of plus stands and forest genetic reserves in Vinnytsia region

N	Tree species composition	Damage, %	Selection category		Length of crowns,%	Condition, score
			after the ice break	before the ice break		
1	*Quercus robur* – 50% *Carpinus betulus* – 30% *Quercus petraea* – 20%	59	2,5	2,3	39	2,5
2	*Quercus robur* – 50% *Quercus petraea* – 20% *Fraxinus excelsior* – 20% *Carpinus betulus* – 10%	72	2,6	2,4	46	2,3
3	*Quercus robur* – 70% *Quercus petraea* – 10% Carpinus betulus – 10%	67	2,5	2,4	36	3,2
4	*Quercus robur* – 40% *Carpinus betulus* – 20% *Fraxinus excelsior* – 20% *Quercus petraea* – 10% *Acer campestre* – 10%	58	2,6	2,3	50	2,8
5	*Quercus robur* – 30% *Fraxinus excelsior* – 20% *Tilia cordata* – 20%	68	2,9	2,6	40	3,2

	Carpinus betulus – 20% *Quercus petraea* – 10%					
6	*Quercus robur* – 30% *Tilia cordata* – 30% *Fraxinus excelsior* – 20% *Carpinus betulus* – 20%	68	2,5	2,3	32	3,1
7	*Quercus robur* – 60% *Fraxinus excelsior* – 20% *Carpinus betulus* – 10% *Tilia cordata* – 10%	41	2,7	2,6	28	3,0
8	*Quercus petraea* – 30% *Quercus robur* – 20% *Carpinus betulus* – 20% *Acer platanoides* – 10% *Fraxinus excelsior* – 10% *Tilia cordata* – 10%	57	2,4	2,2	34	3,0
9	*Quercus robur* – 40% *Fraxinus excelsior* – 30% *Quercus petraea* – 10% *Carpinus betulus* – 10% *Tilia cordata* – 10%	67	3,1	2,8	45	2,8
10	*Quercus petraea* – 40% *Carpinus betulus* – 30% *Quercus robur* – 20% *Fraxinus excelsior* – 10%	64	2,6	2,3	40	3,1
11	*Fraxinus excelsior* – 40% *Carpinus betulus* – 40% *Quercus robur* – 10% *Quercus petraea* – 10%	56	2,5	2,2	41	3,2
12*	*Quercus robur* – 80% *Carpinus betulus* – 20%	54	2,7	2,7	26	3,1
13*	*Quercus robur* – 90% *Carpinus betulus* – 10%	32	2,7	2,6	28	2,9
14	*Quercus robur* – 80% *Carpinus betulus* – 20%	49	2,5	2,4	33	2,7
15	*Carpinus betulus* – 40% *Fraxinus excelsior* – 30% *Quercus robur* – 20% *Tilia cordata* – 10%	45	2,8	2,7	33	3,1

16	*Quercus robur* – 80% *Carpinus betulus* – 10% *Cerasus avium* – 10%	48	2,7	2,6	31	3,0
17*	*Quercus robur* – 90% *Carpinus betulus* – 10%	48	2,1	2,1	35	2,9
18*	*Quercus robur* – 50% *Carpinus betulus* – 30% *Tilia cordata* – 10% *Acer pseudoplatanus* – 10%	12	2,4	2,4	35	2,9
19	*Tilia cordata* – 70% *Quercus robur* – 30%	12	2,4	2,4	30	2,6
20	*Quercus robur* – 80% *Carpinus betulus* – 20%	35	2,5	2,5	29	2,9
21	*Fraxinus excelsior* – 70% *Carpinus betulus* – 20% *Tilia cordata* – 10%	18	2,5	2,5	25	2,8
22	*Quercus robur* – 90% *Carpinus betulus* – 10%	31	2,5	2,5	34	2,7
23	*Quercus robur* – 30% *Carpinus betulus* – 30% *Tilia cordata* – 20% *Fraxinus excelsior* – 20%	32	2,6	2,6	38	2,8
24	*Quercus robur* – 40% *Carpinus betulus* – 30% *Fraxinus excelsior* – 10% *Acer platanoides* – 10% *Tilia cordata* – 10%	29	2,4	2,3	38	2,8

Notes. * - stands with a high level of crown defoliation were noted.

There was no decrease in the selection category of the stands due to damage of crowns by the ice. Thus, with a maximum damage of 72 %, the selection category of the stands decreased by only 0.2. Shoots were formed mainly on the trunks and crowns of damaged trees. The intensive growth of phytomass in sufficient quantities provided woody plants with plastic substances to maintain their vital activity. Tree crowns were restored.

