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Management of roe deer population (Capreolus capreolus L.) in Serbia

[*Gestão da população de cabrito-montês (Capreolus capreolus L.) na Sérvia*]

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ABSTRACT

The research was conducted during the 2018/19 hunting year at three hunting grounds: "Barajevska reka" - "Takovo" and "Jadar". The average density of Roe deer in hunting grounds varied from 48.67 to 74 individuals per 1,000 ha of hunting-productive area. However, when observing the number of individuals per 1,000 ha of total hunting area, the density varies from 16.07 individuals to 34.72 individuals. The determined gender ratio at the hunting ground "Jadar" was (M: F = 1: 0.93). At the hunting ground "Takovo", the gender ratio was (M: F = 1: 1.22), while at the hunting ground "Barajevska reka" the ratio was (M: F = 1: 1.59). The average fertility of Roe deer was 1.67 embryos per individual, or 1.75 embryos per pregnant female. Depending on the study area, the real growth varied from 0.54 to 0.73 fawns per female. Loss in Roe deer are caused mostly by biotic factors. The determined average age of shot individuals varied depending on the hunting ground from 3.53 to 5.24 years. The current state of Roe deer populations in Serbia varies between analyzed hunting grounds, but the overall situation is quite unsatisfactory, especially in terms of density, gender ratio and age structure of culled individuals.

Keywords: Capreolus capreolus L., management, growth rate, losses

RESUMO

A pesquisa foi realizada durante o ano de caça de 2018/19 nos três locais de caça: "Barajevska reka" - "Takovo" e "Jadar". A densidade média de cabrito-montês em áreas de caça variou de 48,67 a 74 indivíduos por 1.000 ha de área produtiva de caça. Entretanto, ao observar o número de indivíduos por 1.000 ha de área total de caça, a densidade varia de 16,07 indivíduos a 34,72 indivíduos. A razão de gênero determinada no terreno de caça "Jadar" foi (M: F = 1: 0,93). No terreno de caça "Takovo", a proporção de gêneros era (M: F = 1: 1,22), enquanto no terreno de caça "Barajevska reka" (M: F = 1: 1,59). A fertilidade média do cervo Roe era de 1,67 embriões por indivíduo, ou 1,75 embriões por fêmea grávida. Dependendo da área de estudo, o crescimento real variou de 0,54 a 0,73 fulvos por fêmea. As perdas em cabrito-montês são causadas principalmente por fatores bióticos. A idade média determinada dos indivíduos abatidos variou de 3,53 a 5,24 anos, dependendo do terreno de caça. O estado atual das populações de cabrito-montês na Sérvia varia entre os locais de caça analisados, mas a situação geral é bastante insatisfatória, especialmente em termos de densidade, proporção de gênero e estrutura etária dos indivíduos abatidos.

Palavras-chave: Capreolus capreolus L., manejo, taxa de crescimento, perdas

INTRODUCTION

Roe deer (Capreolus capreolus L. 1758), as an autochthonous species, is the most numerous wild ungulate in Serbia. Although considered a forest species (Hemami *et al*., 2004), roe deer often occurs on agricultural land (Cimino, Lovari, 2003; Marković, *et al*., 2017), which indicates the wide distribution of this species in different habitats. Wildlife management in Serbia is based on a regal hunting system, in which game species are considered as a natural resource and owned by the State. The State gives it to the users of hunting grounds for management. Hunting grounds in Serbia are grouped in hunting regions and cover almost the entire country's territory (Lavadinović *et al*., 2017).

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Hunting grounds are managed through various hunting ground users, where the largest percentage of hunting grounds (90%) is managed by hunting associations. The State, through its services, controls wildlife management by monitoring the realization of the goals from the hunting grounds' 10-year hunting management plan, which consists of 10 annual plans. Every user of the hunting ground must have these documents. The additional climate changes put more pressure on the roe deer population due to appearance of new infectious diseases (Lazar *et al*., 2017). Popović *et al*. (2015) in their research recognize the inconsistency of hunting management and excessive hunting pressure as factors that threaten the sustainable management of roe deer. Although the quality of hunting ground management has improved compared to the situation in the 1990s, there are still challenges that affect hunting management (Lavadinović *et al*., 2017).

