THE NUTRITION OF EWE PRE MATING TO PARTURITION

Understanding the importance of the Body Condition Score and any interaction with Vaginal Prolapse

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SUMMARY

Bearings (vaginal prolapse) continue to be a costly problem on intensive South Canterbury, Otago and Southland sheep farms. A Meat and Wool Survey in 2000/01 concluded that there was a 1.1% incidence of bearings nationally (then estimated as a $90m cost, now worth $148m, to the industry), but this is highly variable between regions and individual properties.

Bearings can be valued at around $11,600 per year to the average sheep farm where the cash cost of bearings were estimated at $424 per ewe (2012 estimate) and account for the death of up to 3% of the lambs born (as bearings mainly occur in lambs carrying twins and triplets). Estimates since then indicate bearings are still a widespread and significant problem that has the potential to worsen as ewe performance increases. With reducing profits in the sheep industry, increasing competition for land use from dairying and dairy support and a continual increase in input costs it is vital for farmers to reduce any production losses they can.

An issue that farmers increasingly have to deal with is the perception of our overseas consumers. Animal welfare is an important consideration for overseas consumers when buying our produce so visible animal welfare issues such as bearings present a serious danger to our $2 billion export industry.

Over the last 6 years there has been work done in South Otago and Southland (funded by MAF Sustainable Farming Fund, B+LNZ Monitor farm and FiTT programme) to investigate on farm management practices that could reduce bearings. There appeared to be two key factors that reduced bearings:

- maintaining ewes on an even plane of nutrition (by allocating the correct amounts of feed) from pre-tup to scanning
- and changing how the feed was allocated over this period i.e. shifting stock every 4 days rather than every day

Maintaining the ewes on an even plane of nutrition reduced bearings from a consistent rate of 7% per year (over the previous 4 years) to approximately 2%. The effect of changing the way feed was allocated to the stock reduced bearings to approximately 1%. This use of 4 day shifting during pregnancy is a significant departure from current management practices of 1 or 2-day shifts, especially in more intensive sheep farming.

It is important to recognise that farmers aiming to reduce bearings often blame overfeeding. Understanding the potential risk of underfeeding, especially in late pregnancy, is important as restricting late pregnancy nutrition comes with a significant potential production loss. This review of current research examines both bearing incidence and the effect of the ewe’s plane of nutrition, focussing on body condition scoring, on ewe performance and productivity.
AN UNDERSTANDING OF BEARINGS (VAGINAL PROLAPSE) ON SHEEP FARMS

Update on research and understanding of the on farm incidence of bearings.

Introduction

No other species of domestic animal suffers so frequently from bearings (vaginal prolapse) before parturition as the sheep. In New Zealand most sheep breeding flocks experience low incidences of bearings (Hilson et al. 2002) but individual farms occasionally experience outbreaks where up to 10+% of ewes are affected. Managing a bearing outbreak is difficult as bearing incidence is relatively low and is not predictable.

The impact on farm profitability has several facets. Firstly there are direct costs of ewe and lamb deaths. Treatment of bearings also has time and cost associated with it. Culling of surviving ewes and the increased replacement rate also add cost.

There are likely to be indirect costs through any management practices farmers may use in an attempt to reduce the incidence of bearings, such as restricting feed intake in late pregnancy and at lambing, even though there is little evidence to support this. These managements are more likely to impact negatively on flock performance and productivity and may outweigh any perceived benefit.

Why is the occurrence of bearings important to the New Zealand sheep industry?

As an export oriented, high value, protein source, the health and welfare of the animals involved is becoming increasingly important to the consumer. Information on the source of their food is readily available and also becoming more widely used in the marketing of our agricultural products (by NZ exporters). Local market producers also use this type of information (food miles, carbon and water foot printing, health and welfare issues) to lobby against our products.

Therefore bearings continue to be both a direct cost to the sheep industry and a threat to the access to overseas markets because of the animal welfare issues involved. Bearings are also a further significant drain on the farmer during a time of high stress at lambing.