The situation is somewhat different with damage of stands by insect pests. Due to the dry weather during the last vegetation periods, the stands have not recovered properly. The trees of such stands are characterized by low shoot formation and weak growth of phytomass. The tree condition

category, which combines all damage factors, ranges from 2.5 to 3.1. The value of the condition category does not significantly change with the degree of icebreaker stands.

The analysis of the comprehensive assessment of the condition of forest genetic reserves and plus stands showed that most of the stands of the reserves are in good and excellent condition and correspond to their status, and only the condition of stands of the SE "Kryzhopil", SE "Vinnytsia" can be assessed as satisfactory and unsatisfactory.

Most of the *in situ* gene pool in Kyiv region within the Right-Bank Forest-Steppe of Ukraine are concentrated in the SE «Bilotserkivske Forestry» and SE «Klavdievske Forestry». General characteristics of forest genetic reserves are presented in Table 6.

The forest genetic reserves of the English oak are mainly represented by oak-pine stands. In oak forests, the genetic reserves are mostly oak and oak-ash with the dominance of common common hornbeam. The general survey of forest genetic reserves and plus stands indicates good and satisfactory condition. No significant deterioration or tree decline of the main forest-forming species in forest stands was detected.

Over the past 20 years, there have been general trends in increasing the productivity of stands by increasing the average height and diameter of trees. In two of the stands surveyed in the SE "Bilotserkivske Forestry", a decrease in the share of oak in the composition of stands by 10-20% was observed (Table 7).

The stands are characterized by good condition (condition category 1.8-2.7). Some trees show signs of pest damage and decline. However, the share of such trees in the stand is not significant. Most of the trees have well-developed crowns (Table 8).

The forest genetic reserve in the SE "Klavdiyivske Forestry" is somewhat worse (condition category 3, 2). The selection category of trees is 2.1-2.9. The best breeding assessment was established for the stands of the SE "Bilotserkivske Forestry".

Within the Cherkasy region, a survey of forest genetic reserves and plus stands of the SE "Kamiankivske" and SE "Umanske Forestry" was conducted. The age range of the surveyed genetic reserve stands is 90-105 years. In the tree species composition in most stands there is a constant participation of common ash. The share of ash is 30-60%. The stands are characterized by growing stock 282-338 $m^3 \cdot ha^{-1}$.

Table 6

Mensuration characteristics of forest genetic reserves of the Kyiv region in year of selection (1983)

Year selection	Area, ha	Tree species composition of the stands	Age, years	Average		Growing stock ($m^3 \cdot ha^{-1}$)
				H, m	DBH, cm	
SE "Bilotserkivske Forestry"						
1983	27,9	*Quercus robur* – 80% *Tilia cordata* – 20%	80	23	30	270
1983	50,0	*Quercus robur* – 80% *Tilia cordata* – 20%	80	23	30	270
1983	60,0	*Quercus robur* – 80% *Tilia cordata* – 20%	80	23	30	270
1983	60,0	*Quercus robur* – 80% *Tilia cordata* – 20%	80	23	30	270
SE "Bilotserkivske Forestry"						
1983	18,9	*Quercus robur* – 50% *Tilia cordata* – 50%	85	25	30	290
1983	20,0	*Quercus robur* – 50% *Tilia cordata* – 50%	85	24	28	260
1983	20,0	*Quercus robur* – 70% *Tilia cordata* – 30%	90	23	28	260
SE "Bilotserkivske Forestry"						
1983	4,1	*Quercus robur* – 70% *Tilia cordata* – 20% *Pinus sylvestris* – 10%	100	26	32	270
SE "Klavdiyivske Forestry"						
1983	15,0	*Quercus robur* – 100%	120	28	40	340

Over the past 25-40 years, certain changes have occurred in the stands. First of all, we should note the increase in percentage of common ash in the composition of stands due to the loss of common hornbeam. The decline in the share of common hornbeam is due to its lower durability. Thus, during 1980-2020, the share of common hornbeam in the composition of the stands decreased by 20%. In most cases, the share of oak has not changed, which indicates the absence of progressive pathogenic decline. The average height growth ranged from 4 to 10 m. During the study period, there was also a

natural increase in the average diameter. In the forest stands of the SE "Umanske Forestry", the share of English oak in the composition of stands was the lowest and amounted to about 30%. It should be noted, that an insignificant proportion of English oak was observed at the time of selection of these stands. There has been no significant decline in the fullness of these stands over the last 20-30 years. There was some increase in the average height (by 3-4 m) and the growing stock of the stand (by 80-110 m^3 /ha) (Table 9).

