DISCOVERY OF THE FEATURES AND REGULATIONS OF THE PROCESS OF NATURAL REGENERATION OF FORESTS ON THE BASIS OF THE CONSTRUCTION OF PHYTOCENOTIC PYRAMIDS

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ABSTRACT

Studies were conducted on the territories of the Left Bank Polissia, which aimed to assess the state and find out the peculiarities and patterns of natural seed regeneration of the leading forest-forming species of the Left Bank Polissia of Ukraine – *Pinus sylvestris* L., *Quercus robur* L., *Acer platanoides* L., *Betula pendula* Roth., *Populus tremula* L. as a mechanism for ensuring the preservation and functioning of forest phytocoenoses of this region. Phytocoenoses of 24 groups of associations representing forest communities typical for the region were covered by the study. The studies were carried out based on the original system of the division of woody plant populations into intrapopulation structural groups - cohorts. Considering the established facts regarding the prevalence of cohorts in the phytocoenoses of the Left Bank Polissia of Ukraine, a special method of building phytocoenotic pyramids of natural restoration was developed. According to the results of the analysis of the condition and signs of phytocenotic pyramids, it is shown that the natural regeneration of each of the forest-forming species within the areas of the Left Bank Polissia of Ukraine has its own specific features signs of formation, distribution of cohorts and their transition from tier to tier of forest phytocoenoses. Although all these species are characterized by a tendency to decrease the prevalence of cohorts in the range small undergrowth → medium → large.

Keywords: natural regeneration, forest phytocoenosis, Left bank Ukraine Polissya

INTRODUCTION

In the vegetation cover of the Earth, forests have a leading role both in terms of occupied area and value [1, 2]. An important component of the functioning of forest communities is natural regeneration. It is a complex, long-term and multi-stage process, during which qualitative and quantitative changes occur in individuals of a new generation of forest-forming species, which ensure the consistent transition of these plants from one forest layer to the next and their achievement of the tree stand level [3].

In the territorial aspect, the study of natural restoration and clarification of the above-mentioned problematic issues is especially relevant for regions in which forests play a leading role in the formation of natural complexes and have great ecological, stabilizing, sociological and economic importance. In Ukraine, such territories include both Polissia in general and its Left Bank part in particular.

Taking into account the above, studies were conducted on the territories of the Left Bank Polissia, which aimed to assess the state and find out the peculiarities and patterns of natural seed regeneration of the leading forest-forming species of the Left Bank Polissia of Ukraine – *Pinus sylvestris* L., *Quercus robur* L., *Acer platanoides* L., *Betula pendula* Roth., *Populus tremula* L. as a mechanism for ensuring the preservation and functioning of forest phytocoenoses of this region.

METERIALS & METHODS

Phytocoenoses of 24 groups of associations representing forest communities typical for the region were covered by the study (Table 1).

Table 1. Groups associations of forest vegetation Left Bank Polissya of Ukraine (covered by the research)

	Group of associations
VEGETATION TYPE – SILVAE	*1. Pineta (sylvestris) hylocomiosa*
	2. Pineta (sylvestris) calamagrostidosa (epigeioris)
	3. Pineta (sylvestris) nardosa (strictae)
	4. Pineta (sylvestris) coryloso (avellanae)–vacciniosa (myrtilli)
	5. Pineta (sylvestris) asarosa (europaei)
	6. Pineta (sylvestris) pteridiosa (aquilini)
	7. Pineta (sylvestris) franguloso (alni)–vacciniosa (myrtilli)
	8. Pineta (sylvestris) vacciniosa (myrtilli)
	9. Pineta (sylvestris) moliniosa (caeruleae)
	10. Pineta (sylvestris) sphagnosa
	11. Querceto (roboris)–Pineta (sylvestris) vacciniosa (myrtilli)
	12. Querceto (roboris)–Pineta (sylvestris) corylosa (avellanae) sparsi herbosa
	13. Betuleto (pendulae)–Pineta (sylvestris) vacciniosa (myrtilli)
	14. Querceta (roboris) majanthemosa (bifolii)
	15. Querceta (roboris) aegopodiosa (podagrariae)
	16. Querceta (roboris) convallariosa (majalis)
	17. Querceta (roboris) coryloso (avellanae)–convallariosa (majalis)
	18. Acereto (platanoiditis)–Querceta (roboris) coryloso (avellanae)–aegopodiosa (podagrariae)
	19. Acereto (platanoiditis)–Querceta (roboris) stellariosa (holosteae)
	20. Tilieto (cordatae)–Querceta (roboris) stellariosa (holosteae)
	21. Betuleta (pendulae) vacciniosa (myrtilli)
	22. Betuleta (pendulae) caricosa (pilosae)
	23. Betuleta (pendulae) stellariosa (holosteae)
	24. Populeta (tremulae) stellariosa (holosteae)

The studies were carried out based on the original system of the division of woody plant populations into intrapopulation structural groups - cohorts [4]:

1. Seedlings. These are the plants that appear in spring of the current year.

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.

