Contribution to the knowledge on red deer live weight gain in the open state hunting ground No. VII/15 "ZAPADNA GARJEVICA"

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scientific paper

Summary

Red deer (Cervus elaphus L.) is an autochthonous game species in the Republic of Croatia. The prevailing breeding model is natural, with main goals to preserve autochthonous ecosystems. The total of 43 animals was included in this research, divided according to sex and age (calves, yearlings, sub-adults and adults, 5+). Within the category of calves, weight gain was almost identical in both sexes, while with age weight difference between sexes favors males. The average weight gain/day in female calves up to the shooting of yearlings (approximately 18 months) was 96.22 g. For the same category of males,the average weight gain/day was 147.62 g. The difference in weight gain between males and females was 51.40 g daily. In accordance with the obtained results, according to the average values, female yearlings (approximate age of 18 months) are at 76 % of adult hinds' (5+) weight. At the same time, male yearlings (approximate age of 18 months) are at 67 % of adult stag mass. The lowest recorded weight was 51.85 kg (within the group of female calves), and the highest was 202.15 kg in adult stags.

Keywords: *red deer, natural breeding, live weight gain*

Introduction

According to the traditional hunting classification,red deer (*Cervus elaphus L.*) belongs to big furred game (Janicki et al., 2007), i.e. according to older authors, to noble game or big game hunting (Kesterčanek, 1896). The current Hunting Act (Anon., 2005) classifies red deer to big game protected by closed season. The prevailing breeding model of deer game in the Republic of Croatia is still extensive, i.e. natural breeding model (Konjević, 2007). In such breeding model the emphasis is placed on preservation of autochthonous ecosystem, that is, on preservation of native game species in their natural environment (Konjević, 2007). Except for that, rational breeding measures are used in an effort to coordinate the relationship between hunting on the one side and farming, cattle breeding and forestry on the other. That approach is the only way to ensure a survival of an optimal number of game animals of satisfactory breeding and health status, as well as desirable trophy value in increasingly densely populated areas. It is evident here that selection work in a natural game breeding is primarily based on the selection of valuable trophy animals when it comes to stags, that is, animals of satisfactory appearance and success in breeding, when it comes to hinds (Car and Srdić, 1967). In other words, a selection based on meat production characteristics is not carried out in case of natural breeding of game. Except for the natural breeding model, the growing emphasis in game breeding nowadays is also placed on farm breeding model. It is important to emphasize here that a shift in understanding human nutrition and the growth in needs for lean meat has encouraged the development of farm game breeding based on comparative advantages of venison. When it comes to deer game, except for the listed, we should know that a large part of driving force of such farming has been the production of velvet antlers for a long time (Konjević, 2005a, 2007). Unfortunately, farm breeding of deer is in its beginnings in the Republic of Croatia (Konjević, 2007). Still, regardless, the appearance of venison on the market requires its better understanding. And that doesn't include just chemical and microbiological composition, but also knowing the dynamics of live weight gain on certain age classes and gender, the utilization and characteristics of carcasses depending on breeding model, intensity and length of supplemental feeding, and intensity and direction of breeding activities. By comparing certain age classes and gender, it is possible to correct breed-

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ing measures during fall, winter supplemental feeding in natural breeding, but also the intensity of kill per certain age and gender categories.

