Reproductive wastage from farmed deer: data, theories and risk analysis

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Abstract

Reproductive outcomes on New Zealand commercial deer farms are now well understood, based on data from several research and extension projects over the past decade. Failure to conceive, as determined by rectal ultrasound scanning, averages 5% (range 0-27% between farms) and 18% (range 0-67% between farms) for adult and yearling hinds, respectively. Foetal loss rates between scanning and calving ranged 0-2.5%. Losses from birth to weaning average 7% (range 0-15% between farms) and 12% (range 0-33% between farms) of calves born from adult and yearling hinds, respectively. The dystocia rate averages about 1% (range 0-3.6% between farms). Risk factors for increased dystocia rate include body condition score (BCS) ³4, flat topography and increase in weight during pregnancy. There is an interaction between BCS and topography. About half of progeny losses from birth to weaning are undetected and yet others remain undiagnosed. While the cause of many losses remains undetermined, rejection and mis-mothering, fence type, disturbance, hind age, previous reproductive performance, climate and environmental features are risk factors that contribute to losses.

Introduction

Reproductive outcomes have a significant influence on profitability of deer breeding herds with examples of up to 46% increase as a result of improving conception rate and date alone (Wilson et al 2000). Greater returns could be achieved by concurrent improvement of calf survival. It was previously believed that foetal losses were the major cause of poor weaning percentages, but data from ultrasound scanning, combined with determination of carriage of foetus to term, has confirmed that losses from calving to weaning are the most important (Audigé et al 2000, Deer Industry Manual 2001, Asher 2002). Dystocia occurs in about 1% of hinds on average, but individual herds have ranges of up to 10% (Audigé et al 2001a). Death of progeny at birth, or from birth to weaning, averages about 7% and 12% of calves born from adult and yearling hinds, respectively. Figure 1 summarises data on sources of loss during the reproductive cycle from several studies (Audigé et al 1999a; The Richmond Wrightson Deer Performance Project (Walker et al 1999) and The Deer Master Project (Campbell 1998)).

Figure 1: Average (range between farms) numbers of adult and yearling hinds achieving each reproductive outcome for each 100 hinds joined with the stag. (Data summarised from Deer Industry Manual and Wilson et al 2002)

	Yearling	Adult
Hinds to stag	**100**	**100**
	↓ 15-18% loss	↓ 3-7% loss
Scanned pregnant	**82** (33-100)	**95** (73-100)
	↓ 0-1% loss	↓ 0-2.5% loss
Carried to term	**81** (80-82)	**94** (92.5-95)
	↓ 0-33% loss	↓ 4-15% loss
Weaned	**71** (11-92	**87** (68-94

This paper discusses practical means of measuring reproductive outcomes and presents current data on losses and their possible causes. It discusses potential management practices for reducing wastage. This presentation focuses principally on losses at calving and between calving and weaning since losses associated with conception and early pregnancy have been extensively reviewed elsewhere (Beatson et al 2000; Asher and Pearse 2000; Deer Industry Manual 2001; Asher and Pearse 2002; Wilson et al 2002).

Measuring Reproductive Outcomes

It is essential that measures are clearly defined, particularly when used for comparison between farms, between years within farms or for industry planning purposes. Measures should also be easily and economically recorded or calculated. For example, it is usually impractical to physically observe neonatal and post-natal losses on commercial deer farms, so an estimate could be achieved by recording retention of pregnancy at term against calves surviving to weaning (Wilson and Audigé 1998). Sequential recording of outcomes such as pregnancy rate, conception date, number of foetuses carried to term, perinatal and postnatal mortalities and weaning rates throughout the annual reproductive cycle allows a detailed analysis of reproductive performance and identification of where significant losses may be occurring on an individual farm (Wilson et al 2002). The potential ratios and data useful for recording reproductive outcomes are presented in Table 1.

