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ANTLER MALFORMATIONS OF CERVIDAE SPECIES IN OPOLE VOIVODESHIP

DEFORMACJE POROŻA U JELENIOWATYCH W WOJEWÓDZTWIE OPOLSKIM

Abstract: Hunting Law regulations strictly determines which males of quarry species may be harvested during the season. The age and the antlers of the individual play here an important role. The exceptions are the individuals with malformed and long spiked antlers, that is in a form significantly different from the desirable forms described in guidelines by the Chief Hunting Council. Anomalies in shape, structure and size of antlers are obligatory condition for harvesting the individual. It is generally accepted that such individuals are weaker, less valuable, have defective genes, are sick or injured, and are dangerous for conspecific during the rut. The scientific explanations for the development of an antler abnormalities point out many different factors, including the environmental ones. For many years antlers are used to determine the environmental pollution by heavy metals accumulated in it's bone tissue what gives precise annul data. The aim of this work was to check whether the frequency of antlers deformation in cervidae species present in the Opole Voivodeship correlate in any way with ontogenetic features (age and body weight), population features (density and size of population) and environmental factors (woodiness, competition). Results could set new directions in researches for causes of antler malformations in cervidae family.

Keywords: antler malformations, cervidae

Introduction

Antlers developed by the cervidae family spieces are unique bone structures in animal world. They are the fastest growing bones known to science. Also they are shed annually, and than regrown [1]. They play different roles: as a weapon – to compete other males during rut or to defense from predators, as a tool – to dig in snow for food, and reproductive – to attract females [2]. Their shape and structure are consistent amongst cervidae family making it easy to recognize a species by the antler itself. Some slight differences might occur at the level of population and individuals (different shape and angle of beams, the number of tines), yet both beams are usually symmetric and

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absolutely consistent to a species. From hunting point of view, the bigger and heavier the antlers are – the more valuable the trophy is. Hunting low regulations in Poland strictly describe which individuals might be harvested according to their age and form of their antlers. There are only two exceptions to that regulations [3], usually given together: the so called malformed antler and long spiked (“myłkus” and “szydlarz” in Polish) [4].

Although much is known about the molecular mechanisms involved in regrowing the antler [5–6] the reasons why malformations occur are still unclear and varied. Most explanations are focused on endocrine disruptions [7–11] or point out injuries to skull or legs [8, 12–15], but there are other possible causes like diet [16, 17], lack of trace elements [18–21], heritability [22, 23] or even stress factors like fear [24]. We can suspect that at the end most of these factors can lead to endocrine disruptions. Surprisingly there are no direct links in the literature between environment pollution and malformations of the antler, although some knowledge [25] emerges from studying the chemical content of the shed antlers which are used in environmental pollution monitoring giving precise data from following years [26–28].

The purpose of this study was to analyze frequency of antler malformations amongst cervidae in Opole voivodeship for any correlations with interpopulation or environmental factors and choice of most suitable species for further studies.

Materials and methods

Species and samples

Four species of cervidae family are present in Opole voivodeship, the Red deer (*Cervus elaphus*), Fallow deer (*Dama dama*), Roe deer (*Capreolus capreolus*) and Moose (*Alces alces*). Except for the Moose all these species are harvested by local Hunting Association. Among them the most common are the Roe deer and rarest is the Fallow deer. Data achieved from Opole Hunting Association describes species, date of harvesting, hunting area, body weight, antlers weight, antlers type, number of tines and age of the individual. In total: 3363 for Roe deer, 953 for Red deer and 133 for Fallow deer specimens were analyzed.

Hunting grounds and season

Opole voivodeship lies in southern-western Poland and share border with Czech Republic. Main geographical barriers are the A1 highway crossing the region (with very narrow, improperly designed animal transitions) and Odra river. Much of the wildlife management in Opole voivodeship is made by local Hunting Association on 144 out of 156 hunting grounds (it approximately covers 92% of Opole voivodeship) and these were taken into account. Hunting grounds were different in many aspects: the woodiness, area size, human density etc. All specimens were harvested in 2012/2013 hunting season. In some hunting grounds all species were present, in some (open fields) only one, mostly the Roe deer.

