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THE CALCULATION OF LOSSES IN HARES IN VOJVODINA FOR THE PERIOD FROM 1967. TO 2011

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Summary The main and decisive role in the abundance of the hare population in general, and therefore at the beginning of the hunting season, has reduction factors. It is well known that in populations of species of high fertility losses are a key element in abundance regulating (Gossow, 1976). In the hare population for the abundance population dynamic very important, or even decisive role has the losses during the reproduction period. Segments reduction of young animals is very strong. According to Petrusewicz (1970), it is 60% of all births, according to Raczynski (1973) 39-74% and based on research of Pielowski (1976), 77%, and according to Möller (1971) up to 74-90%. Research in Yugoslavia (Vojvodina) showed that the average survival rate of young hares to the beginning of the hunting season within the period of 10 years (1967-1976) amounted to 23.3% (Jovanović, 1971, Šelmić, 1977).

Materials and methods
For conditions of the hunting grounds for the period from 1967. to 2011. based on the parameters of the hunting statistics by year (spring numerical strength, coefficient of real gain, total harvest) the average calculated losses in hares during the period of reproduction for 45 years are 31.44% (with a range from 11.93 to 47.01%), while the winter losses are 32.10% (with a range from 6.96 to 45.47%).

Results
The losses occurring in two periods that we studied were significantly higher than in the previous period and they ranged between 20 and 25% regarding autumn and spring numerical strength. The existing large range at both losses, but considering that long period was studied, proposed losses with which should do the planning documents is valid enough to accept the proposed rates when making future planning documents.

Conclusions
Winter losses and losses in the period of reproduction are rounded, 32%, and they are proposed to be used in the preparation of documents for real planning of hare population, and thus the quality of the balance of the population and the preservation of the hare population in the long run. This would preserve the hare fund for many years, what was the aim of our research.

Keywords: hare, abundance, winter losses, reproduction losses.

Introduction

Reduction factors
Major and a crucial role in the number of hares population in general, and therefore at the beginning of the hunting season, have the reduction factors. It is well known that in populations of species major fertility losses are a key element in regulating of strenght (Gossow, 1976). In hare populations for dynamics strenght is very important, if not crucial role have losses during the reproduction period. Reduction segments of young animals is very strong. According to Petrusewicz (1970), it is 60% of all births, according Racinskom (Raczynsky, 1973) from 39-74% and based on research of Pielowski (1976), 77%, and by Möller (1976) even 74-90%. Researches in Yugoslavia (Vojvodina) showed that

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the average survival rate of young hares until the beginning of the hunting season in the period of 10 years (1967-1976) amounted to 23.3% (Jovanović, 1971; Šelmić, 1977).

Researches by Ristić and associates (Ristić and Matejević, 2010), the average losses at hares between the beginning of the hunting season (October) and the beginnning of reproduction in the next period (March) ranges between 12.58 and 45.47%, or an average of 32% annually for the 41-year observation period in the hunting grounds. For the 42-year period, based on research by Ristić and associates (Ristić and Matejević, 2010), the hunting grounds of Vojvodina, the losses in the period of reproduction of hares are ranged between 11.93 and 47.01%, or an average of 32% annually.

The survival rate of youngs, therefore the real growth of the entire population can be quite reliably determine the age structure in the fall (the beginning of the hunting). This must include the losses in the adult segment, which is twice as reflected in the number of population in the fall. First, by absence of lost part of adult population in the autumn and, second, their total or partial non-participation in reproduction. The losses of adult during the reproduction period during calculation of real growth some authors completely ignored (Petrov and Dragojev, 1962; Černe, 1971; Tomilova, 1972) while in other counts in the form of coefficients in relation to numerical strength of the spring, at the height of 0 , 1 to 0.3 (Hell, 1972; Pielowski 1976, Šelmić 1977, Möller 1978). How is unjustified and illegal to ignore these losses it is equally incorrect to take them as constant coefficients. Because, as observed by Racinski (Raczynsky, 1973), real growth can be satisfying with a small participation of youngs in the autumn population, provided that the losses during the reproduction period were small. However, if we agree that losses in the reproductive period are not the same in different years, we still believe that they should be positively correlated with the losses of youngs, because one and the other segment of the population live together under the same environmental conditions.

