Animal Reproduction Science 193 (2018) 140–152

Contents lists available at ScienceDirect

Animal Reproduction Science

journal homepage: www.elsevier.com/locate/anireprosci

Pregnancy and mid-term abortion rates in farmed red deer in New Zealand

Kandarp Khodidas Patel[a,*], Laryssa Howe[a], Cord Heuer[b], Geoffery William Asher[c], Peter Raymond Wilson[a]

[a] School of Veterinary Science, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand
[b] EpiCentre, School of Veterinary Science, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand
[c] AgResearch, Invermay Agricultural Centre, Private Bag 50034, Mosgiel 9053, New Zealand

ARTICLE INFO

Keywords:
Red deer
Pregnancy
Abortion
Ultrasonography scanning

ABSTRACT

This paper describes pregnancy and mid-term abortion rate data from an investigation of sub-optimal reproductive performance in New Zealand farmed red deer. For 2 years, 87 yearling (YL) and 71 mixed-age adult (MA) herds from 85 farms were observed with 15 YL and seven MA herds observed both years. Hinds were pregnancy diagnosed using ultrasonography in the late autumn-early winter (PD1) and again late winter-early spring (PD2) and mid-term daily abortion rates (DAR) were calculated. Overall, 85.8% of 22,130YL (range, 7.0%–100% between herds) and 93.3% of 36,223 MA hinds (range, 39.8%-100% between herds) were pregnant at PD1. The mean interval between ultrasonic assessments was 90 and 87 days in YL and MA herds, respectively. Mid-term abortions occurred in 305 (2.8%) hinds from 60 (73%) YL herds and 92 (1.2%) hinds from 36 (61%) MA herds. The mean mid-term DAR, was greater ($P = 0.009$) in YL (mean 0.043%, range 0.005%–0.213%, 95% CI = 0.034–0.053) than MA herds (mean 0.025%, range 0.007%-0.101%, 95% CI = 0.018-0.032). In herds with hinds that aborted, the mean DAR was greater in small than large YL herds (0.055% compared with 0.033%, $P = 0.023$), but not MA herds. At PD1, 46 YL and 12 MA hinds had ultrasonographic evidence of abortions from 22 herds. This, combined with the 1.2% to 7.1% foetal loss in three herds pregnancy diagnosed earlier than the usual PD1 date as a pilot to test for earlier abortion, supports that abortion can occur prior to normal pregnancy assessment dates, contributing to sub-optimal pregnancy rates. Abortion rates were not consistent within herd between years for either YL or MA herds. Thus, early and mid-term abortion is prevalent in New Zealand farmed deer constituting a significant production cost, warranting further investigation into causation.

1. Introduction

Reproductive efficiency of farmed red, wapiti and red x wapiti crossbred deer in New Zealand is limited by hinds generally bearing singleton offspring, hence the reproduction efficiency gains reaped by the sheep industry in New Zealand through fecundity genetics are unavailable to deer farmers. Benchmarking studies conducted in the lower North Island (Audigé et al., 1999a),

Abbreviations: DAR, daily abortion rate; GEE, generalised estimating equations; MA, mixed-age, 2 years of age and older; Pd, pregnancy diagnosis using ultrasound scanning; PD1, first pregnancy diagnosis, early in gestation; PD2, second pregnancy diagnosis, later in gestation, approximately at the end of the second trimester; SEM, standard error of mean; YL, primiparous hinds mated at 15 months and calving at 2 years of age

* Corresponding author at: School of Animal and Veterinary Sciences, Faculty of Sciences, The University of Adelaide, Roseworthy, SA 5371, Australia.
E-mail address: kandarp.patel@adelaide.edu.au (K.K. Patel).

https://doi.org/10.1016/j.anireprosci.2018.04.062
Received 17 February 2018; Received in revised form 25 March 2018; Accepted 9 April 2018
Available online 12 April 2018
0378-4320/

Canterbury (Campbell et al., 2000), Hawke's Bay (Walker et al., 2000), Southland (Lawrence, 2003) regions and Invermay AgResearch (Fennessy et al., 1986), indicate there is biological potential for a greater reproductive efficiency than currently achieved on most deer farms. Poor reproductive efficiency remains one of the most common concerns expressed by deer farmers in New Zealand (Asher and Pearse, 2002; Asher, 2003; Asher and Wilson, 2011).