Statistical methods

Correlations between frequencies of malformations in hunting grounds and inter-population or environmental factors were checked using Pearson correlation coefficient (r) or Spearman Rho correlation coefficient in case of lack of normal distribution of data. Statistical significances of differences between values of studied data were checked using t-Student test. The null hypothesis was always that there are no differences between compared groups of specimens in particular feature.

Results

Frequency of antler malformations in different species

Red deer. 953 specimens were harvested in 2012/2013 hunting season of which 74 had malformed or spiked antlers (7.66%). Frequencies of antler malformations in different hunting grounds were in a range of 0.0 up to 0.5 with average value of 0.07.

Fallow deer. 133 specimens were harvested in 2012/2013 hunting season of which 11 had malformed or spiked antlers (8.27%). Frequencies of antler malformations in different hunting grounds were in a range of 0.0 up to 0.4 with average value of 0.10.

Roe deer. 3363 specimens were harvested in 2012/2013 hunting season of which 390 had malformed (without spiked ones) antlers (11.6%). Frequencies of antler malformations in different hunting grounds were in a range of 0.0 up to 1.0 with average value of 0.13.

Antler malformations according to body weight and age

Red deer. The average body weight of harvested stags with properly formed antlers was 111 ± 25 kg and 104 ± 24 kg for ones with antler malformations, while average age was 5.4 ± 2.5 years and 5.32 ± 2.3 years respectively. Correlation between body weight and age in whole population is only positively moderate with $r = 0.52$. Differences between body mass in stags with proper and malformed antlers, despite their age and time of harvesting, were significant, and weight of stags with proper antlers was bigger (d (difference of mean) = 6.40, SD (standard deviation) = 25, p (probability value) = 0.035). Although number of harvested stags with malformed antlers decline along with their age, the percentage of them in whole harvested population in particular age changes, reaching its maximum in the age of 10 years (Fig. 1).

Fallow deer. The average body weight of harvested bucks with properly formed antlers was 50 ± 10 kg and 55 ± 16 kg for ones with antler malformations, while average age was 4.5 ± 1.7 years and 4.5 ± 2.1 years respectively. Differences between body mass in bucks with proper and malformed antlers, despite their age and time of harvesting, were not significant ($d = -4.98$, SD = 10, $p = 0.33$). There is also no differences in age in both groups at significance level of $p = 0.01$. The number of harvested stags with malformed antlers as well as percentage of them among all harvested bucks in particular age changes, reaching its maximum in age of 8 years (Fig. 2).

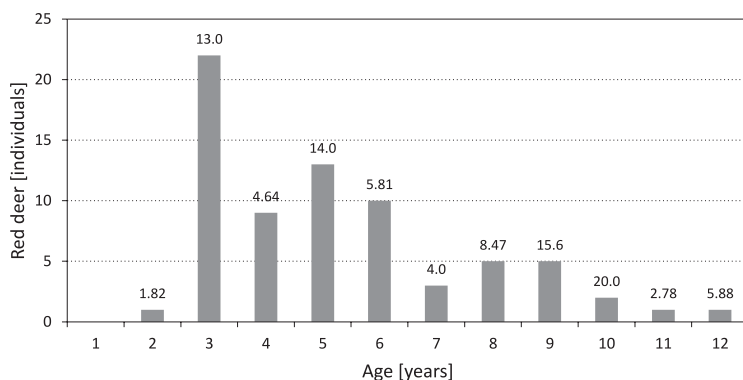


Fig. 1. Stags with malformed antlers harvested in 2012/2013 hunting season with their percentage share among all harvested stags (values given above columns)