Unable to determine the yearly losses of adults, for now we have to accept that they are expressed by the coefficient. The value of this ratio can be yearly checked with partial recounting in the fall, on constant experimental surfaces.

Observantly to the principle that the use of a population or micropopulation of hares should be in range of annual real growth, from the real growth must rejected the losses till the beginning of hunting season which will be developed from the beginning of hunting to the beginning of next reproduction period („winter losses").

Losses in the reproductive period

There are many and varied factors that influence the decreased the number of hares population. From diseases, predators, climatic factors and the intensive cultivation and overhunting.. Reduction of number due to the overhunting (hunting and capture of live hares) is called the use of population, while reducing the impact of the other factors is called losses.

In hare populations a crucial role in regulation of have the number of losses during the reproduction period.

Height of losses since the beginning of reproductive period (15th of March) to the start of of hunting season (15th of October), calculated in determining the real growth of the population or micropopulation or the autumn environmental density can be adjusted during the year. However, the amount of planned losses from the beginning of hunting season (15th of October), to the start of the next reproductive period (15th of March) must be determined as accurately as possible, in order to determine the rate of rational use of hare populations and micropopulations, without risk to reduce spring environmental density.

The survival rate of young hares is very low and ranges on average about 25% of to the hunting season. Losses during the reproduction period, but much smaller, are liable the older hares too (adult). It is estimated that about 30% hares in spring numerical strength die before hunting season. Of course, the dispersal of the population number continues during the hunting season and winter, and occurs as a result of deteriorating of living conditions, but also depends on some relationships within the population. Losses in the hare population from the end of the reproduction period of one to reproduction period until the beginning of next year, amount to an average of 30% of the the numerical strength of autumn, but they are very different from year to year. It was found that a large

impact on this losses have the participation of youngs in autumn population, so the losses are higher if participation of youngs is higher. So once again confirms that environmental policy in populations of major fertility losses have a major role in regulation of numbers.

Winter losses
These losses, which can only conditionally be called "winter losses" are, in fact, the total population losses, micropopulation or their parts, of the beginning of the hunting until the beginning of the next reproductive period.
Losses are determined as the difference between the counting of the game: at the end of the hunting season to 31th of December and at the beginning of the next reproductive period 15th of March.
The effect of reducing factors continues, of course, after the opening of hunting season, and to all tcauses from the reproductive period should be added the losses from injuries in hunting hares, and unfavorable climatic factors over the winter. Although direct losses of winter are not large, amounting to about 6% of the the numerical strength of autumn (Pielowski, 1976), most authors at popolation-dynamic calculations accounts at much larger total lossesand that 10% (Szederjei and Studinka, 1962), 15% (Hell, 1972), 20% (Jakšić 1965; Černe, 1971; Heltay and Széki, 1975) to 25-30% of the the numerical strength of autumn (Petrusewicz, 1970; Ladziansky, 1997).
Researches in Croatia in five experimental hunting grounds with different intensity of use (Romic, 1965) showed that losses vary from year to year (11.1% -67.5%) and the highest in hunting areas are with the highest density, accordingly in hunting ground where was not hunted for 5 years (an average of the five-year period is 58% per year). In other hunting grounds the average losses were much lower - the highest 18.7%. It should be noted, however, that all these informations relating to losses from the end of the hunting season (15th of December)) to the beginning of the next reproductive period (15th of March).
Researches (in Vojvodina) in this direction (Šelmić and Bojović 1979) showed that the average losses in three populations in six consecutive years (1973-1978) amounted to 28.2% ± 14.4 to 29,5 ± 8.9% of the numerical strength of autumn, but in the period from 1st of November (the beginning of of hunting season) until 1th of March next year. However, annual variabilities are very large to completely exclude the use these averages in management planning with hare populations. There was also a positive correlation between participating of young population in autumn and the "winter losses", and the strongest in the population with the lowest environmental conditions, and slightly lower in the population with average environmental conditions, and the smallest in population with the best environmental conditions. Therefore, the age structure of hares population or micropopulation in autumn is not just a consequence of specific changes that occur in the population under the influence of biotic and abiotic factors, but is itself the cause of important changes.

