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Kravchuk Halyna

*Candidate of Agricultural Sciences,
Associate Professor of the Department of Ecology and Environmental Protection,
Vinnytsya National Agrarian University
(21008, Vinnytsya, Soniachna Str.3).*

Dudnik Yevheniia

*post-graduate student of the Department of Ecology and Environmental Protection,
Vinnytsya National Agrarian University
(21008, Vinnytsya, Soniachna Str. 3*

STUDY OF THE STATE OF FOREST ECOSYSTEMS

Annotation. Forest ecosystems of the Shepetivka district of Khmelnytsky comprehensively affect the environment, stabilizing many indicators that improve environmental conditions, biodiversity is preserved, deposited carbon, and stabilizes the district's ecological situation. In the forest cover of Ukraine, which is 15.9%, the total forest cover of the territories occupied by the State Enterprise (SE) "Shepetivka Forestry" is 20.95%: Polonsky district n – 15.9% and Shepetivka district – 26%.

The species composition is dominated by pine plantations, which occupy 41% of the forested area, oak plantations – 28%, birches – 15%, alders – 9%, other breeds – 7%.

The total stock of wood at the "Shepetivka Forestry" State Enterprise is about 7.7 million m³, where coniferous trees - 4.2 million m³, hardwood - 2.1 million m³, softwood - 1.43 million m³. The average stock per 1 ha is 4.1 m³. Plantation area of artificial origin is about 60.3% of the area covered by forest vegetation of lands. The forest-covered area of 32840.3 hectares of phytomass of SE forests "Shepetivka Forestry" is 5224891 tons, where 2604235.8 tons of carbon are accumulated.

However, the analysis of potential productivity of forest areas of SE "Shepetivka Forestry" is only 55.3%. The indicator shows a significant reserve in use potential productivity, which requires the more efficient use of forest areas and improving the quality of forests, increasing their productivity and biological stability.

Key words: forest, ecosystem, biodiversity, carbon deposition, forest cover, plantation restoration, bio productivity.

Forests play an essential role in shaping the carbon balance atmosphere and in the maintenance of biodiversity.

The oxygen production capacity of forests and, at the same time, their potential carbon sequestration and protection from atmospheric pollution by carbon dioxide gas is directly proportional to the productivity of forests and the longevity of their preservation in the form of living natural components. A person's ability to significantly influence the area, structure, and productivity of forests makes them a convenient tool for mitigating the greenhouse effect. A sustainable ecosystem's main parameters are the constancy of species composition, closed cycles of substances, and relatively constant bio productivity [1].

Sozological analysis of biodiversity shows forest ecosystems' uniqueness for conserving rare and endangered plant species [2].

However, forest plantations are significantly affected, especially when intensive climate change [3, 4].

The total area of forest belonging to the forest fund of Ukraine is 10.4 million hectares, including 9.6 million hectares covered with forest vegetation. The forest cover of Ukraine is 15.9%. But despite enough small wooded area, Ukraine ranks 9th in Europe in forest area and sixth place in timber reserves. Conditions for afforestation in Ukraine are extremely

heterogeneous, so forests are unevenly distributed throughout the country [5].

Forests are the most common and valuable than other vegetation types and all categories of the planet's natural resources. Nowadays, they cover about 5.5 billion hectares or 38% of the land surface. The biggest of them are areas located in Asia, South and North America. There are few forests in Europe, only about 6% of the territory. The most forested European countries are Sweden and Finland, where forests cover about 70% of the region.

The territory of Podillya is represented by three typological forest regions, in particular: fresh, moist, and raw lumps. The most common are oak forests, which vary from 91.4% in the Vinnytsya region to 53.4% in the Khmelnytsky region [6].