Table 7

Current mensuration characteristics of stands of forest genetic reserves in Kyiv region

Location	Tree species composition of the stands	Age, years	Average		Growing stock ($m^3 \cdot ha^{-1}$)
			H, m	DBH, cm	
SE "Bilotserkivske Forestry"					
49	*Quercus robur* – 90% *Tilia cordata* – 10%	100	26,0	35,8	541
50	*Quercus robur* – 60% *Tilia cordata* – 40%	100	26,0	42,8	462
SE "Bilotserkivske Forestry"					
122	*Tilia cordata* – 60% *Quercus robur* – 40%	105	26,0	42,0	418
124	*Quercus robur* – 50% *Tilia cordata* – 50%	110	27,0	41,0	417
SE "Bilotserkivske Forestry"					
39	*Quercus robur* – 90% *Carpinus betulus* – 10%	130	31,0	49,6	634
49	*Quercus robur* – 90% *Betula pendula* – 10%	120	30,0	48,0	534
SE "Klavdiyivske Forestry"					
38	*Quercus robur* – 80% *Carpinus betulus* – 10% *Alnus glutinosa* – 10%	110	31,5	47,7	411

In the SE "Uman Forestry", the share of English oak in the stands is the largest and reaches 60-80%. The average height has increased by 10 m and diameter by 17-18 cm in recent decades. At the same time, there have been

negative changes associated with a decrease in stand and a slight increase in the total growing stock (by 40 m^3). The share of common hornbeam in the stand decreased by 20%. The overall productivity of the stand in terms of height has increased. In general, the stands are characterized by fairly high mensuration characteristics and high productivity.

Table 8

Distribution of common oak trees by Kraft classes, breeding categories and plantation condition categories of forest genetic reserves of hardwoods in Kyiv region

Distribution of trees by Kraft class, %.						Distribution of trees by selection category, %.					Distribution of trees by condition categories, %.					
I	II	III	IV	V	average	I	II	III	IV	average	I	II	III	IV	V	average
SE "Bilotserkivske Forestry"																
14	64	17	0	6	2,4	3	61	33	3	2,4	89	6	3	3	0	1,8
9	21	7	1	0	2,2	63	29	9	0	2,6	77	14	3	3	3	1,8
15	62	19	4	0	2,4	4	62	31	4	2,6	31	54	15	0	0	2,1
15	46	15	0	23	1,8	65	35	0	0	2,1	21	55	0	0	24	2,7
26	53	21	0	0	2,2	6	58	36	0	2,6	69	26	5	0	0	1,9
17	40	17	26	0	2,2	3	56	35	6	2,6	45	53	0	0	3	1,7
SE "Klavdiyivske Forestry"																
10	63	21	6	0	2,2	4	21	52	23	2,9	22	19	17	12	30	3,2

Table 9

Mensuration characteristics of forest genetic reserves and plus stands in Cherkasy region and their dynamics

Year of selection, inventory	Plantation composition	Medium			Growing stock ($m^3 \cdot ha^{-1}$)
		A, years	H, m	DBH, cm	
SE “Kamiankivske Forestry”					
2014	*Fraxinus excelsior* – 60% *Quercus robur* – 40%	90	32,0	56,0	338
SE “Uman Forestry”					
1980	*Fraxinus excelsior* – 40% *Quercus robur* – 30% *Carpinus betulus* – 30%	85	26,5	40,0	300
	Quercus robur – 30% *Fraxinus excelsior* – 30%	95	26,5	40,0	300

	Carpinus betulus – 30% *Tilia cordata* – 10%				
2014	*Fraxinus excelsior* – 40% *Quercus robur* – 30% *Tilia cordata* – 20% *Carpinus betulus* – 10%	110	30,5	48,3	379
	Fraxinus excelsior – 60% *Quercus robur* – 30% *Carpinus betulus* – 10%	120	30,0	45,9	411
1980	*Quercus robur* – 60% *Carpinus betulus* – 30% *Fraxinus excelsior* – 10%	80	21,0	28,0	240
2014	*Quercus robur* – 80% *Carpinus betulus* – 10% *Fraxinus excelsior* – 10%	105	31,0	45,2	282

The stands are characterized by good quality structure, no trees with significant trunk curvature, and no defects or damage. The stand is without significant damage by insect pests or pathogens. The selection categoryof the English oak ranges from 2.1-2.5. The highest selection category was 1.0. The condition of trees of the main forest-forming species varies from 2.4 to 3.0.

No significant negative trends were found in the plus stands and genetic reserves. The existing stands fulfill their functions and are in good condition. In some cases, there is damage to oak stands by a complex of insect pests. Intensive damage, with defoliation of about 30%, was detected in only one stand. The damage to the stands is not intense and will not lead to an increase in pathogenic decline in the future. Natural seed regeneration of the main forest-forming species is unsatisfactory.

The lack of reliable self-seeding and undergrowth of English oak indicates negative trends in the genesis of their development and the formation of a uneven-aged stand.

