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Kaposvári Egyetem, Állattudományi Kar, Kaposvár
Kaposvár University, Faculty of Animal Science, Kaposvár

Body weight of hinds as a stability factor in red deer (*Cervus elaphus,* L.) population

D. Degmečić[1], T. Florijančić[2], I. Bošković[2]
[1]Hrvatske šume d.o.o., Uprava šuma Osijek, Šumarija Tikveš, 31325 Bilje, Šandora Petefija 35., Croatia
[2]Faculty of Agriculture, Josip Juraj Strossmayer University of Osijek, 31000 Osijek, Trg Sv. Trojstva 3., Croatia

ABSTRACT

During the hunting season 2007/2008 on the government hunting-ground XIV/9 Podunavlje-Podravlje (*Danube area, Croatia*), *67 hinds were examined. We have identified net weight – weight of the body in cold-storage, gross weight – calculating method, pregnancy, number and sex of the fetuses, as well as body weight and length of the fetus. The overall pregnancy rate was 75% (n=67). Among them 48% of the yearlings (n=19) were pregnant with 65,88 kg average net weight, however those of non pregnant weighted 51.60 kg respectively. 85% of the three-year old or older hinds was fecundated, and their average net body weight was 71.07 kg, whereas for the unfecundated hinds the body weight averaged to 69 kg. From October to December we have measured the weight and length of the fetuses, and this data was used to predict the calving date, all of which were in the period between the early April till late May. Fecundation and calving for the two-year-old hinds were more aligned, so they were all supposed to calve until April 20th of the following year, whereas for the three-year-old or older hinds the estimated time span for calving spread from the early April till late May. Sustainability of economy and survival of the population depend mostly on the success of the hinds during their lifetime.*
(Keywords: red deer, *Cervus elaphus*, hind, body weight, conception/pregnancy, calving)

INTRODUCTION

Number of red deer calves that a hind can biologically reproduce in a lifetime depends directly on the body weight of the hind. For hinds in red deer (*C. elaphus*) population the number of calves born by one hind ranges from 0 to 7 in a lifetime (*Clutton-Brock et al.*, 1982). There are several factors that influence the body weight of hinds, and therefore also their ability to be pregnant, the quality of the food sources in the area where the hinds live and the population density can be especially important (*Duncan et al.*, 1998). Considering the fact that the two sexes are living separate for most of the year, their social system is a matriarchate based on the family. As the number of the females (daughters) of the leading hind grows, so grows the total number of the herd. More head means higher population density and less sources of food, soely a certain number of females do not reach the body weight necessary to start body processes that support reproduction (*Brna*, 1969). After successful breeding and growth and development of the fetus, calving occurs. The place of calving is carefully selected, because later on, during the first few weeks after calving, it is also the place where the young are kept. It is usually in high vegetation (grass, bushes), on dry ground and exposed to sun. Such care for the young is crucial for its survival during the first three months of its life

(*Nikolandić and Degmečić*, 2007). The mortality of the young can be caused by unfavourable weather conditions, small body weight after birth, poorer milk production of the hind, agricultural machines while mowing meadows and forest clearings as well as predators. A period of fast growth and development of the calves ensures them to be fit for winter. The entire reproduction cycle from breeding up to the year-old calf is very complex and the hind must gain experience in nursuring the calf, so the results showing that the prime age hinds have the highest percentage of successful breeding (*Langvatn et al.*, 2004). Young hinds are inexperienced in the tactics of hiding the young, whereas older hinds, who are not as fit, have poorer milk quality, so their young is underdeveloped comparing to the average ones, and such calves have a high mortality rate (*Guinnes et al.*, 1978). In the nature even a small, insignificant advantage over others means survival and transference of such qualities and such small advantages to the future generations. This kind of selection is left up to nature, whereas we as breeders must secure all the necessary conditions in the habitat in order to maximize the production of calves and by selection process specifically exclude those hinds from the population that do not meet the required criteria for the success of each head.

