New Zealand Journal of Agricultural Research, 2002, Vol. 45: 305–308
0028–8233/02/4504–0305 $7.00/0

Short communication

A putative effect of ambient temperature during the rut on time of calving in young red deer hinds

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Abstract The principle cue entraining circannual environmental rhythms and reproductive function in red deer is photoperiod, but other factors probably play important roles in modifying seasonality. Examination of calving records of untreated, first-calving hinds over a 10-year period revealed year-to-year variation in the mean calving date. Most variation was due to individual hinds, however a significant ($P < 0.05$) influence of the mean minimum temperature during the early rutting period on calving date was apparent with colder temperatures associated with slightly earlier mean calving dates.

Keywords red deer; season; puberty; rut; temperature; calving

INTRODUCTION

In many farm animals, the major environmental determinant of reproductive seasonality is probably photoperiod (see Karsch et al. 1984; Ortavant et al. 1985). However, a number of other variables have at least the potential to modify or interact in the control of seasonality, namely food, temperature, and social interactions (see Haynes & Howles 1981; Bronson 1989). Within red deer, for instance, photoperiod (Webster & Barrell 1985), and social interactions (McComb 1987; Fisher & Fennessy 1990; Fisher et al. 1995) can determine the timing of the onset of puberty and seasonal reproduction.

Another environmental variable is ambient temperature, and its effects on the timing of the onset of the breeding season has been recorded in sheep, cattle, and horses (Dutt & Bush 1955; Dale et al. 1959; Godley et al. 1966; Lees 1971; Robinson & Karsch 1984; Guerin & Wang 1994). While there is apocryphal evidence, indeed a belief commonly held among deer stalkers, that cold nights during the rut result in intense sexual activity in deer (Whitehead 1993), an effect of temperature on red deer reproduction has yet to be documented. In the present study, retrospective analysis of the yearly variation in mean calving dates of young hinds suggests that ambient temperature might also modify seasonal reproduction in farmed deer.

MATERIALS AND METHODS

The calving dates of several groups of hinds at Invermay were collated for 1984–85 and 1990–93. All animals were pasture-farmed yearling (15 to 16-month-old) red deer (*Cervus elaphus scoticus*) hinds, that were mated to adult stags. The animals comprised the control or untreated hinds in experiments designed to monitor the onset of, or induce earlier breeding, and consequently, earlier calving (see Table 1 for treatments applied to the hind herd mates of the control animals).

Stags were placed with the hinds in one to four mating groups or mobs per year (one stag per mob), at varying times each year (see Table 1), but in all years were removed in mid to late May. Live weights of hinds were recorded between 8–18 March each year, and in March (the time of the onset of the rut on Invermay) air temperature data were obtained from Invermay records (within 2 km of the deer farm).

A02009; published 9 December 2002
Received 12 February 2002; accepted 29 July 2002

Table 1 Yearly mean, and range, of calving dates recorded in the control (untreated), first-calving hinds in several experiments at Invermay designed to induce early breeding and consequently calving. No data were available for 1986 and only the range for 1988, while data from 1987 (the hinds were in contact with melatonin-treated stags) and 1989 (a late joining date) were excluded from the analysis. PMSG = Pregnant Mare Serum Gonadotrophin; GnRH = Gonadotrophin Releasing Hormone.

Year	Calving date mean	Range	*n*	Date of joining	Live weight (SEM)	Treatments applied to hind herd mates before breeding season	Reference
1984	13 Dec	7–22 Dec	9	14 Mar	84.2 ± 1.86	Progesterone, PMSG, GnRH	Fisher et al. (1986)
1985	7 Dec	27 Nov–20 Dec	8	13 Mar	79.8 ± 1.94	Progesterone PMSG, GnRH	Fisher et al. (1986)
1987	24 Nov	19–29 Nov	9	13 Feb & 19 Mar	79.0 ± 1.88	Melatonin	Fisher et al. (1988)
1988	–	30 Nov–22 Dec	5	12 Apr	87.6 ± 1.69	Melatonin	Fisher et al. (1990)
1989	17 Dec	4–27 Dec	6	13 Apr	82.2 ± 3.18	Melatonin	Fisher et al. (1992)
1990	6 Dec	28 Nov–13 Dec	8	18 Jan	84.8 ± 1.86	None	Fisher et al. (1995)
1991	10 Dec	27 Nov–20 Dec	8	8 Feb	77.1 ± 2.26	Progesterone, PMSG, melatonin, oestradiol	Fisher & Meikle (1997)
1992	3 Dec	24 Nov–26 Dec	15	25 Mar	88.8 ± 1.83	Père David's hybrids*	M. W. Fisher unpubl. data
1993	5 Dec	19 Nov–20 Dec	40	16 & 22 Mar	88.2 ± 1.04	None, Père David's hybrids*	A. J. Whaanga unpubl. data

*The hinds were run with similar aged 1/4 Père David's × 3/4 red deer hinds.