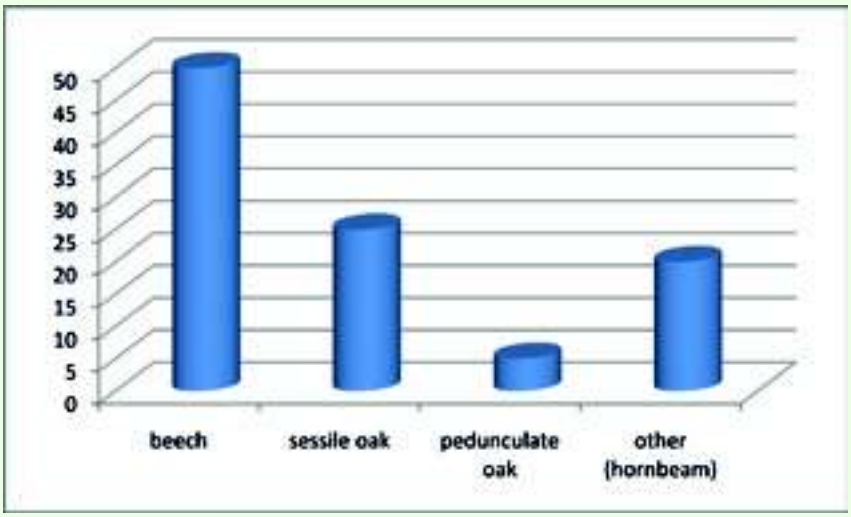
Material and methods

Research area and animals

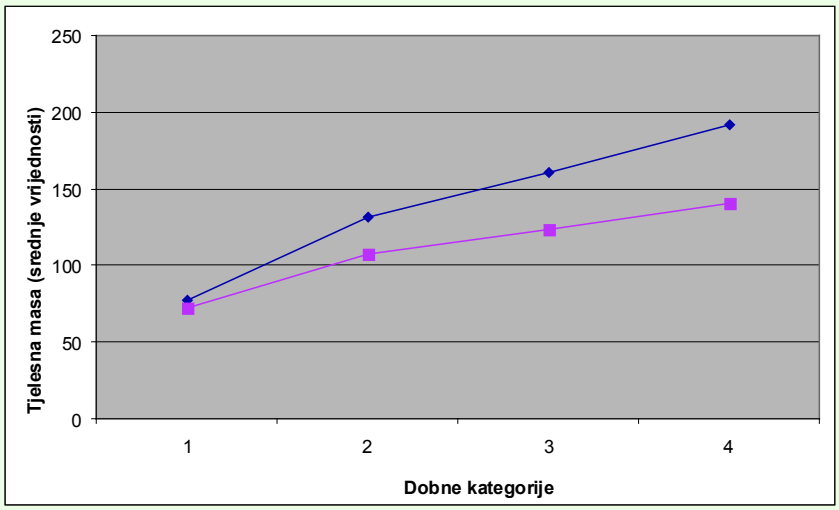
The research was conducted in the open state hunting ground No. VII/15 "ZAPADNA GARJEVICA", located mostly in the area of Bjelovar- Bilogora County, and to a lesser extent in Sisak – Moslavina County. The hunting ground "ZAPADNA GARJEVICA" covers an area of 25 799 ha. The hunting ground is predominantly of mountain type with mostly lower altitudes ranging from 180 to 489 m. The habitat is mildly rough, of hilly configuration rugged by shallow to medium deep and wide ditches. The hunting ground is located in the central European climate zone (moderately warm, rainy type), and vegetation period (temperature threshold above +10°C) lasts for 180 days. Mean air temperature during vegetation period is +16.7°C.

According to the data from hunting management, the population of red deer in breeding stock (spring population) totals 820 animals, and the hunting ground (with the correction of winter supplemental feeding) is categorized to 1st site class for deer (Anon, 2005a). Except for the red deer, Fallow deer (*Dama dama*), roe deer (*Capreolus capreolus*), mouflon (*Ovis ammon musimon*) and wild boar (*Suss crofa*) are also managed in the abovementioned hunting ground. During making a management plan for red deer, the following age categories were determined:

- calves- animals of both sexes since bringing forth till the end of the first hunting season
- yearlings –animals of both sexes during the second hunting season
- adults – separated to three groups according to sex:
  - young animals – animals during the 3rd and 4th hunting year
  - middle age animals – animals during the 5th, 6th, 7th and 8th hunting year
  - mature animals – animals during the 9th and further hunting years



Graph 1 **Percentage of different tree species in forested part of the analyzed hunting ground. Hornbeam is the dominant species in the group "other".**