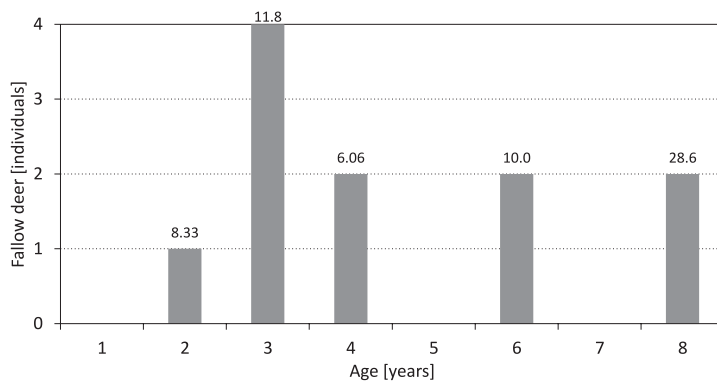


Fig. 2. Bucks of Fallow deer with malformed antlers harvested in 2012/2013 hunting season with their percentage share among all harvested bucks (values given above columns)

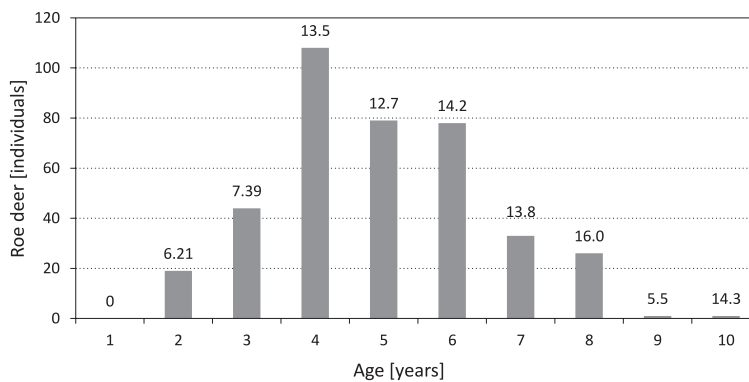


Fig. 3. Bucks of Roe deer with malformed antlers harvested in 2012/2013 hunting season with their percentage share among all bucks (values given above columns)

Roe deer. The average body weight of harvested bucks with properly formed antlers was 16.1 ± 2.1 kg and 16.4 ± 1.9 kg for ones with antler malformations, while average age was 4.9 ± 1.5 years and 4.6 ± 1.5 years respectively. Differences between body weight in bucks with proper and malformed antlers, despite their age and time of harvesting, were significant (t – Student test, $p < 0.01$). The number of harvested stags with malformed antlers as well as percentage of them among all bucks in particular age changes reaching its maximum in age of 10 years (Fig. 3).

Density of population and frequency of antler malformations

The Roe deer were harvested on all hunting grounds managed by Opole Hunting Association, the Red deer were harvested on 101 hunting grounds and Fallow deer on 20. The annual hunting management plans are based on the size of population of a particular species, therefore we can assume that the number of harvested specimens reflects directly the size of local populations. Knowing the exact size of hunting grounds [29] in Opole voivodeship ranging from 3196 ha to 12273 ha (average 5628.3, median 5311.5) and the fact that Roe deer males are faithful to their summer grounds [30] we can calculate a value reflecting density of its local populations. In case of a Red deer we can only assume that migration among males is low (except during the rut) due to flat surface of Opole voivodeship, abundance of food, isolation of Niemodlinskie Forest and none/very low predation risk [31, 32]. Literature about migrations of Fallow deer in Poland is limited, yet, especially in Opole voivodeship where this species have the oldest populations established in hunting grounds managed by National Forestry [33], we can be sure of slow migration based on population density from more to less populated hunting grounds. Considering that low migration does not significantly effect the condition of local populations of studied species we can seek for correlation between value reflecting its densities and frequency of antler malformations. Results of such calculations showed that in 2012/2013 hunting season there were no correlations between density of the Roe deer and frequency of antler malformation ($r = -0.005$, $n = 131$), neither for a Red deer ($r = 0.027$, $n = 99$) and Fallow deer ($r = -0.037$, $n = 20$). Also size of local populations of all three species did not correlated with antler malformation frequency among Roe, Red and Fallow deer ($r = -0.047$, $r = -0.054$ and $r = 0.164$, respectively).