The aim of this paper is to analyze roe deer management in hunting grounds from different hunting‒regions of Serbia. Based on the performed analysis, the directions and measures to improve the management of roe deer populations will be suggested.

MATERIAL AND METHODS

The research was conducted during the 2018/19 hunting year in three hunting grounds of different hunting regions of Serbia: "Barajevska reka" - Belgrade hunting region, "Takovo" - Central hunting region and "Jadar" - Western hunting region. In the hunting grounds, sample areas of 1015 ha, 987 ha and 1598 ha were selected. The first two localitions "Vranić" and "Runjani - Grnčara" are surrounded by populated places and have parts that can be viewed as two separate units. "Ješevac" is almost completely uninhabited, except for 50 ha in the northwestern part.

The calculation of hunting and hunting-productive areas for roe deer was done with the help of Google maps. During the spring (February-March) the counting of the roe deer was performed on these three experimental areas, using various binoculars, a thermal camera, night vision monocular and photo cameras. Based on this, the number, gender, and age structure of the population were determined. Data on hunting-productive areas for roe deer and abundance were taken from the hunting grounds' management plans. The determination of age was performed by counting the annual deposits of dental cement on the longitudinal section of the first molar from the lower jaw. During the work on the project for determining the age of roe deer males where the lower jaw was missing, the assessment was performed based on tooth wear, cuneiform bones fusion, size, appearance and angle of the antler base, and on the base of previous research by Necas (1972); Lehman, Sägesser (1986). Data on roe deer losses were taken from the hunting records of hunting ground users. The animals were not killed because of the research; the researchers only collected the corpses to undertake the research. The data were processed in Microsoft Office Excel and statistical package SPSS 20.

RESULTS AND DISCUSSION

Based on the recorded data of the users of the hunting ground shown in Table 1, the average density of roe deer in hunting grounds varies from 48.67 to 74 individuals per 1000 ha of hunting-productive area (HPA). However, when looking at the number of individuals per 1000 ha of total hunting area (productive hunting area for roe deer and non-hunting productive area), it can be seen that in the hunting ground "Jadar" there are only 16.07 individuals, in the hunting ground "Takovo" 22.88, while in the hunting ground "Barajevska reka" 34.72 individuals. In the hunting grounds "Barajevska reka" and "Jadar", the number of roe deer is slightly above the established optimal fund. In the hunting ground "Barajevska reka" and "Jadar" it is 5.71% and 1.39% respectively above the optimal fund, while in the hunting ground "Takovo" the number is lower by 5.29% than the optimal fund. The gender ratio at all three hunting grounds is optimal 1:1.

Based on Table 2, the calculated optimal fund for the experimental areas according to the hunting grounds' management plans drastically deviate from the actual situation on the ground. In the experimental area "Barajevska reka" - Vranić, the density per 1000 ha of the total hunting area is 112 individuals, per 1000 ha of HPA area according to the hunting grounds' management plan is 239 individuals, while based on the calculated HPA for the experimental part it is

157 individuals. Based on these data, the question can be asked whether the entire hunting ground is of the second bonitet rating and whether the density of 72 individuals at the hunting ground level is correct.

Table 1. Optimal fund, breeding stock and roe deer density at the researched hunting grounds in 2018

Hunting ground	Total hunting area (ha)	HPA (ha)	Optimal fund	Breeding stock fund /individuals/	Density at 1000 ha of HPA	Density at 1000ha total hunting area	Gender ratio
Barajevska reka	21,312	10,000	700	740	74	34.72	1:1.01
Jadar	45,417	15,000	720	730	48.67	16.07	1:1
Takovo	74,292	28,000	1,700	1,610	57.50	22.88	1:1

Table 2. Optimal fund, breeding stock and roe deer density in the sample areas in 2019

