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Розрахунок основних елементів і обґрунтування параметрів канатних лісотранспортних систем для групово-вибіркових рубок

Запропоновано схеми підвісних канатних лісотранспортних систем для збору деревини з площі лісосіки та механізації групово-вибіркових рубок. Отримано залежності для вибору натягу тягово-несучого канату з врахуванням динамічних навантажень. Виконано аналіз аналітичних залежностей і наведено рекомендації для вибору основних параметрів установки.

Ключові слова: канатне оснащення, рубки, навантаження, параметри.

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DISTRIBUTION, STRUCTURE AND PRODUCTIVITY OF OAK STANDS IN WEST UKRAINE

Oak forests in the study region cover an area of 461.5 thousand ha, which amounts to nearly 27.1% of Ukraine's oak forests. The age structure of the stands analyzed, is essentially disturbed. A major portion is made up of middle-aged stands (over 57.2%), somewhat less is represented by stands of sapling stage (21.1%), and the smallest part is made up of mature stands (6.3%). It has been found that in the most representative forest type (moist hornbeam oakery) in the western part of the study region, a substantial proportion of the area is occupied by secondary stands. For oak stands of fertile site type forests in the study region, a clear-cut relationship is shown between the increase in the area of secondary stands and periods of improperly conducted silvicultural measures of oak trees tending.

Keywords: oak stands, oak forests, structure, productivity.

According to the complex forest management zoning, the forest-steppe region occupies the central part of Ukraine as well as a considerable part of the study region extending from its western to eastern border. The western Forest-steppe includes the districts of the Volyn heights, Male Polissia, Rostochia and Opillia, the Prut-Dnister district and North- Western Podillia [1, 3]. The eastern border of this region coincides with the western border of Khmelnytsk region. The relief of the forest management district is broken: there are deep river valleys, gullies and ravines. The most commonly encountered types of soil in this area are Loess grey forest soils and Loess-like clay Loams; also degraded chernozem soils are occasionally found there [1]. The characteristic feature of Forest-steppe is alternation of steppe and forested areas among which an oakery-type of forest is the most widespread (Fig.1).

The forest cover of the study region varies depending on the soil-an-climatic conditions. In particular in the western and the northern parts, predominant are pine-oak, pine and alder stands on soddy podzolic soils. The central part with its prevailing middle-productive soils boasts of beech, oak-beech and oak forests. In the eastern part of the forest management district, hornbeam-oak forests growing on the highly productive neutral and leached chernozem soils, occupy the greatest area [3].

The pre-Carpathian forest management district occupying the southern part of the study region, is located to the south of the Forest-steppe zone and is bordered by the Carpathians along the line that runs from the western border of Ukraine through Borislav, to the north of Bolehiv, to the south of Kolomyia, towards Beregomet and to the border with Romania. The most abundant types of soil in the forest management district involved, are soddy middle-and highly podzolic soils. The most representative stands are oak stands the composition of which gradually changes: from pure oak and horn-beam-oak stands to fir-beech-oak and fir-oak ones in the south-eastern part, and beech-fir in its south-western parts [3].



Fig.1. The distribution of oak stands in the Forest-steppe part of the study region

Common oak is one of the most valuable tree species growing on the territory of Ukraine and within the study region in particular. Oak-participating stands in addition to being a valuable raw material source, fulfill most important soil protection, water-regulation, water-conservation and recreational functions. By absorbing a considerable amount of surface water, they substantially diminish the surface, run-off and subsequently, reduce water erosion. The powerful root system of common oak tree helps the formation of drought-resistant stands, which is of great importance for creation favourable microclimatic conditions on the adjacent area of their distribution [4, 6].

In the past the geographic range of common oak was much wider than the present one, but in response to adverse environmental effects as well as intensive human management activity, its range of distribution has significantly reduced in size. The oak forests suffered the most losses in the study area during the period of 16th-19th centuries. The intensive forest cutting contributed to a decrease in the area of highly-productive oak forests, in the past war period, beginning in 1950s-1970s, the excessive exploitation resulted in considerable reduction in forest cover percentage in Lviv, Ivano-Frankivsk, Ternopil and other regions. For example, from 1946 through 1956, the forest cover percentage in the above mentioned regions decreased: in Lviv region- by 0.9 %, Ivano-Frankivsk region- by 1.5 % and in Ternopil region- by 0.5 % [3, 5].