Woodiness of hunting grounds and antler malformations

Average woodiness for Opole voivodeship is 29,9% and woodiness of hunting grounds of Opole Hunting Association varies in a range from 0% up to 84% [34, 35]. There are two main forest complexes: Niemodlin Forest to the south from Odra river and Stobrawsko-Turawskie Forest to the north. To check the correlation between woodiness and antler malformation I used a Spearman Rho correlation coefficient due to lack of normal distribution of both parameters. For Roe deer, which inhabits hunting grounds with forest cover from 0% to 84% (average 24,9%), antler malformations were not significantly associated with woodiness ($r = 0.009$). The Fallow deer was harvested

on hunting grounds with woodiness from 6% to 84% (average 43,6%), but in this species studied feature was only weakly, negatively associated with woodiness ($r = -0.151$). The Red deer was harvested on hunting grounds with woodiness from 1% to 84% (average 30.0%) and it was the only species in which antler malformations are significantly, but moderately, associated with the woodiness of hunting grounds ($r = 0.34$).

Mutual occurrence of antler malformations among studied species

All three cervidae species coexist in almost all hunting grounds across Opole voivodeship, but except for Roe deer, not everywhere they are harvested. The mutual occurrence of antler malformations in particular hunting grounds average value for specific species are shown below (Table 1).

Table 1

Mutual occurrence of malformations in studied species on particular hunting grounds with frequencies higher than average value for specific species

Game species	Frequencies of antler malformations					
	Min. value	Max. value	Average value	Median value	No. of hunting grounds	Mutual occurrence
Roe deer	0.0	0.37	0.13	0.12	73	13
Fallow deer	0.0	1.0	0.10	0.0	4	2
Red deer	0.0	0.50	0.07	0.0	31	13

Discussion

Antler malformations occur in all harvested cervidae species present in Opole voivodeship. The Roe deer has the lowest value of maximal frequency of antler malformation in particular hunting ground, yet it has the highest percentage share of all specimens with abnormalities in it's whole population. Moreover it is present in all hunting grounds no matter the forest cover and is the most numerous, thus it is the most suitable species for further studies on antler malformations.

If occurrence of antler malformation would be genetically conditioned and would manifest year after year since the first grown antler one could expect that highest share of specimens with antler malformations should be in first years of their life. Later, their share should decline due to higher chance for hunters to harvest such specimens until their share in whole population would drop significantly. But it seems it does not work that way. The percentage of harvested bucks and stags with malformed antlers in particular age did not decline as they got older. This might be explained by three possibilities: 1) genetics condition the occurrence of malformations but additional trigger is needed/malformation would not necessarily manifest since youth, 2) the chances for harvesting specimens with antler malformations are not associated with

their share in whole population, 3) occurrence of malformations is conditioned by environmental or population factors. As heritability of antlers shape and size in cervidae species has not been proven to be very high [22, 23, 36] and been rather correlated with age [37] first explanation, based on genetic conditioning, is rather insufficient (moreover hunters and shed antler collectors can easily recognize the specimen year after year by shape of its antlers, so the new antlers are rather similar to previous ones). The chance for harvesting the specimens with antler malformations according to their share in whole population should rather be considered as high. Hunters have plenty of time to track down such specimens (Roe deer before the rut, Red and Fallow Deer during rut), especially in field-type hunting grounds. Although total number of harvested specimens with visible antler malformations was highest in age of 3–4 for all studied species, that not happened with their share in population across different age. In case of all three studied species the highest percentage share of specimens with antler malformation in population was at age of 10, 8 and 8 for Red, Fallow and Roe deer respectively. It rather seems that environmental or population factors play the key role in occurrence of abnormalities in antlers while stags and bucks are getting older.

Stags with proper antlers harvested in 2012/2013 hunting season were significantly heavier than ones with malformed antler in the same age. This may support statement that specimens with antler malformation are of poorer condition yet contrary results in case of Roe deer and no significant differences in Fallow deer make it rather doubtful or these association vary in different species or across years. Differences between species might depend on different biology, behavior and type of preferred habitat. In most suitable species for further studies on that phenomena, the Roe deer, it seems that bucks with antler malformations are heavier and one can suspect, that in better condition, what need further investigation.