The economic cost of bearings

A Meat and Wool NZ survey (2000/01) estimated that the average incidence of bearings (1.1%) cost the industry $90 million per annum. In 2011 this would be a much higher cost as returns per ewe and the capital cost of replacing a ewe are significantly higher.

Cost per bearing estimate 2012 (estimated using Beef+Lamb NZ data)

- Ewe @ $100
- Two lambs @ 108
- Hogget replacement not sold $108
- Total direct cost $424/ewe

Estimating an average flock size to be 2500 ewes (out of 4000 SU) at 1.1% bearings is $11,600/farm; and 12,700 sheep and beef farms is approximately $148 million/annum.
Bearings are still a widespread and significant problem that is worsening as ewe performance increases as bearings are more likely to occur in ewes carrying twins and triplets. This results in a higher actual lamb loss of greater than 3% of lambs born. The financial cost to the farmer results from the combined effects of ewe death and the cost of her lifetime performance (number of lambing’s), cost of replacement ewes, reduced lamb income plus the animal health cost and labour required.

The current position on bearings research

Bassett (1956) summed up the position regarding ‘bearings’ succinctly in his review. This knowledge can be summarised under two distinct headings; the first is the knowledge and opinion of veterinarians and farmers (often relating more to handling the bearing after occurrence rather than causes), the second is the findings from research.

The cause of bearings was researched in the 1950s and 1960s with no definitive cause and effect determined. Many theories were proposed and tested including hormonal imbalances, hypocalcaemia, high or low body condition, vaginal irritation, oestrogen, dietary fibre, exercise, terrain. Of these there is supporting evidence for multiple lambs and previous incidence of prolapse increasing the likelihood of bearings, some breed and sires are more likely to have bearings, and young ewes are also more likely to have a bearing (this data may be influenced by repeated culling of ewes that have a bearing).

Practices and theories that persist today are a result of either observations or premises that have been reported but have not been supported by research findings. These include relaxation of pelvic muscles, oestrogen, hormones, lying down and a full bladder all playing a part in inducing prolapse (see Bassett 1956 for references). Hosie et al. (1991) found in two flocks the body condition of ewes recently affected by vaginal prolapse was variable and reflected the variation in condition found in the flock, so that ewe condition had no relation to the incidence of a bearing. In a third flock affected ewes had significantly lower body condition scores than unaffected ewes (P < 0.001). He also surmised that hypocalcaemia is more likely a result of a bearing in ewe than a cause. In NZ investigations of the effect of calcium and magnesium supplementation, zeranol dosing and zinc oxide rumen boluses have showed no effect (Hilson et al. 2003).

As the incidence of bearings in a flock is normally very low (up to 1% reported in the literature), and unpredictable, many of the on farm studies or surveys are limited in regard to producing statistically significant results. In addition any research that has attempted to induce bearings while studying suspected causes has been unsuccessful with only previous bearing incidence being related to current incidence.

Surveys of bearing incidence often result when there has been a series of bad seasons with higher numbers of bearings. Hilson et al. (2003) completed a survey of bearings across 113 farms (in yr 1) and 88 farms (in yr 2) and reported incidence of 10.5 bearings per 1000 mixed aged ewe pregnancies per year. A survey of 540 farms in Scotland (Low and Sutherland 1987) reported a similar 0.1 to 1% incidence of bearings. They further analysed the data to show that 40% of the flock reported no bearings, but also that 6.3% of the flocks surveyed had an incidence greater than 5%. However bearings continue to be an issue on those farms where they can occur at much higher levels (7-14% reported).
More recently in New Zealand Litherland et al (2000) compared ewes that had previously had a bearing (PB) with non bearing (NB) ewes. All ewes were fed in excess of their requirements from 8 weeks before lambing and ewe condition had increased by 0.4 CS units by lambing. Scanning results were similar (PB - 151%; NB - 142%) however 20% of the PB ewes had a bearing, compared to 0% NB, with 78% PB who survived treatment rearing a lamb. Their key finding was that high feeding levels in late pregnancy do not necessarily cause bearings and that ewes with bearings should be clearly identified and culled as they are more likely to have bearings the following year.

