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**STRUCTURE AND WAYS OF
IMPROVING FORAGE LANDS
OF WILD UNGULATES UNDER
THE CONDITIONS OF SE
«VINNYTSIA FOREST
RESEARCH STATION»**

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This study examines the present condition of feeding grounds for wild ungulates and provides rationale for their enhancement within the SE «Vinnytsia Forest Research Station». The importance of this research stems from the necessity to guarantee a reliable forage base for game animals given seasonal food shortages, forest ecosystem shifts, and environmental stress from climate and human activity. The study aimed to assess the efficiency of current forage sites, determine their site quality (bonitet), estimate optimal carrying capacity for main ungulate species, and propose measures for optimizing supplementary feeding practices.

*The research was conducted using forest management records, wildlife management data, stand inventory descriptions, forest maps, GIS and stand-level databases, along with the enterprise development project. Hunting areas were categorized into types, subtypes, and species-specific classes; site quality (bonitet) was assessed for *Capreolus capreolus* and *Sus scrofa*, and the optimal density and game population numbers were established.*

*The total forest land area of the study site was found to be 2.045.9 ha, with 1.856.4 ha covered by forest vegetation. For *Capreolus capreolus*, the mean bonitet class across coniferous, deciduous, and mixed forests was 2.47, 2.15, and 2.18, respectively; for *Sus scrofa*, the values were 2.83, 2.76, and 2.57. Meadows and water bodies exhibited the lowest forage suitability, underscoring the need for targeted habitat management, including overseeding legumes, establishing game remises for feed and shelter, and installing biotechnical structures.*

*The current wild population stands at 95 *Capreolus capreolus* and 86 *Sus scrofa*, requiring integration into feed provisioning strategies and population control planning. Recommended guidelines for forage harvesting were formulated based on anticipated population growth and seasonal feeding requirements. The practical relevance of the findings is rooted in their application for optimizing wildlife management practices, boosting habitat productivity, and implementing science-backed management of wild ungulates.*

Key words: forest land, forage resources, productivity, land classification, forage harvesting, biotechnology.

Tab. 6, Fig. 2, Ref. 12.

Problem formulation. Sustainable game management necessitates a science-based approach to preserving and sustaining wildlife populations, especially amidst natural landscape alterations, a declining natural food supply, and climatic pressures. Providing adequate supplementary feeding during the autumn and winter months – when natural food availability is constrained – represents a critical factor in maintaining stable wildlife population levels [1].



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The objective of this research was to assess the efficiency of the current game feeding system in the hunting areas of the SE «Vinnytsia Forest Research Station» and to outline viable strategies for enhancing the forage capacity, notably by establishing game coverts (remises) for food and shelter and installing biotechnical infrastructure.

Literature review. The establishment and sustainable management of feeding grounds for wild ungulates are essential aspects of contemporary game management, as forage capacity directly governs spatial allocation, seasonal movement patterns, physiological status, reproductive success, and biotope preference. A primary research topic centers on determining how food availability drives habitat selection in wild ungulates. M. Bobrowski et al. analyzed the impact of forage availability on winter habitat choice in *Cervus elaphus* and *Capreolus capreolus* [1], focusing on the interplay between food presence, structural habitat attributes, and winter spatial distribution. Comprehensive synthesis regarding ungulate forage resources across Europe is offered in the work of R. Spitzer et al. [11], who reviewed dietary compositions across primary ungulate species. Seasonal fluctuations in forest forage availability were evaluated by P. Smolko, A. Veselovská, and R. Kropil [10], establishing that food accessibility shifts with season, forest succession stage, and canopy cover dynamics. Practical applications in forage land management were addressed by J. Månsson et al., demonstrating the effectiveness of wildlife food plots as a habitat management tool for ungulates [5].

Research materials and methods. The study was conducted using forest management materials, specifically forest stand plans, map sheets, and forest inventory descriptions. Materials related to hunting ground management and the enterprise development plan were also utilized.