In general, in Cherkasy region, the gene pool includes highly productive oak and ash stands with high selection structure. The first one is the stands of the genetic reserve of the SE “Umanske Forestry”. The selection category of this stand is 2.2. Despite the moderate mensuration characteristics, a significant proportion of trees of high selection categories (1.0-1.5) characterizes the stands. The presence of these selection categories makes it possible to select candidates for plus trees.

Table 10

Mensuration characteristics of genetic reserves stands and plus stands in Odesa region

Year of selection, inventory survey	Tree species composition of the stands	Average			Growing stock ($m^3 \cdot ha^{-1}$)
		A, years	H, m	DBH, cm	
FE "Kodymske Forestry"					
1983	*Quercus petraea* – 90% *Tilia cordata* – 30%	85	22,0	26,0	270
1983	*Quercus petraea* – 100%	70	23,0	26,0	300
1983	*Quercus petraea* – 100%	85	22,0	28,0	300
1983	*Quercus petraea* – 100%	90	24,0	30,0	320
1983	*Quercus petraea* – 100%	70	22,0	26,0	300
1983	*Quercus petraea* – 100%	85	25,0	26,0	340
2004	*Quercus robur* – 60% *Quercus petraea* – 40%	100	27,5	39,2	330
2004	*Quercus petraea* – 50% *Quercus robur* – 40% *Tilia cordata* – 10%	110	31,0	43,4	380
FE "Berezivske Forestry"					
1983	*Quercus robur* – 90% *Pinus sylvestris – 10%*	80	25,0	42,0	250
FE "Savranske Forestry"					
1983	*Quercus robur* – 50% *Tilia cordata* – 40% *Carpinus betulus* – 10%	85	26,0	40,0	266
2004	*Tilia cordata* – 50% *Quercus robur* – 30% *Carpinus betulus* – 20%	120	29,5	41,1	255
FE "Ananievske Forestry"					
1983	*Quercus robur* – 100%	70	24,0	36,0	230
1983	*Quercus robur* – 100%	70	24,0	40,0	220
1983	*Quercus robur* – 100%	70	23,0	36,0	210
2004	*Quercus robur* – 70% *Fraxinus excelsior* – 30%	95	30,5	44,5	326
2004	*Quercus robur* – 80% *Fraxinus excelsior* – 20%	95	29,5	47,4	276

The plus stands in SE "Kamiankivske Forestry", along with its high productivity, does not have high selection structure. In general, the stands successfully fulfill their functions and are characterized by a good selection structure and condition. No pronounced degradation processes were detected.

A survey of forest genetic reserves and plus stands of SE "Kodymske Forestry", SE "Baltske Forestry", and SE "Ananivske Forestry" was conducted in Odesa region (Table 10).

Stands of the forest genetic reserves of 95-120 years old are represented by the predominance of English oak and sessile oak. The share of sessile oak in the composition is 5-6 units. In some stands there is an admixture of common ash. The share of ash in the composition does not exceed 30%. However, the completeness and reserve are relatively low. The growing stock is 255-380 m^3/ha.

The forest genetic reserves are represented mainly by stands of sessile oak, which are concentrated in the northern part of Odesa region. The stands are localized mainly in the lowlands and slopes of the northern exposure. The composition is dominated by two main species – English oak and sessile oak with an admixture of Norway maple, field maple, silver birch, common hornbeam and other woody species. The predominant selection categoryis 2.6. The trees are mostly characterized by satisfactory condition – the average condition category is 2.8-3.0.

While the plantations of the Kodymske and Ananievske forestry enterprises are characterized by moderate productivity, the stands of the Savranske forestry enterprise, despite their high age, are extremely low in productivity. In general, negative trends are also evident in the genetic reserves of the Kodymske forestry.

One of the main factors that led to a significant decrease in the completeness and, to some extent, the reserve is the significant damage to the stands (up to 70 %) by ice breakers in 2000. Particularly negative trends were noted in the genetic reserve of the Savran forestry. Oak tree mortality, particularly in low-lying areas, has become extremely high. As a result of pathogenic decline, the plantation density decreased to 0.5, and the stock decreased to 255 m^3 . There were no significant changes in the genetic reserve of the Ananievo forestry. Generally accepted patterns for all plantations are a gradual increase in average height and diameter.

The forest genetic reserves and plus plantations of Khmelnytskyi region are characterized by predominant stands of common oak and forest beech. Old-growth beech stands are widespread in the region and have been designated as *in situ conservation sites*.

A total of 15 sites have been designated in the region. Of these, 8 are forest genetic reserves and 6 are plus plantations. The largest number of plantations is concentrated in Yarmolynets forestry. The dynamics of taxation indicators of forest genetic reserves and plus plantations in Khmelnytskyi region indicates a fairly high productivity of plantations.

