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A NOTE ON MELATONIN-TREATED RED DEER STAGS ADVANCING THE ONSET OF THE CALVING SEASON IN HINDS

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The effects of treating adult red deer hinds and stags with exogenous melatonin on the calving season in hinds were evaluated in a 2 × 2 factorial experiment. Treated stags were implanted with melatonin monthly beginning in December and hinds post calving in January. Melatonin advanced the timing of rutting behaviour in both treated stags. Calving date was significantly influenced by melatonin treatment of hinds (a mean 10-day advancement; P < 0·01) or stags (12-day advancement; P < 0·001). The interaction of hind and stag treatments was not significant, however treatment of both sexes resulted in the greatest advancement in mean calving date (21 days; P < 0·001). These results indicate that treatment of red deer hinds or stags with exogenous melatonin can result in an earlier calving season and suggest seasonally advanced stags can stimulate earlier breeding activity in hinds.

KEYWORDS: calving season, melatonin, red deer.

Red deer display marked seasonal reproductive cycles with farmed hinds normally calving in late spring and early summer (Kelly and Moore, 1977; Hamilton and Blaxter, 1980). In the wild, stags are reproductively active in advance of, and may play a rôle in the timing of, the breeding season of hinds (Lincoln and Guinness, 1973). Similarly, exposure of farmed red deer hinds to the stag or even stag vocalizations, may advance the time of mating and thus calving (Moore and Cowie, 1986; McComb, 1987).

There is considerable interest in techniques designed to induce an early onset of the breeding season which would enable calving and subsequent lactation with its high nutritional demands to coincide better with food production on improved pastures. One such method has been the administration of exogenous melatonin during summer, designed to mimic the effects of ensuing photoperiodic changes. This hormone, produced by the pineal gland during darkness, enables entrainment of annual photoperiodic and reproductive cycles (Karsch, Bittman, Foster, Goodman, Legan and Robinson, 1984).

Previous studies have utilized both melatonin-treated hinds and stags to advance the breeding and calving seasons but there appear to be no reports investigating the possible interaction of stags and hinds. Therefore, the aim of the present experiment was to assess the importance of treating stags and hinds with melatonin, on the onset of the breeding and subsequent calving seasons. Lactating hinds were chosen for study because, assuming that there is a lag phase of about 2 months from the beginning of treatment to reproductive competence, as in the ewe (Karsch *et al.*, 1984), any treatment of adult hinds would need to be imposed during lactation.

A preliminary report of some of this work has previously been presented (Fisher, Fennessy and Milne, 1988).

Adult red deer (*Cervus elaphus*) stags (no. = 4) and hinds (no. = 36) were utilized in a 2 × 2 factorial study in which the factors were melatonin treatment or no treatment of stags or hinds. At the beginning of the experiment (22 December) the stags were aged 3 or 4 years and the hinds 3 years.

Treated stags received two subcutaneous implants each containing 18 mg melatonin (Regulin®, Regulin Ltd, Melbourne, Australia) on each of three occasions at 30-day intervals (22 December, 21 January and

20 February). As calving in the hinds was concentrated around 10 December it was impractical to administer melatonin at this time, and therefore the hinds each received two subcutaneous melatonin implants on two occasions only (14 January and 12 February).

The two treated and two untreated stags were joined with the hinds in four single-sire mating groups (3 March) such that each mating group comprised four or five control hinds and four or five melatonin-treated hinds. To ensure the two untreated stags were not influenced by the advanced seasonality of the treated stags they were kept on a separate deer farm 24 km away, until required for mating. To aid management, the four mating groups were reduced to 2, 32 days later (6 April) and each group run with either a treated or untreated stag as appropriate. These stags were replaced by the other treated and untreated stags after a further 17 days (at weaning on 23 April) and withdrawn 19 days later (12 May).

General observations of rutting behaviour were made on the mating groups in early March prior to the onset of the normal breeding season. Calving date was monitored by observing all hinds daily.

The effects of melatonin treatment of hinds and stags and the interaction of hinds and stags were examined by analysis of variance and Student's t test. There were no differences in calving date for the replicate groups of hinds running with either treated or untreated stags and therefore the data were combined.

It was observed that melatonin-treated stags tended to roar and herd their hinds more actively than untreated stags following joining. Examination of the calving records indicated all 36 hinds had conceived. However, one hind delivered a very small (2·5 kg) male calf on 27 October, 10 days before the remaining hinds began calving, and this died immediately of abdominal haemorrhaging. As male birth weights average about 9·7 kg at Invermay (Moore, Littlejohn and Cowie, 1988) it was considered that this hind had aborted before term and was subsequently treated as not having calved.

