Artificial insemination of red deer (*Cervus elaphus*) with frozen–thawed wapiti semen

J. C. Haigh¹ and G. Bowen²

¹Department of Herd Medicine and Theriogenology, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, S7N 0W0; and ²Ambreed NZ Ltd, Box 97, Kaiapoi, New Zealand

Summary. Semen collected from wapiti (*Cervus elaphus*) in Canada in 1983 was frozen in two extenders. In 1988, the semen was used to inseminate 200 red deer hinds on 2 farms in New Zealand. Oestrus was synchronized in the hinds with progesterone-impregnated intravaginal devices (CIDR); 200 iu pregnant mares' serum gonadotrophin was given to each hind on Day 11. The CIDRs were removed on Day 12 at 20/h, as the numbers of the hinds were recorded. On Day 14, 54–56 h after CIDR removal, the hinds were brought into the yards in the same batches and laparoscopically inseminated. Semen from three sires was used. The overall conception rate was 51%. Gestation length ranged from 239 to 247 days. One hind was lost at calving, 3 calves had to be hand raised and there were 2 neonatal calf deaths.

Keywords: *Cervus elaphus*; artificial insemination; red deer; wapiti; North American elk; cross breed; laparoscopic; oestrus synchronization

Introduction

Artificial insemination (AI), which has long been a standard tool in cattle production, is becoming more widely used in the New Zealand deer industry. The first reported use of this technique in red deer came from Poland (Krzywinski & Jaczewski, 1978). Several subsequent reports involve not only intraspecies insemination, but also the use of semen of different strains of red deer and of hybridization (Dott & Utsi, 1973; Qin & Liang, 1983; Haigh et al., 1984; Asher et al., 1988a, b; Fennessy & Mackintosh 1988; Mulley et al., 1988; Pearse, 1988; Jacobson, 1989; Magyar et al., 1989). We report the results of oestrus synchronization and laparoscopic insemination with wapiti semen of 200 commercially farmed red deer (*Cervus elaphus*) hinds of different ages on 2 farms. AI using wapiti semen was carried out for commercial purposes in order to produce F₁ progeny that would grow more rapidly and attain larger body sizes than would pure red deer (Suttie, 1987; Pearse, 1988; Drew, 1989).

Materials and Methods

Wapiti (*Cervus elaphus*) semen collected by electroejaculation in Canada in 1983 was frozen in 0.5-ml straws in a 2% milk-based extender or an egg-yolk citrate extender by the methods of Haigh et al. (1986). Evaluation was carried out within a few days of freezing and again 2 years later by J. Haigh in New Zealand using previously described criteria (Haigh, 1985; Haigh et al., 1986). No changes in percentage motility, rate of progression or percentage intact acrosomes (PIA) were noted.

On 22 and 23 March 1988, 2 groups of red deer hinds (215 total) were synchronized using a regimen of 12 days of intravaginal, controlled, internal, drug-release devices (9% CIDR-G: AHI plastic moulding Co., Hamilton, New Zealand) containing 300 mg progesterone. An intramuscular injection of 200 iu pregnant mares' serum gonadotrophin (PMSG) was given on Day 11. The sponges were inserted and removed while the animals were restrained in a
standard deer handling chute. CIDRs were withdrawn at 20 h, the numbers of the hinds being recorded. On Day 14, the hinds were again brought into the yards. Each group of 20 hinds was brought into the shed sequentially and processed for insemination.

Anaesthesia was induced with a mixture of the commercial immobilizing agents xylazine hydrochloride (Rompun: Bayer NZ Ltd, Wellington, New Zealand) and a mixture of 10 mg fentanyl citrate/ml and 80 mg azaperone/ml (Fentaz: Smith Kline and French NZ Ltd, Auckland, New Zealand); 450 mg Rompun was mixed with 1 ml Fentaz; 1·6 ml of the mixture (72 mg Rompun, 1·6 mg Fentanyl and 12 mg Azaperone) was injected i.m. into each hind a few minutes before it was inseminated. A small unrecorded number of hinds required an additional intravenous dose of Rompun (12·5–25 mg).

Hinds were suspended by their hind legs in a cradle attached to an overhead rail. A presurgical clip and scrub was carried out in midline just anterior to the udder.

Six batches of semen from 3 stags were used. Semen was thawed in a standard straw thaw unit at 35°C for a minimum of 30 s before transferring into 0·25-ml straws.

All inseminations were carried out by the same individual (G. Bowen), laproscopically, using a modified 0·25-ml pistolette (IMV Cassou Goat) with a custom-designed trocar and cannula. Semen was inserted into each horn ~4 cm from the bifurcation, using half the total dose/horn. Ovaries were not inspected unless they could be seen without disturbing the reproductive tract. Uterine colour and tone were evaluated before insemination. No insemination was carried out if the uterus appeared flaccid and pale.

After insemination, hinds were moved along the overhead rail to a new compartment in the building and treated with an intravenous dose of 10 mg Yohimbine hydrochloride (Recervyl: Aspiring Veterinary Services Ltd, Wanaka, New Zealand).