Hunting ground	Total experimental area (ha)	HPA experimental area (ha)[1]	Calculated HPA on Google maps (ha)	Optimal abundance for experimental area[2]	Breeding stock fund (individuals) 2019	Density at 1.000 ha HPA[3]	Density at 1000ha total hunting area[4]	Density based on calculated HPA[5]	Gender ratio
1	2	3	4	5	6	7	8	9	10
Barajevska reka	1,015	477	727	35	114	239	112	157	1:1.59
Jadar	987	326	659	16	79	242	80	120	1:0.93
Takovo	1,598	1,151	1,548	66	122	106	76	79	1:1.22

[1] Hunting-productive area of the experimental area calculated according to the hunting grounds' management plans; [2] Optimal funds for the experimental area calculated according to the hunting-productive area and the site class from the hunting base; [3]Density at 1.000 ha HPA was calculated by dividing breeding stock fund (individuals) 2019 with LPP experimental area (ha); [4]Density at 1000ha total hunting area was calculated by dividing breeding stock fund (individuals) 2019 with total experimental area (ha); [5]Density based on calculated HPA was calculated by dividing breeding stock fund (individuals) 2019 with optimal abundance for experimental area

On the experimental area "Jadar" - Runjani-Grnčara the density per 1000 ha of total hunting area is 80 individuals, per 1000 ha HPA area according to the hunting grounds' management plans is 242 individuals, while based on the calculated HPA for the experimental part is 120 individuals. Based on these data, the question can be asked whether the hunting ground is of the second or third quality class and whether the density of 48.67 individuals per 1000 ha is correct.

Observing all three experimental areas we can conclude that there is a significantly higher density of game on them in relation to the one predicted by the general evaluation of hunting grounds. This may indicate a situation that in certain parts of the hunting ground there are no roe deer at all, or it is significantly below the projected number per unit of hunting-productive area. Also, this clearly indicates that the management of the roe deer population in one hunting ground must be based on division into smaller hunting areas. The general figure of the hunting ground can cover up both serious and planned management in one district, as well as complete inaction and absence of management and roe deer in another district.

Based on Table 3, the best gender ratio is on the experimental area of "Runjani-Grnčara" (M: F = 1:0.93), while the most unfavorable is on the experimental ground "Vranić" (M: F = 1:1.59). The share of fawns at the experimental ground

"Vranić" is 28.94% in relation to the breeding stock, on the experimental plot "Runjani-Grnčara" 25.32%, and in the experimental area "Ješevac" 23.77%.

Table 3. Age structure and gender ratio of roe deer at the experimental areas in 2019

Hunting ground	Age structure	Male	Female	Breeding stock (individuals) 2019.	Gender ratio M:F
Barajevska reka (Vranić)	<1 years	14	19	114	1:1.59
	2 years	10	20		
	3-4 years	13	19		
	> 5 years	7	12		
	Total	44	70		
Jadar (Runjani-Grnčara)	< 1 years	7	13	79	1:0.93
	2 years	15	8		
	3-4 years	13	11		
	> 5 years	6	6		
	Total	41	38		
Takovo (Ješevac)	< 1 years	15	14	122	1:1.22
	2 years	17	29		
	3-4 years	15	17		
	> 5 years	8	7		
	Total	55	67		

The real increase per roe deer in 2019 on the experimental area "Vranić" was 0.65 fawns, on the experimental area "Runjani-Grnčara" it was 0.73, while on the experimental area "Ješevac" was 0.54 fawns.

The average number of embryos per one pregnant female is 1.54 Popović (1999), with the highest number of embryos (2.0) in five-year-old females, and the lowest in two-year-old (1.33) Perišić *et al*. (2006). However, the real growth is significantly lower according to the research by Popović *et al*. (2006). According to the same authors it varies from 0.65 to 1.11 fawns per one fully mature female, depending on the hunting area. In Vojvodina, according to the research by Ristić (1999), the real growth of roe deer varies from 0.45 to 0.90, on average 0.63. Popović *et al*. (2007), in addition to losses, also showed the way of managing the experimental areas in real terms.