Based on hunting ground management data, forest management materials, and land management records, the hunting grounds were classified by type, subtype, and variety. A classification table for hunting grounds – categorized by site quality class within natural zones – was employed for this purpose. An assessment of hunting grounds within the forest fund was carried out, utilizing data required to differentiate hunting ground types down to the specific classification level (type, subtype, variety) within each forest inventory unit. The site quality assessment (bonitation) of the grounds was performed using average indicators for optimal carrying capacity and biotechnical measures, derived from the compartment-level database of the Central-Western Interregional Department of Forestry and Hunting.

This process utilized a stand-level inventory and mapping database derived from forest management records, as well as a hunting ground classification table based on site quality classes within natural zones.

The average value indicator (mean site quality class) was determined for the primary game species under management, based on the type (subtype or specific category) of hunting grounds. The minimum territorial unit adopted for calculating the mean site quality class for each game species was the forestry unit (within branch lands) or the game warden's patrol area (in other cases).

The mean site quality class was calculated to a precision of two decimal places (0.01). After accounting for factors influencing the status of game populations, users round the mean site quality class to one decimal place (0.1) [10].

The general optimal density of hunting fauna of each specific species is found by calculating the average quality class (bonitet class) for each species. The calculation of the average bonitet class was defined as the optimal density for a given species per 1.000 hectares of hunting grounds (D), which is then multiplied by the total area of the hunting estate for which the calculations are made:

$$N_{\text{total}} = D \times S \text{ where:}$$

N_{total} – total optimal capacity of hunting grounds for one of the identified hunting fauna species within the territory of the estate, heads;

D – optimal species density, i.e., the optimal number of hunting fauna calculated per 1.000 hectares of hunting grounds. Optimal density is determined through the average bonitet for each hunting fauna species, taking into account forest-hunting zoning and the number of heads per 1.000 hectares of grounds;

S – area for which the total optimal capacity of hunting grounds is determined, thousand hectares [10].

The calculation of the required amount of feed for supplemental feeding is provided depending on the forest-hunting zoning, the population of hunting fauna in the grounds, and the duration of the feeding period. The duration of the feeding period depends on the timing of topsoil freezing, the establishment of a significant stable snow cover, and other factors. To calculate the amount of feed required for supplemental feeding during the winter period, an average feeding season of 100 days was adopted (from November 1 to February 15). The duration of the feeding period, as well as its start and end dates, are determined by the user of the hunting grounds depending on climatic and other conditions [9].

Results and discussion. Under the conditions of the Vinnytsia Forest Research Station State Enterprise, a significant portion of the area is occupied by forest tracts, creating prerequisites for the existence of various types of hunting grounds. However, their forage productivity and ability to meet the needs of wild ungulates are uneven. Improving the forage base in the autumn-winter period – when natural resources become scarce or depleted – is particularly relevant. The total forest fund area of the Vinnytsia Forest Research Station State Enterprise is 2.045.9 hectares (Table 1).

According to the table data, the area of forested lands is quite significant, accounting for 1.856.4 ha. Unclosed plantations cover only 59.3 ha. The area of gaps and wastelands is 5.6 ha. Within the structure of the forest fund, swamps and marshes account for a fairly significant area of 75.0 ha. Data regarding the distribution of natural forage lands are presented in Fig. 1. The qualitative assessment of hunting grounds carried out in relation to specific species of game fauna is called habitat suitability rating (game bonitation). In terms of their forage and protective qualities, different types of hunting grounds hold varied significance for game fauna, with the site quality class (bonitation index) determining the potential productivity of the grounds.