At the same time, since the mid-20th century, a tendency for an increase in the area occupied by oak-predominant stands has become evident in Ukraine. As of January 01, 1962 oak-predominant stands occupied an area of 1318400 ha, or 19.2 % of the total area while in 1966- 1419000 ha (20.1 %) and as of January 01, 1966 their area increased to 1710300 ha [7]. According to the statistics data on the forest area inventory in 2002, the total oak stands area of the government agency of forest resources in Ukraine,

amounts to over 1.7 mln ha, which corresponds to nearly 27 % of the forested area within the western Forest-steppe and the pre-Carpathians zone, oak-participating stands cover over 461500 ha, that is about 27.1 % of the oak stands total area in this country. The most part of oak-predominant stands within the study region is in Lviv region (over 95600 ha), somewhat less in Ternopil region (81900 ha), and in Khmelnytsky region (78600 ha). The figures fall far short in Rivne region (58000 ha), Volyn region (58000 ha), Ivano-Frankivsk region (59100 ha) and in Chernivtsi region (30000 ha), the distribution of which being considered for the study region (Table 1). In the above mentioned regional forest management administrations, coppice stands constitute nearly one percent of the oak stands area, the average volume of which in Lviv regional forest management administration amounts to only 118.8 m³ per ha where as the average volume of oak-participating high forests amounts to 189,6 m³ per ha. Similar feature is observed also in other regional forest-and-game management administrations.

In particular, the average volume of coppice oak stands in Ternopil region amounts to 134.9 m³ per ha while the volume of high oak stands is 182.9 m³ per ha in Rivne region- 104.5 m³ per ha and 174.2 m³ per ha, in Ivano-Frankivsk region – 124.0 m³ per ha and 160.7 m³ per ha, respectively. Somewhat higher are the productivity indexes for oak stands in Chernivtsi region where the volume of oak coppice stands averages to 175.5 m³ per ha while 211.5 m³ per ha for highstands and in Khmelnytsk region – 177.9 m³ per ha and 193.1 m³ per ha, respectively.

Table 1. The dynamics of variation in oak stand area in the Forest-steppe zone and the pre-Carpathians according to year classes

Species	The year of inventory	Seedling-stage stands	Sapling-stage stands	Middle-aged stands	Maturing stands	Mature and over mature stands	Total, ha	Percentage of forest cover area
Lviv regional forest-and-game management administration								
Common oak	1960	18623.0	16716.0	16566.0	4240.0	2854.0	58999.0	13.6
	1980	18520.0	20196.0	26919.0	6178.0	4112.0	75925.0	18.3
	2002	6352.0	21048.0	54831.0	8567.0	4863.0	95661.0	22.2
Ternopil regional forest-and-game management administration								
Common oak	1960	29533.0	12447.0	14477.0	627.0	1042.0	58126.0	39.9
	1980	13756.0	33578.0	24697.0	3566.0	1168.0	76765.0	52.6
	2002	5773.0	15769.0	53662.0	4875.0	1832.0	81911.0	57.3
Khmelnytsky regional forest-and-game management administration								
Common oak	1960	15398.0	12528.0	10188.0	568.0	184.0	38866.0	23.5
	1980	10442.0	16845.0	18230.0	2615.0	335.0	48467.0	29.9
	2002	8785.0	15219.0	42540.0	7159.0	4975.0	78678.3	46.7
Rivne regional forest-and-game management administration								
Common oak	2002	4237.0	11476.0	30542.0	3032.0	8714.0	58001.0	10.0
Volyn regional forest-and-game management administration								
Common oak	2002	4964.0	13009.0	32426.0	3552.0	4130.0	58081.0	14.1
Ivano-Frankivsk regional forest-and-game management administration								
Common oak	2002	5419.0	15067.0	34361.0	3032.0	1312.0	59191.0	13.5
Chernivtsi regional forest-and-game management administration								
Common oak	2002	2089.0	5673.0	15813.0	3093.0	3339.0	30007.0	18.8
In total for the study region	2002	37619	97261.0	264175.0	33310.0	29165.0	461530.0	19.8