Material and Methods
Calculation of losses in the period of reproduction
In hares population the most important factor in the regulation of a number have the losses in the reproductive period.
Height of losses since the beginning of reproductive period (March 15th) to the start of the hunting season (15 October), were obtained by calculation. To get to the numerical strength in autumn, the spring numerical strength is multiplied with established real growth per year for the entire population in Vojvodina. From this numerical strength is taken the hunt and numerical strength in spring, and this difference represents losses during the reproduction period. After that, the obtained result was divided by spring numerical strenght state and multiplied by 100. In this way, is calculated percentage of losses in the period of reproduction.
The formula by which we calculated losses and percentage of losses is:

$$g = E2 - e - N$$

g - losses
E2 – numerical strenght in autumn **(E2= N x Krp)**
e - hunt
N – numerical strenght in spring

Krp - coefficient of real growth

$$\%g = \frac{g}{E2} \times 100$$

% g – percentage of losses in the reproduction period

Results and Discussion

Analysis of obtained results for a period of 45 years (1967-2011) identified the loss of reproduction time per year:

For the observed period was the highest in years when losses were between 35-40%, and that 17 years, and only 4 years when they amounted below 20%, so for a period of the average losses in the period of reproduction amounted to 31.44% . From all that comes that in preparing of dynamics population of hares in the planning documents (management plan and annual plan of management) should be calculated with losses in the period of reproduction of **32%**.

Table 1. Indicators of the average losses classified in categories and the number of years with a certain category for the population hares in Vojvodina

Less than 20%	20 - 25%	25 - 30%	30 - 35%	35 -40%	over 40%
4	5	9	6	17	4

Calculation of winter losses

However, the amount of planned losses from the beginning of the hunting season (16th of October), to the start of the next reproductive period (March 15th) must be determined as accurately as possible, in order to determine the rate of rational use of hares populations and the micropopulations, without risk to reduce spring environmental density. These losses are important in preparing of planning documents (the management plan and annual plan of management).

Height of losses since the beginning of the hunting season (16th of October) to the beginning of reproductive period (15th of March), were obtained by calculation. To get to the numerical strength of the fall, the numerical spring strength is multiplied with established real growth per year for the entire population in Vojvodina. From this numerical strength are taken away numerical strength in spring in the following year, and the difference represents the losses from the beginning of the hunting to the beginning of reproductive period. After that, the obtained result is divided by spring numerical strenght from the next year and multiplied by 100. In this way, is calculated the percentage of winter losses.

The formula by which we calculated losses and percentage of losses is:

$$g = E2 - e - Nn+1$$

g - losses
E2 – numerical strenght in autumn **(E2= N x Krp)**
e - hunt
Nn+1 – numerical strenght in spring for next year
Krp – coefficient of real growth

$$\%g = \frac{g}{E2} \times 100$$

% g - the percentage of winter losses

For the observed period between 1967 - 2011th year, for a period of 45 years was the highest in years when losses were between 30-35%, in 11 years, between 35-40%, for 12 years, and only 4 years when they amounted less than 20%, so for whole period the average of winter losses amounted to 32.10%. From all that comes that in preparing of dynamics population of hares in the planning documents (management plan and annual plan of management) should be counted with winter losses of **32%**.

The results of research on the amount of losses in the period of reproduction and winter losses are very different both here and in the (hunting grounds) in the environment. Winter losses some authors

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define as a direct losses, from the impact of winter and snow, and the result is a lack of food due to the depth of snow cover, the others are counting the total population losses, but do not define the period to which they relate, or if they even define a period, they not count the losses that occur during the hunting season. To these losses have paid attention only Erdös, in 1978. and Ladziansky, in 1997.

