Improving the reproductive performance of farmed red deer hinds.

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Summary

The annual reproductive productivity of farmed red deer hinds in NZ has remained at ~85% weaning rate for the last 20 years, despite numerous studies highlighting the main reasons behind wastage. It is likely that the lack of improvement reflects factors such as a constant influx of new entrants into the industry (i.e. farmer inexperience), trends towards increasing intensification, the changing genetic base of the national herd (i.e. hybridisation) and weaknesses in systems of information transfer. The principle causal factor in wastage for adult hinds appears to be perinatal calf mortality, mainly due to "starvation/dehydration syndrome" (a euphasism for mismothering), dystocia, misadventure and infectious agents. Careful attention to management of the calving environment to allow hinds to express innate birthing behaviours holds considerable promise for reducing overall calf mortality. However, for yearling hinds, weaning rates generally fall well below those of adult hinds. This may reflect an additional problem of reduced conception rates in many herds. This will likely be the focus of considerable research over the next few years, particularly in relation to the effects of social hierarchy and stress on ovulation/mating.

1. Introduction

Despite the ever-changing face of modern deer farming in NZ over the last 2-3 decades, reproductive productivity of the breeding herd has always been one of the main criteria of biological performance and commercial viability on most deer farms. In this respect, overall reproductive efficiency is usually measured and conceptualised as the "weaning rate" (calves weaned per 100 hinds mated), although there appears to be increasing emphasis on live mass yield of weaners (reflecting consideration of lactational performance as well as calving performance).

In this paper I offer a personal perspective on reproductive management of red deer to improve the "weaning rate". In doing so, I accept that some of what I write will be viewed as provocative by some and as self-evident by others. The intention is to get managers to view the wider picture in order to trouble-shoot specific problems related to their herds.

Comparison of performance data of monitored herds in the early 80's (Asher & Adam 1985; Moore *et al* 1985) with present day (Wilson & Audigé 1988; Walker *et al* 1999; Beatson *et al* 1999) indicates that overall reproductive efficiency of red deer breeding herds has not improved much in 20 years. While accepting that there is considerable variation between farms, the average "weaning rate" of farmed red deer hinds still lies between 85 - 89% for adults (≥ 3 years old) and 70 - 80% for first calvers (2 years old). In other words, average reproductive wastage is still in the order of 15 - 20% of hinds mated. This raises several important questions ...

- Why has reproductive efficiency of the national herd remained relatively static over the last 20 years?
- What are the causal factors behind the reproductive wastage?
- How can this information be used to facilitate improvements in herd productivity?

I will attempt to put forward some answers to these questions.

2. Why has there been no apparent improvement in reproductive productivity?

I often find this question somewhat vexing given that early studies had clearly identified important sources of reproductive wastage. To a certain extent, the causes of such wastage appear largely unchanged to the present day (e.g. calf mortality due to starvation/mismothering). However, it is important to maintain a perspective on the changing nature of the deer industry over this time. Consider the following...

- While overall reproductive productivity of hinds appears unchanged, some farmers consistently achieve annual weaning rates in excess of 95%. One could argue that farmer "experience" is a big factor in improving hind performance. The number of deer farmed, and the number of deer farms, have both increased dramatically over the last two decades. By inference, therefore, there have been influxes of relatively inexperienced deer farmers throughout that time.
- The high capital cost structures of establishing deer farming have been arguably associated with trends towards increasing intensification. High density stocking may lead to reduced reproductive performance by increased disease/parasite risk, poor nutrition and sub-optimal environments relative to the innate behaviours and needs of red deer. This latter point will be discussed further in relation to social behaviour of deer and the calving environment.

It is important here to point out that there has been some discussion in recent years about the productive benefits of "extensification" of pastoral deer farming (i.e. low density, minimal intervention management), with anecdotal evidence pointing to high weaning rates (95+%) under such systems.

- The genetic base of the deer industry has changed considerably over the last 20 years. In reality, this has probably generated "pluses" and "minuses" in relation to reproductive success of hinds. Culling, by slaughter, of poor performing hinds over the last 10-15 years has undoubtedly improved the reproductive efficiency of many herds. However, we need to consider the consequences of genetic selection for growth/antler traits, particularly by hybridisation between subspecies (e.g. wapiti x red deer). It is likely that such hybridisation and genetic selection has affected reproductive characteristics of many breeding herds.
- While it is my contention that the rate of information uptake by deer farmers exceeds that of other livestock industries by virtue of the industries "newness", it concerns me how often past information is forgotten and the "wheel is reinvented". The challenge, in my opinion, is to overhaul the way that information/technology transfer occurs in NZ primary industries. Recent initiatives in on-farm monitoring/production profiling go some way to addressing this issue, as there is strong farmer "ownership" of the information.

3. Causal factors behind reproductive wastage

As with any species of livestock, identification of the causal factors behind poor reproductive performance is the key to eventual improvements.

There are four main areas of focus

- Failure of conception

- Failure to maintain pregnancy
- Calf mortality
- Calving season

3.1 Failure of conception (early pregnancy establishment)

True "conception rate" is difficult to assess accurately and the best available indicator is "early pregnancy rate" (i.e. % hinds pregnant 30 - 60 days after mating) assessed by real-time ultrasonography around late May - July.