Table 1: Reproductive events and outcomes, and potential ratios and calculated outcomes used to define reproductive performance.

Event	Breeding	Scanning	Calving	Lactation	Weaning
Recording	No Joined (J) No Mated (M)	No. Scanned pregnant (SP)	No Calving (C) No. Dystocias (D)	No. Live Calves Born (LC)	No. Calves Weaned (W)
Ratios	M/J	SP/M, SP/J	C/J, C/M, C/SP, D/SP	LC/M, LC/J, LC/SP, LC/C	W/J, W/M, W/SP. W/C, W/LC

Further data can be calculated such as foetal loss = C – SP, and dead calves born = C – LC.

Breeding

The number joined is those hinds put to the breeding stag, whereas the number mated is those actually coming into oestrus and being inseminated by the stag. The ratio M/J is effectively the submission rate. For practical purposes it is difficult to achieve data for the number mated. However, there may be circumstances where the number mated may be low, for example if estrogenic effects of clovers or fungal toxicity caused by zearalenone are evident.

Scanning

Scanning is a surrogate measure of conception rate if performed early after mating. If SP/M is low this could indicate either stag or hind infertility or early embryonic loss.

Calving

Direct recording the number of hinds that actually calved is difficult because it requires physical observation which is often not practical. However, there are a number of alternative methods for estimating the number of hinds that actually calved:

Immediately pre-calving

Many deer farmers split hinds into calving groups at the end of October or beginning of November. At that time the following measurements can be made:

- Udder palpation/observation. Most hinds will be ‘springing’ but late or primiparous hinds may not be springing at this time.
- Ballotting. It is not difficult to place the arms around the abdomen of a hind and ballot for the foetus. If an udder is not observed balloting may detect a foetus, if both are negative the animal should be suspect as not carrying a calf to term. This can be checked by lactational status at weaning, but also by:
- Scanning either rectally or via the flank should detect a foetus.

- Other. Progesterone measurements may be used. Some farmers believe they can distinguish which hinds are to calve by abdominal conformation changes.

Post-calving

Lactational status. As soon as possible after calving is completed examination of udder conformation should enable differentiation of calving status. Hinds which did not calve will have virtually no udder development (dry/dry): those with some udder development are those which began to lactate but did not rear a calf (wet/dry): those with full udders which reared a calf (wet).

Note: the estimate of the number of hinds calving is the most critical component in enabling differentiation between gestational and peri- and postnatal losses.

Dystocia

It is difficult to get accurate data on the dystocia rate without direct observation and/or post mortem of progeny dying in the neonatal period (Audigé et al 2001a).

Lactation

It is difficult to accurately determine the number of calves that survive the neonatal period because of the hiding behavioural pattern of newborn deer, and possibly scavenging. Even with intense observation, it is common to find only half of the calves that died in the neonatal period.

Weaning

This is simply the number of calves weaned, preferably taken late February/early March to remove potentially confounding effects of autumn mortalities if weaning was post rut

Foetal Loss (abortion).

This can be estimated by subtracting the number of hinds carrying a calf to term from those scanned pregnant.

Neonatal Loss

This is the difference between the number calved and the number surviving the immediate peri-natal period. This can be calculated from knowing the number of hinds carrying a calf to term and the number of live calves shortly after birth. The estimation of wet/dry numbers at weaning will also be a reasonable measure.

Postnatal Losses

This is the difference between those surviving the peri-natal period and those weaned. In practice, this is a difficult figure to ascertain.

Total Calf Loss

This is the difference between the total number of calves born and weaned.

Dystocia

Accurate data of dystocia rates are extremely difficult to determine on commercial deer farms (Audigé et al 2001a). Those authors review data from earlier surveys showing an average dystocia rate of about 0.75% (range 0-9% between farms). Survey data of Audigé et al (2001a) showed a mean incidence of a 0.52% (range 0-3.6%). Thus in some circumstances dystocia rates can be high and a significant cause of loss.