Our analysis of the oak stands area dynamics in the western Forest-steppe and the pre-Carpathians has shown a gradual increase in the oak stands-occupied area beginning in 1960. However there is a dangerous tendency for a decrease in the area occupied by oak stands of younger year classes. In particular, an essential decrease in the oak stands area has been seen for a 10-year class. For example, according to the results of a year 2002 forest inventory in Lviv region, the area of oak stands aged up to 10 years amounted to only 1062,1 ha whereas it was equal to 87280 ha in 1960. Similar tendency was revealed in our study for the same year class in other regional forest management administrations. Such variations in the area of oak stands for some year classes will result in disproportions in the stands age structure [7]. The research that we conducted with the use of statistics data, shows that the age structure of oak stands in the study region has been essentially disturbed. In particular, the middle-aged oak-participating stands in Lviv regional forest management administration occupy the largest area (49.4 %) while the amount of mature and over mature stands is much lower (9.7 %) and the least is the amount of seedling-stage stands (6.7 %). Similar tendency of oak stands age distribution is typical of other regions (Fig.2).

As is apparant from the results of our study, the most significant variations in oak stands age structure is characteristic of Ternopil regional forest management administration where the middle-aged stands occupy over 65 % of the oak forest area. It should be pointed out that this year class is represented without exception in all forest management administrations of the study region. The representativeness of middle-aged oak stands varies from 52.7 % in Rivne and Chernivtsi regions to nearly 58.1 % in Ivano-Frankivsk regional forest-and-game management administration. The greatest amount of sapling stage oak stands in the study region is found in Ivano-Frankivsk forest-and-game management administration. The smallest area amond mature stands of the stydy region is occupied by stands in Ternopil (1832.0 ha) and Ivano frankivsk regions, which amount to only 2.2 % of their total area [3, 6].

The thorough analysis of the peculiarities of growth and productivity of oak stands in the study region made it possible to mark some characteristic features of this process. In particular, the highest average increment (from 3.5 to 4.5 m³ per ha) is characteristic of the stands aged 21 to 40 years. The trend has been toward a gradual decrease in the average increment of oak stands aged 10 years and over, it is most evident in Lviv, Rivne, Ternopil, Ivano-Frankivsk, Volyn, and Chernivtsi regional forest-and-game management administrations.

Somewhat different pattern of the variations of the index value for the average annual increment was marked for oak stands in Khmelnytsky region. For example, the highest index value for the average increment of the middle-aged stands was equal to 3.8 m³ per ha. The highest index value for the average volume is characteristic of mature oak-participating stands in Chernivtsi regional forest management administration (over 328 m³ per ha), Ternopil region (244 m³ per ha) and Khmelnytsky regional forest management administration (over 237 m³ per ha). This index value is much lower in Ivano-Frankivsk region (222 m³ per ha), Lviv region (217 m³ per ha) and Rivne forest-and-game management administration. The optimum growth conditions have been created for oak-participating stands within the study region, at the same time, the existing site conditions are not exploited to the best advantage. In particular, a considerable amount of heat that comes onto the ground surface in the study region is combined with

appropriate amount of moisture, which creates proper conditions for growing oak stands of the first site class. However, the study that we conducted, points to the fact that environmental potential is not utilized to the full advantage (Fig. 3).

