

# Comparison of Carcass and Weight of Antlers of Roebuck (*Capreolus capreolus*) Harvested in Forest and Field Habitats

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## Abstract

In this study, we analysed the weight and measurements of 111 European roebuck (*Capreolus capreolus* L.) carcasses. Animals were obtained from forest and field hunting grounds in north-eastern Poland. The own researching results duly confirm that carcass weight increases with the age of animals that is the carcass weight of the older roebuck is heavier than of younger animals. They were also characterized by the heaviest antlers (over 312.5 g). The average weight of antlers was 268.10 g in field roebucks, and 220.25 g in forest ones. The difference in this trait (near 50 g) was confirmed statistically. Two- and three-year-old roebucks differed significantly in the weight of antlers, whereas there were no such differences in four- and five-year-old animals.

Changes in carcass weight were accompanied by changes in its measurements: the height at withers, the height at sacrum and the chest girth. The carcasses of roebucks aged three years and older were almost 4 cm longer than those of younger ones – the difference was highly significant. The correlations between carcass weight and height at withers, as well as between carcass weight and chest girth, were ascertained. A significant correlation was observed between the weight of antlers and age of roebucks. The indices of reconstruction and massiveness were determined.

**Key words:** European roe deer *Capreolus capreolus*, carcass weight, carcass measurements, weight of antlers

## Introduction

Roe deer are flexible species and easily adapt to various site conditions, so they inhabit many different habitats, from large forest complexes, through small in-field tree stands and shrubs, to treeless grounds and field monocultures. The fact that roe deer live in diverse environmental conditions resulted in the development of two ecotype forms within this species, *i.e.* field roe deer and forest roe deer. These forms differ in both constitution and behavioural characters (Graczyk 1978, Pielowski 1999). Roe deer from various regions of Poland are also characterized by different carcass weights. According to Pielowski (1999), the lightest roe deer can be found in western and north-western parts of Poland. Roe deer in the north on average are 1 kg heavier, whereas those inhabiting central, eastern and north-eastern Poland are the heaviest. Drozd *et al.* (2000) found a correlation between the carcass weight and age of roe deer, confirming the results of previous studies (Kałuziński 1978, Pielowski 1999, Dziejczak 1991). Similar results were obtained by Brzuski *et al.* (1997), who reported that in the region examined the carcass weight of the one-year-old roebucks was 12.84 kg, and that roebucks aged seven years were the heaviest – 17.07 kg.

Gailard *et al.* (1996) indicated the diversity of body weight of young roe deer in two subpopulations. They claimed that roebucks living in areas of colder winters and abundant food achieved heavier body weight. Pettorelli *et al.* (2001) also ascertained positive spatial covariation between habitat quality and local density and fawn body weight.

According to Bresiński *et al.* (2000), the total population of roe deer in Poland in the spring of 2000 reached 531,000 approximately. In the areas monitored their average density was 2 animals/100 hectares of fields and 20 animals/100 hectares of field-forests covering an area of up to 300 hectares.

The aim of this study was to compare body dimension of European roebucks harvested on field or forest hunting areas as well as to analyse their body dimension increasing with the age of living. The correlation between some carcass measurements was also determined.

## Material and methods

The studies were conducted in the five hunting areas covering 19,174 ha, located in the Tabórz Forests, north-eastern Poland, western part of the Warmia and Mazury Province, near the city of Olsztyn

(20°30'E; 53°47'N). Forests constitute 73.1% of the region examined. They include the following habitats: fresh coniferous forest – 48.3%, fresh broadleaved forest - 47.8% and alder carr - 3.9%. The research area was divided into units referred to analysed hunting grounds.

The forest hunting ground was situated in the main forest complex (describe above). The filed hunting ground (near 4.500 ha) was located in the open fields complex where crops were grown (e.g. oat, wheat, maize, sugar beets). The other part of researched areas were comprised by roads, water bodies *etc.*

The studies were carried out in 2001 – 2003 including two hunting seasons: 2001/2002 and 2002/2003. The hunting season for roebucks in Poland begins on the 11<sup>th</sup> of May and ends on the 30<sup>th</sup> of September. To eliminate the impact of the season of the year on the body weight only the roe bucks harvested between 1<sup>st</sup> of June and 31<sup>st</sup> of August (rut season) have been taken to analyse.