Twenty-nine potential animal management, grazing and environmental risk factors for dystocia were analysed from the data of a longitudinal observation study of Audigé et al (2001a). The following is a brief summary of key associations:

Hinds with a post winter body condition score (BCS) over 3.5 were 2.7 times as likely to experience dystocia as hinds scoring 3 or less.

Hinds grazing steep paddocks between September 1 and December 1 were less likely to experience dystocia.

There was a statistically significant interaction between BCS and typography since typography was identified as an important factor only if hinds were over 3.5 BCS. Thus fat hinds on flat land are higher risk of dystocia than fat hinds on hill country.

Given the same class of BCS and typography, a pre-calving weight gain from September to calving was associated with an increased risk of dystocia.

It must be stressed that these associations are statistical and are therefore not proof of causation. However, they are biologically plausible or are known from other research or other species to be causal. Thus it appears the relationship between fatness and fitness is an important one in determining dystocia rate in deer.

Calf Losses

Causes of Calf Losses

Gathering of accurate information on the causes of calf mortalities on commercial farmed deer is extremely difficult because of the behaviour of newborn calves and because a number disappear without trace. The only data sets available are those of Audigé et al (2001b) from commercial deer farms and Gill (1985) from a deer research farm. Data from those authors is summarised in table 2.

This data shows dystocia and stillbirth is a major contributor to neonatal mortality rates while postnatal mortality is associated with a large number of factors. Many of these have been summarised by Asher and Pearse (2002) who describe starvation/dehydration, dystocia, misadventure, non-viability due to excessively small calves particularly in fallow deer, infectious agents and lactational insufficiency as the major contributors to pre- and post-natal mortality rates.

Risk Factors For Calf Rearing to Weaning

Sixty-five risk factors potentially influencing calf survival to weaning during a longitudinal observation study of commercial deer farms were analysed for their association with rearing of a calf to weaning (Audigé et al 2000). The following were the key findings:

Adult hinds over three years of age at calving had an increased probability of rearing a calf to weaning. This is possibly due to there previous experience at rearing a calf coupled with the higher probably that hinds not rearing a calf during there first two breeding seasons would be culled. This factor also is associated with higher loss rates from first calving hinds, for largely unknown reason (See below)

Hinds conceiving early had a higher probability of rearing a calf to weaning. This may be associated with a higher dystocia rate as calving progresses, because of nutritional influences on body condition score of the hind, although this needs to be verified by research investigation.

Hinds with a body condition score of 2.5 or more in September had a high odds of rearing calf to weaning than hinds in poor body condition. Body condition may have influenced the hind's ability to lactate. (Asher and Pearse 2002)

Table 2: Published Survey Data of Calf Losses

Diagnosis	Number (%) Audigé et al (2001b)	Number (%) Gill (1985)
Hind-calf relationship		

Diagnosis	Number (%) Audigé et al (2001b)	Number (%) Gill (1985)
Dystocia	21 (22.1)	11 (24)
Stillbirth	9 (9.5)	11 (24)
Small Weak fawn	2 (2.1)	
Overmothered	1 (1.1)	
Mismothering	6 (6.3)	11 (24)
Fawn victimised	6 (6.3)	
Ruptured stomach	3 (3.2)	
Total	48 (50.5)	
Calf diseases		
Malformation (scoliosis)	1 (1.1)	
Cryptosporidiosis	1 (1.1)	
Liver abscess (navel infection)	1 (1.1)	
Other	1 (2)	
Total	3 (3.2)	
Direct management related		
Weather stress	2 (2.1)	
Handling stress	1 (1.1)	
Fawn lost	1 (1.1)	8 (18)
Lost through fence	8 (8.4)	8 (18)
Left behind	2 (2.1)	8 (18)
Misadventure	2 (2.1)	8 (18)
Broken neck	1 (1.1)	
Broken leg	1 (1.1)	
Broken back	1 (1.1)	
Total	19 (20.0)	
Unconfirmed	25 (26.3)	2 (5)
Total diagnoses	95 (100.0)	

Hinds had about 5 times lower odds of weaning a calf when they were mixed with mature stags in this same paddock during calving.