Selection and allocation of plus stand in SE "Kamianets-Podilskye Forestry" was carried out in 1977. The average age of the plus stand was 90 years. The stand is represented by English oak, common hornbeam and field maple. There is no undergrowth and self-seeding of English oak. The beech forest stands are dominated in the SE "Yarmolynetske Forestry" (tab. 11).

Table 11

Dynamics of mensuration characteristics of forest genetic reserves and plus stands in Khmelnytsky region

Year of selection, inventory	Tree species composition of the stands	Average			Growing stock ($m^3 \cdot ha^{-1}$)
		A, years	H, m	DBH, cm	
SE "Yarmolynetske Forestry"					
1983	*Fagus sylvatica* – 70% *Carpinus betulus* – 20% *Fraxinus excelsior* – 10%	95	27	36	350
	Fagus sylvatica – 100%	100	27	40	310
2004	*Fagus sylvatica* – 100%	120	33,5	52,1	605
1983	*Fagus sylvatica* – 90% *Carpinus betulus* – 10%	110	30	44	400
	Fagus sylvatica – 90% *Carpinus betulus* – 10%	125	30	40	430
	Fagus sylvatica – 50% *Fraxinus excelsior* – 40% *Carpinus betulus* – 10%	120	30	40	400
2004	*Fagus sylvatica* – 100%	145	33,0	50,9	578
1983	*Fagus sylvatica* – 80% *Carpinus betulus* – 20%	150	30	56	300
2004	*Fagus sylvatica* – 100%	170	34,0	53,0	680
	Fagus sylvatica – 90% *Carpinus betulus* – 10%	70	26,5	34,1	409
1983	*Fagus sylvatica* – 50% *Carpinus betulus* – 50%	150	30	60	250

2004	*Fagus sylvatica* – 100%	170	34,5	52	663
SE “Kamianets-Podilske”					
1977	*Quercus robur* – 90% *Carpinus betulus* – 10%	90	28	44	310
2004	*Tilia cordata* – 50% *Quercus robur* – 30% *Carpinus betulus* – 20%	120	29,5	41,1	255
1977	*Quercus robur* – 100%	110	27	48	220
2004	*Quercus robur* – 80% *Carpinus betulus* – 20%	140	30,5	53,6	432
SE “Izyaslavske Forestry”					
1983	*Quercus robur* – 60% *Pinus sylvestris* – 40%	110	26	32	360
2004	*Pinus sylvestris* – 60% *Quercus robur* – 40%	130	29,0	42,9	407
SE “Shepetivske Forestr”					
1983	*Quercus robur* – 80% *Carpinus betulus* – 20%	85	24	28	310
2004	*Quercus robur* – 80% *Carpinus betulus* – 20%	105	29,5	36,7	326
1983	*Quercus robur* – 70% *Betula pendula* – 20% *Populus tremula* – 10%	85	24	30	210
2004	*Quercus robur* – 100%	105	29,5	35,9	389
SE “Letychivske Forestry”					
1983	*Quercus robur* – 80% *Carpinus betulus* – 20%	95	26	32	360
2004	*Quercus robur* – 90% *Carpinus betulus* – 10%	115	29,0	45,8	479
SE “Starokostiantynivske Forestry”					
1983	*Quercus robur* – 100%	65	24	23	250
	Quercus robur – 100%	65	24	23	250
2004	*Quercus robur* – 100%	85	28	34,9	280

First of all, it is worth noting a significant decrease in the share of oak in some stands, as well as a decrease in the completeness and stocking rate. At the same time, there is a natural increase in the average height of stands. The observed degradation processes are mainly associated with pathogenic

oak dieback, which has led to a significant decrease in its share – from 90% to 30% over the past 30 years.

The oak plus stands are characterized by a satisfactory selection structure. In most cases, larger specimens were characterized by a low selection category. The main defects that were widespread and significantly reduced the selection category include the curvature of tree trunks. The stands was also periodically damaged by insect pests. The consequence of which is: significant sparsity of tree crowns; presence of underdeveloped leaves of summer formation of a characteristic light green color, which was formed as a result of early spring damage; significant damage in the form of loss of leaves of the spring (first) generation; more intense powdery mildew damage to the leaves of the second (summer) generation and their premature fall. The significant impact of biotic factors was most likely to occur over the past 2-5 years. The existing signs of damage by insect pests. In general, plus stands do not meet their criteria due to: significant stand thinning; low selection structure; insignificant stand productivity in terms of height and diameter.

The several genetic reserves and plus stands of beech were identified in the SE "Yarmolynetske Forestry" in 1983. All selected stands are old-growth beech trees. Average growing stock was 500-700 m^3. Most of the stands are represented by old European beech stands. However, there are also significant areas of common hornbeam derivatives that were formed as a result of clear-cutting in the past. Preservation and expanded reproduction of the valuable European beech formations is a prerequisite for the future direction of forest management.