Hinds were turned out with red deer stags 12 days after insemination. On the farm where 120 hinds were inseminated, ultrasound examination for pregnancy was carried out 42 days after AI. Hinds deemed pregnant to AI were drafted and managed in a separate mob from the remainder. On the other farm, no pregnancy determination was carried out. Calving dates were recorded and gestation lengths calculated. On the second farm, the owners determined successful AI on the basis of calving dates and phenotype at weaning. Regression analyses of percentage hinds calving to AI were calculated for data on semen quality after thawing. These included percentage of motile spermatozoa at thawing and after 2 h, as well as PIA at the same times.

**Results**

Ten hinds lost their CIDRs during the synchronization period. Five hinds were not inseminated because of the pale flaccid appearance of the uterus; 200 hinds were inseminated, 120 on one farm and 80 on the other.

On the first farm, 64 hinds calved to AI (53%); on the other farm, 38 hinds calved to AI (47·5%). Overall, 102 of 200 (51%) of inseminated hinds delivered crossbred calves after a gestation of 239 to 247 days. Calving to natural matings that occurred on the first oestrus after synchronization started 262 days after AI, peaked at 266 days and ceased at 270 days.

The numbers of calvings to chaser stags were recorded. On the two farms 40 and 30 hinds, respectively, calved to the next oestrus after synchronization, and 14 and 7 to the subsequent one. Seven hinds failed to conceive during the breeding season (3·5%).

Only one hind was lost at calving. On the first farm, there were 2 neonatal calf deaths; on the other, 3 calves had to be hand-raised.

Regression analyses showed no significant statistical correlations between any characteristics of thawed semen quality and calving percentages (Table 1).

**Discussion**

The use of CIDRs as a source of progesterone, with or without the additional use of PMSG, for oestrus synchronization has become standard in New Zealand for both red and fallow deer (*Dama dama*) controlled breeding programmes (Asher & Smith, 1987; Asher et al., 1988a; Fennessy & Mackintosh, 1988; Fennessy et al., 1989). Other methods involving either double prostaglandin treatments or progestagen sponges combined with prostaglandins have been described (Haigh 1984; Haigh et al., 1984; Glover, 1985; Haigh et al., 1988). Fallow deer appear to respond to synchronization much more predictably then red deer (Asher & Smith, 1987).
Insemination 54–56 h after CIDR removal in this trial was chosen on the basis of published reports and personal experience. It is likely that a proportion of hinds did not come into oestrus during the study and that the combination of anaesthesia and handling stress may have suppressed ovulation in some hinds (Packman & Rothchild, 1976; Pang et al., 1977; Echternkamp & Hruska, 1984).

Intravaginal and intracervical inseminations of red deer have been carried out with varying success (Krzywnski & Jaczewski, 1978; Fennessy & Mackintosh, 1988; Bowen, 1989). Red deer hinds are too small to permit insemination techniques involving rectal palpation. The chances of intrauterine insemination via the vagina are therefore limited. Records of the cervical insemination of red deer hinds, using a speculum, indicate that in <25% of hinds can semen be deposited into the uterus, rather than somewhere along the length of the cervix (Bowen, 1989). On the other hand, intrauterine insemination of wapiti females has been reported using standard bovine AI equipment (Haigh et al., 1984).

High conception rates in white-tailed deer (*Odocoileus virginianus*) have been achieved with the use of semen doses in the range of 34 million to 200 million cells deposited at the os cervix (Haigh, 1984; Jacobson et al., 1989). In a trial involving AI in red deer hinds with semen of either Père David’s deer (*Elaphurus davidianus*) or pure red deer, Asher et al. (1988b) used between 18 million and 40 million live cells to achieve conceptions ranging from 5% for the hybrids to 83% (5 of 6) for the pure breds. In studies of AI in fallow deer, Asher (1988) used ~85 million cells to inseminate into the anterior vagina with either fresh or frozen semen. Conceptions were ~50% with either type of semen. He also tried laparoscopic insemination with about the same number of cells and achieved slightly lower conceptions (Asher, 1988). Artificial insemination trials have also been conducted in China for intra- and interspecific insemination (Qin & Liang, 1983; Lü et al., 1984). Glass ampoules have been used and, in one report, 9 of 25 inseminated red deer delivered calves after AI (Lü et al., 1984).

There are several other reports of artificial insemination of red deer. The first of these, in which 3 of 12 hinds conceived to frozen–thawed semen was by Krzywnski & Jaczewski (1978). In New Zealand, 49% of hinds conceived after a double intravaginal/intracervical insemination following CIDR treatment with PMSG at CIDR withdrawal, while 52% conceived after a single insemination 54 h after CIDR withdrawal. In both cases, an estimated 25 million sperm were inseminated (Fennessy et al., 1987). Using similar semen doses the following year, Fennessy & Mackintosh (1988) tested the effects of double or single CIDR regimens using double inseminations, and the effect of single inseminations at different times. The best results were a 60% conception after double CIDR use and double inseminations at 44 and 68 h after PMSG. Although conceptions as high as 75% have been seen in small trials of AI in red deer after intracervical insemination, analysis of larger trials showed that, overall, conception did not exceed 40% (Bowen, 1989). From these studies it was felt that, for commercial purposes, a single, timed, laparoscopic, intrauterine insemination was the best approach (Bowen 1989).