Table 2. Indicators of average winter losses classified in categories and the number of years with a certain category for the population hares in Vojvodina

Less than 20%	20 - 25%	25 - 30%	30 - 35%	35 -40%	over 40%
4	6	6	11	12	6

In the opinion of Šelmić, in 1984. in his research he counted with a twofold losses. First, the losses that would be incurred if there is no hunting, that is with the normal rate of mortality for the hare population as a result of reducing the activities of all the factors that act in certain circumstances. Second, it must be counted also on the losses incurred by using the hunting population, and not registered as a catch. These losses are caused by injury of hares, and that will count 30% of the catch. Interestingly, as pointed out Šelmić, these losses are not interesting in hunting areas where the hare is hunted on one surface by cicrular hunt, however, according to Šelmić, for our hunting groun conditions they are very important.

The results of our study, in which the average losses from the beginning of the hunting (October) to the beginning of the next reproductive period (March) ranges from 12.58 to 45.47%, or an annual average for period of 45 years for hunting ground conditions of Vojvodina it amounted to 32.10 %.

For a period of 45 years based on our study for the conditions of hunting grounds, the losses in the period of reproduction ranged from 11.93 to 47.01%, or 31.44% per annum on average. Losses in reproduction period and winter losses of hares are shown in Figure 1.

Figure 1.
Losses in reproduction period - basic parameters (percentage of losses in the period of hare reproduction - spring-fall, before the hunting) and winter losses of hares from the beginning of the hunting to the next reproductive period (from the 16th of October of the current year until 15th of March of the next year) for hunting grounds in Vojvodina for the period from 1967th to the 2011th year
(Source: Hunting Association of Vojvodina, Ristić Z.)
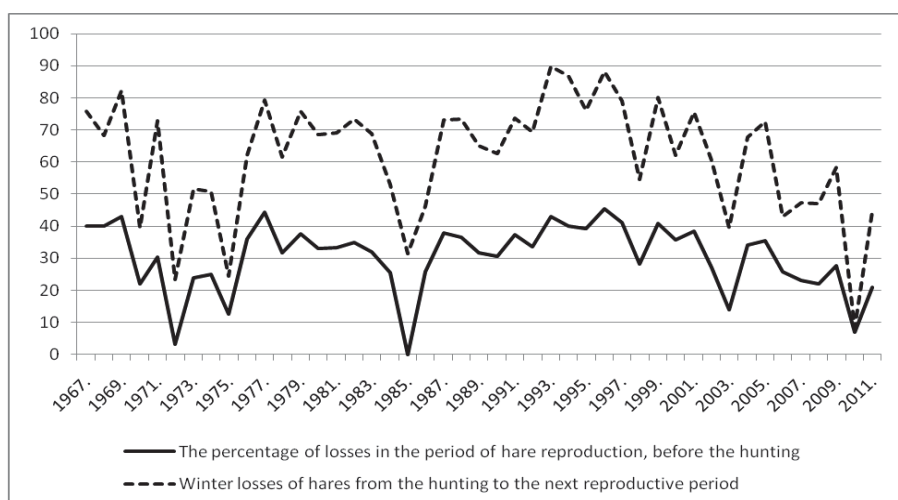
Data on double losses are necessary in preparing of realistic planning documents (management plan and annual plan of management).

Conclusion

Losses that occur in the two periods that we studied were significantly higher than in the previous period and they were moving between 20 and 25% over the autumn and spring strength of.

It is evident that there is a huge range of each other's losses, but given that it was done for a long period, the proposed losses with which should do the planning documents is valid enough to accept the proposed rates in preparing future planning documents.

Winter losses of 32% and losses of the period reproduction are also 32%, and they are suggest for planning documents for realistic planning of hares population, and thus the quality of the balance of the population, and thereby preserve the hare population for a longer period. This would preserve the hare fund for many years that was the aim of our research.

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