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Contents

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Lamb Survival Initiative results 2016

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This article presents the results of the 2016 Lamb Survival Initiative. The results of the 2015 Lamb Survival Initiative were published in the March 2016 edition of the Ovine Observer.

Introduction

Just over 6% of Western Australian (WA) Merino sheep producers and 9% of dedicated prime lamb producers achieve marking rates of over 100%. This means that less than 500 producers in WA achieve 100%+ lamb marking in any given year.

The Lamb Survival Initiative, through involvement with regional grower groups, aims to provide the support required for producers to achieve 100%+ lamb marking rates. The initiative provides training and support, encouraging producers to set achievable targets and benchmarking their marking rates against producers in similar regions and across the state.

Lamb Survival Initiative lambs 2016

ROYALTIES FOR REGIONS

In order to build producer confidence and skills to lift marking rates to 100%+ the initiative encourages producers to:

- undertake pregnancy scanning for multiples on a significant proportion of their adult ewes
- record and submit data on the reproductive rate, marking rate and weaning rate achieved in the scanned ewe flock/s so that the rates can be benchmarked against producers in similar regions
- attend at least one training course or workshop focused on reproduction
- work closely with industry professionals if reproduction rates are less than expected.

2016 was the second year of the Lamb Survival Initiative, and involved six grower groups spread throughout the southern region of WA. These groups included Facey Group (Wickepin), Southern DIRT (Kojonup), the Gillamii Centre (Cranbrook), ASHEEP (Esperance) and two independent groups from the West Midlands and Boyup Brook, with a total of 34 participants.

Lifetime Ewe Management accredited facilitators Ed Riggall and Jonathan England were selected by the groups to provide in-depth information on reproduction. Facilitators met either on-farm with each producer or via group meetings to provide support and training on topics such as condition scoring, feed budgeting and husbandry practices for increasing lamb survival.

Information collected about the reproductive cycle included:

- ewe condition score at rams out and pregnancy scanning
- scanning rate (number of lambs scanned per 100 ewes joined)
- marking rate (number of lambs marked per 100 ewes joined)
- weaning rate (number of lambs weaned per 100 ewes joined)
- weaning weights (where facilities available)
- feed on offer (FOO) at lambing and details of supplementary feeding.

Collection of this information enabled producers to gain valuable understanding on where lambs were being lost throughout the reproductive cycle.

Ewe condition score

As shown in Figure 1, producers from the ASHEEP and Gillamii Centre groups maintained a high average condition score (CS) in their ewes between rams out and pregnancy scanning. Producers from the West Midlands and Southern DIRT groups saw a moderate increase in average ewe CS of 10%, while producers from the Facey Group and Boyup Brook groups saw a slight increase between rams out and pregnancy scanning.

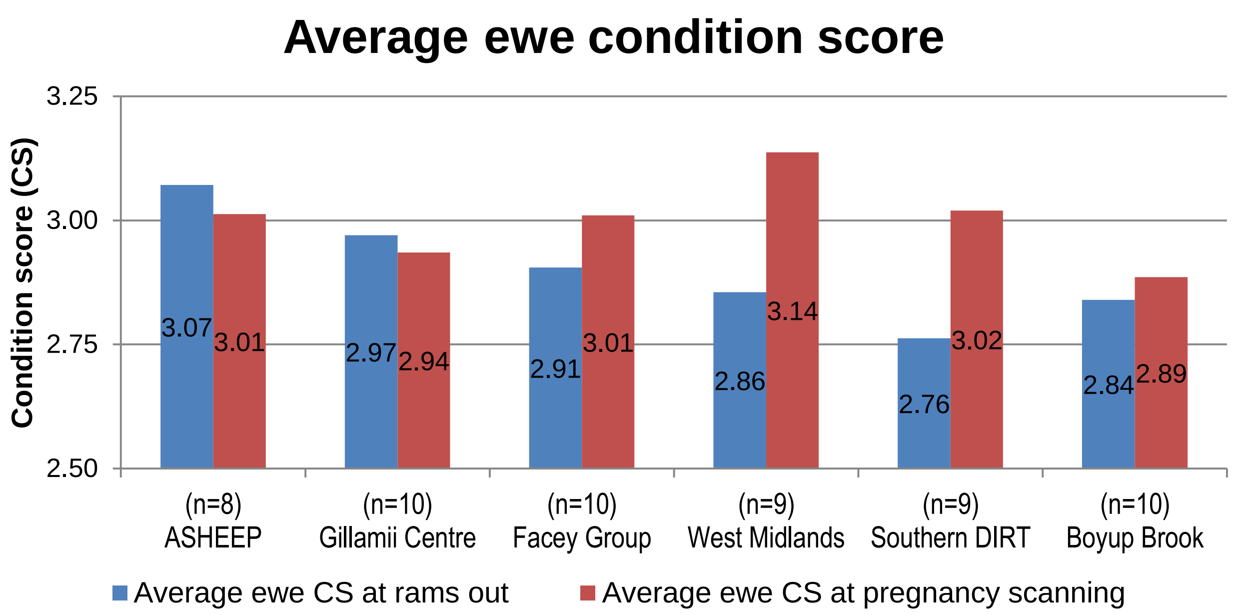

Figure 1 Difference in average condition score (CS) of ewes in the different grower groups between rams out and pregnancy scanning