Sub-optimal weaning rates (calves weaned/hinds joined with stag/s) constitutes a significant reproductive wastage cost to the New Zealand deer industry (Asher, 2003; Asher and Wilson, 2011). The greatest reproductive inefficiency occurs in primiparous hinds, an age at which the greatest negative financial impact occurs through reducing the mean reproductive longevity of hinds. Failure to conceive and loss of calves from birth to weaning have been conventionally regarded as the main factors contributing to sub-optimal reproductive efficiency in both age groups, and much research on reproductive wastage in deer has investigated management factors aimed at optimising performance in those areas (Audigé et al., 1999b,c; Asher et al., 2005a,b, 2011; Asher and Cox, 2013).

By contrast, embryo and foetal loss have historically been regarded as insignificant. This is likely because they are difficult to detect grossly and as hinds are rarely, if ever, checked for foetal loss by repeated pregnancy diagnosis. There, however, have been some attempts at characterising the extent of foetal loss. Fennessy et al. (1986) reported 2.6% abortion in yearling (YL) hinds on a research deer farm, and Campbell et al. (2000) reported an average rate of 1% on 15 mixed-age (MA) deer herds in Canterbury. In a study by Audigé et al. (1999a), foetal loss averaged 0.6% in YL and 0.8% in MA hinds in eight intensively monitored herds in the lower North Island. Data, however, are limited and based on crude measures such as abdominal and udder palpation late in gestation or post-calving, rather than repeated ultrasonic assessments. One overseas report described a foetal mortality of two of seven YL hinds and four of 39 MA hinds on a research farm in Spain (Gomez-Nieto et al., 2011).

A recent clinical investigation that involved repeat pregnancy diagnosis on four large deer farms in New Zealand identified that 1.7%, 7%, 10% and 16% of hinds in four YL herds and 4% of hinds in one MA herd had aborted in mid-pregnancy (Wilson et al., 2012). Similar foetal loss has been observed in cattle and sheep and can be due to various agents, such as *Toxoplasma gondii* in sheep (Hartley et al., 1954; Hartley and Marshall, 1957) and *Neospora caninum* in cattle (Thornton et al., 1991, 1994). The abortions reported by Wilson et al. (2012) suggested that foetal wastage may be occurring on New Zealand deer farms at higher rates than previously believed.

Thus, the aim of this study was to describe pregnancy rate and establish prevalence and incidence rates of abortion in New Zealand farmed red deer. Data include mating management, animal-level and within-herd pregnancy rates, mid-term abortion rates, consistency of abortions within farm between years, and observations on the timing of abortions, from YL and MA deer from 85 deer farms throughout New Zealand for a 2 year period.

2. Materials and methods

This longitudinal observational study was undertaken over two consecutive reproductive cycles, 2012–14, on commercial deer farms throughout New Zealand.

2.1. Herd selection

Commercial deer farmers throughout New Zealand were invited to take part in the study through deer and mixed practice veterinarians, commercial pregnancy diagnosis businesses, or by direct contact by the researchers. Based on initial responses, farms were selected considering suitable handling facilities, willingness to participate, and fulfilment of the requirements of the project for additional pregnancy diagnoses and collection of blood, specimen and data. According to a power analysis, with an absolute precision of 10%, 96 herds from each age group were required to determine abortion, assuming that 50% of herds had at least one case of abortion, with 95% confidence (Cannon and Roe, 1982).

2.2. Animals

The term 'yearling' refers to primiparous hinds mated at 15 months and calving at 2 years of age, while the term 'mixed-age' refers to hinds mated at 2 years of age or older. This study involved red deer (*Cervus elaphus* subsp. *scoticus* and *hippelaphus*) genotypes from both YL and MA age groups although it is acknowledged that some deer may have possessed some wapiti (*Cervus elaphus nelson, roosevelti, manitobensis)* genes. Deer which phenotypically resembled crossbreds (e.g. F1 hybrids) or wapiti were excluded from the study. All manipulations with deer were approved by the Massey University Animal Ethics Committee (Protocol number = 12/34).

2.3. Pregnancy diagnosis

For determination of herd-level prevalence and within-herd incidence of abortion, there were two pregnancy diagnoses (PD), using ultrasonic assessments, for each age-class on each farm in both years. Pregnancy diagnoses were performed by experienced veterinarians or private lay-operators, and by the primary author (KP) in a small number of herds. At the first PD episode (PD1), which was timed according to the farmer's usual practice, all hinds in each herd were diagnosed using a rectal ultrasonic linear probe as described by (Revol and Wilson, 1991). The second pregnancy diagnosis (PD2), largely using the flank method, was timed to approximate the end of the second trimester or later, as determined by the farmer. A subsample of 100 YL and 155 MA hinds from herds greater than those numbers were diagnosed at PD2, in accordance with power analysis to detect abortions of 2% and 1%,