THE DATE OF ANTLER CASTING, AGE AND SOCIAL HIERARCHY RELATIONSHIPS IN THE RED DEER STAG

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ABSTRACT


A five-year observation of social interactions and the antler cycle of the stag was performed in the “white” red deer population in the Žehušice game reserve, Czechoslovakia. The results indicate that the antler casting time of individual stags was dependent primarily on social status and that the influence of age was of secondary importance. The more dominant the stag, the earlier antler casting occurred. The stags of higher social status also tended to shed velvet earlier, although this relationship was not significant.

The hormonal regulation of the antler cycle relating to social hierarchy is discussed.

INTRODUCTION

The work presented is a part of a larger five-year ethological study (Bartoš, 1978) with recently acquired data added. The aim of study was to determine if there is any relationship between social behaviour of “white” red deer and the antler cycle.

MATERIAL AND METHODS

Origin and present state of the population

The observation was carried out on white coloured leucistic red deer (Cervus elaphus L.) in the Žehušice game reserve, Central Bohemia, Czechoslovakia. The zoological and geographical origin of the population is not clear, although it was suggested that the deer belong to the subspecies C.e. maral (Dobroruka and Turek, 1961). The initial attempt to identify the zoological origin of the deer on comparative skull and other measurements resulted in failure. It is suggested that the measurements of the skulls of “white” red deer are identical to the native red deer skulls due to repeated numerous crosses with C.e.hippelaphus (Velek, 1977). This question remains open.

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The population consisted of an increasing number of deer of both sexes, reaching approximately 50 head at the present time. Yearling stags, which are not white in colour, are separated in another game reserve.

**Area description**

The game reserve is of park-like character (2.42 km²) and field conditions for observation are therefore most favourable.

**Observation methods**

The identification of all individual stags is made on characteristic colouring, antler patterns, etc. since birth. Hence their age is known exactly. Observation was made (one day in three or four weeks intervals) between 1975 and 1979, except during the critical periods (the time of antler casting or velvet shedding) when it was done daily. The animals were fed almost every day during the whole year, which is why it was possible to observe the deer during feeding at a distance of approximately 20 m without any apparent disturbance. The records of stag dominance hierarchy were made at the time of feeding for 10 to 30 minutes, until the animals left the feeding area. All animals encountered each other regularly, and if one animal moved away when approached by another, this was taken as an indicator of subordinance. The outcome of such encounters was invariably clear. The rank order presented in the results was based on the encounters of single stags with each animal of the bachelor group. If the winner of current repeated encounters between two stags was not quite clear, then the ranking position was considered to be of equal level. The data on antler casting and velvet shedding were recorded. The social interaction and their relationship to date of antler casting or velvet shedding were recorded in a total of 18 males between spring 1975 and summer 1979. During that time three stags died and three were transferred elsewhere.

**RESULTS**

The social status and its relationship to the age and date of antler casting of all stags is presented in Table I and in simplified illustrative form in Fig. 1 (in which the data concern only the stages which were present during the whole period of observation). The social status is expressed in numbers (1 = alpha, etc.). Social hierarchy of the stags was linear, with no triangular relationships over the whole year, and was very stable. Even during the time of antler casting, there were almost no changes in social rank order, except in spring 1979 (Bartoš, 1980).

The stag Blbec was hurt on 21 February 1978, which was accompanied by a bloody surface swelling of the left hock. Blbec immediately lost one step in the hierarchy. It was followed by Bohumil, the stag who replaced
Blbec in the rank order, casting an antler one day earlier than Blbec. Although Blbec recovered, his fall in social hierarchy continued the following year. In the early spring 1979 Blbec began to behave submissively towards Jaromír. During the following casting season he started to cast his antlers one day later than Jaromír. The young stag named Pišta also started to be aggressive towards Blbec just before antler casting in 1979. This resulted in dominance of Pišta over Blbec as soon as the antlers of Blbec were cast, and this relationship did not change after casting of Pišta’s antlers. That season Pišta cast his antlers 19 days earlier than the previous year.