Feed availability

In 2016, average FOO at lambing was high for all groups. The lowest average FOO for any of the groups in 2016 (1200 kg/ha) was greater than the highest average FOO in 2015 (1060 kg/ha) when most areas received decile 1 rainfall during the growing season.

The available feed (supplementary feeding and FOO) for each of the groups at lambing can be seen in Figure 2, which shows that in most groups producers continued to offer supplementary feed to ewes even when FOO was high. A variety of supplementary feeds were used including hay, wheat seconds, oats, barley, an oat/barley mix and/or lupins. The majority of the supplementary feed recorded was used for feeding twin-bearing ewes.

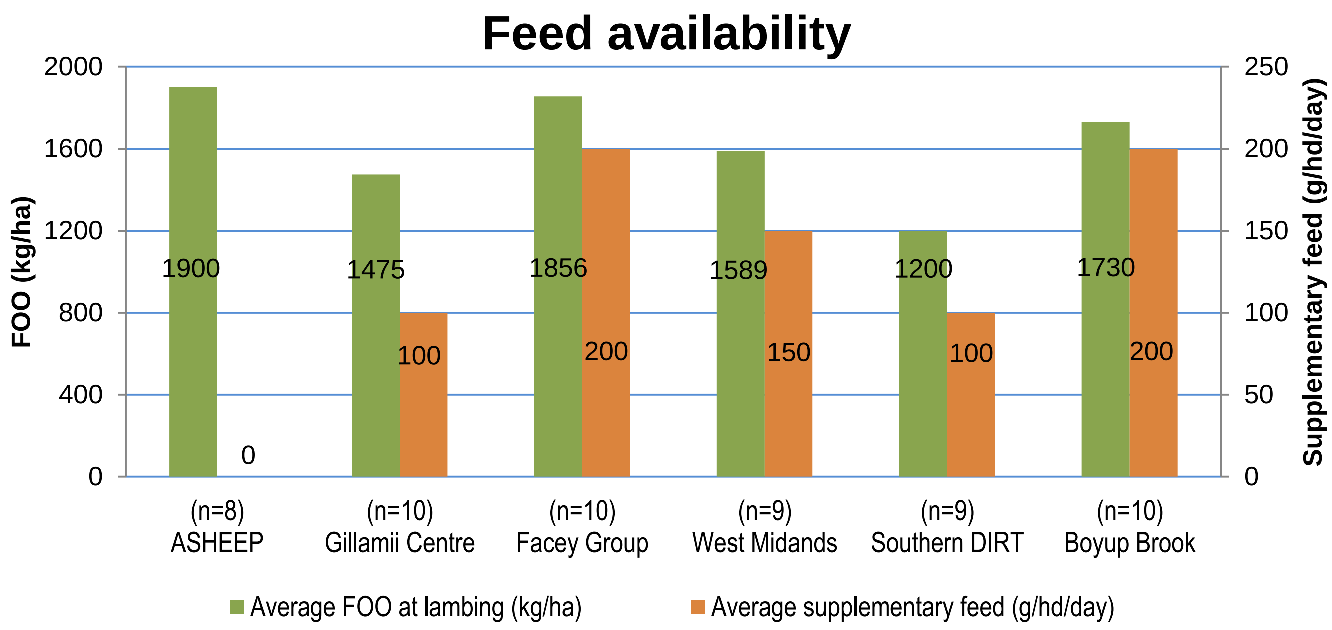

Figure 2 Feed on offer (FOO) and supplementary feeding amounts in the different grower groups. Key: kilograms per hectare (kg/ha); grams per head per day (g/hd/day)