We set out to study forest ecosystems by example, the Shepetivka district of the Khmelnytsky region. To achieve the goal of the study, we have provided several tasks for the implementation:

- to study based on literature sources, scientific developments, materials SE "Shepetivka Forestry" and to make our own research on the state of forests ecosystems of Khmelnytsky region;
- to get acquainted with the structure of "Shepetivka Forestry" State Enterprise;
- to study methods of control over storage and use forest products and prevention of illegal logging;

- to explore the provision of needs in their standard landing materials for artificial afforestation of forest areas;
- to determine the scope of reforestation measured on non-forested vegetation;
- to calculate the degree of use of potentially covered productivity forest vegetation of forest areas;
- to determine the features of hunting management;
- to evaluate the forests of Shepetivka forestry as elements of nature protection territories;
- to select the amount of deposited carbon in the phytomass of forest plantations.

The research object was the State Enterprise "Shepetivka Forestry's" forest plantations, a structural

unit of management forestry and hunting of the Khmelnytsky region.

The clarification of all items mentioned above was provided by statistical processing of research materials, work with regulations and technological maps, inventory documents, fundamental indicators of forest management of the enterprise.

The total forest area of the state forest fund of "Shepetivka Forestry" State Enterprise is 35959.3 ha. The general forest cover of the territories occupied by SE "Shepetivsky forestry" is Polonsky district – 15.9% and Shepetivka district – 26%.

The average age of plantations is 57 years, with young animals occupying 13.9 % and ripe and overripe farms in total – 7.2%.

Species composition of wood species is quite diverse (Fig. 1)

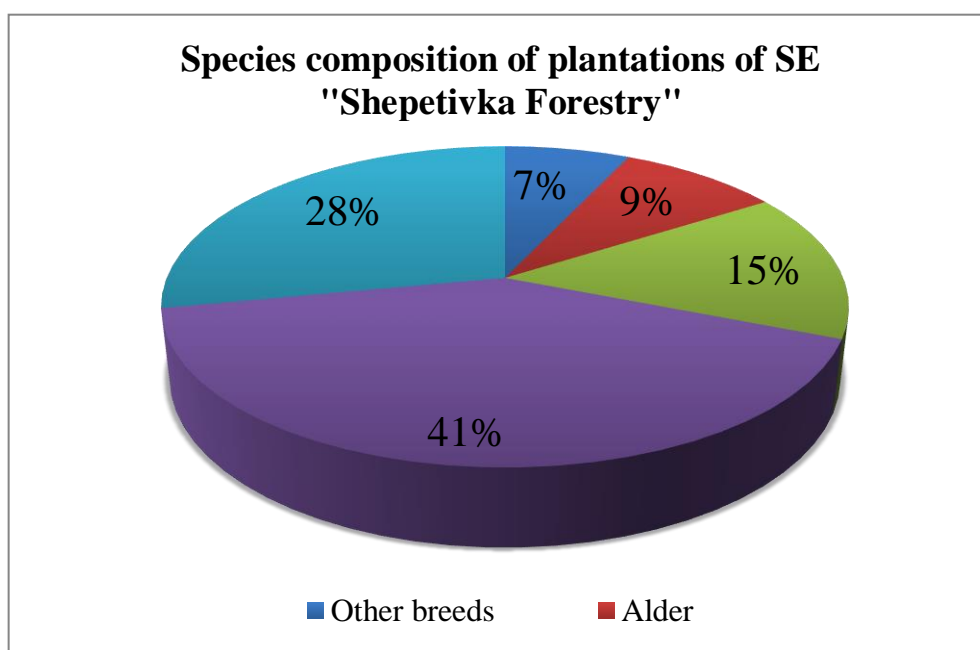


Fig.1. Species composition of plantations of SE "Shepetivka Forestry"

The species composition is dominated by pine stands, which occupy 41% forest area, oak plantations – 28%, birches – 15%, alders – 9%, other breeds – 7%.

The distribution of areas and reserves of forest areas covered with forest vegetation by groups of forest-forming species presented in tab. 1.

Table 1

The distribution of areas and reserves of forest areas covered with forest vegetation by groups of forest-forming species

Indicator	Groups of breeds			Total conifers
	conifers	hardwood	deciduous	
Stock, million m ³	4.2	2.1	1.4	7.7
Percentage on stock, %	54.6	27.3	18.1	100

The total stock of wood at the Shepetivka Forestry State Enterprise is about 7.7 million m³: conifers – 4.2 million m³, hardwood – 2.1 million m³, softwood – 1.43 million m³. The average stock per 1 ha is 4.1 m³. Plantation area of artificial origin is about 60.3% of the area covered by forest vegetation of lands.