The forest genetic reserves of European beech within the tract are represented by the predominant stands of both high productivity and improved selection structure. As a result of the inventory of forest stands, significant clumps of viable self- seeding and undergrowth of beech were recorded, as well as the formed uneven-aged and multi-storey stands. The presence of reliable self-seeding and undergrowth, as well as the formed uneven-aged and multi-storey stands indicates the high resistance of these forest ecosystems to environmental conditions.

During the inventory of the forest area, clumps of sanitary felling were found, which were carried out as a result of a storm. A detailed inspection of these areas did not reveal reliable self-seeding and undergrowth of beech. This led to its replacement by secondary species: common hornbeam, Norway maple and field maple, as well as other related species. The above fact indicates that any logging in beech plantations should be accompanied

by a clear focus on their natural regeneration. Successful natural regeneration of beech stands is possible only if there is a sufficient amount of viable self-seeding and undergrowth.

The complex of management measures in beech stands should be aimed at the formation of multi-age productive stands. The main directions of management in this forest area should primarily be aimed at reducing the area of derivative common hornbeams and the formation of European beech stands with improved selection characteristics. The formation of such stands should begin in the seed years.

The investigation of the stand revealed significant damage to the plus stands and genetic reserves of the forest European beech complex by insect pests. The stands on the canopies and slopes of the southern exposure were more intensively affected by insect pests. The significant loss of leaf surface was not compensated by its growth during the growing season. The processes of photosynthetic apparatus regeneration were slow. As a result, as of July-August, most of the crowns of such stands were characterized by low density. On average, the living part of the crown was about 60 %. Significant damage by leaf- eating insect pests and negative climatic factors caused some deterioration in the condition of these plantations.

Nevertheless, no catastrophic consequences have been observed in such stands. The absence of fresh dead wood indicates that the impact of unfavorable factors was insignificant, and damage of crowns and decline of their parts did not lead to irreversible degradation of the stands. Further reproduction and regeneration will be accompanied by the subsequent renewal of leaves, branches and crowns, which will occur after the population of insect pests decreases. The emergence of fresh deadwood is possible in the next 2-3 years, which will be typical only for trees that have been significantly affected by a complex of unfavorable factors, and their regenerative capacity was too low to ensure the reproduction of the photosynthetic apparatus.

The stands of genetic reserves of European beech forests are mainly located on the edge areas. A small part is located along beams and other elements of the hydrographic grid in conditions D_3, $D_{3–2.}$ The stands are represented by forest beech trees, sometimes with a small participation of common hornbeam in the composition. The analysis of taxonomic and selection indicators as well as the condition of the stands indicates no signs of decline and degradation of the stands.

The forest genetic reserve of the English oak is located in the SE “Starokostiantynivske Forestry”. Over the course of 20 years, the average

stands height increased from 24.0 m to 28.0 m, the average diameter from 23.0 cm to 34.9 cm, and the growing stock from 250 m^3 /ha to 280 m^3 /ha. Along with the identified positive trends, a significant decrease in the fullness of the stand, indicating clearly defined negative trends in the processes of decline and degradation of the stand. Most of the oak trees are predominantly of the first vegetative generation. The length of tree crowns is 44.2 %. The trees are characterized by a low condition category of 2.5, which is the result of abiotic and biotic factors. Among the biotic factors, it should be noted the significant impact of a complex of insect pests. Due to damage in the spring and insufficient recovery of the photosynthetic apparatus, tree crowns did not recover during the growing season.

The forest genetic reserve of SE "Izyaslavskiy Forestry" was selected in 1983. Over the past two decades, there have been natural trends in the growth of average height (by 3.0 m) and average DBH (by 11 cm), and growing stock (by 47 m^3 /ha). At the same time, there are negative trends in the reduction of oak representation to 20%, the location of which is of a clumped nature. The deterioration and loss of pine trees was also detected. As the age of the stand increases, the degradation processes will accelerate.

The genetic reserve in the SE "Shepetivske Forestry" was selected in 1983. Over the past two decades, the stand has increased in height by 5.5 m, DBH by 8.7 cm, and growing stock by 16 m^3 /ha. The average annual growth of the stand is only 0.8 m^3 /ha/year. A slight increase in the total growing stock of the stand is due to pathogenic tree mortality.

The genetic reserve in SPolonske forestry was selected in 1983. Over the last 20 years, there has been a natural increase in the average height (by 5.5 m) and average DBH of the stand (by 5.9 cm), and the growing stock by 179 m^3 /ha. A positive trend is the loss of a significant number of silver birch and aspen trees from the stand. However, this has led to a decrease in the overall completeness of the stand.