Table 1

**Distribution of forest fund land by land category at the State Enterprise
«Vinnytsia Forest Research Station»**

Land categories	Area, ha
Total land area	2045.0
Forest-covered lands	1856.4
Including forest plantations	1225.1
Unclosed forest plantations	59.3
Forest nurseries, plantations	-
Liquids	-
Burned areas and dead stands	-
Clearings	12.9
Gaps and wastelands	5.6
Non-forested lands	18.5
Total forest lands	1954.9
Arable land	1.6
Hayfields	4.1
Pastures	-
Water bodies	1.7
Orchards, vineyards, berry fields	-
Roads, forest rides	-
Homesteads and other lands	4.2
Swamps and marshes	75.0
Other lands	3.5
Non-forest lands	90.1

Source: compiled based on the author's own research

According to their productivity, hunting grounds are divided into five site quality classes (bonitation classes): class I includes hunting grounds with very good forage and protective properties; class II – with good properties; class III – with average properties; class IV – with poor properties; and class V – grounds unsuitable for the habitation of a particular game species.

Since game management planning is conducted once every 15 years, significant changes may occur in the types of hunting grounds over this period (mature stands transition into clearcuts, clearcuts into forested lands, etc.). All these changes affect the average site quality class (bonitation class) calculated during game management planning for each species of game fauna. This applies particularly to forest grounds, as changes in other ground types remain insignificant. In this regard, when calculating the average site quality class for each game species, hunting ground users should, where possible, take these changes into account using data from continuous forest management, which is updated annually and available at forestry enterprises. The average site quality classes for European roe deer are presented in Table 2. According to the table, arable lands are characterized by the highest site quality class – 2.00. The total area of these lands is 1.6 ha. Significantly lower scores were established for deciduous and mixed forests – 2.15 and 2.18, respectively.