For adult hinds, gaining weight between 1 June and September was beneficial. The possible cause of this association, if indeed it is a causal association, is speculative.

Farmers visiting calving paddocks and checking for calving problems without significant intervention achieved a high calf survival rate. This may be a surrogate measure of overall care by farmers who pay more attention to the needs of their animals.

Sunny weather was positively associated with calf survival.

High maximum daily temperatures were negatively associated with calf survival to weaning, suggesting heat stress may be a factor.

Intriguingly, the only statistically significantly association between potentially causative variables and rearing a calf by first calving hinds was the farmer visiting calving paddocks and checking for calving problems. The lack of association between management, individual hind grazing, environmental and calving paddock characteristics suggests that the major factors associated with the high progeny loss rate from first calving hinds may be behavioural and or endocrine factors not measured by Audigé et al (2000).

Data supporting that of Audigé et al (2000) on the influence of conception date is presented in the Deer Industry Manual (2001). The data showed for late conceiving mixed-age hinds there was a fawn loss rate of 19% compared with 11-12% for hinds with early conceptions. The trend was greater in rising 2-year-old hinds where late conceiving hinds lost 27% of calves

compared with 11-15% for earlier conceiving hinds. The later calving of 2-year-olds gives a greater opportunity for them to accumulate body condition, increasing the risk of dystocia.

Influence of disease

On a national basis, disease *per se* plays a minor role in reducing calf survival to weaning (Audigé et al 2001b), although outbreaks of cryptosporidiosis have caused significant losses on individual farms (Hicks 1994).

Attempts to Decrease Calf Losses

Three studies were undertaken as part of the Deer Master Project (Campbell et al 2000; Deer Industry Manual 2001).

Calf Proof Fencing

Calf Proofing was by the installation of chicken netting, or overlaying other netting near the ground, to reduce the risk of escape of newborn calves from the deer paddock. The study was carried out over a 2-year period with higher weaning percentage in 7 of 9 calf-proof paddocks in year 1 and 6 of 13 in year 2. There were no statistically significant differences between conventional deer fence and calf proofed paddocks when a simple statistical analysis was done. However, that sort of analysis is not biologically sound because there are so many confounding effects that differ between paddocks. Multivariable analyses compensate for those effects.

In the above case, multivariable analysis of the effect of calf proofing paddocks was associated with hinds being 1.8 times more likely to wean a calf if grazed behind fawn proof fencing than behind conventional fencing. This would be equivalent to increasing weaning percentage from 90 to 94%.

Vitamin E supplementation

No response in weaning rate has been observed following vitamin E supplementation.

Calving Paddock Characteristics

Hinds with access to shade in the form of trees, shrub or gorse were 2.5 times more likely to wean a calf than those in more exposed paddocks. This would be equivalent to increasing weaning percentage from 90 to 95% (Deer Industry Manual 2001). This is consistent with the observation of Audigé et al (2000) in relation to the effect of temperature.

Iodine Supplementation

Clinical observations of goitre in progeny are observed occasionally on some farms. Iodine supplementation has presented losses associated with goitre.

Conclusion

Accurate and precise recording of reproductive outcomes is necessary for identification of where reproductive losses are occurring on individual farms. Audigé et al (2001b) showed clearly that the most significant cause of reproductive loss is failure to rear a calf to weaning, rather than failure to calve. There is a complex interaction of factors involved with calf survival including dystocia, individual animal characteristics, animal care, management decisions, environment and climate. Some solutions have been researched. A significant increased research effort is needed to evaluate management practices including observation of social interactions, environment, nutrition, and other interventions potentially impacting upon calf survival.

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