

## The Antler Cycle of Adult Reeves' Muntjac

D. I. CHAPMAN & Norma G. CHAPMAN

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The antler cycle of captive, adult Reeves' muntjac, *Muntiacus reevesi* Ogilby, 1839, of known age has been shown to be annual and seasonal at latitude 52°20'N. Casting of the antlers occurs in May and June and cleaning takes place from mid-August to mid-October, and appears to be irrespective of the deer's date of birth. The mean length of the annual antler cycle is 366 days with a range of 351—389 days. The two antlers are frequently cast and mature on the same day although they may be cast up to 12 days apart and cleaned up to 11 days apart. The mean length of the growing period was 106 days with a range of 79—130 days. No change was detected in either the time or duration of the antler-growing period with increasing age of the deer.

[Larkmead, Barton Mills, Bury St. Edmunds, Suffolk IP28 6AA, England]

### 1. INTRODUCTION

Antlers, which occur only in members of the family *Cervidae*, are a secondary sexual character of male deer. The reindeer, *Rangifer tarandus* Linnaeus, 1758, in which both sexes grow antlers, and the Chinese water deer, *Hydropotes inermis* Swinhoe, 1870, in which neither sex has antlers, are exceptions. In species of deer from the northern temperate region of the world, the antlers are cast and regrown annually and the state of an animal's antlers are usually regarded as a good indication of its androgen status (Short & Mann, 1966; Lincoln, Guinness & Short, 1972). These species, such as the fallow deer (*Dama dama*), red deer (*Cervus elaphus*) and even the Asiatic sika deer (*Cervus nippon*), have a well-defined breeding period, rutting usually in the autumn soon after antler growth has been completed, and the females giving birth in the early summer. In contrast, the Asiatic Reeves', or Chinese, muntjac, which now occur over much of the southern half of England (Arnold, 1978), may give birth at any time of the year (Zuckerman, 1953; Chapman & Dansie, 1970) and it has been claimed that the male is fertile throughout the year (Chaplin, 1973). Consequently, a knowledge of the antler cycle of this deer would be of considerable interest. The antler cycle of Reeves' muntjac in its native country, south-east China, appears

to be unknown and information on it in this country is scarce and contradictory. It has been suggested that adult muntjac, which were presumed to be Reeves', have an annual, seasonal antler cycle (Chaplin, 1972) but, as Dansie (1973a) has pointed out, this conclusion is based on four corpses and a single cycle for each of two captive animals, together with an unspecified number of casual observations of unmarked deer for a period of only seven months, namely from October to the following April. The latter author, however, has recorded muntjac with growing antlers and with hard antlers in every month of the year (Dansie, 1973b), a fact which appears to be supported by the observations of Harris & Duff (1970) and Taylor Page (1971). In none of these studies, however, was the ages of the deer taken into consideration.

Muntjac deer are not herd animals and they live in dense vegetation. Consequently it is very difficult to locate and to observe regularly wild muntjac. Therefore, in order to observe particular animals daily, captive deer have been studied. The present paper records the antler cycles of individually-marked adult Reeves' muntjac, most of which were of known age.

## 2. MATERIAL AND METHODS

### 2.1. Animals

The eleven deer were either wild animals ( $n=2$ ) or the descendants ( $n=9$ ), born in captivity, of wild animals. One of the wild deer was an adult male with a well-developed pair of antlers when caught. The other wild deer was just growing its pedicles when caught and its age was estimated at approximately six months. The deer were kept in grass paddocks with some rank vegetation, largely nettles (*Urtica dioica*), as cover. The deer were fed on various root crops, ivy (*Hedera helix*), branches from deciduous trees and shrubs, and flaked maize. Water and a mineral lick were available *ad libitum*. Female muntjac were kept in each paddock and they all bred successfully and repeatedly, which suggests that the deer were not stressed by being kept in captivity. The deer were identified by coloured, plastic sheep tags (Rototag from Dalton Supplies Ltd., Nettlebed, Henley-on-Thames, England) placed in their ears. This was done within a day of birth for animals born in captivity. The deer were readily observed because the paddocks, situated at 52°20'N and 0°30'E, are adjacent to our house. The deer of known age were born in the following months: January, March, June, July, August and October.