3. Small undergrowth (**Us**) 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. The calendar age ranges from 3-5 years to decades.

4. Medium undergrowth (**Um**). 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.

5. Large undergrowth (**Ul**). 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 (**Ty**) of the upper layer of the forest are young trees that have not reached generative maturity and are in a state of „being embedded" in a tree layer of the forest stand.

7. Generative trees of the upper layer of the forest (mature trees) (**Tm**). These trees play a leading role in the formation of the tree stand. The height and age of trees are determined by their species.

In the forest phytocenoses of 24 groups of associations covered by the study, research aimed at studying the presence and distribution of each cohort of *P. sylvestris, Q. robur, A. platanoides, B. pendula, and P. tremula* were carried out.

RESULTS

Table 2 shows the results of the study of the distribution of cohorts of this species by forest phytocenoses of the studied region using the example of *P. sylvestris.*

Table 2. Representation of different cohorts of *Pinus sylvestris* in forest phytocoenoses of the Left Bank Polissia of Ukraine

Species	Cohorts	Group of associations[1]									
		1	2	3	4	5	6	7	8	9	10
Pinus sylvestris	Tm	*	*	*	*	*		*	*	*	*
	Ty	*					*	*	*		*
	Ul	*						*			*
	Um	*	*	*				*	*		*
	Us	*	*	*				*	*		*
		group of associations									
		11	12	13	16	20	21	22	23	24	
	Tm	*	*	*		*		*		*	
	Ty			*				*			
	Ul						*				
	Um	*					*		*		
	Us	*			*		*		*		

Notes: [1]. The numbering of association groups corresponds to Table 1, and the * mark indicates the presence of plants of the corresponding cohort in these forests. Table 2 does not include groups of associations in which natural recovery of *P. sylvestris* has not been registered.

Considering the established facts regarding the prevalence of *P. sylvestris, Q. robur, A. platanoides, B. pendula, P. tremula* cohorts in the phytocoenoses of the Left Bank Polissia of Ukraine, a special method of building phytocoenotic pyramids of natural restoration was developed. Their degrees, corresponding to each specific cohort, provide information on the number of forest phytocoenoses or their types, which include plants of one or another intra-population group. Four theoretically possible types of pyramids

reflect the most all the main options for the possible distribution of cohorts by phytocoenoses (Fig. 1):

1. Each subsequent (older) cohort of a certain species has a lower representation in forest phytocoenoses.

All cohorts of one or another species are present in the same number of forest phytocenoses.

3. Each older cohort, compared to the younger, is represented in a greater number of forest phytocenoses, which indicates the significant complexity of the natural regeneration of one or another species. The appropriateness of restoration of such a model can lead to a significant transformation of forest phytocenoses (primarily natural in origin).

4. The transition from each previous (younger) cohort to the next (senior) can occur against the background of the most diverse dynamics (increase, decrease, stability) in relation to the representation of cohorts in phytocoenoses. This model is typical for species whose natural recovery in the region is not characterized by the stability of its quantitative and qualitative characteristics, including due to the manifestation of well-defined "waves" of regeneration.