Reproductive rates

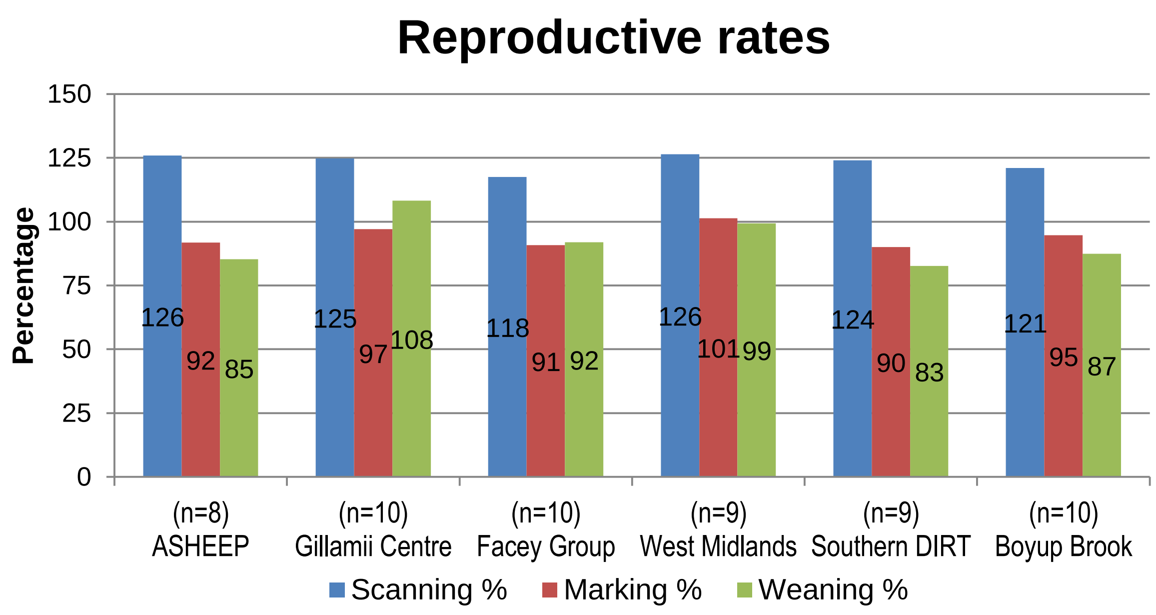

Figure 3 Change in reproductive rates in the different grower groups between scanning, lamb marking and weaning

Reproductive rates included the number of lambs scanned, marked and weaned per 100 ewes joined (Figure 3). As in 2015, the greatest lamb loss for each group occurred between pregnancy scanning (blue) and lamb marking (red). This mortality may be either in-utero, during the birthing process, or during the first 72 hours of life. It has been found that 80% of lamb mortality occurs during the first 72 hours of life.

The Facey Group and Gillami Centre groups recorded surprising results that indicated the number of lambs weaned (green) increased from the number of lambs marked (red). These results may reflect some out-of-season lambing and/or ewes and lambs that weren't present at marking.

Weaning weight

While not all producers involved in the project recorded lamb weights at weaning, the average weaning weights are shown in Figure 4.

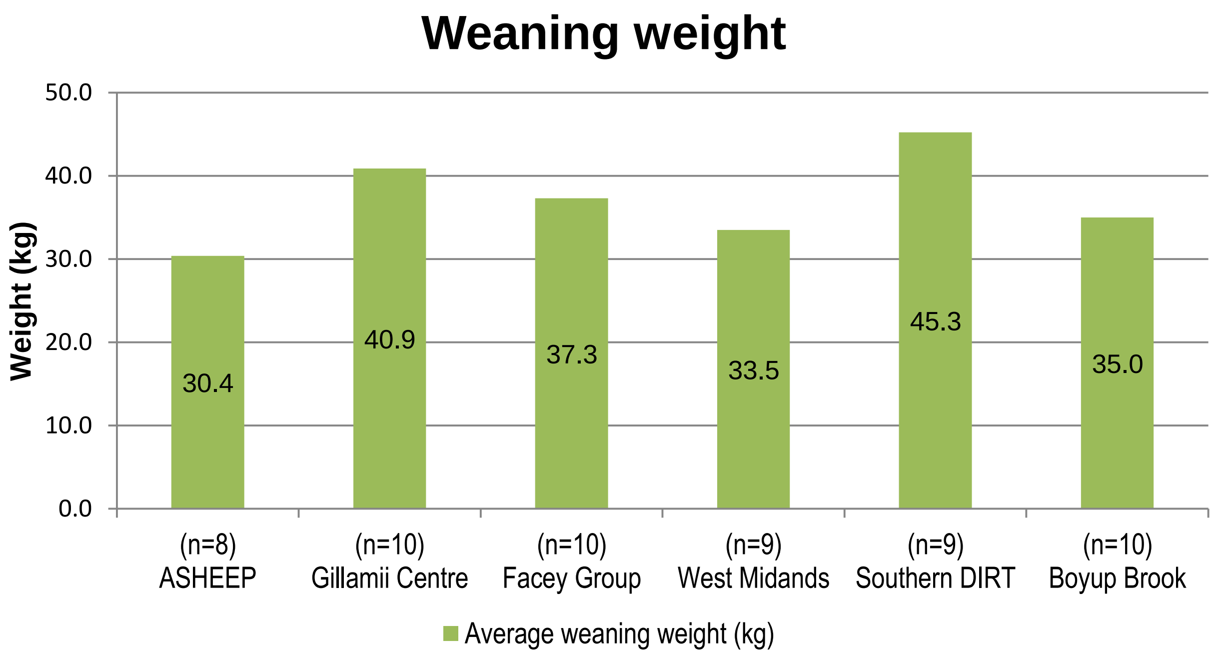

Figure 4 Average weaning weight of lambs in the different grower groups

There are many strategies that can be put in place to increase lamb survival including monitoring the CS of ewes, scanning for multiples foetuses and preferentially feeding twin-bearing ewes, as well as providing shelter and limiting mob size at lambing.