The average stock per 1 ha of forested land is 234 m³, the average annual increase – 134 thousand m³, the total average increase per 1 ha – 4.1 m³.

Much of the research is devoted to the calculation of accumulation forest carbon ecosystems. Given the importance of forest stands as the leading natural carbon deposition systems, we have performed analyses regarding its volumes.

According to research by P.I. Lakida, A.Z. Shvidenko, D. G. Schepaschenko, R. D. Vasylyshyn, A.M. Belous, I. P. Lakida, L.M. Matushevich [7,8] on average total phytomass is 159.1 tons of dry organic

matter (79.3 tons of carbon) per 1 ha of forest areas covered with forest vegetation.

From the total area of forests of the state forest fund of SE "Shepetivka Forestry", 35959.3 hectares,

the forested area is 32840.3 hectares or 91.3%. We determine the deposited carbon in the phytomass of forests of SE "Shepetivsky Forestry" tab. 2.

Table 2

Carbon deposited in the phytomass of SE "Shepetivka Forestry"

Forest covered area, ha	General phytomass on 1ha, t	General phytomass on under study territory	Carbon on 1ha, t	Carbon total, t
32840,3	159,1	5224891	79,3	2604235,8

Thus, on the forest-covered area of 32,840.3 hectares phytomass of forests of SE "Shepetivka forestry" is 5224891 tons, where 2604235.8 tons are accumulated carbon.

Dynamics of development of the system "Electronic wood accounting" – EOD polling stations of Khmelnytsky region, presented in Fig.2.

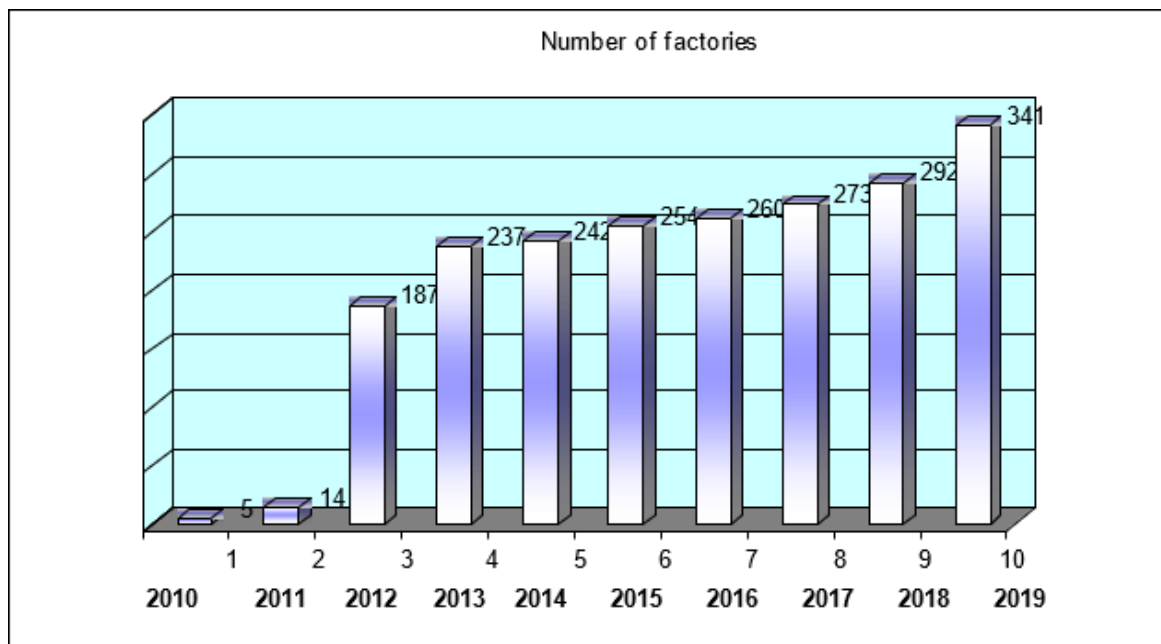


Fig. 2. Dynamics of development of the system "Electronic wood accounting"

Analysis of the dynamics of development of the system "Electronic wood accounting" – EOD indicates intensive implementation and use. Yes, in three years: from 2017 to 2019, the implementation intensity was 109.4% at polling stations. System Electronic wood accounting helps to quickly see the current time remnants of forest products at each felling in terms of species and assortments, which affects the environmental and economic use of wood and prevention of poaching.