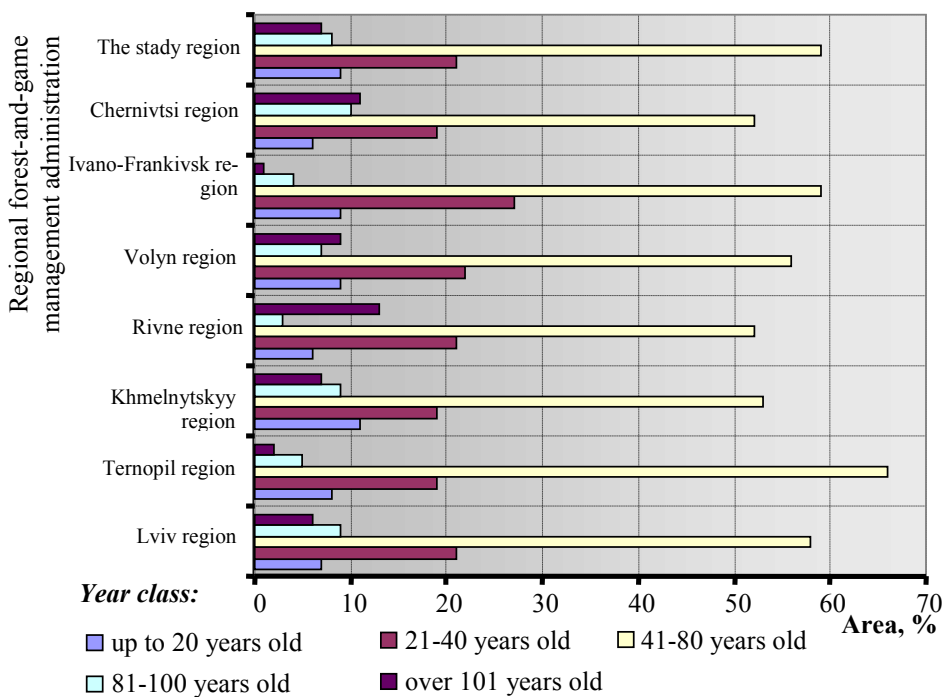


Fig. 2. The correlation of the oak stands areas of different year classes within the study region

It has been pointed out that the productivity of oak-participating young-growth stands on the territory of some forest-and-game management administrations, corresponds to the volume of oak stands of the first site class. However, the results of further analysis of the productivity of oak-participating middle-aged stands shows essential reduction in their volume (nearly by 25 %) compared with stands of the first site class. The decrease in the volume is even more striking for the maturing (up to 30 %) oak stands as well as mature and over mature stands (over 70 %) within the study region as compared with stands of the first site class. This is due to several reasons.

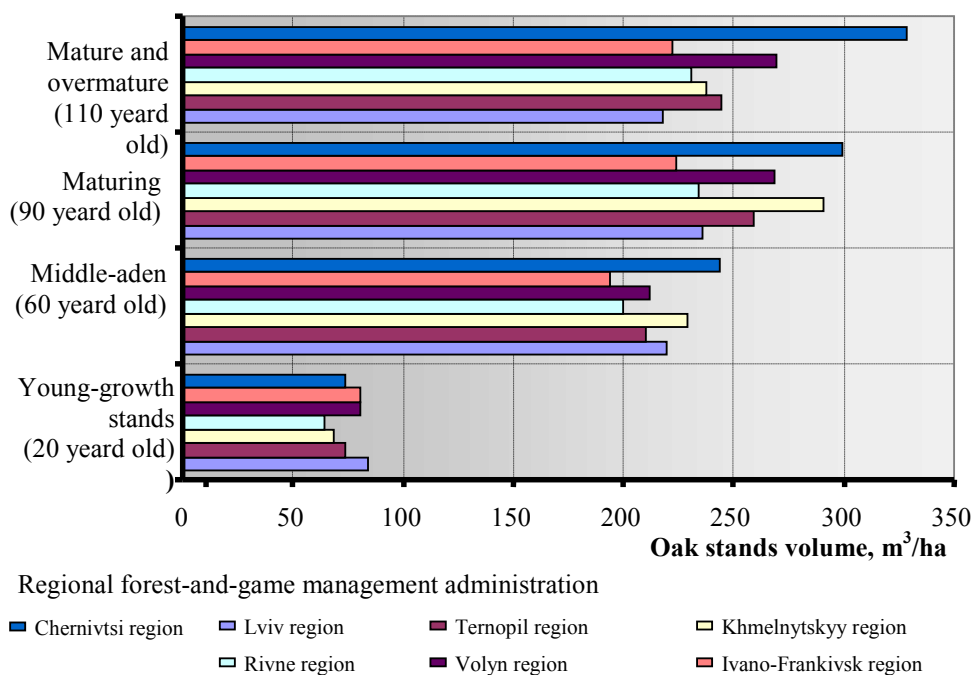


Fig.3. The average index values for oak stands volume in the forest-and-game management administrations of the study region

One of them is improvement cuttings that are not conducted timely, which results in overtopping and suppressing common oak trees by associated tree species. Also high

intensity of belated improvement cutting, excessive and unreasonable removal of common oak trees in middle-aged and maturing stands during improvement cutting may contribute to lower final productivity. There is one more reason for this: insufficient attention is given to natural regeneration of oak stands by seed [3,6,8].

By convention, the study region can be divided into two parts which are distinguished by their differing indexes of average annual precipitation. For example, the central, eastern and southern parts of Lviv region, the west of Ternopil region, the north-western part of Ivano-Frankivsk region differ essentially in their amount of precipitation from the central and southern parts of Ternopil and Khmelnytsk regions. The average annual amount of precipitation in the central part of Lviv region makes up 700 to 742 mm whereas 750 to 800 mm in the pre-Carpathians. The amount of precipitation decreases drastically and makes up 500 to 600 mm in the north-western part of Podillia region which includes the central, southern and north-eastern parts of Ternopil and Khmelnytsk regions, the northern parts of Ivano-Frankivsk and Chernivtsi regions.