Antlers are secondary sex characteristics and are used to fight with other conspecific during the rut. This may lead to many wounds on skull. In fact, such injuries often lead to antler malformations [2, 12–15], especially to accessory antlers [9]. As males compete for females and territories one can suspect, that the higher density of local population of a deer species, the higher the chance for confrontation during rutting time. Therefore the chance for injuries across the so called “antlerogenic territory” leading to occurrence of accessory antler should be also greater. This may explain the growing share of specimens with antler malformations in Red and Fallow deer since gaining maturity. But neither size or density of local populations did not correlated with antler frequencies in all studied species. Thus, the factor which is responsible for antler malformations in older age of studied species is rather environmental than based on these two, important population characteristics.

Forest cover plays important roles for deer species providing food, shelter, peace etc. Only the Roe deer is adopted to live all year long on open fields, the two other studied species need forests to thrive. The weak, negative correlation between antler malformations and woodiness in case of Fallow deer might occur due to small sample. The moderate, positive in Red deer is surprising. Perhaps it is somehow associated with diet or injuries to growing and soft tissue of antler from branches, fences, and dense shrub?

In case of Roe deer woodiness has nothing to antler malformations what makes this species even more suitable for further studies.

Reasons for antler malformations to occur need investigations from longer periods. If lack of correlation between interpopulation factors and antler malformations would be proven across the years in particular population, than environmental (anthropogenic?) factors might play an important role in this phenomena.

Conclusions

The most suitable species for further studies on antler malformation is a Roe deer. The occurrence of antler malformations does not decline along with age in all studied species and it seems that environmental or inter-population factors determine occurrence of abnormalities in antlers, rather than heritability. Moreover two important population factors: density and it's size does not correlate with frequency of antler malformations. The woodiness of hunting grounds, in case of a Roe deer and Fallow deer, also does not correlate with studied feature. Only in Roe deer, the specimens with antler malformations were significantly heavier than does with proper antlers. Frequency of antler malformations need further investigation from across the several years and involving different factors which may induce its occurrence.

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Abstrakt: Regulacje Prawa Łowieckiego ściśle określają, które samce zwierzyny płowej mogą zostać pozyskane w danym sezonie. Kluczową rolę odgrywają tu wiek oraz forma poroża danego osobnika. Wyjątek stanowią tzw. „myłkusy” oraz „szydlarze”, czyli osobniki mające poroże w formie istotnie odbiegającej od wytycznych określanych przez Naczelną Radę Łowiecką. Anomalie w kształcie, budowie i rozmiarach poroża stanowią obligatoryjny warunek do pozyskania mającego je osobnika, którego uważa się za niepożądanego w łowisku. Powszechnie uznaje się takie osobniki za słabsze, mniej wartościowe, mające wadliwe geny, chore lub zranione, a także niebezpieczne dla innych w okresie rui. Naukowe uzasadnienia powstawania anomalii w porożu jeleniowatych wskazują na wiele różnych czynników, w tym środowiskowych. W ostatnich latach podjęto również prace nad określaniem skażenia środowiska bytowania jeleni metalami ciężkim w oparciu o oznaczanie tych pierwiastków w rogowej tkance poroża, które w cyklu rocznym jest nakładane i następnie zrzucane. Celem tej pracy było sprawdzenie, czy częstość występowania deformacji w porożu u jeleniowatych na terenie województwa opolskiego w jakikolwiek sposób koreluje z cechami osobniczymi (wiek oraz waga tuszy), wewnątrzpopulacyjnymi (zagęszczenie i wielkość populacji) oraz środowiskowymi (lesistość, konkurencja). Wyniki mogą wyznaczyć nowe kierunki w badaniach nad przyczynami powstawania deformacji w porożu jeleniowatych.

Słowa kluczowe: myłkus, jeleniowate, poroże