No exact quantified measurements of social rank were performed, though the “social distance” between individuals could be easily estimated by means of behavioural patterns (Bartoš, 1978). The difference between dates of antler casting of individual animals appeared to be a good expression of the relation. For example, when Dědek was alpha and had no serious competition, he cast his antlers one month (1975) and 16 days (1976) earlier than the beta stag Bořivoj. When Bořivoj started to replace Dědek at the top of rank order, the time of antler casting was almost equal. After Bořivoj established his position safely, the difference between the dates of his and Dědek’s antler casting increased.

Venoušek and Antonín were born in 1976. When they were yearlings, a slight dominance of Antonín over Venoušek developed. After that Antonín cast his spikes two days earlier than Venoušek. In 1979, when Antonín’s dominance over Venoušek was more evident, the difference between the dates of antler casting was also more marked (Table I).
### TABLE I

The social status of all males and its relationship to age and date of antler casting

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<td>Koudelka</td>
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*Living mostly solitary; ** removed before the spikes were cast.

### TABLE II

Velvet shedding/social status and age relationships in stags of Zehusice

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* Rank order among presented stags; ** Social status of Dedek and Borivoj was different during antler casting and velvet shedding, 1978; * Since April 1979 Jaromir has been kept in a separate enclosure, accompanied by hinds only.
The antler casting in 1978 and 1979 may have been influenced by the temporal artificial division of the herd into two separate enclosures during the rutting season. This was to prevent any injury to the top hierarchy stags being caused by rutting fights. However, the social behaviour observed on occasional contacts through the fence suggested that the rank order remained unchanged.

The dates of antler casting were positively related to social position in all of 44 observed cases (confidence interval of binomial distribution, $P < 0.001$). In two cases (Pišta and Antonín in 1977; Blbec and Jaromír in 1979) the dominant stag started to cast antlers earlier, but both, dominant and subordinant, finished their casting in the same day. The dates of antler casting were positively related to age in 37 cases and not in eight cases (confidence interval of binomial distribution, $P < 0.01$). In three additional cases stags of different age cast their antlers at the same time (No. 40 and Blbec in 1975; Dědek and Bořivoj in 1977; Blbec and Jaromír in 1979). The relationships of social position to antler casting and age to antler casting differ significantly ($P < 0.01$).

The results of velvet shedding/social status relationships among the stags present during whole observation period are shown in Table II. There is a slight indication that the dominant stags tended to shed velvet earlier, but the relationship to either social status or age of a stag is not significant.

DISCUSSION

The results suggest that the stags’ antler casting time in Žehušice was dependent primarily on the social status and that the influence of age was of secondary importance. This is indicated by the lesser significance of the age/antler casting relationship indicated by comparing stags of similar age, and by the fact that a young stag which dominated an older individual subsequently cast its antlers earlier than the older one. This conclusion may be confirmed by experiments with fallow bucks. When stress caused disturbance of the social hierarchy, alteration in the antler cycle occurred in males occupying extreme hierarchy positions. Control experiments demonstrated that antler stunting did not affect the antler cycle if it was not connected to change in social hierarchy (Topínský, 1975).

