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POACHING IN SERBIA: FACTOR ANALYSIS

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Summary: Republic of Serbia has suitable habitats for most of European game. Game management and hunting in Serbia has long tradition that reached its peak during Socialistic Federative Republic of Yugoslavia. However, during the 1990-es due to economical and political crises in the country, hunting sector was neglected. It resulted with decrease of a game abundance and trophy quality. Nowadays most of large carnivores are threatened, while number of some large ungulates heavily decreased. One of reasons for this situation is poaching. Therefore, in this paper we analyzed level and factors that affect scope of poaching in Central Serbia. Four stakeholders -State Enterprise "Srbijašume", State Enterprise "Borjak", National park "Tara" and Hunting Association of Serbia (LSS), manage all hunting grounds analyzed in this paper.
Key words: Serbia, game management, poaching

Introduction

Serbia is in central part of Balkan Peninsula with total area of 88,407.00 *km*². It consists out of three main regions: lowland, hilly and mountainous one. Serbia has moderate continental climate with four seasons [1]. Thanks to its natural conditions, most of European game species are autochthonous in Serbia [2].
Hunting sector in Serbia has long tradition, which was shaped in modern Serbian history by Austro-Hungarian Empire [3]. During the second half of the XX century, hunting in Socialistic Federative Republic of Yugoslavia (SFRY) became one of most developed hunting sectors in Europe. Parameters of this development are high-quality trophies that have been shooting in local hunting grounds during that period [4]. End of SFRY, followed by crisis during the '90s affected the hunting sector in Serbia. It resulted with decrease of most valuable game abundance, especially wild ungulates such as red deer (*Cervus elaphus*), while some of large carnivores' species became endangered.
Serbia inherited from SFRY a regal hunting system, where game belongs to the State. In such circumstances, the most of hunting ground users are representatives of the State, such as forest state enterprises and national parks. However, the biggest hunting ground user is the Hunting Association of Serbia (LSS) that manages most of Serbian hunting grounds. Until recently, the LSS was the only hunting ground user that was not directly controlled by the State. Number of hunters in Serbia during last decade decreased. According to newest data, Serbia has 77,128 hunters, out of which most are still members of the LSS.
One of most severe problem of Serbian hunting system nowadays is poaching. Therefore, the purpose of this study is to analyze factors that influence poaching, a treat that affects not only the Serbian hunting sector [5] [6] [7] [8] [9], but also countries in the Balkan region [10] [11] [12] [13] [14]. However, it seems that poaching has not significant importance in Serbian wildlife scientific society, since it provided modest research on this topic. Therefore, it is important better understand this problem and to identify factors that influence it. Better understanding of the problem can help us to define recommendations for the decision makers, in order to create instruments that could decrease this illegal activity. Decrease of poaching will improve game protection and increase of game abundance.

Material and Method

In our research, we analyzed 95 hunting grounds in Central Serbia, since its hilly and mountainous regions enable poachers easier to move through hunting grounds. An analyzed hunting ground covers in total 2,945,400.00 ha and gathers approximately 32,500 hunters. All data were obtained from reports that hunting grounds submitted to Directorate of Forestry, Ministry of Agriculture, Trade, Forestry and Water management of Republic of Serbia. Out of 95 hunting grounds included in this research, 14 are managed by state enterprises (14.74%), out of which 13 by the State Enterprise "Srbijašume" and 1 by the State Enterprise "Borjak", 80 (84,21%) are managed by Hunting Association of Serbia trough its hunting fellowships and one hunting ground belongs to the National park "Tara" (1,05%)(Graph 1). For each hunting ground, we analyzed its area, number of members/hunters, number of gamekeepers and managers and number of

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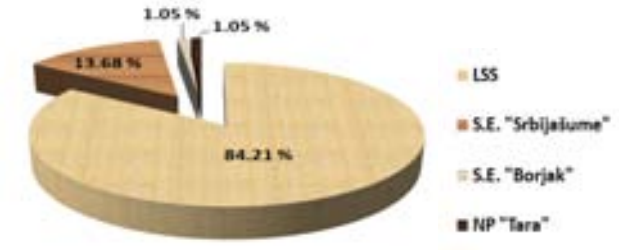
registered offence charges. Number of registered offence charges has been analyzed for 5 years period between 2006 and 2011, while the other data are only for the year 2011.