The forest genetic reserve of the SE "Khmelnytskyi Forestry" was set aside in 1983. In general, positive changes have been detected over the past two decades. First of all, it is worth noting the increase in the share of oak in the composition of the stands, the growth of average height and average diameter (by 3 m and 13.8 cm, respectively), and growing stock (by 119 m /ha).[3]

Stands of forest genetic reserves in Kirovohrad region are 80-130 years old. The stands are mostly mixed. The share of oak in the stands is 4-10%, which is mainly of seed and partially of vegetative origin. The majority of the stands contain a significant proportion of common hornbeam,

Norway maple, and small-leaved linden. In ash-oak subtypes, the share of ash does not exceed 30% The average height of the surveyed stands is 26.0-31.5 m. The growing stock ranges from 293-558 m^3 /ha. [3]

The most productive is the stand of the SE "Veseli Bokovenkyi" forest genetic reserve. The selection category of trees ranges from 2.1-2.8. The condition of the stands varies from 2.0 to 2.4. The trees of the common ash have slightly better viability. In general, all stands are characterized by relatively high productivity and stability, absence of intensive damage and pathogenic decline. The stands of the forest genetic reserve of the SE "Veseli Bokovenky" were characterized by a high fruitification at the time of the survey.

This stand was in good condition and had a high selection category. English oak, Norway maple, field maple, and small-leaved linden represent the stands. In general, it should be noted that the majority of the stands are highly selected category. The stands are characterized by high quality trunks, absence of significant defects and damage, and are in good condition and are characterized by existing reproductive processes (Table 12).

Table 12

Mensuration characteristics of forest genetic reserves and plus stands in Kirovograd region

Year of selection and inventory	Location	Tree species composition of the stands	Age	H, m	DBH, cm	Growing stock ($m3 \cdot ha^{-1}$)
SE "Chornoliske"						
1983	49, 1	*Quercus robur* – 40% *Fraxinus excelsior* – 40% *Carpinus betulus* – 20%	105	27,0	44,0	390
1983	50, 1	*Quercus robur* – 40% *Fraxinus excelsior* – 40% *Carpinus betulus* – 20%	110	26,0	44,0	400
1983	54, 1	*Quercus robur* – 50% *Fraxinus excelsior* – 20% *Carpinus betulus* – 20% *Tilia cordata* – 10%	105	26,0	44,0	360
1983	55, 2	*Quercus robur* – 50% *Fraxinus excelsior* – 30% *Carpinus betulus* – 20%	105	26,0	44,0	360
2004	49, 1	*Quercus robur* – 50%	130	30,0	60	372

		Carpinus betulus – 20% *Tilia cordata* – 20% *Fraxinus excelsior* – 10%				
2004	40, 1	*Quercus robur* – 80% *Carpinus betulus* – 10% *Tilia cordata* – 10%	90	26,0	34,0	344
2004	40, 1	*Quercus robur* – 100%	90	25,5	36,5	283
2004	24	*Quercus robur* – 70% *Fraxinus excelsior* – 30%	90	29,0	42,9	383
1983	95; 1, 2	*Quercus robur* – 60% *Fraxinus excelsior* – 40%	105	31,2	44,9	398
2004	64; 1	*Quercus robur* – 70% *Carpinus betulus* – 20% *Fraxinus excelsior* – 10%	130	30,0	52,0	457
SE “Veselobokovenkivskyi”						
1983	11; 13, 23, 24, 25	*Quercus robur* – 100%	80	29,0	36,0	450
2004	11; 24	*Quercus robur* – 90% *Acer campestre* – 10%	100	31,5	44,0	558
SE “Golovanivske”						
1983	25, 7	*Quercus robur* – 100%	95	22,6	36,0	311
2004	21, 10	*Quercus robur* – 80% *Tilia cordata* – 10% *Carpinus betulus* – 10%	80	26,5	27,3	429

Based on the results of the surveys, the dynamics of Mensuration characteristics of forest genetic reserves stands, their condition and selection structure during 1983-2023 were analyzed. The indicators at the time of stand selection and the results of current research based on the established trial areas were compared. Most of the stands have retained high productivity and are characterized by fairly high stocks of stemwood, and oak in particular. The composition of the stands is dominated by English oak. The first tier also contains common ash. However, its overall share in the composition is not very high.

Critical values are a decrease in the share of the main forest-forming species by more than 20%, stand completeness – below 0.7, selection category– below 0.3, tree condition category – below 3.0 (Table 13).