Based on the age structure (Table 4) on all three experimental areas the share of young males under 2 years is higher than the optimal 48%, while in the middle age class the number of males is slightly above the optimal 26%, while in the third age class over 5 years we have a significantly lower number of these individuals. This clearly indicates that the optimal age structure of roe deer males in the population cannot be achieved, so this also reflects on the trophy value.

The average age of culled males at the hunting ground "Takovo" was 3.98 years, at the hunting ground "Jadar" was 3.53 years, while at the hunting ground "Barajevska reka" it was 5.24 years (Table 5).

According to the research by Popović and Gačić (2006), the age of culled males in Serbia varies from 2 years to 10 years, on an average for the lowland hunting grounds it is 5.14 years and the for the mountain type hunting grounds it is 4.41years. The average age of culled individuals is significantly higher compared to the same areas more than two decades ago (Ristić 1994), but it is still below the management age, which is seven years (Popović and Bogdanović, 2004). The average age of culled bucks in our country is lower than in Hungary, where according to Farkas and Csányi (1990), in the period 1973-1986 years varied between 5.7 and 4.8 years.

Table 4. Male age structure

Hunting ground name – experimental ground		Age structure Young >2 yrs.	Middle age 3-4 yrs.	Mature <5 yrs.	Total
Barajevska reka (Vranić)	Number	24	13	7	44
	%	54.55	29.55	15.90	100
Jadar- (Runjani-Grnčara)	Number	22	13	6	41
	%	53.66	31.71	14.63	100
Takovo- (Ješevac)	Number	32	15	8	55
	%	58.18	27.27	14.55	100
Optimal number	Number	24	13	13	50
	%	48	26	26	100

Table 5. Culled male age at the hunting ground "Barajevska reka" 2016-2018. year and hunting grounds "Jadar" and "Takovo" in 2018

Hunting ground	n	Mean	Min.	Max.	Sd	CV
Barajevska reka	192	5.24	2.00	7.00	1.07	20.35
Jadar	58	3.53	2.00	7.00	1.29	36.42
Takovo	44	3.98	2.00	8.00	1.53	38.53

Based on preliminary research during 2019 at the surveyed hunting grounds (Table 6), the largest losses are due to traffic accidents, and they account for 41.18% of total losses, followed by dogs and other carnivores 20.59%. Based on the insight into the official hunting records, it can be stated that the users of the hunting ground do not record all the losses found in the hunting ground, but only those where possible court disputes are expected. The users of the hunting ground do not record all the losses found due to the accompanying documentation that they have to keep, reporting to the hunting or veterinary inspection that needs to get to the field.

Table 6. Roe deer losses for the period 2019 at the analyzed hunting grounds

Cause of death	Gender and age structure	Number of individuals			Total loss	% from total loss
		Barajevska reka	Jadar	Takovo		
Agricultural mechanization	Fawns	4			4	
	∑	4			4	11.76
Traffic accidents	Male	3	2	3	8	
	Female	2	2	2	6	
	Fawns				0	
	∑	5	4	5	14	41.18
Mechanical injuries	Male	4			4	
	Female				0	
	Fawns				0	
	∑	4			4	11.76
Fawn capture	Fawns	2			2	
	∑	2			2	5.88
Dogs and Foxes	Female	3	1	1	5	
	Fawns	2			2	
	∑	5	1	1	7	20.59
Poachers	Male				0	
	Female			2	2	
	Fawns				0	
	∑			2	2	5.88
Unknown causes	Male	1			1	
	Female					
	∑	1			1	2.95
Total	Male	8	3	3	14	41.18
	Female	5	2	5	12	35.29
	Fawns	8	-		8	23.53
	∑	21	5	8	34	100

Figure 1. Locations of the experimental areas on the map of the Republic of Serbia: 1-Runjanin-Grnčara (Jadar), 2-Vranić (Barajevka reka), 3-Ješevica (Takovo)

Figure 2. Study area Vranić (Barajevska reka)