Further information on increasing lamb survival can be found in the September 2015 edition of Ovine Observer or on the DPIRD website.

Producer feedback

Feedback from producers involved in the initiative indicated that further extension of information about weaner management as well as pasture production and management was highly desirable. DPIRD has responded to this feedback by increasing the number of producer seminars covering these topics (e.g. Managing sheep in the dry spring seminars, held in July 2017).

Participation

If you would like to become involved in the 2018 season of the Lamb Survival Initiative, please contact Rebecca Butcher, Sheep Industry Development Officer, Moora on +61 0(8) 9651 0540 or rebecca.butcher@dpird.wa.gov.au.

The potential for dual energy x-ray absorptiometry to predict lamb age

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Introduction

Lamb maturity, as indicated by age, has been identified as a factor that contributes to eating quality. The current Meat Standards Australia (MSA) lamb model utilises lamb dentition to classify carcases as lamb or hogget. However, the accuracy of lamb age prediction using dentition is poor therefore a single categorical description of age such as teeth eruption is not ideally suited to the marketplace.

Dual energy x-ray absorptiometry (DEXA) has been used for the accurate determination of body composition in production animals including sheep. R values are obtained from the analysis of high and low energy DEXA images, and reflect the atomic mass and mineral content of the tissue being scanned.

DEXA has been used for the measurement of bone in humans, and changes in mineralisation with age/maturity are detectable using DEXA. In lamb, bone mineral content has also been shown to change over time, with older animals having decreased concentrations of cortical bone magnesium. Therefore DEXA images of lambs are likely to reflect the changing bone mineral content and subsequently lamb age and/or maturity. Thus we hypothesise that DEXA R values will associate with lamb age, reflected through changing bone mineral content.

Materials and methods

A total of 595 lambs representing six slaughter ages (kill groups) underwent DEXA scanning using a commercially-installed online DEXA scanner. Of these lambs, 544 had information regarding sire type (122 Maternal, 166 Merino, 256 Terminal), sex (250 wether, 294 female), litter size (196 single, 348 multiple) and dam breed (164 Border Leicester x Merino, 380 Merino).

The first and the last kill groups had bone magnesium, phosphorus and calcium concentrations of the 12th rib determined to examine the extremes of lamb age in the experiment.

DEXA images were obtained using a single emission from a 140 kilovolt (kV) x-ray tube, with a set of two images captured by two photodiodes with separate specificities for low and high energy photons. The DEXA images were analysed to determine R values for every bone pixel and the mean of the R values for each carcase image.

Results

Whole carcase bone DEXA

Bone DEXA R varied between kill groups, sire type, and dam breeds ($P<0.01$). There was no consistent trend between kill groups (age of slaughter) and bone DEXA R. Merino sired lambs had the highest bone DEXA R values, which were 0.02 and 0.03 units greater than the Maternal and Terminal sired lambs ($P<0.01$). Dam breed was only able to be compared within the Terminal sired lambs, and within this group of lambs, the Merino dams had a bone DEXA R that was 0.01 greater than the Border Leicester x Merino dams ($P<0.05$).

The bone DEXA R value decreased (Figure 5) and bone DEXA R standard deviation (SD) increased as lamb age increased. The ability to predict age using Bone DEXA R and SD was moderate (R^2 = 0.19, RMSE 29.6). R^2 is a measure of the variation explained by the model, with 1 being a perfect prediction, and root mean squared error (RMSE) a measure of the error in the predicting model, with a smaller RMSE indicating the prediction based on the bone DEXA R is close to the actual lamb age.

