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CASE STUDY

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ASSESSMENT OF SELECTED INDICATORS OF THE INDIVIDUAL CONDITION OF ROE DEER *CAPREOLUS CAPREOLUS* IN THE CLOSED HUNTING SEASON

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ABSTRACT

The aim of the study was to assess the condition of roe deer in the closed hunting season based on the analysis of body weight and fat reserves in roe deer killed in road collisions. The research material consisted of kidneys dissected from 12 bucks, 4 does, and 5 fawns killed in road accidents between February 12 and May 10, 2020. The measurements were used for calculation of the kidney fat index (KFI) based on the formula [Bobek et al. 1984]: KFI = kidney weight with fat/kidney weight without fat. The study presents the distribution of the analyzed parameters with reference to the animal sex and month in which the animal died in the road collision. A distinct decline in the value of fat reserves expressed as the KFI index and the perirenal fat weight mass was observed in the study. In the first two months (February, March), this decrease coincided with reduced body weight, which rapidly increased in April. This may have been related to the intensive vegetation growth. Nevertheless, the costs of the breeding season (primarily in males) resulted in further weight loss in May. The analysis of carcass weight and fat reserves in roe deer killed in road collisions can complete the information about their individual condition and indirectly shows the condition of the roe deer population in the closed hunting season, i.e. in the critical period for this species (winter and the beginning of the breeding season).

Key words: roe deer, *Capreolus capreolus*, individual condition, KFI, traffic accidents

INTRODUCTION

Compared to farm animals, the welfare of wild-living animals is more difficult to assess. Wild animals are fully dependent on the natural habitat of living with which they form an inseparable entity. Therefore, their living environment directly influences their individual condition and behavior, which in turn reflect the adaptation of the population to the nutritional capacity of the habitat [Bobek et al. 1984, Szukiel 1994]. In practice, the evaluation of the individual condition of animals is mainly based on the assessment of the animal body traits, quality of antlers, and carcass weight [Bonino and Bustos 1998, Majzinger 2004]. In the group of wild ungulates, the condition of cervids has been assessed for over half a century by measurement of the amount of fat accumulated around kidneys [Serrano et al. 2008], which is easy to estimate after the death of the animal. Assessment of fat reserves based on the calculation of the kidney fat index (KFI) was first proposed by Riney [1955].

Research on energy reserves in cervids in Poland has been conducted in deer [Bobek et al. 1990, Okarma 1991, Dzięciołowski et al. 1996, Drozd and Piwniuk 2000] and roe deer [Drozd and Gruszecki 2000, Karpiński et al. 2008, Czyżowski et al. 2018].

Material from game animals for analysis is relatively easily available only in hunting periods, e.g. between May 11 and September 30 in the case of males and from October 1 to January 1 in the case of females of the European roe deer Capreolus capreolus. In other periods, animal carcass as research material is impossible to acquire without special permits, which prevents com-

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plete year-round assessment of the individual condition of these animals. An option in this regard is the analysis of carcasses of animals involved in road accidents, which occur throughout the year and have a completely random nature. This is associated with greater attractiveness of this method for acquisition of research material, as animal carcasses are available in the closed hunting season. Road accidents are random events, and the material collected from deer killed in collisions is more reliable for analysis than material obtained via culling, which has to follow the principles of selection of individuals. The randomness of road collisions is associated with a lower number of samples available for analysis, as it is not always possible to reach the scene of the accident or the carrion storage site quickly and collect samples instantaneously. Additionally, the localization of a dead animal is often reported with a delay, and the poor quality of the carcasses does not always allow preparation of material.

The aim of the study was to assess the condition of roe deer in the closed hunting season based on the analysis of body weight and fat reserves in roe deer killed in road collisions.

MATERIAL AND METHODS

The research material consisted of kidneys dissected from 12 bucks, 4 does, and 5 fawns killed in road accidents between February 12 and May 10, 2020. The animal bodies were stored in the Category I Intermediate Plant in Unin, which is part of Hetman Production and Commercial Company dealing with collection and disposal of wastes. Kidneys dissected from animal carcasses were weighed with an accuracy of 1 g. After removal of fat deposits, the kidneys were weighed again. The measurements were used for calculation of the kidney fat index (KFI) based on the formula [Bobek et al. 1984]: KFI = kidney weight with fat/kidney weight without fat. The perirenal fat weight (g) was determined as the difference between the weight of kidneys with fat and the weight of kidneys without fat. The study presents the distribution of the analyzed parameters with reference to the animal sex and month in which the animal died in the road collision.

The normality of the distribution of the parameters was evaluated using the Shapiro-Wilk test. The differences between the mean values of the parameters were assessed using the non-parametric Kruskal-Wallis test. The relationship of carcass weight with KFI and perirenal fat weight was determined by calculation of Pearson correlation coefficients. Statistical analysis of the results was carried out with the use of the Statistica 13.1 PL statistical package.