**Summary**

The research into the incidence of bearings has provided no clear definition of cause and effect. Some potential reasons have been ruled out and any effects that may have been measured or observed are likely to be a reflection of the condition, rather than the cause. These include

- Mineral imbalance – studies adding calcium, magnesium and sodium have all proven inconclusive. Blood metabolite measurements appear to indicate that changes in these levels are not predictive, but may be altered because of vaginal prolapse.

- Hormone levels – oestrogen was suggested as a potential to cause bearings, but the use of slow release artificial products has not shown any effect.

- Overfeeding – farmers have suggested that ewes that are ‘too fat’ have more bearings, but condition score measurements provide either no relationship, or implicate ewes that are lighter than the average of the mob.

- Exercise – very little research has been published on this, but it is unlikely that exercising skeletal muscle will affect the smooth muscle associated with the uterus and vagina.

- Dietary fibre – the concept of ewes being ‘over-full’ and therefore putting pressure on the uterus and vagina is not tested.

- Genetics – some survey work suggests that some breeds are less likely to have a bearing.
BODY CONDITION SCORING

How do the current recommendations relate to the current NZ sheep flock and how can we better understand the relationship between ewe live weight and BCS throughout the year.

Anecdotal evidence suggests that farmers use the manipulation of feed intake in late pregnancy to attempt to reduce bearings, using the rationale that overfeeding is why a bearing occurs. This appears to be a reflection of farmer’s impressions of handling very heavily pregnant ewes (often bearing twins or triplets) and assuming that they are fat. It also comes from anecdotal evidence that a ‘good’ autumn where feed is abundant, and ewes enter winter with higher than average fat cover are conditions when bearings occur. However, detailed study of on-farm data sets suggest that either ewe condition has no affect or that ewes are actually in lighter condition when a bearing occurs.

It is important for farmers to understand the trade-off they are making between attempted bearings control and the impacts of changing/reducing BCS on productivity. Therefore a review of the importance of optimal BCS is needed to support the summary regarding bearings.

Introduction

Body Condition Scoring of sheep was first described by Murray (1919), and defined as a 5 point scale assessed by palpation of the lumbar region by Jefferies (1961) and further refined by Russel et al. (1968). The score is a subjective assessment of the proportion of fat in a live sheep. The lumbar region was determined by the authors as the best site to assess as the loin is the last part of the growing animal to develop, where fat is deposited last and lost from first.

Russel et al. (1968) also related the BCS to the chemical fat %, using Scottish Blackface sheep, and found that BCS showed a better level of prediction of body fat than live weight.

Better understanding of the importance of BCS is critical to increasing its use on farm as an effective tool for farmers to use.

Body Condition Scoring and liveweight

BCS has been variously described as a monitoring tool, easily used, well tested on farm, and as a good predictor of condition, nutritive status, welfare and health for different times of the year, fitness, fatness, productivity and performance. It has the advantage over weighing sheep of not biasing towards the larger framed heavier stock. Live weight can also be skewed by gut fill (improved by standing off feed for a length of time and always weighing at the same time of day), wool weight, and conceptus (lamb plus placenta) plus wet vs dry weather conditions, and access to water.

Since the BCS scores were developed (with British sheep breeds) further research has shown differences in both fat accumulation and partitioning in different sheep breeds. In general meat production genotypes tend to deposit more carcase fat while milk genotypes tend to deposit more body fat internally (Butler-Hogg 1984; Frutos et al. 1995).
In New Zealand there has been a focus on breeding for a leaner meat carcase so the question is ‘do the current BCS recommendations still fit’ for our sheep flock. In addition there has been use of both meat and milk genetics to develop all-purpose sheep breeds.

