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VITALITY STRUCTURE AND ITS DYNAMICS IN THE PROCESS OF NATURAL REFORESTATION OF *Quercus robur* L.

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Abstract

The article focuses on the original approach to the division of woody plant populations into the intrapopulation structural groups – cohorts. It is shown that the distinctive features of the natural reforestation process are indicative of the six generalizing models. The essence of vitality analysis is revealed and the expediency of its application to the assessment of cohorts of forest-forming species is justified. The authors' approaches to the study of the dynamics of vitality structure of cohorts by the stages of natural reforestation are proposed. It is shown that on the territory of Left-Bank Polissia of Ukraine the cohorts of Quercus robur differ significantly in the diversity of vitality structure. In most phytocoenoses the Quercus robur cohorts are characterized by the trend towards a decrease in values of the quality index that is often manifested during their transition to the next stage of natural reforestation. On the whole, the facts of steady gradual increase in values of the cohort quality index by the stages of natural reforestation have been registered in neither group of associations. In addition, the undergrowth of Quercus robur is often missing in forests, where this species is represented as part of the parent forest stand, and even where the generative cohorts of Quercus robur are characterized by high values of the quality index. This indicates a significant complexity of the process of self-renewal of oak forests in the conditions of Left-Bank Polissia of Ukraine and the actual lack of habitats, where there would be a complex of ecological and coenotic conditions optimal for the sustainable existence of Quercus robur as part of forest phytocoenoses. This may result in a decrease in the area of pure oak forests and forests with the participation of this species in the region under study and lead to the loss of a number of both sozological valuable forest communities and populations of rare species. These facts indicate the need to carry out the systematic monitoring of the state of oak forests and their natural reforestation in the region and, if required, to use balanced and science-based means to facilitate the natural reforestation of Quercus robur.

Key words: *vitality analysis, Left-Bank Polissia of Ukraine, natural reforestation, population, Quercus robur L.*

INTRODUCTION

Common oak (*Quercus robur* L.) is one of the leading forest-forming species in Europe (Zanetto et al., 1994; Brewer et al., 2002; Ducousso and Bordacs, 2004; Kremer, 2015). Currently, groups with its participation are the centers of peculiar biodiversity and powerful suppliers of ecosystem services (White, 2005; Boczon, 2010; Oliver Tomas, 2011; Rousakova and Tzonev, 2018). Under such conditions, the problem of the conservation and long-term existence of these forests, which is directly related to the question of the progress and effectiveness of natural reforestation in them, is of particular importance. It is this process that ensures the sustainable functioning of forest communities, primarily due to the formation of a constant flow of generations of forest-forming species in phytocoenoses (Spurr and Barnes, 1980; Shirer and Zimmerman, 2010).

The effectiveness of natural reforestation is determined by the number of individuals of the young generation of forest-forming species that are formed under the forest canopy, as well as the level of their vitality. Vital analysis is an effective and informative method of assessing the latter characteristic. Its theoretical basis and algorithm have been formulated by Zlobin (1989, 2018). This method provides for the assessment of vitality of individuals by their morphological characteristics, followed by the establishment of the ratio of the shares of plants of different vitality level in a population and the definition of the general population quality index (Q). The undeniable advantage of vitality analysis is that it excludes a subjective approach and enables to obtain unified data on the vitality of individuals and populations as a whole. Today, vitality analysis is extensively used to assess the condition and progress of natural reforestation of leading forest-forming species in Ukrainian Polissia.

The goal of the article is to assess the state and determine the characteristics of natural reforestation of *Quercus robur* under the conditions of Left-Bank Polissia of Ukraine based on the methodology of vitality analysis and approaches to the determination of the dynamics of vitality parameters.

