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General biology of sambar deer (*Cervus unicolor*) in captivity

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Abstract Several biological measurements were made on captive sambar deer over 3 years (1989–92). Calving occurred from January to November, with a peak in April/May. Mean calving date was 8 May (SD = 71.3 days; n = 31). Calf mortality at birth was 28% (12/43), with the major causes being adult aggression and inclement weather. Mortality was higher in stag calves (41%) than hind calves (6%). Most adult stags were in velvet antler between January and April (mean = 125 days; SD = 22.6 days), and in hard antler between May and November (mean = 231 days; SD = 40.0 days), during which time rutting behaviour was observed. Mean dates of velvet stripping and hard antler casting were 17 April (SD = 14.9 days) and 7 December (SD = 35.4 days), respectively. These data are compared with similar data for farmed red deer. Sambar deer were found to be highly nervous and temperamental, but became more settled with regular human contact and feeding with maize and hay.

Keywords sambar deer; *Cervus unicolor*; calving pattern; antler cycle

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INTRODUCTION

In spite of a worldwide interest in deer farming, most deer species presently being farmed are of temperate origin (red deer, *Cervus elaphus*; fallow deer, *Dama dama*; wapiti/elk, *Cervus elaphus* subsp.). Australia, New Caledonia, and Mauritius are currently developing systems for the farming of tropical deer. The most extensive studies conducted to date with tropical species have been with rusa deer (*Cervus timorensis*) (van Mourik 1985; Chardonnet 1988) and axis/chital deer (*Axis axis*) (Chapple 1989; Mylrea 1992). There is a lack of biological data on sambar deer (*Cervus unicolor*).

The establishment of a small semi-domesticated sambar herd in New Zealand provided the opportunity to observe both biology and behaviour and record aspects of relevance to deer farming.

MATERIALS AND METHODS

Location

The study was carried out at Flock House Agricultural Centre, Bulls, Manawatu, New Zealand, latitude 40°14′S and longitude 175°16′E. Average annual rainfall is 875 mm with a dry period from January to March, and strong westerly winds during October and November. The mean monthly temperature ranges from 9 to 20°C.

Animals

The biology and behaviour of two groups of semi-domesticated sambar deer were observed from November 1989 to December 1992. The animals comprised 10 hinds and five stags transferred from adjacent Turakina and Rongotea areas, and transported to Flock House during 1989 and 1990, and 13 hinds and three stags imported from Victoria, Australia, in July 1990.

Group A comprised two stags and six hinds from the Rongotea area which were set-stocked on 0.85 ha of pasture, with access to 0.1 ha of open pampas (*Cortaderia* sp.). The remaining animals

(6 stags and 17 hinds) from Turakina and Australia (Group B) were set-stocked on 2.4 ha of pasture, which included 0.1 ha of pine trees (*Pinus radiata*). The pampas and the pine trees functioned as natural shelter, particularly against westerly winds. Pasture composition and availability have been described by Semiadi et al. (1993). Hay and maize supplements were fed as required during winter.

Animals were not handled because of their aggressive and temperamental nature. All mating occurred naturally and hard antlers were never cut. In May 1992, adult and yearling stags from Groups A and B were removed because of fighting problems, leaving one adult stag per group.

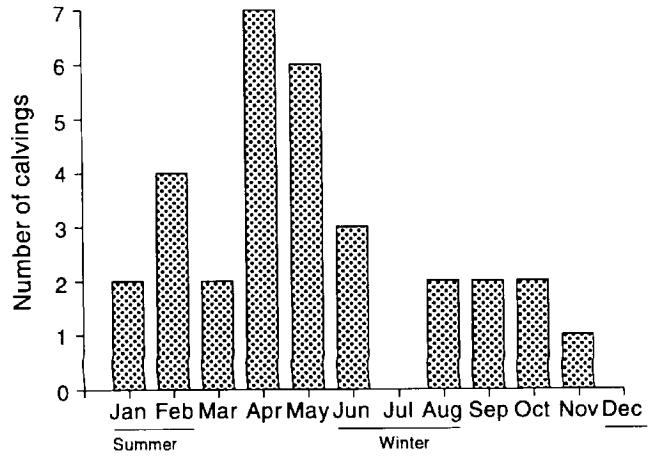

Fig. 1 Monthly calving distribution during 1989–92 of captive sambar deer under New Zealand conditions (winter solstice, 20 June; summer solstice, 20 December).

Observations

Weekly observations of calving in Group A commenced in November 1989, increasing to 3 times weekly in January 1991. As the number of calvings increased, the frequency of observation was increased to a daily basis. Four adult hinds in each group could be identified individually. Twenty-four hours after birth, calves were ear-tagged, weighed, removed from their dams, and hand-reared.