Carcasses of harvested roebucks constituted the experimental material (Table 1).

**Table 1.** Number of carcasses of field and forest roe deer obtained during the research period, according to age groups. Age group I: two- and three-year-old roebucks, Age group II: roebucks older than 3 years

Season	Hunting ground	Number of carcasses measured		
		Age group I	Age group II	TOTAL
2001/2002	Forest	12	10	22
	Field	11	15	26
2002/2003	Forest	18	18	36
	Field	10	17	27
TOTAL		51	60	111

111 carcasses have been measured that constituted 78% of the total number of roebuck carcasses obtained on the study area over the whole research period.

All carcasses were weighed, and the following measurements were taken for each of them using a measuring tape:

1. Trunk length – from the first cervical vertebra (atlas) to the end of the caudal bone,
2. Height at withers – from the highest point of the withers to the centre of the apex of the fore hoof,
3. Height at sacrum – from the highest point of the hind part of the backbone, along the hind leg, to the apex of the hind hoof,
4. Chest girth – behind the withers and shoulders.

The gross weight of antlers was adopted following the documentation kept at the Forestry Headquarters in Miłomłyn.

The roebuck's age was evaluated after shooting them. The estimation was based on the condition of their teeth (the level of attrition) with 1-year accuracy, which was relevant to the methods described before (Lohmman 1987, Osgyan 1989, Raesfeld *et al.* 1978). It permitted to describe of the annual body measurements and antlers weight growth. Then, to compare body building parameters among younger and older animals they were divided into two groups of age (according to the rules affected in Polish hunting management): group I – two- and three-year-old roebucks, group II – roebucks older than 3 years. In order to characterize the proportions and harmony of their constitution, the indices of body build were calculated (Maciejowski and Zięba 1982), *i.e.*:

$$1. \text{Index of reconstruction} = [\text{height at sacrum} / \text{height at withers}] \times 100$$

$$2. \text{Index of massiveness} = [\text{chest girth} / \text{height at withers}] \times 100.$$

A statistical analysis of the numerical data obtained included:

- characteristics of the experimental material, *i.e.* arithmetic means ( $\bar{x}$ ), standard deviations (s), determination of the significance of differences in the traits examined between means for age groups and in the interaction: hunting ground x age.

- coefficients of simple correlation (r) between carcass weight and some of its measurements. The numerical material was analysed with statistical program STATISTICA 5.0 PL.

## Results

It was stated that the average carcass weight of roebucks harvested on the field hunting grounds amounted to 17.15 kg and was significantly higher than the average carcass weight of roebucks harvested in forests (15.65 kg). The values of carcass measurements (height at withers, height at sacrum, chest girth) of the former (II age group) were also significantly higher than those of the latter (I age group) (Table 2). The average weight of antlers was 268.10 g in field roebucks, and 220.25 g in forest ones. The difference in this trait (nearly 50 g) was confirmed statistically.

The carcass weight on average amounted to 15.2 kg in two- and three-year-old roebucks, and to 17.6 kg in older ones. The highly significant difference in this trait (2.4 kg) was noted (Table 2). Changes in carcass weight resulted in changes in its measurements. The carcasses of roebucks aged three years and older were almost 4 cm longer than those of younger ones – the difference was highly significant. The values of the height at withers, height at sacrum and chest girth were also significantly higher in roebucks from age