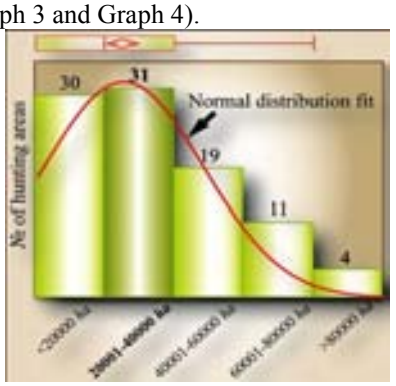


Graph 1. Distribution of hunting grounds between stakeholders

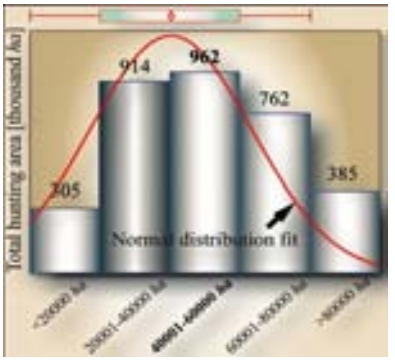
All hunting grounds were classified according to its size in 5 categories: up to 20,000 *ha*, between 20,000-40,000*ha*, between 40,000-60,000 *ha*, between 60,000-80,000 *ha* and hunting grounds with area bigger than 80,000 *ha*. For collected data, a modeling method was applied. Within statistical models regression and correlation analysis were used. Under the regression and correlation analysis, we conducted a power regression, while for evaluation of obtained regressions we used coefficient of determination, correlation, *t*-statistic parameters and *F*-test of correlation coefficient.

Results and Discussion

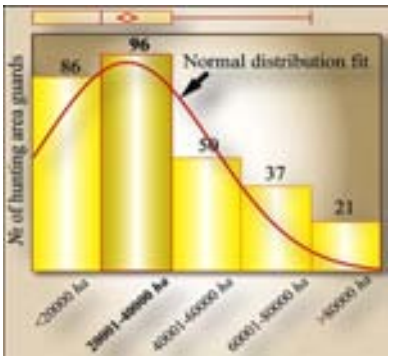
All hunting grounds were classified according to its size area into five categories. Our analysis showed that the classification of hunting grounds per size has normal distribution (Graph 2). Within each category, we summarized the total area of hunting grounds and number of gamekeepers within it. Both analyses have normal distribution (Graph 3 and Graph 4).



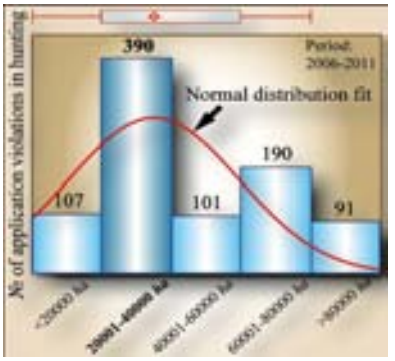
Graph 2. Number of hunting grounds per size categories



Graph 3. Sum of hunting grounds areas per size categories



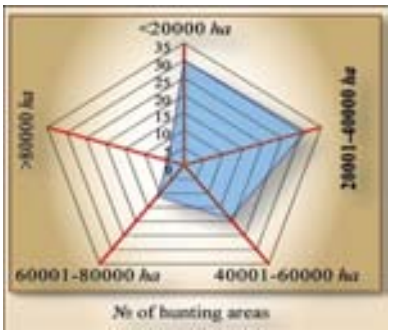
Graph 4.Number of gamekeepers per category



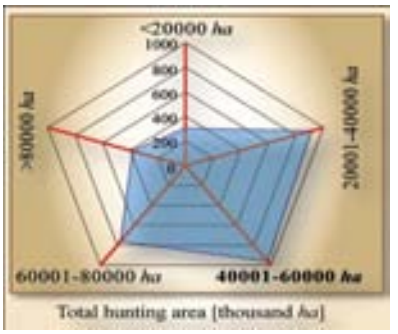
Graph 5. Sum of offense charges per category

However, when we analyzed the sum of offence charges per each size categories (Graph 5) we did not get the normal distribution. It happened with analysis of total number of offence charges per a thousand hectares and sum of offence charges per total number of gamekeepers within each size category. Therefore, we could set

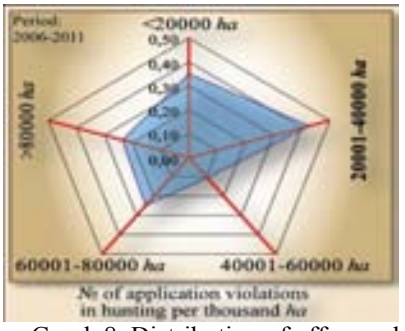
regression models only for the first three analyses, since the rest do not meet prerequisite of the normal distribution. Results of our analysis are presented in graphs 6-11.