Table 13

Distribution of the surveyed forest genetic reserves and plus stands by the dynamics of their condition and breeding evaluation during 1983-2004

Area.	Decrease in the share of the main forest-forming species in the composition by more than 20%, %.	Decrease in stand density below 0.7, %.	Decrease in the selection categoryof trees (below 3.0), %.	Tree condition deterioration (average condition category below 3.0), %.
Vinnytsia	7,7	3,1	1,5	15,4
Kyiv	7,7	1,5	1,5	1,5
Kirovogradskaya	0,0	0,0	10,0	0,0
Odesa	4,6	9,2	4,6	4,6
Khmelnitskaya	4,6	10,8	0,0	0,0
Cherkassy	1,5	0,0	0,0	1,5
Total	26,2	24,6	17,7	23,1

A significant part of the surveyed forest genetic reserves and plus stands is characterized by deterioration of their condition and breeding structure. The decline in the functional suitability of *in situ* gene pool conservation sites is primarily due to unsatisfactory species composition (26.2 %), thinning of stands (24.6 %), and deterioration of tree condition (23.1 %). Most of the stands have a fairly high breeding assessment. Only a small proportion of them (17.7 %) need to be replaced according to this criterion. The most negative trends in terms of decreasing the share of the main forest-forming species were noted in Vinnytsia and Kyiv regions (7.7 %), decreasing the completeness of standss in Odesa and Khmelnytskyi regions (9.2-10.8%), deterioration of the genetic structure in Odesa region (4.6 %), and deterioration of the condition of stands in Vinnytsia region (15.4 %).

In general, the forest genetic reserves surveyed in recent years are in good condition and have a good tree breeding structure. The stands within the Right-Bank Forest-Steppe are mostly represented by deciduous stands with a predominance of English oak and common ash. In some cases, there were stands with English oak only. In the southern part of the region (southern

part of Vinnytsia oblast, northern part of Odesa oblast, western part of Kirovohrad oblast), stands of both English oak and sessile oak are found. These tree species also form hybrid forms.

The stands of English oak are mostly complex in structure and mixed in composition. In the southern part of the region, silver birch is present in the composition. In some stands, the proportion of silver birch reaches 10-20%. Under such conditions, it is advisable to allocate this tree species as a target species.

The forest genetic reserves of English oak and sessile oak are in good condition. Despite significant damage by an icebreaker in 2000, the trees have recovered almost completely due to new shoots, branches and crown development. The predicted intensive damage by stem insect pests and significant decline of the trees did not occur. At present, there are practically no consequences of the icebreaker.

One of the important aspects of the successful genesis of natural oak forests is the presence and successful growth of natural regeneration. Studies of forest genetic reserves have shown that these are mostly single-aged stands represented by one generation. There are negative trends in the gradual aging of oak forests. At the same time, the available natural regeneration identified in the seed years does not ensure further formation of the younger generation of the forest.

Forest beech stands are mainly concentrated in Khmelnytsky region. These stands are mostly pure in composition and complex in structure. The old-growth European beech stands are mostly of different uneven-aged. The stands are characterized by high breeding performance and good condition. There are also stands with common hornbeam in their composition. However, the share of common hornbeam is mostly insignificant and rarely exceeds 1-2 units. The stands of forest beech are mostly characterized by high breeding performance. A significant number of plus trees have been selected in the stands, which can be used to form a permanent forest seed base. The presence of a significant amount of undergrowth ensures the successful genesis of beech stands.

Stands with a predominance of common ash are characteristic of conditions with rich soils. In such stands, the share of ash can reach 50-80%. Ash stands are mostly of high productivity and breeding structure. A sufficient amount of undergrowth ensures their successful natural reproduction. Despite this, in recent decades, the processes of deterioration and decline of ash stands in the region have intensified, due to the impact of insect pests, pathogens, and forest diseases. Processes of mass ash decline

have been identified. Decline is mainly affecting ripening and mature stands.

Forest genetic reserves of black alder occupy small areas and are mainly confined to low relief elements. Given the limited areas of floodplain forests in the region, black alder is not widely distributed. The stands are mostly even-aged and single species structure. The stands are characterized by relatively high breeding performance. Given the regulated nature of rivers, lack of sufficient precipitation, and a declining groundwater level, the condition of most reserves with this species is satisfactory. Natural seed regeneration is practically absent. The main one is the vegetative regeneration of stands after clear-cutting.

The analysis of field materials indicates a significant number of selected forest genetic reserves and plus stands in the middle of the last century. At the same time, the gradual aging of stands requires the application of management measures to ensure their genesis and simultaneous reproduction. This is especially true for stands of English oak and sessile oak [13, 14, 16].

The lack of a clear strategy for their reproduction may lead to their loss in the coming decades [19, 20]. The situation with the stands of common ash and forest beech is much better. The successful genesis of beech is ensured by the available natural regeneration and formation of uneven-aged and multi-storey stands. The gradual change of generations of these stands will ensure the preservation of genetic diversity in the future in the face of anthropogenic environmental change.

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