Graph 2 **Live weight gain of red deer in the area of open state hunting ground No. VII/15 "Zapadna Garjevica". Blue line depicts males, and red line females. Age categories 1) calves, 2) yearlings, 3) young adults and 4) adults (5+).**

The specific quality of the observed population is the fact that in its appearing, but later too, crossing of migration routes and the import of deer had a great influence. Due to constant migrations of deer from Central Croatia to Drava basin and neighboring Hungary and vice versa, the conditions for a frequent transfer of breeding material were ensured. The abovementioned is reflected through excellent trophy values, higher average body weights and twinning in hinds. Hunting of red deer is conducted within a regular game management. Deer are hunted by the methods of shooting from a ground and high hunting stands (Grubešić, 2004) in accordance with current legislation (Anon., 2005; Anon., 2005b; Anon. 2006; Anon. 2006a; Anon., 2007). A total of 43 deer of both sexes were weighed during this research. As collecting of larger number of animals of the same sex for each age category requires a long- term research, and the practice has shown the classifica-

Table 1 **Body weight of red deer of different age categories, both sexes included, after arrival at cooling and cutting facility.**

	calves		yearlings		young adults		adults	
	F	M	F	M	F	M	F	M
1.	93.40	73.60	104.95	119.45	118.65	162.20	181.90	181.55
2.	66.10	76.90	105.90	129.75	123.80	175.60	135.55	199.65
3.	59.65	74.30	115.50	152.90	115.45	165.50	127.20	186.75
4.	51.85	78.40	102.00	118.80	118.75	137.95	114.50	191.90
5.	79.85	81.50	105.35	156.90	137.55	153.70	0	202.15
6.	61.75	0	0	107.10	0	170.30	0	0
7.	88.75	0	0	0	0	0	0	0
$\bar{x}$	71.62	76.94	106.74	130.82	122.84	160.88	139.79	192.40
Max.	93.40	81.50	115.50	156.90	137.55	175.60	181.90	202.15
Min.	51.85	73.60	102.00	107.10	115.45	137.95	114.50	181.55

tion of female deer to the abovementioned age categories as very incorrect (Hespeler and Krewer, 2003), we adjusted age categories to calves, yearlings, sub- adults and adults (5+).

Nutrition base

The hunting ground is rich in drinking water all year long. Smaller watercourses like canals/rivulets are from the river basins of Česma, Pešćenica, Koprivničkarijeka, Ribnjak, Suhaja, Mlinska, Srednjarijeka, Skrajnjarijeka, Velika and Mala Srijedska. There are several depressions full of water in the hunting ground and there is also a large number of natural sources of drinking water which are active throughout the year. All the listed indicates to favorable conditions for game breeding.

Lithostratigraphic features of the hunting ground show that the lower part of the hunting ground in valleys by the streams lies on alluvium as the parent rock. Hydromorphic soils with mostly pseudogley and eugley soil are developed there. These soils are cold and heavy (of clay loam structure) and they are covered with forest and grassland vegetation, so they are appropriate for grassland surfaces. The upper part of the hunting ground lies on loess and rhomboid sediments as the parent rock and brown eutheric and brown eutheric lessived soils. Most soils are characterized by deeper profiles; they're fresh, full of nutrients and suitable for forest and agricultural production. So, parts of the hunting ground by watercourses are suitable for deer because they can use those parts for wallowing during droughts.

Regarding vegetation, it can be emphasized that forests and forest grounds take most part of research area and spread on the total of 8 852 ha. Graph 1 presents regular forest stands of high cultivation form with three basic tree species. In the upper part of the hunting ground there are represented beech species, which belong to beech forests of Pannonian Croatia by phytocoenological affiliation (*Fagetum croaticum pannonicum*, Horv. 1938).Below these forest stands, on milder inclinations and warmer expositions there are represented the species of sessile oak which belong to sessile oak and common hornbeam community (*Querco – Carpinetum illyricum*, Horv. 1938). By ditches and streams of the lower parts of the hunting ground there are stands of pedunculate oak. The community of pedunculate oak and common hornbeam (*Carpino betuli – Quercetum roboris*, Rauš 1969) is the dominant plant community in them, and directly by ditches and streams (fragmentarily), in the moistest parts of these stands there is developed the community of alder with alder buckthorn (*Frangulo – Alnetum glutinosae*, Rauš 1968). Stands of common hornbeam represent degraded forests where noble hardwoods are represented with a very low share in timber, so the share of noble hardwoods (oak– *Quercus* spp. i beech– *Fagus sylvatica*) is tried to be increased by cultivation.