Study area. Garwolin County is located in the Mazowieckie Province in the southeastern part of Mazowiecka Lowland at the border of Warsaw Basin and Siedlce Heights. Its area comprises the Middle Vistula Valley and its small tributaries: Wilga, Okrzejki, and Promnik. The area of the County is crossed by the S17 express road leading from Warsaw to Lublin and parallel railway traction. Garwolin Forest District located in the County covers 12 communes: Borowie, Garwolin, Górzno, Łaskarzew, Maciejowice, Miastków Kościelny, Parysów, Pilawa, Sobolew, Trojanów, Wilga, and Żelechów. The largest forest complex in the Forest District stretches for approximately 30 km north-southwards along the Vistula valley. It includes Podzamcze and Huta state forests and other forested properties. The complex constitutes a majority of Garwolin Forest District (over 9000 ha). The other forested land is composed of 99 complexes with an area from 1 to 2000 ha. They are evenly distributed within the Forest District and are connected with private forest property, creating a mosaic with arable land.

RESULTS

The analysis of the weight of deer carcasses revealed differences related to the sex of the animals (Table 1). The bucks had higher carcass weight than the does and fawns,

Table 1. Distribution of mean carcass weight, KFI, and perirenal fat weight relative to the sex of the roe deer

Tabela 1. Rozkład średniej masy tuszy, KFI i tłuszczu okołonerkowego w zależności od płci sarny

Variables – Zmienne	Bucks – Kozły n = 12		Does – Kozy n = 4		Fawns – Koźlęta n = 5		*p*
	mean – średnia	range – zakres	mean – średnia	range – zakres	mean – średnia	range – zakres	
Carcass weight, kg Masa tuszy, kg	22.2[a]	18.0–26.5	16.0[b]	15.0–18.0	10.1[c]	9.0–11.5	0.0001
KFI	1.62	1.09–3.36	1.52	1.13–1.94	1.38	1.13–1.64	0.8156
Perirenal fat weight, g Masa tłuszczu okołonerkowego, g	65.8	10–260	41.3	10–80	28.0	140–240	0.3946

[a], [b] – means with different letters differ significantly at $P \leq 0.05$.
[a], [b] – różnice oznaczone różnymi literami różnią się istotnie przy $P \leq 0,05$.

Table 2. Distribution of mean carcass weight, KFI, and perirenal fat weight of the roe deer depending on the month

Tabela 2. Rozkład średniej masy tuszy, KFI i okołonerkowej masy tłuszczowej sarny w zależności od miesiąca

Variables – Zmienne	Month – Miesiąc							
	February – Luty		March – Marzec		April – Kwiecień		May – Maj	
	mean średnia	range zakres	mean średnia	range zakres	mean średnia	range zakres	mean średnia	range zakres
Carcass weight, kg Masa tuszy, kg	16.3	10.5–22.0	15.4	9.5–22.0	25.8	25.0–26.5	18.1	9.0–25.2
KFI	2.50	1.64–3.36	1.78	1.36–1.95	1.40	1.35–1.45	1.34	1.09–1.78
Perirenal fat weight, g Masa tłuszczu okołonerkowego, g	152.5	45.0–260.0	65.0	25.0–90.0	40.0	35.0–45.0	34.6	10.0–105.0

and the latter had the lowest weight. All the differences were statistically significant.

Similar differences were found in the case of KFI and kidney fat weight, i.e. the highest values of fat tissue weight were determined in the bucks, whereas the fawns were characterized by the lowest values of the parameters. However, these differences were not statistically significant (Table 1).

The analysis of the distribution of the mean carcass weight values in the subsequent months of the study period revealed that the body weight of roe deer in February and March was significantly lower than in May and June. However, these differences were not statistically significant due to the small sample size (Fig. 1).

During the consecutive months, the mean values of the kidney fat index decreased. The mean KFI value in February was by approx. 30% and 46% higher than in March and May, respectively (Table 2). A similar trend was observed in the changes in the perirenal fat weight, i.e. compared to February, its mean value declined by nearly 60% in March and by 77% in May.

The analysis of the relationships between carcass weight and fat indicators (Fig. 1) showed positive but insignificant correlations between these parameters. A higher positive correlation was found between the carcass weight and the KFI value.

DISCUSSION

The analysis of carcass weight changes in relation to the site and time of sampling is still a useful and easily available tool for monitoring the ontogenic quality of animals. As a rule, due to their advantage in mating fights, large and heavy males have preferential access to females [McElligott et al. 2001]. In turn, larger and heavier females achieve better breeding success, live longer, and reproduce at a younger age, which makes them more likely to rear offspring [Hewison and Gaillard 2001]. A large body size and weight are also an advantage in juveniles of both sexes, since such parameters facilitate survival of the first winter [Pettorelli et al. 2002]. In the present study, the carcass weight of the roe deer changed with the age and sex, which is naturally associated with the somatic development and physiology of the animals [Janiszewski et al. 2009, Flis 2015]. Body weight is strongly correlated with environmental factors. The determinants of body weight include climatic conditions, food base, population density, animal age, and seasonality [Toigo et al. 2006, Kamieniarz 2013].

