

The state of the population of European roe deer (*Capreolus capreolus*, Linnaeus) in the Belgorod region

V Zheltukhina^{1*}, M Kulikova¹, A Melentiev¹, E Kotlyarova¹, and L Manokhina¹

¹Belgorod State Pedagogical University, Belgorod, Russia

Abstract. The population of European roe deer (*Capreolus capreolus*, Linnaeus), in comparison with other ungulate populations, has a fairly high ecological alert and has a good reproductive potential. Currently, an increase in the number and density of individuals of this species is observed on the territory of the Belgorod region. According to the results of the analysis of static indicators of the population, the progressive nature of the dynamic indicators of the roe deer population has been established. The main regulator of the roe deer population in the conditions of the Belgorod region is the anthropogenic factor in the form of sport hunting.

1 Introduction

As a result of the accidental appearance of wild animals in a person's life, their condition arises, and in some cases, this manifests itself in the emergence. The consequence was the result of the impact of pesticides on the fields, pollution of the air and ground environment, because of the intensive development of the transport network. Illegal hunting has also changed negatively in populations, which is pursued at a priority level. But in turn, legal hunting on a moderate scale does not have a negative impact on the environment [1].

Currently, various programs and methods are being developed to detect changes, determine the causes, and analyze the risks of negative consequences. It should also be noted that because of natural disasters, changes occur in the life processes of wild hunting animals, which affect their condition [2].

The animal world is a unique component of the natural environment, the national wealth of the country, a source of spiritual and aesthetic education of people, an object of scientific research. Animals are a self-sufficient value that ensures the functioning of all ecosystems, support the circulation and purification of natural waters, and actively participate in the conservation of soils and climate stability [3].

Rational use of animal resources remains an urgent problem, both for the entire territory of Russia and for individual regions. Intensive development of commercial animals inevitably, as a rule, leads to a sharp drop in their numbers. The exception to this rule is the European roe deer. This ungulate species, possessing high ecological plasticity and reproductive potentials, easily adapts to landscapes of anthropogenic origin, using the

* Corresponding author: Zheltuhina_vi@bsaa.edu.ru

forage resources of agricultural lands in full. So, in the Belgorod region in recent years there has been a steady increase in the population of roe deer.

The purpose of this work is to study the population-dynamic characteristics of the European roe deer in the Belgorod region. [4].

To achieve this goal, the following tasks were set: to determine trends in the number and density of the European roe deer population, to study the factors influencing the number of species in the Belgorod region, to study the territorial placement of roe deer depending on the status of the economic object, to show the role of the anthropogenic factor on the dynamics of the European roe deer population [5].

The object of the study is statistical data on the condition and abundance of European roe deer.

The subject of the study is the European roe deer and the dynamics of its changes on the territory of the Belgorod region.

2 Materials and methods

The paper uses stock materials of state bodies and hunting users for the period from 2014 to 2022.

Data on the distribution and population size of the European roe deer in the Belgorod region were obtained based on the results of accounting according to the order of the Ministry of Natural Resources and Ecology of the Russian Federation "On approval of the Procedure for state accounting, State Cadastre and state monitoring of wildlife objects". Accounting works were carried out according to the methods of the Central Research Institute of the Glavokhota of the Russian Federation using questionnaires and the method of correlation analysis [6].

Within the Belgorod region, the accounting of ungulates is carried out from January to March using three methods: on feeding grounds and fodder fields; winter route accounting and by collecting survey data.

3 Results

The European roe deer, being the smallest representative of the deer family, belongs to the most important hunting and commercial species of the Central Chernozem region and is found in all administrative districts on the territory of the Belgorod region [4]. Among the wide variety of factors determining the indicators of the number and density of the roe deer population, the direct and indirect influence of human economic activity against the background of periodically occurring negative changes in the abiotic and biotic nature of the conditions of existence of the species is imperative [7].

The dynamics of changes in the population of European roe deer over a ten-year period is presented in Table 1.