Surfaces under agricultural crops within the hunting ground are classified as cultivated fields, meadows, pastures and perennials (orchards and vineyards). These surfaces are not equally distributed, but they predominate over the peripheral parts of the hunting ground. Cultivated fields are present in the area of 1 287 ha, and the most frequently presented crops are wheat, barley and corn, potato, beans and other vegetables of arable crops (Anon., 2005). Due to a reduced number of people on the part of the hunting ground, a large part of a former arable land is unmaintained and in the succession stage toward forest communities. Meadows on the surface of 305 ha are also mostly unmaintained and overgrown, and they appear as moist meadows (next to streams) and meadow surfaces of elevated, sloping hillsides and plateaus. Swamps, ponds and other water surfaces within the hunting ground are covered with lush vegetation.

Weighing

Immediately after the delivery to facility for cooling and cutting in GornjaGarešnica, the shot game has been completely weighed on a fixed, stationary scale (Bizerba, Balingen, Germany). The obtained results were noted in a form especially designed for this purpose.

Results

In this research, body weight of whole carcasses of shot deer considering the age categories ranged from the lowest value of 51.85 kg in female

calves to the highest value of 202.15 kg in adult stags (5+) (Table). The movement of weight gain of deer is clear from Graph 2, in a way that stags gain weight much quicker and more than hinds. During the first year of life, weight gain (category of calves) is almost equal with both sexes, whereas it changes in time in favor of male animals, so it is the most expressed with the age group of adults. The average approximate daily weight gain for female calves until female yearling weight is 96.22 g (the exact number of days is not known, so the average value was taken). The average approximate daily weight gain is 147.62 g for the same age group of males. The difference in live weight gain between males and females between the categories of calves and yearlings is 51.40 g. Daily weight gain for other categories hasn't been calculated due to a mismatch in age categories with precise, individual years of life.