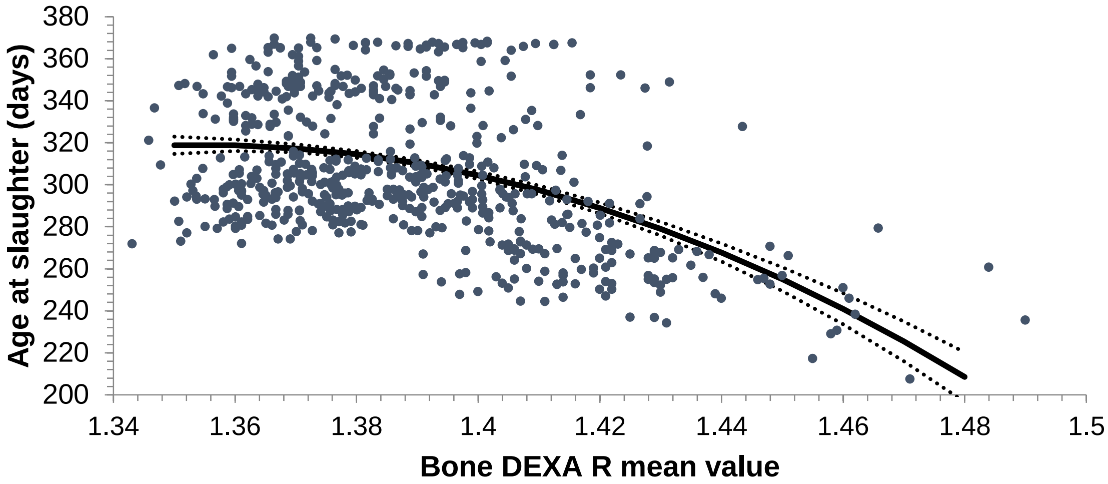

Figure 5 Predicted age at slaughter (days) using bone DEXA R value. Markers represent residuals from the predicted means (solid line) ± standard deviation (dotted line)

Rib mineral content

Only rib magnesium concentration in milligrams per gram (mg/g), wet weight, demonstrated any association with predicting lamb age in days with moderate precision (R^2 = 0.27, RMSE = 42.7). Lamb rib magnesium content was predicted with poor precision by rib DEXA R Mean (R^2 = 0.10, RMSE = 0.57).

Discussion

In support of the hypothesis DEXA has been shown to differentiate lamb age, albeit with relatively poor precision. In this experiment the relationship between bone DEXA R value and lamb age was negative, which suggests that DEXA R values decrease with lamb age. Given the association of DEXA R value with mineral content and atomic mass the opposite was expected, as bones mineralise with maturity. There is a sigmoid relationship between bone mineral density and age in children, so it is possible that the decrease in density associated with age seen in this experiment may be in the time period when there is relatively small change in bone mineral content and bone density.

There was a limited association between bone mineral content and lamb age. Contrary to previous studies in lamb, bone magnesium content increased with age. The magnesium concentration result is difficult to explain but may reflect environmental, dietary, or health differences between the two kill groups.

Another application of DEXA in addition to age determination would be to predict eating quality of lamb meat. Cattle ossification has been shown to be a better indicator of eating quality in beef prior to skeletal maturity, therefore bone mineral profile, and DEXA R mean and SD values may be useful in describing eating quality in lamb.

Conclusion

A rapid post-slaughter method for determining age would provide assurance that lambs were being correctly classified, better satisfying the requirements for inclusion in the MSA pathways program. Future work will focus on improving the relationship between DEXA R value, lamb age and mineral content over an extended lamb age range and diverse genetics. Establishing a link between age, bone mineral content and eating quality has obvious benefits to the lamb industry through its input to the MSA grading system and may lead to better utilisation of older carcases if eating quality can also be predicted.

Predicting lamb composition from carcase weight and tissue depth

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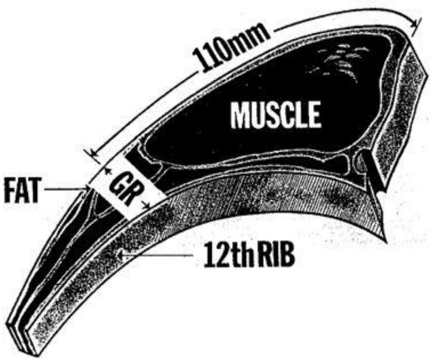
Introduction

Lean meat yield is an important profit driver for the sheep meat industry. The current industry standard for determining carcase composition is based on carcase weight and a measurement of fat depth by palpation of the GR site (located over the 12th rib 110 millimetres from the mid line), however this has been shown to be a highly imprecise estimate of lean meat yield.

This precision can be markedly improved by manually measuring grade rule (GR) tissue depth in millimetres (mm), however reliance upon a single point measurement is still likely to introduce significant bias in genetically diverse populations of lambs. Furthermore, there is concern within the Australian lamb industry that these measures are prone to bias due to human operator error as well as variation in abattoir processing.



GR tissue depth measurement site

There is little data available to quantify this error, with a key limitation being the method for determining carcase composition. Historically this has been reflected through carcase bone-out data, yet this is problematic due to varying bone-out specifications across data sets, as well as large human-imposed operator effects.

In Australia, with the introduction of computed tomography (CT) scanning methodologies, datasets are now available to assess the efficiency of predicting carcase composition using carcase weight and GR tissue depth.

This study assesses the capacity of carcase weight and GR tissue depth to predict carcase CT fat% (the percentage of fat in a carcase, as measured by CT) across multiple datasets. It was hypothesised that the precision and accuracy of this prediction would vary between different groups of animals.

