Puberty in red deer hinds: (2) effects of introducing spiker stags in early January

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ABSTRACT

Calving date of yearling red deer hinds is, on average, two weeks later than that of adult hinds, further misaligning feed quality with nutritional requirements. The hypothesis that early joining of spiker stags with yearling red deer hinds would increase pregnancy rate and advance date of conception was studied. Yearling hinds (n = 309) were grazed in one group at least 500 m from any stags from the first week in November until 14 January when hinds were weighed, wapiti scored and randomly allocated to either an early stag joining (ES) or control (C) treatment. ES hinds were grazed as one group with 20 spiker stags and C hinds were kept in paddocks well removed from stags. On 2 March, all hinds were weighed again and 20 spiker stags joined with the C hinds. ES and C groups were grazed separately until being combined in mid-April. The stags were removed on 18 May, and hinds ultrasound pregnancy scanned on 1 June. There were no significant differences ($P > 0.05$) between ES and C treatments in mean wapiti score (1.8 vs 1.8, SED = 0.08), live weight (January: 79.8 vs 79.0 kg, SED = 0.86; March: 86.4 vs 85.8 kg, SED = 0.85), fetal age (48.5 vs 46.8 days, SED = 1.0) or percent hinds pregnant (85.7 vs 88.7 %, SED = 3.5). The probability of hind pregnancy increased significantly with live weight within wapiti score classes and decreased with increasing wapiti score ($P<0.01$), such that, with mean class live weights of 75, 81, 88 and 95 kg, the expected percentage of pregnant hinds was 95, 91, 88 and 73 % for wapiti scores of 1, 2, 3 and 4+, respectively. Fetal age increased by 0.11 (SEM 0.054) day for every 1 kg increase in January live weight ($P < 0.05$), but showed no significant relationship with wapiti score. These data indicate that early joining of spiker stags did not significantly improve the pregnancy rate or advance conception date of yearling red deer hinds.

Keywords: red deer hinds; puberty; early stag joining.

INTRODUCTION

Red deer evolved in high latitude northern hemisphere countries where pasture growth and quality matches the high nutritional demands of early summer calving and lactation. In New Zealand, pasture quality is generally low during summer, often resulting in a misalignment between feed availability and nutitional demand. Furthermore, mean calving date of yearling hinds is about two weeks later than that of adult hinds (Beatson *et al.*, 2000; Scott *et al.*, 2005), exacerbating the situation.

Onset of puberty (cyclic ovarian activity) in red deer hinds is usually attained during the autumn breeding season at about 16 to 17 months of age, provided they have reached a threshold live weight of about 65-70% of their mature body weight (Kelly & Moore, 1977; Hamilton & Blaxter, 1980). In New Zealand, pre-mating live weights of greater than 80 kg are usually attained for yearling hinds. However, despite this, high non-pregnancy rates are not uncommon in yearling deer herds (Beatson *et al.*, 2000). Also, the average mature weight of farmed red deer hinds appears to have increased from ~100 kg to ~130 kg over the last two decades, possibly because of the introgression of wapiti genes into the national deer herd (Asher & Pearse, 2002). Asher *et al.* (2005) have demonstrated that as the proportion of wapiti genes increases within individuals, then so too does the threshold liveweight for puberty to be attained.

Studies have shown that time of puberty can be changed by modifying daily photoperiod (Webster & Barrell, 1985) and strategic administration of melatonin (Webster & Barrell, 1985; Asher 1990). Treating hinds with progesterone in combination with pregnant mare's serum gonadotrophin (PMSG) or gonadotrophin releasing hormone (GnRH) also induced early onset of puberty, but fertility at the induced ovulation was poor (Moore & Cowie, 1986; Fisher *et al.*, 1986). A short-coming of all of these methods of advancing puberty, however, is the high level of intervention required in what the deer industry perceives should be a 'natural' process.