MATERIALS AND METHODS

The studies were carried out based on the original system of the division of woody plant populations into intrapopulation structural groups - cohorts (Skliar and Zlobin, 2013):

1. Seedlings. These are the plants that appear in spring of the current year. A characteristic feature of individuals of the species with epigeal germination is the presence of cotyledons, and with hypogeal germination - cataphylls. These plants are most commonly found in the above-soil layer below the main canopy of leaf cover of the herbaceous and subshrub layer. In some of phytocoenoses, seedlings are at the level of a moss layer. In the generally accepted system of discrete description of ontogenesis they correspond to the category „p".
2. Plantlets. These are mostly 1 to 3-years-old plants. They have true leaves, predominantly of a juvenile type. Depending on a tree species, they are mostly found under a canopy of leaf cover of the herbaceous and subshrub layer or occupy its lower part. By the ontogenetic state this group is mixed and may include individuals of the category „p" and juvenile individuals of the category „j".
3. Small undergrowth. This is a cohort of plants, which is located entirely in the herbaceous and subshrub layer of forest phytocoenosis. Individuals are up to 50 cm, rarely - up to 60-70 cm in height. Their root system is surface. The calendar age ranges from 3-5 years to decades. By the ontogenetic state these are juvenile or immature individuals, and in adverse environmental conditions, even the so-called quasi-senile („stump plants").
4. Medium undergrowth. The plants of this cohort „emerge" from the herbaceous and subshrub layer and „are embedded" in the undergrowth layer. The individuals of the middle undergrowth are mainly from 0.5 m to 2.5 m in height. By the calendar age they are very different: 10-11 and more years. These are predominantly immature, less commonly, virginile plants. All of them are characterized by a fairly rapid growth in height.
5. Large undergrowth. Individuals of a cohort of large undergrowth are in the undergrowth layer. Compared with small and medium undergrowth, their root system is located in the deeper soil layers. They are mostly plants with a height of 2.5 to 8.0 m. Their calendar age is usually more than 20-25 years (depending on species).
6. Young trees of the upper layer of the forest are in a state of „being embedded" in a tree layer of the forest stand. These are the virginile individuals, which are a little lower than the main canopy of the forest stand.
7. Generative trees of the upper layer of the forest (mature trees). This cohort consists of plants of g_1 - g_3 states. It also includes the subsenile individuals, which still retain reproductive ability. The height and age of trees are determined by their species.

When making the general characterization, the cohorts 1-6 were considered as the young generation of a particular forest-forming species, and the cohorts 3-5 as its undergrowth.

According to the vitality analysis algorithm, the cohorts of *Quercus robur* were originally covered by morphometric studies. 7-26 dimensional indicators were assessed depending on their belonging to a particular cohort. In the next stage the key indicators, that is, those indicators, which were the objective quantitative reflection of the level of vitality, were selected from among the specified morphometric parameters. In this case, the following stages of the calculation procedure were implemented: 1. The selection of the number of morphometric parameters with the highest level of variation; 2. The application of these indicators to a factor analysis; 3. The assessment of the level of correlation between all dimensional indicators and the formation of correlation pleiades; 4. The comparison of the results of factor and correlation solutions;

5. The interpretation of the data obtained on the basis of biological and ecological rules and regularities.

In terms of the theoretical generalization, the vitality analysis for the trees of *Quercus robur*, as well as its large and medium undergrowth was carried out in our work based on such key morphometric parameters as the height of individuals and the diameter of their trunk. This analysis was applied to trees taking into account the belonging of plants to a certain age class.

According to the results of implementation of the vitality analysis algorithm, for small undergrowth of *Quercus robur,* the indicators of absolute growth rate of phytomass (AGRW), absolute growth rate of height (AGRH) and total leaf area (A) were chosen as the key morphological parameters. The key morphological parameters for seedlings and plantlets were the height and phytomass of individuals.

On the final stage of calculations, the proportion of plants with different levels of vitality (high - class „a", intermediate - class „b" and low - class „c") as part of cohorts was determined based on the key morphological parameters. According to the ratio as part of cohorts of plants of these three classes, the belonging of a cohort to one of the three quality types (prosperous, balanced or depressed) was established by the quality index value (Q = 1/2 (a+b)).

In order to unify the studies on the dynamics of cohort vitality parameters, in light of scientific studies in this area (Pasternak and Romanov, 1975; Connel, 1989; Seymour and Hunter, 1999; Ward et al., 2006), we have distinguished the three main phases in the process of natural reforestation:

1. **Initial phase**;
2. Phase of undergrowth formation, growth and development (**Undergrowth phase**);
3. Phase of transition of the young generation of forest-forming species to the tree stand (**Tree stand phase**).

The first of the above phases corresponds to the stage of appearance and enshrinement of cohorts of seedlings and plantlets in the forests. The second phase is characterized by the development of the cohorts of undergrowth: small, medium and large. The third phase is final in the natural reforestation cycle. It may provide for two sub-stages: the formation of cohorts of young and mature trees.