Materials and methods

This study made use of 28 different datasets totaling 2289 lambs where CT estimates of carcase fat% (CT fat%), carcase weight and GR tissue depth measurements had been collected over a nine year period. Each dataset contained recordings for between 48 and 99 lambs.

One of these data sets consisted of lamb carcases that were sourced over a 45-minute period immediately following slaughter from a commercial abattoir near Bordertown, South Australia. These lambs were selected randomly across a broad range of fatness and carcase weight, hence their parentage is unknown.

CT image of lamb carcase

The remaining 27 of these datasets were individual slaughter groups of lambs from the Meat and Livestock Australia Resource Flock experiment, or from the Sheep Cooperative Research Centre Information Nucleus Flock experiment.

The lambs (Merino, Maternal x Merino, Terminal x Merino and Terminal x Border Leicester-Merino) were the progeny of 433 industry sires, representing the major sheep breeds used in the Australian industry.

The siretypes included Terminal sires (Poll Dorset, Suffolk, Texel, White Suffolk), Maternal sires (Border Leicester, Coopworth, Dohne Merino), and Merino sires (Merino, Poll Merino).

Each dataset represented a slaughter group which was balanced for sire breed. In all cases tissue depth at the GR site and hot carcase weight were measured within one hour of slaughter. CT scanned data was captured between two and five days post-mortem.

An equation to predict CT fat%, based on carcase weight and GR tissue depth, was trained in one dataset and then validated in the other 27 datasets. This process was then repeated 28 times to test the transportability of the different prediction equations, providing 756 different tests.

Results and discussion

Within the training data across each of the 28 datasets the error associated with predicting CT fat% (difference between predicted CT fat% and actual CT fat%) from carcase weight and GT tissue depth varied markedly. The root mean squared error (RMSE) of the differences ranged between 1.67 to 3.10 CT fat% units. Therefore within the training data, two thirds of the predictions will fall within 1.6 to 3.10 CT fat% units of the actual CT fat%. The models described as little as 15% and as much as 77% of the variation within these populations.

When the 28 trained models were validated across each of the other datasets the precision and accuracy indicators showed marked variation. Across the 756 validation tests the RMSE values averaged 2.36, yet ranged between 1.67 to 3.33 CT fat% units (Table 1). The R^2 values (a measure of the variation explained by the model) averaged 0.52, yet ranged between 0.12 and 0.77. An R^2 of 1 would indicate a perfect correlation between the predicted and actual CT fat% values.

These results highlight the substantial variation in precision when using carcase weight and GR tissue depth to predict composition. The accuracy indicators also varied, with bias values (indicating over and under prediction) ranging between 6.83 to -6.95 (Table 1).

Table 1 Precision and accuracy estimates for the relationship between actual CT fat % and predicted CT fat % from models containing hot carcase weight in kilograms (kg) and GR tissue depth (mm). Precision estimates include R-squared and RMSE, and accuracy is indicated by the bias.

Values are shown for the mean, standard deviation, minimum and maximum from testing 28 models across 27 datasets, a total of 756 validation tests.

	Mean	Standard Deviation	Minimum	Maximum
R^2	0.52	0.15	0.12	0.77
RMSE	2.36	0.30	1.67	3.33
Bias	1.60*	2.08	-6.95	6.83

*The average of the absolute values of bias is reported.

Figure 6 provides an example of the process of training the model, and then validating it across the remaining datasets. In this example, validation tests are shown for only one of the remaining 27 datasets.

In support of the hypothesis, these results highlight the substantial variation in prediction precision and accuracy when using carcase weight and a single point measure of tissue depth to reflect carcase fatness. This work aligns well with previous studies where carcase weight and GR tissue depth demonstrated poor precision and limited ability to differentiate between genetically diverse lines of sheep.

In part some of the variability would be driven by differences in data range between the datasets, potentially causing some extrapolation beyond the range of the training data. However all of the datasets used had broad variation with data ranges that substantially overlapped, hence in most cases there was relatively little extrapolation. As such, the variability in prediction is likely due to a number of other factors.