Table 1. Dynamics of the number of European roe deer in the Belgorod region for the period from 2014 to 2022.

Indicators	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2020	2022
Number, individuals	6962	7507	7400	7452	7347	7545	7825	8468	9148	9985
Density, individuals per 1000 ha	3.87	4.17	4.11	4.14	4.08	4.19	4.35	4.71	5.08	5.55

4 Discussion

The analysis of tabular data showed a progressive increase in the population by 30.28% and especially over the past three years, which is most likely due to a decrease in anthropogenic influence and favorable weather and climatic conditions.

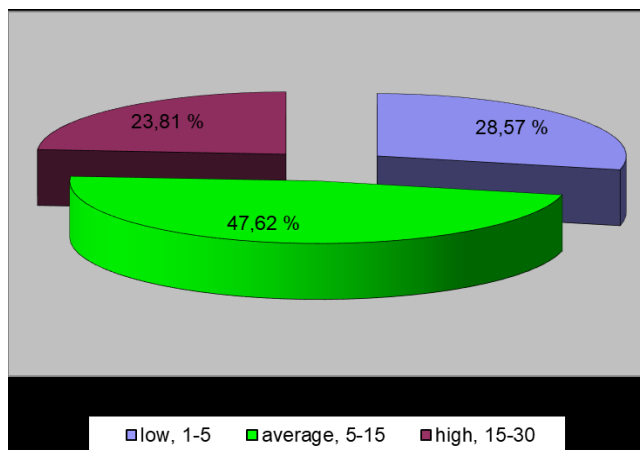


Fig. 1. The structure of distribution of roe deer population densities in the region in 2022.

The lowest population size during the observed period was recorded in 2014. The average annual trend of increasing the number of roe deer for the entire observation period was 302.3 or individuals per year.

The population density indicator, as a derivative of the number, also turned out to be the lowest in 2014 and increased by 30.27% in relation to 2022. The average annual increase in density was 0.17 individuals per year per 1000 hectares [8].

The average density of the roe deer population in the Belgorod region was 5.55 individuals per 1000 hectares.

Analysis of the structural distribution of roe deer population densities (Figure 1.) in the Belgorod region as of 2022 showed that 28.57% of the territory belongs to the territory with low density; 47.62% to medium and 23.81% to high.

The average regional indicator of the roe deer habitat area is 66.69% in relation to its total area. For the biotopic placement of roe deer, an extremely important factor is the indicator of the forest cover of its habitat. The presence of woodlands creates an affordable food base and shelters for animals, especially in open landscapes.

The specific features of the European roe deer, high fertility and ecological valence allow, in the presence of habitable biotopes, to quickly restore their numbers against the background of a sufficiently high anthropogenic pressure. The cultivation of landscapes also contributes to an increase in the number of roe deer. In the conditions of the Belgorod region, with the almost complete absence of large predators, the main regulator of the number of roe deer is man and his fishing and hunting activities [9]. Currently, the total number of registered hunters in the Belgorod region is about 42 thousand.

The processes of urbanization in the Belgorod region are accompanied by the concentration of the population in the regional and district centers. Approximately in the same proportions, citizens who have the right to hunt are distributed by districts. For the regional level, this proportion is formed as 1 roe deer per 4.2 hunters.

The operational characteristics of natural objects, their condition and quality are largely determined by the type of ownership of an economic entity [10]. The economic affiliation of the territories and the number of roe deer are presented in Table 2.

Table 1. Distribution of numbers and densities of the roe deer population depending on the habitat status in 2022.

Hunting grounds and protected areas	Area, thousand hectares	Number, individuals	Population density, individuals per 1000 ha
BROO "Society of Hunters and Fishermen"	244.49	1838	7.52
Public hunting grounds	852.27	842	0,99
Corporate hunting grounds	437.2	5448	12.46
Nature reserves and nature reserves	265.44	1857	7.0
Total	1799.4	9985	5.55

Geographically (Figure. 2) 47.62% are publicly accessible hunting grounds; 13.58% belong to the Belgorod regional public Organization "Society of Hunters and Fishermen"; 24.3% belong to the category of corporate users and 14.75% are specially protected natural territories.