Watson (1971) observed in Luibeg, Scotland, that more tame and more dominant red deer stags came to the artificial feeding site more often during a winter. These stags thus obtained more food and, being in better condition, they cast their antlers earlier than other animals. The system of an artificial feeding in Žehušice is rather different. The stags are usually fed in such a way that individual animals had the same chance to eat almost ad libitum. Unlike Watson’s case, the tamest stags are usually the younger ones (e.g. Pišta in 1978, Antonín and Spičkin in 1979, etc.), often eating straight from the tractor carrying the food. More dominant stags consistently avoided coming into close proximity to the deerkeeper operating the tractor. Hence the findings described are probably based on the neurohormonal regulation.
It is well established that antler casting in the red deer stag occurs when testosterone levels are at their lowest seasonal level (Lincoln, 1971). Nevertheless, the findings of immunohistological localization of testosterone in the growing antlers and anti-androgen administration to white-tailed bucks indicate the importance of testosterone in antler bone matrix syntheses from the beginning of the growth (Bubenik and Bubenik, 1973; Bubenik et al., 1974; Bubenik et al., 1975). In general, the dominant position in mammals is probably related to elevated testosterone levels, as has been shown in laboratory rodents and primates (e.g. Rose et al., 1975; Buhl et al., 1978). The observation of Bubenik et al. (1977) on white-tailed bucks indicates similar pattern in deer. The possible role of testosterone at the time of antler growth initiation might be indicated by the short term peak level of testosterone during the antler casting period. This was determined in only one study in red deer (Blaxter et al., 1974). However, the fluctuation of testosterone is known from many experiments with mammals, making a determination of mean hormonal value difficult. A much greater incidence of the peaks at the time of antler growth initiation within the Cervids than has previously been documented might be indicated by reactivation of testicular activity during the same period, as has been found in several deer species (Robinson et al., 1965; Markwald et al., 1971; Chaplin and White, 1972; West and Nordan, 1976). The effect of testosterone on antler growth initiation could probably be determined by measuring the absolute hormone level. Low amounts of testosterone can stimulate bone growth, and higher levels can be inhibiting. This was demonstrated in experiments with white-tailed deer (Brown et al., 1978). Hypothetically, the pulsative short term peak level secretion of testosterone following the seasonal decline of the hormone may be the trigger factor in antler growth. The more dominant stag may have a higher peak of testosterone pulse; a new antler bone growth may thus be initiated more markedly and the antler casting may occur earlier. In addition the interaction with further steroids is very likely. For example, Bubenik et al. (1979) found two annual oestrogen peaks in white-tailed deer; one of them occurring during the time of antler growth initiation. The positive effect of oestrogen on bone mineral content is known from experiments with white-tailed deer (Bubenik and Bubenik, 1976), as well as from human medicine (e.g. Dalén et al., 1978).

Submissive behaviour seems to be followed by increased values of corticoids, as has been found in monkeys and rodents (e.g. Bowman et al., 1978; Leshner and Politch, 1979). So the higher levels of corticoids may play an important role within the lower part of a rank order. Bubenik et al. (1976) demonstrated in orchidectomized roe buck that the intensive growth of “peruke” began to stagnate several days after the start of cortisone administration. The growth of a new antler bone of more submissive stags might be thus delayed, resulting in later antler casting.

In experiments with artificially altered daylight and its influence on the antler cycle, it was shown that older stags can sometimes express endogenous
annual antler growth, irrespective of artificial light conditions (Goss, 1969). This may be manifested in solitary-living old stags, who cast their antlers earlier in the period of antler casting (e.g. No. 16 in 1975) while performing minimal social interactions. However, the absence of social stimulation may cause these solitary-living stags to cast their antlers later than the top dominant stags within a bachelor group.

The relationship between antler casting and social status across age could have a quite different basis from the relationship within them. Social rank in red deer stag groups increases with the age up to 5–7 y, when adult body weight is reached, and is not closely related to age among older animals (Lincoln et al., 1970; Bützler, 1974). This pattern is probably a consequence of the effort of increasing size on fighting success in growing stags. Before the age of 6 y, stags gain body weight each year, whereas, after this, weight is approximately stable until about 11 years of age (Clutton-Brock et al., 1979). The most extensive published data on the relationship between time of antler casting and age (Lincoln, 1972) show that antler casting becomes earlier with increasing age up to 7 y of age, and is then rather stable.

The fact that times of antler cleaning and the initiation of rutting, which, like antler casting, are controlled by the annual testosterone cycle, are similarly earlier with increasing age (up to approximately 7 y of age) (Lincoln et al., 1970) suggests that antler casting may become earlier with increasing age as a result of changes in the timing of the annual endocrine cycle. However, as Whitehead and McEwan (1973) proposed, velvet shedding in deer may also be accelerated by behavioural changes brought about by testosterone secretion. This suggestion may be supported by the case of the yearling stag Vidlička, who cleaned his spikes in 1977 on 26 July, at the same time as Dědek and Bohumil, which followed an unusually higher social activity of Vidlička within the hind herd (Bartoš, 1978).

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REFERENCES