Depending on diversity of the above phases and stages, natural reforestation may be either complete or incomplete. We consider it possible to indicate the first of them as the **Isp-Usml-Tym** model or its shortened version - **I-U-T**. The above mentioned model corresponds to the natural reforestation that begins with the formation of seedlings of forest-forming species, which gradually reach the level of forest stand and generative state in the forests.

In the incomplete option, „cyclicity" in the self-renewal of forest phytocoenoses is not achieved. The degree of incompleteness may vary. The specified peculiarity of natural reforestation is illustrated by means of the special models given below.

- **I-Usml-Ty** - young generation of a forest-forming species from the initial phase undergoes all stages of recovery, reaches the level of forest stand, but ceases to develop and often exist, at the level of a cohort of young trees;
- **I-Usml** - natural reforestation terminates when the young generation of forest-forming species reaches the state of large undergrowth;
- **I-Usm** - natural reforestation terminates when the young generation of forest-forming species reaches the state of medium undergrowth;
- **I-Us** - natural reforestation terminates when the young generation of forest-forming species reaches the state of small undergrowth;
- **I** - natural reforestation terminates when the young generation of forest-forming species is at the initial phase (at the level of seedlings or plantlets) of this process.

When studying the dynamics of vitality parameters, we preceded from the fact that under natural reforestation, in the transition of plants from one stage to another the following options may be implemented: a) improvement in the vitality structure of cohorts and increase in their quality index; b) deterioration in the vitality structure of cohorts and decrease in their quality index; c) lack of changes in the vitality structure of cohorts and, consequently, in the quality index value.

The results of the analysis of all theoretically conceivable options for change in the vitality structure of cohorts of various categories of young generation and forest stand that correspond to different stages of natural reforestation provide the evidence of the implementation of different vitality tactics by certain groups of individuals. They manifest themselves in the spatial and temporal flexibility of vitality characteristics and their spatial and temporal variability. The spatial and temporal vitality flexibility is manifested in the change of values of the quality index of certain cohorts (populations) of different categories of young generation and forest stand by different habitat or in time. The spatial and temporal vitality flexibility is implemented through the change of the ratio in the composition of a cohort (population) of individuals of different vitality classes („a", „b" and „c").

Both quantitative and qualitative aspects of the vitality flexibility implementation may be expressed by means of a specially developed index of vitality dynamics (IVD - index of vitality dynamics), calculated according to the following formula (1):

$$IVD = (Q_n - Q_p) / 0.166$$

where: Q_n - value of the cohort (population) quality index at the next stage of reforestation (development or gradient degree);

Q_p - value of the cohort (population) quality index at the previous stage of reforestation (development or gradient degree);

0.166 - value of the quality index, at the level of which populations are transferred from one quality type to the other (according to the provisions of the classical vitality analysis, a population is depressed if the value of quality index Q is 0 - 0.166; balanced if Q is 0.167 - 0.332; prosperous if Q is 0.333 - 0.50).

In general, values of the index of vitality dynamics (IVD) range from -3.012 to +3.012.

If IVD = 0, cohorts are characterized by a lack of changes in the value of the quality index Q by the stages of natural reforestation.

If IVD (in absolute value) is less than 1, changes are insignificant.

If IVD (in absolute value) is from 1 to 2, changes are significant.

If IVD (in absolute value) is greater than 2, changes are dramatic.

If value of IVD is with a minus, there is deterioration in the condition of a cohort (population), with a plus - its improvement (Skliar, 2013).

A complex of the applied methods has enabled to obtain the detailed information on the vitality structure of cohorts, their belonging to the corresponding quality types, as well as on the dynamics of vitality parameters by the stages of natural reforestation.

RESULTS AND DISCUSSIONS

The generalized information on the vitality structure of individual cohorts of *Quercus robur* in different groups of associations of Left-Bank Polissia of Ukraine is given in Tables 1 and 2. It is established that the *Quercus robur* cohorts of pine, pine-oak and oak forests are characterized by a high level of vitality structure diversity. A distinctive feature of the groups of such associations as *Pineta (sylvestris) franguloso (alni) - vacciniosa (myrtilli)*, *Pineta (sylvestris) vacciniosa (myrtilli)*, *Pineta (sylvestris) hylocomiosa* and *Querceto (roboris) - Pineta (sylvestris) vacciniosa (myrtilli)* is that the *Quercus robur* cohorts, which by their vitality structure correspond to all three quality types: from depressed to prosperous are formed within them. Within the groups of such associations as *Pineta (sylvestris) franguloso (alni) - vacciniosa (myrtilli), Pineta (sylvestris) hylocomiosa* and *Querceto (roboris) - Pineta (sylvestris) vacciniosa (myrtilli),* the quality index in some cohorts varies from minimum values (0) to maximum possible (0.5).