The growth and development of pedicles and of the first pair of antlers appear to be related to the season of birth and, because muntjac may be born at any time of the year (Zuckerman, 1953; Chapman & Dansie, 1970), only deer which have grown their first antlers have been considered.

### 2.2. Antler Growth

Frequently the skin was shed rapidly and completely and it was not difficult to decide the date of cleaning of the antlers. On other occasions, however, the

process took longer, up to several weeks after cleaning had started. To record the date of cleaning as the date when the last piece of skin was shed from the antler would be unrealistic and would give a false impression of the length of the growing period. When antler-cleaning was protracted, we determined the date of cleaning in retrospect and have taken it as the time when the antler was obviously hard and had lost most of its skin.

Muntjac start to grow a new pair of antlers before the current ones are cast. Some days before casting occurs, a band of dark tumescent tissue frequently surrounds the base of the old antler. Antler growth continues immediately after the old antler is cast. The period of antler growth has been defined, however, as the time between the dates of antler casting and of antler cleaning. Unlike the date of antler cleaning, the date of antler casting can be recorded precisely. Therefore the length of the complete antler cycle has been calculated from the date of casting to the date of casting in the following year.

### 3. RESULTS

From one to six antler cycles of 11 deer have been recorded (Table 1). Six of the deer were observed for more than one cycle and each cast its antlers annually. Although there is a period of almost two months

Table 1  
Antler casting and cleaning dates for adult Reeves' muntjac.

	Date of casting		Date of cleaning	
	Left	Right	Left	Right
Median	27 May	26 May	14 Sep.	12 Sep.
Range	9 May—25 Jun.	7 May—1 Jul.	17 Aug.—20 Oct.	13 Aug.—20 Oct.
n	23	23	17	17

over which the antlers were cast, the dates for an individual animal were much closer. There was a similar spread in the cleaning period but here there was more individual variation. The dates for six antler cycles of an individual deer are given in Figure 1. Two cycles have been omitted because in these years the antler cycle of this animal was affected by a change in its hormone status. There was no evidence to suggest that these changes affected the antler cycle in the following year.

There was no change in either the length or time of the antler-growing period with increasing age of the deer.

An animal's two antlers were not infrequently cast on the same day in a particular year, although they might be cast up to 12 days apart (Fig. 2). A similar spread was noted in the dates of cleaning of both antlers (Fig. 2).

The mean length of the growing period was 106 days (S.D.=14, range=79–127, n=17) for the left antler and 106 days (S.D.=15, range

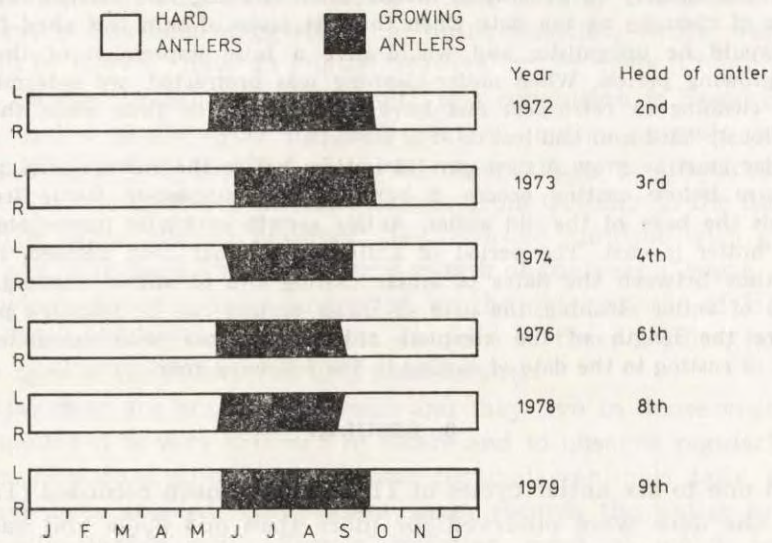


Fig. 1. Six antler cycles of an adult male Reeves' muntjac showing the synchronous dates of casting and of cleaning.