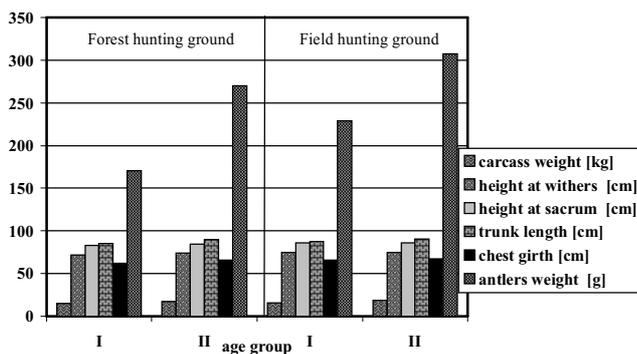
group II than in those from age group I. Considerable differences were noted between these two groups as concerns the weight of antlers. It amounted to 199.85 g in roebucks aged up to three years, and to 288.50 g in older ones. No statistically significant interaction (hunting ground x age) was found between the traits examined.

**Table 2.** Measurements and weight of carcasses and antlers (see table) of roebucks from various hunting grounds and age groups (I Age group: two- and three-year-old roebucks, II Age group: roebucks older than 3 years)

Specification	Statistics	Hunting ground		Age group	
		Forest	Field	I	II
Carcass weight [kg]	x	15.65 <sup>A</sup>	17.15 <sup>B</sup>	15.20	17.60 <sup>xx</sup>
	s	1.73	1.63	1.53	1.84
Height at withers [cm]	x	72.60 <sup>A</sup>	74.70 <sup>B</sup>	73.0	74.30 <sup>x</sup>
	s	2.29	2.47	2.60	2.15
Height at sacrum [cm]	x	83.90 <sup>A</sup>	86.05 <sup>B</sup>	84.60	85.35 <sup>x</sup>
	s	2.08	2.22	2.21	2.13
Carcass length [cm]	x	87.0 <sup>a</sup>	88.95 <sup>b</sup>	86.05	90.0 <sup>xx</sup>
	s	3.45	4.37	3.69	4.13
Chest girth [cm]	x	63.65 <sup>a</sup>	66.50 <sup>b</sup>	63.70	66.45 <sup>x</sup>
	s	2.91	2.83	2.66	3.08
Weight of antlers [g]	x	220.25 <sup>A</sup>	268.10 <sup>B</sup>	199.85	288.50 <sup>xx</sup>
	s	52.80	52.18	59.96	45.03

A, B or xx – P ≤ 0.01  
a, b or x – P ≤ 0.05

Figure 1 presents the weight and measurements of carcasses of roebucks from two age groups, depending on their habitat.



**Figure 1.** Biometric characteristic of roebucks from two age groups, depending on their habitat

Table 3 indicates how the increase in the body of analysed European roebuck's is coursed. The values of the height at withers and height at sacrum were lowest in two-year-old roebucks. These parameters were higher in older animals, and the highest – in the oldest roebucks. The carcass length in roebucks aged

four, five, six years and older was similar (89.80 - 90.40 cm). Two- and three-year-old animals had significantly shorter carcasses, 84 cm and 86 cm, respectively. The weight of antlers was the highest in roebucks older than six years (on average 312.6 g), and the lowest – in those aged two years (on average 129.3 g). Two- and three-year-old roebucks differed significantly in the weight of antlers, whereas there were no such differences in four- and five-year-old ones.