As a broad statement of fact, low conception rates (i.e. <90%) for adult hinds have not generally been a common feature of NZ red deer herds. However, exceptions have occurred and have occasionally been catastrophic. Furthermore, low conception rates in yearling hinds may be more widespread than has previously been thought. It is also true to say that some hybrid herds have suffered from poor conception rates. Factors to consider are as follows:

- Stag fertility/libido
- Ovulatory failure
- Early embryonic loss

Infertile (aspermatic) stags are relatively uncommon but their inadvertent use as single-sires can be disastrous in one-off situations. However, diminished mating success of sires may be a more important consideration. The social and behavioural complexity of the rut is only now being realised by researchers, and it is clear that there is considerable variation between stags in rutting/mating capability. Judicious use of "chaser" sires (i.e. 2^{nd} or 3^{rd} cycle replacement sires) will generally ensure that

conception failures are kept to a minimum, but the downstream consequences of mating failure by primary sires include a late calving season.

There is little doubt that age of the sire has a bearing on mating ability, especially when there exists possibilities of hierarchical dominance and behavioural suppression by nearly adult stags. The more frequent use of young stags arising from intensive genetic improvement programmes necessitates careful management to overcome social inhibitions.

The true level of ovulation failure in red deer hinds is very difficult to assess. However, my gut feeling, based upon numerous studies involving intensive monitoring of oestrus/ovulation in deer, is that ovulation failure (anovulation) is generally quite rare in adult hinds under NZ pastoral conditions. Exceptions to this are likely when environmental conditions are severe enough to seriously compromise hind liveweight and body condition (e.g. as often seen under harsh Scottish conditions) or to induce high levels of chronic stress (e.g. poor reproductive performance of recently captured feral deer). Such conditions are now relatively uncommon in NZ and average adult hind liveweights in this country (i.e. 95 - 115 kg) are probably high enough to generally buffer animals against all but the most severe droughts/poor management. However, while total ovulatory failure in adult hinds may be uncommon, there is growing evidence that the timing of the onset of ovulatory activity each autumn is subtly affected by environmental variables over summer lactation. Poor nutrition combined with the high energy demands of lactation can clearly delay first ovulation by a matter of weeks, thus affecting subsequent calving seasonality.

Ovulatory failure in yearling hinds needs to be considered separately from that of adult hinds. Anovulation in yearlings may be more common than previously thought, and may be a significant factor in the generally poor reproductive performance of first calving hinds. However, data are somewhat limited and research is sorely needed. It is unlikely that lower conception rates of yearling hinds can be accounted for by poor growth, as the majority of yearlings in NZ exceed the critical threshold puberty weights for their respective genotypes (e.g. 65 kg for *Cervus elaphus scoticus*). However, it is possible that the ovulatory process in yearlings may be influenced strongly by social factors (to that extent, yearlings are now commonly mated separately from adult hinds). Also, hybrid genotypes may be more prone to delayed puberty due to higher critical liveweight/condition score thresholds. There are several fertile [sic] areas of research in relation to puberty, and this will likely be a key focus of future studies.

There is presently no evidence that early embryonic mortality (i.e. embryo wastage in the first 20 days from fertilisation) is implicated in poor pregnancy rates in red deer. However, the possibility should not be discounted despite recent studies at Ruakura which suggest very robust pregnancy establishment mechanisms operating in red deer.

3.2 Failure to maintain pregnancy

As a general rule, mechanisms for pregnancy maintenance in red deer appear very robust in the face of various adverse environmental conditions. Foetal loss (abortion) is not regarded as a major problem. Certainly, abortion storms have not been recorded for this species. However, discrepancy between ultrasound scan data and calving records on monitored farms indicate a low level of foetal loss. To date this has ranged from 1 - 2.5% of scanned pregnancies in red deer. The incidence of foetal loss appears to be

higher with hybrid embryos (e.g. 5% in wapiti x red; 10 - 20% in Pere David x red pregnancies) indicating a degree of genetic incompatibility between foetus and dam.

3.3 Calf mortality

This is the area where the greatest proportion of reproductive wastage generally has occurred, with peri-and post-natal calf losses ranging between 5 - 15% of calves born. Although overall calf mortality statistics appear to have changed little over the last 20 years, I believe that this is an area where productivity gains can be made quite rapidly on many farms.

The main causes of calf mortality are as follows ...