**Why is BCS important in a grazing system?**

In a sheep flock many of the productive parameters are linked to body condition. In most sheep production systems under extensive grazing, the farmer relies at times on the ability of the ewe to mobilise body reserves (fat) and yet maintain its productivity or even its survival. Therefore a quick reliable method of monitoring these reserves is important in making better on farm decisions.

**Body Condition Score relationship with the pregnant ewe**

Lamb production is the economic driver of sheep farms and over the years productivity has improved, the fertility of the ewe has lifted and lambing percentage has increased. Therefore the most important use for BCS as a monitoring and management tool is from pre-lambing to post lambing and targets have been proposed that farmers can use. (Body Condition Score Guide: [http://www.beeflambnz.com/Documents/Farm/Body%20condition%20scoring.pdf](http://www.beeflambnz.com/Documents/Farm/Body%20condition%20scoring.pdf) or ‘A Guide to Feed Planning for Sheep Farmers 1994).

These targets are derived from research that highlights the consistent performance of ewes that are maintained between BCS 3 and 3.5. Many important physiological components are optimised at these BCSs and are discussed below.

The relationship between breed, liveweight and BCS is an important consideration. The research highlights the range of live weights and BCS in different breeds used in trials, i.e. Scottish Blackface x Belcare ewes mean. lw 67.6kg; BCS 3.7 (Keady et al. 2008), Corriedale ewes mean lw 48kg; BCS 2.6 (Banchero et al. 2009); Romney ewes mean lw 59kg; BCS 3 (Pitto et al. 2008). Australian researchers have developed a Standard Reference Weight (SRW) system. They then deem that condition score is related to that SRW with a gain or loss of 10% of the SRW as 1 BCS. This means that a ewe in BCS 3 at a liveweight of 70 kg will lose or gain 7 kg per BCS.

**What does research show re the effect of the plane of nutrition during pregnancy?**

The nutrition of the ewe during pregnancy is critical and impacts on factors important to both the ewes and their lambs’ future performance. This includes ewe reproductive efficiency and colostrum production, foetal development and subsequent lamb survival and performance. Ewe nutrition also influences certain metabolic pathways, both directly and indirectly (by providing essential nutrients, the expression of hormonal functions, which in turn influence oocyte maturation, ovulation, embryo development, foetal growth and the viability and vigour of the new born lamb (Robinson et al. 2002)).

The classical studies of Everitt (1964) demonstrated that feed intake during pregnancy had a profound influence on placental weights in sheep, which may influence lamb birth weight, depending on pregnancy nutrition.

Munoz et al. (2008) considered the effect of plane of nutrition during early and mid pregnancy on the performance of mature ewes and lambs. The early pregnancy period was defined as from mating
to day 39 post mating, mid pregnancy was days 40 to 90 while late pregnancy was from day 90 onward. They found that a low plane (lp) of nutrition in early pregnancy (fed at 60% of the predicted requirement for Maintenance) improved immune status, higher growth rates and reduced lamb mortality at weaning. By comparison ewes on a medium plane (mp) of nutrition in mid pregnancy (1.4 x Maintenance) resulted in increased foetal growth and a larger skeletal size at birth. In late pregnancy all the ewes were fed to meet their requirement for late pregnancy.

The combination of these nutrition managements (lp to day 39; mp to day 90) produced the highest number of lambs weaned in the trial. Care needs to be taken with transferring these results to on farm practice as the ewes started this trial in very good body condition (80kg lwt; BCS > 3.8). In the NZ grazing system much of the recorded BCS data shows ewes start at a much lower BCS prior to mating even when liveweights are reasonable (60-75kg). There has also been a wide range of BCS recorded within the ewe flock (BCS 1.5 to 3.5) Dodunski (2007), Kenyon et al (2004).