The peculiarities like this result in the dominance of moist forest type in the western part of the study region, namely moist hornbeam oakery and fairly moist hornbeam oakery in the east [2,3]. With the aim to make more in-depth study of the peculiarities of oak stands formation under conditions of prevailing forest type in the study region, we analyzed the stands in the subsidiary "Lviv Lisgosp" (Lviv forest management). The forest area of "Lisgosp" is represented by fairly large tracts of oak, pine and beech forests. The oak forests are formed by common oak and largely occupy the elevated terrain with claim-loam soils. The most abundant are fairly fertile site type of forest with participations of common oak, common pine as well as associated species such as hornbeam, maple, lime-tree, elm, ash, birch, sycamore maple. The fairly fertile site type of forest is more often found in forest management units situated to the east, west and south of the city of Lviv. The productivity of most forest types is rather high. The age structure is not uniform. The greenspace forests around Lviv tend to have increasing share of mature and maturing stands. In keeping with the results of our studies, it should be noted that percentage of secondary stands is progressively increasing, which has an essentially detrimental effect. According to investigation of many researchers, it is generally taken that naturally-originating stands are the most resistant to adverse environmental effects and anthropogenic impacts, the stands of this type most closely correspond to primary ones in their structure and morphological characteristics. To conduct a typological analysis, we selected a moist hornbeam oakery, one of the most representative (4 185.3 ha) and valuable forest type in the subsidiary "Lviv Lisgosp".

This forest type is common to Krasiv, Lypnyky, Vynnyky, Lapaivka, Borshchovychy and Tovshchiv forest management units. The largest forested area occupied by moist hornbeam oakery is in Lapaivka forest management unit (over 1 330.0 ha), the smallest (255.0 ha) is in Lypnyky forest management unit. The highest percent of forested land occupied by moist hornbeam oakery (over 41 %) is in Tovshchiv forest management unit while the lowest percent is in Lypnyky forest management unit (10.7 %).

The typological analysis made for the given type of forest in the above mentioned forest management units, has revealed essential fluctuation in the rate of typological potential use for different year classes. In particular, the lowest rate of using typological potential is noted for year classes of 11 to 20 years (50.9 %) and 61 to 70 years (32.1 %). The highest rate of using typological potential and the absence of variation in year

classes is characteristic of Lapaivka, Borshchovychy, Krasiv and Vynnyky forest management units. The typological analysis allowed to find that the average age of moist hornbeam oakery stands varies from 50 years in Borshchovychy and up to 65 years in Vynnyky forest management unit. The highest average actual volume of oak stands of this forest type – over 270 m³ per ha – was recorded in Vynnyky forest management unit while the lowest (about 208 m³ per ha) in Lypnyky forest management unit, whereas potential average volume of standard stands is higher in Vynnyky forest management unit by 43 m³ per ha, and almost by 73 m³ per ha in Lypnyky forest management unit. Similar tendency is typical of other forest management units as well.

The division of oak stands into primary and secondary ones made it possible to reveal a sizable proportion of secondary stands, which essentially influences the productivity and resistibility of stands. The percent of secondary stands is especially high in Vynnyky (over 73 %), Borshchovychy (over 71 %) and Krasiv (63.6 %) forest management units (Table 2). A more thorough analysis of the forest type in question in Borshchovychi forest management unit made it possible to reveal the main causes of excessive presence of secondary stands. As a result of our study, it has been found that the percentage of secondary stands aged up to 10 years, amounts to 100 %, which points to the fact that the first cleanings are not given proper attention. The highest percent of secondary stands was established in the period 1983-1993 and from 1963 to 1973. The lowest percent of secondary stands was formed in Borshchovychy forest management unit in the period from 1913 to 1923 (57.8 %) and from 1933 to 1943 (47 %), which testifies to proper attention given to common oak tending at the beginning of the life cycle.