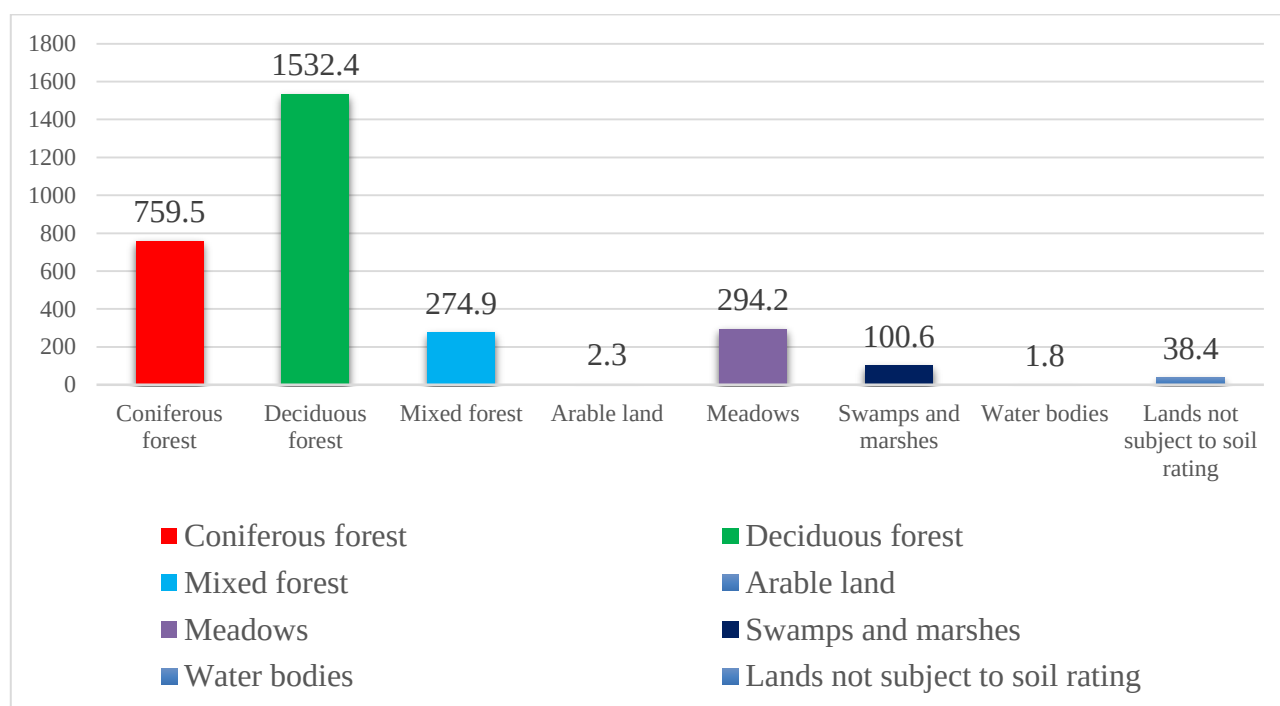


Fig. 1. Distribution of natural forage lands for wild ungulates by forest types

Source: compiled based on the author's own research

The total area of these lands is 1151.4 ha and 248.9 ha, respectively. Meadows and water bodies are characterized by the lowest average site quality classes – 4.00 and 5.00, respectively, with their areas comprising 9.7 ha and 1.7 ha. The presence of low-quality class meadows highlights the necessity of their fundamental improvement.

Table 2

Area distribution of the enterprise by site quality classes of European roe deer natural forage lands under the conditions of SE «Vinnytsia Forest Research Station»

Habitat type	Area, ha	Site quality classes					Average site quality class
		1	2	3	4	5	
Coniferous forest	528.3	-	291.4	228.1	8.8	-	2.47
Deciduous forest	1151.4	164.9	710.2	214.8	61.5	-	2.15
Mixed forest	248.9	47.4	121.5	66.7	13.3	-	2.18
Arable land	1.6	-	1.6	-	-	-	2.00
Meadows	9.7	-	-	-	9.7	-	4.00
Swamps and marshes	75.0	-	33.0	-	42.0	-	3.12
Water bodies	1.7	-	-	-	-	1.7	5.00
Lands not subject to site quality rating	28.4	-	-	-	-	-	-
Total	2016.6	212.3	1157.7	509.6	135.3	1.7	2.28

Source: compiled based on the author's own research

According to the table, mixed and deciduous forests are characterized by a relatively high site quality class (average site quality classes of 2.57 and 2.76), with areas comprising 1,151.4 ha and 248.9 ha, respectively. These are followed by coniferous forests and arable lands (average site quality classes of 2.83 and 3.00) covering 528.3 ha and 1.6 ha, respectively. Meadows are characterized by a fairly low average site quality class of 4.00 (an area of 9.7 ha). Water bodies also have a low site quality rating of 5.00, occupying an area of 1.7 ha. The low average site quality classes for ungulates indicate that these habitats have rather low productivity and require improvement through the oversowing of leguminous grasses.

According to survey data, the total population of ungulates, specifically European roe deer and wild boar, is 95 and 86 individuals, respectively.

Data on the optimal density of the main game species per 1,000 ha of habitat types across site quality classes I–IV adopted for the Vinnytsia region, along with the minimum density allowing for sustainable harvest, are presented in Table 3.

Table 3

Determination of optimal population density of the main game species

Game species	Total area of grounds, ha	Average site quality class (0.1)	Optimal density, ind./1,000 ha	Optimal population, ind.
<i>Capreolus capreolus</i>	2.97	2.7	26.5	78
<i>Sus scrofa</i>	2.97	3.2	5.4	16

Source: compiled based on the author's own research

If the optimal game density is below the minimum threshold, it is recommended to conduct selective culling only – removing sick, old, emaciated, injured, or malformed individuals to improve the overall population status. If it exceeds the threshold, forest game management measures, including hunting, are proposed. Data regarding the actual and optimal ungulate populations are shown in Fig. 2.