In early pregnancy the ewes on the lp lost 6.3kg lwt and 0.02 BCS, those fed maintenance lost 0.8kg lwt and gained 0.1 BCS while ewes fed 2x maintenance gained 6kg and 0.22 BCS units. In mid pregnancy ewes fed 80% of maintenance lost 0.8kg and 0.09 BCS units while those fed 140% of maintenance gained 4.9kg and 0.09 BCS units (ref Fig 1 and 2 below).

This work provided an interesting example of ewes that were in very high condition and supported the view that ewes can be too heavy as gains were made by reducing BCS back towards the optimum recommended range of 3 to 3.5.

Munoz et al. (2009) followed their previous work and looked at the effect of altering the plane of nutrition for 1 and 2 yr old ewes (hogget’s and 2ths, avg lwt 46.7kg and BCS 3.5) in early and mid-pregnancy. They concluded that altering the plane of nutrition in early pregnancy had a greater effect on ewe reproduction and lamb performance. The low plane of nutrition (60% of Maintenance) led to reduced foetal size and lower lamb birth weight. By comparison older ewes compensate for poorer early pregnancy nutrition re foetal size. Therefore age of the pregnant ewe is a factor in pregnancy nutrition.
Quigley et al. (2008) also looked at maternal feed allowance to see if the changes in maternal live weight and ewe BCS prior to mating persist through pregnancy. Feed allowance during pregnancy has been shown to affect both the placenta and foetus.

In this work the ewes were fed at 3 rates where the Control diet was 120% of the recommended ME intake for a 64kg ewe (AFRC) and the restricted diet was 50% and Ad-lib was 150% of the control diet (ie 60% and 180% recommended ME). The importance of this work is that it looks at foetal, placental and maternal characteristics throughout gestation in ewes that were in significantly different body condition prior to conception (50 days) as well as through gestation. The results showed that there were compensatory adaptations of the mother, placenta and foetus to enable foetal survival at the expense of foetal growth. The restricted ewe feed allowance decreased live weight and condition score of ewes which suggested energy and protein deficiencies and the mobilization of fat reserves. Quigley suggests the interaction is more complex that simple nutrient supply and that the timing, duration and severity of any nutrient limitation, the age of the ewe and the on farm management imposed may all influence how the placenta responds.
Blue line at 0 = mating, x axis is days prior to or days after mating (50 = early pregnancy; 92= mid pregnancy; 133 late pregnancy) Quigley et al. 2008.

Morgan-Davies et al. (2008) compared a traditional ewe flock (grazed on the hill all year) with an alternate management where the ewes were shifted to lowland pastures for Nov to Feb (mating to scanning) for five years to see if BCS was a reliable indicator of ewe survival. The flocks were managed by condition score (ie low BCS animals managed separately) however traditional hill flock ewes lost weight and BCS while ewes shifted to lowland pastures (away wintered) tended to gain both.
Their results showed ewes from both managements had a greater risk of mortality at mid-pregnancy as the BCS dropped below 2.25 (Morgan-Davies et al. 2008).
The results show that the traditional hill flock had significantly lower survival rates than the alternate management (away-wintered).

The mid pregnancy BCS (see figure above) did provide a welfare indicator that can be used to predict subsequent ewe survival over a range of changing winter conditions, feeding and body conditions. Management can be adopted to reduce body condition changes such as culling, separate flocks, supplementary feeding, and preferential grazing for low BCS animals and so on.

It was also noted that multiple bearing ewes had higher mean condition scores at mid-pregnancy (3.47 ± 0.02) than the single bearing ewes (2.96 ± 0.01), and therefore it might be expected that their survival would be higher which suggests that the differential management of scanned multiple bearing ewes prevented any impact of increased litter size on survival.

Age was a significant factor, with ewes greater than 5 years old at premating showing the highest levels of mortality.