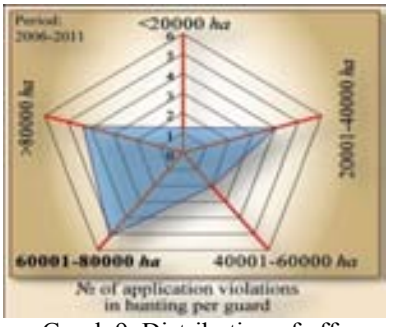
Graph 6. Number of hunting grounds per size categories



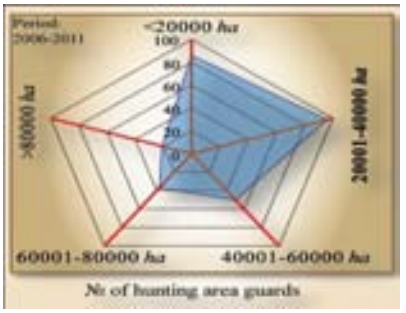
Graph 7. Total area of hunting grounds per size categories



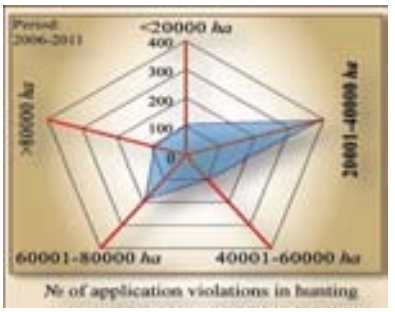
Graph 8. Distribution of offence charges per area within size categories



Graph 9. Distribution of offence charges per gamekeeper within size categories



Graph 10.Distribution of gamekeepers within size categories



Graph 11. Distribution of offence charges per 1000ha within size categories

Analyses resulted with four models that predict number of offence charges against poaching in hunting grounds. First one is based on one variable - size of a hunting ground. Formula is (*t*-statistics of parameters in parenthesis):

$$\ln y = \ln a + b \cdot \ln x$$

(–3.08) (0.0001)

$R^2 = 0.261 \quad R = 0.511 \quad F_{(2,53)} = 18.35$

$$y = 0.0034 \cdot x^{0.783}.$$

This model shows that the number of offence charges directly depends of size of a hunting ground. If the size of hunting ground increase for 1%, than the number of offence charges will also increase for 0.783.
Second model is based on one variable - number of gamekeepers within hunting ground. Formula is (*t*-statistics in parenthesis):

$$\ln y = \ln a + b \cdot \ln x$$

(9.70) (0.00)

$R^2 = 0.255 \quad R = 0.505 \quad F_{(2,53)} = 17.76$

$$y = 5.611 \cdot x^{1.371}.$$

According to this model, the number of offence charges will increase for 1.381 if the number of gamekeepers increase for 1%.

Third model is based on two variables –size and number of gamekeepers within hunting ground. Formula is (*t*-statistics of parameters in parenthesis):

$$\ln y = \ln a + b \cdot \ln x_1 + c \cdot \ln x_2$$

(–1.78) (0.01) (0.01)

$R^2 = 0.347 \quad R = 0.589 F_{(3,54)} = 13.52$

$$y = 0.031 \cdot x_1^{0.532} \cdot x_2^{0.911}.$$

The third model shows that the number of offence charges will increase for 1.443 if size of hunting ground (x_1) and number of gamekeepers (x_2) increase for 1 %.

The final model is based on three variables - size of hunting grounds, number of gamekeepers and number of hunters that are members in that hunting fellowship. Formula is (*t*-statistics of parameters in parenthesis):

$$\ln y = \ln a + b \cdot \ln x_1 + c \cdot \ln x_2 + d \cdot \ln x_3$$

(-2.03) (0.01) (0.06) (0.42)

$R^2 = 0.369 \quad R = 0.607 F_{(4,48)} = 8.76$

$$y = 0.0013 \cdot x_1^{0.8} \cdot x_2^{0.71} \cdot x_3^{0.22}.$$

According to the fourth model, the number of offence charges in hunting ground will increase for 1.73 if variables (x_1 – size of hunting ground, x_2 – number of gamekeepers, x_3 – number of hunters within hunting fellowship) increase for 1%

Conclusion

According to analyzed data, it is proved that factors such as area of a hunting ground, number of gamekeepers and number of members within a local hunting fellowship have significant impact on number of offense charges. According to our analysis, the most effective hunting grounds are with area from 20,000-40,000 *ha*, since the number of offense charges has been the highest there (per area and per thousand hectares). Individually, gamekeepers were most effective in hunting grounds with area between 60,000 and 80,000 *ha*. Most likely constant presence of members and gamekeepers in hunting grounds with area from 20,000-40,000 *ha* decreased poaching activities and increase number of offense charges. Hunting grounds with bigger area should have more gamekeepers or volunteers that will control poaching activities. However, in this study we analyzed only registered offence charges. Therefore, it is reasonable to assume that there were also unregistered poaching activities during this 5-year period that were not taken in consideration. Since this is the first research of this kind in Serbia, we hope that obtained results will help in better understanding of this problem and that this study will motivate other scientists and researchers to focus on poaching as major treat to hunting and wildlife management in the country.

Acknowledgement

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