Discussion

By searching through existent bases, we haven't found any published and accessible data on systematic monitoring of live weight gain of red deer in natural breeding. On the other hand, along with the development of farm breeding of deer in the world, there also appear researches related to weight gain and characteristics of venison. So, for example, Theriez (1989) reports that calves in farm breeding weigh between 8 and 9 kg at calving and that daily weight gain depending on the animal ranges between 250 to 459 g. We should emphasize here that *ad-libitum* nutrition was offered in the research, with hay of high quality for one group and hay with the addition of cereals for the other group of calves. Also, the same author lists that the difference in weight gain between males and females is from 20 to 50 g per day in average, in favor of males. In accordance with the listed, the increasing weight difference between males and females with age is understandable. We should emphasize the fact that biology is not mathematics, so there are differences in weight gains within individual breeding, so, for example, Webster et al. (1997) speak about 189 g per day. An expectedly lower weight gain was determined in this research, which is understandable considering natural breeding, but with determined equal average weight gain between males and females. It is completely clear here that a relatively small number of samples increases the possibility of a mistake and aberration from the determined values. According to Grubešić et al. (2011), threshold weight value for keeping calves in the breeding site"Šeprešhat" (Baranja, "Hrvatskešume" Ltd.) is 10 kg for female, i.e. 12 kg for male calves at the age of 3 weeks. The same authors also list that the highest weight gain, which is still economically justified considering the investments, is achieved until the age of 15 or 18 months. The difference in weight between adult stags and hinds is additionally emphasized with the data that hinds end the growth at the age of 4 to 5 years as a rule, whereas stags continue to grow up to the age of 8 or even 9 years (Theriez, 1989). The fact that males at the age of 2 years had average body weight of 130.82 kg and adults (5+) of 192.40 kg, which makes the difference of 59.58 kg, approximately confirms the assertion of Theriez (1989) that males at the age of 16 to 18 months are only at 50% of body weight. Namely, due to specificity of natural breeding, it's hard to talk about the exact age in months, but the males in our research in the age of about 18 months achieved about 67% of adult stags' body weight. We call it an approximate percentage because the share of deer in hunting management (age between 12 and 14 years) was not included in this research. In other words, we have no data on adult stags. On the other hand, the difference in weight of adult hinds (5+; 139.79 kg) and the category of young hinds is only 33.05 kg. The fact that female yearlings according to our data are at 76% of adult hinds' body weight is in accordance with the results of Theriez (1989), according to which hinds in the age of 16 to 18 months are already at 70-75% of body weight. As opposed to the noticed movement of live weight gain in wild boars (Konjević et al., 2008), live weigh gain of deer is regular through the entire observed period. The application of knowledge to breeding of deer species is quite limited due to the fact that within the family there are certain differences in the rate of development. Namely, as opposed to red deer, roe deer (*Capreolus capreolus*) shows a quick development so roe deer in the area of eastern Slavonia and Baranja are approaching the percentage of 65% of total body weight of adult animals (Degmečić and Bićanić, 2008). According to Mysterud and Østbye (2006), roe deer gains weight within the first three years of life for both sexes, and then remains at the relatively same level. The noticed growth dynamics of red deer females also justifies the possibility of planning hunting according to the principles of the proposition of Zvonko Car, engineer (1961), for roe deer. In such planning, culling of females is conducted in a more intensive way in the first years of life along with the more intensive selection. On the other hand, culling of males is reduced during the first two years of life, and then it is intensified, so the total number of animals still remains the same (ratio 50%:50%). Such approach decreases the mistakes in the estimation of young males' antlers, and females can be correctly estimated earlier based on regularity of appearance and physical development.

As expected, peculiarities of nutrition have a large influence to growth intensity. Exactly because of the listed reason it is necessary to mention the peculiarities of nutrition base and to emphasize the influence of rather favorable share of forests and large

Anlage zur Kenntnis über den natürlichen Zuwachs von Hirsch gewöhnlich auf dem Gebiet des staatlichen offenen Jagdgebietes Nr. VII/15 „ZAPADNA GARJEVICA“

Zusammenfassung

Hirsch gewöhnlich (Cervus elaphus L.) gehört zu der autochtoner Wildsorte in der Republik Kroatien. Die natürliche Zucht ist auch heute das vorwiegende Model der Hirschzucht in Kroatien, wobei das primäre Ziel einer solchen Zucht die Erhaltung der ursprünglichen Lebensgemeinschaften in ihrer natürlichen Umgebung ist. In der Untersuchung sind 43 Hirsche gewöhlich umfasst, geteilt nach Geschlecht und Alter (Kategorien: Kälber, Nachkommenschaft, junge und erwachsene Tiere 5+). Der realisierte Zuwachs in der Kälberkategorie ist fast derselbe bei beiden Geschlechtern, während im späteren Alter männliche Tiere größeren Zuwachs vorzeigen. Der durchschnittliche Zuwachs pro Tag betrug für die weiblichen Kälber bis zum Abschuss von „dvizica“ (zweijährige Hirschkühe) 96.22 g. Für dieselbe Kategorie der männlichen Tiere betrug der tägliche Massenzuwachs 147, 62 g. Der Zuwachsunterschied zwischen den weiblichen und männlichen Tieren (Kategorie Kälber und Nachkommenschaft) betrug täglich 51,40 g. Nach den bekommenen Resultaten, die durchschnittlichen Werte betrachtend, befinden sich die „dvizica“ (Alter etwa 18 Monate) auf etwa 76 % Masse der erwachsenen Hirschkühe (5+). Gleichzeitig befinden sich die „špizer“ (Spizer) (Alter etwa 18 Monate) auf etwa 67 % Masse der erwachsenen Hirsche (5+). Der niedrigste gewogene Wert betrug 51,85 kg bei weiblichen Kälbern, und der höchste gewogene Werte bei erwachsenen Hirschen betrug 202,15 kg.