The least diverse vitality structure is inherent in the cohorts of *Q. robur* formed under the conditions of maple-oak, lime-oak, birch and aspen forests. They are mainly represented by the *Quercus robur* cohorts of high quality, belonging to the category of balanced or prosperous cohorts. Although, sometimes, depressive cohorts occur in them. In general, the most diverse vitality structure is characteristic of small undergrowth cohorts, and the least diverse vitality structure - of the *Quercus robur* cohorts of large undergrowth.

Table 1. Vitality structure of the cohorts of small undergrowth *Quercus robur*

Association groups	Small undergrowth (Us)			
	share of individuals of different classes			quality index (Q)
	a	b	c	
Pineta (sylvestris) hylocomiosa	0.07-0.89	0-0.40	0-0.88	0.06-0.5
Pineta (sylvestris) calamagrostidosa (epigeioris)	0.2-0.22	0-0.04	0.74-0.80	0.1-0.13
Pineta (sylvestris) coryloso (avellanae) - vacciniosa (myrtilli)	0-0.04	0-0.02	0.94-1.0	0-0.03
Pineta (sylvestris) asarosa (europaei)	0.54-0.56	0.12-0.16	0.28-0.34	0.33-0.36
Pineta (sylvestris) pteridiosa (aquilini)	0.28-0.31	0.10-0.13	0.52-0.62	0.19-0.22
Pineta (sylvestris) franguloso (alni) - vacciniosa (myrtilli)	0.20-0.60	0-0.3	0.3-0.80	0.1-0.35
Pineta (sylvestris) vacciniosa (myrtilli)	0.07-0.33	0.01-0.29	0.64-0.66	0.17-0.18
Pineta (sylvestris) moliniosa (caeruleae)	0.10-0.13	0.43-0.52	0.38-0.44	0.28-0.31
Pineta (sylvestris) sphagnosa	0.01-0.05	0.27-0.29	0.68-0.70	0.15-0.16
Querceto (roboris) - Pineta (sylvestris) vacciniosa (myrtilli)	0.20-0.43	0.15-0.16	0.42-0.64	0.18-0.29
Betuleto (pendulae) - Pineta (sylvestris) vacciniosa (myrtilli)	0.5-0.51	0-0.05	0.44-0.5	0.25-0.28
Querceta (roboris) majanthemosa (bifolii)	0.40-0.41	0.18-0.19	0.40-0.42	0.29-0.30
Querceta (roboris) convallariosa (majalis)	0.05-0.08	0.05-0.20.	0.72-0.90	0.05-0.14
Querceta (roboris) coryloso (avellanae) - convallariosa (majalis)	0.08-0.11	0.08-0.09	0.80-0.84	0.08-0.10
Betuleta (pendulae) vacciniosa (myrtilli)	0.27-0.29	0.05-0.09	0.64-0.66	0.17-0.18
Betuleta (pendulae) stellariosa (holosteae)	0.16-0.17	0.09-0.12	0.72-0.74	0.13-0.14