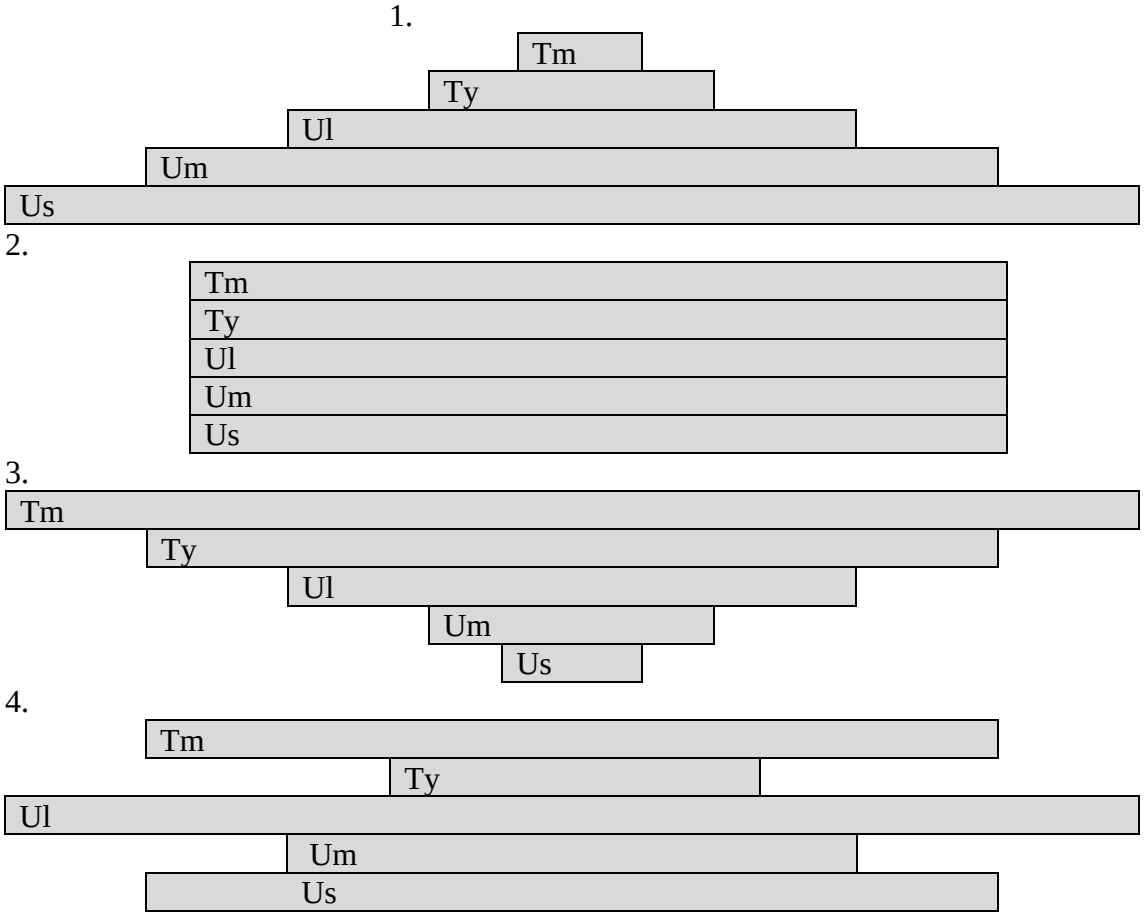

Fig. 1. Theoretical phytocenotic pyramids of the representation of different cohorts of forest-forming species in certain types of forest phytocoenoses

The distribution of cohorts of forest-forming species by phytocoenosis can correspond not only to the four main types of pyramids, but also to their various combinations. Fluctuations over the years in quantitative and qualitative indicators of

reproduction, as well as meteorological conditions and, accordingly, a change in the degree of favorability of local growth conditions for the formation and development of cohorts of the young generation, can lead to pyramids acquiring a fragmented character as a result of "falling out" of plant groups of one or another cohort.

To the results of the study of the representation of cohorts *P. sylvestris, Q. robur, A. platanoides, B. pendula, P. tremula* in forest phytocoenoses, actual phytocoenotic pyramids were developed, which reflect current information on the representativeness of cohorts in the forests of the Left Bank Polissia of Ukraine (Fig. 2).