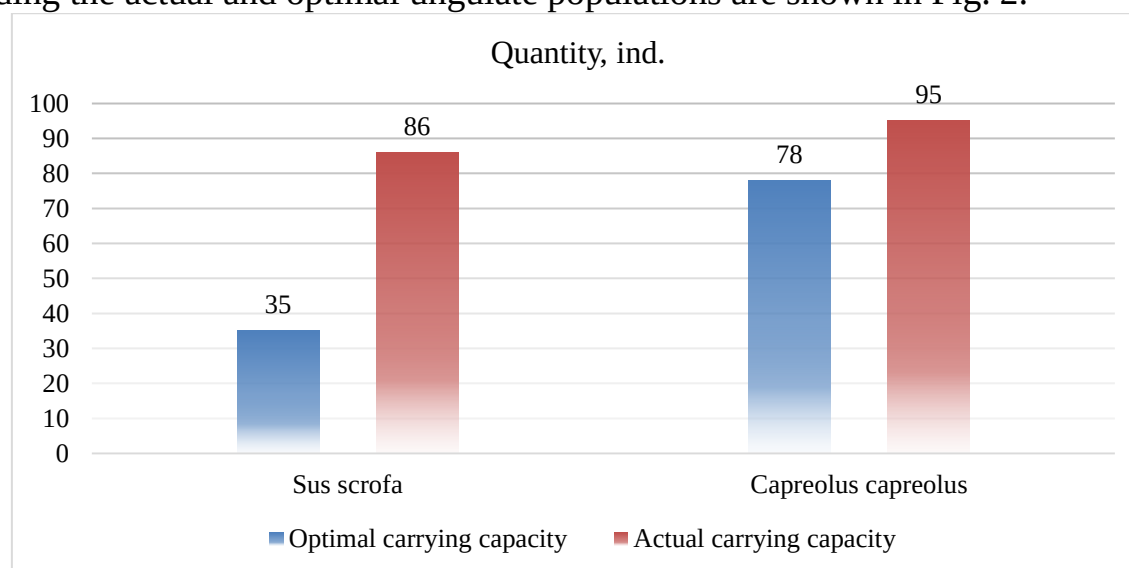


Fig. 2. Optimal and actual population of key ungulate species in the management area

Source: compiled based on the author's own research

The productivity of hunting grounds and the growth or decline in the population of each game species depend on various factors, the main of which are grouped into three ecological categories: biotic, abiotic, and anthropogenic. The extent of their impact is determined by analyzing departmental records as well as through field observations. To account for the influence of these factors, adjustment factors for decreasing (or increasing) the average site class index (bonitet) are introduced for each wild game species. Factors can either lower the average site class or improve it (coefficients with a minus sign) [3].

If the deterioration of the average site class (habitat quality) occurs through the fault of the hunting ground user and leads to a reduction of the average site class by one level (lack of anti-poaching enforcement, absence of supplementary feeding during adverse climatic conditions, unsatisfactory sex and age population structure, insufficient artificially created feeding and protective patches (remises), artificial watering places, biotechnical facilities, inadequate predator control, lack of sanitary and preventive measures, etc.), the established annual harvest rates of population growth for such hunting ground users shall be reduced by 10%.

For the purpose of sustainable hunting management, it is necessary to possess data not merely on individual animals of a given species, but on their aggregations (populations). Maintaining the biological integrity, high productivity, and viability of a population is achievable only through the rational utilization of game fauna, which relies on regulated harvesting according to a scientifically sound plan. To this end, calculations of population growth for each game species are conducted for the revision (management) period, based on current game density levels within the estate and population growth rates derived from their demographic structure [8].

For these calculations, a table of estimated annual population growth of game fauna for the Right-Bank Forest-Steppe zone was used (Table 4). Through sustainable management, it is planned to bring the numbers of game animals to the optimal carrying capacity of the grounds. This is achieved by means of strictly regulated population exploitation, taking into account its natural increase.

Table 4

Estimated annual population growth of key game species

Game species	Minimum density allowing harvesting (hunting, trapping), individuals/1,000 ha	Female participation in reproduction, %	Offspring born per female, individuals	Offspring mortality, %	Adult animal mortality, %	Annual growth limits, %	Average annual growth, %
<i>Capreolus capreolus</i>	35	50	1-2	35	20	10-20	15
<i>Sus scrofa</i>	18	40	4-6	30	25	20-120	30

Source: compiled based on the author's own research

According to the table, the average annual population growth for the *Capreolus capreolus* will be 15%, and for the *Sus scrofa* – 30%. Therefore, further calculations include population growth based on these percentages.