Table 2. Vitality structure of the cohorts of generative trees *Quercus robur*

Association groups	Generative trees of tree layer (Tm)			
	share of individuals of different classes			quality index (Q)
	a	b	c	
Pineta (sylvestris) vacciniosa (myrtilli)	0-0.10	0-0.10	0.9-1.0	0-0.05
Pineta (sylvestris) moliniosa (caeruleae)	0.42-0.50	0.08-0.10	0.4-0.5	0.25-0.30
Pineta (sylvestris) sphagnosa	0.10-0.12	0.08-0.12	0.78-0.80	0.10-0.11
Querceto (roboris) - Pineta (sylvestris) corylosa (avellanae) sparsi herbosa	0.12-0.18	0.10-0.14	0.72-0.74	0.13-0.14
Querceta (roboris) majanthemosa (bifolii)	0.20-0.25	0.73-0.80	0-0.02	0.49-0.5
Querceta (roboris) aegopodiosa (podagrariae)	0.32-0.4	0-0.06	0.60-0.62	0.19-0.2
Querceta (roboris) convallariosa (majalis)	0.01-1.0	0-0.32	0-0.67	0.17-0.50
Querceta (roboris) coryloso (avellanae) - convallariosa (majalis)	0.94-1.0	0-0.04	0-0.02	0.49-0.5
Acereto (platanoiditis) - Querceta (roboris) coryloso (avellanae) - aegopodiosa (podagrariae)	0.47-0.50	0.23-0.26	0.24-0.30	0.35-0.38
Acereto (platanoiditis) - Querceta (roboris) stellariosa (holosteae)	0.60-0.62	0.16-0.20	0.20-0.22	0.39-0.4
Tilieto (cordatae) - Querceta (roboris) stellariosa (holosteae)	0-0.02	0.96-1.0	0-0.02	0.49-0.5

On the territory of Left-Bank Polissia of Ukraine, the natural reforestation of *Quercus robur* takes place against the background of its correspondence to various models. In a small number of association groups, in particular *Querceta (roboris) convallariosa (majalis)* and *Pineta (sylvestris) vacciniosa (myrtilli)*, there is the complete natural reforestation of *Quercus robur*. It corresponds to the **I-Usml-Tym** model, which is incomplete in these groups due to the absence of some cohorts (medium undergrowth or young trees) under the reforestation (Figure 1).

In the **Isp-Usml-Tym** model by the stages of natural reforestation cohorts show both vitality flexibility and variability. The only exception is the stage of transition from medium undergrowth to large in a group of the

Querceta (roboris) convallariosa (majalis) association. At this stage, the quality index value does not change, while the ratio in the cohorts of individuals of classes „a", „b" and „c" is not the same. The transition from the previous stage to the next is mainly accompanied by a decrease in the quality index value. This occurs against the background of changes in the quality type of cohorts and the constancy of this feature.

The natural reforestation of *Quercus robur*, which corresponds to the models **I-Usml-Ty, I-Usml,** is accompanied by both an increase and a decrease in the quality index during the transition from the previous to the next stage of reforestation, as well as maintenance of the constancy of values of this indicator (Figure 2, Tables 3, 4). Changes in the quality index by the stages of natural reforestation in some cases are significant: the value of the index of vitality dynamics (IVD) (in absolute value) is in the range from 1 to 2. There is the transition of cohorts from one quality category to another.

On the territory of Left-Bank Polissia of Ukraine, *Quercus robur* is widely represented by incomplete natural reforestation, the course of which corresponds to the **I-Usm** model. Its implementation is carried out along with a decrease in the quality index of cohorts in the transition from small to medium undergrowth. Only in 11% of cases these changes are dramatic, while in others they are minor or significant. In 63.2% of cases, a change in the quality index is accompanied by a change in the quality category of cohorts (Table 5).

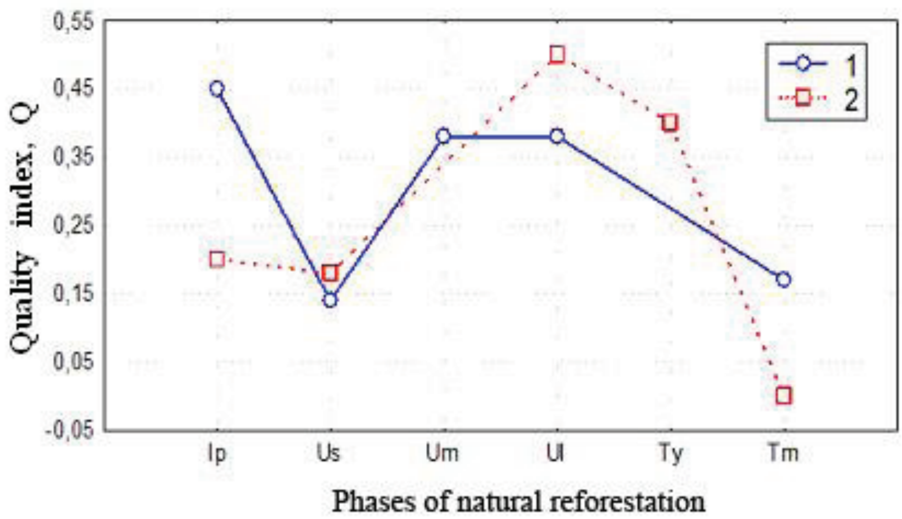

Figure 1. Changes in the quality index of *Quercus robur* under the complete natural reforestation (**I-Usml-Tym** model). Association groups: 1. *Querceta (roboris) convallariosa (majalis)*, 2. *Pineta (sylvestris) vacciniosa (myrtilli)*