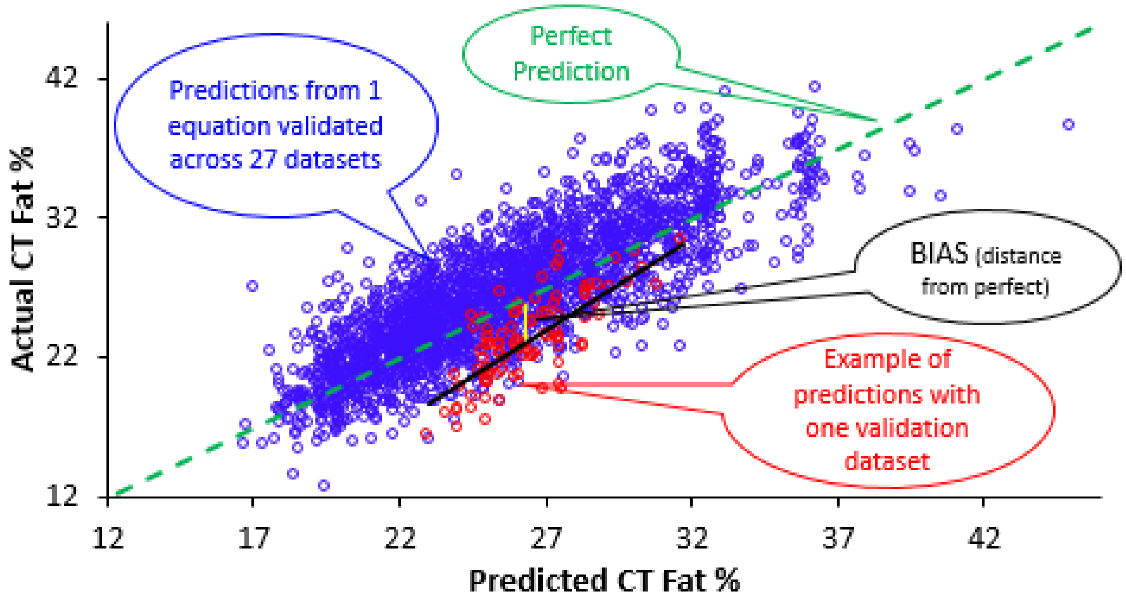


Figure 6 Example of the relationship between actual CT fat % and predicted CT fat % from a model using hot carcase weight (kg) and GR tissue depth (mm). Dashed line represent a perfect prediction; solid line show the average prediction in the validation dataset.

Use of a single measure of tissue depth to reflect carcase fatness relies upon accurate and consistent measurement. Although these are experimental datasets in which great care has been taken during the collection of GR tissue depth, there are still likely to be processing and operator effects which may vary between datasets. Furthermore, under commercial conditions within those abattoirs that measure GR tissue depth there is likely to be even greater variability due to operator error when working at speed.

It should be noted that most Australian abattoirs don't measure GR tissue depth directly, instead using palpation of the carcase to estimate this measure. Hence under commercial conditions the prediction of carcase fatness would be even more variable than that demonstrated in this study.

The prediction of carcase fat composition relies upon a strong correlation between GR tissue depth at its site of measurement with fat composition elsewhere in the carcase. However, there is evidence that suggests that genetics can strongly influence this correlation, redistributing bone, muscle and fat within the carcase. Therefore the genetic differences present across datasets may offer a source of error contributing to the bias and variable precision.

In the present study this effect may be limited as the datasets used are derived from nucleus flock slaughters, with strong genetic linkage between these groups through common sires or common dams. The only exception to this was for dataset 28 which consisted entirely of randomly sourced animals of unknown parentage, thus it is not surprising that this group demonstrated substantial bias (example shown in Figure 6).

Conclusion

These results demonstrate the variability in estimating carcase fat composition from carcase weight and GR tissue depth. Based on the genetic variation present in Australian sheep flocks, and the likely increase in measurement error under commercial conditions, we conclude that the variation in bias and precision demonstrated in this study could well be understating the bias that is present in a commercial setting.

This illustrates why the Australian sheep industry has little confidence in these measurements to reflect carcase composition and highlights the need for a whole carcase composition measurement that is independent of breed, processing and operator error.

Are wormy sheep worried?

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Introduction

The general health and wellbeing of sheep in production environments is subject to challenges. Therefore it is important to regularly monitor and assess sheep welfare, but this can be difficult for large-scale enterprises with limited labour.

Intestinal parasites are considered an important challenge for the sheep industry, with poor intestinal health associated with reductions in growth and performance. The current method for detection of parasite burden is faecal egg count (FEC), which can be both disruptive for the sheep and time consuming for the staff. As such, the sheep industry is interested in developing alternative methods for detection of sheep with high intestinal parasitic burdens.

To date, few studies have investigated the application of behavioural analyses for this purpose. Qualitative Behavioural Assessment (QBA) has been proposed as a methodology for assessing behaviour relevant to welfare, one that is naturally suited for on-farm application, being quick, easy to implement and non-disruptive.

The present study explored the application of QBA to investigate the expressive behaviour of sheep with high intestinal parasitic burdens. The hypotheses tested were that (i) sheep with high intestinal parasitic burdens, as indicated by high FEC and anaemia, will exhibit different behavioural expression to those sheep that are healthy (with respect to intestinal parasites), which can be identified using QBA; and (ii) that the behavioural expression of those same sheep would differ following anthelmintic treatment.

Healthy sheep

Materials and methods

The behaviour of ten Merino sheep in varying conditions of intestinal health, ‘healthy’ (n=5; anthelmintic treatment not required based on FEC) or ‘unhealthy’ (n=5; anthelmintic treatment required based on FEC), were assessed using QBA.