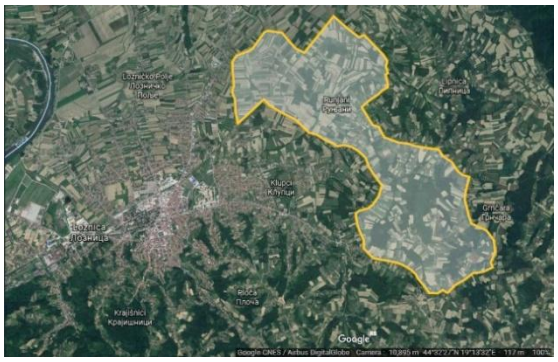

Figure 3. Study area Runjanin-Grnčara (Jadar)

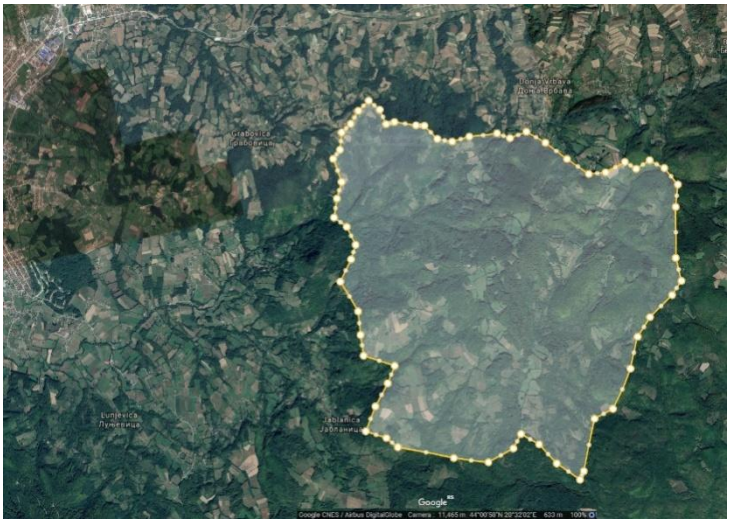

Figure 4. Study area Ješevica (Takovo)

The small percentage of roe deer population used in hunting grounds in Serbia is the result of large losses for this species that have not been recorded. This clearly indicates that the planned losses of roe deer are higher compared to the planned ones in the hunting grounds' management plans (10%), which means that due to the increased losses, the culling was reduced. According to the research by Popović and Bogdanović (2001) and Popović (2006), the largest percentage of these losses were caused by anthropogenic factors. Based on this, during planning, it is necessary to reduce the level of population use and increase predicted losses at certain areas and hunting grounds.

CONCLUSION

Findings from this research indicate that roe deer density is variable and significantly differs between analyzed hunting grounds. The density is in the range from 48.67 to 74 individuals per 1000 ha of hunting-productive area, while it is from 16.07 to 34.72 individuals per 1000 ha of the total hunting area. At the same time the estimated density on the experimental areas varied from 76 to 112 individuals per 1000 ha of total area or 106 to 242 individuals per 1000 ha of hunting-productive area. The gender ratio at all hunting grounds according to the hunting grounds' management plans is 1: 1, while on the experimental areas it is from 1:0,93 to 1: 1,59 (M:F). The real growth rate in the analyzed hunting grounds varies from 0.54 to 0.73. The age structure of roe deer in all observed hunting grounds is below optimal because the average age of culled individuals varies from 3.53 to 5.24 years. It is contrary to optimal management practices which are based on culling of mature individuals. The biggest losses of roe deer are due to traffic accidents, 41.18% of the total losses, followed by predation from feral dogs and wild carnivores, 20.59%. However, these findings are not final, since hunting ground users do not record all losses found in the hunting grounds.

Obtained results suggest that the management of roe deer in analyzed hunting grounds is not sustainable, since it is based on data from hunting grounds' management plans which do not provide proper insight into population density, sex, or age structure. At the same time the losses of population are not adequately monitored. Despite the lack of proper knowledge about the population, wildlife managers estimate scope of culling on wrong estimates which have negative impact on species survival and distribution. In such circumstances it is urgent to change the existing system with more adequate management measures, which will be based on accurate monitoring methodology and reliable data. It is the only solution to achieve sustainable use of Roe deer in the country. Otherwise, the population abundance and number will decline in the future, which will have broader consequences.

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