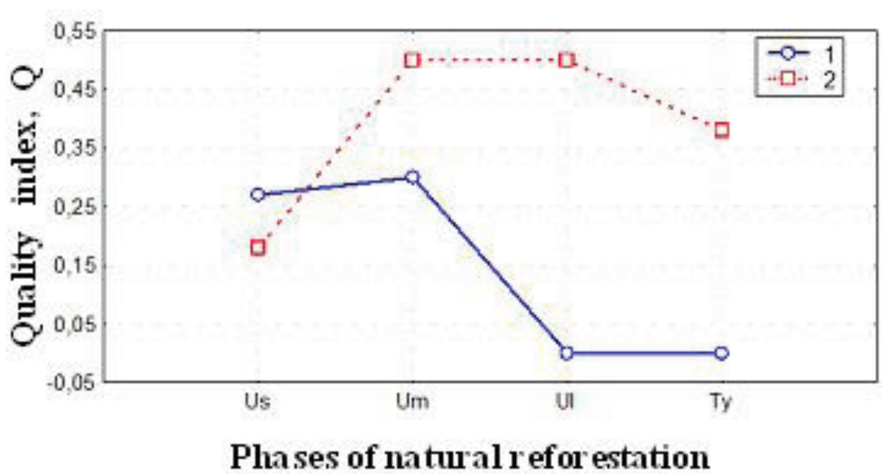

Figure 2. Changes in the quality index of *Quercus robur* under the incomplete natural reforestation (**I-Usml-Ty** model). Association groups: 1. *Pineta (sylvestris) franguloso (alni)–vacciniosa (myrtilli)*, 2. *Querceto (roboris) Pineta (sylvestris) vacciniosa (myrtilli)*

Table 3. Value of the index of vitality dynamics (IVD) and change in the qualitative type of the cohorts *Quercus robur* by the stages of incomplete natural reforestation (**I-Usml-Ty** model)

Phytocenoses of association groups	Transition by the stages of natural reforestation		
	Us→Um	**Um→Ul**	**Ul→Ty**
Pineta (sylvestris) franguloso (alni)-vacciniosa (myrtilli)	0.1807	-1.8072	0
	B-B	B→D	D-D
Querceto (roboris)-Pineta (sylvestris) vacciniosa (myrtilli)	1.8675	0	-0.6627
	B→P	P-P	P-P

Note: In this and similar tables for each group of associations (groups), values of the index of vitality dynamics (IVD) are given in the first line, data on changes in the qualitative type of cohort - in the first line. Letters denote: D - depressed cohort, B - balanced, P - prosperous.

Table 4. Value of the index of vitality dynamics (IVD) and change in the qualitative type of the cohorts *Quercus robur* by the stages of incomplete natural reforestation (**I-Usml** model)

Phytocenoses of association groups	Transition by the stages of natural reforestation	
	Us→Um	**Um→Ul**
Pineta (sylvestris) hylocomiosa	1.626506	-1.98795
	B→P	P→D
Pineta (sylvestris) hylocomiosa	1.686747	-3.01205
	B→P	P→D
Betuleto (pendulae)-Pineta (sylvestris) vacciniosa (myrtilli)	0	0
	B-B	B-B

Table 5. Value of the index of vitality dynamics (IVD) and change in the qualitative type of the cohorts *Quercus robur* by the stages of incomplete natural reforestation (**I-Usm** model)