**Table 3.** Measurements of carcasses of roebucks at a different age

Specification	Statistics	Age (years)				
		2	3	4	5	6 and >
Carcass weight [kg]	x	13.60 <sup>BD</sup>	15.70 <sup>BCD</sup>	17.20 <sup>Chc</sup>	17.50 <sup>A</sup>	18.40 <sup>Aa</sup>
	s	1.72	1.33	1.81	2.03	2.15
Height at withers [cm]	x	70.98 <sup>B</sup>	73.21 <sup>Ab</sup>	73.67 <sup>A</sup>	74.59 <sup>A</sup>	75.00 <sup>Aa</sup>
	s	2.85	2.66	2.47	1.58	2.28
Height at sacrum [cm]	x	83.00 <sup>Bb</sup>	84.70 <sup>a</sup>	84.90 <sup>a</sup>	85.20 <sup>A</sup>	86.20 <sup>A</sup>
	s	2.34	2.38	2.34	2.07	2.13
Carcass length [cm]	x	83.90 <sup>B</sup>	86.50 <sup>Db</sup>	89.80 <sup>Aa</sup>	90.40 <sup>AC</sup>	89.80 <sup>Aa</sup>
	s	3.22	3.76	3.88	4.67	4.51
Chest girth [cm]	x	60.10 <sup>B</sup>	64.60 <sup>Ab</sup>	66.20 <sup>A</sup>	66.90 <sup>Aa</sup>	66.60 <sup>Aa</sup>
	s	2.23	2.57	2.61	2.96	4.02
Weight of antlers [g]	x	129.30 <sup>B</sup>	223.20 <sup>C</sup>	279.40 <sup>Ab</sup>	278.70 <sup>Ab</sup>	312.60 <sup>Aa</sup>
	s	40.83	48.44	42.71	48.04	49.56

A, B, C, D – P ≤ 0.01  
a, b, c, d - P ≤ 0,05

Table 4 shows the coefficients of correlation between the weight and measurements of carcasses, as well as between the age of animals, weight of carcasses and antlers.

**Table 4.** Coefficients of correlation (r) between the traits examined

Age and carcass measurements	Carcass weight	Weight of antlers
Age	0.60 <sup>**</sup>	0.67 <sup>**</sup>
Height at withers	0.75 <sup>**</sup>	-
Height at sacrum	0.69 <sup>**</sup>	-
Body length	0.50 <sup>**</sup>	-
Chest girth	0.79 <sup>**</sup>	-
Weight of antlers	0.74 <sup>**</sup>	-

\*\*P<0.01

The highly significant positive correlation was revealed between the weight and measurements of carcasses (Table 4). It was the highest between the carcass weight and the height at withers, and the carcass weight and the chest girth (r=0.75 and r=0.79 respectively). The weight of antlers was highly correlated with the weight of carcasses (r=0.74). There was also a significant correlation between the weight of antlers and age of roebucks (r=0.67).

The indices of reconstruction and massiveness were calculated for particular groups of roebucks on the basis of carcass measurements – Table 5.

**Table 5.** Indices of body constitution. Age group I: two- and three-year-old roebucks, Age group II: roebucks older than 3 years

Indices	Age groups		Hunting ground	
	I	II	Forest	Field
Index of reconstruction	116.10	114.94	115.72	115.11
Index of massiveness	86.88	89.50	87.72	89.30

Younger animals (group I, 2-3-years-old) were characterized by a slightly higher index of reconstruction, and a lower index of massiveness when compared to older roebucks (group II, 4-6 – year-old and older). The index of reconstruction of forest and field roebucks was similar (115), but there were differences between them as regards the index of massiveness. It was higher in field roebucks (89.3) than in forest animals (87.7).

## Discussion

An analysis of the carcass weight in roe deer is the subject of many papers (Hell 1979, Krupka *et al.* 1986, Dziedzic 1987, Vach 1993), by the data in roe deer from various European countries, and according to the Bergman's principle, the weight of their carcasses is different (Bobek *et al.* 1984, Sabboni *et al.* 2002). The lightest carcasses can be found in Germany (15 – 16 kg). Their weight varies from 16 kg to 18 kg in Bulgaria, Hungary and the Czech Republic it amounts to 21 kg in Sweden, and exceeds 22.5 kg in six-year-old roebucks in Lithuania (Simonic 1976, Raesfeld *et al.* 1978). The carcass weight of roe bucks is also different in various regions of Poland: *e.g.* 15 kg in central and western parts, 16.5 kg in Wielkopolska (south-west), 19 kg in central and eastern parts and 24 kg in the Carpathian Mountains (Fruziński *et al.* 1982, Pielowski 1999). The carcass weight of adult roebucks from north-eastern regions varied in own investigations from 17.5 kg (roebucks aged five years) to 18.4 kg (roebucks aged six years and older). These results confirm those obtained earlier by Pielowski (1999), who suggests that carcasses of roe deer from northern and eastern parts of Poland are heavier than those of roe deer from western regions.