Table 2. Division of forest management subsidiary “Lviv Lisgosp” stands into primary and secondary according to their density

№ з/п	Forest management unit	Total area, ha	The distribution of forest covered areas according to density, ha %					
			Primary			Secondary		
			1.0-0.8	0.7-0.5	< 0.5	1.0-0.8	0.7-0.5	< 0.5
1	Lypnyky	255,0	46.0/18.0	83.2/32.6	5.4/2.1	57.6/22.6	62.8/24.6	
2	Vynnyky	501,0	22.6/4.5	109.4/21.8	2.4/0.4	95.7/19.1	235.5/47.0	35.4/7.0
3	Krasiv	577,2	124.2/21.5	85.4/14.8	-	57.7/10.0	309.2/53.6	
4	Borshchovychi	737,2	65.9/8.9	146.3/19.8	-	273.4/37.1	252.3/34.2	
5	Tovshchiv	782,6	144.4/18.5	338.4/43.2	-	123.6/15.8	176.2/22.5	
6	Lapaivka	1331,6	247.8/18.6	411.5/30.9	21.4/1.6	282.6/21.2	332.9/25.0	35.4/0.3
	Total	4185,3	651.6/15.6	1174.2/28.1	29.2/0.7	890.6/21.3	1368.9/32.6	70.8/1.7

It is of interest to mark a fact that was revealed during the process of making the typological analysis of the forest type prevailing for a given part of the region. In particular, it was found that secondary oak stands in Urmantsi forest management unit subsidiary “Berezhany lisgosp” that were established in the period 1904-1923, from 1944 to 1953, and in the period 1974-1993, dominate over primary oak stands (Fig. 4). It was in these periods when little attention was given to the regeneration of oak stands and especially to timely conducted oak tending. Improvement fellings the aim of which is removing secondary tree species that suppress the growth and development of oak trees, if not done in due time, result in the establishment of secondary stands over a large area (Fig. 5). In Vynnyky forest management unit subsidiary “Yarmolun Lisgosp”, the largest part of secondary stands was formed in the period 1902-1941. The regeneration of primary oak stands was not given a proper attention in this period. That period saw intensive removal

of oak stands for the needs of sugar-producing and other industries. Large areas of secondary stands also appeared in 1920s, 1930s and 1940s, which is accounted for by lack of silvicultural practices and targeted activity of forest management for regeneration of primary oak-participating stands. In succeeding decades, the area of primary stands increased considerably and is dominating over the area of secondary stands.

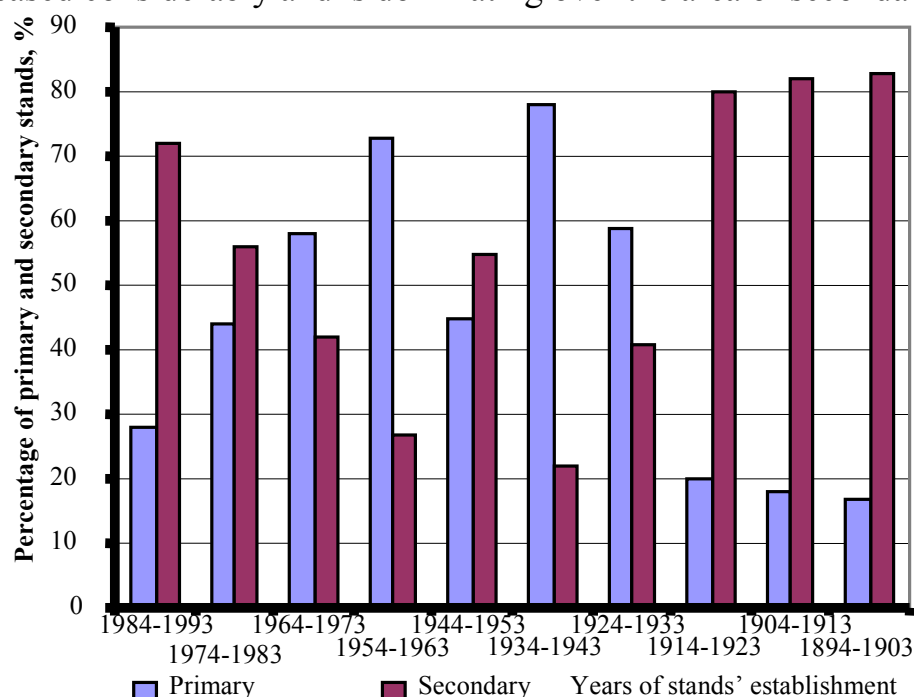


Fig. 4. The correlation of the primary and secondary stands by age structure in the Urmanci forestry

The essential dominance of primary stands over secondary oak stands in seedling and sapling stages, points to the efficiently conducted silvicultural measures during the process of regeneration and growing oak stands in the period from 1974 to 1993.