To meet the needs of its standard landing materials for artificial afforestation areas after continuous felling,

permanent and temporary forest nurseries exist – particular attention is paid to the procurement of high-quality seeds.

Our study found that during 2020, 2289 kg of forest seeds were harvested: common oak – 2000 kg, red oak – 156 kg. Seeds of Scots pine were 50 kg, ash – 30 kg, black walnut – 13 kg, walnut – 40 kg.

3.7 thousand seedlings were grown in forest nurseries. Volumes reforestation measures on lands not covered with forest vegetation and logging of the audit period presented in table 3.

Table 3

Volumes of reforestation measures on non-forested vegetation lands and loggers of the audit period, ha

Breeds, designed for restoration	Categories of forest areas			Total, ha
	not covered with forest vegetation	logging of the audit period		
		main use	solid and reconstructive felling	
1. Forest crops:				
Scots pine	75,9	1111,1	49,9	1236,9
Ordinary oak	45,8	258,2		304,0
Total	121,7	1369,3	49,9	1540,9
2. Natural update				
Scots pine	98,8	118,7	-	217,5
Ordinary oak	23,2	4,7	-	27,9
Birch	0,2	-	-	0,2
Black alder	20,1	116,8	-	136,9
Total	142,3	240,2	-	382,5
Final total	264,7	1609,5	49,9	1924,1

According to the analysis in the conditions of SE "Shepetivske LH" the natural renewal was observed: Scots pine on an area of 217.5 hectares, of which: on logging of the primary use 118.7 hectares; birch

hanging on uncovered forest vegetation areas – 0.2 ha, black alder 136.9 ha.

We set ourselves to determine the degree of potential use productivity of forest areas covered with forest vegetation – the results in Table 4.

Table 4

The degree of use of potential forest land productivity covered by SE "Shepetivka Forestry"

Basic forest-forming breed	The area of forest parts covered with forest vegetation, ha	Average stock per hectare of forested forest areas, m3		The degree of utilization of the potential productivity of forest areas covered with forest vegetation in %
		actual	optimal	
Pine	13443	290	560	51,7
Fir tree	1522	212	310	68,0
European larch	23	50	60	83,3
Red oak	105	116	200	58,0
Oak	9194	223	438	52,1
Hornbeam	167	191	260	73,4
Ash tree	36	168	430	39,0
Birch	5066	157	270	58,1
Black alder	2916	177	370	47,8
Linden	21	233	400	58,25
White acacia	18	146	250	58,4
Black poplar	309	198	580	33,9
Other breeds	20	70	190	36,8
Total by the enterprise:	32840	234	442	55,3

The degree of use of potential productivity covered by forest areas of the "Shepetivka Forestry" State Enterprise is only 55.3%, i.e., the forest's biological potential is used by almost half. This indicator shows a significant reserve in potential productivity, which requires the more efficient use of forest areas and improves forests' quality, increasing their productivity and biological stability.

Forests are affected by several abiotic, biotic, and anthropogenic factors, under the influence of which the growth of wood decreases, there is a partial or complete loss of crowns, drying of individual trees, and plantations.

Annual volumes of forest protection measures (2019) planned and carried out:

forest pathological examination on an area of 6.0 thousand hectares and spraying of nurseries on 12,5 hectares; for this purpose, 11 points of forest protection organized and carried out measures to promote forest protection. Also, biological measures were used for protection: producing 500 artificial nests and equipped with 500 feeders.

The area of the fixed hunting grounds makes 26532 hectares.