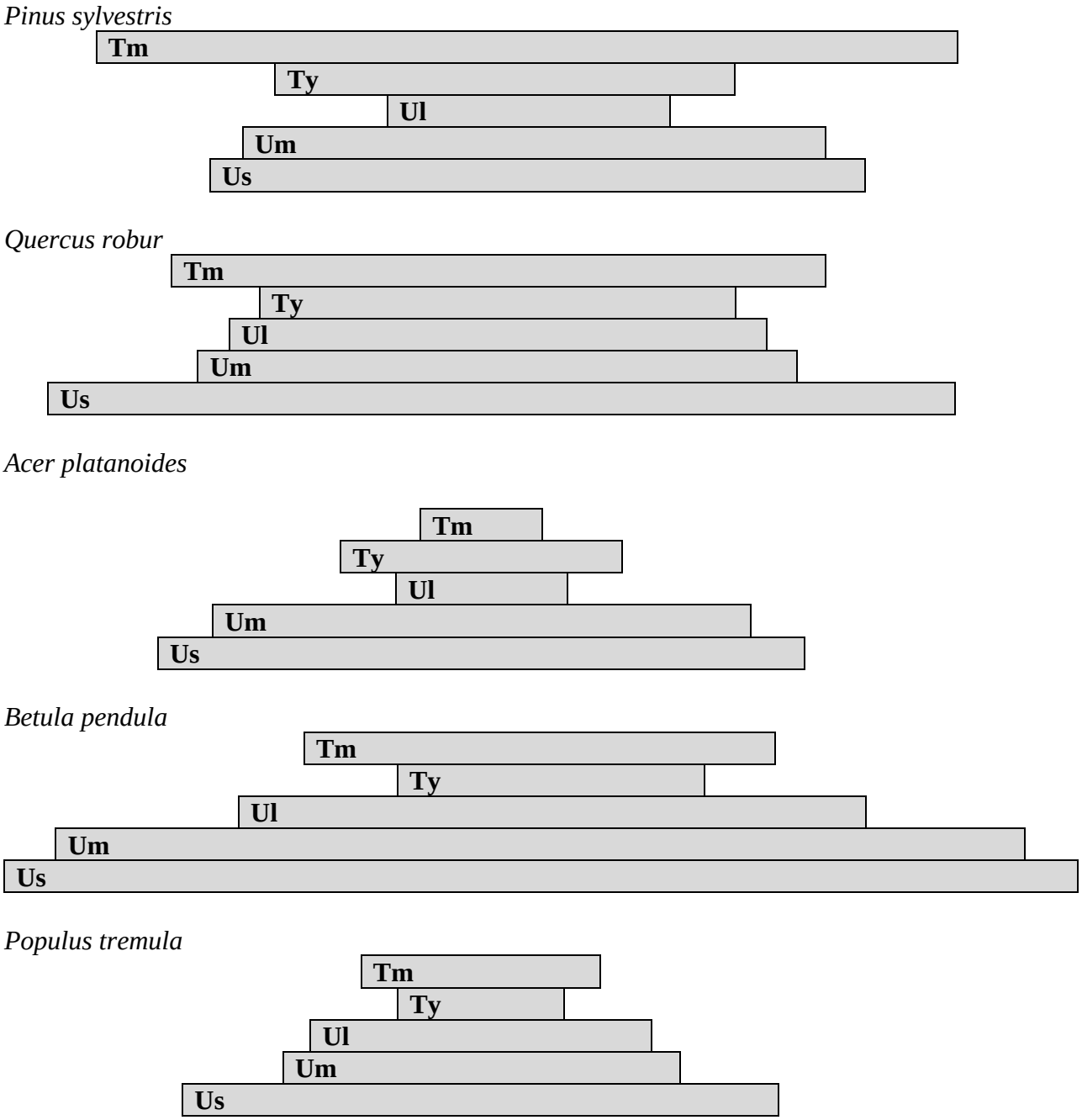

Fig. 2. Actual phytocenotic pyramids of the representation of cohorts of the main forest-forming species within the territory of the Left Bank of Ukraine in the forests of different groups of associations.

DISCUSSION

A comparison of the actual (see Fig. 2) phytocoenotic pyramids with the theoretical ones (see Fig. 1) showed that in *P. sylvestris, Q. robur, B. pendula and P. tremula*, the actual pyramids correspond to a combination of the first and third theoretical types. At the same time, in *P. sylvestris* and *B. pendula*, there is a gradual decrease in prevalence by groups of cohort associations both in the series: small undergrowth → medium → large, and in the series: generative trees → young trees → large growth. In *Q. robur* and *P. tremula*, there is a decrease in prevalence by groups of cohort associations in the series: small undergrowth → medium → large → young trees, as well as in the series: generative trees → young trees.

In *P. sylvestris*, in contrast to *Q. robur, B. pendula, and P. tremula,* cohorts of generative trees are not the most common groups of associations. This is the result of the active and long-term creation of artificial *P. sylvestris* plantations in the region and the use of maintenance felling. The inverted nature of the phytocenotic pyramid indicates that at this time the stable and long-term existence of a number of such forests, due to the absence of undergrowth of *P. sylvestris* under their canopy, cannot be ensured thanks to the natural regeneration of this species

Representation of cohorts of *A. platanoides* predominantly corresponds to the first typical phytocoenotic pyramid. Although at the level of a large undergrowth, signs characteristic of the fourth typical are also manifested.

CONCLUSION

The actual phytocoenotic pyramids formed based on the results of the research will objectively testify that the natural regeneration of each of the forest-forming species (*P. sylvestris, Q. robur, A. platanoides, B. pendula, P. tremula*) within the areas of the Left Bank Polissia of Ukraine has its own specific features signs of formation, distribution of cohorts and their transition from tier to tier of forest phytocoenoses. Although all these species are characterized by a tendency to decrease the prevalence of cohorts in the range small undergrowth → medium → large.

The registered facts regarding the change in the representativeness of cohorts during the transition from each previous (younger) cohort to the next (senior) cohort indicate that the state of natural regeneration is formed as a result of the complex impact of natural and economic processes and is generally complicated. Fragmented versions of actual phytocoenotic pyramids are not registered in the region - this indicates the sustainability of the natural restoration process and the fact that it is an integral component of ensuring the functioning of the forest phytocenoses of the Left Bank Polissia of Ukraine.

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