All sheep were selected from the same flock, and the allocation of individuals to treatment group was achieved by FEC and mucous membrane anaemia scores.

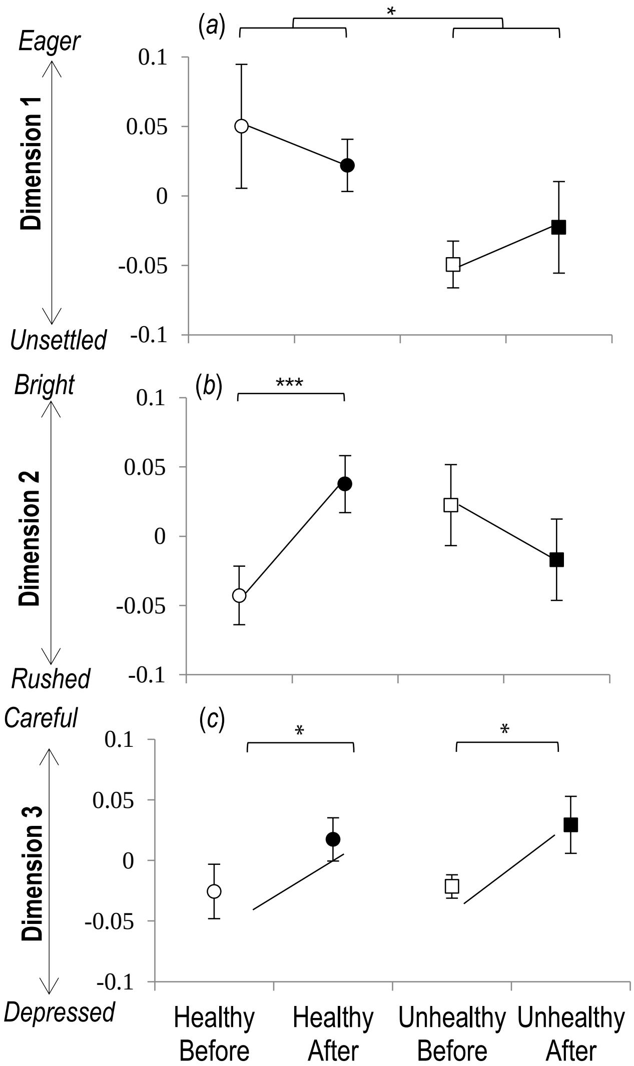
Sheep with high FEC

Faecal sampling and subsequent (next day) video footage capture of the ten sheep in the paddock were conducted one week prior to treatment of all animals with an anthelmintic drench, and again two weeks following treatment, such that each sheep was filmed twice: once before treatment and once after.

This footage was compiled into a series of assessment clips (n=20) and presented, at random, to 35 observers for QBA analysis. Observers first generated lists of descriptive terms. The terms were then used to assess the clips, ranging from minimum to maximum expression (i.e. 0-100).

Patterns in behavioural expression perceived by observers using this methodology were identified using principal component analyses. This resulted in the creation of a multidimensional matrix where each animal was represented along the continuum between the descriptive terms that best describe each dimension. Based on the responses of the observers, dimension 1 ranged from unsettled to eager, dimension 2 ranged from rushed to bright and dimension 3 ranged from depressed to careful.

Treatment differences in the behavioural expression of the sheep were analysed using repeated-measures analysis of variance.



Results and discussion

There was good agreement (P<0.001) between the observers in their assessments of the behavioural expression of the sheep.

The three main dimensions explained 25%, 17% and 10% of the variation in scores attributed to individual sheep, respectively.

In support of the hypotheses, significant differences in behavioural expression were identified on the three dimensions (Figure 7).

Observers were able to distinguish differences in behavioural expression between the treatments, with 'unhealthy' sheep described as more 'unsettled' when compared to 'healthy' sheep, which were described as more 'eager' along dimension 1 (P<0.05).

Anthelmintic treatment altered the behavioural expression of the sheep. Specifically, there was a significant effect on dimension 3 (P<0.05), where both 'healthy' and 'unhealthy' sheep were described by the observers as having a less 'depressed' demeanour following anthelmintic treatment.

On dimension 2 the 'healthy' sheep were described as more 'bright/observant' following anthelmintic treatment (P<0.001) intervention.

Figure 7 Position of sheep within their treatments on dimension 1 (a), 2 (b) and 3 (c), before and after treatment intervention * P<0.05, *** P<0.001

Conclusion

These findings demonstrate that sheep with different intestinal parasitic burdens display differences in behavioural expression, and these differences can be identified using the QBA methodology.

Therefore, not only does the potential exist for QBA to be used as a tool to help distinguish sheep with compromised intestinal health that need treatment, but it may also be used to monitor animals following treatment to test for the effectiveness of the anthelmintic.

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