- Starvation/dehydration syndrome ("mismothering")
- Dystocia (birth injury)
- Misadventure
- Infectious agents

Most studies to date highlight the significance of "starvation/dehydration syndrome" as the leading cause of calf losses. We tend to see this syndrome as a euphanism for mismothering/calf desertion. It is disturbing, to say the least, that after 25 - 30 years of deer farming, that such high levels of mismothering still exist (i.e. 35 - 45% of calf mortalities; or 5 - 8% of calves born). It is my contention that careful attention to calving management and the birthing environment is the key to making significant inroads to reducing reproductive wastage. There is a strong argument that trends towards intensification of deer production have often worked against reproductive performance, principally by compromising the innate birthing behaviours of hinds. In

particular, hinds seek and require isolation from herd mates (and other potential disturbances) during the parturition period to facilitate dam-calf bonding processes. High stocking densities, small paddocks, low levels of natural cover and human disturbances are all known to induce high levels of anxiety in parturient hinds, easily observed as fence-pacing prior to and during birth. This simply reflects the animals desire to find isolated birth sites. Such obvious anxiety undoubtedly contributes to mismothering, especially if there are also increased opportunities for disturbance immediately following birth. This may be further exacerbated by synchronised calving patterns leading to increased opportunities for cross-mothering, dam pirating, etc.

There is a growing school of deer farmers advocating extensification, particularly for breeding herds (as opposed to venison finishing units). They argue that weaning rates under such systems approach the biological maximum (i.e. 95+%) as a consequence of low stocking density and minimalist intervention. In reality, the answer to reducing calf mortality on most farms lies in a balance between the commercial imperatives of intensification and the ideals of extensification. Cost structures, geography, etc simply do not allow many farmers the luxury of dramatically reducing stock rate. However, careful planning of the calving environment, particularly with respect to stocking density around calving, cover and disturbance, may go a long way to significantly reducing calf losses, even on the most intensively managed units. Special consideration should be given to the management and calving environment of first calving hinds, as these animals are likely to be more sensitive than adults to calving disruptions.

Dystocia has been, and still is, a significant cause of calf (and hind) mortality. Early studies indicated that birth injury accounted for 34% of calf mortalities. This figure

may have improved over the last 20 years, but dystocia still ranks as an important cause of reproductive wastage (i.e. 15 - 25% of calf mortalities). There has been much discussion over the years about the causes of dystocia in red deer, and the following themes have repeatedly emerged:

- small, poorly grown hinds that are habitual offenders
- overfeeding (excessive body condition) in late pregnancy
- low levels of physical fitness/exercise on intensive units
- sire effects on excessive birth weight/calf limb size (e.g. hybridisation)
- disturbance around calving

Over the last 10 years, large numbers of poor performing hinds have been culled from the national herd. I would venture to bet that this has been at least partly responsible for an apparent reduction in the overall significance of dystocia in calf mortality. However, the other factors need closer evaluation if the reducing trend is to continue. Perhaps the most controversial discussions on the causes of dystocia centre around the "fatness/fitness" conundrum. This has led to polarised views on management of hinds in late pregnancy, ranging from virtual starvation diets to luxury feeding. Such disparate management strategies still persist, although most farmers take more balanced approaches and manage pregnant hinds within a moderate range of body condition scores. The jury in still out with regard feeding/management practices during late pregnancy. Recent studies indicate that red deer hinds can buffer foetal growth against extremes in nutrition and may, under extreme circumstances, compensate by altering gestation length to ensure appropriate birth weights. Thus, there may be consequences

of late pregnancy feeding strategies on calf birth dates that are completely independent of conception dates.

Hybridisation effects on birth weight/dystocia incidence are reasonably well documented, and are now generally managed by selecting breeding hinds capable of delivering larger calves (e.g. hybrid hinds) and avoiding specific sires known to create birthweight problems. However, farmers adopting hybridisation options seem prepared to accept some increased risk of dystocia over that of pure red deer systems. It is a question of balancing the costs (higher calf losses) with benefits (faster growing calves).

The issue of disturbance-induced dystocia perhaps needs some quantification. However, given that disturbance can undoubtedly lead to mismothering, there may be additional spin-offs of reduced disturbance around calving on calf survival. One wonders if the high dystocia incidences recorded in the early 80's reflected disturbance effects brought on by paranoid farmers over-keen to assist hinds with apparent calving difficulties!

Calf losses through "misadventure" are always going to occur. I once witnessed a happy-go-lucky calf hit a fence post and die while chasing a playmate. Bad luck really!! However, misadventure through bad management/facilities is avoidable. The worst offenders are poorly constructed fences (especially in combination with a general lack of ground cover). Newborn calves naturally seek shelter to hide. In its absence, they will wander great distances and seek it outside the birth paddock. From then it is only a matter of time before they get lost and starve or get hung up in the fencing wire.

The message is simple: ensure fences are calf-proof and reduce the incentive for calves to wander by providing ground cover. This seems overly simple but recent on-farm studies indicate that a surprisingly large number of calves still simply disappear from the calving paddock.

The list of infectious agents contributing to calf mortality seems to grow as time goes on. Again, this may reflect growing trends towards intensification. While the overall national herd incidence of such mortalities may seem low (2 - 5% of calf losses?), the sporadic nature of infection often has disastrous consequences on calf production on individual farms.

Such infectious agents include:

- E. coli
- Cryptosporidia
- Fusiformis
- Leptospira
- Cattle tick

The best advice to prevent occurrences *or* re-occurrences of such problem seems to be (1) early detection and identification, (2) rapid intervention with prophalxous where possible, and (3) prevention of future occurrences (e.g. vaccination). In all cases, veterinary expertise is critical.

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