Table 1. Data on wapiti semen collected, frozen and evaluated in Canada in 1983 and used to inseminate red deer in New Zealand in 1988 as indicated; number of calves born and percentage conceptions are shown

<table>
<thead>
<tr>
<th>Stag/Batch</th>
<th>% Motile sperm After 2 h at 37°C</th>
<th>% Intact acrosomes After 2 h at 37°C</th>
<th>No. of live cells inseminated (× 10^-6)</th>
<th>No. calved/no. bred</th>
<th>% Conception</th>
</tr>
</thead>
<tbody>
<tr>
<td>76/130</td>
<td>45</td>
<td>58</td>
<td>9.0</td>
<td>20/42</td>
<td>47.6</td>
</tr>
<tr>
<td>76/111</td>
<td>43</td>
<td>63</td>
<td>18.0</td>
<td>19/36</td>
<td>52.8</td>
</tr>
<tr>
<td>80/127</td>
<td>33</td>
<td>57</td>
<td>10.8</td>
<td>9/24</td>
<td>37.5</td>
</tr>
<tr>
<td>4/141</td>
<td>73</td>
<td>75</td>
<td>11.7</td>
<td>33/58</td>
<td>56.9</td>
</tr>
<tr>
<td>4/22</td>
<td>32</td>
<td>50</td>
<td>8.0</td>
<td>6/18</td>
<td>33.3</td>
</tr>
<tr>
<td>4/126</td>
<td>38</td>
<td>65</td>
<td>14.0</td>
<td>15/22</td>
<td>68.2</td>
</tr>
</tbody>
</table>

Artificial insemination of red deer
The semen dose in the study reported here is substantially lower than most of those previously reported and yet the results are similar. There was no statistical correlation between pregnancy rates and any particular criterion by which the thawed ejaculates were evaluated. The lack of statistical significance may have been due to inadequate data. The two lowest conception rates occurred after insemination with 8 million and 10.8 million cells, which were the two batches with the fewest sperm (Table 1). The numbers did not approach those usually considered in analysis of AI programmes in the dairy industry. Until more data are available, it is not possible to make specific recommendations.

In only one of the 2 herds was pregnancy diagnosis carried out. This was done by ultrasonography 42 days after AI; this method has proved accurate in red deer and has been reported to allow prediction of calving to within 1 day of actual dates (Bingham et al., 1988; Revol & Wilson, 1989). This information allowed the farmer to segregate the group that were carrying crossbred calves and to manage them accordingly for the prevention of dystocia.

In the other herd, differentiation of AI crossbreds and pure red deer conceived at a later date was based upon size differences evident throughout the first 90 days of life and at weaning. The gestation period recorded was, as expected, roughly midway between that of red deer and wapiti. Artificially inseminated red deer hinds have been reported to calve from 231 to 235 days after conception (Krzywinski & Jaczewski, 1978). On the other hand, the gestation of wapiti is reported as 255 ± 7 days (Sadlier, 1982). Although the interoestrous period is reported to be ~18 days in red deer (Kelly et al., 1985), a hind that failed to conceive to the synchronized oestrus could have returned to oestrus shortly after the introduction of a chaser stag and delivered a purebred red deer in 231 days, which would correspond to a 244-day gestation of a crossbred calf. The evident disparity in calf size, and especially in growth rate, over the first 3 months of life (Pearse, 1988; Suttie, 1987; Drew, 1989) would provide confirmation that the juvenile was indeed a wapiti × red deer, rather than a pure red deer.

The AI programme probably had some effect upon the overall breeding management on the farms concerned. In well-managed operations, it is possible to achieve almost 100% conception after first natural matings. Under New Zealand conditions, this might occur in late March. It is evident that the AI programme, involving an abnormal amount of deer handling, as well as potentially stressful anaesthesia, did not markedly affect the overall conception rates on the farms, although conception rates to the first (artificial) breeding were lower than in natural mating systems involving wapiti × red deer crosses on well-managed properties (Bringnans, 1986). Overall, 96.5% of the hinds delivered calves the following summer. Of these, 46% were delayed by 3–6 weeks. Since delayed fawning can have negative effects on calf growth rates and weaning weights this could have negative management implications (Hamilton, 1987). On the other hand, the greater weights of the crossbred calves could be considered to be of benefit and the 96.5% overall delivery is at least equal to, and perhaps better than, some published reports for natural mating on deer farms during an 8-week breeding season (Moore, 1985).

The authors gratefully acknowledge the financial assistance of the Saskatchewan Department of Agriculture during the semen collection period, and N. Beatson for assistance with the AI trial design.

References


Asher, G.W., Adam, J.L., Otway, W., Bowmar, P., van Reenan, G., MacIntosh, C.G. & Dratch, P. (1988b) Hybridization of Père David’s deer (Elaphurus
Artificial insemination of red deer

davidianus) and red deer (Cervus elaphus) by artificial insemination. J. Zool., Lond. 215, 197–203.


Received 20 August 1990