The regional differences of European roebucks' body weight was indicated by other authors *e.g.*: Blant and Gaillard (2004) in France and Switzerland, Sabbioni *et al.* (2002) in Italy or Osgyan (1989) in Germany.

Kaluziński (1978), Bobek *et al.* (1984), Dziedzic (1987) and Brzuski *et al.* (1997) report that age of roe deer is an important factor differentiating their carcasses. The studies conducted by Pielowski (1999) indicate that the oldest animals (aged four to eight years

and older) are the heaviest (19.3 kg). Dziedzic (1991) claims that the carcass weight of roebucks increases with age, from 17.1 kg in two-year-old ones, 18.4 kg in three-year-old ones, to 18.9 kg in five- and six-year-old ones. The results obtained by Brzuski *et al.* (1997) also show that the carcass weight of roebucks changes with age, from 14 kg in two-year-old ones, 16 kg in three-year-old ones, to 17 kg in four-year-old ones. The carcass weight of older roebucks, *i.e.* aged 5 to 7 years, is similar. This suggests that their growth stops at the age of about five years. Own results indicate that in the second, third and fourth year of growth the carcass weight of roebucks increases, whereas in the fifth and sixth year it remains at the same level, which confirms that their growth stops at the age of about five years. Kałuziński (1978) made similar observations. Such results were also obtained in the Czech Republic. According to them, the five-year-old roebucks are the heaviest (Vach 1993). Also Pelabon and van Breukelen (1998) indicated that carcass mass and the size of antlers had been increasing until 4 and 6 years of age respectively, and then remained constant.

Drozd *et al.* (2000) report that roebucks, living in various provinces located in central and eastern Poland, differ in carcass weight. The heaviest carcasses come from mixed forests and fields areas with the domination of forests. According to some authors (Graczyk 1978, Pielowski 1999, Krupka 1989), the fact that roe deer live in so diverse environmental conditions resulted in the development of two ecotypes within this species, *i.e.* field roe deer and forest roe deer. Field roe deer are heavier than forest deer – the difference may exceed 2.5 kg (Krupka 1989). The relationship concerning forest and field roe deer as well as mixed forest-field ecotypes is similar in Lithuania (Padaiga 1996, Baleisis *et al.* 2003, Petelis and Brazaitis 2003). The results of other papers (Brzuski *et al.* 1997) and own investigations confirm that the habitat affects the weight of roe deer. The heaviest roebucks (16.39 – 16.48 kg) come from areas with no forests or bushes, and the lightest (15.26 – 15.49 kg) – from those dominated by forest complexes (Brzuski *et al.* 1997). Klein and Strandgaard (1972) analysing Denmark's populations of roe deer stated that the animals living in the areas with lower percentage of forest achieved bigger dimension and weight of the body. Own research shows that roebucks inhabiting fields are characterized by higher carcass weight than those living in afforested areas (the difference could reach 1.5 kg).

According to Brzuski *et al.* 1997, body measurements allow to determine the size of roe deer. When taken at a different age, they provide a basis for establishing standards for population evaluation. These authors claim that carcass measurements in roebucks

change with age, and that their growth and development stop at the age of ca. five years, when they reach 71.2 cm in height at withers, 114.5 cm in body length, 65.4 cm in chest girth. A comparison between the measurements of carcasses of roebucks from south-western parts of Poland and those obtained in own studies indicates that roebucks inhabiting northeastern regions are both heavier and bigger. The values of height at withers obtained for adult roebucks in own research were by over 3 - 4 cm higher than those reported by other authors (Kałuźński 1978, Brzuski *et al.* 1997). Taking measurements for the larger number of animals would allow determining a standard model of their constitution.