The calculation of feed procurement and the evaluation of the forage base are calculated taking into account the specified increase in animal numbers. Recommended rates for feed procurement and deployment per individual wild ungulate during the supplemental feeding season are presented in Table 5.

Table 5

Recommended rates of feed procurement and deployment per individual during the supplemental feeding season

Types of feed	Unit of measurement	Game animal species	
		Capreolus capreolus	Sus scrofa
1. Forest, vetch, or vetch-oat hay	kg	10	-
2. Haylage (silage)	kg	10	40
3. Broadleaf twig bundles (browse bundles)	pcs.	20	-
4. Cereal sheaves (grain sheaves)	pcs.	-	-
5. Grain, compound feed, grain screenings, acorns, beechmast, barley, oats	kg	15	30
6. Ear corn (corn on the cob)	kg	20	80
7. Root crops (root vegetables / succulent feeds)	kg	30	100
8. Salt licks (mineral block salt)	kg	3	5

Source: compiled based on the author's own research

According to the table, the required amount of forest (vetch-oat) hay per individual roe deer is 10 kg. The required amount of silage for the *Capreolus capreolus* and *Sus scrofa* is 10 kg and 40 kg, respectively. The required number of broadleaf twig bundles is 20 pcs. for roe deer. The required amount of compound feed for roe deer and *Sus scrofa* is 15 kg and 30 kg, respectively; ear corn – 20 kg and 80 kg; and root crops – 30 kg and 100 kg, respectively. The required amount of salt per individual roe deer and wild boar is 3 kg and 5 kg, respectively.

Based on the population growth of game animal species and the required amount of feed, we have calculated the feed procurement volumes for the three current years. The data regarding these calculations are presented in Table 6.

According to the table data and the projected animal population growth, the required amount of hay for roe deer for the years 2018–2020 will be 110, 120, and 140 kg; broadleaf twig bundles – 220, 240, and 280 pcs.; grain screenings – 165, 180, and 210 kg; ear corn – 220, 240, and 280 kg; root crops – 330, 360, and 420 kg; and salt – 33, 36, and 42 kg, respectively.

The required amount of feed for wild boar will be: silage – 160, 200, and 240 kg; grain screenings – 120, 150, and 180 kg; ear corn – 320, 400, and 480 kg; root crops – 400, 500, and 600 kg; salt lick – 16, 20, and 24 kg.

Conclusions and prospects for further research. As a result of the conducted studies, it was established that forest lands constitute the main component of the hunting grounds of SE «Vinnytsia Forest Research Station».

Table 6

Feed procurement volumes over the next three years at SE

Game animal species	Type of feed	Unit of measurement	Procurement norm per individual	Years					
				2023		2024		2025	
				Number of animals	Required amount of feed, tons	Number of animals	Required amount of feed (tons)	Number of animals	Required amount of feed (tons)
<i>Capreolus capreolus</i>	Hay	kg	10	11	110	12	120	14	140
	Silage	kg	-		-		-		-
	Broadleaf twig bundles	pcs.	20		220		240		280
	Grain screenings	kg	15		165		180		210
	Ear corn	kg	20		220		240		280
	Root crops	kg	30		330		360		420
	Salt lick	kg	3		33		36		42
<i>Sus scrofa</i>	Silage	kg	40	4	160	5	200	6	240
	Grain screenings	kg	30		120		150		180
	Ear corn	kg	80		320		400		480
	Root crops	kg	100		400		500		600
	Salt lick	kg	4		16		20		24

Source: compiled based on the author's own research

The total area of forest fund lands is 2045.9 ha, of which 1856.4 ha are covered with forest vegetation. Such a territorial structure creates favorable prerequisites for the existence of wild ungulate populations; however, the forage productivity of individual habitat types is heterogeneous and requires a differentiated approach to their utilization and improvement.