Schlüsselwörter: *Hirsch gewöhnlich, natürliche Zucht, Zuwachs der Körpermasse*

Contributo alla conoscenza del cervo europeo sul terreno di caccia aperto no. VII/15 “GARJEVICA OCCIDENTALE”

Sommario

Il cervo europeo (Cervus elaphus L.) appartiene alla selvaggina autoctona nella Repubblica di Croazia. L’allevamento naturale è ancora in vigore in Croazia, e lo scopo primario di questo tipo d’allevamento è salvare le communità fondamentali nel loro ambito naturale. La ricerca è stata focalizzata su 43 cervi europei divisi secondo il sesso e l’età (categorie: vitelli, cerbiatti, giovani e adulti 5+). L’incremento realizzato nella categoria di vitelli è praticamente lo stesso da ambedue sessi, ma come crescono loro cresce anche la differenza a favore di maschi. L’incremento aprossimativo al giorno per le femmine fino al momento di caccia era 96,22 g. Per la stessa età di maschi l’incremento giornaliero era 147,62 g. La differenza tra maschi e femmine nelle categorie di vitello e cerbiatto era 51,40 g al giorno. In concordanza con i risultati ottenuti, e guardando i valori in media, le cerbiatte (di età di 18 mesi) hanno il 76% del peso delle cerve adulte (5+). Nello stesso tempo i cerbiatti (di età di 18 mesi) hanno il 67% del peso dei cervi adulti (5+). Il valore più basso che è stato misurato sono 51,85 g dalle femmine piccole, e il valore più alto 202,15 dai maschi adulti.

Parole chiave: *cervo europeo, allevamento naturale, incremento del peso corporeo*

annual yield of forest seeds, as well as the existence of pasture areas in the hunting ground. Except for natural food in the hunting ground, the deer in the area of “ZAPADNA GARJEVICA” hunting ground are additionally intensively fed on hay of high quality and cereals, so it stands out from most hunting grounds in the area of Croatia. Exactly because of that reason, we limited ourselves to the contribution to the knowledge of red deer live weight gain in the area of the hunting ground, and not generally in natural breeding. Namely, reinforced nutrition can vary a lot, and it is proscribed by the hunting management, but the quantity of forage is not limited. Part of the research speaks for the kind of additional food which is exposed to deer and that should be taken into consideration when evaluating live weight gain in certain area. So, for example Davies (1991) determined an extremely low live weight gain of only 20 to 50 g per day in deer fed on predominant share of silage. As opposed to them, animals fed additionally and on concentrated feed, especially pelleted, can reach higher daily gains of about 189 g (Webster et al., 1997). A negative side of nutrition based on silagemostly was confirmed later by Webster et al., (2000) too. When we speak about nutrition based on pasture, Adam (1987) says that daily live weight gain on mass of about 200 g requires a daily feed intake which ensures about 5 kg of dry matter. Judson (2003) says that for a daily live weight gain of about 250 g in calves of red deer, a daily intake of 4 kg of dry matter is enough. A special attention in deer nutrition should be paid to the period of fall when deer are predetermined for storing nutrients in their organism. Namely, in the period of winter, due to certain morphological changes in digestive system, and especially due to changes in the activity of cortex of adrenal gland, there appear changes from anabolism to catabolism and redirection to their own reserves (Huber et al., 2003; Konjević, 2009).

Acknowledgement

This paper was supported by funds of the project by the Ministry of Science, education and sports “Applied biomedical research on deer”. The authors are thankful to Mr.IvicaTodorić for ceding the samples, as well to employees of LG Moslavina for the help with weighing.

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Received: March 12, 2012.
Accepted: April 30, 2012.