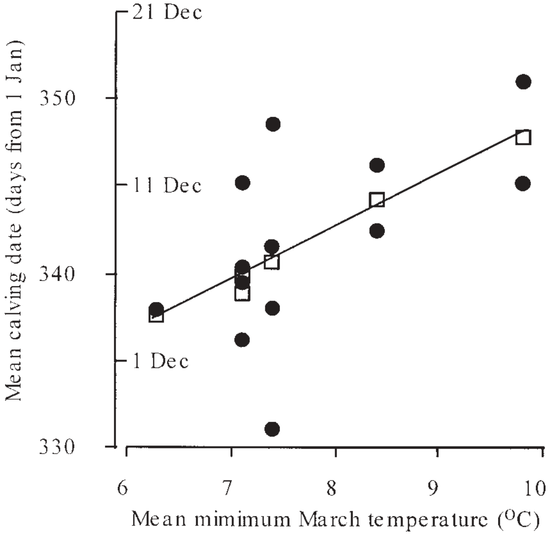

Fig. 1 The effects of the mean minimum temperature during the early rut (March) on calving date in first-calving red deer hinds. The calving data are shown as the mob groups (●), on which the regression line was calculated, and the mean for each year (□).

Weighted (for the number of observations) regression was used to fit a straight line to the relationship between the date of calving and the mean minimum March temperature and mean mob live weight of hinds. Since other variables (hind live weight at joining, date of joining, mean date of calving for each mob, and date of first individual calving hind in each mob) could potentially affect the time of calving, they were also added to the analysis.

RESULTS

Over the period 1984–93 calving in untreated hinds ranged from 19 November to 27 December (mean calving date, 6 December equivalent to a mean date of conception of 18 April). There was a significant ($P < 0.05$) relationship between the mean minimum March temperature (mean 7.7, range 6.3–9.8°C) on calving date (Fig. 1), with colder temperatures being associated with earlier calving. The date of calving (days from 1 January) = 317.49 + 3.10 × temperature (°C). None of the other variables were significant, though the mean date of calving for the mob just failed to attain significance, suggesting a possible influence of the stag independent of ambient temperature.

DISCUSSION

Pubertal red deer hinds on the Invermay farm routinely calve during the month of December, a pattern evident over several seasons in the present study and continuing earlier observations (G. H. Moore unpubl. data). Even though there is some variation between years and locations, early summer calving is apparent in red hinds, whether on farms (Blaxter et al. 1988; Asher & Fisher 1991), in zoos (Fletcher 1974) or in the wild (Clutton-Brock et al. 1982), and is retained on those farms where seasonal nutrient supply would better suit an earlier spring calving. This suggests that the control of seasonality is predetermined, or that the animals favour, or are predisposed to, birth in early summer because of environmental factors other than pasture nutrient supply.

Nevertheless, there is evidence in the present study for minor variation between years, a pattern also noted by Blaxter et al. (1988). The source of this variation is unknown, although undoubtedly a component is due to variation between animals within years. Although in the present study, we were unable to control or standardise variables such as nutritional status, body condition, hind:stag ratios, stag age (although all were adult) and behaviour, and possible interactions (behavioural, pheromonal, auditory, etc.) between treated and untreated hinds, there was clear evidence suggesting that some variation could be related to ambient temperature during the breeding season. The mean time of calving was altered by 3 days for every 1°C change in mean minimum air temperature during March.

Ambient temperature might have this effect via pasture/nutritional conditions, or may merely be an indicator of some other climatic variable. For instance Audige (1995) suggested that sunshine hours and ambient temperature influenced the timing of conception in hinds partly via an influence on pasture clover growth. Ambient temperature might also affect the behaviour of the animals, as the commonly held belief about cold and the rut suggests (Whitehead 1993). The presence of the stag, and even just his roaring, can influence the timing of onset of the breeding season in hinds (McComb 1987; Fisher & Fennessy 1990; Fisher et al. 1995). While there are thus mechanisms by which seasonality/puberty could be influenced by an environmental variable like ambient temperature, further speculation is beyond the information presented here.

ACKNOWLEDGMENTS

The staff of the Invermay deer farm, especially Adam Whaanga, are thanked for their assistance.

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