MATERIALS AND METHODS

Field data has been collected throughout the hunting season 2007/2008, on the area of the state hunting ground XIV/9 Podunavlje-Podravlje (Danube area, Croatia). In early November, more precisely November 6, 2007, during the hunting season 2007/2008 the first fetus has been found after a red deer hind (*C. elaphus*) has been culled. From that point on, field material has been used for this paper. The total number of culled hinds has been inspected (n=67 head). Out of 67 head, 48 head have been hinds, 3 years old or older, while the other 19 were two-year old females (yearling hinds). The following instruments were used for data collection: measuring tape with millimetre division (mm), weighing scale with decagram precision, weighing scale with gram precision. The following factors were measured (n=67): net weight – weight of the body in refrigeration plant (eviscerated game without head and lower legs), gross weight – calculation method (*Clutton-Brock et al.*, 1982), pregnancy, number and sex of the fetuses (by inspection and counting), and body weight (weighing scale with gram precision) and length of the fetus (by placing the sewing thread onto the fetus from the top of its snout to the tip of its tail, following the spine, and transferring the thread onto the measuring tape and reading the length in millimetres) (*Valentinčić*, 1986). The data were processed with SPSS 16.0.

RESULTS AND DISCUSSION

Managing wild game may aim to achieve production of healthy and high quality animals after they become mature in the economical sense, will be used as a product to be marketed, or the aim of the wild game management may be limiting or preventing damage caused by wild game in some other, currently more important, field of work (agriculture, forestry etc). Both aims, and especially the production, demand knowledge of the parameters of the population dynamics. This helps us understand the ways and conditions on which production resources are being renewed and improved in the nature. The population grows, stagnates or decreases depending on the achieved increase. This refers to the process that includes mating, calving, raising the young, the rate of total loss and results with the status before hunting starts. When discussing the stability of income

and sustainability of managing the red deer population hinds are extremely important as the bearers of production. Growth, stability or decrease in the population are determined by the achieved increase, and the increase may be improved if the number of calves increases that one hind in the population may give birth to (fecundity), if the rate of total loss is decreased or if the mating age for hinds is lowered (*Silby and Hone,* 2003). Many factors influence the body weight of hinds, and thus the ability to reproduce, but the quality of food sources in the area where the hind lives as well as population density must be especially emphasized (*Clutton-Brock et al.*, 1982; *Mysterud et al.*, 2002).

Out of 67 females, 50 were pregnant, that is 75% of successfully fecundated females. For yearling hinds the fecundation was successful in 47% of the cases, whereas for three-year old and older hinds fecundation was successful in 85% of the cases. The ways of life of the species from the deer population (red deer, roe-deer) that populate this area of Croatia as indigenous species in free nature, dictate the readiness for fecundation. A larger number of animals causes greater population density and decrease in food sources, so a certain number of females does not gain enough body weight to start pre-mating processes (*Langvatn et al.,* 2004).

The average body weight of the females that potentially could have mated is $\Delta_{žuk}$=64.57 kg of net body weight, or 92.24 kg of gross body weight. According to the research of *Clutton-Brock et. al.* (1982), the net body weight amounts from 60% to 73% of the gross body weight, depending on whether it is the males', fecundated females' or non-fecundated females' weight, and similar results have been found in the still unpublished research field material from eastern Slavonija (Spačva forest). Yearling hinds, took part in the mating process for the first time, had the average body weight of Δ_{duk}=58.37 kg net or 83.39 kg gross. The calculated average net body weight for fecundated yearling hind is $\Delta_{dopl.}$=65.88 kg and for non-fecundated $\Delta_{dnopl.}$=51.60 kg. By comparing the mean values of net body weight of the fecundated and non-fecundated yearling hinds it has been found that there is a significant difference between the net body weights of the specimens. The so called small specimen test "t–test" was used, the differences in mean values were distributed according to the Student "t" distribution ($\Delta_{dopl.}$=65,88 kg, $Sd^2_{dopl.}$=71.73, $Sd_{dopl.}$=8.47; $\Delta_{dnopl.}$=51.60 kg, $Sd^2_{dnopl.}$=126.04, $Sd_{dnopl.}$=11.23; t_{izr}=3.15, and is bigger than $t_{0,05}$=2.110 and $t_{0,01}$=2.898 – therefore there is a significant difference between the two groups).