Observations on the measurements of field roe deer are given by Kałuźński (1978). According to this author, a comparison of body measurements of roe deer in relation to ecotypes is reliable only when the data come from not too distant areas, permanently inhabited by typical populations of both forest and field roe deer. The results presented in the present paper (fulfilling the above condition of data collection) show that field roebucks, compared with forest animals, are characterized by longer carcasses and achieve higher values as regards height at withers and sacrum. The index of massiveness calculated for them also confirms their bigger size.

A positive and highly significant correlation between carcass weight and measurements in roebucks, observed in the present study, could make a source of information on the proper constitution of these animals, enabling their objective evaluation. However, a discussion of the results is difficult because of the insufficient number of papers on the body measurements of roebucks and their relationship with weight. The weight of antlers is an important indicator of both the physical condition of animals inhabiting a given area and of the regularity of selective shooting. An analysis of the weight of antlers made for several years indicates that antlers become the heaviest when roebucks are ca. five years of age (from four to over six years). The experimental data gathered by Drozd *et al.* (2000) and Brzuski *et al.* (1997) suggests that the development of antlers reaches its culmination point in the five-year-old roebucks. A similar tendency was noted in the given study. Roebucks aged four, five and six years were characterized by the heaviest antlers.

Drozd *et al.* (2000) determined the weight of antlers in roebucks living in four provinces in Poland. They found that it varied from 134 g to 138 g in one- and two-year-old roebucks, and that the weight of antlers was the highest in roebucks older than five years - from 292 g to over 333 g. The same authors

calculated the coefficients of correlation between the weight of carcass and the weight of antlers. They turned out to be positive and statistically significant in roebucks from all of the provinces and age groups analyzed. The effect of habitats on the weight of antlers was also observed in own investigations. The antlers in field roebucks were almost 50 g heavier than those in forest ones. A significant positive correlation between the weight of carcass and the weight of antlers enables selection oriented towards these traits, but only in specified age groups. It should also be kept in mind that antlers are a hunting trophy (Jaczewski 1992, Markusson and Folstad 1997, Pielowski 1999, Osgyan 1989). Moreover, good quality in roe deer and other *Cervidae* species is one of the consequences of proper game management.

This investigation has pointed out that the quality is dissimilar in roebucks that live in different habitats. The kind of hunting ground would be the additional factor, which should have been considered while formulating the criteria of culling roebucks.

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## СРАВНИТЕЛЬНЫЙ АНАЛИЗ РОГОВ И ТУШИ САМЦОВ ЕВРОПЕЙСКОЙ КОСУЛИ (*CAPREOLUS CAPREOLUS*) ДОБЫТЫХ НА ТЕРРИТОРИИ ЛЕСНЫХ И ПОЛЕВЫХ ОХОТНИЧЬИХ УГОДЬЯХ

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Резюме

Проанализировано вес и размеры туши 111 самцов европейской косули (*Capreolus capreolus* L.), обитающих в лесных и полевых охотничьих угодьях в районе северо-восточной части Польши. Во время исследований обнаружено, что на этой территории вес туши самцов косули увеличивается с их возрастом. Самого большого веса туши (18,4 кг) и рогов (312,5г), самцы косули достигали в возрасте около 6 лет жизни. Средний вес рогов самцов косули добытых на полевых угодьях достигал 268,10 г, а в лесных угодьях 220,25 г. Разница веса, доходящая до 50г в пользу обитающей на полях косули, подтверждается статистически. Наибольшая дифференциация веса рогов среди самцов косули была отмечена на 2-3 году жизни, в то время как у особей на 4 и 5 году жизни дифференциация веса рогов была несущественна.

Вместе с изменениями веса туши, изменялись и её размеры: высота в холке и поясницы и размеры грудной клетки. Тушки 3-летних и старших косуль были в среднем около 4 см длиннее туш младших косуль (разница довольно существенная). На основании вычисленных коэффициентов соотношений между весом туши и высотой в холке и окружностью грудной клетки, отмечена существенная взаимосвязь между весом рогов и возрастом косуль. Вычислены показатели их телосложения.

**Ключевые слова:** европейская косуля, *Capreolus, capreolus*, вес туши, размер туши, вес рогов