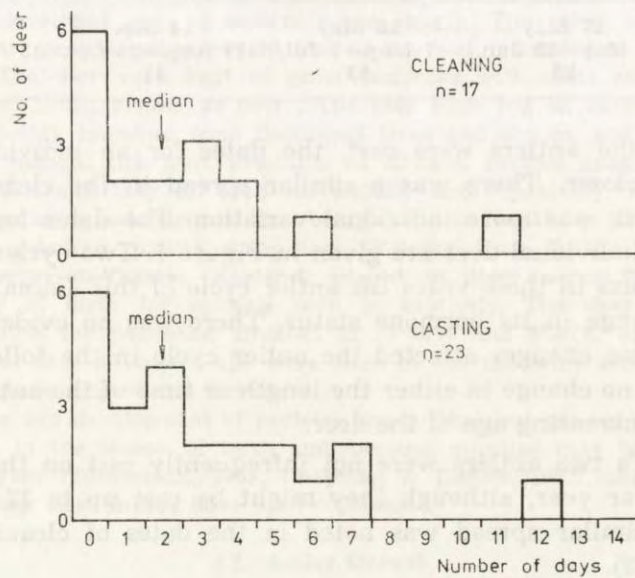


Fig. 2. Number of days between casting or cleaning of left and right antlers of adult male Reeves' muntjac.

81–130,  $n=17$ ) for the right antler. The wide range in the lengths of the growing periods was seen in individual deer, and was not the result of combining values from several animals. For example, a mature buck cast both his antlers on 14 May 1975 and cleaned them on 14 September 1975, a period of 124 days. In 1976, he cast his antlers on 18 and 21 May and cleaned them on 13 and 17 August, giving growing periods of 88 and 89 days for the left and right antlers respectively.

The month of birth did not appear to affect the time of year when the antlers were cast (Table 2).

The mean length of the complete antler cycle for 9 cycles involving five deer was 366 days (S.D. = 10, range = 351–389,  $n=18$ ).

Table 2  
The time of antler casting in relation to the month of birth of Reeves' muntjac.

Month of birth	Antler-casting dates
January	22–24 May
March	7–11 May
June	14–18 May
July	24 Jun.—1 Jul.
August	31 May—12 Jun.
October	16–27 May

#### 4. DISCUSSION

It has been shown that at latitude  $52^{\circ}20'N$  captive, adult Reeves' muntjac exhibit an annual antler cycle which is synchronised to a considerable extent between individual animals: casting occurring in May–June and maturation of the antlers occurring from mid-August to mid-October. The length of the complete cycle is almost exactly one year and this agrees with the 360 and 361 days reported for the cycle of a single pair of antlers of an Indian muntjac, *Muntiacus muntjak* Zimmermann, 1780, kept in Frankfurt zoo (Schmidt, 1866).

The antler cycle is similar to those of species of deer from the northern temperate regions and suggests, as with these deer, that the cycle is related to the season. It has been shown that the antler cycle of sika deer (Goss, 1969a, b) and of red deer (Jaczewski, 1952; 1954) is controlled by changes in day length. It seems likely that the antler cycle of adult muntjac is controlled in a similar manner, at least when kept in the northern temperate regions.

It is of interest to try to correlate the present observations with the conflicting reports about the muntjac's antler cycle which have been recorded in the literature. Our observations agree with Dansie's (1970) claim that the antlers are shed annually and with Chaplin's (1972) sug-

gestion that adult animals have an annual, seasonal cycle. They do not, however, support the latter's contention that "older animals tend to clean and cast their antlers in advance of younger ones" nor do they support Dansie's (1970) view that antler growth is related to the month of birth. Dansie (1973b) records that he has observed muntjac with growing and with hard antlers in every month of the year and this has been confirmed by our own observations (Chapman, unpublished results). As has been shown (Table 1), adult muntjac may be found with hard antlers in every month of the year, but adult animals with growing antlers were observed from May to October only. The animals with growing antlers observed from November to April were immature deer, still growing their first pair of antlers. Dansie (1973 a) did not record the ages of his deer and an explanation for his observations is that they were of a mixture of immature and adult animals.