Mostly forests. Wetlands only 1212.8, and field – 459.2 hectares. In the enterprise's lands, there are such

species of animals as elk, wild boar, roe deer, beaver, hare, fox, badger, otter, forest marten, American mink, European protein. Of the birds – grouse, pigeon, chicken, coot, various species ducks and waders

Carrying out of biotechnical actions is a basis of conducting forestry farms. They account for the largest share of costs (Fig. 3)

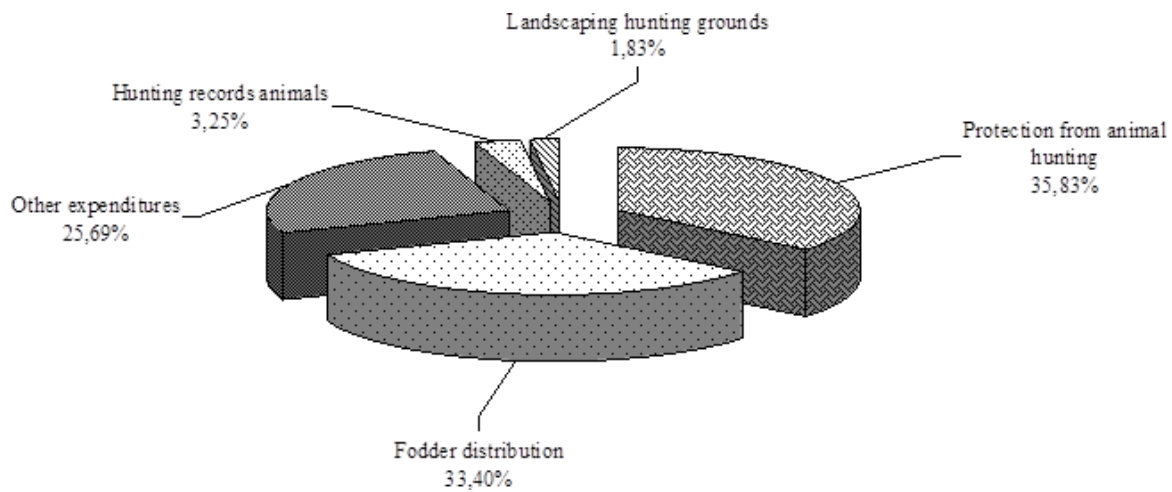


Fig. 3. Expenditures for biotechnical measures of SE "Shepetivka Forestry"

More than a third of the costs is for protection from animal hunting – 35.83% and fodder distribution – 33.4%. The least accounted for – hunting records animals, – 3.25% and landscaping hunting grounds is – 1.83%.

Based on the results of the assessment, the activity is evaluated and planned farms, shooting rates for the next hunting season are determined, decisions are made on the need for a partial or complete ban on hunting for a particular species, the dynamics of the number of animals is persistent (Fig. 4).