Caldeira et al. (2007) looked at the effect of BCS on blood metabolites and hormone levels in ewes. The researchers stabilised ewe bodyweight and BCS for the trial animals by managing the diet to provide different proportions of theoretical energy required for maintenance i.e. BCS 1.25 (30% M), BCS 2 (60% M), BCS 3 (100% M), and BCS 4 (120% M). They found ewes with a different BCS demonstrated a different metabolic status. Ewes with a BCS of 3 had a more balanced metabolic status while those with a BCS below 2 or above 3 were more susceptible to metabolic imbalances. Under nutrition of ewes was evident with a BCS of 2 and lower.

They suggested that BCS was more readily usable on farm as an indicator of the animals’ metabolic status than metabolic tests and could be easily used to indicate changing metabolic status through pregnancy and when feeding levels needed to be lifted.
Annett and Carson (2006) found that allowing adolescent ewes to lose moderate amounts of weight in the month post mating could improve the proportion that conceived. However they also determined that as it was then difficult to manage them to improve their liveweight and condition in time for lactation they concluded that the best management post mating was to keep ewes on a feeding strategy that maintained liveweight and BCS.

Improvements in pregnancy rate and embryo survival have been reported for ewes that were both overfed (Parr et al., 1987) and underfed (Robinson, 1977) during early pregnancy, while other studies have shown the productivity of ewes is insensitive to the level of food intake (Wallace et al., 1994; Abeecia et al., 1997). The variable nature of these responses has been attributed to several factors including differences in ewe genotype, body condition score at mating and the severity and timing of the nutritional regimes imposed.
New Zealand research

Peterson et al. (2006) reported that for lactating ewes 1 BCS is equivalent to a 5kg live weight change which was similar to the results reported by Kenyon et al. (2004) for non lactating ewes.

Everett-Hincks et al. (2004) highlighted the importance of good body condition in multiple bearing ewes at lambing so that the lambs survive and grow to weaning. In this trial the East-Friesian Coopworth ewes maintained BCS between pregnancy, scanning and lambing (3.2 at scanning; 3.1 two weeks prelamb) whereas the Coopworth ewes lost BCS (0.35 CS ie 3.6 at scanning; 3.2 two weeks prelamb). By recording a Maternal Behaviour Score they suggest that ewes that maintain condition in late pregnancy provide a better maternal environment for their lambs. This may simply be because the ewe has fewer requirements to travel for food soon after lambing.

In 2009 a study looked at the performance and fate of very thin ewes in 5 NI hill country flocks (ref http://www.agmardt.org.nz/downloads/AIG%2028Grant%201120%29%20The%20life%20and%20times%20of%20tail%20end%20ewes.pdf). They showed a range of outcomes for ewes that are at a BCS<2 at the beginning of the mating period (autumn) including reduced fertility, increased death rate, higher impact of parasitism, and more likely to not rear a lamb. Their lambs, if the survived, were also significantly lighter at docking and weaning.

In the 2 graphs below the ewes were classified as ‘thin’ BCS <2, ‘medium’ BCS 2.5, and ‘fat’ BCS>3. They show the wide variation in BCS at different liveweights (Fig 2) and that all ewes lost condition through pregnancy (Fig 3). The average BCS of all ewes at the start was 2.4, by weaning 9 months later the average BCS was 2.1.

Range of BCS in a ewe flock (Cook et al 2010)
BCS trends for thin, medium and fat ewes (Cook et al 2010)

Dodunski and Cook (2007) showed a similar change in ewe BCS (below) from scanning to weaning

Fig. Body Condition Score change in ewes from scanning to weaning

CONCLUSION

Body Condition score has been measured in many trials looking at different aspects of ewe nutrition and pregnancy. The most consistent result is that feeding management that targets maintaining ewe BCS between 3 and 3.5 is optimal for many factors including immune system, hormone levels, conception, foetal size and growth, lamb survival and lactation.

The genetics of the sheep play a role in determining where fat deposition occurs (meat versus milk genetics) which may alter the BCS reading and the relevant range for best production. This may be important for our crossbred ewes and may need more research to determine if the recommended BCS ranges still fit.
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