The conducted habitat quality evaluation (bonitation) demonstrated that among forest habitats, broadleaf stands possess the highest forage value for *Capreolus capreolus*, with an average quality class (bonitation class) of 2.15, followed by mixed forests at 2.18 and coniferous forests at 2.47. For *Sus scrofa*, the highest indicator among forest lands was recorded in mixed forests (2.57), while broadleaf (2.76) and coniferous forests (2.83) exhibited slightly lower values. The lowest forage capacity was characteristic of meadows and water bodies, with average quality classes of 4.00 and 5.00, respectively, for both studied species. This highlights the expediency of enhancing specific habitat categories by overseeding legume grasses, establishing forage and protective plots (remises), and installing biotechnical facilities.

According to census data, the actual population of *Capreolus capreolus* and *Sus scrofa* is 95 and 86 individuals, respectively. The estimated optimal population for the studied area was determined to be 78 individuals of *Capreolus capreolus* and 16 individuals of *Sus scrofa*. The obtained indicators must be taken into account when planning population management measures, organizing supplementary feeding, and ensuring the balanced use of game resources.

Taking into account the established seasonal supplementary feeding norms, the required procurement of hay, broadleaf twig bundles, grain screenings, ear corn, root crops, and salt licks for *Capreolus capreolus*, as well as silage, grain screenings, ear corn, root crops, and salt licks for *Sus scrofa*, has been substantiated. The calculated feed amounts for future years allow for planning feed procurement in accordance with projected population dynamics and ensuring timely supplementary feeding during periods of limited availability of natural food sources.

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АНОТАЦІЯ

СТРУКТУРА ТА ШЛЯХИ ПОКРАЩЕННЯ КОРМОВИХ УГІДЬ ДИКИХ КОПИТНИХ ТВАРИН В УМОВАХ ДП «ВІННИЦЬКА ЛНДС»

У статті досліджено сучасний стан кормових угідь диких копитних тварин та обґрунтовано напрями їх покращення в умовах ДП «Вінницька лісова науково-дослідна станція». Актуальність роботи зумовлена необхідністю забезпечення стабільної кормової бази мисливської фауни в умовах сезонного зниження доступності природних кормів, трансформації лісових екосистем та впливу антропогенних і кліматичних чинників. Метою дослідження було оцінювання ефективності наявних кормових угідь, визначення їх бонітету, встановлення оптимальної ємності для основних видів копитних тварин і розроблення пропозицій щодо вдосконалення системи підгодівлі.

Дослідження виконано на основі матеріалів лісовпорядкування, мисливського впорядкування, таксаційних описів, планів лісонасаджень, картографічної та повидільної баз даних, а також проєкту організації розвитку підприємства. Проведено розподіл мисливських угідь за типами, підтипами та видами, здійснено їх бонітування для козулі європейської (*Capreolus capreolus*) і дикого кабана (*Sus scrofa*), а також визначено оптимальну цілісність та чисельність мисливської фауни.

Встановлено, що загальна площа земель лісового фонду досліджуваного господарства становить 2045,9 га, з яких 1856,4 га припадає на землі, вкриті лісовою рослинністю. Для козулі європейської середній клас бонітету хвойних, листяних і змішаних лісів становить відповідно 2,47; 2,15 та 2,18, тоді як для кабана – 2,83; 2,76 та 2,57. Найнижчі показники кормової цінності встановлено для луків і водойм, що свідчить про доцільність проведення заходів із покращення окремих категорій угідь, зокрема шляхом підсіву бобових трав, створення кормових і захисних ремізів та облаштування біотехнічних споруд. Фактична чисельність козулі європейської та кабана становить відповідно 95 і 86 особин, що потребує врахування під час планування кормозабезпечення та регулювання чисельності популяцій. Запропоновано орієнтовні обсяги заготівлі кормів з урахуванням прогнозованого приросту поголів'я та сезонної підгодівлі. Практичне значення результатів полягає у можливості їх використання для вдосконалення організації мисливського господарства, підвищення продуктивності угідь і забезпечення біологічно обґрунтованого управління популяціями диких копитних тварин.

Ключові слова: лісові угіддя, кормова база, продуктивність, бонітування угідь, заготівля кормів, біотехнія.

Табл. 6, Рис. 2, Літ. 12.

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