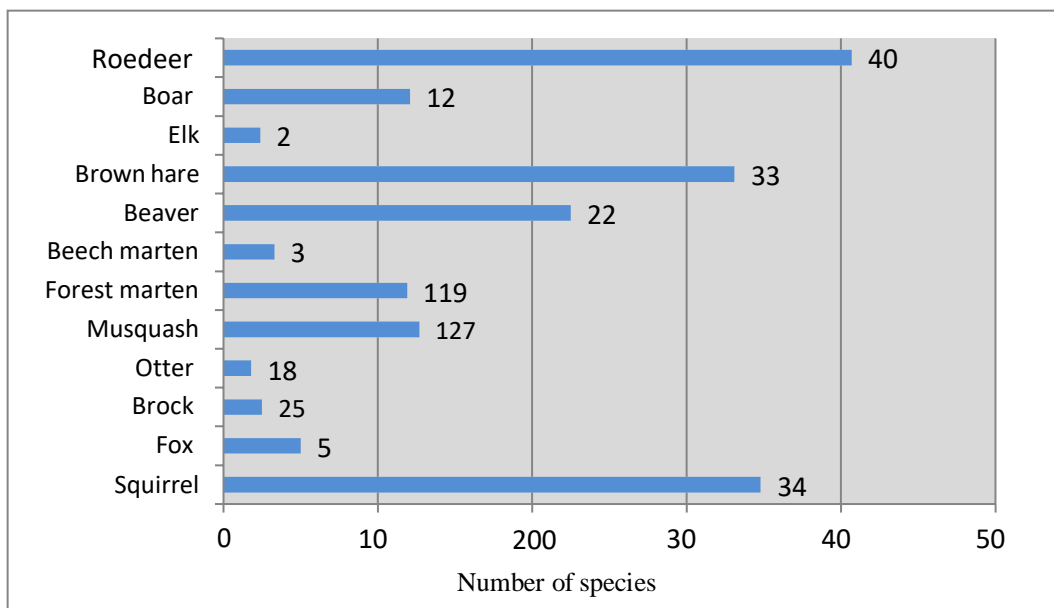


Fig. 4. The number of hunting animals of SE "Shepetivka Forestry," section Malovan forestry

The forestry management is deliberately restraining the number of hunts to speed up the number of animals in the forestry lands to the optimal. At present the territory of SE "Shepetivka Forestry" Malovan Workshop already has 407 roe deer, 121 wild boars, 24 moose, and also the brown hare – 331, the beaver – 225, the stone marten – 33, the forest marten – 119, muskrat – 127, otter – 18, badger – 25, fox – 50, squirrel – 348.

A result of the fight against poaching during 2019 – 20 people who violated hunting rules were detained (protocols and rulings are issued on violators according to Article 85 Part 1 of the Administrative Code of Ukraine – 11 866.00 hryvnias).

The regional landscape park "Malovanka" is located on the territory of "Shepetivka Forestry" with 16915.3 hectares, which occupies the part of Shepetivka and Polonsky districts.

A relatively unchanged natural landscape dominates the park. The forest cover of the territory is

about 80%; for the region, this indicator is – 11.9%, for the Shepetivka district – 29.2% (Table 5).

Table 5

Lists of territories and objects of the ecological network

Name	Location	Area, ha
Landscape Park "Malovanka"	On the territory of Shepetovsky district, State Enterprise "Shepetivskoe forest economy" Malyovanske and Polonskoe forestry	16915,3
Kupinsky (hydrological reserve of local significance)	On the territory of Shepetovsky district, State Enterprise "Shepetivskoe forest economy" Klimentovitske forestry 44/13	12,00
English oak (natural botanical monument of local importance)	On the territory of Shepetovsky district, State Enterprise "Shepetivskoe forest economy" Kamyankiv forestry 55/13	9,10
Liznyavsky (general construction and zoological reserve of local importance)	On the territory of Shepetovsky district, State Enterprise "Shepetivskoe forest economy" Romaniv forestry 37-40	422,00

The territories and objects of the ecological network of local significance located on the lands of SE "Shepetivka Forestry" include:

Kupinsky Hydrological Reserve with an area of 12 hectares. This is a sphagnum swamp that supports the Tsvitokha River's hydrological regime, with rare swamp vegetation from the Red Book: clownfish and rare for Khmelnytsky region - andromeda multi-leaf.

The general zoological reserve Liznyavsky (422 hectares) is also an exciting area with a fatty floral composition; habitats for beavers, muskrats, wild boars, moose, and foxes are found.

More than 9 hectares are occupied by the genetic reserve of high-yielding oak plantations about 100 years old.

Conclusions. The versatility of the SE "Shepetivske Forestry" is a necessary condition for ecologically balanced management farms. This is economical logging and comprehensive reforestation measures, combating illegal logging, implementing electronic timber accounting, and increasing forest productivity, hunting management, and care for natural objects reserve fund.

Forest ecosystems of the Shepetivka district of Khmelnytsky complex affect the environment, stabilizing many indicators that are due to this environmental conditions improve, biodiversity is preserved and stabilized the district's ecological situation. 2604235.8 are deposited in the phytomass of forest ecosystems tons of carbon.

However, the analysis of the use of potential productivity covered by forest the vegetation of forest areas of the Shepetivka Forestry State Enterprise is only 55.3%. The indicator shows a significant reserve in potential productivity, which requires the more efficient use of forest areas and improving the quality of forests, increasing their productivity and biological stability.

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