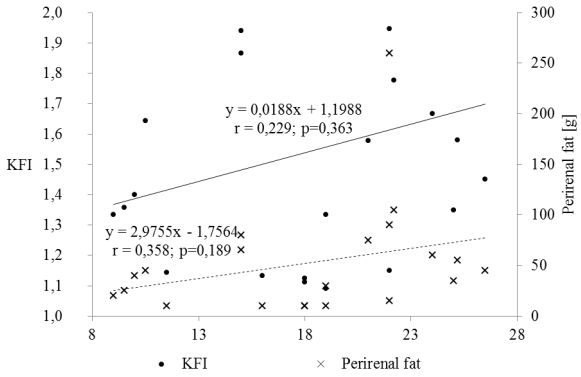

Fig. 1. Correlation of carcass weight with KFI and perirenal fat weight in roe deer

Rys. 1. Korelacja masy tuszy z KFI i tłuszczem okołonerkowym u sarny

The mean carcass weight of the bucks involved in road accidents was higher than that of specimens from western Poland [Wajdzik et al. 2015], which is consistent with data reported by other authors showing that roe deer from eastern Poland exhibit one of the highest body weight values on the country scale [Flis 2005, Dziedzic and Flis 2006].

The present study showed no differences in the KFI index values between the sexes, which is consistent with other data [Serrano et al. 2008] demonstrating that the level of fat reserves does not depend on the reproductive cycle and thus suggesting that carcass weight is a more

reliable indicator in assessment of deer condition. As reported by other researchers, compared to other wild ungulates, roe deer have very low body fat reserves; hence, body weight and perirenal fat weight are better indicators of the ontogenic quality than KFI [Andersen et al. 2000, Toïgo et al. 2006].

Body weight is mainly composed of the body size, skeleton, muscle mass, and accumulated fat reserves [Toïgo et al. 2006]. The body weight determinants include seasonal variability as well as the quality and quantity of consumed food, which is reflected in the reduction of the fat and muscle tissue in winter [Weber and Thompson 1998]. Additionally, during winter and early spring, roe deer exhibit substantial energy losses associated with migration, thermoregulation, and development of the fetus in the case of females [Flis, 2015]. The present study demonstrated a decline in fat reserves expressed by the KFI index and perirenal fat weight. As reported by Hewison et al. [1996], the decrease in the KFI value is associated with atmospheric conditions, as adverse weather contributes to reduction of these parameters especially in winter and spring.

The analysis of the roe deer body weight in April may suggest that the increase in the value of this parameter observed in the present study results primarily from the enrichment of the food base. As shown by Bobek [1977], deciduous shoots and undergrowth are the most valuable food for roe deer during the vegetation season in Poland. In turn, reduced body weight is observed in May, which may be associated with the increased activity of bucks and migration in the beginning of the breeding season.

The present study showed a positive correlation between the carcass weight and the KFI value. Similar values of the correlation coefficient between doe carcass weight and KFI in winter months were reported by Majzinger [2004].

CONCLUSION

A distinct decline in the value of fat reserves expressed as the KFI index and the perirenal fat weight mass was observed in the study. In the first two months (February, March), this decrease coincided with reduced body weight, which rapidly increased in April. This may have been related to the intensive vegetation growth. Nevertheless, the costs of the breeding season (primarily in males) resulted in further weight loss in May.

The analysis of carcass weight and fat reserves in roe deer killed in road collisions can complete the information about their individual condition and indirectly shows the condition of the roe deer population in the closed hunting season, i.e. in the critical period for this species (winter and the beginning of the breeding season).

In assessment of the condition of roe deer, management of hunting districts should consider not only the carcass weight analysis but also changes in fat reserves reflected by KFI and perirenal fat weight.

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OCENA WYBRANYCH WSKAŹNIKÓW KONDYCJI OSOBNICZEJ SAREN *CAPREOLUS CAPREOLUS* POZA SEZONEM ŁOWIECKIM

STRESZCZENIE

Celem pracy była ocena kondycji saren poza sezonem łowieckim na podstawie analizy masy ciała i zapasów tłuszczowych saren potrąconych podczas kolizji drogowych. Materiał do badań stanowiły nerki wypreparowane z 12 kozłów, 4 kóz oraz 5 koźląt potrąconych w okresie od 12 lutego do 10 maja 2020 roku na terenie powiatu garwolińskiego. Na podstawie otrzymanych pomiarów wyliczono wskaźnik tłuszczu okołonerkowego (KFI) oraz masę tłuszczu okołonerkowego (g). W pracy przedstawiono rozkład analizowanych parametrów, uwzględniając płeć i miesiąc, w którym zwierzę zginęło w wyniku kolizji drogowej. Zaobserwowano wyraźny spadek wartości gromadzonego tłuszczu zapasowego wyrażonego wskaźnikiem KFI i masy tłuszczu okołonerkowego. W pierwszych dwóch miesiącach (w lutym, marcu) spadek ten pokrywał się ze spadkiem masy ciała, której nagły wzrost w kwietniu mógł być wynikiem bujnego rozwoju wegetacji w badanym roku. Jednak koszty związane z okresem rozrodczym (głównie u samców) powodowały dalszy spadek masy ciała w maju.

Słowa kluczowe: sarna europejska, *Capreolus capreolus*, kondycja osobnicza, KFI, wypadki drogowe

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