Phytocenoses of association groups	Transition by the stages of natural reforestation
	Us → Um
Pineta (sylvestris) calamagrostidosa (epigeioris)	0.903614
	D→B
Pineta (sylvestris) franguloso (alni)-vacciniosa (myrtilli)	0.180723
	B-B
Pineta (sylvestris) franguloso (alni)-vacciniosa (myrtilli)	-1.50602
	B→D
Pineta (sylvestris) moliniosa (caeruleae)	-1.0241
	B→D
Querceta (roboris) majanthemosa (bifolii)	1.26506
	B→P
Querceta (roboris) coryloso (avellanae)-convallariosa (majalis)	-0.48193
	D-D
Pineta (sylvestris) hylocomiosa	-1.14458
	B→D
Pineta (sylvestris) hylocomiosa	-1.14458
	B→D
Pineta (sylvestris) hylocomiosa	-2.466988
	P→D
Pineta (sylvestris) hylocomiosa	0
	P-P
Pineta (sylvestris) hylocomiosa	0.421687
	D→B

The small undergrowth of *Quercus robur*, available in the phytocoenoses of oak forests, where the natural reforestation corresponds to the **I–Us** model, basically does not have a high level of vitality (Q=0.04-0.13), which is often much less than the vitality of the parent forest stand cohorts (Q=0.17-0.50). Subject to the implementation of the **I–Us** model of natural reforestation in the forests, the forest stands of which do not contain *Quercus robur*, the small undergrowth of this type mostly has the quality index value of 0.14–0.30, which corresponds to the level of depressive and balanced cohorts. However, 10% of phytocoenoses are characterized by the formation of prosperous cohorts of the small undergrowth of *Quercus robur*, which have a very high value of the quality index (Q=0.5).

In the **I-Us** model of natural reforestation, the highest values of the quality index were registered in the *Quercus robur* cohorts, formed in a group of associations of *Pineta (sylvestris) hylocomiosa*, and the lowest – in a group of associations of *Pineta (sylvestris) sphagnosa.*

In some groups of such associations as (*Acereto (platanoiditis) - Querceta (roboris) coryloso (avellanae) - aegopodiosa (podagrariae)*, *Acereto (platanoiditis) - Querceta (roboris) stellariosa (holosteae)*, *Tilieto (cordatae) - Querceta (roboris) stellariosa (holosteae)*, *Querceta (roboris) aegopodiosa (podagrariae)*), despite the availability of the *Quercus robur* cohorts of generative ontogenetic state of high vitality (Q=0.38-0.50) within their forest stand, the undergrowth of this species is missing. However, the seedlings and plantlets of *Quercus robur* are formed there. In the cohorts of the latter a significant proportion (55-95%) is the individuals of low vitality (class „c"), therefore, the cohorts of seedlings are predominantly depressed ($Q < 0.17$) or balanced ($0.17 < Q < 0.23$).

CONCLUSIONS

The results of vitality analysis applied to various cohorts of *Quercus robur* indicate that in the conditions of Left-Bank Polissia of Ukraine, they differ in diverse vitality structure, which in most cases is the integrated reflection of ecological and coenotic conditions of each habitat.

Among the undergrowth and mature trees there are prosperous cohorts, including those, in which the quality index value reaches the maximum value (0.5).

In most phytocoenoses, the *Quercus robur* cohorts are characterized by the trend towards a decrease in values of the quality index by the stages of natural reforestation. On the whole, the facts of steady gradual increase in values of the cohort quality index by the stages of natural reforestation have been registered in neither group of associations. In addition, the undergrowth of *Quercus robur* is often missing in forests, where this species is represented as part of the parent forest stand, and even where the generative cohorts of *Quercus robur* are characterized by high values of the quality index (0.38-0.50).

These negative facts about the vitality structure of cohorts are observed against the background of a wide representation of incomplete natural reforestation. This indicates a significant complexity of the process of self-renewal of oak forests in the conditions of Left-Bank Polissia of Ukraine and the actual lack of habitats, where there would be a complex of ecological and coenotic conditions optimal for the sustainable existence of *Quercus robur* as part of forest phytocoenoses. The only exception is a group of associations of *Querceta (roboris) convallariosa (majalis).* However, in its groups, as in a vast majority of other groups of associations, different models of natural reforestation are manifested against the background of low density of undergrowth, which in each of its cohorts usually does not exceed 2 000 individuals/ha.

The persistent long-term manifestation of these negative trends may result in a decrease in the area of pure oak forests and forests with the participation of this species. This, in turn, may lead to the loss of a number of both sozological valuable forest communities and populations of rare species. These facts indicate the need to carry out the systematic monitoring of the state of oak forests and their natural reforestation in the region and, if required, to use balanced and science-based means to facilitate the natural reforestation of *Quercus robur.*

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