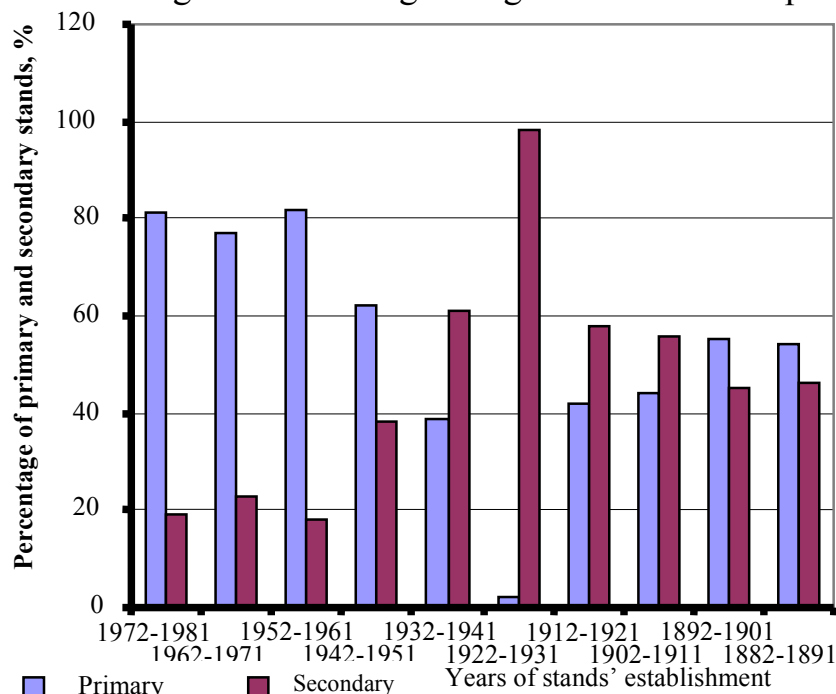


Fig. 5. The correlation of the primary and secondary stands by age structure in the Vinkivci forestry

Conclusions:

- For oak stands of fertile site type forests in the study region, a clear-cut relationship is shown between the increase in the area of secondary stands and periods of improperly conducted silvicultural measures of oak trees tending. The most part of secondary stands in Urmantsi forest management unit subsidiary “Berezhany Lisgosp” was formed in the period 1904-1923, 1944-1953 and from 1974 to 1993. The most part of secondary stands in Vynnyky forest management unit was formed in the period 1902-1941.

- Oak forests in the study region cover an area of 461.5 thousand ha, which amounts to nearly 27.1 % of Ukraine's oak forests. The most part of common oak-participating stands is concentrated in Lviv region (over 95.6 thousand ha), somewhat less amount of oak stands is found in Ternopil region (78.6 thousand ha).
- It has been found that in the most representative forest type (moist hornbeam oakery) in the western part of the study region, a substantial proportion of the area is occupied by secondary stands. Large areas of secondary stands are found in Vynnyky forest management unit (over 73 %), Borshchovychy (over 71 %) and in Krasiv forest management unit subsidiary "Lviv Lisgosp" (over 63.6 %).
- The age structure of the stands analyzed, is essentially disturbed. A major portion is made up of middle-aged stands (over 57.2 %), somewhat less is represented by stands of sapling stage (21.1 %), and the smallest part is made up of mature stands (6.3 %).

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Поширення, структура та продуктивність дубових насаджень заходу України

Проведено аналіз поширення дубових лісостанів в межах регіону досліджень. Подано динаміку зміни площі лісових насаджень, особливостей типологічної структури, продуктивності за участю дуба звичайного в західній частині України в межах Західного Лісотепу та Прикарпаття. Досліджено специфіку співвідношення корінних та похідних дубових деревостанів в умовах сфіжних та вологих грабових дібров.

Ключові слова: дубові насадження, дубові ліси, структура, продуктивність.

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THE DYNAMICS OF BEAR POPULATION IN THE EASTERN CARPATIANS

In the dynamics of bear population in the Eastern Carpatians, there are two recorded periods of change in the numbers. The first one that lasted over 50 years, started in the late 1940s and ended in the year 2001. The second one has started in the early 21-st century.

Keywords: population, hunting, environmental factors, poaching.