Much of the roe deer population (Figure 2) 54.56% is concentrated in corporate hunting farms; 18.41 and 18.6% are in the territories of the Belgorod regional public organization "Society of Hunters and Fishermen" and specially protected natural objects, respectively; the share of publicly accessible hunting grounds accounts for only 8.43%.

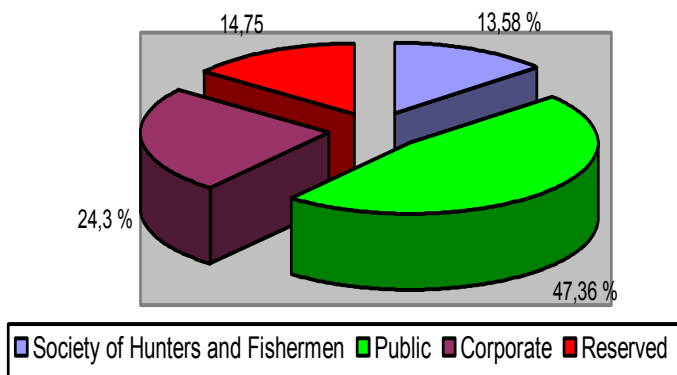


Fig. 2. Distribution of roe deer habitat areas depending on the economic status of the territory in 2022.

The priorities of the population density indicator were distributed according to the number of roe deer: the maximum density was recorded in corporate hunting farms of 12.46 and the minimum – 0.99 in public hunting grounds.

Regulation of the use of wild ungulates' resources is carried out on the basis of allocation of quotas for their commercial and hunting prey (Table 3).

The priorities of the population density indicator were distributed according to the number of roe deer: the maximum density was recorded in corporate hunting farms of 12.46 and the minimum – 0.99 in public hunting grounds.

Regulation of the use of wild ungulates' resources is carried out on the basis of allocation of quotas for their commercial and hunting prey (Table 3).

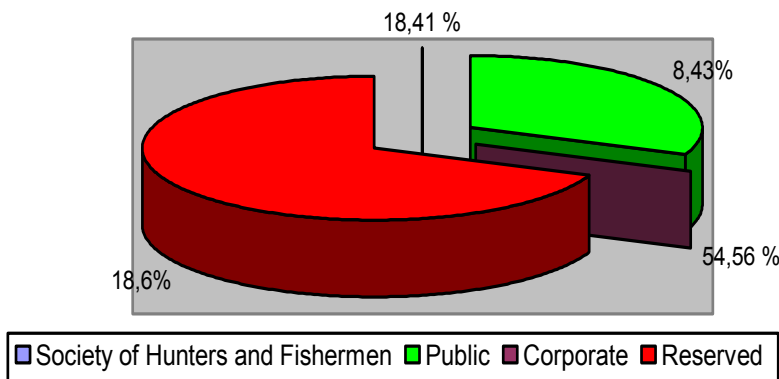


Fig. 3. The distribution structure of the roe deer population depending on the economic status of territories in 2022.

Table 3. Quotas for the extraction of European roe deer in the Belgorod region.

Year	Total number	Set production limits					
		older than 1 year		up to a year		in total	
		individuals	% of limit	individuals	% of limit	individuals	% from the number
2016	7545	274	62.4	165	37.6	439	5.8
2017	7825	278	61.1	177	38.9	455	5.9
2018	8468	331	60.96	212	39.04	543	6.4
2019	9148	331	59.53	225	40.47	556	6.08
2020	9985	372	58.31	266	41.69	638	6.39

Analysis of the data on the licensing rationing of roe deer production for the period from 2018 to 2022 showed that the increase in the number of livestock was 32.34%, and the limits increased by 45.33%. The licensed share of the total population increased by 0.59%. In the age balance of the harvested individuals, there was a shift towards a greater withdrawal of young animals by 4.09%.