The average body weight of 3-year-old or older hinds is $\Delta_{kuk.}$=70.77 kg net or 101.10 kg gross. Fecundated females weighed $\Delta_{kopl.}$=71.07 kg, whereas non-fecundated females weighed $\Delta_{knopl.}$=69 kg. The small specimen test (Student t-test) has shown that there are no significant differences between the average body weights of the two groups. Also, the mean net body weights of fecundated hinds by months of cull were calculated, and the results were: $\Delta_{November}$=68.92 kg, $\Delta_{December}$=70.65 kg, $\Delta_{January}$=67.73 kg; there were no significant differences. Further, the mean values of body weight and length of the fetus by months of cull were calculated. According to *Valentinčić* (1991), the measuring of the fetus length determines the stage (week) of its development, which subsequently helps us to set the date of mating and the date of calving. By applying *Valentinčić* (1991) research results on our specimen we were able to calculate the average dates of fecundation and calving. The average dates of fecundation both in yearling hinds and in 3-year-old and older hinds are set in the last week of August, and if we add 236.1±4.75 days for male fetuses and 234.2±5.04 days for female fetuses (*Clutton-Brock et al.*, 1982), the calving date is set around April 25 the following year.

Figure 1 shows the dynamics of fecundation during 2007. The highest percentage of females, 38%, was fecundated in the period from August 21 to August 31, however

the period from August 10 to August 20 is no less important, since 24% of the females were fecundated at that time. The percentage in the first week of September was 30%, although it was expected to be higher. *Figure 2* shows the dynamics of the expected calving during 2008. It was expected that the most of the calves (38%) will be born around April 25, but the expected percentage of the so-called early calves to be born around April 15 is also important.

Figure 1

The conception dynamics during Summer/Fall 2007

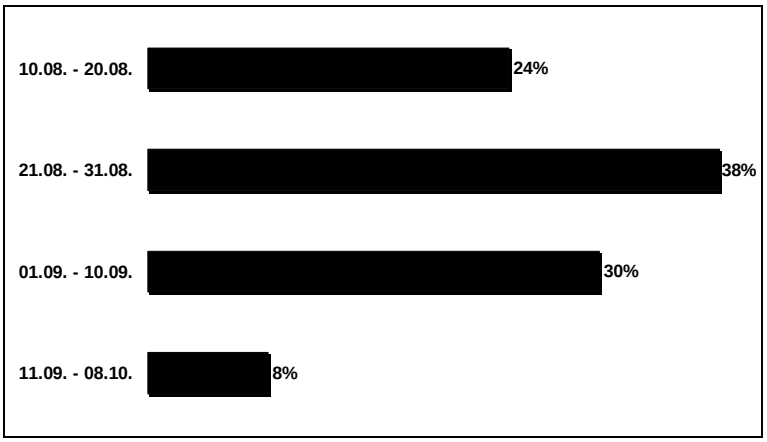
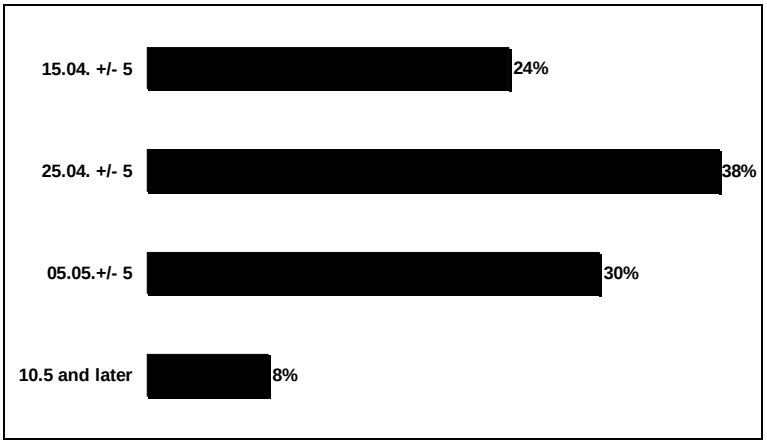


Figure 2

The dynamics of calving during Spring 2008



Many factors influence the body weight of hinds, and thus the ability to reproduce, but the quality of food sources in the area where the hinds live as well as population density must be especially emphasized (*Duncan et al.,* 1998). In his research on the fenced areas in Australia, *Tuckwell* (1998) found that 65 kg is the minimum gross body weight of red