In the wild, the red deer rut, as defined by stag behaviour, begins about a month before hinds come into oestrus and coincides with an increase of a characteristic odour emanating from the hind (Lincoln & Guinness, 1973). The rutting activity (herding and roaring) of the stag then seems to promote oestrus in the hinds, which seems to further stimulate the stags. This results in a synchronised oestrus within the hind herd and most of the hinds being mated at the peak of rutting activity (Lincoln & Guinness, 1973). In the farmed situation, the average date stags are joined with the hind herd is not until mid-March (Audigé *et al,* 1999a), thus denying hinds of the social interaction with stags early in the rut, as may happen in the wild. Moore and Cowie, (1986) exposed adult hinds to vasectomised stags 15 days before entire joining (March 22), which resulted in more calves being born before 20 November, but did not advance significantly the mean calving date. Treating stags with melatonin before joining to adult hinds on 3 March advanced mean calving date, with further advances in mean calving date made when both hinds

and stags were treated (Fisher & Fennessy, 1990). Audigé *et al.* (1999b) reported that yearling hinds had 3.2 times higher odds of conceiving before 1 May when left in the same mob with yearling stags during late summer.

The aim of the present study was to quantify the effects of joining spiker stags with yearling red deer hinds in early January in a herd where a degree of wapiti introgression is known to occur.

MATERIALS AND METHODS

Animals and treatments

This study was conducted on a commercial deer farm at Tuatapere (latitude 46° 07′ S) and approved by the AgResearch Invermay Animal Ethics Committee.

Yearling hinds (n = 309) were grazed on mixed ryegrass/clover pasture at least 500 m removed from any stags from the first week in November. On 14 January the hinds were yarded, wapiti scored and weighed, then randomly allocated to one of two treatment groups. Early stag exposure hinds (ES) were joined by 20 spiker stags (1:8 ratio stags:hinds) on return to pasture, control hinds (C) were returned to pasture well removed from any stags. Both groups were yarded and weighed again on 2 March, with C hinds being joined by a different group of 20 spiker stags on return to pasture. The original group of 20 stags remained with the ES hinds. Treatment groups were managed separately until mid-April when, for ease of management, they were run as one group. The stags were removed on 18 May and the hinds pregnancy scanned on 1 June.

Wapiti scoring

Wapiti score (WS) was assessed on a 5-point ranking previously described by Asher *et al.* (2005). Briefly, a score of 1 represented individuals with no observable physical features indicative of wapiti parentage and 5 represented individuals that exhibited obvious features of wapiti parentage. The scoring was performed by a single observer (J.F.W. who performed all of the wapiti scoring in the previous study). Assessment of wapiti-like features was based on general body height/length relative to herd mates (taller and longer stature for wapiti), size and colour of the rump patch (larger and paler for wapiti), general body pelage colour (paler for wapiti), colour of the neck and face (darker for wapiti) and the appearance of the neck mane (more pronounced for wapiti). The score was not devised to assess the degree (%) of wapiti parentage, only the obviousness of physical features.

Ultrasonography

A single operator using a 5 MHz linear array transducer (Aloka SSD 500; Aloka Co. Ltd., Japan) performed all the rectal ultrasonographic diagnoses for pregnancy assessment and fetal aging. During ultrasonography, hinds were restrained individually in an upright position in a pneumatic crush. A liberal coating of carboxymethylcellulose was applied to the transducer before it was inserted carefully into the rectum until an echo-image of the bladder was observed. The transducer was then gently rotated 90° clockwise and 180° counter-clockwise while being moved forward until the fetus was located. Fetal age was estimated by measuring fetal size according to the method of Revol and Wilson, (1991).

Statistical analyses

Live weight data was analysed by analysis of variance, fitting time of stag introduction, with change in live weight being adjusted for WS. Fetal age and pregnancy status data were analysed using regression techniques (linear and binomial generalized linear, respectively) fitting terms for 14 January live weight and WS.

RESULTS

A number of hinds (40) were removed from the data set because there were duplications in tag number, causing ambiguity. Analyses were, therefore, carried out on 133 ES and 136 C hinds.

Because there were so few (4) hinds in wapiti score class 5, classes 4 and 5 were combined to form a single class (4+). There were no significant differences between treatments in mean wapiti score, live weight in January or March, or live-weight change (Table 1). Time of stag introduction had no significant effect on fetal age or percent of hinds pregnant (Table 1).

TABLE 1: Mean wapiti score (WS), live weights in January and March, live weight gain (adjusted for WS), fetal age (adjusted for live weight and WS) and percent of yearling hinds pregnant (adjusted for live weight and WS) when joined with spiker stags in January (ES) or March (C).