Fresh faecal samples were obtained from both groups on a monthly basis, by collecting 8–12 pellets voided per animal from at least 70% of the total animals. These were examined for lungworm larvae (*Dictyocaulus viviparus*) and gastrointestinal helminth eggs (*Strongylate* sp.) by the Department of Veterinary Pathology, Massey University. A veterinarian undertook post-mortem examinations on dead calves.

Calculation of data

Calving dates and birth weights were tabulated monthly, over 3 years. Calving dates and birth weights for the 1991 season for animals imported from Australia were not included, based on the assumption that the period of quarantine/transport might have altered the normal New Zealand breeding pattern. However, calf sex and cause of mortality of these animals were recorded and are included in the data presented. Date of antler casting, period of velvet antler growth, and the period of time stags were in hard antler were calculated from the antler data. Date of velvet stripping was recorded when one of the antlers showed pronounced velvet stripping. Date of antler casting was recorded as the average of the two sides. Antler length (length of beam) was measured from the base of the coronet to the farthest tip of the beam, and beam circumference was measured from c. 5 cm above the brow tine, using flexible polypropylene tape.

RESULTS

Calving pattern and calving interval

Sambar births occurred almost all year round, except in July and December, with a peak during April and May (Fig. 1). Mean calving date was 8 May (SD = 71.3 days; $n = 31$), with little variation between years. Mean calving interval from the identified hinds was 329 days (SD = 29.7 days; $n = 6$) and in each year all adult hinds gave birth.

Birth weight, sex ratio, and mortality

Birth weights for male and female calves were similar, 8.1 kg (SD = 1.37; $n = 17$) and 7.8 kg (SD = 1.72 kg; $n = 15$), respectively. Pooled data from live and dead calves over 3 years showed that the sex ratio of male to female was 1.6:1.0 ($n = 43$). Mortality of calves within 24 h after birth was 28% ($n = 12/43$), with a high proportion of deaths resulting from exposure (33.3%, $n = 4$) and aggressiveness of adult sambar deer towards the newborn calves (33.3%; $n = 4$), but the level of accuracy for the causes of mortality may not be high because of the low numbers of calves involved. Mortality of male and female calves was 41% ($n = 11$) and 6% ($n = 1$), respectively.

Antler data

Mean hard antler casting date in adult stags was 7 December, some 45 days earlier than young stags (Table 1). Most stags were in velvet antler between January and April, yet young stags spent varying periods in velvet antler (range 102–155 days), depending on when they were born. The net result was that there was a tendency for sambar stags to be synchronised in hard antler between May and November (Table 2). For the sambar stags in this sample, hard antler weight of the adult stags was twice that of young stags (Table 1).

Table 1 Date of hard antler commencement (mean; SD) in captive adult (≥ 3 years of age) and young (< 3 years of age) sambar deer stags, and length of time (days; SD) in velvet antler and hard antler, during 1990–92, under New Zealand conditions (*n* = number of observations).

	Adult	*n*	Young	*n*
Mean date of velvet stripping[1]	17 Apr (14.9)	11	10 Jun (84.6)	4
Mean length of time in hard antler (days)	231 (40.0)	8	205 (107.8)	3
Mean date of antler casting	7 Dec (35.4)	8	21 Jan (45.2)	3
Hard antler[2]:				
Length (cm)	50.8 (6.92)	8	39.5 (4.45)	6
Circumference (cm)	11.9 (1.48)	8	10.1 (1.00)	6
Weight (g)	817 (297.6)	8	402 (79.7)	6
Mean length of time after antler casting to the first sign of velvet stripping (days)[3]	125 (22.6)	8	136 (29.8)	3

[1]Calculated from one side
[2]Individual animals were not identified
[3]Period of velvet antler growth

Table 2 Antler status from identified captive adult (≥ 3 years of age) and young (< 3 years of age) sambar deer in New Zealand between 1990 and 1992.

Stag no.	Year	J	F	M	A	M	J	J	A	S	O	N	D
Adult													
1	1990	V	V	H	H	H	H	H	H	H	H	H	H
	1991	H	H	V	V	V	H	H	H	H	H	H	H
	1992	V	V	V	H	H	H	H	H	H	H	H	V
5	1990		V	V	H	H	H	H	H	H	H	H	V
	1991	V	V	V	H	–[1]							
7	1990		V	V	H	H	H	H	H	H	H	H	H
	1991	V	V	V	V	H	H	H	H	H	H	H	V
	1992	V	V	V	H	H	–[1]						
4	1990												V
	1991	V	V	V	V	H	H	H	H	H	H	H	V
	1992	V	V	V	H	H	H	H	H	H	H	V	V
Young													
37	1991											V	V
	1992	V	V	V	H	H	–[1]						
A	1990					V	V	V	V	S	S	S	S
	1991	V	V	V	H	H	H	H	H	H	H	H	H
	1992	V	V	V	V	H	–[1]						
965	1991	V	V	V	V	V	S	S	S	S	S	S	S
	1992	S	S	S	V	V	–[1]						

V = velvet antler, H = hard antler, S = hard spike;
–[1] = no recording, stag removed from area.