The development of the planned limit (Table 4) from 2020 to 2022 decreased significantly from 58.75% to 19.6%. Such a significant decrease in the development of quotas is most likely due to the ban on wild boar hunting in the Belgorod region and, as a result, a decrease in interest in collective hunting for ungulates.

Table 4. Development of the limit of licensed roe deer production in the Belgorod region.

Year	Number, individuals	Limit, individuals	Mastering the limit, including	
			individuals	%
2018–2019	8468	543	319	58.75
2019–2020	9148	556	109	19.6
2020–2021	9985	638	-	-

5 Conclusion

Thus, according to the results of the conducted analytical studies, the progressive nature of the dynamic indicators of the roe deer population has been established. For the period from 2014 to 2022, in general, the number and density of the European roe deer population increased by 30.3%. The average annual trend of population increase was 302.3; population density was 0.17 individuals per year per 1000 hectares.

Analysis of the distribution structure of population densities showed that 47.62% belong to territories with an average degree of population density.

The main regulator of the roe deer population in the conditions of the Belgorod region is the anthropogenic factor in the form of sport hunting. The share of the planned license withdrawal of individuals over the past five years did not exceed 7% of the total livestock with a decrease in the development of quotas from 58.7 to 19.6% in 2022. Such a significant decrease in the development of quotas contributes to the growth of the number of roe deer in the Belgorod region.

References

1. E.B. Goldin, A.D. Markov, Local population of European roe deer *Capreolus Capreolus* L. In the forest ecosystems of the Southwestern Crimea, the Journal Days of Science of the V.I. Vernadsky KFU, 25-27 (2019)
2. O.A. Manuilova, K.E. Smirnov, A.S. Igolkin, The quality of wild animal populations and the problems of preserving the subspecific purity of their genotype Use and protection of natural resources in Russia, **1**, **157**, 44-49 (2019)
3. A.A. Danilkin, Optimal abundance and rationing of wild ungulates in the hunting economy: theory and practice Bulletin of Hunting, **11**, **1**, 63-73 (2014)
4. A.V. Degtyar, O.I. Grigorieva, R.Yu. Tatarintsev, Ecology of the White Mountains in figures. Department of Agro-industrial Complex and Environmental Reproduction of the Belgorod region, Limited Liability Company "CONSTANT", Belgorod, 122 (2016)
5. M. V. Pronov, G.A. Kisterny, *Features of winter feeding of European roe deer in the forest cultures of the Brasovsky forestry of the Bryansk region Environment surrounding humans: natural, man-made, social: Materials of the International Scientific and Practical Conference dedicated to the 90th anniversary of the University, Bryansk State University of Engineering and Technology*, 61-64 (2020)
6. V.V. Chervonny, Comparative analysis of different methods of accounting for ungulates and evaluation of their results Scientific Bulletin of Belgorod State University, Series: Natural Sciences, **17**, 188, 86-94 (2014)
7. V.L. Yarysh, G.E. Yarysh, Population dynamics of the European roe deer (*Capreolus Capreolus*) in the Karadag Nature Reserve Man-Nature-Society: Theory and practice of life safety, ecology and valeology, **6**, **13**, 110-113 (2020)
8. O.A. Manuilova, K.E. Smirnov, A.S. Igolkin, The quality of wild animal populations and the problems of preserving the subspecific purity of their genotype Use and protection of natural resources in Russia, **1**, **157**, 44-49 (2019)
9. A.I. Kozorez, A.I. Rovkach, Factors determining the quality of hunting grounds for roe deer Trudy BSTU, Forestry, **1**, **19**, 100-103 (2011)
10. A.S. Melnikov, The dynamics of the number of European roe deer (*Capreolus capreolus*) on the territory of the Ryazan region Young scientist, **39**, **277**, 217-219 (2019)