	ES (n = 133)	C (n =136)	SED	Significance
Wapiti score	1.8	1.8	0.08	NS
Live weight – January 14 (kg)	79.8	79.0	0.86	NS
Live weight – March 2 (kg)	86.4	85.8	0.85	NS
Change in live weight (kg)	6.5	6.8	0.38	NS
Fetal age (days)	48.5	46.8	1.0	NS
Percent pregnant	85.7	88.7	3.5	NS

The probability of hinds becoming pregnant increased significantly with live weight within wapiti score classes ($P < 0.01$), and decreased with increasing wapiti score ($P < 0.01$). Thus, at mean class live weights of 75, 81, 88 and 95 kg, the expected percentage of pregnant hinds was 95, 91, 88 and 73 % for wapiti scores of 1, 2, 3 and 4+, respectively.

There was a significant ($P < 0.05$) relationship between fetal age and live weight, such that, for every 1 kg increase in January live weight, fetal age increased by 0.11 (SEM 0.054) day. There was no significant relationship of fetal age with wapiti score.

DISCUSSION

The results indicate that joining spiker stags with yearling hinds in early January does not advance significantly conception date or improve their pregnancy rate. Mean conception date of the C (14 April) and ES (12 April) hinds was similar to the 15 April mean conception date obtained in yearling hinds in a previous study (Scott *et al.*, 2005).

In a farmed situation it is very difficult to isolate completely hinds from all stag stimuli. The C treatment group hinds in the present study were separated from all stags by at least 500 m from early November until 2 March. Although this was a sufficient visual barrier, it is highly unlikely that the hinds were isolated from all olfactory and auditory stimuli. It has been shown that both olfactory (sheep; Knight & Lynch, 1980) and auditory (deer; McComb, 1987) processes alone may be sufficient to advance oestrus in seasonal breeders. However, Fisher *et al.* (1995) considered that, to advance puberty in yearling hinds, the influence of stags alone is not sufficient, and requires the additional presence of seasonally advanced hinds as was the case in a study by Fisher *et al.* (1988). Therefore, even though C hinds may not have been isolated completely from all stag stimuli in the present study, it is unlikely that this had any influence on their conception date.

The rut is characterised by aggressive stag behaviours such as roaring, herding of hinds, and fighting. Although testes and accessory gland development in young stags reaches a peak at 16 months of age, spiker stags show little rutting behaviour (Lincoln, 1971). Adult stags do not normally begin rutting behaviour until about one month before the start of the breeding season (Lincoln & Guiness, 1973). Fisher and Fennessy, (1990) observed that melatonin treated stags roared and herded their hinds more actively following joining on 3 March than untreated stags. This resulted in hinds that were joined with the seasonally advanced stags having a significantly earlier mean calving date when compared to contemporary hinds joined with untreated stags. However, in a study that investigated the influence of social factors on the timing of puberty in red deer hinds (Fisher *et al.*, 1995), ovarian activity and calving date were influenced by early introduction of untreated stags, but no further gains were made by treating the stags with melatonin. A significant advance in onset of ovarian activity and calving date was noted though, when both stags and hinds were melatonin treated. The authors considered that with pubertal hinds being reproductively naïve, they might require the extra social facilitation of reproductively advanced hinds in order to respond to the stag. Taken together, it is perhaps unsurprising then that in the present study, conception date of yearling hinds was not advanced significantly by joining with spiker stags in early January.

Conception date was significantly correlated with live weight, being 0.11 days earlier for every 1 kg increase in live weight. This was somewhat less than the 0.3 days per kg reported by Hamilton and Blaxter (1980) and 0.47 days per kg recorded in our previous study (Scott *et al.*, 2005). Nevertheless, it does indicate that yearling hinds should be selected for high live weight to increase the probability of them conceiving early.

The present study was carried out on a commercial property that was previously used to study the effects of wapiti introgression on puberty in red deer hinds (Asher *et al.*, 2005). A degree of wapiti influence was known to occur on this farm. Data from the present study confirms those of Asher *et al.* (2005), such that, pregnancy rate was positively correlated with live weight within wapiti score class, but decreased with increasing wapiti score. It is important to note then, that in a herd with known wapiti influence, selecting yearling hinds on the basis of attaining a threshold live weight alone may, in fact, have an undesirable impact on pregnancy rate. Conception date, was not influenced by wapiti score.

CONCLUSION

Joining spiker stags with yearling red deer hinds early in January did not advance significantly mean conception date or improve pregnancy rate. Spiker stags do not show intense rutting behaviour and pubertal hinds probably require the extra social facilitation of seasonally advanced stags and hinds to influence timing of puberty.

Yearling red deer hinds should be selected on the basis of live weight to improve the chances of early conception, provided that any wapiti influence is taken into account.

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