The remaining hinds calved between 8 November and 26 December (corresponding to conception during the period from 21 March to 8 April) and the data are summarized in Table 1. Melatonin treatment of hinds resulted in a significant 10-day advancement in the mean calving date (18 November (s.e. 1·8 days) in the treated *v.* 28 November (s.e. 3·0 days) in the untreated hinds; $P < 0{\cdot}01$). Similarly, melatonin treatment of stags resulted in a significant 12-day advancement. Mean calving dates were 17 November (s.e. 1·6 days) in the hinds running with melatonin-treated stags compared with 29 November (s.e. 3·0 days) in the hinds running with the control stags ($P < 0{\cdot}001$). The interaction of hind and stag treatments was not significant, however melatonin treatment of both hinds and stags resulted in a further significant ($P < 0{\cdot}001$) advancement in the mean calving date (14 November (s.e. 1·5 days).

Exposing red deer to exogenous melatonin during summer advanced the timing of the rut in stags and successful mating and subsequently calving in hinds confirming previous reports in red (e.g. Adam and

TABLE 1
Mean and range of calving dates and number of hinds calving by treatment

Hind		Stag: Control	Stag: Melatonin
Control	Mean calving date	4 December	21 November
	Range	19 Nov. to 26 Dec.	13 Nov. to 2 Dec.
	No. calving	9/9	9/9
Melatonin	Mean calving date	23 November	14 November
	Range	15 Nov. to 6 Dec.	8 Nov. to 22 Nov.
	No. calving	8/9	9/9

Atkinson, 1984; Lincoln, Fraser and Fletcher, 1984; Adam, Moir and Atkinson, 1986; Adam, Moir and Shiach, 1989) and other deer (Bubenik, 1983; Asher, Barrell, Adam and Staples, 1988).

It is possible that the results noted in the present experiment may have been more apparent if the untreated hinds had been kept separately from the treated hinds. There is evidence that control ewes kept with their melatonin-treated flockmates exhibit an earlier onset of the breeding season compared with those isolated from melatonin-treated animals (Kennaway, Dunstan and Staples, 1987). Furthermore, the onset of the breeding season can occur earlier in untreated hinds associating with hinds and stags in which mating has been induced (Moore and Cowie, 1986).

A clear result of the present study was that seasonally advanced (melatonin-treated) stags influenced the onset of the breeding and subsequent calving season in hinds. As similar advances in the mean date of calving were attained by the treatment of either hinds or stags alone, some practical applications of this technique might simply require the treatment of stags alone, although for further advancement both sexes may need exposure to melatonin.

In the wild, the stag appears to be reproductively active in advance of the hind and may promote the onset of oestrus. In turn this may further stimulate the stag resulting in the rut quickly gaining momentum (Lincoln and Guinness, 1973). It has been reported that exposure of farmed red deer hinds to the stag advances the onset of the breeding season (Moore and Cowie, 1986; McComb, 1987). Thus it may be expected that a seasonally advanced stag would be more effective in promoting the onset of the breeding season in hinds. Similarly, seasonally advanced hinds might be more effective in stimulating the stag. In sheep, the male can influence reproductive activity in the female. Legan and Karsch (1983) found that ewes rendered non-photoperiodic by blinding could maintain reproductive seasonality when in the presence of a sighted ram. Similarly, the introduction of a ram to ewes pre-conditioned by a period of isolation from rams, induces synchronized breeding prior to the onset of the breeding season, termed the 'ram effect', (Underwood, Shier and Davenport, 1944; Martin, Oldham, Cognié and Pearce, 1986). The results noted in the present study are not a result of a 'stag effect' comparable with the 'ram effect' as there was little obvious synchrony of calving corresponding to mating 3 to 4 weeks after stag introduction. However, while the hinds were never in close contact with stags prior to joining they were never completely isolated so the possible contribution of a 'stag effect' could not be critically evaluated. Nevertheless, the results indicate that further investigation is warranted, particularly to assess the relative importance of both the presence of the stag on the onset of the breeding season and of the synchronous inductive effects of male introduction on females pre-conditioned by a period of isolation from males. These results also raise the possibility of manipulating the onset of the breeding season in farmed red deer by mimicking or manipulating the complex of social events which may occur in the wild, especially if a proportion of seasonally advanced animals can be utilized.

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