Behaviour

Regardless of origin, all sambar deer in this study were very alert and nervous. Their disquiet was exhibited by stamping of their front hooves with tails erect. They would walk in a step-by-step manner and then run with their heads lowered, later forming several small groups. When frightened, the leader would bark, causing all members of the group to run spasmodically. In a very stressful situation, they would lie down after running. Because of their alert behaviour, sambar deer would notice any slight change within their paddock and they would avoid an area of disturbance for some time. Despite their nervous temperament, it was possible to quieten them through regular daily contact and feeding with maize or hay (0.5 kg/head per day) during winter.

Most active rutting behaviour in sambar stags was observed between late May and early November. Rutting behaviour in sambar stags was marked by wallowing, threshing the ground with antlers, head-rubbing on posts and trees, and urinating on their head and antlers. Rutting sambar stags did not appear to produce strong body odours, as commonly found in red stags, and roaring was never heard during daytime. Daytime observations (0900–1000 or 1500–1600 h) indicated that although the dominant rutting sambar stag collected a harem, the dominant stag displayed a high degree of tolerance toward the presence of other stags in hard antler within the harem. On four occasions the dominant stag was seen chasing a rival stag from the vicinity of the harem. On four other occasions, both dominant and rival stags were observed to be mode-fighting (pushing each other), while the hinds were either grazing or lying nearby. Although there was an impression of harmony between hard antler stags, two deaths were recorded from injuries sustained during fighting. Antler casting apparently did not change the behaviour of a dominant stag in keeping the harem, providing there were still hind(s) in oestrus. A dominant stag was observed chasing a hind, both before and after antler casting. However, dominant stags were not aggressive towards stags in velvet antler.

Health status

Monthly checks over 12 months revealed no lungworm larvae or strongylate eggs in faeces of either group. On one occasion a young hand-reared sambar stag (5 months of age), grazing with young hand-reared red deer (7 months of age), became heavily infested with lung worm. The symptoms were heavy coughing, restlessness, refusal to eat, and loss of body weight (–9.4 kg within 27 days). There were 3350 lungworm larvae and 150 strongylate eggs/g faeces. Treatment involved drenching with Ivermectin (IVOMEC, Merck, Sharp & Dohne, New Zealand) at 1/3 of the full dosage (5 ml; 1000 μg) for 3 consecutive days, and a booster of full dosage (15 ml; 3000 μg) on Day 4. Three deaths caused by malignant catarrhal fever (MCF) were recorded during the 3 years—an adult hind in late winter 1991; a yearling stag in late autumn 1992; and a yearling hind in late winter 1992.

DISCUSSION

Sambar deer demonstrated peak calving in autumn (April–May), with a very large spread (Fig. 1). Peak calving time of wild sambar in Nepal was reported close to the monsoon season (June–July, local time), also with a very large spread (Mishra 1982). This suggests that sambar deer in New Zealand have retained their ancestral calving pattern and, unlike temperate deer, the reproductive pattern of tropical deer is not strongly linked to daylength. Several other studies support this view. Loudon & Curlewis (1988) found chital stags in Great Britain did not respond to melatonin treatment and calved throughout the year. Unmated chital hinds in New South Wales, Australia, had continuous oestrous cycles throughout the year (Mylrea 1991). In New Zealand, calves born during late autumn and winter could face inclement weather conditions and low availability of pasture. This is supported by the high calf mortality observed in the present study, and similar calf mortality has been noted with rusa and chital deer in Australia (Mylrea 1991). This high mortality may be responsible for the relative lack of success of sambar in the Manawatu (Kelton 1981). The greater neonatal mortality of sambar stag calves is surprising and it is interesting that there is a higher ratio of stag to hind calves born. The percentage of calf mortality as a result of adult deer aggressiveness in the present study was similar to the finding in an earlier study of farmed red deer (Kelly & Drew 1977), 33 versus 27% , respectively. It was suggested that lack of shelter and high stocking rate were the main cause of the mortalities in red deer. The wide spread of calving in sambar coupled with the likelihood of adult aggression means that single sire mating of sambar deer should be practised and stags removed before calving.