The Indian muntjac (*Muntiacus muntjak*) is said to cast its antlers annually in May and to grow them by August (Lydekker, 1898). Three Indian muntjac in Berlin Zoo cast their antlers in June and the new ones were cleaned in October and November (Lau, 1968) whereas the antlers of animals in Paris Zoo were cast from the end of May to July and the new ones cleaned from the end of September to November (Dubost, 1971). Therefore both species of muntjac appear to have a similar antler cycle when kept in captivity in northern latitudes.

The length of the antler growth period reported here agrees with the 104 days recorded for a single cycle of a captive muntjac, and for that of a second animal of which only the tips of the antlers were clean after 107 days (Chaplin, 1972). The growth period, for a single, wild muntjac in southern England has been recorded as 87 days (Soper, 1969) but there was no evidence that the same animal was being observed on both occasions. Despite the small size of muntjac antlers, the period of growth is similar to that of the 85—115 days recorded for the much larger fallow deer (Chapman & Chapman, 1975). The range in the length of the fallow deer's antler growing period is due, in part, to the fact that older deer usually cast their antlers before the younger ones but they all clean them about the same time. This means that the length of the antler growing period increases with increasing age and, in general, antler size increases with increasing age. There is much less variation in the antler size of adult Reeves' muntjac with increasing age and this may explain why there was no apparent change in the length of the growing period with increase in age.

The dates of antler casting of fallow deer in England and in New Zealand appear to be more variable than do the dates of cleaning (Riney, 1954; Chapman & Chapman, 1975), which is the opposite to

what occurs with Reeves' muntjac. Most species of deer from the northern temperate regions have an annual rut, which can be defined as a restricted period of hypersexual activity, and the antlers are cleaned in response to a rising concentration of testosterone just beforehand. Testosterone concentrations peak at, or just before, the rut (Short & Mann, 1966; Lincoln, 1971). Reeves' muntjac do not rut in the same way and do not fight with their antlers (Barrette, 1977). Consequently, there may be less need for the maturation of their antlers to be as synchronised as it is in the species of deer that have a social rut.

Reeves' muntjac may be born in any month of the year (Zuckerman, 1953; Chapman & Dansie, 1970), and so the question remains as to the stage of pedicle and antler development at which the immature deer synchronise with the adult cycle, and what factors trigger this change. This aspect of the muntjac antler cycle is being investigated at present.

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D. I. CHAPMAN i Norma G. CHAPMAN

#### NASADZANIE I ZRZUCANIE POROŻA U DOROSŁYCH MUNDŻAKÓW

##### Streszczenie

Badano cykl nasadzania i zrzucania poroża u dorosłych osobników *Muntiacus reevesi* Ogilby, 1839, żyjących na szerokości geograficznej 52°20'N. Zwierzęta o dokładnie znanym wieku, trzymane były w specjalnych zagrodach, w niewoli.

Stwierdzono, że zrzucanie poroża rozpoczyna się u tego gatunku w maju i trwa do czerwca, a wycieranie scypułu ciągnie się od połowy sierpnia do połowy października (Tabela 1, Ryc. 1). Średnia długość nasadzania i zrzucania poroża wynosi 366 dni (351—389). Najczęściej oba narostki zrzucane są równocześnie a nowe równocześnie są wycierane. Jednakże, w niektórych przypadkach różnice w ich zrzucaniu się sięgają 12 dni, a w wycieraniu — 11 dni (Ryc. 2). Średnia długość okresu wzrostu poroża wynosi 106 dni (79—130 dni). Nie stwierdzono różnic związanych z wiekiem badanych zwierząt w terminie nasadzania poroża i okresie jego rozwoju (Tabela 2).