deer females that are physiologically ready for mating, but he stresses that 80 kg is the desired gross body weight. Furthermore, he points out that the weight of 80 kg and more results in giving birth to more calves (which have larger body weights at calving), and who survive until their second year of life. The research mentioned in this paper confirms the body weight of females of about 80 kg as optimal for fecundation. Fecundated females that are 3 or more years old have the body weight of 70.77 kg net or 101.10 kg gross, whereas females that are going to mate for the first time, the so-called yearling hind, have the body weight of 65.88 kg net or 94 kg gross. The direct result of such body weights is the fact that 75% of females were successfully fecundated. The non-fecundated females that will mate for the first time have a significantly smaller body weight than the fecundated females, and it is 51.60 kg net or 73.71 kg gross, which confirms the fact that there is a certain threshold of body weight that enables mating and fecundation. Experts often point out the body fat index as a useful indicator of body fitness in wild ruminants (*Bolen and Robinson,* 2003). In cases when hinds remain unfecundated that are 3 years old or older and meet the criterion of the needed body weight, they might be said to be barren, but still the fact has to be kept in mind that hinds may take a year's pause for resting in order to be fit for mating next year. It is also important to know that during one season, a hind is ready for fecundation (on heat) only two to three days and that this cycle is repeated every 18 days until she is fecundated or until the sex hormones are no longer secreted, which makes it possible that there was not a male deer around in those three days and so she could not have been fecundated (*Clutton-Brock et al.,* 1982). Apart from fecundation, the body weight in hinds is also important for the size and weight of the calf at the time of calving. Females who were calved as small calves, with body weight below the average of the management area, will also in the future, in all age groups, have under-average body weight and will produce weak calves who will not be able to catch up with their peers and contribute to the progress of the population management in a particular area (*Langvatn et al.*, 2004; *Clutton-Brock and Coulson*, 2003). Body size and body weight in females ensures that the calf will be bigger, and clearly, a stronger and bigger calf will sooner be able to follow the mother and escape from the predators (*Geist,* 1998).

The data on the length of the fetuses is used to draw conclusions on the dynamics of mating, on the process of fecundation and on the planned dynamics of calving. The data on the length of the fetuses in 2007 shows that the mating took place with different dynamics from approximately August 10 till approximately October 8. It is possible that some of the hinds conceived even later, but the field material did not provide proof that. The aim of game management is to place the mating period in as short a period of time as possible. The research in Scotland shows more than 70% synchronized conception in two weeks (*Clutton-Brock,* 1982). The results of the research conducted in the state hunting ground XIV/9 Podunavlje-Podravlje in 2007 show that 68 % of fecundation took place within around 20 days in late August and early September. A high percentage of early fecundation was observed in this area, from August 10 to August 20, as much as 24% of the specimen, and also a high percentage of fecundation from mid-September to mid-October, 8%. The explanation for early fecundation can be found in extremely favourable climate conditions which caused a rich and varied development of food base, whereas the cause of the high percentage of the so-called late fecundation can be found in a large number of two-year-old females and over aged hinds (old animals) who only later gained the body weight needed for fecundation or due to a lack of males ready for mating, so some hinds got fecundated in their third or fourth cycle. It is necessary to direct further research primarily on the age and sex structure of the population. It is clear

that a long mating period can only result in a long calving period. Early mating, before August 20, brought 24% of the early calved young who will display, and they were observed, above-average bodily development. Such calves can bring forth progress in the fecundity of females and in the trophy structure of the males. The late born young will have below average body weight due to the low body weight of the hinds, and will not have milk of the same quality as did the calves born in early spring, because the quality of nutrients in vegetation will decrease and so these calves will develop more slowly (*Noyes et al.,* 2004; *Brna,* 1979). When body weight is met as a condition, the reproduction cycle and the beginning of the reproduction cycle is influenced by the photoperiod, weather conditions, adrenal gland and an intensive demonstration of sexual behaviour (scenting, characteristic cries and so on). Photoperiod or a response of the organism to a relative duration of lighter and darker periods ratio acts as a trigger for the reproduction cycle and stimulates the release of the adrenal hormones which trigger the activity of testicles and ovaries and thus the production of sex hormones. After the concentration of the sex hormones in blood increases, the animal displays sexual behaviour and the reproduction cycle begins. So, the amount of light or "duration of daylight" not only influences the physiological processes of the plants, but is also a trigger for all relevant physiological processes of the animals, as in the case of red deer (reproduction cycle, growth and development of the antler, moulting, lactation, and so on) (*Lincoln,* 1998).

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Corresponding authors:

Tihomir Florijančić
Department for Wildlife, Fisheries and Beekeeping
Faculty of Agriculture, Josip Juraj University of Osijek
HR-31000 Osijek, Trg Svetog Trojstva 3., Croatia
Tel: +385 31 224 275; fax: +385 31 207 017
e-mail: flory@pfos.hr