As the onset of rutting behaviour commenced in May/early June, and assuming the gestation period of sambar deer is 8 months (Schaller 1967; Bentley 1978), onset of calving should have commenced in January. Calving did in fact commence at this time, and continued to November, with a peak in April/May. It would therefore seem that some sambar stags were capable of mating in any month of the year. A study from Nepal (Mishra 1982) indicates that peak mating activity of sambar deer is between October and November (local time), when the sambar stag population is in a transition from a high number of stags in velvet antler (October) to a peak number of stags in hard antler (December). This suggests that mating by sambar stags in velvet antler is likely. Other reports support the finding of tropical stags being fertile at any stage of antler development (Goss 1983; English 1992; G. W. Asher pers. comm.). Mylrea (1991) also noted that chital stags in velvet antler could produce fertile spermatozoa and mount an oestrous hind. Moreover, sambar stag mating behaviour was observed during early velvet antler growth in the present study.

In contrast, red stags are not fertile while in velvet antler (Wilson 1984), and Clutton-Brock & Albon (1989) showed that although wild red stags are in hard antler for more than 7 months, the active breeding season lasted only 1.5 months. This suggests that compared to temperate deer, tropical stags are capable of mating over a much longer period. Continuous oestrous cycles and the ability of tropical stags to produce fertile spermatozoa and to mount hinds at any stage of antler development would explain such a wide spread of calving.

Calving and antler data in adult sambar and red deer are compared in Table 3. Both sambar and red stags appear to carry their velvet and hard antler for similar periods of time, but under New Zealand conditions both antler casting and velvet stripping occurred 10–12 weeks later in sambar than in red stags. There has been historical debate on the length of time that sambar stags in New Zealand carry antlers. However, annual hard antler casting observed in this study supports the observations of Rudd (1978) for wild New Zealand sambar stags, and the findings of Acharjyo (1983) in India that sambar stags lost their antlers each year.

Sambar deer are known as shy and cunning animals (Harris 1966). In their natural environment, sambar live in dense habitat, where natural predators are present at all times (Kitchener 1961; Rice 1986). However, an alert and cautious behaviour has been retained after 130 years in New Zealand in spite of an absence of natural predators, other than humans. Despite their nervous temperament, sambar become quieter under farmed conditions through regular human contact and feeding with maize or hay.

Malignant catarrhal fever was diagnosed as the cause of death in 3 cases and several other authors have indicated that tropical deer may be susceptible

Table 3 Some comparisons of the biology of antler growth and reproduction in captive adult sambar deer and red deer in New Zealand.

	Sambar deer	Author	Red deer	Author
Antler growth				
Mean time of hard antler commencement (SD)	17 Apr (14.9)	Present study	9 Feb (6.1)	Fennessy & Mackintosh (1992)
Mean days in hard antler (SD)	231 (40.0)	Present study	249	Fennessy & Mackintosh (1992)
Mean hard antler casting date (SD)	7 Dec (35.4)	Present study	25 Sep	Muir & Sykes (1988)
Mean days in velvet antler (SD)	125 (22.6)	Present study	120	Fennessy & Suttie (1985)
Reproduction				
Mean calving date (SD)	8 May (71.3)	Present study	8 Dec (12)	Moore et al. (1988)
Gestation period (days)	240	Bentley (1978)	233	Kelly & Moore (1977)
Birth weight (kg)	7.8–8.1	Present study	6.2–9.6	Moore et al. (1988)
Oestrous cycle length (days)	17	English (1988)[1]	18.2	Kelly & Moore (1977)

[1]Australia

to MCF (Soraja et al 1987; G. W. Asher pers. comm.). Although high resistance to internal parasites has been reported in rusa deer (Chardonnet 1988; Woodford 1991), the heavy lungworm burden in a young stag suggests that young sambar deer may be susceptible when exposed to a source of infection. Normal worm burden levels in New Zealand deer farming are 0–72 lungworm larvae/g faeces (Wilson 1985), compared to 3350 lungworm larvae/g faeces in the infected sambar grazing in contact with red deer. Otherwise, no significant health problems were evident with set-stocked sambar deer during the 3 years of the present study where they were not in contact with other deer species.

The pattern of red deer feed requirements (calving in late spring/early summer) generally does not fit with the spring peak of pasture production in New Zealand. Advancing the calving season of red deer through hybridisation with other deer species has been suggested as a means of better matching feed supply with feed demand. Hybridising red deer with Pere David's deer (*Elaphurus davidianus*) or rusa deer has been suggested as a means of advancing the calving season (Tate et al. 1992). Present observations indicate that sambar deer, on average, calve 7 months earlier than red deer in New Zealand and the gestation period is similar for sambar and red deer (Table 3). The production of a fertile hybrid sambar × red deer could thus be valuable to the New Zealand deer industry.

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